ENGLISH TRANSLATION

STRUCTURE OF INTER-STATIONARY CONTROL DATA CONVEYED BY ANCILLARY DATA PACKETS

ARIB STANDARD

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Preface

ARIB (Association of Radio Industries and Businesses) has established the ”ARIB standards” for the basic technical conditions of standard specification related to variety of radio communication equipments, broadcasting transmission equipments, and its reception equipments using radio wave with the participation of radio communication equipment manufactures, broadcasting equipment manufacturers, electric communication companies, service providers and the other users.

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This standard is applicable to the structure of inter-stationary control data as conveyed in the form of ancillary data packets. In order to assure impartiality and transparency during its formulation, interested parties such as manufacturers of wireless communication devices, manufacturers of broadcasting devices, operators of telecommunication services, broadcasters, and the users of these products and services participated in discussions at the ARIB Standards Committee, and this standard represents the consensus of opinion so achieved.
It is the hope of this association that this standard will be used in a beneficial and proactive manner by manufacturers of wireless communication devices, manufacturers of broadcasting devices, operators of telecommunication services, broadcasters, users of these products and services, and the like.

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Chapter 1 General Items

1.1 Purpose

The purpose of this standard is to establish regulations regarding the structure of inter-stationary control data which is conveyed using ancillary data packets within component bit-serial interface for 525/60-television systems, bit-serial interface for 1125/60 HDTV systems, and the like as used inside and outside studios at broadcasting stations. Furthermore, this standard is to apply to the following types of broadcasting when implementing the above interfaces: digital broadcasting and high-definition television signal broadcasting as relevant to standard television broadcasting (hereinafter referred to as “digital terrestrial television broadcasting”); digital broadcasting via satellite and which uses frequencies over 11.7 GHz and below or equal to 12.2 GHz (hereinafter referred to as “BS digital broadcasting”); and digital broadcasting via satellite and which uses frequencies over 12.2 GHz and below or equal to 12.75 GHz (hereinafter referred to as “CS digital broadcasting”).

1.2 Scope

This standard is applicable to devices which convey inter-stationary control data for digital terrestrial television broadcasting, BS digital broadcasting, and CS digital broadcasting using ancillary data packets for bit-serial digital interfaces which defined in ARIB Standard STD-B6 (Ancillary Data Packet and Space Formatting of Bit-Serial Digital Interface for 525/60 Television System) and ARIB Standard BTA S-005B (Ancillary Data Packet and Space Formatting of Bit-Serial Digital Interface for 1125/60 HDTV System).

1.3 References

1.3.1 Referenced Documents

Some or all of the items defined in the following documents have been referenced in this standard.

(1) ARIB STD-B5: *Data Multiplex Broadcasting System For The Conventional Television Using The Vertical Blanking Interval*

(2) ARIB STD-B6: *Ancillary Data Packet and Space Formatting of Bit-Serial Digital Interface for 525/60 Television System*

(3) BTA S-005B: *Ancillary Data Packet and Space Formatting of Bit-Serial Digital Interface for 1125/60 HDTV System*

(4) ARIB STD-B31: *Transmission System For Digital Terrestrial Television Broadcasting*

(5) SMPTE 352M: *Television-Video Payload Identification for Digital Television Interfaces*

(6) ITU-T Recommendation G.957: *Optical interfaces for equipment and systems relating to the synchronous digital hierarchy*

(7) ISO/IEC 13818-7: *Information technology — Generic coding of moving pictures and associated audio information.* Part 7: *Advanced Audio Coding (AAC)*

1.4 Terminology

1.4.1 Definition of Terminology

The terms used in this document are defined as follows:

Current ** mode	The current video or audio mode.
Status bit	A continuous signal, which is sent at appropriate intervals and indicates a condition.
Down-mix specification (or DM specification)	Conversion coefficient for signal processing when creating 2-channel stereo from multi-channel stereo with 3 front channels and 2 rear channels. Corresponds to matrix_mixdown_idx from ISO/IEC 13818-7.
Trigger bit	Intermittent signal or pulse used to provide control timing.
Next ** mode	Video or audio mode which is intended to be used next.
Net cue signal, Broadcast-transmission -control signal	Signal used for inter-stationary control and data transmission which is inserted at the vertical blanking interval of television signals.
8-bit coding	A coding system with high levels of efficiency for character broadcasting, and when compared with 7-bit coding, with smaller overhead upon switching of character-code groupings. Specifically, character-code groupings from the left of the setting code table correspond to GL; those from the right, GR.
Frame synchronizer	FS — i.e., equipment used for synchronizing non-synchronous television signals.
Frame skip	The loss of one frame's worth of data.
Frame repeat	The duplication of one frame's worth of data.
Ancillary data	Various types of signal, which are conveyed using the blanking interval for video signals within digital interfaces.

