UNIT 13 BROADCAST MEDIA : RADIO AND TELEVISION

Structure

13.0 INTRODUCTIION

In the earlier blocks of this course, we have discussed the nature of communication in general, with specific reference to the communication process in the context of education and training. The role played by technology in the field of education and training have also been clarified. This block deals with the role of audio and video media in educational communication. Within the spectrum of audio and video media, broadcast media in particular have special role in the field of educational technology and this forms the subject matter for the present unit.

Broadcasting can be defined as instant dissemination of information through wireless means to the public at large. Radio and TV are the twin broadcast media, which have established themselves all over the world, the former as a means of transmission of sound and the latter as a means of transmission of moving pictures and sound. In the recent past, the word broadcasting has acquired a broader connotation to include data broadcasting, (transmission of computerized data through wired/wireless means), Internet broadcasting, etc. For the purpose of this unit however, we confine ourselves to broadcasting in the traditional sense, namely radio and television.

Let us bear in mind that the technologies of radio and TV are specialized areas of studies in themselves. However, for students of educational technology an understanding of these technologies from a user's point of view is important rather than from the view point of broadcast engineering, design and development. Therefore, we shall concentrate on the common technological features of the two technologies as well as their individual features but leave out intricate details concerning specific equipments and systems.

13.1 OBJECTIVES

After studying this unit, you should be able to :

- describe, briefly, the historical development of broadcast media;

- explain the principles of working of radio as well as television;
- enumerate the basic hardware features of a broadcast setup (radio as well as television);
- discuss the different models of transmission and reception of Radio/TV signals;
- visualize some on-going and future developments in the world of broadcasting.

13.2 BROADCASTING: HISTORICAL GENESIS

Broadcasting developed as a result of early experiments in wireless communications conducted towards the last decade of the 19th century. Although Marconi is usually credited as the inventor of wireless, parallel inventions by several other pioneers working independently in other countries, including India, have contributed to the birth of wireless and its offspring, the broadcast media - Radio and Television.

Radio

Broadcasting in India was started in 1927 by a company called the Indian Broadcasting Company (IBC), through radio stations established at Bombay and, later at Calcutta. In 1930, this company was taken over by the government and the two radio stations were continued under the banner 'Indian Broadcasting Service'. In 1936, the Delhi radio station went on the air, and soon the name 'All India Radio'(AIR) was given to the Indian Broadcasting Service. It became popular as Akashvani.

AIR has steadily grown over the years both in terms of its reach and variety in its programme content and has since become a household name across the country. After independence, successive five year plans have helped radio broadcasting to emerge as unique mass medium with the mandate to inform, educate and entertain people.

The spread of portable transistor radio sets during the later half of 1960's is a major landmark in the history of radio. As the transistor sets operated on batteries, were highly portable and available at affordable prices, radio became a byword as the common person's medium. Today the reach of radio is almost cent percent (99.37%) with almost every family in the country owning at least one radio set.

Even though entertainment programmes form the bulk of day-to-day broadcasts and commanded maximum listenership, educational programmes have always been a compulsory factor in the fixed-point charts of all the radio stations. Usually you find a typical radio station airing school broadcasts, for schools, universities and distance education learners, which are broadcast from different AIR stations both on medium wave and short-wave. Since 1993, programmes meant for IGNOU students are being broadcast from select AIR stations regularly. Unfortunately, the listenership of educational broadcasts is rather marginal in many cases because of several factors like the timings not being suitable to the target audience, non-availability of radio reception facility at the schools, programmes not sufficiently exciting, lack of enthusiasm on the part of teachers in programme production and the domineering presence of Television. The National Education Policy document of 1986 and also the Programme of Action, 1992 underpinned the need for harnessing radio for educational purposes. The real breakthrough in this regard came in the year 1999, when the Ministry of Information and Broadcasting took a policy decision to throw open FM Radio to private broadcasters at 40 select places in the country. While unveiling the scheme, one frequency at each of the 40 places was kept reserved for educational broadcasting and passed them on to the Ministry of Human Resource Development for establishing the FM radio stations. The Indira Gandhi National Open University was chosen as the nodal agency to implement the project within a time frame of 3 years starting from the year 2001-02. These stations were established under the banner 'Gyan Vani': Allahabad, Banglore, Coimbatore, Lucknow, Mumbai, Vishakhapatnam and Bhopal. With daily transmission ranging from 8 hours to 12 hours and a coverage area of about 60 km radius each.

The Gyan Vani network of 26 stations aims to address the educational and development needs of the local communities. Each Gyan Vani station operates in an autonomous manner with the collaboration of local educational institutions and NGO's in the day-to-day management and running of the station. Live educational lessons with phone-in interactions from the target audience are the noteworthy features of Gyan Vani broadcasts at all the places. The medium is usually English or Hindi or the local language At present there is transmission of educational and enrichment audio programmes through FM Radio network of the Gyan Vani Stations located at different places of the country. There is also transmission of live Interactive Radio Counseling (**IRC**) sessions for IGNOU students through AIR Stations (http://www.ignou.ac.in)

Table 1 : Radio Broadcasting Milestones

1895-1900	Early experiments in wireless communication by Alaksander S Popov of Russia, Guglielmo Marconi in England and Jagdish Chandra Bose in India.
1912	Radio Amateurs pick up SOS sent out by Titanic.
1920	Broadcasting on a regular scale starts in USA, followed by U.K.
1927	The Indian Broadcasting company starts from Bombay.
1934	Birth of All India Radio.
1960's	The transistor revolution results in rapid expansion of radio sets.
1970's	FM Broadcasting takes roots in different countries, including India.
1980's	Over powering popularity of TV causes set back to radio listening, especially in urban areas.
1990's	Digital Audio Broadcasting(DAB) starts in advanced countries. FM radio expansion in India.
2001	IGNOU's 'Gyan Vani' Educational FM radio; first Gyan Vani station starts at Allahabad.
2004	DTH Service of Prasar Bharati launched.

Television

Television came into our country as late as in September, 1959, and that too only in Delhi. By that time the advanced countries were having colour television. To begin with, it was an experimental venture and viewership was confined to 180 odd community sets located in 'tele-clubs' formed in and around Delhi under a grant-in-aid by UNESCO. The transmission timings were just about 20 minutes, twice a week. School television (STV) was started in 1961 and entertainment programmes in 1965, by which time daily transmissions too were introduced.

