Response from abertis telecom to the Questionnaire on the long term spectrum requirements for television broadcasting in the European Union including the number of TV services, HDTV, interactive services, mobility requirements and the possible introduction of Ultra High Definition Television.

Josep Ventosa
Barcelona, 28/09/12

Annex 1: Questionnaire

Member State Response details (please complete):

Member State	*Name*	*Organisation*	*Date*
Spain	**Josep Ventosa**	**Abertis telecom**	**28/09/2012**

Question 1 (consider section 1 of Annex 1 to help you with your answer):

(See Annex 2 for example answers for your assistance)

i) **Please describe the DTT platform in your country, currently on-air, in following terms (please use the following format for your answers):**

Member State	No. of Multiplexes	Reception availability	Reception mode[1]	Number of TV program services and content format	DTT System and modulation	Intended coverage reach[2]	Coverage obligation (Y/N)[3]	Coverage (as a percentage of population)	Spectrum band used (UHF IV/V or VHF Band III)
SP	1	Free-to-air	Fixed	4SD	DVB-T, 64-QAM	NATIONAL	Y	98%	UHF BAND IV/V
SP	1	Free-to-air	Fixed	1SD, 1HD, 1HD (planned)	DVB-T, 64-QAM	NATIONAL	Y	98%	UHF BAND IV/V
SP	5	Free-to-air & Pay – TV	Fixed	24 SD MPEG2 + 4 HD MPEG4	DVB-T, 64-QAM	NATIONAL	Y	96%	UHF BAND IV/V
SP	1 (17 Regions)	Free-to-air	Fixed	4 SD MPEG2 / 3 SD MPEG2 + 1 HD MPEG4	DVB-T, 64-QAM	REGIONAL	Y	98%	UHF BAND IV/V
SP	1 (256 Regions)	Free-to-air	Fixed	4SD MPEG2	DVB-T, 64-QAM	LOCAL	Y	98%	UHF BAND IV/V

Situation referred to 1/1/2014, after finishing the migration process of the digital dividend.

[1] E.g., fixed (roof-top), portable indoor, portable outdoor, mobile.
[2] E.g., national, regional, local.
[3] Is there a legislative coverage obligation, e.g., a Public Service Broadcaster.

ii) **Are there plans to deploy (a) additional DTT multiplexes and/or (b) foresee the launch of new services in the short term (1 – 5 years)?**

(a) additional DTT multiplexes (please use the following format for your answers)

Member State	additional Multiplexes (Y/N)	No. of additional Multiplexes	Reception availability	Reception mode[4]	Expected content format (SD and or HD)	Expected DTT system and modulation (if known)	Intended coverage reach[5]	Intended Coverage (as a percentage of population)	Spectrum band used (UHF IV/V or VHF Band III)
SP	Y	1	Free-to-air	Mobile	SD	DVB-T / DVB-T2 lite	NATIONAL	96%	UHF BAND III/IV/V
SP	Y	1	Free-to-air	Fixed	HD	DVB-T2	NATIONAL	96%	UHF BAND III/IV/V

(b) foresee the launch of new services (please use the following format for your answers)

Member State	Additional Services (Y/N)	Expected content format (SD and or HD)	Reception availability	Expected content format (SD and or HD)	Interactive services (Y/N)	VoD (Y/N)	Ultra High Definition TV (Y/N)	Other (Y/N)	If answer Yes to Other, please specify
SP	Y	HD & UHD	Free-to-air		Y	Y	Y	Y	See Q4, ii)

iii) **When do the existing DTT licenses in your country expire?**

National private licenses expire in 2025.

[4] E.g., fixed (roof-top), portable indoor, portable outdoor, mobile.
[5] E.g., national, regional, local.

Question 2

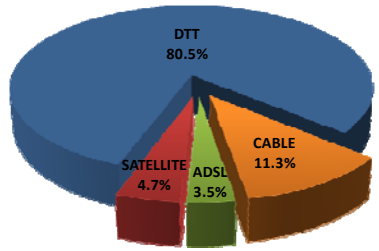
How do you foresee different means of reception (DTT, ADSL, Cable, satellite, etc) complementing each other?

