
RADIO SPECTRUM MASTER PLAN



IDA RSMP
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INTRODUCTION

Radio frequency spectrum is a scarce resource. It is also an essential resource for radio-communications, which are deployed as a 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;
- (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, co-ordinating frequency assignments with neighbouring countries, monitoring spectrum usage and resolving radio interference. Shown in **Annex 1** is Singapore's Spectrum Allocation Chart. **Annex 2** 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 has two schemes to charge users for access to the radio spectrum, namely market-based charging (via auction) and cost-based charging. For frequency bands which are in scarce supply to meet the competing demand for provision of public radio-communication services, an auction is used to set a market-based charge for using the frequencies. Otherwise, a cost-based charge is set 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 (i.e. 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
824-835 MHz / 869-880 MHz	Digital Cellular Systems	Not assigned
880-890 MHz / 925-935 MHz	EGSM	Partially assigned
890-915 MHz/935-960 MHz	GSM900	Fully assigned
1444-1452 MHz/1492-1500 MHz	PDC	Not assigned
1710-1785 MHz/1805-1880 MHz	GSM1800	Partially assigned
1885-1900 MHz	Cordless Systems / (3G Cellular Mobile Services (TDD) when necessary)	Currently used by DECT.
1899.9-1904.9 MHz	3G Cellular Mobile Services (TDD)	Not assigned
1904.9-1920 MHz	3G Cellular Mobile Services (TDD)	Fully assigned
1920-1964.9MHz/ 2110.3-2154.9MHz	3G Cellular Mobile Services (FDD)	Fully assigned
1964.9-1979.7MHz/ 2154.9-2169.7MHz	3G Cellular Mobile Services (FDD)	Not assigned
2010-2025 MHz	3G Cellular Mobile Services (TDD)	Not assigned.
2500-2690 MHz	WBA Services / (3G Cellular Mobile Services (TDD / FDD) when necessary)	Re-planned for WBA services.

800 MHz & 900 MHz

The GSM900 spectrum band has been fully assigned to SingTel Mobile and M1. With the growing subscriber base of the two GSM900 networks and the impending introduction of GPRS for data services, IDA has approved the implementation of dualband by SingTel Mobile and M1.

Since the Master Plan was made known to the industry, there is little interest to use 824-835 MHz/869-880 MHz bands which have been reserved for Digital Cellular Systems (DCS) operating world-wide. In anticipation for demand and expansion from operators, IDA has reallocated part of DCS for Extended GSM 900 (EGSM). EGSM is an extension to GSM 900 spectrum to provide additional services. As such, DCS bands have been shrunk down to 824-835 MHz / 869-880 MHz. This is to reallocate 880-890 MHz / 925-935 MHz for Extended GSM (EGSM) services.

1400 MHz

IDA has allocated the 1400 MHz band for PDC mobile systems. However, to date, IDA has not received any indication from the industry that they would be interested in acquiring this band for mobile services. This band is therefore currently under review to see if alternative services could be offered.

1700 MHz & 1800 MHz

The spectrum within the GSM1800 band has not been fully utilised. SingTel Mobile, M1 and StarHub Mobile are currently the only occupants of the band offering GSM1800 and dualband services. IDA is aware that with the advent of GPRS data services, the usage of airtime per subscribers will increase. This implies that additional spectrum will be required to support the same pool of subscribers.

In the 1800 MHz spectrum for 2G services, StarHub Mobile service is allocated 2 x 20.2 MHz, M1 is allocated 2 x 20 MHz and Singtel Mobile is allocated 2 x 5.3 MHz and 2 x 10 MHz.

The current 2G spectrum allocation in the 1800MHz is as follows:

Frequency Range (1800 MHz)	Existing/Planned Systems	Operators
1739.5 - 1759.7 MHz / 1834.5 - 1854.7 MHz (Channels 659 - 759 inclusive)	GSM1800	StarHub Mobile
1710.1 - 1715.4 MHz / 1805.1 - 1810.4 MHz (Channels 512 - 538 inclusive) 1720.5 - 1730.5 MHz / 1815.5 - 1825.5 MHz (Channels 564 – 613 inclusive)	GSM1800	Singtel Mobile
1759.9 - 1779.9 MHz / 1854.9 - 1874.9 MHz (Channels 761 - 860 inclusive)	GSM1800	M1

The existing 2G Spectrum Rights will expire in 30 September 2008. IDA is currently reviewing the framework to ensure the most efficient use for the spectrum.

