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Television systems; Specification of the D-MAC/Packet system

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ETSI

European Telecommunications Standards Institute

ETSI Secretariat

Postal address: 06921 Sophia Antipolis Cedex - FRANCE
Office address: Route des Lucioles - Sophia Antipolis - Valbonne - FRANCE

Tel.: + 33 92 94 42 00 - Fax: + 33 93 65 47 16

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Foreword

This European Telecommunication Standard (ETS) has been produced under the authority of the Joint Technical Committee (JTC) of the European Broadcasting Union (EBU) and the European Telecommunications Standards Institute (ETSI).

This ETS is based upon the EBU SPB 491 specification. In view of the urgency for presenting the technical content and for historic reasons, this ETS is presented in its original form as received from the EBU. Therefore, this ETS has not undergone the normal ETSI editing or quality control procedures relating to its presentation.

NOTE: The EBU/ETSI Joint Technical Committee was established in 1990 to co-ordinate the drafting of European Telecommunication Standards in the specific field of radio, television and data broadcasting.

The European Broadcasting Union (EBU) is a professional association of broadcasting organisations whose work includes the co-ordination of its Members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has Active Members in about 50 countries in the European Broadcasting Area; its headquarters is in Geneva *.

The European Telecommunication Standard embodied in the present document is the result of studies carried out.

* European Broadcasting Union
Case Postale 67
CH-1218 GRAND SACONNEX (Geneva)
Switzerland

Tel: +41 22 717 21 11
Fax: +41 22 717 24 81

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Introduction

1. The members of the MAC/packet family

The MAC/packet family of systems consists of the following three members: C-MAC/packet, D-MAC/packet, D2-MAC/packet. These systems incorporate the following common features:

- time-division multiplexing
- MAC picture coding, with the capacity for extended aspect ratio and enhanced picture quality
- packet multiplexing for sound and data
- digital high and medium quality sound coding and error-protection method
- service identification
- conditional access with video, sound and data scrambling
- full-channel digital mode of operation.

The clock frequencies used in these systems have simple relationships with the sampling frequencies of the digital studio standard defined in CCIR Recommendation 601.

The specification of the three members of the MAC/packet family is given in EBU doc. Tech. 3258, 2nd issue. The present document is only concerned with the D-MAC/packet system.

2. Expected bearers

The D-MAC/packet system is suitable for satellite broadcasting with frequency modulation and for cable distribution with vestigial-sideband amplitude modulation, with full transparency.

3. Summary description of the system

The particular features of the D-MAC/packet system are:

- a baseband time-division multiplex in which analogue picture signals are combined with duobinary encoded digital sound, synchronization and data signals

- the capacity of the sound/data multiplex is about 3 Mbit/s in the case of normal television transmissions and nearly 20 Mbit/s in the case of full-channel sound and data mode of operation; these figures are respectively equivalent to eight and up to 52 high-quality sound channels with 15 kHz bandwidth, with near-instantaneous 14/10-bit companding (protected by one parity bit per sample). The spare data capacity can be used for other services.

It can be used with frequency modulation in a satellite channel, or with AM/VSB in a channel of at least 10.5 MHz bandwidth.

4. General organization of the system

The MAC/packet signal is the common bearer for numerous services. Each service is based on the use, possibly combined, of service components which can be classified in three categories:

- picture (analogue broadcasting)
- sound (digitally broadcast)
- data, a general term covering components which do not belong to the two preceding categories.

The following considerations introduce other important points:

- the multiplicity of channels available to the user imposes the need for channel identification to facilitate receiver tuning

- technology allows the design of a system broadcasting analogue and digital components in the same RF channel, and with the possibility to modify the respective parts of each component. For this purpose, a time-division multiplexing technique is used, referred to in this Introduction as <u>TDM multiplex</u> for transmission (time-division multiplex)

- the end of the traditional one-to-one relationship between service and RF channel imposes the need for the system to provide the user with tools to ease the service access