DTT provides universal coverage and easy access for most viewers, in fact, DTT is the only platform that provides free-to-air TV services without the need of extra payment. In many countries the terrestrial broadcast platform is the primary means of delivering broadcast services. The consumer uptake of DTT across Europe continues to grow steadilyand the terrestrial platform remains the key platform for television distribution in the vast majority of European countries. DTT is the choice for consumers in Europe serving 275 million people:

- More than 50% of EU households use DTT (Digital Terrestrial Television) for their primary source of TV.
- Kitchen-TVs, Bedroom-TVs, Second Homes, Caravans etc add another significant share.
- Many IP TV and Satellite set-top-boxes are also equipped with DTT tuners.
- Households using DTT; Spain, Italy, Greece ≈ 100%, France ≈ 85%, UK ≈ 75%
- Simple to use and install, reliable and universally available with content free at the point of consumption
- Development has been spectacular – more than1800 TV channels are distributed by DTT in Europe today.
- About 200 Million DTT enabled receivers sold in Europe.

In Spain[6] only DTT offers a free-to-air platform to access to high quality audio-visual content. In the case of ADSL / Cable / Satellite, there are not free platforms, only subscription based services. For this, in Spain, the percentages of viewer uptake (screen share) are: (source Kantar Media, 05-12):

- DTT: 80,5%
- Cable: 11,3 %
- IP TV (ADSL): 3,5%
- Satellite: 4.7%

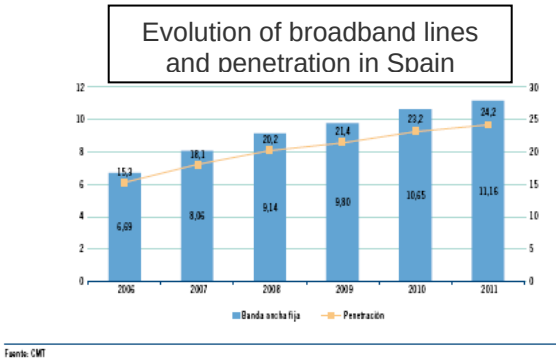


[6] Some facts about Spain:

- Population: 47.2M (2011 estimate).
- Area: 505,992 km^2
- Households: 17M
- TV sets: 35M

In addition, in the Spanish case, DTT reception is the optimum solution taking into account:

- The audiovisual Spanish environment based on a national / regional / local content model.
- Equipment and reception system legacy.
- Coverage.
- Broadband penetration under 25%:
- Satellite dishes penetration under 20% of households.



While DTT networks in many countries are principally designed for fixed reception i.e. to a rooftop aerial, DTT also provides the possibility for mobile and portable reception in non-rural areas where the DTT signal usually is sufficiently strong. In some countries the DTT networks have been designed to provide portable indoor reception, i.e. Austria, Germany and the Netherlands.

Cable TV is predominantly available in areas of high population and cannot generally be expected to expand further. Satellite transmissions can be available across large areas but require line of sight between the satellite and the receiving dish, which in many cases is not possible. ADSL based TV distribution is still very limited in most European countries and the capacity required for IPTV distribution cannot be provided everywhere since it depends on the distance from the user's premises to the nearest telephone exchange. In the case of fibre the extent of households served varies considerably across member states and there are significant doubts regarding universal service deployment due to the high levels of CAPEX required.

We see lots of evidence that the current market changes and consumption trends are unlikely to result in a reduction in the future demand for DTT capacity, and may on the contrary make DTT even more important, particularly in an environment when the benefit of co-operative operation with other platforms is considered. To this end, broadband technologies are increasingly important as a complement to broadcasting, e.g. the delivery of non-linear services to Smart TVs and companion screens. The DTT platform already has access to on demand and over the top services via the fixed telecom network exploiting a hybrid model that realises the benefits of the DTT platform in delivering the linear broadcast service with on demand and other non-real time and less bitrate hungry services delivered via broadband. Some examples of hybrid broadcast -broadband markets which are under development are:

- HbbTV in many countries such as Spain, France, Germany, etc.
- YouView in UK.
- TiVú ON in Italy.

