13-Sep-2013

Ms. Aileen Chia
Deputy Director General (Telecoms and Post)
Infocomm Development Authority of Singapore
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438

Dear Ms. Chia,

CONSULTATION ON THE PROPOSED REGULATORY FRAMEWORK FOR TV WHITE SPACE OPERATIONS IN THE VHF/UHF BANDS

The Institute for Infocomm Research (I^2R) applauses the leadership of IDA in coming out with the proposed regulatory framework for TV White Space for Singapore.

In general, we are supportive of the framework proposed in the consultation paper and we would like to offer our comments for your consideration.

If you have any clarifications please do not hesitate to contact the undersigned.

Yours Sincerely,

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Dr. Oh Ser Wah

Head, TV White Spaces Programme
Institute for Infocomm Research

Tel: 6408-2225
Email: swoh@i2r.a-star.edu.sg

Comments for IDA Consultation Paper on TVWS

By: Institute for Infocomm Research

Question 1:
IDA invites views on adopting a license-exempt approach for WSDs in Singapore, subject to the devices meeting the conditions set by IDA.

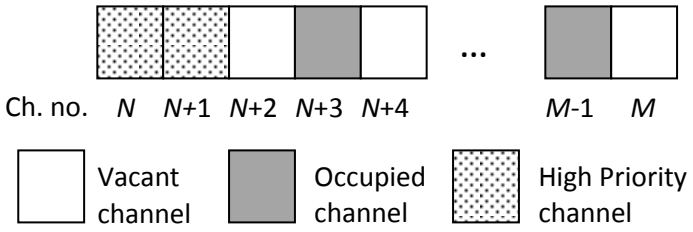
Supportive. Adopting license-exempt approach for WSDs in Singapore could lower system operation cost and result in larger market potential. As the approach is similar to FCC & Ofcom, it will help in global harmonization.

Question 2:
IDA invites views on designating a restricted number of TVWS channels to support the deployment of services that require certainty of spectrum access.

We are very happy to see innovation and willingness to try out new ideas from IDA. We agree that a restricted number of TVWS channels can be designated to services that require certainty of spectrum access. This will allow TVWS to have wider applications than currently allowable by other regulations. However, in the spirit of better spectrum utilization, the number of such restricted channels should be dynamic and temporary. If such services have very low usage of spectrum during certain period of time, designating too many channels for them will prevent other WSDs from using the otherwise available channels, thus, defeating the purpose of white space access for better spectrum utilization.

Question 3:
In the event where IDA designates channels to support such services, IDA invites views on the appropriate regulatory approach in designating and managing these TVWS channels and the regulatory framework for the operations of prioritized WSDs.

The assignment of these designated channels shall be done dynamically in order to optimize the spectrum utilization. These channels shall be marked as high-priority channels in the database, HPC (see diagram below). During normal operations, all WSDs, no matter high or low priority, shall access the vacant channels only as in normal WSD operations. High priority WSDs could start using HPC when certain criteria are met. The details of the criteria and the method on how many HPC to allocate are described in Annex A. It is also suggested that the number of HPC should be a small percentage of the total available TVWS channels and this number could also be zero.



Question 4:
IDA invites views on allowing operation of WSDs in the 694 MHz – 806 MHz band until IDA allocates these frequencies for IMT deployment.

Agree that 694 MHz – 806 MHz band can be used by WSDs before IDA allocates these frequencies for IMT deployment. However, after the reallocation, the number of channels available for TVWS will become even lesser, reducing from 24 to 10. To increase the opportunities for WSDs, IDA should open the access to the local TV broadcast channels when they are not in use. Some of the local broadcasters do not transmit 24 hours per day. They usually cease transmission after midnight. Even if the broadcasting radio might still be turned on at lower power, the channel could still be used for WSDs since there is no TV content being transmitted (except during the period of test pattern transmission) and thus not protected. The channels can be used for TVWS transmission, e.g., daily scheduled update of metering information for smart grid systems.

IDA should review this approach regularly and make more spectrum available whenever possible and necessary.

