

*Full Length Research Paper*

# Implementation of DTT in Spain: Technological barriers to entry and consolidation of terrestrial technology

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**This paper analyzes the process of television digitalization in Spain and its regulatory framework, concluding that the promotion of already established terrestrial technology has resulted in the development of entry barriers to alternative technologies, such as satellite. The Spanish regulation and its implementation are analyzed in this paper, especially with regard to public funding to support the development of terrestrial networks. The conclusion suggests that the Spanish regulatory bodies should define an interconnection framework to allow different operators to compete in distribution. Additionally, the separation of the various satellite markets, in particular transport to feed terrestrial networks and direct to home distribution (DTH), would be advisable.**

**Key words:** Transition to digital TV, regulation, barriers to entry, broadcasting services, satellite, Spain.

## INTRODUCTION

Spain has just completed the transition process from analogue to digital TV (the terrestrial analogue switch off has taken place on April 3, 2010), becoming one of the first large European countries, in terms of population, to accomplish this process, ahead of France, Italy and the UK.

The aforesaid process requires a regulatory framework in order to facilitate the development of the most efficient solution for final users that should be based on technological neutrality. But the fact is that, in every country, Government policies have been key to determine the transition to digital TV (Galperin, 2002), mainly because Governments own the radio spectrum employed for terrestrial broadcasting, but also due to the fact that information broadcasting is deemed to be a democratic right (Adda and Ottaviani, 2005). In Spain, the Government promoted the terrestrial technology already established

*versus* other digital technologies theoretically more efficient to reach all the population, such as satellite.

The purpose of this paper is to analyze the Spanish television digitalization process, reviewing its regulatory framework, its implementation through public funding and the impact on the future TV distribution market, showing that there could be some regulatory decisions to make in the future to minimize the impact of the technological entry barriers created, regardless of any political or social reasons that may have led to promote one technology *versus* others.

In our opinion, this topic is of great interest at this stage mainly for two reasons: firstly, because the Spanish case is one of the first European experiences, and secondly, because this process will change the model of television broadcasting, setting the dominant technology in the future and consequently affecting market rules. Moreover, our conclusions are applicable not only in Europe but also in American and African countries where Digital Terrestrial Television (DTT) is being introduced and evaluated such as Brazil, Argentina, Kenya or South Africa (Watanabe et al., 2003; Dupagne and Seel, 2006; Feng

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**Table 1.** Terrestrial broadcast revenue split in Spain (2008-2009).

	Q IV - 2008	Q I - 2009	Q II - 2009	Q III - 2009	12 months	
<b>Per service</b>					<b>M€</b>	<b>%</b>
Analogue TV broadcast	38.8	39.5	40.7	38.8	157.8	57%
Digital TV broadcast	18	20	20.7	22.5	81.1	29%
Analogue radio	9.2	8.9	8.9	9.0	36.0	13%
Digital radio	0.8	0.8	0.8	0.8	3.3	1%
<b>Per network operator</b>						
Abertis	58.3	60.5	62.4	63.3	244.5	88%
Axión	5.7	5.8	5.8	5.7	23.1	8%
Others	2.86	2.78	2.79	2.7	11.2	4%
<b>Total revenues</b>	<b>66.8</b>	<b>69.1</b>	<b>71</b>	<b>71.8</b>	<b>278.8</b>	<b>100%</b>

Axion is a Regional company that operates in Andalucía and in 2009 has been in a take over process by Abertis  
Source: Telecommunications Market Commission quarterly reports, 2008 and 2009.

et al., 2009).

Our analysis focuses on technology used to distribute FTA ("free to air") national channels, as they are the audience leaders in the Spanish market, representing 78.3% in November 2009 (Sofres, 2009), since the analysis of regional channels and pay TV would certainly require a separate article<sup>1</sup>.

### Technological environment

In Spain, television is broadcast using mainly four technologies: terrestrial, satellite, cable and IPTV (internet protocol TV). Although they can be either analogue or digital, in Spain only terrestrial TV had a relevant analogue share, all the rest being currently fully digitalized, including cable. Mobile TV is not considered in this paper as it is a new service with limited presence in the market.

**Terrestrial:** Terrestrial technology is the leader technology in Spain in terms of audience. The national FTA ("free to air") channels use this technology, both the public ones (TVE1, TVE2), and the private channels (T5, A3, Cuatro, La Sexta, Veo and Net). It has recently migrated from analogue to digital terrestrial television (DTT). To broadcast the signal, national broadcasters use mainly the network of Abertis Telecomunicaciones<sup>2</sup>,

<sup>1</sup> According to current regulation, in 2010 there could be 136 regional channels and up to 1,164 local channels. Additionally, DTT pay TV has just been regulated and started operations in October 2009.

<sup>2</sup> Abertis Telecomunicaciones is a company fully owned by Abertis Group, a traded company focused on the management of infrastructures including telecommunication networks, airports toll roads, car parks and logistics, its major shareholders being the Catalan savings bank "La Caixa" and a Spanish construction and services company, ACS, owning 29% and 26% respectively (Spanish National Securities Market Commission, CNMV, 2009).

although there are other minor and public networks (Table 1).

