STD-B45 Provisional Translation

Release Notes

ISDB-Tmm is standardized by ARIB. There are several STDs and TRs (technical reports) concerning ISDB-Tmm.

ARIB STD-B45 is intended to formulate a “Download system for digital broadcasting,” which consists of the following two parts.

Part One: Download system for advanced wide band satellite digital broadcasting
Part Two: Download system for terrestrial mobile multimedia broadcasting based on connected segment transmission

This document is an English version of Part Two of ARIB STD-B45 Version 2.2, which was translated by DiBEG.

The original document of ARIB STD-B45 is written in Japanese, and this document is regarded merely as reference information. In addition, the original document may have been further revised. Therefore, users should check the latest version of the original document at the following URL:

http://www.arib.or.jp/english/html/overview/index.html

Part Two

DOWNLOAD SYSTEM FOR TERRESTRIAL MOBILE MULTIMEDIA BROADCASTING BASED ON CONNECTED SEGMENT TRANSMISSION

Part Two
Contents

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Chapter 1: General Matters

1.1 Objective

This standard stipulates the download system for terrestrial mobile multimedia broadcasting based on a connected segment transmission (hereafter referred to as "ISDB-Tmm terrestrial mobile multimedia broadcasting") conducted by broadcasting stations using radio waves (VHF high bands) with a frequency of 207.5 MHz or more and 222 MHz or less from among various types of terrestrial multimedia broadcasting for mobile and portable terminals.

1.2 Scope

This standard applies to digital broadcasting by the download system used in ISDB-Tmm terrestrial mobile multimedia broadcasting.

1.3 References

1.3.1 Normative References

The following documents are those of which parts defined in the documents are referred to or cited from as parts of this standard.

- "Ministrial ordinance for amending the entire standard transmission system for digital broadcasting among standard television broadcasting, etc." (Ordinance No. 87 of the Ministry of Internal Affairs and Communications, 2011) (hereinafter referred to as the "Ordinance")
- "Notification of the structure and transmission procedure of relevant information, PES packets, section types, TS packets, the transmission procedure of IP packets and TLV packets, the structure of transmission control signals and identifiers, and the structure of emergency information descriptors (Notification No. 299 of the Ministry of Internal Affairs and Communications, 2011)"
- " Service Information for Digital Broadcasting System," ARIB Standard, ARIB STD-B10
- "Data Coding and Transmission Specification for Digital Broadcasting," ARIB Standard, ARIB STD-B24
- "Conditional Access System Specifications for Digital Broadcasting," ARIB Standard, ARIB STD-B25
- "Video Coding, Audio Coding and Multiplexing Specifications for Digital Broadcasting," ARIB Standard, ARIB STD-B32
- "Coding, Transmission and Storage Specification for Broadcasting System Based on Home Servers," ARIB Standard, ARIB STD-B38
- "Transmission System for Terrestrial Mobile Multimedia Broadcasting Based on Connected Segment Transmission," ARIB Standard, ARIB STD-B46

- “Receiver for Terrestrial Mobile Multimedia Broadcasting Based on Connected Segment Transmission,” ARIB Standard ARIB STD-B53
- ITU-T Rec.H.222.0 | ISO/IEC13818-1:2006: Information technology – Generic coding of moving pictures and associated audio information: Systems
- IETF RFC 768 'User Datagram Protocol'
http://www.ietf.org/rfc/rfc768.txt
- IETF RFC 791 'Internet Protocol'
http://www.ietf.org/rfc/rfc791.txt
- IETF RFC 793 'Transmission Control Protocol'
http://www.ietf.org/rfc/rfc793.txt
- IETF RFC 2045 'Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies'
http://www.ietf.org/rfc/rfc2045.txt
- IETF RFC 2046 ' Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types '
http://www.ietf.org/rfc/rfc2046.txt
- IETF RFC 2616 'Hypertext Transfer Protocol – HTTP/1.1'
http://www.ietf.org/rfc/rfc2616.txt
- IETF RFC 2818 'HTTP Over TLS'
http://www.ietf.org/rfc/rfc2818.txt
- IETF RFC 3095 'RObust Header Compression (ROHC): Framework and four profiles: RTP, UDP, ESP, and uncompressed'
http://www.ietf.org/rfc/rfc3095.txt
- IETF RFC 3450 'Asynchronous Layered Coding (ALC) Protocol Instantiation'
http://www.ietf.org/rfc/rfc3450.txt
- IETF RFC 3451 'Layered Coding Transport (LCT) Building Block'
http://www.ietf.org/rfc/rfc3451.txt
- IETF RFC 3926 'FLUTE - File Delivery over Unidirectional Transport'
http://www.ietf.org/rfc/rfc3926.txt
- IETF RFC 4326 'Unidirectional Lightweight Encapsulation (ULE) for Transmission of IP Datagrams over an MPEG-2 Transport Stream (TS)'
http://www.ietf.org/rfc/rfc4326.txt
- IETF RFC 4566 'SDP: Session Description Protocol'
http://www.ietf.org/rfc/rfc4566.txt
- IETF RFC 4815 'RObust Header Compression (ROHC): Corrections and Clarifications to RFC 3095'
http://www.ietf.org/rfc/rfc4815.txt
- IETF RFC 5052 'Forward Error Correction (FEC) Building Block'

http://www.ietf.org/rfc/rfc5052.txt

- IETF RFC 5170 'Low Dencity Parity Check (LDPC) Staircase and Triangle Forward Error Correction (FEC) Schemes'

http://www.ietf.org/rfc/rfc5170.txt

1.3.2 Informative References

The following are the standards related to this standard.

- "Notification on the compression procedure and transmission procedure for picture signals by means of PES packets from among picture signals and the compression procedure and transmission procedure for sound signals by means of PES packets from among sound signals" (Notification No. 300 of the Ministry of Internal Affairs and Communications, 2011)"
- "Download Specifications" IPTVFJ STD-0003

https://www.iptvforum.jp/download/

- ITU-T Rec. T.81|ISO/IEC10918-1:1994: Information technology – Digital compression and coding of continuous-tone still images
- ITU-T Rec.H.264|ISO/IEC14496-3:2005: Information technology – Coding of audio-visual objects – Part 3: Audio
- ITU-T Rec.H.264|ISO/IEC14496-10:2010: Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding
- ITU-T Rec.H.264|ISO/IEC14496-14:2003: Information technology – Coding of audio-visual objects – Part 14: MP4 file format
- ITU-T Rec.H.264|ISO/IEC14496-15:2006: nconfiguration technology – Coding of audio-visual objects – Part 15: Advanced Video Coding(AVC) file format
- PNG specification Ver1.0 W3C Rec. Oct.1996
- 3GPP TS 26.245 '3GPP Timed Text'
- W3C 'Widgets 1.0: Packaging and Configuration'

http://www.w3.org/TR/widgets/

1.4 Terminology

1.4.1 Definitions

ALC/LCT header	ALC stipulated in IETF RFC 3450 and LCT header information stipulated in IETF RFC 3451
CRID	Identification information uniquely identifying the content of download-type services
EPG/ECG metadata	Description language-type metadata stipulated in ARIB STD-B38 that is used for the guidance of content and the navigation of content

FDT instance	Object used to transmit a File Delivery Table (FDT), which describes a variety of attributes with regard to the files delivered by FLUTE, which is stipulated in IETF RFC 3926
FLUTE	File delivery protocol for unidirectional communication (RFC3926)
HTTP	Protocol that is used for the data transfer of WWW (World Wide Web) in application layer protocols (RFC2616)
INT	Designates a receiver IP address, which is the target of the transport stream ID/service ID/component tag for a platform ID in the stream constituting a download-type broadcasting service
IP	Defines network layer protocols and Internet address mechanisms, and performs the processing of data transmission (RFC791)
ISDB-Tmm terrestrial mobile multimedia broadcasting	Multimedia broadcasting carried out with terrestrial basic broadcasting stations defined in Chapter 4, Section 1 of the “Ministerial ordinance for amending the entire standard transmission system for digital broadcasting among standard television broadcasting, etc., (Ordinance No. 87 of the Ministry of Internal Affairs and Communications, 2011)”
LDPC	Low-density parity check code: Error correcting code that allows the repair of portions where receipt was impossible by using repair data (RFC5170)
MPEG-2	Moving Pictures Expert Group-2: A compression coding technology standardized by the International Organization for Standardization for compressing data such as video and audio (ISO/IEC 13818)
PSI	Program Specific Information: This information is necessary for selecting a specific program, and consists of five tables: PAT, PMT, NIT, CAT, and INT.
ROHC	System stipulated in RFC3095 and RFC4815, used to compress headers above IP layers
SDP	Data in the SDP format used to retain information in FLUTE sessions transmitting download-type content (RFC4566)

SI	Service Information: SI is defined as various information designed to improve the convenience of program selection, defined by the ordinances of the Ministry of Internal Affairs and Communications and specified by the ARIB standard. The information also includes MPEG-2 PSI information in addition to an expansion of the ARIB standard.
TCP	Standard protocol for transport layers utilized for the Internet; this provides highly reliable connection-type transfers with error detection and correction capabilities (RFC793).
TOI	Object identification information in an FLUTE session; the identification information value shall be “0” at the time of FDT instance transmission.
TS	Transport Stream: The transport stream defined by the MPEG-2 system standard (ISO/IEC 13818-1); in multimedia broadcasting, one TS can be allocated for both each of the 13 segments and for one segment.
TSI	Session identification information for FLUTE
UDP	System used for Internet data transmission; this is a communications protocol that does not need confirmation whether the data is transmitted to the destination addresses after data transmission (RFC768).
UEP	Efficient error correction by means of uneven error protection
ULE	Encapsulation function of IP packets enabling the realization of IP transmission on MPEG-2 systems (RFC4326)
User Service Description	One piece of the three pieces of data stipulated by transmission control metadata, which includes Session Description and Associated Delivery Procedure Description
XML	One of the description languages established by W3C
Conditional Access	To make contents available only for users who have the rights to access the contents
Conditional Access server	A transmission function that realizes conditional access
Conditional accesser	A receiver function that realizes conditional access

Application layer FEC	FEC system in the application layer
Export processing function portion	This is the processing portion where the download-type content is utilized outside the functions relating to the service. No stipulation is provided for this standard.
Encrypt	Encryption of download-type content
Content delivery FLUTE session	This is the FLUTE session used for metadata delivery system B. This is similar to a FLUTE session delivering download-type content.
Commodity	Unit of content sales; it is possible for more than one content type to be assigned to one commodity.
Complement of stored content	To repair the content that has not been fully stored upon the termination of broadcasting using complementary data
Decrypt	Decrypting of encrypted download-type content
Transmission control metadata	Data in the XML document format in which the information needed for the receipt of download-type content and downloading are described
Metadata delivery system A	Delivery system using a partial receiving layer for metadata delivery
Metadata delivery system B	Delivery system using layers other than the partial receiving layer for metadata delivery
Manifest file	This is one of the configuration files for download-type content and is also the data in the XML document format that describes the information about configuration file management and scenario management.

Metadata delivery FLUTE session	This is the FLUTE session used for metadata delivery system A. This is primarily used for the delivery of metadata.
License	This includes the key-related information used to decrypt the encrypted download-type content and use conditions.
Resource	Minimum reference unit constituting content in utilization units, as well as minimum utilization units
Use condition	Conditions under which utilization is permitted, such as the time available for download-type content
Utilization unit content	This is the content that users can use. The utilization unit content consists of one or more resources. Note that the utilization unit content may be simply described as “content” in this standard.

1.4.2 Abbreviations

AL-FEC	Application Layer - Forward Error Correction
BiM	Binary format for MPEG-7
CRID	Content Reference Identifier
FDT	File Delivery Table
FLUTE	File Delivery over Unidirectional Transport
HTTP	HyperText Transfer Protocol
INT	INT IP/MAC Notification Table
IP	Internet Protocol
LDPC	Low Density Parity Check Code
MPEG-2	Moving Pictures Expert Group –2
PSI	Program Specific Information
ROHC	RObust Header Compression
SDP	Session Description Protocol
SI	Service Information
TCP	Transmission Control Protocol
TS	Transport Stream
UDP	User Datagram Protocol

UEP	Uniqual Error Protection
ULE	Unidirectional Lightweight Encapsulation
XML	Extensible Markup Language

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Chapter 2: Service Model

This chapter gives a description of the requirements for services provided from the download system of ISDB-Tmm terrestrial mobile multimedia broadcasting.

2.1 Outline of Services

ISDB-Tmm terrestrial mobile multimedia broadcasting is based on the premise of the use of movable receivers and makes it possible to realize access to content and services that is not constrained by broadcasting time and place, by extending terrestrial digital television broadcasting in combination with communications. This broadcasting assumes broadcasting content on a real-time basis (pictures, sounds, and data, or a combination of these elements) and download-type content (pictures, sounds, images, texts, and data, or a combination of these elements), along with services in combination of these. Note that this document deals with services provided from download-type content.

2.2 Service Offerings

A description is given of an outline of the system configuration for providing services for ISDB-Tmm terrestrial mobile multimedia broadcasting and the protocol stack in receivers.

2.2.1 Outline of System Configuration for Service Offerings

In ISDB-Tmm terrestrial mobile multimedia broadcasting, information relevant to content, content navigation, and conditional access is delivered to receivers using a broadcasting and communications means. Figure 2-1 shows an outline of system configuration.

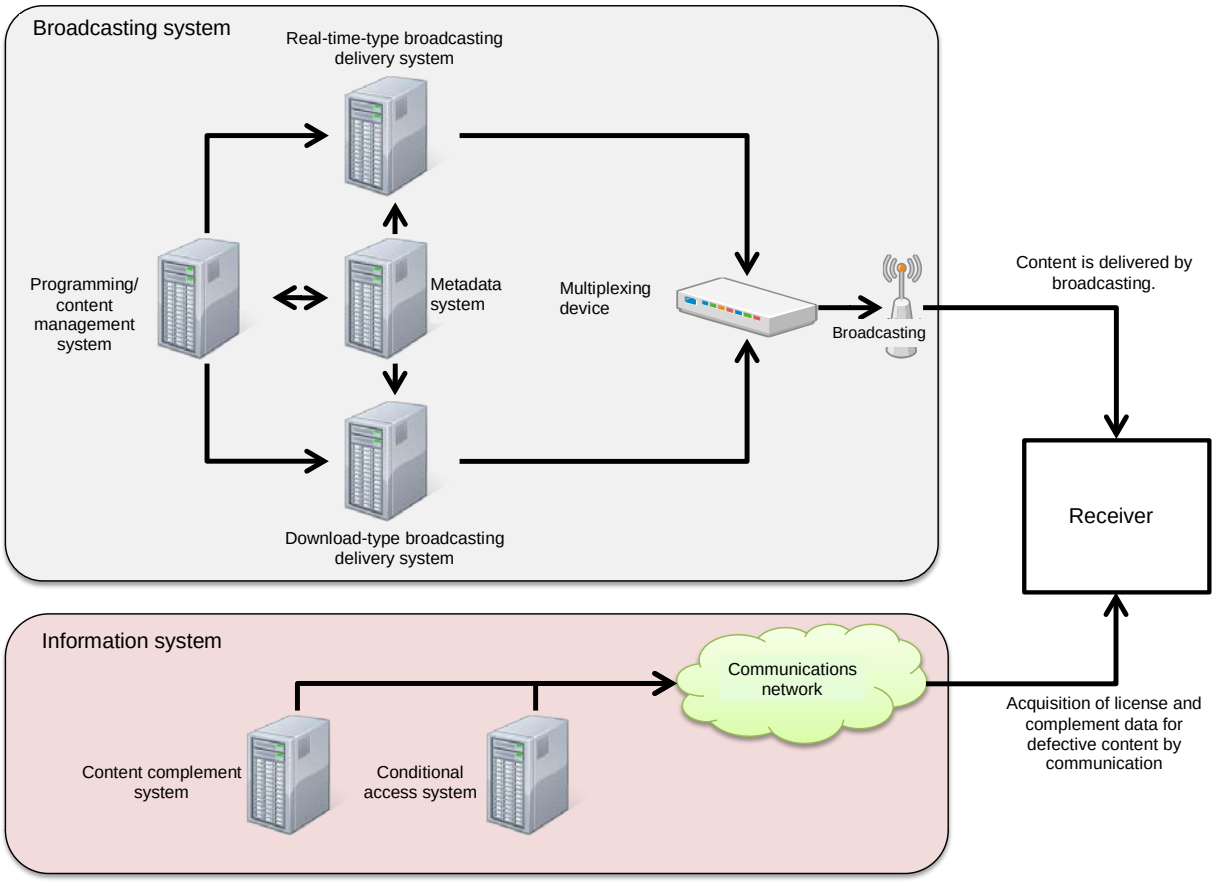

Fig. 2-1: Outline of system configuration

As summarized in Table 2-1, different usages are assumed for broadcasting and communications.

