REPORT 1225

DATA BROADCASTING SYSTEMS AND SERVICES IN AN HDTV ENVIRONMENT

(1990)

1. Introduction

The broadcasting of services using new television systems described in CCIR Recommendation 650 and of HDTV systems described in CCIR Report 1075 will encourage the build-up of a receiver base of high resolution and wide aspect ratio display equipment. Such equipment will offer an attractive prospect for the enhancement of existing data broadcasting services such as teletext, and for the development of entirely new services.

CCIR Recommendation 653 provides information about teletext systems developed for use with television systems of CCIR Recommendation 470 i.e. with NTSC, SECAM and PAL. This report is intended to be the basis on which a new draft recommendation, appropriate to the data broadcasting systems associated with the TV systems of Recommendation 650 and the HDTV systems of Report 1075, will be prepared during the study period 1990-1994.

The transition from conventional television to HDTV will offer the possibility of developing data broadcasting within a balanced distribution of maintaining compatibility between existing and new services. The introduction of HDTV services opens new possibilities for the broadcasting of data and accelerates the evolution of present teletext services towards the use of more sophisticated presentation features (e.g. DRCS, geometric, photographic, etc.) and completely new applications.

High resolution and wide aspect ratio displays make attractive the introduction of a variety of new teletext display formats, from computer-like 80 Latin alphabet characters per row, through to studio quality caption generator font styles and colour palette options.

Development of data broadcasting also acts in favour of the existing trend towards the integration at the technical and service levels between interactive and broadcast digital networks. In this process it is extremely important to maintain close cooperation with the CMTT, the appropriate CCITT Study Groups, the IEC and the ISO.

Emissions in digital format in an HDTV environment include integral parts of the programme such as sound and digital television components, primary programme related services such as subtitles and access control messages, and secondary digital components for non-TV-related services such as teletext, telesoftware and other data broadcasting services, which occupy capacity not used by the TV related services or freed by the removal of the TV service outside of broadcast hours.

At the present stage of development of HDTV in satellite broadcasting, two systems have been developed for use in the 12 GHz band i.e. MUSE and HD-MAC. Both systems require extensive signal processing to insert the HDTV signal into the relatively "narrow RF-band" channels (24 - 27 MHz). It is currently believed that not only will the channel bandwidth available in the 12 GHz band prevent the achievement of the full quality potential of the HDTV studio standard, but will also restrict the available capacity for data broadcasting services [CCIR, 1986-90a, b].

The CCIR has therefore envisaged the need for a further BSS band carrying HDTV in "wide RF-band" channels and offering received picture quality approaching that of the studio originated standard (see CCIR Report 1075).

To this end the WARC-ORB(88) has identified the frequency range for world-wide allocation to HDTV from 12.7 to 23 GHz. Preliminary proposals for "wide RF-band" HDTV systems, which use both analogue FM and fully digital solutions, consume from about 54 to 105 MHz depending on the system. In developing these proposals the necessary capacity for sound and data services must be adequately taken into account. The best prospect of achieving this is likely to be obtained from the fully digital approach to "wide RF-band" HDTV.

2. Harmonized evolution of sound and data services accompanying HDTV

There is a need to plan and provide adequate capacity and management flexibility for all digit components of HDTV emissions. Capacity for digital services may be located in the vertical blanking interval (VBI) or the horizontal blanking interval (HBI) of television systems which have an analogue vision part or in the multiplex of a wholly digital television system.

2.1 Integral digital components of the television service

2.1.1 Sound

All proposed HDTV transmissions make use of digital sound coding. In general the sound is likely to occupy a major proportion of the available capacity of the sound and data multiplex which could carry data broadcasting services depending on service requirements. These signals are described in Report 1075.

2.1.2 DATV

The use of DATV (digitally-assisted television) has been introduced in the HD-MAC system to improve the effectiveness of motion compensation techniques. It requires a capacity of 1.1 Mbit/sec which can be carried in the VBI, leaving in the VBI, only two lines in each field available for data broadcasting services. Wider RF-band HDTV emission systems should allow for more data capacity. DATV signals are described by [Storey, 1986] and discussed in Report 801, Part 7.

2.2 Digital services directly related to the programme

2.2.1 Subtitling

Subtitles [CCIR, 1986-90c] help viewers to follow television programmes in foreign languages. The alternative approach of sound dubbing is not only more expensive but risks the loss of much of the "atmosphere" of the artistic rendition included naturally in the original sound.

"Open" subtitles (permanently in the picture) may impair the visual quality of the television picture. Therefore the use of "closed" subtitling using data broadcasting giving the viewer the choice whether he should have subtitles or not is attractive especially in HDTV when the overall subjective response to the picture is particularly important.

