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What additional details do you want to keep confidential?:

No

If you want part of your response kept confidential, which parts?:

Ofcom may publish a response summary:

Yes

I confirm that I have read the declaration:

Yes

Additional comments:

Question 1: What other developments, in addition to the international and public sector developments we have identified, are relevant to our identification and assessment of options for release? :

Analog Devices, Inc. is pleased to have the opportunity to respond to Ofcom's UHF spectrum release consultation. Some developments that are relevant to Ofcom's identification and assessment of options for spectrum release include a lack of standards in Europe that technically address key active application spaces, such as building and home automation,

alarms, automotive, wireless metering communications, RFID, and M2M.

The IEEE has now completed additional amendments to the 802.15.4 baseline which provide new PHY standards for the European 868MHz bands. TIA has been working in TR-51 to develop the ANSI/TIA-4957 series which enhances the IEEE's accompanying MAC specification and integrate it with network and transport layer specifications to better address key elements like security and multi-hop delivery. ETSI is leveraging the work of both IEEE and TIA via ERM TG28 and TS 102 887 to provide for use of this new low-layer protocol within the proposed 870-876 and 915-921MHz bands.

Representation within IEEE, TIA, and ETSI from many semiconductor manufacturers, including Freescale, Semtech, Silicon Labs, Analog Devices, Atmel, and Texas Instruments, and major global manufacturers, including Ericsson, Cisco, Itron, Elster, Landis and Gyr, Sensus, and General Electric further substantiates the credible proactive development of these standards. These standards also provide for FSK, O-QPSK, and OFDM, and this provides developers with three different modulation options to specifically address application objectives.

Much work is ongoing investigating the potential effects of LTE adjacency to the 870-876 and 915-921MHz bands. While traditional communications services may find these effects to restrict their use of these bands, license-exempt ISM-focused products should find the band to be ideal.
License-free spectrum which provides for higher transmit power and higher datarates has seen considerable success in other areas of the world, for example the US, Australia, and Japan. Utilities, specifically, have chosen subGHz wireless mesh as their primary communications options for the Smart Grid. As an added benefit, application of this technology can provide means for IP-based wireless applications and extend the plausibility of the "Internet of Things".

Question 2: Do you have any additional information or analyses that could help to inform our assessment of the value that could be created through different uses of the spectrum?:

As an example, the gas, water, and heat metering markets are growing rapidly in Europe and deploying now. Many companies are clamoring to solve range and coverage issues with 169 and 433MHz, but they face implementation issues such as the need for a larger antenna and the high noise floor that is seen from the strong harmonics of FM radio. This proposed spectrum can be deployed to help address the challenges of these applications; addressing link margin from the transmit side and addressing the receiver with sufficient and contiguous bandwidth to use interference avoidance techniques which can be placed in the higher layers of the protocol.

As mentioned earlier, TS 102 887 has completed a PHY specification and is nearing completion of the MAC specification. This standard provides IEEE 802.15.4g-like performance with additional considerations for ETSI compliance in the MAC and enhanced security, an important element that has hindered the success of EN 13757 (Wireless MBus) and Zigbee. These new bands provide a better means for addressing gas and water applications that seek a subGHz band for use with the popular protocols, such as ZigBee, as the 868MHz band has insufficient transmit power allowance for penetration along with fragmented and insufficient bandwidth for interference management.

This new spectrum could, indeed, be the motivating force behind bringing IP-enabled, secure standards to Europe for gas, water, and heat. If analogous to the success of the 902-928MHz license free spectrum in the US, albeit 12MHz versus 26MHz, the value would be substantial.

In addition, from a technical perspective, semiconductor manufacturers have greatly improved short range device (SRD) radio parameters and added key features like Gaussian filtering and transmit power control (TPC). These, in combination with better temperature compensated crystal oscillators (TCXOs), which have seen significant price closure with lower performance crystals, can provide cleaner and more efficient transmitters. Receiver sensitivity has also improved, and automatic frequency control (AFC) circuits are faster and more robust, which helps to improve spectral efficiency.

Question 3: Do you agree with our proposal to release 870-876 MHz / 915 -921 MHz for licence exempt SRD and RFID applications if Government releases 870-872 MHz / 915-917 MHz? :

Yes, Analog Devices agrees with this proposal. Release of the full 12MHz is the ideal scenario. A Government release of 870-872 / 915-917 MHz would, in addition, imply that due diligence has been completed for some profiles allowing 868MHz coexistence. There may be implication of lower transmit power allowance, tighter channelization, or other rules that would need further evaluation in the Government-released band. The 12MHz would be enough for good interference avoidance, collocation strategy, and channelization options for higher datarates. It would also not put restriction on a choice of system architecture. Mesh, tree, or star systems would benefit from the additional spectrum The two 6MHz pieces can also take full advantage of the three modulation options described in TS 102 887 -1, and this would likely spur considerable innovation. With the Government release, there may be an easing, then, to the low side requirements for 872-876 and 917-921MHz. This option, too, provides the bandwidth required to secure a very good balance between the benefits and weaknesses of the 2.4GHz (i.e. high bandwidth, low transmit power, and short range) and 169MHz (i.e. low bandwidth, large antenna, high range) bands.

Question 4: Do you agree with our proposal to release 872-876 MHz / 917-921 MHz for licence exempt SRD and RFID applications if Government does not release 870-872 MHz / 915-917 MHz? :

Analog Devices certainly agrees that some spectrum is better than none, but this is a 33% reduction in the release. There may be technical ramifications regarding a need for higher co-channel rejection, given this scheme. While there is possibly the consequence of a relaxed low-end Adjacent Channel Rejection (ACR), there is, likewise, a possibility of even more stringent limits on Adjacent Channel Power (ACP) and phase noise, for example. In the event that this option is pursued, Analog Devices would like to understand the Government's technical basis for not releasing the spectrum. If, for instance, there are major differences in the speed and ease with which 8MHz can be released versus the full 12MHz, then Analog Devices more favorably implores this approach, especially if the 8MHz release is a true stage in an overall plan where the entire 12MHz is ultimately released.

Question 5: Do you have a view on the sequencing and timing of Ofcom?s next steps if the spectrum is released for licence exempt SRD and RFID applications?:

Analog Devices favors Ofcom moving quickly. Coverage and range continue to be key "pain points" for many application spaces. Companies often adopt proprietary protocols because they are unable to sufficiently address their challenges. Wireless metering communications in Europe, for example, is a cost and performance driven market that would greatly benefit from standards within spectrum that provides freedom to meet system specifications and requirements. Unfortunately, the reactive versus proactive Wireless MBus and ZigBee protocols are often referenced as the "only" viable options. New IEEE 802.15.4 amendments, the ANSI/TIA-4957 series, and ETSI TS 102 887 will bring new possibilities, but metering customers, specifically, need the spectrum as soon as possible to get developers onboard with DECC's 2014-2019 mandated timetable pressuring system decisions now. Coexistence and interoperability frameworks will take some time to define given technical and political considerations. Analog Devices believes that releasing the full spectrum now will provide the UK and Europe with a strong option that is consistent with successful deployments in other regions. Rapid release will provide more time for the assignment and completion of critical work around coexistence and interoperability.