
RADIO SPECTRUM MASTER PLAN



IDA RSMP
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INTRODUCTION

Radio frequency spectrum is a scarce resource and is essential for radio-communications, which are deployed as means to communicate with moving objects or to substitute landlines in telecommunication systems. Efficient usage of frequency spectrum is therefore important to ensure that maximum radio-communications can be operated within limited frequency bands without mutual interference.

Traditionally, regulations on the use of spectrum are done at two levels:

- (a) Worldwide level by International Telecommunications Union (ITU) through its Radio Regulations, which among other things, prescribe frequency allocations for various services; and
- (b) National level by telecommunication regulatory bodies which set requirements and conditions for services operating within countries and in line with the overall framework of ITU Radio Regulations.

SPECTRUM ALLOCATION PLAN

In Singapore, IDA as the telecommunication regulator, is charged with the responsibility of administering frequency management matters. The responsibility includes drawing up frequency allocation plans for various services, coordinating frequency assignments with neighbouring countries, monitoring spectrum usage and resolving radio interference. **Annex 1** provides an overview of existing and planned services within the spectrum plan as well as the priority for review on an on-going basis.

SPECTRUM ALLOCATION MECHANISM

IDA allocates spectrum using two methods, namely administrative-based and market-based (e.g. via auction). For frequency bands where there is strong market demand for spectrum to provide public radio-communication services, an auction is typically used to set a market-based price for using the frequencies. Otherwise, for administrative allocations, a fee is imposed to recover the costs incurred in administering the use of spectrum such as frequency coordination, radio monitoring, interference investigations and frequency database management. The cost-based fees take into account the occupied bandwidth and the nature of frequency usage (e.g. exclusive or shared-use). To ensure the optimal use of the scarce spectrum resource, IDA will be looking at setting fees in frequency bands which are congested or potentially congested, according to the opportunity cost of spectrum (i.e. Administrative Incentive Pricing).

SPECTRUM ALLOCATIONS FOR WIRELESS SERVICES

MOBILE SERVICES

(a) Public Cellular Mobile Telecommunication Services

Frequency Range	Existing/Planned Systems	Status
880-890 MHz/925-935 MHz	EGSM / 3G Cellular Mobile Services (FDD)	Partially assigned
890-915 MHz/935-960 MHz	GSM900 / 3G Cellular Mobile Services (FDD)	Fully assigned
1710-1785 MHz/1805-1880 MHz	GSM1800 / 4G	Fully assigned
1885-1900 MHz	Cordless Systems / (3G Cellular Mobile Services (TDD) when necessary)	Currently used by DECT
1900-1904.9 MHz	3G Cellular Mobile Services (TDD)	Not assigned
1904.9-1920 MHz	3G Cellular Mobile Services (TDD)	Fully assigned
1920-1979.7MHz/ 2110.3-2169.7MHz	3G Cellular Mobile Services (FDD)	Fully assigned
2010-2025 MHz	3G Cellular Mobile Services (TDD)	Not assigned
2300-2350 MHz	WBA Services	Not assigned
2500-2690 MHz	WBA Services / (4G Cellular Mobile Services (TDD / FDD) when necessary)	Partial assigned

EGSM/GSM900 Band

The GSM900 spectrum band has been fully assigned to SingTel Mobile Pte Ltd (STM) and M1 Limited (M1). IDA has also assigned the Extended GSM band (882-887 MHz / 927-932 MHz) to StarHub Mobile Pte Ltd (SHM). With the growing of mobile data demands, IDA has approved the implementation of 3G services over the EGSM/GSM900 spectrum band.

The allocation of the GSM900 band is as follows:

Frequency Range (900 MHz)	Operators
890 – 900 MHz / 935 – 945 MHz	M1
900 – 915 MHz / 945 – 960 MHz	STM

GSM1800 Band

The spectrum within the GSM1800 band is fully assigned. STM, M1 and SHM are currently the occupants of this band offering GSM1800 and dualband services. STM, SHM and M1 are allocated with a total spectrum of 2 x 25 MHz each.

