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SERIES J: CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Ancillary digital services for television transmission

Service information for digital broadcasting in cable television systems

Recommendation ITU-T J.94

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Service information for digital broadcasting in cable television systems

Summary

Recommendation ITU-T J.94 specifies Service Information (SI) describing the services residing within streams constructed in accordance with Recommendation ITU-T H.222.0 | ISO/IEC 13818-1 (MPEG-2 Systems). This Recommendation defines the standard protocol for transmission of the relevant SI data tables carried in the MPEG-2 Transport Stream multiplex.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T J.94	1998-11-19	9	11.1002/1000/4346
1.1	ITU-T J.94 (1998) Amd. 1	2000-10-06	9	11.1002/1000/5167
1.2	ITU-T J.94 (1998) Amd. 2	2001-03-09	9	11.1002/1000/5377
1.3	ITU-T J.94 (1998) Amd. 3	2016-03-15	9	11.1002/1000/12763
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FOREWORD

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In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Introduction

The development of new digital technology has reached the point at which it is evident that they enable digital systems to offer significant advantages, in comparison with conventional analogue techniques, in terms of vision and sound quality, spectrum and power efficiency, service flexibility, multimedia convergence and potentially lower equipment costs. Moreover, the use of cable distribution for the delivery of video and audio signals to individual viewers and listeners is continually growing, and has already become the dominant form of distribution in many parts of the world. It is also evident that these potential benefits can best be achieved through the economies of scale resulting from the widespread use of digital systems designed to be easily implementable on existing infrastructure and which take advantage of the many possible synergies with related audiovisual systems.

This Recommendation has three annexes, that provide the specifications for the service information for the three digital television cable systems submitted to ITU-T.

This reflects the fact that standardization of digital cable television systems is being addressed for the first time by ITU-T and that a number of systems had been developed and provisionally implemented when this standardization effort was undertaken by ITU.

Administrations and private operators planning the introduction of digital cable television services are encouraged to consider the use of one of the systems described in Annexes A, B and C, and to seek opportunities for further convergence, rather than developing a different system based on the same technologies.

Recommendation ITU-T J.94

Service information for digital broadcasting in cable television systems

1 Scope

The scope of this Recommendation defines the Service Information that conveys the relevant description of the services contained in a multiplex of audio, video, and data that is distributed by cable networks (e.g., CATV systems). [ITU-T J.83] defines the transmission characteristics for digital multi-programme signals distributed through cable networks.

NOTE – The service information is specified to be contained within the MPEG-2 transport layer as Program Specific Information (PSI). This mechanism provides some ancillary data capacity in the forward channel, which can be used to accommodate the needs of other services such as program guides (a description of the provision and characteristics of these services is outside the scope of this Recommendation).

Being highly flexible, the MPEG-2 transport layer can be configured to deliver any desired mix of television, sound and data signals (with sound either related or unrelated to the video signal content, and at various possible levels of quality).

This Recommendation is intended to ensure that the designers and operators of cable distribution (e.g., CATV) networks carrying multi-programme signals will have the information they need to be able to establish and maintain fully satisfactory networks. It also provides the information needed by the designers and manufacturers of equipment (including receivers) for digital multi-programme signals distributed by cable networks.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.222.0] Recommendation ITU-T H.222.0 (2014) | ISO/IEC 13818-1:2015, *Information technology – Generic coding of moving pictures and associated audio information: Systems.*

[ITU-T J.83] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound and data services for cable distribution*.

[EBU SPB 492] EBU SPB 492 (1992), *Teletext specification (625-line Television Systems).*

[ETR 162] ETR 162, Digital Video Broadcasting (DVB); *Allocation of Service Information (SI) codes for DVB systems.*

[ETR 154] ETR 154, Digital Video Broadcasting (DVB); *Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications.*

[ETR 211] ETR 211, Digital Video Broadcasting (DVB); *Guidelines on implementation and usage of Service Information (SI).*

[IEC 61883] IEC Publication 61883 (1998), *Consumer audio/video equipment – Digital interface. (Parts 1 and 4.)*

[IEEE 1394] IEEE 1394, *High Performance Serial Bus.*

[ISO 639] ISO 639:1988, *Code for the representation of names of languages.*

[ISO 3166] ISO 3166:1997, *Codes for the representation of names of countries and their subdivisions.*

[ISO/IEC 6937] ISO/IEC 6937:1994, *Information technology – Coded graphic character set for text communication – Latin alphabet.*

[ISO/IEC 8859] ISO/IEC 8859, *Information technology – 8-bit single-byte coded graphic character sets, Latin alphabets.* (All parts).

[ISO/IEC 8859-1] ISO/IEC 8859-1 to 10, *Information technology – 8-bit single-byte coded graphic character sets.*

[ISO/IEC 10646-1] ISO/IEC 10646-1:1993, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane.*

[ISO/IEC 10646-1] ISO/IEC 10646-1:2000, *Information technology – Universal Multiple-Octet Coded Character Set (UCS) – Part 1: Architecture and Basic Multilingual Plane.*

[ISO/IEC 13818] ISO/IEC 13818, *Information technology – Generic coding of moving pictures and associated audio information*. (All parts).

3 Terms and definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 MPEG-2 [ISO/IEC 13818]: Refers to ISO/IEC standard 13818 (All parts). Systems coding is defined in Part 1. Video coding is defined in Part 2. Audio coding is defined in Part 3.

3.1.2 transport stream (TS) [ITU-T H.222.0]: A TS is a data structure defined in [ITU-T H.222.0].

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 bouquet: A collection of services marketed as a single entity.

3.2.2 broadcaster (SERVICE Provider): An organization which assembles a sequence of events or programmes to be delivered to the viewer based upon a schedule.

3.2.3 component (ELEMENTARY Stream): One or more entities which together make up an event, e.g., video, audio, teletext.

3.2.4 conditional access (CA) system: A system to control subscriber access to services, programmes and events e.g., Videoguard, Eurocrypt.

3.2.5 delivery system: The physical medium by which one or more multiplexes are transmitted e.g., satellite system, wide-band coaxial cable, fibre optics, terrestrial channel of one emitting point.

3.2.6 descriptor: A data structure of the format: descriptor_tag, descriptor_length, and a variable amount of data. The tag and length fields are each 8 bits. The length specifies the length of data that begins immediately following the descriptor_length field itself. A descriptor whose descriptor_tag identifies a type not recognized by a particular decoder shall be ignored by that decoder. Descriptors can be included in certain specified places within PSIP tables, subject to certain restrictions. Descriptors may be used to extend data represented as fixed fields within the tables. They make the protocol very flexible since they can be included only as needed. New descriptor types can be standardized and included without affecting receivers that have not been designed to recognize and process the new types.

3.2.7 digital channel: A set of one or more digital elementary streams. See virtual channel.

3.2.8 entitlement management messages (EMM): Are private Conditional Access information which specify the authorization levels or the services of specific decoders. They may be addressed to individual decoder or groups of decoders.

3.2.9 event: A grouping of elementary broadcast data streams with a defined start and end time belonging to a common service, e.g., first half of a football match, News Flash, first part of an entertainment show.

3.2.10 forbidden: The term "forbidden" when used in the clauses defining the coded bitstream, indicates that the value shall never be used.

3.2.11 instance: See table instance.

3.2.12 logical channel: See virtual channel.

3.2.13 message: The more general term *message* is used interchangeably with *section*, especially to refer to non-table-oriented data structures such as, for example, the SYSTEM TIME message. Likewise, the term *message* is used to refer to a data structure that may deliver portions of various types of tables. The NETWORK INFORMATION message, for example, defines portions of several types of network tables.

3.2.14 multiplex: A stream of all the digital data carrying one or more services within a single physical channel.

3.2.15 network: A collection of MPEG-2 Transport Stream (TS) multiplexes transmitted on a single delivery system, e.g., all digital channels on a specific cable system.

3.2.16 original_network_id: A unique identifier of a network.

3.2.17 physical channel: A generic term to refer to the each of the 6-8 MHz frequency bands where television signals are embedded for transmission. Also known as the Physical Transmission Channel (PTC). One analog virtual channel fits in one PTC but multiple digital virtual channels typically coexist in one PTC.

3.2.18 physical transmission channel: See physical channel.

3.2.19 programme: A concatenation of one or more events under the control of a broadcaster e.g., news show, entertainment show.

3.2.20 program element: A generic term for one of the elementary streams or other data streams that may be included in a program. For example: audio, video, data, etc.

3.2.21 reserved: The term "reserved" when used in the clause defining the coded bitstream, indicates that the value may be used in the future for ISO defined extensions. Unless otherwise specified within this Recommendation, all "reserved" bits shall be set to "1".

3.2.22 reserved_future_use: The term "reserved_future_use", when used in the clause defining the coded bitstream, indicates that the value may be used in the future for ETSI defined extensions. Unless otherwise specified within this Recommendation all "reserved_future_use" bits shall be set to "1".

3.2.23 section: A section is a syntactic structure that shall be used for mapping each [ITU-T H.222.0] defined PSI table or private data table into transport stream packets. Private data tables include service information (SI) except for PSI.

3.2.24 service: A sequence of programmes under the control of a broadcaster which can be broadcast as part of a schedule.

3.2.25 service_id: A unique identifier of a service within a TS.

3.2.26 service information (SI): Digital data describing the delivery system, content and scheduling/timing of broadcast data streams, etc. It includes MPEG-2 PSI together with independently defined extensions.

3.2.27 stream: An ordered series of bytes. The usual context for the term *stream* is the series of bytes extracted from Transport Stream packet payloads which have a common unique PID value (e.g., video PES packets or Program Map Table sections).

3.2.28 sub_table: A sub_table is collection of sections with the same value of table_id and:

– for a NIT: the same table_id_extension (network_id) and version_number;

– for a BAT: the same table_id_extension (bouquet_id) and version_number;

– for a SDT: the same table_id_extension (transport_stream_id), the same original_network_id and version_number;

– for a EIT: the same table_id_extension (service_id), the same transport_stream_id, the same original_network_id and version_number.

The table_id_extension field is equivalent to the fourth and fifth byte of a section when the section_syntax_indicator is set to a value of "1".

3.2.29 table: A table is comprised of a number of sub_tables with the same value of table_id.

3.2.30 table instance: Tables are identified by the table_id field. However, in cases such as the RRT and EIT, several instances of a table are defined simultaneously. All instances have the same PID and table_id but different table_id_extension.

3.2.31 transport_stream_id: A unique identifier of a TS within an original network.

3.2.32 virtual channel: A virtual channel is the designation, usually a number, that is recognized by the user as the single entity that will provide access to an analog TV program or a set of one or more digital elementary streams. It is called "virtual" because its identification (name and number) may be defined independently from its physical location. Examples of virtual channels are: digital radio (audio only), a typical analog TV channel, a typical digital TV channel (composed of one audio and one video stream), multi-visual digital channels (composed of several video streams and one or more audio tracks), or a data broadcast channel (composed of one or more data streams). In the case of an analog TV channel, the virtual channel designation will link to a specific physical transmission channel. In the case of a digital TV channel, the virtual channel designation will link both to the physical transmission channel and to the particular video and audio streams within that physical transmission channel.

The relationships of some of these definitions are illustrated in the service delivery model in Figure 1.

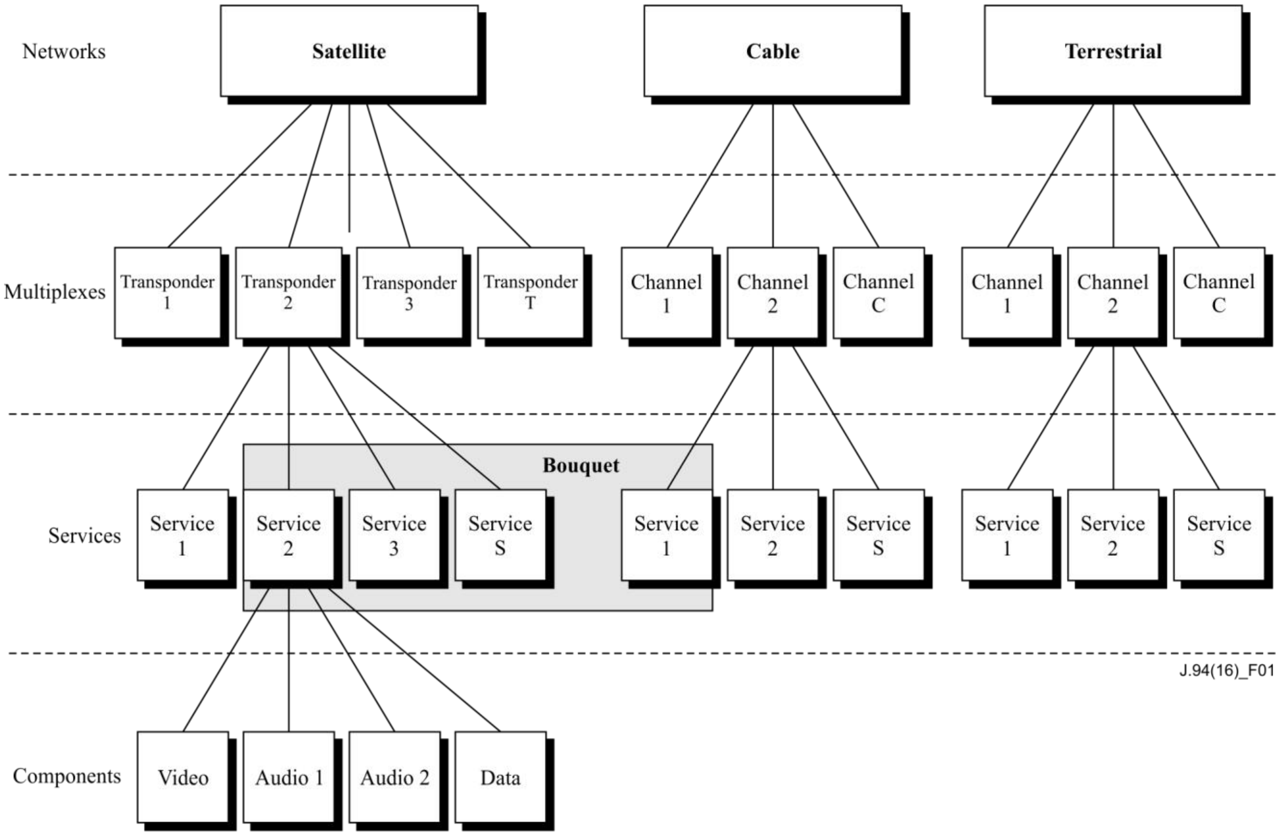


Figure 1 – Digital broadcasting, service delivery model

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ATSC	Advanced Television Systems Committee
BAT	Bouquet Association Table
BCD	Binary Coded Decimal
bslbf	bit string, left bit first
CA	Conditional Access
CAT	Conditional Access Table
CDT	Carrier Definition Table
CLUT	Colour Look-Up Table
CRC	Cyclic Redundancy Check
CVCT	Cable Virtual Channel Table
DIT	Discontinuity Information Table
DTV	Digital Television
DVB	Digital Video Broadcasting
EBU	European Broadcasting Union
ECM	Entitlement Control Message
EIT	Event Information Table
EMM	Entitlement Management Message
EPG	Electronic Programme Guide
ETM	Extended Text Message

ETS	European Telecommunication Standard
ETT	Extended Text Table
FEC	Forward Error Correction
GA	Grand Alliance
GMT	Greenwich Mean Time
GPS	Global Positioning System
IEC	International Electrotechnical Commission
IRD	Integrated Receiver-Decoder
ISO	International Organization for Standardization
LSB	Least Significant Bit
MCPT	Multiple Carriers per Transponder
MGT	Master Guide Table
MJD	Modified Julian Date
MMT	Modulation Mode Table
MPAA	Motion Picture Association of America
MPEG	Moving Pictures Expert Group
NIT	Network Information Table
NVOD	Near Video-on-Demand
PAT	Program Association Table
PCR	Program Clock Reference
PES	Packetized Elementary Stream
PID	Packet identifier
PMT	Program Map Table
PSI	Program Specific Information
PSIP	Program and Service Information Protocol
PSTN	Public Switched Telephone Network
PTC	Physical Transmission Channel
PTS	Presentation Time Stamp
QAM	Quadrature Amplitude Modulation
QPSK	Quaternary Phase Shift Keying
rpchof	remainder polynomial coefficients, highest order first
RRT	Rating Region Table
RS	Reed-Solomon
RST	Running Status Table
SCTE	Society of Cable Telecommunications Engineers
SDT	Service Description Table
SECAM	Sequential colour with memory (*Séquentiel Couleur avec Mémoire*)
SI	Service Information
SIT	Satellite Information Table
SMI	Storage Media Interoperability
ST	Stuffing Table

STD	System Target Decoder
STT	System Time Table
TAI	International Atomic Time[1]
TDT	Time and Date Table
TNT	Transponder Name Table
TOT	Time Offset Table
TS	Transport Stream
TVCT	Terrestrial Virtual Channel Table
uimsbf	unsigned integer most significant bit first
UTC	Universal Time coordinated
VCN	Virtual Channel Number
VCT	Virtual Channel Table Used in reference to either TVCT or CVCT

5 Conventions

None.

6 Service information for systems A, B, and C

Service information for systems A, B, and C are defined in the relevant annexes in this Recommendation, i.e., AnnexesA, B and C.

[1] French acronym used.

Annex A

Service information for digital multi-programme system A

(This annex forms an integral part of this Recommendation.)

A.1 Scope

This annex is derived from work done in Europe and is based upon the European Telecommunication Standard (ETS) 300 468. It specifies the service information (SI) data which forms a part of digital video broadcasting (DBV) bitstreams, in order that the user can be provided with information to assist in selection of services and/or events within the bitstream, and so that the integrated receiver decoder (IRD) can automatically configure itself for the selected service. SI data for automatic configuration is mostly specified within [ITU-T H.222.0] as program specific information (PSI). This annex specifies additional data which complement the PSI by providing data to aid automatic tuning of IRDs, and additional information intended for display to the user. The manner of presentation of the information is not specified in this annex, and IRD manufacturers have the freedom to choose appropriate presentation methods.

It is expected that electronic programme guides (EPGs) will be a feature of digital TV transmissions. The definition of an EPG is outside the scope of the SI specification, but the data contained within the SI specified here may be used as the basis for an EPG.

Rules of operation for the implementation of this annex are specified in [ETR 211].

A.2 References

For references, see clause 2.

A.3 Definitions, abbreviations and acronyms

The terms, definitions, abbreviations and acronyms used in this Recommendation can be found in clauses 3 and 4.

A.4 Service information (SI) description

[ITU-T H.222.0] specifies SI which is referred to as PSI. The PSI data provides information to enable automatic configuration of the receiver to demultiplex and decode the various streams of programs within the multiplex.

The PSI data is structured as four types of table. The tables are transmitted in sections.

1) *Program Association Table (PAT)*

   For each service in the multiplex, the PAT indicates the location [the Packet Identifier (PID) values of the Transport Stream (TS) packets] of the corresponding Program Map Table (PMT). It also gives the location of the Network Information Table (NIT).

2) *Conditional Access Table (CAT)*

   The CAT provides information on the CA systems used in the multiplex; the information is private (not defined within this annex) and dependent on the CA system, but includes the location of the EMM stream, when applicable.

3) *Program Map Table (PMT)*

   The PMT identifies and indicates the locations of the streams that make up each service, and the location of the Program Clock Reference fields for a service.

4) *Network Information Table (NIT)*

   The location of the NIT is defined in this annex in compliance with [ITU-T H.222.0] , but the data format is outside the scope of [ITU-T H.222.0]. It is intended to provide information about the physical network. The syntax and semantics of the NIT are defined in this annex.

In addition to the PSI, data are needed to provide identification of services and events for the user. The coding of this data is defined in this annex. In contrast with the PAT, CAT, and PMT of the PSI, which give information only for the multiplex in which they are contained (the actual multiplex), the additional information defined within this annex can also provide information on services and events carried by different multiplexes, and even on other networks. These data are structured as nine tables:

1) *Bouquet Association Table (BAT)*

   The BAT provides information regarding bouquets. As well as giving the name of the bouquet, it provides a list of services for each bouquet.

2) *Service Description Table (SDT)*

   The SDT contains data describing the services in the system, e.g., names of services, the service provider, etc.

3) *Event Information Table (EIT)*

   The EIT contains data concerning events or programmes such as event name, start time, duration, etc.

   The use of different descriptors allows the transmission of different kinds of event information, e.g., for different service types.

4) *Running Status Table (RST)*

   The RST gives the status of an event (running/not running). The RST updates this information and allows timely automatic switching to events.

5) *Time and Date Table (TDT)*

   The TDT gives information relating to the present time and date. This information is given in a separate table due to the frequent updating of this information.

6) *Time Offset Table (TOT)*

   The TOT gives information relating to the present time and date and local time offset. This information is given in a separate table due to the frequent updating of the time information.

7) *Stuffing Table (ST)*

   The ST is used to invalidate existing sections, for example at delivery system boundaries.

8) *Selection Information Table (SIT)*

   The SIT is used only in "partial" (i.e., recorded) bitstreams. It carries a summary of the SI information required to describe the streams in the partial bitstream.

9) *Discontinuity Information Table (DIT)*

   The DIT is used only in "partial" (i.e., recorded) bitstreams. It is inserted where the SI information in the partial bitstream may be discontinuous.

Where applicable, the use of descriptors allows a flexible approach to the organization of the tables and allows for future compatible extensions. See Figure A.1.

A.5 Service information (SI) tables

A.5.1 SI table mechanism

The SI specified in this annex and MPEG-2 PSI tables shall be segmented into one or more sections before being inserted into TS packets.

The tables listed in clause A.4 are conceptual in that they need never be regenerated in a specified form within an IRD. The tables, when transmitted shall not be scrambled, with the exception of the EIT, which may be scrambled if required (see clause A.5.1.5).

A section is a syntactic structure that shall be used for mapping all MPEG-2 tables and SI tables specified in this annex, into TS packets.

These SI syntactic structures conform to the private section syntax defined in [ITU-T H.222.0].

A.5.1.1 Explanation

Sections may be variable in length. The sections within each table are limited to 1024 bytes in length, except for sections within the EIT which are limited to 4096 bytes. Each section is uniquely identified by the combination of the following elements:

a) Table_id:

   The table_id identifies to which table the section belongs.

   Some table_ids have been defined by ISO and others by ETSI. Other values of the table_id can be allocated by the user for private purposes. The list of values of table_id is contained in Table A.2.

b) Table_id_extension:

   The table_id_extension is used for identification of a sub_table.

   The interpretation of each sub_table is given in clause A.5.2.

c) Section_number:

   The section_number field allows the sections of a particular sub_table to be reassembled in their original order by the decoder. It is recommended, that sections are transmitted in numerical order, unless it is desired to transmit some sections of the sub_table more frequently than others, e.g., due to random access considerations.

   For the SI tables as specified in this annex, section numbering applies to sub_tables.

d) Version_number:

   When the characteristics of the TS described in the SI given in this annex change (e.g., new events start, different composition of elementary streams for a given service), then new SI data shall be sent containing the updated information. A new version of the SI data is signalled by sending a sub_table with the same identifiers as the previous sub_table containing the relevant data, but with the next value of version_number.

   For the SI tables specified in this annex, the version_number applies to all sections of a sub_table.

e) Current_next_indicator:

   Each section shall be numbered as valid "now" (current), or as valid in the immediate future (next).

   This allows the transmission of a future version of the SI in advance of the change, giving the decoder the opportunity to prepare for the change. There is, however, no requirement to transmit the next version of a section in advance, but if it is transmitted, then it shall be the next correct version of that section.

A.5.1.2 Mapping of sections into Transport Stream (TS) packets

Sections shall be mapped directly into TS packets. Sections may start at the beginning of the payload of a TS packet, but this is not a requirement, because the start of the first section in the payload of a TS packet is pointed to by the pointer_field. There is never more than one pointer_field in a TS packet, as the start of any other section can be identified by counting the length of the first and any subsequent sections, since no gaps between sections within a TS packet are allowed by the syntax.

Within TS packets of any single PID value, one section is finished before the next one is allowed to be started, or else it is not possible to identify to which section header the data belongs. If a section finishes before the end of a TS packet, but it is not convenient to open another section, a stuffing mechanism may be used to fill up the space.

Stuffing may be performed by filling each remaining byte of the TS packet with the value "0xFF". Consequently the value "0xFF" shall not be used for the table_id. If the byte immediately following the last byte of a section takes the value of "0xFF", then the rest of the TS packet shall be stuffed with "0xFF" bytes. These bytes may be discarded by a decoder. Stuffing may also be performed using the adaptation_field mechanism.

For a more detailed description of the mechanism and functionality, refer to clause 2.4.4 and Annex C of [ITU-T H.222.0].

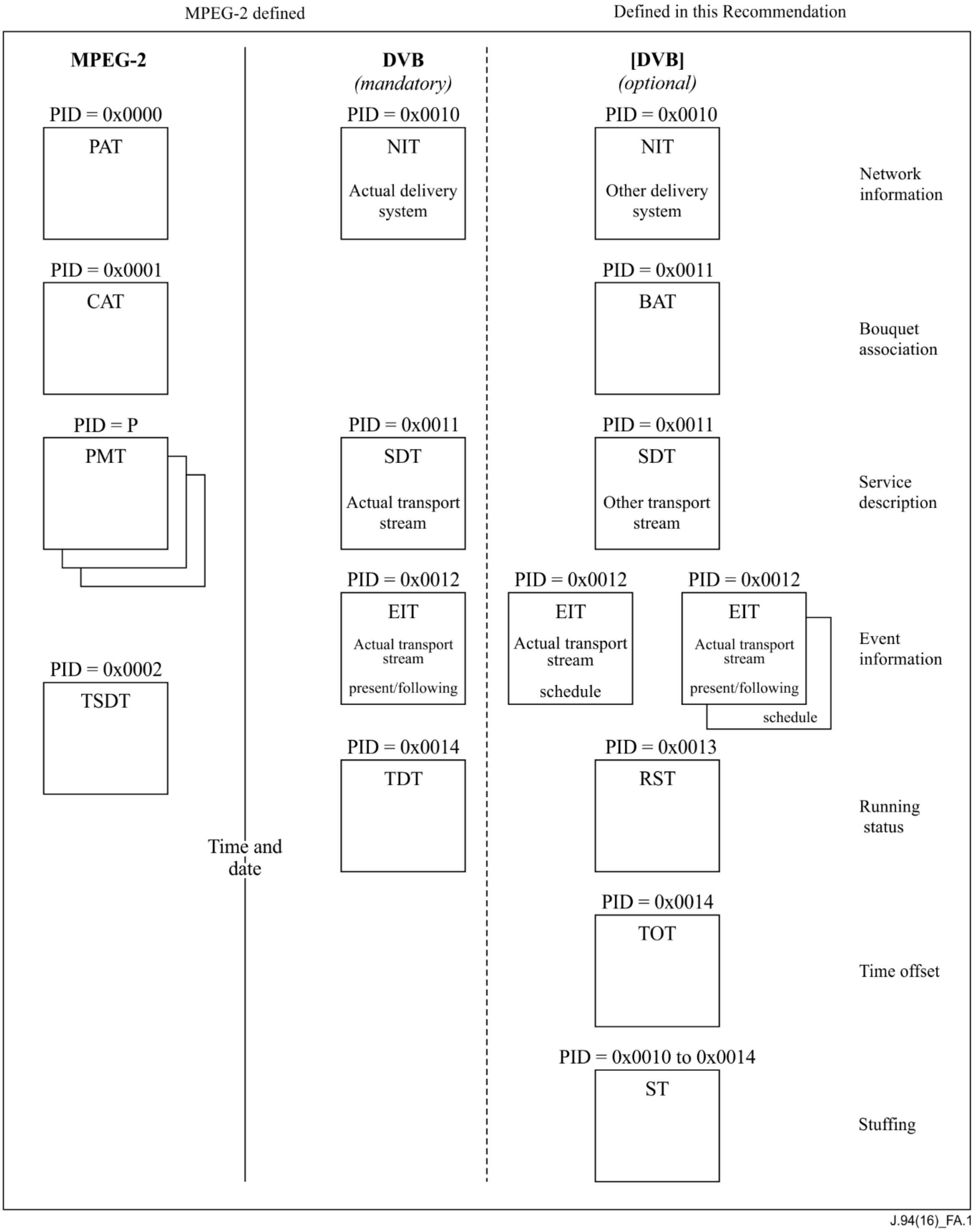


Figure A.1 – General organization of the service information (SI)

A.5.1.3 Coding of PID and table_id fields

Table A.1 lists the PID values which shall be used for the TS packets which carry SI sections.

Table A.1 – PID allocation for SI

Table	PID value
PAT	0x0000
CAT	0x0001
TSDT	0x0002
Reserved	0x0003 to 0x000F
NIT, ST	0x0010
SDT, BAT, ST	0x0011
EIT, ST	0x0012
RST, ST	0x0013
TDT, TOT, ST	0x0014
Network synchronization	0x0015
Reserved for future use	0x0016 to 0x001D
DIT	0x001E
SIT	0x001F

Table A.2 lists the values which shall be used for table_id for the service information, defined in this annex.

A.5.1.4 Repetition rates and random access

In systems where random access is a consideration, it is recommended to re-transmit SI sections specified within this annex several times, even when changes do not occur in the configuration.

For SI specified within this annex, the minimum time interval between the arrival of the last byte of a section to the first byte of the next transmitted section with the same PID, table_id and table_id_extension and with the same or different section_number shall be 25 ms. This limit applies for TSs with a total data rate of up to 100 Mbit/s.

A.5.1.5 Scrambling

With the exception of the EIT carrying schedule information, all tables specified in this annex shall not be scrambled. One method for scrambling the EIT schedule table is given in Appendix A.II, Bibliography. If a scrambling method operating over TS packets is used, it may be necessary to use a stuffing mechanism to fill from the end of a section to the end of a packet so that any transitions between scrambled and unscrambled data occur at packet boundaries.

In order to identify the CA streams which control the descrambling of the EIT data, a scrambled EIT schedule table shall be identified in the PSI. Service_id value 0xFFFF is allocated to identifying a scrambled EIT, and the program map section for this service shall describe the EIT as a private stream and shall include one or more CA_descriptors (defined in [ITU-T H.222.0]) which give the PID values and, optionally, other private data to identify the associated CA streams. Service_id value 0xFFFF shall not be used for any other service.

A.5.2 Table definitions

The following clauses describe the syntax and semantics of the different types of table.

NOTE – The symbols and abbreviations, and the method of describing syntax used in this annex are the same as those defined in clauses 2.2 and 2.3 of [ITU-T H.222.0].

Table A.2 – Allocation of table_id values

Value	Description
0x00	program_association_section
0x01	conditional_access_section
0x02	program_map_section
0x03	transport_stream_description_section
0x04 to 0x3F	Reserved
0x40	network_information_section – actual_network
0x41	network_information_section – other_network
0x42	service_description_section – actual_transport_stream
0x43 to 0x45	Reserved for future use
0x46	service_description_section – other_transport_stream
0x47 to 0x49	Reserved for future use
0x4A	bouquet_association_section
0x4B to 0x4D	Reserved for future use
0x4E	event_information_section – actual_transport_stream, present/following
0x4F	event_information_section – other_transport_stream, present/following
0x50 to 0x5F	event_information_section – actual_transport_stream, schedule
0x60 to 0x6F	event_information_section – other_transport_stream, schedule
0x70	time_date_section
0x71	running_status_section
0x72	stuffing_section
0x73	time_offset_section
0x74 to 0x7D	Reserved for future use
0x7E	discontinuity_information_section
0x7F	selection_information_section
0x80 to 0xFE	User-defined
0xFF	Reserved

A.5.2.1 Network Information Table (NIT)

The NIT (see Table A.3) conveys information relating to the physical organization of the multiplexes/TSs carried via a given network, and the characteristics of the network itself. The combination of original_network_id and transport_stream_id allow each TS to be uniquely identified throughout the ETS application area. Networks are assigned individual network_id values, which serve as unique identification codes for networks. The allocation of these codes may be found in [ETR 162]. In the case that the NIT is transmitted on the network on which the TS was originated, the network_id and the original_network_id shall take the same value.

Guidelines for the processing of SI at transitions between delivery media boundaries, e.g., from satellite to cable or SMATV systems, can be found in [ETR 211].

IRDs may be able to store the NIT information in non-volatile memory in order to minimize the access time when switching between channels ("channel hopping"). It is also possible to transmit a NIT for other networks in addition to the actual network. Differentiation between the NIT for the actual network and the NIT for other networks is achieved using different table_id values (see Table A.2).

The NIT shall be segmented into network_information_sections using the syntax of Table A.1. Any sections forming part of an NIT shall be transmitted in TS packets with a PID value of 0x0010. Any sections of the NIT which describe the actual network (that is, the network of which the TS containing the NIT is a part) shall have the table_id value 0x40 with the network_id field taking the value assigned to the actual network in [ETR 162]. Any sections of an NIT which refer to a network other than the actual network shall take a table_id value of 0x41 and the network_id shall take the value allocated to the other network in [ETR 162].

Table A.3 – Network information section

Syntax	No. of bits	Identifier
network_information_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
network_id	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved_future_use	4	bslbf
network_descriptors_length	12	uimsbf
for(i=0;i<N;i++){		
descriptor()		
}		
reserved_future_use	4	bslbf
transport_stream_loop_length	12	uimsbf
for(i=0;i<N;i++){		
transport_stream_id	16	uimsbf
original_network_id	16	uimsbf
reserved_future_use	4	bslbf
transport_descriptors_length	12	uimsbf
for(j=0;j<N;j++){		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

Semantics for the network information section

table_id: See Table A.2.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and including the CRC. The section_length shall not exceed 1021 so that the entire section has a maximum length of 1024 bytes.

network_id: This is a 16-bit field which serves as a label to identify the delivery system, about which the NIT informs, from any other delivery system. Allocations of the value of this field are found in [ETR 162].

version_number: This 5-bit field is the version number of the sub_table. The version_number shall be incremented by 1 when a change in the information carried within the sub_table occurs. When it reaches value 31, it wraps around to 0. When the current_next_indicator is set to "1", then the version_number shall be that of the currently applicable sub_table defined by the table_id and network_id. When the current_next_indicator is set to "0", then the version_number shall be that of the next applicable sub_table defined by the table_id and network_id.

current_next_indicator: This 1-bit indicator, when set to "1", indicates that the sub_table is the currently applicable sub_table. When the bit is set to "0", it indicates that the sub_table sent is not yet applicable and shall be the next sub_table to be valid.

section_number: This 8-bit field gives the number of the section. The section_number of the first section in the sub_table shall be "0x00". The section_number shall be incremented by 1 with each additional section with the same table_id and network_id.

last_section_number: This 8-bit field specifies the number of the last section (that is the section with the highest section_number) of the sub_table of which this section is part.

network_descriptors_length: This 12-bit field gives the total length in bytes of the following network descriptors.

transport_stream_loop_length: This is a 12-bit field specifying the total length in bytes of the TS loops that follow, ending immediately before the first CRC-32 byte.

transport_stream_id: This is a 16-bit field which serves as a label for identification of this TS from any other multiplex within the delivery system.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system.

transport_descriptors_length: This is a 12-bit field specifying the total length in bytes of TS descriptors that follow.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in Annex E after processing the entire section.

A.5.2.2 Bouquet Association Table (BAT)

The BAT (see Table A.4) provides information regarding bouquets. A bouquet is a collection of services, which may traverse the boundary of a network.

The BAT shall be segmented into bouquet_association_sections using the syntax of Table A.4. Any sections forming part of a BAT shall be transmitted in TS packets with a PID value of 0x0011. The sections of a BAT sub_table describing a particular bouquet shall have the bouquet_id field taking the value assigned to the bouquet described in [ETR 162] . All BAT sections shall take a table_id value of 0x4A.

Table A.4 – Bouquet association section

Syntax	No. of bits	Identifier
bouquet_association_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
bouquet_id	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved_future_use	4	bslbf
bouquet_descriptors_length	12	uimsbf
for(i=0;i<N;i++){		
descriptor()		
}		
reserved_future_use	4	bslbf
transport_stream_loop_length	12	uimsbf
for(i=0;i<N;i++){		
transport_stream_id	16	uimsbf
original_network_id	16	uimsbf
reserved_future_use	4	bslbf
transport_descriptors_length	12	uimsbf
for(j=0;j<N;j++){		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

Semantics for the bouquet association section

table_id: See Table A.2.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and including the CRC. The section_length shall not exceed 1021 so that the entire section has a maximum length of 1024 bytes.

bouquet_id: This is a 16-bit field which serves as a label to identify the bouquet. Allocations of the value of this field are found in [ETR 162] .

version_number: This 5-bit field is the version number of the sub_table. The version_number shall be incremented by 1 when a change in the information carried within the sub_table occurs. When it reaches value 31, it wraps around to 0. When the current_next_indicator is set to "1", then the version_number shall be that of the currently applicable sub_table defined by the table_id and bouquet_id. When the current_next_indicator is set to "0", then the version_number shall be that of the next applicable sub_table defined by the table_id and bouquet_id.

current_next_indicator: This 1-bit indicator, when set to "1", indicates that the sub_table is the currently applicable sub_table. When the bit is set to "0", it indicates that the sub_table sent is not yet applicable and shall be the next sub_table to be valid.

section_number: This 8-bit field gives the number of the section. The section_number of the first section in the sub_table shall be "0x00". The section_number shall be incremented by 1 with each additional section with the same table_id and bouquet_id.

last_section_number: This 8-bit field specifies the number of the last section (that is the section with the highest section_number) of the sub_table of which this section is part.

bouquet_descriptors_length: This 12-bit field gives the total length in bytes of the following descriptors.

transport_stream_loop_length: This is a 12-bit field specifying the total length in bytes of the TS loop that follows.

transport_stream_id: This is a 16-bit field which serves as a label for identification of this TS from any other multiplex within the delivery system.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system.

transport_descriptors_length: This is a 12-bit field specifying the total length in bytes of TS descriptors that follow.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in Annex E after processing the entire private section.

A.5.2.3 Service Description Table (SDT)

Each sub_table of the SDT (see Table A.5) shall describe services that are contained within a particular TS. The services may be part of the actual TS or part of other TSs, these being identified by means of the table_id (see Table A.2). The SDT shall be segmented into service_description_sections using the syntax of Table A.5. Any sections forming part of an SDT shall be transmitted in TS packets with a PID value of 0x0011. Any sections of the SDT which describe the actual TS (that is, the TS containing the SDT) shall have the table_id value 0x42, and any sections of an SDT which refer to a TS other than the actual TS shall take a table_id value of 0x46.

Table A.5 – Service description section

Syntax	No. of bits	Identifier
service_description_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transport_stream_id	16	uimsbf

Table A.5 – Service description section

Syntax	No. of bits	Identifier
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
original_network_id	16	uimsbf
reserved_future_use	8	bslbf
for (I=0;i<N;i++){		
service_id	16	uimsbf
reserved_future_use	6	bslbf
EIT_schedule_flag	1	bslbf
EIT_present_following_flag	1	bslbf
running_status	3	uimsbf
free_CA_mode	1	bslbf
descriptors_loop_length	12	uimsbf
for (j=0;j<N;j++){		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

Semantics for the service description section

table_id: See Table A.2.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and including the CRC. The section_length shall not exceed 1021 so that the entire section has a maximum length of 1024 bytes.

transport_stream_id: This is a 16-bit field which serves as a label for identification of the TS, about which the SDT informs, from any other multiplex within the delivery system.

version_number: This 5-bit field is the version number of the sub_table. The version_number shall be incremented by 1 when a change in the information carried within the sub_table occurs. When it reaches value "31", it wraps around to "0". When the current_next_indicator is set to "1", then the version_number shall be that of the currently applicable sub_table. When the current_next_indicator is set to "0", then the version_number shall be that of the next applicable sub_table.

current_next_indicator: This 1-bit indicator, when set to "1", indicates that the sub_table is the currently applicable sub_table. When the bit is set to "0", it indicates that the sub_table sent is not yet applicable and shall be the next sub_table to be valid.

section_number: This 8-bit field gives the number of the section. The section_number of the first section in the sub_table shall be "0x00". The section_number shall be incremented by 1 with each additional section with the same table_id, transport_stream_id, and original_network_id.

last_section_number: This 8-bit field specifies the number of the last section (that is the section with the highest section_number) of the sub_table of which this section is part.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system.

service_id: This is a 16-bit field which serves as a label to identify this service from any other service within the TS. The service_id is the same as the program_number in the corresponding program_map_section.

EIT_schedule_flag: This is a 1-bit field which when set to "1" indicates that EIT schedule information for the service is present in the current TS, (see [ETR 211] for information on maximum time interval between occurrences of an EIT schedule sub_table). If the flag is set to 0, then the EIT schedule information for the service should not be present in the TS.

EIT_present_following_flag: This is a 1-bit field which when set to "1" indicates that EIT_present_following information for the service is present in the current TS, (see [ETR 211] for information on maximum time interval between occurrences of an EIT present/following sub_table). If the flag is set to 0, then the EIT present/following information for the service should not be present in the TS.

running_status: This is a 3-bit field indicating the status of the service as defined in Table A.6.

Table A.6 – running_status

Value	Meaning
0	Undefined
1	Not running
2	Starts in a few seconds (e.g., for video recording)
3	Pausing
4	Running
5 to 7	Reserved for future use

For an NVOD reference service, the value of the running_status shall be set to "0".

free_CA_mode: This 1-bit field, when set to "0", indicates that all the component streams of the service are not scrambled. When set to "1", it indicates that access to one or more streams may be controlled by a CA system.

descriptors_loop_length: This 12-bit field gives the total length in bytes of the following descriptors.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in Annex E after processing the entire section.

A.5.2.4 Event Information Table (EIT)

The EIT (see Table A.7) provides information in chronological order regarding the events contained within each service. Four classifications of EIT have been identified, distinguishable by the use of different table_ids (see Table A.2):

1) actual TS, present/following event information = table_id = "0x4E";

2) other TS, present/following event information = table_id = "0x4F";

3) actual TS, event schedule information = table_id = "0x50" to "0x5F";

4) other TS, event schedule information = table_id = "0x60" to "0x6F".

The present/following table shall contain only information pertaining to the present event and the chronologically following event carried by a given service on either the actual TS or another TS, except in the case of a Near Video-on-Demand (NVOD) reference service where it may have more than two event descriptions. The event schedule tables for either the actual TS or other TSs, contain a list of events, in the form of a schedule, namely, including events taking place at some time beyond the next event. The EIT schedule tables are optional. The event information shall be chronologically ordered.

The EIT shall be segmented into event_information_sections using the syntax of Table A.7. Any sections forming part of an EIT shall be transmitted in TS packets with a PID value of 0x0012.

Table A.7 – Event information section

Syntax	No. of bits	Identifier
event_information_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
service_id	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
transport_stream_id	16	uimsbf
original_network_id	16	uimsbf
segment_last_section_number	8	uimsbf
last_table_id	8	uimsbf
for(i=0;i<N;i++){		
event_id	16	uimsbf
start_time	40	bslbf
duration	24	uimsbf
running_status	3	uimsbf
free_CA_mode	1	bslbf
descriptors_loop_length	12	uimsbf
for(i=0;i<N;i++){		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

Semantics for the event information section

table_id: See Table A.2.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field. It specifies the number of bytes of the section, starting immediately following the section_length field and including the CRC. The section_length shall not exceed 4093 so that the entire section has a maximum length of 4096 bytes.

service_id: This is a 16-bit field which serves as a label to identify this service from any other service within a TS.

The service_id is the same as the program_number in the corresponding program_map_section.

version_number: This 5-bit field is the version number of the sub_table. The version_number shall be incremented by 1 when a change in the information carried within the sub_table occurs. When it reaches value 31, it wraps around to 0. When the current_next_indicator is set to "1", then the version_number shall be that of the currently applicable sub_table. When the current_next_indicator is set to "0", then the version_number shall be that of the next applicable sub_table.

current_next_indicator: This 1-bit indicator, when set to "1", indicates that the sub_table is the currently applicable sub_table. When the bit is set to "0", it indicates that the sub_table sent is not yet applicable and shall be the next sub_table to be valid.

section_number: This 8-bit field gives the number of the section. The section_number of the first section in the sub_table shall be "0x00". The section_number shall be incremented by 1 with each additional section with the same table_id, service_id, transport_stream_id, and original_network_id. In this case, the sub_table may be structured as a number of segments. Within each segment the section_number shall increment by 1 with each additional section, but a gap in numbering is permitted between the last section of a segment and the first section of the adjacent segment.

last_section_number: This 8-bit field specifies the number of the last section (that is the section with the highest section_number) of the sub_table of which this section is part.

transport_stream_id: This is a 16-bit field which serves as a label for identification of the TS, about which the EIT informs, from any other multiplex within the delivery system.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system.

segment_last_section_number: This 8-bit field specifies the number of the last section of this segment of the sub_table. For sub_tables which are not segmented, this field shall be set to the same value as the last_section_number field.

last_table_id: This 8-bit field identifies the last table_id used (see Table A.2). If only one table is used, this is set to the table_id of this table. The chronological order of information is maintained across successive table_id values.

event_id: This 16-bit field contains the identification number of the described event (uniquely allocated within a service definition).

start_time: This 40-bit field contains the start time of the event in Universal Time Coordinated (UTC) and Modified Julian Date (MJD) (see Appendix A.I). This field is coded as 16 bits giving the 16 LSBs of MJD followed by 24 bits coded as 6 digits in 4-bit Binary Coded Decimal (BCD). If the start time is undefined (e.g., for an event in a NVOD reference service), all bits of the field are set to "1".

Example 1 – 93/10/13 12:45:00 is coded as "0xC079124500".

duration: A 24-bit field containing the duration of the event in hours, minutes and seconds.

format: 6 digits, 4-bit BCD = 24 bit.

Example 2 – 01:45:30 is coded as "0x014530".

running_status: This is a 3-bit field indicating the status of the event as defined in Table A.6. For an NVOD reference event, the value of the running_status shall be set to "0".

free_CA_mode: This 1-bit field, when set to "0", indicates that all the component streams of the event are not scrambled. When set to "1", it indicates that access to one or more streams is controlled by a CA system.

descriptors_loop_length: This 12-bit field gives the total length in bytes of the following descriptors.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in Annex E after processing the entire private section.

A.5.2.5 Time and Date Table (TDT)

The TDT (see Table A.8) carries only the UTC-time and date information.

The TDT shall consist of a single section using the syntax of Table A.8. This TDT section shall be transmitted in TS packets with a PID value of 0x0014, and the table_id shall take the value 0x70.

Table A.8 – Time and date section

Syntax	No. of bits	Identifier
time_date_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
UTC_time	40	bslbf
}		

Semantics for the time and date section

table_id: See Table A.2.

section_syntax_indicator: This is a one-bit indicator which shall be set to "0".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and up to the end of the section.

UTC_time: This 40-bit field contains the current time and date in UTC and MJD (see Appendix A.I). This field is coded as 16 bits giving the 16 LSBs of MJD followed by 24 bits coded as 6 digits in 4-bit BCD.

Example – 93/10/13 12:45:00 is coded as "0xC079124500".

A.5.2.6 Time Offset Table (TOT)

The TOT (see Table A.9) carries the UTC-time and date information and local time offset. The TOT shall consist of a single section using the syntax of Table A.9. This TOT section shall be transmitted in TS packets with a PID value of 0x0014, and the table_id shall take the value 0x73.

Table A.9 – Time offset section

Syntax	No. of bits	Identifier
time_offset_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
UTC_time	40	bslbf
reserved	4	bslbf
descriptors_loop_length	12	uimsbf

Table A.9 – Time offset section

Syntax	No. of bits	Identifier
for(i=0;i<N;i++){		
descriptor()		
}		
CRC_32	32	rpchof
}		

Semantics for the time offset section

table_id: See Table A.2.

section_syntax_indicator: This is a one-bit indicator which shall be set to "0".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and up to the end of the section.

UTC_time: This 40-bit field contains the current time and date in UTC and MJD (see Appendix A.I). This field is coded as 16 bits giving the 16 LSBs of MJD followed by 24 bits coded as 6 digits in 4-bit BCD.

Example – 93/10/13 12:45:00 is coded as "0xC079124500".

descriptors_loop_length: This 12-bit field gives the total length in bytes of the following descriptors.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in Annex E after processing the entire private section.

A.5.2.7 Running Status Table (RST)

The RST (see Table A.10) allows accurate and rapid updating of the timing status of one or more events. This may be necessary when an event starts early or late due to scheduling changes. The use of a separate table enables fast updating mechanism to be achieved.

Table A.10 – Running status section

Syntax	No. of bits	Identifier
running_status_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
for (i=0;i<N;i++){		
transport_stream_id	16	uimsbf
original_network_id	16	uimsbf
service_id	16	uimsbf
event_id	16	uimsbf
reserved_future_use	5	bslbf
running_status	3	uimsbf
}		
}		

The RST shall be segmented into running_status_sections using the syntax of Table A.10. Any sections forming part of an RST shall be transmitted in TS packets with a PID value of 0x0013, and the table_id shall take the value 0x71.

Semantics for the running status section

table_id: See Table A.2.

section_syntax_indicator: This is a one-bit indicator which shall be set to "0".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and up to the end of the section. The section_length shall not exceed 1021 so that the entire section has a maximum length of 1024 bytes.

transport_stream_id: This is a 16-bit field which serves as a label for identification of the TS, about which the RST informs, from any other multiplex within the delivery system.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system.

service_id: This is a 16-bit field which serves as a label to identify this service from any other service within the TS. The service_id is the same as the program_number in the corresponding program_map_section.

event_id: This 16-bit field contains the identification number of the related event.

running_status: This is a 3-bit field indicating the status of the event, as defined in Table A.6.

A.5.2.8 Stuffing Table (ST)

The purpose of this section (see Table A.11) is to invalidate existing sections at a delivery system boundary, e.g., at a cable head-end. When one section of a sub_table is overwritten, then all the sections of that sub_table shall also be overwritten (stuffed) in order to retain the integrity of the section_number field.

Table A.11 – Stuffing section

Syntax	No. of bits	Identifier
stuffing_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
for (i=0;i<N;i++){		
data_byte	8	uimsbf
}		
}		

Semantics for the stuffing section

table_id: See Table A.2.

section_syntax_indicator: This 1-bit field may take either the value "1" or "0".

section_length: This is a 12-bit field. It specifies the number of bytes of the section, starting immediately following the section_length field and up to the end of the section. The section_length shall not exceed 4093 so that the entire section has a maximum length of 4096 bytes.

data_byte: This 8-bit field may take any value and has no meaning.

A.5.2.9 Discontinuity Information Table (DIT)

See clause A.7.1.1

A.5.2.10 Selection Information Table (SIT)

See clause A.7.1.2

A.6 Descriptors

This subclause describes the different descriptors that can be used within the SI (for further information, refer to [ETR 211]).

A.6.1 Descriptor identification and location

Table A.12 lists the descriptors defined within this annex, giving the descriptors-tag values and the intended placement within the SI tables. This does not imply that their use in other tables is restricted.

Table A.12 – Possible locations of descriptors

Descriptor	Tag value	NIT	BAT	SDT	EIT	TOT	PMT	SIT (Note 1)
network_name_descriptor	0x40	*	–	–	–	–	–	–
service_list_descriptor	0x41	*	*	–	–	–	–	–
stuffing_descriptor	0x42	*	*	*	*	–	–	*
satellite_delivery_system_descriptor	0x43	*	–	–	–	–	–	–
cable_delivery_system_descriptor	0x44	*	–	–	–	–	–	–
Reserved for future use	0x45	–	–	–	–	–	–	–
Reserved for future use	0x46	–	–	–	–	–	–	–
bouquet_name_descriptor	0x47	–	*	*	–	–	–	*
service_descriptor	0x48	–	–	*	–	–	–	*
country_availability_descriptor	0x49	–	*	*	–	–	–	*
linkage_descriptor	0x4A	*	*	*	*	–	–	*
NVOD_reference_descriptor	0x4B	–	–	*	–	–	–	*
time_shifted_service_descriptor	0x4C	–	–	*	–	–	–	*
short_event_descriptor	0x4D	–	–	–	*	–	–	*
extended_event_descriptor	0x4E	–	–	–	*	–	–	*
time_shifted_event_descriptor	0x4F	–	–	–	*	–	–	*
component_descriptor	0x50	–	–	–	*	–	–	*
mosaic_descriptor	0x51	–	–	*	–	–	*	*
stream_identifier_descriptor	0x52	–	–	–	–	–	*	–
CA_identifier_descriptor	0x53	–	*	*	*	–	–	*
content_descriptor	0x54	–	–	–	*	–	–	*
parental_rating_descriptor	0x55	–	–	–	*	–	–	*
teletext_descriptor	0x56	–	–	–	–	–	*	–

Table A.12 – Possible locations of descriptors

Descriptor	Tag value	NIT	BAT	SDT	EIT	TOT	PMT	SIT (Note 1)
telephone_descriptor	0x57	–	–	*	*	–	–	*
local_time_offset_descriptor	0x58	–	–	–	–	*	–	–
subtitling_descriptor	0x59	–	–	–	–	–	*	–
terrestrial_delivery_system_descriptor	0x5A	*	–	–	–	–	–	–
multilingual_network_name_descriptor	0x5B	*	–	–	–	–	–	–
multilingual_bouquet_name_descriptor	0x5C	–	*	–	–	–	–	–
multilingual_service_name_descriptor	0x5D	–	–	*	–	–	–	*
multilingual_component_descriptor	0x5E	–	–	–	*	–	–	*
private_data_specifier_descriptor	0x5F	*	*	*	*	–	*	*
service_move_descriptor	0x60	–	–	–	–	–	*	–
short_smoothing_buffer_descriptor	0x61	–	–	–	*	–	–	*
frequency_list_descriptor	0x62	*	–	–	–	–	–	–
partial_transport_stream_descriptor	0x63	–	–	–	–	–	–	*
data_broadcast_descriptor	0x64	–	–	*	*	–	–	*
CA_system_descriptor (Note 2)	0x65	–	–	–	–	–	*	–
data_broadcast_id_descriptor	0x66	–	–	–	–	–	*	–
Reserved for future use	0x67 to 0x7F							
User-defined	0x80 to 0xFE							
Forbidden	0xFF							

* Possible location.

NOTE 1 – Only found in Partial Transport Streams.

NOTE 2 – Reserved for DAVIC/DVB use: DAVIC shall define its use.

A.6.2 Descriptor coding

When the construct "descriptor ()" appears in the subclauses of clause A.5.2, this indicates that zero or more of the descriptors defined within this subclause shall occur.

The following semantics apply to all the descriptors defined in this clause.

descriptor_tag: The descriptor tag is an 8-bit field which identifies each descriptor. Those values with MPEG-2 normative meaning are described in [ITU-T H.222.0]. The values of descriptor_tag are defined in Table A.12.

descriptor_length: The descriptor length is an 8-bit field specifying the total number of bytes of the data portion of the descriptor following the byte defining the value of this field.

A.6.2.1 Bouquet name descriptor

The bouquet name descriptor provides the bouquet name in text form, see Table A.13.

Table A.13 – Bouquet name descriptor

Syntax	No. of bits	Identifier
bouquet_name_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for(i=0;i<N;i++){		
char	8	uimsbf
}		
}		

Semantics for the bouquet name descriptor

char: This is an 8-bit field, a sequence of which conveys the name of the bouquet about which the BAT sub_table informs. Text information is coded using the character sets and methods described in Annex D.

A.6.2.2 CA identifier descriptor

The CA identifier descriptor (see Table A.14) indicates whether a particular bouquet, service or event is associated with a conditional access system and identifies the CA system type by means of the CA_system_id.

Table A.14 – CA identifier descriptor

Syntax	No. of bits	Identifier
CA_identifier_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++){		
CA_system_id	16	uimsbf
}		
}		

Semantics for the CA identifier descriptor

CA_system_id: This 16-bit field identifies the CA system. Allocations of the value of this field are found in [ETR 162] .

A.6.2.3 Component descriptor

The component descriptor identifies the type of component stream and may be used to provide a text description of the elementary stream (see Table A.15).

Table A.15 – Component descriptor

Syntax	No. of bits	Identifier
component_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reserved_future_use	4	bslbf
stream_content	4	uimsbf

Table A.15 – Component descriptor

Syntax	No. of bits	Identifier
component_type	8	uimsbf
component_tag	8	uimsbf
ISO_639_language_code	24	bslbf
for (i=0;i<N;i++){		
text_char	8	uimsbf
}		
}		

Semantics for the component descriptor

stream_content: This 4-bit field specifies the type (video, audio, or EBU-data) of stream. The coding of this field is specified in Table A.16.

component_type: This 8-bit field specifies the type of the video, audio or EBU-data component. The coding of this field is specified in Table A.16.

component_tag: This 8-bit field has the same value as the component_tag field in the stream identifier descriptor (if present in the PSI program map section) for the component stream.

ISO_639_language_code: This 24-bit field identifies the language of the component (in the case of audio or EBU-data) and of the text description which may be contained in this descriptor. The ISO_639_language_code contains a 3-character code as specified by [ISO 639] . Both ISO 639-2/B and ISO 639-2/T may be used.

Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

text_char: This is an 8-bit field. A string of "text_char" fields specify a text description of the component stream.

Text information is coded using the character sets and methods described in Annex D.

Table A.16 – stream_content and component_type

stream_content	component_type	Description
0x00	0x00 to 0xFF	Reserved for future use
0x01	0x00	Reserved for future use
0x01	0x01	Video, 4:3 aspect ratio
0x01	0x02	Video, 16:9 aspect ratio with pan vectors
0x01	0x03	Video, 16:9 aspect ratio without pan vectors
0x01	0x04	Video, >16:9 aspect ratio
0x01	0x05 to 0xFF	Reserved for future use
0x02	0x00	Reserved for future use
0x02	0x01	Audio, single mono channel
0x02	0x02	Audio, dual mono channel
0x02	0x03	Audio, stereo (2 channel)
0x02	0x04	Audio, multilingual, multichannel

Table A.16 – stream_content and component_type

stream_content	component_type	Description
0x02	0x05	Audio, surround sound
0x02	0x06 to 0x3F	Reserved for future use
0x02	0x40	Audio description for the visually impaired
0x02	0x41	Audio for the hard of hearing
0x02	0x42 to 0xAF	Reserved for future use
0x02	0xB0 to 0xFE	User-defined
0x02	0xFF	Reserved for future use
0x03	0x00	Reserved for future use
0x03	0x01	EBU Teletext subtitles
0x03	0x02	Associated EBU Teletext
0x03	0x03 to 0x0F	Reserved for future use
0x03	0x10	DVB subtitles (normal) with no monitor aspect ratio criticality
0x03	0x11	DVB subtitles (normal) for display on 4:3 aspect ratio monitor
0x03	0x12	DVB subtitles (normal) for display on 16:9 aspect ratio
0x03	0x13	DVB subtitles (normal) for display on 2.21:1 aspect ratio
0x03	0x14 to 0x1F	Reserved for future use
0x03	0x20	DVB subtitles (for the hard of hearing) with no monitor aspect
0x03	0x21	DVB subtitles (for the hard of hearing) for display on 4:3
0x03	0x22	DVB subtitles (for the hard of hearing) for display on 16:9
0x03	0x23	DVB subtitles (for the hard of hearing) for display on 2.21:1
0x03	0x24 to 0xFF	Reserved for future use
0x04 to 0x0B	0x00 to 0xFF	Reserved for future use
0x0C to 0x0F	0x00 to 0xFF	User-defined

A.6.2.4 Content descriptor

The intention of the content descriptor (see Table A.17) is to provide classification information for an event.

Table A.17 – Content descriptor

Syntax	No. of bits	Identifier
content_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++) {		
content_nibble_level_1	4	uimsbf
content_nibble_level_2	4	uimsbf
user_nibble	4	uimsbf
user_nibble	4	uimsbf
}		
}		

Semantics of the content descriptor

content_nibble_level_1: This 4-bit field represents the first level of a content identifier. This field shall be coded according to Table A.18.

content_nibble_level_2: This 4-bit field represents the second level of a content identifier. This field shall be coded according to Table A.18.

user_nibble: This 4-bit field is defined by the broadcaster.

