DIGITAL HEADENDS

The Cable TV Industry in India is poised for another big change. Since the beginning of Cable TV, there have been major technological advancements both in control room equipment and also in distribution network equipment. The last major change, few years ago, was changing the distribution trunk from coaxial to fiber optic.

Now the new revolution is in the control room to change from analog to digital TV. Normally the cable operators resist the change as it looks complex or difficult to understand, but as they understand the technology they find it easier to manage and give better quality picture.

This study material includes the limitations of analog system, the components of digital equipments required and their use and to make the cable operator realize that though complex, it is not very difficult to incorporate digital technology in their control rooms.

Also we will explore the other important components of a digital CATV system like The Conditional Access System (CAS), The Set Top Box (STB), The Subscriber Management System (SMS), and The Middleware etc.

ADVANTAGES OF DIGITAL NETWORK OVER ANALOG:
Today even in an 860 MHz network, the maximum channels that can be delivered is 106. Currently India receives more than 150 programs and the 860 MHz analog bandwidth is not enough. So we have to go for the compression system and digitalize the signal. The scheme we use currently for compression is the MPEG-2.

Mpeg-2 Digital Compression
MPEG-2 is a digital format. In an MPEG-2 signal, the adjacent frames are compared and only those sections of picture which have changed or moved are recorded. In the next frame of video, only changed picture is transmitted / recorded. Mpeg-2 compression reduces the digital data required for moving video, by about 55 to 1. MPEG-2 has advantages such as being robust and not prone process.

Using MPEG-2 digital, approximately 8 TV Channels can be compressed into 7 MHz, which otherwise supports only 1 analog channel. As a result, a 550 MHz bandwidth can accommodate about 700 TV Channels! The Modulation used in the digital headend is QAM (Quadrature Amplitude Modulation).

Cable Attenuation
The picture in an analog transmission degrades as distance increases, but in digital transmission it will stay perfect. Also the major benefit in digital transmission is the ease to have added services like:
- ✓ Pay Per view
- ✓ Video On Demand
- ✓ Data (internet Services)
- ✓ Interactive services like Gaming.

- ✓ Telephony

These additional services can be easily accommodated, since enough bandwidth is available.

Stereo Sound & Dolby

Even the audio is significantly enhanced in MPEG-2 compared to analog transmissions. Analog CATV transmissions do not support Dolby or stereo sound. Digital offers Dolby stereo and even 5.1 Surround Sound.

Now let us take a closer look at the various equipment which are required at the digital headend and their functions:

EQUIPMENTS REQUIRED FOR DIGITAL HEADEND

- ✓ Transmodulators
- ✓ Professional IRDs
- ✓ Multiplexers
- ✓ QAM modulators
- ✓ Scramblers
- ✓ CAS system.

TRANSMODULATORS

The function of transmodulator is to convert QPSK modulation signals which are used in satellite transmissions, to QAM modulation, used in digital Cable TV systems. QAM signal are also down-shifted in frequency to any frequency band from 45 MHz to 860 MHz. The down-converted frequency is determined by the Cable network, depending on the frequencies at which they decide to include digital transmissions on their network.

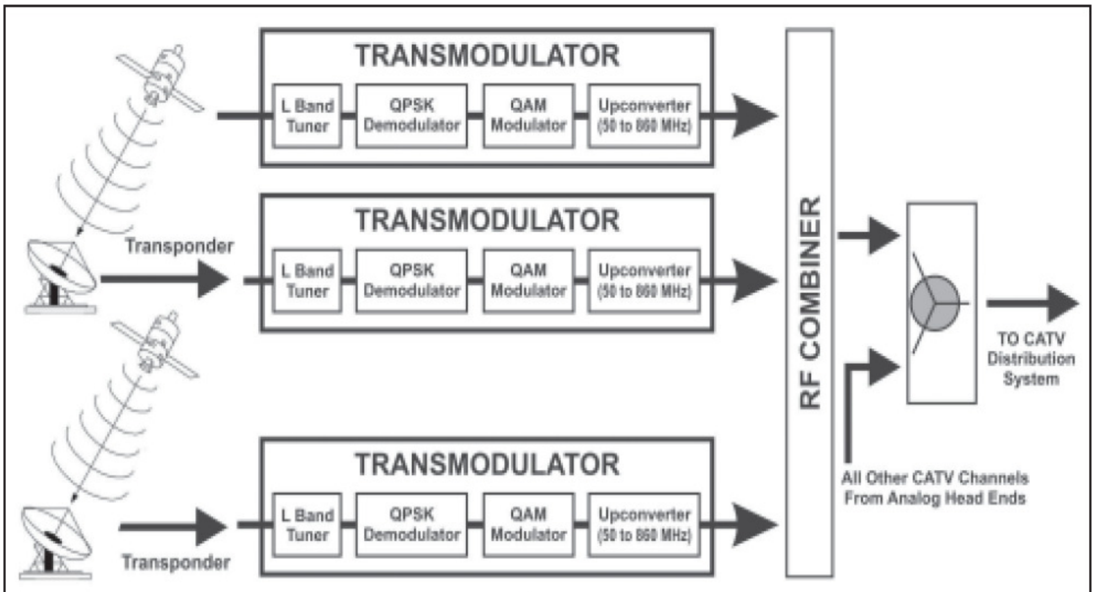


Fig. 1

A transmodulator receives the signal directly from the LNB; changes the modulation and converts the frequency for the entire channel received from that LNB.

As an example, the INSAT 2E satellite carries a bouquet of the ETV regional language channels. The entire bouquet can be converted to digital and added onto an existing CATV network, by a single transmodulator. Hence, just 1 transmodulator will convert all programs on a particular transponder.

ADVANTAGES OF TRANSMODULATORS
A transmodulator is relatively in-expensive, at approximately Rs 25,000 each. As a result 10 or more digital CATV channels can be generated on a CATV network at just Rs 25,000; the cost of a single transmodulator. Further, the transmodulator is frequency agile, and its output frequency can be varied at will by the Cable operator.

DISADVANTAGE OF TRANSMODULATORS
We cannot remove a particular program from the bouquet of channels as all the channels will be converted to QAM. Some transmodulators have the facility to accept a SMART Card to decode incoming pay TV channels. Of course this would require all the incoming Pay TV channels to have the same encryption. It would also require the Pay TV broadcaster to provide a SMART Card that would simultaneously decode multiple pay channels.

Also if selective delivery via CAS is planned, it is not possible to locally scramble the programs available on the output of a transmodulator. The transmodulator is an ideal, low cost solution for adding FTA (Free-To-Air) channels to a digital bouquet. Implementation of CAS & consumer selection of channels, demands the use other equipments which we will see one by one.

TYPICAL CAS HEADEND
A typical digital headend with CAS is shown in the Figure 2 block diagram.

