1. SCOPE

This Operational Practice recommends the method of applying the Time Date Table (TDT) and Time Offset Table (TOT) sections for digital terrestrial television broadcasting in Australia.

Important information for those involved in setting TDT and TOT in DVB-SI generation equipment can be found in the Annex.

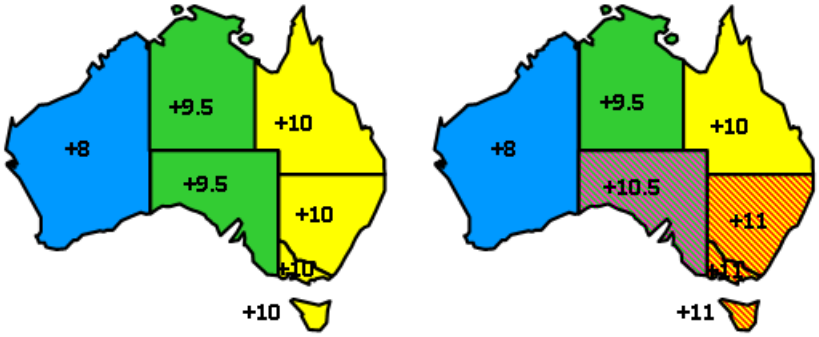
2. APPLICATION

Broadcast of the Time and Date Table (TDT) and Time Offset Table (TOT) provides a mechanism for broadcasters to signal the time of events in their broadcast stream and for receivers to display these times in a convenient manner for the viewer.

The TDT carries UTC[1] time and date. This information is given in separate table sections due to the frequent updating of this information. The TOT also provides this information, but importantly also provides information for the local time offset.

3. AUSTRALIAN TIME ZONES

Australia is divided into several timezones that span from +8 hours to +11 hours relative to UTC. From October to March, some Australian states change to daylight saving time creating both a north/south and east/west change in timezones. These are shown in Figure 1 below:



Standard Time Zones Daylight Saving Time Zones

FIGURE 1. Typical Australian Time Zones

Further explanatory detail regarding Australian time zones is available on the Internet at

http://australia.gov.au/about-australia/our-country/time
including the actual date of change for each Australian state.

[1] UTC is Coordinated Universal Time defined in Rec. ITU-R TF.460-5

4. Table Use and Description

4.1 Time and Date Table (TDT)

The syntax and semantics of the Time and Date Table are provided in Section 4.2.7 of Australian Standard *Digital Television – Terrestrial Broadcasting* AS 4599.1 [1] with references to ETSI EN 300 468 [2]. The TDT contains the current time in UTC and date in Modified Julian Date (MJD) format.

Broadcasters must transmit this table in SI of their DVB-T transport stream and ensure that it is derived from a reliable time standard, e.g. global positioning system, to present an accurate UTC time reference to receivers. As Australian broadcasters' DVB-T transmissions are independent of each other, accurate referencing will create a consistent time signal when viewers change from one broadcaster's signal to another.

ETSI TR 101 211 [3] recommends the repetition rate of the TDT table sections to be 30 seconds or less.

4.2 Time Offset Table (TOT)

The syntax and semantics of the Time Offset Table are provided in Section 4.2.7 of Australian Standard *Digital Television – Terrestrial Broadcasting* AS 4599.1 [1] with references to ETSI EN 300 468 [2]. The TOT contains the current time in UTC and date in Modified Julian Date (MJD) format and the local_time_offset_descriptor which contains the time offset information. While ETSI EN 300 468 [2] indicates that this table is optional, the Australian practice is for this to be mandatory.

ETSI TR 101 211 [3] recommends the repetition rate of the TOT table sections to be 30 seconds or less.

4.3 Local time offset descriptor

The local time offset descriptor syntax is described in Section 4.2.7 of Australian Standard *Digital Television – Terrestrial Broadcasting* AS 4599.1 [1] and ETSI EN 300 468 [2]. Table 4.5 of AS 4599.1 [1] indicates the Australian coding of the country_region_id and is reproduced in Table 1 below.

The local_time_offset_descriptor is used to indicate the local time offset and the automatic entry/exit daylight savings time compensation within receivers. The data given in the descriptor will be constant for most of the time, but is updated biannually to mark the change in the transitions to/from daylight savings time.

The local_time_offset_descriptor (tag 0x58) is inserted in the descriptor loop of the Time Offset Table sections. It lists a country_code, then a

country_region_id, local_time_offset_polarity, local_time_offset followed by a time_of_change and next_time_offset.

If the TOT is to signal offsets for multiple time zones, a separate local_time_descriptor may be repeated for each time zone, or within one descriptor listing, multiple loops commencing on the country_code may be inserted – either method is allowed.

The descriptor information shall be kept current to indicate at a minimum, the next time of change and applicable time offset.