**Satellite:** Satellite broadcast is also referred to as "direct to home" (DTH). In Spain, the leading operator of this technology is the pay-TV platform Digital +, using SES Astra satellite in the orbital position 19.2°E and Hispasat satellite in the orbital position 30°W.

**Cable:** The leading operator in Spain is ONO, offering a complete bouquet of pay TV channels and audiovisual content. They usually pack TV content together with their core services, such as telephony and broadband Internet access, TV being mainly complementary to those services. There are also some smaller regional operators in the north of Spain: In Galicia "R", in the Basque Country "Euskaltel" and in Asturias "Telecable". They manage their own network and reach cities over 10,000 people; consequently, cable is not able to serve 100% of the population.

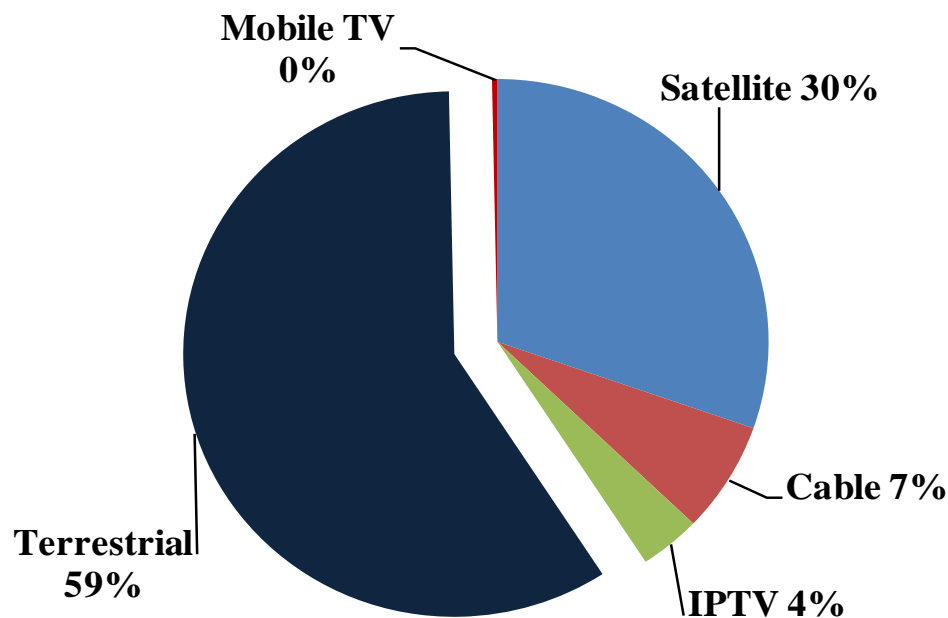
**IPTV:** Short for "Internet Protocol TV". The leading operator in Spain is Telefónica under the brand name "Imagenio", and to a lesser extent others such as Orange and Jazztel. Telefónica uses its own ADSL network to distribute the service, since it requires high speeds (over 6 Mbps) and therefore a high quality copper "local loop". This service is currently available only in large cities and is complementary to broadband.

The first two technologies (terrestrial and satellite) serve to purely audiovisual business models based on television, while the other two (cable and IPTV) serve telecommunications business models that include telephony and broadband, in which television plays a complementary role, being offered in commercial packages ("double Play"

**Table 2.** Evolution of TV revenues per technology ex-subsidies. Millions of Euros.

	2002	2003	2004	2005	2006	2007	2008
Satellite	1 022	1 147	1 237	1 387	1 474	1 522	1 542
Cable	149	222	275	319	339	349	347
IPTV	0	0	0	18	80	131	185
Terrestrial	2 183	2 990	2 684	2 929	3 035	3.312	2 994
Mobile TV	0	0	0	0	0	9	16
Total	3 353	4 360	4 196	4 653	4 928	5 323	5 084

Source: Telecommunications Market Commission, Annual Report 2008.



**Figure 1.** Percentage of TV revenues in 2008 per technology, ex-subsidies. Millions of Euros.  
Source: Telecommunications Market Commission, Annual Report 2008.

and "triple Play") jointly with telephony and Internet. Additionally, because of its low reach in terms of population, cable and IPTV are not adequate to provide 100% population coverage.

Traditionally, terrestrial TV has been the leading technology in Spain, as reflected in its turnover, amounting to 2,994 M€ in 2008, that is, 59% of sector revenues (Table 2 and Figure 1).

### Transition process

The TV broadcasting industry is now facing a radical transition phase, from an analogue to a digital system that will help to provide new services and change the shape of the industry (Noll, 1999; Watanabe et al., 2003). In

particular, digital TV broadcasting is expected to provide such advanced services as a variety of information services by data casting interactive services that will allow viewers to participate in TV programs, less deterioration in the quality of screen images, and manageable closed captions (Parker, 1999).

### *Benefits of digital terrestrial TV (DTT)*

DTT broadcasting has advantages over the analogue system as it allows a more efficient use of the radio spectrum, that is, roughly six times as many channels to be broadcast with the same amount of spectrum used by one analogue channel. The foregoing has consequences both for commercial television broadcasters and final

users.