Question 5:
IDA invites views on adopting a database approach as the mandated method to access white space spectrum.

Supportive but the current database approach is not efficient. It is suggested to let the database optionally collect information such as spectrum scanning results from devices so as to improve database accuracy. At the same time, database providers have additional information collected for possible use for other applications to sustain their business.

IDA should also continue to explore other options such as spectrum sensing especially for scenarios where the use of database is impossible or not cost effective.

Question 6:
IDA invites views on the proposed general requirements for the database query and registration.

Supportive

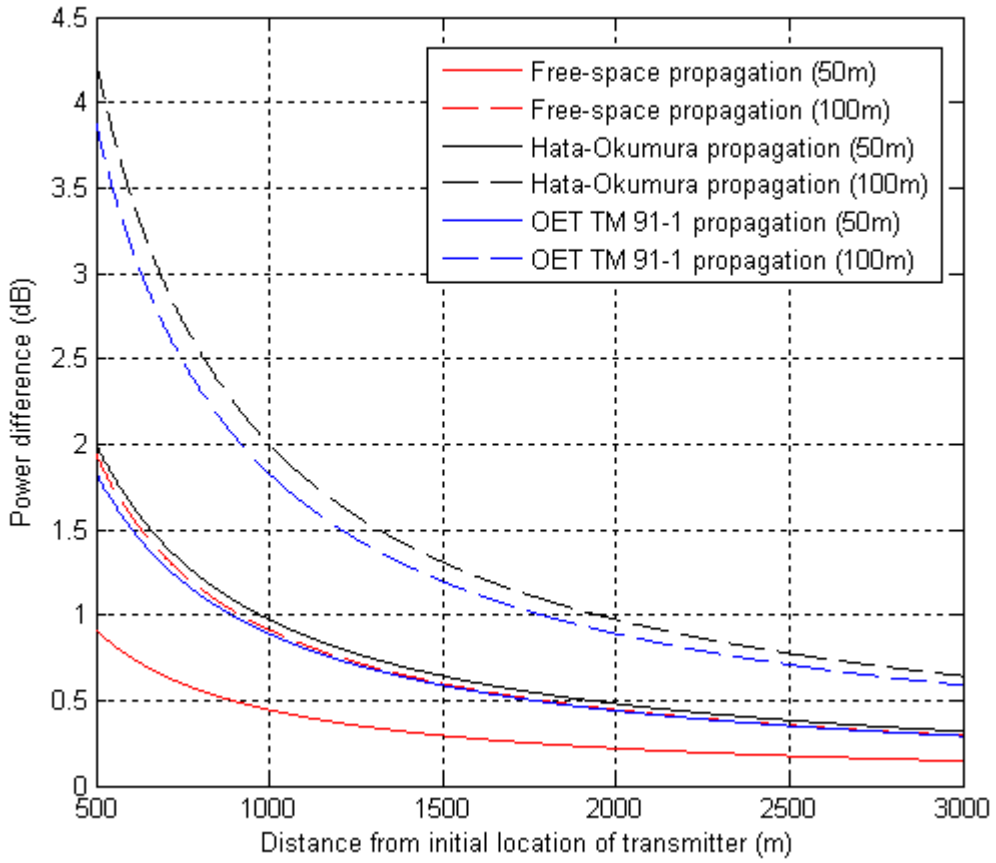
Question 7:
IDA invites views on the three situations in which a WSD must query the database. In particular, IDA invites views on defining 50m as the maximum distance that WSDs are allowed to move

from its original location, without contacting the geo-location database.

Refer to the graph below on calculation of the difference in power for moving 50m or 100m towards the transmitter with TX and RX antenna heights of 1.5m. The x-axis depicts the distance of WSD from the transmitter and the y-axis depicts the difference in the power received by the WSD when it is moved either 50m or 100m towards the transmitter. As an example, let's take the case when WSD is initially at 1km distance from the transmitter. When it moves 50m or 100m, the difference in the received power is 1dB or 2dB, respectively, using Hata-Okumura propagation calculations. This means that the difference in power level between 50m and 100m is only 1dB. This number is even lower when the WSD is further away from the transmitter, which is typically the case.

