ip.access Ltd welcomes Ofcom's proposals to include specific provision within the auction proposals for low power spectrum licences that would be suited to small cell systems (also known as femtocells and picocells). We feel that they will benefit consumers of wireless services in a number of ways. The enormous growth in demand for mobile data capacity will require the use of smaller cells as well as additional spectrum and new technologies. Femtocells can provide a highly efficient use of spectrum since their relatively low power will allow frequencies to be re-used intensively leading to higher capacity than can be achieved using only a conventional larger cell network architecture. The provision of multiple low power shared spectrum within the auction will open up the possibility for additional innovation and competition which is targeted to specific consumers on a localised basis.

Service innovation can benefit both residential and enterprise consumers, in a number of ways, including the provision of more personalised and location-based services to the consumer using one or more standardised devices. Moreover, a more comprehensive and attractive service offering for the consumer may be available if the conditions are made appropriate for some roaming between femtocells and the existing macro-layer infrastructure. This is being played out in Netherlands where access to DECT guard band spectrum is opening up new business models for "private GSM" and integrated communications solutions for large and small enterprises.
ip.access believes that small cells represent the most efficient use of spectrum to deliver current and future capacity demands, as well as being a significant enabler for new services.

Question 4.1: What use, if any, would you make of the top 2x10 MHz of the 800 MHz band in the second half of 2012 if it were available for use? What would be the benefits for citizen and consumers of such availability?:

Question 4.2: If we were to offer shared access low-power licences in some way, do you have any comments on the appropriate technical licence conditions which would apply for the different options?:

The necessary technical licence conditions will vary depending on the spectrum made available and the number of concurrent operators. Ip.access notes that several options are presented in the consultation document and that Ofcom plans a further consultation on the detailed technical licence conditions. For pure indoor use a lower power would be sufficient but for outdoor use some cooperation measures would be appropriate between licensees to manage the interference environment effectively and Ofcom may wish to consider this aspect further. The optimum technical conditions and utility of the spectrum may depend on the number of licenses awarded.

1. The dedicated spectrum option with ideally 2x 20MHz, concurrent low power spectrum represents the simplest form of spectrum packaging with minimum technical coordination effort between low and high power operators. look-up database should be used by Ofcom (or its 3rd party) to store up to date location and cell information of every small cell deployed which is similar to the current coordination framework maintained by Mobile200 (on behalf

of Ofcom) for GSM/DECT guard band spectrum at 1800MHz. Appropriate technical coordination is still needed amongst the low power operators to deal with co-channel interference.

2. 2x 10MHz of concurrent low power spectrum would also enable operation of the low power spectrum in a similar way, independent of the macro network, but would render the deployment of very dense low power networks more challenging

3. The hybrid spectrum option (2*20MHz concurrent low power spectrum with 2*10MHz are for low power use only and 2*10MHz are for high power use with low power as an underlay) is an interesting packaging option and has strong merit due to its ability to offer the maximum data rates to end users provided suitable interference mitigation techniques can be put in place to deal with co-channel channel interference issues not only with other low power operators and also impacted high power operators. The look-up database would need to be extended to store up to date location and cell information of every macro cell (only in impacted high power band) and small cell deployed. This will allow both the high power and low power operators to check for possible co-channel interference should they intend to deploy a cell in the vicinity areas. In the event of interference, low power operators can take appropriate actions to minimise interference towards macro operator by reducing the channel bandwidth to the upper 2*10MHz spectrum band at the expense of data rate reduction. Alternatively, both low and high power operators could deploy SON (Self-Organising Network) to invoke dynamic power control and resource scheduling to allow low power operator to maintain the use of 2*20MHz of channel bandwidth.
All femtocells have a Network Listen (NWL) capability to listen for neighbouring cells, and thus have the ability adjust their operating parameters (in particular transmit power on various channels) to minimise interference to other cells whilst meeting target service requirements for users of the femtocell. Although the Ofcom proposals are technology agnostic we note that a technology such as LTE has further capabilities to request the handset to make specific measurements that can be used for optimisation (Automatic Neighbor Relation - ANR) which is also now being developed for 3GPP 3G technologies in the Rel-10 / Rel-11 timeframe. It is our understanding that the drive for operating efficiencies and delivering cost-effective performance to the end-user is leading to many new macrocell and microcell deployments to also have a NWL capability in order to allow macro networks some degree of self-organisation without manual intervention. Thus the additional hardware costs of rolling out SON over and above what is currently deployed should be relatively small

4. The concurrent spectrum option (2*10MHz concurrent low power and high power use) will require significant coordination efforts between low power and high power operators. In a similar way, the look-up database will be a beneficial tool to use to identify areas of interference where technical coordination efforts are most needed. The use of SON will become more important to deal with co-channel interference.