No alternative technology will be able to replace the terrestrial broadcasting service in all aspects of its service provision for the foreseeable future. When assessing various options for TV distribution all relevant technical and non-technical issues need to be taken into account – i.e. costs, coverage, reliability, simplicity, easy access to the networks, QoS, control over the signal integrity, and an existing and very large customer base. However, to remain viable DTT will need to have the appropriate conditions for its development and evolution, i.e. access to appropriate spectrum and the capability to introduce new services such as HD, 3D and UHD.

Question 3:

i) Do you think that the DTT platform in your country will evolve to being capable of delivering audio-visual services also to mobile terminals?

Yes, in fact, delivering audio-visual services to mobile terminals by DTT is already technically and commercially feasibleas demonstrated by the existence of such services in countries like Japan, China and South Korea.

Terrestrial broadcasting is the most efficient way to deliver audio-visual services, radio and additional multimedia services for both **fixed** and **portable/mobile** terminals because of its spectral efficiency, wide area coverage and comparatively low network costs. As of today, broadcast networks are designed, in general, to ensure a fixed (roof-top) coverage, although the robustness of broadcast networks also allows for portable and / or mobile reception under certain conditions and modes as defined in the DVB-T standards, e.g. automotive systems are accessible in the UK. In some countries (e.g. Austria, Germany and the Netherlands) the DTT networks are designed and operated to allow portable reception and delivery of services to mobile terminals with practically universal reach. In most other countries portable reception is generally possible in areas where signal strength is sufficiently high.

Nevertheless, the market reality in Europe is that smartphones and tablets are not, with a few exceptions, equipped with DTT tuners. Therefore, the market demand for audio-visual content on smartphones and tablets is currently addressed only via wireless broadband (i.e. mobile communications networks and typically WiFi networks both home and public). As the unicast mode is the only possibility on wireless networks this is currently fuelling the growth of data traffic on broadband networks while the potential of DTT remains unused.

In conclusion, an evolution towards cooperative use of DTT and mobile broadband networks may well happen if the commercial and regulatory framework facilitates the development of a wide range of mobile/portable devices that include a DTT tuner.

ii) If yes, what is the required evolution of the DTT network platform architecture? Please give details in relation to:

a. the DTT network topology (whether there will be a need to migrate from high- power/ high- tower to low- power/ low- tower type of networks);
b. to the use of MFN versus SFN networks to achieve the evolution, and
c. a possible migration to a new DTT system(e.g. to facilitate interactive services) and transmitting technologies (e.g., DVB-T2, DVB-T2 Lite, etc.).

To be capable of delivering audio-visual services to mobile terminals to a high QoS, the existing DTT networks will typically requires reengineering / optimization of the network, since in general, the current platform architecture is designed to serve fixed rooftop reception.

a) The present DTT network topology is based on a high tower / high power topology that is optimised to deliver the most effective and efficient terrestrial broadcasting service against the existing service requirements and coverage targets. This includes, depending on countries, not only rooftop reception but also portable and in-vehicle mobile reception as highlighted in response to Question 3(i).

From BNE's perspective, the consumption of audio-visual content on mobile terminals in an outdoor context is unlikely to modify the present DTT network topology as it is a one-to-many service that is independent of volume. However, to deliver mobile reception on a national basis both outdoor and in-building, existing DTT networks would likely need to be augmented with targeted in-fill, in combination with a suitable choice of transmission modes and power. In essence, BNE sees no need to radically alter the existing DTT topology to make it resemble that of dense cellular network since the mobile networks are specifically dense to cope with high traffic volumes and bi-directional communications whilst the capacity of a DTT network is independent of its level of densification.

b) The DTT platform has already evolved to utilise SFNs, which is a well-established and mature technique. Indeed, broadcasters have already implemented SFNs in many European countries.

