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| **Recommendation ITU-R BT.1577**  **(06/2002)** |
| **Serial digital interface-based transport interface for compressed television signals in networked television production based on Recommendation ITU-R BT.1120** |
| **BT Series**  **Broadcasting service**  **(television)** |

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

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| Series of ITU-R Recommendations  (Also available online at <http://www.itu.int/publ/R-REC/en>) | |
| **Series** | Title |
| **BO** | Satellite delivery |
| **BR** | Recording for production, archival and play-out; film for television |
| **BS** | Broadcasting service (sound) |
| BT | Broadcasting service (television) |
| **F** | Fixed service |
| **M** | Mobile, radiodetermination, amateur and related satellite services |
| **P** | Radiowave propagation |
| **RA** | Radio astronomy |
| **RS** | Remote sensing systems |
| **S** | Fixed-satellite service |
| **SA** | Space applications and meteorology |
| **SF** | Frequency sharing and coordination between fixed-satellite and fixed service systems |
| **SM** | Spectrum management |
| **SNG** | Satellite news gathering |
| **TF** | Time signals and frequency standards emissions |
| **V** | Vocabulary and related subjects |

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| ***Note***: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.* |

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RECOMMENDATION ITU-R BT.1577[[1]](#footnote-1)\*

Serial digital interface-based transport interface for compressed television  
signals in networked television production based on  
Recommendation ITU-R BT.1120

(Question ITU-R 130/6)

(2002)

Scope

This Recommendation provides a means to transport packetized compressed or uncompressed data over the HDTV serial interface. The packetized data is identified with a unique identifier.

The ITU Radiocommunication Assembly,

considering

a) that the high definition serial digital interface (HD-SDI) is being implemented in television production studios and that it is documented in Recommendation ITU‑R BT.1120;

b) that Recommendation ITU-R BR.1356 – User requirements for application of compression in television production, already exists;

c) that maintaining video signals in compressed form as far as possible throughout the production and post-production process offers the potential of increased operating efficiency;

d) that programme data composed of audio, compressed video and metadata should be streamed in a container commonly available in the high-definition production studio;

e) that a transport mechanism must be established which allows point-to-point and point‑to‑multipoint routing of these data through a digital production and post-production chain;

f) that the transport should allow synchronous data transfer to facilitate absolute and relative timing between programme data;

g) that the transport mechanism should allow faster than real-time and non-real time transfer of programme data,

recommends

**1** that for applications based on the HD-SDI infrastructure in networked production and post‑production based on Recommendation ITU-R BT.1120 the high definition serial data transport interface (HD-SDTI) described in Annex 1 should be used;

**2** that compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words “shall” or some other obligatory language such as “must” and the negative equivalents are used to express requirements. The use of such words shall in no way be construed to imply partial or total compliance with this Recommendation.

Annex 1  
  
SDI-based transport interface for compressed television signals  
in networked television production

Introduction

This Recommendation specifies a data stream used to transport packetized data within a studio/production centre environment. The data packets and synchronizing signals are compatible with Recommendation ITU-R BT.1120 (see Fig. 1). This Recommendation describes the assembly of two channels of 10-bit words multiplexed onto one HD-SDI line for the purpose of transporting the data streams in a structured framework. The HD-SDTI data blocks and synchronizing signals provide a data transport protocol that can readily be added to the infrastructure described in Recommendation ITU-R BT.1120.

Recommendation ITU-R BT.1120 requires a sequence of 10-bit words which define a television horizontal line comprising five areas in the following sequence (Note − The first two areas are often described together):

– EAV: a 4-word unique timing sequence defining the end of active video (EAV) (of the previous line);

– LN/CRC: 2 words defining the line number (LN) followed by a 2-word cyclic redundancy check (CRC) error detection code;

– digital line blanking;

– SAV: a 4-word unique timing sequence defining the start of active video (SAV); and

– digital active line.

An associated television source format standard defines the rate of television horizontal lines by defining the following parameters:

– the number of words per line;

– the number of words in the digital active line (and hence the number of words in the digital line blanking period);

– the number of lines per frame;

– the number of frames per second.

