

# THE DEVELOPMENT OF DIGITAL SATELLITE TELEVISION IN COUNTRIES OF THE FORMER YUGOSLAVIA

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Subject review

This paper presents an overview of the development of satellite television in the former Yugoslavia (Serbia, Montenegro, Bosnia and Herzegovina, Croatia, Slovenia and Macedonia) in the period 1991 ÷ 2012. As a precursor to digital satellite TV, a brief analysis of the development of analog satellite TV is given. A number of free and coded channels for the area since the first digital channel are given in charts and graphics. Also, the basic characteristics of direct to home platforms are given, and an overview of the most popular satellite positions used by providers. We have analysed the presence of foreign satellite channels that perform localization of specific languages. The graphs show the development of localization, as well as the representation of specialized genre of foreign satellite channels. Based on the presented analysis, it can be determined in which direction will go further development of satellite television in the observed region.

**Keywords:** analog satellite TV, digital satellite TV, direct to home (DTH) platform, localized channels

## Razvoj digitalne satelitske televizije u zemljama bivše Jugoslavije

Pregledni članak

U radu je predstavljen pregled razvoja satelitske televizije na području bivše Jugoslavije (Srbija, Crna Gora, Bosna i Hercegovina, Hrvatska, Slovenija i Makedonija) u razdoblju 1991. ÷ 2012. godina. Kao prethodnica digitalne satelitske TV dana je kraća analiza razvoja analogne satelitske TV. Tabela i grafički su prikazani broj kodiranih i slobodnih kanala za dano područje od pojave prvih digitalnih kanala. Također, navedene su osnovne karakteristike "direct to home" platformi, kao i pregled najpopularnijih satelitskih pozicija koje koriste davatelji usluga. Analizirana je i zastupljenost inozemnih satelitskih kanala koji vrše lokalizaciju za određeno govorno područje. Grafički su prikazani razvoj lokalizacije, kao i žanrovska zastupljenost specijaliziranih inozemnih satelitskih kanala. Na temelju predstavljene analize može se utvrditi u kojem smjeru će se dalje razvijati satelitska televizija u promatranoj regiji.

**Ključne riječi:** analogna satelitska TV, digitalna satelitska TV, "direct to home" (DTH) platforma, lokalizirani kanali

### 1 Introduction

The analysis was done for the territory of the former Socialist Federative Republic of Yugoslavia (SFRY), from which six countries were formed: Serbia, Montenegro, Bosnia and Herzegovina, Croatia, Slovenia and Macedonia, which are members of International Telecommunication Union (ITU) [1]. All TV channels which are broadcasting from the former Yugoslavia on satellites that cover Europe are covered [2]. Region of the former Yugoslavia is characterized primarily by similarity of language, and channels from one country to another are available, without significant language barrier [3]. Unlike other forms of distribution of TV signals (terrestrial, cable, IPTV), satellite signal is available throughout the region, and covers the areas that are inaccessible to other forms of distribution [4, 5, 6].

Television signals from the TV studios are distributed to the terrestrial satellite station and at a frequency of about 14 GHz they are sent to the satellite. The signals the satellites get are going to a satellite transponder control unit, where they are amplified and converted to frequencies from 10,700 to 12,750 GHz, in a local oscillator. After that these signals are routed to the antenna towards the surface of the Earth, where they are "caught" using a parabolic antenna [4, 5, 6, 7].

As a precursor to today's digital satellite TV transmission signal, analogue satellite television was used. The main feature of the analogue distribution is that one TV channel is using a single frequency or a single satellite transponder [8, 9]. This method of distribution has resulted in the high cost of leasing transponders, and

thus a small number of broadcasted TV channels compared to digital transmission.

Unlike analog, digital signal transmission allows a larger number of programs with digital quality picture and sound. With the arrival of digital technology, the number of available positions on a transponder has considerably increased, and the cost of using the frequency is much lower and therefore the number of television and radio channels, as well as other forms of communication, is significantly increased [8, 9].