3G Spectrum 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. SingTel Mobile, M1 and StarHub were each allocated 2 x 15 MHz of paired spectrum from 1920-1980 MHz/2110-2170 MHz (FDD) and 5 MHz of unpaired spectrum from 1900-1920 MHz (TDD) to roll out its services. There is one lot available for 3G spectrum, a single 5 MHz band and a 2 x 14.8 MHz band.

IDA will continue to allow unlicensed cordless systems such as PHS (operating in the 1880-1899.9 MHz) and DECT to operate in the 1880-1900 MHz frequency range.

As for the 2010-2025 MHz spectrum band, IDA intends to allocate it for 3G TDD for future expansion. Currently, there are no demands from the operators for this band. IDA is aware of the potential use for other services 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.

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

- (i) 806-960 MHz
- (ii) 1710-2025 MHz
- (iii) 2110-2200 MHz
- (iv) 2500-2690 MHz

However, bands (i) and (ii) are currently used for 2G mobile services. IDA is well aware that several trials for 3G services have been successfully executed in band (i). The licenses for 2G mobile services will expire after September 2008 and IDA will be reviewing the services and allocation in these two bands.

Band (iii) has been successfully auctioned off by IDA in (date) for Wireless Broadband Access (WBA). Please see (v) **Wireless Broadband Services**.

4G Spectrum Bands

4G (Fourth-Generation Communications System) is the next evolution in wireless communications, capable of providing data rate up to 100MBit/sec. The bands that have been identified by ITU during WRC-07 for 4G are as followed:

- (i) 450 - 470 MHz
- (ii) 698 - 862 MHz
- (iii) 2300 - 2400 MHz
- (iv) 3400 - 3600 MHz

Bands (i) and (iii) are globally-harmonised for 4G technology except for band (ii) and (iv) which are more contentious and therefore there are no global harmonisation at WRC-07. IDA's primary interest is to give flexibility for mobile/wireless services to operate within band (ii) and (iv) while ensuring such services will not

interfere with broadcasting or FSS services 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) Public Radio Paging Service

Frequency Range	Existing/Planned Services	Status
150-168 MHz	1-way paging	To be recovered in 2008.
279-280 MHz	1-way paging	Partially assigned
279-280 MHz/917-921 MHz	2-way paging	To be recovered in 2008.
279-280 MHz/921-923 MHz	2-way paging	To be recovered in 2008.

From July 2008 onwards, there will be one paging service provider, Sunpage, operating in the 279-280 MHz when SingTel Paging ceases to operate its service. IDA is looking into deploying the unutilised portion of the spectrum for other innovative applications. IDA therefore welcomes any such proposals from the industry.

(c) Mobile Data Service

Frequency Range	Existing System	Status
415-417 MHz/425-427 MHz	Mobitex	Partially assigned

Mobile data networks are primarily used for asset tracking purposes. Transport and logistic companies such as those operating taxis or despatch services commonly deploy such networks. Many mobile data services however are facing competition from cellular services.

(d) Trunked Radio Services

Frequency Range	Existing/Planned Systems	Status
380-400 MHz	TETRA	Mostly assigned
410-430 MHz	Digital Trunk Radio	Partially assigned
450-470 MHz	PMR	Partially assigned
806-823 MHz/851-868 MHz	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 data services. As analogue trunked networks migrate to digital platform, more data services are able to be supported by digital trunked radio. The band 410-430 MHz is now being used for private digital trunked networks. The band 450-470 MHz can also be used for digital trunk radio services if necessary.

A potential application in the 450-470 MHz band is for the provision for 4G services. There are however constraints to operate this band for 4G services because of the small amount of spectrum available.

(e) Wireless Broadband Services

Frequency Range	Existing / Planned System	Status
2300-2350 MHz	Wireless Broadband Access	Fully assigned
2500-2700 MHz	Wireless Broadband Access	Fully assigned
3400-3600 MHz	Satellite Services / Mobile/Wireless Services.	Please refer to Satellite Services.

