GUIDELINES ON IMPLEMENTATION AND USAGE OF SERVICE INFORMATION

DVB Document A005 Rev.1
March 1998

DVB Project Office
March 1998

Contents

Digital Video Broadcasting (DVB) Project

Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

* European Broadcasting Union
Case Postale 67
CH-1218 GRAND SACONNEX (Geneva)
Switzerland

Tel: +41 22 717 21 11
Fax: +41 22 717 24 81

1 Scope

This BlueBook provides implementation guidelines for the use and implementation of the Digital Video Broadcasting (DVB) Service Information (SI) coding in a DVB digital TV environment including satellite- cable- and terrestrial networks.

The guidelines are intended to be highly recommended rules for the usage of the DVB SI syntax specified in ETS 300 468 [1]. As such, they facilitate the efficient and reliable implementation of basic user-interaction functions in Integrated Receiver-Decoders (IRDs). The rules apply to broadcasters, network operators as well as manufacturers.

The rules are specified in the form of constraints on the DVB SI streams or in terms of intended interpretation by IRDs.

The specification of these functions in no way prohibits IRD manufacturers from including additional features, and should not be interpreted as stipulating any form of upper limit to the performance. The guidelines do not cover features related to user-interface details or advanced Electronic Program Guides (EPG). Such issues are left to the marketplace.

NOTE: It is highly recommended that the IRD should be designed to allow for future compatible extensions to the DVB SI syntax. All the fields "reserved" (for ISO), "reserved_future_use" (for ETSI), and "user defined" in the ETS 300 468 [1] should be ignored by IRDs designed not to make use of them. The "reserved" and "reserved_future_use" fields may be specified in the future by the respective bodies, whereas the "user defined" fields will not be standardized.

This guidelines document uses the terminology defined in ETS 300 468 [1] and should be read in conjunction with that ETS.

2 References

For the purposes of this BlueBook, the following references apply:

[1] ETS 300 468: "Digital broadcasting systems for television, sound and data services; specification for Service Information (SI) in Digital Video Broadcasting (DVB) systems".

[2] ISO/IEC 13818-1: "Information Technology - Generic Coding of Moving Pictures and Associated Audio Recommendation H.222.0 (systems)".

[3] ETS 300 472: "Digital broadcasting systems for television, sound and data services; Specification for conveying ITU-R System B Teletext in Digital Video Broadcasting (DVB) bitstreams".

[4] ETR 162: "Digital broadcasting systems for television, sound and data services; Allocation of Service Information (SI) codes for Digital Video Broadcasting (DVB) systems".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this BlueBook, the following definitions apply:

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

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

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

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

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.

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.

MPEG-2: Refers to the standard ISO/IEC 13818. Systems coding is defined in part 1. Video coding is defined in part 2. Audio coding is defined in part 3.

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

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

section: A section is a syntactic structure used for mapping all service information into ISO/IEC 13818-1 [2] Transport Stream packets.

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

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

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

sub-table: A sub-table is comprised of a number of sections with the same value of table_id, table_id_extension 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".

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

transport stream: A data structure defined in ISO 13818-1 [2]. It is the basis of the Digital Video Broadcasting (DVB) standards.

3.2 Abbreviations

For the purposes of this BlueBook, the following abbreviations apply:

BAT	Bouquet Association Table
bslbf	bit string, left bit first
CA	Conditional Access
DIT	Discontinuity Information Table
DVB	Digital Video Broadcasting
EIT	Event Information Table
EPG	Electronic Program Guide
IRD	Integrated Receiver-Decoder
MJD	Modified Julian Date
MPEG	Moving Pictures Expert Group
NIT	Network Information Table
NVOD	Near Video On Demand
PAT	Program Association Table
PCR_PID	Program Clock Reference_ Packet IDentifier
PID	Packet IDentifier
PMT	Program Map Table
PSI	Program Specific Information
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RST	Running Status Table
SDT	Service Description Table
SHY	Soft Hyphen
SI	Service Information
SIT	Selection Information Table
SMATV	Satellite Master Antenna TeleVision
ST	Stuffing Table
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream
uimsbf	unsigned integer, most significant bit first
UTC	Universal Time Coordinated
VCR	Video Cassette Recorder

4 Rules of operation

This clause contains some recommendations on the usage of the Digital Video Broadcasting (DVB) Service Information (SI) syntax.

4.1 Service Information (SI) table information

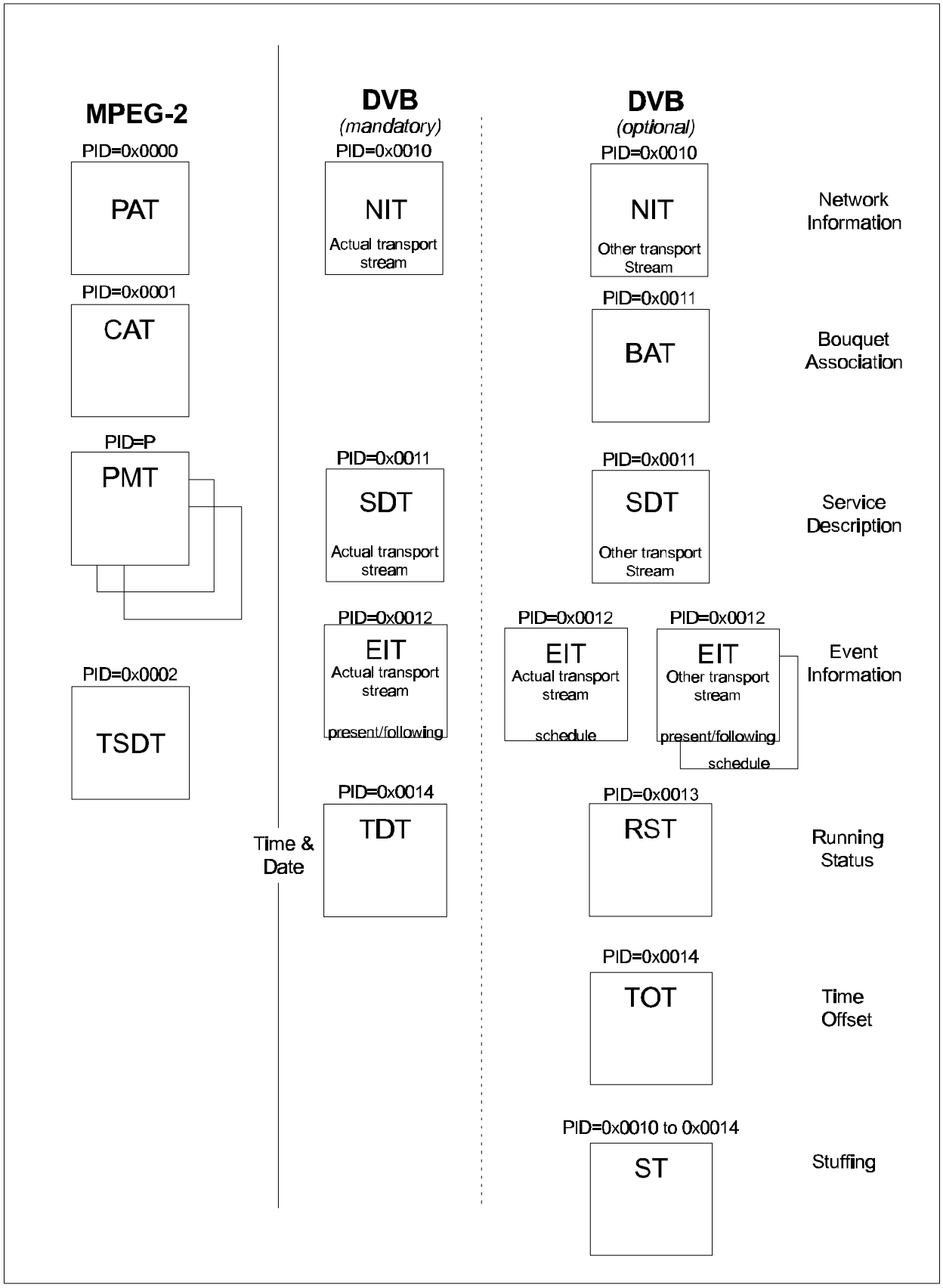


Figure 1: SI table information

4.1.1 Network Information Table (NIT) information

The Network Information Table (NIT) provides a grouping of Transport Streams (TSs) and the relevant tuning information. The NIT could be used during set-up procedures of the IRD and the relevant tuning information may be stored in non-volatile memory. The NIT also could be used to signal changes of tuning information. The following rules apply to the NIT:

a) transmission of the NIT is mandatory for the actual delivery system;

b) the NIT describing the actual delivery system is valid if and only if it contains applicable delivery system descriptors for the actual delivery system. This rule specifies the conditions under which the NIT contains valid information. At some transitions of broadcast delivery system boundaries, the NIT carried in a Transport Stream is allowed to describe an earlier network in the broadcast chain. A different mechanism has to be selected by the IRD to obtain the relevant tuning information for the actual delivery system. If a satellite IRD receives a satellite delivery system descriptor for the actual delivery system, then it is valid. If a cable IRD receives a cable delivery system descriptor for the actual delivery system, then it is valid. If a cable IRD receives a satellite delivery system descriptor for the actual delivery system, then it is assumed to be invalid for the cable IRD;

c) if a valid NIT for the actual delivery system is present in the SI bit stream then it shall list all Transport Streams of the actual delivery system;

d) the SI stream shall have at least 8 Transport Stream packets per 10 seconds carrying NIT data or NULL packets. This rule simplifies the replacement of the NIT at broadcast delivery system boundaries. With the simple replacement mechanism, local frequency control is possible with relatively low cost equipment.

The SI uses two labels related to the concept of a delivery system, namely the network_id and the original_network_id. The latter is intended to support the unique identification of a service, contained in a Transport Stream (TS), even if that Transport Stream has been transferred to another delivery system than the delivery system where it originated. A transport stream can be uniquely referenced through the path original_network_id/transport_stream_id. A service can be uniquely referenced through the path original_network_id/transport_stream_id/service_id. The network_id, thus, is not part of this path. In addition each service_id shall be unique within each original_network_id. When a service (contained inside a Transport Stream) is transferred to another delivery system, only the network_id changes, whereas the original_network_id remains unaffected.

By way of example, consider the following, where two services (A and B), which originate in two different delivery systems and happen to have the same service_ids and transport_stream_ids, are transferred to a new delivery system.

In the example, the two services are located on different transport streams (X and Y) in the new network. Note that if the two services were being combined onto the same transport stream, then it would be necessary to modify the identification of the services, since the same service_id value cannot be assigned to more than one service within a transport stream, and only one original_network_id can be associated with a transport stream (see subclause 5.3 for further discussion on transitions at broadcast delivery media boundaries).

