



**TRIAL OF WHITE SPACE TECHNOLOGY
ACCESSING VHF AND UHF BANDS IN SINGAPORE**

Test Plan

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1 Introduction

1.1 The White Space Technology Test Plan described in this document is in support of the effort of the Info-communications Development Authority (“IDA”) to encourage the trial of white space technology in Singapore. The results of the white space technology and device tests are intended to assist the IDA in its assessment of the impact of allowing low power radio transmitting devices – such as TV Broadcast Devices (“TVBDs”) – access to parts of the radio spectrum that are currently allocated for use, on a primary basis, for the provision of terrestrial broadcast.

1.2 The term “white space” relates to those parts of the television broadcast radio spectrum, which in a given location or any given time remains unused for broadcast television. These white spaces consist of both interleaved and contiguous blocks of spectrum and could be considered for use by new technology such as cognitive radio system technologies.

1.3 An issue with using white spaces in this manner is how to ensure that the white space devices operate only in the unoccupied frequencies or channels and within the limits imposed on the transmission parameters. If they fail to do so, interference may be caused to licensed users in Singapore and the neighbouring countries. To prevent this, it is necessary for the TVBDs to:

- a) determine the presence of a licensed user (TV signal); and
- b) transmit at a power level that will not cause interference to licensed services.

This test plan sets out a series of measurements on TVBDs, which aim to determine whether it is possible to allow the operation of white space devices in the unoccupied frequencies or channels without causing any interference to other licensed users in these bands/channels.

1.4 To achieve this, the IDA hopes to assess the merits of different techniques employed by TVBDs to determine the presence of a TV signal or wireless microphone. Options addressed within this plan include:

- a) spectrum sensing; and
- b) geo-location databases (using pre-defined frequency and location information for licensed services).

Any alternate method(s) to determine the presence of TV channels or wireless microphones should also be given full consideration.

2 TV Band Incumbent Users

LICENSED USERS

2.1 The Very High Frequency (“VHF”) spectrum between 174 to 230 MHz and the Ultra High Frequency (“UHF”) spectrum between 494 to 790 MHz are allocated for the provision of broadcast services. The predominant users of the band are television broadcasters, although Channel 7 between 188 to 195 MHz is occupied by digital radio broadcasting services.

2.2 As described above, the broadcast service uses both the VHF and UHF radio frequencies. The specific channels occupied by these services are further described in the table below.

Channel	Country	Operator	Station
5	Singapore	MediaCorp TV Holdings	Channel 5
8	Singapore	MediaCorp TV Holdings	Channel 8
12	Singapore	MediaCorp TV Holdings	Suria
24	Singapore	MediaCorp TV Holdings	Vasantham
28	Singapore	MediaCorp TV Holdings	Channel U
29	Singapore	MediaCorp TV Holdings	Channel 5, Channel 8, Channel U and Channel NewsAsia
30	Singapore	MediaCorp	Okto
32	Singapore	MediaCorp	Channel NewsAsia
37	Singapore	MediaCorp	TV Mobile
38	Singapore	MediaCorp	HD5

2.3 In the VHF band, each channel occupies a 7 MHz bandwidth and the television channels are broadcast using the PAL-B standard.

2.4 In the UHF band, each channel occupies an 8 MHz bandwidth. Analogue TV channels are broadcasting using the PAL-G standard. Digital channels (29, 37, and 38) are transmitted using the DVB-T standard.

Channel	Country	Operator	Station
7B	Singapore	Mediacorp (Smart Radio)	Y.E.S 93.3, Class 95, Symphony 92.4, NewsRadio 93.8
7C	Singapore	Mediacorp (Smart Radio)	Y.E.S 93.3, Class 95, Perfect 10 98.7, Ria

2.5 Radio channels in the VHF band are broadcasting using the DAB-T standard. The DAB Block 7B carrier frequency is centred on 190.64 MHz, and the DAB Block 7C frequency is centred on 192.352 MHz. **TVBDs are not permit to transmit in Channel 7 of the VHF band.**

UNLICENSED USERS

2.6 In the 470 – 806 MHz band, wireless microphones operate on a secondary basis without causing interference to, nor seeking protection from, the broadcast service. Wireless microphones occupy the UHF bands, and use either analogue or digital technology. Analogue devices occupy 200 kHz channels, while digital devices occupy 200, 400, or 600 kHz channels¹. As secondary users, professional wireless microphones will not receive protection from TVBDs during the trial.

