DVB SCENE

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The Technology Update from DVB

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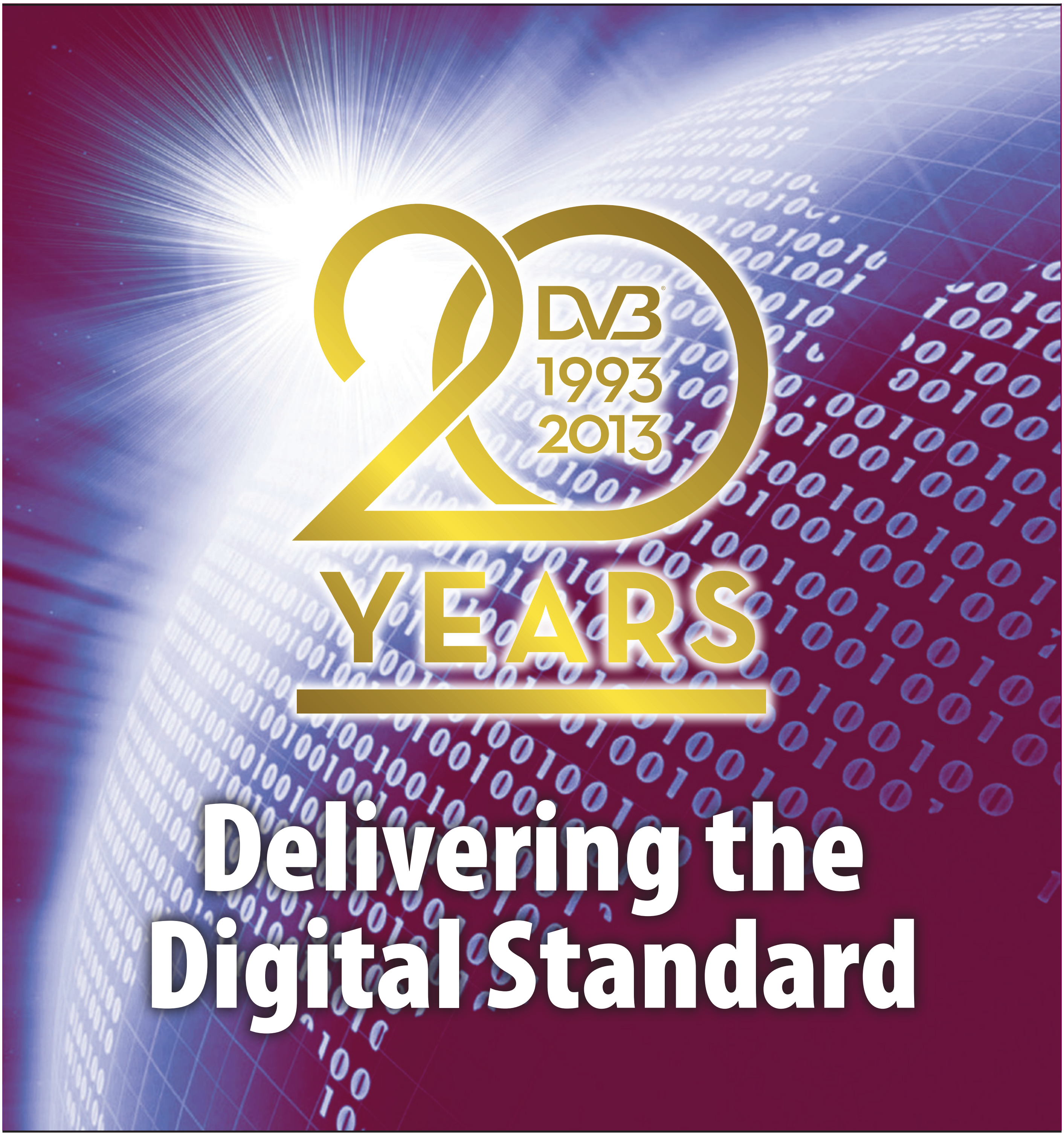


20 Years of
Raising Standards
Congratulations DVB!
To date, an ever-increasing number of television viewers rely on DVB technology in some way or another. DVB's world-class standards and international progress have challenged and inspired DekTec to raise our standards in the most positive sense of the word.
In more than one way we owe our success to being a member of DVB. We are proud to be able to contribute our part to DVB's achievements with our product range. We hope to continue this win-win relationship for many years to come.
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Long Lasting

A Word From DVB

Peter Siebert
Executive Director

With the 20th anniversary of the DVB Project upon us, I am wondering if the signatories of the first MoU would ever have predicted that the Project would become such a long lasting success story? Not surprisingly, from time to time over the last 20 years, the question has come up of whether DVB has completed its job. As we all know, and for very good reasons, the answer has always been "No"! There is always something new on the horizon.The first transmission standards were followed by a second generation. After SD came HD, then there were new video and audio coding technologies that had to be integrated into our specifications. At present, we are working on important technologies for the near future: resolutions beyond HD, second screen, the next generation of CI Plus, OTT and IPTV.

Will we come together again in 10 years from now to celebrate 30 years of DVB? For me, the answer is a clear "Yes". Broadcast will remain the most popular way of delivering entertainment and information to a mass audience. New business ideas and technologies will come up and will need to be supported by broadcast standards. As with today, DVB will also be there tomorrow to create the necessary standards. Why am I confident about the role DVB plays? There are three unique selling points that DVB offers. First of all we are commercially driven. Secondly, with manufacturers, broadcasters, network operators and regulators, we bring together the relevant market players. And finally, over the last 20 years we have developed the necessary culture to agree and to achieve consensus. This is a very special art and because it cannot be copied easily, it makes DVB special.

I am looking forward to the next ten years. We do not know what will come up next on the broadcast horizon, but I am confident that development will go on. Personally, I very much appreciate working on the future of broadcast together with our DVB Members, the chair persons and of course my colleagues from the Project Office. Together we will bring broadcast technology to the next level.

New Standards

EN 302 307: Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications (DVB-S2) (Mar 2013)
TS 103 127: Content Scrambling Algorithms for DVB-IPTV Services using MPEG-2 Transport Streams (May 2013)
TS 103 129: Framing structure, channel coding and modulation of a carrier identification system (DVB-CID) for satellite transmission (May 2013)
TS 102 809: Signaling and carriage of interactive applications and services in Hybrid broadcast/broadband environments (Jul 2013)

New Members

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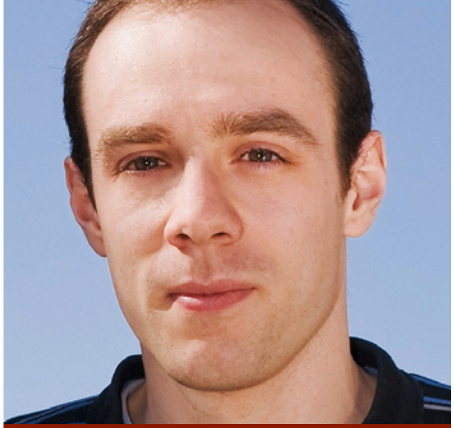
Terrestrial Cooperation

Spectrum & Energy Efficient Media Content Delivery

Jan Zöllner, Chair, TM-CSU



Jan Zöllner, Braunschweig Technical University

The advent of smartphones and tablet PCs as personal devices for everyday use is causing a significant change to the way people consume media. The new services that have been enabled by these new types of devices significantly increase the demand for unicast broadband transmission. Among other things, this increase resulted in the assignment of the terrestrial broadcast spectrum in the 800 MHz band to cellular networks, the so called Digital Dividend, to satisfy the spectrum demand for media consumption on the move. With the increasing traffic in cellular networks and the stepwise introduction of DVB-T2, the second generation of terrestrial broadcast in Europe, the pressure is growing on the terrestrial broadcast spectrum. At the World Radio Conference 2012 (WRC-12) the 700 MHz band was defined as a resource for co-primary use by broadcast and cellular broadband network operators. Some countries such as Germany are already discussing a second Digital Dividend in the 700 MHz band. Spectrally efficient transmission with high robustness against interference in the crowded terrestrial spectrum is hence crucial and a substantial part of DVB's strategy.

In the light of these developments, a Study Mission on "Cooperative Spectrum Use" (TM-CSU) was established in January by the DVB Technical Module. The Study Mission is investigating approaches that enable the cooperative use of terrestrial spectrum, in particular the joint use of the same terrestrial frequency resources by broadcast and other services, such as wireless broadband. The aim of these approaches is to improve the spectrum and energy efficiency and to reduce the cost of media content delivery. To achieve these goals, the Study Mission is analyzing different degrees of freedom for cooperative spectrum use and possible ways to exploit them. These degrees of freedom are:

- use a channel for different purposes at different times
- use a channel for different purposes in different geographical areas
- support cellular networks with broadcast infrastructure.

An example for such an approach is the use of a Tower-Overlay network, supporting cellular broadband networks by means of broadcast cells in the UHF band with larger cell sizes, to improve the efficiency of the delivery of point-to-multipoint services. This allows for off-loading linear or highly popular media content from the cellular to the broadcast network. The Tower-Overlay network can reuse existing broadcast infrastructure to reduce operational cost by using a UHF carrier frequency to exploit the good propagation conditions, with the carrier frequency being signaled by the cellular networks via cross carrier signaling.

Another approach being analyzed is Dynamic Broadcast, which takes advantage of the broadband connection and storage devices available at the terrestrial user terminal. The choice of the delivery network of the media services is then carried out depending on the number of viewers. In addition, other degrees of freedom can be exploited dynamically over time, such as the choice between live broadcast and pre-downloaded content, the terrestrial channel allocation and the choice of the transmission parameters of the broadcast network. Dynamic Broadcast may target an increase of the transmission capacity, the reduction of the power consumption of the network, or the reduction of the required amount of terrestrial spectrum.

The freed spectrum can be considered as dynamic TV White Spaces, which are managed by a dynamic White Space database and can be used by White Space devices, e.g., a secondary wireless broadband network. A crucial requirement for the exploitation of TV White Spaces is to maintain the well-known high quality of service of the broadcast network by avoiding interference from White Space devices. This can be achieved by regulating the transmission frequency and transmission power of White Space devices according to the particular interference situation.