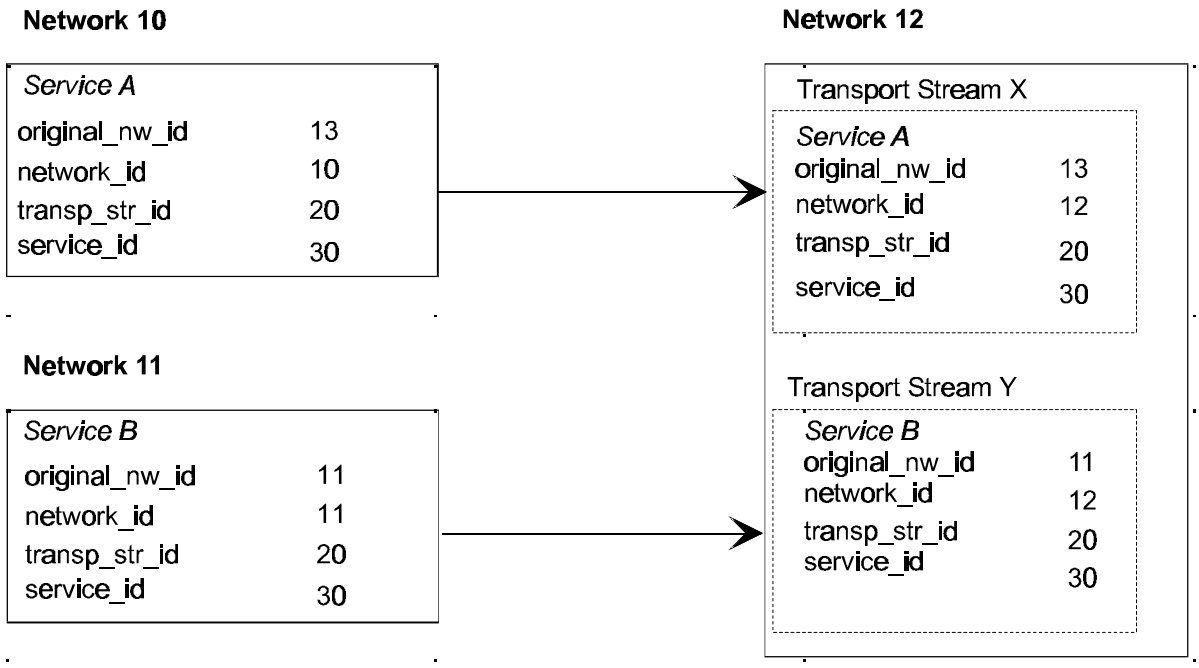


Figure 2: Transfer to a new delivery system

4.1.2 Bouquet Association Table (BAT) information

The Bouquet Association Table (BAT) provides a grouping of services which serves as one basis on which an IRD presents the available services to a user. Transmission of the BAT is optional. The following rule improves the consistency in the SI bit streams and simplifies the processing in the IRDs.

The SI bit stream shall list in each BAT sub-table all the services belonging to that bouquet.

NOTE: One service may belong to more than one bouquet. This rule creates consistency across the different Transport Streams which are accessible to the IRD.

If it is intended for the IRD to present service information to the user grouped in bouquets, then it would be beneficial to ensure that every service is listed in one or more bouquets, or some services will be omitted from this method of presentation. A bouquet may group together services from more than one Transport Stream, which could even be carried in different networks. The IRD's access to information on all the services of a bouquet would be facilitated if all the services referred to in the BAT were listed in the Service Description Table (SDT). Similarly, the IRD's access to these services is facilitated if NIT information is given for all Transport Streams in which services of the bouquet occupy capacity.

4.1.3 Service Description Table (SDT) information

The SDT is used to list the names and other parameters of the services within Transport Streams. For each Transport Stream a separate SDT sub-table exists. The following rules apply in order to improve the acquisition of services:

- the transmission of the SDT for the actual Transport Stream is mandatory;
- the SI bit stream shall list in the SDT of a particular Transport Stream at least all the services of that Transport Stream.

In addition:

- any SDT for another Transport Stream than the actual one (i.e. with table_id = 0x46) shall list all the services of that Transport Stream;
- it is strongly recommended that service_ids, once assigned to a specific service within a network, remain unchanged in order to enable IRDs to implement features like favourite channel lists, etc.

4.1.4 Event Information Table (EIT) information

The Event Information Table (EIT) is used to transmit information about present, following and further future events. For each service a separate EIT sub-table exists.

4.1.4.1 EIT Present/Following information

The following rule simplifies the acquisition of the EIT Present/Following information. The SI specification states that an EIT section has a maximum size of 4 096 bytes.

The SI bit stream shall have two sections per service for an EIT Present/Following with the section_number 0x00 reserved for the description of the present event and section_number 0x01 for the following event. These constraints do not apply in the case of an NVOD reference service which may have more than one event description per section, and may have more than two sections in the EIT Present/Following. It is recommended that the event descriptions be given in ascending order of event_id.

The SI bit stream shall have maximum of 4 096 bytes to describe a single event in a section.

The organisation of the EIT Present/Following is based on the concept of present and following events. Which event is the present one can be determined using the following scheme:

a) at each instant in time, there is at most one present event;

b) when there is a present event, this event shall be described in section 0 of the EIT Present/Following;

c) when there is no present event (e.g. in the case of a gap in the schedule) an empty section 0 of the EIT Present/Following shall be transmitted;

d) the running_status field in the description of the present event shall be given the interpretation in table 1:

Table 1: running_status of the present event

undefined	No information except the nominal status is provided. IRDs and VCRs shall treat the present event as running.
running	IRDs and VCRs shall treat the present event as running.
not running	IRDs and VCRs shall treat the present event as not running. In other words, this event is nominally the present one, but at this time has either not started or already ended.
pausing	IRDs and VCRs shall treat the present event as pausing. In other words, this event is nominally the present one and has already started, but at this time the material being broadcast is not a part of the event itself. The transmission of event material shall resume at a later time.
starts in a few seconds	IRDs and VCRs shall prepare for the change of event status to "running" in a few seconds.

The duration of an event as encoded in the field duration of the EIT shall also include the duration of all times when the event has the status "not running" or "paused". The start time of an event as encoded in the field start_time of the EIT shall be the start time of the entire event, i.e. not the start time after the pause has finished.

e) at each point in time, there shall be at most one following event;

f) if a following event exists, it shall be described in section 1 of the EIT Present/Following;

g) if no following event exists, an empty section 1 of the EIT Present/Following shall be transmitted;

h) the running_status field in the definition of the following event shall be given the following interpretation:

Table 2: running_status of the following event

undefined	No information except the nominal status is provided. IRDs and VCRs shall treat the following event as not running.
running	Not allowed.
not running	IRDs and VCRs shall treat the present event as not running.
pausing	This status is intended to indicate that the "following" event has been running at some time, but is now overlapped by another event. In such a case, during the whole time that the "following" event has status "pausing", one and the same overlapping event shall be encoded in section 0 of the EIT Present/Following. Furthermore, an event which has the status "pausing" shall acquire the status "running" at a later time, then replacing the overlapping event in section 0 of the EIT Present/Following.
starts in a few seconds	IRDs and VCRs shall prepare for the status of the following event to change to running within a few seconds.

The duration of an event as encoded in the field duration of the EIT shall also include the duration of all times when the event has the status "not running" or "paused". The start time of an event as encoded in the field start_time of the EIT shall be the start time of the entire event, i.e. not the start time after the pause has finished.

NOTE 1: The start time of one event plus its duration may be smaller than the start time of the following event. In other words, gaps between events are allowed. In such a case, the following event is considered to be the event scheduled to begin after the gap. This event shall be encoded in section 1 of the EIT Present/Following.

NOTE 2: The start time and duration are scheduled times. Some broadcasters may update this information if the schedule is running late, whereas others may prefer to keep the indicated start time unchanged, e.g. to avoid having an event called "The News at 8" from being indicated as starting at 8:01:23, instead of 8:00:00.

4.1.4.2 EIT Schedule information

4.1.4.2.1 EIT Schedule structure

The EIT Schedule information is structured in such a way that it is easy to access the EIT data in a flexible manner. The EIT Schedule Tables shall obey the following rules:

a) the EIT/Schedule is distributed over 16 table_ids, being 0x50 - 0x5F for the actual Transport Stream, and 0x60 - 0x6F for other Transport Streams, which are ordered chronologically;

b) the 256 sections under each sub-table are divided into 32 segments of 8 sections each. Segment #0, thus, comprises sections 0 to 7, segment #1 section 8 to 15 etc.;

c) each segment contains information about events that start (see below) anywhere within a three-hour period;

d) the information about separate events is ordered chronologically within segments;

e) if only n < 8 sections of a segment are used, the information shall be placed in the first n sections of the segment. To signal that the last sections of the segment are not used, the value s0 + n - 1, where s0 is the first section number of the segment, shall be encoded in the field segment_last_section_number of the EIT header. As an example, if segment 2 contains only 2 sections, the field segment_last_section_number shall contain the value 8 + 2 - 1 = 9 in those two sections;

f) segments that contain all their sections shall have the value s0 + 7 encoded in the field segment_last_section_number;

g) entirely empty segments shall be represented by an empty section, (i.e. a section which does not contain any loop over events) with the value s0 + 0 encoded in the field segment_last_section_number;

h) the placing of events in segments is done referring to a time t0. t0 is "last midnight" in Universal Time Coordinated (UTC) time. Suppose, for instance, that it is 5.00 PM in the time zone UTC-6. It is then 11.00 PM in the time zone UTC+0, which makes it 23 hours since "last midnight". Therefore, t0 is 6.00 PM the previous day in UTC-6;

i) segment #0 of table_id 0x50 (0x60 for other Transport Streams) shall contain information about events that start between midnight (UTC Time) and 02:59:59 (UTC Time) of "today". Segment #1 shall contain events that start between 03:00:00 and 05:59:59 UTC time, and so on. This means that the first sub-table (table_id 0x50, or 0x60 for other Transport Streams) contains information about the first four days of schedule, starting today at midnight UTC time;

j) the field last_section_number is used to indicate the end of the sub-table. Empty segments that fall outside the section range indicated by last_section_number shall not be represented by empty sections;

k) the field last_table_id is used to indicate the end of the entire EIT/Schedule structure. Empty segments that fall outside the table_id range indicated by last_table_id shall not be represented by empty sections;

l) segments that correspond to events in the past may be replaced by empty segments (see rule g));

m) the running_status field of event definitions contained in the EIT/Schedule shall be set to undefined (0x00).

n) EIT/Schedule tables are not applicable to NVOD Reference Services, since these have events with undefined start times.

4.1.4.2.2 EIT scrambling

The EIT Schedule Tables may be scrambled. In order to provide an association with the Conditional Access (CA) streams, it is necessary to allocate a service_id (= MPEG-2 program_number) which is used in the Program Specific Information (PSI) to describe scrambled EIT Schedule Tables.
The EIT is identified in the Program Map Table (PMT) section for this service_id as a programme consisting of one private stream, and this PMT section includes one or more CA_descriptors to identify the associated CA streams. The service_id value 0xFFFF is reserved in DVB applications for this purpose.

