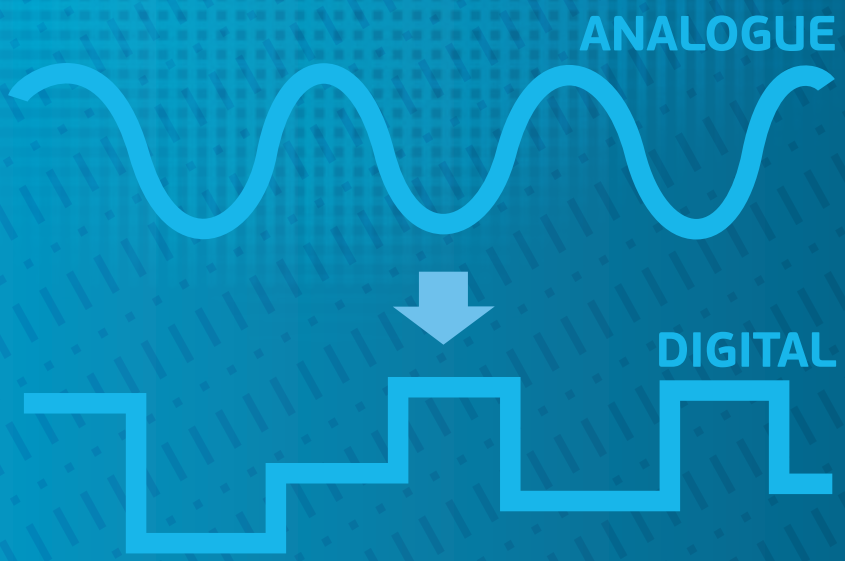
FINAL REPORT

ITU-D STUDY GROUP 2

QUESTION 11-3/2

EXAMINATION OF TERRESTRIAL DIGITAL SOUND AND TELEVISION BROADCASTING TECHNOLOGIES AND SYSTEMS, INTEROPERABILITY OF DIGITAL TERRESTRIAL SYSTEMS WITH EXISTING ANALOGUE NETWORKS, AND STRATEGIES AND METHODS OF MIGRATION FROM ANALOGUE TERRESTRIAL TECHNIQUES TO DIGITAL TECHNIQUES



5TH STUDY PERIOD 2010-2014

Telecommunication Development Sector

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QUESTION 11-3/2:

Examination of terrestrial digital sound and television broadcasting technologies and systems, interoperability of digital terrestrial systems with existing analogue networks, and strategies and methods of migration from analogue terrestrial techniques to digital techniques

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Study Group 2

Study Group 2 was entrusted by WTDC-10 with the study of nine Questions in the areas of information and communication infrastructure and technology development, emergency telecommunications and climate-change adaptation. The work focused on studying methods and approaches that are the most suitable and successful for service provision in planning, developing, implementing, operating, maintaining and sustaining telecommunication services which optimize their value to users. This work included specific emphasis on broadband networks, mobile radiocommunication and telecommunications/ICTs for rural and remote areas, the needs of developing countries in spectrum management, the use of ICTs in mitigating the impact of climate change on developing countries, telecommunications/ICTs for natural disaster mitigation and relief, conformance and interoperability testing and e-applications, with particular focus and emphasis on applications supported by telecommunications/ICTs. The work also looked at the implementation of information and communication technology, taking into account the results of the studies carried out by ITU-T and ITU-R, and the priorities of developing countries.

Study Group 2, together with ITU-R Study Group 1, also deals with Resolution 9 (Rev. WTDC-10) on the "Participation of countries, particularly developing countries, in spectrum management".

This report has been prepared by many experts from different administrations and companies. The mention of specific companies or products does not imply any endorsement or recommendation by ITU.

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0 Acknowledgements and Preface

The transition from analogue to digital terrestrial broadcasting, being extremely complex and delicate process, is becoming more sophisticated and diverse in the potential outcomes. It is having a profound impact not only on the entire broadcasting chain but also on the future wireless broadband and mobile communication services.

While a complex process in its implementation, it provides the viewing public with far greater opportunities for sources of entertainment and information than analogue television broadcasting was ever capable.

It is of concern to Governments and to relevant Authorities at international, national, regional and community level, Regulatory Authorities, Broadcasters, Operators, Industry, viewers and listeners- briefly to the entire population of the modern world-how this will evolve to meet the needs of the public.

The terms of reference before ITU-D Study Question 11-3/2 were so vast that the provision of extensive consultation and advice by world-wide broadcasting experts was a prerequisite for successful completion of this Report.

Indeed, ITU-R Study Group 6 has provided us with generous support from the onset and we should like to acknowledge the valuable inputs and advice provided by Mr.Christoph Dosch, Chairman of ITU-R SG-6, IRT, Germany; Dr. David Wood, Chairman of ITU-R WP 6C, EBU; Dr. Joseph Flaherty, Senior Vice President, CBS, USA; and Mr.Roger Bunch, Director of Engineering, Free TV Australia Ltd., just to name few.

Indeed valuable inputs from the Administrations of , Argentina, Australia, Brazil, Bulgaria, Egypt, France, Germany, Hungary, Japan, Nepal, Niger, Russian Federation, Ukraine, and organisations such as the DVB and European Broadcasting Union and Thales, France have been incorporated thus contributing substantially to the value of this Report.

We should also like to acknowledge the continuous support by Mr. Lieven Vermaele, Technical Director, EBU; Dr. Roland Beutler, Acting Chairman for the EBU Strategic Programme on Cooperative Terrestrial Networks (SP-CTN) and Focus Team ECS-SDB, Head of Strategy Programme Distribution SWR, Germany; who have shared knowledge and up to date research information enhancing further the value of this Report.

This Report is conceptualized to be considered as supplement to the published Report on ITU-D Study Question 11-2/2 during the study period 2006-2010 and as one component of a family of ready for use Publications of ITU-R SG-6, namely:

– ITU-R DTTB Handbook, http://www.itu.int/pub/R-HDB-39

– Report ITU-R BT.2140-6 (2013) "Transition from analogue to digital terrestrial broadcasting" www.itu.int/pub/R-REP-BT.2140 (available only in English), and

– Handbook on "Digital television signals: Coding and interfacing within studios" www.itu.int/pub/R-HDB-19 .

At this juncture I am honoured to thank the Vice-Rapporteurs of this Study Question Messrs. Roberto Mitsuake Hirayama, Brazil; Philippe Mege, Thales Communications, France; Yasuo Takahashi, Japan; and Shree Bhadra Wagle, Nepal; as well as the honourable delegates of ITU-D SG-2 for their constructive contributions and confidence bestowed on us.

Finally I should like to thank Messrs. Istvan Bozsoki, BDT Focal Point to this Study Question and Nangapuram Venkatesh, Counsellor of ITU-R SG-6 as well as the BDT Secretariat for extending their support and assistance in achieving the objectives of ITU-D Study Question 11-3/2.

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12 September 2013

1 Statement of the Situation, Introduction and Executive Summary

1.1 Background

In many countries, the terrestrial broadcast platform is the primary means of delivering broadcast services. It has an important role in fulfilling their universal service obligations and general interest objectives.

The terrestrial platform combines a number of features such as:

– near-universal coverage,

– ability to provide for fixed, portable and mobile reception,

– ability to efficiently provide regional and local content

– large receiver base,

– free-to-air services,

– flexibility,

– technical and cost efficiency,

– support by broadcasters, network operators, regulators and the industry,

– market success and acceptance by the public, and

– potential for further development.

This powerful combination would be rather difficult to replicate by any single alternative technology.

New technologies (e.g. IPTV, fixed and wireless broadband) will complement terrestrial broadcasting but are not perceived as viable alternatives for distribution to a mass audience across large areas. In particular, these new technologies may not be available in the sparsely populated areas.

It is therefore expected that the terrestrial broadcast platform will prevail at least for the next 5 – 10 years and possibly longer, both for radio and TV services. Nevertheless, the role of the terrestrial platform is changing alongside the evolving needs of the broadcasters and the audiences/viewers.

1.2 Broadcast Services

Traditional linear broadcast services will continue to develop with ever increasing demand for choice and quality. The number of terrestrial TV programme channels is steadily growing and the same is true for the viewing time. Content is increasingly offered in HD quality and in the future this may include 3D TV and maybe also Ultra-HDTV. Likewise, there is increasing demand for more radio programmes and enhanced radio services.

One of the most important developments in recent years is a significant growth of non-linear media services. Particularly popular are catch-up and time-shifted viewing or listening of the linear programming and true on-demand content. In addition, data services are being provided in support of the primary audiovisual offers. Demand for non-linear services, some of which are considerably different from traditional broadcast services, is expected to continue to grow in the future.

The context in which the users access media services is also changing. In addition to the traditional shared environment, the users are creating a personal environment where media services are accessed via an additional device (e.g. a personal or tablet computer or a mobile phone) which can be used independently from or in conjunction with the main screen. Both could be stationary, portable or entirely mobile.

1.3 Distribution Options

A fundamental issue that broadcasters face is how to deliver the full range of their services, both linear and non-linear, to the shared environment as well as to the personal environment. Broadcast networks are uncontested in providing linear radio and TV services, given their ability to serve very large audiences with high Quality of Service (QoS). This is particularly relevant for the shared user environment but also for the personal environment, provided that user devices are equipped with broadcast receivers. Said broadcast receivers could include both sound and TV broadcast system functionality.

Access to non-linear services normally requires a return channel and some degree of interactivity. Truly non-linear services have been introduced on broadband networks to be received on PCs, tablet computers and mobile phones. These services are very popular and are one of the main drivers for broadband take-up and the consumer device market. An issue for broadcasters is that these devices usually do not come with a broadcast receiver (except tablets on sale in Japan and Republic of Korea). At the same time, an increasing number of TV sets and radio receivers are able to connect to the Internet. In any case, distribution of radio and TV services over broadband networks is becoming more and more widespread.

Broadcast and broadband technologies can be used in a truly complementary way thus combining the advantages of both platforms to enable the full range of services (linear, non-linear, interactive, personalized and on-demand) to a variety of users.

The current Hybrid Broadband Broadcast (HBB) solutions combine broadcast and broadband delivery in the TV receivers. Unfortunately, the fact there are several digital sound and TV systems may be a potential obstacle for the future developments. Furthermore, as the broadband delivery is generally not under broadcaster's control there is a risk that the quality will not be maintained throughout the delivery chain. Also, the broadcast signal could be altered when displayed on the screen or mixed with the content from other sources.

Hybrid distribution networks are being developed that combine both broadcast and broadband functionality in the same network(s) and this provides a solution for broadcasters in the long term. In such a scenario the terrestrial broadcast platform is evolving to provide mobile 2nd and 3rd screen applications. Further research is required in that area and a number of technical, regulatory and commercial issues need to be addressed such as parental guidance schemas for delivered content.

In brief the changes in users' habits thanks to the unprecedented technological choice at the consumer end and associated expectations by the general public, supplemented by the need for broadcasters to offer a great variety of linear, nonlinear and hybrid radio and television programmes, all add to ever growing pressure on terrestrial broadcasting service to expand.

1.4 Available Offers to Choose From

Indeed in a multimedia world we are facing growing market fragmentation caused by using multiple content delivery standards and/or technologies already reported. The key question is whether ITU can manage the opportunities which could be realized by platform convergence.

The difficulty to choose from in the digital terrestrial broadcasting domain is created by so many options: 50Hz/60Hz/120Hz/130Hz; 720/1080/4k lines; interlace or progressive; STD, HDTV or UHDTV (currently under testing, development and standardization), multiple compression systems with numerous parameters at great variance, etc.

For the sake of illustration let's focus our attention on the second generation DVB system for terrestrial broadcasting (DVB-T2) [Rec. ITU-R BT.1877, (www.itu.int/rec/R-REC-BT.1877/) , DVB Document A122r1 (www.dvb.org/standards) and EBU TECH 3348 (http://tech.ebu.ch/docs/tech/tech3348.pdf) is already in growing commercial use in several countries around the world. The primary application of the networks operated in these countries is the transmission of HDTV content to stationary receivers equipped with

roof-top aerials enabling terrestrial broadcast delivery of 3-4 HDTV programmes per multiplex. However, the DVB-T2 standard has been developed as a toolbox, offering a significantly wider range of potential application scenarios. In fact the DVB-T2 standard foresees a variety of algorithms for increasing its performance, e.g. Rotated Constellations, Multiple Physical Layer Pipes (M-PLPs), transmit diversity – Multiple Input Single Output (MISO), or a sophisticated Time-Interleaver.

The forecasted growth of the screen size of digital TV stationary receivers reported in preceding Study Question 11-2/2 is confirmed by the available digital TV receivers on sale-already large Flat Panel Display (FPD) screens of 55-65 inches are available to general public-therefore the predictions that 60 inches large FPD screens of TV receivers for stationary reception will dominate the market as from 2015 are to be taken very seriously into consideration.

In turn this implies that the viewers will demand HDTV programme delivery also by digital terrestrial broadcasting platforms as already offered by competing satellite, cable and IPTV operators (otherwise the SDTV coding related artefacts will be annoying to unacceptable level on said 55-65 inches large FPD screens).

One of many reasons for concern is illustrated as follows: While DVB-T2 with video coding Rec. ITU-T H.264/AVC MPEG-4 Part 10 would permit 3-4 HDTV programmes to be delivered over single multiplex, the DVB-T with same video coding and statistical multiplexing enables delivery of 2-3 HDTV TV programmes per multiplex over single classical TV broadcasting channel. Furthermore, the ATSC, ISDB and the DVB-T (with Rec. ITU-T H.262 MPEG-2 video coding) have capacity of a single HDTV programme delivery per multiplex carried over one terrestrial TV broadcasting channel. The recently developed ITU-T Rec H.265 "Coding of moving video High Efficiency Video Coding" or HEVC ISO/IEC 23008-2 standard allows the bitrate of video to be halved as compared to MPEG-4, while keeping the quality the same. As result it enables to increase further the number of HDTV programmes per multiplex in single broadcasting channel by factor of two.

While planning, strategic leapfrogging decisions are to be taken not only on technical parameters, but also on number and type of TV programmes (SD, HDTV and/or UHDTV) to be produced and assembled, multiplexed and broadcasted for delivery to and reception by the general public. Herein we enter into the world of very complex and sometimes conflicting interests of relevant stakeholders within and outside the broadcasting chain.

It is worth reiterating the importance of attractive content offers and value-added innovative services, when shifting from analogue to digital to thwart any delays to hamper the migration to digital broadcasting.

1.5 Recent Developments

As pointed out by Dr Roland Beutler ("The future role of broadcasting in a world of changing electronic communication", EBU Technical Review, 2013 Q1, http://tech.ebu.ch/docs/techreview/trev_2013-Q1_Broadcasting_Beutler.pdf) the Regional Radiocommunication Conference of ITU-R (RRC-06) adopted a new frequency plan for digital terrestrial broadcasting for 120 countries in Region 1. However, just one year later, the sweet dreams for broadcasting future prospects turned into a nightmare when WRC-07 decided to re-allocate the band 790 – 862 MHz to the Mobile Service (International Mobile Telecommunications-IMT) on co-primary basis in Region 1. In the meantime, many European countries have released this band from broadcasting service. All 27 member countries of the European Union will release this band from broadcasting service by 2013 so that it will be available exclusively to IMT only.

Just prior to the WRC-12, strategic article "Broadcasting Radio spectrum needs for changing lives", prepared by two visionary authors: Mr Christoph Dosch, Institut für Rundfunktechnik GmbH (IRT) and Dr David Wood, European Broadcasting Union (EBU). It was published in № 1/2012 issue of ITU News (January / February) which can be found online in all six official languages of the Union at: https://itunews.itu.int/En/2065-Radio-spectrum-needs-for-changing-lives.note.aspx.

As the world of communication and media had entered a process of transformation, broadcasters started to reclaim their fundamental needs and objectives. This is still ongoing and far from concluded (close follow up of the proceedings of ITU-R JTG-4,5,6 and 7, created by the last WRC-12, could provide important information to be taken into account while planning further the digital terrestrial broadcasting service). www.itu.int/ITU-R/index.asp?category=study-groups&rlink=jtg4-5-6-7.

The EBU Technical, for example, went through a similar process and decided to put in place two so-called Strategic Programmes dealing with the issues of the future of terrestrial broadcasting and the cooperation between broadcast and broadband networks, with a focus on terrestrial broadcasting and mobile broadband. The first Strategic Programme on Terrestrial Broadcasting (SP-TB) came up with EBU Technical Report 13 "The Future of Terrestrial Broadcasting", in which a broader approach was employed to look at future perspectives of the terrestrial platform in a more holistic manner. http://tech.ebu.ch/docs/techreports/tr013.pdf.

The development of new distribution technologies has been in focus for a long time in the broadcasting world. However, the advent of the Internet and the progress of mobile broadband technology have changed the picture. Via broadband connections, access to audio and video was becoming a more and more widespread option. Hence, broadcasting distribution technologies were confronted with a new and potent competitor in the battle for favour with consumers.

The second Strategic Programme on Cooperative Terrestrial Networks (SP-CTN) was set up within EBU with objective to look into ways of making broadcast and broadband networks work together in the task of delivering broadcasters' content. Market investigations in recent years have clearly shown two fundamental trends in broadcasting:

– The linear television is and remains a killer application for the foreseeable future; and

– An average viewing time of more than 4 hours/day for each European citizen, with a tendency to increase, is a remarkable figure (see for example Statista – The Statistics Portal for Market Data, Market Research and Market Studies "Average daily TV viewing time per person in selected countries in 2011 in minutes"(www.statista.com/statistics/214353/average-daily-tv-viewing-time-per-person-inselected-countries).

However, there is also a very pronounced increasing demand for nonlinear broadcast content. This trend can be derived from the traffic data of broadcasters' web portals and the increasing traffic figures on broadband networks which are driven by audio-visual content.

Therefore, SP-CTN has decided to base its analysis on the following three elements:

– services that broadcasters may wish or have to provide in the foreseeable future;

– technical devices on which these services are consumed; and

– users habits and expectations' change under the influence of the digital revolution in communications.

Only once all these aspects are clearly understood, appropriate distribution technologies should be investigated in order to decide which technical platforms (or a combination of them) are best suited to meet the broadcasters' and users' demands.

1.6 Changing Media Environment

Until recently radio and television services were all linear and, in order to receive them, the audience/viewers had to install a roof-top antenna directed towards a broadcast transmitter. Moreover, listening to radio or watching television was a group social event, it was a shared experience.

Even though the world of today has changed completely, there are two elements dating back to the beginning of broadcasting which are still very important. This refers to the consumption of audio-visual content in company with others and the fact that a roof-top antenna is used. However, broadcasting has become far more diverse in the meantime.

When looking at the service side, an amazing improvement in the technical quality of programmes can be witnessed. The step from SD television to HD television is certainly remarkable; however, another quantum leap is just around the corner with Ultra High Definition Television (UHDTV) offering even higher (4k) resolution pictures. Apparently, the Three Dimensional Television (3DTV) adds another perspective to the user experience in terms of providing, so far, unknown impressions. On the audio side, surround sound has also opened a new chapter in media consumption experiences.

Nevertheless, all this refers to linear programmes in the first place. "Linear" in this context means that an editorial department of a broadcasting company has produced and organized programmes in a way to be consumed by listeners and viewers passively. After having tuned to the programme, one can either watch what is offered or – if it is not interesting – change to another channel or switch it off.

Today, broadcasting offers much more. Linear content is complemented by many different nonlinear offers. It starts with straightforward time-shifted consumption of audio-visual content, moving on to real on-demand requests. In between one will find catch-up services implemented in terms of podcasts or access to media libraries (for example ARD-Mediathek or BBC iPlayer). These different types of broadcast services are not necessarily used independently but linear and nonlinear elements could be combined to create a new user experience. Hybrid Broadband Broadcast Television (HbbTV) is a good example for this.

In the past there was not much choice with regard to the device that was used for listening to the radio or watching television. Nowadays, the capabilities of different devices begin to overlap and therefore their usage is no longer exclusive as it used to be. Most large-screen TV sets can be connected to the Internet while smart phones and tablets offer 2nd and 3rd screen delivery of broadcasting content media consumption capabilities alongside their original communication features. The same is naturally true for personal computers (PCs) and laptop computers.

Media consumption is omnipresent today. It happens in the company of others or individually and is no longer restricted to the living room as it used to be, not so long ago. People listen to music, watch video clips or access the Internet while they are on the move from home to work and back. They do so at work or during their leisure time. What is very important in this respect is that such usage has to be affordable and should be easy and straightforward.

1.7 Cooperation Between Networks

In spite of divergence of opinions and views amongst broadcasters, there will probably be no dissent that a single distribution technology can not cover all requirements, certainly not today and maybe not even in foreseeable future.

Generally speaking, broadcast networks are superior with respect to the delivery *of linear audio-visual media services* across large areas to a mass audience, while broadband networks are strong in the area of *unicast delivery of on-demand content*. As broadcasters obviously have to provide both linear and nonlinear content, they need to exploit the potential of these different technologies in a complementary manner.

Today, broadcasters employ terrestrial broadcasting, satellite or cable networks to deliver radio and television programmes. Even Internet Protocol Television (IPTV), which has gained a significant market share, may be counted under the category of broadcasting technology with regard to its ability to provide "one-to-many distribution". All of these broadcast delivery options could be combined with either fixed or wireless broadband networks in order to achieve the broadcasters' objectives.

1.7.1 Terrestrial Broadcasting and Wireless Broadband

Development of cross platform delivery between terrestrial broadcast and wireless broadband networks is very attractive for broadcasters for several reasons. First of all, smart phones and tablets are devices which are designed to display audio-visual content. They are easy to use and their market penetration is increasing explosively. Indeed, it can be expected that within the next few years these devices will gain utmost importance as they tend to develop into universal personal communication devices.

Thereby, users will naturally expect that such cooperation will be able to provide to them any kind of communication service, or access to their preferred audio-visual content. Hence, it is important for broadcasters that their content is available on these devices.

Moreover, terrestrial broadcast and wireless broadband networks are truly complementary to each other.

For broadcasters it is vital to be able to offer their content on all relevant devices under the regulatory and economic conditions to which they have to adhere. This includes all forms of linear and nonlinear offers. Linear content can be most efficiently delivered by terrestrial broadcasting networks while, for the nonlinear part, broadband networks are required. As it will be economically prohibitive to roll out their own wireless broadband networks, broadcasters consequently have to seek innovative cooperation between broadcast and broadband networks.

From a technical point of view, there seem to be obvious ways to facilitate such cooperation between broadcast and mobile networks:

– If smart phones and tablets are equipped with broadcast receivers, all services can be received straightforwardly. As both technologies would be integrated, synergies – in terms of more efficient usage of spectrum resources – could be achieved. This integration corresponds to a short- to mid-term objective that broadcasters should pursue actively.

– Integration of broadcast receivers into smart phones and tablets does not necessarily mean cooperation between networks. Even hybrid services such as HbbTV do not require cooperation between networks, as the intelligence where to get the content from and how to combine it lies with the receiving devices and not with the networks. However, as soon as more efficient management of resources is envisaged – i.e. spectrum or data capacity, depending on the actual demand – then cooperation between networks becomes an issue. The large-area broadcast networks need to “talk” to cellular wireless or mobile broadband networks and vice versa to optimize the delivery of content. The major challenge in this respect is not the technology but rather bringing together the very different business models of the corresponding network providers.

– On a long-term basis, the development of a terrestrial delivery system should be supported which is able to use unicast, multicast and broadcast modes, depending on the demand and the available resources, in an optimal way. Basically, this corresponds to combining the strengths of broadcast and broadband technologies under one roof. Whether this is a viable option for broadcasters, from an economic point of view, is an important question which has to be addressed alongside all the technical issues.

Clearly, there is a need for detailed research to fully exploit the potential of these options.

Recently a non-profit association was created called the “Future of Broadcast Television Initiative (FOBTV), details available online at: www.nercdtv.org/fobtv2012/index.html, drawing its membership amongst broadcasters, manufacturers, network operators, standard development organizations, research institutes and others from more than 20 countries all over the world. The main objective of this association is to develop future ecosystem models for digital terrestrial TV broadcasting.

1.7.2 Broadcasting and Fixed Broadband

Looking at the discussion about cooperation between networks or convergence of technologies from a more general point of view gives rise to the basic question: *"What kind of distribution do broadcasters actually need?"* Putting it into simple words, it seems broadcasters are in need of a big downstream pipe for linear audio-visual content delivery and a unicast link to satisfy requests for access of nonlinear content upon demand.

1.8 Future Network Concept Summary

Terrestrial broadcasting remains a very important pillar for the future ecosystem of broadcast content distribution. As such it is important to ensure that enough spectrum remains accessible for terrestrial broadcasting. This refers in the first place to the 700 MHz band which is one of the hot topics of the WRC-15 preparatory work.

