Consultation questions

Q1: Are these the appropriate topics to be consulting on?

Yes; also considering that Ofcom seems keen to adopt for UWB an attitude departing from "conventional" frequency management insofar taken for "conventional" services and systems.

Q2: Do you agree with this analysis of our statutory duties? Are there any important factors that have been omitted?

In general yes, but with one exception:
The **"Current and future demand for spectrum"** does not seem fairly exposed; if the statement about *"novel applications that can only be provided using UWB technology"* is correct, it should be completed by another one for Primary Services, currently allocated in the (very wide) range of spectrum where UWB are intended to operate (namely form 3 to 10.6 GHz).
Such a statement should fairly address "novel and future applications in the Primary Services allocated in these bands"; e.g. the economic study does not take into account that "*4G and beyond*" systems are already under consideration for bands from 3 to 6 GHz, currently mostly allocated to Fixed, Fixed Satellite and Mobile.
Therefore, being the UWB interested band so wide, a higher-level duty of preserving some spectrum integrity for novel and future Primary Services development (e.g. WiMAX and 4G) should somehow temperate the "statutory duties" towards UWB.
Actually the Mason's economic report highlighted the serious potential interference and blocking for "BFWA", but Ofcom consultation seems to treat it as a "minor" issue, not considering it as a problem to be mandatory solved, prior than proposing the mask contained in the consultation.

Q3: (Q3-1)Do you agree with the economic study? (Q3-2)Are there other studies that Ofcom should be conducting?

Q3-1: In most part the economic study is valuable, we supported the principles of the five recommendations (particularly 2, 4 and 5) provided by the consultant.
However, in our opinion, one point is not fairly addressed:
For Fixed microwave point-to-point links, impact from UWB has been considered using a possibly fake interfering scenario; the conclusions could not be accepted.
The assumption of a Scenario so that *"the affected antenna was situated on top of an office building with a high density of UWB activity"* is clearly too much favourable (for UWB) and the expected interference would have clearly been NONE also without any study in support.
In fact, in this situation, the FS antenna beam is pointing ~90° from the source of interference (i.e. with ~40 dB decoupling (Mason's assumed 0dBi gain while PP antennas have ~40 dB gain); in addition all UWB signals will be vertically blocked by one or more floors (i.e. 18 dB/floor in Mason's report).
A more correct scenario would have been to evaluate the Pe coming from a UWB building(s) placed at ~ 1 km to few kms away, in the general direction of the beam (assumed to pass ~25/30 m above the roof or with few degrees of offset from boresight); further considering that a number of "glass & steel" corporate buildings are distributed on suburban areas, at different degree of visibility from the FS antenna point of view, possibly roughly along the link, would contribute to interference aggregation.
In this case, the path elevation angle of UWB interference would be ~ 1° or less; UWB interference paths exit from the building through windows or walls (then with far less attenuation than a number of 18 dB/floor) and entering directly in the mean beam of the antenna (having ~ 40 dB more gain); these increment of potential interference will be hardly compensated by additional longer path loss.

Q3-2: Following both the Mason's conclusions for wireless BWA (see Q1) and the above considerations in Q3-1, we believe that the study should be complemented by:
1) A study with more appropriate scenario for microwave PP links as depicted above, or similar.
2) A study for evaluating the possible mitigation techniques (including the economic evaluation of limiting UWB in bands above 6 GHz only) to be enforced to UWB for protecting below 6 GHz wireless BWA that are shown in the present study to be in high danger of severe blocking; this will complete the inconclusiveness of the present economic study on the issue.

Q4: Is there a better way that future use of the spectrum could be taken into account?

We believe that in the text leading to this question there are two considerations that would undermine the present valuable attempt for a "balanced" view for UWB deployment:
1) For not taking into account 4G impact, the consideration that UWB technology itself might be among 4G is a "chicken and egg" debate that does not give support to the statement.
2) The idea that the UWB mask could be changed in future, when millions of devices will be produced and all investment have been made by UWB industries, does not seem practical.

