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DVB-T2 Transmission System in the GE-06 Plan

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Abstract: *Albania is in last steps of full digitization of audiovisual transmission as an obligation derive from ITU Agreement GE-06 "On the planning of terrestrial digital broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-863 MHz". Digital switchover should be carried out without spoiling the existing structure of the Albania media market which was composed by a considerable numbers of broadcasters. On the other hand, in a study carried out for the EBU Technical Committee it is considered that in the future all TV programmers will be in HD quality and that a minimum of 20 to 25 HDTV programmers will need to be provided on the terrestrial platform in order to make it attractive for the viewers. The GE06 digital broadcasting plan allows for implementation of HDTV services, i.e. using DVB-T. In 2009 the DVB consortium issued specific conditions for the DVB-T2 technologies as an extension of the existing DVB-T standard. Such an extension results in an increase of 30-50% of the DVB-T2 effectiveness compared to DVB-T may and be used in favor of HDTV and increased number of programs. Taking into account the advantage of using DVB-T2 technologies, opportunities and economic benefits to the effective use of frequency spectrum they offer, as well as the need to release as soon as possible the Digital Dividend, it is required by the law in Albania that all digital networks to be DVB-T2 based. This paper analyses how to effectively use the advantages of DVB-T2 transmission systems in case of Albania audiovisual market without changes to the GE06 Plan and increasing the number of HDTV programmers.*

Keywords: *HDTV programmers, GE-06 Plan, DVB-T2, MPEG4, spectrum*

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I. Introduction

The Regional conference on radio-communication (RRC-06) was organized by International Telecommunication Union (ITU) in 16 June 2006 in Geneva in order to establish the new international agreement for digital transmission of radio and television program. Final Acts were adopted with agreement Geneva 2006 (GE–06) "On the planning of terrestrial digital broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-863 MHz", which enables introduction of completely digital diffuse radio transmission in planned zones. Based on this agreement all european countries were engaged to switch to digital transmission of radio and television signal and to analog switch off analogue transmission (ASO) no later than 17th of June 2015. In most of countries this has already been implemented. In Albania this process is still going on. Part of the GE-06 agreement was the Digital Broadcasting Frequency Plan including the Albanian Digital Broadcasting Frequency Plan, based on which are generated the broadcasting capacity as is reflected in the following table (Tab.1).

TABLE-1. Albanian Digital Broadcasting Frequency Plan

Networks	Allotment Shkoder	Allotment Kukes	Allotment Diber	Allotment Lezhe	Allotment Tirane	Allotment Elbasan	Allotment Fier	Allotment Berat	Allotment Korçe	Allotment Gjirokaster	Allotment Vlore
	Channels	Channels	Channels	Channels	Channels	Channels	Channels	Channels	Channels	Channels	Channels
National Netw. 1	9	9	8	9	10	7	10	5	6	8	8
National Netw. 2	22	26	24	23	21	23	22	24	21	26	23
National Netw. 3	28	32	25	29	34	33	27	25	27	29	39
National Netw. 4	34	36	30	33	39	40	28	30	28	35	43
National Netw. 5	41	40	38	43	53	42	29	32	43	37	46
National Netw. 6	45	42	54	46	57	46	31	36	45	38	57
National Netw. 7	51	50	55	66	59	48	35	47	51	44	64
National Netw. 8	59	52	60	68	61	49	45	52	55	48	68
Local Netw.		56	63			56	51	54	57	50	
Local Netw.		65	69			58		61	59	53	
Local Netw.						62		65	64	56	
Local Netw.						68		66		58	
Local Netw.										60	
Local Netw.										63	
Local Netw.										67	
Local Netw.										69	

In Albania the digital broadcastings are a reality since over nine years. These programs are in interest of a considerable part of the population and they have been tailored to various interests and age-groups. On the other hand, a considerable number of analogue broadcasters offers free-to-air TV programs.

It's a strategic objective of Albanian government that the digital switchover to be carried out without spoiling the existing structure of the media market. Maintaining the market structure means that the existing analogue programs to continue to be broadcasted free-to-air.

From the other side it is considered that in the future all TV programmers will be in HD quality.

In this conditions, aim to maintain the existing Albanian market structure, as well as to give opportunities of accessing new media technologies it was decided all digital network to be DVB-T2 based.

