Look out! Your home is invaded from the skies.

- G.P.Vinaybabu

Year: 1982,
Event: Ninth Asian Games
Venue: New Delhi

It was a memorable event for India. Being one of the conceptualisers of Asian Games concept and host to the first ever event of its kind in 1952, it was a historic moment for India to play host to the greatest Asian sporting extravaganza, yet again. However, it was not just the aura of Asian Games that made India proud and euphoric. Concurrently and quite unknowingly the games had sown the seeds for a different kind of a revolution in the country. If India's record at the games was nothing spectacular; a record on a different front was really remarkable. A record of sorts was created in the proliferation of mass media in the country that year. Television sales shot up from nothing to gigantic proportions that year - what with the live telecast of the games evoking unprecedented response from the Indian viewers. Except for world attention grabbers here and there, like the grand wedding of Prince Charles with Lady Diana and the fantabulous final between tennis superstars Bjorn Borg and John McEnroe, no event had raised such enthusiasm among the tube gazers as this. It was certainly the beginning of a new era for Indian entertainment industry.

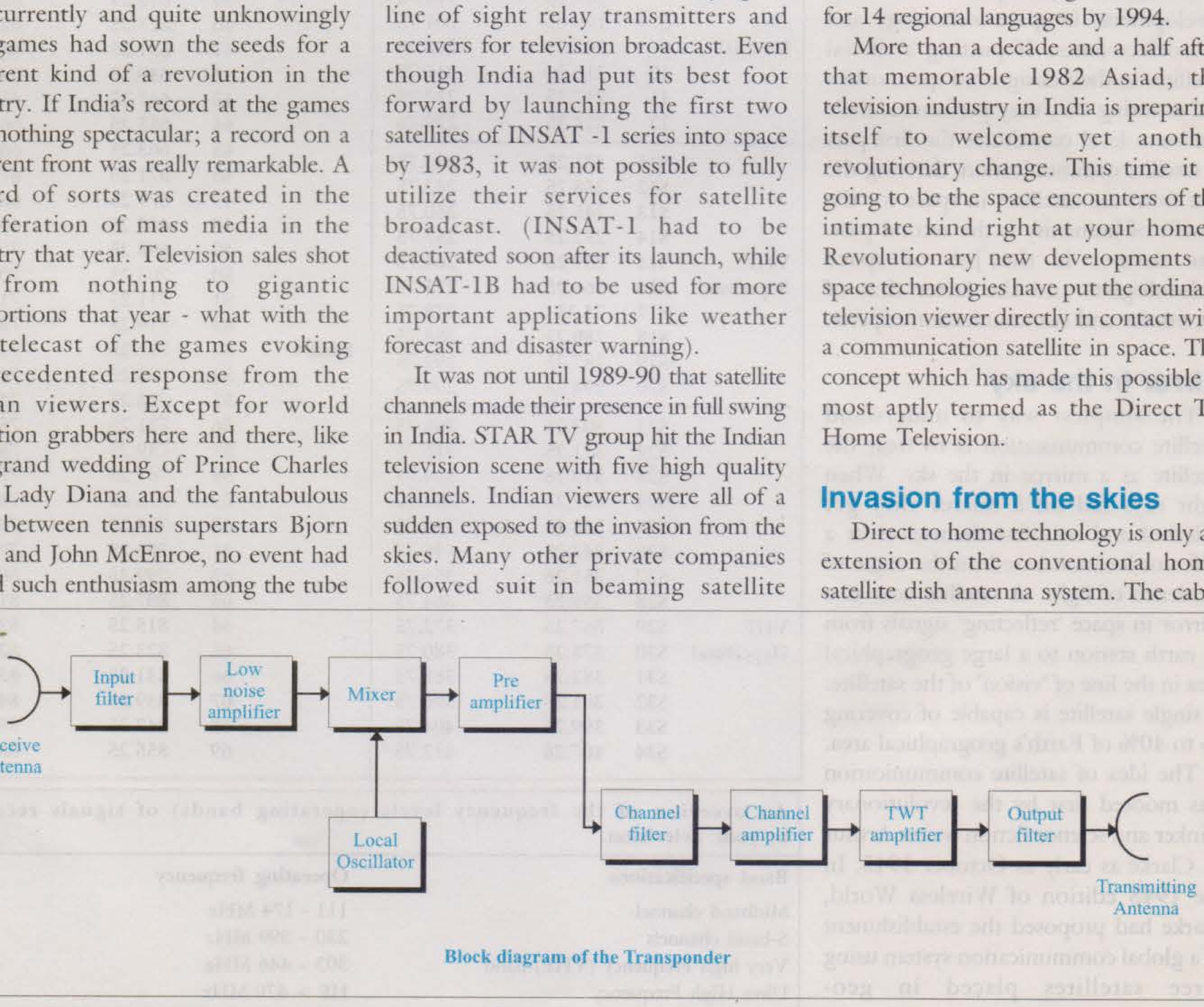
It was not quite a revolution though, as it was expected to be. While the Wild West was racing wildly in pursuit of greater variety in programming through hundreds of round-the-clock satellite channels, India was still struggling to come to terms with the lone Doordarshan channel beaming programs for less than half a day. The problem was, India was still relying on line of sight relay transmitters and receivers for television broadcast. Even though India had put its best foot forward by launching the first two satellites of INSAT -1 series into space by 1983, it was not possible to fully utilize their services for satellite broadcast. (INSAT-1 had to be deactivated soon after its launch, while INSAT-1B had to be used for more important applications like weather forecast and disaster warning).