To increase Singapore’s broadband offerings and competition in the local broadband market, IDA awarded the above spectrum lots in 2005. The current wireless broadband services spectrum allocations are as follow:

Frequency Range (2300 - 2350 MHz)	Existing/Planned Systems	Operators
2300 2330 MHz	Wireless Broadband Access	Qala Singapore Pte Ltd
2330 – 2350 MHz	Wireless Broadband Access	Inter-touch Holdings (Singapore) Pte Ltd
2516 - 2528 MHz / 2636 – 2648 MHz	Wireless Broadband Access	MobileOne Ltd
2540 - 2552 MHz / 2660 – 2672 MHz	Wireless Broadband Access	Singapore Pte Ltd
2564 - 2576 MHz / 2588 – 2600 MHz / 2672 – 2678 MHz	Wireless Broadband Access	Pacific Internet Corporation Pte Ltd
2576 - 2588 MHz	Wireless Broadband Access	StarHub Ltd

With demand from the market for higher speeds and larger coverage, deployment of the new Wireless Broadband Access (WBA) services will deliver greater broadband services for businesses and consumers. As the 2.3/2.5GHz spectrum has been fully assigned, IDA is looking into opening more spectrum for WBA services and has identified 200 MHz bandwidth in the 3.5 GHz band (3.4 - 3.6 GHz) for mobile/wireless services.

FIXED SERVICES

(a) Point-to-Point Fixed Links

Frequency Range	Channelling Plan	Utilisation	Sharing with Fixed Satellite Services (FSS)
5925-6425 MHz	Rec F. 383	High	FSS (Uplink)
6430-7110 MHz	Rec F. 384	High	FSS (Uplink)
7125-7725 MHz	Rec F. 385	High	FSS (Downlink)
7725-8500 MHz	Rec F. 386	High	FSS (Uplink))
10.15-10.65 GHz	Rec F. 747	High	-
10.7-11.7 GHz	Rec F. 387	High	FSS (Downlink)
12.2-12.7 GHz	Rec F. 746	High	FSS (Downlink)
12.75-13.25 GHz	Rec F. 497	Medium	FSS (Downlink)
14.4-15.35GHz	Rec F. 636	Medium	FSS (Uplink)
17.7-19.7 GHz	Rec F. 595	Medium	FSS (Downlink)
21.2-23.6 GHz	Rec F. 637	Low	-

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.

The utilisation of spectrum below 12 GHz is high. These lower microwave bands are popularly used for traditional fixed links as they are suitable for longer distance applications albeit having smaller channel bandwidth. Frequencies within the 5925-6425 MHz and 6430-7110 MHz bands are also being used for Fixed Satellite Services (FSS).

At present, the demand for spectrum above 12 GHz is relatively low. This is because higher microwave bands experience greater path loss and rain attenuation and are thus more suitable for short distance broadband applications. With broadband technology evolving at a rapid pace, there is a strong likelihood that demand for such high frequencies would increase significantly in the near future.

(b) Fixed Wireless Access (FWA)

Wireless access technology can serve as an alternative for new FBOs to break into the broadband market. IDA’s objective is to release sufficient spectrum to encourage increased broadband service offerings and boost broadband penetration rates in Singapore. In 2001, IDA identified the 24.5-31.3 GHz band for fixed wireless access (FWA) services and planned to conduct an auction. However, there was no interest from the industry.

(c) High Altitude Platform Stations (HAPS)

HAPS are essentially transmitting stations operating in the stratosphere at an altitude of about 20 km. Balloons, manned aircraft or unmanned aircraft are commonly used to house such systems. The service coverage area of each HAPS ranges from 150 km to 1000 km in diameter. The HAPS system is an attractive alternative solution to satellite as the cost is much lower. The two Radio Conferences of ITU (WRC-97 and WRC2000) have designated the 47.2-47.5 GHz/47.9-48.2 GHz and 18–32 GHz for use by HAPS.

As HAPS is more applicable for countries with a large landmass, it may not be practical to implement such a system in Singapore, as co-ordination with neighbouring countries would be required. IDA will continue to monitor on the development in HAPS technology and the findings and recommendations of the various ITU studies.