The allocation of the GSM 1800 band is as follows:

Frequency Range (1800 MHz)	Operators
1710-1735 MHz/1805-1830 MHz	STM
1735-1760 MHz/1830-1855 MHz	SHM
1760-1785 MHz/1855-1880 MHz	M1

The existing 2G Spectrum Rights will be expiring on 31 March 2017. IDA has approved the implementation of 4G services over the GSM1800 spectrum band, and is currently reviewing the assignment framework for GSM900 band to ensure the most efficient use for the spectrum.

3G Bands

ITU has identified the following spectrum for the implementation of 3G services:

- (i) 1920-1980 MHz/2110-2170 MHz (FDD)
- (ii) 1885-1920 MHz (TDD)
- (iii) 2010-2025 MHz (TDD)

In April 2001, IDA issued three 3G spectrum licenses to STM, M1 and SHM respectively, with each operator allocated 2 x 15 MHz of paired spectrum from 1920-1964.9 MHz/2110.3-2154.9 MHz (FDD) and 5 MHz of unpaired spectrum from 1904.9-1920 MHz (TDD) to roll out its services.

In October 2010, IDA issued the remaining 2 x 14.8 MHz of paired spectrum from 1964.9-1979.7 MHz / 2154.9-2169.7 MHz (FDD) to the three operators. STM and M1 were each allocated 2 x 5 MHz of paired spectrum and SHM was allocated 2 x 4.8 MHz of paired spectrum. Currently, there is

only one lot available for 3G spectrum, which is a single 5 MHz band from 1899.9-1904.9 MHz (TDD).

As for the 2010-2025 MHz spectrum band, there is currently no demand from the operators. IDA is aware of the potential use of this band such as pairing up the 2010-2025 MHz spectrum band with parts of 2570-2620 MHz for FDD services. IDA welcomes proposals from the industry in utilising this band for other innovative uses.

The existing 3G Spectrum Rights will be expiring on 31 December 2021. IDA is reviewing the assignment framework and prepared to allow 4G deployment, to ensure the most efficient use for the spectrum.

Wireless Broadband Access (WBA) / 4G Bands

To increase Singapore's broadband offerings and competition in the local broadband market, IDA awarded the below spectrum lots in 2005.

Frequency Range	Existing / Planned System	Status
2300-2350 MHz	Wireless Broadband Access	Not assigned
2500-2690 MHz	Wireless Broadband Access / 4G	Partially assigned

IDA has re-allocated the WBA spectrum band for 4G services in 2014. The current wireless broadband and 4G services spectrum allocations are as follow:

Frequency Range	Existing/Planned Systems	Operators
2500-2520 MHz/ 2620-2640 MHz	4G (FDD)	SHM
2520-2540 MHz/ 2640-2660 MHz	4G (FDD)	M1
2540-2560 MHz/ 2660-2680 MHz	4G (FDD)	STM
2564-2570 MHz 2570-2600 MHz	Wireless Broadband Access	SHM

Future IMT Spectrum Bands

The framework of standards for International Mobile Telecommunications (IMT) encompasses IMT-2000 (3G) and IMT-Advanced (4G), and will continue to evolve as 5G with "IMT for 2020 and beyond". The bands that have been identified by ITU for International Mobile Telecommunications (IMT) as at January 2012 are as followed:

- (i) 450-470 MHz
- (ii) 610-790 MHz
- (iii) 698-960 MHz
- (iv) 1710-2025 MHz
- (v) 2110-2200 MHz
- (vi) 2300-2400 MHz
- (vii) 3400-3600 MHz

IDA's primary interest is to give flexibility for 4G services to operate within band (i), (iii), (v) and (vi) while ensuring such services will not interfere with other services, such as, satellite or radar in the adjacent bands. IDA will take appropriate measures to ensure that there is adequate lead time for existing services to migrate to other alternative modes of reception when the needs arise.

(b) Trunked Radio Services

Frequency Range	Existing/Planned Systems	Status
380-400 MHz	TETRA	Mostly assigned
400-410 MHz	Land Mobile Radio	Mostly assigned
410-430 MHz	Digital Trunked Radio	Fully assigned
440-450 MHz	Land Mobile Radio	Mostly assigned
806-823 MHz/851-868 MHz	Digital Trunked Radio	Mostly assigned

One key feature of the trunked radio is the ability to make one-to-many group calls which are crucial for operations that require information to be verbally communicated to all field staff in different locations simultaneously. Trunked networks are also able to support narrow-band data services.

