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Response to the Call for Input on the 700 MHz Issue

Samsung Electronics is pleased to have the opportunity to reply on the call for input on the 700 MHz issue.

Question 1: Have we correctly identified and characterised the potential costs set out above, and what other costs – if any – should be taken into account in our assessment?

Samsung Electronics generally agrees with costs listed in section 4. In addition, Samsung Electronics would like to clarify the following aspects:

Costs to Upgrade and Modify Reception Installations

OFCOM's studies should also have some fact findings about typical households, not only limited to the aerial but taken into account the whole reception equipment. From the experience of LTE800 the interference issues are mainly born into the aerial reception. OFCOM should therefore get an overview on typical aerial installation.

A particular focus should be on the need to upgrade the installations (i.e. filters or swapping amplifiers) or possibly reorient the antennas:

- The DTT success was built on widely reuse existing installations. This means that households receiving DTT are not necessarily meeting recent standards. Nevertheless, they are perfectly suitable for current DTT reception, so it legitimate to consider these households as having the right to the re-establish their reception after LTE introduction.
- The need for reorienting the antennas may be necessary if the re-planning result in a need for many frequency changes and new sites. This may be the result of international coordination with the target to keep the same number of layers whilst obtaining protection for mobile services in the band 694 – 790 MHz.

Cost of Transition to DVB-T2

There will be additional costs associated with a transition to T2 or any other technology change and the needed for additional communication effort. Their rationales are more detailed in question 21.

In the event that higher receiver immunity forms a large part of the strategy to release the 700 MHz band, additional costs could arise from the increased price and the reduced choice of receivers or the consumer. Response to question 21 explains why using the instrument of requiring better receiver immunity as interference management measure may delay availability of the band 700 MHz for mobile.

Cost associated with Secondary TVs

Secondary TVs need to be considered as well when assessing the costs. These are often reuse of former “living room” receivers and are consequently very often MPEG-2 / DVB-T receivers only.

Cost of Interference management

Irrespectively on how immune receivers will be, there will still be need for a proactive interference management as carried out with DMSL. This will be associated with costs.

Cost on Consumer Communication

The transition to 700 MHz will be needed to be accompanied with additional communication effort in order to deliver a clear message to the consumer after the DMS activities, the start of White Space Devices and the temporary introduction of additional services in the 600 MHz band.

Cost on CE manufacturers

From a CE manufacturer perspective, should new interference immunity requirements be formulated, additional costs with this associated new interference immunity requirements will occur. These will be through R & D costs for new performance levels, higher performance components, Instability of immunity requirements, the risk associated with uncertainties on the future of DTT.

These costs are further more detailed in question 21.

Overall, the costs might be present if other countries would decide to release the 700 MHz for mobile even if the United Kingdom decided to keep the band reserved for DTT.

Question 2: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in assessing each of these potential costs? Please identify any sources of specific evidence to which we should have regard.

[no response]

Question 3: Have we correctly identified and characterised the potential benefits set out above, and what other benefits – if any – should be taken into account in our assessment?

Yes, Samsung Electronics generally agrees on the identified benefits set out by OFCOM.

Question 4: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in assessing each of these potential benefits? Please identify any sources of specific evidence to which we should have regard.

[no response]

Question 5: In particular, what is your view of the likely future demand for additional sub-1 GHz spectrum for the provision of mobile data services, and what evidence supports this view?

Samsung Electronics supports the request for additional spectrum for wireless broadband. Nevertheless, we assume that the transition should be managed in a way that there should be no disruption for the consumer and the impact for CE industry should be minimized.

Question 6: Should we place different weights on some costs and benefits than on others, for example depending on whether costs would be borne by consumers, DTT operators, or mobile operators?

Samsung Electronics generally agrees with the costs and their weight but the added aspects described in question 1 need to be taken into account as well.

Question 7: Do you have any other comments on the work we are currently undertaking on potential costs and benefits?

The key objective should be to reach European harmonized market at early stage - at the stage of preparing and starting the transition in UK to the extent possible. This is valid for the consumer electronics industry as well as the mobile industry.

It is therefore of prime importance that OFCOM seeks common understanding on the release of the 700 MHz and encourages other European countries to set informed long term perspective on the UHF band and the future of DTT. This would facilitate the transition process and lead to economies of scales.

Question 8: Have we correctly identified the costs and benefits that could vary depending on the timing of release, and the impact of those factors? Are there other costs and benefits which would vary depending on the timing of release of the 700 MHz band which we should take into account?