4.1.5 Time and Date Table (TDT)

The Time and Date Table (TDT) transmits the actual UTC-time coded as Modified Julian Date (MJD). It may be used to synchronise the internal clock of an IRD. The TDT shall be transmitted at least every 30 seconds. The encoded time is intended to be valid when the section becomes valid according to figure 3 of this document.

4.1.6 Time Offset Table (TOT)

The TOT transmits the actual UTC-time including also time offset information coded as MJD. It may be used to synchronise the internal clock of an IRD. Transmission of the TOT is optional, but if present it shall be transmitted at least every 30 seconds. The encoded time is intended to be valid when the section becomes valid according to figure 3 of this document.

4.1.7 Running Status Table (RST)

Running status sections are used to rapidly update the running status of one or more events. Running status sections are sent out only once, at the time the status of an event changes, unlike other SI Tables which are normally repetitively transmitted. Thus there does not exist any update mechanism for RSTs.
At the moment an RST is transmitted to update the running status of an event, it invalidates the running status of that event, transmitted previously by the EIT Present/Following. The following time the EIT is transmitted, it shall contain the updated running status bits.

The intended use of this optional mechanism is to enable IRDs or VCRs to implement highly accurate switching to the beginning of events by setting up a filter on Running Status Tables and waiting for the occurrence of the RST section containing the event.

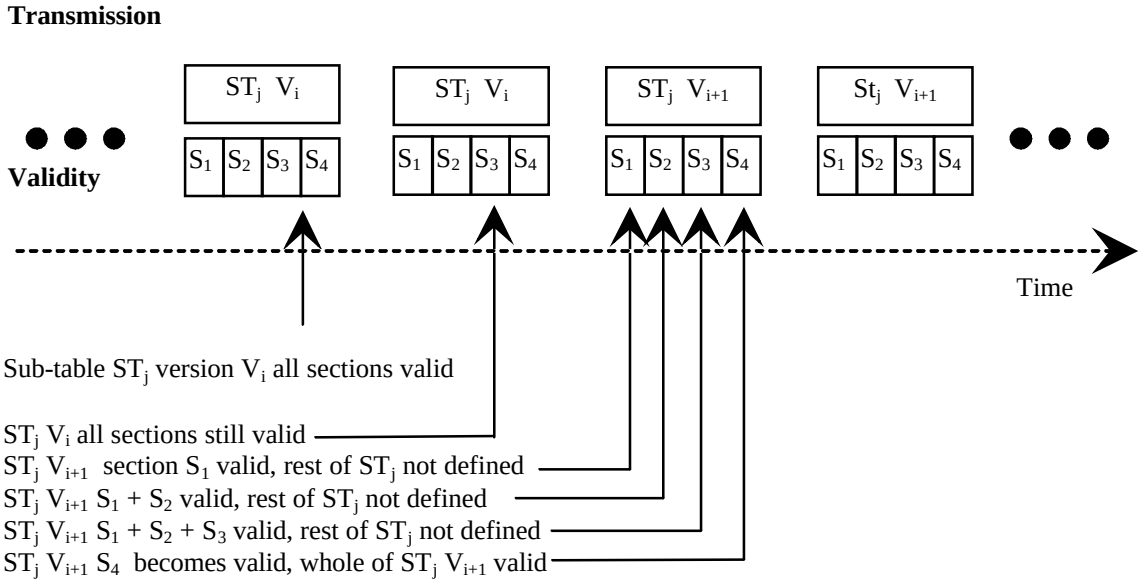
4.1.8 Stuffing Table (ST)

A stuffing section may occur in anywhere that a section belonging to an SI Table is allowed. Stuffing Tables may be used to replace or invalidate either sub-tables or complete SI Tables. In order to guarantee consistency, all sections of a sub-table shall be stuffed. It is not allowed to replace some sections of a sub-table by stuffing some sections while keeping others.

4.1.9 Table update mechanism

The section syntax used in the DVB Service Information (SI) supports various signalling mechanisms for SI contents updates.

The update of a section will be signalled by incrementing the version_number field. The update will be effective immediately following the last byte of the CRC_32 of the new version of the section, so the current_next_indicator shall always have the value of "1". Sections with current_next_indicator set to "0" are never transmitted.



NOTE: Sections of a sub-table do not have to be transmitted in number order. Some IRD implementations may acquire data with improved efficiency if the sections of a sub-table are transmitted in numerical order. However, a broadcaster may not transmit the sections in order owing to random access considerations.

Figure 3: Timing of table updates and validity

4.2 Service Information (SI) descriptor allocation and usage

This subclause specifies the location where descriptors can be expected in a SI bit stream, and identifies which descriptors may occur multiple times. Descriptors which contain fundamental SI data are identified as recommended to be decoded by the IRD. The interpretation of other descriptors by the IRD is optional.

4.2.1 Descriptors of the Network Information Table (NIT)

The NIT is organised as follows:

```
/* header ....*/
for i = 0; i < N; i++ {   /* 1st descriptor loop */
    descriptor()
}
for ( i = 0; i < N; i++) {
    /* loop over Transport Streams */
    transport_stream_id
    original_network_id
    for ( j = 0; j < M; j++) { /* 2nd descriptor loop */
        descriptor()
    }
}
/* CRC etc. */
```

4.2.1.1 First descriptor loop

Only the DVB SI descriptors in this subclause have a defined meaning in the first loop of the NIT.

4.2.1.1.1 Linkage descriptor

This descriptor is used to give a link to another service or transport stream. If it appears in this loop it links to a service that is attached to the network operator. This descriptor is allowed more than once in this loop, it could for example point to the "Paris Cable Info channel" and to "Paris Cable Text". Transmission of this descriptor is optional. The meaning of the descriptor when it occurs here depends on the value of the linkage_type. If the linkage_type is:

a) 0x01, it refers to a service that contains information about the network. An example of the intended use is for the IRD to switch to the information service when the user requests additional information about the network;

b) 0x02, it refers to an Electronic Program Guide (EPG) for the network. Note that the IRD can only make use of this type of linkage if it can decode the EPG service. This BlueBook does not specify the contents of such a service;

c) 0x04, it refers to a transport stream which carries comprehensive Service Information. The SI carried in the referenced transport stream includes at least all the SI information available on all other transport streams of the network.

The meaning of other values of linkage_type is not defined in this context. Note that the linkage_type does not indicate the service_type of the referenced service. An example of the intended use of the linkage descriptor is that an IRD user interface could include a mechanism like "info about the network" which would make the IRD tune to the linked service after the user initiated the mechanism.

4.2.1.1.2 Multilingual Network Name Descriptor

This descriptor may be used to convey the name of the network in one or more languages. It may be included once in the descriptor loop. Inclusion of this descriptor is optional.

4.2.1.1.3 Network name descriptor

This descriptor is used to transmit the name of a physical network, e.g. "ASTRA", "EUTELSAT", "MUNICH CABLE" etc. This descriptor shall be used exactly once in any NIT sub-table.

4.2.1.2 Second descriptor loop

Only the DVB SI descriptors in this subclause have a defined meaning in the second loop of the NIT.

4.2.1.2.1 Delivery system descriptors

The delivery system descriptors are the satellite_delivery_system_descriptor, cable_delivery_system_descriptor and the terrestrial_delivery_system_descriptor. Descriptors for other delivery systems may be defined in the future. The delivery_system_descriptors are used to transmit the physical parameters for each transport multiplex in the network.

One (and only one) delivery system descriptor shall appear in each loop. IRDs shall be able to interpret the delivery system descriptor in order to tune to Transport Streams quickly (see subclauses 4.1.1 and 5.3.1).

4.2.1.2.2 Service list descriptor

This descriptor is used to list the services and service types for each Transport Stream. The services are listed identified by service_id (= MPEG-2 program_number). The transport_stream_id and original_network_id, which are necessary to identify a DVB service uniquely, are given at the start of the descriptor loop.

The service list descriptor is allowed only once in each loop. Transmission of this descriptor is optional, but if it is present, then the service list shall be complete.

4.2.1.2.3 Frequency list descriptor

This descriptor lists the additional frequencies used in transmission of a multiplex on other frequencies.

The frequency_list descriptor is allowed only once in each loop for which there is a delivery system descriptor. Inclusion of this descriptor is optional, but if it is present, then the list of frequencies shall be complete.

4.2.2 Descriptors of the Bouquet Association Table (BAT)

The BAT is organised as follows:

```
/* header ....*/
for i = 0; i < N; i++ {   /* 1st descriptor loop */
    descriptor()
}
for ( i = 0; i < N; i++) {
    /* loop over Transport Streams */
    transport_stream_id
    original_network_id
    for ( j = 0; I < M; j++) { /* 2nd descriptor loop */
        descriptor()
    }
}
/* CRC etc. */
```

The BAT has the same structure as the NIT. The BAT gives a logical grouping of services into bouquets, which may group together services delivered by different networks. A Transport Stream may contain services from more than one bouquet within a network. Each BAT collects the services that are allocated to the specified bouquet.

4.2.2.1 First descriptor loop

Only the DVB SI descriptors in this subclause have a defined meaning in the first loop of the BAT.

4.2.2.1.1 Bouquet name descriptor

This descriptor is used to transmit the name of the bouquet the following services are allocated to, e.g. "THE NEWS BOUQUET", "HEAVEN MOVIE CHANNELS" etc. This descriptor is allowed once in each sub-table of the BAT. It is mandatory to be transmitted in any BAT sub-table in the Transport Stream.

4.2.2.1.2 Conditional Access (CA) identifier descriptor

Transmission of this descriptor is optional; it is allowed only once in this loop. It identifies one or more CA systems which apply to the services in the BAT.

4.2.2.1.3 Country availability descriptor

This descriptor is used to indicate whether a bouquet is available in a specific country. It has no meaning in the sense of Conditional Access, however it may be a good feature for IRDs to interpret this descriptor, not to display bouquets that are not available in order to avoid frustration of the user.

This descriptor is allowed a maximum of twice in each BAT sub-table, once to indicate a list of countries in which the bouquet is intended to be available, and once to indicate those countries in which it is not intended to be available. If the descriptor is not present, the availability status of the bouquet is undefined. Transmission of this descriptor is optional.

4.2.2.1.4 Linkage descriptor

This descriptor is used to give a link to another service or transport stream. If it appears in this loop it links to a service that is attached to the bouquet provider. The linkage_descriptor is allowed more than once in this loop, for example it could point to the "Heaven movie teasers" and to "Heaven text TV". Transmission of this descriptor is optional. The meaning of the descriptor when it occurs here depends on the value of the linkage_type. If the linkage_type is:

a) 0x01, the descriptor refers to a service that contains information about the bouquet. An example of the intended use is for the IRD to switch to the information service when the user requests additional information about the bouquet;

b) 0x02, the descriptor refers to an Electronic Program Guide (EPG) for the bouquet.

   NOTE: The IRD can only make use of this type of linkage if it can decode the EPG service. This BlueBook does not specify the contents of such a service.

c) 0x04, it refers to a transport stream which carries comprehensive Service Information. The SI carried in the referenced transport stream includes at least all the SI information available on all other transport streams which carry services of the bouquet.