Table 2-1: Assumed different usages for broadcasting and communications

	Broadcasting	Communications
Content proper	✓	✓ (However, this is limited to the complement when the storage state of the content in question is incomplete at the time of the termination of the broadcasting of the content in question)
EPG/ECG metadata	✓	✓
Transmission control metadata	✓	✓

License offered to download-type content			✓
License offered to real-time-type broadcasting content (reference)	ECM	✓	
	EMM	✓	✓

2.2.2 Protocol Stack

As the protocol stack for ISDB-Tmm terrestrial mobile multimedia broadcasting, the ISDB-Tmm system is employed in which the ISDB-T employed in terrestrial digital television broadcasting is extended. The protocol stack is more specifically shown in Fig. 2-2.

<table>
<tr><td colspan="2">Real-time-type broadcasting content</td><td>PSI/SI</td><td>Download-type broadcasting content</td><td>EPG/ECG metadata
Transmission control metadata</td></tr>
<tr><td rowspan="3">PES</td><td rowspan="3">Section</td><td colspan="3">FLUTE/AL-FEC</td></tr>
<tr><td colspan="3">UDP/IP/ROHC</td></tr>
<tr><td colspan="3">ULE</td></tr>
<tr><td colspan="5">MPEG-2 TS</td></tr>
<tr><td colspan="5">Physical layer (stipulated by ARIB STD-B46)</td></tr>
</table>

Fig. 2-2: Protocol stack

2.3 Assumed Services

2.3.1 Prerequisite

2.3.1.1 Configuration of Content

- Handled in this service is the content composed of pictures and sounds, along with content other than pictures and sounds (for instance, data for electronic books, game programs, etc.).

2.3.1.2 Network Environment of Receivers

- Receivers shall be based on the premise that they can be connected with the IP network.
- Licenses shall be based on the premise that they can be obtained from the IP network.
- When communication is impossible due to external factors, the utilization of solely available services on a limited basis without utilizing communication shall not be excluded.

2.3.1.3 Assumed Receivers

- Receivers shall be equipped with a storage function with storage capacity sufficient for using a service.

2.3.2 Requirements

The requirements for the standard of download-type broadcasting in ISDB-Tmm terrestrial mobile multimedia broadcasting are described below.

2.3.2.1 General

- The mixing of real-time-type broadcasting and download-type broadcasting shall be possible on one MPEG-2 TS.
- Dynamically changing the respective band frequencies allocated to real-time-type broadcasting and download-type broadcasting on one MPEG-2 TS shall be possible.
- The provision of services by multiple service providers on one MPEG-2 TS shall be possible.
- Offering services on the respective TS using multiple MPEG-2 TSs by one service operator shall be possible.

2.3.2.2 Transmission of Broadcasting Schedule Information

- The acquisition of information needed for making a download reservation for content using a broadcasting transmission path shall be possible.
- The acquisition of information needed for making a download reservation for content using a communication transmission path shall be possible.

2.3.2.3 Transmission of Content

- Storage by receivers shall be possible by utilizing the protocol stack shown in Fig. 2-2 and by transmitting the content using a broadcasting transmission path.

2.3.2.4 Download Reservations

- Reservations shall be possible using the resident function of receivers using information necessary for download reservations acquired via broadcasting or communication.
- Storage reservations shall be possible with the real-time-type broadcasting service provided by ISDB-Tmm terrestrial mobile multimedia broadcasting as its starting point.
- In order to allow the capability to perform download reservation from a list of content displayed in a communication portal, obtaining the information needed for the download reservation shall be possible.

- Making reservations such as series reservations shall be possible.

2.3.2.5 Storage of Content

- The storage of content on the TS in a selective manner shall be possible upon the content broadcasting starting time described in the broadcasting schedule information.
- The simultaneous storage of multiple download-type content delivered at the same time and on the same TS shall be possible.
- The storage of download-type broadcasting content shall be possible while viewing and listening to real-time-type broadcasting content being delivered at the same time and on the same TS.
- When there is a defect in content when receiving broadcasting, the defect shall be repaired as far as possible using AL-FEC.
- In the case where the defect was not successfully repaired even when using AL-FEC, the complement of the defect shall be possible by communication means.
- Responding to the updating of broadcasting schedules shall be possible.
- Storage on local recoding media or removable recording media shall be possible.

2.3.2.6 Acquisition of Licenses

- The acquisition of a license through communication shall be possible.
- Even when the license obtained by receivers is eliminated for some certain reason, the re-acquisition of the license shall be possible as far as the effectiveness of the license is guaranteed.
- The elimination of the license shall be possible according to the instruction of the viewer.
- The automatic elimination of the license for which the utilization conditions have expired shall be possible, for instance, regarding the expiration date and the time of viewing.

2.3.2.7 Conditional Access

- The setting of content protection shall be possible.
- The setting of utilization periods shall be possible.
- The setting of utilization times shall be possible.

2.3.2.8 Billing

- The prior billing of the download and the prior billing of utilization shall be possible.
- Free viewing, sales of single commodities, and sales of packages shall be possible.
- Encrypted content shall be available free of charge.
- Non-encrypted content shall be available.

2.3.2.9 Encoding of Content

- The display of subtitles shall be available.
- The handling of a variety of content other than that stipulated in this standard shall be possible.

2.3.2.10 Utilization and Writing Out of Content

- Reproducing the content acquired shall be possible from a list of content that is displayed by the resident function of receivers.
- The assumption that the start of the content acquired can be utilized with real-time-type broadcasting content provided via ISDB-Tmm terrestrial mobile multimedia broadcasting designated as its starting point shall be possible.
- The users' elimination of content from a list of content that has been stored and displayed by the resident function of receivers shall be possible.
- The unavailability of the content shall be possible by the instruction of a service provider even if the content is stored in a receiver.
- The assumption that the writing out of content is processed according to systems established by service providers on a content-by-content basis shall be possible.

2.3.3 Services to Be Offered

The types of download-type broadcasting services to be offered in ISDB-Tmm terrestrial mobile multimedia broadcasting are shown in Table 2-2.

Table 2-2: Types of download-type broadcasting in ISDB-Tmm terrestrial multimedia broadcasting

Item number	Type of service	Definition
1	Content download service	This is a download-type broadcasting service in which at least one piece of information provided to download-type broadcasting of stream_type = "0x91" is included, and unlike general broadcasting services, the transmitting time and utilizing time are not the same when content is delivered to receivers via broadcasting waves and where viewing and listening is possible after storage.
2	EPG/ECG metadata service	Service of broadcasting EPG/ECG the metadata of stream_type = "0x91".

As indicated in the protocol stack in Fig. 2-2, these services make use of the system of multiplexing IP packets by ULE using FLUTE protocol. After converting content, metadata, etc., into files, file division is conducted, which is followed by the generation of FEC packets, the addition of the FLUTE header, and conversion into UDP/IP packets. After that, the UDP/IP packet header is compressed by ROHC, followed by encapsulation for transmission on the MPEG-2 TS by the ULE to transmit the resultant data via the transmission path of ISDB-Tmm terrestrial mobile multimedia broadcasting.

2.3.4 Typical Service Flow

It is assumed that a typical pattern for receiving services in ISDB-Tmm terrestrial mobile multimedia broadcasting is composed of four steps as shown in Fig. 2-3 (1. Acquisition of metadata, 2. Storage reservation, 3. Reception and storage, and 4. Utilization of content). In addition, it is also assumed that during these four steps, the purchase of commodities, acquisition of licenses, and the complementary processing by communication for the portions in which storage has not been completed are implemented.

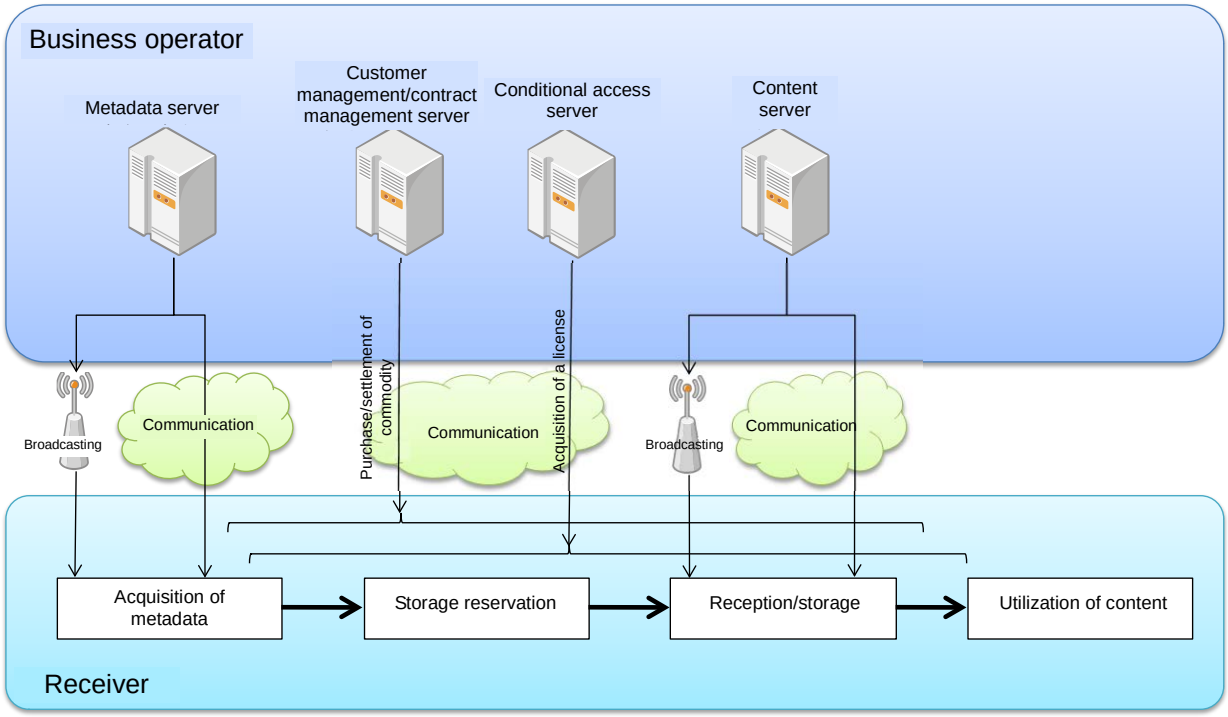

Fig. 2-3: Typical service flow

2.3.4.1 Acquisition of Metadata

First, EPG/ECG metadata is acquired when a receiver starts broadcasting, and then various types of information are acquired, which include the name of the broadcasting content,

broadcasting time, reception method, price, etc. The details of the information are stipulated in Chapter 6 of this document. Note that acquisition by communication is assumed to be possible when it is not possible to receive the broadcasting.

2.3.4.2 Storage Reservation

Receivers conduct processing for the storage of content in which the implementation of storage processing is designated. Two types are available for the designation of storage processing: By designation by the viewer via ECG and by the storage designation information included in EPG/ECG metadata. The details of the information are stipulated in Chapter 6 of this document.

2.3.4.3 Reception and Storage

Receivers begin reception operation when the broadcasting time of the content is designated to implement storage processing, and the storage processing for the designated content is then initiated. It is assumed that the processing of AL-FEC is also properly implemented when conducting the processing of reception and storage. The details of the processing for AL-FEC are stipulated in Section 8.2.3 of this document.

2.3.4.4 Utilization of Content

The utilization of content using receivers is roughly divided into two categories: 1. Assuming output such as pictures and sounds (output from a portion displaying pictures, sounds, etc., attached to a terminal, and output from an output interface) after confirming the utilization requirements stipulated in the license for stored content each time before the content is used, and 2. Assuming that the processing of writing to another processing system is conducted after confirming the utilization conditions set forth in the license to the content stored, at the first utilization, and after that, the content utilization is exclusively conducted by another processing system. The details of content utilization are described in Chapter 4 of this document.

2.3.4.5 Purchase of Commodity

When utilizing encrypted content, users are required to purchase commodities that include the content in question. It can be assumed to obtain the information about commodities simultaneously when receiving metadata by the receiver for purchase through ECG, as well as to purchase commodities through sites with a sales function for commodities offered through servers via browsers. It is assumed that the purchase of commodities is completed by the time when the license for the content is issued. Specific procedures and methods on how to sell commodities shall be dependent on the operation of service providers.

2.3.4.6 Acquisition of Licenses

When receivers utilize encrypted content, the utilization is based on the premise that the license to the content in question has already been acquired. For this reason, if the license is not acquired when the content is utilized, there is a need for the license to be issued by making a request to the server for the issuance of the license. Furthermore, if the user has not yet purchased the commodity with the license, the user acquires the license after completing the purchase processing for the commodity. The details of license acquisition are stipulated in Chapter 4 of this document.

2.3.4.7 Complementary Processing of Stored Content by Communication

When the content is not stored in a perfect condition (when there is a defect in the information constituting the content) at the time of the termination of broadcasting, it may be assumed that the receiver may obtain data for detecting the defect and acquiring the data needed for complementing this defect, by communication. The details of complementary processing for stored content by communication are stipulated by practical applications.

Chapter 3: System Model

3.1 Receiver Model

A typical receiver in ISDB-Tmm terrestrial mobile multimedia broadcasting is assumed to be mounted on a mobile phone. The receiver makes it a condition that it can receive information either by 13-segment broadcasting (ISDB-T) (including reception on a partial reception layer), by 1-segment broadcasting, or all of these broadcasting systems. Moreover, in order to utilize the services of ISDB-Tmm terrestrial mobile multimedia broadcasting, the receiver is assumed to be equipped with functions as indicated in the following typical example.

3.1.1 Typical Receiver Model

An example of a typical receiver configuration and an entity model involved in download-type broadcasting in ISDB-Tmm terrestrial mobile multimedia broadcasting are shown in Fig. 3-1 and Table 3-1, respectively.