We believe also that the only viable method for future spectrum use, by Primary allocated services for 4G, is to study (now that UWB industries are still on a development phase) and enforce the necessary mitigation techniques (see also above Q3-2), taking into account that protection criteria for any 4G terminal would likely be similar to 3G and BFWA terminals (any radio frequency receiver is mainly dominated by its sensitivity through its noise figure).

Q5: What is the most appropriate solution to the potential interference from UWB to BFWA?

We believe that the only practical solution will be either in the first bullet or in the first part of the last bullet. Here are our bullet-by-bullet considerations on the valid or invalid proposals made:

- **VALID**: the increase of the lower frequency limit would obviously solve the problem (for BFWA and any 4G system) for ever.
- **INVALID**: Standing the current foreseen deployment of BFWA (e.g. WiMAX) and UWB WPANs, provision in this bullet will bar in practice the use of one of the two. Typical use of BFWA is a video streaming on/from network and computers, which screens or video-cameras are driven by a UWB interface. This will clearly not work unless adequate mitigation techniques are enforced.
- **INVALID**: the use of low directivity antennas for BFWA, allowing indoor, cheap and unskilled end-user self-deployment is one of the major targets of these BFWA technologies.
- **First statement, VALID**: the detection prior transmission coupled to dynamic frequency selection/blanking has already been proved valid for RLAN in 5 GHz and has already been proposed (see SE24/TG3 contributions), as a possibility, by some UWB proponents.
  Second statement, INVALID: the proposal does not firstly consider that UWB devices should be implemented for recognising such "silence command" and secondly is posing severe constraints in term of development and per unit cost to a Primary Service application for being protected by a UWB (RR Art 4.4 ??) application (it would be equivalent to have UWB as a Primary service or even more when considering that UWB will not be similarly affected by any relatively narrower band BFWA).

Q6: Would it be possible to achieve sufficient isolation between radio astronomy and UWB through practical methods of physical separation?

No comments.

Q7: Are there any other options that we should consider?

For sure, and they are highly recommended!
Besides what Ofcom mentions about limiting the UWB only above a certain frequency (5 or 6 GHz), the followings are of major importance.
As mentioned also in the Mason's recommendation 5 (page 22), for allowing UWB emissions at power levels equal to FCC regulation at 3.1 to 10.6 GHz, the whole FCC provisions should first be adopted.
In particular, FCC forbids (unless specifically licensed after co-ordination study) the use of any "fixed outdoor UWB applications" and the request of "shut-down" of UWB on hand-held terminals if transmission is not acknowledged by a corresponding UWB receiver within 10s.
These provisions, aiming to reduce "outdoor" generated interference, have already been accepted by UWB proponents, while sensibly reduce the interference potential to outdoor based "fixed victim locations" (e.g. Fixed links, BFWA base stations and FSS earth stations).
As an example for Fixed Service outdoor stations, would these provision been included in the "generic assumptions for UWB" in ECC Report 64, the results, even with the same conservative scenarios could have been more favourable of 6 to 10 dB; this would be due to the drastic reduction of the percentage of outdoor UWB that could concur to the aggregation (outdoor would be limited to hand-held terminals likely at ground level (and in deep shadowing) only.
Also single-entry interference would have been limited to "indoor" only giving immediate benefit of 10 dB.

A second important issue contained in FCC is the wide band (50 MHz) peak power limitation in order to control low PRF devices (see also our reply to Q12).

Q8: Are there any major technical studies that we have omitted?

Yes, see answer to Q3.

Q9: Have we made an accurate assessment of the existing studies?

As a general comment, we regret that Ofcom, while being among supporters of "conservative protection assumptions" in international coexistence studies within CEPT Rep 64 and ITU-R TG1/8, now in this consultation states that most of them are too or extremely conservative.
Specific comment is related to studies for protection of Services within the band 3.1 to 10.6 GHz where the highest UWB interference power is possibly expected:
Provided that most of them show large incompatibility, we believe that, while recognising their possibly "conservative" nature, those studies could not be discarded with simplistic statements like "*this is a conservative study and Ofcom in practice does not expect problems*" but a more careful analysis (with less conservative, but still appropriate, assumptions) should be carried on before assuming a definite position in CEPT (this is actually a possible new task for ECC TG3).
In particular we pointed out the cases in our reply to Q3.