After long years of lull, TV expansion made a quantum leap with Bombay TV coming on the air in October 1972. A year later, Srinagar and Amritsar stations were inaugurated. Calcutta, Madras and Lucknow stations were added in 1975.An important milestone in the history of Indian television is the Satellite Instructional Television Experiment (SITE) conducted during 1975-76 with the help of an American Satellite ATS-6. Educational and developmental programmes were beamed to 2400 villages across the country which received them through Direct Reception Sets (DRS). The success of this unique experiment has paved the way for satellite television in our country through our own Satellite system INSAT, at a later stage. Television as a separate entity from All India Radio was announced in 1976 and was christened as Doordarshan on April 6 that year.

The 1980s saw major strides in television expansion. National programme was initiated in 1982.Colour television was also introduced in the eve of the Asian Games in 1982. Close on its heels followed satellite television through the INSAT system. In 1984 the University Grants Commission (UGC) telecasts (later called 'country wide classroom') were introduced. The second channel of Doordarshan from Delhi was also commenced that year. The VCR (Video Cassette Recorder) revolution too made its beginning in the 80's, and soon made inroads into the nooks and corners of the country. Theatrical viewing of feature films, which till then had been the most popular pastime of the masses, suffered a setback as the 'video boom' readily offered everyone the more

convenient and cheaper alternative of domestic viewing through VHS (Video Home System) cassettes.

The television scene in the 1990s was marked by initiatives like development of trans-national TV channels through satellites and the spread of cable. The hitherto unchallenged dominance of Doordarshan gave way to dozens of foreign as well as domestic TV channels, which competed fiercely with one another for viewership and advertisement revenues. While most of these channels are entertainment-oriented, there are notable exceptions like the 'Discovery Channel' and the 'National Geographic' which are dedicated to exploration and adventure documentaries.

IGNOU telecasts on Doordarshan made a modest start in 1991 with half hour slots on alternate days. In due course, they were extended to all days of the week. A separate educational TV channel, 'Gyan Darshan' was started on 26th Jan, 2000. Gyandarshan is a satellite-based channel airing programmes contributed by major educational bodies in the country such as IGNOU, UGC-CEC, NCERT-CIET, National Institute of Open Schooling, etc. Another significant development is the birth of the technology channel 'Ekalavya' which started on 26th Jan, 2003, as part of the Gyan Darshan bouquet, to cater to engineering students. Gyan Darshan (GD), a fully digital 24 hour exclusive Educational TV Channel, is a digital bouquet of 4 channels. The transmission of GD channels is almost completely automated through the installation of the video server (http.// www.ignou.ac.in/).

While these are undoubtedly major developments on the educational TV scene, the limitation at the moment is the apathy of the cable operators who, in most cases, shy away from including the educational channels on their networks. So most of the homes in the country do not in practice receive them. Although satellite television is becoming common but the companies offering these services too did not include these channels till at the initial stage. However, developments like DTH services (Direct-to-Home TV of which you will study in detail in Unit 4 of this Block) and Conditional Access System (It is a system introduced by the Union of India under the provisions of Cable Television Networks (Regulation) Amendment Act, 2002 to regulate the functioning of cable services in India and to give consumers a choice to view and pay for channels of their choice, are taking care of this problem to some extent.

Table 2: Television Milestones

The world	
1925	Mechanical Television invented by J.L. Baird in UK.
1930-35	Electronic television by Baird in UK, Gaborisky in Russia, Takayenagi in Japan, Jenkins and Zworkyin in USA.
1935	First regular TV services in the world, from Berlin.
1954	Colour TV starts in USA(NTSC system)
1967	Birth of PAL and SECAM colour TV systems in UK and France respectively
1968	Birth of Satellite Television(USA & Europe)
1974	First Video Cassette Recorder(VCR) by Japan
1988	High Definition TV Broadcasting starts in Japan
1990's	World-wide boom in Satellite and Cable networks
1995 onwards	DTH (Direct-to-Home) makes inroads in developed countries
India	
1959	Experimental TV service(from Delhi) starts
1965	Regular TV service(from Delhi) starts
1975-76	Satellite Instructional Television Experiment(SITE)
1982	Colour Television and satellite relays start on the eve of Asian Games
1985	Teletext service from Delhi
2000	Gyan Darshan(India's first educational TV channels) starts
2003	Eklavya Technology Channel starts.

Since 2005, DD Bharati channel carries a special slot called Gyan Sarita offering enrichment programme in science, technology, etc. produced by IGNOU.

13.3 RADIO BROADCASTING

In the foregoing section, we have seen how the twin media of Radio and Television have evolved and grown over the years. Having understood the prominent place the two media have come to occupy in the personal and community life of the people, let us now take up Radio and discuss its technical building blocks and how exactly radio broadcasts take place.

Radio Broadcasting sub-systems: Any radio broadcasting system can be understood as consisting of the following major sub-systems:

- The studio center
- Studio-to-Transmitter Link (STL)
- The transmitting center
- Radio propagation path
- Reception system (radio set).

13.3.1 Technical Description

Studio

The studio center is the place where the programmes are recorded, edited, produced, and played back at the time of transmission. This is the place where all recordings, editing, dubbing, mixing, live broadcast and announcements during transmissions take place. In the case of live broadcasts, the studio center again is the place of origin of the programmes with the concerned artists/performers/ announcers/news readers operating from one or the other studio of the studio center. Even in the case of OP's(outside broadcast), the events being broadcast from the OB spot are invariably routed through the studio center for convenience of switching and other technical reasons. Thus the studio center becomes the eventual outlet for the programmes in all cases.

A studio center may have just one or more studios designed for recording different kinds of programmes. Apart from Studio(s) , the center will also have facilities such as editing rooms, control room and other related technical facilities. Broadcast organizations like the All India Radio earmark their studio for specific purposes e.g. talks, music, drama and transmission (playback). This is because, ideally, different kinds of programmes require to be recorded in different acoustic conditions. This aspect is taken care of while designing the studio structure and its acoustics. Acoustics of the studio is done in such a manner that the studios are insulated from outside noises and generate sounds with the clarity and the required reverberation.

Multi-purpose Studio

Smaller production houses cannot afford to create separate studios for individual purposes like talks, drama, music, etc. In this case, a single multi-purpose studio is the answer. The acoustics of a multi-purpose studio can be designed essentially for talks. When it has to be used for music or drama, reverberation can be added electronically (such electronic devices are available and are common as a part of the control room set up) in the right magnitude.

