Telecom Regulatory Authority of India

Recommendations

on

Allocation of Spectrum Resources for Residential and Enterprise Intra-telecommunication Requirements/ cordless telecommunications system (CTS)

12th October, 2012

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CONTENTS

INTRODUCTION

1 On 19th February 2010, TRAI issued a "Request for Comments" on its website for seeking the comments of various stakeholders on the issue of allocations of Spectrum for Cordless Technologies to meet the Residential and Enterprise Intra-Telecommunication Requirements.

2 Based on the comments received and the International practices in various countries in respect of cordless residential & enterprise solution, consultation paper on "Allocation of Spectrum Resources for Residential and Enterprise Intra-telecommunication Requirements/ cordless telecommunications system (CTS)" was issued on 26th December 2011. The paper discussed the current allocation of spectrum for CTS, requirement for allocation of additional spectrum, possibility of de-licensing of 1880-1900 MHz or 1910-1920 MHz band for low power CTS applications and the coexistence issues with adjacent GSM band. In response to the consultation paper forty two Comments and two counter-comments were received from the stakeholders. These have been posted on TRAI's web site www.trai.gov.in. An open House Discussion was conducted on 10th July 2012. Based on the comments of the stakeholders, examination of the various issues involved and the international practices, the Authority has finalised its recommendations, which are contained in the following Chapters.

CHAPTER-I

CORDLESS TELECOMMUNICATION SYSTEMS

A. General:

1.1 Cordless phones were originally designed to provide a low-cost low-mobility wireless connection to the PSTN, i.e. a short wireless link to replace the cord connecting a telephone base unit and its handset. With the advancement of technology, digital cordless telecommunication systems are now providing terminal mobility in residential or business applications where the users can originate and receive calls on their portable terminals as they change locations and move about the coverage area at pedestrian speeds. By their reduced functionality, cordless telephone systems are able to offer lower complexity and cost than their cellular counterparts. Cellular communications systems are designed to provide wireless communications to larger user communities over wide areas and to support highly mobile terminals. In contrast, cordless systems are aimed at providing wireless communications to smaller user communities with much less support for mobility.

1.2 Cordless telephone systems are intended for in-building or localised on-site operations, providing communications in radius of a few hundred metres. Cordless terminals transmit at lower power than cellular, resulting in the use of micro cells. In high density (in-building) applications much smaller cells (pico-cells) can be used so that significantly higher traffic densities can be supported. These systems operate in an unregulated, open- market environment, where system installation and frequency planning can- not be coordinated or planned, and cost and performance as perceived by the end user are key factors in market acceptance. Their main applications are market segment dependent (residential or business). Some of them are Cordless telephony (residential), cordless PABX & Cordless LANs

(small and large enterprises) and Telepoint & Local loop replacement (Public use).

1.3 In addition to basic cordless telephony for residential use, single cell or multi-cell cordless systems can serve the need of small or large business respectively to provide wireless access to the enterprise's Private Automatic Branch Exchange (PABX) or Local Area Network (LAN). Wireless PABX systems can range from a one cell system for a small office to multiple cell systems that cover several floors of a multi-storey office building or a factory or large industrial complex. These multi-cell systems are also capable of call handover between cells within the office or factory site.

1.4 Wireless LANs, also known as Radio LAN (RLAN), uses low power radio to provide two way data communications within buildings/offices environment. RLAN provides a cost effective and flexible solution in data transfer between various computer terminals. In digital CTS standards, each channel is divided into a number of time-slots, each carrying one digitised voice signal for telephony application. However, the standards also allow the time-slots to be combined to provide sufficient throughput required for computer applications. This feature is utilised by manufacturers to provide low to medium data transfer.

1.5 CTS systems generally function on the basis of dynamic channel selection. Each terminal maintains an ordered list of some of the least interfered channels, which are regularly updated in order to detect changes in the local environment and to detect movement between base stations. The least interfered channels thus detected are used for the first bearer set up attempt to the strongest accessible base station. The big advantage of this kind of channel selection is that the set-up of a new channel takes into account the local interference situation in that instant: in this way the system is self-adapting. There is no need for a pre-planning of the system, but different applications and different operators can share dynamically the same spectrum resource

without prior distribution of channels to specific services or base stations. This will give to each user an additional capacity when compared with systems using Fixed Channel Allocation (FCA) mechanisms.

1.6 A similar advanced radio technology is emerging which is known as Cognitive radio (CR), This also autonomously adapt its communications channel access to the dynamic radio frequency (RF) environment in which it exists by enabling a radio device to monitor, sense and detect the use of same frequency at that point of time. In other words, CR devices can sense, detect, and monitor the surrounding RF conditions including interference and access availability and reconfigure their own operating characteristics to best match those conditions. Using dynamic frequency selection, CR technology can help in avoiding spectrum congestion and dynamic spectrum access to improve spectrum efficiency.

1.7 As per ITU[1], Cordless systems should be designed with the following minimum basic objectives:

- The radio spectrum be used efficiently;
- A system of high subscriber capacity be realized;
- Simple and miniature circuits be used to ensure that the weight and size of the equipment are comparable with ordinary telephones;
- It can be provided economically and the cost of equipment can be reduced to be acceptable for a mass market;
- The system provide good quality for public communication and that a flexible system of operation can be provided that does not require complicated frequency management;
- The system provide as far as possible normal telephone features;

[1] Rec. ITU-R M.1033-1 :Technical And Operational Characteristics Of Cordless Telephones And Cordless Telecommunication Systems

- The system provides security of call charges.