Service provision to mobile terminals can be achieved by either MFN, or SFN networks, or a mixture of both. SFNs may in some cases increase spectrum efficiency and improve quality of mobile coverage compared to MFN. However, the SFN architecture also bears a number of inherent constraints, in particular those related to self-interference[7], which require trade-offs to be made between the size of the coverage area, capacity, ruggedness and costs. Therefore, the implementation of SFNs does not automatically lead to better performance for mobile delivery.

Hence, the required evolution of the DTT network architecture to enhance its capability to provide audio-visual services to mobile terminals whilst maintaining optimum spectrum efficiency will result in an evolution to a 'MFN of SFN' networks.

c)

a. In terms of interactivity:

Current DTT networks are optimised for the delivery of linear broadcasting services and as such have a limited ability to carry advanced broadcast services which require both forward and return path functionality including on-demand, interactive, hybrid, data and multi-screen services. Nevertheless, DTT can provide a forward path and carry a linear component of hybrid services (HbbTV). Advanced interactive broadcast services are dependent on the availability of a broadband connection and consequently their reach is constrained by the penetration and the capabilities of the broadband platforms. However, broadband networks on their own, in particular mobile broadband, seldom or never have sufficient capacity for a

[7] Self-interference is an effect of mutual interference between transmitters in the same network. As all transmitters operate on the same channel signals from remote transmitters can disrupt the reception of signals from near-by transmitters under certain conditions. Mitigating self-interference may lead to the reduction of the available transmission capacity in particular for large SFNs.

universal delivery of broadcast services to large audiences offering a sustained quality of service. If broadcast networks are used in conjunction with broadband networks the delivery of the whole range of broadcast services can be realised.

b. In terms of transmitting technologies:

For fixed (roof top) reception DVB-T2 is an improved, second generation of the DVB-T standard. It provides significant improvements over earlier specifications and it is expected that DVB-T2 will eventually prevail on the DTT platform. However, this evolution will have to take account of economic realities, in particular the investments in DVB-T based equipment made by DTT network operators and the consumer associated with the recent analogue to digital switch-over. It is likely that DVB-T and DVB-T2 will co-exist for a prolonged period of time across Europe.

For mobile and portable reception, the DVB-T2 standard facilitates enhanced efficiency of broadcast service delivery. In particular, a specific profile, T2-Lite, has been defined in the DVB-T2 specification to allow simpler receiver implementations for mobile broadcasting. Furthermore, T2-Lite can be mixed with conventional T2 signals in a single multiplex while allowing separate optimisation for the delivery to handheld devices. However, mobile terminals with DVB-T2 receivers are not as yet available on the market and ideally they would be integrated in mass market mobile terminals. Whilst the T2- Lite version of DVB-T2 has been demonstrated via trials a further enhancement of the standard, DVB-NGH, is under development which seeks to optimise further the mobile capability of DTT systems.

Finally, to facilitate the existence of a wide range of mobile / portable devices that include a DTT tuner, the adoption of a truly Global standard would be a clear step in the right direction and this is a key aspect under consideration by the Future of Broadcasting TV (FOBTV) initiative.

iii) Do you believe that a DTT platform evolving towards delivering audio-visual services also to mobile terminals may also be used by mobile operators to cope with:
a. the data traffic required to deliver linear video content (i.e., with mobile terminals including broadcasting tuners), and
b. certain non-linear content that could be pushed (and stored)?

Yes, there seems to be a clear case for complementary service delivery by terrestrial broadcasting and wireless broadband. While both platforms would continue to operate independently when required for specific services, these service platforms in combination could facilitate significant technical enhancements and cost efficiencies. Hence, the utilisation of the DTT platform to deliver audio-visual services (linear / non linear) or other forms of highly consumed content to mobile terminals would enable the mobile operators to:

a) utilise their spectrum assets to deliver bi-directional mobile services for which the spectrum and the technical standards have been optimised thus avoiding any efficiency losses that might arise through the partitioning of spectrum for linear and non-linear content delivery. In particular, efficiency losses will result where linear data streams utilise FDD banded spectrum allocations. Furthermore, broadcast delivery of content offers enhanced coverage as well as a guaranteed QoS that goes way beyond anything typically available from mobile networks. This aspect of service delivery is particularly relevant to high impact content, e.g. live sporting events.