(d) Other Fixed Services

Frequency Range	Status
31.8-33.4 GHz	Not assigned
37-40 GHz	Not assigned
40.5-43.5 GHz	Not assigned
51.4-52.6 GHz	Not assigned
55.78-59 GHz	Not assigned
64-66 GHz	Not assigned

The above bands have been made available by WRC-2000 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. In light of the high rainfall in Singapore, IDA welcomes any interested parties to conduct trial on HDFS systems in Singapore to investigate the feasibility of deploying such systems. IDA will make available these bands once there is a demand for use of these bands.

SATELLITE SERVICES

(a) Fixed Satellite Services (FSS)

Frequency Range	Uplink/Downlink	Remarks
3400-4200 MHz	Downlink	3400-3600 MHz has been identified for future Mobile/Wireless Services.
5850-7075 MHz	Uplink	
7250-7750 MHz	Downlink	
7900-8400 MHz	Uplink	
12.20-12.75 GHz	Downlink	
13.75-14.4 GHz	Uplink	
18.8-19.3 GHz	Downlink	
28.6-29.1 GHz	Uplink	

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 co-ordinated by the respective 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 basically involves three spectrum bands, viz. 4-6 GHz, 7-8 GHz and 11-14 GHz. Although numerous bands above 20 GHz are also allocated for fixed-satellite services, none is 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

(VSAT) 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 that the mutual interference level is acceptable.

The WRC-95 has allocated spectrum in the 18.8-19.3 GHz / 28.6-29.1 GHz bands for Broadband Satellite Communication Service on a shared basis with existing services. However, as the demand for such services is still unclear, IDA will monitor the situation to see if a portion of these bands could be used for other services in Singapore.

(b) Mobile Satellite Services (MSS)

Frequency Range	Uplink/Downlink	Remarks
1525-1559 MHz	Downlink	
1626.5-1660.5 MHz	Uplink	
1610-1626.5 MHz	Uplink	
2483.5-2500 MHz	Downlink	
1980-2010 MHz	Downlink	Identified by ITU as possible band for expansion of 3G services.
2170-2200 MHz	Uplink	

IDA welcomes any proposal from the industry to use the above MSS bands for the operation of MSS.

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 bordering 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 had 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). 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 in use.
SW (Short Wave)	5.95 - 21.85	10 kHz	In use. Usage subject to coordination by ABU.
FM (Frequency Modulation)	88 - 108	180 or 300 kHz	In use. Fully assigned.
TV (Television)	174 - 230	7 MHz	In use. Fully assigned.
	494 - 790	8 MHz	In use. Mostly assigned.
DAB (Digital Audio Broadcasting)	174 - 230	1.536 MHz	In use. Mostly assigned.
	1452 - 1492	1.536 MHz	Not in use.
DVB (Digital Video Broadcasting)	494 - 790	8 MHz	In use. Mostly assigned.
DBS (Direct Broadcasting Satellite)	11700 - 12200	27 MHz	Not in use.

Digital Broadcasting Services

The introduction of digital television provides an opportunity for IDA to review the current use of the broadcast spectrum. The switchover from analogue to digital broadcasting will free up significant amounts of spectrum that can be used for other wireless services. Currently, IDA is coordinating with its regulatory counterparts in the neighbouring countries to re-plan spectrum in the VHF and UHF bands to introduce digital terrestrial broadcasting and new wireless/mobile services.

There are many competing uses for the digital dividend such as International Mobile Telecommunication (IMT), Public Protection Disaster Recovery (PPDR) and White Space Devices (WSD). It is therefore in the public interest that the digital dividend is managed as efficiently as possible to satisfy the maximum demand. IDA will study the technical constraints of the various technologies and decide how the spectrum should be used, taking into account the potential uses and their benefits for society.

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 are unlikely to cause interference to other services and are 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 SRDs.

