Radio Spectrum Policy Group

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

The questionnaire in **Annex 1** has been prepared to facilitate the work of the sub-working group of Radio Spectrum Policy Group (RSPG) preparing the draft opinion on the future spectrum requirements for Wireless Broadband, specifically issues relative to the future of the 700 MHz frequency band (694 -790 MHz). This frequency band is currently used in Europe for terrestrial television and in many countries also for PMSE on secondary basis and represents approximately 30% of the total remaining UHF spectrum used by the television broadcasting. The impact of an exclusive reallocation of this spectrum to wireless broadband will therefore be significantly more important for the broadcasting service than in the case of the 800 MHz band.

The responses to the questionnaire[1] will contribute to the analysis of the RSPG on the future use of the 700 MHz as well as on the evolution of the digital terrestrial platform (DTT) over the next decade (2012 – 2022)

For more information on the background to the various elements of the questionnaire see **Annex 2.**

For an example of how to respond to Question 1 please see **Annex 3**.

Please submit completed questionnaire contained in Annex 1 and return to [zeeshan.nazneen@comreg.ie] by [Friday 28th September 2012].

[1] The RSPG is aware of the ITU-R WP 6A questionnaire which addresses similar issues and we will if possible try to use responses to that questionnaire to complement the information/views in the draft opinion.

Annex 1: Questionnaire

Member State Response details (please complete):

Member State	*Name*	*Organisation*	*Date*
FRANCE	**Eric Fournier**	**ANFR**	

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[2]**	**Number of TV program services and content format**	**DTT System and modulation**	**Intended coverage reach[3]**	**Coverage obligation (Y/N)[4]**	**Coverage (as a percentage of population)**	**Spectrum band used (UHF IV/V or VHF Band III)**
FRANCE	6 (called R1 to R6) in main land France	95% time/location per pixel	Fixed	The number of services given below corresponds to full-time TV channels. R1: 6 SD MPEG2* R2: 6 SD MPEG2 R3: 1 HD MPEG4, 3 SD MPEG4,	DVB-T, 64-QAM, FEC ¾, 1/8 GI, corresponding to 24.88 Mb/s capacity	National	Yes, for all free-to-air DTV (95% of population by law)	97 % for existing 6 MUX except R5 (94,4%, which will increase up to 97% by 2015)	UHF IV/V

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

				R4: 3 SD MPEG2, 1 SD MPEG4, 1 HD MPEG4 R5: 3 HD MPEG4 R6: 4 SD MPEG2, 3 SD MPEG4 with SD: 720×576 and HD: currently 1920×1080i - – 50 Hz					

*More precisely, 5 national free-to-air SD MPEG-2 TV channels + 1 local/regional full-time free-to-air SD MPEG-2 television service are delivered over multiplex R1. This slot for 1 local/regional full-time free-to-air SD MPEG-2 television service is used by 34 local TV services covering together 60% of the French metropolitan population (and quite soon, 36 local TV services covering together almost 63% of the French metropolitan population), and by local variations of the TV channel called “France 3” covering ~32% of the French metropolitan population

In addition to these 6 multiplex, 13 DVB-T channels in the UHF IV/V frequency band are locally used to broadcast regional/local free-to-air TV channels.

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)?**

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**[5]	**Expected content format (SD and or HD)**	**Expected DTT system and modulation (if known)**	**Intended coverage reach**[6]	**Intended Coverage (as a percentage of population)**	**Spectrum band used (UHF IV/V or VHF Band III)**
FRANCE	Yes	2 to be launched in December 2012	95% time/location per pixel	Fixed	3 HD MPEG4 per multiplex	DVB-T, 64-QAM, FEC ¾, 1/8 GI, corresponding to 24.88 Mb/s capacity	National	97%	UHF IV/V

(a) 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**		**Interactive services (Y/N)**	**VoD (Y/N)**	**Ultra High Definition TV (Y/N)**	**Other (Y/N)**	**If answer Yes to**

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

									Other, please specify
FRANCE	Y	The whole existing DTT offer is expected to migrate towards HD video format in the medium term in France : 24 full-time free-to-air TV channels + 8 pay-TV channels + 51 regional/local free-to-air TV channels + plus local variations of the TV channel called “France 3” + any new TV channels	The DTT platform could evolve towards mobility, with the objective to provide mobile reception of DTT programmes towards secondary screens, including but not limited to smart-phones and tablets (i.e. mobile terminals including broadcasting tuners).		Yes, through increase use of HbbTV (several services were launched in 2011 in France).	Yes. One on-demand audiovisual media service (offering push-VOD) is in the process of being authorized (candidate already selected by CSA after a call for tender), plus any new on-demand audiovisual media services that may be	Yes. In the longer term, the consumer demand for higher picture resolution could probably continue to grow. All relevant TV distribution platforms, including DTT, would, in this case, benefit from		

		that may be authorized in the future on the DTT platform. The HDTV video format is also expected to evolve from 1080i (which is the HD format broadcast in France today) to full HD format (1080p). Indeed, in the short term, certain programmes could use transitionally 1080p HD quality. In the longer term, under the condition of more efficient transmission/coding technology, there may be a demand to broadcast all programmes in 1080p HD quality, as consumers are more and more equipped with full HD TV sets. DTT will also continue to deliver higher audio quality, multichannel				authorized in the future on the DTT platform	supporting ultra HDTV (4K) to meet this demand.		

		sound, better accessibility of TV programmes through higher availability of subtitles and audio-description.							

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

Answer:

The time duration of the public service TV channels authorization is set by the government.

For other existing national authorizations (i.e. other free-to-air TV channels and pay-TV channels), the license expiry date is currently between 2015 and 2022 (most of them in 2020), depending on each TV channel. However, the French audiovisual media Law gives the possibility to the broadcasting regulator (CSA) to award one extension of 5 years, under certain conditions.

DTT licenses of local channels expire after 10 years of broadcasting but may be extended once for 5 years. Currently, 45 local DTT are authorized (51 by the end of the year 2012).

Question 2

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

Answer:

DTT offers free-to-air TV channels and is currently the most "universal" means of reception (used by 61% of TV-equipped French households in all areas and by all categories of population) and, in general, easy-to-use. DTT has replaced analogue terrestrial reception in more than 95% of the French households which had been using this reception means before.

DTT is also complementing other means of reception in households: 51.5% of the French households own or lease at least 2 TV sets. DTT is used by 60% of TV sets of rank 2 (to be compared to 29% in H2 20009) where only 9.6 % of TV sets of rank 2 use a pay reception means, that is a pay TV offer over cable, satellite, IPTV or FTTH (to be compared to 11.2% in H2 2009). DTT is the most widely adopted reception means for secondary TV sets. The same conclusion is valid for TV reception in secondary lodgements (7.7% of households have a secondary lodgement).

25% of households have several reception modes (from H2-2008 to H2-2011, the rate of households with at least 2 TV reception means has grown from 19.1% to 25.3%. The most widely adopted combination of 2 TV reception means is not anymore terrestrial TV and satellite TV, but terrestrial TV and TV over IP).

By the end of 2011, DTT has 97% population coverage while other means of reception are not available in all places, including satellite where dish installations are restricted.

ADSL is now the second TV reception mode (30.8%) and has continuously increased since the introduction of IPTV services (from 7.7% in H1 2007 to 30.8% in H2 2011). FTTH will extend ADSL capacity as TV broadcasting platform.