But the GE-06 digital broadcasting plan has been based in implementing DVB-T transmission system. The aim of this paper is to define how to better use all the advantages of the DVB-T2 technology in GE-06 Plan in order to maximize the number of HDTV programmers transmitted in one multiplex.

II. DVB-T2/MPEG4 Benefits

DVB-T, in common with almost all modern terrestrial transmission systems, uses OFDM (orthogonal frequency division multiplex) modulation. This type of modulation, which uses a large number of sub-carriers, delivers a robust signal that has the ability to deal with very severe channel conditions. DVB-T has technical characteristics that make it a very flexible system:

• 3 modulation options (QPSK, 16QAM, 64QAM)
• 5 different FEC (forward error correction) rates
• 4 Guard Interval options
• Choice of 2k or 8k carriers
• Can operate in 6, 7 or 8 MHz channel bandwidths (with video at 50Hz or 60Hz).

A DVB-T multiplex has a given bit rate capacity, which in practice ranges between 8 Mbit/s (QPSK, 2/3) and 27 Mbit/s (64 QAM, 3/4). In principle, the multiplex can be used to deliver HDTV programmers providing that the services fit into the available channel capacity and are receivable at an adequate bit error rate.

To allow a better use of the spectrum resources and to meet the needs of countries after they have completed Analogue Switch-Off, the DVB consortium issued, in 2009, specific conditions for the DVB-T2 technologies as an extension of the existing DVB-T standard. Using advanced transmission systems such as DVB-T2 it is possible to provide a higher transmission capacity than DVB-T without changes to the GE06 Plan. Such an extension results in an increase of 30-50% of the DVB-T2 effectiveness compared to DVB-T.

DVB-T2 is a standard that makes efficient terrestrial HDTV transmission possible offering significantly smaller sensitivity on disturbance and noise and providing increased flow of data which particularly suits HDTV (High definition television). DVB-T2 uses COFDM modulation and considering number of carriers (1K, 2K, 4K, 8K, 16K, 32K) modulations that are used (QPSK, 16-QAM, 64-QAM, 256-QAM).

TABLE-2. DVB-T vs. DVB-T2

	DVB-T	**DVB-T2**
FEC	Conv. Coding + RS 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modulation	COFDM: QPSK, 16QAM, 64QAM	COFDM: QPSK, 16QAM, 64QAM, 256QAM
Guard interval	1/4, 1/8, 1/16, 1/32	1/4, 19/256, 1/8, 19/128, 1/16, 1/32, 1/128
FFT size	2k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered pilots	8% of total	1%, 2%, 4%, 8% of total

Considering that busyness of frequency spectrum depends on bit flow, it is necessary to reduce it, so the compression of signal is performed using several methods. Standard that is widely used for digital television is MPEG-2, followed by MPEG-4, H.264/AVC. It had several improvements considering new means of coding and reducing bit flaw without image degradation. Compression of signal is followed by multiplexing which consists of forming of package of appropriate longitude and they form transporting sequence.

MPEG-4 transmissions particularly benefit from statistical multiplexing. In a large statistical multiplex, with mature encoders, future HD services may be able to operate with an average bit rate of about 8-10 Mbit/s. In a standalone service, up to 16 Mbit/s will be needed, depending on the development of encoders in the future. In a small statistical multiplex, the bit rate needed will lie between the two. The combined introduction of these two technologies theoretically increase the capacity of a multiplex by up to 160% for fixed reception and in more realistic estimation it's consider 100%. It is also assumed that the capacity gain in the case of portable or mobile reception will be similar to that of fixed reception.

III. Data Rate Capacity Required To Deliver HDTV

In HDTV technology the quality of signal (image and sound) is significantly better compared with the traditional technologies. In Table 3 we see the difference between the basic features of digital TV standards (SDTV, HDTV).

TABLE-3. Primary digital TV standards

DTV	Resolution	Aspect Ratio	Number of frames per second
HDTV	1920 x 1080	16:9	25p.50i
	1280 x 720	16:9	25p.50i
SDTV	720 x 576	16:9	25p.50i
	720 x 576	4:3	25p.50i

720 and 1080 represent "height" of image, and width is 1280 and 1920 pixels respectively. Number of images in second is quoted beside the mark, for example, 720p50 which marks resolution 1280×720, progressive way of image drawing with 50 images in second. Television of Ultra high definition (UHDTV – Ultra High Definition Television) includes 4K UHDTV (2160p) and 8K UHDTV (4320p), which are two digital video formats that were suggested by NHK Science & Technology Research Laboratories and approved by International Telecommunication (ITU). Minimal resolution of this format is 3.840x2.160 pixels.