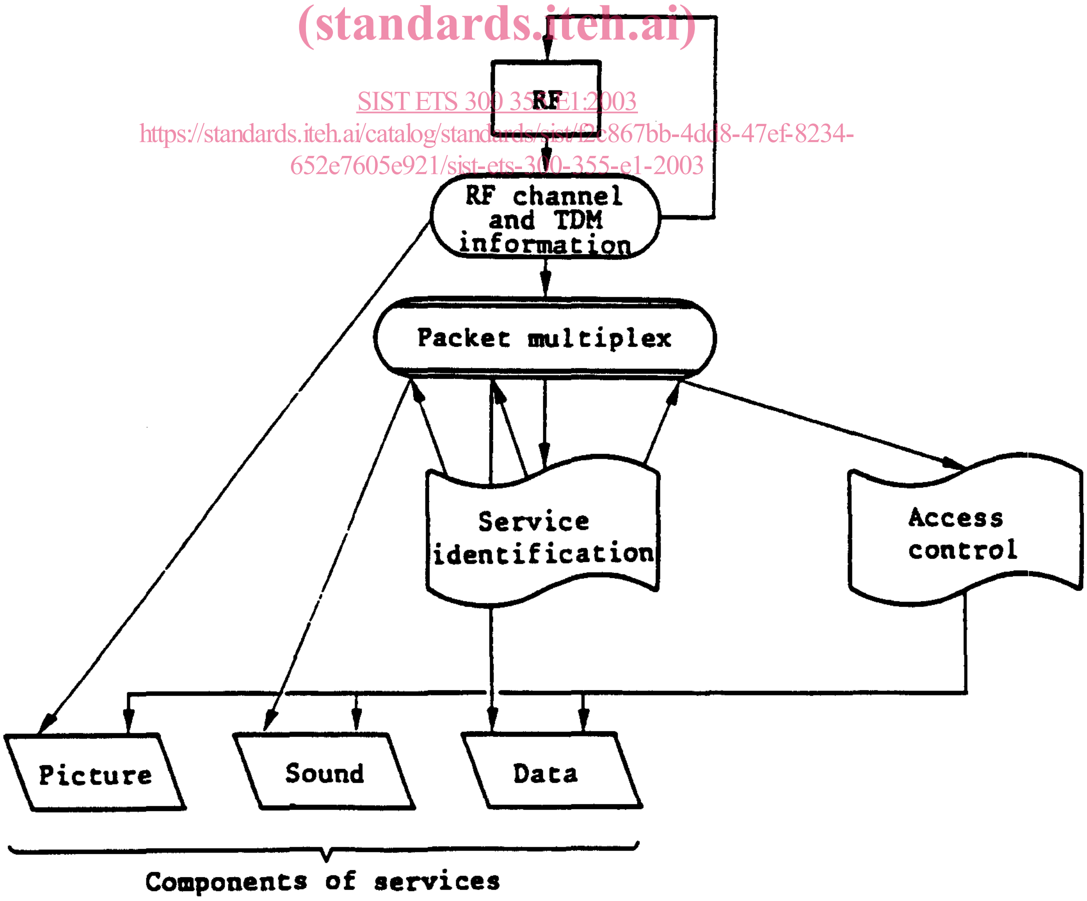
- to diversify operating modes, the system includes the tools for implementing access control to the services.

The list above leads to the conclusion that the system needs a skeleton, which connects the components of different services and the various mechanisms easing the utilisation of these components. This rôle of a skeleton is played by the service identification system inside the data broadcasting system, based on a packet multiplexing technique together with RF channel and TDM configuration data outside the packet multiplex.

Through these two mechanisms, the following important functions are realised:

- to facilitate access to the RF channel
- to define the configuration of the TDM
- to facilitate the access to services
- to control the access to services
- to broadcast the sound services
- to broadcast the data services.

The following diagram illustrates these:



The processing of the RF channel and TDM configuration data allows the receiver to separate the analogue part of the TDM, that is to say the picture, from its digital part, that is to say the packet multiplexes.

The service identification information itself is available in a fixed address data channel of the packet multiplexes. The processing of this information gives access to the channels carrying the different digital components of the various services, and to the data channel managing the access control to these components.

6. Methods of conveying satellite signals in cabled distribution networks

In the case of collective antenna installations where constraints from spectrum occupation or use of high frequencies do not exist, the distribution at the "first intermediate frequency" (950-1750 MHz)*, without remodulation, would provide a solution fully complying with the requirements. If the availability of a limited number of channels is acceptable to the user, signals received from the satellite could be distributed in the middle band (110-174 MHz) and in the extended super band (230-470 MHz) simply by means of frequency translation from the first intermediate frequency. These cases are therefore not discussed in more detail.

In the case of large cabled distribution networks, demodulation of the FM D-MAC/packet signal followed by remodulation in AM/VSB provides a simple method of conveying the satellite signals in cabled distribution networks with full transparency.

Transcoding from D-MAC/packet to D2-MAC/packet involves the loss of half of the sound/data capacity. In addition, the bandwidth of the luminance component must be limited which would inevitably involve a certain reduction in the picture quality.

In order to avoid the need for several variants of receivers, it would be desirable for all receivers in the future to be designed to be equally suitable for operation with all members of the MAC/packet family. It is also desirable that television receivers produced from now onwards should be equipped with the standard CENELEC "peritelevision" connector.