In addition to the technical approaches for cooperative spectrum use, boundary conditions are being studied by TM-CSU: The spectrum use across Europe and in particular the international regulation is of importance when discussing cooperative approaches. Furthermore, use cases for cooperative spectrum use based on potential transmission systems are being discussed. The work of the Study Mission is expected to be completed by the end of the year and will be presented as a Study Mission Report to the DVB Technical Module.

Drawings courtesy of Braunschweig Technical University

Fig. 1: Tower-Overlay: A P2MP carrier supporting an LTE-A carrier

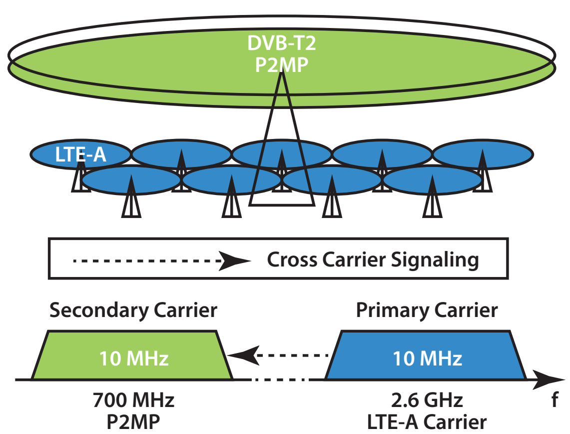
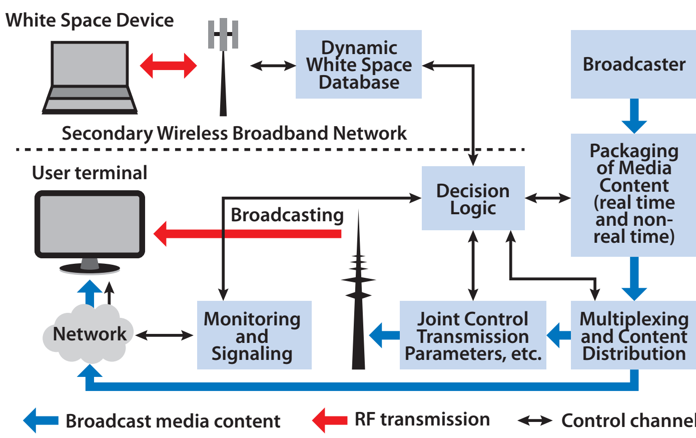


Fig. 2: Overview of Dynamic Broadcast



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Promising Efficiency

Working With HEVC

Ken McCann, Chair, TM-AVC

We are currently witnessing something that has become a once-in-a-decade event in the world of video compression: the emergence of a major new family of video compression standards.

The mid-1990s saw the introduction of MPEG-2, the first compression standard to be widely adopted in broadcasting applications. H.264/AVC appeared in the mid-2000s, offering the same subjective quality at approximately half the bitrate. Now, a new standard, High Efficiency Video Coding (HEVC), has been developed that promises a further factor of two improvement in compression efficiency for the mid-2010s.

The HEVC standard has been jointly developed by the same two standardization organizations whose previous collaboration resulted in both MPEG-2 and H.264/AVC: the ISO/IEC Moving Picture Experts Group (MPEG) and the ITU-T Video Coding Experts Group (VCEG).

The initial edition of the HEVC standard was completed in January 2013 and it is published by ISO/IEC as ISO/IEC 23008-2 (MPEG-H Part 2) and by ITU-T as Recommendation H.265. This first version supports applications that require single-layer 4:2:0 video with 8 or 10 bit sampling. Further work is planned to be completed in 2014 to extend the standard to support contribution applications, as well as adding tools for scalable video coding and more sophisticated 3D coding.

HEVC Overview

The basic architecture of HEVC is the same as that of both MPEG-2 and H.264/AVC: a block-based hybrid that combines motion-compensated prediction and transform coding with entropy coding.

A simplified block-diagram of an HEVC encoder is shown in Figure 1.

Within this traditional architecture, HEVC includes many innovations, particularly in the flexible quad-tree block partitioning structure that facilitates the use of large sizes of coding, prediction and transform blocks. Figure 2 highlights some of the key differences between HEVC and the H.264/AVC standard.

HEVC Profiles, Tiers and Levels

Conformance points for HEVC are defined by using a combination of three constructs: profiles, tiers and levels. Previous video coding standards used only profiles and levels.

Profiles define subsets of the syntax and semantics of the standard. The initial HEVC standard contains three profiles: the Main, Main 10, and Main Still Picture profiles. DVB applications are likely to focus on the Main and Main 10 profiles, which support 4:2:0 format video with 8 bit depth and up to 10 bit sampling depth, respectively.

Two tiers have been defined for HEVC, to specify classes of applications whose requirements differ only in terms of the maximum bit and coded picture buffer size. The Main Tier is relevant for most DVB use cases, although the High Tier may be applicable to contribution and other "professional" applications.

Levels define limits on the allowed values of key parameters, such as the maximum sample rate and the maximum picture size, which consequently specify which video formats are supported. 13 levels have been specified for the Main and Main 10 profiles, as shown in Figure 3. The supported video formats include UHDTV formats as large as 7680×4320 at 120 frames/s.

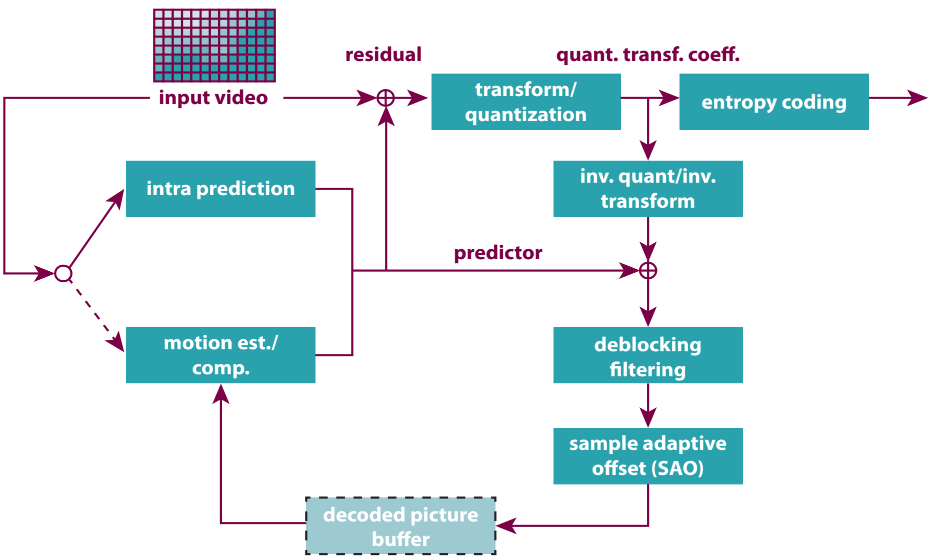
Ken McCann, ZetaCast

HEVC Performance

There are two types of measurements that can be carried out to evaluate the performance of a compression system: objective and subjective. Objective measurements perform some form of mathematical calculation, typically using the Peak Signal-to-Noise Ratio (PSNR), and are a convenient method of obtaining an approximate indication of video quality. However, the only way to really determine the quality perceived by viewers is still the time-consuming and expensive process of running formal subjective tests.

The goal of the HEVC work was to create a new standard that would require only about half the bitrate to give the same subjective quality as H.264/AVC. Verification testing to determine whether or not this performance goal has been

Fig. 1: Simplified block diagram of an HEVC encoder



achieved would ideally use a different set of test sequences from those used during the development of the standard, to avoid any accidental bias in favor of particular types of sequences.

Such an evaluation process is currently underway within the "Beyond HD" group of the EBU. The subjective testing has not yet been completed, but objective testing results for Main and Main 10 profile at level 5.1 were reported (at the DVB/EBU UHDTV Fact Finding Meeting in May) to give average bitrate savings of about 46% relative to the equivalent H.264/AVC profile and level combinations, for both 8 and 10 bit coding. These results were consistent with those of other studies, as were the observations that the greatest gains were achieved at the highest video resolutions. It appears that HEVC is particularly well suited to encoding UHDTV content, due to the larger coding and transform block sizes.

Inclusion of HEVC in DVB standards

Work is already underway on including HEVC in the DVB specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream (TS 101 154). Since the Commercial Requirements have not yet been completed, a "straw man" is being drafted to help facilitate the technical discussion. Main Tier will be used, but the exact choice of profile and level combinations has not yet been finalized. The general approach is to add DVB constraints to the generic HEVC profiles and levels only if application-specific requirements are identified, e.g., to enhance interoperability by constraining the combinations of video resolution, frame-rate and chromaticity that may be used in DVB applications.

The plan is to complete the work on the inclusion of HEVC in a revision of TS 101 154 in early 2014.

When will HEVC-based services be launched?

A specification is all very well, but when will there actually be HEVC services? The experience of MPEG-2 and H.264/AVC implies that consumers and industry are prepared to consider a change of video compression algorithm roughly once a decade, provided that it can be justified by about a factor of two improvement in coding efficiency and commercially attractive new services. If history repeats itself, then HEVC could support both a new generation of 1080p HDTV services and also the launch of the first UHDTV services in 2015.