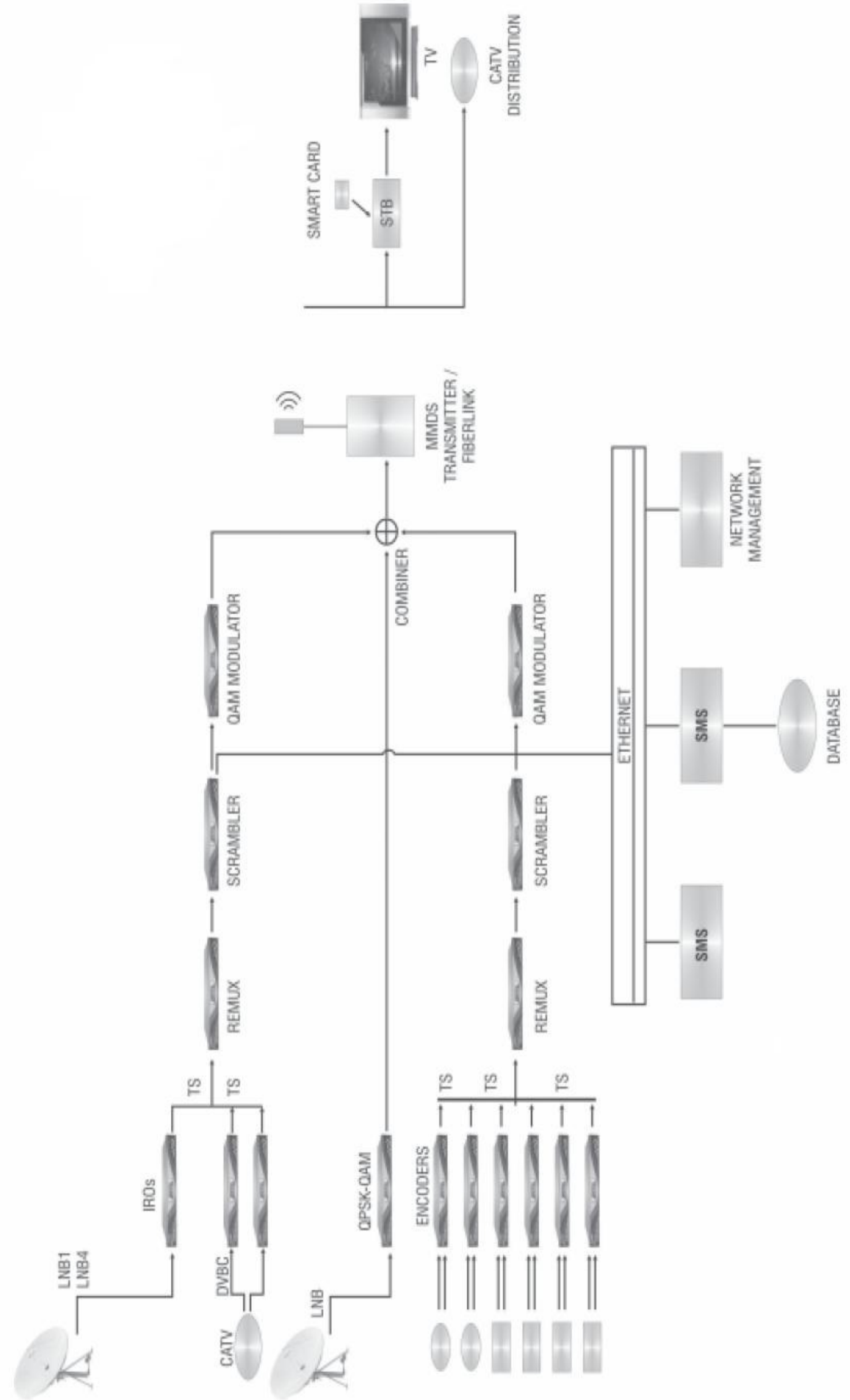

LNB1
LNB4
IROs
TS
TS
DVBC
CATV
LNB
QPSK-QAM
ENCODERS
TS
TS
TS
REMUX
SCRAMBLER
QAM MODULATOR
REMUX
SCRAMBLER
QAM MODULATOR
COMBINER
MMDS
TRANSMITTER /
FIBERLINK
SMART CARD
STB
TV
CATV
DISTRIBUTION
ETHERNET
SMS
SMS
DATABASE
NETWORK
MANAGEMENT

Fig. 2

FTA CHANNELS

At an Analog Headend, the digital satellite receiver produces an analog output which is benefit to an analog modulator. In a digital headend, the free to air digital channels must be maintained in their digital format. This is done by special digital satellite receivers which provide a digital data stream as an output instead of analog audio and video outputs.

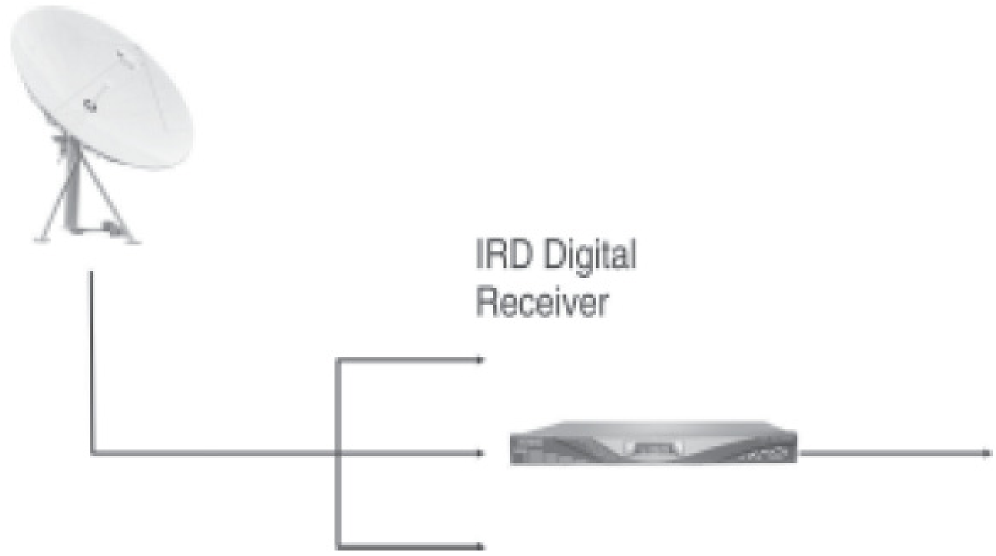


Fig. 3

This digital data stream has been standardised as an Asynchronous Serial Interface, which is MPEG- 2 compatible. The ASI interface maintains full digital quality of the incoming satellite signal. As an example, the Sahara package can be tuned by a single IRD to receive 8 programs in a single stream (currently 2 programs are scrambled).

