RP 206-1999

SMPTE RECOMMENDED PRACTICE

Opportunistic Data Flow Control Using Ethernet as a Control Channel in an MPEG-2 Transport Emissions Multiplex

NOTE: This practice, if implemented according to this document, may not provide interoperability due to an incomplete description of the Ethernet interface

1 Scope

This practice proposes a means of implementing opportunistic data flow control in a DTV MPEG-2 transport broadcast using the flow control messages defined in SMPTE 325M. This practice defines an implementation that uses ethernet as the control channel from the emissions multiplexer to the data server. The data server's data are delivered to the emissions multiplexer via either an ASI, SDTI, or ethernet point-to-point connection.

An emissions multiplexer requests opportunistic data packets as the need for them arises. The data server responds by forwarding data already encapsulated in MPEG-2 transport stream packets. Emissions multiplexer control messages are transmitted to the data server over ethernet with the SMPTE 325M opportunistic flow control messages encapsulated in the network protocol of choice. The data server's information is delivered via a dedicated data link of sufficient quality to ensure reliable interaction between the hardware/software entities in the multiplexer and data server. There is no guarantee of real time response in this system.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the edition indicated was 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 standard indicated below.

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

3 Definition of terms

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

3.2 data channel: The logically unidirectional connection from the data server to the emissions multiplexer where the MPEG-2 transport stream packets are delivered for output 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. The transport stream packets are delivered to the emissions multiplexer via the data channel.

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 flow control: The mechanism by which a multiplexer requests additional MPEG-2 transport stream packets from a data server.

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

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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 connections between multiplexer and data server

4.1 The physical connection where SMPTE 325M opportunistic data flow control messages are carried from an emissions multiplexer to one or more data servers shall be ethernet. The standard practice of using ethernet hubs or ethernet repeaters to interconnect multiple data servers to an emissions multiplexer should be followed.

4.1.1 The selection of the network protocol(s) that is (are) used above the ethernet MAC layer to deliver control messages shall be the responsibility of the manufacturer. This practice discusses the use of either the TCP/IP or UDP/IP network protocols.

4.1.1.1 The UDP/IP protocol is recommended in ethernet environments where the ethernet carrying the control channel is dedicated to the carriage of the control channel. In this environment, it is assumed that there is a significantly low probability of collisions occurring on the ethernet. Thus, delivery is nearly guaranteed and the use of a nonguaranteed delivery protocol is considered acceptable. UDP/IP is preferred in this environment because of its lower overhead.

4.1.1.2 The TCP/IP protocol is recommended in ethernet environments where the ethernet carrying the control channel is being shared with other applications. Care must be taken that packets from other applications do not adversely impact the performance of the system. TCP/IP is recommended because of its reliable data delivery mechanism, and in ethernet where collisions can occur, the desire for a guaranteed delivery of the SMPTE 325M opportunistic flow control messages is ideal.

4.1.2 The MPEG-2 transport stream packets defined in SMPTE 325M shall be carried in the payload portion of the network protocol. The number of SMPTE 325M messages carried in the payload portion of a single message of the network protocol shall be the responsibility of the manufacturer.

4.1.3 The end-point identification shall be the responsibility of the manufacturer and is based upon the network protocols selected by the manufacturer. For TCP/IP or UDP/IP, the end stations shall be identified by their IP address. The TCP/IP or UDP/IP communication shall use a well-known port number specific to the system. All SMPTE 325M messages shall be distributed to this port number. It is the responsibility of the manufacturer's application to demultiplex multiple sessions as defined below (see 5.1).

4.2 Figure 1 illustrates multiple data servers (DS) connected to an emissions multiplexer (EM). The data channel connections from the DS to the EM are point-to-point connections. The control channel connections from the EM to the DS use ethernet as per this practice and are represented as a bus.

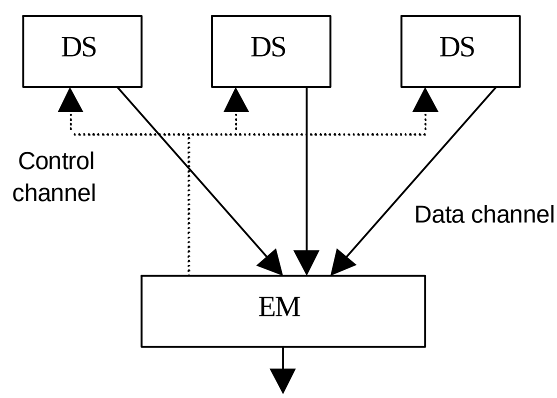

Figure 1 – Multiple data servers

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 a data link.

5.2 SMPTE 325M allows for an extensible flow control protocol by utilizing the DSM-CC 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 stream packets and waits for a complete response from the data server.

6.3 Practical configuration information is necessary to bound the request-and-wait circumstance. 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 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.

6.5 The data request pattern of the multiplexer is arbitrary and the responsibility of the multiplexer manufacturer according to the internal architecture of the equipment. It is expected that the multiplexer will contain a buffer to hold a number of opportunistic data packets locally so that one is ready for transmission when needed. However, this is not mandatory and is irrelevant from the external opportunistic data flow control perspective.

Annex A (informative)
Bibliography

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The Ethernet — A Local Area Network, Version 1.0, Digital Equipment Corporation, Intel Corporation, Xerox Corporation, September 1980