Fig. 2: Comparison of HEVC and H.264/AVC

	HEVC	H.264/AVC
Coding Tree Unit	64x64, 32x32, 16x16 CTU	16 x 16 macroblock
Coding Unit	64x64, 32x32, 16x16, 8x8 CU	16 x 16 macroblock
Prediction Unit	square, symmetric rectangular, asymmetric rectangular PU	square, symmetric rectangular
Transform Unit	32x32, 16x16, 8x8, 4x4 TU	8x8, 4x4 transforms
Intra prediction	33 directional modes, planar, DC	9 directional modes
Motion prediction	advanced motion vector prediction	spatial median, temporal colocated
Luma interpolation	¼ pixel 7-tap, ½ pixel 8-tap	½ pixel 6-tap + ¼ pixel bilinear
Chroma interpolation	4-tap	bilinear
Entropy coding	CABAC	CABAC, CAVLC
Loop filtering	deblocking filter, sample adaptive offset (SAO)	deblocking filter

Fig. 3: Levels for Main and Main 10 profiles

Level	Maximum luma sample rate (samples/s)	Maximum luma picture size (samples)	Maximum bitrate (Mbits/s)		Example video formats
			Main Tier	High Tier	
1	552 960	36 864	0.35	-	
2	3 686 400	122 880	1.50	-	
2.1	7 372 800	245 760	3	-	
3	16 588 800	552 960	6	-	
3.1	33 177 600	983 040	10	-	
4	66 846 720	2 228 224	12	30	720p @ 50/60Hz
4.1	133 693 440	2 228 224	20	50	1080p @ 50/60Hz
5	267 386 880	8 912 896	25	100	
5.1	534 773 760	8 912 896	40	160	4Kx2K @ 50/60Hz
5.2	1 069 547 520	8 912 896	60	240	4Kx2K @ 100/120Hz
6	1 069 547 520	35 651 584	60	240	
6.1	2 139 095 040	35 651 584	120	480	8Kx4K @ 50/60Hz
6.2	4 278 190 080	35 651 584	240	800	8Kx4K @ 100/120Hz

No Pain, No Gain

The Reality of Ultra High Definition

David Wood, Chair, CM-UHDTV & CM-3DTV

David Wood, EBU Consultant

There is a saying that 'the greatest pain of human nature is the pain of a new idea'. Ultra High Definition Television (UHDTV) would not qualify as 'new', but even so, there will surely still be pain. CM-UHDTV is helping with the DVB equivalent of aspirins – i.e., meetings.

By the end of the 1990s, the major 'idea' for UHDTV was already agreed by the ITU. The format of future television systems should be based on assembled multiples of the 'building block' of the '1080p/1920 16:9' image used for HDTV.

The increase in picture quality in an image is proportional to the square root of the increase in the number of 'pixels' in the image. It's an easy road map for the pixel count of future TV formats – step one is four times 1080p/1920, and step two is 16 times 1080p/1920. But there are many other factors that affect quality. Alas, after pixel count or resolution, we have to say goodbye to easy selection of parameter values.

ITU and DVB progress

ITU-R made progress in 2012 in Recommendation BT. 2020 – worldwide agreement on a set of parameter values, with options, for two UHDTV levels – the 'wow' and the 'double wow' levels. The quality jump between each of them is roughly the same as the jump from SDTV to HDTV.

Later in 2012, CM-UHDTV agreed that we need a DVB broadcast format for the 'first' UHDTV level, four times 1080p/1920, usually called 'UHD-1' or 'Ultra-HD' or '4k'. Set makers plan to introduce TV sets for this level from 2014/15. If we were to do nothing, we could risk constraining broadcasters, by legacy, to use a less-than-best broadcast format. We should also try to ensure the public doesn't buy something that subsequently cannot be used. So, arguably, we must move forward with UHDTV broadcast standards now, whatever date we begin UHDTV broadcasting.

The CM agreed with that, but we did not have enough information yet for CM-AVC and TM-AVC to develop an Ultra-HD broadcast format. CM-UHDTV convened specialists from around the world for an over-subscribed workshop at the end of May 2013 to clear the mist.

How do you choose frame-rate?

The problem of choosing UHDTV parameters is not unlike selecting a new car. You choose how big the car and the engine should be. The bigger the engine, the steeper the hill you can ascend, but the more the car costs. Do you choose for the 'worst' steepness, or for 'average' steepness, or for 'flat roads'? It is not black and white; it is statistics.

The frame-rate (images per second) options in ITU-R 2020 include all the 'usual suspects' 24, 25, 50, 60, plus a new higher frame-rate, 120 Hz. Just a minute, you say, – movies are made with only 24 frames per second, and often have about the same resolution as UHD-1, so why do we need any more than that for broadcasting UHD-1?

One key factor is that the frame-rate affects the look of 'realness' – and realness is what we will want for UHDTV. 24 Hz would be impossibly low for good sports' coverage in UHD-1 - probably a 'killer application' for UHDTV. Even 50 or 60 Hz is borderline. Compared to TVs today, with larger UHD screens we will be viewing at a closer distance. As such, the potential judder of 'eye track-able' moving objects increases, unless you increase the number of frames per second – so higher is better.

We are in 'statistics of achieving a given quality' country – the higher the frame-rate, the greater the percentage of content of different types that will look good. How much of the content, and which type of scene content, do you want to 'suit'? This same situation applies to many of the UHDTV parameters we need to choose.

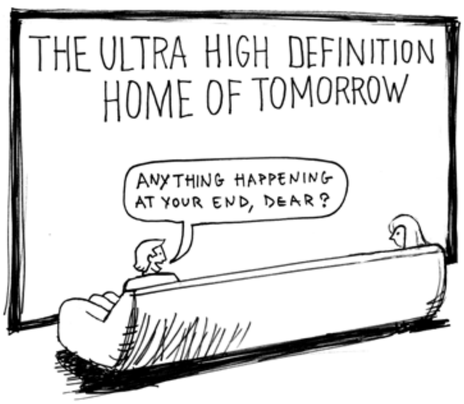
If UHDTV broadcasts are only movies, we could use only a frame-rate of 24 Hz.

> …the frame-rate affects the look of 'realness' – and realness is what we will want for UHDTV.

If we want more critical movement to look good, we would need 50 or 60 Hz. If we want to really show-off UHDTV in sports coverage, the frame-rate could usefully go up to 120 Hz.

But increasing the frame-rate cannot be done 'just like that'. As the frame-rate increases, so does the bitrate we need to broadcast the signal, and the complexity of the receiver. In fact, it will be some years before integrated circuits that can process 120 Hz for inclusion in TVs will be available.

So what 'frame-rate' will be possible in 2014/15? The answer is probably up to 50 and 60 frames per second. If we use this, we will have a format that we might call UHD-1C (C for conventional frame-rates). But after some years, ICs that can process



Eurovision Gdance Contest Meets UHDTV. The annual Eurovision Dance Contest which took place earlier this year in Gdansk, Poland saw test shooting in both UHD-1 and 3DTV. Photo: Yvonne Thomas.

up to 120 Hz may become available and then we could have a second-generation system that we might call UHD-1H (H for higher frame-rates). Of course, UHD-1C signals will still be understandable on UHD-1H sets – 'backwards compatibility'. We need more studies on whether the reverse 'forward compatibility' can be achieved by a process called 'temporal scaling', which would be nice if this can be done.

Colors for UHDTV

The ITU BT. 2020 UHDTV parameter values were designed to be 'future proof', and last for decades. Colors we see on the screen come from the combinations of the three 'primary colors' actually in the screen. The farther apart the color primaries are, the larger the range of accurate colors you see. As years goes by, technology allows primaries that are ever further apart to be included in TV sets, and hence the potential for ever better 'colorimetry'.

For our 'future proof' BT. 2020, we specified a wider set of primaries than are actually used in the first UHD-1 TV sets. So, how can we cope with a broadcast that assumes the color primaries are wider apart than they actually are in the TV set today? There are two options, and we may need both. One is to specify exactly how to make the best conversion between the primaries, and the other is to 'opt-out' of broadcasting the wider primaries for the moment – telling the receiver that you are doing so by 'metadata'.

Discussion Proposal for a DVB UHDTV Broadcast Profile — Version 1.0 (summer 2013)

Main Characteristics		
	UHD-1C	UHD-1H
Availability	2014/15+	2017/18+
Scanning format	2160p/up to 60 Hz	(spatial scalable) 2160p/up to 120 Hz including 100 Hz, with 1080p base layer
Aspect ratio	16:9	16:9
Bit depth	10 bit/sample	10 bit/sample
Audio	5.1 Audio	Advanced audio beyond surround sound
Additional features	(base layer for UHD-1H) decode 1080p/up to 120 Hz including 100 Hz	
HDR	Possibly HDR if available	HDR
Issues to resolve:	need for additional 150 Hz for UHD-1H base layer, NTSC-linked field rates, metadata	need for additional 150 Hz, metadata, NTSC-linked field rates, may be base layer for spatially scalable UHD-2 (4320p/up to 120 Hz)

Helping Contrast Range

Another critical factor affecting image quality is the 'contrast range' – how many 'shades' you can fit between the lightest and the darkest colors. In real life, the contrast range is really huge and TV displays have to bring this into a more manageable range, yet one that looks real. BT. 2020 offers certain dynamic range options (governed by the number of bits/sample), but some DVB Members believe that this alone will not do justice to what could be achieved. Additional signals and processing could be used to enhance the dynamic range (High Dynamic Range or HDR). This idea would be useful for very bright TV displays and for showing the depths of black, and glints in the eye. There are a number of suggestions about how this could be done, and we hope for a single proposal soon.

Sound for UHDTV

There is another complex issue - the audio system to use for UHDTV. As the TV screen size increases, 'height' information in the audio becomes more valuable. Today's stereo and 5.1 surround sound systems tell us from where a sound is coming from laterally – usually from where in a rectangle lying flat around you, at ear height. With TV screens of 70 inches or more, knowing how far up the screen the sound is coming from will be valuable too. A sound system is valuable that can allow us to 'locate' a sound source laterally and vertically. This can be done in a number of ways, and each approach currently has its proponents. It will take some time to agree a single worldwide system. Thus it seems that the audio for UHD-1C will need to be based on 5.1 audio – which will still be a very good experience.

There is more…

Another very complex issue is the 'color coding', which would take a textbook to explain. Allow me to leave this, and whether we need frame-rates of both 120 Hz and 100 Hz, for another day.

For the moment let me say that throughout all the discussion there was a common thread. We need to develop a system of signaling ('metadata') to explain to the receiver how the program was made and broadcast. Meetings and aspirins can be arranged.