However, as a matter of fact, WRC-12 has already co-allocated the 700 MHz band to the mobile service in ITU Region 1 under certain conditions, to be re-assessed and confirmed by WRC-15. Therefore, the political and economic pressure to free this band from broadcasting services is steadily increasing. There seems to be little hope that WRC-15 will retract the co-primary mobile allocation of 2012. Hence, broadcasters in Region 1 need to make sure that their interests remain guarded with respect to using the spectrum above 694 MHz for the benefit of broadcasting.

In order to safeguard the future role of terrestrial broadcasting, broadcasters should engage in the following fields which require actions in the short and mid-term:

1.8.1 WRC-15 Preparation and Influence on Spectrum Allocation

Some European mobile operators are pressing for the 700 MHz band to be auctioned off as soon as the year 2016. However, if this happens shortly after WRC-15, then the auction process will certainly not take into consideration the need to use this band for the delivery of nonlinear broadcast services. Rather, similar to the auctions in the 800 MHz band done after the WRC-07, the spectrum will be used for traditional IMT networks. Then, calling for cooperation between broadcast and mobile networks will most likely not be successful.

Therefore, broadcasters should:

– Lobby their administrations to propose, at WRC-15, postponing the allocation of the 700 MHz band in the Northern part of ITU Region 1 to an appropriate date. This can be achieved by virtue of a corresponding footnote; and

– Lobby administrations at European level to postpone the auctions of the 700 MHz band spectrum to a point in time when the concepts for cooperation between broadcast and mobile networks are mature in order to prevent it being used only for traditional IMT services.

Alternatively, if auctioning is envisaged at an early stage, conditions for the usage of spectrum should be imposed which would enable cooperation between broadcast and broadband networks at a later point in time.

1.8.2 Integration of Broadcast Receivers in Smart Phones and Tablets

It is important to investigate prevailing regulatory and economic conditions, identify differences and, if such integration proves to be applicable, develop a strategy to lobby for such challenge at a European and why not at least at Region 1 level.

It is worth noting that regulators base their decisions on the feedback received during corresponding consultation processes. Broadcasters around the world should carefully monitor any such activities and participate in associated consultation processes to the extent practicable.

1.8.3 Development of Technically Feasible Options for Network Cooperation

Broadcasters should actively engage in the development of technological options for cooperation between broadcast and broadband networks. Several activities in this area are already underway which are associated with what is called "Dynamic Broadcasting" or "Overlay broadcast and cellular mobile networks". Broadcasters should decide to actively participate in this research. Also, it would be beneficial to convince for example the European Commission to support such activities at least at European level. It is important in this respect to consider a wider range of broadband technologies beyond IMT (for example Wi-Fi) to ensure optimal usage of resources such as spectrum and network infrastructure.

1.9 Executive Summary of Lessons Learned and What is Next

1.9.1 Legislation Aspects

Once the concept of public service broadcasting is embraced, it needs to be implemented in practice, and in the first place through appropriate legislation. To this end, a concrete Model Law Handbook was developed by ITU and UNESCO and used extensively in ITU Regions 1 and 2, together with explanatory comments. It is recommended that this handbook be dully taken into consideration at appropriate country level. A Model Law is just a model – no more but also no less. This means that it cannot be used verbatim, without taking into account the country's legal system and traditions, its geographical size and possible division into (autonomous) regions, the ethnic and religious composition of its population, the state of development and education, the economic situation, the social realities, etc. An example can be found in the joint ITU/UNESCO "Model public service broadcasting law and aspects of regulating commercial broadcasting, 1999, which is available online at: http://portal.unesco.org/ci/en/file_download.php/5aaba93cbe249941a13c36a3000863a9Model+public+service+broadcasting+law.pdf

On the other hand, the model includes a number of fundamental principles which are universally valid and must be incorporated into any law, anywhere in the world, that aims to set out the legal basis for a truly independent public service broadcasting system not ignoring the aspects of commercial broadcasting.

Complementary valuable information may be obtained from the following publications:

– Toby Mendel: Public Service Broadcasting. A comparative Legal Survey. – Kuala Lumpur : UNESCO, Asia Pacific Institute for Broadcasting Development, 2000, www.unesco.org/webworld/publications/mendel/jaya_index.html; and

– Elizabeth Smith: A Road Map to Public Service Broadcasting. – Kuala Lumpur: Asia-Pacific Broadcasting Union, CBA and UNESCO, 2012, ISBN No. 978-967-99927-3-1. www.cba.org.uk/wp-content/uploads/2012/04/A-Road-Map-to-Public-Service-Broadcasting.pdf

In this respect ITU has assisted several Administrations with analysis and proposals for update of pertinent legislation instruments trimmed to the specific social, economic and cultural environment at country level.

1.9.2 Spectrum Planning

The Article 12 of RRC-06 stipulates the following:

"12.6 The *Transition period* shall end on 17 June 2015 at 0001 hours UTC. However, for the countries listed in footnote 1 below, for the band 174-230 MHz, the *Transition period* shall end on 17 June 2020 at 0001 hours UTC. After the end of the applicable *Transition period*, the corresponding entries in the analogue Plan shall be cancelled by the Bureau, and

– the provisions of § 4.1 of Article 4 referring to the modification of the analogue Plan; and

– remarks with respect to analogue assignments shall cease to apply to the analogue assignments in the corresponding countries."

"12.7 After the end of the above-mentioned Transition period, the Bureau shall review the status of the assignments which were contained in the analogue Plan and recorded in the MIFR and invite the administrations to cancel the corresponding entries in the MIFR."
In brief, extensive spectrum planning exercise at national level is carried out not only in ITU Region 1 countries, but also in other countries from ITU Regions 2 and 3.

1.9.3 More Reasons for Going Digital

It is worth noting that the lifespan of analogue terrestrial broadcasting in developing countries is approaching its end, which in turn will unavoidably force broadcasters and audiences/viewers to migrate to digital broadcasting service. Thus the digital broadcasting is becoming the only feasible alternative for both the developed and developing countries, because of availability and affordability of technology and relevant after sales service.

1.9.4 Mandatory Considerations for Going Digital

Taking into account all of the above-mentioned considerations it is becoming mandatory to consider them as universally applicable to the migration to digital terrestrial sound and television broadcasting (subject to this Study Question and reported herein).

It is also becoming mandatory and urgent, that countries select the most future-proof, feasible and well planned in advance migration strategy to digital terrestrial broadcasting. The general public, investing in using the linear and non-linear broadcasting content made available, will follow the strategy for migration to digital broadcasting, providing that its expectations for more attractive programmes and services are met and smooth transition to linear reception of digital terrestrial broadcasting services ensured by timely availability of relevant affordable terminals (receivers and Set Top Boxes-STBs). The audience/viewers are to be assisted and properly guided during the entire migration process.

1.9.5 Recommended ITU Publications to Reference

Digital terrestrial broadcasting standards are produced and developed further by ITU and various worldwide, regional and national standards-setting organizations/entities.

A concise overview of digital terrestrial sound and television broadcasting technologies, standards, and system migration, supplemented with number of case studies could be found at the ITU-R Report BT.2140-6-2013 "Transition from analogue to digital terrestrial broadcasting", available at: www.itu.int/pub/R-REP-BT.2140-6-2013 . The said Report in force, which is currently available in English only, outlines the available options for migration to digital terrestrial broadcasting. Complementary up to date information can be obtained from the ITU-D Report "Trends in broadcasting: An overview of developments", August 2012, available at: www.itu.int/dms_priv/itu-d/oth/01/2A/D012A00003 53301PDFE.pdf.

Valuable freely available ITU-D publications have been produced by experts selected by the Development Bureau as follows:

– "Guidelines for the transition from analogue to digital broadcasting" (www.itu.int/dms_pub/itu-d/opb/hdb/D-HDB-GUIDELINES.01-2010-R1-PDF-E.pdf), and

– "Guidelines for the Transition from Analogue to Digital Broadcasting-including the Asia-Pacific Region" (www.itu.int/ITU-D/tech/digital_broadcasting/project-dbasiapacific/Digital-Migration-Guidelines_EV7.pdf).

They provide precious and well organized information in detail on the transition from analogue television to Digital Terrestrial Television Broadcasting (DTTB) and introduction of Mobile Television Broadcasting (MTV). Both guidelines identify the policy, economic and technology choices to be made and their potential impact on the transition to DTTB and introduction of MTV. They contain elements related to choices and information regarding the cost benefit analysis of policy decisions and best practices.

Said guidelines were extensively used for elaboration of country road maps by ITU Members assisted by ITU experts. Relevant road maps produced are freely available on the ITU website with links provided in Chapter Seven of this Report.

Based on the experience acquired and lessons learned, while elaborating country road maps in the field, valuable recommendations could help remaining ITU membership getting it done in efficient, well thought and organized manner as follows:

– The presidency, parliament and government, users/citizens, regulatory authorities, TV programme assembling operators (TV Editors), TV distribution and on-air broadcasting operators, relevant stake-holders as well as interest groups within and outside broadcasting chain may have conflicting interests of different nature that might delay or jeopardize the process of migration to DTTB. Key to success of DTTB is the establishment of framework of National Task Force or National Committee for Transition to Digital Broadcasting at highest possible national level incorporating all of them in a well-structured manner.. They should discuss issues in full transparency and strive to consolidate opinions on every aspect to the transition to digital terrestrial broadcasting. They shall elaborate coherent national strategy, policy, draft proposals to amend acts, legislation and decrees in force and elaborate regulations, procedures, technical, operational and financial frameworks for said transition;

– The elaboration of National Concept for DTTB Transition should enable harmonized modification of pertinent Laws and Legislation in force to be adopted by the Parliament in timely manner; and

– Within this framework setting up of National Road Map Team with clear mandate for action with defined deadlines and responsibilities for the implementation of said strategy at both national and international level.

Some countries have appointed few distinguished individuals with specialized expertise within and/or outside the government, resulting in quick elaboration of such strategy/plan followed by limited consultation period for comments by general public consequently approved by the government. However such “efficient” arrangements fired back by imposing important delays in the implementation of the migration to digital terrestrial broadcasting. Reverting to the procedure described beforehand has enabled to normalize the migration process, but delays incurred were impossible to be compensated.

In summary hindrances may occur if:

– Advertising market value is ignored (crucial for defining optimal number of self-sustaining commercial TV programme operators);

– Use and sharing of existing infrastructure is omitted or prohibited;

– Regulatory Authority/s are not yet empowered accordingly to act;

– Licensed analogue operators bluntly resist to change if not consulted and informed timely for upcoming challenges and opportunities;

– Users’ interests are not dully taken into account;

– Controversial multiplex issues are not clearly defined;

– Business plans submitted for programme production, multiplexing and broadcasting operations are not up to the state of the art requirements;

– Analogue/digital simulcast duration is too long or not subsidized by treasury;

– Foreign ownership and capital TV investment is practically not allowed by the legislation;

– Mobilization of funds needed for the migration not ensured at country level;

– Provisions for attractive content and programme grids, superior technical quality and availability of digital receivers/set top boxes not ensured, etc.

The switch over to digital terrestrial broadcasting poses variety of issues to be dealt with such as:

– *Legal and Political issues:* Laws and legislation; program editors; free to air/subscription/advertisement & sponsorship; licensing; programmes, number and ownership of multiplexes; network operators; public TV; commercial TV; local TV; programme grids, local content and cultural identity; Analogue Switch Off (ASO) and Digital Switch Over (DSO); etc.

– *Technical issues:* standards (SDTV/HDTV); type of reception (fixed, portable or mobile); encoding and data rate choice; Video coding system selection (MPEG-2 versus MPEG-4 and HEVC); spectrum availability and allocation of digital dividend; network planning specifics (MFN/SFN); frequency assignment versus channel allotment planning and subsequent international interference protection impact; choice of transmission system (DVB-T versus DVB-T2) or alternatives; coverage areas; end-users' terminals and backward compatibility (Set-Top Boxes/ IDTV's); information campaign; staff training; curriculum's adaptation at colleges, schools and universities; etc.

– *Fiscal, societal and environment related issues:* new business models; funding (treasury/subscription/advertising & sponsorship); investment encouragement; transition costs; simulcast; promotional start-up measures; subsidizing vulnerable people with low income and disabilities; and last but not least recycling of old receivers and equipment.

2 Identification of Milestones for Successful Transition from Analogue to Digital Broadcasting

ITU continues carrying out series of Workshops, Forums and Summits at regional and sub-regional level. Members share experience and strive to gather common harmonized goals and objectives within the plethora of opportunities offered by the transition to digital terrestrial broadcasting and published on the ITU website. Particular consent for recommendations has been achieved in Africa by ITU /ATU Summit of value beyond their region, namely on the following points (http://atu-uat.org/index.php/reports/summit-reports):

"1. Adopt the Recommendations from the Bamako and Kampala frequency coordination workshops

3. With regards to the DTT Standards:

– The Summit recommends to African Administrations the adoption of DVB-T2 with MPEG-2 or MPEG-4 compression;

– The Summit recommends to African Administrations the adoption of the dual HDTV/SD format for the set-top boxes;

– The Summit notes that some African administrations have already implemented DVB-T and are moving to DVB-T2.

– The Summit also notes that the GE 06 Agreement authorizes the use of any Standard provided that the interference mask meets the characteristics of the DVB-T assignments/allotments in the GE 06 Plan.

5. Any channelling plan adopted for the 700 and 800 MHz (Digital Dividend) bands in Africa should address national/regional developmental objectives, while striving to achieve harmonization, to the extent possible, with other Regions (APT and CEPT). Such harmonization will enable economies of scale.

7. A mechanism/process for carrying out detailed interrogation of channelling options (at a continental level), and ensuring that views from such process are reflected in ITU-R (WP-5D and JTG 4-5-6-7) deliberations, be initiated urgently. This could be achieved by convening a two-day technical workshop for Spectrum Managers from all African countries before the next meetings of WP-5D.

8. Government intervention is crucial to the success of the transition from analogue to digital broadcasting. Therefore, African governments should provide funding and support for:

a) Rollout of infrastructure for the public signal distributor

b) Availability of affordable set top boxes (STBs) through a variety of intervention methods such as:

   i. purchase/importation;;

   ii. manufacturing;

   iii. market distribution;

   iv. waiver of duty and import tax/zero rate taxes; and

   v. incentive schemes for the vulnerable citizens.

c) Consumer education and awareness since comprehensive consumer information and education is essential to create awareness and adoption of DTV (broadcasters, distributors, manufacturers, and retailers of consumer electronic products should be involved).

11. The participants at the Summit endorsed that the ATU and ITU organize the 3rd Digital Migration and Spectrum Policy Summit in the 3rd or 4th quarter of 2013 to:

– review progress on the implementation of the digital dividend and the transition to digital terrestrial television broadcasting,

– review final reports on the results of frequency coordination workshops and consequential modifications of the GE06 Plan, and

– decide the way forward for the preparation of WRC-15 by the African Administrations.

12. In this regard, it was recommended that the ATU and ITU organize, at the earliest opportunity, a final frequency coordination workshop for all African countries to enable finalization of modifications of the GE06 Plan."

Very different in nature but most informative contributions, falling within the scope of this Chapter, have been submitted as contributions by Brazil, Egypt, France, Hungary and Japan. They are included in Chapter 7 to this Report as case studies for further reference to the reader.

2.1 Actions to be Considered by Each Country Prior to the Deployment and Start of Transmissions

Prior to the deployment of the first transmissions a thorough and careful planning needs to be carried out. The regulatory framework that involves broadcasting is one of the important and fundamental subjects that need to be considered. Alongside with that subject, each country is recommended to consider the planning of the usage of spectrum, and specific policies regarding incentives for the deployment as well.

In the case of the regulatory framework, a careful analysis needs to be done so that new innovative services, that are possible with digital transmissions, be allowed and promoted/incentivized. It is recommended that prior to the decision of which standard to adopt, each country reflects in its regulations regarding broadcasting the goals and objectives that need to be fulfilled by the digital broadcasters and service providers.

For example, if one country wants to promote *Interactive Services and Applications*, so that social objectives of digital inclusion of its population, with more people getting access to the internet by means of Digital Television, it is recommended that the Administration of the country state this goal in the public policies for digital broadcasting. The same perspective is valid for other services like *Mobile TV*, *High Definition Television*, etc.

Other important issue that needs to be addressed by the Regulatory Framework is the *convergence between Television and Telecommunications*. The borders between different services, in the perspective of both the users and the services providers, are fading and new user experience is possible and can be provided by both broadcasters and telecom service providers. The regulations for both broadcasting and telecommunications need to reflect this new opportunities and promote new innovative user experience allowing service providers to offer these new services.

In Summary, the recommended steps to look after in changing the national telecommunications and broadcasting regulatory frameworks are the following:

– Analysis of social and economic environments in order to clear state objectives and goals to be accomplished with digital broadcasting;

– Wide discussion with all the stakeholders on a national plan for digital broadcasting and telecommunication services, including the discussion of social goals and objectives;

– Reflect accordingly in the national regulatory framework (laws, decrees and other lower level regulations) the consensus reached in the discussion referred in item 2;

– Adopt a digital broadcasting standard bearing in mind the objectives stated in the updated regulatory framework;

– Plan and grant the needed spectrum for the transition period which will allow simulcast transmissions of analogue and digital broadcasting;

– Fine tune public policies, including financial aid for broadcasters and telecom providers in the deployment of the infrastructure needed to accomplish the social goals stated in the regulatory framework.

– Each of the specific actions will be detailed further below.

2.2 Analysis of Social and Economic Environments in Order to Clear State Objectives and Goals to be Accomplished with Digital Terrestrial Broadcasting

The social and economic status of a nation can have great influence in the decision making process of the Government and its Administration, which includes the Agencies taking care of broadcasting and telecommunications' regulations. The greatest objective of given nation is the welfare of its people and throughout the years of innovation, especially that in the field of communications, in order to help bridging social gaps and allow for more economic development at country level.

Innovation and social and economic development can be side-by-side if public policies of each country clearly state the objectives aimed with the deployment of new technologies, financed either by public spending or with the creation of an environment that stimulate private investments in those technologies.

The broadcasting field is not different and specifically in the transition between analogue and digital technologies for broadcasting, which needs lots of investment in the deployment of new infrastructure, the task of establishing a clear set of objectives to be accomplished with the digitalization of television can be very beneficial to prioritize the areas that need investment first from those that can be postponed to a second step in the process.

One of the objectives can be the deployment of more television stations allowing for more content production and more diversity and pluralism. However, new services and improved quality from the incumbent broadcasters can also be stimulated. It is also recommended that public policies state how and where the initial digital transmissions will take place and also set a schedule of the deployment until the complete coverage of the countries territory or the substitution of all existent stations. This can influence the decisions of investment and set specific priorities for public spending.

As an example of the statement of objectives and goals for digital broadcasting, it can be pointed out the Presidential Decree n. 4.901/2003 of the Brazilian Government which clearly states the objectives of the Brazilian Digital Television System (SBTVD) and establishes formal committees and groups in charge of the discussion of the implementation of digital broadcasting in Brazil. The referred Decree formally establishes the SBTVD which is aimed, among other things, at promoting the social inclusion, cultural diversity and the country´s language through access to digital technology, with focus at the democratization of access to information. Additional information is available online at: www.planalto.gov.br/ccivil_03/decreto/2003/d4901.htm (text in Portuguese).

Another example is Mongolia which also established clear aims for the transition process. In 2010 the Mongolian Government established the "National Programme on Transition of Radio and Television Broadcasting to the Digital Technology", which was approved by the 275th Government Resolution of Mongolia. The latter policy document was significant in that it included four main objectives, framework and results of the implementation of the programme.

The first objective is to create the legal environment for transition of radio and television broadcasting to the digital technology. The second objective is to make technological solution for transition of radio and television broadcasting to the digital technology. The third objective is to organize framework for transition of radio and television broadcasting to the digital technology according to the unified plan in terms of the geographical position partly and step by step. The fourth objective is to organize the training and advertise about the programme to the public, institutions and economic entities.

Furthermore, the programme announced some information for public such as the unified plan to lead the organizational activities for transition of radio and television broadcasting to the digital technology and to process the Analogue and Digital system instantaneously in terms of geographical position partly and step by step. Network, which is transmitting the system of Analogue technology in Mongolia now, will be terminated at 12 a.m., 31st June, 2014, and the digital technology system will start to be in use.

Moreover, in the Table 1: Overview of below the policy documents are formulated by Information Technology, Post and Telecommunications Authority (ITPTA) and Communications Regulatory Commission (CRC), and it includes many main principles.

Table 1: Overview of enabling policies for the transition from analogue to digital in Mongolia

	Policy documents	Approved date and decree	Main principle
1	Policy of Transition from analogue to digital television broadcasting system	The decree of ITPTA No. 83 in 2011	• DVB-T2, DVB-C, DVB-C2, DVB-S, DVB-S2 Frequency allotment -470-690 МГц
2	Policy of Transition from analogue to digital radio broadcasting system	The decree of ITPTA No. 58 in 2011	• DRM, DRM+ • LF: 164kHz, 209 kHz, 227 kHz • MF: 882kHz, 990 kHz • SW: 3950 – 26100 kHz

	Policy documents	Approved date and decree	Main principle
3	Policy of Migration for digital broadcasting system	The decree of ITPTA No. 66 in 2012	• Analogue and digital system will be instantaneously implemented until 80% penetration of whole householders which will receive digital broadcasting in the village and provinces • Radio frequency which is released from analogue broadcasting system will reallocate and regulate license issues

2.2.1 Wide Discussion with All the Stakeholders on a National Plan for Digital Broadcasting and Telecommunication Services, including the Discussion of Social Goals and Objectives

It is advisable that the government/agencies of each country promote open discussions with the stakeholders regarding all the important matters related to the planning and implementation of digital television, and the transition from analogue to digital broadcasting.

The reason for an open and transparent discussion is to help creating a balanced environment for establishing countries´ goals and objectives for public policies on digital broadcasting, which will be beneficial for approving new laws and regulations, as well as, setting aside in the government´s budget, funds for the implementation. The budget is, in most countries, quite reduced and limited by the people´s demands and priorities. Therefore, much discussion usually needs to be carried out to set different priorities from the on-going governmental programmes.

The specific process and rules governing the relationship between all the stakeholders can vary from country to country, but the basic principle is to guarantee diversity of points of view and actors involved, each of which is allowed to contribute with their views, helping to create a balanced decision making process. To reach that goal the discussion needs to be performed with a variety of actors, including high governmental leadership, broadcasters (public and private), local and foreign industries, universities/academia, and all other organized interested parties.

Another important point is that the discussions between the interested parties be held by rules and processes previously established (political context[1]) and that the results of those discussions be registered in some way. The consensus reached in that previously set political context need also to be binding to the officials/agencies that will decide on the roadmap of the transition and on the national plan. The reason for that is the acceptance of the decisions by the interested parties and the enforcement of the conditions set forth. In a transparent and diverse environment where the decisions afterward are made based on binding consensus reached by the plurality of the involved, the enforcement tends to be easier.

[1] "Political Context" is the setting within which the activity of representation is taking place (Stanford Encyclopedia of Philosophy – SEP, Available at: http://plato.stanford.edu/entries/political-representation/, Accessed Jan 23rd, 2013) and "political representation is the activity of making citizens' voices, opinions, and perspectives "present" in the public policy making processes" (Pitkin,1967). In other words, in the political representation we need to have some party that is representing (the representative, an organization, movement, state agency, etc.), some party that is being represented (the constituents, the clients, etc.), something that is being represented (opinions, perspectives, interests, discourses, etc), and the political context (SEP).

Discussion Environment – Pre-implementation

It is recommended that a locus for discussion be formally created and the people/institutions involved be appointed by the government. It is important that the composition of the discussion committees/groups set forth be plural and diverse and reflects the interested parties. It is also recommended that interested parties from outside the government be allowed to participate on the discussions.

As an example, the discussion locus and processes undertaken by Brazil to advise the president´s cabinet on the digital implementation matters were set forth by the Presidential Decree Nr. 4901/2003 (details available at: www.planalto.gov.br/ccivil_03/decreto/2003/D4901.htm), which established the structure and environment for the discussions on digital television implementation.

The referred Decree created three committees: the Development Committee, the Advisory Committee and the Steering Group. Each of which carried out specific duties set forth by the Decree. Among the tasks of the committees were setting guidelines and strategies, proposing specific actions and/or recommendations for government authorities that would ultimately decide on the transition plan, approving research projects, reporting to government authorities, controlling and supervising the discussion process and research projects, etc.