The high picture quality of HDTV should be matched by a corresponding high visual quality of the subtitles. Compared with present subtitling features, the following improvements have been identified:

- smoother character fonts with proportional spacing;
- alternative fonts as well as larger character repertoires;
- enhanced colour features, such as variable saturation;
- smoother insertion into the picture;
- accuracy of timing of subtitle appearance (especially where several language subtitles are broadcast) of the positioning in the picture;
- separation of distinct parts of the subtitle service, e.g. in an interview situation, to distinguish between the speech and the name caption of the interviewed person.

The level of compatibility with present systems and services for subtitling requires study, in particular for HDTV systems which are compatible with standard TV systems.

Selection of subtitles and of the language variant, should follow a simple and standardized procedure.

Standards for the exchange of subtitles via different media should be established to avoid the need for costly reformatting.

2.2.2 *Controlled Access Messages*

Broadcasters are increasingly aware of the need for flexibility in the way they obtain revenue. Conditional access provides the means to control a mixture of advertiser supported, subscription and pay-per-view sources of revenue. This might allow the broadcaster to diversify his programming between advertisement supported and viewer supported programs.

Much effort has already been spent in the design of conditional access control systems. These systems were mainly developed for satellite delivery of scrambled services. The technology has reached a point where it is feasible to keep track of millions of subscribers at the transmit end with a reasonable size computer facility that allow channels, tiering and impulse pay-per-view to be controlled at each receiver containing a secure microprocessor.

2.2.3 *Management of channel data resource*

The time division multiplexed nature of HDTV transmission may follow a permanent structure or can be modified dynamically to suit the needs of the particular broadcast [CCIR, 1986-90a, d]. The control of such modification which must carefully synchronize the receiver with the transmission requires a data channel.

2.2.4 *Programme Delivery Control*

With the proliferation evident in the number of television services available in a given home there is an increasing need for mechanisms to be provided for the viewer to choose and watch / record selected programmes. Early systems of providing such control of Programme Delivery are operational and more sophisticated developments are being studied.

2.3. Digital data services not directly related to the programme

2.3.1 *Teletext*

The availability of HDTV will provide opportunities for enhanced presentation features to teletext services [CCIR, 1986-90e].

The wider aspect ratio and improved resolution of HDTV displays allows the presentation of much improved textual messages. HDTV displays could allow the side-by-side presentation of two full pages of text. This is a significant improvement over previous display capabilities which limits typical teletext displays to 24 rows of 40 characters.

The geometric graphics capabilities currently found in some teletext systems can be used to generate high quality graphics for HDTV displays. No modification is required other than to redefine the domain of the display area to suit the 16:9 aspect ratio and, if required, to specify data points with greater precision to suit the increased resolution of the display.

Coding schemes based on the transmission of geometric primitives, which provide compressed information to describe graphic images, offers significant advantages in transmission efficiency over other coding schemes, which rely on comparatively uncompressed data transmissions. In general, the higher the resolution of the display, the greater the efficiencies that can be obtained with geometric coding.

In addition improvements in Dynamically Redefinable Character Sets (DRCS), and photographic (still image) reproduction are possible.

2.3.2 *Telesoftware*

Such services which provide programmes for downloading into homes and business personal computers are well known.

2.3.3 Independent data services

In addition to teletext and telesoftware one way message services are another kind of such data broadcasts which can be expected to fill any available capacity. The residual data capacity available beyond the television service requirements is a scarce but powerful resource for addressing a national or international audience of receivers simultaneously. A wide variety of independent data services can be expected to fill any capacity made available in HDTV emissions.

3. Sound and data services which make use of the HDTV environment

When an HDTV transmission channel is not actively carrying an HDTV signal its capacity may be freed for other in particular independent data services. Similarly when the HDTV receiver is not in use for watching a television channel it may be put to other uses.

One application, whether delivered by the HDTV channel operating for instance in a "full channel digital mode" or by video disc, CD-ROM, ISDN or within conventional television services combines sequences of still images with sound.

A service system transmitting both still pictures of high-definition television(HDTV) quality and high quality PCM sounds using a data broadcasting channel is under development in Japan.

4. Data broadcasting resources within HDTV channels

Unlike conventional television systems in which the "unused" lines of the vertical blanking interval permitted the introduction of teletext, and digital sound capacity has been added by the use of additional subcarriers, a digital element has been a required starting component of all new television systems and HDTV systems.

