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*
ITALY	**Francesco TROISI**	**M.I.S.E - COMUNICAZIONI**	**27 September 2012**

Italian Administration prefers to keep reserved the information included in this document

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 multi-plexes	Reception availability	Reception mode	Number of TV program services and content format	DTT System & modulation	Intended coverage reach	Coverage Obbligation	Coverage as a percentage of population	Spectrum Band used (UHF IV/V or VHF Band III)
ITALY Public Service (RAI)	1	Free-to-air Public service broadcaster multiplex with one different regional program for each region	Fixed	4 SD MPEG2 + 3 radio programs	DVB-T, 64-QAM SFN in UHF Band	National, Regional	Y (99% Nat. Pop.)	>99.0% Nat. Pop.	VHF III + 1 different channel in UHF IV/V different for each region
			Fixed		DVB-T, 64-QAM MFN in VHF Band				
	3	Free-to-air Public service multiplexes	Fixed	12 SD MPEG2 + 1 HD MPEG4 + 5 radio programs	DVB-T, 64-QAM SFN in UHF Band	National	Y (90% Nat. Pop.)	>90.0% Nat. Pop.	UHF IV/V
	1	Free-to-air Public service multiplex	Fixed	[See Reply 8]	DVB-T2 in VHF Band	National	Y (80% Nat. Pop.)	trial	VHF III
ITALY (Mediaset)	1	Free-to-air	Fixed	6 SD	DVB-T, 64 QAM	National	Y (80% Nat. Pop.)	> 95 % Nat. Pop.	UHF IV/V
	3	1 Free + 2 Pay-Tv	Fixed	13 SD + 5 HD	DVB-T, 64 QAM	National	Y (80% Nat. Pop.)	> 90 % Nat. Pop.	
	1		Portable/mobile	9 Portable	DVB-H, 16 QAM	National		> 90 % Nat. Pop.	
ITALY (TIMB)	3	Free-to-air	Fixed	21 SD + 1 radio	DVB-T, 64 QAM	National	Y (80% Nat. Pop.)	> 90 % Nat. Pop.	UHF IV/V
ITALY (Rete A)	2	Free-to-air	Fixed	10 SD + 10 radio	DVB-T, 64 QAM	National	Y (80% Nat. Pop.)	> 80 % Nat. Pop.	UHF IV/V
ITALY (DFREE)	1	Pay-Tv	Fixed	9 SD	DVB-T, 64 QAM	National	Y (80% Nat. Pop.)	> 90 % Nat. Pop.	UHF IV/V
ITALY (H3g)	1		Portable/mobile	7 Portable	DVB-H, QPSK	National		> 80 % Nat. Pop.	UHF IV/V
ITALY (Retecapri)	1	Free-to-air	Fixed	7 SD + 1 radio	DVB-T, 64QAM	National	Y (80% Nat. Pop.)	> 80 % Nat. Pop.	UHF IV/V
ITALY (Europa 7)	1	Pay-Tv	Fixed	4 HD MPEG4	DVB-T2, 256 QAM	National	Y (80% Nat. Pop.)	n.a.	VHF III
ITALY (Regional-Local, typ. Number)	18 [see note 1]	Mainly Free-to-air	Fixed	typical: 120 SD + 10 HD + 10 radio	DVB-T, 64 QAM	Regional	N	> 80 % Nat. Pop.	Generally: UHF IV/V Sometimes: VHF III
ITALY (DAB)	-	-	Mobile	-	-	-	-	-	VHF III

ITALY	37	-		-	-	-	-	-	VHF III, UHF IV/V

Note 1: In Italy there are more than 500 regional-local Broadcasters that produce an average occupancy of spectrum equivalent to 18 national Muxes (both VHF and UHF bands are considered)

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	No of multiplexes	Reception availability	Reception mode	Expected content format	Expected DTT System & modulation	Intended coverage reach	Coverage as a percentage of population	Spectrum Band used (UHF IV/V or VHF Band III)
ITALY	Y	6	t.b.d.	Fixed	t.b.d.	DVB-T, 64 QAM	National	> 80 %	Generally: UHF IV/V Sometimes: VHF III (see note 2)