Compared to DTT, ADSL and FTTH offer additional services (higher number of TV channels, VoD or catch-up TV). However, they are exclusively pay-TV platforms, TV over ADSL is currently mainly urban and has a coverage limitation (TV over ADSL is available for about 60% of ADSL lines) and it remains difficult to forecast when FTTH will become a widespread mode of reception for TV.

Finally pay-satellite also offers additional number of services compared to DTT (free-satellite offers are nearly identical to the free-DTT offer, except for local TV channels), but requires the installation of a satellite dish and the acquisition of a specific STB.

Overall, the future of each mean of TV reception will depend on political choice (including spectrum) and the penetration of each mode can only evolve slowly. In 2020, we foresee that the DTT platform will remain important.

<u>TV platform penetration</u>

At the end of 2011 in France, according to the French observatory of household equipment for digital TV reception[7]:

- 61% of the French households use an aerial (antenna on the roof or on the top of a TV set) to receive DTT. As DSO was not fully completed in H2-2011, 62.3% of households use an aerial to receive terrestrial TV (analogue or digital);
- IPTV ("ADSL") or FTTH is used by 30.8% of the French households;
- Digital satellite is used by at least 22.5% of the French households (satellite reception (either analogue or digital) by 24.5% of the French households);

[7] Observatoire de l'équipement des foyers pour la réception de la télévision numérique is led by CSA in cooperation with French Government and France Télé Numérique, the body in charge of DSO communication. Observatoire studies rely on around 40,000 phone interviews for first half of a year and around 36000 phone interviews for second half. These studies are therefore the most precise statistical tool about French TV reception means. The percentage base of theses studies are the number of metropolitan households which are equipped with at least one TV set. They only refer to the principal lodgement.

- Cable reception, either pay or free, is used by 10.8% of the French households.

Digital TV platform penetration evolution

Digital TV Platform Penetration in Metropolitan France

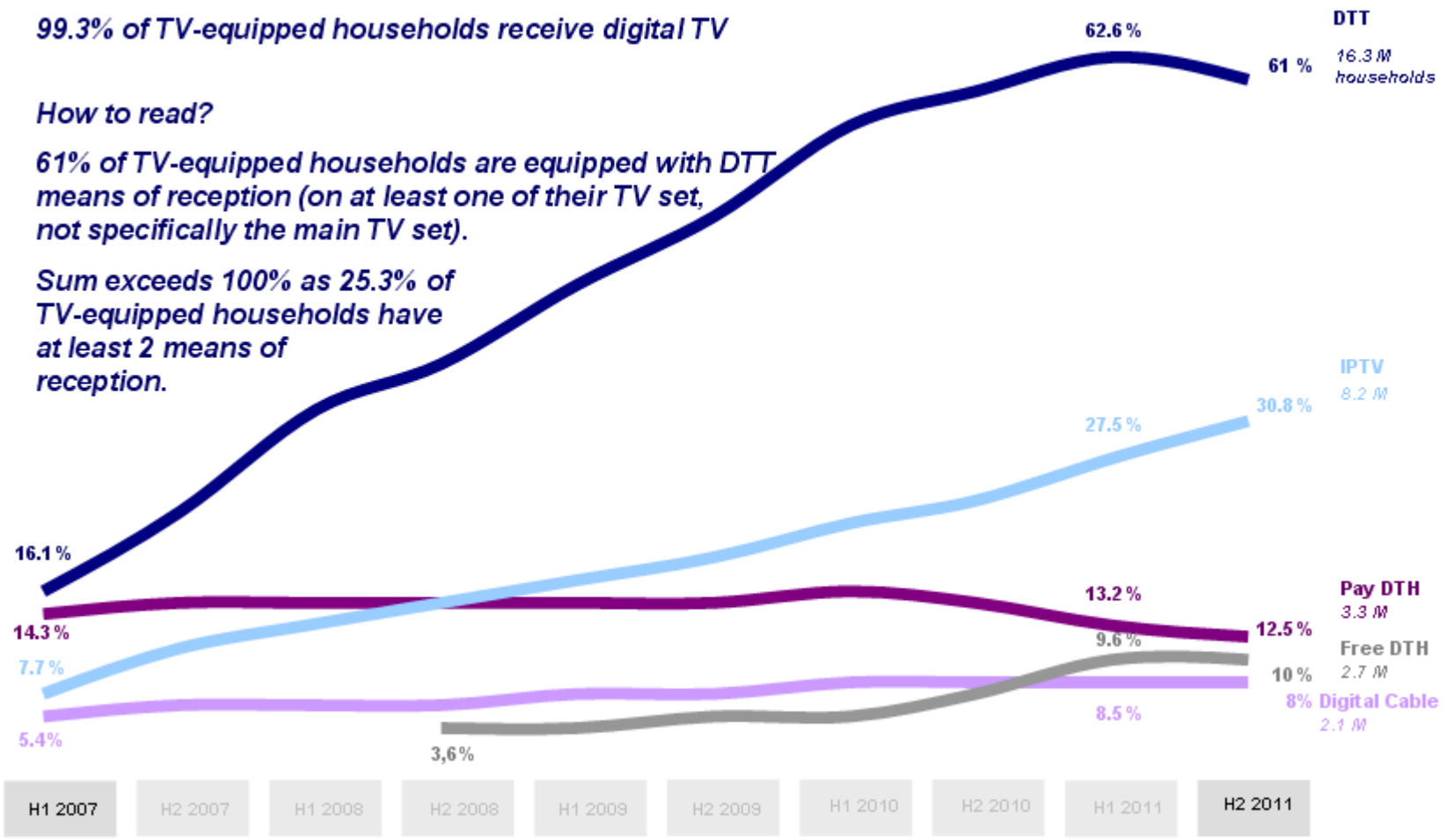
***26.8 M households** equipped with at least one TV set*

99.3% of TV-equipped households receive digital TV

How to read?

61% of TV-equipped households are equipped with DTT means of reception (on at least one of their TV set, not specifically the main TV set).

Sum exceeds 100% as 25.3% of TV-equipped households have at least 2 means of reception.



DTH = Direct-to-Home satellite

The diagram above shows digital only TV platforms. In H2-2011, DSO was not fully completed yet (November the 30th, 2011), which means that in H2-2011, some households were still using analogue TV platforms (terrestrial, satellite, cable):

	H2 2011	
	Number of households	%
TV-equipped households (Metropolitan France)	**26 790 000**	100,0%
Households receiving digital TV	**26 601 000**	**99,3%**
Households receiving terrestrial TV	**16 698 000**	**62,3%**
Households receiving TV by ADSL	**8 240 000**	**30,8%**
Households receiving TV by satellite	**6 549 000**	**24,4%**
Households receiving TV by cable	**2 883 000**	**10,8%**

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?

Answer:

Two different scenarios can be envisaged, although a mixed of these 2 scenarios could also be envisaged:

1) **Scenario 1 (same DTT architecture – services of mainly linear TV towards outdoor mobile, eg cars, transportation)** : DTT platform evolves **to offer to mobile receivers such as automobiles mainly existing TV, although some additional linear or non-linear services will be possible**. The **architecture of the DTT networks does not change significantly under this scenario**. Using diversity antenna technology, most of the car makers are proposing this option today (in Germany with DVB-T 16QAM, in Japon with ISDB-T Full SEG, in China with CMMB and CTTB,..). However, this service is mainly valid outdoor with limited indoor coverage, due to the high power high tower DTT infrastructure that offer enough signal power

outdoor but not in indoor environment. In particular, the availability of the DTT signal indoor for mobile terminals (smartphones/tablets) cannot be guaranteed at all. In that scenario, the indoor coverage would assume the use of other means such as WiFi.