Regarding commercial broadcasters, the regulation allows them to offer more channels when migrating to digital. In Spain, private broadcasters move from one analogue channel up to four digital channels.

Regarding final users, the major advantages are:

1. Improved quality of the signal, high definition television ("HDTV") and high definition audio.
2. More content available due to the increased number of channels.
3. New services, such as electronic program guide allows viewing the content available on different channels, subtitles, different languages, radio channels and other additional digital contents.

Moreover, due to the more efficient use of the radio spectrum, the process of migration to digital television will release radio spectrum, which has become known as the "digital dividend".

The use of this spectrum is a major concern for Governments, because it is a "scarce resource" that can be assigned by the Public Administration to new uses, mainly to cover the growing demand of mobile broadband.

Therefore, this migration is being driven by the European Governments, establishing migration schedules and analogue switch-off dates (Table 3).

The take-up of DTT varies greatly across the European nations from above 30% of primary television households in France, Spain, Italy and the UK, to below 10% in Belgium, the Netherlands and Austria (not including countries in which the platform is still to launch).

The success of a DTT platform is primarily dependent on the penetration of cable and satellite platforms. In some countries, cable is seen as a utility by consumers; in others, the satellite platform has had particular success, usually due to the presence of exclusive content. For example, in Belgium, where there is 90% cable and satellite television household penetration, the DTT service has had low-take up (2% in 2008) and has been used mainly for secondary set viewing. In the UK, where analogue terrestrial is a stronger platform, the take-up of DTT has been greater (41% in 2008).

Future success will be determined by DTT's ability to capture consumers migrating from analogue to digital. The run-up to analogue switch-off (ASO) is an uncertain time for analogue customers as they are forced to make a decision on TV service. In the case of FTA DTT platforms, terrestrial is often best –placed as many customers not already paying for a cable or other pay TV proposition, are unlikely to do so in the future. For pay DTT services, prices are generally cheaper than other platforms and so are expected to fair well, also.

Post ASO, with no major commercial and technological

intervention, we would expect to see some stability of take-up between platforms (Spectrum Value Partners, 2008).

### ***Current status of the terrestrial analogue to digital transition in Spain***

According to Impulsa TDT (2009)<sup>3</sup>, by June 2009, 96.27% of the population was able to receive digital terrestrial signal broadcast by Abertis terrestrial network.

In terms of household penetration (those households that receive the digital signal and are properly equipped with a set top box and adapted antenna), at the end of December 2009 digital terrestrial signal reached 77.4% of households (Impulsa TDT, 2009).

And regarding audience, digital terrestrial technology reached 49.1% of audience share in November 2009 (Figure 2). During the last year, as the switch off date approached, analogue terrestrial television gradually ceded leadership to digital terrestrial.

### **METHODOLOGY**

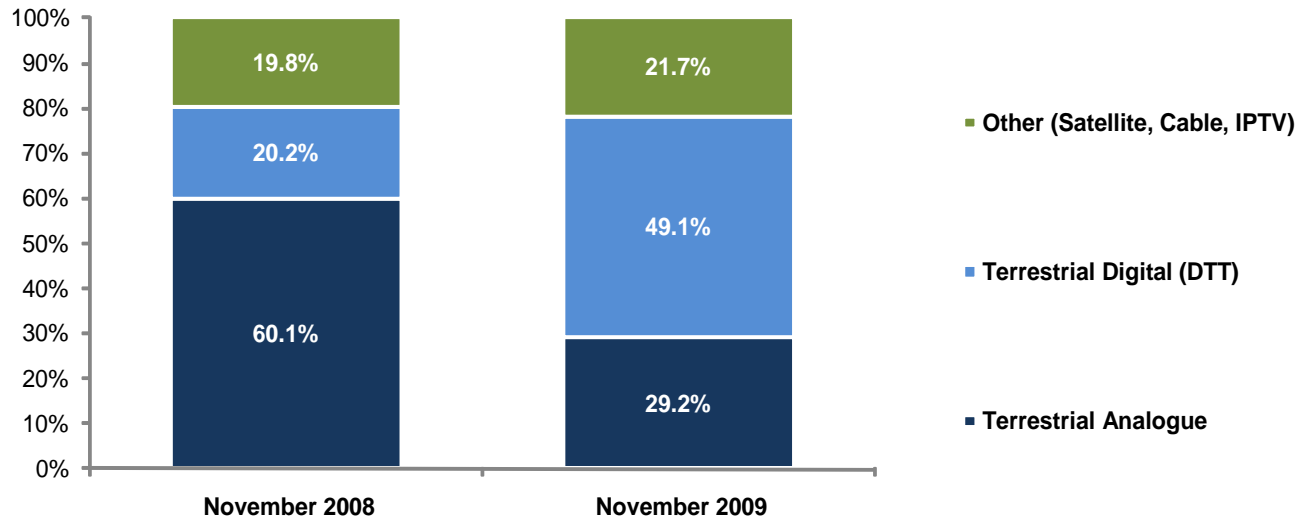
The position of the Spanish Government, as resulting from all the laws and regulations approved, is that television is an essential public service and, as such, its purpose must be primarily to satisfy the general interest of citizens and to contribute as a means of social communication to pluralism, the formation of a free public opinion and the spread of culture. Most likely due to this position and in order to avoid major disruptions to the population, terrestrial existing technology has been promoted as the base of the digitalization process.

