SATELLITE COMMUNICATION

Towards an unwired world

Satellite Communication is one of the fastest growing technological areas. From long distance telephone calls to remote printing to live television broadcast, a host of applications have been made possible because of satellite communications

By G.P. Vinaybabu

Arthur C Clarke's theory (propounded in 1945) of positioning three satellites in predetermined orbits in space to provide a global communication system seemed so far fetched and unachievable that most dismissed it as a wild dream and nothing short of a sci-fi fiction. But Clarke's theory today is not only a grand reality but is almost indispensable for the explosive growth of a host of technologies that have changed forever the way we live and communicate. The greatest beneficiaries of the satellite boom however have been the business and student communities.

Just have a look at the array of technological applications satellites have made possible. Long distance telephone services, telex, fax, trans-continental air ticket booking, credit verification and authorisation of bank accounts, simultaneous remote printing of several daily newspaper editions around the globe, disaster relief and health care, flight deck voice and data services, automatic flight positioning and status reporting, in-vehicle transportable phone, fleet management for land transport, disaster and emergency communications... the list goes on. This list however doesn't include the two most important and most popular technological applications the satellites are put into. The live video broadcast and Internet services. Right from the contribution of raw feeds to the TV studios to providing platforms for distribution of direct-to-home programming, satellites have made a huge difference to the video broadcast. Hundreds of satellites are today beaming images, sound and data in analogue and digital format, from anywhere to elsewhere in the world.

Satellite links are also proving most indispensable for Internet - the most powerful technological revolution in the history of mankind. With the Internet traffic growing ever so rapidly, the satellite links are replacing terrestrial links as the satellites offer a direct single hop to the Internet backbone instead of several hops in case terrestrial loops.

See as it happens

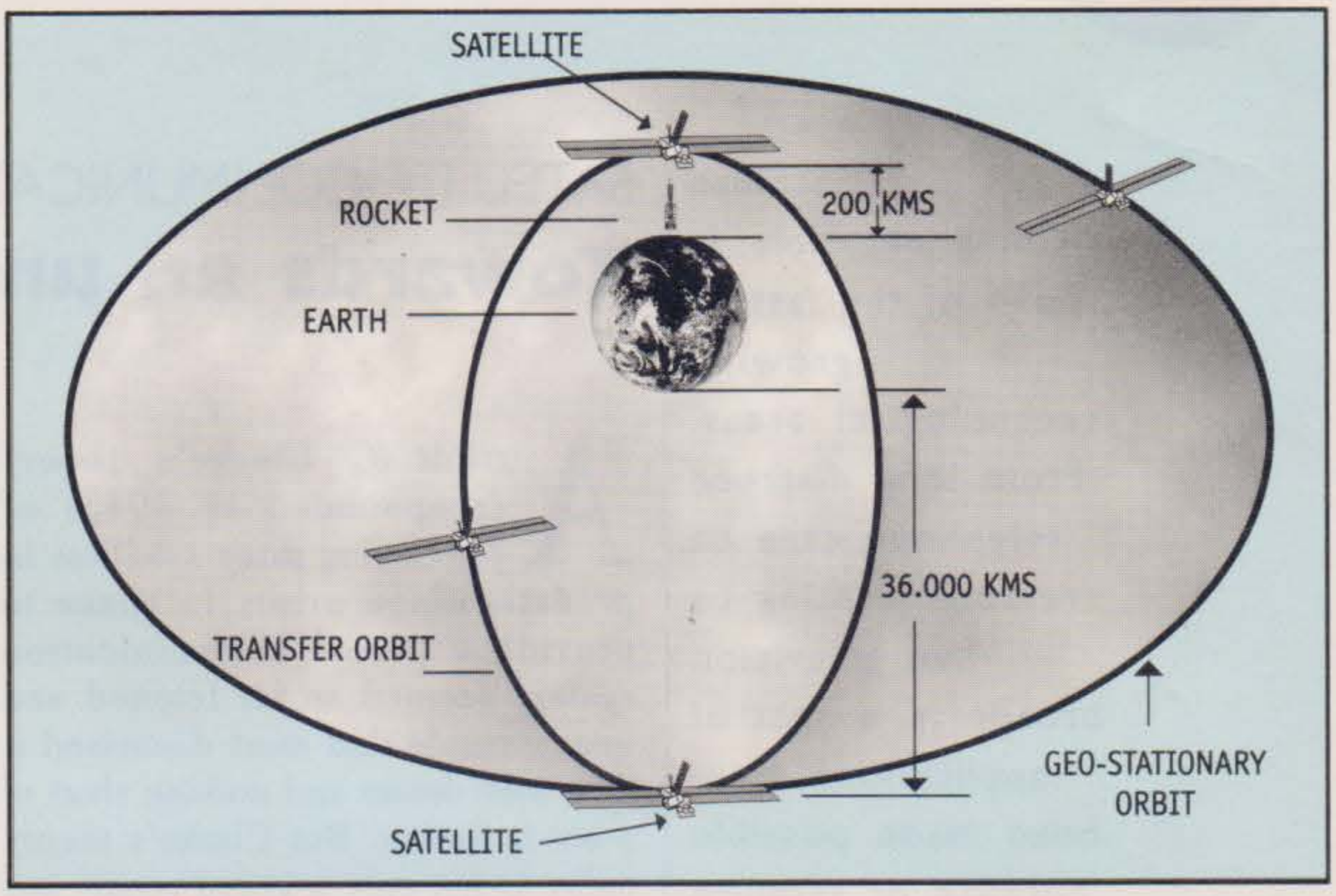
One of the greatest benefits of satellite communication systems is its ability to transmit multimedia images over

