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Subject: This document describes all MPEG encoding requirements for Thales Avionics TopSeries Systems. This specification is intended for Post-Production Labs (PPLs) to process audio, video and captions / subtitles content into an MPEG digital media compatible with TopSeries Systems.

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REVISION

See page 2

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Revision Information

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LIST OF REVISIONS

REVISION	DESCRIPTION OF CHANGE	DATE	BY
A	Initial Release per EO 045055	01-15-2010	EBH
B	Revise per EO 045528 Change PID values from decimal specified as hexadecimal by error to true hexadecimal values in Section 6-2 & 6-3 tables	02-01-2010	BS
C	Revise per EO 046744 1. Update of section 2.1 table for Broadcast Video and VOD in i5000 with SVDU Gen 3 to accept MPEG-4 and CC/SUB 2. Spell out MP2/MP3 as MPEG-1 Audio, Layer 2/3 in requirements 3. Update R3-22 & R4-25 to MPEG-2 Transport Stream at Constant Bit Rate (CBR) 4. Update R4-30 for Video Bit Rates to be stated as a range from 1.5 Mbps (CBR) to 2.0 Mbps (CBR) instead of two fixed bit rates 5. Update R4-46 by removing HE-AAC and update of MP2 to MP3 for compliance with WAEA 0403 6. Add R3-25 exclusions, R3-48 to R3-49, R4-50 to R4-61, R5-21 to R5-38 requirements 7. Remove R4-42 requirement	06-15-2010	EBH
D	Revise per EO 048277 1. Correct minor typos and formats 2. Change notes in Section 2.1 table, add R3-50, R3-52, R4-62, R4-63 and update R3-45 3. Add equivalency between dBFS and dBu 4. Move CC/Subtitles input files requirements to Appendix C and update R6-3 5. Changes added for compliance with WAEA 0403 Best Practice: 5.1. Add R4-42 & R4-64 requirements 5.2. Remove R4-37 requirement 5.3. Update R4-30, R4-32, R4-51, R4-38, R4-54 R4-56, R4-57 & R4-59 requirements	01-04-2011	BS
E	Revise per EO 048537 1. Correct minor typos and formats 2. Remove Tamil from the Legacy Language PID Assignments table in Section 6 and added a note for adding a non-legacy language 3. Update R3-45 requirement 4. Update Figure C-1	02-07-2011	BS
E1	Revise per EO 048571 Correct incorporation of requirement R3-45 update	02-08-2011	BS

LIST OF REVISIONS			
REVISION	**DESCRIPTION OF CHANGE**	**DATE**	**BY**
F	Revise per EO 059310 1. Many text editions to facilitate compliance 2. Add i5G4, i8G4 & AVANT platforms in all applicable sections, text, tables and requirements 3. Increase all Content File Name Lengths to less than 250 ASCII characters to allow encode selections descriptions by Post-Production Labs 4. Add SVDU Gen3 and SVDU Gen4 MPEG audio decoders support of MP2 & MP3 audio formats as well as of LC-AAC, HE-AAC v1 & HE-AAC v2 audio formats 5. Add 3D Audio encode requirements 6. Add APEX best practices for GOP size in MPEG-1 and MPEG-2 7. Add few MPEG-4 video parameters for enhanced passenger experience 8. Add 720p*(constrained), 720p and 1080p encode requirements 9. Add written Chinese and Brazilian Portuguese in Section 6 Language PID Assignments 10. Update R3-1, R3-2, R3-3, R3-8, R3-21, R3-28, R3-39, R3-40, R3-42, R3-54, R3-55, R4-2, R4-3, R4-19, R4-24, R4-28, R4-37, R4-38, R4-46, R4-54, R4-61, R4-63, R4-64, R5-1, R5-2, R5-3, R5-9, R5-21, R6-1 to R6-3, R7-1 to R7-6 11. Add R3-56 to R3-60 and R4-65 to R4-105 12. Remove R4-1	01-17-2014	

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1 Purpose

This document describes all MPEG encoding requirements for Thales Avionics TopSeries Systems.

This specification is intended for Post-Production Labs (PPLs) to process audio, video and captions / subtitles content into an MPEG digital media compatible with TopSeries Systems.

It is highly recommended that the Post-Production Lab consults with a Thales TopEffects Representative to acquire the media profile requirements that are specific to a particular airline.

2 Scope

2.1 Format Compatibility per Platform & per Service

- The following table helps the encoding facility and Thales Media Manager to select the appropriate MPEG format for a specific service in a Thales TopSeries system with particular seat displays.
- It describes the encoding compatibility for:
  - Audio in MPEG-1 Audio, Layer 2 (MP2) or Layer 3 (MP3) and LC-AAC or HE-AAC (v1 or v2) commonly called AAC in the table below,
  - Standard Definition Video (SD) in CBR MPEG-1, CBR MPEG-2 or CBR MPEG-4 Part 10 (H.264/AVC),
  - High Definition Video (HD) in CBR MPEG-4 Part 10 (H.264/AVC),
  - Open Captions (OC), being part of the analog video, are MPEG encoded and cannot be turned off,
  - Closed Captions and Subtitles (CC/SUB) in DVB Subtitling systems standard,
  - Systems in CBR MPEG-2 Transport Stream.

Service / Platform	BGM / PRAM	In-Seat Broadcast Audio	AOD	VA / VOE / VOR	In-Seat Broadcast Video	VOD
i2000	MP3	MP3	N/A	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1 & 2)**	N/A	N/A
i3000	MP3	MP3	N/A	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1 & 2)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 2)**	N/A
i4000 with SVDU Gen 1	MP3	MP3	MP2 in CBR MPEG-2 TS	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1 & 2)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 2)**	SD in MPEG-1 Audio in MP2 (OC for all)
i4X00 with SVDU Gen 2	MP3	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1 & 2)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 2)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all)
i5000 with SVDU Gen 2	MP2 or MP3 in CBR MPEG-2 TS **(Note 1)**	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all)	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all)
i5000 with SVDU Gen 3	MP2 or MP3 in CBR MPEG-2 TS **(Note 1)**	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)
i5000 with SVDU Gen 4 **(i5G4)**	MP2 or MP3 in CBR MPEG-2 TS **(Note 1)**	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 (OC for all) **(Note 1)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD & HD* in MPEG-4 Audio in MP2 or AAC (CC/SUB for all) **(Note 3)**

Service / Platform	BGM / PRAM	In-Seat Broadcast Audio	AOD	VA / VOE / VOR	In-Seat Broadcast Video	VOD
i8000 with SVDU Gen 3	MP3 only (recommended) or MP2 or MP3 in CBR MPEG-2 TS **(Note 1)**	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (OC or CC/SUB for all) **(Note 1)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)
i8000 with SVDU Gen 4 **(i8G4)**	MP3 only (recommended) or MP2 or MP3 in CBR MPEG-2 TS **(Note 1)**	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (OC or CC/SUB for all) **(Note 1)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD & HD* in MPEG-4 Audio in MP2 or AAC (CC/SUB for all) **(Note 3)**
AVANT with SVDU Gen 4	MP3 only (recommended) or MP2 or MP3 in CBR MPEG-2 TS **(Note 1)**	MP3	MP3	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD & HD in MPEG-4 Audio in MP2 or AAC (OC or CC/SUB for all) **(Note 1)**	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD & HD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)	SD in MPEG-1 or SD in MPEG-2 Audio in MP2 Or SD & HD in MPEG-4 Audio in MP2 or AAC (CC/SUB for all)

Note 1: Only primary audio PIDs are used over the PA system. This applies to BGM, PRAM & VA when encapsulated into an MPEG-2 Transport Stream. VOE & VOR are also using primary audio PIDs only.

Note 2: Only one video client can play MPEG-2 content at 3.5 Mbps with the other five playing MPEG-1 content.

Note 3: HD* requirements have been constrained for i5G4 and i8G4.

In case of hybrid IFEC systems with different platforms in First, Business and/or Economy classes, the most compatible content is the one encoded for the oldest platform.

2.2 Terminology

- The word **SHALL** expresses a mandatory requirement. Departure from such a requirement is not permissible without formal agreement between the Supplier and the Purchaser.
- The word **SHOULD** expresses a recommendation or an advice. The Purchaser expects such recommendation to be followed unless good reasons are stated.
- The word **MUST** is associated with a legislative or regulatory requirement (e.g. Health and Safety). Both the Purchaser and the Supplier have to fulfill the requirement.
- The word **WILL** expresses Purchaser-supplied service or intention. The Supplier can rely on such service or intention.
- The word **MAY** expresses a permissible practice or action. It does not express a requirement of the Specification.
- **Requirement**: Feature or function that is necessary for a Thales Avionics TopSeries decoder to work properly. Failure to meet a requirement could cause decoding restrictions, results in improper functioning of the systems or hinders operations. A requirement contains the word **SHALL** or **MUST** and is flagged by the letter "**R**".

2.3 Recommended Tools

For best encoding results, Thales Avionics recommends the use of:

1. Stream (version 3.7 or higher) from Digital Rapids for enhanced AVC/H.264 encoding quality and performance,
2. MPEG-2 Transport Stream Multiplexer Enhanced version (MP2TSME version 7.0 or higher) from Manzanita Systems to support Closed Captions / Subtitles as defined in this document for compliance with APEX 0403 version 1.1 or higher.

For delivering content from Post-Production Labs to TopEffects, Thales Avionics TopEffects uses file-level encryption with SecretAgent (any version) from Information Security Corporation.

3 Audio (without Video)

TopSeries Systems support MP2 and MP3 formats for all encoded audio-only content. SVDU Gen3 and SVDU Gen4 MPEG decoders support MP2 & MP3 audio formats as well as LC-AAC, HE-AAC v1 & HE-AAC v2 audio formats. Section 2.1 table above provides the encoding compatibility for each platform.

3.1 Audio Input Quality

All audio without video shall comply with:

Requirements	Parameters	Input Quality
R3-1	Supported Platforms for Section 3.1	i2000, i3000, i4X00, i5000, i8000 and AVANT
R3-56	Audio	Be free of objectionable noise, audible clipping and other distortions that are not part of the original recording

3.2 Digital-to-Analog Audio Level Conversion

- Audio amplitude levels for digital content are measured in dBFS or dB Below Full Scale (digital clip).
- Full Scale means that the encoded audio signal value goes to all 1s at maximum level (audio peak level).
- dBFS is well explained in Wikipedia at http://en.wikipedia.org/wiki/DBFS. It shows that there is no single standard for conversion between digital and analog levels, mostly due to the differing capabilities of different equipment.
- The conversion level is chosen as the best compromise for the typical headroom and signal-to-noise levels of the equipment in question:

Airbus, Boeing and Thales Avionics use 0 dBFS = +6 dBm with 0 dBm = 1 mW into 600 Ω

- To get 0 dBm or 1 mW into 600 ohms, a voltage of 0.775 VRMS needs to be generated across a 600 ohms resistor.
- 0.775 VRMS is also the reference level used in dBu with an unloaded, open circuit source. There is no reference to impedance with dBu (u = unloaded).
- If the generator or circuit source internal impedance is very small compared to 600 ohms (which is the case of most analog audio amplifier's outputs), then this generator appears to be unloaded and dBm and dBu values are equivalent.
- WAEA 1289-2 (paragraph 7.1.5) and WAEA 0395 (paragraph 9.3.1.2 c) recommend encoding all audio levels at -12 dBFS. This Thales MPEG Encoding Specification follows these recommendations.
- PRAM and VA canned voiced messages are increased by 6 dB to provide a louder voice for safety messages.

Note 1: Theatrical masters in the US follow the American SMPTE standard that defines -20 dBFS as the Alignment Level. Post-Production Labs move this alignment level to -12 dBFS when MPEG encoding for Airlines.

Note 2: dBFS is not the same as "average audio peak level". -12 dBFS = -6 dBu in IFE audio circuits. This is the same audio encoding level that was used in the previous Thales Avionics "iSeries – Media Specifications and Encoding Requirements", document No. 245520 Rev E where the average audio peak level was specified at –6 dB.

3.3 Audio Levels Summary

TopSeries Systems	BGM / PRAM (All mono)	In-Seat Broadcast Audio (Stereo)	AOD (Stereo)	VA (Mono) / VOE / VOR (All stereo)	In-Seat Broadcast Video (Stereo)	VOD (Stereo)
Audio Levels in dBFS	**BGM:** -12 **PRAM:** -6	-12	-12	**VA:** -6 **VOE/VOR:** -12	-12	-12
Audio Levels in dBm	**BGM:** -6 **PRAM:** 0	-6	-6	**VA:** 0 **VOE/VOR:** -6	-6	-6
Audio Levels in dBu	**BGM:** -6 **PRAM:** 0	-6	-6	**VA:** 0 **VOE/VOR:** -6	-6	-6

3.4 AOD.mp3 & In-SeatBroadcastAudio.mp3

AOD and In-Seat Broadcast Audio content in MP3 shall comply with the following specifications:

Requirements	Parameters	MP3 Specifications
R3-1	Supported Platforms for Section 3.4	i2000, i3000, i4X00, i5000, i8000 and AVANT
R3-2	Content File Names (recommended)	**AOD:** Artist_Album_AudioDecoderAudioMode-Track#.mp3 Where: **Artist:** name of artist - use upper/lower cases with no spaces **Album:** name of album - use upper/lower cases with no spaces **AudioDecoder:** mp3 = MPEG-1 Audio, Layer 3 **AudioMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Track#:** use three digit track numbers **Example:** JessicaSimpson_InThisSkin_mp3js-001.mp3 **Broadcast Audio:** ChannelName_AudioDecoderAudioMode_MMYY.mp3 **Example:** Pop_mp3dc_0604.mp3
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-4	Track Separation	Only one Elementary Audio Stream per content file
R3-5	Systems Stream Type	None
R3-6	Elementary Video Stream Type	None
R3-7	Elementary Audio Stream Type	MP3 (MPEG-1 Audio, Layer 3)
R3-8	Elementary Audio Bit Rate (no 3D Audio)	128 Kbps (CBR)
R3-57	Elementary Audio Bit Rate (3D Audio)	256 Kbps (CBR)
R3-9	Modes (no 3D Audio)	Single Channel or Joint Stereo
R3-58	Mode (3D Audio)	Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0

Requirements	Parameters	MP3 Specifications
R3-59	Padding	Required to adjust mean bit rate (128 or 256 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-14	Program Reference Level for Source	-12 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels

3.5 AOD.mpg

AOD content in MPG (MP2 in CBR MPEG-2 TS) shall comply with the following specifications:

Requirements	Parameters	MP2 in CBR MPEG-2 TS Specifications
R3-20	Supported Platform for Section 3.5	i4000 with SVDU Gen 1
R3-21	Content File Name (recommended)	Artist_Album_AudioDecoderAudioMode-Track#.mpg Where: **Artist:** name of artist - use upper/lower cases with no spaces **Album:** name of album - use upper/lower cases with no spaces **AudioDecoder:** mp2 = MPEG-1 Audio, Layer 2 **AudioMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Track#:** use three digit track numbers **Example:** JessicaSimpson_InThisSkin_mp2js-001.mpg
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-22	Systems Streams Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:1996
R3-48	Null Packets PID	0x1FFF is reserved
R3-23	Number of Elementary Streams multiplexed in Systems Stream	One Video Stream + one Audio Stream
R3-24	Elementary Video Stream Type	MPEG-1 Video (black video required)
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R3-26	Elementary Video Bit Rate	1.0 Mbps (CBR)
R3-27	D Picture	None
R3-60	GOP size	15 frames for 30 fps media
R3-29	VBV size	1835008 bits max
R3-30	Video Standard	NTSC
R3-31	Aspect Ratio	4:3
R3-32	Frame Rate	29.97 fps
R3-33	Video Resolution	352 x 240 pels (SIF)
R3-34	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16
R3-35	Chroma Format	4:2:0 only
R3-36	First Line of Video to be Encoded	Line 22, Field 1
R3-37	Elementary Audio Stream Type	MP2 (MPEG-1 Audio, Layer 2)
R3-38	Elementary Audio Stream PID	See tables in Section 6 Language PID Assignments
R3-8	Elementary Audio Bit Rate	128 Kbps (CBR)
R3-9	Modes	Single Channel or Joint Stereo
R3-10	Private Bit in Audio Header	Set to 0
R3-59	Padding	Required to adjust mean bit rate (128 or 256 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-14	Program Reference Level for Source	-12 dB below full scale (digital clip)

Requirements	Parameters	MP2 in CBR MPEG-2 TS Specifications
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels

3.6 BGM.mp3 & PRAM.mp3

BGM and PRAM content in MP3 shall comply with the following specifications:

Note: This Section provides the best encoding results for BGM & PRAM content for platforms other than i5000.