The development of digital telecommunications enabled the use of High Definition Television (HDTV) besides standard digital television (SDTV). HDTV is a technology that offers picture and sound quality significantly higher than the traditional technology of the picture and sound (analog PAL, NTSC, SECAM,..., and digital SDTV). Since the resolution is higher, picture is clearer, less blurry and generally closer to reality. HD offers smoother motion, more detailed and vivid colours, and there is a very high quality multi-channel sound that makes the viewing experience even better [10, 11].

**Table 1** Primary DTV standards

DTV standard	Resolution	Aspect ratio	Frames per second
HDTV	1920 × 1080	16:9	24p, 25p, 30p, 50i, 60i
	1280 × 720	16:9	24p, 25p, 30p, 50i, 60i
SDTV	704 × 480	16:9	24p, 25p, 30p, 50i, 60i
	704 × 480	4:3	24p, 30p, 60i, 60p
	640 × 480	4:3	24p, 30p, 60i, 60p

HDTV offers two signals with different quality: 720 and 1080 are the basic codes, to which letter "i" or the letter "p" can be added to indicate what kind of drawing

pictures is used (i = interlaced - draws every second line, and then the other lines are drawn; p = progressive - line by line is drawn). Numbers 720 and 1080 are the "height" of the image, and the width is 1280 or 1920 pixels. Number of frames per second (FPS) can be given apart from the mark, for example, 720p50 which means that the resolution is  $1280 \times 720$ , mode of images rendering is progressive and there are 50 images per second [10, 11].

Transmission of television / video signals in their uncompressed form requires very high bandwidth flow that is larger than the flow that supports modern VDSL technology. In particular, HD (high definition) and 3D video signals require a large flow rate. For transmission of uncompressed HD video at full resolution  $1920 \times 1080$ , 4:2:2 format, you need a binary flow at about 3 GB/s, and for the 3D image even more. Because of this, different algorithms for compressing video signals are used [8, 9]. In Table 2 flows of compressed television signals used in practice in the broadcast are given, obtained based on MPEG-2 and MPEG-4 standards.

**Table 2** Flows of compressed video / audio signals for specific standards

Standards for video compression	TV video resolution	Flows compressed video/audio signals, MB/s
MPEG-2	SDTV	2 ÷ 4
	HDTV	15 ÷ 20
MPEG-4	SDTV	1,5 ÷ 2
	HDTV	6 ÷ 8

DVB-S (DVB-Satellite) is the oldest DVB standard that was proposed by the DVB Project. It was adopted in 1994 by the European Telecommunications Standards Institute (ETSI). It is a satellite transmission of digitized audio and video content over long distances through a complex system of transmitters, geostationary satellites and the corresponding receivers. The second generation of this standard was ratified by ETSI DVB-S2 (has a larger capacity, uses more efficient modulation and compression H.264/VC-1) and it is a support for high-definition content (HDTV). Compared to the DVB-S, DVB-S2 delivers about 30 % better performance which, combined with MPEG-4 AVC (H.264) compression, enables HDTV to broadcast with the same flow that prior to it was needed for SDTV [4, 5, 6, 12].

## 2 Analog satellite television

Introduction to today's satellite TV was analog satellite television. In the region of the former Yugoslavia, the first analog satellite TV channel was a satellite version of the national JRT TV Belgrade (later RTS Sat), which began its broadcasting on 14 May 1991 on Eutelsat I-F4 7° East [13, 14]. Later, the other state television from Croatia, Bosnia and Herzegovina and Montenegro joined. For all channels there is a typical hourly broadcast and evening broadcast for a few hours. At the frequencies used by public stations sporadically are appearing commercial broadcasters from the same countries with their blocks (usually on weekends) prior to the regular program of the state TV [14].

In Tab. 3 the TV channels that used analogue transmission are given.

