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Digital television—Requirements for receivers

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Australian Standard

Digital television—Requirements for receivers

Part 1: 7MHz VHF/UHF DVB-T television broadcasts

(Revision of AS 4933.1—2000)

(To be AS 4933.1—200x)

This draft Standard defines both essential and optional requirements for DVB-T compliant digital broadcast television receivers for Australia with the capability of receiving Standard Definition television and optionally High Definition television via terrestrial broadcasting services.

Comment on the draft is invited from persons and organizations concerned with this subject. It would be appreciated if those submitting comment would follow the guidelines given on the inside front cover.

Attention is drawn to the fact that this document is a draft Australian Standard only and is liable to alteration in the light of comment received. It is not to be regarded as an Australian Standard until finally issued as such by Standards Australia.

PREFACE

This Standard was prepared by the Joint Standards Australia / Standards New Zealand Committee CT 002, Broadcasting and Related Services. It is the result of a consensus among the representatives to the Joint Committee to produce it as an Australian Standard.

The objective of this Standard is to provide television receiver manufacturers with the technical specifications and requirements of digital television receivers in order to achieve successful reception from free-to-air DTTB transmissions that comply with the Australian DTTB transmission Standard:

AS 4599, [including current Amendments] *Digital television — Terrestrial broadcasting — Characteristics of digital terrestrial television transmissions.*

Interoperability issues for DVB-S, DVB-C and Datacasting are not addressed in this part of the Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the Annex to which they apply.

A ‘normative’ Annex is an integral part of a Standard, whereas an ‘informative’ Annex is only for information and guidance. Informative sections are included also in the main body of this standard.

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FOREWORD

Digital terrestrial television broadcasting (DTTB) in Australia officially commenced on January 1st, 2001. The transmissions are based on the DVB-T[1] system, however, it should be noted that the international DVB Standards and related ETSI, IEC/ISO and ITU-R documents provide a range of operational choices.

Many other implementations of digital television systems around the world operate on pay satellite and cable systems where compatibility between transmission and reception equipment of each system is generally under the control of a single system operator. These are known as 'vertical' markets.

In contrast, no single operator will be in control of the Australian implementation of the digital terrestrial television broadcasting system. There are multiple free-to-air services and multiple receiver/decoder manufacturers, as well as subscription television services and datacasting services delivered in the digital television broadcasting environment. Domestic digital television receivers are expected to be available from a wide range of manufacturers through many retail suppliers; this is known as a 'retail' or 'horizontal' market.

Consumers will expect a choice of receiving equipment from many manufacturers, ranging from fully integrated receivers with cathode ray tubes or other display devices to modular set-top-box receivers intended for connection to a separate display and sound reproduction system, (see Annex C). This equipment will be expected to satisfactorily receive digital terrestrial television broadcasts from a choice of multiple broadcasters (each probably using a different brand of encoding and transmission equipment).

A separate Australian Standard, AS 4599, details information specific to the transmission aspects of the Australian adaptation of the relevant ETSI DVB-T Standards. For an overview on DVB documents the reader is referred to the technical report from DVB: TR 101 200 V1.1.1 (1997-09); 'Digital Video Broadcasting (DVB); A guideline for the use of DVB specifications and Standards'.

This Standard aims to provide the necessary information so that any digital terrestrial television receiving equipment made for the Australian system will operate satisfactorily on Australian digital terrestrial television broadcast transmissions.

While some receiver requirements are nominated to be essential, in general, it will be a marketing choice by the manufacturer as to how the various receiver models operate with a variety of conditions.

Conformance testing related to this standard is the responsibility of the manufacturer.

See below for a summary of important DTTB receiver requirements to operate in the Australian environment.

Manufacturers should note that DTTB is a rapidly evolving technological environment and, consequently, this Standard may require revisions and additions. Readers are urged to contact any Standards Australia office or broadcasters regarding such changes.

[1] DVB-T: Digital Video Broadcasting (project) – Terrestrial. The DVB Project Office is co-located at the headquarters of the European Broadcasting Union in Geneva, Switzerland. Their web site is http://www.dvb.org/

Summary of Minimum DTTB Receiver Requirements for Australia

(a) The receiver shall operate in a 7MHz VHF/UHF channel allocation with possibly higher powered analog PAL signals present in adjacent channels – digital channel allocations range from 174 MHz to 820MHz, some with 125kHz offsets;

(b) All COFDM modes, including all COFDM hierarchical modulation modes shall be receivable by both SD-only receivers and receivers that also have HD capabilities. (See Sections 4.1 and 4.3 of Table 1);

(c) Receivers shall be able to demodulate and decode the Transmission Parameter Signalling (TPS) data to determine or confirm transmission parameters when an RF transmission is first accessed or when a service on a different RF transmission is selected. As COFDM transmission parameters may change from time-to-time, TPS data should also be accessed if a signal is lost;

(d) Single Frequency Network (SFNs) are in use and all receivers are expected to operate in these environments;

(e) Receivers should use the broadcast Logical Channel Numbering of services to simplify channel selection. (This is an Australian adaptation from the UK DTG and EACEM definition of Logical Channel Numbering and is found in the NIT 2nd loop with tag of 0x83 – See Annex I 1. page 81);

(f) Broadcasters may change COFDM modes and available services in the transport stream from time-to-time, requiring receivers to refresh the 'PAT', 'PMT', 'NIT' and 'SDT' data on a regular (typically 10sec), basis. Receivers shall check in the PMT, the PID values for video, audio and other components of a service when selected, as these may change from time-to-time. Receivers shall not assume any sequenced or ordered numbering of the PID values of various components of a service;

(g) All receivers shall be capable of decoding 50Hz based Standard Definition (SD) MPEG-2 picture formats with displayable closed captions and MPEG-1 Layer II sound, and optionally, Dolby Digital® (AC-3) sound. Receivers may also decode a number of 50Hz based High Definition (HD) picture formats (see preferred interface and scanning details in Annex H), with additional decoding for up to 5.1 channel Dolby Digital® (AC-3) sound (See Sections 7 and 8 of Table1);

(h) Standard Definition receivers (SD-only), if switched to a HD (MP@HL) service, should not attempt to decode the service and either present a message to the user or a blank screen (See Annex I 5. on page 84).

(i) Receivers should use Australian specific look-up tables for on-screen display for time-zone region setting using the transmitted Time Offset Table (TOT) and Parental-Guidance codes and Program Content (Genre) codes using the transmitted Event Information Table (EIT);

(j) If a receiver includes an optional Dolby Digital® (AC-3) sound decoder, then the receiver shall operate to a viewer's preset preference or indicate and give a choice to the viewer if a service has other audio channels (sound tracks), which the receiver is able to decode;

(k) Some transmissions will include radio services in MPEG-1 layer-II format, which receivers shall be able to decode;

(l) Receivers shall be able to provide decoding of Closed Captions broadcast in Teletext. Bit-mapped format decoding may also be provided. In the case of set-top-boxes, the teletext shall be added to the VBI on the analog outputs;

(m) Optionally provide DSM-CC support to enable capability for databroadcasting and system software upgrade (SSU) by over-the-air download, conforming to DVB/ETSI standards;

(n) Optionally provide interactivity conforming to the DVB MHP with optional return channel capability such as an inbuilt modem or a serial data port such as RS232 or USB, capable of supporting a modem;

(o) Optional Common Interface (CI) expandability using one or more 'PCMCIA' sockets and optional 'SmartCard' socket may be provided.

Manufacturers of DTTB receivers incorporating interactive capabilities will need to confirm aspects of the Australian Interactive Digital Television 'Feature Set' which is currently under development.

Australian Standard

Digital television—Requirements for receivers

Part 1: 7MHz VHF/UHF DVB-T television broadcasts

1. SCOPE AND APPLICATION

1.1 Scope

This Standard defines both essential and optional requirements for DVB-T compliant digital broadcast television receivers for Australia with the capability of receiving Standard Definition television and optionally High Definition television via terrestrial broadcasting services. Other optional features include interactivity, datacasting services, surround sound, multi lingual and appropriate interfaces for ancillary equipment. Specifications for subscription/pay services should be obtained from the operators of those services although specifications for the possible addition to a receiver of a Conditional Access system or other features are included.

See Annex A for abbreviations and a glossary of terms used in this Standard.

See Annex H for details on 50Hz SD and HD scanning and interface parameters.

See Annex I for receiver functionality issues that have attracted attention since the commencement of transmissions.

1.2 Application

Australian digital terrestrial transmissions will include SD pictures at 2 possible line rates and HD TV pictures at 3 possible line rates. The terrestrial transmissions' sound format for SD services will be MPEG-1 (Layer II), or both MPEG-1 (Layer II) and AC-3 (Dolby Digital®), whereas for HD, the sound format will be MPEG-1 (Layer II) or AC-3 (Dolby Digital®), or both.

A range of receiving equipment may be available either in modular or fully integrated forms that extend from low-cost limited-facility with a standard definition video and monophonic sound output to premium full-facility features providing high definition display with full surround sound. Modular equipment may be set-top box style integrated-receiver-decoders or plug-in PC card tuner-decoders.

Annex C gives an example of the components of the architecture of a typical digital terrestrial television receiver and set-top-box.

While this Standard seeks to identify minimum essential requirements for reception, demodulation and decoding of television broadcasts complying with the Australian implementation of DVB-T, additional information and recommendations are provided to clarify preferred implementation if a feature is included in the receiver's design.

As a minimum requirement, equipment must be capable of simultaneously decoding from the transport stream, a video stream, an associated audio stream and associated teletext subtitles and/or bit-mapped subtitle closed captions. The decoded information shall be presented in a time-synchronized manner suitable for a display device and sound reproduction system.

If necessary, the video may be required to be spatially format converted ('scaled'), as the received format may be different to the display format. For example, if a digital terrestrial set-top-box receiver is connected to a standard 4:3 television display, down-scaling will be required to display a high definition 16:9 program. Correspondingly, the received audio channels may need to be processed or down mixed to suit the available sound reproduction equipment.

2. REFERENCED DOCUMENTS

The following documents are referenced in this Standard. Where no particular edition or version of the referenced document is specified, the latest or current edition or version should be used.

AS

4599 plus amendments	Digital television—Terrestrial broadcasting—Characteristics of digital terrestrial television transmissions
[XXXX]	Australian Broadcast Teletext Specifications (in preparation)
4542	Consumer television interfaces
4542.1	Part 1: PAL RF
4542.2	Part 2: Analog baseband
4542.3	Part 3: Digital interfaces (in course of preparation)

AS/NZS

1053	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.
60065	Approval and test specification—Mains operated electronic and related equipment for household and similar general use
60950	Approval and test specification—Safety of information technology equipment including electrical business equipment

IEC

48B	Connectors for consumers appliances
60065	Audio, video and similar electronic apparatus—Safety requirements
60169	Radio-frequency connectors
60169-2	Part 2: Coaxial unmatched connector
60598	Digital audio interfaces
60598-4	Part 4: Professional applications
60950	Safety of information technology equipment
61937	Processing of audio bit streams
IEC/CENELEC 62 216-1:	Baseline Digital Terrestrial TV Receiver Specification - (formerly EACEM Technical Report - TR-030 version 1.1)
62315	DTV profiles for uncompressed digital video interfaces Draft is being circulated under the TC 100 accelerated procedure.

ISO

7816	Identification cards— Integrated circuit(s) cards with contacts

ISO/IEC

11172	Information technology — Coding of moving pictures and associated audio for digital storage media at up to about 1.5 Mbit/s
11172-1	Part 1: Systems
11172-2	Part 2: Video
11172-3	Part 3: Audio

Referenced Documents (Continued)

13818	Information technology—Generic coding of moving pictures and associated audio information
13818-1	Part 1: Systems
13818-2	Part 2: Video
13818-3	Part 3: Audio
CENELEC	
R206-001:1998	Guidelines for Implementation and Use of the Common Interface for DVB Decoder Applications. (Prepared by the Technical Committee CENELEC TC 206)
EN50049-1	Domestic and similar electronic equipment interconnection requirements: Peritelevision connector.
EBU	
EBU SPB 492	Teletext specification (625 line television systems)
ETSI	
EN 300 468	Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems
EN 300 472	Specification for conveying ITU-R System B Teletext in DVB bitstreams
EN 300 744	Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television - A012 Rev. 2 (03/01)
EN 301 192	Digital Video Broadcasting (DVB); Specification for data broadcasting
EN 301 775	Specification for the delivery of VBI data in DVB bitstreams
EN 50221	Common Interface Specification for Conditional Access and other Digital Video Broadcasting Decoder Applications
ETR 289	Digital Video Broadcasting (DVB); Support for use of scrambling and Conditional Access (CA) within digital broadcasting systems
ETS 300 743	Subtitling systems [refer DVB Blue Book A009]
TR 101 154	Digital broadcasting systems for television; Implementation guidelines for the use of MPEG-2 systems; Video and audio in satellite, cable and terrestrial broadcasting applications: A001 Rev. 6 (05/00)
Draft TR 101 162	Allocation of Service Information (SI) codes for DVB systems (N.B. frequently changed, available on Internet)
TR 101 211	Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)
TR 101 200	Digital Video Broadcasting (DVB);A guideline for the use of DVB specifications and standards
TS 101 191	Digital Video Broadcasting (DVB); DVB mega-frame for Single Frequency Network (SFN) synchronization
TS 101 699	Digital Video Broadcasting (DVB); Extensions to the Common Interface Specification (EN 50221)
TS 102 006	Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems

Referenced Documents (Continued)

TS 102 201	Digital Video Broadcasting; Interfaces for DVB Integrated Receiver Decoder (DVB-IRD)
TS 101 812	Digital Video Broadcasting (DVB); Digital Video Broadcasting; Multimedia Home Platform (MHP)
TS 102 812	Multimedia Home Platform (MHP) Specification 1.1
C.TVA [2]	C.TVA - Commercial Television Australia (formerly Federation of Australian Commercial Broadcast Stations)
Operational Practices (OPs)	Reference is made to a number of CTVA (FACTS) OPs. These OPs are documents designed and used by Australian free-to-air broadcasters, which may be regarded by receiver manufacturers as “informative” but may give a useful insight into how particular aspects of Australian digital TV services and SI are configured.
IEEE	
802	
1394	Standards for a high performance serial bus
ITU-R	
BT 653-2	Teletext Systems (System B)
BT 709-3	Parameter Values for the HDTV Standards for Production and International Programme Exchange
BT.1358	Studio Parameters of 625 and 525 Line Progressive Scan Television Systems
BT 1368	Planning Criteria for Digital Terrestrial Television Services in the VHF/UHF Bands
BS 1196-1	Audio Coding for Digital Terrestrial Television Broadcasting. (Note: DVB implementation differs to that used by the ATSC standards.)
Australian Broadcasting Authority	
ABA Planning Handbook	Digital Terrestrial Television Broadcasting Planning Handbook, including Technical and General Assumptions;Australian Broadcasting Authority, July 1999 (www.aba.gov.au/)
Australian Communications Authority	
ACA TS 001	Safety Requirements for Customer Equipment www.aca.gov.au/standards/
AS/ACIF S 002 2001	Analog Interworking and Non interference Requirements for Customer Equipment connected to the Public Switched Telephone Network

[2] C.TVA - Commercial Television Australia (formerly Federation of Australian Commercial Television Stations), 44 Avenue Road, Mosman, NSW 2088 (was www.facts.org.au - now www.ctva.com.au)

3. ESSENTIAL AND OPTIONAL REQUIREMENTS

3.1 Introduction to Table 1

The details listed in Table 1 for the operation of DTV reception equipment are based on the Australian adaptation of the DVB-T Standards for digital television terrestrial transmissions and are for the guidance of manufacturers and suppliers of Australian DTTB consumer equipment.

Table 1 : Receiver Requirements

Item Description	Remarks	Reference Standards	Applicability
1. BASIC FEATURES			
1.1 Minimum Requirements For Terrestrial Reception - Performance[3] This clause lists the essential conformance requirements for any DVB-T receiver to operate on Australian DTTB transmissions. These are based on ETSI/DVB-T Standards, with the choices applicable to Australia, as identified in the Australian transmission Standard, AS 4599.	The receiver shall be able to receive and decode a free-to-air television service, in a correctly constituted Australian DVB-T transport stream irrespective of other services (that may possibly be encrypted) in that transport stream. A situation may arise on datacasting transmissions, which may carry subscription services using Conditional Access as well as free-to-air television services in their transport stream The receiver shall not require the presence of a decryption enabling mechanism such as conditional access (CA) system and/or a 'smartcard' in order to receive and decode free-to-air television services. For reception of Standard Definition (SD) broadcasts, basic receivers shall be capable of decoding from the transport stream: - 1. any Standard Definition (SD) video stream of up to 720 × 576 × 50i MP@ ML MPEG video, and 2. an associated audio stream of MPEG-1 Layer II, and 3. optionally, an associated audio stream of up to 5.1 channels of Dolby Digital AC-3, and 4. teletext closed captions and, 5. bit-mapped subtitles, and present the decoded (and scaled if necessary), picture, sound and other information in a time-synchronized manner. Receivers may optionally provide interactivity conforming to the MHP standards. High Definition (HD) capable receivers, in addition to being capable of receiving SD broadcasts with MPEG audio, as defined above, shall be capable of decoding from a High Definition broadcast transport stream: - 1. any High Definition (HD) video stream of up to 1920 × 1080 × 50i MP@ HL MPEG video, and 2. an associated audio stream of up to 5.1 channel of Dolby Digital AC-3, or 3. an associated audio stream of MPEG-1 Layer II, and 4. teletext closed captions, and 5. bit-mapped subtitles and present the decoded (and scaled if necessary), picture, sound and other information in a time-synchronized manner. Receivers may optionally provide interactivity conforming to the MHP standards.		All receivers All SD-only receivers All HD capable receivers
1.2 Receive capability for analog PAL transmissions	For example, integrated receivers operating in areas where PAL services are not yet duplicated on digital.		Optional, at manufacturer's choice.

[3] Refer to Government regulatory requirements and broadcasters' intentions in Australia.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
1.3 Australian regulatory and safety requirements			
1.3.1 Electrical safety	Mains-powered equipment shall comply with AS/NZS 60065-2000. Australian electrical mains supply is nominally 240 V AC 50 Hz. Where a modem is incorporated in the digital receiver equipment for wired connection to a public telecommunications network (see Table 5, Item 16.3), the receiver shall comply with ACA TS 001 and TS 002 safety requirements. If the digital equipment is also supplied with an accessory telephone cable it shall comply to ACA TS008	AS/NZS 60065 AS/NZS 60950	All receivers Receivers with inbuilt modems
1.3.2 EMC [4] [5]	To satisfy Australian Communications Authority (ACA) EMC regulatory requirements, equipment shall comply with AS/NZS 1053.	AS/NZS 1053	All receivers
1.4 Receiver display resolution specification	See Manufacturers and Retailers "Code of Practice" for receivers and display devices. www.dba.org.au/ and ANNEX H of this document.		Recommended for all receivers
2. POWER ON OPERATIONS			
2.1 First time operation initialization	See Item 3.3 – in summary, request through on-screen set-up menu to : • set OSD language (Default - English) • set output video type (if required –eg. STB) • set preferred picture format • set user PIN and Parental Guidance • enter region for time offset • start frequency scan for available services (or enter tuning details) • enter other stored user data (as required in interactive receivers)		Recommended all receivers
2.2 Subsequent switch-on	Return to previous set-up or pre-set preference channel. If previous program stream is not available, then manufacturers should be aware that broadcasters may provide a "linkage_descriptor" (refer 3.4) to take the receiver to a currently operating service.		Recommended for all receivers
2.3 Identifying new services in current or new location	All receivers should have a scanning capability to identify all receivable services. This function should be user initiated. Receivers should have an efficient scanning capability taking in note the frequencies in Annex E.		Recommended for all receivers
2.4 Stand-By Power [6]	Manufacturers may implement one or more standby modes and should be aware of Australian Government and international concerns regarding excess standby power consumption.		

4 ACA web site www.aca.gov.au/ gives an outline of Australian EMC requirements.

5 Note that Australia uses 7 MHz VHF/UHF channels for *both* analog and digital broadcasting and that interference is of critical concern, particularly to existing analog TV receivers caused by digital receiving equipment including set-top-boxes. A further reduction of interference could be achieved by reference to AS 4542.1.

Receiver manufacturers are advised that technologies to reduce 'impulse noise' interference require consideration. Impulse noise interference can be experienced, particularly on VHF digital DVB transmissions and may not be adequately defined by CISPR 13 or CISPR 20.

6 The Australian Government is participating in the Energy Star program.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
3. USER OPERATION			
3.1 Operating system	Manufacturer's choice (underlying basic operating system) (see Item 9)		Manufacturer's choice
3.2 Hardware reset	Should be easily accessible. This is intended to reset operating system while retaining stored values. A second option of full reset to manufacturer's default start-up settings may be fitted at manufacturer's choice		Recommended for all receivers
3.3 Initial Set-Up			
3.3.1 Set-up Menu and Non-volatile information storage	The receiver should have a set-up menu for initiating processes such as a tuning scan and for the user to enter data which needs to be retained in non volatile memory. Such information may include set-ups for preferred picture format, aspect ratio, language and should include location for correct interpretation and display of the broadcast time information. 'Parental Guidance' set-up and PIN entry should also be provided. Receivers that provide interactivity may also need to provide additional data entry and retention of local information as the user wishes for the interactive system.		Recommended for all receivers
3.3.2 Initial tuning scan (Virgin Mode)	Receivers should do a full scan of the broadcast bands which may commence at the start of VHF Band III There are several more likely combinations of COFDM parameters but each broadcaster may choose a different set and these may change from time-to-time, so the receiver scan should include all possibilities until the transmission is found. Decoding the Transmission Parameter Signalling (TPS) is regarded as essential and should expedite the process. It is unlikely that tuning details of all stations will be found in the NIT of every broadcaster, i.e. cross-carriage of SI between networks is unlikely. Note however that a hierarchical transmission may have NIT_{other} information in each transport stream detailing the other stream' parameters and LCNs. The ability to rescan the tuning tables should be an easily accessible menu function.	AS 4599 EN 300 744	All receivers Informative
3.4 Assigning Numbering to Services and navigation			
3.4.1 Menu List of Services	A receiver should provide as a minimum, a menu listing of available services		Recommended All receivers as a minimum

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
3.4.2 Logical Channel Numbering (LCN)	**Logical Channel Numbering (LCN) data** should be used for Menu listing and Remote-Control selection During scanning, the receiver should examine the transport stream SI tables and identify the LCN data from the Logical Channel Descriptor (tag value 0×83) that is included in the cyclic 2nd loop of the NIT. Each service in a transport stream is identified both by the program_number (service_id) in the corresponding program_map_section and the LCN in the NIT. Information on logical_channel_descriptor syntax is found in Annex I and AS 4599-2002. It is similar to that specified in the UK's DTG "D-book" and European IEC/CENELEC 62 216-1 receiver standard. The number selection for a service on the remote control should correspond with that service's LCN unless changed by viewer preferences. **Informative:** In many receiving locations, especially in some overlapped broadcast areas, after scanning, a receiver might show 50 or more services. To bring some order to this, Australian broadcasters have adopted the system of Logical Channel Numbers (LCNs), which is technically similar to that specified by the UK's DTG and EACEM. Broadcasters are assigning unique LCNs to each TV and radio program and any other service they carry. While this number can be between 1 to 999, Australian broadcasters have agreed to use an 'Operational Practice' convention that assigns LCNs with a correspondence to each broadcaster's 'brand' number . C.TVA (FACTS) Operational Practice 41 details how broadcasters will allocate LCNs. See also Annex I.	AS 4599 Section 6, Cl 6.2.8.4 (Aus) IEC/ CENELEC 62 216-1	Highly Recommended All receivers
3.4.3 Services without LCNs	Receivers should allocate services found without LCNs to numbers starting at 350.	CTVA OP41	Highly Recommended All receivers
3.4.4 Duplicated LCNs and Service (Channel) list editing.	If the logical channel descriptor carried by broadcasters is correctly interpreted by receivers, there should be little need to provide alternate means for the viewer to create or edit the logical channel numbering. However in overlapped broadcast service areas, a receiver when frequency scanning, may encounter duplicated services, for example, from a translator. This creates the situation where there might be identical services with the same LCN but on different frequency channels. In such cases the receiver should provide a choice to the viewer to select the desired source – usually the better signal-quality service, and delete the undesired duplicate or re-insert the desired service from the channel list. Receivers should recognise duplicate LCNs in overlapped broadcast service areas and provide choice for deletion and re-ordering for 'favourites'. Note: the LCN values may change dynamically following changes to the service listed in the NIT and SDT. Refer to AS4599 Section 6 Clause 6.2.8.4 (Aus).	Annex I	Highly Recommended All receivers