Requirements	Parameters	MP3 Specifications
R3-39	Supported Platforms for Section 3.6	i2000, i3000 & i4X00 with AM6-12, i8000 with AVC-D, i5G4, i8G4 & AVANT
R3-40	Content File Name (recommended)	FileName_BGM_AudioDecoderAudioMode_MMYY.mp3 FileName_PRAM_AudioDecoderAudioMode_MMYY.mp3 Where: **FileName:** name of file - use upper/lower cases with no spaces **BGM:** Background Music **PRAM:** Pre-Recorded Announcement Machine **AudioDecoder:** mp3 = MPEG-1 Audio, Layer 3 **AudioMode:** sc = single channel **MMYY:** Month & Year numbers **Examples:** Boarding_BGM_mp3sc_0313.mp3 Decompression_PRAM_mp3sc_0313.mp3
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-4	Track Separation	Only one Elementary Audio Stream per content file
R3-5	Systems Stream Type	None
R3-6	Elementary Video Stream Type	None
R3-7	Elementary Audio Stream Type	MP3 (MPEG-1 Audio, Layer 3)
R3-53	Elementary Audio Bit Rate	128 Kbps (CBR)
R3-50	Mode	Single Channel (mono audio)
R3-10	Private Bit in Audio Header	Set to 0
R3-11	Padding	Required to adjust mean bit rate (128 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-41	Program Reference Level for Source	**BGM:** -12 dB below full scale (digital clip) **PRAM:** -6 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels

3.7 BGM.mpg & PRAM.mpg

BGM and PRAM content in MPG (MP2 or MP3 in CBR MPEG-2 TS) shall comply with the following specifications:

Note: This Section provides encoding requirements for BGM & PRAM content for i5000 while still being compatible with other platforms.

Requirements	Parameters	MP2 or MP3 in CBR MPEG-2 TS Specifications
R3-42	Supported Platform for Section 3.7	i5000 with AVC-D, i8000 with AVC-D, i5G4, i8G4 & AVANT
R3-54	Content File Name (recommended)	FileName_BGM_AudioDecoderAudioMode_MMYY.mpg FileName_PRAM_AudioDecoderAudioMode_MMYY.mpg Where: **FileName:** name of file - use upper/lower cases with no spaces **BGM:** Background Music **PRAM:** Pre-Recorded Announcement Machine **AudioDecoder:** mp2 = MPEG-1 Audio, Layer 2; mp3 = MPEG-1 Audio, Layer 3 **AudioMode:** sc = single channel **MMYY:** Month & Year numbers **Examples:** Boarding_BGM_mp3sc_0313.mpg Decompression_PRAM_mp2sc_0313.mpg
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-22	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:1996
R3-48	Null Packets PID	0x1FFF is reserved
R3-43	Number of Elementary Streams multiplexed in Systems Stream	One Audio Stream
R3-51	PCR PID	0x0031 is reserved for PCR value **Note:** No primary video stream
R3-6	Elementary Video Stream Type	None
R3-44	Elementary Audio Stream Types	MP2 (MPEG-1 Audio, Layer 2) or MP3 (MPEG-1 Audio, Layer 3)
R3-45	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments **Note:** Use primary audio PID(s) only
R3-53	Elementary Audio Bit Rate	128 Kbps (CBR)
R3-50	Mode	Single Channel (mono audio)
R3-10	Private Bit in Audio Header	Set to 0
R3-11	Padding	Required to adjust mean bit rate (128 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-41	Program Reference Level for Sources	**BGM:** -12 dB below full scale (digital clip) **PRAM:** -6 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None

Requirements	Parameters	MP2 or MP3 in CBR MPEG-2 TS Specifications
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels

3.8 LLAB.mpg

Low Latency Audio Broadcast content in MPG (MP2 or MP3 in CBR MPEG-2 TS) used in crew rest audio with QSEB for i5000 shall comply with the following specifications:

Requirements	Parameters	MP2 or MP3 in CBR MPEG-2 TS Specifications
R3-46	Supported Platform for Section 3.8	i5000
R3-55	Content File Name (recommended)	FileName_LLAB_AudioDecoderAudioMode_MMYY.mpg Where: **FileName:** name of file - use upper/lower cases with no spaces **LLAB:** Low Latency Audio Broadcast **AudioDecoder:** mp2 = MPEG-1 Audio, Layer 2; mp3 = MPEG-1 Audio, Layer 3 **AudioMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **MMYY:** Month & Year numbers **Example:** File1_LLAB_mp2dc_0313.mpg
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-22	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:1996
R3-48	Null Packets PID	0x1FFF is reserved
R3-47	Number of Elementary Streams multiplexed in Systems Stream	Up to four Audio Streams
R3-51	PCR PID	0x0031 is reserved for PCR value **Note:** No primary video stream
R3-6	Elementary Video Stream Type	None
R3-44	Elementary Audio Stream Types	MP2 (MPEG-1 Audio, Layer 2) or MP3 (MPEG-1 Audio, Layer 3)
R3-52	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments
R3-8	Elementary Audio Bit Rate (No 3D Audio)	128 Kbps (CBR)
R3-57	Elementary Audio Bit Rate (3D Audio)	256 Kbps (CBR)
R3-9	Modes (No 3D Audio)	Single Channel or Joint Stereo
R3-58	Modes (3D Audio)	Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0
R3-11	Padding	Required to adjust mean bit rate (128 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-14	Program Reference Level for Sources	-12 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels

3.9 ID3 Tagging

- TopSeries MP3 audio streamers and decoders accept ID3 tagging as part of MP3 files for audio metadata such as title, album, performer, website, lyrics, equalizer presets, pictures, etc.
- TopSeries systems do not use ID3 tags and require separate metadata to be used for content selection.

Requirements	Parameters	ID3 Tag Specifications
R3-1	Supported Platforms for Section 3.9	i2000, i3000, i4X00, i5000, i8000 and AVANT
R3-49	ID3 tag size	ID3v1 tag: 128 Bytes ID3v2 tag: 256 Mbytes max

4 Video (with Audio)

Thales Avionics TopSeries support MPEG-1, MPEG-2 and MPEG-4 Part 10 (AVC) formats for all encoded video content. Section 2-1 table above provides the encoding compatibility for each platform.

4.1 Video with Audio Input Quality

All video with audio shall comply with:

Requirements	Parameters	Input Quality
R3-1	Supported Platforms for Section 4.1	i2000, i3000, i4X00, i5000, i8000 and AVANT
R4-98	Video (1)	Be free of compression artifacts (such as macro blocking and mosquito noise), aliasing (such as artifacts associated with scan conversion), frame dropouts, and other artifacts associated with conversion and encoding
R4-99	Video (2)	Be free of impairments associated with legacy analog equipment such as lag, smear, scratches, videotape dropouts, head switching and composite video artifacts
R4-100	Audio	Be free of objectionable noise, audible clipping and other distortions that are not part of the original recording
R4-101	Music & Sound Effects Levels	Are sufficiently below dialog levels to insure that a wide variety of passengers can understand the dialog upon first viewing in aircraft cabin listening conditions with high ambient noise and moderate program levels

4.2 SD in MPEG-1

SD video content in MPEG-1 shall comply with the following specifications:

Requirements	Parameters	MPEG-1 Specifications for SD
R3-1	Supported Platforms for Section 4.2	i2000, i3000, i4X00, i5000, i8000 and AVANT

Requirements	Parameters	MPEG-1 Specifications for SD
R4-2	Content File Names (recommended)	Title_BitRateVDecoder_VFormatFrameRate_ADecoderAMode_SPK_OC_CC_SUB.mpg Where: **Title:** Name of content - use upper/lower cases with no spaces **BitRate:** 15 = 1.5 Mbps **VDecoder (video):** M1 = MPEG-1 **VFormat (video):** **SD:** **Source:** S = SIF (352x240) **Display:** S = Standard (4x3) **FrameRate:** 23 = 23.976 fps; 29 = 29.97 fps **ADecoder (audio):** mp2 = MPEG-1 Layer 2 **AMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Languages (spoken):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SPK for spoken languages **Language (open caption):** Three character abbreviation per ISO 639 (See tables in Section 6 Language PID Assignments) followed by OC for open captions for hard of hearing persons. If none, no field **Languages (closed caption):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by CC for closed captions for hard of hearing persons. If none, no field **Languages (subtitle):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SUB for subtitles for language translation. If none, no field **Example:** MyMovie_15M1_SS29_mp2js_EngFraSPK_EngCC.mpg This file name represents a title called “My Movie”. The video is encoded in MPEG-1 at 1.5 Mbps, at SIF resolution in Standard aspect ratio and at 29.97 fps. All audio tracks are encoded in MPEG-1 Layer 2 in joint stereo. The spoken languages are English & French and there are English Closed Captions
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-22	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:1996
R3-48	Null Packets PID	0x1FFF is reserved
R4-61	Quad-Byte alignment	Yes The Multiplexer forces the data preceding each picture start code to be quad-byte aligned when the video elementary stream is multiplexed
R4-3	Number of Elementary Streams multiplexed in Systems Stream (1)	For i2000, i3000, and i4X00 only: One Video Stream + Between two and eight Audio Streams + Up to one Open Caption (encoded into Video)
R4-28	Number of Elementary Streams multiplexed in Systems Stream (2)	For i5000, i8000 & AVANT only: One Video Stream + up to sixteen Audio Streams + up to one Open Caption (encoded into Video) or up to twelve Closed Caption Streams or up to twelve Subtitle Streams or up to twelve Closed Caption and Subtitle Streams combination **Note:** OC does not coexist with CC or Sub

Requirements	Parameters	MPEG-1 Specifications for SD
R4-50	A/V Synchronization	Video lags Audio by no more than 20 ms and Video leads Audio by no more than 40 ms
R4-4	Elementary Video Stream Type	MPEG-1 Video
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R4-5	Elementary Video Bit Rate	1.5 Mbps (CBR)
R3-27	D Picture	None
R3-28	GOP size	12 frames for 24 fps media & 15 frames for 30 fps media but could be shortened if an I-Frame is triggered by a scene change
R3-29	VBV size	1835008 bits max
R4-6	Frame rate change	Allowed during the program
R3-30	Video Standard	NTSC
R3-31	Aspect Ratio	4:3
R4-8	Frame Rates	23.976 fps for film sources or 29.97 fps for video sources
R4-54	Film Mode Frame Rate Conversion	Reverse telecine to be used before encoding in the case where telecine pull-down is present in the source
R3-33	Video Resolution	352 x 240 pels (SIF)
R4-9	Down-filtering from CCIR-601 to SIF	At least equivalent in quality to that of the 7-tap Finite Impulse Response (FIR) and 4-tap FIR filters described in ISO/IEC 11172-2:1993 on subclause D.3.1
R4-10	Down-filtering from CCIR-601 to SIF: Horizontal line extraction	720 to 352 Start 8 pels from left, 2:1 conversion
R4-11	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16 White to be set at 235
R3-35	Chroma Format	4:2:0 only
R3-36	First Line of Video to be Encoded	Line 22, Field 1
R3-37	Elementary Audio Stream Type	MP2 (MPEG-1 Audio, Layer 2)
R4-62	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments **Note:** VA / VOE / VOR use primary audio PIDs only
R3-8	Elementary Audio Bit Rate (No 3D Audio)	128 Kbps (CBR)
R3-57	Elementary Audio Bit Rate (3D Audio)	256 Kbps (CBR)

Requirements	Parameters	MPEG-1 Specifications for SD
R4-63	Modes (No 3D Audio)	**VOD:** Single Channel or Joint Stereo **In-Seat Broadcast Video:** Single Channel or Joint Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Single Channel or Joint Stereo
R4-102	Modes (3D Audio)	**VOD:** Dual Channel or Independent Stereo **In-Seat Broadcast Video:** Dual Channel or Independent Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0
R3-11	Padding	Required to adjust mean bit rate (128 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R4-12	Program Reference Level for Sources	**All:** -12 dB below full scale (digital clip) **VA:** -6 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels
R4-13	Open Captions	Included in Video and MPEG Encoded with Video **Note:** Does not coexist with Closed Captions or Subtitles
R4-14	Closed Captions	See Section 5 below **Note:** Does not coexist with Open Captions
R4-15	Closed Captions PID(s)	See tables in Section 6 Language PID Assignments
R4-16	Subtitles	See Section 5 below **Note:** Does not coexist with Open Captions
R4-17	Subtitles PID(s)	See tables in Section 6 Language PID Assignments
R4-18	CC/SUB PID(s)	Included from start of stream when CC/SUB present in media

4.3 SD in MPEG-2

SD video content in MPEG-2 shall comply with the following specifications:

Requirements	Parameters	MPEG-2 Specifications for SD
R3-1	Supported Platforms for Section 4.3	i2000, i3000, i4X00, i5000, i8000 and AVANT
R4-19	Content File Names (recommended)	Title_BitRateVDecoder_VFormatFrameRate_ADecoderAMode_SPK_OC_CC_SUB.mpg Where: **Title:** Name of content - use upper/lower cases with no spaces **BitRate:** 35 = 3.5 Mbps **VDecoder (video):** M2 = MPEG-2 **VFormat (video):** **SD:** **Source:** H = 1/2 D-1 (352x480), F = Full D-1 (720x480) **Display:** S= Standard (4x3); W= Widescreen (16x9) **FrameRate:** 23 = 23.976 fps; 29 = 29.97 fps **ADecoder (audio):** mp2 = MPEG-1 Layer 2 **AMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Languages (spoken):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SPK for spoken languages **Language (open caption):** Three character abbreviation per ISO 639 (See tables in Section 6 Language PID Assignments) followed by OC for captions for hard of hearing persons. If none, no field **Languages (closed caption):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by CC for captions for hard of hearing persons. If none, no field **Languages (subtitle):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SUB for subtitles for language translation. If none, no field **Example:** MyMovie_35M2_FW23_mp2js_EngFraSPK_EngCC_HinAraSUB.mpg This file name represents a title called “My Movie”. The video is encoded in MPEG-2 at 3.5 Mbps, at Full D-1 resolution in Widescreen aspect ratio and at 23.976 fps. All audio tracks are encoded in MPEG-1 Layer 2 in joint stereo. The spoken languages are English & French and there are English Closed Captions and Subtitles in Hindi and Arabic
R3-3	Content File Name Length	Less than 250 ASCII characters
R3-22	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:1996
R3-48	Null Packets PID	0x1FFF is reserved
R4-61	Quad-Byte alignment	Yes The Multiplexer forces the data preceding each picture start code to be quad-byte aligned when the video elementary stream is multiplexed
R4-3	Number of Elementary Streams multiplexed in Systems Stream (1)	For i2000, i3000, and i4X00 only: One Video Stream + Between two and eight Audio Streams + Up to one Open Caption (encoded into Video)