The availability of local storage aligned to an embedded DTT tuner would offer additional functionality to the mobile terminal further reducing the need for the mobile networks to be drowned by the increasing demand for audio-visual content.

b) Similar mechanisms could be applied for other type of content, e.g. 'push' on-demand audio-visual and other services, software upgrades, etc. More possibilities would emerge as the technology, services and network operation practices develop.

In addition, users would benefit from an increased choice of services and seamless integration of both broadcast and broadband likely to be at a fraction of the cost for mobile only or broadband only delivery. Therefore, as noted above, a common core specification for mobile terminals should be included in both future DTT and mobile broadband standards in order to facilitate access to rich media services 'on the go' irrespective of the delivery method.

Under an scenario of cooperation between terrestrial broadcasting and wireless broadband, broadcast would be used to transmit the Fat Tail Contents, as following:

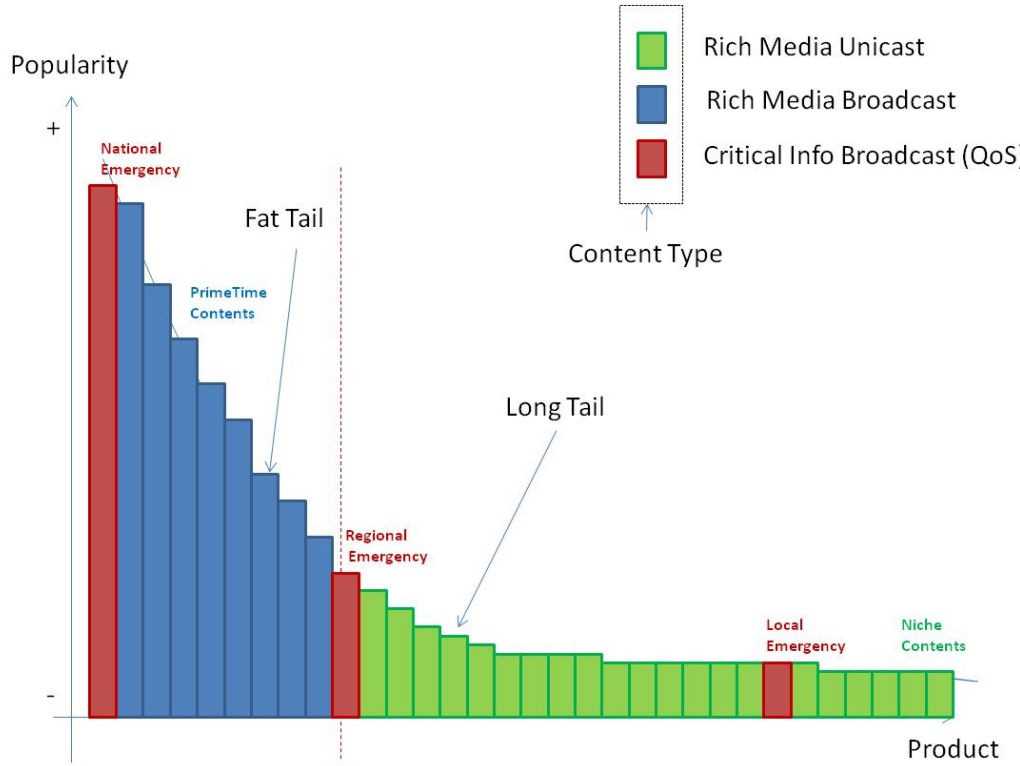
- Delivering **live video** contents.
- Delivering **non live video** contents at non-peak hours using time slots without much consumption of television. Transmitted programs could be stored in the user receiver until later consumption at a given time slot even when the receiver is out of the broadcasting coverage area. For example, DVB-T2 is capable of carrying those types of services. Furthermore, combining broadcasting and broadband delivery with the storage capabilities in the user devices would open new possibilities for the delivery of content and services.
- **Delivering highly consumed multimedia content**, such as:
  - **Distribution of information** (press, applications ...): Data casting information through the broadcast network, periodically or not, that allows the user to receive content and consume it later even without access to the network.
- Transmitting **critical information** such as emergency messages that require a high QoS and reliability. These messages require a guaranteed allocation of frequency band, to avoid problems of availability when its needed, such as:
  - **Emergency Warnings**: EWBS System (Emergency Warning Broadcasting System), which allows receiving terminals switch on automatically if the signal is received, providing a newsletter with the information. Such information could be added as a subtitle to the channel currently tuned.