The meaning of other values of linkage_type is not defined in this context. Note that the linkage_type does not indicate the service_type of the referenced service. An example of the intended use of the linkage descriptor is that

an IRD user interface could include a mechanism like "info about the bouquet" which would make the IRD tune to the linked service after the user initiated the mechanism.

4.2.2.1.5 Multilingual Bouquet Name Descriptor

This descriptor may be used to convey the name of the bouquet in one or more languages. It may be included once in the descriptor loop. Inclusion of this descriptor is optional.

4.2.2.2 Second descriptor loop

Only the DVB SI descriptors in this subclause have a defined meaning in the second loop of the BAT.

4.2.2.2.1 Service list descriptor

This descriptor is used to list the services and service types for each Transport Stream that belong to the bouquet of this section. This allows to find all services that belong to a specific bouquet.

The service_list_descriptor is allowed only once in each loop. It should be transmitted if a BAT exists.

4.2.3 Descriptors of the Service Description Table (SDT)

The SDT is organised as follows:

```
table_id      /* distinction between actual & foreign MUXes */
/* header ....*/
transport_stream_id
original_network_id
for i = 0; i < N; i++ {  /* descriptor loop */
    service_id
    EIT_schedule_flag
    EIT_present_following_flag
    running_status
    free_CA_mode
    for ( j = 0; j < M; j++){
      descriptor()
    }
}
/* CRC etc. */
```

The SDT has a loop for descriptors for each service described in the SDT. Only the DVB SI descriptors in this subclause have a defined meaning in the SDT.

4.2.3.1 Bouquet name descriptor

This descriptor is used to transmit the name of the bouquet the service is allocated to, e.g. "THE NEWS BOUQUET", "Heaven movie channels" etc. This descriptor is allowed more than once in the loop because a service could belong to more than one bouquet. It is not allowed if there is a time_shifted_service_descriptor.

Transmission of this descriptor is optional in the SDT. The use of this descriptor in the SDT is wasteful of bandwidth, since the information can be conveyed more efficiently using the BAT.

4.2.3.2 Conditional Access (CA) identifier descriptor

If a service is generally CA-protected, this descriptor may be used to transmit data of the CA-system. The CA_identifier_descriptor is not involved in any CA control function, it is an indication for the user interface software in the IRD that a service is under conditional access and which CA-system is used. Then the user interface software may decide whether this service is reachable or not. The aim of the transmission of this descriptor is to avoid frustration to users caused by services being displayed for selection that are not reachable.

This descriptor is allowed only once in the loop. It is not allowed if there is a time_shifted_service_descriptor. Transmission of this descriptor is optional in the SDT.

4.2.3.3 Country availability descriptor

This descriptor is used to indicate whether a service is available in the specified country. It has no meaning in the sense of Conditional Access, however it may be a good feature for IRDs to interpret this descriptor, not to display services that are not available in order to avoid frustration of the user.

This descriptor is allowed a maximum of twice in each SDT service loop, once to indicate a list of countries in which the service is intended to be available, and once to indicate those countries in which it is not intended to be available. If the descriptor is not present, the availability status of the service is undefined. It is not allowed if there is a time_shifted_service_descriptor.

Transmission of this descriptor is optional.

4.2.3.4 Data_broadcast_descriptor

see subclause 4.2.7.3

4.2.3.5 Linkage descriptor

This descriptor is used to give a link to another service. If it appears in this loop it links to a service that is attached to this service. Transmission of this descriptor is optional. More than one linkage descriptor is allowed in a loop. The meaning of the descriptor, when it occurs here, depends on the value of the linkage_type. If the linkage_type is:

a) 0x01, the descriptor refers to a service that contains information about this service. An example of the intended use is for the IRD to switch to the information service when the user requests additional information about this service;

b) 0x02, the descriptor refers to an Electronic Program Guide (EPG) for this service;

NOTE 1: The IRD can only make use of this type of linkage if it can decode the EPG service. This BlueBook does not specify the contents of such a service.

c) 0x03, the descriptor refers to a CA replacement service for this service. An example of the intended use is for the IRD to switch automatically to the replacement service if the CA system denies access to this service.

d) 0x05, the descriptor refers to a replacement service for this service. An example of the intended use is for the IRD to switch automatically to this replacement service when the selected service has a running status of “not running”.

NOTE 2: The linkage_type does not indicate the service_type of the referenced service. An example of the intended use of the linkage descriptor is that an IRD user interface could include a mechanism like "info about the service", which would make the IRD tune to the linked service after the user initiated the mechanism.

4.2.3.6 Mosaic descriptor

This descriptor may be located in the SDT and/or PMT. It is used to describe mosaic services is described in subclause 5.2. It is not allowed if there is a time_shifted_service_descriptor.

4.2.3.7 Multilingual Service Descriptor

This descriptor may be used to convey the name of the service provider and service name in one or more languages. It is allowed only once in the descriptor loop and if there is no time_shifted_service_descriptor. Inclusion of this descriptor is optional.

4.2.3.8 Near Video On Demand (NVOD) reference descriptor

This descriptor lists the services which belong to a NVOD service. A description of the NVOD-mechanisms is given in subclause 5.1. The NVOD_reference_descriptor is allowed only once in each loop and if there is no time_shifted_service_descriptor. It is mandatory to be transmitted if the corresponding services are described using the time_shifted_service_descriptor. IRDs are recommended to make use of the NVOD_reference_descriptor in order to allow access to NVOD-services.

4.2.3.9 Service descriptor

This descriptor contains the basic textual identifications of a service such as service name and provider name. The service_descriptor is allowed only once in each loop and if there is no time_shifted_service_descriptor.

It is mandatory to be transmitted. IRDs are recommended to make use of it in order to display the service names in the user interface.

4.2.3.10 Telephone descriptor

Transmission of this descriptor is optional, and it may occur more than once in the loop. It is not allowed if there is a time_shifted_service_descriptor. IRDs cannot make use of it without further information (see bibliography).

4.2.3.11 Time shifted service descriptor

This descriptor identifies a service as a time shifted copy of another service (subclause 5.1). The time_shifted_service_descriptor is allowed only once in each loop. It is mandatory to be transmitted for services listed in a NVOD_reference_descriptor. IRDs are recommended to be able to interpret it in order to access NVOD-events.

4.2.4 Descriptors of the Event Information Table (EIT)

An EIT-section is organised as follows:

```
table_id     /* classification of the EI-section : present following etc. */
/* header ....*/
service_id
transport_stream_id
original_network_id
for i = 0; i < N; i++ {   /* descriptor loop */
    event_id
    start_time
    duration
    running_status
    free_CA_mode
    for ( j = 0; j < M; j++){
        descriptor()
    }
}
/* CRC etc. */
```

The EIT has a loop for descriptors for each event described in the EIT. Only the DVB SI descriptors in this subclause have a defined meaning in the loop.

4.2.4.1 Component descriptor

This descriptor is used to specify all streams that are attached to an event. The descriptor may appear more than once in a loop since there may be more than one stream. If there is a time_shifted_event_descriptor, this descriptor is not allowed.

Transmission of this descriptor is mandatory in the EIT Present/Following for the actual Transport Stream. It is optional for other EITs. It is useful to indicate which streams will be available for future events.

4.2.4.2 Content descriptor

This descriptor is used to classify the content of the event. Only one content descriptor may appear in the loop, but there is the possibility to transmit more than one classification term because there is a loop within the descriptor. If there is a time_shifted_event_descriptor, this descriptor is not allowed, since the content information can be provided in the EIT sub-table for the corresponding NVOD reference service. Transmission of this descriptor is optional.

4.2.4.3 Data_broadcast_descriptor

see subclause 4.2.7.3

4.2.4.4 Extended event descriptor

This descriptor is used to transmit a bigger amount of textual information for an event than is possible with the short_event_descriptor. The information in extended event descriptors supplements that given in a short event descriptor. A language code is transmitted in order to indicate in which language the text is written. More than one extended_event_descriptor is allowed, for transmitting more data than one descriptor may contain (255 bytes excluding header) and for different languages. Descriptors for the same language have to be grouped together, the last_descriptor field specifies the number of the last extended_event_descriptor for a specific language.

If there is a time_shifted_event_descriptor, this descriptor is not allowed. Transmission of this descriptor is optional.

4.2.4.5 Linkage descriptor

This descriptor is used to give a link to another service. If it appears in this loop it links to a service that is attached to this event. Transmission of this descriptor is optional. If there is a time_shifted_event_descriptor, this descriptor is not allowed. More than one linkage descriptor is allowed in a loop. The meaning of the descriptor, when it occurs here, depends on the value of the linkage_type. If the linkage_type is:

- 0x01, the descriptor refers to a service that contains information about this event. An example of the intended use is for the IRD to switch to the information service when the user requests additional information about this event.

The meaning of other values of linkage_type is not defined in this context. Note that the linkage_type does not indicate the service_type of the referenced service. An example of the intended use of the linkage descriptor is that an IRD user interface could include a mechanism like "info about the event" which would make the IRD tune to the linked service after the user initiated the mechanism.

4.2.4.6 Multilingual Component descriptor

This descriptor may be used to convey text describing a component of an event in one or more languages. It may be included once in the descriptor loop for each component of an event. If there is a time_shifted_event_descriptor, then this descriptor is not allowed. Inclusion of this descriptor is optional.

4.2.4.7 Parental rating descriptor

This descriptor is used to give a rating of the programme based on age or other criteria that is used to prevent children from viewing unsuitable programmes. If there is a time_shifted_event_descriptor, this descriptor is not allowed, since the parental rating information can be provided in the EIT sub-table for the corresponding NVOD reference service. The parental_rating_descriptor may appear just once in a loop. Transmission of this descriptor is optional.

Country_codes relating to groups of countries may be used within the descriptor. If, as a result, there is more than one entry for a country in the descriptor, then the first entry in the descriptor which includes the country shall take precedence over any subsequent entry. For example, the following sequence of data within the descriptor would describe a parental rating of minimum age of 12 in all countries except UK, for which the minimum age is 18:

EXAMPLE:
country_code = UK
rating = 0x0F
country_code = all countries
rating = 0x09

4.2.4.8 Short event descriptor

This descriptor is used to transmit the name and a short text description for an event. A language code is transmitted in order to indicate in which language the title and the text are written. Transmission of this descriptor is mandatory, unless there is a time_shifted_event_descriptor, in which case the descriptor is not allowed. This descriptor is allowed more than once in the loop for different languages. Thus it is not allowed to have more than one short_event_descriptor with the same language code.

4.2.4.9 Telephone descriptor

Transmission of this descriptor is optional, and it may occur more than once in the loop. IRDs cannot make use of it without further information. See bibliography.

4.2.4.10 Time shifted event descriptor

This descriptor is used to indicate that an event is the time-shifted copy of another event. If this descriptor is present no other descriptor is allowed in the loop.