Satellites have enabled global mobile communications

large distances. This happens in a satellite communication loop which passes through three basic steps - uplinking, processing and down linking.

Uplinking

The signal, be it from a cricket match or any live event, carrying the barrage of information, has to travel 36,000 kms through free space to reach the satellite. In its journey the signal is bound to weaken in strength, due to the interference of spurious signals (noise), electromagnetic radiation effects from solar and thermal sources and artificial noise generated by various components. It is, therefore important that the strength of the signal be enhanced. The signal is uplinked and is converted to a very high frequency in GHz range at the uplinking station. Uplinking of the signal provides two advantages. Firstly, it improves the velocity at which the signal travels and secondly a smaller receiver antenna can be

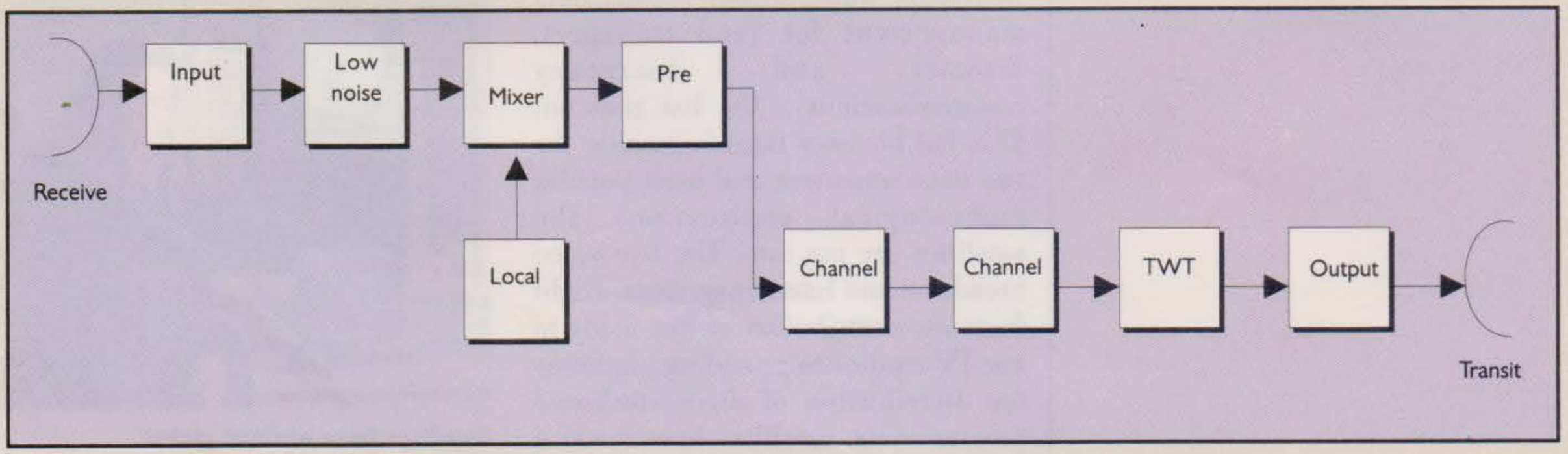


Launch of satellite into space orbit

ROLE OF THE TRANSPONDER

Every geo-stationary satellite carries a vital equipment called transponder, a term derived from transmitter and responder. The uplinked signal from the earth station is collected by the receive antenna of the satellite.