Note 2: **The Italian "internal digital dividend".** Due to an infringement procedure moved by the EU against Italy, whose media market was accused to be too closed to newcomers, in July 2011, the Ministry for Economic Development published the rules for the handing over of 5 groups of frequencies to be allocated to DVB-T Multiplexes, plus 1 frequency to be allocated to a DVB-H (or DVB-T2) Multiplex after an evaluation of the possible candidates (or "Beauty Contest"). These "5+1" groups of frequencies are the so called "internal digital dividend" result of the transition from analogue to digital television and to be used for broadcasting service.
In January 2012, the new Minister of Economic Development has decided to suspend the Beauty Contest for a period of three months for further in-depth considerations, in light of the outcomes of the WRC12.
On 24th April 2012 a new law was approved in which it is announced that, by the end of October 2012, the rules for acquiring the 5+1 groups of frequencies of the "internal digital dividend" will be defined : the government decided to assign such frequencies by allocating the licenses through a bid up process.
In the following **Table 1** are listed the groups of frequencies constituting the "internal digital dividend". However the table could be modified by an AGCOM decision also subject to a approval of European Commission.

Table 1

Group	Channels	Standard
1	6, 7 VHF	DVB-T
2	25, 23 UHF	DVB-T
3	28, 24, **59** UHF	DVB-T
4	**55** UHF	DVB-T
5	**58** UHF	DVB-T
6	**54** UHF	DVB-T2

(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
ITALY	Y	SD/HD	-	SD/HD	Y	Y	Y	Y	(See Note 3)

Note 3: The following **Table 2** gives details of the number and nature of planned services.

Table 2

	SERVICES/ CONTENTS	DESCRIPTION	Capacity (Mb/s)
1	AUDIO	5+1 and greater audio coding to be adopted with the incoming HD, 3D and UHDTV standards	1,5 Mbit/s for each multiplex
2	SERVICES FOR SECONDARY SCREENS	Usage of multiple PLP (Physical Layer Pipe) to carry IP information associated to television programmes to be linked by tablets, smart phones and portable devices through wi-fi or blue-tooth	5 Mbit/s for each multiplex
3	INTERACTIVITY	Evolution of MHP (1.13 and subsequent) will need more spectrum then now	5 Mbit/s for each multiplex
4	H/IBB	Development of H/IBB (Hybrid/Integrated Broadband and Broadcasting) applications requires some bandwidth also on broadcast side	5 Mbit/sec for each multiplex
5	HD	The usage of wider screen, flat instead of CRT (from 21"-24" to 42"–50") requires HD transmission with double capacity than SD in order to keep the same quantization noise	an increase of 10 Mbit/s for each multiplex
6	3D	3D content	increase of 50% of capacity compared to HD programme

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

Answer: All Italian DTT Licenses will last until 2032.

Question 2

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

Answer:

The current percentage of the Italian population reached by digital terrestrial broadcasting signals is around 99% population (the Italian Analogic Switch Off process ended on 4th July 2012: after this date, there is no analogue television signals on air.).

The percentage of users who receive television primarily by terrestrial means is around 83% population.
The percentage of user who receive television primarily by satellite means is around 17%.
IPTV users are under 1% population.

A free to view satellite service called “Tivù Sat” was launched in July 2009 as result of a joint venture of the main Italian terrestrial broadcasters (Rai, Mediaset, Telecom Italia Media and two associations of local/private broadcasters – Aeranti Corallo and FRT). This platform, available from Eutelsat Hotbird 13°, offers its viewers access to all the free-to-air programs already available on the DTT platform (contents are encrypted with Nagravision system to restrict viewing only to Italian users equipped with the Tivùsat smartcard). Today, after three years, there are 1.4 million active TivùSat smartcards for a total of approximately 4 million viewers reached. The activation trend was particularly high during ASO dates (in the involved areas) and in all those areas where DTT signals are received with some difficulty (e.g. due to different coverage extension of the various DTT multiplexes, or because of particular orographic characteristics or SFN networks synchronization problems).

The Smart TV market growth could lead to a long term opportunities to deliver contents to users on the same device (TV screen) by different platforms. In Italy the DTT platform could be complemented by the ADSL platform exclusively for non-linear contents.

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:

Yes

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:

a. The present DTT network topology developed onto previous analogue network topology and based on high tower /high power type topology is the best and effective way to provide terrestrial broadcasting service. Slight improvements have to be performed to meet SFN requirements in comparison to MFN (analogue network was based onto MFN type and precision offset technique). The constrains given by OFDM and GI for the most used system configurations are more significant than those given by precision offset.

b. The use of SFN is already largely used in Italy to optimize the frequencies use and certainly will be repeated for DVB-T2.

c. In Italy the digital terrestrial platform will migrate gradually towards the DVB-T2 for, at least, the following reasons:
   1. at present, in DVB-T multiplexes there is no capacity enough to introduce new services (see also table on note 3 above) or improve the technical quality of broadcast content (SD towards HD and beyond);
   2. Following the outcome of the last WRC-12 to reduce the amount of spectrum to broadcasting service in favour of mobile services new and more efficient modulation and transmission techniques will be necessary to satisfy the enhanced TV services (i.e. DVB-T2/HEVC) on DTT platform.