Question 5.1: Do you agree that national wholesalers need a reasonable overall portfolio of spectrum to be credible providers of higher quality data services? In particular, do you agree that national wholesalers need some sub-1 GHz in order credibly to be able to offer higher quality data services? Please state the reasons for your views.:

Question 5.2: Do you agree there is a material risk of a significant reduction in the competitive pressures, at least to provide higher quality data services, in retail and wholesale markets without measures in the auction to promote competition? Please state the reasons for your views.:

Question 5.3: Do you agree there is a risk of potentially beneficial sub-national RAN uses not developing without measures to promote competition? Please state the reasons for your views.:

Ip.access agrees with Ofcom that sub-national network infrastructure will bring innovation and competition to the benefit of consumers. A number of well-known factors contribute to a very high barrier to entry in the national mobile market, whereas sub-national networks are a potential opportunity for new players which ip.access welcomes.

However, the initial approaches adopted for 2G and 3G roll-out in the UK showed the problems of an approach such as focusing on Greater London to start with and then extending nomadically, with consumers frustrated at the lack of coverage. This has demonstrated the customer requirement for ubiquitous coverage over a wide geographic area. Consequently we believe that any new entrant in the sub-national low-power space would need the right to some sort of national roaming agreement at fair interconnection rates with the established wholsale operators, and that Ofcom should have a view of what such a 'fair' rate should be if the licensee(s) of the low-power spectrum were unable to reach commercial agreement with other operators to supply such roaming capability away from their own area of coverage. We describe a technical issue related to such roaming in the next paragraph.

We are aware of debate on the desirability of a goal of combining the macro-cellular infrastructure in a seamless way with an almost free nomadic lower layer that had similar open characteristics to WiFi. Whilst this goal is laudable it raises some significant issues related to how 'seamless' the roaming can actually be. The 3GPP cellular standards in use in the UK today all have the property that the cells broadcast a neighbour cell list (NCL) that is used by handsets in an active call to limit their scan of frequencies and technologies to hand over to. This neighbour cell list is limited in size, with neighbours partitioned between co-channel, other frequencies and other technologies, and a significant proportion of the entries are taken up by other cells in the macro network, leaving limited space to indicate the potentially numerous cells in a femto layer that lie within range of the macrocell. Consequently seamless hand-in from a macrocell to the femto layer may not be universally achievable, although hand-out from the femto layer to the macro layer is more straightforward because of the much smaller number of neighbours of a single femtocell. Good quality handover of packet-based services that are delay tolerant may be a more practicable goal that provides the consumer with many of the benefits and without requiring extensive and potentially cost-increasing handset modifications such as an additional radio to scan with. We recommend that this issue is considered further if Ofcom is considering the roaming issue between the current macrocellular system and a femto-type underlay.

Question 5.4: Do you agree with the analysis that at least four competitors are necessary to promote competition?:

Question 5.5: Do you agree that the specific measures we propose to take to ensure there are at least four holders of such spectrum portfolios are appropriate and proportionate?:

Question 5.6: Given the measures we propose to take to ensure four holders of spectrum portfolios sufficient credibly to provide higher speed data services, do you agree that it would not be appropriate or proportionate to introduce a regulated access condition into the mobile spectrum licences to be awarded in the combined award?:

Question 5.7: Do you consider that we should take measures to design the auction to assist low-power shared use of 2.6 GHz? If so, what specific measures do you consider we should take?:

ip.access supports the inclusion of specific provision within the auction that would guarantee that multiple operators can secure low power spectrum that is suitable for femtocell deployments. Shared low-power spectrum provides a cost effective opportunity for new entrants to provide bespoke wireless data services to customers without having to operate a full macro mobile network. This will provide the opportunity for operators to develop bespoke solutions for customers that may not get the same focus from the large national mobile operators.

We think 2x10MHz of spectrum should be reserved solely for shared low power use. Spectrum shared between high and low power users will work in some instances but cannot be relied upon to provide adequate service in all cases and therefore is only viable as part of a hybrid approach.