Transmission Studio

This is for the purpose of playing back pre-recorded tapes interspersed by live announcements etc. in a pre-determined sequence. The number of transmission studios

(also called playback studios) would depend upon the number of broadcast channels that the station handles. All India Radio's Broadcasting House (BH) in Delhi, for example, contains 36 studios – some of them for production, and the rest for transmission.

Announcer Booth

An announcer booth is attached with each of the production studios. While the actual programme (talk/ discussion/ drama/ music concert/ etc.) takes place inside the studio, the Announcer Booth serves various related works like keeping continuity with programmes from other studios, linking announcements, playing filler music and pre-recorded material, playback of pre-recorded music into the studio, etc.

Microphones

The primary source of audio in any broadcast studio is the microphone. It is an indispensable device for audio recording, whether inside the studio or outside. At this stage the following particulars may be noted for a preliminary understanding of the subject.

Microphone (mike for short) is a device which converts sounds into electrical signals. These electrical signals are further amplified and processed in succeeding stages of the broadcast chain. There are different kinds of microphones to suit different occassions places and purposes. From a programmer's standpoint, there are two broad categories of microphones:

Omni-directional microphone: These are mikes which can pick up sounds from any direction equally well. When such a mike is placed at the center of a table with the persons seated all around, all the voices will be picked up by it without any discrimination. In studios, omni-directional mikes can be used for group discussions and multi-way interviews, as a single mike would suffice the purpose and provides operational convenience.

Uni-directional microphones: These are mikes which can pick up sounds very well only in one direction and hardly from other directions. In other words, uni-directional mikes are like a sensitive ear in the direction in which they are pointed, whereas they are deaf to sounds coming from all other directions. These mikes are much more sensitive than omni-directional ones in the particular direction in which they are pointed; so they can be used to pick up of sounds from a distance e.g. in outdoor locations for sports events. In the studios, unidirectional mikes can be used for announcers/news reader and in radio plays.

In between these two omni and unidirectional mikes there are mikes with directional patterns like bi-directional, cardioid (can pick up sound from the front but rejects sounds to the side and rear).

Audio Mixer

Audio mixer is the generic term for the announcer console (a device for combining, routing, and changing the level, tone, and/or dynamics of audio signals. From an operational stand point, an audio mixer can be understood as an equipment to which all the sources in the studio and announcer booth (microphones, tape decks, CD player, etc) are connected and from which the selected source(s) at any time can be passed on to the succeeding stages of the broadcast chain, or for other purposes like monitoring, recording, editing etc. Like so many other electronic gadgetry, audio mixers too are available in a wide range of models, facilities and technical features.

A minimum of eight channels (eight different sources) can be kept connected to the mixer: say, 3 or 4 microphone channels and the rest of tape deck, CD player, cassette player, etc. Bigger recording studios meant for western orchestra use many more

microphones simultaneously and therefore the channel capacity of the mixer too needs to be larger in their case. While the features may differ in details, but in all cases it is the audio mixer, which combines the programme sources of a studio and gives out the composite programme from the announcer booth to the control room.

Control Room

The control room is the focal area at which all the technical activities in a studio center con erge. Engineers in control room have overall responsibility for the technical operations in the studio set up, for switching of broadcast feeds to the transmitting center and incoming feeds from external sources. In particular, the following functions are carried out in the control room:

- To receive programmes online from each studio (through the respective announcer booth), and from external sources like the radio-networking terminal, outside broadcast spot, etc.
- To distribute the programmes to respective transmitters, other radio stations that may be forming a network for programme exchange, satellite up-link facility or to any other destination.

Thus, the control room set-up is primarily an electronic switching system. These switching operations are performed by using a 'control console'. The control console has provision for continuous monitoring of the ongoing programmes either through headphones or loudspeakers to control their audio levels. The audio levels are carefully controlled, as too high a level will cause distortion and also overload the transmitter. On the contrary, too low a level will cause poor signal-to-noise ratio and, ultimately, poor reception in the radio sets.

Studio-to-Transmitter Link (STL)

The programmes emanating from the studio center are transported electronically to the transmitting center through the STL. This is because, in most cases, broadcast transmitters are located several kilometers away from the studio center, usually in the outskirts of the city. This fact necessitates some form of electronic link between the studio and transmitter. In the few cases where a transmitter is co-located as they require a large area for the aerial field with the studio, this link can be a hard-wired connection between the two. In practice, STL can be any one of the several technical options available: telephone lines, coaxial cables, microwave link, FM radio link, etc.

Telephonic Lines

Dedicated leased telephone lines are the most popular form of STL. Normal telephone lines have a narrow frequency response which is good enough for telephonic conversation but not as a transparent medium for broadcast quality audio. Hence the telephone lines used for STL are specially 'loaded' for improved frequency response and carefully maintained to prevent breakdowns or loss of quality.

Coaxial Cable

Coaxial cable connection is generally more robust than a telephone line in its physical construction and performance. Coaxial cables are relatively less prone to loss during signal transmission and protect the signals from cross-talk and other interferences. For longer STL routes, coaxial cables are preferred over telephone lines.

Microwave Link, FM Radio & Satellite

Microwave, FM radio and satellite links offer wireless solutions for STL. In all these cases the transmitting equipment (Microwave transmitter/FM transmitter/satellite uplink) is installed as part of the studio center and corresponding receiving system at the radio transmitter site.

STLs of either kind (wired and wireless) have their own advantages and disadvantages. For example, a dedicated telephone line link is simple and easy to maintain but is prone to failures during rainy season and road repair works. Coaxial cable links are costly to install and maintain, but they can offer better quality over long haul routes. Microwave and FM links can provide reliable service over short distances, provided that there are no natural or man-made obstructions such as big trees or buildings. There is a need for line-of-sight (free of physical obstructions) between the studio and transmitting stations. A satellite link requires a costly ground installation at the studio end which becomes costly to maintain as well, apart from the expenses involved for use of satellite itself. But if a number of transmitters spread across the country have to be fed from the same studio center, the satellite link becomes very convenient and economical.

We can appreciate that the STL is a crucial link and even a temporary failure of it causes disruption in the broadcast schedule. Hence, in most cases redundancy is ensured by, say, providing one telephone line link and a back-up FM link for the same STL.

