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OF TELEVISION, SOUND PROGRAMME AND OTHER
MULTIMEDIA SIGNALS

Interactive systems for digital television distribution

Client digital program insertion API

Recommendation ITU-T J.215

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Client digital program insertion API

Summary

The digital program insertion (DPI) Recommendations given in ITU-T J.181 and ITU-T J.280 have enabled cable operators to provide local ad insertion on digital content at a head-end level, using equipment available from multiple vendors. Recommendation ITU-T J.215 enables similar functionality for DPI including addressable commercials, or other content, to be inserted at a device level in the consumer premises equipment.

Source

Recommendation ITU-T J.215 was approved on 14 December 2007 by ITU-T Study Group 9 (2005-2008) under the ITU-T Recommendation A.8 procedures.

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FOREWORD

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Recommendation ITU-T J.215

Client digital program insertion API

1 Scope

This Recommendation defines requirements for digital program insertion, henceforth referred to as DPI.

This recommendation enables digital program insertion in host devices ("client devices") within customers' homes, enabling addressable commercials to be inserted and addressed at a household level (or even at an individual television set level).

2 References

2.1 Normative 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 J.202] Recommendation ITU-T J.202 (2005), *Harmonization of procedural content formats for interactive TV applications*.
- [ITU-T J.280] Recommendation ITU-T J.280 (2005), *Digital Program Insertion: Splicing application program interface*.
- [DVB-SAD] ETSI TS 102 823 v1.1.1 (2005), *Digital Video Broadcasting (DVB); Specification for the carriage of synchronized auxiliary data in DVB transport streams*, <<http://pda.etsi.org/pda/queryform.asp>>.
- [ANSI/SCTE 138] ANSI/SCTE 138 (2009), *Stream Conditioning for Switching of Addressable Content in Digital Television Receivers*.

2.2 Informative references

- [ITU-T J.181] Recommendation ITU-T J.181 (2004), *Digital program insertion cueing message for cable television systems*.
- [ITU-T J.201] Recommendation ITU-T J.201 (2004), *Harmonization of declarative content format for interactive television applications*.

3 Definitions

This Recommendation defines the following terms:

3.1 application: An application is a functional implementation realized as software running in one or spread over several interplaying hardware entities.

3.2 application program interface (API): An application program interface is the software interface to system services or software libraries. An API can consist of classes, function calls, subroutine calls, descriptive tags, etc.

3.3 broadcast: A broadcast is a service that is delivered to all customers. Each customer may select a particular broadcast channel out of many.

3.4 broadcast application: A broadcast application is an application running on the set-top converter that is loaded through in-band information, inserted either at the head-end or by a content provider farther upstream.

3.5 client device: The CPE that is connected to the cable network in the consumer's home, receives the television signals at the client's premises, and presents it for display on a display device.

3.6 digital program insertion (DPI): Insertion of alternative content into digitally encoded content in response to messaging in the stream.

3.7 packet identifier (PID): MPEG-2 assigns a PID to each data packet. Packets with the same PID belong to the same logical channel.

3.8 program map table (PMT): This is a MPEG-2 entity that contains all of the PIDs that make up a program.

3.9 switch engine: This term refers to the functionality that executes switching in the host device. This switching can either be seamless, or non-seamless. Because this functionality needs to be implemented in a real-time way, with predictable timing behaviour, the switching engine is implemented as part of an OpenCable Applications Platform (OCAP) implementation ("below the line"). It exposes an API to OCAP applications (targeting engines) to select which commercials are switched to/from. A switching engine can be implemented in hardware, software, or a combination of both.

3.10 unicast advertising: Advertising content directed at a single target or small group of targets.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

API	Application Program Interface
DPI	Digital Program Insertion
OCAP	OpenCable Applications Platform
PMT	Program Map Table

5 Conventions

The following words are used throughout this Recommendation to define the significance of particular requirements:

SHALL	This word, or the adjective REQUIRED, means that the item is an absolute requirement of this Recommendation.
SHALL NOT	This phrase means that the item is an absolute prohibition of this Recommendation.
SHOULD	This word, or the adjective RECOMMENDED, means that valid reasons may exist in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
SHOULD NOT	This phrase means that there may exist valid reasons in particular circumstances when the listed behaviour is acceptable or even useful, but the

full implications should be understood and the case carefully weighed before implementing any behaviour described with this label.