Q10: Do you agree that we should seek a common European framework for the introduction of UWB?

Yes. Standing the "consumer" nature of UWB, a common European position is the only sensible approach for all interested parties.

Q11: (11-1)Have we proposed the most appropriate mask? (11-2)Will it be possible to deliver equipment conforming to this mask?

Q11-1: For bands **below 3.1 GHz** (UWB unwanted emission range) it seems a good compromise between the need of protection and the UWB operation (in particular we are pleased that Ofcom retains the ECC TG3 and ITU-R WP8F studies for 3G appropriate); however, for **bands 3.1 to 11.6 GHz** no compromise is assumed, it favours UWB accepting the limits

required by proponents (then likely over-dimensioned) and it neglects the serious interference problematic still unresolved by the economic study (e.g. BFWA). We believe that more than one option should be considered (e.g. having the portion from 3.1 to 5/6 GHz reduced by 10 dB as compromise ~ in the middle between UWB proponents and the Report 64 conclusions) and/or additional mitigation techniques (to be evaluated) should be jointly mentioned.
Q11-2: **We believe** that generalised "deliveries" of UWB are premature, unless for controlled experimental purposes and also because UWB industries seem still in a development phase.
Moreover in bands 3.1 to 10.6 GHz (and particularly from 3 to 6 GHz) there are still unresolved serious problematic also recognised by Ofcom (for BFWA, RA and other cases including future 4G); in particular our comments in replying to Q3 and Q5 stand.

Q12: To what extent should we define parameters such as those listed above? What is the most appropriate definition for each of these parameters?

In principle, all mentioned parameters are valuable for reducing interference potential; **however, the following one**, while mentioned in other parts of the document, **is missing**:

- Should UWB devices be required to detect the presence of a nearby victim transmitter terminal (e.g. a BFWA terminal) and consequently blanking UWB emission in the corresponding receive band (e.g. similarly to DFS for RLANs, possibly suggested by SE38 also for BFWA in 5.8 GHz bands)?

We believe that this is the only viable solution for a peaceful coexistence between UWB and BFWA (and possibly 4G) in bands from 3.1 to ~5 GHz and **we propose** that it should be added to the list.

Hereby we give a bullet-by-bullet comment to other provisions mentioned:

- *Should there be a minimum pulse repetition factor (PRF)? Low rates of PRF might make the interference less noise-like and potentially more problematic.*

We believe that the issue of PRF should rather be more generally and flexibly addressed with a limitation of wide–band peak power density as in the FCC R&O that suggest:

> *".....rather our proposal was to establish an average limit and a peak limit with the latter consisting of two parts: a total peak power based on the bandwidth of the emission and a peak power limit based on a 50 MHz bandwidth. In actual practice, a UWB transmitter will be subject to the average limit or to the peak limit but not both. Systems with low PRFs will be governed by the peak limits and systems with high PRFs will be governed by the average limits." (FCC R&O 02-48 section 165)*

Further rationale is that the interference impact due to low PRF is actually related to the peak power of the UWB signal in the victim bandwidth. Our experience in testing broadband fixed links with UWB-SRR (see Annex C of ECC Report 23) shows that peak interference impact is related to PRF only in single pulse UWB (with a bi-univocal relationship); however, when dealing with frequency-hopping UWB systems, even with relatively high PRF, the peak could be enhanced over the average also by using fast hopping associated with low duty-cycle (see Annex C of ECC Report 23).
We then propose, also according FCC R&O, that, whichever is the UWB average level enforced, the wide-band peak in any 50MHz be limited to a value no more than ~41 dB higher.