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HOME SWEET HOME

CONGRATULATIONS TO THE DVB PROJECT FROM YOUR PROUD HOSTS AT THE EBU

Photo: Edgar Wilson

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This year we celebrate the 20th anniversary of the founding of the DVB Project. The proliferation of DVB based TV services around the world is evidence of the impact the DVB Project has had in the twenty years since its inception in 1993. With second generation standards now established and the number of receivers reaching the one billion mark, DVB continues to be a vital force in digital media. Over the next eight pages we bring you some of the highlights of the last twenty years and our extended timeline marks the significant milestones achieved over the period.

Celebrating 20 Years

Helmut Stein
Chair, DVB-PCM

DVB is the most successful and globally recognized set of standards for digital video broadcasting and beyond. The promotion and adaptation of the different solutions created in DVB has been a challenging task. In the beginning, the broadcaster focus made it a self-running implementation, at least in Europe. Globally, DVB-S and DVB-C were also widely adopted without real competition. However, with terrestrial broadcasting outside Europe, USA and Japan, a battle began with the two main competitors: ATSC and ISDB-T. Many presentations, demonstrations and comparisons were done worldwide, and the row about detailed technical parameters like S/N and propagation, robustness and net data rates, suitability for SD, HD or mobile services, in all theoretical and real environments, took over the decision process about adaptation in countries planning for ASO. Suddenly, the brave and technical DVB community had to learn about commercial offers beyond pure technology and deal with true and absolutely false statements in lobbying. And, unfortunately, this still goes on in certain areas of the world.

Nevertheless, DVB made its way very successfully and today has approximately one billion receivers installed in the global market. In the broadcast market, at the end of 2011, DVB had a global market share of 68% of which 40% was satellite, 37% cable and 23% terrestrial distribution.

Nonetheless, so many new challenges are still ahead of us. We will continue to work hard on these projects and we will hopefully present more outstanding solutions on the way to our 30th anniversary.

The basis of all this tremendous success however is the incredible spirit of our members in working together, taking up challenges and cooperating in the pre-competitive phase of new ideas. This has been the major success factor of this great project and if you don't believe it, just join the world of DVB!

From the Chairman

Phil Laven
Chair, DVB Steering Board

When looking back over the last 20 years, it is tempting to examine DVB's history in terms of its individual specifications – some of which have been outstandingly successful, whilst others have been dismal failures! More broadly, the fact that analog switch-off has already been completed in 23 of the 27 EU Member States is an obvious testament to the success of DVB. Noting that DVB started life as a European initiative, it is also gratifying to observe that, today, about 40 percent of DVB's Members are non-European and that DVB's technologies are now widely used throughout the world.

Before DVB, the setting of TV standards in Europe was a political issue. Harmonization of TV standards was seen as a solution to the fragmentation of analog TV standards across Europe. The 1986 TV Standards Directive[1] imposed MAC as the mandatory standard for broadcasting satellites. The 1992 Directive[2] mandated the use of HD-MAC and D2-MAC for satellite transmissions that were "not completely digital". This important "get-out" clause recognized that digital TV would be a better solution. In fact, DVB's activities changed the mood – politicians realized that it was better to let industry stakeholders select the most appropriate standards. The result was the 1995 Directive[3] which stated "All television services transmitted to viewers in the Community whether by cable, satellite or terrestrial means shall... if they are fully digital, use a transmission system which has been standardized by a recognized European standardization body". This Directive was subsequently repealed by the 2002 Framework Directive[4] which noted DVB's role in allowing European market players to develop "a family of television transmission systems" and emphasized that regulators and governments should be bound by the concept of "technological neutrality". In essence, DVB succeeded in "stopping politicians picking winners". I regard this as a major achievement.

DVB's accomplishments have not been achieved easily. It has been built on the sustained efforts of thousands of individuals. I take this opportunity to thank all of those "unsung heroes" who, over the last 20 years, have done so much for the benefit of DVB and for the wider community.

1. 86/529/EEC
2. 92/38/EEC
3. 95/47/EC
4. 2002/21/EC

The DVB Project would like to thank all its Members for their participation in the success of the DVB over the last twenty years. In particular a very warm thank you to the following Member companies sponsoring the DVB 20th Anniversary Event: ***DekTec, Harris Broadcast, Newtec, SES, Sichuan Changhong Network Technologies Co. Ltd., Sky Deutschland GmbH & Co., TeamCast and Technicolor.***

DekTec Harris Broadcast Newtec SES CHANGHONG sky TeamCast technicolor

DVB: the right ideas, the right people, and the right timing

David Wood
EBU Consultant

We do not create the greatest ideas - they are already there in the wind waiting for us. We just reach out and grab them. The idea of the DVB Project was there twenty years ago, and brought about the most successful and influential broadcast standards of the age. Philip Juttens' DVB logo lives in hundreds of millions of homes across the world. It is a fascinating story.

One definition of history is 'things that never happened, written by someone who wasn't there'. Even written by one who was there, as in this case, it will be incomplete. The story can never all be covered in a short article. May I begin therefore with an apology to those people and things missed? At least you know who you are and what you did, and you have all our thanks[1].

DVB logo designed in 1993 by artist Philippe Juttens, which now lives in hundreds of millions of homes and businesses across the world on products compliant with DVB specifications.

The genesis of the project

The DVB Project had at least two 'geneses' in the early years of the 1990s; one centered in Germany, and one centered in the EBU[2] Technical Committee. In both cases, astute individuals recognized that digital broadcasting was now practical, following the revolutionary development of digital video compression based on transform coding, in the ISO/IEC Moving Picture Experts Group (a pretentious name but a group that achieved so much).

In the EBU Technical Committee, the idea of a pan-industry project to develop a common digital terrestrial television standard came first from Swedish Television, together with John Forrest from the UK-IBA[3]. But (and maybe fortunately) the EBU decision to create a cross industry group was delayed by a difficult internal debate. John Forrest went on to become Chair of the first Commercial Module on Cable and Satellite Television.

In Germany, the debate was spearheaded in the German Ministry of Posts and Telecommunications together with industry, with leadership from a very dynamic Chief Engineer of the broadcaster NDR, Ulrich Reimers. He was to become the major pillar of the DVB Project for the next 20 years. Europe, and the world, was becoming a more unified market, and hence such an ambitious project needed to go well beyond Germany. The question on the table there was how wider involvement should be arranged.

The ELG, WG-DTB, and DVB Secretariat

All the elements came together with agreement by the two interest areas to join forces to create a European Launching Group, which led, via a sub-group the WG-DTB, and the preparation of an MoU, to the DVB Project itself. The Secretariat of the activities was to be shared between the German ministry, and the EBU.
The DVB Steering Board would be led by Peter Kahl from the German Ministry who would provide its Secretariat. The Secretariat of the DVB work below the Steering Board would be done by the EBU. The EBU team providing the Secretariats was the author and Kristina Kabat. There would be a 'mainstay' of a Technical Module led by Ulrich Reimers, and two Commercial Modules on Satellite/Cable and Terrestrial broadcasting, led respectively by John Forrest and Philippe Levrier from the GRF[4].

Eventually all the Secretariat was taken over by the EBU. Was this for efficiency, or partly because the lunches were much better (than Frankfurt airport) at the EBU? EBU staffs were recruited to focus on DVB – Peter MacAvock and Lou Dutoit. Peter MacAvock went on to be the brick of the project, and serve it famously until 2009. The current Project Office team is (as if you didn't know) Desiree Gianetti, Eva Markvoort, and Feyo Kolff, led by Peter Siebert.

Lessons from the past

In life, wisdom comes after all other possibilities have been exhausted. The DVB founding fathers had much to learn from, of earlier broadcast system projects that had not met expectations in practice. The 1970s saw the DSR system in Germany. The early 1980s saw the 'MAC/packet' satellite broadcasting standard led by the EBU, followed by the HD-MAC standard led by the consumer electronics industry. Later in the decade came PALplus led by German, Dutch, and UK companies. There was also the DAB system, where work was centred on a Eureka collaborative project. All of these had led to great systems, but either (forgive me if, like me, you helped develop some of them) whose time had not yet come, were too expensive, or did not offer the public enough gain over existing technology.

But digital television broadcasting, in the early 1990s, was an idea whose time had come, and the experience was there to make it successful. The name 'DVB' came from Armin Silberhorn (then on secondment to ETSI from the MPT in Germany) – drawing a little on the name of the earlier European digital radio project, DAB.

EBU Headquarters in Geneva, Switzerland home of the DVB Project Office.

[1] Do e-mail us major things missed (dwood@amp151.hbs.edu).
[2] The EBU is the collective organization of Europe's national broadcasters.
[3] Then the controlling body for the UK's public service commercial TV companies
[4] The collective organization of broadcasters in France.

One of the most significant elements of the project was its 'bicameral' nature, an idea that was proposed by Robin Crossley from SES. The concept was that a specification should be prepared based on an appraisal of what it needs to do to be commercially successful.

DVB Montreux Symposium event in 1999 where Members and invited guests enjoyed a cruise aboard a Swiss Paddle Steamer on Lake Geneva.

The structure of the project

Though the bicameral groups, the Technical and Commercial Modules were (and still are) the heart of DVB, in a short time a comprehensive group structure was developed. It included a further Commercial Module led by Graham Mills on Interactive Services, groups on regulation, rules of procedure, IPR, budgets, conditional access, and a host of ad-hoc groups in the modules. Helmut Stein enthusiastically led the Communications and Promotions Module at the start[5] - as he does today.

The project brought together broadcasters, consumer electronics manufacturers, signal carriers, and regulatory bodies with the common goal of creating common, commercially valuable technical standards. There were three 'by-words': open, interoperable, and market driven. They have served the project well ever since.

The focus of the project is the specification, with as many common elements as practical, of alternative ways of delivering digital television – by satellite, cable, MVDS, and terrestrially, and all the elements that serve them. The first system DVB developed was DVB-S. The first users were Multichoice in South Africa, Shinawatra in Thailand, DF1 in Germany and Canal+ in France.

Over the years when IC technology evolution allows, new generations of the systems are developed. DVB-T, DVB-T2, DVB-S, DVB-S2, DVB-C, DVB-C2, DVB-H, DVB-NGH. The project tries to stay one step ahead of the game. This is the way it has to be, but it does mean that sometimes the commercial environment has changed between the time the requirements are drawn up, and prospective launch, so inevitably not all specifications will be 'hits' – though most are - but that is the price you pay for being in the lead vehicle.

