ENGINEERING COMMITTEE
Network Operations Subcommittee

SCTE STANDARD

SCTE 142 2017

Recommended Practice for
Transport Stream Verification

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1.0 SCOPE

This Recommended Practice provides a common methodology for describing Transport Stream conformance criteria. This document explicitly describes the elements and parameters of SCTE 54 [2], along with ATSC A/53-3 [5] and A/65 [6] that should be verified in an SCTE Transport Stream for it to be considered a proper emission. It does not cover RF, captioning or elementary streams.

This Standard is based upon an ATSC Recommended Practice, A/78A [16], which provided a complete foundation for this work. SCTE would like to express its gratitude to the ATSC for this pioneering work.

While the SCTE standards define strict limits for each parameter, in practice the severity of the error may depend upon the magnitude of the deviation. This document recommends severity levels associated with the ranges of deviation from the standard in these parameters.

2.0 DEFINITIONS AND ACRONYMS

AEIT - Acronym for Aggregate Event Information Table.

AETT - Acronym for Aggregate Extended Text Table, defined in A/65C [6].

ANSI - Acronym for American National Standards Institute.

ARIB - Acronym for Association of Radio Industries and Businesses.

CM - Acronym for Component Missing.

CRC - Acronym for Cyclic Redundancy Check, defined in 13818-1 [14].

CVCT - Acronym for Cable Virtual Channel Table, defined in A/65C [6].

DPI - Acronym for Digital Program Insertion.

DTS - Acronym for Decoding Timestamp, defined in 13818-1 [14].

DTV - Acronym for Digital Television.

DVB - Acronym for Digital Video Broadcasting.

EAS - Acronym for Emergency Alert System.

EIT - Acronym for Event Information Table, defined in A/65C [6].

EPG - Acronym for Electronic Program Guide.

ES - Acronym for Elementary Stream, defined in 13818-1 [14].

ETT - Acronym for Extended Text Table.

FCC - Acronym for Federal Communications Commission.

GPS - Acronym for Global Positioning System.

L-VCT - Acronym for Long-form Virtual Channel Table, defined in A/65C [6].

MPEG - Acronym for Moving Picture Experts Group.

MGT - Acronym for Master Guide Table, defined in A/65C [6].

NIT - Acronym for Network Information Table, defined in 13818-1 [14].

NTT - Acronym for Network Time Table, defined in A/65C [6].

OOB-SI - Acronym for Out of Band - SI.

PAT - Acronym for Program Association Table, defined in 13818-1 [14].

PCR - Acronym for Program Clock Reference, defined in 13818-1 [14].

PES - Acronym for Packetized Elementary Streams, defined in 13818-1 [14].

PID - Acronym for Packet ID, defined in 13818-1 [14].

PMT - Acronym for Program Map Table, defined in 13818-1 [14].

POA - Acronym for Program Off Air.

PSI - Acronym for Program Specific Information, defined in 13818-1 [14].

PSIP - Acronym for Program and System Information Protocol, defined in A/65C [6].

PTS - Acronym for Presentation Time-Stamp, defined in 13818-1 [14].

PVR - Acronym for Personal Video Recorder.

QAM - Acronym for Quadrature Amplitude Modulation.

QoS - Acronym for Quality of Service.

RAM - Acronym for Random Access Memory.

RF - Acronym for Radio Frequency.

RP - Acronym for Recommended Practice.

RRT - Acronym for Rating Region Table, defined in A/65C [6].

SCTE - Acronym for Society of Cable Telecommunications Engineers.

SI - Acronym for Service Information, defined in ANSI/SCTE 54 [2].

SLD - Acronym for Service Location Descriptor, defined in A/65C [6].

STT - Acronym for System Time Table, defined in A/65C [6].

S-VCT - Acronym for Short-form Virtual Channel Table, defined in A/65C [6].

TNC - Acronym for Technically Non-Conformant.

TOA - Acronym for Transport Stream Off Air.

TVCT - Acronym for Terrestrial Virtual Channel Table, defined in A/65C [6].

TS - Acronym for Transport Stream, defined in ANSI/SCTE 54 [2].

T-STD - Acronym for Transport Stream System Target Decoder, defined in 13818-1 [14].

VCT - Acronym for Virtual Channel Table.

3.0   NORMATIVE REFERENCES

The following documents contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

3.1   SCTE References

[1]   ANSI/SCTE 43-2005, Digital Video Systems Characteristics Standard for Cable Television

[2]   ANSI/SCTE 54-2009, Digital Video Service Multiplex and Transport System Standard for Cable Television

[3]   ANSI/SCTE 65-2008, Service Information Delivered Out-Of-Band for Digital Cable Television

3.2   Standards from other Organizations

[4]   ATSC A/52B: "Digital Audio Compression (AC-3, E-AC-3) Standard," Advanced Television Systems Committee, Washington, D.C., 14 June 2005.

[5]   ATSC A/53-3:2007: "ATSC Digital Television Standard, Part 3 – Service Multiplex and Transport Subsystem Characteristics," Advanced Television Systems Committee, Washington, D.C., 3 January 2007.

[6]   ATSC A/65C: "Program and System Information Protocol for Terrestrial Broadcast and Cable," Advanced Television Systems Committee, Washington, D.C., 2 January 2006.

4.0   INFORMATIVE REFERENCES

The following documents may provide valuable information to the reader but are not required when complying with this standard.

4.1   SCTE References

[7]   ANSI/SCTE 35-2007, Digital Program Insertion Cueing Message for Cable

[8]   ANSI/SCTE 18-2007 (also known as ANSI J-STD-042-2002), Emergency Alert Message for Cable

[9]   SCTE 128-2007, AVC Video Systems and Transport Constraints for Cable Television

4.2   Standards from other Organizations

[10]   ATSC A/69: "Recommended Practice: Program and System Information Protocol Implementation Guidelines for Broadcasters," Advanced Television Systems Committee, Washington, D.C., 25 June 2002.

[11]   ATSC A/110A: "Synchronization Standard for Distributed Transmission, Revision A," Advanced Television Systems Committee, Washington, D.C., 19 July 2005.

[12]   CableLabs OC-SP-HOST2.1-CFR-I01-070720, OpenCable™ Host Device 2.1 Core Functional Requirements, July 2007.

