Indigo Broadband South Africa written response to the questions posed in the document:

DISCUSSION PAPER ON THE DRAFT FRAMEWORK FOR DYNAMIC AND OPPORTUNIISTIC SPECTRUM MANAGEMENT

Q	*Icasa Question*	Commentary
1	*Do you agree that ICASA has the appropriate legislative mandate to address the issues of dynamic and opportunistic spectrum management and TV White Spaces and to build a suitable framework? If the answer is no, please elaborate*	Yes if applied objectively. Sections 2, 4, 30 and 33 of the ECA Act and Sections 4(3)(c) and 4B of the ICASA Act form the basis that supports this view.
2	*Are there any existing licensing models overlooked here?*	No the seven mentioned in the discussion paper cover all the typical options.
3	*Do you have any comments about these four areas of spectrum reform?*	The framework for dynamic spectrum assignment is our area of interest and focus as this is the most likely technological application that can currently be applied to achieve the targets to connect rural subscribers to the internet in South Africa. Due to the vast areas, rugged and hilly/mountainous terrain that is often a feature of the South African rural landscape to be covered and high maintenance costs of any fixed line last mile solution which would be prohibitive, compared to an effective low powered off grid solution for which TVWS is well suited. The DSA framework will also lead to workable coexistence spectrum sharing approaches that will greatly assist in improving spectrum efficiency in the DTT UHF band and spur investment and innovation in applications and devices that will be used not only in the TV band but eventually in other frequency bands such as above 50GHz and in the 5 GHz bands as well. PLC is an area of interest but will be challenging to be able to control interference and the transmissions over a power line without possible interference. Power Lines are currently used internally for control communications via capacitive decoupled means but this would not be suitable at present for broadband connectivity.
4	*Do you favour making more license exempt spectrum available in the 5 GHz band?*	Yes, as mentioned above in (3), this could assist in improving spectrum efficiency in the 5 GHz band and spur investment and innovation in applications and devices that will be used in this band.
5	*And in any other bands? Be specific, please, and support your recommendations*	None

6	*Do you believe that the Dynamic Spectrum Assignment approach is viable and worthwhile?*	Yes most definitely, dynamic spectrum allocation using databases is a new and flexible spectrum access method and technology that has so far proven that it can be deployed without causing harmful interference to incumbent operators and as such we expect its implementation to improve and evolve over time. It is thus one of the most efficient uses of available spectrum on a geographical basis co coherent coexistence of multi users of the spectrum.
7	*Do we have enough data about the TV broadcast transmitters to be able to model their propagation accurately?*	It is advisable to always scan an area to be deployed to determine if records and RF broadcast pattern predictions are up to date before a deployment in an area as the "known" data required for accurate modelling may itself be inaccurate or incorrect. Necessary data should include antennas radiation patterns (for TV broadcasters), transmitter power and EIRP. Also, GPS coordinates for TV broadcasting towers and antennas heights should be known. Furthermore, the available and known data about the TV broadcast transmitters is a good start but is in no way sufficient for purposes of analysing coexistence between DTT and other services such those provided by WSDs for instance. Whichever DTT sophisticated propagation analysis model or planning tool may be/has been chosen to be deployed in South Africa, its output will be adequate for estimating gross DTT coverage in South Africa only but will be inadequate for purposes of accurately estimating the number of locations which may suffer harmful interference caused by WSDs. It just is one parameter that needs to be calibrated in conjunction with several others in order to produce a model that overall results in a real-life low probability of harmful interference. Further extensive evidence from real-life situations testing conducted in laboratories, pilots, tests in open fields, and tests in a sample of households in selected areas of the country would need to be undertaken. In addition, the SABC, eTV , Mnet and Sentech (who operate the DTT infrastructure in the SA) have to conduct their own tests and provide additional data.
8	*Does enabling the operation of TVWS contribute to the objective of ensuring efficient use of radio frequency spectrum?*	Yes it will if dynamic spectrum assignment is applied to ensure optimum use of the available free channels per geographic area. The interference free coexistence framework approach with DTT primary incumbents that TVWS advocates in the UHF band, coupled with the geo-location database governed opportunistic spectrum sharing and usage by WSDs on a secondary assignment basis is the best contribution by TVWS technology towards achieving the goals of ensuring the most efficient uses of radio spectrum.

