DIDON: DIGITAL DATA IN VIDEO

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Didon is an acronym which stands for Diffusion de Données and translates loosely into Broadcast transmission of data. It represents a novel technique developed by the CCETT in Rennes, France, as a transmission system using video channel for high density digital information transfert.

CCETT is a research center commonly operated by the French TV Network (TDF) and the Directorate General of Telecommunications (DGT). It is the leading edge for the development of an ambitious telematique program which purpose is to give access at a low cost for the general public to various digital communications facilities and computerized information. The telematique area covers person to person electronic link like telecopy or telewriting which allow to transmit graphics as they are drawn, simultaneously with voice; home to computer connection for library research, teleshopping or education; it covers also multipoint services which have the various forms of electronic newspaper.

The concept of digital transmission has been developed a long time ago starting maybe with the Telegram Chappe, close in its principle to the flag transmission still used for boats. Through various steps it has grown to the multi-level transmission protocols used by modern interactive pocket switching network.

The increasing need of digital transmission associated with economical factors has forced engineers to think of possible use of existing networks initially designed for analogic transmission. Various types of modems have already modified the potential use of a simple phone line which can now connect somebody to a computer. The TV network appears to have perhaps an even greater once the adapted digital transmission system is available, and here comes Didon with all the features of a specialized network, but using the existing infrastructure for a very low implementation cost. Didon has the following objectives:

- no modification of the present existing television networks whatever they are,
- an easy adaptability to the variety of current international TV standards including various channel bandwidths,
- standardisation of the use of unused time slots on a video channel and all free television lines,

- possibility to share easily the high bit rates (in the range of 3 megabits/second) between a large number of possible applications. Packet data broadcasting give an easy solution to this problem, to be transparent, which means at the level of the network, not to have to know about any application, nor to impose any form of specific constraint to anyone.

The packet data broadcasting concept consists of making packets from the incoming data and of puting on each packet a prefix or header which will allow to handle it in a completely autonomous way. One packet is put on each free line of the television signal.

Didon is a multiplexing system which optimizes the use of a video channel by adding a data packet on each free line of the video signal.

1 - Principal characteristics of the data packet

The prefix, the purpose of which is to provide for the management of the packet is to provide for the management of the packet, consists in 8 bytes: two are used for bit synchronization, one for the byte synchronization, three convey the code identifying the channel, including its protection, one conveys the continuity check, and the eighth defines the format (or the length of the line). The clock frequency is matched to the channel bandwidth. “Non return to zero” (NRZ) modulation is used, shaped inder to adapt the spectral energy distribution to the transmission channel.

Illustration number one

2 - Throughput

In all the different TV systems, 525 lines 60 Hz and 625 lines 50 Hz, the time of a line is very close to 64 microseconds. The active part of the line or the usable time is 50 microseconds, therefore the amount of bytes which can be transmitted in this time is directly related to the bit frequency. Because of bandwidth characteristic and Shannon limitations, the packet size varies from 28 bytes corresponding to the bit frequency of 4.35 MHz to 40 bytes corresponding to a 6.03 MHz frequency. However the equipment has been designed to accept any frequency from 1 MHz to 7 MHz. Shannon at the one end, and economical factors at the other limit the excursion.

Today the bit frequency is 5.72 MHz, in the U.S., for the teletext experiment made by two TV stations in Los Angeles (the PBS affiliate, KCET-Channel 28 and the CBS affiliate, KNXT-Channel 2). Because of an FCC authorisation for the use of two lines only, lines 15 and 16, the header used is a short header of 5 bytes, with two bytes for bit synchronization, one byte (0010001) for byte synchronization and a short header identification, and two bytes for channel identification.

Each packet contents 31 bytes of information for a total throughput of 29.76 kbit/s. broadcast simultaneously with no disruption of the normal video program.

For a full channel use of Didon the total throughput, depending on the bit frequency selected will range from 2 to 3 megabits per second.

3 - The multiplexing equipment

The Didon multiplexer needs a video in, one or more data input and provides the multiplexed signal. In case of the full channel use the video in will be a pattern generator or any clean synchronized video signal.

