Urban Connected Community (UCC) Project's Response to Ofcom's call for input on:

Enabling opportunities for innovation.

12th March 2019

Executive summary:

1. We support the proposition of spectrum sharing and also agree that proposal has potential to be able to remove spectrum access barrier to promote digital innovation. Subsequently, this will accelerate potential development of low-cost private networks to use 5G technologies to attain enhanced productivity.
2. Additionally, we believe temporal spectrum sharing can be possible with ease along-side the proposed location based sharing- as a central interference management is proposed to be governed by OFCOM. This will support non-periodic or unplanned traffic peak management.
3. The proposed sharing model will be helpful to accelerate innovation, as this will provide a relaxed oligopoly in spectrum usages; subsequently opening a new avenue for SME's to develop solution towards low-cost private network to support high-volume, high-density & ultra-delay sensitive connectivity.
4. We support the proposed location based licence model. However, to support SME – there could be a multi-band area (size) driven fee structure rather than per-equipment based fee structure, keeping per equipment transmit power restriction the same.
5. As the equipment for 3.8-4.2GHz is likely to be available by end of 2020, the initial term of 5-year is recommended to create impact with the usages of the proposed spectrum sharing, followed by 3-year renewal.

Introduction:

In December 2018, 3GPP (Rel - 15) has defined the 5G NR (new radio) frequency band below 6 GHz is to be band 77, covering 3.3GHz till 4.2GHz. Most of the countries are aiming to roll out 5G within 3.4-3.8GHz band, with national licence allocation. Japan and USA being the front runner on the proposed usages of 3.8-4.2GHz band, UK and Canada are expected to be immediate follower of the usages of the same band. As global 5G equipment manufacturing is driven by 3.4-3.8GHz band, early definition of the frequency release as well as usage definition & validation within 3.8-4.2GHz will make UK as niche for innovation. This will provide a great opportunity to UK SMEs to innovate in digital connectivity, creativity & productivity with reduced spectrum CAPEX; we welcome the proposition from OFCOM. Globally, uncertainty on the usage of the band kept the 5G equipment development within this band as green opportunity. Early definition on the nature of accessibility of spectrum will provide UK SMEs with the opportunity to be leader in the development of equipment within this band. UCC is looking forward to pave the way for the UK to facilitate this.

UCC Scope and Vision:

West Midland has been chosen by DCMS to be the preferred location to facilitate a multicity testbed to connect 3 million people, aiming at least 0.5 million people to be directly benefited from the initiative with urban connected community (UCC) project.

UCC is aimed to provide the opportunity to use developing technologies in the innovative delivery of both public and commercial services to individuals and businesses, to improve the quality of urban

living and working. It is also expected that it will open the potential for economic development by stimulating the development of a 5G ecosystem involving multiple industry sectors.

UCC is in conversation with number of organsiations, who expressed their interests on standalone product & service development using 5G technology; but identified spectrum is one of the major barriers to deliver this.

The proposed spectrum sharing scheme as well as the availability of low cost 5G technology compatible spectrum (3.8-4.2GHz) will support UCC's vision of being able to support UK businesses and public sector organisation.

Facilitating this will enhance UK's 5G technology competitiveness & faster growth in digital productivity.

In preparation of the set of responses, UCC team has been in consultation with the existing 5G testbeds & university research groups (e. g. Worcestershire5G, ISN@BCU etc.)

UCC's Responses to CFI:

Questions	Response
Question 1: Do you agree with our proposal for a single authorisation approach for new users to access the three shared access bands and that this will be coordinated by Ofcom and authorised through individual licensing on a per location, first come first served basis? Please give reasons supported by evidence for your views.	UCC/WM5G team has the appended published research outputs and modelling track records on spectrum sharing, which supports OFCOM's proposal. Supported by our research results ([1-6]; as appended), we agree with the proposal of single authorization & co-ordination approach. Our analytical result suggests, the proposed single authorization approach can ensure - a) efficient spatio-temporal usages of spectrum, b) management of spectrum to be easy & efficient. Per location licence will promote SME's co-creation of 5G products and services development as well as fast track evaluation & validation at the pre-commercial phase, as most of the 5G equipment is expected to eventually be compatible with 3.8-4.2GHz.
Question 2: Are there other potential uses in the three shared access bands that we have not identified?	Aligned with the proposed objective of promoting innovation, this will allow innovation & development within operation of private networks are various scales.
Question 3: Do you have any other comments on our authorisation proposal for the three shared access bands?	We do not have additional comments on this; we believe the proposed single point authorization and allocation of spectrum is reasonable, which are aligned with our research results [5-6].