9	*Do you believe that it will also further objectives of encouraging investment and innovation in the electronic communications sector?*	Yes, if it is successfully demonstrated that dynamic spectrum assignment of well managed and effective in optimising the available frequency spectrum, for multiple users. Resolution of these issues will allow manufacturers to begin manufacturing and marketing unlicensed communications devices and systems that operate on frequencies in the TV bands. Further investment to the application in other bands currently dedicated to specific users but under utilised could be applied. More efficient and effective use of the available spectrum will be applied allowing more data volume for to cater for the growth in traffic
10	*What are the benefits that could be expected from making TVWS available?*	TVWS availability will spur industry to come up with a varied range of potential use cases and applications such as database systems development, cognitive technology systems development, Super Wi-Fi and Wi-Fi offload, webcam backhaul, CCTV monitoring, remote sensor monitoring, M2M (machine to machine communications), digital signage, mining, marine and rural broadband to name but a few. For South Africa, rural broadband is probably the most important. Due to the nature of rural topography and the lack of available grid power TVWS, being a Sub 1Ghz technology, will have far better propagation across this terrain and will be able to operate in a "near line of sight" (NLOS) mode. Thus allowing areas to be reached in a far more economical manner in being able to provide affordable internet access to potential users in the low income earners at the bottom of the income pyramid. TVWS allows for low power & renewable energy power solutions to be used allowing the areas to be reached where no reliable grid power is available.
11	*What are the disadvantages that could be expected from making TVWS available?*	No initial disadvantages are envisaged at this stage. The primary advantage however will be the enablement of multiple broadband ISP's to roll out an affordable and simple wireless last mile solutions to reach areas previously not economically viable.
12	*Do you foresee any risks?*	Not if one uses the OFCOM regulatory approach to use the dynamic spectrum database to protect other users and TV broadcasters from interference with each other. OFCOM also proposes, in their regulations, that devices dynamically adjust their power settings based on TV transmitter power levels to ensure that the TV broadcast is not interfered with. Furthermore there should be a structured use of the DTT planning tool and the propagation analysis model of choice for SA with real-life sample testing of WSDs interfence using actual transmitters in use per location in order to obtain reliable data so as to avoid the risk of overprotecting DTT incumbents and therefore resulting in unnecessary spectrum sterilization.
13	*Does it support SA Connect goals regarding the deployment and adoption of broadband?*	Yes, very much so in that the far remote areas and locations can be reached on a cost effective and economically affordable basis where the spectrum remains either license exempt or partially licensed,with low basic fees. Just like SA Connect envisions, TVWS technology

		enablement will provide a widespread communication system and platform that will be universally accessible; such infrastructure providing an enabling platform for economic enterprise, active citizenship, social engagement and innovation. The SA Connect Policy identifies making significant amounts of otherwise underutilized spectrum available for broadband use as holding promise for increasing South Africa's broadband capacity. The proposed regulatory framework for dynamic spectrum assignment would enable the widespread utilization of this underutilized spectrum and in doing so promote more efficient use of available spectrum. It is another implementation of an important recommendation of the National Broadband Plan, which emphasizes the vital role of spectrum to our economic future and the need for spectrum efficiency, spectrum recovery, and smart spectrum policy.
14	*What mechanisms should be put in place for dynamic spectrum assignment in meeting future demand for spectrum?*	The first step would be to implement a workable TVWS framework based on the Ofcom model but tailored for SA. This will act as an appropriate starting point for proceeding with implementing the authorisation of use of WSDs in the UHF TV band. It will offer a viable way forward that can implemented now but one which is anticipated can be refined in the future to meet the objective of ensuring efficient use of the UHF TV band. There should then be a follow up general review of the effectiveness of the TVWS framework and suggest doing this within the first 18 months of operation. The second step would be to establish a TVWS Technical Working Group whose focus will be on providing ICASA with technical evidence to assist in ensuring that the coexistence framework continues to result in a low probability of harmful interference and, consistent with that objective, facilitating the use and development of the TVWS framework. If the results prove beyond a reasonable doubt that the TVWS framework works, it can then start to be implemented in other bands in a phased approach. With the Advent of Cognitive radios, now programmable through the range of most telecom frequencies, dynamic spectrum assignment should be considered in other spectrum ranges to optimise its use on a geo-location basis. This however is rather complex and more research and development is need in this area to extend to other Frequency bands. In the DTT UHF Spectrum dynamic assignment will allow optimum usage of the available channel per geo-location area to allow multiple operators to service the demand for that area.
15	*Could TVWS provide increased consumer value and/or improved social and economic inclusion?*	Most definitely. It has been shown that by providing internet connectivity to underserviced areas the economic climate and GDP of the area can be raised by a significant amounts. The creation of many employment opportunities, the increase of the education levels and the encouragement of local enterprise , from agriculture to SME's ,has been evident wherever internet has been made available .