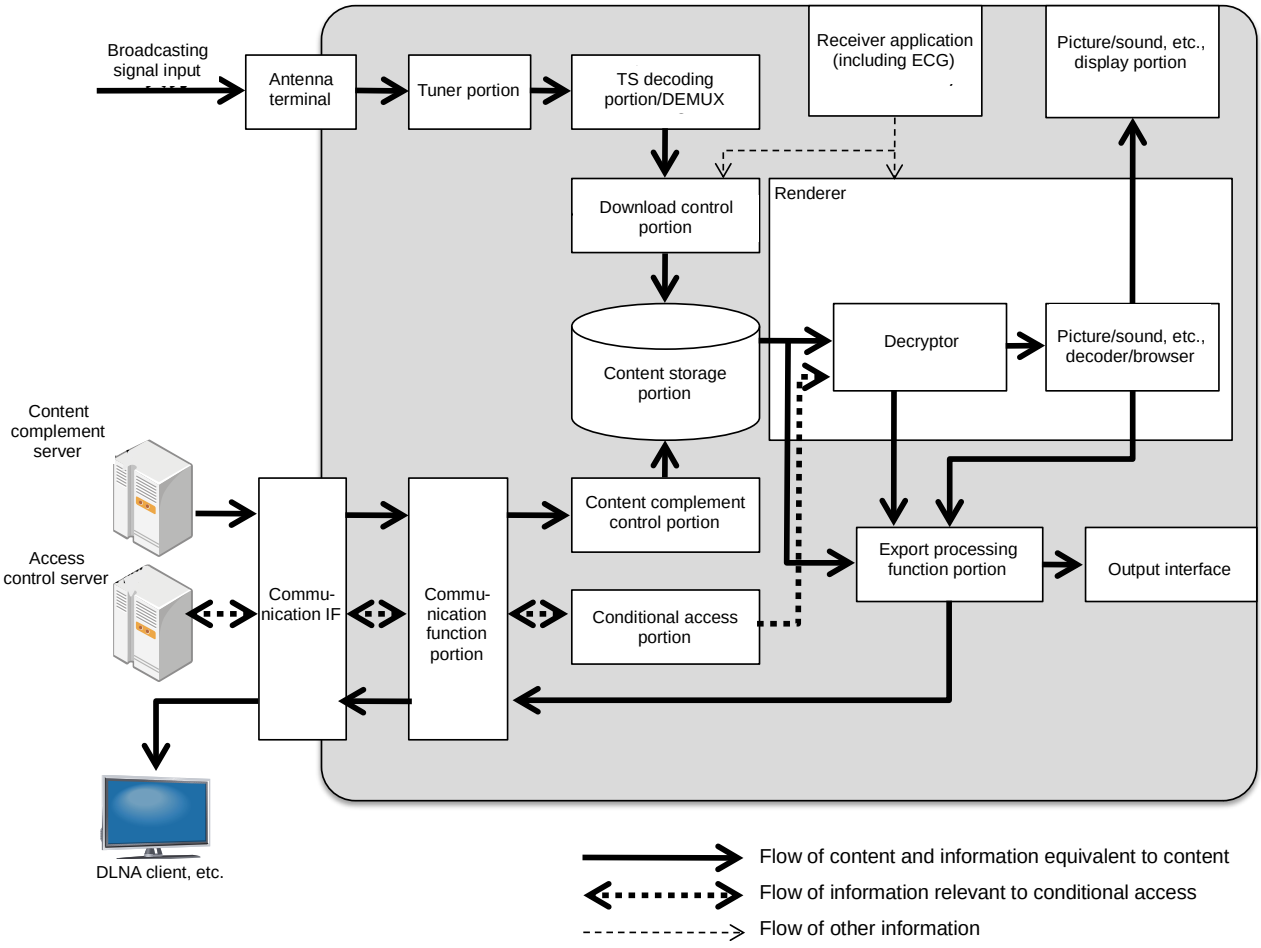

Fig. 3-1: Example of a typical receiver configuration involved in download-type broadcasting

Table 3-1: Entity models of a typical receiver involved in download-type broadcasting

Item number	Name of entity	Modeled function	Typical mounting example
1	Antenna terminal	Input from antenna	Whip antenna terminal
2	Tuner portion	Demodulation of digital broadcasting	Tuner module for digital broadcasting
3	TS decoding portion and DEMUX	Decoding processing for digital broadcasting and the selection processing of download-type content	
4	Download controller	Selection function for the content reserved for storage, including FLUTE/AL-FEC processing	FLUTE/AL-FEC stack
5	Content storage portion	Non-volatile memory device housing stored content	Various types of non-volatile memories
6	Communication IF	Connection interfacing with a communications network	Mobile phone functions (3GPP, 3GPP2, etc.), wired LAN IF, wireless LAN IF, etc.
7	Communication function portion	Connection interfacing with a communications network	TCP/IP, UDP, HTTP, SSL/TLS, HTTPMU, RTP, etc.
8	Content complementing control portion	Loss detection and request for complements for stored content and for the merging process	FLUTE/AL-FEC stack
9	Conditional access controller	Terminal built-in function of the conditional access function to content	Resident
10	Renderer	Regeneration function for content (pictures, sound, HTML, etc.)	
11	Decryptor	Decoding function for encrypted content	AES decoder

12	Decoder for pictures, sound, etc., and browsers	Regeneration of picture signals, sound signals, and analysis and display processing of HTML, etc.	H.264 picture decoder AAC decoder HTML parser and renderer
13	Picture/sound display portion	Decoded screen and picture (processing results and others of still pictures, HTML, etc.), and the output of sound	Liquid-crystal display and mainframe speakers
14	Export processing function portion	Encrypting of output information when re-encryption is required at the time of external output to a content terminal	CPRM HDCP SCMS-T DTCP-IP, etc.
15	Output interface	IF used to take out content outside the receivers Not only physical IFs but also logical IFs are permitted.	HDMI Wireless/wired LAN Bluetooth Removable memory, etc.
16	Receiver application	Function portion that offers user interfaces for storage reservation, settlement, and others, including EPG/ECG, to users	Application within an arbitrary terminal

3.2 Server/Receiver Model

The communication function indispensable for enjoying the services provided from ISDB-Tmm terrestrial mobile multimedia broadcasting is assumed to be used as follows.

3.2.1 Typical Server/Receiver Model

An example of the typical server/receiver configuration and an entity model involved in download-type broadcasting in ISDB-Tmm terrestrial mobile multimedia broadcasting is shown in Fig. 3-2 and Table 3-2, respectively.

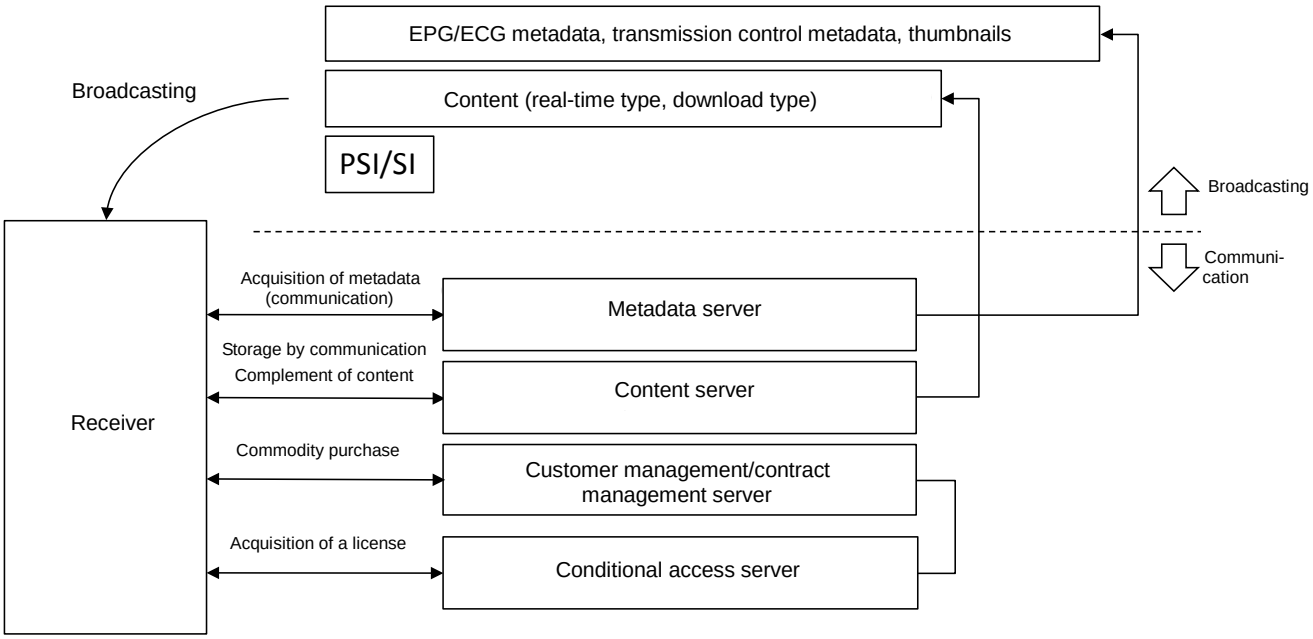

Fig. 3-2: Example of a typical server/receiver configuration involved in download-type broadcasting

Table 3-2: Entity models of a typical server/receiver involved in download-type broadcasting

Item number	Name of entity	Modeled function	Typical mounting example
1	Metadata server	Server used to collect metadata, which is required to prepare EPG/ECG from among the metadata operated by the service providers of ISDB-Tmm terrestrial mobile multimedia broadcasting, and to deliver the collected metadata to receivers It is assumed that offers are be made by communication and broadcasting.	Web server function Database function
2	Content server	Content server operated by service providers Content offered from respective service providers is stored. This is based on the delivery of content by	Web server function Database function

		broadcasting, but offers (limited to complements) from communications are also available.	
3	Customer management/contract management server	Server in charge of commodity sales processing and customer management	Web server function Database function
4	Conditional access server	Server used to provide conditional access information for utilizing the content stored in a receiver, in response to a request from the receiver and the sales status of the commodity	Web server Database function
5	Delivery of EPG/ECG metadata, transmission control metadata, and thumbnails	Delivery of the metadata needed for EPG/ECG configuration (including thumbnail delivery) and transmission control metadata	Download-type content delivery device
6	Content (download type) delivery	The delivery of the content supplied from download-type broadcasting is conducted.	
7	PSI/SI delivery	Various types of information required for the decoding of TS, and others, are delivered.	
8	Receiver	Receivers capable of receiving the services of ISDB-Tmm terrestrial mobile multimedia broadcasting	

Chapter 4: Outline of the Conditional Access System for Download-type Content

This chapter shows a system model as an outline of the conditional access system involved in download-type content and stipulates an outline of functions and requirements. For the detailed regulations relating to this download system, refer to Part IV of ARIB STD-B25.

4.1 Outline of the System Model and Functions Involved in Conditional Access

In addition to giving a brief overview of the conditional access system in download-type broadcasting services, this chapter stipulates the outline and functional requirements necessary for a conditional access system. However, the outline of the system stipulated herein does not provide the regulations for implementation.

4.1.1 Outline of a Conditional Access System in Download-type Broadcasting Services

A diagram illustrating the outline of the delivery system, server, and receiver function system involved in the conditional access system in download-type broadcasting services is shown in Fig. 4-1.

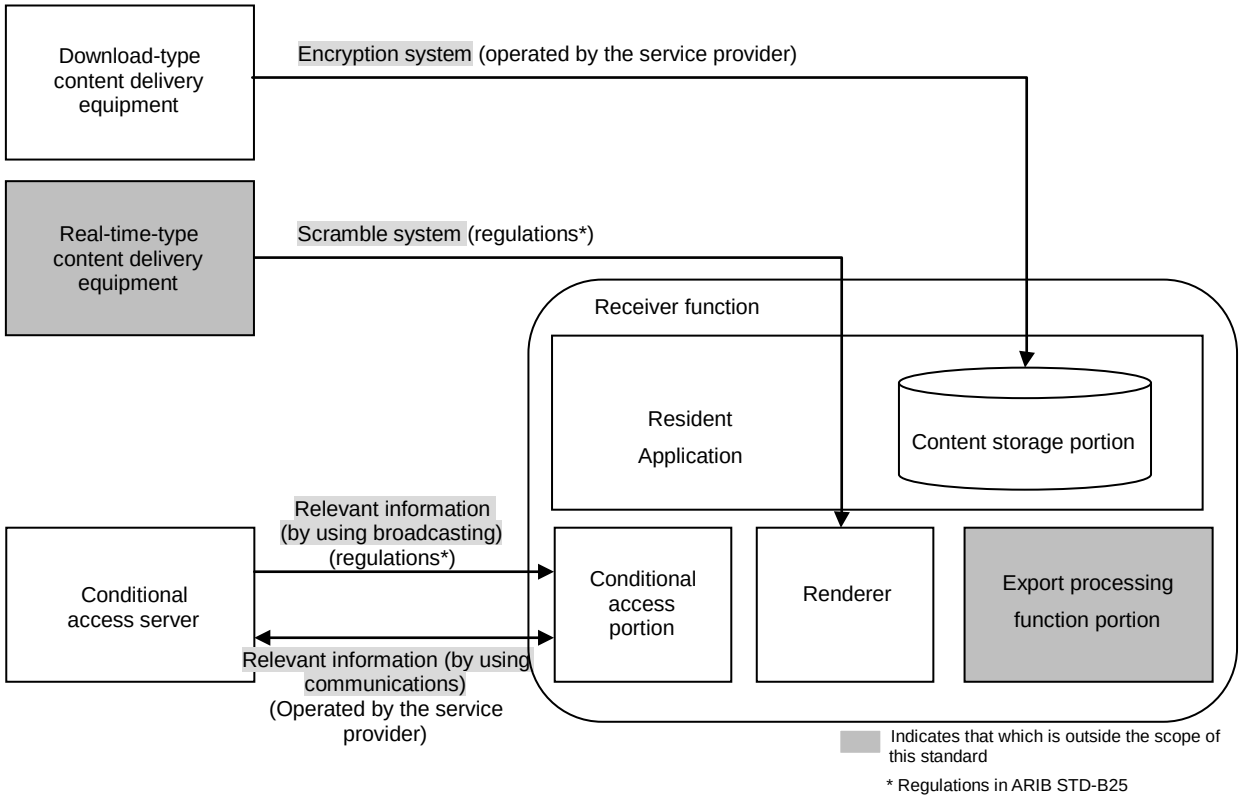

Fig. 4-1: Outline of the conditional access system involved in ISDB-Tmm terrestrial mobile multimedia broadcasting

4.1.2 System Configuration Functions of Conditional Access

The functions constituting the outline of conditional access systems are shown below.

- Conditional access server

Functional portion that carries out the issuance processing relevant to licenses; this server possesses the following functions.

- Generation and management of licenses, including content keys and utilization requirements
- Establishment of security for communication with the conditional access portion
- Determination as to the issuance of licenses and the issuance and delivery of licenses based on a request from a conditional access portion

- Download-type content delivery equipment

Function for encrypting and delivering content in download-type broadcasting as broadcasting waves; this possesses the following functions.

- Content that has been protected or encrypted is encrypted using content keys to generate encrypted content and to temporarily be stored and managed
- Delivery of encrypted content as broadcasting waves
- Output for the delivery function using the complementing function for download-type content by communication

- Content storage portion

A receiver function used to download, store, and manage the encrypted content acquired by receiving download-type content.

- Conditional access portion

A receiver function used to acquire and manage licenses and to supply content keys at the time of content utilization; this possesses the following functions.

- Establishment of a secure communication path with the conditional access server
- Acquisition of and management of licenses from the conditional access server
- Supply of renderer and content keys/utilization requirements to the export processing function portion

- Renderer

A function used to decode the encrypted content that has been downloaded and stored in a content storage portion, and to regenerate the content; this possesses the following functions.

- Decoding (decrypting) of encrypted content using the content keys supplied from the conditional access portion
- Decoding of decoded content (rendering)
- Regeneration of content, conditional access, and the control of output to display devices such as the output of pictures and sounds, etc., based on the utilization requirements included in the licenses supplied from the conditional access portion

- Export processing function portion

A receiver function used to decode the encrypted content that has been downloaded and stored in the content storage portion and to conduct the processing of exporting to the output interface with a removable recording medium or external equipment; the content after export are outside the scope of conditional access in this chapter. When there is a necessity for the succession of content protection, it is desirable that the export be limited only to the output to the removable recording medium or external equipment capable of being provided with this function. This possesses the following functions.

  - Control over writing to a removable recording medium and external equipment or output control over an external output interface based on the utilization requirements for the licenses supplied from the conditional access portion
  - It is desirable that the output to removable recording medium or external equipment with content protection after export be possible.

- Resident application

Software that carries out the overall sequence control of processing for realizing download-type broadcasting services based on the conditional access system as a receiver function; this application corresponds to downloading, storage control, ECG, etc., in the services relevant to this standard.

4.2 Download-type Broadcasting Service Model Involved in License Issuance

In download-type broadcasting service, the utilization requirements relating to the content needed for paid services are included in a license. The license is delivered from the conditional access server to the conditional access portion.

The license includes at least the following items. For details, refer to Section 3.4.2, Part IV of ARIB STD-B25.