B. History:

1.8 Originally, cordless telephones were developed to provide users with mobility within a residence or small office by separating the handset from rest of the telephone (called the base unit) and providing a simple analog wireless link. As technology improved, digital cordless telephones were developed. As the same manufacturer sold the base station and the handset as a unit, the products in the market used proprietary wireless interfaces and there was no need for a common standard. Standards making bodies became interested in standardizing cordless technology to widen its range of applicability, to ensure support for multiple users from the same base station and to facilitate that these systems can also operate in a number of environments such as Residential, Office or Telepoint.

1.9 Various cordless personal communications systems developed since early 1990s are as given below:

- Cordless Telephony CT2
- The Digital European Cordless Telecommunications (DECT) System.
- The Japanese Personal Handyphone System (PHS)
- The North American Personal Access Communications Systems (PACS)

1.10 The cordless telephony standards adopted by the European Telecommunications Standards Institute (ETSI) are Cordless Telephony-2 (CT2) and Digital Enhanced Cordless Telecommunications (DECT). Personal Handy- phone System (PHS) was standardized by the Telecommunication Technology Committee (TIC) in Japan, and Personal Access Communication System (PACS) is a North American low power PCS standard primarily based on the wireless access communication system (WACS) developed by the Bell

Communications Research (Bellcore) laboratories. All these systems are digital systems and can be used in residential cordless, wireless PABX, and low mobility (pedestrian speed) public and private (in the licensed and unlicensed frequency bands) applications.

1.11 Following table summarizes the radio characteristics of CT2, DECT, PACS, and PHS, the four main standards on low power wireless or cordless telecommunications[2].

Table 1.1

Radio Specifications for Cordless Telecommunication Systems

Radio Parameter	**CT2**	**DECT**	**PACS**	**PHS**
Access method	FDMA/TDD	TDMA/TDD	TDMA/FDD	TDMA/TDD
Spectrum allocation	864-868 MHz	1880-1900 MHz	1910-1920	1895-1918 MHz
Carrier spacing	100 kHz	1728 kHz	300 kHz	300 kHz
Number of carriers	40	10	16 pairs/10 MHz	77
Channel/carrier	1	12	8/pair	4
Modulation	GFSK	GFSK	Pi/4 shifted QPSK	pi/4 shifted QPSK
Transmission rate	72 kb/s	1152 kb/s	384 kb/s	384 kb/s
Speech coding	32 kb/s ADPCM	32 kb/s ADPCM	32 kb/s ADPCM	32 kb/s ADPCM
Frame duration	2 ms	10 ms	2.5 ms	5 ms
Peak output power	10mW	250mW	200mW	80mW

[2] 'Mobile and Personal Communication Systems and Services' by Raj Pandya, IEEE Press

CHAPTER-II

DE-LICENSING OF SPECTRUM FOR CTS

A. Present Allocation for CTS

2.1. As per the National Frequency Allocation Plan(NFAP), there are some frequency spots already assigned for cordless telephony. As per IND04 for base unit, frequencies are earmarked in the 1.6 MHz and 43-46 MHz band and for the Remote unit, frequencies are earmarked in the 26MHz, 48-49 MHz and 150 MHz band. As per IND52, certain frequency spots in the frequency band 926–926.5 MHz may be considered for very low power cordless telephone systems on non-interference, non-protection and non-exclusiveness basis.

2.2. Apart from the above allocations, there are some unlicensed bands earmarked for low power devices as given below:

- IND62: Use of low power equipments in the frequency band 2.4-2.4835 GHz using a maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power) with spectrum spread of 10 MHz or higher has been exempted from licensing requirement.

- IND67: use of low power equipments for wireless access system, including Radio Local Area Networks, in the frequency band 5.150 to 5.350 GHz and 5.725 to 5.875 GHz using a Maximum mean Effective Isotropic Radiated Power (EIRP) of 200 mW and a maximum mean Effective Isotropic Radiated Power density of 10 mW/ MHz in any 1 MHz bandwidth, for the indoor applications has been exempted from licensing requirement.

- IND72: Use of low power equipments in the frequency band 5.825 to 5.875 GHz using a maximum transmitter output power of 1 Watt (4 Watts Effective Radiated Power) with spectrum spread of 10 MHz or higher has been exempted from licensing requirements.

2.3. As per IND57 of NFAP-2011, requirements of micro cellular wireless access systems (fixed/mobile) based on TDD access techniques, especially indigenously developed technologies and low power digital cordless telephones systems and devices with maximum transmit power of 250 mW, capable of coexistence with multiple operators, may be considered in the frequency band 1880-1900 MHz, subject to coordination on a case-by-case basis

B. Need for a Separate De-licensed Band for Cordless Telecommunication System

2.4. In the consultation paper, the stakeholders were requested to give their opinion on the need and feasibility of de-licensing a separate spectrum band for CTS devices, considering the availability of cellular mobile services in the country and availability of similar solutions in the 2.4 GHz & 5.8 GHz bands.