[13]   ETSI TR 101 290 V1.2.1, Digital Video Broadcasting (DVB): Measurement guidelines for DVB systems, May 2001.

[14]   ISO/IEC IS 13818-1:2000 (E), International Standard, Information technology – Generic coding of moving pictures and associated audio information: systems.

[15]   ISO/IEC 13818-4:2004 (E), International Standard, Information technology – Genetic Coding of Moving Pictures and associated audio information: Conformance Testing.

[16]   ATSC A/78A, Recommended Practice: Transport Stream Verification, 9 May 2007.

[17]   ATSC A/54A, Recommended Practice: Guide to the Use of the ATSC Digital Television Standard, 4 December 2003.

5.0   INTRODUCTION

The SCTE and ATSC standards define the contents and characteristics of the emission Transport Stream. There may be a large number of interactions and interrelationships

amongst various components. Successful tuning and display of programs can be enabled if this Transport Stream adheres to the SCTE standards. The connection between the emission remultiplexer and the QAM modulator is the reference analysis point assumed in this document, as shown in Figure 1.

Please note that this diagram shows only a conceptual, functional block view of a DTV system. In practice, actual implementations will only share MPEG data with other devices using the MPEG-2 Transport Stream (TS), as Elementary Streams (ES) or Packetized Elementary Streams (PES) cannot tolerate the introduction of any transmission errors and once synchronization is lost the system crashes. Furthermore, real systems may group the functions in different ways and will likely appear different on an electrical or physical block diagram.

This Standard uses terms and acronyms defined in ISO 13818-1 [14], A/53-3 [5] and A/65 [6], and assumes a fair degree of familiarity with MPEG-2 systems as implemented per the SCTE standards. Readers that do not recognize the terms should read A/54A [17], A/69 [10], SCTE 54 [2], and SCTE 65 [3].
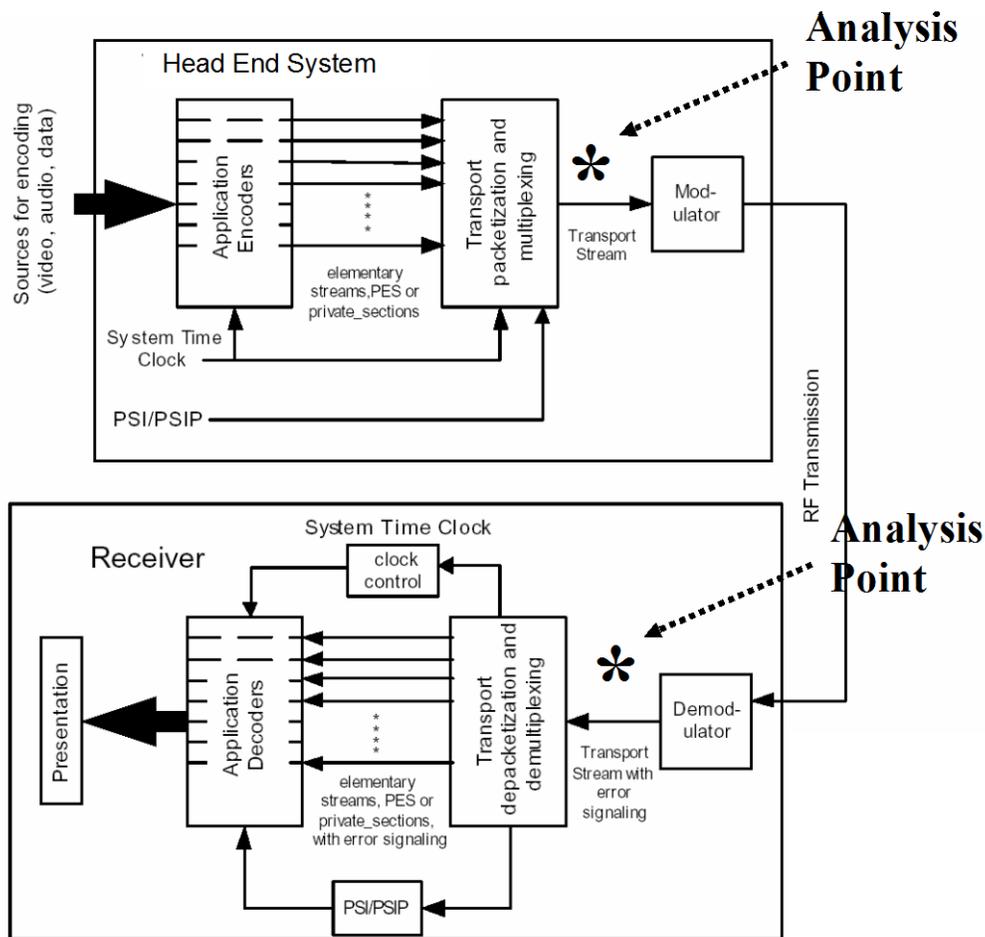

Figure 1 – Reference analysis point in the DTV system.

This Standard identifies transport stream issues by type, dividing errors into the following categories:

- ☐ Section 7.0: PSI tables (PAT and PMT)
- ☐ Section 8.0 Out-Of-Band Tables
- ☐ Section 9.0 In-Band Tables
- ☐ Section 10.0: PSIP tables (MGT, VCT, etc.)
- ☐ Section 11.0: Timing Model and Buffering
- ☐ Section 12.0: Consistency
- ☐ Section 13.0: General Errors

Each error type is also provided with an error severity, as listed below:

- ☐ Transport Stream Off Air (TOA)
- ☐ Program Off Air (POA)
- ☐ Component Missing (CM)
- ☐ Quality Of Service (QOS)
- ☐ Technically Non-Conformant (TNC)

6.0 ERROR CHARACTERIZATION

As noted earlier, in this document, errors are categorized as:

- ☐ Transport Stream Off Air (TOA)
- ☐ Program Off Air (POA)
- ☐ Component Missing (CM)
- ☐ Quality Of Service (QOS)
- ☐ Technically Non-Conformant (TNC)

The distinctions between these are important and should be taken into account both by equipment manufacturers of SCTE TS monitoring equipment and the users of that equipment.