Italian government has announced that as of 2015, all DTT receivers must include a tuner with the DVB-T2 standard. At the moment there is no plan for the transition from DVB-T standard towards the DVB-T2 standard.
The evolution towards DVB-T2 / DVB-T2 Lite, is a great opportunity for broadcasters also to deliver Radio and Video content in mobility (especially in-car) using the same infrastructure already in use for "fixed" reception (complemented by gap fillers in specific areas).

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: These two possibilities are both technically feasible. The final choice will depend on the Broadcasting and Telco strategies as well as from business models envisaged (currently under consideration).

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 ITU Report BT. 2139 shows that DTT mobility reception (especially in-car) is possible with the current network topology by through the use of diversity receivers. For two branch receivers the mobile reception availability inside coverage area planned for fixed reception is more than 90% and it increases up to 98% for four o more branch receivers. Therefore the DTT network topology is suitable to deliver linear video to mobile terminals and it can be complemented by domestic gap fillers like wi-fi, blu-tooth and so on originated by domestic DTT smart device. Connected smart device can also act as return channel for interactivity.

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: The technology and service convergence should be a good opportunity for a more efficient use of radio spectrum, for scale economy for the benefit of end user. However we have to take into account that the use of mobile (unicast) networks for delivering linear video content requires much more radio spectrum than broadcasting networks

Question 4:

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

Answer:

- About 40 both at national and regional level

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

Answer:
(See note 3 in answer to question 1.ii.b above)

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

Answer:

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.

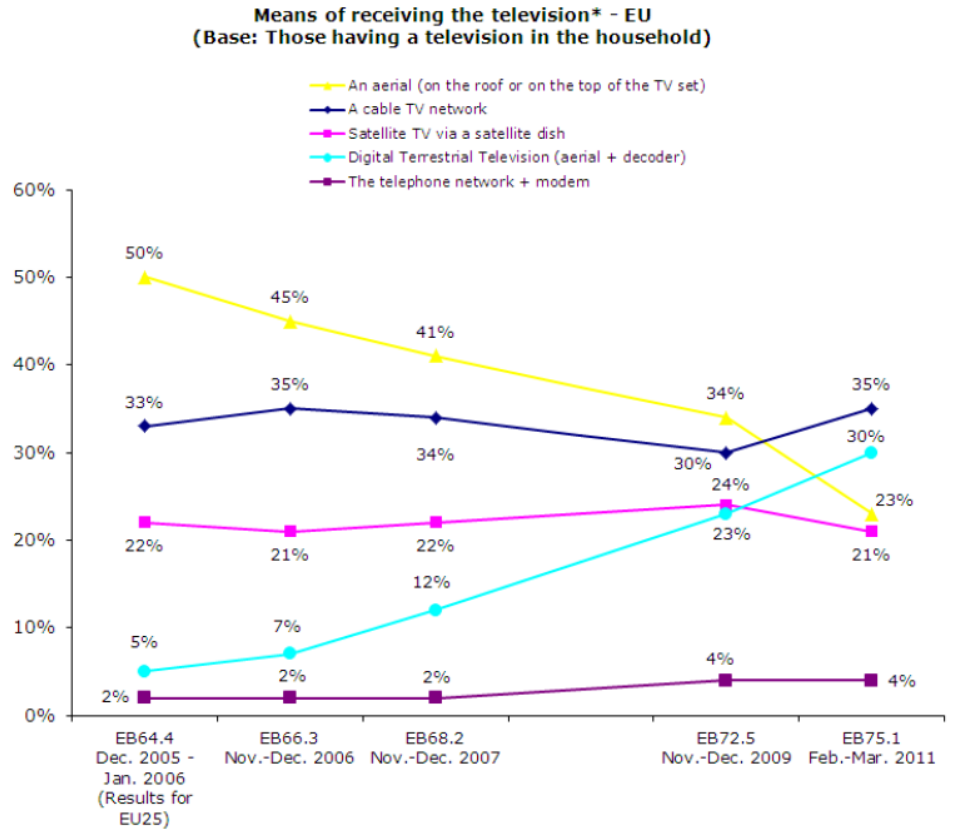


Figure 1: How European households receive TV? (source: Eurobarometer 362[2], E-communications household survey, July 2011)