FIXED SERVICES

(a) Point-to-Point Fixed Links

Frequency Range	Channelling Plan	Sharing with Fixed Satellite Services (FSS)
5925-6425 MHz	ITU-R F. 383	FSS (Uplink)
6425-7125 MHz	ITU-R F. 384	FSS (Uplink)
7125-7725 MHz	ITU-R F. 385	FSS (Downlink)
7725-8500 MHz	ITU-R F. 386	FSS (Uplink)
10.15-10.68 GHz	ITU-R F. 1568	-

Frequency Range	Channelling Plan	Sharing with Fixed Satellite Services (FSS)
10.7-11.7 GHz	ITU-R F. 387	FSS (Downlink)
12.2-12.7 GHz	ITU-R F. 746	FSS (Downlink)
12.75-13.25 GHz	ITU-R F. 497	
14.4-15.35GHz	ITU-R F. 636	
17.7-19.7 GHz	ITU-R F. 595	FSS (Downlink)
21.2-23.6 GHz	ITU-R F. 637	-

IDA has reserved the above spectrum bands for point-to-point fixed links which could serve as:

- Back-up backbone links between major exchanges or to link Singapore to off-shore islands or border areas of neighbouring countries;
- Links for local access networks to be provided by Facilities-Based Operators (FBOs);
- Links for broadcasters to perform outdoor broadcasting; and
- Links for use by government agencies.

Point-to-point fixed links are assigned individually, as it is possible to reuse frequency for different purposes with sufficient physical separation. IDA requires operators to justify the requirement of a fixed link in their applications and the actual spectrum allocated will depend on spectrum availability at the time of approval. Each point-to-point fixed link is subject to renewal by IDA on an annual basis. Generally, frequencies for point-to-point fixed links are also being co-allocated for Fixed Satellite Services (FSS).

(b) Other Fixed Services

ITU has identified 31.8-33.4 GHz, 37-40 GHz, 40.5-43.5 GHz, 51.4-52.6 GHz and 55.78-59 GHz for high-density applications in the fixed services (HDFS). The propagation condition and high degree of frequency reuse enable the use of frequency bands above 30GHz for high-density deployment of wireless point-to-point and point-to-multipoint systems. These bands are currently unoccupied and IDA will continue to monitor the developments in this area and the availability of equipment.

SATELLITE SERVICES

(a) Fixed Satellite Services (FSS)

Frequency Range	Uplink/Downlink
3400-4200 MHz	Downlink
4500-4800 MHz	Downlink
5850-7075 MHz	Uplink
7250-7750 MHz	Downlink
7900-8400 MHz	Uplink
10.7-11.7 GHz	Downlink
12.2-12.75 GHz	Downlink
13.75-14 GHz	Uplink
14-14.5 GHz	Uplink
17.3-18.1 GHz	Uplink
18.1-18.4 GHz	Downlink
18.4-19.3 GHz	Downlink

Fixed-satellite services (FSS) primarily involve communications between fixed earth stations via satellite, i.e. uplinks and downlinks. However, certain inter-satellite links and feeder links may also be established.

The frequencies to be used by each satellite network are coordinated by the respective satellite operators at bilateral/multilateral meetings, in accordance with the recommendations of the ITU. The satellite operators are responsible in ensuring the availability of frequencies for their networks through such concerted activities.

The fixed-satellite service in Singapore basically involves four spectrum bands, viz. 4-6 GHz, 7-8 GHz, 11-14 GHz and 17-19 GHz. Although numerous bands above 20 GHz are also allocated for fixed-satellite services, there are none presently in use.

Currently, companies in Singapore can select any fixed satellite network to set up communications to their remote overseas offices to provide point-to-point international leased circuit (ILC) connectivity using Very Small Aperture Terminal technology. This ILC can be used for telephone, data, fax, video-conferencing and other applications.

Fixed satellite bands can also be shared by other services, in particular terrestrial fixed services. The sharing criteria (e.g. the power flux density)

are recommended by ITU to ensure an acceptable level of mutual interference, if any.

