

## INMARSAT Fourth Generation Satellite And BGAN Service

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### 1. Introduction

The data communication demand on the Internet has been rapidly expanding and the terrestrial data communication bit rate has become extremely fast by the spread of broadband access lines such as ADSL (Asymmetric Digital Subscriber Line). The data communication speed of 144kbps has been the highest in the field of the mobile satellite communication so far. INMARSAT launched the next generation satellites from the hope for further speeding-up of the data communication also in the mobile satellite communication in the future. In this article the outline of INMARSAT fourth generation satellite (I-4: Inmarsat-4) newly launched and BGAN (Broadband Global Area Network) service provided by the I-4 satellites are described.

### 2. INMARSAT fourth generation satellite

INMARSAT fourth generation satellites (I-4) launched to correspond to the higher-speed data transmission service in March and November, 2005, respectively can generate the 256 beams in the service link (satellite-mobile terminal; L-band). I-4 satellite has a capability to generate three kinds of beams, that is, 1 global beam, 19 wide spot beams, and 200 narrow spot beams or more besides the beam for the control of the satellite. The BGAN service described in the next paragraph is provided within the range of the narrow spot beams. Existing INMARSAT service (INMARSAT mini- M service etc.) besides the BGAN service is provided by a global beam or wide spot beams. The first I-4 satellite was allocated in IOR (Indian Ocean Region), and the second one was in AOR-W (Atlantic Ocean Region-West). POR (Pacific Ocean Region) is expected to have the third satellite. These satellites made by the ASTRIUM company were launched respectively with Atlas V launcher from Cape Canaveral, Florida by the ILS(International Launch Services) and with Zenit-3SL by the Sea Launch Co. from the equator area around south-east of Christmas Island, Republic of Kiribati in Pacific Ocean .