Requirements	Parameters	MPEG-2 Specifications for SD
R4-28	Number of Elementary Streams multiplexed in Systems Stream (1)	For i5000, i8000 & AVANT only: One Video Stream + up to sixteen Audio Streams + up to one Open Caption (encoded into Video) or up to twelve Closed Caption Streams or up to twelve Subtitle Streams or up to twelve Closed Caption and Subtitle Streams combination **Note:** OC does not coexist with CC or Sub
R4-50	A/V Synchronization	Video lags Audio by no more than 20 ms and Video leads Audio by no more than 40 ms
R4-20	Elementary Video Stream Type	MPEG-2 Video
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R4-21	Elementary Video Bit Rate	3.5 Mbps (CBR)
R3-27	D Picture	None
R3-28	GOP size	12 frames for 24 fps media & 15 frames for 30 fps media but could be shortened if an I-Frame is triggered by a scene change
R3-29	VBV size	1835008 bits max
R4-6	Frame rate change	Allowed during the program
R3-30	Video Standard	NTSC
R4-7	Aspect Ratios	4:3 or 16:9 Widescreen
R4-8	Frame Rates	23.976 fps for film sources or 29.97 fps for video sources
R4-54	Film Mode Frame Rate Conversion	Reverse telecine to be used before encoding in the case where telecine pull-down is present in the source
R4-22	Video Resolutions	352 x 480 pels (Half D-1) or 720 x 480 pels (Full D-1)
R4-23	Down-filtering from CCIR-601 to Half D-1: Horizontal line extraction	720 to 352 Start 8 pels from left, 2:1 conversion
R4-11	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16 White to be set at 235
R3-35	Chroma Format	4:2:0 only
R3-36	First Line of Video to be Encoded	Line 22, Field 1
R3-37	Elementary Audio Stream Type	MP2 (MPEG-1 Audio, Layer 2)
R4-62	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments **Note:** VA / VOE / VOR use primary audio PIDs only
R3-8	Elementary Audio Bit Rate (No 3D Audio)	128 Kbps (CBR)

Requirements	Parameters	MPEG-2 Specifications for SD
R3-57	Elementary Audio Bit Rate (3D Audio)	256 Kbps (CBR)
R4-63	Modes (No 3D Audio)	**VOD:** Single Channel or Joint Stereo **In-Seat Broadcast Video:** Single Channel or Joint Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Single Channel or Joint Stereo
R4-102	Modes (3D Audio)	**VOD:** Dual Channel or Independent Stereo **In-Seat Broadcast Video:** Dual Channel or Independent Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0
R3-11	Padding	Required to adjust mean bit rate (128 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R4-12	Program Reference Level for Sources	**All:** -12 dB below full scale (digital clip) **VA:** -6 dB below full scale (digital clip)
R3-15	Dynamic range of encoded signal	No more than 40 dB
R3-16	Frequency Response	50 Hz to 15 KHz ± 3 dB
R3-17	Audio Emphasis	None
R3-18	Signal-to-Noise Ratio	Greater than 45 dB Referenced to max signal level from 50 Hz to 15 KHz
R3-19	Crosstalk	Less than 45 dB between channels
R4-13	Open Captions	Included in Video and MPEG Encoded with Video **Note:** Does not coexist with Closed Captions or Subtitles
R4-14	Closed Captions	See Section 5 below **Note:** Does not coexist with Open Captions
R4-15	Closed Captions PID(s)	See tables in Section 6 Language PID Assignments
R4-16	Subtitles	See Section 5 below **Note:** Does not coexist with Open Captions
R4-17	Subtitles PID(s)	See tables in Section 6 Language PID Assignments
R4-18	CC/SUB PID(s)	Included from start of stream when CC/SUB present in media

4.4 SD in MPEG-4

SD video content in MPEG-4 shall comply with the following specifications:

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for SD
R4-24	Supported Platforms for Section 4.4	i5000, i8000 and AVANT
R4-37	Content File Names (recommended)	Title_BitRateVDecoder_VFormatFrameRate_ADecoderAMode_SPK_OC_CC_SUB.mpg Where: **Title:** Name of content - use upper/lower cases with no spaces **BitRate:** 15 = 1.5 Mbps; 20 = 2.0 Mbps **VDecoder (video):** M4 = MPEG-4 **VFormat (video):** **SD:** **Source:** F = Full D-1 (720x480) **Display:** S= Standard (4x3); W= Widescreen (16x9) **FrameRate:** 23 = 23.976 fps; 29 = 29.97 fps **ADecoder (audio):** mp2 = MPEG-1 Layer 2; mp3 = MPEG-1 Layer 3; lcaac = Low Complexity Advanced Audio Codec; heaacv1 = High Efficiency AAC version 1; heaacv2 = HE AAC version 2 **AMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Languages (spoken):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SPK for spoken languages **Language (open caption):** Three character abbreviation per ISO 639 (See tables in Section 6 Language PID Assignments) followed by OC for captions for hard of hearing persons. If none, no field **Languages (closed caption):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by CC for captions for hard of hearing persons. If none, no field **Languages (subtitle):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SUB for subtitles for language translation. If none, no field **Example:** MyMovie_15M4_FW23_mp2js_EngFraSPK_EngCC.mpg This file name represents a title called “My Movie”. The video is encoded in MPEG-4 at 1.5 Mbps, at Full D-1 resolution in 16x9 aspect ratio and at 23.976 fps. All audio tracks are encoded in MPEG-1 Layer 2 in joint stereo. The spoken languages are English & French and there are English Closed Captions
R3-3	Content File Name Length	Less than 250 ASCII characters
R4-25	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:2000
R3-48	Null Packets PID	0x1FFF is reserved
R4-26	Transport Stream	Every PES of TS contains completed H.264 NAL units
R4-27	PES packet	SPS and PPS of H.264 ES are placed at the beginning of PES packet
R4-60	PES alignment	The first Byte of each PES packet payload is the first Byte of an access unit
R4-61	Quad-Byte alignment	Yes The Multiplexer shall force the data preceding each picture start code to be quad-byte aligned when the video elementary stream is multiplexed

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for SD
R4-67	PCR-PTS gap limit	PTS is greater than PCR by a maximum of 1 second **Note:** When using the Manzanita Systems' MPEG-2 Transport Stream Multiplexer Enhanced Version 7.0 or higher (MP2TSME V7.0), MaxDecodeDelay = 90 000 clock cycles
R4-68	PCR packet insertions	Always before a frame start and never between frame data
R4-69	Transport Scrambling Control	0x00 **Note:** These 2 bits are located in the header of each MPEG-2 TS packet
R4-28	Number of Elementary Streams multiplexed in Systems Stream	One Video Stream + up to sixteen Audio Streams + up to one Open Caption (encoded into Video) or up to twelve Closed Caption Streams or up to twelve Subtitle Streams or up to twelve Closed Caption and Subtitle Streams combination **Note:** OC does not coexist with CC or Sub
R4-50	A/V Synchronization	Video lags Audio by no more than 20 ms and Video leads Audio by no more than 40 ms
R4-29	Elementary Video Stream Type	MPEG-4 Part 10 (H.264/AVC) Video
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R4-30	Elementary Video Bit Rates	From 1.5 Mbps (CBR) [default] to 2.0 Mbps (CBR) **Note:** When visual quality requires, the default value could be varied from with the concurrence of the stakeholders who could include the compressionist, the content provider, the system provider and the airline
R4-70	Rate Control Mode	Set to “CBR + Filler” (CBR plus “padding” for HRD compliance) in Digital Rapids Studio AVC Profile
R4-31	Profile	Main
R4-32	Level	3.1 (APEX best practices) **Note:** TopSeries decoders conforming to level 3.1 are capable of decoding all bitstreams that are encoded for that level and for all lower levels
R4-51	Slices	1
R4-52	Pixel Accuracy	¼ Pixel
R4-53	Motion Search	16x16, 16x8, 8x16, 8x8
R4-33	Reference B-Frames	No
R4-34	Number of Reference Frames	2
R4-35	Weighted Prediction	No
R4-36	Key-Frame on Scene Cut	Yes
R4-38	GOP Size	12 frames for 24 fps media & 15 frames for 30 fps media but could be shortened if an I-Frame is triggered by a scene change
R4-39	Number of B-frames	2
R4-40	Encoding Mode	Progressive
R4-41	Entropy	CABAC
R4-42	IDR Frequency	1 on every key frame
R4-43	Video Standard	SDTV

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for SD
R4-44	Video Input	Progressive (480p)
R4-7	Aspect Ratios	4:3 or 16:9 Widescreen
R4-64	Frame Rates	23.976 fps (23p) for 24 fps film sources or 29.97 fps (29p) for 30 fps NTSC video sources
R4-54	Film Mode Frame Rate Conversion	Reverse telecine to be used before encoding in the case where telecine pull-down is present in the source
R4-45	Video Resolution	720 x 480 pels (Full D-1)
R4-11	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16 White to be set at 235
R3-35	Chroma Format	4:2:0 only
R4-55	Access Unit Delimiters	Yes
R4-56	Sequence End Code	No
R4-57	Timestamp	No
R4-59	Timestamp Offset	No
R4-58	Deblocking Filter	Yes
R4-46	Elementary Audio Stream Types	MP2 (MPEG-1 Audio, Layer 2) or LC-AAC or HE-AAC (v1 & v2) **Note:** APEX 0403 Spec version 1.3 and higher does not support MP3 (MPEG-1 Audio, Layer 3) anymore. For compatibility with APEX 0403 v 1.2 and below, Thales TopSeries continue to support MP3 but it is not recommended for new encodes.
R4-103	Multiple Audio Stream Type	When providing multiple audio language tracks, the same Elementary Audio Stream Type (codec, bitrate & mode) is used throughout the MPEG-2 Transport Stream
R4-62	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments **Note:** VA / VOE / VOR use primary audio PID(s) only
R4-65	Elementary Audio Bit Rates (No 3D Audio)	128 Kbps for MP2, MP3 or LC-AAC 64 Kbps for HE-AAC (v1 & v2)
R4-92	Elementary Audio Bit Rates (3D Audio)	256 Kbps for MP2, MP3 or LC-AAC 128 Kbps for HE-AAC (v1 & v2)
R4-63	Modes (No 3D Audio)	**VOD:** Single Channel or Joint Stereo **In-Seat Broadcast Video:** Single Channel or Joint Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Single Channel or Joint Stereo
R4-102	Modes (3D Audio)	**VOD:** Dual Channel or Independent Stereo **In-Seat Broadcast Video:** Dual Channel or Independent Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0
R4-66	Padding	Required to adjust mean bit rate (256, 128 or 64 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R4-12	Program Reference Level for Sources	**All:** -12 dB below full scale (digital clip) **VA:** -6 dB below full scale (digital clip)

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for SD
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R4-47	Frequency Response	20 Hz to 20 KHz ± 3 dB
R3-17	Audio Emphasis	None
R4-48	Signal-to-Noise Ratio	Greater than 50 dB Referenced to max signal level from 20 Hz to 20 KHz
R4-49	Crosstalk	Less than 50 dB between channels
R4-13	Open Captions	Included in Video and MPEG Encoded with Video **Note:** Does not coexist with Closed Captions or Subtitles
R4-14	Closed Captions	See Section 5 below **Note:** Does not coexist with Open Captions
R4-15	Closed Captions PID(s)	See tables in Section 6 Language PID Assignments
R4-16	Subtitles	See Section 5 below **Note:** Does not coexist with Open Captions
R4-17	Subtitles PID(s)	See tables in Section 6 Language PID Assignments
R4-18	CC/SUB PID(s)	Included from start of stream when CC/SUB present in media

4.5 HD* (720p) in constrained MPEG-4

HD 720p video content in MPEG-4 for i5G4 and i8G4 shall comply with the following constrained specifications:

Note: While this encoding is compatible with AVANT, Sections 4.6 and 4.7 are recommended for AVANT.

Requirements	Parameters	Constrained MPEG-4 Part 10 (H.264/AVC) Specifications for HD* (720p)
R4-71	Supported Platforms for Section 4.5	i5G4, i8G4 & AVANT
R4-72	Content File Names (recommended)	Title_BitRateVDecoder_VFormatFrameRate_ADecoderAMode_SPK_OC_CC_SUB.mpg Where: **Title:** Name of content - use upper/lower cases with no spaces **BitRate:** 40 = 4.0 Mbps; 45 = 4.5 Mbps **VDecoder (video):** M4 = MPEG-4 **VFormat (video):** **HD:** 720p **FrameRate:** 23 = 23.976 fps; 25 = 25 fps; 29 = 29.97 fps **ADecoder (audio):** mp2 = MPEG-1 Layer 2; heaacv2 = High Efficiency Advanced Audio Codec version 2 **AMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Languages (spoken):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SPK for spoken languages **Language (open caption):** Three character abbreviation per ISO 639 (See tables in Section 6 Language PID Assignments) followed by OC for captions for hard of hearing persons. If none, no field **Languages (closed caption):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by CC for captions for hard of hearing persons. If none, no field **Languages (subtitle):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SUB for subtitles for language translation. If none, no field **Example:** MyMovie_40M4_720p29_mp2js_EngFraSPK_EngCC_HinAraSUB.mpg This file name represents a title called “My Movie”. The video is encoded in MPEG-4 at 4.0 Mbps, in 720p at 29.97 fps. All audio tracks are encoded in MPEG-1 Layer 2 in joint stereo. The spoken languages are English & French and there are English Closed Captions and Subtitles in Hindi and Arabic
R3-3	Content File Name Length	Less than 250 ASCII characters
R4-25	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:2000
R3-48	Null Packets PID	0x1FFF is reserved
R4-26	Transport Stream	Every PES of TS contains completed H.264 NAL units
R4-27	PES packet	SPS and PPS of H.264 ES are placed at the beginning of PES packet
R4-60	PES alignment	The first Byte of each PES packet payload is the first Byte of an access unit
R4-61	Quad-Byte alignment	Yes The Multiplexer shall force the data preceding each picture start code to be quad-byte aligned when the video elementary stream is multiplexed

Requirements	Parameters	Constrained MPEG-4 Part 10 (H.264/AVC) Specifications for HD* (720p)
R4-67	PCR-PTS gap limit	PTS is greater than PCR by a maximum of 1 second **Note:** When using the Manzanita Systems' MPEG-2 Transport Stream Multiplexer Enhanced Version 7.0 or higher (MP2TSME V7.0), MaxDecodeDelay = 90 000 clock cycles
R4-68	PCR packet insertions	Always before a frame start and never between frame data
R4-69	Transport Scrambling Control	0x00 **Note:** These 2 bits are located in the header of each MPEG-2 TS packet
R4-73	Number of Elementary Streams multiplexed in Systems Stream	One Video Stream + up to **four** Audio Streams + up to one Open Caption (encoded into Video) or up to **four** Closed Caption Streams or up to **four** Subtitle Streams or up to **four** Closed Caption and Subtitle Streams combination **Note:** OC does not coexist with CC or Sub
R4-50	A/V Synchronization	Video lags Audio by no more than 20 ms and Video leads Audio by no more than 40 ms
R4-29	Elementary Video Stream Type	MPEG-4 Part 10 (H.264/AVC) Video
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R4-74	Elementary Video Bit Rates	From 4.0 Mbps (CBR) [default] to **4.5 Mbps** (CBR) **Note:** When visual quality requires, the default value could be varied from with the concurrence of the stakeholders who could include the compressionist, the content provider, the system provider and the airline
R4-70	Rate Control Mode	Set to “CBR + Filler” (CBR plus “padding” for HRD compliance) in Digital Rapids Studio AVC Profile
R4-75	Profile	High
R4-32	Level	3.1 (APEX best practices) **Note:** TopSeries decoders conforming to level 3.1 are capable of decoding all bitstreams that are encoded for that level and for all lower levels
R4-76	Slices	4
R4-52	Pixel Accuracy	¼ Pixel
R4-53	Motion Search	16x16, 16x8, 8x16, 8x8
R4-33	Reference B-Frames	No
R4-77	Number of Reference Frames	3
R4-78	Weighted Prediction	Yes
R4-36	Key-Frame on Scene Cut	Yes
R4-79	GOP Size	12 frames for 24 or 25 fps media & 15 frames for 30 fps media but could be shortened if an I-Frame is triggered by a scene change
R4-80	Number of B-frames	3
R4-40	Encoding Mode	Progressive
R4-41	Entropy	CABAC
R4-42	IDR Frequency	1 on every key frame