The Chairs of the DVB Steering Board over the last 20 years have been Peter Kahl, Theo Peek, and (today) Phil Laven. The Technical Module Chairs have been Ulrich Reimers and (today) Nick Wells. The Commercial Module Chairs have been John Forest, Philippe Levrier, and (today grouping all elements together) Graham Mills. These truly have been the 'right people'.

The DVB team have many fascinating stories to tell about the project – the arguments, the meetings, the personalities, the political issues, the demonstrations, the heartaches when things didn't work, and the joy when they did. Just offer them a drink and listen-up.

Finally, my personal thanks to Dr. George Waters, the wise-man of the project, who gave me and the DVB Project so much help and advice in the launch.

Dr. George T. Waters was former Director General of the Irish Public Broadcaster, Radio Telefis Eirean before joining the European Broadcasting Union in 1986 as Director of the Technical Department until 1997. He served as the DVB Steering Board representative for the EBU and as Chairman of the Finance AHG.

IBC over the years has seen many "world's firsts" using DVB technologies. The annual event, which sees over 90 DVB Members exhibiting also provides an excellent opportunity for the DVB family to catch-up with one another on the DVB stand.

[5] The video explanation of the project, 'Marilyn', prepared by the PCM, is available on the DVB website.

DVB's Commercial and Technical Modules

How they work together to define DVB specifications

Graham Mills
Chair, DVB-CM

Dr. Nick Wells
Chair, DVB-TM

From its inception, DVB's work has been guided by a deep understanding of what the market requires, as identified by a Commercial Module (CM), focusing on the most commercially relevant areas. DVB specifications are then developed by a Technical Module (TM) with a Steering Board overseeing the work of these two modules. Within the CM and TM, around a dozen sub-groups are active at any one time, working on specifications for TV delivery over satellite, terrestrial and cable networks as well as signaling and other specifications, including those for IP-based networks and companion devices.

The separation of commercial and technical discussions has proved to be very successful. It enables market requirements and use cases to be defined before looking at technical options in detail. It provides a purposeful focus for technical work, preventing lengthy discussions in technical groups about whether particular functionality is required or not. It provides effective separation of the different types of expertise required for commercial as opposed to technical discussions. An example of how this works in practice was in the DVB-T2 standard. Engineers involved in the technical work would have loved to include a state-of-the-art technique known as MIMO to give a significant improvement in transmission capacity through the use of two or more receive antennas. However, this technique would have required all homes to replace their aerial installations. The CM decided that a key reason for the success of DVB-T was its ability to re-use existing aerials and down-leads. Including MIMO would therefore be a hindrance rather than a benefit. Hence, the TM avoided wasting valuable resources on a specification for MIMO that wasn't seen to be required within the T2 specification.

Often there are technical innovations that provide new commercial opportunities. Therefore, DVB has a practice of initiating TM 'Study Missions' to explore the potential of new technologies without initial commercial requirements. The results are then considered by the CM which might then develop commercial requirements for specifications work within the TM. Important work areas currently underway are:

- *Completing the Next Generation Handheld (DVB-NGH) specification*
- *T2-MIMO Study Mission*
- *Extensions to the satellite specification (DVB-S2) to improve capacity and features*
- *Extensions to the cable specification (DVB-C2) to meet new requirements*
- *Extension of the CI Plus specification for conditional access modules*
- *IPTV specification enhancement for IPv6*
- *Incorporating MPEG-DASH into DVB-IPTV specifications*
- *3DTV specifications including subtitles*
- *Higher resolution services, beyond HDTV, including HEVC*

Future work areas include terrestrial broadcasting, where intense, growing pressure on limited spectrum resources is coming from ever increasing demand for more TV channels and higher bit-rates for 3D-TV, HDTV and beyond. The mobile telecom industry is also competing for spectrum that has traditionally been assigned to broadcasters. Inevitably, there will be pressure on all spectrum users to make the most efficient and flexible use of spectrum and pressure on broadcasters and mobile operators to share spectrum. DVB is uniquely well-placed to contribute its know-how, working with mobile standards bodies to reduce demand on 2-way mobile networks carrying growing volumes of intrinsically one-way services, through enhanced standards that meet demand in a spectrum-efficient way.

Broadcasters are experiencing rapid growth in the proportion of viewing through IP network-connected devices. Much of this is for catch-up services on the Web but it will reach a turning point where consumers can view a virtually unlimited range of real-time broadcast services in full-HD or higher quality over the high-speed broadband networks now being rolled out. Although open standards for the core technologies are already in place, there are many opportunities to set open standards for supporting functionality – particularly for programme discovery and description.

> ***"TM 'Study Missions' often explore the potential of new technologies and the results are then considered by the CM, which might then develop commercial requirements for specifications work within the TM***

The rapid adoption of tablet computers and the increasing sophistication of smartphone apps open up further opportunities for broadcast and related services to use companion screens i.e. associated content and apps on a device that interacts with a programme on their main TV. Several aspects of such systems, such as device synchronisation, could be standardised for the benefit of users, broadcasters and consumer equipment manufacturers.

In summary, DVB has a full programme of current and future work in important and relevant areas for the broadcast industry. DVB's strength is in the business capabilities of its member companies and the expertise of the individuals contributing within DVB working groups. This is reinforced through its culture of building consensus throughout the commercial and technical aspects of the work to be done.

Delivering Digital Standards for 20 Years

DVB 1993 2013 20 YEARS

1993

Memorandum of Understanding for the Development of Harmonised Digital Video Broadcasting (DVB) Services in Europe

DVB founded with the signing of the Memorandum of Understanding in Bonn, Germany by 80 members

Peter Kahl
Chairman,
DVB

DVB-S

MPEG-2 approved by ISO

DVB-CSA

DVB-SI

1994

DVB logo registered

Peter MacAvock
becomes Executive Director,
DVB Project Office

DVB-C

ITU recommends DVB-S for digital satellite television

1995

DVB-T

Making its debut at IFA, the DBox was one of the first DVB-S compliant satellite set-top boxes. It went on to be produced and distributed in large quantities

DVB-PI

DVB-MPEG

DVB-CI

1996

Theo Peek
Chairman,
DVB

Digital satellite services on-air in France, Germany, South Africa and Thailand using DVB-S

1997

First digital cable service launched in USA using DVB-C

DVB-M

DVB-DATA

1998

First ever digital terrestrial services go on-air in the UK using DVB-T

1999

Making its debut at IFA, the Nokia Media Screen was the first mobile device combining DVB-T, GSM and internet (WAP)

The year of Mobile Digital Television. DVB demonstrated the first mobile digital television transmissions using DVB-T at NAB in Las Vegas, followed by demonstrations in Singapore and on trams during IBC in Amsterdam. The COFDM multi-carrier modulation systems used in DVB-T enabled reception in the challenging mobile environment

DVB-DSNG

2000

DVB demonstrated the flexibility of DVB-T and its Hierarchical Modulation capability by transmitting a dual service of HDTV and SDTV at 6 Mhz in the same channel. Both fixed and mobile screens were used for reception of the service broadcasted from a transmitter site atop Black Mountain in Nevada, during NAB in Las Vegas. At the DVB press conference, Nat Ostroff of Sinclair Broadcasting astounded journalists with the demonstration of the service on a portable device

DVB-RCS

2001

DVB WORLD 2001

First DVB World Conference held in Dublin. The three day event covered topics such as 'DVB - Worldwide Technology For Digital Broadcasting', 'What Is The Main Driving Force In The Introduction Of DVB', 'MHP - Interactivity & Multimedia', 'Codex DVB: Rights and Content Management', and 'The Future Of Digital Broadcasting And Delivery'. The conference programme included a dinner at Trinity College, Dublin

Multichannel News International Ground Breaker Award for Technology Innovation

DVB wins prestigious Multichannel News International Ground Breaker Award for Technology Innovation. The judges "were particularly impressed with the DVB's efforts to bring so many industry companies together to build a consensus and for standards that advance the international multichannel TV industry"

Australia becomes first Asia-Pacific country to launch DVB-T services

2002

Launch of DVB-SCENE magazine with an introduction by Erkki Liikanen, European Commissioner for Enterprise and Information Society

2003

DVB celebrates its 10th Anniversary with a dinner held at the prestigious Beurs van Berlage in Amsterdam, which itself was celebrating its 100th Year Anniversary. The evening was a resounding success with many DVB founders and luminaries enjoying an evening with other DVB Members and celebrating the enormous achievements of the first ten years. Pictured L – R: Peter MacAvock, Carter Elzroth, Philippe Levrier, Anthony Dixon, Peter Kahl, Graham Mills, Theo Peek, Helmut Stein, Ulrich Reimers

MHP services launched in Italy

DVB - SCENE e-news

First DVB Scene eNews launched

DVB-GEM

2004

DVB-S2

DVB-H

DVB-IPTV

2005

Blu-ray Disc

Blu-ray Disc Association adopts DVB-GEM for its interactivity on Blu-ray discs

2006

Joint DVB-TM and DVB-CM Meeting

ITU recommends DVB-S2

2007

DVB-SH

DVB-CSA3

2008

Phil Laven
Chairman,
DVB

DVB-T2

2009

The DVB-T2 Validation and Verification group, coordinated by the Technical Module TM-T2 working group, completed a very successful Plug Fest at the RAI Research Centre in Turin

Peter Siebert
becomes Executive Director,
DVB Project Office

DVB-C2

DVB-T

Launch of the new design DVB Sub-Brand Logos

2010

World's first DVB-T2 services launched in the UK. BBC's T2 engineers at a UK transmitter site

DVB in conjunction with BBC wins IBC Innovation Award for Content Delivery Technology with DVB-T2 specification

Newly designed DVB Scene is launched

DVB-3DTV

2011

India Adopts DVB-T2

DVB launches new design for DVB-Scene eNews

DVB-RCS2

2012

DVB wins prestigious Technical Emmy® Award for Active Format Description system

Introduction of Sony CXD2841ER chipset, a combined DVB-T2 (incl. T2-Lite), DVB-T, DVB-C2, DVB-C, DVB-S2, DVB-S demodulator, enables DVB first and second generation transmission standards in one iDTV.