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
3.4.5 Linkage Descriptor	Australian broadcasters will use the DVB Linkage descriptor, particularly the linkage_type (= "05"), which indicates that a "service_replacement" service exists. Receivers should read and use the Linkage descriptor within the Service Description Table (SDT) for navigating away from "not_running" services -see Section 6 in this table. The broadcasters operational use this descriptor may be found in C.TVA (FACTS) OP43. Receivers that do not incorporate this feature would require the viewer to manually navigate away from services that have switched to a "not running" status. Note that the linkage_type = 0x09 is also used with over-the-air data download "System Software Update" (SSU) operations.	EN 300 468 TR 101 211	Recommended All receivers
3.4.6 Dynamic response to PAT, PMT, NIT and SDT updates • Receivers should be able to use the **other** and **current_next** versions of the NIT and SDT if present.	Check NIT and SDTs at least on a regular 10 second basis as broadcasters may dynamically change available services – eg switch from HD to multichannel/multiview services The receiver should respond to changes to services as identified in the NIT and SDT, by dynamically altering channel lists presented to the consumer in a timely fashion without re-tuning. A maximum latency of 10 seconds is expected. The receiver is expected to be capable of switching to new operating parameters advised by 'next' information in the NIT and SDT.	EN 300468	Recommended for all receivers

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
3.5 Display Electronic Services Guide (OSD) and navigation • Information displayed • Icons for special features	The Electronic Services Guide (Sometimes known as 'I-plate'), is the information display presented for a short period when a service is selected. The display is normally across the lower picture area and may be opaque or partly transparent. The information derived from the NIT, SDT and $EIT_{now/next}$ typically displayed includes: (recommended minimum) Service number (LCN) -3 digits Service name -13 characters Program title -40 characters Extended -200 characters Parental Guidance rating -2 characters Now/Next event start/end times -13 characters The receiver may display the time, the network name, service name, program name, and also optionally, at the viewer's choice, short and extended event information. Australian broadcasters will be utilising the two event descriptors as follows: Short_event_descriptor may be used to identify both the program and in some instances an episode title. Extended_event_descriptor may be used to provide a synopsis of the program. For further information on how broadcasters will use these descriptors, see C.TVA (FACTS) OP44. Manufacturers may also choose to display information or icons to indicate other features of a program that the receiver supports such as stereo mode, teletext closed captions or subtitles or other languages.	TR 101 211 Cl. 4.6	Recommended for all receivers
3.6 Signal quality monitor	A menu accessed OSD that shows a combination of signal strength and bit error rate—valuable for ensuring best reception when setting up receiving antenna or identifying reception problems as signal-quality related. Useful for providing feedback to service industries and broadcasters on the difficulty in reception. A numerical readout scale is desirable (see Annex D)	Annex D	Recommended for all receivers
3.7 Selection of Radio Services	Radio services should be easily selectable via menu or direct remote control selection –See Item 6.8 .		Recommended for all receivers
3.8 Service Unavailable - On-screen advice : • Poor or no RF signal, • Service selected that has no content or not 'running' • HD service selected by SD-only receiver	For no signal or below threshold of decoding - Display 'Loss of signal' If broadcaster includes a 'linkage_descriptor' , go to linked service – no message necessary. If no linkage or service not 'running', display suitable message See section 6. For selection of service outside decode capability of receiver- Display for example 'HD Services not available on this receiver' or any other suitable message.		Recommended for all receivers SD receivers
3.9 Remote Control	Where a remote control is provided, if the receiver also provides interactivity or can be expanded to provide interactivity, the remote control should conform with basic requirements such as coloured buttons, as given in Item 10.11. Remote controls are **highly recommended** to include a button **for Aspect Ratio control** – See Item7.8 Some portable receivers may implement control via a touch screen.		Recommended for all receivers

Table 1 : Receiver Requirements (Continued)

Item Description		Remarks	Reference Standards	Applicability
4. RF CHARACTERISTICS, COFDM DEMODULATION AND CHANNEL DECODING		For more detail on RF characteristics, see also Annex B : DTTB Receiver RF Specification (Normative)		
4.1	**RF Characteristics**			
4.1.1	*Transmission channel bandwidth*	The transmission channel bandwidth is 7 MHz at VHF & UHF. Digital receivers must operate in an environment where both the upper and lower adjacent channel could contain high-level signals such as analog (PAL) or digital transmissions.	AS 4599	All receivers
4.1.2	*Notional receiver noise figure* [7]	Digital receiver noise figure VHF/UHF Bands III, IV and V - better than 6 dB, 7 dB and 8 dB respectively (see Annex B).		Recommended for all receivers
4.1.3	*RF connector*	The tuner RF input connector shall be of a type 75 Ω, IEC Female	AS 4542.1 (IEC 60169-2	All receivers
4.1.4	*Digital terrestrial receiver tuner's frequency range*	The digital receiver tuner's frequency range shall nominally cover from VHF Band III, (174-230MHz), UHF Band IV (519-582MHz) and UHF Band V, (582-820MHz), in accordance with the Australian channel tuning table- Annex E, Table E1 & E2. [8] Note that the channel centre frequencies are 3.5MHz from the channel frequency limits except where an offset is used (see below 4.0.5). Optionally the tuner may also cover the frequency bands for cable and MATV channels given in Annex E, Table E3 [9]		All receivers
4.1.5	*Channel Offsets*	The tuner shall be capable of tuning to transmissions with a channel offset of + or - 125 kHz. (Where required, some stations will operate with this offset – Channels 8 and 29 in Capital cities are examples).		All receivers
4.1.6	*COFDM Intermediate Frequency (IF) and Spectrum polarity*	The 1st IF is not specified but is nominally centred near 36MHz. NOTE: DVB-T COFDM emission spectrum is not symmetric. The polarity is as defined by DVB	EN 300 744	Informative
4.2	**Operation in Single Frequency Network (SFN) Environments**	SFN are widely used in Australia. Receivers shall be able to operate in SFN environments with either pre-echo or post-echo signals within the guard interval. When a receiver tunes to a mix of two signals from a SFN, if the received signals are close in amplitude, it is recommended that the receiver selects the earlier signal even when the later signal amplitude is within ± 3dB. Note that single frequency network (SFN) performance of receivers is addressed in Annex B of this Standard.		All Receivers Recommended all receivers

7 Receiver noise figures are those of a 'notional receiver'. The figure is used for coverage planning (see Annex B).

8 Bands I and II are not expected to be used in Australia for digital terrestrial transmissions. The ability to tune to the new digital frequencies for Channels 10 and 11 (shift of +1MHz on analog frequencies) is required for all receivers (see Annex E).

9 Non-portable receiving equipment is recommended to have a capability to tune to the S-Band (cable) channels to enable access to channel shift in MATV systems (see Annex E).

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
4.3 COFDM modes [10] The receiver shall: • Use Transmission Parameter Signalling (TPS) • Be able to receive 2 k and 8 k • Accept all guard intervals • Accept all code rates • Demodulate all Hierarchical modes	The receiver shall automatically detect which modulation mode is being used in the selected 7 MHz channel. This may be identified in the TPS carriers. The receiver shall be able to receive COFDM 2K and 8K carrier modes and all COFDM modulation types up to a possible maximum of 27.71 Mbit/s payload in the 7 MHz channel. The values of the DVB-T COFDM timings are in accordance with the 7 MHz channel bandwidth requirement, which sets the elementary period T to 1/8 µs. These modes are detailed in AS 4599 - Section on Australian variations to ETSI EN 300 744. The receiver shall be capable of operating with any DVB-T valid guard interval. (Informative: It is suggested that a search sequence of Δ/T_U = $^1/_8$ first, then $^1/_{16}$, then $^1/_{32}$ and finally $^1/_4$ might reduce tuner search time. For example, 8k transmissions most probably may use Δ/T_U = $^1/_8$ or $^1/_{16}$ and 2k transmissions Δ/T_U = $^1/_8$.). The receiver shall observe the TPS data, to confirm the guard interval, code (FEC) rate and the presence of Hierarchical Modulation) When tuned to a hierarchical transmission, receivers shall be capable of selecting a service from either priority for COFDM demodulation and subsequent de-multiplexing and MPEG decoding, - See Item 4.3 below.	EN 300 744 AS 4599	All receivers
4.3.1 COFDM Mode Change Acquisition Time	Acquisition lock time should preferably be: • within 2 seconds when a viewer changes to a service which is on a different RF channel; or, • within 5 seconds when a broadcaster changes the COFDM transmission mode of a transmitter, as identified by TPS signalling or in a NIT_{next}. This does not apply to 2K/ 8K mode changes.	AS 4599 Section 3 on ETSI EN 300 744 and Annex E (AUS) - Normative	Recommended All receivers

[10] Different broadcasters may use different COFDM modes and change modes from time to time.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
4.3.2 Reception of Hierarchical Modulation (HM) Transmissions • TPS and NIT can identify the parameters in use • Receivers shall refer to the current_next versions of the NIT and SDT to be aware of a transmission switch to hierarchical. • When tuned to a service on a 'low priority' stream, if reception conditions become worse and change to less than the receiver's capability to demodulate the low priority modulation, the receiver may display a 'lost signal' notice. As an optional feature, the receiver could switch to the first listed service in the high priority stream – which typically might be the main SD program.	Receivers shall be capable of demodulation of all DVB-T listed Hierarchical Modulation (HM) modes. When tuned to a HM transmission, receivers shall be capable of identifying the transmission as hierarchical via TPS and/or the NIT carried in the high priority QPSK part. Receivers shall be capable of selectively demodulating either of the COFDM's high priority (QPSK) or low priority (2nd QPSK or 16QAM) parts, within the range of the receiver's operational carrier to noise ratio, and passing the demodulated transport stream for subsequent demultiplexing and decoding. HM transmissions will use the same 'guard interval' but the 'code_rate' FEC for the low and high priority modulation may be different and these can be identified by the NIT's subloop terrestrial_delivery_system_descriptor (Tag value 0x5A) semantics. Receivers should look for SI tables such as NIT_{other} in each transport stream, which Broadcasters may include with information on the 'other' transport steam to assist receivers in identifying the services available in both parts of a hierarchical transmission. Where a receiver is in a varying signal level environment such as in portable or mobile, if a service in the LP stream has been selected and then at later time, the receiver's signal falls below threshold of decoding of the LP stream, the receiver should display a 'lost signal' type notice. Informative: Two separate Transport Streams are carried in a HM COFDM transmission, as the COFDM constellation in effect becomes two separate RF parts. The basic QPSK part (known as high priority HP), has inserted on top of it a secondary QPSK or 16QAM part, (known as low priority or LP). Although the resultant constellation appears as though it were 16 QAM or 64 QAM respectively, a COFDM demodulator aware that the transmission is hierarchical will be able to selectively demodulate either the HP QPSK part or the LP part. When tuned to a service in the LP stream, a recommendation is given above for receiver action if the signal falls below the receiver's decode threshold. An alternative has been suggested where the receiver could revert to a video service in the HP stream, but if there is more than one service in the HP stream, it would be difficult for the receiver to identify which one. Further experience with HM might provide a method using a linkage_descriptor, for example. For further background on Hierarchical Modulation, see Annex A – Abbreviations and Glossary.	AS 4599 Sect 3 Cl. 4.6.2, Table 9 & EN 300 744 Cl. 4.6.2.6 AS 4599 & EN 300 468 Cl. 5.2.1 & Cl. 6.2.8.3	All receivers
4.4 Interference immunity			
4.4.1 Impulse noise rejection	**Impulse noise is more severe in the VHF band**, as used in Australia. Adoption of noise suppression technology is recommended. Note that the impact of impulse noise on VHF digital DVB-T transmissions may not be adequately defined by CISPR 13 or CISPR 20.		Recommended

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
5. MULTIPLEX AND TRANSPORT STREAM			
5.1 PID Filters	Manage 32 – Simultaneously Note: receivers with interactive features may need to increase this figure.		Informative
6. SERVICE INFORMATION (SI) PROCESSING			
6.1 Interpretation of SI variations for Australia	Australian DTTB transmissions have some variations to deal with Australian broadcasters legislative and other requirements. Items directly concerning receiver manufacturers include:- In the EIT: • Parental Guidance, (see Item 12 and Annex-F) • Content 'Genres', (see Item 6.5) In the TDT & TOT: • Time offset zones, (see Item 6.4) In the NIT: • Logical Channel Numbers, (see Item 3.4) In the SDT: • Linkage_descriptor (see Items 3.4.5 and 6.3) These are identified in Australian coverage of DVB-T documents in AS 4599 and this standard. Informative: Other information on broadcaster codes for DVB-T such as 'network_id' etc. that are not necessary for receiver design but may be of interest for receiver manufacturers are available from C.TVA [11] (FACTS) as 'Operational Practices'.	AS 4599	All receivers

[11] Commercial Television Australia (formerly Federation of Australian Commercial Television Stations FACTS), 44 Avenue Road, Mosman, NSW 2088 www.ctva.com.au

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
6.2 Interpretation of MPEG-2, DVB mandatory and DVB optional tables • Receivers should refer to the PAT, PMT, NIT, SDT, TOT, and EIT$_{now/next}$ information. • Receivers should monitor NIT and SDTs on a regular 10 second basis including both current_and next information	The receiver should be capable of reading and dynamically reacting to changes in the DVB-SI and MPEG tables such as the PAT, PMT, NIT, SDT, TOT, EIT now/next to navigate between various services in any transport stream and adapt to changes in the broadcaster's configuration. This includes Australian registration in DVB of original_network_id; network_id; bouquet_id; ca_system_id; private_data_specifier and country/region codes. Note: DVB and Australian changes to EN 300 468 Table 12 identify: • VBI data and VBI teletext (SIS-28) (Tag Values 0x45, 0x46) - and • AC-3 audio - PMT Tag value 0x6A.	AS 4599 Sect 6 on EN 300 468 Cl. 4 – 5; & Sect 7 on TR 101 211 Cl. 4	Recommended All receivers
6.3 Interpretation of other descriptors [12]	Receiving equipment shall interpret MPEG-2 and DVB descriptors correctly and shall be able to skip over those which are currently 'reserved', or which correspond to functions not implemented by the receiving equipment It is important to note that Australian DTTB transmissions will use the Logical Channel Descriptor (tag value 0×83), which in the Australian implementation is a 'public' descriptor - See Item 3.4 above. • logical_channel_descriptor – (located in the NIT with Tag 0x83) Emerging applications under discussion within DVB forums may result in additional new descriptors being adopted by Australian terrestrial broadcasters.	AS 4599 Sect 3 on EN 300 468 Cl. 6; & Sect 7 on TR 101 211 Cl. 5	Recommended All receivers highly recommended

[12] For interoperability, recognition and decoding of the Transport Stream Description Table (PID 0×0002) is recommended [Refer AS 4599 Clauses 5.2.11 and 6.1 –Table 12 (Aus)].

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
6.4 Interpretation of time and date and time offset tables • Note Australian time-zone regions	Australian broadcasters will use time-offset tables for reasons such as daylight-savings. Receivers should use this information to display the current local time on the STB front panel and/or in OSD programme guides. Receiving equipment should correctly interpret the Time and Date Table (TDT) and Time Offset Tables (TOT) in a transmission. These tables are found with a PID of 0x0014 and table_id s of 0x70 and 0x73 respectively. To correctly interpret the local_time_offset descriptor (tag value 0x58) information found in the TOT, the receiver will need to have a menu entry and long-term storage of the following: Transmitted Code — Set-up Display country_region_id = 00 0000 Not used 00 0001 Reserved 00 0010 NSW/ACT 00 0011 VIC 00 0100 QLD 00 0101 SA 00 0110 WA 00 0111 TAS 00 1000 NT 00 1001 Reserved --- | --- 11 1111 Reserved Receivers should provide a set-up menu where the viewer may choose their region as shown in the above list. The receiver will typically need in the TDT and TOT to recognise and respond to: country_code = AUS '0100 0001 0101 0101 0101 0011' local_time_offset_polarity = '0' (advanced to UTC, east of Greenwich) and a range of: local_time_offset = '0001 0001 0000 0000' (Summer: Australian Eastern Daylight Saving Time +11 hours UTC) to '0000 1000 0000 0000' (Australian Western Standard Time +8 hours UTC)	AS 4599 Sect 6 on EN 300 468 Cl. 4 – 5 & Cl. 6.2.12 TR 101 211 Cl. 5 See also Annex I	Recommended for all receivers

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
6.5 Content descriptors • Note Australian variation to DVB • Content_nibble_level_1 as shown • Content_nibble_level_2 and user_nibble currently not defined.	Receivers may display as required, a program's classification/genre type as identified by the content_descriptor (Tag value 0x54) found in the EIT. Only the content_nibble_level_1 is currently defined and is as follows: **Content_nibble_level_1 code_** / **Description** 0x0 Undefined content 0x1 Movie 0x2 News 0x3 Entertainment 0x4 Sport 0x5 Children's 0x6 Music 0x7 Arts/Culture 0x8 Current Affairs 0x9 Education/Information 0xA Infotainment 0xB Special 0xC Comedy 0xD Drama 0xE Documentary 0xF Reserved -not defined	AS 4599 Sect. 6 on EN 300 468	Recommended for all receivers
6.6 EITs and present/following (Now/Next)	Provide minimum EPG display—See Items 3.5 'I-Plate display and 10.5 Receiving equipment shall continue to operate in the absence of EIT information.	AS 4599 Sect 6 on EN 300 468	Recommended for all receivers
6.7 EIT (optional schedules)	(see Item 10.5)	AS 4599 Sect 6 on EN 300 468	Informative
6.8 Radio Services	Radio Services shall be identified in the SDT by Service_type 0x02 in the service_descriptor (tag 0x48) syntax. Radio services are expected to use the MPEG-1 Layer II format.	EN 300 468 Cl. 6.2.24	All receivers
7. VIDEO DECODE AND DISPLAY	Display format choices are given in ANNEX H		
7.1 MPEG video decoding	SD receivers should not attempt to decode HD streams	See Annex I	All SD-only receivers
7.1.1 Decode "SD" MP@ML video formats[13]	The receiver shall decode all valid MP @ ML 25 Hz & 50 Hz formats. Pixels × lines: 720 × 576; 544 × 576; 480 × 576; 352 × 576; and also 704 pixels × 576 line at — (a) 25 frame per sec progressive scan ('film mode' -see Item 7.2), or (b) 50 field per sec interlaced The receiver shall decode 352 × 288 MPEG 1 (CIF) format.	EN 300 468 Table 16 TR 101 154 Cl.5 Annex A (examples only) ISO/IEC 13818-2 Refer to ANNEX H	All receivers

[13] The MP@ML decoder should be able to decode lower MPEG levels such as MP@LL. For interoperability, 704 pixels × 576 line formats may be used, as this is a common industry standard in widespread use

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
7.1.2 Decode "HD" MP@HL video formats[14]	High definition streams will be identified by the MPEG video header and in the EIT component_descriptor (tag 0x50) syntax. The receiver shall decode all valid MP @ HL 50 Hz formats. (a) 1080 active line formats at 25 frame/s progressive scan (film mode) or 50 field/s Interlace: 1920 or 1440 or 1280 × 1080 line (**1080i**); (b) Progressive Formats at 50 frame per sec. 720 × 576 active line '**576 50p**' [15] 1280 × 720 active line '**720 50p**' Note: The 1152 active line format is not expected to be broadcast, although manufacturers may choose to interconnect and/or display 720p or 1080i in a 1152i (1250 total) line format. See footnote and ANNEX H - for details on scan timings and HD output requirements.	EN 300 468 Table 16 AS 4599 TR 101 154 Cl. 5 Annex A For digital and analog interface formats refer to Sect. Interfaces and connectors page 42 For displays Refer to Annex H	Only HD capable receivers

[14] Terrestrial broadcasters may use a range of active-lines-in-pictures formats including 1080x50i or 25p, 576x50p, 50i or 25p and (576/2) 288x25p. At the time of preparing this Standard, some terrestrial broadcasters have advised that they will not use 720 line progressive formats, while at least 2 broadcasters have indicated that the 720 50p HD format is under consideration for future use.
SCAN FREQUENCIES (Refer ANNEX H):
There is benefit in the interest of lower cost displays that for CRT based 'HD-Input' displays, to consider a single frequency horizontal line scan system at 31.25 kHz. (e.g. 2 × 15.625 kHz), which is also used for '100Hz' SD display. Such a scan frequency is suitable for display of 576x50p pictures, SD 576 line pictures scaled up by 2, and for 1080i pictures if the VBI is reconstructed so that the total lines are 1250.

720 50p pictures can also be displayed if vertically "up-scaled" by 8/5 (720/1152=1.6). N.B. MPEG video transmission carries only active picture. Blanking intervals are reconstructed in the receiver for interconnects and display.

The video output(s) of HD-STB's for the consumer market should minimally support 576p (625line total) and 1152i (1250line total) fixed output scan formats under user selection and should for this purpose provide frame/field conversions to convert any of the transmitted (input) formats to the fixed output format. The preferred way is to letterbox "1080i active" line systems into an "1152i" (1250 lines total) format by extending the vertical blanking period by adding 36 black lines at both the top and bottom, ie "36+1080i+36" as this will preserve the original video quality. The display will need to recognise this and switch in a vertical scan increase of 6.7% to correct picture geometry.

The display may determine the video interconnect format by the appropriate horizontal and vertical synchronising signals as indicated in Section 15 and given in Annex H.

[15] 720 x 576p @ 50 Hz is also used by PAL Progressive Scan DVD players.

DVB MHP has indicated a graphics format for 576 line displays with square pixels on 16:9 displays – i.e. 1024x576.

Table 1 : Receiver Requirements (Continued)

Item Description		Remarks	Reference Standards	Applicability
7.2	**Reproduction of Progressive Scan Video Formats**[16,17,18]	For reproduction on interlaced displays including standard 625 (total) line displays, 25 frame/s progressive formats (presumably from film sources) will need to be output in 50 field/s interlaced format. See footnote 18 on inclusion of vertical video filtering to reduce interline twitter in interlaced displays. NOTE: This is not to discourage the use of progressive format displays at 50 or 100 Hz or direct pixel addressed displays. For interconnect standards, and possible display formats refer to this table, Section 15 and ANNEX H.	TR 101 154 Cl. 5 and Table 4	All receivers
7.3	**Video scaling for display and output, up and down**	Refers to translation of transmitted format to display format as these may be different. May also be used for aspect ratio mode choices. Preferred values typically are 1/2, 3/4 and 2 also 3/2, 4/3, 2/3. Digital processing filters should be multi-tap. Scaling may be required for display of interactive material.	Refer to Annex H	Optional
7.4	**Display of transmitted video stills**	Part of the DVB MPEG system	TR 101 154 Cl 5.2	All receivers
7.5	**Multiview display**	In a MP@HL decoder, SIF concurrent decoding recommended for picture-in-picture.		Recommended in premium receivers, otherwise, optional
7.6	**Mosaic display**	Displayed from a single transport stream	TR 101 211 Cl. 5 EN 300 468 Cl. 6.2.13	Optional
7.7	**SD decoder response to a HD Service**	Identify on screen the inability of the unit to display selected service. Note: SD Receivers with MP @ ML decoders should not try to display 720 x 576 x 50p MP @ HL streams		All SD receivers
7.8	**Aspect ratio**			
7.8.1	*Picture 'shape' setup for a receiver and/or display*	Digital STB receivers with video outputs shall provide, via the setup menu, a choice of display configurations to satisfy the viewer's display unit which may be a standard 4:3 or widescreen 16:9 format . 16:9 pictures should be capable of being displayed on a 4:3 display. The choices should include 4:3 centre-cut or 4:3 pan & scan, letterbox or, for a widescreen video display, true 16:9. When outputting 4:3 pictures from a pan & scan cutout of a widescreen picture, receivers may optionally follow offsets data if included in the MPEG video bitstream (refer to Item 7.85 below) Manufacturers may also choose to provide overscan and stretch modes for 4:3 pictures on wide-screen displays. It's recommended that a receiver's remote control include some picture shape control (refer to Item 7.8.3 below)		All SD receivers And SD outputs of HD

16 Video 25 or 50 frame/s progressive scan formats may be broadcast.

17 The receiver does not need to accept 24 or 23.98 frame/s progressive formats used for Cinema production. In the Australian 25/50 Hz environment such formats will be broadcast when sped up by 4% to 25 frame/s progressive.

