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Virtual Reality:
Revolution or Passing Fashion? That is the question!

Looking Ahead

A Word From DVB

Peter Siebert
Executive Director

Welcome to the first edition of DVB Scene in 2016. 2015 ended on a high note with the positive outcome for terrestrial and satellite spectrum at the World Radio Conference (WRC-15). Having sufficient spectrum in Region 1 guaranteed until 2030 gives network operators and broadcasters the commercial stability for future investment in the terrestrial platform. I am also pleased with the outcome of the C-Band discussions for satellite. Even when most of the broadband satellite services in Europe are using Ku band frequencies, C-Band is essential for many regions of the world with high rain attenuation.

Although the broadcast community could defend its spectrum allocation this time, the competition for frequencies will continue and we have to be prepared for the next rounds. The best defense is to provide attractive services in the bands allocated for broadcast.

In this context, I am excited about the introduction of the new terrestrial platform in Germany. The technological basis for the service combines the spectral efficiency of DVB-T2 with the latest video coding technology of HEVC. It is set to be the first use of this new video coding standard for broadcasting HD content. The new platform will deliver a bouquet of HD services in combination with HbbTV to the German market. I am also confident that this solution will find success in other markets.

I am equally enthusiastic about DVB's work on UHD-1 Phase 2 to provide the necessary standards for transmitting 'better pixels'. In 2016, the work will focus on High Dynamic Range (HDR), a wider color gamut, as well as immersive audio coding. Later, following the development cycles of new chipset technology, DVB will also provide the necessary specification for Higher Frame Rates (HFR). I have seen demonstrations of these new technologies and I am impressed by the video and audio quality. These will certainly move the television experience to a new level.

The end of 2015 also saw the closure of DigiTAG. With the successful introduction of digital terrestrial television throughout Europe, DigiTAG has effectively completed its mission. During these times DVB and DigiTAG have worked closely together. Hence, it is logical that the remaining activities of DigiTAG transfer to DVB. DTT services will continually need to evolve to retain relevance. DVB will continue to provide the necessary technology and also to promote terrestrial television. DigiTAG members and others interested in these continuing efforts are invited to join the DVB's Promotions and Communications Module to be a part of this work.

New Standards

EN 302 755 Ver. 1.4.1:	Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2) (Jul - 2015)
EN 301 192 Ver. 1.6.1:	DVB specification for data broadcasting (Aug - 2015)
EN 300 744 Ver. 1.6.2:	Framing structure, channel coding and modulation for digital terrestrial television (Oct - 2015)
EN 302 769 Ver. 1.3.1:	Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2) (Oct - 2015)
TS 103 205 Ver. 1.2.1:	Extensions to the CI Plus TM Specification (Nov - 2015)
TR 102 376-1 Ver. 1.2.1:	Implementation guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 1: DVB-S2 (Nov - 2015)
TR 102 376-2 Ver. 1.1.1:	Implementation guidelines for the second generation system for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 2: S2 Extensions (DVB-S2X) (Nov - 2015)
TS 101 547-1 Ver. 1.2.1:	Planostereoscopic 3DTV; Part 1: Overview of the multipart (Dec - 2015)
TS 102 034 Ver. 2.1.0:	Transport of MPEG-2 TS Based DVB Services over IP Based Networks (Jan - 2016)
TS 102 991 Ver. 1.3.1:	Implementation Guidelines for a second generation digital cable transmission system (DVB-C2) (Jan - 2016)

New Members

Broadpeak designs and manufactures video delivery components for content providers and network service providers deploying IPTV, cable, OTT and mobile services. **www.broadpeak.tv**

Shenzhen Skyworth Digital Technology Co., Ltd (Skyworth) provides digital TV products and services. **www.skyworthdigital.com**

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Virtual Reality

Revolution or Passing Phase?

David Wood, Chair, DVB Study Mission Group - VR

"Captain Picard ...emergency... come quickly to the Holodeck... all the Enterprise's tires have been Vulcan-ized!" This line was never in any script, but the Star Trek 'Holodeck' is one more manifestation of human desire for a totally immersive experience that transports the viewer to another place at the click of a switch. On the journey toward this, Virtual Reality (VR) systems are one of today's hottest topics. DVB has created a Study Mission to try to establish whether it will be important for DVB Members.

Not a Holodeck, but by using a headset, or an enveloping very large screen, will it be possible to feel that we are 'somewhere else'? Will this be something we want to experience permanently, occasionally, or will we soon tire of it? Where will it take us? How will it be done technically? What kind of content would it suit? We know the questions; finding the answers will take time.

The uses of VR in general may, it is claimed, include medicine, military, broadband streaming and possibly broadcasting. In principle, VR could be an option for a DVB delivery system.

We can consider the VR system to be in three parts:

- the image capture;
- the delivery system for processing and transporting the image;
- the display system used.

The VR image is essentially a panorama. Current thinking is that we should try to capture the complete 360 degree environment. Some see this as moving from 'image capture' to 'scene capture'. Complementary 360 degree sound capture also adds to the experience. The 'earthling viewer' himself does not have 360 degree sight, and points his/her gaze towards a smaller angled 'Region of Interest' (RoI). This right RoI should ideally be available instantly to the VR viewer from the panorama, so the viewing experience is the same as in natural viewing.