DVB also introduces new combined Sub-Brand logos

DVB-NGH

2013

DVB receivers reaching the 1 billion mark!

DVB-C2 trials begin in Germany

Since its inception in 2002, DVB Scene has sought to keep DVB Members and non-members abreast of the latest developments in digital broadcast technology. Over this time, some of the most innovative and distinguished figures in their field have generously contributed to bring us up to date with the ground breaking evolutions taking place in the digital domain. We much appreciate their efforts and look forward to working together in the future.

DVB-CID

DVB-S

1993 The DVB-S system for digital satellite broadcasting was developed in 1993. It is a relatively straightforward system using QPSK. The specification described different tools for channel coding and error protection which were later used for other delivery media systems.

DVB-C

1994 The DVB-C system for digital cable networks was developed in 1994. It is centred on the use of 64 QAM, and for the European satellite and cable environment can, if needed, convey a complete satellite channel multiplex on a cable channel. The DVB-CS specification described a version which can be used for satellite master antenna television installations.

DVB-T

1995 The digital terrestrial television system DVB-T was more complex because it was intended to cope with a different noise and bandwidth environment, and multi-path. The system has several dimensions of receiver 'agility', where the receiver is required to adapt its decoding according to signalling. The key element is the use of OFDM. There are two modes: 2K carriers plus QAM, 8K carriers plus QAM. The 8K mode can allow more multi-path protection, but the 2K mode can offer Doppler advantages where the receiver is moving. Guidelines for the applications are available.

DVB-S2

2004 Responding to increased consumer demand for a broader range of (digital TV) services, many cable operators have already upgraded their networks, deploying 256-QAM modulation (thus achieving 50 Mbit/s payload per cable channel) and increasing the frequency range used for downstream transmission up to its maximum of 862 MHz. Many cable operators currently offer a rich analogue TV package alongside several hundreds of digital TV channels and an increasing amount of new, and more sophisticated (interactive and personalised) services.

Demand for more and more advanced services however is constantly growing, and cable operators are seeking ways to offer products like HDTV and VoD on a commercial scale within a relatively short timeframe, together with the required accompanying interactive services. Hybrid Fibre Coax (HFC) networks are therefore being optimised providing enhanced performance and thus allowing even higher modulation schemes than DVB-C is offering today.

A DVB-TM Study Mission (DVB TM 3811 Rev.1) addressing this challenge showed that recent technological developments in the areas of signal processing, channel coding and modulation well provide the means to significantly increase the transmission

DVB-T2

2008 DVB-T2 offers an increased efficiency of 30-50% in its use of spectrum compared to DVB-T.

DTT is designed to facilitate the switch-off of analogue terrestrial transmissions. It's more efficient than equivalent analogue technologies, and less wasteful of spectrum especially if you're able to deploy single frequency networks. Not all countries use DVB-T; some, like the United States and South Korea, use ATSC and Japan has deployed ISDB-T.

But each of these countries will see analogue switch-off just as in DVB-T markets. The difference is that ATSC has no solution to exploit the better spectral efficiencies possible with modern technology, and ISDB-T has likewise not sought to exploit the unique opportunity afforded by ASO to update its systems.

Is DVB-T2 a candidate for advanced services in territories which don't use DVB-T and which are switching off analogue television in the coming years? Of course it is!

DVB-C2

2009 On February 18, 2008 it was announced that a new standard – DVB-C2 – would be developed during 2008, and a "Call for Technologies" was issued.[1] Proposals including simulation programs and information on patent rights could be submitted until June 16, 2008.

"The results of the DVB-C2 Study Mission already provided clear indications that technologies are available allowing the performance of the second generation DVB cable transmission system to get so close to the theoretical Shannon Limit that any further improvements in the future would most likely not be able to justify the introduction of a disruptive third generation of cable transmission system." (DVB-C2 CfT)

By using state of the art coding and modulation techniques, DVB-C2 should offer greater than 30% higher spectrum efficiency under the same conditions, and the gains in downstream channel capacity will be greater than 60% for optimized HFC networks.

The final DVB-C2 specification was approved by the DVB Steering Board in April 2009.[2]

DVB-C2 allows bitrates up to 83.1 Mbit/s on a 8 MHz channel bandwidth when using 4096-QAM modulation; future extensions will allow up to 97 Mbit/s and 110.8 Mbit/s per channel using 16384-QAM and 65536-AQAM modulation.[3]

Modes and features of DVB-C2 in comparison to DVB-C

Technologies that drive Televes products

Televes congratulates DVB on its 20th Anniversary

Televes designs, develops and manufactures systems
and solutions for distribution and reception of television services
within digital building and home infrastructures.
Support and full committment to open standards for digital television has driven our product development for more than 50 years.

DVB MEMBER NUMBER 50251 SINCE 1995

100% Designed, Developed & Manufactured by Televes Corporation
televescorporation ▪ televes.com ▪ televes@televes.com

Televes

Maintaining Excellence

Enhancing a Great Standard

Alberto Morello, RAI

Alberto Morello, Chair, TM-S2

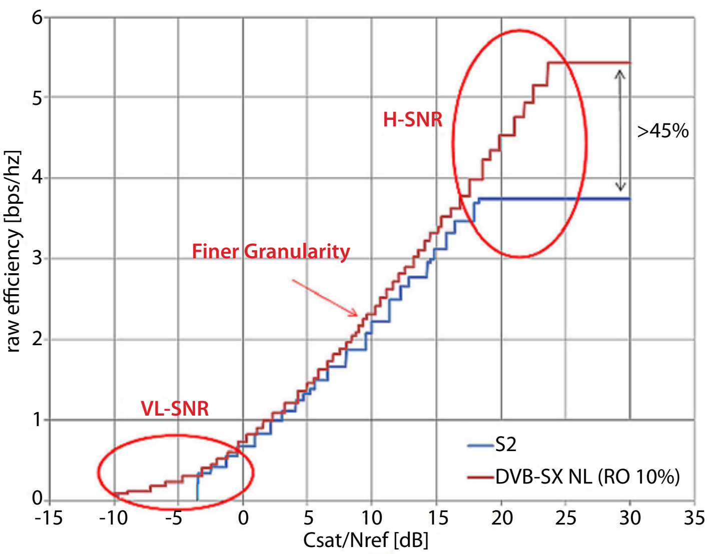
In 1993 with DVB-S, and then again in 2003 with DVB-S2, the satellite standards have been the first physical layer systems of a new generation of digital standards to be developed in the DVB family, setting the benchmark for technical excellence and also for driving the design concepts for terrestrial and cable applications. Now, ten years after the development of S2, the DVB Project is analyzing a further evolution of satellite technologies. In 2013, following a request by the Commercial and Technical Modules, two parallel initiatives were launched in the DVB-S2 group. One of which was for the development of an evolution of the DVB-S2 specification - fine-tuning the technical specification without major increases of the receiver complexity. The other was for the launch of a study mission on "revolutionary" satellite technologies that would analyze the potential of totally new technical approaches with much wider complexity boundaries several times that of DVB-S2. The DVB-Sx specification, still in draft form, is suitable for covering traditional S2 use cases that include digital video broadcasting, interactive broadband applications (forward link), Digital Satellite News Gathering and other professional links such as internet trunking. It also encompasses new use cases operating at very low SNR, such as mobile services for business jets, fast-trains, and boats, etc., and low-aperture terminals for journalists. DVB-Sx enhances the flexibility of DVB-S2 by means of various fine-tunings:

- sharper roll-off filtering has been introduced (10% and 5%) in order to limit interference on adjacent channels when the transmission symbol-rate is maximized;
- the number of modulation and coding combinations (MODCODs) have been roughly doubled in order to achieve a finer granularity in terms of spectral efficiency versus required SNR, including new high-order modulation formats (64APSK to 256APSK) to better operate at very high SNRs;
- new transmission modes have been introduced to cope with very-low SNRs (down to -10 dB).

The graph shows the Capacity / SNR curve of DVB-Sx compared to S2, evaluated on a simplified satellite channel model of fixed bandwidth, where the Sx transmitted symbol-rate is increased by 10% due to the sharper roll-off (10% instead of 20%). It shows the very low SNR region of Sx, which is off-limits for S2, and the very high SNR region where the S2 performance is saturated due to the lack of higher order constellations. The tables (preliminary results, further work being in progress) show the average efficiency gain of Sx in the various SNR regions for the nonlinear and linear (AWGN) channels. The enhanced flexibility of Sx will reinforce the excellence of S2 as the only standardized system capable of covering a wide variety of application scenarios from consumer to professional. Another nice surprise from the activity of the S2 group was to discover that the use of more sophisticated receivers (including a linear adaptive equalizer, already present in some state-of-the-art chip-sets, or even more advanced and complex recursive decoding/demapping technologies) can significantly improve the efficiency of S2 and Sx, from 5% to 10%. Thus, for the launch of new UHDTV-1 services combined with HEVC video coding, the new decoder may include Sx extensions for enhanced flexibility and spectrum efficiency optimization.

The summer 2013 meetings of the Technical and Commercial Modules and of the Steering board reviewed the Sx developments and the recommendations to develop a new Annex to EN 302 307 (the name of which is still under discussion). We expect that this work will be completed by the end of the year.

But will this be enough to guarantee that DVB will remain the lighthouse for standardized satellite systems for the next decade? This strategic question is still under study in the S2 group, where a variety of next generation technologies are under evaluation: FEC schemes including rateless Raptor codes and iterative demapping-decoding algorithms, combined decoding/equalization, interference mitigation to achieve a higher frequency re-use in interactive satellite applications. In particular, "faster-than-Nyquist" signaling reduces the waveform spacing in time without changing the occupied bandwidth by introducing a controlled amount of inter-symbol interference that is removed by the receiver. Another technique, single carrier-OFDM, allows a simplified sharp roll-off implementation and could be beneficial, in particular, for mobile applications requiring linear equalization. The first results seem to indicate that the "King S2/Sx" is still steady on his throne, however, to have final confirmation we will need to wait until the end of the year when the study mission completes its tasks.