18 When HD progressive scan format material is received, and the interconnect or display format is 50 field/sec interlaced, it is recommended to include vertical video filtering to reduce interline twitter in the interlaced display.

Table 1 : Receiver Requirements (Continued)

Item Description		Remarks	Reference Standards	Applicability
7.8.2	*Identification of 4:3 and 16:9 pictures* • Optional use of Active-Format-Descriptor (AFD) • Optional use of Wide-Screen-Signalling (WSS)	Broadcasts may have 4:3 or 16:9 pictures as identified by the 4-bit integer aspect_ratio_information '0010' or '0011' respectively found in the MPEG video header information. The use of extra widescreen 2.21:1 format is not expected. Additional AFD information may be included. Use of AFD indication of picture 'area of interest' by a receiver is optional. Also WSS carried via DVB packetised VBI Data (See EN 301 775) may be reinserted on VBI line 23 analog output or used to activate WSS on a SCART connector.	ISO/IEC 13818-2 Cl. 6.3.12 TR 101 154 Cl. 5.1.3 Annex B ETS 300 294 EN 301 775	All receivers Optional Optional
7.8.3	*Changing between 16:9 and 4:3 pictures on displays* • Provide 'wide-screen' – 'standard' (4:3 center cut) format switching on remote control • in 'letterbox' mode to feed a 4:3 display, the incoming video should be blanked to line 25 to avoid accidental display of VBI	Note that Australian broadcasters have indicated that both SD and HD programs will be 16:9 wherever possible. However in many cases only a 4:3 format version of a program is available and the program may be broadcast as 16:9 'pillarbox' with black bars on either side. Furthermore, occasionally letterbox material in a 4:3 format may be broadcast. On a 16:9 display, such a picture would have black bars left and right, top and bottom – sometimes known as 'postage-stamp'. For these reasons, receiver manufacturers are **highly recommended** to provide the ability to switch between display formats as a user selectable function button on the remote control. This would need to override signalling such as WSS and/or AFD. **Letterbox display** To create a 'letterbox' display the incoming 576 active lines (288 line per field), are normally scaled on the video output to 432 lines with 72 lines of black added top and bottom. **Avoid visibility of VBI signals in Letterbox display** A common problem with letterbox display is the occasional visibility of VBI signals such as WSS or vertical interval time-code that may be (accidentally) broadcast offset to their regular position. This may be prevented if the incoming video is blanked to line 25 instead of line 23 before scaling.	ISO/IEC 13818-2 Cl. 6.3.12	Highly recommended for all receivers Recommended for all receivers
7.8.4	*Display of broadcast 14:9 pictures*	Some broadcasts may use this ratio but on a 16:9 background. Manufacturers may choose to provide a 14:9 option for 16:9 video on a 4:3 display.		Optional
7.8.5	*On 4:3 displays, show full height 4:3 pictures cut from a 16:9 video program stream by use of MPEG-2 pan and scan vectors*	(This applies to set-top-boxes feeding existing 4:3 display TV sets or integrated digital receivers with 4:3 displays) Horizontal (Pan) offset may be available in the MPEG video bitstream The (16-bit signed) integer frame_centre_horizontal_offset will be included in the video bitstream semantics. If this element is absent from the bitstream then a zero offset (ie. centred) is assumed. Vertical (scan) offsets (per TR 101 154) will not be used In the case of HD 16:9 program video that is being fed to a SD 4:3 display, the received line structure should be scaled appropriately	ISO/IEC 13818-2 Cl. 6.3.12	Recommended for all receivers
7.8.6	*Frame accuracy of use of scan offset when cutting 4:3 picture from transmitted 16:9 picture*	Shift of picture should be frame accurate with reception of frame_centre_horizontal_offset information		All receivers

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
7.9 Picture colorimetry		TR 101 154 Cl. 5	
7.9.1 Chroma_format	Chroma decoding to 4:2:0 format chroma_format will be 0 × 01	ISO/IEC 13818-2 Cl.6.1.1.8 Cl.6.3.5; Table 6-5	All receivers
7.9.2 Colorimetry	SDTV to Recommendation ITU-R BT.470-6 – "Conventional Television Systems" –Table 2, B-PAL Chromaticity; HD to Rec. ITU-R BT. 709-4. Transmitted pictures will be colour balanced to D6500 Manufacturers may choose to alter or provide various display colour temperature options	ISO/IEC 13818-2 Cl.6.3.6; Table 6-7 ITU-R BT 709-4	Optional
8. AUDIO—DECODE AND REPRODUCTION			
8.0.1 Audio Outputs	Manufacturers may choose to include digital outputs in addition to analog interfaces. For further information on preferred analog and digital outputs, see Items 15.31 and 15.41 below.		Optional
8.1 MPEG audio			
8.1.1 Decode Audio stream using MPEG-1 Layer II	MPEG-1 layer II audio streams may be in single (mono) or dual or joint stereo or stereo modes. Multiple services may be present to support other languages. The User should be able to select these.	ISO/IEC 11172-3	All receivers
8.1.2 Decode all MPEG-1 Layer II sampling rates	Broadcasts may use either 32, 44.1 or 48 kHz sampling rates — all audio frames have the same bit rate.		All receivers
8.1.3 Decode all MPEG-1 Layer II formats if MPEG-2 decoder fitted	Backward compatible basic stereo information should be able to be decoded.	TR 101 154 Cl. 6.1	If MPEG-2 audio decoder fitted
8.1.4 If MPEG-1 decoder fitted, ability to decode MPEG-2 audio formats	If an MPEG-1 decoder fitted, forward decode compatibility of MPEG-2 (MPEG-2 multichannel sound includes 5.1 and 7.1 channel audio.)	ISO/IEC 13818-3	Optional
8.2 AC-3—Decoding and Output	AC-3 may be included in the DVB TS with the MPEG stream_id set to 0×BD (private stream_1) –see detail below AC-3 may be used for mono, stereo, stereo with matrix encoded surround sound or discrete 5.1 channel surround sound. Stereo with matrix encoded surround sound may be decoded using decoding technology such as Prologic. Receiving equipment with AC-3 decoders should be able to downmix to output requirement (e.g. 5.1 to mono in simple single speaker receivers) Receiving equipment with a digital SP/DIF output capable of feeding an external AC-3 decoder are not required to downmix an AC-3 stream on that output. Other features of AC-3 follow:	AS 4599 Section 5 & TR 101 154 Annex C also AS 4599 Section 6 Annex E (Aus)	Receivers with AC-3 decoders

Table 1 : Receiver Requirements (Continued)

Item Description		Remarks	Reference Standards	Applicability
8.2.1	*Ability to decode AC-3*	Complete main (CM) services each 1 to 5.1 channels plus associated services The coding and decoding of an AC-3 elementary stream is based upon Recommendation ITU-R BS1196 – Annex 2. Each CM service may have a complete mix or only music effects which could be mixed in the receiver with dialogue (ME&D); Visually Impaired; Hearing Impaired. Additionally, where a second decoder is fitted, the following have over-ride capability: Commentary; voice over & emergency (C&VO) Ability to decode ME & D and C&VO services are not required.	TR 101 154 Ver 4 Annex C ITU-R BS 1196, Annex 2 DVB implement-ation differs from ATSC	Receivers with AC-3 decoders
8.2.2	*AC-3 karaoke mode*			Not applicable
8.2.3	*Dual AC-3 decoders*	Refers to presentation of dual sound channels in a time synchronous manner when required	TR 101 154 Ver4, Annex-C Cl. C.5.2, Decoding	Optional for receivers with AC-3 decoders
8.2.4	*Decodable AC-3 sampling frequency range*	Receiver sampling frequency range Digital audio sampled at a frequency of 32 kHz, 44.1 kHz or 48 kHz, locked to the 27 MHz system clock. The 48 kHz audio sampling clock is defined as: 48 kHz audio sample rate = (2 ÷1125) × (27 MHz system clock)	ITU-R BS 1196, Annex 2	Receivers with AC-3 decoders
8.2.5	*Decodable AC-3 bitrate range*	The receiver should be able to decode the transmission bit rates as defined below: A main audio service, or an associated audio service which is a complete service (containing all necessary program elements) will be encoded at a bit rate less than or equal to 640 kbit/s. A single channel associated service containing a single program element will be encoded at a bit rate less than or equal to 128 kbit/s. A two channel associated service containing only dialogue will be encoded at a bit rate less than or equal to 256 kbit/s. The combined bit rate of a main service and an associated service which are intended to be decoded simultaneously will be less than or equal to 768 kbit/s	ITU-R BS 1196, Annex 2	Receivers with AC-3 decoders
8.2.6	*Recognition of AC-3 in a DVB MPEG transport stream*	AC-3 PES audio is identified by a public DVB descriptor. When an AC-3 stream is present in a DVB transport stream, it may be identified by the presence of the AC-3_descriptor. The DVB AC-3_descriptor is defined in ETS 300 468, Annex E. The AC-3_descriptor has a tag value 0 × 6A The AC-3 PES is carried as an MPEG private data stream type, conforming to the structure of a private_stream_1 as described in ISO/IEC 13818-1 Table 2-18 (stream_id) and Table 2-29 (stream_type). Since the AC-3 descriptor is not a DVB private descriptor, but is a public DVB descriptor, the component_tag is not used, nor are the component_tag values of component_type assigned When the component descriptor is referring to a DVB AC-3 PES, the value assigned to the stream_content field is 0 × 04 for values of the component_type field between 0 × 00 and 0 × 7F The values of component_type between 0 × 00 and 0 × 7F indicate the particular mode of AC-3 audio in the PES. There may be other AC-3 streams and/or other private data streams such as sub-title data with the same stream_id also present	AS 4599 Sect 5 & TR 101 154 Ver 4 Annex C also AS 4599 Sect. 6 Annex E (Aus) ETS 300 468 Annex E, Tables E.2 and E.3 ITU-R BS 1196NO TE: AC-3 implement-ation in DVB differs from ATSC	Receivers with AC-3 decoders

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
8.3 Audio identification and control	User facility via OSD and/or remote control		
8.3.1 Identifying which audio stream present	Menu option may indicate stream type (eg. AC-3 5.1), available for selected program. (Refer to Item 8.32 for other languages available for selected program)		Optional
8.3.2 User access to other audio streams (including other language)	Menu option. To give user access if several audio streams are present in either MPEG-1 layer II and/or AC-3		All receivers
8.3.3 Receiver auto-switch when program audio changes from MPEG-1 layer II to AC-3 or vice versa	For channel change or if a program stream changes its audio delivery from MPEG-1 layer II to AC-3 or vice-versa, switch should be automatic and muted		If AC-3 decoder fitted.
8.3.4 Ability to present stereo audio encoded with surround information suitable for external Dolby Pro Logic™ decoding.	To ensure satisfactory Dolby Pro Logic™ decoding, the audio phase response must be maintained on the stereo output interface for the decoded MPEG-1 layer II or AC-3.		For MPEG and/or AC-3. Recommended in premium receivers, otherwise, optional
8.3.5 System reference level The reference levels for system alignment used at the Transmission Audio Encoder are: MPEG-1 (Layer II)……...–18 dBFs AC-3……–20 dBFs [19]	The fixed gain nature of the MPEG-1 system gives a receiver reference level of –18 dBFS, i.e. 18dB below the digital transmission clipping level. The Dolby Digital (AC-3) system operation allows: 1. Dialog norm (*dialnorm*) control by the broadcaster 2. Dynamic range control (DRC) parameters by the broadcaster and 3. Selection of two standard output level profiles or operating modes called Line Mode and RF Mode 4. Protection limiting against overload in the receiver. For each programme, the available dynamic range in both Line and RF modes is determined by the programme content and the DRC profile selected at the encoder. Line Mode for 5.1 channel outputs has the added ability to scale the amount of high-level compression applied. In Line mode, with dialnorm set to -31 dB and no mixdown to stereo, the system has unity gain. Some ability to scale the DRC in the decoder may be available in this mode. In RF mode, the system has 11 dB gain relative to Line mode, with dynamic range being set by the DRC profile selected at the encoder Clause 8.36 provides guidance to potentially achieve matching of loudness between digital programme services. Clause 8.37 & 8.38 provides guidance when an RF PAL modulated output is provided on a receiver.	AS4599 AC-3: ITU-R Rec. BS 1196, Annex 2; MPEG: TR 101 154 Cl. 6	Informative

[19] Subject to change. Relative levels of audio from different systems including PAL with analog-FM, if fitted, need to be taken into account

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
8.3.6 Receiver Average Output level	Manufacturers of digital TV receivers for the Australian market should be aware that some services may be broadcast in MPEG-1 layer II and/or AC-3 digital audio. Receiver manufacturers should also be aware that there may be some level differences when changing between MPEG-1 layer II and AC-3 bitstreams due to these two types of decoders and the available AC-3 operating modes and the presence of metadata.		Informative
8.3.7 Modulated RF Output Deviation If a RF modulated output is fitted: it shall be compatible with the PAL-B system; and produce FM Output deviation of ± 20 kHz (with 400Hz input) at the reference alignment level of : –18 dBFs for MPEG-1 Layer II and –20 dBFs for AC-3	It is recommended for compatibility with attached PAL receivers and analog transmissions, that STB's have a variable output that can provide the specified FM deviations at slightly less than the maximum volume setting. Designers should be aware that the maximum typical deviation that can be accepted in PAL receivers, without excessive distortion is +/- 70kHz for any audio frequency. For AC-3 encoded audio the default setting in the STB decoder shall be the RF Mode operating mode.	AS4542.1	Recommended
8.3.8 Operating mode and audio dynamic range control	For products with RF modulators, the default AC-3 operating mode is RF mode. The user may then be able to select the Line Mode and dynamic range options. For products without RF modulators, the preferred AC-3 operating mode is Line Mode. However if the receiver has dynamic range options fitted, this will become a user selectable function. Manufacturers may choose also to provide a compression facility on the MPEG audio.		If AC-3 decoder fitted, recommended in premium receivers, otherwise, optional
8.3.9 Maximum picture-sound timing mis-alignment (Lip Sync)	As a result of receiver processing alone ± 10 ms Applies to MPEG audio and AC-3		Recommended for MPEG and AC-3.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
9. OPERATING SOFTWARE AND MIDDLEWARE API[20]			
9.1 API[21] NOTE: See also related Items: Item 6: Service information (SI) processing Item 10: Interactivity and on-screen display Item 13: Conditional access Item 17: System software revision	Basic operating system—at manufacturers' choice. API and coding (virtual machine) are to be specified such that applications may be potentially downloaded to receivers. A software system design no less complicated than the remainder of the specification document will be necessary. The system level design is the subject of active standards work in DVB and other forums and is being addressed in Australia. For operation with MHP, the capability to decode DSM-CC object and data carousels would be considered essential.	ISO/IEC 13818-6	Informative Informative for Data Download and interactivity equipped receivers
9.2 Middleware API			
9.2.1 DVB MHP	Australian television broadcasters have adopted the DVB MHP Specification as in DVB/ETSI: TR 101 812 DVB/ETSI: TS 102 812 Multimedia Home Platform (MHP) Specification 1.1 including DVB-HTML is under consideration. – see 10.1.2 Receivers incorporating interactive capabilities according to DVB/ETSI: TR 102 812 Multimedia Home Platform Specification 1.1 are highly recommended to include the DVB-HTML option.	DVB ETSI: TS 101 812 DVB ETSI: TR 102 812	Informative Informative
10. INTERACTIVITY[22] **AND ON-SCREEN DISPLAY**			
10.1 Remote Control			
10.1.1 Conformance of Remote Control design - (where supplied) • Cursor keys • Coloured Buttons (Red, green yellow & blue)	As a minimum, the remote control should provide the requirements for basic navigation in the digital TV environment and where interactivity is provided: cursor, select, menu and information keys and the standardised coloured buttons. A separate button to provide Aspect Ratio switching on remote control is recommended - (see Item 7.83)		Recommended
10.1.2 Capability to operate interactively • Follow MHP Specification	It is expected that Australian broadcasters will use MHP as in Item 9.1	DVB/ETSI: TR 101 812 & TR 102 812	Recommended in premium receivers, otherwise, optional
10.2 On-Screen-Displays (OSD)			
10.2.1 Video planes—	At least video and static OSD; the OSD may also be used to display subtitles—closed captions Additional planes with degrees of transparency and colour range are optional although receivers conforming to the MHP standard, will need to follow that specification. NOTE: For optional inclusion of interactive applications, additional video planes are required including support of a 'cursor'		All receivers Optional for interactive receivers

20 Refer to Section 17 for operating software revisions by download by broadcaster

21 DVB APIs are under discussion in International forums.

22 System operation providing capabilities for interactivity are currently under discussion in DVB forums including aspects of receiver design such as remote control functionality.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
10.3 Teletext closed captions	Note that receivers are only expected to implement decoding and display of teletext services to support closed captioning on the Australian DVB-T transmissions. Full teletext support is optional. There may be multiple teletext data streams in a transport stream. In the transport stream, each program service may have both a teletext caption stream and a teletext information stream each with their own PIDs. Teletext may be used for the provision of closed captions in one or more languages. These will be able to be identified by the receiver in the usual manner from the PMT (Tag = 0x56). It is recommended to ignore the teletext private data PCR and PTS when decoding and present to the display when received – see "decoding" below. NOTES: (a) Provision of teletext decoding for closed captions is required (see Item 10.3.1) (b) The teletext information — (i) shall be capable of being displayed on the picture as a normal over-write of the picture by text; and (ii) shall be added as standard analog teletext data to the VBI of a PAL format output – refer Item 10.3.3 below (this option would apply to modular set-top-boxes to feed teletext capable TVs). (c) Refer to Items 10.3.1 to 10.3.5 (d) Note changes identified in descriptor tables (tag values 0x046, 0x047 & 0x056) in latest EN 300 468	EN 300 468 Cl. 6. Table 12 EN 300 472 DVB A056 ETS 300 706 Refer to Annex G and Annex I	All receivers
10.3.1 Access to closed captions in a teletext format for hearing impaired	Australian DTTB transmissions may include closed captions for hearing impaired in a teletext format. This will generally correspond to only a few lines of text per second On Australian analog PAL broadcasts these subtitles are on lines 21 and 334 on teletext page 801. This information is carried in the DVB teletext packets per EN 300 472 The receiving equipment shall be capable of decoding the teletext caption data when present. The receiving equipment shall be capable of overlaying the teletext subtitles on the picture, and this feature should be controllable from the receiver's remote control. In the case of set-top-boxes capable of connection to SD PAL TVs, the teletext shall be re-inserted on the output PAL VBI as detailed in Item 10.3.3	EN 300 472 EN 300 468 TR 101 211 Cl.4.2.6.4 Refer to Annex G	All receivers
10.3.2 Decoding of teletext information	The OSD shall indicate to the viewer that teletext subtitles are available in a service The PIDs are identified in PMT of the PSI The PMT teletext_descriptor tag value is 0x56 The stream_type is 0x06 (private data) Each stream identified by different data_identifier Even though a PMT may reference a teletext data stream associated with a video stream, the teletext stream may have a different PCR to the video. Consequently it is recommended to ignore the teletext private data PCR and PTS when decoding and present to the display when received – see Annex I and EN 300 472 Annex A, PTS transmission.	EN 300 468 Cl. 6.2.32 EN 300 472 and revisions	All receivers for teletext subtitles but optional for other teletext

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
10.3.3 Teletext re-insertion on VBI of analog SD or ED 625 line output- (applies to set-top-boxes)	Where fitted, teletext shall be reinserted on VBI lines of video output for display on teletext capable PAL TVs connected to the STB. The teletext line will be identified in the teletext packet information as detailed in EN 300 472	EN 300 472 Cl. 1 ITU-R BT653-2 EBU SPB 492	All set-top-boxes' Standard Definition outputs
10.3.4 Use assigned colour and position where displayed on 4:3 and 16:9 pictures	In teletext assigned colour and position.		All receivers
10.3.5 Time accuracy of closed captions (CC)	The receiver's decoding delay for the teletext output or display of the line 21/334 teletext closed captions should not be more than 2 video frames (80msec). PTS are not used.		All receivers
10.4 Bit-mapped subtitles	Subtitles, logos and other graphical elements may be coded and carried in DVB bitstreams This format may also include bitmapped closed captions for the hearing impaired. The receiving equipment shall be capable of decoding bit-mapped captions when present.	EN 300 743 EN 300 468 Clause 6, Tables 12 and Clause 6.2.30	All receivers
10.4.1 Decoding of bit-mapped information	The OSD shall indicate to the viewer that subtitles are available in a service and may be displayed. The receiver is able confirm this information from the PMT (Tag = 0x59)		All receivers
10.4.2 Features of display minimum number of colours	At least 256 colour system is recommended.		Recommended All receivers
10.4.3 Closed caption display	The bit-mapped captions display should be easilly activated at the user's choice by a dedicated button on the remote control.		All receivers
10.4.4 Time accuracy of display of closed captions	bit-mapped captions provided +/- 40 msec with respect to PTS		All receivers
10.5 Electronic program guide (EPG)			
10.5.1 EPG General	Receivers shall be able to use information from EIT tables but shall not be adversely affected by the absence of EIT tables in a transmission At the time of publication, Australian DTV broadcasters will transmit their own SI which may include EIT tables for their own services only. Receiver manufacturers relying on EIT information will need to make their own decisions on memory and allocation for viewer's convenience in referring to previously captured EPG data.		All receivers Optional
10.5.2 Use of EPG flush	EPG Flush function may erase EPGs		Informative
10.5.3 Display of broadcaster supplied EPGs	Under discussion with broadcasters and dependant on receiver API software. EPGs may be provided by broadcasters as a feature of an interactive service.		Informative
10.5.4 Use of now/next (present/following)	Required for basic navigation in digital and for parental guidance operation in consumer DTV receivers. Supplied by EIT. See Items 3.5 & 6.6		All receivers
10.5.5 Use of extended program information	Some broadcasters may provide this information.		Informative
10.5.6 Running Status Table	Use in Australia not determined. Receivers should not rely on this table for operation.	EN 300 468	**Not required**

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
11. DATA BROADCASTING (BROADCAST TELEVISION RELATED)	Will be dependent on application software (see Item 9.1) For detailed information on datacasting specific receivers refer to the relevant part of this Standard	EN 301 192 TR 101 202	Informative
11.1 Access to data service	Receivers should be capable of operating with DSM-CC streams. There may be more than one data broadcast stream in a transport stream. See EN 301 192 Databroadcasters may include proprietary private streams and may be encrypted requiring a CA system.	ISO/IEC 13818-6	Recommended in premium receivers, otherwise, optional
11.2 Data interface	Where data interface is fitted, options for interface is given in Item 15 Interfaces and connectors		Optional
12. PARENTAL GUIDANCE • Use Code provided by Broadcaster in EIT • Display Code in EPG (Now & Next) • Provide 'Lock-out' with PIN access	The Australian Parental Guidance classification codes for television programs when transmitted, are intended to be displayed, and form a part of the parental service locking mechanism in a digital receiver. Unlike the DVB European usage, the Australian code is based on program content without age assignment. The transport stream EIT will generally include the DVB parental_rating_descriptor (Tag = 0x55) and associated information but the receiver should use the 'look-up' table given in Annex-F for the on-screen EPG display and the lock-out set-up screen. The receiver should check the parental_rating_descriptor as indicated in the $EIT_{now/next}$, when accessing a program, and if the parental guidance lock-out is activated, blank the program if the parental guidance rating is exceeded.	EN 300 468 Modified as detailed in Annex F	Recommended for all receivers
13. CONDITIONAL ACCESS (CA) [23] NOTE: Options include the following: (a) Provide for fitting CA system later (b) Include a CA system (c) No CA system	Manufacturers have two choices for Option (a) : i) Fit a 'PCMCIA/PC-Card' socket using DVB common interface (CI). Then CA Service providers can provide customers with an appropriate PC-Card as required. ii) Fit a 'smartcard' slot and provision to download CA software to be 'embedded' in the receiver software. CA service providers can provide customers with an appropriate smartcard and arrange software download later. This option requires great care in software download of CA system.	ETR 289; DVB A011	Option (a) i) Recommended for all receivers
13.1 SimulCrypt compliance of receivers with a CA system or where provision to add a CA later is provided	Where the ability to fit a CA system to a receiver after purchase is provided, compliance with DVB (ETSI ETR 289) common scrambling algorithm is essential, i.e. if the receiver has a CA system fitted or is capable of being fitted (e.g. via a common interface) with a CA system, then it shall be capable of successfully decoding a DVB SimulCrypt compliant transmission.	AS4599 ETR 289 TS 101 197 Part 1 & 2	All receivers complying with 13.0 a i or ii
14. COPYRIGHT PROTECTION ON OUTPUTS [24]			
14.1 Activation	Activated by MPEG copyright bit flag and/or descriptor	ISO/IEC 13818-1	Informative
14.2 Digital outputs	IEEE 1394 CP and DVI / HDCP under international discussion	IEC 62315	Informative
14.3 High definition analog outputs	Under international discussion		Informative
14.4 Standard definition analog outputs	Under international discussion		Informative

[23] Range of use and type of Conditional Access system subject to outcome of Government, Broadcasters and Industry discussions. Manufacturers will need advice if Option (c) is preferred.