The Spanish Government regulated the transition from terrestrial analogue to terrestrial digital TV through the National Technical Plan for Digital Terrestrial Television, approved by Royal Decree 944/2005 of July 29, 2005, complemented by the second additional provision of Royal Decree 920/2006 of July 28, 2006, basically on the following terms:

1. The switch off date was determined as April 3, 2010.
2. A timetable was set for commercial broadcasters to extend their digital coverage:
  - i) 80% of the population by 31 December 2005.
  - ii) 85% of the population by 31 July 2007.
  - iii) 88% of the population by 31 July 2008.
  - iv) 90% of the population by 31 December 2008.
  - v) 93% of the population by 31 July 2009.
  - vi) 96% of the population to the private concession companies and 98% of the population to public entities or autonomous state level, before 3 April 2010.

1. Entities providing the service must cease progressively analogue broadcasts in "technical areas" according to a plan agreed for that

<sup>3</sup> Impulsa TDT is an association to promote the development of Digital Terrestrial Television in Spain, that was established in late 2005 by commercial broadcasters and the terrestrial network operator. It is funded by their associates and the Spanish Administration.



**Figure 2.** Audience share per distribution network, November 2009.  
Source: Impulsa TDT (2009).

purpose.

2. As to the number of channels, since 2005 and until the switch off date, commercial national broadcasters were to have some additional digital channels, up to 20. After the switch off date, the total number of national digital channels will be 32, every national private broadcaster will have a full "mux" (digital multi-channel that allows 4 TV channels) and Radio Televisión Española, the Public broadcaster, will have 2 muxes (Figure 3).

In addition to the National Technical Plan, during 2009 the Spanish Government has approved a series of laws that jointly with the National Plan of DTT shape the current regulatory framework in the audiovisual market.

The most important law in relation to the broadcasting technology promoted is Law 7/2009, of July 3, 2009, on urgent measures in telecommunications (based on Royal Decree-Law 1/2009, of February 23, 2009), which addresses two key aspects:

1. The coverage of the entire population, up to 100%, requiring a further extension of coverage through satellite systems, which is estimated to reach approximately the last segment of 1.5% of the population.
2. The merger between commercial broadcasters, establishing the barrier only at 27% of the average audience share.

This regulatory framework based on the National Technical Plan and Law 7/2009 provides for the terrestrial technology to serve up to 98.5% of the population, limiting the role of satellite to distribute DTT channels (DTT Sat) to only 1.5% of the population.

### Implementation

In Spain, as resulting from the regulatory framework summarized above, the digitalization process has been conceived as a process of encouragement of digital terrestrial television (DTT). Therefore, former analogue terrestrial networks must be digitalized and extended in order to match coverage obligations regulated by law.

To implement the digitalization of terrestrial networks, a National

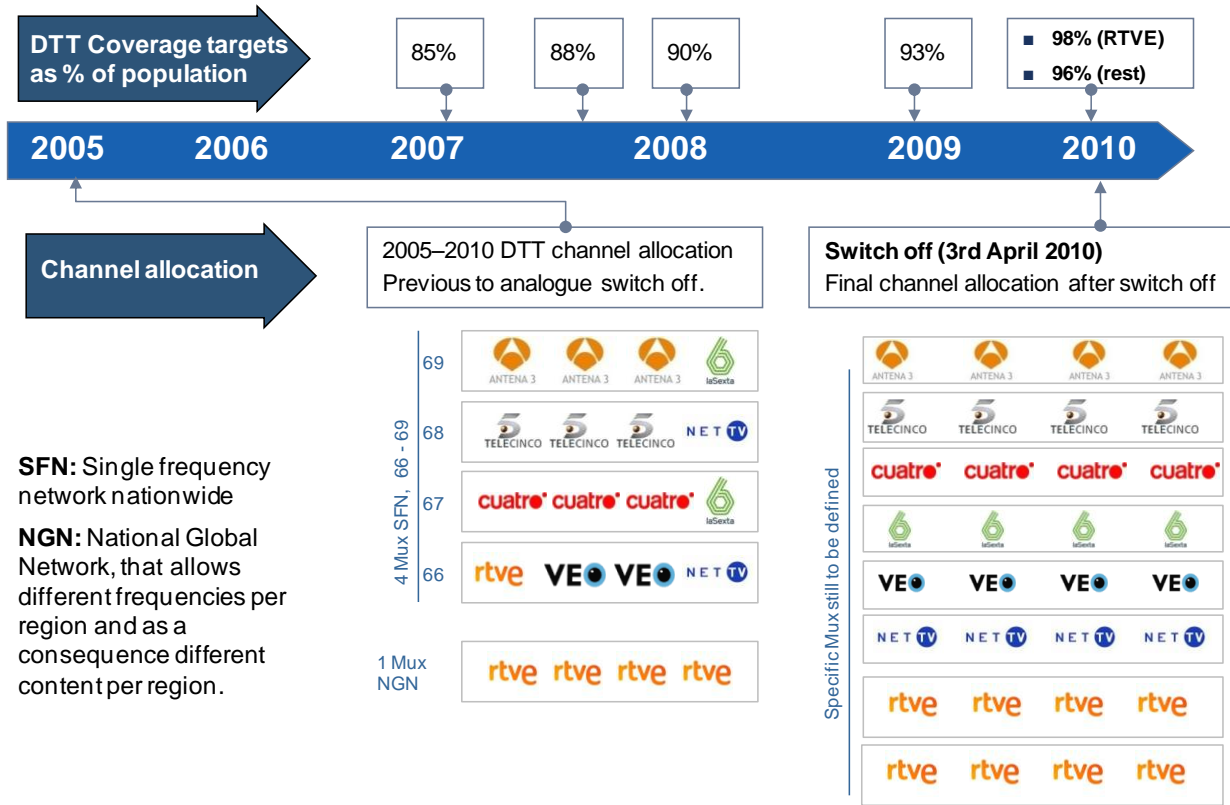
Plan for Transition to DTT has been prepared by the Public Administration. The basic management unit of the Transition Plan is the "Transition Project", defined as the orderly planning of the cessation of analogue broadcasts in every center included in every "Technical Area" (area covered by one principal center and a number of secondary centers), and the full replacement by digital broadcasts.