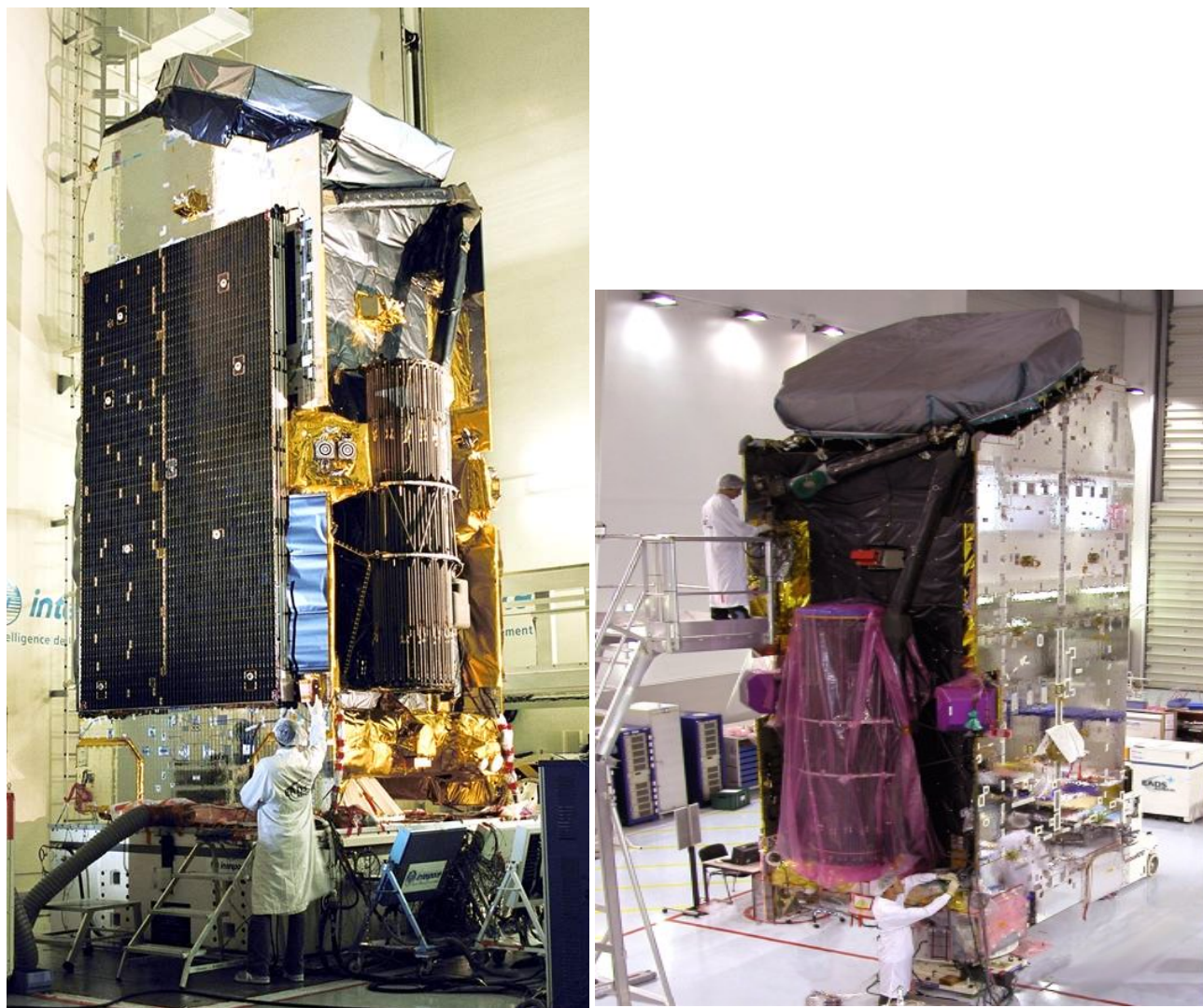


Figure 1 INMARSAT fourth generation satellite

The main specifications of the third generation satellite (I-3) and the fourth generation satellite are compared and summarized in Table 1. The I-4 satellite is about six tons in weight at the launch, 48m in total length including the solar panel, and is one of the largest communication satellites in the world. The size of the satellite payload corresponds to "double-decker bus in London", and the width of the solar panel is almost equal to "side of the soccer pitch". It can be recognized from figure 1 how large the satellite is.

Existing & Evolved Inmarsat services (E&E services) such as mini M/M4 which is provided only in spot beam area cannot be globally offered due to the lack of I-3 satellite's coverage of spot beams, while since the I-4 satellite covers global area with the wide spot beam, the coverage of such services using spot beams will be made available in the global area in I-4 era. Figure 2 shows the arrangement of the narrow spot beam in the Indian Ocean and the Atlantic Ocean West regions. One narrow spot beam and adjacent 6 narrow spot beams (7 beams totally) are assigned 7 different frequency slots, respectively and these 7 frequency

slots are reused as one group about 30 times ideally. I-4 satellite has about five times frequency band more than I-3 satellite has in the feeder link (from 30MHz to 150MHz in C band) corresponding to the frequency reuse in the service link. Moreover, it is understood that the effective bandwidth of 300MHz is achieved by dual polarization scheme using both right and left hand circular polarizations in C band.

Table 1 satellite specifications

Item	third generation satellite	fourth generation satellite
Number of satellites	4+1 spare	2+1 spare
Weight at liftoff / dry mass (kg)	1,830/822	6,000/3,000
The total length (m)	21.5	48.0
Design lifetime	13 years	10 years
Electric power generation capability (kW)	2.3	9.0
Bandwidth of Service link / feeder link (frequency band)	34MHz(L)/30MHz(C)	34MHz(L)/150MHz(C)
Beam type	Global beam 7 spot beams	Global beam 19 wide spot beams 200 narrow spot beams
Service link EIRP	49dBW	67dBW