Given the incumbents are typically far from WSDs and sufficient protection has been catered in calculation of database, there is no need to restrict 50m as the maximum distance that WSDs are allowed to move before contacting the geo-location database. Instead, 100m or above is sufficient. By having larger positioning tolerance will also allow potential use of other cheaper technologies for positioning rather than relying solely on GPS. By relaxing this requirement will also reduce the amount of traffic generated through database queries. This will reduce the cost of operating databases significantly.

On top of the above, the database should also set a transmission boundary according to primary users' service area. As long as portable WSDs are outside the transmission boundary, the frequency on request for location update could be lowered. This will avoid unnecessary database queries.



Question 8:
IDA invites views on the output power transmission of WSDs as shown in Table 2.

We are in general supportive of the proposed output power transmissions. However, for better clarity, there should be another class of device defined as Fixed Device but does not have ability to query the database. Similar to Mode I device, this type of device with the presence of a Fixed Device (with ability to query the database) or Mode II device in the same TVWS network. As this class of device has fixed location and thus the potential of interfering to the incumbent is lower, it shall be allowed to transmit up to 4W similar to Fixed Devices with ability to query the database.

In addition, we'd like to request for IDA to consider allowing query of an area instead of a location to database. In this case, if a network has many fixed or portable devices connected to a gateway fixed device which has ability to query database, this gateway fixed device could send an enquiry to the database specifying its current location and a radius (or other methods of describing an area) instead of having each device in the network to send independent queries. This will save cost of queries as well as allowing more innovative use of TVWS channels for different network topologies and setup.

We further suggest that in certain type of applications where interference is less restrictive (e.g., point-to-point backhaul, underground, etc.), more than 4W should be considered.

Question 9:
IDA invites views on allowing the Fixed Devices to have tunable output power that is capped at a maximum of 4Watts EIRP

Supportive. When a device does not need to use the maximum transmit power for its transmission, allowing it to tune down its power reduces the interference it causes to other WSDs and hence improves spectrum reuse. The same applies to devices designed at lower transmit power due to cost or other considerations. In addition, we'd like to suggest Portable Devices should also optionally support tunable power and IDA just need to regulate on the maximum powers.

We further suggest that in certain type of applications where interference is less restrictive (e.g., point-to-point backhaul, underground, etc.), more than 4W should be considered. Refer to answer to Q8.

Question 10:
IDA invites views on the requirement of a Unique WSD Identifier and for this identifier to be based on standards developed by recognized standards organizations.

Supportive

Question 11:
IDA invites views on the proposed maximum transmission level of 100mW EIRP for WSDs operating in channels adjacent to a local broadcast channel.

Supportive. However, it should not be limited to Mode I and II devices only. Fixed devices which limit their transmission power to 100mW EIRP should also be allowed.

Question 12:
IDA invites views on the proposed OOB emission limit of -56.8dBm, which will be imposed on WSDs operating in channels that are directly adjacent to a local broadcast service.

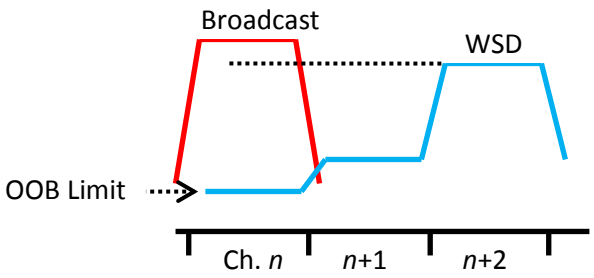
In fact, -56.8dBm is lower than the current FCC Part 15 unintentional radiation limit of -49.2dBm for this range of frequency. If -56.8dBm OOB protection is really required, the current legal unintentional radiators such as switching regulators, laptops, desktops and so on would have long interfering with TV receivers. But, this does not seem to be the case now. Thus, the strict protection limit of -56.8dBm may not be needed. In addition, typically spurious requirements (unintentional radiation) are more stringent than OOB. Therefore, a reasonable figure for OOB should not be lower than -49.2 dBm.