- *Should devices that are not linked with other UWB devices ("non-associated device") limit their emissions? Non-associated devices might make emissions to alert other nearby devices to their presence. Limiting these would result in less noise but potentially increase the length of time for nearby devices to "find" each other.*

This is a provision also adopted by FCC (for hand-held UWB only, even asking turn-off rather then limitation) that, even if not easily quantified, will act in keeping interference potential as low as possible.
We believe that it will not impose particular constraint to UWB devices and **we propose** to adopt it.

- *Should there be a mandated ability to turn UWB transmitters off? This might be valuable if users note that their UWB devices are interfering with other devices that they own (eg W-LANs) and wish to turn one off.*

This is a provision for "last resource" possibility to remove interference; then should be possible. However we believe that in "stand-alone" UWB devices this would be an inherent feature (either through AC mains cable removal or a switch for saving battery charge). The problem is when UWB are used as sub-units in more complex structure (e.g. a computer); in this case the requirement should be for the final integrator, modern computers have already the possibility to disable such peripherals.
We then believe that it should be related to the "*information on intended use*" accompanying the UWB device according R&TTE Directive Art 6.3.

- *Should UWB devices be required to use the minimum power for the data rate and range that they are trying to achieve? This might result in power levels lower than the maximum being used for many applications, with resulting reduction in potential interference.*

We believe it has to be seriously considered and it should not be too onerous for UWB proponents. This is another mitigation technique mentioned by some UWB proponents and is possibly already considered within IEEE 802.15.3a standard (to be verified); it would be highly effective in the proposed UWB operating range 3.1 to 10.6 GHz for the protection of Services (e.g. FS and FSS sensitive to aggregation) not otherwise protected by the proposed mask.

- *Should there be any guidance provided to UWB users? The FCC issues detailed guidance about issues such as the use of UWB devices out of doors. If so, what should the instructions cover?*

We believe that, if such regulatory provisions (similar to that taken by FCC) are adopted also by CEPT in a specific Decision, the necessary information to the user on the "*intended use of the apparatus*" shall be given under R&TTE Directive; it might refer to Art 6.3 of the Directive.
For example also FCC requires that indoor UWB "shall bear" notice to user as follows:

> *FCC Title 47 - Section 15.517*
> *.....*
> *(g) UWB systems operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device or in the instruction manual supplied with the device:*
>
> > *This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. § 301 and could subject the operator to serious legal penalties.*

Obviously the legal aspects of such statements for European application should be carefully analysed and specific text should be developed.

- *Should there be a minimum bandwidth for UWB? The FCC have required a bandwidth of at least 500MHz. Suggesting a minimum bandwidth would seem to provide technological constraints when they might not be necessary.*

This seems necessary for defining which apparatus could claim itself of being under a specific UWB regulation, avoiding its possible abuse or misuse by "non UWB applications".
Depending on the actual provisions of a possible European regulation, abuses might not be relevant; in any case, careful analysis should be done before removing this limitation.

- *Are there are specific applications where the potential consequences of UWB outweigh the potential benefits, e.g. replacement of monitor cables due to high data rate combined with continuous operation? If so, would it be practical to limit the range of applications that UWB could be used for?*

In principle, avoiding "video streaming" applications will reduce the average activity factor and would improve compatibility with existing services; however, video applications are major targets for UWB proponents.
More technical analysis should be taken on this issue; noting also that some UWB proponents have already proposed limitation of video streaming application to ~40 MHz maximum rate.

Q13: Is our proposed approach to international bodies appropriate?

While, in principle, we concur that a European harmonised solution should be sought, **we believe** that the mask proposed above is not appropriate in the range 3.1 to 11.6 GHz (see our response to Q11) unless contemporarily complemented by the proposal of mitigation techniques for solving the unacceptable interference (blocking) potential from UWB to BFWA (and likely to any 4G terminal in that bands), identified by Mason's report and presently disregarded in this Ofcom proposal.

Q14: How should we best deal with the precedent potentially set by our proposed approach to UWB?