This coverage of outdoor mobile / automotive can be done with specific multiplex or inside the same multiplex as for fixed reception.

Therefore, for broadcasting, this evolution of the DTT platform would imply a kind of trade-off between the use of the capacity for new services for fixed television and the availability of the DTT signal for mobile outdoor/automotive reception in terms of coverage of the population.

For broadcasting, this evolution of the DTT platform would imply a kind of trade-off between the use of the capacity for new services for fixed television or for new services for mobile outdoor/automotive.

2) **Scenario 2 (new broadcast architecture for delivery of digital content to smartphone/tablets) :** a new development for the **delivery of digital content to mobile receivers (smartphones/tablets)** through a **new broadcast type of network** in order to help in responding to the explosive demand for digital media consumption.

   In this scenario, a DTT mux will not be capable to address simultaneously both traditional fixed / rooftop receivers and mobile receivers under the current and foreseeable technology status; the signal level specifications of these two situations being very different, a network aiming at both would be quite over-specified and costly for fixed reception, leading to an inefficient network deployment and spectrum usage. Therefore, it assumes that one or two multiplex will be dedicated to this mobile delivery platform.

   The associated model is the one of Mobile Multimedia Broadcast or of NotTV operated under the lead of NTT DoCoMo in Japan, were the mobile broadcast network is operated as a versatile and flexible platform for delivering any type of digital content (in Broadcast mode) to mobile receivers; this will include live and non live TV / video content, the same for radio programing, electronic press content (magazines and dailies), etc.

   These contents are then broadcasted, stored on mobile devices (with some filtering to be applied based on issue date, existence of access rights, etc...) and are then available for the end-user to play them, in live or in on-demand model.

   Such model, which is an adaptation of the broadcast platform to the new usage patterns for digital media, is integrating the major trends which are mobile, non linear viewing and tablets as the versatile preferred device for all kind of medias, and ultimately, the convergence of media (e.g.; a newspaper will more and more integrate video content, while a TV program/service will –and already is – integrating text news content).

   This versatile mobile delivery platform would be used under a combination of different business models;

   - for a certain part, it could be used by media players who would be able to buy certain chunks of capacity, live or non live, enabling them to push their content towards their audience

- for other parts, the capacity could be used by service providers (e.g. ; mobile operators) who would decide to off-load on the broadcast network the contents which are demanded by a high number of their users, thus savings scarce capacity on the mobile network thanks to the broadcast network.

It is not clear yet whether the second scenario could materialize. For some mobile operators, the next generation of mobile cellular networks based on more spectral efficient technologies e.g. LTE / LTE-A, including eMBMS, which will be capable of delivering high-definition audio-visual services and rich media contents to mobile terminals, will satisfy the mobile operator requirement, without the need for a dedicated network/technology with potential impact on the terminal. They question, given the failure of previous mobile TV projects, the consumers need for on-demand services and emphasize the possibility to use LTE eMBMS for addressing any need to broadcast content to terminals. In any case, the issue remains the balance between the cost of a dedicated network (and potential impact on terminals) and the volume such network may offload from mobile networks and the relative economy.

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.).

Answer:

In scenario 1, there is no change in network topology. DVB-T2 with multiple PLP and DVB-T2-Lite with FEF would probably be the best technical solution to merge fixed and mobile services in the same infrastructure. But, as discussed above, it would decrease the overall bitrate of a multiplex used for such service, thus obliging broadcasters to trade-off with the development of new services for fixed reception.

In scenario 2, the mobile reception oriented network would be based on high power high tower architectures reusing part of the DTT existing network as macro cells, completed with additional sites, with mixed SFN/MFN as for existing DTT and the use of T2 lite standard. This network would require one or two dedicated multiplex. The ultimate goal could be a new global broadcast standard, which is referred to by many as CBS (Common Broadcast System). CBS should be a best of breed and global mobile broadcast standard (as opposed to the current broadcast standards which are only regional, which puts them at a disadvantage against the telecommunication and internet standards) that should aim also to convergence with the mobile standard (LTE eMBMS) so as to mutualize broadcast features.

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)?

Answer:

This is the critical question behind scenario 2.

Such scenario assume that mobile operators would consider that this solution is beneficial for off-loading mobile data traffic to broadcast network, compared to the use of eMBMS.

Also, it has to be considered that DTT is under other regulations and operated by different companies than mobile networks. In any case, the development of mobile broadcast technology should definitely encompass linear and non linear content, as well as non video content (press, magazines, ...) : only such versatility could create sufficiently large traffic / economic scope to have sustainable business models and a sufficiently attractive value proposal towards intended users and stake holders ; networks that would be dedicated to one vertical application / type of media with a strict content definition supposed to apply for long period of time, are doomed to fail, as demonstrated by recent un-successful attempts (mobile TV in DVB H).

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?

Answer:

The relative link budget for a roof top antenna and a mobile reception are around 40 to 45 dB apart when delivering the same C/N to the respective target terminal. The practical consequence is that the two networks are fundamentally different. A fixed reception optimized network has little chance of providing

reasonable service to an indoor mobile. A mobile network is over specified for roof top delivery and, as soon as a signal is designed for mobile reception, it has a cost in terms of spectrum efficiency. Additionally, the contents to be carried for fixed and mobile reception will be for a large part quite different; for example, a multiplex intended for fixed reception will predominantly (but not solely) be made of HD (even UHD) live programs with high bit rates, while content intended for mobile reception will mainly be made of shorter items, with lower resolutions (say about 1 Mbps versus the 4-8 Mbps in fixed HD), and have a much higher weight of non-linear / on demand content. From a strict technical perspective, if some higher definition TV content isbroadcast by mobile networks, they could be also received by fixed terminals.
However, it would not be economically relevant to broadcast TV programmes for fixed reception on all mobile networks sites since they can be broadcast using the much more limited number of broadcasting sites.

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?

Answer:

Convergence is often referred to as a key technological evolution in the digital society and the practical application is now materializing with the convergence of services over on mobile devices, with smartphones and tablets. One of the driving factors is the demand for rich multimedia content, which is consumed in various forms such as high definition audio/video streaming, live content, podcasts, file casts, on-line gaming, social networking and apps downloading.

Data based traffic over mobile broadband networks is predicted to increase rapidly over the coming years driven by this rich multimedia usage. Mobile technologies have evolved to support the efficient delivery of multimedia services to mobile devices with carrier aggregation, , unicast/broadcast handoff, dynamic adaptive streaming etc.. eMBMS allows to broadcast content to multiple devices in the mobile networks, this would be particularly useful during live events, such as music concerts or sports events, where multiple users are simultaneously viewing the same content. It would also allow seamless operation in a unicast and broadcast mode over LTE in mobile networks.. eMBMS physical layer has very low incremental complexity in an LTE handset compared to a dedicated mobile TV physical layer.

Again, the question is whether this broadcast approach in the mobile networks will be able to provide the sufficient data capacity, in particular for linear programs, to all users, including at the edge of cells or whether a broadcast over high power high tower networks (scenarios 1 and 2 described above) will provide a better solution.

