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**APT REPORT ON**

**THE USE OF SATELLITE TECHNOLOGY TO FULFIL THE BROADBAND REQUIREMENTS OF SOCIAL, INDUSTRIAL AND ECONOMIC DEVELOPMENT**

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APT REPORT

ON THE USE OF SATELLITE technology TO FULFIL the BROADBAND REQUIREMENTS OF SOCIAL, INDUSTRIAL AND ECONOMIC DEVELOPMENT

# Introduction

Broadband connectivity is now regarded as a powerful tool, which is capable of improving the lives of people around the world. Broadband communications carry information and provide access to essential services that could tremendously broaden horizons and opportunities for people everywhere. However, broadband is not reaching the majority of the world’s population for various reasons, which include lack of terrestrial infrastructure as well as cost constraints. In view of the benefits of satellite technology such as easy deployment and wide seamless coverage, satellites could be used to bridge the gap that exists between broadband connectivity and users.

There is no doubt that satellites play an essential role in facilitating the penetration of broadband. The Task Group on Modern Satellite Applications conducted a survey among APT countries, including satellite operators and vendors within the Asia Pacific region, to gather information on:

* the use of satellite technology to fulfil the broadband requirements of social, industrial and economic development
* the characteristics, regulatory and technical requirements of broadband satellite implementation to satisfy these needs.

The questions of the survey as well as the responses obtained are annexed to this report. This report summarises the findings of the survey and further elaborates on how the satellite component could satisfy the demand for broadband in the social, industrial and economic sectors.

# National Broadband Plans/Policies and the Involvement of Satellites

The APT countries that responded to the survey have initiated or developed their own national broadband plan which aimed at improving the availability and accessibility of broadband to their citizens. An overview on the targets and implementation of the national broadband plan in each of these countries are provided in the following sections.

## Australia

The National Broadband Network (NBN), initiated by the Australian Government in 2009, is a high speed broadband network that is planned to reach all Australian premises with a combination of fibre, fixed wireless and satellite technologies. It is indicated that 93% of the premises in urban and regional towns will be connected with fibre to the premises (FTTP) capable of providing broadband speeds of up to 100 Megabits per second. The remaining 7% of premises will be connected via next generation fixed wireless and satellite technologies with peak speeds of 12 Megabits per second downstream and 1 Megabits per second upstream. The government has established NBN Co Limited to design, build and roll out the NBN which is planned to connect more than 10.9 million existing premises, including 2 million new premises over the life of the project. The cost for the NBN is estimated at $43 billion and will take almost 10 years to complete.

## Republic of Korea

Basically, the national broadband plan of Republic of Korea is focused on the terrestrial services. However, the hybrid/integrated satellite system is also considered for providing broadband communication complementary to terrestrial systems and public purposes. The plan of using the satellite system is at the initial stage and the satellite configuration will be a geostationary satellite orbit (GSO) system with multi beams. In addition, there are also studies on the Ka-band satellite system for broadband communication.

## Thailand

The Thai Government established the National Broadband Policy in 2010 to develop a nationwide network for high-speed internet services. The policy seeks to support the establishment of the broadband network so that the public will have enough services at reasonable prices under free and fair competition. It is expected that the broadband network will cover 80% of the Thai population by 2015 and at least 95% by 2020. Also by 2020, a fibre-optic broadband network with a connection speed of no less than 100 megabits per second will be introduced in major economic centres in the regions of the country. Satellite technology would be used to complement the fibre network [1].

## Vietnam

The Government of Viet Nam has established a national information and communications technologies (ICT) project that specified the national broadband targets which includes the use of satellite communication. By the year 2015, the national broadband network will cover most communes, with mobile broadband covering 85% of population. In 2020, the national broadband network will cover most of the villages, with mobile broadband covering 95% of population. The first Vietnamese satellite, VINASAT-1 was manufactured by Lockheed Martin and launched to 132°E on April 18 2008. It also provides broadband services.

## Malaysia

The Malaysian Government launched the National Broadband Implementation Strategy or better known as National Broadband Initiative (NBI) in 2010, which puts in place the national strategy that will bring broadband to the whole nation. One of the media used to deliver the broadband service is via satellite applications such as very small aperture terminal (VSAT). VSAT technology is widely used as backhaul in rural/remote areas to provide internet connectivity.

## China

Since 2004, China started to develop “Village Communication Project” which aims to let every village obtain telecommunication service. In this project, near 2000 villages in remote areas not covered by terrestrial systems are deployed with satellite terminal (VSAT or Isatphone) to proved satellite communication service. The advanced “Village Broadband Communication Project” has been implemented in several areas, and satellite communication system is the main way to provide broadband service in the remote mountainous areas, islands, etc.

Satellite communication systems are also widely used as the emergency backup of existing terrestrial wireless broadband service in the national broadband plan of China.

# Technical Requirements and Spectrum Usage of Satellite Broadband

So far there has been no specific definition for satellite broadband, which is understood as the delivery of broadband services which include, high definition television (HD-TV) broadcasting service, multimedia service and high speed data communication (similar to terrestrial broadband system) by means of related technologies, such as time-slicing and high-speed modem.

In some APT countries, there is quantification in terms of transmission speed for satellite services, to qualify as satellite broadband, as shown in Table 1.

Table 1 Range of the upstream/downstream transmission speed of satellite broadband

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| --- | --- |
| **Country** | **Description** |
| Australia | Broadband is commonly associated with the speeds equal to or greater than those provided by an asymmetric digital subscriber line (ADSL) service—that is, a minimum download speed of 265 kbps and minimum upload speed of 64 kbps. Satellite broadband services in Australia will provide speeds in excess of these minimum speeds. |
| Republic of Korea | S-band: maximum 3.12 bps/Hz in downstream and 1.56 bps/Hz in upstream based on satellite long term evolution (LTE) (e.g. maximum 31.2 in downstream and 15.6 Mbps in upstream in satellite LTE with 10MHz bandwidth)  Ka-band: the range of transmission speed is not defined yet for broadband satellite. But to support the broadband data, the bandwidth for satellite transmission should be over 100MHz. |
| Japan | Approximately upstream 400 kbps to 1.2Mbps/downstream 4 Mbps to 8 Mbps) |

In Australia, parts of the Ku-band and Ka-band are envisaged for use by satellite broadband service providers. These higher frequencies, particularly the Ka-band, are favoured due to the re-usability that can be more readily achieved at these frequencies. In Japan, the Ku- and Ka-bands are also preferred. In Viet Nam, the C- and Ku-bands are currently considered for the satellite broadband services. In China, the C-, Ku- and Ka-bands are used or envisaged for such services. The VSAT systems in Malaysia use C-band as well as Ka-band (for gateway) and Ku-band (for remote terminals).

S-band is considered for the satellite broadband services in the Republic of Korea because this frequency band can be used for both terrestrial and satellite services in the terrestrial-satellite collaboration system. Satellite broadband in the S-band could leverage on the 3G assets to the maximum, including reusing 3G sites, as the S-band for the satellite segment is directly adjacent to the terrestrial 3G band. The Ka-band is also appropriate to provide broadband in the Republic of Korea because of its wide bandwidth. However, the rain mitigation techniques should be considered in this band.

# Experiences of Implementing National Broadband Using Satellite Systems

Satellite technology should be integrated into the national broadband communications infrastructure and plans of a country to enable the delivery of services to a significantly larger number of household and business premises. The regulators/administrations of some APT countries provided information on the involvement of satellite communications in the promotion or provision of national broadband in their respective countries. Satellite capabilities also provide an important component of a future IMT system.

In the Republic of Korea, the terrestrial broadband services can be provided well with high performance. So satellite systems have some difficulties to compete with terrestrial system. Nowadays, satellite system would be considered as collaboration system of terrestrial systems especially for public purposes like Public Protection and Disaster Relief (PPDR).

Furthermore, the satellite is used for communication and broadcasting purposes in the many islands of the Republic of Korea, which include the Community Access Television (CATV) backhaul system. The national broadcasting station delivers the television programs via satellite and distributes them to the islands for public viewing. The satellite system is excellent to serve areas not covered by terrestrial infrastructure and PPDR.

In Japan, Vietnam and China, satellite broadband systems are suitable as emergency backup to existing terrestrial broadband systems and to serve rural/remote areas where communication amenities do not exist. Hence, the satellite broadband service can be one of the efficient ways to resolve the digital divide in such areas.

However, the rental cost of satellite transponder is too high for satellite broadband to be implemented so far on a full scale in the Republic of Korea. Similarly in Japan, Vietnam and China, higher costs has also been cited as an obstacle which hinders satellite communication systems to be used for promoting national broadband systems. Another criterion brought up was that high availability of satellite broadband communication is essential, as in Thailand, it is considered for applications such as supporting air traffic control services.

In Malaysia, the challenges that are being experienced for using the satellite communication systems for the national broadband initiatives are from the cost perspective, especially on the operational expenditure (OPEX), compared to using fixed or wireless broadband network. Besides, the vulnerability of the quality of service to weather conditions especially in tropical country like Malaysia and high latency (longer response time) as compared to other services are also major concerns. Thus, it becomes the last option especially to address the need for fast implementation and to solve broadband service requirement especially at rural/ remote areas where there is no other choices of media for broadband service.

As an example, in Malaysia, satellite subscriptions in 2011 account for less than 0.02% (this percentage is per 100 household) of the household internet broadband penetration and this translates to 6 325 subscription nationwide. Despite the low figure, this represents a threefold increase compared to the number of subscriptions in 2007. In the Republic of Korea, approximately 6% and 8% of the total urban and rural households, respectively use satellite communications for standard definition (SD) and HD-TV reception. For the business sector, the use of satellite is roughly below 1% in the Republic of Korea. In Australia, the majority of satellite broadband connections are in rural areas. From December 2007 to June 2011, the total number of satellite internet connections in Australia (which may or may not all be considered as broadband for all of this period) increased from 58000 to 106000.