3 Protection Criteria

3.1 This test plan considers two methods to determine the presence of existing users within a channel. These are:

- a) spectrum sensing; and
- b) geo-location databases.

3.2 The TVBD devices must operate within the technical parameters defined below. Companies conducting TVBD technology trials must declare that their TVBDs used during the tests are compliant with these parameters, and are responsible for on-going compliance with regard to their use of permitted frequencies and operation within the limits placed on power levels.

TVBD Parameter for Detection	Value
Sensitivity (assuming 0 dBi antenna)	-120dBm
Transmit Power	4dBm adjacent channel 17dBm (,N+2,...)
Transmit-power	100mW
Bandwidth	$N^2 \times 8\text{MHz}$
Out-of-band-performance	< -48dBm
Time between sensing	< 1 second
Maximum Continuous transmission	400 milliseconds
Minimum pause after transmission	100 milliseconds

TVBD Parameter for geo-location	Value
Location accuracy	< 50m
Transmit Power	As specified in database (up to 100mW)
Bandwidth	$N^3 \times 8\text{MHz}$
Out-of-band-performance	< -48dBm
TVBD Refresh rate	1 second
Database refresh rate	24 hours
Maximum Continuous transmission	400 milliseconds
Minimum pause after transmission	100 milliseconds

¹ ETSI EN 300 422

² N being the maximum number of contiguous channels that is identify by the white space devices.

³ N being the maximum number of contiguous channels that is identify by the white space devices.

SPECTRUM SENSING

3.3 TVBDs using sensing technology must be able to detect TV broadcast channels in the following radio bands:

- VHF Channels 2 – 12; and
- UHF Channels 21 – 62.

Spectrum sensing assumes that the TVBD scans available spectrum to determine which channels are occupied, if any. To do this the TVBD must be capable of detecting the presence of incumbent services with a sensitivity to signal levels of -120dBm .

GEO-LOCATION DATABASE

3.4 **For the purposes of the trial**, TVBDs using a geo-location database to determine the presence of occupied spectrum must mark the following Channels as occupied:

- VHF Channels 2 – 12; and
- UHF Channels 21 – 40, 50, 52 and 55 – 62.

TVBD TRANSMISSIONS

3.5 **For the purpose of the trial**, TVBDs must only transmit in the following channels:

- UHF Channels 41 – 49, 51, and 53 – 54.

4 Cognitive Radio Venue (CRAVE)

4.1 The cognitive radio field tests will be conducted at the following sites:

Test Site	Coordinates	Site Description
Kranji Carpark	1°26'16.14"N, 103°44'07.08"E	Singapore / Malaysian Coast
Marina South Pier	1°16'15.4"N, 103°51'47.6"E	Singapore / Indonesia Coast
Opposite Beauty World	1°20'38.79"N, 103°46'28.8"E	Mitigation near broadcast tower
Cairnhill Carpark	1°18'13.08"N, 103°50'12.0"E	Dense urban environment
Science Park II	1°17'14.39"N, 103°46'53.0"E	In-building environment

5 TEST MATRIX

5.1 The test matrix is developed with the objective of assisting IDA in assessing the possibility of allowing the use of white space devices in the unused spectrum of the broadcast bands. This test matrix will also allow IDA to assess the reliability of white space devices operating within the limits of the technical framework. The tests are intended for IDA’s evaluation of white space technology and do not determine the final framework that IDA might adopt.