**Table 3** TV channels that used analogue transmission

Channel name	Country	Start (year)	End (year)
RTS Sat	Serbia	1991	1999
HRT Sat	Croatia	1991	1998
BHT Sat	Bosnia and Herzegovina	1995	2002
Voice of America	USA (in Serbian)	1996	2004
Juvekomerc	Serbia	1997	2002
RTCG Sat	Montenegro	1999	2001
RTK Sat	Serbia (Kosovo)	1999	2001

All of the above listed channels for distributing were using solely the Eutelsat company satellites. Analog satellite TV in the late nineties of the twentieth century and at the beginning of the twenty-first century gradually lost its importance, and it was replaced by the digital satellite television.

## 3 Digital satellite television

The growth of digital telecommunication suppresses analogue satellite TV, and the digital satellite TV enters the scene with numerous advantages as compared to analog [8, 9]. With the arrival of digital technology, the number of available frequencies on a transponder has increased considerably, and in this regard the use of frequency rate is significantly cheaper and the number of television and radio channels has increased significantly.

In Tab. 4 and Tab. 5, the change in the number of Free-To-Air (FTA) compared to a scrambled digital satellite channels is given, for each country. The first digital satellite channel from the former Yugoslavia began broadcasting in 1996 OBN channel from Bosnia and Herzegovina [15]. At that time, analog television continues to lead on, primarily due to the cost of monitoring equipment. Digital services are mainly used as a feed to power terrestrial transmitters or for distribution to cable stations.

**Table 4** Change of the number of free-to-air satellite channels

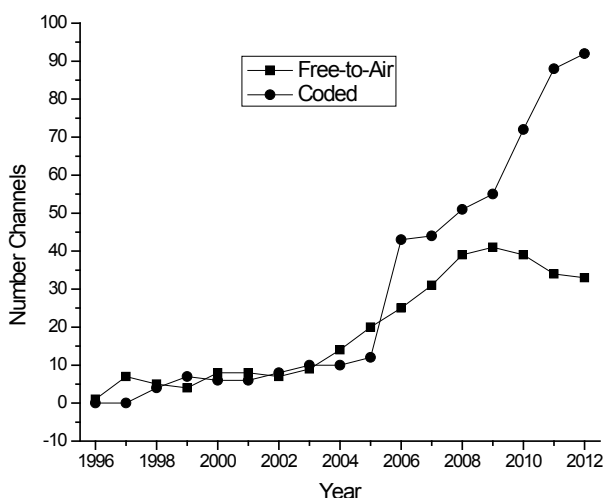
Year	Serbia	Montenegro	Bosnia and Herzegovina	Croatia	Slovenia	Macedonia
1996	0	0	1	0	0	0
1997	0	0	1	3	3	0
1998	1	0	1	2	1	0
1999	1	1	1	1	0	0
2000	3	1	2	1	0	1
2001	3	1	2	1	0	1
2002	2	1	1	1	1	1
2003	2	1	1	2	2	1
2004	2	1	3	2	4	2
2005	3	1	4	2	5	5
2006	3	1	4	4	6	7
2007	8	2	4	5	6	6
2008	11	2	5	5	6	10
2009	11	2	8	4	7	9
2010	11	2	9	5	6	6
2011	11	2	7	3	6	5
2012	9	2	7	3	6	6

Cross-section of the channel in the tables and pictures is provided for each year per day of 31 December, except for 2012 where one section was done for 31 October.