Requirements	Parameters	Constrained MPEG-4 Part 10 (H.264/AVC) Specifications for HD* (720p)
R4-81	Video Standard	HD 720p
R4-44	Video Input	Progressive
R4-82	Aspect Ratios	16:9 only HD content encoded as 16:9 display aspect ratio HD content with an Original Aspect Ratio (OAR) other than 16:9 is to be framed in a 16:9 presentation: - HD content that is in 4:3 is to be pillar-box matted - HD content with an aspect ratio wider than 16:9 is to be letterbox matted
R4-83	Frame Rates	23.976 fps, 25 fps, and 29.97 fps are acceptable - Content originated at film rates is available as 23.976 HD masters, and is to be encoded at that rate. - Content mastered at 25 fps is to be encoded as 25P or converted to 23.976P. - Higher frame rates, such as 50P, 50i, 60P and 60i is to be reduced to a frame rate available in the standard. - When the content to be encoded is presented as 29.97 fps or 59.94 fps video, best practice is to, if possible, reverse telecine down to a film frame rate and encode as 23.976. In any event, the source is to be de-interlaced before encoding.
R4-54	Film Mode Frame Rate Conversion	Reverse telecine is to be used before encoding in the case where telecine pull-down is present in the source
R4-84	Video Resolution	1280 x 720 (square pixels) ITU-R Recommendation BT.709-5
R4-11	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16 White to be set at 235
R3-35	Chroma Format	4:2:0 only
R4-55	Access Unit Delimiters	Yes
R4-56	Sequence End Code	No
R4-57	Timestamp	No
R4-59	Timestamp Offset	No
R4-58	Deblocking Filter	Yes
R4-85	Elementary Audio Stream Types	MP2 (MPEG-1 Audio, Layer 2) or HE-AAC v2
R4-103	Multiple Audio Stream Type	When providing multiple audio language tracks, the same Elementary Audio Stream Type (codec, bitrate & mode) is used throughout the MPEG-2 Transport Stream
R3-52	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments
R4-86	Elementary Audio Bit Rates (No 3D Audio)	128 Kbps for MP2 64 Kbps for HE-AAC v2
R4-104	Elementary Audio Bit Rates (3D Audio)	256 Kbps for MP2 128 Kbps for HE-AAC v2
R4-87	Mode (No 3D Audio)	**VOD:** Single Channel or Joint Stereo
R4-105	Modes (3D Audio)	**VOD:** Dual Channel or Independent Stereo

Requirements	Parameters	Constrained MPEG-4 Part 10 (H.264/AVC) Specifications for HD* (720p)
R3-10	Private Bit in Audio Header	Set to 0
R4-66	Padding	Required to adjust mean bit rate (256, 128 or 64 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-14	Program Reference Level for Sources	-12 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R4-47	Frequency Response	20 Hz to 20 KHz ± 3 dB
R3-17	Audio Emphasis	None
R4-48	Signal-to-Noise Ratio	Greater than 50 dB Referenced to max signal level from 20 Hz to 20 KHz
R4-49	Crosstalk	Less than 50 dB between channels
R4-13	Open Captions	Included in Video and MPEG Encoded with Video **Note:** Does not coexist with Closed Captions or Subtitles
R4-14	Closed Captions	See Section 5 below **Note:** Does not coexist with Open Captions
R4-15	Closed Captions PID(s)	See tables in Section 6 Language PID Assignments
R4-16	Subtitles	See Section 5 below **Note:** Does not coexist with Open Captions
R4-17	Subtitles PID(s)	See tables in Section 6 Language PID Assignments
R4-18	CC/SUB PID(s)	Included from start of stream when CC/SUB present in media

4.6 HD (720p) in MPEG-4

HD 720p video content in MPEG-4 shall comply with the following specifications:

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (720p)
R4-88	Supported Platform for Section 4.6	AVANT
R4-89	Content File Names (recommended)	Title_BitRateVDecoder_VFormatFrameRate_ADecoderAMode_SPK_OC_CC_SUB.mpg Where: **Title:** Name of content - use upper/lower cases with no spaces **BitRate:** 40 = 4.0 Mbps; 80 = 8.0 Mbps **VDecoder (video):** M4 = MPEG-4 **VFormat (video):** **HD:** 720p **FrameRate:** 23 = 23.976 fps; 25 = 25 fps; 29 = 29.97 fps **ADecoder (audio):** mp2 = MPEG-1 Layer 2; heaacv2 = High Efficiency Advanced Audio Codec version 2 **AMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Languages (spoken):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SPK for spoken languages **Language (open caption):** Three character abbreviation per ISO 639 (See tables in Section 6 Language PID Assignments) followed by OC for captions for hard of hearing persons. If none, no field **Languages (closed caption):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by CC for captions for hard of hearing persons. If none, no field **Languages (subtitle):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SUB for subtitles for language translation. If none, no field **Example:** MyMovie_40M4_720p29_mp2js_EngFraSPK_EngCC_HinAraSUB.mpg This file name represents a title called “My Movie”. The video is encoded in MPEG-4 at 4.0 Mbps, in 720p at 29.97 fps. All audio tracks are encoded in MPEG-1 Layer 2 in joint stereo. The spoken languages are English & French and there are English Closed Captions and Subtitles in Hindi and Arabic
R3-3	Content File Name Length	Less than 250 ASCII characters
R4-25	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:2000
R3-48	Null Packets PID	0x1FFF is reserved
R4-26	Transport Stream	Every PES of TS contains completed H.264 NAL units
R4-27	PES packet	SPS and PPS of H.264 ES are placed at the beginning of PES packet
R4-60	PES alignment	The first Byte of each PES packet payload is the first Byte of an access unit
R4-61	Quad-Byte alignment	Yes The Multiplexer shall force the data preceding each picture start code to be quad-byte aligned when the video elementary stream is multiplexed

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (720p)
R4-67	PCR-PTS gap limit	PTS is greater than PCR by a maximum of 1 second **Note:** When using the Manzanita Systems' MPEG-2 Transport Stream Multiplexer Enhanced Version 7.0 or higher (MP2TSME V7.0), MaxDecodeDelay = 90 000 clock cycles
R4-68	PCR packet insertions	Always before a frame start and never between frame data
R4-69	Transport Scrambling Control	0x00 **Note:** These 2 bits are located in the header of each MPEG-2 TS packet
R4-90	Number of Elementary Streams multiplexed in Systems Stream	One Video Stream + up to 16 Audio Streams + up to one Open Caption (encoded into Video) or up to 16 Closed Caption Streams or up to 16 Subtitle Streams or up to 16 Closed Caption and Subtitle Streams combination **Note:** OC does not coexist with CC or Sub
R4-50	A/V Synchronization	Video lags Audio by no more than 20 ms and Video leads Audio by no more than 40 ms
R4-29	Elementary Video Stream Type	MPEG-4 Part 10 (H.264/AVC) Video
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R4-91	Elementary Video Bit Rates	From 4.0 Mbps (CBR) [default] to 8.0 Mbps (CBR) **Note:** When visual quality requires, the default value could be varied from with the concurrence of the stakeholders who could include the compressionist, the content provider, the system provider and the airline
R4-70	Rate Control Mode	Set to “CBR + Filler” (CBR plus “padding” for HRD compliance) in Digital Rapids Studio AVC Profile
R4-75	Profile	High
R4-32	Level	3.1 (APEX best practices) **Note:** TopSeries decoders conforming to level 3.1 are capable of decoding all bitstreams that are encoded for that level and for all lower levels
R4-76	Slices	4
R4-52	Pixel Accuracy	¼ Pixel
R4-53	Motion Search	16x16, 16x8, 8x16, 8x8
R4-33	Reference B-Frames	No
R4-77	Number of Reference Frames	3
R4-78	Weighted Prediction	Yes
R4-36	Key-Frame on Scene Cut	Yes
R4-79	GOP Size	12 frames for 24 or 25 fps media & 15 frames for 30 fps media but could be shortened if an I-Frame is triggered by a scene change
R4-80	Number of B-frames	3
R4-40	Encoding Mode	Progressive
R4-41	Entropy	CABAC
R4-42	IDR Frequency	1 on every key frame
R4-81	Video Standard	HD 720p

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (720p)
R4-44	Video Input	Progressive
R4-82	Aspect Ratios	16:9 only HD content encoded as 16:9 display aspect ratio HD content with an Original Aspect Ratio (OAR) other than 16:9 is to be framed in a 16:9 presentation: - HD content that is in 4:3 is to be pillar-box matted - HD content with an aspect ratio wider than 16:9 is to be letterbox matted
R4-83	Frame Rates	23.976 fps, 25 fps, and 29.97 fps are acceptable - Content originated at film rates is available as 23.976 HD masters, and is to be encoded at that rate. - Content mastered at 25 fps is to be encoded as 25P or converted to 23.976P. - Higher frame rates, such as 50P, 50i, 60P and 60i is to be reduced to a frame rate available in the standard. - When the content to be encoded is presented as 29.97 fps or 59.94 fps video, best practice is to, if possible, reverse telecine down to a film frame rate and encode as 23.976. In any event, the source is to be de-interlaced before encoding.
R4-54	Film Mode Frame Rate Conversion	Reverse telecine is to be used before encoding in the case where telecine pull-down is present in the source
R4-84	Video Resolution	1280 x 720 (square pixels) ITU-R Recommendation BT.709-5
R4-11	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16 White to be set at 235
R3-35	Chroma Format	4:2:0 only
R4-55	Access Unit Delimiters	Yes
R4-56	Sequence End Code	No
R4-57	Timestamp	No
R4-59	Timestamp Offset	No
R4-58	Deblocking Filter	Yes
R4-85	Elementary Audio Stream Types	MP2 (MPEG-1 Audio, Layer 2) or HE-AAC v2
R4-103	Multiple Audio Stream Type	When providing multiple audio language tracks, the same Elementary Audio Stream Type (codec, bitrate & mode) is used throughout the MPEG-2 Transport Stream
R3-52	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments
R4-86	Elementary Audio Bit Rates (No 3D Audio)	128 Kbps for MP2 64 Kbps for HE-AAC v2
R4-104	Elementary Audio Bit Rates (3D Audio)	256 Kbps for MP2 128 Kbps for HE-AAC v2
R4-63	Modes (No 3D Audio)	**VOD:** Single Channel or Joint Stereo **In-Seat Broadcast Video:** Single Channel or Joint Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Single Channel or Joint Stereo

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (720p)
R4-102	Modes (3D Audio)	**VOD:** Dual Channel or Independent Stereo **In-Seat Broadcast Video:** Dual Channel or Independent Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0
R4-66	Padding	Required to adjust mean bit rate (256, 128 or 64 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-14	Program Reference Level for Sources	-12 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R4-47	Frequency Response	20 Hz to 20 KHz ± 3 dB
R3-17	Audio Emphasis	None
R4-48	Signal-to-Noise Ratio	Greater than 50 dB Referenced to max signal level from 20 Hz to 20 KHz
R4-49	Crosstalk	Less than 50 dB between channels
R4-13	Open Captions	Included in Video and MPEG Encoded with Video **Note:** Does not coexist with Closed Captions or Subtitles
R4-14	Closed Captions	See Section 5 below **Note:** Does not coexist with Open Captions
R4-15	Closed Captions PID(s)	See tables in Section 6 Language PID Assignments
R4-16	Subtitles	See Section 5 below **Note:** Does not coexist with Open Captions
R4-17	Subtitles PID(s)	See tables in Section 6 Language PID Assignments
R4-18	CC/SUB PID(s)	Included from start of stream when CC/SUB present in media

4.7 HD (1080p) in MPEG-4

HD 1080p video content in MPEG-4 shall comply with the following specifications:

Note: Hollywood copyrighted content can be encoded in 1080p only after the APEX Specification 0403 rev 1.4 is released (Estimated to be in Q4 2014).

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (1080p)
R4-88	Supported Platform for Section 4.7	AVANT
R4-93	Content File Names (recommended)	Title_BitRateVDecoder_VFormatFrameRate_ADecoderAMode_SPK_OC_CC_SUB.mpg Where: **Title:** Name of content - use upper/lower cases with no spaces **BitRate:** 60 = 6.0 Mbps; 80 = 8.0 Mbps **VDecoder (video):** M4 = MPEG-4 **VFormat (video):** **HD:** 1080p **FrameRate:** 23 = 23.976 fps; 25 = 25 fps; 29 = 29.97 fps **ADecoder (audio):** mp2 = MPEG-1 Layer 2; heaacv2 = High Efficiency Advanced Audio Codec version 2 **AMode:** sc = single channel; dc = dual channel or independent stereo; js = joint stereo **Languages (spoken):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SPK for spoken languages **Language (open caption):** Three character abbreviation per ISO 639 (See tables in Section 6 Language PID Assignments) followed by OC for captions for hard of hearing persons. If none, no field **Languages (closed caption):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by CC for captions for hard of hearing persons. If none, no field **Languages (subtitle):** Three character abbreviations per ISO 639 (See tables in Section 6 Language PID Assignments) followed by SUB for subtitles for language translation. If none, no field **Example:** MyMovie_60M4_1080p29_mp2js_EngFraSPK_EngCC_HinAraSUB.mpg This file name represents a title called “My Movie”. The video is encoded in MPEG-4 at 6.0 Mbps, in 1080p at 29.97 fps. All audio tracks are encoded in MPEG-1 Layer 2 in joint stereo. The spoken languages are English & French and there are English Closed Captions and Subtitles in Hindi and Arabic
R3-3	Content File Name Length	Less than 250 ASCII characters
R4-25	Systems Stream Type	MPEG-2 Transport Stream at Constant Bit Rate (CBR) per ISO/IEC 13818-1:2000
R3-48	Null Packets PID	0x1FFF is reserved
R4-26	Transport Stream	Every PES of TS contains completed H.264 NAL units
R4-27	PES packet	SPS and PPS of H.264 ES are placed at the beginning of PES packet
R4-60	PES alignment	The first Byte of each PES packet payload is the first Byte of an access unit