5.2 IDA invites the industry to provide information that will be relevant to the test matrix so that the trials will yield results that will assist IDA in developing the final framework for the use of white space devices.

Test Description					Device Type			
Test No.	Description		Receive	Transmit	System	Sensing	Geo-DB	Other
Controlled Tests								
TV Signals								
1	A	Single TV signal detection	✓			✓		
	B	Single TV signal detection threshold	✓			✓		
	C	Two TV signal detection	✓			✓		
	D	Multiple TV signal detection	✓			✓		
	E	Transmission characteristics		✓		✓	✓	✓
	F	Listen-before-talk			✓	✓	✓	✓
	G	Detect-and-avoid			✓	✓	✓	✓
	H	TVBD interference to TV signals			✓	✓	✓	✓
Wireless Microphone Signals								
2	A	Wireless Microphone Detection	✓			✓		
	B	Interference		✓		✓	✓	✓
Operational Environment – Laboratory								
3	A	Listen-before-talk			✓	✓	✓	✓
	B	Detect-and-avoid			✓	✓	✓	✓
	C	On-the-air TV signal detection			✓	✓	✓	✓
	D	On-the-air TV signal detect-and-avoid			✓	✓	✓	✓
Field Tests								
TV Signals								
4	A	On-the-air TV signal detection	✓			✓		
	B	On-the-air TV signal detect-and-avoid			✓	✓	✓	✓
Wireless Microphone Signals								
5	A	Wireless microphone detection	✓			✓		
	B	Wireless microphone detect-and-avoid			✓	✓	✓	✓

6 TEST PLAN

Television Signal Related Tests			
Controlled Tests			
1)	a)	TV signal detection	
		<p><u>Test</u> Establish that the TVBD can detect a TV signal on any channel.</p>	<p><u>Method</u> Perform a single signal scanning test using a clean laboratory TV signal set to -28dBm.</p>
			<p><u>Process</u> Repeat the test with the DVB-T centred on a different channel each time. Repeat for all Channels: VHF: 2 – 12 UHF: 21 – 62</p>
	b)	TVBD Sensitivity	
		<p><u>Test</u> Establish the minimum signal level that can be detected by the TVBD under optimal conditions.</p>	<p><u>Method</u> Perform single scanning tests conducted with a 'clean' laboratory generated signal over a range of input signal power levels including the minimum sensing threshold of -120dBm as well as any different threshold claimed by the TVBD manufacturer.</p> <p>The scan should be conducted from Channel 2 to Channel 12 in the VHF band and from Channel 21 to Channel 62 in the UHF band.</p> <p>Record minimum sensing level of the TVBD under test. The power level of the 'clean' carrier should be reduced in steps of 0.5dB to determine the minimum sensing threshold of the TVBD under test.</p>
			<p><u>Process</u> Repeat scan 10 times with the 'clean' laboratory carrier set on the following channels: VHF: 2, 7, 12 (PAL-B) UHF: 21, 42, 62 (PAL-G and DVB-T)</p> <p>Repeat test with TVBD set to 5 different scanning rates</p>
	c)	Detection with Two DVB-T signals	
		<p><u>Test</u> Determine the sensitivity of the TVBD in the presence of two TV signals.</p>	<p><u>Method</u> This should be performed on both analogue and digital channels on the detection channel with the maximum detection threshold from Test 1)b), with the carrier signal level set to the minimum sensing level of the device from Test 1)b).</p> <p>Set the TVBD to the optimum scanning rate determined in Test 1)b).</p>
			<p><u>Process</u> Repeat the process with the second 'clean' TV signal on Channel N±1 and Channel N±2.</p> <p>Repeat test for: VHF: Analogue PAL-B UHF: Analogue PAL-G and Digital DVB-T</p>