[see question 9]

Question 9: How quickly could the 700 MHz band be released? What would be the impact on DTT infrastructure costs of releasing at the earliest possible time compared to a later time? What would be the factors which affect these costs?

There are number of factors associating the date of the 700 MHz release and the costs of the 700 MHz release:

- A desynchronized date with other European countries would lead to additional costs (see question 1 and question 7)
 - o Simple filtering of the band is not possible on European wide basis, it complicates the logistics and diversity of receivers
 - o LTE800 was introduced based on European wide EC Decision. However LTE800 was deployed with different national approaches with different interference management, different resulting performance requirements for DTT receivers and different test signals. These elements were generally defined in a two year frame between the start of discussion and the implementation. Such a short time frame and a national fragmented approach increase the difficulty of manufacturers to react accordingly.

- Given the common replacement cycle for IDTVs of 7 years and much longer cycle for aerial installations, setting early dates decreases the timeframe for replacement or upgrade of the equipment with following consequences:
 - o Decrease of the time frame for manufacturers to offer suitable products
 - o Decrease of the time available for suitable communication, increase of confusion with the other process like WSD introduction, LTE800 deployment and 600 MHz DTT deployment.
 - o Increase needed effort of authorities for measures to accompany a successful transition (systematic upgrade of installations, full interference management, subsidies on receivers) or raises the required motivation to a challenging level

These points are developed further in question 21.

Question 10: How, and to what extent, are the costs for existing (PMSE) and potential (WSD) interleaved users of the 700 MHz band likely to vary depending on the timing of release? What would be the factors which affect these costs?

[no response]

Question 11: Should we consider any other cost-related arguments / evidence in favour of an earlier or later release date?

As raised in question 9, the possible harmonization and the clarification on long term strategy for terrestrial delivery of broadcast content are needed in order to motivate stakeholders to take a proactive approach. These aspects are further raised in question 21.

Question 12: What would be the impact on mobile broadband delivery and competition of releasing the 700 MHz band later rather than sooner?

[no response]

Question 13: Should we consider any other benefit-related arguments / evidence in favour of an earlier or later release date?

[See question 11]

Question 14: Is the range of potential dates for release likely to be wide enough to merit consideration of an incentive auction approach?

Question 15: If so, what are the challenges to designing an effective incentive auction in this case, and how might these challenges be addressed?

Question 16: If we followed an incentive auction approach, how should we take account of wider costs and benefits – i.e. those not felt by participants in the auction?

Question 17: Do you have any views at this stage as to the parameters of an incentive auction, such as the default date and payment mechanism?

Question 18: Is there a version of the overlay auction approach which could be suitable for 700 MHz release?

Due to the number of involved stakeholders (mobile equipment industry, mobile operators, installers, broadcasters, broadcast network operators, CE manufacturers, PMSE users, WSD users and WSD management), it may be extremely challenging to establish

mechanisms to vary the target date of release and to ensure that all the impacted stakeholders are adequately compensated. This is amongst others due to the difficulty to quantify in a precise and firm way the costs associated with the variation of a release date for each stakeholder.

Question 19: What are the benefits and risks of conducting an overlay auction in this case?

An overlay auction would lead to mixed / scattered operation of mobile and broadcast which may be not be beneficial due to the challenging coexistence situation.

Question 20: Have we correctly identified and characterised the potential impact of 700 MHz release on consumers accessing DTT? What other impact – if any – should be taken into account in order to identify pre-emptive measures to reduce this impact?

[see question 1]

Question 21: Do you have any comments on the pre-emptive measures relevant to DTT identified above? Are there other pre-emptive measures we should be considering?

Interference management and communications measures will be needed to allow for a timely release of the 700 MHz band. In order to avoid the confusion to the customer, it may be beneficial to merge LTE800, WSD and LTE700 interference management activities. OFCOM should work with the CE industry to define stable and long term targets for immunity, also from European point of view. As these can only very partly decrease the need for interference management, not too high expectations should be placed into interference immunity else it would be rather counterproductive and delay the transition by increasing the receiver costs and reducing the choice of receivers.

In the scope of long term and stable objectives, these new immunity requirements should be defined when the interference environment and the technologies applicable to these devices are known; in other words:

- When a clear longer term commitment to a stable DTT delivery spectrum framework for the development of cost and technically effective immunity performance is reached. This commitment needs to be European market wide.
- when Channel arrangements and emission levels of the 700 MHz are stable
- when other influencing factors like transitions to other technologies beyond T2/AVC are understood.