Table A.18 – content_nibble level 1 and 2 assignments

content_nibble_level_1	content_nibble_level_2	Description
0x0	0x0 to 0xF	Undefined content
		Movie/Drama
0x1	0x0	Movie/drama (general)
0x1	0x1	Detective/thriller
0x1	0x2	Adventure/western/war
0x1	0x3	Science fiction/fantasy/horror
0x1	0x4	Comedy
0x1	0x5	Soap/melodrama/folkloric
0x1	0x6	Romance
0x1	0x7	Serious/classical/religious/historical movie/drama
0x1	0x8	Adult movie/drama
0x1	0x9 to 0xE	Reserved for future use
0x1	0xF	User-defined
		News/Current affairs
0x2	0x0	News/current affairs (general)
0x2	0x1	News/weather report
0x2	0x2	News magazine
0x2	0x3	Documentary
0x2	0x4	Discussion/interview/debate
0x2	0x5 to 0xE	Reserved for future use
0x2	0xF	User-defined
		Show/Game show
0x3	0x0	Show/game show (general)
0x3	0x1	Game show/quiz/contest
0x3	0x2	Variety show
0x3	0x3	Talk show
0x3	0x4 to 0xE	Reserved for future use
0x3	0xF	User-defined

Table A.18 – content_nibble level 1 and 2 assignments

content_nibble_level_1	content_nibble_level_2	Description
		Sports
0x4	0x0	Sports (general)
0x4	0x1	Special events (Olympic Games, World Cup etc.)
0x4	0x2	Sports magazines
0x4	0x3	Football/soccer
0x4	0x4	Tennis/squash
0x4	0x5	Team sports (excluding football)
0x4	0x6	Athletics
0x4	0x7	Motor sport
0x4	0x8	Water sport
0x4	0x9	Winter sports
0x4	0xA	Equestrian
0x4	0xB	Martial sports
0x4	0xC to 0xE	Reserved for future use
0x4	0xF	User-defined
		Children's/Youth programmes
0x5	0x0	Children's/youth programmes (general)
0x5	0x1	Pre-school children's programmes
0x5	0x2	Entertainment programmes for 6 to14
0x5	0x3	Entertainment programmes for 10 to 16
0x5	0x4	Informational/educational/school programmes
0x5	0x5	Cartoons/puppets
0x5	0x6 to 0xE	Reserved for future use
0x5	0xF	User-defined
		Music/Ballet/Dance
0x6	0x0	Music/ballet/dance (general)
0x6	0x1	Rock/pop
0x6	0x2	Serious music/classical music
0x6	0x3	Folk/traditional music
0x6	0x4	Jazz
0x6	0x5	Musical/opera
0x6	0x6	Ballet
0x6	0x7 to 0xE	Reserved for future use
0x6	0xF	User-defined

Table A.18 – content_nibble level 1 and 2 assignments

content_nibble_level_1	content_nibble_level_2	Description
		Arts/Culture (without music)
0x7	0x0	Arts/culture (without music, general)
0x7	0x1	Performing arts
0x7	0x2	Fine arts
0x7	0x3	Religion
0x7	0x4	Popular culture/traditional arts
0x7	0x5	Literature
0x7	0x6	Film/cinema
0x7	0x7	Experimental film/video
0x7	0x8	Broadcasting/press
0x7	0x9	New media
0x7	0xA	Arts/culture magazines
0x7	0xB	Fashion
0x7	0xC to 0xE	Reserved for future use
0x7	0xF	User-defined
		Social/Political issues/Economics
0x8	0x0	Social/political issues/economics (general)
0x8	0x1	Magazines/reports/documentary
0x8	0x2	Economics/social advisory
0x8	0x3	Remarkable people
0x8	0x4 to 0xE	Reserved for future use
0x8	0xF	User-defined
		Education/ Science/Factual topics
0x9	0x0	Education/science/factual topics (general)
0x9	0x1	Nature/animals/environment
0x9	0x2	Technology/natural sciences
0x9	0x3	Medicine/physiology/psychology
0x9	0x4	Foreign countries/expeditions
0x9	0x5	Social/spiritual sciences
0x9	0x6	Further education
0x9	0x7	Languages
0x9	0x8 to 0xE	Reserved for future use
0x9	0xF	User-defined
		Leisure hobbies
0xA	0x0	Leisure hobbies (general)
0xA	0x1	Tourism/travel

Table A.18 – content_nibble level 1 and 2 assignments

content_nibble_level_1	content_nibble_level_2	Description
0xA	0x2	Handicraft
0xA	0x3	Motoring
0xA	0x4	Fitness & health
0xA	0x5	Cooking
0xA	0x6	Advertisement/shopping
0xA	0x7	Gardening
0xA	0x8 to 0xE	Reserved for future use
0xA	0xF	User-defined
		Special Characteristics
0xB	0x0	Original language
0xB	0x1	Black & white
0xB	0x2	Unpublished
0xB	0x3	Live broadcast
0xB	0x4 to 0xE	Reserved for future use
0xB	0xF	User-defined
0xC to 0xE	0x0 to 0xF	Reserved for future use
0xF	0x0 to 0xF	User-defined

A.6.2.5 Country availability descriptor

In order to identify various combinations of countries efficiently, the descriptor may appear twice for each service, once giving a list of countries and/or groups of countries where the service is intended to be available, and the second giving a list of countries and/or groups where it is not. The latter list overrides the former list. If only one descriptor is used, which lists countries where the service is intended to be available, then it indicates that the service is not intended to be available in any other country. If only one descriptor is used, which lists countries where the service is not intended to be available, then it indicates that the service is intended to be available in every other country. If no descriptor is used, then it is not defined for which countries the service is intended to be available (see Table A.19).

Table A.19 – Country availability descriptor

Syntax	No. of bits	Identifier
country_availability_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
country_availability_flag	1	bslbf
reserved_future_use	7	bslbf
for (i=0;i<N;i++){		
country_code	24	bslbf
}		
}		

Semantics for the country availability descriptor

c**ountry_availability_flag**: This 1-bit field indicates whether the following country codes represent the countries in which the reception of the service is intended or not. If country_availability_flag is set to "1", the following country codes specify the countries in which the reception of the service is intended. If set to "0", the following country codes specify the countries in which the reception of the service is not intended.

country_code: This 24-bit field identifies a country using the 3-character code as specified in [ISO 3166] .

Each character is coded into 8-bits according to [ISO 8859] and inserted in order into the 24-bit field.

In the case that the 3 characters represent a number in the range 900 to 999, then country_code specifies an ETSI defined group of countries. These allocations are found in [ETR 162].

Example – United Kingdom has 3-character code "GBR", which is coded as:
'0100 0111 0100 0010 0101 0010'.

A.6.2.6 Data broadcast descriptor

The data broadcast descriptor identifies the type of the data component and may be used to provide a text description of the data component (see Table A.20).

Table A.20 – Data broadcast descriptor

Syntax	No. of bits	Identifier
data_broadcast_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
data_broadcast_id	16	uimsbf
component_tag	8	uimsbf
selector_length	8	uimsbf
for (i=0; i<selector_length; i++){		
selector_byte	8	uimsbf
}		
ISO_639_language_code	24	bslbf
text_length	8	uimsbf
for (i=0; i<text_length; i++){		
text_char	8	uimsbf
}		
}		

Semantics of the data broadcast descriptor

data_broadcast_id: This 16-bit field identifies the data broadcast specification that is used to broadcast the data in the broadcast network. Allocations of the value of this field are found in [ETR 162] .

component_tag: This optional 8-bit field has the same value as the component_tag field in the stream identifier descriptor that may be present in the PSI program map section for the stream on which the data are broadcasted.

If this field is not used, it shall be set to the value 0x00.

selector_length: This 8-bit field specifies the length in bytes of the following selector field.

selector_byte: This is an 8-bit field. The sequence of selector_byte fields specifies the selector field.

The syntax and semantics of the selector field shall be defined by the data broadcast specification that is identified in the data_broadcast_id field. The selector field may contain service specific information that is necessary to identify an entry-point of the broadcast data.

ISO_639_language_code: This 24-bit field contains the [ISO 639] three-character language code of the following text fields. Both ISO 639-2/B and ISO 639-2/T may be used. Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

text_length: This 8-bit field specifies the length in bytes of the following text describing the data component.

text_char: This is an 8-bit field. A string of "char" fields specify the text description of the data component.

Text information is coded using the character sets and methods described in Annex D.

A.6.2.7 Data broadcast id descriptor

The data broadcast id descriptor identifies the type of the data component (see Table A.21). It is a short form of the broadcast descriptor and it may be placed in the component loop of the PSI PMT table.

Table A.21 – Data broadcast id descriptor

Syntax	No. of bits	Identifier
data_broadcast_id_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
data_broadcast_id	16	uimsbf
}		

Semantics of the data broadcast id descriptor

data_broadcast_id: This 16-bit field identifies the data broadcast specification that is used to broadcast the data in the broadcast network. Allocations of the value of this field are found in [ETR 162] .

A.6.2.8 Delivery system descriptors

The delivery system descriptors all have the same overall length of 13 bytes. This facilitates the interchange of these descriptors when a TS is transcoded from one delivery system to another, e.g., satellite to cable.

A.6.2.8.1 Cable delivery system descriptor

See Table A.22.

Table A.22 – Cable delivery system descriptor

Syntax	No. of bits	Identifier
cable_delivery_system_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
frequency	32	bslbf
reserved_future_use	12	bslbf
FEC_outer	4	bslbf
modulation	8	bslbf
symbol_rate	28	bslbf
FEC_inner	4	bslbf
}		

Semantics for cable delivery system descriptor

frequency: The frequency is a 32-bit field giving the 4-bit BCD values specifying 8 characters of the frequency value. For the cable_delivery_system_descriptor, the frequency is coded in MHz, where the decimal occurs after the fourth character (e.g., 0312.0000 MHz).

FEC_outer: The FEC_outer is a 4-bit field specifying the outer Forward Error Correction (FEC) scheme used according to Table A.23.

Table A.23 – Outer FEC scheme

FEC_outer bit 3210	Description
0000	Not defined
0001	No outer FEC coding
0010	RS(204/188)
0011 to 1111	Reserved for future use

modulation: This is an 8-bit field. It specifies the modulation scheme used on a cable delivery system according to Table A.24.

Table A.24 – Modulation scheme for cable

Modulation (hex)	Description
0x00	Not defined
0x01	16-QAM
0x02	32-QAM
0x03	64-QAM
0x04	128-QAM
0x05	256-QAM
0x06 to 0xFF	Reserved for future use

symbol_rate: The symbol_rate is a 28-bit field giving the 4-bit BCD values specifying 7 characters of the symbol_rate in Msymbol/s where the decimal point occurs after the third character (e.g., 027.4500).

FEC_inner: The FEC_inner is a 4-bit field specifying the inner FEC scheme used according to Table A.25.

Table A.25 – Inner FEC scheme

FEC_inner bit 3210	Description
0000	Not defined
0001	1/2 conv. code rate
0010	2/3 conv. code rate
0011	3/4 conv. code rate
0100	5/6 conv. code rate
0101	7/8 conv. code rate
1111	No conv. Coding
0110 to 1110	Reserved for future use

A.6.2.8.2 Satellite delivery system descriptor

See Table A.26.

Table A.26 – Satellite delivery system descriptor

Syntax	No. of bits	Identifier
satellite_delivery_system_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
frequency	32	bslbf
orbital_position	16	bslbf
west_east_flag	1	bslbf
polarization	2	bslbf
modulation	5	bslbf
symbol_rate	28	bslbf
FEC_inner	4	bslbf
}		

Semantics for satellite delivery system descriptor

frequency: The frequency is a 32-bit field giving the 4-bit BCD values specifying 8 characters of the frequency value. For the satellite_delivery_system_descriptor the frequency is coded in GHz, where the decimal point occurs after the third character (e.g., 011.75725 GHz).

orbital_position: The orbital_position is a 16-bit field giving the 4-bit BCD values specifying 4 characters of the orbital position in degrees where the decimal point occurs after the third character (e.g., 019.2 degrees).

west_east_flag: The west_east_flag is a 1-bit field indicating if the satellite position is in the western or eastern part of the orbit. A value "0" indicates the western position and a value "1" indicates the eastern position.

polarization: The polarization is a 2-bit field specifying the polarization of the transmitted signal. The first bit defines whether the polarization is linear or circular (see Table A.27).

Table A.27 – Polarization

polarization	Description
00	Linear – horizontal
01	Linear – vertical
10	Circular – left
11	Circular – right

modulation: This is a 5-bit field. It specifies the modulation scheme used on a satellite delivery system according to Table A.28.

Table A.28 – Modulation scheme for satellite

Modulation bit 4 3210	Description
0 0000	Not defined
0 0001	QPSK
0 0010 to 1 1111	Reserved for future use

symbol_rate: The symbol_rate is a 28-bit field giving the 4-bit BCD values specifying 7 characters of the symbol_rate in Msymbol/s where the decimal point occurs after the third character (e.g., 027.4500).

FEC_inner: The FEC_inner is a 4-bit field specifying the inner FEC scheme used according to Table A.25.

A.6.2.8.3 Terrestrial delivery system descriptor

See Table A.29.

Table A.29 – Terrestrial delivery system descriptor

Syntax	No. of bits	Identifier
terrestrial_delivery_system_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
centre_frequency	32	bslbf
bandwidth	3	bslbf
reserved_future_use	5	bslbf
constellation	2	bslbf
hierarchy_information	3	bslbf
code_rate-HP_stream	3	bslbf
code_rate-LP_stream	3	bslbf
guard_interval	2	bslbf
transmission_mode	2	bslbf
other_frequency_flag	1	bslbf
reserved_future_use	32	bslbf
}		

Semantics for terrestrial delivery system descriptor

centre_frequency: The centre_frequency is a 32-bit uimsbf field giving the binary coded frequency value in multiples of 10 Hz. The coding range is from minimum 10 Hz (0x00000001) up to a maximum of 42 949 672 950 Hz (0xFFFFFFFF).

bandwidth: This is a 3-bit field specifying what is the bandwidth in use. See Table A.30.

Table A.30 – Signalling format for the bandwidth

bandwidth	Bandwidth value
000	8 MHz
001	7 MHz
010 to 111	Reserved for future use

constellation: This is a 2-bit field. It specifies the constellation pattern used on a terrestrial delivery system according to Table A.31.

Table A.31 – Signalling format for the possible constellation patterns

constellation	Constellation characteristics
00	QPSK
01	16-QAM
10	64-QAM
11	Reserved for future use

hierarchy_information: The hierarchy_information specifies whether the transmission is hierarchical and, if so, what the α value is. See Table A.32.

Table A.32 – Signalling format for the α values

hierarchy_information	α value
000	Non-hierarchical
001	α = 1
010	α = 2
011	α = 4
100 to 111	Reserved for future use

code_rate: The code_rate is a 3-bit field specifying the inner FEC scheme used according to Table A.33. Non-hierarchical channel coding and modulation requires signalling of one code rate. In this case, 3 bits specifying code_rate according to Table A.34 are followed by another 3 bits of value '000'. Two different code rates may be applied to two different levels of modulation with the aim of achieving hierarchy. Transmission then starts with the code rate for the HP level of the modulation and ends with the one for the LP level.

Table A.33 – Signalling format for each of the code rates

code_rate	Description
000	1/2
001	2/3
010	3/4
011	5/6
100	7/8
101 to 111	Reserved for future use

guard_interval: The guard_interval is a 2-bit field specifying the guard interval values. See Table A.34.

Table A.34 – Signalling format for each of the guard interval values

guard_interval	Guard interval values
00	1/32
01	1/16
10	1/8
11	1/4

transmission_mode: This 2-bit field indicates the number of carriers in an OFDM frame. See Table A.35.

Table A.35 – Signalling format for transmission mode

transmission_mode	Description
00	2k mode
01	8k mode
10 to 11	Reserved for future use

other_frequency_flag: This 1-bit flag indicates whether other frequencies are in use:

– 0: no other frequency in use.

– 1: one or more other frequencies in use.

A.6.2.9 Extended event descriptor

The extended event descriptor provides a detailed text description of an event, which may be used in addition to the short event descriptor. More than one extended event descriptor can be associated to allow information about one event greater in length than 256 bytes to be conveyed. Text information can be structured into two columns, one giving an item description field and the other the item text. A typical application for this structure is to give a cast list, where for example the item description field might be "Producer" and the item field would give the name of the producer. See Table A.36.

Table A.36 – Extended event descriptor

Syntax	No. of bits	Identifier
extended_event_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
descriptor_number	4	uimsbf
last_descriptor_number	4	uimsbf
ISO_639_language_code	24	bslbf
length_of_items	8	uimsbf
for (i=0;i<N;i++){		
item_description_length	8	uimsbf
for (j=0;j<N;j++){		
item_description_char	8	uimsbf
}		
item_length	8	uimsbf
for (j=0;j<N;j++){		
item_char	8	uimsbf
}		
}		
text_length	8	uimsbf
for (i=0;i<N;i++){		
text_char	8	uimsbf
}		
}		

Semantics for the extended event descriptor

descriptor_number: This 4-bit field gives the number of the descriptor. It is used to associate information which cannot be fitted into a single descriptor. The descriptor_number of the first extended_event_descriptor of an associated set of extended_event_descriptors shall be "0x00". The descriptor_number shall be incremented by 1 with each additional extended_event_descriptor in this section.

last_descriptor_number: This 4-bit field specifies the number of the last extended_event_descriptor (that is, the descriptor with the highest value of descriptor_number) of the associated set of descriptors of which this descriptor is part.

ISO_639_language_code: This 24-bit field identifies the language of the following text fields. The ISO_639_language_code contains a 3-character code as specified by [ISO 639]. Both ISO 639-2/B and ISO 639-2/T may be used. Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

length_of_items: This is an 8-bit field specifying the length in bytes of the following items.

item_description_length: This 8-bit field specifies the length in bytes of the item description.

item_description_char: This is an 8-bit field. A string of "item_description_char" fields specify the item description. Text information is coded using the character sets and methods described in Annex D.

item_length: This 8-bit field specifies the length in bytes of the item text.

item_char: This is an 8-bit field. A string of "item_char" fields specify the item text. Text information is coded using the character sets and methods described in Annex D.

text_length: This 8-bit field specifies the length in bytes of the non-itemized extended text.

text_char: This is an 8-bit field. A string of "text_char" fields specify the non-itemized extended text. Text information is coded using the character sets and methods described in Annex D.

A.6.2.10 Frequency list descriptor

The frequency list descriptor may be used in the NIT. It gives the complete list of additional frequencies for a certain multiplex which is transmitted on multiple frequencies. See Table A.37.

Table A.37 – Frequency list descriptor

Syntax	No. of bits	Identifier
frequency_list_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reserved_future_use	6	bslbf
coding_type	2	bslbf
for (i=0;i<N;i++){		
centre_frequency	32	uimsbf
}		
}		

Semantics for the frequency list descriptor

coding_type: This is a 2-bit field that indicates how the frequency is coded and relates to the delivery system used. It has a value indicated in Table A.38.

Table A.38 – Coding type values

coding_type	Delivery system
00	Not defined
01	Satellite
10	Cable
11	Terrestrial

centre_frequency: This is as defined in the delivery_system_descriptor for the delivery system given by the coding_type.

A.6.2.11 Linkage descriptor

The linkage descriptor (see Table A.39) identifies a service that can be presented if the consumer requests for additional information related to a specific entity described by the SI system. The location of the linkage descriptor in the syntax indicates the entity for which additional information is available. For example a linkage descriptor located within the NIT shall point to a service providing additional information on the network, a linkage descriptor in the BAT shall provide a link to a service informing about the bouquet, etc.

A CA replacement service can be identified using the linkage descriptor. This service may be selected automatically by the IRD if the CA denies access to the specific entity described by the SI system.

A service replacement service can also be identified using the linkage_descriptor. This replacement service may be selected automatically by the IRD when the running status of the current service is set to "not_running".

Table A.39 – Linkage descriptor

Syntax	No. of bits	Identifier
linkage_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
transport_stream_id	16	uimsbf
original_network_id	16	uimsbf
service_id	16	uimsbf
linkage_type	8	uimsbf
for (i=0;i<N;i++){		
private_data_byte	8	bslbf
}		
}		

Semantics for the linkage descriptor

transport_stream_id: This is a 16-bit field which identifies the TS containing the information service indicated.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system of the information service indicated.

service_id: This is a 16-bit field which uniquely identifies an information service within a TS. The service_id is the same as the program_number in the corresponding program_map_section. If the linkage_type field has the value 0x04, then the service_id field is not relevant, and shall be set to 0x0000.

linkage_type: This is an 8-bit field specifying the type of linkage e.g., to information (see Table A.40).

Table A.40 – Linkage type coding

linkage_type	Description
0x00	Reserved for future use
0x01	Information service
0x02	EPG service
0x03	CA replacement service
0x04	TS containing complete Network/Bouquet SI
0x05	Service replacement service
0x06	Data broadcast service
0x07 to 0x7F	Reserved for future use
0x80 to 0xFE	User-defined
0xFF	Reserved for future use

private_data_byte: This is an 8-bit field, the value of which is privately defined.

A.6.2.12 Local time offset descriptor

The local time offset descriptor (see Table A.41) may be used in the TOT to describe country specific dynamic changes of the local time offset relative to UTC.

Table A.41 – Local time offset descriptor

Syntax	No. of bits	Identifier
local_time_offset_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for(i=0;i<N;i++){		
country_code	24	bslbf
country_region_id	6	bslbf
reserved	1	bslbf
local_time_offset_polarity	1	bslbf
local_time_offset	16	bslbf
time_of _change	40	bslbf
next_time_offset	16	bslbf
}		
}		

Semantics for the local time offset descriptor

country_code: This 24-bit field identifies a country using the 3-character code as specified in [ISO 3166].

Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

In the case where the 3 characters represent a number in the range of 900 to 999, then country_code specifies an ETSI defined group of countries. These allocations are in [ETR 162]. Country codes for groups of countries shall be limited to those within a single time zone.

Example – United Kingdom has 3-character code "GBR", which is coded as:
'0100 0111 0100 0010 0101 0010'.

country_region_id: This 6-bit field identifies a zone in the country which is indicated by country_code.

This is set to "000000" when there are no different local time zones in the country. See Table A.42.

Table A.42 – Coding of country_region_id

country_region_id	Description
00 0000	No time zone extension used
00 0001	Time zone 1 (most easterly region)
00 0010	Time zone 2
....	....
11 1100	Time zone 60 (most westerly region)
11 1101 – 11 1111	Reserved

local_time_offset_polarity: This 1-bit information indicates the polarity of the following local_offset_time.

If this bit is set to "0", the polarity is positive and the local time is advanced to UTC. (Usually east direction from Greenwich.) If this bit is set to "1", the polarity is negative and the local time is behind UTC.

local_time_offset: This 16-bit field contains the current offset time from UTC in the range between −12 hours and +12 hours at the area which is indicated by the combination of country_code and country_region_id in advance.

These 16 bits are coded as 4 digits in 4-bit BCD in the order hour tens, hour, minute tens and minutes.

time_of_change: This is a 40-bit field which specifies the date and time in MJD and UTC (see Appendix A.I) when the time change takes place. This 40-bit field is coded as 16 bits giving the 16 LSBs of MJD followed by 24 bits coded as 6 digits in the 4-bit BCD.

next_time_offset: This 16-bit field contains the next offset time after the change from UTC in the range between −12hours and +12hours at the area which is indicated by the combination of country_code and country_region_id in advance. These 16 bits are coded as 4 digits in 4-bit BCD in the order hour tens, hour, minute tens and minutes.

A.6.2.13 Mosaic descriptor

A mosaic component is a collection of different video images to form a coded video component. The information is organized so that each specific information when displayed appears on a small area of a screen.

The mosaic descriptor gives a partitioning of a digital video component into elementary cells, the allocation of elementary cells to logical cells, and gives a link between the content of the logical cell and the corresponding information (e.g., bouquet, service, event, etc.), see Table A.43.

Table A.43 – Mosaic descriptor

Syntax	No. of bits	Identifier
mosaic_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
mosaic_entry_point	1	bslbf
number_of_horizontal_elementary_cells	3	uimsbf
reserved_future_use	1	bslbf
number_of_vertical_elementary_cells	3	uimsbf
for (i=0;i<N; i++) {		
logical_cell_id	6	uimsbf
reserved_future_use	7	bslbf
logical_cell_presentation_info	3	uimsbf
elementary_cell_field_length	8	uimsbf
for (i=0;i<elementary_cell_field_length;i++) {		
reserved_future_use	2	bslbf
elementary_cell_id	6	uimsbf
}		
cell_linkage_info	8	uimsbf

Table A.43 – Mosaic descriptor

Syntax	No. of bits	Identifier
If (cell_linkage_info ==0x01){		
bouquet_id	16	uimsbf
}		
If (cell_linkage_info ==0x02){		
original_network_id	16	uimsbf
transport_stream_id	16	uimsbf
service_id	16	uimsbf
}		
If (cell_linkage_info ==0x03){		
original_network_id	16	uimsbf
transport_stream_id	16	uimsbf
service_id	16	uimsbf
}		
If (cell_linkage_info ==0x04){		
original_network_id	16	uimsbf
transport_stream_id	16	uimsbf
service_id	16	uimsbf
event_id	16	uimsbf
}		
}		
}		

Semantics for the mosaic descriptor

mosaic_entry_point: This is a 1-bit field which, when set to a value of "1", indicates that the mosaic is the highest mosaic in a hierarchy. A complete mosaic system could be organized in a tree structure, the flag being set to identify the entry point in the tree.

number_of_horizontal_elementary_cells: This 3-bit field indicates the number of cells of horizontal screen display, see Table A.44 for coding.

Table A.44 – Coding of horizontal_elementary_cells

Value	Meaning
0x00	One cell
0x01	Two cells
0x02	Three cells
0x03	Four cells
0x04	Five cells
0x05	Six cells
0x06	Seven cells
0x07	Eight cells

number_of_vertical_elementary_cells: This 3-bit field indicates the number of cells of vertical screen display, see Table A.45 for coding.

Table A.45 – Coding of vertical_elementary_cells

Value	Meaning
0x00	One cell
0x01	Two cells
0x02	Three cells
0x03	Four cells
0x04	Five cells
0x05	Six cells
0x06	Seven cells
0x07	Eight cells

logical_cell_id: This 6-bit field is coded in binary form.

Different adjacent (see Figure A.2) elementary cells may be grouped together to form a logical cell. A logical_cell_number is associated to such a group of adjacent elementary_cell_ids. The total number of logical cells shall not exceed the number of elementary cells (maximum = 64). Each elementary cell shall be allocated to one logical cell.

More than one elementary cell may belong to one logical cell.

Cells B, D, H, F are adjacent to cell E; C is not adjacent to A or D; D is not adjacent to H.

A	B	C
D	E	F
G	H	I

Figure A.2 – Adjacent cells

logical_cell_presentation_info: This 3-bit field identifies the type of presentation for a logical cell.

The logical_cell_presentation information allows an identification of presentation styles, which are defined in Table A.46.

Table A.46 – Coding of logical_cell_presentation_info

Value	Meaning
0x00	Undefined
0x01	Video
0x02	Still picture (Note)
0x03	Graphics/text
0x04 to 0x07	Reserved for future use
NOTE – Still picture: A coded still picture consists of a video sequence containing exactly one coded picture which is intra-coded.	

elementary_cell_field_length: The elementary_cell_field_length is an 8-bit field specifying the number of bytes following this field up to and including the last elementary_cell_id in this logical_cell_id loop.

elementary_cell_id: This 6-bit field indicates in binary form the number of the cell. The value of this field is in the range 0 to N.

NOTE – The elementary cells are implicitly numbered from 0 to N. The value 0 is allocated to the cell of the first row (top left corner). This number is incremented from left to right and from top to bottom in such a way that the number N is allocated to the cell of the last position of the last row (bottom right corner).

cell_linkage_info: This 8-bit field identifies the type of information carried in a logical cell, see Table A.47 for coding.

Table A.47 – Coding of cell_linkage_info

Value	Meaning
0x00	Undefined
0x01	Bouquet related
0x02	Service related
0x03	Other mosaic related
0x04	Event related
0x05 to 0xFF	Reserved for future use

bouquet_id: This is a 16-bit field which serves as a label to identify the bouquet described by the cell.

original_network_id: This 16-bit field is a label (see clause A.5.2) which in conjunction with the following fields uniquely identifies a service, event or mosaic.

transport_stream_id: This is a 16-bit field which serves as a label identifying the TS which contains the service, event or mosaic described by the cell.

service_id: This is a 16-bit field which identifies a service within a TS. The service_id is the same as the program_number in the corresponding program_map_section.

The interpretation of this field is context sensitive, dependent on the value of cell_linkage_info:

– when cell_linkage_info = "0x02", this is the service_id of the service described by the cell;

– when cell_linkage_info = "0x03", this is the service_id of the mosaic service described by the cell;

– when cell_linkage_info = "0x04", this is the service_id of the service to which the event described by the cell belongs.

event_id: This is a 16-bit field containing the identification number of the described event.

A.6.2.14 Multilingual bouquet name descriptor

The multilingual bouquet name descriptor (see Table A.48) provides the bouquet name in text form in one or more languages.

Table A.48 – Multilingual bouquet name descriptor

Syntax	No. of bits	Identifier
multilingual_bouquet_name_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++) {		
ISO_639_language_code	24	bslbf
bouquet_name_length	8	uimsbf

Table A.48 – Multilingual bouquet name descriptor

Syntax	No. of bits	Identifier
for (j=0;j<N;j++){		
char	8	uimsbf
}		
}		
}		

Semantics for the multilingual bouquet name descriptor

ISO_639_language_code: This 24-bit field contains the [ISO 639] three-character language code of the language of the following bouquet name. Both ISO 639-2/B and ISO 639-2/T may be used.

Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

bouquet_name_length: This 8-bit field specifies the length in bytes of the following bouquet name.

char: This is an 8-bit field. A string of char fields specify the name of the bouquet about which the BAT sub-table informs in the language specified. Text information is coded using the character sets and methods described in Annex D.

A.6.2.15 Multilingual component descriptor

The multilingual component descriptor (see Table A.49) provides a text description of a component in one or more languages. The component is identified by its component tag value.

Table A.49 – Multilingual component descriptor

Syntax	No. of bits	Identifier
multilingual_component_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
component_tag	8	uimsbf
for (i=0;i<N;i++) {		
ISO_639_language_code	24	bslbf
text_description_length	8	uimsbf
for (j=0;j<N;j++){		
text_char	8	uimsbf
}		
}		
}		

Semantics for the multilingual component descriptor

component_tag: This 8-bit field has the same value as the component_tag field in the stream identifier descriptor (if present in the PSI program map section) for the component stream.

ISO_639_language_code: This 24-bit field identifies the language of the following text description of the component. The ISO_639_language_code contains a 3-character code as specified by [ISO 639]. Both ISO 639-2/B and ISO 639-2/T may be used. Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

text_description_length: This 8-bit field specifies the length in bytes of the following text description.

text_char: This is an 8-bit field. A string of "text_char" fields specify a text description of the component stream. Text information is coded using the character sets and methods described in Annex D.

A.6.2.16 Multilingual network name descriptor

The multilingual network name descriptor (see Table A.50) provides the network name in text form in one or more languages.

Table A.50 – Multilingual network name descriptor

Syntax	No. of bits	Identifier
multilingual_network_name_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++) {		
ISO_639_language_code	24	bslbf
network_name_length	8	uimsbf
for (j=0;j<N;j++){		
char	8	uimsbf
}		
}		
}		

Semantics for the multilingual network name descriptor

ISO_639_language_code: This 24-bit field contains the [ISO 639] three-character language code of the language of the following network name. Both ISO 639-2/B and ISO 639-2/T may be used. Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

network_name_length: This 8-bit field specifies the length in bytes of the following network name.

char: This is an 8-bit field. A string of char fields specify the name of the network about which the NIT informs in the language specified. Text information is coded using the character sets and methods described in Annex D.

A.6.2.17 Multilingual service name descriptor

The multilingual service name descriptor (see Table A.51) provides the names of the service provider and service in text form in one or more languages.

Table A.51 – Multilingual service name descriptor

Syntax	No. of bits	Identifier
multilingual_service_name_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++) {		
ISO_639_language_code	24	bslbf
service_provider_name_length	8	uimsbf
for (j=0;j<N;j++){		
char	8	uimsbf
}		
service_name_length	8	uimsbf
for (j=0;j<N;j++){		
char	8	uimsbf
}		
}		
}		

Semantics for the multilingual service name descriptor

ISO_639_language_code: This 24-bit field contains the [ISO 639] three-character language code of the language of the following text fields. Both ISO 639-2/B and ISO 639-2/T may be used.

Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

service_provider_name_length: This 8-bit field specifies the length in bytes of the following service provider name.

service_name_length: This 8-bit field specifies the length in bytes of the following service name.

char: This is an 8-bit field. A string of char fields specify the name of the service provider or service.

Text information is coded using the character sets and methods described in Annex D.

A.6.2.18 Near Video-on-Demand (NVOD) reference descriptor

This descriptor, in conjunction with the time shifted service and time shifted event descriptors, provides a mechanism for efficiently describing a number of services which carry the same sequence of events, but with the start times offset from one another. Such a group of time-shifted services is referred to as Near Video-on-Demand, since a user can at any time access near to the start of an event by selecting the appropriate service of the group.

The NVOD reference descriptor (see Table A.52) gives a list of the services which together form a NVOD service.

Each service is also described in the appropriate SDT sub_table by a time-shifted service descriptor, see clause A.6.2.29. The time shifted service descriptor associates a time-shifted service with a reference_service_id.

The reference_service_id is the label under which a full description of the NVOD service is given, but the reference_service_id does not itself correspond to any program_number in the program_map_section.

The time-shifted event descriptor is used in the event information for each time-shifted service. Instead of duplicating the full information for each event, the time-shifted event descriptor points to a reference_event_id in the reference service. The full event information is provided in the event information for the reference service.

The services which make up an NVOD service need not all be carried in the same TS.

However, a reference service shall be described in the SI in each TS which carries any services of the NVOD service.

Table A.52 – NVOD reference descriptor

Syntax	No. of bits	Identifier
NVOD_reference_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++) {		
transport_stream_id	16	uimsbf
original_network_id	16	uimsbf
service_id	16	uimsbf
}		
}		

Semantics for the NVOD reference descriptor

transport_stream_id: This is a 16-bit field which identifies the TS.

original_network_id: This 16-bit field gives the label identifying the network_id of the originating delivery system.

service_id: This is a 16-bit field which uniquely identifies a service within a TS. The service_id is the same as the program_number in the corresponding program_map_section.

A.6.2.19 Network name descriptor

The network name descriptor provides the network name in text form (see Table A.53).

Table A.53 – Network name descriptor

Syntax	No. of bits	Identifier
network_name_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++){		
char	8	uimsbf
}		
}		

Semantics for the network name descriptor

char: This is an 8-bit field. A string of char fields specify the name of the delivery system about which the NIT informs. Text information is coded using the character sets and methods described in Annex D.

A.6.2.20 Parental rating descriptor

This descriptor (see Table A.54) gives a rating based on age and allows for extensions based on other rating criteria.

Table A.54 – Parental rating descriptor

Syntax	No. of bits	Identifier
parental_rating_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++){		
country_code	24	bslbf
rating	8	uimsbf
}		
}		

Semantics for the parental rating descriptor

country_code: This 24-bit field identifies a country using the 3-character code as specified in [ISO 3166].

Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

In the case where the 3 characters represent a number in the range of 900 to 999, then country_code specifies an ETSI defined group of countries.

These allocations are found in [ETR 162].

Example – United Kingdom has 3-character code "GBR", which is coded as:
'0100 0111 0100 0010 0101 0010'.

rating: This 8-bit field is coded according to Table A.55, giving the recommended minimum age in years of the end user.

Table A.55 – Parental rating descriptor, rating

Rating	Description
0x00	Undefined
0x01 to 0x0F	Minimum age = rating + 3 years
0x10 to 0xFF	Defined by the broadcaster

Example – 0x04 implies that end users should be at least 7 years old.

A.6.2.21 Partial Transport Stream (TS) descriptor

See clause A.7.2.1

A.6.2.22 Private data specifier descriptor

This descriptor is used to identify the specifier of any private descriptors or private fields within descriptors. See Table A.56.

Table A.56 – Private data specifier descriptor

Syntax	No. of bits	Identifier
private_data_specifier_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
private_data_specifier	32	uimsbf
}		

Semantics for the private data specifier descriptor

private_data_specifier: The assignment of values for this field is given in [ETR 162].

A.6.2.23 Short smoothing buffer descriptor

A smoothing_buffer_descriptor is specified in [ITU-T H.222.0] which enables the bit-rate of a service to be signalled in the PSI.

For use in DVB SI Tables, a more compact and efficient descriptor, the short_smoothing_buffer_descriptor, is defined here.

This descriptor may be included in the EIT Present/Following and EIT Schedule Tables to signal the bit-rate for each event.

The bit-rate is expressed in terms of a smoothing buffer size and output leak rate.

The presence of the descriptor in the EIT Present/Following and EIT Schedule Tables is optional.

The data flows into and from the smoothing buffer are defined as follows:

– bytes of TS packets belonging to the associated service are input to the smoothing buffer at the time defined by equation 2-4 of [ITU-T H.222.0] (definition of the mathematical byte delivery schedule).

  The following packets belong to the service:

  • all TS packets of all elementary streams of the service, i.e., all PIDs which are listed as elementary_PIDs in the extended program information part of the PMT section for the service during the time that the event is transmitted;

  • all TS packets of the PID which is identified as the program_map_PID for the service in the PAT at the time that the event is transmitted;

  • all TS packets of the PID which is identified as the PCR_PID in the PMT section for the service at the time that the event is transmitted.

– all bytes that enter the buffer also exit it.

See Table A.57.

Table A.57 – Short smoothing buffer descriptor

Syntax	No. of bits	Identifier
short_smoothing_buffer_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
sb_size	2	uimsbf
sb_leak_rate	6	uimsbf
for (i=0;i<N;i++){		
DVB_reserved	8	bslbf
}		
}		

Semantics for the short smoothing buffer descriptor

sb_size: This 2-bit field indicates the size of the smoothing buffer, and is coded according to Table A.58.

Table A.58 – Smoothing buffer size

Value	Buffer size (bytes)
0	DVB_reserved
1	1536
2	DVB_reserved
3	DVB_reserved

NOTE – Due to implementation constraints, the specified buffer size value considers spare capacity that may be required in a 2 kbyte RAM for packet jitter.

sb_leak_rate: This 6-bit field indicates the value of the leak rate from the buffer, and is coded according to Table A.59.

Table A.59 – Smoothing buffer leak rate

Value	Leak rate (Mbit/s)
0	DVB_reserved
1	0.0009
2	0.0018
3	0.0036
4	0.0072
5	0.0108
6	0.0144
7	0.0216
8	0.0288
9	0.075
10	0.5
11	0.5625
12	0.8437

Table A.59 – Smoothing buffer leak rate

Value	Leak rate (Mbit/s)
13	1.0
14	1.1250
15	1.5
16	1.6875
17	2.0
18	2.2500
19	2.5
20	3.0
21	3.3750
22	3.5
23	4.0
24	4.5
25	5.0
26	5.5
27	6.0
28	6.5
29	6.7500
30-32	((value) − 16) × 0.5 (7.0, 7.5, 8.0 Mbit/s)
33-37	((value) − 24) (9, 10, 11, 12, 13 Mbit/s)
38	13.5
39-43	((value) − 25) (14, 15, 16, 17, 18 Mbit/s)
44-47	((value) − 34) × 2 (20, 22, 24, 26 Mbit/s)
48	27
49-55	((value) − 35) × 2 (28, 30, 32 ... 40 Mbit/s)
56	44
57	48
58	54
59	72
60	108
61-63	DVB_reserved

A.6.2.24 Service descriptor

The service descriptor (see Table A.60) provides the names of the service provider and the service in text form together with the service_type.

Table A.60 – Service descriptor

Syntax	No. of bits	Identifier
service_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
service_type	8	uimsbf

Table A.60 – Service descriptor

Syntax	No. of bits	Identifier
service_provider_name_length	8	uimsbf
for (i=0;i<N;i++){		
char	8	uimsbf
}		
service_name_length	8	uimsbf
for (i=0;i<N;i++){		
char	8	uimsbf
}		
}		

Semantics for the service descriptor

service_type: This is an 8-bit field specifying the type of the service. It shall be coded according to Table A.61.

Table A.61 – Service type coding

service_type	Description
0x00	Reserved for future use
0x01	Digital television service
0x02	Digital radio sound service
0x03	Teletext service
0x04	NVOD reference service
0x05	NVOD time-shifted service
0x06	Mosaic service
0x07	PAL coded signal
0x08	SECAM coded signal
0x09	D/D2-MAC
0x0A	FM Radio
0x0B	NTSC coded signal
0x0C	Data broadcast service
0x0D to 0x7F	Reserved for future use
0x80 to 0xFE	User-defined
0xFF	Reserved for future use

service_provider_name_length: This 8-bit field specifies the number of bytes that follow the service_provider_name_length field for describing characters of the name of the service provider.

char: This is an 8-bit field. A string of char fields specify the name of the service provider or service.

Text information is coded using the character sets and methods described in Annex D.

service_name_length: This 8-bit field specifies the number of bytes that follow the service_name_length field for describing characters of the name of the service.

A.6.2.25 Service list descriptor

The service list descriptor (see Table A.62) provides a means of listing the services by service_id and service type.

Table A.62 – Service list descriptor

Syntax	No. of bits	Identifier
service_list_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;I++){		
service_id	16	uimsbf
service_type	8	uimsbf
}		
}		

Semantics for the service list descriptor

service_id: This is a 16-bit field which uniquely identifies a service within a TS. The service_id is the same as the program_number in the corresponding program_map_section, except that in the case of service_type = 0x04 (NVOD reference service) the service_id does not have a corresponding program_number.

service_type: This is an 8-bit field specifying the type of the service. It shall be coded according to Table A.61.

A.6.2.26 Service move descriptor

If it is required to move a service from one TS to another, a mechanism is provided which enables an IRD to track the service between TSs by means of a service_move_descriptor. See Table A.63.

Table A.63 – Service move descriptor

Syntax	No. of bits	Identifier
service_move_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
new_original_network_id	16	uimsbf
new_transport_stream_id	16	uimsbf
new_service_id	16	uimsbf
}		

Semantics for the service move descriptor

new_original_network_id: This field contains the original_network_id of the TS in which the service is found after the move.

new_transport_stream_id: This field contains the transport_stream_id of the TS in which the service is found after the move.

new_service_id: This field contains the service_id of the service after the move. If the service remains within the same original network, then the new_service_id is the same as the previous service_id.

A.6.2.27 Short event descriptor

The short event descriptor provides the name of the event and a short description of the event in text form (see Table A.64).

Table A.64 – Short event descriptor

Syntax	No. of bits	Identifier
short_event_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
ISO_639_language_code	24	bslbf
event_name_length	8	uimsbf
for (i=0;i<event_name_length;i++){		
event_name_char	8	uimsbf
}		
text_length	8	uimsbf
for (i=0;i<text_length;i++){		
text_char	8	uimsbf
}		
}		

Semantics for the short event descriptor

ISO_639_language_code: This 24-bit field contains the [ISO 639] three-character language code of the language of the following text fields. Both ISO 639-2/B and ISO 639-2/T may be used.

Each character is coded into 8 bits according to [ISO 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

event_name_length: An 8-bit field specifying the length in bytes of the event name.

event_name_char: This is an 8-bit field. A string of "char" fields specify the event name.

Text information is coded using the character sets and methods described in Annex D.

text_length: This 8-bit field specifies the length in bytes of the following text describing the event.

text_char: This is an 8-bit field. A string of "char" fields specify the text description for the event. Text information is coded using the character sets and methods described in Annex D.

A.6.2.28 Stream identifier descriptor

The stream identifier descriptor (see Table A.65) may be used in the PSI PMT to label component streams of a service so that they can be differentiated, e.g., by text descriptions given in component descriptors in the EIT if present.

The stream identifier descriptor shall be located following the relevant ES_info_length field.

Table A.65 – Stream identifier descriptor

Syntax	No. of bits	Identifier
stream_identifier_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
component_tag	8	uimsbf
}		

Semantics for the stream identifier descriptor

component_tag: This 8-bit field identifies the component stream for associating it with a description given in a component descriptor. Within a program map section, each stream identifier descriptor shall have a different value for this field.

A.6.2.29 Stuffing descriptor

The stuffing descriptor provides a means of invalidating previously coded descriptors or inserting dummy descriptors for table stuffing (see Table A.66).

Table A.66 – Stuffing descriptor

Syntax	No. of bits	Identifier
stuffing_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i= 0;i<N;i++){		
stuffing_byte	8	bslbf
}		
}		

Semantics for the stuffing descriptor

stuffing_byte: This is an 8-bit field. Each occurrence of the field may be set to any value. The IRDs may discard the stuffing bytes.

A.6.2.30 Subtitling descriptor

In the [ITU-T H.222.0] Program Map Table (PMT), the value of stream_type for any PID carrying DVB subtitle shall be '0x06' (this indicates a PES carrying private data). See Table A.67.

Table A.67 – Subtitling descriptor

Syntax	No. of bits	Identifier
subtitling_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i= 0;i<N;i++){		
ISO_639_language_code	24	bslbf
subtitling_type	8	bslbf
composition_page_id	16	bslbf
ancillary_page_id	16	bslbf
}		
}		

Semantics for the subtitling descriptor

ISO_639_language_code: This 24-bit field contains the [ISO 639] three-character language code of the language of the subtitle. Both ISO 639-2/B and ISO 639-2/T may be used. Each character is coded into 8 bits according to [ISO/IEC 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

subtitling_type: This 8-bit field provides information on the content of the subtitle and the intended display.

The coding of this field shall use the codes defined for component_type when stream_content is 0x03 in Table A.16, "stream_content and component_type".

composition_page_id: This 16-bit field identifies the composition page. DVB_subtitling_segments signalling this page_id shall be decoded if the previous data in the subtitling descriptor matches the user's selection criteria.

NOTE 1 – The composition_page_id is signalled in at least the DVB_subtitling_segments that define the data structure of the subtitle screen; the page_composition_segment and region _composition_segments.

It may additionally be signalled in segments containing data on which the composition depends.

ancillary_page_id: This identifies the (optional) ancillary page. DVB_subtitling_segments signalling this page_id shall also be decoded if the previous data in the subtitling descriptor matches the user's selection criteria.

The values in the ancillary_page_id and the composition_page_id fields shall be the same if no ancillary page is provided.

NOTE 2 – The ancillary_page_id is never signalled in a composition segment.

It may be signalled in Colour Look-Up Table (CLUT) definition segments, object segments and any other type of segment.

NOTE 3 – (Terminology): A segment that signals a particular page number in its page_id field is said to be "in" that page. The page is said to "contain" that segment.

A.6.2.31 Telephone descriptor

The telephone descriptor may be used to indicate a telephone number which may be used in conjunction with a modem (PSTN or cable) to exploit narrow-band interactive channels. Further information is given in "Implementation guidelines" for the use of telecommunications interfaces in Digital Video Broadcasting systems (see Bibliography).

The telephone descriptor syntax is specified in Table A.68.

Table A.68 – Telephone descriptor

Syntax	No. of bits	Identifier
telephone_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reserved_future_use	2	bslbf
foreign_availability	1	bslbf
connection_type	5	uimsbf
reserved_future_use	1	bslbf
country_prefix_length	2	uimsbf
international_area_code_length	3	uimsbf

Table A.68 – Telephone descriptor

Syntax	No. of bits	Identifier
operator_code_length	2	uimsbf
reserved_future_use	1	bslbf
national_area_code_length	3	uimsbf
core_number_length	4	uimsbf
for (i=0;i<N;i++){		
country_prefix_char	8	uimsbf
}		
for (i=0;i<N;i++){		
international_area_code_char	8	uimsbf
}		
for (i=0;i<N;i++){		
operator_code_char	8	uimsbf
}		
for (i=0;i<N;i++){		
national_area_code_char	8	uimsbf
}		
for (i=0;i<N;i++){		
core_number_char	8	uimsbf
}		
}		

Semantics for the telephone descriptor

foreign_availability: This is a 1-bit flag. When set to "1", it indicates that the number described can be called from outside of the country specified by the country_prefix. When set to "0", it indicates that the number can only be called from inside the country specified by the country_prefix.

connection_type: This is a 5-bit field which indicates connection types. One example of the use of the connection type is to inform the IRD that when, if an interaction is initiated, if the connection is not made within 1 minute, then the connection attempt should be aborted.

country_prefix_length: This 2-bit field specifies the number of 8-bit alphanumeric characters in the country prefix.

international_area_code_length: This 3-bit field specifies the number of 8-bit alphanumeric characters in the international area code.

operator_code_length: This 2-bit field specifies the number of 8-bit alphanumeric characters in the operator code.

national_area_code_length: This 3-bit field specifies the number of 8-bit alphanumeric characters in the national area code.

core_number_length: This 4-bit field specifies the number of 8-bit alphanumeric characters in the core number.

country_prefix_char: This 8-bit field which shall be coded in accordance with [ISO/IEC 8859] gives one alphanumeric character of the country prefix.

international_area_code_char: This 8-bit field which shall be coded in accordance with [ISO/IEC 8859] gives one alphanumeric character of the international area code.

operator_code_char: This 8-bit field which shall be coded in accordance with [ISO/IEC 8859] gives one alphanumeric character of the operator code.

national_area_code_char: This 8-bit field which shall be coded in accordance with [ISO/IEC 8859] gives one alphanumeric character of the national area code.

core_number_char: This 8-bit field which shall be coded in accordance with [ISO/IEC 8859] gives one alphanumeric character of the core number.

A.6.2.32 Teletext descriptor

The Teletext descriptor (see Table A.69) shall be used in the PSI PMT to identify streams which carry EBU Teletext data. The descriptor is to be located in a program map section following the relevant ES_info_length field.

Table A.69 – Teletext descriptor

Syntax	No. of bits	Identifier
teletext_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0;i<N;i++){		
ISO_639_language_code	24	bslbf
teletext_type	5	uimsbf
teletext_magazine_number	3	uimsbf
teletext_page_number	8	uimsbf
}		
}		

Semantics for the Teletext descriptor

ISO_639_language_code: This 24-bit field contains the 3-character [ISO 639] language code of the language of the teletext. Both ISO 639-2/B and ISO 639-2/T may be used. Each character is coded into 8 bits according to [ISO/IEC 8859] and inserted in order into the 24-bit field.

Example – French has 3-character code "fre", which is coded as:
'0110 0110 0111 0010 0110 0101'.

teletext_type: This 5-bit field indicates the type of Teletext page indicated. This shall be coded according to Table A.70.

Table A.70 – Teletext descriptor, teletext_type

teletext_type	Description
0x00	Reserved for future use
0x01	Initial Teletext page
0x02	Teletext subtitle page
0x03	Additional information page
0x04	Programme schedule page
0x05	Teletext subtitle page for hearing impaired people
0x06 to 0x1F	Reserved for future use

teletext_magazine_number: This is a 3-bit field which identifies the magazine number as defined in [EBU SPB 492].

teletext_page_number: This is an 8-bit field giving two 4-bit hex digits identifying the page number as defined in [EBU SPB 492].

A.6.2.33 Time-shifted event descriptor

The time-shifted event descriptor (see Table A.71) is used in place of the short_event_descriptor to indicate an event which is a time-shifted copy of another event.

Table A.71 – Time-shifted event descriptor

Syntax	No. of bits	Identifier
Time_shifted_event_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reference_service_id	16	uimsbf
reference_event_id	16	uimsbf
}		

Semantics for the time-shifted event descriptor

reference_service_id: This 16-bit field identifies the reference service of a NVOD collection of services.

The reference service can always be found in this TS. The service_id here does not have a corresponding program_number in the program_map_section.

reference_event_id: This 16-bit field identifies the reference event of which the event described by this descriptor is a time-shifted copy.

A.6.2.34 Time-shifted service descriptor

This descriptor is used in place of the service descriptor to indicate services which are time-shifted copies of other services (see Table A.72).

Table A.72 – Time-shifted service descriptor

Syntax	No. of bits	Identifier
time_shifted_service_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reference_service_id	16	uimsbf
}		

Semantics for the time-shifted service descriptor

reference_service_id: This 16-bit field identifies the reference service of a NVOD collection of services.

The reference service can always be found in this TS. The service_id here does not have a corresponding program_number in the program_map_section.

A.7 Storage media interoperability (SMI) measures

[IEC Publication 61883] describes methods for delivering TS over the [IEEE 1394] "High Performance Serial Bus" to receivers. One likely source for this data is a digital storage device.

In certain cases TSs can be "incomplete", thus not conforming to the normal broadcast specifications. These "partial" TSs represent a subset of the data streams in the original TS. They may also be "discontinuous" – that is there may be changes in the TS or the subset of the TS presented and there may be temporal discontinuities. This subclause on Storage Media Interoperability (SMI) describes the SI and PSI required in the delivered data in these cases.

A.7.1 SMI tables

The SMI tables are encoded using the private section syntax defined in [ITU-T H.222.0].

The SIT may be up to 4096 bytes long.

The bitstream presented at a digital interface shall either be a "complete" TS conforming to [ETR 154] and with SI conforming to this annex or it shall be "partial" TS.

In the latter case, the SI and PSI shall conform to the following subclauses.

A "partial" TS shall not carry any SI tables other than the Selection Information Table (SIT) and Discontinuity Information Table (DIT) described below. The PSI shall be restricted to the PAT and PMT instances required to correctly describe the streams within the "partial" TS.

The presence of the SIT in a bitstream identifies the bitstream as a "partial" TS coming from a digital interface. In this case, the receiver should not expect the SI information required in a broadcast TS and should instead rely on that carried by the SIT.

The SIT contains a summary of all relevant SI information contained in the broadcast stream. The DIT shall be inserted at transition points where SI information is discontinuous. The use of the SIT and DIT is restricted to partial TSs, they shall not be used in broadcasts.

A.7.1.1 Discontinuity Information Table (DIT)

The DIT (see Table A.73) is to be inserted at transition points at which SI information may be discontinuous.

Table A.73 – Discontinuity information section

Syntax	No. of bits	Identifier
discontinuity_information_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transition_flag	1	uimsbf
reserved_future_use	7	bslbf
}		

Semantics for the discontinuity information section

table_id: See Table A.2.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "0".

section_length: This is a 12-bit field, which is set to 0x001.

transition_flag: This 1-bit flag indicates the kind of transition in the TS. When the bit is set to "1", it indicates that the transition is due to a change of the originating source. The change of the originating source can be a change of originating TS and/or a change of the position in the TS (e.g., in case of time-shift). When the bit is set to "0", it indicates that the transition is due to a change of the selection only, i.e., while staying within the same originating TS at the same position.

A.7.1.2 Selection Information Table (SIT)

The SIT describes the service(s) and event(s) carried by the "partial" TS. See Table A.74.

Table A.74 – Selection information section

Syntax	No. of bits	Identifier
selection_information_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
DVB_reserved_future_use	1	bslbf
ISO_reserved	2	bslbf
section_length	12	uimsbf
DVB_reserved_future_use	16	uimsbf
ISO_reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
DVB_reserved_for_future_use	4	uimsbf
transmission_info_loop_length	12	bslbf
for(i =0;i<N;i++) {		
descriptor()		
}		
for(i=0;i<N;i++){		
service_id	16	uimsbf
DVB_reserved_future_use	1	uimsbf
running_status	3	bslbf
service_loop_length	12	bslbf
for(j=0;j<N;j++){		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

Semantics for the selection information section

table_id: See Table A.2.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field, the first two bits of which shall be "00". It specifies the number of bytes of the section, starting immediately following the section_length field and including the CRC. The section_length shall not exceed 4093 so that the entire section has a maximum length of 4096 bytes.

version_number: This 5-bit field is the version number of the table. The version_number shall be incremented by 1 when a change in the information carried within the table occurs. When it reaches value 31, it wraps around to 0.

When the current_next_indicator is set to "1", then the version_number shall be that of the currently applicable table. When the current_next_indicator is set to "0", then the version_number shall be that of the next applicable table.

current_next_indicator: This 1-bit indicator, when set to "1", indicates that the table is the currently applicable table. When the bit is set to "0", it indicates that the table sent is not yet applicable and shall be the next table to be valid.

section_number: This 8-bit field gives the number of the section. The section_number shall be 0x00.

last_section_number: This 8-bit field specifies the number of the last section. The last_section_number shall be 0x00.

transmission_info_loop_length: This 12-bit field gives the total length in bytes of the following descriptor loop describing the transmission parameters of the partial TS.

service_id: This is a 16-bit field which serves as a label to identify this service from any other service within a TS. The service_id is the same as the program_number in the corresponding program_map_section.

running_status: This 3-bit field indicates the running status of the event in the original stream. This is the running status of the original present event. If no present event exists in the original stream, the status is considered as "not running". The meaning of the running_status value is as defined in [ETR 211].

service_loop_length: This 12-bit field gives the total length in bytes of the following descriptor loop containing SI related information on the service and event contained in the partial TS.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in Annex B of [ITU-T H.222.0] after processing the entire section.

A.7.2 SMI descriptors

This subclause contains syntax and semantics for descriptors exclusively found in partial TSs.

A.7.2.1 Partial Transport Stream (TS) descriptor

The transmission information descriptor loop of the SIT contains all the information required for controlling and managing the play-out and copying of partial TSs. The following descriptor is proposed to describe this information. See Table A.75.

Table A.75 – Partial Transport Stream (TS) descriptor

Syntax	No. of bits	Identifier
partial_transport_stream_descriptor() {		
descriptor_tag	8	bslbf
descriptor_length	8	uimsbf
DVB_reserved_future_use	2	bslbf
peak_rate	22	uimsbf
DVB_reserved_future_use	2	bslbf
minimum_overall_smoothing_rate	22	uimsbf
DVB_reserved_future_use	2	bslbf
maximum_overall_smoothing_buffer	14	uimsbf
}		

Semantics for the partial TS descriptor

peak_rate: The maximum momentary transport packet rate (i.e., 188 bytes divided by the time interval between start times of two succeeding TS packets). At least an upper bound for this peak_rate should be given.

This 22-bit field is coded as a positive integer in units of 400 bit/s.

minimum_overall_smoothing_rate: Minimum smoothing buffer leak rate for the overall TS (all packets are covered). This 22-bit field is coded as a positive integer in units of 400 bit/s.

The value 0x3FFFFF is used to indicate that the minimum smoothing rate is undefined.

maximum_overall_smoothing_buffer: Maximum smoothing buffer size for the overall TS (all packets are covered). This 14-bit field is coded as a positive integer in units of 1 byte.

The value 0x3FFFFF is used to indicate that the maximum smoothing buffer size is undefined.

Annex B

Service information for digital multi-programme System B

(This annex forms an integral part of this Recommendation.)

B.1 Purpose, scope and organization

B.1.1 Purpose

This annex defines a standard for service information (SI) delivered out of band on cable. This annex is designed to support "navigation devices" on cable. The current specification defines the syntax and semantics for a standard set of tables providing the data necessary for such a device to discover and access digital and analogue services offered on cable.

B.1.2 Scope

This annex defines SI tables delivered via an out-of-band path to support service selection and navigation by digital cable set-top boxes and other "digital cable-ready" devices. The SI tables defined in this annex are formatted in accordance with the Program Specific Information (PSI) data structures defined in MPEG-2 Systems ITU-T H.222.0 | ISO/IEC 13818-1.

The formal definition of "digital cable-ready" has a scope broader than that of the current standard. The formal definition includes requirements related to navigation and service selection, demodulation and decoding, video format decoding, Emergency Alert handling, and other aspects. The current specification supports, primarily, the navigation and service selection function for services delivered in the clear, as well as those subject to conditional access.

This annex does not address the electronic program guide application itself or any user interface which might deal with the presentation and application of the Service Information.

A digital cable-ready device can take the form of a cable set-top box, a computer, a television, or a convergence of these. Devices such as digital video recorders may also be cable-ready. A digital cable-ready device capable of processing access controlled digital services supports an interface to a conditional access module. As used here in this Recommendation, the term "Host" refers to the capability to support an interface to a standard point of deployment (POD) security module.

SI data delivered out of band is transported in accordance with the Extended Channel interface defined in SCTE DVS 131r7 (1998) and SCTE DVS 216r4 (2000). To have access to the Extended Channel interface, the cable-ready device must act as a Host to a POD security module. The Extended Channel interface presents the needed SI data to the Host. This data can be used by the Host for channel navigation, construction of electronic program guides and other associated functions.

Figure B.1 is a high-level block diagram illustrating the POD module to Host interface via the Extended Channel interface. The Host is responsible for providing a standard receiver/QPSK demodulator function for the POD module. The choice of transport format of bits coming across from the receiver/QPSK demodulator to the POD module is by mutual agreement between the POD and the cable head-end equipment. The transport format of data travelling between the Host and POD module on the Extended Channel interface conforms to standards defined in SCTE DVS 131r7 (1998) and SCTE DVS 216r4 (2000).