6.1 Regarding "Technically Non-Conformant" error handling

Considering these classes of errors, particular attention needs to be paid to the "TNC" or "Technically Non-Conformant" class. In Standards as complex as MPEG-2 and those from the SCTE, situations arise where two "shall" statements collide. At such junctures, the Transport Stream (TS) may be momentarily non-conformant. An example of this might be "PAT repetition error" (see Section 7.1). If the multiplexer is faced with a choice of outputting a packet carrying a PTS on a video PID on the schedule required by Section 11.2 or a repetition of the PAT within the requirements of Section 7.1, an implementer may choose to output the PTS sample rather than the PAT. Either way, the TS is for a moment non-conformant. Neither choice of non-conformance will affect any real-world receivers. Neither will result in disruption of service. Either will be non-conformant. There is no avoiding these conflicts, and they arise periodically in real-world equipment.

Should a manufacturer of MPEG analysis equipment choose to make either of these errors the cause of an operator alarm, after multiple false alarms the operator may ignore all alarms. That is not desirable.

A number of the possible errors within this Section fall into these categories. While a continuous occurrence of any should constitute an operator alarm, a single occurrence of any should (as indicated by the table) be treated merely as a minor problem, which, unless re-occurring, is not significant.

6.2 Discussion of Error Classification

An explanation of the error classification scheme is as follows:

1. **Transport Stream Off Air (TOA)**: The transport is effectively off-air as the Transport Stream errors are severe enough that transport level logical constructs are damaged beyond utility. Receivers will not be able to tune and decode anything within the transport. The complete or repeated absence of sync bytes would be an example of this level of error.

2. **Program Off Air (POA):** A main service (virtual channel) is flawed to the point that that service is effectively off air for conformant/reasonable receiver designs. This could involve all of the program elements being improperly constructed or incorrect/missing signaling about elements. The absence of a PMT instance for a service would be an example of this type of error.

3. **Component missing (CM):** One of the program components that is signaled by PSIP or PSI as present is either not present or cannot be found and decoded. One example would be a mismatch between the video PID signaled in the PMT and the actual PID used for the video elementary stream.

4. **Quality of Service (QOS)**: Parameters are out of specification by such a margin that a significant fraction of the receivers can be expected to produce flawed outputs. In many cases, the broadcast is viewable, but may exhibit some form of degradation to the viewer. An example might be the PAT cycle time being somewhat longer than the specification, which would cause slower than normal tuning.

5. **Technically Non-Conformant (TNC)**: Violates the letter of the standard, but in practice will have little effect on the viewing experience. Errors of this type should be corrected, but do not have the urgency of higher severity errors. An example might be a single instance of a 102 ms PAT cycle time (with the remainder of the PATs coming at less than 100 ms intervals).

In most cases the error threshold for what may appear to be escalating categorization is based on: 1) the official metric to twice the metric, 2) twice the official metric to 5 times the metric, and 3) over five times the metric. The nominal mathematical expression of this is shown below, where Tc is the metric for the cycle time and t is the time since the last arrival (note that for clarity of expression of the time intervals, this document ignores time advances during each millisecond increment):

1. $Tc < t \le 2Tc$
2. $2Tc < t \le 5Tc$
3. $5Tc < t$

This scale can prevent "shall-statement collisions" from producing meaningless error alarms, yet provides guidance to equipment makers and users regarding severities.

6.3   Regarding CRC errors

Readers may note that CRC errors are categorized as "TNC" rather than as higher severity. Analysis equipment may wish to track repetition rates of CRC errors and produce a higher level indication (such as QoS) if they reoccur with any frequency.

The sole exception to this categorization is for SCTE 35 messages, as loss of the message due to CRC error may result in loss of revenue to the operator of the ad insertion system. Thus this error is categorized as "CM" (Component Missing).

7.0   PSI ERRORS

An SCTE transport stream is also required to be MPEG-2 conformant (see Section 5 in reference [15]). Therefore, an SCTE transport stream must include the two mandatory Program Specific Information (PSI) tables. These two tables are known as the Program Association Table (PAT) and the Program Map Table (PMT). The syntax is defined within ISO/IEC 13818-1 [14]. The maximum interval for the PAT is specified in the SCTE standards as 100 ms. The maximum interval for the PMT is specified in the SCTE standards as 400 ms. Exceeding the interval on each of these tables by a small amount should not have a major impact on a receiver, especially since each SCTE conformant receiver should be able to fully tune to any SCTE channel through the use of the SCTE SI tables.

7.1   PAT

Error conditions for the Program Association Table are classified in Table 7.1

Table 7.1 PAT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
PAT repetition error	PAT repetition interval error (100ms < cycle time ≤ 200ms)[1]					X
PAT repetition error	PAT repetition interval error (200ms < cycle time ≤ 500ms)				X	X
PAT absence error	PAT not found (cycle time > 500ms)	X	X	X	X	X
PAT syntax error	Packet with PID 0x0000 doesn't have table_id 0x00	X	X	X	X	X
PAT syntax error	CRC is incorrect for table_id 0x00 within PID 0x0000 [2]					X
PAT syntax error	scrambling_control_field is not '00' for packet within PID 0x0000 [3]	X	X	X	X	X

Legend:
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:
1) Or over 140 ms with regards to the hard limit of 80 kbps. In A/53-3, Section 6.4 it is noted that in cases where the table section sizes are such that the 100 millisecond repetition rate of the program_association_section() would cause the 80,000 bps maximum rate to be exceeded, the time interval between the byte containing the last bit of the program_association_section() may be increased but in no event shall exceed 140 milliseconds, so that under no circumstances the limit of 80,000 bps is exceeded.
2) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.
3) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.

7.2   PMT

Error conditions for the Program Map Table are classified in Table 7.2.

Table 7.2 PMT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
PMT repetition error	PMT repetition interval error (400ms < cycle time ≤ 800ms)					x
PMT repetition error	PMT repetition interval error (800ms < cycle time ≤ 2000ms)				x	x
PMT absence error	PMT not found (cycle time > 2000ms)		x	x	x	x
PMT syntax error	Packet with "PMT_PID" doesn't have table_id 0x02		x	x	x	x
PMT syntax error	CRC is incorrect for table_id [1]					x
PMT syntax error	scrambling_control_field is not '00' for packets containing PMT [2]		x	x	x	x
PMT syntax error	"PMT_PID" referenced by PAT not found		x	x	x	x
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3. 2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.						