It was not until 1989-90 that satellite channels made their presence in full swing in India. STAR TV group hit the Indian television scene with five high quality channels. Indian viewers were all of a sudden exposed to the invasion from the skies. Many other private companies followed suit in beaming satellite channels. Soon, within a span of a year or two, there were upto 30 television channels on the satellite network. On the other hand Doordarshan achieved its own milestone during the same period by introducing secondary channels in four major cities of the countries. The successful deployment of INSAT-1D also contributed to a fresh initiative for Doordarshan to bring in satellite channels to Indian homes. Later, with the success of INSAT 2 series of satellites, Doordarshan was successful in devoting a channel each for 14 regional languages by 1994.

More than a decade and a half after that memorable 1982 Asiad, the television industry in India is preparing itself to welcome yet another revolutionary change. This time it is going to be the space encounters of the intimate kind right at your homes. Revolutionary new developments in space technologies have put the ordinary television viewer directly in contact with a communication satellite in space. The concept which has made this possible is most aptly termed as the Direct To Home Television.

Invasion from the skies

Direct to home technology is only an extension of the conventional home satellite dish antenna system. The cable



Block diagram of the Transponder

operators don't come into the picture in DTH. The channels are beamed in high frequency Ku-band transponders, are digitally compressed and provide LD quality video and CD quality stereo at your homes. What is DTH really? What is digital broadcast? What are these transponders? What is Ku- band and what is frequency? To appreciate the advantages of DTH better, and to get answers to all the above questions, it is necessary that the technology behind satellite television broadcast be understood.

Earth to space and back to Earth

Satellite communication is a perfect example of how the technological developments in multidisciplinary areas are fast combining. Modern satellite communication is the outcome of a combination of path breaking developments in space technology and microelectronics. If putting artificial satellites in their designated space orbits and ensuring that they perform at their optimum level constitutes the first part of satellite communication, deriving the best from the satellites in space for the benefit of humanity is the second part. The former is the job of space technologists and the latter that of electronics and communication experts.

Mirror in the sky

The simplest way to understand satellite communication is to treat the satellite as a mirror in the sky. When light rays fall on a mirror they get reflected and manifest themselves at a different location based on the angle of incidence of light. A satellite acts as a mirror in space 'reflecting' signals from an earth station to a large geographical area in the line of 'vision' of the satellite. A single satellite is capable of covering up to 40% of Earth's geographical area.

The idea of satellite communication was mooted first by the revolutionary thinker and science fiction writer Arthur C. Clarke as early as October 1945. In the 1945 edition of Wireless World, Clarke had proposed the establishment of a global communication system using three satellites placed in geo-

