TV technology DIGITAL IS HOT

Providing viewers the full satisfaction in terms of picture quality and services, digital technology offers an opportunity to reshape completely the electronic media

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Recent years have witnessed a dramatic changeover of TV technology from analogue to digital. Countries in both Europe and Asia region are trying to master this revolutionising technology. The story began in 1998 when terrestrial digital TV broadcasts first got underway in the UK and the US. Now, Japan is also preparing for terrestrial digital programming. For this, test broadcasts are being contemplated, with full-scale services in Tokyo, Nagoya, and Osaka. By 2010, European countries hope to complete their transition from analogue to digital TV broadcasts.

Home entertainment is becoming increasingly digital. The trend has been driven by digital technology's inherent benefits. The primary incentive for extension of the digital revolution into broadcasting is spectrum efficiency. Four to six TV channels can be carried as a multiplex on the equivalent of one of the current analogue channels. Digital TV promises to deliver better quality pictures, and offers a route to high-definition TV (HDTV) and wide-screen pictures. It provides more stable programme reception.

The development of digital broadcasting in Europe sharply contrasts with its evolution in USA. In USA, TV networks have commenced digital HDTV broadcasts. Instead of focusing on the improvements that digital technology can bring to picture quality, Europeans are showing a strong interest in the services that digital technology can accommodate. Accordingly, broadcasters are moving in the direction of multimedia broadcasting and interactive services.

The reasons behind this trend in Europe for focusing more on services than on picture quality are threefold. Prevailing phase alteration line (PAL) broadcasting system in Europe already offers relatively fine picture quality. Europeans collectively speak many languages. This creates the need for multilingual broadcasting services that digital broadcasting can accommodate.

Europeans do not have the funds necessary for HD broadcasting. They are uncertain whether HD will attract sufficient new revenues from advertisers to cover the additional costs. The UK took the lead in Europe when BBC started digital terrestrial services in Sept. 1998.

The technique

The conversion of TV signals to a digital format is being increasingly adopted by modern TV studios and receivers. Telecommunications links, connecting studios with each other and with transmitters, are using digital techniques. At one time, digital TV broadcasting to the home was considered expensive and impractical. The first and the inseparable problem in realising digital broadcasting was the development of a suitable compression scheme to accommodate a digitally encoded broadcast signal within the available channel allocation. The solution to this problem required systems for coding and multiplexing vision, sound, control, and service data.

The digitising process involves source coding, multiplexing, modulation, system management, and control data inputs in the form of service information (SI). The SI together with programme-specific information (PSI) is used to supply the receiver relevant data to gain access to TV broadcast services. The digital TV receiver is more functional and flexible than analogue ones, as it has complex devices to perform high-quality decoding of video and audio. Complexities of the system indicate the requirement of

NDS digital interactive TV

162cm DTV SharpVision

a microprocessor with software to manage functionality.

Modulation

Australia, India, and Singapore have chosen the coded orthogonal frequency division multiplex (COFDM) modulation process to implement digital TV broadcast services. Bell Laboratories, USA, discovered spread spectrum techniques. These techniques were used by French research centre 'Centre Commun d'Etudes en Télédiffusion et Télécommunication' to develop the COFDM system.

The basic idea of the COFDM stemmed from an observation of the impairment of signals during channel propagation. The response of the channel is not identical for each of its sub-bands. Due to the sum of the received carriers (main and echoes), either no energy or the energy more than that of the transmitted one is often received. To overcome this problem, the data to be transmitted is spread over a large number of closely spaced frequency sub-bands. This data is reconstructed at the receiver.

The characteristics of the transmission channel are not constant in the time domain. But, during a short interval of time, the terrestrial propagation characteristics are invariant. To benefit from this behaviour, COFDM implements a partitioning of the transmission channel in frequency and time domains. As a consequence, the channel is organised as sets of narrow frequency sub-bands and small contiguous time-segments.

Each time-frequency cell is equipped with dedicated sub-carrier. A set of sub-carriers during a time-segment is known as OFDM symbol. The receiver demodulates the signal, sampling it during the useful period of the OFDM symbol. Pilot sub-carriers, regularly spread over the transmission channel, function as synchronisation markers.