As the devices and uses of mobile broadband are changing rapidly at this early stage of implementation, it is likely that there will be organisations in the future who will be able to bring consumer benefit using the low power shared spectrum. These may include companies, but also community enterprises looking to improve communications for their locality. While it is impractical to add additional macro wholesale providers without providing additional spectrum, the same restrictions do not apply to the use of low power shared spectrum. Ofcom should give some consideration in the design of the auction to enable new entrants after the initial auction to acquire access to the low power spectrum on an equitable basis.

Question 6.1: Do you have any comments on the proposal to include in one of the 800 MHz licences an obligation to serve by the end of 2017 an area in which 95% of the UK population lives, while providing a sustained downlink speed of 2Mbps with a 90% probability of indoor reception? Do you think there is another way of specifying a coverage obligation that would be preferable?:

Question 6.2: We would welcome views and evidence on the costs and benefits of imposing an additional coverage obligation focussed on particular geographical areas, and if such an obligation were to be imposed what might be the appropriate specification of geographic areas?:

Question 6.3: Do you have any comments or evidence on whether an additional obligation should be imposed to require coverage on specific roads?:

Question 6.4: Do you have any comments on our proposal not to use the combined award to address existing not-spots?:

Question 6.5: Do you have any comments on our proposal not to impose ?use it or sell it? obligations but to consider including an additional power to revoke during the initial term of the licences?:

Question 7.1: Do you have any comments on the proposals relating to the duration of the initial licence period, our rights to revoke the licence during this period, the charging of licence fees after the end of the initial period and our additional revocation powers following the initial period?:

Question 7.2: Do you have any comments on the proposal to amend the spectrum Trading Regulations to apply to the auctioned licences in the 800 MHz and 2.6 GHz bands, to include a competition check before we consent to a spectrum trade of mobile spectrum and not to allow transfers that would increase the number of 2.6 GHz low-power licensees?:

Ip.access does not see the need to artificially restrict the number of low power licencees. Indeed, we see an advantage in terms of innovation and new consumer offerings, to enable as wide a field as technically possible to enter the market and offer services to consumers using the low power shared use spectrum. This will require a suitable interference co-ordinations and management system, but there is no reason why the system established early on in the use of the low power shared spectrum could not be extended to cover new entrants at a later date.

Question 7.3: We welcome views on the merits of the proposed approach to information provision, in particular concerning the type of information that may be helpful and any impacts that publication of information might have both on licence holders and the wider spectrum market.:

Question 8.1: Do you agree with the way in which we are taking account of the main factors relevant to spectrum packaging and why?:

Question 8.2: Are there other factors that we should consider to develop our approach to packaging? If so which ones and why?:

Question 8.3: Do you agree with our packaging proposals for the 800 MHz band? Please give reasons for your answer.:

Question 8.4: Do you agree with our proposal not to allow relinquishment of 900 MHz spectrum and why? Do you have any other comments regarding our packaging proposals for the 900 MHz band?:

Question 8.5: Do you agree with our proposal not to allow relinquishment of 1800 MHz spectrum and why? Do you have any other comments regarding our packaging proposals for the 1800 MHz band?:

Question 8.6: Do you agree with our proposal not to make provisions to include 2.1 GHz spectrum in this auction and why?:

Question 8.7: Which aspects of our packaging proposals for the 2.6 GHz band do you agree with and why?:

Question 8.8: Do you agree with our proposed approach for eligibility points and why?:

Question 8.9: Which approach to reserve prices do you think would be most appropriate to secure optimal spectrum use in the interests of citizens and consumers, and why?:

Question 9.1: Do you agree with our proposals for the auction design and why?:

Question 9.2: Do you have any comments on the proposed auction rules as explained in section 9, Annex 9 and Annex 10?:

Question 9.3: Do you have any comments on how we should approach the payment of deposits and licence fees?:

Question 10.1: Do you have any comments on our proposal to use 800 MHz price information as derived from the auction to estimate the full market value of 900 MHz spectrum?:

Question 10.2: Do you have any comments on our proposal to use an average of 800 MHz and 2.6 GHz price information as derived from the auction to estimate the full market value of 1800 MHz spectrum?:

Question 10.3: Do you have any comments on the proposed approach to convert lump sum amounts into annual payment?: