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ECCN: 9E991

DIGITAL MEDIA ENCODING SPECIFICATION

for the

AUDIO VIDEO ON DEMAND (AVOD) PRODUCTS

530014-528-39

Panasonic Avionics Corporation

LF Document Control Released

Revision N

Rev. N

Date 11-14-13

48 Pages

Initials AR


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**DIGITAL MEDIA ENCODING SPECIFICATION
for the
AUDIO VIDEO ON DEMAND (AVOD) PRODUCTS**

October 10, 2013

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REVISION HISTORY

REV	DATE	REASON FOR REVISION
-	September 29, 2000	Initial Release This document supersedes document 510122-520, Revision A, to correct part number. Changed title of Section 4.0 to MPEG Compression Requirements, and reworked to account for added System 3000 functionality. Incorporated Sections 5.10 and 10.0 (Encoding Requirements for System 3000) to account for added System 3000 functionality. Expanded Section 2.4, Acronyms and Abbreviations
A	April 17, 2001	Updated PAT and PMT rates, Sections 10.2.3 and 10.2.4 Added clarification for supported PAL resolutions, Section 10.3.1.2 Updated default audio encoding rates, Section 10.5.1.2 Clarified PID values for VOD, AOD, and B'Cast Audio Shows, Section 10.5.3.1 Added new Section 10.6 (Broadcast Audio (when supplied via QMU/HDDA)) Corrected various spelling errors
B	February 4, 2002	Update Video ES encoding rates to reflect WAEA 0395 Rev 2.0 recommendations. Clarification for AVOD 1.0/1.5 and System 3000 file title formats. Clarification regarding differences between System 3000 media and AVOD 1.0/1.5 media. Revised and redrawn per redlines. SRR# 9970
C	January 27, 2004	Added eFX references to Sections 1.0, 4.0, and 5.0. Added Section 11.0 with specific eFX media encoding requirements. (rk)1 Added specific description of mp3 audio. Removed references to Transport stream formatting for audio-only files. (rs) Added PCM encoding specifications for eFX PRAM. (rk) Added file title format for PRAM and BGM files (sections 5.10.9 and 5.10.10). (rk)
D	November 11, 2004	Corrected file format for VOD 1.0 and VOD 1.5 audio files; should be audio elementary stream (new paragraph 4.1.3). (rks) Added recommendation for 2 seconds of "dead air" at the beginning of all AOD and VOD files that will be used on system 3000 (new paragraph 10.3.1). (rks) Changed "30 frames/second" to 29.970 and 24frames/s to 23.976 under the encoding requirements (paragraph 10.3.2.3). Added support for Layer 2 audio elementary streams to eFX encoding specifications (paragraphs 11.2.2., 11.4.1.1). (rks)

REV	DATE	REASON FOR REVISION
E	June 8, 2006	<p>Company name changed from MAS to Panasonic throughout.</p> <p>Changed to correct obsolete functionality:</p> <p>Section 1.1, Introduction, revised text to reference X-Series (eFX and eX2).</p> <p>Section 4.0, MPEG Compression Requirements, revised text to reference X-Series.</p> <p>Section 4.1.5, MPEG File Format for eFX, removed option for MPEG1.</p> <p>Added Section 4.7, File Extensions, specifying which files should have .MPG and .ABS file extensions.</p> <p>Section 5.2.2, AOD (File Format), changed reference from .MPG to .ABS for AOD files.</p> <p>Section 5.10, S3000 and eFX (File Format), removed eFX, added new filename-convention, modified filenames in examples.</p> <p>Added new Sections 5.10.13 and 5.10.14, clarifying filenames.</p> <p>Sections 6.1.1 – 6.1.2, File Content Requirements, added DVD to media types.</p> <p>Section 6.8.1, Multiplexed, revised text.</p> <p>Added new Section 6.12, In Service Month.</p> <p>Added new Section 6.13, Archive Software.</p> <p>Section 7.0, DAT/DLT Labeling, added DVD to title of section.</p> <p>Section 7.1, Label Content, added DVD to media types.</p> <p>Section 7.5, DAT/DLT Inlay Card label, added DVDs to media types and title of section.</p> <p>Added new Section 7.5, General Points on Media Delivery.</p> <p>Section 8.5, Encryption Software, specify Secret Agent 5.7.1, and that any alternative must be approved by Panasonic.</p> <p>Section 10.1, Encoding Requirements for System 3000, Introduction, added text for S3000.</p> <p>Section 11.1, Encoding Requirements for eFX, Introduction, added text for eFX.</p> <p>Added new Section 12.0, Encoding Requirements for eX2 (preliminary).</p> <p>Added new Section 14.0, Shipping Documentation.</p>

REV	DATE	REASON FOR REVISION
F	October 24, 2006	<p>Section 2.2, Top-Level Description, revised Figure 1.</p> <p>Section 4.1, MPEG File Format, revised paragraphs 4.1.5 and 4.1.6 to mention eX2.</p> <p>Section 4.7, File Extension, revised paragraph 4.7.2 to differentiate between media file extensions for AVOD 1.5, S3K, and X Series.</p> <p>Removed Sections 5.2 through 5.10 and replaced them with Tables 3, 4, and 5 to describe file title formats for all applicable systems.</p> <p>Section 6.1, Requirements, revised paragraph 6.1.1 to indicate that the preferred method of delivery is DVD.</p> <p>Section 6.12, In-Service Month, revised paragraph 6.12.1 to include play period in in-service information.</p> <p>Section 7.0, changed title to "DVD/CD Labeling."</p> <p>Removed paragraphs 7.2.3 through 7.5.4 and replaced them with Figure 2, to depict DVD label. Removed most references to DAT and DLT throughout document.</p> <p>Moved previous section 14.0, Shipping Documentation, to current section 8.0.</p> <p>Added information to current section 13.0 (previous section 12.0), Encoding Requirements for eX2.</p>
G	January 22, 2008	<p>Section 1.3.2 and acronyms list – Added AI and MS.</p> <p>Section 5.1.1 Table 4 – Changed 5 digit # to 5 to 7 digit #. Generated complete separate table for eFX/eX2</p> <p>Section 6.0 – FILE CONTENT INFORMATION – Changed shall to must and added requirement to identify replacement media.</p> <p>Sections 6.7.2 and 6.7.3 – Added If applicable.</p> <p>Section 7.0 – CD/DVD LABELING - Changed shall to must and added requirement to identify replacement media.</p> <p>Section 8.0 – SHIPPING DOCUMENTATION - Changed shall to must. Added items 19 and 20.</p> <p>Updated eX2 encoding requirements to include the following:</p> <ul style="list-style-type: none"> - MPEG-4 AVC (H.264) - DVD Subtitles and Captioning - ID3v2 Metadata update of Subtitle and Captioning descriptors

REV	DATE	REASON FOR REVISION
H	October 28, 2008	<p>Section 4.7.2 – Added “...and audio broadcast” to paragraph.</p> <p>Section 4.7.3 – Deleted</p> <p>Table 5 – eFX/eX2 File Title Format – Added NOTE.</p> <p>Section 8,0, number 7) – Added paragraph after Content Filenames</p> <p>Section 13.3.2.2 – Sample Profile – Changed section number to 13.3.2.1.1</p> <p>Section 13.3.2.2 – Advanced Video Coding – Added bullets 3, 5, 7-8, 10-13. Changed bullet 6 from 1.05 – 2.0 Mb/s to 1.5 – 2.0 Mb/s and added text.</p> <p>Section 13.3.2.3 – Added second and third bullets.</p> <p>Section 13.6.2.2 – Added Tape_Type parameter requirement to display schedule file</p> <p>Section 13.6.3.1 – Added note to clarify concerns for aspect ratio of caption font</p> <p>Section 13.6.4.2 – Added 20 frame minimum for display of captions</p> <p>Section 13.6.4.4 – Added bullet to specifically indicate caption timing needs to be validated for synchronization throughout the file.</p> <p>Section 13.6.4.5 – Pointed out that encoder must verify that same master was used for both video encoding and caption file creation.</p> <p>Section 14.2 – Added “Tape_Type DROP” to the example caption schedule file</p> <p>Section 4.2.4, Table 2 – added BGM, PRAM audio levels</p>

REV	DATE	REASON FOR REVISION
J	November 30, 2009	Revised to reflect new functionality: Section 1.4.1 – Added Scenarist DVD authoring format reference. Section 1.5 – Added CS, DVD and EFT Section 2.2.3, Figure 1 – Added encryption step. Section 3.0 – Added digital files as additional source media. Removed subheadings 3.2, 3.3, and 3.4. Section 4.0 – Added statement regarding specification compliance and exceptions. Section 4.2.4, Table 2 – Added Audio encoding levels for PRAM, add 1 second dead air, and Video PA Audio levels. Section 5 – Corrected entire section Section 6 – Added delivery, received, and storage. Section 8 – 6 removed ship date. 17 Corrected play period. 19 added documentation for different delivery types. Section 11.3.3.1 – Added max numbers of audio tracks. Section 12.0 – Added specifications for Digital MPES system. Section 13.3.2.2 – Clarified MP4 GOP structure requirement and added exception for scene change detection. Added all streams conform to the latest revision of ISO/IEC 14496-10 AVC. Section 13.3.2.2 – Changed default for MP4 CIF to 0.7 Mb/s. Section 13.3.3.3 – Added max numbers of audio tracks. Section 13.3.2.2 – Added specific reference to Progressive scan, 23.976 frames/s for MPEG2 and MP4 encoded film sourced materials. Section 13.3.4 – Changed lower bound for audio encoding rate. Section 13.4.2 – Added spoken word audio file specifications and default values. Section 13.7.1.3 – Added max TS bit rate clarification. Section 11.7 – Added Subtitles and Closed Captions for Video Files for S3K. Section 11.7.1 – Added reference to section 13.7. Section 13.7 – Changed wording to include S3K, and added statement regarding system support and exceptions. Figure 3. Updated to include MPG to VOD application for S3K Section 13.7.x – Changed wording to reflect the inclusion of S3K systems
K	February 4, 2010	Section 4.2.8 – Added “minimum length of PRAM, BGM, and VPA files” requirements.