Recommendation ITU-R BT.1120 currently defines several source formats. Recommendation ITU‑R BT.656 defines the meaning of the EAV and SAV word sequences which can be applied to all relevant source formats.

A decoder compliant with this Recommendation shall not be required to decode all the source formats available to Recommendation ITU-R BT.1120. The source formats that must be supported by the decoder shall be specified in application recommendations.

# 1 HD-SDTI mapping onto HD-SDI

The source formats, in combination with Recommendation ITU-R BT.1120, describe the bit-serial format formed from C/Y word-multiplexed channels as illustrated in Fig. 1.



The HD-SDTI data shall be serialized, scrambled, coded, and interfaced according to Recommendation ITU-R BT.1120 and the associated source format standard. The signal specifications and connector types shall be as described in Recommendation ITU-R BT.1120.

The data word length shall be 10 bits defined as bits B0 through to B9. B0 is the least significant bit (LSB) and B9 is the most significant bit (MSB). The order of bit-transmission shall be LSB first as defined in Recommendation ITU-R BT.1120.

Source data shall be in groups of four 10-bit words representing a word-multiplexed *CB*, *Y*1, *CR*, *Y*2 signal, where *CB* and *CR* form one parallel C-data channel and *Y*1 and *Y*2 form a second parallel Y‑data channel.

The C/Y word clock rate shall be exactly 74.25 MWords/s for those picture rates which are an exact integer number per second and shall be 74.25/1.001 MWords/s for those picture rates which are offset by a divisor of 1.001.

The bit clock rate shall be 20 times the C/Y word clock rate (i.e., 1.485 Gbit/s or 1.485/1.001 Gbit/s).

The timing reference signals, EAV and SAV, shall occur on every line and shall be C/Y interleaved as described in the source format document. The LN and CRC shall occur on every line and shall be C/Y interleaved as described in Recommendation ITU-R BT.1120.

The HD-SDTI header data shall be encapsulated by an ancillary data packet according to Recommendation ITU-R BT.1364 and placed in the data space between the end of the EAV/LN/CRC and the beginning of the SAV.

The HD-SDTI payload shall be placed between the end of the SAV and the beginning of the EAV.

There shall be space for two HD-SDTI header data and payloads per line. The first HD-SDTI header data and payload shall use the C data channel and the second HD-SDTI header data and payload shall use the Y data channel. The two channels shall be word multiplexed according to Recommendation ITU-R BT.1120.

Each C/Y multiplexed line is treated as a separate HD-SDTI payload. Any line may carry an HD‑SDTI payload on either the C-channel or the Y-channel. Where a line carries both C-channel and Y-channel payloads, the C-channel payload shall be assumed first in time, followed by the Y‑channel payload.

Figure 2 shows the data placement of the two HD-SDTI header data and payloads for one line.



# 2 Extended mode for constant payload data rate

The default HD-SDTI payload for each channel is the defined C/Y active line-channel period for the source format at all picture rates. An optional extension mode allows source formats that would otherwise reduce the payload data rate to advance the timing of the SAV marker so that the payload data rate remains a constant value. In extended mode, the constant payload data rate value is either exactly 129.6 Mbit/s or 129.6/1.001 Mbit/s depending on whether the frame rate of the source format includes a 1.001 divisor. The payload lengths associated with particular source formats are given in Table 1.

TABLE 1

Payload length extension values for varying source frame rates

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Frame rate | Lines per frame | Samples per line | Blanking length | Payload length | Payload rate |
| 25 | 1 125 | 2 640 | 336 | 2 304 | 129.6 Mbit/s |
| 24 (24/1.001) | 1 125 | 2 750 | 350 | 2 400 | 129.6 Mbit/s |
| NOTE 1 – Not all equipment may support the extended mode. Users are cautioned to check whether advancement of the SAV is supported by the HD-SDI infrastructure and the HD-SDTI decoder. | | | | | |

# 3 Double-rate operation

The source format may allow frequencies of double the baseline rate to accommodate the carriage of progressively scanned pictures at the rates of 50 Hz, 60/1.001 Hz and 60 Hz for some source formats.