- Keys for use in the decoding of encrypted content
- Utilization requirements for content

4.2.1 Outline of License Issuance for Download-type Broadcasting Services

A typical example of the download-type broadcasting services involved in license issuance is shown below.

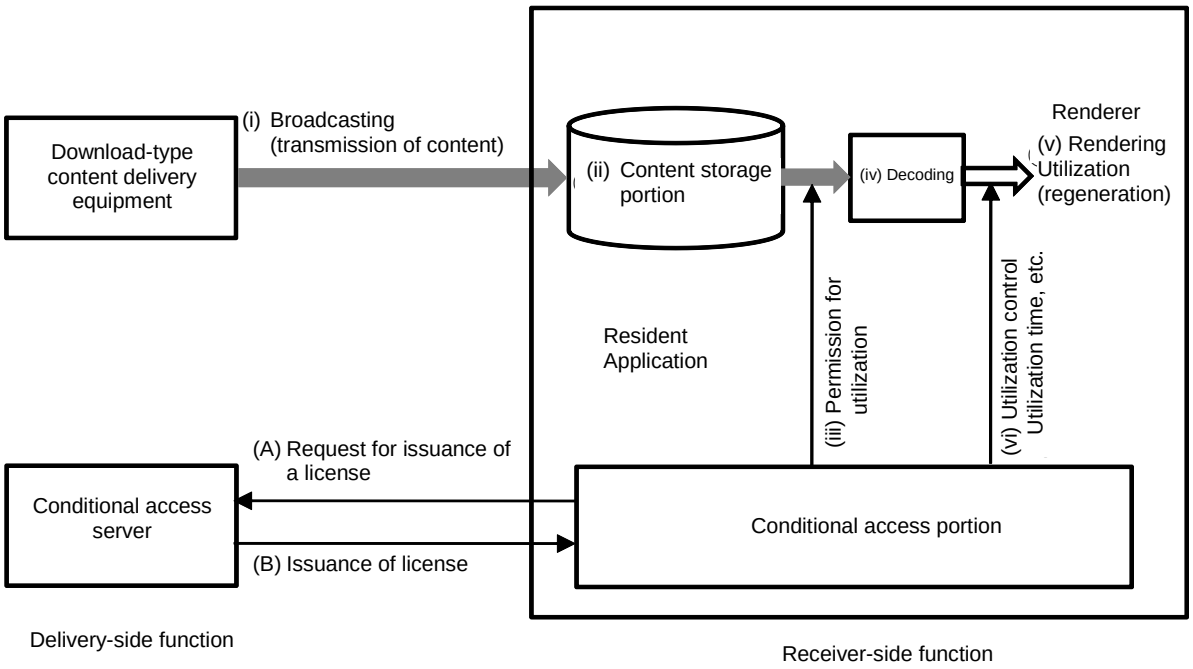

Fig. 4-2: Conceptual diagram of license issuance involved in download-type content

Figure 4-2 shows a typical processing procedure as an example. The processing order indicated as the sequence of (i) to (ii) and (A) to (B) is not stipulated as a standard.

Pre-stage preparation for this processing procedure (items irrelevant to conditional access):

- In the receiver function, the content to be downloaded shall be designated by some means.
- Download-type content is complemented by using communication, in some cases.

(i) Download type content is received by broadcasting.

(ii) The download-type content thus received is stored in the content storage portion.

(A) A request for the issuance of the license for the content to be utilized is made from the conditional access portion of the receiver to the conditional access server using communication.

(B) The license is issued from the conditional access server to the conditional access portion of the receiver using communication.

In relation to (A) and (B), it is assumed that charging, settlement, and others be made in the case of paid download-type content. The charging, settlement, and others are the matters that should not be stipulated in this standard.

After completing (i), (ii), (A), and (B), the procedure proceeds to the next step.

(iii) Comparison is made between the utilization requirements included in the license and

the status of the current receiver function.

(iv) Encrypted content is decoded. Note that no processing is allowed for download-type content that has been decoded, except for storage after export processing.

(v) The content undergoes rendering to be utilized (regeneration).

(vi) Utilizable requirements are monitored. In some cases, utilization requirements may expire during a regeneration (utilization) period, such as the regeneration (utilization) deadline.

4.2.2 Outline of Licenses Utilized in Download-type Broadcasting Services (Commentary)

Licenses are utilized in download-type broadcasting services. Commodities, sales, charging, settlement, etc., utilized in general commercial dealings are a series of actions fulfilled as the utilization of content. However, the matters relevant to the above-mentioned actions are outside the scope of this standard. Unencrypted content is not handled in this chapter.

Content is broadcast after it is encrypted. Licenses need to be acquired for utilization (regeneration, etc.) at the receiver side. For details, refer to Section 3.4.2, Part IV of ARIB STD-B25.

The main features of licenses are shown below.

- Licenses are issued for each receiver.
- Licenses are issued based on a request for acquisition by communication from the receiver.

Contracts may be classified as monthly, daily, or as on content-by-content basis, etc., but the licenses shall be issued each on a content basis (CRID).

4.2.3 Utilization of Licenses in Download-type Broadcasting Services

In the utilization requirements included in the license, there is a case where utilization requirements are changed (consumption in a conceptual sense) from the time of license issuance due to the utilization of content, while there is another case where the utilization period and others are specified. With regard to the renderer, there is a need for rendering on the basis of the utilization requirements.

As far as download-type content and licenses are concerned in which the expiration date of utilization designated in the utilization requirements has passed, the licenses are not needed along with the content. In consideration that the capacity of the content storage portion of a receiver is limited, it is envisaged that there is a need in some cases to eliminate unnecessary content and licenses.

4.3 Requirements for Content Protection

The following stages exist for download-type content up to the utilization of the content (regeneration), and the content protection for the renderer and conditional access portion needs to be properly executed in each stage.

(i) Stage of receiving downloads in series and storing download-type content
(ii) Stage of storing and managing content after the completion of reception
(iii) Stage of confirming the utilization requirements for content and making a judgment as to the utilization of content
(iv) Stage of outputting the content to the region of the export processing portion other than multimedia broadcasting receivers, where necessary

With respect to (iii), there is a necessity for sufficient protection to be provided at the renderer side so that the utilization going beyond the utilization requirements for the content is not easily available as a physical device or software.

Regarding (iv), the receiver function needs to be formulated in such a manner that no external output is performed with the exception of those originally intended by service providers. It is most desirable for service providers to be able to check that the function of the external output destination has a safe system from the standpoint of content protection.

4.3.1 Requirements for External Output

Content protection is needed for (iv) of the previous Section 4.3 in the following two cases.

- In the case where the content to be rendered by the receiver is temporarily output to the outside and stored
  - Preventing the content from being utilized by the time when it is utilized or from being utilized beyond the utilization conditions
  - Preventing the content from being output as permitted under the utilization conditions and others or by service providers
- In the case where the receiver is utilized as a device to receive the transmitted content with the aim of utilizing the receiver as a function other than the receiver (an export processing function portion)
  - Content protection may be needed based on the utilization conditions until the content is output to the export processing function portion. Note that after the content is output from the export processing portion, the content protection is outside the scope of this standard because it is envisaged that the export processing function portion is equipped with an as-needed protective mechanism.

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Chapter 5: Encoding of Content/File Format

Information source encoding systems and file formats for the content transmitted by download-type broadcasting are identified by means of transmission control metadata or FDT instance media models. Utilizable media models comply with, but are not restricted by, Annex Regulation C of ARIB-STD B24 Second Edition. Details are stipulated by service providers' operation regulations.

An example of information source encoding systems and file formats is shown in Reference Material 1.

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Chapter 6: Metadata

6.1 EPG/ECG Metadata

For the specification for EPG/ECG metadata in this standard, refer to Annex C.2 of ARIB STD-B38.

6.2 Transmission Control Metadata

6.2.1 Overview

For the receivers to receive download-type content, there is a need to make a reception schedule of the content according to the transmission control metadata specified in this chapter. The metadata is the XML document that includes all the information needed for the reception schedule of download-type content reserved by the receiver and storage of object files included in the received content. The URL of the transmission control metadata described as ProgramURL of Program Location in the ECG metadata allows a reception schedule to be made for the content that is selected from the navigation screen for download-type content listed in the ECG of receivers according to theECG metadata. In addition, it is also envisaged that the CRID described as a hyperlink in the BML documents allows a reception schedule to be made for the content that is selected from the navigation screen for download-type content listed in the BML content of real-time-type broadcasting. The transmission control metadata is composed ofthe following information on download-type content: the broadcasting schedule , the configuration of the object files to be stored, theirreception schedule, and the control information about content repair. Note that there is a description in Chapter 6.5 about the storage of transmission control metadata and download-type content.

6.2.2 Description Format for Transmission Control Metadata

The details of the data format for transmission control metadata used in the transmission of download-type content are specifiedin this clause.

Transmission control metadata is composed of parameters relevant to the FLUTE session used in the transmission of download-type content, the parameters relevant to content repair, and the parameters relevant to reception reports. For this reason, this metadata is closely correlated with EPG/ECG metadata as well. For the relationship between the transmission control metadata and the EPG/ECG metadata, refer to Section 6.5.1.

The following three elements exist in transmission control metadata.

- User Service Description
- Session Description

- Associated Delivery Procedure Description

As shown in Fig. 6-1 below, the User Service Description includes the rest of two elements inside: Session
Description and Associated Delivery Procedure Description and it is described in a XML format.

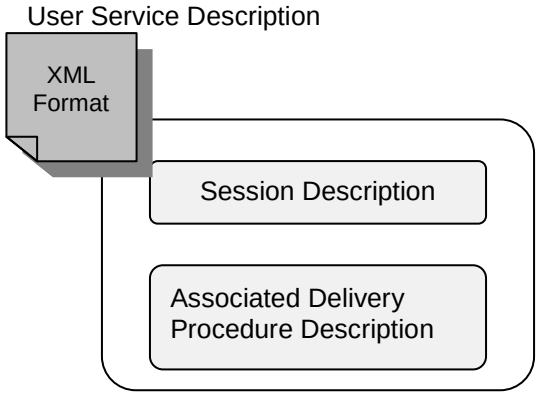

Fig. 6-1: Configuration of User Service Description

For the schema of transmission control metadata, refer to Annex A.1.

6.2.2.2 User Service Description

User Service Description is composed of various types of description information related to content transmission. The semantics of User Service Description are defined as follows.

Table 6-1: Definition of User Service Description

Element/name of attribute	Definition
userServiceDescription	User Service Description information is described.
Version	The version of User Service Description is described.
Program	The corresponding CRID is described.
sessionDescription	SessionDescription information (SDP) is described.
associatedProcedureDescription	Content repair/reception report information is described.
postFileRepair	Control information for content repair is described.
@offsetTime	Offset time(s) is/are described.
@randomTimePeriod	Random time period(s) is/are described.
@manualRepairStartDate	The manual repair starting date is described.
@manualRepairEndDate	The manual repair finishing date is described.

@autoRepairAutoStorePercentage	At the time of automatic storage, the threshold (%) for automatic repair is described.
@autoRepairManualStorePercentage	At the time of manual storage, the threshold (%) for automatic repair is described.
@manualRepairAutoStorePercentage	At the time of automatic storage, the threshold (%) for manual repair is described.
@manualRepairManualStorePercentage	At the time of manual storage, the threshold (%) for manual repair is described.
@optionValue	Option values relevant to content repair control are described. Specific values are not specified in this standard.
receptionSchedule	Reception schedule information about requests for content repair is described. Refer to Table 6-2.
postReceptionReport	Reception report control information is described.
@offsetTime	Offset time(s) is/are described.
@randomTimePeriod	Random time period(s) is/are described.
@samplePercentage	The threshold (%) for reception reports is described.
@reportType	Report-type information is described.
receptionSchedule	Reception schedule information is described. Refer to Table 6-2.

Table 6-2: Definitions regarding receptionSchedule

Element/name of attribute	Definition
receptionSchedule	The reception schedule information about a request for content completion is described.
serverURI	The URL of the content server is described.
receptionPeriod	The reception period information about a request for content repair is described.
receptionCycleStartTime	The reception starting time within the server reception period is described.
receptionCycleEndTime	The reception finishing time within the server reception period is described.

6.2.2.3 Session Description

Session Description is the SDP format data used in a FLUTE session. It is described in the

sessionDescription element of the User Service Description.
Session «Description is described in the following order. ("*" represents optional.)

Session Description
- v=　(protocol version)
- o=　(owner/creator and session identifier).
- s=　(session name)
- i=* (session information)
- u=* (URI of description)
- c=* (connection information - not required if included in all media)
- b=* (bandwidth information)
- ＜Time description＞
- z=* (time zone adjustments)
- a=* (zero or more session attribute lines)
- ＜Media description＞

Each field of Time description
- t=　(time the session is active)
- r=* (zero or more repeat times)

Each field of Media description
- m=　(media name and transport address)
- i=* (media title)
- c=* (connection information - optional if included at session-level)
- b=* (bandwidth information)
- a=* (zero or more media attribute lines)

The details of each field are shown below.

v (Protocol Version)

Content　：Version of SDP
Field　：v = 0 (fixed)

o (Origin)

Content　：　Originator information of Session Description
Field　：　o=<username> <session id> <version> <network type> <address

type> <address>

Sub-field : Username: User login name of the originator
Session id: Session identification information (Unix time format)
Version: Version of Session Description information (Unix time format)
Network type: Network type “IN”
Address type: Type of address “IP4,” “IP6”
Address: IP address in accordance with address type

s (Session Name)

Content : Name of session designated in Session Description

Field : s=<session name>

i (Session and Media Information)

Content : Information about session or media

Field : i=<session/media description>

u (URI)

Content : Reference to additional information

Field : u=<URI>

c (Connection Data)

Content : Destination address to session

Field : c=<network type> <address type> <connection address>[/<ttl>] (Note1)[/<number of addresses>](Note 2)

Sub-field : Network type: Network type “IN”
Address type: Kind of address “IP4,” “IP6”
Connection address: IP address in accordance with address type
ttl: Effective period of packets (number of hops capable of relay)
Number of addresses: Number of multi-cast groups to be used

Note 1: Not available for use in IPv4 unicast, IPv6 unicast, and IPv6 multicast

Note 2: Default is regarded as “1”, not available for use in IPv4 unicast and IPv6 unicast

b (Bandwidth)

Content : Designation of bandwidth

Field : b=<modifier>:<bandwidth-value>

Sub-field : Modifier: Identification information about the destination of the bandwidth (“CT,” “AS,” “RR,” etc.)
Bandwidth value: Bandwidth used by the modifier, in units of kbps

t (Times)

Content : Broadcasting period starting time and broadcasting finishing time of the content

Field : t=<start time> <stop time>

Sub-field : Start time: Broadcasting period starting time (Unix time format)
Stop time: broadcasting period finishing time (Unix time format)

r (Repeat Times)

Content : Repetitive designation of session

Field : r=<repeat interval> <active duration> <list of offsets from start-time>

Sub-field : Repeat interval: Repeat interval
Active duration: Active period
List of offsets from start-time: List of offsets from starting time

z (Time Zones)

Content : Designation of time zones

Field : z=<adjustment time> <offset> <adjustment time> <offset> ....

Sub-field : Adjustment time: Adjusting time from a base time

Offset: Offset from the starting time

a (Attributes)

Content : Designation of attributes

Field : a=<attribute>
a=<attribute>:<value>

Sub-field : Attribute: Name of attribute
Value: Value of attribute

The main attributes to be used are as follows.