Transmission of this descriptor is mandatory in case of NVOD. IRDs are recommended to decode this descriptor, without which access to the Service Information of NVOD events is not possible.

4.2.5 Descriptors of the Time Offset Table (TOT)

4.2.5.1 Local time offset descriptor

This descriptor may be used to indicate the local time offset and the automatic adjustment between summer and winter time by an IRD.

The data given in the descriptor will be constant for most of the time, but will change in the transitions from summer time to winter time and vice versa. In the TOT descriptor loop the local time offset descriptor may occur more than once. It is assumed that the same set of countries/country regions be included in each transmission of the TOT.

If a country uses more than one time zone, the country_region_id field identifies the different regions of the country with different time zones.

Example data for the descriptor fields:

country_code:	x9yy (European Continent countries group)
country_region_id	000000'
local_time_offset_polarity	0'
local_time_offset	'0000000100000000' (Winter: 1 hour)
	'0000001000000000' (Summer: 2 hours)

The descriptor may be applied in the following applications:

- display of the current local time on the IRD or TV screen;
- display of the programme guide in local time;
- timer programming of the video recorder in local time.

4.2.6 Descriptors of the Program Map Table (PMT)

In addition to the descriptors defined in ISO/IEC 13818-1 [2] the following DVB SI descriptors may be used in the Program Map Table.

4.2.6.1 Mosaic descriptor

This descriptor may be located in the PMT and/or SDT. Its use to describe mosaic services is described in subclause 5.2.

4.2.6.2 Service Move Descriptor

This descriptor provides a mechanism which enables an IRD to track a service which moves from one Transport Stream to another. Note that some disturbance to the decoded video and audio will occur at such a transition. The following rules are recommended to minimise the discontinuity:

a) in the PMT of the service which is to move, a service_move_descriptor is inserted, no earlier than the time that the service commences on the new Transport Stream and at least as long as the service continues to exist on the old Transport Stream;

b) the service should be described in the PAT and PMT of the new stream at least from the time that the service_move_descriptor is inserted in the old Transport Stream.

If a complete transport stream is moved, then this can be achieved by updating the NIT tuning information for the transport stream. In this case the original_network_id, transport_stream_id, and service_ids are unchanged, and the service_move_descriptor is not applicable.

4.2.6.3 Stream identifier descriptor

This descriptor enables specific streams to be associated with a description in the EIT, in cases where there are more than one stream of the same type within a service. The descriptor is mandatory only if the service contains more than one stream of the same type and there are component descriptors for that type of stream within the EIT.

4.2.6.4 Teletext descriptor

This descriptor is used to identify EBU Teletext data which is coded in accordance with ETS 300 472 [3]. The descriptor shall be used once in the appropriate ES_info field for any stream containing EBU Teletext coded in accordance with ETS 300 472. The descriptor allows the identification of the language and type of particular

"reference" pages such as subtitle or index pages. The loop within the descriptor may be omitted, in which case no specific indication of language, teletext type, or page is given (i.e. equivalent to selecting teletext on analogue transmissions).

4.2.7 Other descriptors

4.2.7.1 Private Data Specifier Descriptor

If this descriptor is located within any descriptor loop of an SI Table, then any specifier identified within a loop applies to all following descriptors and user-defined values in the particular loop until the end of the loop, or until another occurrence of a private_data_specifier_descriptor. The use of the descriptor in the first descriptor loop of the NIT or BAT does not apply to descriptors or user-defined values in the second descriptor loop.

4.2.7.2 Stuffing descriptor

This descriptor is allowed in any place in the SI where descriptors are allowed. It is used to stuff tables for any reason or to disable descriptors that are not valid (e.g. in case of re-multiplexing). An IRD should skip over a stuffing_descriptor.

4.2.7.3 Data_broadcast_descriptor

This descriptor is used to identify within the Service Information (SDT and/or EIT) data broadcast services in the DVB framework. For service based implementation of data broadcasting it is recommended to place the descriptor within the SDT. For an event oriented data broadcasting service, a descriptor may also be placed within the EIT.

Within this descriptor there is a field called data_broadcast_id, identifying the type of data service within the multiplex. The allocation of the values is given in ETR 162.

Values 0x0001-0x0007 of the data_broadcast_id (see ETR 162) are specified in EN 301 192 (DVB Data Broadcasting Specification). Guidelines for the use of EN 301 192 are given in TR 101 202 (Guidelines for the implementation and usage of the DVB Data Broadcasting Specification). A range of values (0x0100 - 0xFFFE) can be used for the registration of private data broadcast systems. ETR 162, which is frequently updated, gives a list of all registered data_broadcast_ids.

4.2.9 ISO 13818-1 descriptors

The following ISO/IEC 13818-1 [2] (MPEG-2) descriptors can be expected in the DVB SI bit streams:

- registration_descriptor;
- private_data_descriptor;
- copyright_descriptor;
- ISO_639_language_descriptor.

This descriptor lists the different languages in which a service/event is broadcast. This descriptor may be present in the SDT (and in the EIT). When present, the descriptor can be used by the IRD to select services or events with a language criterion. When this descriptor is used within the DVB SI bit streams the audio type field should be set to the value 0x00 (undefined).

The meaning of other MPEG-2 defined descriptors is not defined if included in the DVB SI Tables.

4.2.10 Unknown descriptors

If a DVB-defined descriptor appears in a context where its meaning is not specified in this BlueBook, or if the IRD encounters a descriptor with an unrecognised tag, the IRD is recommended to skip over that descriptor (using the length field) and proceed with decoding the following SI data.

4.3 Program Specific Information (PSI) and DVB SI operational interaction states

For the description of a service state the following four columns of table 4 are relevant: Program Association Table (PAT), PMT, SDT and EIT. The possible indications given by these tables for a service are listed in table 3. The first three columns and the fifth column give the possible combinations of the existence of the four tables, the fourth column lists the relevant combinations of the running status bits in the SDT.

For information about the states of the running_status field in event information, see subclause 4.1.4.

Table 3: Service state

Service present in					
PAT	**PMT**	**SDT**	**SDT running status**	**EIT p/f**	**State of the service**
yes	no	x	x	x	Transition state
no	yes	x	x	x	Transition state
yes	yes	no	-	x	Transition state
yes	yes	yes	x	no	Transition state
yes	yes	yes	running or undefined	yes	Service is running and broadcasting
yes	yes	yes	pausing or not running	x	Transition state
no	no	no	-	yes	Transition state
no	no	no	-	no	Idle state, corresponds to the start of the creation of a service or end state of a service
no	no	yes	running	x	Transition state
no	no	yes	pausing, not running or undefined	x	The service definition still exists => The service will broadcast again

4.4 Minimum repetition rates

4.4.1 Satellite and cable delivery systems

For satellite and cable delivery systems, where there will usually be sufficient bandwidth within a single delivery system to carry the SI, the following minimum repetition rates are specified:

a) all sections of the NIT shall be transmitted at least every 10 seconds, including those for other delivery systems, if present;

b) all sections of the BAT shall be transmitted at least every 10 seconds, if present;

c) all sections of the SDT for the actual multiplex shall be transmitted at least every 2 seconds;

d) all sections of the SDT for other Transport Streams shall be transmitted at least every 10 seconds, if present;

e) all sections of the EIT Present/Following Table for the actual multiplex shall be transmitted at least every 2 seconds;

f) all sections of the EIT Present/Following Table for other Transport Streams shall be transmitted at least every 10 seconds, if present;

g) all sections of the EIT Schedule Table for the first 8 days shall be transmitted at least every 10 seconds, including those for other Transport Streams, if present;

h) all sections of the EIT Schedule Table for further than 8 days ahead shall be transmitted at least every 30 seconds, including those for other Transport Streams, if present;

i) the TDT and the TOT shall be transmitted at least every 30 seconds.

4.4.2 Terrestrial delivery systems

For terrestrial delivery systems bandwidth within a single transmitted transport stream is a valuable resource and in order to safeguard the bandwidth allocated to the primary services receivable from the actual multiplex the following minimum repetition rates are specified in order to reflect the need to impose a limit on the amount of available bandwidth used for this purpose:

a) all sections of the NIT shall be transmitted at least every 10 seconds;

b) all sections of the BAT shall be transmitted at least every 10 seconds, if present;

c) all sections of the SDT for the actual multiplex shall be transmitted at least every 2 seconds;

d) all sections of the SDT for other transport streams shall be transmitted at least every 10 seconds if present;

e) all sections of the EIT Present/Following Table for the actual multiplex shall be transmitted at least every 2 seconds;

f) all sections of the EIT Present/Following Tables for other transport streams shall be transmitted at least every 20 seconds if present.

The repitition rates for further EIT tables will depend greatly on the number of services and the quantity of related SI information. The following transmission intervals should be followed if practicable but they may be increased as the use of EIT tables is increased. The times are the consequence of a compromise between the acceptable provision of data to a viewer and the use of multiplex bandwidth.

a) all sections of the EIT Schedule table for the first full day for the actual transport stream, shall be transmitted at least every 10 seconds, if present;

b) all sections of the EIT Schedule table for the first full day for other transport streams, shall be transmitted at least every 60 seconds, if present;

c) all sections of the EIT Schedule table for the actual transport stream, shall be transmitted at least every 30 seconds, if present;

d) all sections of the EIT Schedule table for other transport streams, shall be transmitted at least every 300 seconds, if present;

e) the TDT and TOT shall be transmitted at least every 30 seconds.

4.5 Terrestrial systems

4.5.1 Terms used within terrestrial systems

In the context of SI for a digital terrestrial television system a network is the collection of transport streams from a service insertion point none of whose components are subsequently altered.

An emitting point is a reference to a physical location of a transmitter which broadcasts a multiplex. More than one reference may be made to the same physical location. Each network from such an emitting point shall be identified by a unique network_id.

The implementation of terrestrial systems can be based on two strategies:

SFN network: A Single Frequency Network is one in which all of the transmitters relating to a particular network broadcast the same (and only the same) multiplex(es) using the same frequency to achieve a large coverage area (national, regional or local).

MFN network: A Multi-Frequency Network is one in which transmitters use different frequencies to broadcast the same multiplexes.

In the context of digital terrestrial television a relay is defined as a transmitter that receives the full multiplex signal from another transmitter and changes the frequency on which that multiplex is broadcast, without changing the content of any of the constituent components. The radiated multiplex therefore has the same network_id as the original multiplex signal.

If there is any change in any of the components or elements of a multiplex which has been received with the intention of rebroadcasting, (for example, a regional variation in a video programme or a change of teletext data), then, for the purpose of digital terrestrial television, the emitter shall not be recognised as a relay but as a further instance of a service insertion point and thus it shall have a new network_id.

4.5.2 The use of alternative frequencies for multiplexes

The NIT shall signal the use of possible alternative frequencies. Two solutions may be implemented:

1 Use the other_frequency_flag n the terrestrial_delivery_system descriptor to advise the IRD that the identical multiplex may be receivable on other centre frequencies. The IRD may, for example, try scanning for a more reliable signal.