**Table 4** Change of the number of encoded satellite channels

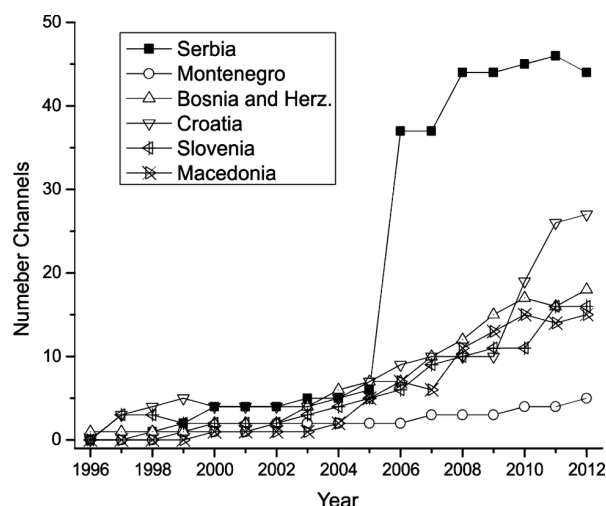
Year	Serbia	Montenegro	Bosnia and Herzegovina	Croatia	Slovenia	Macedonia
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	2	2	0
1999	1	0	0	4	2	0
2000	1	0	0	3	2	0
2001	1	0	0	3	2	0
2002	2	1	1	3	1	0
2003	3	1	3	2	1	0
2004	3	1	3	3	0	0
2005	3	1	3	5	0	0
2006	34	1	3	5	0	0
2007	29	1	6	5	3	0
2008	33	1	7	5	4	1
2009	33	1	7	6	4	4
2010	34	2	8	14	5	9
2011	35	2	9	23	10	9
2012	35	3	11	24	10	9

Fig. 1 provides an overview of changes in the number of FTA and coded satellite channels for the entire region. We can see that the number of FTA and encrypted channels is constantly increasing and that by 2006 their number was approximately equal, i.e., that the number of FTA channels is slightly higher.



**Figure 1** Change in the number of FTA and coded satellite channels for all countries in the region

However, in 2006 the start of the first two direct to home (DTH) platforms brought extreme increase in the number of coded channels [16, 17]. Later, two more direct-to-home platforms started working, and the number of channels further increased. Number of coded channels is directly related to the DTH platform since they tend to distribute encoded channels, and less FTA. Direct-to-home platforms will be discussed in more detail in the next section. Number of FTA channels, in contrast to the coded ones, after 2009 fell slightly, primarily due to the impact of the economic crisis, since the FTA channels do not depend directly on subscription for direct to home platform.



**Figure 2** Change in the total number of satellite channels (FTA + coded) separately for each country

In Fig. 2, the change in total number (FTA + coded) for each individual country in the region observed is given. In Fig. 2, it can be seen that since 1996 the number of channels in each country is constantly growing. Also, as shown in Fig. 1, it can be concluded that the growth of the channels intensified since 2006 when the direct-to-home platform started in Serbia and Croatia. By the number of channels Serbia is far ahead of other countries.

#### 4 Direct to home platforms

Direct to home (DTH) platforms are definitely the engine of the satellite television development. They are in charge of the distribution of a large number of encrypted and FTA TV channels. The first DTH platform in the region started working in January 2005 and it was named Seemore. It contained only nine foreign channels [18]. In 2006 Digi TV was taking over and the offer of domestic and international channels was significantly improved. In terms of direct-to-home platform with local channels, the first is certainly the Total TV that started in 2006. Tab. 5 provides an overview of launching DTH platform in the region by years [19, 20, 21, 22]. The most significant DTH platform is Total TV, which operates in all six countries, and Digi TV, which is available for Serbia and Croatia.

If we compare Fig. 2 and Tab. 5 it can be seen that an increase in the number of channels in one country coincides with the year in which the DTH platform started in the country.

In Tab. 6 the basic technical characteristics for satellite transponders of DTH platform are given [23, 24].

Fig. 3 shows a graph of the total change in the number of channels (FTA + coded) throughout the region by satellite positions.

We have taken into account the four satellite positions where most of the TV channels are broadcasted.

In Fig. 3, one can see that the most popular position is certainly 16° East, because two DTH platforms are broadcasting from that position.