Question 4:

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

Answer:

Although some objectives have been defined for the development of new DTT services, there is no detailed plan available for the time-being in France. In this context, different scenarios can be identified, without taking into account any spectrum constraint.

1) For fixed reception, if UHD is introduced and full HD (1080p) generalized, a scenario after transition to DVB-T2/HEVC (e.g. 2022) could assume two thirds of TV channels being full-HD (1080p) and one third of TV channels being ultra HD (4K)

	Number of national full-time TV channels (video + audio + associated data, including interactive data) Dimensioning hypotheses (1/3 Ultra HD channels envisaged around 2022)		Number of fixed national multiplexes needed at the end of the migration towards DVBT-2/HEVC (envisaged around 2022) (95% of the French metropolitan population)
Low (30 TV channels)	20 full-HD	10 4K	7
Medium (35 TV channels)	23 full-HD	12 4K	8
High (40 TV channels)	26 full-HD	14 4K	9

2) For mobility, the implementation of scenario 1 (**same DTT architecture – services of mainly linear TV towards outdoor mobile, eg cars, transportation)** or scenario 2 (**new broadcast architecture for delivery of digital content to smartphone/tablets)** may require the introduction of mobile SFN/MFN DVB-T2 multiplex, although it is difficult to assume a specific number.

3) In a nut shell, with the previous hypotheses, 7 to 9 national multiplexes would be necessary to support these scenarios (assuming a full DVB-T2/HEVC landscape by 2022).

If it is not possible to maintain 8 multiplexes as of today (e.g. in relation with a possible allocation of the 700 MHz to mobile service in France at a date decided by the government), then this would imply a reduction of the DTT platform service offering at that horizon, in terms of UHD/4K TV channels availability and/or the ability to migrate all national TV channels towards full HD and/or the ability of the DTT platform to evolve towards mobility. Moreover, there is a risk that, with limited incentive for the end user, the transition towards DVB-T2/HEVC would be more complex and lengthy.

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

Answer:

See answer to i) above

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

Answer:

There is no detailed plan available for the time-being in France concerning the transition period towards DVB-T2 and MPEG-4/HEVC.
Moreover, the timing of HEVC DTT receiver availability is not clear for the moment. HEVC is a new video compression standard currently developed jointly by ISO/IEC MPEG and ITU-T VCEG. The HEVC standard may be finalized in January 2013.
These new transition(s) will be very challenging and probably very different from the DSO (transition from analogue to digital television), because:

- HDTV is already available on the French DTT platform since 2008, using DVB-T/MEPG-4. Therefore, new incentives will be required for viewers to accept the transition(s), because they will have to pay for new user equipment. If new consumer propositions are not sufficiently attractive to drive the adoption of new technologies, an important Government intervention will be required;
- There will be very limited spectrum available for a simulcast with old and new technologies. In particular, a simulcast of the existing DVB-T offer and its DVB-T2 counterpart will be impossible (see below).

In the spectrum currently allocated to DTT in France (470-790 MHz), there is no possibility to coordinate any new 9th nationwide multiplex with neighbouring countries. Therefore, the migration towards DVB-T2 will first require an MPEG-2 to MPEG-4 switchover, because it will free the capacity of one nationwide multiplex without reducing the DTT service offer.
It is estimated that this MPEG-2 switch-off may be possible in 2015/2016 with limited Government intervention. This is due to the fact that following the market success of free-to-air MPEG-4 HDTV available on DTT since 2008, the French Parliament decided in 2009 to adopt legal measures mandating progressive integration of HD capability (i.e. DVB-T/MPEG-4) in products sold on the French market (TV sets with integrated DTT tuners and from December 2012, DTT set-top boxes). Therefore, in a way, the transition towards MPEG-4 has already begun.
Once this step is completed, the capacity of only one nationwide DVB-T2 multiplex will be available:

- Will DVB-T2/HEVC receivers be available at reasonable cost for end users at that time (i.e. 2016, after MPEG-2 switch-off) or may this DVB-T2 multiplex be launched at first in DVB-T2/MEPG-4, followed several years later by another switch to DVB-T2/HEVC, therefore requiring two migrations which might be ineffective and unrealistic if these two transitions are too close?
- What will be the consumer incentives born by this only one DVB-T2 multiplex? Will it be enough capacity to make viewers buy new equipment?
- And finally, how the remaining 7 national DVB-T multiplexes will switch to DVB-T2?

Annex 2: Background and Context

The terrestrial television digital switchover (DSO), i.e. the transition from analogue to digital broadcasting, is well advanced within the European Union. Most Member States have already completed their migration plan or are expected to have completed it by 2012.

Compared to analogue TV, DTT delivers greater variety and choice for EU households (greater number of services, higher video and audio quality, multichannel sound, better accessibility of TV programmes through higher availability of subtitles and audio-description, linear and interactive services, free-to-air and subscription television, local/regional TV).

The terrestrial broadcast platform is the primary means of delivering broadcast services within the EU and it is observed that DSO has revitalized terrestrial distribution in some European countries, inducing a growing number of viewers at the European scale.

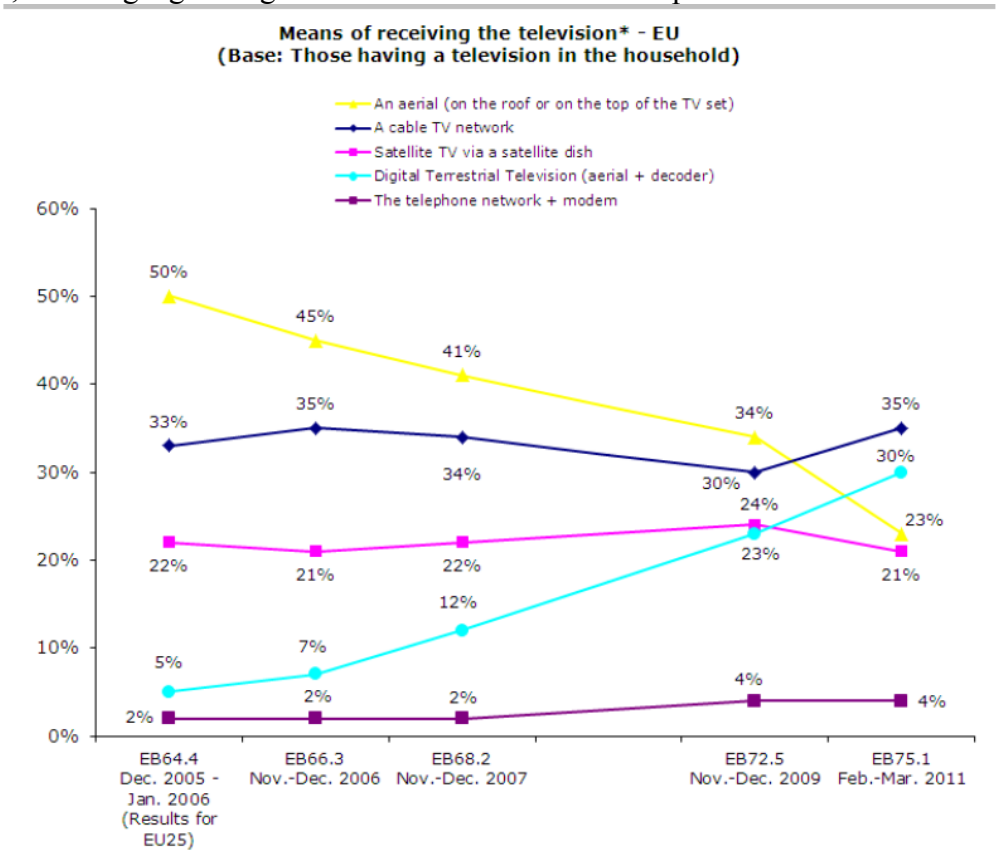
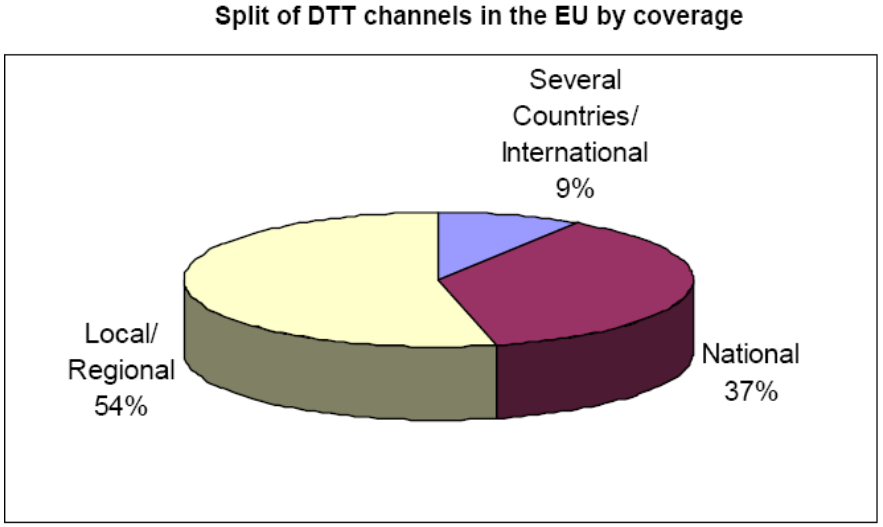