2.5. Stakeholders mainly, the Cellular Telecom Service Providers (CMSPs) were of the opinion that spectrum bands in 2.4 GHz and 5.8 GHz have already been de-licensed and are being used for Wi-Fi and CTS applications. In their view, technologies in these bands have already matured and are offering benefits to the subscribers due to economies of scale and ease of deployment. They further emphasised that intra-enterprises requirements can easily be fulfilled by the existing UASL/CMTS licensees as the coverage of these networks is quite ubiquitous and the Closed User Group (CUG) plans of mobile services, which provide intra-office communications, are already very popular with the enterprises. Such solutions not only support communications in a given location, but also among various branches of the enterprise at different locations across the country. Also, the proposed CTS band lies within the IMT band, therefore, according to these stakeholders, allocating spectrum to CTS based technologies would result in a wasteful of precious spectrum.

2.6. Stakeholders having contrary view, submitted that old de-licensed bands for analog cordless technology (CT0) are not used now for obvious reasons of obsolescence, poor conversation security, cost & size of handset etc. In their view, the only other band available for digital cordless is the Industrial, Scientific and Medical (ISM)/Wi-Fi de-licensed band. However, these bands allow for the uncoordinated usage of a variety of incompatible devices and also do not have any co-existence etiquette, leading to interference from un-coordinated broadband equipments such as IEEE 802.11x WLANs, microwave ovens and Bluetooth devices in the same local area using the same band. Their contention was that these devices have an adverse effect on voice communication which is a time critical application, but is less critical on best effort packet data services using Wi-Fi technology. Therefore, the 2.4 GHz unlicensed band is more suitable for Wi-Fi equipments using 802.11 data protocols, where interferences between the different un-coordinated broadband equipment without any co-existence etiquette are easily and automatically corrected by non-time critical packet re-transmissions. In their opinion, the interference to the cordless phones is likely to become very pronounced with the expansion of broadband network and this is the primary reason for the un-popularity of 2.4 & 5.8 GHz cordless sets in the developed world where Wi-Fi is omni-present.

2.7. Regarding the mobile CUG/Pico cell based technologies, these stakeholders were of the view that these are unsuitable for residential/SOHO applications besides having limitations in their application due to radio planning issues and service cost issues. One of the responses was that femto/Pico cell based cellular technology has not been offered to residential customers by any operator in India and it is also doubtful whether these could cater to the very large co-located residential needs without getting into interference problems.

2.8. One stakeholder submitted that Cordless technologies such as DECT provide a reliable, affordable wireless solution for residential and

Small Enterprise Establishments (SMEs) without the use of Cellular spectrum and no radio planning requirements. In future, use of such technologies will not be limited to voice but will also be used for data and video and machine to machine communications. In its opinion, CTS and FMC technologies will continue to co-exist due to high demand of capacity in the last mile wireless access. Also, the possibility of seamless working of both types of technologies cannot be ruled out. It was also submitted that CTS equipments can be installed by the consumers themselves and these can be integrated with the existing PABXs/IP-PABXs easily. Also, due to the dynamic channel selection feature, CTS equipments can work without interference for multiple co-located installations with no radio planning.

2.9. The Authority noted that despite the presence of a well established mobile network, DECT, which is one of the CTS technologies, is present in more than 100 countries including the USA and the European Countries. Also, there is continual upgradation in the technology adopted in 1.9GHz band, whereas no innovation is taking place in the CTS devices in 2.4 GHz band. Though there are cordless phones available in the 2.4 GHz band, but Enterprises are mostly using wireline PABXs for catering to their intra-enterprises solutions and the usage/availability of cordless PABX is negligible in the country. This can be attributed to the lack of options available.

2.10. The Authority also noted that a major chunk of the calls are initiated by the subscribers from their home or offices and a substantial number of such calls are intra-enterprise calls. Also, the indoor coverage of GSM/CDMA cannot be said to be satisfactory. Therefore, it is expected that the digital CTS technology will complement the cellular mobile technology in terms of efficient use of the scarce spectrum resource and also will aid to indoor coverage requirements. Due to interference issues with various ISM band devices, particularly Wi-Fi devices, which are primarily being used for data communications, it is not possible for the CTS devices to deliver good

quality services, and therefore, it is essential that a separate band be earmarked for CTS devices.

2.11. In view of the foregoing, the Authority is of the view that despite the presence of GSM/CDMA mobile technologies, there is no justified reason for denying digital CTS technology to the Indian consumers when it is being used world over. In any case, it should be left to the consumers to choose from the alternatives available rather than prohibiting the use of CTS.