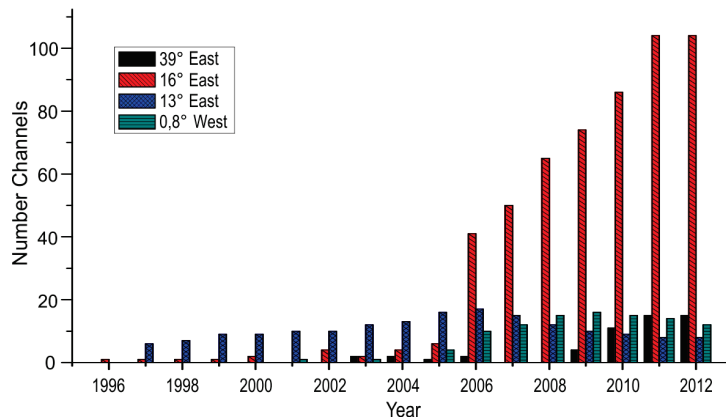
Before the onset of the DTH platforms the most popular position was 13° East on which Eutelsat Hotbird satellites are placed [25].

**Table 5** Start of DTH platform in the region

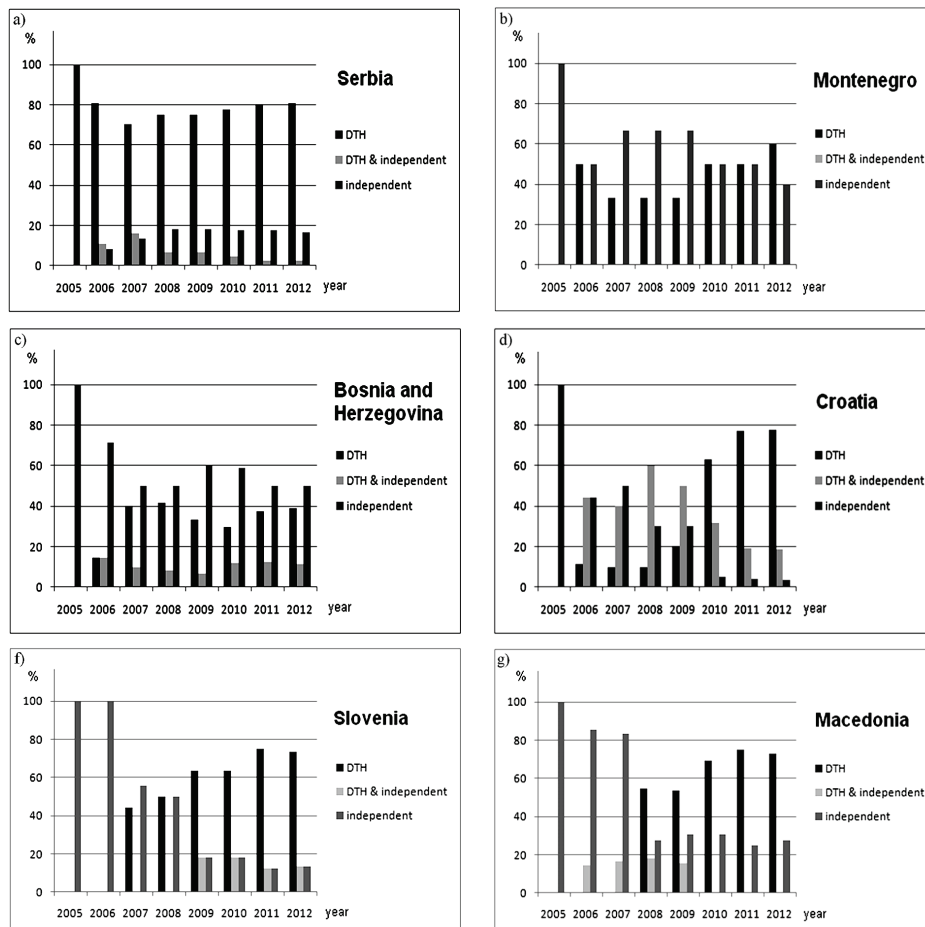
DTH platform name	Satellite position	Serbia	Montenegro	Bosnia and Herzegovina	Croatia	Slovenia	Macedonia
Total TV	16° East	2006	2006	2007	2008	2007	2009
Digi TV	0,8° West	2006	-	-	2006	-	-
PolarisMedia	39° East	2010	-	-	-	-	-
Max TV Sat	16° East	-	-	-	2010	-	-