Thus, we expect a model of "**Overlaid Broadcast**", in which the broadcast signal source is independent of Telco network and supplemented by this signal, running both (broadcast and Telco) simultaneously at the receiver. This mechanism offers an offload solution to network operators.

Furthermore, this type of broadband solution could serve as a signal broadcast redundancy in case of network failure and to complement indoor coverage for mobile terminals.

To bring this into practice, we'll face the following challenges:

- Exploiting the potential of existing broadcasting infrastructure and lower cost required to deploy new broadcasting networks with the aim of providing audiovisual content to mobile terminals. To cover high density population cities, current HT-HP broadcast networks should be complemented with LT-LP sites (tipically co-sited in telco networks)
- Interactivity (return channel) it is compulsory to integrate broadcasting with broadband as well as defining the operator-broadcaster-user management model to manage interactivity.
- *Seamless Discovery* to allow the user to have clear visibility of all content and services, and discover whatever their origin, unicast or broadcast, even on a complementary way (eg broadcast content but with additional audio information associated received via broadband).
- Providing not just to TVs, but to all types of devices through which you can access multimedia content (fixed or portable computers, tablets, smartphones, future radio receivers ...) with integrated DTT receiver.
- Providing all media receivers (including televisions) with content storage systems (type PVR), with corresponding management applications that allow intuitive navigation transparent to the user between the contents of high consumption (which is accessed by DTT) and the low consumption content (which is accessed by data networking broadband).



- Implementing management solutions and content delivery platform (in header), able to differentiate and manage the contents of high consumption and / or direct events (FAT TAIL) to DTT distribution system and more residual contents (LONG TAIL) to broadband data distribution systems.
- Establishing proper technical agreements with Mobile Standardization Bodies (like 3GPP and others).
- Defining right business models for the cooperative approach.

iv) What evolutions do you expect would be required for mobile networks to be capable of delivering linear video content ubiquitously to both fixed and mobile terminals?

In order to optimise service quality, availability, cost and consumer benefits, a range of networks could be used to deliver linear video content to fixed and / or mobile reception. In essence, three different scenarios could be envisaged:

- For big screen, live and linear content, high quality and fixed reception, current DTT networks will remain and evolve to deliver enhanced services e.g. UHD, 3D, etc. Current DTT networks provide a near universal coverage and are optimized for this type of services. Delivery costs on DTT are independent of the number of concurrent users.
- For medium / small screen, linear and non-linear content, medium quality:
    - In the case of outdoor reception, a cooperative DTT – Mobile network arrangement would be the optimal approach.
    - In the case of indoor reception, where a vast majority (>80%) of media consumption takes place, innovative solutions such as WiFi offload, and femtocells are some of the possible solutions.
- For small screen, non-linear content, low quality and mobile reception, current mobile network topology seems the optimum infrastructure for low volumes.

In summary, mobile networks will not become a viable alternative to DTT, instead, the two platforms should be used in a complementary way which would facilitate their evolution and enhance the consumer experience.

v) Of a possible convergence between terrestrial mobile and (evolved) DTT platforms, what do you consider will be the consequences of mobile networks being capable of delivering linear video content to mobile terminals?