2.12. **Therefore, the Authority is of the opinion that allocation of separate band for CTS devices apart from existing licence free 2.4 GHz/5.8 GHz bands is fully justified.**

C. De-licensing the CTS Band

2.13. In the consultation paper, issues concerning the de-licensing of the spectrum for digital CTS applications such as co-existence issue between existing cellular systems using adjacent bands and low power CTS allocations, revenue loss to the Government and any potential security threat were raised. These issues are discussed below:

(i) **Revenue Loss to the Government/Telecom Operators**:

2.14. In response to the consultation paper, a number of stakeholders, primarily the existing CMSPs, submitted that the de-licensing of spectrum band in either 1880-1900 MHz or 1910-1920 MHz band for low power CTS applications will definitely result in loss of revenue to the Government as these spectrum bands are also earmarked for IMT technologies. In addition to the one time Spectrum charges, the exchequer would also not receive any licence fee/spectrum usage charges from these services. They were also of the view that with the deployment of CTS systems, there would be a corresponding reduction in the volume of calls currently handled by the telecom operators, thus impacting their revenues. During the Open House Discussions,

these stakeholders were asked to specify the estimated loss to the Government and to their respective businesses. In response, only one of the stakeholders submitted a rough estimate of the likely impact on the revenue of the licensed operators and the Government exchequer. According to the stakeholder, considering the total AGR of TSPs as Rs. 1,00,000 crore per annum and assuming that 70% of the revenue is earned through in-building calls and further assuming that CTS will have share of 10% of in-building calls, there could be a loss of Rs.7000 crore revenues for TSPs per annum initially. The stakeholder also submitted that on account of de-licensing the spectrum in this band, there could be a loss of approximately Rs. 36220 crore (10 MHz x Rs. 3622 crore) on account of one time Spectrum Fee, Rs. 3622 crore being the recommended reserve price for 2x1 MHz of spectrum; Rs. 420 crore per annum on account of Spectrum Usage Charges and Rs. 560 crore on account of Annual Licence Fee to the Government.

2.15. CMSPs also submitted that the proposal to permit CTS as unlicensed service would create non-level playing field due to provision of similar services by one set of operators at zero or no regulatory cost whereas the licensed telecom service providers would be burdened with licence fee, spectrum usage charges and other regulatory compliances.

2.16. Stakeholders, in favour of de-licensing the spectrum for CTS, submitted that earlier also, analog CTS as well as 2.4 GHz and the 5.8 GHz cordless technology was allowed on a de-licensed basis in the public interest, without any consideration of revenue earnings to the Govt. of India. These stakeholders were of the view that internationally wherever the spectrum is allocated for commercial telecom service ventures, it is licensed and wherever, the spectrum is for the larger good of the public and is to be used on a non-commercial basis, it is not licensed. They further argued that they are not aware about any country where spectrum for CTS technology has been licensed for earning revenues for the Government. However, if the Govt. of India feel necessary to earn revenue out of this spectrum allocation, it could

perhaps consider earning the revenues through levy of sales tax etc rather than licensing every residential and enterprise installation of digital CTS. These stakeholders submitted that, a licensing policy applicable to residential use equipment is practically impossible to implement and would only encourage illegal sale of digital CTS systems. Moreover, the spectrum of 1880-1900 MHz is the unusable gap band between cellular systems and is likely to remain unused if not de-licensed.

2.17. The Authority is of the view that the spectrum band 1880-1900 MHz is presently not being used for any revenue generating commercial services. It will also lead to the proliferation of the wireless network in the areas where there is at present no mobile coverage or insufficient coverage. In fact, it shall be complementary to the mobile services. Further, the private use of CTS technology cannot take off, unless its use is de-licenced. In many countries (Europe, USA, Canada, Australia, Singapore, Malaysia, Hongkong, UAE etc), some part of 1880-1930 MHz is de-licenced for CTS/UPCS. In India, though 1880-1900 is allocated to CTS, but being licenced band, there is hardly any wireless PABXs solution available in the Indian market. Eco-system for CTS in 1800-1900 MHz band is quite well developed whereas device availability is limited in the 2.4GHz de-licenced band. Moreover, in view of the fact that due to large proliferation of equipments/applications in the 2.4 GHz/5.8 GHz bands, these bands cannot be used for cordless voice communications.

2.18. A licence-exempt model does not assign users exclusive use privileges over spectrum, therefore, users may operate wireless devices without specific user or device authorizations. Unlicensed spectrum is an enabling resource. It provides a barrier-free and cost-effective platform for innovation which facilitates the experimentation and testing and thus allows for the evolution of services and technologies. Licence-exempt bands have served as a valuable catalyst for the emergence of

successful technologies such as Bluetooth and Wi-Fi devices that have become ubiquitous. Equitable and fair access to spectrum resources by way of de-licensing its use is desirable for the Scientific and Educational Research Institutes also for indigenous R&D, which in turn will promote indigenous manufacturing. This will also be in line with the two objectives of National Telecom Policy-2012, viz. *"Promote innovation, indigenous R&D and manufacturing to serve domestic and global markets ...."* and *"De-licensing additional frequency bands for public use."* The strategy outlined in the NTP-2012 for spectrum management includes the identification of additional frequency bands periodically, for exempting them from licensing requirements for operation of low power devices for public use.

2.19. Therefore, the Authority is of the opinion that proposal for de-licensing the spectrum band for low power CTS devices can be agreed to. However, keeping in mind the reservation expressed by the CMSPs, the Authority is of the view that de-licensing of CTS band can be considered for the private and indoor use only. Its use shall have to be purely for non- commercial purpose. Though the intra-enterprise calls will not be through the licensed TSPs, but the inter-enterprise calls shall be through public networks only.