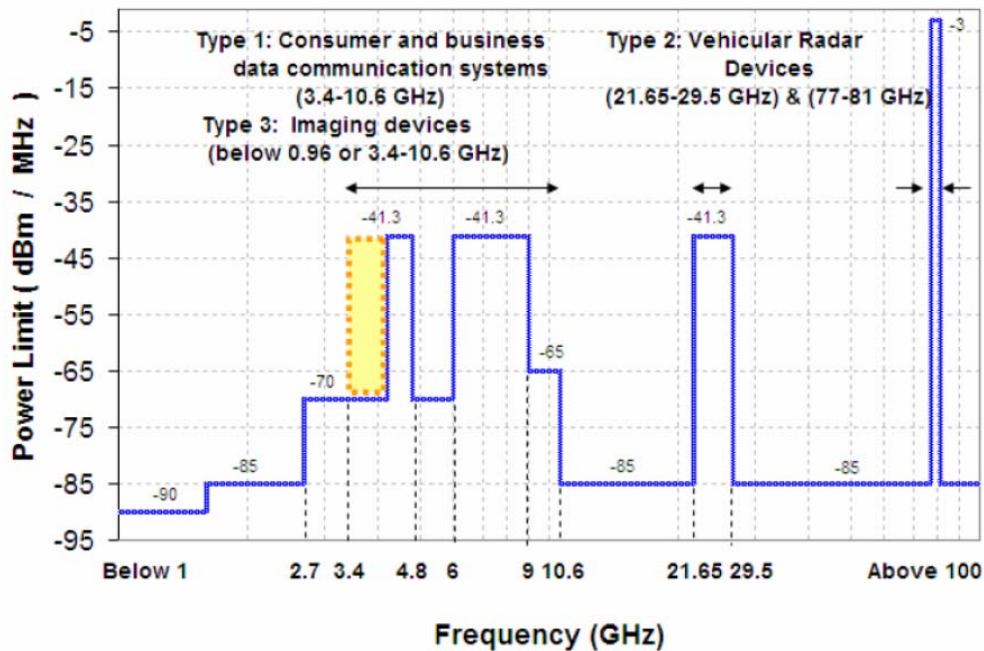
IDA also facilitates use of other SRDs employing new technology such as UWB and Radio Local Area Network (RLAN) which are described in the following sections:

(a) Ultra Wideband (UWB)

UWB is a technology used for short range, high bandwidth communications by transmitting information over a large bandwidth (> 500MHz) without interfering with other specified narrowband users. UWB allows for very high-speed data transfer of up to 480 megabits per second.

On 2nd January 2008, IDA allocated 3400 – 10600 MHz as the operating bands for UWB technology on licence-exempt basis. Prior to that, in September 2007, IDA established a regulatory framework for devices using Ultra-WideBand (UWB) technology so that businesses and consumers may enjoy the benefits of this nascent technology.

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. WRC2003 allocated 5150-5350 MHz and 5470-5725 MHz bands for implementation of wireless access systems including RLANs. IDA has opened up 5150-5350 for wireless access systems and is currently reviewing the 5470-5725 MHz band for the same application.

CONCLUSIONS

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.