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (1080p)
R4-61	Quad-Byte alignment	Yes The Multiplexer shall force the data preceding each picture start code to be quad-byte aligned when the video elementary stream is multiplexed
R4-67	PCR-PTS gap limit	PTS is greater than PCR by a maximum of 1 second **Note:** When using the Manzanita Systems' MPEG-2 Transport Stream Multiplexer Enhanced Version 7.0 or higher (MP2TSME V7.0), MaxDecodeDelay = 90 000 clock cycles
R4-68	PCR packet insertions	Always before a frame start and never between frame data
R4-69	Transport Scrambling Control	0x00 **Note:** These 2 bits are located in the header of each MPEG-2 TS packet
R4-90	Number of Elementary Streams multiplexed in Systems Stream	One Video Stream + up to 16 Audio Streams + up to one Open Caption (encoded into Video) or up to 16 Closed Caption Streams or up to 16 Subtitle Streams or up to 16 Closed Caption and Subtitle Streams combination **Note:** OC does not coexist with CC or Sub
R4-50	A/V Synchronization	Video lags Audio by no more than 20 ms and Video leads Audio by no more than 40 ms
R4-29	Elementary Video Stream Type	MPEG-4 Part 10 (H.264/AVC) Video
R3-25	Elementary Video Stream PID	0x0031 is reserved for primary video stream and PCR value
R4-94	Elementary Video Bit Rates	From 6.0 Mbps (CBR) [default] to 8.0 Mbps (CBR) **Note:** When visual quality requires, the default value could be varied from with the concurrence of the stakeholders who could include the compressionist, the content provider, the system provider and the airline
R4-70	Rate Control Mode	Set to “CBR + Filler” (CBR plus “padding” for HRD compliance) in Digital Rapids Studio AVC Profile
R4-75	Profile	High
R4-95	Level	4.1 (APEX best practices) **Note:** TopSeries decoders conforming to level 4.1 are capable of decoding all bitstreams that are encoded for that level and for all lower levels
R4-76	Slices	4
R4-52	Pixel Accuracy	¼ Pixel
R4-53	Motion Search	16x16, 16x8, 8x16, 8x8
R4-33	Reference B-Frames	No
R4-77	Number of Reference Frames	3
R4-78	Weighted Prediction	Yes
R4-36	Key-Frame on Scene Cut	Yes
R4-79	GOP Size	12 frames for 24 or 25 fps media & 15 frames for 30 fps media but could be shortened if an I-Frame is triggered by a scene change
R4-80	Number of B-frames	3
R4-40	Encoding Mode	Progressive

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (1080p)
R4-41	Entropy	CABAC
R4-42	IDR Frequency	1 on every key frame
R4-96	Video Standard	HD 1080p
R4-44	Video Input	Progressive
R4-82	Aspect Ratios	16:9 only HD content encoded as 16:9 display aspect ratio HD content with an Original Aspect Ratio (OAR) other than 16:9 is to be framed in a 16:9 presentation: - HD content that is in 4:3 is to be pillar-box matted - HD content with an aspect ratio wider than 16:9 is to be letterbox matted
R4-83	Frame Rates	23.976 fps, 25 fps, and 29.97 fps are acceptable - Content originated at film rates is available as 23.976 HD masters, and is to be encoded at that rate. - Content mastered at 25 fps is to be encoded as 25P or converted to 23.976P. - Higher frame rates, such as 50P, 50i, 60P and 60i is to be reduced to a frame rate available in the standard. - When the content to be encoded is presented as 29.97 fps or 59.94 fps video, best practice is to, if possible, reverse telecine down to a film frame rate and encode as 23.976. In any event, the source is to be de-interlaced before encoding.
R4-54	Film Mode Frame Rate Conversion	Reverse telecine is to be used before encoding in the case where telecine pull-down is present in the source
R4-97	Video Resolution	1920 x 1080 (square pixels) ITU-R Recommendation BT.709-5
R4-11	Encoder Range	Full range of bits 0-255 Black at 0 IRE to be set at 16 White to be set at 235
R3-35	Chroma Format	4:2:0 only
R4-55	Access Unit Delimiters	Yes
R4-56	Sequence End Code	No
R4-57	Timestamp	No
R4-59	Timestamp Offset	No
R4-58	Deblocking Filter	Yes
R4-85	Elementary Audio Stream Types	MP2 (MPEG-1 Audio, Layer 2) or HE-AAC v2
R4-103	Multiple Audio Stream Type	When providing multiple audio language tracks, the same Elementary Audio Stream Type (codec, bitrate & mode) is used throughout the MPEG-2 Transport Stream
R3-52	Elementary Audio Stream PID(s)	See tables in Section 6 Language PID Assignments
R4-86	Elementary Audio Bit Rates (No 3D Audio)	128 Kbps for MP2 64 Kbps for HE-AAC v2
R4-104	Elementary Audio Bit Rates (3D Audio)	256 Kbps for MP2 128 Kbps for HE-AAC v2

Requirements	Parameters	MPEG-4 Part 10 (H.264/AVC) Specifications for HD (1080p)
R4-63	Modes Modes (No 3D Audio)	**VOD:** Single Channel or Joint Stereo **In-Seat Broadcast Video:** Single Channel or Joint Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Single Channel or Joint Stereo
R4-102	Modes (3D Audio)	**VOD:** Dual Channel or Independent Stereo **In-Seat Broadcast Video:** Dual Channel or Independent Stereo **VA:** Single Channel (mono audio) **VOE & VOR:** Dual Channel or Independent Stereo
R3-10	Private Bit in Audio Header	Set to 0
R4-66	Padding	Required to adjust mean bit rate (256, 128 or 64 Kbps) to sampling frequency (44.1 KHz)
R3-12	CRC	None
R3-13	Audio Sampling Frequency	44.1 KHz
R3-14	Program Reference Level for Sources	-12 dB below full scale (digital clip)
R3-15	Dynamic Range of Encoded Signal	No more than 40 dB
R4-47	Frequency Response	20 Hz to 20 KHz ± 3 dB
R3-17	Audio Emphasis	None
R4-48	Signal-to-Noise Ratio	Greater than 50 dB Referenced to max signal level from 20 Hz to 20 KHz
R4-49	Crosstalk	Less than 50 dB between channels
R4-13	Open Captions	Included in Video and MPEG Encoded with Video **Note:** Does not coexist with Closed Captions or Subtitles
R4-14	Closed Captions	See Section 5 below **Note:** Does not coexist with Open Captions
R4-15	Closed Captions PID(s)	See tables in Section 6 Language PID Assignments
R4-16	Subtitles	See Section 5 below **Note:** Does not coexist with Open Captions
R4-17	Subtitles PID(s)	See tables in Section 6 Language PID Assignments
R4-18	CC/SUB PID(s)	Included from start of stream when CC/SUB present in media

5 Captions / Subtitles

- Captions are implemented either as open or closed.
  - Open Captions reside on the picture and cannot be turned off. They are always visible.
  - Closed Captions are text displayed as an overlay to the picture and can be turned on or off by the viewer if the particular IFEC equipment has this capability.
- Captions are also understood as providing a text description of all sounds coming from the program to help a hearing- impaired person experience the program, but subtitles could be used in the same manner as either open or closed captions.
- Subtitles provide a text translation of dialogues only.
- Thus "captions" are used in 2 different contexts: Its implementation and its usage.
- Per Section 2-1 table, i2000, i3000, i4X00 and i5000 with SVDU Gen 2 systems as well as all i5000 systems for VA / VOE / VOR support Open Captions only.

Requirements	Parameters	CC / SUB Specifications
R5-1	Supported Platforms for Section 5	I5000 with SVDU Gen 3 & 4 for VOD and Broadcast Video services (Not for VA / VOE / VOR services) and i8000 & AVANT for all video services

5.1 Overview

- Closed Captions and Subtitles files for IFEC systems are provided to the Post-Processing Labs with the Sonic Scenarist® SD DVD authoring format for subtitling. This format consists of a combination of TIFF images and a display schedule file with time-on/off for each CC/Subtitle image. See Appendix C for CC/Sub files requirements for multiplexing.
- The Scenarist DVD authoring format for subtitling is then post-processed into a DVB Subtitle stream that is contained in the Constant Bit Rate MPEG-2 Transport Stream of the Thales Avionics TopSeries compatible content file.
  Note: The supported subtitle and captioning streams could contain any language and any font since input requirements for captioning and subtitle streams are image-based. Asian character sets, languages that read right-to-left as well as Western languages are all supported.
- In the DVB standard, a closed caption subtitle stream conveys one or more subtitle services. A subtitle service displays its information in a sequence of pages that are intended to be overlaid on the associated video image. A subtitle page potentially contains one or more regions of the image.

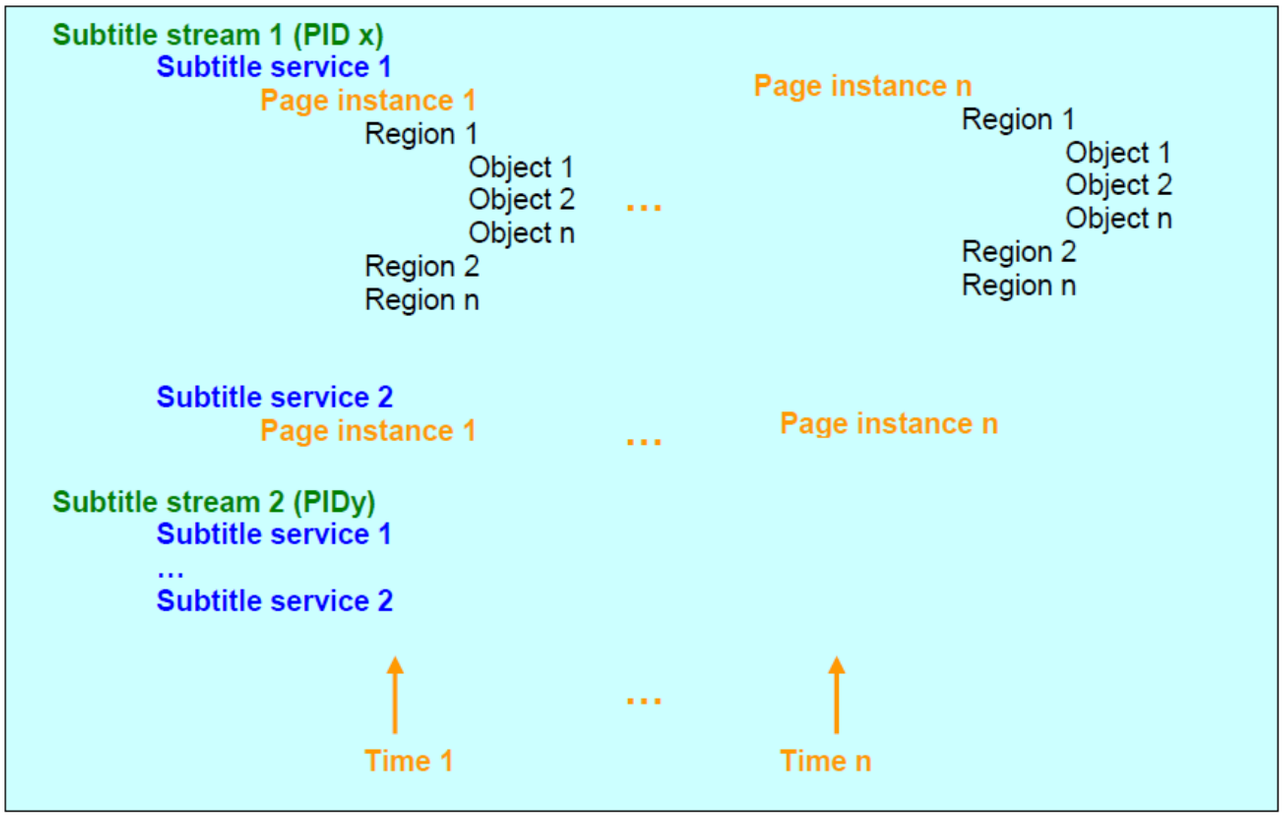

Figure 5-1: Structure of the DVB subtitle streams

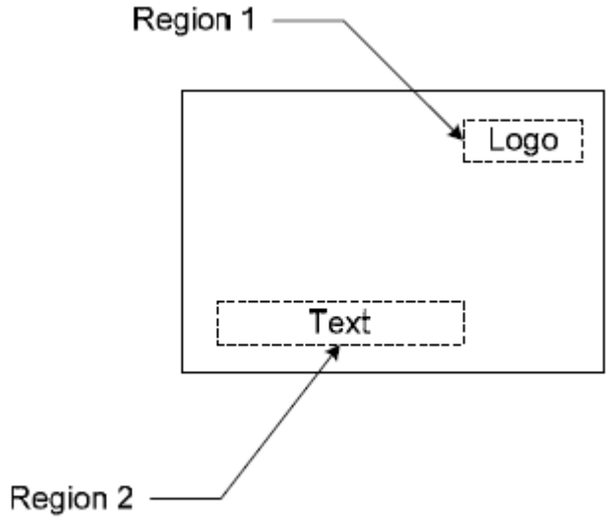

Figure 5-2: Example of a DVB subtitle page with two regions

5.2 Stream Format

- Several image files and several display schedule files are used as inputs to create the multiplexed MPEG-2 Transport Stream including the actual video, one or several audio tracks and one or several CC/subtitle streams.

- To enhance compatibility with commercial off-the-shelf decoders, the integrated CC/subtitled video program is expected to be DVB compliant. Indeed, to ensure operability with Thales Avionics TopSeries, improve system response time, and reduce complexity, we need to restrict some requirements from the DVB Subtitling systems standard.
- Graphically, the content integration performed by Post Production Labs is described in the following Figure.

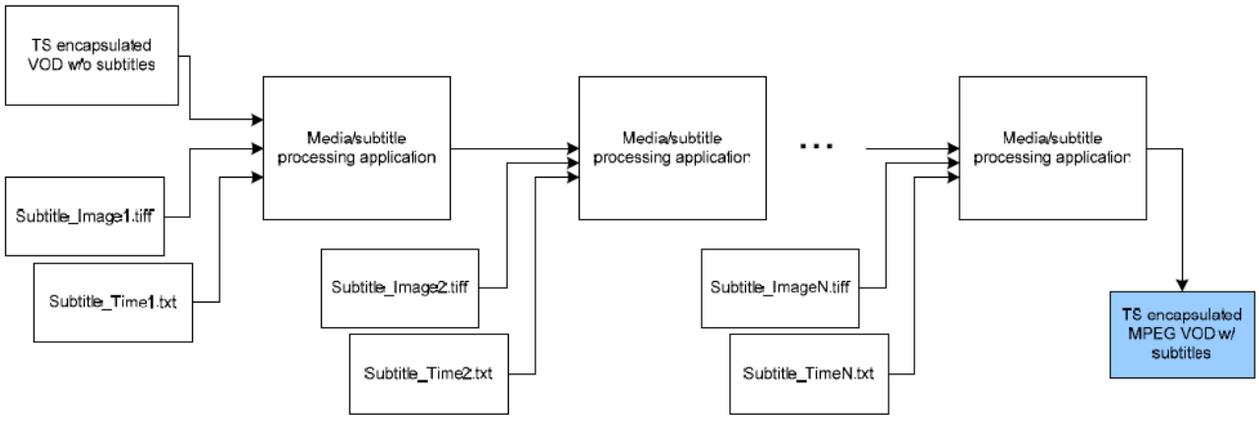

Figure 5-3: Media integration process

Requirements	Parameters	CC / SUB Specifications
R5-21	DVB Standard Compliance	The integrated CC/subtitled video transport stream shall be compliant with the DVB Subtitling systems standard **Note:** Manzanita Systems MPEG-2 Transport Stream Multiplexer Enhanced version MP2TSME version 7.0 and higher have added DVB Subtitles and Closed Caption support from Sonic Scenarist® SD DVD authoring format for subtitling (as defined in this document for compliance with APEX 0403 version 1.1 or higher)

5.3 Display Set

The complete set of segments needed to decode a new subtitle page instance and associated data is called a display set. This paragraph describes the display set applicable to Thales Avionics TopSeries. Details on the segment definitions can be found in the DVB standard.