Conditional access

SCM Microsystems, USA, has developed a DVB conditional access module (CAM). The set-top box (STB) receives the DVB signal and transfers the data to the CAM which checks user's smart card for authorisation to view the broadcast. If the card is accepted, CAM descrambles the data. Decoded data is provided as output for the TV.

NDS Innovations

NDS, UK, is a renown world leader in digital video compression, conditional access, and provision of end-to-end solutions for digital broadcasting. It offers its advanced technologies to digital satellite and terrestrial broadcasting systems all over the world.

XTV or extended TV, an NDS novelty, extends the realm of digital TV for broadcasters, consumers, and advertisers, by extending bandwidth, time, and convenience to viewers. XTV is a time shifter that frees viewers from the constraints of a regular broadcast schedule. It lets users watch what they want, irrespective of time.

XTV combines digital storage on a hard disk in the STB with a smart software to help viewers select and store favourite programmes. The digital content is protected since it is encrypted using VideoGuard conditional access. Content remains encrypted on a hard disk inside the STB. Smart software interprets the meta data inserted by the broadcaster at the head-end, and seeks out and stores programmes the viewers are likely to watch.

Viewer's habits are studied and profiles updated, suggesting contents that may be interesting for the viewer. XTV has introduced a host of pay-per-view opportunities. Advertisers are able to extend their reach, with advertisements linked to the content they support. Programme guide information, available in digital head-ends, is used by the STB to identify and select programmes to record.

NDS digital terrestrial receiver is a fully integrated receiver decoder that combines an OFDM tuner, OFDM demodulator, error correction sub-system, and MPEG-2 decoder. This receiver has been extensively tested and proved for mobile operation at speeds over 170 km/h.

NDS transcoder offers digital TV broadcasters the flexibility to receive and transmit content across cable, satellite, and terrestrial broadcast media. Broadcasters often need to receive content from a variety of sources. Cable operators may

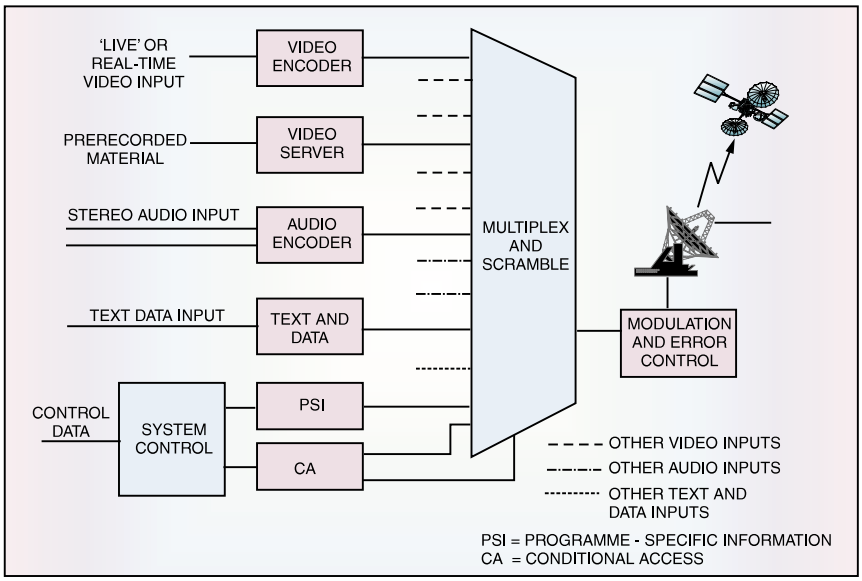


Fig. 1: Digital TV transmitter

have to take in a satellite feed requiring conversion from quarter phase shift keying (QPSK) and quarter amplitude modulation (QAM). Operators using terrestrial modulation would need to bring in content from satellites or phone lines. NDS transcoder handles these operations. The programme can be selected, irrespective of the input source.

NDS 'MediaStorm II' system securely delivers digital TV and Internet Protocol (IP) data broadcasting to PCs. Broadcasters can provide this service over LANs, bridging large geographical areas. VideoGuard conditional access lets content providers ensure that the broadcast is reaching the right audience. It has a secure callback (reverse path) feature for accurate reporting of programme purchases. The requisite information can be communicated periodically from the subscriber to the broadcaster, even when a subscriber TV is 'off'.

