Additional comments:

Spectrum Bridge applauds the effort Ofcom has undertaken to find new and innovative ways to provide access to wireless spectrum. Broadly speaking Spectrum Bridge supports the proposed implementations. Our comments and concerns are addressed within the context of the six (6) questions Ofcom presented in the Consultation.

Spectrum Bridge would be interested in providing more detail or clarification to Ofcom and is also willing to share additional details regarding current TVWS implementations including the execution of our certified US data base and prototype solutions that have been created for various regulatory domains including the UK

General Notes:

While Ofcom must ensure that the use of license exempt devices will not cause undue interference to DTT operations, overly cautious protection will limit the availability of white space such that it will not be economically feasible to develop and deploy TVWS solutions. We suggest that two additional questions be asked:

1. What is the minimum requirement for white space availability to make usage viable?
2. How is availability defined?

It should be noted that there are two primary considerations when determining the availability/usability of a TVWS channel. The first is the interference created that could adversely affect a DTT, which is a function of the received signal strength and location of the WSD. The second is the energy that the High Power TV transmitter is injecting into the white space, potentially making it unusable for low power WSDs. This can be significant when adjacent channel blocking is evaluated.

One further observation on the topic of protection is that database use in the US has demonstrated that protection can be very precise, applied to very specific locations, times of day, specific devices and specific frequencies, such that protection is not applied per worst case scenario. The Spectrum Bridge database was certified and became operational before the current rules were finalized and published but necessary modifications were integrated into a live ecosystem with no noticeable disruption. As a result, it is not necessary to expect the final rules to be adopted before initial implementation. Another advantage of this approach to spectrum management is the ability to adapt to changing conditions and support the continuous evolution of spectrum use.

In section 3.7 Ofcom discusses how information would be provided to the WSDB and how protection should be calculated. Concerns are expressed regarding the complexity and consistency of results. The FCC model requires that the WSDB calculate the protection (and available channel list(s)) and requires that all WSDB's provide consistent protection. A group of WSDB providers collaborated to create a series of specifications and standards that, with consultation and review by the FCC, became the standard for creating consistent and accurate protection. The goal of this effort was to ensure that accuracy requirements met or exceeded the expectations of the FCC. The variability in the end results is expressed in parts per million which should alleviate any concerns regarding the consistency and accuracy of results

provided by qualified database providers.. One further advantage of allowing the WSDB to calculate the protection parameters is that they are well-equipped to deal with anomalies and unintended consequences through a comprehensive understanding and application of the algorithms and protection parameters. This ability is also significant in that it allows WDSB's to provide additional technical capability and create enhanced services identified by Ofcom.

Question 1: Do you agree with our approach to defining the various categories of WSDs?:

We agree with the approach. Defining a small number of categories simplifies the management of devices and reduces system complexity. The "device parameters" are sufficient to provide the detail required to adequate definition of a particular use case. The fact that Ofcom is proposing a cloud-based database management system, allows for modification, enhancement, or addition of parameters in the future to better reflect actual use cases and necessary protections. We note that under FCC rules , a Fixed Master and a Fixed Slave have different operating parameters, with respect to interaction with the WSDB, than a personal/portable master and personal/portable slave. One reason for this difference is that the FCC allows higher power limits for Fixed devices than for personal/portable devices, albeit there are fixed limits for each device type. While this difference is not explicitly envisioned by Ofcom, part of the rationale for different operating procedures is that the FCC requires more stringent tracking of the high power devices because of their increased potential to cause interference (higher power, higher antenna gain, antenna location). Specifically the FCC requires fixed devices to "register" with the WDSB which includes information about the owner/operator of the device including contact information.
Footnote: FCC rules described in: 47 C.F.R. § 15.701, and See Unlicensed Operation in the TV Broadcast Bands, ET
Docket No. 04-186, Second Memorandum Opinion and Order, 25 FCC Rcd 18661 (2010)

Question 2: Do you agree with our proposed sequence of operations for WSDs?:

Agree. Within the discussion on sequence of operations, and more generally within the Consultation document, a number of different time durations are discussed. These range from one (1) second to twenty-four (24) hours. Spectrum Bridge suggests that these durations be consolidated or standardized via a simpler format or list. This will result in more comprehensible rules and reduce the potential for one particular rule to conflict with another. For example, there is a proposed 'kill-switch' (60 second activation), duration for a device to validate availability of a database (5 minutes), and duration for channel permission (many minutes). These varying durations and the potential effect on communications with the database create significant messaging overhead and perhaps unnecessary and significant protocol complexity. Spectrum Bridge suggests that all timing and duration requirements be considered holistically. For example, if a rule requires that a device must validate a channel assignment every 5 minutes, a single database query should allow for validation of the channel, validation of communication with the database while eliminating the reliance on a "kill switch". Implementation of a reliable 'kill-switch' without compliance with IPV6 could be problematic and unreliable.