Question 4: What is your view on the status of equipment availability that could support DSA and how should DSA be implemented?	Within our experience – dynamic spectrum sharing will be driven by software. Hence definition of resource pool, priorities can make it feasible to activate on hand-off and roaming principles. Sharing agreement between the operators is the biggest obstacle to overcome, as found in our research in [2-3, 6] which this proposal has addressed.
Question 5: Do you agree with our proposal for the low power and medium power licence? Please give reasons supported by evidence for your views.	With a strict set of frequency planning, considering the 1st & 2nd order adjacent channel interference – we agree with the OFCOM's proposal for low power & medium power licence. In comparison to the existing set of link budgets (5G BS 1-O indoor (33dBm) and outdoor (47dBm)) within incumbent user, the proposed indoor and outdoor power set is [24dBm (low power) and 42dBm(medium power)] respectively; hence proposed co-existence will be manageable. Our learning for Worcestershire 5G testbed [7] support this too. As the medium power transmission is restricted within rural areas, 5dB difference in power will not pose significant threat to incumbent users.
Question 6: Are there potential uses that may not be enabled by our proposals? Please give reasons supported by evidence for your views.	We believe, beside location based licence – temporal licence could be useful for traffic peak-shaving or slice extension during non-periodic peak-hour as well as disastrous scenarios, as reported in theoretical models [5, 6]. As one of the major objectives of the proposal is efficient usage of spectrum, especially for 3.8-4.2GHz – availability of on-demand temporal licence along-side location limiting licence could provide additional efficiency for MNO's licenced bands. Location & temporal licence will enhance the reserve resource pool during peak hour; hence there will be opportunities for co-creation/co-operation between private-public and private-private networks as we have found in our works [5-6]. It is also possible to manage with ease as OFCOM is intended to manage interference centrally from a single authorization entity.
Question 7: Do you agree with our proposal to limit the locations in which medium power licences are available? Please give reasons supported by evidence for your views.	We do agree with the proposal of location/equipment limiting licences. The current proposal of medium power licences are limited for rural areas. This due to the existence of high-density small cells of the incumbent users subsequently poses higher risk of interference.
Question 8: Do you have other comments on our proposed new licence for the three shared access bands?	No other comment.

Question 9: Do you agree that our standard approach to non-technical licence conditions is appropriate? Please give reasons supported by evidence for your views.	The proposed non-technical conditions are reasonable. Within our scope we agree with this approach.
Question 10: Are you aware of any issues regarding numbering resources and Mobile Network Codes raised by our proposals which we have not considered here?	Within our scope, we do not anticipate any issue at least within 5G as well as its predecessor mobile usages very soon. One of the possibilities will be assignment of a single MNC to all the new users or a short list of MNCs can be assigned to each of the private networks, classified according to the nature of the usage. In worst case scenario, if a UE enters a non-parent private network – the registration will be denied anyway due the lack of registration information, although registered MNC may be the same.
Question 11: Do you agree with the proposed technical licence conditions for the three shared access bands? Please give reasons supported by evidence for your views.	On the basis of the 3GPP defined mask and measurement attained from Worcestershire 5G testbed [7], we do agree with the proposed technical condition specification for both low power and medium power. Especially, not restricting the antenna height for medium power (3.8-4.2GHz) is sensible for rural areas.
Question 12: Are there other uses that these bands could enable which could not be facilitated by the proposed technical licence conditions? Please give reasons supported by evidence for your views.	Within our scope, our answer to this is NO.
Question 13: Do you agree with our proposed coordination parameters and methodology? Please give reasons supported by evidence for your views.	The major obstacles of spectrum sharing to attain the highest possible spectral efficiency are attaining the agreement of sharing as well as co-operative interference management at a given time and space. The proposed coordination parameter & methodology alongside single point authorization overcomes these obstacles. Our analytical models in [1-6] support the proposed co-ordination parameters and methodology, in terms of spectral utilization efficiency, promoting relaxed oligopoly for spectrum market as well as enhanced profitability.
Question 14: What is your view on the potential use of equipment with adaptive antenna technology (AAS) in the	Within our scope, we believe there is great potential of adaptive antenna technology within this band. As the technology is available, there are number of potential applications SMEs can take the opportunity for innovation, such as low cost indoor and outdoor