PAY CHANNELS WITH CAS

Incorporating pay TV digital channels is also possible using ASI output digital satellite receivers. However, if the channels have different encryption systems, a separate ASI output digital satellite receiver will be required for each channel. Such descrambling digital satellite receivers are often termed as Integrated Receiver + Decoder (IRD because the decoder is built into (or integrated with) the digital satellite receiver.

For IRDs indicated above, it is essential that the pay TV broadcaster authorises the IRD and provides a smart card to match it. Most pay TV broadcasters in India are not quite as cooperative and they insist that only their common digital satellite receivers, which do not provide an ASI out, are used. In such cases the digital cable headend has no option but to use equipment described in the “Local Encoding” section below.

Some encryption systems such Scientific Atlanta’s PowerVu do not provide a cam module to interface with other manufacturer’s ASI output IRDs In such cases, the digital headend has no option but to purchase PowerVu IRDs, at relatively higher costs.

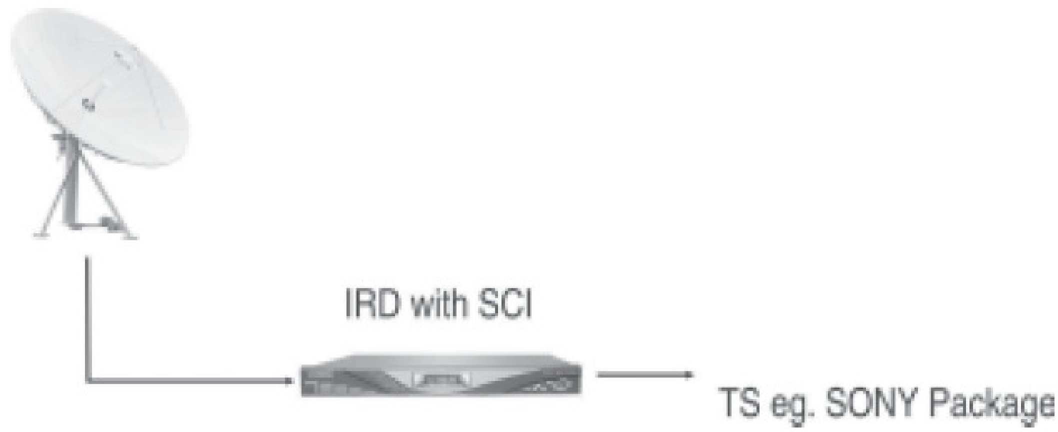


Fig. 4

PAY CHANNELS NOT PROVIDING CAM MODULES

As indicated above, some pay channel broadcasters refuse to provide IRDs with an ASI digital output stream. In such cases the output is only available as analog audio and video signals.

In such cases, it is necessary to convert the analog A/V signals into digital signals and then send this digital data stream for local encoding. Conversion of the analog A/V signal to a digital stream is done by the MPEG-2 encoder. The encoders are relatively expensive devises and can account for a large share of the total headend cost. As an example, an MPEG-2 encoder will typically cost Rs. 20 lakhs per channel if procured from a reputed international manufacturer. The received and locally encoded signals will be sent to the digital QAM modulators.

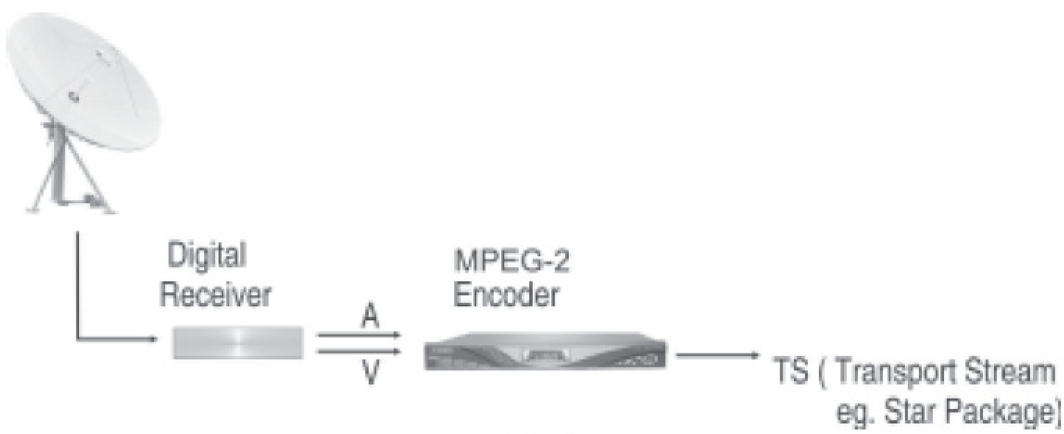


Fig. 5

LOCAL CHANNELS

Cable headends often create their own local channels. Large MSOs often creates their own Hindi Movie channels while smaller networks often create, in-house produced, local news channels. The output from the cameras or play-out VCRs and DVDs are analog audio + video signals. Once again, these signals need to be converted into a digital data stream, often referred to as “Transport Stream”. The Transport Stream is then locally encoded and sends to the digital QAM modulators.

Fig. 6

MULTIPLEXER AND QAM MODULATOR WITHOUT CAS

As seen above, each TV channel in a digital headend is generated as a digital data stream. However, one analog channel bandwidth can accommodate multiple digital channels (often ranging from 6 channels to 24 digital channels).

Hence, it is necessary to ‘Re-Bundle’ each of the digital Transport Streams into a bundled Transport Stream (TS). The Re-Bundling process is done by a Multiplexer or MUX. Each Multiplexer will typically have 8 or 16 ASI inputs. Each of these 16 ASI inputs receives an ASI data stream from its digital satellite receiver or MPEG-2 encoder. Using a local Multiplexer, the digital cable headend has the facility to create its own bundle of different channel, as apart of single Transport Stream.

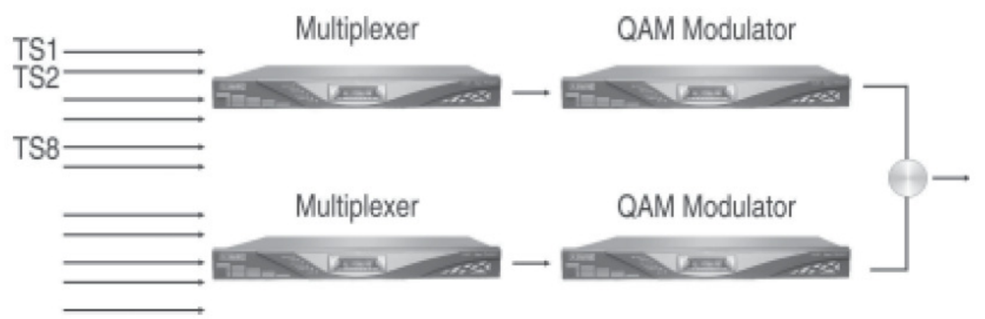


Fig. 7

EFFICIENT MULTIPLEXING

As we have seen earlier that, MPEG-2 compression is done by only transmitting changes in the picture from one frame to another. Hence a news channel which shows the face of a news reader for most of the time can be very efficiently compressed for transmission over a very small digital bandwidth. On the other hand a Sports channel, where the camera follows the ball, has a very high rate of a changing picture. Such channels cannot be compressed to the same extent as a News channel.