We also presented some typical OOB requirements for LTE and other systems in Annex B. As one could see, typical N+1 adjacent channel OOB ranges around -30dBm.

With the above, we urge IDA to reconsider this OOB emission limit and reduce the requirement to -30dBm.

Also, we would like to clarify with IDA the bandwidth for this limit. We are assuming it is 100kHz.

In addition to the adjacent channel, we would like to propose for WSDs to meet this OOB emission requirement even if they are a few channels away. For example, if WSD operates at 2 channels away from local broadcast service (considered as WSD to WSD operations in this consultation), the WSD should ensure its OOB for the 2nd adjacent channel (to the local broadcast service) should meet the stipulated regulation (see figure below).



Question 13:
IDA invites views on defining the OOB emission limits for WSD to WSD operations

We welcome IDA's decision to relax the OOB emission limits for WSD to WSD operations. This sounds more reasonable instead of a one-size-fit-all approach. Nevertheless, the additional proposal stated in the answer to Question 12 should be considered.

Question 14:
IDA invites views on the proposed approach to manage coexistence between a WSD and the other secondary services within the TVWS channels.

Since the bandwidth for secondary users are smaller, they should occupy the same channel(s) when registering to the database so as to allow as many TVWS channels available as possible. There should also be a cap to the number of channels that could be used for such secondary services in order to encourage better optimized use of the spectrum.

Question 15:
IDA invites views on the proposed propagation model and parameters used to determine the maximum transmission power level of a WSD.

We are in general agreeable to the use of Hata Okumura propagation model for computation of propagation loss. However, with 9km separation for 4Watts transmission, it basically means these co-channels are unusable if we have a few secondary transmitters transmitting across the island. In view of this, can we limit the number of channels that secondary devices could use?

Question 16:
IDA invites views on its proposal for the protection of license-exempt and licensed wireless microphones. IDA also invites views and comments on the optimal number of safe harbour channels required to ensure that license-exempt wireless microphones can continue to be used once WSDs are deployed.

Given the small number of channels available for TVWS usage in Singapore (only 11 channels available after 2020), reserving two safe harbor channels for wireless microphone will further reduce the number of TVWS channels available. We have two proposals below:

Proposal 1:
It is suggested to limit the safe harbor channel to one and let larger event organizer register their usage with IDA and update in database for protection over a certain duration.

In addition, we also suggest to mark these channels as safe harbor channels in the database instead of blocking them off completely so that these channels may still be reusable in certain scenario, e.g., inside a large factory, inside deep tunnels, highly directional point-to-point communication or other innovative applications / technologies in the future.

Proposal 2:
Wireless microphones have Priority access rather than exclusive access. In other words if a microphone needs the protected channel it can register and get priority over TVWS devices but when the channel is not being used it should be free for use by TVWS devices.

Question 17:
IDA invites views on the need to develop a registration process for users of license-exempt wireless microphones that require additional channels beyond the safe harbor channels.

We support IDA's view on the need to develop a registration process for such access. The details should be studied by IDA's TSAC WG6 standardization group.

Question 18:
IDA invites views on whether the proposed demarcation zone approach is sufficient in terms of managing cross border interference issue and if there are any other factors IDA should consider.

We would like to clarify with IDA that the demarcation zone is from the country border.

The -120 dBm specified as the limit for the maximum power at the border is quite stringent. It is suggested to use -115 dBm as shown in Table 3. This is because the noise floor in Singapore or our neighbors should be reciprocal. Also, the noise floor shown is at locations not near the border. It is expected that these numbers could be higher at the border. Please also indicate the bandwidth used for measurement of the noise floor levels in Table 3. From the numbers presented, it is unlikely to be the noise floor over a TV channel of 8 MHz as the measured numbers are lower than theoretical noise floor for 8 MHz which is -105 dBm.

We agree that an authorized database should be used to calculate the demarcation zone dynamically based on this noise floor guideline with an appropriate propagation model.