The full digitalization of the terrestrial network includes 90 "Transition Projects", which cover the entire Spanish territory. For each Transition Project defined in the National Plan for Transition to DTT, there was a deadline that had to be complied with to cease emissions with analogue technology. In particular, the schedule consisted of three phases as follows:

1. Phase I, 32 "Transition Projects" that had to be completed before June 30, 2009: projects that have a population of less than 500,000 inhabitants and a high percentage of DTT coverage, and require a small number of repeaters to achieve similar coverage to that provided by the analogue technology.
2. Phase II, 25 "Transition Projects" that had to be completed before December 31, 2009: projects with medium population (between 500,000 and 700,000 inhabitants).
3. Phase III, 33 "Transition Projects" that had to be completed by April 3, 2010: projects with very high population (over 700,000 inhabitants) and/or requiring the installation of a large number of centers and repeaters to achieve similar coverage to that provided by the analogue technology.

To implement the cessation of analogue broadcasts and the digital broadcasts full substitution in each Transition Project, it is necessary to match the previously existing analogue coverage through:

1. Anticipations of coverage: works in advance to digitalize sites, in order to meet the deadlines established in the Transition Plan.
2. Coverage extensions: additional centers to be deployed to obtain a digital coverage similar to that in analogue, over the obligations of broadcasters (96/98%).



**Figure 3.** Coverage targets and channel allocation according to national technical plan. Source: Prepared based on National Technical Plan.

These coverage extensions go beyond the obligations of commercial broadcasters and, therefore, they have to be funded by the Public Administration. The National Technical Plan of 2005 did not address the 100% coverage of the population (in fact it did not provide coverage obligations in excess of 96% / 98%). As indicated in its twelfth amendment, Municipal Governments in coordination with Regional Governments were responsible to fund the additional network deployments when required.

Therefore, the Public Administration, both at regional and central levels, have invested significant amounts of public funds in the so-called “extension plans”, consisting in deploying and equipping public and private terrestrial networks to overcome the limits of coverage that were mandatory under the National Technical Plan. In order to do so, the Spanish Central Government has approved the funding of these coverage extensions and has agreed with the Regional Governments of the 17 Spanish Regions (*Comunidades Autónomas*) their additional funding share. In particular, the Central Government has transferred the following amounts:

1. By 17<sup>th</sup> October, 2008 a total amount of 8.72 M€ to Phase I, assigned as follows (Table 4):
2. By 04<sup>th</sup> May, 2009 a total amount of 52 M€ to Phase II and Phase III, assigned as shown in Table 5.

These funds are used to digitalize (equip and deploy new ones, if needed) terrestrial centers. It is also important to note that the recurring charges of operation and maintenance due to this

extension of network are due to the Regional Governments.

In summary, the total investment from the Spanish Central and Regional Governments in 2008 and 2009 could be close to 100M€, and in 2010 (that is, the switch off year) additional amounts will be invested. Moreover, regions and municipalities with coverage problems will most likely need to make additional investments from their own budgets to complete the terrestrial digitalization. Therefore, the total invested amount would be larger by the end of the process.

Finally, since terrestrial networks are not able to reach 100% of the population, for the last stretch of coverage equivalent to approximately 1.5% of the population located in rural and isolated areas, Law 7/2009 allows the use of satellite, offering DTT channels via satellite (“DTT Sat”).

Currently this service is being provided by Hispasat<sup>4</sup>, the Spanish satellite services provider, re-using the satellite transport signal (it is the satellite capacity used to feed Abertis terrestrial towers). Consequently, the service has no capacity costs but since this “transport” signal is used for transport to feed terrestrial towers, not for commercial DTH, it requires non standard equipment at end user premises, i.e., Set Top Boxes (STBs) to decode the signal properly. This equipment in some regions is being paid by the Administration (for instance, the Region of Extremadura approved the funding on July 16, 2009).