16	*What impact is the digital switchover expected to have on the use and availability of TVWS?*	After the analogue to digital migration and subsequent restacking, 75% of spectrum will be unused in any one of the 11 regions as only four channels are required to receive the 4 multiplexes at any given location. Except on the border areas, 168 MHz will be available for TVWS use. It will significantly increase the available channels for TVWS as the digital TV is far more efficient in the use of each channel, hence more content and additional TV channels for an 8MHz digital channel. It has also been shown that TVWS can exist in adjacent channels to existing high dense analogue Terrestrial Broadcasting as demonstrated in the Western Cape, TENET pilot project. The Digital switch over will reduce the number of Transmitter sites to the planned 189 DTT sites meaning that the >1000 analogue site may be switched off.
17	*Do you believe white spaces should be utilised without authorisation or licensing?*	A certain amount of regulation is necessary to authorise access to TVWS and to protect the existing users, but we believe that the regulatory burden must be minimized as much as possible so as to be consistent with the need to prevent undue interference, in order to maintain flexibility. We believe that it should be controlled via the dynamic spectrum database through the Regulator or designated database management agency. However, in order to keep the service cost to customer as low as possible the license should be free, or at least based only on an admin fee payable to ensure accurate records and registration are maintained for the DSA
18	*Should there be rules for such usage?*	Yes, in order to ensure there is no interference with DTT broadcasts and in addition between TVWS operators. It is necessary to ensure control and adherence in connection to the DSA database
19	*Does the advent of TVWS have the potential to remove the existing "spectrum scarcity", at least in some bands?*	Yes to a certain extent. It will allow more users of a spectrum which is totally underutilized, especially in rural areas. This in turn will allow otherwise unused UHF spectrum to be used – often many times over in different areas – thus relieving the so-called "spectrum scarcity".
20	***No Question***	
21	*Is there a space for license-exempt, unmanaged use of TVWS?*	No, there is no space for license-exempt, unmanaged TVWS use due to the fact that an unmanaged licensing model does not easily lend itself to interference mitigation with existing broadcasting services.We therefore cannot see it being unmanaged in the sense that it could be automatically managed with the active dynamic spectrum assignment database that has access in real time to all the networks operating. License exempt opportunities is definitely the way to go to ensure that the entry level costs are affordable to the lower end of the pyramid of users.

22	*Is there a space for license-exempt, managed use of TVWS?*	Yes definitely as per my comment in 21 above it should be license – exempt, however managed to ensure quality of service and dynamic frequency allocation and maintenance. A license-exempt, managed TVWS licensing model perfectly lends itself to interference mitigation with existing broadcasting services.
23	*Is there a space for licensed use of TVWS?*	I cannot see it being a licensed TVWS. It will then increase the cost of being able to provide affordable internet connection to those who desperately need it. However a nominal administrative fee for the licenses purely for the registration of operators ,may be practical. Otherwise it will greatly increase the regulatory and administration burden to both the Authority and the operators.
24	*If so, should licensed users pay the minimum annual fee, or a fee proportionate to use?*	It should be a minimal annual fee if any - Not proportional to use. Where the fees are excessive it would be uneconomical for any enterprise to make a profitable business case to be able to provide and create the many new employment opportunities in the rural communities for the support and maintenance of the networks and its customers.
25	*Does the combination give us the best of both worlds?*	The combination of unlicensed but managed give the best of both worlds in our . if set up correctly on initiation.
26	*Which of the licensing regimes do you favour? Why?*	License exempt but managed. This to provide an affordable business model to ensure that the end user benefits from both low cost affordable internet access which has quality of service in which the efficient use of the spectrum is maintained. A license-exempt, managed TVWS licensing model perfectly lends itself to interference mitigation with existing broadcasting services. Generally, licence exemption entails the least regulatory and administrative burden compared to other forms of authorisation, such as individual licences. There may be a wide variety of use cases for White Space technology. Some of the applications for TVWS that have been proposed by industry could potentially lead to mass market consumer use of devices and/or deployments of a very large number of devices (for example for machine to machine applications). We consider that authorisation on a license exempt basis would be the most likely to remove barriers to access to the spectrum, foster innovation and competition in the development of WSDs, and thereby result in benefits to consumers.
27	*Rank the licensing regimes in order of preference with reasons for your preferred order.*	1. **Managed License exempt** - this has shown to be most effective in the trial operation worldwide which has been successfully adopted by some regulators already. With the spectrum database under control, one can ensure that devices are protected not only from one another but across co-located networks. Real time DSA database management should be mandatory for all operators. **2.** All devices must be, even in an unlicensed regime, managed as a "**Light Licensed**

