

1. SCOPE

This Operational Practice specifies the operational parameters for use of the logical_channel_descriptor for Australian free-to-air Digital Terrestrial Television transmissions and assigns the allocation of Logical Channel Numbers (LCNs) to be used to identify television and radio services carried on free-to-air DVB-T transmissions.

This Operational Practice also makes recommendations to receiver manufacturers and broadcasters to cover situations where receivers find repeated LCNs in reception overlap areas with varied reception quality or where there is no LCN. The informative Appendix A gives some background and suggested scenarios on how LCNs are used in Australia.

The logical_channel_descriptor specifications are in compliance with the detail in the Australian Digital TV Transmission standard, AS 4599 [1]. The Australian specification, while based on the original development of the Logical Channel Descriptor¹ by the UK DTG [2], has variations and extensions in its implementation similar to its use in Europe.

2. APPLICATION

The intention of the Logical Channel Descriptor is to provide a broadcaster assigned virtual channel number or label, for each of the services available to the DTTB receiver. These services are defined by the "DVB triple" a combination of the original_network_id, transport_stream_id and service_id, whose values are allocated according to Free TV Operational Practice OP-40 [3].

Logical Channel Numbers (LCNs) are used in Australia to identify services, some of which may not be present at all times. All DTTB services are each allocated a Logical Channel Number by the broadcaster in accordance with the allocation table in this Operational Practice.

The Logical Channel Descriptor is inserted in the second descriptor loop of the Network Information Table. The Logical Channel Descriptor is assigned the tag value of 0x83 within the DVB Service Information (refer to the Australian DTTB transmission standard, AS 4599 [1]). Within the Australian implementation of the DVB-T system, the Logical Channel Descriptor is treated as a public descriptor.

2.1 Visible and Non-Visible Services

While all DTTB services within a broadcast multiplex are allocated Logical Channel Numbers by broadcasters, not all services within a multiplex may be intended to be seen or selected by the viewer. Certain services such as Multimedia streams, Data streams or System Software Updates may need to be concealed from the receiver service list and made invisible to the viewer.

In order that the receiver can discriminate between (broadcaster intended) visible and non-visible services, the European EICTA receiver guidelines have introduced the concept of the visible_service_flag.

¹ The UK Digital TV Group has claimed copyright of the use of the Logical Channel Descriptor and has granted approval for its use in Australia.

The `visible_service_flag` utilises one bit of the former six bit reserved field in the service loop of the Logical Channel Descriptor. The reserved bits are normally set to “1”. By setting the least significant bit (b0) to “0”, the service and the associated LCN, should not be visible or accessible to the viewer in the normal Service Lists and Electronic Service Guides. The remaining five bits of the reserved field continue to be set to “1”.

As is the case in Europe, this method allows the introduction of the visible service flag into the Australian LCN Syntax in a completely backward compatible way.

When the `visible_service_flag` is set to ‘0’, broadcasters prefer that the receiver should adopt the following behaviour;

- The service shall not be visible to viewer or selectable by the normal remote control interface,
- The LCN shall not be visible to viewer or selectable by the normal remote control interface,
- The service may be called by another applet (embedded or downloaded) executing in the receiver.

2.2 Logical Channel Number Syntax

The proposed new syntax and semantics of the `logical_channel_descriptor` is indicated in Table 1, as follows;

Table 1. Logical Channel Descriptor Syntax

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

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 service is normally visible and selectable (subject to the service type being suitable etc.) via the receiver service list. When set to ‘0’ this indicates that the receiver is not expected to offer the service to the user in normal navigation modes however the receiver may

provide a mechanism to access these services (for example, during the execution of an application, resident within the STB).

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. Table 3 provides an allocation of the LCNs agreed between Australian broadcasters.

3. DTTB RECEIVER OPERATION

3.1 Table Repetition Rates

Australian broadcasters transmit the NIT and SDT table sections in accordance with the requirements of TR 101 211 [4] (i.e. at intervals not greater than 10 seconds), as referenced by AS 4599 [1]. It is highly recommended that receivers read the NIT and SDT tables at a similar rate.

3.2 Conflicts

3.2.1 *Conflicts due to Coverage Overlaps*

LCN allocations to broadcasters are intended to avoid an individual receiver receiving more than one service with the same LCN. In practice due to DVB-T coverage area overlaps, it is possible that competing services (i.e. different services with the same LCN) are received from different transmitters.