<sup>4</sup> Abertis Telecom has a stake of 17.65% in Hispasat.

**Table 3.** Transition schedule and switch off dates in Europe.

<b>Country</b>	<b>Launch date</b>	<b>Completion of analogue switch off</b>
Spain	2005	2010
Estonia	2006	2010
Austria	2006	2010
Latvia	2009	2010
France	2005	2011
Czech Republic	2005	2011
Slovenia	2006	2011
Hungary	2008	2011
Croatia	2009	2011
UK	1998	2012
Italy	2004	2012
Lithuania	2008	2012
Portugal	2009	2012
Slovakia	2009	2012
Ireland	2010	2012
Poland	2009	2013
Ukraine	2008	2014
Russia	TBC	2015
Sweden	1999	Completed
Finland	2001	Completed
Switzerland	2001	Completed
Germany	2002	Completed
Belgium (Flemish)	2002	Completed
NL	2003	Completed
Denmark	2006	Completed
Norway	2007	Completed

Source: DigiTAG (2009).

## RESULTS

Based on the previous analysis of the Spanish regulatory framework and taking into account what it provides for in terms of population coverage, technology to be used and implementation, three segments of coverage have been identified (Figure 4).

1. Population coverage to 96/98% of the population, where according to the National Technical Plan, the cost of providing the service is due by national broadcasters throughout its service fees to Abertis.
2. Over the mandatory coverage of 96/98% of the population, but not including the final 1.5% tranche, where funds are provided by the Public Administrations through the so-called "extension plans".
3. Final tranche of 1.5% of the population, served by satellite (DTT Sat) and funded from various sources: the commercial broadcasters allow the re-use of the "satellite

transport signal" that they already pay to provide the end user service, and the Regional Public Administrations finance the end user equipment.

### **First segment, up to (96/98)% of the population, financed by commercial terrestrial broadcasters**

The commercial broadcasters, both public (TVE) and private (T5, Antena3, Cuatro, Sexta, Veo and Net) pay Abertis for the broadcasting service up to a 98/96% population coverage, as required by law. To provide this service, Abertis operates a national terrestrial network consisting of 3,200 sites (Abertis Telecom, 2008); although it is estimated that only around 1,000 are engaged in this stretch of coverage (Abertis Telecom, 2009). Technical costs including transmission are normally under 7% of total commercial broadcaster costs (Figure 5).

**Table 4.** Cases of European countries where ASO is completed.

Country	Digital television transition
Germany	Cable and satellite are widely spread in this country. Approximately 60% of households has cable access and 35% to satellite. It is estimated that the analogue switch-off only affected 9% of households.
Austria	The analogue switch-off has been completed in Austria. In order to guarantee channel universal coverage, in April 2008 it was decided that Austria used the Astra satellite to broadcast its DTT channels.
Sweden	The analogue switch-off took place in 2007. Implementation is taking place in different phases. Most households are provided with cable television services.
Finland	The analogue switch-off took place in 2007. Implementation is taking place in different phases. Most households are provided with cable television services.
The Netherlands	The Netherlands completed the analogue switch-off in December 2006. Cable is used by the majority of users with a 53.9% share. Satellite DTH ranks second with a 20.9% share, followed by digital terrestrial with 18.8%.
Switzerland	The analogue switch-off was completed in October 2008. Analogue and digital cable still dominates the market. Satellite comes next followed by IPTV.
Denmark	Denmark has successfully completed the analogue switch-off. According to official reports, the entire population of Denmark can access digital terrestrial television; thus, tools for monitoring service availability are not necessary. Nevertheless, citizens have access to a call centre in case technical problems arise. However, this resource is underused due to the lack of significant issues. Cable technology is predominant.
Norway	In September 2007 Digital Terrestrial television (DTT) was launched in Norway. The analogue network was shut down region by region and was completed in late 2009. The Government stated that the digital network must cover 95% of the permanent households and 70% of cottages and leisure homes. But the actual coverage exceeds these demands, and covers 98% of all households and 87% of cottages/leisure homes. Both cable-TV and satellite viewing have a strong position in Norway, but approximately 1/3 of the TV viewers are expected to use the DTT network.

Source: Own preparation based on European Commission (2010) and DigiTag (2009) data.

### **Second segment, up to 98.5% of the population, financed by Public Administrations**

Terrestrial broadcasting networks require a very large number of locations to reach coverage levels close to 98.5% of the population (over 4,500 locations in Spain, according to Abertis (Tortola, 2008).

These terrestrial network extension costs are being borne by the Public Administrations, who make the necessary investments in digital terrestrial technology through the "expansion plans" to achieve a similar coverage to that of the analogue system.

These public funds invested in the development of a terrestrial network obviously create entry barriers to other

technologies and competitors, as only Abertis Telecom is able to offer this service at these levels of coverage and no other operator could replicate and finance an alternative national network.