The following parameters are accessible and need to be selected, fixed or trimmed:

- bit frequency with an internal crystal or an outside frequency generator,
- maximum packet size, clearly related to the first parameter,
- header length and type (11100111 for the long header)
- number and position of the insertion lines
- data channel identificators, i.d. the 2 or 3 byte identification in the header.

For a multi channel Didon, the total throughput has to be shared between the different channels. This is assured by two different means. First a maximum speed can be assigned to one channel. Second, a relative priority can be given to the different channels. With these two selections you can assign a 19200 bit/s speed to a channel at a requested time without wasting the always limited resource, when the channel is temporarily unused.

Illustration number two

For the case of the non-continuous use of a channel you can also select to a partially full-packet or wait for the following data.

A new type of Didon equipment is under development at present time, it is a data bridge. This will offer an extra capability: checking the video in for possible data and selective transmission.

4 - Measuring equipment

As the video-data multiplex signal can be corrupted at the source or during broadcast, or at reception, the introduction and development of services using data broadcasting requires certain equipment specifications, and a clear determination of the broadcast conditions within which data reception is expected to be correct.

Corruption of the digital information is easy to detect and to measure. A pseudo-random polynomial information covering the entire range of possible configuration is transmitted and at the reception end compared with the polynomial generated locally. A digital measuring equipment (Enertec 5736) calculates error rate and loss rate. A packet is lost when the header has been corrupted so far that the Hamming protection used cannot restore it.

The quality of the analogic signal video-data has a direct influence on the error rate and loss rate. The 2T pulse and noise measurement line does not always provide sufficient information, so the eye pattern measurement is used. The eye pattern is obtained, on an oscilloscope, by surimposing the data signals during successive time intervals.

Illustration number 3

The way the eye pattern is interpreted is linked to the way the demodulator of the data receiver works. The demodulator determines a slicing level to distinguish between logical one and zero states, and a sampling time for the bit value to be memorised.

Consequently, the most important parameters which can be measured on the eye diagram are: first, the eye height, which is the aperture height at the sampling instant expressed as a percentage of the difference between the steady state one and zero levels; and second, the eye width which indicates the sensitivity of the data signal to sampling instant errors.

5 - Reception circuits

The reception function is the extraction of the data from the video signal. This function includes two kinds of signal processing: one essentially analog performed by the demodulator, the other digital performed by the demultiplexer.

For interchangeability purposes, a standardized interface between the demodulator and the demultiplexer has been defined. This interface is composed of three signals:

- DS: serial data
- HD: data clock
- VAL: validation signal.

The main functions of the demodulator are:

- amplification of the video signal
- extraction of video synchronization
- recognition fo packet presence and delivery of the validation signal

- determination of the data slicing level
- recovery of the bit frequency.

The demodulator quality is critical to the overall system performance. The demodulators were designed with the use of bipolar linear technology, and can operate at bit rates ranging from 3.5 to 7 MHz, as required by local. broadcast characteristics.

The main functions of the demultiplexer are:

- detection of the framing code
- selection of a digital channel
- check of packet sequencing
- use of format byte for data delivery.

Three manufacturers are currently producing the demodulator and the demultiplexer circuits: Texas Instruments France and RTC (a Philips subsidiary) offer a set of two circuits, Thomson offers three circuits for the same function, 2 for the demodulator and 1 for the demultiplexer.

DIDON: TODAY'S USES

As far as the data packet is concerned, broadcast is somewhat different from both video transmission and more classical data transmission. I would like to illustrate the potential and reality of Didon by providing some examples of the way Didon is used today.

A - Teletext or electronic magazines

Didon is currently used for broadcast teletext in various parts of the world: France, Belgique, Germany, Italy, Spain, Portugal, Australia, United States, Venezuela and more. This shows its adaptability to different TV standards.