Most encoders provide a facility to set the compression ratio for that particular channel. Hence, efficient digital compression can be achieved if the local digital headend creates its own re-bundle Transport Stream consisting of a mix of sports, news and movie/general entertainment channels. It is therefore important for the digital cable headend to Multiplex /Bundle the correct digital channels in each Transport Stream.

STATISTICAL MULTIPLEXING

Even a News channel will often shift to outdoor news reporting, with rapid changes in the picture. On the other hand a sports channel may focus on the commentator and therefore, at that moment in time, the sports channel could be compressed more efficiently. To compress multiple channels most efficiently, Statistical Digital Multiplexing is utilised. A computer continuously monitors a group of 15 to 20 channels and allocates – 50 times every second – the compression ratio for each of the channels in one particular Transport Stream.

As a result at some instant in time, a news channel may require, and receive lower compression than a sports channel, and vice-aversa. Using Digital Statistical Multiplexing, Indian MSOs often put out 15 to 20 digital channels in the bandwidth occupied by a single analog channel.

QAM MODULATORS

Digital CATV signals are modulated using Quadrature Amplitude Modulation (QAM). QAM digital modulation operates efficiently in applications such as CATV, where the signal levels are quite large, such as 60 dBU to 120 dBU as typically deployed in a CATV network. Under these conditions, QAM provides for very dense digital data transmission in the same bandwidth. In contrast QPSK modulation used for transmission of less than 1 micro-watt of satellite power cannot pack dense data but provides excellent error-free translation even for miniscule signals. All QAM modulators are frequency agile and the cable operator has the option of setting their output at any convenient frequency band in the cable TV spectrum.

Three levels of QAM modulation are usually utilised for CATV networks. These are:

- ✓ QAM 64
- ✓ QAM 128
- ✓ QAM 256.

QAM 64 provides smaller digital signal carrying capacity than QAM 128 or QAM 256. In practice, QAM 64 provides 38 Mbps over a 7 MHz bandwidth i.e. around 8 to 10 program can be transmitted per analog channel bandwidth. QAM 128 provides 44 Mbps. Over the same bandwidth i.e. around 12 programs per analog channel. QAM 256 provides carriage of 51 Mbps digital information, i.e. around 14 programs can be inserted per analog channel. Only QAM modulator is required per Transport Stream and the output of the QAM modulator is then combined using conventional splitters, to form a composite Digital Output stream.

ALLOCATION OF DIGITAL FREQUENCY

The TRAI requires that all Indian CATV networks must carry the free-to-air channels as analog channels. This implies that all Indian CATV networks must; by law; the hybrid and deliver both analog and digital CATV signals. Even assuming that digital will squeeze just 10 digital channels per analog channel bandwidth, it is more than adequate to allocate 10 analog channel bandwidth for digital capacity. The digital headend must therefore decide which 10 analog channels are to be vacated for creating digital capacity. The prime band channels (E-2 to E-12) are ruled out because of they yield prime carriage fees.

On the other hand, the top end of the spectrum, towards 860 MHz would be an unwise decision since many last mile operators cannot provide adequate quality signals to their consumers at these extreme UHF frequencies. Generally MSOs provide their digital channels at frequencies ranging from 300 MHz to 450 MHz. Most LMOs provide excellent carriage of these frequencies. An added advantage is that old TV sets do not tune to these frequencies and at least some of the customers will not even miss the analog bandwidth that has been redeployed for digital channels.

MULTIPLEXER AND QAM MODULATOR WITH CAS SYSTEM

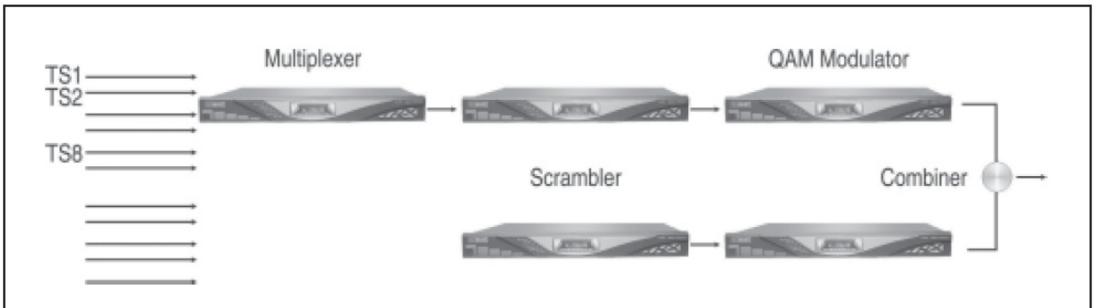


Fig. 8

CONDITIONAL ACCESS SYSTEM

The Conditional Access Systems will give security to the program allowing only those subscribers to view the program who have paid for it or have opted for it.

Conditional Access systems differ from one another due to the protocols used to manage and transmit access rights and keys mainly by software embedded in STB and subscribers smart card. The typical hardware required for the CAS includes scramblers. Various Conditional access (CA) systems are offered as integral parts of scramblers.

SCRAMBLERS

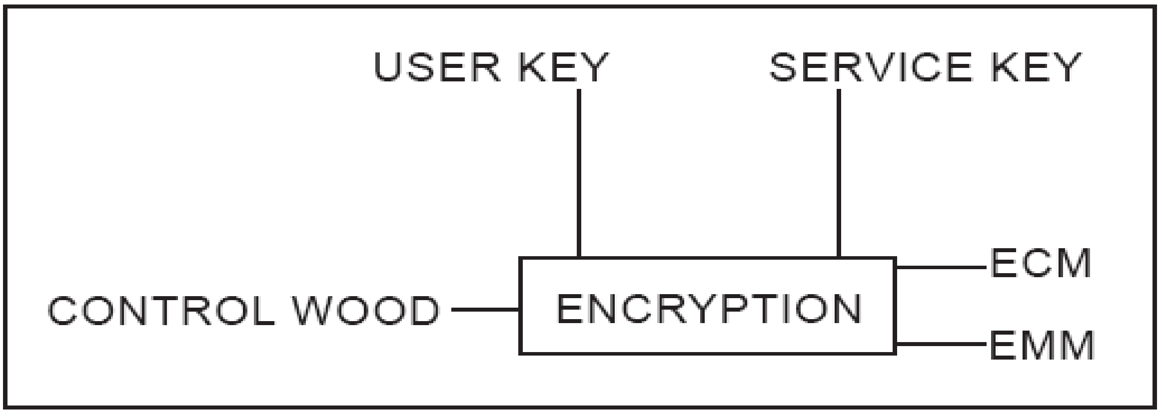
The scramblers used at a CAS headend are generally provided by the hardware supplier. Various conditional access systems are possible. In a network to have different CA systems as per the DVB standards, the scrambler may have the following options:

SIMULCRYPT: Here the networks can use different CA system but the same scrambling algorithms. The transport stream can carry the CA packets for each CA that can be used to access the programs.