3.2.2 *LCN Conflicts due to Parent Transmitters and Translators*

Within a broadcaster’s licensed service area, a parent transmitter may be augmented by additional translator channels to improve coverage. Inevitably, there will be overlaps between the parent and the translator services albeit on different frequencies and bands. Translator services may be identified by having the same SI and PSI as the parent although received on different RF channel frequencies.

Broadcasters shall indicate the use of additional translator frequencies for the same service multiplex by setting the `other_frequency_flag` in the `terrestrial_delivery_system_descriptor` and listing the translator frequencies in the `frequency_list_descriptor` of the Network Information Table sections (NIT) (refer ETSI EN 300 468 [5]).

Consequently, the receiver could discriminate between duplicated services and LCNs by examining the link between parent and translator services in the frequency list descriptor of the NIT. In such cases duplicated services of lower received quality should be discarded by the receiver in favour of the best quality service instance (see section 3.2.3).

Unfortunately some broadcasters choose to use the same LCN for different program services in adjoining regions which will cause in overlap reception conditions, conflicting services and LCN situations. Generally, in these cases, each transmission will have the same `original_network_id` but different `transport_stream_id` and will not be linked in the frequency list descriptor of each transmission’s NIT.

3.2.3 Signal Quality Matrix

If competing duplicate services (i.e. those that have the same LCN allocated) are received from different transmitters, then a receiver that complies with the Australian DVB-T receiver standard, AS 4933 [6], will place the service with the highest received quality in the correct LCN position and the other(s) made available to the user, for example stored at the next available unallocated number in the range 350 - 399, unless it is intentionally duplicated by the broadcaster as indicated by its presence in the frequency list descriptor of the NIT (see section 3.2.2), in which case it can be safely discarded.

After this allocation, in order to account for user regional viewing preference, the choice of service competing for a common service positioning should be user-selectable.

Table 2 provides a logical set of coverage overlap scenarios and recommended receiver behaviour in accordance with 3.2 and 3.3 above.

Table 2. DVB-T Coverage Overlap Scenarios

NIT Scan Action	Overlap Case 1 Translator fed by Parent Transmitter		Overlap Case 2 Overlapping regional services from same broadcaster		Overlap Case 3 Overlaps from different broadcasters	
	Parent Channel	Translator Channel	Parent Channel	Other Transmitter Channel	Parent Channel	Other Transmitter Channel
(Example) Channel	6	34	X	Any Other Channel	X	Any Other Channel
NIT Terrestrial_delivery_system_descriptor Other_frequency_flag	yes	yes	X	X	X	X
NIT frequency_list_descriptor	Listed	Listed	X	Not Listed	X	Not Listed
(Example) Transport_stream_id	0xAAAA	0xAAAA	0xAAAA	0xZZZZ	0xB BBB	0xC CCC
(Example) service_id	0xDDDD	0xDDDD	0xDDDD	0xEEEE	0xDDDD	0xEEEE
(Example) Duplicated LCN	5	5	2	2	5	5
Receiver Assumption	Same service		Different service		Different service	
Signal Quality (BER)	Choose Highest QOS		Choose Highest QOS		Choose Highest QOS	
Receiver Action 1	Discard channel with lowest QOS		Bump lowest QOS LCN to 350-399		Bump lowest QOS LCN to 350-399	
Receiver Action 2 (Optional)	No further action		Allow viewer to choose		Allow viewer to choose	
Legend	X = don't care QOS = Quality of Service (received signal quality) Values shown are typical examples					

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3.3 Services without LCNs

If a service is found without an LCN, a receiver that complies with AS4933 should allocate the next unused channel number between 350 and 399.

3.4 Allocation of LCNs

Table 3 indicates the allocation of LCN values to Australian Broadcasters.

A broadcaster may allocate more than one Logical Channel Number to a service. This allows the main digital service defined by a single digit LCN, to also be allocated a 2 digit or 3 digit LCN; and permit the main digital service to be in a contiguous group of the broadcaster's services (refer to Annex A for further detail).