8.0   OUT-OF-BAND TABLE ERRORS

ANSI/SCTE 65 [3] defines out-of-band service information for cable. The service information is designed to support "navigation devices" on cable. There are two main categories of information in the ANSI/SCTE 65 Standard, system information and schedule data. System information allows navigation among and access to the channels currently within the DTV transport stream. It is similar to the PSI data discussed elsewhere in this document. The schedule data provides necessary information for efficient browsing and selection of current and future events.

Six profiles are described within ANSI/SCTE 65 - defining required and optional data specified for out-of band transport via cable.

- **Profile 1 – Baseline**: This Baseline Profile reflects a practice in cable where the Short-Form Virtual Channel Table, the Modulation Mode Subtable and the Carrier Definition Subtable are used for channel navigation.

- **Profile 2 – Revision Detection:** Profile 2 uses the same channel navigation mechanism as Profile 1 while adding a detection mechanism that facilitates revision handling of tables. The revision detection mechanism is applicable to the Network Information Table, Network Text Table, and S-VCT that are also used in Profile 1.

- **Profile 3 – Parental Advisory:** Profile 3 uses Profile 2 as the base and adds support for the Rating Region Table in order to be compliant with the FCC-mandated V-chip content

advisory scheme. Since for the U.S. and its possessions, EIA-766 [25] defines the contents of version 0 RRT, use of RRT is more applicable to outside of North America. The channel navigation mechanism is the same as in Profile 1.

- **Profile 4 – Standard Electronic Program Guide Data:** Profile 4 uses Profile 3 as the base and further defines a standard format for delivery of Electronic Program Guide data by using the Aggregate Event Information Table and the Aggregate Extended Text Table. The Master Guide Table is required to manage the AEITs, AETTs and other applicable tables from Profile 3. The same mechanism as in Profile 1 is used for channel navigation.

- **Profile 5 – Combination:** Support for channel navigation based on L-VCT and MGT is added. Backward compatibility with systems operating within profiles 1 to 4 is maintained. Using profile 5, a cable operator could have a mixture of devices requiring the S-VCT, NIT and NTT tables as well as ones requiring the long-form tables: i.e., L-VCT, MGT. When using profile 5, both the S-VCT and the L-VCT must be present, and each must describe all available services.

- **Profile 6 – PSIP Only:** Profile 6 is based solely on long-form tables and is an extension of the terrestrial broadcasting mechanism. Channel navigation is based on the Long-form Virtual Channel Table. The AEIT and the optional AETT streams are used to provide EPG data.

8.1 Master Guide Table (MGT)

When present, error conditions for the Master Guide Table are classified in Table 8.1.

Table 8.1 MGT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
MGT repetition error	MGT repetition interval error (500ms < cycle time $\leq$ 1000ms)					X
MGT repetition error	MGT repetition interval error (1000ms < cycle time $\leq$ 5000ms)				X	X
MGT absence error	MGT not found (cycle time > 5000ms)	X	X	X	X	X
MGT syntax error	CRC is incorrect for table_id 0xC7 [1]					X
MGT syntax error	scrambling_control_field is not '00' for packets containing MGT [2]	X	X	X	X	X
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3. 2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.						

8.2 Short-form Virtual Channel Table (S-VCT)

When present, error conditions for the Short-form Virtual Channel Table are classified in Table 8.2.

Table 8.2 S-VCT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
VCT repetition error	VCT repetition interval error (2 minutes < cycle time ≤ 4 minutes)					X
VCT repetition error	VCT repetition interval error (4 minutes < cycle time ≤ 10 minutes)				X	X
VCT absence error	VCT not found (cycle time > 10 minutes)		X [3]	X	X	X
VCT syntax error	CRC is incorrect for table_id 0xC4 [1]					X
VCT syntax error	scrambling_control_field is not '00' for packets containing VCT [2]		X [3]	X	X	X

Legend:
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:
1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.
2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.
3) S-VCT generator is off-air. Tuning algorithms based on S-VCT will fail.

8.3   Long-form Virtual Channel Table (L-VCT)

When present, error conditions for the Long-form Virtual Channel Table are classified in Table 8.3.

Table 8.3 L-VCT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
VCT repetition error	VCT repetition interval error (2 minutes < cycle time ≤ 4 minutes)					X
VCT repetition error	VCT repetition interval error (4 minutes < cycle time ≤ 10 minutes)				X	X
VCT absence error	VCT not found (cycle time > 10 minutes)		X [3]	X	X	X
VCT syntax error	CRC is incorrect for table_id 0xC9 [1]					X
VCT syntax error	scrambling_control_field is not '00' for packets containing VCT [2]		X [3]	X	X	X

Legend:
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:
1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.
2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.
3) L-VCT generator is off-air. Tuning algorithms based on L-VCT will fail.

8.4   Rating Region Table (RRT)

When present, error conditions for the Rating Region Table are classified in Table 8.4.

Table 8.4 RRT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
RRT [1]						
RRT repetition error	RRT repetition interval error (1 minute < cycle time ≤ 2 minutes)					X
RRT repetition error	RRT repetition interval error (2 minutes < cycle time ≤ 5 minutes)				X	X
RRT absence error	RRT not found (cycle time > 5 minutes)			X [4]	X	X
RRT syntax error	CRC is incorrect for table_id 0xCA [2]					X
RRT syntax error	scrambling_control_field is not '00' for packets containing RRT [3]			X [4]	X	X

Legend:
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:
1) RRT is not required to be present for Rating Region 1. If the RRT is signaled in the MGT, then these error conditions apply.
2) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.
3) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.
4) OOB SI component missing.

8.5   Aggregate Event Information Table (AEIT) and Aggregate Extended Text Table (AETT)

When present, error conditions for the Aggregate Event Information Table and Aggregate Extended Text Table are classified in Table 8.5.

Table 8.5 AEIT and AETT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
AEIT-0,1/AETT-0,1 syntax error	AEIT-0,1 & AETT-0,1 sections with common MGT_tag values do not share a common PID			X	X	X
AEIT-2,3/AETT-2,3 syntax error	AEIT-2,3 & AETT-2,3 sections with common MGT_tag values do not share a common PID			X	X	X
AEIT syntax error	CRC is incorrect for table_id 0xD6 [1]					X
AEIT syntax error	scrambling_control_field is not '00' for packets containing AEIT [2]			X	X	X
AETT syntax error	CRC is incorrect for table_id 0xD7 [1]					X
AETT syntax error	scrambling_control_field is not '00' for packets containing AETT [2]			X	X	X

Legend:
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:
1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.
2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.