REV	DATE	REASON FOR REVISION
L	December 14, 2011	PESAlign for TS mux of K and X series CABAC vs CAVLC for MP4 content that requires 30frames/s (29.970 frames/s) encoding Section 13.3.3.3 – Clarified requirement for encoded frame rate of 23.976 frames/sec for all MP4 encoding. Section 13.3.3.1 - Added Deblocking Filter information Section 13.3.3.1 - Added Number of B Frames information Section 1.5 - Added SD and HD definitions, removed TBD Section 12.3.1.1 – removed TBD Section 12.3.1.2 – removed TBD Section 13.3.2 – Edited PAL description, added HD system qualification statement Section 13.3 – Revised entire section to include HD specification by rearranging subsections and splitting into SD and HD separately. Section 13.3.3 – Split off into Standard Definition video only section Section 13.3.4 – Created new High Definition supplement section Section 13.3.5 – Split off into Standard Definition Audio only section Section 13.3.6 – Split off into High Definition Audio only section Section 13.4.2 – Added HE AAC v2 audio reference Section 13.7.1 – Removed DVB compliant Closed Captions section and collapsed into one section for Scenarist DVD authoring. Section 13.9.1 – Removed PAL TBD Section 13.3.3.3 – “All masters require standards conversion to 23.976 frame rate before encoding with MPEG-4.” Section 4.2.9 – Added metadata and padding not to be included in PRAM files. Section 13.4.1 – added exception for PRAM files Section 5.1.1 – Changed IATA to Panasonic Airline Table 4 – Overhaul naming convention to reflect new media type definitions and match naming convention example. Table 5 – Overhaul naming convention to reflect new media type definitions and match naming convention example. Section 1.5 – Changed MPA to MPAA Section 5.1.1 – Revised w1 to indicate 16x9 only and the NOTE to read “The preferred widescreen format is 1.78.”
M	March 30, 2012	Revised per Program eX2 System_InitDev. Section 4.0 – Added detail to further clarify requirements compliance with “default” values. Section 13.10 – Added this section for eX2 System bandwidth limits to address system design limitations.

REV	DATE	REASON FOR REVISION
N	October 10, 2013	Revised per Program eX2 System_InitDev. Section 1.4 - Update references to include APEX 0403 Spec Section 5 – New incoming file naming conventions Section 12.3 - Removed 30fps limitations for MP4 encoding Section 12.3 - Lowered minimum encoding rate to 3Mbps for 720P MP4 encoding Section 12.3 - Remove VBV max size requirement for MP4 encoding. Section 12.4, 12.5 – Added clarification that support for HE AAC v1/v2 audio elementary streams with x-series DSP DM642 and newer decoders/displays. Added eX1 and eX3 references throughout and also used X-Series where appropriate.

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1.0 SCOPE

1.1 Introduction

This specification defines the criteria for delivering digital media to the Panasonic Avionics Corporation Audio Video on Demand (AVOD) products, which include AVOD 1.0, AVOD 1.5, System 3000, eFX, Digital Multiplexed Passenger Entertainment System (MPES), eX1, eX2 and eX3. It is limited to applications in which source media is encoded to either Audio/Video on Demand (AVOD) or Moving Picture Experts Group (MPEG) format prior to delivery to the carrier.

In-Flight Entertainment (IFE) systems are generally constrained with respect to processing, storage capacity, communication bandwidth, and screen resolution by requirements imposed on carriers to meet low power, size and weight standards.

In addition, this specification provides for the ability to deliver digital audio-visual content from its origin to storage arrays on board commercial aircraft, and comprises detailed specifications for source media, digitization, encoding, security, and media distribution.

System 3000 and X-Series are substantially different from AVOD 1.0 and AVOD 1.5 IFE systems and because of these differences; some information in this specification may not be relevant for all AVOD systems. Section 10.0 contains requirements specific for System 3000, Section 11.0 contains requirements specific to eFX and Digital MPES, and Section 12.0 contains requirements specific to eX1, eX2 and eX3. The information in Sections 10.0 thru 12.0 shall supersede other information should it conflict with other sections.

1.2 Purpose

1.2.1 The purpose of this specification is to define the encoding parameters, format, and delivery of digital MPEG media to the Panasonic Avionics Corporation AVOD IFE systems.

1.3 Applications

1.3.1 Digital media shall be used for several IFE core applications, as listed in Table 1.

Table 1. Core Applications

Full-Length Feature Motion Pictures (Video Movies)
Video Trailers
Video Short Features
Video Graphics
Video Advertisements
Video Help
Audio Entertainment

1.3.2 This specification applies to encoded audio/video content that is streamed from the following IFE LRUs: QMU, VSPC, VSPCII, ASPC, ASPCII, SC, SC-A, FS, AI, MS, CS, and NC.

1.4 Reference Documents

1.4.1 Standards

The following reference documents contain industrial standards that, through reference in this specification, constitute provisions of this document. All standards are subject to revision, and parties to agreements based on this specification are encouraged to apply the most recent editions, if possible.

Digital Content Delivery Methodology for Airline In-Flight Entertainment, Version 1.3
Airline Passenger Experience Association
Document No. APEX 0403

Content Delivery for In-Flight Entertainment, Version 2.0
World Airline Entertainment Association
Document No. WAEA 0395

Information Technology – Coding of Moving Pictures and Associated Audio for digital storage media at up to 1.5 Mb/s, Part 1: Systems a.k.a. MPEG-1 Systems
International Standards Organization/IEC Electronics Corporation
Document No. ISO/IEC 11172-1:1993

Information Technology – Coding of Moving Pictures and Associated audio for digital storage media at up to 1.5 Mb/s, Part 2: Video a.k.a. MPEG-1 Systems
International Standards Organization/IEC Electronics Corporation
Document No. ISO/IEC 11172-2:1993

Information Technology – Coding of Moving Pictures and Associated Audio for Digital Storage Media at up to 1.5 Mb/s, Part 3: Audio a.k.a. MPEG-1 Systems
International Standards Organization/IEC Electronics Corporation
Document No. ISO/IEC 11172-3:1993

Information Technology – Generic Coding of Moving Pictures and Associated Audio Information, Part 1: Systems, including Amendment 1: “Registration procedure for copyright-identifier” a.k.a. MPEG-2 Systems
International Standards Organization/IEC Electronics Corporation
Document No. ISO/IEC 13818-1:1993

Information Technology – Generic Coding of Moving Pictures and Associated Audio Information, Part 2: Systems, Including Amendment 1: “Registration procedure for copyright-identifier” a.k.a. MPEG-2 Systems
International Standards Organization/IEC Electronics Corporation
Document No. ISO/IEC 13818-2:1993

Digital Recording of Audio Signals
International Telecommunication Union – Radio Communication
Document No. REC ITU-R BR.648

MPEG-4 Specification, Part 1
Document No. ISO/IEC 14496-1

MPEG-4 Specification, Part 2
Document No. ISO/IEC 14496-2

MPEG-4 Specification, Part 3
Document No. ISO/IEC 14496-3

MPEG-4 Specification, Part 10
Document No. ISO/IEC 14496-10

CD Digital Audio Systems
IEC Electronics Corporation
Document No. IEC Publication 908:1987

International Standards Organization/IEC Electronics Corporation
Document No. ISO/IEC 639 3-Letter Language Codes

Scenarist DVD Authoring Format - http://en.wikipedia.org/wiki/DVD_authoring

1.5 Acronyms and Abbreviations

AAC-LC	Advanced Audio Coding-Low Complexity
ACC	Advanced Audio Coding
ADTS	Audio Data Transport Stream
AES	Audio Elementary Stream
AI	Aircraft Interface
AOD	Audio On Demand
ASP	Advanced Simple Profile
ASPC	Audio Server/PC Controller
AVC	Advanced Video Codec
AVOD	Audio Video On Demand
BGM	Background Music
CAGE	Commercial and Government Entity
CBR	Constant Bit Rate
CD	Compact Disc
CIF	Common Interface Format
COB	Close of Business
CS	Content Server
dBm	Decibel (referenced to milliwatts)
DLT	Digital Linear Tape
DMD	Digital Media Distribution
DVD	Digital Video Disc
ECCN	Export Control Classification Number
EFT	Electronic File Transfer
ENCR	Encrypted Method Registration (tag field)
ES	Elementary Stream – MPEG compressed audio or video data
FS	File Server
GOP	Group of Pictures
HD	High Definition
HDDA	Hard Disk Drive Array
HE-AAC	High Efficiency Advanced Audio Coding
ID3v2	Refers to MPEG tag version
IDR	Instantaneous Decoding Refresh
IEC	International Engineering Consortium
IFE	In-Flight Entertainment
ISO	International Standards Organization
ITU	International Telecommunication Union
Kb/s	Kilobits per second (= 1,000 bits per second)

kHz	KiloHertz
LATM	Low-overhead Audio Transport Multiplex
LRU	Line Replaceable Unit
Mb/s	Megabits per second (= 1,000,000 bits per second)
MP-3	MPEG Audio Layer 3
MCAA	Motion Picture Association of America
MPEG	Moving Pictures Experts Group
MPES	Multiplexed Passenger Entertainment System
MS	Media Server
N/A	Not Applicable
NC	Network Controller
NTSC	National Television Standards Committee
PA	Public Address
PAL	Phase Alteration by Line
PAT	Program Association Table – Packet that contains references to all programs on the TS.
PCM	Pulse Code Modulation
PCR	Program Clock Reference – Packet that contains timing information used to synchronize the decoder clock with the program information.
PES	Packetized Elementary Stream – MPEG compressed audio or video data that has been formatted for delivery in the MPEG Transport Stream.
PID	Packet Identifier – MPEG-2 Transport Stream term used to identify individual data payloads carried by the Transport Stream.
PMT	Program Map Table – Packet that refers to the specific PES PIDs of a program.
PRAM	Pre-Recorded Announcement Machine
PST	Pacific Standard Time
PST	Program Stream
PTS	Presentation Time Stamp
QAM	Quadrature Amplitude Modulation
QMU	QAM Modulator Unit
RMS	Root Mean Square
S3K	System 3000
SC	System Controller
SC-A	System Controller - Audio
SD	Standard Definition
SP	Simple Profile
SS	Systems Stream
TC	Technical Committee
TS	Transport Stream – MPEG-2 protocol specification for transmission of one or more video, audio and private data programs.
VC-1	Refers to Video Compression standard
VES	Video Elementary Stream
VOD	Video On Demand

VPA	Video PA
VSPC	Video Server/PC Controller
WAEA	World Airline Entertainment Association
X-Series	Refers to eFX/eX1/eX2/eX3/Digital MPES

2.0 SYSTEM MODEL

2.1 Purpose

2.1.1 The system model identifies the pertinent interfaces between the source media and the IFE equipment, or AVOD sub-system. These interfaces are identified to facilitate a common understanding of the overall requirements.

2.2 Top-Level Description

2.2.1 The overall system flow deals with obtaining digital media from the media provider through the laboratories, and the process for secure delivery to IFE system components. The IFE system provides various service capabilities to passengers through the system distribution architecture. Figure 1 depicts the overall system flow.

2.2.2 The IFE system can consist of either the equipment on board an aircraft, or a secure IFE processing facility that supports on-board IFE equipment.

2.2.3 An acceptable IFE processing facility meets the recommendations of the Motion Pictures Association (MPA) security review.