The appointees, which will carry out the discussions on the Discussion Locus/Committees/Groups formally created, have also to reflect, as much as possible, different areas of the government. The reason for the wide government representation resides on the goals and objectives set previously. If the objectives include, among others, social inclusion, fostering local industry, stimulating innovation and national technologies, convergence, etc., different government agencies/ministries that address those matters need to be involved. To guarantee that all these objectives are considered in the discussion process, the structure needs to include a diversity of actors.

It is also recommended that the Discussion Locus/Committees/Groups be formed by a variety of organizations, reflecting the views of the industry, the academia, NGOs (Non-Government Organizations), journalists´ associations, broadcasters, etc. Alongside with that wide representation, the participants need also to be allowed to fully contribute to the outcomes of the discussions held. To reach that objective and formal processes need to be in place.

For example, Public Hearings and Public Meetings are a good tool to reinforce the transparency and openness that will guarantee rich and diverse discussions. Another important aspect is that dispute resolution and negotiation processes be also in place. Negotiation and Dispute Resolution mechanisms are very important to reach minimum consensus, which is the ultimate goal of the whole process. The consensus reached need to be carefully reflected in the recommendations reported to the proper Government Authorities (Higher Government Authorities like the President and/or its Cabinet) that will carry out important decisions to be made.

To carry out its activities the Discussion Locus/Committees/Groups could dispose of public funding. In the case of Brazil, for example, as stipulated the Decree Nr. 4901/2003, resources from the Fund for Technological Development of Telecommunications (FUNTTEL) and other sources of public and private funding, whose implementation plans were approved by the Development Committee, could be used.

For more information and details on the specific rules and processes set forth in Brazil and the structure put in place kindly please refer to the Brazilian Case Study in Chapter 7 of this Report.

Another interesting example is the case of Niger which established a National Committee, via the decree n°64/MC/DPT/TN/2009 of December 30th, 2009, that is in charge to elaborate a national strategy for A-D Transition.

The missions of this committee are:

– Study technical, economic, regulatory, cultural and social repercussions related to A-D Transition;

– Evaluate the required investments;

– Propose the use for the Digital Dividend;

– Prepare a draft document of national strategy for A-D Transition.

The committee which had worked on UHF band (470 – 862 MHz) and had not integrated digital sound broadcasting comes out with four (4) strategic axes and accompanying measures for A-D Transition.

The National Committee carried out a diagnosis of Niger broadcasting sector concerned with the legal and institutional framework as well as technical, socio-economic and cultural aspects. The analysis of the sector had led to identify its weakness and strengths, in order to establish a Strategic Plan for the A-D transition.

The analysis identified four (4) strategic axes with accompanying measures which implementation will make possible to ensure the A-D Transition. The axes are:

– Adaptation of legal and institutional framework;

– Infrastructures development;

– Content and TV programme development;

– Capacity building.

For further information on the Niger Case Study kindly refer to Chapter 7 of this Report.

2.2.2 Discussion Environment and the Implementation of Digital Television

The discussions and negotiation among the interested parties cannot end with the decisions made by the proper authorities of the Government, reflected in the Laws, Decrees and Regulations approved and published. Much needs to be done prior and after the initial digital transmissions. It is recommended that formal committees/institutions be established to carry the discussion during the implementation phase.

The creation of a Digital Television Forum is a good example of establishing a discussion arena, where several segments of the economy of broadcasting would interact to define about the best practices for the implementation. The political decisions formally stated in the Laws, Decrees and Regulations prior to the implementation are initial steps towards the implementation. However, many other actions need to be carried out to enable the initial digital transmissions.

A Digital Television Forum can help and encourage the installation and improvement of sound and image in transmission and receiving systems, and promote standards and quality that meet the demands of the users. A Digital Television Forum can also propose voluntary or mandatory technical norms and technical standards for the Broadcasters, and foster and promote representation, relationship and integration with other national and international institutions.

The objectives of a Digital Television Forum could include also:

– Identification and harmonization of requirements;

– Definition and management of technical specifications;

– Promotion and coordination of technical cooperation between sound and television

– broadcasting stations, operated directly by the State or through the granting of concessions or authorizations; terrestrial television signal transmission equipment manufacturers; terrestrial television signal receiver equipment manufacturing industry, the software industry, and the teaching and research institutions;

– Proposing solutions to issues related to intellectual property; and

– Proposal and promotion of solutions to issues related to human resources training.

Membership to the Digital Television Forum needs to be comprised of at least the following sectors:

– Broadcasters;

– Manufacturers of receiver or transmitter equipment;

– Software industry; and

– Teaching and research institutions with activities directly linked to DTTV.

The Digital Television Forum can be able to draw up general policies of action, strategies, and priorities, adopt the results of the work, and refer them to the Government so that they can be properly reflected in the regulation and relevant follow-up action.

2.2.3 Reflect Accordingly in the National Regulatory Framework (Laws, Decrees and Other Lower Level Regulations) the Consensus Reached in the Discussion Referred to in Section 2.2.2

As mentioned briefly in section 2.1.2, when the consensus reached in a wide discussion of a National Plan for the transition between analogue and digital broadcasting is binding and the decisions made based on these discussions consider all the aspects put forwards by the interested parties and reflect the common understanding of the involved parties involved, the enforcement becomes an easier task.

However, before enforcing the National Plan and guaranteeing that the investment/deployment is done as planned, the decisions made by government officials or Agencies need to be accordingly reflected in the national regulatory framework based strictly on the results of the process.

The National Regulatory Framework, incorporating the above-mentioned decisions, formalizes the whole decision making process, which involve several tasks beginning with the establishment of the rules and processes of engagement of the interested parties in the discussion, and end with the decision of government officials and Agencies prior to the deployment. This task is essential for assuring transparency and to stimulate the involvement of the interested parties in the deployment, especially to carry out the investments needed.

2.2.4 Adopt a Digital Broadcasting Standard Bearing in Mind the Objectives Stated in the Updated Regulatory Framework

After establishing a National Plan and reflecting accordingly all the decisions taken in the National Regulatory Framework, the next step is choosing the digital broadcasting standard that best suites the objectives and goals put forth in the law or any other formal rules and regulations.

Each of the current standards for digital television broadcasting (for more details please refer to ITU-R Recommendation BT.1603) has their particularities and can address countries' specific needs differently.

Some aspects that can be considered in this process are:

– Spectrum Efficiency;

– Transmission Reliability;

– Support for Mobile Television Services;

– Richness of Interactive Services Development Environment which can allow the creation of a software development community that can address the broadcasters' demands for interactive applications on the television);

– Opportunities for capacity building and training on a specific standard; and

– Other economic and financial aspects related to the deployment.

The list above is not extensive and have only the objective of pointing out some important considerations that need to be taken into account during the decision making process.

It is recommended that each country rely on their specific objectives and goals to be achieved by reached with the digitalization of television broadcasting service and its value chain. On this note a cost-benefit analysis is to be carried out for each standard under consideration in order to reach the decision on most suitable standard to become obligatory for use by all country's television stations.

2.2.5 Plan and Grant the Needed Spectrum for the Transition Period Which Will Allow Simulcast Transmissions of Analogue and Digital Broadcasting

With regard planning and granting spectrum, the national government or other entities responsible for spectrum planning need to pay special attention to the following procedures:

- Review the existing regulations to ensure that they reflect the implications of digital terrestrial broadcast transmissions;
- Define if the DTTB service will focus on High Definition (HD) transmissions, and specify the relevant set-up of multiplexes and channels;
- Develop a preliminary allotment plan for digital channels to foresee the needed spectrum for the simulcast period, considering the conditions stated at the reviewed framework; and
- Define priorities for digital implementation, taking into account variables like population density and existing geographic distribution of TV broadcasting stations, in order to promote digital coverage for most of the population in an optimized timeframe.

Many issues are involved while planning the usage of spectrum. Each country has its own objectives and priorities. However, terrestrial broadcasting is a unique and efficient way of delivering content with universal access and technical excellence. Spectrum is crucial for a flexible and innovative terrestrial broadcasting. A high percentage of viewers in several countries depend on the terrestrial platform to receive audio-visual content, as compared to other platforms (Cable, Satellite, IPTV), during the challenging transition period. Convincing advantages for viewers, such as higher quality and multiprogramming, are indispensable for viewers to accept the transition to new techniques which impose an upgrade of the end user equipment that they will have to pay for.

The spectrum planning is important for addressing those issues, as well as, guaranteeing that the population receives television signals that are not interfered by other communications. The spectrum planning task is to constantly revise the allotment plan to avoid situations of interference. In the case of television broadcasting, the final objective of such study is to calculate how many different digital channels it is required to operate digital networks alongside with existent analogue networks, minimizing the risk of interference, and ensuring optimized coverage for their digital signal. This process also shows the need of certain amount of additional spectrum to accomplish the transition to new and more efficient techniques that will certainly be required by broadcasting.

Among the issues involved in the planning of spectrum usage are included:

- How much spectrum will be allocated for each broadcaster in the simulcast period and for how long?
- Will the broadcaster be asked to pay for the right to use the new spectrum allocated for the digital transition?
- Will multiprogramming be fostered?
- How much spectrum will be freed after the Analogue Switch-Off?

As an example of how these challenges involved in the spectrum planning are being faced, below it is presented some choices that can be made while planning spectrum allocation.

One of the key aspects involved is the amount of spectrum that each broadcaster will be granted for the simulcast period. One of the options is to allocate to each broadcaster´s existent 6, 7 or 8 MHz analogue channel another channel for the digital transmission. Another option is to allocate chunks of a channel (a portion of a 6, 7 or 8 MHz channel) that can be used to deliver relevant TV programming.

Either one of the choices have its pros and cons, the first one – allocating a full channel for each existent analogue channel – can allow for more services (interactivity, data services, mobile services, etc) and enhanced video and sound quality. On the other hand, it will not allow more diversity of content being distributed, because the spectrum will be assigned for the same broadcaster. The second option – to allocate chunks of a channel – can be beneficial for new entrants in the broadcasting market, however can make it difficult to deploy new innovative services.

In the process of planning spectrum allocation priorities can be established, for example:

– Assignment for stations of state and national capitals;

– Assignment for stations of other municipalities bearing in mind their economic and regional importance.

The Regulatory Authority or Ministry responsible for the formal assignment of the digital channels The channel can be grant with extra spectrum free of charge or can ask for compensation for the new spectrum based on the amount that each broadcaster will receive. Again each of the options has its pros and cons, not asking for compensation can be an incentive to broadcasters because they will have extra financial resources to invest on the digitalization. However, if the Regulatory Authority/Ministry asks for compensation, the broadcasters will have incentives to ask for the amount of spectrum that they really will use, that can help reallocating spectrum[2] for other uses.

It is recommended that the planning starts even before the adoption of the digital standard and be based on some specific objectives, for example: the digital television channels would use preferably the VHF and the UHF bands ; DTTB would keep the service area equivalent to that of the current analogue service; for each analogue channel considered, a digital channel shall be assigned during the analogue-to-digital transition period, without prejudice to the current coverage of the analogue signal; allocation of 6, 7 or 8 MHz channel spacing or chunks of spectrum; and the technical criteria adopted must meet the protection and interference requirements.

Regarding interference, some technical limitations can occur when planning the allocation of spectrum. An analogue and digital channels coexistence plan needs to be established, if it is not current in place[3], in which the digital channels are recommended to protect the analogue channels in their coverage area. This plan can be developed, for example, restricting the digital channels to assure that no interference is caused to the analogue channels during the transition period. Due to the spectrum limitation it could be very difficult to assign new digital channels in all locations.

It is worth noting that digital television service coverage is characterized by a very rapid transition from near perfect reception to no reception at all (so called “fall off the cliff effect”) and it thus becomes critical to be able to define which areas are going to be covered and which are not. In this sense, it is important to properly define the minimum field strength needed to ensure a good reception and adjust the channel planning. This value can be found in ITU-R Recommendation BT.1368-9, but can be adapted according to the characteristics of each country, taking into account also that the quality of receivers tends to improve over the years.

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[2] Auctions in the 700MHz band are a good reason to carefully think about the options for spectrum allocation.

[3] For example, the GE06 Agreement has some spectrum prescriptions for Region 1 and other countries that adopted that Plan.

A good practice when adding the digital channels that integrate the referred coexistence plan is to discuss necessary changes in the existent channels (frequency, power, etc.). Broascasting Networks may need to agree upon on changes in frequency of many analogue channels, in areas with high occupancy of radiofrequency spectrum, creating vacancy in the spectrum for the "arrival" of the digital channels. Alongside with that, the networks might need to group their stations in a smaller number of channels with adequate powers and antenna radiation diagrams of the analogue stations to avoid mutual interferences within their own stations.

One good example of high channel occupancy is São Paulo State in Brazil. Only in the state of São Paulo the frequencies of more than 500 analogue stations needed to be change, due to new allocations to reach a Analogue and Digital Coexistence Plan. In São Paulo, digital channels have been enabled in "spectrum gaps". Due to the high spectrum congestion in this region it was necessary to use extensively Single Frequency Network (SFN), including situations with critical distances between the stations.

For the post-transition stage, the Analogue and Digital Channels Coexistence Plan will need to be revaluated to optimize digital coverage with no risk of interference between stations.

The SFN usage of the current plan can be revised aiming to verify the need for reducing the number of stations in each SFN, to eliminate the likelihood of mutual interference between stations.

For example, in Brazil a study is being carried out by ANATEL (National Telecommunications Regulatory Agency) to optimize the current allotment plan. The study is based on the installation conditions, field strength needed to ensure reception of 51 dB (μV/m), interfering field strength equal or higher than 31 dB (μV/m), and operating parameters that influence on SFN operations, such as the Guard Interval and the distance between stations. The susceptibility of DTTB receivers to interference is characterized by the digital-to-digital protection ratios (dB). While evaluating the interference on each station, only areas in which the 20 dB protection relation is violated by interfering signals were considered. Population covered by the station within the municipality subject of the broadcasting license is been calculated based on hundred meters uniformly spaced locations.

2.2.6 Fine-tune Public Policies, including Financial Aid for Broadcasters and Telecom Providers in the Deployment of the Infrastructure Needed to Accomplish the Social Goals Stated in the Regulatory Framework

Regarding to fine tuning public policies, special attention is recommended on allowing and promoting public and private investments for the deployment of the infrastructure necessary for the digitalization of the broadcasting value chain, including from content production to its consumption by viewers through digital television receivers.

Financing the deployment can be critical for the success of the transition from analogue to digital terrestrial TV broadcasting. The Government has a very important contribution in that regard, either by allowing sufficient funds for Public Broadcasters so that they can deploy all the infrastructure necessary or by establishing financing strategies to fund Commercial Broadcasters.

The task of financing commercial (private) broadcasters can be more complex and the financial system of each country (private and public investment banks) has an important role on creating a healthy environment that stimulates investments and reduces risks involved.

Some of the options for financing commercial broadcasters include:

– Direct Financing, for example by creating Special Investment Funds for commercial broadcasting companies with money from the state budget;

– Creation of conditions so that Private Financial Institutions can finance the commercial broadcasting companies.

As an example, it can be pointed out the experience of Brazil with the financing provided by the Social and Economic Development Bank of Brazil – BNDES (*Banco Nacional de Desenvolvimento*, website: www.bndes.gov.br/SiteBNDES/bndes/bndes_en/) with the Program ProTVD – Program to Support the Implementation of the Brazilian Terrestrial Digital Television System (SBTVD). Some details of the programme can be found below.

This programme of BNDES was constituted to assure a financing policy for the implementation of the SBTVD, and has initially a budget of R$ 1 Billion (USD 625 Million) and will be active until the end of 2013.

BNDES supports R&D activities, modernization of infrastructure, and production of components, equipment, software, and content, as well as the financing of retailers that provide DTV receivers/STBs. The objective of the programme is to finance investments on the broadcasting value chain and create conditions to the development of technology on the audio-visual sector. The programme contributes also to the development of national suppliers of solutions for digital television. The participation of BNDES in the financing of the DTT Value Chain stimulates the growth of Brazilian companies supplying national technology.

ProTVD is included in the governmental programmes that aim at promoting social inclusion, creating a universal distance learning network and investing in R&D. The programme is subdivided in four segments ProTVD-Supplier (financing transmitters and receivers manufacturers), ProTVD-Broadcasting (financing broadcasters on the deployment of digital infrastructure, including studios), ProTVD-Content (financing the production of Brazilian Audiovisual Content) and ProTVD-Consumer (financing retailers selling DTV Receivers/STBs).

Further details can be found at Chapter 6 “Local Production and/or adequate supply of equipment, receiving park” of this Report.

2.3 Actions to be Carried Out After the Initial Digital Transmissions Require Coherent Planning and Execution of the Analogue Switch Off

One of the main tasks that need to be carried out after the initial digital transmissions is a thorough planning of the Analogue Switch-Off (ASO). Many reasons can be pointed out as motivations for a fast and speed process, the most important of them being to free the spectrum for other uses and to re-plan the allotment of channels for the existent television stations. This way a more efficient usage of the spectrum can be reached.

However, to switch off the analogue transmissions it is recommended that the deployment of digital infrastructure and the adoption of the digital television receivers/STBs be in an advanced stage. In that regard, one example of country whose infrastructure deployment and technology takeover can be reference to other countries is Japan.

Among other reasons, the fast and smooth deployment allowed Japan to switch off its analogue transmission. Japan has succeeded in the complete digitalization of terrestrial television broadcasting by terminating analogue broadcasting on Sunday, 24th July, 2011, (except in some regions afflicted by the earthquake/tsunami damage), being the first country in the world to succeed in Analog Switch Off in a large-scale basis (120 million population) without confusion to its viewers.

During the planning the Analogue Switch-Off the Ministry of Internal Affairs and Communications (MIC) of Japan could test some strategies that were successful for a speedy and smooth transition process.

The first highlight that can be done is that in Japan, the government, broadcasters, manufacturers, and many stakeholders have taken dedicated efforts to achieve the complete digitalization of terrestrial television broadcasting, this is key for the success of every activity on the process of transitioning from analogue to digital in broadcasting.

Other best practices, based on the Japanese case, are presented below:

Success Tip 1 – Prepare consultation offices close to citizens (working together with the government, broadcasters, manufacturers and electricians)

Television broadcasting is a universal service and an important infrastructure for most of the people to rely on as an information source. Therefore, it is indispensable to care for the people who are not familiar with digital technology, especially elderly people and people without enough income. The MIC put in place a total of 51 support centres for digital terrestrial viewers, called "Digi-Suppo," in cooperation with broadcasters, manufactures and electricians in every prefecture to enable easy access and the asking of relevant questions. In addition, especially just before the ASO, temporary Q&A booths to support people who had not switched to digital broadcasting yet were set up widely under cooperation with local governments. Moreover a lot of volunteers called elderly people to confirm whether they had switched to digitalization.

Therefore, a management structure, concentrating efforts of broadcasters, manufacturers, retailers and electricians, is a key factor for the success of TV digitalization.

Success Tip 2 – Develop measures along with a schedule and target

Regarding transmission network preparation, the schedule for starting digital broadcasting in each region was publicly announced (called the "master plan"). The master plan indicates that digital broadcasting would start in 3 metropolitan areas (Tokyo, Nagoya and Osaka) by 2003 and in mid-size cities by 2006. Also the starting dates for the other regions were also indicated in the plan. This schedule was announced in each region respectively.

After the complete digitalization of most of the transmission stations, the MIC returned its attention to fitting out an environment for receiving digital broadcasting waves from the point of view of the citizens. The Digi-Suppos helped citizens to solve any difficulties in their receiving system, including through consultations on a shared receiving system in areas where broadcast signals are blocked by mountains or hills or apartment complexes.

In the border area of analogue broadcasting coverage, where the received signal level is very weak, a cliff effect might have occurred. Therefore, in such areas, additional measures were taken, such as installing new shared receiving facilities or replacing antennas to high-gain antennas.

Furthermore, for the areas where these measures could not be delivered before the ASO, the MIC and broadcasters delivered satellite networks as a temporary safety network to broadcast terrestrial TV programmes.

Success Tip 3 – Develop actions to spread digital receivers

By standardizing the minimum functional requirements for set-top boxes (STBs) along with the technology development efforts of manufacturers, the price of digital TV receivers and STBs have steadily become cheaper, contributing to the spread of digital receivers as a result. In addition, the government implemented an incentive programme for consumers to purchase and switch to digital televisions (called the "eco-point" programme), accelerating digital receiver diffusion. As a result, there were 25 million shipments of flat panel televisions in 2010 (in the first year of digitalization, there were 10 million shipments). In particular, the amount of sales in November was more than 5 times the amount of November 2009 due to announcing the 50% reduction of eco-points in advance.

As for a safety network for the people who had not prepared a digital receiver, STBs have been distributed for free to low income households since 2009.

Success Tip 4 – Start public announcements, including statistical results of the digital spread rate and the ASO notification through the analogue broadcasted programmes

During the simulcast phase, the Japanese Government shared statistical results with viewers via the media, including the results of a survey on the household digital receiver spread rate and a survey on viewer's awareness of the timing of the ASO. This showed viewers that digitalization was making steady progress.

Regarding the preparation of an environment in which all citizens could receive digital broadcasting waves, the status of digitalization using shared receiving systems and in apartment complexes was published to publicize the progress of digitalization.

On the other hand, broadcasters notified viewers that analogue programmes would end on 24th July by transmitting in all broadcasting channels the same promotion programme at the same time (called a "soft test"). The promotion programme was developed in the letter-box format showing on the screen the word "analogue" and the telephone number of the call centre, in order to indicate that the viewer was watching an analogue programme.

From 1st July 2011, broadcasters inserted a superimposed image showing the days remaining until the day of the analogue switch off on the screen in their analogue programmes as a final effort to avoid having unprepared households due to insufficient awareness raising. These measures largely contributed to preventing confusion when analogue television broadcasting was switched off successfully.

Success Tip 5 – Spread of "digitalization of terrestrial television broadcasting" to citizens by using characters and distinguished persons (media strategy)

In Japan, industry side developed many campaigns and commercials by using an animal mascot, a famous entertainer as a symbolic of promotion and popular newsreaders as ambassadors of promotion. In addition, various generations recognized "digitalization of Terrestrial Television Broadcasting" through distinguished entertainers corresponding to the same generation, who were named as a cheering party and they participated in a lot of campaigns.

Furthermore, promotional clips appealed to fans at professional baseball/football stadiums and horse racing tracks using public viewing systems with huge screens.

These actions have created nationwide understanding of and familiarity forward "digitalization of Terrestrial Television Broadcasting".

Success Tip 6 – Define the strategy of the switch-off plan (one-shot or regionally)

As mentioned above, the digitalization of terrestrial television broadcasting in Japan was planned to be executed in one-shot, by terminating analogue broadcasting on a specific day in the role country. In other countries, like France, this process was developed to be implemented in stages, switching off the analogue signals in different regions and in different dates. This approach allows planners to spread the cost and resource the effort of digitalisation more manageable, avoiding logistical and economic problems. The speed of the process will be determined by the time necessary to ensure that viewers no longer depend on the analogue terrestrial platform. So, considering this strategy, it is usual to start the process in regions that Human Development Index (HDI) is high, to guarantee that most of the viewers are already receiving all digital channels before switching off the analogue signals.

Success Tip 7 – Plan and execute a pilot switch-off test

In Japan, Suzu city (with approx. 10 thousand households) in Ishikawa prefecture switched off analogue broadcasting one year prior to the nationwide ASO. With this action it was possible to evaluate the impact for the citizen and to develop strategies based on these invaluable experiences to the preparation for the nationwide ASO. Depending on the size of the country it may be necessary to execute more than one pilot test, in order to evaluate different economical regions.

Another good example of Analogue Switch-Off (ASO) planning is the case of Hungary, which selected a region of this country to test the strategies that would be used in a country wide basis later on. This might be a very good option for big and diverse countries like Brazil, China, India, Russia and others. The same strategy has been used also by Germany.

A test project was started by the Hungarian Regulatory Authority (NMHH) in March of 2012 in order to facilitate the digital switch over and support of those in need. The aims of the test project were seeking solution to critical process which can make more difficult the digital switch over and testing of subsidy system before the nationwide digital switch over. The nationwide digital switch over can be made more streamline based on the experience of the test project. The test project occurred in two areas which are different in condition of economic, population density and demography. These areas were Sopron and Barcs.

The Hungarian Authority collaborated with other institutions to complete the test project. These institutions ware:

– Local governments – giving the personal details of those in need, supporting the communication, sending the information about people who possibly left out of the survey;

– Hungarian broadcasting operator – to switch off the analogue transmitter and retune the digital transmitter.

The Hungarian Authority and the competent state institutions determined the long-term social-care categories during the survey which defines the range of those in need. The regular social assistant gives entitlement for using the subsidy system for example in case of blindness, disability and old-age care among other things.

The Hungarian Authority identified the eligible households, secured the subsidy requirement and form of support during the survey.