2. Use the frequency_list_descriptor in order to provide a list of all the possible frequencies used in transmitting this particular multiplex within the transmission service area. This descriptor is in the second descriptor loop of the NIT and so it is specific to a single transport stream. The IRD may, for example, try to determine the best signal to use at the time.

The second solution provides a faster method for an IRD to find a usable frequency on which other services may be received.

Where the frequencies list descriptor is used, it is strongly recommended that the list for each transport stream reflects the same order of emitting stations. Thus, if there are two transport streams in a network each being emitted from the same three emitting stations, then the order in the frequency list descriptor should, for both transport streams, be: station_1, station_2, station_3. Where one of the emitting stations does not broadcast a particular transport stream the corresponding frequency in the list should be set to zero

In many cases a receiver will receive all of the available transport streams from a single aerial position. This descriptor can be used to aid the receiver in finding a “best first guess” of the frequency. The IRD can then try first the alternative frequency for a second multiplex which is in the corresponding position within the list for the receivable frequency for the first multiplex.

Table 4: Use of ordered alternative frequency lists

	station_1	station_2	station_3
frequency list for multiplex_A	frequency_1, A	frequency_2, A	frequency_3, A
frequency list for multiplex_B	frequency_1, B	frequency_2, B	frequency _3, B

Where a transmission service area covers a large geographical area, it is possible that different emitting stations may use the same frequency for different transport streams. It is therefore important to the viewer that the IRD ensures that the services provided are those which are requested.

In some places, an IRD may be able to receive signals from more than one emitting point which carry different networks. If an IRD receives a signal from one emitting point, it would normally only have information about services from that point. The use of NIT_other and SDT_other is recommended to assist the IRD in finding the services from the other networks.Even though an NIT may indicate that a transport stream is available it does not guarantee that the stream can be received by the IRD . It is important that the IRD should ensure the availability of the service before offering the service to the viewer for selection.

Allocation of network_ids can be found in ETR 162.

4.5.3 Regional or local Services

The insertion of local services is an important feature of terrestrial TV systems (see Figure 4). The aim is to have a principal service which, at some precise time, may be displaced in order to provide a regional or local service. Such a local service may occupy the same bandwidth as the principal service at the moment of the switch.

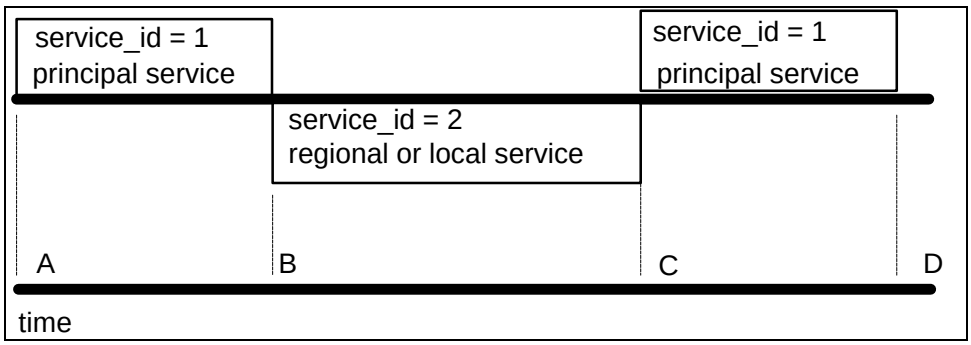


Figure 4: Showing a simple replacement of a principal service by a regional or local service

At time B the principal service, service_id=1, is displaced by a locally provided service, service_id=2. This runs from time B to time C at which time the principal service, service_id=1, is restored. Up to time A the service_id=1 has a running_status set to “running” and service_id=2 has a running_status set to “not running”. The changes in the SI tables reflect the more precisely timed changes in the PSI tables and streams.

During the period when service_id=2 is not providing a service it is a null service. This can be achieved by simply providing a reference to the service in the SDT only. PAT and PMT data are not required at this time (see subclause 4.3). It is not necessary to provide any video or audio packets and thus the overhead incurred by this null service is reduced to the bits involved in the SDT entry.

The running-status permits the setting of an intermediate state “starts in a few seconds”. The IRD may use this period to prepare for the change. At the time of the change the appropriate data, audio and video streams for service_id=2 are introduced whilst those for service_id=1 are simultaneously ceased. At the point of change service_id=1 will become a null service.

The process reverses when service_id=2 terminates. It may be thought preferable for operational reasons to provide a number of still picture frames, either at black or using a viewable picture, in order to accommodate the effect of switching to a fresh video and audio stream.

The path to the replacement service shall be indicated by the linkage_descriptor using the linkage_type “service replacement service”.

More complex service switching operations can be envisaged (see Figure 5). These include switching from two services to a single higher bitrate service and from three services to two higher bitrate services. In either case the changes in the SI tables will reflect the more precisely timed changes in the PSI tables and streams. The IRD must decide what to do at the end of the service replacement. In many cases the IRD will be able to determine that the identity of the service to which it should return from the identity of the service from which it switched. The automatically determined choice may not necessarily be optimal.

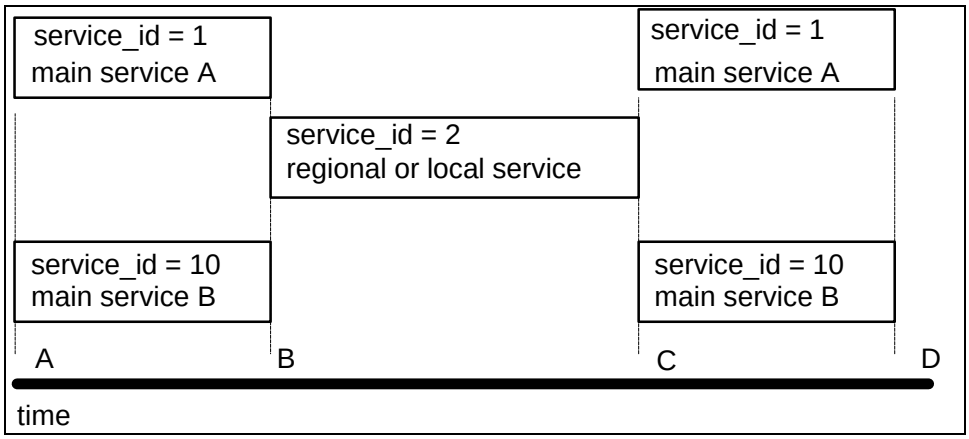


Figure 5: Showing a more complex replacement of two main services by a premium wider bandwidth service.

4.6 Text string formatting

4.6.1 Use of control codes in names

Name fields are found in the descriptors shown in table 5.

Table 5: Name fields

bouquet_name_descriptor	bouquet name
network_name_descriptor	network name
service_descriptor	service provider name service name
short_event_descriptor	event name

The following rules apply to the use of control codes in these name fields:

a) it is expected that the range of name lengths transmitted might vary significantly. It is also expected that IRDs may have some limitations in the text length that can be displayed. Such limitations may depend on the method of display in use at the time. For example an IRD may be able to present the time-schedule of events in a graphical format, but only with a short label for each event.

The following mechanism allows a short section of a name to be identified. This uses the emphasis control codes with the following interpretation in the name fields:

- 0x86 short_name_on;
- 0x87 short_name_off.

These codes may only be used in pairs, and the short_name_off code should be preceded by the short_name_on code. Use of the codes to identify a short name in any name field is optional.

EXAMPLES: The [0x86]Asterix[0x87] Digital Satellite TV Network
(short name: Asterix).
The [0x86]P[0x87]ay [0x86]M[0x87]ovie [0x86]C[0x87]hannel
(short name: PMC).

b) use of the CR/LF code is not recommended in name fields.

4.6.2 Use of control codes in text

Text fields are found in the descriptors shown in table 6.

Table 6: Text fields

short_event_descriptor:	text
extended_event_descriptor:	item description
	item text

The following rules apply to the use of control codes in these text fields:

a) the "emphasis character on code" indicates that the IRD is recommended to emphasise the display of text which follows this code, e.g. by using bold or highlighted characters, and the "emphasis character off code" indicates when an IRD should revert to the normal character display;

EXAMPLES: The winners are announced of the [0x86]£10million[0x87] draw
Is J.R. [0x86]really[0x87] dead?

b) the CR/LF code is used to indicate points in the text where the IRD is recommended to start on a new line, i.e. it indicates new paragraphs. The IRD is expected to perform automatic word-wrapping to suit its text display width;

c) the use of the Soft-HYphen code (SHY in the character coding tables) is recommended to indicate possible hyphenation points in long words.

5 Applications

The SI syntax is designed to work under a wide range of operation conditions. This clause describes some applications and explains how SI can be used in such an environment.

5.1 Near Video On Demand (NVOD) services

The MPEG-2 specification provides the means of transmitting several video programmes simultaneously in a single Transport Stream, which allows for the possibility of a broadcaster to provide a Near Video On Demand (NVOD) service. This subclause describes how such a service could be implemented and how it is described within the Service Information.

The concept of providing a NVOD service where several time shifted versions of the same programme are transmitted simultaneously is not a new one, but it was not until the advent of the DVB System that the system became a viable one. Figure 6 shows the concept using six time shifted versions of a service. This is the simplest form of such a service where all the programmes are identical on all of the channels (other forms could exist where for example the interstitial breaks could be different).

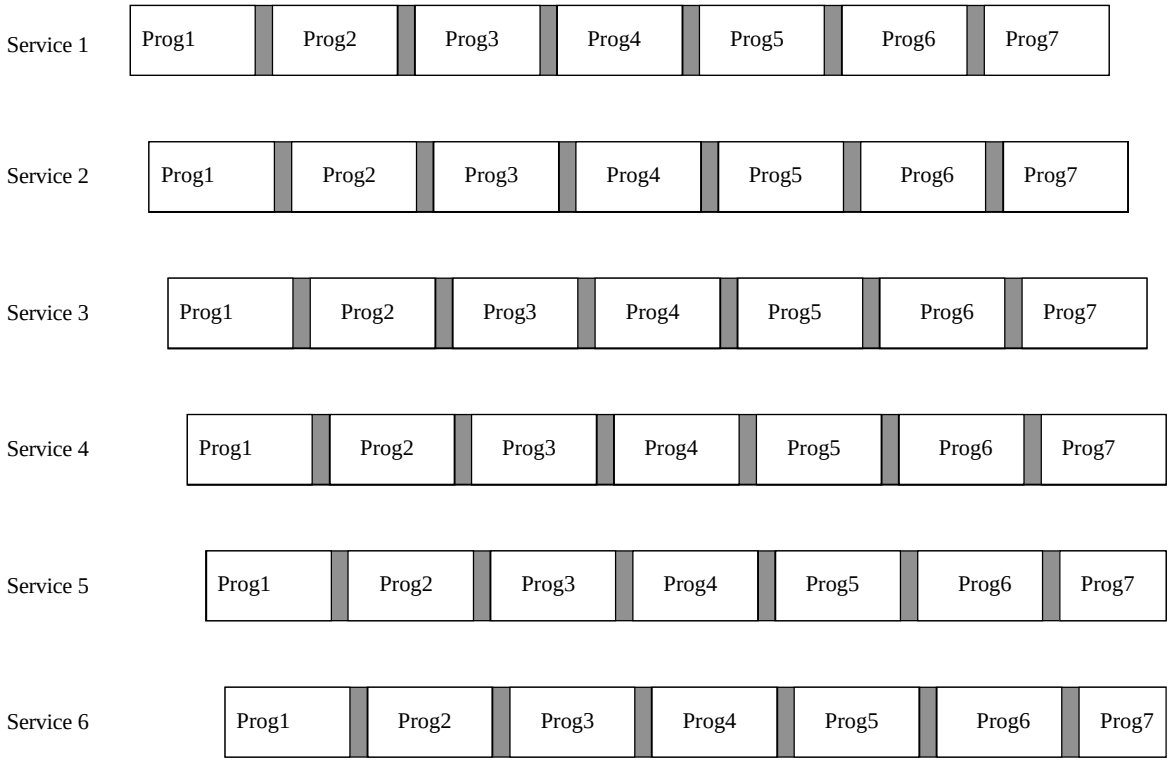


Figure 6: Example of a NVOD service

To describe such a NVOD service with conventional Service Information would require the repetition of six Event Information Tables (EIT). Instead the concept of a "Reference Service" is used.