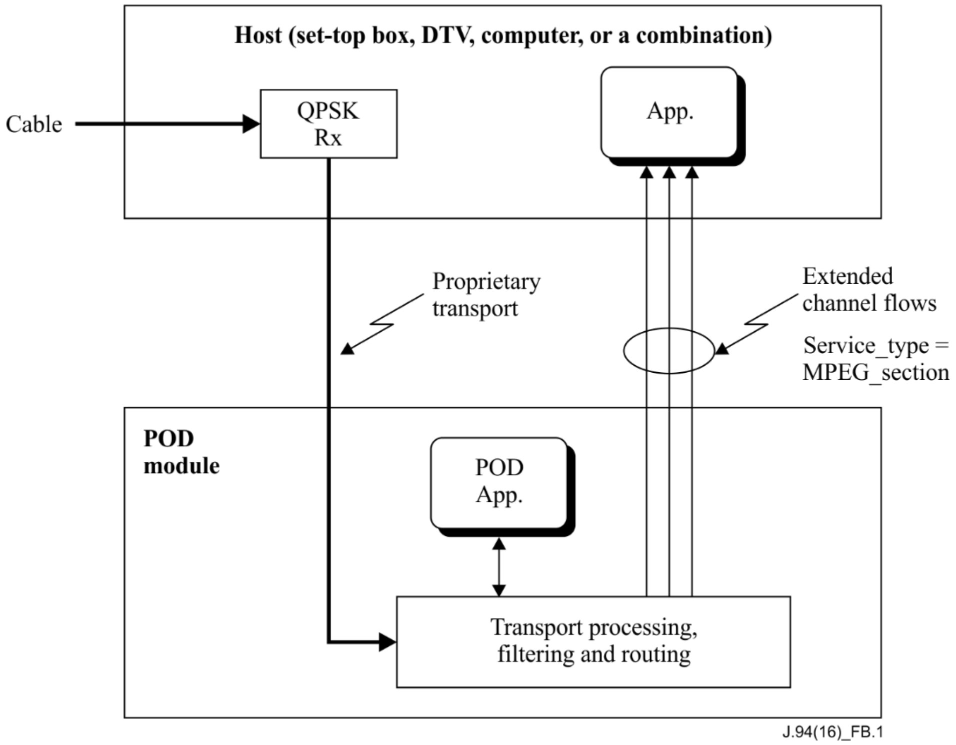

Host (set-top box, DTV, computer, or a combination)
Cable
QPSK Rx
App.
Proprietary transport
Extended channel flows
Service_type = MPEG_section
POD module
POD App.
Transport processing, filtering and routing
J.94(16)_FB.1

Figure B.1 – A framework for the extended channel service information stream

The POD module may perform various transport, filtering, and error checking/correction functions on the out-of-band data stream as depicted by the box labelled "Transport Processing, Filtering, and Routing." As described in SCTE DVS 216r4 (2000), the Host may request from the POD module to open one or several "flows" in which to receive PSI sections taken from the cable out-of-band data stream. Each flow is associated with a PID value, in accordance with MPEG-2 Transport Stream concepts.

Data flowing to the Host from the POD module that is associated with Service_type=MPEG_section is required to be in the form of MPEG PSI data structures. However, data delivered into the POD from cable out-of-band may or may not be organized in a Transport Stream compliant with ITU-T H.222.0 | ISO/IEC 13818-1. In other words, PID values associated with MPEG-2 tables on the Extended Channel interface *may or may not* correspond to MPEG-2 Transport Stream packet header PID values from the cable out of band.

Independent of the fact that out-of-band data may reach the POD module via a proprietary method, the data structures delivered across the Extended Channel shall be formatted as MPEG-2 table sections. Like table sections carried in an MPEG-2 Transport Stream, each is associated with a PID value.

B.1.3 Organization

This annex is organized as follows:

– Clause B.1 – Provides a general introduction.

– Clause B.2 – Lists applicable references.

– Clause B.3 – Provides a list of definitions used in this annex.

– Clause B.4 – Provides a list of acronyms and abbreviations used in this annex.

– Clause B.5 – Describes the basic structure of sections.

- Clause B.6 – Describes formats of sections carried in the Base PID.[1]
- Clause B.7 – Explains descriptors applicable to the tables defined in this annex.
- Clause B.8 – Describes multilingual character string coding.
- Annex F – Defines profiles of choice for cable operator compliance with this annex.
- Annex G – Specifies packet rates for delivery of SI data.
- Annex H – Defines the standard Huffman tables used for text compression.
- Appendix I – Conversion between time and date conventions for System A.
- Appendix II – Discusses recommendations for receiver implementations.
- Appendix III – Provides an overview of tables defined in this Service Information Annex B.
- Appendix IV – Defines the daylight savings time control fields in the System Timetable.

B.2 References

For references, see clause 2.

B.3 Definitions

B.3.1 Compliance notation

As used in this annex, "shall" denotes a mandatory provision of the recommendation. "Should" denotes a provision that is recommended but not mandatory. "May" denotes a feature whose presence does not preclude compliance, that may or may not be present as optional for the implementers.

B.3.2 Definition of terms

The following terms are used throughout this annex:

B.3.2.1 conditional access: The control and security of subscriber access to cable or broadcast services and events in the form of video, data and voice communications.

B.3.2.2 host: A device capable of supporting a POD module by implementing the interface protocol defined in SCTE DVS 131r7 (1998) and SCTE DVS 216r4 (2000). These protocols define the Extended Channel data path through which the SI tables defined in this annex are passed.

B.3.2.3 navigation: The process of selection and movement among analogue and digital services offered on the cable network. The service information tables defined in this protocol assist in the navigation process by providing physical service locations, channel names and numbers for user reference. Those tables supporting electronic program guides also assist the navigation process.

B.3.2.4 program element: A generic term for one of the elementary streams or other data streams that may be included in a program.

B.3.2.5 program: A collection of program elements. Program elements may be elementary streams. Program elements need not have any defined time base. Those that do have a common time base are intended for synchronized presentation. The term *program* is also used in the context of a "television program" such as a scheduled daily news broadcast. The distinction between the two usages should be understood by context.

B.3.2.6 region: As used in this annex, a region is a geographical area consisting of one or more countries.

[1] The Base PID is the PID associated with the "base" Service Information tables. In this protocol, the base_PID is fixed at 0x1FFC. Refer to Table B.2.

B.3.2.7 section or table section: A data structure comprising a portion of an [ITU-T H.222.0 | ISO/IEC 13818-1] –defined table, such as the Program Association Table (PAT), Conditional Access Table (CAT), or Program Map Table (PMT). The term conforms to MPEG terminology. All sections begin with the table_ID and end with the CRC_32 field. Sections are carried in Transport Stream packets in which the starting point within a packet payload is indicated by the pointer_field mechanism defined in theITU-T H.222.0 | ISO/IEC 13818-1 Systems document. The Network Information Table, for example, defines portions of several types of tables.

B.3.2.8 service: ITU-T H.222.0 | ISO/IEC 13818-1 uses the term *program* to refer to a collection of program elements with no regard to time. In this Service Information annex, the term *service* is used in this same context to denote a collection of elementary components. Usage of the term *service* clarifies certain discussions that also involve the notion of the term *program* in its traditional meaning – for example, in the statement, "A video service carries a series of programs." In a broader sense, *service* is also intended for multimedia services of video, voice and data, as these services become prevalent.

B.3.2.9 stream: An ordered series of bytes. The usual context for the term *stream* involves specification of a particular PID (such as the "Program Map PID stream"), in which case the term indicates a series of bytes extracted from the packet multiplex from packets with the indicated PID value.

B.3.3 Section and data structure syntax notation

This annex contains symbolic references to syntactic elements. These references are typographically distinguished by the use of a different font (e.g., restricted), may contain the underscore character (e.g., sequence_end_code) and may consist of character strings that are not English words (e.g., dynrng).

The formats of sections and data structures in this annex are described using a C-like notational method employed in ITU-T H.222.0 | ISO/IEC 13818-1. Extensions to this method are described in the following clauses.

B.3.3.1 Field sizes

Each data structure is described in a table format wherein the size in bits of each variable within that section is listed in a column labelled "Bits." The column adjacent to the Bits column is labelled "Bytes" and indicates the size of the item in bytes. For convenience, several bits within a particular byte or multi-byte variable may be aggregated for the count. Table B.1 is an example:

Table B.1 – Field sizes example

	Bits	Bytes	Format
foo_section(){			
section_syntax_indicator	1	1	
...			
if (section_syntax_indicator) {			
table_extension	16	(2)	uimsbf
Reserved	2	(1)	bslbf
version_number	5		uimsbf
current_next_indicator	1		bslbf {next, current}
...			
}			
...			

In the byte count column, items that are conditional (because they are within a loop or conditional statement) are in parentheses. Nested parentheses are used if the loops or conditions are nested.

B.4 Acronyms and abbreviations

The following acronyms and abbreviations are used within this annex:

AEIT	Aggregate Event Information Table
AETT	Aggregate Extended Text Table
ATSC	Advanced Television Standards Committee
BMP	Basic Multilingual Plane
bslbf	bit serial, leftmost bit first
CAT	Conditional Access Table
CC	Closed Caption
CDS	Carrier Definition Subtable
CRC	Cyclic Redundancy Check
DCM	Defined Channels Map
DTV	Digital Television
ECM	Entitlement Control Message
EMM	Entitlement Management Message
ETSI	European Telecommunications Standards Institute
GPS	Global Positioning System
ICM	Inverse Channel Map
ITU	International Telecommunication Union
LSB	Least Significant Bit
L-VCT	Long-form Virtual Channel Table
MGT	Master Guide Table
MMS	Modulation Mode Subtable
MPAA	Motion Picture Association of America
MPEG	Moving Picture Experts Group
MSB	Most Significant Bit
MSS	Multiple String Structure
MTS	Multi-lingual Text String
NTSC	National Television System Committee
NVOD	Near Video On Demand
OOB	Out-of-band
PAT	Program Association Table
PCR	Program Clock Reference
PES	Packetized Elementary Stream
PID	Packet Identifier
PMT	Program Map Table
POD	Point of Deployment

PSIP	Program and System Information Protocol
PTC	Physical Transmission Channel
PTS	Presentation Time Stamp
rpchof	remainder polynomial coefficients, highest order first
RRT	Rating Region Table
SCTE	Society of Cable Telecommunications Engineers
SI	Service Information
SNS	Source Name Subtable
S-VCT	Short-form Virtual Channel Table
TS	Transport Stream
uimsbf	unsigned integer, most significant bit first
UTC	Coordinated Universal Time
VCM	Virtual Channel Map

B.5 Table structure

This clause describes details of the structure of MPEG-2 tables defined in this annex.

Tables and table sections defined in this Service Information annex are structured in the same manner used for carrying ITU-T H.222.0 | ISO/IEC 13818-1 -defined PSI tables. The MPEG-defined 32-bit CRC is required.

B.5.1 Table ID ranges and values

Table B.2 defines table_ID ranges and values for tables defined in MPEG and in this annex.

Table B.2 – Table ID ranges and values for out-of-band transport

Table ID Value (hex)	Tables	PID	Reference
	[ITU-T H.222.0] Sections		
0x00	Program Association Table (PAT)	0	[ITU-T H.222.0]
0x01	Conditional Access Table (CAT)	1	[ITU-T H.222.0]
0x02	TS Program Map Table (PMT)	Per PAT	[ITU-T H.222.0]
0x03-0x3F	[ISO Reserved]		
	User Private Sections		
0x40-0x7F	[User Private for other systems]		
0x80-0xBF	[SCTE User Private]		
	Other Standards		
0xC0-0xC1	[Used in other standards]		
	Service Information Tables		
0xC2	Network Information Table (NIT)	0x1FFC	Clause B.6.1
0xC3	Network Text Table (NTT)	0x1FFC	Clause B.6.2
0xC4	Short-form Virtual Channel Table (S-VCT)	0x1FFC	Clause B.6.3
0xC5	System Timetable (STT)	0x1FFC	Clause B.6.4
0xC6	[Used in other standards]	–	–
0xC7	Master Guide Table (MGT)	0x1FFC	Clause B.6.5

Table B.2 – Table ID ranges and values for out-of-band transport

Table ID Value (hex)	Tables	PID	Reference
0xC8	Reserved	–	–
0xC9	Long-form Virtual Channel Table (L-VCT)	0x1FFC	Clause B.6.6
0xCA	Rating Region Table (RRT)	0x1FFC	Clause B.6.7
0xCB-0xD5	[Used in ATSC]	–	–
0xD6	Aggregate Event Information Table (AEIT)	Per MGT	Clause B.6.8
0xD7	Aggregate Extended Text Table (AETT)	Per MGT	Clause B.6.9
0xD8	Cable Emergency Alert Message	0x1FFC	SCTE DVS 208r6 (1999)
0xD9-0xFE	[Reserved for future use]	–	–

Table sections defined in this Service Information annex, and any created as user extensions to it are considered "private" with respect to ITU-T H.222.0 | ISO/IEC 13818-1. Table section types 0x80 through 0xBF are user-defined (outside the scope of this Service Information annex).

The maximum total length of any table section defined in this annex is 1024 bytes, except for the MGT, L-VCT, AEIT and AETT, each of which has a maximum total length of 4096 bytes. This total includes table_ID, CRC, and all fields contained within the specific table section.

B.5.2 Extensibility

This Service Information annex defines a number of tables and table sections. The Service Information annex is designed to be extensible via the following mechanisms:

1) Reserved Fields: Fields in this Service Information annex marked reserved are reserved for use either when revising this annex, or when another Recommendation is issued that builds upon this one. See clause B.5.4.

2) Standard Table Types: As indicated in Table B.2, table_ID values in the range 0xCE through 0xFE are reserved for use either when revising this Service Information annex, or when another Recommendation is issued that builds upon this one.[2]

3) User Private Table Types: As indicated in Table B.2, table_ID values in the range 0x80 through 0xBF are reserved for "user private" use. The format of user private tables carried in the Network PID shall conform to the syntax described in Table B.3.

4) User Private Descriptors: Privately defined descriptors may be placed at designated locations throughout the table sections described in this Service Information annex. Ownership of one or more user private descriptors is indicated by the presence of an MPEG registration_descriptor() preceding the descriptor(s).

[2] NOTE – Assignment of table_ID values in the 0xCE to 0xFE range requires coordination between ATSC and SCTE.

Table B.3 – Network private table section format

	Bits	Bytes	Format
Network_private_table section(){			
private_table_ID	8	1	uimsbf (0x80 <= table_ID <= 0xBF)
section_syntax_indicator	1	2	bslbf
Zero	1		bslbf
Reserved	2		bslbf
section_length	12		uimsbf
if (section_syntax_indicator==1) {			
table_extension	16	(2)	uimsbf
Reserved	2	(1)	bslbf
version_number	5		uimsbf
current_next_indicator	1		bslbf {next, current}
section_number	8	(1)	uimsbf
last_section_number	8	(1)	uimsbf
}			
Zero	3	1	bslbf
protocol_version	5		See clause B.5.4.1.
format_identifier	32	4	uimsbf
private_message_body()	N*8	N	
CRC_32	32	4	rpchof
}			

B.5.3 Reserved fields

reserved: Fields in this Service Information annex marked reserved shall not be assigned by the user, but shall be available for future use. Hosts are expected to disregard reserved fields for which no definition exists that is known to that unit. Fields marked reserved shall be set to "1" until such time as they are defined and supported.

zero: Indicates the bit or bit field shall be "0".

B.5.4 Private table section syntax

Table B.3 defines the syntax for user private table sections. The MPEG-defined CRC is required. Refer to ITU-T H.222.0 | ISO/IEC 13818-1 for definition of MPEG-standard fields.

private_table_ID: The value of table_ID in private table sections shall be in the range 0x80 through 0xBF.

B.5.4.1 Protocol version

protocol_version: A 5-bit unsigned integer field whose function is to allow, in the future, any defined table type to carry parameters that may be structured fundamentally differently from those defined in the current protocol. At present, all defined table section types in this protocol are defined for protocol_version zero only. Nonzero values of protocol_version may only be processed by Receivers designed to accommodate the later versions as they become standardized.

B.5.4.2 Format identifier

format_identifier: A 32-bit unsigned integer value which unambiguously identifies the entity defining this network_private_table_section() syntax. Values for format_identifiers shall be obtained from SCTE.

B.5.4.3 Private Message Body

private_message_body(): A data structure defined by the private entity identified by format_identifier.

B.5.4.4 CRC

CRC_32: The 32-bit CRC value defined in ITU-T H.222.0 | ISO/IEC 13818-1 for PSI sections. The MPEG-2 CRC shall be checked in the POD, and only messages that pass the CRC check shall be forwarded to the Host. The Host shall not check the CRC.

B.6 Table section formats

The following clauses define the formats of table sections as they are delivered across the Extended Channel interface from POD module to Host.

B.6.1 Network Information Table

Sections of the Network Information Table shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID. This table delivers sections of non-textual tables applicable system-wide. The table types included are the Carrier Definition Subtable (CDS) and the Modulation Mode Subtable (MMS).

Table B.4 shows the format of the Network Information Table section.

Table B.4 – Network Information Table section format

	Bits	Bytes	Format
network_info_table_section(){			
table_ID	8	1	uimsbf value 0xC2
Zero	2	2	bslbf
Reserved	2		bslbf
section_length	12		uimsbf
Zero	3	1	bslbf
protocol_version	5		See clause B.5.4.1.
first_index	8	1	uimsbf range 1-255
number_of_records	8	1	uimsbf
transmission_medium	4	1	uimsbf
table_subtype	4		uimsbf (See Table B.5.)
for (i=0; i<number_of_records; i++) {			
if (table_subtype==CDS) {			
CDS_record()		((5))	
}			
if (table_subtype==MMS) {			
MMS_record()		((6))	
}			
Descriptors_count	8	(1)	uimsbf range 0-255
for (i=0; i<descriptors_count; i++) {			
descriptor()	*	((*))	Optional
}			
}			
for (i=0; i<N; i++) {			
descriptor()	*	(*)	Optional
}			
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the Network Information Table section shall be 0xC2.

first_index: An 8-bit unsigned integer number in the range 1 to 255 that indicates the index of the first record to be defined in this table section. If more than one record is provided, the additional records define successive table entries following first_index. The value zero is illegal and shall not be specified.

number_of_records: An 8-bit unsigned integer number that specifies the number of records being defined in this table section. The maximum is limited by the maximum allowed length of the table section.

transmission_medium: This 4-bit field shall be set to zero (0x0).

table_subtype: A 4-bit value that defines the type of table delivered in the table section. One instance of a Network Information Table section can define entries within at most one type of table. The table_subtype parameter is defined in Table B.5.

Table B.5 – Network Information Table Subtype

table_subtype	Meaning
0	Invalid
1	CDS – Carrier Definition Subtable
2	MMS – Modulation Mode Subtable
3-15	Reserved

The receiver shall discard a Network Information Table section with table_subtype indicating an unknown or unsupported table_subtype.

B.6.1.1 Carrier definition subtable (CDS)

Table B.6 defines the structure of the CDS_record(). Each CDS defines a set of carrier frequencies. A full frequency plan table shall be constructed from one or more CDS_record() structures, each defining a starting frequency, a number of carriers, and a frequency spacing for carriers in this group.

The specified carrier represents the nominal centre of the spectral band for all modulation methods, including analogue. Carrier frequencies in the table thus represent the data carrier frequency for digital transmissions modulated using QAM or PSK.[3]

Each CDS_record represents a definition of N carriers. The first_index parameter reflects the index in a flat space between 1 and 255, representing the first carrier in the CDS_record. Starting from the first CDS_record defining carriers C_1, C_2, C_3, …, C_N, where N = number_of_carriers, the carrier index for C_I is equal to first_index + I – 1. If the table section includes more than one CDS_record(), the carrier index of the second CDS_record would be first_index plus the number of carriers defined in the first CDS_record(), namely, first_index + number_of_carriers. References to the Carrier Definition Subtable, such as the CDS_reference in the virtual_channel() of Table B.20, are to the carrier index (a carrier defined within a CDS_record()), between 1 and N, where N is normally much smaller than 255. These references are *not* to the index of a CDS_record() itself, which is sequenced from first_index and is not reset to 1 until it exceeds 255.

Note that the carriers, as defined by one or more CDS_record()s, may or may not end up sorted in the order of increasing carrier frequency. Certain frequency plans may be specified by overlapping two or more CDS_record()s, each of which defines equally-spaced carriers.

[3] Note that transmission systems using VSB modulation transmit spectra are not symmetrical about the carrier or pilot tone. Acquisition of a VSB-modulated signal involves computation of the pilot tone (or in analogue VSB, the picture carrier) location relative to the centre of the band. For example, for the ATSC Digital Television Standard (ASTC A/53), where the channel bandwidth is 6 MHz, the pilot tone is located 310 kHz above the lower edge of the channel, or 2.690 MHz below the specified centre of the band. Similarly, for analogue NTSC, the picture carrier is 1.25 MHz above the lower edge of the channel, or 1.75 MHz below the specified centre of the band.

Note also that carriers may be defined that are currently not in use. To facilitate the compressed delivery format, defined carriers may not reflect reality. An example: carriers at 1, 2, 4, 5, 7, 8 MHz could be defined as eight carriers at 1 MHz spacing (3 MHz and 6 MHz do not really exist, or are not currently in use).

Table B.6 – CDS record format

	Bits	Bytes	Format
CDS_record(){			
number_of_carriers	8	1	uimsbf
spacing_unit	1	2	bslbf (See Table B.7.)
Zero	1		bslbf
Frequency_spacing	14		uimsbf range 1-16 383 units of 10 or 125 kHz
Frequency_unit	1	2	bslbf (See Table B.8.)
first_carrier_frequency	15		uimsbf range 0-32 767 units of 10 or 125 kHz
}			

number_of_carriers: An unsigned integer in the range 1 to 255 that represents the number of carriers whose frequency is being defined by this CDS_record().

spacing_unit: A 1-bit field identifying the units for the frequency_spacing field. Table B.7 defines the coding for spacing_unit.

Table B.7 – Spacing unit

spacing_unit	Meaning
0	10 kHz spacing
1	125 kHz spacing

frequency_spacing: A 14-bit unsigned integer number in the range 1 to 16 383 that defines the frequency spacing in units of either 10 kHz or 125 kHz, depending upon the value of the spacing_unit parameter. If spacing_unit is zero, indicating 10 kHz, then a value of 1 indicates 10 kHz spacing; 2 indicates 20 kHz, and so on. If the number_of_carriers field is one, the frequency_spacing field is ignored. The maximum frequency spacing that can be represented is $(2^{14} - 1) * 125$ kHz = 2047.875 MHz. The minimum frequency spacing is 10 kHz.

frequency_unit: A 1-bit field identifying the units for the first_carrier_frequency field. Table B.8 defines the coding for frequency_unit.

Table B.8 – Frequency unit

Frequency_unit	Meaning
0	10 kHz units
1	125 kHz units

first_carrier_frequency: A 15-bit unsigned integer number in the range 0 to 32 767 that defines the starting carrier frequency for the carriers defined in this group, in units of either 10 kHz or 125 kHz, depending on the value of frequency_unit. If only one carrier is defined for the group, the first_carrier_frequency represents its frequency. When the frequency_unit indicates 125 kHz, the first_carrier_frequency can be interpreted as a fractional frequency (1/8 MHz) in the least-significant 3 bits, and an integer number of megahertz in the upper 12 bits. The range of frequencies that can be represented is 0 to $(2^{15} – 1) * 125$ kHz = 4095.875 MHz.

B.6.1.2 Modulation mode subtable (MMS)

Table B.9 defines the structure of the MMS_record().

Table B.9 – MMS record format

	Bits	Bytes	Format
MMS_record(){			
transmission_system	4	1	uimsbf (See Table B.10.)
inner_coding_mode	4		uimsbf (See Table B.11.)
split_bitstream_mode	1	1	bslbf {no, yes}
Zero	2		bslbf
modulation_format	5		uimsbf (See Table B.12.)
Zero	4	4	bslbf
symbol_rate	28		uimsbf units: symbols per second
}			

transmission_system: A 4-bit field that identifies the transmission standard employed for the waveform defined by this MMS record. Table B.10 defines the coding for transmission_system.

Table B.10 – Transmission system

transmission_system	Meaning
0	unknown – The transmission system is not known.
1	Reserved (ETSI)
2	[ITU-T J.83] Annex B – The transmission system conforms to the ITU North American standard specified in Annex B of [ITU-T J.83].
3	Defined for use in other systems
4	ATSC – The transmission system conforms to the ATSC Digital Television Standard.
5-15	Reserved (satellite)

inner_coding_mode: A 4-bit field that indicates the coding mode for the inner code associated with the waveform described in this MMS record. The following values are currently defined: 5/11, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, and 7/8. Coding of the inner_coding_mode field is shown in Table B.11.

Table B.11 – Inner coding mode

inner_coding_mode	Meaning
0	Rate 5/11 coding
1	Rate 1/2 coding
2	Reserved
3	Rate 3/5 coding
4	Reserved
5	Rate 2/3 coding
6	Reserved
7	Rate 3/4 coding
8	Rate 4/5 coding
9	Rate 5/6 coding
10	Reserved
11	Rate 7/8 coding
12-14	Reserved
15	None – indicates that the waveform does not use concatenated coding

modulation_format: A 5-bit field that defines the basic modulation format for the carrier. Table B.12 defines the parameter.

Table B.12 – Modulation format

modulation_format	Meaning
0	unknown – The modulation format is unknown.
1	QPSK – The modulation format is QPSK (Quadrature Phase Shift Keying).
2	BPSK – The modulation format is BPSK (Binary Phase Shift Keying).
3	OQPSK – The modulation format is offset QPSK.
4	VSB 8 – The modulation format is 8-level VSB (Vestigial Sideband).
5	VSB 16 – The modulation format is 16-level VSB.
6	QAM 16 – Modulation format 16-level Quadrature Amplitude Modulation (QAM).
7	QAM 32 – 32-level QAM
8	QAM 64 – 64-level QAM
9	QAM 80 – 80-level QAM
10	QAM 96 – 96-level QAM
11	QAM 112 – 112-level QAM
12	QAM 128 – 128-level QAM
13	QAM 160 – 160-level QAM
14	QAM 192 – 192-level QAM
15	QAM 224 – 224-level QAM
16	QAM 256 – 256-level QAM
17	QAM 320 – 320-level QAM

Table B.12 – Modulation format

modulation_format	Meaning
18	QAM 384 – 384-level QAM
19	QAM 448 – 448-level QAM
20	QAM 512 – 512-level QAM
21	QAM 640 – 640-level QAM
22	QAM 768 – 768-level QAM
23	QAM 896 – 896-level QAM
24	QAM 1024 – 1024-level QAM
25-31	Reserved

symbol_rate: A 28-bit unsigned integer field that indicates the symbol rate in symbols per second associated with the waveform described in this MMS record.

B.6.1.3 Descriptors count

descriptors_count: An 8-bit unsigned integer value in the range 0 to 255 representing the number of descriptor blocks to follow.

descriptor(): The table section may include at its end one or more structures of the form tag, length, data. The number of descriptors present is determined indirectly by processing the section_length field. Descriptors are defined in clause B.7.

B.6.2 Network Text Table

The Network Text Table shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID. This table delivers sections of textual tables applicable system-wide. Each instance of Network Text Table is associated with a language, as such the textual information may be provided multi-lingually. The Network Text Table delivers the Source Name Subtable (SNS).

Table B.13 shows the format of the Network Text Table.

Table B.13 – Network Text Table section format

	Bits	Bytes	Format
network_text_table_section(){			
table_ID	8	1	uimsbf value 0xC3
Zero	2	2	bslbf
Reserved	2		bslbf
section_length	12		uimsbf
Zero	3	1	
protocol_version	5		See clause B.5.4.1.
ISO_639_language_code	24	3	Per ISO 639-2/B
transmission_medium	4	1	uimsbf
table_subtype	4		uimsbf (See Table B.14.)
if (table_subtype==SNS) {			
source_name_subtable()	*	(*)	
}			
for (i=0; i<N; i++) {			
descriptor()	*	(*)	Optional
}			
CRC_32	32	4	rpchof
}			

The Network Text Table carries Multilingual Text Strings, formatted as defined in clause B.8.2. Text Strings included in the Network Text Table shall not include format effectors (defined in clause B.8.1.2). If format effectors are present in a text block, the Host is expected to disregard them.

table_ID: The table_ID of the Network Text Table section shall be 0xC3.

ISO_639_language_code: A 3-byte language code per ISO 639-2/B defining the language associated with the text carried in this Network Text Table. The ISO_639_language_code field contains a three-character code as specified by ISO 639-2/B. Each character is coded into 8 bits according to ISO 8859-1 (ISO Latin-1) and inserted, in order, into the 24-bit field. The value 0xFFFFFF shall be used in case the text is available in one language only. The value 0xFFFFFF shall represent a "wild card" match when filtering by language.

transmission_medium: This 4-bit field shall be set to zero (0x0).

table_subtype: A 4-bit value that defines the type of table delivered in the table section. One instance of a Network Text Table section can define entries within at most one type of table. The table_subtype parameter is defined in Table B.14.

Table B.14 – Network Text Table Subtype

table_subtype	Meaning
0	Invalid
1-5	Reserved
6	SNS – Source Name Subtable
7-15	Reserved

A Host shall discard a Network Text Table section with table_subtype indicating an unknown or unsupported value.

The SNS can provide a textual name associated with each service defined in the Short-form Virtual Channel Table, by reference to its source_ID. The format of the source_name_subtable() is given in Table B.15.

Table B.15 – Source Name Subtable format

	Bits	Bytes	Format
source_name_subtable(){			
number_of_SNS_records	8	1	uimsbf range 1-255
for (i=0; i<number_of_SNS_records; i++) {			
application_type	1	(1)	bslbf {false, true}
Zero	7		bslbf
if (application_type) {			
Application_ID	16	((2))	uimsbf
} else {			
source_ID	16	((2))	uimsbf
}			
name_length	8	(1)	Size of source_name() (L)
source_name()	L*8	(L)	Multilingual text
SNS_descriptors_count	8	(1)	uimsbf range 0-255
for (i=0; i<SNS_descriptors_count; i++) {			
descriptor()	*	((*))	
}			
}			
}			

number_of_SNS_records: An unsigned 8-bit integer number in the range 1 to 255 that specifies the number of records being defined in this table section.

application_type: A Boolean flag, when set, indicates that the name string being defined is for an application of the given application_ID. When the flag is clear, the name string being defined is for a source of the given source_ID. Support for application-type virtual channels is optional. Hosts not supporting application-type virtual channels may disregard name strings associated with these VC. Support for application-type virtual channels is beyond the scope of this annex.

application_ID: A 16-bit unsigned integer value identifying the application associated with the name string that follows. This field may be disregarded by Hosts not supporting application-type virtual channels.

source_ID: A 16-bit unsigned integer value identifying the programming source associated with the source name to follow.

name_length: An unsigned 8-bit integer number in the range 1 to 255 that defines the number of bytes in the source_name() that follows.

source_name(): A Multilingual Text String defining the name of the source or application, formatted according to the rules defined in clause B.8.1.

SNS_descriptors_count: An unsigned 8-bit integer number, in the range 0 to 255, that defines the number of descriptors to follow.

descriptor(): The table section may include, at its end, one or more structures of the form tag, length, data. The number of descriptors present is determined indirectly by processing the section_length field. Descriptors are defined in clause B.7.

B.6.3 Short-form Virtual Channel Table Section

The Short-form Virtual Channel Table section delivers portions of the Virtual Channel Map (VCM), the Defined Channels Map (DCM) and the Inverse Channel Map (ICM). Sections of the Short-form Virtual Channel Table shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID.

Table B.16 shows the syntax of the Short-form Virtual Channel Table section.

Table B.16 – Short-form Virtual Channel Table section format

	Bits	Bytes	Format
shortform_virtual_channel_table_section(){			
table_ID	8	1	uimsbf value 0xC4
Zero	2	2	bslbf
Reserved	2		bslbf
section_length	12		uimsbf
Zero	3	1	bslbf
protocol_version	5		See clause B.5.4.1.
transmission_medium	4	1	uimsbf
table_subtype	4		uimsbf (See Table B.17.)
VCT_ID	16	2	uimsbf
if (table_subtype==DCM) {			
DCM_structure()	*	(*)	
}			
if (table_subtype== VCM) {			
VCM_structure()	*	(*)	
}			
if (table_subtype== ICM) {			

Table B.16 – Short-form Virtual Channel Table section format

	Bits	Bytes	Format
ICM_structure()	*	(*)	
}			
for (i=0; i<N; i++) {			
descriptor()	*	(*)	Optional
}			
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the Short-form Virtual Channel Table shall be 0xC4.

transmission_medium: This 4-bit field shall be set to zero (0x0).

table_subtype: A 4-bit field that indicates the map type being delivered in this S-VCT section. Three map types are currently defined: the Virtual Channel Map (VCM), the Defined Channels Map (DCM), and the Inverse Channel Map (ICM). Table B.17 defines table_subtype.

Table B.17 – S-VCT Table Subtypes

table_subtype	Meaning
0	VCM – Virtual Channel Map
1	DCM – Defined Channels Map
2	ICM – Inverse Channel Map
3-15	Reserved

An S-VCT section received with table_subtype indicating an unknown or unsupported map type shall be discarded.

VCT_ID: A 16-bit unsigned integer value, in the range 0x0000 to 0xFFFF, indicating the VCT to which the channel definitions in this table section apply. This 16-bit field may be used by the POD module for filtering purposes. The Host is expected to ignore VCT_ID. Only one version of the S-VCT, corresponding to one value of VCT_ID, shall be delivered to the Host across the Extended Channel interface at a given time.

B.6.3.1 Defined Channels Map

Table B.18 shows the format of the DCM_structure().

Table B.18 – DCM structure format

	Bits	Bytes	Format
DCM_structure(){			
Zero	4	2	bslbf
first_virtual_channel	12		uimsbf range 0-4095
zero	1	1	bslbf
DCM_data_length	7		uimsbf range 1-127
for (i=0; i<DCM_data_length; i++) {			
range_defined	1	(1)	bslbf {no, yes}
channels_count	7		uimsbf range 1-127
}			
}			

first_virtual_channel: An unsigned 12-bit integer reflecting the first virtual channel whose existence is being provided by this table section, for the map identified by the VCT_ID field. The range is 0 to 4095.

DCM_data_length: A 7-bit unsigned integer number, in the range 1 to 127, that defines the number of DCM data fields to follow in the table section.

The DCM data bytes taken as a whole define which virtual channels, starting at the channel number defined by first_virtual_channel, are defined and which are not. Each DCM_data_field defines two pieces of data: a flag indicating whether this block of channels is defined or not, and the number of channels in the block. The bytes are interpreted in an accumulative way, with a pointer into the Short-form Virtual Channel Table which is initialized to first_virtual_channel. As each byte is processed, the pointer is incremented by the number of channels indicated by the channels_count field.

For example, if channels 2-90, 200-210, 400-410, 600-610, 800-810, and 999 were defined, and first_virtual_channel was zero, the DCM data sequence (in decimal) would be the following, where underlined numbers have the range_defined bit set: 2, 89, 109, 11, 127, 62, 11, 127, 62, 11, 127, 62, 11, 127, 61, 1.

range_defined: A Boolean flag that indicates, when true, that the number of channels given by channels_count is defined in the VCT, starting at the current pointer value. When the flag is clear, the number of channels equal to channels_count are currently not defined starting at the current pointer value.

channels_count: An unsigned 7-bit integer number, in the range 1 to 127, that indicates the number of defined (or undefined) channels in a group.

B.6.3.2 Virtual Channel Map

Table B.19 shows the format of the VCM_structure().

Table B.19 – VCM structure format

	Bits	Bytes	Format
VCM_structure(){			
zero	2	1	bslbf
descriptors_included	1		bslbf {no, yes}
Zero	5		bslbf
Splice	1	1	bslbf {no, yes}
Zero	7		bslbf
activation_time	32	4	uimsbf
number_of_VC_records	8	1	
for (i=0; i<number_of_VC_records; i++) {			
virtual_channel()	*	(*)	
}			
}			

descriptors_included: A Boolean flag that indicates, when set, that one or more record-level descriptors are present in the table section. Record-level descriptors are those defined in Table B.20 following the "if (descriptors_included)" statement. When the flag is clear, the record-level descriptor block is absent. The descriptors_included flag is not applicable to the section level descriptors shown at the bottom of Table B.16.

The activation time indicates the time at which the data delivered in the table section will be valid.

splice: A Boolean flag that indicates, when set, that the Host should arm video processing hardware to execute the application of the data delivered in the VCM_structure() at the next MPEG-2 video splice point if the virtual channel changes described in the table section apply to a currently acquired channel, and the activation_time is reached. If the activation is immediate or specified as a time that has since passed, the data should be applied immediately. When the splice flag is clear, the virtual channel change is made directly, without arming video hardware for a splice.

activation_time: A 32-bit unsigned integer field providing the absolute second the virtual channel data carried in the table section will be valid, defined as the number of seconds since 0000 Hours UTC, January 6th, 1980. If the GPS_UTC_offset delivered in the System Timetable is zero, activation_time includes the correction for leap seconds. Otherwise, activation_time can be converted to UTC by subtracting the GPS_UTC_offset. If the activation_time is in the past, the data in the table section shall be considered valid immediately. An activation_time value of zero shall be used to indicate immediate activation.

A Host may enter a virtual channel record whose activation times are in the future into a queue. Such a queue may be called a *pending virtual channel* queue. Hosts are not required to implement a pending virtual channel queue, and may choose to discard any data that is not currently applicable.

number_of_VC_records: An 8-bit unsigned integer number, in the range 1 to 255, that identifies the number of virtual_channel() records to follow in the table section. The number of records included is further limited by the allowed maximum table section length.

virtual_channel(): Table B.20 defines the virtual_channel() record structure.

Table B.20 – Virtual channel record format

	Bits	Bytes	Format
virtual_channel(){			
Zero	4	2	bslbf
virtual_channel_number	12		uimsbf range 0-4095
application_virtual_channel	1	1	bslbf {no, yes}
Zero	1		bslbf
path_select	1		bslbf (See Table B.21.)
transport_type	1		bslbf (See Table B.22.)
channel_type	4		uimsbf (See Table B.23.)
if (application_virtual_channel) {			
application_ID	16	(2)	
} else {			
source_ID	16	(2)	
}			
if (transport_type==MPEG_2) {			
CDS_reference	8	((1))	uimsbf range 1-255
program_number	16	((2))	
MMS_reference	8	((1))	uimsbf range 1-255
} else { /* non-MPEG-2 */			
CDS_reference	8	((1))	uimsbf range 0-255
Scrambled	1	((1))	bslbf {no, yes}
Zero	3		bslbf
video_standard	4		uimsbf (See Table B.24.)
Zero	16	((2))	bslbf
}			
if (descriptors_included) {			
descriptors_count	8	(1)	uimsbf
for (i=0; i<descriptors_count; i++) {			
descriptor()	*	((*))	
}			
}			
}			

virtual_channel_number: An unsigned 12-bit integer, in the range 0 to 4095, reflecting the virtual channel whose definition is being provided by this virtual channel record, for the map identified by the VCT_ID field.

application_virtual_channel: A binary flag that, when set, indicates this virtual channel defines an access point represented by the application_ID. When the flag is clear, the channel is not an application access point, and this virtual channel defines an access point represented by the source_ID. Support for application-type virtual channels is optional. Hosts not supporting application-type virtual channels may disregard all data associated with them. Support for application-type virtual channels is beyond the scope of this annex.

path_select: A 1-bit field that associates the virtual channel with a transmission path. For the cable transmission medium, path_select identifies which physical cable carries the Transport Stream associated with this virtual channel. Table B.21 defines path_select.

Table B.21 – Path Select

path_select	meaning
0	path 1
1	path 2

transport_type: A 1-bit field identifying the type of transport carried on this carrier as either being an MPEG-2 transport (value zero), or not (value one). Table B.22 defines the coding.

Table B.22 – Transport Type

transport_type	Meaning
0	MPEG-2 transport
1	Non-MPEG-2 transport

channel_type: A 4-bit field defining the channel type. Table B.23 defines channel_type.

Table B.23 – Channel Type

channel_type	Meaning
0	Normal – Indicates that the record is a regular virtual channel record. For non-MPEG-2 channels, the waveform_type shall be defined as "normal."
1	Hidden – Indicates that the record identifies a virtual channel that may not be accessed by the user by direct entry of the channel number (hidden). Hidden channels are skipped when the user is channel surfing, and appear as if undefined if accessed by direct channel entry. Programs constructed for use by specific applications (such as NVOD theaters) utilize hidden virtual channels. If a channel_properties_descriptor() is present and the hide_guide bit is 0, the channel may be considered to be *inactive*. Inactive channels may appear in EPG displays.
2-15	Reserved – Hosts are expected to treat virtual channel records of unknown channel_type the same as non-existent (undefined) channels.

application_ID: A 16-bit unsigned integer number, in the range 0x0001 to 0xFFFF, that identifies the application associated with the virtual channel, on a system-wide basis. One particular program guide application, for example, may look for a program carrying data in its native transmission format by searching through the Short-form Virtual Channel Table for a match on its assigned application_ID. In some cases, one application may be able to process streams associated with more than one application ID. The application ID may be used to distinguish content as well as format, for the benefit of processing within the application. The value zero for application_ID shall not be assigned; if specified in a Virtual Channel record, the value zero indicates "unknown" or "inapplicable" for the application_ID/source_ID field.

Support for application-type virtual channels is optional. Hosts not supporting application-type virtual channels may disregard all data associated with them. Support for application-type virtual channels is beyond the scope of this annex.

source_ID: A 16-bit unsigned integer number, in the range 0x0000 to 0xFFFF, that identifies the programming source associated with the virtual channel, on a system-wide basis. In this context, a *source* is one specific source of video, text, data, or audio programming. For the purposes of referencing virtual channels to the program guide database, each such program source is associated with a unique value of source_ID. The source_ID itself may appear in an EPG database, where it tags entries to specific services. The value zero for source_ID, if used, shall indicate the channel is not associated with a source ID.

program_number: A 16-bit unsigned integer number that associates the virtual channel number being defined with services defined in the Program Association and TS Program Map Table sections. Access to elementary streams defined in each virtual channel record involves first acquiring the Transport Stream on the carrier associated with the virtual channel, then referencing the Program Association section in PID 0 to find the PID associated with the TS Program Map Table section for this program_number. PIDs for each elementary stream are then found by acquisition of the TS Program Map Table section.

A program_number with value 0x0000 (invalid as a regular program number) is reserved to indicate that the Host is expected to discard the corresponding virtual channel record from the queue of pending virtual channel changes. Records are identified in the pending queue by their activation_time, VCT_ID, and virtual_channel_number. If no pending virtual channel change is found in the Host's queue, no action should be taken for this virtual channel (i.e., the record is expected to be discarded).

For inactive channels (those not currently present in the Transport Stream), program_number shall be set to zero. This number shall **not** be interpreted as pointing to a Program Map Table entry.

descriptors_count: An 8-bit unsigned integer value, in the range 0 to 255, that defines the number of descriptors to follow.

CDS_reference: An unsigned 8-bit integer number, in the range 0 to 255, that identifies the frequency associated with this virtual channel. Values 1 to 255 of CDS_reference are used as indices into the Carrier Definition Subtable to find a frequency to tune to acquire the virtual channel. The value zero is reserved to indicate that the referenced service is carried on *all* digital multiplexes in this VCM. The CDS_reference field shall be disregarded for inactive channels.

MMS_reference: An 8-bit unsigned integer value, in the range 0 to 255, that references an entry in the Modulation Mode Subtable (MMS). The value zero is illegal and shall not be specified. For digital waveforms, the MMS_reference associates the carrier with a digital modulation mode. For Host implementations that support only one set of modulation parameters, in systems in which one modulation method is used for all carriers, storage and processing of the MMS_reference is unnecessary. The MMS_reference field shall be disregarded for inactive channels.

video_standard: A 4-bit field that indicates the video standard associated with this non-Standard virtual channel. Table B.24 defines video_standard.

Table B.24 – Video Standard

video_standard	Meaning
0	NTSC – The video standard is NTSC
1	PAL 625 – The video standard is 625-line PAL
2	PAL 525 – The video standard is 525-line PAL
3	SECAM – The video standard is SECAM
4	MAC – The video standard is MAC
5-15	Reserved

descriptor(): The table section may include, at its end, one or more structures of the form tag, length, data. The number of descriptors present is determined indirectly by processing the section_length field. Descriptors are defined in clause B.7.

B.6.3.3 Inverse Channel Map

The Inverse Channel Map, once reconstructed in the Host from a sequence of Virtual Channel records that belong to the ICM, consists of a list of source_ID/virtual_channel_number pairs, ordered by source_ID. The Host may use this table to quickly find the virtual channel carrying the program given by a particular value of source_ID (by binary search), if such a virtual channel exists. One Inverse Channel Map can be defined per Virtual Channel Map. The ICM may be constructed from the VCM, or linear searches may be done to resolve source_ID references. Transmission of the ICM is therefore optional.

Virtual channels that provide access points for applications (i.e., with the application_virtual_channel flag set to "yes") are not included in the ICM.

Table B.25 describes the format of the ICM_structure().

Table B.25 – ICM structure format

	Bits	Bytes	Format
ICM_structure(){			
Zero	4	2	bslbf
first_map_index	12		uimsbf range 0-4095
zero	1	1	bslbf
record_count	7		uimsbf range 1-127
for (i=0; i<record_count; i++) {			
source_ID	16	(2)	uimsbf
zero	4	(2)	bslbf
virtual_channel_number	12		uimsbf range 0-4095
}			
}			

first_map_index: A 12-bit unsigned integer, in the range 0 to 4095, that represents the index into the Inverse Channel Map where data carried in this ICM_structure() should be stored.

record_count: A 7-bit unsigned integer value, in the range 1 to 127, that represents the total number of source_ID/virtual_channel pairs defined in this table section.

source_ID: A 16-bit unsigned integer number, in the range 0x0000 to 0xFFFF, that identifies the source associated with the virtual channel, on a system-wide basis. In this context, a "source" is one specific source of video, text, data, or audio programming. For the purposes of referencing virtual channels to the program guide database, each such source is associated with a unique value of source_ID.

virtual_channel_number: A 12-bit unsigned integer value, in the range 0 to 4095, that represents the virtual channel, in the Short-form Virtual Channel Table section (see Table B.16) given by VCT_ID, associated with the given source_ID through the virtual_channel() record (see Table B.20). A virtual_channel_number of zero indicates that the program given by source_ID is currently not carried in this Short-form Virtual Channel Table. Such placeholders are useful in the case where the existence of a certain program within a VCM may come and go.

B.6.4 System Timetable Section

The System Timetable is used to synchronize Hosts with accurate calendar time. The System Timetable shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID. Rate of transmission is typically once per minute, at second *00* of each minute.

The processing of the System Timetable in the Host is time-critical. Delays between reception and processing of the table section increase the inaccuracy of timed events. Processing delays should be kept below 200 milliseconds.

Table B.26 shows the format of the System Timetable section.

Table B.26 – System Timetable section format

	Bits	Bytes	Format
system_time_table_section(){			
table_ID	8	1	uimsbf value 0xC5
Zero	2	2	bslbf
Reserved	2		bslbf
section_length	12		uimsbf
Zero	3	1	
protocol_version	5		See clause B.5.4.1.
Zero	8	1	bslbf
system_time	32	4	uimsbf
GPS_UTC_offset	8	1	uimsbf seconds
for (i=0; i<N; i++) {			
descriptor()	*	(*)	Optional
}			
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the System Timetable shall be 0xC5.

system_time: A 32-bit unsigned integer quantity representing the current system time, as the number of GPS seconds since 0000 Hours UTC, January 6th, 1980. The system_time value may or may not include the correction factor for leap seconds, depending upon the value of GPS_UTC_offset, as described below.

GPS_UTC_offset: An 8-bit value that serves dual roles. When set to zero, the field indicates that the system_time field carries UTC time directly. When GPS_UTC_offset is not equal to zero, it is interpreted as an 8-bit unsigned integer that defines the current offset in whole seconds between GPS and UTC time standards. To convert GPS time to UTC, the GPS_UTC_offset is subtracted from GPS time. Whenever the International Bureau of Weights and Measures decides that the current offset is too far in error, an additional leap second may be added (or subtracted), and the GPS_UTC_offset will reflect the change.

descriptor(): The table section may include at its end one or more structures of the form tag, length, data. The number of descriptors present is determined indirectly by processing the section_length field. Descriptors are defined in clause B.7.

B.6.5 Master Guide Table (MGT)

The Master Guide Table is used to indicate the location, size, and version of tables it references. The MGT shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID. The MGT syntax is shown in Table B.27. Syntax and semantics are identical to SCTE DVS 097, ATSC Standard A/65 (1997), except that additional table types are added to refer to all tables defined in this protocol.

Table B.27 – Master Guide Table section format

	Bits	Bytes	Format
master_guide_table_section () {			
table_ID	8	1	0xC7
Section_syntax_indicator	1	2	'1'
private_indicator	1		'1'
Reserved	2		'11'
Section_length	12		uimsbf
map_ID	16	2	uimsbf
Reserved	2	1	'11'
version_number	5		uimsbf
current_next_indicator	1		'1'
section_number	8	1	0x00
last_section_number	8	1	0x00
protocol_version	8	1	uimsbf
Tables_defined	16	2	uimsbf
for (i=0;i<tables_defined;i++) {			
table_type	16	2	uimsbf
Reserved	3	2	'111'
table_type_PID	13		uimsbf
Reserved	3	1	'111'
table_type_version_number	5		uimsbf
number_bytes	32	4	uimsbf
Reserved	4	2	'1111'
table_type_descriptors_length	12		uimsbf
for (k=0;k<N;k++)			
descriptor()	var		
}			
Reserved	4	2	'1111'
descriptors_length	12		uimsbf
for (I = 0;I< N;I++)			
descriptor()	var		
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the Master Guide Table section shall be 0xC7.

section_syntax_indicator: This 1-bit field shall be set to '1'. It denotes that the section follows the generic section syntax beyond the section length field.

private_indicator: This 1-bit field shall be set to '1'.

section_length: 12-bit field specifying the number of remaining bytes in this section immediately following the section_length field up to the end of the section. The value of the section_length shall be no larger than 4093.

map_ID: This 16-bit field may be used by the POD module for filtering purposes. The Host is expected to ignore map_ID. Only one version of the MGT, corresponding to one value of map_ID shall be delivered to the Host across the Extended Channel interface at a given time. Consequently, the Host can disregard map_ID and may process the MGT version_number field as an indication that the MGT version has changed.

NOTE – The map_ID may be considered to be an identifier for this instance of the Master Guide Table. In some applications, the POD module may receive multiple Master Guide Table sections corresponding to distinct channel maps. In this case, the POD module is responsible for accepting one MGT and discard the others. It may use the map_ID to filter them, using information provided outside the scope of this annex.

In every case, the Host will receive just one MGT across the POD to Host interface, and the map_ID parameter may be ignored.

version_number: This 5-bit field is the version number of MGT. The version number shall be incremented by 1 modulo 32 when any field in the table_types defined in the loop below or the MGT itself changes.

current_next_indicator: This 1-bit indicator is always set to '1' for the MGT section; the MGT sent is always currently applicable.

section_number: The value of this 8-bit field shall always be 0x00 (this table is only one section long).

last_section_number: The value of this 8-bit field shall always be 0x00.

protocol_version: An 8-bit unsigned integer field whose function shall be to allow, in the future, this table type to carry parameters that may be structured differently than those defined in the current protocol. At present, the only valid value for protocol_version is zero. Non-zero values of protocol_version may only be processed by Hosts designed to accommodate the later versions as they become standardized.

tables_defined: This 16-bit unsigned integer in the range 0 to 65 535 represents the number of tables in the following loop.

table_type: This 16-bit unsigned integer specifies the type of table, based on Table B.28.

Table B.28 – MGT Table Types

table_type	Meaning
0x0000-0x0001	**[Assigned by ATSC]**
0x0002	**Long-form Virtual Channel Table** with current_next_indicator=**1**
0x0003	**Long-form Virtual Channel Table** with current_next_indicator=**0**
0x0004	**[Assigned by ATSC]**
0x0005-0x000F	**[Reserved]**
0x0010	**Short-form Virtual Channel Table-VCM Subtype**
0x0011	**Short-form Virtual Channel Table-DCM Subtype**
0x0012	**Short-form Virtual Channel Table-ICM Subtype**
0x0013-0x01F	**[Reserved]**
0x0020	**Network Information Table-CDS Table Subtype**
0x0021	**Network Information Table-MMS Table Subtype**
0x0021-0x02F	**[Reserved]**
0x0030	**Network Text Table-SNS Subtype**
0x0031-0x00FF	**[Reserved]**
0x0100-0x017F	**[Assigned by ATSC]**
0x0180-0x01FF	**[Reserved]**
0x0200-0x027F	**[Assigned by ATSC]**
0x028F-0x0300	**[Reserved]**
0x0301-0x03FF	**Rating Region Table with rating_region 1-255**

Table B.28 – MGT Table Types

table_type	Meaning
0x0400-0x0FFF	**[User private]**
0x1000-0x10FF	**Aggregate Event Information Table with MGT_tag 0 to 255**
0x1100-0x11FF	**Aggregate Extended Text Table with MGT_tag 0 to 255**
0x1200-0xFFFF	**[Reserved]**

For table types formatted with the MPEG short-form syntax, the revision_detection_descriptor() shall be used to indicate the section number and version. For example, table_type 0x0020 indicates the Network Information Table, CDS table subtype. One MGT reference to CDS would cover all sections of the delivered CDS.

MGT table types 0x1000 through 0x10FF reference AEIT instances with MGT_tag values 0x00 through 0xFF, respectively. Table types 0x1100 through 0x11FF reference AETT instances with MGT_tag values 0x00 through 0xFF, respectively. A table_type value of 0x1023 in the MGT, for example, refers to the instance of the AEIT with MGT_tag value 0x23.

Note that the choice of value of the MGT_tag is independent of the timeslot number. For example, the MGT_tag value used to deliver AEIT-0 may be zero or any other value up to 255.

table_type_PID: This 13-bit field specifies the PID for the table_type described in the loop.

table_type_version_number: This 5-bit field reflects the version number of the table_type described in the loop. The value of this field shall be the same as the version_number entered in the corresponding fields of tables and table instances. The version number for the next L-VCT (current_next_indicator = 0) shall be one unit more (modulo 32) than the version number for the current L-VCT (current_next_indicator = 1).

number_bytes: This 32-bit unsigned integer field indicates the total number of bytes used for the table_type described in the loop. There may be more than one instance of the indicated table_type.

table_type_descriptors_length: Total length of the descriptors for the table_type described in the loop (in bytes).

descriptors_length: Total length of the MGT descriptor list that follows (in bytes).

descriptor(): The table section may include, at its end, one or more structures of the form tag, length, data. Descriptors are defined in clause B.7.

CRC_32: This is a 32-bit field that contains the CRC value to ensure a zero output from the registers in the decoder defined in Annex A of ITU-T H.222.0 | ISO/IEC 13818-1 "MPEG-2 Systems" after processing the entire Master Guide Table section.

B.6.5.1 Restrictions on PID values

Certain restrictions apply to the PID values specified in the MGT. These restrictions are necessary to ensure the Host can collect EPG data using a minimum number of concurrent flows on the Extended Channel.

– All AEIT and AETT table sections with common MGT_tag values shall share a common PID.

– AEIT-0, AETT-0, AEIT-1 and AETT-1 instances shall share a common PID value.[4]

– AEIT-2, AETT-2, AEIT-3 and AETT-3 instances shall be associated with a second separate PID value.

[4] Please refer to clause B.6.8 for definition of the AEIT-*n* and AETT-*n* notation convention used in this annex.

- EPG data describing events farther into the future may be associated with one or more PID values; the second PID value may be used for all or some of the AEIT/AETT-4 through AEIT/AETT-N instances (N < 256).

B.6.5.2 Restrictions on order of occurrence of table references

For all table references except AEIT and AETT, the order of appearance in the MGT of various table references is not specified or restricted. For AEIT and AETT references, the following restriction applies:

- The order of appearance of AEIT/AETT references in the MGT shall correspond to increasing time slot assignments.

NOTE – This rule allows a Host to know, before processing the AEIT/AETT data, which table instances correspond to near-term data and which correspond to data farther into the future. This information is useful if the Host has insufficient RAM to hold all data transmitted.

B.6.6 Long-form Virtual Channel Table

The Long-form Virtual Channel Table is carried in MPEG-2 table sections with table ID 0xC9, and conforms to the syntax and semantics of the MPEG-2 Private Section as described in clauses 2.4.4.10 and 2.4.4.11 of ITU-T H.222.0 | ISO/IEC 13818-1. The Long-form Virtual Channel Table shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID.

The bit stream syntax for the Long-form Virtual Channel Table is shown in Table B.29.

Table B.29 – Long-form Virtual Channel Table section format

Syntax	Bits	Bytes	Format
longform_virtual_channel_table_section () {			
table_id	8	1	0xC9
section_syntax_indicator	1	2	'1'
private_indicator	1		'1'
Reserved	2		'11'
section_length	12		uimsbf
map_ID	16	2	uimsbf
Reserved	2	1	'11'
version_number	5		uimsbf
current_next_indicator	1		bslbf
section_number	8	1	uimsbf
last_section_number	8	1	uimsbf
protocol_version	8	1	uimsbf
num_channels_in_section	8	1	uimsbf
For(i=0; i<num_channels_in_section;i++) {			
short_name	7*16	(14)	unicode™BMP
reserved	4	(3)	'1111'
major_channel_number	10		uimsbf
minor_channel_number	10		uimsbf
modulation mode	8	(1)	uimsbf
carrier_frequency	32	(4)	uimsbf
channel_TSID	16	(2)	uimsbf
program_number	16	(2)	uimsbf
reserved	2	(2)	'11'
access_controlled	1		bslbf
hidden	1		bslbf
path_select	1		bslbf
out_of_band	1		bslbf
hide_guide	1		bslbf
reserved	3		'111'
service_type	6		uimsbf
source_id	16	(2)	uimsbf
reserved	6	(2)	'111111'

Table B.29 – Long-form Virtual Channel Table section format

Syntax	Bits	Bytes	Format
descriptors_length	10		uimsbf
for (i=0;i<N;i++) {			
descriptors()			
}			
}			
reserved	6	2	'111111'
additional_descriptors_length	10		uimsbf
For(j=0; j<N;j++) {			
additional_descriptors()		var	
}			
CRC_32	32	4	rpchof
}			

table_id: An 8-bit unsigned integer number that indicates the type of table section being defined here. For the longform_virtual_channel_table_section, the table_ID shall be 0xC9.

section_syntax_indicator: The section_syntax_indicator is a one-bit field which shall be set to '1' for the longform_virtual_channel_table_section().

private_indicator: This 1-bit field shall be set to '1'.

section_length: This is a twelve-bit field that specifies the number of bytes of the section, starting immediately following the section_length field, and including the CRC. The value in this field shall not exceed 4093.

map_ID: A 16-bit identifier for this Long-form Virtual Channel Table. In some applications, the POD module may receive multiple Long-form Virtual Channel Table sections corresponding to distinct channel maps. In this case, the POD may use the map_ID to distinguish them, using information provided outside the scope of this annex. In every case, the Host will receive just one L-VCT across the POD to Host interface, and the map_ID parameter may be ignored.

version_number: This 5-bit field is the version number of the Long-form Virtual Channel Table. For the current L-VCT (current_next_indicator = 1), the version number shall be incremented by 1 whenever the value of the current L-VCT changes. Upon reaching the value 31, it wraps around to 0. For the next L-VCT (current_next_indicator = 0), the version number shall be one unit more than that of the current L-VCT (also in modulo 32 arithmetic). In any case, the value of the version_number shall be identical to that of the corresponding entries in the MGT.

current_next_indicator: A 1-bit indicator, which when set to '1' indicates that the Long-form Virtual Channel Table sent is currently applicable. When the bit is set to '0', it indicates that the table sent is not yet applicable and shall be the next table to become valid.

section_number: This 8-bit field gives the number of this section. The section_number of the first section in the Long-form Virtual Channel Table shall be 0x00. It shall be incremented by one with each additional section in the Long-form Virtual Channel Table.

last_section_number: This 8-bit field specifies the number of the last section (that is, the section with the highest section_number) of the complete Long-form Virtual Channel Table.

protocol_version: An 8-bit unsigned integer field whose function is to allow, in the future, this table type to carry parameters that may be structured differently than those defined in the current protocol. At present, the only valid value for protocol_version is zero. Non-zero values of protocol_version may only be processed by Hosts designed to accommodate the later versions as they become standardized.

num_channels_in_section: This 8-bit field specifies the number of virtual channels in the L-VCT section. The number is limited by the section length.

short_name: The name of the virtual channel, represented as a sequence of one to seven 16-bit character codes coded in accordance with the Basic Multilingual Plane (BMP) of Unicode, as specified in ISO/IEC 10646-1. If the name of the virtual channel is shorter than seven Unicode characters, one or more instances of the null character value 0x0000 shall be used to pad the string to its fixed 14-byte length.

major_channel_number, minor_channel_number: These two 10-bit fields represent either a two-part or a one-part virtual channel number associated with the virtual channel being defined in this iteration of the "for" loop. One-part numbers range from 0 to 16 383. Two-part numbers consist of a major and a minor number part; the range of each is 0 to 999. The one- or two-part number acts as the user's reference number for the virtual channel. Some channels may be represented with a one-part number while others in the VCT are represented with two-part numbers.