Question 19:
IDA invites views on the aggregate interference effect of WSD and whether any adjustment in terms of technical requirement is needed.

Supportive

Question 20:
IDA invites views on using GPS as the method to determine location accuracy, and on whether 50m is a sufficient location accuracy requirement for the operation of WSDs.

IDA should specify location accuracy and leave the positioning method / technology to the industry. This will enable more innovative solutions. We suggest that as long as WSD can obtain its location position within the required accuracy, it can operate normally.

Location accuracy of 50m should be more than sufficient. Judging from the fact that typical TVWS network covers quite a large area, IDA could consider relaxing this 50m accuracy requirement to 100m.

Question 21:
IDA invites views on allowing the manual input and internal storage of geographic coordinates for indoor Fixed Devices.

Supportive of manual input or coordinates but not only for indoor Fixed Devices, it should also cover outdoor Fixed Devices as well and indoor Mode II Devices with fixed location (nomadic).

Question 22:
IDA invites views on the requirement of an approval process for the installer of indoor Fixed Devices and the necessary conditions for approval.

We are supportive of developing such a process. The installer, operator or device user is required to provide his/her contacts to IDA or its designate.

Question 23:
IDA invites views on the possible types of TVWS network topologies and use case scenarios.

Figures 5 & 6 are just examples of use scenarios. There could be other potential network topologies and use case scenarios for TVWS. We are of the view that IDA may not need to regulate on the potential network topologies and use case scenarios as long as the other regulations are met.

With regard to this, perhaps a better way of managing a network (as typical TVWS operates within a network) is to let the TVWS base station / access point / gateway send an enquiry to the database on the coverage of the network (location of the base station / access point / gateway and a serving radius) instead of having individual nodes sending in the requests. This will not only reduce the amount of traffics to the database, it will also provide the possibility of lower cost nodes within the network as geo-location and internet connectivity are not required.

We also understand from the consultation description that indirect database access, i.e., accessing to database from a device without internet connection through other WSD(s) with ability to query database is allowed and therefore would like to urge IDA to mention this specifically in the final regulation.

Question 24:
IDA invites views on the payment of fees for the use of database services.

We are in the view that we should let the market competition to determine the best charging regime.

Question 25:
IDA invites views on both approaches in managing the database (i.e. industry-managed or government-managed database).

We support industry managed databases.

Question 26:
To better gauge the level of interest from the industry, IDA invites companies that are interested in developing and managing the database for Singapore to register its interest with us and share the following details:
i) Funding for database development and management (i.e. self-funded, cost recovery, etc)
ii) Business models considered when providing database services
iii) Possible fees involved for TVWS users

No comments

Question 27:
IDA invites views on the proposed preliminary conditions for the operation and administration of the databases

Supportive of list of preliminary condition, but what goes into the list is for further study by IDA TSAC WG6 standardization group.

Question 28:
IDA invites views on the proposed approach and communications protocols between the following:
i) WSD and IDA website containing the list of authorized database administrators
ii) WSD and the database

We support the general flow of database access and recommend to let IDA TSAC WG6 look at the standardization aspect of the protocol and interfaces especially the security aspects.

Question 29:
IDA invites views on the proposed frequency of update for Time A validity and Time B validity.

We are in general supportive of the proposed frequency of update. However, the time B validity of 6 hours seems long compared to Ofcom recommendation.

We further suggest IDA to take note of the correlation between time validity A & B.

Question 30:
IDA invites views on requiring the adjustment of the value for Time A validity and Time B validity, and for this to be within the range of 6 to 24 hours.

We are supportive of such adjustment so as to allow better spectrum management in the future. The range should be fixed so that WSDs can be designed accordingly. The database or IDA website should have a field to indicate the values.

Question 31:
IDA invites views on the benefits and costs of a requirement for WSD to report its operational parameters to the database.