# Constraints Faced by Satellite Service Providers in Broadband Delivery

The satellite service providers from Thailand, Indonesia, Malaysia, China, Australia and the Republic of Korea shared the difficulties or problems encountered in the deployment of satellite broadband services from the aspects of regulations, spectrum, technology and operations.

## Regulatory Constraints

Lack of public regulatory information e.g. technical standard of equipments, frequency allocation and licensing of services in some countries, may constrain the ability of satellite operators to offer services in those countries. These have been indicated as key regulatory constraints faced by satellite operators.

Furthermore, the complicated requirements for space, ground, and spectrum licenses and the process of acquiring approval from multiple concerned authorities often result in multiple application forms, high licensing fees and delay in licensing approval. In some countries, the national regulation requires service providers to use satellite capacity from national satellite operator(s), practicing a “closed skies” policy.. The landing rights policy is also an obstacle to the deployment of satellite services.

Each country takes a variety of different approaches toward spectrum management and may allocate a specific spectrum range for certain services. In such cases, it is difficult to apply the same spectrum license which is regulated to be allocated for services other than 2-way satellite broadband service by regulatory. For example, in countries where International Mobile Telecommunications (IMT) / Worldwide Interoperability for Microwave Access (Wimax) systems are deployed in satellite downlink bands, the regulators lack the guidelines/procedures of detecting and resolving satellite interference.

Ka-band satellite systems have recently started to be deployed, and some regulators are still in the process of developing their regulations for terminal authorisation. The use of broadband satellite on mobile platforms, as opposed to fixed terminals, may require modification to the regulations in some countries. In this context, it may be noted that the CEPT has developed new ECC Report 184[[1]](#footnote-1) and ECC Decision ECC/DEC/(13)01[[2]](#footnote-2) related to the authorisation of and designation of spectrum for Ka-band Earth Stations on Mobile Platforms (ESOMPs). The framework set out in these documents for the authorisation of Ka-band ESOMPs in Europe offers an example of another jurisdiction.

Equipment standards for fixed and mobile satellite terminals in the European region have been developed by the European Telecommunications Standards Institute (ETSI)[[3]](#footnote-3).

Somehow, there is some confusion among governments with respect to the relative contribution of satellite and terrestrial solutions for ICT projects development. In some cases, satellite is sometimes portrayed as obsolete compared to terrestrial, whereas in actual fact the satellite based systems are a tremendous complement/catalyst for ICT growth in all projects.

## Spectrum, Technical and Operational Constraints

There are views indicating that there is not sufficient spectrum to cope with the increasing demand for satellite services, especially for FSS. As an example, Agenda Item 1.6 of the World Radiocommunication Conference 2015 (WRC-15) intends to resolve the spectrum inadequacy experienced in the Earth-to-space direction for the range 13 -17 GHz in the Asia Pacific region. Also, Agenda Item 1.9 deals with FSS and MSS allocations in the 7/8 GHz band.

Latency is a general technical constraints with satellite communications. While some applications, such as fax services, cannot tolerate delays, satellite technology has evolved over the years, and now effective techniques have been developed to overcome such difficulties faced with latency.

The rain attenuation which is experienced in the higher frequency ranges, for example Ku-band, affects the availability of satellite broadband applications at such frequencies. New techniques such as high power smaller spot beams coupled with adaptive coding and adaptive power control are used to overcome some of the effects of rain attenuation.

The trend towards the deployment of very small and mobile terminals increases the occurrence of interference that may occur between the adjacent satellite networks. However the use of higher frequencies allows smaller terminals to be used, while maintaining a narrow beam and therefore maintaining sufficient discrimination with respect to closely spaced satellites.

Adjacent satellite interference is typically due to antenna mispointing. Considerable amount of time and effort is required to locate the source of interference as this requires liaising with the suspected interfering satellite operator. There could be situations where the elimination of the interference is slow due to the lack of knowledge of the interference being caused, or lack of skilled manpower on their side. Satellite operators are beginning to deploy VSAT systems which employ “Carrier ID”, which assists operators in tracing the location of any interference, or “Carrier Interlock” systems, which ensure that terminals do not transmit unless they are accurately pointed. The network control function also assists in deactivating the mispointed satellite terminals. In addition, some satellite operators have formed collectives to manage, amongst other things, interference between satellite networks

Interference is also likely when frequencies are shared between the satellite and the terrestrial networks, for example the situation that arises due to the incompatibility between IMT/Wimax and satellite services. The interference mitigation may require large separation distances and the installation of LNB filters and these may help to alleviate but not eliminate the interference.

For Ka-band in particular, technical constraints include those arising from the coordination of the satellite network with other operators, constraints due to the capabilities of satellite technology and terminal technology, and constraints due to the propagation conditions. These constraints have already been addressed, or are currently being addressed. Other constraints arise due to some of the Ka-band frequencies being used by other services (e.g. the fixed service).

The planned Inmarsat Global Xpress system will operate in the Ka-band FSS allocations. Some of those allocations are exclusive to satellite systems and hence no significant interference issues are anticipated. Some of the allocations are shared with the FS, and hence there could be interference issues if satellite user terminals are operated in the same areas where FS systems are deployed.

# Incentives to Promote Satellite Broadband

The future demand of satellite broadband is described to be in the medium category in the Republic of Korea, Viet Nam and Malaysia, and low in Australia, China and Japan. As broadband is essential to promote the growth in the social, industrial and economic sectors, any form of incentive that could boost the use of satellite broadband, could be explored and provided. For example in Malaysia, individual end users (of terrestrial or satellite technology) are entitled to personal tax deductions up to a maximum of RM 500 per year for internet broadband subscription fees incurred [2].

The following section describes the National Broadband Network (NBN) project of the Australian Government in further detail with regards to the incentives provided for satellite broadband.

## The Australian Broadband Guarantee

The Australian Government previously implemented a scheme called the Australian Broadband Guarantee (ABG), which was relevant to satellite broadband provision. The ABG is an initiative created to assist residential and small business premises access high-quality broadband services regardless of where they were located, with any technology means which include satellite technology. The objective of ABG was to ensure that there would be a smooth transition to the high speed broadband services that would be made available under the NBN.

To keep the broadband services reasonably priced for the subscribers, the Australian Government provided financial assistance in the form of Incentive Payments to the Internet service providers registered with this program. Incentive Payment was the amount of funding paid to the service providers for the provision of the service. The funding received would be subject to a few factors such as the type of service solution used as indicated in Table 2.

Table 2 Different levels of incentive payment

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| --- | --- |
| Level 1  (upgrade option) | A Payment of up to $2500, or up to $2000 in Metropolitan areas, as determined by the Department, applies for:  a) a Program Service made available through upgrading a Service Solution provided under a Past Program; or  b) a Program Service based on upgrading an existing commercial network. |
| Level 2 | A Payment of $1000 applies for a Program Service where the connection to the Premises is based on a fixed line Service Solution (e.g. ADSL). |
| Level 3 | A Payment of $2000 applies for a Program Service where the connection to the Premises is based on a terrestrial wireless Service Solution in a Metropolitan Area. |
| Level 4 | A Payment of $2500 applies for a Program Service where the connection to the Premises is based on a satellite Service Solution, or on a terrestrial wireless Service Solution in an area other than a Metropolitan Area. |
| Level 5 | A Payment of more than $2500 and up to $6000 applies for a Program Service where the connection to the Premises is based on a Service Solution in any Service Area with identified difficult and costly installation requirements (for example, infrastructure suitable to withstand cyclone conditions) |

The program was especially aimed at users in remote areas, who were unable to access commercial metro-comparable services. A metro-comparable broadband service was defined as any service that offered a minimum 512 kbps download and 128 kbps upload data speed, with 3 gigabytes per month data usage at a total cost of $2500 over three years (including installation and connection fees).

As part of the NBN long term plans to deliver broadband via satellite, 2 next-generation Ka-band satellites will be launched in 2015, to provide access to the NBN, in areas outside the fibre and fixed wireless infrastructure. The satellites will deliver high speed broadband coverage to roughly 3% of premises including rural and remote areas. With these 2 satellites, wholesale services configured for a planned 12 Mbps download and 1Mbps upload service (speeds will depend on several factors) will be made available. While awaiting the availability of the 2 new satellites, the Interim Satellite Service initiative under the NBN will use existing satellite capacity purchased from other operators to assist the transition from the ABG program to the NBN long term satellite service plans.

# The Role of Satellite Broadband in Social, Industrial and Economic Development

The opportunities and potential growth presented by broadband access towards the development of a country in the social, industrial and economic sectors are unlimited. Like terrestrial communications services, satellite services are undergoing a progressive evolution in order to meet escalating demand for broadband data applications. Strategic planning and investment has been necessary to move to a next generation platform which is a highly reliable and efficient contribution to future broadband infrastructure. It will also reach into developing regions, geographies and mobile applications.

For example, the Intelsat Epic**NG** platform is an innovative approach to satellite and network architecture utilizing C-, Ku- and Ka-bands, wide beams, spot beams, and frequency reuse technology to provide a customer-centric benefits, including high performance and lower cost per-bit to customers, wide beams and spot beams in the same band for broadcast and high-throughput, C-, Ku- and Ka-band frequencies aligned to region and application-specific requirements, open architecture and use of smaller, mobility-friendly terminals.

The innovation and advancements achieved in satellite technology, as well as the characteristics of satellite services such as the ease of use and rapid deployment make it an attractive option to deliver broadband services for myriad applications such as consumer broadband, banking, education, health, government services, broadcast service, public safety, disaster recovery, mobile backhaul/trunking, rural telephony and maritime. Also, government users are anticipated to have increased demand in the near future. This section provides examples on the satellite broadband applications which are forecasted to have an increase in demand.