Towards the consumer, the stability is also necessary to deliver a credible message the consumer. Additional value proposition for DTT is needed to counterbalance the negative impact of new migrations (upgrades).

The reasoning for these conclusions is discussed hereafter:

Immunity improvement against LTE interference has their drawbacks and will lead to a cost increase of DTT receivers if not carefully established with the CE industry on long term

Most receivers have in common the same architecture which is based on low noise amplifier with automatic gain control and channel decoder. This allows a high sensitivity of receivers

with an affordable price. To increase the immunity, several elementary measures are possible and some are discussed hereafter:

- Filtering out the band 470 – 694 MHz:
 - o Advantages
 - It is a pragmatic solution but is only improving the situation with respect of the band 694 -862 MHz.
 - o Drawbacks
 - Possible extensions of the band for WBB and immunity against other interferer require new filters.
 - It requires a clear view on long term on 700 MHz band plan and a coordinated release of the band 700 MHz as the receiver. If not, this leads to additional diversity in the market which is challenging to achieve and lead to additional costs
 - DVB-T channel decoder and DVB-C channel decoder are generally integrated. Such a method will increase the costs due to the need of two different decoders or include some switchable RF filter bypass circuitry under software control with additional losses and costs
 - Cumulative effects with already installed filters (LTE800) needs further assessment
- Decrease the sensitivity of receivers
 - o It may be a strategy adopted by some manufacturers if challenging mandatory requirements on immunity would appear.
 - o Advantages:
 - Raises the maximum input power
 - Reduce adjacent channel interference sensitivity
 - o Drawbacks
 - This has the obvious drawback that aerials and transmitters will need to be upgraded to compensate the degradation.
- Increasing the dynamic range of the AGCs
 - o Advantages
 - This leads to some improvement with respect to receiver blocking
 - o Drawbacks
 - Increasing the dynamic range is difficult to achieve with the limited power supply voltage and power dissipation requirements of silicon tuners used in modern TV sets

- Decreases the performance of zapping time, adaptation in multipath environment
 - Reduces the sensitivity in presence of strong adjacent signals
 - Increase of recovery time in case of transient signals
- Increasing the resolution of Analogue to Digital Conversion and Digital Signal Processing
- Advantages
 - Increases the selectivity of receivers and their blocking level if assumed that the tuner is not the limiting factor (see above).
 - Drawbacks
 - Increases significantly the costs of a higher resolution and fast AD converter
 - Required processing performance must be significantly increased otherwise an effective channel equalization, a fast synchronization is not possible anymore. This could mean extending the width of the data path throughout the whole demodulator design, adding significantly to silicon area, cost and power consumption
 - Higher order additional digital filtering
 - Higher amount of data sample to be processed
 - Higher Processing power increases
 - the power consumption
 - the costs of components
 - heat dissipation and therefore form factor constraints
 - Due to the non availability of components which such higher digital signal processing it can be anticipated that it would reduce the number of available vendors and highly increase the price of DTT tuners & channel decoders

It can be therefore concluded that the receivers cannot substantially improve their immunity against LTE interference without increasing the price of receivers.

Uncertainties on the interference environment and on the future of DTT increase the investments risk of R & D on better immunity

Additionally to the challenging character of increasing immunity, DTT receiver manufacturers are confronted with a very unstable interference environment and its associated regulatory environment:

- The deployment of LTE800 was on very short term and different countries adopted different regimes and requirements from 2009 to 2013.
- In 2009 and in 2012 the European Commission requested two times a better immunity of receivers with respect to the LTE interference
- The introduction of receive only devices in the Radio Equipment Directive may lead to other new requirements
- The CEPT has to defined yet the technical conditions and the band plan of LTE700
- The introduction of possible interferers like WSD and PPDR may impact the requirements although these services are deemed to be introduced on non interference basis.

This instable interference environment is associated with the general question of future of DTT as several new systems and concepts are discussed as a replacement of DVB T/T2. Additionally, the European Commission considers converged systems as a possible option¹ and the CEPT has started a general discussion on the UHF band. In this context, the development of new receiving architectures and design is a risk investment, which can be seen as additional costs for a receiver development with better immunity.

The effect of higher immunity requirements will not necessarily strongly decrease the amount of needed interference management

Receiver chip design usually last over several years, so an annually change in design does not appear realistic. It was recognized by OFCOM that only 80 % of receivers will be equipped with T2 receivers by 2018, although users are motivated by HD services. In analogy, when considering replacement of receivers with better immunity, the motivation of users to upgrade to receivers with higher prices without clear added value will be lower. It is difficult to expect faster replacement.