The use of double-rate sampling frequencies is allowed within this Standard as a specified extension. The effect is a doubling of the number of line-channels per second and there is no effect on the data structure within each line-channel save doubling of the clock rates.

This is a significant extension of the source format capability and only specified equipment may support this operation. Users are cautioned to check whether double clock rate is supported by the HD‑SDI infrastructure and the HD-SDTI decoder.

## 3.1 Header data specifications

For each line-channel carrying an HD-SDTI payload, HD-SDTI header data shall be encapsulated by an ancillary data packet conforming to a Recommendation ITU-R BT.1364 ancillary data packet structure (type 2) as shown in Table 2.

TABLE 2

HD-SDTI ancillary data packet structure

|  |  |  |
| --- | --- | --- |
| Name | Acronym | Value |
| Ancillary data flag (10-bit words) | ADF | 000h, 3FFh, 3FFh |
| Data identification | DID | 40h |
| Secondary data identification | SDID | 02h |
| Data count | DC | 2Ah |
| HD-SDTI header data | 42 words | – |
| Check sum | CS | – |

The total size of the ancillary data packet shall be 49 words of which the HD-SDTI header data comprises the 42 words as shown in Table 3. The structure of the HD-SDTI header data packet is further described in Fig. 3.

TABLE 3

HD-SDTI header data

|  |  |
| --- | --- |
| Name | Word length |
| Code and authorized address identifier (AAI) | 1 word |
| Destination address | 16 words |
| Source address | 16 words |
| Block type | 1 word |
| CRC flag | 1 word |
| Reserved data | 5 words |
| Header CRC | 2 words |



HD-SDTI header data shall be located immediately after the EAV/LN/CRC sequence, as shown in Fig. 3, on lines specified in the application document. In the special case of HD-SDTI applications that embed digital audio according to Recommendation ITU-R BT.1365, the HD-SDTI header data packets shall be placed immediately following any such Recommendation ITU‑R BT.1365 ancillary data packets.

For line-channels that do not carry an HD-SDTI payload, the Block Type shall be set to a value of 00h to indicate a null payload (plus definition of other header data).

All data in the HD-SDTI header data shall use 8-bit words using bits B0 to B7 of each word. For all words of the HD-SDTI header data, bit B8 shall be the even parity of bits B0 to B7 and bit B9 shall be the complement of bit B8.

# 4 Ancillary data formatting

The ADF, DID, SDID, DC and CS data words shall conform to Recommendation ITU-R BT.1364. All data in the ancillary packet following the ADF shall be 8-bit words where the word value is defined by bits B7 through B0; Bit B8 is even parity of bits B7 through B0 and bit B9 is the complement of bit B8.

## 4.1 Data ID (DID)

The data ID shall have the value 40h for bits B7 through B0.

## 4.2 Secondary data ID (SDID)

The secondary data ID shall have the value 02h for bits B7 through B0.

## 4.3 Data count (DC)

The DC shall represent 42 words for the header and have the value 2Ah for bits B7 through B0.

# 5 AAI and code

Both AAI and code shall consist of 4 bits (see Fig. 4).

AAI shall comprise bits B7 to B4.

Code shall comprise bits B3 to B0.



## 5.1 AAI

The AAI shall identify the format of both the destination and source address words from one of 16 different states.

TABLE 4

Assignment of payload size

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Address identification | B7 | B6 | B5 | B4 |
| Unspecified format | 0 | 0 | 0 | 0 |
| IP-v6 addressing | 0 | 0 | 0 | 1 |

The value 0h is reserved for applications where no source and destination address format is specified. In this case, any non-zero value in the source and destination address shall be ignored.

## 5.2 Code

“Code” shall identify the length of the payload which shall be contained in the area between the SAV and EAV timing reference points.