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		<p>Apply a 'clean' signal to the TVBD on the test channel (Channel N). Set the power level of Channel N below to the minimum detection level recorded during with Test 1)b).</p> <p>Apply a second 'clean' TV signal to Channel N+1 at a high power level (-28dBm).</p> <p>Increase power level of Channel N until it is detected by the TVBD under test.</p> <p>Record minimum sensing level of the TVBD under test.</p> <p>To ensure the repeatability of this test, recorded signals should be used.</p>	
d)	Detection with Multiple DVB-T signals		
	<p><u>Test</u> Determine the sensitivity of the TVBD in the presence of multiple DVB-T signals.</p>	<p><u>Method</u> This should be performed on the detection channel with the maximum detection threshold from Test 1)b), with the carrier signal level set to the minimum sensing level of the device from Test 1)b).</p> <p>Set the TVBD to the optimum scanning rate determined in Test 1)b).</p> <p>Apply a 'clean' signal to the TVBD on the test channel (Channel N). Set the power level of Channel N below to the minimum detection level recorded during with Test 1)b).</p> <p>Apply a second 'clean' TV signal to Channel N+1 at a high power level (-28dBm).</p> <p>Apply a third 'clean' TV signal to Channel N-1 at a high power level (-28dBm).</p> <p>Increase power level of Channel N until it is detected by the TVBD under test.</p>	<p><u>Process</u> Repeat the process with the second and third 'clean' TV signals on Channels N±1, Channel N±2, Channel N+1 and Channel N-2, Channel N-1 and Channel N+2.</p> <p>Repeat test for: VHF: Analogue PAL-B UHF: Analogue PAL-G and Digital DVB-T</p>

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			Record minimum sensing level of the TVBD under test.	
	e)	Transmission Characteristics		
		<p><u>Test</u> Determine the transmission characteristics of a TVBD.</p>	<p><u>Method</u> The following operational parameters for each TVBD should be determined:</p> <ul style="list-style-type: none"> i. Tuning range (Hz) ii. Transmission bandwidth(s) (Hz). iii. Maximum power (W) iv. Minimum power (W) v. Range of dynamic power control (dB) vi. Step sizes of dynamic power control (dB) vii. Duration of continuous emissions (s) viii. Duration of pause between emissions (s) ix. Out-of-band emissions <ul style="list-style-type: none"> a. Position (Hz) b. Power level (Hz) c. Spectral signature 	<p><u>Process</u> Repeat process for all transmission bandwidths. Repeat scan 10 times with the TVBD transmit carrier set on the following channels: VHF: 2, 7, 12 UHF: 21, 42, 62</p>
	f)	Listen Before Talk (switch-on)		
		<p><u>Test</u> Test the TVBD's ability to detect the presence of TV signal(s) and begin transmitting on a free channel. Confirm Master / Slave operation where a geolocation database is used.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Apply a TV signal to 3 pre-selected and 3 single randomly selected test channels. Set the power level to the maximum sensing level recorded – for any channel - during Test 1)b). If necessary increase the power level in each channel until it is detected by the TVBD under test. Record the minimum sensing level for each channel for the TVBD under test. Activate TVBD transmission mode. Confirm that the TVBD has chosen a free transmission channel. Confirm operational parameters are consistent with those measured in Test 1)e).</p>	<p><u>Process</u> Repeat exercise 10 times using different randomly selected channels each time. Perform test using the following channels: VHF: 5, 8, 12 UHF: 38, 39, 40</p>