MULTICRYPT: Here the functions required for different CA and descrambling will be in a detachable module in a common interface slot. The STB will have more than one DVB CI slot to allow connection of many CA modules. This becomes more expensive to implement. The other equipment to be supplied by the CA is Encryptors, CA Scramblers, Servers and the Smart cards. The information required for descrambling is transmitted in specific conditional access message namely The ECM (Entitlement control messages) and the EMM (Entitlement management messages) In MPEG2, the complete process of understanding the coding and decoding the program signals by Set Top Box requires the study of the transport stream, the packet Identification codes (PID) and the Program Specific Information (PSI) which are specified by

- ✓ NIT – Network Information Table
- ✓ PAT – Program Association Table
- ✓ CAT – Conditional Access Table
- ✓ TSDT – Transport Stream Description Table.

For the selection of CAS, the major issue to look at, is the security aspect. Also if the system is hacked how fast can the system recover and remove the hacked boxes is also important. Other important aspects are the features and functionality, future upgrades for growth, the support and maintenance options and last but not the least the affordability or the cost benefits.



THE SUBSCRIBER MANAGEMENT SYSTEM (SMS)

This forms an important component of a CAS system. It is the front end software which will accept all the inputs from operator to switch on or off the programs for different STBs and accept various bouquet or CA requests. The SMS will be integrated with the CA system to pass the request and ask the CA to do the necessary actions. In addition to this it has to do the billing part i.e. Financial Accounting and handle payments gateways.

In the digital CAS systems, various bouquets and special packages will be created to attract customers. The SMS has to handle them and create necessary billing as per the packages.

Also for SMS, it is very essential to generate various reports and store data as per the TRAI guidelines. The details of STBs connected in the system, the pay channels requested by each. STB, the details of complaints received and attended is very important. The front end of SMS has to be user friendly and easy to use so that normal operator can work on it, while the overall architecture of SMS should be modular and flexible to support the future growth plans and options and the increasing subscriber base.

THE SET TOP BOX (STB)

The STB forms the largest component both in terms of quantity and also the total investment in a digital headend system. Since STB is going to the subscriber house, the features like sleek look, ease of use, good remote control features and fast operation all will play a major part in its selection. But in addition to this there are important parameters to look into the STB selection namely the

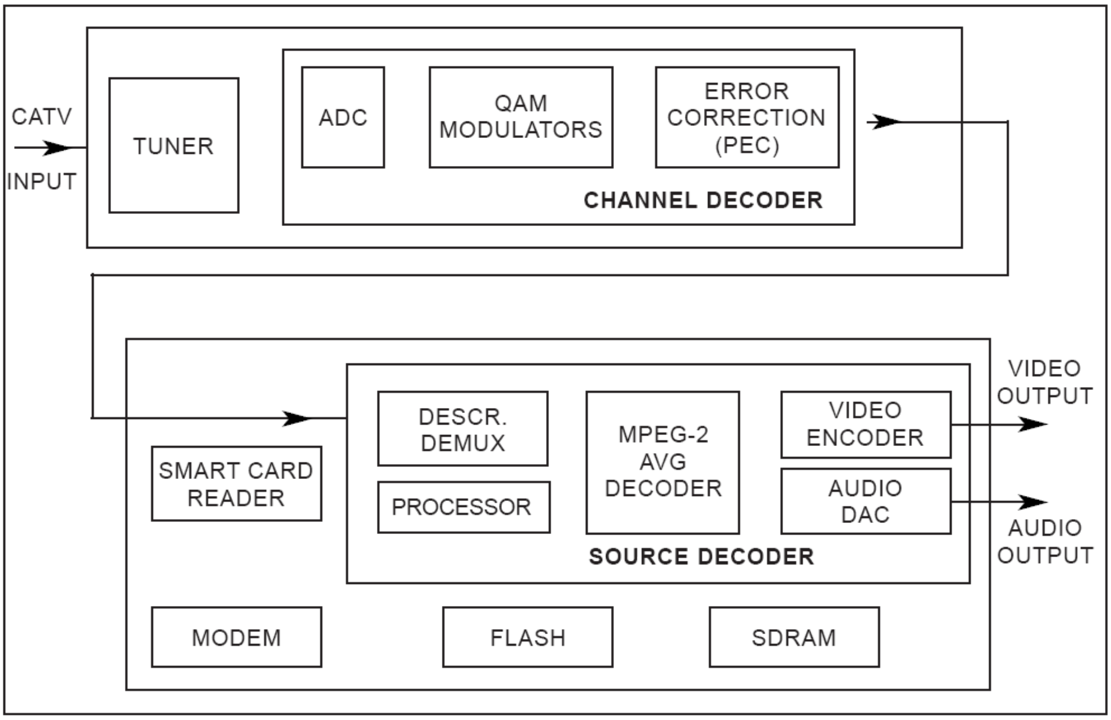
- ✓ Flash Memory
- ✓ SDRAM
- ✓ OTA functions,
- ✓ EPG / NVOD Supports
- ✓ Finger printing
- ✓ Verifier Key

Since the BIS Specs are drafted for the digital STB, all STBs have to adhere to the BIS specs. Also the broadcasters have specific requirements on fingerprinting which have to be followed.

BLOCK DIAGRAM OF A TYPICAL STB

The over all function of the box depends on the flash memory and SDRAM capacity and the microprocessor chip used. The cost of the box will also depend on these parameters. The cable operator will have to select maybe 3 types of different STBs in their system depending on the type of subscribers namely

1) Lower level with basic flash memory for subscribers who only want basic service and would not go for high end options
2) Higher level with full support of NVOD (Near Video On Demand) and interactive options and full middle ware support. These boxes will form the major quantity deployment
3) STBs with an even higher level features like DVR (Digital Video recorder) that can record programs.
4) High Definition TV (HDTV) capable STBs.



EPG

It enables the user to see the program details of what is going on at a specific time on a specific day. The guide often provides program details for several days in advance – usually for the entire calendar month. The subscriber can select what they prefer to watch and also lock a particular program at a particular time. At the pre-determined time, the STB will automatically switch to the pre-programmed channel. A typical EPG system will help in automatic management of producing, editing, scheduling and broadcasting of the program related information.