TSI

Content : Designation of TSI

Field : a=flute-tsi:＜tsi＞

Sub-field : tsi: TSI value to be used

FEC

Content : Reference to the FEC information declaration to be used

Field : a=FEC:<fec-ref>

Sub-field : fec-ref: FEC-declaration identification information

FEC-declaration

Content : FEC information declaration

Field : a=FEC-declaration:<fec-ref> fec-enc-id=<encode id>
[;fec-inst-id=<instance id>]

Sub-field : fec-ref: Identification information about FEC information declaration within SDP
encode id: FEC Encoding ID
instance id: FEC Instance ID (optional)

FEC-OTI-extension

Content　：OTI unique to an FEC code needed for a recipient to restructure an FEC payload

Field　：a=FEC-OTI-extension:<fec-ref> <oti-extension>

Sub-field　：fec-ref: Identification information about FEC information declaration within SDP
oti-extension: Object Transmission Information unique to an FEC code
BASE64 format

m (Media Announcements)

Content　：Details of media information

Field　：m=<media> <port>/<number of port> <transport> <fmt list>

Sub-field　：Media: Type of media (“application” is set in the FLUTE session.)
Port: Port number to be used
Number of ports: Number of port to be used
Transport: Transmission protocol (“FLUTE/UDP” is set in the FLUTE session.)
fmt list: List of payload types (“0” is set in the FLUTE session.)

6.2.2.3.1 Extension of SDP

In order for receivers to secure the memory capacity needed for the storage of content, the following parameters are extended in Media Description.

StorageDemands

Content　：Capacity of the memory device needed for the storage of content

Field　：a=storageDemands:<size>

Sub-field　：Size: Memory capacity (in units of kbs)

In addition, the following parameters are extended in Media Description with the aim of

imparting the version information and broadcasting schedule information of the transmission file object.

TransmissionSchedule

Content : Sending object information (version and broadcasting schedule)

Field : a=transmissionSchedule:<content-location> [version=<version> number=<sendnumber> <schedule>] (Note 1)

Sub-field : Content-location: Information about a content's location
Version: Version information about a sending object

: Sendnumber: Sending order
Schedule: Sending starting time/sending finishing time
Sending starting time <YYYY-MM-DDThh:mm:ss+hh:mm> (Note 2)
Sending finishing time <hh:mm:ss+hh:mm>
* A description of the sending object information in a collective manner is possible. In that case, the name of each object file is omitted in the information about the content location, and the name of the representative path is described.
Example: a=transmissionSchedule:/image/ version=201105150900 number=1 2011-05-15T00:00:00+09:00 00:00:30+09:00 number=2 2011-05-15T03:00:00+09:00 03:00:30+09:00 number=3 2011-05-15T03:00:00+09:00 06:00:30+0900
Note 1: The omission of those within [] is possible.
Note 2: +hh:mm is the time zone offset.

6.2.2.4 Associated Delivery Procedure Description

Associated Delivery Procedure Description provides a regulation for the processing to be conducted by receivers after the transmission of download-type content. This includes a repair procedure for files when the loss of a packet is detected in a FLUTE session and a reception reporting procedure that reports the completion of the reception of download-type content. Associated Delivery Procedure Description is described in the associatedProcedureDescription element of User Services Description.

6.2.2.4.1 Reception Reporting Procedure for Associated Delivery Procedure Description

Receivers are capable of notifying the reception report in accordance with the postReceptionReport procedure for Associated Delivery Procedure Description. However, the notification method for reception reports, schemas, and semantics are stipulated separately by

service providers.

6.2.2.5 Location Resolution of Transmission Control Metadata

A location resolution can be achieved for transmission control metadata by using the following method. The location of transmission control metadata can be implemented first by acquiring the content reference identifier described after /TVAMain/ProgramDescription/ProgramInformationTable/ProgramInformation/@programId of the metadata (program information element), which points to the download-type broadcasting utilization unit content, and then by acquiring the URL described after /TVAMain/ProgramDescription/ProgramLocationTable/OnDemandService/OnDemandProgram /ProgramURL of the metadata (program location information element) where the content reference identifier identical to the above-cited content reference identifier is described.

6.3 Metadata Delivery Operation

For the metadata delivery means, the following are envisaged.

- Transmission by download-type broadcasting
- Supply from the server via the communication network

Meanwhile, the following is envisaged as the timing for receivers to acquire the metadata.

- Simultaneous acquisition of EPG/ECG metadata and transmission control metadata

In light of the above-mentioned means for delivery and the acquisition timing by the receiver, a guideline for delivery operation is indicated for the case of transmitting metadata by broadcasting and for the case of transmission by the communication network.

6.3.1 Broadcasting Transmission Operation

As the metadata delivery system used in download-type broadcasting services, two systems: metadata delivery system A and metadata delivery system B, are stipulated as follows.

Metadata delivery system A is a metadata delivery system where the metadata of the content broadcast within a certain period of time is delivered repetitively in a cyclic manner. On the other hand, metadata delivery system B is a metadata delivery system where the metadata of the content broadcast within a certain period of time is delivered based on a broadcasting schedule. Note that the delivery cycle in metadata delivery system A and the broadcasting schedule in metadata delivery system B shall be separately settable by service providers according to their own choice.

6.3.1.1 Brief Concept of Metadata Delivery Operation in Metadata Delivery System A

The delivery of metadata is made using a metadata delivery FLUTE session. Delivery content varies depending on the metadata categories.

Table 6-3: Relationship between the metadata category and the delivery content

Metadata category	Delivery content	
	EPG/ECG metadata	Transmission control metadata
Real-time-type metadata for broadcasting	✓	-
Download-type metadata for broadcasting	✓	✓

✓ Files to be delivered - Files not to be delivered

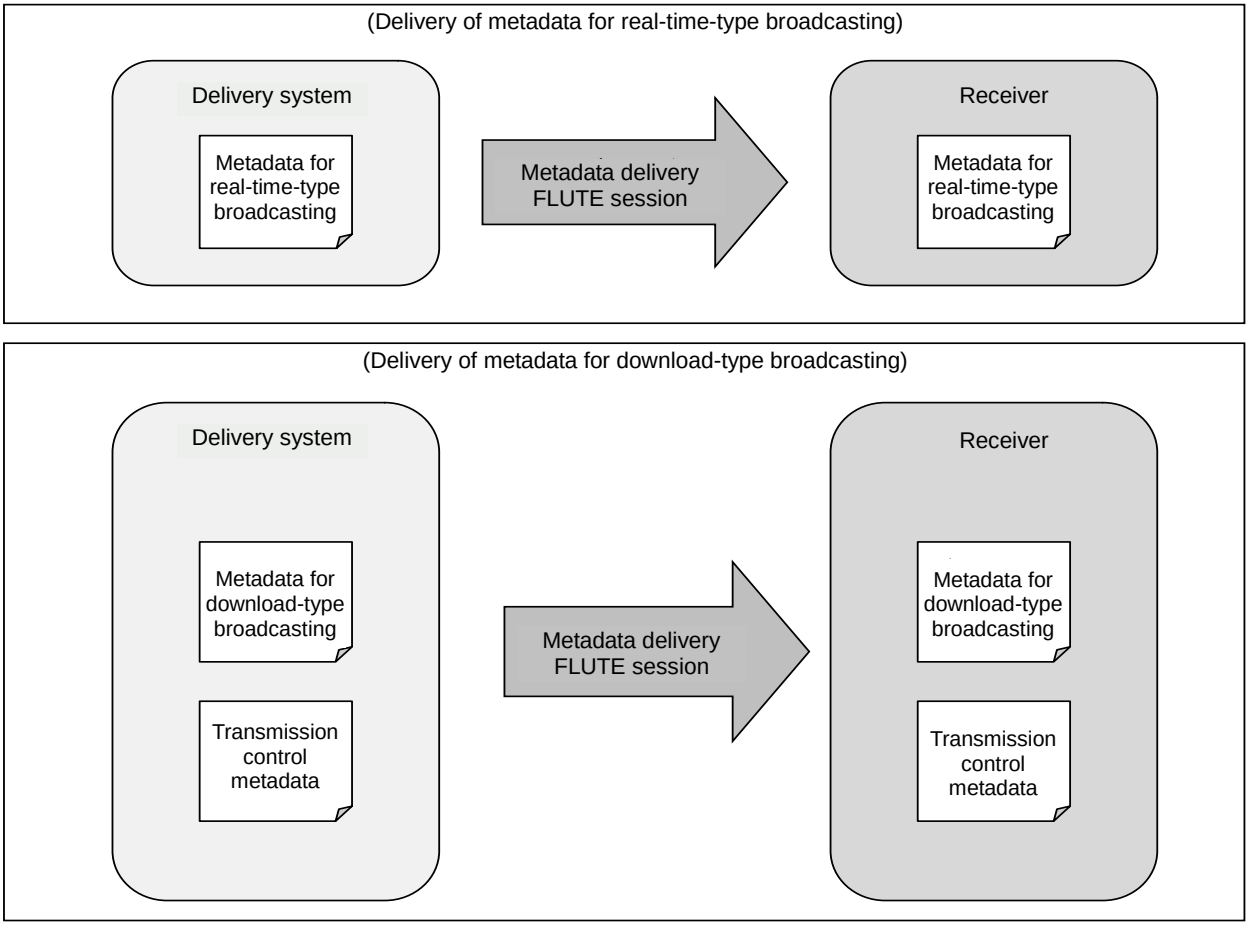

Fig. 6-2: Conceptual diagram for metadata delivery operation in metadata delivery system A

6.3.1.2 Brief Concept of Metadata Delivery Operation in Metadata Delivery System B

The delivery of metadata is made using the content delivery FLUTE session. Delivery content varies depending on metadata categories. Metadata is delivered as download-type content in metadata delivery system B.

Table 6-4: Relationship between the metadata category and the delivery content

Metadata category	Delivery content	
	EPG/ECG metadata	Transmission control metadata
Real-time-type metadata for broadcasting	✓	-
Download-type metadata for broadcasting	✓	✓

✓ Metadata to be delivered - Metadata not to be delivered

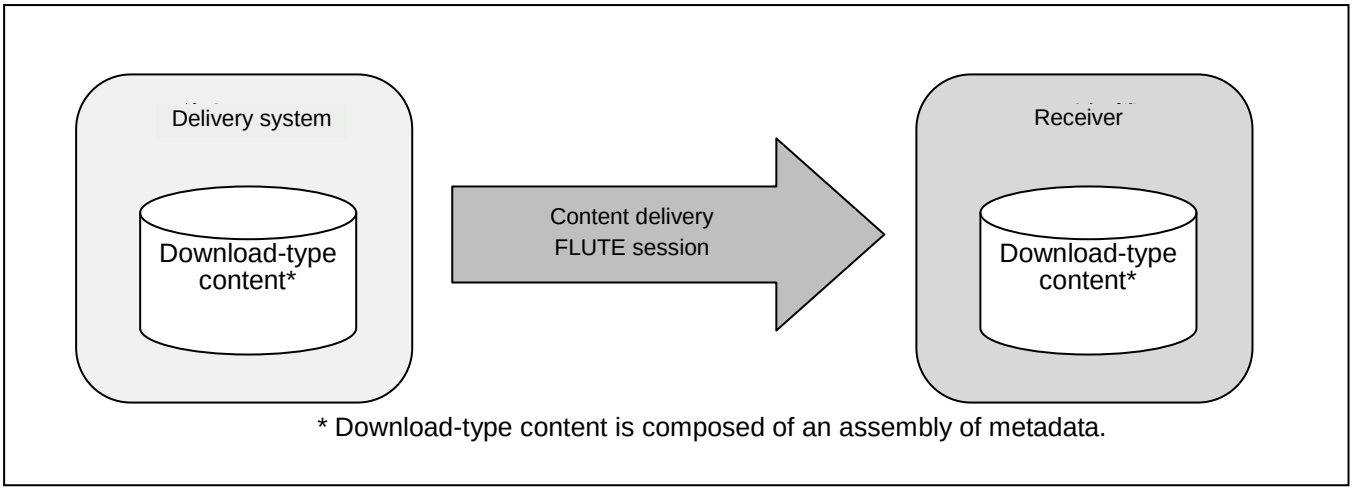

Fig. 6-3: Conceptual diagram for metadata delivery operation in metadata delivery system B

6.3.1.3 Reference Destination Information Regarding the Broadcasting Schedule Defined by Metadata

The reference destination of the metadata broadcasting schedule needed for the grouping of the delivery is shown for each metadata category as follows.

Table 6-5: Relationship between the metadata category and the reference destination for the broadcasting schedule

Metadata category	Reference destination	Note
Real-time-type metadata for broadcasting	ProgramLocationTable/BroadcastEvent/ PublishedStartTime	
Download-type metadata for broadcasting	ProgramLocationTable/OnDemandService/ OnDemandProgram/StartOfAvailability	

6.3.1.4 Transmission File Format

When transmitting metadata, the file format stipulated below is used. The transmission format for EPG/ECG metadata shall be based on Section 3.4.3.1 of ARIB STD-B38. Furthermore, when transmission control metadata is transmitted, the multiple transmission control metadata documents in the files that store transmission control metadata are stored in the body portion after the HTTP header format in Multipart/Mixed (RFC2046 format). Note that this format is also employed when one transmission control metadata document is stored. The following unique header is added to an HTTP header portion.

X-latestversion: <maximum-version>

The maximum value (maximum-version) of the version in the transmission control metadata stored in the body portion is indicated in YYYYMMDDhhmmss format.

Transmission control metadata is stored in each part in the binary BiM-translated format, and the following information is added to each part header. Note that in all part headers the Content-Length field is used, but the Content-Location field is not used.

Content-Description: <CRID>,<Version>

CRID information (userSerivceDescription/program element) and the version of userSerivceDescription/program element that is handled by the transmission control metadata, which is stored in parts, are indicated.

Content-Type: application/X-arib-meta+bim

This indicates that the transmission control metadata is stored in the binary-translated (BiM) format. Shown below is an example of the files that store transmission control metadata.

Example

Content-Type: multipart/mixed; boundary=gc0p4Jq0M2Yt08j34c0p

Content-Length: 80192

X-latestversion: 20110331000000

--gc0p4Jq0M2Yt08j34c0p

Content-Type: application/X-arib-meta+bim

Content-Description:crid://example.jp/20110401/fd/0010/cid1,20110331000000

Content-Length: 6452

BiM data (binary)

} 1st transmission control metadata

--gc0p4Jq0M2Yt08j34c0p

...

--gc0p4Jq0M2Yt08j34c0p

Content-Type: application/X-arib-meta+bim

Content-Description:crid://example.jp/20110401/fd/0010/cid2,20110331000000

Content-Length: 6500

BiM data（binary）

} 2nd transmission control metadata

--gc0p4Jq0M2Yt08j34c0p--

6.3.2 Communication Transmission Operation

6.3.2.1 Outline of the Metadata Delivery System

The operation of metadata delivery by utilizing communication is stipulated in this section.

Making a request for acquisition with the search conditions capable of identifying the metadata that has been added enables one to acquire a list of the metadata in question, its CRID, and others. This delivery system is based on the premise of bi-directional communication by TCP/IP. An outline of the delivery is shown in Fig. 6-4.

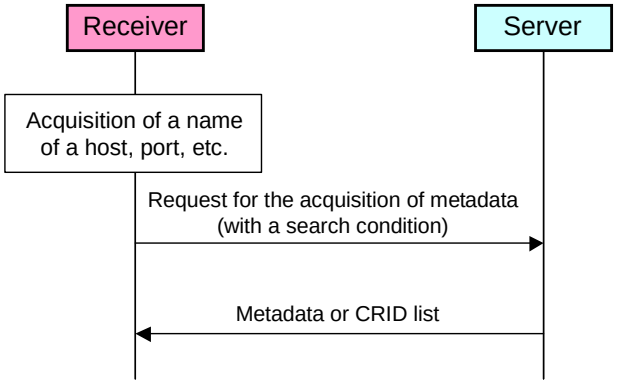

Fig. 6-4: Outline of metadata delivery

6.3.2.2 Premised Protocol

The transmission for a request of acquisition (transmission for a request for a search) and its corresponding reception of the search result is conducted either by HTTP (RFC2616) or by HTTPS (RFC2818).

6.4 Storage Operation of Metadata

6.4.1 Guideline for the Storage of Metadata

The method for realizing the storage of metadata (storage method, storage directory, etc.) is not stipulated in this standard. However, the validity date of stored metadata is managed in conformity to Section 6.4.4 of this standard.

In addition, when the content corresponding to metadata is in a stored state, the corresponding metadata shall be stored within the storage directory (for details, refer to Section 3.5 of ARIB STD-B38) of the content in question.