MAY

This word, or the adjective OPTIONAL, means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

6 DPI overview

The digital program insertion (DPI) standards within [ITU-T J.181] and [ITU-T J.280] have enabled cable operators to provide local ad insertion on digital content at a head-end level, using equipment available from multiple vendors. This Recommendation enables similar functionality for DPI including addressable commercials, or other content, to be inserted at a device level.

To allow for programmability by a cable operator as well as meet time sensitive insertion requirements, the DPI functionality is separated into two logical components: a 'switch engine' implemented as part of the J.201 platform that performs real-time functions of switching between programs and program elements, and one or more 'targeting engine' applications that control the behaviour of the switch engine.

A switch engine performs switch operations to present inserted content. In the broadcast scenario, which is the only scenario defined herein, inserted content MAY be within the same MPEG-2 transport stream as the original program or broadcast within a different MPEG-2 transport stream. Other scenarios, such as those where the original or inserted content are available on a storage device, may be defined elsewhere.

A switch engine implements two distinct types of switches; a Level 0 (L0) switch, which appears to the viewer as a channel change, and a Level 1 (L1) switch, which is totally invisible to the viewer. During an L0 switch, a switch engine may be required to tune to a different channel to access an insertion stream. An L1 switch never requires tuning; in this case, all of the insertion streams are within the same transport stream as the original program content.

Requirements on content to enable L0 and L1 switches are defined by [ANSI/SCTE 138]. The switch engine behaviour is defined in clause 7.2. Detailed requirements on OCAP to perform L0 and L1 switches are defined in Annex A.

An illustration of the logical components of the OCAP DPI capability is provided in Annex A.

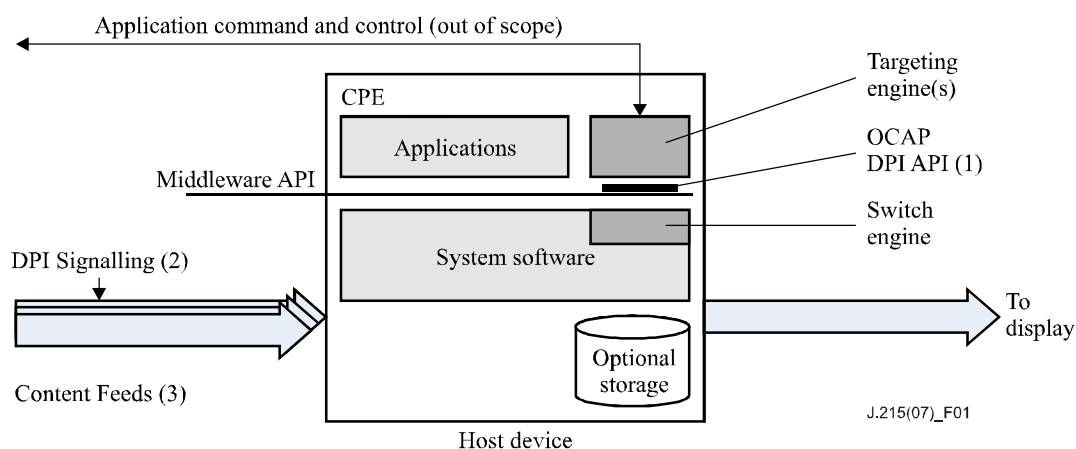


Figure 1 – OCAP DPI overview

Indicated as (1) in Figure 1, a targeting engine API is defined Annex A to enable applications to provide the switch engine with instructions and to receive status information on previously submitted instructions.

Indicated as (2) in Figure 1, DPI signalling are messages that are processed by the switch engine. Signalling may be in the form of DPI triggers or timelines. See clause 7.1 below for detailed requirements on processing DPI signalling.