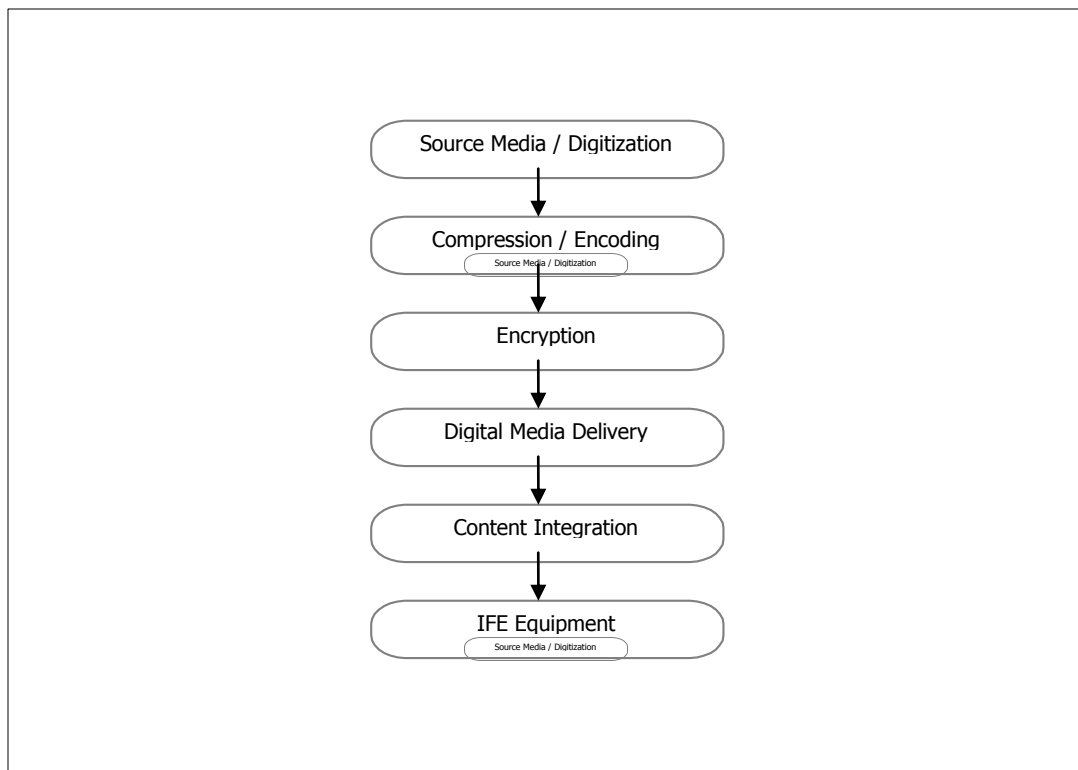


Figure 1. Top-Level Process Distribution Flow

3.0 SOURCE MEDIA

Because the condition of the source media largely determines the quality of the resulting compressed digital output, only the highest-quality source media shall be considered for the following application types.

3.1 Types

- 3.1.1 Potential forms of source media shall include film, digital media, analog videotape, and digital videotape.
- 3.1.2 Source media shall be in accordance with APEX Specification 0403 *Digital Content Delivery Methodology for Airline In-Flight Entertainment*

3.2 Program Information

- 3.2.1 Program information considered as source media for this application shall be in accordance with APEX Specification 0403 *Digital Content Delivery Methodology for Airline In-Flight Entertainment*.

3.3 Entertainment Audio

- 3.3.1 Entertainment audio included with audio-only programming considered for use as source media for this application shall include digital media, digital audiotape, compact disc, and mini disc.
- 3.3.2 Source media shall be in accordance with APEX Specification 0403 *Digital Content Delivery Methodology for Airline In-Flight Entertainment*

4.0 MPEG COMPRESSION REQUIREMENTS

The compression requirements in this section were originally developed for the AVOD 1.0 and AVOD 1.5 IFE products where MPEG-1 audio and video is used exclusively. The information in this section applies also to System 3000 and X-Series since the System 3000 and X-Series families of IFE products are backward compatible with these MPEG-1 compression requirements. However, in addition to this section, Sections 10.0 thru 12.0 contain requirements specific to System 3000 and X-Series (eFX, Digital MPES, eX1, eX2 and eX3). Refer to these sections for additional encoding and file format requirements unique to System 3000 and X-Series.

The requirements contained within this document are an attempt to specify the full range of support for all systems defined. Compliance with this specification is assumed unless prior permission for deviation is requested. Specifically, compliance with the “default” values, where specified for specific parameters, is required unless prior permission for deviation has been granted.

4.1 MPEG File Format

- 4.1.1 Video shall be encoded using the Constant Bit Rate (CBR) mode only.
- 4.1.2 Video files for AVOD 1.0/1.5 shall be multiplexed as MPEG-1 systems stream files.
- 4.1.3 Audio files for AVOD 1.0/1.5 shall be MPEG-1 Layer 1 or Layer 2 audio elementary stream files.
- 4.1.4 Video and audio files for System 3000 shall be multiplexed as MPEG-2 transport stream files.
- 4.1.5 Video files for X-Series shall be multiplexed as MPEG-2 transport.
- 4.1.6 Audio files for X-Series shall be MPEG-1 layer 3 (mp3) elementary stream files.

4.2 Encoding Levels

- 4.2.1 For video movie applications, the digitally encoded data shall establish an amplitude ratio between the sound effects component and dialogue component of the soundtrack, relative to the aircraft cabin environment, while maintaining maximum intelligibility. To accomplish this, a reduction in the amplitude of the sound effects component and the music component, relative to the actual dialogue component, is required to enhance the dialog component of the soundtrack.
- 4.2.2 Once the relationship between soundtracks has been established, the transfer process shall utilize the appropriate audio compressors and limiters to generate the overall composite soundtrack. The dynamic range of the composite soundtrack shall be 42 +/- 8 dB from 50 Hz to 15 KHz at standard line output. To achieve improved intelligibility, mid-range frequencies (2 through 5 KHz) may require increased amplitude adjustments of 3 to 6 dB, referenced to 1 KHz.
- 4.2.3 Additional compression to reduce the dynamic range to 30 dBm may be required if the dialogue track is abnormally low. Since each feature film has its own characteristics, each mix-down would be unique in achieving the required results.
- 4.2.4 Table 2 lists the encoding levels for audio applications.

Table 2. Encoding Levels for Audio Applications

Media Type	Peak Level	Average Peak Level	Average RMS Power	Dialogue
AOD	-6 dB below digital clip	-8 dB below digital clip	N/A	-10 +/- 2 dB below digital clip
Broadcast audio	-6 dB below digital clip	-8 dB below digital clip	N/A	-10 +/- 2 dB below digital clip
Video soundtracks	-6 dB below digital clip	-8 dB below digital clip	N/A	-10 +/- 2 dB below digital clip
BGM and other digital audio files sourced from Panasonic Avionics Corporation IFE	-6 dB below digital clip	-8 dB below digital clip	N/A	-10 +/- 2 dB below digital clip
PRAM	-3 dB below digital clip	N/A	-14 dB +/- 1 dB	N/A
Video PA (VPA)	-3 dB below digital clip	N/A	-14 dB +/- 1 dB	N/A

- 4.2.5 Compression may be required to meet PRAM and VPA requirements for both Peak Level and Average RMS Power.
- 4.2.6 PRAM and VPA audio with gaps of silence between multiple spoken sections will result in a lower Average RMS Power measurement and may require additional amplification to obtain the desired level of volume. This is subjective and would need to be handled on a case-by-case basis.
- 4.2.7 One second of “dead air” shall be included in the beginning of PRAM audio files and VPA files. This is to allow time for the aircraft PA system to respond and not cut off the beginning of the announcement.
- 4.2.8 The minimum length of PRAM, BGM, and VPA files shall be 6 +/- 0.5 seconds. Any silence required to meet this requirement shall be included at the end of the file. The total length includes the required one second of leading silence for PRAM and VPA files.
- 4.2.9 No metadata or padding shall be included in the encoded PRAM file.

4.3 Video Encoding Rates

- 4.3.1 The MPEG encoding rate for video movies shall be 1.5 Mb/s, unless otherwise specified by the customer. This bit rate refers to the elementary video stream only.
- 4.3.2 The MPEG encoding rate for video short features shall be 1.5 Mb/s, unless otherwise specified by the customer. This bit rate refers to the elementary video stream only.
- 4.3.3 The MPEG encoding rate for video graphics shall be 1.5 Mb/s, unless otherwise specified by the customer.
- 4.3.4 The MPEG encoding rate for video trailers shall be 1.5 Mb/s, unless otherwise specified by the customer. This bit rate refers to the elementary video stream only.
- 4.3.5 The MPEG encoding rate for video help shall be 1.5 Mb/s, unless otherwise specified by the customer. This bit rate refers to the elementary video stream only.
- 4.3.6 The MPEG encoding rate for video advertisements shall be 1.5 Mb/s, unless otherwise specified by the customer. This bit rate refers to the elementary video stream only.

4.4 Audio On Demand (AOD) Encoding Rates

- 4.4.1 The encoding rate for AOD applications shall be 128 Kb/s, unless otherwise specified by the carrier.

4.5 Broadcast Audio Encoding Rates

- 4.5.1 The encoding rate for broadcast audio shall be 128 Kb/s, unless otherwise specified by the carrier.

4.6 Video Sound Tracks Encoding Rates

- 4.6.1 The encoding rate for video sound tracks shall be 128 Kb/s, unless otherwise specified by the carrier.
- 4.6.2 The encoding rate for MPEG compression of Dolby headphone audio tracks shall be 256 kb/s, unless otherwise specified by the carrier.

4.7 File Extension

- 4.7.1 Final multiplexed MPEG files should be given an .MPG extension.
- 4.7.2 S3K AOD and audio broadcast files should be given an .ABS extension. X-Series AOD and audio broadcast files should be given an .MP3 extension. If an AOD and audio broadcast file is to be used in both S3K and X-Series systems, the .ABS extension should be used.

5.0 FILE TITLE FORMAT

5.1 Applications

5.1.1 For identification purposes, the title of each digital media file shall follow a specific format, as described in the following tables. Table 3 describes the file title formats for Systems 3000/3000i, and Table 4 describes the file title formats for X-Series systems. All files are required to start with the 2-letter Panasonic Airline code. All file names shall be in lower case.