The entitled households were able to choose from the following services:

– A free digital terrestrial television broadcasting (DTTB) programme package or free satellite subscription package in case of DTTB coverage was not provided; and

– Two different paying satellite subscription packages which were recommended by two Hungarian telecommunication operators.

The entitled households received a Set-Top-Box for DTTB reception during the test project (and they can keep it for the nationwide digital switch off) which was put in operation by the installers contracted by the NMHH, and they provided assistance also if the antennas needed to be replaced or re-configured. The installers had to provide for the best DTTB reception. It is rather interesting to mention that a lot of people did not require support during the test project.

The analogue TV repeater of Barcs which broadcasted public service programme and covered half part of population of Barcs (about 6500 people), was switched off on 31st October 2012. Thus the digital switch over in Barcs was completed.

The Hungarian Authority did sent a detailed information letter to the habitants of Barcs, who were affected by the test project, in connection with the work to be done. In addition the population was informed by one of the most effective tools, the news-lane inserts, which contained the further tasks. Since the Barcs transmitter was a repeater, we had to investigate how the news-lane inserts can be implemented in the area of Barcs and where it can cause communication problems within the area covered by the main transmitter. Based on the joint decision of the NMHH and the operator the analogue repeater was changed to another low-power transmitter which broadcasts on baseband. The area covered by the news-lane inserts was reduced to the concerned geographical area with change of transmitter.

Other successful examples

The Government of Argentina established an Operational plan for access to open digital television receiver equipment, which can accelerate the transition process and allow for a speedy ASO. The Government of Argentina's initiative is called "Open digital television" (*Televisión Digital Abierta,* abbreviated as TDA), which is a government-sponsored project to bring about universal access to television broadcasting services, free of charge, promoting diversity of content and high image and sound quality and bringing together new information, knowledge and entertainment technologies. The design, development and implementation of the new system are government-led and public-service oriented.

Within that framework, specific plans have been developed to ensure that the public enjoy equal opportunities in access to TDA and thereby reduce the digital divide. One such plan is the Operational plan for access to open digital television receiver equipment, known as "*Mi TV Digital*" in Spanish.

With this plan, the Government has approved the provision, free of charge, of receiving equipment required for TDA for all citizens and institutions considered to be disadvantaged. Two main groups of beneficiaries have been defined, taking into account their social roles and their degree of vulnerability in the technological transition process: public institutions and social organizations, on the one hand, and socially and economically vulnerable households, on the other. In the latter case, use has been made of the databases of relevant specialized government agencies in order to ensure transparency in identifying target groups.

Public institutions with a mandate to undertake social, cultural and educational activities and/or audiovisual content promotion were selected as beneficiaries on the basis of their social function and territorial integration, these being criteria that are fundamental in bringing about greater public access to digitized signals. With that in mind, an attempt has been made to generate a multiplier effect to meet the demands of more people in sectors that enjoy fewer opportunities and are at risk of exclusion during the transition to digital television.

The social organizations include non-profit civil associations, foundations and cooperatives, which exist to undertake social, cultural, educational and/or audiovisual promotion activities and which by virtue of their territorial presence, social function and direct contact with members of the community, provide a reference for promoting the expansion of access to digital transmissions. The aim is to facilitate inclusion of social groups in the transition process by creating collective and community spaces for the transmission of audiovisual content.

The households considered to be socially and economically vulnerable include citizens receiving non-contributory pensions (old-age pensions for those over 70 years of age; illness and disability pensions; mothers with seven or more children), universal child benefits, minimum asset pensions and beneficiaries of various other social programmes and plans.

The receiving equipment package provided comprises: one UHF receiver; one remote control unit with batteries; one indoor UHF antenna; one 220V cable; one RCA audio/video connector cable; and one users' manual in Spanish, with a telephone number for the use of the customer. In areas where signal strength is less than ideal, an outdoor antenna is also provided to improve reception.

In areas which are not reached by terrestrial signals owing to factors relating to geography and/or population density, the Government will guarantee reception of digital TV via satellites and will provide and install free of charge satellite decoders and antennas for all social institutions and citizens considered to be socially vulnerable.

3 Spectrum Planning Issues

3.1 Sound Broadcasting

Analogue sound broadcasting, particularly FM, continues to dominate worldwide. Digital radio is introduced and used marginally in few countries. Re-planning of analogue sound broadcasting bands is not in the agenda of next WRC-15. There is no indication for the time being that the agenda of future WRC´s after WRC-15 would incorporate digital sound broadcasting item/s. Hence this Report focuses on digital terrestrial television broadcasting (DTTB) aspects.

3.2 Television Broadcasting

3.2.1 Network Planning Aspects

Experience of competent frequency planners has shown that a single nation-wide coverage of analogue terrestrial TV broadcasting service could be achieved in VHF Band III. Furthermore, two to three nation-wide coverage of said TV broadcasting services could be achieved in UHF Bands IV and V. Finally, densely populated agglomerations benefited from some additional TV broadcasting channels in the above-mentioned frequency bands.

Situation did improve substantially with the transition to DTT broadcasting service being able to offer much more TV programmes – every analogue TV broadcasting channel was possible to be replaced with multiplex containing number of standard definition (SD) and/ or high definition (HD) programmes. This represents an enhancement to both numbers and quality of TV programmes broadcasted digitally. The selection of: video coding and compression standard (MPEG-2 which already is considered obsolete, MPEG-4 or the latest HEVC); highest possible quality at any time of the encoder at the end of TV programme centre; relevant DTT broadcasting transmission standard, its data rates and parameters defining the type of antenna for reception (roof top, portable or mobile), SD or HD quality of TV broadcasts; single frequency network (SFN) or multiple frequency network (MFN); and appropriate auxiliary services – all of them will result in the definition of number of TV programmes within given multiplex. Depending on the choices made, the viewers may be provided with one to three HDTV programmes or with up to 8 or even more SDTV programmes per multiplex (alternatively with mix between said SDTV and HDTV programmes). The choice of number of multiplexes will define the total number of TV programmes broadcasted terrestrially to viewers. Said improvements are noticeable for end users (viewers) and they indeed represent one of the most important assets of the digital dividend (DD). After the completion of the analogue switch off (ASO) there will be some spectrum left within said VHF/UHF bands for other radiocommunication services, predominantly the mobile.

Already the WRC-07 did allocate 790 to 862 MHz frequency band to mobile service. Furthermore the WRC-12 concluded with a decision to create a new mobile allocation in the band 694-790 MHz in ITU Region 1, which is proposed to come into force in 2015 in order to enable the necessary technical studies to be concluded regarding the availability and assignment of the new band before bringing this band into use as decided. In this respect ITU has begun a significant work programme of technical studies on two important agenda items for WRC-15, namely, agenda item 1.1 in accordance with Resolution 233 (WTC-12) and agenda item 1.2 in accordance with Resolution 232 (WRC-12). This spectrum expansion for the mobile service is called a second digital dividend. The issues are extremely complex and there are conflicting interests between the broadcasters and the mobile operators on many issues making impossible to predict what kind of final decision would be taken at WRC-15 on the matter.

Said spectrum issues will have an important impact on many facets: political, social, financial, technical, operational, etc.

For these reasons the BDT has started an ITU Spectrum Management Training Programme (SMTP) assisting creation of teams of competent spectrum planners at national level; produced publication "Guidelines for the transition from analogue to digital broadcasting", January 2010, as well as another valuable publication "Digital Dividend: Insights for spectrum decisions", August 2012 thus assisting member states with the planning and implementation of the transition to DTTV and has provided expert assistance upon request.

For the very same reasons the Radiocommunication Bureau of ITU (BR) is assisting ITU member states on the frequency planning aspects of their DTTB networks by relevant information provided on the ITU website, seminars of world, regional or sub-regional level and expert consultation. Of particular importance is the assistance provided for coordinating relevant DTTB frequency assignments/allotments to avoid interference because any change of frequency plan is costly and disruptive, even more so when it is not planned in advance.

The most difficult phase of the transition to DTTB is the analogue/digital simulcast and relevant frequency coordination with the administration from neighbouring countries. This also holds true to lesser extent for the 120 member countries, most from ITU Region 1, who did ratify the GE 06 Plan "Final Acts of the Regional Radiocommunication Conference for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz (RRC-06)", Geneva, 15 May – 16 June 2006. Although they have agreed on the technical criteria to be used as basis for coordination of relevant MFN assignments/SFN allotments planned the spectrum planning workload remains substantial and rather complex.

At this juncture we should like to comment in particular the use of single frequency networks (SFN)-subject to strong interest of many developing countries. While it is true that most digital TV standards allow the implementation of single frequency networks thus further increasing spectrum efficiency, there are also trade-offs associated. SFNs are technically more complex than MFNs. As such, SFNs require timing synchronisation and more complicated signal distribution.

As all transmitters in an SFN network use the same channel they cannot be operated independently. Subsequently, to work correctly the transmitters require a high degree of timing synchronisation, which makes network design and operation more demanding compared to an MFN. This entails additional cost.

One of the main costs of a network is the distribution of content to the transmitters. In an MFN it is common to take the off-air signal from a main transmitter and re-broadcast it with relay or gap filling transmitters. This network architecture is extremely cost efficient and is subsequently widely adopted. In SFNs this relay system becomes more difficult to implement and may not be possible in many cases. The consequence could be a significant rise in network costs as a dedicated means of distributing the signal could be required. A key parameter in a Single Frequency Network is the 'guard interval'; this defines the size of a SFN's area and has an inverse relationship to the capacity in a DTTB signal. Making the SFN's area larger requires a longer guard interval, which decreases capacity.

SFNs cannot be used over arbitrarily large areas because of self-interference. The larger the SFN area, the more difficult it is to mitigate self-interference. There are three main ways of overcoming self-interference; adopting a more robust transmission mode, increasing the guard interval1 or by adding new transmission sites to increase the network density. The first two options reduce capacity while the third significantly increases costs. SFNs therefore introduce an additional trade-off between the competing factors of cost, capacity and coverage.

The potential impact of self-interference in SFNs, together with editorial, commercial and capacity requirements necessitate broadcasters to choose the network architecture that best suits their needs in each case. In particular it cannot always be assumed that SFNs will be more efficient than MFNs.

Additional information can be found in publication TR 016 "Benefits and Limitations of single frequency networks (SFN) for DTT", EBU Technical Report, October 2012, available at: http://tech.ebu.ch/docs/techreports/tr016.pdf

Another important point to make is associated with the band allocation of the frequency/allotment planning for the DTT broadcasting. It has been noted that some regulatory authorities, having analogue terrestrial TV broadcasting in VHF Band III, prefer to plan the DTTB networks exclusively in UHF Bands IV and V in order to simplify the DSO process. Such approach however is having negative implications on the cost of operations because of the very nature of the radio wave propagation (analogue broadcasting experience has shown that for the same coverage UHF bands transmitters are to be planned with around two and a half times higher nominal output power as compared with that of VHF band transmitter and there are no reasons to believe that same finding will not be applicable to DTTB transmitters). Therefore, in spite of the DSO simplicity, it is strongly recommended that planning arrangements be made in such a way that the entire VHF Band III continues to be used for DTT broadcasting after the completion of the DSO.

3.2.2 Digital Dividend

Pursuant to the ITU GE06 Agreement (bands 174-230 MHz and 470-862 MHz), television channels in those countries signatory to the Agreement – and in other countries having made the political choice to do so – are to stop broadcasting their programmes using analogue on a specific date (ASO). It should be noted that broadcasting a channel using digital requires around 3-6 times less resources in terms of frequencies than an analogue channel. This means that, despite the increase in the number of TV programmes broadcasted via DTTV and or enhancement of their technical quality to HDTV or UHDTV level, it is possible to free up some frequencies initially set aside for audiovisual on primary basis (as stipulated in the ITU Radio Regulations) and introduce new radiocommunication services. This is the the essence of "digital dividend" (DD). See also the ITU Report “Digital Dividend: Insights for spectrum decisions” available at: www.itu.int/ITU-D/tech/digital_broadcasting/Reports/DigitalDividend.pdf

The issues at stake

The crux of the matter therefore lies in ascertaining what the State intends to do with these frequencies, given that numerous operators are interested in and eagerly awaiting their allocation. Indeed, the frequency band in question (700/800 MHz) is extremely sought after: the frequencies have better physical radio propagation qualities, allowing greater ranges and better building penetration – i.e. better coverage using relatively few transmitters. Mobile operators want to use these frequencies for very high speed wireless (4G), Internet access providers for WiMAX (IEEE 802.16e), broadcasting operators for high definition television, mobile radio and TV. And leaving aside the audiovisual and electronic communication sectors, the digital dividend could be used to certain extent for the deployment of civil security or national defence networks.

The allocation of these "freed-up" frequencies and the associated services is a political choice of very complex nature.

a) Position of radiocommunication operators

In order to increase the density of GSM coverage and then launch 3G, radiocommunication operators have had to associate their frequencies in the 900 MHz band with high frequencies: 1 800 MHz, 2 100 MHz and 2 600 MHz. These frequencies require the installation of a greater number of transmitters, and this is costly. Moreover, the proliferation of antennas is not welcomed by the public (health considerations and sustainable development). This is why radiocommunication operators do not envisage deploying future 4G (very high-speed) networks without these additional frequencies. In France for example, Orange estimates that coverage for its 3G network beyond 70 per cent of the population will cost it four times more without the "freed-up" frequencies.

b) Position of television broadcasters

The broadcasting operators are not prepared to abandon their frequencies where they operate on primary basis. On the contrary, in order to be able to compete with satellite, cable and IPTV, they would like to distribute the maximum possible number of high definition (HD) channels, which take up more

frequency resources, and perhaps multiply the number of channels for personal mobile television reception. This could partly be resolved by introducing new video coding and transmission standards: abandoning MPEG 2 in favour of MPEG 4, or later to HEVC once matured and readily available; as well as abandoning DVB-T in favour of DVB-T2; would make it possible to enhance the efficient use of the spectrum resource used to broadcast television programmes terrestrially. This means that up to around 300-375 MHz of frequencies currently allocated to terrestrial broadcasting could be freed up and become available for further use.

c) The State

The switch-over from analogue to digital terrestrial television will free up a significant amount of radio spectrum. This "digital dividend" provides a unique opportunity for all States to satisfy the increased demand for new wireless communication services, allow broadcasters to extensively develop their services and, at the same time, provide spectrum for social and economic uses: this contributes to bridging the "digital divide" in order to guarantee equitable access to information and new communication technologies for everyone.

A public survey should be conducted by the government, regulatory authorities in charge of radiocommunication, audiovisual and competition by involving the different national players in the field of ICT, including users. The results of such a survey would facilitate the drawing up of legislation/regulations governing the future use of the "digital divide" frequencies of the spectrum, in respect of which the main challenge is to establish a framework for t decision/s on allocation of said frequencies. The regulatory text must not overlook social and cultural obligations, and access for everyone to new digital services and the values they can promote: access to information, culture and knowledge under reasonable economic conditions. Moreover, the rules for allocating the frequencies and the economic value of the digital dividend must be clearly established. The latter cannot simply comprise a strict economic optimization, but must take account of externalities with societal objectives (development of social integration, public security, education and health services, contribution to sustainable development, land-use planning, the fight against exclusion, etc.).

Each State can decide, with full sovereignty, on the allocation of this resource, but is often bound to coordinate with other States concerned, particularly in application of the said GE06 Agreement (RRC-06).

4 Impact of Convergence with Other Terrestrial Telecommunication Services and Interactive Multimedia Applications Enabled by Terrestrial Digital Broadcasting

4.1 Current Situation of Digital Terrestrial Broadcasting

4.1.1 Digital Terrestrial Sound Broadcasting

Digital Terrestrial Sound Broadcasting (DTSB) systems have been developed since the early 1990's. Regarding the digital terrestrial sound broadcasting systems below 30 MHz, two systems were standardized and are now in service. One is the Digital Radio Mondiale (DRM) system, the other is the In Band on Channel (IBOC) system. These systems are registered in both Recommendations ITU-R BT.1514 and BT.1114.

DRM is designed to be used at any frequency below 30 MHz, i.e. within the long-wave, medium-wave and short-wave broadcasting bands. The DRM system includes a multiplexing feature, which allows multiplexing of up to four different services, which can be a mix of audio and/or data.

The IBOC DTSB system was originally designed to operate below 30MHz, mainly in the AM band, then be extended up to over 30 MHz in the FM band (IBOC FM DTSB system). This system is designed to operate

in both a "hybrid" and "all-digital" mode. The hybrid mode of operation permits simultaneous broadcast of identical program material in both an analogue and digital base format within the channel currently occupied by the analogue signal. The all-digital mode provides enhanced capabilities for operation on another channel.

Both DRM (System G) and IBOC (System C) are also registered in Recommendation ITU-R BT.1114.

In the VHF and UHF bands, two other systems were also developed and registered in ITU-R BT.1114. One is digital system A, known as the Eureka 147 Digital Terrestrial Audio Broadcasting (DTAB or T-DAB) system. T-DAB is designed to provide high-quality, multi-service digital radio broadcasting for reception by vehicular, portable and fixed receivers. It is designed to operate at any frequency up to 3 000 MHz for terrestrial, satellite, hybrid (satellite and terrestrial), and cable broadcast delivery. The T-DAB system is a rugged yet highly spectrum- and power-efficient sound and data broadcasting system.

The other system is digital system F, also known as the ISDB-T_{SB} (integrated services digital broadcasting – terrestrial for sound broadcasting) system, which is designed to provide high-quality sound and data broadcasting with high reliability even in mobile reception. It is a rugged system which uses OFDM modulation, two-dimensional frequency-time interleaving and concatenated error correction codes. ISDB-T_{SB} is in the ISDB-T transmission system family, which includes a digital television standard (ISDB-T) and digital mobile multimedia broadcasting standard (ISDB-Tmm). These systems are based on common transmission technology, named the "segmented OFDM transmission" system.

4.1.2 Digital Terrestrial Television Broadcasting

Digital Terrestrial Television Broadcasting (DTTB) systems have been developed since the late 1990's. Many countries have started a Digital Television Broadcasting service, and several countries have finished an Analogue Switch-Off (ASO). Regarding digital terrestrial television systems, four digital television systems are standardized and registered in Recommendation ITU-R BT.1306. These are: ATSC (System A), DVB-T (System B), ISDB-T (System C) and DMB-T (System D).

The Advanced Television System Committee (ATSC) system is known as a "single carrier system" and was specifically designed to permit a digital transmitter to be added to each existing National Television System Committee (NTSC) transmitter in the United States. The single-carrier digital television system is designed to transmit high quality video and audio and ancillary data using the same channel bandwidth as present television systems. The system can reliably deliver about 19 Mbps of data throughput in a 6 MHz terrestrial broadcasting channel and higher rates in 7 and 8 MHz channels.

The multi-carrier Terrestrial Digital Video Broadcasting (DVB-T) system was designed originally for the 8 MHz UHF channel spacing used in Europe and has been adapted to fit 7 and 6 MHz channels. Depending on the choice of coding and modulation parameters, data rates from 20 to 30 Mbps can be realized to deliver high quality digital television through the broadcasting channels. The system was also designed to be robust against interference from delayed signals, either echoes from terrain or buildings or signals from distant transmitters in a single frequency network (SFN). The DVB-T system features a number of selectable parameters, allowing it to accommodate a large range of values for C/N ratio and channel behaviour, allowing fixed, portable, or mobile reception, with a trade-off in the usable bit rate.

The ISDB-T system is known as a "Multi-carrier system with radio-frequency band segmentation", which is a new type of broadcasting for multimedia services in 6, 7 and 8 MHz channel. It systematically integrates various kinds of digital content, each of which may include multi-programme video from limited definition television to HDTV, multi-programme audio, graphics, text, and so on. One feature of ISDB-T is a hierarchical transmission technology, which enables both an HDTV stationary reception service and a handheld reception service in one frequency band.

The Terrestrial-Digital Multimedia Broadcasting (DMB-T) system (kindly refer to for details to ITU-R Rec BT.1833-2, www.itu.int/rec/R-REC-BT.1833-2-201208-I/) is known as a "Single- and multi-carrier combined system", and has been developed in China. Any of single carrier or multi-carrier (3780) can be

selected, according to service type. The DMB-T system also has many transmission parameter sets, the data rate of DMB-T depends on transmission parameter sets. Thus data rates from 4 Mbps up to over 30 Mbps are available in the 8 MHz channel. The 6 MHz channel and 7 MHz channel systems are also standardized.

The second- generation multi-carrier system, known as the "DVB-T2 system" has been standardized. This system was developed to carry HDTV service. DVB-T2 has many parameters set, so, according to a system requirement, many combinations of transmission parameter sets are available. However, DVB-T2 adopts different transmission technologies from the DVB-T system. Recommendation ITU-R BT.1877 shows details of the DVB-T2 system.

4.1.3 Digital Terrestrial Mobile Broadcasting

A mobile multimedia broadcasting service is one of the key features of a digital broadcasting system.

In analog TV broadcasting, TV reception service has been limited to roof-top or indoor and portable/vehicular reception, while in digital broadcasting system vehicular reception, handheld reception and portable reception services can be made available. Because of this advantage, the extension of broadcasting services and new broadcasting services, for example, become available even in developing countries. There are two types of mobile multimedia service, one is based on a mobile communication network with IP cast, while the other is based on its own broadcast network in broadcast frequency band. This section of the Report will focus on the mobile broadcasting service based on the broadcast network in the broadcast frequency band.

Six digital terrestrial digital mobile broadcasting systems have been developed and registered in Recommendation ITU-R BT.1833-2, namely, "System A", known as T-DMB, has a common transmission platform as T-DAB, and is extended to provide multimedia services including video, audio and interactive data. "System B", known as ATSC mobile DTV, of which transmission technology is based on ATSC TV, is designed to extend to mobile and handheld services. "System C" and "System F", known as part of the ISDB-T family, have a common transmission platform for digital sound broadcasting and digital television broadcasting. These systems provide both narrow band and wideband mobile reception service. "System H", known as DVB-H, has a common transmission platform and provides IP cast service. "System M", known as Forward Link Only (FLO), is designed for mobile applications and for wireless multimedia services. "System T2", known as DVB-T2-Lite, uses common technology for a transmission system as DVB-T2.

Regarding commonality with digital audio broadcasting and/or a digital television broadcasting system, as described above, T-DMB uses a common RF platform of the T-DAB system. DVB-H also has a common transmission platform of DVB-T. In case of the ISDB-T family, ISDB-T for TV broadcasting, ISDB-T_{SB} for sound broadcasting and ISDB-Tmm for multimedia mobile broadcasting have a common transmission platform named "Band Segmented OFDM Transmission (BST-OFDM)". The commonality of transmission system between other digital broadcasting media leads to an advantage of commonality of receiver platform. Several service examples on ISDB-T family are shown in the Chapter 7 of this Report as "Mobile Terrestrial Broadcasting Service".

These mobile digital and mobile multimedia systems of which the RF platform is common among digital television and/or sound broadcasting systems, and have also RF-compatibility with digital television and/or sound broadcasting systems, therefore, similar transmission network configurations are available, such as SFN, etc. Therefore, these systems have advantages of saving frequency resources and may adopt similar network design technology. These mobile multimedia broadcasting systems enable portable/handheld (mobile) and in car reception (vehicular) service. For these reception services, many kinds of receiving terminals have been developed and are now in service. The mobile broadcasting system also creates new services, such as outside reception in transportation, and local area interactive services with other telecommunication networks.

4.2 Other Terrestrial Telecommunication Services

The development of wireless chips and networks with the embedding of WiFi, WiMAX and IP enabled System-on–chips in virtually all mobile and handheld devices, has added a new dimension to the move towards wireless services. Fuelled by such technology along with different telecommunication services and networks there is immense potential for the next generation of digital broadcasting services too.

4.2.1 NGN Technology

Next Generation Networks (NGN) concept is modelled in two very distinctly different ways:

1) Broad concept encompassing the whole development of new network technologies, new access infrastructures and even new services, and

2) Focussed concept on specific network architecture and related equipment, with one common IP core network deployed for the entire legacy, current and future access networks.

ITU defines NGN as: "a packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies. It supports generalized mobility, which will allow consistent and ubiquitous provision of services to users" [ITU-T Recommendation Y.2001].

- **WiFi**

The best known Wi-Fi standard is IEEE 802.11(b). It is using the unlicensed Industrial, Science and Medical (ISM) band. In the absence of licensing barriers, and because of the simplicity of the technology and its cost effectiveness, Wi-Fi networks have developed rapidly. Indoor coverage of 50 to 100 meters with bit rates of 11 to 54 Mbps is possible.

However in point-to-point architecture, the Wi-Fi networks can have wider coverage (up to about 30km). This is very important for the developing countries, where no legacy telephony or cable networks exist. In developed countries, Wi-Fi is mainly used as the local extension of a broadband infrastructure.