Figure 1: How European households receive TV? (source: Eurobarometer 362[8], E-communications household survey, July 2011)

The objective of this questionnaire is to invite Members States to share their views on the evolution of the digital terrestrial platform (DTT) over the next decade (2012-2022).

1) The DTT platform in 2012 in the EU

According to the "MAVISE TV database", developed by the European Audiovisual Observatory for the European Commission**,** it was expected that 16 EU countries would have completed their switch-off of analogue terrestrial signals by the end of 2011.
The "MAVISE TV database" showed that the total number of TV channels broadcast on European DTT networks was almost 1,800 in June 2011 (compared to almost 1,500 in October 2010). The total includes a very large number of local channels. There are very significant numbers of local channels in Italy, Spain and Denmark.



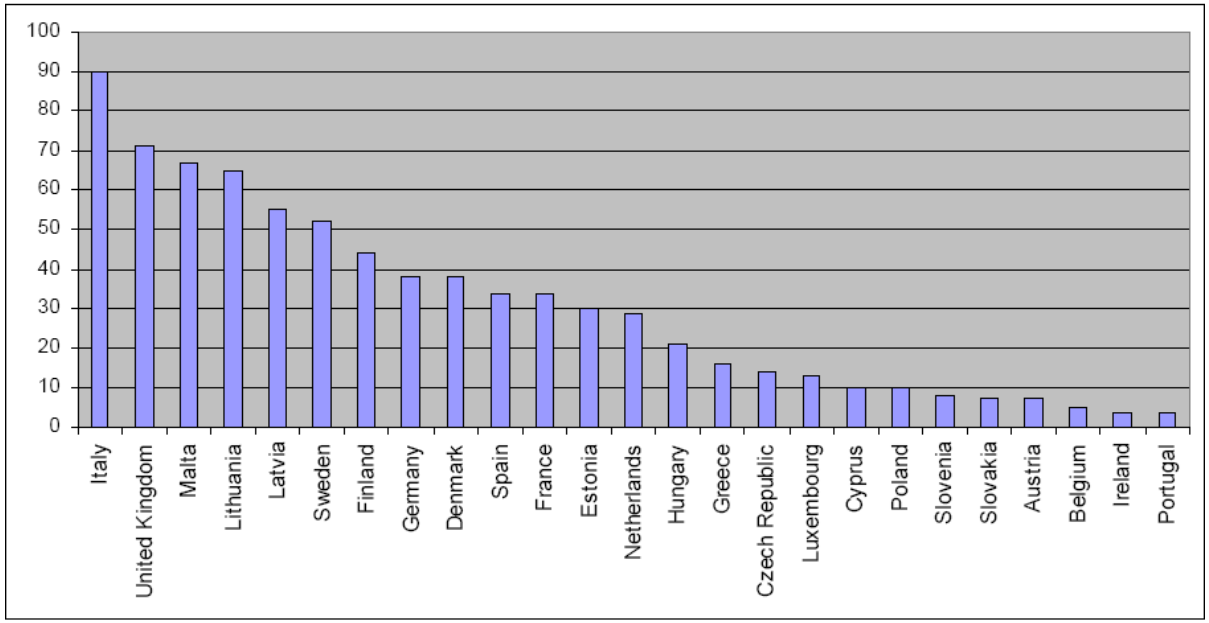
Source: MAVISE June 2011

The number of national and international TV channels available to DTT households has increased to more than 820 in June 2011 (compared to 500 in April 2009).

[8] Conducted by TNS Opinion & Social at the request of Directorate-General Information Society and Media of the European Commission

In the EU, the number of TV channels available nationally varies widely between countries (see figure below). The maturity of the DTT market, the sharing of frequencies between TV channels (full-time TV channels vs. part-time TV channels) and the availability of pay TV packages may influence this. For example, the most recent launches in Ireland and Portugal have the least number of TV channels. At the other end of the scale, Italy has a far higher number of national TV channels than all other EU countries.

National Channels on DTT networks in the EU



Source: MAVISE June 2011

There are various digital TV platforms available in EU countries after DSO
:

- Digital terrestrial TV
- IPTV (“ADSL”) or FttH ;
- Digital satellite;

QC4 Does your household receive the television via...?
(MULTIPLE ANSWERS POSSIBLE)

	Digital Terrestrial Television (aerial + decoder)	An aerial (on the roof or on the top of the TV set)	Satellite TV via a satellite dish + decoder	A cable TV network (analog = directly connected to the TV set)	A cable TV network + decoder (digital TV)	The telephone network + modem and/ or decoder	Don't know
EU27	30%	23%	21%	19%	16%	4%	1%
BE	6%	*0%*	4%	**46%**	34%	14%	0%
BG	19%	19%	7%	**41%**	15%	*0%*	1%
CZ	**34%**	28%	21%	10%	11%	*0%*	0%
DK	7%	13%	13%	25%	**39%**	6%	3%
DE	6%	2%	**38%**	30%	28%	*1%*	0%
EE	18%	12%	*10%*	**33%**	23%	*10%*	2%
IE	5%	26%	**43%**	12%	16%	*1%*	3%
EL	11%	**92%**	3%	1%	*0%*	*0%*	0%
ES	**76%**	25%	*2%*	*2%*	6%	*2%*	1%
FR	**51%**	35%	16%	*4%*	7%	19%	1%
IT	**56%**	41%	17%	6%	9%	*1%*	1%
CY	14%	**82%**	8%	6%	4%	*2%*	0%
LV	29%	7%	15%	**41%**	7%	*2%*	2%
LT	12%	**37%**	6%	**37%**	9%	*2%*	1%
LU	8%	*3%*	21%	32%	**39%**	5%	2%
HU	*1%*	16%	17%	**54%**	12%	*1%*	0%
MT	**37%**	7%	5%	21%	33%	*1%*	1%
NL	22%	*0%*	6%	**42%**	31%	4%	2%
AT	5%	7%	**45%**	37%	10%	*2%*	2%
PL	7%	**32%**	26%	28%	10%	*0%*	1%
PT	8%	**47%**	8%	27%	11%	*2%*	2%
RO	18%	6%	5%	**60%**	10%	*1%*	2%
SI	22%	7%	*4%*	**37%**	23%	10%	1%
SK	13%	26%	**28%**	27%	10%	*1%*	1%
FI	21%	32%	*2%*	12%	**36%**	*0%*	1%
SE	27%	11%	14%	25%	**28%**	6%	4%
UK	35%	27%	**36%**	2%	15%	*1%*	1%