Transmitting Center

The transmitting center is the place which houses the radio transmitter and the antenna system with the help of which the programmes are transformed into 'radio' frequencies and radiated in the form of 'electromagnetic' waves. A separate radio transmitter is needed for each broadcast channel. In the case of a radio station broadcasting many channels, the transmitting center houses that many individual transmitters and contains an elaborate technical infrastructure and a sprawling aerial field, with masts of different heights and shapes towering over the surrounding landscape.

In the case of radio stations broadcasting multiple channels, (say, Delhi 'A', Delhi 'B', etc.) the transmitting center may house all the concerned transmitters (and the antennas) in the same place. Alternatively, a transmitting center may contain just one transmitter, to cater to a single-channel station. In either case, a separate transmitter with a distinct 'carrier frequency' is essential for each broadcast channel. For example, Delhi 'A' channel is broadcast through a transmitter which operates at a carrier frequency of 809 Hz(medium wave), while Delhi 'B' is broadcast through another transmitter operating at a carrier frequency of 1020 KHz (again in the medium wave). The transmitter generates the allocated RF (radio frequency) 'carrier', and it is this frequency that distinguishes the particular broadcast channel. Broadcast stations invariably announce this frequency in their opening announcements as so many 'kilo hertz' or so many 'meters'(of wavelength). The incoming audio signals 'modulate' the carrier in such a manner that either the amplitude (the strength) or the frequency of the carrier is continuously varied in accordance with the amplitude variations of the audio signals. This modulated RF contains the on-going programme either in the form of its amplitude variations (called amplitude modulation) or frequency variations (frequency modulation). The radio transmitter also amplifies the modulated RF power to a sufficient level (the power output of a transmitter is as so many kilowatts) for delivering to the transmitting aerial.

The audio signals (programmes) delivered from the studio center through STL are 'modulated' onto the carriers generated by the respective transmitter and then the modulated RF (radio frequency) power is fed from the transmitter to the antenna. From the antenna, the RF power gets radiated outwards in the form of electromagnetic waves also called radio (waves). The nature of radio waves is such that their propagation follows different paths depending on the carrier frequency of transmission. Frequencies in the Medium wave range (roughly between 300 KHz to 3 MHz) travel skyward, get reflected by the electric charges in the upper atmosphere and reach places several hundred kilometers away.

In general, MW (medium wave) broadcasts are limited to a radius of around 500 Km, while SWs (short waves) can reach (under favorable conditions) as far as 4000 Km.

FM (frequency modulation) radio, on the contrary, can provide only line-of-sight coverage that is, typically, about 50 to 60 kms.

Radio receiver technology has undergone a sea change with the invention of transistor. Before that, the radio sets were, like the present day TV sets, heavy and bulky, consuming a lot of battery/electric power and requiring a long outdoor aerial wire to pick up the broadcasts. Since 1960's, the transistor radios have made rapid inroads into people's homes, as they became increasingly portable, trouble-free and economical on power consumption. Nowadays, pocket sized single-band radios are the most popular among listeners. The radio owes its universal reach largely to these tiny devices which form the last link in the broadcast chain.

Check Your Progress 1

Answer the following questions briefly:

1. What would be the role of studio in case of outside broadcast?

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2. Recapitulate the major categories of microphone.

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3. Explain the functions of STL.

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Radio Receivers

The universal popularity of radio broadcasting particularly in the rural and remote areas is mainly on account of its simple reception mechanism- the radio set. Rapid technological advances have transformed the radio reception system from the heavy and bulky sets of the past (which adorned the rich and middle class homes till the 1970's) to the highly portable, virtually trouble-free transistor radios which have since become the common possession of the poor. In fact, the transformation is so complete that today the name 'radio set' hardly exists in common parlance; instead, we just refer to them as 'transistor sets' or simply as 'transistor'! There are innumerable tapes and models of these 'transistor sets' to suit different applications, tastes, and pockets.

Irrespective of the type or model, all radio sets receive the broadcasts in the same way: the basic receptor is the receiving aerial. Communication receivers use externally installed aerials of different shapes and lengths especially for HF reception (i.e. SW Band). In all other receiver sets, it is the in-built telescopic rod aerial whose length and orientation are adjustable for best reception of the particular HF broadcast. MW Broadcast are picked up by a ferrite rod aerial mounted inside the set. For best reception, the orientation of this has to be adjusted in the horizontal plane and, for this purpose, the set itself will have to be rotated.

The radiation picked up by the aerial is too weak and needs amplification. The electronics inside the set firstly selects the particular broadcast station's frequency, (by the act of

band selection and tuning) amplifies this particular radio frequency, down-converts it to a lower order called intermediate frequency, "detects" the audio frequency(AF) signal by stripping off its 'carrier', amplifies the AF still further and finally delivers it the loudspeakers(s) or headphones. The end transducer is the loudspeaker/headphone which converts the AF (which is an electrical signal) back into sound energy, which alone can be heard by us.

In a nut shell, we can say that a broadcast from the studio is sent through to the the transmitter (an electronic device which through an antenna sends the audio signal). From here the signal travels to the tower (typically, tall structures designed to support antennas also known as aerials and then to the people. Or it may come through a communications satellite,. Networks of stations may simultaneously broadcast the same programme at the same time through microwave link or by satellite. At the end it is received by an antenna and the reciever of the radio set. Through the Internet too radio services may be available.

13.3.2 AM and FM Radio Waves

AM (Amplitude modulation) was used extensively for radio broadcast in the last century and is done even now. It involves the transmission of messages via a radio carrier wave, which is a waveform that happens to be modulated. AM moderates the strength of the transmitted signal according to the information being sent and the amplitude of the transmitted signal is made proportional to the sound amplitude captured by the microphone but there is no change in the transmission frequency. Where as in frequency modulation (FM) it is the frequency that is varied. Because of the susceptibility of AM broadcast to atmospheric disturbances like ionospeneric refractions, and relatively lower quality transmission , the shift is towards FM radio. However in FM broadacst, the radio waves do not bend but go straight and hence, need line of sight i.e. they are hindered by physical obstacles and need antennas palced very high.

13.3.3 Ham radio

It is also known as amateur radio. The operators use personal communication equipments like transmitters and receivers to communicate with other such ham radio operators. There can be a network of such ham radios. They are useful for conversation as they allow two way flow of information. Ham radio is useful for broadcasting local news, entertainment programmes and warnings about disasters and accidents to the community.