TABLE 5

Assignment of payload size

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Payload bits | B3 | B2 | B1 | B0 |
| SDI | 0 | 0 | 0 | 0 |
| 1 440 words | 0 | 0 | 0 | 1 |
| 1 920 words | 0 | 0 | 1 | 0 |
| 1 280 words | 0 | 0 | 1 | 1 |
| Reserved for 143 Mbit/s applications | 1 | 0 | 0 | 0 |
| 2 304 words (extension mode) | 1 | 0 | 0 | 1 |
| 2 400 words (extension mode) | 1 | 0 | 1 | 0 |
| 1 440 words (extension mode) | 1 | 0 | 1 | 1 |
| 1 728 words (extension mode) | 1 | 1 | 0 | 0 |
| 2 880 words (extension mode) | 1 | 1 | 0 | 1 |
| 3 456 words (extension mode) | 1 | 1 | 1 | 0 |
| 3 600 words (extension mode) | 1 | 1 | 1 | 1 |
| Reserved but not defined | All other codes | | | |

The value 0h is reserved to carry a line-channel of SDI signal in the active line-channel area.

Code values higher than 8h shall only be used if the HD-SDTI is being used in extended mode with support for advanced SAV positioning as detailed in Table 1.

# 6 Destination and source address

The destination and source address represents the address of the devices within the connection according to the AAI.

16 bytes are allocated for both destination and source address with the bit allocation for each address as shown in Fig. 5.



The default condition when neither destination nor source address is required is that all 16 bytes of the destination and source addresses shall be set to 00h in accordance with AAI = 0h. When all 16 bytes of the destination address are zero filled in accordance with AAI = 0h, it shall indicate a universal address to all destination devices connected to the interface.

# 7 Block type

The block type shall consist of one word comprising bits B7 to B0. The block type shall define the segmentation of the payload. Either fixed block size or variable block size may be defined.

A block type value of 00h shall be used to indicate that the payload area does not contain an HD‑SDTI payload.

## 7.1 Fixed block type

B7 and B6 form the prefix to define the fixed block data structure as follows.

B7 B6  
 Fixed block size without error correction control (ECC): 0 0  
 Fixed block size with ECC: 0 1

Where the fixed block includes ECC, the ECC is contained within the fixed block data and the type of ECC shall be defined by the application.

The possible segmentation of the fixed block size and the values for bits B5 to B0 are shown in Table 6.

The first fixed block shall start immediately following the last word of the SAV for the line‑channel. Where more than one fixed block is present on a line-channel, the fixed blocks shall form a contiguous string. Any space between the end of the last fixed block and first word of the EAV shall be filled with the value 200h.

TABLE 6

Payload segmentation for fixed blocks

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Block type | Block size |  | Block type | Block size |
| 01h | 1 438 words |  | 2Ah | 193 words | |
| 02h | 719 words |  | 2Bh | 257 words | |
| 03h | 479 words |  | 2Ch | 385 words | |
| 04h | 359 words |  | 2Dh | 513 words | |
| 09h | 1 918 words |  | 2Eh | 609 words | |
| 0Ah | 959 words |  | 31h | 62 words | |
| 0Bh | 639 words |  | 32h | 153 words | |
| 11h | 766 words |  | 33h | 171 words | |
| 12h | 383 words |  | 34h | 177 words | |
| 13h | 255 words |  | 35h | 199 words | |
| 14h | 191 words |  | 36h | 256 words | |
| 21h | 5 words |  | 37h | 144 words | |
| 22h | 9 words |  | 38h | 160 words | |
| 23h | 13 words |  | 39h | 1 278 words | |
| 24h | 17 words |  | 3Ah | 1 726 words | |
| 25h | 33 words |  | 3Bh | 2 302 words | |
| 26h | 49 words |  | 3Ch | 2 398 words | |
| 27h | 65 words |  | 3Dh | 2 878 words | |
| 28h | 97 words |  | 3Eh | 3 454 words | |
| 29h | 129 words |  | 3Fh | 3 598 words | |

## 7.2 Variable block type

The presence of a variable block size on the payload line-channel shall be indicated by the value C1h. Thus bits B7 and B6 are set to 1 to define the presence of a variable block easily.

With a variable block, any size of consecutive block data words are permitted and the variable block may extend beyond the length of one line-channel.