## Disaster recovery

The Asia Pacific region is very prone to natural disasters which include earthquakes, heavy floods, typhoons and landslides. In the 2008 Wenchuan earthquake, all terrestrial communication systems in the disaster affected areas were damaged, and the satellite communication systems played a very important role in restoring communication. In Japan, terrestrial communication systems were also destroyed and some satellite communication systems, such as the VSAT systems, were affected by the tsunami and blackout caused by the Great East Japan Earthquake in 2011. The satellite communication systems played an important role to:

* ensure voice communications by satellite phone systems
* ensure entrance networks of base stations of mobile phone systems and temporary telephone booth by VSAT systems
* ensure access networks to the Internet from municipal offices, shelter and temporary housing by VSAT systems
* transmit pictures of disaster areas by Satellite News Gathering (SNG) systems
* ensure communications in disaster relief and recovery operations by Earth Stations on the Vessels (ESV) systems

A rapid re-establishment of telecom facilities becomes essential not only for the victims to communicate with the outside world, but also for the first responders and disaster recovery personnel to properly coordinate their activities. Telecom companies need to re-establish their service coverage as early as possible, and may not be able to rely on traditional terrestrial backhaul methods at least in the primary stages of their recovery efforts.

Recently, IPSTAR CCTV solution assists Thai Flood Relief Operations Centre to monitor flood water levels as well as provide instant communications in flood-hit areas. What is most difficult about disaster preparedness is the prediction of when and where disasters will strike. However, advances in technology have today provided us the means to monitor disaster-prone locations and make preparations so that effective decisions may be taken as the disaster unfolds. Such disaster-prone locations that require monitoring also need a reliable means of communication so that a constant stream of data can be sent to the decision makers. Since terrestrial means of telecommunication may be unreliable or simply unavailable when disasters strike, the only dependable form of communication is via satellite.



**Figure 1 IPSTAR CCTV solution to monitor flood water levels [3]**

The mobile service providers in Japan selected IPSTAR for its instant backhaul capability to bring back their service into operation. Base stations of various capabilities such Pico BTS, Micro BTS, and even full capacity Macro BTS made use of IPSTAR backhaul to connect to their core network. This backhaul over IPSTAR will continue until the service providers recover their capability to reconnect their lost terrestrial networks. Up to 500 base stations have been reconnected via IPSTAR, with most of the deployments in the hardest hit Iwate and Miyagi prefectures. The earthquake and resulting tsunami caused extensive and crippling structural damages. Besides heavy destruction of housing and transportation infrastructure, destruction of a nuclear power plant, collapse of a dam, as well as fires in many areas, the disaster also caused massive disruption of cellular phone services.

In 2010, IPSTAR joined forces with AIS (Advance Info Service Plc.) to provide emergency mobile phone service in the disaster hit areas using MVV (Mobile VSAT Vehicle) equipped with Femtocell Access Point (AP). A Femtocell AP is a small cellular base station which works on plug and play basis. It supports a small number of concurrent voice calls and was originally intended for indoor use in areas with bad network coverage. However because of its ease of use and fast deployment capability, it has been adapted for use with the IPSTAR platform to provide mobile phone coverage in remote areas or disaster zones.

Equipped with a Femtocell, the MVV became a moving mobile base station which served flood hit areas in Hat Yai city during 4-8 November, 2010 and landslide hit areas in Pakmark sub-district of Surat Thani during 16-18 November, 2010. The MVV was also equipped with a Wi-Fi AP and a VOIP phone. All equipments were powered with electricity generated by a dynamo connected to the running MVV engine. Residents having mobile phone handsets could make calls immediately after getting coverage; whereas people without handsets could make use of the VOIP phone. Several people with laptops in the business district of Hat Yai also made use of the Wi-Fi to access Internet. The Femtocell service is estimated to have benefited hundreds of people in Hat Yai and Surat Thani. In Pakmark, Surat Thani the MVV was stationed at a local school and security forces deployed for rescue operations also made use of the communication facilities. The MVV was moved from place to place according to coverage needs and its deployment was stopped after coverage was restored through BTS towers

## Maritime Broadband

Maritime broadband communications is increasingly popular as more shipping companies are relying on satellites for ship operations, remote management and crew welfare communications. The Japanese operator SKY Perfect JSAT Cooperation will be providing OceanBB, a maritime broadband service to Japanese container vessels in the NYK SATCOM Project. The service is intended for the safe operation of vessels and the information transmission between vessels and land. OceanBB could achieve high-speed Internet access with a transmission rate of up to 1 Mbps at a fixed charge and also covers the major sea areas in the world based on the roaming with the service of KVH in the U.S.

In the vessel communication field, it is becoming more commonplace for commercial vessels to be mounted with broadband systems as there is a necessity for the transmission of large volume of data. The adoption of OceanBB in the NYK SATCOM Project indicates that there is a trend for the broadband systems in Asian commercial ships to be standardised. It is anticipated that to ensure efficient operation management and enhance crew welfare, many Japanese and other Asian commercial vessels will be using with satellite broadband service.

The OceanBB service by SKY Perfect JSAT Corporation equips ships with a reliable broadband communication environment to ensure the reliability and safety of international maritime transport [4].



**Figure 2 Satellite broadband service configuration of OceanBB [4]**

Inmarsat will launch the Global Xpress system, consisting of three new Ka-band satellites, ground based infrastructure, and user terminals. The system is fully funded and is currently under construction. The first Global Xpress satellite will launch in 2013. These services are particularly aimed at providing maritime mobile broadband to terminals on ships. In addition, the system also caters to aircraft, land-vehicles and broadband users in remote areas. Typical user terminals will use a dish of about 60 cm diameter, and will have the capability for 5 Mbit/s uplink and 50 Mbit/s downlink. Terminals will be able to operate globally (except the polar regions). The system will be available in the Asia Pacific region in 2014.

## Mobile Backhaul/Trunking

Mobile backhaul/trunking is rapidly expanding due to the maturation of third-generation (3G) wireless network services, the development of smartphones and other mobile computing devices, the emergence of broad new classes of connected devices and the rollout of fourth-generation (4G) wireless technologies such as Long Term Evolution (LTE) and WiMAX. However, many remote backhaul/trunking sites are difficult and costly to be connected via fibre and microwave.

The two-way communication scenario is regarded as coverage extension and service continuity of the terrestrial part, and the satellite component has an advantage over terrestrial component for the delivery of same content over a wider geographic area. The satellite can provide services and applications similar to those of terrestrial systems outside terrestrial and complementary ground component (CGC) coverage under the inherent constraints imposed by power limitation and long round-trip delay.

The IPSTAR satellite has solution which enables mobile network operators to deploy their services in remote areas economically with minimal additional infrastructure. The IPSTAR platform significantly reduces transponder capacity needs by assigning access by multiple base stations to a single IP stream on a demand basis. Current IPSTAR deployments for mobile service are over 3,000 sites and growing in Japan, India, Thailand and other countries

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**Figure 3 Cellular network with IPSTAR backhaul configuration [5]**

## Education

The Government of Thailand is implementing the “One Tablet per Child” (OTPC) project, whereby every 800,000 first-graders around the country, will get a 7 inch tablet to be used in classrooms [6]. The main ideas behind the OTPC project are:

* equipping Thai students with mobile tablets
* managing and developing of E-learning and teaching materials
* enhancing teacher and educational personnel development
* improving high-speed internet provision

Under the project, the Ministry of Education (MOE) is responsible for digital content development and distribution to schools and the Ministry of Information Communication and Technology (MICT) is responsible for table procurement and random inspections. The tablet content will include five core subjects in the form of e-books, e-learning and multi-media applications.

TOT PLC is working on providing the satellite broadband connectivity required for the project in remote areas. The OTPC project is of great benefit to students in remote areas since it enabled students to learn via multimedia, audio resources, pictures etc. This project is a good example where satellite broadband is used to improve living standards of the rural community by providing education via up-to-date technology.

Satellite broadband brings the education level in Thailand to greater heights as it promotes the use of ICT to boost the knowledge and intellect of Thai students [7].

# Summary

In this ICT era, broadband communications should be made accessible and affordable to everyone. Due to its rapid and easy deployment of terminals as well as the provision of extensive coverage, satellite technology could be considered as an effective platform to deliver broadband services to some sectors of the broadband consumer market, particular in areas poorly served by terrestrial means. Satellite technology should therefore be considered as an essential component of national broadband plans. The constraints faced in the provision of satellite broadband from the regulatory, spectrum, technological and operational viewpoints should be further considered, to look for possible solutions or improvements.

APT Member administrations may wish to review their regulations to allow for the provision of satellite broadband applications compatible with requirements for new systems, in particular Ka-band satellite networks. The constraints placed on satellite systems, as identified in this report, are considerations for administrations and if feasible may be regionally harmonised in the future through APT.

Various other options could be explored to promote satellite broadband usage, such as providing tax reliefs or incentives payments to satellite service providers. Many critical broadband applications which promote the development of the social, industrial and economic sectors rely on the use of satellites. Satellite technology plays a role in bridging the digital divide and is able to effectively deliver universal high speed broadband services for the benefit of all mankind.