While in general more information is better, the cost to it has to be analyzed carefully. In the future when the number of WSDs becomes large, the processing and storage power of the database will become more stringent. In addition, unless sufficient operational parameters are given, it may not result in better spectrum utilization. For example, if the channels used by WSDs are being reported to the database but not the actual usage pattern such as duty cycle, bursty/continuous transmission, etc., the information on which channel is being occupied will result in limited impact.

In addition, certain system may be designed to operate with fast changing operational parameters, such as frequency hopping system. In this case, reporting of operational parameters may not be easy and will create significant overhead to the overall system.

There is also another issue when multiple databases are being used. In this case, the databases need to synchronize such operational parameters in order to optimize the spectrum utilization, but this will in return cause quite significant overhead for database synchronization.

With the above consideration, we suggest that reporting of WSD operational parameters should be optional but not mandatory, and IDA should allow the industry to figure out what is the best option to deal with this reporting.

Question 32:
IDA invites views on the benefits of including within the TVWS regulations a requirement for WSD to register its contact parameters to the database.

Supportive. However, since most of the information will be repeated, it is suggested that this registration should be carried out during the initial stage or whenever there is a change in location.

Annex A

The followings are some possible predefined criteria for accessing the HPC.

A. Regulatory Approach

To determine which device is allowed to access the HPC, a possible approach is through regulatory and standardization control. A regulatory / standardization / certification body will set certain guidelines and certify devices based on their class of access and the need for urgent communication. Special class identification (ID) will be issued for devices that meet the criteria. A possible class ID could be using the certain portion of the ID bit fields of the device to determine the priority level. For example, if the ID field consists of 6 Bytes, the first 1 Byte (Priority Field, PF) could be used to indicate the priority level.

The regulator could also set a 'threshold' for IDs that are classified as having high priority. The easiest way is to use 0xFF as the PF for devices that does not need any priority. This 'threshold' could also be changed dynamically depending on the demand to the shared channels in order to maximize the success rates of high priority communications. The device ID could also be combined with service ID of a device depending on which service the device is currently trying to access. Although the data comes from the same device, certain service requires higher priority whilst certain service does not need real-time access. For example, a smart meter sending meter reading may not need real-time access, whilst a meter tampering message shall be sent with high priority.

B. Commercial Approach

The second approach is a market-driven approach. A small fee (the amount may be adjustable based on demand, similar to auctions, or as directed by IDA) is imposed whenever a device accesses a HPC. For devices which are really in need to access the channel for urgent communication, this small fee may be acceptable. In this case, we could deter unnecessary access to the HPC even when the vacant channels are still usable.

C. Hybrid Approach

A hybrid approach combining two approaches above could also be used to ensure better spectrum utilization while maintaining QoS via the database.

Apart from high priority data, the HPC could also be utilized for signaling purposes. For instance, when low-priority device loses its channels and there is a need for the master device to signal changes to the slave device, the HPC may be utilized.

The details should be left to the TSAC WG6 to finalize.

The below describes HPC allocation. Denote *R* as the number of HPC.

A. Fixed Allocation

The regulator fixed certain *R*'s. The database is not allowed to change *R* no matter what is the demand. In other word, $R = C$ where *C* is a constant. Nevertheless, the regulator may set different *C* for different regions. This approach is easy to manage but the spectrum utilization may not be optimum.

B. Semi-Fixed Allocation

The regulator fixed $R = C_t$. The database is not allowed to change R at its own wish. Whenever required, the database has to send a request for changing R to the regulator based on demand. The database shall present the number of requests at each time interval to justify the need to increase or reduce the R's. The regulator or its agent aggregates the demands from multiple database administrators and decides on the new R's accordingly. This may be done at certain locations and based on the requests initiated by the database. In other words, C_t is a parameter that may be changed by the regulator or its agent at certain time intervals.

C. Semi-Dynamic Allocation

The database is allowed to change R's based on a range provided by the regulator, i.e., $C_1 < R < C_2$. The purpose of providing a range instead of a fixed value is to reduce the traffic between database and the regulator or its agent. In this case, the database determines a suitable R based on real-time demand from the devices. The database shall reserve the least amount of R to meet this demand. The demand and R's shall be recorded for auditing purposes so as to avoid the database from over-allocating the R's for its own benefits especially when commercial criteria is used for accessing the HPC.