Where instructed by a targeting engine, the switch engine performs a program insertion operation on receipt of a DPI trigger, or based on a timeline. The DPI API provides the mechanism by which a targeting engine application configures the switch engine to perform a switch operation. A switch operation occurs when the switch engine is properly configured by a targeting application through the DPI API, and the proper signalling is subsequently detected.

Indicated as (3) in Figure 1, content feeds are MPEG-2 transport streams that carry program feeds and may contain other insertion feeds, such as advertising feeds. The program feeds (as well as the separate insertion feeds) may contain DPI signalling that is used by the switch engine to insert content, such as addressable commercials during addressable breaks. The program feeds and insertion feeds may be subject to certain encoding (and other) restrictions that make it easier for the switching engine to switch to and from insertion content, see [ANSI/SCTE 138].

The command and control element shown in Figure 1 represents a hypothetical private communication channel between a targeting engine and an associated network component. Advanced advertising systems are expected to incorporate logical components within the cable network that manage both the insertion of DPI signalling and the actions of a targeting engine.

No security model has been defined to protect signalling from detection by non-authorized users. Because of the extremely tight synchronization between signalling and video content needed to perform seamless L1 switches, signalling must be in-band, in the same program stream as the original content feed. Strategies for obfuscating signals may be developed, but none are described herein.

7 Requirements for digital program insertion (DPI)

7.1 DPI signalling

This clause describes signaling used to enable a switch engine to perform its operations.

Two signalling protocols are used to support DPI: DPI triggers and DPI timelines. DPI trigger messages embedded within a content segment indicate opportunities to perform a switch operation. DPI timelines are messages embedded within a content segment to enable the implementation to maintain a metadata timeline for a segment. Switch operations MAY be based on timelines.

All DPI signalling is expected to be carried on a single data PID within the original content stream. This data stream SHALL be identified by DPI registration descriptor in a program's PMT.

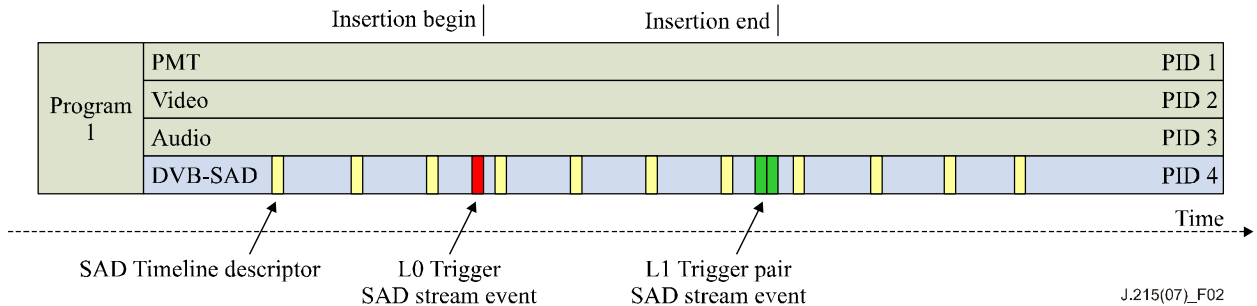


Figure 2 – DPI signalling stream

Figure 2 illustrates a hypothetical MPEG-2 program stream containing DPI signalling. The DVB-SAD PID contains a series of timeline descriptors, and examples of L0 and L1 triggers. The details of these descriptors and their placement are provided below.

7.1.1 DPI Signalling descriptor

The `dpi_signaling_descriptor` is defined for use in the elementary stream information loop of the PMT. This descriptor indicates that the associated elementary stream contains a DPI signalling stream, containing DPI triggers and timeline messages as defined below. Only one elementary stream signalled by the PMT SHALL contain a `dpi_signaling_descriptor`. In the event that more than one PMT entry contains a `dpi_signaling_descriptor`, the implementation SHALL ignore all but the first instance listed in the PMT's elementary stream information loop.

A PMT entry with a `dpi_signaling_descriptor` MAY be associated with a `stream_type` of 0xC0 or 0x05.