(b) Broadcast-Satellite Service (BSS)

Broadcast-Satellite Service (BSS) is a radio communication service in which signals transmitted or retransmitted by space stations are intended for direct reception of information or programming by the user receivers. The BSS includes systems to deliver high definition television service (BSS-HDTV) and audio services (BSS-Sound). However, as the demand for such services in Singapore is minimal, IDA will monitor the situation to see if a portion of these bands could be used for other services.

(c) Mobile Satellite Services (MSS)

Mobile Satellite Service-Complementary Ground Component (MSS-CGC) is a ground-based infrastructure in a satellite network, which is used to enhance the satellite coverage in highly shadowed areas, such as urban areas and in-building coverage. Notwithstanding the use of satellite services in Singapore is not high, IDA is aware that the MSS-CGC could be an alternative to the traditional cellular mobile services.

BROADCASTING SERVICES

The planning and channelling of the broadcasting spectrum is carried out in international level (ITU), regional level (Asia-Pacific Broadcasting Union, ABU) and bilateral level (i.e. border coordination). As Broadcasting services are intended for high power and wide coverage, the use of spectrum requires close coordination with neighbouring countries. As such, there are only a certain number of channels in each broadcasting allocation that can be used in Singapore.

The usage plans for broadcasting services had already been established. With the advent of digital broadcasting, IDA has also planned the spectrum allocations for both digital audio and digital video broadcasting.

To provide broadcasting services, a license is required from Media Development Authority (MDA) of Singapore. The clearance on the broadcasting transmission station falls under the purview of IDA.

Service	Band (MHz)	Channel Bandwidth	Status
MW(Medium Wave)	0.5265-1.6065	10 kHz	Not assigned
SW (Short Wave)	5.95-21.85	10 kHz	Usage subject to coordination by ABU
FM (Frequency Modulation)	88-108	180 or 300kHz	Mostly assigned
TV (Television)	174-230	7 MHz	Fully assigned
	494-790	8 MHz	Mostly assigned
DAB (Digital Audio Broadcasting)	174-230	1.536 MHz	Not assigned
	1452-1492	1.536 MHz	Not assigned
DVB (Digital Video Broadcasting)	494-790	8 MHz	Mostly assigned
DBS (Direct Broadcasting Satellite)	11700-12200	27 MHz	Not assigned

(a) Digital Broadcasting Services

The introduction of digital broadcasting services provides an opportunity for IDA to review the current use of the broadcast spectrum. The switchover from analogue to digital broadcasting will free up spectrum that can be used for other services, such as mobile broadband services. Currently, IDA is coordinating with the neighbouring countries to re-plan the VHF and UHF bands for the digital broadcasting services and the possible new wireless services.

IDA notes that there are many competing uses for the freed spectrum such as cellular mobile, Public Protection Disaster Recovery, etc. It is with the public interest that this freed spectrum is efficiently managed, fulfilling the different needs in Singapore. Depending on the amount of freed spectrum, IDA will assess on how the spectrum should be used, taking into account the potential uses and their benefits for the public.