**Table 6** Basic technical characteristics of DTH platforms

DTH platform name	Satellite position	DVB-S standard	Compression	Modulation
Total TV	16° East	DVB-S, DVB-S2	MPEG-2, MPEG-4	QPSK, 8PSK
Digi TV	0,8° West	DVB-S	MPEG-2	QPSK
PolarisMedia	39° East	DVB-S, DVB-S2	MPEG-2, MPEG-4	QPSK, 8PSK
Max TV Sat	16° East	DVB-S2	MPEG-4	8PSK



**Figure 3** Number of TV channels at the most popular satellite positions



**Figure 4** Representation of satellite channels within and outside of the DTH platform in the observed region: a) Serbia, b) Montenegro, c) Bosnia and Herzegovina, d) Croatia, e) Slovenia and f) Macedonia

Fig. 4 shows the percentage of channels that are broadcast in the DTH platforms, channels that are present in the DTH platform and independent of it, as well as channels that broadcast on their own, i.e. independent of the DTH platform.

In all the countries, after activation of DTH platforms, there was a reduction in the number of channels that are broadcast independently, i.e. independent of the DTH platform. Channels are grouped, i.e. there is a formation of multiplex from multiple channels, and the individual broadcast is reduced. The only area that is still "disorganized" is the area of Bosnia and Herzegovina, because there are still a large number of channels transmitted outside the DTH platform.

### 5 Localization of international channels

The development of satellite television in the former Yugoslavia entails the inclusion of foreign TV channels and their localization for specific languages. Localization implies synchronization or subtitling of foreign channels in local languages.

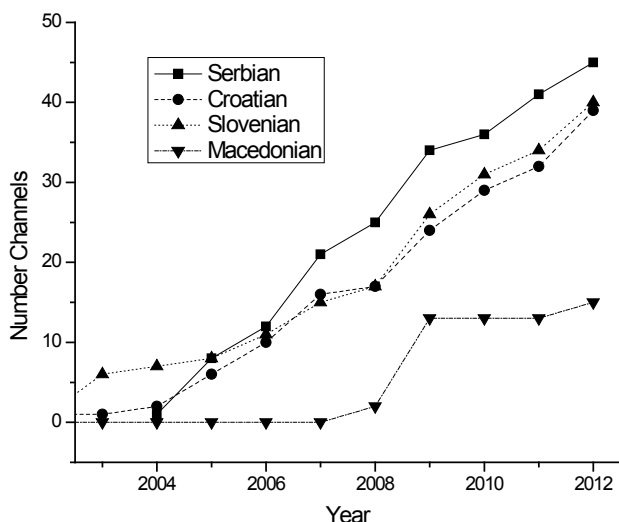


Figure 5 Growth in the number of localized SDTV channels

These are mostly specialized channels for sports, movies, documentaries, children's and entertainment programs. The development of digital telecommunications has enabled adding multiple audio channels or options for on or off for various DVB subtitles to one video channel. This possibility means that in one channel (one satellite video feed) we can localize several languages, which significantly lowers the cost of broadcasting. For the observed region localization is done in four languages: Serbian, Croatian, Slovenian and Macedonian. Because of the similarities in the languages, the same localization is used in several countries, for example: Serbian in Serbia, Montenegro and Bosnia and Herzegovina, Croatian in Croatia and Bosnia and Herzegovina.

Localized channels are used as a satellite for distribution to cable and IPTV stations, as well as for end users through DTH platform. In Fig. 5 we demonstrate a change in the number of localized channels for a particular language.

Although at the very beginning of the development of localized digital television channels number of these channels was very small, over time this number increased significantly. In the beginning, by the number of localized channels the Slovenian language was in the first place, however, since 2005 the Serbian language is much more common than any other. The reason for this is certainly the largest market in terms of DTH satellite, cable and IPTV distribution channels to end users.