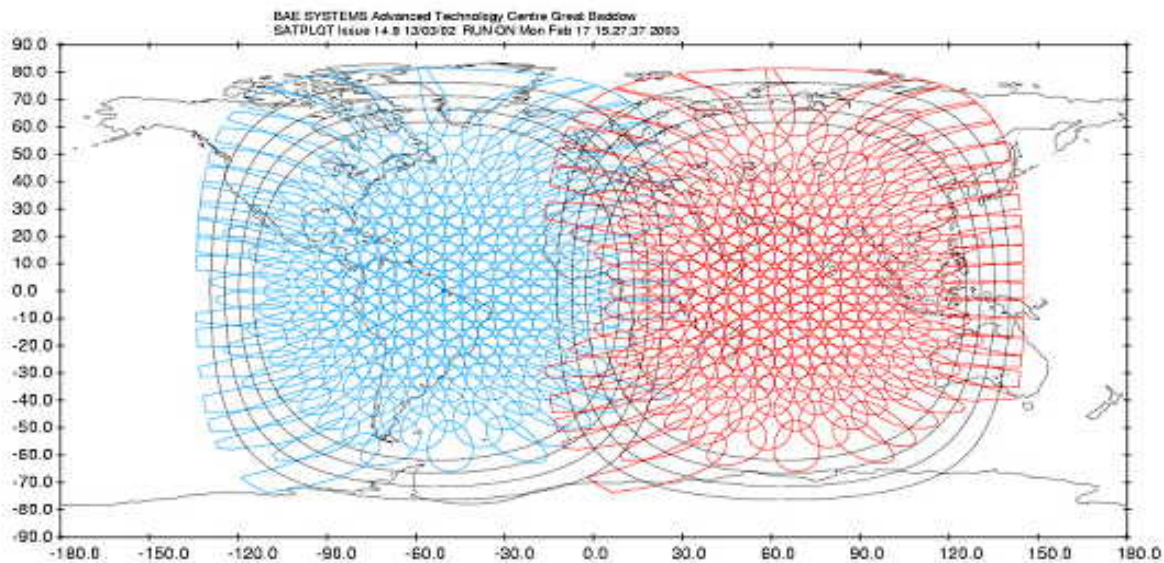


Figure 2 Narrow spot beam coverage of fourth generation satellites (IOR and AOR)

### 3. INMARSAT BGAN service

INMARSAT BGAN service provided by I-4 is regarded as the satellite version of the third generation cellular phone (3G UMTS: 3rd Generation Universal Mobile Telecommunications System). The interface with the land network called Core Network (CN) is compatible with 3G UMTS though the interface with satellite link adopts the TDM/TDMA system originally specified by INMARSAT. The BGAN service has been offered for land mobile terminals since December, 2005.

Figure 3 shows INMARSAT BGAN network. The gateway systems called SAS (Satellite Access Station) are located in Netherlands and Italy, and operate to interwork with a public network (telephone and Internet, etc.). IP data service and circuit switching service are provided as well as 3G UMTS. The following two services are planned to be offered commonly to the IP data service and circuit switching services.

- Prepaid settlement  
Service that uses SIM (Subscriber Identify Module) card for rechargeable prepaid settlement
- Roaming by SIM card for the third generation cellular phone and GPRS(General Packet Radio Service)  
Plastic (SIM Card) roaming service that can be used by putting common SIM card with the cellular phone in BGAN terminal

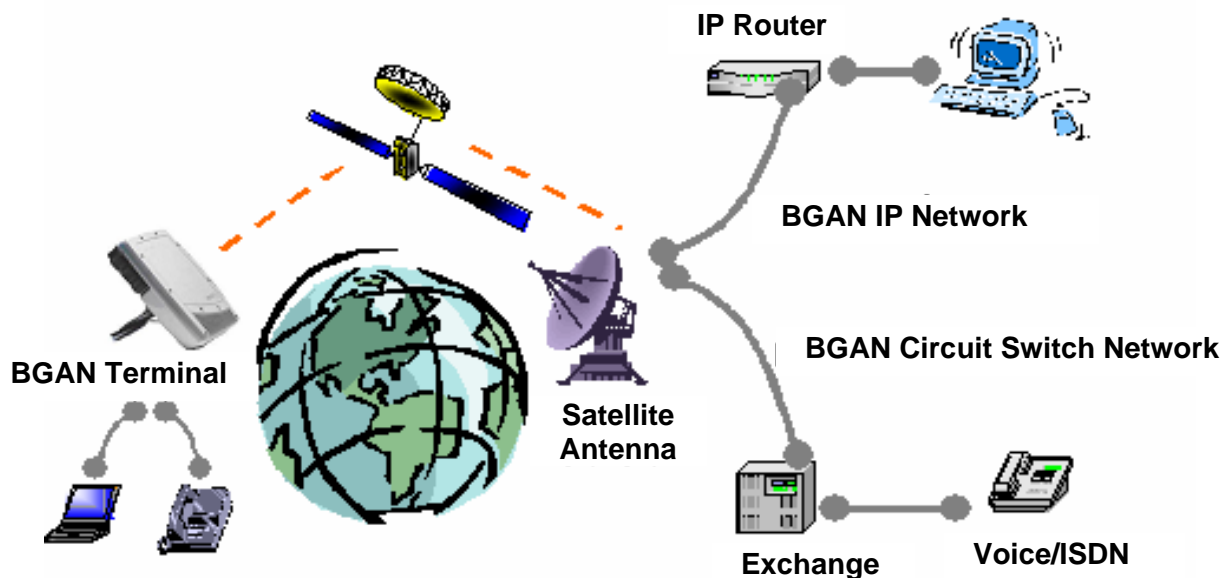


Figure 3 INMARSAT BGAN network

### 3.1 IP data service

Data transmission speed of 492kbps or less by the best effort scheme is provided, which speed will be different depending on the kind of the mobile satellite terminal. Moreover, it is planned to introduce the TCP/IP accelerator that improves the throughput taking into account of the satellite propagation delay. Various Internet applications such as Web access, E-mail, the VPN (Virtual Private Network) connections and streaming transmission. can be used. Moreover, either 'Standard service' or 'Premium service' can be chosen according to desired service quality.