D. Fully-Dynamic Allocation

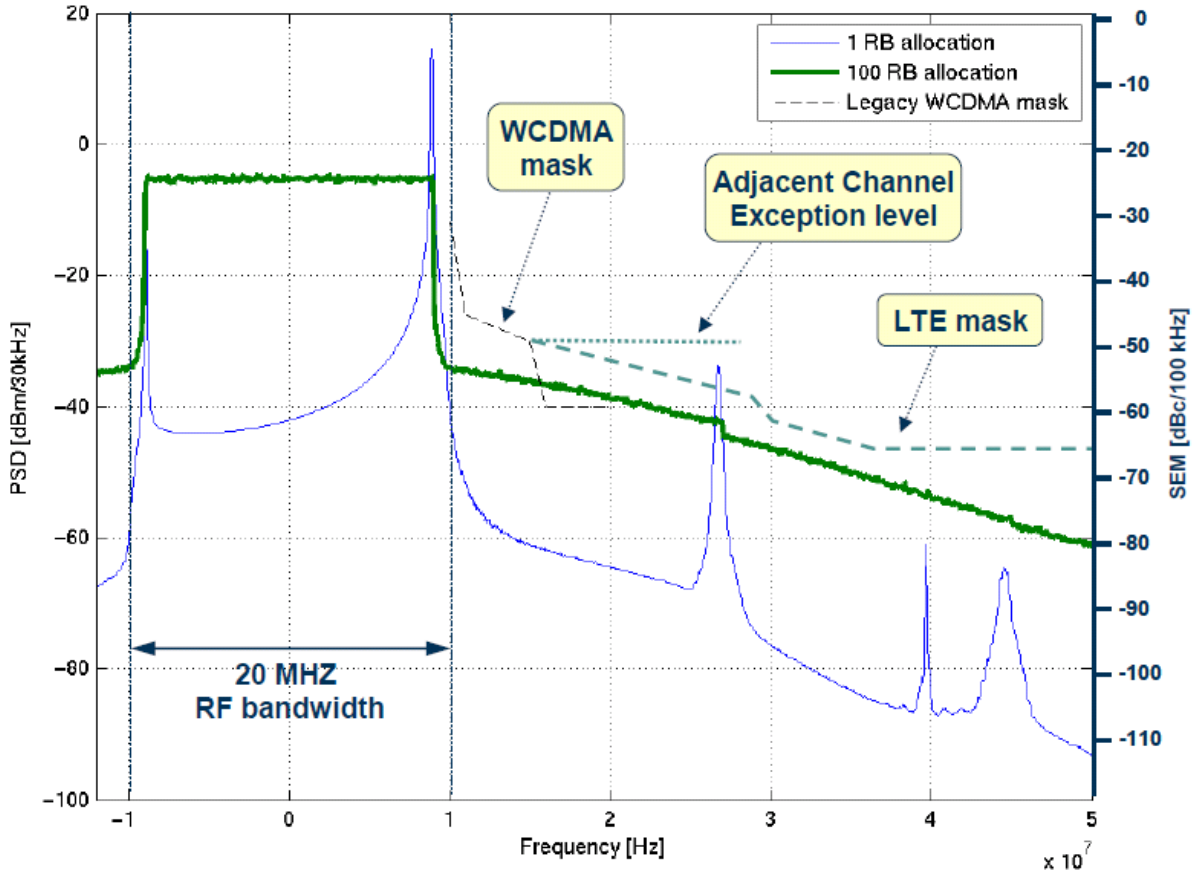
In this approach, the database is given the highest level of autonomy. The database is allowed to change R's up to the maximum number of vacant channels, i.e., $0 \leq R \leq T$. There is limited direct control from the regulator or its agent. The allocation is purely based on demand and supply of frequency spectrum. Similar to semi-dynamic allocation above, the database determines R's based on real-time demand from the devices under the guidance of a set of rules set by the regulation. The demands and R's from the WSDs shall be recorded for audit purposes.