Note: ** can represent either "video" or "audio."

1.4.2 Abbreviations

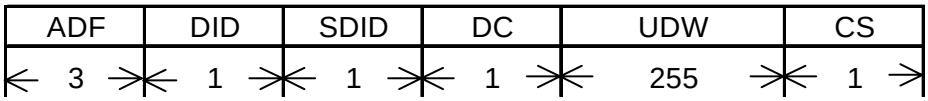
The following abbreviations are used within this document.

BCD	Binary Coded Decimal
BER	Bit Error Rate
ECC	Error-Correcting Code
FS	Frame Synchronizer
GL	Graphic-set left
GR	Graphic-set right
ISO/IEC	International Organization for Standardization / International Electrotechnical Commission
ITU	International Telecommunication Union
ITU-T	ITU Telecommunication Standardization Sector
JST	Japan Standard Time
RS	Reed Solomon
SMPTE	Society of Motion Picture and Television Engineers

Chapter 2 Inter-Stationary Control Data Packet

2.1 Inter-Stationary Control Data Packet Format

Inter-stationary control data are conveyed using inter-stationary control data packet. The format of the inter-stationary control data packet shall conform to type 2 of ancillary data packet as defined in ARIB Standard STD-B6 for bit-serial interfaces for 525/60 television systems and in ARIB Standard BTA S-005B for bit-serial interfaces for 1125/60 HDTV systems. In this format, furthermore, 1 word consists of 10 bits. The format of inter-stationary control data packet is illustrated in Figure 1.



ADF	Ancillary data flag
DID	Data identification word. DID of inter-stationary control data packet shall be set to 0x25F.
SDID	2nd data identification word. SDID of inter-stationary control data packet shall be set to 0x1FE.
DC	Data count word
UDW	User data word
CS	Check sum word

Figure 1: Inter-Stationary Control Data Packet Format

(Numbers indicate word counts. Same applied to Figure 2 and Figure 4)

2.2 User Data Word Format

Inter-stationary control data uses the user data word (UDW) of inter-stationary control data packet. The UDW comprises an inter-stationary control data word, an added inter-stationary control data header word and an error correction parity word (optional). The format of the UDW from inter-stationary control data packet is illustrated in Figure 2.

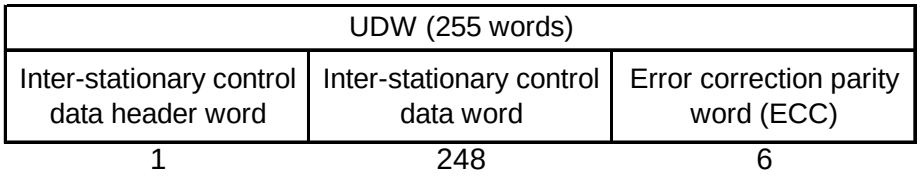


Figure 2: User Data Word Format

2.2.1 Inter-Stationary Control Data Header Word

An inter-stationary control data header of a single word is placed at the front of the UDW. Bit assignment for the inter-stationary control data header word is illustrated in Table 1.

Table 1: Bit Assignment for the Inter-Stationary Control Data Header Word

Bit number	Description
b9(MSB)	not b8
b8	Even parity for b0 through b7
b7	Error correction identifier
b6	Undefined (See note.)
b5	
b4	
b3	CI
b2	
b1	
b0(LSB)	

Note: Undefined bits shall be set to 0 (zero) until defined.

2.2.1.1 Error Correction Identifier

The error correction identifier indicates whether or not an error correction parity word is present. If set to [No error correction], the last 6 words from the UDW shall not be used, and shall be set to 0x200. If set to 1 [Error correction], the last 6 words from the UDW constitute an error correction parity word. Code assignment for the error correction identifier is illustrated in Table 2.

Table 2: Error Correction Identifier

b7	Description
0	No error correction
1	Error correction

2.2.1.2 Continuity Index

The continuity index (CI) indicates the state of data packet continuity in video field unit for the interlaced scan systems, or in video frame unit for progressive scan systems. The CI shall be increased by 1 for each packet by modulo 16.

2.2.2 Inter-Stationary Control Data Word

The lower 8 bits(b0 through b7) of the inter-stationary control data word constitute the inter-stationary control data. Bit assignment for the inter-stationary control data word is illustrated in Table 3.

Table 3: Bit Assignment for the Inter-Stationary Control Data Word

Bit number	Description
b9(MSB)	not b8
b8	Even parity for b0 through b7
b7	Inter-stationary control data
b6	
b5	
b4	
b3	
b2	
b1	
b0(LSB)	

2.2.2.1 Inter-Stationary Control Data Format

The format of inter-stationary control data is illustrated in Figure 3.

