



Report ITU-R RA.2195
(10/2010)

**The transition to digital television and
its impact on the unprotected use by the
radio astronomy service of bands used for
terrestrial television broadcasting**

RA Series
Radio astronomy



Documents
Document Sharing Hub

Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Reports

(Also available online at <http://www.itu.int/publ/R-REP/en>)

Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management

***Note:** This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

Electronic Publication
Geneva, 2011

© ITU 2011

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without written permission of ITU.

REPORT ITU-R RA.2195

**The transition to digital television and its impact on the unprotected
use by the radio astronomy service of bands used
for terrestrial television broadcasting**

(2010)

TABLE OF CONTENTS

	<i>Page</i>
1 Introduction	2
Annex 1 – Transition from analogue to digital television broadcasting	4
1 Australia	4
1.1 Date of transition	4
1.2 Frequency allocations and assignments	4
1.3 Transmission spectrum mask and the maximum permitted power level of spurious emission or unwanted emission	4
1.4 Radio astronomy observations in frequency bands allocated to terrestrial broadcasting	8
2 Brazil	8
2.1 Brazilian DTT standard	8
2.2 Date of transition	8
2.3 Frequency allocations and assignments	9
2.4 Current situation of digital terrestrial television deployment in Brazil	9
3 Japan	10
3.1 Date of transition	10
3.2 Frequency allocations and assignments	10
3.3 Transmission spectrum mask and the maximum permitted power level of spurious emission or unwanted emission	10
3.4 Radio astronomy station in the frequency range between 470 and 710 MHz	13
4 United States of America	13
4.1 Date of transition	13
4.2 Changes to frequency allocations	13
4.3 Changes to allotments and assignments	15
4.4 Changes to allowed transmit power and unwanted emissions	17
4.5 Changes to the spectrum of the transmitted signal	18

1 Introduction

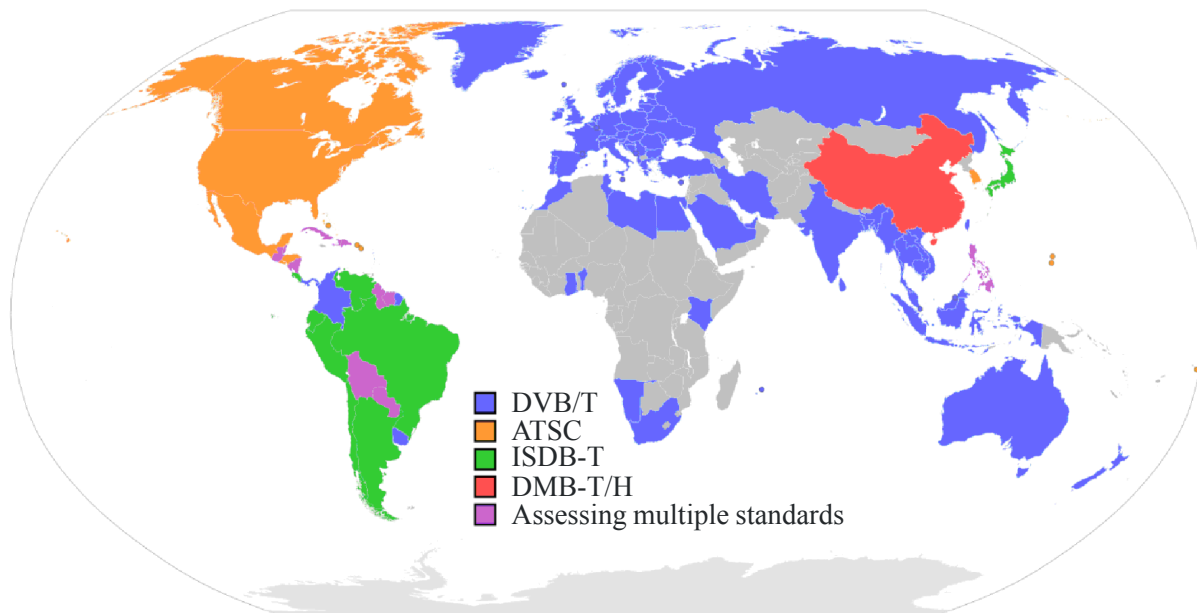
Television has become a fundamental form of communication in every region of the world. Its utility as a source of news, entertainment, and emergency information has been evident since its inception more than 60 years ago. Presently providing coverage to a global population numbering in the billions, terrestrial television broadcasting is one of the most ubiquitous uses of the radio spectrum.

The radio astronomy service does not share any allocations with terrestrial television broadcasting; however, such broadcasts generally occupy spectrum that is extremely important to low-frequency astrophysics and the observation of red shifted neutral hydrogen (HI) arising from early epochs in the formation of the universe. To date, radio astronomers have made use of TV bands to conduct observations, in accordance with No. 4.4 of the Radio Regulations (RR).