Highest percentage per country *Lowest percentage per country*

Highest percentage per item | Lowest percentage per item

Cable reception, either pay or free.

Figure 2: How European households receive TV? (source: Eurobarometer 362[9], E-communications household survey, July 2011)

The penetration of each digital TV platforms evolves differently in EU countries.

It has also to be noted that many households are equipped with more than one TV set and are using different platforms.

TV platform penetration analysis should also include households which are equipped with at least 2 TV sets as basic pay-TV offers do not include equipment or intellectual property rights to receive TV channels on a secondary TV set[10].

The competitiveness of the DTT platform is related to the number and video-audio quality of services delivered to viewers, which in turn depends on the amount of UHF spectrum available. To deliver benefits to citizens and consumers, the DTT platform should remain sufficiently attractive to viewers so that it can remain commercially sustainable as a platform, and sustain consumer choice in TV content, platforms and equipment.

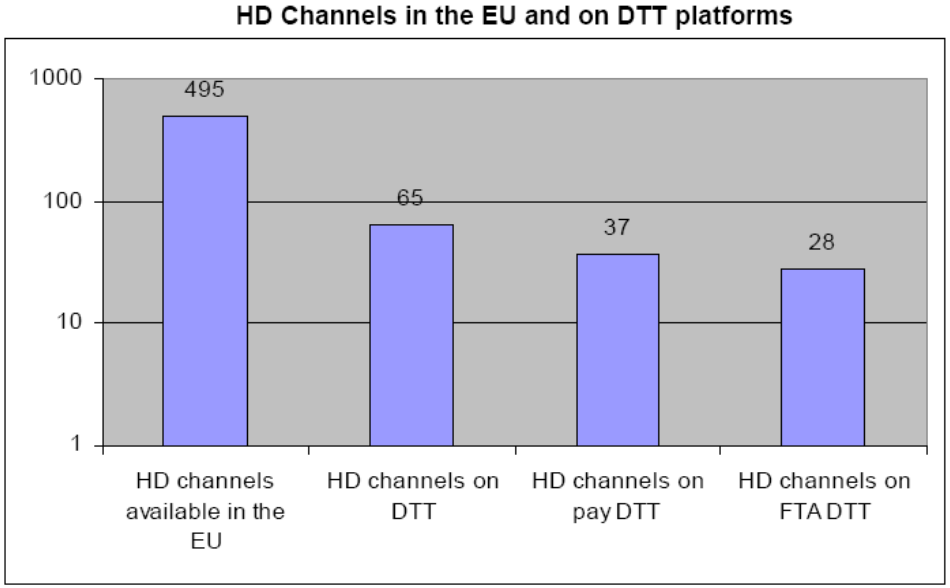
2) Video Format Evolution

There is a strong demand for **HDTV** in the EU, which – among several factors – can be explained by the dramatic adoption of large flat screen television by consumers.

The success of DVD, of Blu-Ray discs, of video-game consoles or home theatre equipments has also reinforced the growing expectation of video and audio quality of EU-households, and is making Standard Definition (SD) content appear comparatively inferior in terms of quality.
HDTV technology, along with large screen displays, has become the norm in homes, where audiences enjoy high-quality programme content.

According to the "MAVISE TV database", developed by the European Audiovisual Observatory for the European Commission**,** HDTV channels were available on DTT platforms in 13 EU countries in June 2011 (as compared to 8 in October 2010): Czech Republic, Denmark, Finland, France, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Spain, Sweden, the United Kingdom and also in Norway.
HDTV channels were available on both Free-to-Air and Pay-TV platforms in most of these countries (except Latvia and Lithuania where HD is on Pay DTT only). On the Free-to-Air platforms, the TV channels were the simulcast or HD versions of the major national public and private generalist TV channels. On the pay-TV platforms, the HDTV channels were niche channels, film channels and pan-European documentary channels.

[9] Conducted by TNS Opinion & Social at the request of Directorate-General Information Society and Media of the European Commission
[10] Secondary TV sets means TV set of rank 2 but also TV sets of rank 3, 4… whenever they exist.



Source: MAVISE June 2011

	SD	HD			UHD	
	576i	720p	1080i	1080p	4Kx2K	8Kx4K
Pixels x Lines	720 x 576 25 frames/s	1280 x 720 50 frames/s	1920 x 1080 25 frames/s	1920 x 1080 50 frames/s	3840 x 2160 50 frames/s	7680 x 4320 50 frames/s
Mpixel/s	10	46	52	104	415	1659

SD = Standard Definition TV format
HD = High Definition TV format (the resolution of HDTV is described in Recommendation ITU-R BT.709 as 1920×1080).
UHD = Ultra High Definition TV format

HDTV offers higher picture quality than SDTV. Instead of providing an image with 576 active lines, HDTV provides an image with a format of either 720 or 1080 active lines on the screen. Motion portrayal can also be better rendered than by traditional SDTV depending on whether the active lines form a progressively scanned picture fifty times a second, rather than a complete interlaced image twenty five times a second. HDTV is also always formatted as 16:9, and for equal picture resolution needs proportionately a greater number of pixels per line than for the conventional 4:3 format.

The 1080i format is often broadcast at a reduced horizontal resolution 1440 pixels x 1080 lines at 25 frames/s, corresponding to 39 Mpixel/s.

Migration towards a full HDTV (1080p) landscape

Production technology is full HD, which means that all programmes in the future will be 1080p HD quality, as for Blu-ray discs. Moreover, consumers are more and more equipped with full HD TV sets.

In order to continue to provide a competitive and attractive DTT platform, it is believed that DTT services should be delivered to consumers in a full HD format (1080p).

3DTV

ITU-R Report BT.2160 «Features of three-dimensional television video systems for broadcasting».

For the next decade (2012-2022), it is assumed that 3D services will be occasionally available on the DTT platform (special sports events or certain movies for example). It is expected that it will remain a relatively minor part of the total programme offering and hence, should not have a significant impact on the overall DTT capacity requirement.

According to the "MAVISE TV database", 3D-DTT tests were being carried out in several EU countries in June 2011 (Italy, the Netherlands, Spain, Sweden, the United Kingdom, etc.). At that time, 3DVoD was already available in Italy.

UHDTV (4Kx2K)

ITU-R Report BT.2246 «The present state of ultra high definition television» was adopted in October 2011: UHDTV[11] is a television application that is intended to provide viewers with an enhanced visual experience primarily by offering a wide field of view that virtually covers all of the human visual field with appropriate sizes of screens relevant to usage at home and in public places.