The `dpi_signaling_descriptor` is defined in Table 1.

Table 1 – DPI signalling descriptor syntax

Syntax	Bits	Mnemonic
<code>dpi_signaling_descriptor() {</code>		
<code>descriptor_tag</code>	8	uimsbf
<code>descriptor_length</code>	8	uimsbf
For (<code>i=0; i<n; i++</code>) {		
<code>private_use</code>	8	bslbf
}		
}		

descriptor_tag This 8-bit integer with value 0xA2 identifies this descriptor.

descriptor_length This 8-bit integer indicates the number of bytes following the descriptor length field.

private_use This field MAY be used to carry private data to a receiver which interprets this signalling stream. Its use is not defined by this Recommendation.

7.1.2 DPI triggers

The format for DPI triggers SHALL be the DVB-SAD synchronized event descriptor, see section 5.2.5 of [DVB-SAD]. When present in a content or insertion feed, the implementation SHALL process every instance of a DVB-SAD synchronized event descriptor.

The use of DPI triggers is different for L0 and L1 switches. To signal an L0 switch, a single DPI trigger MAY be used to indicate the point in a stream at which the switch may occur. For L1 switches, a DPI trigger SHALL be present for each component that will be switched; typically, one for video and one for audio. For L1 switches, a set of DPI triggers SHALL be used to signal a single switch operation.

The following semantics are defined for the DVB-SAD synchronized event descriptor (section 5.2.5 of [DVB-SAD]):

synchronized_event_context: This field SHALL be encoded according to Table 2. If this field contains a value not defined below, the implementation SHALL ignore this descriptor.

Table 2 – synchronized_event_context

Value	Description
10	L1 video
11	L1 audio
12	L0

synchronized_event_id: This field identifies a switch operation. The implementation SHALL use this value to associate a switch instruction with this trigger, if such an instruction has been received from an application.

synchronized_event_data_byte: This field SHALL be encoded according to Table 3. If this field is not conformant to Table 3, the implementation SHALL ignore this descriptor.

Table 3 – synchronized_event_data_byte

Syntax	No. of bits	Identifier
set_size	8	uimsbf
position_in_set	8	uimsbf

set_size: This field indicates the number of triggers signalling a switch. For an L0 switch, this value is 1, for an L1 switch, this value is at least 1 and is typically 2; one for video, one for audio.

position_in_set: This field indicates the position of this trigger within a set of triggers, zero based.

DPI triggers for L0 switches SHALL be present in a stream at a point TBD.

DPI triggers for L1 switches SHALL be present in a stream at a point TBD. For more details on the structure of an L1 conditioned stream, see [DVB-SAD].

7.1.3 DPI timelines

A content segment MAY contain timeline messages that allow the implementation to maintain a timeline synchronized to the video and audio content. Timeline messages SHALL be in the DVB-SAD broadcast timeline descriptor format, see [DVB-SAD] clause 5.2.2 for a description of the broadcast timeline descriptor. When present within a content feed, the implementation SHALL process every instance of a DVB-SAD broadcast timeline descriptor to maintain an interpolated metadata timeline. [DVB-SAD] contains descriptions and references to definitions of timelines within several clauses. The reader should be familiar with [DVB-SAD] in its entirety.

L0 switch operations MAY be performed when a point on a timeline is reached. In order to enable time-based switch scenarios in which a viewer may tune away, then tune back into a service during a switch opportunity, streams MAY contain a series of DPI timeline messages throughout the original program.

Within a content feed that signals a timeline and supports L0 switches, a DPI timeline SHALL be continuous throughout the relevant segment. The associated insertion feeds SHALL signal a timeline that is proceeding at the same rate with the same values as the original feed.

Within a content feed that signals a timeline and supporting L1 switches, the DPI signalling stream SHALL contain a continuously advancing timeline.

The following semantics are defined for the DVB-SAD synchronized event descriptor:

Where broadcast_timeline_type equals 0:

tick_format: This field SHALL have the value 0x11. See Table 6 of [DVB-SAD].