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**Annex**

**Information on Questionnaire Respondents:**

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| Thailand | Name of organization : Ministry of Information and Communication Technology (MICT)  Postal address : The Government Complex., Chaengwatthana Road,Laksi, Bangkok 10210, Thailand  Phone : 0 2141 7006  Email address : inter\_affairs@mict.mail.go.th  Organisation : Administration  Name of organisation : The Public Relations Department, (NBT)  Postal address : PRD building, Rama6 Rd., Phayathai, Bangkok 10400  Phone : +662-618-2323 (1921)  Email address : Tanpisit@hotmail.com  Organisation : Operator  Name of organization : CAT Telecom Public Company Limited  (International Network Department)  Postal address : 99 Moo 3, Chaeng Watthana Road, Laksi,  Bangkok 10210-0298, Thailand  Phone : +66 2 104 3296, 104 4213  Email address : aniruth.h@cattelecom.com  Organisation : Operator  Name of organisation : Aeronautical Radio of Thailand  Postal address : 102 Soi Ngamduplee, Tungmahamek, Sathon, Bangkok 10120 Thailand  Phone : +66 0 22859457  Email address : choosit.ku@aerothai.co.th  Mr. Choosit Kuptaviwat, Director of Air Traffic Services Engineering Planning Department  Organisation : Service Operator  Name of organization : TOT Public Company Limited  Postal address : 82/2, Chaengwatthana Road, Laksi,  Bangkok 10210, Thailand  Phone : +66 2 575 8160  Email address : [woraniti@tot.co.th](mailto:woraniti@tot.co.th)  Organisation : Satellite service provider  Name of organisation : THAICOM Plc.  Postal address : 41/103 Rattanathibet Rd., Amper-Muang, Nonthaburi, 11000  THAILAND  Phone : +66 2 591 0736 to 49  Email address : fcd@thaicom.net  Organisation : Satellite Operator / Vendor |
| Malaysia | Name of organisation : Malaysian Communications and Multimedia Commission  Postal address : Off Persiaran Multimedia, 63000 Cyberjaya, Selangor, Malaysia  Phone : +603-86888000  Email address : srpd@cmc.gov.my  Organisation : Regulator  Name of organisation : MEASAT Satellite Systems Sdn Bhd  Postal address : MEASAT Teleport and Broadcast Centre, 63000 Cyberjaya, Malaysia  Phone : +60(3) 82132188  Email address : [ceteh@measat.com](mailto:ceteh@measat.com)  Organisation : Satellite Operator |
| China | Name of organisation : China  Postal address : 100191  Phone :+ 86-10-18600824835  Email address : zhuying@ritt.cn  Organisation : Administration  Name of organisation : Asia Satellite Telecommunications Co. Ltd.  Postal address : AsiaSat Tai Po Earth Station, 15 Dai Kwai Street,  Tai Po Industrial Estate, NT, Hong Kong  Phone :+852 26009142  Email address : [spectrum@asiasat.com](mailto:spectrum@asiasat.com)  Organisation : Satellite Operator |
| Australia | Name of organisation : Australian Communications and Media Authority  Postal address : PO Box 78, Belconnen ACT 2616 Australia  Phone : +61 2 6219 5555  Email address : [satellite.coordination@acma.gov.au](mailto:satellite.coordination@acma.gov.au)  Organisation : Administration / Regulator  Name of organisation : Intelsat  Postal address : P.O.Box 60 Elsternwick Australia 3185  Phone : +613 5259 1794  Email address : bhorton53@hotmail.com  Organisation : Satellite Operator  Name of organisation : Inmarsat  Postal address : P.O.Box 60 Elsternwick Australia 3185  Phone : +613 5259 1794  Email address : bhorton53@hotmail.com  Organisation : Satellite Operator |
| Republic of Korea | Name of organization : Korea Communication Committee  Postal address : 20, Sejong-ro, Jongro-gu, Seoul, 110 – 777. Republic of Korea  Phone : +82 2 750 2271  Email address : lyho@kcc.go.kr  Organisation : Administration  Name of organization : KT (Korea Telecom)  Postal address :206, jeongja-dong, Bundang-gu, Seongnam, Kyunggido,463-711, Republic of Korea  Phone : +82 31 727 0714  Email address :  [joohong@kt.com](mailto:joohong@kt.com)  Organisation : Satellite Operator |
| Japan | Name of organisation :Ministry of Internal Affairs and Communications (MIC)  Postal address :2-1-2 Kasumigaseki, Chiyoda-ku, Tokyo, Japan  Phone :+81-3-5253-5901  Email address :h.takeshita@soumu.go.jp  Organisation : Administration |
| Vietnam | Name of organization : Authority of Radio Frequency Management  Postal address : 115 Tran Duy Hung, Cau Giay District, Ha Noi, Viet Nam  Phone : +84.4.3.5564980  Email address : cuongnh@rfd.gov.vn  Organisation : Administration/Regulator |
| Indonesia | Name of organisation : PT Telekomunikasi Indonesia  Postal address : Jl. Raya Narogong Km 26.5 Cileungsi Bogor Indonesia  Phone : +62-21-8231000  Email address : danindra@telkom.co.id  Organisation : Satellite operator |

**Questions to Regulators/Administrations:**

1. Does your country have a national broadband plan using satellite communication systems? Could you provide a brief summary of the plan, which include its targets, timeline and satellite systems characteristics (e.g. GSO, MEO, LEO)?

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| --- | --- |
| Australia | In April 2009, the Australian Government initiated plans to establish the National Broadband Network, which includes a satellite component. Further information is available on the website of the Department of Broadband, Communications and the Digital Economy (DBCDE) [www.dbcde.gov.au](http://www.dbcde.gov.au) |
| Republic of Korea | Basically, national broadband plan of the Republic of Korea is focused on the terrestrial services. However, the hybrid/integrated satellite system is also considered for providing broadband communication as assistance of terrestrial systems and public purposes. The plan using satellite system is initial stage and the satellite would be GSO system with multi beams. In addition, Ka-band satellite system also has been studied for broadband communication. |
| Thailand | The government has established the National Broadband Policy in order to clarity and to reserve as a framework for implementing and driving the development of broadband service which will make use of diverse technologies, be advanced and up-to-date, and in line with the context and situation of Thailand. |
| Vietnam | Viet Nam government has established a national ICT project that specified the national broadband targets including satellite communication.  By the year 2015, national broadband network cover most of communes, with mobile broadband cover 85% of population.  In 2020, national broadband network cover most of hamlets, with mobile broadband cover 95% of population.  The first satellite VINASAT-1 (132E) manufacture red by Lockheed Martin was launched on April 18, 2008. VINASAT-1, operating in C and Ku bands, is able to provide a range of services tailored to customers’ needs. |
| Malaysia | Malaysian Government launched the National Broadband Implementation Strategy or better known as National Broadband Initiative (NBI) which puts in place the national strategy that will bring broadband to the whole nation. One of the media used to deliver the broadband service is via satellite (VSAT). VSAT technology is widely used as backhaul in rural/remote areas to provide internet connectivity. |
| China | Since 2004, China started to develop “Village Communication Project” which aims to let every village can obtain telecommunication service. In this project, near 2000 villages in remote areas not covered by terrestrial systems are deployed with satellite terminal (VSAT or Isatphone) to proved satellite communication service. The advanced “Village Broadband Communication Project” has been implemented in several areas, and satellite communication system is the mainly way to provide broadband service in the remote mountainous areas, islands, etc.  Satellite communication systems are also widely used as the emergency backup of existing terrestrial wireless broadband service in the national broadband plan of China. |

1. How is satellite broadband defined in your country?

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| --- | --- |
| Australia | Satellite broadband is defined as the delivery of broadband services via satellite. |
| Republic of Korea | There is no exact definition for satellite broadband but Gbps transmission technique has studied for broadband satellite system. Satellite broadband can provide HD-TV broadcasting service, multimedia service and high speed data communication similarly to terrestrial broadband system by means of related technologies like time-slicing, high-speed MODEM. |
| Japan | Not defined (but approximately above upstream 400 kbps/downstream 4 Mbps) |
| Vietnam | There is no definition for satellite broadband but it is known that satellite broadband can provide HD-TV broadcasting service, multimedia service and high speed data communication, ect. |
| Malaysia | There is no specific definition for satellite broadband in Malaysia. |
| China | No exact definition. |

1. What is the range of upstream /downstream transmission speed of satellite broadband?

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| --- | --- |
| Australia | Broadband is commonly associated with the speeds equal to or greater than those provided by an asymmetric digital subscriber line (ADSL) service—that is, a minimum download speed of 265 kbps and minimum upload speed of 64 kbps. Satellite broadband services in Australia may provide speeds in excess of these minimum speeds. |
| Republic of Korea | S-band: maximum 3.12 bps/Hz in downstream and 1.56 bps/Hz in upstream based on satellite LTE (e.g. maximum 31.2 in downstream and 15.6 Mbps in upstream in satellite LTE with 10MHz bandwidth)  Ka-band: the range of transmission speed is not defined yet for broadband satellite. But to support the broadband data, the bandwidth of satellite should be over 100MHz. |
| Japan | Approximately upstream 400 kbps to 1.2Mbps/downstream 4 Mbps to 8Mbps) |
| Malaysia | Not applicable |
| China | No exact definition. |

1. Could you describe the experience and challenges faced, if any, in promoting or implementing national broadband using satellite communication systems in your country?