[24] Use and type of copyright protection system(s) subject to Broadcaster and Industry discussions.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
15. INTERFACES AND CONNECTORS	ETSI TS 102 201 V1.1.1 (1999-03) *Digital video Broadcasting; Interfaces for DVB Integrated Receiver Decoder (DVB-IRD)*. Sections of this document that are applicable to Australian requirements are under consideration		
15.1 RF input/output			
15.1.1 RF input	IEC 60169-2 (VHF/UHF) female, 75 Ω. An RF loop-through output (Male) may also be fitted.	IEC 60169-2	All receivers
15.1.2 RF modulated PAL composite output	Where fitted, complies with AS 4542.1 RF Output should be tuned by software or hardware in a range between 470-862 MHz in PAL B (7MHz channel spacing VHF/UHF and 5.5MHz sound).	Clause 3.1.2 AS 4542.1	Recommended for SD STBs
15.2 Base-band analog video connectors	Where fitted, options are the following:		
15.2.1 Component Analog outputs for HD and SD using Y, Pb, Pr or RGB+HV	<u>For High Definition Receivers</u> **Y** (with bi-level sync, tri-level optional), **Pr**, **Pb** provided on Cinch / RCA-phono / BNC, or **RGB+HV** provided on VGA D-Sub 15pin / 5x Cinch / RCA phono Note: It's recommended that HD receivers provide HD analog outputs that are switchable (preferably mechanical), between 'native' HD formats or CRT-friendly (31.25kHz) formats. HD receivers are also recommended to have separate SD output(s) or outputs that are switchable to SD. (For example this is useful for consumers that initially wish to connect to an SD display but may wish to upgrade to an HD display later.) <u>For Standard Definition Receivers</u> Y, Pr and Pb provided on Cinch/RCA-phono or BNC Analog voltage levels for SD & HD: Y Blanking to peak level = +700mV Pb, Pr maximum peak level = ± 350mV Sync on Y = –300mV (bi-level), ± 300mV (tri-level) RGB+HV per VESA VGA standards for monitor displays or EIA/CEA-861-B / ITU-R BT1358 for CRT TV displays	An explanation of Y, Pb, Pr is given in the Glossary in Annex A Refer to Annex H for details of sync wave-forms See Annex H See Annex H	Recommended on HD receivers Recommended
15.2.2 PAL composite (CVBS)	Complies with 625/50 line PAL ITU-R Report 624-4. Connector -IEC 48B Sec.316 (Yellow Cinch / RCA-phono) Note: High Definition receivers when receiving a HD service may also provide downconverted video to its SD PAL output. See AS 4542.2 -Consumer television interfaces, Part 2: Analog baseband.	AS 4542.2	Recommended for all receivers
15.2.3 S-video (Y/C)	Note: High Definition receivers when receiving a HD service may also provide downconverted video to its SD S-Video output. See AS 4542.2 -Consumer television interfaces, Part 2: Analog baseband	AS 4542.2	Recommended for all receivers for SD output

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
15.2.4 SCART Video and Audio	If a SCART connector is fitted and marked "TV", SD video outputs shall be provided on this connector with **RGB**, CVBS (PAL) and optional S-video. Stereo left and right Audio shall also be provided. Wide-screen signalling is optional. Selection between **RGB**, CVBS and S-Video (Y/C) may be via a user set-up menu. See AS 4542.2 -Consumer television interfaces, Part 2: Analog baseband. (also known as Peritelevision or Euroconnector) **Note:** If manufacturers choose to provide non-Euro-standard SCART connections with Y, Pb, Pr instead of G, B, R on pins 11, .7, 15 respectively, these should be prominently marked to avoid consumer confusion with non compatible equipment and consequent loss of picture quality.	AS 4542.2 ETSI TS 102 201 Sect 4.9 – Table 1 EN 50049-1	Optional for SD output
15.3 Base-band audio connectors			
15.3.1 Analog audio	See AS 4542.2 - Consumer television interfaces, Part 2: Analog baseband. Dependant on receiver type – may be Cinch/RCA-phono or minature headphone jack on portables.	AS 4542.2	All Receivers
15.4 Digital program interfaces			
15.4.1 Audio SP/DIF and/or Toslink: • PCM/AC-3 data bit-stream output - Optical or electrical	S/PDIF digital audio output – electrical or optical (TOSLINK). This digital interface may carry PCM stereo audio and/or AC3 coded audio and/or MPEG1-L2 audio streams to an external decoder multichannel sound system.	IEC 61937 IEC 60958	Recommended for receivers with AC-3 decoders, otherwise optional
15.4.2 Uncompressed Digital Video outputs	For SD and HD formats using DVI and uncompressed digital video interfaces and appropriate synchronising signals.	IEC 62315	Optional
15.4.3 Digital program stream	Transport or program stream. For example; to and from digital recorder or from satellite receiver Use of IEEE-1394A or 1394B is proposed but a copy protection system may be required.	IEEE 1394 A/B	Recommended in premium receivers, otherwise, optional
15.5 Common interface (CI) connector [25]	PCMCIA (PC-Card) socket(s) may be fitted. The PC-Card may be used for CA or other applications. Pin assignments in accordance with EN 50221. Support for modules of type 2, type 3 is optional. Ease of viewer access is recommended as PC-Cards used in this connector may include a 'smartcard' holder.	EN 50221 CENELEC R206-001:1998 TS 101 699	Recommended for receivers with interactive or data output capabilities
15.5.1 Additional CI slot	PCMCIA (PC-Card) socket	EN 50221	Recommended in premium receivers, otherwise, optional
15.6 Smartcard slot(s)	For interactive applications including T-commerce	ISO 7816 (Series)	Optional
15.6.1 Additional smartcard slot	Card interface Specifications are not yet finalised	ISO 7816	Optional

[25] Copy management and protection of CI transport stream interface currently under discussion in DVB forums.

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
15.7 Data connectors	Where fitted, options are the following:	AS 4542.3	
15.7.1 Serial port For use with a PC or to connect to an external modem	9 pin D (RS-232) Female (DCE configuration) capable of connection to a PC or other external device. Additionally or alternatively a Male (DTE) connection may be provided for connection to an external modem. Otherwise the female (DCE) port could also be used to connect a modem but would require a "NULL Modem" adapter or interconnect cable. If this option is intended to be available then the need for the adapter should be clearly indicated in the operating literature accompanying the unit.	AS 4542.3	Optional
15.7.2 Parallel data port	25-pin D female IEEE 1284 possibly to be used by dedicated printer or other external devices. Such a facility is now considered superseded by USB.	AS 4542.3	Optional
15.7.3 IEEE 1394A or 1394B	This may provide interconnection between various components in an in-home digital network and carry two-way transport stream, program stream or data. In the case of transport stream or program stream, the requirements of copyright protection could be applicable (also known as – FireWire or i.Link™)	AS 4542.3 ; IEC 61883-1; IEC 61883-4 1998-02; IEEE 1394 A/B	Recommended in premium receivers, otherwise, optional
15.7.4 USB Port	May be future preferred home network interconnection for a cable, xDSL or cord-less phone type modem or peripherals items such as a keyboard, printer, external hard-disk etc. If a USB port is fitted and the receiver includes interactive capabilities, the receiver should have installed or the ability to install, printer driver software. As a minimum, a generic ASCII text driver may be fitted which could be used for print-out of on-screen text derived from data in an interactive application such as DigitalTeletext.	USB	Optional
15.7.5 LAN Connection	The receiver may as an additional or alternative feature be fitted with a physical or wireless network connection complying with IEEE 802 formats including IEEE 802.11b (wireless) or similar such as 'Bluetooth'.	IEEE 802	Optional

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
16. RETURN CHANNEL PATH	Some features of the 'return channel' are proposed be confirmed in an Australian 'Feature Set' for interactivity based on MHP. The return channel may be implemented by a variety of methods at the manufacturers choice, which will typically provide a data path back to an IP address.	MHP HAVi	Recommended
16.1 Type of operation— Internal or External	The access to a return channel may be via a data interface such as described in Section 15 above. In such cases the access may be via a wired or wireless connection to a cable or xDSL modem, or an inbuilt or external dial-up modem intended for connection to the PSTN, ISDN, GSM style or other. DVB-RCT (ETSI EN 301 958) is under consideration.		Optional
16.2 External Modem	If a port for an external modem is provided, the configuration may be either as a USB port or a standard serial data communications port on a D9 connector as detailed in 15.71 above and use standard "Hayes AT" commands.		Recommended
16.3 Internal Modem	Where fitted, a V92 (fast connect) is recommended	ACA TS001 ACA TS002	Optional
16.4 Internal modem port connector	RJ 11		Optional
17. SYSTEM SOFTWARE REVISION			
17.1 Ability to upgrade	Ability to upgrade the operating software of a receiver is recommended. This may be used to correct operational 'bugs' and/or add new or improved features. DVB/ETSI have published a standard for digital receiver software upgrades, available from ETSI (TS 102 006). Provision for revision of software is recommended as specified in TS 102 006 or using a method determined by the manufacturer.	TS 102 006 V1.2.1	Recommended
17.2 Receiver embedded identification	To identify model, software release etc. (e.g. for software upgrades, loading APIs). Use of an Organisational Unique Identifier (OUI) is recommended.	TS 102 006 V1.2.1	Recommended
17.3 Via DTTB transmission	Some broadcasters have indicated a willingness to provide the broadcast option for use throughout Australia. Manufacturers and suppliers will need to negotiate with the broadcasters. Typical requirements would include that the download for the particular brand of receiver would not interfere with any other receivers.	TS 102 006 V1.2.1	Recommended
17.4 Other methods	For example, Via PC to USB or RS-232 Serial port, IEEE 1284 parallel port, IEEE 1394, CI slot or modem may be used		Alternative Recommend-ation

Table 1 : Receiver Requirements (Continued)

Item Description	Remarks	Reference Standards	Applicability
18. MEMORY AND PROCESSOR REQUIREMENTS [26]			
18.1 Ability to expand	For upgraded future applications		Optional
18.2 Minimum Memory requirement	Will depend on operating system interactivity and APIs		Informative
18.2.1 Video Memory	Typically: 2MByte for an SD video MPEG decoder 8MByte for an HD video decoder		Informative
18.2.2 Non-volatile and Volatile for operation and applications	Suggested minimum for MHP applications: Profile 1 (enhanced): 8 + 16 MByte Profile 1 & 2 (interactive): 16 + 32 MByte Profile 1, 2 & 3 (Internet): 16 + 32 MByte		Informative for MHP equipped receivers
18.2.3 Other Storage	For TV-Anytime / Personal Video Recorder type applications, hard-disk drives may be fitted. In such cases encryption may be required so that recorded program material cannot be in a readable format if the drive is removed to another unit such as a PC. This requirement would be as an anti-piracy measure.	TV-Anytime MHP	Informative
18.3 Processor	These figures are indicative only as performance may be determined by processor architecture. Suggested minimum for MHP applications: Profile 1 (enhanced): 100 MIP's Profile 1 & 2 (interactive): 150 MIP's Profile 1, 2 & 3 (Internet): 200 MIP's		Informative for MHP equipped receivers

[26] Receiving equipment memory requirements include consideration for API operating system and upgrades; decoding of program material including MP @ HL pictures; audio (including advanced features for AC-3) and caption buffer sizes for synchronous presentation; decoding and display of OSDs and captions; Storage of 5 station minimum EPGs based on now/next schedules in EITs; 'housekeeping' items such as storage of tuning tables; Program interactive applications etc.

ANNEX A :

ABBREVIATIONS AND GLOSSARY

(Informative)

'5.1' channel sound

A five point one channel sound system actually has 6 channels of surround sound. The first 5 channels are centre speaker, and then left, right, rear left and rear right. The extra point one refers to the reduced bandwidth Low frequency effects (LFE) sounds that are often reproduced using a 'sub-woofer' loudspeaker. Very low frequency sound below about 100 Hz does not have to be directionalized because human hearing has no directional sensing of these sounds.

Advanced home 5.1 channel 'surround sound' systems can source the six channels either from information derived from incoming stereo (two channel) using systems such as Dolby® Surround ProLogic™ (I / II) or, for better performance, from separate 5.1 channel information carried in advanced digital audio systems such as Dolby AC-3 (5.1 version) or MPEG-2/AAC (5.1 and 7.1 channel versions).

AC-3

A proprietary digital sound system developed (and patented) by Dolby Laboratories Inc. (Dolby®). It can carry multiple channels, stereo with ProLogic and 5.1 discrete channel. Also known as Dolby Digital®, variants of the system are used in movie theatres and DVD and in the US ATSC and Australian DVB-T digital broadcast systems. Decode systems may include a second decoder for special requirements.

Conditional Access (CA)

Conditional access refers to methods that scramble or encrypt the program or private data so that it may be received only by 'authorized' receivers. While a number of different 'private' schemes using 'smartcards' have been used by Pay-TV operators working primarily via satellite, the arrangements for terrestrial services are different because free-to-air services should be receivable without CA authorization. In Europe, a Common Scrambling Algorithm was designed to minimize the likelihood of piracy attack over a long period of time. By using the Common Scrambling Algorithm system in conjunction with the standard MPEG data transport and selection mechanisms it is possible to incorporate in a DVB transmission the means to carry multiple messages which all enable control of the same scrambled broadcast but are generated by a number of different CA systems. This '**Simulcrypt**' technique allows both the delivery of one program to a number of different decoder populations that contain different CA systems, and also for the transition between different CA systems in any decoder population, for example to recover from piracy.

The 'Multicrypt' option is also available, facilitated by the Common Interface (DVB-CI) specification proposed for standardization by CENELEC (European Committee for Electrotechnical Standardization). The CA module may operate in conjunction with a smartcard or with a PCMCIA card as popularly used with lap-top PCs.

Carrier-to-Noise Ratio (C/N or CNR)

A measurement of the received carrier power relative to the power of background noise at the receiver input.

CENELEC

European Committee for Electrotechnical Standardization.

Colour Look-Up Table (CLUT)

For DTV on-screen-displays, the CLUT is a look-up table of colour values for translating an object's pseudo-colours into screen display colours. It is a way of simplifying the amount of data required to display an object but has the limitation that only 4, 16 or 256 colour values are allowed somewhat like early PC EGA graphics systems. Not all decoders may support a CLUT with 256 entries. A palette of four colours would be enough for graphics that are basically monochrome, like subtitles, while a palette of 16 colours allows for cartoon-like coloured objects.

COFDM

A method of coded OFDM used by DVB for digital terrestrial television broadcasting (see OFDM).

Data carousel

The scenario of the user-to-network download protocol which embodies the cyclic transmission of data by a DSM-CC download server as defined in ISO/IEC 13818-6 Section 7.

Differential latency

Also known as synchronization latency. The time that data is presented to a decoding device relative to the time its associated video is presented to the same decoding device.

Digital Video Broadcast (DVB)

The digital video broadcast is a consortium of over several hundred manufacturers, research institutes, and broadcast organisations principally located in Europe but spread throughout the world. The Project has produced a series of interlinked broadcasting standards for satellite, cable and terrestrial. Through other European groups such as 'ACTS' the work is now going on to interlink computer networking and multimedia.

Annex A – Abbreviations and Glossary (Continued)

Digital Video Interface (DVI)	Digital Video Interface is a high-speed digital connection standard to connect a PC (or digital TV STB), to a display device. As display technology moves away from the analog CRT type display to flat-panel and other displays that use digital processing, older analog interconnect standards, such as VGA, introduce further distortions by additional, unnecessary D/A and A/D conversions. The need for these conversions is removed by the introduction of this DVI standard. DVI is a much simpler standard than IEEE 1394 because it is only a point-to-point link, 1394 is a bus standard with protocols and such. Current maximum data rate of a single DVI link is 165 MHz RGB, transmitted as 3 serial digital streams of 1.65 Gb/s each. The DVI standards was developed by the Digital Display Working Group, which includes companies such as Intel, Compaq, H-P, IBM and NEC. http://www.ddwg.org/
DVB-T	The DVB-T terrestrial digital television broadcasting specification is based on a transmission system of COFDM carrying program and data as MPEG packets. It was approved by the Steering Board, in December 1995 and subsequently accepted by ETSI as a European Standard. The work was based on a set of user requirements produced by the Terrestrial Commercial Module of the DVB Project. DVB members contributed to the technical development of DVB-T through the DTTV-SA (Digital Terrestrial Television—Systems Aspects) of the Technical Module. The European Projects SPECTRE, STERNE, HD-DIVINE, HDTVT, dTTb, and several other organizations, developed system hardware and produced results which were fed back to DTTV-SA. http://www.dvb.org/
Dolby®	A US based company specializing in proprietary compression and noise reduction techniques for audio transmission and recording.
Dolby Surround Pro-Logic™	A method of encoding rear 'surround' and centre information in a 2-channel stereo audio signal. Some receivers have 'Pro-Logic™' enhancement to improve channel separation in the two rear loudspeakers. 'Pro-Logic II™ provides further improvements in the decoding process with greater channel separation and stereo surrounds, giving 5 channels.
Dynamic range	The ratio between the greatest signal power that may be transmitted over a multichannel analog transmission system without exceeding distortion or other performance limits, and the least signal power that may be utilized without exceeding noise, error rate or other performance limits.
Electronic Industries Association (EIA)	A US voluntary body of manufacturers that, among other activities, prepares and publishes Standards.
Electronic Program Guide (EPG)	An EPG implies a degree of electronic interactivity and not a static Program Guide. Broadcasters using DVB, transmit program schedule information in Event Information Tables (EIT) tables. These tables may be in several different forms containing - immediate information ($EIT_{now/next}$, also known as EIT_{pf} - present/following) and in limited cases, future program information (known as $EIT_{schedule}$) – related to the transport stream carrying the EIT or other (broadcasters') transport streams. Receivers may decode this data, and perhaps information from other broadcasters, and produce EPGs. Broadcasters may also generate EPGs in API specific or private data but that would require a particular application program in the receiver- eg. MHP, OpenTV, Liberate etc.. Other suppliers may provide EPGs either through unrelated data streams or, perhaps, over the Internet. Note that in Australia, the Broadcasting Services Act imposes certain obligations on broadcasters and datacasters in regard to EPGs.
European Telecommunication Standards Institute (ETSI)	The major European Standards publishing body. http://www.etsi.org/ Most DVB related standards are available from this site.
Free-To-Air broadcaster (FTA)	FTA broadcasters offer their programs and related material, where receivable, to be freely accessed by the public. This contrasts with subscription or pay broadcasters that impose a charge on a viewer/listener to access their material. FTA broadcasters may be government, community or commercially (advertising) funded.
Forward Error Correction (FEC)	Methods of improving the ability to recover error-free data from a transmission or storage system usually by adding extra data (about the payload data) before transmission. For example in DVB-T coding, a system of FEC referred to as 'Viterbi' or 'inner' coding can be set to different levels from 7/8 to 1/2 with 1/2 providing the most error protection. Further error protection known as Reed-Solomon adds a further 16 bytes to the 188 Byte MPEG-2 transport stream packet making a new packet size of 204 bytes.

HAVi

Home Audio Video interoperability: HAVi is a home networking standard for interoperability between digital audio and video consumer devices. It is an initiative from eight major Consumer Electronics companies - Grundig AG, Hitachi, Ltd., Matsushita Electrical Industrial Co., Ltd. (Panasonic), Royal Philips Electronics, Sharp Corp., Sony Corp., Thomson Multimedia and Toshiba Corp. Parts of the HAVi specifications including 'user interface' have been included into the MHP. www.havi.org

Header

In data transmission, the header is protocol control information located at the beginning of a protocol data unit.

Hierarchical modulation (HM)

One class of the many possible modes of DVB-T COFDM radio-frequency transmission where the transmission effectively becomes split into two parts – known as high and low priority (HP & LP), which results in enhanced receivability for the HP stream while the LP stream can maintain standard receivability characteristics similar to the non-hierarchical transmission. Each part carries its own transport data stream with the data capacity split approximately 1/3 and 2/3 of a non-hierarchical transmission.

HM is best understood by considering the COFDM constellation of possible modulated states in each of the four quadrants. The simplest, and most robust modulation is 4QAM (QPSK) with 16QAM and 64QAM as other less robust possibilities. If a case of QPSK is taken and say, a lower amplitude 16QAM signal (at the same clock rate and same guard interval) added to it, then the constellation would have the appearance of 64QAM but the QPSK and 16QAM would each be carrying their own data (transport stream). Another possibility is QPSK on QPSK, the resultant constellation then appearing as 16QAM.

The HP part of the COFDM transmission, which is carried on the base QPSK modulation, is capable of being more reliably received under difficult reception conditions such as in mobile or portable situations, whereas the low priority stream (if 16QAM), would have comparable receivability to standard 64QAM. The high priority stream's enhanced receivability characteristics may be further strengthened by stronger FEC and/or a shift of the modulation pattern (alpha factor), which in effect increases the amplitude of the QPSK component.

Receivers with a single tuner/COFDM demodulator can only receive one of the streams at a time and can select either the HP stream or the LP stream. In poorer reception conditions where standard non-HM signals are lost, the LP stream will be affected similarly.

With the 16QAM on QPSK case, the demodulated high priority stream typically has a data capacity of between one third and one quarter of the non-hierarchical signal while the low priority is about two thirds to one half. Refer to ETSI EN 300 744 and AS 4599. This implies that in a 7MHz channel, typically 5~7 Mb/s and 14~16 Mb/s may be carried in each transport stream, typically allowing SD in the HP stream and HD or other combinations of SD in the LP stream.

The presence and type of a Hierarchical COFDM transmission may be identified by the COFDM low data rate Transmission Parameter Signalling (TPS). Receiver design should also include software to process Nit $_{other}$ as hierarchical broadcasts should include Nit $_{other}$ in each transport stream with details of the other stream.

Hierarchical (video and/or audio) coding

Not used in DVB implementations. It is a possible feature of MPEG-2 where the video and/or audio information can be coded and scaled spatially or temporally. That is where a base or course layer and a fine detail layer may be sent separately. For example, the Simple, Main, SNR Scalable, Spatially Scalable and High profiles have a hierarchical relationship. Therefore the syntax supported by a 'higher' profile includes all the syntactic elements of 'lower' profiles (e.g., for a given level, a Main profile decoder shall be able to decode a bitstream conforming to Simple profile restrictions). Refer ISO/IEC 13818, Parts 1 to 3.

High Definition Television (HDTV)

High definition television has a resolution of approximately twice that of standard television in both the horizontal (H) and vertical (V) dimensions and a wide screen picture aspect ratio (H:V) of 16:9. ITU-R Recommendation 1125 further defines 'HDTV quality' as the delivery of a television picture which is subjectively identical with the interlaced HDTV studio standard. Note that the number of lines alone does not give an indication of the perceived picture sharpness. Different types of display will affect the result. For example, it is generally agreed that a 720 line 'progressive' format display will have similar degree of sharpness to a 1080 line 'interlace' format display. For MPEG-2 compression, a receiver is required with a 'main profile @ high level' (MP @ HL) decoder, which will decode pixel sample rates greater than 10,368,000 samples per second and less than 62,668,800 samples per second. The maximum is actually determined by maximums of: - samples per line (1920), lines per frame (1152) and frames per second (30).

Hyper-text-transfer protocol (http)

An Internet protocol for transferring text files with layout information.