TABLE 1: Australian Coding of country region id (also refer Table 4.5 AS 4599.1 [1])

Country_region_id	Description	Australian Postcode Equivalent[2]
00 0000	no time zone extension used	
00 0001	reserved	
00 0010	NSW/ACT	2XXX
00 0011	VIC	3XXX
00 0100	QLD	4XXX
00 0101	SA	5XXX
00 0110	WA	6XXX
00 0111	TAS	7XXX
00 1000	NT	08XX
00 1001 – 11 1100	reserved for future use	
11 1101 – 11 1111	reserved	

Example data for the descriptor fields:

country_code:	'0100 0001 0101 0101 0101 0011' (AUS)
country_region_id	'00 0010' (NSW/ACT)
local_time_offset_polarity	'0' (advanced to UTC, east of Greenwich)
local_time_offset	'0001000100000000' (Summer: Australian Eastern Daylight Saving Time +11 hours UTC)
	'0001000000000000' (Winter: Australian Eastern Standard Time +10 hours UTC)

This is illustrated in the example loop structure in Table 2.

[2] Included where decoders accept postcode in the user set up menus.

Broadcasters must ensure that the TOT time offset values signal a change at the prescribed times as indicated by government notice.

Note : the actual times entered will be in UTC, not local times.

Broadcasters shall include a TOT with a local_time_offset_descriptor containing each country_region_id where the broadcast is intended to be received.

For example:

- *Single timezone coverage* – e.g. broadcasts for the Sydney region need only carry a local_time_offset for the NSW/ACT region.
- *Multiple timezone coverage* – e.g. Broadcasts for the northern NSW regional market which includes the Gold Coast area in southern Queensland should broadcast a TOT which includes both the NSW/ACT and the Queensland country_region_ids.
- *All timezone coverage* – e.g. National broadcasters are not constrained by license areas and hence may broadcast a TOT containing all Australian country_region_ids in each of their DVB-T streams.

For operational reasons, broadcasters may optionally include in their DVB-T streams additional country_region_ids outside of the intended market area.

TABLE 2. Local Time Offset Descriptor - Example of country loop syntax

4.4 Time of next change

EIT listed program start times are in UTC format and need to be adjusted to local time with the time offset for display by a receiver or PVR. In the period before a daylight-savings change over, if a viewer accesses EPG information (i.e., from EIT schedule) relating to programs going to air after the change over, the time_of_change and next_time_offset information is needed by the receiver so that those future program's times shown will be correct.

5. Event Information Tables (EIT)

Free TV Operational Practice OP44 recommends the method of applying Electronic Service Guide (ESG) program information, for digital terrestrial television broadcasting in Australia, using the DVB short_event_descriptor and extended_event_descriptor, located in the Event Information Table sections (EIT).

6. Receiver and PVR Behaviour

It is highly recommended that receivers read the EIT, TDT and TOT to allow the receiver to display to the viewer the correct local time, based on synchronizing to the broadcast UTC time reference and adding the local time offset. In order to determine the correct time the receiver should access:

- the viewer selected country_region_id
- then comparing the current UTC date and time and offset to the selected country_region_id
- comparing the current date and time to the next time of change in the local time offset descriptor for their country_region_id to determine if standard time or daylight savings time should be displayed.

The time related tables may be applied in the following viewable applications to correctly display:

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

If only one country_region_id is transmitted, the receiver should default to use this timezone in the presentation of events to the viewer.

Further information regarding DTV receiver behaviour may be found in Australian Standard AS 4933.1 [4].

7. References

[1]	Australian Standard, Digital television – Terrestrial broadcasting Part 1: Characteristics of digital terrestrial television transmissions	AS4599.1-2011
[2]	Digital Video Broadcasting (DVB);Specification for Service Information (SI) in DVB systems	ETSI EN 300 468 V1.11.1 (2010-04)
[3]	Digital Video Broadcasting (DVB); Guidelines for implementation and usage of Service Information (SI)	ETSI TS 101 211 V1.10.1 (2009-07)
[4]	Australian Standard, Digital television – requirements for receivers Part 1: VHF/UHF DVB-T television broadcasts	AS4933.1 – 2010

Annex

Setting of UTC Time, Date, Local Offsets and Daylight Savings Changes in Time and Date Tables (TDT) and Time Offset Tables (TOT)

1. Background

This supplement is intended to add important information for correct settings of TDT and TOT in DVB-SI generation equipment. These items should be brought to the attention of all those involved in setting this type of information into SI generation equipment.

2. Use of UTC as a Fixed Reference

The TDT and TOT are required to be transmitted at least every 30 seconds in the SI in a DVB compliant transport stream.

Both the TDT and TOT carry the current UTC date and time – not the local time. This needs to be accurate – possibly linked to GPS or similar.

The TOT has a **local_time_offset_descriptor** (0x58) added with either a single or multiple loops for a single or multiple state(s) /regions – either situation is valid.

This descriptor as well as carrying a 'valid' **local_time_offset** field for the state/region, also carries a **time_of_change** field (in UTC date and time) with an accompanying **next_time_offset**. These are only changed twice a year for daylight savings changes, otherwise not at all.