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| --- | --- |
| Republic of Korea | The terrestrial broadband services can be provided well with high performance in the Republic of Korea. So satellite systems have some difficulties to compete with terrestrial system. Nowadays, satellite system would be considered as collaboration system of terrestrial systems especially for Public purposes like PPDR. Additionally, the rental cost of satellite transponder is too high for satellite broadband to be implemented so far. |
| Japan | Because the terrestrial broadband service has spread, the users using the satellite broadband service is restrictive and the price is higher than the terrestrial broadband service. |
| Vietnam | Demand on leasing satellite transponders in Ku band is very high, especially for providing HDTV service.  The rental cost of satellite transponder is too high for satellite broadband to be implemented so far. This is the most challenge in promoting national broadband using the satellite communication system. |
| Malaysia | The challenges that are being experienced for using the satellite communication systems for the national broadband initiatives are from the cost perspective, especially on the OPEX, compared to using fixed or wireless broadband network. Besides, the vulnerability of the quality of service to weather conditions especially in tropical country like Malaysia and high latency (longer response time) as compared to other services are also major concerns. Thus, it becomes the last option especially to address the need for fast implementation and to solve broadband service requirement especially at rural/ remote areas where there is no other choices of media for broadband service. |
| China | The satellite broadband service is mainly required in remote rural areas where not covered by terrestrial systems and emergency backup and high through put services. One of the challenge to promote the satellite broadband service widely is its price is with lower competitive advantages than terrestrial broadband service for the public users. |

1. What is the approximate percent of urban households that have a satellite broadband connection in your country?

|  |  |
| --- | --- |
| Australia | A minority of urban households have a satellite broadband connection in Australia. |
| Republic of Korea | Satellite broadband for the SD and HD-TV broadcasting service has the approximate 6% of total urban households in the Republic of Korea. |
| Malaysia | The indicator that we have is percentage per 100 household (not by urban/ rural). As for satellite subscriptions, the contribution is less than 0.02% to household broadband penetration. (as of 14 Mar 2012) |

1. What is the approximate percent of rural households that have a satellite broadband connection in your country?

|  |  |
| --- | --- |
| Australia | The majority of satellite broadband connections in Australia are in rural areas. |
| Republic of Korea | Satellite broadband for the SD and HD-TV broadcasting service has the approximate 8% of total rural households in the Republic of Korea. |
| Malaysia | Refer to Q. 5 |

1. What is the approximate percent of businesses that have a satellite broadband connection in your country?

|  |  |
| --- | --- |
| Australia | Unsure |
| Republic of Korea | Satellite broadband for the business service has the approximate 1% below in the Republic of Korea. |
| Malaysia | As of now, there are about 6,325 satellite broadband subscriptions nationwide, however no detail information on the percentage for businesses. |

1. What are the wireless technologies being used to support broadband in your country? Which of these technologies is widely used and why (you may indicate more than 1 answer)?

|  |  |
| --- | --- |
| Australia | Wi-Fi, WiMax, BWA, satellite  Others: cellular mobile |
| Republic of Korea | Microwave, Wi-Fi, WiMax, BWA, satellite  Many Wi-Fi systems are installed at the various public areas as well as home. The Wi-Fi systems can play an important role in dispersing the data traffic from WCDMA or LTE system. |
| Japan | Microwave, Wi-Fi, WiMax, BWA, satellite  Others: FWA |
| Thailand | Microwave, Wi-Fi, WiMax, BWA, satellite. |
| Vietnam | Microwave, Wi-Fi, WiMax, BWA, satellite  Others: 3G (UMTS and HSPA)  Many Wi-Fi systems are installed at the various public areas, coffee restaurants as well as home,and the ancient city of Hoi An is the first wifi city.  3G Mobile network operators in Viet Nam provide [mobile broadband](http://en.wikipedia.org/wiki/Mobile_broadband) access of several [Mbit/s](http://en.wikipedia.org/wiki/Mbps) to [smartphones](http://en.wikipedia.org/wiki/Smartphone) and [mobile modems](http://en.wikipedia.org/wiki/Mobile_modem) in laptop computers. |
| Malaysia | Microwave, Wi-Fi, WiMax, BWA, satellite  Others: 3G  3G, Wi-Fi, Wimax, microwave and BWA. Most of Wi-Fi hotspots are connected to fixed network (DSL and fibre) as backhaul. 3G and Wimax has been commercially rolled out to provide broadband services to users. |
| China | Microwave, Wi-Fi, BWA, satellite  Others: Cellular systems  The terrestrial cellular systems and Wi-Fi are widely used for the wide coverage, low price and high speed performance. |

1. What are the frequency bands used and/or envisaged to be used for the satellite broadband services and why are these frequency bands preferred?

|  |  |
| --- | --- |
| Australia | Parts of Ku-Band and Ka-Band are envisaged for use by satellite broadband service providers. These higher frequencies, particularly Ka-Band, are favoured due to the re-usability that can be more readily achieved at these frequencies. |
| Republic of Korea | S-band is considered for the satellite broadband services in the Republic of Korea because that frequency band can be used to both terrestrial and satellite services in the terrestrial-satellite collaboration system. Satellite broadband in S-band could leverages 3G assets to the maximum including 3G site reuse because satellite S-band is directly adjacent to terrestrial 3G band.  Also the Ka-band is appropriate to provide broadband because of wide bandwidth. However, the rain mitigation techniques should be considered in this band. |
| Japan | Ku-band, Ka-band |
| Thailand | Satellite frequencies are determined by the National Broadcasting and Telecommu-nication Commissions (NBTC) with respect to ITU Radio Regulations (RR). |
| Vietnam | C and Ku bands are currently considered for the satellite broadband services in Viet Nam. The Ka-band is appropriate to provide broadband because of wide bandwidth. However, the rain mitigation techniques should be considered in this band. |
| Malaysia | VSAT using Ka-band (gateway) and Ku-band (remote).  VSAT using C and Extended C band. |
| China | C, Ku and Ka bands |

1. How would you describe the future demand of satellite broadband in your country?

|  |  |
| --- | --- |
| Australia | Low |
| Republic of Korea | Medium |
| Japan | Low |
| Vietnam | Medium |
| Malaysia | Medium |
| China | Low |

1. Could you describe any economic incentives provided for satellite broadband end users such as tax exemption etc?

|  |  |
| --- | --- |
| Japan | We don’t provide any economic incentives to users. |
| Malaysia | Tax exemption is given to broadband users in general. |

1. Could you describe any economic incentives provided for satellite broadband providers such as tax exemption etc?

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| --- | --- |
| Australia | The Australian Government previously implemented a scheme called the Australian Broadband Guarantee, relevant to satellite broadband provision, details of which can be found online at DBCDE’s website <http://www.dbcde.gov.au/broadband/australian_broadband_guarantee> |
| Japan | We don’t provide any economic incentives to providers. |
| Malaysia | None |

1. Could you describe the regulatory procedures such as spectrum access and types of licenses applicable to satellite broadband services in your country?

|  |  |
| --- | --- |
| Australia | Detailed information on space systems regulation in Australia can be found on the ACMA website <http://www.acma.gov.au/WEB/STANDARD/pc=PC_300241> |
| Republic of Korea | There are regulatory procedures for satellite services irrespective of the service type in the Republic of Korea. In order to provide the satellite service, the operator submits the application for frequency assignment to the administration before sending the API to the ITU-R Radiocommunication Bureau. The administration will decide to assign the frequency to the operator based on the examination result taking into account the frequency coordination results, business value, and related materials. |
| Japan | Access the following web site.  <http://www.tele.soumu.go.jp/e/adm/proc/index.htm> or  <http://www.tele.soumu.go.jp/e/adm/proc/manual/index.htm> |
| Vietnam | In order to provide the satellite service, the operator submits the application for frequency assignment to the administration and then the administration will send the API to the ITU-R Radiocommunication Bureau. The administration will decide to assign the frequency to the operator based on the examination result taking into account the frequency coordination results, business value, and related materials. |
| Malaysia | There is no specific regulatory procedure for satellite broadband services. However, in general, to provide satellite broadband service in Malaysia, the service provider is required to hold:  1) Network Facilities Provider (NFP) Individual Licence;  2) Network Service Provider (NSP) Individual Licence; and  3) Application Service Provider (ASP) Class Licence. |
| China | There are regulatory procedures for satellite services irrespective of the service type in China. In order to provide satellite service, generally service provider needs to submit the applications to the administration for the relevant system and spectrum licenses. |

1. Could you provide information on the fees applicable to satellite broadband services in your country?

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| --- | --- |
| Australia | Fees applicable to apparatus licensed radiocommunication services (which may include certain satellite broadband services) in Australia are outlined on the ACMA website <http://www.acma.gov.au/WEB/STANDARD/pc=PC_1614> |
| Japan | We collect spectrum user fees depending on the classification of the licensed radio stations. For more information, access the following web site.  <http://www.tele.soumu.go.jp/riyoryo_e/RiyoryoGkInit.jsp> |
| Malaysia | The fees are subject to the licence applied and the spectrum bandwidth to be utilized. |

1. Could you explain whether the communication systems in your country have ever been disrupted by natural disasters?

|  |  |
| --- | --- |
| Australia | Communication systems have been disrupted by natural disasters in Australia. |
| Republic of Korea | There have been several heavy floods and typhoons striking local areas in a year and some communication systems have been damaged by them. |
| Japan | Terrestrial communication systems were destroyed and some satellite communication systems, such as the VSAT system, were flooded by tsunami and blackout by the East Japan great earthquake last year.  While satellite communication systems played roles as described below;   * To ensure voice communications by satellite phone systems * To ensure entrance networks of base stations of mobile phone systems and temporary telephone booth by VSAT systems * To ensure access networks to the Internet from municipal offices, shelter and temporary housing by VSAT systems * To transmit pictures of disaster areas by SNG (Satellite News Gathering) systems   To ensure communications in disaster relief and recovery operations by ESV (Earth Stations on the Vessels) systems |
| Malaysia | Yes, due to flood and landslide. |
| China | In 2008 Wenchuan earthquake, all the terrestrial communication systems in disaster areas were damaged, and the satellite communication systems played a very important role in exchanging information. |