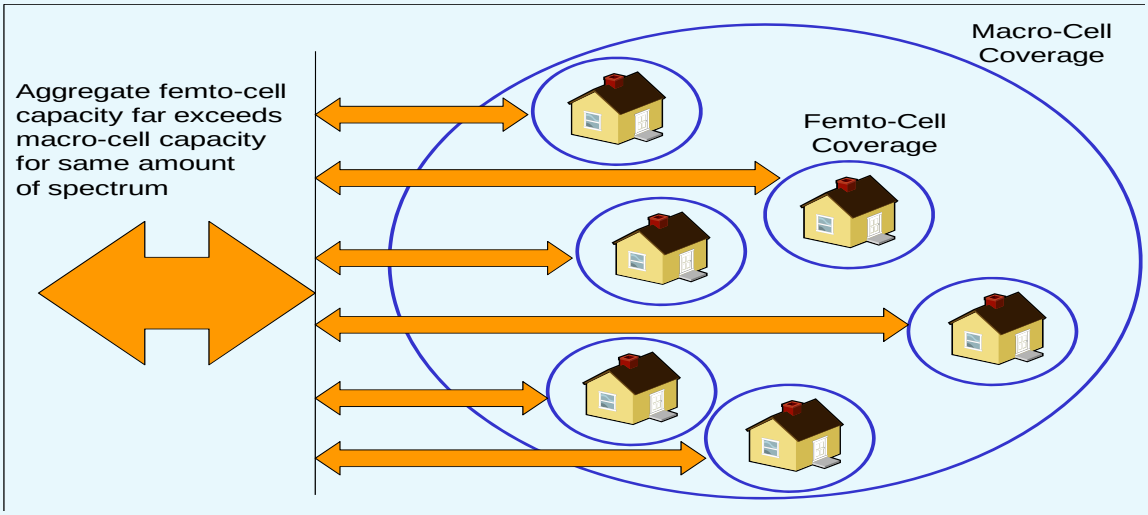
WiFi enabled devices are better suited for video sharing, media downloading and receiving online streaming of audio and video content through server.

- ***Broadband Wireless Access, including IMT***

The IEEE 802.16 standards, otherwise known as WiMAX or Broadband Wireless Access (BWA), enable true broadband speeds over full IP based wireless networks to enable mass market adoption. BWA and WiMAX offer a combination of both broadband and mobility.

Although it is true that most Broadband Wireless Access (BWA) systems are now offering throughputs of about 2 Mbps, the overall capacity of wireless systems is generally lower than it is with wireline systems. With wireline operators looking to provide 20 to 100 Mbps to either people's homes or businesses – the pertinent question to ask for is as follows: Is it possible to match these rates using wireless approaches? It is only possible to achieve these rates by using large amounts of spectrum, generally more than is available for current BWA systems, and by using relatively small cell sizes. A possible wireless approach to address such high-data consumption is with hierarchical cell approaches, such as femto cells as shown inError! Reference source not found.. This presupposes, however, an existing wireline Internet connection (e.g., DSL).

Figure 1: Femto cells used to expand capacity



What makes much more sense today is using wireless technology for access only when there are no good wireline alternatives. Hence, the interest developing countries have in broadband-wireless technologies. Table summarizes the strengths and weaknesses of wireless versus wireline broadband approaches.

Table 2: Strengths and weakness of broadband approaches

	Strength	Weakness
Cellular mobile broadband	Constant connectivity. Broadband capability across wide areas. Good access solution for areas lacking wireline infrastructure. Capacity/coverage enhancement options via femto cells.	Lower capacity than wireline approaches. Future evolution to serve high-bandwidth applications such as IP TV.
Wireline broadband	High capacity broadband at very high data rates. Evolution to extremely high throughput rates.	Expensive to deploy new networks, especially in developing economies lacking infrastructure.

- ***IPTV***

Internet Protocol Television (IPTV) is defined as the provision of video services (for example, live television channels, near Video-On-Demand (VOD) or pay-per-view) and multimedia services through an IP platform.

This encompasses not only one-way video broadcasting services but also ancillary interactive video and data services. IPTV providers now commonly include in their commercial packages a Personal Video Recorder (PVR) through a hard disk in the set-top-box (STB) or on the network, allowing “time shifted” or “catch-up” viewing of TV broadcasts. With an IP-based managed network, the service provider is able to offer a high Quality of Service (QoS) level and high “Quality of Experience” (QoE), as well as security, interactivity and reliability.

4.3 Impact of Convergence Between Terrestrial Broadcasting and Other Communication Services

4.3.1 Impact on Value Chain of Broadcasting Networks

The impact of convergence can be envisaged on the broadcasting chain that includes the following components:

1. Contribution networks delivering various inputs for assembling of programmes.
2. Production networks to assemble and process the sound and TV programmes.
3. Distribution networks to transport these programs to transmitting networks. Transmission networks deployed for broadcasting those programs to the audience/ or viewers. The network service providers may face challenges on all or either of the following segments:
   - Radiation characteristics, air interface and/or user interface to different platforms,
   - Different modulation techniques, e.g. variants of DVB-T, COFDM/QAM,
   - Encoders and multiplexes and their numbers, and
   - Additional sites to improve or extend coverage (eg. SFN, MFN).
4. Viewers/listeners receiving and recording/playback terminal park

The recent progress of digital broadcasting technology and the migration to digital technology are facing sophisticated challenges in these components of the broadcasting chain, affecting the audience/viewers and, largely, to the broadcasting network providers.

4.3.2 Optimization and More Efficient Use of Spectrum including Digital Dividend

The digital dividend could be used for broadcasting services, such as digital terrestrial television with rooftop, indoor or outdoor reception, mobile TV, HDTV and interactive television services.

When the frequency band 790-862 MHz was made available for low/medium power electronic communications networks and mobile radiocommunication services by WRC-07, this band is no longer available for broadcasting. The consequences of this change will be significant for broadcasters. It will lead to the following:

- Migration of the existing DTT services to the band below 790 MHz;
- Protection of broadcasting services from mobile interference in the long term;
- Alternative frequencies for broadcasting services should be identified below 790 MHz to compensate the 'lost' channels for the existing and planned DTT services above 790 MHz;
- Constraints on already migrated DTT networks in order to protect analogue TV services in the neighbouring countries; Ensuring the continuity and further development of wireless microphone applications and other secondary uses of the UHF spectrum.
- EBU Response to the EC Consultation document, 3 September 2009; and
- Generating revenue through spectrum auction to new ICT service bidders.

4.3.3 Economic Aspects including Investment Costs to Broadcasters and Consumers

The total infrastructure investment made by broadcasters might be substantially inferior to the total infrastructure investment made by the audience and viewers for their receiving, recording and playing back terminal park enabling reception, recording and play back of broadcasting programs in serviced areas. Questions that must be posed are why audience/viewers should be forced to buy Set Top Boxes

(STB) or face hurdles associated with renewal of their receiving/recording/playback terminal park just for the sake of changing from analogue to digital.

4.3.4 Policy and Strategy of Migration and Analogue Switch-Off (ASO)

The transition to the digital broadcasting environment is largely affected by the ASO transition models and a mandatory date set for Analog Switch Off. Each national Government has to plan for specific objectives when initiating the ASO process and adopt implementation guidelines to achieve the prescribed objectives.

4.3.5 Other Areas of Impact

– A broadcast service market with a variety of attractive programmes complemented by innovative services and applications including progamme/news content and web content for mobile devices;

– Knowledge and skills of staff involved in the whole broadcast chain; and

– Checking compliancy with national public policies and regulations including convergence policies in other sectors related to ICT and on competition/ownership.

4.4 Impact of Interactive Multimedia Technologies and Applications

4.4.1 Interactivity

Interactivity multimedia is an important aspect of digital broadcasting service. The first thing to be clarified is the concept of "interactivity" in digital broadcasting. In general, two types of interactivity in digital broadcasting can be distinguished.

– *Local interactivity:* where interactivity is provided at the terminal end, due primarily to the terminal device's capability. The interactivity is provided because the device itself is interactive (e.g., remote controller or other sensor device) or applications or content can be stored (either temporarily or in a non-volatile manner) on the terminal device (e.g., downloaded and temporarily cached application that can interact with the user's behavior, or downloaded content stored on the hard-disk for later use). Local interactivity requires only uni-directional delivery of content and information.

– *Full (or remote) interactivity:* where interactivity is provided by exchange of information between the terminal side and the remote side via a return path. This is bi-directional interactivity. With multimedia technology, full interactivity can in principle provide to digital broadcasting the ability to offer not only interactive video services such as video-on-demand, but also integrated interactive applications such as voting-on-TV, shopping on TV, and interactive e-learning.

The ability to provide either of these two types of interactivity depends on many different factors: the type of content and service to be provided, the bandwidth of broadcasting channel, and the availability of a return path (e.g., the Internet connection) and broadband.

4.4.1.1 Source of Impact

As digital broadcasting enables more multimedia interactivity, the convergence of PC-like technologies and web-like services with more conventional video-centric uni-directional broadcasting services and technologies will be inevitable. This will have an impact on the way broadcasting is operated and especially on the business-models and service-models. One example is advertisement. The conventional simple model of advert insertion will not be the primary source of advertising revenue but there will be more interactive ways to make advertisement more effective: e.g., targeted adverts, "banner-like" adverts, DAL (dedicated advertiser location) adverts, telescoping adverts, keyword based profiling, click-based counting, etc.

Another example is the possibility for broadcasting to become even more relevant to improving QoL (Quality of Life) of the public: e.g., the use of e-government applications/services on digital broadcasting using interactive multimedia, e-health, e-learning, smart-home and smart-city projects using digital broadcasting receivers as the "hub" of home network, etc.

These examples, though not showing the whole picture, are enough to indicate the importance and the impact that multimedia interactive applications on digital broadcasting will have, especially for developing countries, because such countries will experience this convergences at a rate that no developed countries have ever experienced.

4.4.2 Technical Components of Interactive Multimedia for Digital Broadcasting

4.4.2.1 Standards of Interactive Multimedia for Digital Broadcasting

Within ITU, there are many technologies already available for digital broadcasting. ITU-T Rec. H.760 describes many standard technologies of interactive multimedia for digital broadcasting. The following are the Recommendations of ITU-T that specifically address this issue.

– ***ITU-T Rec.J.201:*** BML (Broadcast Markup Language) is an XML-based framework developed for a data broadcasting specification for digital television broadcasting. It was first codified in 1999, as ARIB-STD-B24 "Data Coding and Transmission Specification for Digital Broadcasting" for ISDB. It is currently widely used in Japan for providing data broadcasting daily over more than 120 million fixed terminals as well as 115 million mobile receivers.

– ***ITU-T Rec. H.761:*** Ginga-NCL is an XML based framework for multimedia interaction. It is often used to combine and integrate different multimedia content. It uses a script language called Lua to control some aspects. Ginga-NCL is similar to W3C SMIL (Synchronized Multimedia Integration Language) and can be used as a "wrapper" to contain other more basic languages, such as HTML. It can be used alongside an HTML based framework such as LIME.

– ***ITU-T Rec. H.762:*** (Lightweight Interactive Multimedia Environment) LIME is an HTML-based framework for multimedia application. As with many present-day web-based frameworks, it uses Java script and CSS to define dynamic content integrated with video and broadcast content. It is directly derived from BML, whose original implementation was based on that of MHEG-5 and thus it can be considered an extension of MHEG-5 via HTML. It is currently profiled to be a subset of HTML5 but it can also partially be processed by a BML processor.

– ***ITU-T Rec. T-175:*** MHEG-5. MHEG stands for "Multimedia and Hypermedia Experts Group" and was originally standardized by ISO/IEC as part of a set of international standards for the presentation of multimedia information. It is primarily used in Commonwealth countries, such as the United Kingdom and Australia.

4.4.2.2 Platforms

– ***DTTV***: On Digital Terrestrial TV (DTTV) platforms there has already been wide use of interactive multimedia application services for many years. This typically relies on the technology called a data and object carousel, which carries multimedia interactive content in-band with a broadcast signal. MHEG-5 has been in use since 1998 and it has been deployed in more than 20 million receivers. ISDB's BML has been in use since 2000. It has been deployed in more than 120 million fixed receivers. BML especially has been used extensively daily for interactive services, providing news, weather reports, program information, games, etc. In Japan's case, the service is not just with local interactivity but also with full interactivity, as BML supports interfaces for a return-path.

– ***DVR***: Digital Video Recorder (DVR) is a receiver equipped with a hard-disk drive, which allows the user to view programs in a non-linear manner. DVR allows a near-on-demand user experience

called "download and play", which caches some part of the (programmed) content for a sufficient length of playback time and plays it back, while continuing on to download the rest of the content.

– ***IPTV***: Internet Protocol TV (IPTV) is a form of digital broadcasting that delivers and receives content and information over an IP-based network, such as Content Delivery Network (CDN) and sometimes the Internet. In ITU-T, it is defined as "multimedia services, such as television; video; audio; text; graphics; data, delivered over IP based networks managed to provide the required level of QoS/QoE, security, interactivity and reliability". ITU-T Rec. Y.1910 defines the architecture for such IPTV services, primarily targeted at NGN. ITU-T Rec. H.721 defines the IPTV terminal device, such as a TV set and a set-top box that provides common core features of IPTV. ITU-T Rec. H.721 is the only IPTV standard readily available that is currently deployed widely.

– ***Hybrid Terminals***: In some cases, "hybrid" terminals are introduced to complement the insufficiency in bandwidth in broadcasting. In a typical hybrid service, a small file is sent in-band with a broadcast signal that contains a link to the main part of the content, which resides in a server typically in the Internet. If the bandwidth of the IP connection is not broad enough, the interactive multimedia content that can be delivered may not be so rich. The broadcast service for hybrid terminals typically requires both a broadcasting system with an in-band data transmission capability, such as a carousel, and a broadband connection.

– ***Mobile TV***: Mobile TV is an important feature of the recent trends in digital broadcasting. The first standard-based mobile digital broadcasting started in Japan in 2006, based on ISDB-T standard. These terminals in Japan are equipped with a "BML browser" that receives multimedia interactive content from an in-band broadcast signal. Recently, all the relevant platforms – DTTV, DVR, IPTV, and Hybrid Broadband Broadcast (HBB) – should also be considered for mobile TV. For example, Japan's recent ISDB-Tmm standard supports all these services on a mobile terminal. Such a service can be provided on DTTV, DVR, IPTV, and Hybrid at the same time.

4.4.3 Examples of Interactive Multimedia Services on Digital Broadcasting

Several types of interactive/ multimedia service have already been in commercial service or are now on the way to commercial service assuming both local and full interactivity.

These are: Interactive Electronic Program Guide (EPG), Advanced Advertisement (such as DAL, Telescoped Advertisement, Terget Advertisement, etc.), E-commerce (TV shopping, banking, etc.), Video on Demand (VOD) service, Voting (both entertainment and government) and entertainment services (Karaoke, Game, etc.). For public services, E-Government services which include many areas, such as E-publishing (e-Book, Newspaper, etc.), E-learning (distance learning), E-health (telemedicine, telehealth care, etc.), and several types of public information services (billboards, digital signage, disaster alerts, traffic news, etc.).

Some examples of interactive/multimedia services on digital broadcasting platform are introduced in Chapter 7 of this Report.

4.5 Relevant Activities Carried out in ITU-T and ITU-R

4.5.1 ITU-R

Activities, standards and information of ITU-R are useful references for ITU-D SG2 Q11 Report. These are: Report ITU-R BT.2140-6 (2013), ITU-R Recommendations and Reports for "Spectrum management" (SG-1), "Radio propagation" (SG-3) and "Broadcasting service" (SG-6).

Especially, Recommendations ITU-R BT.1114 and ITU-R BT.1514 for digital sound broadcasting; ITU-R BT.1306 and ITU-R BT.1877 for digital television broadcasting; and ITU-R BT.1833-2 for digital mobile broadcasting are to be dully taken into account while planning digital terrestrial broadcasting services.

4.5.2 ITU-T

Activities, standards and information of ITU-T are also useful references of ITU-D SG2 Q11 Report. These are: ITU-T Recommendations and Reports for "Integrated broadband cable networks and television and sound transmission" (SG 9), "Optical and other transport networks" (SG-15), and Multimedia services, systems and terminals" (SG-16).

The following ITU-T Recommendations are reference in particular for the Video Coding: Rec ITU-T H. 262, Rec ITU-T H.264 and Rec ITU-T H.265 and especially valuable references for the interactive and multimedia area of digital broadcasting as well as for IPTV systems and services, namely: ITU-T Rec.J201, ITU-T Rec.H.760, ITU-T Rec.H.761, ITU-T Rec.H.762,ITU-T Rec,T-175, ITU-T Rec. Y.1910 and ITU-T Rec. H.721.

Note: *Free online access to ITU-R and to most "in force" ITU-T Recommendations, as well as to numerous other publications is available via the ITU Publication website www.itu.int/en/publications/Pages/default.aspx)*

5 Key aspects of households' digital receiving terminal park

Television incorporates, in a complex and often conflicting way, the cultural, political, social and economic aspects of communications and media. On the one hand, television can be a political tool, promoting a national culture and informing citizens. On the other hand, television has always been part of a globalized media industry which is constantly incorporating technological innovations and new content, so as to meet – and drive – consumer demand. The various perceptions of television – different but not necessarily contradictory – which see it as both a commercial and a political instrument, explain why regulatory authorities have a duty to establish a balance between the mandates of public broadcasters and the economic interests of commercial broadcasters, as well as cable and satellite service providers, in the interests of the viewer

Any potential DTTV viewer should, before getting connected, ask the following questions:

5.1 Available Broadcast Media

According to the existing or planned television infrastructure, a household will have different options for DTTV reception, namely cable/optical fibre or wireless. The availability of such media is publicly announced by the State (Government, regulators):

– Cable (copper pairs): installation of ADSL/VDSL by a telecommunication operator or service provider, with optional Internet and VoIP, via an ADSL/VDSL modem or router (Recommendation ITU-T G.992) / (Recommendation ITU-T G.993).

– Optical fibre: provision of television programmes (broadband/high-speed) by a cable operator or telecommunication operator. Both types of operator generally also propose Internet and VoIP as an option. Optical fibre can accommodate both HD and 3D television.

– PLC (power line communication): television transmission using the power supply system as a support (see IEEE P1901 (March 2011) and Reports ITU-R SM.2057 and 2058).

– Wireless media using land infrastructure (see ITU-R SG 6 Recommendations, reports and handbooks).

The public is kept informed by the State regarding the date for the total or partial turn-off of analogue television transmissions, and of the consequent need to obtain digital receiver equipment.

Television viewers must also remain attentive to official announcements about the adoption of new standards.

5.2 How to Receive DTTV

5.2.1 Antenna

The first thing to do is find out when the household in question will be covered by digital broadcasting. In most cases, no additional installation is required and DTTV can be received via the existing "rake" antenna. In practice, however, it is estimated that one out of every two antennas will require redirection or modification (revision of the reception filters located at the antenna output).

5.2.2 Receiving Equipment

To ensure the unbroken reception of television services during the transition to full digital, television viewers must obtain in advance the receiving equipment appropriate to their own particular situation:

– Where the intention is to keep the existing television set: a DTTB decoder, in which case the television set must be equipped with a SCART and/or Composite Video connector.

– A television set with built-in decoder.

To receive DTTB channels broadcasting in high definition (HD), one has to be in the appropriate coverage area and have a special adapter capable of HD reception.

It should be noted that some DTTB television sets come with a built-in DVD player.

5.2.3 2D Flat Screens

Flat-screen TVs (wide-image format 16:9, in which the image width is compressed) are becoming an increasingly common household feature. Their reduced bulk and weight and lower power consumption make them preferable to conventional (4:3) television sets. When purchasing a flat-screen TV, one has to choose between the two dominant technologies in the global marketplace at present: namely LCD (liquid crystal display) or Plasma.

Annex 1 to this Chapter provides for the key characteristics of DTTB television sets with Plasma and LCD flat screens.

5.2.4 3D Flat Screens

Television in relief – otherwise known as 3D television or 3D TV – uses stereoscopic techniques to broadcast images characterized by an impression of depth and nearness.

An increasing number of manufacturers are offering 3D TV sets. With a relatively high purchase price (around EUR 1 500), 3D TV sets can display all films or programmes broadcast in 3D, as well as all other transmissions in 2D. For example, a conversion processor enables 2D content to be watched in 3D, although the quality is not as good as that of a programme or film that is broadcast in 3D. Viewers must generally equip themselves with 3D glasses (active or passive) to be able to watch 3D TV, unless they wish to purchase a dedicated 3D set, i.e. a television set with an auto-stereoscopic screen, also referred to by the term alioscopy (lenticular process), obviating the need for glasses. In the case of a 3D HD-compatible plasma/LCD screen, a refresh rate of at least 120 Hz, 60 Hz or 60 images/second for each eye is necessary, with some models providing 240 Hz, 480 Hz or even 600 Hz.

For further information kindly refer to Annex 2 to this Chapter "DTTB Global Market and Trends".

5.2.5 Electrical Power for TV Sets

Faced with sustainable development objective and the global need for energy efficiency, the energy consumption of TV sets itself needs to be minimized. Manufacturers invested efforts in technology between 2010 and 2011 resulting in energy consumption for TV sets of all sizes to be reduced by 50 per cent on average. The bigger the set, the higher the energy consumption; for a doubling in size, power

consumption increases by a factor of four. A 50-inch LCD TV set switched on for six hours a day consumes annually only half the energy used by a plasma screen of the same size. We must also factor in the standby mode consumption, which may account for up to 10 per cent of a household's electricity bill, not including heating (in Europe since 2010 that consumption has been limited to 1 W). Advances in technology mean that a TV set can be switched off completely without losing its programming or time settings. The consumer should therefore consider the "energy consumption" factor when purchasing.

Note: The application of Recommendation ITU-T L.1001 "External universal power adapter solutions for stationary information and communication technology devices" will reduce the number of adapters that need to be manufactured as well as promote the re-use and recycling of adapters.

The European regulations (see European Commission Regulation 1062/2010 of 28 September 2010) which stipulates that every television set is to be provided with an energy label based on its Energy Efficiency Index (EEI) which has been obligatory in Europe since 1 January 2012.

5.3 Economic Considerations

Connected TVs, 3D TVs, mobile phones, computers, touch-screen tablets, etc. result in growth of the list of broadcast platforms. But how are they used? How do they receive information? And above all, what content are they used for? Although digital technologies have caused great upheavals in the audiovisual sector, in particular by accelerating technological, economic and cultural convergence, they have also led to the emergence of new economic models (crowdfunding, the financing of business by individuals over the Internet), collaborative production processes and specialized forms of audiovisual creation (small-scale multimedia works, pocket films (broadcasting films with a mobile phone), web documentaries, interactive films, machinima/3D synthesis images, and so on). This is the technological and cultural context that will shape our future debates on the aesthetic and economic aspects of digital media in the audiovisual sector.

5.3.1 Changing Business Models

The term "business model" refers to a synoptic plan of the manner in which an enterprise aims to create value, carry on business activities and deliver results, all of which are crucial to the sustainability of business models based on five key factors:

– identifying the value to be created (e.g. subscriptions);

– identifying the market or market segments concerned (e.g. ADSL/VDSL subscribers);

– defining the internal value chain of the enterprise (resources, purchases, technology integration);

– position of the enterprise in the external value chain (content producers, aggregators, distributors, etc.);

– service provision strategy (direct, collective, paid, free of charge) and different means of content distribution.

Even if new actors appear such as content aggregators, the occupations and activities that characterize the value chain segments of the audiovisual industries in the digital world remain the same: creative activity, production, international sales, exploitation on physical media (DVD and Blu-Ray) and/or virtual media (VOD, SVOD, TV catch-up services, pay as you view TV, free access TV, complementary channels). The business basis is clear: take full advantage of spectators' willingness to pay by creating a programme access hierarchy. That scaffolding is coming under pressure as the public's expectations are transformed by new technologies and the emergence of new players. The conventional value chain, involving a clear sequence of different steps from content production to final delivery, is changing and re-structuring. Many players are developing new business models and no longer following the "classical" models of vertical integration with strong market positioning with regard to one element or two connected

elements in the value chain (production, distribution to cinemas, as DVD, or online). Instead, they are adopting a completely new strategy of “global integration”.

Kindly refer to Annex 2 to this Chapter of the Report for further pertinent information.

5.3.2 Fees/Subscriptions

In some countries, state television is subsidized by means a tax referred to as a "fee". This annual fee, which is established by law and collected as from the time of purchase of a new television set (mandatory declaration on the part of the distributor/sales outlet), enables the reception of free DTTV channels (the number and format of which are established by law). The reception of paying channels is subject to purchase of a subscription from a service provider as well as, in many cases, rental of a dedicated decoder.