Channel Allocation

TV bands	Ch	Picture Carrier MHz	Sound carrier MHz
	2	48.25	53.75
	3	55.25	60.75
	4	62.25	67.75
Band I	X	69.25	74.75
	Y	76.25	81.75
	Z	83.25	88.75
	Z+1	90.25	95.75
	Z+2	97.25	102.75
	S1	105.25	110.75
	S2	112.25	117.75
	S3	119.25	124.75
	S4	126.25	131.75
VHF	S5	133.25	138.75
Midband	S6	140.25	145.75
	S7	147.25	152.75
	S8	154.25	159.75
	S9	161.25	166.75
	S10	168.25	173.75
	5	175.25	180.75
	6	182.25	187.75
	7	189.25	194.75
	8	196.25	201.75
Band III	9	203.25	208.75
	10	210.25	215.75
	11	217.25	222.75
	12	224.25	229.75
	S11	231.25	236.75
	S12	238.25	243.75
	S13	245.25	250.75
	S14	252.25	257.75
VHF	S15	259.25	264.75
Superband	S16	266.25	271.75
	S17	73.25	278.75
	S18	280.25	285.75
	S19	287.25	292.75
	S20	294.25	299.75
	S21	303.25	308.75
	S22	311.25	316.75
	S23	319.25	324.75
	S24	327.25	332.75
	S25	335.25	340.75
	S26	343.25	348.75
	S27	351.25	356.75
	S28	359.25	364.75
VHF	S29	367.25	372.75
Hyperband	S30	375.25	380.75
	S31	383.25	388.75
	S32	391.25	396.75
	S33	399.25	404.75
	S34	407.25	412.75
	S35	415.25	420.75
	S36	423.25	428.75
	S37	431.25	436.75
	S38	439.25	444.75
	S39	447.25	452.75
	S40	455.25	460.75
	S41	463.25	468.75
	21	471.25	476.75
	22	479.25	484.75
	23	487.25	492.75
	24	495.25	500.75
	25	503.25	508.75
	26	511.25	516.75
	27	519.25	524.75
	28	527.25	532.75
UHF	29	535.25	540.75
	30	543.25	548.75
	31	551.25	556.75
	32	559.25	564.75
	33	567.25	572.75
	34	575.25	580.75
	35	583.25	588.75
	36	591.25	596.75
	37	599.25	604.75
	38	607.25	612.75
	39	615.25	620.75
	40	623.25	628.75
	41	631.25	636.75
	42	639.25	644.75
	43	647.25	652.75
	44	655.25	660.75
	45	663.25	668.75
	46	671.25	676.75
	47	679.25	684.75
	48	687.25	692.75
	49	695.25	700.75
	50	703.25	708.75
	51	711.25	716.75
	52	719.25	724.75
Band V	53	727.25	732.75
	54	735.25	740.75
	55	743.25	748.75
	56	751.25	756.75
	57	759.25	764.75
	58	767.25	772.75
	59	775.25	780.75
	60	783.25	788.75
	61	791.25	796.75
	62	799.25	804.75
	63	807.25	812.75
	64	815.25	820.75
	65	823.25	828.75
	66	831.25	836.75
	67	839.25	844.75
	68	847.25	852.75
	69	855.25	860.75

An overview of the frequency levels (operating bands) of signals received by your Television.

Band specifications	Operating frequency
Midband channel	111 - 174 MHz
S-band channels	230 – 399 MHz
Very high Frequency (VHF) band	302 – 446 MHz
Ultra High Frequency	HF > 470 MHz

synchronous orbit at equal distance from each other. His idea was simple. At that altitude, i.e., 20-25,000 Km from the Earth, these satellites would be in a position to beam the communication signals all across the globe. He put forward the theory of uplinking signals to the satellite from an uplink antenna, which could be electronically processed by the satellite and downlinked by a downlink antenna to any earth station in the satellite's 'footprint'. Before we proceed any further in understanding the satellite communication, knowledge of communication fundamentals would come in handy.

processing-downlink process of the signal takes less than 0.4 seconds. This is what makes satellite communication instantaneous. A property of EM waves, the frequency is an all-important property in communication. Frequency is a measure of the number of vibrations per second. This is what determines whether the microwaves can be used for mobile telephony or satellite broadcast. Polarization is another property of EM waves that determine the vibration pattern and orientation. This property lends itself to the increased capacity of satellites to beam channels.