The **UTC_time** and **time_of_change** are carried as 40 bit fields that are a little odd in assembly as the UTC date section is converted to MJD with the 16 LSBs of MJD normally displayed as 4 hex alphanumeric characters (see examples below); followed by 24 bits coded as 6 digits in 4 bit BCD (formulas for MJD conversion are given in an annex of EN 300 468).

3. Time_of_change

In broadcast markets that have daylight-savings, it is preferable that all networks arrange their SI generators to change the next-change dates and offsets in their Transport Stream's TOT exactly at the **time_of_change** time. In some cases that might not be possible and that might cause short-term receiver problems – see Clause 7 below.

The **time_of_change** for the eastern States is **always 4:00pm** (16:00:00 UTC) on the day previous to the change date in Australia - i.e., the Saturday afternoon preceding the Australian date of Sunday morning change-over.

This always applies both for the beginning and end of daylight saving even though the Australian times are shown as 2:00am or 3:00am. Similarly for South Australia with 9½ or 10 ½ hour offset, it would be always 4:30pm (16:30:00) UTC. If WA had daylight saving it would be 6:00pm (18:00:00) UTC

4. States That Don't Have Daylight Saving

From TS 101 211 § 4.2.5.1: "If the time of the next change is unknown, or there is no next change (in the case of a region that does not use daylight saving) then the **time_of_change** field shall contain a valid value and the **next_time_offset** field shall convey the same value as the **local_time_offset** field."

5. Examples of No Daylight Saving

Even if a State does not have daylight saving (e.g. WA, QLD and NT), the **time_of_change** can be set 1) in the far future, 2) the near future or 3) in the past - so long as the **next_time_offset** field and the **local_time_offset** fields are the same (per TS 101 211):

i. Valid descriptor with **time_of_change** in the far future
country_code: 0x415553 => "AUS"
country_region_id: 6 (00 0110)
local_time_offset_polarity: 0
local_time_offset: 08:00:00 (hh:mm)
time_of_change: 0xF47E180000 => (MJD=62590 - Saturday) 2030/03/30 18:00:00
next_time_offset: 08:00 (hh:mm)

ii Valid descriptor with **time_of_change** in the near future
country_code: 0x415553 => "AUS"
country_region_id: 6 (00 0110)
local_time_offset_polarity: 0
local_time_offset: 08:00:00 (hh:mm)
time_of_change: 0xDB8F180000 => (MJD=56207 - Saturday) 2012/10/07 18:00:00
next_time_offset: 08:00 (hh:mm)

iii Valid descriptor with **time_of_change** in the past
Implication for a Receiver – **next_time_offset** is assumed current and used by a receiver
country_code: 0x415553 => "AUS"
country_region_id: 6 (00 0110)
local_time_offset_polarity: 0
local_time_offset: 08:00:00 (hh:mm)
time_of_change: 0x9252120000 => (MJD=37458 - Saturday) 1961/06/08 12:00:00
next_time_offset: 08:00 (hh:mm)

In the above examples where daylight savings do not apply, **local_time_offset** and **next_time_offset** must be the same.

6. Receivers and PVRs – Expected Operation

To display the current local time or the correct local start time of a program in an EPG, the receiver needs to access from the EITs, the UTC current time and/or program start times and set them to local by use of a time offset.

Where the TOT has the time_of_change set in the future, a receiver/PVR needs the local_time_offset value to calculate the local time or program start time, but in the 8 (14) day window before the changeover date when accessing information on programs due to go to air after the change-over date, the next_time_offset has to be used.

However if a broadcaster does not change the TOT settings until sometime after change over, the time_of_change is now in the past, so the next_time_offset is correct, not the local_time_offset and a receiver needs to recognise this and use the next_time_offset for local time and program start calculations.

Similarly – in a broadcast market that doesn't have daylight-savings, if the broadcaster has set the never-changing time_of_change to a past date, a receiver needs to recognise this and use the next_time_offset .

For a receiver to correct interpret the TOT offset descriptor information, the receiver's software is required to first check if the time_of_change is in the past. This process can be represented by the following pseudo-code:

```
if (UTC_time >= time_of_change) then
    local_time = UTC_time + next_time_offset
else
    local_time = UTC_time + local_time_offset
end if
```

where: local_time is the receiver's resulting local time,
UTC_time is the value broadcast within the TDT and TOT, and
time_of_change, local_time_offset and next_time_offset
are the values broadcast within the TOT for the configured country region.

7. Minimum Recommended Updates to TOT

Currently, some of the SI generation systems in use by Australian broadcasters do not support automatic update of the TOT at the time of the AEST transition and therefore require manual configuration changes.

As soon as possible following a change into or out of daylight saving, it's recommended the TOT should be updated with the next scheduled change date and time offset even though it's nominally 6 months away

8. Next changes

Daylight Saving Time begins at 2am AEST (16:00 UTC) on the first Sunday in October and ends at 2am AEST (16:00 UTC), (which is 3am Australian Eastern Daylight Time) on the first Sunday in April. Dates of change are usually found at:
http://www.bom.gov.au/climate/averages/tables/dst_times.shtml or
http://australia.gov.au/about-australia/our-country/time