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TITLE : Multiplexing protocols for H.222.1

PURPOSE : Proposal

1. INTRODUCTION

Draft Recommendation H.222.1 currently specifies both the H.222.0 Program Stream and Transport Stream. The 26th Study Group 15 EG meeting called for contributions as to whether the H.32X terminal should support both, or one thereof, of the Program Stream or Transport Stream [1]. This document proposes that the H.32X terminal should always be able to decode the Program Stream.

2. PROGRAM STREAM AND TRANSPORT STREAM COMPARISON

2.1. Functions

As shown on Table 1, the Program Stream and the Transport Stream have similar functionality.

function	PS	TS
packet synchronisation	M	M
demultiplexing	M	M
packet sequence integrity	M	M
payload synchronisation indication	M	M
encoder timebase recovery	M	M
presentation synchronisation	M	M
MPEG data transfer	M	M
buffer management	M	M
random access	O	M
payload scrambling	O	O
private data transfer	O	O
trick modes	O	O
network maintenance	O	O
packet redundancy	-	O

a)

function	PS	TS
remultiplex support	-	O
local program insertion	-	O
priority	O	O

b)

Table 1. Functions supported by the Program Stream (PS) and the Transport Stream (TS) in a) a decoder, and b) a network element. (O - optional, M - mandatory).

2.2. Multiplexing capacity

The Program Stream supports only one program while the Transport Stream supports many. The Transport Stream has much greater multiplexing capacity.

2.3. Protocol structure

The Program Stream is a single layer packet protocol, consisting of PES packets.

The Transport Stream is a two layer protocol model. These layers can be identified in generic terms as a,

- packet layer - the PES packet layer
- "cell" layer - the Transport Stream packet layer

The Transport Stream packet is of fixed length to support high speed multiplexing, and allow fast packet synchronisation. These are the same reasons that the ATM cell is small and fixed length. In the Transport Stream this supports the ability to remove and insert programs or elementary streams i.e. add/drop multiplexing. The remultiplex operation may involve,

- PID reassignment, since PID values must be unique within a Transport Stream
- insertion of new PSI tables, since PSI tables have to correctly indicate the stream contents
- updating of PCR values, since PCR values have to be correct, within bounds, with respect to the stream in which they reside

ISO/IEC 13818-1 may be misleading with respect to comparison between the Program Stream and Transport Stream. It says that the Program Stream is designed for error free environments while the Transport Stream is for environments where errors may occur. It is unreasonable to compare the Program Stream and the Transport Stream in this way, since the Program Stream does not cover the same parts of the protocol model as the Transport Stream. With respect to error performance the Program Stream is equivalent to the PES layer of the Transport Stream. What the Program Stream lacks is simply what an appropriate ATM/AAL protocol would provide. For example packet synchronisation can be provided by AAL mechanisms, which can replace or augment the function of Program Stream packet start codes.

It is noted that spatial error localisation, as defined in ISO/IEC 13818-2, may be unfavourable using the Transport Stream, due to poor packing efficiency [2].

2.4. Implementation

The Program Stream may be easier to implement than the Transport Stream, as dedicated hardware will be required for the Transport Stream, while the Program Stream should be suitable for implementation in software.

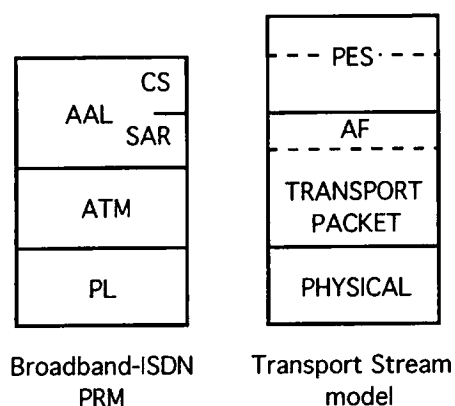
3. TRANSPORT STREAM DESIGN MODEL

A typical application for which the Transport Stream was designed, is the "Grand Alliance" specification, which is proposed to the United States FCC for high definition television delivery (HDTV) in that country [3]. Transport Stream packets have 20 bytes of Reed-Solomon parity overhead added, and are diagonally interleaved. Trellis coded vestigial sideband modulation is used for the digital transmission. Two versions are specified. The first is referred to as 8-VSB, and provides 19.3 Mbits/s in a 6 MHz terrestrial channel. The second is for cable delivery, and is referred to as 16-VSB. It provides twice the capacity of the terrestrial system, but is less robust to noise.

4. RELATIONSHIP BETWEEN THE TRANSPORT STREAM AND ATM

The Transport Stream provides similar functionality to ATM. Indeed this similarity is hailed as a feature of the Transport Stream (e.g. [3]). Such similarity suggests that the Transport Stream may be viewed as a competing technology to ATM. Equivalence between fields in ATM and the ATM Adaptation Layer (AAL), and the MPEG-2 Transport Stream has been previously reported [4]. Based upon this similarity it may be possible to illustrate equivalence in the protocol models, as shown in Figure 1. Referring to Figure 1 the following comments can be made:

- the Transport Stream packet contains a sequence number which in ATM is an AAL function
- the optional Transport Stream adaptation_field is a per segment operation, and thus is similar to a SAR header.
- the PES layer has some similarity to a Convergence Sublayer, though from the ATM viewpoint it also contains higher layer application specific information.



CS - Convergence Sublayer
 SAR - Segmentation and Reassembly sublayer
 AAL - ATM Adaptation Layer
 PL - Physical Layer
 PRM - Protocol Reference Model
 PES - Packetised Elementary Stream
 AF - Adaptation Field

Figure 1. Broadband-ISDN and MPEG-2 Transport Stream protocol models.

5. CONCLUSION

The H.32X receive terminal should always be able to decode the Program Stream, a packet layer multiplex.

Given the Transport Stream's overlapping functionality with ATM and the AAL, and its implementation burden, the Transport Stream should not be made mandatory in a H.32X send terminal.

While there may be considerable current commercial interest in the Transport Stream, the H.32X series of standards may become alienated from some industry sectors in the future, if a packet multiplex i.e. the Program Stream, is not also supported.

6. REFERENCES

- [1] AVC-673R, "Report of the Sixteenth Experts Group Meeting in Grimstad (13-22 July 1994)", ITU-T Study Group 15 Experts Group for Video Coding and Systems in ATM and Other Network Environments, July 1994.
- [2] AVC-585, "ATM network adaptation performance parameters", ITU-T Study Group 15 Experts Group for Video Coding and Systems in ATM and Other Network Environments, October 1993.
- [3] "Grand Alliance HDTV System Specification", Version 1.0, April 14, 1994.
- [4] AVC-464, "Relation between MPEG-2 transport mux and ATM/AAL (Japan)", ITU-T Study Group 15 Experts Group for Video Coding and Systems in ATM and Other Network Environments, March 1993.

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