As noted above BNE anticipates that mobile networks will only ever be able to deliver content in low or limited quality and low volume to mobile terminals. However, a number of mutual benefits can be realised from a cooperative utilisation of DTT and mobile networks as noted above subject to a scenario where (evolved) DTT and mobile networks continue to coexist with optimised service provision through a "*converged*" mobile terminal capable of accessing both networks seamlessly to provide both on-demand and linear services to the consumer.

Otherwise, there is an inherent risk of inefficient spectrum use through duplicated service provision across multiple delivery options (e.g. DTT, Wifi, white spaces, mobile broadband, etc) with the resulting weak and unsustainable business models, as demonstrated by recent unsuccessful service launches (mobile TV in DVB-H, MediaFlo). Finally, a scenario where mobile networks could ultimately replace DTT networks is unlikely both from technical, economic and societal grounds.

Question 4:

i) **How many DTT multiplexes do you expect will be needed in your country in the long-term (beyond 2020),**

In order to increase the advanced services, the quality of them, to grant the technological innovation in DTT and taking into account a possible convergence between DTT and mobile networks, we expect to have the following multiplexes beyond 2020:

- Up to 12 multiplexes:
  - National / regional / local coverage for fixed antenna reception, to allocate the new services like 1080p HDTV, 3D or future formats.
  - Multiplex for portable antenna reception.
  - Multiplex for mobile reception.

Those multiplexes must be allocated in band III, band IV and band V.

ii) **What services do you expect the DTT multiplexes to carry (assuming use of DVB-T2/HEVC)?**

There is an inherent need for the platform to develop and evolve over time to keep up with competing platform developments and consumer demand. Central to this continued platform development will be an expansion of the range of HD content available (initially HDTV 1080i / 720p and then in due course HDTV 1080p) and perhaps in future the provision of services in 3D. The proportion of content that will need to be provided in HD and 3D will be a function of local demand and the proportion of content available in these formats. In addition other service enhancements will be required by the consumer over time and the DTT platform needs appropriate amounts of spectrum to afford it the flexibility to provide these services when relevant, e.g. improved audio quality, Ultra High Definition TV (4k HD), services for second screens, and 'over the air' interactive services.

Other new services that we expect to carry-out:

- Content Related Services.
- More auxiliary data (subtitled audio-description).
- More pay TV Services.
- New interactive applications.
- New applications as content push on demand.
- New audio formats as Dolby 7.1.
- Emergency warning system.

Additional to these services we are considering services for portable outdoor reception, portable indoor reception, mobile reception and handheld reception.

iii) **What transition and migration paths do you anticipate will be required to achieve this long-term DTT goal for your country?**

Whilst gains associated with a switch to DVB-T2 could make it easier to enable the introduction of the service enhancements described in Question 4 (ii), the extent to which these services are introduced will determine the long term requirements of spectrum for the provision of terrestrial broadcast services. However, in the short term due consideration will need to be given to how best to facilitate a platform transition from DVB-T to DVB-T2, i.e. what form of simulcast arrangements may be necessary to encourage the consumer to adopt new DVB-T2 enabled receivers. Finally, whilst a move from DVB-T to DVB-T2 service delivery would provide for spectrum efficiency gains in the long run, and hence additional service capability, in the short term additional multiplexes may be necessary and hence aggregate multiplex efficiency may decline temporarily.

In any case, this technological evolution requires, to provide security to the sector, the definition of early rules about migration including, among others:

- Spectrum allocations taking into account the number of multiplex (actual and future) and simulcast period.
- Definition of the technological standards.
- Definition of a phased migration plan.
- DVB-T2/T2 lite trial.
- Measures to encourage the entry of new equipment on the market and deadline for inclusion in new equipment.
- Specification for mobile/portable terminals for including both DTT and mobile broadband tuners.

However, it's necessary to clarify the main rules as the regulatory framework and the spectrum allocation. This is necessary to ensure the operators and consumers investments.