Table 3. System 3000/3000i File Title Formats

MEDIA TYPE	FILE NAMING CONVENTION	EXAMPLE
AOD	Panasonic Airline Code a = Audio On Demand Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	sqa071300011ma.abs sqa071300017ma.abs
Audio Book	Panasonic Airline Code i = Audio Book Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	sqi071300000ma.mp3
Broadcast Audio	Panasonic Airline Code b = Broadcast/Radio Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	mhb080800003ma.mp3
PRAM Audio	Panasonic Airline Code p = PRAM Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	jap020000080ma.wav
Boarding Music Audio	Panasonic Airline Code j = Background music Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	tgj120800041ma.abs
Advertisement	Panasonic Airline Code c = Advertisement Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension	cic010800127m1.mpg cic020800003m2.mpg
Dummy File	Panasonic Airline Code d = Dummy File Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension	ekd0108034m1.mpg ekd0308045m2.mpg
Decompression File	Panasonic Airline Code f = Decompression File Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension	sqf010800034m1.mpg sqf030800045m2.mpg

MEDIA TYPE	FILE NAMING CONVENTION	EXAMPLE
Graphic, Screensaver	Panasonic Airline Code g = Graphic/Screensaver File Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension	cxg010800034m1.mpg cxg030800045m2.mpg
Help files, Safety Videos, Airline info, Destination Videos, Duty Free Videos	Panasonic Airline Code h = Help files, Safety Videos, Airline info, Destination Videos, Duty Free Videos Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension	nwh070800021m1.mpg nwh060800022m2.mpg
Movies	Panasonic Airline Code m = Movie Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension (SA encryption per content owner requirements)	sam071300172m1.mpg sam071300240m2.mpg
Short, News, Sports, Documentary	Panasonic Airline Code s = Short, News, Sports, Documentary Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension (SA encryption per content owner requirements)	sas110800001m1.mpg sas100800124m2.mpg
Movie Trailers	Panasonic Airline Code t = Trailer Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2) Required Extension	klt071300285m1.mpg klt071300032m2.mpg

Table 4. X-Series File Title Format

MEDIA TYPE	FILE NAMING CONVENTION	EXAMPLE
AOD	Panasonic Airline Code a = Audio On Demand Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	sqa071300011ma.mp3 sqa071300017ma.mp3
Audio Book	Panasonic Airline Code i = Audio Book Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	sqi071300000ma.mp3
Broadcast Audio	Panasonic Airline Code b = Broadcast/Radio Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	mhb080800003ma.mp3

MEDIA TYPE	FILE NAMING CONVENTION	EXAMPLE
PRAM Audio	Panasonic Airline Code p = PRAM Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	jap020000080ma.wav
Boarding Music Audio	Panasonic Airline Code j = Boarding Music Designated 9-digit # (mmyyxxxxx) Audio format designation (ma) Required Extension	tgj120800041ma.mp3
Advertisement	Panasonic Airline Code c = Advertisement Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	cic0108127m1.mpg cic0208003m2.mpg cic0408001m4.mpg cic0408001h7.mpg
Dummy File	Panasonic Airline Code d = Dummy File Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	ekd0108034m1.mpg ekd0308045m2.mpg ekd0708101m4.mpg ekd0708101h7.mpg
Decompression File	Panasonic Airline Code f = Decompression File Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	qff0108034m1.mpg qff0308045m2.mpg qff0708101m4.mpg qff0708101h7.mpg
Graphic, Screensaver	Panasonic Airline Code g = Graphic/Screensaver File Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	cxg0108034m1.mpg cxg0308045m2.mpg cxg0708101m4.mpg cxg0708101h7.mpg
Help files, Safety Videos, Airline info, Destination Videos, Duty Free Videos	Panasonic Airline Code h = Help files, Safety Videos, Airline info, Destination Videos, Duty Free Videos Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	nwh0708021m1.mpg nwh0608022m2.mpg nwh0808123m4.mpg nwh0808123h7.mpg
Movies	Panasonic Airline Code m = Movie Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension (SA encryption per content owner requirements)	sam1108001m1.mpg sam1008124m2.mpg sam1008124m4.mpg sam0608092h7.mpg
Short, News, Sports, Documentary	Panasonic Airline Code s = Short, News, Sports, Documentary Designated 9-digit # (mmyyxxxxx) MPEG format (m1/m2/m4/h7) Required Extension (SA encryption per content owner requirements)	sas110800001m1.mpg sas100800124m2.mpg sas100800124m4.mpg sas060800092h7.mpg

MEDIA TYPE	FILE NAMING CONVENTION	EXAMPLE
Movie Trailers	Panasonic Airline Code t = Trailer Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	klt020800021m1.mpg klt030900001m2.mpg klt010008081m4.mpg klt060800092h7.mpg
Encrypted TV content	Panasonic Airline Code e = Encrypted TV content Designated 9-digit # (mmyyxxxxx) MPEG format/ (m1/m2/m4/h7) Required Extension	sqe020800021m1.mpg sqe030900001m2.mpg sqe030900001m4.mpg sqe060800092h7.mpg

File name example: sqm060800101m2.mpg

sq = 2-letter Panasonic Airline Code

m = Media Type:

- a = Audio on demand
- i = Audio Book
- b = Broadcast/Radio
- j= Audio Boarding Music
- c = Advertisement
- d = Dummy File
- f= Decompression files
- g = Graphic, screensaver
- h = Help files, Safety Videos, Airline info, Destination Videos, Duty Free Videos
- m = Movie
- p = Audio PRAM <Public Address>
- s = Short, News, Sports, Documentary
- t = Movie Trailer
- e = Encrypted TV content <HBO, Showtime>
- w = CD Audio <multi-track format>

06 = Month of Play Cycle

08 = Year of Play Cycle

00101 = Number of file <5 digits>

m2 = MPEG format/Aspect Ratio:

- m1 = MPEG-1 4x3
- m2 = MPEG-2 4x3
- m4 = MPEG-4 4x3
- m1 = Widescreen MPEG-1 16x9
- m2 = Widescreen MPEG-2 16x9
- m4 = Widescreen MPEG-4 16x9
- h7 = HD at 720p
- z4 = eXW
- ma = Audio File Designation

mpg = File extension

NOTE: MPEG-4 is primarily used for the eX1, eX2 and eX3 systems. Contact the Panasonic Avionics Corporation Media Department for use on other system types.

The preferred widescreen format is 1.78. If the content is unavailable in this format, please consult the Panasonic Avionics Corporation Media Department.

6.0 FILE CONTENT INFORMATION

The preferred method of delivery is DVD and EFT.

6.1 CD/DVD

6.1.1 Specific CD/DVD file content information must be included with all media shipments as part of an invoice or alternate packing sheet. Refer to Section 7.0 for CD/DVD labeling.

6.2 Electronic File Transfer

6.2.1 EFT is acceptable by approval. Transmission via Service or Media Provider FTP sites is unacceptable. For authorization, contact the Panasonic Avionics Media Department.

6.3 Portable Drives

6.3.1 Portable Drives are accepted, pre-approval is required; contact the Panasonic Avionics Media Department for approval. If sending a drive with multiple customers, the use of a folder structure shall be used, one folder per customer. Shipment documentation must be separate for each airline. Drives shall be labeled with airline names. Drives will be held for six months.

6.4 Media Storage

6.4.1 All masters will be held for 6 months. Files can be recalled for up to six months, if past six months a new file with filename shall be sent. CD/DVD will be destroyed at a certified disposal facility after six months. Portable drives will be returned upon request.

6.5 File Received

6.5.1 Files must be received by close of business (COB) (5:00 PST) to be received that calendar business day. All files received after COB will be received the next business day.

6.5.2 Receipt, registration, and initial order of compliance results are typically available within two business days.

7.0 CD/DVD LABELING

7.1 Label Content

7.1.1 DVDs containing digital media programming for AVOD purposes must comply with the labeling format described in paragraph 7.2 and Figure 2.

7.2 DVD Label – Video

7.2.1 The DVD label must contain information arranged in a specific manner.

7.2.2 The DVD label shall identify the carrier code, month and year the digital media programming is to be used, media type, encoded file format (.MPG or .SA), file size, and file name. If the file is a replacement, it must be identified as Replacement or Redo on the DVD label and documentation (see Figure 2 below).

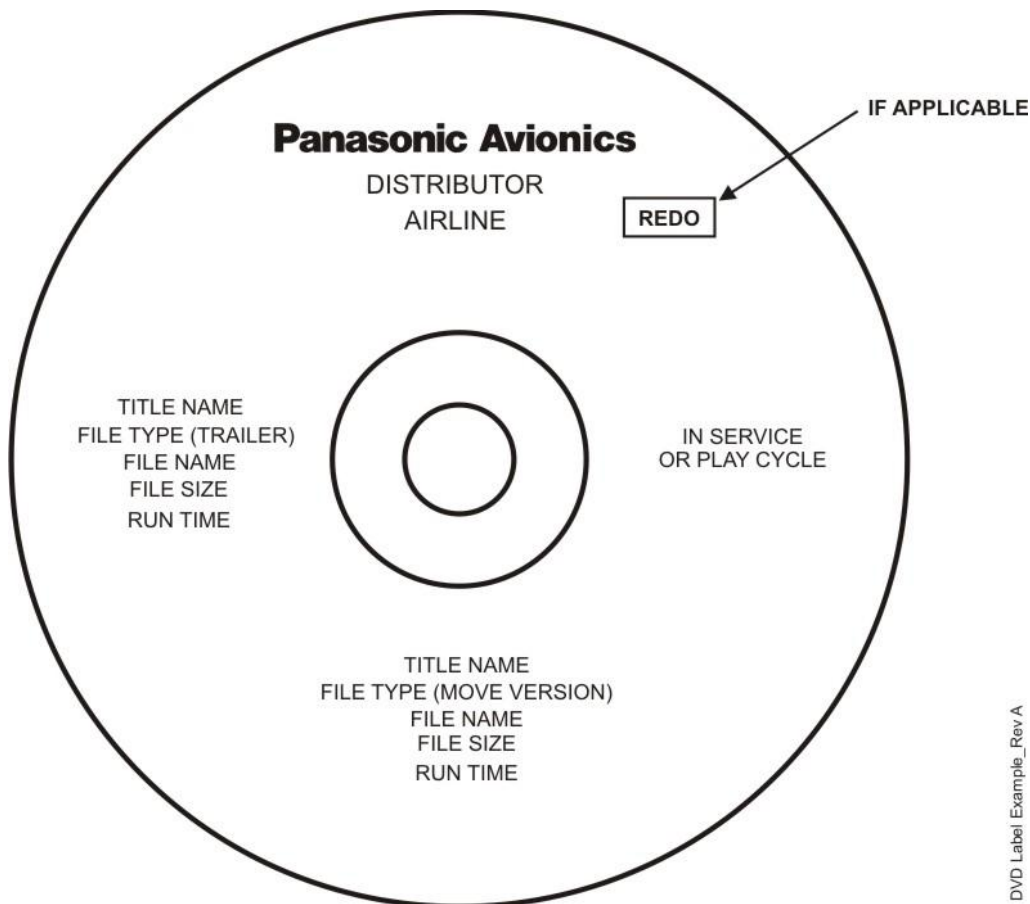


Figure 2. DVD Label Example

DVD Label Example_Rev A

8.0 SECURITY

8.1 Requirements

- 8.1.1 The content delivery system shall protect intellectual property from unauthorized access. The security system shall have minimum impact on the handling of the protected content.
- 8.1.2 The intellectual property owner shall determine if a particular item or class of property shall be protected.

8.2 Secure Facilities

- 8.2.1 Secure facilities are defined as those facilities that have adopted recommendations resulting from an MPAA security review.

8.3 Data Encryption

- 8.3.1 Data encryption shall protect content from being accessed without authorization and keep any control information exchanged between the participants confidential. Control information includes the exchange of cryptographic keys.