Within the proposals for "wide RF-band" HDTV transmission is one fully digital example. In this case the data broadcasting service is no longer inserted within the spectral or temporal structure of the television signal, but takes its place alongside digital picture and sound components. Such fully digital solutions (which may be available also in "narrow RF-band" channels) leads to the concept of ISDB - Integrated Services Digital Broadcasting.

The locations in the television signal in which data broadcasting services may be placed are indicated in the table. In addition the complete television signal carrying the data services may be itself distributed within fibre and cable channels, and the broadband ISDN.

	Terrestrial broadcast channels	Satellite broadcast channels	
		Narrow RF band	Wide RF band
Vertical blanking interval	*	*	
Horizontal blanking interval	*	* (digital multiplex)	
Additional subcariers	*		
Full channel digital mode	*	*	*
Full channel digital multiplex for ISDB		*	*

Table - *Location of data broadcasting services in HDTV television signals*

5. Compatibility requirements for evolving data services

In the HD-MAC environment the possible coexistence of various data services in every sub-frame of the Time Division Multiplex is ensured by taking into account the opportunity of using different bit rates.

In the HD-MAC system the data capacity is split as follows:

- four lines per TV frame in the vertical blanking interval;
- forty lines per TV frame in the VBI for DATV signals;
- use of the digital line burst for sound and data transmission (including conditional access messages).

Residual capacity of the digital packet multiplex can be used for data broadcasting. A dynamic allocation of the VBI capacity can be achieved, with the highest priority given to DATV, as DATV data do not always require the use of 40 lines per frame which depends on the bit rate required. This dynamic allocation can be signalled by means of a code contained in line 625 or by other means.

To obtain better compatibility in the interface between data broadcasting channels and services, the transport mechanisms used in the HDTV channel should be identical to those of conventional data channels in the terrestrial and satellite television systems.

6. Basic model of an HDTV chain (see Fig. 1)

Specific aspects for further study include:

- integration of data services over broadcast and interactive digital networks;
- definition of data signal parameters at the physical interfaces;
- intelligent data receiver (recognition of flexible data reallocation in the digital packet multiplex, enhanced presentation features, etc.)