Where the variable block occupies more than one line-channel, the line-channels used shall be contiguous and header data shall be repeated for all line-channels associated with the variable block. The line-channels shall be considered as part of the contiguous sequence of a variable block with the C-channel of any line preceding the Y-channel.

# 8 Payload CRC flag

The payload CRC flag shall consist of one word provided only for compatibility with Recommendation ITU-R BT.1381. This word is redundant in HD-SDTI because the CRC words of each EAV sequence are calculated from the first word of the payload to the last word of the LN number.

The payload CRC flag word shall be set to 00h. All other values are reserved but not defined.

# 9 Header expansion reserved data

The header expansion reserved data shall be positioned after the CRC flag. The default value for the five reserved data words shall be 00h.

# 10 Header CRC

The header CRC shall be inserted following each ancillary data header. The header CRC applies to all 10 bits of each word, starting with the DID word through to the last reserved data word.

The generator polynomial for the header CRC shall be:

*G*(*X*) = *X*18 + *X*5 + *X*4 + 1 (see Fig. 7).

The header CRC shall be contained in bits CRC17 through CRC0 as defined in Fig. 6, and the initial value shall be set to all ones.

Figure 6

Header CRC bit definitions





## 10.1 Payload data formats

HD-SDTI payload data may be present on any line-channel from the end of SAV to the beginning of EAV. Some applications may constrain the use of certain line-channels.

Although data may exist on any line it should be noted that data may be corrupted during a switch.

# 11 Payload bit assignment

The payload data shall consist of either:

– 8-bit words contained in bits B7 to B0 with bit B8 set to be even parity of bits B7 to B0;

– 9-bit words contained in bits B8 to B0.

The application shall define whether 8-bit or 9-bit inputs are used. It is recommended that 8‑bit input modes are used unless clear reasons for using the 9-bit input mode can be provided. The 9‑bit mode is provided primarily for backwards compatibility with Recommendation ITU-R BT.1381.

In all cases, bit B9 of each payload data word shall be set to the complement of bit B8 with the exception of the separator and end-code words of variable blocks.

# 12 Data type

The data type shall consist of one 8-bit word contained in bits B7 to B0 for both fixed and variable blocks.

TABLE 7

Data type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | Description |  | Type | Description |
| 101h  102h  203h  104h  205h  206h  107h  108h  209h  20Ah  10Bh  20Ch  10Dh  10Eh  20Fh  110h | SXV  CP-System  CP-Picture  CP-Audio  CP-Data |  | 241h  242h  143h  244h  145h  146h  247h  248h  149h  14Ah  24Bh  14Ch  24Dh  24Eh  14Fh  250h | DV CAM-1  HDCam |
| 211h  212h  113h  214h  115h  116h  217h  218h  119h  11Ah  21Bh  11Ch  21Dh  21Eh  11Fh  120h | SDTI-PF |  | 151h  152h  253h  154h  255h  256h  157h  158h  259h  25Ah  15Bh  25Ch  15Dh  15Eh  25Fh  260h | MPEG-2 P/S  MPEG-2 T/S |

TABLE 7 (*continued*)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | Description |  | Type | Description |
| 221h  222h  123h  224h  125h  126h  227h  228h  129h  12Ah  22Bh  12Ch  22Dh  22Eh  12Fh  230h | DVCPRO1/Digital S  DVCPRO2 |  | 161h  162h  263h  164h  265h  266h  167h  168h  269h  26Ah  16Bh  26Ch  16Dh  16Eh  26Fh  170h |  |
| 131h  132h  233h  134h  235h  236h  137h  138h  239h  23Ah  13Bh  23Ch  13Dh  13Eh  23Fh  140h | HD-D5 |  | 271h  272h  173h  274h  175h  176h  277h  278h  179h  17Ah  27Bh  17Ch  27Dh  27Eh  17Fh  180h |  |
| 281h  282h  183h  284h  185h  186h  287h  288h  189h  18Ah  28Bh  18Ch | SXA |  | 1C1h  1C2h  2C3h  1C4h  2C5h  2C6h  1C7h  1C8h  2C9h  2CAh  1CBh  2CCh | SXC |