8.4 Encryption Method

- 8.4.1 Using a file level encryption method shall ensure security. File level encryption shall require the use of a software key to encrypt the entire digital media file content.
- 8.4.2 The software keys shall be encrypted using a public key encryption system. The resulting control words are then distributed with the MPEG stream to any carriers entitled to use the program.

8.5 Encryption Software

- 8.5.1 Secret Agent 5.7.1 is the only currently approved software. Any alternative to this must be submitted and pre-approved by Panasonic Avionics Corporation.

8.6 Key Management

- 8.6.1 The media provider, Panasonic Avionics Corporation, and the carrier shall use software keys to jointly manage access control. The focus of key management is the secure distribution of suitable software keys to those parties involved in the decryption process.

9.0 QUALITY ASSURANCE

9.1 Compliance

- 9.1.1 Compliance with this specification does not guarantee acceptable quality of the encoded media, and does not replace the need for skill and judgment in the art and science of motion picture and video laboratory practices. This document is not intended to replace quality assurance processes for media providers.

10.0 ENCODING REQUIREMENTS FOR SYSTEM 3000

10.1 Introduction

10.1.1 This section contains unique digital media encoding requirements for the System 3000 IFE system. System 3000 is substantially different from AVOD 1.0 and AVOD 1.5 IFE systems. This section contains requirements specific for System 3000, and the information in this section shall supersede other information should it conflict with other sections in this document. The S3000 encoding specifications are a subset of the X-Series encoding specifications described in a subsequent section.

10.2 Media File Format Specifications

10.2.1 All digital media for System 3000 must be formatted in an MPEG-2 Transport Stream (TS).

10.2.2 Various levels of video and audio quality and corresponding video and audio bit rates are supported by System 3000. Because of this flexibility, the installation of System 3000 can be customized to meet each airline's requirements. However, for a given installation/configuration, the multiplex rate (established by prior agreement between the airline and Panasonic Avionics Corporation) of video and audio files are critical. The following is a basic requirement on the multiplexed file:

The amount of NULL packets included in the TS file shall be minimized.

10.2.3 Program Association Table (PAT) rate shall be no less than 2 Hz and no more than 10 Hz (default = 10 Hz).

10.2.4 PMT rate shall be no less than 2 Hz and no more than 10 Hz (default = 10 Hz).

10.2.5 For VOD files, the Program Clock Reference (PCR) Packet Identifier (PID) must be the same as the Video Elementary Stream (ES) PID.

10.2.6 For AOD files, the PCR PID must be the same as the Audio ES PID.

10.2.7 For Broadcast Audio files, the PCR PID must be the same as the first Audio ES PID.

10.2.8 The average time period between PCRs must not exceed 100 ms.

10.2.9 All Transport Stream formatted media is required to pass a T-STD buffer analysis as specified in MPEG-2, Part 1 specification.

10.3 VOD Media

10.3.1 To assure that no portion at the beginning of a video file is missed, Panasonic Avionics Corporation recommends including two seconds of "dead air" at the beginning video files for System 3000. This allows the MPEG decoder to mute any objectionable audio artifacts that may occur during the transition between files and still be able to present the entire file's meaningful content to the passenger.

10.3.2 Video Elementary Stream:

10.3.2.1 Video Encoding Basics:

- Constant bit rate
- Main Level at Main Profile
- MPEG-1 or MPEG-2 Video (default is MPEG-1)
- MPEG-1 @ 1.0 – 2.5 Mb/s (default is 1.5 Mb/s)
- MPEG-2 Half D1 @ 2.0 – 3.5 Mb/s (default is 3.5 Mb/s)
- MPEG-2 Full D1 @ 3.0 – 4.5 Mb/s (default is 3.5 Mb/s)

10.3.2.2 Video Resolutions:

- MPEG-1 @ 352x240 NTSC or 352x288 PAL
- MPEG-2 Half D-1 @ 352x480 NTSC or 352x576 PAL
- MPEG-2 Full D-1 @ 720x480 and 704x480 (default is 720x480) NTSC or 720x576 PAL

10.3.2.3 Video Sources:

- PAL (25 frames/s)
- NTSC (29.970 frames/s)
- Film (23.976 frame/s)

10.3.3 Audio Elementary Stream:

10.3.3.1 Audio Encoding Basics:

- Layer-1 and Layer-2 Audio (default is Layer-2)
- Joint Stereo, Stereo, Mono and Dual (default is Joint Stereo for both primary and alternate languages)
- 128 – 256 Kb/s (default is 128 Kb/s)
- Audio Presentation Time Stamp (PTS) required
- Stereo mode encoding at 256 Kb/s is recommended for Dolby Headphone audio
- Up to 6 independent audio streams shall be supported in a single video file, for a total bitrate of 2.4Mb/s.

10.3.3.2 Audio Sampling Rates:

- 44.1 kHz (default)
- 48 kHz

10.3.4 Transport Stream File Format Example (VOD):

10.3.4.1 Packet Identifiers (PIDs) for Program Map Table (PMT), PCR, Audio Elementary Stream (ES) and Video ES are examples used only to show the hierarchical relationship of the multiplex components. The actual PID values used can be different from those shown in the example below, but the Video ES PID and PCR PID must be equal to each other, as indicated in the following example:

```
PAT PID = 0x00
  PMT PID = 0x3F
    PCR PID = 0x30
    Video ES 1 PID = 0x30
    Audio ES 1 PID = 0x31
      (Optional) Audio ES 2 PID = 0x32
      (Optional) Audio ES 3 PID = 0x33
      (Optional) Audio ES 4 PID = 0x34
```

10.4 AOD Media

10.4.1 To assure that no portion at the beginning of an audio file is missed, Panasonic Avionics Corporation recommends including two seconds of “dead air” at the beginning audio files for System 3000. This allows the MPEG decoder to mute any objectionable audio artifacts that may occur during the transition between files and still be able to present the entire file’s meaningful content to the passenger.

10.4.2 File Basics:

- AOD files shall contain only one audio elementary stream.
- AOD files shall contain no video elementary stream.
- 128 – 256 Kb/s (default is 128 Kb/s).
- Refer to Section 10.3.3 for additional information on audio elementary stream requirements.

10.4.3 Transport Stream File Format Example (AOD):

10.4.3.1 PIDs for PMT, PCR, and Audio ES are examples only used to show the hierarchical relationship of the multiplex components. The actual PID values used can be different from those shown in the example below, but the Audio ES PID and PCR PID must be equal to each other, as indicated in the following example:

```
PAT PID = 0x00
PMT PID = 0x3F
PCR PID = 0x30
Audio ES 1 PID = 0x30
```

10.5 Broadcast Audio Shows (when supplied via QMU/HDDA True Broadcast Mode)

NOTE: QMU refers to the Quadrature Amplitude Modulation (QAM) Modulator Unit (QMU). HDDA refers to the Hard Drive Disk Array.

10.5.1 File Basics:

10.5.1.1 Each transport stream file shall contain up to four audio elementary streams. If the number of broadcast audio programs is not a multiple of four, files with less than four audio streams shall be permitted.

10.5.1.2 Audio encoding rates: 128 – 256 Kb/s (default is 128 Kb/s).

10.5.1.3 Refer to Section 10.3.3 for additional information on audio elementary stream requirements.

10.5.2 File Content Examples for Broadcast Audio Shows:

10.5.2.1 Broadcast Audio TS File 1:

```
Audio Elementary Stream-1 - Country (selection1, selection2, selection3, ...
selection50)
Audio Elementary Stream-2 - Blues (selection1, selection2, selection 3, ...
selection50)
Audio Elementary Stream-3 - Rock ( ", ", ...)
Audio Elementary Stream-4 - R&B ( ", ", ...)
```

10.5.2.2 Broadcast Audio TS File 2:

```
Audio Elementary Stream-1 - Classic1 (selection1, selection2, selection3, ...
selection50)
Audio Elementary Stream-2 - Classic2 (selection1, selection2, selection 3, ...
selection50)
Audio Elementary Stream-3 - Classic3 ( ", ", ...)
Audio Elementary Stream-4 - Classic4( ", ", ...)
```


10.5.3 Transport Stream File Format Example (Broadcast Audio):

10.5.3.1 PIDs for PMT, PCR and Audio ES are examples only used to show the hierarchical relationship of the multiplex components. The actual PID values used can be different from those shown in the example below, but the First Audio ES PID and PCR PID must be equal to each other, as indicated in the following example:

```
PAT PID = 0x00
PMT PID = 0x3F
PCR PID = 0x30
Audio ES 1 PID = 0x30
(Optional) Audio ES 2 PID = 0x31
(Optional) Audio ES 3 PID = 0x32
(Optional) Audio ES 4 PID = 0x33
```

10.6 Broadcast Audio Shows (when supplied via QMU/HDDA Virtual Broadcast Mode)

10.6.1 For customer configurations with Full Aircraft VOD capability or Virtual Broadcast, there are two possibilities for broadcast audio file format:

10.6.1.1 Customers that use existing AOD files for distribution of Digital Broadcast Audio, shall encode each transport stream file as specified in Section 10.4. In this case, the broadcast audio shows will be composed of many AOD files, linked together dynamically on the aircraft by the Video Server according to the customer's database.

10.6.1.2 Customers that create special multi-hour broadcast audio shows shall encode the audio files as specified in Section 10.5. In this case, the broadcast audio shows are composed of one to four independent channels of audio, where each file is several hours long and contains many sequential songs.

10.7 Subtitles and Closed Captions for Video Files

This section contains digital media encoding requirements for Subtitles and Closed Captions for Panasonic Avionics Corporation's S3000 IFE systems. It contains requirements that are specific to the captioning and subtitling that is not "burned" into the video image. Rather, this specification is for captioning and subtitles that are contained in elementary streams separate from the video and associated video-audio.

10.7.1 The S3000 Subtitle and Closed Caption encoding specifications are detailed in succeeding section 12.7, Subtitles and Closed Captions for Video Files.

11.0 ENCODING REQUIREMENTS FOR eFX AND DIGITAL MPES

11.1 Introduction

This section contains unique digital media encoding requirements for the eFX IFE system and also the Digital MPES system (where the SC-A is used to store and stream the digital content). The eFX encoding specifications are a subset of the eX1, eX2 and eX3 system encoding specifications described in a subsequent section. This section contains requirements specific for the eFX and Digital MPES systems, and the information in this section shall supersede other information should it conflict with other sections in this document.

11.2 Media File Format Specifications

11.2.1 All digital video media (VOD, digital broadcast video, etc.) for eFX and Digital MPES must be formatted in an MPEG-2 Transport Stream (TS).

11.2.2 All digital audio-only media (AOD, digital broadcast audio, boarding music, etc.) for eFX and Digital MPES must be formatted as MPEG audio elementary stream files (MPEG Layer 2 or Layer 3), with the exception of PRAM messages.