The signal is then passed to an input filter which confines the bandwidth of the signal allowed in the transponder (eg: the transponders operating on the C-band allow signals in the range of 3.7 to 4.2 GHz). This is the first of the several levels of filtering designed to reject unwanted signal frequencies. The signal is amplified by passing it through a low noise amplifier. It is then downconverted to a lower frequency using a mixer circuit. Having been 'cleaned up' by the input filter, amplified by the low noise amplifier and converted to the downlink frequency, the signal is further amplified by passing through channel filters - which defines the 'usable bandwidth' of the transponder, an important factor as far as the user of the service is concerned. The successfully amplified and carefully filtered signal thus passes from the transponder to the transmitting antenna which directs it on its long journey (36,000 kms) back to earth.



Schematic diagram of Transponder working

used on the satellite (an increase in the frequency results in decrease in the size of the antenna). The microwave signals transmitted from the OB van antenna are captured by the receiver antenna of the satellite. The OB van, then is the primary information provider.

Downlinking

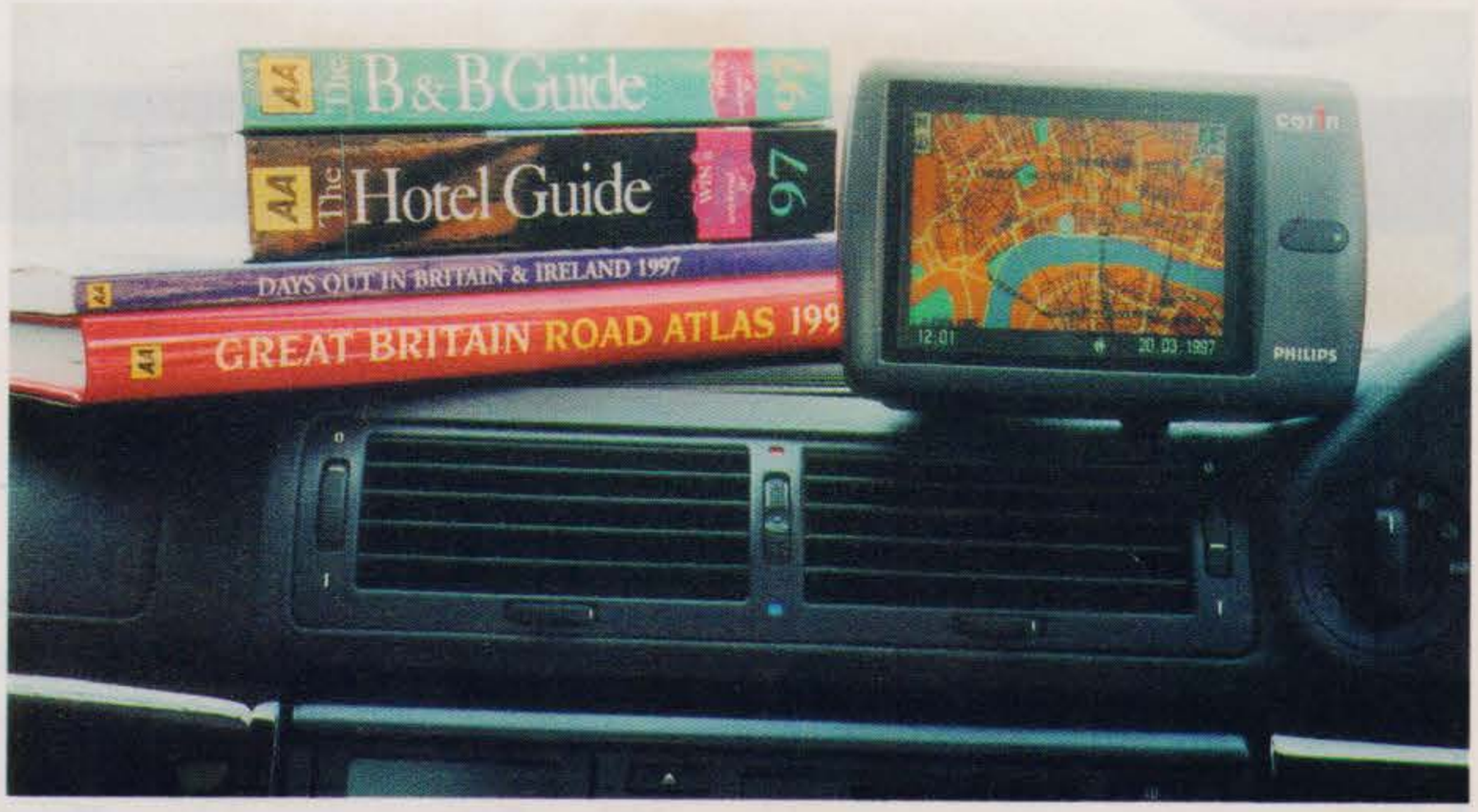
The signals transmitted by the satellite are at very high frequencies of 3.7 GHz to 4.2 GHz. These are generally referred to as the C-band frequencies. At the receiving end (our friendly neighbourhood dish antenna) the signals are downconverted to 950 MHz (Mega Hertz) - 1.450 MHz range since the equipment at the receiving end cannot receive signals at the GHz range. This process of receiving the microwave signals, processing and downconverting is referred to as 'downlinking'.