Satellite Frequency Bands

S-Band

This frequency range between 2.500 – 2.700Ghz

C-Band

This frequency range between 3.700 – 4.200 Ghz

Ext-C Band

This frequency range between 4.200 – 4.700 Ghz

Ku-Band

This is the frequency range between 10.700 – 18.000 Ghz used for most of the satellite TV broadcasts in Europe. Contained within this frequency range are three separate frequency bands:

FSS (Fixed Satellite Services)	10.950 – 12.100 Ghz
DBS (Direct Broadcast Satellites)	11.700 – 12.850 Ghz
BSS **(Broadcast Satellite Services)	12.425 – 13.575 Ghz

**Also known as 'T-Comm'

FSS (10.950 – 12.100Ghz)

Portion of the KU-Band originally intended for business use, but now the main satellite TV band

DBS (11.700 – 12.850 Ghz)

Portion of the KU-Band intended for Direct Broadcast Satellite channels.

BSS OR T-Comm (12.425 – 13.575 Ghz)

Used mainly by French Telecommunications Satellites

Electromagnetic waves, power, frequency, polarization, coding, modulation, bandwidth, amplification and noise are some of the most commonly used terms in communication technology. Let us understand them one by one.

Electromagnetic waves

Electromagnetic (EM) waves are the basic elements of communication. They are microwaves, which act as agents in carrying radio and television signals. The EM waves vibrate in the form of ripples and travel at the speed of light - 300,000 kilometers per second. At that speed, the entire satellite uplink-

Coding

The most important aspect of communication is coding. For radio waves to act as carriers of message across large distances, the message should be converted into a form that can be carried by radio waves. This is coding. There are two ways of coding - analog and digital. Analog coding sticks to the pattern of variations in electrical voltages. If the message is voice as in a telephone, which is an audio signal, the microphone of the phone converts it into an electrical voltage pattern. This pattern changes according to change in loudness and frequency of the sound. This is converted back into the its original audio signal form at the receiver of the destination telephone. In contrast, digital coding contains all information about the signals within 1s and 0s representing frequencies and voltages. Digital coding provides the best reproduction of a signal at the reception site. This is exactly the coding methodology adopted in Direct To Home telecast.

Modulation

The signals after being coded either in the analog or digital format, have to be carried by radio waves to its destination. The process of impression of analog or digital signals upon radio waves at an assigned frequency is called modulation. The receiving location - radios, TVs or other communication equipment, demodulates or extracts the original message.

The process of modulation is carried out in different ways for different purposes, the most popular being the Amplitude Modulation and Frequency Modulation as in AM/FM radiobroadcasts. Amplitude modulation varies the power of carrier wave in accordance with the voltage level of the message being carried while the frequency modulation varies the power in accordance with the frequency of the carrier in response to the message. Amplitude modulated messages require relatively high power to be capable of travelling longer distances. Moreover, AM is more prone to disturbances such as noise. In comparison Frequency modulated messages need relatively low power for long distance transmission. That's why satellite messages are always sent by frequency modulation.

Bandwidth

Bandwidth is an indicator to the information carrying capacity of a signal. The signals usually are relayed over a frequency range, which is nothing but the bandwidth. As such TV signals require a higher bandwidth than radio signals. A typical C-band television channel broadcast needs a bandwidth of 36 MHz whereas a voice channel requires only 3,000 to 4,000 cycles per second for quality sound reproduction.

Noise

A perfect communication system will have no noise. But such systems cannot be realised in practice. All matter contains noise above zero deg.K. The most common sources of noise are ground heat on a warm day, outer space, atmosphere and internal heat in amplifiers, receivers and other electronic equipment. Man made signals not intended for reception at a station is also a type of noise popularly referred to as terrestrial interference (TI). The quality of communication is determined by the ratio of signal to noise power (S/N). Typically televisions must receive a signal having more than 63,000 times the accompanying noise in order to recreate a clear picture.

Satellite Broadcast

Satellite broadcast essentially revolves around three main activities; the uplink of signal, down converting of the signal on-board the satellite for downlink and finally down linking the signal to earth stations. This is exactly what Arthur C. Clarke visualized in 1945.

The most significant feature of satellite communication is the parabolic structures seen everywhere along the satellite communication link. These parabolas are nothing but dish antennas; dish because they are dish (or bowl) shaped. Dish antennas are used in all the three activities of satellite broadcast.

The uplink antenna is a relatively large. The task of this antenna is very precise. To locate the receiving antenna on the satellite and focus all the signal beams on to it. The size of the uplink antenna is determined by the wavelength and frequency of the signals. According to wave physics, electromagnetic waves can be better focussed by an antenna which is larger than the wavelength of the signals it transmits. Therefore amplitude modulated (AM) signals of wavelength say 200m would require a very large and cumbersome antenna. At the same time, a frequency modulated (FM) signals of the order of several GHz, can be managed by just a two-man length wide antenna.