8.6 System Time Table (STT)

When present, error conditions for the System Time Table are classified in Table 8.8.

Table 8.8 STT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
STT repetition error	STT repetition interval error (1 minute < cycle time $\leq$ 2 minutes)					X
STT repetition error	STT repetition interval error (2 minutes < cycle time $\leq$ 5 minutes)				X	X
STT absence error	STT not found (cycle time > 5 minutes)			X [2]	X	X
STT syntax errors	CRC is incorrect for table_id 0xC5 [1]					X
STT time value error	STT time value is more than 30 seconds away from current correct GPS second_count (including GPS_UTC_offset impact)			X [2,3]	X	X
Legend:						
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes:						
1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.						
2) OOB SI component missing.						
3) This error is considered large enough to have a noticeable impact on users who tune/record by time of day.						

9.0 IN-BAND TABLE ERRORS

9.1 EAS

Error conditions associated with EAS (ANSI/SCTE 18 [8]) are classified in table 9.1.

Table 9.1 EAS Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
EAS syntax error	Section with table_id 0xD8 found on PID other than 0x1FFB[1] or 0x1FFC[2]			x	x	x
EAS syntax error	CRC is incorrect for table_id 0xD8[3]			x	x	X
Legend:						
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes:						
1) For transport streams carrying one or more programs in the clear						
2) For out-of-band use on the Extended Channel.						
3) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.						

9.2 SCTE 35 DPI

Error conditions associated with Digital Program Insertion (ANSI/SCTE 35 [7] messages) are classified in Table 9.2:

Table 9.2 SCTE 35 Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
SCTE 35 missing MRD	Section with table_id 0xFC found on PID not associated with an SCTE 35 registration descriptor in the PMT.			x	x	x
SCTE 35 CRC error	CRC is incorrect for table_id 0xFC[1]			x	x	X
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.						

10.0 PSIP ERRORS

PSIP (A/65) [6] is the glue that holds the digital television (DTV) signal together. PSIP is a voluntary standard of ATSC and the SCTE and version C has been fully and completely adopted into the regulations of the Federal Communications Commission (FCC), so it is, in fact, a requirement in terms of actual real-world operation[1]. In most locations, multiple DTV stations can be received, and in some cases, from multiple markets. The purpose of PSIP is to describe the information at the system and event levels and to enable an abstract of the collection of programs called a virtual channel. There are two main categories of information in the ATSC PSIP Standard, system information and schedule data. System information allows navigation among and access to the channels currently within the DTV transport stream. It is similar to the PSI data discussed elsewhere in this document. The schedule data provides necessary information for efficient browsing and selection of current and future events.

There are two forms of virtual channel tables defined by the ATSC standards: Terrestrial (TVCT) and Cable (CVCT). A terrestrial broadcast must carry a TVCT and may optionally carry a CVCT.

The ATSC standards require the carriage of up to 12 hours of EIT information (EIT0-3). Carriage of more EITs is recommended, but not required. Because EIT-0 carries signaling information about the current event, a more rapid cycle time has been set for it. EIT1-3, while required to be present, may arrive less frequently. For purposes of this document, the recommendations in the PSIP Standard (A/69) [10] have been utilized.

The ATSC standards set limits on the cycle times and allowed inaccuracy of the time carried in the System Time Table (STT). While a receiver is tuned to a given station, the STT gives the

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[1] The current version of A/65 contains additional features and capabilities that are not covered by this RP.

receiver that channel's current time. If there are differences between the STT times carried by different stations, then viewers can experience problems such as missing the beginning of programs or incorrect PVR switching.

10.1 MGT

Error conditions for the Master Guide Table are classified in Table 10.1.

Table 10.1 MGT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
MGT repetition error	MGT repetition interval error (150ms < cycle time ≤ 300ms)					X
MGT repetition error	MGT repetition interval error (300ms < cycle time ≤ 750ms)				X	X
MGT absence error	MGT not found (cycle time > 750ms)	X	X	X	X	X
MGT syntax error	CRC is incorrect for table_id 0xC7 [1]					X
MGT syntax error	scrambling_control_field is not '00' for packets containing MGT [2]	X	X	X	X	X
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3. 2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.						

10.2 TVCT

Error conditions for the Terrestrial Virtual Channel Table are classified in Table 10.2.

Table 10.2 TVCT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
TVCT repetition error	TVCT repetition interval error (400ms < cycle time ≤ 800ms)					X
TVCT repetition error	TVCT repetition interval error (800ms < cycle time ≤ 2000ms)				X	X
TVCT absence error	TVCT not found (cycle time > 2000ms)	X [3]	X	X	X	X
TVCT syntax error	CRC is incorrect for table_id 0xC8 [1]					X
TVCT syntax error	scrambling_control_field is not '00' for packets containing TVCT [2]	X [3]	X	X	X	X
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3. 2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected. 3) PSIP system is off-air. Tuning algorithms based on PSIP will fail. The FCC rules require PSIP (A/65B).						

10.3 CVCT

Error conditions for the Cable Virtual Channel Table are classified in Table 10.3.

Table 10.3 CVCT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
CVCT [1]						
CVCT repetition error	CVCT repetition interval error (400ms < cycle time ≤ 800ms)					X
CVCT repetition error	CVCT repetition interval error (800ms < cycle time ≤ 2000ms)				X	X
CVCT absence error	CVCT not found (cycle time > 2000ms)		X [4]	X	X	X
CVCT syntax error	CRC is incorrect for table_id 0xC8 [2]					X
CVCT syntax error	scrambling_control_field is not '00' for packets containing CVCT [3]		X [4]	X	X	X

Legend:

TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:

1) The CVCT is not required to be present in a terrestrial broadcast.

2) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.

3) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.

4) CVCT generator is off-air. Tuning algorithms based on CVCT will fail.

10.4 RRT

Error conditions for the Rating Region Table are classified in Table 10.4.

Table 10.4 RRT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
RRT [1]						
RRT repetition error	RRT repetition interval error (60,000ms < cycle time ≤120,000ms)					X
RRT repetition error	RRT repetition interval error (120,000ms < cycle time ≤ 300,000ms)				X	X
RRT absence error	RRT not found (cycle time > 300,000ms)			X [4]	X	X
RRT syntax error	CRC is incorrect for table_id 0xCA [2]					X
RRT syntax error	scrambling_control_field is not '00' for packets containing RRT [3]			X [4]	X	X

Legend:

TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:

1) RRT is not required to be present for Rating Region 1. If the RRT is signaled in the MGT, then these error conditions apply.

2) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.

3) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.

4) PSIP component missing.

10.5 EIT and ETT

Error conditions for the Event Information Table and Extended Text Table are classified in Table 10.5.

Table 10.5 EIT and ETT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
EIT-0 repetition error	EIT-0 repetition interval error (500ms < cycle time ≤ 1000ms)					X [3]
EIT-0 repetition error	EIT-0 repetition interval error (1000ms < cycle time ≤ 2500ms)				X [4]	X [3]
EIT-0 absence error	EIT-0 not found (cycle time > 2500ms)		X [4]	X [4]	X [4]	X [3]
EIT syntax error	CRC is incorrect for table_id 0xCB [1]					X
EIT syntax error	scrambling_control_field is not '00' for packets containing EIT [2]			X [5]	X	X
EIT-1 repetition error	EIT-1 repetition interval error (3 seconds < cycle time ≤ 6 seconds)					X [6]
EIT-1 repetition error	EIT-1 repetition interval error (6 seconds < cycle time ≤ 15 seconds)				X [6]	X [6]
EIT-1 absence error	EIT-1 not found (cycle time > 15 seconds)			X [6]	X [6]	X [6]
EIT-2, EIT-3 repetition error	EIT-2, EIT-3 repetition interval error (1 minute < cycle time ≤ 2 minutes)					X [6]
EIT-2, EIT-3 repetition error	EIT-2, EIT-3 repetition interval error (2 minutes < cycle time ≤ 5 minutes)				X [6]	X [6]
EIT-2, EIT-3 absence error	EIT-2, EIT-3 not found (cycle time > 5 minutes)			X [6]	X [6]	X [6]
ETT syntax error	CRC is incorrect for table_id 0xCC [1]					X
ETT syntax error	scrambling_control_field is not '00' for packets containing ETT [2]			X [5]	X	X

Legend:
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:
1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.
2) An error in the setting of the scrambling control field is most likely an indicator of a hard failure or incorrect setting and will persist until corrected.
3) This condition is technically compliant, but violates the A/65 recommended interval (in the U.S., the FCC recommended interval).
4) EIT-0 is required. Certain receivers may have difficulty tuning and EPG display may be affected.
5) PSIP component missing – may or may not affect behavior of receiver.
6) EIT1–3 are required. EPG display may be affected if missing. Recommended timings for EIT1–3 are given in A/69 (PSIP Standard).

10.6 STT

Error conditions for the System Time Table are classified in Table 10.6.

Table 10.6 STT Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
STT repetition error	STT repetition interval error (1000ms < cycle time ≤ 2000ms)					X
STT repetition error	STT repetition interval error (2000ms < cycle time ≤ 5000ms)				X	X
STT absence error	STT not found (cycle time > 5000ms)			X [2]	X	X
STT syntax errors	CRC is incorrect for table_id 0xCD [1]					X
STT time value error	STT time value is more than 30 seconds away from current correct GPS second_count (including GPS_UTC_offset impact)			X [2,3]	X	X
Legend:						
TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes:						
1) Each instance of an incorrect CRC should be interpreted as the table not being present. This occurrence should be considered as part of a repetition or absence error determination. See Section 6.3.						
2) PSIP component missing.						
3) This error is considered large enough to have a noticeable impact on users who tune/record by time of day.						

11.0   TIMING AND BUFFER ERRORS

Timing is the key to the MPEG-2 encoding and decoding processes. MPEG-2 Systems (ISO/IEC 13818-1) [14] defines a model for the system timing, adherence to which allows independent design of encoders and decoders that can interoperate. An MPEG-2 decoder's 27 MHz reference clock needs to be synchronized with the equipment that is creating the encoded stream. In order to achieve this synchronization, PCR (Program Clock Reference) 27 MHz clock timestamps are sent within the stream at a rate frequent enough to re-synchronize the decoder with the encoder clock.

Multiple conditions can cause the decoder clock to get out of sync with the encoder:

☐ Incorrect PCR timestamps inserted in the TS. This condition can send the decoder reference clock out of sync with the encoder clock.

☐ PCR not inserted often enough. This condition could cause the decoder reference clock to drift away from the encoder clock as it does not receive resynchronized timestamps often enough.

☐ Jitter introduced during the delivery process (packets arriving early or late, which creates drift of the decoder clocks and causes buffer underflow or overflow).

A referenced clock is used during the decoding process to indicate when to move data between buffers and to indicate when a frame should be decoded and presented to the stream.

Null packets are used to maintain a constant bit rate transport stream for the modulator. Some facilities see these Null packets as opportunistic packets and replace them with private data packets. This process should not impact a normal SCTE receiver. Although, physically dropping a Null packet prior to modulation, or replacing one Null packet with two private data packets, will negatively impact the PCR timing, and possibly the modulator also. This is why re-multiplexers must take great care to accurately restamp all PCR, PTS, and DTS values whenever transport packets are shifted in time.

The PTS (Presentation Time-Stamp) and DTS (Decoding Timestamps) are based on the PCR and are used by the decoder to sequence the decoding process, and to manage the decoding buffer.

If the local decoder clock is not synchronized with the encoder, it may affect the decoding process by providing incorrect timing. The consequences of de-synchronization can be buffer overflow or underflow, or presentation timing mismatch. The result of this error can lead to freeze or missing frames on the display. Another result of this scenario could be poor audio/video lip-synchronization.

Buffer, PTS, and DTS errors can also be introduced by encoders and multiplexers outside of PCR errors (see Section 5 in reference [15] for timestamp accuracy and consistency). They can also create some timing errors, resulting in missing or out of sync decoded elements.

> Note: Actual decoders may have a larger buffer than the minimum required by MPEG-2, therefore are capable of absorbing some effects of timing errors and buffer overflow. The standard provides a minimum amount of RAM so that a theoretical model will never underflow or overflow. Some receivers may provide more memory than is required by the standard. Therefore, it is possible to have some receivers working well while others fail. A model using the minimum amount of RAM as specified by the standard may fail, while another model with 50 percent more RAM works flawlessly. This is a sign that the T-STD buffers in the encoder are either underflowing or overflowing. Meeting these buffer requirements does not guarantee a high quality program, but it does mean that the program can be decoded by any receiver that complies with the SCTE standard.