The microwave signals that fall on the antenna reflector (generally referred to as 'dish' which would be seen on the rooftop of cable operators) are focussed on the Low Noise Block Down Converter (LNBC) which is mounted on the dish at the centre (which can be observed as a projection on the dish of the cable operator).

It is the small antenna located within this LNBC which actually receives the signals. It is the prime function of LNBC to downconvert signals back to the MHz range, and also to amplify the signal keeping the noise level low. The receivers at the downlink station are connected to the LNBCs via co-axial cables. The receiver processes the downconverted signal and gives an output of two types.

1. Demodulated output in the form of audio and video signals.

2. RF signals - very high frequency (VHF) and ultra high frequency (UHF) signals, both compatible to television sets having either an audio video input or UHF/



GPS is a major SatCom application

VHF input. These signals are modulated after passing through modulators to get the most compatible RF output.

The Internet option

Internet, which is fast emerging as the default lingua franca for the people around the world, is yet another application that makes use of satellite communications of the world.

With the rapid growth of Internet, a huge demand for high-quality broadband data delivery systems that provide fast, reliable, and secure connections to the Internet, anywhere in the world has emerged. Geostationary satellites have been an integral link in transmitting international Internet traffic since 1973, just four years after the Internet's beginning.

Advantages of Internet via Satellite

Satellites provide Internet access and extend its network reach to meet customer demand in areas where terrestrial systems are inadequate or simply unavailable.

With speeds up to 155 Mbps, satellites supply just the amount of bandwidth that is right for Internet applications. In addition to backbone needs, satellite capacity can be customised to meet asymmetrical and multipoint requirements. These services are available via