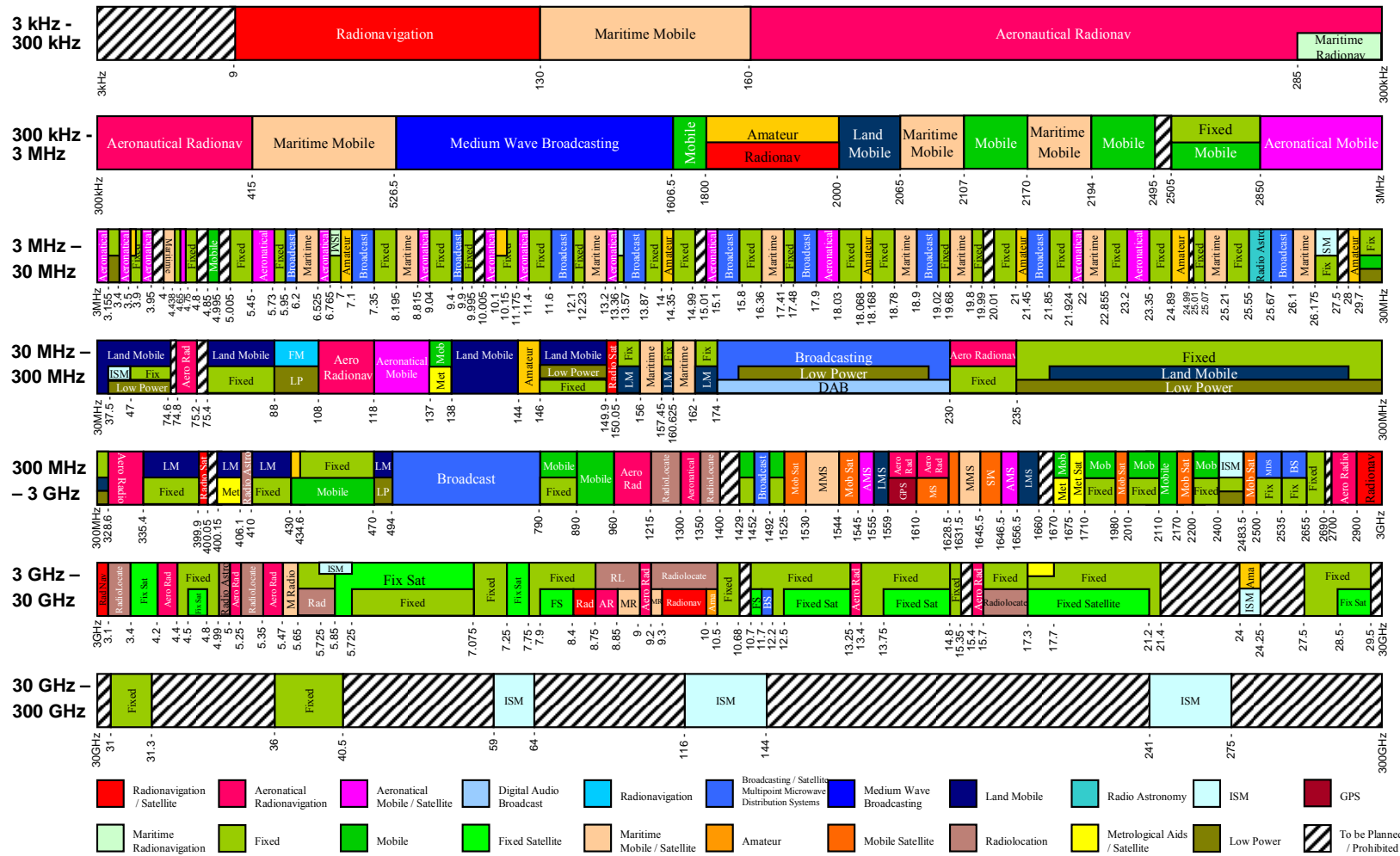
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Singapore Spectrum Allocation Chart

•Frequency Spectrum is not drawn to scale.



IDA's Spectrum Plan

Frequency Range	Existing/Planned Services	Priority for Review ¹
0.5265-21.85 MHz	Broadcasting Services	Low
88-108 MHz	Broadcasting Services	Low
150-168 MHz	Paging Services	High
174-230 MHz	Analogue Broadcasting Services	Low
174-230 MHz	Digital Broadcasting Services	High
279-280 MHz	1-way Paging Services	Low
279-280 MHz/917-921 MHz	2-way Paging Services	High
279-280 MHz/921-923 MHz	2-way Paging Services	High
380-400 MHz	Trunked Radio Services	Low
410-430 MHz	Digital Trunked Radio Services	Low
415-417 MHz/425-427 MHz	Mobile Data Services	Low
450-470 MHz	Trunked Radio Services	Low
494 - 790 MHz	Analogue Broadcasting Services	Low
494 - 790 MHz	Digital Broadcasting Services	High
806-823 MHz/851-868 MHz	Trunked Radio Services	Low
824-835 MHz/869-880 MHz	Digital Mobile Services	Medium
890-915 MHz/935-960 MHz	Cellular Mobile Services	Low
820-920 MHz	Short Range Devices	Medium
880-890/925-935 MHz	Enhanced GSM	High
1444-1452 MHz/1492-1500 MHz	PDC	Medium
1452-1492 MHz	Broadcasting Services	Low
1525-1660.5 MHz	Mobile Satellite Services	Low
1710-1785 MHz/1805-1880 MHz	Cellular Mobile Services	Medium