Compared with current HDTV, UHDTV should bring considerably improved benefits to its viewers. Those benefits may include:

– stronger sensation of reality or presence;
– higher transparency to the real world;
– more information.

It may be presented in:

– living rooms;
– personal spaces in mobile and non-mobile environments;
– collective viewing locations such as theatres.

In ITU-R Report BT.2246, it is concluded that, from the point of view of image presentation, 4Kx2K UHDTV television broadcasting to the home may find acceptance with in-home television audiences, while it may be unlikely that 8Kx4K UHDTV will do so. The 8Kx4K UHDTV image system may instead find applications for television presentations to the public in theatres, in home theatres, auditoria, theme parks, and other public venues.

[11] Ultra High Definition Television

ITU has announced in May 2012 that a new Recommendation that represents a major advance in television broadcasting that will create an entirely new television broadcast environment with the advent of 'Ultra High Definition Television' or UHDTV.

3) The introduction of non-linear services

Non-linear services correspond to on-demand audiovisual services (catch-up TV, VoD…), HbbTV, etc.

4) DTT Reception Mode Evolution: from fixed (rooftop) reception towards mobility

Non-linear content delivery / "Datacasting" [TBD on the basis of ITU-R Report BT.2049 : digital broadcasting to handheld terminals via broadcast spectrum in a mobile environment including in-door, in-vehicle and in-transit reception at speeds matching cellular mobile networks characteristics. Broadcasting of multimedia and data applications to mobile devices will also elaborate the expanded service opportunities offered by the inclusion of interactivity through the application of wireless networks such as those of the IMT family.].

DVB-H, MediaFLO: no commercial success of dedicated mobile TV networks (except T-DMB/S-DMB in Korea).

Some European countries (like Germany or Switzerland) have chosen a mixed fixed/mobile reception scheme for their DVB-T services, which permits to address at least part of the mobile reception, with coverage complemented if needed by other means.

Is there a new opportunity with DVB-T2?

DVB-T2 can provide robust mobile reception at high speeds, at the cost of reduced bitrate. To facilitate the implementation of mobile application, DVB has defined a mobile profile of T2 called *T2-Lite*. This new profile is basically a subset of the already existing T2 specification with a few minor add-ons and a data rate limited to 4 Mbit/s, which allows a reduction of the receiver chip size by 50%. The *T2-Lite* profile allows the mixing of frames with different FFT sizes and guard intervals in a time-division-multiplex – the so-called Future Extension Frames (FEF) thus optimizing OFDM parameters for fixed and mobile reception. The *T2-Lite* profile will soon be completed with additional technologies that are not yet included in the T2 toolbox such as MIMO.

Aside this T2-Lite option, there is also the possibility to have an hybrid network in T2, which delivers HD or SD services both to fixed, portable and mobile receivers, with a coverage complement over other point-to-point networks. It is to be noted that both recent smartphones and tablets embeds high resolution displays that are already very close to full HD resolutions.

Providing services towards mobile terminals is likely to require higher field strength for the coverage. This may have an impact on the platform network architecture.

5) Technical considerations

It appears that DTT landscape will no longer evolve without an evolution of transmission or compression standards.

Improvements in video compression technologies
ITU-T Recommendations H.262 (MPEG-2 Video)

ITU-T Recommendation H.264 (MPEG-4/AVC). MPEG-4/AVC was designed to provide a 50% bit-rate saving compared to MPEG-2. The use of this technology made it possible to launch HDTV services on the DTT platform.

Draft ITU-T Recommendation H.265 (HEVC): a new video compression standard, called HEVC (High Efficiency Video Coding), is currently being developed jointly by ISO/IEC MPEG and ITU-T VCEG. This new technology is designed to achieve up to 50% video compression efficiency gain compared to MPEG-4/AVC, but at a cost of greater computation power[12]. A wide range of video resolutions is expected to be covered, from low resolution to UHD (4Kx2K and 8Kx4K). The HEVC standard may be finalized in January 2013 and it may be possible to envisage the launch of first broadcast services in 2015/2016.
The use of this technology, along with DVB-T2, may allow the transition towards full HDTV services (1080p) and the launch of the first UHDTV (4K) services over the DTT platform within the end of the next decade (2022).

Bit-rate savings (at constant video quality):
There is a gradual evolution of encoders giving greater efficiency within a specification, where existing decoders can continue to be used.
- MPEG-2 encoder performance may still be improved by manufacturers. A further gain of 5 to 10% may be expected within 3 to 5 years;
- MPEG-4/AVC encoder performance will also be improved over time. A further gain estimated between 10% and 20% may be achievable within 3 to 5 years.
- First generations of HEVC encoders may provide, in 2015/2016, a 30% bit-rate saving compared to the best MPEG-4/AVC encoders available today, and a 50% bit-rate saving in 2022.

However, it shall be noted that two specific requirements of broadcast TV services can hinder these bit-rate saving expectations, particularly in the case of the HEVC saving forecast:
- Step-in the live video stream implies higher bit-rates since there is an obligation to regularly broadcast enough information to allow a fast reconstruction of the first image to be displayed after zapping (compared to downloaded media);
- "on the fly" encoding does not allow a great optimization of the bitrates since it has to be performed "real time".

		Today			**Expected 2015/2016**			**Expected 2022**		
Format	Video coding	Video data rate (Mbit/s)	Audio and other associated data	Total (Mbit/s)	Video data rate (Mbit/s)	Audio and other associated data	Total (Mbit/s)	Video data rate (Mbit/s)	Audio and other associated data	Total (Mbit/s)

[12] It is estimated that the computational complexity will be 10 times that of MPEG-4/AVC for encoders and 2 to 3 times for decoders

			(Mbit/s)			(Mbit/s)			(Mbit/s)	
SD	MPEG-2	3	0,5 to 1	3,5 to 4	2,7	0,5 to 1	3,2 to 3,7	2,7	0,5 to 1	3,2 to 3,7
SD	MPEG-4/AVC	2 to 2,5	0,5 to 1	2,5 to 3,5	1,7 to 2,1	0,5 to 1	2,2 to 3,1	1,7?	0,5 to 1	2,2 to 2,7
HD-720p	MPEG-4/AVC	6 to 7	1 to 1,5	7 to 8,5	5,1 to 5,95	1 to 1,5	6,1 to 7,45	5?	1 to 1,5	6 to 6,5?
HD-1080i	MPEG-4/AVC	7 to 8	1 to 1,5	8 to 9,5	5,95 to 6,8	1 to 1,5	6,95 to 8,3	5,8?	1 to 1,5	6,8 to 7,3
HD-1080p	MPEG-4/AVC	12 to 13	1 to 2	13 to 15	10,2 to 11	1 to 2	11,2 to 13	10?	1 to 2	11 to 12?
HD-1080p	HEVC				8,4 to 9,1	1 to 2	9,4 to 11,1	5?	1 to 2	6 to 7?
4k	HEVC				[20 to 30]	1 to 2	[21 to 32]	[11 to 20]?	1 to 2	[12 to 22]?