3.8-4.2 GHz band? What additional considerations would we need to take into account in the technical conditions and coordination methodology to support this technology and to ensure that incumbent users remain protected?	positioning, asset tracking or non-privacy invasive monitoring applications. For medium power usages, definition for beam characteristics (width, elevation) will be required to manage interference to define suburban usages. As medium power licence is to be assessed in case by case basis, and interference management will be conducted centrally by OFCOM, AAS will allow 3.8-4.2GHz band sub-urban & urban areas.
Question 15: Do you agree with our proposal not to assign spectrum to new users in the 3800-3805 MHz band and the 4195-4200 MHz band?	We are in support of having a guard-band to avoid band-edge inference. Proposed 5MHz band at both side of the proposed band is sufficient to ensure interference insulation.
Question 16: Do you agree with our fee proposal for the new shared access licence? Please give reasons supported by evidence for your views.	For small scale usage the proposed fee might be reasonable, as 50m radius lead to a circular coverage of 0.0157km^2. However, if we consider a warehouse of size for example 1km^2 and intend to have licence for 100MHz - then annual cost will become in access of £50k. The similar CAPEX/OPEX limitation may will arise for manufacturing plant with bigger footprint, subsequently raising per unit production cost. In this context, the Worcestershire5G Consortium [7] suggested the view that cost-effective Private Networks (which is one of the primary objectives of the proposal) are vital if the UK is to take full advantage of the Industry 4.0. There could be alternative ways to define fees for private usage of spectrum in bigger geographical foot-print e.g. large warehouse (as an example); such as multi-band approach in either the total number of transmitting equipment or total areas to be covered.
Question 17: Do you agree with our proposal to change the approach to authorising existing CSA licensees in the 1800 MHz shared spectrum? Please give reasons supported by evidence for your views.	Yes, we agree with the proposal. Our analytical studies in [5,6] show single point authorization & co-ordination will support SMEs (e.g. telemetric research and innovation etc.) to innovate low-cost product & services due to the accessibility of low cost spectrum and readily available equipment at the market.

Question 18: Do you agree with our proposal for the Local Access licence? Please give reasons supported by evidence for your views.	Yes. Our analysis presented in [4-6] suggests the proposed local licencing approach will ensure more relaxed oligopoly in spectrum. Subsequently, CAPEX required for innovation from SME will reduce significantly.
Question 19: Do you have any other comments on our proposal?	No.
Question 20: What information should Ofcom consider providing for potential applicants in the future and why would this be of use?	Alongside the technical & non-technical licence conditions, access to the following information will be helpful for the new applicants: 1. Average existing power-map within the proposed bands to identify not-spot & interference free spot. 2. Access to live power-map of the proposed sharing bands. These information will allow new applicant to identify sites as well as plan a periodic usage pattern to co-exist with the other users.
Question 21: Do you agree with our proposal to have a defined licence period and do you have any comments on the proposed licence term of three years?	In principle, we agree with the period of the licence to be minimum 3-year and relaxed nature of renewal during the subsequent years. The proposed option of negotiated licence duration will be helpful for SME, at least the first round of users.
Question 22: Do you have any other comments on the proposed Local Access licence terms and conditions?	No.
Question 23: Do you agree with our fee proposal for the new local access licence? Please give reasons supported by evidence for your views.	Our response is the same as in 16. [For small scale usage the proposed fee might be reasonable, as 50m radius lead to a circular coverage of 0.0157km^2. However, if we consider a warehouse of size for example 1km^2 and intend to have licence for 100MHz - then annual cost will become in access of £50k. The similar CAPEX/OPEX limitation may will arise for manufacturing plant with bigger footprint, subsequently raising per unit production cost. In this context, the Worcestershire5G Consortium [7] suggested the view that cost-effective Private Networks (which is one of the primary objectives of the proposal) are vital if the UK is to take full advantage of the Industry 4.0. There could be alternative ways to define fees for private usage of spectrum in bigger geographical foot-print e.g. large warehouse (as an

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Reference:

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