One critical element affecting the quality, the viewer experiences and the transmission costs, is the data rate used for delivering the compressed HDTV video signal.

The HDTV digital transmission capacity depends on a number of factors, such as:

- type of compression,
- HDTV scanning format,
- the degree of acceptable picture impairments,
- if the compression is done as the programmers unfolds -'on the fly'- or not,
- whether the HDTV signal is part of a 'statistical multiplex',
- the performance encoding equipment,
- the type, size of the display and viewing distance in the home,
- the type of content.

Albanian broadcasters are obliged by law to broadcast HDTV on the terrestrial platform using MPEG-4 as the most advanced compression model.

Regarding the minimum fixed bitrates in order to achieve an HDTV image quality the below options are suggested:

- For the 1080i/25 HDTV format and horizontal sub-sampling to 1440 samples a minimum bitrate of 12 Mbit/s is recommended
- For the 1080i/25 HDTV format and no horizontal sub-sampling a minimum bitrate of 12 - 14 Mbit/s is recommended
- For the 720p/50 HDTV format and no horizontal sub-sampling a minimum bitrate of 10 Mbit/s is recommended.

It's important to make a trade-off of advantages and disadvantages in order to choice the bit rate for deliver HDTV programmers and to achieve this is needed to consider a number of factors.

Nevertheless, it should look for further improvements of the quality as far as they are available (more spectrum, better compression, statistical multiplexing and so on...).

The bit rate used for current HDTV services is constrained by commercially available encoder performance, which is constantly evolving.

IV. DVB-T2 in GE06 Plan

The GE06 Plan covers the frequency band 174 - 230 MHz (Band III - arranged into seven or eight channels with 8 or 7 MHz bandwidth, respectively, depending on the country,) and the frequency band 470 - 862 MHz (Bands IV/V - subdivided into 49 channels, each with 8 MHz bandwidth).

A GE06 Plan entry is implemented as one DVB-T multiplex transmitted over a corresponding coverage area. This applies to both assignments and allotments. Allotments are normally converted into a single assignment or a set of assignments that operate as an SFN.

DVB-T2 is a new transmission standard. Early estimates of performance of the baseline specification suggest over 45% bit rate capacity gain for a typical application for the same reception conditions.

The GE06 Agreement allows for implementation of DVB-T2 under the envelope concept; i.e. provided that it does not cause more interference nor require higher protection that the original Plan entry.

DVB-T2 standard complies with the interference levels and spectrum mask requirements as defined by GE-06 Agreement. This is the reason the implementation of the DVB-T2 standard avoids the need to renegotiate

a major international treaty involving over 110 countries. The DVB-T2 standard also complies with the requirements of the Radio Regulations, the international framework governing the use of frequency spectrum and satellite orbits. While the Radio Regulations do not set out the specific standards which can be used in the various frequency channels, it does regulate the usage of the channels. At the last World Radio communication Conference 2007 (WRC-07), national administrations modified the Radio Regulations by allowing for the allocation of mobile services in the terrestrial frequency bands between 470-862 MHz traditionally reserved for broadcasting in Europe after June 2015. While this decision does not have a direct impact on a national administration's decision to launch DVB-T2 services, it does highlight the demand for such frequencies and the likelihood that these frequencies will need to be shared between various service providers. A digital broadcast standard, such as DVB-T2, that makes maximal efficient use of spectrum will have much appeal for national administrations.

One HD programmer currently requires a fixed bit rate of 10-20 Mbit/s depending on the format and compression method used (e.g. MPEG-2 or MPEG-4). If statistical multiplex is applied an average bit rate of 7-8 Mbit/s per programmer can be achieved (e.g. if 3 HD services are multiplexed together in a DVB-T multiplex with around 24 Mbit/s). Careful design of the production chain and high quality MPEG-4 encoders in combination with statistical multiplexing and horizontal sub-sampling will allow that these bit-rates provide perceptible improvements over state-of-the-art MPEG-2 based SDTV services on DTT. Consequently, one GE06-based DTT multiplex can theoretically carry one to three HD programmers for fixed reception and a maximum of one or two HD programmer for the more robust system variants that allow for portable or mobile reception. Some system variants do not have sufficient capacity for HDTV.