11.2.3 All PRAM messages must be formatted as Windows PCM audio files.

11.3 VOD and Digital Broadcast Video Media

11.3.1 Video Elementary Stream

All specifications listed in Section 10.3.2 apply to eFX and Digital MPES with the exception of PAL formatted content. PAL is not supported in eFX. In addition to the specifications in Section 10.3.2, MPEG-4 video encoding is supported according to the specifications listed in the following subsections.

11.3.1.1 Video Encoding Basics:

MPEG4 as defined in Section 12.3.3.1

MPEG4 is supported on all DMPES systems.

MPEG4 is supported on eFX with systems using seat display units with DSP decoders, with exception of the RD-KWxxx series seat displays.

11.3.1.2 Video Resolutions:

MPEG4 resolutions as defined in Section 12.3.3.2

11.3.1.3 Aspect Ratio

- 4:3
- 16:9

11.3.2 Audio Elementary Stream

All specifications listed in Section 10.3.3 apply to eFX and Digital MPES.

11.4 Broadcast Audio, Boarding Music Audio, and AOD Media

11.4.1 Audio Elementary Stream

11.4.1.1 Audio Encoding Basics:

- Audio files shall contain only one audio elementary stream.
- Audio files shall contain no video elementary stream.
- Audio files shall be encoded at a constant bit rate
- Encoding bit rate shall be between 128 Kb/s and 256 Kb/s (128 Kb/s is default).
- Audio files shall be encoded as MPEG Layer-2 or layer-3 audio (mp3)

- Audio files may be encoded as joint stereo (default), stereo, dual, or monaural.

NOTE: Boarding music audio may be encoded in monaural, but does not require monaural encoding. This audio will be output to the aircraft PA system in monaural (left + right) regardless of the encoding format.

11.4.1.2 Audio Sampling Rate:

Audio files shall be sampled at 44.1 kHz or 48 kHz.

11.5 PRAM Audio

11.5.1 PRAM Audio Elementary Stream

11.5.1.1 PRAM Audio Encoding Basics:

- PRAM audio files shall be encoded as Windows 16-bit PCM audio (.wav); i.e. not in an MPEG compressed format.
- PRAM audio files shall be encoded as monaural.

11.5.1.2 PRAM Audio Sampling Rate:

PRAM audio files shall be sampled at 22050 Hz.

11.6 Broadcast Audio Shows

11.6.1 Broadcast audio shows (long play compilation programs) may be created as follows.

11.6.1.1 A broadcast audio show may be composed of multiple audio files encoded as specified in Section 10.3.3, linked together dynamically by the aircraft audio server according to the customer's requirements.

11.6.1.2 A broadcast audio show may be composed of a single audio file, consisting of the entire program, encoded as specified in Section 10.3.3.

12.0 ENCODING REQUIREMENTS FOR EX1, EX2 AND EX3

12.1 Introduction

This section contains unique digital media encoding requirements for the eX1, eX2 and eX3 IFE systems. The eX1, eX2 and eX3 IFE system media encoding requirements include support for content created for both System 3000 and eFX system described in Sections 10.0 and 11.0. In addition to supporting these legacy formats, the eX1, eX2 and eX3 systems will support additional media formats and file properties. This section contains the requirements which are specific to the eX1, eX2 and eX3 systems. Both additional formats as well as exceptions and changes from previous formats are described. The information in this section shall supersede other information should it conflict with other sections in this document.

12.2 Media File Format Specifications

- 12.2.1 As in eFX and System 3000, all digital video media (VOD, digital broadcast video, etc.) for eX1, eX2 and eX3 must be formatted in an MPEG-2 Transport Stream (TS).
- 12.2.2 As in eFX and System 3000, all digital audio-only media (AOD, digital broadcast audio, boarding music, etc.) for eX1, eX2 and eX3 must be formatted as either MPEG audio elementary stream files (MPEG Layer 2 or Layer 3), or MPEG 2 TS files, with the exception of PRAM messages.
- 12.2.3 As in eFX, all PRAM messages that require minimum delay between commanded start of the message and actual sound presented to the PAX, must be formatted as Windows PCM audio files.

12.3 VOD and Digital Broadcast Video Media

This section contains digital media encoding requirements for MPEG-4 VOD files for the eX1, eX2 and eX3 In-Flight Entertainment Systems.

12.3.1 Beginning and End of File Performance

There is no longer a requirement to include 2 seconds of “dead air” at the beginning video files for eX1, eX2 and eX3 like we required for System 3000. Enhancements have been designed into the eX1, eX2 and eX3 systems that provides PC-like performance during start of decoding and transitions between multi-file presentations.

12.3.2 Video Elementary Stream

All specifications listed in Section 10.3.2 apply to eX1, eX2 and eX3 with the exception of PAL formatted content. PAL is not supported in eX1 and eX2 with DSP-based decoders. In addition to the specifications in Section 10.3.2, MPEG-4 video encoding is supported according to the specifications listed in the following subsections. High Definition (HD) video encoding is supported on qualifying systems only and according to the specifications listed in the subsequent subsections.

In addition to the above, all streams shall comply with ISO/IEC 14496-10.

12.3.3 Standard Definition (SD) MPEG-4 Video Encoding Basics:

12.3.3.1 SD Advanced Video Coding (AVC)

- Advanced Video Coding (MPEG-4, Part 10, also called H.264)
- Main Profile, Level 3.0 (default), or Base Profile, Level 3
- Set CABAC for Main Profile
- Constant bit rate encoding
- 1.5 – 2.0 Mb/s for Full D1 resolution (default is 1.5 Mb/s)
- 0.8 – 1.5 Mb/s for Half D1 resolution (default is 1.0 Mb/s)
- 0.5 – 1.0 Mb/s for CIF resolution (default is 0.7 Mb/s)
- Closed GOP must be set
- GOP size shall be equal to ½ second (e.g., 12 frames for 24 frames/s source, or 15 frames for 30 frames/s) with the following exception:

- Utilizing GOP sizes less than ½ second is acceptable and shall be used for scene change detection.
- Every I-frame must be in an IDR; i.e. IDR Frequency shall be set to 1.
- Streaming format is required, e.g. SPS and other sequence headers shall be repeated throughout the stream to facilitate fast decoder synchronization during random access.
- B-Frames shall be used when Main Profile is chosen
- No referenced B-Frames
- Number of B-frames shall be set to 2 or 3
- Number of reference frames shall be set to 2
- Encode without weighted prediction
- Encoding from 23.976 frames/s film source shall be progressive scan
- Number of slices shall be set to 1, 2, or 4
- Deblocking filter shall be enabled

12.3.3.2 SD MPEG-4 Video Resolutions:

- Full D-1 720x480 NTSC
- Half D-1 352x480 NTSC
- CIF 352x240 NTSC

12.3.3.3 SD MPEG-4 Video Sources:

- The source shall be de-interlaced before encoding.
- PAL (25 frame/s) is not supported in eX1 and eX2 with DSP-based decoders.
- All film masters require standards conversion to 23.976 frame rate before encoding with MPEG-4.

Film (24 or 23.976 frames/s) shall be encoded at 23.976 frames/s. If an NTSC (29.970 frames/s) tape master is provided for a film source, then inverse telecine is required before encoding.

12.3.3.4 SD MPEG-4 Aspect Ratios:

- 4:3
- 16:9 Anamorphic

12.3.4 High Definition (HD) MPEG-4 Video Encoding Basics:

In addition to the specifications in Section 10.3.2, High Definition MPEG-4 video encoding is supported on qualifying systems according to the specifications listed in the following subsections.

12.3.4.1 HD Advanced Video Coding (AVC)

- High Profile Level 3.1 (720p)
- 3.0 – 8.0 Mb/s for HD 720p resolution (default is 4.0 Mb/s)
- Number of slices shall be set to 4
- Number of B-frames shall be set to 3
- Number of reference frames shall be set to 3
- Weighted prediction shall be enabled

12.3.4.2 HD MPEG-4 Video Resolutions:

- HD 720p 1280x720

12.3.4.3 HD MPEG-4 Video Sources:

- Same as SD

12.3.4.4 HD MPEG-4 Aspect Ratio

- 16:9 only

- Other aspect ratios to be framed as 16:9

12.3.5 Standard Definition (SD) MPEG-4 Video-Audio Elementary Stream

All specifications listed in Section 10.3.3 apply to eX1, eX2 and eX3 and, in addition, MP3 and AAC Audio is also supported with the following properties:

12.3.5.1 SD MPEG-4 Video-Audio Elementary Stream

- ADTS AAC-LC (ISO/IEC 13818-7) audio elementary streams are supported in the VOD file.
- ADTS AAC-HE v2 (ISO/IEC 13818-7) audio elementary streams are supported in the VOD file with systems using seat display units with DSP DM642 or newer decoders, with exception of the RD-KWxxx series seat displays.
- MP3 audio elementary streams are supported in the VOD file.
- Up to 12 independent audio streams shall be supported in a single video file.

12.3.5.2 SD AAC and MP3 Audio Stream parameters:

- Audio shall be encoded at a constant bit rate
- Audio encoding bit rate shall be between 48 Kb/s and 256 Kb/s (128 Kb/s is default)
- Audio may be encoded as joint stereo (default), stereo or monaural
- Audio shall be sampled at 44.1 kHz or 48 kHz (default)

12.3.6 High Definition (HD) MPEG-4 Video-Audio Elementary Stream

In addition to the Standard Definition (SD) elementary streams specified in Section 12.3.5, the following shall be supported:

12.3.6.1 HD MPEG-4 Video-Audio Elementary Stream

- ADTS AAC-HE v2 (ISO/IEC 13818-7) audio elementary streams are supported in the VOD file.

12.3.6.2 HD AAC Audio Stream parameters:

- AAC-HE v2 audio encoding bit rate shall be between 48 Kb/s and 128 Kb/s (64 Kb/s is default)

12.4 Broadcast Audio, Boarding Music Audio, and AOD Media

12.4.1 Beginning and End of File Performance

There is no longer a requirement to include two seconds of “dead air” at the beginning of audio files for eX1, eX2 and eX3 like we required for System 3000, with the exception of PRAM files which require 1 second of leading silence per Section 4.2.8. Enhancements have been designed into the eX1, eX2 and eX3 system that provides PC-like performance during start of decoding and transitions between multi-file presentations.

12.4.2 Audio Elementary Stream

All specifications listed in Section 10.4 and 11.4 apply to eX1, eX2 and eX3. In addition, AAC audio encoding is also supported with the following properties:

- Audio files may be encoded as AAC-HE v2 (ISO/IEC 14496-3) audio Elementary Stream files with systems using seat display units with DSP DM642 or newer decoders, with exception of the RD-KWxxx series seat displays..
- Audio files may be encoded as AAC-LC (ISO/IEC 14496-3) audio Elementary Stream files.
- Spoken word (audio books, “pod casts”, etc.) audio files may be encoded as low as 48 Kb/s, but 64 Kb/s is default.
- Refer to Section 12.3.5 and 12.3.6 for additional information on audio elementary stream requirements.

12.5 PRAM Audio

All specifications listed in Section 11.5 apply to eX1, eX2 and eX3.