¹ 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 Review¹
1880-1900 MHz	Cordless Systems / 3G Cellular Mobile Services	Medium
1899.9-1904.9 MHz	Cordless systems / 3G Cellular Mobile Services	Low
1904.9-1964.9 MHz/2110-2154.9 MHz	3G Cellular Mobile Services	Low
1964.9-1979.7 MHz/2154.9-2169.7 MHz	3G Cellular Mobile Services	High
1980-2010 MHz/2170-2200 MHz	Mobile Satellite Services	Medium
2010-2025 MHz	3G Cellular Mobile Services	Medium
2300-2350 MHz	Wireless Broadband Access	Low
2400-2483.5 MHz	Short Range Devices	Low
2483.5-2500 MHz	Mobile Satellite Services	Low
2500-2690 MHz	Wireless Broadband Access	Low
3400-3600 MHz	Satellite Services / (Under review for WBA Services)	High
3400-10600 MHz	Ultra-wideband (UWB) services	Low
5470-5725 MHz	To be planned for Short Range Devices (RLANs)	Medium
10150-10650 MHz	Fixed Services	High
11700-12200 MHz	Broadcasting Satellite Services	Low
17301-18000 MHz	Broadcasting Satellite Services	Low
3.400-23.6 GHz	Fixed Services / Fixed Satellite Services	Low
24.5-31.3 GHz	Fixed Wireless Access Services	High
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
47.2-47.5 GHz/47.9-48.2 GHz	High Altitude Platform	Medium
51.4-52.6 GHz	High Density Fixed Services	Medium
55.78-59 GHz	High Density Fixed Services	Medium
64-66 GHz	High Density Fixed Services	Medium

Technical Requirements for SRDs

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength (dB(μ V/m))
Induction loop system IDA TS SRD	16 – 150 kHz	-	≤ 66 dB μ A/m @ 3m
	0.150 – 5.00 MHz	-	≤ 13.5 dB μ A/m @ 10m
	6.765 – 6.795 MHz	-	≤ 42 dB μ A/m @ 10m
	7.400 – 8.800 MHz	-	≤ 9 dB μ A/m @ 10m
Radio detection, alarm system IDA TS SRD	0.016 – 0.150 MHz	-	≤ 100 dB μ A/m @ 3m
	13.553 – 13.567 MHz	-	≤ 94 dB μ A/m @ 10m
	146.350 – 146.500 MHz 240.150 – 240.300 MHz 300.000 – 300.300 MHz 312.000 – 316.000 MHz 444.400 – 444.800 MHz	≤ 100 mW (e.r.p)	-
	0.51 – 1.60 MHz 40.66 – 40.70 MHz 88.00 – 108.00 MHz	-	≤ 57 @ 3m ≤ 65 @ 10m ≤ 60 @ 10m
Wireless Microphone IDA TS SRD	470.00 – 806.00 MHz	≤ 10 mW (e.r.p)	-
	169.400 – 175.000 MHz	≤ 500 mW (e.r.p)	-
Wireless Microphone, Hearing/Audio assistance aids IDA TS SRD	180.000 – 200.000 MHz 487.000 – 507.000 MHz	-	≤ 112 @ 10m
	26.96 – 27.28 MHz 34.995 – 35.225 MHz	≤ 100 mW (e.r.p)	-
Remote controls of garage door, cameras, toys and miscellaneous devices IDA TS SRD	40.665 – 40.695 MHz 40.77 – 40.83 MHz 72.13 – 72.21 MHz	≤ 500 mW (e.r.p)	-
	26.96 – 27.28 MHz 29.70 – 30.00 MHz	≤ 500 mW (e.r.p)	-
Remote controls of aircraft and glider models, telemetry, detection and alarm systems IDA TS SRD	26.96 – 27.28 MHz 29.70 – 30.00 MHz	≤ 500 mW (e.r.p)	-

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength (dB(μV/m))
Remote control of cranes and loading arms IDA TS SRD	170.275 MHz 170.375 MHz 173.575 MHz 173.675 MHz 451.750 MHz 452.000 MHz 452.050 MHz 452.325 MHz	≤ 1000 mW (e.r.p)	-
On-site radio paging system IDA TS SRD	26.96 – 27.28 MHz 40.66 – 40.70 MHz	≤ 3000 m (e.r.p)	-
	151.125 MHz 151.150 MHz	≤ 3000 mW (e.r.p)	-
Medical and Biological telemetry IDA TS SRD	40.500 – 41.000 MHz	≤ 0.01 mW (e.r.p)	-
	216.00 – 217.00 MHz	> 25 μ W (e.r.p) ≤ 100 mW (e.r.p)	-
	454.00 – 454.50 MHz	≤ 2 mW (e.r.p)	-
	1427.00 – 1432.00 MHz	> 25 μ W (e.r.p) ≤ 100 mW (e.r.p)	-
	All Frequencies	≤ 25 μ W (e.r.p)	-
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 mW (e.r.p)	-
Short range radar systems such as automatic cruise control and collision warning systems for vehicle IDA TS SRD	76 – 77 GHz	-	≤ 37 dB EIRP when vehicle is in motion ≤ 23.5 dB EIRP when vehicle is stationery
Radio telemetry, Telecommand, system IDA TS SRD	433.05 – 434.79 MHz	≤ 10 mW (e.r.p)	-
Radio telemetry, telecommand, RFID	866 – 869 MHz 920 – 925 MHz	≤ 500 mW (e.r.p)	-