The maximum capacity currently available in the GE06 Plan in terms of number of programmers is as in Table 4, where the figures are based on the following assumptions:

- most countries have 7-8 layers in UHF and 1 layer in VHF in the GE06 Plan
- all DVB-T Plan entries will be used to provide HDTV services
- the performance MPEG-4 encoders, which are continuously evolving, are sufficiently advanced by the time when DVB-T2 is implemented

TABLE-4. Maximum number of programmers in the GE-06 Plan

	Fixed reception		**Portable reception**	
	UHF Bands IV/V	**VHF Band III**	**UHF Bands IV/V**	**VHF Band III**
DVB-T	7-24	1-3	7-16	1-2
DVB-T2	21-40	4-5	14-24	2-3

It is important to highlight that these conditions may not always be applicable in practice. The maximum bit rates for DVB-T can only be achieved with MFNs or SFNs using short guard intervals, otherwise the actual net bit rates are less than the stated maximum.

V. Conclusion

GE06 Plan permits a significant degree of flexibility in the implementation of transmission networks that may be used in favor of advanced technologies as DVB-T2.

By combining the expected advances in the transmission systems and using statistical multiplexing, and taking into consideration that with the future developments in video coding and advances in the transmission system it is assumed that HD fixed bit rate requirements will be reduced to 8-10 Mbit/s per programmer, it should be possible to aggregate up to 4 or 5 HDTV programmers per multiplex for fixed reception, or 2 to 3 HDTV programmers in a multiplex for portable or mobile reception.

However further investigation are being done, taking into account the restriction of implementing the DVB-T2 system in GE-06 Plan and further the need in the future to release the 700 MHz band (Second Digital Dividend) from audiovisual transmissions.

It should be noted that the launch of a full HDTV offering on the terrestrial platform in a country could be achieved only if in all their neighbors the analogue switch-off is completed.

References

[1] EBU BPN 005 - *Terrestrial Digital Television: Planning and Implementation Considerations*; Third issue, Summer 2001
[2] EBU Tech 3299*: High Definition (HD) Image Formats for Television Production*; December 2004
[3] EBU Tech 3307: *Service Requirements for Free-to-Air High Definition Television Receivers*, EBU, June 2005
[4] EBU Tech 3312: *Digital Terrestrial HDTV Broadcasting in Europe; The data rate capacity needed (and available) for HDTV;* February 2006
[5] EBU Tech 3328: *Current Status of HDTV Delivery Technology;* May 2008
[6] Resolutions of the First Session of the RRC for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 and 470-862 MHz, Geneva, 10-28 May 2004

[7] 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 bands174-230 MHz and 470-862 MHz (RRC-06)
[8] EBU Technical Review: *GE06 - Overview of the second session (RRC-06) and the main features for broadcasters;* Terry O'Leary, Elena Puigrefagut and Walid Sami, October 2006 http://tech.ebu.ch/docs/techreview/trev_308-rrc-06.pdf
[9] EBU Strategy paper: *Projected requirements for public service media for the digital dividend;* Nigel Laflin, SMC Chairman, June 2008
[10] DVB Blue Book A122 '*Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)';* June 2008, http://www.dvb.org/technology/dvbt2/
[11] UK Ofcom Consultation: *The Future of Digital Terrestrial Television*; November 2007 http://www.ofcom.org.uk/consult/condocs/dttfuture/dttfuture.pdf
[12] UK Ofcom Statement: *Digital Television: Enabling New Services*; April 2008 http://www.ofcom.org.uk/consult/condocs/dttfuture/statement/statement.pdf
[13] EBU Technical Review: *The roll-out of DTT in France — not just SD ... but HD and mobile TV services as well;* Aurélien Louis and Matthieu Roger, Issue: 2008-Q1; http://tech.ebu.ch/docs/techreview/trev_2008-Q1_csa-roger.pdf
[14] Digitag: *HD on DTT - key issues for broadcasters, regulators and viewer; 2007* http://www.digitag.org/HDTV_v01.pdf
[15] EBU Recommendation R 124: *Choice of HDTV Compression Algorithm and Bitrate for Acquisition, Production & Distribution;* June 2008
[16] EBU BPNs 085, 086 and 087: *New HDTV Distribution Compression System Analysis;* May 2008 [EBU Members only]

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