Requirements	Parameters	CC / SUB Specifications
R5-22	Display Set Aggregation	All segments belonging to a single display set associated to one subtitle service shall be carried in one or more PES packets having the same PTS value
R5-23	Display Set	The display set shall include the following segments: 1. Display definition segment 2. Page composition segment 3. Region composition segment 4. CLUT definition segment 5. Object data segment 6. End of display set segment

Note: Since the CLUT can be modified at any time, the PTS of the CLUT definition segment is not relevant to build the display set. The last segment that was received defines the CLUT.

5.3.1 Display definition segment

Requirements	Parameters	CC / SUB Specifications
R5-24	Display definition segment	The display definition segment shall specify the display_width and display_height corresponding to the encoded video stream

5.3.2 Page composition segment

The subtitle stream is constructed from the image file and the image parameter file. This mechanism allows only a single image to be displayed at any particular time. For this reason we limit the number of regions and the number of objects to one.

Requirements	Parameters	CC / SUB Specifications
R5-25	Unique Region	The page composition segment shall contain a unique region

5.3.3 Region composition segment

The DVB standard defines two types of objects, graphical objects and text objects. APEX 0403 has limited the two types to the use of graphical objects only.

Requirements	Parameters	CC / SUB Specifications
R5-26	Unique Graphical Object	The region composition segment shall cover the full window size and contain a unique graphical object

The Region Pixel Depth is limited to 2 bits (4 possible colors). This means that each pixel is defined by only 2 bits of the 4-bit (recommended) or 8-bit color index. Each index refers to an entry in a Color Look-up Table (CLUT) that is also transmitted as part of the transport stream. Several CLUT can be transmitted to the decoder. Each region defines which CLUT to use.

Requirements	Parameters	CC / SUB Specifications
R5-27	Region Pixel Depth	The region composition segment shall have pixel region_depth of 2 bits

5.3.4 CLUT definition segment

Associated to a region is a CLUT_id. The Corresponding CLUT is defined in a CLUT segment.

Requirements	Parameters	CC / SUB Specifications
R5-28	Clut Segment Support	The transport stream shall include CLUT definition segments defining a single 4-bit/entry CLUT with a single CLUT_id
R5-29	Clut Segment Insertion Condition	The CLUT segments shall be inserted in the transport stream under the following conditions: • At the beginning of the stream in the first display set • Every time the CLUT definition changes • On a periodic basis (period configurable in the tool, default period = 5 seconds)

The DVB Standard defines a non-modifying color that is set in entry value 1 of the CLUT. This non modifying color needs to be set to a specific value for the transparency mechanism (Chroma-key) to work on the SVDU.

Requirements	Parameters	CC / SUB Specifications
R5-30	Non-modifying Color	The non-modifying color (R = 0x08, G = 0x08, B = 0x08) shall be located in entry 1 of the CLUT

5.3.5 Object data segment

The content integrator needs to compress the subtitle images.

Requirements	Parameters	CC / SUB Specifications
R5-31	Subtitle Image Compression	Pixel data within object data segment shall be compressed using run-length coding as specified in the DVB standard
R5-32	Background Color Conversion	The background color of each image file shall be converted into the “01” pixel code pointing to the entry value ‘1’ of the CLUT
R5-33	Non Modifying Color Flag	The non-modifying color flag of the object data segment shall be set to 1 to indicate that the first entry of the CLUT table is the non-modifying color

5.3.6 End of display set segment

The DVB decoder needs to know when all the subtitle images for a video frame are received. The end_of_display_set_segment command provides an explicit indication to the decoder that transmission of a display set is complete.

Requirements	Parameters	CC / SUB Specifications
R5-34	End Of Display Set Segment	The end_of_display_set_segment command shall be inserted into the stream by the integration tool immediately after the last object for each display set

5.4 Performance

Requirements	Parameters	CC / SUB Specifications
R5-35	Monotonic PTS	All PTS in a video program’s TS shall be monotonically non-decreasing

To upper bound the maximum bit rate of a subtitled program, we limit the number and average bit-rate of subtitle streams per video program.

Requirements	Parameters	CC / SUB Specifications
R5-36	Subtitle Streams Limit	Up to 12 independent subtitle streams shall be supported in each TS encapsulated program file
R5-37	Subtitle Bit Rate Limit	The average bit rate of each subtitle stream (at MPEG-2 TS encapsulated layer) shall be less than 15 Kbps

Although the DVB standard allows an operator to map multiple subtitle services to one subtitle stream (Program ID), we have a stricter requirement to reduce variety in implementation options. This means that we allow only one language to be transported in each PID.

Requirements	Parameters	CC / SUB Specifications
R5-38	Unique Subtitle Service Per Subtitle Stream	Each subtitle stream (PID) shall contain only one subtitle service

6 Language PID Assignments

USE ONLY LANGUAGES SUPPORTED BY A SPECIFIC AIRLINE PLATFORM

The language PID Assignments shall comply with the following specifications:

Requirements	Parameters	PID Assignment Specifications
R3-1	Supported Platforms for Section 6	i2000, i3000, i4X00, i5000, i8000 and AVANT
R6-1	Primary Audio PID	Used for the video main audio track
R6-2	Secondary Audio PID	Used when multiplexing two instances of the same language **Example:** The secondary audio stream PID could be used for the director's comments audio track
R6-3	Primary Audio PID Secondary Audio PID Closed Captions PID Subtitles PID	Select one or more languages listed in the tables below

6.1 Legacy Language PID Assignments

The following table with 29 languages is compatible with i2000, i3000, i4x00, i5000, i8000 and AVANT.

Note: An Unknown Language is specified in the above table for
1. No spoken language in this content, or
2. Adding any other language selected by an Airline, e.g. Tamil, Tagalog, etc…

Line Number	Legacy Language Name	Primary Audio PID	Secondary Audio PID	Closed Captions PID	Subtitles PID	ISO 639-2,3,5 Alpha-3 Code
0	Unknown Language	0x0098	0x0099	0x0214	0x0215	zxx
1	Arabic	0x0034	0x0035	0x01B0	0x01B1	ara
2	Danish	0x0036	0x0037	0x01B2	0x01B3	dan
3	German	0x0038	0x0039	0x01B4	0x01B5	deu
4	Greek	0x0040	0x0041	0x01BC	0x01BD	ell
5	English	0x0042	0x0043	0x01BE	0x01BF	eng
6	Spanish (Castillian)	0x0044	0x0045	0x01C0	0x01C1	spa
7	Spanish (Latin)	0x0046	0x0047	0x01C2	0x01C3	spn
8	Persian	0x0048	0x0049	0x01C4	0x01C5	fas
9	Finnish	0x0050	0x0051	0x01CC	0x01CD	fin
10	French (Canadian)	0x0052	0x0053	0x01CE	0x01CF	cfr
11	French (Parisian)	0x0054	0x0055	0x01D0	0x01D1	fra
12	Hindi	0x0056	0x0057	0x01D2	0x01D3	hin
13	Indonesian	0x0058	0x0059	0x01D4	0x01D5	ind
14	Italian	0x0060	0x0061	0x01DC	0x01DD	ita
15	Hebrew	0x0062	0x0063	0x01DE	0x01DF	heb
16	Japanese	0x0064	0x0065	0x01E0	0x01E1	jpn
17	Korean	0x0066	0x0067	0x01E2	0x01E3	kor
18	Malay	0x0068	0x0069	0x01E4	0x01E5	msa
19	Dutch	0x0070	0x0071	0x01EC	0x01ED	nld
20	Norwegian	0x0072	0x0073	0x01EE	0x01EF	nor
21	Portuguese	0x0074	0x0075	0x01F0	0x01F1	por
22	Russian	0x0076	0x0077	0x01F2	0x01F3	rus
23	Swedish	0x0078	0x0079	0x01F4	0x01F5	swe
24	Thai	0x0080	0x0081	0x01FC	0x01FD	tha
25	Spoken Chinese (Mandarin)	0x0082	0x0083	N/A	N/A	cmn
26	Spoken Chinese (Cantonese)	0x0084	0x0085	N/A	N/A	yue
27	Simplified Chinese CC/Sub	N/A	N/A	0x01FE	0x01FF	chi
28	Traditional Chinese CC/Sub	N/A	N/A	0x0200	0x0201	lzh

6.2 AVANT Language PID Assignments

The following table lists all languages supported by i5G4, i8G4 and AVANT.

Note 1: An Unknown Language is specified in the below table for:
1. No spoken language in this content, or
2. Adding any other language selected by an Airline, e.g. Tamil, Tagalog, etc…

Note 2: Rows in grey below show compatibility with the Legacy Language PID Assignments table above.

Line Number	AVANT Language Name	Primary Audio PID	Secondary Audio PID	Closed Captions PID	Subtitles PID	ISO 639-2,3,5 Alpha-3 Code
1	Abkhazian	0x0032	0x0033	0x01AE	0x01AF	abk
2	Arabic	0x0034	0x0035	0x01B0	0x01B1	ara
3	Danish	0x0036	0x0037	0x01B2	0x01B3	dan
4	German	0x0038	0x0039	0x01B4	0x01B5	deu
5	Afar	0x003A	0x003B	0x01B6	0x01B7	aar
6	Afrikaans	0x003C	0x003D	0x01B8	0x01B9	afr
7	Akan	0x003E	0x003F	0x01BA	0x01BB	aka
8	Greek	0x0040	0x0041	0x01BC	0x01BD	ell
9	English	0x0042	0x0043	0x01BE	0x01BF	eng
10	Spanish (Castillian)	0x0044	0x0045	0x01C0	0x01C1	spa
11	Spanish (Latin)	0x0046	0x0047	0x01C2	0x01C3	spn
12	Persian	0x0048	0x0049	0x01C4	0x01C5	fas
13	Albanian	0x004A	0x004B	0x01C6	0x01C7	sqi
14	Amharic	0x004C	0x004D	0x01C8	0x01C9	amh
15	Aragonese	0x004E	0x004F	0x01CA	0x01CB	arg
16	Finnish	0x0050	0x0051	0x01CC	0x01CD	fin
17	French (Canadian)	0x0052	0x0053	0x01CE	0x01CF	cfr
18	French (Parisian)	0x0054	0x0055	0x01D0	0x01D1	fra
19	Hindi	0x0056	0x0057	0x01D2	0x01D3	hin
20	Indonesian	0x0058	0x0059	0x01D4	0x01D5	ind
21	Armenian	0x005A	0x005B	0x01D6	0x01D7	hye
22	Assamese	0x005C	0x005D	0x01D8	0x01D9	asm
23	Avaric	0x005E	0x005F	0x01DA	0x01DB	ava
24	Italian	0x0060	0x0061	0x01DC	0x01DD	ita
25	Hebrew	0x0062	0x0063	0x01DE	0x01DF	heb
26	Japanese	0x0064	0x0065	0x01E0	0x01E1	jpn
27	Korean	0x0066	0x0067	0x01E2	0x01E3	kor
28	Malay	0x0068	0x0069	0x01E4	0x01E5	msa
29	Avestan	0x006A	0x006B	0x01E6	0x01E7	ave
30	Aymara	0x006C	0x006D	0x01E8	0x01E9	aym
31	Azerbaijani	0x006E	0x006F	0x01EA	0x01EB	aze
32	Dutch	0x0070	0x0071	0x01EC	0x01ED	nld
33	Norwegian	0x0072	0x0073	0x01EE	0x01EF	nor
34	Portuguese	0x0074	0x0075	0x01F0	0x01F1	por
35	Russian	0x0076	0x0077	0x01F2	0x01F3	rus
36	Swedish	0x0078	0x0079	0x01F4	0x01F5	swe
37	Bambara	0x007A	0x007B	0x01F6	0x01F7	bam
38	Bashkir	0x007C	0x007D	0x01F8	0x01F9	bak
39	Basque	0x007E	0x007F	0x01FA	0x01FB	eus
40	Thai	0x0080	0x0081	0x01FC	0x01FD	tha

Line Number	AVANT Language Name	Primary Audio PID	Secondary Audio PID	Closed Captions PID	Subtitles PID	ISO 639-2,3,5 Alpha-3 Code
41	Spoken Chinese (Mandarin)	0x0082	0x0083	N/A	N/A	cmn
42	Spoken Chinese (Cantonese)	0x0084	0x0085	N/A	N/A	yue
43	Simplified Chinese CC/Sub	N/A	N/A	0x01FE	0x01FF	chi
44	Traditional Chinese CC/Sub	N/A	N/A	0x0200	0x0201	lzh
45	Belarusian	0x0086	0x0087	0x0202	0x0203	bel
46	Bengali	0x0088	0x0089	0x0204	0x0205	ben
47	Bihari	0x008A	0x008B	0x0206	0x0207	bih
48	Bislama	0x008C	0x008D	0x0208	0x0209	bis
49	Bosnian	0x008E	0x008F	0x020A	0x020B	bos
50	Catalan	0x0090	0x0091	0x020C	0x020D	cat
51	Breton	0x0092	0x0093	0x020E	0x020F	bre
52	Bulgarian	0x0094	0x0095	0x0210	0x0211	bul
53	Burmese	0x0096	0x0097	0x0212	0x0213	mya
54	Unknown Language	0x0098	0x0099	0x0214	0x0215	zxx
55	Chamorro	0x009A	0x009B	0x0216	0x0217	cha
56	Chechen	0x009C	0x009D	0x0218	0x0219	che
57	Chichewa	0x009E	0x009F	0x021A	0x021B	nya
58	Church Slavic	0x00A0	0x00A1	0x021C	0x021D	chu
59	Chuvash	0x00A2	0x00A3	0x021E	0x021F	chv
60	Cornish	0x00A4	0x00A5	0x0220	0x0221	cor
61	Corsican	0x00A6	0x00A7	0x0222	0x0223	cos
62	Cree	0x00A8	0x00A9	0x0224	0x0225	cre
63	Croatian	0x00AA	0x00AB	0x0226	0x0227	hrv
64	Czech	0x00AC	0x00AD	0x0228	0x0229	ces
65	Divehi	0x00AE	0x00AF	0x022A	0x022B	div
66	Dzongkha	0x00B0	0x00B1	0x022C	0x022D	dzo
67	Esperanto	0x00B2	0x00B3	0x022E	0x022F	epo
68	Estonian	0x00B4	0x00B5	0x0230	0x0231	est
69	Ewe	0x00B6	0x00B7	0x0232	0x0233	ewe
70	Faroese	0x00B8	0x00B9	0x0234	0x0235	fao
71	Fijian	0x00BA	0x00BB	0x0236	0x0237	fij
72	Fulah	0x00BC	0x00BD	0x0238	0x0239	ful
73	Galician	0x00BE	0x00BF	0x023A	0x023B	glg
74	Ganda	0x00C0	0x00C1	0x023C	0x023D	lug
75	Georgian	0x00C2	0x00C3	0x023E	0x023F	kat
76	Guaraní	0x00C4	0x00C5	0x0240	0x0241	grn
77	Gujarati	0x00C6	0x00C7	0x0242	0x0243	guj
78	Haitian	0x00C8	0x00C9	0x0244	0x0245	hat
79	Hausa	0x00CA	0x00CB	0x0246	0x0247	hau
80	Herero	0x00CC	0x00CD	0x0248	0x0249	her
81	Hiri Motu	0x00CE	0x00CF	0x024A	0x024B	hmo
82	Hungarian	0x00D0	0x00D1	0x024C	0x024D	hun
83	Icelandic	0x00D2	0x00D3	0x024E	0x024F	isl
84	Ido	0x00D4	0x00D5	0x0250	0x0251	ido
85	Igbo	0x00D6	0x00D7	0x0252	0x0253	ibo
86	Interlingua	0x00D8	0x00D9	0x0254	0x0255	ina
87	Interlingue	0x00DA	0x00DB	0x0256	0x0257	ile
88	Inuktitut	0x00DC	0x00DD	0x0258	0x0259	iku
89	Inupiaq	0x00DE	0x00DF	0x025A	0x025B	ipk