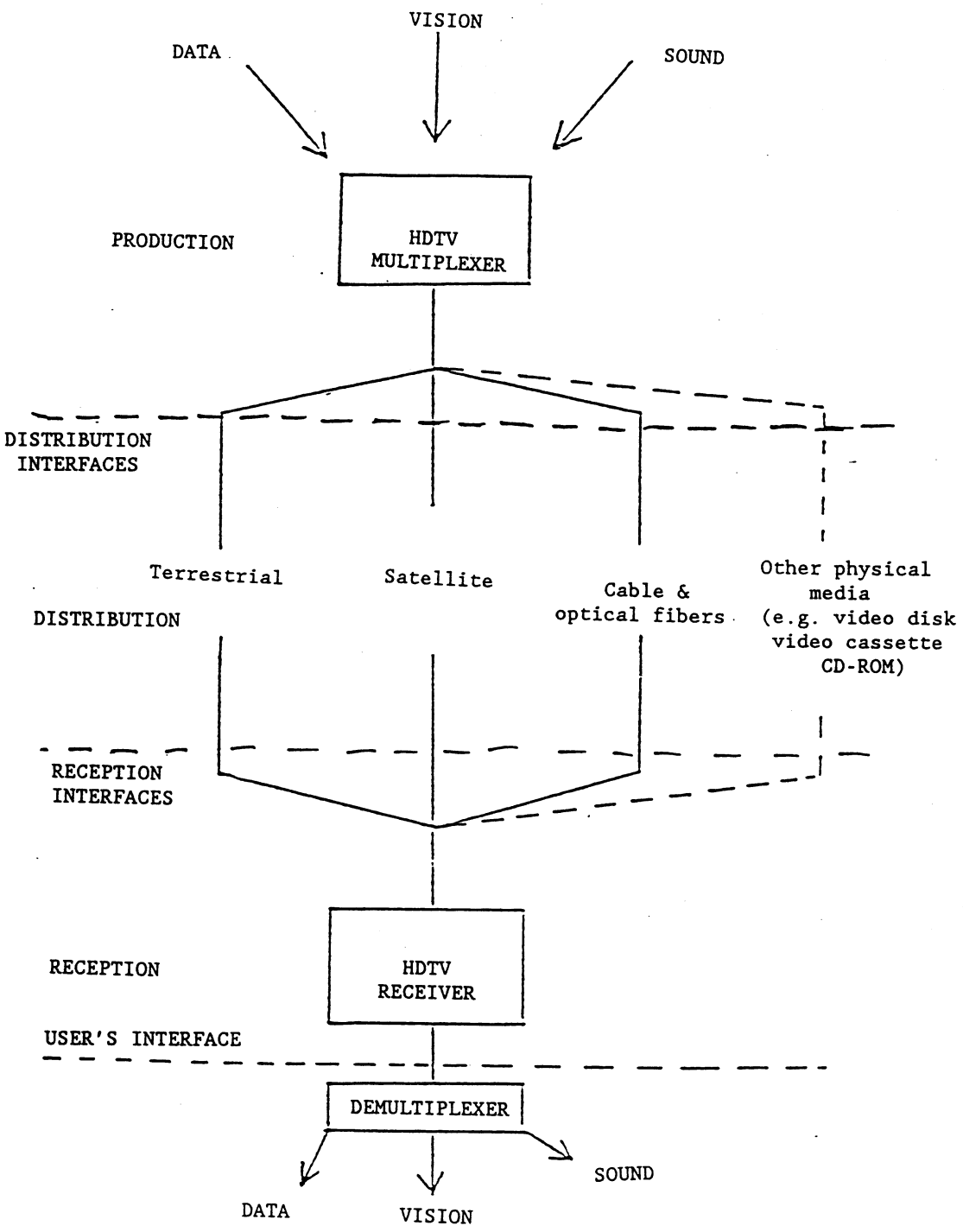

Figure 1 - *The basic model for HDTV signal distribution (vision, sound and data)*

7. Error protection strategies

The selection of error protection strategy for a particular data broadcasting service is very much service dependent. Report 1210 ———— as far as it applies to HDTV channels discusses appropriate strategies for certain service examples. Wideband HDTV transmission may require other solutions.

8. Evaluation of the quality

8.1 Data channel quality

The quality of data channel transmissions may be determined by on-line objective measurements of error ratios.

8.2 *Data service quality*

The performance of a given service in the presence of errors on reception will be measured by subjective testing methods. One example of an HDTV still image service under the influence of errors is given here. The three graphs (Fig. 2) show clearly how the removal of redundancy (going from component to subsampled and then subsampled DPCM signals) increases the subjective impairment at a given bit error ratio [CCIR, 1986-90f].

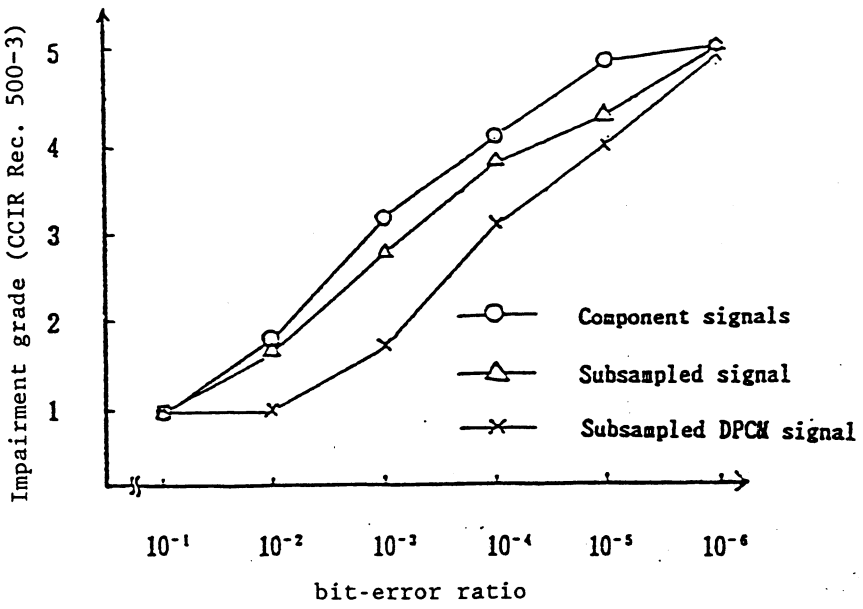

Figure 2 - *Subjective impairment due to bit errors of an HDTV still image (1125/60/2:1) at various levels of data compression*

REFERENCES

STOREY, R. [1986] - HDTV motion adaptive bandwidth reduction using DATV. BBC, UK IEE Conf. Publ. No. 268.

CCIR Documents

[1986-90]: a. JIWP 10-11/5-67 (Italy); b. JIWP 10-11/5-68 (Japan); c. JIWP 10-11/5-69 (Sweden); d. JIWP 10-11/5-64 (France); e. JIWP 10-11/5-70 (Canada); f. JIWP 10-11/5-32 (Japan).