RP 203-2000

SMPTE RECOMMENDED PRACTICE

Real Time Opportunistic Data Flow Control in an MPEG-2 Transport Emission Multiplex

1 Scope

This practice defines the means of implementing opportunistic data flow control in a DTV MPEG-2 transport broadcast according to flow control messages defined in SMPTE 325M. An emissions multiplexer requests opportunistic data packets as the need for them arises and a data server responds by forwarding data already inserted into MPEG-2 transport stream packets. The control protocol that allows this transfer of asynchronous data is extensible in a backward compatible manner to allow for more advanced control as may be necessary in the future. Control messages are transmitted over a dedicated data link of sufficient quality to ensure reliable real-time interaction between the multiplexer and the data server.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below:

SMPTE 305M-1998, Television — Serial Data Transport Interface

SMPTE 325M-1999, Digital Television — Opportunistic Data Broadcast Flow Control

DVB-A010, Interfaces for CATV, SMATV Head-ends and Similar Professional Equipment, Annex B: Asynchronous Serial Interface(ASI)

3 Definition of terms

3.1 control channel: The logically unidirectional connection from the emissions multiplexer to the data server over which the SMPTE 325M opportunistic data flow control messages are carried.

3.2 data channel: The logically unidirectional connection from the data server to the emissions multiplexer over which the MPEG-2 transport stream packets are delivered for broadcast by the emissions multiplexer.

3.3 data server: A computing device that emits data encapsulated within MPEG-2 transport stream packets intended for broadcast at the correct data rates specified for the particular services. In the case of opportunistic data, there is no defined fixed data rate.

3.4 opportunistic data: A data stream whose bit rate is unspecified and, over any time interval, may range from zero to the full bandwidth of the emissions channel.

3.5 opportunistic data session: The interconnection of a data server containing opportunistic data and an emissions multiplexer that is able to insert that data into the transport multiplex whenever there is unused available bandwidth. There may exist multiple sessions between the same physical multiplexer and data server.

3.6 opportunistic data flow control: The mechanism by which a multiplexer requests additional MPEG-2 transport packets from a data server and by which that data server emits a response.

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3.7 PID: Packet identifier. A 13-bit field in an MPEG-2 transport stream packet header that identifies the transport stream packet as part of a larger data stream that is separate from other streams marked with different PIDs.

4 Physical connection between multiplexer and data server

4.1 The physical connection over which opportunistic data flow control messages are carried from a multiplexer to one or multiple data servers can take either of two forms according to the circumstances of a given system implementation. This physical connection is defined as originating at a multiplexer output port and terminating at a data server input port.

4.1.1 One data link, one session: There may exist one physical data link for each opportunistic data session.

4.1.2 One data link, multiple sessions: There may exist one shared physical data link for multiple opportunistic data sessions. In cases where multiple data servers share a common flow control data link, a distribution amplifier must be used to distribute the signal from the multiplexer due to the point-to-point nature of the recommended physical data links (see 4.2).

4.2 Two physical/data link standards are applicable for real time opportunistic data flow control because they meet several requirements. The link must have sufficient bandwidth to carry the flow control messages fast enough to be useful. The link must be capable of reliable, real time operation with a minimum latency of transmission. The link protocol must be sufficiently compact so as to facilitate hardware-only parsing and/or generation of the messages in implementations that require minimum response latency.

4.2.1 DVB-ASI: The data link operates at a usable data rate of 216 Mb/s and places no significant constraints on the timing or format of packets carried over it. It is recommended that manufacturers implement DVB-ASI receivers that are polarity insensitive because it allows increased interoperability with SMPTE 259M routing equipment.

4.2.2 SMPTE 305M (SDTI): The data link operates at a raw data rate of 270 or 360 Mb/s. At 270 Mb/s, seven transport stream packets may be placed on each line, resulting in a usable bandwidth of 165 Mb/s. The underlying physical medium is SMPTE 259M. The transmission of data packets must be held off during the horizontal sync and SDTI framing portions of the signal and must conform to the encapsulation provisions set forth in SMPTE 305M. It is not recommended that the extended data space of SMPTE 305M be used.

5 Logical communication between multiplexer and data server

5.1 The logical communication of flow control information between the multiplexer and data server is session based. Each opportunistic data session is assigned a unique transport PID that will be used to carry flow control information specific to a given session. When performing flow control of multiple opportunistic data sessions on a single data link, each session must be marked with a PID that is unique with respect to that data link. However, it is recommended that all PIDs in a broadcast environment be assigned uniquely to avoid accidental confusion of one stream for another, even where only one session is present on the data link.

5.2 Flow control response time should be considered in the context of the real-time nature of the emissions multiplex. At any given time, the multiplexer may observe that no valid MPEG-2 transport stream packet is waiting to be transmitted. This will result in the emission of a null transport stream packet if the multiplexer is unable to acquire an opportunistic data packet in a sufficient amount of time. The possibility of single packet-time flow control is made available by the inherently high data rates and low latencies of the recommended data links.

An MPEG-2 transport stream packet encapsulated flow control message takes less than 7 µs to travel over either recommended data link. Therefore, a systems designer may consider how many flow control messages may be transferred in the period of time it would take for the emissions multiplexer to transmit a transport stream packet. As an example: with a transmission data rate of approximately 19.4 Mb/s, the transmission time for a single MPEG-2 transport stream packet is 78 µs. Using the physical interfaces defined in this practice would allow the transmission of roughly 11 control messages in the span of time required to transmit a single emissions transport stream packet.

5.3 SMPTE 325M addresses the network, transport, session, and presentation layers of an opportunistic data flow control messaging mechanism in the common OSI network model.

5.4 SMPTE 325M allows for an extensible flow control protocol by utilizing the DSM-CC message version field to denote versions of the standard protocol. The basic protocol consists solely of a request from the multiplexer for a specified number of whole MPEG-2 transport stream packets. It is intended that any equipment designed to the first protocol version will be interoperable with any future protocol versions (backward compatibility).

6 Opportunistic data flow control

6.1 The application layer is implemented by the multiplexer and data server equipment manufacturers and consists of the multiplexer observing a need for more opportunistic data and the data server responding with the requested data packets.

6.2 The operational model for opportunistic data flow control is request and wait. The multiplexer issues a request for a specified number of whole MPEG-2 transport packets and waits for a complete response from the data server.

6.3 Practical configuration information is necessary to bound the request-and-wait mode of operation. It is recommended that the following information be communicated to the multiplexer and used by the multiplexer manufacturer appropriately:

6.3.1 Maximum data server response time: This tells the multiplexer how long the data server may take to respond to any requests for additional data. The multiplexer should consider this latency when making a request so that the request is issued within at least the maximum response time.

6.3.2 Maximum data server request size: This tells the multiplexer how much data the server is capable of providing at any one request over the specified response time. The multiplexer should consider this capacity when making a request to avoid the case where too much data are requested, causing the data not to arrive at the multiplexer as expected.

6.4 The multiplexer should be able to accept the full amount of data that it has requested at the fastest data rate and lowest latency of the data link that it supports.

Annex A (informative)
Bibliography

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and 4f_{sc} Composite Digital Signals — Serial Digital Interface

SMPTE 332M-2000, Television — Encapsulation of Data Packet Streams Over SDTI (SDTI-PF)

ISO/IEC 13818-6:1998, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information — Part 6: Extensions for DSM-CC