(ii) **Interference Issues:**

2.20. During the consultation process, a number of stakeholders also raised the issue regarding interference with the adjacent cellular bands. Some stakeholders commented that the proposed CTS band is in TDD mode and is adjacent to both the 2G and 3G spectrum bands. Such co-existence will cause serious interference with 2G/3G networks. The band 1880-1930 MHz overlaps with the 3G band (1920-1980/2110-2170 MHz) and the adjoining 2G band (1710-1785/1805-1880 MHz).

2.21. CDMA operators submitted that the band 1900-1910/1980-1990 MHz has been identified for the growth of CDMA networks. Un-licenced operations in the 1.9 GHz band could be counter-productive due to

likelihood of interference to adjacent 2G/3G bands. Therefore, 1.9GHz band should be kept for licensed operation of IMT only.

2.22. Another operator commented that in the event of allowing the CTS in the unlicensed band it may not be possible to control the number of players and the hence the level and extent of the interference. Thus, according to the stakeholder, there is a strong likelihood that operations of CTS in the band may lead to deterioration in the overall quality of service to the existing mobile services, both individual and enterprise.

2.23. With reference to the use of 1880-1900 MHz for digital CTS and the possibility of interference with the adjacent cellular bands, the other group of stakeholders submitted that there are plenty of documented studies on this subject as well as practical implementation in the other countries to indicate that adjacent band interference issues do not exist. All over the world, CTS systems co-exist with cellular systems both in the 1880-1900 MHz and 1910-1920 MHz band.

2.24. The Authority has studied the usage of this band in some of the countries and is of the view that any cellular technology, which is expected to be adjacent to a license exempt allocation in India, is already adjacent to the band allocated for digital CTS applications in other countries and has been for many years, as shown in Table below:

Table 2.1

Countries	CTS/DECT allocation	Adjacent Cellular Technologies
Europe , Australia, New Zealand, several Asian and African countries	1880 – 1900 MHz	GSM, 3G, (LTE, Wimax)
Most Latin American countries	1910-1930 MHz	GSM, CDMA, 3G
Brazil and Uruguay	1910 -1920 MHz	GSM, CDMA, 3G
USA, Canada and a few Latin American countries	1920 – 1930 MHz	GSM, CDMA, 3G, (LTE)

2.25. Further the analysis of interference to adjacent bands have been done by the CEPT and had concluded that CTS assignment in1880 – 1900 MHz bands requires no guard band between unlicensed residential/enterprise CTS and cellular systems below 1880 MHz and above 1900 MHz band.[3]

(iii) **Potential Security Threat:**

2.26. Another issue raised by the CMSPs is the possibility of security threat due to the usage of un-licensed operations by the enterprises. Their contention was that the principle for mitigating threats to security arising from the use of telecom services is linked to the licence and the requirement of the Lawful Enforcement Agencies (LEAs) to pin-point the user and also to legally intercept all communications by a target user. Presently, these conditions are to be fulfilled by the telecom licensee. As per the current requirement, Telecom Service providers (TSPs) have to provide location details of the subscribers as close as 50 meters in urban scenario and also, that any telecom equipment used in the country has to have desired certification and

[3] References:
- ERC Report 31 on "Compatibility between DECT and DCS1800";
- ERC Report 65 on "Adjacent band compatibility between UMTS and other services in the 2 GHz BAND";
- ERC Report 100 on "Compatibility between certain radio communications systems operating in adjacent bands, evaluation of DECT / GSM 1800 compatibility".
- ECC Report 96 on " Compatibility between UMTS 900/1800 and systems operating in adjacent bands"

should have all the security related features. In light of this, potential security threats may arise using CTS as unlicensed operations. They argued that it would not be possible to ensure that mandatory requirements like subscribers' verification and lawful interception and monitoring are fulfilled, if such services are offered on un-licensed band. Considering several small and independent networks across the country, call records at central locations for the purpose of verifications in case of fraud/illegal activities will not be feasible.

2.27. Other set of stakeholders have commented that CTS systems are connected to public PSTN/ISDN/IP network just like wireline phones. Also, a large number of such devices are already in use in the country and also world-wide, therefore, there is no security concern.

2.28. The Authority agrees with the comments that the CTS systems shall be connected to the public PSTN/ISDN/IP network and all the outgoing/incoming calls from the premises will be on public network and hence can be monitored. The proposed de-licensing is for private and indoor solution and not for the public switching. At present, wireline EPABXs are working in the similar manner. Also, there is no restrictions on the installation of wireless PABXs in 2.4 GHz unlicensed band.

2.29. In view of the foregoing, "**the Authority recommends that:**

(a) 1880-1900 MHz band should be delicensed for low power operations of CTS for private and indoor use (not for commercial use).

(b) De-licensing will be only with regard to private and indoor operations for residential/enterprise solutions.

(c) Outdoor, non-localised or inter-building operation of cordless systems is subject to DoT/WPC permission.

(d) DoT/WPC may grant permission for inter-building operation of cordless systems if they are located within the same premise.

D. Etiquettes for the de-licensed CTS Band

2.30. In response to the consultation paper, some of the stakeholders submitted that technology neutrality is an established licensing policy and allotment of spectrum for a particular technology would be against this principal.