1. Could you provide an example of a satellite broadband system that is used for social, industrial and/or economic development in your country? (e.g. emergency backup of existing terrestrial broadband service, coping with new demand, providing service to areas not covered by terrestrial broadband, maritime broadband service)

|  |  |
| --- | --- |
| Republic of Korea | There are many islands in the Rep. of Korea. The satellite is used for communication and broadcasting services. For example, the CATV backhaul system is good model. The national broadcasting station delivers the TV programs via satellite and distributes them in island for public welfare. |
| Japan | Emergency backup of existing terrestrial broadband service, providing service to areas not covered by terrestrial broadband, maritime broadband service. |
| Vietnam | The satellite is used for communication and broadcasting services. For example, VINASAT-1 can provide services:[Transponder Leasing](http://www.vinasat.com.vn/52/103/382.html), VSAT, Video Conference, DTH and backhaul for Mobile network in remote areas. |
| Malaysia | Providing service to areas which is not covered by terrestrial communication network e.g. using VSAT to link communication center (Telecentre initiatives) at remote/rural areas to the outside world. |
| China | Emergency backup of existing terrestrial broadband service, providing service to areas not covered by terrestrial broadband, maritime broadband service. |

1. In your opinion, what criteria are of importance for satellite broadband service to satisfy social, industrial and/or economic development needs in your country? Please elaborate (e.g. high availability, high upstream or/and downstream speeds, coverage areas not covered by terrestrial broadband, pricing)

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| --- | --- |
| Republic of Korea | The satellite system seems to have good advantages with respect to coverage area not covered by terrestrial system and PPDR. Additionally, the satellite broadband service can be one of the efficient ways to resolve the digital divide in some areas. |
| Japan | Coverage areas not covered by terrestrial broadband, Pricing. |
| Thailand | Thailand is of the view that high availability would be an important and desirable criterion for satellite broadband services, such as for supporting air traffic control services. |
| Vietnam | The satellite system has good advantages with respect to coverage area not covered by terrestrial systems or in rural and remote areas. |
| Malaysia | Improved upstream and downstream speeds are important criteria since satellite communication experience high latency (longer response time). |
| China | Coverage areas not covered by terrestrial broadband, pricing. |

1. In order to see the change in overall traffic volume of satellite broadband communications in each country, please provide the following statistics on the usage of satellite broadband communications in your country:
2. The total number of subscriptions by year for the past five years
3. Estimated capacity per year in the unit of Gigabytes for the past five years, with the names of applications deployed.

|  |  |
| --- | --- |
| Australia | From December 2007 to June 2011, the total number of satellite internet connections in Australia (which may or may not all be considered as broadband for all of this period) increased from 58000 to 106000. Further information is available on the website of the Australian Bureau of Statistics [www.abs.gov.au](http://www.abs.gov.au) |
| Malaysia | |  |  | | --- | --- | | Year | Subscriptions (‘000) | | 2007 | 2.0 | | 2008 | 4.9 | | 2009 | 5.3 | | 2010 | 6.4 | | 2011 | 6.4 |   None |

**Questions to Operators:**

1. What are the satellite broadband applications of your customers?

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| --- | --- |
| Thaicom PLC | Consumer broadband, banking, education, health, government services, broadcast service, public safety.  Others: Disaster recovery, mobile backhaul/trunking, rural telephony. |
| MEASAT | Consumer broadband, banking, education, health, government services, broadcast service, public safety.  Others: Maritime |
| AsiaSat | Consumer broadband, banking, education, health, government services, broadcast service, public safety. |
| KT | Consumer broadband, government services, broadcast service, public safety. |
| NBT | Broadcast service |
| CAT Telecom PLC | Consumer broadband, education. |
| TOT PLC | As the NSO, we are the only satellite service provider in Thailand. Our customers applications are:  (a) Consumer broadband (i.e. home use, etc.),  (b) Banking (remote branches),  (c) Education (Ministry of Education Network, i.e. schools),  (d) Health (for municipal medical centers),  (e) Government Service (Citizen Identification cards), and  (f) Public Safety (i.e. Police Mobile Vehicle, Department of Water Resources, Royal Project, etc.) |
| PT Telekomunikasi | Broadcast service |
| Intelsat | Consumer broadband, government services, broadcast service.  Others: cellular backhaul, maritime services. |
| Inmarsat | Consumer broadband, banking, education, health, government services, broadcast service, public safety.  Inmarsat satellite broadband services may be used for almost any application and current applications certainly include all of those identified above. Other common applications for Inmarsat satellite broadband service include broadband Internet service for ships and aircraft (for use by crew and passengers), cell-phone backhaul for ships and aircraft, disaster relief communications, and TV news gathering. |

1. What are the satellite broadband applications for which you forecast an increase in demand?

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| --- | --- |
| Thaicom PLC | * 1. **Mobile Backhaul/Trunking:**       1. The remoteness of backhaul/trunking sites those would be difficult and costly (unsustainable) to reach with fibre & microwave      2. Another key drivers of this growth include the maturation of third-generation (3G) wireless network services, the development of smartphones and other mobile computing devices, the emergence of broad new classes of connected devices and the rollout of fourth-generation (4G) wireless technologies such as Long Term Evolution (LTE) and WiMAX      3. The two-way communication scenario is regarded as coverage extension and service continuity of the terrestrial part, and the satellite component has an advantage over terrestrial component for delivery of same content to spread over a wide geographic area      4. The satellite can provide services and applications similar to those of terrestrial systems outside terrestrial and complementary ground component (CGC) coverage under the inherent constraints imposed by power limitation and long round-trip delay      5. Current IPSTAR deployments for mobile service are over **3,000 sites** and growing in Japan, India, Thailand and other countries   2. **Disaster Recovery:**       1. VSAT terminals have the attributes to be easily deployed and provide wide area coverage that is independent of local infrastructure, for providing immediate means of telecommunication to help in relief operations during natural disaster and emergency situations      2. A rapid re-establishment of telecom facilities becomes essential not only for the victims to communicate with the outside world, but also for the first responders and disaster recovery personnel for proper coordination of their activities. Telecom companies need to re-establish their service coverage as early as possible, and may not be able to rely on traditional terrestrial backhaul methods at least in the primary stages of their recovery effort      3. Recently, IPSTAR CCTV solution assists Thai Flood Relief Operations Center keep an eye on flood water levels as well as provide instant communications in flood-hit areas. What is most difficult about disaster preparedness is the prediction of when and where disasters will strike. However, advances in technology have today provided us the means to monitor disaster-prone locations and make preparations so that effective decisions may be taken as the disaster unfolds. Such disaster-prone locations that require monitoring also need a reliable means of communication so that a constant stream of data can be sent to the decision makers. Since terrestrial means of telecommunication may be unreliable or simply unavailable when disasters strike, the only dependable form of communication is via satellite.      4. The mobile service providers in Japan selected IPSTAR for its instant backhaul capability to bring back their service into operation. Base stations of various capabilities such Pico BTS, Micro BTS, and even full capacity Macro BTS made use of IPSTAR backhaul to connect to their core network. This backhaul over IPSTAR will continue until the service providers recover their capability to reconnect their lost terrestrial networks. Up to **500 base stations** have been reconnected via IPSTAR, with most of the deployments in the hardest hit Iwate and Miyagi prefectures. The earthquake and resulting tsunami caused extensive and crippling structural damages. Besides heavy destruction of housing and transportation infrastructure, destruction of a nuclear power plant, collapse of a dam, as well as fires in many areas, the disaster caused massive disruption of cellular phone services.      5. Back to 2010, IPSTAR joined forces with AIS(Advance Info Service Plc.) to provide emergency mobile phone service in the disaster hit areas using MVV (Mobile VSAT Vehicle) equipped with Femtocell Access Point (AP). A Femtocell AP is a small cellular base station which works on plug and play basis. It supports a small number of concurrent voice calls and was originally intended for indoor use in areas with bad network coverage. However because of its ease of use and fast deployment capability, it has been adapted for use with the IPSTAR platform to provide mobile phone coverage in remote areas or disaster zones. Equipped with a Femtocell, the MVV became a moving mobile base station which served flood hit areas in Hat Yai city during 4-8 November, 2010 and landslide hit areas in Pakmark sub-district of Surat Thani during 16-18 November, 2010. The MVV was also equipped with a Wi-Fi AP and a VOIP phone. All equipments were powered with electricity generated by a dynamo connected to the running MVV engine. Residents having mobile phone handsets could make calls immediately after getting coverage; whereas people without handsets could make use of the VOIP phone. Several people with laptops in the business district of Hat Yai also made use of the Wi-Fi to access Internet. The Femtocell service is estimated to have benefited hundreds of people in Hat Yai and Surat Thani. In Pakmark, Surat Thani the MVV was stationed at a local school and security forces deployed for rescue operations also made use of the communication facilities. The MVV was moved from place to place according to coverage needs and its deployment was stopped after coverage was restored through BTS towers |
| MEASAT | Maritime communications, as more shipping companies are relying on satellites for ship operations, remote management and crew welfare communications. Education, as satellite broadband is used to provide internet access to schools in particular rural areas. |
| AsiaSat | Consumer broadband in terrestrially underdeveloped locations or in remote areas where broadband services cannot be economically established; Content Delivery to IPTV Platforms; Public safety; Emergency backup of terrestrial broadband service |
| KT | The HD-TV broadcasting service, multimedia service and high speed data communication using the satellite broadband are expected to be increased. |
| NBT | Consumer broadband and broadcasting service |
| CAT Telecom PLC | Broadband service and rural broadband internet. |
| TOT PLC | We believe that the educational application would increase the demand in connectivity according to one of the government project named One Tablet per Child (OTPC). |
| PT Telekomunikasi | Data and video services |
| Intelsat | Cellular backhaul, maritime and aeronautical services, government services, Oil and Gas, enterprise solutions. |
| Inmarsat | Increase in demand is anticipated in particular for the provision of Internet to mobile users (ships, aircraft and land-mobile terminals). Also government users are anticipated to have increased demand in the near future. |