Check Your Progress 2

Answer the following questions briefly:

1. Differntiate between AM and FM waves.

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2. Explain an amateur radio service

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13.4 HOW TELEVISION WORKS

It is said that 90% of all the knowledge that we get from the external world is through our eyes. The power of the television medium springs from this basic fact: it is a visual medium with the unique ability to make us 'see' events talking place in distant parts of the globe, recorded or live. Obviously, the technology involved in television is highly complex one. But, for our purposes, it is possible to understand the basic principles of its working, without going too deep into the intricate scientific or engineering aspects.

The basic device that converts the real world scenes into TV signals is the video camera. A process called 'scanning' that takes place inside the camera does this. The light from the real world scene enters the video camera through its lens system in the front and converges inside the camera, where it forms a tiny optical image of the real scene. This optical image is a true replica of the real world scene- with all its detail, the motion and colours exactly reproduced therein. A beam of electrons inside the camera 'scans' this optical image point-by-point, line-by-line, and from top to bottom, much as we read the page of this unit: each line word-by-word, and from top to bottom, as we go along. As it scans, the optical information contained at each point (brightness and colour) is translated as a 'video signal'.

When the electron beam comes to the last point at the bottom of the optical image (in other words, when the scanning of the image is completed), the electronic system in the camera makes the beam to quickly bounce back to the top to repeat the process of scanning all over again. Technically, one cycle of scanning is called a 'frame' and the process takes place so rapidly that as many as 25 frames are scanned within just one second.

The video signals thus generated go through a complex chain of equipment, get transmitted and finally reach your TV set. Inside the TV set, the same process of scanning takes place in exact synchronization with the one inside the camera. The electron beam in the picture tube (that is, TV screen) 'writes' the image point-by-point and line-by-line, thereby recreating the total optical image, as it was formed inside the camera. In other words, the TV system generates discreet still images of the real scene from instant, but they are generated at a rapid rate of 25 frames per second. The human eye suffers from a limitation called 'Persistence of Vision' (in this context, it is to be seen as an advantage), because of which it cannot distinguish such rapid changes: instead, it perceives the image as a single one with motion contained in it. This property, coupled with the fact that TV signals travel as fast as light, makes the television broadcasting possible.

Please bear in mind that what we described above is a gross over simplification of what goes on in the numerous and complex machinery that form the TV broadcast chain, with the camera and the TV set at the two ends of it. While a detailed technical description is not required for our purposes a broad understanding of the hardware setup of a typical television station would be very much in our scope. In the following section let us dwell on these aspects. Since we have already studied the features of a radio station in earlier sections of this unit, we will concentrate now on the additional features that a TV station is composed of.

TV Studio

The studio is the place where action takes place and the same is shot with the help of video cameras (usually more than one simultaneously). The floor area of a TV studio ranges from that of a typical living room (~ 25 square meter) to as much as 400 square meter or even more. Bigger studios are necessary if drama sequences employing elaborate sets and lighting arrangements are to be provided. For other purposes, e.g. news reading, interviews, educational lectures etc., small studios are preferred, because of economic reasons and also because modern technology permits space-saving by

way of 'virtual' sets, portable equipment, etc. Most studios in the educational sector and private TV channels adopt this trend.

The interiors of a TV studio, as in a radio studio, are acoustically treated for noise-free environment, and contain soundproof double doors. A separate soundproof entry for sets, and a lighting grid which is suspended from the ceiling, are some of the additional features of a TV studio.

Production Control Room (PCR)

Every TV studio is invariably associated with a Production Control Room, which houses all the electronic equipment and operational controls to conduct the 'show'. It is usually located adjacent to the studio, with an observation glass window between the two. From the PCR, the producer (sometimes called Director) of the programme calls the shots, while other technical personnel are engaged in their assigned tasks like camera control, audio control, lights, vision mixing, insertion of external feeds, and recording the programme on a video tape.

The cameramen in the studio handle their individual TV cameras to compose the shots from different angles, in accordance with the 'commands' of the producer. Inter-communication between the producer in the PCR and the cameramen in the studio happens through the headsets, which the cameramen constantly wear during the shooting.

Editing/Post Production Suites

The terms postproduction refers collectively to all the processes that follow in making the final TV programme, after the basic material is shot either within the studios or outdoors. These processes may include putting the wanted shots in the desired sequence, adding the opening and closing shots, laying the commentary track, music mixing, graphics/animation sequences and other inserts, and producing the final master tape. The amount of editing and postproduction work depends on the format of the programme. As for instance, drama and documentary programmes involve extensive post production work that may run into several days, while current affairs programmes, educational talks, simple demonstrations, etc. require less postproduction work. Live programmes like news, of course, cannot have any postproduction. However, in their case, editing of news clips, visuals, etc. happens beforehand and they are played back as part of the programme during the telecast.

Computer Graphics and Animation

This is an indispensable facility for educational programmes in particular. Successive advancements in computer technology have resulted in a variety of user-friendly software for graphics and animation which can run on computers. This kind of 'open architecture' has the added advantage of easy upgradeability and networked operation within a studio complex.

Set Design

Traditionally, sets in a TV studio are constructed by assembling 8ft. X 4 Ft. plywood cutouts in the required shape. Modular set-design containing sub-assemblies, which can easily be dismantled and re-used for different shapes and sizes, is preferred now a days for reasons of economy and easy storage. 'Virtual sets' are those which are created electronically on the TV screen against the background of performers in the studio, with the help of computer-generated imagery. This concept is gaining currency as it can obviate the tedium and the cost involved in traditional set design and construction. In this case, nothing actually exists in the studio, except a blue screen, as the backdrop for the performers. The set is 'created' on the final image by electronically replacing the blue background by the artwork generated with the help of computers.

The computer software also provides for perspective changes of the virtual set, as per changes in camera angles, as if in a realistic situation.

Outdoor Coverage Facilities

All TV production houses, particularly those involved in news and current affairs programmes, need these facilities in an adequate measure. At the simplest, they consist of a hand-held or shoulder mounted camcorder (portable audio/video recorder) with a built-in microphone and a single person crew. This may be good enough for a quick coverage of a natural disaster, an accident site, etc. for a pre-planned event or documentary production. Otherwise things like portable lighting equipment, tripod-mounted camcorder, wheels and trolley for jerk-free movement of the camera, different kinds of microphones, etc. are used. The size of the crew too may have to be bigger as a producer, a production assistant, cameraman, sound recordist, an electrician, and a helper are needed .