12.6 Broadcast Audio Shows

All specifications listed in Section 11.6 apply to eX1, eX2 and eX3.

12.7 Subtitles and Closed Captions for Video Files

This section contains digital media encoding requirements for Subtitles and Closed Captions for Panasonic Avionics Corporation's eX1, eX2 and eX3 IFE systems only. This section contains requirements that are specific to the captioning and subtitling that is not "burned" into the video image. Rather, this specification is for captioning and subtitles that are contained in elementary streams separate from the video and associated video-audio. For subtitle and captioning specifications relating to any other systems not detailed in this section, please contact the Panasonic Avionics Corporation media department for approval.

12.7.1 Closed Captions and Subtitles for our IFE system shall be provided in the Scenarist DVD authoring format for subtitling. This format consists of a combination of TIFF images and a script file with time-on/off for each CC/Subtitle image. The requirements for this delivery format are outlined in this section.

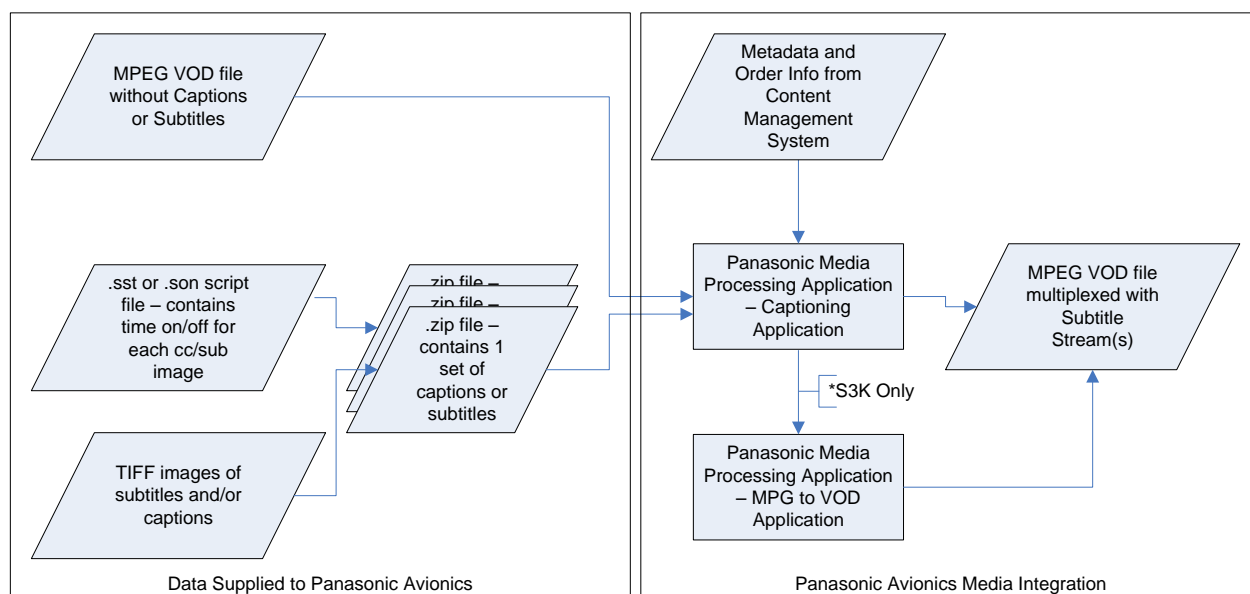


Figure 3: Captioning and Subtitling Process Flow

12.7.1.1 The supported subtitle and captioning streams may contain any language and any font. Since input requirement for captioning and subtitle streams is image-based, the IFE system will support captioning and subtitles in any language, including Asian character sets, languages that read right-to-left as well as Western languages.

12.7.1.2 Up to 12 independent subtitle streams and closed caption streams shall be supported in a single file up to a maximum TS bit rate of 5 Mb/s. For example, a single VOD file may contain three streams of captioning for the hard of hearing and 9 streams of subtitles for language translation purposes provided the total TS stream bit rate is less than or equal to 5 Mb/s.

12.7.1.3 When supplying captioning and subtitles in the DVD subtitle authoring format, they shall be provided as a separate archive containing the timing and associated subtitle/closed caption images. As part of our ground processing applications, Panasonic Avionics Corporation will provide the ability to integrate the DVD formatted captioning and subtitles stored in a Scenarist DVD authoring format into the DVB compatible multiplexed VOD file format. The following sections describe the Scenarist DVD authoring format accepted by the eX1, eX2 and eX3 system and media integration applications.

12.7.1.4 Closed Captions and Subtitles File Format Specifications

12.7.1.4.1 The basic requirement for delivery of Closed Captions and Subtitles to our system is the Scenarist DVD authoring format for DVD Subtitles. It is a combination of TIFF images and a script file with time-on/off for each CC/Subtitle image.

12.7.1.4.2 A separate zip file shall be required for each CC/Subtitle stream. The script file and all corresponding images shall be compressed into a single zip file. In other words, if three languages are required, there shall be three separate zip files each with the complete set of files for one language.

12.7.1.4.3 The zip file shall be named as follows: <VOD_File_Name>_<CC/Sub_Language><Caption_Type>.zip; where:

<VOD_File_Name> = the base name of the corresponding mpeg video file.

<CC/Sub_Language> = the ISO 639 3-letter code for this language

<Caption_Type> = CAP for captions for hard of hearing persons, SUB for subtitles for language translation

Example: AA0123M2_ENG_CAP.ZIP

12.7.2 Display Schedule File Format

The display schedule file shall be provided in a Scenarist compliant script file format, also known as .sst or .son files. Section 13.2 includes a sample of a script file. Although other Scenarist fields/parameters may be included in the display schedule file, only the Base_Time and Tape_Type parameters are processed by the integration tools at this time.

12.7.2.1 Base_Time

Base_Time is a required parameter in the display schedule file. It 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. This value is specified as follows:

Base_Time hh:mm:ss:ff

Where:

hh = 2-digit hours value of the PTS at the start of the video stream

mm = 2-digit minutes value of the PTS at the start of the video stream

ss = 2-digit seconds value of the PTS at the start of the video stream

ff = 2-digit frame number value at the start of the video stream

NOTE: Typically, it is expected the Base_Time and PTS in the MPEG file will be 01:00:00:00 at the start of the MPEG file. In this case, the Time-On and Time-Off values in the script file shall include this offset.

12.7.2.2 Tape_Type

Tape_Type is a required parameter in the display schedule file. It represents the type of timing used in the display schedule. Possible values are DROP for Drop Frame Time Code and NON_DROP for Non Drop Frame Time Code. Proper timing of the subtitles will depend on this parameter being defined properly; it must correspond with the type of time code used in the control file. An error in the value of this parameter will lead to a drift in the subtitle timing of 3.58 seconds per hour of video.

12.7.3 Image File Format

12.7.3.1 Both TIFF and BMP file formats are accepted. The following are specific image file parameter requirements:

- Width = 720 pixels.
- Height = 480 pixels.
NOTE: The bitmaps may be stretched beyond the 3:2 aspect ratio to fit wide-screen displays. The fonts may be rendered with that in mind, though in most cases one rendering should view fine both when display aspect ratio is 4x3 and when DAR is 16x9.
- Color Depth = four bit (recommended) or eight bit.
- Number of unique colors: four colors or fewer. For example, eight bit TIFF images can be accepted, as long as the color pallet includes four colors or fewer.
- Color Representation = Palletized and RGB are both acceptable
- Compression = RLE and other similar TIFF compression types are supported

12.7.3.2 The following colors shall be used for caption and subtitle images:

- Font Color shall be white (RGB = 255 255 255)
- Font Outline Color shall be black (RGB = 0 0 0)
- (Optional) Font Anti-Alias Color shall be grey (RGB = 190 190 190)
- Background Color shall be any color which is not already used in the image file for any of the other three colors above. For example, Green = (0, 255, 0)

12.7.3.3 Font sizes shall be based on a 32 pixel height for a full size character, e.g. “[“.

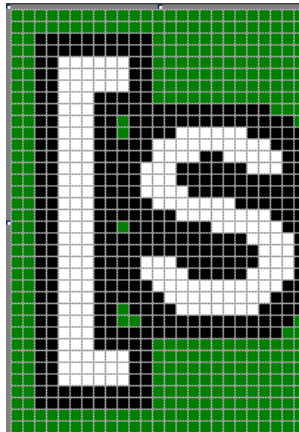


Figure 4. Pixel View of Captioning and Subtitle Characters

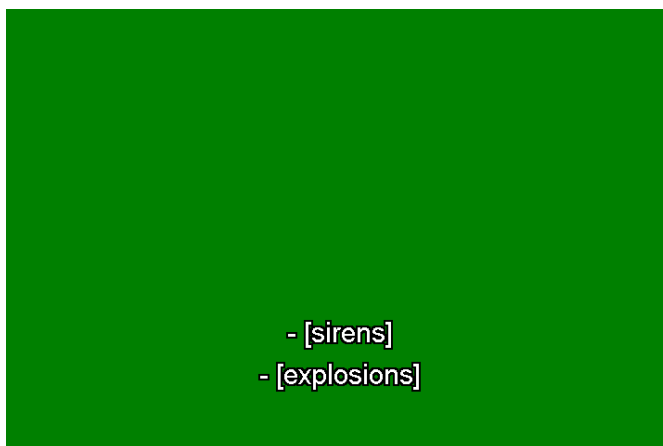


Figure 5. Example of Full Screen Caption Image

12.7.4 Timing Validation

It is expected that incoming media shall be validated for proper video-captioning synchronization prior to receipt by Panasonic Avionics Corporation.

12.7.4.1 For each image identified in the display schedule file, the preceding Time Off value must be less than the Time On value of the next image.

12.7.4.2 For each image identified in the display schedule file, the Time Off value must be at least 20 frames greater than the Time On value. That is, a minimum duration for a single subtitle is 20 frames. Durations less than 20 frames may not be displayed.

12.7.4.3 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 may be considered.

12.7.4.3.1 The file produced for a DVD may have the first subtitle cued in at 01:00:43:11, whereas the cue time in the new MPEG file will be 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 will correct the misalignment.

12.7.4.3.2 The new MPEG encoded file might have five 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).

12.7.4.4 In the absence of the ability to play the MPEG file and display or overlay the subtitles and verify synchronization, the following steps shall be followed 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.
- Verify at sufficient points throughout the file that the caption is correctly aligned with the video.

12.7.4.5 Verify the master used for the caption/subtitle creation was the same as is used for VOD encoding. If the caption display schedule file was produced from a different master that may contain edits, the captions may not align with the video. In this case, even if Base_Time is adjusted carefully to assure initial synchronization, different edits in the VOD master may lead to a lack of synchronization later in the video.

12.8 Metadata for Video and Audio Files

eX1, eX2 and eX3 system and media integration applications will support ID3v2 tags on all files, video or audio. In addition to the standard fields defined, eX1, eX2 and eX3 will require that certain proprietary fields are included to describe the file properties. The following subsections describe the proprietary fields.