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength (dB(μ V/m))
system IDA TS SRD			
Radio Frequency Identification (RFID) Systems IDA TS SRD	920 – 925 MHz	> 500 mW (e.i.r.p) \leq 2000 mW (e.i.r.p)	-
Wireless video transmitter and other SRD applications IDA TS SRD	2.4000 – 2.4835 GHz	\leq 100 mW(e.i.r.p)	-
	10.500 – 10.550 GHz	-	\leq 117 @ 10m
	24.000 – 24.250 GHz	\leq 100 mW (e.i.r.p)	-
Bluetooth IDA TS SSRD	2.4000 – 2.4835 GHz	\leq 100 mW (e.i.r.p)	-
Wireless LAN only IDA TS SRD	2.4000 – 2.4835 GHz	\leq 200 mW (e.i.r.p)	-
SRD applications IDA TS SRD	5.725 – 5.850 GHz	\leq 100 mW (e.i.r.p)	-
Wireless LAN and broadband access (WBA) only IDA TS SRD	5.725 – 5.850 GHz	\leq 1000 mW (e.i.r.p)	-
	5.725 – 5.850 GHz	> 1000 mW (e.i.r.p) \leq 4000 mW (e.i.r.p)	-
Wireless LAN IDA TS SRD	5.150 – 5.350 GHz	> 100 mW (e.i.r.p) \leq 200 mW (e.i.r.p)	-
	5.150 – 5.350 GHz	\leq 100 mW (e.i.r.p)	-
Generic UWB Devices e.g. standalone or plug-in radio devices for host systems IDA TS UWB	Below 1.6 GHz	\leq - 90 dBm/MHz	-
	1.6 – 2.7 GHz	\leq - 85 dBm/MHz	-
	2.7 – 3.4 GHz	\leq - 70 dBm/MHz	-
	3.4 – 4.2 GHz	\leq - 70 dBm/MHz ²	-
	4.2 – 4.8 GHz	\leq - 41.3 dBm/MHz ³	-
	4.8 – 6.0 GHz	\leq - 70 dBm/MHz	-
	6.0 – 8.5 GHz ⁴	\leq - 41.3 dBm/MHz	-

² 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.

³ To be replaced by more restrictive conditions beyond 31 Dec 2010.

⁴ The extension of this band from 6.0 to 9.0 GHz is also acceptable in the light of potential new applications.

Examples of SRD Applications	Authorised Frequency Bands/Frequencies	RF Output Power	Field Strength (dB(μ V/m))
	8.5 – 10.6 GHz	$\leq - 65$ dBm/MHz	-
	10.6 – 21.65 GHz	$\leq - 85$ dBm/MHz	-
	21.65 – 29.50 GHz	$\leq - 41.3$ dBm/MHz	-
	29.50 – 77.00 GHz	$\leq - 85$ dBm/MHz	-
	77.00 – 81.00 GHz	$\leq - 3$ dBm/MHz	-
	Above 81.00 GHz	$\leq - 85$ dBm/MHz	-
Automotive Short-Range (SRR) systems that are vehicular radar systems intended for collision mitigation and traffic safety applications. IDA TS UWB	21.65 – 26.65 GHz ^(5,6,7)	$\leq - 41.3$ dBm/MHz	-
	77.00 – 81.00 GHz	$\leq - 3$ dBm/MHz	-
Ground and Wall Probing Radar (GPR and WPR) systems 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		

⁵ SRR may be allowed to work in the extended band from 21650 to 29500 MHz.

⁶ 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.

⁷ 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.