		Regime". A fee of R120 per device could work out to be very costly and add to the cost of the service to the end user. Perhaps a light fee per base station and not device could be considered to ensure the registration of the location of the transmitter sites that control the channel connection with the WSD's (White space devices) 3. **Fully Licensed Regime -** Although the model proposed in the paper for TVWS is different from the traditional, the concern is the fees being charged could increase the cost to provide the service making it unviable for a successful business model to provide affordable services. Perhaps only the licensing of the transmitting base station would be a compromise and enforcing the Dynamic Spectrum Assignment database 4. **Mixed Regime** - This has some benefits in the hierarchy proposed to ensure that the primary users (TV Broadcasters) are protected first, Then, if licensed to only license the base stations transmitting but not every device,as with the advent of the "super wifi" devices, this is where the end users of mobile public devices could become unmanageable and also push up the end user pricing to above that of the bottom of the pyramid user's affordability . 5. **License Exempt - Unmanaged** - This is a regime to be avoided as it will only create gross interference, no control as a result poor service delivery. Even if devices are type approved, the whole concept of white space usage is that it is a controlled managed environment. This allows for efficient and effective co-existence of multiple operators and users without having to dedicate specific spectrum to specific users.
28	*Do you see this as possible? Why / why not?*	Automated Licensing - **Yes definitely** it must be an automated process with the database controlling the Master Devices and the hierarchy of operators. It would not be an efficient system if it was not automated . However I see this as the managed License exempt regime for the reason given in the answer 1 above to question 27. The AIP license fee calculation would kill the TVWS business especially if the number WSDs in use rises exponentially so we still maintain that no fee structure should be imposed.
29	*Does this provide a significant improvement on the status quo?*	It will provide an improvement in that is will be automated and not require the manual registration process for the multitude of users to be connected.
30	*If some form of this approach is adopted, how should TVWS databases and TVWS database service providers be managed?*	ICASA should consider getting into contractual arrangements with White Space 3rd party database providers who are able to demonstrate that their databases meet certain requirements and are able to provide information on TV White Space availability to devices by taking the data provided by ICASA and providing responses to WSDs that accurately identify available channels and acceptable power levels, etc.

		The database providers will need to go through a process of qualification in which ICASA tests a database to gain assurance that the database is capable of operating in accordance with the terms on which it has been appointed. Hence, a key component of the qualification process will be testing that the database is capable of implementing ICASA's coexistence framework. ICASA should consult fully in advance of introducing any charge to database providers. ICASA should allow the designation of multiple database administrators and will rely on market forces to shape the structure of the database administration functions and service offerings, subject to the various requirements set forth in the rules. The multiple database administrators will offer services on a competitive basis, this will prevent a single party from obtaining monopoly control over the database, could provide an incentive for database operators to provide additional services beyond those required by the rules and could result in lower costs to consumers.
31	*From a South African perspective what will be the socio-economic benefits of TVWS?*	TVWS will being affordable internet connection to the rural areas where currently only expensive GSM data exists. This will enable the upliftment of communities, connect schools, clinics and government institutions as well as small business. and the public via nomadic wifi access. connecting the unconnected will give the areas an economic boost and raise the GDP
32	*Will TVWS be of the most benefit to rural or urban areas? Please provide reasons – technical and socio-economic*	TVWS will benefit the rural areas the most due to its "near line of sight" feature allowing long range connection in point to point and also point to multipoint being in the sub 1 Ghz range. the bandwidth is relative limited and suited to a more sparsely concentrated area compared to a high density urban area. The lower frequency and 8 Mhz channel width limits the max speed per channel to 20Mb/s . Hi density urban areas require the high frequency band to accommodate the need to much higher Mb/s per channel and more channels available. TV broadcast spectrum below 1 GHz has better propagation characteristics than spectrum above 1 GHz, enabling signals to travel further and penetrate walls and irregular terrain. As a result, it is uniquely well-suited for non-line-of-sight broadband communication
33	*Please provide proposals on the regulatory framework (including none at all) for TVWS*	We propose an interference free coexistence framework approach with DTT primary incumbents in the UHF band, coupled with the geo-location database governed opportunistic spectrum sharing and usage by WSDs on a secondary assignment basis for ensuring the most efficient use of radio spectrum. We suggest Dynamic and Opportunistic Spectrum Assignment by designating selected bands as 'interleaved' or shared spectrum. A large fraction of the UHF DTT broadcast bands are unused at any one place are termed TV White Spaces. By defining the rules of operation of a geo-location database and related processes the Authority can implement a regulatory framework for dynamic spectrum assignment. This approach would allow devices to use available channels in this band, based on a set of rules and supporting technologies, and