Bit Number	Transmitting-station code	Transmitting-station time	Video mode			Audio mode			Trigger bits				
			Current video mode	Next video mode	Video mode countdown	Current DM specification / Current audio mode	Next DM specification / Next audio mode	Audio mode countdown					
b7									Q8	Q16	Q24	Q32	～
b6									Q7	Q15	Q23	Q31	
b5									Q6	Q14	Q22	Q30	
b4									Q5	Q13	Q21	Q29	
b3									Q4	Q12	Q20	Q28	
b2									Q3	Q11	Q19	Q27	
b1									Q2	Q10	Q18	Q26	
b0									Q1	Q9	Q17	Q25	
Words	8	9	4	4	1	1	1	1	1	1	1	1	
Word number	1～8	9～17	18～21	22～25	26	27	28	29	30	31	32	33	

～	Trigger counter				Trigger countdown				Status bits		Reserved area	Private area
	Q1 counter	Q2 counter	Q3 counter	Q4 counter	Q1 countdown	Q2 countdown	Q3 countdown	Q4 countdown				
									S8	S16		
									S7	S15		
									S6	S14		
									S5	S13		
									S4	S12		
									S3	S11		
									S2	S10		
									S1	S9		
	1	1	1	1	1	1	1	1	1	1	64	141
	34	35	36	37	38	39	40	41	42	43	44～107	108～248

Figure 3: Inter-Stationary Control Data Format

(Note: DM specification = Down-mix specification)

The following describes the format and implementation of each item of inter-stationary control data.

(1) Transmitting-station code (8 words)

The transmitting-station code is used to provide display equipments with the name of the transmitting station. Specifically, Character No.1 through No. 8 are conveyed in these word sequence. The characters, which may be used within the transmitting-station code conform with the 8-bit coded system as defined in ARIB STD-B5 (Data Multiplex Broadcasting System For The Conventional Television Using The Vertical Blanking Interval). In addition to the space character, usable characters correspond to the 8-bit coded table of alphanumeric characters (8-bits coding) from the GL coding range and of *katakana* characters (8-bits coding) from the GR coding range. Control codes other than the space cannot be used.

Character No. 5 through No. 8 are optional, and when sending only as far as Character No. 4, all subsequent characters shall be spaces. If no transmitting-station code is sent, all characters shall be spaces.

(2) Transmitting-station time (9 words)

The transmitting-station time is used to provide information regarding the time at the transmitting station. Specifically, 4-bit binary-coded decimal (BCD) is used to encode the year, month, date, day, hour, minute, second, and millisecond. This encoding method is illustrated in Table 4.

Table 4: Coding of Transmitting-Station Time

		Date section				Time section			Millisecond section	
		Year	Month	Date	Day	Hour (Note 2)	Minute	Second	Millisecond	
Word position		W0	W1	W2	W3	W4	W5	W6	W7	W8
Bit number	b7(MSB)	Order of 10 (BCD)	←	←	0x0	Order of 10 (BCD)	←	←	0x0	Order of 10 (BCD)
	b6									
	b5									
	b4									
	b3	Order of 1 (BCD)	←	←	(Note 1)	Order of 1 (BCD)	←	←	Order of 100 (BCD)	Order of 1 (BCD)
	b2									
	b1									
	b0(LSB)									

Note 1: Sunday (0x0), Monday (0x1), Tuesday (0x2), Wednesday (0x3), Thursday (0x4), Friday (0x5), Saturday (0x6)

Note 2: The 24-hour system is used.

The lower 8 bits of unsent words shall be set to 0xFF.

The following values are valid.

- Year: Decimal values from 0 to 99
- Month: Decimal values from 1 to 12
- Date: Decimal values from 1 to 31
- Day: Decimal values from 0 to 6
- Hour: Decimal values from 0 to 23
- Minute and second: Decimal values from 0 to 59
- Millisecond: Decimal values from 0 to 999

(3) Current video mode, next video mode (4 words)

Current video mode and next video mode are used to indicate video attributes. Specifically, current video mode corresponds to the current attribute; next video mode, to the next scheduled attribute. Both current video mode and next video mode are encoded as illustrated in Table 5. By setting the lower 8 bits from the first word (W0) to 0x00, it can be indicated that all 4 words from the corresponding current video mode or next video mode are unused.