Unlike national and regional channels which are distributed by satellite in SDTV resolution, foreign channels are gradually introducing localization in the HDTV channels. Fig. 6 presents a graph of the growth of foreign HDTV channels that are localized for the markets of former Yugoslavia.

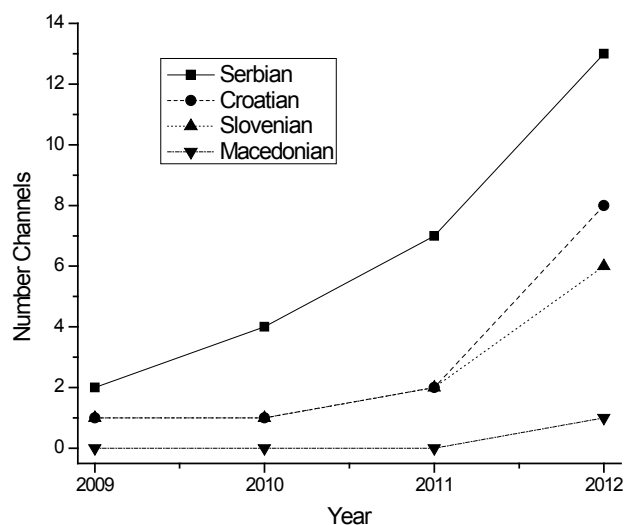


Figure 6 Growth in the number of localized HDTV channels

In Tab. 7 and Tab. 8, a review of localized SDTV and HDTV foreign channels on 31 October 2012 is given. In Tab. 7 and Tab. 8, the symbol "X" denotes existence of localized channel in a particular language.

Basically it is one and the same channel that is localized by subtitles or dubbing for specific languages. The same channels are available in their original language (English) and distributed outside the observed region. The only exceptions are the Sports Club channels that are specially implemented for the markets of the former Yugoslavia. They even created a unique version for each language area.

Table 7 Review of localized SDTV channels

Channel name	Serbian	Croatian	Slovenian	Macedonian
Eurosport	X			
Eurosport 2	X			
Motors TV	X			
Sport Klub	X	X	X	
Sport Klub +	X	X	X	
Sport Klub Prime	X	X		
Golf Klub	X		X	
HBO Adria	X	X	X	X
HBO Comedy Adria	X	X	X	X
Cinemax	X	X	X	
Cinemax 2	X	X	X	

TV 1000	X	X	X	
MGM	X	X	X	
FOX Movies	X	X	X	
FOX	X	X	X	X
FOX Crime	X	X	X	X
FOX Life	X	X	X	X
Universal	X	X	X	
AXN	X	X	X	X
Sci-Fi	X	X	X	
Zone Romantica		X	X	
Comedy Central Extra	X	X	X	
National Geographic	X	X	X	X
NatGeo Wild	X	X	X	
Discovery Channel	X	X	X	X
Animal Planet	X	X	X	X
Travel Channel	X	X	X	
History Channel	X	X	X	
Viasat History	X	X	X	
Viasat Explorer	X	X	X	
Viasat Nature	X	X	X	
Da Vinci Learning	X	X	X	X
Zone Reality		X	X	
TLC	X	X	X	X
Investigation Discovery	X		X	
Crime & Investigation	X	X	X	
Outdoor Channel	X			
Fishing & Hunting	X	X	X	
MTV Adria	X	X	X	X
VH1 Adria	X	X	X	
E! Entertainment TV	X	X	X	X
Style Network		X		
BBC Entertainment	X			
24 Kitchen	X	X	X	X

Minimax	X		X	
Disney	X	X	X	
Disney XD	X			
Nickelodeon		X		
Kids Co				X
Ginx	X	X	X	

Table 8 Review of localized HDTV channels

Channel name	Serbian	Croatian	Slovenian	Macedonian
Eurosport HD	X			
Eurosport 2 HD	X			
Sport Klub HD	X			
Sport Klub + HD	X	X	X	
Sport Klub Prime HD	X	X		
Sport Klub Premium HD	X	X	X	
HBO Adria HD	X	X	X	
NatGeo Wild HD	X	X		
Travel HD	X			
History HD	X	X	X	
Viasat History-Nature HD	X	X	X	
Outdoor HD	X			
E! Entertainment TV HD	X	X	X	X

In Fig. 7, we can see the presence of localized SDTV channels by genre. The most common are movie and documentary channels.