6.4.2 Addition/Updating of Metadata

The use of fragment identification for metadata belonging to the same authority allows receivers to identify logical additions/updating in units of fragments of metadata. With the use of fragmentVersion defined in Section 3.2.3.2 of ARIB STD-B38, the identification of fragment is conducted.

When the fragmentId of the metadata acquired is a new one, it is possible to carry out additional processing for storage by the receiver judging it as an addition of metadata. Meanwhile, if the fragmentId of the acquired metadata is already in existence in the receiver, and when fragmentVersion is new as compared with the fragment of metadata that has already been stored, the updating processing for metadata can be performed.

6.4.3 Elimination of Metadata

A judgment as to whether metadata can be eliminated or not is made on the basis of the expiration date and the storage state of the content corresponding to the metadata in question. The metadata shall not be eliminated if the period of validity is found unexpired and when the content corresponding to the metadata is in a stored state, even if the period of validity is expired. Note that the means for elimination from terminals are not stipulated in this standard.

6.4.4 Expiration Date of Metadata

As for the expiration date of metadata, the final expiration date (Japan Standard Time) is described in the fragmentExpirationDate attribute (for details, refer to Section 3.2.3.2 of ARIB STD-B38) in dateTime format (YYYY-MM-DDThh:mm:ss+hh:mm format). Time zone hh:mm shall be fixed at +09:00 in Japan.

6.5 Transmission Control Metadata and the Storage of Download-type Content

6.5.1 Download-type Content and Transmission Control Metadata

One piece of transmission control metadata corresponds to one piece of download-type content, which is a storage unit. The download-type content is uniquely determined by the information that identifies a specific FLUTE session, and the information that identifies the broadcasting schedule from the broadcasting starting time consist of both information being included in transmission control metadata. The relationship between the transmission control metadata and control information each stipulated by the download-type content transmission system is shown in Fig. 6-5.

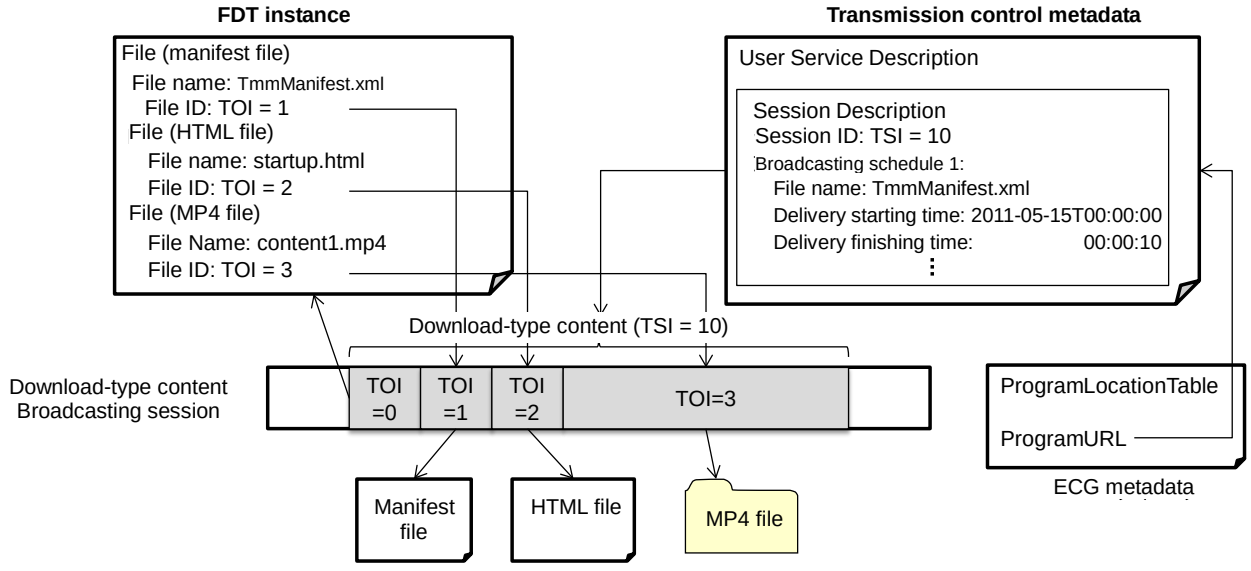

Fig. 6-5: Reference relationship between transmission control metadata and download-type content

Fig. 6-5 shows an example of transmitting download-type content in which four files: FDT

instance (TOI = 0), manifest file (TOI = 1), HTML file (TOI = 2), and MP4 file (TOI = 3), are transmitted in the broadcasting session of download-type content. In addition, an example of the description of transmission control metadata at this time is shown in Annex A.2.

6.5.2 Example of Basic Storing Action

On the basis of transmission control metadata and download-type content transmission systems, receivers are capable of realizing the reception and storage of download-type content in accordance with the following procedure.

(i) Reservations are made for storage based on the transmissionSchedule attribute described in the sessionDescription element of the transmission control metadata, which was acquired for use in the navigation of download-type content.

(ii) A storing action begins a few seconds before the transmission starting time described in the above-mentioned transmissionSchedule attribute. First, the FLUTE session is received based on the TSI value indicated in the flute-tsi attribute, which is described in the sessionDescription element of the transmission control metadata, and the following processing is implemented for the stored packets along with the start of storage in a content storage portion from the transmission starting time described in the transmissionSchedule attribute.

(iii) As the first step in the storage processing, FDT instance at TOI = 0 is acquired in the LCT header. Next, this is analyzed followed by the process of relating the object file subject to storage that is indicated in the Content-Location attribute of each File element described within the FDT instance to the TOI value indicated in the TOI attribute.

(iv) For the above-mentioned object file subject to storage, the writing processing is completed in accordance with the Content-Length attribute of the File element described within the FDT instance (in the case of no loss of packets).

(v) Reception processing is completed upon the completion of the writing processing for all object files described in the above-mentioned FDT instance, or at the transmission finishing time, which is described in the transmissionSchedule attribute determined by the sessionDescription element of the transmission control metadata.

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Chapter 7: Manifest File

7.1 Outline

Download-type content is an assembly of multiple files that include one manifest file and one or more resources, and the structure shown in Fig. 7-1 constitutes the content of one utilization unit.

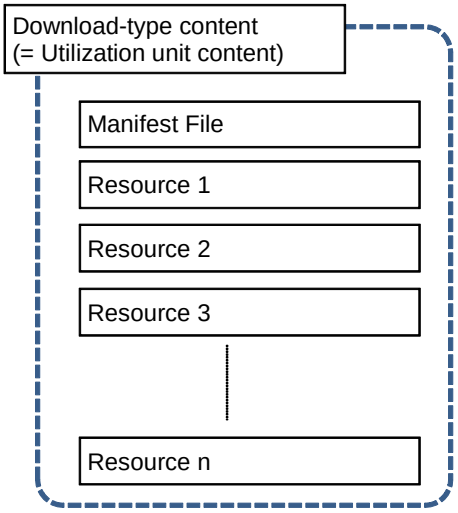

Fig. 7-1: Configuration of download-type content

The manifest file in this standard refers to one of the configuration files of the utilization unit content in download-type broadcasting services and is a term referring to the file in which the information relevant to configuration file management and scenario management is described in XML document format. In configuration file management, the encrypted state of each file, the utilization conditions as file storing relevance to the utilization conditions of utilization unit content, and others are defined along with a list of the files constituting utilization unit content. On the other hand, the conditions relevant to the scenario of utilization unit content, such as the playback/display order of the file and others, are defined in the scenario management.

The manifest file is the first file referred to from among multiple files constituting utilization unit content when stored utilization unit content is playbacked/displayed by the renderer, and is processed in the secure area of the renderer. One manifest file is defined without fail for each piece of utilization unit content. However, the manifest file shall not be defined for EPG/ECG metadata, and the manifest file is not included as the configuration file of the EPG/ECG metadata.

The details of operations are specified by service operators.

7.2 Description Format of the Manifest File

The semantics of the manifest file is defined in Table 7-1. In addition, each element and attribute of the manifest file are shown below. Note that for the schema relevant to the manifest file and for an example of its description, refer to Annex B.

Table 7-1: Definition of the manifest file

Name of element/attribute	Definition
manifests	This is the root element of the manifest file and includes multiple versions of the manifest element.
manifest	This indicates the definition element of each version.
@version	This indicates the version of the manifest element.
assets	This indicates the container element for the inclusion of various types of resources constituting a piece of utilization unit content.
@count-asset-id	This indicates the representative file for counting the limitations of the number of playback.
asset	This defines the various resources constituting a piece of utilization unit content.
@id	This indicates the value that uniquely identifies the resources in the utilization unit content.
@src	This indicates the logical position of the resource and the file name.
@encrypted	This indicates whether there is any encrypted resource. This is regarded as “true” when omitted.
@value	This indicates the value of a parameter used by a resident application when the resource is playbacked/displayed.
@content-type	This indicates the types of resident applications capable of playbacking/displaying the resource. Refer to RFC2045 5. Content-type.
scene	This defines the scene in video resources.
@scene-id	This indicates the value that uniquely identifies the scene in a piece of utilization unit content.
@start	This indicates the starting time of a scene in hh:mm:ss.ms format. When omitted, this is regarded as the starting position of a video.

@end	This indicates the finishing time of a scene in hh:mm:ss.ms format. When omitted, this is regarded as the finishing position of a video.
scenario	This indicates the container element that defines the regeneration/display sequence of a piece of utilization unit content.
sequence	This indicates the element that defines the regeneration/display sequence of a resource.
@label	This indicates the name that uniquely identifies the <sequence> element.
@asset-idref	This indicates the attribute that designates the resource implementing regeneration/display in the <sequence> element.
@prev	In the <sequence> element, the previous resource to the resource designated by the asset-idref attribute in the playback/display sequence is shown. When the resource is omitted, the directly previous <sequence> element is interpreted as the previous resource in the playback/display sequence. Furthermore, "_first_" can be used as a reserved word.
@next	In the <sequence> element, a resource subsequent to the resource designated by the asset-idref attribute in the playback/display sequence is shown. When omitted, the directly subsequent <sequence> element is interpreted as the subsequent resource in the playback/display sequence. Furthermore, "_last_" can be used as a reserved word.
@time	In the <sequence> element, when the regeneration/display sequence to the resource designated by the asset-idref attribute makes a transition, the waiting time to the beginning of the playback/display of the resource in question is indicated. The unit is in milliseconds.

7.2.1 <manifests> Element

The <manifests> element is the root element of the manifest file and is the container element

for the inclusion of the manifest definition of multiple versions.

7.2.2 <manifest> Element

The <manifest> element is the manifest definition element of an individual version. The version of the manifest definition is described in the version attribute.

7.2.3 <assets> Element

The <assets> element is the container element for the inclusion of various resources constituting a piece of utilization unit content.

The count-asset-id attribute is the attribute for counting the number of viewings/listenings for the entire content. It is troublesome to count all the resources (those defined by the <asset> element) in order to count the number of viewing and listening content. Therefore, any one of the resources defined is counted as a representative, which is taken as the number of viewings and listenings for the entire content.

7.2.4 <asset> Element

The <asset> element is the element used for defining various resources constituting a piece of utilization unit content.

The id attribute is the unique value utilized to identify an asset. A description is given in the src attribute that includes the logical position (directory) of a targeted resource. It is possible to designate by encrypted attribute whether or not the resource is encrypted.

The content-type attribute is used for selecting the resident application appropriate for the processing of the resource. Moreover, the value attribute is used to make it possible to deliver a parameter to the resident application. Note that the specific value of the value attribute can be stipulated separately by service operators.

7.2.5 <scene> Element

The <scene> element is the element used for dividing the resource into several scenes.

The start attribute and end attribute refer to the starting time and finishing time of the scene within the video resource, respectively, and users can use these as a chapter of the video resource designated.

The scene-id attribute is the attribute used for identifying the scene and makes it possible to

implement prohibition control over the trick play of a scene designated by the attribute in question. This attribute is unique within the <manifest> element.

7.2.6 <scenario> Element

The <scenario> element is the container element used for defining the playback/display sequence of resources.

7.2.7 <sequence> Element

The <sequence> element is the element for defining the playback/display sequence of the resource defined by <asset>.

The label attribute is the name defined in this <sequence> and is a unique name within <sequence>.

The asset-idref attribute is the attribute that designates a resource and is designated by id of the <asset> element defined above. When an id that is not defined is designated, this is deemed as an invalid value and its <sequence> element is not interpreted.

The prev attribute and next attribute regard an entire scenario as a bidirectional digraph and define its playback/display sequence.

The next attribute value describes the label of <sequence> that leads to the next scene. It is also possible to designate multiple labels of <sequence> by comma (",") separation, and in this case, the branch of the playback/display sequence shall be implemented in the resident application side. "_last_" is defined as the special attribute value available for the next attribute. This indicates the completion of the content here. In the case where the next attribute is omitted, the next <sequence> element is regarded as the next node of the content. If the next <sequence> is missing, it is interpreted as "_last_".

As is the case with the next attribute value, the prev attribute value is also used to define the playback/display sequence. "_first_" is defined as the special prev attribute value indicating the resource that is playback/displayed first from among the utilization unit content. When omitted, the directly previous <sequence> element is interpreted as the previous node of the content. When there is no designation of "_first_", the first <sequence> element is interpreted as the starting resource of the utilization unit content.

The time attribute has a meaning when the resource is static (HTML file, still picture, etc.).

After a lapse of the time (milliseconds) that has been designated by the time attribute, the regeneration/display of the next resource begins.

Chapter 8: Data Transmission System

The data transmission system for transmitting files is stipulated in this chapter.

8.1 IP Packetizing of Files

Arbitrary files such as media files and metadata files are divided into a unit of constant length. After the AL-FEC coding and FLUTE packetizing of the arbitrary files are thus divided, a UDP header is added to the files, which is followed by header compression and the addition of a ULE header, and then the files are transmitted by MPEG-2 TS. An outline of the processing starting from content files up to the transmission by MPEG-2 TS is shown in Fig. 8-1.

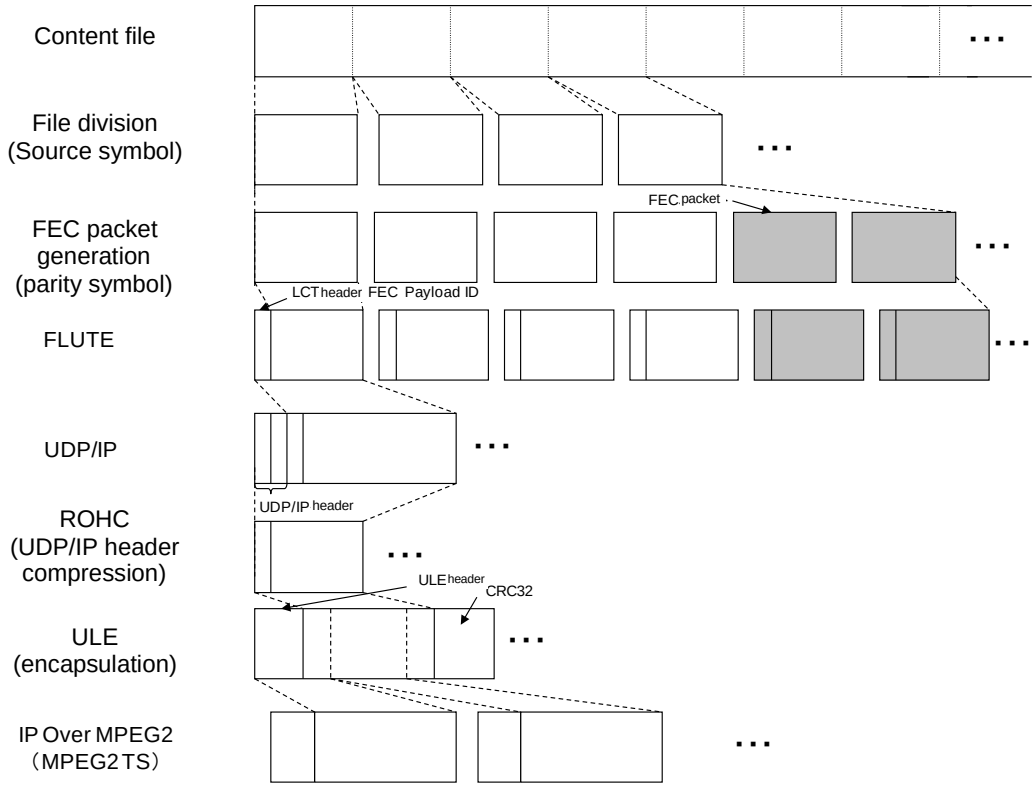

Fig. 8-1: Processing starting from a content file up to transmission by mpeg-2 ts

8.2 Transmission Method by FLUTE

8.2.1 FLUTE Packet Structure

The packet structure of FLUTE is shown below.