Table 5: Encoding of Video Mode

<table>
<tr><th colspan="2">Word position</th><th>W0</th><th>W1</th><th>W2</th><th>W3</th></tr>
<tr><td rowspan="8">Bit number</td><td>b7</td><td>Version identification:
Normally 1</td><td>Scan format for send structure:
Interlace (0) or progressive (1)
Note: Only when W0 = 0x85</td><td>Video aspect ratio:
4:3(0) or 16:9(1)</td><td>Reserved area</td></tr>
<tr><td>b6</td><td rowspan="7">Video format and digital interface (Table 6)</td><td>Scan format for picture:
Interlace (0) or progressive (1)</td><td>No. of horizontal Y samples:
720(0) or 960(1)
Note: Only when W0 = 0x81</td><td>Channel allocation:
No. 1 link (0) or No. 2 link (1)
Note: Only when W0 = 0x82</td></tr>
<tr><td>b5</td><td rowspan="2">Reserved area</td><td>Display range aspect ratio
4:3(0) or 16:9(1)</td><td rowspan="3">Reserved area</td></tr>
<tr><td>b4</td><td>Reserved range</td></tr>
<tr><td>b3</td><td rowspan="3">Frame rate (Table 7)</td><td rowspan="3">Sampling structure (Table 8)</td></tr>
<tr><td>b2</td></tr>
<tr><td>b1</td></tr>
<tr><td>b0</td><td>Bit depth:
8 bits (0) or 10 bits (1)</td></tr>
</table>

Note: The items only valid for specific W0-value are treated as reserved areas when the other W0-value are specified.

Code value	Video format	Digital interface
0x01	525i, 625i	270 Mbps, 360 Mbps
0x02	525p, 625p	360 Mbps single link, 270 Mbps dual link
0x03	525i/p, 625i/p	540 Mbps
0x04	750p	1.485 Gbps (nominal)
0x05	1125i/p	1.485 Gbps (nominal)
0x06 to 0x7F	Reserved	—

Table 6: Encoding of Video Format and Digital Interface

Table 7: Encoding of Frame Rate

Code value	Frame rate (Hz)
0x0	Undefined
0x1	Reserved
0x2	24/1.001
0x3	24
0x4	Reserved
0x5	25
0x6	30/1.001
0x7	30
0x8	Reserved
0x9	50
0xA	60/1.001
0xB	60
0xC to 0xF	Reserved

Table 8: Encoding of Sampling Structure

Code value	Sampling structure
0x0	4:2:2 (Y/Cb/Cr)
0x1	4:4:4 (Y/Cb/Cr)
0x2	4:4:4 (G/B/R)
0x3	4:2:0
0x4	4:2:2:4 (Y/Cb/Cr/A)
0x5	4:4:4:4 (Y/Cb/Cr/A)
0x6	4:4:4:4 (G/B/R/A)
0x7	Reserved
0x8	4:2:2:4 (Y/Cb/Cr/D)
0x9	4:4:4:4 (Y/Cb/Cr/D)
0xA	4:4:4:4 (G/B/R/D)
0xB to 0xF	Reserved

Note: With regard to 4:2:2:4 and 4:4:4:4, A refers to the video channel, and D refers to the non-video (i.e., data) channel

(4) Current audio mode, next audio mode (1 word)

Current audio mode and next audio mode indicate the attributes of the audio, conveyed together with the video signal. Specifically, current audio mode corresponds to the current attribute; next audio mode, to the next scheduled attribute. The lower 5 bits (b0 through b4) of current audio mode and next audio mode provide audio mode data; the upper 3 bits(b5 through b7) provide information regarding the down-mix specification. Encoding of each word is as illustrated in Table 9a and Table 9b. However, a down-mix specification is valid only when the audio mode contains a 3/2 or 5.1 format, and in all other cases, this shall be encoded as 000.

Table 9a: Encoding of Audio Mode

(b0 to b4)

Code value	Audio mode
0x00	Unused
0x01	M
0x02	2M(D)
0x03	3M(D+M)
0x04	4M(2D)
0x05	5M(2D+M)
0x06	6M(3D)
0x07	7M(3D+M)
0x08	8M(4D)
0x09	S
0x0A	2S
0x0B	3S
0x0C	4S
0x0D	3/0
0x0E	2/1
0x0F	3/1
0x10	2/2
0x11	3/2
0x12	3/2+LFE(5.1)
0x13	Stereo / mono (S+M)
0x14	Stereo / 2 mono (S+D)
0x15	5.1+S
0x16	3/1+S
0x17	3/2+S
0x18	9M or more（M only）
0x19	5S or more（S only）
0x1A	Other
0x1B to 0x1F	Reserved

Table 9b: Encoding of Down-Mix Specification

(b5 to b7)

Code value			matrix_mixdown_idx
b7	b6	b5	
0	0	0	Unspecified
0	0	1	Reserved
0	1	0	
0	1	1	
1	0	0	‘00’ [A=1/√2]
1	0	1	‘01’ [A=1/2]
1	1	0	‘10’ [A=1/(2√2)]
1	1	1	‘11’ [A=0]

Note
- M = Monaural; S = Stereo; D = Dual mono (2-channel audio)
- Number of channels for front/rear speakers. Example: 3/2 = 3 front, 2 rear
- LFE = Low Frequency Enhancement
- Refer to ISO/IEC 13818-7 for more details regarding matrix_mixdown_idx and A from Table 9b.