The receiving antenna on the satellite has the specific job of down converting the signals to the downlink frequency while filtering the unwanted signals. This is carried out by an important equipment on all communication satellites called the transponder.

Transponder

Transponder is a combination of transmitter and responder. A transponder contains a series of filters and amplifiers which cleans up and amplifies the signal to the down link frequency. As explained in the block diagram, the uplink signal is subjected to the input filter, where only the signals in the specified range are allowed, filtering out the unwanted signal frequencies. The cleaned up signal is then amplified by a low noise amplifier and later down converted into a lower downlink frequency using a mixer circuit. The signal then passes through yet another series of filters and amplifiers before it is sent out through the transit antenna.

The number of transponders used to be 12 in the earlier generation communication satellites for a frequency bandwidth of 500 MHz. But due to the polarisation techniques, the present satellites are capable of transmitting more than 24 channels. The INSAT 2 C and D satellites have 12 C-band, 6 extended C-band (6.75-7GHz in uplink and 4.5-4.75 GHz in the downlink) and three Ku-band transponders (14.25-14.5 GHz in the uplink and 11.45-11.7 GHz in the downlink). Most generally, both the uplink and downlink frequencies have a bandwidth of 500 Mhz. The most common frequency bandwidth for the broadcast of satellite channels is in the C-band. INSAT 2 series of satellites carrying C-band transponders operate in the frequency range of 5.9GHz- 6.4GHz in the up link and 3.7 to 4.2 GHz range in the down link at a common bandwidth of 500 MHz. There are satellites known as hybrid satellites, which carry both C-band and Ku-band frequency transponders. The INSAT 2C satellite carries 3 Ku-band transponders.

The downlink, as in the case of uplink is also done at very high frequencies of the GHz level. The reason for this is the avoidance of the interference from noise, solar sources and spurious signals. The downlinked signal can be captured by any home television dish antenna in the 'footprint' of the satellite. Signals received here are then transmitted to individual subscriber homes of the cable operator by co-axial cables.

But one may wonder as to why the signals are uplinked and downlinked at such high frequencies when the television sets at homes can only receive and display signals in the range of 100 - 500 MHz. As explained above, the low frequency signals cannot reach the satellite at the height of 22,500 km above ground level, as they encounter noise and terrestrial interference enroute.

Table 1-1. The Decibel Notation

Number of Decibels	Relative Increase in Power
0	1
1	1.26
3	2
10	10
20	100
30	1,000
50	100,000
100	10,000,000,000

Table 1-2. FCC Assignment of some Radio Frequencies

Frequency (MHz)	FCC Assignment
54-54	Mobile Radio
72-72	VHF TV Channels 2-4
76-76	Radio Services
76-88	VHF TV Channels 5 & 6
108-108	FM Radio
120-120	Aeronautical
136-136	Aeronautical
144-144	Government
148-148	Amateur Radio
151-151	Radio Navigation
174-174	Land, Mobile, Maritime
216-216	VHF TV Channels 7-13
329-329	Government
329-890	UHF TV Cllannels 14-83

Moreover such low frequency signals would be too weak in power to reach its destination.

The DTH advantage

The conventional satellite broadcast has many problems. It is not possible to get all the satellite channels at your home directly. You have to go through a cable operator who has the complete control of all the channels and not you. The signals received on a huge dish antenna are then passed through a series of electronic devices in the communication link before it reaches your home some times grainy and sometimes totally distorted. The frequency of operation is less (C-band - 3.7 to 4.2 GHz) which is subjected to interference in transit. And moreover, the signals are analog coded. The most common problem associated with analog formats, which most people would have experienced, is the distortion or total blackout of the programs every time an aircraft hovers above your locality. This is completely eliminated by DTH.

The DTH provides several advantages over the traditional satellite broadcast system. All you need is a little dish antenna, a small receiver box, a viewing card and a remote control to welcome DTH into your home.

First of all, DTH brings fully digital channels right at your homes. The broadcast frequency of all DTH channels is in the Ku-band range, which is the highest frequency range available for satellite broadcast. Since the broadcast is at the highest frequency level, the signal distortion due to intermediary interference is removed. Further, as the satellite channels are made available right at your homes, there is no loss in quality of satellite channel information due to cable transit or other devices like receivers, decoders, or amplifiers in the communication link. These are some of the readily apparent distinguishing features of DTH.