### **Third segment, funded by Public Administrations and indirectly by commercial national broadcasters**

According to Law 7/2009, of July 3, 2009 (based on Royal Decree-Law 1/2009, of February 23, 2009), the final 1.5% coverage must be achieved using satellite direct broadcast of DTT channels (DTT Sat).

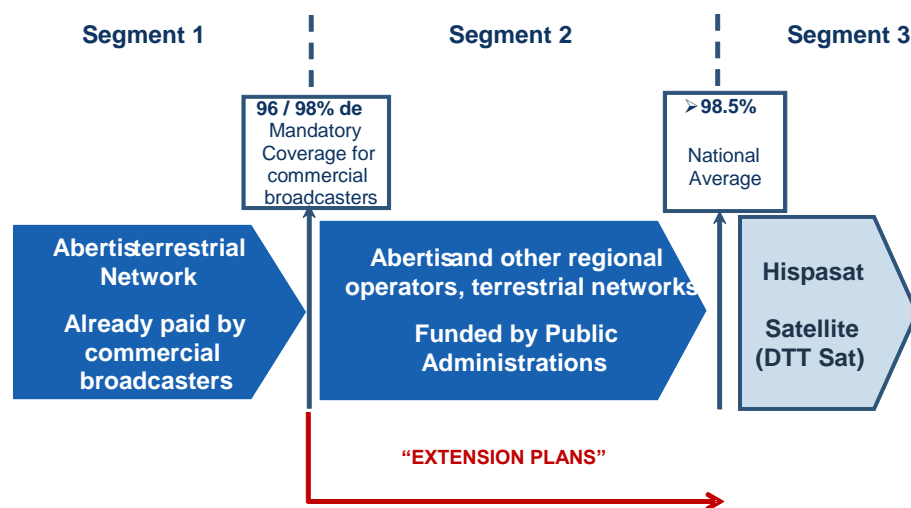
Law 7/2009 requires that all national broadcasters must



**Table 5.** Amount transferred to Regions by the Central Government in October 2008.

Region (Comunidad autónoma)	Amount (€)
Andalucía	729 000
Aragón	603 500
Asturias	102 500
Canarias	577 000
Cantabria	387 750
Castilla-La Mancha	1 157 750
Castilla y León	1 650 500
Cataluña	244 250
Ceuta	54 000
Comunidad Valenciana	206 250
Extremadura	265 000
Galicia	1 657 750
Islas Baleares	40 000
La Rioja	365 250
Madrid	147 750
Melilla	54 000
Murcia	13 500
Navarra	11 250
País Vasco	462 750
Total	8 729 750

Source: Board of ministers press release, 2008 (Ministry of industry, tourism and trade, 2008).



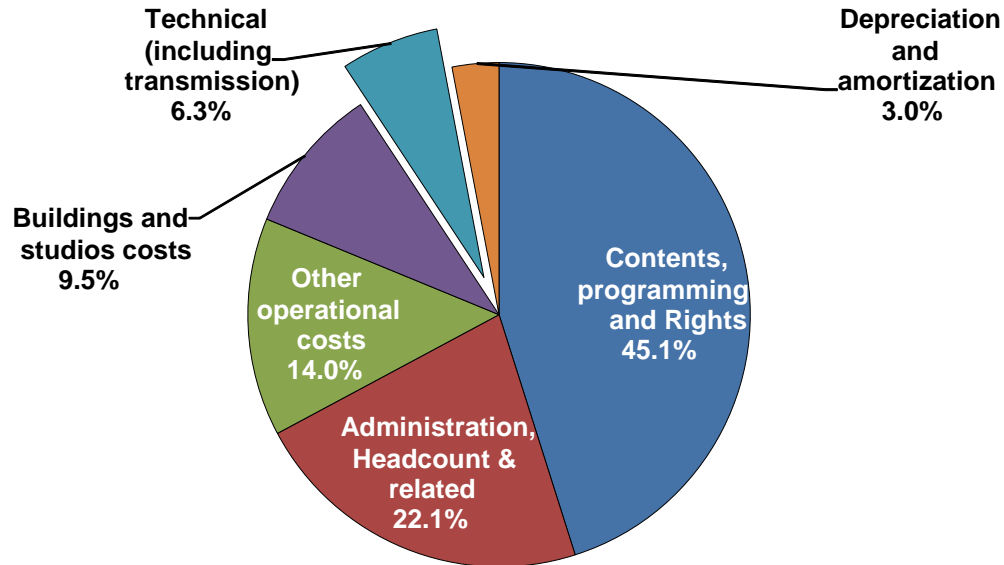
**Figure 4.** Segments of coverage.

Source: Own preparation based on regulatory framework and public data.