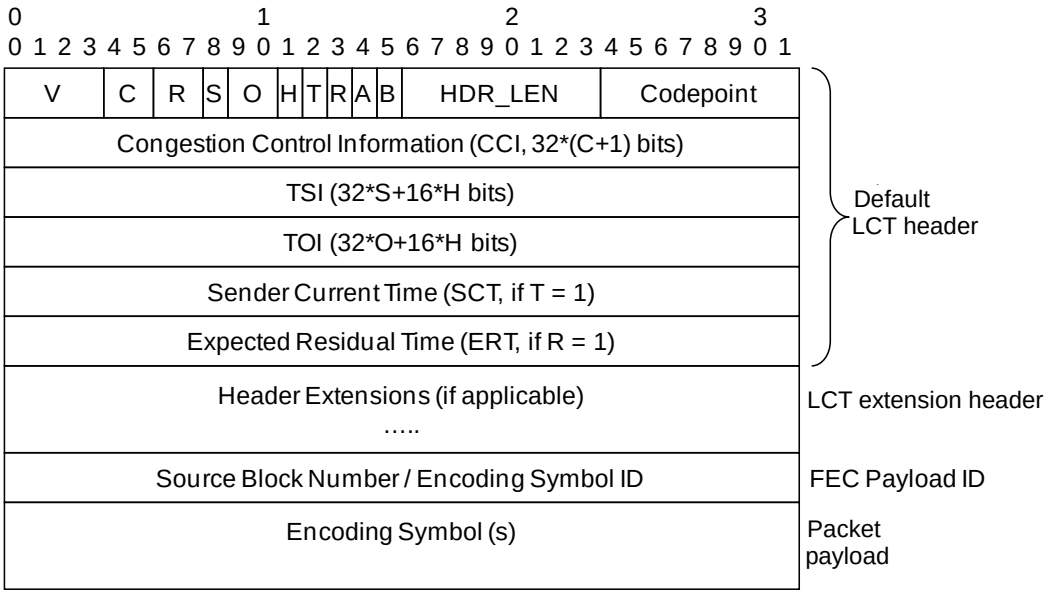

Fig. 8-2: FLUTE packet structure

The detail of each field is indicated below.

8.2.1.1 Default LCT Header

Table 8-1: Default LCT header parameter

Name of field	Size (bit)	Summary
V	4	ALC version number; this is set at 1.
C	2	Designation of CCI field length C = 0: 32 bits C = 1: 64 bits C = 2: 96 bits C = 3: 128 bits
R	2	Reserved
S	1	The TSI field length is designated in units of 32 bits.
O	2	The designation of TOI field length is in units of 32 bits.
H	1	The designation of TSI/TOI field length is in units of 16 bits.
T	1	Presence of an SCT field T = 0: No T = 1: Yes

Name of field	Size (bit)	Summary
R	1	Presence of an ERT field T = 0: No T = 1: Yes
A	1	Close session flag; the details are stipulated separately by an operation regulation.
B	1	Close Object flag; the details are stipulated separately by an operation regulation.
HDR_LEN	8	The LCT header length is designated in units of 32 bits.
CP	8	Codepoint; the details are stipulated separately by an operation regulation.
CCI	32	CCI information; the details are stipulated separately by an operation regulation.
TSI	32	Designates the TSI value
TOI	32	Designates the TOI value
SCT	32	The Sender Current Time is designated in units of ms.
ERT	32	The Expected Residual Time is designated in units of ms.

8.2.1.2 LCT Extension Header

(i) EXT_NOP

Header for invalidating an extension header; this is set when additional information is not transmitted in the extension header. The details of the format and the field are shown below.

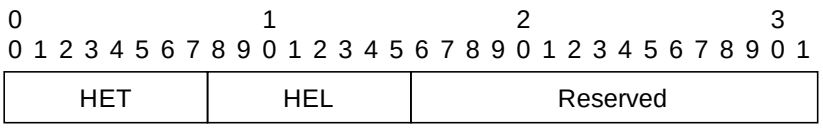

Fig. 8-3: EXT_NOP structure

Table 8-2: EXT_NOP parameter

Name of field	Size (bit)	Summary
HET (Header Extension Type)	8	Header Extension Type; this is set at "0".
HEL (Header Extension Length)	8	Header Extension Length Designates the total length of the extension header in units of 32 bits
Reserved	16	Unused region

(ii) EXT_FTI

This is a header used to transmit the information that is needed for the restructuring of an FDT instance. The details of the format and the field are shown below.

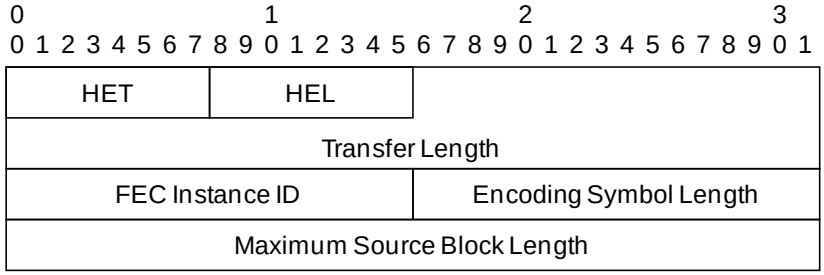

Fig. 8-4: EXT_FTI structure

Table 8-3: EXT_FTI parameter

Name of field	Size (bit)	Summary
HET (Header Extension Type)	8	Header Extension Type; this is set at "64".
HEL (Header Extension Length)	8	Header Extension Length; designates the total length of extension header in units of 32 bits.
Transfer Length	48	File length is designated in units of bytes; this is set at the length of FDT Instance.
FEC Instance ID	16	Describes FEC Encoding ID
Encoding Symbol Length	16	Length of the encode symbol

Name of field	Size (bit)	Summary
Maxmum Source Block Length	32	The number of source symbols in a source block; this is set at the maximum number of units in one block described in transmission file attribute information.

(iii) EXT_FDT

This is a header used to transmit the identification information about FDT instance that is included in packet payload. The details of the format and field are shown below.

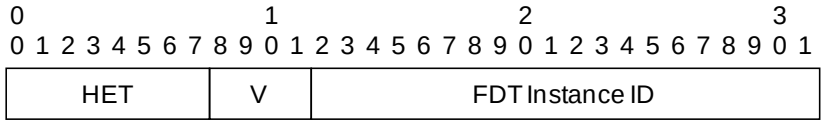

Fig. 8-5: EXT_FDT structure

Table 8-4: EXT_FDT parameter

Name of field	Size (Bit)	Summary
HET (Header Extension Type)	8	Header Extension Type; this set at “192”.
V (Version)	4	Version of FLUTE
FDT Instance ID	20	FDT Instance number

8.2.1.3 FECPayload ID

The encode-symbolized payload information stored in a packet payload portion is indicated. When LDPC-Staircase is used, it is desirable to follow the system described in Annex C.

8.2.1.4 Packet Payload

The encode-symbolized payload is stored. After an object (content and FDT instance) is divided into source blocks, it is encode-symbolized by the FEC schema. Each encode symbol is identified by a FEC Payload ID.

8.2.2 FDT Instance

FDT instance is the data in XML format that describes the detailed information about objects transmitted within the FLUTE session. Information is mapped to the object transmitted by a TOI value.

8.2.2.1 Delivery of FDT Instance

FDT instance is delivered (first-time delivery) without fail prior to the delivery of the object transmitted. After the first-time delivery, the object is transmitted but it is possible to deliver the FDT instance again during the course of object transmission. The re-delivery of FDT instance allows receivers to receive FDT instance even in the midstream of the FLUTE session, thereby making it possible to receive the transmitted object.

8.2.2.2 Semantics of FDT Instance

The semantics of FDT instance are defined below.

Table 8-5: Semantics of FDT instance

	Definition
FDT-Instance	FDT instance information
@Expires	The validity date of FDT instance is described. This is expressed in UNIX time format.
File	The file object information to be transmitted is described.
@Content-Location	The URL of the content is described.
@TOI	Object identification information is described.
@Content-MD5	The message digest of the file object is described.
@FEC-OTI-FEC-Encoding-ID	The FEC Encoding ID is described. For the usage method, RFC5052 shall be followed.
@FEC-OTI-FEC-Instance-ID	The FEC Instance ID is described.
@FEC-OTI-Maximum-Source-Block-Length	The maximum number of source symbols within the source block is described.
@FEC-OTI-Encoding-Symbol-Length	The length of the encode symbol is described.
@FEC-OTI-Max-Number-of-Encoding-Symbols	The maximum number of encode symbols within the source block is described.
@FEC-OTI-Scheme-Specific-Info	A unique parameter is described for each FEC coding algorithm to be applied.

8.2.2.3 Extension of FDT

In addition to the information described in 8.2.2.2, transmitting the extension information

designated by service operators to FDT shall be possible.

8.2.3　Application Layer FEC

Transmission data is divided into multiple source symbols, and parity symbols are generated from these source symbols by application layer FEC coding. Encode symbols are formed by combining the source symbols and the parity symbols together. The source symbols that have disappeared in a transmission path can be restored from the source symbols and parity symbols that have been successfully received.

The algorithm applied to the application layer FEC is stipulated separately by an operation regulation. When LDPC-Staircase is used, it is desirable to follow the method described in Annex C.

8.3 UDP/IP Transmission

Transmission by UDP/IP shall be based on Item 3.4 “IP packet,” Chapter 3, Part II of ARIB STD-B32.

8.4 IP Header Compression

IP header compression shall be based on Item 3.7 “Compressed IP packet,” Chapter 3, Part II of ARIB STD-B32.

8.5 ULE Packet

ULE packet shall be based on Item 3.6 “ULE packet,” Chapter 3, Part II of ARIB STD-B32.

8.6 Multiplexing System

The multiplexing system shall be based on the regulations for MPEG-2 Systems (ITU-T H.222.0|ISO 13818-1).

8.6.1　PSI/SI

PSI and SI shall be the signals that comply with ARIB STD-B10.

The types of PSI tables and SI tables shall be based on Item 4.1 “Types of tables,” Chapter 4, Part I of ARIB STD-B10.

In addition, the allocation of the PID value of the transport stream packet that transmits the section of PSI/SI shall be based on Item 5.1 “PID for tables,” Part I of ARIB STD-B10, while the values (table_id) allocated to the identification of PSI and SI tables shall be based on Item 5.2

“Table identifier and transmission standard,” Part I of ARIB STD-B10.

The types of descriptors used in PSI/SI shall be based on Item 4.2 “Types of descriptor,” Part I of ARIB STD-B10. The types of descriptors used in INT shall be based on Item 4.3 “Types of descriptor used in INT,” Part I of ARIB STD-B10. In addition, the tag value allocated to the descriptor shall be based on Item 5.3 “Identifier of descriptors” and Item 5.4 “Identifier for descriptors used in INT,” Part I of ARIB STD-B10.

Each table, and the definition and structure of the descriptor, shall be based on Part II of ARIB STD-B10.

8.6.2 Selection of ULE Content

For the selection of the content transmitted by ULE from among the transport stream packets, it is desirable to use INT. For an example of the selection methods using INT, refer to Attachment Item 1.15 “IP/MAC notice table (INT)” of ARIB STD-B10.

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Annex A: Transmission Control Metadata

A.1 XML Schema of Transmission Control Metadata

The XML schema of transmission control metadata is defined as follows.

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema
  xmlns="http://www.arib.or.jp/tmm/fci/2011/03"
  xmlns:xs="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.arib.or.jp/tmm/fci/2011/03"
  elementFormDefault="qualified">

<xs:element name="userServiceDescription" type="userServiceDescriptionType"/>
  <xs:complexType name="userServiceDescriptionType">
    <xs:sequence>
      <xs:element name="version" type="xs:unsignedLong"/>
      <xs:element name="program" type="CRIDType"/>
      <xs:element name="sessionDescription" type="SDPType" minOccurs="0"/>
      <xs:element name="associatedProcedureDescription"
                  type="associatedProcedureDescriptionType" minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="CRIDType">
    <xs:restriction base="xs:anyURI">
      <xs:pattern value="(c|C)(r|R)(i|I)(d|D)://.*/.*"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="SDPType">
    <xs:restriction base="xs:string"/>
  </xs:simpleType>
  <xs:complexType name="associatedProcedureDescriptionType">
    <xs:sequence>
      <xs:element name="postFileRepair" type="repairProcedureType" minOccurs="0"/>
      <xs:element name="postReceptionReport" type="reportProcedureType"
minOccurs="0"/>
    </xs:sequence>
  </xs:complexType>
  <xs:complexType name="basicProcedureType">
    <xs:sequence>
      <xs:element name="receptionSchedule" type="receptionScheduleType"
                                                maxOccurs="unbounded"/>
    </xs:sequence>
    <xs:attribute name="offsetTime" type="xs:unsignedLong" use="optional" default="0"/>
    <xs:attribute name="randomTimePeriod" type="xs:unsignedLong" use="required"/>
  </xs:complexType>
```

```
<xs:complexType name="receptionScheduleType">
  <xs:sequence>
    <xs:element name="serverURI" type="URLType"/>
    <xs:element name="receptionPeriod" type="receptionPeriodType" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>
<xs:simpleType name="URLType">
  <xs:restriction base="xs:anyURI">
    <xs:pattern value="(h|H)(t|T)(t|T)(p|P)(s|S)?://.*/.*"/>
  </xs:restriction>
</xs:simpleType>
<xs:complexType name="repairProcedureType">
  <xs:complexContent>
    <xs:extension base="basicProcedureType">
      <xs:attribute name="manualRepairStartDate" type="xs:dateTime" use="optional"/>
      <xs:attribute name="manualRepairEndDate" type="xs:dateTime" use="optional"/>
      <xs:attribute name="autoRepairAutoStorePercentage "
                                          type="percentageType" use="optional"/>
      <xs:attribute name="autoRepairManualStorePercentage"
                                          type="percentageType" use="optional"/>
      <xs:attribute name="manualRepairAutoStorePercentage"
                                          type="percentageType" use="optional"/>
      <xs:attribute name="manualRepairManualStorePercentage"
                                          type="percentageType" use="optional"/>
      <xs:attribute name="optionValue" type="xs:string" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:complexType name="receptionPeriodType">
  <xs:sequence>
    <xs:element name="receptionCycleStartTime" type="xs:time"/>
    <xs:element name="receptionCycleEndTime" type="xs:time"/>
  </xs:sequence>
</xs:complexType>
<xs:complexType name="reportProcedureType">
  <xs:complexContent>
    <xs:extension base="basicProcedureType">
      <xs:attribute name="samplePercentage" type="percentageType" use="optional"/>
      <xs:attribute name="reportType" type="xs:unsignedInt" use="optional"/>
    </xs:extension>
  </xs:complexContent>
</xs:complexType>
<xs:simpleType name="percentageType">
  <xs:restriction base="xs:byte">
    <xs:minInclusive value="0"/>
    <xs:maxInclusive value="100"/>
  </xs:restriction>
```

```
  </xs:simpleType>
</xs:schema>
```

A.2 Example of a Description of Transmission Control Metadata

An example of description of transmission control metadata is shown below.