For live coverage of outdoor events, an OB Van (Outdoor Broadcast Van) is used. The technical system in the Van will be similar to that found in the TV studio and control room to facilitate production in real time by a multi-camera set up. In other words, an OB Van can be described as a multi camera set up on wheels.

Video Tape Formats

Even though the ongoing digital revolution has brought in its wake tape less recording systems for video, at the present juncture however tape is still the most widely used medium for professional applications. There are a number of technical formats in vogue for recording and reproduction of video, the more prominent of which are described below.

VHS (Video Home System)

This is a widely used domestic video format. The recording is done on VHS cassettes containing half-an-inch wide tape which can hold up to 4 hours of programme. With the growing popularity of VCDs (Video Compact Disc) and DVDs (Digital Versatile Disc), the VHS tapes are likely to become a thing of the past in a few years from now.

U-matic: This was very popular as a professional tape format during the 1980's and it uses a ¾ inch wide tape. U-matic 'High Band' and U-matic 'SP' were later versions of the format with superior features. The U-matic format is now largely overtaken by later inventions like the Betacam etc.

Betacam: It is a family of half-inch professional videotape products. It is meant for analogue recording of video. Betacam cassettes contain half inch wide tape like the VHS, but the similarity between the two ends there. While VHS is only a domestic format, Betacam is a professional grade format meant for institutional use and broadcast. Among the analogue formats, Betacam is the most dominant format in the broadcast world as on date.

Digital formats: In recent years a number of formats for digital recording of video on tape have gained currency, the chief among which are the DVC pro format for recording very high quality digital video and Digital Betacam, which is superior to betacams and also ensures better quality.

As a rule, all analogue (glossary) tape formats suffer from generation losses i.e. degradation in technical quality when a programme is transferred from one tape to another. Such transfers are essential especially during post production. Digital (glossary) formats, on the contrary, are immune to generation losses; so the final master tape can be technically as good as the raw stock on which the original recording is done. Digital formats also offer other advantages like better shelf life of recorded tapes, easier post production, convenience in transfer of tape content through computer networks, broadcast automation, etc.

13.4.1 TV Transmission Techniques

So far, we have discussed about things related to TV studios and television production. That, of course, is only part of the story. Now let us understand how television transmission takes place and how exactly the many TV channels reach your TV set even though they originate at different places, in different countries.

Basically, the three most popular means of distribution of TV signals to homes are:

- Broadcasting through terrestrial(ground-based) transmitters
- Satellite and cable distribution
- Direct-to-Home(DTH) Television via satellite

Terrestrial Transmitters

As in the case of a radio transmitter, a TV transmitter 'modulates the incoming TV signals on to a higher frequency carrier, amplifies the power of the modulated waves and sends them to the aerial system for radiation into space in the form of electromagnetic waves. Since a TV signal is in practice two distinct signals one for the picture and the other for the sound - a TV transmitter is in effect a two-in-one transmitter, which deals with the picture as well as sound transmission in an integrated fashion. Again, while radio transmission takes place in medium wave, shortwave, VHF (glossary) and UHF (glossary) bands, for compelling technical reasons international regulations restrict terrestrial TV to VHF and UHF bands only. Please recall that wave propagation in these bands follows a straight path, which, means that TV signals, like FM radio, travel over line-of-sight (glossary) distances. To maximize the coverage area of a TV station, therefore, the transmitting aerials are located on the top of tall masts. The typical coverage area of a 10 KW TV transmitter with a 200 meter high mast is about 60 Km radius. In metro cities with many skyscrapers, you need much taller towers to satisfy the line-of-sight requirements within the coverage area. So is the case in hilly areas with many ups and downs. Short towers will do if the area is a flat, rural landscape. For example, in Mumbai, the Doordarshan tower is 300 meters tall. Also, wherever possible, TV towers are located on hill tops, to gain maximum visibility (and therefore coverage) for the transmitting aerial. This is the case in Pune where the TV tower is located on the Sinhagarh hill.

Terrestrial transmissions can be received by TV homes by means of simple 'Yagi' aerial which can be erected on a roof top or a balcony. A typical Yagi aerial contain 3 aluminum rods of specific lengths (to suit the wave length of transmission). Out of these, the middle one is folded inwards and is known as a folded di-pole. The transmissions picked up by the folded dipole are carried to the TV set inside the house through a flat cable called feeder line.

The rod in front of the folded dipole is called 'director' and the one behind is called 'reflector'. Together, they help in maximizing the 'gain' of the aerial in the wanted direction.

Till a decade ago, urban areas in our country were replete with these aerials, sprouting from the rooftops of numerous households, as TV reception would have been impossible without them. Terrestrial transmission of Television is now largely overtaken by satellite and cable because of the phenomenal growth in cable networks in the recent past. For non-cable TV households, however, terrestrial TV continued to be the only lifeline. Therefore, Doordarshan maintains a large fleet of terrestrial transmitters across the country to ensure TV coverage to remote rural communities at affordable cost.

Satellite and Cable Distribution

A chief limitation of terrestrial TV, you will agree, is its limited range, further limited by line-of-sight propagation. This limited range can be improved to some extent by erecting taller towers and increasing the power of transmitters, but obviously there

are limits and terrestrial transmissions cannot be expected to go beyond 100 km even in favourable circumstances. The only way of expanding terrestrial TV coverage across longer distances is by setting up 'repeater' stations, i.e. pickup the signals at the fringe of the coverage area of the original transmitter and re-transmit them through a second transmitter, and so on. While this is practicable and is being adopted in many cases, it is a very costly proposition as tens of thousands of such repeater would be needed for a country of our size.

It is here that satellite communications come in, as an economical alternative to terrestrial repeaters. Communication satellites are man made devices placed at an altitude of about 36,000 km up above the equator, so that they revolve around the earth, much like the moon(earth's natural satellite) revolves around the earth. However, because of the particular altitude of their orbit, communications satellites take exactly 24 hours to complete one revolution, the same time that earth takes to rotate around itself. Any satellite at a lower orbit revolves much faster, while those at higher orbits revolve slower. The time period of 24 hours is unique to this particular orbit which is known by the name 'geo-stationary orbit', because the satellites in this orbit appear stationary as seen from the earth. Communications satellites receive the signals sent towards them from the ground and, after necessary frequency conversion and amplification, retransmit them back earthward, so that they can be received by a suitably equipped dish antenna located within the 'foot print' (that is, coverage area) of the satellite. Since a single satellite can 'see' as much as one-third of the earth's surface, a compliment of just three satellites can provide global coverage of television, cutting across national boundaries and continents.