		doing so without causing harmful interference to licensed users.
34	*What are the advantages and disadvantages of different methods?*	• **Advantages** : A controlled regulated environment will allow a structured regime with control over interference and co-location to enable operator to provide a quality reliable service. • **Disadvantages:** They are limited unless it is an non automated system that could get bogged down in administrative backlogs and delays resulting in poor perception of provision of service
35	*How should South Africa define TVWS?*	TVWS should rather be defined as Cognitive Radio in the DTT UHF band as with multiple users and DTV there should be very limited "white Spaces "
36	*How will the rules for non-compliance apply?*	If an operator is non compliant the additional service should be suspended until they become compliant failure to do so within a specified window period will result in suspension of services op the offending Operator. Non compliant devices will need to be barred from operating on any network.
37	*On what basis should white space use in the 470-694 MHz band be authorised?*	As mentioned before we proposed the License-exempt managed regime to authorise the use of the 470-694Mhz frequency band controlled by an active dynamic spectrum assignment database . Each Operator to be licensed my comply to the database rules and operation
38	*Do the benefits of adopting a licence-exempt managed assignment approach apply?*	Yes as stated in the Answer 27 : ***Managed License exempt*** *- this has shown to be most effective in the trial operation worldwide and successfully adopted by some regulators already. However with the spectrum database in control one can ensure that devises are protect from one another and across co-located networks . Even in an unlicensed regime but managed all devices must be type approved and real time DSA database management is mandatory for all operators.* Generally, licence exemption entails the least regulatory and administrative burden compared to other forms of authorisation, such as individual licences
39	*If a license-exempt managed assignment approach is adopted, what registration requirements, if any, might apply?*	Applications to register as an operator and for certification of WSDs are to include a high level business case and operational description of the technologies and measures that are incorporated in the device to comply with the security requirements for non interference to DTT services. In addition, applications for certification of fixed and Type A/ Mode II WSDs are to identify at least one of the whitespaces databases operated by an ICASA accredited whitespaces database administrator that the device will access for channel availability and

		affirm that the device will conform to the communications security methods used by that database. Therefore each Operator must be a registered participant and be connected to the DSA database
40	*Do you think that licensed use of TVWS requires the operator to have an ECNS license?*	Yes this will ensure that standards covered for an ECNS operator are adhered to and that their operation can be subject to the ECNS license.
41	*Should the white spaces database approach be adopted and or is there an alternative system?*	At present the best approach proven is the DSA database approach to ensure the dynamic active use of available spectrum. Under a managed spectrum assignment approach, the Authority need not be as conservative when establishing power restrictions, and can allow considerably more flexibility when developing technical rules applicable to TVWS devices, as compared to unmanaged services, such as Wi-Fi.
42	*What additional measurements should be adopted for greater accuracy?*	Maybe frequency interference and quality monitoring can be provided by each operator in regular reports to indicate the number of incidents and how the network dynamically changed channels to clear the issue. I don't think that sensing is necessary as it will only add to the cost of trying to provide affordable broadband connectivity to the remote rural areas who are at the bottom of the pyramid. In the absence of sensing technology in the meantime, there should be a structured use of the DTT planning tool and the propagation analysis model of choice for SA with real-life sample testing of WSDs interference using actual transmitters in use per location in order to obtain reliable data so as to avoid the risk of overprotecting DTT incumbents and therefore resulting in unnecessary spectrum sterilization.
43	*Should the Authority allow – or require - sensing as an option at this time?*	As mentioned above I don't think that it is necessary at this time. If the DSA database is functional in real time it can function effectively to ensure interference free operations and quality service to the end users. At present sensing devices are still under development. It might be to all advantage at a later stage when there are many operators and devices in co-located areas.
44	*What mechanisms should be put in place to ensure that database providers obtain information required to protect incumbent operations (e.g. location of TV transmitters)?*	TV operators have to submit their transmit frequencies and location of transmitter as part of their operation approval. This information needs to be tied in directly to the DSA database and any changes are updated on the database immediately to ensure the TV Broadcasters are protected as the primary Frequency band users.

45	*What mechanisms should be put in place to ensure that broadcasters and/or signal distributors provide the Authority and database operators with accurate updated information?*	As mentioned before each operator /TV broadcaster should be actively connected to the DSA database or at least provide monthly online updates or when any changes to the database information occur, these to include PMSE usage. The changes for TV Broadcasters is much less frequent.
46	*What parameters should the Authority set forth for TVWS databases?*	If multiple database operators are to be considered there need to be an automatic synchronisation between them to enable information sharing with the Regulatory Authority being the Ultimate authority responsible for the databases . We concur with the proposed parameters for TVWS databases except the certification of the TVWS devices should be restricted to the **TVWS transmitters** and the CPE devices will then be automatically registered on the relative operator network when a customer is authorised on a network • Certifying a TVWS Transmitter device (Base Station) in conjunction with the database, or databases, in which it will operate, rather than certifying the device in isolation • Requiring that the database restrict the operation of a device causing harmful interference; • Requiring data retention to allow auditing of interference complaints
47	*What criteria should be used to certify, recognise, or authorise TVWS databases?*	The Database criteria can be summarised as follows: These requirements are intended to ensure that devices communicate to a database the information necessary in order for a database to be able to calculate the frequencies and powers at which a WSD may transmit so as to avoid harmful interference to other spectrum users and to ensure that the database obtains from devices the information necessary for interference management purposes: • A master WSD shall only transmit in accordance with parameters that it has received from a WSDB that has been qualified by the Regulator • A slave WSD shall only transmit in accordance with parameters that it has received from a master WSD, which may be 'generic operational parameters' (i.e. operational parameters that can be used by all slave devices operating in the master WSD's coverage area) or 'specific operational parameters (i.e. parameters that are specific to the slave device's characteristics). • A master WSD or a slave WSD that requires specific operational parameters from a WSDB must report certain specific characteristics (which we call 'device parameters') to the WSDB. • A slave WSD that intends to use the generic operational parameters broadcasted by a master must report its unique identifier (we describe what this means below).