DVB-SX NL (RO 10%) vs DVB-S2 (RO 20%)	Nonlinear	
	Efficiency	#modcods
Mobile (-10 – -3)	26.77%	6
Low (-3 – 5)	11.50%	11
Broadcast (5 – 12)	9.53%	15
Professional (12 – 24)	17.16%	18
Full (-10 – 24)	16.24%	50

DVB-SX L (RO 10%) vs DVB-S2 (RO 20%)	Linear	
	Efficiency	#modcods
Mobile (-10 – -3)	10.01%	6
Low (-3 – 5)	6.10%	14
Broadcast (5 – 12)	12.19%	20
Professional (12 – 24)	29.71%	13
Full (-10 – 24)	16.50%	53

w w w . t e a m c a s t . c o m

10 years TeamCast

ROVER INSTRUMENTS

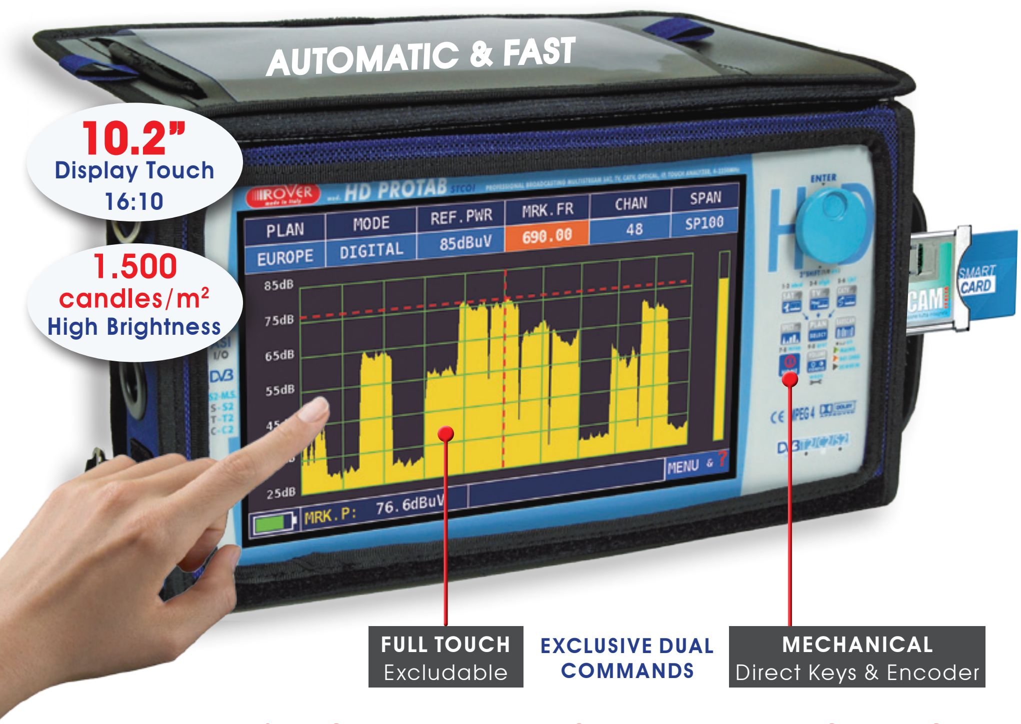
DVB T2/C2/S2 MPEG4

HD PROTAB STCOI

SAT TV CATV OPTIC IP TV

DOLBY APPROVED

PROFESSIONAL BROADCAST HD ANALYZER for:
DVB–T2 / T2 LITE / C2 / S2 & ATSC / ISDB–T / GB20600 / J83B



50Ω “N” Connector / 75Ω “F” Connector — RF IN
- FREQ. RANGE 4–2.250 MHz
- DVB–S2 MULTISTREAM
- DVB–T2–T2 LITE & C2
- ISDB–T (6/8 MHz)–ATSC–GB20600
- ANALOG TV
- FM RADIO
- DAB & DAB +
- REAL TIME SPECTRUM
- MINI SPECT. WITH PICTURES
- GSM BAND
- LTE ANALYSIS & FILTER
- ITU QUALITY COVERAGE
- PRODRIVE TEST SW

ASI T.S.
- INPUT/OUTPUT
- DVB–T SFN NETWORK DELAY MEAS
- ETR 101–290 T.S. ANALYZER
- RECORD/READER

IP TV
- IP TO ASI DENCAP.
- ASI TO IP ENCAP. (opt.)
- IPTV ANALYZER

LAN
- T.S. LIVE STREAMING
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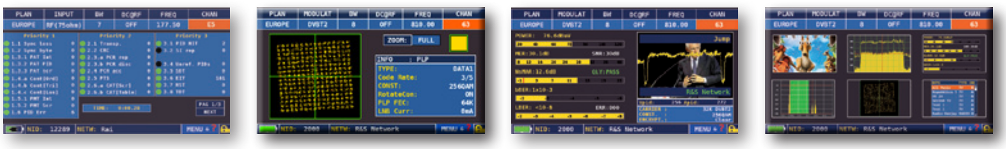

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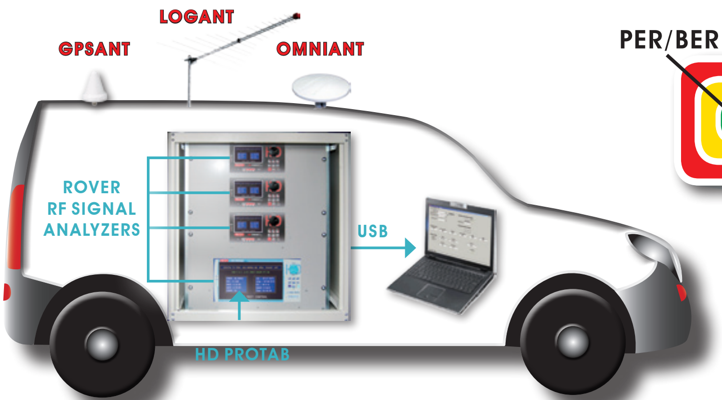

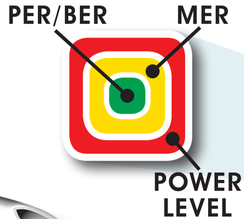

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Notes on New Measurement Guidelines for DVB-C2 signals

Jürgen Lauterjung, Chair, TM-MG

The DVB Measurement Guidelines for C2 signals were approved by the TM and subsequently by the CM and the Steering Board in early 2013. In March 2013 they were published as a Blue Book (A14-3).

The first part of the C2 Measurement Guidelines describes the RF related measurements. Their description was adapted to the particularities of the C2 signal.

- RF frequency accuracy - the measurement is based on the pilots frequencies which are known from the L1-signaling carried in the C2 signal.
- RF sampling frequency - this measurement identifies the occupied bandwidth (7.61 MHz or 5.71 MHz) and is calculated from the edge pilots and/or continual pilots of the DVB-C2 signal (with consideration of notches which may be inserted in the C2 signal).
- AFC capture range - the steps for this out-of-service measurement for C2 receivers are similar to those for T2 receivers but the L1-signaling must remain constant when the modulator frequency is changed.
- Phase noise of LO - is a standard out-of-service measurement as in the T2 Measurement Guidelines.
- RF/ IF signal power - the signal power of a C2 signal is defined as the mean power of the signal between the outermost pilots of the 7.61 MHz (or 5.71 MHz) signal.
- Noise power - the noise power can, in principle, be measured in-service if empty notches (signal-free frequency slots) are created in the frequency range of interest.

The following parameters are all standard measurements:

- RF and IF spectrum
- Receiver sensitivity/ dynamic range for a Gaussian channel
- Linearity characterisation (shoulder attenuation)
- BER before LDPC (inner) decoder
- Number of LDPC iterations

Example of channel occupation in a cable network indicating an unoccupied channel

- BER before BCH (outer) decoder
- Baseband Frame Error Rate BBFER

Standard measurements apply for the IQ-related Modulation Error Ratio (MER), Amplitude Imbalance (AI), Quadrature Error (QE), as well as for the L1-signaling error parameter.

For the Receiver Buffer Assumptions (RBA) validation test parameter, new test streams are required that stretch the receiver buffer to its limits in a well-defined way.

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Seamless Transitions

HII (Hybrid IPTV / Internet TV) aka DVB's MPEG-DASH Profile

Jeff Goldberg, Chair, TM-IPI Ad-Hoc Group HII

Jeff Goldberg, Cisco Systems

Tablets, and I don't mean the soluble kind, are the latest devices to receive TV programming using IP, mostly on-demand but sometimes live. The use by tablets of wireless connectivity meant that the previous way of IP delivery, as characterized by DVB's IPTV specifications, needed to change to make the video stream fit the network and device characteristics, rather than DVB-IPTV method of making the network to fit the video steam. This "Adaptive Bitrate (ABR)" technology is now seen as a better way to deliver any TV programming over IP, both live and on-demand, to Connected TVs as well as tablets and set-top boxes.

ABR works by taking the output from an encoder and encapsulating the stream into a stream of 2 to 10 second segments at several different bit rates. These segments are then placed on a standard web-server and cached using standard web techniques such as CDNs. A file with a list of these segments known as the manifest (XML) or playlist (text) is retrieved by the client, which then pulls the right segment from the web server. The adaptation happens because for each segment there are different bitrates and the client retrieves the segment that it perceives most closely matches the bandwidth of the network, or some other factor such as screen size. When there is insufficient bandwidth due to network congestion, the client retrieves a segment with a lower bandwidth, seamlessly switching between the two segments.

Whilst ABR has been deployed in various proprietary forms since 2007, it was only in April 2012 that ISO ratified the version of its standard: MPEG-DASH. In spite of the length of gestation, this has significant support across the industry, with an industry forum[1] to promote collaboration and interoperability being formed with many members across the whole industry.