The transmission side of a typical satcom system consists of an 'earth station' to which the programmes generated by the studio center are sent. The earth station contains necessary electronic equipment to 'uplink' (that is, transmit upwards to the satellite) the signals in the desired frequency band, with the help of a large dish antenna which is accurately kept directed to the satellite in the sky. Once adjusted, the dish remains pointed towards the satellite all the time. So it does not need to be disturbed except for very occasional perturbations. Presently, maximum number of satellite TV channels the world over operates in the so called 'C' band (4 to 6 GHz range). However, as this band is already crowded, 'Ku' band (12 to 18 GHz) is the new frequency band which is rapidly gaining currency for upcoming TV channels, as well as for DTH.

The receiving system is known by the acronym DRS (Direct Reception System) which consists of a dish antenna (typical size 8 to 12 ft. diameter) fitted with a feed-horn and LNBC (Low Noise Block Converter) at its focus. When the earthward transmission from the satellite falls on the dish, the electromagnetic waves get reflected to converge at its focus. A 'feed-horn' mounted at this point collects the energy and feeds the LNBC.

The LNBC performs the dual task of amplification and conversion of high frequencies, to similar signals carried at a much lower frequency. These lower frequencies travel through cables and is then fed to a satellite receiver. It is the job of the satellite receiver to process the received signals into a form which can be handled by the domestic TV set, which is kept connected to the output of the satellite receiver.

Most satellite TV channels as of now adopt digital transmission techniques to economize on the satellite transponder space. Therefore the satellite receiver employed in the DRS should be a digital one. Such receivers are known by the technical term Integrated Receiver Decoder (IRD). Digital satellite TV channels also often employ 'scrambling' techniques, so that only authorized IRD are activated for de-scrambling the signals. For example, most of the private TV channels like DD (Doordarshan) and Gyandarshan are free-to-air, without any scrambling.

We have noted above that C band DRS employ dishes which are typically 8 to 12 ft in diameter. Moreover, as different TV channels are sent through different satellites,

you need so many dishes, each pointing towards one or the other satellite, to receive all the channels on your TV set. This is clearly a cumbersome proposition; hence the need for a cable operator as a necessary middle man in the process. A cable operator receives all the channels through a cluster or DRS systems (called cable head-end) and distributes them to individual homes through cables. The equipment used at the head-end permits the same cable to carry all the channels without getting mixed up. The tail-end of the cable is wired into your home and connected to your TV set.

From the above description, you will appreciate that cable networks are a necessary adjunct to satellite television. Direct-to-Home TV services operating in Ku-band, however, are an exception to this rule. About DTH and related matters, you will study separately in another unit of this Block.

Check Your Progress 3

Answer the following questions briefly:

1. Explain the main function of production control room.

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2. Explain some advantages of satellite TV vis-à-vis terrestrial distribution.

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3. Why are hill tops or high altitude locations needed for TV towers?

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13.5 EMERGING TRENDS IN BROADCASTING

Recent technological advancements have brought in their wake many epoch-making changes in the way broadcasting is carried out, some of them altering the very nature of broadcasting as it was understood so far. Let us take a brief look at some of the current and emerging trends.

Digital Audio Broadcasting(DAB) through Satellites

Digital Audio Broadcasting (DAB) through satellites enables global coverage and also CD like quality for audio broadcasts. Thus, DAB is an efficient solution for the problems of quality as well as quantity at one stroke. However, the disadvantage is that ordinary radio sets cannot work for DAB; you need special sets which are quite expensive for the common man. The 'Worldspace' radio is an example of satellite based DAB. With a fleet of three satellites, Worldspace aims to provide high fidelity programmes to global audiences. In the context of education, DAB can have interesting applications for distance education institutions that wish to offer their programmes for learners dispersed across continents.

Campus Radio

At the other end of the scale, the concept of highly localized broadcasting with a coverage area of no more than 5 km radius, is also gaining currency. Educational

institutions can set up their own radio station at minimal cost to serve their respective campuses and neighborhood. Campus Radio can be used to promote community life, student welfare activities, supplementary educational lessons beyond classroom hours, counseling through distance mode, career guidance, cultural activities etc.

Briefcase radio

A briefcase radio is a radio station that is so simply designed and compact that it can fit into a briefcase. It is being used in some places as a community radio to share the local news, knowledge and problems. The community is active in the production and broadcast of such programmes. The programme shave a limited reach but serve the purposes of the community quite well. It has been successfully used in some places like Gujrat, Karnataka, Andhra Pradesh., etc. You may visit the websites such as http://www.communityradionetwork.org/toplinks/archives/sen%20radio to know more about briefcase radio.

Digital Terrestrial Television (DTT)

While the traditional TV transmission is terrestrial analogue, DTT is digital. To receive DTT, you need a set top box before your TV set. Doordarshan has DTT mode in the four metro cities already. Apart from superior picture and sound quality, the real advantage of DTT lies in the value-added services it can offer to the viewers: video-on-demand, tele-shopping, program-related services, etc.

Webcasting

The universal reach of the internet and World Wide Web has enabled broadcasters to adopt this medium to reach out specific audiences irrespective of geographical boundaries and, in the process, take advantage of the value-added features that only the web casting mode can offer. Unlike conventional broadcasts, webcasting enables viewers/listeners to access their chosen programmes at a time of their convenience on their computer sets and repeatedly if desired. Access can be restricted by the broadcaster as per their marketing strategy: say pay-per-view, as per monthly/yearly subscription etc.

Many leading sound broadcasters around the world (including All India Radio) have their web casting channels. But television channels on the web are still not so prolific because of technical reasons like non-availability of sufficient bandwidth at many places. In the absence of adequate bandwidth, web cast pictures tend to lack definition and be jerky, unclear and go into freeze every now and then.

13.6 SUMMARY

Broadcasting as you know now is the instant communication of messages to the masses through electronic but wireless mode. In this unit we have discussed about the two most popular technologies for broadcasting –radio and television. Due to factors like economy and greater accessibility these two technologies are still very popular and are of special use for educational purposes. From a humble beginning, radio has become economic, portable and above all accessible to almost every one. Hence, it is a valued technology for educational broadcast. Facilities for interactivity had added to its value Television has although arrived much later but its appeal is greater as it provides visuals along with audio. Educational programmes are being telecast today through Indian channels as well as foreign ones.