1. What kind of satellite broadband applications do you intend to deploy in the near future?

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| --- | --- |
| Thaicom PLC | 1. **IPSTAR IP Video Streaming:** (IP) video via satellite either LIVE or PUSH VoD (Video-on-Demand) method for both fixed and mobile services. The range of destinations for video over IP rapidly is expanding, business models for video streaming in the enterprise sector involves corporate training and Web conferencing continue to gain steam, and is gradually extending into new field as well, including the area of home and mobile device entertainment. The quality of video streaming via IPSTAR can support excellence HD content. 2. **IPSTAR Backhaul for Digital Cinema:** Movies can be distributed via satellite and projected using a digital projector (instead of a conventional film projector) with high-quality image and sound. The content can be encrypted with secure delivery, playback, and reporting of play times to the distribution company. 3. **IPSTAR for Maritime & In-flight Services:** Apart from broadband services on the land, in the sea and sky area is also a future of our satellite business as well. There are plans to offer high-speed broadband on airliners and vessels by offering applications such as GSM/3G mobile and internet access through wired and wireless technology. With these services, crews feel never far from home and passengers never stop enjoy their conversation and web-surfing. |
| AsiaSat | Depends on customer's demand. |
| KT | The UHD/3D-TV broadcasting and high speed internet service using the satellite would be deployed in the near future |
| NBT | Broadcast service especially Television via satellite and IPTV. |
| CAT Telecom PLC | Transmission of video-audio signal via video streaming. |
| TOT PLC | We are testing the IPTV and Video Broadcasting over Satellite communications at the moment. |
| PT Telekomunikasi | Data and video services |
| Intelsat | Cellular backhaul, maritime and aeronautical services, government services, enterprise solutions. |
| Inmarsat | New services will be launched in 2014 on the Inmarsat Global Xpress system, operating in the Ka-band frequencies. These services are particularly aimed at providing mobile broadband (around 5 Mbit/s uplink and 50 Mbit/s downlink) to mobile terminals on ships, aircraft and land-vehicles. Consumer broadband may also be provided to users in remote areas. |

1. What are the technical constraints faced, if any, in the deployment of satellite broadband services?

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| --- | --- |
| Thaicom PLC | There is not adequate spectrum due to high growth demand. |
| MEASAT | Interference from terrestrial services which requires the installation of LNB filters which are costly to customers. Interference from adjacent satellite is difficult to resolve due to lack of skilled manpower from the interfering satellite operator. |
| AsiaSat | Deployment of satellite broadband applications in the Ku-Band is not desirable in high rain region because the high rainfade affect the availability of the service. |
| KT | It depends on the service cost rather than technical constraints. |
| NBT | None |
| CAT Telecom PLC | Whenever the defective user terminal is replaced by the new one, we need time to test its uplink due to their incompatibility. We cannot use it promptly. |
| TOT PLC | As the natural technical constraints of satellite communications, some applications cannot tolerate delay in the satellite communications such as FAX services. These drawbacks can be overcome with some techniques introduced in the applications. A signal shortage during sun outage phenomenon and heavy rain are also known issues. Available spot beam allocation cannot be reassigned to areas where needed. |
| PT Telekomunikasi | Frequency capacity, rain attenuation if occupy higher frequency than ku bands |
| Intelsat | Deployment of very small terminals. |
| Inmarsat | Technical constraints include those arising from the coordination of the satellite network with other operators, constraints due to the capabilities of satellite technology and terminal technology, and constraints due to the propagation conditions in the Ka-band. These constraints have already been addressed, or are currently being addressed. Other constraints arise due to some of the Ka-band frequencies being used by other services (e.g. the fixed service). |

1. Could you describe your experience on interference issues encountered from other types of services, if any, in the deployment of satellite broadband services?

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| Thaicom | There are some interference issues with other services. |
| MEASAT | The adjacent satellite interference is typically due to antenna mispointing. Considerable amount of time and effort is required to locate the source of interference as this requires liaising with the suspected interfering satellite operator. There could be situations where the elimination of the interference is slow due to the lack of skilled manpower on their side. This results in loss of revenue due to the inability to use the affected frequency bands. There is also the interference from terrestrial services in countries where Wimax is allowed to operate in satellite bands, in particular the extended C-band. It is difficult to resolve the interference due to the incompatibility between Wimax and satellite services which requires large separation distances and the installation of LNB filters which could only alleviate but not eliminate the interference. Furthermore, the local regulations are inadequate to ensure that the satellite services are protected. |
| KT | There was no experience on the interference issue yet. However, because of the trends of the miniaturization and mobility of terminals, the interference between the adjacent satellite networks may be occurred. |
| NBT | None |
| CAT Telecom PLC | None |
| TOT PLC | We have had none so far. |
| PT Telekomunikasi | Currently, no interference issue. |
| Intelsat | None so far. |
| Inmarsat | Inmarsat’s current broadband service operates in the L-band MSS spectrum (around 1.5/1.6 GHz) and no major interference issues have been encountered.  The planned Global Xpress system will operate in the Ka-band FSS allocations. Some of those allocations are exclusive to satellite systems and hence no significant interference issues are anticipated. Some of the allocations are shared with the FS, and hence there could be interference issues if satellite user terminals are operated in the same areas where FS systems are deployed. |

1. What are the regulatory constraints faced, if any, in the deployment of satellite broadband services?

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| Thaicom PLC | Lack of public regulatory information e.g. standard of equipments and services in many countries for the satellite operator in preparation for providing a service is the key regulatory constraint that we have faced.  The complicated requirements for space, ground, and spectrum licenses and the conditions of a multiplicity of concerned authorities often result in multiple application forms and high licensing fees and delay in license approval which are difficult to meet in due course.  Each country takes a variety of different approaches toward spectrum/ frequency management and may allocate spectrum range specifically for certain services. Therefore, it is difficult to apply the same spectrum license which is regulated to be allocated for other services than 2-way satellite broadband service by regulatory.  Policy on landing right is one regulatory constraint faced in the deployment of satellite broadband services. |
| MEASAT | In countries where Wimax are deployed in satellite downlink bands, the local regulations lack the guidelines/procedures of detecting and resolving satellite interference. There are also constraints in expanding into new markets as the countries of interest do not practice open skies policy. |
| KT | There were no regulatory issues in the deployment of satellite broadband services. |
| NBT | None |
| CAT Telecom PLC | There is a national regulation which limits operators to use only Thai satellite leased circuits. |
| TOT PLC | We have had none so far. |
| PT Telekomunikasi | Frequency issue |
| Intelsat | Regulatory constraints: Uncertainty due to IMT frequencies discussions; some confusion among governments with respect to the relative contribution of satellite and terrestrial solutions for ICT projects development - satellite is sometimes portrayed as obsolete vs terrestrial, whereas it is a tremendous complement/catalyst for ICT growth in all projects we have been leading. |
| Inmarsat | Ka-band satellite systems have recently started to be deployed, and some regulators are still in the process of developing their regulations for terminal authorisation. The use of broadband satellite on mobile platforms, as opposed to fixed terminals, may require modification to the regulations in some countries. In this context, it may be noted that the CEPT is developing a new ECC Report and ECC Decision related to the authorisation of Ka-band earth stations on mobile platforms. |

1. Do you have any communications systems where by the satellite and terrestrial components complement each other? Please describe these systems.

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| Thaicom PLC | Please see the answer in Section C-2 (2) |
| MEASAT | Satellite GSM backhaul allows GSM services to be provided to underserved areas which lack terrestrial infrastructure. Satellite backhaul gives the ability to cover remote areas without using terrestrial infrastructure, the possibility of expanding the coverage of a cellular network and to act as a backup for another terrestrial network. Satellites are used to provide links between the remote base transceiver stations and base controller stations, or between controllers and mobile centres. |
| AsiaSat | IP Backbone Connectivity:  AsiaSat supplies capacity to ISPs for Internet backbone connectivity in terrestrially underdeveloped locations or in remote areas where broadband services cannot be economically established. While satellite helps resolve backbone congestion, ISPs can offer greater service availability across their markets.  Rural and Remote Internet Access Connectivity:  AsiaSat has been used in complementing terrestrial service to deliver broadband Internet access services to users located in remote areas or places where broadband infrastructure such as DSL or cable does not exist. |
| KT | There are no such communications systems in the Republic of Korea at this time. However, the systems of satellite and terrestrial components could be considered. |
| NBT | Trunk Radio |
| CAT Telecom PLC | We have a transmission link between the IPSTAR Gateway and Internet Exchange. |
| TOT PLC | As a solely NSO in Thailand, we do provide total solutions to our satellite customers by providing them with various technologies, for example DDN (Backup/bachaul system for cellular operators), IP-VPN (for banking), Metro-LAN, DSL-VPN (MoE-Net), etc. |
| PT Telekomunikasi | Yes, we have it. It is for backhaul mobile network. Communication by satellite is deployed when some rural area is not cover by Fibre optics or microwave system. |
| Intelsat | Intelsat has developed a comprehensive MPLS fiber network to provide easy access points to customers across the globe and make the satellite just another node in their networks. |
| Inmarsat | Inmarsat broadband applications are typically used on mobile terminals where terrestrial broadband is non-existent (e.g. for aircraft and ships) or are used in land areas where terrestrial alternatives are non-existent or are inadequate. In this respect satellite and terrestrial broadband services are complementary to one-another, with satellite applications able to fill in the ‘holes’ in terrestrial broadband coverage. |