(5) Video mode countdown, audio mode countdown (1 word)

Countdowns are used to provide timing information for video mode and audio mode. Specifically, they count down the time remaining until mode-switch timing in field units; however, there is no concept for field units when attached to progressive-scan video signals, and consequently, count down is carried out in frame units. Encoding is not carried out using binary coded decimal (BCD); rather, values between 0 and 254 are expressed in 8-bit format. A value of 0xFF indicates that count down is not being carried out.

(6) Trigger bits Q1 through Q32 (1 bit)

Trigger bits are used to provide notification of a specific event either in advance or at the required timing. Trigger send is considered to commence when the trigger bit switches from 0 to 1, and the meaning of the bit, send timing, and send duration are arbitrary.

(7) Trigger counter (1 word)

Trigger counters are used with trigger bit Q1 through Q4. Encoding is not carried out using binary coded decimal (BCD); rather, values between 0 and 254 are expressed in 8-bit format. A value of 0xFF indicates that the trigger counter is not being used.

(8) Trigger countdown (1 word)

Trigger countdowns are used to provide timing information for trigger bits Q1 through Q4. Specifically, they count down the time remaining until the timing specified for the trigger bit in field units; however, here is no concept for field units when attached to progressive-scan video signals, and consequently, count down is carried out in frame units. Encoding is not carried out using binary coded decimal (BCD); rather, values between 0 and 254 are expressed in 8-bit format. A value of 0xFF indicates that count down is not being carried out.

(9) Status bits S1 through S16 (1 bit)

Status bits are used to indicate status using the 0 or 1 condition of the bits. Unused bits shall be set to 0, and the meaning of the bits is arbitrary.

(10) Reserved area

The reserved area has been included to allow for future expansion of this standard; accordingly, it shall not be used until the corresponding standard has been concluded.

(11) Private area

The private area may be freely utilized by the user.

2.2.3 Error Correction Parity Word (optional)

In consideration of the error characteristics of the transmission system, the Reed-Solomon code RS(254,248) is adopted for the error correction parity word. The length of the protected data word is 248, which is from the second UDW — not including the inter-stationary control data header word — to the error correction parity word. Reed-Solomon code is defined as shown below.

The Reed-Solomon code generator polynomial shall be

$$G(x) = (x+1)(x+\alpha)(x+\alpha^2)(x+\alpha^3)(x+\alpha^4)(x+\alpha^5)$$

where α is defined by the Galois field GF(2^8) generator polynomial

$$HF(x) = x^8 + x^4 + x^3 + x^2 + 1$$

If the data word sequence D(x) for the lower 8 bits of the UDW to be protected is expressed as:

$$D(x) = D_{247}x^{247} + D_{246}x^{246} + \cdots + D_2x^2 + D_1x + D_0$$

then the polynomial for error-correction parity words P5, P4, P3, P2, P1, and P0 can be expressed as the remainder P(x) when $x^6D(x)$ is divided by G(x).

$$P(x) = P_5x^5 + P_4x^4 + P_3x^3 + P_2x^2 + P_1x + P_0$$

The polynomial representation C(x) of the lower 8 bits of the entire conveyed code is as follows:

$$C(x) = x^6D(x) + P(x)$$

Note that for each P(x) words from the conveyed packet, b8 (even parity for b0 through b7) and b9 (inverse of b8) will — in the same way as for D(x) — be added at the two upper MSBs to enable conveyance of a single 10-bit word. Bit allocation for the error correction parity word is illustrated in Table 10; the format of UDW featuring ECC, in Figure 4.

Table 10: Bit Allocation for Error Correction Parity Word

Bit number	Description
b9(MSB)	not b8
b8	Even parity for b0 through b7
b7	Error correction parity word
b6	
b5	
b4	
b3	
b2	
b1	
b0(LSB)	

<table>
<tr><td colspan="7">UDW (255 words)</td></tr>
<tr><td rowspan="2">Inter-stationary control data header word</td><td rowspan="2">Inter-stationary control data word</td><td colspan="5">Error correction parity word</td></tr>
<tr><td>P_5</td><td>P_4</td><td>P_3</td><td>P_2</td><td>P_1</td><td>P_0</td></tr>
<tr><td>1</td><td>248</td><td colspan="5">6</td></tr>
</table>

Figure 4: Format of UDW Featuring ECC

Informative Explanation

A1 About a Scope

Although this standard provides regulations for inter-stationary control data which is conveyed using bit-serial digital interfaces for 525/60 and 1125/60 television systems, it may also be applied in its present condition to equipments using bit-serial digital interfaces for other television systems, such as 750p and the like. Said systems are regulated by ministerial ordinance but have not previously been standardized within Japan; accordingly, it is considered that conveyance of inter-stationary control data is attained by common specification.

