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## **Sencore HDTV998 Dual RF Output Card Transport Stream File Requirements**

### **1.0 Useful References**

- 1.1 ISO/IEC 13818-1 "Generic Coding of Moving Pictures and Associated Audio Information: SYSTEMS" ISO/IEC 13818-2 (a.k.a. MPEG-2: SYSTEMS).
- 1.2 ISO/IEC 13818-2 "Generic Coding of Moving Pictures and Associated Audio Information: VIDEO" (a.k.a. MPEG-2: VIDEO).
- 1.3 SMPTE 312M-1999 Television — Splice Points for MPEG-2 Transport Streams.
- 1.4 Streams.
- 1.5 Doc.A/53B "ATSC Digital Television Standard - Revision B".
- 1.6 Doc.A/58 "Harmonization with DVB SI in the use of the ATSC Digital Television Standard".
- 1.7 Doc. A/65A "Program and System Information Protocol for Terrestrial Broadcast and Cable (Revision A) and Amendment No.1"
- 1.8 Doc. A/69 "ATSC Recommended Practice: Program and System Information Protocol Implementation Guidelines for Broadcasters"
- 1.9 ATSC website at [www.atsc.org](http://www.atsc.org).

### **2.0 General Discussion**

- 2.1 The encoding and media creation entities should be aware of the basic application and operation of the HDTV998 playback system. The individual media files required by the system are ATSC transport streams that will be modulated onto an ATSC 8-VSB channel and connected to consumer ATSC/MPEG-2 receiver/decoders, such as DTV set-top boxes and television sets. (An ATSC transport stream is an MPEG-2 transport stream with certain restrictions and extensions as defined by ATSC Doc.A/53b. While every ATSC Transport Stream is MPEG-2 compliant, not every MPEG-2 transport stream is ATSC compatible.)
- 2.2 The exact model and manufacturer of the consumer receiver/decoder that will process the ATSC channel generated by the HDTV998 card is unknown. These devices will expect to receive a compliant ATSC 8VSB RF channel carrying a compliant ATSC transport stream. To ensure interoperability, the transport stream files should be compliant with the combined minimum recommendations of ATSC specifically and MPEG-2 in general.
- 2.3 The TS file creation process should take into account:
  - 2.3.1 Minimum requirements to ensure compatibility with the playback equipment (HDTV998 card and software).
  - 2.3.2 Encoding and multiplexing requirements to ensure smooth visual transitions when files are played sequentially in a play-list.
  - 2.3.3 Encoding and multiplexing recommendations to ensure the highest visual and audible playback quality possible.
  - 2.3.4 Encoding and multiplexing recommendations to ensure maximum interoperability with consumer devices.

## 3.0 Minimum Requirements for Playback

- 3.1 The TS file should contain an MPEG-2 fixed rate transport stream (TS) multiplexed to a final rate of 19.392658 Mbps (+/- 54 bps) as required by ATSC. A fixed rate multiplex is achieved by adding null packets to the combined audio, video and data table packets as needed to maintain the constant transport rate.
- 3.2 The TS multiplex should contain the desired video and audio programs encoded as valid MPEG-2 packetized elementary streams (PES) following the restrictions of ATSC document A/53b.
  - 3.2.1 Each video access unit should be packaged in a unique PES packet, and each video access unit should contain a PTS/DTS stamp (A/53b).
  - 3.2.2 The Program Clock Reference (PCR) should be encoded with the video PES.
- 3.3 The Video elementary stream should be encoded in one of the 18 recommended ATSC frame-rate/resolution formats.
- 3.4 The Audio elementary stream should be an AC-3 compressed bit-stream per ATSC document A/52.
- 3.5 The TS should contain a valid Program Association Table (PAT) multiplexed at intervals of no more than 100mS from the beginning of the file to the end.
- 3.6 As required by MPEG-2, the PAT should have a Table I.D. 0x00 and be located at packet identifier (PID) 0x00.
- 3.7 The PAT should contain entries for all Program Map Tables (PMTs) needed to describe programs in the stream.
- 3.8 A valid version of each PMT should be multiplexed at intervals of no more than 400mS from the beginning of the file to the end.
- 3.9 As required by MPEG-2, the PMT tables should all have a Table I.D. of 0x02.

## 4.0 MPEG-2 Encoding recommendations for smooth file transitions

- 4.1 The video PES should begin with a sequence header and the first GOP of the file should be CLOSED.
- 4.2 IF THE FIRST GOP OF THE TS FILE CANNOT BE CLOSED, then 2 seconds or (tbd) frames of black should be added to the beginning and end of the UNCOMPRESSED clip with a smooth fade-in / fade-out.

## 5.0 Recommendations for best playback quality

- 5.1 If possible, all source clips (before MPEG-2 compression) should be native HD-1080i or 720p and encoded as 1080i or 720p streams.
- 5.2 The highest quality encoder settings should be used for a given source clip. This should result in the encoded video using as much of the available 19.39 Mbps TS capacity as possible (video bit-rate > 15 Mbps recommended).
- 5.3 Recommended groups of pictures (GOP) structure:
  - 5.3.1 Each GOP should begin with an I-frame.
  - 5.3.2 GOPs should have M=3.
  - 5.3.3 GOP size should be nominally 15 for 30fps source, 12 for 24fps source.

## 6.0 Recommendations to ensure correct operation of the Sencore seamless splice feature and compatibility with consumer receiver / decoders.

- 6.1 All files should begin and end on a whole transport stream packet and at whole PES packet boundaries. The first byte in the file should be the sync byte (0x47) of the first packet.
- 6.2 Every file must begin with a closed GOP. The first coded picture in the file must be an I-frame belonging to a closed GOP, but does not have to be the first byte in the file. (If the first GOP cannot be closed, a fade-in/out to/from black should be used.)
- 6.3 Each TS file should contain a multiplex of only one MPEG-2 audio/video program. The audio and video elementary streams should be present throughout the file.
- 6.4 The single program entry in the PAT should be "Program 1".
  - 6.4.1 The PMT for the single program entry should have a PMT\_PID value of 0x10 (16).
  - 6.4.2 The Video\_PID value should be 0x11 (17).
  - 6.4.3 The Audio\_PID value should be 0x14 (20).
- 6.5 The Program Clock Reference (PCR) should be encoded with the video PES on PID 0x11 (17).
- 6.6 Each TS file should have valid place-holders and repetition for the minimum recommended ATSC PSIP tables, including MGT(required), TVCT(required), STT, RRT, and four EITs. Consumer equipment relies on the presence of PSIP to identify and acquire the ATSC channel.
- 6.7 If possible, all source clips (before MPEG-2 compression) should be native HD-1080i. At a minimum all files in the same seamless list MUST be the same ATSC format (1080i, 720p, etc.) – this will ensure that all sequence headers are identical across the playlist boundaries, otherwise unpredictable consumer responses can occur at the format change points.