1. Do you have any ongoing pilot satellite broadband projects? Please describe these systems.

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| Thaicom PLC | **IPSTAR Open Access Platform:**   * For selected vertical markets, IPSTAR now offer unbundled service * The IPSTAR Open Access Platform allows operators and service providers to utilize the IPSTAR bandwidth capacity with their ground system of choice - the switch from conventional to broadband satellite has never been easier * Customers not only benefit from our state-of-the-art teleport facilities but also from our full frequency licenses in 14 countries in Asia-Pacific * IPSTAR Open Access promises increased competitiveness and flexibility to deliver high Quality of Service (QoS) at lower cost |
| AsiaSat | Content Delivery to IPTV Platforms:  Satellite is the prime vehicle for cost effective content distribution to multiple locations across a vast region like Asia Pacific. AsiaSat plays an integral part in the global and regional distribution network of many broadcasters and programme providers, distributing content to many IPTV platforms across the region.  IP Backbone Connectivity:  AsiaSat supplies capacity to ISPs for Internet backbone connectivity in terrestrially underdeveloped locations or in remote areas where broadband services cannot be economically established. While satellite helps resolve backbone congestion, ISPs can offer greater service availability across their markets.  Rural and Remote Internet Access Connectivity:  AsiaSat has been used in complementing terrestrial service to deliver broadband Internet access services to users located in remote areas or places where broadband infrastructure such as DSL or cable does not exist. |
| KT | We do not have ongoing pilot satellite broadband projects. However, the hybrid/integrated satellite system would be considered for providing broadband communication. |
| NBT | None |
| CAT Telecom PLC | None |
| TOT PLC | We are working on providing connectivity for the “One Tablet per Child” Project (OTPC) of the Government at this moment. |
| PT Telekomunikasi | Not yet. We plan to deploy broadband satellite in 2016. The project is in the stage of RFI. |
| Intelsat | The EpicNG Satellite Platform  Like terrestrial communications services, satellite services are undergoing a progressive evolution in order to meet escalating demand for broadband data applications. Strategic planning and investment has been necessary to move to a next generation platform which is a highly reliable and efficient contribution to future broadband infrastructure. It will also reach into developing regions, geographies and mobile applications.  Intelsat has recently announced a next generation satellite platform that will deliver global high-throughput technology without sacrificing user control of service elements and hardware.  The Intelsat EpicNG platform is an innovative approach to satellite and network architecture utilizing C-, Ku- and Ka-bands, wide beams, spot beams, and frequency reuse technology to provide a customer-centric benefits, including:  (i)      high performance and lower cost per-bit to customers;  (ii)     wide beams and spot beams in the same band for broadcast and high-throughput;  (iii)    C-, Ku- and Ka-band frequencies aligned to region and application-specific requirements;  (iv)    open architecture;  a.       backward compatibility; use of existing network infrastructure and customer-preferred network topology for lower total cost;  b.      forward compatible as ground technology advances.  (v)     high throughput, efficiency and reliability enables smaller, mobility-friendly terminals supporting new applications such as mobility and aero, and benefitting data-centric services like cellular backhaul.  Designed as a complementary overlay to the world’s largest fixed satellite network, Intelsat EpicNG will be fully integrated with Intelsat’s existing satellite fleet and global IntelsatONESM terrestrial network |
| Inmarsat | As mentioned above, Inmarsat will launch the Global Xpress system, consisting of three new Ka-band satellites, ground based infrastructure, and user terminals. The system is fully funded and is currently under construction. The first Global Xpress satellite will launch in 2013. The system will be available in the APT region in 2014. Typical user terminals will use a dish of about 60 cm diameter, and will have the capability for 5 Mbit/s uplink and 50 Mbit/s downlink. Terminals will be able to operate globally (except the polar regions). More information is available here: <http://www.inmarsatgx.com/>. |

**Questions to Vendors:**

1. What are the satellite related products of your company?

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| --- | --- |
| Thaicom PLC | Hardware. Please provide a brief description of product(s).  Ground Technology  The IPSTAR system is comprised of a gateway earth station communicating over the Thaicom-4 (IPSTAR) satellite to provide broadband packet-switched communications to a large number of small terminals with network STAR topology configuration.  A wide-band data link from the gateway to the user terminal utilizes an Orthogonal Frequency Division Multiplexing (OFDM) with a Time Division Multiplex (TDM) overlay. These forward channels employ highly efficient transmission methods including Turbo Product Coding (TPC) and higher order modulation (L-codes) for increased system performance.  In the terminal-to-gateway direction or return link, the narrow-band channels employ the same efficient transmission methods. These narrow-band channels operate in different multiple-access modes based on bandwidth usage behavior, including ALOHA and TDMA on the STAR return link waveform.  IPSTAR Gateway System  The IPSTAR air interface is designed for mass broadband applications. The IPSTAR gateway provides packet-switched broadband communications to a large number of small terminals or Customer Terminal Equipment (CTE). IPSTAR terminals work in conjunction with the satellite and gateway. The air interface employs advanced waveforms on the forward and return channels, and is optimized for overall system efficiency.  The IPSTAR gateway incorporates proprietary Adaptive Coding and Modulation (ACM) for an efficient use of RF power and bandwidth allowing high transmission rates in conjunction with small antennas (84–120 cm.) and transmitters. The interface between the IPSTAR gateway to any device or network is based on the industry standard Internet Protocol (IP) to ensure seamless integration of existing applications, hardware, and systems. Network configuration is based on gateway STAR topology: a user terminal receives/transmits signals from/to a beam, which connects to the IPSTAR gateway that is linked to other networks, such as the Internet backbone or telephone networks.  A wide-band data link from the gateway to the user terminal utilizes an OFDM with TDM overlay. The forward channel employs highly efficient transmission methods, including TPC and higher order of modulation (L codes) for increased performance. The waveform of the forward channel is based on TDM-OFDM technology that utilizes bandwidth and power more efficiently. The forward channel is optimized to accommodate multiple data rates and forward error correction coding. The return channel is based on MF-TDMA technology to offset bursty traffic and to accommodate applications that require higher bandwidths. The waveform is fixed to a more robust modulation to ensure high link availability at low transmission power. The narrow-band channel operates in multiple access modes based on bandwidth usage behavior, such as ALOHA and TDMA.  IPSTAR User Terminal:  IPSTAR is driven by a quest for excellence and an ongoing commitment to innovation to broaden the scope of satellite applications, allowing us and our partners to develop and deliver cost-effective broadband satellite services and solutions.  IPSTAR has built success not only on the reliability and flexibility of its in-orbit resource, but with its ground system technology and products as well.  Leveraging the reach and power of broadband satellite, IPSTAR user terminals permit high-performance broadband applications for a variety of markets and projects.  IPSTAR user terminals are fully compliant with the IPSTAR gateway system and specifications, and offer ease of installation and use.  Fully IP compatible, all IPSTAR terminals permit interfacing with a wide range of existing network applications, utilities and hardware—resulting in a rich set of terminal configuration options designed to meet the requirements of a diverse user and application base.  Software. Please provide a brief description of product(s).  The development of software products are based on Hardware products as described above.  Please see the answer of C-3 (1). |

1. What is your latest product supporting satellite broadband services (you can mention more than 1 product)?

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| --- | --- |
| Thaicom PLC | iCON user terminal: Designed for Consumer Broadband Mass-Market Scale  The iCON is our consumer priced terminal and is designed for mass-market scale and reliability. In combination with our small sized antennas, residential and business users will appreciate the maximum 5 Mbps download and 4 Mbps upload speeds\* the iCON offers for a variety of bandwidth-demanding applications, such as high speed Internet, voice, and media streaming.    The iCON's embedded CPU with Turbo Product Coding enhancement feature is optimized for high-speed data applications. The iCON supports Adaptive Coding and Modulation (ACM) for most reliable operation even under severe weather conditions.  Features:  Maximum download speed: 5 Mbps\*  Maximum upload speed: 4 Mbps\*  Compatible with Thaicom-4 (IPSTAR)  Embedded CPU  Adaptive Coding and Modulation (ACM)  Turbo Product Coding Turbo Product Coding  Low power consumption  \* Maximum throughput is not applicable for simultaneous download and upload. Maximum throughput for simultaneous download and upload is 4 Mbps receive and 2 Mbps transmit |

1. Does this product have any technological features or advantages such as reducing the signal latency, the cost of satellite service etc?

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| --- | --- |
| Thaicom PLC | Yes, the IPSTAR proprietary ground system and gateway operations in 14 countries along with IPSTAR user terminals and appliances together is optimized for high-speed IP data, video and voice, the IPSTAR system supports a wide variety of IP-based applications and services, from high-speed Internet/intranet access, to video conferencing, to Voice over IP (VoIP) with service level control providing the ability to have multi-level QoS offerings.  Especially, IPSTAR VoIP service is optimized for the IPSTAR satellite environment so its performance is significantly better than generic VoIP. It incorporates Constant Bit Rate (CBR) on satellite to minimize latency (delay) and jitter. |

1. Is this product intended for a specific broadband application?

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| --- | --- |
| Thaicom PLC | Yes, please see the answer in C-3 (3) |

1. What are the emerging broadband applications that any new products in your company may be based on in the near future?

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| --- | --- |
| Thaicom PLC | Please see the answer in C-2 (3) & (8) |

1. What are the technical/regulatory constraints that you encounter in selling your product in different countries?

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| --- | --- |
| Thaicom PLC | Please see the answer in C-2 (6) |

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1. ECC Report 184 will be available by March 2013 at <http://www.ecodocdb.dk/> [↑](#footnote-ref-1)
2. ECC Decision ECC/DEC/(13)01 will be available by March 2013 at <http://www.ecodocdb.dk/> [↑](#footnote-ref-2)
3. Most applicable here are: EN 301 459, EN 301 428, EN 301 360, and EN 303 978 and are available from http://www.etsi.org/standards [↑](#footnote-ref-3)