Line Number	AVANT Language Name	Primary Audio PID	Secondary Audio PID	Closed Captions PID	Subtitles PID	ISO 639-2,3,5 Alpha-3 Code
90	Irish	0x00E0	0x00E1	0x025C	0x025D	gle
91	Javanese	0x00E2	0x00E3	0x025E	0x025F	jav
92	Kalaallisut	0x00E4	0x00E5	0x0260	0x0261	kal
93	Kannada	0x00E6	0x00E7	0x0262	0x0263	kan
94	Kanuri	0x00E8	0x00E9	0x0264	0x0265	kau
95	Kashmiri	0x00EA	0x00EB	0x0266	0x0267	kas
96	Kazakh	0x00EC	0x00ED	0x0268	0x0269	kaz
97	Khmer	0x00EE	0x00EF	0x026A	0x026B	khm
98	Kikuyu	0x00F0	0x00F1	0x026C	0x026D	kik
99	Kinyarwanda	0x00F2	0x00F3	0x026E	0x026F	kin
100	Kirghiz	0x00F4	0x00F5	0x0270	0x0271	kir
101	Kirundi	0x00F6	0x00F7	0x0272	0x0273	run
102	Komi	0x00F8	0x00F9	0x0274	0x0275	kom
103	Kongo	0x00FA	0x00FB	0x0276	0x0277	kon
104	Kurdish	0x00FC	0x00FD	0x0278	0x0279	kur
105	Kwanyama	0x00FE	0x00FF	0x027A	0x027B	kua
106	Lao	0x0100	0x0101	0x027C	0x027D	lao
107	Latin	0x0102	0x0103	0x027E	0x027F	lat
108	Latvian	0x0104	0x0105	0x0280	0x0281	lav
109	Limburgish	0x0106	0x0107	0x0282	0x0283	lim
110	Lingala	0x0108	0x0109	0x0284	0x0285	lin
111	Lithuanian	0x010A	0x010B	0x0286	0x0287	lit
112	Luba-Katanga	0x010C	0x010D	0x0288	0x0289	lub
113	Luxembourgish	0x010E	0x010F	0x028A	0x028B	ltz
114	Macedonian	0x0110	0x0111	0x028C	0x028D	mkd
115	Malagasy	0x0112	0x0113	0x028E	0x028F	mlg
116	Malayalam	0x0114	0x0115	0x0290	0x0291	mal
117	Maltese	0x0116	0x0117	0x0292	0x0293	mlt
118	Manx	0x0118	0x0119	0x0294	0x0295	glv
119	Māori	0x011A	0x011B	0x0296	0x0297	mri
120	Marathi	0x011C	0x011D	0x0298	0x0299	mar
121	Marshallese	0x011E	0x011F	0x029A	0x029B	mah
122	Moldavian	0x0120	0x0121	0x029C	0x029D	mol
123	Mongolian	0x0122	0x0123	0x029E	0x029F	mon
124	Nauru	0x0124	0x0125	0x02A0	0x02A1	nau
125	Navajo	0x0126	0x0127	0x02A2	0x02A3	nav
126	Ndonga	0x0128	0x0129	0x02A4	0x02A5	ndo
127	Nepali	0x012A	0x012B	0x02A6	0x02A7	nep
128	North Ndebele	0x012C	0x012D	0x02A8	0x02A9	nde
129	Northern Sami	0x012E	0x012F	0x02AA	0x02AB	sme
130	Norwegian Bokmål	0x0130	0x0131	0x02AC	0x02AD	nob
131	Norwegian Nynorsk	0x0132	0x0133	0x02AE	0x02AF	nno
132	Occitan	0x0134	0x0135	0x02B0	0x02B1	oci
133	Ojibwa	0x0136	0x0137	0x02B2	0x02B3	oji
134	Oriya	0x0138	0x0139	0x02B4	0x02B5	ori
135	Oromo (Afan)	0x013A	0x013B	0x02B6	0x02B7	orm
136	Ossetian	0x013C	0x013D	0x02B8	0x02B9	oss
137	Pāli	0x013E	0x013F	0x02BA	0x02BB	pli
138	Punjabi	0x0140	0x0141	0x02BC	0x02BD	pan

Line Number	AVANT Language Name	Primary Audio PID	Secondary Audio PID	Closed Captions PID	Subtitles PID	ISO 639-2,3,5 Alpha-3 Code
139	Pashto	0x0142	0x0143	0x02BE	0x02BF	pus
140	Polish	0x0144	0x0145	0x02C0	0x02C1	pol
141	Quechua	0x0146	0x0147	0x02C2	0x02C3	que
142	Raeto-Romance	0x0148	0x0149	0x02C4	0x02C5	roh
143	Romanian	0x014A	0x014B	0x02C6	0x02C7	ron
144	Samoan	0x014C	0x014D	0x02C8	0x02C9	smo
145	Sango	0x014E	0x014F	0x02CA	0x02CB	sag
146	Sanskrit	0x0150	0x0151	0x02CC	0x02CD	san
147	Sardinian	0x0152	0x0153	0x02CE	0x02CF	srd
148	Scottish Gaelic	0x0154	0x0155	0x02D0	0x02D1	gla
149	Serbian	0x0156	0x0157	0x02D2	0x02D3	srp
150	Serbo-Croatian	0x0158	0x0159	0x02D4	0x02D5	hbs
151	Shona	0x015A	0x015B	0x02D6	0x02D7	sna
152	Sichuan Yi	0x015C	0x015D	0x02D8	0x02D9	iii
153	Sindhi	0x015E	0x015F	0x02DA	0x02DB	snd
154	Sinhala	0x0160	0x0161	0x02DC	0x02DD	sin
155	Slovak	0x0162	0x0163	0x02DE	0x02DF	slk
156	Slovenian	0x0164	0x0165	0x02E0	0x02E1	slv
157	Somali	0x0166	0x0167	0x02E2	0x02E3	som
158	South Ndebele	0x0168	0x0169	0x02E4	0x02E5	nbl
159	Southern Sotho	0x016A	0x016B	0x02E6	0x02E7	sot
160	Sundanese	0x016C	0x016D	0x02E8	0x02E9	sun
161	Swahili	0x016E	0x016F	0x02EA	0x02EB	swa
162	Swati	0x0170	0x0171	0x02EC	0x02ED	ssw
163	Tagalog	0x0172	0x0173	0x02EE	0x02EF	tgl
164	Tahitian	0x0174	0x0175	0x02F0	0x02F1	tah
165	Tajik	0x0176	0x0177	0x02F2	0x02F3	tgk
166	Tamil	0x0178	0x0179	0x02F4	0x02F5	tam
167	Tatar	0x017A	0x017B	0x02F6	0x02F7	tat
168	Telugu	0x017C	0x017D	0x02F8	0x02F9	tel
169	Tibetan	0x017E	0x017F	0x02FA	0x02FB	bod
170	Tigrinya	0x0180	0x0181	0x02FC	0x02FD	tir
171	Tonga	0x0182	0x0183	0x02FE	0x02FF	ton
172	Tsonga	0x0184	0x0185	0x0300	0x0301	tso
173	Tswana	0x0186	0x0187	0x0302	0x0303	tsn
174	Turkish	0x0188	0x0189	0x0304	0x0305	tur
175	Turkmen	0x018A	0x018B	0x0306	0x0307	tuk
176	Twi	0x018C	0x018D	0x0308	0x0309	twi
177	Uighur	0x018E	0x018F	0x030A	0x030B	uig
178	Ukrainian	0x0190	0x0191	0x030C	0x030D	ukr
179	Urdu	0x0192	0x0193	0x030E	0x030F	urd
180	Uzbek	0x0194	0x0195	0x0310	0x0311	uzb
181	Venda	0x0196	0x0197	0x0312	0x0313	ven
182	Vietnamese	0x0198	0x0199	0x0314	0x0315	vie
183	Volapük	0x019A	0x019B	0x0316	0x0317	vol
184	Walloon	0x019C	0x019D	0x0318	0x0319	wln
185	Welsh	0x019E	0x019F	0x031A	0x031B	cym
186	Western Frisian	0x01A0	0x01A1	0x031C	0x031D	fry
187	Wolof	0x01A2	0x01A3	0x031E	0x031F	wol

Line Number	AVANT Language Name	Primary Audio PID	Secondary Audio PID	Closed Captions PID	Subtitles PID	ISO 639-2,3,5 Alpha-3 Code
188	Xhosa	0x01A4	0x01A5	0x0320	0x0321	xho
189	Yiddish	0x01A6	0x01A7	0x0322	0x0323	yid
190	Yoruba	0x01A8	0x01A9	0x0324	0x0325	yor
191	Zhuang	0x01AA	0x01AB	0x0326	0x0327	zha
192	Zulu	0x01AC	0x01AD	0x0328	0x0329	zul
193	*** New Entry:***	0x032A	0x032B	0x032C	0x032D	ADMIN ONLY
194	Brazilian Portuguese	0x032E	0x032F	0x0330	0x0331	pob

7 Security for Content Delivery to Thales TopEffects

The security of content delivery is described below:

Requirements	Parameters	Content Delivery Security Specifications
R3-1	Supported Platforms for Section 7	i2000, i3000, i4X00, i5000, i8000 and AVANT
R7-5	Encryption Tool	All below described encryptions shall use SecretAgent from Information Security Corporation
R7-1	AES encryption	All content shipped to Thales TopEffects for integration shall be file-level encrypted using AES, 128-bit symmetric key with Cypher Block Chaining (CBC)
R7-2	RSA Public Key	Each Post-Production Lab shall request an RSA Public Key created by Thales Avionics TopEffects using the RSA algorithm with 2048-bit key strength
R7-3	RSA encryption	The Thales Public Key shall be used by the Post-Production Lab to encrypt the AES encryption key
R7-4	Content Key Delivery	The RSA encrypted AES encryption key shall be sent separately from encrypted content to Thales Avionics TopEffects
R7-6	Content Delivery	All MPEG Digital Media shall be encrypted and delivered on: • DVD Recordable or • External USB hard drive or • Smartjog (preferred mode of delivery)

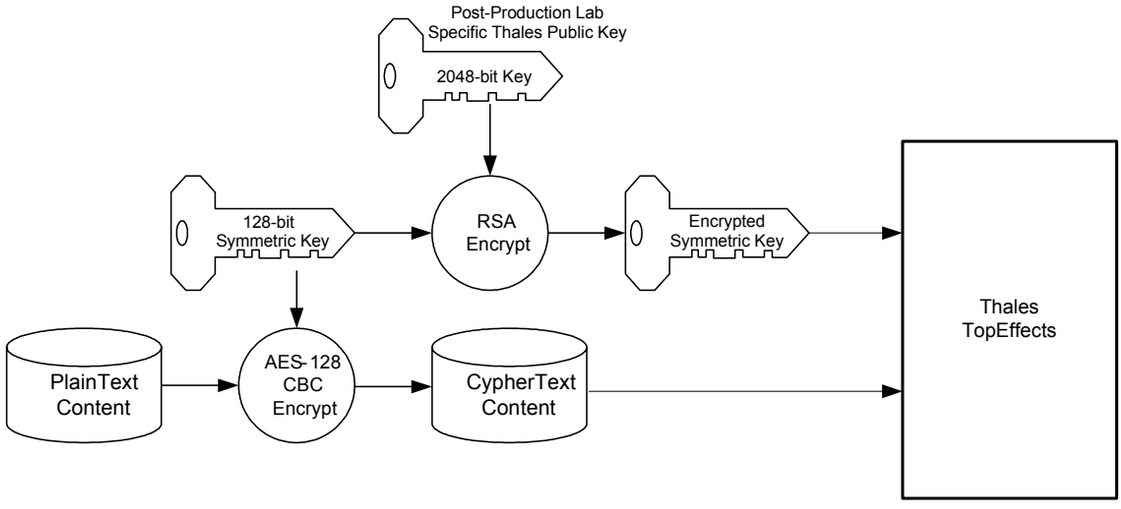

Figure 7-1: Security Process for content delivery to Thales TopEffects

APPENDIX A: ASSOCIATED DOCUMENTS

Document Number	Document Title
ISO/IEC 11172-2:1993 (a.k.a., MPEG-1 Video)	Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbps -- Part 2: Video
ISO/IEC 13818-2:1996 (a.k.a., MPEG-2 Video)	Information technology -- Generic coding of moving pictures and associated audio information -- Part 2: Video
ISO/IEC 11172-3:1993 (a.k.a., MPEG-1 Audio)	Information technology -- Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbps -- Part 3: Audio
ISO/IEC 13818-1:1996 (a.k.a., MPEG-2 Systems)	Information technology -- Generic coding of moving pictures and associated audio information -- Part 1: Systems **Note:** This MPEG-2 Systems specification is used for the multiplex of above Video and Audio streams.
ISO/IEC 13818-1:2000 (a.k.a., MPEG-2 Systems)	This new edition contains MPEG-2 Part 1 Amendment 7: Carriage of MPEG-4 over MPEG-2 Systems **Note:** This MPEG-2 Systems specification is used for the multiplex of below Video and Audio streams.
ISO/IEC 14496-3:2005 (a.k.a., MPEG-4 AAC)	Information technology -- Coding of audio-visual objects -- Part 3: Audio
ISO/IEC 14496-10:2005 (a.k.a., MPEG-4 AVC)	Information technology -- Coding of audio-visual objects -- Part 10: Advanced video coding
ITU-R Recommendation BT.601-5	Studio Encoding Parameters of Digital Television for Standard 4:3 and Wide-screen 16:9 Aspect Ratios, October 1995
ITU-R Recommendation BT.709-5	Parameter values for the HDTV standards for production and international programme exchange, April 2002
WAEA Specification 0395, Version 2.0	Content Delivery for In-Flight Entertainment, Nov. 6, 2001
APEX Specification 0403, Version 1.3	Digital Content Delivery Methodology For Airline In-Flight Entertainment Systems, May 22, 2012
APEX Specification 1289-2, Revision 3	Specification for Master Tape Recording, Tape Duplication, Compact Disc Replication, and Digital Encoding for Airborne Audio Entertainment Systems, 20 January 2005
ETSI EN 300 743 V1.3.1 (2006-11)	Digital Video Broadcasting (DVB); Subtitling systems, 24 November 2006
ISO 639-2:1998	Codes for the representation of names of languages — Part 2: Alpha-3 code, 1998
ISO 639-3:2007	Codes for the representation of names of languages — Part 3: Alpha-3 code for comprehensive coverage of languages, 2007-02-05
ISO 639-5:2008	Codes for the representation of names of languages — Part 5: Alpha-3 code for language families and groups, 2008-05-15