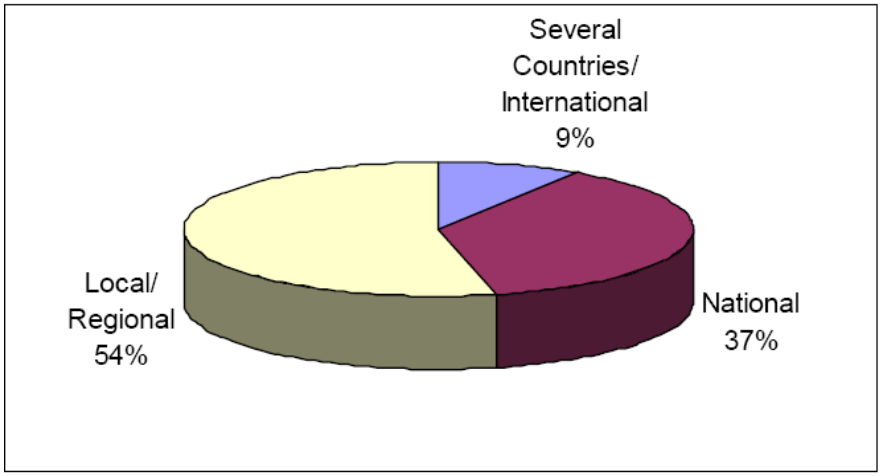
The objective of this questionnaire is to invite Members States to share their views on the evolution of the digital terrestrial platform (DTT) over the next decade (2012-2022).

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

1) The DTT platform in 2012 in the EU

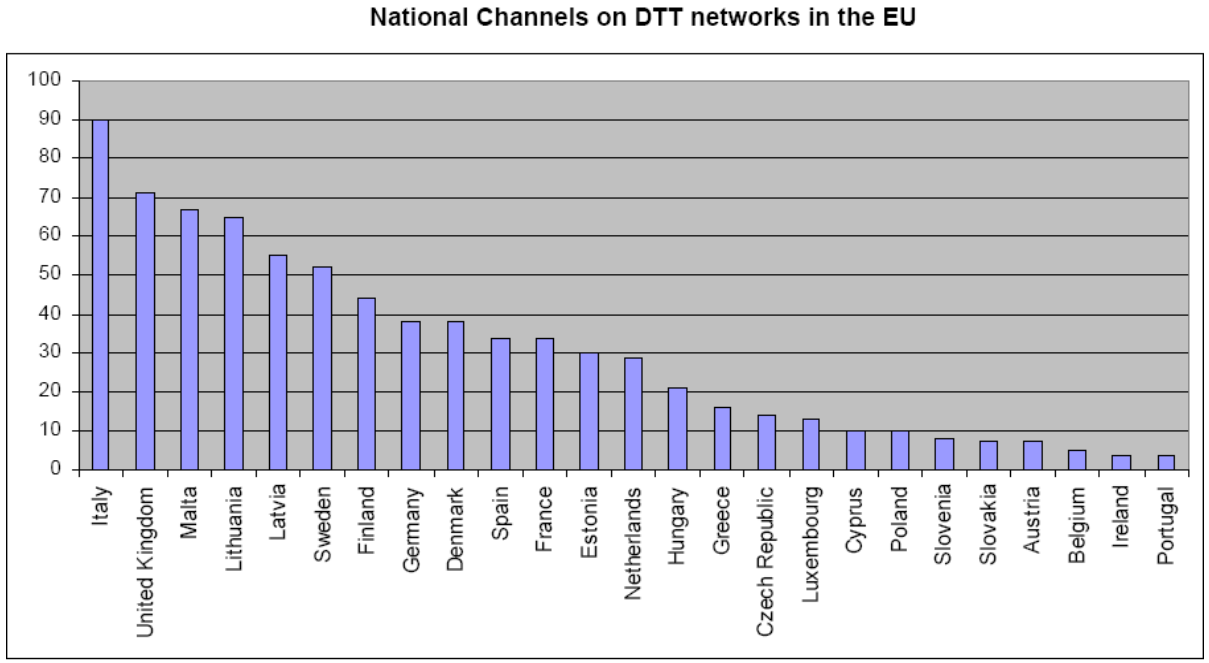
According to the "MAVISE TV database", developed by the European Audiovisual Observatory for the European Commission**,** it was expected that 16 EU countries would have completed their switch-off of analogue terrestrial signals by the end of 2011.
The "MAVISE TV database" showed that the total number 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.