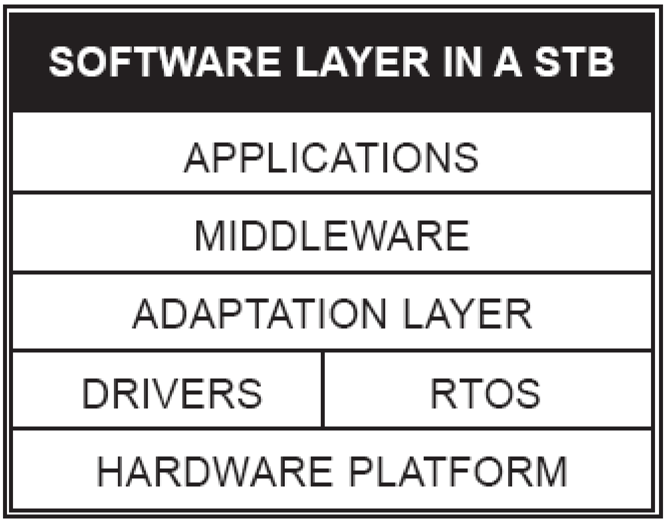
The equipment required for the EPG includes:

- ✓ EPG Server
- ✓ EPG Software
- ✓ TS Generator and splitter
- ✓ EPG Edit / Check workstation
- ✓ Operating system and database software.

MIDDLEWARE

The software part which will allow interoperability between different operators to allow middleware. It allows STBs to provide a user friendly interface, for various applications and selections TV programs and interactive applications. The middleware will provide various add on services which will help to increase the customer base and also to increase the revenue from each customer.

The middleware will define the look and feel of the user interface, the EPG, PPV programmes, games and other PVR function. One of the key features of most middleware is to make the applications independent of the hardware platform on which it is run assuming it has sufficient resources.



BASIC ARCHITECTURE OF A DIGITAL CATV HEADEND

Cable TV headends through out the country are now seriously considering the addition of digital CATV channels. Besides the advantages of better picture clarity and multi channel sound as well as the potential to deliver HDTV (High Definition Television), the key necessity to shift to digital is large number of channels and the limited analog channel capacity of 106 analog channels on a cable TV network.

Digital CATV provides for carriage of 6 to even 20 digital channels in the bandwidth of a single analog channel. Hence, if 10 analog channels are vacated, that bandwidth can carry 60 to 200 digital channels. The fact that CAS roll out countrywide is only a matter of time, further adds to the impetus to roll out digital CATV channels from the headend.

LOCAL ENCODING - ANALOG TO DIGITAL CONVERSION

Signals from pay or Free-To-Air (FTA) satellite channels are typically available at the headend through an IRD (Integrated Receiver- Decoder) which provides a composite video (analog) output signal along with separate mono or stereo sound signals. Both, the video and audio signals are analog signals are need to be converted to a digital signal for use in a digital headend.

This conversion of the analog video and audio signals to a digital data stream is done by a MPEG-2 Encoder. The MPEG-2 encoder provides a signal stream of digital data that contains both, the video and audio digital signals. One encoder is required per analog TV channel. Hence, if 20 analog TV channels are to be carried as digital channels, the digital headend will require 20 separate encoders to convert the analog signals to digital signals.

Fig. 1 : Local Encoding At The Digital Headend

Encoders form a crucial component in the quality of the digital signal. If the conversion of analog to digital is not done well, the picture quality will certainly suffer. The cost of digital encoders used for local encoding is very high and would typically account for a major part of the headend cost. MPEG-2 encoders will typically cost Rs. 20,000 to Rs. 2 lakhs per channel, depending on the brand, quality and facilities offered.

BIT RATE ALLOCATION

MPEG-2 also permits the user to set the maximum digital bit rate of the digital output signal. An analog channel can be converted into a digital channel with bit rates varying from 1.5 MBps to 5 MBps or even higher. The larger the bit allocated to each analog channel, the better the picture quality. However, larger bit rates imply that fewer the digital channels can be squeezed into the bandwidth of 1 analog channel. On the other hand a low bit rate of 1.5 MBps may result in a visibly poor digital picture quality. As technology marches on, it has been possible to achieve good picture quality with lower bit rates using MPEG-2 compression.

TYPICAL BIT RATES

Larger bit rates are required for channels where the picture changes rapidly, such as in a sports channel covering a football game. The camera continuously follows the ball and the entire picture changes rapidly. Such channels require a bit rate of 3 MBps to 5 MBps. On the other hand a News channel often has very little change in picture content from TV frame to TV frame. The news reader's face and background remains almost constant. Such channels require a much lower bit rate. It is generally felt that news channels can be adequately encoded by allocating them a bit rate of 1.5 MBps to 2.5 MBps.

STATISTICAL MULTIPLEXING

Of course, there will be certain period when the sports channel focuses only on the Commentator’s face. At these durations, the lower bit rate applicable for News channels would be adequate for the Sports channel. Similarly if the News channel shows an outdoor clip, it would require a much higher bandwidth. It would be extremely wasteful if News channels and Sports channels were allocated fixed data rate. This has led to the advanced development of - "Statistical Multiplexing". This examines the picture content of each channel approximately 20 times every second and continuously allocates different bit rates for different channels, depending on the instantaneous picture requirement for each channel.

If fixed data rates encoding accommodates 6 digitals channels per analog channel, statistical multiplexing practically increases it to 10 or 12 digital channels compressed into an analog channel bandwidth.

DIGITAL INTEGRATION

As indicated above, the coast of digital encoders is typically very high. A digital headend can therefore save a substantial amount of money if the digital satellite receiver provides for a digital (ASI) output rather than the audio video analog outputs. Many professional digital satellite receivers offer such a facility though typically, the digital IRDs distributed by pay TV channels do not offer an ASI (Digital) output. Further, since pay channels "pair" their IRDs and smart cards, it is also not possible for the cable operator to use an authorised smart card with an independently procured digital satellite receiver with ASI output. This is an area that the TRAI needs to look into and address, to facilitate lower cost digitisation of CATV headends. If the satellite receiver directly provides an ASI output, no encoder is required and the digital signals can be directly fed into the digital combiner (multiplexer or MUX, See Figure 2)