Potential viewers should therefore conduct a technical (equipment) and economic (number of channels, services) comparison of the packages on offer for their place of residence before taking a decision.

5.3.3 Advertising

Advertising is a consumption-oriented communication strategy targeting a particular audience. But what is its real economic and commercial function? How effective is it? The latter is not so easy to measure, especially as one of the functions of advertising is to allow the consumer to rationalize a purchase he has already made, to save him/her the guilt that follows choosing and spending. It corresponds to a fundamental trend of the consumer society: creating the demand needed to stimulate large-scale, innovative supply. Essentially an economic and commercial phenomenon, advertising seeks to influence our behaviour by mirroring our existing ideas. It does not simply promote a particular product or brand: its aim is to generate profit. Advertising is the chief source of revenue for private television and without it, not a single programme would exist.

In the case of public channels, some countries have decided to eliminate advertising, either partially (France from 5 January 2009) or entirely (Spain from 1 January 2010).

Advertising depends on the audience of a channel or particular programme: viewing and broadcasting figures for TV programmes on more than 2 000 channels across five continents are available thanks to Eurodata TV Worldwide.

5.3.4 Audience Measurement

For all audiovisual editors and broadcasters, knowing the size of the audience is absolutely essential in order to adapt programme production and optimize productivity. With this in mind, many countries have established bodies for measuring the audience. In the context of such audience surveys, the terms market share and audience share are synonymous. They refer to the number of listeners or viewers of a particular TV or radio station as a proportion of the total audience. The audience share of a programme is the average number of listeners/viewers of that programme as a proportion of the total number of listeners/viewers at a given time.

Audience share is important in that it can be used to highlight the total audience figure. Audience share and total audience are complementary and inextricably linked figures. A large total audience at a peak viewing time may in fact equate to a low audience share and, conversely, at off-peak times a low total audience may equate to a high audience share. Another advantage of audience share is its measure of the power of the medium. Unlike the total audience, which is variable (depending on the time, day of the week, season, weather, and so on), audience share is a ratio which can be interpreted and compared more directly. For example between 21h00 and 24h00 the number of viewers of a given TV channel may fall but the relevant audience share does not necessarily do so because the total number of TV viewers also falls during the same period. Audience share can thus be calculated for a day, week, month or year and the variations easily compared over different periods and across different media.

For more information refer to Annex 3 of Chapter Five to this Report.

5.3.5 Assistance for Disadvantaged Groups

All citizens have the right to information. On the basis of this principle (in many cases enshrined in a country's constitution), and to enable all individuals to have access to digital television, the law may provide for an assistance fund to enable less fortunate households to continue to receive television services free of charge. Specific eligibility criteria tailored to the economic and social situation of households (elderly persons, persons with disabilities, persons exempted from payment of radio and television fee and persons falling below a certain income threshold) are set by decree. In addition, technical assistance may be available for the setting up and configuration of equipment in the homes of some categories of persons. Practical arrangements may differ from country to country but valuable information on this matter has been already provided in Chapter 2 of this Report.

5.3.6 Guarantee

Any purchase of equipment must be accompanied by a guarantee of a minimum duration, in accordance with the corresponding legislation in force. In many cases, manufacturers propose extended guarantees for specific sub-assemblies (for example, LCD panel or number of screen pixels). Another point to watch out for is the availability, cost-free or otherwise, of direct telephone access to the manufacturer's or distributor's technical helpline experts.

5.3.7 Ecotax

This contribution, generally known as an "ecotax", is in fact anything but a tax since it is paid in full to entities responsible for the collection and processing of electrical and electronic wastes. In Europe, regulation in this regard has been in existence since 1999 – Directive 1999/95/EC, subsequently consolidated by 2002/95/EC, RoHS (***R****estriction of the use* ***o****f certain* ***H****azardous* ***S****ubstances in electrical and electronic equipment)*, which entered into force on 1 July 2006. Similar directives are in force in other regions of the world, such as the Basel Convention, BAN (amendment of the Basel Convention), ACPEIP in China, RCRA in the United States, and ORDEE in Switzerland.

5.4 Health and Television

For years doctors have been saying that spending too much time watching television is bad for one's health. Annex 4 to Chapter Five of this Report provides information for relevant studies on this subject.

5.5 Legal Considerations

The Regulatory Authorities must monitor ongoing compliance by the various players with the laws and regulations governing the audiovisual sphere, while ensuring that fundamental public freedoms are not flouted. Furthermore, while national laws on freedom of the press and freedom of communication provide for the unrestricted communication of information to the public (readers, listeners, viewers), there nevertheless has to be oversight in regard to audiovisual media, in accordance with the legislation in force.

Further information is provided by the case studies in Annex 5 "Regulatory and legal aspects" to Chapter 5 of this Report.

5.5.1 Consumer protection/television environment

Consumption is one of the basic patterns of daily life. The development of modern society has created an environment overloaded with objects, signs and interactions based around market exchanges. The production of manufactured goods is increasing rapidly. Economic actors, whether analysts or practitioners, are searching for points of reference because the stakes are high, as much for marketing professionals as for consumer rights organizations. The former want to influence market participants while the latter are trying to establish a counterweight. Businesses have to ensure their economic survival, but that will not be possible without thinking seriously about ethics. If we accept that studying consumer buying patterns can give businesses an analytical framework for improving their economic performance, the same analytical framework can be used by consumer rights organizations to counteract certain abuses.

Among its main obligations, the regulator for the audiovisual sphere is required to:

– process complaints and requests received from consumers, either directly or via consumer associations;

– draw the attention of audiovisual consumers to the legal texts governing that sphere and to the regulator's mission in regard to disputes;

– provide assistance and advice to consumer associations (i.e. associations responsible for defending the rights of citizens in their capacity as consumers, from the moment they purchase a product).

5.5.2 Users' Associations

Generally speaking, the law provides for the creation, under specific conditions, of legal entities for consumers or users. However, the right to represent consumers in official bodies and the right to take legal action in the interests of consumers are not systematically accorded to all consumer associations; for this they have to obtain the necessary approval.

Resolution 64 of the WTDC-10 may be referred to as well.

5.5.3 Protection of Young Television Viewers and Listeners in Regard to Television Programmes

The Regulatory Authority for the audiovisual sphere is responsible for the following:

– *A priori* oversight

The Authority may regularly conduct preventative campaigns aimed at drawing parents' attention to the programmes watched by their children. They may also enact directives specifying the obligations that are incumbent on audiovisual professionals, including a programme classification system (indicating "not for viewing by anyone under X years of age") based on the harmfulness of any given programme (*portrayals of hatred, discrimination, explicit violence and/or sex*).

– *A posteriori* oversight

A priori oversight is often not enough, and *a posteriori* oversight then becomes necessary. This is a matter solely for the independent authority. It must, moreover, be legally possible for any viewer to draw the authority's attention to inadequately flagged programmes.

Kindly refer to Annex 6 "Accessibility to TV programmes for persons with disabilities" to Chapter Five of this Report for further information on the matter.

5.5.4 Competition

The law must provide for the establishment of a regime designed to ensure that competition is not distorted, since competition law has essentially to do with anti-competitive practices (cartels and abuses of dominant position), merger controls and state aid control. The application of competition law, known as anti-trust law in the British and North American contexts, is handled by the competition authorities. Where sanctions are concerned, financial penalties known as "damages" may be imposed, and the victims of anti-competitive practices, including viewers' associations, may also bring civil liability actions (user protection). In Europe, the rules and rights of competition are governed by Articles 101 to 109 of the Treaty of Lisbon.

5.5.5 Convergence

a) Regulatory considerations

Having regard to technological change and the convergence of the telecommunication and audiovisual spheres, in States where there is both a regulator for telecommunications and a regulator for audiovisual matters, the two are obliged to cooperate on certain subjects (for example, mobile TV and 3G/4G cellular). Their coming together is a political matter to be decided by the State. Since the TV viewer is in general also a telecommunication user, the merger itself enables him to benefit from a single set of regulations, assists him with regard to his rights to information, and promotes multiservice subscriptions at lower cost.

b) Technical considerations

Technological convergence between computers and TVs/decoders makes possible the integration of Internet functions and Web 2.0 functions in TVs and decoders as well as in peripheral devices such as Blu-Ray decoders and games consoles. With these devices, TV viewers can search for videos, films, photos and other content on the Web, on a DTTV channel, satellite TV channel, or local storage unit. These Smart TV/Connected TV systems will extend the range of multimedia content to include TV in a coherent package and give the TV viewer easier access to digital broadcast and multimedia Internet content (including Internet TV and IPTV) via a TV set. Special control units allow TV viewers to take advantage of connected TV services without changing their TV sets. These units connect to the TV set and to the Internet and assume the connection function. In the case of ADSL/VDSL units all the technical elements of Connected TV are available (TV reception and Internet connection) but without supply of relevant software.

5.6 Sociological Aspects of the TV Medium

Technological revolutions and inventions always seem to cause upheaval in the structure and operation of the media sector, in particular in the audiovisual sector. First of all, the introduction of new processes and new means at the content production or broadcasting stages alters the economic and commercial equations (whether these be in terms of financial investment requirements, manufacturing costs, or the size of the populations exposed to the media messages, and so on). At the same time, the spread of IT equipment and Internet access into households has, at least in part, begun to undermine the media's monopoly over the role of *mediation*. Media users are now able to broadcast their own audiovisual compositions and productions (via forums, blogs, social networks and sharing sites).

The television has "a *de facto* monopoly of sorts over forming the opinions of a large part of the population". This monopoly over news is a real problem, because televisions thus has a tendency to impose its own value systems, its ways of thinking, its way of ordering and categorizing reality, on large swathes of the population. By imposing these "tinted spectacles", these ways of seeing, it indirectly forces other fields to speak out or to adopt the medias' way of thinking. The reception of a TV broadcast depends as much on the TV broadcast itself as on the reception. "That is, the reception (and undoubtedly the broadcast as well) depends largely on the objective structure of relations between the objective

positions in the social structure of the interacting parties" (Pierre Bourdieu, *Esquissed'unethéorie de la pratique*, Paris, Seuil, 2000, p. 246; unofficial translation).

In spite of the numerous criticisms that can be leveled against it, can television not contribute to the acquisition of real culture? We should note here that TV allows the individual/viewer to broaden his or her intellectual and cultural knowledge.

6 Local Production and/or Adequate Supply of Equipment, Receiving Park Inclusive

This Chapter aims on discussing some initiatives that Governments can implement to further develop local markets of digital terrestrial television equipment, especially receivers. The focus is not only on local production but also in a sustainable supply of said equipment to both broadcasters and consumers. This is key for a successful transition from analogue to digital in broadcasting and can be fundamental to speed up the Analogue Switch-Off (ASO).

6.1 Public Policies on Local Production and/or Adequate Supply of Equipment, Receiving Park Inclusive

The supply of equipment to all involved in the value chain of digital broadcasting is one of the challenges that need to be faced for successful transition from analogue to digital broadcasting. The television broadcasting value chain includes at least the following activities:

– Content Production**:** organizing images and sound in the form of a television programme;

– Channel Programming: schedule television programmes in a channel;

– Channel Transmission: transmitting the channel to the viewers;

– Content Consumption: receiving the television channels and consuming their content.

Each of these activities has specific demands in terms of equipment. Public Policies can help in the difficult task of guaranteeing a sustainable offer of digital television equipment, especially receivers in the retail market – the far end of the broadcasting value chain. These policies need also to guarantee that equipment can be purchased in affordable prices.

Government/Agencies of each country have a key contribution to the success of the transition from analogue to digital broadcasting. Their tasks are incorporating the National Industrial Policies by which local manufacturing and its supply chain is incentivized to reach national objectives, including fostering employment and access of the population to consumer goods and services.

Several options can be considered for stimulating the supply of relevant equipment and in particular two of them will be detailed in this Chapter, namely:

– Fostering Local Production of Equipment of the Broadcasting Value Chain; and

– Establishing Fiscal Incentives for the Supply of Equipment of the Broadcasting Value Chain.

6.1.1 Public Policies on Local Production for Digital Television

This section presents a view of some public policy initiatives on DTV that can be taken by the Government concerning the launch of digital television broadcasting and further national DTV industry development.

Initially, the Government has to bear in mind what are the objectives and goals that it seeks in the implementation of digital broadcasting. If one of them is to foster the supply chain of digital broadcasting equipment, much can be done to allow for more local and foreign investment.

One good example of the role of Government is the financing of specific sectors of the local industry, and local network suppliers and integrators with the objective of allowing for part of the equipment and services needed to deploy the infrastructure for the digitalization be carried out by national companies.

The Government can provide seed money[4] for specific projects that are aimed in creating or strengthening local players in the broadcasting supply chain, not only in the transmission side but also in the other segments of the DTV broadcasting value chain. For example, fostering content production and programming industries is an important task due to the increasing costs of producing content to be transmitted by a digital network (high definition programming can be more costly than regular analogue content). Even if that content is syndicated[5] by a network to its affiliate, if it is High Definition digital content, an increase in the costs for acquiring that content is most probable.

The other segments of the supply chain are also very important and each of them can be addressed differently. In that regard, another example of financing strategy is to finance retailers in order to create right incentives for a proper supply of receiving equipment, such as antennas, set top boxes (STBs), cables, TV receivers with embedded tuners, etc. This can be done either by public or private banks, once the financing funds are in place.

Specific financing strategies carried out by Brazil and other countries can be found in the Case Studies in section Seven of this Report.

Regarding public policies to incentivize the local production of digital broadcasting infrastructure, special attention is recommended on allowing and promoting public and private investments on the deployment of the infrastructure. As an example, it can be pointed out the experience of Brazil with the financing provided by the Social and Economic Development Bank of Brazil – BNDES (*Banco Nacional de Desenvolvimento*, web site www.bndes.gov.br/SiteBNDES/bndes/bndes_en/) with the Programme ProTVD. Some details of the program can be found below.

This programme of BNDES was constituted to assure a financing policy for the implementation of the SBTVD, and has initially a budget of R$ 1 Billion (USD 625 Million) and will be active until the end of 2013.

BNDES supports R&D activities, modernization of infrastructure, and production of components, equipment, software, and content, as well as the financing of retailers that provide DTV receivers. The objective of the programme is to finance investments on the broadcasting value chain and create conditions to the development of technology on the audio-visual sector. The programme contributes also to the development of national suppliers of solutions for digital television. The participation of BNDES in the financing of the DTV Value Chain stimulates the growth of Brazilian companies supplying national technology.

ProTVD is included in the governmental programmes that aim at promoting social inclusion, creating a universal distance learning network and investing in R&D. The program is subdivided in four segments ProTVD-Supplier (financing transmitters and receivers' manufacturers), ProTVD-Broadcasting (financing

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[4] **Seed Money** sometimes known as seed funding, is a form of securities offering in which an investor purchases part of a business. The term seed suggests that this is an early investment, meant to support the business until it can generate cash of its own, or until it is ready for further investments. Seed money can be used to pay for such preliminary operations as market research and product development.

[5] **Syndication**: In broadcasting, syndication is the sale of the right to broadcast radio shows and television shows by multiple radio stations and television stations, without going through a broadcast network, though the process of syndication may conjure up structures like those of a network itself, by its very nature. It is common in countries where broadcast programming is scheduled by television networks with local independent affiliates, particularly in the United States. In the rest of the world, however, most countries have centralized networks and/or TV stations without local affiliates and syndication is less common, although shows can also be syndicated internationally. In the film industry, film distribution is handled by film distributors.

broadcasters on the deployment of digital infrastructure, including studios), ProTVD-Content (financing the production of Brazilian Audio-visual Content) and ProTVD-Consumer (financing retailers selling DTV Receivers).

ProTVD-Supplier – The objective of this segment is financing investments of manufacturing companies on software, electronic components and equipment for SBTVD. BNDES grants a minimum value of R$ 400,000.00 for each R&D project and R$ 1 million for all other purposes. Special fixed interest rates of 4.5% per year were established and the bank can finance up to 100% of R&D projects. For all other projects, a rate of TJLP+1 to 1.5% applies (TJLP – Long Run Interest Rate, which is the reference interest rate for BNDES, fixed by Brazilian National Monetary Council – CMN based on inflation targets and risk premium. As of July 2011, TJLP is fixed at 6%).

ProTVD-Broadcasting – The objective of this segment is financing investments on the construction of the digital television transmission network. BNDES will finance the deployment and modernization of the network during the transition period; implementation and/or modernization of studios; and training. The minimum value granted is of R$ 5 million per company and only the broadcasting concessionaires can apply for this financing. The transmission equipment financed need to have a nationalization index of more than 60%. However, equipment for studios, which are mostly imported, can also be financed.

ProTVD-Content – The objective of this segment is to increase the participation of national content in the programming of the broadcasters, since multiprogramming is a strong possibility for digital television. Multiprogramming and HDTV are expected to increase the demand for content. For that reason, BNDES supports the production of national documentaries, television series and movies and also educational content. These programs can be produced by the broadcaster or independent producers. The minimum value that the bank finances is R$ 3 Million and supports up to 60% of the production (interest rates of TJLP+3% per year for broadcasters and TJLP+2% per year for independent producers).

ProTVD-Consumer – The objective of this segment is to promote the implementation of SBTVD-T, by financing the retailers that provide DTV Receivers, including set top boxes and TV receivers with CRT, LCD or Plasma screens. The equipment have to be new, locally produced and with a nationalization index of more than 60% or be included in a Basic Production Process (BPP). For all cases, a rate of TJLP+1 to 4.5% applies, and the bank can finance 100% the equipment.
More information regarding ProTVD is available on the following website:
www.bndes.gov.br/SiteBNDES/bndes/bndes_pt/Institucional/Apoio_Financeiro/Programas_e_Fundos/Protvd/.

6.2 Fiscal Incentives as a Means of Stimulating an Adequate Supply of Digital Television Receivers

This section presents examples of public policies that can help in the difficult task of guaranteeing a sustainable offer of digital television receivers in the retail market, as well as guaranteeing that these receivers can be purchased at affordable prices.

Government/Agencies of each country have a key contribution to the success of the transition from analogue to digital broadcasting. Their tasks are incorporating the National Industrial Policies by which local manufacturing and its supply chain is incentivized to reach national objectives, including fostering employment and access of the population to consumer goods and services.

In this context, the adequate supply of receiving equipment necessary for the viewers to have access to the audio-visual content being digitally broadcasted is important for the success of a National Industrial Policy that targets a successful transition from analogue to digital television. The receiving park can include equipment such as Digital Terrestrial Television (DTT) or Hybrid Set-Top Boxes, Television sets with embedded DTTB tuners, Mobile Phones, Computers and Tablets. More details on the receivers available can be found in dedicated Chapter Five of this Report that deals with the receiving park.

Governments can consider creating fiscal incentives, for example, the reduction of taxation of consumer goods and/or inputs for local industry (chipsets, cables, electrical energy, etc.), as well as the reduction of import tariffs of manufactured goods, such as DTTB receivers, and/or inputs for the local industry, as a suitable way of fostering a local market for said equipment and as an initial boost for the creation of an adequate supply chain for this market. On the other hand, this policy can also help creating a demand momentum for that equipment which can stimulate its supply, being extremely beneficial for both the market and the consumer, and also as a stimulus for the broadcasters´ investments on the digital transmission networks (towers, antennas, cables, transmitters, production centres, etc.).

It is advisable that the Government promote open discussions with the stakeholders regarding the size and duration of such fiscal incentives and also the equipment that will be scope of such a policy. These policies also need to be discussed inside the Government in the budgetary process. The Government is, in most cases, the entity empowered by law to propose priorities in the budgetary process, following the due policymaking process of each country. The final decision on the country´s budget comes after discussion, revision and approval by the legislative (National Congress, Parliament, etc.). The reason for an open and transparent discussion is to help creating a balanced environment for establishing countries´ goals and objectives, which will be beneficial for approving tax reductions. The government´s budget is, in most countries, quite reduced and limited by the people´s demands and priorities.

The kind of discussion that needs to be held, for example, is the scope of such fiscal incentives. Some questions could be asked in the process of discussion, including:

– What are the priorities, Set-Top Box type equipment, or Television Sets with embedded DTTB receivers or both?

– Is it reasonable to target incentives on CRT (Cathode Ray Tube) television sets? or Do we focus only on LCD/Plasma/LED TV sets?

– Do we need to establish policies for mobile equipment, such as TV enabled cellular phones?

– Can we foster local production of such equipment or not?

– Can we to attract foreign investment in local production and/or local supply chain development for receivers?

Who should be involved in the discussion for establishing the scope of the fiscal incentives?

Similar discussion can also be held for deciding the amount of tax reductions that can be established and the duration of the reductions.

One example of a country that discussed such policies is the Federative Republic of Brazil. The main focus of the Brazilian Policy is stimulating the adoption of embedded receiver solutions by local manufacturing companies, in other words the Industrial Policies carried out by both Ministries of Science, Technology and Innovation (MCTI) and Development, Industry and Foreign Trade (MDIC) of Brazil have the objective of fostering the market of television sets with embedded DTTB receivers (tuners).

Another decision made by the Brazilian Government was to provide incentives only to the LCD/LED and Plasma TV sets, so that the increasing demand for these types of TV receiving sets could help on the adoption of digital terrestrial television as well. Other solutions, like a combination of the existent CRT TVs with a DTTB Set-Top Box, were left as an alternative option.

In Brazil, the mechanism in place to implement these policies is named Basic Production Processes (BPP). The Basic Production Process was defined by Law Nr. 8387, of December 30th, 1991, as "the minimal set of operations and manufacturing facilities, which characterizes the effective industrialization of a given product." In summary, the BPP is the minimum necessary manufacturing steps that companies must meet to produce a product in order to receive compensatory tax benefits. The BPP is made for a specific product.

In the *Manaus Free Trade Zone*, in the Brazilian Amazon Region, are about 235 companies in different sectors, which have projects approved by SUFRAMA (Superintendence of the Manaus Free Trade Zone) and can manufacture products with incentives. In the sector of electrical materials, electronic and communication are 79 qualified companies in this region of the Amazon. The purpose of the Free Trade Zone is to promote regional development in the Amazon Region. In the rest of the country, by means of the *Informatics Law* (Law Nr. 8248/1991), other 500 companies receive tax incentives and, as compensation, need to comply with PPBs.

Specific details of each of the BPPs can be found in the Brazilian Case Study in Chapter 7 to this Report.

The use of tax incentives linked to BPPs were responsible for attracting many industrial enterprises to Brazil, both in the Manaus Free Trade Zone, as elsewhere in the country through the *Informatics Law*. As an example of the tax incentives in place, products manufactured in the *Manaus Free Trade Zone* are granted the following incentives:

– 88% reduction of the Import Tax (IT) of imported inputs;

– exemption from Tax on Industrialized Products (TIP) of the final good;

– 75% reduction of Income Tax and additional non-refundable taxes calculated based on profit;

– exemption of PIS/PASEP and COFINS (social security taxation) for internal operations in the Manaus Free Trade Zone;

– refund (ranging from 55% to 100% depending on the project) of the Tax for Operations Related to Goods and Services Delivery on Interstate and Intercity Transportation and Communication (ICMS).

7 Best Practices (Production, Distribution, Multiplex and Broadcasting Networks), Public Policies and Case Studies

The arrival of DTTV broadcasting has substantial impact on the whole broadcasting chain and on the ways it is regulated, planned and deployed for the benefit of end users. It entails profound revisit and critical analysis of all associated aspects in every country. Furthermore it is having far reaching consequences on the way end users get access not only to radio and television, but also to modern communications. It has challenged everybody having to deal with it. BDT and visionary administrations of Japan and Korea, Republic of, have consolidated experience, knowledge and innovation in producing publications of great value as follows:

– Guidelines for the transitions in English and French with update for Asia-Pacific specific information, including archives, are available at the links below:
www.itu.int/ITU-D/tech/digital_broadcasting/project-dbasiapacific/Digital-Migration-Guidelines_EV7.pdf

– Roadmaps for Asia Pacific and Africa:
www.itu.int/ITU-D/tech/digital_broadcasting/project-dbafrica/db_afr_roadmaps.html
www.itu.int/ITU-D/tech/digital_broadcasting/project-dbasiapacific/db_asp_roadmaps.html

– Digital Dividend: Insights for spectrum decisions:
www.itu.int/ITU-D/tech/digital_broadcasting/Reports/DigitalDividend.pdf

– Digital broadcasting trends:
www.itu.int/dms_priv/itu-d/oth/01/2A/D012A0000353301PDFE.pdf

– Spectrum Management Certificate Program (SMCP)
http://academy.itu.int/news/item/1077/

Furthermore experts consulted administrations upon request and produced valuable outputs. Extremely useful contributions on public policies, case studies and best practices were kindly submitted by Argentina, Brazil, Egypt, France, Japan, Hungary and the BDT Focal Point.