A2 Inter-Stationary Control Data Header Word

A2.1 Continuity Index

The continuity index is used to check for the occurrence of frame skipping, frame repeating, freezing, and the like.

A2.2 Frame Skip & Frame Repeat

In situations where a frame synchronizer (FS) is being used, it is theoretically possible for a single frame's worth of data to be lost (i.e., frame skip) or to be duplicated (i.e., frame repeat). As for status signals and trigger signals, if an operation, which sends two or more frames continuously, is applied, no problems will be experienced as a result of the occurrence of either frame skip or frame repeat. However, in the case of countdown signals, a countdown values may result in discontinuous.

A3 Inter-Stationary Control Data Word

This standard does not define whether the various items of inter-stationary control data word are mandatory or optional. The requirement for usage of these items shall be determined separately in operational guidelines.

A3.1 Transmitting-Station Code

In principle, the transmitting-station codes are broadcast constantly using the current abbreviated name of the corresponding station. Although a unique code should be assigned to each individual transmitting station, codes should be assigned so that transmitting stations are identified using only Character No. 1 through Character No. 4, because Character No. 5 and all subsequent characters are optional.

When no transmitting-station code is to be broadcast or when only broadcasting as far as

Character No. 4, the space character is to be used for all non-broadcast characters; however, the use of spaces within valid character strings is not prohibited. Accordingly, care must be taken in the design of functionality for the display of transmitting-station codes so that spaces are not decoded as the end of character strings. In situations where difficulty exists in replacement of the transmitting-station code when re-transmission to other station after recording or when re-transmission via another station, re-transmission using the transmitting-station code of the original transmitting station is permitted.

A3.2 Transmitting-Station Time

It is assumed that the transmitting-station time could be used for the adjustment of device timing or as an index similar to a time code for broadcasting recorded materials. The yearly calendar shall be used independent of date changing within broadcasting control systems. In cases where daylight saving time is implemented, no regulation is defined in the usage of either Japan Standard Time (JST) or the human-system display time. Regulations for this case shall be determined separately in operational guidelines.

It is also assumed that the date section (i.e., year, month, date, and day) and the time section (hour, minute, and second) are sent, but the millisecond section is not sent.

A3.3 Video Mode

The format adopted for video mode corresponds to addition of a definition for Display Range Aspect Ratio to the video payload identification as defined in SMPTE352M (Video Payload Identification for Digital Television Interfaces). The video aspect ratio and the display-range aspect ratio are specified as follows:

- For letterbox mode:

Video aspect ratio = 4:3 Display-range aspect ratio = 16:9

- For squeeze mode:

Video aspect ratio = 16:9 Display-range aspect ratio = 16:9

- For side panel mode:

Video aspect ratio = 16:9 Display-range aspect ratio = 4:3

This standard is not applicable to the following video formats and digital interfaces as regulated by SMPTE352M. Note that the hexadecimal values shown in parentheses correspond to the [Video format & Digital interface] values as indicated by Bit 6 through B0 of Word 0.

- 4:4:4:4i, 270-Mbps dual link {in certain 0x02 cases}
- 525i/p, 1.485-Gbps (nominal) {0x06}
- 1125i/p, 1.485-Gbps dual link (nominal) {0x07}

A3.4 Audio Mode

This standard does not define the method for mapping of audio channels to the broadcast channel, and the method for utilization of the down-mix specification, as it has relation to the process for encoding or broadcasting of audio, or the operation of receivers. In situations where this standard is applied in the control of audio encoding parameters, it will be necessary to determine the correspondence of audio mode values and control parameter values between the stations in question.

Regulations regarding transmission of the down-mix specification were added in Version 1.1 of this standard. The down-mix specification is a conversion coefficient for signal processing used when creating 2-channel stereo from multi-channel stereo with 3 front channels and 2 rear channels as defined in ISO/IEC 13818-7. It is provided to allow the audio-creation wishes of the sender to be clearly indicated. In consideration of the fact that this specification — including current and next information — will need to be handled in the same way as the audio mode, it was realized using the upper order 3 bits of the audio-mode data, thus ensuring compatibility with earlier standards.

Note that restrictions apply to the audio modes for which the specification of conversion coefficients is valid, and for this reason, care must be taken in situations where no specification is made. As a result of the addition of the down-mix specification, the audio-mode reserved area now extends from 0xIB to 0x1F, and this has been determined to present no current or future difficulties.

A3.5 Video Mode Countdown & Audio Mode Countdown

A countdown value can be use to video mode and audio mode. The maximum possible value of a countdown is 254 (video fields); therefore, when field frequency of the video signal is 60 fields per second, countdown will be possible from approximately 4.2 seconds in advance. A jump of a countdown value, an inversion, and a repetition may occur by a skip, a repeat, etc. of a video frame. Suitable processing is desired to it.