The six MSBs of the major_channel_number field, when all 1, indicate that a one-part number is being specified. The value of the one-part number is given, in C syntax, by:

one_part_number = (major_channel_number & 0x00F) << 10 + minor_channel_number

When the six MSBs of the major_channel_number field are not all 1, and the 10-bit major_channel_number field is less than 1000, two fields specify a two-part channel number. The value of the two-part number is given by major_channel_number and minor_channel_number.

Table B.30 summarizes the coding of the major_channel_number and minor_channel_number fields.

Table B.30 – Major and minor channel number field coding

	20-bit major/minor field (10-bit major + 10-bit minor)		User channel number
Two-part channel numbers (1000 major numbers, each with 1000 minor numbers)	Major Number (10 bits)	Minor Number (10 bits)	Two-part user channel number
	000d	000d	0-0
	000d	001d	0-1
	…	…	…
	000d	999d	0-999
	001d	000d	1-0
	…	…	…
	999d	999d	999-999
[Reserved]	000d to 999d	1000d-1023d	N/A
	1000-1007d	All values	N/A
One-part channel numbers (16 383 linear space numbers)	6-bit flag (set = 111111b)	One-Part Number (14 bits)	One-part user channel number
	Set	0d	0
	Set	1d	1
	Set	…	…
	Set	16383d	16383

modulation_mode: An 8-bit unsigned integer number that indicates the modulation mode for the transmitted carrier associated with this virtual channel. Values of modulation_mode are defined by this annex in Table B.31. For digital signals, the standard values for modulation mode (values below 0x80) indicate transport framing structure, channel coding, interleaving, channel modulation, forward error correction, symbol rate, and other transmission-related parameters, by means of a reference to an appropriate standard. Values of modulation_mode 0x80 and above are outside the scope of SCTE.

These may be used to specify non-standard modulation modes in private systems. A value of 0x80 for modulation_mode indicates that modulation parameters are specified in a private descriptor. The modulation_mode field shall be disregarded for inactive channels.

Table B.31 – Modulation modes

Modulation_mode	Meaning
0x00	[Reserved]
0x01	analogue – The virtual channel is modulated using standard analogue methods for analogue television.
0x02	SCTE_mode_1 – The virtual channel has a symbol rate of 5.057 Msymb/s, transmitted in accordance with *Digital Transmission Standard for Cable Television*, Ref. SCTE DVS 031 (Mode 1). Typically, mode 1 will be used for 64-QAM.
0x03	SCTE_mode_2 – The virtual channel has a symbol rate of 5.361 Msymb/s, transmitted in accordance with *Digital Transmission Standard for Cable Television*, Ref. SCTE DVS 031 (Mode 2). Typically, mode 2 will be used for 256-QAM.
0x04	ATSC (8 VSB) – The virtual channel uses the 8-VSB modulation method conforming to the *ATSC Digital Television Standard*, ATSC Standard A/53 (1995).
0x05	ATSC (16 VSB) – The virtual channel uses the 16-VSB modulation method conforming to the *ATSC Digital Television Standard*, ATSC Standard A/53 (1995).
0x06-0x7F	[Reserved for future use]
0x80	Modulation parameters are defined by a private descriptor
0x81-0xFF	[User Private]

carrier_frequency: A 32-bit unsigned integer that represents the carrier frequency associated with the analogue or digital transmission associated with this virtual channel, in Hz. For QAM-modulated signals, the given carrier_frequency represents the location of the digitally modulated carrier; for VSB-modulated signals, the given carrier_frequency represents the location of the pilot tone; for analogue signals, it represents the frequency of the picture carrier. The carrier_frequency field shall be disregarded for inactive channels.

channel_TSID: A 16-bit unsigned integer field, in the range 0x0000 to 0xFFFF, that represents the MPEG-2 Transport Stream ID associated with the Transport Stream carrying the MPEG-2 program referenced by this virtual channel. For inactive channels, channel_TSID represents the ID of the Transport Stream that will carry the service when it becomes active. The Host may use the channel_TSID to verify that a TS acquired at the referenced carrier frequency is actually the desired multiplex. Analogue signals may have a TSID provided that it is different from any DTV Transport Stream identifier; that is, it shall be truly unique if present.[5] A value of 0xFFFF for channel_TSID shall be specified for analogue channels that do not have a valid TSID.

program_number: A 16-bit unsigned integer number that associates the virtual channel being defined here with the MPEG-2 Program Association and TS Program Map tables. For virtual channels representing analogue services, a value of 0xFFFF shall be specified for program_number. For inactive

[5] A method to include such a unique 16-bit "Transmission Signal ID" in the NTSC VBI is specified in the EIA-752 specification.

channels (those not currently present in the Transport Stream), program_number shall be set to zero. This number shall **not** be interpreted as pointing to a Program Map Table entry.

access_controlled: A 1-bit Boolean flag, when set, indicates that events associated with this virtual channel may be access controlled. When the flag is set to 0, event access is not restricted.

hidden: A 1-bit Boolean flag that indicates, when set, that the virtual channel is not accessed by the user by direct entry of the virtual channel number. Hidden virtual channels are skipped when the user is channel surfing, and appear as if undefined, if accessed by direct channel entry. Typical applications for hidden channels are test signals and NVOD services. Whether a hidden channel and its event may appear in EPG displays depends on the state of the hide_guide bit.

path_select: A 1-bit field that associates the virtual channel with a transmission path. Two paths are available as defined in Table B.32. For the cable transmission medium, path_select identifies which of two physical input cables carries the Transport Stream associated with this virtual channel.

Table B.32 – Path Select

path_select	Meaning
0	path 1
1	path 2

out_of_band: A Boolean flag that indicates, when set, that the virtual channel defined in this iteration of the "for" loop is carried on the cable on the Extended Channel interface carrying the tables defined in this protocol. When clear, the virtual channel is carried within a standard tuned multiplex at that frequency.

NOTE – A virtual channel carried on the out-of-band channel may be acquired by opening a flow between Host and POD to capture the PAT on PID 0. Processing the PAT will determine the PID associated with that service's PMT. Then, a flow can be opened to capture and process the PMT to determine the PIDs associated with elementary stream components of the service. Finally, a flow associated with the service's PID can be opened to capture service-related data.

hide_guide: A Boolean flag that indicates, when set to 0 for a hidden channel, that the virtual channel and its events may appear in EPG displays. This bit shall be ignored for channels which do not have the hidden bit set, so that non-hidden channels and their events may always be included in EPG displays regardless of the state of the hide_guide bit. Typical applications for hidden channels with the hide_guide bit set to 1 are test signals and services accessible through application-level pointers.

An *inactive channel* is defined as a channel that has program guide data available, but the channel is not currently on the air. Inactive channels are represented as hidden channels with the hide_guide bit set to 0. The Transport Stream shall not carry a Program Map Table representing an inactive channel.

service_type: A 6-bit enumerated type field that identifies the type of service carried in this virtual channel, based on Table B.33.

Table B.33 – Service Types

service_type	Meaning
0x00	[Reserved]
0x01	**analogue_television** – The virtual channel carries analogue television programming
0x02	**ATSC_digital_television** – The virtual channel carries television programming (audio, video and data) conforming to the ATSC Digital Television Standard
0x03	**ATSC_audio_only** – The virtual channel conforms to the ATSC Digital Television Standard, and has one or more standard audio and data components but no video.
0x04	**ATSC_data_broadcast_service** – Conforming to the ATSC data broadcast standard under development by T3/S13.
0x05-0x3F	[Reserved for future ATSC use]

source_id: A 16-bit unsigned integer number that identifies the programming source associated with the virtual channel. In this context, a *source* is one specific source of video, text, data, or audio programming. Source ID value zero is reserved to indicate that the programming source is not identified. Source ID values in the range 0x0001 to 0x0FFF shall be unique within the Transport Stream that carries the VCT, while values 0x1000 to 0xFFFF shall be unique at the regional level. Values for source_IDs 0x1000 and above shall be issued and administered by a Registration Authority designated by the ATSC.

descriptors_length: Total length (in bytes) of the descriptors for this virtual channel that follows.

additional_descriptors_length: Total length (in bytes) of the VCT descriptor list that follows.

CRC_32: This is a 32-bit field that contains the CRC value that ensures a zero output from the registers in the decoder defined in Annex A of ITU-T H.222.0 | ISO/IEC 13818-1 "MPEG-2 Systems" after processing the entire Long-form Virtual Channel Table section.

For inactive channels, the short_name, major_channel_number, and minor_channel_number fields reflect the name and channel number of the inactive channel, and may be used in construction of the program guide. The source_ID for inactive channels is used, as it is for active channels, to link the virtual channel to the program guide data. The service_type field and attribute flags reflect the characteristics of the channel that will be valid when it is active.

B.6.7 Rating Region Table (RRT)

The Rating Region Table carries rating information for multiple geographical regions. The RRT shall be associated on the POD-Host interface with PID value 0x1FFC, the SI_base PID.

Transmission of the RRT is required whenever any Transport Stream carries a service that includes a content_advisory_descriptor() in one of its Program Map Tables, or if a content_advisory_descriptor() appears in any transmitted AEIT. An instance of the RRT for each region referenced in any content_advisory_descriptor() shall be transmitted.

Each RRT instance, identified by rating_region (the eight least significant bits of table_id_extension), conveys the rating system information for one specific region. The size of each RRT instance shall not be more than 1024 bytes (including section header and trailer), and it shall be carried by only one MPEG-2 private section.

Table B.34 describes the Rating Region Table.

Table B.34 – Rating Region Table section format

	Bits	Bytes	Format
rating_region_table_section () {			
table_ID	8	1	0xCA
section_syntax_indicator	1	2	'1'
private_indicator	1		'1'
Reserved	2		'11'
section_length	12		uimsbf
table_ID_extension{			
Reserved	8	1	0xFF
rating_region	8	1	uimsbf
}			
Reserved	2	1	'11'
version_number	5		uimsbf
current_next_indicator	1		'1'
section_number	8	1	uimsbf
last_section_number	8	1	uimsbf
protocol_version	8	1	uimsbf
rating_region_name_length	8	1	uimsbf
rating_region_name_text()	var		
dimensions_defined	8	1	uimsbf
for(i=0; i<dimensions_defined;i++) {			
dimension_name_length	8	1	uimsbf
dimension_name_text()	var		
Reserved	3	1	'111'
graduated_scale	1		bslbf
values_defined	4		uimsbf
for (j=0;j<values_defined;j ++) {			
abbrev_rating_value_length	8	1	uimsbf
abbrev_rating_value_ text()	var		
rating_value_length	8	1	uimsbf
rating_value_ text()	var		
}			
}			
Reserved	6	2	'111111'
descriptors_length	10		uimsbf
for (i=0;i<N;i++) {			
descriptors()	var		
}			
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the Rating Region Table (RRT) shall be 0xCA.

section_syntax_indicator: This 1-bit field shall be set to '1'. It denotes that the section follows the generic section syntax beyond the section length field.

private_indicator: This 1-bit field shall be set to '1'.

section_length: 12-bit field specifying the number of remaining bytes in this section immediately following the section_length field up to the end of the section. The value of the section_length shall be no larger than 1021.

rating_region: An 8-bit unsigned integer number that defines the rating region to be associated with the text in this rating_region_table_section(). The value of this field is the identifier of this rating region, and thus this field may be used by the other tables (e.g., MGT) for referring to a specific rating region table. Values of rating_region are defined in Table B.35.

Table B.35 – Rating Regions

rating_region	Rating Region Name
0x00	Forbidden
0x01	US (50 states + possessions)
0x02-0xFF	[Reserved]

version_number: This 5-bit field is the version number of the Rating Region Table identified by combination of the fields table_ID and table_ID_extension. The version number shall be incremented by 1 modulo 32 when any field in this instance of the Rating Region Table changes. The value of this field shall be the same as that of the corresponding entry in MGT.

current_next_indicator: This 1-bit indicator is always set to '1'.

section_number: The value of this 8-bit field shall always be 0x00.

last_section_number: The value of this 8-bit field shall always be 0x00.

protocol_version: The value of this 8-bit field shall always be 0x00.

rating_region_name_length: An 8-bit unsigned integer number that defines the total length (in bytes) of the rating_region_name_text() field to follow.

rating_region_name_text(): A data structure containing a Multiple String Structure which represents the rating region name, e.g., "U.S. (50 states + possessions)", associated with the value given by rating_region. The rating_region_name_text() shall be formatted according to the Multiple String Structure (see clause B.8.2). The display string for the rating region name shall be limited to 32 characters or less.

dimensions_defined: This 8-bit field (1-255) specifies the number of dimensions defined in this rating_region_table_section().

dimension_name_length: An 8-bit unsigned integer number that defines the total length in bytes of the dimension_name_text() field to follow.

dimension_name_text(): A data structure containing a Multiple String Structure which represents the dimension name being described in the loop. One dimension in the U.S. rating region, for example, is used to describe the MPAA list. The dimension name for such a case may be defined as "MPAA". The dimension_name_text() shall be formatted according to the Multiple String Structure (see clause B.8.2). The dimension name display string shall be limited to 20 characters or less.

graduated_scale: This 1-bit flag indicates whether or not the rating values in this dimension represent a graduated scale, i.e., higher rating values represent increasing levels of rated content within the dimension. Value 1 means yes, while value 0 means no.

values_defined: This 4-bit field (1-15) specifies the number of values defined for this particular dimension.

abbrev_rating_value_length: An 8-bit unsigned integer number that defines the total length (in bytes) of the abbrev_rating_value_text() field to follow.

abbrev_rating_value_text(): A data structure containing a Multiple String Structure which represents the abbreviated name for one particular rating value. The abbreviated name for rating value 0 shall be set to a null string, i.e., "". The abbrev_rating_value_text() shall be formatted according to the Multiple String Structure (see clause B.8.2). The abbreviated value display string shall be limited to 8 characters or less.

rating_value_length: An 8-bit unsigned integer number that defines the total length (in bytes) of the rating_value_text() field to follow.

rating_value_text(): A data structure containing a Multiple String Structure which represents the full name for one particular rating value. The full name for rating value 0 shall be set to a null string, i.e., "". The rating_value_text() shall be formatted according to the Multiple String Structure (see clause B.8.2). The rating value display string shall be limited to 150 characters or less.

descriptors_length: Length (in bytes) of all of the descriptors that follow this field.

CRC_32: This is a 32-bit field that contains the CRC value that ensures a zero output from the registers in the decoder defined in Annex A of ITU-T H.222.0 | ISO/IEC 13818-1 "MPEG-2 Systems" after processing the entire Rating Region Table section.

B.6.8 Aggregate Event Information Tables (AEIT)

The Aggregate Event Information Table delivers event title and schedule information that may be used to support an Electronic Program Guide application. The transmission format allows instances of table sections for different time periods to be associated with common PID values. For use on the Extended Channel (out-of-band), reduction of the total number of PID values in use for SI data is important, because the POD module can typically support only a small number of concurrent data flows (each associated with one PID value).

Each AEIT instance describes event data for one three-hour time period. The start time for any AEIT is constrained to be one of the following eight UTC times: 00:00 (midnight), 03:00, 06:00, 09:00, 12:00 (noon), 15:00, 18:00, and 21:00.

The notation AEIT-*n* refers to the AEIT corresponding to timeslot *n*. Value 0 for *n* indicates the current timeslot, value 1 the next timeslot, etc. The same notational methods apply to AETT.

Except for AEIT-0, each AEIT instance shall include event data only for those events actually starting within the covered time period.[6] AEIT-0 shall also include event data for all events starting in a prior timeslot but continuing into the current timeslot. In addition, if the VCT entry for a particular source ID includes a time_shifted_service_descriptor(), AEIT-0 shall describe event data for active events on any channels referenced through the time_shifted_service_descriptor().

ETMs for events described in AEIT-0 shall be provided in AETT-0 on the PID associated with AEIT-0 until they are no longer referenced by AEIT-0.

Table B.36 defines the syntax of the Aggregate Event Information Table.

Table B.36 – Aggregate Event Information Table format

Syntax	Bits	Bytes	Format
aggregate_event_information_table_section () {			
table_ID	8	1	0xD6
section_syntax_indicator	1	2	'1'
private_indicator	1		'1'
Reserved	2		'11'
section_length	12		uimsbf
AEIT_subtype	8	1	uimsbf
MGT_tag	8	1	uimsbf
Reserved	2		'11'
version_number	5		uimsbf
current_next_indicator	1		'1'

[6] Although AEIT is similar in structure to the EIT in ATSC A/65, its properties differ from EIT in this regard.

Table B.36 – Aggregate Event Information Table format

Syntax	Bits	Bytes	Format
section_number	8	1	uimsbf
last_section_number	8	1	uimsbf
if (AEIT_subtype == 0) {			
num_sources_in_section	8	1	uimsbf
for (j = 0; j< num_sources_in_section;j++) {			
source_ID	16	(2)	uimsbf
Num_events	8	(1)	uimsbf
for (j = 0; j< num_events;j++) {			
reserved	2	((2))	'11'
event_ID	14		uimsbf
start_time	32	((4))	uimsbf
reserved	2	((3))	'11'
ETM_present	2		bslbf
duration	20		uimsbf
title_length	8	((1))	uimsbf
title_text()	var		
reserved	4	((2))	'1111'
descriptors_length	12		
for (i=0;i<N;i++) {			
descriptor()			
}			
}			
}			
else			
reserved	n*8	n	
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the Aggregate Event Information Table shall be 0xD6.

section_syntax_indicator: This 1-bit field shall be set to '1'. It denotes that the section follows the generic section syntax beyond the section length field.

private_indicator: This 1-bit field shall be set to '1'.

section_length: 12-bit field specifying the number of remaining bytes in this section immediately following the section_length field up to the end of the section, including the CRC_32 field. The value of this field shall not exceed 4093.

AEIT_subtype: This 8-bit field identifies the subtype of the AEIT. In the current protocol, only table subtype value 0x00 is defined. Host devices shall discard instances of the aggregate_event_information_table_section() in which an unknown AEIT_subtype is specified (currently, any value other than zero).

MGT_tag: An 8-bit field that ties this AEIT instance to the corresponding table_type in the MGT and to an AETT instance with the same value. The MGT_tag value for an AEIT instance for a given timeslot shall be one higher (modulo 256) than the instance for the preceding time period.

version_number: This 5-bit field is the version number of the AEIT instance. An instance is identified by the MGT_tag. The version number shall be incremented by 1 modulo 32 when any field in the AEIT instance changes. The value of this field shall be identical to that of the corresponding entry in the MGT.

current_next_indicator: This 1-bit indicator is always set to '1' for AEIT sections; the AEIT sent is always currently applicable.

section_number: This 8-bit field gives the number of this section.

last_section_number: This 8-bit field specifies the number of the last section.

num_sources_in_section: This 8-bit field gives the number of iterations of the "for" loop describing program schedule data.

source_ID: This 16-bit field specifies the source_ID of the virtual channel carrying the events described in this section.

num_events: Indicates the number of events to follow associated with the program source identified by source_ID. Value 0 indicates no events are defined for this source for the time period covered by the AEIT instance.

event_ID: This 14-bit field specifies the identification number of the event described. This number serves as a part of the event ETM_ID (identifier for event Extended Text Message). An assigned event_ID shall be unique at least within the scope of the instance of the AEIT in which it appears. Accordingly, as an example, the event associated with event_ID 0x0123 in AEIT-m shall be considered to be an event distinct from event_ID 0x0123 in AEIT-n, when m is not equal to n.

start_time: A 32-bit unsigned integer quantity representing the start time of this event as the number of seconds since 0000 Hours UTC, January 6th, 1980. If the GPS_UTC_offset delivered in the System Timetable is zero, start_time includes the correction for leap seconds. Otherwise, start_time can be converted to UTC by subtracting the GPS_UTC_offset.

ETM_present: This 2-bit field indicates the existence of an Extended Text Message (ETM) based on Table B.37.

Table B.37 – ETM_present

ETM_present	Meaning
0x00	No ETM
0x01	ETM present on this out-of-band Extended Channel
0x02-0x03	[Reserved for future use]

duration: Duration of this event in seconds.

title_length: This field specifies the length (in bytes) of the title_text(). Value 0 means that no title exists for this event.

title_text(): The event title in the format of a Multiple String Structure. title_text() shall be formatted according to the Multiple String Structure (see clause B.8.2).

descriptors_length: Total length (in bytes) of the event descriptor list that follows.

CRC_32: This is a 32-bit field that contains the CRC value that ensures a zero output from the registers in the decoder defined in Annex A of ITU-T H.222.0 | ISO/IEC 13818-1 "MPEG-2 Systems" after processing the entire Aggregate Event Information Table section.

B.6.9 Aggregate Extended Text Tables (AETT)

The Aggregate Extended Text Table contains Extended Text Messages (ETM), which are used to provide detailed descriptions of events. An ETM is a multiple string data structure. Thus, it may represent a description in several different languages (each string corresponding to one language). If necessary, the description may be truncated to fit the allocated display space.

The transmission format of the AETT and its affiliated AEIT allows instances of AEIT/AETT table sections for different time slots to be associated with common PID values.

AETT-*n* shall be associated with the same PID value as AEIT-*n* for a given value of *n*.

The Aggregate Extended Text Table is carried in an MPEG-2 private section with table_ID 0xD7. An instance of the AETT includes one or more ETMs. Each description is distinguished by its unique 32-bit ETM_ID.

Table B.38 defines the syntax of the Aggregate Extended Text Table.

Table B.38 – Aggregate Extended Text Table format

Syntax	Bits	Bytes	Format
aggregate_extended_text_table_section () {			
table_ID	8	1	0xD7
section_syntax_indicator	1	2	'1'
private_indicator	1		'1'
Reserved	2		'11'
section_length	12		uimsbf
AETT_subtype	8	1	uimsbf
MGT_tag	8	1	uimsbf
Reserved	2	1	'11'
version_number	5		uimsbf
current_next_indicator	1		'1'
section_number	8	1	uimsbf
last_section_number	8	1	uimsbf
if (AETT_subtype == 0) {			
num_blocks_in_section	8	1	uimsbf
for (j = 0; j< num_blocks_in_section;j++) {			
ETM_ID	32	(4)	uimsbf
reserved	4	(2)	'1111'
extended_text_length	12		uimsbf
extended_text_message()	var		
}			
}			
Else			
reserved	n*8	n	
CRC_32	32	4	rpchof
}			

table_ID: The table_ID of the Aggregate Extended Text Table shall be 0xD7.

section_syntax_indicator: This 1-bit field shall be set to '1'. It denotes that the section follows the generic section syntax beyond the section length field.

private_indicator: This 1-bit field shall be set to '1'.

section_length: 12-bit field specifying the number of remaining bytes in the section immediately following the section_length field up to the end of the section. The value of the section_length shall be no larger than 4093.

AETT_subtype: This 8-bit field identifies the subtype of the AETT. In the current protocol, only table subtype value 0x00 is defined. Host devices shall discard instances of the aggregate_extended_text_table_section() in which an unknown AETT_subtype is specified (currently, any value other than zero).

MGT_tag: An 8-bit field that ties this AETT instance to the corresponding table_type in the MGT and to an AEIT instance with the same value. The MGT_tag value for an AETT instance for a given time period shall be one higher (modulo 256) than the instance for the preceding time period.

version_number: This 5-bit field is the version number of the AETT instance. An instance is uniquely identified by its MGT_tag. The version number shall be incremented by 1 modulo 32 when any field in the AETT instance changes. The value of this field shall be identical to that of the corresponding entry in the MGT.

current_next_indicator: This 1-bit indicator is always set to '1' for AETT sections; the AETT sent is always currently applicable.

section_number: This 8-bit field gives the number of this section.

last_section_number: This 8-bit field specifies the number of the last section.

num_blocks_in_section: This 8-bit field gives the number of iterations of the "for" loop describing ETM data.

ETM_ID: Unique 32-bit identifier of this Extended Text Message. This identifier is assigned by the rule shown in Table B.39.

Table B.39 – ETM ID

	MSB		**LSB**
Bit	31 16	15 2	1 0
event ETM_ID	source_ID	event_ID	1 0

extended_text_length: A 12-bit unsigned integer number that represents the length, in bytes, of the extended_text_message() field directly following.

extended_text_message(): The extended text message in the format of a Multiple String Structure (see clause B.8.2).

CRC_32: This is a 32-bit field that contains the CRC value that ensures a zero output from the registers in the decoder defined in Annex A of ITU-T H.222.0 | ISO/IEC 13818-1 "MPEG-2 Systems" after processing the entire Transport Stream AETT section.

B.7 Descriptors

This clause defines descriptors applicable for use with various table sections defined in this annex.

B.7.1 Descriptor usage

Table B.40 lists all descriptors, their tag numbers and associated table sections applicable to out-of-band SI transport. Asterisks mark the tables where the descriptors may appear. The range of descriptor tags defined or reserved by MPEG-2 includes those with tag values 0x3F or below, plus 0xFF.

Table B.40 – Descriptor usage

Descriptor name	Tag	Table section								
		PMT	NIT	NTT	S-VCT	STT	MGT	L-VCT	RRT	AEIT
Stuffing descriptor	0x80	*	*	*	*	*	*	*	*	*
AC-3 audio descriptor	0x81	*								*
Caption service descriptor	0x86	*								*
Content advisory descriptor	0x87	*								*
Revision detection descriptor	0x93		*	*	*					
Two part channel no. descriptor	0x94				*					
Channel properties descriptor	0x95				*					
Daylight savings time descriptor	0x96					*				
Extended channel name descriptor	0xA0							*		
Time shifted service descriptor	0xA2							*		
Component name descriptor	0xA3	*								
User private descriptors	0xC0-0xFF		*	*	*	*	*	*	*	*

B.7.2 Stuffing descriptor

For certain applications it is necessary to define a block of N bytes as a placeholder. The N bytes themselves are not to be processed or interpreted. The stuffing_descriptor() is specified for this purpose. The stuffing_descriptor() is simply a descriptor type for which the contents, as indicated by the descriptor_length field, are to be disregarded. The tag type for the stuffing descriptor is 0x80. The stuffing_descriptor() may appear where descriptors are allowed in any table defined in this annex.

B.7.3 AC-3 audio descriptor

The AC-3 audio descriptor, as defined in ATSC Standard A/52 (1995), and constrained in Annex B of ATSC Standard A/53 (1995), may be used in the PMT and/or in AEITs.

B.7.4 Caption service descriptor

The caption service descriptor provides closed captioning information, such as closed captioning type and language code for events with closed captioning service. This descriptor shall not appear on events with no closed captioning service.

The bit stream syntax for the Caption Service Descriptor is shown in Table B.41.

Table B.41 – Caption Service Descriptor format

Syntax	Bits	Bytes	Format
caption_service_descriptor() {			
descriptor_tag	8	1	0x86
descriptor_length	8	1	uimsbf
Reserved	3	1	'111'
number_of_services	5		uimsbf
for (i=0;i<number_of_services;i++) {			
Language	8*3	(3)	uimsbf
cc_type	1	(1)	bslbf
Reserved	1		'1'
if (cc_type==line21) {			
reserved	5		'11111'
line21_field	1		bslbf
}			
Else			
caption_service_number	6		uimsbf
easy_reader	1	(2)	bslbf
wide_aspect_ratio	1		bslbf
Reserved	14		'11111111111111'
}			
}			

descriptor_tag: An 8-bit field that identifies the type of descriptor. For the caption_service_descriptor() the value is 0x86.

descriptor_length: An 8-bit count of the number of bytes following the descriptor_length itself.

number_of_services: An unsigned 5-bit integer in the range 1 to 16 that indicates the number of closed caption services present in the associated video service. Note that if the video service does not carry television closed captioning, the caption_service_descriptor() shall not be present either in the Program Map Table or in the Aggregate Event Information Table.

Each iteration of the "for" loop defines one closed caption service present as a sub-stream within the 9600 bit/s closed captioning stream. Each iteration provides the sub-stream's language, attributes, and (for advanced captions) the associated Service Number reference. Refer to EIA-708 Specification for Advanced Television Closed Captioning (ATVCC), for a description of the use of the Service Number field within the syntax of the closed caption stream.

language: A 3-byte language code per ISO 639-2/B defining the language associated with one closed caption service. The ISO_639_language_code field contains a three-character code as specified by ISO 639-2/B. Each character is coded into 8 bits according to ISO 8859-1 (ISO Latin-1) and inserted in order into the 24-bit field.

cc_type: A flag that indicates, when set, that an advanced television closed caption service is present in accordance with EIA-708 Specification for Advanced Television Closed Captioning (ATVCC). When the flag is clear, a line-21 closed caption service is present. For line 21 closed captions, the line21_field indicates whether the service is carried in the even or odd field.

line21_field: A flag that indicates, when set, that the line 21 closed caption service is associated with the field 2 of the NTSC waveform. When the flag is clear, the line-21 closed caption service is associated with field 1 of the NTSC waveform. The line21_field flag is defined only if the cc_type flag indicates line-21 closed caption service.

caption_service_number: A 6-bit unsigned integer value in the range zero to 63 that identifies the Service Number within the closed captioning stream that is associated with the language and attributes defined in this iteration of the "for" loop. See EIA-708 Specification for Advanced Television Closed Captioning (ATVCC) for a description of the use of the Service Number. The caption_service_number field is defined only if the cc_type flag indicates closed captioning in accordance with EIA-708 Specification for Advanced Television Closed Captioning (ATVCC).

easy_reader: A Boolean flag which indicates, when set, that the closed caption service contains text tailored to the needs of beginning readers. Refer to EIA-708 Specification for Advanced Television Closed Captioning (ATVCC), for a description of "easy reader" television closed captioning services. When the flag is clear, the closed caption service is not so tailored.

wide_aspect_ratio: A Boolean flag which indicates, when set, that the closed caption service is formatted for displays with 16:9 aspect ratio. When the flag is clear, the closed caption service is formatted for 4:3 display, but may be optionally displayed centered within a 16:9 display.

B.7.5 Content advisory descriptor

The content_advisory_descriptor() is used to indicate, for a given event, ratings for any or all of the rating dimensions defined in the RRT (Rating Region Table). Ratings may be given for any or all of the defined regions, up to a maximum of 8 regions per event. An event without a content_advisory_descriptor() indicates that the rating value for any rating dimension defined in any rating region is zero. The absence of ratings for a specific dimension is completely equivalent to having a zero-valued rating for such a dimension. The absence of ratings for a specific region implies the absence of ratings for all of the dimensions in the region. The absence of a content_advisory_descriptor() for a specific event implies the absence of ratings for all of the regions for the event. The bit stream syntax for the content_advisory_descriptor() is shown in Table B.42.

Table B.42 – Content Advisory Descriptor format

Syntax	Bits	Bytes	Format
content_advisory_descriptor() {			
descriptor_tag	8	1	0x87
descriptor_length	8	1	uimsbf
Reserved	2	1	'11'
rating_region_count	6		
for (i=0; i<rating_region_count; i++) {			
rating_region	8	1	uimsbf
rated_dimensions	8	1	uimsbf
for (j=0;j<rated_dimensions;j++) {			
rating_dimension_j	8	1	uimsbf
reserved	4	1	'1111'
rating_value	4		uimsbf
}			
rating_description_length	8	1	uimsbf
rating_description_text()	var		
}			
}			

descriptor_tag: This 8-bit unsigned integer shall have the value 0x87, identifying this descriptor as content_advisory_descriptor.

descriptor_length: This 8-bit unsigned integer specifies the length (in bytes) immediately following this field up to the end of this descriptor.

rating_region_count: A 6-bit unsigned integer value in the range 1 to 8 that indicates the number of rating region specifications to follow.

rating_region: An unsigned 8-bit integer that specifies the rating region for which the data in the bytes to follow is defined. The rating_region associates ratings data given here with data defined in a Ratings Region Table tagged with the corresponding rating region.

rated_dimensions: An 8-bit unsigned integer field that specifies the number of rating dimensions for which content advisories are specified for this event. The value of this field shall not be greater than the value specified by the field dimensions_defined in the corresponding RRT section.

rating_dimension_j: An 8-bit unsigned integer field specifies the dimension index into the RRT instance for the region specified by the field rating_region. These dimension indices shall be listed in numerical order, i.e., the value of rating_dimension_j+1 shall be greater than that of rating_dimension_j.

rating_value: A 4-bit field represents the rating value of the dimension specified by the field rating_dimension_j for the region given by rating_region.

rating_description_length: An 8-bit unsigned integer value in the range 0 to 80 that represents the length of the rating_description_text() field to follow.

rating_description_text(): The rating description in the format of a Multiple String Structure (see clause B.8.2). The rating_description display string shall be limited to 16 characters or less. The rating description text shall represent the program's rating in an abbreviated form suitable for on-screen display. The rating description text collects multidimensional text information into a single small text string. If "xxx" and "yyy" are abbreviated forms for rating values in two dimensions, then "xxx-yyy" and "xxx (yyy)" are examples of possible strings represented in rating_description_text().

The program source provider shall be the responsible party for insertion of correct content_advisory_descriptors in the Program Map Table (PMT). Also, the content_advisory_descriptors may be included in Aggregate Event Information Tables. If content_ advisory_descriptors are available both in AEIT and PMT, the PMT should be used first, then the AEITs.

B.7.6 Revision detection descriptor

The revision_detection_descriptor() is used to indicate whether new information is contained in the table section in which it appears.

Table B.43 describes the revision_detection_descriptor. This descriptor should be the first descriptor in the list to limit processing overhead.

Table B.43 – Revision Detection Descriptor format

	Bits	Bytes	Format
revision_detection_descriptor(){			
descriptor_tag	8	1	uimsbf value 0x93
descriptor_length	8	1	uimsbf
reserved	3	1	bslbf
table_version_number	5		uimsbf range 0-31
section_number	8	1	uimsbf range 0-255
last_section_number	8	1	uimsbf range 0-255
}			

descriptor_tag: An 8-bit unsigned integer number that identifies the descriptor as a revision_detection_descriptor(). The tag shall have the value 0x93.

descriptor_length: An 8-bit unsigned integer number that indicates the number of bytes to follow in the descriptor. At present, just three bytes are defined, but the length field shall be processed to allow new data to be added to the descriptor in the future.

table_version_number: This 5-bit unsigned integer in the range 0 to 31 identifies the version of the current table. This integer applies only to the table (or the section of it) currently transmitted. Other types of tables may have different version numbers. To indicate a change in a specific table, this integer is incremented by 1 modulo 32.

section_number: An 8-bit unsigned integer in the range 0 to 255 that identifies the current table section. Version numbers for all sections of a table must be the same. Note that section_number = 0 indicates the first section of a table.

last_section_number: An 8-bit unsigned integer in the range 0 to 255 that identifies the number of sections in a table. Note that if the last_section_number = 0, then there is only one section in this table.

B.7.7 Two-art channel number descriptor

Table B.44 describes the two_part_channel_number_descriptor(). This descriptor may appear in the virtual_channel() record, contained in the VCM_structure; within the Short-form Virtual Channel Table section. The descriptor may be used by compatible Hosts to associate a two-part user channel number with any virtual channel. Some channels may have a two_part_channel_number_descriptor() while others do not.

NOTE – For the L-VCT, the 10-bit major/minor number fields can be coded to represent a one-part channel number. The one-part representation is not needed for the major/minor number fields in the two_part_channel_number_descriptor() in the S-VCT, because there is already a 12-bit one-part number on each channel in S-VCT. It would cause confusion to allow a second one-part number to be associated with a channel defined in S-VCT.

Table B.44 – Two-part Channel Number Descriptor format

	Bits	Bytes	Format
two_part_channel_number_descriptor(){			
descriptor_tag	8	1	uimsbf value 0x94
descriptor_length	8	1	uimsbf
Reserved	6	2	bslbf
major_channel_number	10		uimsbf range 0-999
Reserved	6	2	bslbf
minor_channel_number	10		uimsbf range 0-999
}			

descriptor_tag: An 8-bit unsigned integer number that identifies the descriptor as a two_part_channel_number_descriptor(). The tag shall have the value 0x94.

descriptor_length: An 8-bit unsigned integer number that indicates the number of bytes to follow in the descriptor. At present, just four bytes are defined, but the length field shall be processed to allow new data to be added to the descriptor in the future.

major_channel_number: A 10-bit unsigned integer in the range 0 to 999 that identifies the "major" channel number to be associated with the virtual channel.

minor_channel_number: A 10-bit unsigned integer in the range 0 to 999 that identifies the "minor" channel number to be associated with the virtual channel.

Hosts that support two-part channel numbering must support this descriptor. It is only mandatory for this descriptor to be sent in the instance where system support of two-part channel numbering is required. This means for virtual_channel() records where the Host does not receive the two-part channel number descriptor, that the Host is expected to use the virtual_channel_number described in the virtual_channel() record in clause B.6.3.2.

B.7.8 Channel properties descriptor

The channel_properties_descriptor() is defined to allow both forms of VCTs (S-VCT and L-VCT) carrying the same properties. Table B.45 describes the syntax for this descriptor. The descriptor may appear within a virtual_channel() record in the Short-form Virtual Channel Table.

Table B.45 – Channel Properties Descriptor format

	Bits	Bytes	Format
channel_properties_descriptor(){			
descriptor_tag	8	1	uimsbf value 0x95
descriptor_length	8	1	uimsbf
channel_TSID	16	2	uimsbf
reserved	6	1	'111111'
out_of_band_channel	1		uimsbf
access_controlled	1		uimbsf
hide_guide	1	1	bslbf
reserved	1		'1'
service_type	6		uimsbf
}			

descriptor_tag: An 8-bit unsigned integer number that identifies the descriptor as a channel_properties_descriptor(). The tag shall have the value 0x95.

descriptor_length: An 8-bit unsigned integer number that indicates the number of bytes to follow in the descriptor. At present, just four bytes are defined, but the length field shall be processed to allow new data to be added to the descriptor in the future.

channel_TSID: A 16-bit unsigned integer field in the range 0x0000 to 0xFFFF that represents the MPEG-2 Transport Stream ID associated with the Transport Stream carrying the MPEG-2 program referenced by this virtual channel. For inactive channels, channel_TSID represents the ID of the Transport Stream that will carry the service when it becomes active. The Host may use the channel_TSID to verify that a TS acquired at the referenced carrier frequency is actually the desired multiplex. Analogue signals may have a TSID that is different from any MPEG-2 Transport Stream identifier, that is, it shall be truly unique if present. A value of 0xFFFF for channel_TSID shall be specified for situations where a valid TSID is not known (reserved as a wildcard capability).

out_of_band: A Boolean flag that indicates, when set, that the virtual channel associated with this descriptor is carried on the cable on the Extended Channel interface carrying the tables defined in this protocol. When clear, the virtual channel is carried within a standard tuned multiplex at that frequency.

access_controlled: A Boolean flag that indicates, when set, that events associated with this virtual channel may be access controlled. When the flag is zero, event access is not restricted.

hide_guide: A Boolean flag that indicates, when set to 0 for a channel of channel_type hidden, that the virtual channel and its events may appear in EPG displays. This bit shall be ignored for channels which are not the hidden type, so that non-hidden channels and their events may always be included in EPG displays regardless of the state of the hide_guide bit. Typical applications for hidden channels with the hide_guide bit set to 1 are test signals and services accessible through application-level pointers.

service_type: A 6-bit enumerated type field that identifies the type of service carried in this virtual channel. Service type is coded according to Table B.33.

Hosts may use this descriptor to become aware of aspects of the channel. In the case where this descriptor is not received, the Host must tune the channel and self-discover these aspects of the channel. For example, if this descriptor is not sent, and the channel is access controlled, the Host must determine when it can obtain access permission (the same as if that bit in the descriptor were set). Similar rules can be applied for service type and channel_TSID.

B.7.9 Extended channel name descriptor

The extended channel name descriptor provides the long channel name for the virtual channel containing this descriptor.

The bit stream syntax for the extended channel name descriptor is shown in Table B.46.

Table B.46 – Extended Channel Name Descriptor format

Syntax	Bits	Bytes	Format
extended_channel_name_descriptor() {			
descriptor_tag	8	1	0xA0
descriptor_length	8	1	uimsbf
long_channel_name_text()	Var		
}			

descriptor_tag: This 8-bit unsigned integer shall have the value 0xA0, identifying this descriptor as extended_channel_name_descriptor().

descriptor_length: This 8-bit unsigned integer specifies the length (in bytes) immediately following this field up to the end of this descriptor.

long_channel_name_text(): The long channel name in the format of a Multiple String Structure (see clause B.8.2).

B.7.10 Time-shifted service descriptor

This descriptor links one virtual channel with one or more virtual channels that carry the same programming on a time-shifted basis. The typical application is for Near Video On Demand (NVOD) services.

NOTE – For the L-VCT, the 10-bit major/minor number fields can be coded to represent a one-part channel number. The one-part representation is not applicable for the major/minor number fields in the time_shifted_services_descriptor() because this descriptor is not applicable to S-VCT (see Table F.2). The major/minor number fields in the time_shifted_services_descriptor() are only used to match against fields in the LVCT.

The bit stream syntax for the time_shifted_service_descriptor() is shown in Table B.47.

Table B.47 – Time-Shifted Service Descriptor format

Syntax	Bits	Bytes	Format
time_shifted_service_descriptor() {			
descriptor_tag	8	1	0xA2
descriptor_length	8	1	uimsbf
reserved	3	1	'111'
number_of_services	5		uimsbf
for (i=0;i<number_of_services;i++) {			
reserved	6	1	'111111'
time_shift	10	1	uimsbf
reserved	4	2	'1111'
major_channel_number	10		uimsbf
minor_channel_number	10	2	uimsbf
}			
}			

descriptor_tag: This 8-bit unsigned integer shall have the value 0xA2, identifying this descriptor as time_shifted_service_descriptor().

descriptor_length: This 8-bit unsigned integer specifies the length (in bytes) immediately following this field up to the end of this descriptor.

number_of_services: A 5-bit number in the range 1 to 20 that indicates the number of time-shifted services being defined here.

time_shift: A 10-bit number in the range 1 to 720 that represents the number of minutes the time-shifted service indicated by major_channel_number and minor_channel_number is time-shifted from the virtual channel associated with this descriptor.

major_channel_number: A 10-bit number in the range 1 to 999 that represents the "major" channel number associated with a time-shifted service.

minor_channel_number: A 10-bit number in the range 0 to 999 that, when non-zero, represents the "minor" or "sub-" channel number of the virtual channel that carries a time-shifted service.

B.7.11 Component name descriptor

Table B.48 defines the component_name_descriptor(), which serves to define an optional textual name tag for any component of the service.

Table B.48 – Component Name Descriptor format

Syntax	Bits	Bytes	Format
component_name_descriptor() {			
descriptor_tag	8	1	0xA3
descriptor_length	8	1	uimsbf
component_name_string()	var		
}			

descriptor_tag: This 8-bit unsigned integer shall have the value 0xA3, identifying this descriptor as component_name_descriptor.

descriptor_length: This 8-bit unsigned integer specifies the length (in bytes) immediately following this field up to the end of this descriptor.

component_name_string(): The name string in the format of a Multiple String Structure (see clause B.8.2).

B.7.12 Daylight savings time descriptor

This descriptor is defined for optional carriage in the System Timetable section (and in no other type of table). Hosts may use the data in the descriptor if present. If not present, *no indication is being provided as to whether daylight savings time is in effect or not.* In other words, the Host shall not infer that the lack of a descriptor means that daylight savings time is not currently in effect.

A description of the use of the daylight_savings_time_descriptor() is provided in Appendix B.III. The syntax is shown in Table B.49.

Table B.49 – Daylight Savings Time Descriptor format

Syntax	Bits	Bytes	Format
daylight_savings_time_descriptor() {			
descriptor_tag	8	1	uimsbf value 0x96
descriptor_length	8	1	uimsbf
DS_status	1	1	bslbf
reserved	2		'11'
DS_day_of_month	5		uimsbf
DS_hour	8	8	uimsbf
}			

descriptor_tag: This 8-bit unsigned integer shall have the value 0x96, identifying this descriptor as daylight_savings_time_descriptor.

descriptor_length: This 8-bit unsigned integer specifies the length (in bytes) immediately following this field up to the end of this descriptor.

DS_status: This bit indicates the status of daylight savings.

DS_status = '0': Not in daylight savings time.

DS_status = '1': In daylight savings time.

DS_day_of_month: This 5-bit unsigned integer field indicates the local day of the month on which the transition into or out of daylight savings time is to occur (1-31).

DS_hour: This 8-bit unsigned integer field indicates the local hour at which the transition into or out of daylight savings time is to occur (0-18). This usually occurs at 2 a.m. in the United States.

B.7.13 User private descriptors

Privately defined descriptors are those with descriptor_tag in the range 0xC0 through 0xFF. They may be placed at any location where descriptors may be included within the table sections described in this Service Information annex. Ownership of one or more user private descriptors is indicated by the presence of an MPEG registration_descriptor() preceding the descriptor(s).

B.8 Text string coding

This clause describes the format of text strings in this Service Information annex. Two different formats are used in this annex. Text strings in the Network Text Table uses a format called Multilingual Text String (MTS), consisting of one or more mode-length-segment blocks. The MTS format is described in clause B.8.1. All other tables and descriptors use a data structure called Multiple String Structure, described in clause B.8.2. Tables B.50 and B.51 summarize these rules.

Table B.50 – Text String Coding Format in Tables

Table ID Value (hex)	Table	Coding	Reference
0xC3	Network Text Table (NTT)	MTS	Clause B.8.1
0xCA	Rating Region Table (RRT)	MSS	Clause B.8.2
0xD6	Aggregate Event Information Table (AEIT)	MSS	Clause B.8.2
0xD7	Aggregate Extended Text Table (AETT)	MSS	Clause B.8.2

Table B.51 – Text String Coding Format in Descriptors

Descriptor tag value (hex)	Descriptor	Coding	Reference
0x87	Content advisory descriptor	MSS	Clause B.8.2
0xA0	Extended channel name descriptor	MSS	Clause B.8.2
0xA3	Component name descriptor	MSS	Clause B.8.2

B.8.1 Multilingual Text String (MTS) Format

The format of Multilingual Text Strings adheres to the following structure. Items in square brackets may be repeated one or more times:

<mode><length><segment> [<mode><length><segment>]

A string_length field always precedes one or more instances of mode, length, segment. This field is described in each instance where multilingual text is used, and may be either 8- or 16-bits in length, as appropriate. The value of string_length represents the sum total of all mode, length, segment blocks comprising the multilingual text string to follow, and serves to indicate the end of the text string structure.

The multilingual text data structure is designed to accommodate the need to represent a text string composed of characters from a variety of alphabets, as well as ideographic characters. Whereas characters could be represented using 16- or 32-bit character codes (as does Unicode ISO/IEC 10646-1), that form is inefficient and wasteful of transmission bandwidth for strings composed primarily of alphabetic rather than ideographic characters. To accommodate the need to handle Chinese, Japanese, and Korean, modes are defined that allow 16-bit (double byte) character representations in standard formats.

References below to ISO/IEC 10646-1 (Unicode) shall be to the Basic Multilingual Plane (BMP) within that standard.

mode: An 8-bit value representing the text mode to be used to interpret characters in the segment to follow. See Table B.52 for definition. Mode bytes in the range zero through 0x3E select Unicode character code pages. Mode byte value 0x3F selects 16-bit Unicode character coding. Mode bytes in the range 0x40 through 0xFF represent selection of a format effector function such as *underline ON* or *new line*. If mode is in the range 0x40 to 0x9F, then the length/segment portion is omitted. Format effector codes in the range 0x40 through 0x9F involve no associated parametric data; hence the omission of the length/segment portion. Format effector codes in the range 0xA0 through 0xFF include one or more parameters specific to the particular format effector function.

Table B.52 – Mode Byte Encoding

Mode Byte	Meaning	Language(s) or script
0x00	Select ISO/IEC 10646-1 Page 0x00	ASCII, ISO Latin-1 (Roman)
0x01	Select ISO/IEC 10646-1 Page 0x01	European Latin (many)[a)]
0x02	Select ISO/IEC 10646-1 Page 0x02	Standard Phonetic
0x03	Select ISO/IEC 10646-1 Page 0x03	Greek
0x04	Select ISO/IEC 10646-1 Page 0x04	Russian, Slavic
0x05	Select ISO/IEC 10646-1 Page 0x05	Armenian, Hebrew
0x06	Select ISO/IEC 10646-1 Page 0x06	Arabic[b)]
0x07-0x08	Reserved	–
0x09	Select ISO/IEC 10646-1 Page 0x09	Devanagari[c)], Bengali
0x0A	Select ISO/IEC 10646-1 Page 0x0A	Punjabi, Gujarti

Table B.52 – Mode Byte Encoding

Mode Byte	Meaning	Language(s) or script
0x0B	Select ISO/IEC 10646-1 Page 0x0B	Oriya, Tamil
0x0C	Select ISO/IEC 10646-1 Page 0x0C	Telugu, Kannada
0x0D	Select ISO/IEC 10646-1 Page 0x0D	Malayalam
0x0E	Select ISO/IEC 10646-1 Page 0x0E	Thai, Lao
0x0F	Select ISO/IEC 10646-1 Page 0x0F	Tibetan
0x10	Select ISO/IEC 10646-1 Page 0x10	Georgian
0x11-0x1F	Reserved	–
0x20	Select ISO/IEC 10646-1 Page 0x20	Miscellaneous[d)]
0x21	Select ISO/IEC 10646-1 Page 0x21	Misc. symbols, arrows
0x22	Select ISO/IEC 10646-1 Page 0x22	Mathematical operators
0x23	Select ISO/IEC 10646-1 Page 0x23	Misc. technical
0x24	Select ISO/IEC 10646-1 Page 0x24	OCR, enclosed alpha-num.
0x25	Select ISO/IEC 10646-1 Page 0x25	Form and chart components
0x26	Select ISO/IEC 10646-1 Page 0x26	Miscellaneous dingbats
0x27	Select ISO/IEC 10646-1 Page 0x27	Zapf dingbats
0x28-0x2F	Reserved	–
0x30	Select ISO/IEC 10646-1 Page 0x30	Hiragana, Katakana
0x31	Select ISO/IEC 10646-1 Page 0x31	Bopomopho, Hangul elem.
0x32	Select ISO/IEC 10646-1 Page 0x32	Enclosed CJK Letters, ideo.
0x33	Select ISO/IEC 10646-1 Page 0x33	Enclosed CJK Letters, ideo.
0x34-0x3E	Reserved	–
0x3F	Select 16-bit ISO/IEC 10646-1 mode	All
0x40-0x9F	Format effector (single byte)	See Table B.41.
0xA0-0xFF	Format effector (with parameter[s])	–

[a)] When combined with page zero (ASCII and ISO Latin-1), covers Afrikaans, Breton, Basque, Catalan, Croatian, Czech, Danish, Dutch, Esperanto, Estonian, Faroese, Finnish, Flemish, Firsian, Greenlandic, Hungarian, Icelandic, Italian, Latin, Latvian, Lithuanian, Malay, Maltese, Norwegian, Polish, Portuguese, Provencal, Ghaeto-Romanic, Romanian, Romany, Slovak, Slovenian, Serbian, Spanish, Swedish, Turkish, and Welsh.

[b)] Also Persian, Urdu, Pashto, Sindhi, and Kurdish.

[c)] Devanagari script is used for writing Sanskrit and Hindi, as well as other languages of northern India (such as Marathi) and of Nepal (Nepali). In addition, at least two dozen other Indian languages use Devanagari script.

[d)] General punctuation, superscripts and subscripts, currency symbols, and other diacritics.

Table B.53 describes the format of the multilingual_text_string().

Table B.53 – Multilingual text string format

	Bits	Bytes	Format
multilingual_text_string(){			
For (i=0; i<N; i++) {			
Mode	8	(1)	uimsbf
if (mode < 0x3F) {			
eightbit_string_length	8	((1))	uimsbf
for (i=0; i<eightbit_string_length; I++) {			
eightbit_char	8	(((1)))	uimsbf
}			
} else if (mode==0x3F) {			
sixteenbit_string_length	8	((1))	uimsbf (even)
for (i=0; i<(sixteenbit_string_length); i+=2) {			
sixteenbit_char	16	(((2)))	uimsbf
}			
} else if (mode >= 0xA0) {			
format_effector_param_length	8	((1))	uimsbf
for (i=0; i<(format_effector_param_length); i++) {			
format_effector_data	8	(((1)))	
}			
}			
}			
}			

length: An 8-bit unsigned integer number representing the number of bytes in the segment to follow in this block.

segment: An array of bytes representing a character string formatted according to the mode byte.

B.8.1.1 Mode byte definition

The mode byte is used either to select an ISO/IEC 10646-1 code page from the BMP (exact mapping, or in the case of page zero, an extended mapping as defined herein), or to indicate that the text segment is coded in one of a number of standard double-byte formats. Table B.52 shows the encoding of the mode byte. Values in the zero to 0x33 range select ISO/IEC 10646-1 code pages.

Value 0x3F selects double-byte forms used with non-alphabetic script systems, where the segment consists of a sequence of 16-bit character codes according to the ISO/IEC 10646-1 standard. Byte ordering is high-order byte first (Motorola 680xx style), also known as *big-endian*.

B.8.1.2 Format effectors

Mode bytes in the 0x40 to 0xFF range are defined as format effectors. Table B.54 defines the encoding for currently defined single-byte values. Format effectors in the range 0x40 through 0x9F are self-contained, and do not have a length or data field following them. Format effectors in the range 0xA0 through 0xFF include a multi-byte parameter field. No multi-byte format effectors are currently defined.

Table B.54 – Format Effector Function Codes

Mode byte	Meaning
0x40-0x7F	Reserved
0x80	new line, left justify
0x81	new line, right justify
0x82	new line, center
0x83	italics ON
0x84	italics OFF
0x85	underline ON
0x86	underline OFF
0x87	bold ON
0x88	bold OFF
0x89-0x9F	Reserved

Line justification

Values 0x80, 0x81, and 0x82 signify the end of a line of displayed text. Value 0x80 indicates that the text is displayed left justified within an enclosing rectangular region (defined outside the scope of the text string). Value 0x81 indicates that the text is displayed right justified. Value 0x82 indicates that the text is centered on the line. The dimensions and location on the screen of the box into which text is placed is defined outside the scope of the text string itself.

Italics, underline, bold attributes

These format effectors toggle *italics*, underline, and **bold** display attributes. The italics, underline, and bold format effectors indicate the start or end of the associated formatting within a text string. Formatting extends through new lines. For example, to display three lines of bold text, only one instance of the *bold ON* format effector is required.

Processing of unknown or unsupported format effectors

Hosts must discard format effectors that are unknown, or known not to be supported within a specific Host model. If a parameter value carries an undefined value, that format effector is expected to be discarded.

B.8.1.3 Default attributes

Upon entry to a multilingual text string, all mode toggles (bold, underline, italics) shall be assumed "OFF".

B.8.1.4 Mode Zero

ISO/IEC 10646-1 page zero (U+0000 through U+00FF) includes ASCII in the lower half (U+0000 through U+007F), and Latin characters from ISO 8859-1, *Latin-1*, in U+0090 through U+00FF. This set of characters covers Danish, Dutch, Faroese, Finnish, French, German, Icelandic, Irish, Italian, Norwegian, Portuguese, Spanish and Swedish. Many other languages can be written with this set of letters, including Hawaiian, Indonesian/Malay, and Swahili.

Table B.55 shows encodings of page zero characters in the range 0x80 through 0x9F (these are undefined within ISO/IEC 10646-1).

Table B.55 – Encodings of columns 8 and 9 of mode zero latin character set

	8	9
0	<RESERVED>	<RESERVED>
1	<RESERVED>	<RESERVED>
2	<RESERVED>	<RESERVED>
3	<RESERVED>	<RESERVED>
4	<RESERVED>	<RESERVED>
5	<RESERVED>	<RESERVED>
6	<RESERVED>	<RESERVED>
7	<RESERVED>	<RESERVED>
8	<RESERVED>	U+2030 – <PER MILLE>
9	<RESERVED>	<RESERVED>
A	<RESERVED>	U+266A – <MUSICAL NOTE>
B	<RESERVED>	<RESERVED>
C	<RESERVED>	U+2190 – <LEFT ARROW>
D	<RESERVED>	U+2191 – <UP ARROW>
E	<RESERVED>	U+2192 – <RIGHT ARROW>
F	<RESERVED>	U+2193 – <DOWN ARROW>

B.8.1.5 Supported characters

Support for specific characters and languages depends upon the specific model of Standard-compatible Host. Not all Hosts support all defined character sets or character codes. Use of multilingual text must be predicated on the knowledge of limitations in character rendering inherent in different Host models for which text is available.

B.8.2 Multiple String Structure (MSS)

The Multiple String Structure is a general data structure used specifically for text strings. Text strings appear as event titles, long channel names, the ETT messages, and RRT text items. The bit stream syntax for the Multiple String Structure is shown in Table B.56.

Table B.56 – Multiple String Structure

Syntax	Bits	Format
multiple_string_structure () {		
number_strings	8	uimsbf
for (i= 0;i< number_strings;i++) {		
ISO_639_language_code	8*3	uimsbf
number_segments	8	uimsbf
for (j=0;j<number_segments;j++) {		
compression_type	8	uimsbf
Mode	8	uimsbf
number_bytes	8	uimsbf
for (k= 0;k<number_bytes;k++)		
compressed_string_byte [k]	8	bslbf
}		
}		
}		

number_strings: This 8-bit unsigned integer field identifies the number of strings in the following data.

ISO_639_language_code: This 3-byte (24 bits) field, in conformance with ISO 639-2/B, specifies the language used for the ith string.

number_segments: This 8-bit unsigned integer field identifies the number of segments in the following data. A specific mode is assigned for each segment.

compression_type: This 8-bit field identifies the compression type for the jth segment. Allowed values for this field are shown in Table B.57.

Table B.57 – Compression types

compression_type	Compression method
0x00	No compression
0x01	Huffman coding using standard encode/decode tables defined in Table C.4 and C.5 in Annex C of SCTE DVS 097, ATSC Standard A/65 (1997).
0x02	Huffman coding using standard encode/decode tables defined in Table C.6 and C.7 in Annex C of SCTE DVS 097, ATSC Standard A/65 (1997).
0x03 to 0xAF	Reserved
0xB0 to 0xFF	User private

mode: An 8-bit value representing the text mode to be used to interpret characters in the segment to follow. See Table B.58 for definition. Mode values in the range zero through 0x3E select 8-bit Unicode character code pages. Mode value 0x3F selects 16-bit Unicode character coding. Mode values 0x40 through 0xDF are reserved for future use by ATSC. Mode values 0xE0 through 0xFE are user private. Mode value 0xFF indicates the text mode is not applicable. Hosts shall ignore string bytes associated with unknown or unsupported mode values.