Regarding the mentioned conservativeness of present ECC study for FS, we note that, while scenarios might possibly be conservative, from the point of view of protection objectives (i.e. the 1% mentioned) they have been carried using the same methodology and conservativeness used in the past for coexistence with "secondary" services.
We also disagree with the statement *" …which is not reflected in practical measurements"*; actually in ECC Rep 23 (on 24 GHz UWB SRR) tests between considerable number of "pulsed UWB emissions" and wide band FS receiver have been presented in perfect agreement with the theoretical study (the different frequency band and different UWB application does not impact the results because UWB and victim receiver are of the same physical nature). Ofcom (RA at that time) was also present as supporter and witness to the test campaign.

Regarding the requested opinion on how to deal with the presented policy implications we offer the following considerations:
Obviously, CEPT Administrations, for favouring UWB, may change attitude towards protection of primary services; however this would create a precedent that, unless politically kept under control, might disrupt international coexistence rules insofar taken.
An example is the SE19 study for coexistence of "secondary" FSS ESV (Earth Stations aboard Vessel) with primary FS links in 14.3 GHz band, for which similar assumptions as those for UWB and FS have been applied; should now "secondary" FSS complain back for having been threatened less fairly than a "no status" application and asking for a relaxed regulation ??
Second example, co-primary sharing between FS and FSS are generally based on I/N=–10 dB (corresponding to 10% allowance on performance degradation), if UWB would be granted the same, what should be done for all ITU-R SF series Recommendations??
Specifically, FS "intra-service" interference is controlled through licence and frequency co-ordination processes generally assuming that other non primary interference source are null; a higher allowed UWB interference might be considered in those processes (e.g. licensing an higher eirp for the same link or FWA cell); however, existing links may not have extra-power to offer (in particular longer hops are often very marginal for the fulfilment of ITU-R performance requirements), the cost for their re-fitting should be paid for (our comment to Q3 on the inadequate scenario used by Mason for microwave point-to-point links should be also considered).

Regarding the proposed equation "UWB = out-of-band emission" (referencing to Spectrum framework review), **we should underline** that out-of-band from adjacent band licensed service are confined in a limited portion of frequency close to the borders. Regarding "unwanted emissions" their limit has been agreed within CEPT on the basis that they happen randomly in few spot frequencies within a band. UWB emissions are expected to permanently affect the whole band(s).
Therefore mixing UWB with OOB or unwanted emission is not recommended; they should be in any case considered as a separate issue.

Regarding the final proposal for "*each case on its merits, including understanding the economics of the situation"*, **we believe** that it is the only viable solution for UWB considering that they, physically, are a complete different case with respect to any other "conventional" spectrum competition. However, the present Ofcom proposal seems equivalent to considering UWB as Primary Service.
Economic implication on case by case maybe better suited, provided that it is thoroughly and fairly considered; this is also the process for primary and secondary allocations by Conferences. However, we feel that in Mason's and Ofcom's documents the economic aspects are suitably treated in term of **gains for citizens** (more wireless application on the market) and **gains for UWB proponents** (opening mass market with proposed regulations for UWB communications similar, in practice, to FCC ones), while **costs for primary license holders** in bands 3.1 to 11.6 GHz are not (yet ?) clearly identified, nor views on who should pay them (e.g. a license fee reduction) are offered.

Q15: What should Ofcom's role be in setting and monitoring EMC standards?

The mentioned equivalence of UWB with computers EMC is not physically correct.
PC clocks frequencies are nowadays ~ 1 GHz or more; emissions are then confined to a number of "unwanted" harmonics spaced ~ 1 GHz (maybe with few sub-harmonics conversion products) or anyhow widely spaced. UWB emissions are composed by a constant series of spectral lines spaced few MHz or less; therefore, the potential spectrum span affected is several order of magnitude higher than any EMC phenomenon.
Also in this case, we recommend that UWB is considered as a specific single case without any mixture with well proven EMC concepts and regulations.