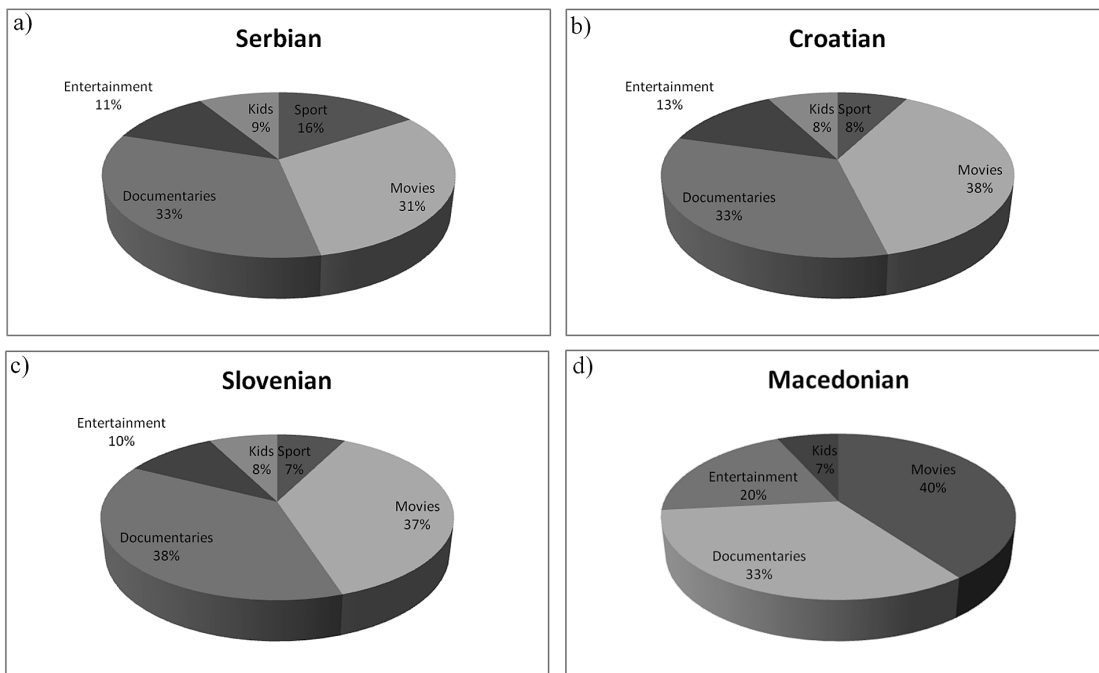


Figure 7 Representation of localized SDTV channels per theme in: a) Serbian, b) Croatian, c) Slovenian, d) Macedonian

## 6 Conclusion

Analysis shows that the number of FTA and encrypted channels is steadily increasing. In 2006 the first two direct-to-home platforms that entail extreme increase in the number of coded channels started with the operation. After 2009 number of FTA channels, in contrast to coded ones, fell slightly. The largest number of

TV channels in the observed region is concentrated in position 16° East. Development of DTH increasing number of channels is oriented to distribution through the DTH platform while reducing the individual distribution.

Number of international channels which have been localized in local languages in recent years is much higher. Next year is expected to increase the number of localized channels, especially those that are broadcast in

high definition. Number of local channels will certainly increase. Preference will still be given to SDTV channels, but over time the number of HDTV channels will exceed SDTV channels. DTH platform is gradually switching from DVB-S to DVB-S2 standard and MPEG-2 compression is replaced with MPEG-4. The reason is the ability to broadcast multiple channels within the same bit rates.

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