At the present time, many countries are transitioning from analogue to digital television broadcast standards (see Fig. 1), and some are also revising their broadcast allocations to recover spectrum that is expected to be freed up by the so-called “digital dividend”. Some aspects of the digital transition are expected to result in a reduction in the ability of radio astronomers to make use of the terrestrial television broadcast bands for observations that are currently conducted on an unprotected basis (see Fig. 2). Some aspects may improve the ability to make passive observations in the TV bands.

FIGURE 1

Distribution of planned digital TV transition, by technology.
Areas in gray have no current plans for digital TV transition

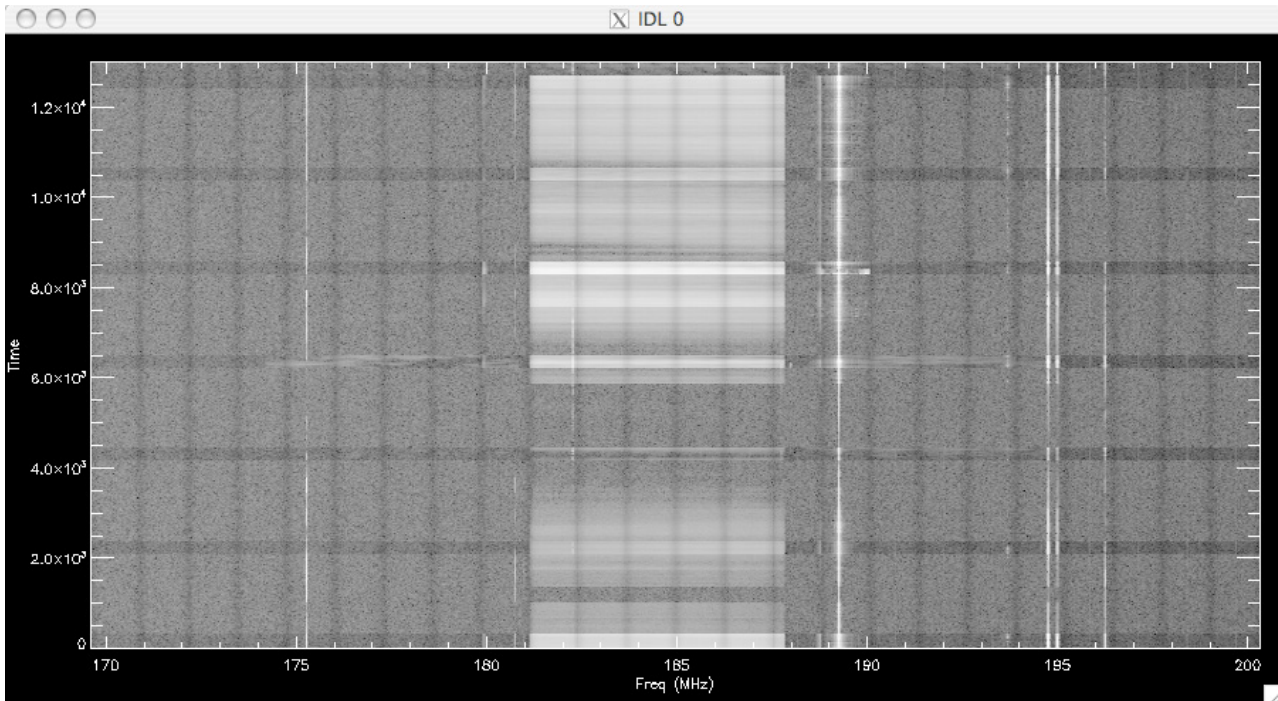


Report RA.2195-01

FIGURE 2

An example of the impact of digital TV signals compared to analogue TV. The spectra were obtained at a radio astronomy site during a brief period of highly enhanced propagation.

**The TV signals are originating from approximately 290 km away.
The digital signal from 181-188 MHz “fills” the spectrum much more substantially than the analogue TV signals occupying 174-181, 188-195, and 195-202 MHz, whose spectra are concentrated in discrete video, chrominance, and audio carriers**



Report RA.2195-02

Annex 1 summarizes the plans for the transition to digital television for several countries around the world with current radio astronomy programmes operating within bands used for terrestrial television broadcasting, and for countries of strategic importance to future radio astronomy stations presently under design and development that intend to utilize such bands. The impact of service rules for digital television on the use of the television broadcast bands for radio astronomy is discussed.

The material in this report is specific to the impact of the digital transition on the radio astronomy service. A more general introduction to the transition to digital TV is available in Report ITU-R BT.2140 – Transition from analogue to digital terrestrial broadcasting.

Annex 1

Transition from analogue to digital television broadcasting

The following sections summarize those aspects of the transition to digital television that may impact the opportunistic use of the television broadcast bands for radio astronomy.