When Out-Of-Band SI information is present, a maximum data rate has been defined to keep the receiver microprocessor from overflowing. A maximum data rate of 150 kbps is defined for each of the following:

1) SI Base PID (0x1FFC)

2) Any AEIT PID

3) Any AETT PID

Similarly, a minimum transmission rate has been set for some OOB-SI packet streams to ensure efficient recovery of EPG data for the current time period. A minimum data rate of 10kbps is defined for:

1) AEIT-0,1/AETT-0,1 PID

11.1   PCR

Error conditions for the Program Clock Reference are classified in Table 11.1.

Table 11.1 PCR Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
PCR [1]						
PCR error	Unsignaled PCR discontinuity				X	X
PCR repetition error	PCR repetition interval error (100ms < cycle time ≤ 200ms)					X
PCR repetition error	PCR repetition interval error (200ms < cycle time ≤ 500ms)				X	X
PCR absence error	PCR not found (cycle time > 500ms)		X	X	X	X
PCR error	500 ns < ⎪PCR inaccuracy⎪ ≤ 2500 ns					X
PCR error	⎪PCR inaccuracy⎪ > 2500 ns				X	X
PCR related parameters	810 Hz < PCR frequency offset ≤ 4050 Hz					X
PCR related parameters	PCR frequency offset > 4050 Hz)				X	X
PCR related parameters	75 milliHerz/second (mHz/s) < PCR frequency drift ≤ 375 mHz/s					X
PCR related parameters	PCR frequency drift > 375 mHz/s				X	X
PCR related parameters	25 μS < PCR overall jitter ≤ 125 μs					X
PCR related parameters	PCR overall jitter > 125 μS				X	X
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) ETSI TR 101 290 v1.2.1 Section 5.3 and Annex I [13] provide measurement techniques for these PCR-related parameters. The thresholds therein are explicitly not part of this recommendation and should be ignored in favor of those in the table..						

11.2 PTS

Error conditions for the Presentation Time-Stamp are classified in Table 11.2.

Table 11.2 PTS Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
PTS interval error [2]	700 ms < Interval between coded PTS values ≤ 1400 ms [3]					X
PTS interval error	1400 ms < Interval between coded PTS values ≤ 3500 ms [3]				X	X
PTS absence error	Interval between coded PTS values > 3500 ms [3]			X	X	X
PTS increment error	PTS time not incrementing at the reciprocal of the frame rate [1]					X

Legend:

TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:

1) Any discrepancy in the correlation of the timing between the PTS time and the frame rate could result in decoding buffer overflow or underflow. This could be manifested by the display of missing or frozen frames at an interval that depends on the size of the offset between the reciprocal of the PTS time and the frame rate. This could also contribute to changes in the apparent audio/video synchronization ("lip synch").

2) A/53-3 places tighter constraints on video PES construction than SCTE 54 [2]; many manufacturers will follow A/53-3. For more information see the section on PES constraints in A/53-3.

3) PTS values are required with intervals not exceeding 700 ms in each elementary audio and video stream. These time intervals are measured in presentation time, that is, in the same context as the values of the fields, not in terms of the times that the fields are transmitted and received.

11.3 Buffer Errors

Buffer errors are classified in Table 11.3

Table 11.3 Buffer Error Conditions

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
Buffer errors	Overflow of transport buffer					X
Buffer errors	Overflow of system information buffer					X
Buffer errors	Overflow of MPEG-2 Video buffer					X
Buffer errors	Underflow of MPEG-2 Video buffer				X	X
Buffer errors	Overflow of AC-3 Audio buffer					X
Buffer errors	Underflow of AC-3 Audio buffer				X	X
OOB-SI bandwidth	When present, SCTE-65 maximum OOB-SI bandwidth (150kb/s for base PID, 150kb/s for any AEIT/AETT PID) [1]				X	X
OOB-SI bandwidth	When present, SCTE-65 minimum OOB-SI bandwidth (10kb/s for AEIT-0,1/AETT-0,1 PID) [2]				X	X

Legend:

TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:

1) Exceeding this limit may result in degradation of other services.

2) Required to ensure efficiency of recovery of EPG data covering the current time period across the POD to Host interface.

12.0   CONSISTENCY ERRORS

Before a receiver can decode a transport stream, it must identify the relationship between components in the stream. Some components contain audio and video (Elementary Streams), and other components contain information describing the relationship between them (Metadata). The receiver uses metadata to identify each component, determine its function and select an appropriate set of components when the user selects a virtual channel for decoding. Conflicts and problems within the structure of metadata are called 'consistency errors.' Consistency errors can result in broken decoding, missing system components (such as closed captioning), and/or missing program guide information. This section covers the types of errors that can cause these problems.

Cable operators need to concern themselves with two kinds of metadata. Metadata defined by the SCTE is called 'Service[2] Information (SI), and Metadata defined by MPEG is called 'Program Specific Information' (PSI). Some of the functions of PSI are duplicated by SI. The duplication creates alternative means of locating system components; problems arise if they conflict.

There are three categories of metadata consistency errors: external, internal, and collision errors.

External consistency errors occur when the PSIP and PSI information do not agree with one another. These errors typically occur when more than one device in the system is configured to generate metadata. If the PSIP is generated by one system device, and the PSI is generated by another system device, then it is possible for the two devices to get out of 'sync' with each other. For example, the PMT is a PSI table, and the TVCT is a PSIP table. Both tables contain the program_number field. Suppose the PMT (generated on a multiplexer) lists one value for the program_number, and the TVCT (generated in a PSIP generator) contains a different one. The receiver is forced to decide between the PSIP and the PSI, and cannot determine which one is correct. The response of a receiver to a specific external consistency error depends upon the receiver implementation. Two receivers from different vendors will frequently react differently to the same external table inconsistency.

Internal consistency errors occur when metadata contains references that are wrong but do not cross the boundary between PSI and PSIP. For example, the Program Map Table (PMT) is a PSI table. One of the data fields in the PMT is the PCR_PID. If the value of the PCR_PID field is incorrect, then receivers may have difficulty displaying video and audio. This is an internal constancy error because the PCR_PID value is found in a PMT (a PSI table) and not carried in any PSIP table.