A short summary of the case studies relevant to this Report are included in the table below:

Argentina

RGQ11-3/2/13	ARG	Operational plan for access and supply of digital television receiver equipment. Information on the plan that has been put in place to guarantee public access to digital terrestrial television services.

Brazil

2/194	B	Governmental programmes that can be used in order to stimulate an adequate supply of digital television receivers with the objective of speeding up the transition from analog to digital terrestrial television broadcasting. Brazilian experience on local production and/or adequate supply of equipment, receiving park inclusive.
2/196	B	Specific processes that can be used to engage all the stakeholders on the transition from analog to digital broadcasting and that can be established in order to reach a balanced decision making environment, so that the decisions on the important matters related to the transition can be made by involving all the interested parties.
2/197	B	Information on spectrum planning process, and its importance for the transition period.
RGQ11-3/2/32	B	Digital Television Broadcasting implementation is considered a priority for the Brazilian government, mainly because of the relevance of the broadcasting sector to the Brazilian society. Summary of the tasks carried out by Brazil, either by the government or by all other interested parties, to reach a successful transition and to be able to shutdown the analogue transmissions in 2016. Key points organized as: *Actions carried out in the pre-implementation phase;* *Actions carried out in the implementation phase (Simulcast period); and* *Actions forseen to be carried out in the post-implementation phase.*

Egypt

2/146	Egypt	Results of preparatory studies and consultations of "Migration to Terrestrial Digital Television Broadcasting (DVB-T) Services in Egypt" performed by the National Telecommunications Regulatory Authority (NTRA) of Egypt in collaboration with the Egyptian Radio and Television Union (ERTU) and some independent consultancy firms. The study consists of three major parts. -goal and the purpose of such studies; -outputs and scenarios proposed by different parties; and - recommendations for the implementation phase.

Hungary

2/157	HNG	Overview of the experience of analogue to digital switchover in Hungary.
RGQ11-3/2/39	HNG	Additional information about the analogue-to digital switch over in Hungary as a continuation of the contribution in Doc. 2/157 as well as an overview of 3DTV test programme.
2/336	HNG	Complementary information about the results of the analogue to digital switch over in Hungary as a continuation of the contribution in Documents 2/157 and RGQ11-3/2/39.

Japan

2/209	J	Updated and expanded information on the transition from analogue to digital terrestrial television broadcasting (DTTB) in Japan, which is based on Japanese contribution for ITU-R BT.2140-6-2013 "Transition from analogue to digital terrestrial broadcasting".
2/115	J	Japan has succeeded in the complete digitalization of terrestrial television broadcasting by terminating analog broadcasting on Sunday, 24th July, 2011, (except in some regions affected by the earthquake/tsunami damage). Success tips intended for other countries planning the Analog Switch-Off (ASO) process in the near future.
RGQ11-3/2/16	J	Insight into some of the activities related to the transition to digital terrestrial broadcasting in the Asia Pacific region
RGQ11-3/2/41, (based on RGQ11-3/2/35)	J	Case study of interactive and multimedia applications in digital broadcasting The impact of convergence with other terrestrial telecommunication services and interactive multimedia applications enabled by terrestrial digital broadcasting. Several operational examples of actual mobile broadcasting services in Japan.

Mongolia

RGQ11-3/2/40	MNG	Progress report on Analogue Switchover of Broadcast Services in Mongolia In 2010 "National Programme on Transition of Radio and Television Broadcasting to the Digital Technology" was approved by the 275th Government Resolution of Mongolia. The network, which is transmitting the system of Analogue technology in Mongolia nowadays, will be terminated at 12 a.m., 31st June, 2014, and the digital technology system will start to be in use therein after.

Niger

RGQ11-3/2/12	NIG	Niger has set up a National Committee charged to elaborate a strategy for the transition from Analogue to Digital (A-D Transition) which has carried out an assessment and analysis of broadcasting sector and then defined the possible strategic directions/axis for action. The draft national strategy document for A-D Transition contains 30 actions in total.

Rwanda

2/INF/40	RWA	Different parameters that are required for the smooth transition were identified before the beginning of the process in Rwanda: I. Identification of benefits and additional services which are possible in digital sound and television broadcasting. II. Implications of the switchover from the analogue to digital broadcast in Rwanda. The number of the MUX Operators required countrywide. III. Key players in the broadcasting chain were also identified: the Regulator and the Multiplexer (MUX) Operator.

Tanzania

Case study library	TZA	The implementation of digital terrestrial broadcasting in Tanzania started in 2005 straight after the first session of Regional Radiocommunication Conference (RRC-04) held in Geneva. The migration process in this country is a policy driven rather than market forces based. The Tanzania Communications Regulatory Authority (TCRA) regulates through consultation with the industry stakeholders aimed at self-regulating the industry. It was through this strategy that Tanzania successfully started switching off analogue on 31st December 2012 as planned and continues doing so in every area where digital signals are ready for reception by the viewers. The objective of this contribution is to share experience that Tanzania has gained on the migration to DTT broadcasting.

Thales Communications (France)

2/154	Thales	Highlights of the technical and regulatory developments that have taken place in digital television in France since the end of 2011.
2/288-F	Thales	Information about the Practical Guideline for the digital broadcasting transition for Sub-Saharan African countries developed by France (2013)

BDT

RGQ11-3/2/11+ Annex	BDT	The following documents provided updates on BDT's activities on the transition from analogue to digital terrestrial television broadcasting. Summary of the meetings that ITU has been involved in related to said transition. Some insights into the roadmap development for several countries.
2/163 + Annex	BDT	
2/106	BDT	
RGQ11-3/2/34 + Annex	BDT	
RGQ11-3/2/33(Rev.1)+Annex	BDT	Overview of the concept of the planned Spectrum Management Training Program (SMTP) under the ITU Academy

8. Glossary of Terms and Abbreviations Used

720p/50	HDTV format with 720 horizontal lines and each line with 1280 pixels, progressively scanned at 50 frames per second, as specified in SMPTE 296M-2001 and EBU Tech3299
720p/50-60	HDT V image format with 1280 horizontal pixel x 720 vertical lines, progressively scanned at 50 or 60 frames per second.
1080i/25	HDTV format with 1080 horizontal lines and each line with 1920 pixels, interlaced scanning at 25 frames per second or 50 fields per second as specified in SMPTE 274 and ITU-R BT.709-5
1080i/25-30	HDTV format with 1920 horizontal pixel x 1080 vertical lines interlaced scanning at 25 or 30 frames per second or 50 or 60 fields per second.
1080p/50	HDTV format with 1080 horizontal lines and each line with 1920 pixels, progressively scanned at 50 frames per second as specified in SMPTE 274 and ITU-R BT.709-5
ADSL	Asymmetric Digital Subscriber Line (ITU-T Rec. G 992.1)
APT	Asia-Pacific Telecommunity
ATSC	Advanced Television System Committee
ASO	Analogue Switch-Off
ATU	African Telecommunication Union
BER	Bit Error Ratio
BML	Broadcast Markup Language
BPP	Basic Production Process
BR	Radiocummunication Bureau of ITU
BWA	Broadband Wireless Access, otherwise known as WiMAX or IEEE 802.16 standard
CATV	Cable Television
CDN	Content Delivery Network
CEPT	European Conference of Posts and Telecommunications
CRT	Cathode Ray Tube
DAL	Dedicated Advertiser Location
DMB-T	Terrestrial-Digital Multimedia Broadcasting
DRM	Digital Radio Mondiale
DSO	Digital Switch Over
DTSB	Digital Terrestrial Sound Broadcasting, equivalent to DTAB
DTAB or T-DAB	Digital Terrestrial Audio Broadcasting
DTTB	Digital Terrestrial Television Broadcasting
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcasting (the name of the standard) www.dvb.org/
DVB-H	Digital Video Broadcasting – Handheld (the name of the standard)
DVB-T	DVB – Terrestrial

DVB-T2	Second generation DVB system for terrestrial broadcasting [Rec. ITU-R BT.1877, DVB Document A122r1 and EBU TECH 3348]
DVR	Digital Video Recorder
EBU	European Broadcasting Union
EBU	Technical – http://tech.ebu.ch
EEI	Energy Efficiency Index
EPG	Electronic Program Guide
FLO	Forward Link Only
FPD	Flat Panel Display
FOBTV	Future of Broadcast Television Initiative
GE-06	GE-06 Agreement or GE-06 Plan adopted at RRC-06 held in Geneva, 2006
HBB	Hybrid Broadband Broadcast
HbbTV	Hybrid Broadband Broadcast Television
HD	High-Definition
HDCP	High-bandwidth Digital Content Protection
HDMI	High-Definition Multimedia Interface
HDTV	High-Definition Television
HEVC	ITU-T Rec H.265 “Coding of moving video High Efficiency Video Coding” or HEVC ISO/IEC 23008-2 standard
HDI	Human Development Index
IBOC	In Band On Channel
ICT	Informational and Communication Technologies
IDTV	Integrated Digital TV receiver
IMT	International Mobile Telecommunications: IMT-2000 (3G) and IMT-Advanced (4G)
IPTV	Internet Protocol Television
ISDB-T	Integrated Services Digital Broadcasting – Terrestrial
ISDB-Tsb	Integrated Services Digital Broadcasting – Terrestrial for Sound Broadcasting
ISDB-Tmm	Integrated Services Digital Broadcasting -digital mobile multimedia broadcasting standard
ITU	International Telecommunication Union www.itu.int
ITU-R JTG-4, 5, 6 and 7	ITU Radiocummunication Sector’s Joint Task Group created at WRC-12
ITU-T H.262	identical to MPEG-2
ITU-T H.264/AVC	identical to MPEG-4 Part 10
LCD	Liquid Crystal Display
LIME	Lightweight Interactive Multimedia Environment
MFN	Multiple Frequency Network

MTV	Mobile Television Broadcasting
MHEG	Multimedia and Hypermedia Experts Group
MHP	Multimedia Home Platform
MISO	Multiple Input Single Output – smart antenna technology in which multiple antennas are used at the source (transmitter). The destination (receiver) has only one antenna. The antennas are combined to minimize errors and optimize data speed. **MISO** is one of several forms of smart antenna technology, the others being MIMO (multiple input, multiple output) and **SIMO** (single input, multiple output)
MPEG	Moving Picture Experts Group www.chiariglione.org/mpeg/
MPEG-2	Motion Picture Expert Group – 2 (the name of the standard)
MPEG-4	Motion Picture Expert Group – 4 (the name of the standard)
MPEG-4/AVC	Refers to ISO/IEC 14496-10, 2003. Information Technology – Advanced Video Coding: A codec for video signals that is also called AVC and is technically identical to the ITU-T H.264 standard. 14496-10. Geneva: ISO/IEC. [Rec. ITU-R BT.1877]
M-PLPs	Multiple Physical Layer Pipes
MUX	Multiplexer
NGN	Next Generation Networks
NTSC	National Television System Committee
OLED	Organic Light-Emitting Device (Diode)
OpenTV	Interactive television technology offering a variety of enhanced applications including EPG, HD, VoD, PVR, and home networking.
PDP	Plasma Display Panel
QoE	Quality of Experience
QoL	Quality of Life
QoS	Quality of Service
PCs	Personal Computers
PVR	Personal Video Recorder
RoHS	Restriction of the use of certain Hazardous Substances in electrical and electronic equipment
SFN	Single Frequency Network
SBTVD	Brazilian Digital Television System
SD	Standard-Definition
SDTV	Standard Definition Television
SMIL	Synchronized Multimedia Integration Language
SMPT	ITU Spectrum Management Training Programme
SP-TB	Strategic Programme on Terrestrial Broadcasting
SP-CTN	Strategic Programme on Cooperative Terrestrial Networks
STBs	Set Top Boxes

TDA	Televisión Digital Abierta
3DTV	Three Dimensional Television
UHDTV	Ultra High Definition Television
UHF	Ultra High Frequency
VHF	Very High Frequency
VDSL	Very High Speed Digital Subscriber Line (ITU-T Rec. G 993.2)
VOD	Video-On-Demand
WRC-07, 12, 15	World Radiocommunication Conferences held during 2007 and 2012 or foreseen to be held in 2015
WTDC-10	World Telecommunication Development Conference, 2010

Annexes to Chapter 5

Annex 1 to Chapter 5: Key Characteristics of Receiving Terminals

Annex 2 to Chapter 5: Trends

Annex 3 to Chapter 5: The TV Audiences Around the World

Annex 4 to Chapter 5: Studies on Health Versus Watching TV

Annex 5 to Chapter 5: Regulatory and Legal Aspects

Annex 6 to Chapter 5: Accessibility to Programmes for Persons with Disabilities

Annex 1 to Chapter 5: Key Characteristics of Receiving Terminals

1. Overview

The key characteristics of digital Terrestrial TV Broadcasting receiving park terminals (Plasma TV and LCD screen TV sets) are provided in this Annex.

The **Plasma TV** set is a flat screen that uses a display technology in which a mixture of gases made up of neon, helium and xenon emits light resulting from ionization at the intersecting points of a grid of metal wires when a magnetic field is generated by an electric current.

An **LCD screen** is made up of a liquid-crystal panel on which the points and colours of the image are formed. A neon-tube light source located behind the panel renders the image luminous and visible. There are two main types of LCD:

1 **LED (Liquid Cristal Displays with LED backlighting)** In the so-called LED variant, the neon tubes are replaced by diodes. It would therefore be more accurate to refer to LED or LED-backlit LCDs. The "LED" thus describes a backlighting system and is not in itself a display technology as is LCD. There are in fact three types of LED backlighting:

– Edge LED, where diodes are positioned around the rim of the screen and a special diffusion panel is used to spread the light evenly behind the screen.

– Local-dimming LED: the LEDs are white and located behind the entire surface of the LCD panel, making for more homogeneous lighting and optimized contrast.

– RGB LED, where a white light is produced through the association of red, green and blue diodes. It combines the advantages of the preceding case with the ability to make precise adjustments to the colour of the light.

2 **TFT (Thin Film Transistor)** is an active matrix LCD technology that enables a higher responsiveness and better image quality than conventional LCD screens. It replaces the front electrode grid with a single ITO (indium tin oxide, InSn203) electrode, and the rear grid with a thin-film transistor matrix, one per pixel and three per colour pixel, making for better control of the tension of each pixel and hence for an improved response time and image stability.

It should be noted that CCFL (Cold Cathode Fluorescent Lamps) LCDs are nearing the end of their lifespan. Compared with LEDs, this type of TV has several shortcomings, particularly in terms of contrast (black appears less deep) and reduced brightness.

2. Key considerations when choosing a flat-screen TV

2.1 Definition: this refers to the number of pixels that the screen can display. This number generally lies between 640x480 (640 pixels in length, 480 pixels in width) and 1920x1080 (DVB: see ETSI TS 101 154 and EN 300 241).

2.2 Size has beencalculated by measuring the **screen diagonal** and expressed in inches (one inch equals 2.54 cm). Television sets exist in the following dimensions: 15" (38 cm), 20" (51 cm), 23" (58 cm), 26" (66 cm), 27" (68 cm), 32" (80 cm), 37" (94 cm), 40" (101 cm), 42" (107 cm), 45" (114 cm),50" (127 cm) and screens with diagonals of 55” to 65” have become available. Depending on where one wishes to watch television, one has to consider the available space and viewing distance (wall mounting, suspension from

ceiling, supported by table or pedestal). As a general rule, the viewing distance should be equal to five or six times the height of the TV set. In the case of HD viewing, the distance can be reduced to three to four times the height of the set thanks to the higher resolution provided by this format, i.e.:

– 50-69 cm (20-27") screens = viewing distance 76 to 150 cm;

– 81-94 cm (32-37") screens = viewing distance 180 to 240 cm;

– 107-117 cm (42-46") screens = viewing distance 300 to 425 cm;

– 127 cm (50") and over = viewing distance 365 to 480 cm; and

– home cinema, minimum 32" screen.

Care must be taken not to confuse screen definition with screen size, as the definition provided by different screens of the same size may differ. Generally speaking, however, large screens will be characterized by high definition.

2.3 Format: The ratio of image width to image height. The traditional 4/3 format represents a width/height ratio of 1.33:1. The 16/9 format represents a ratio of 1.77:1, which was adopted to offer a useful compromise when broadcasting films on television and which is better adapted to so-called panoramic (HD) human ocular perception. The 16/9 format is also used for publishing video on digital platforms: DVD video, Blu-ray, VOD.

2.4 Resolution: this refers to the number of pixels per surface unit, expressed as Dots Per Inch (DPI). Where HD is concerned, there are two possible resolutions: HD Ready and Full HD.

3. Technology

3.1 HD Ready technology: It is compatible only with 16:9 wide screens (Recommendation ITU-R BT.1202). HD Ready is a label applicable to HD video broadcasting. To be able to use this label, brands must comply with a very strict set of requirements:

– minimum 720-line display;

– equipped with DVI (digital), HDMI (digital) and YPbPr1 (analogue) connectors;

– acceptance of video formats 720p (1280x720 pixels at 50 and 60 Hz, progressive), or 1080i (1920x1080 pixels at 50 and 60Hz, interlaced); and

– HDMI or DVI inputs compatible with HDCP anti-pirating protection.

3.2 Full HD technology: TV sets bearing the Full HD label have a 1920x1080 pixel resolution (i.e. four times higher than a conventional set).

3.3 HDTV technology: Since 2009, **the HD Ready and Full HD labels have ceased to be used in France**. They have been replaced, respectively, by **HDTV and HDTV 1080p**. HDTV signifies that the TV set has a native resolution of 720p (720 points per line) and has a built-in DTTV HD (MPEG-4) tuner. HDTV 1080p signifies that the set has a native resolution of 1080p (1920x1080 points) and has a DTTV HD (MPEG-4) tuner.

3.4 Connected TV technology (HbbTV/Smart TV) is covered by ETSI standard 102 796 (July 2010). On a hybrid TV set (CE-HTLM) equipped with a DVB HD tuner, a network connection and the appropriate software, it enables the reception of both DTTV and Internet channels. HbbTV enables television networks to publish additional content in addition to and alongside their televised programmes. Its principal advantage is that it makes the broadcast interactive service neutral vis-à-vis the brand of TV receiver that incorporates this standard. This standard has been available since the end of 2011 in most European countries and Argentina. The DTTV 2.0 “standard” (standardized by ETSI following a request from France and Germany) appeared at the start of 2012: it is a new name that encompasses the HbbTV standard and

the related services that are now included in many DVB-T television sets. DTTV 2.0 is primarily (and above all) a means of protecting the diverse content accessible over connected portals against piracy. The DTTV 2.0 standard is version 1.5 of HbbTV (MPEG-DASH/Dynamic Adaptive Streaming over HTTP). Herein the broadcasted TV programmes are not more than 50% of the total of the video consumed by users while the remaining video consumption originates from Internet. The Connected TV is oriented towards interface personalisation (e.g. face recognition) enabling appearance of personalised page to the connection with preferred content (TV channels, cloud multimedia content, social networks, etc.).

3.5 Luminance: This is expressed in candelas per square metre (Cd/m^2). The luminance of an LCD television screen is in the order of 500 Cd/m^2 as against 1 000 Cd/m^2 for plasma screens.

3.6 Contrast: This is the variation in luminance intensity between the lightest and darkest areas of the image. The greater this variation, the better will be the colour rendering. (The gamma curve shows a screen's ability to reproduce all the shades between the various colours).

3.7 Vertical and horizontal viewing angle: Expressed in degrees, it is used for stating the angle beyond which viewing becomes difficult when one is no longer directly in front of the screen.

3.8 Refresh rate: this is the rate at which the video image is refreshed. The higher the rate, the more significant the result, as the image becomes more stable with almost imperceptible flicker. Currently, the minimum is 100 Hz. At this speed the image is refreshed 100 times per second. Some recent models now boast speeds of 200 Hz and higher.

3.9 Connectors: all models are equipped with SCART sockets. HD flat screens all have one or two HDMI (high-definition multimedia interface) sockets, and users should check to ensure that the set has the latest software version. On the audio side, DTS and Dolby outputs are desirable for a quality sound experience. It is a good idea to choose a TV set with at least three HDMI sockets, thereby making it an easy matter to connect external devices such as cable or satellite decoders, game consoles, camcorders, etc., without always having to disconnect one device to make room for another. The availability of a USB port and/or memory card reader can also be useful. A USB port enables one to plug in a USB stick or digital camera and display one's photos on the wide screen, while a card reader will accept the camera's memory card.

Further information may be found in Annex 4 of the Report on Question 11-2/2 for the period 2006-2010: Document 2/258(Rev.2) "EBU Document TECH 3333 – Receiver requirements".

See below a comparison of the various HD labels.

Table 1: Comparison of the various HD labels

	HD Ready	HD TV	Full HD	HD Ready 1080p	HD TV 1080p
HDMI Port	Yes	Yes	Yes	Yes	Yes
720p and 1080i	Yes	Yes	Yes	Yes	Yes
1080p	No	No	Yes	Yes	Yes
Integrated DTTV HD tuner	No	Yes	No	No	Yes

3.10 Advantages/disadvantages of LCD and 2D plasma TV sets

Table 2: Advantages/disadvantages of LCD and 2D plasma TV sets

SCREEN TYPE	ADVANTAGES	DISADVANTAGES
LCD	– Not affected by temperature variations – Lighter and less bulky than a plasma screen with the same dimensions – 170° viewing angle – Low power consumption (120 to 150 W for a 42" screen)	– Movements somewhat jerky – Colour changes and loss of contrast according to viewing angle – Colour depth relatively low, especially whites and blacks – Possibility of dead pixels, although relatively rare (seen as constant black dots)(1)
PLASMA	– Image purity and depth – Brightness and contrast truer than nature – Expressive colours, wide variety of shades – Very flat screen, uniform image without shake – 160° viewing angle	– Sensitive to temperature – Only large screens available (32" and above) – Releases heat – Power consumption (200 to 250 W for a 42" screen) – Heavier than LCD screens

(1) Standard ISO 13406-02 regulates the guaranteeing of LCD and plasma TV sets against dead pixels. It provides for several classes according to level of requirement, the highest level being Class I, with zero dead pixels per million pixels. Most manufacturers maintain conformity with Class II.

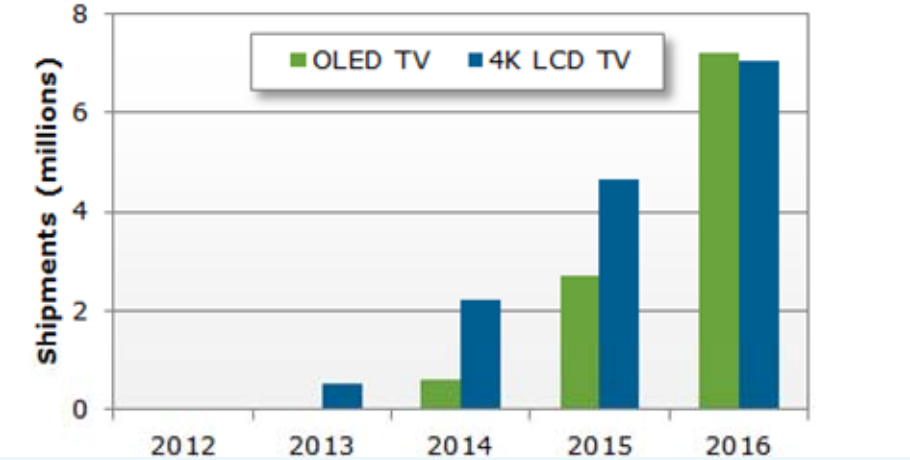
Remark: Standards ISO 9241-300 and 302-307 establish "requirements for the ergonomic design of electronic visual displays". Standard ISO 9241 as a whole relates to the ergonomics of human-system interaction. It comprises various chapters produced since 1998. Chapter 300 has recently (in 2009) been revised and provides additional details regarding the viewing of information on screens. The term "screens" covers all types of screen (computers, televisions, telephones, control rooms), and the factors taken into consideration include character size, contrast, luminance and ambient lighting.

4. Emerging technologies

4.1 Screens using OLED (*organic light-emitting diode*) technology have appeared on the market (better colour rendering, wide viewing angle, slimness, mounting flexibility, response time < 0.1 ms). This technology is already used in products with a short or medium lifetime (14 000 hours), such as mobile telephones, digital cameras and MP3 players, whereas the minimum requirement for a TV screen is 50 000 hours. This type of screen is currently hard to find on the market and its price is high (for further details kindly refer to Part 309 of ISO 9241-300). Prototypes of curved screen OLED television sets were already demonstrated at the beginning of year 2013.