The example of use of a video or audio mode, and countdown is shown in Table A1. This is an example in the following conditions.

- Countdown is started 3 seconds before changing the mode.
- The countdown value reaches to 0 at the field just before changing the mode.
- Sending of the next mode is carried out even when countdown is not being performed.

Table A1: Example of Countdown for Audio & Video Modes

Time (fields) ↓

Timing	Countdown value	Current mode	Next mode
	255(0xFF)	A	B
	255(0xFF)	A	B
3 s in advance	179	A	B
	178	A	B
2 fields in advance	1	A	B
1 field in advance	0	A	B
Switch timing	255(0xFF)	B	C
	255(0xFF)	B	C

A3.6 Trigger Bits

32 bits can be used as a trigger signal. Actual number of the bits to be used, the meaning of bits, the send timing, the send duration, and the like are to be determined in operational guidelines. Each bit of a trigger bit is independent; however, multiple bits may be sent simultaneously to provide indication of phenomena requiring multi-bit representation.

A3.7 Trigger Counters

Trigger counters may be used with trigger signals Q1 through Q4, and these are provided to allow visual confirmation of trigger signals. Typical uses of these counters are presented below.

- For each program, trigger counters indicate the sequence position for the next trigger. A counter is reset to 1 at the beginning of the program, and simultaneously with trigger sending out. During said reset at the beginning of the program, resetting of a value of 0 is permitted in cases where it is not intended to send triggers during the program. Furthermore, when the final trigger is sent out in a program, you may reset to 0.

- The next of 254 is set to 0, when not resetting per program and applying as a cyclic counter.

A3.8 Trigger Countdown

Trigger countdowns may be used with trigger signals Q1 through Q4. The maximum possible value of a countdown is 254 (fields); therefore, when the field frequency of the video signal is 60 fields per second, countdown will be possible from approximately 4.2 seconds in advance.

In the case of Q1 through Q4, it is conceivable that a countdown will not be sent even though the corresponding trigger signal is sent; however, trigger signals do not feature flags to indicate whether or not a countdown will be sent. Countdown operational guidelines, including the

solution for cases where there is an inconsistency in the timing indicated by the trigger signal and that indicated by the countdown, need to be determined in the actual operation. Also, there is a possibility that skipping, repeating, and other similar video-frame problems will result in countdown values being skipped, reversed, or repeated, and it is desirable that the appropriate processing is prepared for those cases.

Table A2 presents a typical use of a countdown for trigger signals, and the following conditions are assumed in this case.

- Video switching is indicated by a trigger featuring a countdown.
- Trigger sending is carried out over the 0.5-second period starting 3 seconds in advance of the required timing.
- Countdown is started at the field where trigger sending commences.
- The countdown value reaches 0 at the field immediately before the required timing.

Table A2: Example of Countdown for Trigger Signals

Time (fields) ↓

Timing	Countdown value	Trigger bit value	Video
	255(0xFF)	0	A
	255(0xFF)	0	A
3 s in advance	179	1	A
	178	1	A
	150	1	A
2.5 s in advance	149	0	A
2 fields in advance	1	0	A
1 field in advance	0	0	A
Required timing	255(0xFF)	0	B
	255(0xFF)	0	B

A3.9 Status Bits

Although 16 bits may be used for status bits, actual number of the bits to be used and the meaning of bits are to be determined in operational guidelines. Each bit from a status bit is independent; however, multiple bits may be sent simultaneously to indicate a status signal defined by multi-bit representation.

A4 Background and Discussion of Inter-Stationary Control Data

A4.1 Adapting Inter-Stationary Control Data for Multi-Purpose Usage

During the formulation of inter-stationary control data, broadcasting companies presented a large

number of proposals regarding items implemented in NHK program-transmission control signals and commercial broadcaster net cue signals, and also regarding items considered relevant in terms of digital-broadcasting characteristics. In conclusion, upon consideration of common inter-stationary control data items, which are both practical and necessary, it was decided that the transmitting-station code, the transmitting-station time, the video mode, and the audio mode should be common.

Trigger bits: Essential items such as net-cue signals are not necessarily consistent between NHK and commercial broadcasters; for this reason, sufficient area was provided for 32 individual triggers and it was left up to the operator to determine the corresponding regulations in accordance with their proposed use. The send timing and send duration for trigger bits were not established. Because there was concern that all trigger bits may possibly be set to the same value. Realization of the net-cue CM number has been made possible using the counter attached to the trigger bits.

Sufficient area has also been provided for 16 status signals — including net-cue S1, S2, and S3 bits — and it was determined that the corresponding regulations should be determined separately in operational guidelines. Free usage of the user range (i.e., 141 words) has been made possible as an option in order to provide for situations where items not corresponding to trigger bits and status bits are used.

The following section will provide an overview of common regulated items.