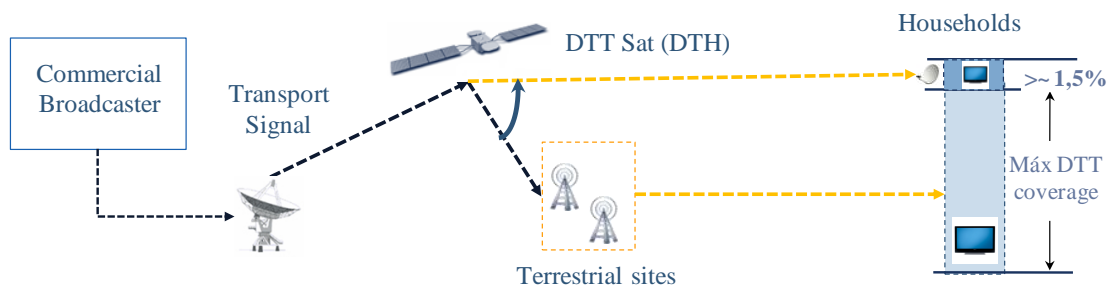
"jointly" make their channels available to a single provider of satellite services. At this point, it is worth clarifying that the terrestrial television networks are fed mainly from satellite terrestrial locations that receive a "satellite

transport signal" and redistribute them to households. The satellite used by Abertis for this purpose is Hispasat.

The Abertis-led solution, is to re-use the transport



**Figure 5.** Estimated Cost Structure of Spanish national commercial broadcasters in 2007.  
Source: Own preparation based on Commercial Broadcasters Public data of Tele 5 and Antena 3.



**Figure 6.** Re-use of transport signal for DTH of DTT Sat.  
Source: Own preparation.

signal for DTH. This solution has the apparent advantage of being "free" of cost because it implies the use of an existing signal already paid by broadcasters (Figure 6).

However, this solution has at least one obvious drawback, which is that the final user receiving equipment (Set Top Box) to decode the signal is not standard in the market, and consequently needs to be designed and produced "ad hoc" for this purpose. Therefore, this solution has an extra cost of STBs, and these STBs do not share the advantages of commercial products, features and performance, such as high definition or standard conditional access capability for pay TV services.

In addition to the foregoing, it is a proprietary technology owned by Abertis/Hispsat, end-users being captive,

a technology entry barrier to competition having also been created in this 1.5% segment of the market.

#### Alternative efficient technologies: Satellite

In this environment, it would be sensible to evaluate additional satellite coverage. In fact, digital satellite delivery is free from other technologies diseconomies when providing services to remote or topographically inconvenient regions (Cave, 1997; Xing et al., 2009).

This is because from the standpoint of service costs, the satellite has a fixed cost *versus* the growing cost involved in the deployment of a terrestrial network, which

**Table 6.** Amount transferred to regions by the central government in May 2009.

<b>Region (Comunidad autónoma)</b>	<b>Amount (€)</b>
Andalucía	3, 939, 650
Aragón	5, 303, 750
Asturias	4, 947, 350
Baleares	258, 150
Canarias	1, 375, 650
Cantabria	2, 841, 750
Castilla-La Mancha	7, 047, 200
Castilla y León	12, 180, 350
Cataluña	1, 794, 050
Ceuta	0
Comunidad Valenciana	1, 616, 000
Extremadura	1, 973, 250
Galicia	4, 519, 550
La Rioja	864, 100
Madrid	406, 550
Melilla	0
Murcia	135, 750
Navarra	305, 600
País Vasco	2, 487, 800
<b>Total</b>	<b>51, 996, 500</b>

Source: Board of ministers press Release, 2009 (ministry of industry, tourism and trade, 2009).

requires a growing number of sites when increasing coverage. Additionally, operation and maintenance costs are considerably lower in satellite.

In fact, two standard satellite transponders (that are able to carry over 4 DTT muxes each) would be enough to broadcast all the Spanish national DTT channels (eight digital muxes as presented before). And taking into account that the market price of a digital transponder in Europe is approximately 3.5 million Euros (Merrill Lynch, 2009), the total cost of broadcasting all Spanish national DTT channels through satellite would be around 7 million euros. This figure is well below the investment required for the deployment and recurrent operation and maintenance costs of a terrestrial network, as has been previously presented in this article. Besides, other European countries will use satellite in a larger extent than Spain (Table 4). For instance, satellite will cover 5% of the population in France, a percentage well above the 1.5% in Spain, and in Italy, RAI, Mediaset and Telecom Italia have launched the distribution platform for TV "Tivù" containing the current freeview channels, distributed by both terrestrial and satellite.

## CONCLUSIONS AND RECOMMENDATIONS

In Spain, the digitalization of television has been conceived and regulated as a process of migration from "analogue terrestrial" to "digital terrestrial".

A broader view of the digitalization process, allowing the early entry of other technologies such as satellite, could have led to a less intensive capital investment scenario in order to achieve 100% coverage.

Additionally, the path followed has created entry barriers in the market of Free to Air TV broadcasting signal and, in particular:

1. It has consolidated digital terrestrial as the leading technology, and Abertis as a monopolistic national terrestrial network provider, since the Public Administration investment in the deployment of terrestrial networks up to 98.5% of the population cannot be replicated by any other private operator.
2. Other technologies such as satellite (DTT Sat) are relegated to a marginal role serving a small number of users (around 1.5% of the population).

In this environment, it would be advisable to have a clear regulatory framework to allow competition, including measures such as:

1. The regulation of an interconnection service to allow other operators to provide the broadcasting service using terrestrial infrastructures.
2. The separation of the various satellite markets, transport to feed terrestrial networks and distribution direct to home (DTH).

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