Such a protocol could also include a "channel used" parameter. This could replace or eliminate the need for a specific "channel(s) to be used" message in the initial request and resolve the dilemma of what a device is required to do if the channel it originally chose

becomes unusable or undesired, or if the device intends to switch to a new channel.

Spectrum Bridge also recommends that the definition and use of time be relative, not absolute. Use of absolute time requires a device to know its local time. In the UK only a single time zone exists, but across Europe, North America and other land masses this is not the case. Use of relative time must be accommodated, or the UK will not be compatible with other TVWS ecosystems.

Question 3: Do you agree with our proposed additional operational requirements for master WSDs?:

Agree. We suggest the use of Antenna height (altitude) above ground level (HAGL) rather than Antenna height (altitude) above sea level (HASL) for device elevation. A geo-location database is already equipped with the terrain data to accurately determine HASL as a function of location. Furthermore, it is much easier and already necessary to determine antenna height at the point of installation.

The specific definition of "the territories of the UK" must be defined for consistent and accurate operation of a geo-location database. In the US the definitions are explicitly defined by the FCC to include not only specific geographic coordinates of land boundaries but also coastal and waterway boundaries.

In 5.49 the concept of "suspending" a WSDB is introduced. The implication is that a WSD will cease to interact with a suspended WSDB. While not explicitly forbidden, we foresee many device manufacturers entering business relationships with WSDB providers. The most likely scenario we anticipate is a Primary and Secondary relationship in which the manufacturer would expect to be able to use the Secondary provider if the Primary provider is unavailable.

We agree that restricting user access to the mandatory parameters (5.53). However, the optional parameters, like antenna height will not be known to the device in all cases so consideration should be given for these parameters to be modified.

In 5.54 a 60 second "cease operation" limit is defined, However, it is not clear what initiates this "kill switch" or how the information is conveyed to the WSDB and ultimately to the device. It is our anticipation that the 60 second interval allowed to cease operations after receiving such a message is reasonable but the timeframe for identifying a WSD, informing the WSDB of the intent and having the WSDB implement and execute the command will be variable and potentially significantly longer. This is not consistent with the view described in 5.55.

In 5.57 the concept of geography is described such that a WSD must re-acquire a channel list from a WSDB if it moves more than 50 meters. We currently support mobile applications, such as a tractor moving back and forth across a field or a train moving down a track, in which it is very efficient for a WSD to query for a contiguous set of 50 meter pixels that will be valid for a specific time window. We request that such a 'batch request' mechanism not be precluded

Question 4: Do you agree with our proposed additional operational requirements for slave WSDs?:

Agree. It would be beneficial to the industry if the operation of fixed WSDs were treated consistently within the various rules. The operational requirements for a fixed slave device differ from the way that the FCC defines operation. Therefore, it might be beneficial if a common approach was adopted. The FCC makes the same assumption for both fixed slave and personal/portable devices - a slave device must be within range of the master. To this end, the FCC requires a fixed slave device to act like a master because the antenna parameters and mode of operation may create a much larger interference area beyond the range of the serving master.

Question 5: Do you agree with the proposed device parameters, operational parameters and channel usage parameters? :

Agree. Several of the mandatory device parameters require harmonization (ETSI BRAN) with no clear timeframe for implementation. We suggest that an initial list of parameters be explicitly defined by Ofcom, until such time as a harmonized list is available.

6.7.6 describes the device providing a master/slave identification. It should be noted that some devices can operate in either mode and some may be operating in both modes simultaneously.

6.7.8 antenna height of a personal/portable device is a function of location, as the antenna will be embedded or permanently attached. In the case of a fixed device, particularly in a last mile broadband or M2M application, the antenna may be many meters away from the actual device, both in terms of latitude, longitude and altitude. The FCC requires antenna height to be specified for fixed devices and this may be parameter that Ofcom may want to add. Alternatively, a maximum antenna height limit (for example the FCC specifies maximum HAAT and HAGL) may be useful.
6.16.4 note previous comments on real time versus absolute time.

The definition of channel use parameters in 6.23 is a concern. The way in which channels are used may vary significantly between SC-FDMA, OFDM and CDMA technologies. Many existing technologies that will be used as the basis for WSD implementations monitor (sense) RF channel environments and may rapidly change to different channels when interference and/or congestion reach unacceptable limits. How and when a WSD reports channel use is not well understood for frequency agile and cognitive radio technologies.

The use of channels by a slave device is discussed in 6.26 in the context of a slave communicating with a master, and thus the channel used being inferred to be the same as that of the master. However, many technologies allow for peer-to-peer communication between slaves to reduce the congestion of the master (in a relay mode). In such cases, the slaves, while within the operating range and control of a master, may choose to use a separate frequency for the peer-to-peer communications. This results in different channel utilization by the slaves and the master.

Question 6: Do you agree with our approach of implementing the requirements in the example SI and the draft IR and VNS?:

Agree.