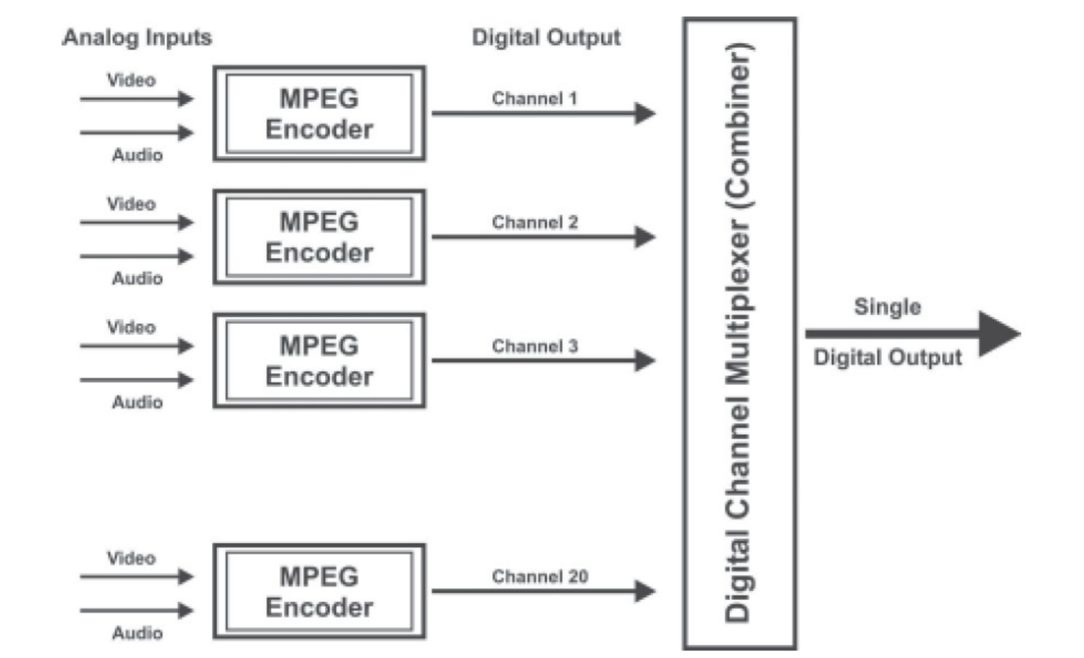


Fig. 2 : Combining Of Digital Channels

THE MULTIPLEXER

Encoders provide separate digital output for each TV channel as indicated in Fig. 1. In an analog headend a channel combiner combines multiple analog channels. Similarly, in a digital headend a multiplexer (MUX) combines multiple digital cannels and creates a "Transport Stream" (TS) The Transport Stream not only combines the digital channels but also creates a summary of the digital data contained in the Transport Stream similar to the index page of a book which lists the different content and the location of each content.

Multiplexers are typically available to 'combine' either 12 or 20 digital channels. Such multiplexers accept ASI inputs upto 200 MBps and offer between 1 to 4 outputs. The block diagram in Fig.2 shows (for simplicity) a single ASI output from the multiplexer.

MULTIPLE OUTPUTS

A multiplexer combines several digital channels to form a single transport stream that will be carried in the bandwidth of a single analog channel. Depending on the capability of the encoders and whether statistical multiplexing is used, the number of channels that can be compressed into the space of a single analog CATV channel (8 MHz for PAL-G) varies from 6 channels to as high as 16 to 20 channels. However, the amount of digital content (MBps) that can be carried on a single analog channel will also depend on the type of modulation used by the cable TV network.

QAM MODULATION

Quadrature Amplitude Modulation (QAM) provides for carriage of a large amount of digital data in a small bandwidth. QAM however requires strong signal strengths with very little noise. Hence QAM modulation cannot be used for satellite transmission but is used universally for digital CATV networks.

QAM modulation is typically used as either QAM 64, QAM 128 or QAM 256. QAM 64 offers the least compression and is most tolerant to external noise injected into the network due to poor quality cables, connectors or tap-offs. On the other hand QAM 256 provides the largest number of digital channels within a single analog channel but requires very good networks to transmit digital pictures to the consumer without freezing or pixelising (picture breaking up into small squares or dots).

MULTIPLEX CONFIGURATION

Depending on whether QAM 64, 128 or 256 is to be used for digital modulation, the multiplexer is to be configured to offer the appropriate mixing. The multiplexer is configured by connecting it to a PC, through SNMP via an ethernet port.

Table 1 shows the different digital output bit rates applicable for QAM 64, 128 & 256.

QAM 64	38 MBps
QAM 128	48 MBps
QAM 256	51 MBps

Table 1 : Typical Bit Rates For Different Levels of QAM Modulation

The multiplexer can be used for multiple channel inputs with a total bit rate of upto 200 MBps. Hence if the full 200 MBps input capability is utilised, the multiplexer will have to be configured to provide for separate ASI output data streams each of 50 MBps. The cable network will have no choice but to use 256 QAM digital modulation after the multiplexer.

If the network intents to use 128 QAM it will have to reduce the input data rate to the multiplexer by either:
I) Using more compression per channel (hence more expensive encoders or poorer picture quality) or
II) Using fewer channels.

SCRAMBLING

CAS requires that pay channels be scrambled and the subscriber's STB decodes/un-scrambles only the channels that they pay for. Hence a digital headend that carries pay channels will typically have to scramble the pay channels.

Fig.3 shows the location of the scrambler in the digital headend.

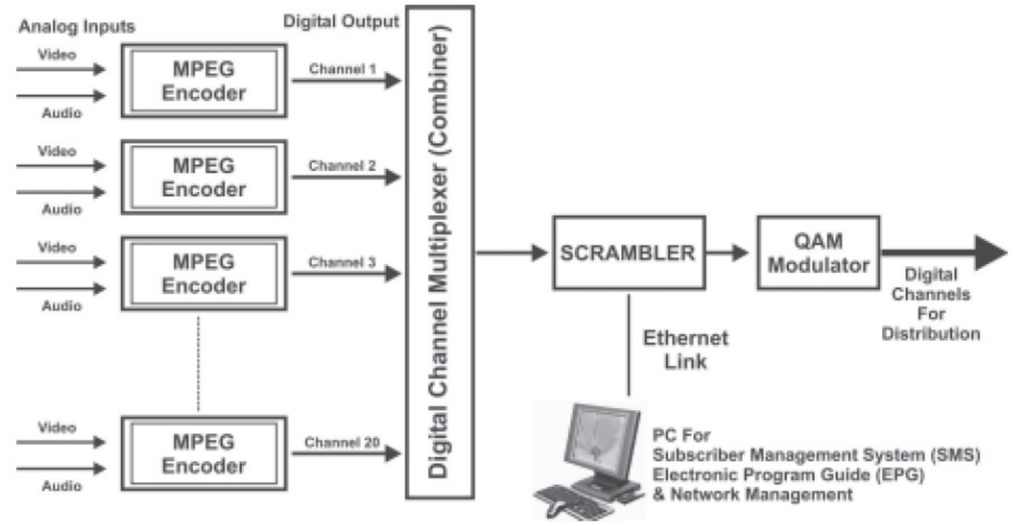


Fig. 3 : Digital Encoders + Scrambling + QAM Modulators

Each multiplex output requires a separate scrambler. The cost of the scrambler can vary very widely depending on the scrambling system used. As a rough estimate a scrambler could cost Rs. 2 lakhs each. Note that if their multiplexer is configured with 4 outputs, 4 separate scramblers will have to be installed, increasing the cost of digital headend very substantially.