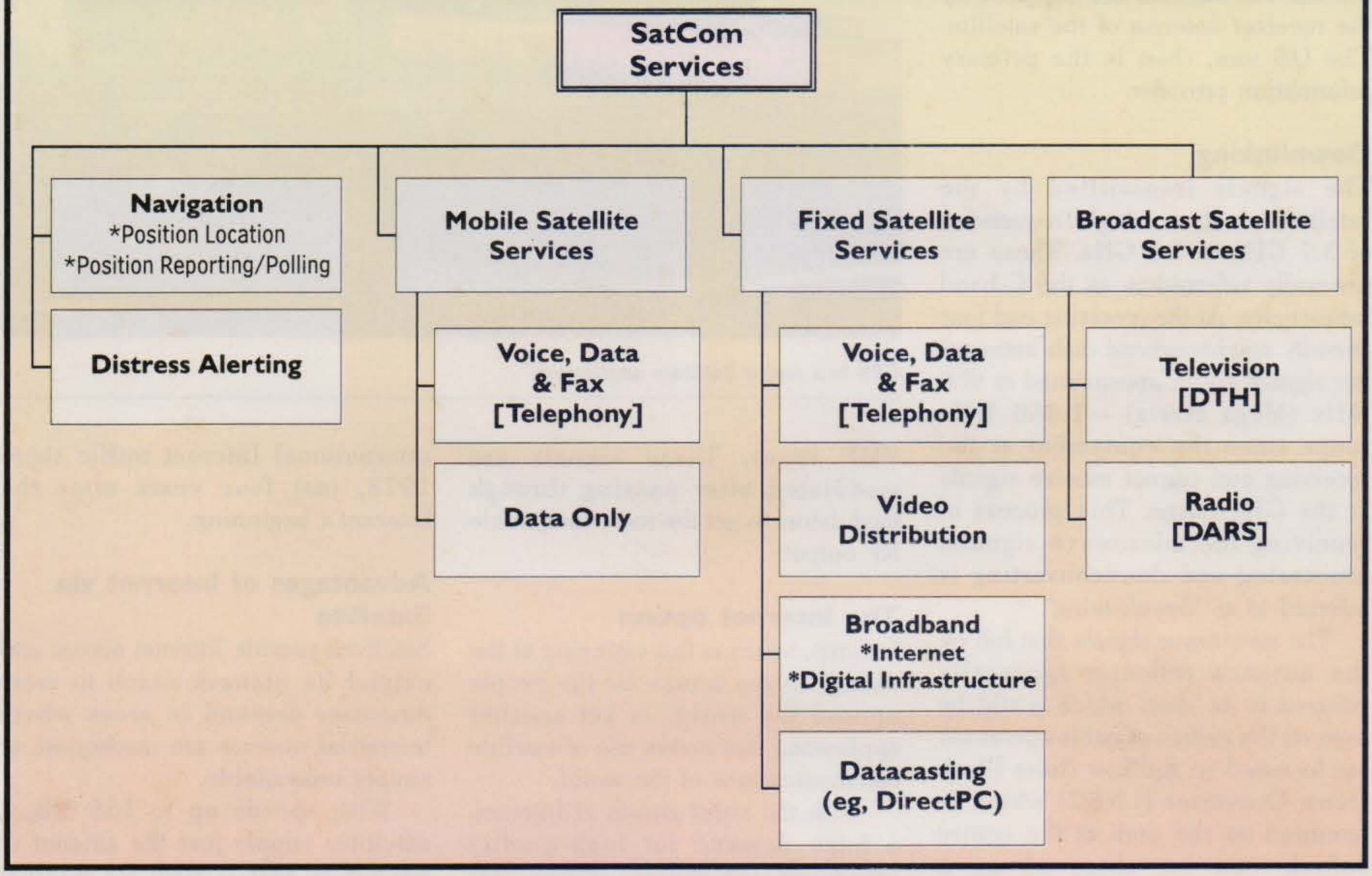
GLOBAL SATCOM INDUSTRY: KEY SECTORS ($ Bn)

Sector	1997	2000*	2007*
FSS	5.75	7.32	14.72
MSS	0.73	11.14	37.05
DBS	8.59	17.76	45.71
Multi-M	0.09	0.37	37.49
Equip & Launch	23.25	24.86	29.57
Total	**38.11**	**59.31**	**171**

FSS - Fixed Satellite Services. **MSS** - Mobile Satellite Services. * Estimates

Source: Merrill Lynch - Global Sat Marketplace '98

DIVERSIFICATION OF SATELLITE SERVICES



Geostationary satellites can deliver high-speed, point-to-multipoint Internet applications to multiple continents with IP multicasting.

geostationary satellites already in orbit and are economically priced and most importantly, are available today to help us meet the exploding demand for Internet access from all corners of the world. Carriers and ISPs have an ever-increasing demand for geostationary satellites to support Internet traffic

There are several advantages of Internet connectivity over the satellite links. Firstly, links can be established quickly anywhere in the world, and offer high quality and excellent availability. Secondly, satellite service also provides the opportunity for distance-insensitive pricing, meaning that users pay the same price whether they are dialing up a server on the other side of the world or in the same city. And thirdly, significant cost savings are realised when providers and end users take advantage of satellite's inherent asymmetric nature (more data flowing in one direction than another). Geostationary satellites can deliver high-speed, point-to-multipoint Internet applications to multiple continents with IP multicasting.

IP multicasting delivers requested information to many users simultaneously through the efficient use of bandwidth. For example, if 10 users request the same information, the information can be sent to all 10 users simultaneously on a shared satellite connection, freeing up bandwidth to be used for other applications.

With the technological breakthroughs happening at the wink of an eye, the application spectrum of satellites are bound to grow further to provide better services for the communication hungry world population. ●