MPEG-DASH like any MPEG standard is a toolbox, and constraints are needed on the toolbox to make interoperability easier. In addition, MPEG-DASH was defined initially for tablet and other mobile use cases, rather than TVs. This means that both additions and constraints are required to make MPEG-DASH work for the DVB environment, and this is what the TM-IPI Ad-Hoc Group on HII intends to do. Indeed, this is the only focus of the group, as the work needs to get done by the end of 2013, to satisfy market needs.

The market needs stem from HbbTV and others having products using a simple profile of MPEG-DASH, mostly for VoD programming, already shipping in the market. DVB is working with members of HbbTV and members of many other organizations to ensure that the resulting DVB profile remains as compatible as possible with existing products, whilst extending only necessary functionality.

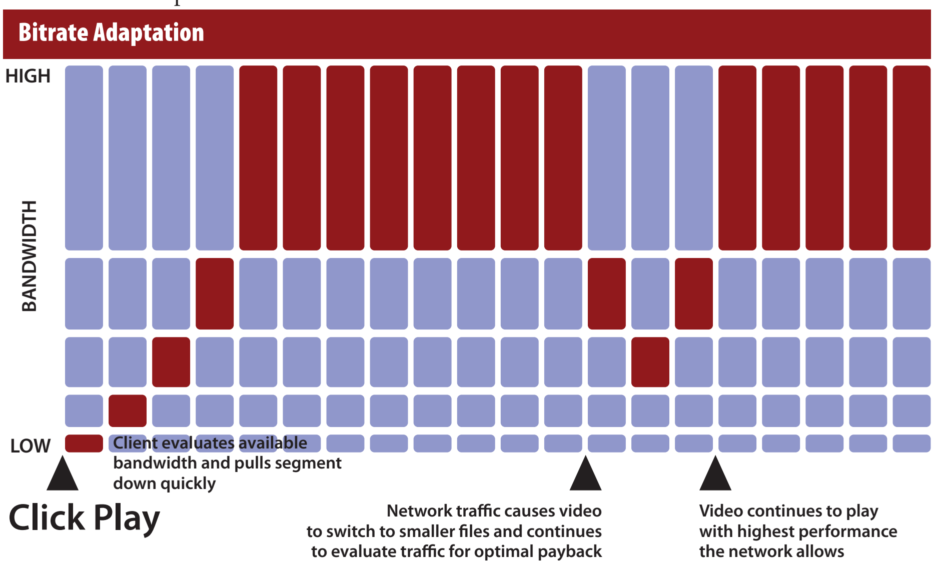
The extended functionality aims to address some key areas which are vital for TV programming:

- Subtitles - HII is working with the EBU in an open forum to make a profile of EBU-TT suitable for distribution.
- Interlaced video streams, e.g., 1080i and multichannel audio.
- Stream Events - to allow the ability to synchronize between applications and the program, for example to trigger a URL at a certain point in the program.
- Advertising - the ability to insert adverts in the stream is vital for broadcasters, but little has been defined on how to make this interoperable or cover all the necessary use cases.

Whilst extended functionality is nice, the basics of interoperability need to be covered too. HII is intending to cover this by defining key parts, such as the types of adaptations that will result in seamless transitions for the viewer. Trick modes also remain a tricky area, and HII will provide guidance and some definitions to make them both more interoperable and a client easier to build.

The first HII document will use the ISO BMFF container format more familiarly known as "fragmented MP4." This is the first time in 13 years TM-IPI has broken away from the much loved MPEG-2 TS. It's a big change, but one vital to meet the requirements of the wider MPEG-DASH market, and shows how DVB is adapting to market changes.

[1] www.dashif.org



Software Friendly

A New Scrambling Algorithm

Alain Durand, Chair, TM-CPT

Alain Durand, Technicolor

In early 2013, DVB published a new specification (ETSI TS 103 127) addressing content scrambling algorithms for DVB-IPTV services using MPEG-2 Transport Stream (TS). A content scrambling algorithm is a cryptographic method used to encrypt audio-visual content streams so that it is necessary to know the decryption key to access and view the content. Scrambling algorithms are ubiquitously used to protect broadcast TV content or VoD content. While it is common to standardize scrambling algorithms, access rights management systems that permit a device to recover content decryption keys are generally proprietary and known as Conditional Access Systems (CAS) or Digital Rights Management (DRM).

DVB issued its first security and encryption standard DVB-CSA in 1994. DVB-CSA technology has been specified in two versions, the CSA1 and the CSA2, both called DVB-CSA, as the only difference is in the length of the key used. The initial DVB-CSA version was designed to last for at least ten years. Fourteen years later, in 2008, DVB issued a new version, called DVB-CSA3, with increased security. One of the main design criteria for both DVB-CSA and DVB-CSA3 was the convenience to implement the algorithm in hardware while it should be difficult to implement in software. One rationale for this criterion is that hardware implementation is more difficult to reverse engineer than software implementation and therefore algorithm secrecy could be better ensured. Algorithm secrecy is a tool to increase legal enforcement against piracy, as implementers need to sign a licence to get access to the algorithm specification.

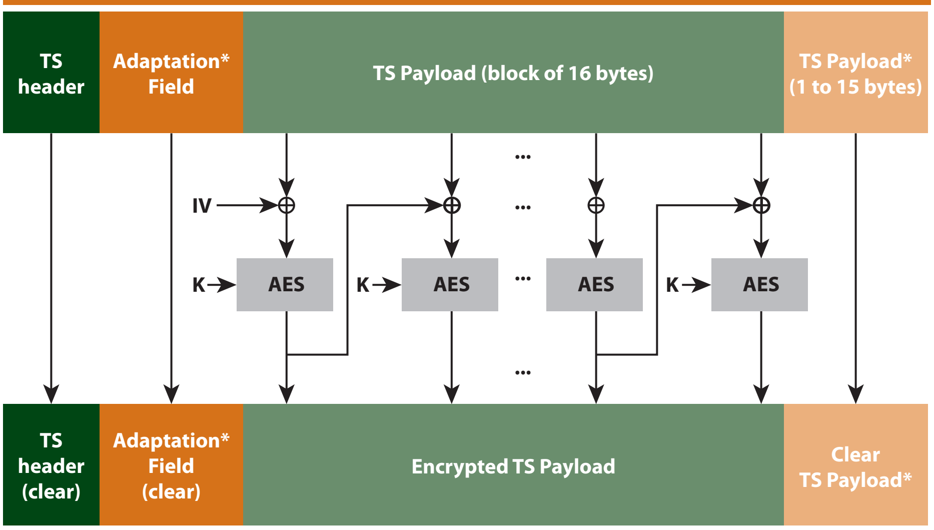
The fact that DVB-CSA3 is not well suited to software environments was the main motivation for DVB to work on a new scrambling specification. It was actually felt that DVB services delivered on IP will have a larger reach than traditional broadcast services (e.g., set-top boxes or digital TVs) and will also target devices with a general purpose CPU like a personal computer, a game console or a tablet. A further motivation was to allow service providers to deliver the same streams – using the same scrambling algorithm – to these devices with general purpose CPUs as well as to set-top boxes or digital TVs. Therefore, the new "software-friendly" algorithm had to be implementable on low-power platforms, preferably in hardware to dedicate the platform computation power to features more appealing to the end-user, like EPGs or user interfaces. As a consequence, the term "software-friendly" shall not be interpreted as "hardware-unfriendly". Furthermore, in order to facilitate market introduction, scrambling algorithms that are already supported by recent generations of set-top boxes were to be preferred.

A candidate, meeting all the above requirements, was indeed existing: It is the Advanced Encryption Standard (AES) which has been selected as the encryption standard by NIST (National Institute for Standards and Technologies) in 2000 after three years of competition between algorithms proposed by world-class cryptographers. AES is ubiquitously used for banking, network or content (e.g., AACS – Advanced Access Content System – used to protect Blu-ray disks or CI+ specification) security. AES is also implemented in recent chips in digital TVs. However, AES by itself is not enough for scrambling purposes. This standard actually only tells how to encrypt 16 bytes. Hence, in addition there is a need to specify a mode to scramble a full MPEG-2 TS packet. Again, there seemed to be a well-suited candidate, the "counter" (CTR) mode that has been recently selected by MPEG to protect content delivered using DASH (Dynamic Adaptive Streaming over HTTP). However, while this mode is very well suited for file-based distribution, it was found not to be very well suited to protect MPEG-2 TS.

Another mode, so called CBC (Cipher Block Chaining), which is also used, for instance, in AACS, was therefore selected to give birth to the Common IPTV Software-oriented Scrambling Algorithm (CISSA). It has to be noted however that, for a relevant implementation in software, implementers will need to be aware of specific software threats and to implement relevant countermeasures.

CISSA is not the only algorithm that is part of the ETSI publication: DVB-CSA (in its longer key version) and DVB-CSA3 are also expected to be used for protecting IPTV services. The future will tell whether CISSA will meet the same success that DVB-CSA did!

CISSA Overview



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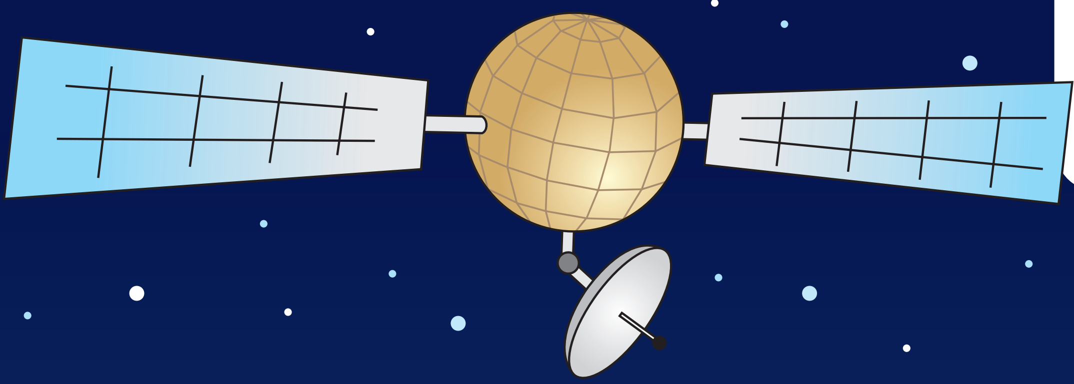

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