What is digital broadcast?

Digital signals contain a series of ones and zeroes representing different

GLOSSARY OF TERMS

C-Band (3.7 - 4.2 GHz) - Satellites operating in this band can be spaced as close as two degrees apart in space, and normally carry 24 transponders operating at 10 to 17 watts each. Typical receive antennas are 6 to 7.5 feet in diameter. Virtually every cable programming service is delivered via C-Band. Fixed Satellite Service (FSS) Ku Band (11.7 - 12.2 GHz) - Satellites operating in this band can be spaced as closely as two degrees apart in space, and carry from 12 to 24 transponders which operate at a wide range of powers from 20 to 120 watts each. Several "hybrid" satellites carry both C-Band and Ku-Band transponders.

Broadcasting Satellite Service (BSS) Ku-Band (12.2 - 12.7 GHz) - Satellites operating in this band are spaced nine degrees apart in space, and normally carry 16 transponders which operate at powers in excess of 100 watts. A total of 32 DBS "channels" are available at each orbital position, which allows for delivery of some 250 video signals when digital compression technology is employed.

Clarke Belt - The name given in honor of Arthur C. Clarke to the orbit 22,300 miles directly above the equator where satellites can maintain a stationary position in relation to the earth. Also called geo-stationary orbit.

DBS (Direct Broadcast Satellite) - The transmission of audio and video signals via satellite direct to the end user

DTH (Direct-To-Home) - Official term used by the Federal Communications Commission referring to the satellite television and broadcasting industries.

Encryption, Decryption - Encryption is the process of electronically altering a video and/or audio signal from its original condition to prevent unauthorized reception. Decryption is the process of returning the video and/or audio to its original condition.

IRD (Integrated Receiver Decoder) - A device capable of receiving, tuning and decoding signals. The output of the receiver can be either baseband video for use with video monitors or RF for use with standard TV sets.

Impulse Pay-Per-View - Technology which allows the consumer to purchase a movie or special event instantly through a computerized order processing center

LNB (Low Noise Block Convertor) - A system device used to amplify and convert satellite signals into frequencies sent to the set-top tuner.

Ku-Band - The 11.7-12.2 GHz (Gigahertz) frequency band. This band has been split into two segments by the Federal Communications Commission. The first is the 11.7-12.7 GHz band known as FSS (Fixed Satellite Service), and there are 22 FSS Ku-Band satellites in orbit over North America today. They range in power from 20 to 60 watts per transponder, requiring a three to five foot antenna for clear reception. The 12.2-12.7 GHz segment is known as BSS (Broadcasting Satellite Service). Satellites in this band range in power from 100-200 watts per transponder, allowing the use of receiver antennas as small as 18 inches.

Modulation - The process of superimposing an information signal onto a carrier for transmission

SCPC (Single Channel Per Carrier) - an economical way to get multiple signals on one transponder.

Scrambling - Altering a video signal transmission so it can not be received without an authorized operating decoder. Satellite Antenna (Dish) - A parabolic antenna which collects and focuses satellite signals. C-Band antennas range in size from five to eight feet in diameter, and K-Band antennas range from 18 inches to five feet.

Smart Card - Technology which allows for the upgrade of encryption security through the use of a consumer-installable card containing a new computerized security code.

TVRO (Television Receive-Only) - A traditional term used to describe a home satellite system which only receives, and does not transmit, satellite television signals.

Transponder (Channel) - A device located on board the satellite which receives signals uplinked by a programmer and transmits them back to earth on a different frequency. Most satellites carry 24 transponders.

Video Compression - Technology which significantly reduced the bandwidth and/or data required to transmit a video signal, making possible the carriage of numerous quality signals on a single satellite transponder.

VHF (Very High Frequency) - the band in the 30 to 300 MHz range, including TV channels 2 through 13

VSAT (Very Small Aperture Terminal) - a means of narrowcast transmission of video, voice and data by SCPC means to a satellite, typically used in business applications.

Zapping - Changing the channel by remote control during a program to avoid a commercial.