2.31. The Authority is of the opinion that instead of allocating spectrum for a specific technology, it is better to adopt technology-neutrality approach and accordingly, it is preferable to specify certain general etiquettes, which shall be required to be followed by each CTS device which operates in the un-licensed band. Specifying etiquettes for the unlicensed spectrum bands is necessary so that un-coordinated CTS installations may work with better service quality without affecting the operations of each other and thus ensuring the optimal utilisation of valuable spectrum resources without compromising the quality of service. The etiquettes should take care of the various concerns expressed by the stakeholders particularly security related, interference related and also revenue related.

2.32. The Authority has noticed that many countries have allowed DECT and PHS technology as the digital CTS technologies as these are the prominent CTS technologies. In USA, Part 15 (Subpart D) of the Electronic Code of Federal Regulations (e-CFR) sets out the rules for Unlicensed PCN devices in the band 1920-1930.

2.33. In European countries, Antenna gain of 12dBi is permitted. Also, in some countries such as Australia, peak EIRP of 36 dBm for DECT is permitted, which is 12 dB higher than the maximum transmitted power of 250mW (i.e. 24 dBm) which is permissible in India in 1880-1900 MHz band. In some countries such as Singapore and Malaysia,

maximum Radiated power for DECT systems is 24 dBm EIRP, i.e. no additional margin for antenna gain is permitted. In USA, although antenna gain upto 3 dBi is permitted, the maximum transmitted power is approx. 22 dBm, considering 2.5 MHz of emission bandwidth.

2.34. The Authority is of the view that enhanced radiated power on account of directional gain is more useful when it is to be used for outdoor applications such as Fixed Wireless Access as a substitute for copper pairs in the "last mile". However, when the use of CTS is intended for indoor use, maximum radiated power may be kept as 24 dBm EIRP i.e. not more than the maximum transmitted power of 250 mW as specified in the NFAP-2011 for low power CTS applications in the 1880-1900 MHz band.

2.35. **The Authority, after examining the etiquettes set by different countries, recommends the following etiquettes for the CTS devices operating in the un-licensed spectrum band of 1880-1900 MHz band**:

- **Maximum Radiated power =250 mW EIRP.**
- **TDD based technology. (As defined in NFAP-2011)**
- **Dynamic channel selection for co-existence on a common frequency band.**
- **Maximum Carrier bandwidth: 2 MHz.**
- **Base units to be installed inside the buildings.**
- **CTS devices are required to operate on a "no-interference no-protection" basis, i.e. they may not cause radio interference and cannot claim protection from interference.**
- **Equipment has to comply with EMF radiation requirements as specified by the Government.**

CHAPTER-III

INTERNATIONAL PRACTICES

A. Australia

3.1 The 'Radiocommunications (Cordless Communications Devices) Class Licence 2001' authorises any person to operate a land station or hand set that operates in any of the following frequency range:

(i) 1.7175 MHz to 1.7925 MHz; 30.0625 MHz to 30.3125 MHz; 39.7625 to 40.250 MHz; 857 MHz to 861 MHz; 861 MHz to 865 MHz; OR

(ii) A radiocommunications device that uses Personal Handy Phone System (PHS) technology on a frequency greater than 1895 MHz and not greater than 1899.8 MHz; OR

(iii) A radiocommunications device that uses Digitally Enhanced Cordless Telecommunications (DECT) technology on a frequency greater than 1880 MHz and not greater than 1900 MHz.

3.2 Under a class licence, all users operate in the same spectrum segment on a shared basis and are subject to the same conditions. A class licence governs the frequencies that may be used, commonly prescribes equipment standards, and may specify other technical and operational parameters. Class licences do not have to be applied for, and no licence fees are payable.

3.3 Radiocommunications devices authorised under class licences are typically low power transmitters providing short range communications that do not require individual frequency co-ordination for interference management purposes. Class licences authorise the operation of specific types of radiocommunications devices provided that the devices are operated in accordance with

the conditions of the class licence. General conditions are that the cordless communication device:

(a) must be used only for private purposes;

(b) must not be used for the provision of commercial cordless telecommunications services to the public; and

(c) must not be used for the provision of a connection under a wireless local loop arrangement.

3.4 ACMA referred to the ARIB RCR STD-28 standard published by the Association of Radio Industries and Businesses for the Digital Cordless PHS devices with the modifications that the device must operate with a radiated power of no more than 21.5 dBm EIRP. For DECT devices, it has referred to standards set out in ETSI EN 301 406 with the modifications that the device must operate with a radiated power of no more than 36 dBm EIRP.

B. USA

3.5 Earlier, in USA, 1910-1930 MHz spectrum band in the PCS band was allocated for unlicensed PCS (U-PCS) devices. To minimize the potential of U-PCS devices interfering with other users of the 1910–1930 band, unlicensed operations were subdivided into two classifications: isochronous (principally voice) operations in the 1920–1930 MHz portion, and asynchronous (principally data) operations in the 1910–1920 MHz portion of the band. But, in 2004, 1910-1920 band was allocated for licensed operations in association with 1990-2000 MHz band. Therefore, FCC did away with the "isochronous" designation in the specific operating requirements in

the 1920-1930 MHz band, meaning that thereafter it would be used for isochronous operations and asynchronous operations.[4]

3.6 The 1920-1930 MHz band is allocated to Fixed and Mobile services on a primary basis and is designated for use by UPCS devices on an unlicensed basis. Currently, the major use of the 1920-1930 MHz band is for unlicensed cordless telephones that operate under Part 15 of the Commission's rules.