From the experience of LTE800 almost of the cases were not due to the receivers but due to the reception and distribution system weaknesses. Therefore, a better immunity of receiver may not lead to a lower effort on interference management.

Avoid consumer's confusion with new multiple interferers and needed upgrade of installation represents an important challenge to be carefully organized

From the viewer's perspective, it may be difficult to identify the correct interference management authority when an interference case occurs (LTE800, LTE700, WSD, other). It would be therefore beneficial to merge the activities under one umbrella organization, so that the viewer only needs to establish contact with one body. Synergies could even emerge from such cooperation.

Moreover, in case due to re-planning aerial need to be reoriented and upgraded, the activities of making interference proof and upgrading the aerials could be conducted together.

¹ Commission services' discussion paper on the future use of the 700 MHz band in the European Union - Option 4

A clear and sustainable message on DTT with an additional value proposition is needed to counterbalance the negative impact of a need to upgrade to manage new interference sources

The success of the DTT switch over was due to significant effort put from the stakeholders to create a high motivation for user to upgrade its receiving equipment. Significant effort was put in communication to the viewer which was implying that the bought equipment would be a unique investment.

It is already foreseeable that a new upgrade of the reception installation will be needed. If several operation cycles are now needed in the next years to upgrade the reception installation and the receivers, and new plans to reduce again the DTT spectrum without additional value to counterbalance these negative impact for the terrestrial platforms,

- There will be a lack of acceptance towards the British authorities
- The timely transition may be affected
- Viewers may switch over to alternative reception means like satellite, cable or IPTV

The time window of 2015 and 2020 will be associated with UHDTV introduction on other delivery paths. So far, DTT has been offering similar FTA services over terrestrial as on delivery paths with affordable costs. If the receivers' prices are higher, the differential of value proposition for the consumer, broadcaster and manufacturers compared to other delivery means would be even higher and increase the migration towards other delivery means. In the meantime, there is a risk that the remaining households reject any upgrade.

Question 22: Have we identified the correct measures to support consumer adoption of DVB-T2?

In general, Samsung Electronics agrees with the measures developed. Additionally, we would like to underline:

- There are still higher costs associated with T2 receivers and AVC decoders which will not decrease on middle term. On long term DVB-T/ MPEG-2 receivers may become obsolete, but this can be reasonably assumed only in the horizon 2020.
- There will be a cost associated by a migration and with the communication of it. So far the message was that DVB-T2 / AVC is associated with HD simulcast. Giving up the simulcast needs explanation to General public and its acceptance
- There is a need for user motivation to upgrade their receivers or alternatively subsidies need to help to upgrade households on large scale.
- These motivations have obviously to be driven by the services and the necessary provisions need to be worked with the broadcasters and broadcast network operators.

Question 23: What regard, if any, should we have to wider technical evolution of the DTT platform, such as HEVC?

Although a migration towards more efficient technologies is always beneficial, the specific situation of the British households with already advanced deployment of DVB-T2 /AVC need to be taken into account:

- It was recognized already from the previous questions that there is a risk of confusion and demotivation of the user.

- The expected difference of potential added value to the user between T2/AVC generalization and T2/HEVC introduction seem to be low at this stage.

We therefore consider that the transition to HEVC could only be coupled when at least one of the two milestones is achieved:

- The Introduction and transition to UHD services
- The integration of HEVC in DTT receivers is systematic and a high number of households are sufficiently equipped. This will be influenced by the fact that other countries will associate T2 and HEVC introduction.

It is difficult to predict a timescale for one of these conditions would be met. Nevertheless, after 2020 may be realistic and may be associated with additional technologies.

From today's point of view, it hence appears that HEVC should not be associated with the release of the 700 MHz as it would delay the process. However introduction of HEVC could be already planned in a long term roadmap for creating additional value to the user without disruption.

Question 24: Have we correctly identified and characterised the potential impact of 700 MHz release on PMSE users? What other impact – if any – should be taken into account in order to identify pre-emptive measures to mitigate this impact?

Question 25: Do you have any comments on the pre-emptive measures identified above? Are there other pre-emptive measures we should be considering?

Question 26: Do you have suggestions for how we can assess the impact on PMSE users and equipment if 700 MHz is no longer available for PMSE use?

[no response]