		• A WSD must report back to the database the actual channels and powers that it intends to use (we refer to these as the 'channel usage parameters') and must only transmit in accordance with the channels and powers that it reports to the database. Two other parameters which will be used by a database to identify which categories of device a particular WSD falls into and which a database will take into account in determining a device's operational parameters. These parameters will be selected from a predefined set of values and will be declared by the manufacturer: • **Device category:** Two categories are defined: master and slave. A master is a WSD that is able to communicate with and obtains operational parameters from a qualifying WSDB, and a slave is a WSD that is only able to operate in TVWS when under the control of a master WSD. • **Device type** ETSI Harmonised Standard, defines two types of device: **Type A** and **Type B**. A **type A WSD** is a device that is intended for fixed use only. This type of equipment can have integral, dedicated or external antennas. A type B WSD is a device that is not intended for fixed use and which has an integral antenna or a dedicated antenna. WSDBs will allocate different operational parameters to type A and type B devices as one type might be more likely to cause harmful interference than another in certain situations. • **Unique identifier** The unique identifier will be a set of characters which will be used by a database to identify a particular WSD. This will allow the database to log which white space devices are associated with it and which devices are using which channels and powers at any given time. The unique identifier will not be pre-defined but will be declared by the manufacturer and will consist of the unique serial number of a WSD, the WSD's model number or other identifier of the product family to which the white space device belongs and a unique identifier of the manufacturer of the device. • **Antenna location and antenna location uncertainty** Master WSDs will need to have a geo-location capability, and slave WSDs may not need to have a geo-location capability. These device parameters will be used to identify to the database a WSD's location, expressed as its antenna latitude and longitude coordinates and the level of uncertainty in the accuracy of the WSD's antenna latitude and longitude coordinates, specified as ±Δx, ±Δy and ±Δz metres respectively, corresponding to a 95% confidence level. • Fixed Type A/Mode I Master WSDs shall access the database at least once a day to verify that the operating channels continue to remain available. Operation on a channel must cease immediately if the database indicates that the channel is no longer available.

		• WSDs shall incorporate adequate security measures to ensure that they are capable of communicating for purposes of obtaining lists of available channels only with databases operated by administrators authorized by ICASA, and to ensure that communications between WSDs and databases are secure to prevent corruption or unauthorized interception of data. This requirement includes implementing security for communications between Type B/Mode I personal portable devices and fixed or Type A/ Mode II devices for purposes of providing lists of available channels.
48	*How should the Authority approach issues such as non-discrimination, security, and quality of service?*	The provisions and limitations specified in licence exemption regulations must be such that they:- • do not discriminate unduly against particular persons or against a particular description of persons; • have an adverse effect on technical quality of service; • endanger or compromise the safety of communications dataor introduce undue interference As such it should only be left to the Operator to offer different classes of service with the relative parameters for QOS. Non-discrimination and security should not be optional and should rather be mandated via the relevant parameters. As mentioned above, the security parameters can be enhanced by making sure that communications between WSDs and databases are secure to prevent corruption or unauthorized interception of data.
49	*Should the Authority require the registration of some or all devices? If only some, which devices?*	Yes. Fixed master WSDs of Type A or Mode II devices shall transmit identifying information, an ICASA ID. The identification signal must conform to a standard established by a recognized industry standards setting organization. The identification signal shall carry sufficient information to identify the device and its geographic coordinates. An identification signal will provide a useful means to help locate a specific device or one slave device in its control in the event that it causes interference. Since these devices also have to register in the whitespaces database, the transmitted identification information will be correlated, perhaps identical, with the database information to facilitate the location of a specific device. All WSDs should be type approved but registration is done automatically on the relative networks so not required by the Authority
50	*Should mobile devices be obliged to have geolocation determination capability? How should the regulatory framework differentiate among devices types?*	Master WSDs will need to have a geo-location capability, and slave WSDs may not need to have a geo-location capability. • **Device type** ETSI Harmonised Standard, defines two types of device: **Type A** and **Type B**. A **type A WSD** is a device that is intended for fixed use only. This