Annex A – Abbreviations and Glossary (Continued)

IETF	See Internet Engineering Task Force.
Institute of Electrical and Electronic Engineers (IEEE)	An international voluntary organization based in the US which, among other things, sponsors Standards committees and is accredited by the American National Standards Institute. Various Standards such as IEEE 1394 (also known as FireWire or i.Link) have recently been developed for domestic high-speed digital interlinking of TV cameras, recorders and computer equipment. www.ieee.org/
International Electrotechnical Commission (IEC)	An international Standards body based in Europe.
International Organization for Standardization (ISO)	An international Standards body, commonly known as the International Standards Organization.
International Telecommunication Union-Radiocommunication (ITU-R)	An international Standards body and a part of the ITU, based in Geneva. It is the recognized Standards publisher for broadcast radio and television transmission standards and Standards on international program exchange.
Internet Engineering Task Force (IETF)	A body of interested organizations responsible, among other things, for developing Standards used for the Internet.
Local Area Network (LAN)	A non-public data network in which serial transmission is used for direct data communication among data stations located on the user's premises. Examples are 'ethernet' in various forms as defined by IEEE 802.
Latency	The time for material to be passed from the input to the output of a system.
Multimedia and Hypermedia information coding Expert Group (MHEG)	Multimedia and Hypermedia information coding Expert Group: The Standard known as MHEG-5 is ISO/IEC IS 13522-5 (1996): "Information technology - Coding of Multimedia and Hypermedia Information - Part 5: Support for Base-Level Interactive Applications". This standard for interactive television has been adopted by UK terrestrial broadcasters.
Multimedia Home Platform (MHP)	The Multimedia Home Platform (MHP) standard (as an offshoot of DVB), defines a generic interface between interactive digital applications and the terminals (eg STBs, iDTV receivers) on which those applications execute. This interface decouples different provider's applications from the specific hardware and software details of different MHP terminal implementations. It enables digital content providers to address all types of terminals ranging from low-end to high-end set top boxes, integrated digital TV sets and multimedia PCs. The MHP extends the existing, DVB open standards for broadcast and interactive services in all transmission networks including satellite, cable, terrestrial and microwave systems. Elements of the MHP specification include the DVB-J platform with DVB defined APIs and selected parts from existing Java APIs, JavaTV, HAVi (user interface) and DAVIC APIs. (http://www.mhp.org/). *Australian terrestrial broadcasters have adopted this standard for interactive television.*
Moving Picture Experts Group (MPEG)	A voluntary body ISO/IEC Joint Technical Committee 1, Sub Committee 29/Working Group 11 which has and continues to develop Standards for digital compressed moving pictures and associated audio. MPEG Standards are published in the ISO/IEC 11172 (MPEG-1), and ISO/IEC 13818 (MPEG-2) series of documents. Current work in MPEG includes MPEG-4 which addresses coding and distribution of multimedia objects, and MPEG-7 which defines a multimedia content description interface, for indexing and searching of multimedia information.
Mosaic display	An array of small pictures to make a total full-screen picture. Generally provided to give an indication of the content of a number of video programs.
MPEG-1 and MPEG-2	Also refer to entry under 'Moving Pictures Experts Group (MPEG). These are the most common video and audio compression schemes now in use. MPEG-1 was used for lower data rate video on early CDi and VideoCDs. MPEG-2 provides for better quality (at higher data rates) and is used in a variety of professional and consumer applications from SDTV to HDTV on terrestrial, satellite and cable broadcast and DVD. The emerging standard is **MPEG-4**: ITU Rec H.264; DVB's AVC group have prepared a draft ETSI standards for carriage of MPEG-4 in DVB transport streams.

MPEG-1 layer II audio	The compressed audio Standards of MPEG-1 were published in the 1993 International Standard ISO/IEC 11172-3. This dealt with mono and two-channel stereo sound coding, at sampling frequencies commonly used for high quality audio (48, 44.1 and 32 kHz). Compared to Layer I, Layer II is able to remove more of the signal redundancy and to apply the psychoacoustic threshold more efficiently. There is also a Layer III, known as MP3, which is again more complex and is directed towards lower bit rate applications due to the additional redundancy and irrelevancy extraction from enhanced frequency resolution in its filterbank. A 'full Layer II' decoder accepts Layer I and II bitstreams. Likewise an MPEG-2 decoder should be capable of fully compatible decoding an MPEG-1 bitstream. The development of audio standards for MPEG-2 resulted in the 1995 International Standard ISO/IEC 13818-3. New systems are now attracted to the superior performance of Advanced Audio Coding (**AAC**), refer to ISO/IEC 13818-7.
Multiview display	Additional video programs relating to a main program. The additional video may be from other (fixed or switched) point-of-view cameras or simply graphical and text information such as a sporting event statistics. These additional picture sources may be similar or lesser formats to the main program and may be displayed full screen or in advanced receivers in a PIP type window. They may be assigned a Logical Channel Number for selection oan simple "zapping" STBs and/or selection through an interactive application on receivers appropriately equipped.
Multiplexer (Mux)	A physical device which is capable of inserting data into and extracting data from an MPEG-2 transport stream.
National Television Systems Committee (NTSC)	A US committee formed in the late 1940s and '50s, which defined the analog colour television broadcast standard used today in North America.
Opportunistic data	Data inserted into the remaining available bandwidth in a given transport stream after all necessary bits have been allocated for video and audio services.
On-Screen Display (OSD)	On screen display of menu for user's setup of receiver's operating parameters. Also refers to display of choices and interaction with a receiver's closed caption or teletext display and/or program interactivity.
Orthogonal Frequency Division Multiplexing (OFDM)	A modulation system which uses a very large number of separate radio frequency carriers each of which carries a small proportion of the total information content to be sent. Also used in Digital Audio Broadcasting (DAB), OFDM has good performance in a very strong multipath (ghosting) environment. DVB based digital television broadcasts use Coded OFDM.
Packet Identifier (PID)	A unique integer value used to identify elementary streams of a program in a single- or multi-program MPEG-2 stream. Carried on 13 bits within each 4byte packet header.
Phase Alternate Line (PAL)	An analog encoding system for colour television. Compatible with analog monochrome systems of the same scanning rates. It has a high frequency subcarrier to carry two colour component signals, similar to the principles used in NTSC but alternates the phase of one of the colour signals so that the receiver may correct colour errors with a delay line. It was developed by AEG Telefunken Laboratories in Hanover, Germany.
Program Clock Reference (PCR)	A signal transmitted typically 25 times a second to allow synchronisation of a decoder's system clock (usually 27MHz) to the original MPEG encoder 'clock'. Decoders may also use it with 'Presentation Time Stamps' (PTS) included with the video and audio to ensure the correct presentation of picture and sound (lip-sync).
Personal Computer Memory Card International Association (PCMCIA)	Also known as PC card. A card/socket with 68 pins commonly found on notebook computers, digital cameras and in digital TVs for expanded facilities. Three types are defined – Type I, Type II and Type III. The thinnest (3.3 mm thick) are Type I, which are primarily used for memory devices like flash ram. Type II cards are the type normally used in digital TV applications and the card may have a 'smartcard' slot inbuilt. Type II are 5mm thick. Common examples are modems and LAN adapters in PCs. Type III cards are 10.5 mm and are used for the devices that require more space such as disk drives and wireless communication devices.
Packetised Elementary Stream packet (PES packet)	The data structure used to carry elementary stream data. A variable length packet beginning with a PES packet header followed by a number of contiguous bytes from one elementary stream.
PES stream	A PES stream consists of PES packets, containing only data from a single elementary stream, and which all have the same stream_id as defined in ISO/IEC 13818-1. It is not use in DVB specified environments.

Annex A – Abbreviations and Glossary (Continued)

Picture-In-Picture (PIP)	A feature of some television receivers (usually with more than one tuner) to display video from other programs. Usually displayed as a smaller window. PIP may also become useful for the display of 'multiview' video, from digital program sources with this optional available.
Program, Program Stream (PS)	A collection of coded audio, coded video and perhaps other data objects such as caption data. Such objects need not have a defined time base; however, those that do, refer to a common time base for presentation synchronization.
Program-Specific Information (PSI)	In MPEG-2, normative data necessary for the demultiplexing of transport streams and the successful regeneration of programs.
Protocol	A set of rules and formats which determines the communication behaviour of layer entities in the performance of the layer functions.
Quadrature Amplitude Modulation (QAM)	A method of modulating digital signals onto a radio-frequency carrier signal involving both amplitude and phase coding.
Quadrature Phase-Shift Keying (QPSK)	A method of modulating digital signals onto a radio-frequency carrier signal using four phase states to code two digital bits.
Return channel	A path for return information from the end-user, usually via a telephone modem. Necessary for full interactivity. In cable systems, the signal flows towards the headend, away from the subscriber; equivalent to upstream.
SCART Connectors	Large flat multi-pin plug-socket found on STBs, TVs, DVD players and VCRs for modular interconnects. Mandatory for EU countries. Two specifications, dependent on type of equipment. Includes stereo audio interconnect, separate RGB video signals and/or 'S-Video' and/or Composite PAL, as well as wide-screen signalling. RGB video or 'S-Video' connections are preferred interconnects for digital transmissions to bypass the resolution loss and artefacts caused by composite PAL. This is an analog connector with no provision for HD. (Also known as "peritel" - peripheral television interconnect or Euroconnector).
Service multiplex and transport	In an MPEG system, 'service multiplex and transport' refers to the division of the digital data stream into 'packets' of information and the means of uniquely identifying each packet or packet type. Also the appropriate methods of multiplexing these video data stream packets with audio data stream packets and ancillary data stream packets into a single data stream consisting of a sequence of 188-byte transport packets.
Set-Top-Box (STB)	A modular unit for decoding video, audio, and data services physically separated from a display device. Also known as a set-top-unit (STU) or an integrated receiver decoder (IRD), mainly in regard to satellite services. "Zapping" boxes refer to receivers without an operatable interactive middleware such as MHP, MHEG or OpenTV.
Standard Definition Television (SDTV)	This term is used to signify a digital television system in which the quality is approximately equivalent to that of broadcast or cable NTSC and PAL as seen in the customer's TV receiver. The term Conventional Definition Television (CDTV) has been used to signify the analog PAL or NTSC television system as defined in Recommendation ITU-R BT 470.
Surround sound	Refers to listening environments where loudspeakers are positioned around the listener(s). Besides the front loudspeakers, other loudspeaker(s) are positioned to the rear and sometimes to the sides. The intention is to recreate the ambience and directionality of the original scene being reproduced. Sound systems employing surround sound can recreate such effects by processing the program stereo channels; or better stereo with phase encoded material such as Dolby ProLogic™; or best, from a discrete multichannel system of at least six channels including a low frequency sub-woofer channel.
Service Information (SI)	In an MPEG data stream, Service information (SI) is included within a DVB MPEG-2 transport stream to assist the user in selection of services and/or events within the digital multiplex, and so that the receiver can automatically configure itself for the selected service. Information carried within SI allows for identification of services or events for the user and may also provide information on services carried by different multiplexes and even other networks. SI data complements the PSI tables by providing other data to aid automatic tuning of decoders, and information intended for display to the user. In general, SI augments and extends the relevant Program specific information (PSI) specified in ISO/IEC 13818-1 (MPEG-2 Systems), the Program association table (PAT) and Program map table (PMT).

S-Video connector	A domestic analog baseband video interconnection on a small 4 pin plug where the video is separate luminance (Y), and chrominance (C – RF colour subcarrier), so as to avoid the resolution loss and artefacts caused by PAL or NTSC decoding. (Also known as S-VHS or Y/C.)
Transmission Parameter Signalling (TPS)	The TPS carriers are used for the purpose of signalling parameters related to the transmission scheme, i.e. to channel coding and modulation. The TPS is transmitted in parallel on 17 TPS carriers for the 2K mode and on 68 carriers for the 8K mode. Every TPS carrier in the same symbol conveys the same differentially encoded information bit.
Transport Stream (TS)	In DVB/MPEG-2, a Transport Stream is a time-division multiplex of one or several program streams into a single stream of 'packetised' data. Each packet contains data from one source of material. This material may be video, audio or other information such as teletext, bit-mapped subtitles, or other supporting material in an internet IP-type format. Other material may be from streams in a private data format. Each packet is 188 bytes but FEC information may be added on the end that increases the size to 204 bytes. A packet has a 4 byte header containing a packet-ID (PID), and a 184 byte payload that may include video, audio, or information on the format of the contents (PSI) and/or adaptation fields or empty stuffing bytes to keep the data rate constant.
Vertical Blanking Interval (VBI)	Present in conventional, uncompressed TV signals, this unseen space at the top of a TV picture is now used to carry ancillary data, such as teletext including closed captions. Historically it was provided for CRT picture displays to allow time for the deflection circuit to return the scanning beam from the bottom of the screen to the top in preparation for the next picture scan.
Wide Screen Signalling (WSS)	A wide screen signalling system using line 23 in 625 line systems originally used for the analog PAL-Plus system. The wide screen signalling information contains information on the aspect ratio range of the transmitted signal and its position, on the position of the subtitles and on the camera/film mode. Furthermore signalling for EDTV and for surround sound is included. The details of the standard are found in ETS 300 294.

Y, Pb, Pr for analog and Y, Cb, Cr for digital

These are designations for types of component video. Various Standards organisations such as SMPTE and ITU-R use the "Y, Pb, Pr" notation as the 3channel **parallel analog** component baseband representation of a colour television signal, but if this is digitised, then the digital representation is notated as "Y, Cr, Cb".

Equipment interconnect designations Y, Pb, Pr are analog signals used for equipment interconnection by three (3) separate parallel leads. The Y lead also carries a composite of the horizontal and vertical scan synchronisation signals.

Y, Cb, Cr are **digital** signals and are usually present internally in equipment in digital processing, but when used for external interconnects, the three signals are streamed over **a single lead** in sequence, such as the 270 Mbps Serial Digital Interface used in professional equipment, (see ITU-R BT.656-- Interfaces for digital component video signals in…625-line television systems operating at the 4:2:2 level of ITU-R BT.601), and for HD as shown in ANSI/SMPTE 295M-1997 1920x1080 50 Hz Scanning and Interfaces.

Colour television requires three signals, which are initially captured, and ultimately displayed, as shades of Red Green and Blue (RGB). While RGB is found in interconnects such as Scart, VGA etc., for intermediate processes such as storage on tape, editing, switching and transmission systems using MPEG, it is more convenient to mathematically matrix the RGB signals into Luminance (Y) and two "colour-difference" (R-Y and B-Y) signals. These have been chosen to match the physiology of the human eye to help mask noise or distortion effects introduced in these processes.

While the Y signal is regarded as always positive, the B-Y and R-Y signals can range from positive to negative in value. For example, a yellow picture made from equal Red and Green is bright (so Y is large), but there is no Blue colour, so B-Y will be negative.

In analog interconnects where the Y signal is 0Volt (black) to 700mV (white), to limit the excursion of B-Y and R-Y to ± 350 mV peak, the signals are reduced (scaled) to the new values represented by Pb and Pr (P for parallel) where:

Pb = 0.564(B-Y) and Pr = 0.713(R-Y) for 576i(625line SD) and 576p50 HD
But, Pb = 0.539(B-Y) and Pr = 0.635(R-Y) for 1080i & 720p HD
(Note there's a slight value difference for SMPTE and ITU-R based standards).
These components are coded as Cb and Cr for digital systems..

Symbols such as RGB, Y, Pb, Pr are generally understood be a "shorthand" that represent voltage levels which are found in the ITU and SMPTE standards as E_Y', E_{Pb}', E_{Pr}' etc., where the ' represents that the signals are, in fact, pre-corrected signals. That is, the video voltage levels are non-linearly related to reproduced picture brightness levels. This non-linear relationship of a display device's video input voltage versus output picture brightness is known as "gamma". The current values are based on a Cathode-Ray-Tube's grid-cathode input voltage and the beam current. The earlier designed NTSC system nominated a gamma value of 2.2 and later, PAL, a gamma of 2.8 – partly necessitated by a receiver design change from driving the picture tube's grids to driving the cathodes.

ANNEX B :

DTTB RECEIVER RF SPECIFICATION

(Normative)

B 1. GENERAL

This receiver specification is used to define a notional receiver for emission and channel planning purposes.

B 2. RECEIVER TUNING RANGE

DTTB transmissions in Australia are based upon a 7 MHz channel spectrum plan for VHF Band III (174 - 230MHz : channels 6 to 12), UHF Band IV (520 – 582MHz : channels 27 to 35) and UHF Band V (582 – 820MHz : channels 36 to 69). The transmissions are nominally centred in the channel with the exact location determined by the DTTB offset requirements. Refer to Annex E, Table E1, for the channel frequencies.

B 3. CHANNEL OFFSETS

Where applied, the digital channel offsets referenced to the nominal 7MHz channel centre frequency will be + 125 kHz or - 125 kHz. Refer to Table E1 for Australian DTV channel plan.

B 4. DVB-T MODES

The receiver shall be capable of correctly demodulating all COFDM non-hierarchical and hierarchical modes with both 2k-carrier and 8k-carrier operation specified in AS 4599 (as in EN300 744).

The modes shall be detected automatically upon change. This is signalled by the TPS carrier information.

B 5. RECEIVER RF INPUT CONNECTOR and RETURN LOSS

At the RF input socket shall be an IEC female in accordance with IEC 60169.2, preferably with a return loss of better than 10 dB for the VHF or UHF channel being received.

B 6. RECEIVER NOISE FIGURE

(Measured at receiver RF 75 ohm input socket)

VHF Band III	6 dB max
UHF Band IV	7 dB max
UHF Band V	8 dB max

The receiver NF should not exceed the above figures on any channel within the Bands indicated.

Note: Such Receiver NF performance is required in combination with the following C/N Threshold performance. Note also that, to obtain overall adequate performance, the lack of NF performance cannot necessarily be balanced or improved by a better C/N threshold performance than indicated below to obtain overall adequate performance.

B 7. CARRIER TO NOISE THRESHOLD PERFORMANCE

The receiver should have a minimum C/N threshold performance given in Table B1 for non-hierarchical modes with 2k carrier or 8k carriers operation. A receiver implementation margin loss for service planning purposes is included in the table and for example is assumed to be 3.5dB for 64QAM with a FEC of 2/3. This margin loss is expected to decrease with time as technology improves.

Annex B – (Continued)

Table B1. C/N Threshold minimum performance for QEF reception

Modulation	Code rate	Gaussian	Ricean	Rayleigh
QPSK	1/2	6.4	6.9	8.7
QPSK	2/3	8.2	9.0	11.7
QPSK	3/4	9.2	10.1	14.0
QPSK	5/6	10.2	11.3	16.5
QPSK	7/8	11.0	12.0	19.7
16QAM	1/2	12.1	13.0	14.6
16QAM	2/3	14.4	14.9	17.6
16QAM	3/4	15.9	16.4	20.2
16QAM	5/6	16.9	17.8	22.9
16QAM	7/8	17.3	18.4	26.8
64QAM	1/2	17.8	18.1	19.4
64QAM	2/3	20.0	20.6	22.9
64QAM	3/4	21.5	22.2	25.5
64QAM	5/6	22.9	23.7	30.0
64QAM	7/8	23.8	24.8	34.1

Note: Quasi Error Free (QEF) reception corresponds to a BER = 10^{-11} at the input to the MPEG-2 demultiplexer. This nominally corresponds to a BER = 2×10^{-4} after Viterbi decoding.

B 8. MULTIPATH PERFORMANCE

The C/N threshold shall not increase by more than 10 dB above the C/N threshold performance defined in section B7, when the echo profile given in table B2 is applied to a received signal with an operating mode of 64QAM, 2/3 FEC and a guard interval of 1/32.

Table B2. Echo profile

Delay (μSec)	Relative Attenuation (dB)
0	2.8
0.05	0
0.4	3.8
1.45	0.1
2.3	2.6
2.8	1.3

B 9. SINGLE FREQUENCY NETWORK (SFN) PERFORMANCE

Single frequency networks are likely to produce both pre-echoes and post-echoes. To ensure the maximum potential for successful reception in an SFN environment the receiver shall have the same pre-echo and post-echo performance.

To ensure that guard intervals are fully utilised, the BER shall be better than 2×10^{-4} after Viterbi decoding when the channel contains two static paths with a relative delay equal to the guard interval length, independent of the relative amplitudes and phases of the two paths and with no noise added.

B 10. SIGNAL LEVEL RANGE (at RECEIVER INPUT)

The minimum range the receiver is able to operate over shall be as follows:

(3 dBµV + NF + C/N) to 85 dBµV (-22 dBm)

where : NF = Noise figure of receiver; and

C/N = C/N threshold in a Gaussian environment.

Giving, for C/N thresholds of 20 dB (eg 64QAM, FEC 2/3):

VHF Band III	**29 dBµV to 85 dBµV**
UHF Band IV	**30 dBµV to 85 dBµV**
UHF Band V	**31 dBµV to 85 dBµV**

Giving, for C/N thresholds of approximately 6.5 dB (eg QPSK, FEC 1/2):

VHF Band III	**15.5 dBµV to 85 dBµV**
UHF Band IV	**16.5 dBµV to 85 dBµV**
UHF Band V	**17.5 dBµV to 85 dBµV**

B 11. RECEIVER SELECTIVITY

The transmission environment in Australia will have:

- 7 MHz channels with DVB-T services interleaved with PAL-B (with A2 sound carriers) services and other DVB-T services;
- DVB-T and / or PAL-B services on adjacent channels transmitted from one or more individual towers;
- DVB-T services with, typically, 3dB to 10dB less effective radiated power than the equivalent coverage PAL services in the same Band;
- Maximum levels of:
  - up to eight (8)[27] PAL-B channels with an allowance up to 90 dBµV (-17dBm) each; and
  - up to eight (8) DVB-T channels with an allowance up to 85 dBµV (-22dBm) each.

The selectivity requirement are:

The nominal mode for the wanted service in the receiver selectivity specification is to be taken to be 64QAM with a FEC of 2/3.

To cater for the above conditions so as to provide QEF (quasi-error-free) output from the wanted DVB-T channel, the receiver selectivity shall be sufficient that:

When an upper or lower adjacent channel analog service is up to:

1. 37dB on lower and 38 dB on the upper, greater than the DVB-T wanted channel with a level up to 50 dBµV;
2. tapering down to 10 dB higher than the DVB-T wanted channel with a level up to 85 dBµV.

[27] In areas of overlapping coverage. Typically six (6) channels would be encountered.

Annex B – (Continued)

When an upper or lower adjacent channel digital service is up to:

1. 30 dB with higher than the DVB-T wanted channel with a level up to 50 dBµV;
2. tapering down to 10 dB higher than the DVB-T wanted channel with level up to 85 dBµV.

When an analog service on another channel, including an image channel is up to:

1. 46 dB with higher than the DVB-T wanted channel with a level up to 50 dBµV;
2. tapering down to 20 dB higher than the DVB-T wanted channel with a level up to 85 dBµV.

When a digital service on another channel, including an image channel is up to:

1. 30 dB higher than the DVB-T wanted channel with a level up to 50 dBµV;
2. tapering down to 20 dB higher than the DVB-T wanted channel with a level up to 85 dBµV.

B 12. PROTECTION RATIOS

The receiver selectivity requirements have been derived from the protection ratios used for planning and are shown in Figure B1 and Tables B3. The protection ratios has been extracted from recommendation ITU-R BT.1368 the *Planning Criteria for Digital Terrestrial Television Services in the VHF/UHF Bands*. (This document is now at revision 2 and will be further revised as more data becomes available)

FIGURE B1. Digital Planning Protection Ratio

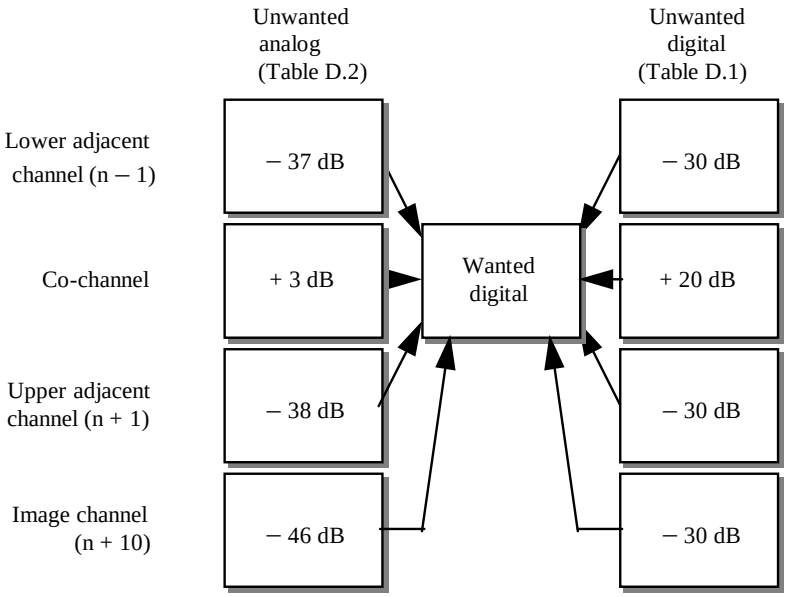


TABLE B3. Protection Ratios (dB) For 7 MHz DVB-T Interfered with by 7 MHz DVB-T

Parameter	Δf	Tropospheric	Continuous	Note or ITU Table
Lower Image (n – Y)			–30	Note 1 & 4
Lower LO (n – X)			–30	Note 2 & 3
Lower Adjacent (n – 1)	–7		–30	Note 1
Co-channel (n)	0		+20	Table 6
Upper Adjacent (n + 1)	+7		–30	Note 1
Upper LO (n + X)			–30	Note 2 & 3
Upper Image (n + Y)			–30	Note 1 & 4

- The frequency difference (Δf) is the centre frequency of the wanted DVB-T signal minus the centre frequency of the unwanted DVB-T signal in megahertz (MHz).