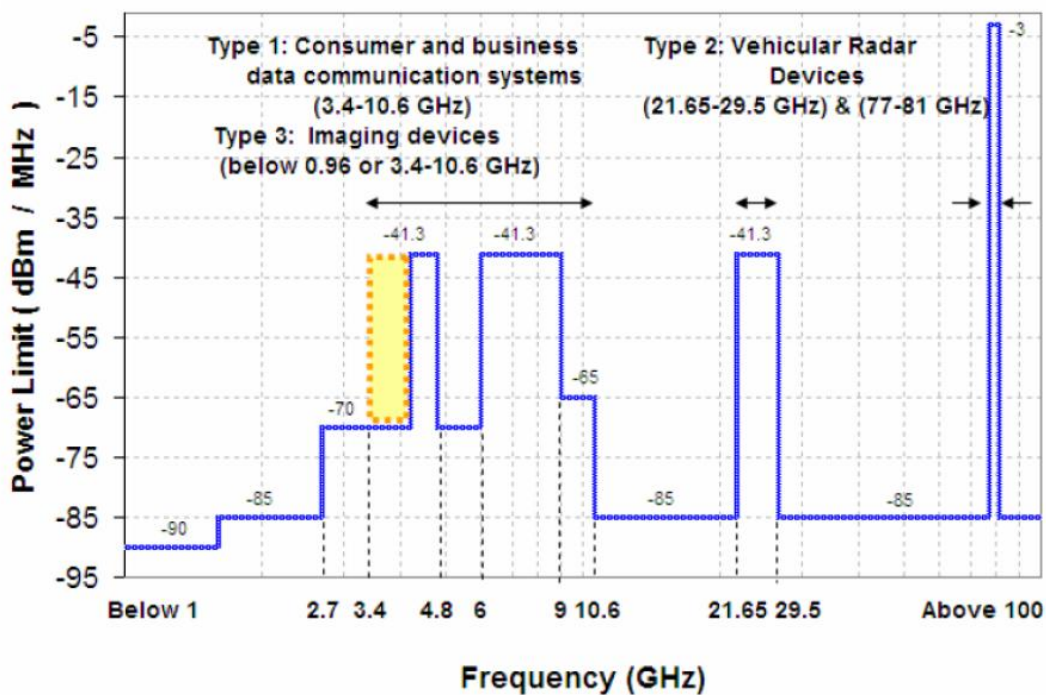
SHORT RANGE DEVICES

Short Range Devices (SRD) are devices which emit low power and have a limited distance of communication of about 30 m or less. Use of these devices is unlikely to cause interference to other services and is therefore allowed on a non-interference and non-protection basis. Over the years, IDA has opened up a number of frequency bands with limits of operating power for typical applications of SRDs. To facilitate use of these SRDs, users of these devices are exempted from obtaining licences from IDA.

Annex 3 shows the frequency bands and other technical details and typical applications of such SRD.

(a) Ultra Wideband (UWB)

UWB technology is used for short range, high bandwidth communications by transmitting information over a large bandwidth (> 500MHz) without interfering with other specific narrowband users. In September 2007, IDA established a regulatory framework for devices using UWB technology so that businesses and consumers may enjoy the benefits of this nascent technology. On 2nd January 2008, IDA allocated 3400-10600 MHz for devices using UWB technology on a licence-exempt basis¹. The figure shown below specifies the UWB emission mask for the operation of various devices as defined by IDA.



UWB Emission Mask

(b) Radio Local Area Networks (RLANs)/5GHz

Radio Local Area Networks (RLANs) include networks using IEEE802.11 and HiperLAN standards.

IDA has opened up 5150-5350 MHz, 5470-5725 MHz and 5725-5850 MHz for wireless access systems

¹ To be licence exempted, the devices will need to comply with the technical specifications

(c) Multi-Gigabit Wireless System (MGWS)

Multiple Gigabit Wireless System (MGWS) technology in the 60 GHz band is widely considered by the industry as one of the solutions for short range multi-gigabyte data rate applications. There are many possible low power applications for 60 GHz band such as the distribution of HD video content to wireless home entertainment systems and interactive multimedia services for home and office networking that transfer gigabytes of data between devices almost instantly.

The table below shows the summary of the spectrum allocations for MGWS.

Applications	Authorised Frequency Band	RF Output Power	Key Requirements
MGWS WPAN/WLAN	57 – 66 GHz	Not to exceed 40dBm EIRP (10W)	Indoor use is restricted to maximum mean EIRP density of 13 dBm/MHz Outdoor use is restricted to maximum EIRP of 25 dBm and maximum EIRP power spectral density of -2 dBm/MHz Must conform to EN 302 567

The spectrum plans covered in this paper primarily focus on frequency allocations for public radiocommunication services as well as for applications commonly required by corporate and individual users. As technology evolves and new services are introduced, additional spectrum bands may be identified and existing ones refarmed. In achieving an effective spectrum master plan, IDA welcomes industry's feedback on spectrum allocation and usage in Singapore and where necessary, will update its spectrum plan periodically to take into account the latest market trends and technology developments.

For any queries or clarifications, please refer to the following website www.ida.gov.sg.