AVOD media used in Panasonic Avionics Corporation eX1, eX2 and eX3 IFE systems may contain ID3 tags based on the specification of ID3v2 version 4.0. The following paragraphs describe additional information included in the ID3 tags in Panasonic Avionics Corporation media files.

12.8.1 ID3v2 Frame Header

The ID3v2 User Defined Text Information Frame (TXXX) will be used for all media attributes added by Panasonic Avionics Corporation in the ID3 tag.

The frame header is of the following format:

Header Field	Size (Bytes)	Description
Frame ID	4	TXXX
Size	4	Syncfree integer
Flags	2	Frame header flags

12.8.2 Panasonic Avionics Corporation Defined ID3v2 Frames

The body of the TXXX frame consists of a text encoding description byte and a null terminated description string followed by the actual (value) string. Both strings are in ASCII. The description byte of 0x00 is ISO-8869-1, null terminated strings of character values ranges from 0x20 to 0xff. All required frames for the eX1, eX2 and eX3 system are marked with an asterisk (*).

The following TXXX frames may be added:

Description String	Value String
Panasonic Avionics Corporation serial number*	variable length string
composite bit rate*	bits per second in integer
source aspect ratio*	decimal number (4:3 = 1.333 or 16:9 1.777)
target aspect ratio*	decimal number (4:3 = 1.333 or 16:9 1.777) (From source/target aspect ratio the decoder/interactive can determine if there are black bars encoded in the video.)
video resolution*	One of the three: cif, hd1 (half D1), or fd1 (full D1)
encoding type*	MPEG-1, MPEG-2, MPEG4-SP, MPEG4-ASP, MPEG4-AVC, VC-1, MP3, WAV, AAC NOTE: 'MPEG4-AVC' is equivalent to H.264. 'VC-1' is standardized version of Windows Media.
encryption type*	3DES, AES128, none NOTE: 3DES is expected only for eFX systems.
stream type*	TS (Transport Stream), ES (Elementary Stream)

Description String	Value String
videoPID*	integer
media version*	TH (Theatrical), ED (Edited), CU (Custom for unique custom edits)
audio encoding type*	MPEG-1, MPEG-2, MP3, ... (This tag is left blank if the audio encoding type of the language tracks is the same as the video encoding type. If the audio tracks are encoded in a different format then the video then it is specified in this tag.)
audio encrypted*	Boolean 0 = no, 1 = yes. (To specify if the language tracks of a transport stream video file are encrypted. If this value is true then the encryption type is the defined in the ENCR frame.)
stretch	no (no stretch allowed), user (the user may select to resize the media) or auto (the decoder will automatically resize the media to fit the screen size). (To specify if the interactive/decoder can resize the original aspect ratio to fit the screen size. Ex: stretch 4x3 media to fit 16x9 display.)

* Required frames.

Below are examples of each Panasonic Avionics Corporation-defined TXXX frame:

Description String	Complete Frame
Panasonic Avionics Corporation serial number	TXXX 0x00 0x00 0x00 0x20 0x00 0x00 0x00 Panasonic serial number 0x00 123456 0x00
composite bit rate	TXXX 0x00 0x00 0x00 0x1c 0x00 0x00 0x00 composite bit rate 0x00 1500000 0x00
source aspect ratio	TXXX 0x00 0x00 0x00 0x1b 0x00 0x00 0x00 source aspect ratio 0x00 1.333 0x00
target aspect ratio	TXXX 0x00 0x00 0x00 0x1b 0x00 0x00 0x00 target aspect ratio 0x00 1.777 0x00
video resolution	TXXX 0x00 0x00 0x00 0x16 0x00 0x00 0x00 video resolution 0x00 fd1 0x00
encoding type	TXXX 0x00 0x00 0x00 0x15 0x00 0x00 0x00 encoding type 0x00 MPEG1 0x00
encryption type	TXXX 0x00 0x00 0x00 0x19 0x00 0x00 0x00 encryption type 0x00 AES128 0x00
stream type	TXXX 0x00 0x00 0x00 0x10 0x00 0x00 0x00 stream type 0x00 TS 0x00
videoPID	TXXX 0x00 0x00 0x00 0x0D 0x00 0x00 0x00 videopid 0x00 20 0x00
media version	TXXX 0x00 0x00 0x00 0x12 0x00 0x00 0x00 media version 0x00 TH 0x00
audio encoding type	TXXX 0x00 0x00 0x00 0x19 0x00 0x00 0x00 audio encoding type 0x00 MP3 0x00
audio encrypted	TXXX 0x00 0x00 0x00 0x13 0x00 0x00 0x00 audio encrypted 0x00 1 0x00
stretch	TXXX 0x00 0x00 0x00 0x0C 0x00 0x00 0x00 stretch 0x00 no 0x00

12.8.3 Existing ID3v2 Frames Supported

Panasonic Avionics Corporation will also augment the usage of the below existing ID3v2 frames as described below. All required frames for the eX1, eX2 and eX3 system are marked with an asterisk (*). All additional frames are optional.

Frame	Description	Value String
TALB	Album/Movie/Show title	string
TCOM	Composer/Director	string
TEXT	Lyricist/Script/Text writer	string
TIT1	Content group description	string
TIT2	Title/song name/content description	string
TLAN*	Language	Contains one or more null-terminating strings, each for one language. The string contains the ISO-639-3 three-letter language code followed by the corresponding PID after an intervening space.
TLEN*	Length/Duration	seconds in numeric string.
TPE1	Lead performer(s)/Soloist(s)/ Actor(s)	Contains one or more null-terminating strings.
TPE2	Band/orchestra/accompaniment	string
TPE3	Conductor/Director	string
TPOS	Part of a set	string
TPUB	Publisher/Studio	string
TRCK	Track number/Position in set	numeric string
TSST*	Captioning/Subtitle Info	Contains one or more null-terminating strings, each for one language. The string contains the ISO-639-3 three-letter language code followed by the corresponding PID and then the subtitle type. There is an intervening space between the language code and PID as well as between the PID and subtitle type. Subtitle type "CAP" = Captioning for Hard of Hearing persons Subtitle type "SUB" = Subtitles for Language Translation

* Required frames.

Below are examples of each supported frame:

Frame	Complete Frame
Album/Movie/Show title	TALB 0x00 0x00 0x00 0x0b 0x00 0x00 0x00 Test Title 0x00
Composer/Writer	TCOM 0x00 0x00 0x00 0x0f 0x00 0x00 0x00 Test Composer 0x00
Lyricist/Script/Text writer	TEXT 0x00 0x00 0x00 0x0d 0x00 0x00 0x00 Test Writer 0x00
Content group description	TIT1 0x00 0x00 0x00 0x0c 0x00 0x00 0x00 Test Group 0x00

Frame	Complete Frame
Title/song name/content description	TIT2 0x00 0x00 0x00 0x0f 0x00 0x00 0x00 Test Songname 0x00
Language	TLAN 0x00 0x00 0x00 0x0e 0x00 0x00 0x00 eng 49 0x00 fre 49 0x00
Length/Duration	TLEN 0x00 0x00 0x00 0x06 0x00 0x00 0x00 7200 0x00
Lead performer(s)/Soloist(s)/ Actor(s)	TPE1 0x00 0x00 0x00 0x0f 0x00 0x00 0x00 Actor1 0x00 Actor2 0x00
Band/orchestra/accompaniment	TPE2 0x00 0x00 0x00 0x0b 0x00 0x00 0x00 Test Band 0x00
Conductor/Director	TPE3 0x00 0x00 0x00 0x0f 0x00 0x00 0x00 Test Director 0x00
Part of a set	TPOS 0x00 0x00 0x00 0x0a 0x00 0x00 0x00 Test Set 0x00
Publisher/Studio	TPUB 0x00 0x00 0x00 0x0d 0x00 0x00 0x00 Test Studio 0x00
Track number/Position in set	TRCK 0x00 0x00 0x00 0x03 0x00 0x00 0x00 1 0x00
Subtitles	TSST 0x00 0x00 0x00 0x18 0x00 0x00 0x00 "eng 49 SUB" 0x00 "fre 50 CAP" 0x00

12.9 Exceptions From Previously Accepted Media Formats

12.9.1 eX1 and eX2 DSP-based decoders do not support PAL sourced media. For stored VOD MPEG content, standards conversion to NTSC format is required before MPEG encoding.

12.10 System Bandwidth

The default eX1 and eX2 system bandwidth design is limited to 5.0 Mbits/sec per passenger. Because of this basic design criteria, the composite bitrate of the transport stream VOD file, including video + audio streams + subtitle streams, is limited to a total of 5.0 Mbits/sec maximum. Therefore, exceeding this amount may reduce the total number of possible simultaneous AVOD streams, especially in redundancy/failure scenarios, and could result in less than 100% passenger coverage for AVOD. For example, HE-AAC audio tracks at 64kbps are recommended when using 4.0 Mbps video (ex. 720p MPEG4) in order to be able to include up to 10 audio tracks per movie. Customized X-Series configurations may allow higher composite bitrates, but prior analysis and approval from Panasonic is necessary before exceeding 5.0 Mbit/sec file bitrate.

13.0 INFORMATIVE ANNEXES

13.1 Explanation of MPEG-1 and MPEG-2 Terminology

MPEG-1: A standard for compression of audio and video. The standard defines the file format of compressed audio, called Audio Elementary Streams (AES); the file format of compressed video, called Video Elementary Streams (VES); and a multiplexed file format for a file that contains both audio and video, called MPEG-1 Systems Stream (SS).

MPEG-2: A more recent standard for compression of audio and video. The standard defines a new file format for AES, a new file format for VES, and two multiplexed file formats for files that contain both audio and video called MPEG-2 Program Stream (PS) and MPEG-2 Transport Stream (TS). MPEG-2 PS and TS file formats are capable of carrying both MPEG-1 and MPEG-2 compressed video/audio. System 3000 uses the TS file format because it is designed for environments like satellite and terrestrial broadcast television, where digital media is transmitted over a distance.

Media files for AVOD 1.0/1.5 are MPEG-1 System Stream file format. It is possible to transcode MPEG-1 SS media files to MPEG-2 TS media file format. The transcoding process can be performed using off-the-shelf MPEG multiplexing products to perform the following steps:

- Demultiplex the MPEG-1 AES and VES out of the SS file. The result is individual files, each containing 1 elementary stream, either MPEG video or MPEG audio.
- Multiplex the AES and VES files into the MPEG-2 TS file format as specified in this document. The result is as follows: the AES and VES are of MPEG-1 type, but the multiplexed file format conforms to the MPEG-2 standard.

13.2 Sample Subtitle and Captioning Script File

```
st_format 2
#####
# Title :
#
# English Subtitle File
#
# Edited by :
# Date : 070403
#
#####
# BG = Background color
# PA = Text foreground color (letter body)
# E1 = Antialiasing color
# E2 = Text border color
#####
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
```