4.2 4K televisions (Ultra HDTV): An image in 4K format has a definition twice that of 1920x1080 HD, equivalent to around 4096x2160 pixels. There are also definitions of 4096x1728 pixels for the cinemascope 2.37:1 format and 4000x2160 pixels for the traditional 1.85:1 format. At present the 4K format is mostly used in digital cinema. It should become available to the general public in the next few years. The name 4K comes from the fact that this resolution has around 4000 (4K) horizontal pixels. At the IFA trade show in September 2011 (Consumer electronics trade show held in Berlin every year) the first consumer 4K equipment was unveiled. 4K is supported by DVI dual-link connections and by the HDMI standard from version 1.4 onwards. There are 4K LED television sets offering 3D viewing without special glasses.

Figure 1: Forecast for OLID and 4K TV LCD television sets



Source: NPD Display Search trimestriel d'expédition avancée: Global TV et Forecast Report

Note: On 23 August 2012, ITU-R adopted Recommendation BT.2020, i.e. the Ultra HDTV (2160p), previously designated as 4K TV by manufacturers and the Ultra HDTV (4320p) or as 8K TV standard.

4.3 Laser television sets, recently developed in Japan, likewise represent an opportunity for the future. Each pixel is illuminated by three laser beams, one blue, one green and one red. Such screens are interesting for various reasons: they consume a third of the energy used by a plasma screen of the same size; their colour contrast and luminance is significantly greater; they can display a much wider range of colours than LCD or plasma screens; they are fully compatible with HD; their lifetime should be considerably higher than that of LCD and plasma screens; and, last but not least, they should be very affordable, costing less than plasma screens to manufacture. Some laser TV sets are integrating 2 types of back lighting technology: red lasers of 638 nm wavelength combined with cyan lasers (mix of blue and green.

4.4 TV compatible with Digital Living Network Alliance (DLNA): Entire digital content (music, movies and photos) is kept in computer. In order to be able to access it at households there was a need to use multimedia digital disc. game console or hard multimedia disc Actually, the HD television set can directly access said content. For simple sharing of it the DLNA protocol was developed linking client (TV set) with server (said computer). The DLNA defines in fact an interoperability standard (software and connectivity) enabling reading, sharing and control of multimedia equipment independently from their manufacturer or nature. In order to be able to be to add DLNA sticker to their products, manufacturers have to pass via dedicated certification procedure

Both TV set and computer, already certified and holders of relevant DLNA sticker have to be connected via home communication network to be able to communicate with each other. The simplest way to achieve this is using RG-45 network cables but such system is cumbersome and spoils the internal household design.

Therefore alternative, more simple and practical solutions are can be used like CPL or WiFi /USB WiFI connections with which both the TV set and the computer must be equipped. Than by simply pressing the remote control key « Sources » of the TV set we can access to different periferials enabled by the DLNA at our home network and their content be displayed via corresponding menus.

Annex 2 to Chapter 5: Trends

1. Global TV trends

Three studies of global TV trends, from the end of 2011, are of interest:

a) **Accenture** showed that:

– traditional TV consumption fell from 71 per cent to 48 per cent of audience share between 2009 and 2011;

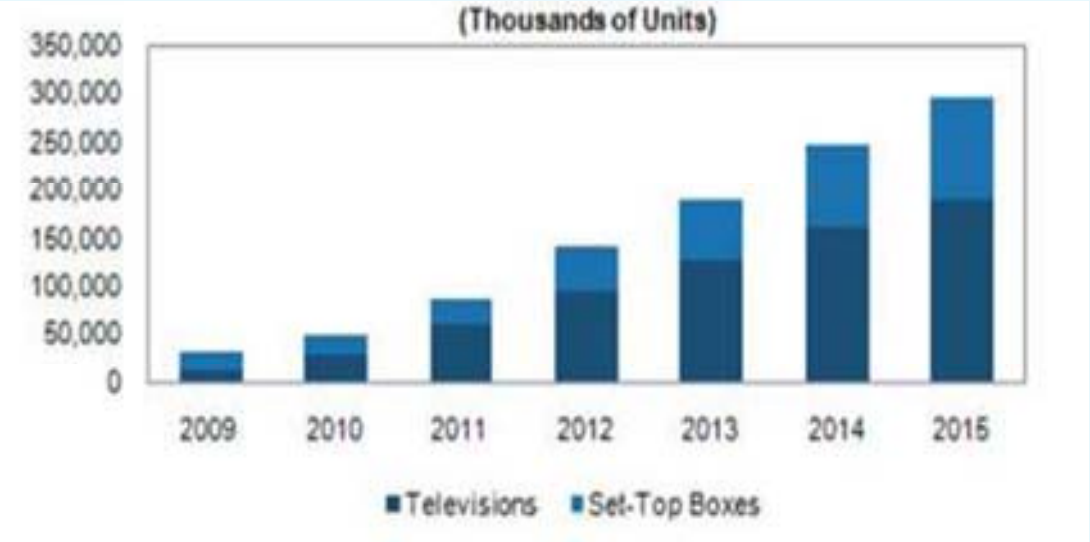
– traditional TV sets are losing ground to mobiles, tablets and laptops: 44 per cent of tablet owners watch video on their devices; 33 per cent of consumers watch television and films on their PCs and 10 per cent on their smartphones;

– 56 per cent of consumers have changed their behaviour as a result of the availability of new online services, and one third have stopped renting DVDs.

b) **Informa Telecoms & Media** expects so-called OTT (over the top) solutions (ways of consuming television over the Internet without using a telecommunication operator's interface box) to overtake IPTV-managed services in 2013. In 2014 it is expected that there will be 380 million users of OTT video sources such as connected TV, games consoles and Internet boxes.

In addition, there is also the phenomenon of "cord cutting", with consumers cancelling their cable TV subscriptions, mostly in the United States. ISI Group has shown that cable has lost 3.8 per cent of its customers (53 per cent of subscriptions in 2010 and less than 50 per cent at the end of 2011). These subscribers have seemingly migrated to satellite and telephone services, which grew by 3.6 per cent and 0.2 per cent respectively in the United States.

Figure 2: Global shipment forecast of Intern-enabled televisions and Internet-enabled set top boxes

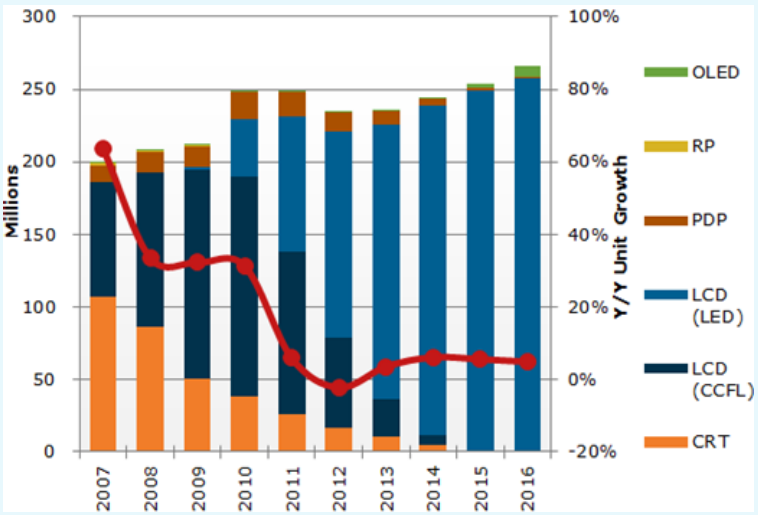


Source*: HIS iSuppli Research, September 2011*

2. Flat-screen market

The global TV set market stabilized in 2011 compared with 2010 (economic crisis in the developed countries). The global delivery of TV sets was reduced to 6% during the year 2012. It has been estimated that the sales of TV sets will be identical during 2013 but would grow afterwards.

Figure 3: Global TV set market



Source*: NPD DisplaySearch* trimestriel d'expédition avancée Global TV et Forecast Report

We may note that 31 per cent of users are likely to replace their TV sets in 2013: these replacement purchases should logically result in domination of mature markets by 40 to 44 inch models. This will be the case in Europe. In the emerging markets, it is important to take into account the fact that the process of replacing cathode ray tube models is still not complete.

2.1 LCD/Plasma

LCD, which is in the process of moving towards LED backlighting, largely dominates the market. Following growth of 30 per cent in 2010 (as a result of price advantages), Plasma screen sales are reported to have dropped by 13 per cent to 16.3 million units in 2011; fewer than 10 million low-energy units are expected to be sold in 2015.

The larger formats (more than 40") should experience the greatest growth – 12 per cent, and 18 per cent for sizes above 50". Formats of less than 40" are expected to decline by 3 per cent (the effect of major price reductions: USD 1 000 for 50" and USD 2 000 for 60"). The average format in France in 2011 was 31.2".

2.2 OLED screens

The first large OLED screens should arrive on the market during the second half of 2012, but at prices of more than €4 000, their market share in expected to remain marginal for several years.

2.3 Crystal LED

This new technology is an emissive technology like OLED, except that the emission does not come from so-called organic components but from more traditional crystal-based LEDs.

The result compared with LCD is:

– 3.5 times more contrast;

– better colour rendition thanks to a broader range of displayable colours;

– better response time (x10);

and compared with OLED:

– greater LED resistance over time;

– lower manufacturing cost, particularly for larger sizes.

2.4 3D TV

Some 23 million units were sold in 2011 and an expected 100 million units will be sold in 2015, equivalent to a good third of the market. Demand was not so strong in 2011, particularly in the United States, but manufacturers are not losing faith in this technology, which allows them to maintain better pricing levels for their televisions and the functions of connected televisions.

It should be noted that in the United States a study has shown that 6-8 million people have "monovision" and are therefore not concerned by 3D TV.

NOTE: A Japanese manufacturer has suggested transforming a 2D screen into a 3D screen without glasses by covering it with a film that includes a lenticular network. This technology is currently only on sale in Japan and 3D content must be converted using software provided by this company.

2.5 4K TV format (Ultra HDTV)

A resolution of 4096x2160 is also used in digital cinema, particularly in post-production. The first commercial TV screens with the 4K label use a related resolution: 3840x2160, which represents four times the area of 1080p.

Certain trends are leading manufacturers to promote their 4K TVs:

– Hollywood is digitizing its conventional film stock in 4K to make the best use of its stock.

– Cinema production is adopting 4K, with new generation video cameras.

– Technical considerations: 4K is the resolution closest to that of 35mm conventional movies and with which the pixels are no longer visible on an image up to a third of the size of a cinema screen. The adoption of 4K will therefore begin in cinemas. Most of them, however, are equipped with 4K video projectors, most frequently based on DLP technology. It will take time to update this existing capacity, which was installed at great expense.

– 4K screens can be used to display passive 3D without the loss of resolution experienced with 1080p screens, where every other vertical line is devoted to one of the eyes.

The perspectives, created by the adoption of High Efficiency Video Coding (HEVC) standard during January 2013 (see ITU-T Recommendation H.265), are to be dully taken into account.

2.6 The global TV market

The Consumer Electronics Show (CES), held annually since 2006, assesses the digital entertainment industry, which covers several sectors: digital media (television, audio, photo), mobile technology (smartphones and tablets), micro-computing, applications for the home, gaming and digital-related "green" products (greentechs) associated with digital technology (batteries, solar power, transport, and so on). The major trends seen in CES 2012, which was held from 10 to 13 January 2012 in Las Vegas, were connected TVs, social networks and mobile technology, including a wide range of smartphones and tablets running on Android 4.0.

It was clear that the worlds of video and television are becoming increasingly closely linked and that this sector is changing dramatically. Video consumption is growing exponentially and television use is increasingly social, based around a multi-screen model, attracting numerous actors in the technology sphere who want to play a role in "connected TV/Smart TV". Numerous value shifts are taking place, usually to the detriment of established stakeholders (TV networks, TV manufacturers, and pay TV operators and distributers) and to the benefit of Internet stakeholders. It is becoming obvious that we are becoming part of integrated audiovisual market.

There are also other examples, such as the triple-play set-top box or indeed the tablet. Television is facing dangerous competition from the "second screen" (the tablet), which is more open.

Annex 3 to Chapter 5: The TV Audiences Around the World

All TV audience figures for all programmes broadcast on more than 5 500 channels across all five continent (100 countries, few African countries are concerned) are available thanks to Eurodata TV Worldwide. Information is provided directly by the relevant agencies such as Médiamétrie in France, which collect daily audience figures in their respective countries. The information is reported every month by Eurodata TV Worldwide which each year publishes a report on TV audience and market trends.

According to the 19th annual survey "One Television Year in the World" (2012) published by Eurodata TV Worldwide, TV continues to make headway around the world. Using data from 100 countries, the body notes that TV has been able to reinvent itself to remain the major medium in terms of directness and exclusivity.

In 2011, average daily viewing time per person was three hours and 16 minutes, some six minutes more than in 2010 and 20 minutes more than 20 years ago. That increase has been especially evident in Asia and particularly in China, where daily TV viewing has grown by 12 minutes in one year. A similar increase has been seen in Europe: +15 minutes in France, +7 minutes in Italy, +5 minutes in Spain. Interestingly, average daily viewing time in the United States and in Japan, both countries with high TV "consumption", is falling but still 4 hours 50 minutes in the United States (-4 minutes) and 4 hours 29 minutes (-2 minutes) in Japan.

TV news programmes accounted for 63 per cent of factual programming in 2011, marking an increase of 10 points over the previous year. In terms of programme type, 41 per cent of the most popular programmes in 2011 were fiction. This trend was bolstered by series which capture 69 per cent of the highest audience figures thanks in particular to local productions.

Figures published in September 2012 for the period January to August 2012 highlight the fact that the downward trend is more pronounced among young adults. Outside the United States, that cohort watches TV for less than 2 hours 50 minutes on average each day. The trend is also downwards in Germany and the Netherlands, although in France average viewing among 15 to 34 year olds has gone up by nine minutes to 2 hours 49 minutes. One possible explanation is that young adults also watch many TV programmes though other media such as PCs. Young people in the 15 to 24 year age group are the first to adopt new so-called "ATAWAD" practices ("anytime, anywhere, any device"). Not surprisingly, it is they who watch non-real time TV programmes, on other media, and in their friends' homes. Almost one in every four does all three (8 per cent of 15+ years age group), and nine out of ten do at least one of these (two thirds of the 15+ years age group).

Annex 4 to Chapter 5: Studies on Health Versus Watching TV

This Annex provides summary of various studies made on the subject of danger to health resulting from excessive television viewing. According to a study conducted by researchers at the University of Queensland (Australia), published in the *British Journal of Sports Medicine* in August 2011, watching television for at least six hours per day could have a significant negative impact on life expectancy. This is estimated at five years less than that of a person who watches television infrequently (from a sample of more than 11 000 people). According to this study it is not television as such that is responsible for the harm to our health, but rather the associated lack of physical activity; the study also demonstrated that those often watch television while engaged in some form of physical activity are not affected by this drop in life expectancy.

According to another Australian study from the University of Sydney, published in April 2011 (in the Journal of the American Heart Association), children (aged 6-7 years) who watch too much television are at higher risk of subsequently developing heart disease, hypertension or diabetes.

Likewise, ophthalmologists advise keeping a distance from the screen of at least six times the diagonal of the screen. Eye care specialists agree that watching television will not damage your eyes or vision if the room in which you are watching is well lit. When the room is completely dark, the contrast between the television screen and the surrounding environment is too great and viewing is neither comfortable nor effective. Soft lighting, on the other hand, minimizes unwanted excessive contrast (*Source*: www.opto.ca/). In fact, watching television normally requires less effort than tasks such as sewing or reading. But watching for long periods can lead to eye fatigue.

Table 3 below provides findings related to the distance for watching an LCD, Plasma full-HD screen with HD or SD source. The resolving power of the human eye is e = 1/3 000 radians, or for one pixel: 0.33 mm at a distance of 1 m, 1 mm at a distance of 3 m, and 3.3 mm at a distance of 10 m.

Table 3: Findings related to the distance for watching an LCD

Diagonal of the tube in cm (inches)	Dimension of the visible image at 16/9 (width in cm x height in cm)	Number of pixels (width x height)	Optimal distance	Average pixel size
81 cm (32")	71 cm x 40 cm	1920 x 1080 (HD)	1.12 m	0.37 mm
81 cm (32")	71 cm x 40 cm	1023 x 576 (SD)	2.10 m	0.69 mm
94 cm (37")	82 cm x 46 cm	1920 x 1080 (HD)	1.30 m	0.43 mm
94 cm (37")	82 cm x 46 cm	1023 x 576 (SD)	2.42 m	0.80 mm
102 cm (40")	89 cm x 50 cm	1920 x 1080 (HD)	1.40 m	0.46 mm
102 cm (40")	89 cm x 50 cm	1023 x 576 (SD)	2.63 m	0.87 mm
107 cm (42")	93 cm x 52 cm	1920 x 1080 (HD)	1.45 m	0.48 mm
107 cm (42")	93 cm x 52 cm	1023 x 576 (SD)	2.73 m	0.90 mm
119 cm (47")	103 cm x 58 cm	1920 x 1080 (HD)	1.62 m	0.53 mm
119 cm (47")	103 cm x 58 cm	1023 x 576 (SD)	3.05 m	1 mm
127 cm (50")	111 cm x 62 cm	1920 x 1080 (HD)	1.73 m	0.57 mm

Diagonal of the tube in cm (inches)	Dimension of the visible image at 16/9 (width in cm x height in cm)	Number of pixels (width x height)	Optimal distance	Average pixel size
127 cm (50")	111 cm x 62 cm	1023 x 576 (SD)	3.26 m	1.08 mm
132 cm (52")	115 cm x 65 cm	1920 x 1080 (HD)	1.82 m	0.60 mm
132 cm (52")	115 cm x 65 cm	1023 x 576 (SD)	3.42 m	1.13 mm
140 cm (55")	122 cm x 69 cm	1920 x 1080 (HD)	1.94 m	0.64 mm
140 cm (55")	122 cm x 69 cm	1023 x 576 (SD)	3.63 m	1.20 mm
152 cm (60")	132 cm x 75 cm	1920 x 1080 (HD)	2.10 m	0.69 mm
152 cm (60")	132 cm x 75 cm	1023 x 576 (SD)	3.94 m	1.30 mm
165 cm (65")	144 cm x 81 cm	1920 x 1080 (HD)	2.27 m	0.75 mm
165 cm (65")	144 cm x 81 cm	1023 x 576 (SD)	4.26 m	1.40 mm

Conclusion:

Health-risk statistics show that watching too much television is bad for the health:

– 14 hours of television per week increases the risk of metabolic syndrome (cardiovascular problems, strokes) by 48 per cent and the risk of developing type 2 diabetes (high blood sugar levels) by 140 per cent.

– More than 17 hours of television per week increases the risk of obesity by 97 per cent.

– More than 21 hours of television per week logically increases the chances of insomnia.

Annex 5 to Chapter 5: Regulatory and legal aspects

Hereinafter various examples are provided on the regulations applicable to DTTV:

1. ITU Trends in Telecommunication Reform 2010/11 – "Enabling Tomorrow 's Digital World" (www.itu.int/pub/D-REG-TTR.12-2010)/;
2. The West African Economic and Monetary Union (WAEMU): Regulation No. 02/2002/CM/UEMOA relating to anti-competitive practices within the West African Economic and Monetary Union and Regulation No. 03/2002/CM/UEMOA relating to procedures governing cartels and abuse of dominant position within the West African Economic and Monetary Union;
3. European Directive 2007/65/EC on Audiovisual Media Services, known as the "AVMS Directive", guarantees the protection of sector participants, including television viewers; and

3) Protection for authors of video content in France

In response to the pirating of videos and music, the French Government has established an independent body, the High Authority for the Broadcasting of Creative Works and the Protection of Rights on the Internet(HADOPI), under Law No. 2009-669 of 12 June 2009, promoting the broadcasting and protection of creative work on the Internet. This law, in accordance with European Directive 2001/29/EC, is intended principally to put an end to peer-to-peer file sharing where it infringes copyright.

Since 1 October 2010, HADOPI has put in place a "graduated response procedure" in order to deter and prohibit any Internet user from illegally downloading music or video material. The different stages in the procedure leading to possible sanctions against Internet pirates are indicated below.

1. Recording of an infringement

An Internet user pirates a musical or video file via a peer-to-peer platform, that is, one which allows individuals to exchange files. The infringement is recorded by a company mandated by music or video suppliers to carry out monitoring. The user's IP address and the identification number of his device are recorded.

2. Referral to HADOPI

HADOPI is notified of the IP address of the suspect and of the time and date of the alleged contravention, and provided with an excerpt from the illegally downloaded material.

3. Verification

It is the responsibility of the HADOPI Committee for the Protection of Rights (CPD) to verify the information provided by the authorized users. At this stage the CPD can decide to drop proceedings.

4. Identification

If proceedings are not dropped by the CPD, HADOPI contacts the Internet access provider and requests the address of the suspect. The provider must provide the subscriber contact details (name, postal address and email) within eight days of receiving the request.

5. First warning

Not more than two months after obtaining the Internet user's electronic address, HADOPI sends the user an email via the access provider informing him/her that the obligation to monitor his/her Internet access has not been met, warning the user of the penalties that may be incurred, and drawing attention to the means available to secure the connection.

6. Second warning

If any further contravention is noted within six months of the first warning, the Internet user receives a second email warning backed up with a recorded-delivery letter.

7. Third warning

If, despite the first two warnings, the Internet user offends again, a final recorded letter is sent to warn of possible prosecution.

8. Deliberation

The CPD may now decide either to refer the file to the courts or to drop the proceedings.

9. The courts

The prosecution service may prosecute the Internet user for "gross negligence", that is, allowing an act of Internet piracy. If found guilty the user faces a fine of 1 500 euros and suspension of Internet subscription of up to one month. The user may also be prosecuted for infringement of copyright, and if found guilty may be liable to a fine of 300 000 euros, three years' 'imprisonment and a one year suspension of Internet subscription.

Results:

Since the entry into force of this provision, on 1 October 2010: 3 million IP addresses were identified, 1 150 000 preliminary emails sent (6 per cent contacted HADOPI), 100 000 Internet users received a second email warning (23 per cent contacted HADOPI), and 340 received a third and final email warning (75 per cent contacted HADOPI).

Annex 6 to Chapter 5: Accessibility to Programmes for Persons with Disabilities

Definition**:** Accessibility enables persons with disabilities to enjoy autonomy and participation by reducing or eliminating contradictions between abilities, needs and wishes on the one hand, and the various physical, organizational and cultural components of their environment on the other.

Two categories of persons with disabilities could be distinguished as follows:

a) Persons having a hearing disability

The legal obligation to provide teletext (subtitling) responds for the most part to the audiovisual requirements of this category of citizen. However, it does not work for illiterate people, and associations representing hearing-impaired persons prefer the use of sign language. Furthermore, subtitling should be present on all television sets in public places (in the United States, for example, television sets in bars have subtitling activated by default).

b) Non-sighted and visually impaired persons

Use is made of audio description, whereby the scenes of a film or programme are described by an off-screen voice during dialogue-free moments to enable non-sighted or visually impaired persons to understand better what is happening on screen. The term audiovision refers to the describing of images in a film by acoustic means for the same purpose. In fictional dramas and documentaries, the dialogue is interspersed with short commentaries to describe both the content of the images and action taking place. The aim of audio vision is to enable non-sighted and visually impaired persons to follow a film easily without having to depend on an adjacent viewer.

It must therefore be a requirement for both the regulator and individual channels to inform non-sighted or visually impaired viewers, by all appropriate means, that a given programme is accompanied by audio description.

Manufacturers, in the context of the new technologies, have developed various technologies enabling disabled people to access content broadcast on TV: Smart TV intended for this category of viewer. In addition to 2D and 3D contentbroadcasting, some TV sets (Smartphone TV, smart TV or connected TV) respondto voice commands and physical gestures and are provided with an integrated face recognitionsystem allowing more personalized use of these features. With no more need for remote control units, these technological features enable most disabled people to interact with their TV set without assistance.

– **Smart TV – a TV set with facial recognition.** With face recognition technology, the integrated video camera instantly recognizes the viewer's face and thus obviates the need for ID and password. The user can thus connect easily to the application; the screen can be unlocked by facial recognition using the frontal video camera.

– **Smart TV – a TV set with voice recognition.** Thanks to voice recognition technology, the disabled viewer can directly control his or her Smart TV by voice. He can just speak and can switch on the unit, change channel, turn upthe volume, navigate via the interactive portal and even search on the Internet.

– **Smart TV – a TV set with gesture recognition**. Gesture recognition simplifies interaction with the Smart TV. This new technology responds to hand movements for changing channel, adjust volume, and navigate via the interactive portal or use one of the compatible applications.

Operations such as switching on or off, changing channel, accessing applications and web surfing, thus no longer require any buttons and can be carried out by simple movements or voice commands.

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