A teletext magazine is a package of information pages, each page being a TV screen filled with alpha-mosaic and text information. Currently, KCET (PBS) and KNXT (CBS), in Los Angeles, broadcast a 80-page magazine on news, TV programs, games, events, weather, traffic ... The magazine can be updated or modified every minute. It is stored in a microcomputer who feeds a data channel of the Didon multiplexer, or a cyclic base with a programmable sequence of pages. The viewer has a modified TV set with the Didon chips and the Antiope chips (data interpretation and video generator) organized around a microprocessor. The typical push button sequence would be:

- select the correct TV channel
- enter magazine number (the 2 or 3 bytes of the data channel)
- enter page number or first enter index for the contents of the magazine.

The major advantage of teletext over other information system resides in different factors:

- the system is never overloaded. 3,000 people can request the same piece of information
- information can be updated by an operator or a computer
- the waiting time for a request is only a matter of seconds.

B - Program or picture related data

Epeos is another acronym related to the central of home video recorder and describing the following. Didon is used to transmit in the blanking interval a special identification sequence. This sequence received by the proper decoder will be compared with the recording request of the user, and then eventually starts or stops the recording equipment. By an adequate sequencing anyone can request the recording of either specific program, or type of programs, like cartoons, news, feature or cooking lessons. The decoder developed by the CCETT can even “watch” several channels simultaneously but record only one.

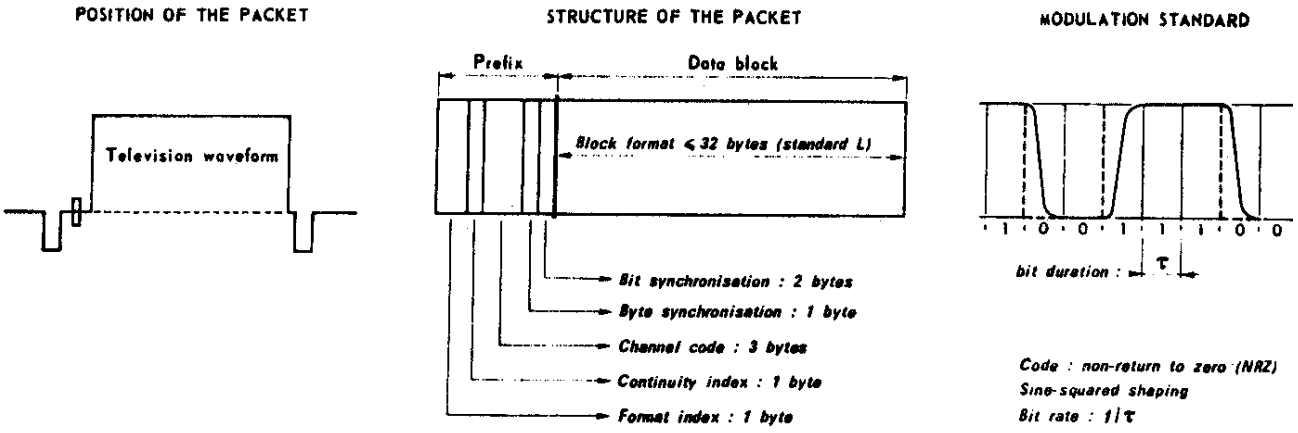

Fig. 1. — Principal characteristics of the data packet in the Didon system.