Rough estimate of average DTT bitrates for different formats&coding technologies over next years[13]

(Highest expected saving figures were retained for calculation)

In addition to the video signal, the audio component and other associated data must be transmitted [TBD]:

- Audio component(s)[14]:: 0,2 to 0,5 Mbit/s;
- Subtitles/audio-description: 0,1 to 0,3 Mbit/s;
- EPG: strongly depending on data depth and details, and on technology used
- Signalling (MPEG PSI, DVB-SI):: [tbd]
- Interactivity (HbbTV,…): typically 0,1 to 1 Mbit/s per channel.

Improvements in DTT transmission technology: DVB-T2

DVB-T2[15] is an improved variant of DVB-T providing higher capacity and/or more robustness. DVB-T2 has already been introduced in some countries, with the main target to provide HDTV using MPEG-4 for fixed rooftop reception.

DVB-T2 also offers additional transmission modes suitable for the provision of portable and mobile reception.

One of the new features DVB-T2 offers is called multiple Physical Layer Pipes (PLPs). Multiple PLPs enable service-specific robustness. For example, a single DVB-T2 multiplex could carry a mixture of HDTV aiming at household television sets fed by rooftop aerials, as well as some low-bit rate, more rugged services aiming at portable receivers.

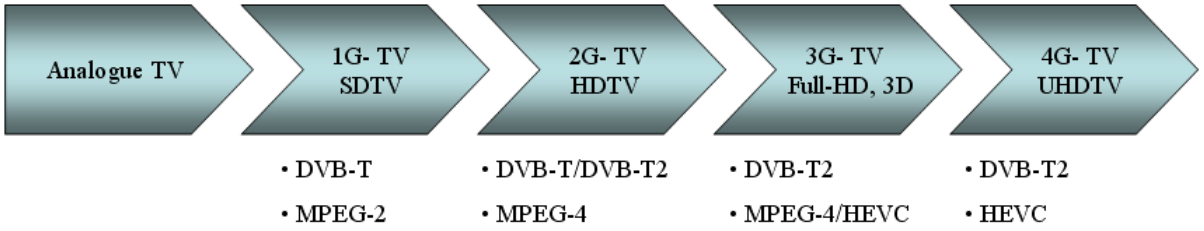
[13] Further studies to better estimate these average bitrates are needed.

[14] There is a trend to add to the national language audio stream two other audio: native original langage, audio description. Moreover multichannel audio (5.1 and over) needs higher bitrates than stereo.

[15] http://www.dvb.org/technology/dvbt2

DVB-T2 can also provide robust mobile reception at high speeds. To facilitate the implementation of mobile application, DVB has also defined a mobile profile of T2 called *T2-Lite* (see above).

Technology transitions



A critical aspect of the implantation of new source coding technologies and transmission technologies is the transition.

Lessons from the DSO:
- For a certain period of time, a simulcast with old and new technologies is required;
- A certain amount of additional spectrum is needed;
- An incentive is required for viewers to accept the transition because they will have to pay for new user equipment. Technology transitions should be associated with new consumer propositions sufficiently attractive to drive the adoption of new technology;
- A Government intervention is required.

The free-to-air DTT platform is a horizontal market where any retailer can market the customer premises equipment (digital TV sets, digital set-top boxes). The DTT platform management and ecosystem are relatively complex. The decision-making process relies on coordination and consensus among many players involved.

Should the technology transition be a market-led process? It seems difficult to envisage a simple infrastructure change with no or little added value for citizens[16]. Many routes are possible in terms of the speed and length of the process, the parties involved, and the degree of government intervention. Furthermore, the transition challenge may vary from MS to MS, depending on the initial situation. In France, HDTV was launched using DVB-T/MEPG-4 in 2008, whereas in the UK, HDTV was launched using DVB-T2/MPEG-4.
MS that have already accomplished the full DSO with MPEG-2/DVB-T will hesitate to quickly adopt MPEG-4 and/or DVB-T2 since viewers would be required to replace their recently acquired receiving equipment. On the other hand, EU countries that made a late start to DTT are in the position to directly begin DTT deployments in MPEG-4/DVB-T2.

[16] See the example of SECAM « bottles » removal in France, that took decades to be completed

Although DVB-T2 may offer many advantages over DVB-T, it is likely that both systems will co-exist across Europe for a relatively long period of time in order to safeguard the users' investments during the analogue switch-off. Nevertheless, a gradual transition to DVB-T2 could be beneficial in the long term.

It is believed that the transition "dividend" shall benefit to maintain an attractive and competitive DTT platform and follow the service offering evolution expected on the other platforms: higher quality, new linear and non-linear services, mobility, etc.

6) Spectrum Requirements

To assess the amount of spectrum required to provide a certain number of services, it is necessary to make assumptions about the required multiplex capacity.

The spectrum needs to support DTT in the EU may be envisaged, based on the identification of 3 different scenarios:

1) EU countries with strong DTT penetration vs. other platforms (France, UK, Italy, Spain, …)
2) EU countries with medium DTT penetration vs. other platforms
3) EU countries with low DTT penetration vs. other platforms (Sweden, Germany, Netherlands, …)

**

Annex 3: Suggested format with example Answers to Question 1

Question 1 (i) - Please describe the DTT platform in your country, currently on-air:

Member State	No. of Multiplexes	Reception availability	Reception mode[17]	Number of TV program services and content format	DTT System and modulation	Intended coverage reach[18]	Coverage obligation (Y/N)[19]	Coverage (as a percentage of population)	Spectrum band used (UHF IV/V or VHF Band III)
IX	2	Free-to-air	Fixed	6 SD, 1 HD	DVB-T, 64-QAM	National	Y	98.7%	UHF Band IV/V
IX	2	Pay-TV	Portable indoor	12 SD, 4 HD	DVB-T2, 256-QAM	National	N	90.5%	UHF Band IV/V
AY	2	Free-to-air	Fixed	4 SD, 1 HD	DVB-T, 64-QAM	National	Y	97.5%	VHF Band III
AY	2	Free-to-air	Fixed	6 SD, 4 HD	DVB-T2, 256-QAM	National	N	95.4%	UHF Band IV/V
BZ	4	Free-to-air	Fixed	16 SD, 4 HD	DVB-T, 64-QAM	National	Y	98.2%	UHF Band IV/V
BZ	1	Free-to-air	Fixed	6 SD, 4 HD	DVB-T2, 256-QAM	National	N	96.8%	UHF Band IV/V
BZ	1	Free-to-air	Portable indoor	6 SD	DVB-T, 16-QAM	Regional	N	33.6%	UHF Band IV/V

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

Question 1 (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*

Member State	**additional Multiplexes (Y/N)**	**No. of additional Multiplexes**	**Reception availability**	**Reception mode[20]**	**Expected content format (SD and or HD)**	**Expected DTT system and modulation (if known)**	**Intended coverage reach[21]**	**Intended Coverage (as a percentage of population)**	**Spectrum band used (UHF IV/V or VHF Band III)**
IX	Y	2	Free-to-air	Fixed	SD and HD	DVB-T2, 256-QAM	National	99%	UHF Band IV/V
AY	Y	1	Free-to-air	Fixed	HD	DVB-T2, unknown	National	95%	UHF Band IV/V
BZ	Y	4	Free-to-air	Fixed	SD	DVB-T, 16-QAM	Local	25%	UHF Band IV/V
CW	N								

(b) *foresee the launch of new services*

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**
IX	Y	HD	Free-to-air	SD and HD	Y	N	Y	Y	3D TV
AY	N								
BZ	Y	Free-to-air	Pay-TV	HD	Y	Y	N	N	

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