Table B.58 – Modes

Mode	Meaning	Language(s) or script
0x00	Select ISO/IEC 10646-1 Page 0x00	ASCII, ISO Latin-1 (Roman)[a)]
0x01	Select ISO/IEC 10646-1 Page 0x01	European Latin (many)[b)]
0x02	Select ISO/IEC 10646-1 Page 0x02	Standard Phonetic
0x03	Select ISO/IEC 10646-1 Page 0x03	
0x04	Select ISO/IEC 10646-1 Page 0x04	Russian, Slavic
0x05	Select ISO/IEC 10646-1 Page 0x05	Armenian, Hebrew
0x06	Select ISO/IEC 10646-1 Page 0x06	Arabic[c)]
0x07-0x08	Reserved	–
0x09	Select ISO/IEC 10646-1 Page 0x09	Devanagari[d)], Bengali
0x0A	Select ISO/IEC 10646-1 Page 0x0A	Punjabi, Gujarati
0x0B	Select ISO/IEC 10646-1 Page 0x0B	Oriya, Tamil
0x0C	Select ISO/IEC 10646-1 Page 0x0C	Telugu, Kannada
0x0D	Select ISO/IEC 10646-1 Page 0x0D	Malayalam
0x0E	Select ISO/IEC 10646-1 Page 0x0E	Thai, Lao
0x0F	Select ISO/IEC 10646-1 Page 0x0F	Tibetan
0x10	Select ISO/IEC 10646-1 Page 0x10	Georgian
0x11-0x1F	Reserved	–
0x20	Select ISO/IEC 10646-1 Page 0x20	Miscellaneous
0x21	Select ISO/IEC 10646-1 Page 0x21	Misc. symbols, arrows

Table B.58 – Modes

Mode	Meaning	Language(s) or script
0x22	Select ISO/IEC 10646-1 Page 0x22	Mathematical operators
0x23	Select ISO/IEC 10646-1 Page 0x23	Misc. technical
0x24	Select ISO/IEC 10646-1 Page 0x24	OCR, enclosed alpha-num.
0x25	Select ISO/IEC 10646-1 Page 0x25	Form and chart components
0x26	Select ISO/IEC 10646-1 Page 0x26	Miscellaneous dingbats
0x27	Select ISO/IEC 10646-1 Page 0x27	Zapf dingbats
0x28-0x2F	Reserved	–
0x30	Select ISO/IEC 10646-1 Page 0x30	Hiragana, Katakana
0x31	Select ISO/IEC 10646-1 Page 0x31	Bopomopho, Hangul elem.
0x32	Select ISO/IEC 10646-1 Page 0x32	Enclosed CJK Letters, ideo.
0x33	Select ISO/IEC 10646-1 Page 0x33	Enclosed CJK Letters, ideo.
0x34-0x3E	Reserved	–
0x3F	Select 16-bit ISO/IEC 10646-1 mode	All
0x40-0xDF	Reserved	
0xE0-0xFE	User private	
0xFF	Not applicable	

a) The languages supported by ASCII plus the Latin-1 supplement include Danish, Dutch, English, Faroese, Finnish, Flemish, German, Icelandic, Irish, Italian, Norwegian, Portuguese, Spanish and Swedish. Many other languages can be written with this set of characters, including Hawaiian, Indonesian, and Swahili.

b) When combined with page zero (ASCII and ISO Latin-1), covers Afrikaans, Breton, Basque, Catalan, Croatian, Czech, Esperanto, Estonian, French, Frisian, Greenlandic, Hungarian, Latin, Latvian, Lithuanian, Maltese, Polish, Provencal, Rhaeto-Romanic, Romanian, Romany, Sami, Slovak, Slovenian, Sorbian, Turkish, Welsh, and many others.

c) Also Persian, Urdu, Pashto, Sindhi, and Kurdish.

d) Devanagari script is used for writing Sanskrit and Hindi, as well as other languages of northern India (such as Marathi) and of Nepal (Nepali). In addition, at least two dozen other Indian languages use Devanagari script.

number_bytes: This 8-bit unsigned integer field identifies the number of bytes that follows.

compressed_string_byte[k]: The kth byte of the jth segment.

Annex C

Service Information for digital multi-programme System C

(This annex forms an integral part of this Recommendation.)

Summary

This annex describes the service information for digital broadcasting by cable television of Annex C of [ITU-T J.83] and basically constitutes a subset of Annex A to this Recommendation.

However, there are some specifications which are different from those of Annex A and also there are some specifications which are yet to be established.

C.1 SI tables

The specifications for SI tables are fully aligned with those in Annex A both in table names and in their function. See Table C.1.

Table C.1 – SI tables and their function

Table	Function
Program Association Table (PAT)	For each service in the multiplex, the PAT indicates the location (the PID values of the Transport Stream packets) of the corresponding Program Map Table (PMT). It also gives the location of the Network Information Table (NIT).
Conditional Access Table (CAT)	The CAT provides information on the Conditional Access (CA) systems used in the multiplex; the information is private (not defined within ITU-T H.222.0 | ISO/IEC 13818-1 and dependent on the CA system, but includes the location of the EMM stream, when applicable.
Program Map Table (PMT)	The PMT identifies and indicates the locations of the streams that make up each service, and the location of the Program Clock Reference fields for a service.
Network Information Table (NIT)	The location of the NIT is defined in ITU-T H.222.0 | ISO/IEC 13818-1, but the data format is outside the scope of ITU-T H.222.0 | ISO/IEC 13818-1. It is intended to provide information about the physical network. The syntax and semantics of the NIT are defined in this Recommendation.
Bouquet Association Table (BAT)	The BAT provides information regarding bouquets. As well as giving the name of the bouquet, it provides a list of services for each bouquet.
Service Description Table (SDT)	The SDT contains data describing the services in the system, e.g., names of services, the service provider, etc.
Network Information Table for Type Length Value (TLV-NIT)	It is intended to provide information about the physical network when the signal is transmitted by TLV packets streams. The syntax and semantics of the TLV-NIT are defined in this Recommendation.
Event Information Table (EIT)	The EIT contains data concerning events or programs such as event name, start time, duration, etc.; the use of different descriptors allows the transmission of different kinds of event information, e.g., for different service types.
Running Status Table (RST)	The RST gives the status of an event (running/not running). The RST updates this information and allows timely automatic switching to events.
Time and Date Table (TDT)	The TDT gives information relating to present time and date. This information is given in a separate table due to the frequent updating of the time information.
Stuffing Table (ST)	The ST is used to invalidate existing sections, for example at delivery system boundaries.

The PID allocation for SI and the allocation of table_id values are as shown in Tables C.2 and C.3, which are the same as those in Tables A.1 and A.2.

Table C.2 – PID allocation for SI

Table	PID value
PAT	0x0000
CAT	0x0001
NIT, ST	0x0010
SDT, BAT, ST	0x0011
EIT, ST	0x0012
RST, ST	0x0013
TDT	0x0014
NULL	0x1FFF

Table C.3 – Allocation of table_id values

Value	Table and description
0x00	PAT
0x01	CAT
0x02	PMT
0x40	NIT, network_information_section-actual_network or TLV-NIT, network_information_actual_network
0x41	NIT, network_information_section-other_network or TLV-NIT, network_information_other_network
0x42	SDT, service_description_section-actual_transport_stream
0x46	SDT, service_description_section-other_transport_stream
0x4A	BAT
0x4E	EIT, event_information_section-actual_transport_stream, present/following
0x4F	EIT, event_information_section-other_transport_stream, present/following
0x50 to 0x5F	EIT, event_information_section-actual_transport_stream, before 8th day EIT, event_information_section-actual_transport_stream, on or after 8th day
0x60 to 0x6F	EIT, event_information_section-other_transport_stream, before 8th day EIT, event_information_section-other_transport_stream, on or after 8th day
0x70	TDT, time_date_section
0x71	RST, running_status_section
0x72	ST, stuffing_section
0x82 to 0x85	Reserved for conditional access system
0x90 to 0xBF	Selectable as operator setting table_id

C.2 Descriptor

C.2.1 Location and tag value

The location and tag value of each descriptor are as shown in Table C.4. The description, data structure, and syntax of each descriptor are the same as those in Table A.12. However, the coding of the data field of each descriptor is not specified.

Table C.4 – Possible locations of descriptors

Descriptor	Tag value	NIT	BAT	SDT	EIT	PMT	CAT	TLV-NIT
CA_descriptor	0x09					*	*	
network_name_descriptor	0x40	*						
stuffing_descriptor	0x42	*	*	*	*			
cable_delivery_system_descriptor	0x44	*						
bouquet_name_descriptor	0x47		*	*				
service_descriptor	0x48			*				
linkage_descriptor	0x4A	*	*	*	*			
NVOD_reference_descriptor	0x4B			*				
time_shifted_service_descriptor	0x4C			*				
short_event_descriptor	0x4D				*			
extended_event_descriptor	0x4E				*			
time_shifted_event_descriptor	0x4F				*			
component_descriptor	0x50				*			
mosaic_descriptor	0x51			*		*		
stream_identifier_descriptor	0x52					*		
content_descriptor	0x54				*			
parental_rating_descriptor	*0x55*				*			
User-defined	0x80 to 0xBF							
channel_bonding_cable_delivery_system_descriptor	0xF3	*						*
Forbidden	0xFF							
area_specified_service_descriptor	0x96		*	*				
data_coding_method_descriptor	0xFD					*		
* Possible location								

Descriptors which are used in Japan but not specified in Annex A are detailed in the following clauses.

C.2.2 CA descriptor

The CA descriptor which is described in CAT and PMT identifies the type of conditional access and also identifies the PID in TS packet that carries the information related to conditional access. Conditional access is only available when this descriptor is used. See Table C.5.

Table C.5 – CA descriptor

Syntax	Bits	Identifier	Note
CA_descriptor(){			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
CA_system_id	16	uimsbf	
reserved	3	bslbf	"111"
CA_PID	13	uimsbf	
for (i = 0; i < N; i++) {			
private_data }	8xN	bslbf	
}			

C.2.3 Area specified service descriptor

This descriptor is used to render the services to the specified part within a given service area by transmitting either the area list of the service reception area or the one beyond the service reception area (see Table C.6). Area specified service is only available when this descriptor is used.

Table C.6 – Area specified service descriptor

Syntax	Bits	Identifier	Note
area_specified_service _descriptor(){			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
descriptor_flag	1	bslbf	(1: available, 0: not available)
reserved	7	bslbf	
for (i = 0; i < N; i++) { area_code	24	bslbf	Alphanumeric 3 characters
}			
}			

C.2.4 Data coding method descriptor

The data coding method descriptor which is described in PMT identifies the data coding method for data broadcasting services. See Table C.7.

Table C.7 – Data coding method descriptor

Syntax	Bits	Identifier	Note
data_coding_method_descriptor(){			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
data_component_id	16	uimsbf	
for (i = 0; i < N; i++) {			
additional_identification_information	8xN	bslbf	
}			
}			

C.2.5 Cable delivery system descriptor

This descriptor which is described in NIT identifies the physical conditions of the cable channel. See Table C.8.

Table C.8 – Cable delivery system descriptor

Syntax	No. of bits	Identifier
cable_delivery_system_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
Frequency	32	bslbf
reserved_future_use	8	bslbf
frame_type	**4**	**bslbf**
FEC_outer	4	bslbf
Modulation	8	bslbf
symbol_rate	28	bslbf
FEC_inner	4	bslbf
}		

Semantics for cable delivery system descriptor

frequency: The frequency is a 32-bit field giving the 4-bit BCD values specifying 8 characters of the frequency value. For the cable_delivery_system_descriptor, the frequency is coded in MHz, where the decimal occurs after the fourth character (e.g., 0312.0000 MHz).

frame_type: The frame_type is a 4-bit field specifying the frame type according to Table C.9. The frame type indicates the number of slots in the TSMF, N, and the maximum number of TSs or data streams with specific PID transmitted simultaneously, M if the TSMF is used. The values of N and M should be identical to those in [b-ITU-T J.183].

Table C.9 – Frame type

frame_type bit 3210	Description
0000	Reserved for future use
0001	(N, M) = (53, 15)[a)] TSMF is for both single channel and/or channel bonding functionality.
0010	(N, M) = (53, 15)[a)] Used for channel bonding functionality
0011 to 1110	Reserved for future use
1111	None – indicates that the waveform does not use TSMF
[a)] The frame type (N, M) is (53,15) for Annex C. It might be determined for other transmission systems.	

FEC_outer: The FEC_outer is a 4-bit field specifying the outer Forward Error Correction (FEC) scheme used according to Table C.10.

Table C.10 – Outer FEC scheme

FEC_outer bit 3210	Description
0000	Not defined
0001	No outer FEC coding
0010	RS(204/188)
0011 to 1111	Reserved for future use

modulation: This is an 8-bit field. It specifies the modulation scheme used on a cable delivery system according to Table C.11.

Table C.11 – Modulation scheme for cable

Modulation (hex)	Description
0x00	Not defined
0x01	16-QAM
0x02	32-QAM
0x03	64-QAM
0x04	128-QAM
0x05	256-QAM
0x06 to 0xFF	Reserved for future use

symbol_rate: The symbol_rate is a 28-bit field giving the 4-bit BCD values specifying 7 characters of the symbol_rate in Msymbol/s where the decimal point occurs after the third character (e.g., 027.4500).

FEC_inner: The FEC_inner is a 4-bit field specifying the inner FEC scheme used according to Table C.12.

Table C.12 – Inner FEC scheme

FEC_inner bit 3210	Description
0000	Not defined
0001	1/2 conv. code rate
0010	2/3 conv. code rate
0011	3/4 conv. code rate
0100	5/6 conv. code rate
0101	7/8 conv. code rate
1111	No conv. Coding
0110 to 1110	Reserved for future use

C.2.6 Channel bonding cable delivery system descriptor

This descriptor, which is described in NIT or TLV-NIT, is defined to identify the physical layer specification of multiple channels for demodulation and combining to restore the original stream. See Table C.13.

Table C.13 – Channel bonding cable delivery system descriptor

Syntax	No. of bits	Identifier
channel_bonding_cable_delivery_system_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for(i=0;i<N;i++){		
Frequency	32	bslbf
reserved_for_future_use	8	
frame_type	4	uimsbf
FEC_outer	4	bslbf
Modulation	8	bslbf
symbol_rate	28	bslbf
FEC_inner	4	bslbf
group_id	8	bslbf
}		
}		

The value of descriptor tag,'0xF3', is used as described in Table C.4

N: number of carriers

group_id: This is an 8-bit field. It specifies a unique identifier of a group corresponding to bonding channels.

Other semantics are the same as 'Cable delivery system descriptor' in clause C.2.5.

C.3 Character code tables

The tables corresponding to Annex A are currently under study.

Annex D

Coding of text characters for System A

(This annex forms an integral part of this Recommendation.)

Text items can optionally include information to select a wide range of character tables as indicated below.

For the European languages a set of five character tables are available. If no character selection information is given in a text item, then a default character set is assumed.

D.1 Control codes

The codes in the range 0x80 to 0x9F are assigned to control functions as shown in Table D.1.

Table D.1 – Single byte control codes

Control code	Description
0x80 to 0x85	Reserved for future use
0x86	Character emphasis on
0x87	Character emphasis off
0x88 to 0x89	Reserved for future use
0x8A	CR/LF
0x8B to 0x9F	User-defined

For two-byte character tables, the codes in the range 0xE080 to 0xE09F are assigned to control functions as shown in Table D.2.

Table D.2 – DVB codes within private use area of [ISO/IEC 10646-1]

Control code	Description
0xE080 to 0xE085	Reserved for future use
0xE086	Character emphasis on
0xE087	Character emphasis off
0xE088 to 0xE089	Reserved for future use
0xE08A	CR/LF
0xE08B to 0xE09F	Reserved for future use

D.2 Selection of character table

Text fields can optionally start with non-spacing, non-displayed data which specify the alternative character table to be used for the remainder of the text item. The selection of character table is indicated as follows:

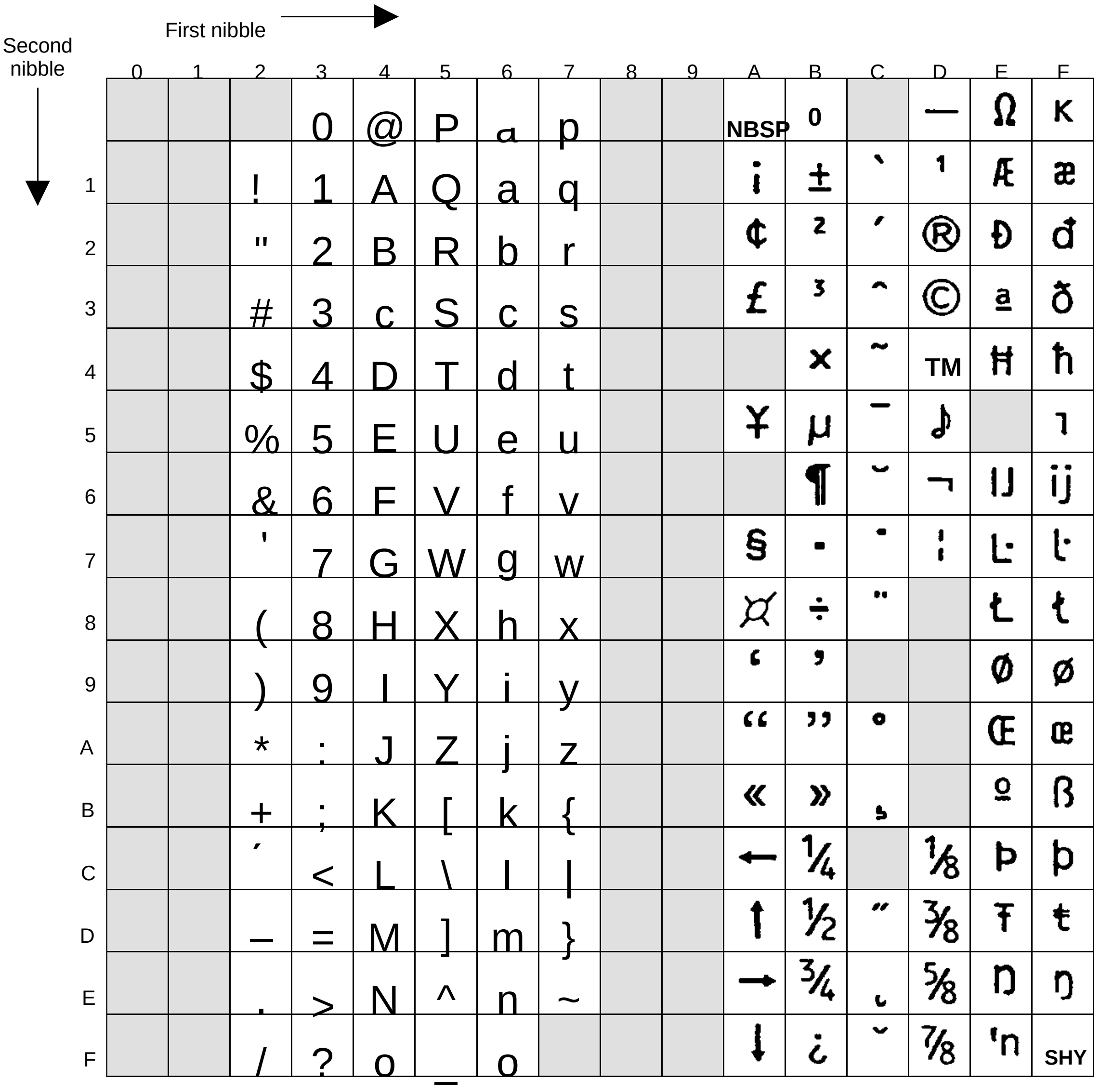
– if the first byte of the text field has a value in the range "0x20" to "0xFF", then this and all subsequent bytes in the text item are coded using the default character coding table (table 00 Latin alphabet) of Figure D.1;

– if the first byte of the text field has a value in the range "0x01" to "0x05", then the remaining bytes in the text item are coded in accordance with character coding tables 01 to 05 respectively, which are given in Figures D.2 to D.6 respectively;

– if the first byte of the text field has a value "0x10", then the following two bytes carry a 16-bit value (uimsbf) N to indicate that the remaining data of the text field is coded using the character code table specified by [ISO/IEC 8859], Parts 1 to 9;

– if the first byte of the text field has a value "0x11", then the remaining bytes in the text item are coded in pairs in accordance with the Basic Multilingual Plane of [ISO/IEC 10646-1].

Values for the first byte of "0x00", "0x06" to "0x0F", and "0x12" to "0x1F" are reserved for future use.



First nibble →

Second nibble ↓

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
				0	@	P	ɑ	p			NBSP	°		―	Ω	ĸ
1			!	1	A	Q	a	q			¡	±	`	¹	Æ	æ
2			"	2	B	R	b	r			¢	²	´	®	Đ	đ
3			#	3	C	S	c	s			£	³	ˆ	©	ª	ð
4			$	4	D	T	d	t				×	˜	™	Ħ	ħ
5			%	5	E	U	e	u			¥	µ	¯	♪		ı
6			&	6	F	V	f	v				¶	˘	¬	Ĳ	ĳ
7			'	7	G	W	g	w			§	·	˙	¦	Ŀ	ŀ
8			(	8	H	X	h	x			¤	÷	¨		Ł	ł
9			)	9	I	Y	i	y			‘	’			Ø	ø
A			*	:	J	Z	j	z			“	”	˚		Œ	œ
B			+	;	K	[	k	{			«	»	¸		º	ß
C			,	<	L	\	l	|			←	¼		⅛	Þ	þ
D			–	=	M	]	m	}			↑	½	˝	⅜	Ŧ	ŧ
E			.	>	N	^	n	~			→	¾	˛	⅝	Ŋ	ŋ
F			/	?	O	_	o				↓	¿	ˇ	⅞	ŉ	SHY

T0906080-98/d03

NOTE 1 – The SPACE character is located in position 20h of the code table.

NOTE 2 – NBSP = No-Break Space.

NOTE 3 – SHY = Soft Hyphen.

NOTE 4 – Table reproduced from ISO/IEC 6937 (1994).

NOTE 5 – All characters in column C are non-spacing characters (diacritical marks).

Figure D.1 – Character code table 00 – Latin alphabet

First nibble →

Second nibble ↓

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
			SP	0	@	P	a	p			NBSP	А	Р	а	р	№
1			!	1	A	Q	a	q			Ё	Б	С	б	с	ё
2			"	2	B	R	b	r			Ђ	В	Т	в	т	ђ
3			#	3	c	S	c	s			Ѓ	Г	У	г	у	ѓ
4			$	4	D	T	d	t			Є	Д	Ф	д	ф	є
5			%	5	E	U	e	u			Ѕ	Е	Х	е	х	ѕ
6			&	6	F	V	f	v			І	Ж	Ц	ж	ц	і
7			'	7	G	W	g	w			Ї	З	Ч	з	ч	ї
8			(	8	H	X	h	x			Ј	И	Ш	и	ш	ј
9			)	9	I	Y	i	y			Љ	Й	Щ	й	щ	љ
A			*	:	J	Z	j	z			Њ	К	Ъ	к	ъ	њ
B			+	;	K	[	k	{			Ћ	Л	Ы	л	ы	ћ
C			´	<	L	\	l	|			Ќ	М	Ь	м	ь	ќ
D			–	=	M	]	m	}			SHY	Н	Э	н	э	§
E			.	>	N	^	n	~			Ў	О	Ю	о	ю	ў
F			/	?	o	_	o				Џ	П	Я	п	я	џ

T0906090-98/d04

NOTE 1 – For the Ruthenian language, the characters in code positions Ah/5h (S) and Fh/5h (s) are replaced by Г and г, respectively.

NOTE 2 – Table reproduced from ISO/IEC 8859-5 (1988).

Figure D.2 – Character code table 01 – Latin/Cyrillic alphabet

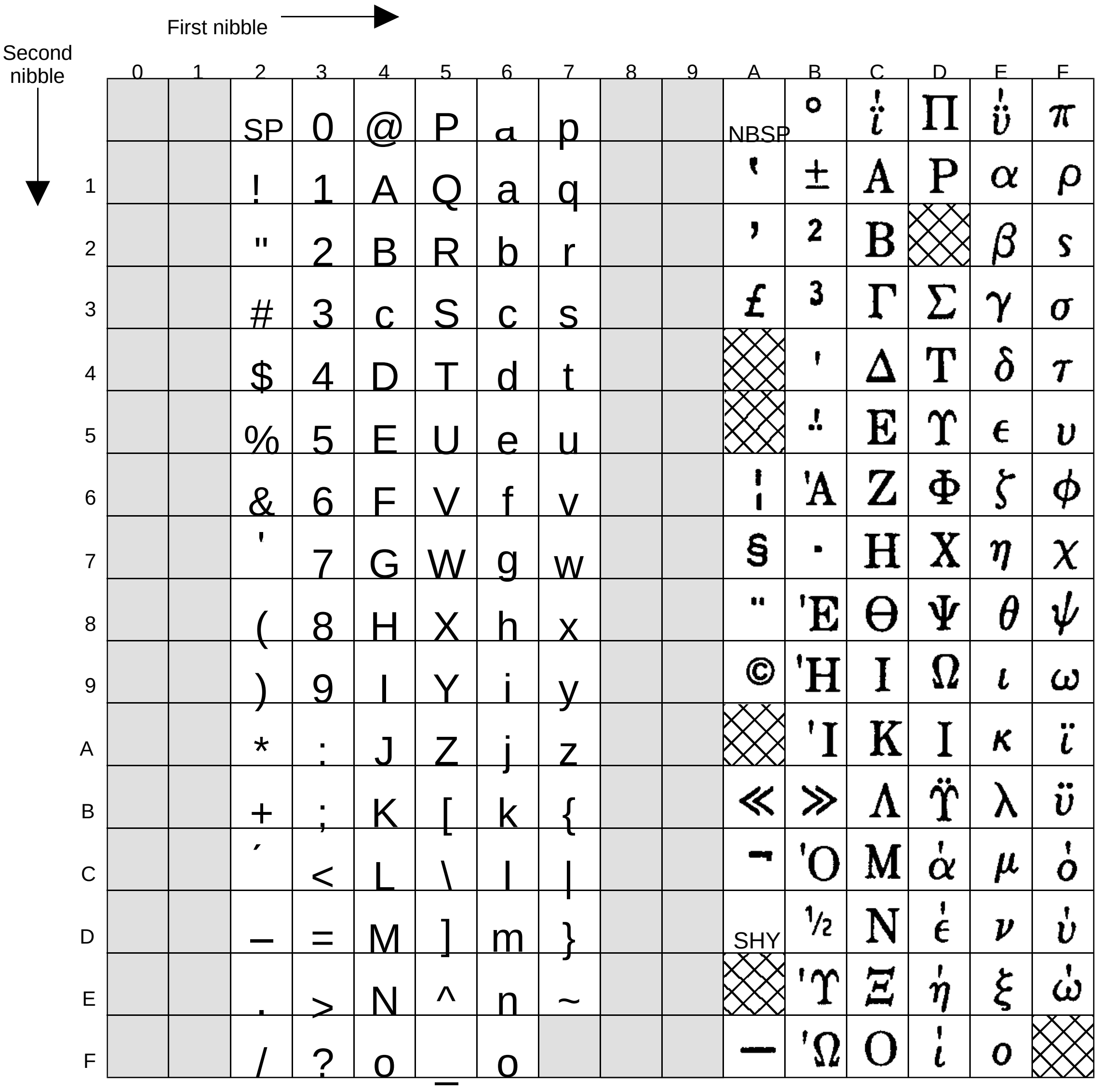
First nibble

Second nibble	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
			SP	0 ٠	@	P	ɑ	p			NBSP			ذ	—	ِ
1			!	1 ١	A	Q	a	q					ء	ر	ف	ّ
2			"	2 ٢	B	R	b	r					آ	ز	ق	ْ
3			#	3 ٣	c	S	c	s					أ	س	ك	
4			$	4 ٤	D	T	d	t			¤		ؤ	ش	ل	
5			%	5 ٥	E	U	e	u					إ	ص	م	
6			&	6 ٦	F	V	f	v					ئ	ض	ن	
7			'	7 ٧	G	W	g	w					ا	ط	ه	
8			(	8 ٨	H	X	h	x					ب	ظ	و	
9			)	9 ٩	I	Y	i	y					ة	ع	ى	
A			*	:	J	Z	j	z					ت	غ	ي	
B			+	;	K	[	k	{				؛	ث		ً	
C			´	<	L	\	l	|			،		ج		ٌ	
D			–	=	M	]	m	}			SHY		ح		ٍ	
E			.	>	N	^	n	~					خ		َ	
F			/	?	o	_	o					؟	د		ُ	

T0906100-98/d05

NOTE – Table reproduced from ISO 8859-6 (1987).

Figure D.3 – Character code table 02 – Latin/Arabic alphabet


First nibble
Second nibble

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
			SP	0	@	P	a	p			NBSP	°	ΐ	Π	ΰ	π
1			!	1	A	Q	a	q			ʽ	±	Α	Ρ	α	ρ
2			"	2	B	R	b	r			’	²	Β	▨	β	ς
3			#	3	c	S	c	s			£	³	Γ	Σ	γ	σ
4			$	4	D	T	d	t			▨	΄	Δ	Τ	δ	τ
5			%	5	E	U	e	u			▨	΅	Ε	Υ	ε	υ
6			&	6	F	V	f	v			¦	Ά	Ζ	Φ	ζ	φ
7			'	7	G	W	g	w			§	·	Η	Χ	η	χ
8			(	8	H	X	h	x			¨	Έ	Θ	Ψ	θ	ψ
9			)	9	I	Y	i	y			©	Ή	Ι	Ω	ι	ω
A			*	:	J	Z	j	z			▨	Ί	Κ	Ι	κ	ϊ
B			+	;	K	[	k	{			«	»	Λ	Ϋ	λ	ϋ
C			´	<	L	\	l	|			¬	Ό	Μ	ά	μ	ό
D			–	=	M	]	m	}			SHY	½	Ν	έ	ν	ύ
E			.	>	N	^	n	~			▨	Ύ	Ξ	ή	ξ	ώ
F			/	?	o	_	o				―	Ώ	Ο	ί	ο	▨

T0906110-98/d06

NOTE – Table reproduced from ISO 8859-7 (1987).

Figure D.4 – Character code table 03 – Latin/Greek alphabet

First nibble →

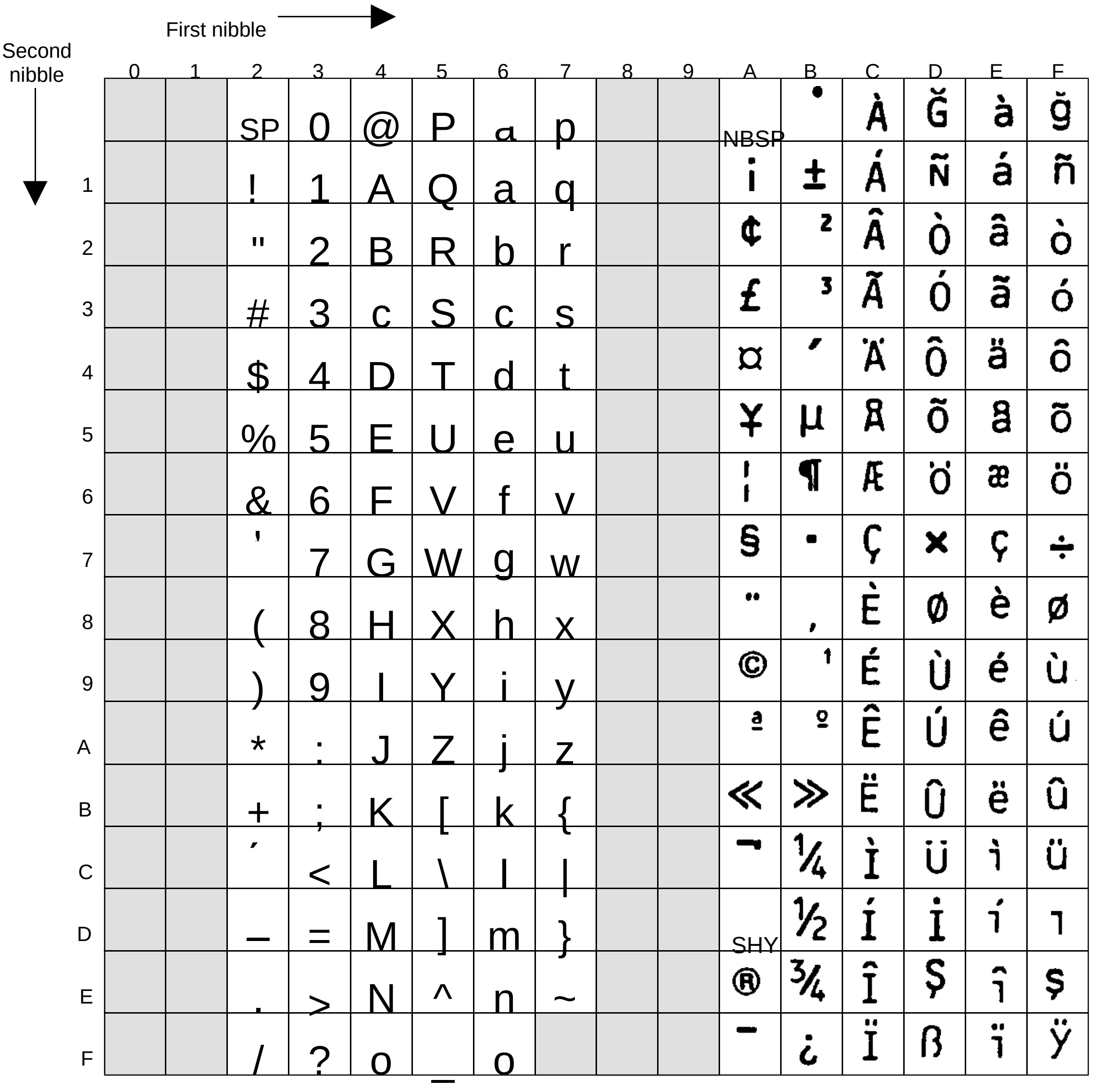
Second nibble ↓

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
			SP	0	@	P	ɑ	p			NBSP	°	▨	▨	א	נ
1			!	1	A	Q	a	q			▨	±	▨	▨	ב	ס
2			"	2	B	R	b	r			¢	²	▨	▨	ג	ע
3			#	3	c	S	c	s			£	³	▨	▨	ד	ף
4			$	4	D	T	d	t			¤	´	▨	▨	ה	פ
5			%	5	E	U	e	u			¥	µ	▨	▨	ו	ץ
6			&	6	F	V	f	v			¦	¶	▨	▨	ז	צ
7			'	7	G	W	g	w			§	·	▨	▨	ח	ק
8			(	8	H	X	h	x			¨	¸	▨	▨	ט	ר
9			)	9	I	Y	i	y			©	¹	▨	▨	י	ש
A			*	:	J	Z	j	z			×	÷	▨	▨	ך	ת
B			+	;	K	[	k	{			«	»	▨	▨	כ	▨
C			´	<	L	\	l	|			¬	¼	▨	▨	ל	▨
D			–	=	M	]	m	}			SHY	½	▨	▨	ם	▨
E			.	>	N	^	n	~			®	¾	▨	▨	מ	▨
F			/	?	o	_	o				‾	▨	▨	‗	ן	▨

T0906120-98/d07

NOTE – Table reproduced from ISO 8859-8 (1988)

Figure D.5 – Character code table 04 – Latin/Hebrew alphabet



First nibble →

Second nibble ↓

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
			SP	0	@	P	ɑ	p			NBSP	°	À	Ğ	à	ğ
1			!	1	A	Q	a	q			¡	±	Á	Ñ	á	ñ
2			"	2	B	R	b	r			¢	²	Â	Ò	â	ò
3			#	3	c	S	c	s			£	³	Ã	Ó	ã	ó
4			$	4	D	T	d	t			¤	´	Ä	Ô	ä	ô
5			%	5	E	U	e	u			¥	µ	Å	Õ	å	õ
6			&	6	F	V	f	v			¦	¶	Æ	Ö	æ	ö
7			'	7	G	W	g	w			§	·	Ç	×	ç	÷
8			(	8	H	X	h	x			¨	¸	È	Ø	è	ø
9			)	9	I	Y	i	y			©	¹	É	Ù	é	ù
A			*	:	J	Z	j	z			ª	º	Ê	Ú	ê	ú
B			+	;	K	[	k	{			«	»	Ë	Û	ë	û
C			´	<	L	\	l	|			¬	¼	Ì	Ü	ì	ü
D			–	=	M	]	m	}			SHY	½	Í	İ	í	ı
E			.	>	N	^	n	~			®	¾	Î	Ş	î	ş
F			/	?	o	_	o				¯	¿	Ï	ß	ï	ÿ

T0906130-98/d08

NOTE – Table reproduced from ISO/IEC 8859-9.

Figure D.6 – Character code table – Latin alphabet No 5

Annex E

CRC decoder model for system A

(This annex forms an integral part of this Recommendation.)

The 32-bit CRC decoder is specified in Figure E.1.

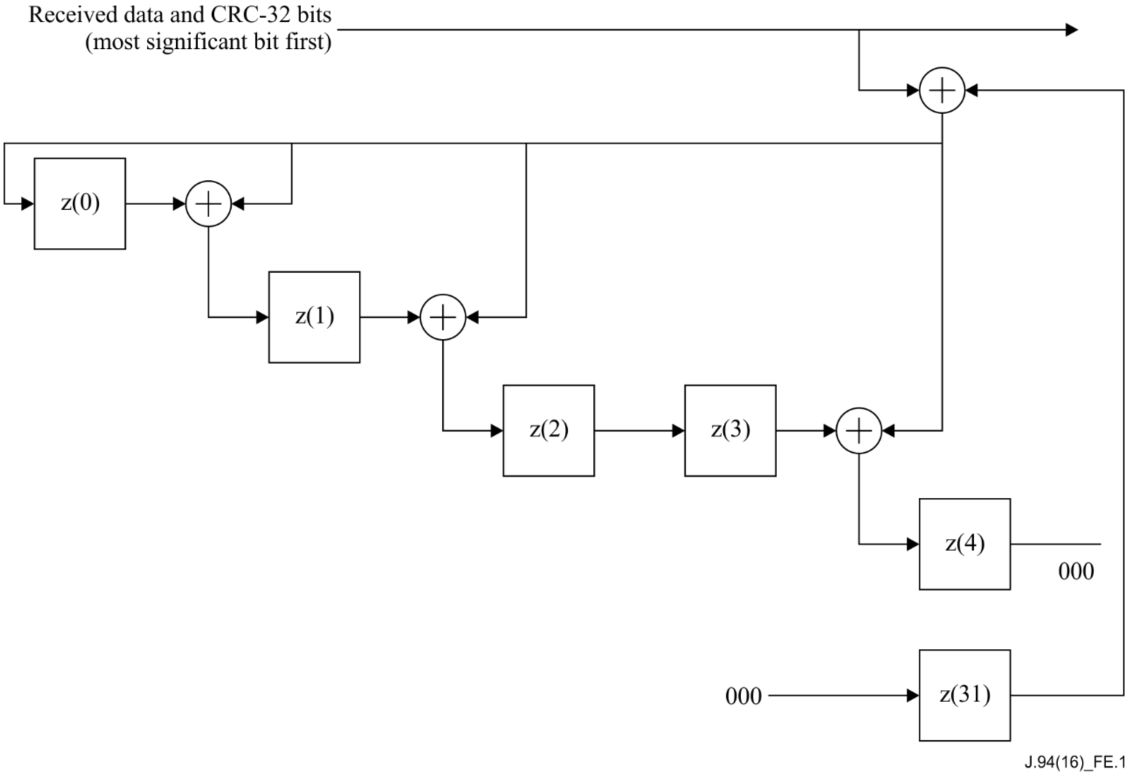


Figure E.1 – 32 bit CRC decoder model

The 32-bit CRC decoder operates at bit level and consists of 14 adders + and 32 delay elements z(i).

The input of the CRC decoder is added to the output of z(31), and the result is provided to the input z(0) and to one of the inputs of each remaining adder.

The other input of each remaining adder is the output of z(i), while the output of each remaining adder is connected to the input of z(I + 1), with i = 0, 1, 3, 4, 6, 7, 9, 10, 11, 15, 21, 22 and 25 (see Figure E.1).

This is the CRC calculated with the polynomial:

$$x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1$$

At the input of the CRC decoder bytes are received.

Each byte is shifted into the CRC decoder one bit at a time, with the most significant bit (msb) first, i.e., from byte 0x01 (the last byte of the startcode prefix), first the seven "0"s enter the CRC decoder, followed by the one "1".

Before the CRC processing of the data of a section the output of each delay element z(i) is set to its initial value "1". After this initialization, each byte of the section is provided to the input of the CRC decoder, including the four CRC_32 bytes.

After shifting the last bit of the last CRC_32 byte into the decoder, i.e., into z(0) after the addition with the output of z(31), the output of all delay elements z(i) is read. In case of no errors, each of the outputs of z(i) has to be zero.

At the CRC encoder the CRC_32 field is encoded with such value that this is ensured.

Annex F

Operational profiles for cable service information delivery for system B

(This annex forms an integral part of this Recommendation.)

F.1 Operational profiles

Annex F specifies Service Information tables that are required for delivery via an out-of-band channel on cable. Six profiles are described with required and optional data specified for out-of-band transport via cable. Adherence to these profile specifications is necessary for compliance with SCTE standard transport streams.

F.1.1 Profile 1 – Baseline

This Baseline Profile reflects a practice in cable where the Short-Form Virtual Channel Table, the Modulation Mode Subtable and the Carrier Definition Subtable are used for channel navigation.

F.1.2 Profile 2 – Revision detection

Profile 2 uses the same channel navigation mechanism as Profile 1 while adding a detection mechanism that facilitates revision handling of tables. The revision detection mechanism is applicable to the Network Information Table, Network Text Table, and S-VCT that are also used in Profile 1.

F.1.3 Profile 3 – Parental advisory

Profile 3 uses Profile 2 as the base and adds support for the Rating Region Table in order to be compliant with the FCC-mandated V-chip content advisory scheme. Since for the U.S. and its possessions, EIA-766 defines the contents of version 0 RRT, use of RRT is more applicable to outside of North America. The channel navigation mechanism is the same as in Profile 1.

F.1.4 Profile 4 – Standard electronic program guide data

Profile 4 uses Profile 3 as the base and further defines a standard format for delivery of Electronic Program Guide data by using the Aggregate Event Information Table and the Aggregate Extended Text Table. The Master Guide Table shall be supported to manage the AEITs, AETTs and other applicable tables from Profile 3. The same mechanism as in Profile 1 is used for channel navigation.

F.1.5 Profile 5 – Combination

Support for channel navigation based on L-VCT and MGT is added. Backward compatibility with systems operating within profiles 1 to 4 is maintained. Using Profile 5, a cable operator could have a mixture of devices requiring the S-VCT, NIT and NTT tables as well as ones requiring the long-form tables: i.e., L-VCT, MGT.

When using Profile 5, both the S-VCT and the L-VCT shall be present, and each shall describe all available services.

F.1.6 Profile 6 – PSIP Only

Profile 6 is based solely on long-form tables and is an extension of the terrestrial broadcasting mechanism. Channel navigation is based on the Long-form Virtual Channel Table. The AEIT and the optional AETT streams are used to provide EPG data.

F.2 Profile Definition Tables

In order to conform to this Service Information Annex F, a cable operator shall send a collection of tables that corresponds to one or more of the defined operational profiles defined in Tables F.1 and F.2.

Table F.1 – Usage of Table Sections in Various Profiles

		Profile 1	**Profile 2**	**Profile 3**	**Profile 4**	**Profile 5**	**Profile 6**
Table Section	Table ID	Baseline	Revision Detection	Parental Advisory	Standard EPG Data	Combi-nation	PSIP only (Note 1)
Network Information Table	0xC2						
Carrier Definition Subtable		M	M	M	M	M	–
Modulation Mode Subtable		M	M	M	M	M	–
Network Text Table	0xC3						
Source Name Subtable		O	O	O	M	M	–
Short-form Virtual Channel Table	0xC4						
Virtual Channel Map		M	M	M	M	M	–
Defined Channels Map		M	M	M	M	M	–
Inverse Channel Map		O	O	O	O	O	–
System Timetable	0xC5	M	M	M	M	M	M
Master Guide Table	0xC7	–	–	(Note 2)	M	M	M
Rating Region Table	0xCA	–	–	(Note 3)	(Note 3)	(Note 3)	(Note 3)
Long-form Virtual Channel Table	0xC9	–	–	–	–	M	M
Aggregate Event Information Table	0xD6	–	–	–	M	M	M
Aggregate Extended Text Table	0xD7	–	–	–	O	O	O

M Mandatory (shall be present)
O Optional (may or may not be present)
– Not applicable (shall not be present)

NOTE 1 – Exception: System Timetable (table ID 0xC5 is used here instead of table ID 0xCD defined in PSIP) and other modifications.

NOTE 2 – Mandatory for outside of North America to describe any transmitted RRT. For region 0x01 (US and possessions), delivery of an RRT is optional, because this table is standardized in EIA-766.

NOTE 3 – Exception: delivery of the RRT corresponding to region 0x01 (US and possessions) is optional, because this table is standardized in EIA-766.

Table F.2 – Usage of Descriptors in Various Profiles

		Profile 1	**Profile 2**	**Profile 3**	**Profile 4**	**Profile 5**	**Profile 6**
Descriptor (and associated table)	Tag	Baseline	Revision Detection	Parental Advisory	Standard EPG Data	Combi-nation	PSIP only (Note 1)
AC-3 audio (PMT, AEIT)	0x81	–	–	–	O	O	O
Caption service (PMT, AEIT)	0x86	–	–	–	O	O	O
Content advisory (PMT, AEIT)	0x87	–	–	(Note 2)	(Note 2)	(Note 2)	(Note 2)
Revision detection (NIT,NTT, S-VCT)	0x93	–	M	M	M	M	–
Two-part channel number (S-VCT)	0x94	–	–	–	O	O	–
Channel properties (S-CT)	0x95	–	–	–	O	O	–
Daylight savings time (STT)	0x96	–	–	O	M	M	M
Extended channel name (L-VCT)	0xA0	–	–	–	–	O	O
Time-shifted service (L-CT)	0xA2	–	–	–	–	O	O
Component name (PMT)	0xA3	–	–	–	O	O	O

M Mandatory (shall be present)

O Optional (may or may not be present)

– Not applicable (shall not be present)

NOTE 1 – Exception: System Timetable (table ID 0xC5 is used here instead of table ID 0xCD defined in PSIP) and other modifications.

NOTE 2 – The content_advisory_descriptor() shall be present in the AEIT and PMT for a given program when Content Advisory data is available for that program. It is not required for programs for which Content Advisory data is not available.

F.3 Operational considerations for the use of profiles (Informative)

1) If devices deployed in a particular cable system require the S-VCT in Profiles 1-5 for navigation, cable operator's use of P6 will cause operational problems.

2) If devices in use require L-VCT for navigation, cable operator's use of Profiles 1-4 will cause operational problems.

3) To provide EPG data, cable-ready devices operating on a cable system conforming to Profiles 1, 2 or 3 must use alternative protocols and methods which are beyond the scope of this Annex F.

Annex G

Packet rates for system B

(This annex forms an integral part of this Recommendation.)

G.1 Maximum cycle times

Table G.1 lists the maximum cycle time for Service Information table sections for out-of-band cable operation, when the indicated table is present.

Table G.1 – Maximum cycle time for the STT, MGT, S-VCT, L-VCT and RRT

Table Section	STT	MGT	S-VCT	L-VCT	RRT
Cycle time	1 min	500 msec	2 min	2 min	1 min

G.2 Maximum transmission rates

Table G.2 lists the maximum transmission rate for SI packet streams.

Table G.2 – Maximum rate for each packet stream

PID	SI_base PID	Any AEIT/AETT PID
Rate (bit/s)	150 000	150 000

G.3 Minimum transmission rates

Table G.3 lists the minimum transmission rate for SI packet streams. Minimum per-PID bit rates are required to ensure efficiency of recovery of EPG data covering the current time period (3 hours minimum) across the POD to Host interface, given the small number of PID values that can be used concurrently.

Table G.3 – Minimum rate for each packet stream

PID	AEIT-0,1/AETT-0,1 PID
Rate (bit/s)	10 000

Annex H

Standard Huffman tables for text compression for system B

(This annex forms an integral part of this Recommendation.)

Annex H describes the compression method adopted for the transmission of English-language text strings in PSIP. The method distinguishes two types of text strings: titles and program descriptions. For each of these types, Huffman tables are defined based on 1st-order conditional probabilities. Clause H.2 defines standard Huffman encode and decode tables optimized for English-language text such as that typically found in program titles. Clause H.3 defines Huffman encode and decode tables optimized for English-language text such as that typically found in program descriptions. Hosts supporting the English language are expected to support decoding of text using either of these two standard Huffman compression tables.

The encode tables provide necessary and sufficient information to build the Huffman trees that need to be implemented for decoding. The decode tables described in Tables H.5 and H.7 are a particular mapping of those trees into a numerical array suitable for storage. This array can be easily implemented and used with the decoding algorithm. However, the user is free to design its own decoding tables as long as they follow the Huffman trees and rules defined in this annex.

H.1 Character set definition

This compression method supports the full ISO/IEC 8859-1 (*Latin-1*) character set, although only characters in the ASCII range (character codes 1 to 127) can be compressed. The following characters in Table H.1 have special definitions:

Table H.1 – Characters with special definitions

Character	Value (Decimal)	Meaning
String Terminate (ASCII Null)	0	The *Terminate* character is used to terminate strings. The Terminate character is appended to the string in either compressed or uncompressed form. The first encoded character in a compressed string is encoded/decoded from the Terminate sub-tree. In other words, when encoding or decoding the first character in a compressed string, assume that the previous character was a Terminate character.
Order-1 Escape (ASCII ESC)	27	Used to escape from first-order context to uncompressed context. The character which follows the Escape character is uncompressed.

H.1.1 First Order Escape

The order-1 Huffman trees are *partial*, that is, codes are not defined for every possible character sequence. For example, the standard decode tables do not contain codes for the character sequence *qp*. When uncompressed text contains a character sequence which is not defined in the decode table, the order-1 escape character is used to escape back to the uncompressed context. Uncompressed symbols are coded as 8-bit ASCII (*Latin-1*). For example, the character sequence *qpa* would be coded with *compressed q*, *compressed ESC*, *uncompressed p*, *compressed a*.

First-order escape rules for compressed strings:

- Any character which follows a first-order escape character is an uncompressed (8-bit) character. (Any character which follows an uncompressed escape character is compressed).
- Characters (128 … 255) cannot be compressed.
- Any character which follows a character from the set (128 … 255) is uncompressed.

H.1.2 Decode table data structures

Decode tables have two sections:

– **Tree Root Offset List**: Provides the table offsets, in *bytes* from the start of the decode table, for the roots of the 128 first-order decode trees. The list is contained in bytes (0 … 255) of the decode table, and is defined by the first "for" loop in Table H.1.

– **Order-1 Decode Trees**: Each and every character in the range (0 … 127) has a corresponding first-order decode tree. For example, if the previous character was "s", then the decoder would use the "s" first-order decode tree (decode tree #115) to decode the next character (ASCII "s" equals 115 decimal). These 128 decode trees are delimited by the second "for" loop in Table H.2.

Decode tables have the following format:

Table H.2 – Decode Table Format

Syntax	Bits	Format
decode_table() {		
for (i==0; i<128; i++) {		
byte_offset_of_char_i_tree_root	16	uimsbf
}		
for (i==0; i<128; i++) {		
character_i_order_1_tree()	8*M	
}		
}		

Note that even though the ISO *Latin-1* character set supports up to 256 characters, only the first 128 characters may be represented in compressed form.

H.1.2.1 Tree root byte offsets

byte_offset_of_character_i_tree_root: A 16-bit unsigned integer specifying the location, in bytes from the beginning of the decode table, of the root for the ith character's order-1 tree.

H.1.2.2 Order-1 decode trees

Order-1 decode trees are binary trees. The roots of the decode trees are located at the table offsets specified in the tree root offset list. The left and right children of a given node are specified as *word* offsets from the root of the tree (a *word* is equivalent to two bytes).

Decode trees have the format as shown in Table H.3:

Table H.3 – Decode tree format

Syntax	Bits	Format
character_i_order_1_tree() {		
for (j==0; j<N; j++) {		
left_child_word_offset_or_char_leaf	8	uimsbf
right_child_word_offset_or_char_leaf	8	uimsbf
}		
}		

left_child_word_offset_or_character_leaf: An 8-bit unsigned integer number with the following interpretation: If the highest bit is cleared (i.e., bit 7 is zero), the number specifies the offset, in words, of the left child from the root of the order-1 decode tree; if the highest bit is set (bit 7 is one), the lower 7 bits give the code (e.g., in ASCII) for a leaf character.

right_child_word_offset_or_character_leaf: An 8-bit unsigned integer number with the following interpretation: If the highest bit is cleared (i.e., bit 7 is zero), the number specifies the offset, in words, of the right child from the root of the order-1 decode tree; if the highest bit is set (bit 7 is one), the lower 7 bits give the code (e.g., in ASCII) for a leaf character.

Each node (corresponding to one iteration of the for-loop) has a byte for the left child or character, and a byte for the right child or character.

Characters are *leaves* of the order-1 decode trees, and are differentiated from intermediate nodes by the byte's most significant bit. When the most significant bit is set, the byte is a character leaf. When the most significant bit is not set, the byte contains the tabular word offset of the child node.

H.2 Standard compression Type 1 Encode/Decode Tables

The following encode/decode tables (Tables H.4 and H.5) are optimized for English-language program title text. These tables correspond to multiple_string_structure() with compression_type value 0x01, and a mode equal to 0xFF.

Table H.4 – English-language Program Title Encode Table

```
Prior Symbol:  0 Symbol: 27  Code: 11001011
Prior Symbol:  0 Symbol: '$'  Code: 1100101011
Prior Symbol:  0 Symbol: '2'  Code: 011010010
Prior Symbol:  0 Symbol: '4'  Code: 1100101010
Prior Symbol:  0 Symbol: '7'  Code: 011010011
Prior Symbol:  0 Symbol: 'A'  Code: 0111
Prior Symbol:  0 Symbol: 'B'  Code: 1001
Prior Symbol:  0 Symbol: 'C'  Code: 1011
Prior Symbol:  0 Symbol: 'D'  Code: 11011
Prior Symbol:  0 Symbol: 'E'  Code: 10001
Prior Symbol:  0 Symbol: 'F'  Code: 11000
Prior Symbol:  0 Symbol: 'G'  Code: 11100
Prior Symbol:  0 Symbol: 'H'  Code: 11111
Prior Symbol:  0 Symbol: 'I'  Code: 10000
Prior Symbol:  0 Symbol: 'J'  Code: 01100
Prior Symbol:  0 Symbol: 'K'  Code: 1100110
Prior Symbol:  0 Symbol: 'L'  Code: 11101
Prior Symbol:  0 Symbol: 'M'  Code: 1010
Prior Symbol:  0 Symbol: 'N'  Code: 0011
Prior Symbol:  0 Symbol: 'O'  Code: 011011
Prior Symbol:  0 Symbol: 'P'  Code: 11110
Prior Symbol:  0 Symbol: 'Q'  Code: 01101000
Prior Symbol:  0 Symbol: 'R'  Code: 11010
Prior Symbol:  0 Symbol: 'S'  Code: 000
Prior Symbol:  0 Symbol: 'T'  Code: 010
Prior Symbol:  0 Symbol: 'U'  Code: 0110101
Prior Symbol:  0 Symbol: 'V'  Code: 1100111
Prior Symbol:  0 Symbol: 'W'  Code: 0010
Prior Symbol:  0 Symbol: 'Y'  Code: 1100100
Prior Symbol:  0 Symbol: 'Z'  Code: 110010100
Prior Symbol:  1 Symbol: 27  Code: 1
Prior Symbol:  2 Symbol: 27  Code: 1
Prior Symbol:  3 Symbol: 27  Code: 1
Prior Symbol:  4 Symbol: 27  Code: 1
Prior Symbol:  5 Symbol: 27  Code: 1
Prior Symbol:  6 Symbol: 27  Code: 1
Prior Symbol:  7 Symbol: 27  Code: 1
Prior Symbol:  8 Symbol: 27  Code: 1
Prior Symbol:  9 Symbol: 27  Code: 1
Prior Symbol: 10 Symbol: 27  Code: 1
Prior Symbol: 11 Symbol: 27  Code: 1
Prior Symbol: 12 Symbol: 27  Code: 1
Prior Symbol: 13 Symbol: 27  Code: 1
Prior Symbol: 14 Symbol: 27  Code: 1
Prior Symbol: 15 Symbol: 27  Code: 1
Prior Symbol: 16 Symbol: 27  Code: 1
Prior Symbol: 17 Symbol: 27  Code: 1
Prior Symbol: 18 Symbol: 27  Code: 1
Prior Symbol: 19 Symbol: 27  Code: 1
Prior Symbol: 20 Symbol: 27  Code: 1
Prior Symbol: 21 Symbol: 27  Code: 1
Prior Symbol: 22 Symbol: 27  Code: 1
Prior Symbol: 23 Symbol: 27  Code: 1
Prior Symbol: 24 Symbol: 27  Code: 1
Prior Symbol: 25 Symbol: 27  Code: 1
Prior Symbol: 26 Symbol: 27  Code: 1
Prior Symbol: 27 Symbol: 27  Code: 1
Prior Symbol: 28 Symbol: 27  Code: 1
Prior Symbol: 29 Symbol: 27  Code: 1
Prior Symbol: 30 Symbol: 27  Code: 1
Prior Symbol: 31 Symbol: 27  Code: 1
Prior Symbol: ' ' Symbol: 27  Code: 10010100
Prior Symbol: ' ' Symbol: '&'  Code: 010001
Prior Symbol: ' ' Symbol: '''  Code: 010000100
Prior Symbol: ' ' Symbol: '-'  Code: 00000001
Prior Symbol: ' ' Symbol: '1'  Code: 010000101
Prior Symbol: ' ' Symbol: '2'  Code: 00000010
Prior Symbol: ' ' Symbol: '3'  Code: 01000001
Prior Symbol: ' ' Symbol: '9'  Code: 000000000
Prior Symbol: ' ' Symbol: 'A'  Code: 10111
Prior Symbol: ' ' Symbol: 'B'  Code: 0010
Prior Symbol: ' ' Symbol: 'C'  Code: 1100
Prior Symbol: ' ' Symbol: 'D'  Code: 11100
Prior Symbol: ' ' Symbol: 'E'  Code: 011010
Prior Symbol: ' ' Symbol: 'F'  Code: 10011
Prior Symbol: ' ' Symbol: 'G'  Code: 00001
Prior Symbol: ' ' Symbol: 'H'  Code: 10101
Prior Symbol: ' ' Symbol: 'I'  Code: 111111
Prior Symbol: ' ' Symbol: 'J'  Code: 111110
Prior Symbol: ' ' Symbol: 'K'  Code: 010011
Prior Symbol: ' ' Symbol: 'L'  Code: 11110
Prior Symbol: ' ' Symbol: 'M'  Code: 0101
Prior Symbol: ' ' Symbol: 'N'  Code: 10110
Prior Symbol: ' ' Symbol: 'O'  Code: 011011
Prior Symbol: ' ' Symbol: 'P'  Code: 11101
Prior Symbol: ' ' Symbol: 'Q'  Code: 100100011
Prior Symbol: ' ' Symbol: 'R'  Code: 10100
Prior Symbol: ' ' Symbol: 'S'  Code: 1101
Prior Symbol: ' ' Symbol: 'T'  Code: 1000
Prior Symbol: ' ' Symbol: 'U'  Code: 1001001
Prior Symbol: ' ' Symbol: 'V'  Code: 1001011
Prior Symbol: ' ' Symbol: 'W'  Code: 0011
Prior Symbol: ' ' Symbol: 'X'  Code: 0000000010
Prior Symbol: ' ' Symbol: 'Y'  Code: 000001
Prior Symbol: ' ' Symbol: 'Z'  Code: 00000011
Prior Symbol: ' ' Symbol: 'a'  Code: 01100
Prior Symbol: ' ' Symbol: 'b'  Code: 10010101
Prior Symbol: ' ' Symbol: 'c'  Code: 01000000
Prior Symbol: ' ' Symbol: 'd'  Code: 01000011
Prior Symbol: ' ' Symbol: 'e'  Code: 0000000011
Prior Symbol: ' ' Symbol: 'f'  Code: 10010000
Prior Symbol: ' ' Symbol: 'i'  Code: 010010
Prior Symbol: ' ' Symbol: 'l'  Code: 100100010
Prior Symbol: ' ' Symbol: 'o'  Code: 0001
Prior Symbol: ' ' Symbol: 't'  Code: 0111
Prior Symbol: '!' Symbol:  0  Code: 1
Prior Symbol: '!' Symbol: 27  Code: 01
Prior Symbol: '!' Symbol: ' '  Code: 00
Prior Symbol: '"' Symbol: 27  Code: 1
Prior Symbol: '#' Symbol: 27  Code: 1
Prior Symbol: '$' Symbol: 27  Code: 1
Prior Symbol: '$' Symbol: '1'  Code: 0
Prior Symbol: '%' Symbol: 27  Code: 1
Prior Symbol: '&' Symbol: 27  Code: 0
Prior Symbol: '&' Symbol: ' '  Code: 1
Prior Symbol: ''' Symbol: 27  Code: 011
Prior Symbol: ''' Symbol: ' '  Code: 010
Prior Symbol: ''' Symbol: '9'  Code: 0001
Prior Symbol: ''' Symbol: 'd'  Code: 0000
Prior Symbol: ''' Symbol: 's'  Code: 1
Prior Symbol: ''' Symbol: 't'  Code: 001
Prior Symbol: '(' Symbol: 27  Code: 1
Prior Symbol: ')' Symbol: 27  Code: 1
Prior Symbol: '*' Symbol: 27  Code: 00
Prior Symbol: '*' Symbol: 'A'  Code: 01
Prior Symbol: '*' Symbol: 'H'  Code: 10
Prior Symbol: '*' Symbol: 'S'  Code: 11
Prior Symbol: '+' Symbol: 27  Code: 1
Prior Symbol: ',' Symbol: 27  Code: 0
Prior Symbol: ',' Symbol: ' '  Code: 1
Prior Symbol: '-' Symbol: 27  Code: 01
Prior Symbol: '-' Symbol: ' '  Code: 111
Prior Symbol: '-' Symbol: '-'  Code: 1101
Prior Symbol: '-' Symbol: '1'  Code: 1000
Prior Symbol: '-' Symbol: 'A'  Code: 001
Prior Symbol: '-' Symbol: 'M'  Code: 000
Prior Symbol: '-' Symbol: 'R'  Code: 1001
Prior Symbol: '-' Symbol: 'S'  Code: 1010
Prior Symbol: '-' Symbol: 'T'  Code: 1011
Prior Symbol: '-' Symbol: 'U'  Code: 1100
Prior Symbol: '.' Symbol:  0  Code: 111
Prior Symbol: '.' Symbol: 27  Code: 101
Prior Symbol: '.' Symbol: ' '  Code: 0
Prior Symbol: '.' Symbol: '.'  Code: 110
Prior Symbol: '.' Symbol: 'I'  Code: 10010
Prior Symbol: '.' Symbol: 'S'  Code: 1000
Prior Symbol: '.' Symbol: 'W'  Code: 10011
Prior Symbol: '/' Symbol: 27  Code: 1
Prior Symbol: '0' Symbol:  0  Code: 01
Prior Symbol: '0' Symbol: 27  Code: 001
Prior Symbol: '0' Symbol: ' '  Code: 10
Prior Symbol: '0' Symbol: '-'  Code: 000
Prior Symbol: '0' Symbol: '0'  Code: 11
Prior Symbol: '1' Symbol:  0  Code: 010
Prior Symbol: '1' Symbol: 27  Code: 011
Prior Symbol: '1' Symbol: ' '  Code: 110
Prior Symbol: '1' Symbol: '0'  Code: 111
Prior Symbol: '1' Symbol: '1'  Code: 100
Prior Symbol: '1' Symbol: '2'  Code: 101
Prior Symbol: '1' Symbol: '9'  Code: 00
Prior Symbol: '2' Symbol:  0  Code: 11
Prior Symbol: '2' Symbol: 27  Code: 10
Prior Symbol: '2' Symbol: '0'  Code: 01
Prior Symbol: '2' Symbol: '1'  Code: 000
Prior Symbol: '2' Symbol: ':'  Code: 001
Prior Symbol: '3' Symbol:  0  Code: 0
Prior Symbol: '3' Symbol: 27  Code: 11
Prior Symbol: '3' Symbol: '0'  Code: 10
Prior Symbol: '4' Symbol: 27  Code: 0
Prior Symbol: '4' Symbol: '8'  Code: 1
Prior Symbol: '5' Symbol: 27  Code: 1
Prior Symbol: '6' Symbol: 27  Code: 1
Prior Symbol: '7' Symbol: 27  Code: 0
Prior Symbol: '7' Symbol: '0'  Code: 1
Prior Symbol: '8' Symbol: 27  Code: 0
Prior Symbol: '8' Symbol: ' '  Code: 1
Prior Symbol: '9' Symbol: 27  Code: 11
Prior Symbol: '9' Symbol: '0'  Code: 01
Prior Symbol: '9' Symbol: '1'  Code: 100
Prior Symbol: '9' Symbol: '3'  Code: 101
Prior Symbol: '9' Symbol: '9'  Code: 00
Prior Symbol: ':' Symbol: 27  Code: 0
Prior Symbol: ':' Symbol: ' '  Code: 1
Prior Symbol: ';' Symbol: 27  Code: 1
Prior Symbol: '<' Symbol: 27  Code: 1
Prior Symbol: '=' Symbol: 27  Code: 1
Prior Symbol: '>' Symbol: 27  Code: 1
Prior Symbol: '?' Symbol:  0  Code: 1
Prior Symbol: '?' Symbol: 27  Code: 0
Prior Symbol: '@' Symbol: 27  Code: 1
Prior Symbol: 'A' Symbol: 27  Code: 00010
Prior Symbol: 'A' Symbol: ' '  Code: 010
Prior Symbol: 'A' Symbol: '*'  Code: 1101000
Prior Symbol: 'A' Symbol: '-'  Code: 1101001
Prior Symbol: 'A' Symbol: '.'  Code: 1101010
Prior Symbol: 'A' Symbol: 'B'  Code: 110110
Prior Symbol: 'A' Symbol: 'b'  Code: 110010
Prior Symbol: 'A' Symbol: 'c'  Code: 01100
Prior Symbol: 'A' Symbol: 'd'  Code: 001
Prior Symbol: 'A' Symbol: 'f'  Code: 01101
Prior Symbol: 'A' Symbol: 'g'  Code: 011110
Prior Symbol: 'A' Symbol: 'i'  Code: 110011
Prior Symbol: 'A' Symbol: 'l'  Code: 100
Prior Symbol: 'A' Symbol: 'm'  Code: 111
Prior Symbol: 'A' Symbol: 'n'  Code: 101
Prior Symbol: 'A' Symbol: 'p'  Code: 110111
Prior Symbol: 'A' Symbol: 'r'  Code: 0000
Prior Symbol: 'A' Symbol: 's'  Code: 00011
Prior Symbol: 'A' Symbol: 't'  Code: 011111
Prior Symbol: 'A' Symbol: 'u'  Code: 11000
Prior Symbol: 'A' Symbol: 'v'  Code: 1101011
Prior Symbol: 'A' Symbol: 'w'  Code: 01110
Prior Symbol: 'B' Symbol: 27  Code: 00010
Prior Symbol: 'B' Symbol: 'A'  Code: 000110
Prior Symbol: 'B' Symbol: 'C'  Code: 0000
Prior Symbol: 'B' Symbol: 'S'  Code: 000111
Prior Symbol: 'B' Symbol: 'a'  Code: 111
Prior Symbol: 'B' Symbol: 'e'  Code: 01
Prior Symbol: 'B' Symbol: 'i'  Code: 1010
Prior Symbol: 'B' Symbol: 'l'  Code: 1011
Prior Symbol: 'B' Symbol: 'o'  Code: 110
Prior Symbol: 'B' Symbol: 'r'  Code: 001
Prior Symbol: 'B' Symbol: 'u'  Code: 100
Prior Symbol: 'C' Symbol: 27  Code: 00101
Prior Symbol: 'C' Symbol: ' '  Code: 10110
Prior Symbol: 'C' Symbol: 'A'  Code: 0011100
Prior Symbol: 'C' Symbol: 'B'  Code: 001111
Prior Symbol: 'C' Symbol: 'O'  Code: 101110
Prior Symbol: 'C' Symbol: 'a'  Code: 100
Prior Symbol: 'C' Symbol: 'e'  Code: 101111
Prior Symbol: 'C' Symbol: 'h'  Code: 01
Prior Symbol: 'C' Symbol: 'i'  Code: 00110
Prior Symbol: 'C' Symbol: 'l'  Code: 000
Prior Symbol: 'C' Symbol: 'o'  Code: 11
Prior Symbol: 'C' Symbol: 'r'  Code: 1010
Prior Symbol: 'C' Symbol: 'u'  Code: 00100
Prior Symbol: 'C' Symbol: 'y'  Code: 0011101
Prior Symbol: 'D' Symbol: 27  Code: 01001
Prior Symbol: 'D' Symbol: 'a'  Code: 10
Prior Symbol: 'D' Symbol: 'e'  Code: 111
Prior Symbol: 'D' Symbol: 'i'  Code: 110
Prior Symbol: 'D' Symbol: 'o'  Code: 00
Prior Symbol: 'D' Symbol: 'r'  Code: 011
Prior Symbol: 'D' Symbol: 'u'  Code: 0101
Prior Symbol: 'D' Symbol: 'y'  Code: 01000
Prior Symbol: 'E' Symbol: 27  Code: 011
Prior Symbol: 'E' Symbol: 'C'  Code: 1010
Prior Symbol: 'E' Symbol: 'a'  Code: 111
Prior Symbol: 'E' Symbol: 'd'  Code: 000
Prior Symbol: 'E' Symbol: 'l'  Code: 1100
Prior Symbol: 'E' Symbol: 'm'  Code: 0100
Prior Symbol: 'E' Symbol: 'n'  Code: 1101
Prior Symbol: 'E' Symbol: 'q'  Code: 101110
Prior Symbol: 'E' Symbol: 's'  Code: 10110
Prior Symbol: 'E' Symbol: 'u'  Code: 101111
Prior Symbol: 'E' Symbol: 'v'  Code: 100
Prior Symbol: 'E' Symbol: 'x'  Code: 001
Prior Symbol: 'E' Symbol: 'y'  Code: 0101
Prior Symbol: 'F' Symbol: 27  Code: 011111
Prior Symbol: 'F' Symbol: ' '  Code: 011110
Prior Symbol: 'F' Symbol: 'L'  Code: 01110
Prior Symbol: 'F' Symbol: 'a'  Code: 10
Prior Symbol: 'F' Symbol: 'e'  Code: 0110
Prior Symbol: 'F' Symbol: 'i'  Code: 110
Prior Symbol: 'F' Symbol: 'l'  Code: 000
Prior Symbol: 'F' Symbol: 'o'  Code: 010
Prior Symbol: 'F' Symbol: 'r'  Code: 111
Prior Symbol: 'F' Symbol: 'u'  Code: 001
Prior Symbol: 'G' Symbol: 27  Code: 10110
Prior Symbol: 'G' Symbol: '.'  Code: 101010
Prior Symbol: 'G' Symbol: 'A'  Code: 101111
Prior Symbol: 'G' Symbol: 'a'  Code: 1110
Prior Symbol: 'G' Symbol: 'e'  Code: 110
Prior Symbol: 'G' Symbol: 'h'  Code: 10100
Prior Symbol: 'G' Symbol: 'i'  Code: 100
Prior Symbol: 'G' Symbol: 'l'  Code: 101011
Prior Symbol: 'G' Symbol: 'o'  Code: 01
Prior Symbol: 'G' Symbol: 'r'  Code: 00
Prior Symbol: 'G' Symbol: 'u'  Code: 1111
Prior Symbol: 'G' Symbol: 'y'  Code: 101110
Prior Symbol: 'H' Symbol:  0  Code: 111010
Prior Symbol: 'H' Symbol: 27  Code: 111011
Prior Symbol: 'H' Symbol: 'a'  Code: 110
Prior Symbol: 'H' Symbol: 'e'  Code: 10
Prior Symbol: 'H' Symbol: 'i'  Code: 1111
Prior Symbol: 'H' Symbol: 'o'  Code: 0
Prior Symbol: 'H' Symbol: 'u'  Code: 11100
Prior Symbol: 'I' Symbol:  0  Code: 1000
Prior Symbol: 'I' Symbol: 27  Code: 1001
Prior Symbol: 'I' Symbol: ' '  Code: 11110
Prior Symbol: 'I' Symbol: '.'  Code: 111110
Prior Symbol: 'I' Symbol: ':'  Code: 101110
Prior Symbol: 'I' Symbol: 'I'  Code: 1100
Prior Symbol: 'I' Symbol: 'T'  Code: 101111
Prior Symbol: 'I' Symbol: 'c'  Code: 10110
Prior Symbol: 'I' Symbol: 'm'  Code: 1010
Prior Symbol: 'I' Symbol: 'n'  Code: 0
Prior Symbol: 'I' Symbol: 'r'  Code: 111111
Prior Symbol: 'I' Symbol: 's'  Code: 1101
Prior Symbol: 'I' Symbol: 't'  Code: 1110
Prior Symbol: 'J' Symbol: 27  Code: 000
Prior Symbol: 'J' Symbol: 'a'  Code: 01
Prior Symbol: 'J' Symbol: 'e'  Code: 11
Prior Symbol: 'J' Symbol: 'o'  Code: 10
Prior Symbol: 'J' Symbol: 'u'  Code: 001
Prior Symbol: 'K' Symbol: 27  Code: 000
Prior Symbol: 'K' Symbol: 'a'  Code: 0100
Prior Symbol: 'K' Symbol: 'e'  Code: 001
Prior Symbol: 'K' Symbol: 'i'  Code: 1
Prior Symbol: 'K' Symbol: 'n'  Code: 0111
Prior Symbol: 'K' Symbol: 'o'  Code: 0101
Prior Symbol: 'K' Symbol: 'u'  Code: 0110
Prior Symbol: 'L' Symbol: 27  Code: 01001
Prior Symbol: 'L' Symbol: ' '  Code: 01000
Prior Symbol: 'L' Symbol: 'a'  Code: 10
Prior Symbol: 'L' Symbol: 'e'  Code: 011
Prior Symbol: 'L' Symbol: 'i'  Code: 11
Prior Symbol: 'L' Symbol: 'o'  Code: 00
Prior Symbol: 'L' Symbol: 'u'  Code: 0101
Prior Symbol: 'M' Symbol: 27  Code: 1011111
Prior Symbol: 'M' Symbol: '*'  Code: 10111100
Prior Symbol: 'M' Symbol: 'T'  Code: 10111101
Prior Symbol: 'M' Symbol: 'a'  Code: 11
Prior Symbol: 'M' Symbol: 'c'  Code: 101110
Prior Symbol: 'M' Symbol: 'e'  Code: 1010
Prior Symbol: 'M' Symbol: 'i'  Code: 100
Prior Symbol: 'M' Symbol: 'o'  Code: 00
Prior Symbol: 'M' Symbol: 'r'  Code: 10110
Prior Symbol: 'M' Symbol: 'u'  Code: 010
Prior Symbol: 'M' Symbol: 'y'  Code: 011
Prior Symbol: 'N' Symbol: 27  Code: 1000
Prior Symbol: 'N' Symbol: ' '  Code: 110001
Prior Symbol: 'N' Symbol: 'B'  Code: 1001
Prior Symbol: 'N' Symbol: 'F'  Code: 110010
Prior Symbol: 'N' Symbol: 'N'  Code: 110000
Prior Symbol: 'N' Symbol: 'a'  Code: 1101
Prior Symbol: 'N' Symbol: 'e'  Code: 0
Prior Symbol: 'N' Symbol: 'i'  Code: 111
Prior Symbol: 'N' Symbol: 'o'  Code: 101
Prior Symbol: 'N' Symbol: 'u'  Code: 110011
Prior Symbol: 'O' Symbol: 27  Code: 010
Prior Symbol: 'O' Symbol: ' '  Code: 001
Prior Symbol: 'O' Symbol: 'd'  Code: 01110
Prior Symbol: 'O' Symbol: 'f'  Code: 11010
Prior Symbol: 'O' Symbol: 'l'  Code: 1100
Prior Symbol: 'O' Symbol: 'n'  Code: 10
Prior Symbol: 'O' Symbol: 'p'  Code: 0001
Prior Symbol: 'O' Symbol: 'r'  Code: 0110
Prior Symbol: 'O' Symbol: 's'  Code: 01111
Prior Symbol: 'O' Symbol: 'u'  Code: 111
Prior Symbol: 'O' Symbol: 'v'  Code: 11011
Prior Symbol: 'O' Symbol: 'w'  Code: 0000
Prior Symbol: 'P' Symbol: 27  Code: 111111
Prior Symbol: 'P' Symbol: ' '  Code: 1111100
Prior Symbol: 'P' Symbol: '.'  Code: 011001
Prior Symbol: 'P' Symbol: 'G'  Code: 111101
Prior Symbol: 'P' Symbol: 'R'  Code: 111100
Prior Symbol: 'P' Symbol: 'a'  Code: 00
Prior Symbol: 'P' Symbol: 'e'  Code: 010
Prior Symbol: 'P' Symbol: 'i'  Code: 0111
Prior Symbol: 'P' Symbol: 'l'  Code: 1110
Prior Symbol: 'P' Symbol: 'o'  Code: 110
Prior Symbol: 'P' Symbol: 'r'  Code: 10
Prior Symbol: 'P' Symbol: 's'  Code: 1111101
Prior Symbol: 'P' Symbol: 'u'  Code: 01101
Prior Symbol: 'P' Symbol: 'y'  Code: 011000
Prior Symbol: 'Q' Symbol: 27  Code: 00
Prior Symbol: 'Q' Symbol: 'V'  Code: 01
Prior Symbol: 'Q' Symbol: 'u'  Code: 1
Prior Symbol: 'R' Symbol: 27  Code: 10001
Prior Symbol: 'R' Symbol: 'a'  Code: 101
Prior Symbol: 'R' Symbol: 'e'  Code: 11
Prior Symbol: 'R' Symbol: 'h'  Code: 10000
Prior Symbol: 'R' Symbol: 'i'  Code: 00
Prior Symbol: 'R' Symbol: 'o'  Code: 01
Prior Symbol: 'R' Symbol: 'u'  Code: 1001
Prior Symbol: 'S' Symbol: 27  Code: 101110
Prior Symbol: 'S' Symbol: ' '  Code: 1110100
Prior Symbol: 'S' Symbol: '*'  Code: 1011000
Prior Symbol: 'S' Symbol: '.'  Code: 1011011
Prior Symbol: 'S' Symbol: 'a'  Code: 1111
Prior Symbol: 'S' Symbol: 'c'  Code: 11100
Prior Symbol: 'S' Symbol: 'e'  Code: 000
Prior Symbol: 'S' Symbol: 'h'  Code: 100
Prior Symbol: 'S' Symbol: 'i'  Code: 1100
Prior Symbol: 'S' Symbol: 'k'  Code: 101111
Prior Symbol: 'S' Symbol: 'l'  Code: 1011001
Prior Symbol: 'S' Symbol: 'm'  Code: 1110110
Prior Symbol: 'S' Symbol: 'n'  Code: 1110111
Prior Symbol: 'S' Symbol: 'o'  Code: 1010
Prior Symbol: 'S' Symbol: 'p'  Code: 001
Prior Symbol: 'S' Symbol: 'q'  Code: 1011010
Prior Symbol: 'S' Symbol: 't'  Code: 01
Prior Symbol: 'S' Symbol: 'u'  Code: 1101
Prior Symbol: 'S' Symbol: 'w'  Code: 1110101
Prior Symbol: 'T' Symbol: 27  Code: 1111010
Prior Symbol: 'T' Symbol: '-'  Code: 11110110
Prior Symbol: 'T' Symbol: 'N'  Code: 11110111
Prior Symbol: 'T' Symbol: 'V'  Code: 111100
Prior Symbol: 'T' Symbol: 'a'  Code: 1010
Prior Symbol: 'T' Symbol: 'e'  Code: 1011
Prior Symbol: 'T' Symbol: 'h'  Code: 0
Prior Symbol: 'T' Symbol: 'i'  Code: 1110
Prior Symbol: 'T' Symbol: 'o'  Code: 110
Prior Symbol: 'T' Symbol: 'r'  Code: 100
Prior Symbol: 'T' Symbol: 'u'  Code: 111110
Prior Symbol: 'T' Symbol: 'w'  Code: 111111
Prior Symbol: 'U' Symbol: 27  Code: 101
Prior Symbol: 'U' Symbol: '.'  Code: 1001
Prior Symbol: 'U' Symbol: 'l'  Code: 1000
Prior Symbol: 'U' Symbol: 'n'  Code: 0
Prior Symbol: 'U' Symbol: 'p'  Code: 11
Prior Symbol: 'V' Symbol:  0  Code: 000
Prior Symbol: 'V' Symbol: 27  Code: 0011
Prior Symbol: 'V' Symbol: ' '  Code: 01010
Prior Symbol: 'V' Symbol: 'C'  Code: 01011
Prior Symbol: 'V' Symbol: 'a'  Code: 011
Prior Symbol: 'V' Symbol: 'e'  Code: 0100
Prior Symbol: 'V' Symbol: 'i'  Code: 1
Prior Symbol: 'V' Symbol: 'o'  Code: 0010
Prior Symbol: 'W' Symbol: 27  Code: 00011
Prior Symbol: 'W' Symbol: 'F'  Code: 000100
Prior Symbol: 'W' Symbol: 'W'  Code: 000101
Prior Symbol: 'W' Symbol: 'a'  Code: 111
Prior Symbol: 'W' Symbol: 'e'  Code: 110
Prior Symbol: 'W' Symbol: 'h'  Code: 001
Prior Symbol: 'W' Symbol: 'i'  Code: 01
Prior Symbol: 'W' Symbol: 'o'  Code: 10
Prior Symbol: 'W' Symbol: 'r'  Code: 0000
Prior Symbol: 'X' Symbol: 27  Code: 1
Prior Symbol: 'Y' Symbol: 27  Code: 001
Prior Symbol: 'Y' Symbol: 'a'  Code: 000
Prior Symbol: 'Y' Symbol: 'e'  Code: 01
Prior Symbol: 'Y' Symbol: 'o'  Code: 1
Prior Symbol: 'Z' Symbol: 27  Code: 00
Prior Symbol: 'Z' Symbol: 'a'  Code: 01
Prior Symbol: 'Z' Symbol: 'o'  Code: 1
Prior Symbol: '[' Symbol: 27  Code: 1
Prior Symbol: '\' Symbol: 27  Code: 1
Prior Symbol: ']' Symbol: 27  Code: 1
Prior Symbol: '^' Symbol: 27  Code: 1
Prior Symbol: '_' Symbol: 27  Code: 1
Prior Symbol: '`' Symbol: 27  Code: 1
Prior Symbol: 'a' Symbol:  0  Code: 00010
Prior Symbol: 'a' Symbol: 27  Code: 1111010110
Prior Symbol: 'a' Symbol: ' '  Code: 10110
Prior Symbol: 'a' Symbol: '''  Code: 11110100
Prior Symbol: 'a' Symbol: ':'  Code: 1111010111
Prior Symbol: 'a' Symbol: 'b'  Code: 010010
Prior Symbol: 'a' Symbol: 'c'  Code: 11111
Prior Symbol: 'a' Symbol: 'd'  Code: 10100
Prior Symbol: 'a' Symbol: 'e'  Code: 101011000
Prior Symbol: 'a' Symbol: 'f'  Code: 10101101
Prior Symbol: 'a' Symbol: 'g'  Code: 01000
Prior Symbol: 'a' Symbol: 'h'  Code: 0100111
Prior Symbol: 'a' Symbol: 'i'  Code: 10111
Prior Symbol: 'a' Symbol: 'j'  Code: 101011001
Prior Symbol: 'a' Symbol: 'k'  Code: 101010
Prior Symbol: 'a' Symbol: 'l'  Code: 001
Prior Symbol: 'a' Symbol: 'm'  Code: 0101
Prior Symbol: 'a' Symbol: 'n'  Code: 110
Prior Symbol: 'a' Symbol: 'p'  Code: 111100
Prior Symbol: 'a' Symbol: 'r'  Code: 100
Prior Symbol: 'a' Symbol: 's'  Code: 1110
Prior Symbol: 'a' Symbol: 't'  Code: 011
Prior Symbol: 'a' Symbol: 'u'  Code: 1111011
Prior Symbol: 'a' Symbol: 'v'  Code: 00011
Prior Symbol: 'a' Symbol: 'w'  Code: 1010111
Prior Symbol: 'a' Symbol: 'x'  Code: 111101010
Prior Symbol: 'a' Symbol: 'y'  Code: 0000
Prior Symbol: 'a' Symbol: 'z'  Code: 0100110
Prior Symbol: 'b' Symbol:  0  Code: 11111
Prior Symbol: 'b' Symbol: 27  Code: 111101
Prior Symbol: 'b' Symbol: ' '  Code: 0110
Prior Symbol: 'b' Symbol: 'a'  Code: 00
Prior Symbol: 'b' Symbol: 'b'  Code: 01111
Prior Symbol: 'b' Symbol: 'e'  Code: 1010
Prior Symbol: 'b' Symbol: 'i'  Code: 1110
Prior Symbol: 'b' Symbol: 'l'  Code: 010
Prior Symbol: 'b' Symbol: 'o'  Code: 110
Prior Symbol: 'b' Symbol: 'r'  Code: 1011
Prior Symbol: 'b' Symbol: 's'  Code: 111100
Prior Symbol: 'b' Symbol: 'u'  Code: 01110
Prior Symbol: 'b' Symbol: 'y'  Code: 100
Prior Symbol: 'c' Symbol:  0  Code: 010110
Prior Symbol: 'c' Symbol: 27  Code: 1000011
Prior Symbol: 'c' Symbol: ' '  Code: 0100
Prior Symbol: 'c' Symbol: 'C'  Code: 0010110
Prior Symbol: 'c' Symbol: 'G'  Code: 1000010
Prior Symbol: 'c' Symbol: 'L'  Code: 0010111
Prior Symbol: 'c' Symbol: 'a'  Code: 011
Prior Symbol: 'c' Symbol: 'c'  Code: 001010
Prior Symbol: 'c' Symbol: 'e'  Code: 111
Prior Symbol: 'c' Symbol: 'h'  Code: 101
Prior Symbol: 'c' Symbol: 'i'  Code: 0011
Prior Symbol: 'c' Symbol: 'k'  Code: 110
Prior Symbol: 'c' Symbol: 'l'  Code: 010111
Prior Symbol: 'c' Symbol: 'o'  Code: 1001
Prior Symbol: 'c' Symbol: 'r'  Code: 10001
Prior Symbol: 'c' Symbol: 's'  Code: 00100
Prior Symbol: 'c' Symbol: 't'  Code: 000
Prior Symbol: 'c' Symbol: 'u'  Code: 01010
Prior Symbol: 'c' Symbol: 'y'  Code: 100000
Prior Symbol: 'd' Symbol:  0  Code: 011
Prior Symbol: 'd' Symbol: 27  Code: 101110
Prior Symbol: 'd' Symbol: ' '  Code: 11
Prior Symbol: 'd' Symbol: '.'  Code: 101101110
Prior Symbol: 'd' Symbol: 'a'  Code: 1010
Prior Symbol: 'd' Symbol: 'd'  Code: 100000
Prior Symbol: 'd' Symbol: 'e'  Code: 00
Prior Symbol: 'd' Symbol: 'g'  Code: 100001
Prior Symbol: 'd' Symbol: 'i'  Code: 1001
Prior Symbol: 'd' Symbol: 'l'  Code: 1011010
Prior Symbol: 'd' Symbol: 'o'  Code: 101111
Prior Symbol: 'd' Symbol: 'r'  Code: 101100
Prior Symbol: 'd' Symbol: 's'  Code: 0101
Prior Symbol: 'd' Symbol: 'u'  Code: 101101111
Prior Symbol: 'd' Symbol: 'v'  Code: 10001
Prior Symbol: 'd' Symbol: 'w'  Code: 10110110
Prior Symbol: 'd' Symbol: 'y'  Code: 0100
Prior Symbol: 'e' Symbol:  0  Code: 001
Prior Symbol: 'e' Symbol: 27  Code: 1010111100
Prior Symbol: 'e' Symbol: ' '  Code: 01
Prior Symbol: 'e' Symbol: '!'  Code: 1010111101
Prior Symbol: 'e' Symbol: '"'  Code: 10101100
Prior Symbol: 'e' Symbol: '-'  Code: 1010111110
Prior Symbol: 'e' Symbol: ':'  Code: 00010010
Prior Symbol: 'e' Symbol: 'a'  Code: 1000
Prior Symbol: 'e' Symbol: 'b'  Code: 10101101
Prior Symbol: 'e' Symbol: 'c'  Code: 100111
Prior Symbol: 'e' Symbol: 'd'  Code: 00011
Prior Symbol: 'e' Symbol: 'e'  Code: 10100
Prior Symbol: 'e' Symbol: 'f'  Code: 1001100
Prior Symbol: 'e' Symbol: 'g'  Code: 1010100
Prior Symbol: 'e' Symbol: 'h'  Code: 1010111111
Prior Symbol: 'e' Symbol: 'i'  Code: 10101110
Prior Symbol: 'e' Symbol: 'j'  Code: 000100000
Prior Symbol: 'e' Symbol: 'k'  Code: 1010101
Prior Symbol: 'e' Symbol: 'l'  Code: 10010
Prior Symbol: 'e' Symbol: 'm'  Code: 1001101
Prior Symbol: 'e' Symbol: 'n'  Code: 1110
Prior Symbol: 'e' Symbol: 'o'  Code: 000101
Prior Symbol: 'e' Symbol: 'p'  Code: 000001
Prior Symbol: 'e' Symbol: 'q'  Code: 000100001
Prior Symbol: 'e' Symbol: 'r'  Code: 110
Prior Symbol: 'e' Symbol: 's'  Code: 1111
Prior Symbol: 'e' Symbol: 't'  Code: 10110
Prior Symbol: 'e' Symbol: 'u'  Code: 000100010
Prior Symbol: 'e' Symbol: 'v'  Code: 000000
Prior Symbol: 'e' Symbol: 'w'  Code: 10111
Prior Symbol: 'e' Symbol: 'x'  Code: 00010011
Prior Symbol: 'e' Symbol: 'y'  Code: 00001
Prior Symbol: 'e' Symbol: 'z'  Code: 000100011
Prior Symbol: 'f' Symbol:  0  Code: 11100
Prior Symbol: 'f' Symbol: 27  Code: 1111001
Prior Symbol: 'f' Symbol: ' '  Code: 0
Prior Symbol: 'f' Symbol: 'a'  Code: 11101
Prior Symbol: 'f' Symbol: 'e'  Code: 110
Prior Symbol: 'f' Symbol: 'f'  Code: 1011
Prior Symbol: 'f' Symbol: 'i'  Code: 1001
Prior Symbol: 'f' Symbol: 'l'  Code: 111101
Prior Symbol: 'f' Symbol: 'o'  Code: 1010
Prior Symbol: 'f' Symbol: 'r'  Code: 111111
Prior Symbol: 'f' Symbol: 's'  Code: 111110
Prior Symbol: 'f' Symbol: 't'  Code: 1000
Prior Symbol: 'f' Symbol: 'u'  Code: 1111000
Prior Symbol: 'g' Symbol:  0  Code: 110
Prior Symbol: 'g' Symbol: 27  Code: 1110000
Prior Symbol: 'g' Symbol: ' '  Code: 01
Prior Symbol: 'g' Symbol: '"'  Code: 1001100
Prior Symbol: 'g' Symbol: ':'  Code: 11100010
Prior Symbol: 'g' Symbol: 'a'  Code: 1000
Prior Symbol: 'g' Symbol: 'e'  Code: 101
Prior Symbol: 'g' Symbol: 'g'  Code: 1111010
Prior Symbol: 'g' Symbol: 'h'  Code: 00
Prior Symbol: 'g' Symbol: 'i'  Code: 11101
Prior Symbol: 'g' Symbol: 'l'  Code: 1111011
Prior Symbol: 'g' Symbol: 'n'  Code: 100111
Prior Symbol: 'g' Symbol: 'o'  Code: 111001
Prior Symbol: 'g' Symbol: 'r'  Code: 10010
Prior Symbol: 'g' Symbol: 's'  Code: 11111
Prior Symbol: 'g' Symbol: 't'  Code: 1001101
Prior Symbol: 'g' Symbol: 'u'  Code: 111100
Prior Symbol: 'g' Symbol: 'y'  Code: 11100011
Prior Symbol: 'h' Symbol:  0  Code: 11101
Prior Symbol: 'h' Symbol: 27  Code: 1110001
Prior Symbol: 'h' Symbol: ' '  Code: 1011
Prior Symbol: 'h' Symbol: 'a'  Code: 1100
Prior Symbol: 'h' Symbol: 'b'  Code: 11100110
Prior Symbol: 'h' Symbol: 'e'  Code: 0
Prior Symbol: 'h' Symbol: 'i'  Code: 100
Prior Symbol: 'h' Symbol: 'l'  Code: 1110010
Prior Symbol: 'h' Symbol: 'n'  Code: 101001
Prior Symbol: 'h' Symbol: 'o'  Code: 1101
Prior Symbol: 'h' Symbol: 'r'  Code: 10101
Prior Symbol: 'h' Symbol: 't'  Code: 1111
Prior Symbol: 'h' Symbol: 'u'  Code: 11100111
Prior Symbol: 'h' Symbol: 'w'  Code: 1110000
Prior Symbol: 'h' Symbol: 'y'  Code: 101000
Prior Symbol: 'i' Symbol:  0  Code: 00110101
Prior Symbol: 'i' Symbol: 27  Code: 00110110
Prior Symbol: 'i' Symbol: ' '  Code: 000100
Prior Symbol: 'i' Symbol: '!'  Code: 001101000
Prior Symbol: 'i' Symbol: 'a'  Code: 00011
Prior Symbol: 'i' Symbol: 'b'  Code: 0011000
Prior Symbol: 'i' Symbol: 'c'  Code: 1111
Prior Symbol: 'i' Symbol: 'd'  Code: 0010
Prior Symbol: 'i' Symbol: 'e'  Code: 1101
Prior Symbol: 'i' Symbol: 'f'  Code: 00111
Prior Symbol: 'i' Symbol: 'g'  Code: 1100
Prior Symbol: 'i' Symbol: 'i'  Code: 00110010
Prior Symbol: 'i' Symbol: 'k'  Code: 00110011
Prior Symbol: 'i' Symbol: 'l'  Code: 0110
Prior Symbol: 'i' Symbol: 'm'  Code: 11101
Prior Symbol: 'i' Symbol: 'n'  Code: 10
Prior Symbol: 'i' Symbol: 'o'  Code: 0100
Prior Symbol: 'i' Symbol: 'p'  Code: 000101
Prior Symbol: 'i' Symbol: 'r'  Code: 11100
Prior Symbol: 'i' Symbol: 's'  Code: 0111
Prior Symbol: 'i' Symbol: 't'  Code: 0101
Prior Symbol: 'i' Symbol: 'v'  Code: 0000
Prior Symbol: 'i' Symbol: 'x'  Code: 001101001
Prior Symbol: 'i' Symbol: 'z'  Code: 00110111
Prior Symbol: 'j' Symbol: 27  Code: 10
Prior Symbol: 'j' Symbol: 'a'  Code: 11
Prior Symbol: 'j' Symbol: 'o'  Code: 0
Prior Symbol: 'k' Symbol:  0  Code: 01
Prior Symbol: 'k' Symbol: 27  Code: 00011
Prior Symbol: 'k' Symbol: ' '  Code: 111
Prior Symbol: 'k' Symbol: ':'  Code: 00001
Prior Symbol: 'k' Symbol: 'T'  Code: 000000
Prior Symbol: 'k' Symbol: 'a'  Code: 001111
Prior Symbol: 'k' Symbol: 'e'  Code: 10
Prior Symbol: 'k' Symbol: 'f'  Code: 000100
Prior Symbol: 'k' Symbol: 'i'  Code: 110
Prior Symbol: 'k' Symbol: 'l'  Code: 000101
Prior Symbol: 'k' Symbol: 'o'  Code: 000001
Prior Symbol: 'k' Symbol: 's'  Code: 0010
Prior Symbol: 'k' Symbol: 'w'  Code: 001110
Prior Symbol: 'k' Symbol: 'y'  Code: 00110
Prior Symbol: 'l' Symbol:  0  Code: 1000
Prior Symbol: 'l' Symbol: 27  Code: 0111001
Prior Symbol: 'l' Symbol: ' '  Code: 010
Prior Symbol: 'l' Symbol: '''  Code: 01100010
Prior Symbol: 'l' Symbol: '-'  Code: 11110011
Prior Symbol: 'l' Symbol: ':'  Code: 01100011
Prior Symbol: 'l' Symbol: 'a'  Code: 1110
Prior Symbol: 'l' Symbol: 'b'  Code: 0110000
Prior Symbol: 'l' Symbol: 'c'  Code: 01110000
Prior Symbol: 'l' Symbol: 'd'  Code: 000
Prior Symbol: 'l' Symbol: 'e'  Code: 110
Prior Symbol: 'l' Symbol: 'f'  Code: 1111000
Prior Symbol: 'l' Symbol: 'i'  Code: 001
Prior Symbol: 'l' Symbol: 'k'  Code: 011001
Prior Symbol: 'l' Symbol: 'l'  Code: 101
Prior Symbol: 'l' Symbol: 'm'  Code: 1111010
Prior Symbol: 'l' Symbol: 'o'  Code: 11111
Prior Symbol: 'l' Symbol: 'r'  Code: 11110010
Prior Symbol: 'l' Symbol: 's'  Code: 01101
Prior Symbol: 'l' Symbol: 't'  Code: 011101
Prior Symbol: 'l' Symbol: 'u'  Code: 01111
Prior Symbol: 'l' Symbol: 'v'  Code: 1111011
Prior Symbol: 'l' Symbol: 'w'  Code: 01110001
Prior Symbol: 'l' Symbol: 'y'  Code: 1001
Prior Symbol: 'm' Symbol:  0  Code: 0100
Prior Symbol: 'm' Symbol: 27  Code: 010101
Prior Symbol: 'm' Symbol: ' '  Code: 001
Prior Symbol: 'm' Symbol: 'a'  Code: 101
Prior Symbol: 'm' Symbol: 'b'  Code: 0000
Prior Symbol: 'm' Symbol: 'e'  Code: 11
Prior Symbol: 'm' Symbol: 'i'  Code: 011
Prior Symbol: 'm' Symbol: 'm'  Code: 0001
Prior Symbol: 'm' Symbol: 'o'  Code: 1001
Prior Symbol: 'm' Symbol: 'p'  Code: 1000
Prior Symbol: 'm' Symbol: 's'  Code: 010111
Prior Symbol: 'm' Symbol: 'u'  Code: 010110
Prior Symbol: 'm' Symbol: 'y'  Code: 010100
Prior Symbol: 'n' Symbol:  0  Code: 000
Prior Symbol: 'n' Symbol: 27  Code: 01110011
Prior Symbol: 'n' Symbol: ' '  Code: 110
Prior Symbol: 'n' Symbol: '"'  Code: 011101
Prior Symbol: 'n' Symbol: ':'  Code: 1001010
Prior Symbol: 'n' Symbol: 'a'  Code: 11100
Prior Symbol: 'n' Symbol: 'b'  Code: 111010000
Prior Symbol: 'n' Symbol: 'c'  Code: 01111
Prior Symbol: 'n' Symbol: 'd'  Code: 001
Prior Symbol: 'n' Symbol: 'e'  Code: 010
Prior Symbol: 'n' Symbol: 'f'  Code: 1001011
Prior Symbol: 'n' Symbol: 'g'  Code: 101
Prior Symbol: 'n' Symbol: 'h'  Code: 111010101
Prior Symbol: 'n' Symbol: 'i'  Code: 1000
Prior Symbol: 'n' Symbol: 'j'  Code: 111010001
Prior Symbol: 'n' Symbol: 'k'  Code: 1110110
Prior Symbol: 'n' Symbol: 'l'  Code: 111010110
Prior Symbol: 'n' Symbol: 'm'  Code: 111010111
Prior Symbol: 'n' Symbol: 'n'  Code: 10011
Prior Symbol: 'n' Symbol: 'o'  Code: 1110111
Prior Symbol: 'n' Symbol: 'r'  Code: 111010100
Prior Symbol: 'n' Symbol: 's'  Code: 0110
Prior Symbol: 'n' Symbol: 't'  Code: 1111
Prior Symbol: 'n' Symbol: 'u'  Code: 11101001
Prior Symbol: 'n' Symbol: 'v'  Code: 0111000
Prior Symbol: 'n' Symbol: 'y'  Code: 100100
Prior Symbol: 'n' Symbol: 'z'  Code: 01110010
Prior Symbol: 'o' Symbol:  0  Code: 00101
Prior Symbol: 'o' Symbol: 27  Code: 01110001
Prior Symbol: 'o' Symbol: ' '  Code: 0101
Prior Symbol: 'o' Symbol: '"'  Code: 01110000
Prior Symbol: 'o' Symbol: '.'  Code: 0111011010
Prior Symbol: 'o' Symbol: '?'  Code: 011101100
Prior Symbol: 'o' Symbol: 'a'  Code: 1100010
Prior Symbol: 'o' Symbol: 'b'  Code: 001001
Prior Symbol: 'o' Symbol: 'c'  Code: 110000
Prior Symbol: 'o' Symbol: 'd'  Code: 01111
Prior Symbol: 'o' Symbol: 'e'  Code: 0111001
Prior Symbol: 'o' Symbol: 'f'  Code: 1001
Prior Symbol: 'o' Symbol: 'g'  Code: 00010
Prior Symbol: 'o' Symbol: 'h'  Code: 0111010
Prior Symbol: 'o' Symbol: 'i'  Code: 01110111
Prior Symbol: 'o' Symbol: 'k'  Code: 1100011
Prior Symbol: 'o' Symbol: 'l'  Code: 0100
Prior Symbol: 'o' Symbol: 'm'  Code: 1000
Prior Symbol: 'o' Symbol: 'n'  Code: 111
Prior Symbol: 'o' Symbol: 'o'  Code: 0011
Prior Symbol: 'o' Symbol: 'p'  Code: 01101
Prior Symbol: 'o' Symbol: 'r'  Code: 101
Prior Symbol: 'o' Symbol: 's'  Code: 11001
Prior Symbol: 'o' Symbol: 't'  Code: 00011
Prior Symbol: 'o' Symbol: 'u'  Code: 1101
Prior Symbol: 'o' Symbol: 'v'  Code: 01100
Prior Symbol: 'o' Symbol: 'w'  Code: 0000
Prior Symbol: 'o' Symbol: 'x'  Code: 0010000
Prior Symbol: 'o' Symbol: 'y'  Code: 0010001
Prior Symbol: 'o' Symbol: 'z'  Code: 0111011011
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Prior Symbol: 'p' Symbol: 27  Code: 101110
Prior Symbol: 'p' Symbol: ' '  Code: 010
Prior Symbol: 'p' Symbol: '"'  Code: 1100101
Prior Symbol: 'p' Symbol: 'a'  Code: 1001
Prior Symbol: 'p' Symbol: 'd'  Code: 101111
Prior Symbol: 'p' Symbol: 'e'  Code: 111
Prior Symbol: 'p' Symbol: 'h'  Code: 11000
Prior Symbol: 'p' Symbol: 'i'  Code: 1010
Prior Symbol: 'p' Symbol: 'l'  Code: 0110
Prior Symbol: 'p' Symbol: 'm'  Code: 1100100
Prior Symbol: 'p' Symbol: 'o'  Code: 00
Prior Symbol: 'p' Symbol: 'p'  Code: 0111
Prior Symbol: 'p' Symbol: 'r'  Code: 10001
Prior Symbol: 'p' Symbol: 's'  Code: 10000
Prior Symbol: 'p' Symbol: 't'  Code: 10110
Prior Symbol: 'p' Symbol: 'y'  Code: 110011
Prior Symbol: 'q' Symbol: 27  Code: 0
Prior Symbol: 'q' Symbol: 'u'  Code: 1
Prior Symbol: 'r' Symbol:  0  Code: 1001
Prior Symbol: 'r' Symbol: 27  Code: 01100101
Prior Symbol: 'r' Symbol: ' '  Code: 1111
Prior Symbol: 'r' Symbol: '"'  Code: 0110011
Prior Symbol: 'r' Symbol: ','  Code: 110011101
Prior Symbol: 'r' Symbol: '.'  Code: 0111100
Prior Symbol: 'r' Symbol: ':'  Code: 110011100
Prior Symbol: 'r' Symbol: 'a'  Code: 000
Prior Symbol: 'r' Symbol: 'b'  Code: 01111101
Prior Symbol: 'r' Symbol: 'c'  Code: 0111111
Prior Symbol: 'r' Symbol: 'd'  Code: 11000
Prior Symbol: 'r' Symbol: 'e'  Code: 101
Prior Symbol: 'r' Symbol: 'f'  Code: 11001111
Prior Symbol: 'r' Symbol: 'g'  Code: 0111101
Prior Symbol: 'r' Symbol: 'i'  Code: 010
Prior Symbol: 'r' Symbol: 'k'  Code: 110010
Prior Symbol: 'r' Symbol: 'l'  Code: 0011
Prior Symbol: 'r' Symbol: 'm'  Code: 011000
Prior Symbol: 'r' Symbol: 'n'  Code: 01101
Prior Symbol: 'r' Symbol: 'o'  Code: 1101
Prior Symbol: 'r' Symbol: 'p'  Code: 01111100
Prior Symbol: 'r' Symbol: 'r'  Code: 01110
Prior Symbol: 'r' Symbol: 's'  Code: 1110
Prior Symbol: 'r' Symbol: 't'  Code: 1000
Prior Symbol: 'r' Symbol: 'u'  Code: 1100110
Prior Symbol: 'r' Symbol: 'v'  Code: 01100100
Prior Symbol: 'r' Symbol: 'y'  Code: 0010
Prior Symbol: 's' Symbol:  0  Code: 11
Prior Symbol: 's' Symbol: 27  Code: 0010011
Prior Symbol: 's' Symbol: ' '  Code: 01
Prior Symbol: 's' Symbol: '''  Code: 001011010
Prior Symbol: 's' Symbol: ','  Code: 001011011
Prior Symbol: 's' Symbol: '.'  Code: 00100101
Prior Symbol: 's' Symbol: ':'  Code: 0000001
Prior Symbol: 's' Symbol: '?'  Code: 001011100
Prior Symbol: 's' Symbol: 'C'  Code: 001011101
Prior Symbol: 's' Symbol: 'H'  Code: 001011110
Prior Symbol: 's' Symbol: 'a'  Code: 101010
Prior Symbol: 's' Symbol: 'c'  Code: 101011
Prior Symbol: 's' Symbol: 'd'  Code: 001011111
Prior Symbol: 's' Symbol: 'e'  Code: 1011
Prior Symbol: 's' Symbol: 'f'  Code: 00000000
Prior Symbol: 's' Symbol: 'h'  Code: 00001
Prior Symbol: 's' Symbol: 'i'  Code: 0011
Prior Symbol: 's' Symbol: 'k'  Code: 000001
Prior Symbol: 's' Symbol: 'l'  Code: 00101010
Prior Symbol: 's' Symbol: 'm'  Code: 00000001
Prior Symbol: 's' Symbol: 'n'  Code: 00101011
Prior Symbol: 's' Symbol: 'o'  Code: 10100
Prior Symbol: 's' Symbol: 'p'  Code: 001000
Prior Symbol: 's' Symbol: 'r'  Code: 00100100
Prior Symbol: 's' Symbol: 's'  Code: 0001
Prior Symbol: 's' Symbol: 't'  Code: 100
Prior Symbol: 's' Symbol: 'u'  Code: 0010100
Prior Symbol: 's' Symbol: 'y'  Code: 00101100
Prior Symbol: 't' Symbol:  0  Code: 010
Prior Symbol: 't' Symbol: 27  Code: 11000010
Prior Symbol: 't' Symbol: ' '  Code: 101
Prior Symbol: 't' Symbol: '''  Code: 11000011
Prior Symbol: 't' Symbol: ':'  Code: 110110000
Prior Symbol: 't' Symbol: '?'  Code: 110110001
Prior Symbol: 't' Symbol: 'a'  Code: 0000
Prior Symbol: 't' Symbol: 'b'  Code: 100000
Prior Symbol: 't' Symbol: 'c'  Code: 1101101
Prior Symbol: 't' Symbol: 'd'  Code: 11000000
Prior Symbol: 't' Symbol: 'e'  Code: 011
Prior Symbol: 't' Symbol: 'h'  Code: 111
Prior Symbol: 't' Symbol: 'i'  Code: 001
Prior Symbol: 't' Symbol: 'l'  Code: 10001
Prior Symbol: 't' Symbol: 'm'  Code: 100001
Prior Symbol: 't' Symbol: 'n'  Code: 11011001
Prior Symbol: 't' Symbol: 'o'  Code: 1001
Prior Symbol: 't' Symbol: 'r'  Code: 11010
Prior Symbol: 't' Symbol: 's'  Code: 0001
Prior Symbol: 't' Symbol: 't'  Code: 110111
Prior Symbol: 't' Symbol: 'u'  Code: 11001
Prior Symbol: 't' Symbol: 'w'  Code: 11000001
Prior Symbol: 't' Symbol: 'y'  Code: 110001
Prior Symbol: 'u' Symbol:  0  Code: 0011110
Prior Symbol: 'u' Symbol: 27  Code: 000100
Prior Symbol: 'u' Symbol: ' '  Code: 001110
Prior Symbol: 'u' Symbol: 'a'  Code: 00110
Prior Symbol: 'u' Symbol: 'b'  Code: 10011
Prior Symbol: 'u' Symbol: 'c'  Code: 11100
Prior Symbol: 'u' Symbol: 'd'  Code: 10000
Prior Symbol: 'u' Symbol: 'e'  Code: 0010
Prior Symbol: 'u' Symbol: 'f'  Code: 0011111
Prior Symbol: 'u' Symbol: 'g'  Code: 11101
Prior Symbol: 'u' Symbol: 'i'  Code: 00011
Prior Symbol: 'u' Symbol: 'k'  Code: 0001010
Prior Symbol: 'u' Symbol: 'l'  Code: 0000
Prior Symbol: 'u' Symbol: 'm'  Code: 10010
Prior Symbol: 'u' Symbol: 'n'  Code: 110
Prior Symbol: 'u' Symbol: 'p'  Code: 10001
Prior Symbol: 'u' Symbol: 'r'  Code: 01
Prior Symbol: 'u' Symbol: 's'  Code: 101
Prior Symbol: 'u' Symbol: 't'  Code: 1111
Prior Symbol: 'u' Symbol: 'z'  Code: 0001011
Prior Symbol: 'v' Symbol: 27  Code: 0010
Prior Symbol: 'v' Symbol: 'a'  Code: 000
Prior Symbol: 'v' Symbol: 'e'  Code: 1
Prior Symbol: 'v' Symbol: 'i'  Code: 01
Prior Symbol: 'v' Symbol: 'o'  Code: 00111
Prior Symbol: 'v' Symbol: 's'  Code: 00110
Prior Symbol: 'w' Symbol:  0  Code: 001
Prior Symbol: 'w' Symbol: 27  Code: 01010
Prior Symbol: 'w' Symbol: ' '  Code: 011
Prior Symbol: 'w' Symbol: '''  Code: 010010
Prior Symbol: 'w' Symbol: 'a'  Code: 000
Prior Symbol: 'w' Symbol: 'b'  Code: 010011
Prior Symbol: 'w' Symbol: 'c'  Code: 010111
Prior Symbol: 'w' Symbol: 'e'  Code: 1111
Prior Symbol: 'w' Symbol: 'i'  Code: 1100
Prior Symbol: 'w' Symbol: 'l'  Code: 010110
Prior Symbol: 'w' Symbol: 'n'  Code: 1110
Prior Symbol: 'w' Symbol: 'o'  Code: 1101
Prior Symbol: 'w' Symbol: 'r'  Code: 01000
Prior Symbol: 'w' Symbol: 's'  Code: 10
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Prior Symbol: 'x' Symbol: 27  Code: 1010
Prior Symbol: 'x' Symbol: ' '  Code: 1011
Prior Symbol: 'x' Symbol: 'a'  Code: 000
Prior Symbol: 'x' Symbol: 'e'  Code: 001
Prior Symbol: 'x' Symbol: 'i'  Code: 100
Prior Symbol: 'x' Symbol: 'p'  Code: 111
Prior Symbol: 'x' Symbol: 't'  Code: 01
Prior Symbol: 'y' Symbol:  0  Code: 10
Prior Symbol: 'y' Symbol: 27  Code: 111110
Prior Symbol: 'y' Symbol: ' '  Code: 0
Prior Symbol: 'y' Symbol: '!'  Code: 1101101
Prior Symbol: 'y' Symbol: '''  Code: 110101
Prior Symbol: 'y' Symbol: '-'  Code: 11110101
Prior Symbol: 'y' Symbol: 'a'  Code: 1101110
Prior Symbol: 'y' Symbol: 'b'  Code: 1111011
Prior Symbol: 'y' Symbol: 'c'  Code: 11110100
Prior Symbol: 'y' Symbol: 'd'  Code: 1100000
Prior Symbol: 'y' Symbol: 'e'  Code: 11001
Prior Symbol: 'y' Symbol: 'i'  Code: 1100001
Prior Symbol: 'y' Symbol: 'l'  Code: 111111
Prior Symbol: 'y' Symbol: 'm'  Code: 1101111
Prior Symbol: 'y' Symbol: 'n'  Code: 1100010
Prior Symbol: 'y' Symbol: 'o'  Code: 1100011
Prior Symbol: 'y' Symbol: 'p'  Code: 1101000
Prior Symbol: 'y' Symbol: 's'  Code: 1110
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Prior Symbol: 'z' Symbol: 'a'  Code: 01
Prior Symbol: 'z' Symbol: 'e'  Code: 1010
Prior Symbol: 'z' Symbol: 'i'  Code: 111
Prior Symbol: 'z' Symbol: 'y'  Code: 001
Prior Symbol: 'z' Symbol: 'z'  Code: 1011
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Prior Symbol: '|' Symbol: 27  Code: 1
Prior Symbol: '}' Symbol: 27  Code: 1
Prior Symbol: '~' Symbol: 27  Code: 1
Prior Symbol: 127 Symbol: 27  Code: 1
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Table H.5 – English-language Program Title Decode Table

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1265	155
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1267	236
1268	243
1269	242
1270	128
1271	225
1272	2
1273	3
1274	244
1275	233
1276	239
1277	230
1278	4
1279	5
1280	6
1281	7
1282	229
1283	8
1284	9
1285	10
1286	15
1287	16
1288	186
1289	249
1290	167
1291	244
1292	155
1293	1
1294	231
1295	236
1296	2
1297	238
1298	3
1299	239
1300	245
1301	4
1302	242
1303	5
1304	6
1305	233
1306	7
1307	243
1308	225
1309	8
1310	9
1311	10
1312	11
1313	229
1314	128
1315	12
1316	232
1317	160
1318	13
1319	14
1320	229
1321	13
1322	226
1323	245
1324	247
1325	155
1326	236
1327	1
1328	249
1329	238
1330	2
1331	3
1332	4
1333	242
1334	5
1335	128
1336	6
1337	160
1338	225
1339	239
1340	7
1341	244
1342	233
1343	8
1344	9
1345	10
1346	11
1347	12
1348	21
1349	22
1350	161
1351	248
1352	233
1353	235
1354	1
1355	128
1356	155
1357	250
1358	226
1359	2
1360	3
1361	4
1362	160
1363	240
1364	5
1365	6
1366	7
1367	225
1368	8
1369	230
1370	242
1371	237
1372	246
1373	9
1374	228
1375	10
1376	239
1377	244
1378	236
1379	243
1380	231
1381	229
1382	11
1383	227
1384	12
1385	13
1386	14
1387	15

1388	16
1389	17
1390	18
1391	19
1392	238
1393	20
1394	239
1395	1
1396	155
1397	225
1398	11
1399	12
1400	212
1401	239
1402	230
1403	236
1404	247
1405	225
1406	1
1407	186
1408	2
1409	155
1410	249
1411	3
1412	4
1413	5
1414	243
1415	6
1416	7
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1418	233
1419	160
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1422	229
1423	10
1424	21
1425	22
1426	167
1427	186
1428	227
1429	247
1430	242
1431	173
1432	226
1433	1
1434	2
1435	155
1436	230
1437	3
1438	237
1439	246
1440	4
1441	235
1442	5
1443	244
1444	6
1445	7
1446	8
1447	243
1448	9
1449	245
1450	10
1451	239
1452	11
1453	12
1454	128
1455	249
1456	225
1457	13
1458	228
1459	233
1460	160
1461	14
1462	15
1463	236
1464	229
1465	16
1466	17
1467	18
1468	19
1469	20
1470	10
1471	11
1472	249
1473	155
1474	245
1475	243
1476	1
1477	2
1478	226
1479	237
1480	128
1481	3
1482	240
1483	239
1484	4
1485	160
1486	5
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1488	6
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1491	8
1492	9
1493	229
1494	24
1495	25
1496	226
1497	234
1498	242
1499	232
1500	236
1501	237
1502	250
1503	155
1504	1
1505	245
1506	2
1507	3
1508	246
1509	4
1510	186
1511	230
1512	5
1513	6
1514	235
1515	239
1516	7
1517	167
1518	249
1519	8
1520	9
1521	10
1522	11
1523	227
1524	12
1525	238
1526	225
1527	13
1528	243
1529	14
1530	233
1531	15
1532	16
1533	244
1534	128
1535	228
1536	229
1537	17
1538	18
1539	231
1540	160
1541	19
1542	20
1543	21
1544	22
1545	23
1546	27
1547	28
1548	174
1549	250
1550	191
1551	1
1552	167
1553	155
1554	2
1555	233
1556	248
1557	249
1558	3
1559	229
1560	232
1561	4
1562	225
1563	235
1564	5
1565	226
1566	6
1567	7
1568	227
1569	8
1570	231
1571	244
1572	9
1573	128
1574	246
1575	240
1576	10
1577	228
1578	11
1579	243
1580	247
1581	12
1582	13
1583	239
1584	236
1585	160
1586	14
1587	15
1588	237
1589	230
1590	16
1591	245
1592	17
1593	18
1594	19
1595	20
1596	21
1597	242
1598	22
1599	238
1600	23
1601	24
1602	25
1603	26
1604	14
1605	15
1606	237
1607	167
1608	155
1609	228
1610	1
1611	249
1612	243
1613	242
1614	244
1615	2
1616	232
1617	3
1618	236
1619	240
1620	4
1621	225
1622	233

1623	5
1624	6
1625	128
1626	160
1627	7
1628	8
1629	9
1630	10
1631	229
1632	239
1633	11
1634	12
1635	13
1636	155
1637	245
1638	24
1639	25
1640	186
1641	172
1642	246
1643	155
1644	240
1645	226
1646	1
1647	230
1648	2
1649	167
1650	174
1651	231
1652	3
1653	227
1654	245
1655	4
1656	237
1657	5
1658	6
1659	7
1660	235
1661	8
1662	9
1663	238
1664	242
1665	10
1666	228
1667	11
1668	249
1669	236
1670	12
1671	13
1672	244
1673	128
1674	14
1675	239
1676	243
1677	160
1678	225
1679	15
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1682	17
1683	229
1684	18
1685	19
1686	20
1687	21
1688	22
1689	23
1690	25
1691	26
1692	167
1693	172
1694	191
1695	195
1696	200
1697	228
1698	230
1699	237
1700	242
1701	174
1702	236
1703	238
1704	249
1705	1
1706	2
1707	3
1708	4
1709	186
1710	5
1711	155
1712	245
1713	6
1714	7
1715	8
1716	9
1717	235
1718	240
1719	10
1720	11
1721	12
1722	225
1723	227
1724	13
1725	232
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1727	15
1728	239
1729	16
1730	17
1731	243
1732	18
1733	233
1734	19
1735	229
1736	20
1737	21
1738	244
1739	22
1740	23
1741	160
1742	24
1743	128
1744	20
1745	21
1746	186
1747	191
1748	228
1749	247
1750	155
1751	167
1752	1
1753	238
1754	2
1755	3
1756	4
1757	227
1758	226
1759	237
1760	5
1761	249
1762	6
1763	244
1764	7
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1768	242
1769	9
1770	225
1771	243
1772	10
1773	239
1774	11
1775	12
1776	13
1777	233
1778	128
1779	229
1780	14
1781	160
1782	15
1783	232
1784	16
1785	17
1786	18
1787	19
1788	17
1789	18
1790	235
1791	250
1792	128
1793	230
1794	155
1795	1
1796	160
1797	2
1798	3
1799	233
1800	225
1801	4
1802	228
1803	240
1804	237
1805	226
1806	227
1807	231
1808	236
1809	5
1810	229
1811	6
1812	7
1813	8
1814	9
1815	244
1816	10
1817	11
1818	12
1819	243
1820	238
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1829	239
1830	155
1831	1
1832	225
1833	2
1834	3
1835	233
1836	11
1837	12
1838	167
1839	226
1840	236
1841	227
1842	242
1843	1
1844	155
1845	2
1846	3
1847	4
1848	233
1849	239
1850	238
1851	229
1852	225
1853	128
1854	5
1855	160
1856	6
1857	7

1858	8
1859	9
1860	243
1861	10
1862	5
1863	6
1864	155
1865	160
1866	225
1867	229
1868	233
1869	1
1870	128
1871	240
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1873	244
1874	3
1875	4
1876	160
1877	19
1878	227
1879	173
1880	228
1881	233
1882	238
1883	239
1884	240
1885	244
1886	246
1887	161
1888	225
1889	237
1890	1
1891	226
1892	2
1893	3
1894	4
1895	167
1896	5
1897	6
1898	247
1899	7
1900	155
1901	236
1902	8
1903	229
1904	9
1905	10
1906	11
1907	12
1908	13
1909	14
1910	243
1911	15
1912	16
1913	17
1914	128
1915	18
1916	5
1917	6
1918	229
1919	250
1920	160
1921	249
1922	155
1923	1
1924	128
1925	233
1926	2
1927	225
1928	3
1929	4
1930	155
1931	155
1932	155
1933	155
1934	155
1935	155
1936	155
1937	155
1938	155
1939	155

H.3 Standard compression Type 2 Huffman Encode/Decode tables

The following encode/decode tables (Tables H.6 and H.7) are optimized for English-language program description text. These tables correspond to multiple_string_structure() with compression_type value 0x02, and mode equal to 0xFF.

Table H.6 – English-language Program Description Encode Table