Split of DTT channels in the EU by coverage



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).
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.



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, eithe r pay or free.

Figure 2: How European households receive TV? (source: Eurobarometer 362[3], 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[4].

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.

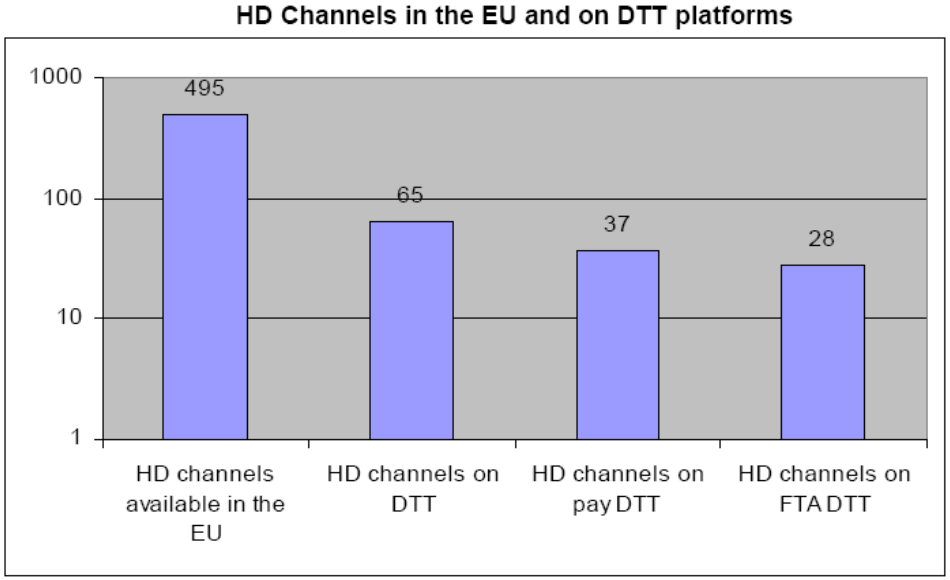
2) Video Format Evolution

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.

[3] Conducted by TNS Opinion & Social at the request of Directorate-General Information Society and Media of the European Commission
[4] 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[5] 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.

[5] 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[6]. 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 (Mbit/s)	Total (Mbit/s)	Video data rate (Mbit/s)	Audio and other associated data (Mbit/s)	Total (Mbit/s)	Video data rate (Mbit/s)	Audio and other associated data (Mbit/s)	Total (Mbit/s)

[6] 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

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[7]

(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)[8]:: 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[9] 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.

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).

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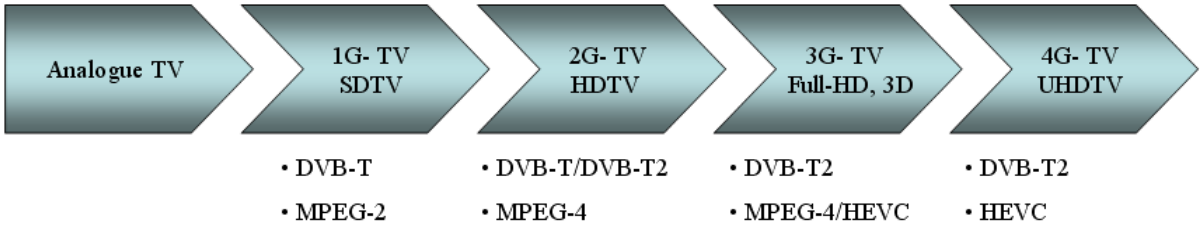
[7] Further studies to better estimate these average bitrates are needed.

[8] 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.

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

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[10]. 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.
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.

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

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, …)

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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**[11]	**Number of TV program services and content format**	**DTT System and modulation**	**Intended coverage reach**[12]	**Coverage obligation (Y/N)**[13]	**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

[11] E.g., fixed (roof-top), portable indoor, portable outdoor, mobile.
[12] E.g., national, regional, local.
[13] 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[14]**	**Expected content format (SD and or HD)**	**Expected DTT system and modulation (if known)**	**Intended coverage reach[15]**	**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	

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