For free-to-air (FTA) channels no scramblers to be used and the output of the multiplexer is fed directly to a QAM modulator as shown in Fig. 3.

QAM MODULATORS

A single QAM modulator will modulate multiple channels. All channels within a single transport stream (e.g. 8 to 12 channels) are modulated by a single QAM modulator which costs approximately Rs. 1 lakh. As a result the cost of digital modulation; per Digital Channel; is not very high and in fact comparable with the cost of good quality analog modulators. The QAM modulator can be user configured for QAM 64, QAM 128 or QAM 256 modulation.

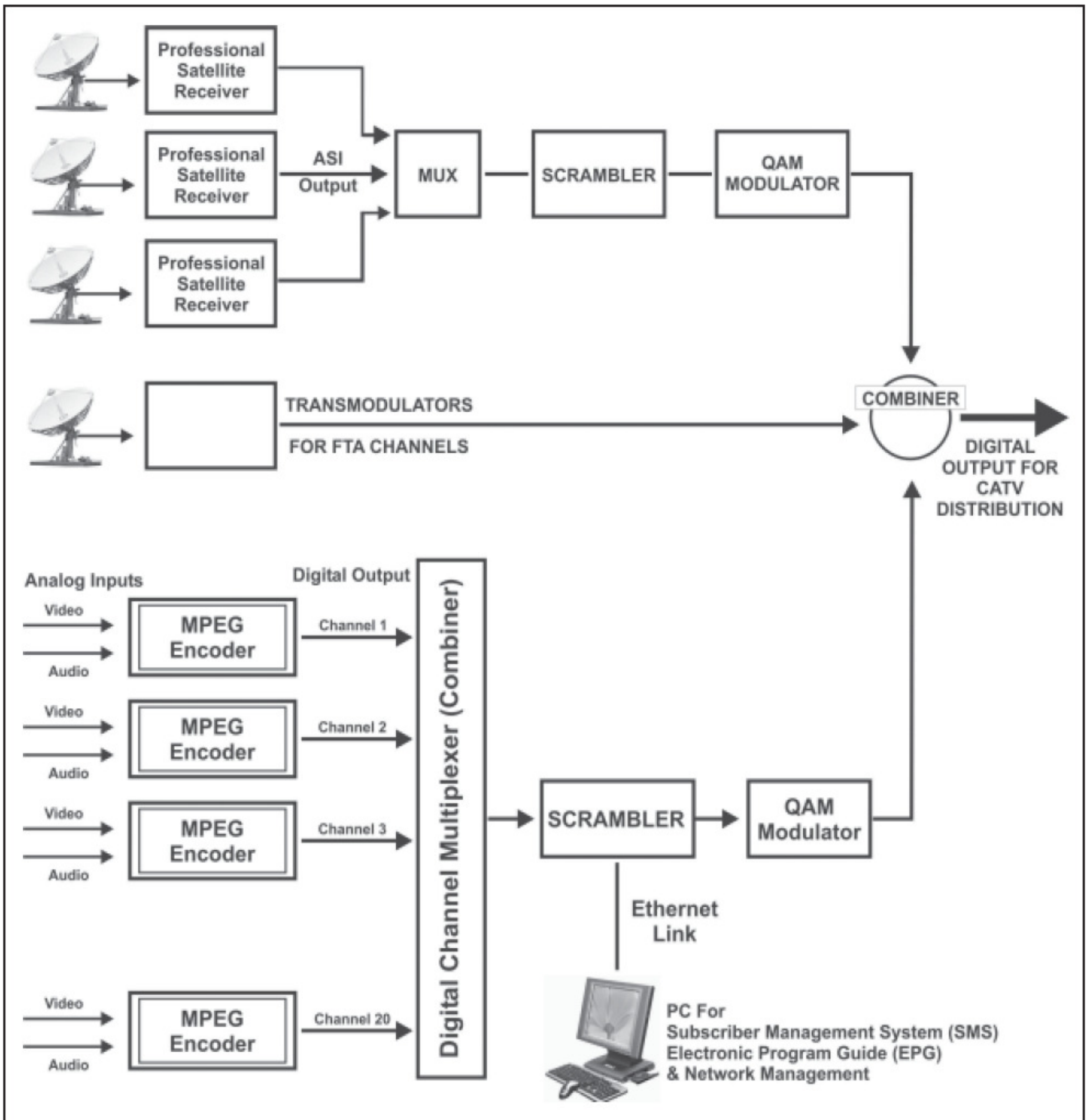


Fig. 4 : A Complete Digital Headend (Simplified View)

TRANSMODULATORS

Satellite transmissions use QPSK modulation. Cable TV transmission use QAM modulation. A transmodulator simply converts the digital signal from the satellite which has QPSK modulation into a digital signal, with the same properties but with QAM modulation. Such a QPSK to QAM converted digital signals can be directly mixed at the final output of the digital headend. This is shown in Figure 3.

IP DIGITAL SIGNALS

In this entire article we have referred to the digital signal in the ASI digital format. While ASI is very widely used in most digital heads worldwide, it is not the only option. The wide adoption of the internet had led to widespread use of the IP (Internet

Protocol) digital data format. Hence, it is possible to use equipment that converts the analog signals into an IP digital data stream instead of an ASI digital data stream.

The IP signals can then be multiplexed and modulated. However an IP multiplexer will be required. Some international manufacturers such as Teleste now offer a combination unit of Multiplexer + QAM Modulator for approx. Rs. 15 lakhs. The use of IP digital signals through out the digital headend enable IPTV to also be easily deployed from the same digital headend. However IPTV is usually deployed by telephone companies using digital modems and IPTV set top boxes. Cable TV distribution networks typically use DVB-C STBs.

About RTPL:

Rudraksha Technology Private Limited was founded in 2006 to provide high-quality consulting and custom software development services to the broadcast industry.

RTPL provides innovative, cost-effective, high-performance solutions in the areas of digital video technologies and custom software solutions for broadcasters. RTPL is dedicated to develop and provide powerful, easy-to-use software to manage broadcast operations from Ingesting of the content to putting the content on air.

Our products are pre-installed on rugged, high performance and rack-mountable super servers, each equipped with a pair of mirrored hard drives, hot-swappable dual power supplies, and extra cooling fans. The servers are designed based on the requirements of the system.

We take great pride in being highly customer focused and in providing solutions that truly meet our clients' needs. We listen to our end-users and implement changes based on their feedback. We value our clients, both as partners and as an indispensable source of design improvements and product enhancements.

Our technical support exemplifies the company's customer-first focus. Our engineers are extensively trained on the software, as well as in the broadcast technology. The technical support team is always just a phone call away. Our system is designed so that a single call - day or night - is all that's needed to be connected directly with an engineer. We understand that our future depends on your automation success.

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