```
<?xml version="1.0" encoding="UTF-8"?>
<userServiceDescription xmlns="http://www.arib.or.jp/tmm/fci/2011/03">
  <version>20110501090000</version>
  <program>crid://example.com/fc/2011/c00123</program>
  <sessionDescription>
    <![CDATA[
      v=0
      o=example.com 1305385200 1304143200 IN IP4 192.168.0.128
      s=crid://example.com/fc/2011/c00123
      t=1305385200 1305396300
      m=application 12345 FLUTE/UDP 0
      c=IN IP4 224.2.1.1/127
      a=flute-tsi:10
      a=storageDemands:65536
      a= transmissionSchedule:/TmmManifest.xml version=20110501090000
                number=1 2011-05-15T00:00:00+09:00 00:00:10+09:00
                number=2 2011-05-15T03:00:00+09:00 03:00:10+09:00
      a= transmissionSchedule:/startup.html version=20110501090000
                number=1 2011-05-15T00:00:10+09:00 00:00:20+09:00
                number=2 2011-05-15T03:00:10+09:00 03:00:20+09:00
      a= transmissionSchedule:/video/content1.mp4 version=20110501090000
                number=1 2011-05-15T00:00:20+09:00 00:05:00+09:00
                number=2 2011-05-15T03:00:20+09:00 03:05:00+09:00 ]]>
  </sessionDescription>
  <associatedProcedureDescription>
    <postFileRepair
      offsetTime="5"
      randomTimePeriod="10"
      autoRepairAutoStorePercentage ="50"
      autoRepairManualStorePercentage ="50"
      manualRepairAutoStorePercentage ="50"
      manualRepairManualStorePercentage ="50">
      <receptionSchedule>
        <serverURI>http://example.com/fileRepair1_Server/</serverURI>
        <receptionPeriod>
          <receptionCycleStartTime>09:00:00+09:00</receptionCycleStartTime>
          <receptionCycleEndTime>16:00:00+09:00</receptionCycleEndTime>
        </receptionPeriod>
      </receptionSchedule>
    </postFileRepair>
  </associatedProcedureDescription>
</userServiceDescription>
```

Annex B: Manifest File

B.1 XML Schema of the Manifest File

The XML schema of the manifest file is defined as follows.

```
<?xml version="1.0" encoding="UTF-8"?>
<xsd:schema
  xmlns="http://www.arib.or.jp/tmm/manifest/2011/03"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  targetNamespace="http://www.arib.or.jp/tmm/manifest/2011/03"
  elementFormDefault="qualified">

  <xsd:element name="manifests">
    <xsd:complexType>
      <xsd:sequence>
        <xsd:element name="manifest" type="manifest-type" maxOccurs="unbounded"/>
      </xsd:sequence>
    </xsd:complexType>
  </xsd:element>

  <xsd:complexType name="manifest-type">
    <xsd:sequence>
      <xsd:element name="assets" type="assets-type"/>
      <xsd:element name="scenario" type="scenario-type"/>
    </xsd:sequence>
    <xsd:attribute name="version" type="version-type" use="required"/>
  </xsd:complexType>

  <xsd:complexType name="assets-type">
    <xsd:sequence>
      <xsd:element name="asset" type="asset-type" maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="count-asset-id" type="asset-id-type"/>
  </xsd:complexType>

  <xsd:complexType name="asset-type">
    <xsd:sequence>
      <xsd:element name="scene" type="scene-type" minOccurs="0"
                                                    maxOccurs="unbounded"/>
    </xsd:sequence>
    <xsd:attribute name="id" type="asset-id-type" use="required"/>
    <xsd:attribute name="src" type="file-type" use="required"/>
    <xsd:attribute name="encrypted" type="xsd:boolean" default="true"/>
    <xsd:attribute name="content-type" type="xsd:string"/>
    <xsd:attribute name="value" type="xsd:string"/>
  </xsd:complexType>
```

```
<xsd:complexType name="scene-type">
  <xsd:attribute name="scene-id" type="scene-id-type" use="required"/>
  <xsd:attribute name="start" type="sci-type"/>
  <xsd:attribute name="end" type="sci-type"/>
</xsd:complexType>

<xsd:complexType name="scenario-type">
  <xsd:sequence>
    <xsd:element name="sequence" type="sequence-type" maxOccurs="unbounded"/>
  </xsd:sequence>
</xsd:complexType>

<xsd:complexType name="sequence-type">
  <xsd:attribute name="label" type="label-type" use="required"/>
  <xsd:attribute name="asset-idref" type="asset-id-type" use="required"/>
  <xsd:attribute name="prev" type="label-type"/>
  <xsd:attribute name="next" type="label-type"/>
  <xsd:attribute name="time" type="xsd:unsignedInt"/>
</xsd:complexType>

<xsd:simpleType name="sci-type">
  <xsd:restriction base="xsd:string">
    <xsd:pattern value="[0-9]{2}:[0-9]{2}:[0-9]{2}.[0-9]{3}"/>
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="asset-id-type">
  <xsd:restriction base="xsd:unsignedInt"/>
    </xsd:simpleType>

<xsd:simpleType name="scene-id-type">
  <xsd:restriction base="xsd:unsignedInt"/>
    </xsd:simpleType>

<xsd:simpleType name="version-type">
  <xsd:restriction base="xsd:string">
    <xsd:pattern value="¥d+¥.¥d+"/>
  </xsd:restriction>
</xsd:simpleType>

<xsd:simpleType name="file-type">
  <xsd:restriction base="xsd:string"/>
</xsd:simpleType>

<xsd:simpleType name="label-type">
  <xsd:restriction base="xsd:string"/>
</xsd:simpleType>
```

```
</xsd:schema>
```

B.2 Example of a Description of a Manifest File

An example of a description of a manifest file in download-type content where a transmission example is indicated in Section 6.5.1 of this document is shown as follows.

```
<?xml version="1.0" encoding="UTF-8"?>
<manifests xmlns="http://www.arib.or.jp/tmm/manifest/2011/03">
  <manifest version="1.0">
    <assets count-asset-id="2">
      <asset id="1" src="startup.html" encrypted="true" content-type="text/html"/>
      <asset id="2" src="video/content1.mp4" encrypted="true" content-type="video/mp4"/>
          <scene scene-id="1" start="00:00:00.000" end="00:02:30.000"/>
          <scene scene-id="2" start="00:02:30.000" end="00:06:00.000"/>
          <scene scene-id="3" start="00:06:00.000" end="00:10:00.000"/>
      </asset>
    </assets>
    <scenario>
      <sequence label="menu" asset-idref="1" prev="_first_" next="a1,b1,c1"/>
      <!-- scenario route_a -->
      <sequence label="a1" asset-idref="1" prev="menu" next="a2"/>
      <sequence label="a2" asset-idref="1" prev="a1" next="a3"/>
      <sequence label="a3" asset-idref="1" prev="a2" next="_last_"/>

      <!-- scenario route_b -->
      <sequence label="b1" asset-idref="1" prev="menu" next="b2"/>
      <sequence label="b2" asset-idref="1" prev="b1" next="_last_"/>

      <!-- scenario route_c -->
      <sequence label="c1" asset-idref="1" prev="menu" next="_last_"/>
    </scenario>
  </manifest>
</manifests>
```

<Blank Page>

Annex C: LDPC-Staircase Code

C.1 Transmission by LDPC-Staircase Code

When LDPC-Staircase code is used, a notice is given to receivers by the IP packetized instance of the sending-side and receiving-side files.

Unique parameters are stored in FEC-OTI-Scheme-Specific-Info on an FEC coding algorithm basis. In the case of LDPC-Staircase code, the seed of random numbers, the order,* and the number of symbols multiplexing are stored. These parameters are stored respectively in the five-byte region shown in Fig. C-1. Furthermore, in the case of applying UEP mentioned later, the number of UEP lines, the UEP left-end column number, and the UEP right-end column number are respectively stored in the region shown in Fig. C-2, in addition to the seed of random numbers, the order, and the number of symbols multiplexing.

In the case of the FEC Payload ID field, Source Block Number and Encoding Symbol ID are respectively stored in the region shown in Fig. C-3.

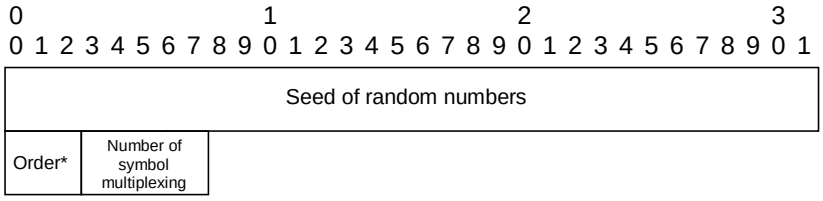

Fig. C-1**:** FEC-OTI-Scheme-Specific-Info

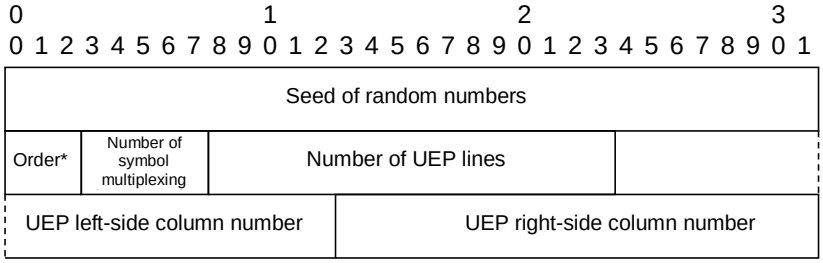

Fig. C-2**:** FEC-OTI-Scheme-Specific-Info (when UEP is in use)

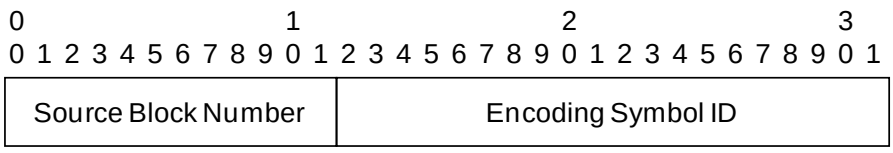

Fig. C-3: FEC Payload ID

* The value (N1m3) obtained by subtracting 3 from the order of the matrix. For details, refer to RFC5170.

C.2 UEP (Unequal Error Protection)

When there is a necessity to set resistance against disappearance high for parts from among the source symbols and from among the content head portion and certain symbols, the following Unequal Error Protection (UEP) function is utilized. In UEP, the number of lines (the number of UEP lines) that raises the density of 1, the left-side column number (UEP left-end column number) and the right-side column number (UEP right-end column number) in the column range, which raise the distribution of 1, are added by FEC-OTI-Scheme-Specific-Info, which is an FDT instance of FLUTE, and these numbers are notified to recipients. The extension field of FEC-OTI-Scheme-Specific-Info is shown below. The number of UEP lines of 16 bits, the UEP left-side column number of 20 bits, and the right-side column number of 20 bits are added to FEC-OTI-Scheme-Specific-Info.

Note that when UEP is in use, the left_matrix_init function described in RFC5170 is replaced by the following function.

```
void left_matrix_init(int k, int n, int N1, int m, int low, int high)
{
        int i, j, h, t, u[N1 * k], uep;

        for(h = N1 * k – 1; h >= 0; h--){
                u[h] = h % (n – k – m);
        }
        t = 0;
        for (j = 0; j < k; j++) {
                for (h = 0; h < N1; h++) {
                        for (i = t; i < N1*k && matrix_has_entry(u[i], j); i++);
                        if (i < N1*k) {
                                do {
                                        i = t + pmms_rand(N1*k-t);
                                }
                                while (matrix_has_entry(u[i], j));
                                matrix_insert_entry(u[i], j);
                                u[i] = u[t]; t++;
                        }
                        else {
                                do {
                                        i = pmms_rand(n – k – m);
                                }
                                while (matrix_has_entry(i, j));
                                matrix_insert_entry(i, j);
                        }
                }
         }

        uep = high – low + 1;
        for (h = N1 * uep – 1; h >= 0; h--){
                u[h] =    (n – k – m) + (h % m);
        }
        t = 0;
        for (j = low; j < high; j++) {
                for (h = 0; h < N1; h++) {
                        for (i = t; i < N1*uep && matrix_has_entry(u[i], j); i++);
                        if (i < N1*uep) {
                                do {
                                        i = t + pmms_rand(N1*uep-t);
                                }
                                while (matrix_has_entry(u[i], j));
                                matrix_insert_entry(u[i], j);
                                u[i] = u[t]; t++;
                        }
                        else {
                                do {
                                        i =    (n – k – m) + pmms_rand(m);
                                }
                                while (matrix_has_entry(i, j));
                                matrix_insert_entry(i, j);
                        }
                }
        }
}
```

In the above function, when only less than two of 1 are inserted into each line, the function of degree_of_row, which makes a determination as to how many of 1 are present in each line, is implemented using the following algorithm. For a line with less than two of 1, the element is selected in a random manner and 1 is inserted until 1 reaches two.

```
for (i = 0; i < n-k-m; i++) {
                    if (degree_of_row(i) == 0) {
                                j = pmms_rand(k);
                                matrix_insert_entry(i, j);
                    }
                    if (degree_of_row(i) == 1) {
                                do {
                                            j = pmms_rand(k);
                                } while (matrix_has_entry(i, j));
                                matrix_insert_entry(i, j);
                    }
}

for (i = n-k-m; i < n-k; i++) {
                    if (degree_of_row(i) == 0) {
                                j = low + pmms_rand(high – low + 1);
                                matrix_insert_entry(i, j);
                    }
                    if (degree_of_row(i) == 1) {
                                do {
                                            j = low + pmms_rand(high – low + 1);
                                } while (matrix_has_entry(i, j));
                                matrix_insert_entry(i, j);
                    }
}
```

Appendix

Reference 1: Information Source Coding Systems and File Formats

In this reference material, an example of the information source coding systems and file formats used in download-type broadcasting is described. Other information source coding systems are stipulated in an operation regulation of the service operator.

1.1 JPEG

The system shown in ISO/IEC10918-1 is used for bit map coding by JPEG.

1.2 GIF

"GRAPHICS INTERCHANGE FORMAT Version 89a" stipulated by Compuserve Inc., U.S.A., is used for the graphics file format of GIF (Graphics Interchange Format).

1.3 PNG

The Standard of W3C (PNG Specification Ver1.0 W3C Rec. Oct. 1996) is used for the graphics file format for PNG (Portable Network Graphics). For the details of the coding system, refer to Annex Regulation B "PNG Coding System," Section 2, Part I of ARIB STD-B24.

Restrictions on PNG

The following regulations shall be followed for the operation of PNGs.

- When the color type is "3" (palette index), the omission of a PLTE chunk in PNG data shall be possible. However, when a PLTE chunk is omitted, a need arises to separately prepare CLUT in the multimedia content. In this case, receivers shall not refer to the PLTE chunk but should refer to the outside CLUT.

1.4 MP4

Pictures, sounds, subtitles, etc., are stored in obedience to MP4 file format (ISO/IEC 14496-14), AVC file format (ISO/ICE 14496-15), and 3GPP Timed Text (3GPP TS 26.245).

Table 1: Content type

Extension	.mp4
MIME Type	audio/mp4: Sound only video/mp4: Others

In the MP4 file used for download-type broadcasting, it is possible to store the picture coding data stipulated in Section 1.5.2.2 "System conforming to mpeg-4 avc standard" and Appendix 3

"Operation guideline for MPEG-4 AVC standard in low-resolution picture service," of ARIB-STD B32, the sound coding system by MPEG-4 Audio (ISO/IEC 14496-3), and 3GPP Timed Text.

- Compact sample size box "stz2" is not used.
- File type box 'ftyp': major_brand = 'isom', minor_version=0, compatible_brands='iso2', 'avc1'
- In order to make manual complement possible, "moov" shall be installed immediately after "ftyp".

When multiple media tracks are included, each track shall be arranged by interleaving with the interleave depth set to less than one second. (Section 5.4.5 of 3GPP TS26.244-910 shall be followed for the definition of the interleave depth.)