The typical Australian situation is a dominant incoming signal with lower level delayed signals and thermal noise. This will normally be the case with directional antennas at roof level. In the case of a Single Frequency Network (SFN), the delay signals may also come from other transmitter sites.

Of the three types of propagation channels used of Gaussian, Ricean and Rayleigh; for fixed antenna reception, the Ricean channel figures have been adopted for planning.

Indoor reception is also common hence performance with Rayleigh complexity is important in the Australian market.

Note:

1 For adjacent and image channel interference a protection ratio of –30 dB is assumed to be appropriate. This assumption is based on only one measurement, further studies are required

2 For overlapping channels, in the absence of measurement information the protection ratio should be extrapolated from the co-channel ratio Figure as follows.

PR = 20 + 10*Log_{10} (Overlap (MHz) / 7 (MHz))

PR= –30 dB should be used when the above formula gives PR < –30 dB.

3 Where X is the number of channels between the wanted channel and the channel affected by local oscillator (LO) interference. In the case of current Australian analog planning X = 5.

4 Where Y is the number of channels between the wanted channel and the channel affected by image interference. In the case of current Australian analog planning Y = 10.

Refer to ‘Digital Terrestrial Television Broadcasting Planning Handbook including Technical and General Assumptions’ Australian Broadcasting Authority, July 1999. (Australian Broadcasting Authority website: http://www.aba.gov.au/)

ANNEX C :

RANGE OF RECEIVERS AND RECEIVER BLOCK DIAGRAM

(Informative)

TABLE C1. Example Range Of Receiving Equipment

	Modular equipment units (STB)	**Integrated receiver with display**
Low cost with basic limited facilities	Typically: Low cost, may operate with existing 4:3 PAL TV; single tuner, Outputs may include SD (S-Video, PAL baseband and RF); Mono or stereo audio output; CI card slot	Small TVs, portable TVs; single tuner; may have 16:9 display; single or dual speakers; CI card slot
	Range ↑↓	Range ↑↓
Premium with full facilities	Outputs may be HD RGB+HV, to feed hi-quality 16:9 display, and/or SD S-Video/Scart /PAL; Data and IEEE 1394 ports; CI card(s) & SmartCard slot(s); May have modem, internal hard-disk storage, DVD, for example.	Hi-quality 16:9 display; May have several display modes for HD, progressive, line doubling for SD input; PIP; Digital and PAL tuner; Full surround audio Data and IEEE 1394 ports; CI card(s) & SmartCard slot(s); Modem

Note:

- Modular equipment may be Set-top box style Integrated-Receiver-Decoders or plug-in PC card tuner-decoders.
- PIP: Picture-in-Picture, STB: Set-Top-Box, (see Glossary in Annex A.).

Annex C (Cont) :
Receiver Block Diagram

(Informative)

Figure C1 gives an example of the components of the architecture of a typical digital terrestrial television receiver set-top-box.

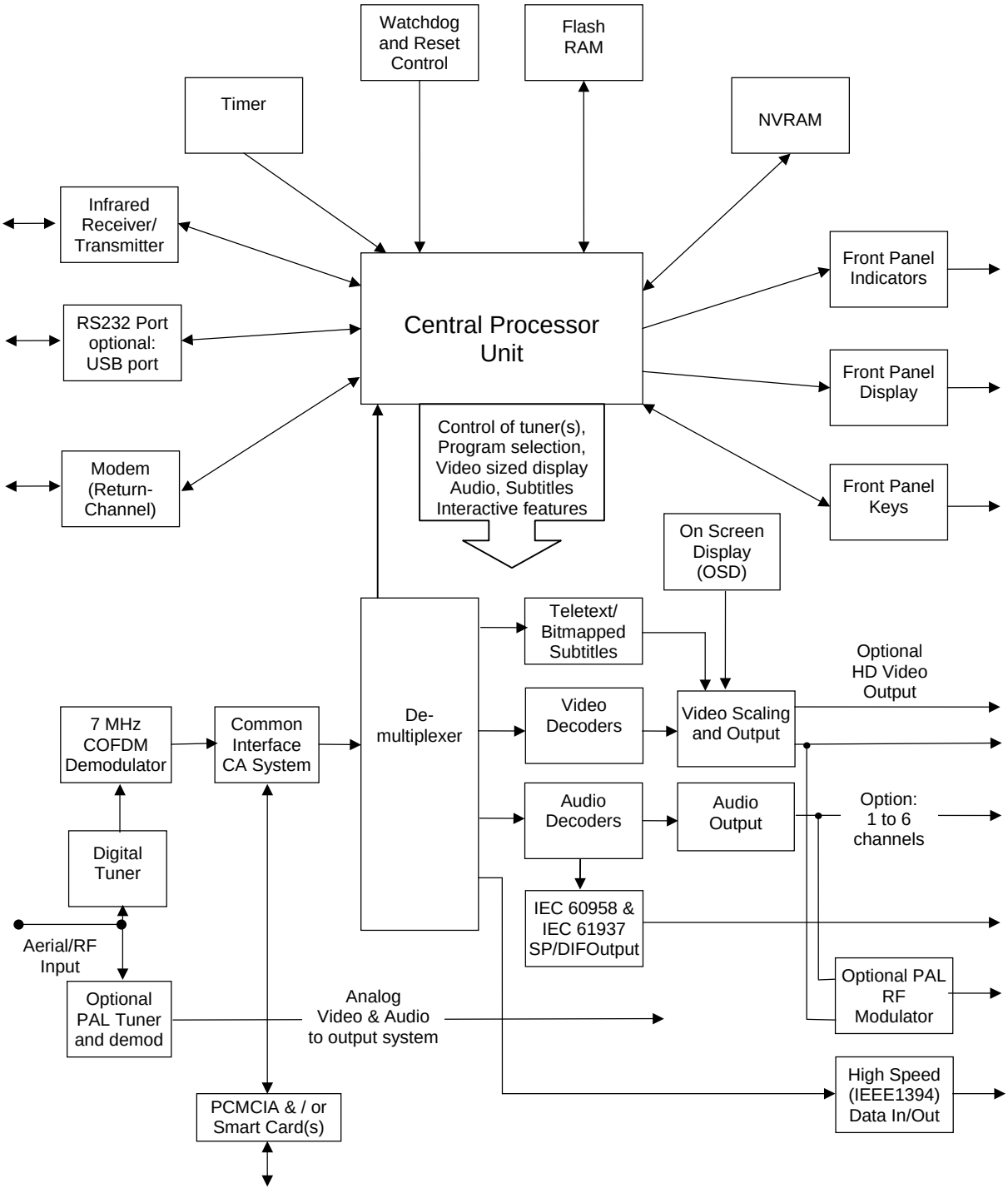


FIGURE C1 Example of a DTTB Set-Top-Box Receiver Architecture

ANNEX D :

RECEPTION QUALITY OSD METER

(Informative)

Satisfactory reception of a digital terrestrial television emission is dependent upon total signal quality. Satisfactory reception cannot be guaranteed on signal strength alone.

A tuning meter should not be activated by signal strength or AGC level alone. There are other effects such as multipath (ghosting) which even with a strong signal strength may result in error levels that renders the signal undecodable.

Figure D1 shows a suggested on-screen display (OSD) of decoding margin for use on DTTB receivers and decoding equipment to be used by either a technician or viewer.

Note: The display should be the result of both the received signal level and bit error rate prior to error correction, for the display to be meaningful in the DVB-T COFDM environment.

As an alternative, a manufacturer may choose to display the received signal level and bit error rate, prior to error correction, as side-by-side bar graphs. In any case however, a numerical scale is considered essential to quantify the reception quality as this will aid any reference back to the manufacturer or the broadcaster in cases of user inquiry.

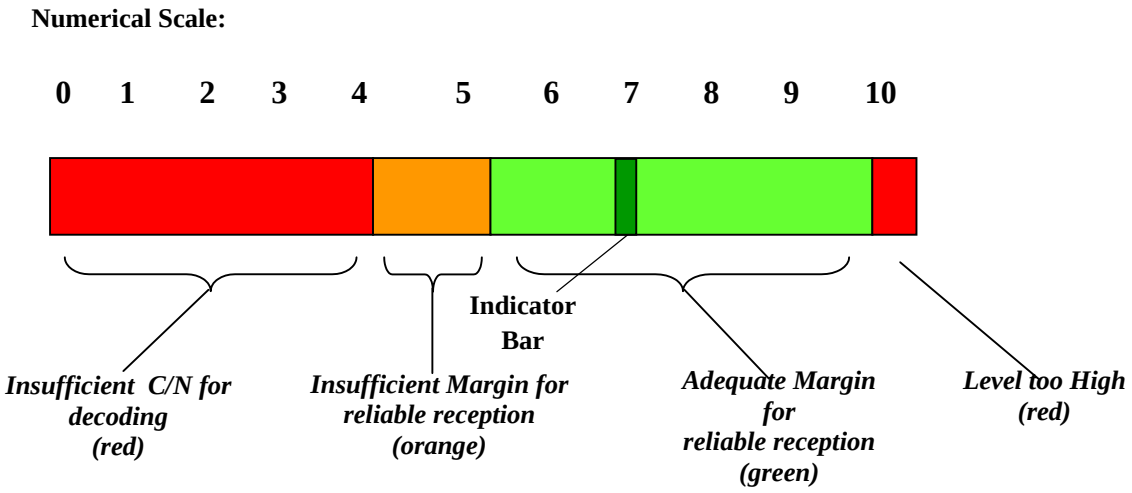


FIGURE D1 Suggested On-Screen Display Of Decoding Margin

This type of indicator will allow the following:

- Proper installation of fixed antennas;
- Alignment of portable or ‘rabbit ears’ antenna;
- Correct distribution system outlet levels.

ANNEX E :

BROADCAST AND NON-BROADCAST BAND – 7MHz CHANNEL PLAN

(Normative)

TABLE E1: Australian Digital Television Broadcast Bands Channel Numbers And Centre Frequencies (in MHz)

(Where applicable, add or subtract 125kHz offsets)

Digital channel	Nominal Centre Frequency MHz
	BAND III
6	177.500
7	184.500
8	191.500
9	198.500
9A	205.500
10	212.500
11	219.500
12	226.500
	BAND IV
27[5]	+++ 522.500 +++
28	529.500
29	536.500
30	543.500
31	550.500
32	557.500
33	564.500
34	571.500
35	578.500
	BAND V
36	585.500
37	592.500
38	599.500
39	606.500
40	613.500
41	620.500
42	627.500
43	634.500
44	641.500
45	648.500
46	655.500
47	662.500
48	669.500
49	676.500
50	683.500
51	690.500
52	697.500
53	704.500
54	711.500
55	718.500
56	725.500
57	732.500
58	739.500
59	746.500
60	753.500
61	760.500
62	767.500
63	774.500
64	781.500
65	788.500
66	795.500
67	802.500
68[6]	809.500
69[6]	816.500

TABLE E2: Overview of Australian Television Broadcast Bands—Television Channel Numbers And Frequency Limits (in MHz)

	VHF, MHz		UHF, MHz		UHF, MHz
	BAND I[1]		**BAND IV**		**BAND V**
0	45–52	27[5]	520–526	48	666–673
1	56–63	28	526–533	49	673–680
2	63–70	29	533–540	50	680–687
		30	540–547	51	687–694
		31	547–554	52	694–701
	BAND II[1]	32	554–561	53	701–708
3	85–92	33	561–568	54	708–715
4	94–101	34	568–575	55	715–722
5	101–108	35	575–582	56	722–729
			BAND V	57	729–736
		36	582–589	58	736–743
	BAND III	37	589–596	59	743–750
5A[2]	137–144	38	596–603	60	750–757
6	174–181	39	603–610	61	757–764
7	181–188	40	610–617	62	764–771
8	188–195	41	617–624	63	771–778
9	195–202	42	624–631	64	778–785
9A[3]	202–209	43	631–638	65	785–792
10[4]	208–215 (old)	44	638–645	66	792–799
10	209–216 (new)	45	645–652	67	799–806
11[4]	215–222 (old)	46	652–659	68[6]	806–813
11	216–223 (new)	47	659–666	69[6]	813–820
12[3]	223–230				

NOTES to Tables E1 and E2:

1 Television Bands I (Channels 0, 1 and 2) and Band II (Channels 3, 4 and 5) are not being considered for the introduction or ongoing transmission of digital television services.

2 VHF Channel 5A is currently within the broadcasting services bands (BSB) and has been recommended for clearance by the ABA and ACA to allow for the introduction of low earth orbiting (LEO) satellites. Channel 5A is not being considered for the introduction or ongoing transmission of digital television services.

3 Clearance of radio communication services from 202–208 MHz and from 222–230 MHz has allowed a revised channel arrangement to be implemented. The current channel arrangement has two new channels (channels 9A and 12). To accommodate channel 9A, channels 10 and 11 were shifted up in frequency by 1 MHz.

4 The majority of existing services on channels 10 and 11 were assigned using the superseded channel arrangement. Services on channels 10 and 11 may be required to shift in frequency to align with the current channel arrangement. Any such requirement will be considered on a case-by-case basis. New services on channels 10 and 11 will be assigned according to the current channel arrangement i.e. channel 10 (209–216 MHz) and channel 11 (216–223 MHz).

5 UHF television Channel 27 has a bandwidth of 6 MHz and, therefore, is not currently suitable for digital television services. The ABA and ACA are considering ways of making use of channel 27 as a 7 MHz channel. As a 6 MHz channel, channel 27 could possibly be suitable for use by non-broadcasting services, e.g. datacasting services.

6 The ABA and ACA are considering spectrum that may be re-allocated for non-broadcasting purposes due to the increased spectral efficiency with digital television. In particular the use of part, or the entire frequency band 806–820 MHz is under consideration. Where practicable the ABA will endeavour to avoid the use of channels 68 and 69.

7 These tables are reproduced from the ABA Digital Terrestrial Television Planning Handbook, Annex F and AS 4542.

TABLE E3: Australian Television Non-Broadcast Bands
Channel Numbers And Frequency Limits (in MHz)

VHF—lower special channels		UHF—special channels		Band IV (non-broadcast)	
S2	111–118	Cable distribution system pilot and control signals: 300–302		20	470–477
S3	118–125			21	477–484
S4	125–132			22	484–491
S5	132–139			23	491–498
S6	139–146	S21	302–309	24	498–505
S7	146–153	S22	309–316	25	505–512
S8	153–160	S23	316–323	26	512–519
S9	160–167	S24	323–330	27	519–526
S10	167–174	S25	330–337		
		S26	337–344		
		S27	344–351	Band V (non-broadcast)	
VHF—upper special channels		S28	351–358		
		S29	358–365	70	820–827
S11	230–237	S30	365–372	71	827–834
S12	237–244	S31	372–379	72	834–841
S13	244–251	S32	379–386	73	841–848
S14	251–258	S33	386–393	74	848–855
S15	258–265	S34	393–400	75	855–862
S16	265–272	S35	400–407		
S17	272–279	S36	407–414		
S18	279–286	S37	414–421		
S19	286–293	S38	421–428		
S20	293–300	S39	428–435		
		S40	435–442		
		S41	442–449		
		S42	449–456		
		S43	456–463		
		S44	463–470		

ANNEX F :

AUSTRALIAN PARENTAL GUIDANCE CODES

(Normative)

F 1. General

Recommended on-screen-display for parental guidance codes transmitted within DVB-SI EIT information using the DVB parental_rating_descriptor.

Table F1. Australian Parental Guidance Codes

			Receiver Menu Set-up and Suggested OSD Wording for Setting Blocking (Restriction of access)							
			Block All	Block G and above (optional)	Block PG and above	Block M and above	Block MA and above	Block AV and above	Block R and above	No Block
Transmitted rating hex code	Australian parental guide code	On-screen display	**Resultant receiver action to received hex code ✓ is show program — X is block until PIN entered**							
0×00	Not Classified	-	X	✓	✓	✓	✓	✓	✓	✓
0×01		-	X	✓	✓	✓	✓	✓	✓	✓
0×02	**P Pre school**	**P**	X	✓	✓	✓	✓	✓	✓	✓
0×03		P	X	✓	✓	✓	✓	✓	✓	✓
0×04	**C Children's**	**C**	X	✓	✓	✓	✓	✓	✓	✓
0×05		C	X	✓	✓	✓	✓	✓	✓	✓
0×06	**G General**	**G**	X	X	✓	✓	✓	✓	✓	✓
0×07		G	X	X	✓	✓	✓	✓	✓	✓
0×08	**PG Parental Guidance Recommended**	**PG**	X	X	X	✓	✓	✓	✓	✓
0×09		PG	X	X	X	✓	✓	✓	✓	✓
0×0A	**M Mature Audience 15+**	**M**	X	X	X	X	✓	✓	✓	✓
0×0B		M	X	X	X	X	✓	✓	✓	✓
0×0C	**MA Mature Adult Audience 15+**	**MA**	X	X	X	X	X	✓	✓	✓
0×0D		MA	X	X	X	X	X	✓	✓	✓
0×0E	**AV Adult Audience, Strong violence 15+**	**AV**	X	X	X	X	X	X	✓	✓
0×0F	R Restricted 18+	R	X	X	X	X	X	X	X	✓

Annex F (Cont.)

Notes on Australian Parental Guidance Codes:

a. The parental guidance set-up in a receiver allows the user to set a maximum parental guidance rating level so that the receiver will only show programs below that level while a PIN number controls access to higher level programs.

b. The OSD column in the above table should be used in the parental guidance fields of the receiver's displayed electronic program guide.

c. In the case of 0×00 and 0×01, a dash should be displayed.

d. The rows shown in **Bold** characters show the codes that are expected to be in transmissions but receivers should react to all codes.

e. The inclusion of a 'Block G and above' function as shown the above table in the receiver's OSD is optional.

ANNEX G :

TELEXTEXT FORMAT FOR CLOSED CAPTION TRANSMISSIONS

(Normative)

The following details the specifications that are being used in Australia for carrying Closed Captions in a Teletext Data stream on a 625/50 analog video signal. These specifications are in addition to those detailed in the ITU-R System B Teletext Standards. Therefore where Teletext based Closed Captions are used for DTTB transmissions in Australia these specifications should be used in addition to those detailed in the ITU-R document and also those in ETSI EN 300 472 (Digital Video Broadcasting (DVB) Specification for conveying ITU-R System B Teletext in DVB bitstreams.)

In addition to normal pre-produced Closed Captions, Teletext is also used in Australia for so called "Live Captions". Such captions may be displayed with additional words being displayed near existing words or as a complete new row replacing a previous row which would then "scroll upwards", or in some similar manner. To ensure optimum display of such Live Captions on a DTTB receiver the details listed below, Item (h) should be noted.

(a)	TV Data Lines	Lines 21 and 334 are exclusively used for teletext closed captions
(b)	Data Line "Dummy Headers"	During transmission of Closed Captions lines 21 and 334 should always contain Teletext information. This should consist of so called "dummy header rows" between transmissions of actual teletext rows containing closed caption data. The "null page address" of such dummy header rows may be either FF 3F 7F or FE 3F 7F. Refer to CTVA (FACTS) OP42[28] "Distribution, Transmission, and Monitoring of Closed Captions on Line 21/334"
(c)	Magazine and Page Address	Magazine 8 shall be used and reserved for Closed Caption transmissions. Page 801 should be used for the English version of a Closed Caption service.
(d)	Double Transmission of Caption Data	Closed Caption data may be transmitted twice to reduce the possibility of reception errors. On the first transmission control bit C8 should be set to 1 whilst on the second transmission it should be set to 0.
(e)	Magazine Parallel Transmission	Control Bit C11 shall be set to 0 (Parallel mode transmission) for both the Closed Caption and any other Teletext service that may be carried on the same (analog) video signal. This is necessary to ensure compatibility between the two (or more) Teletext transmissions.
(f)	Sub-title Indicator Bit	Control Bit C6 shall be set to 1.
(g)	Interrupted Sequence Bit	Control Bit C9 shall be set to 1.
(h)	Live Closed Captions	For Live Closed Captions it shall not be necessary for the erase page bit C4 to be set to 1 between the transmissions of caption data.
(i)	Character Height	Australian Closed Captions may use the "double height" Teletext character set for visibility reasons.

[28] Commercial Television Australia CTVA (formerly FACTS) Operational Practices are available from www.ctva.com.au/

ANNEX H :

50Hz HD & SD PICTURE TIMINGS PARTICULARLY RELATED TO SCAN RATES FOR CRT BASED DISPLAYS

(Normative and Informative)

H 1. Introduction – Receivers and Displays

This Annex deals with advice to manufacturers of Set-Top-Boxes (STB), Digital Terrestrial Television (DTT) receivers and display equipment on recommended picture timings and scan-rates for 50 Hz based High-Definition (HD) picture formats at 1080i, 720p and 576p as broadcast on Australian DTT.

Because STBs with HD decoding will be connected to a range of display types, including scanning displays (CRTs), and fixed pixel format displays that use digital 'scaling' technologies, manufacturers are recommended to adopt specifications given in this Annex to maintain optimum picture quality and avoid consumer equipment compatibility problems.

Details are given for the recommended scan timings for display on both analog and digital interconnect interfaces of 50Hz based HD and SD formats.

Of special note is a recommended scanning set for 1080i50, 720p50 and 576p50 HD broadcasts, based on more economic CRT-based HD-capable displays using 100Hz CRT television architecture with fixed 31.25kHz scan, as detailed in Clause H 3 and Tables H 2 and H 3. These CRT-friendly HD display formats are derived from the ITU-R BT.1358 standard, specifically intended for Consumer Electronic (CE) manufacturers who wish to provide a simple cost effective HD CRT display solution that avoids the variations in horizontal scan frequencies encountered in studio and professional equipment.

HD capable STBs are recommended to have analog and/or digital HD output interconnect options as detailed in Section 15 of Table 1. The formats of those outputs for all video modes are detailed in this Annex H.

The HD video output formats should be able to be switched between ‘native’ or CRT-friendly formats, (a user-accessible hardware switch is recommended). HD capable STBs are also recommended to have separate SD analog outputs. Because it is unlikely in a single tuner receiver, for a user to have separate SD and HD displays connected to a STB, it is a manufacturer’s choice whether their STB has circuitry so that both the HD and SD outputs operate continuously, or the hardware switching provides either SD or HD output operation.

H 2. Professional and Studio ‘Native’ Video Formats

There are several different 50Hz video formats for HD, which if displayed as professional broadcast studio formats would require a CRT based display to be able to switch to four different scan frequencies, as shown in Table H 1 below. The use of these formats is only recommended in professional equipment and as added capability in CE equipment intended for non CRT-based displays.

Table H 1.
Native Horizontal Scan Rates for CRT Based Professional Displays

Active Lines	Total Lines including VBI	Format	Frame Rate, per second	Horizontal Scan Frequency	Pixel Frequency
576i	625	SD 576 50i	25 (50i)	**15.625 kHz**	13.50 MS/s
576p	625	HD 576 50p	50 p	**31.250 kHz**	27.00 MS/s
720p	750	HD 720 50p	50 p	**37.500 kHz**	74.25 MS/s
1080i	1125	HD 1080 50i/25pSf	25 (50i)	**28.125 kHz**	74.25 MS/s

H 3. Consumer Equipment Formats for CRT-based Displays

For consumer CRT based '50 Hz HD Input' products, a potentially cost-effective solution is shown in Table H 2 and recommended for the display of both SD and HD pictures using the existing '100Hz' TV architecture based on a fixed 31.250kHz scan frequency and a 32 µs scan line period.