APPENDIX B: DEFINITIONS AND ABBREVIATIONS

AAC	-	Advanced Audio Coding (MPEG-4 Part 3)
AES	-	Advanced Encryption Standard
AOD	-	Audio On-Demand
APEX		Airline Passenger Experience Association (previously WAEA)
AVC	-	Advanced Video Coding (MPEG-4 Part 10)
AVC-D	-	Audio Video Controller – Digital
BGM	-	Background Music
BMP	-	Bitmap image file format
CABAC	-	Context-Adaptive Binary Arithmetic Coding
CBC	-	Cypher Block Chaining
CBR	-	Constant Bit Rate
CC	-	Closed Captions
CLUT		Color Look-Up Table
CRC	-	Cyclical Redundancy Check
CCIR	-	Consultative Committee for International Radio
CSP		Content Service Provider
dB	-	Decibel
dBFS		Decibel below Full Scale referenced to digital clip
dBm		Decibel referenced to 1 mW into 600 ohms
dBu		Decibel unloaded referenced to open circuit source
DSU-AM6-12	-	Digital Server Unit – Analog Modulated output (6 Video signal inputs -- with associated stereo audio -- and 12 Stereo Audio signal inputs).
DSU-D	-	Digital Server Unit
DVB	-	Digital Video Broadcast (a standardization organization)
DVD	-	Digital Versatile Disc
EQ	-	Equalization
FIR	-	Finite Impulse Response
G or Gen	-	Generation
GOP	-	Group of Pictures
HD		High Definition (720p, 1080i, 1080p)
HDTV		High Definition Television
Hz	-	Hertz (cycles per second)
IDR	-	Instantaneous Decoding Refresh
IEC	-	International Electrotechnical Commission
IFE	-	In-Flight Entertainment
IFEC		In-Flight Entertainment & Connectivity
IFES	-	In-Flight Entertainment Systems
Interlingua	-	International Auxiliary Language Association
IRE	-	Institute of Radio Engineers
ISO	-	International Standardization Organization
ITU-R	-	International Telecommunication Union – Radiocommunication
Kbps	-	Kilobits per second
KHz	-	Kilohertz (one thousand cycles per second)
LC-AAC	-	Low Complexity Advanced Audio Coding
LLAB	-	Low Latency Audio Broadcast (Crew rest audio with QSEB for i5000)
LRU	-	Line Replaceable Unit
Mbps	-	Megabits per second
MP2	-	MPEG-1 Audio, Layer 2
MP3	-	MPEG-1 Audio, Layer 3
MPEG	-	Moving Pictures Expert Group
NAL	-	Network Abstraction Layer

NTSC	-	National Television System Committee
PA		Passenger Announcement
PCR	-	Program Clock Reference
pel	-	Picture Element
PES	-	Packetized Elementary Stream
PID	-	Packet Identifier
PPL		Post-Production Labs or Post-Processing Labs
PPS	-	Packets per second
PRAM	-	Pre-Recorded Announcement and Boarding Music Reproducer
PTS	-	Presentation Time Stamp
RGB	-	Additive color model based on Red, Green, Blue
RLE	-	Run-Length Encoding data compression algorithm
RSA	-	A cryptographic algorithm invented by R. Rivest, A. Shamir and L. Adleman
SD		Standard Definition (NTSC)
SDTV	-	Standard Definition Television
SIF	-	Source Input Format (not Common Interface Format (CIF))
SMPTE		Society of Motion Picture and Television Engineers
SPS	-	Samples Per Second
SUB	-	Subtitles
SVDU	-	Smart Video Display Unit
TIFF	-	Tagged Image File Format
TS	-	Transport Stream
USB	-	Universal Serial Bus
VA	-	Video Announcement
VBV	-	Video Buffer Verifier
VOD	-	Video On-Demand
VOE	-	Video Overhead Entertainment
VOR	-	Video OverRide
VRMS		Root Mean Square of Voltage or quadratic mean value
W		Watt
WAEA	-	World Airline Entertainment Association (Now APEX)

APPENDIX C: CC/SUB.ZIP INPUT

The subtitling process flow has been standardized by WAEA. Requirements regarding the process inputs have been extracted from WAEA 0403.

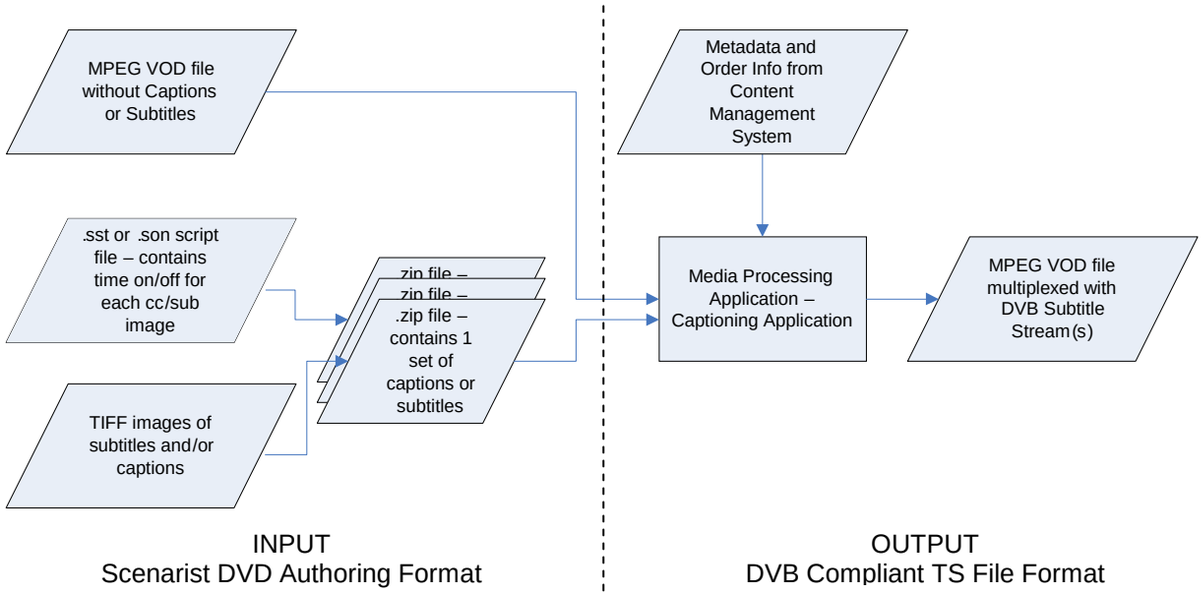

Figure C-1: Captioning and Subtitling Process Flow

The basic content building block is an MPEG-1, MPEG-2 or MPEG-4 program encapsulated in an MPEG-2 Transport Stream. Associated with each TS encapsulated program are one or more subtitle streams. A subtitle stream could be used to convey text and/or logos and is constructed using data from two input files; one is a zip file, containing a set of subtitle images (BMP or TIFF), and the other is a text file, containing timing and image positioning parameters.

Requirements	Parameters	CC/SUB.zip Specifications
R5-1	Supported Platforms for Appendix C	I5000 with SVDU Gen 3 & 4 for VOD and Broadcast Video services (Not for VA / VOE / VOR services) and i8000 & AVANT for all video services
R5-2	CC/SUB File Name (recommended)	Title_CC/SUBLanguageCaptionType.zip Where: **Title:** Name of content - use upper/lower cases with no spaces **CC/SUBLanguage:** ISO 639 3-letter code for this language (See tables in Section 6 Language PID Assignments). **CaptionType:** CC for captions for hard of hearing persons or SUB for subtitles for language translation. **Example:** MyMovie_EngCC.zip
R5-3	CC/Sub File Name Length	Less than 250 ASCII characters

Requirements	Parameters	CC/SUB.zip Specifications
R5-4	CC/Sub File Format	Sonic Scenarist® SD DVD authoring format Zip file containing: 1. TIFF images and 2. Display schedule file with time-on/off for each CC/Subtitle image
R5-5	Language Separation	Only one language stream per CC/Subtitle zip file

C.1. Image File Format

The Image File Format shall comply with the following specifications:

Requirements	Parameters	Image Specifications	Comments
R5-6	File Formats	TIFF or BMP	
R5-7	Width	720 pixels	
R5-8	Height	480 pixels	The bitmaps are stretched beyond the 3:2 aspect ratio to fit a given display. The fonts are rendered with that in mind. However, in most cases, one rendering views fine in both display aspect ratios, 4:3 and 16:9
R5-9	Color Depth (bit depth)	4 bits or 8 bits	4 bits are recommended
R5-10	Number of Unique Colors	4 colors or less	For example, 8 bit TIFF images can be accepted, as long as the color pallet includes 4, or less, colors
R5-11	Color Representation	Palletized or RGB	Both are acceptable
R5-12	Compression	RLE	or other similar TIFF compression types
R5-13	Background Color	Differs from the other colors used for the fonts	all pixels equal to the background color are made transparent when the image is displayed on the IFEC systems
R5-14	Font Sizes	32 pixels height for a full size character	e.g. “[s“

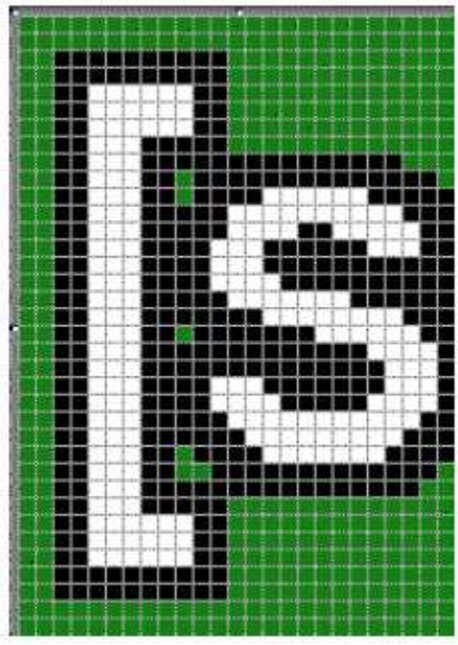

Figure C-2: Pixel View of Captioning and Subtitle Characters

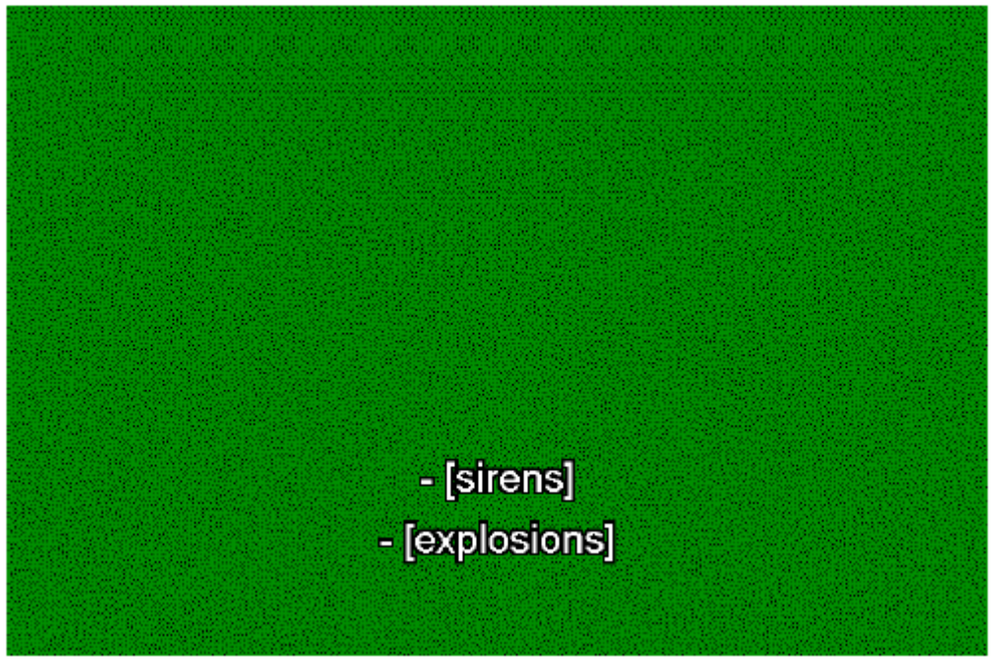

Figure C-3: Example of Full Screen Caption Image

C.2. Display Schedule File Format

- Although other Scenarist fields/parameters could be included in the display schedule file, only the Base_Time and Tape_Type parameters are processed by the integration tools at this time.
- It is expected that before content integration can take place, the media is validated for proper video captioning synchronization. That is, the base time contained in the delivered TXT file is to be aligned with the initial Program Time Stamp value in the MPEG VOD file.
- The Display Schedule File Format shall comply with the following specifications:

Requirements	Parameters	Display Schedule Specifications	Comments
R5-15	File Formats	.sst or .son	st_format 2 file type, Scenarist compliant script file format
R5-16	Base_Time	hh:mm:ss:ff where: hh:mm:ss = 2-digit hours / minutes / seconds values of the PTS at the start of the video stream ff = 2-digit frame number value after the start of the above specified second within the video stream (non-drop frame count)	Represents the PTS of the start of the mpeg file and can be used to offset the display of the captions from the time codes shown in the schedule file **Note:** Typically, it is expected that the Base_Time and PTS in the mpeg file is 01:00:00:00 at the start of the mpeg file. In this case, the Time-On and Time-Off values, in the display schedule file, include this offset
R5-17	Tape_Type	DROP (Drop Frame Time Code) or NON_DROP (Non Drop Frame Time Code)	Represents the type of timing used in the display schedule **Note:** Proper timing of the subtitles depends on this parameter being defined properly; it corresponds to the type of time code used in the control file. An error in the value of this parameter leads to a drift in the subtitle timing of 3.58 seconds per hour of video!

C.3. Timing Validation

It is expected that incoming media is validated for proper video-captioning synchronization prior to receipt by the Media Integrator. The Timing Validation shall comply with the following specifications:

Requirements	Parameters	Timing Validation Specifications	Comments
R5-18	Time On value	Less than the Time Off value	For each image identified in the display schedule file
R5-19	Preceding Time Off value	Less than the Time On value of the next image	For each image identified in the display schedule file
R5-20	Time Off value	At least 20 frames greater than the Time On value	For each image identified in the display schedule file Minimum duration for a single subtitle is 20 frames Durations less than 20 frames might not be displayed

Note 1: If the caption display schedule file was produced for DVD production, care is required to provide an adjusted Base_Time to align the timing to a new MPEG encoded movie file. Two common elements that introduce an offset are described in the following subsections, but others could be considered:

- The file produced for a DVD might have the first subtitle cued in at 01:00:43:11, whereas the cue time in the new MPEG file is 00:00:43:11. For example, where the DVD file lists the first subtitle in hour=1, instead of hour=0, a Base_Time of 01:00:00:00 corrects the misalignment.
- The new MPEG encoded file might have 5 seconds of Black appended at its head or a content warning for example. For example, if the newly encoded file has 12 seconds of added footage then the Base_Time becomes 00:59:48:00 (1 hour minus 12 seconds)

Note 2: In the absence of the ability to play the MPEG file and display or overlay the subtitles and verify synchronization, follow the steps below to verify video caption synchronization:

- Look at the first caption image file (.tif file) with a viewer.
- From the display schedule take the start time for that image and subtract the Base_Time (to arrive at the actual display time).
- Using a software media player, check the video and audio at the same point in the media file.
- Verify the initial caption is correctly aligned with the video.

C.4. Sample Subtitle and Captioning Display Schedule File

```
st_format 2
################################################
# Title :
#
# English Subtitle File
#
# Edited by :
# Date : 070403
#
################################################
# BG = Background colour
# PA = Text foreground colour (letter body)
# E1 = Antialiasing colour
# E2 = Text border colour
################################################
Subtitle ERCH
Tape_Type DROP
Display_Start non_forced
Pixel_Area (2 479)
Display_Area (0 2 719 479)
Color (3 3 7 4)
Contrast (15 2 15 0)
BG (255 255 255 = = = )
PA (0 0 0 = = = )
E1 (255 0 0 = = = )
E2 (0 0 255 = = = )
directory C:\media\movie1
Base_Time 00:59:53:00
################################################
SP_NUMBER START END FILE_NAME
0001 01:00:30:12 01:00:35:08 eng0001.tif
0002 01:00:35:13 01:00:40:07 eng0002.tif
0003 01:00:41:17 01:00:44:08 eng0003.tif
0004 01:00:44:13 01:00:48:02 eng0004.tif
```