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IDA's Spectrum Plan

Frequency Range	Existing/Planned Services	Priority for Review ²
0.5265-1.6065 MHz	Broadcasting Services	Low
5.95-21.85 MHz	Broadcasting Services	Low
88-108 MHz	Broadcasting Services	Low
174-230 MHz	Analogue Broadcasting Services	Low
174-230 MHz	Digital Broadcasting Services	High
380-400 MHz	Trunked Radio Services	Low
400-410 MHz	Land Mobile Radio	Medium
410-430 MHz	Digital Trunked Radio Services	High
440-450 MHz	Land Mobile Radio	Medium
494-790 MHz	Analogue Broadcasting Services	Medium
494-790 MHz	Digital Broadcasting Services	Medium
806-823 MHz/851-868 MHz	Digital Trunked Radio Services	Low
880-890/925-935 MHz	Cellular Mobile Services	Low
890-915 MHz/935-960 MHz	Cellular Mobile Services	Low
1452-1492 MHz	Broadcasting Services	Low
1710-1785 MHz/1805-1880 MHz	Cellular Mobile Services	Medium
1885-1900 MHz	Cordless Systems / Cellular Mobile Services	Medium
1899.9-1904.9 MHz	Cellular Mobile Services	Low
1904.9-1920 MHz	Cellular Mobile Services	Low
1920.9-1979.7 MHz/2110.3-2169.7 MHz	Cellular Mobile Services	Low
2010-2025 MHz	Cellular Mobile Services	Medium
2300-2350 MHz	Wireless Broadband Access	Low

² An indicative timeframe for spectrum review is 1-2 years for “high priority” spectrum bands, 2-4 years for “medium priority” spectrum bands and beyond 4 years for “low priority” spectrum bands.

Frequency Range	Existing/Planned Services	Priority for Review²
2400-2483.5 MHz	Short Range Devices	Low
2500-2690 MHz	Cellular Mobile Services	Low
3400-4200 MHz	Fixed Satellite Services	Low
3400-10600 MHz	Ultra-wideband (UWB) services	Low
4500-4800 MHz	Fixed Satellite Services	Low
5150-5350 MHz	Short Range Devices (RLANs)	Low
5470-5850 MHz	Short Range Devices (RLANs)	Low
5925-8500 MHz	Fixed / Fixed Satellite Services	Low
10.15-10.68 GHz	Fixed Services	Low
10.7-11.7 GHz	Fixed / Fixed Satellite Services	Low
12.2-12.7 GHz	Fixed / Fixed Satellite Services	Low
12.75-13.25 GHz	Fixed / Fixed Satellite Services	Low
13.75-14 GHz	Fixed Satellite Services	Low
14.4-15.35 GHz	Fixed	Low
17.7-19.7 GHz	Fixed / Fixed Satellite Services	Low
21.2-23.6 GHz	Fixed Services	Low
31.8-33.4 GHz	High Density Fixed Services	Medium
37-40 GHz	High Density Fixed Services	Medium
40.5-43.5 GHz	High Density Fixed Services	Medium
51.4-52.6 GHz	High Density Fixed Services	Medium
57-66 GHz	Multi Gigabit Wireless Systems	Low
55.78-59GHz	High Density Fixed Services	Low

Technical Requirements for SRDs

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength
Induction loop system IDA TS SRD	16 - 150 kHz	-	$\leq 66 \text{ dB}\mu\text{A/m @ 10m}$
	150 - 5000 kHz	-	$\leq 13.5 \text{ dB}\mu\text{A/m @ 10m}$
	6765 - 6795 kHz	-	$\leq 42 \text{ dB}\mu\text{A/m @ 10m}$
	7400 - 8800 kHz	-	$\leq 9 \text{ dB}\mu\text{A/m @ 10m}$
Radio detection, alarm system IDA TS SRD	0.016 - 0.150 MHz	-	$\leq 100 \text{ dB}\mu\text{V/m @ 3m}$
	13.553 - 13.567 MHz	-	$\leq 94 \text{ dB}\mu\text{V/m @ 10m}$
	146.35 - 146.50 MHz 240.15 - 240.30 MHz 300.00 - 300.30 MHz 312.00 - 316.00 MHz 444.40 - 444.80 MHz	$\leq 100 \text{ mWERP}$	-
Wireless Microphone IDA TS SRD	0.51 - 1.60 MHz	-	$\leq 57 \text{ dB}\mu\text{V/m @ 3m}$
	40.66 - 40.70 MHz	-	$\leq 65 \text{ dB}\mu\text{V/m @ 10m}$
	88.00 - 108.00 MHz	-	$\leq 60 \text{ dB}\mu\text{V/m @ 10m}$
	470.00 - 806.00MHz	$\leq 10 \text{ mWERP}$	-
Wireless Microphone, Hearing/Audio assistance aids IDA TS SRD	169.40 - 175.00 MHz	$\leq 500 \text{ mWERP}$	-
	180.00 - 200.00 MHz 487.00 - 507.00 MHz	-	$\leq 112 \text{ dB}\mu\text{V/m @ 10m}$
Remote control of garage door, cameras, toys and miscellaneous devices IDA TS SRD	26.96 - 27.28 MHz 34.995 - 35.225 MHz	$\leq 100\text{mWERP}$	-
	40.665 - 40.695 MHz 40.77 - 40.83MHz 72.13 - 72.21 MHz	$\leq 500\text{mWERP}$	