Transmitting-station codes: Although the compatibility of transmitting-station codes with the transmitting-station display codes (4-byte) was supported by public broadcasters, it was considered that 4 bytes alone may not be sufficient for this code. Accordingly, these 4 bytes were augmented with an additional 4 bytes (optional). Although JIS C 6220 (currently JIS X 0201) is used with respect to the encoding of characters in net-cue, this standard implements the code collection as defined in ARIB STD-B5 according to that standard's 1-byte representation of *katakana* voiced sounds and non-voiced sounds.

Transmitting-station times: The necessity for transmitting-station time was recognized that the measurement of delay time could prove useful in the prevention of getting a glimpse of other video. This has been standardized, however, the transmitting-station times need not necessarily be sent out.

Video mode: The following opinions were expressed regarding video modes during the creation of this standard's initial draft.

- The format, aspect ratio, and horizontal resolution should be encoded.
- Compatibility with SMPTE standards is desirable.
- Parameters required for Mpeg encoder control should be included.
- In situations where format conversion is carried out, the data corresponding to the original video

should be included.

• In order to facilitate usage in real-time control, next mode and switch timing data will be required.

Furthermore, in order to provide real-time control for video mode and audio mode, it was decided to indicate the current mode and the next mode, and to use countdowns.

From the early stages of evaluation, all broadcasters and device manufacturers agreed on the necessity for glimpse prevention. It was decided, therefore, that such a standard for inter-stationary control data should use countdowns for video mode, audio mode, and trigger signals in order to indicate the correct timing. Actual glimpse prevention will depend on the employment of the appropriate devices on the various broadcasters' equipment.

Within the 32 trigger signals, it was decided to attach countdowns and counters for only 4. Upon consideration of device design and device implementation costs, and of space reductions for ancillary data, it was concluded that the provision of these items for only 4 triggers would be sufficient for practical operation.

A4.2 Error in Inter-Stationary Control Data Packets

A.4.2.1 Types of Conveyed Signal Error

It is considered that errors could occur in the following case during station-internal transmission and during inter-stationary transmission.

• Station-internal base band transmission (coaxial cable)
• Station-internal base band transmission (optical fiber)
• Inter-stationary base band transmission (optical fiber) (See Note 1)
• Inter-stationary compressed transmission (optical fiber)
• Frame-synchronizer (FS) frame skipping and frame repeating

These can be broadly classified into errors in the transmission system and frame skipping or repeating by the frame synchronizer. The error characteristics of each type are illustrated in Table A3.

Table A3: Error Types and Characteristics

Error type	Error characteristics	Bit Error Rate (BER)
Transmission system error (optical fiber)	Burst and random errors	Very low: 10^{-10} or less
Transmission system error (coaxial cable)	Burst and random errors	Assumed to be approximately 10^{-10}
FS frame skipping or frame repeating	Loss of one frame of data Duplication of one frame of data	Once every three months

Note 1:SDH transmission using optical fibers is assumed. See Recommendation ITU-T G.957 (1995). Optical interfaces for equipment and systems relating to the synchronous digital hierarchy

A4.2.2 Correction of Errors in Inter-Stationary Control Data Packets

In accordance with the fact that the structure of ancillary data makes block-specific correction of errors ideal for inter-stationary control data packets, block encoding was selected in place of convolution coding. Furthermore, since difficulties would exist in the use of different encoding methods for transmission-line burst errors and random errors, burst error was considered to be the more prevalent and the decision was taken to implement Reed-Solomon code. This type of coding has been implemented for both digital satellite broadcasting (ARIB STD-B20) and digital terrestrial television broadcasting (ARIB STD-B31), and positive results have been obtained with the corresponding standards.

Although Turbo code is available as an extension of Reed-Solomon code, evaluation of the adoption of this method were suspended due to its requirement for large-scale calculation processing and the lack of effectiveness in the correction of transmission-line errors.

With a bit error rate (BER) of 10^{-10}, quality in the transmission lines is high, and particularly in the case of base band transmission, it was determined that the number of error words per packet was low; accordingly, Reed-Solomon code with 3-word correction and 6-word error detection was adopted for usage. Note that this differs from the 8-word correction and 16-word error detection for RS(255,239) (See Note 2) as used in transmission for digital satellite broadcasting and digital terrestrial television broadcasting.

There is an error correction identifier defined in the header word of UDW. Although RS(255,249), which includes header word as protection data via Reed Solomon code was considered the outcome of studies resulted in the header word being no longer subjected to this data protection and therefore, RS(254, 248) was adopted.

Note 2: Using abbreviated Reed-Solomon code, RS (204, 188)

STRUCTURE OF INTER-STATIONARY CONTROL DATA
CONVEYED BY ANCILLARY DATA PACKETS

ARIB STANDARD

ARIB STD-B39 VERSION 1.1-E1
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