Radio broadcasting comprises the functioning of several subsystems such as studio, which is the prime location for recording and is the first step from which audio transmission initiates. It has several equipments like microphones, audio mixers, etc. The audio signals are carried from the studio by STL to transmitting centers, through

wired or wireless means. From these centers radio signals received are converted into radio frequencies and radiated as electromagnetic waves. The radio receivers finally pick up these waves and play it to us. FM radio is today more popular than AM radio as frequency modulation leads to transmission , not prone to atmospheric disturbances.

In television the video camera is the basic device needed for capturing the audio and visuals and translate them into video that are transmitted to television sets which deliver the sound and pictures to us. Television studio is the venue for indoor shooting. Television signals can be distributed through several modes like satellite and cable distribution and DTH via satellite. AT the end of this unit we have discussed about the new trends that are emerging today in broadcasting such as DAB, campus radio, etc.

13.7 UNIT END ACTIVITIES

1. Visit the web site of IGNOU and read about the Electronic Media Production Center.
2. Visit your nearest TV/Radio station and look around the studio and other technical areas. Make your own notes of the facilities you have observed and relate them to what you have read in this unit. Broadcast stations are usually restricted areas. So you may require prior permission from the station authorities for your visit, although such permission may not be difficult to obtain if have your student Identity card and explain the purpose of your visit.

13.8 REFERENCES AND SUGGESTED READING

You may visit websites on topics discussed in this unit, like the following:

http://www.indiatogether.org/media/articles/air75.htm retrieved on29.5.07

http://en.wikipedia.org/wiki/All_India_Radio retrieved on 29.5.07

http://planningcommission.nic.in/reports/peoreport/cmpdmpeo/volume2/erosi.pdf retrieved on 29.5.07

http://en.wikipedia.org/wiki/Broadcasting retrieved on 29.5.07

http://en.wikipedia.org/wiki/Mixing_console retrieved on 31.5.07

http://www.answers.com/topic/broadcasting retrieved on 31.5.07

http://en.wikipedia.org/wiki/Radio retrieved on 31.5.07

http://www.cybercollege.com/frtv/frtv017.htm retrieved on 31.5.07

http://www.adamwilt.com/DV.html retrieved on 1.6.07

http://www.webopedia.com/TERM/A/analog.html retrieved on 1.6.07

http://www.answers.com/line%20of%20sight retrieved on 1.6.07

http://telecom.hellodirect.com/docs/Tutorials/AnalogVsDigital.1.051501.asp retrieved on 1.6.07

Glossary

AM: Amplitude Modulation. A system of modulation which is adopted for transmission of radio broadcasting in the medium wave and short wave bonds. AM is also used for transmission of video signals in terrestrial TV transmissions.

Aerial/Antenna: A Metal wire/rod/dish-shaped structure which radiates/receives electromagnetic waves. The physical dimensions of the antenna elements are designed to be a simple fraction or multiple of the 'wavelength' of radiation.

Conditional Access System (CAS): A system of cable distribution which enables the viewers to selectively subscribe for their preferred channels. A 'set top box' at the subscriber end can be made to receive only the subscribed channels and block the rest.

C-Band: Frequencies in the range 4 to 6 GHz. C band is popular for satellite TV uplinks and downlinks.

DTH: Direct to Home Television: A system of satellite TV which enables direct reception at homes through small, individual dishes, rather than through cable distribution. DTH services are broadcast on Ku band and still higher frequency bands.

FM: Frequency Modulation. A system of modulation which is adopted for transmission of radio broadcasting in the VHF(Very High Frequency) and UHF(Ultra High Frequency) bands. FM is also used for transmission of sound signals in terrestrial TV, and satellite communications.

Ku Band: Frequencies in the range 12 to 18 GHz, which are used in satellite communication mostly for DTH services.

MW: Medium Wave: Frequencies in the range 300 KHz to 3000 KHz(3 MHz). MW broadcasts have a typical coverage area range upto 500 Kms radius.

Modulation: The process by which the audio/video information is embedded on to a higher frequency 'carrier' for the purpose of transmission. Such as Amplitude Modulation (AM); Frequency Modulation (FM).

Persistence of Vision: Property of human eye, because of which we perceive rapidly changing(but discreet) still frames as a single frame containing motion. Cinema and Television make use of this property to give us the illusion of moving pictures, while in reality, what they present is a series of still frames which follow each other in rapid succession.

RF: Radio Frequency: The portion of electromagnetic spectrum used for transmission of radio and TV broadcasts.

SW: Short Wave: Frequencies in the range 3 MHz to 30 MHz. SW broadcasts can reach distances of 2000 Kms or more, due to reflections from ionosphere.

Studio to Transmitter Link (STL): The means of connecting studio to the transmitter for sending audio/video programs. The link can be either a hard-wire one (e.g. non-exchange line, ISDN, Coaxial cable) or wireless (e.g. microwave, FM, satcom).

Transponder: A Satellite-borne electronic device meant for receiving and transmitting the broadcasts.

UHF: Ultra High Frequencies: Frequencies in the range 300 MHz to 3000 MHz are known as UHF.

VHF: Very High Frequency: Frequencies in the range 30 MHz to 300 MHz are known as VHF.

Analog and digital form: analog is the process of taking an audio or video signal and translating it into electronic pulses as for instance by ordinary telephones or radio. Digital on the other hand is breaking the signal into a binary format where the data is represented by a series of "1"s and "0"s as for example by computers.

Line of sight: An unobstructed view from transmitter to receiver. Satellite, infrared (IR) and microwave transmissions require line of sight between nodes, whereas portable phones, cell phones and wireless LANs (Wi-Fi) do not. (http://www.answers.com/line%20of%20sight

13.9 CLUES TO CHECK YOUR PROGRESS

Check Your Progress 1

1 Even outside broadcast routed through it.

2. Unidimentional , omnidimensional, cardioid, etc.

3. Audio from studio transported to transmitter through STL

Check Your Progress 2

1. AM modulates the strength of the transmitted signal according to the information being sent.; FM- frequency is varied.

2. Ham radio

Check Your Progress 3

1. It houses all the electronic equipments and operational controls and the producer and the technical personnel perform their jobs.

2. Terrestrial distribution suffers from line of sight limitation

3. For line of sight transmission