The "Reference Service" is a fictitious service and provides a means within the Service Information of associating the actual time shifted services (Services 1 to 6). This "Reference Service" is allocated a reference_service_id which links a common description of the events within the service for all the services belonging to the NVOD service. The Event Information Table (EIT) of the reference service can always be found in the Transport Stream in which the NVOD services are located. Each time shifted service is given a full reference in terms of transport_stream_id, original_network_id, service_id and these services are listed in the NVOD_reference_descriptor. In addition, each time shifted service is described by a time_shifted_service_descriptor which points back to the reference description. This is shown in figure 7.

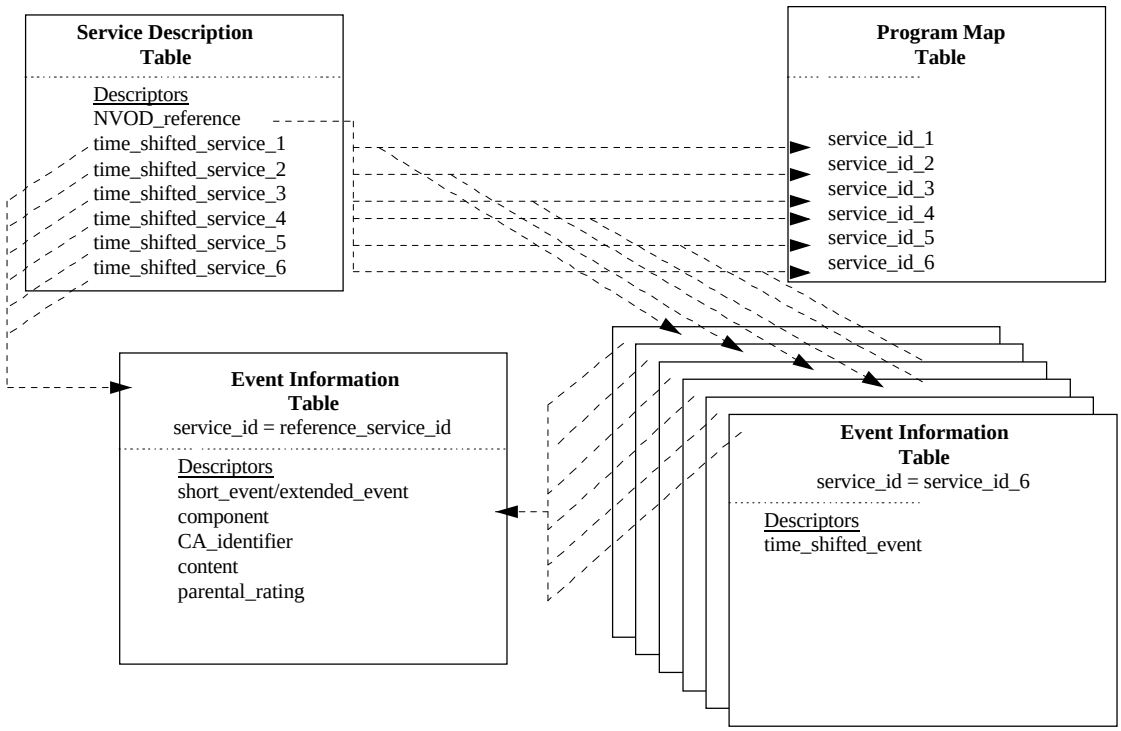


Figure 7: SI description of NVOD services

Using this method reduces the amount of data by nearly five times. The start times in the Event Information Table for the Reference Service are set to void values of all "1"s, the correct start times for each event being given in the EITs of the respective time shifted services. All the events of the NVOD reference service (i.e. all the events which are referenced from the associated EIT present/following and EIT schedule tables of the associated time-shifted services) shall be described in the EIT present/following table of the NVOD reference service.

5.2 Mosaic services

5.2.1 General considerations

Mosaic services can be spread out over several Transport Streams. A complete mosaic system can be organised in a tree structure.

A mosaic component is a collection of different video images to form a coded MPEG-2 video stream. The merging of the video images is performed at the source level, in such a way that at the display each image will occupy a specific area of the screen.

Each specific area is called a logical cell. Logical cells are composed of elementary cell(s). The mosaic screen is subdivided by a maximum of 8 x 8 elementary cells. Each elementary cell is numbered. A logical cell is a collection of elementary cells. Each logical cell is identified by a unique logical_cell_id.

The mosaic descriptor identifies the elementary cells (see figure 8), groups different elementary cells to form logical cells (see figure 9), and establishes a link between the content of all or part of the logical cell and the corresponding information carried in the SDT or EIT or BAT. Thus there is a close association between the mosaic descriptor and other SI Tables. The mosaic descriptor may be placed in either or both of the SDT and PMT sections for the mosaic service. Use in the SDT reduces the amount of interaction between the DVB SI and MPEG Tables. However, a single mosaic service containing multiple video components can only be described by having the mosaic descriptor appearing multiple times within the PMT section. Some logical cells may have no link to Service Information (see figure 8).

5.2.2 Relationship between Mosaic Service and SI/PSI Tables

Algorithm to look for a mosaic service:

a) check the SDT Tables (actual Transport Stream / other Transport Streams);

b) if a mosaic service exists:

- go to the corresponding Transport Stream;
- process the PAT and PMT;
- display the mosaic service;
- look after the content of the mosaic service:

    - if you are interested by the content of one logical cell and if it is related to:

        - a bouquet: display the information of the corresponding BAT, go forward or cancel;

        - a service: display the information of the corresponding SDT, process the PAT and the PMT and display the selected service;

        - an event: display the information of the corresponding EIT, process the PAT and the PMT and display the selected event;

        - a mosaic service: display the information of the corresponding SDT, process the PAT, the PMT, display the selected mosaic service, and go to "- look after the content of the mosaic service".

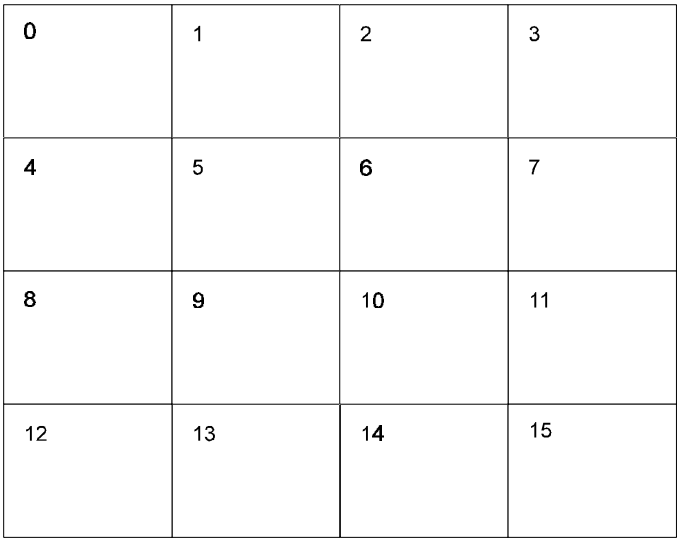
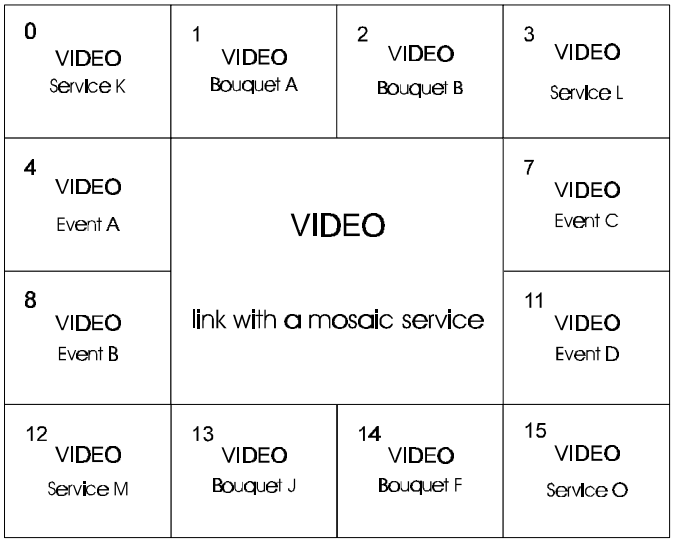