		type of equipment can have integral, dedicated or external antennas. A type B WSD is a device that is not intended for fixed use and which has an integral antenna or a dedicated antenna. WSDBs will allocate different operational parameters to type A and type B devices as one type might be more likely to cause harmful interference than another in certain situations.
51	*What rules should be attached to each type of device?*	• The geographic coordinates of a fixed WSD shall be determined by an incorporated geo-location capability • A Mode II personal/portable device shall always incorporate a geo-location capability to determine its geographic coordinates • Mode II personal/portable devices must access a whitespaces database over the Internet to determine the channels that are available at their geographic coordinates prior to their initial service transmission at a given location • A Mode I personal/portable WSD may only transmit upon receiving a list of available channels from a fixed or Mode II WSD that has contacted a database and verified that the ICASA identifier (ICASA ID) of the Mode I device is valid
52	*Should operating parameters differ by device type or technology?*	Operating parameters should only differentiate by technology and not device type
53	*Should transmit power levels be different for different device types?*	Yes the database can determine the transmit power to allow best performance and also allow max power in low density areas.
54	*Should the Authority consider a variable power limit which could increase the utility of spectrum for devices?*	Yes. The channel usage parameters are reported by a WSD to inform a WSDB of the actual frequencies and powers that it intends to use when operating in TVWS. This will enable a database to be able to log the frequencies and powers actually being used by the WSDs it serves, which is important for interference management purposes. They will include the following information: • The lower and upper frequency boundaries within which the white space device will transmit; and • The maximum in-block EIRP spectral density at which the white space device will transmit between each lower frequency boundary and its corresponding upper frequency boundary.
55	*Should there be a maximum power output and what maximum power level should the Authority consider?*	We concur with the Authority that the view that in order to increase the potential range and utility of TVWS devices, transmitter power levels should be determined and limited by the

		database and that when there are no TV broadcasters in adjacent channels, transmission power higher than 4 W should be allowed. A continuous range of TVWS device transmitter power levels and the use of the database to limit the locations and frequencies the TVWS device can use will ensure that television broadcasting interference protection requirements are met. This approach could significantly increase the amount of spectrum available to TVWS devices without increasing the risk of harmful interference.
56	*Should licensed devices be allowed a higher power limit than licence-exempt devices?*	No they should fall under the same conditions and license Exempt.
57	*Recognising that allowing adjacent channel use would significantly improve spectrum utilisation and increase the amount of spectrum available for use by TVWS devices, should the Authority permit TVWS devices to operate in channels adjacent to incumbent operations? Please substantiate*	Yes the trial in Cape Town proved this successfully and coexisted with TV broadcasters in adjacent channels with no interference or effect on the TV Broadcasters. Even FCC changed the rules to allow adjacent channel utilisation between operators and DTT broadcasters. We
58	*Are there any substantiated concerns regarding harmful interference associated with adjacent channel operation?*	No considering that it has proved successful in one of the most densely utilised TV UHF spectrum
59	*Should the Authority establish out of band emissions limits in order to improve spectral efficiency? If so, what are your recommendations to protect incumbent operators? What out-of-band emissions rules will best improve spectral efficiency and protect incumbent operations?*	Yes, All devices must conform strictly to IEEE 802.22 or IEEE802.11 and FCC emission rules for TVWS devices to ensure that out of band emissions are adhered to. Furthermore, the ETSI Harmonised Standard sets out five classes specified by their ACLR masks. Devices with better out of block emissions are less likely to interfere with existing users and hence will get better TVWS availability. Devices may report their emission class to a database and where they do so this will be taken into account by the database in calculating operational parameters for that device. Where devices do not report their emission class, the database will calculate operational parameters on the assumption that the device falls within Class 5,the worse emission class and restrict TVWS availability accordingly as set out in the ETSI Harmonised Standard. We recommend that the Authority should follow this route in establishing out of band emission limits.
60	*Should the Authority mandate a particular propagation model for database providers?*	At present the proposed propagation model is the geolocation model combined with databases. The UK propagation model that is based on 100X100 pixels rather than the US one that is based on contours would be well suited for SA and should be further refined and be targeted to be mandated so as to focus the technical working group towards a common model. The Frequency sensing model still requires more research and development at this stage.