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength
Remote control of aircraft and glider models and machines, telemetry and alarm systems IDA TS SRD	26.96 - 27.28 MHz 29.70 - 30.00 MHz	≤ 500 mWERP	-
Medical and biological telemetry IDA TS SRD	0.009 – 0.315 MHz	-	≤ 30 dBμA/m @ 10m
	40.50 - 41.00 MHz	≤ 0.01 mWERP	-
	216.00 - 217.00 MHz	> 25 μWERP to ≤ 100 mWERP	-
	454.00 - 454.50 MHz	≤ 2 mWERP	-
	1427.00 - 1432.00 MHz	> 25 μWERP to ≤ 100 mWERP	-
	All frequencies	≤ 25 μWERP	-
Remote control of cranes and loading arms IDA TS SRD	170.275 MHz 170.375 MHz 173.575 MHz 173.675 MHz 451.75 MHz 452.00 MHz 452.050 MHz 452.325 MHz	≤ 1000 mWERP	-
On-site radio paging system IDA TS SRD	26.96 - 27.28 MHz 40.66 - 40.70 MHz	≤ 500 mWERP	-
	26.96 - 27.28 MHz 40.66 - 40.70 MHz	> 500 mWERP ≤ 3000 mWERP	-
	151.125 MHz 151.150 MHz	≤ 1000 mWERP	-
	151.125 MHz 151.150 MHz	> 1000 mWERP ≤ 3000 mWERP	-

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength
Wireless modem, data communication system IDA TS SRD	72.080 MHz 72.200 MHz 72.400 MHz 72.600 MHz 158.275/162.875 MHz 158.325/162.925 MHz 453.7250/458.7250 MHz 453.7375/458.7375 MHz 453.7500/458.7500 MHz 453.7625/458.7625 MHz	≤ 1000 mWERP	-
Short range radar systems such as automatic cruise control and collision warning systems for vehicle IDA TS SRD	76 - 77 GHz	≤ 37 dBm EIRP when vehicle is in motion ≤ 23.5 dBm EIRP when vehicle is stationery	-
Radio telemetry, telecommand system IDA TS SRD	433.05 - 434.79 MHz	≤ 10 mWERP	-
Radio telemetry, telecommand, RFID system IDA TS SRD	866 - 869 MHz 920 - 925 MHz	≤ 500 mWERP	-
	920 - 925 MHz	> 500 mWERP ≤ 2000 mWERP	-
Wireless video transmitter and other SRD applications IDA TS SRD	2.4000 - 2.4835 GHz	≤ 100 mWEIRP	-
	10.50 - 10.55 GHz	-	≤ 117 dB μ V/m @ 10m
	24.00 - 24.25 GHz	≤ 100 mWEIRP	-
Bluetooth IDA TS SSRD	2.4000 - 2.4835 GHz	≤ 100 mWEIRP	-
Wireless LAN only IDA TS SRD	2.4000 - 2.4835 GHz	≤ 200 mWEIRP	-
SRD applications IDA TS SRD	5.725 - 5.850 GHz	≤ 100 mWEIRP	-
Wireless LAN and broadband access	5.725 - 5.850 GHz	≤ 1000 mWEIRP	-