'Standard service' provides best effort service and is charged according to the total traffic volume sent and received. On the other hand, 'Premium service' guarantees the transmission speeds of the satellite link to be either 32kbps, 64kbps, 128kbps or 256kbps according to the request from the satellite terminal for the application such as voice over IP, video over IP, etc. requiring a constant, steady transmission rate. In this case, the communication charge becomes an account according to not volume of data but the communication period used.

### 3.2 Circuit switching service

Telephone and ISDN (Integrated Services Digital Network) services are provided In the circuit switching service. The former is the voice communication service with the CODEC quality of 4kbps. The latter service which supports only one B channel (64kbps line), offers 64kbps data communication and 3.1kHz audio with the voice grade quality almost equal to terrestrial line. Additionally, a short message, the caller ID notification and call forwarding etc. are offered as an optional service.



### 3.3 Outline of BGAN terminal

Several types of mobile BGAN terminal with different antenna size, the maximum data speed etc. have been put into the market as shown in Table 2. The BGAN terminal is designed as a modem for satellite communications and it consists of the antenna, communication control part and interface with the user terminals (telephone handset, PC etc.). The user terminal originates the communication, that is, when it accesses the Internet, the connection is supposed to be done by calling with a dial-up network from PC connected with BGAN or calling with an application through LAN (Local Area Network) interface. Additionally, it is also possible to configure the BGAN terminal to access WAN (Wide Area Network) through router which has user side LAN composed of several user terminals. Figure 4 shows an example of PC communication with smallest BGAN terminal (Nera WorldPro 1000).



Figure 4 Example of BGAN Terminal usage

### 3.4 Communication charge

Table 3 shows KDDI BGAN service charges which have several package plans similar to the cellular phone. These charges are composed of the basic monthly charge including some amount of free communication charge, different packet charges according to package plan and voice/ISDN communication charges which are common among all package plans.

Table 3 Charge table of KDDI BGAN services

Price plan	BGAN plan S	BGAN plan M	BGAN plan L	BGAN plan XL	RBGAN plan R
Basic monthly charge	5,000 yen	12,500 yen	60,500 yen	380,000 yen	5,000 yen
Free communicatio n charge	None	7,500 yen	50,000 yen	300,000 yen	3,000 yen
Packet charge(/MB)	850 yen	650 yen	540 yen	430 yen	650 yen
Voice charge(/min )	170 yen				
ISDN charge(/min )	840 yen				

#### 4. Summary

INMARSAT system that firstly started from an analog communication system becomes more efficiently, higher-speed and more stable system along with the digitalization of network and introduction of advanced satellites. It is expected that the network with less digital divide has been established through realizing the Internet access by BGAN system with data speed of almost 500kbps, even which does not reach the trend of land broadband.

Moreover, addition to the land mobile terminals provided now, the terminal for the aircraft and for vessels are currently being developed which will offer the same services as BGAN system from next year on.

Table 2 BGAN terminals

					
<b>Product name</b>	R-BGAN	Wideye Sabre I	Nera WorldPro 1000	Explorer 500	HNS 9201
<b>Size</b>	A4 (300×240mm)	A5+ (384×180mm)	A5 (200×140mm)	A4 (217×217mm)	A4+ (345×275mm)
<b>Weight</b>	1.6 kg	1.25 kg	<1 kg	<1.5kg	2.8 kg
<b>Manufacturer</b>	HNS(Hughes) Co. (United States)	Add Value Co. (Singapore) - to be salsed	Nera SatCom Co. (Norway)	Thrane&Thrane Co. (Denmark)	HNS(Hughes) Co. (United States)
<b>Standard IP</b>	144/144 kbps	384/240 kbps	384/240 kbps	464/448 kbps	492/492 kbps
<b>Streaming IP</b>	-	32, 64 kbps	32, 64 kbps	32, 64, 128 kbps	32, 64, 128, 256 kbps
<b>ISDN</b>	-	-	-	-	64 kbps ISDN
<b>Voice (interface)</b>	-	RJ11	RJ45 (ISDN hand set)	RJ11	RJ45 (ISDN hand set)
<b>Data interface</b>	USB, Ethernet	USB, Ethernet	USB, (Ethernet: to be provided this year)	USB, Ethernet	USB, Ethernet
<b>Continuous standby time</b>	36 hours	36 hours	36 hours	36 hours	36 hours
<b>Continuous call time</b>	1 hour	1 hour	1 hour	1.5 hours@144kbps	162MB