61	*Which propagation model or models are most accurate for this application?*	As all the propagation models are variations of the Friis Transmission Equation, whichever propagation model that is chosen for SA will still require real-life field measurements to be undertaken in order to verify the accuracy of the predictions.At Present geolocation using databases and employing the propagation model using pixels is the most accurate due to the data gathers and digital map sources of all the relative clutter data.
62	*Which model or models maximise spectral efficiency?*	The sensing techniques when combined with Spectrum databases have the potential to minimise the possible under-protection of incumbent services "false-vacancy" error, or the over protection of incumbent services - "false-occupancy" error – that might be caused by radio propagation models when spectrum databases are used alone. Frequency Sensing should maximise spectral efficiency in theory when the model is more research and the relative tools are fully commercially available. At present the best available to maximize spectral afficiency is the geolocation based tool using databases and employing pixels as the propagation model
63	*Which models best protect incumbent operations?*	If it was available Frequency sensing would provide the most accurate model to protect incumbent operations but the current use of geolocation with databases and applying the propagation models using pixels will adequately be able to protect them at this stage.
64	*Overall, what is the appropriate method of determining the required protection from authorised users in the TV bands?*	The best approach starts with determining the best choice of propagation model to employ in calculations to define coexistence parameters with DTT. We can use the existing SA DTT Planning tool data and use it in the DTT coexistence calculations whilst also ensuring that the underlying data in the model better reflects the actual position regarding DTT viewers' reception in any particular pixel in SA, for example in terms of the transmitters that provide TV services to the viewer and the DTT field strength. So whichever propagation model that is chosen for SA will still require real-life field measurements to be undertaken in order to verify the accuracy of the predictions. We also have to consider the different categories of protection ratios for DTT and give special consideration of whether different device technologies or use cases may be more likely to disrupt DTT receivers and whether and how the framework should take account of this.
65	*On balance, do the potential benefits of permitting licence-exempt managed assignment TVWS devices outweigh any potential risks?*	Definitely if the purpose is to provide affordable internet access to the low income rural areas.
66	*Do the techniques discussed above adequately mitigate any interference potential?*	Yes with current information available geolocation based RF models have worked well in other spectrum bands. The approach that has been recommended in setting the regulatory criteria for white spaces is not intended in any way to define or identify at what point interference from white space (or any other) device would be harmful, it has instead worked to limits that there is confidence they will offer the protection needed to secure a low likelihood of harmful

		interference to users Dynamic spectrum allocation using databases is a new and flexible spectrum access method and technology. As such it is expected that its implementation will improve and evolve. Other issues will undoubtedly emerge as the market develops. The framework set out here is intended to allow use of TV white spaces to get underway and provide an opportunity for markets in both applications and equipment to develop whilst also achieving the aim of ensuring a low probability of harmful interference to existing users.
67	*Should we oblige every device to have GPS location capability?*	No only the Type A WSD's need GPS location capability to ensure the location of the transmitters for frequency management
68	*In the US model, only latitude and longitude was required of GPS location. Is there any reason why we shouldn't demand full 3D location?*	I think its a nice to have but will not impact greatly on the frequency management. However when planning a network the height above ground is normally stipulated in order to achieve the predicted coverage so it should be readily available.
69	*What about the situation where a fixed device is professionally installed with an external antenna and an internal unit. Should we accept the location details provided by the installer? Using what mechanism?*	We suggested that only the Type A devices ie the transmitters only should require GPS location so only a GPS reading of the location would be required for network record purposes. The rules should provide professional installation as an alternative to including a geo-location capability in other fixed devices, and the intended purpose is to ensure that the geographic coordinates are correctly ascertained. A "professional installer" means an entity consisting of an individual or team of individuals with experience in installing radio communications equipment and that provides service on a fee basis – such an individual or team can generally be expected to be capable of ascertaining the geographic coordinates of a site and entering them into the device for communication to a database. The task of ascertaining geographic coordinates and entering them into a device is not particularly difficult or complex so in this context, we find it adequate to simply provide that a professional installer may be responsible for assuring the accuracy of the entered coordinates.
70	*Do you believe that Dynamic Spectrum Assignment should be applied to other bands, beyond the proposed TVWS operation? Please provide reasons?*	Yes We have given reasons to an earlier similar question. it will allow more efficient use of the allocated spectrum and ensure that Operators comply and not hang onto spectrum that is not being utilised.
71	*If so, which bands should be considered next?*	2G, 3G, 4G/LTE bands
72	*Are the study questions above the most relevant?*	Yes

73	*Are there additional study questions that you would propose?*	Yes. Since the propagation characteristics of the white spaces are ideal for long range wireless backhaul, particularly in unserved and underserved areas, and that because fixed point-to-point backhaul equipment is available now, fixed licensed operations would spur immediate broadband deployment to unserved and underserved areas. Since all mobile broadband networks need wireless backhaul and that there is a critical shortage of spectrum available for that purpose, will the Authority be considering fixed licensed Point-to-Point backhaul use of TVWS now or in the future? If so how does it propose to go about this exercise?
74	*Are there any additional devices or services in the 470-698 MHz UHF DTT band that should be considered in authorising use of TVWS?*	Not to our knowledge

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