The picture quality of the three possible 50Hz HD modes is maintained and no rescaling of 1080i50 video is needed although a simple scaling in the STB of the 720p50 mode is required. Displays will need to have a nominal vertical zoom mode for correct geometry of 1080i50, which is easily recognised when the synchronising signal formats detailed in Table H 4 are used.

This 'HD CRT' mode is intended as a low cost solution to be implemented in both STBs and displays through CRT based "100Hz" televisions (possibly fitted with an analog tuner). Also, integrated digital television receivers (iDTVs), with 100Hz displays may incorporate these scanning formats, which would have the additional benefit that HD A/V inputs could be provided for other advanced consumer products such as 576p50 DVD players. These 50Hz HD interconnect formats essentially become a common format for uncompressed video of (576p) 625 total lines progressive scan or (1152i) 1250 total lines interlaced. Some CRT television manufacturers have indicated their 'HD Input' CRT televisions will support 'HD Native' modes (Table H 9) while European CRT television manufacturers will support 'HD CRT' modes as shown in Table H 2.

Table H 2.
Possible Consumer HD CRT Display Modes and Interconnect Format for 50Hz SD & HD Using a Single 31.250kHz Horizontal Scan Frequency

Received Format	Read-out at	Displayed Active Lines	Total Lines including VBI	Vertical scan rate	Horizontal Scan Freq
SD 576 50i	SD Progressive (preferred)	576p	625	50 Hz	31.250kHz
	SD @ 100Hz	576	625	100 Hz	
	SD @ 75Hz	768	833	75 Hz	
	SD Line doubled	1152	1250	50 Hz	
HD 576 50p[29]	Native	576p	625	50 Hz	31.250kHz
HD 720 50p	8/5 vertical upscale 720p line to 1152i line or, (not preferred) 4/5 vertical downscale 720 line to 576 line	1152i 576p	1250 625	50 Hz	31.250kHz
HD 1080 50i Or HD 1080 25pSf	1080i (1250) ('1080i letterboxed in 1152i' - 1250 line total) through faster MPEG memory line readout, longer vertical interval	1080i	1250	50 Hz	31.250kHz

The '1080i letterboxed in 1152i' 1250 line total solution shown in Table H 2 results in no potential loss in picture quality and explained in detail through out this Annex.

Table H3 on the following page, shows a more complete list of timings for various SD and HD formats as found in broadcast studios. It should be noted that studio implementation of 1080x50i also includes an exceptionally long horizontal blanking interval.

[29] 720 x 576p @ 50 Hz is also used by PAL Progressive Scan DVD players.

Table H 3.

DIGITAL TV TIMING PARAMETERS – 50Hz DISPLAY FORMATS

System / Parameters	'HD Native Mode' Formats as used in Broadcast Studios				'HD CRT' modes for CRT Displays (31.250 kHz)		
	SD	HD	HD	HD	HD	HD	HD
	625 line 720 x 576 x 50i	**625 line** 720 x 576 x 50p	**750 line** 1280 x 720 x 50p	**1125 line** 1440 or 1920 x 1080 x 25p/50i	**625 line** 720 x 576 x 50p	**1250 line** 1280 x 1152 x 50i	**1250 line** 1920 x 1080 x 50i
Format Description	Standard Definition 576i	High Def 576p	High Def 720p	High Def 1080i	High Def 576p	High Def 1152i	High Def 1080i (1250)
Transmitted as MPEG in DVB-T	Yes	Yes	Yes	Yes	Yes	No	No
Possible use for interface or display	SD Display Format	Display Format: STB to Matrix or CRT display interconnect via Y, Pb, Pr or RGB+HV interface			Display Format: STB to CRT only display interconnect via Y, Pb, Pr or RGB+HV interface		
Y Sync on Y, Pb, Pr - see note (a)	**bi-level**	**bi-level**	tri-level	tri-level	**bi-level**	**bi-level**	**bi-level**
Picture (Frame) Rate Frame /sec	25	50	50	25	50	25	25
Display (Field) Rate /sec	50	50	50	50	50	50	50
Interlace or Progressive, Segmented frame transmit (interlace display)	i	P	P	i (pSf)	P	i	i
Lines in Active Picture	576	576	720	1080	576	1152	1080
Total lines per frame	625	625	750	1125	625	1250	1250
Total vertical interval – lines	29.5 + 29.5	49	30	22.5 + 22.5	49	49+49	85+85
Active Picture pixels per line	720	720	1280	1920	720	1280	1920
Total pixels per line	864	864	1,980	2,640	864	1,536	2,304
Sample Clock Freq MHz	13.5	27	74.25	74.25	27	48	72
Bits per clock sample- Y+0.5(Cr+Cb)	20	20	20	20	20	20	20
Un-compressed Mbit/sec	270	540	1,485	1,485	540	960	1,440
Horiz. Blanking width Pixels	144	144	700	720	144	256	384
Horiz. Blanking % of total line	16.7%	16.7%	35.4%	27.3%	16.7%	16.7%	16.7%
Horiz. Line period µs	64	32.00	26.67	35.56	32.00	32.00	32.00
Horiz. Active line period µs -Note (b)	53.33	26.67	17.24	25.86	26.67	26.67	26.67
Horiz. Blanking period µs	10.67	5.33	9.43	9.70	**5.33**	**5.33**	**5.33**
Horiz-Scan: % Variance to 31250 Hz	50%	100%	120%	90%	100%	100%	100%
Horizontal Scan Frequency Hz	15,625	31,250	37,500	28,125	**31,250**	**31,250**	**31,250**

Notes for Table H 3

(a) For 'HD CRT' modes @ 31.25kHz, 'bi-level' sync is recommended on interconnect interfaces. Analog component Y, Pb, Pr with 'bi-level' sync (-300 mV) on Y complies with ITU-R BT.1358 standard while Y, Pb, Pr with 'tri-level' sync (+/- 300 mV p-p) on Y complies with EIA 770.3 standard.

(b) Standard 625 line PAL is nominally 702 pixels or 52 µs. 53.33 µs is for 720 pixels active picture. Similarly for 576 x 50p the active picture is assumed to be 720 pixels wide giving an active picture time of 26.67 µs.

H 3.1 720p Picture Conversion to 1152i @ 31.250kHz for CRT Displays

1280x720p@50Hz is up-converted (8/5 vertical upscale) and interlaced by the STB to 1280x1152i@50Hz using the nominal '100 Hz' CRT timings of 31.250 kHz line frequency with no perceptible loss of video quality.

An alternative of 5/4 down-converted 720p to 576p could be used but it is less recommended as this results in loss of vertical video resolution.

H 3.2 1080i Displayed in 1250 line total @ 31.250kHz for CRT Displays

1080i is 'letterboxed' (i.e. 36 top + 1080i + 36 bottom) by the STB in 1152i active / 1250 total lines raster. This is known as the 1080i(1250) display format. Note that the 1080i active lines are NOT scaled to 1152 active lines but letterboxed.

Because the compressed MPEG signal does not include the horizontal and vertical blanking period signals, these have to be reconstructed in the receiver MPEG decoder memory readout and this allows for different timings, blanking intervals and VBI lines, while avoiding processing or scaling the active video.

The readout of the MPEG line store memory is faster than in 'native mode – i.e at 31.25kHz (32µs per line) instead of 28.125kHz (35.56µs per line). This results in extra time being available for more VBI lines including the extra 36 + 36 active black lines that are added to the vertical flyback or vertical over-scan. The line frequency, now at 31.250 kHz, is the horizontal scan frequency standard for PAL '100 Hz' CRT applications.

Reducing the number of clock pulses (also by the STB) from 2640 to 2304 reduces the horizontal flyback and blanking period from 9.70 µs to 5.33 µs. A horizontal flyback time between 5.33 µs and 6.00 µs is considered ideal for CRT television applications. In effect the excess time that was present in the 'native' 1080i horizontal blanking interval has been "collected" and added to the vertical interval.

The display device is then required to increase the CRT scan height (+6.7% vertical over-scan) to correct picture geometry. Automatic vertical over-scan for 1080i(1250) video can be achieved by measuring the V-sync length on Y, Pb, Pr or sync polarity on RGB+HV as detailed in section H3.4.

H 3.3 1152i and 1080i(1250) 31.250kHz display formats – IMPORTANT DESIGN NOTES

Video timings for 1152i and 1080i(1250) are derived from the 576p (ITU-R BT.1358) standard. The most important deviations from the 576p (and SMPTE295M) standard are as follows:

- These formats have an even number of total lines per frame (625x2=1250) that do not provide a naturally interlaced scanning raster. Therefore the frame must be split in two unequal fields of 624.5 and 625.5 lines (refer Figure H2) and a DC coupled vertical raster deflection circuit is required.
- Y, Pb, Pr vertical sync occurs in the first half of Line 1 and in the second half of Line 625 (refer Figure H2)
- Y, Pb, Pr vertical sync is 13.67µs (refer Figure H1 and Table H6)
- Y, Pb, Pr sync is a bi-level sync (refer Figure H1 and Table H6)
- 1080i (1250) RGB+HV horizontal and vertical syncs are opposite polarity (refer Table H4)

H 3.4 How does a 31.250kHz HD CRT display distinguish between 576p(625), 1152i(1250) and 1080i(1250) video

HD-STB's that output 576p/1152i/1080i(1250) video also provide a simple method for fixed 31.250kHz HD CRT displays to distinguish between full screen 576p / 1152i video and letterboxed 1080i(1250) video that enables the display to automatically zoom (+6.7% vertical over-scan) the 1080i(1250) video and remove the letterbox bars. The following details a simple method for identifying 1080i(1250) video via Y, Pb, Pr and RGB+HV interfaces.

H3.4.1 *Analog Y, Pb, Pr interface*

As per Figure H1 and Table H6, Y, Pb, Pr vertical sync lengths on 'Y' are as follows:

- 576p vertical sync on 'Y' = 5 lines long
- 1152i vertical sync on 'Y' = 5 lines long
- 1080i(1250) vertical sync on 'Y' = 1/2 line long

The display can identify the HD video type by measuring the v-sync length on 'Y' using an RC filter circuit that can be used to trigger the 6.7% vertical zoom circuit for 1080i(1250) video.

H3.4.2 *Analog RGB+HV / DVI interface*

Normally, RGB+HV horizontal and vertical sync are always the same polarity. By using opposite horizontal and vertical sync polarity for 1080i(1250) video, the display can identify 1080i(1250) and trigger the 6.7% vertical zoom circuit.

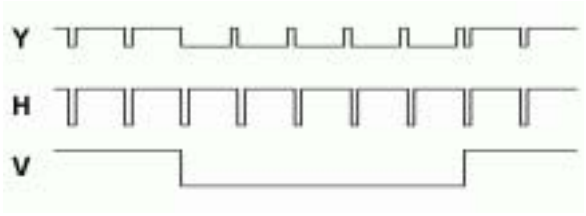
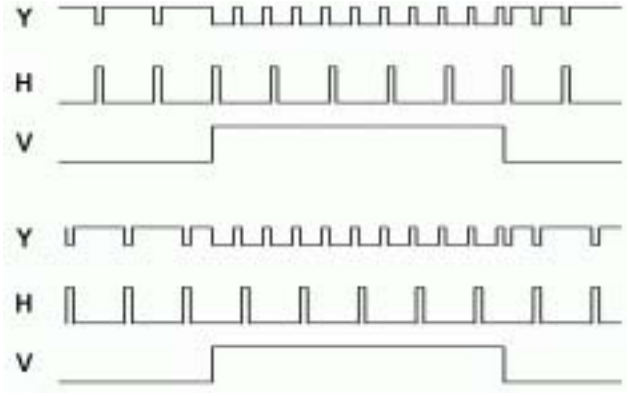
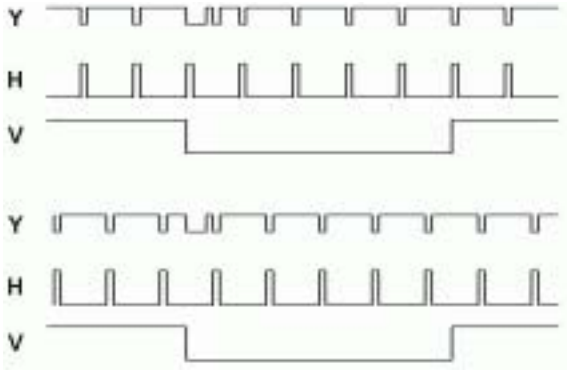
Table H 4.
Zoom Truth Table for Y, Pb, Pr V-sync on 'Y' and RGB+HV sync polarity

	Y, Pb, Pr (bi-level sync on 'Y')	**RGB+HV**	**6.7% Vertical Zoom**
576p (625)	V Sync: 5 lines, 160µs	H&V Sync: Same Polarity	No
1152i (1250) (up-scaled 720p)	V Sync: 5 lines, 160µs	H&V Sync: Same Polarity	No
1080i (1250) (1080i letterboxed in 1152i)	V Sync: 1/2 line, 13.67µs	H&V Sync: *Opposite Polarity*	Yes

H 4. Synchronising Waveform and Timing Details for 'Native' and CRT-based HD Formats

Table H5 gives a notional view of how a display can distinguish between the various 31.25kHz based HD formats through the examination of the sync waveforms. This detail is further expanded in Figure H1 and Table H6 and Figure H2.

Table H 5.
Notional view of sync waveforms: 576p, 1152i and 1080i(1250)

	Y, Pb, Pr (bi-level sync on 'Y') / RGB+HV
576p (625) ITU-R BT.1358	 Notes: 1) Y, Pb, Pr: 5 lines of vertical sync; 160µs 2) RGB+HV: H&V sync same polarity
1152i (1250) (up-scaled 720p)	 Notes: 1) Y, Pb, Pr: 5 lines of vertical sync; 160µs 2) RGB+HV: H&V sync same polarity
1080i (1250) (1080i letterboxed in 1152i)	 Notes: 1) Y, Pb, Pr: 1/2 line of vertical sync; 13.67µs 2) RGB+HV: H&V sync opposite polarity

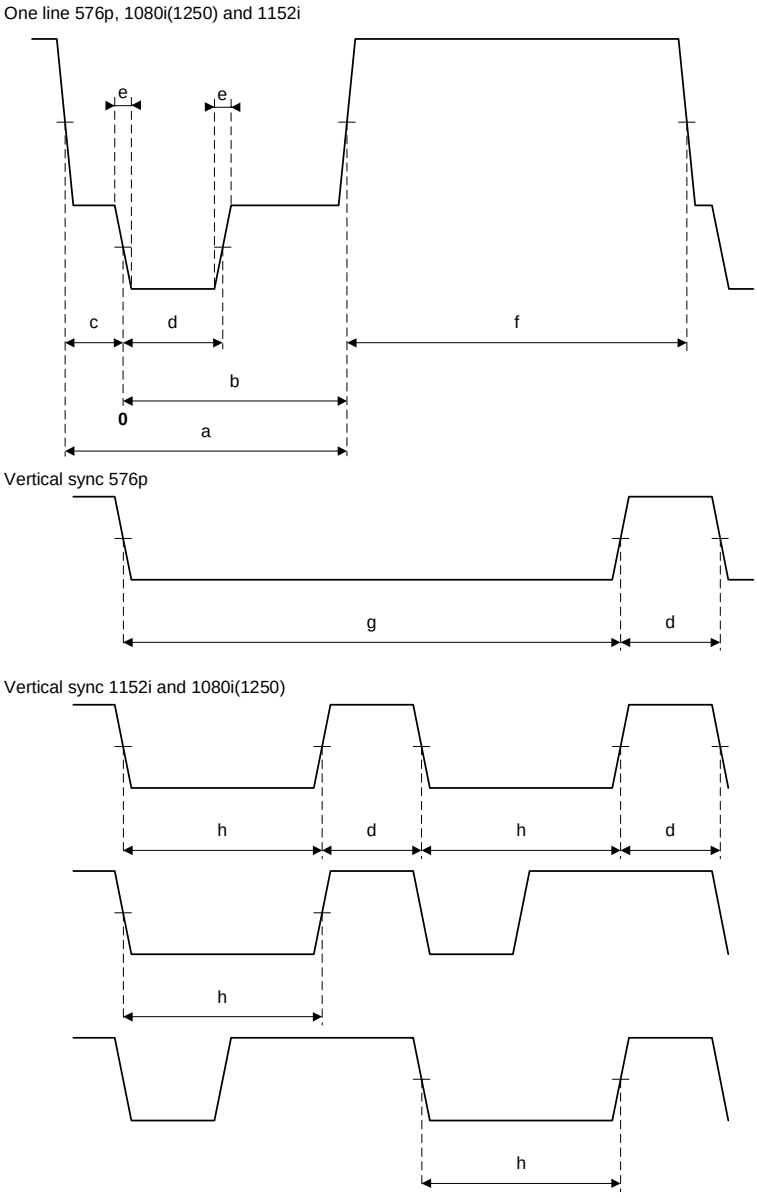
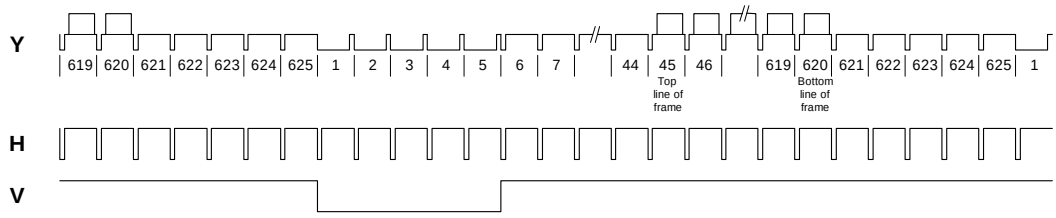


Figure H 1 and Table H 6. Line Timings & Clocks for 31.25kHz HD Formats

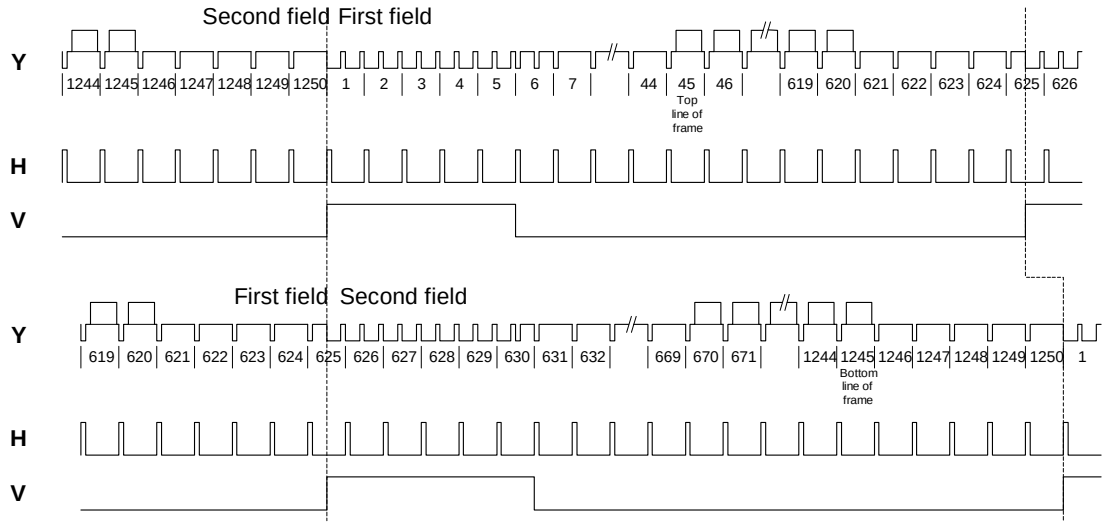
	720 x 576p		**1280 x 1152i (up-scaled 720p)**		**1920 x 1080i(1250) (1080i letterboxed in 1152)**	
Line Freq [kHz]	**31.250**		**31.250**		**31.250**	
Sample Clock Freq [MHz]	27		48		72	
	[clocks]	[µs]	[clocks]	[µs]	[clocks]	[µs]
Total # pixels	864	32.00	1536	32.00	2304	32.00
A	144	5.33	256	5.33	384	5.33
B	132	4.89	235	4.90	352	4.89
C	12	0.44	21	0.44	32	0.44
D	63	2.33	112	2.33	168	2.33
E	2	0.074	4	0.083	4	0.055
F	720	26.67	1280	26.67	1920	26.67
G	801	29.67				
H			656	13.67	984	13.67

Figure H 2
Vertical Sync Block Details of Y, H & V for 31.25kHz HD CRT Modes

576p

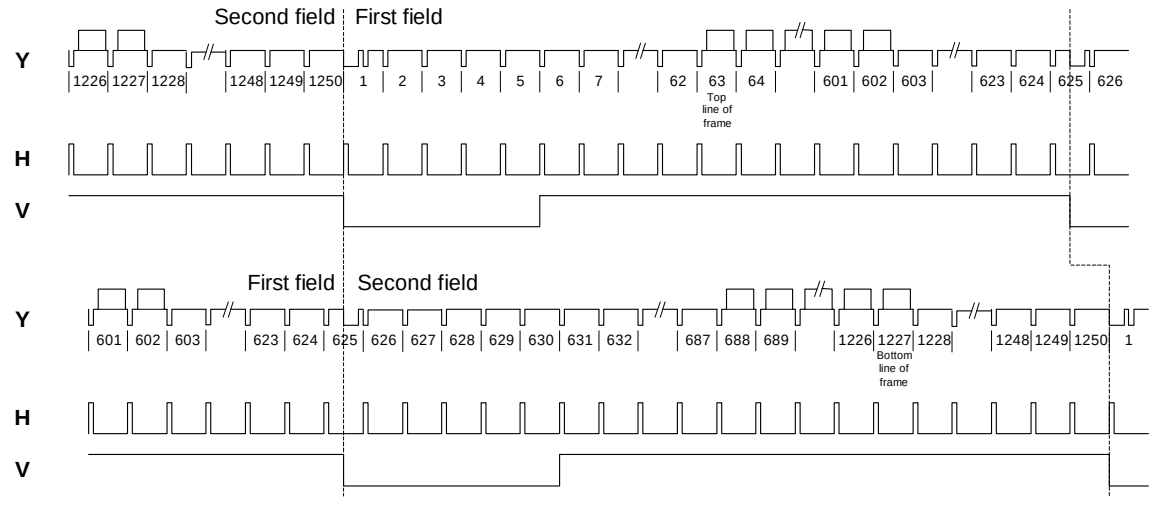


1152i



first field = 624.5 lines ; second field = 625.5 lines

1080i(1250)



first field = 624.5 lines ; second field = 625.5 lines

Table H 7.
HD CRT Timing Parameters for 31.250kHz CRT display devices

	720 x 576 @ 50p (same as 'native')	**1280 x 1152 @ 50i** (up-scaled 720p)	**1920 x 1080(1250) @ 50i** (1080i letterboxed in 1152)
Max. active pixels	720	1280	1920
Min. blanking pixels	144	256	384
Total pixels	864	1536	2304
Pixel frequency	27.00 MS/s	48.00 MS/s	72.00 MS/s
Line frequency	**31250 Hz**	**31250 Hz**	**31250 Hz**
Max. active line time	26.67 µs	26.67 µs	26.67 µs
Min. hor. Flyback time	5.33 µs	5.33 µs	5.33 µs
Total line time	**32.00 µs**	**32.00 µs**	**32.00 µs**
Min. active pixels	702	1248	1872
Min. active line time	26.00 µs	26.00 µs	26.00 µs
Max. hor. blanking time	6.00 µs	6.00 µs	6.00 µs
Min. visible pixels	661.5	1176	1764 (See note a)
Min. visible line time	24.50 µs	24.50 µs	24.50 µs
Max. blanking + overscan	7.50 µs	7.50 µs	7.50 µs
Scanning raster	Progressive	Interlaced	Interlaced
Active lines	576 x 1	576 x 2	540 x 2
Blanking lines	49 x 1	49 x 2	85 x 2 (see note b)
Total lines	625 x 1	625 x 2	625 x 2
Line frequency	31250 Hz	31250 Hz	31250 Hz
Field frequency	50 Hz (p)	50 Hz (i)	50 Hz (i)
Frame frequency	50 Hz	25 Hz	25 Hz
Active field time	18.43 ms x 1	18.43 ms x 2	17.28 ms x 2
Vertical flyback time	1.57 ms x 1	1.57 ms x 2	2.72 ms x 2
Total field time	20.00 ms x 1	20.00 ms x 2	20.00 ms x 2
Min. visible lines	543 x 1	543 x 2	509 x 2
Min. visible field time	17.38 ms x 1	17.38 ms x 2	16.29 ms x 2
Max. blanking + overscan	2.62 ms x 1	2.62 ms x 2	3.71 ms x 2

Notes to Table H 7:

(a) Maximum Overscan: Of the 1920 active pixels, a minimum of 1872 must be active, of which 1764 will be visible. 48 pixels may be sacrificed to mask the inevitable edge artifacts of digital video processing, (eg. FIR filters, scalers, motion compensation, etc.). Therefore, the maximum overscan is 156 pixels.