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength
only IDA TS SRD	5.725 - 5.850 GHz	> 1000 mWEIRP ≤ 4000 mWEIRP	-
Wireless LAN IDA TS SRD	5.150 - 5.350 GHz	> 100 mWEIRP ≤ 200 mWEIRP	-
	5.150 - 5.350 GHz	≤ 100 mWEIRP	
Wireless LAN and broadband access IDA TS SRD	5.470 - 5.725 GHz	≤ 1000 mWEIRP	-
MGWS WPAN/WLAN	57 - 66 GHz	≤ 10 WEIRP	-
Generic UWB Devices e.g. standalone or plug-in radio devices for host systems IDA TS UWB	Below 1.6 GHz	≤ - 90 dBm/MHz	-
	1.6 - 2.7 GHz	≤ - 85 dBm/MHz	-
	2.7 - 3.4 GHz	≤ - 70 dBm/MHz	-
	3.4 - 4.2 GHz	≤ - 70 dBm/MHz ³	-
	4.2 - 4.8 GHz	≤ - 41.3 dBm/MHz ⁴	-
	4.8 - 6.0 GHz	≤ - 70 dBm/MHz	-
	6.0 - 8.5 GHz ⁵	≤ - 41.3 dBm/MHz	-
	8.5 - 10.6 GHz	≤ - 65 dBm/MHz	-
	10.6 - 21.65 GHz	≤ - 85 dBm/MHz	-
	21.65 - 29.50 GHz	≤ - 41.3 dBm/MHz	-
	29.50 - 77.00 GHz	≤ - 85 dBm/MHz	-
	77.00 - 81.00 GHz	≤ - 3 dBm/MHz	-
Above 81.00 GHz	≤ - 85 dBm/MHz	-	
Automotive Short-Range (SRR)	21.65 - 26.65 GHz (6,7,8)	≤ - 41.3 dBm/MHz	-

³ UWB devices with mitigation techniques are allowed to operate at a level of -41.3dBm/MHz in the band from 3.4 to 4.2 GHz (with peak level emissions in the 50 MHz bandwidth not exceeding 0 dB e.i.r.p.). Otherwise, the emission level is capped at 70dBm/MHz.

⁴ To be replaced by more restrictive conditions beyond 31 Dec 2010.

⁵ The extension of this band from 6.0 to 9.0 GHz is also acceptable in the light of potential new applications.

⁶ The extension of this band from 21650 to 29500 MHz is acceptable.

⁷ For the 24050 to 24250 MHz range, narrow-band emission mode/component with a maximum peak power of 20dBm e.i.r.p and a duty cycle limited to 10% for peak emissions higher than -10dBm e.i.r.p is allowed.

⁸ Emission within the 23.6 GHz to 24 GHz band that appear 30° or greater above the horizontal plane shall be attenuated by at least 25dB up to year 2010 and 30dB up to 1 July 2013.

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength
systems that are vehicular radar systems intended for collision mitigation and traffic safety applications. IDA TS UWB	77.00 - 81.00 GHz	≤ - 3 dBm/MHz	-
Ground and Wall Probing Radar (GPR and WPR) systems ^{9,10} used in survey and detection application. IDA TS UWB	< 230 MHz	Please refer to UWB Emission Mask under “SHORT RANGE DEVICES” of the Master Plan.	
	230 - 1000 MHz		
	1000 - 1600 MHz		
	1600 - 3400 MHz		
	3400 - 5000 MHz		
	5000 - 6000 MHz		
	> 6000 MHz		

⁹ GPR and WPR imaging systems shall be designed to operate while in contact with or close to the ground or wall, and their emissions being directed into the ground.

¹⁰ GPR and WPR equipment shall have a deactivation mechanism to deactivate the equipment when normal use is interrupted.

Document Change History

Document Name:		Radio Spectrum Master Plan
Version	Date	Key Changes
1.0	Nov 2001	Baseline copy
2.0	22-Mar-2008	Amendments to Baseline copy
2.1	11-Apr-2008	Amendments to Annex 3 Inclusion of UWB Emission Mask (Page 12)
2.2	22-Apr-2008	Inclusion of 'Document Change History' Page as Annex 4
2.3	25-Apr-2011	Amendments to company address and contact email
2.4	30-November-2012	Amendments to Mobile Services, Fixed Services, Satellite Services, Broadcasting Services and Short Range Devices
		Amendments to Annex 2 - 3
		Removal of Annex 1
2.5	19 September 2013	Amendment to Mobile Services
2.6	10 January 2014	Amendment to Satellite and WBA Services
2.7	8 August 2014	Amendment to Mobile Services