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g)	<p>Detect and avoid</p> <p><u>Test</u> Test the TVBDs ability to detect the presence of TV signal(s) and change transmitting frequency to a free channel.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Activate TVBD transmission mode.</p> <p>Apply a 'clean' TV signal to the TVBD on the channel used by the TVBD for transmission. Set the power level to the maximum detection level recorded during with Test 1) b).</p> <p>Confirm that the TVBD successfully manages to detect-and-avoid the TV signal. If necessary increase the power of the TV signal until it is detected by the TVBD.</p> <p>Measure the time taken from application of the TV signal until the TVBD changes to a free channel.</p>	<p><u>Process</u> Repeat process 10 times. Repeat process for:</p> <p>VHF: 5, 8, 12 (PAL-B) UHF: 21, 48, 62 (PAL-G and DVB-T)</p>
h)	<p>TVBD Interference to TV Signals</p> <p><u>Test</u> Test the impact of a TVBD signal on adjacent TV signals</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Apply 'clean' TV carriers to Channels N+1 and N+2 at power levels equal to the maximum sensing threshold from Test 1)b). Capture the spectral profile of the TV carriers.</p> <p>Apply TVBD transmission signal to Channel N at minimum power level. Capture the spectral profile of the TV carriers.</p> <p>Repeat the process across the full dynamic power range of the TVBD in step sizes equal to those defined by Test 1)e)vi) for the device.</p>	<p><u>Process</u> Repeat process with Channel N set to: VHF: 5, 8, 12 (PAL-B) UHF: 21, 48, 62 (PAL-G and DVB-T)</p>

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Wireless Microphone Related Tests			
Controlled Tests			
2)	a)	Sensitivity to wireless microphones	
		<p><u>Test</u> Determine the sensitivity of TVBD in presence of wireless microphone signals.</p>	<p><u>Method</u> Perform single scan with wireless microphone channel in the centre of Channel N, and at the channels edges.</p> <p>Adjust the wireless microphone power level to determine the TVBD sensitivity.</p> <p>This test should be performed wirelessly.</p>
			<p><u>Process</u> Repeat process 10 times. Repeat process for the following channels: UHF: 21, 48, 62</p> <p>Repeat process for analogue (200kHz) and digital (600kHz) systems. Repeat with 5 different scan rates.</p>
	b)	Interference to wireless microphones	
		<p><u>Test</u> Test the impact of TVBD signal on co-channel and adjacent channel wireless microphone.</p>	<p><u>Method</u> Apply Wireless Microphone carriers to Channels N, N+1 and N+2. Capture the spectral profile of the signals.</p> <p>Apply TVBD transmission signal to Channel N at minimum power level. Capture the spectral profile of the signals.</p> <p>Repeat the process across the full dynamic power range of the TVBD in step sizes equal to those defined by Test 1)e) vi) for the device</p>
			<p><u>Process</u> Repeat process with TVBD in 25 different locations with regard to wireless microphone receiver. Measurements should include cases with TVBD in same room, in adjacent room, on different floor, and if possible outside.</p> <p>Repeat process for the following channels: UHF: 21, 48, 62</p> <p>Repeat process for analogue (200kHz) and digital (600kHz) systems. Repeat with 5 different scan rates.</p>

Operational Environment related Tests			
3)	a)	Listen Before Talk (switch-on)	
		<p><u>Test</u> Test the TVBDs ability to detect the presence of TV and wireless microphone signal(s) and begin transmitting on a free channel.</p> <p>Confirm Master / Slave operation where a geolocation database is used.</p>	<p><u>Method</u> Apply a TV signal to 3 pre-selected and 3 randomly selected test channels. Set the power level to the maximum sensitivity level recorded during with Test 1)b).</p> <p>Apply wireless microphone signals to 3 randomly selected test channels. Set the</p>
			<p><u>Process</u> Repeat exercise 10 times using different randomly selected channels each time.</p> <p>Repeat for analogue (200kHz) and digital (600kHz) wireless microphones. Repeat for using the following pre-selected TV channels:</p>