(b) 1080i active lines with 36 lines of black added top and bottom i.e.; 36+1080i+36 = 1152 lines.

Table H 8.
HD Output Interface Specifications including 31.25kHz Formats

Waveform Timings		**576x50p (625)**	**1152x50i (1250)**	**1080x50i (1250)**	**720x50p (750)** (native)	**1080x50i (1125)** (native)
Total lines including Vertical Blanking		625	1250	1250	750	1125
Sample Clock Frequency	MHz	27.000	48.000	72.000	74.250	74.250
Nominal Line Period	µs	**32.00**	**32.00**	**32.00**	26.67	35.56
Active line	µs	26.67	26.67	26.67	17.24	25.86
Horizontal blanking (Max for 31.25kHz formats)	µs	6 0	6.0	6.0	9.43	9.70
Sync pulse width -Standard & tri-level –see Note (a)	µs	2.35	2.33	2.33	0.54+0.54	0.6+0.6
Sync pulse Risetime	µs	0.1	0.08	0.06	0.05	0.05
Front Porch Width (EAV to 0H sync ref)	µs	0.75[.44]	1.96	1.98	5.93	7.12
Blanking Risetime	µs	0.15±0.05	0.05	0.05	0.06	0.05
Frame Period	ms	20	40	40	20	40
Vertical Blanking Period	Lines (H)	49H+6µs	22+23	85+85	30	22+23
Vert Sync serration (broad pulse) width	µs	29.67	13.67	13.67	0.54+0.54	11.85
Blanked Lines- pre Vert Sync	Lines	5	See Note (b)	See Note (b)	5	2+2½
Vertical Block	Lines	5	5	5	5	5
Blanked Lines- post Vert Sync	Lines	39	See Note (b)	See Note (b)	20	15
Analog Bandwidths						
Luminance Y or R, G and B	-1dB	10MHz	30MHz	30MHz	30MHz	30MHz
Pb and Pr	-1dB	5MHz	15MHz	15MHz	15MHz	15MHz
Analog Output Levels						
Luminance Y or R, G and B (peak level)	mV	+700	+700	+700	+700	+700
Blanking level	mV	0	0	0	0	0
Sync Pulse amplitude - see Note (a)	mV	-300	-300	-300	- or ± 300	- or ± 300
Pb and Pr maximum - see Note (d)	mV	+350	+350	+350	+350	+350
Pb and Pr reference	mV	0	0	0	0	0
Pb and Pr minimum	mV	-350	-350	-350	-350	-350
Digital Output Levels - see Note (c)						
Luminance Y and R, G, B (peak level)	10b /8b	940 /235	940 /235	940 /235	940 /235	940 /235
Blanking level	10b /8b	64 /16	64 /16	64 /16	64 /16	64 /16
Sync Pulse amplitude	10b /8b	-	-	-	-	-
Cb and Cr maximum - see Note (d)	10b /8b	960 /240	960 /240	960 /240	960 /240	960 /240
Cb and Cr reference	10b /8b	512 /128	512 /128	512 /128	512 /128	512 /128
Cb and Cr minimum	10b /8b	64 /16	64 /16	64 /16	64 /16	64 /16

Notes to Table H 8

(a) For 'native' 1080i and 720p formats - 'Tri-level' sync timings and values are as specified for analog interfaces in standards: SMPTE274M (1125 line 50i System 6) and SMPTE296M–2001 (720p - 50p System 3).

(b) For number of lines pre and post vertical block blanking for the 1080i(1250) and 1152i(1250) formats – see Figure H 1 and Table H 6. Line Timings & Clocks for 31.25kHz HD Formats.

(c) For DVI outputs refer to IEC 62315: DTV profiles for uncompressed digital video interfaces.

(d) Cb, Cr are digital representations and Pb, Pb analog representations, proportional to the B-Y and R-Y signals respectively.
Levels: Pb = 0.564(B-Y) and Pr = 0.713(R-Y) for 576i(625line SD) and 576p50 HD
but, Pb = 0.539(B-Y) and Pr = 0.635(R-Y) for 1080i & 720p HD
(Note there's a slight value difference for SMPTE and ITU-R based standards – see Glossary Y, Pb, Pb.

H 5. Summary of Native and CRT-Friendly Formats

Table H 9 summarises the recommendations for the received video formats and how they should be delivered from a STB to a display device that maintains optimum picture performance.

Table H 10 summarises the recommendations for format timings and hardware requirements for HD-STB's and HD display devices and reference standards from which the formats are derived.

Table H 9
RECOMMENDED HD-STB VIDEO OUTPUTS

SD or HD Received Format	'HD Native' Mode on HD Outputs	'HD CRT' Mode on HD Outputs
SD: 576i @ 50Hz 15.625 kHz	576p @ 50 Hz / 31.25 kHz (bi-level sync on 'Y')	576p @ 50 Hz / 31.25 kHz (bi-level sync on 'Y')
HD: 576p @ 50 Hz 31.25 kHz	576p @ 50 Hz / 31.25 kHz (bi-level sync on 'Y')	576p @ 50 Hz / 31.25 kHz (bi-level sync on 'Y')
HD: 720p @ 50 Hz 37.50 kHz	720p @ 50 Hz / 37.50 kHz (tri-level sync on 'Y')	1152i @ 50 Hz / 31.25 kHz '720p up-scale to 1152i' (bi-level sync on 'Y')
HD: 1080i @ 50 Hz 28.125 kHz	1080i @ 50 Hz / 28.125 kHz (tri-level sync on 'Y')	1080i(1250) @ 50 Hz / 31.25 kHz '1080i letterboxed (not scaled) in 1152i' (bi-level sync on 'Y')
Intended Display Device	Matrix displays with a digital scaler; i.e. Plasma / LCD displays LCD / DLP projectors etc …	16:9 CRT televisions with fixed 31.25kHz scan 576p(625) / 1152i(1250) HD input
	CRT projectors - or - 16:9 CRT televisions with 576p / 720p / 1080i HD input	

Table H 10.
Recommended 50Hz HD-STB Video Outputs and
50Hz HD Display Video Inputs Hardware requirements

Item Description	Formats and Connectors	Reference Standards	Applicability
HD-STB Video Output Formats and Timings	HD-STBs shall provide output video signals in the following formats: - HD Native modes and - HD CRT modes and - SD video *Note:* The HD video output sockets should be switchable between HD Native and HD CRT video modes by the use of a user accessible hardware switch.	Table H9 of this Annex H in this document ITU-R BT.1358 (576p) SMPTE 296M-2001 (Systems 3 & 6) (720p) SMPTE274M (1080i)	All HD-STB's
HD-STB High Definition Video output connectors	RGB+HV Y, Pb, Pr	Refer Table 1, 15.2.1, Component Analog outputs for HD and SD using Y, Pb, Pr or RGB+HV	ALL HD-STB's
HD-STB Standard Definition Video output connectors	CVBS (PAL) Y/C (S-Video) Y, Pb, Pr or SCART with RGB+CVBS and Y/C (SCART video selection via user set-up menu)	Refer Table 1, 15.2, Base-band analog video connectors	ALL HD-STB's
50 Hz HD Input Display Devices Video Input formats Timings	50 Hz HD Input display devices shall accept and display correctly: - HD Native mode video format timings or - HD CRT mode video format timings *Notes:* Matrix display devices with a 'digital scaler' such as LCD / DLP projectors, plasma etc., require HD Native mode video for optimum picture performance. The HD CRT mode is specifically intended for CRT television display devices using 31.25kHz deflection. European CRT TV manufacturers have indicated their preference for 50Hz HD CRT modes @ 31.250kHz as detailed in Table H9 using Y, Pb, Pr with bi-level sync on 'Y' or RGB+HV connectivity. Other CRT TV manufactures have indicated their preference for HD Native mode formats as detailed in Table H 9 using Y, Pb, Pr or RGB+HV connectivity.	Table H9 of this Annex H in this document ITU-R BT.1358 (576p) SMPTE 296M-2001 (Systems 3 & 6) (720p) SMPTE274M (1080i)	ALL 50 Hz HD Input display devices

Notes to Table H 10:

- HD Native modes:
  576p @31.250kHz, 720p @37.5kHz and 1080i @28.125kHz
- HD CRT modes:
  576p @31.250kHz, 1152i @31.250kHz (up-converted 720p) and 1080i(1250) @31.250kHz

ANNEX I

RECEIVER FUNCTIONAL DESIGN ISSUES OF SPECIAL NOTE FOR AUSTRALIAN DTT

(Informative Annex)

This Annex is intended as an assistance to manufacturers and software designers of digital terrestrial television receiving equipment for operation in the Australian broadcast environment. The additional information given in the following design issues has been brought to special note through the experience gained in the early year's of on-air transmissions.

I 1. Use of Logical Channel Numbers (LCNs)

Receiver manufacturers are strongly recommended to use the broadcaster provided Logical Channel Numbers for the various services broadcast. Australian use of LCNs is similar to the use in the UK and Europe.

The logical channel descriptor is found in the second descriptor loop of the NIT with a tag value of 0x83

The syntax of the Logical Channel Descriptor is:

Syntax	No. of bits	Mnemonic
logical_channel_descriptor{		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for (i=0; i<N; i++){		
service_id	16	uimsbf
visible_service_flag	1	bslbf
reserved	5	bslbf
logical_channel_number	10	uimsbf
}		
}		

Where:

descriptor_tag: This shall be assigned to be [0x83] .

service_id: This is a 16-bit field which serves as a label to identify this service from any other service within the Transport Stream. The service_id is the same as the program_number in the corresponding program_map_section. Services shall be included irrespective of their running status.

visible_service_flag: This 1-bit field when set to '1' indicates that the receiver shall make the service visible and selectable (subject to the service type being suitable etc.) via the receiver's service list. If set to '0' the receiver is not expected to offer the service to the user in normal service list or navigation modes however the service shall remain accessible by direct entry of the logical channel number on a remote control. Note that this feature was added as an amendment to the European standard and is backward compatible with versions that used 6 reserve bits.

reserved: All "reserved" bits shall be set to '1'.

logical_channel_number: This is a 10-bit field which indicates the broadcaster preference for ordering services. A 10-bit binary number is displayed as its equivalent in decimal notation. For example, 00 0001 0100 is displayed as LCN 20. Valid numbers are 1 to 999. A service with an LCN of "0" should be ignored.

Methods of LCN display in a Receiver's OSD

There are two methods of program list display in common use in Australian DVB-T receivers:

- All numbers in numerical sequence – i.e. 1, 2, 3 …9, 10, 11,…99, 100 … 200 … etc
- Numbers grouped by broadcaster – i.e.
  - TEN – 1, 10, 11, 12, …
  - ABC – 2, 20, 21, 22, … 200 …
  - SBS – 3, 30, 31, 32, … 300 … etc.

Notes on LCNs:

Unlike recommendations to European broadcasters, Australian broadcasters do use non-contiguous LCNs and 3 digit LCNs.

Australian broadcasters have adopted an "Operational Practice" (CTVA OP41), for unique use of LCNs in given transmission areas. However if a receiver is located in overlap areas of parent transmitter and translators, the same broadcaster's signal might be received twice on different frequencies but with the same SI.

European standards for LCNs also specify:

"Services with the same original_network_id/service_id *shall have the same* logical_channel_number. *Within the scope of one network, logical channel numbers shall be allocated uniquely. When defining regional variants of a service the same* logical_channel_number *can be used (e.g. in neighbouring networks). This facilitates defining a consistent and compact national / regional / local channel numbering scheme as well as indicating to the receiver that services with the same* logical_channel_number *are similar (regional variants)".*

Australian use of original_network_ids and network_ids is a little different to the use by European broadcasters as within a large island continent each Australian broadcasting network has been assigned its own original_network_id. Broadcasters have assigned the ids as detailed in the CTVA Operational Practice (OP40) so that:

"A service can be uniquely referenced through the path - original_network_id/transport_stream_id/service_id".

A second receiver situation for LCN overlap might arise with an overlap of parent transmitters or translators from two different transmission areas. Broadcasts from public network broadcasters ABC and SBS could be a common source for this problem as the transmissions from the same broadcaster would have the same original_network_id, but each main transmitter has its own unique transport_stream_id and service_id.

For example, receivers located in the overlap region of the ABC's transmissions from Sydney and Wollongong to the south might receive the Sydney transmission with:

original_network_id = 0x1010 and service_id =

whereas the transmission from Wollongong would have original_network_id and service_id :

original_network_id = 0x1010 and service_id =

A receiver with LCN software may choose to ignore the original_network_id and deal with these situations as suggested in Section I 2. "Overlap of translator and main transmitter programs" below.

Further information is given on LCNs in this Standard's Table 1, Item 3.4.2, "Logical Channel Numbering (LCN)" on page 21.

Reference may also be made to the broadcasters' Operational Practice on LCNs – OP41 and on Australian broadcaster's assignment of original_network_ids and network_ids in OP40. These are available from CTVA (formerly FACTS) – www.ctva.com.au/ ..

I 2. Overlap of translator and main transmitter programs

There is a problem where receivers may operate in an overlap region of main transmitters or translators where the same broadcaster's DTT signal may be receivable on different frequencies. The program LCNs may be the same and a viewer needs to determine which signal is the better or their preferred.

Many Australia DTT translators receive their input from direct off-air reception of the parent transmitter. Even though these translators may operate with other translators in an SFN, their operating frequency is different to the parent transmitter. There is no SI change at these translators, so it's not possible to change the LCNs of a program service, (although the frequencies of the parent transmitter and translators are carried in the original NIT).

Receivers, in their initial set-up frequency scan, usually start at the lowest frequencies and proceed up. Many parent transmitters (in the capital cities for example), are in VHF band III, while all translators are at UHF in band IV and V. If a receiver first detects a parent at VHF then a weaker translator at UHF, the LCNs of the parent might be overwritten, which is undesirable.

Recommendation:

During the scanning process, when a receiver finds another transmission with services that have identical LCNs to those on a previously found transmission, the receiver should not overwrite or discard either until it has identified to the user, preferably, which transmission has the stronger signal and give the user a choice of discarding or altering the LCNs of the less preferred transmission.

I 3. Setting Time Regions

To avoid incorrect on-screen time displays, receivers manufacturers are recommended to use the DTT broadcast's SI "Time Offset Table" (TOT) in conjunction with a user-menu preset choice of time zone.

During the Australian winter months, the country is divided into 3 time zones, which increase to 5 and sometimes 6, different zones during various periods in the summer months. For the purposes of interpreting and correctly displaying program time information from the EIT, receiver manufacturers need to have a "localisation" in the user-setup-menu, where the user can identify the region of the country they are in. This allows the receiver to calculate the local time from the transmitted "Time Offset Table" (TOT), which carries UTC and a number of time offsets linked to the "country region ids".

The preferred on-screen choices for Australia are the abbreviated names of the States (eg. NSW, VIC etc. as given in this Standard's Table 1, Item 6.4, "*Interpretation of time and date and time offset tables*" on page 29). Each State name corresponds to a country_region_id which the receiver will find in the TOT with an accompanying offset. Broadcasters automatically update these offsets in the broadcast TOT when daylight savings time comes into and out of effect so that the viewers always see correct local time even if the changeover date is changed for some reason (This happened in NSW in 2000 prior to the Sydney-2000 Olympic Games).

Time offsets found in Australian DVB-T broadcasts will have different values over the year but will always be in advance of UTC - Typical current values are +11, +10.5, +10, +9.5, +8 (hours), but these could be added to, if for example, a State Government votes to change. This is of no consequence to a receiver which follows DVB semantics rules as the process is one of simple conversion of the broadcast Modified Julian Date and addition/subtraction according to the broadcast time offset value.

Australian DVB-T broadcasters actually transmit two tables: the DVB "Time and Date Tables" (TDT) and "Time Offset Tables" (TOT) as specified in DVB-ETSI EN 300 468.

The Time and Date Table (TDT), has a single purpose in life - to transmit the current time and date in UTC and MJD - and as such is of less use.

The Time Offset Table (TOT) is the more important. It also carries the current time and date in UTC and MJD - plus the local time offsets. The local time offsets may be used in a DTT receiver to:

- display of the current local time on the IRD or TV screen;
- display of the programme guide in local time;
- timer programming of the video recorder in local time.

(see ETSI TR 101 211 V1.5.1 (2003-01) Sect. 4.2.5.1 Local time offset descriptor) The Time Offset Table (TOT) carries the country code and offsets identified in a "local_time_offset_descriptor" (0x58).

I 4. Vertical interval signals visible in letterbox mode

Australian government regulation requires free-to-air broadcasters to 'simulcast' their main SD program on both the analog PAL and DTT services. While the broadcasters are working towards maximising the number of wide-screen 16:9 programs for digital viewers, the broadcasters need to continue to provide standard (4:3) aspect ratio pictures for the majority of viewers who currently, are still watching analog PAL transmissions. To assist in controlling their networks, some broadcasters are using vertical interval data signals such as line-23 WSS (ETSI ETS 300 294).

Various viewer complaints received indicate that with some digital receivers, these and other vertical interval signals are unfortunately appearing in the on-screen video of some DTT services. These type of video disturbances become more visible if the viewer is using any picture manipulation modes of the digital receiver or display unit and becomes particularly noticeable in widescreen digital pictures that are displayed in letterbox mode on standard 4:3 displays.

Receivers are recommended to blank incoming video information down to line 25 as detailed in this Standard's Table 1, Item 7.8.3, "Changing between 16:9 and 4:3 pictures on displays' on page 33.

I 5. Identification of 50Hz High Definition video programs streams

Because Australia at present, is the only country with 50Hz DVB-T broadcasts that regularly include HD video formats, the determination of type of video format is a necessary function for digital receivers. The need for this function is not yet encountered in other 50Hz-based countries with only MP@ ML encoding.

Australian DTT broadcast transport streams will mainly carry 576x50i SD video, but for significant periods will also contain HD in 3 possible MP@ HL video formats: 1080x50i, 720x50p or 576x50p. (1080 may also be broadcast in "film mode" 25p).

While there a number of SD-only receivers that have entered the Australian market, some SD-only receivers appear to be designs that have been tested to operate in an SD-only environment (as currently encountered in other 50Hz countries, for example).

If a user accidentally selects a high definition program these receivers seem to be unable to recognise that they are not capable of decoding HD formats. For example, if the HD service is in HD 576x50p format, because the pixel format is similar to SD, some SD receivers try to decode it but the result is generally a staccato presentation of pictures like a rapid slide show. This confuses the viewer who cannot determine if there is a problem with their receiver or with the broadcast!

It's assumed software design of these SD-only receivers take "shortcuts" and lack the important process to identify the video format. If a viewer mistakenly tries to select a HD service the screen should, preferably, display an on-screen message saying "service not available" or High Definition service" or even simply go blank.

Where the Video format is identified

It is unreliable for a receiver to retrieve information about HD/SD formats from the component_descriptor() of the EIT. While the various 25 and 50Hz frame formats are identified as examples in ETSI DVB TR 101 154 Annex-A for example, the ETSI/DVB EN 300 468 component descriptor as used in the EIT, currently only has values for 25 Hz and 30 Hz HD formats. This problem has been drawn to the attention of the DVB-SI-DAT or DVB-GBS groups and the CTVA (FACTS) engineering group.

The most reliable method to distinguish an HD service is by the "profile_and_level_indication" in a video_stream_descriptor(), but this may appear in two places – the PMT and the program stream header.

(i) The PMT Transport stream map section [TS_program_stream_map_section()], in its stream_type loop should indicate video by a stream_type 0x02, followed by the elementary_PID, and perhaps, also followed by the video_stream_descriptor().

(ii) "profile_and_level_indication" in the video_stream_descriptor() also must appear in the Program Stream sequence_header()/ sequence_extension()

To take information from the HD service PMT may also be less reliable because in a broadcaster's chain of equipment, the PMT is usually inserted by an SI generator associated with the multiplexer (MUX). Therefore some data in the PMT may not always be present or accurate.

To achieve rapid channel change (zapping), the PMT video_stream_descriptor() may provide the information more quickly. Nevertheless, the broadcaster's equipment with the best guarantee of accuracy is the original MPEG encoder which will insert the necessary information in the Program Stream sequence_header().

Recommendation:

Receivers should **not** retrieve information about HD/SD formats from the component_descriptor() of the EIT. The PMT video_stream_descriptor() details of profile and level may be accessed more quickly but the most reliable way to determine a video stream's format parameters is to examine the MPEG-2 PSI header information per ISO/IEC 13818 part 2.

All receivers should read a video program stream's sequence_header()/sequence_extension() to retrieve the profile_and_level_indication, etc. and to distinguish between 25 and 50 Hz progressive and interlace HD and SD formats.

For other details, refer to this Standard's Table 1, Item 7, "Video decode and display" on page 30 and following sub items.

I 6. Closed Captions on High Definition Programs

If a HD capable receiver has an internal teletext decoder, it's recommended that a suitable scaling function be provided to adapt the font to the HD display format.

This will enable Closed Captions to be displayed on High Definition programs by access to teletext captions on page 801, if the broadcaster provides an appropriate link in the HD stream's PMT.

If available, this data will be indicated in the PMT and delivered in the transport stream as private data as described in the ETSI DVB standard EN 300 472 and in this Standard's Table 1, Item 10.3 Teletext closed captions" on page 39.

Important Note:

There may be only one teletext private data stream containing closed captions for simulcast SD and HD versions of a program. That is, the HD program PMT may reference the same teletext PID as used by the simulcast SD program. However this means that the broadcaster's encoders are unlikely to be able to encode the teletext and the video with the same PCR.

This should not create a problem with different PCRs, as recent discussions in the DVB forums have identified that while the ETSI standard retains reference to PTS, such data may be displayed as received without reference to the PTS and this is the preferred arrangement for Australian receiver operation.

The consequence is that receivers designed for Australian DTT are recommended to decode the teletext even if the teletext packet PCR is different to the video PCR. This may occur with both SD and HD video services.

Further information on Australian implementation of teletext for closed captions is given in Annex G.

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PREPARATION OF AUSTRALIAN STANDARDS

Australian Standards are prepared by a consensus process involving representatives nominated by organizations drawn from all major interests associated with the subject. Australian Standards may be derived from existing industry Standards, from established international Standards and practices or may be developed within a Standards Australia technical committee.

During the development process, Australian Standards are made available in draft form at all sales offices and through affiliated overseas bodies in order that all interests concerned with the application of a proposed Standard are given the opportunity to submit views on the requirements to be included.

The following interests are represented on the committee responsible for this draft Australian Standard:

Australian Broadcasting Authority
Australian Broadcasting Corporation
Australian Caption Centre
Australian Chamber of Commerce and Industry
Australian Communications Authority
Australian Electrical and Electronic Manufacturers Association
Australian Information Industry Association
Australian Subscription Television and Radio Association
Community Broadcasting Association of Australia
Consumer Electronics Suppliers Association, Australia
Consumers Telecommunications Network Inc, Australia
Department of Communications, Information Technology and the Arts, Australia
Department of Industry Science and Resources (Commonwealth), Australia
Electronic Services Industry Association Inc, Australia
Commercial Television Australia (C.TVA) (formerly Federation of Australian Commercial TV Stations)
Ministry of Commerce NZ
Broadcast Australia
Optus Communications, Australia
Special Broadcasting Service, Australia
Television NZ
Telstra Corporation, Australia

Additional interests participating in preparation of Standard:

Seven Network (Operations) Ltd.
ADB
Austar Entertainment
Network Ten Pty Limited
Consultants
Foxtel
Intermedia
JJB Associates
Masushita Electric Company (Aust)
Modern Antenna Systems
Motorola Semiconductor Products
NDS Asia Pacific
Nine Network Australia
Philips Consumer Electronics
Samsung Electronics Australia
Sanyo Australia Ltd
Sharp Corporation of Australia
Sony (Australia)
UEC Technologies (Pty) Ltd