Blackout capabilities enable events to be 'blacked out' for specific regions or groups. 'Pairing' feature links a smart card to a particular STB and can be activated by the broadcaster on a per-programme basis. VideoGuard conditional access is being used by leading digital broadcasters world over.

Toshiba on-demand digital TV server

All-digital studio

The use of digital technique in TV programme production and distribution is one of the important events in the history of audio-visual communications. It offers benefits in the domain of programme creation and delivery, completely reshaping the electronic media.

The all-digital studio is here. With the exception of the pick-up (of the scene), which will probably remain for a foreseeable time analogue, and the display, which will always remain analogue, unless the so much advertised new information age initiates a mutation of the human sight, all other elements are already digital. In other words, all black-boxes in TV production are digital, namely, vision mixers, special effects, graphic stations, videotape recorders, servers, editing systems, routers, etc.

Worldwide users of NDS digital TV technology

In TV studios or production complexes, picture and sound are in their digital form all the time, except at the monitoring points and at the transmitter. Digital signal processing (DSP) techniques have helped in the development of digital time-base correctors, frame synchronisers, character generators, picture manipulation devices, graphic stations, servers, editing systems, virtual sets, digital switches, etc.

Studio automation allows programmes to be presented in an attractive manner, with a provision to add variety. Besides the content of the programme, the manner in which the gap in between two programmes is filled with promos, messages and advertisements, etc attracts the viewers and adds glamour to the presentation.

Automation enables last-minute changes with respect to programme schedule, play-list, image inserts, etc. It helps to build a library database of programmes, commercials, promos, etc, for multichannel TV broadcasts. Video servers provide random access to the media material. These are ideal for playing commercial spots, promos, etc one after another.

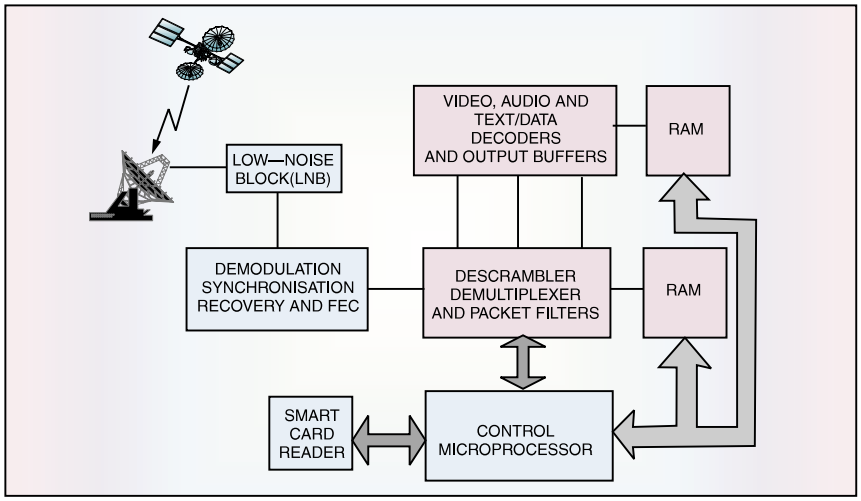


Fig. 2: Digital TV receiver

Mitsubishi 91cm flat HDTV

Japan dominates

The global digital TV battle-lines are already drawn with Japanese manufacturers in the lead. Panasonic has taken the lead in meeting the demands of USA viewers anxious to enjoy breathtakingly sharp, colourful HDTV broadcasts. It has introduced five distinct DTV products varying in function, size, and cost.

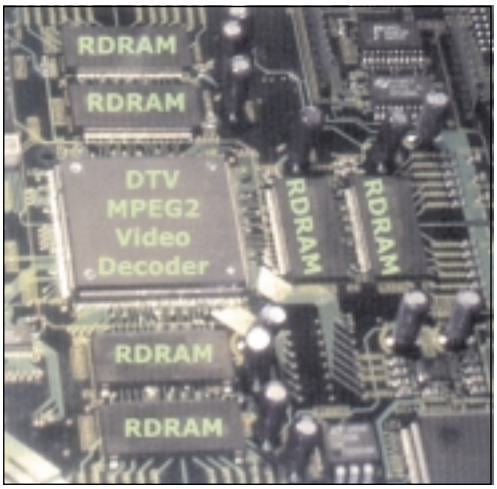
Panasonic PT-56WXF90 is the first TV designed by the company specifically for HDTV. For image acquisition, it offers a line of advanced DVCPRO digital TV cameras. Digital images are no better than the hardware used to edit and reproduce them. Panasonic also features a full line of digital broadcast studio equipment.