1 Australia

1.1 Date of transition

The Australian Government has announced a programme to switchover from analogue to digital transmissions and that it will be “completing the switchover by 31 December 2013”.

1.2 Frequency allocations and assignments

In the Australian Radiofrequency Spectrum Plan (ARSP) VHF bands I (45-70 MHz), II (85-108 MHz) and III (137-144/174-230 MHz) as well as UHF bands IV (520-582 MHz) and V (582-820 MHz) have a primary allocation to the broadcasting service.

Digital television has been planned for operation within existing allocated broadcasting services bands in bands III (174-230 MHz), IV (526-582 MHz) and V (582-820 MHz).

Australian terrestrial television broadcasting services have been planned on a 7 MHz channel raster in both VHF and UHF bands.

1.3 Transmission spectrum mask and the maximum permitted power level of spurious emission or unwanted emission

Technical aspects of the planning and protection of the broadcasting service are based upon information contained in Recommendation ITU-R BT.1368 (for digital systems) and Recommendation ITU-R BT.470 (for analogue systems). Further details are contained in the Australian Communications and Media Authority's (ACMA) *Broadcasting Services (Technical Planning) Guidelines 2007*¹. These guidelines are supplemented by more detailed information contained in the ACMA *DTTB Planning Handbook*². A summary of differences between the Australian digital terrestrial television service planning assumptions and the data contained in Recommendation ITU-R BT.1368 are as follows.

Australian planning for both analogue and digital terrestrial television is based on an assumption of fixed reception using outdoor receiving antennas. Therefore protection ratios relevant to Ricean channels are used where available. The DVB-T mode 64-QAM with 2/3 FEC and a 1/8 guard interval has been adopted as the basis for digital television planning, however to achieve a higher picture quality for SD/HD simulcast, a number of broadcasters have selected 64-QAM with 3/4 FEC and a 1/16 guard interval.

¹ Refer http://www.acma.gov.au/WEB/STANDARD/pc=PC_90249.

² Refer http://www.acma.gov.au/WEB/STANDARD/pc=PC_91853.

Protection ratios for digital-digital and digital-analogue co-channel and adjacent channel interference from other television broadcasting services were first defined in July 1999. Only minor changes have been made to those original values. The values used in Australian planning are the same as the 64-QAM, 2/3 FEC values set out in Recommendation ITU-R BT.1368-7³.

Australia's planning for digital television services takes into account a legislated requirement that "... in SDTV digital mode in that area should achieve the same level of coverage and potential reception quality as is achieved by the transmission of that service in analogue mode in the same area". Following this approach, Australia's digital services are typically planned with a maximum e.r.p. of 6 dB less than same band analogue television services.

The operating radiated power levels of digital services across the VHF and UHF bands are chosen on the basis of addressing the coverage requirements of each transmitter. Radiated power levels of particular digital services in band III range up to 50 kW e.r.p. in metropolitan areas and up to 100 kW e.r.p. in some regional areas. Services in band IV have been planned with e.r.p. levels that range up to 500 kW e.r.p. and services in band V range up to 1.25 MW e.r.p. in regional areas.

Australian digital television planning is based on provision of a minimum median field strength level. The Australian planning values are reasonably close to the values that can be derived from the sample calculation value provided in Table 44 of Recommendation ITU-R BT.1368-7⁴.

The Australian values are higher than values that would be derived from the Recommendation. The difference is due to: inclusion of a 1 dB higher receiver noise figure allowance; use of 6.7 MHz rather than 7.6 MHz for the receiver bandwidth; and use of frequencies at the top rather than the middle of each band as the reference frequency for the calculation. The Australian minimum field-strength calculations also include a 1 dB "Interference margin" for the support of co-channel, frequency reuse planning.

Planning guidelines in Australia also specify minimum median field strengths (referred to a measurement height of 10 m above local terrain) for digital television services as shown in Table 1^{5, 6}.

TABLE 1
Minimum median field strength for DTTB Planning in Australia

Environment	Band III (dB(μV/m))	Band IV (dB(μV/m))	Band V (dB(μV/m))
Urban	66	71	74
Suburban	57	63	67
Rural	44	50	54

³ The original 1999 values were adopted following protection ratio measurements made in 1998 using the "traditional" wanted-to-wanted protection ratio measurement approach, rather than the more recent $C/(I+N)$ approach that appeared in Recommendation ITU-R BT.1368-1 (and later revisions).

⁴ Australian planning is based on provision of a service at 80% of locations within 200 m by 200 m areas. A 4.5 dB correction factor is applied to convert from a 50% of locations to an 80% locations field strength value.

⁵ Refer http://www.acma.gov.au/WEB/STANDARD/pc=PC_91853.

⁶ Field strength values used here apply to 7 MHz channel bandwidths.