3.7 Part 15 of the Electronic Code of Federal Regulations (e-CFR) sets out the regulations under which an intentional, unintentional, or incidental radiator may be operated without an individual license.

3.8 To facilitate the sharing of spectrum in the UPCS band, the current rules require use of "spectrum etiquette" to be followed by each UPCS device to avoid interference. To protect UPCS devices already using particular time and spectrum windows from transmissions from another device, each UPCS device must monitor the combined time and spectrum windows that it intends to use before beginning transmissions and defer use or find other spectrum windows if the monitored signal level is above the threshold (a "listen-before-transmit" protocol).

3.9 Technical requirements set out by FCC for UPCS transmitters includes that Peak transmit power P is related to bandwidth BW in Hz by P = 100μW (Emission BW) $^{1/2}$. Also Power spectral density is limited to 3 mW in any 3 kHz band. It also specifies that peak transmit power must be reduced by the amount in decibels that the maximum directional gain of antenna gain exceeds 3 dBi. There are certain additional technical requirements for the devices to operate in 1920-1930 MHz band. The emission bandwidth shall be less than 2.5 MHz but in no case it should be less than 50 KHz. The frame period (a set of consecutive time slots in which the position of each time slot can be identified by reference to a synchronizing source) of an intentional radiator operating in this band shall be 20

[4] http://www.etsi.org/deliver/etsi_tr/101300_101399/101310/01.02.01_60/tr_101310v010201p.pdf

milliseconds or 10 milliseconds/X where X is a positive whole number.

C. Singapore

3.10 Infocomm Development Authority of Singapore (IDA) defined the minimum technical requirements for operating cordless telephones and cordless telecommunication systems (generally termed "cordless systems")[5]., which are intended for in-building or localised on-site operations. These Specifications applies to common applications of the cordless systems such as cordless telephony and cordless PABX (digital cordless systems e.g. DECT and PHS). IDA has specified DECT and PHS as the digital cordless systems which can operate in Singapore. IDA has specified transmitted power for portable and fixed part of digital cordless systems as 250 mW EIRP for DECT (ETSI) and 20 mW for PHS (Japan) system. It has specified typical indoor range of 30 meter and 50 meter or DECT and PHS respectively.

DECT

3.11 The DECT cordless system shall comply with the characteristics given in Table below and the DECT common interface requirements given in ETSI EN 300 175-1 to 300 175-8, operating in its authorised frequency band.

PHS

3.12 The PHS cordless system shall comply with the characteristics given in Table below and the PHS common air interface standards given in RCR STD-28 V4.1, operating in its authorised frequency band.

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5 http://www.ida.gov.sg/doc/Policies%20and%20Regulation/Policies_and_Regulation_Level2/IDA_TS_CT-CTS_i1r1.pdf

Table 3.1 : Characteristics of Digital Cordless Systems

Digital Cordless System	DECT (ETSI)	PHS (Japan)
Class of emission	F1W and F7W	G1W and G7W
Multiple access scheme	Multi-carrier TDMA	Multi-carrier TDMA
Duplex type	TDD	TDD
Authorised frequency band (MHz)	1881.792 – 1897.344 (10 RF Carriers)	1895.00 – 1898.75 (Channel 1 to 12)
Radio frequency channel spacing (kHz)	1728	300
Gross bit rate per carrier (kbit/s)	1152	192 – 3200
Number of speech channels	12 (per carrier)	4 (per carrier)
Transmission power, mW EIRP – portable set – fixed part	Peak power over time-slot ≤ 250 ≤ 250	≤ 20 (personal station) ≤ 20 (cell and relay station,)
Typical service range (m) – indoor – outdoor	30 200	50 200
Voice signals – type of modulation – processing	GFSK ADPCM or CVSDM	π/4 QPSK ADPCM
Identification code	> 10^7 combinations	> 10^8 combinations
Note 1: Outdoor, non-localised or inter-building operation of cordless systems is subject to IDA's licensing. IDA may grant exemption of licensing to inter-building operation of cordless systems if they are located within the same premise i.e. the buildings and areas in between the buildings belong to the same owner. Note 2: Transmission power for public cell stations is ≤ 4 W EIRP, subject to IDA's approval.		

D. Malaysia

3.13 Malaysia has specified only DECT technology in the technical specification for cordless telephone systems and specified 250 mW EIRP as Maximum transmitted power (peak power over time-slot).

E. Hongkong

3.14 In the technical requirements of the DECT equipment for private use, Telecommunications Authority of Hongkong (OFTA) has mentioned that the DECT equipment should comply with the relevant parts of the ETSI specifications EN 300 175 (Common Interfaces) and EN 300 176 (Test Specifications) and it shall be evaluated in accordance with the ETSI standard EN 301 406.

F. Europe:

3.15 The 20 MHz spectrum designated for DECT in Europe require that the DECT standard (EN 300 175, parts 1 to 8) are followed. Such a spectrum is called protected DECT spectrum. It provides for maintained high spectrum efficiency and maintained high quality radio links (e.g. speech and video) in an environment of a multitude of uncoordinated system installations.

