Additional Comments

Senaptic strongly support the careful addition of NRPs into the 870-873 MHz band. In general, wireless IoT networks try to minimise the number of NRPs needed because they tend to be more expensive and difficult to install than other network nodes. The increase in throughput afforded by these relaxations on duty cycle makes such networks much more economically viable.

Questions

Density of Network and NRP deployment

A4.1 Responses to these questions would be welcomed to inform our views.

Question 1. Do you have any evidence to inform Ofcom's view on the density of higher duty cycle (up to 10%) NRPs deployments, whether this is likely to exceed 10 NRPs/km2 and the total number of higher duty cycle NRPs that might be deployed?

Senaptic's ultra-narrowband Apella technology has been deployed in a variety of networks around the UK for street light control with several hundred thousand connected street lights. The NRPs use the existing Rec. 70-03 Annex 1 g1.3 sub-band. The largest system has an NRP density of $8.3x10^{-3}$ NRPs/km^2. This is more than one thousand times less than the 10 NRPs/km^2 limit. Even if the NRP spacing were reduced by a factor of 10 the density would still be 10 times less than this limit.

Question 2. Do you have a view on how intra-network interference caused by NRPs deployed in large numbers within a network will be managed?

Apella uses the following techniques to manage intra network interference: (1) cellular frequency reuse between NRPs; (2) synchronous operation with scheduled transmissions; (3) planning of NRP locations.

Question 3. Do you have any evidence that networks may fail if the aggregate density of higher duty cycle NRPs reaches or exceeds 10 NRPs/ km2?

In principle the cellular frequency re-use approach scales to high NRP densities. The simulations reported in ECC report 200 (specifically in Table 41 on page 79) show that without power control or frequency planning and with a vulnerable portable alarm receiver that a density of 10 NRPs / km^2 is viable. The simulations did not allow for any of the politeness protocols and included a strong mix of interference sources other than the NRPs. Running these simulations again with higher NRP density will show a "tragedy of the commons" alluded to in the consultation. It is therefore important that organisations licenced to operate NRPs are able to report on their locations if requested so that this density can be policed.

Question 4.Do you have any views on whether exchanging NRP deployment information between licensees and developing and using an industry-managed code of practice would be practical and sufficient to manage the risk of some networks failing?

We would be happy to actively participate in the development and operation of an industry managed code of practice. On top of the regulations already in place for this band and those additional measures proposed for NRPs, we see that main additional points for the code of practice to be: (1) monitoring the total density of NRPs deployed in an area, (2) collecting evidence of harmful interference and (3) appeal to Ofcom to limit the number of licensees if necessary or tighten the licence conditions if necessary. Such a code of practice would provide more reassurance to end customers considering deploying mission critical applications in this spectrum.

Clear Channel Assessment

A4.2 Responses to these questions would be welcomed to inform our views.

Question 5.Do you think CCA as defined by ETSI will be an effective protocol for (a) managing interference between networks? (b) managing interference to short range devices using the 870-873 MHz band?

(a) The CCA scheme defined by ETSI leads to a non-persistent CSMA-like scheme operating between networks. This is known to increase the overall throughput above simple ALOHA by allowing the contending transmitters to schedule their transmissions around each other. The benefit relies on nearby NRPs being able to hear each other's transmissions. NRPs are typically well sited from a coverage perspective so this is likely. Consequently we expect that CCA will is likely to be effective between NRPs.

(b) Lower power SRDs in the 870-873 MHz band and sited in poor radio coverage locations are less likely to be heard by all nearby NRPs and hence the CCA scheme will work less well, but it will still often be effective. This is the portable alarm scenario simulated in ECC report 200 (Table 48) without CCA and so it should be fine. Furthermore such SRDs are likely to be operating over shorter distances than the Hata-SRD 100m assumed for the portable alarms and so will be considerably more robust because of that.

Question 6. Do you have a view on the costs and benefits of adding effective mitigation protocols such as Clear Channel Assessment to higher duty cycle NRPs?

We have considered adding transmit power control and CCA to our NRP design for operation in this band. Both are feasible and should not be expensive to implement.

ETSI EN 303 204 implicitly assumes the following:

(1) links are unicast – i.e. point to point between two nodes
(2) transmit and receive frequencies of all such links are the same.

Neither of these conditions generally apply to Apella NRPs, some transmissions are broadcast rather than unicast and generally more bandwidth is allocated to receive than transmit due to the general flow of sensor information from the sensors to the network.

Both these features lead to a considerably more bandwidth efficient system. We therefore propose an additional clause in the license conditions e.g. in IR 2095 or elsewhere as follows.

(1) NRPs do not have to have identical transmit and receive frequencies
(2) Transmit Power control and CCA do not apply to the parts of an NRPs transmissions which the manufacturer can show to be broadcast but only to unicast transmissions.

Authorisation options and analysis

Question 7. Do you agree with our proposals to authorise spectrum for NRPs using non-exclusive, network licences available on demand?

Yes, but we would add a constraint to limit to density of NRPs to [1] /km^2.

Proposed Licence conditions

Question 8. Do you agree with the proposed licence conditions for higher duty cycle NRPs?

Yes, but we request the clarifications in question 6 to be applied to IR 2095.