Toshiba focuses on the USA and British markets. Toshiba digital TVs are posting brisk sales in Britain. The advanced imaging division covers a broad range of digital TVs, digital still cameras, digital tuner circuits, etc. The company is planning to introduce digital projection TVs in USA.

Sharp Electronics Corp. has released rear-projection HDTV sets, along with the TU-DTV1000 DTV decoder. It is equipped with multiple tuners, including an advanced television standards committee (ATSC) decoder that decodes 18 different DTV broadcast modes. Dual NTSC tuners enable broadcast or cable reception with picture-in-picture viewing. A digital expansion port enables consumers to upgrade as services and applications become available, such as HD cable programming and future data services.

SharpVision's set-top decoder enables easy switching from the present TV standard to DTV. Hitachi has developed UltraVision lineup of DTVs for USA. Sony's digital reality creation (DRC) system adopts digital progressive technologies for obtaining fine-definition image signals. The technology doubles the scanning lines and pixel counts of the NTSC system. Many of the latest HDTVs are employing this technology.

Sony has introduced a CRT digital TV with a built-in decoder in North America. In Europe, the company is releasing two WEGA digital TV models. Sony's KW-34HD1 HD compatible digital TV uses Sony's FD Trinitron picture tube as CRT. Most products lined up for the DTV market in USA are HDTV-ready models without built-in decoders. UK is one of the largest European markets of Sony for digital TVs.



Panasonic digital TV MPEG-2 video decoder

Korean TMA system

Korea's Daewoo Electronics has developed an innovative display technique, the thin-film micro-mirror array-actuated (TMA) system. This technology uses micromechanical systems. It can provide brighter images that are less expensive than competing systems. TMA displays will soon be offered in the emerging HDTV market.

The secret behind TMA's superior quality lies in its micromechanical chips fabricated using special technology. These systems move on their own to create images on screens. Each TMA module contains a silicon wafer that holds 800,000 micromirrors. Three of these modules form a TMA system. TMA systems can produce 256 gradations and 6.77 million colours.

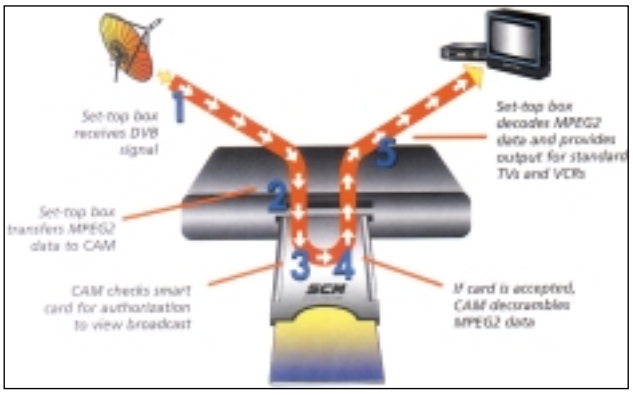


Fig. 3: Digital video broadcasting conditional access module

Chinese initiative

China first began research and development related to digital broadcasting in 1989. Test transmissions of digital broadcasts were conducted in 1998. Sony Corporation's medium-size digital HDTV relay van, delivered to Beijing in 1999, was used in experimental transmissions. In China, work on digital HDTV transmitters/receivers, HDTV codec system, and studio for digital HDTV broadcasts is in progress to facilitate early induction of DTV.

Indian scenario

The coming decade will witness a global switch over from analogue to digital TV transmission systems. Keeping this in mind, it is important for India to embark on this development as early as possible. R&D work and testing of DTV transmissions are expensive. Large investment is one of the major hurdles in introducing this service.

The government subsidy and financial help from big industrial houses will play a major role in the early induction of the technology. Countries like Taiwan are offering subsidies to manufacturers for testing and development of DTV services. Thus, coordinated R&D efforts and financial assistance can enable India to meet the deadline. ❑