Internal consistency errors are not limited to PSI tables; they can occur in PSIP tables too. Consider the Master Guide Table (MGT) and the Channel Extended Text Table (Channel ETT), both of which are PSIP tables. Correctly formatted PSIP requires an MGT, but the Channel ETT is an optional PSIP table. If the MGT (required table) contains a reference to the Channel ETT (optional table), but the Channel ETT does not exist in the stream, then the resulting stream has a

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[2] Some standards call this "system information" instead.

PSIP internal consistency error. Internal consistency errors can cause receivers to search for absent stream elements, or fail to find existing elements. Program guide information, closed captioning, and secondary audio channels are examples of program elements that may be affected by internal consistency errors.

Collision errors are the third kind of consistency error. They occur when similar metadata is generated on different devices in a system, and then multiplexed together into the same output. For example, multiplexers and PSIP generators are frequently capable of generating PSI. Consider the case where PSI is generated on a multiplexer, and also generated by a PSIP generator. Unless steps are taken to consolidate the PSI from these two sources, the two different versions of PSI will collide at the output of the multiplexer. The output will contain alternating versions of PSI from each source (in this case the multiplexer and PSIP generator version). Many receiver implementations will simply fail to decode in the presence of a collision error.

Consistency errors are classified in Table 12.1.

Table 12.1 Consistency Errors

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
TSID values in PAT and VCT (transport_stream_id) do not match [1]		X	X	X	X	X
PAT/VCT mismatch [2]	Different number of programs found in VCT than signaled in PAT [3]		X		X	X
VCT/PMT mismatch	SLD/PMT mismatch (number of services)		X	X	X	X
VCT/PMT mismatch	SLD/PMT element mismatch (different "parameters" for matching program elements)			X	X	X
PMT/EIT-0 descriptor mismatch [4]	Mismatch in duplicated descriptors for current event between PMT and EIT-0			X	X	X
ETT syntax errors	ETT has invalid ETM_ID or ETM_ID does not match existing event_id in EIT (excludes channel ETT)			X [5]	X	X
ETT syntax errors	ETT has ETM_ID of channel ETT, but MGT does not flag channel ETT on this PID				X	X
Multiple sources of PSI	Version numbers for particular PSI tables should never decrease (except at wraparound) [6]	X	X	X	X	X
Daylight Savings time settings	STT contains invalid values for Daylight Savings time switchover					X
Service Location Descriptor missing from VCT	No Service Location Descriptor in VCT		X	X	X	X
Dangling source_id	source_id mismatch (either source_id in VCT does not have a corresponding source_id in EIT or source_id in EIT does not have a corresponding source_id in VCT)		X	X	X	X
MGT mismatch	Version number and/or size of tables signaled in MTG does not match with actual table [7]				X	X
MGT mismatch	PSIP table found in stream, but not signaled in MGT					X
Language mismatch	Mismatch between AC-3 and ISO 639 language descriptors			X	X	X

Legend:

TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant

Notes:

1) Receivers may not tune if these fields do not agree.

2) While some receivers may operate correctly, others may not display the program in this case.

3) Conditional on the state of the hidden flag in the VCT, whether the virtual channel is digital or analog and whether the virtual channel is in another transport

4) This error condition may cause captioning to not work.

5) The text description of the event is the missing component.

6) This condition is indicative of multiple sources of PSI tables (from both multiplexer and PSIP generator).

7) Tables signaled differently than the actual parameters can lead to variable behavior, dependant on the receiver and the actual table.

13.0   GENERAL ERRORS

The errors listed within this Section cover a variety of types of problems (typically transport-related). For those listed in only the QOS and TNC columns, a single occurrence should be treated merely as a minor problem, which, unless periodically re-occurring, is not of concern. A repeated occurrence should warrant investigation, as it might be indicative of a device approaching total failure.

Some types of errors do occur which are not listed in the following table. Specifically, they are:

☐ One or more transport packets were detected with a PID value that was not part of a properly signaled service. This situation is sometimes referred to as an "orphan PID".

☐ Some TS may also contain DVB or ARIB system tables in addition to PSIP. All of these tables have fixed PID assignments and do not appear in the PMT. User notification of such occurrences in a given TS may need to be conditioned by user expectations rather than treated as errors.

Note: Multiple MPEG-2 Registration Descriptors within a loop may be a commonly encountered error as the rules for usage were originally unclear and only clarified after significant amounts of equipment were deployed.

General errors are classified in Table 13.1.

Table 13.1 General Errors

Error Condition	Error Qualifier	TOA	POA	CM	QOS	TNC
TS Synch Loss [1]	Two or more sync bytes are corrupt (not 0x47)	X	X	X	X	X
Sync Byte Error [1]	Single Sync byte is not 0x47				X	X
Continuity Count Errors	Packets have been lost				X	X
Transport error [2]	transport_error_indicator in TS packet header is set					X
Multiple registration descriptors	Multiple registration descriptors in any given iteration of a descriptor loop [3]					X
PID values below 0x30 are used in the TS	PID values below 0x30 are reserved for specific applications as defined in the relevant standards. Any other use of these PID values is an error.					X
Missing Descriptors	One or more required descriptors were not found in the stream [4]			X	X	X
Legend: TOA: TS Off Air, POA: Program Off Air, CM: Component Missing, QOS: Quality of Service, TNC: Technically Non-Conformant						
Notes: 1) See also special case of Distributed Transmission Adapter (Cadence Sync Byte) [11]. 2) Transport sync errors are indicative of missing packets. Missing packets are treated elsewhere in this document. 3) The error may be more severe, depending upon the situation. 4) The following descriptors are required to be present in the stream: AC-3 Audio Descriptor, Program Smoothing Descriptor, ISO-639 Language Descriptor and Service Location Descriptor. 5) The ATSC A/53-3 Standard [5] requires language signaling to be placed in the extended AC-3 descriptor and changed the insertion in the PMT of the ISO-639 language descriptor from required to optional, effective March 2008. While some broadcasters may include the ISO-639 language descriptor in addition to the extended AC-3 descriptor to signal the language of each audio service, some may not. The policy question of who is responsible for making the PMT conform to the requirements of SCTE 54 [2] Section 5.8.3.2 is outside the scope of this Recommended Practice.						