Table 3. Allocated Logical Channel Numbers

Series (note (a))	Primary User (note (b))	Remote and Independent User (note (c))	Allocated Single digit Number	Allocated 2- digit Numbers	Allocated 3-digit Numbers	Unallocated
1	TEN Network	RABS	1	10-19	100-149	150 - 199
2	ABC	ABC RABS	2	20-29	200-299	
3	SBS	SBS RABS	3	30-39	300-349	
	Receiver allocation				350-399 (note (e))	
4	Miscellaneous Multiplex Operator	Not allocated	Not Allocated	44 (note(d))	Not Allocated	4 40-43, 45-49 400-449 450-499 (note (f))
5	TEN Affiliates / Regionals	RABS	5	50-59	550-599	500 - 549
6	SEVEN Affiliates / Regionals	WAW RABS	6	60-69	650-699	600 - 649
7	SEVEN Network	Southern Cross Broadcasting RABS	7	70-79	750-799	700 - 749
8	NINE Affiliates / Regionals	WOW RABS	8	80-89	850-899	800 - 849
9	NINE Network	Imparja RABS	9	90-99	950-999	900 - 949

NORMATIVE NOTES to Table 3:

- (a) The use of an LCN of 0 or, LCNs greater than 999, are not covered by this Operational Practice.
- (b) The allocation of values to 'Primary Users' protects against overlaps where adjacent coverage areas occur. Users who are licenced in more than one service area are allocated a single digit number, and range of double digit numbers and a range of triple digit numbers that may be related to a "brand" number. The double digit and triple digit numbers are intended to be unique in each service/coverage area.
- (c) The allocation of values to 'Remote and Independent Users' presumes that there is no overlap with 'Primary Users'.
- (d) Allocated to the community television service in each service area.
- (e) This region has been allocated for duplicated services and services without LCNs. Broadcasters should not allocate a LCN in the range 350 – 399. Refer to Clause 3.2 and 3.3 of this OP.
- (f) The LCN range 450 – 499 has been reserved for temporary use by non-broadcasters for licensed trial services. Trial services introduced by existing broadcasters will be assigned within their allocated LCN range.

3.0 REFERENCES

[1]	Australian Standard, Digital television – Terrestrial broadcasting Part 1: Characteristics of digital terrestrial television transmissions	AS4599.1-2007
[2]	Digital Terrestrial Television, Requirements for Interoperability	Digital TV Group V 3.0 November 1998
[3]	Free TV Australia Operational Practice 40 – Allocation of DVB Service Information Codes for Australia.	Issue 2 February 2010
[4]	Digital Video Broadcasting (DVB); Guidelines for implementation and usage of Service Information (SI)	ETSI TR 101 211 V1.6.1 (2004-5)
[5]	Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems	ETSI EN 300 468 V1.6.1 (2004-11)
[6]	Australian Standard, Digital television – requirements for receivers Part 1: VHF/UHF DVB-T television broadcasts	AS4933.1 - 2005

Appendix A (Informative) – Implementation of Logical Channel Numbers in Australia.

A1. Introduction

Through the systematic use of Logical Channel Numbers, broadcasters can ensure that a viewer can quickly choose the desired program or service from a service list menu displayed on their DTV. This innovation was developed by the UK's DTG called "Logical Channel Numbers" (LCNs) and now extends to the EICTA and NORDIG specifications.

If each DTV broadcaster includes a LCN tag number for each service and DTV receivers have the LCN facility, then the virtual service numbers are assigned to remote control buttons.

The two fundamental system requirements are;

- The broadcasters must "tag" each of their services with an LCN;
- The receivers are equipped with firmware recognition of the LCN descriptor.

Real benefits to viewers are realised when the broadcasters agree to use the numbers in an orderly way that;

- offers broadcasters an opportunity to prioritize their services;
- is user friendly and convenient; i.e. the numbers are arranged in a "logical" manner that is easy for a viewer to store and recall their "favourites";
- avoids service conflicts, i.e. all broadcasters agree not to use the same number in the same transmission area.

A2. Logical Channel Numbering

Each broadcast station may offer several types of service including a main service, presumably the SD service, a HDTV service or, multiple SD program channels or multi-view SD channels, as well as digital radio services, interactive television, data-broadcasting and other enhancement/information services.

The possibility of large numbers of services requires digital TV receivers to expect up to 3 numbers, entered via remote control, to select the LCN of a program service. The receiver's remote control interface will need to have inbuilt hysteresis, allowing enough time to capture a single, double or triple digit entry.

Without an organised system of user readable program numbering;

- a broadcaster has no control over the order and priority of the transmitted services; and
- a receiver could assign numbers as it finds them, either during the initial set-up and tuning process, or in the process of finding new services.

Appendix A (Informative) – Implementation of Logical Channel Numbers in Australia.