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		<p>power level to the maximum sensitivity level recorded during with Test 3)a).</p> <p>Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Confirm that TVBD under test has successfully detected the presence of TV and wireless microphone signals. If necessary increase the power levels of the TV and wireless microphone signals. Record the sensing level for each TV and wireless microphone signal for the TVBD under test.</p> <p>Activate TVBD transmission mode. Confirm that the TVBD has chosen a free transmission channel. Confirm operational transmit parameters are consistent with those measured in Test 1)e).</p>	<p>VHF: 5, 8, 12 (PAL-B) UHF: 21, 48, 62 (PAL-G and DVB-T)</p>	
	b)	<p>Detect and avoid</p>		
		<p><u>Test</u> Test the TVBDs ability to detect the presence of TV signal(s) and wireless microphone signals and change transmitting frequency to a free channel.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Activate TVBD transmission mode.</p> <p>Apply a TV signal to 3 pre-selected and 3 randomly selected test channels. Set the power level to the maximum sensitivity level recorded during with Test 1)b).</p> <p>Apply wireless microphone signals to the Channel occupied by the TVBD under test. Set the power level to the maximum sensitivity level recorded during with Test 3)a).</p> <p>Confirm that TVBD under test has successfully detected the presence of the wireless microphone signal and moved to a</p>	<p><u>Process</u> Repeat exercise 10 times using different randomly selected channels each time.</p> <p>Repeat for analogue (200kHz) and digital (600kHz) wireless microphones. Repeat for using the following pre-selected TV channels: VHF: 5, 8, 12 (PAL-B) UHF: 21, 48, 62 (PAL-G and DVB-T)</p>

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			<p>free channel. If necessary increase the power levels of the TV and wireless microphone signals.</p> <p>Record the sensing level for the wireless microphone signal for the TVBD under test.</p> <p>Measure the time taken from application of the wireless microphone signal for the TVBD under test to change to a free channel.</p>	
	c)	Sensitivity to on-the-air TV		
		<p><u>Test</u> Assess TVBD sensitivity to on-the-air TV channels.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Identify available on-the-air TV channels. Identify analogue and DVB-T channels with lowest receivable signal level (above threshold identified for TVBD in Test 1)b). Initiate scan to determine if TVBD can detect the presence of on-the-air TV channels.</p>	<p><u>Process</u> Repeat process with TVBD set at 5 different scan rates.</p>
	d)	Interference to on-the-air TV		
		<p><u>Test</u> Assess the impact of a TVBD signal on on-the-air TV channels.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Identify available on-the-air TV channels. Identify TV Channel with lowest receivable signal level (above threshold identified for TVBD (in Test 1)b). Capture spectral profile of TV signals. Activate TVBD transmission signal at maximum power setting. Capture spectral profile of TV signal.</p>	<p><u>Process</u> Repeat process with TVBD in 25 different locations with regard to TV receiver. Measurements should include cases with TVBD in same room, in adjacent room, on different floor, and if possible outside). Repeat process with TVBD transmission in both VHF and UHF band. Confirm that the TVBD has successfully managed to detect and avoid on-the-air TV channels.</p>

Television Signal Related Tests				
Field Tests				
4)	a)	Sensitivity to on-the-air TV		
		<p><u>Test</u> Assess TVBD sensitivity to on-the-air TV channels.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for test 4)a) and b). Identify available on-the-air TV channels. Use a spectrum analyser to measure the signal level of available on-the-air TV channels. Initiate scan and determine if TVBD can detect the presence of on-the-air TV channels.</p>	<p><u>Process</u> Repeat for all CRAVE identified for DTT tests.</p>
	b)	Interference to on-the-air TV		
		<p><u>Test</u> Assess the impact of a TVBD signal on on-the-air TV channels.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 1)b). Identify available on-the-air TV channels. Use a spectrum analyser to capture the spectral profile and power level of all on-the-air TV signals. Activate TVBD in transmission. Capture spectral profile of TV signals. Confirm that the TVBD has successfully managed to detect-and-avoid on-the-air TV signals.</p>	<p><u>Process</u> Repeat process with TVBD in 25 different locations with regard to TV receiver. Measurements should include cases with TVBD in same room, in adjacent room, on different floor, and if possible outside). Repeat for all CRAVE identified for DTT tests.</p>