3.16 In Europe the power limit laid down for use of the DECT spectrum (250 mW peak) is expressed in ERP, rather than the more commonly-used EIRP, permitting the use of high-gain directional antennas to produce much higher EIRP and hence long ranges. It recommends general use of up to 12 dBi gain antennas and up to 22 dBi upon (case by case) approval by national authorities.[6]

G. Japan:

3.17 The Japanese PHS (Personal Handyphone System) standard for cordless telecommunications was completed at the end of 1993 by the Research and Development Center for Radio Systems (RCR). The PHS addresses application environments similar to those of CT2, DECT, and PACS (e.g., residential, business, and public cordless access), using a single low power handyphone. The spectrum

[6] ETSI 71 ETSI TR 101 310 V1.2.1 (2004-04): Digital Enhanced Cordless Telecommunications (DECT); Traffic capacity and spectrum requirements for multi-system and multi-service DECT applications co-existing in a common frequency band

allocation of PHS is in the 1895-1918.1 MHz band, which is partitioned into 77 carrier frequencies with a separation of 300 kHz. Like other cordless telecommunication systems such as CT2 and DECT, PHS deploys dynamic channel assignment, whereby channel selection is autonomous based on measured signal strength.

3.18 In order to cope with future advanced demands (such as light data services and wide-band audio) yet realizing efficient use of spectrum allocated in the 1.9 GHz band, the Ministry of Internal Affair and Communications (MIC) in Japan has amended the regulations for Digital Cordless Telephone on 26 October, 2010 – to allow the technical conditions of the scheme compliant with DECT, which uses the 1.9 GHz band.

CHAPTER-IV

SUMMARY OF RECOMMENDATIONS

4.1. The Authority recommends that:

a) 1880-1900 MHz band should be delicensed for low power operations of CTS for private and indoor use (not for commercial use).

b) De-licensing will be only with regard to private and indoor operations for residential/enterprise solutions.

c) Outdoor, non-localised or inter-building operation of cordless systems is subject to DoT/WPC permission.

d) DoT/WPC may grant permission for inter-building operation of cordless systems if they are located within the same premise. (Para 2.29)

4.2. The Authority, after examining the etiquettes set by different countries, recommends the following etiquettes for the CTS devices operating in the un-licensed spectrum band of 1880-1900 MHz band:

- **Maximum Radiated power =250 mW EIRP.**
- **TDD based technology. (As defined in NFAP-2011)**
- **Dynamic channel selection for co-existence on a common frequency band.**
- **Maximum Carrier bandwidth: 2 MHz.**
- **Base units to be installed inside the buildings.**
- **CTS devices are required to operate on a "no-interference no-protection" basis, i.e. they may not cause radio interference and cannot claim protection from interference.**
- **Equipment has to comply with EMF radiation requirements as specified by the Government. (Para 2.36)**

List of Abbreviations Used

2G	Second Generation
3G	Third Generation
ACMA	Australian Communications and Media Authority
AGR	Adjusted Gross Revenue
ARIB	Association of Radio Industries and Businesses, Japan
CDMA	Code Division Multiple Access
CEPT	Center for Environmental Planning and Technology
CMSPs	Cellular Telecom Service Providers
CMTS	Cellular Mobile Telecom Service
CT0	Analog Cordless Technology
CT1	First-generation cordless telephones
CT2	Second-generation cordless telephones
CTS	Cordless telecommunications system
CUG	Closed User Group
DCT	Digital Cordless Telephony
DECT	Digital Enhanced Cordless Telecommunications
DL	Down-link
e-CFR	Electronic Code of Federal Regulations
EIRP	Effective Isotropic Radiated Power
EPABX	Electronic Private Automatic Branch Exchange
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
FDMA	Frequency Division Multiple Access
FMC	Fixed Mobile Convergence
GSM	Global System for Mobile Communications
IDA	Infocomm Development Authority of Singapore
IMT	*International Mobile Telecommunications*
IP	Internet Protocol
ISDN	*Integrated Services Digital Network*
ISM	Industrial, Scientific and Medical
ITU	International Telecommunication Union

LAN	Local Area Network
LEAs	Lawful Enforcement Agencies
LTE	Long Term Evolution
NFAP	National Frequency Allocations Plan
NTP	National Telecom Policy
OFTA	Telecommunications Authority of Hongkong
PABX	Private Automatic Branch Exchange
PACS	Personal Access Communications System
PCS	Personal Communications System
PHS	Personal Handyphone System
PSTN	Public Switched Telephone Network
RCR	Research and Development Center for Radio Systems
RLAN	Radio Local Area Network
SMEs	Small Enterprise Establishments
TIC	Telecommunication Technology Committee
TDD	Time Division Duplex
TDMA	Time Division Multiple Access
TSPs	Telecom Service Providers
UASL	Unified Access Service License
UL	Up-link
UPCS	Unlicensed Personal Communications Service Devices
WACS	Wireless Access Communication System
Wi-Fi	Wireless Fidelity
WLAN	Wireless Local Area Network
WLL	Wireless in Local Loop
WPBX	Wireless Private Branch Exchange