This may result in an ad-hoc assignment of program numbers. Consequentially, it will be difficult for viewers to find desired programs amongst the litany of other services, particularly if some of these services are changing from time to time.

Not all these services will necessarily be operating simultaneously or continuously, due to broadcast regulatory constraints and/or the finite capacity of the digital terrestrial transport stream.

In the Australian implementation of the Logical Channel Number descriptor, a service can be identified by more than one logical channel (Clause 3.4 of this Operational Practice).

This allows Logical Channel “place markers” to be present all the time, pointing to virtual services with no additional data bandwidth overhead, providing the broadcaster with the ability to dynamically re-assign the logical channel number of an intermittent or absent service, to another service that is currently present, even though that service already has an existing LCN allocated to it.

This implementation of the Logical Channel Number is of benefit to both the broadcaster and the viewer.

- For the viewer,
 - a familiar menu of numbered service listings is maintained; and
 - the receiver will not attempt to select an absent service with unpredictable results.
- For the broadcaster, the service list can be efficiently maintained without the need to reserve (waste) valuable data bandwidth to maintain absent (empty) services.

A3. Implementation of Logical Channel Numbers in Australia

LCNs can range from 1 to 999 – the receiver normally expects up to 3-digit program selection from the remote control.

To provide some recognised order to the various program choices, a scheme has been devised which allows services to be selected from

- a single button push – i.e. 1 to 9;
- a double button push – 10 to 99 – or
- a triple button push – 100 to 999.

Appendix A (Informative) – Implementation of Logical Channel Numbers in Australia.

A3.1 Services assigned to a single digit number

Most broadcasters have a single number to identify their main service – even though they may have a range of services that require a range of, say, up to 10 LCNs in total. Both city and regional broadcasters could use this scheme e.g. If a viewer in the main reception area wants the ABC – press 2, or Seven – press 7 – so in essence:

1 selects TEN;	4 Reserved for future allocation.;	7 selects Seven;
2 selects the ABC;	5 selects the TEN Affiliate;	8 selects Nine Affiliate;
3 selects SBS;	6 selects Seven Affiliate;	9 selects NINE

A3.2 Services assigned to 2 or 3 digit numbers

Obviously all other services will have to be assigned a 2 or 3 digit number. The number range assigned to each network uses their single digit Logical Channel Number as the first digit – for example, the SBS would use numbers in the range 30 to 39 – and similarly in the case of 3-digit numbers – so in the ABC case, the range is 200 - 299.

A3.2.1 2-Digit numbers

Capital cities and major regional cities will use 2 digit numbers for other services such as multi-channels.

A3.2.2 3-Digit numbers

The requirement for the use of three digit LCNs arises because of same-network broadcasts in adjacent service areas. For example if the same Network has two stations in adjacent service areas which broadcast the same LCN and a STB in the coverage overlap area received both stations, the STB may bump one of the broadcast LCN values into the range 350-399 (refer to this OP41 Table 3).

Which station would retain the broadcast LCN value? The viewing public may get confused as to which is their local station.

This scheme proposes that it is better to provide the majority audience with simple scheme for their channel selection and have an alternative but again simple, arrangement for viewers in overlap areas.

Appendix A (Informative) – Implementation of Logical Channel Numbers in Australia.

A range of 3 button entry numbers for adjacent service areas of the same Network solves the overlap problem. This operates similarly to the 2-digit scheme except the 1st digit is repeated.

In nearby adjacent service areas with overlaps (such as Ballarat and Bendigo, for example), WIN could use 8 in both cities for their main program but for those viewers in overlap areas, the Ballarat main program might also be tied to LCN 88 whereas the Bendigo WIN station would have its main program also tied to 888. There is no doubt 88 tunes Ballarat WIN and 888 tunes WIN Bendigo.

If all broadcasters in Bendigo and Ballarat adopt the same scheme then it would simplify for the viewer that all stations in Ballarat are 2 digit numbers and all stations in Bendigo can be found with 3 digit numbers.

A Network with services in adjacent areas, in each area can use the single digit LCN for their main service but the range of services in each adjacent area will be identified either by a 2-digit or 3-digit range of numbers.

This concept will also serve areas adjacent to the main capital city where the ABC and SBS could operate 3-digit numbers in Newcastle and Wollongong for example.

Also for Metropolitan Networks with break away services (eg, if the Seven Network had a breakaway service on the Central Coast translators), then the local central coast main service could be found on 3- digit numbers.