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Wireless Microphone Related Tests				
Field Tests				
5)	a)	Sensitivity to wireless microphones		
		<p><u>Test</u> Determine the sensitivity of TVBD in presence of wireless microphone signals.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 2)a). Identify presence of wireless microphone signals. Use a spectrum analyser to capture the spectral profile and power level of signals. Initiate scan and determine if TVBD can detect the presence of on-the-air TV channels.</p>	<p><u>Process</u> Repeat for all CRAVE identified for wireless microphone tests.</p>
	b)	Interference to wireless microphones		
		<p><u>Test</u> Determine impact of TVBD transmissions on wireless microphones.</p>	<p><u>Method</u> Set TVBD scan rate to that which yielded maxim successful detections for Test 2)a). Identify presence of wireless microphone signals. Use a spectrum analyser to capture the spectral profile and power level of signals. Initiate TVBD in transmission mode. Use a spectrum analyser to capture the spectral profile and power level of signals. Assess the TVBDs ability to detect and avoid on-the-air TV signals.</p>	<p><u>Process</u> Repeat process with TVBD in 25 different locations with regard to TV receiver. Measurements should include cases with TVBD in same room, in adjacent room, on different floor, and if possible outside). Repeat at all CRAVE identified for wireless microphone tests.</p>

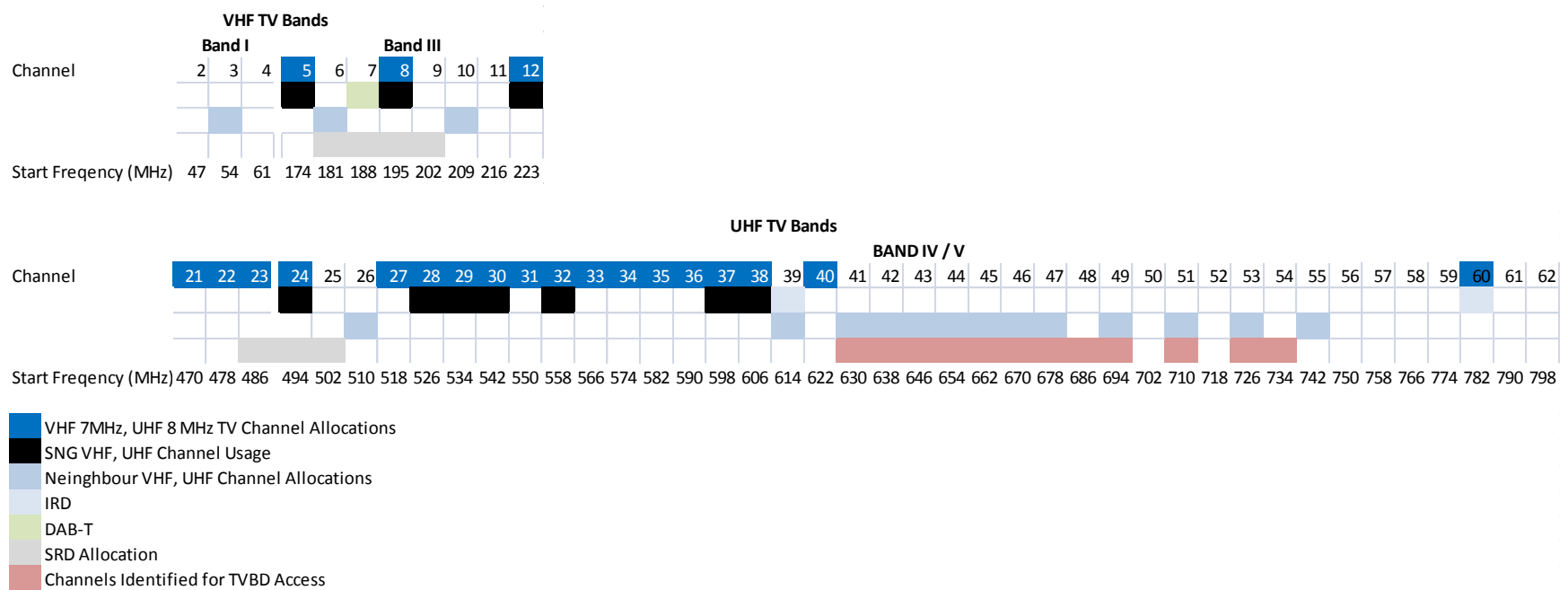
ANNEX

Spectrum Environment

The chart below details all broadcast signals identified in Singapore.