Zipping-Fast - forwarding through commercials when playing back a program on a VCR.

characteristics of the signal. Digital signals do not suffer from interference. Nothing really affects a digitally coded signal till it is unscrambled by a digital satellite decoder that comes with the DTH package.

On the satellite, Ku-band transponders transmitting DTH signals carry much more than just one channel information thanks to improved techniques. Up to 10 high quality digital channels can be handled by a single Ku-band transponder as a result of digital compression techniques. This is the real great advantage of DTH.

Hardware for DTH

- The dish antenna required for DTH reception is a regular dish antenna, except that it is only less than 2 feet in diameter. It can be fixed just about anywhere at your home premises- on walls, terrace, or balcony.
- The digital satellite decoder is a compact box that unscrambles digital information from satellite, of course in sync. with a viewing card.
- The viewing card contains a microchip, which interprets the satellite signal sent to the receiver. The microchip also contains information about your subscription and personalized messages from the service provider.

Other advantages

Advantages, which you wouldn't have even dreamt of, would be a reality with DTH.

- For the first time ever, the new digital decoder will bring Laser Disc quality picture and Compact Disc quality sound to your favourite TV channels.
- Digital technology will allow you to access all the programme schedules for the entire week on screen and allow you to pre-book your favourite programmes.
- If you do not want your children to spend all their time watching TV, the new digital decoder also features a parental lock function. The parental-lock functionality enables parents to prevent their children from watching certain programmes,
- A e-mail facility which helps the service provider to send mails regarding subscription status, special offers and new programs.
- A viewing card inserted into the DSD allows the DSD to unscramble the satellite information and authorization/de-authorization instructions from the service provider via satellite. The viewing card can handle sophisticated transaction such as Pay Per View.
- Once you are subscriber, the digital satellite decoder features an electronic program guide which, at the touch of a button on the remote control, will tell you what will be shown on each channel for the next seven days.

DTH is big business in the US and other western countries. But dirty politics, arcane laws and ignorance of the benefits of revolutionary technologies has prevented India from benefiting from DTH. The broadcast bill pending approval on the floor of the parliament house has recommendations for the implementation of DTH in India. But short-lived governments and indecisive communication ministers have only been successful in postponing the passing of the bill on the floor of the house. Star TV was ready with its entire paraphernalia for the implementation of DTH in India has been made to wait endlessly. It is high time the government and all other progressive thinking people in other parties take initiative in implementing the same before we lose too much of whatever is left in terms of technological advantage.

About the Author:

Mr. G.P.Vinaybabu is a freelance writer based in Bangalore.

KEY DATES IN SATELLITE TELEVISION

- **1945** Science fiction writer Arthur C. Clarke writes an article in which he outlines the possibilities for establishing a global communications system using three satellites placed in geosynchronous orbit at equal distance from each other.
- **1962** First satellite TV transmission via Telstar I: an eight-minute experimental broadcast from France to the U.S.
- **1975** HBO establishes the first operational satellite broadcast system on Westar I to send programming to its cable affiliates.
- **1976** Taylor Howard of San Andreas, California, becomes the first individual to receive C-band satellite TV signals on a home-built system.

Christian Broadcasting Network (later to become The Family Channel) launches as the first satellite-delivered "" programming service.

DTH industry picks up steam as technology is shared between "radio" operators around the world.

- **1980** Considered the "" year for the DTH industry. 5,000 systems shipped.
- **1985** Home Box Office announces its plan to market scrambled HBO and Cinemax programming to home satellite TV viewers via local cable companies.
- **1986** HBO becomes the first programmer to scramble its movie services full-time.
- **1992** Consumer upgrade and conversion to VideoCipher II Plus and VCRS (VideoCipher Renewable Security) begins. Some 400,000 consumers receive new decoders at no charge. Programmers begin shutting down VideoCipher II data stream, VideoCipher II Plus remains secure.

Hughes announces DIRECTV DBS project.

Nashville, TN hosts the largest satellite industry trade show in SBCA history as over 6,400 flock to Opryland to visit with new DBS companies.

- **1994** PRIMESTAR rolls out nationwide digital TV service via medium-power Ku-Band satellite. Company unveils plans to transition to high-power DBS operations in 1996.

DIRECTV authorizes Toshiba, Uniden and Hughes Network Systems to manufacture DSS equipment.

EchoStar successfully launches DBS-1 satellite.

FCC votes to auction DBS channels at 110 degrees.