Figure 8: Elementary cell organisation



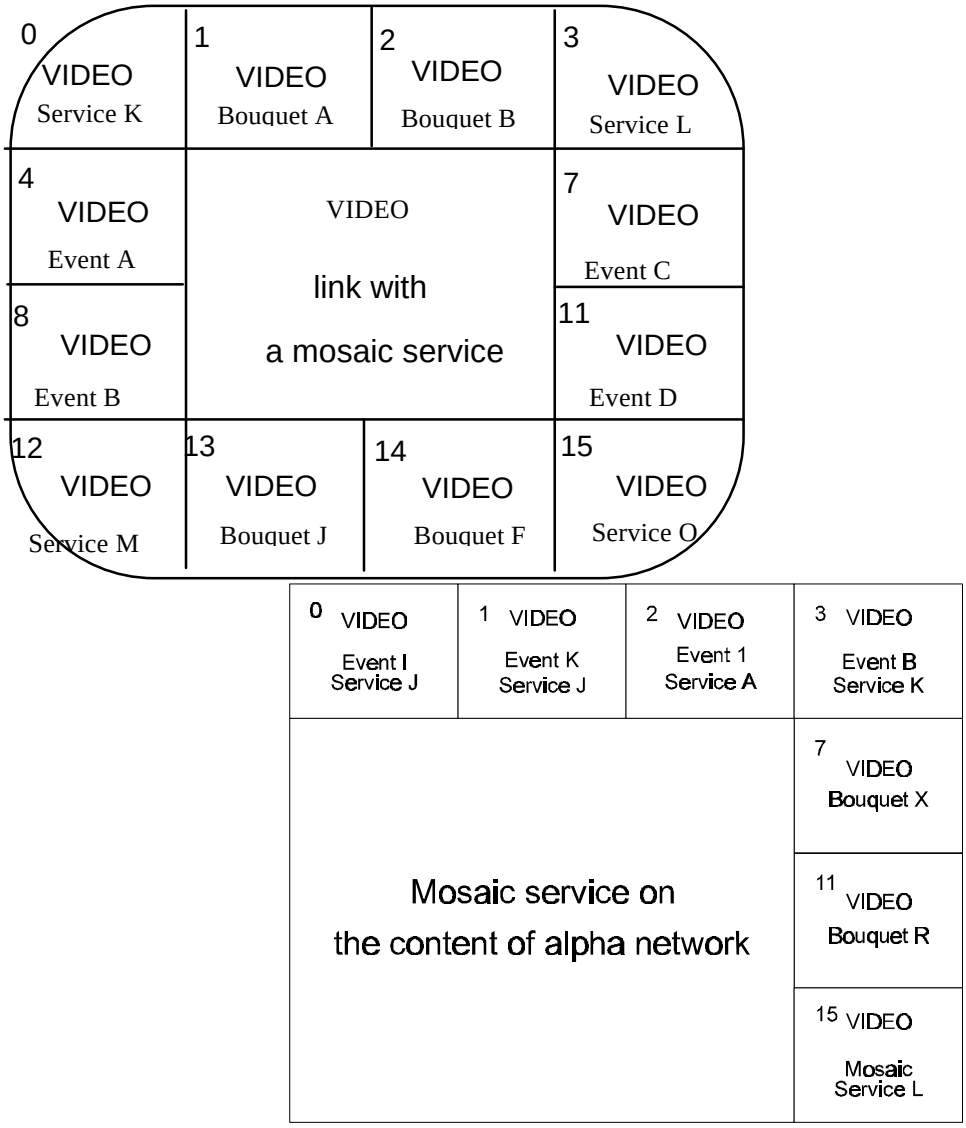


Figure 9: Examples of logical cell organisation and content

5.3 Transitions at broadcast delivery media boundaries

A very common broadcast delivery media infrastructure will be, that signals received from the a satellite are converted and rebroadcast on a cable network. Depending on the size of the network, various technical options exist to facilitate these transitions.

5.3.1 Seamless transitions

A simple and low-cost solution is to remove the Quadrature Phase Shift Keying (QPSK) modulation from a satellite signal and replace it with a Quadrature Amplitude Modulation (QAM) suitable for the cable system or a modulation system suitable for (Satellite) Master Access TeleVision ((S)MATV). This mode is usually called a seamless transition. The major complication in this seamless mode is that the bit stream is left unchanged, which causes the NIT to be invalid for the actual delivery system to which the IRD is connected, for example a cable or SMATV system.

Seamless transitions are supported by the SI System, with the proviso that it must be readily possible for the IRD to identify whether the NIT information is valid. The rules of operation specified in subclause 4.1.1 permit invalid NIT data in the case that applicable delivery system descriptors are not given for the actual delivery system.

The NIT is intended to simplify the set-up and installation procedure for the viewers, and to signal changes of tuning information. However, since it is impossible after a seamless transition of a broadcast delivery media boundary always to maintain valid information in the NIT, the IRD may require mechanisms in addition to reception of the NIT to obtain tuning data.

The support of seamless network transitions is based on the definition of a unique identification mechanism for a Transport Stream. The transport_stream_id field, as specified in the MPEG-2 standard, allows 65 536 Transport Streams to be uniquely identified. If transport_stream_id values are uniquely assigned to multiplex originators in Europe, this number is considered too small. Thus, the range of unique identifications of Transport Streams has been extended in the DVB SI by a field called original_network_id of 16 bits. The concatenation of these 2 fields results in 4 294 967 296 unique identifiers for Transport Streams. This gives sufficient room to allow for a unique identification of Transport Streams without requiring a registration procedure.

Given this unique identification of the Transport Streams, it is then possible to build IRDs that do not require a correct NIT for correct installation purposes. In order to support seamless transitions of Transport Streams for small cable systems and SMATV it is highly recommended that IRDs are able to initiate a frequency scan and store the unique Transport Stream identifiers with the sets of delivery system parameters. With this procedure the same information as carried in the NIT can be obtained. However, the presence of a NIT does provide certain advantages for installation set-up and network management purposes.

In a seamless mode of operation, an IRD is able to detect the permitted instances of incorrect NIT data, even though no modifications to the bit stream have been made. In general, a network transition will occur between two different types of networks, e.g. from satellite to cable. In this case, the detection of an incorrect NIT is based on the value of the descriptor_tag in the NIT's delivery_system_descriptor. If the transition is between networks of the same type, the NIT should be replaced (see subclause 5.3.2) by either a valid NIT or a NIT for another type of network. After the detection of an incorrect NIT, the IRD should be able to initialise itself correctly, e.g. by using a frequency scanning procedure.

5.3.2 Non-seamless transitions without re-multiplexing

A slightly more complex option is to restore the Transport Stream (TS) packet bit stream and to perform some selective TS packet replacements in the Transport Stream. Such a packet replacement option does not require a re-timestamp operation and is of relatively low complexity. Some error handling operations need to be implemented in order to deal with the unrecoverable errors in the satellite signal and with lost TS packets. The NIT is carried in TS packets with a unique Packet IDentifier (PID) value which allow the replacement function to be based on simple PID filter logic.

If a network transition is based on a TS packet replacement function, it is desirable that the new NIT information is stored and managed at the network boundary. This is the logical location, as each network operator will demand the control over the frequency allocation in his network. For this local control to be as simple as possible, a fixed PID value is selected for TS packets carrying NIT data.
A certain minimum data rate for the transmission of NIT data is specified to allow the replacement function to meet the minimum repetition time for the replacement NIT.

5.3.3 Transitions with re-multiplexing

The most complicated and expensive solution is to combine two or more Transport Streams into a single one at the broadcast delivery media boundary. This re-multiplexing also involves the re-timing of the TS packets and the generation of a new SI data stream. The SI data in other Transport Streams might in this case also be incorrect, which requires the checking and regeneration of the SI data in all Transport Streams in the network. This option will only be feasible for very large networks.

6. Storage Media

A partial bitstream from the DVB transport stream does not carry any DVB SI data other than the Selection Information Table (SIT) described in ETS 300 468. The SIT contains a summary of all SI information in the broadcast stream relevant for storage media. All relevant MPEG-2 PSI information should be coded to correctly describe the partial MPEG-2 Transport Stream.

The presence of the SIT in a bitstream flags the bitstream as a partial bitstream coming from the digital interface. This allows the IRD to ignore the absence of any mandatory SI tables and only use information coded into the SIT.

In addition to the SIT table, a second table, called Discontinuity Information Table (DIT), is defined in ETS 300 468. This table is to be inserted at transition points at which SI information may be discontinuous.

6.1 Program Association Table (PAT)

The PAT only lists selected services. In addition, the network_PID reference should take the value of the SIT_PID instead of the NIT_PID. The references to non-selected programs/services should be removed. The PAT should not violate the MPEG-2 Systems rules.

6.2 Program Map Table (PMT)

The PMT should not violate the MPEG-2 Systems requirements.

For selected services, the corresponding PMT section may remain unchanged only if all elementary streams referenced from it are selected and kept unchanged. In case any of the referenced elementary streams of the service is removed or changed, the PMT section should be modified to reflect this.

For non selected services the obsolete PMT sections may remain in the stream only if they are in the same PID as a PMT section of any selected service. In all other cases they should be removed.

6.3 SI tables (NIT, SDT, EIT, BAT, RST, TDT, TOT):

These tables should be removed after selection.

6.4 Selection Information Table (SIT)

The SIT should be packetized in transport stream packets starting from the beginning of the payload, i.e. in a packet with payload_unit_start_indicator in the transport stream packet header set to “1” and with the pointer_field set to “0x00”. Furthermore, it is recommended that the SIT is packetized in a single transport stream packet (if possible).

The transmission_info_loop in SIT should contain the partial_transport_stream_descriptor.

The following loop should contain all the service_ids of the selected services. The service_loop may contain descriptors from the original EIT and SDT.

6.5 Discontinuity Information Table (DIT)

At a transition, the bitstream may be discontinuous with respect to any of the SI information (including PAT and PMT). The DIT table shall be inserted at this transition point.

Whenever a partial bitstream discontinuity occurs, two transport packets belonging to PID 0x001E shall be inserted directly at the transition point, with no other packets in between. The first one shall have 184 bytes of adaptation field stuffing with discontinuity_flag set to “1” (in order to ensure compliance to MPEG-2 continuity counting constraints for successions of transitions introduced at independent transmisssion/storage stages). The second of these transport packets shall contain the “DIT” and shall not have such a flag set to “1”.

Annex A (informative): Inter-operation with ATSC Systems

If it is desired to inter-operate between DVB and ATSC systems, it is possible to produce transport streams containing both DVB and ATSC System Information (see bibliography). In such a situation, which is particularly likely in satellite broadcasting, it is necessary to apply certain constraints to the construction of the multiplex to ensure compatibility with the ATSC system. It is recommended that the following constraints are applied to all DVB bitstreams to ease inter-operation with ATSC.

A.1 PIDs

The PID value 0x1FFC is reserved for carriage of ATSC SI, and PID value 0x1FFD is reserved for the ATSC Master Program Guide.

A.2 Table Ids

Table ID values 0xC0 to 0xFE are used or reserved for use in the ATSC specification. This range of user-defined table_id values should not be used on PIDs carrying PMTs. For tables carried by the DVB SI PIDs, or by streams which have been identified in a PMT, no restriction on the existing DVB allocation is needed. There is, however, a requirement to include some identification of such streams in the PMT, by using the registration or private data indicator descriptors.

A.3 Descriptor tags

Descriptor tag values 0x80 to 0xAFare used or reserved for use in the ATSC specification This range of user-defined descriptor tag values should not be used within the PMT. For descriptors being used within the DVB SI PIDs, or within streams which have been identified in a PMT, no restriction on the existing DVB allocation is needed. There is, however, a requirement to include some identification of such streams in the PMT, by using the registration or private data indicator descriptors.

Annex B (informative): Bibliography

- Implementation guidelines for use of telecommunications interfaces in the Digital Broadcasting systems.
- “System Information for Digital Television”, ATSC Document A/56 (http://www.atsc.org).

DVB Project Office
c/o European Broadcasting Union
17A Ancienne Route
CH-1218 Grand-Saconnex / Geneva
Switzerland

ph: +41 22 717 27 19
fax: + 41 22 717 27 27
e-mail: dvb@dvb.org