Annex B

Table 6.6.2.1.1-1: General E-UTRA spectrum emission mask

Spectrum emission limit (dBm)/ Channel bandwidth							
Δf_{OOB} (MHz)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	Measurement bandwidth
± 0-1	-10	-13	-15	-18	-20	-21	30 kHz
± 1-2.5	-10	-10	-10	-10	-10	-10	1 MHz
± 2.5-2.8	-25	-10	-10	-10	-10	-10	1 MHz
± 2.8-5		-10	-10	-10	-10	-10	1 MHz
± 5-6		-25	-13	-13	-13	-13	1 MHz
± 6-10			-25	-13	-13	-13	1 MHz
± 10-15				-25	-13	-13	1 MHz
± 15-20					-25	-13	1 MHz
± 20-25						-25	1 MHz

Source: Table 6.6.2.1.1-1 of
http://www.etsi.org/deliver/etsi_ts/136100_136199/136101/08.10.00_60/ts_136101v081000p.pdf



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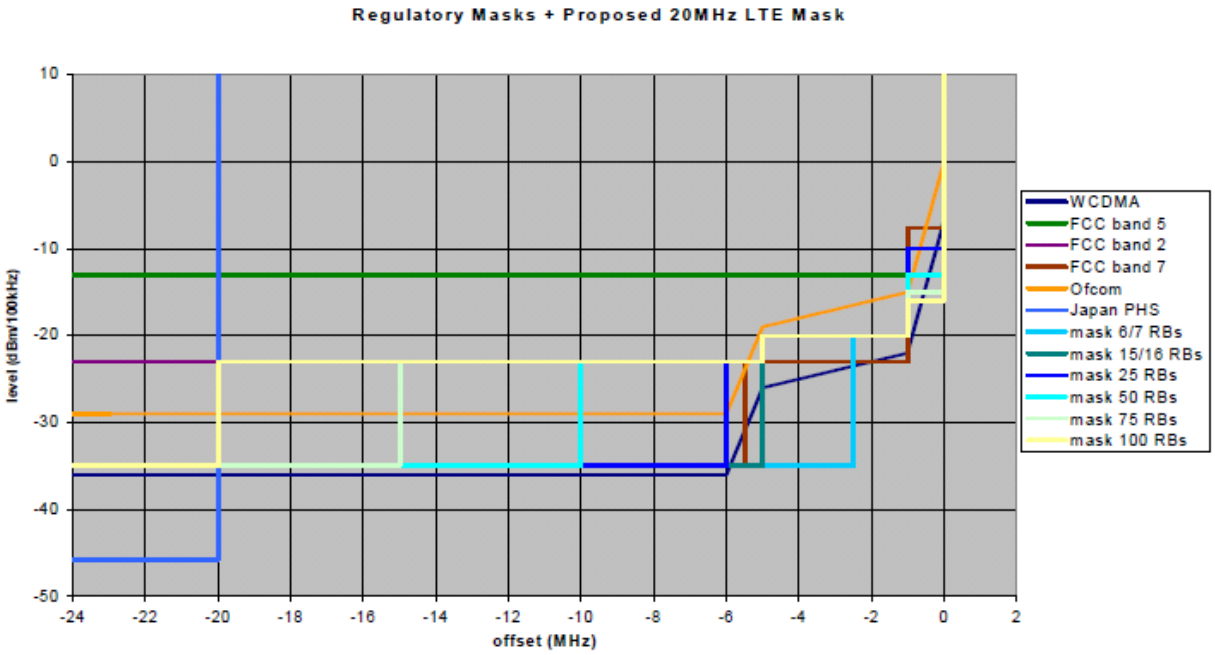

TR 36.803 v1.0.0 Figure 6.6.2.1 -1: Regulatory mask and proposed E-UTRA masks

Source: Slide 24 of http://www.home.agilent.com/upload/cmc_upload/All/4-B_Track_1-Paper_2.pdf?&cc=SG&lc=eng