TABLE 7 (*continued*)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | Description |  | Type | Description |
| 28Dh  28Eh  18Fh  290h |  |  | 1CDh  1CEh  2CFh  1D0h |  |
| 191h  192h  293h  194h  295h  296h  197h  198h  299h  29Ah  19Bh  29Ch  19Dh  19Eh  29Fh  2A0h |  |  | 2D1h  2D2h  1D3h  2D4h  1D5h  1D6h  2D7h  2D8h  1D9h  1DAh  2DBh  1DCh  2DDh  2DEh  1DFh  1E0h | FC |
| 1A1h  1A2h  2A3h  1A4h  2A5h  2A6h  1A7h  1A8h  2A9h  2AAh  1ABh  2ACh  1ADh  1AEh  2AFh  1B0h | Up to 64 ITU‑R BS 647 Audio/data channels |  | 2E1h  2E2h  1E3h  2E4h  1E5h  1E6h  2E7h  2E8h  1E9h  1EAh  2EBh  1ECh  2EDh  2EEh  1EFh  2F0h | User application  User application  User application  User application  User application  User application  User application  User application  User application  User application  User application  User application  User application  User application  User application  User application |
| 2B1h  2B2h  1B3h  2B4h  1B5h  1B6h  2B7h  2B8h |  |  | 1F1h  1F2h  2F3h  1F4h  2F5h  2F6h  1F7h  1F8h | User application  User application  User application  User application  User application  User application  User application  User application |

TABLE 7 (*end*)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type | Description |  | Type | Description |
| 1B9h  1BAh  2BBh  1BCh  2BDh  2BEh  1BFh |  |  | 2F9h  2FAh  1FBh  2FCh  1FDh  1FEh  2FFh | User application  User application  User application  User application  User application  User application  User application |
| 2C0h |  |  | 200h | Invalid data |

# 13 Fixed block data structure

The fixed block data structure shall be as defined in Fig. 8 comprising of a 1-byte data type word followed by the data block.

The data type word shall identify the type of data contained in the data block. The length of each data block shall be identified by block type value contained in the header data and defined by the length indicated in Table 6.



# 14 Variable block data structure

The variable block data structure shall be as defined in Fig. 9. It shall comprise a 1-word separator, followed by a 1-byte data type word, a 4-byte word count, the data block and terminating in a 1‑word end-code.

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If a variable block exceeds the length of one line-channel, the data shall continue over succeeding line-channels until the end of the block. Header data must be consistent for all line channels which carry a part of the same variable block.

It is recommended that each and every variable block starts on a new line immediately following the SAV.

Any space between the end code word of a variable block and either the start of a new variable block or the first word of the EAV on the same line shall be filled with the value 200h.

## 14.1 Separator and end-code

Each variable block shall start with a 1-word separator and end with a 1-word end-code. The values of separator and end-code shall be 10-bit words as follows.

B9 B8 B7 B6 B5 B4 B3 B2 B1 B0  
Separator, 309h : 1 1 0 0 0 0 1 0 0 1  
End-code, 30Ah : 1 1 0 0 0 0 1 0 1 0

Note that bit B9 of the separator and end-codes is not the complement of bit B8. These two codes are registered values that break the normal HD-SDTI rules in order to guarantee their unique value and hence provide unambiguous start and stop codes for each variable block.

## 14.2 Word-count

The word-count shall consist of four words as shown in Fig. 10. The word-count shall be used to represent the number of words in the data block.

The word-count shall be contained in bits C31 through C0, and shall be interpreted as a single 32‑bit unsigned integer with C31 as the MSB.

A word-count value of 00h, 00h, 00h, 00h shall be used to indicate either a variable block of unknown length or a variable block whose length exceeds that of the word-count capability. In such a case, the completion of a variable block is defined only by the reception of an end-code word.



It is the intent of this standard that all receiving equipment should attempt to receive data in a variable block even if the word-count has a zero value.

1. \* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in October 2010 in accordance with Resolution ITU-R 1. [↑](#footnote-ref-1)