```
Prior Symbol:  0 Symbol: 27  Code: 1110000
Prior Symbol:  0 Symbol: '''  Code: 111001
Prior Symbol:  0 Symbol: 'A'  Code: 010
Prior Symbol:  0 Symbol: 'B'  Code: 0011
Prior Symbol:  0 Symbol: 'C'  Code: 0111
Prior Symbol:  0 Symbol: 'D'  Code: 11101
Prior Symbol:  0 Symbol: 'E'  Code: 10010
Prior Symbol:  0 Symbol: 'F'  Code: 10110
Prior Symbol:  0 Symbol: 'G'  Code: 011011
Prior Symbol:  0 Symbol: 'H'  Code: 10111
Prior Symbol:  0 Symbol: 'I'  Code: 011000
Prior Symbol:  0 Symbol: 'J'  Code: 1100
Prior Symbol:  0 Symbol: 'K'  Code: 00101
Prior Symbol:  0 Symbol: 'L'  Code: 10011
Prior Symbol:  0 Symbol: 'M'  Code: 1111
Prior Symbol:  0 Symbol: 'N'  Code: 00100
Prior Symbol:  0 Symbol: 'O'  Code: 011001
Prior Symbol:  0 Symbol: 'P'  Code: 000
Prior Symbol:  0 Symbol: 'R'  Code: 1000
Prior Symbol:  0 Symbol: 'S'  Code: 1010
Prior Symbol:  0 Symbol: 'T'  Code: 1101
Prior Symbol:  0 Symbol: 'V'  Code: 1110001
Prior Symbol:  0 Symbol: 'W'  Code: 011010
Prior Symbol:  1 Symbol: 27  Code: 1
Prior Symbol:  2 Symbol: 27  Code: 1
Prior Symbol:  3 Symbol: 27  Code: 1
Prior Symbol:  4 Symbol: 27  Code: 1
Prior Symbol:  5 Symbol: 27  Code: 1
Prior Symbol:  6 Symbol: 27  Code: 1
Prior Symbol:  7 Symbol: 27  Code: 1
Prior Symbol:  8 Symbol: 27  Code: 1
Prior Symbol:  9 Symbol: 27  Code: 1
Prior Symbol: 10 Symbol: 27  Code: 1
Prior Symbol: 11 Symbol: 27  Code: 1
Prior Symbol: 12 Symbol: 27  Code: 1
Prior Symbol: 13 Symbol: 27  Code: 1
Prior Symbol: 14 Symbol: 27  Code: 1
Prior Symbol: 15 Symbol: 27  Code: 1
Prior Symbol: 16 Symbol: 27  Code: 1
Prior Symbol: 17 Symbol: 27  Code: 1
Prior Symbol: 18 Symbol: 27  Code: 1
Prior Symbol: 19 Symbol: 27  Code: 1
Prior Symbol: 20 Symbol: 27  Code: 1
Prior Symbol: 21 Symbol: 27  Code: 1
Prior Symbol: 22 Symbol: 27  Code: 1
Prior Symbol: 23 Symbol: 27  Code: 1
Prior Symbol: 24 Symbol: 27  Code: 1
Prior Symbol: 25 Symbol: 27  Code: 1
Prior Symbol: 26 Symbol: 27  Code: 1
Prior Symbol: 27 Symbol: 27  Code: 1
Prior Symbol: 28 Symbol: 27  Code: 1
Prior Symbol: 29 Symbol: 27  Code: 1
Prior Symbol: 30 Symbol: 27  Code: 1
Prior Symbol: 31 Symbol: 27  Code: 1
Prior Symbol: ' ' Symbol: 27  Code: 101000001
Prior Symbol: ' ' Symbol: '''  Code: 111111010
Prior Symbol: ' ' Symbol: '('  Code: 1111111100
Prior Symbol: ' ' Symbol: '-'  Code: 11111111110
Prior Symbol: ' ' Symbol: '/'  Code: 11111111111
Prior Symbol: ' ' Symbol: '1'  Code: 0101011
Prior Symbol: ' ' Symbol: '2'  Code: 0100010
Prior Symbol: ' ' Symbol: '3'  Code: 1111111101
Prior Symbol: ' ' Symbol: '4'  Code: 110010100
Prior Symbol: ' ' Symbol: '5'  Code: 1111111110
Prior Symbol: ' ' Symbol: '7'  Code: 1010000000
Prior Symbol: ' ' Symbol: 'A'  Code: 10010
Prior Symbol: ' ' Symbol: 'B'  Code: 010100
Prior Symbol: ' ' Symbol: 'C'  Code: 111100
Prior Symbol: ' ' Symbol: 'D'  Code: 1111010
Prior Symbol: ' ' Symbol: 'E'  Code: 0100011
Prior Symbol: ' ' Symbol: 'F'  Code: 0101010
Prior Symbol: ' ' Symbol: 'G'  Code: 000010
Prior Symbol: ' ' Symbol: 'H'  Code: 1111011
Prior Symbol: ' ' Symbol: 'I'  Code: 11001011
Prior Symbol: ' ' Symbol: 'J'  Code: 000011
Prior Symbol: ' ' Symbol: 'K'  Code: 1100100
Prior Symbol: ' ' Symbol: 'L'  Code: 010110
Prior Symbol: ' ' Symbol: 'M'  Code: 101001
Prior Symbol: ' ' Symbol: 'N'  Code: 001100
Prior Symbol: ' ' Symbol: 'O'  Code: 10100001
Prior Symbol: ' ' Symbol: 'P'  Code: 001101
Prior Symbol: ' ' Symbol: 'R'  Code: 1111100
Prior Symbol: ' ' Symbol: 'S'  Code: 01001
Prior Symbol: ' ' Symbol: 'T'  Code: 1100110
Prior Symbol: ' ' Symbol: 'U'  Code: 111111011
Prior Symbol: ' ' Symbol: 'V'  Code: 111111100
Prior Symbol: ' ' Symbol: 'W'  Code: 010000
Prior Symbol: ' ' Symbol: 'Y'  Code: 111111101
Prior Symbol: ' ' Symbol: 'Z'  Code: 1010000001
Prior Symbol: ' ' Symbol: 'a'  Code: 011
Prior Symbol: ' ' Symbol: 'b'  Code: 10111
Prior Symbol: ' ' Symbol: 'c'  Code: 10011
Prior Symbol: ' ' Symbol: 'd'  Code: 10000
Prior Symbol: ' ' Symbol: 'e'  Code: 100010
Prior Symbol: ' ' Symbol: 'f'  Code: 11101
Prior Symbol: ' ' Symbol: 'g'  Code: 100011
Prior Symbol: ' ' Symbol: 'h'  Code: 0001
Prior Symbol: ' ' Symbol: 'i'  Code: 10101
Prior Symbol: ' ' Symbol: 'j'  Code: 11001111
Prior Symbol: ' ' Symbol: 'k'  Code: 11111010
Prior Symbol: ' ' Symbol: 'l'  Code: 010111
Prior Symbol: ' ' Symbol: 'm'  Code: 00000
Prior Symbol: ' ' Symbol: 'n'  Code: 1010001
Prior Symbol: ' ' Symbol: 'o'  Code: 0010
Prior Symbol: ' ' Symbol: 'p'  Code: 10110
Prior Symbol: ' ' Symbol: 'q'  Code: 110010101
Prior Symbol: ' ' Symbol: 'r'  Code: 00111
Prior Symbol: ' ' Symbol: 's'  Code: 11100
Prior Symbol: ' ' Symbol: 't'  Code: 1101
Prior Symbol: ' ' Symbol: 'u'  Code: 11111011
Prior Symbol: ' ' Symbol: 'v'  Code: 11111100
Prior Symbol: ' ' Symbol: 'w'  Code: 11000
Prior Symbol: ' ' Symbol: 'y'  Code: 11001110
Prior Symbol: '!' Symbol: 27  Code: 1
Prior Symbol: '"' Symbol:  0  Code: 000
Prior Symbol: '"' Symbol: 27  Code: 10
Prior Symbol: '"' Symbol: ' '  Code: 11
Prior Symbol: '"' Symbol: '.'  Code: 001
Prior Symbol: '"' Symbol: 'H'  Code: 010
Prior Symbol: '"' Symbol: 'T'  Code: 011
Prior Symbol: '#' Symbol: 27  Code: 1
Prior Symbol: '$' Symbol: 27  Code: 1
Prior Symbol: '%' Symbol: 27  Code: 1
Prior Symbol: '&' Symbol: 27  Code: 1
Prior Symbol: ''' Symbol: 27  Code: 00
Prior Symbol: ''' Symbol: ' '  Code: 010
Prior Symbol: ''' Symbol: 's'  Code: 1
Prior Symbol: ''' Symbol: 't'  Code: 011
Prior Symbol: '(' Symbol: 27  Code: 1
Prior Symbol: ')' Symbol: 27  Code: 1
Prior Symbol: ')' Symbol: ','  Code: 0
Prior Symbol: '*' Symbol: 27  Code: 1
Prior Symbol: '+' Symbol: 27  Code: 1
Prior Symbol: ',' Symbol: 27  Code: 00
Prior Symbol: ',' Symbol: ' '  Code: 1
Prior Symbol: ',' Symbol: '"'  Code: 01
Prior Symbol: '-' Symbol: 27  Code: 10
Prior Symbol: '-' Symbol: ' '  Code: 1110
Prior Symbol: '-' Symbol: 'a'  Code: 000
Prior Symbol: '-' Symbol: 'b'  Code: 0010
Prior Symbol: '-' Symbol: 'c'  Code: 110
Prior Symbol: '-' Symbol: 'd'  Code: 0011
Prior Symbol: '-' Symbol: 'e'  Code: 0100
Prior Symbol: '-' Symbol: 'f'  Code: 0101
Prior Symbol: '-' Symbol: 'r'  Code: 1111
Prior Symbol: '-' Symbol: 's'  Code: 011
Prior Symbol: '.' Symbol:  0  Code: 1
Prior Symbol: '.' Symbol: 27  Code: 000
Prior Symbol: '.' Symbol: ' '  Code: 01
Prior Symbol: '.' Symbol: '"'  Code: 0010
Prior Symbol: '.' Symbol: 'J'  Code: 00110
Prior Symbol: '.' Symbol: 'S'  Code: 00111
Prior Symbol: '/' Symbol: 27  Code: 0
Prior Symbol: '/' Symbol: ' '  Code: 1
Prior Symbol: '0' Symbol: 27  Code: 100
Prior Symbol: '0' Symbol: ' '  Code: 111
Prior Symbol: '0' Symbol: '0'  Code: 00
Prior Symbol: '0' Symbol: '7'  Code: 101
Prior Symbol: '0' Symbol: 's'  Code: 01
Prior Symbol: '0' Symbol: 't'  Code: 110
Prior Symbol: '1' Symbol: 27  Code: 111
Prior Symbol: '1' Symbol: ' '  Code: 10
Prior Symbol: '1' Symbol: '8'  Code: 110
Prior Symbol: '1' Symbol: '9'  Code: 0
Prior Symbol: '2' Symbol: 27  Code: 101
Prior Symbol: '2' Symbol: ' '  Code: 11
Prior Symbol: '2' Symbol: '.'  Code: 0
Prior Symbol: '2' Symbol: '6'  Code: 100
Prior Symbol: '3' Symbol: 27  Code: 10
Prior Symbol: '3' Symbol: ' '  Code: 0
Prior Symbol: '3' Symbol: '0'  Code: 11
Prior Symbol: '4' Symbol: 27  Code: 10
Prior Symbol: '4' Symbol: ' '  Code: 11
Prior Symbol: '4' Symbol: '.'  Code: 0
Prior Symbol: '5' Symbol: 27  Code: 11
Prior Symbol: '5' Symbol: ' '  Code: 10
Prior Symbol: '5' Symbol: '.'  Code: 0
Prior Symbol: '6' Symbol: 27  Code: 1
Prior Symbol: '7' Symbol: 27  Code: 0
Prior Symbol: '7' Symbol: ','  Code: 10
Prior Symbol: '7' Symbol: '.'  Code: 11
Prior Symbol: '8' Symbol: 27  Code: 1
Prior Symbol: '9' Symbol: 27  Code: 110
Prior Symbol: '9' Symbol: ' '  Code: 111
Prior Symbol: '9' Symbol: '5'  Code: 00
Prior Symbol: '9' Symbol: '6'  Code: 01
Prior Symbol: '9' Symbol: '8'  Code: 10
Prior Symbol: ':' Symbol: 27  Code: 0
Prior Symbol: ':' Symbol: ' '  Code: 1
Prior Symbol: ';' Symbol: 27  Code: 0
Prior Symbol: ';' Symbol: ' '  Code: 1
Prior Symbol: '<' Symbol: 27  Code: 1
Prior Symbol: '=' Symbol: 27  Code: 1
Prior Symbol: '>' Symbol: 27  Code: 1
Prior Symbol: '?' Symbol: 27  Code: 0
Prior Symbol: '?' Symbol: ' '  Code: 1
Prior Symbol: '@' Symbol: 27  Code: 1
Prior Symbol: 'A' Symbol: 27  Code: 10010
Prior Symbol: 'A' Symbol: ' '  Code: 11
Prior Symbol: 'A' Symbol: 'd'  Code: 10011
Prior Symbol: 'A' Symbol: 'f'  Code: 101000
Prior Symbol: 'A' Symbol: 'l'  Code: 00
Prior Symbol: 'A' Symbol: 'm'  Code: 10101
Prior Symbol: 'A' Symbol: 'n'  Code: 01
Prior Symbol: 'A' Symbol: 'r'  Code: 1011
Prior Symbol: 'A' Symbol: 's'  Code: 10000
Prior Symbol: 'A' Symbol: 't'  Code: 10001
Prior Symbol: 'A' Symbol: 'u'  Code: 101001
Prior Symbol: 'B' Symbol: 27  Code: 10010
Prior Symbol: 'B' Symbol: 'a'  Code: 101
Prior Symbol: 'B' Symbol: 'e'  Code: 111
Prior Symbol: 'B' Symbol: 'i'  Code: 00
Prior Symbol: 'B' Symbol: 'l'  Code: 10011
Prior Symbol: 'B' Symbol: 'o'  Code: 110
Prior Symbol: 'B' Symbol: 'r'  Code: 01
Prior Symbol: 'B' Symbol: 'u'  Code: 1000
Prior Symbol: 'C' Symbol: 27  Code: 01110
Prior Symbol: 'C' Symbol: 'a'  Code: 00
Prior Symbol: 'C' Symbol: 'h'  Code: 10
Prior Symbol: 'C' Symbol: 'i'  Code: 01111
Prior Symbol: 'C' Symbol: 'l'  Code: 110
Prior Symbol: 'C' Symbol: 'o'  Code: 111
Prior Symbol: 'C' Symbol: 'r'  Code: 0101
Prior Symbol: 'C' Symbol: 'u'  Code: 0110
Prior Symbol: 'C' Symbol: 'y'  Code: 0100
Prior Symbol: 'D' Symbol: 27  Code: 1111
Prior Symbol: 'D' Symbol: 'a'  Code: 01
Prior Symbol: 'D' Symbol: 'e'  Code: 100
Prior Symbol: 'D' Symbol: 'i'  Code: 00
Prior Symbol: 'D' Symbol: 'o'  Code: 101
Prior Symbol: 'D' Symbol: 'r'  Code: 1101
Prior Symbol: 'D' Symbol: 'u'  Code: 1110
Prior Symbol: 'D' Symbol: 'y'  Code: 1100
Prior Symbol: 'E' Symbol: 27  Code: 10
Prior Symbol: 'E' Symbol: 'a'  Code: 0110
Prior Symbol: 'E' Symbol: 'd'  Code: 000
Prior Symbol: 'E' Symbol: 'i'  Code: 0111
Prior Symbol: 'E' Symbol: 'l'  Code: 001
Prior Symbol: 'E' Symbol: 'n'  Code: 1100
Prior Symbol: 'E' Symbol: 'r'  Code: 111
Prior Symbol: 'E' Symbol: 's'  Code: 010
Prior Symbol: 'E' Symbol: 'v'  Code: 1101
Prior Symbol: 'F' Symbol: 27  Code: 00
Prior Symbol: 'F' Symbol: 'e'  Code: 100
Prior Symbol: 'F' Symbol: 'l'  Code: 101
Prior Symbol: 'F' Symbol: 'o'  Code: 01
Prior Symbol: 'F' Symbol: 'r'  Code: 11
Prior Symbol: 'G' Symbol: 27  Code: 000
Prior Symbol: 'G' Symbol: 'a'  Code: 110
Prior Symbol: 'G' Symbol: 'e'  Code: 01
Prior Symbol: 'G' Symbol: 'i'  Code: 100
Prior Symbol: 'G' Symbol: 'l'  Code: 001
Prior Symbol: 'G' Symbol: 'o'  Code: 1011
Prior Symbol: 'G' Symbol: 'r'  Code: 111
Prior Symbol: 'G' Symbol: 'u'  Code: 1010
Prior Symbol: 'H' Symbol: 27  Code: 010
Prior Symbol: 'H' Symbol: 'a'  Code: 00
Prior Symbol: 'H' Symbol: 'e'  Code: 011
Prior Symbol: 'H' Symbol: 'i'  Code: 110
Prior Symbol: 'H' Symbol: 'o'  Code: 10
Prior Symbol: 'H' Symbol: 'u'  Code: 111
Prior Symbol: 'I' Symbol: 27  Code: 011
Prior Symbol: 'I' Symbol: ' '  Code: 000
Prior Symbol: 'I' Symbol: '.'  Code: 100
Prior Symbol: 'I' Symbol: 'I'  Code: 001
Prior Symbol: 'I' Symbol: 'n'  Code: 11
Prior Symbol: 'I' Symbol: 'r'  Code: 101
Prior Symbol: 'I' Symbol: 's'  Code: 010
Prior Symbol: 'J' Symbol: 27  Code: 1000
Prior Symbol: 'J' Symbol: '.'  Code: 1001
Prior Symbol: 'J' Symbol: 'a'  Code: 111
Prior Symbol: 'J' Symbol: 'e'  Code: 1101
Prior Symbol: 'J' Symbol: 'i'  Code: 1100
Prior Symbol: 'J' Symbol: 'o'  Code: 0
Prior Symbol: 'J' Symbol: 'u'  Code: 101
Prior Symbol: 'K' Symbol: 27  Code: 111
Prior Symbol: 'K' Symbol: 'a'  Code: 100
Prior Symbol: 'K' Symbol: 'e'  Code: 0
Prior Symbol: 'K' Symbol: 'i'  Code: 101
Prior Symbol: 'K' Symbol: 'r'  Code: 110
Prior Symbol: 'L' Symbol: 27  Code: 0110
Prior Symbol: 'L' Symbol: 'a'  Code: 11
Prior Symbol: 'L' Symbol: 'e'  Code: 00
Prior Symbol: 'L' Symbol: 'i'  Code: 0111
Prior Symbol: 'L' Symbol: 'o'  Code: 10
Prior Symbol: 'L' Symbol: 'u'  Code: 010
Prior Symbol: 'M' Symbol: 27  Code: 11010
Prior Symbol: 'M' Symbol: 'a'  Code: 0
Prior Symbol: 'M' Symbol: 'c'  Code: 11011
Prior Symbol: 'M' Symbol: 'e'  Code: 1111
Prior Symbol: 'M' Symbol: 'i'  Code: 10
Prior Symbol: 'M' Symbol: 'o'  Code: 1100
Prior Symbol: 'M' Symbol: 'u'  Code: 1110
Prior Symbol: 'N' Symbol: 27  Code: 1100
Prior Symbol: 'N' Symbol: 'a'  Code: 111
Prior Symbol: 'N' Symbol: 'e'  Code: 0
Prior Symbol: 'N' Symbol: 'i'  Code: 1101
Prior Symbol: 'N' Symbol: 'o'  Code: 10
Prior Symbol: 'O' Symbol: 27  Code: 10
Prior Symbol: 'O' Symbol: '''  Code: 010
Prior Symbol: 'O' Symbol: 'l'  Code: 110
Prior Symbol: 'O' Symbol: 'n'  Code: 011
Prior Symbol: 'O' Symbol: 'r'  Code: 111
Prior Symbol: 'O' Symbol: 's'  Code: 00
Prior Symbol: 'P' Symbol: 27  Code: 10010
Prior Symbol: 'P' Symbol: 'a'  Code: 0
Prior Symbol: 'P' Symbol: 'e'  Code: 111
Prior Symbol: 'P' Symbol: 'h'  Code: 10011
Prior Symbol: 'P' Symbol: 'i'  Code: 1000
Prior Symbol: 'P' Symbol: 'l'  Code: 1101
Prior Symbol: 'P' Symbol: 'o'  Code: 101
Prior Symbol: 'P' Symbol: 'r'  Code: 1100
Prior Symbol: 'Q' Symbol: 27  Code: 1
Prior Symbol: 'R' Symbol: 27  Code: 0000
Prior Symbol: 'R' Symbol: '.'  Code: 0001
Prior Symbol: 'R' Symbol: 'a'  Code: 01
Prior Symbol: 'R' Symbol: 'e'  Code: 10
Prior Symbol: 'R' Symbol: 'i'  Code: 001
Prior Symbol: 'R' Symbol: 'o'  Code: 11
Prior Symbol: 'S' Symbol: 27  Code: 1011
Prior Symbol: 'S' Symbol: '.'  Code: 0001
Prior Symbol: 'S' Symbol: 'a'  Code: 100
Prior Symbol: 'S' Symbol: 'c'  Code: 0010
Prior Symbol: 'S' Symbol: 'e'  Code: 1110
Prior Symbol: 'S' Symbol: 'h'  Code: 110
Prior Symbol: 'S' Symbol: 'i'  Code: 0011
Prior Symbol: 'S' Symbol: 'o'  Code: 1111
Prior Symbol: 'S' Symbol: 't'  Code: 01
Prior Symbol: 'S' Symbol: 'u'  Code: 1010
Prior Symbol: 'S' Symbol: 'v'  Code: 00000
Prior Symbol: 'S' Symbol: 'y'  Code: 00001
Prior Symbol: 'T' Symbol: 27  Code: 1010
Prior Symbol: 'T' Symbol: 'V'  Code: 1000
Prior Symbol: 'T' Symbol: 'a'  Code: 1001
Prior Symbol: 'T' Symbol: 'e'  Code: 11010
Prior Symbol: 'T' Symbol: 'h'  Code: 0
Prior Symbol: 'T' Symbol: 'i'  Code: 1011
Prior Symbol: 'T' Symbol: 'o'  Code: 111
Prior Symbol: 'T' Symbol: 'r'  Code: 1100
Prior Symbol: 'T' Symbol: 'w'  Code: 11011
Prior Symbol: 'U' Symbol: 27  Code: 10
Prior Symbol: 'U' Symbol: '.'  Code: 0
Prior Symbol: 'U' Symbol: 'n'  Code: 11
Prior Symbol: 'V' Symbol: 27  Code: 111
Prior Symbol: 'V' Symbol: ' '  Code: 10
Prior Symbol: 'V' Symbol: 'e'  Code: 110
Prior Symbol: 'V' Symbol: 'i'  Code: 0
Prior Symbol: 'W' Symbol: 27  Code: 010
Prior Symbol: 'W' Symbol: 'a'  Code: 111
Prior Symbol: 'W' Symbol: 'e'  Code: 110
Prior Symbol: 'W' Symbol: 'h'  Code: 011
Prior Symbol: 'W' Symbol: 'i'  Code: 10
Prior Symbol: 'W' Symbol: 'o'  Code: 00
Prior Symbol: 'X' Symbol: 27  Code: 1
Prior Symbol: 'Y' Symbol: 27  Code: 0
Prior Symbol: 'Y' Symbol: 'o'  Code: 1
Prior Symbol: 'Z' Symbol: 27  Code: 1
Prior Symbol: '[' Symbol: 27  Code: 1
Prior Symbol: '\' Symbol: 27  Code: 1
Prior Symbol: ']' Symbol: 27  Code: 1
Prior Symbol: '^' Symbol: 27  Code: 1
Prior Symbol: '_' Symbol: 27  Code: 1
Prior Symbol: '`' Symbol: 27  Code: 1
Prior Symbol: 'a' Symbol: 27  Code: 111001101
Prior Symbol: 'a' Symbol: ' '  Code: 101
Prior Symbol: 'a' Symbol: '"'  Code: 111001110
Prior Symbol: 'a' Symbol: '.'  Code: 1110010
Prior Symbol: 'a' Symbol: 'b'  Code: 001011
Prior Symbol: 'a' Symbol: 'c'  Code: 11001
Prior Symbol: 'a' Symbol: 'd'  Code: 00111
Prior Symbol: 'a' Symbol: 'e'  Code: 0011001
Prior Symbol: 'a' Symbol: 'f'  Code: 001010
Prior Symbol: 'a' Symbol: 'g'  Code: 00100
Prior Symbol: 'a' Symbol: 'h'  Code: 001100010
Prior Symbol: 'a' Symbol: 'i'  Code: 111000
Prior Symbol: 'a' Symbol: 'k'  Code: 110000
Prior Symbol: 'a' Symbol: 'l'  Code: 1101
Prior Symbol: 'a' Symbol: 'm'  Code: 11101
Prior Symbol: 'a' Symbol: 'n'  Code: 01
Prior Symbol: 'a' Symbol: 'o'  Code: 001100011
Prior Symbol: 'a' Symbol: 'p'  Code: 00000
Prior Symbol: 'a' Symbol: 'r'  Code: 100
Prior Symbol: 'a' Symbol: 's'  Code: 0001
Prior Symbol: 'a' Symbol: 't'  Code: 1111
Prior Symbol: 'a' Symbol: 'u'  Code: 110001
Prior Symbol: 'a' Symbol: 'v'  Code: 001101
Prior Symbol: 'a' Symbol: 'w'  Code: 111001111
Prior Symbol: 'a' Symbol: 'x'  Code: 111001100
Prior Symbol: 'a' Symbol: 'y'  Code: 00001
Prior Symbol: 'a' Symbol: 'z'  Code: 00110000
Prior Symbol: 'b' Symbol: 27  Code: 101000
Prior Symbol: 'b' Symbol: ' '  Code: 0101
Prior Symbol: 'b' Symbol: '.'  Code: 101001
Prior Symbol: 'b' Symbol: 'a'  Code: 100
Prior Symbol: 'b' Symbol: 'b'  Code: 101010
Prior Symbol: 'b' Symbol: 'd'  Code: 1010110
Prior Symbol: 'b' Symbol: 'e'  Code: 00
Prior Symbol: 'b' Symbol: 'i'  Code: 1011
Prior Symbol: 'b' Symbol: 'l'  Code: 0100
Prior Symbol: 'b' Symbol: 'o'  Code: 110
Prior Symbol: 'b' Symbol: 'r'  Code: 1110
Prior Symbol: 'b' Symbol: 's'  Code: 1010111
Prior Symbol: 'b' Symbol: 'u'  Code: 1111
Prior Symbol: 'b' Symbol: 'y'  Code: 011
Prior Symbol: 'c' Symbol: 27  Code: 00010
Prior Symbol: 'c' Symbol: ' '  Code: 10000
Prior Symbol: 'c' Symbol: ','  Code: 010000
Prior Symbol: 'c' Symbol: '.'  Code: 0100011
Prior Symbol: 'c' Symbol: 'D'  Code: 0100110
Prior Symbol: 'c' Symbol: 'a'  Code: 110
Prior Symbol: 'c' Symbol: 'c'  Code: 010010
Prior Symbol: 'c' Symbol: 'e'  Code: 011
Prior Symbol: 'c' Symbol: 'h'  Code: 111
Prior Symbol: 'c' Symbol: 'i'  Code: 0101
Prior Symbol: 'c' Symbol: 'k'  Code: 1001
Prior Symbol: 'c' Symbol: 'l'  Code: 10001
Prior Symbol: 'c' Symbol: 'o'  Code: 101
Prior Symbol: 'c' Symbol: 'q'  Code: 0100010
Prior Symbol: 'c' Symbol: 'r'  Code: 00011
Prior Symbol: 'c' Symbol: 't'  Code: 001
Prior Symbol: 'c' Symbol: 'u'  Code: 0000
Prior Symbol: 'c' Symbol: 'y'  Code: 0100111
Prior Symbol: 'd' Symbol: 27  Code: 1010001
Prior Symbol: 'd' Symbol: ' '  Code: 11
Prior Symbol: 'd' Symbol: '"'  Code: 01111010
Prior Symbol: 'd' Symbol: ','  Code: 101011
Prior Symbol: 'd' Symbol: '.'  Code: 0100
Prior Symbol: 'd' Symbol: ';'  Code: 01111011
Prior Symbol: 'd' Symbol: 'a'  Code: 1000
Prior Symbol: 'd' Symbol: 'd'  Code: 01010
Prior Symbol: 'd' Symbol: 'e'  Code: 00
Prior Symbol: 'd' Symbol: 'f'  Code: 10100000
Prior Symbol: 'd' Symbol: 'g'  Code: 10101011
Prior Symbol: 'd' Symbol: 'i'  Code: 1011
Prior Symbol: 'd' Symbol: 'l'  Code: 011111
Prior Symbol: 'd' Symbol: 'm'  Code: 10100001
Prior Symbol: 'd' Symbol: 'n'  Code: 1010100
Prior Symbol: 'd' Symbol: 'o'  Code: 0110
Prior Symbol: 'd' Symbol: 'r'  Code: 01110
Prior Symbol: 'd' Symbol: 's'  Code: 1001
Prior Symbol: 'd' Symbol: 'u'  Code: 101001
Prior Symbol: 'd' Symbol: 'v'  Code: 0111100
Prior Symbol: 'd' Symbol: 'w'  Code: 10101010
Prior Symbol: 'd' Symbol: 'y'  Code: 01011
Prior Symbol: 'e' Symbol: 27  Code: 101110011
Prior Symbol: 'e' Symbol: ' '  Code: 111
Prior Symbol: 'e' Symbol: '"'  Code: 10111010
Prior Symbol: 'e' Symbol: ')'  Code: 100110000
Prior Symbol: 'e' Symbol: ','  Code: 000111
Prior Symbol: 'e' Symbol: '-'  Code: 10011001
Prior Symbol: 'e' Symbol: '.'  Code: 00110
Prior Symbol: 'e' Symbol: ';'  Code: 10011010
Prior Symbol: 'e' Symbol: 'a'  Code: 1000
Prior Symbol: 'e' Symbol: 'b'  Code: 0001100
Prior Symbol: 'e' Symbol: 'c'  Code: 10010
Prior Symbol: 'e' Symbol: 'd'  Code: 0000
Prior Symbol: 'e' Symbol: 'e'  Code: 10100
Prior Symbol: 'e' Symbol: 'f'  Code: 10111011
Prior Symbol: 'e' Symbol: 'g'  Code: 0001101
Prior Symbol: 'e' Symbol: 'h'  Code: 100110001
Prior Symbol: 'e' Symbol: 'i'  Code: 000100
Prior Symbol: 'e' Symbol: 'k'  Code: 10011011
Prior Symbol: 'e' Symbol: 'l'  Code: 0010
Prior Symbol: 'e' Symbol: 'm'  Code: 100111
Prior Symbol: 'e' Symbol: 'n'  Code: 010
Prior Symbol: 'e' Symbol: 'o'  Code: 001110
Prior Symbol: 'e' Symbol: 'p'  Code: 001111
Prior Symbol: 'e' Symbol: 'r'  Code: 110
Prior Symbol: 'e' Symbol: 's'  Code: 011
Prior Symbol: 'e' Symbol: 't'  Code: 10101
Prior Symbol: 'e' Symbol: 'u'  Code: 101110010
Prior Symbol: 'e' Symbol: 'v'  Code: 101100
Prior Symbol: 'e' Symbol: 'w'  Code: 101111
Prior Symbol: 'e' Symbol: 'x'  Code: 000101
Prior Symbol: 'e' Symbol: 'y'  Code: 101101
Prior Symbol: 'e' Symbol: 'z'  Code: 10111000
Prior Symbol: 'f' Symbol: 27  Code: 1110111
Prior Symbol: 'f' Symbol: ' '  Code: 10
Prior Symbol: 'f' Symbol: '.'  Code: 1110110
Prior Symbol: 'f' Symbol: 'a'  Code: 1111
Prior Symbol: 'f' Symbol: 'e'  Code: 000
Prior Symbol: 'f' Symbol: 'f'  Code: 0101
Prior Symbol: 'f' Symbol: 'i'  Code: 001
Prior Symbol: 'f' Symbol: 'l'  Code: 111010
Prior Symbol: 'f' Symbol: 'o'  Code: 110
Prior Symbol: 'f' Symbol: 'r'  Code: 011
Prior Symbol: 'f' Symbol: 't'  Code: 0100
Prior Symbol: 'f' Symbol: 'u'  Code: 11100
Prior Symbol: 'g' Symbol: 27  Code: 1111010
Prior Symbol: 'g' Symbol: ' '  Code: 10
Prior Symbol: 'g' Symbol: '"'  Code: 1111011
Prior Symbol: 'g' Symbol: ','  Code: 111110
Prior Symbol: 'g' Symbol: '-'  Code: 0101010
Prior Symbol: 'g' Symbol: '.'  Code: 01011
Prior Symbol: 'g' Symbol: 'a'  Code: 1110
Prior Symbol: 'g' Symbol: 'e'  Code: 00
Prior Symbol: 'g' Symbol: 'g'  Code: 0101011
Prior Symbol: 'g' Symbol: 'h'  Code: 011
Prior Symbol: 'g' Symbol: 'i'  Code: 1101
Prior Symbol: 'g' Symbol: 'l'  Code: 111100
Prior Symbol: 'g' Symbol: 'o'  Code: 0100
Prior Symbol: 'g' Symbol: 'r'  Code: 111111
Prior Symbol: 'g' Symbol: 's'  Code: 11000
Prior Symbol: 'g' Symbol: 'u'  Code: 11001
Prior Symbol: 'g' Symbol: 'y'  Code: 010100
Prior Symbol: 'h' Symbol: 27  Code: 1011100
Prior Symbol: 'h' Symbol: ' '  Code: 100
Prior Symbol: 'h' Symbol: '"'  Code: 10101000
Prior Symbol: 'h' Symbol: ','  Code: 10101001
Prior Symbol: 'h' Symbol: '-'  Code: 10101011
Prior Symbol: 'h' Symbol: '.'  Code: 101001
Prior Symbol: 'h' Symbol: 'a'  Code: 011
Prior Symbol: 'h' Symbol: 'e'  Code: 11
Prior Symbol: 'h' Symbol: 'i'  Code: 00
Prior Symbol: 'h' Symbol: 'n'  Code: 101011
Prior Symbol: 'h' Symbol: 'o'  Code: 010
Prior Symbol: 'h' Symbol: 'r'  Code: 101111
Prior Symbol: 'h' Symbol: 's'  Code: 10101010
Prior Symbol: 'h' Symbol: 't'  Code: 10110
Prior Symbol: 'h' Symbol: 'u'  Code: 101000
Prior Symbol: 'h' Symbol: 'y'  Code: 1011101
Prior Symbol: 'i' Symbol: 27  Code: 00011101
Prior Symbol: 'i' Symbol: ' '  Code: 0001111
Prior Symbol: 'i' Symbol: ','  Code: 100110100
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Prior Symbol: 'i' Symbol: '.' Code: 10011000
Prior Symbol: 'i' Symbol: 'a' Code: 11010
Prior Symbol: 'i' Symbol: 'b' Code: 100110101
Prior Symbol: 'i' Symbol: 'c' Code: 1111
Prior Symbol: 'i' Symbol: 'd' Code: 10000
Prior Symbol: 'i' Symbol: 'e' Code: 1110
Prior Symbol: 'i' Symbol: 'f' Code: 100111
Prior Symbol: 'i' Symbol: 'g' Code: 10010
Prior Symbol: 'i' Symbol: 'k' Code: 10011011
Prior Symbol: 'i' Symbol: 'l' Code: 1100
Prior Symbol: 'i' Symbol: 'm' Code: 10001
Prior Symbol: 'i' Symbol: 'n' Code: 01
Prior Symbol: 'i' Symbol: 'o' Code: 11011
Prior Symbol: 'i' Symbol: 'p' Code: 000110
Prior Symbol: 'i' Symbol: 'r' Code: 0000
Prior Symbol: 'i' Symbol: 's' Code: 101
Prior Symbol: 'i' Symbol: 't' Code: 001
Prior Symbol: 'i' Symbol: 'v' Code: 00010
Prior Symbol: 'i' Symbol: 'x' Code: 00011100
Prior Symbol: 'i' Symbol: 'z' Code: 10011001
Prior Symbol: 'j' Symbol: 27 Code: 000
Prior Symbol: 'j' Symbol: 'a' Code: 001
Prior Symbol: 'j' Symbol: 'e' Code: 010
Prior Symbol: 'j' Symbol: 'o' Code: 1
Prior Symbol: 'j' Symbol: 'u' Code: 011
Prior Symbol: 'k' Symbol: 27 Code: 0000
Prior Symbol: 'k' Symbol: ' ' Code: 01
Prior Symbol: 'k' Symbol: ''' Code: 10000
Prior Symbol: 'k' Symbol: ',' Code: 10011
Prior Symbol: 'k' Symbol: '.' Code: 0001
Prior Symbol: 'k' Symbol: 'e' Code: 11
Prior Symbol: 'k' Symbol: 'i' Code: 101
Prior Symbol: 'k' Symbol: 'l' Code: 100100
Prior Symbol: 'k' Symbol: 'n' Code: 10001
Prior Symbol: 'k' Symbol: 's' Code: 001
Prior Symbol: 'k' Symbol: 'y' Code: 100101
Prior Symbol: 'l' Symbol: 27 Code: 0011100
Prior Symbol: 'l' Symbol: ' ' Code: 110
Prior Symbol: 'l' Symbol: ''' Code: 00111100
Prior Symbol: 'l' Symbol: ',' Code: 001101
Prior Symbol: 'l' Symbol: '-' Code: 00111101
Prior Symbol: 'l' Symbol: '.' Code: 00100
Prior Symbol: 'l' Symbol: 'a' Code: 000
Prior Symbol: 'l' Symbol: 'b' Code: 0011101
Prior Symbol: 'l' Symbol: 'c' Code: 00111111
Prior Symbol: 'l' Symbol: 'd' Code: 10111
Prior Symbol: 'l' Symbol: 'e' Code: 111
Prior Symbol: 'l' Symbol: 'f' Code: 010110
Prior Symbol: 'l' Symbol: 'i' Code: 011
Prior Symbol: 'l' Symbol: 'k' Code: 10110110
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Prior Symbol: 'l' Symbol: 'm' Code: 010111
Prior Symbol: 'l' Symbol: 'n' Code: 00111110
Prior Symbol: 'l' Symbol: 'o' Code: 1010
Prior Symbol: 'l' Symbol: 'p' Code: 00101
Prior Symbol: 'l' Symbol: 'r' Code: 10110111
Prior Symbol: 'l' Symbol: 's' Code: 01010
Prior Symbol: 'l' Symbol: 't' Code: 001100
Prior Symbol: 'l' Symbol: 'u' Code: 1011010
Prior Symbol: 'l' Symbol: 'v' Code: 101100
Prior Symbol: 'l' Symbol: 'y' Code: 0100
Prior Symbol: 'm' Symbol: 27 Code: 101010
Prior Symbol: 'm' Symbol: ' ' Code: 111
Prior Symbol: 'm' Symbol: ''' Code: 1010110
Prior Symbol: 'm' Symbol: '.' Code: 110101
Prior Symbol: 'm' Symbol: ';' Code: 1010111
Prior Symbol: 'm' Symbol: 'a' Code: 00
Prior Symbol: 'm' Symbol: 'b' Code: 10100
Prior Symbol: 'm' Symbol: 'e' Code: 01
Prior Symbol: 'm' Symbol: 'i' Code: 1100
Prior Symbol: 'm' Symbol: 'm' Code: 10110
Prior Symbol: 'm' Symbol: 'o' Code: 1000
Prior Symbol: 'm' Symbol: 'p' Code: 1001
Prior Symbol: 'm' Symbol: 's' Code: 10111
Prior Symbol: 'm' Symbol: 'u' Code: 11011
Prior Symbol: 'm' Symbol: 'y' Code: 110100
Prior Symbol: 'n' Symbol: 27 Code: 0100000
Prior Symbol: 'n' Symbol: ' ' Code: 10
Prior Symbol: 'n' Symbol: ''' Code: 0100011
Prior Symbol: 'n' Symbol: ',' Code: 111100
Prior Symbol: 'n' Symbol: '-' Code: 011011010
Prior Symbol: 'n' Symbol: '.' Code: 01100
Prior Symbol: 'n' Symbol: ';' Code: 011011011
Prior Symbol: 'n' Symbol: 'a' Code: 11111
Prior Symbol: 'n' Symbol: 'b' Code: 011011100
Prior Symbol: 'n' Symbol: 'c' Code: 01001
Prior Symbol: 'n' Symbol: 'd' Code: 110
Prior Symbol: 'n' Symbol: 'e' Code: 001
Prior Symbol: 'n' Symbol: 'f' Code: 01000101
Prior Symbol: 'n' Symbol: 'g' Code: 000