It should be noted that those VHF and UHF channels allocated to Singapore require protection from TVBDs, those allocated to neighbouring countries do not.

However, TVBDs operation in Singapore must not cause interference to broadcast services within the territories of Malaysia or Indonesia.



Singapore TV Broadcast Channels

Channel	Country	Operator	Station	Transmitter Location
5	Singapore	MediaCorp TV Holdings	Channel 5	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
8	Singapore	MediaCorp TV Holdings	Channel 8	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
12	Singapore	MediaCorp TV Holdings	Suria	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
24	Singapore	MediaCorp TV Holdings	Vasantham	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
28	Singapore	MediaCorp TV Holdings	Channel U	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
29	Singapore	MediaCorp TV Holdings	Channel 5, Channel 8, Channel U and Channel NewsAsia	Bedok, Bukit Batok, Senoko, Westin Stamford
30	Singapore	MediaCorp	Okto	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
32	Singapore	MediaCorp	Channel NewsAsia	Bukit Batok (01°, 21' 07"N, 103° 45' 57")
37	Singapore	MediaCorp	TV Mobile	Alexandra Point, Bedok, Bukit Batok, Hougang, Pasir Ris, Senoko, Tampines, Toa Payoh, Westin Stamford, Yishun
38	Singapore	MediaCorp	HD5	Bukit Batok (01°, 21' 07"N, 103° 45' 57")

Malaysian and Indonesian TV Broadcast Channels

Channel	Country	Operator	Station	Transmitter Location
3	Malaysia	RTM	TV1	Gunung Palai (01° 36' 12"N, 103° 32' 50"E)
6	Indonesia	TVRI	TVRI	
10	Malaysia	RTM	TV2	Gunung Palai (01° 36' 12"N, 103° 32' 50"E)
26	Malaysia	Sistem TV	TV3	Gunung Palai (01° 36' 12"N, 103° 32' 50"E)
39	Indonesia	PT Semenanjung Televisi Batam	STV	Jalan Palapa 2, Sekupang, Batam (01°07'12"N, 103°57'12"E)
41	Indonesia	PT Cipta Televisi Pendidikan	TPI	Jalan Ir. Sutami, Sekupang, Batam (01°07'12"N, 103°57'12"E)
42	Malaysia	Nat Seven sdn bhd	Ntv7	Gunung Palai (01° 36' 12"N, 103° 32' 50"E)
43	Indonesia	PT Rajawali Citra Televisi Indonesia	RCTI	Batam (01° 7' 45"N, 103° 56'03"E)
44	Malaysia	Sistem TV	Tv9	Gunung Palai (01° 36' 12"N, 103° 32' 50"E)
45	Indonesia	PT Televisi Tranformasi Indonesia	Trans TV	Jalan Palapa 2, Sekupang, Batam (01°07'12"N, 103°57'12"E)
46	Malaysia	Metropolitan TV sdn bhd	8TV	Gunung Palai (01° 36' 12"N, 103° 32' 50"E)
47	Indonesia	PT Surya Citra Televisi	SCTV	Batu Ampar, Batam (01° 10'44"N, 104° 00'48"E)
49	Indonesia	PT Indosiar Visual Mandiri	Indosiar	
51	Indonesia	Riau Pos Group	Bata TV	Batam (01° 7' 45"N, 103° 56'03"E)
53	Indonesia	PT Cakrawala Andalas Televisi	AnTEVE	Batam (01° 7' 45"N, 103° 56'03"E)
55	Indonesia	PT Media Televisi Indonesia	Metro TV	Batam (01° 7' 45"N, 103° 56'03"E)