* See EBU Technical Statement D46-1985

7. Presentation of the specification

The specification of the D-MAC/packet system is presented in eight parts:

Annexes to these Parts contain supplementary information which is nevertheless part of the specification or helpful to the understanding of the specification. Additional supplementary information are contained in Appendices of EBU doc. Tech. 3258, 2nd issue, particularly for the design of receivers, but they were elaborated before the present specification and were not updated.

8. Advantages of the system

Several CCIR Reports give additional details regarding advantages of this system and the experimental results obtained. In particular, Report 634 establishes the conformity of the protection ratios required by this system with the prescriptions of the Final Acts of the WARC-BS 77 and RARC-SAT 83. Nevertheless, the principal advantages of this system are recalled here; they are:

- to adopt the general principle of time-division multiplex for substantially improving the quality of the signals and in particular for eliminating the problems of intermodulation and cross-colour
- to introduce digital techniques for the sound
- to use a sound/data multiplex (associated with the service-identification system) making available the capacity required and at the same time the maximum of flexibility
- to permit the subsequent compatible introduction of further services or further improvements to the quality.

PART 1: SPECIFICATION OF THE TIME-DIVISION MULTIPLEX

Contents

Part 1

1. Subject of Part 1

This Part of the document contains the specification of the multiplexing system for the D picture/sound/data system. D-MAC/packet is suited for use in satellite broadcasting. D-MAC/packet is also suited to use on a transmission medium which guarantees a baseband equal to or greater than 8.5 MHz. In particular, the D system can be used with AM/VSB modulation on cabled distribution networks with a channel spacing not less than 10.5 MHz.

2. Basic hypotheses

2.1 Vision standard

The present specification is compatible with the MAC vision standard, as described in Part 2. However, through the TDM control information (see Section 5.4) provision is made for future enhancements.

In baseband the signal polarity is such that the maximum brightness corresponds to maximum positive amplitude.

2.2 Capacity for the sound/data multiplex accompanying in a normal MAC vision signal

For the D system, the available capacity is equivalent to eight high-quality sound channels together with the video signal (see Part 3).

2.3 Sound/data capacity with full-channel digital mode of operation

For the D system, the available capacity is nearly 20 Mbit/s (equivalent to up to 52 high-quality sound channels - see Part 3).

3. Transmission multiplex structure

In the case where a normal MAC vision signal is transmitted for each line, the baseband multiplex structure for the D-MAC/packet signal is shown in Fig. 1a.

In the case of full-channel digital mode of operation, the time-multiplex structure for each line is shown in Fig. 1b.

A uniform sample numbering system is used. Data and vision sample timing uses a reference timing of equispaced sample instants given by a 20.25 MHz clock. Sample numbering runs from 1 to 1296 inclusive to describe the instants on a television line of the MAC/packet baseband signal. Associated with each sample instant is a clock period of 1/20.25 μs which is numbered so that it contains the sample instant of the same number.

Vision samples, synchronisation and data bits are placed at sample instants.

It should be noted that in Fig. 1a, the boundaries between regions lie on sample instants, and that each region includes the sample instant on its right-hand boundary. For example, the luminance region has boundaries at 589 and 1286, and therefore contains sample 590 to 1286. The run-in bit for the D system, which lies on sample 1296 therefore is included in region k, not a.

3.1 Instantaneous bit-rate

For D-MAC/packet, the instantaneous bit-rate of the data burst shall be 20.25 Mbit/s ± 2.5 parts in 10 million.

3.2 Data burst formats

3.2.1 Data burst format for normal television transmissions (see Fig. 2a)

For the D system, for standard television transmissions defined in Part 2, each data burst shall contain a total of 206 bits*. One bit shall be allocated as a run-in bit for differential demodulation. Six bits will be allocated as a line synchronization word. The last bit of the burst will not be allocated. The remaining 198 bits are used for sound and data.

The sound/data multiplex system occupies 623 data bursts per video frame, leaving one data burst free for insertion of a clamp marker** and one data burst free for the insertion of a frame synchronization word.

3.2.2 Data burst format for full-channel digital mode of operation (see Fig. 2b)

For full-channel digital mode of operation, the basic television multiplex structure described in Section 3.2.1 is used, except that the analogue vision signal is replaced by digital signals.

In principle, the digital TDM components of the D system are divided in two subframes, one of them being intended to be handed over to a D2 system. These components are identified by TDMCID codes 01-OE (see Section 5.4).

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* The whole of line 625 is available for transmission of special data (see Section 5).

** Provisionally, a clock run-in is transmitted in the spare bits on line 624, just preceding the clamp marker word (Figs. 2a and 2b).