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Prior Symbol: 'n' Symbol: 'i'  Code: 01111
Prior Symbol: 'n' Symbol: 'j'  Code: 011011101
Prior Symbol: 'n' Symbol: 'k'  Code: 1111010
Prior Symbol: 'n' Symbol: 'l'  Code: 01101100
Prior Symbol: 'n' Symbol: 'm'  Code: 011011110
Prior Symbol: 'n' Symbol: 'n'  Code: 01110
Prior Symbol: 'n' Symbol: 'o'  Code: 1111011
Prior Symbol: 'n' Symbol: 'r'  Code: 011011111
Prior Symbol: 'n' Symbol: 's'  Code: 0101
Prior Symbol: 'n' Symbol: 't'  Code: 1110
Prior Symbol: 'n' Symbol: 'u'  Code: 0100001
Prior Symbol: 'n' Symbol: 'v'  Code: 0110100
Prior Symbol: 'n' Symbol: 'y'  Code: 0110101
Prior Symbol: 'n' Symbol: 'z'  Code: 01000100
Prior Symbol: 'o' Symbol: 27  Code: 101010011
Prior Symbol: 'o' Symbol: ' '  Code: 001
Prior Symbol: 'o' Symbol: ','  Code: 01001111
Prior Symbol: 'o' Symbol: '-'  Code: 01001110
Prior Symbol: 'o' Symbol: '.'  Code: 0100110
Prior Symbol: 'o' Symbol: 'B'  Code: 101010010
Prior Symbol: 'o' Symbol: 'a'  Code: 100001
Prior Symbol: 'o' Symbol: 'b'  Code: 110111
Prior Symbol: 'o' Symbol: 'c'  Code: 100000
Prior Symbol: 'o' Symbol: 'd'  Code: 110101
Prior Symbol: 'o' Symbol: 'e'  Code: 1010101
Prior Symbol: 'o' Symbol: 'f'  Code: 000
Prior Symbol: 'o' Symbol: 'g'  Code: 1101000
Prior Symbol: 'o' Symbol: 'h'  Code: 1101001
Prior Symbol: 'o' Symbol: 'i'  Code: 1101101
Prior Symbol: 'o' Symbol: 'k'  Code: 010010
Prior Symbol: 'o' Symbol: 'l'  Code: 0101
Prior Symbol: 'o' Symbol: 'm'  Code: 1100
Prior Symbol: 'o' Symbol: 'n'  Code: 111
Prior Symbol: 'o' Symbol: 'o'  Code: 10100
Prior Symbol: 'o' Symbol: 'p'  Code: 01000
Prior Symbol: 'o' Symbol: 'r'  Code: 011
Prior Symbol: 'o' Symbol: 's'  Code: 10001
Prior Symbol: 'o' Symbol: 't'  Code: 10010
Prior Symbol: 'o' Symbol: 'u'  Code: 1011
Prior Symbol: 'o' Symbol: 'v'  Code: 101011
Prior Symbol: 'o' Symbol: 'w'  Code: 10011
Prior Symbol: 'o' Symbol: 'x'  Code: 10101000
Prior Symbol: 'o' Symbol: 'y'  Code: 1101100
Prior Symbol: 'p' Symbol: 27  Code: 011011
Prior Symbol: 'p' Symbol: ' '  Code: 000
Prior Symbol: 'p' Symbol: '-'  Code: 1010010
Prior Symbol: 'p' Symbol: '.'  Code: 101000
Prior Symbol: 'p' Symbol: 'a'  Code: 001
Prior Symbol: 'p' Symbol: 'e'  Code: 110
Prior Symbol: 'p' Symbol: 'h'  Code: 1111
Prior Symbol: 'p' Symbol: 'i'  Code: 1011
Prior Symbol: 'p' Symbol: 'l'  Code: 010
Prior Symbol: 'p' Symbol: 'm'  Code: 1010011
Prior Symbol: 'p' Symbol: 'o'  Code: 0111
Prior Symbol: 'p' Symbol: 'p'  Code: 11101
Prior Symbol: 'p' Symbol: 'r'  Code: 100
Prior Symbol: 'p' Symbol: 's'  Code: 01100
Prior Symbol: 'p' Symbol: 't'  Code: 11100
Prior Symbol: 'p' Symbol: 'u'  Code: 10101
Prior Symbol: 'p' Symbol: 'y'  Code: 011010
Prior Symbol: 'q' Symbol: 27  Code: 0
Prior Symbol: 'q' Symbol: 'u'  Code: 1
Prior Symbol: 'r' Symbol: 27  Code: 10011111
Prior Symbol: 'r' Symbol: ' '  Code: 111
Prior Symbol: 'r' Symbol: '''  Code: 1001110
Prior Symbol: 'r' Symbol: ')'  Code: 100111100
Prior Symbol: 'r' Symbol: ','  Code: 100100
Prior Symbol: 'r' Symbol: '-'  Code: 11001100
Prior Symbol: 'r' Symbol: '.'  Code: 10001
Prior Symbol: 'r' Symbol: ';'  Code: 100111101
Prior Symbol: 'r' Symbol: 'a'  Code: 1101
Prior Symbol: 'r' Symbol: 'b'  Code: 11001101
Prior Symbol: 'r' Symbol: 'c'  Code: 100001
Prior Symbol: 'r' Symbol: 'd'  Code: 11000
Prior Symbol: 'r' Symbol: 'e'  Code: 101
Prior Symbol: 'r' Symbol: 'f'  Code: 110011111
Prior Symbol: 'r' Symbol: 'g'  Code: 100101
Prior Symbol: 'r' Symbol: 'i'  Code: 010
Prior Symbol: 'r' Symbol: 'k'  Code: 110010
Prior Symbol: 'r' Symbol: 'l'  Code: 00100
Prior Symbol: 'r' Symbol: 'm'  Code: 00101
Prior Symbol: 'r' Symbol: 'n'  Code: 01100
Prior Symbol: 'r' Symbol: 'o'  Code: 000
Prior Symbol: 'r' Symbol: 'p'  Code: 11001110
Prior Symbol: 'r' Symbol: 'r'  Code: 100110
Prior Symbol: 'r' Symbol: 's'  Code: 0111
Prior Symbol: 'r' Symbol: 't'  Code: 0011
Prior Symbol: 'r' Symbol: 'u'  Code: 100000
Prior Symbol: 'r' Symbol: 'v'  Code: 110011110
Prior Symbol: 'r' Symbol: 'y'  Code: 01101
Prior Symbol: 's' Symbol: 27  Code: 10011100
Prior Symbol: 's' Symbol: ' '  Code: 0
Prior Symbol: 's' Symbol: '"'  Code: 100111100
Prior Symbol: 's' Symbol: '''  Code: 100111101
Prior Symbol: 's' Symbol: ','  Code: 111011
Prior Symbol: 's' Symbol: '.'  Code: 1000
Prior Symbol: 's' Symbol: ';'  Code: 11101011
Prior Symbol: 's' Symbol: 'a'  Code: 110011
Prior Symbol: 's' Symbol: 'b'  Code: 100111110
Prior Symbol: 's' Symbol: 'c'  Code: 10010
Prior Symbol: 's' Symbol: 'e'  Code: 1101
Prior Symbol: 's' Symbol: 'h'  Code: 11000
Prior Symbol: 's' Symbol: 'i'  Code: 11100
Prior Symbol: 's' Symbol: 'k'  Code: 100111111
Prior Symbol: 's' Symbol: 'l'  Code: 1110100
Prior Symbol: 's' Symbol: 'm'  Code: 111010100
Prior Symbol: 's' Symbol: 'n'  Code: 111010101
Prior Symbol: 's' Symbol: 'o'  Code: 11110
Prior Symbol: 's' Symbol: 'p'  Code: 1001101
Prior Symbol: 's' Symbol: 's'  Code: 11111
Prior Symbol: 's' Symbol: 't'  Code: 101
Prior Symbol: 's' Symbol: 'u'  Code: 110010
Prior Symbol: 's' Symbol: 'w'  Code: 10011101
Prior Symbol: 's' Symbol: 'y'  Code: 1001100
Prior Symbol: 't' Symbol: 27  Code: 11000011
Prior Symbol: 't' Symbol: ' '  Code: 111
Prior Symbol: 't' Symbol: '''  Code: 11000100
Prior Symbol: 't' Symbol: ','  Code: 0111100
Prior Symbol: 't' Symbol: '-'  Code: 01111110
Prior Symbol: 't' Symbol: '.'  Code: 01101
Prior Symbol: 't' Symbol: ';'  Code: 110000100
Prior Symbol: 't' Symbol: 'a'  Code: 0100
Prior Symbol: 't' Symbol: 'b'  Code: 110000101
Prior Symbol: 't' Symbol: 'c'  Code: 11000101
Prior Symbol: 't' Symbol: 'e'  Code: 101
Prior Symbol: 't' Symbol: 'h'  Code: 00
Prior Symbol: 't' Symbol: 'i'  Code: 1101
Prior Symbol: 't' Symbol: 'l'  Code: 0111101
Prior Symbol: 't' Symbol: 'm'  Code: 01111111
Prior Symbol: 't' Symbol: 'n'  Code: 0111110
Prior Symbol: 't' Symbol: 'o'  Code: 100
Prior Symbol: 't' Symbol: 'r'  Code: 11001
Prior Symbol: 't' Symbol: 's'  Code: 0101
Prior Symbol: 't' Symbol: 't'  Code: 01100
Prior Symbol: 't' Symbol: 'u'  Code: 01110
Prior Symbol: 't' Symbol: 'w'  Code: 1100000
Prior Symbol: 't' Symbol: 'y'  Code: 1100011
Prior Symbol: 'u' Symbol: 27  Code: 1001100
Prior Symbol: 'u' Symbol: ' '  Code: 100000
Prior Symbol: 'u' Symbol: 'a'  Code: 100111
Prior Symbol: 'u' Symbol: 'b'  Code: 100001
Prior Symbol: 'u' Symbol: 'c'  Code: 10001
Prior Symbol: 'u' Symbol: 'd'  Code: 11100
Prior Symbol: 'u' Symbol: 'e'  Code: 11101
Prior Symbol: 'u' Symbol: 'g'  Code: 11110
Prior Symbol: 'u' Symbol: 'i'  Code: 10010
Prior Symbol: 'u' Symbol: 'k'  Code: 1001101
Prior Symbol: 'u' Symbol: 'l'  Code: 0100
Prior Symbol: 'u' Symbol: 'm'  Code: 111111
Prior Symbol: 'u' Symbol: 'n'  Code: 110
Prior Symbol: 'u' Symbol: 'o'  Code: 11111010
Prior Symbol: 'u' Symbol: 'p'  Code: 0101
Prior Symbol: 'u' Symbol: 'r'  Code: 00
Prior Symbol: 'u' Symbol: 's'  Code: 011
Prior Symbol: 'u' Symbol: 't'  Code: 101
Prior Symbol: 'u' Symbol: 'v'  Code: 11111011
Prior Symbol: 'u' Symbol: 'y'  Code: 1111100
Prior Symbol: 'v' Symbol: 27  Code: 00010
Prior Symbol: 'v' Symbol: 'a'  Code: 001
Prior Symbol: 'v' Symbol: 'e'  Code: 1
Prior Symbol: 'v' Symbol: 'i'  Code: 01
Prior Symbol: 'v' Symbol: 'o'  Code: 0000
Prior Symbol: 'v' Symbol: 's'  Code: 000110
Prior Symbol: 'v' Symbol: 'y'  Code: 000111
Prior Symbol: 'w' Symbol: 27  Code: 011101
Prior Symbol: 'w' Symbol: ' '  Code: 001
Prior Symbol: 'w' Symbol: '.'  Code: 011100
Prior Symbol: 'w' Symbol: 'a'  Code: 010
Prior Symbol: 'w' Symbol: 'e'  Code: 1110
Prior Symbol: 'w' Symbol: 'h'  Code: 000
Prior Symbol: 'w' Symbol: 'i'  Code: 10
Prior Symbol: 'w' Symbol: 'l'  Code: 011110
Prior Symbol: 'w' Symbol: 'm'  Code: 011111
Prior Symbol: 'w' Symbol: 'n'  Code: 11111
Prior Symbol: 'w' Symbol: 'o'  Code: 110
Prior Symbol: 'w' Symbol: 'r'  Code: 0110
Prior Symbol: 'w' Symbol: 's'  Code: 11110
Prior Symbol: 'x' Symbol: 27  Code: 10
Prior Symbol: 'x' Symbol: ' '  Code: 0110
Prior Symbol: 'x' Symbol: ','  Code: 0111
Prior Symbol: 'x' Symbol: '-'  Code: 1100
Prior Symbol: 'x' Symbol: 'a'  Code: 111
Prior Symbol: 'x' Symbol: 'e'  Code: 00
Prior Symbol: 'x' Symbol: 'i'  Code: 010
Prior Symbol: 'x' Symbol: 't'  Code: 1101
Prior Symbol: 'y' Symbol: 27  Code: 01010
Prior Symbol: 'y' Symbol: ' '  Code: 1
Prior Symbol: 'y' Symbol: '''  Code: 010010
Prior Symbol: 'y' Symbol: ','  Code: 0001
Prior Symbol: 'y' Symbol: '.'  Code: 0111
Prior Symbol: 'y' Symbol: ';'  Code: 011001
Prior Symbol: 'y' Symbol: '?'  Code: 0100110
Prior Symbol: 'y' Symbol: 'a'  Code: 0100111
Prior Symbol: 'y' Symbol: 'b'  Code: 0110000
Prior Symbol: 'y' Symbol: 'd'  Code: 000001
Prior Symbol: 'y' Symbol: 'e'  Code: 0010
Prior Symbol: 'y' Symbol: 'f'  Code: 0110001
Prior Symbol: 'y' Symbol: 'i'  Code: 000010
Prior Symbol: 'y' Symbol: 'l'  Code: 01000
Prior Symbol: 'y' Symbol: 'm'  Code: 000000
Prior Symbol: 'y' Symbol: 'n'  Code: 01011
Prior Symbol: 'y' Symbol: 'o'  Code: 01101
Prior Symbol: 'y' Symbol: 's'  Code: 0011
Prior Symbol: 'y' Symbol: 'w'  Code: 000011
Prior Symbol: 'z' Symbol: 27  Code: 100
Prior Symbol: 'z' Symbol: ' '  Code: 1110
Prior Symbol: 'z' Symbol: '.'  Code: 1111
Prior Symbol: 'z' Symbol: 'a'  Code: 000
Prior Symbol: 'z' Symbol: 'e'  Code: 001
Prior Symbol: 'z' Symbol: 'i'  Code: 110
Prior Symbol: 'z' Symbol: 'l'  Code: 010
Prior Symbol: 'z' Symbol: 'o'  Code: 101
Prior Symbol: 'z' Symbol: 'z'  Code: 011
Prior Symbol: '{' Symbol: 27  Code: 1
Prior Symbol: '|' Symbol: 27  Code: 1
Prior Symbol: '}' Symbol: 27  Code: 1
Prior Symbol: '~' Symbol: 27  Code: 1
Prior Symbol: 127 Symbol: 27  Code: 1
```

Table H.7 – English-language Program Description Decode Table

0	1	42	1	84	1	126	2	168	3
1	0	43	84	85	252	127	94	169	74
2	1	44	1	86	1	128	2	170	3
3	44	45	86	87	254	129	96	171	90
4	1	46	1	88	2	130	2	172	3
5	46	47	88	89	0	131	98	173	94
6	1	48	1	90	2	132	2	174	3
7	48	49	90	91	4	133	118	175	100
8	1	50	1	92	2	134	2	176	3
9	50	51	92	93	22	135	132	177	110
10	1	52	1	94	2	136	2	178	3
11	52	53	94	95	32	137	148	179	112
12	1	54	1	96	2	138	2	180	3
13	54	55	96	97	34	139	162	181	114
14	1	56	1	98	2	140	2	182	3
15	56	57	98	99	44	141	178	183	116
16	1	58	1	100	2	142	2	184	3
17	58	59	100	101	50	143	186	185	118
18	1	60	1	102	2	144	2	186	3
19	60	61	102	103	56	145	200	187	120
20	1	62	1	104	2	146	2	188	3
21	62	63	104	105	60	147	210	189	122
22	1	64	1	106	2	148	2	190	3
23	64	65	106	107	64	149	222	191	124
24	1	66	1	108	2	150	2	192	3
25	66	67	222	109	68	151	234	193	126
26	1	68	1	110	2	152	2	194	3
27	68	69	224	111	70	153	242	195	128
28	1	70	1	112	2	154	2	196	3
29	70	71	234	113	74	155	252	197	180
30	1	72	1	114	2	156	3	198	3
31	72	73	236	115	76	157	8	199	206
32	1	74	1	116	2	158	3	200	3
33	74	75	238	117	84	159	16	201	240
34	1	76	1	118	2	160	3	202	4
35	76	77	240	119	86	161	26	203	26
36	1	78	1	120	2	162	3	204	4
37	78	79	242	121	88	163	40	205	88
38	1	80	1	122	2	164	3	206	4
39	80	81	248	123	90	165	42	207	110
40	1	82	1	124	2	166	3	208	4
41	82	83	250	125	92	167	52	209	142

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213	216
214	4
215	224
216	4
217	244
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219	36
220	5
221	64
222	5
223	118
224	5
225	174
226	5
227	206
228	5
229	208
230	6
231	6
232	6
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234	6
235	96
236	6
237	134
238	6
239	146
240	6
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246	6
247	236 248 6
249	238
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251	240
252	6
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262	215
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267	203
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271	204
272	198
273	200
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1198	172
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1200	248
1201	155
1202	174
1203	250
1204	1
1205	235
1206	2
1207	160
1208	3
1209	4
1210	240
1211	5
1212	6
1213	230
1214	246
1215	7
1216	228
1217	237
1218	231
1219	8
1220	225
1221	239
1222	242
1223	9
1224	10
1225	11
1226	236
1227	12
1228	229
1229	227
1230	13
1231	244
1232	14
1233	243
1234	15
1235	16
1236	17
1237	238
1238	18
1239	19
1240	3
1241	239
1242	155
1243	225
1244	229
1245	245
1246	1
1247	2
1248	8
1249	9
1250	236
1251	249
1252	167
1253	238
1254	1
1255	172
1256	155
1257	174
1258	2
1259	3
1260	4
1261	243
1262	5
1263	233
1264	6
1265	160
1266	7
1267	229
1268	22
1269	23
1270	167
1271	173
1272	238
1273	227
1274	235
1275	242
1276	155
1277	226
1278	1
1279	2
1280	245
1281	3
1282	244
1283	172
1284	4
1285	5
1286	230
1287	237
1288	246
1289	6
1290	174
1291	240
1292	7
1293	8
1294	243
1295	9
1296	10
1297	228
1298	11
1299	12
1300	249
1301	13
1302	239
1303	14
1304	225
1305	15
1306	16
1307	233
1308	236
1309	17
1310	160
1311	229
1312	18
1313	19
1314	20
1315	21
1316	12
1317	13
1318	167
1319	187
1320	155
1321	1
1322	249
1323	174
1324	226
1325	2
1326	237
1327	243
1328	3
1329	245
1330	239
1331	240
1332	4
1333	5
1334	233
1335	6
1336	7
1337	8
1338	9
1339	160
1340	225
1341	229
1342	10
1343	11
1344	25
1345	26
1346	173
1347	187
1348	226
1349	234
1350	237
1351	242
1352	250
1353	230
1354	236
1355	1
1356	2
1357	3
1358	155
1359	245
1360	4

1361	167
1362	246
1363	249
1364	5
1365	6
1366	235
1367	239
1368	7
1369	8
1370	9
1371	10
1372	172
1373	11
1374	12
1375	227
1376	174
1377	13
1378	238
1379	233
1380	14
1381	225
1382	15
1383	243
1384	16
1385	17
1386	244
1387	18
1388	231
1389	229
1390	19
1391	20
1392	228
1393	21
1394	22
1395	23
1396	160
1397	24
1398	26
1399	27
1400	194
1401	155
1402	173
1403	172
1404	248
1405	1
1406	174
1407	2
1408	3
1409	229
1410	231
1411	232
1412	249
1413	233
1414	235
1415	4
1416	227
1417	225
1418	5
1419	246
1420	6
1421	228
1422	7
1423	226
1424	240
1425	8
1426	9
1427	243
1428	244
1429	247
1430	239
1431	10
1432	11
1433	12
1434	13
1435	236
1436	14
1437	15
1438	16
1439	245
1440	237
1441	17
1442	230
1443	160
1444	18
1445	242
1446	19
1447	20
1448	21
1449	238
1450	22
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1453	25
1454	14
1455	15
1456	173
1457	237
1458	249
1459	155
1460	174
1461	1
1462	243
1463	2
1464	3
1465	245
1466	244
1467	240
1468	4
1469	239
1470	5
1471	233
1472	6
1473	232
1474	160
1475	225
1476	236
1477	7
1478	242
1479	8
1480	229
1481	9
1482	10
1483	11
1484	12
1485	13
1486	155
1487	245
1488	25
1489	26
1490	169
1491	187
1492	246
1493	230
1494	1
1495	155
1496	173
1497	226
1498	240
1499	2
1500	167
1501	3
1502	4
1503	5
1504	245
1505	227
1506	172
1507	231
1508	242
1509	6
1510	235
1511	7
1512	236
1513	237
1514	238
1515	249
1516	8
1517	174
1518	9
1519	10
1520	228
1521	11
1522	12
1523	244
1524	13
1525	243
1526	14
1527	15
1528	16
1529	225
1530	239
1531	17
1532	233
1533	18
1534	19
1535	229
1536	20
1537	160
1538	21
1539	22
1540	23
1541	24
1542	160
1543	22
1544	162
1545	167
1546	226
1547	235
1548	237
1549	238
1550	155
1551	247
1552	1
1553	2
1554	3
1555	187
1556	249
1557	240
1558	4
1559	5
1560	236
1561	6
1562	7
1563	8
1564	245
1565	225
1566	9
1567	172
1568	227
1569	10
1570	232
1571	11
1572	233
1573	12
1574	239
1575	243
1576	174
1577	13
1578	14
1579	229
1580	15
1581	16
1582	17
1583	244
1584	18
1585	19
1586	20
1587	21
1588	20
1589	21
1590	187

1591	226
1592	173
1593	237
1594	1
1595	155
1596	167
1597	227
1598	172
1599	236
1600	238
1601	2
1602	247
1603	3
1604	4
1605	249
1606	5
1607	6
1608	7
1609	8
1610	244
1611	174
1612	245
1613	9
1614	10
1615	242
1616	225
1617	243
1618	11
1619	12
1620	13
1621	233
1622	14
1623	15
1624	239
1625	229
1626	16
1627	160
1628	232
1629	17
1630	18
1631	19
1632	17
1633	18
1634	239
1635	246
1636	155
1637	235
1638	249
1639	1
1640	160
1641	226
1642	2
1643	225
1644	3
1645	237
1646	4
1647	227
1648	233
1649	5
1650	228
1651	229
1652	231
1653	6
1654	236
1655	240
1656	7
1657	8
1658	9
1659	10
1660	11
1661	243
1662	12
1663	244
1664	238
1665	13
1666	242
1667	14
1668	15
1669	16
1670	5
1671	229
1672	243
1673	249
1674	155
1675	1
1676	239
1677	2
1678	3
1679	225
1680	4
1681	233
1682	10
1683	11
1684	174
1685	155
1686	236
1687	237
1688	1
1689	2
1690	243
1691	238
1692	242
1693	3
1694	229
1695	4
1696	232
1697	160
1698	225
1699	5
1700	239
1701	6
1702	7
1703	8
1704	233
1705	9
1706	5
1707	6
1708	160
1709	172
1710	173
1711	244
1712	233
1713	1
1714	2
1715	225
1716	229
1717	3
1718	155
1719	4
1720	17
1721	160
1722	191
1723	225
1724	226
1725	230
1726	237
1727	228
1728	233
1729	247
1730	167
1731	1
1732	2
1733	187
1734	3
1735	4
1736	236
1737	5
1738	155
1739	238
1740	6
1741	239
1742	7
1743	172
1744	229
1745	243
1746	8
1747	9
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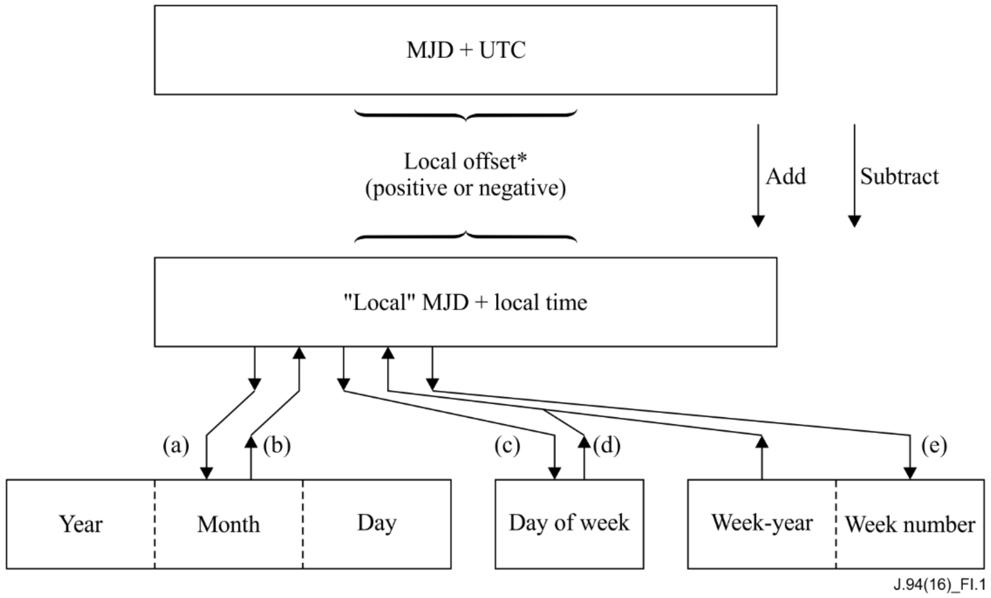
1749	174
1750	11
1751	12
1752	13
1753	14
1754	15
1755	16
1756	6
1757	7
1758	160
1759	174
1760	225
1761	229
1762	236
1763	250
1764	155
1765	239
1766	233
1767	1
1768	2
1769	3
1770	4
1771	5
1772	155
1773	155
1774	155 1775 155
1776	155
1777	155
1778	155
1779	155
1780	155
1781	155

Appendix I

Conversion between time and date conventions for System A

(This appendix does not form an integral part of this Recommendation.)

The types of conversion which may be required are summarized in Figure I.1.



* Offsets are positive for longitudes East of Greenwich and negative for longitudes West of Greenwich

Figure I.1 – Conversion routes between Modified Julian Date (MJD) and Universal Time Coordinated (UTC)

The conversion between MJD + UTC and the "local" MJD + local time is simply a matter of adding or subtracting the local offset. This process may, of course, involve a "carry" or "borrow" from the UTC affecting the MJD.

The other five conversion routes shown on the diagram are detailed in the formulae below:

Symbols used:

MJD	Modified Julian Date
UTC	Universal Time Coordinated
Y	Year from 1900 (e.g., for 2003, Y = 103)
M	Month from January (= 1) to December (= 12)
D	Day of month from 1 to 31
WY	"Week number" Year from 1900
WN	Week number according to ISO 2015:1976
WD	Day of week from Monday (= 1) to Sunday (= 7)
K, L, M′, W, Y′	Intermediate variables
×	Multiplication
int	Integer part, ignoring remainder
mod 7	Remainder (0-6) after dividing integer by 7

a) To find Y, M, D from MJD

$Y' = \text{int}\ [\ (MJD - 15078.2) / 365.25\ ]$

$M' = \text{int}\ \{\ [\ MJD - 14956.1 - \text{int}\ (Y' \times 365.25)\ ] / 30.6001\ \}$

$D = MJD - 14956 - \text{int}\ (Y' \times 365.25) - \text{int}\ (M' \times 30.6001)$

If $M' = 14$ or $M' = 15$, then $K = 1$; else $K = 0$

$Y = Y' + K$

$M = M' - 1 - K \times 12$

b) To find MJD from Y, M, D

If $M = 1$ or $M = 2$, then $L = 1$; else $L = 0$

$MJD = 14956 + D + \text{int}\ [\ (Y - L) \times 365.25\ ] + \text{int}\ [\ (M + 1 + L \times 12) \times 30.6001\ ]$

c) To find WD from MJD

$WD = [\ (MJD + 2) \bmod 7\ ] + 1$

d) To find MJD from WY, WN, WD

$MJD = 15012 + WD + 7 \times \{\ WN + \text{int}\ [\ (WY \times 1461 / 28) + 0.41\ ]\ \}$

e) To find WY, WN from MJD

$W = \text{int}\ [\ (MJD / 7) - 2144.64\ ]$

$WY = \text{int}\ [\ (W \times 28 / 1461) - 0.0079\ ]$

$WN = W - \text{int}\ [\ (WY \times 1461 / 28) + 0.41\ ]$

Example – MJD = 45218 W = 4315

Y = (19)82 WY = (19)82

M = 9 (September) WN = 36

D = 6 WD = 1 (Monday)

NOTE – These formulae are applicable between the inclusive dates 1 March 1900 to 28 February 2100.

Appendix II

Implementation recommendations for System B

(This appendix does not form an integral part of this Recommendation.)

II.1 Implications for retail digital cable-ready devices

Given that a cable operator could choose to deliver SI tables according to any of the profiles defined in Annex D on any given hub, digital cable-ready devices offered for retail sale should be able to accept a Short-form Virtual Channel Table for basic navigation if the Long-form Virtual Channel is not provided. It should also accept the Long-form Virtual Channel Table if the Short-form table is not provided.

II.2 Channel number handling

Host devices are expected to support navigation based on virtual channel records associated with two-part channel numbers. If an S-VCT virtual channel record includes a two_part_channel_number_descriptor(), the Host is expected to use it, and to disregard the 12-bit virtual_channel_number field in the same virtual_channel() record.

If a two_part_channel_number_descriptor() is not present in the record-level descriptors loop of a particular S-VCT virtual channel record, the Host is expected to use the virtual_channel_number field in the virtual_channel() record, (see Table B.20) as the channel number reference.

Both numbering schemes may co-exist in a channel map, but each individual channel must be considered labelled with either a one-part or a two-part number.

II.3 Processing of dynamic changes to service information

The Host is expected to monitor SI data on a continuous basis, and react to changes dynamically. For example, an update to an S-VCT or L-VCT may indicate that the definition of the currently acquired virtual channel has changed. The change could involve, for example, association of the channel with a different MPEG-2 program_number within a Transport Stream on a different carrier frequency. In response to such a change, the Host is expected to tune to and acquire the service as redefined.

For some types of changes, the Host is not expected to respond in a visible way. For example, the name of the current event may change, but the new name would be visible as the response to a regular user action to show the event name on-screen or in a program guide display.

II.4 AEITs may include event information for inaccessible channels

In the out-of-band system, depending on the data delivery methods employed by the cable headend and POD module, there may be occasions where AEITs are broadcast for which some set-top boxes do not have corresponding virtual channel assignments. In these cases, the Host is expected to discard portions of the AEITs corresponding to source_ID values not present in the Virtual Channel Table (short- or long-form).

For example, the AEIT may include data describing the program schedule for a service identified with source_ID value 0x0123, and suppose the Virtual Channel Table does not include a channel associated with source_ID 0x0123. When constructing a program guide display, the channel name, number and physical location associated with events tied to source_ID 0x0123 will not be available. Therefore, the events described in the AEIT data for this channel are inaccessible, and the AEIT records for this source_ID should be discarded.

II.5 Splice flag processing

The S-VCT includes a flag called splice. Hosts supporting application of virtual channel changes tied to video splice point timing are expected to execute the change after two seconds following the activation_time, in the absence of a video splice point prior to that time.

Support of the splice timing function is optional in Hosts. A Host not supporting the splice timing feature is expected to apply the data delivered in the VCM_structure() at the indicated activation time (i.e., the splice flag may be simply disregarded).

Appendix III

Service Information overview and guide for System B

(This appendix does not form an integral part of this Recommendation.)

III.1 Table hierarchy

Figures III.1 through III.5 describe the relationships between SI tables for Profiles 1 through 6 in a simplified form. A mandatory table is shown in a solid box. An optional table is shown in a dotted box. An italicized name indicates a sub-table or a map carried within the table.

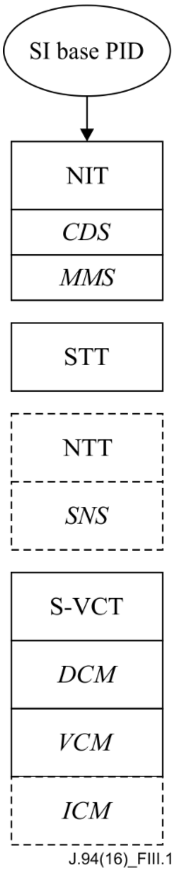


Figure III.1 – Hierarchy of Table Sections – Profiles 1 and 2

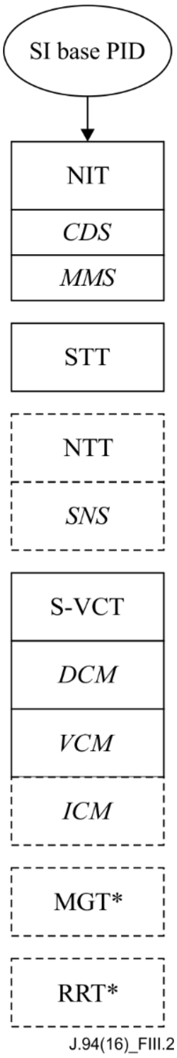


Figure III.2 – Hierarchy of Table Sections – Profile 3

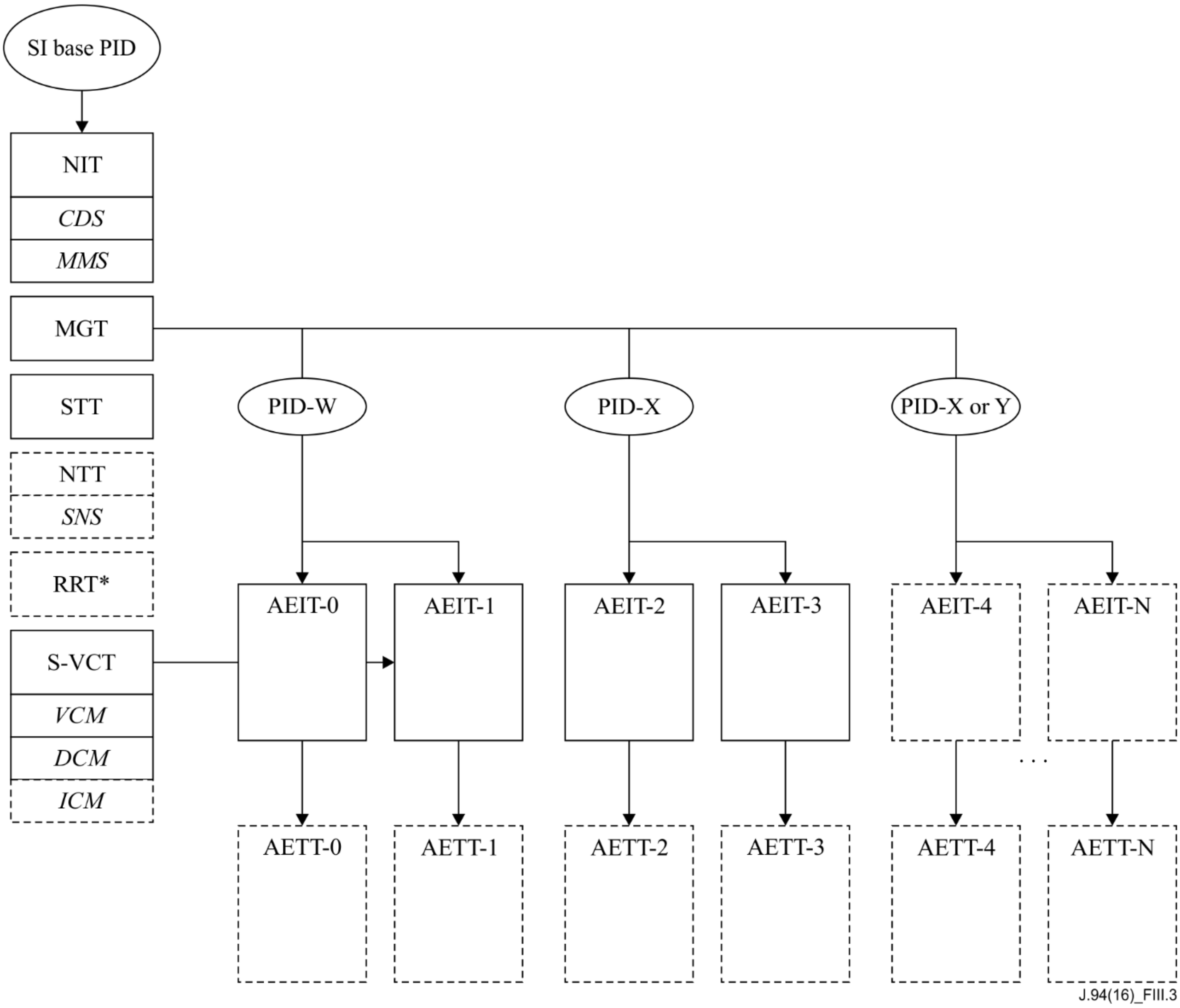


Figure III.3 – Hierarchy of Table Sections – Profile 4

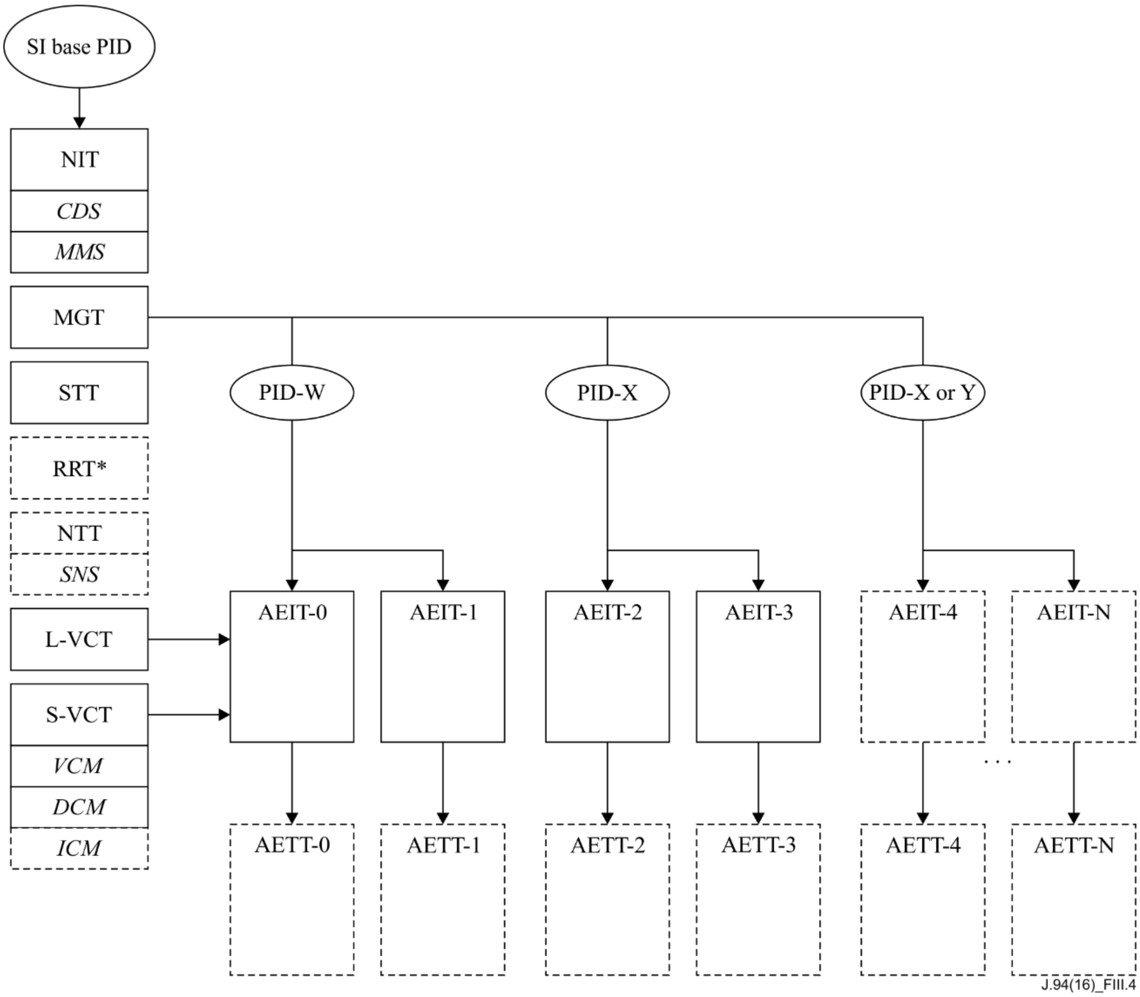


Figure III.4 – Hierarchy of Table Sections – Profile 5

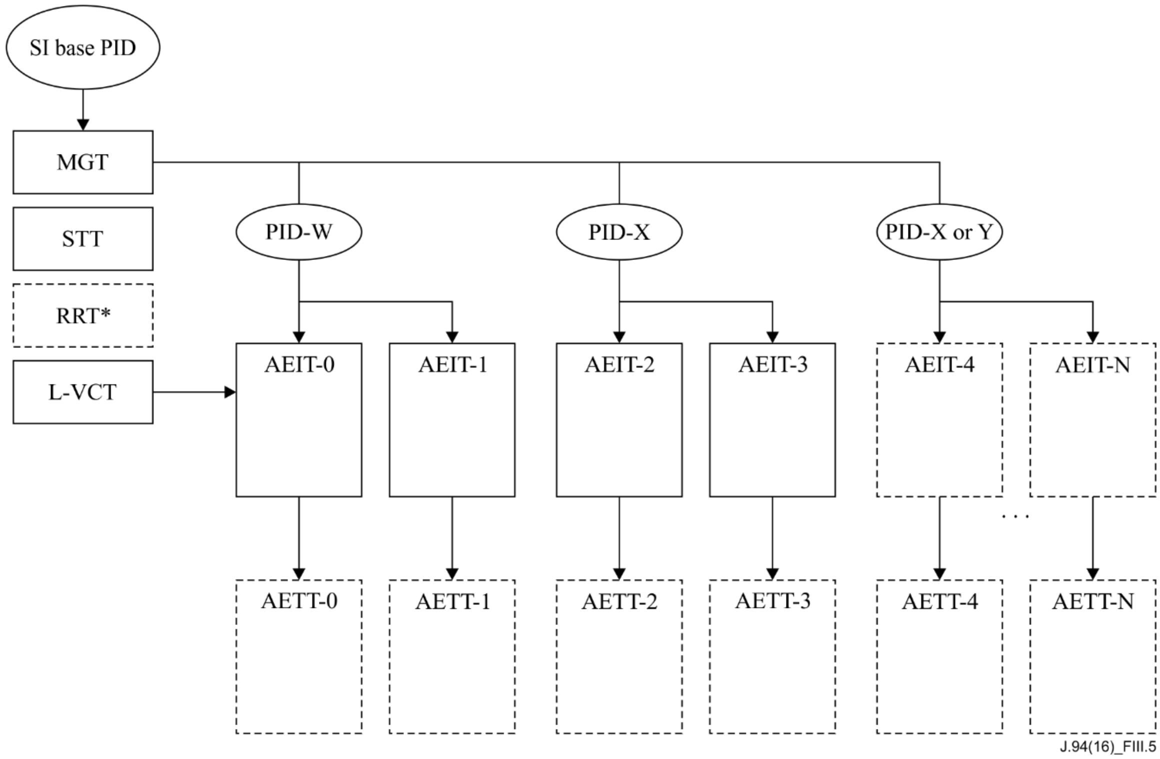


Figure III.5 – Hierarchy of Table Sections – Profile 6

The Short-form Virtual Channel Table section (table_ID 0xC4) or the Long-form Virtual Channel Table (table_ID 0xC9) provide navigation data on the out-of-band path. If MGT is provided, it references all tables present in Service Information (except the System Timetable).

The Master Guide Table provides general information about all of the other tables including the S-VCT, L-VCT, RRT, AEIT, and AETT. It defines table sizes necessary for memory allocation during decoding; it defines version numbers to identify those tables that need to be updated; and it gives the packet identifier (PID) values associated with instances of AEITs and AETTs.

In Profile 3 and higher, the Rating Region Table must be included, with one exception, to describe rating regions in use. The exception is that delivery of version 0 of the RRT for region 0x01 (US and possessions), need not be sent because this table is standardized in EIA-766. Furthermore, for Profile 3, the MGT need not be sent if no RRT is sent.

Aggregate Event Information Tables are included in the out-of-band data in Profiles 4-6. Each AEIT instance describes the events or TV programs associated with a particular three-hour time slot. In the AEIT table structure, program schedule and title data for all virtual channels is aggregated together.

Each AEIT instance is valid for a time interval of three hours. As shown in Figure III.3, at minimum, AEIT-0 through AEIT-3 must be sent. Therefore, when Profiles 4-6 are used, current program information and information covering nine to twelve hours of future programming will be available to the Host.

Up to 256 AEITs may be transmitted; over 30 days of future programming may therefore be described. For the fourth timeslot and beyond (AEIT-4 through AEIT-N), the tables may be associated with the same or different PID values.

The start time for any AEIT is constrained to be one of the following UTC times: 00:00 (midnight), 03:00, 06:00, 09:00, 12:00 (noon), 15:00, 18:00, and 21:00. Imposing constraints on the start times as well as the interval duration simplifies re-multiplexing. During re-multiplexing, AEIT tables coming from several distinct Transport Streams may end up grouped together or *vice versa*. If no constraints were imposed, re-multiplexing equipment would have to parse AEIT by content in real time, which is a difficult task.

However, it is also possible to regenerate one or several AEIT at any time for correcting and/or updating the content (e.g., in cases where "to be assigned" events become known). Regeneration of an AEIT may be flagged by updating version fields in the MGT. A new AEIT may also be associated with a PID value not in current use. The MGT may be updated to show this new PID value association.

In Profiles 4-6, there can be several Aggregate Extended Text Tables, each of them having its associated PID defined in the MGT. As its name indicates, the purpose of an Aggregate Extended Text Table is to carry textual data. For example, for an event such as a movie listed in the AEIT, the typical data is a short paragraph that describes the movie itself. Each Aggregate Event Information Table can have one associated AETT. Each AETT instance includes all the text associated with events starting within a particular timeslot. Aggregate Extended Text Tables are optional in Profiles 4-6.

III.2 SI_base PID

Data associated with the SI_base PID defines information of system-wide applicability such as frequency plans, channel maps, and channel names. The SI_base PID value is 0x1FFC. The types of table sections that may be included in the Network Stream include:

– Network Information Table, carrying the:
  - Carrier Definition Subtable,
  - Modulation Mode Subtable;
– Network Text Table, carrying the Source Name Subtable;
– Short-form Virtual Channel Table, carrying the:
  - Virtual Channel Map,
  - Defined Channels Map,
  - Inverse Channels Map;
– Long-form Virtual Channel Table;
– Master Guide Table;
– Rating Region Table;
– System Timetable.

Carrier Definition Subtable

The Carrier Definition Subtable provides a foundation for the definition of frequency plans by defining a set of carrier frequencies appropriate to a particular transmission medium. The CDS is stored in the Host as an array of as many as 255 CDS records, each consisting of:

– Carrier frequency, 15 bits, in units of 10 or 125 kHz.

Modulation Mode Subtable

The Modulation Mode Subtable provides a foundation for quick acquisition of digitally modulated waveforms. A separate MMS shall be transmitted in Network data for each transmission medium supported by that network. An MMS is stored in the Host as an array of up to 255 MMS records, each consisting of:

– Modulation format: analogue NTSC or QAM;
– Transmission system: ITU-T (North America) or ATSC;

- Symbol rate, in units of 1 Hz;
- Inner coding mode, expressed as either "none" or an integer ratio such as 1/2 or 3/4;
- For QAM modulation, the number of levels.

Each MMS contains entries for each modulation mode currently in use by any digital waveform, plus entries for any modes anticipated to be used. As with the CDS, changes to the table are rare.

Parameters defined within the MMS are not specifically manipulated by Hosts compliant with the SI protocol, but are referenced by the Host when attempting to acquire a digitally encoded and modulated waveform.

Short-form Virtual Channel Table and Virtual Channel Record

The Short-form Virtual Channel Table is a hierarchical data structure that may carry within it the Virtual Channel Map and Virtual Channel record, for support of up to 4096 channel definition records. Each virtual channel is associated with a 16-bit reference ID number called the source_ID. Each record in the VCM consists of:

- The MPEG program number, associating the virtual channel record with a program defined in the Program Association Table and TS Program Map Table.
- For virtual channels associated with programs carried in a program guide, the source_ID, a number that may be used to link the virtual channel to entries in the Electronic Program Guide (EPG) database.
- For virtual channels used as access paths to application code or data (such as EPG), the *application ID*[7].

Source ID

Source ID is a 16-bit number associated with each program source, defined in such a way that every programming source offered anywhere in the system described in this Service Information annex is uniquely identified. For example, HBO/W has a different assigned source ID than HBO/E, and both are different from HBO-2 or HBO-3. Uniqueness is necessary to maintain correct linkages between an EPG database and virtual channel tables. See below for a discussion of the relationship between source_ID, virtual channels, and an EPG database.

Source Names and Source Name Subtable

The Source Name is a variable length multilingual text string associating a source ID with a textual name. The Source Name Subtable is delivered within the Network Text Table section.

Source name information is delivered in a table format separate from the table containing other information comprising the virtual channel table. Name information is not strictly necessary for channel acquisition, and (depending on the memory management scheme employed in the Host) may not always be available from memory at acquisition time. Source name information may be refreshed often, and can be available within several seconds of acquisition.

An EPG database may define textual reference names associated with given program sources (referenced by source ID). Such a database may be used to derive virtual channel names in some applications, though in an EPG database the name is generally abbreviated due to display considerations.

[7] Source ID and application ID need never be defined in the same virtual channel record, therefore they share a common 16-bit field in the stored map. Channels are defined as for "application access" or not; if they are application access, the field defines the application ID, if not, it defines the source ID.

Name data is, unlike the regular VCT data, language tagged, so that multilingual source names may be defined. Transmission format for multilingual text is defined to include references to multiple phonetic and ideographic character sets.

Defined Channels Map and Inverse Channels Map

For a given Standard-compliant channel, DCM data consist of a series of bytes that, taken as a whole, specify which channels in the map are defined, and which are not.

Each Virtual Channel Table has associated with it a table listing source_IDs and their associated virtual channel numbers. The source_ID values are sorted by value from the lowest to the highest in the table, to facilitate (using a binary search) lookup of a virtual channel given a source ID.

Master Guide Table

Use of the MGT is optional in certain profiles. Table III.1 shows a typical Master Guide Table indicating, in this case, the existence in the Transport Stream of a Long-form Virtual Channel Table, the Rating Region Table, four Aggregate Event Information Tables, and two Aggregate Extended Text Tables describing the first six hours' events.

Table III.1 – Example Master Guide Table content

table_type	PID	version_number	table size (bytes)
LVCT	0x1FFC	4	5 922
RRT – region 6	0x1FFC	0	1 020
AEIT-0 – MGT_tag = 56	0x1DD2	6	29 250
AEIT-1 – MGT_tag = 57	0x1DD2	4	28 440
AEIT-2 – MGT_tag = 58	0x1DD3	10	25 704
AEIT-3 – MGT_tag = 59	0x1DD3	2	27 606
AETT-0 – MGT_tag = 56	0x1DD2	2	24 004
AETT-1 – MGT_tag = 57	0x1DD2	7	25 922
AETT-2 – MGT_tag = 58	0x1DD3	8	27 711
AETT-3 – MGT_tag = 59	0x1DD3	0	19 945

The first entry of the MGT describes the version number and size of the Long-form Virtual Channel Table. The second entry corresponds to an instance of the Rating Region Table for region 6. If some region's policy makers decided to use more than one instance of an RRT, the MGT would list each PID, version number, and size.

The next entries in the MGT correspond to the four AEITs that must be supplied in the Transport Stream for profiles 4-6. After the AEITs, the MGT references four Aggregate Extended Text Tables. The PID values for AEIT-0 and AEIT-1 are both 0x1DD2. MGT_tag values 56 and 57 are used for these. For AEIT-2 AEIT-3, PID 0x1DD3 is used. The last four references are to Aggregate ETTs.

Note that AETT-n shares a common PID value with AEIT-n for every value of n. AEIT-0 and AETT-0 are associated with PID 0x1DD2, as are AEIT-1 and AETT-1. AEIT-2 and AETT-2 are associated with PID 0x1DD3, etc.

Descriptors can be added for each entry as well as for the entire MGT. By using descriptors, future improvements can be incorporated without modifying the basic structure of the MGT. The MGT is like a flag table that continuously informs the Host about the status of all the other tables (except the System Time which has an independent function). The MGT is continuously monitored at the Host to prepare and anticipate changes in the channel/event structure. When tables are changed at the broadcast side and the PID association is unchanged, their version numbers are incremented and the new numbers are listed in the MGT. Another method that can be used to change tables is to associate the updated tables with different PID values, and then update the MGT to reference the new PID values. Based on the MGT version or PID updates and on the memory requirements, the Host can reload the newly defined tables for proper operation.

Table III.2 is an example of a MGT that may be sent after the instance in Table III.2 has expired due to the passage of time. In this example, three hours have passed, and the time slot covered in the old AEIT-0 is in the past. The AEIT with MGT_tag = 57 moves now to become AEIT-0. The AEIT with MGT_tag = 58, the new AEIT-1, moves to PID 0x1DD2. A new AEIT is added to the mix, the AEIT with MGT_tag = 60.

Table III.2 – Example Revised Master Guide Table content

table_type	PID	version_number	table size (bytes)
LVCT	0x1FFC	4	5 922
RRT – region 6	0x1FFC	0	1 020
AEIT-0 – MGT_tag = 57	0x1DD2	4	28 440
AEIT-1 – MGT_tag = 58	0x1DD2	10	25 704
AEIT-2 – MGT_tag = 59	0x1DD3	2	27 606
AEIT-3 – MGT_tag = 60	0x1DD3	0	30 055
AETT-0 – MGT_tag = 57	0x1DD2	7	25 922
AETT-1 – MGT_tag = 58	0x1DD2	8	27 711
AETT-2 – MGT_tag = 59	0x1DD3	0	19 945
AETT-3 – MGT_tag = 60	0x1DD3	0	22 522

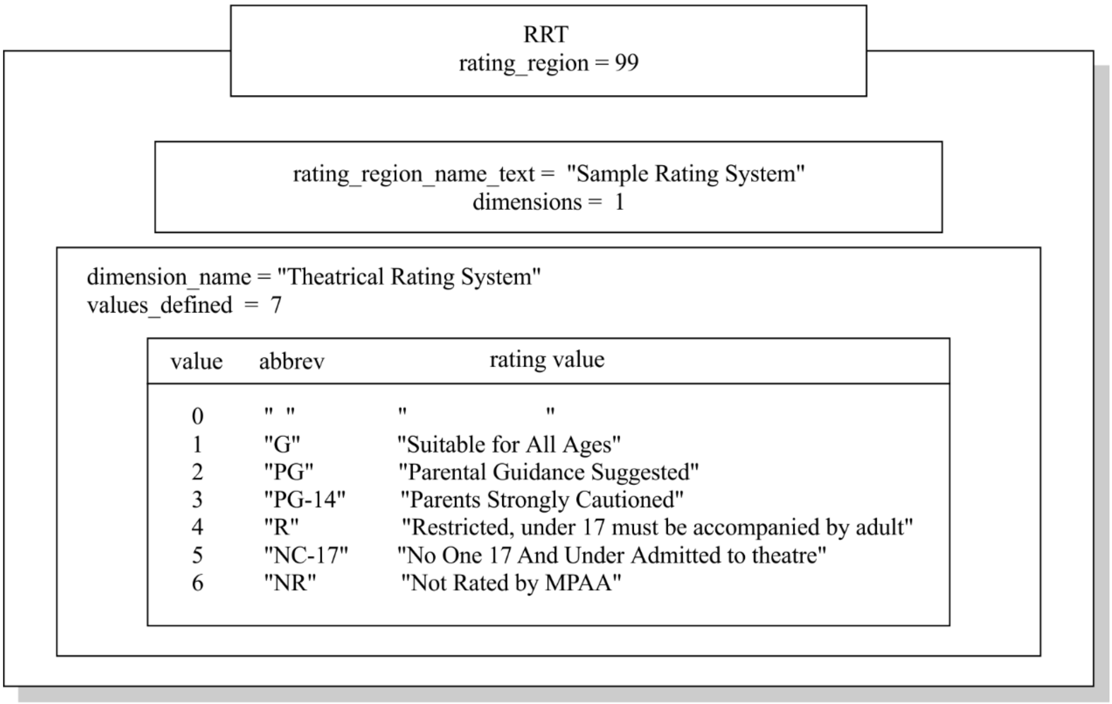
L-VCT

The L-VCT combines all the data pertinent to the description of a virtual channel into a single table. Use of the L-VCT instead of the S-VCT eliminates the need to send CDS, MMS, SNS, DCM, or ICM. The L-VCT follows the standard MPEG-2 long-form section syntax (section_syntax_indicator = 1).

Rating Region Table

The Rating Region Table is a fixed data structure in the sense that its content remains mostly unchanged. It defines the rating standard that is applicable for each region and/or country. The concept of table instance introduced in the previous clause is also used for the RRT. Several instances of the RRT can be constructed and carried in the Transport Stream simultaneously. Each instance is identified by a different table_id_extension value (which becomes the rating_region in the RRT syntax) and corresponds to one and only one particular region. Each instance has a different version number which is also carried in the MGT. This feature allows updating each instance separately.

Figure III.6 shows an example of one instance of an RRT, defined for rating region 99 and carrying an example rating system. Each event listed in any of the EITs may carry a content advisory descriptor. This descriptor is an index or pointer to one or more instances of the RRT.


RRT
rating_region = 99
rating_region_name_text = "Sample Rating System"
dimensions = 1
dimension_name = "Theatrical Rating System"
values_defined = 7

value	abbrev	rating value
0	" "	" "
1	"G"	"Suitable for All Ages"
2	"PG"	"Parental Guidance Suggested"
3	"PG-14"	"Parents Strongly Cautioned"
4	"R"	"Restricted, under 17 must be accompanied by adult"
5	"NC-17"	"No One 17 And Under Admitted to theatre"
6	"NR"	"Not Rated by MPAA"

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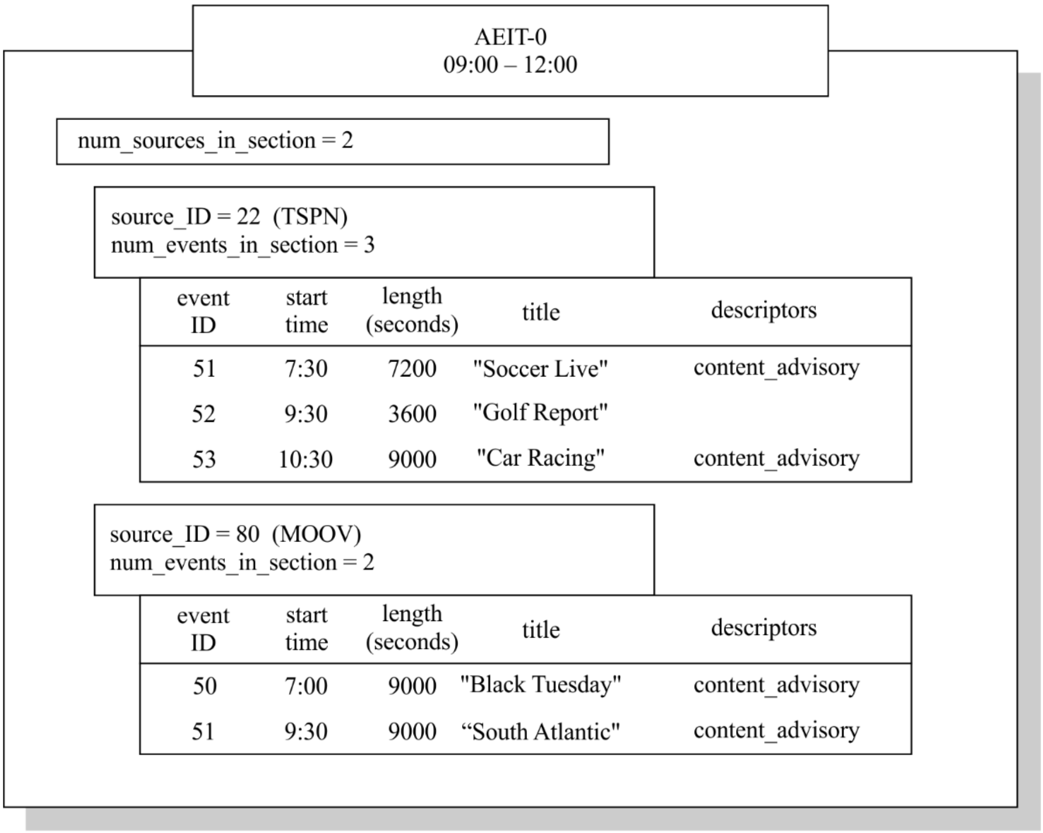
Figure III.6 – An instance of a Rating Region Table

Aggregate Event Information Tables and Aggregate Extended Text Tables

The purpose of an AEIT is to list all events for those channels that appear in the VCT for a given time window. As mentioned before, AEIT-0 describes the events for the first 3 hours and AEIT-1 for the second 3 hours. AEIT-0 and AEIT-1 share a common associated PID value as defined in the MGT. In MPEG, tables can have a multitude of instances. When different instances of a table share the same table_id value and PID, they are distinguished by differences in the 16-bit table_id_extension field.

In this SI appendix for out-of-band use, each instance of AEIT-k contains a list of events for each virtual channel. Linkage to each channel in the VCT is made via the source_ID. For the AEIT, the table_id_extension field appears as MGT_tag.

Figure III.7 shows, for example, a program provider's instance for AEIT-0.



AEIT-0
09:00 – 12:00

num_sources_in_section = 2

source_ID = 22 (TSPN)
num_events_in_section = 3

event ID	start time	length (seconds)	title	descriptors
51	7:30	7200	"Soccer Live"	content_advisory
52	9:30	3600	"Golf Report"	
53	10:30	9000	"Car Racing"	content_advisory

source_ID = 80 (MOOV)
num_events_in_section = 2

event ID	start time	length (seconds)	title	descriptors
50	7:00	9000	"Black Tuesday"	content_advisory
51	9:30	9000	“South Atlantic"	content_advisory

Figure III.7 – Example AEIT-0

AEIT-0 is unique in that it must list all events starting within the three-hour time period it covers, as well as any events that started earlier but extend into the covered period. For all other AEITs, only those events actually starting within the three hour time period are included. The Host is expected to collect AEITs in order of their time coverage. If AEIT-4 is available to the Host but AEIT-3 is not, for example, information for events that started in the time period covered by AEIT-3 but extending into AEIT-4 will not be available for display.

Figure III.7 shows an example of a small AEIT-0, including event data for two sources, a channel called "TSPN" (source_ID 22) and one called "MOOV" (source_ID 80). For the three-hour period covered by AEIT-0, 9 a.m. to noon, three events are listed for TSPN and two for MOOV. The field event_id is a number used to identify each event. The event_id is used to link events with associated text delivered in the AETT. The assignment of an event_ID value must be unique within a source ID and a 3-hour interval defined by one AEIT instance. The event_id is followed by the start_time and then the length_in_seconds. Notice that for AEIT-0 only, events can have start times before the activation time of the table. ETMs are simply long textual descriptions. The collection of ETMs constitutes an Aggregate Extended Text Table (ETT).

An example of an ETM for the Car Racing event may be:

"Live coverage from Indianapolis. This car race has become the largest single-day sporting event in the world. Two hundred laps of full action and speed."

Several descriptors can be associated with each event. The most important is the content advisory descriptor which assigns a rating value according to one or more systems. Recall that the actual rating system definitions are tabulated within the RRT.

Figure III.8 diagrams the AEIT data structure. As shown, the AEIT includes event data for all sources listed in the VCT. In the figure, the hatched box represents one or more "event data" blocks, each comprised of the data items shown in the upper left.

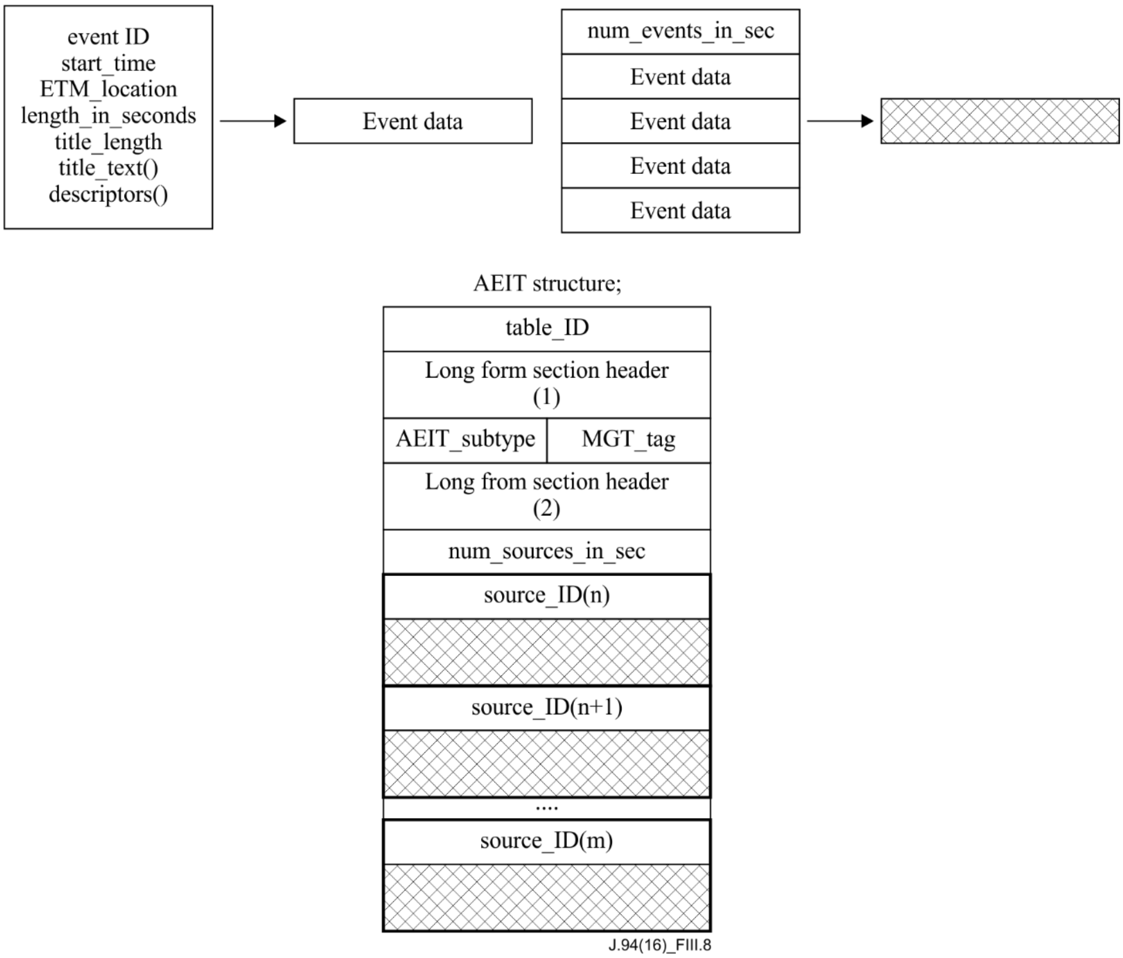


Figure III.8 – AEIT data structure

Figure III.9 diagrams the AETT data structure. The AETT aggregates text for a given timeslot into one sectioned MPEG table.

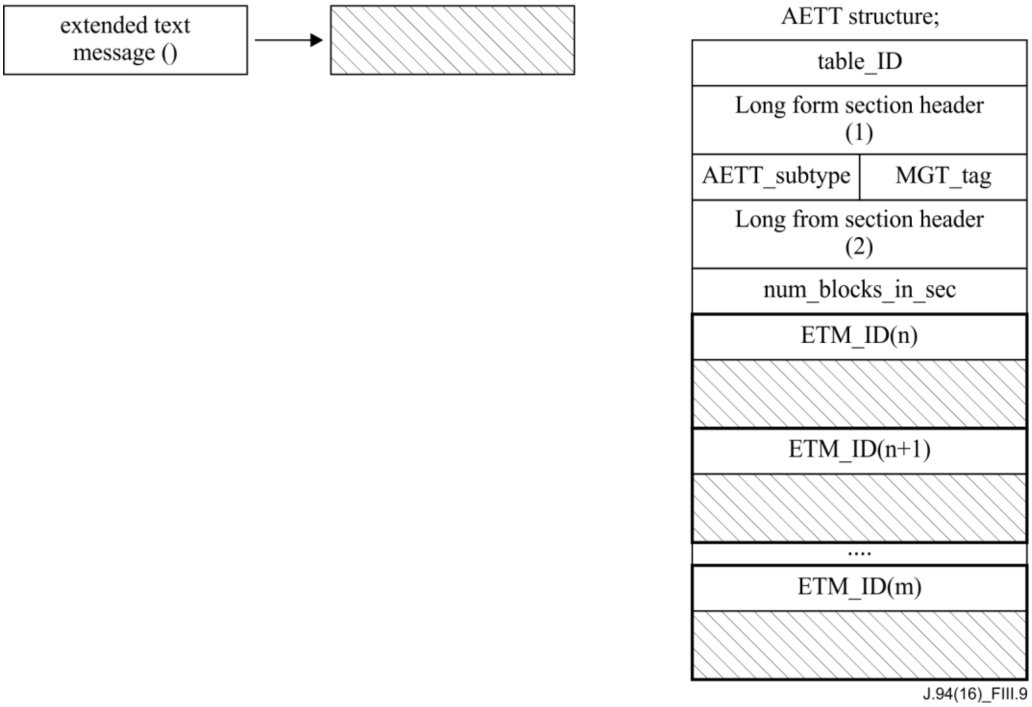


Figure III.9 – Structure of AETT

An AETT-*n* instance for a given value of *n* (timeslot) is associated with the same PID value as AEIT-*n*. This means that they can be collected using a single Extended Channel data flow between Host and POD.

Inactive Channels

Any channels in the L-VCT which are not currently active shall have the hidden attribute set to 1 and the hide_guide attribute set to 0. Inactive channels in the S-VCT shall have the hidden attribute in channel_type, and the hide_guide flag in the channel_properties_descriptor() set to 0.

Table III.3 shows expected DTV behavior for the various combinations of the hidden and hide_guide attributes. In the table the "x" entry indicates "don't care." A check in the "surf" column indicates the channel is available by channel surfing and via direct channel number entry. A check in the "guide" column indicates that the channel may appear in the program guide listing.

Table III.3 – Receiver Behavior with hidden and hide_guide attributes

hidden	**Hide_guide**	**Receiver Behavior**		
		Surf	Guide	
0	x	✓	✓	Normal channel
1	1			Special access only
1	0		✓	Inactive channel

III.3 Representation of Time

The System Timetable provides time of day information to Hosts. In this Service Information appendix, time of day is represented as the number of seconds that have elapsed since the beginning of "GPS time," 0000 Hours UTC, January 6th, 1980. GPS time is referenced to the Master Clock at the US Naval Observatory and steered to Coordinated Universal Time (UTC). UTC is the current time of day at the time zone local to Greenwich, England, and is the time source we use to set our clocks.

The cycle of the seasons, technically known as the tropical year, is approximately 365.2422 days. Using the Gregorian calendar we adjust for the fractional day by occasionally adding an extra day to the year. Every fourth year is a leap year, except that three leap years in every 400 are skipped (the centennial years not divisible by 400). With this scheme there are 97 leap years in each 400 year span, yielding an average year that is 365.2425 days long.

UTC is occasionally adjusted by one-second increments to ensure that the difference between a uniform time scale defined by atomic clocks does not differ from the Earth's rotational time by more than 0.9 seconds. The timing of occurrence of these "leap seconds" is determined by careful observations of the Earth's rotation; each is announced months in advance. On the days it is scheduled to occur, the leap second is inserted just following 12:59:59 p.m. UTC.

UTC can be directly computed from the count of GPS seconds since January 6th, 1980 by subtracting from it the count of leap seconds that have occurred since the beginning of GPS time. In the months just following January 1st, 1999, this offset was 13 seconds.

This protocol defines various time-related events and activities, including starting times for programs, text display, changes to VCTs, and others. Two methods of time distribution are used in headend systems. One method derives time in the form of GPS seconds from GPS Hosts. These Hosts also provide current GPS/UTC offset data. The second method of time distribution relies on the Internet Standard Network Time Protocol (NTP). NTP servers provide output in the form of UTC time, and do not provide GPS/UTC offset data. The Standard-compliant Host is synchronized to system time by the System Timetable, which provides time either in the form of GPS seconds since week zero of GPS time, January 6th, 1980, or directly in UTC time. The interpretation depends on the value of the GPS/UTC offset field. The special value of zero is used to indicate that the system is being driven by a UTC time source directly, and that GPS/UTC offset data is not available.

System Time

GPS satellites typically output GPS time in a format consisting of a week count (Tw) and a seconds within the week count (Ts), where week zero is defined as starting January 6th, 1980. For purposes of building the System Timetable, the following formula may be used:

$$T = (Tw * 604\,800) + Ts$$

There are 604 800 seconds per week.

When converting between GPS seconds and current local time in hours/minutes/seconds, the following factors must be taken into account:

– GPS to UTC offset – Given a time represented as GPS seconds, the Host first subtracts the GPS/UTC offset to convert to UTC.

– 1980 – The first year of GPS time started on January 6th, yielding 361 days in the first year (1980 was also a leap year).

– Leap years – The number of leap years that occurred between the current GPS second and 1980 must be accounted for. A leap year is a year whose number is evenly divisible by four, or, in the case of century years, by 400.

NOTE – According to this rule, the year 2000 *is* a leap year even though it is a century year, because it is also divisible by 400.

– **Time zones** – Time zones are signed integer values in the range −12 to +13 hours, where positive numbers represent zones east of the Greenwich meridian and negative numbers west of it. Pacific Standard Time (PST) is 8 hours behind standard time, and Eastern Standard Time (EST) is 5 hours behind. The system defined by this Service Information standard accommodates time zones that are not an integral number of hours offset from Greenwich by defining time zone as an 11-bit signed integer number in units of minutes. To convert to local time, the time zone is added to Greenwich time using signed integer arithmetic.

– **Daylight savings time** – If applicable, daylight savings time must be taken into account. On a unit by unit basis, each Host may be given a definition for when daylight savings time is entered into in Spring, and when it is exited in Fall. Entry/exit points are given as absolute times (GPS seconds), and hence are given in one second resolution.

Transmission Format for Event Times

In this messaging protocol, the absolute time of action is specified for most events in terms of an unsigned 32-bit integer number, the count of GPS seconds since January 6th, 1980. This count does not wrap until after the year 2116[8].

Handling of Leap Second Events

In this Service Information protocol, times of future events (such as event start times in the EIT) are specified the same as time of day, as the count of seconds since January 6th, 1980. Converting an event start time to UTC and local time involves the same calculation as the conversion of system time to local time. In both cases, the leap seconds count is subtracted from the count of GPS seconds to derive UTC.

GPS time is used to represent future times because it allows the Host to compute the time interval to the future event without regard for the possible leap second that may occur in the meantime. Also, if UTC were to be used instead, it would not be possible to specify an event time that occurred right at the point in time where a leap second was added. UTC is discontinuous at those points.

Around the time a leap second event occurs, program start times represented in local time (UTC adjusted by local time zone and [as needed] daylight savings time) may appear to be off by plus or minus one second. Generating equipment may use one of two methods to handle leap seconds.

In method A, generating equipment does not anticipate the future occurrence of a leap second. In this case, prior to the leap second, program start times will appear correct. An event starting at exactly 10 a.m. will be computed as starting at 10:00:00. But just following the leap second, that same event time will be computed as 9:59:59. The generating equipment should re-compute the start times in all the EITs and introduce the leap second correction. Once that happens, and Hosts have updated their EIT data, the computed time will again show as 10:00:00. In this way the disruption can be limited to a matter of seconds.

In method B, generating equipment does anticipate the occurrence of a leap second, and adjusts program start times for events happening after the new leap second is added. If the leap second event is to occur at midnight tonight, an event starting at 10 a.m. tomorrow will be computed by receiving equipment as starting at 10:00:01.

For certain types of events, the precision of method B is necessary. By specifying events using a time system that involves no discontinuities, difficulties involving leap seconds are avoided. Events such as program start times do not require that level of precision. Therefore, method A works well.

[8] Prior to that time, all initial Receivers will surely be out of service, and new ones can be designed to handle the wrap condition.

Handling of Leap Second Events

Consider the following example. Times are given relative to UTC, and would be corrected to local time zone and daylight savings time as necessary.

–	Time of day (UTC):	1:00 p.m., December 30th, 1998
–	Event start time (UTC):	2:00 p.m., January 2nd, 1999

– A leap second event will occur just after 12:59:59 p.m. on December 31st , 1998.

– Leap seconds count on December 30th is 12.

The data in the System Timetable is:

– GPS seconds = 599 058 012 = 0x23B4E65C

– GPS to UTC offset = 12

Using method A (upcoming leap second event is not accounted for):

–	Event start time in EIT:	599 320 812 = 0x23B8E8EC
–	Converted to UTC:	2:00:00 p.m., January 2nd, 1999
–	Number of seconds to event:	262 800 = 73 hours, 0 minutes, 0 seconds

Using method B (upcoming leap second event is anticipated):

–	Event start time in EIT:	599 320 813 = 0x23B8E8ED
–	Converted to UTC:	2:00:01 p.m., January 2nd, 1999
–	Number of seconds to event:	262 801 = 73 hours, 0 minutes, 1 second

Note that using method B, the number of seconds to event is correct, and does not need to be recomputed when the leap seconds count moves from 12 to 13 at year-end.

Appendix IV

Daylight Savings Time control for System B

(This appendix does not form an integral part of this Recommendation.)

In order to convert GPS into local time, the Host needs to store a time offset (from GPS to local time) in local memory and an indicator as to whether daylight savings is observed. These two quantities can be obtained from the user interface (indicating time zone and daylight savings observance) or from the conditional access system, if present, and stored in non-volatile Host memory.

Since there is a common time (GPS) transmitted in SI, a mechanism to indicate when the Host should switch into (or out of) daylight savings time at the appropriate local time can be very useful. Once all the Hosts have transitioned at their local times, the entire system can be shifted into daylight savings time. This is accomplished by appropriate setting of the daylight_savings in the daylight_savings_time_descriptor() the STT. The basic use of daylight savings fields through the year is shown in Table IV.1.

Table IV.1 – Basic use of daylight savings fields through the year

Conditions	DS status	DS_day of_month	DS_hour
At the beginning of the year (January) daylight savings is off. This is the status of the fields until:	0	0	0
When the transition into daylight savings time is within less than one month, the DS_day_of_month field takes the value day_in, and the DS_hour field takes the value hour_in. The DS_status bit is 0 indicating it is not yet daylight savings time. (The transition is to occur on the day_in day of the month at hour=hour_in; for example, if the transition were on April 15 at 2 a.m., then day_in=15 and hour_in=2.)	0	day_in	hour_in
After all time zone daylight transitions (within the span of the network) have occurred, the DS_status bit takes the value 1, indicating that daylight savings time is on. The DS_day_of_month field and the DS_hour field take the value 0. (In the U.S., this transition has to occur no later than 7 p.m. Pacific Time on the day day_in.) This is the status of the fields until:	1	0	0
When the transition out of daylight savings time is within less than one month, the DS_day_of_month field takes the value day_out, and the DS_hour field takes the value hour_out. The DS_status bit is 1 indicating it is still daylight savings time. (The transition is to occur on the day_out day of the month at hour=hour_out; for example, if the transition were on October 27 at 2 a.m., then day_out=27 and hour_out=2.)	1	day_out	hour_out
After all time zones (within the span of the network) have shifted out of daylight savings time, the DS_status bit takes the value 0, indicating that daylight savings time is off. The DS_day_of_month field and the DS_hour field take the value 0. (In the U.S., this transition has to occur no later than 7 p.m. Pacific Time on the day day_out.) This finishes the cycle.	0	0	0

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