FIGURE NUMBER ONE

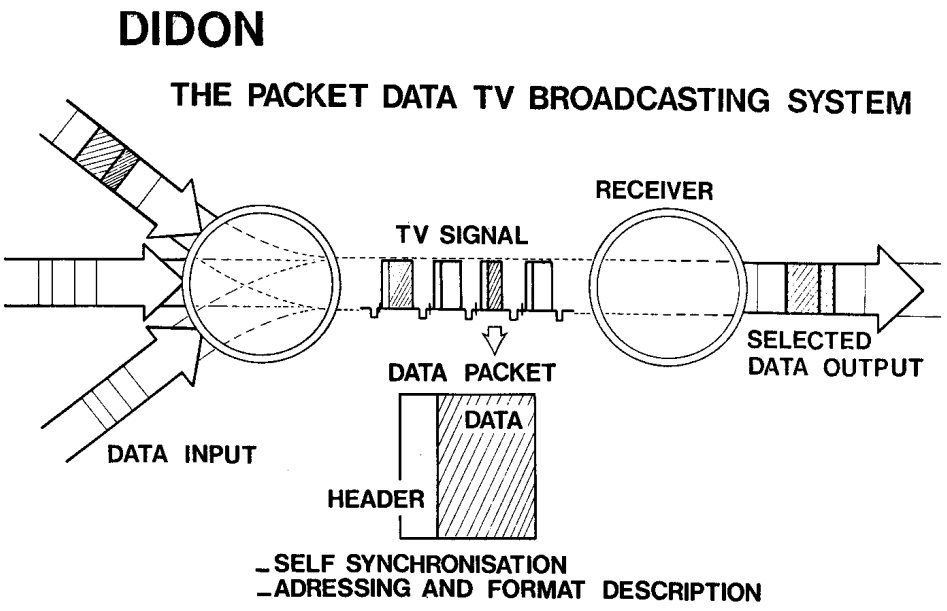

FIGURE NUMBER TWO

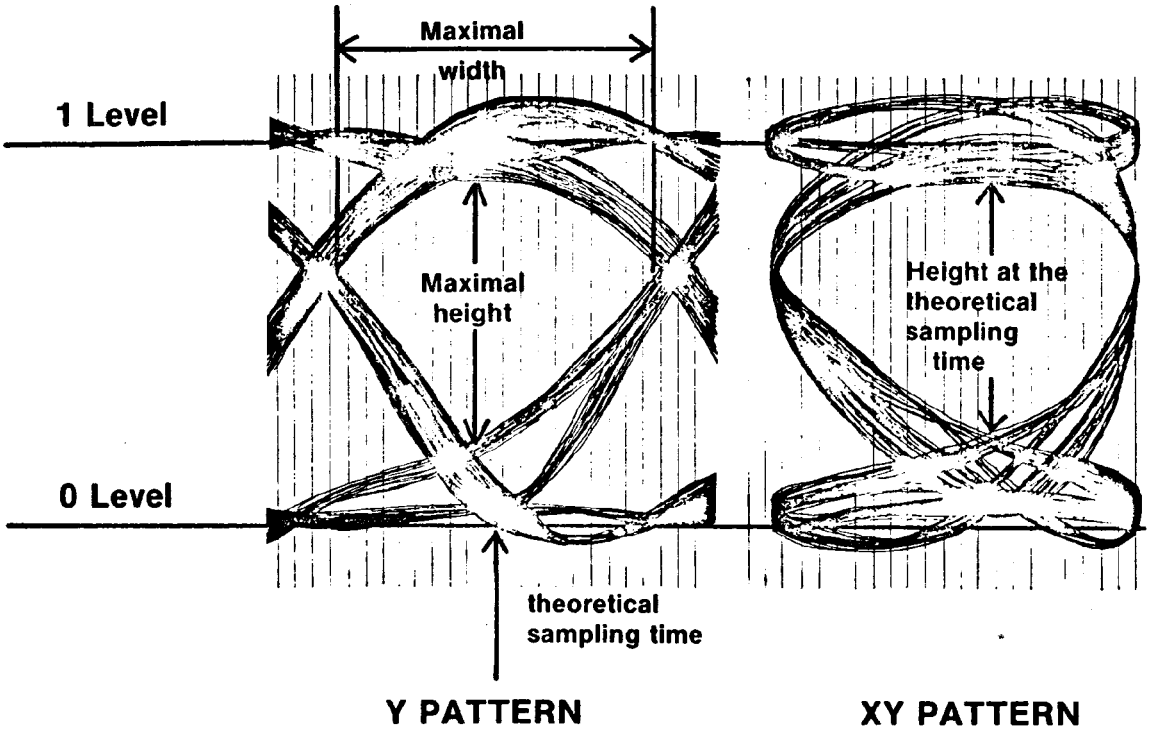

FIGURE NUMBER THREE