A 360 degree camera, creating the basis for the panorama, needs a series of cameras pointing at different angles, and the images from them need to be stitched together - think Google Maps recording your street. But now we need a more sophisticated camera that stitches together the moving images perfectly, and for which the resulting panorama can be corrected for geometrical and other distortions. Several models have been developed, which involve using a series of angled mirrors that the cameras fire at. The results can be impressive, but the systems are relatively complex.

> ...the key to success, once the technology is practical, is the availability of content that viewers are willing to pay for.

How far does the VR image need a 'z' plane as well as 'x and y' planes to be immersive? The simple form of providing 3D, stereoscopic imaging is done by providing slightly different left and right eye images. But the fusing of the L and R images by our visual cortex can be mentally taxing, and can only be done for a certain duration. Stereoscopic 360 degree cameras, though a technical challenge, have been developed, but perhaps we need to be 'open minded sceptics' here, because of the experience with 3DTV.

David Wood has chaired the DVB CM-UHDTV group that prepared the Commercial Requirements for the DVB UHDTV systems. The UHD-1 Phase 2 requirements were agreed by the DVB Steering Board in November 2015. David is Consultant, Technology and Innovation, for the European Broadcasting Union, and has previously chaired the ITU-R groups that prepared the Recommendation for UHDTV, ITU-R BT 2020. David leads the DVB's Study Mission Group on Virtual Reality.

The most likely form of VR display is the 'Head Mounted Display' (HMD). There are currently two types. One has built in LCD, OLED, or AMOLED displays. The other works in conjunction with a smartphone that can be inserted into a holder. Some models have a head tracking system built in, or provided by the smartphone, to follow the viewer's RoI. Different systems have different sizes, weight, and levels of comfort. HMDs have been around for many years, but recently, higher resolutions have become possible, which has been one of the main stimuli for VR HMD.

The delivery system for VR could be locally stored content, but it could also be a broadcast or internet channel. There need to be mechanisms for matching the delivery system to the source content format and the display format. For example, as the whole panorama is not needed at once for the HMD, the corrected panoramic image may need to divide into separate 'tiles', so that the delivery bitrates needed are practical. There are many challenges in delivering the right tiles without any time delays.

As always with new technology, the key to success once the technology is practical is the availability of content that viewers are willing to pay for. Which types of content would best suit VR? How can we tell a story using VR? Would it be a new kind of drama production, where each viewer is his own Director? Would it be the view from the terrace at sporting events?

If not quite Star Trek, 2016 will be an exciting year for VR.

P.S. The cardboard VR viewers are not always great on the nose.

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Spectrum Savior

What the WRC-15 decisions mean for Broadcasters

Darko Ratkaj, European Broadcasting Union

Darko Ratkaj is Senior Project Manager at the EBU's Department of Technology & Innovation with the focus on the audiovisual media distribution models and the associated market evolution. This includes technical, regulatory, and policy issues as well as spectrum management aspects of both broadcast and broadband platforms.

The terrestrial broadcasting industry breathed a sigh of relief when the ITU World Radiocommunications Conference 2015 (WRC-15) ended on the 27 November 2015. The key portion of the UHF band was preserved almost intact.

The central issue in the complex negotiations at WRC-15 was the need to allocate more spectrum for mobile communication services. As all candidate bands for a new mobile allocation are already occupied by other users, the delegates had to find a way of meeting the growing spectrum requirements of the mobile industry without jeopardizing future opportunities for the incumbent services. This was a difficult task, indeed.

Going to the conference, broadcasters' main concern was that the frequency band 470-694/698 MHz, which is the core spectrum for terrestrial television in all parts of the world, would be allocated to mobile services. Had this happened, it would discourage investment and would most likely lead to a decline of the terrestrial platform, hence the future of Digital Terrestrial Television (DTT) was at stake.

Fortunately, this did not happen at WRC-15. Instead, the conference decided to keep the allocation in the UHF band unchanged, i.e., an exclusive allocation to broadcasting, except in North America and a few other countries around the world where a mobile allocation was introduced in this band.

Furthermore, it was also decided that this issue will not be revisited at the next WRC in 2019, but only at the subsequent conference scheduled in 2023 after a review of the spectrum use in the entire UHF band (470-960 MHz). On the basis of this review, WRC-23 will consider whether or not to make further changes to the Radio Regulations[1].

The mobile industry has obtained a substantial amount of spectrum at WRC-15 although much less than requested. Following a decision adopted already at WRC-12, the 700 MHz band (694/698-790 MHz) has been globally allocated to mobile services. As a consequence, this frequency band will be released in many countries from terrestrial TV services in the coming years and used for mobile broadband services.

> ...an incentive for further investment in terrestrial broadcasting and turn the platform into a lasting success.

In the C-band, a mobile allocation was included in the lower part (3400-3600 MHz) while the rest of the band (3600-4200 MHz) remains unchanged. This is good news for the satellite industry and many broadcasters around the world that rely on this frequency band for distribution of their services.

Overall, the WRC-15 outcome is good for the broadcast industry. It sends a strong signal that national administrations recognize the importance of terrestrial broadcasting, which in many countries contributes to social cohesion and the growth of the creative and cultural sector. In particular, the terrestrial broadcast platform is crucial for free-to-air TV services.

The WRC-15 decisions give certainty of spectrum access for DTT well into the next decade and the spotlight is now on broadcasters and their industry partners. There is an incentive for further investment in terrestrial broadcasting, in particular, to complete the transition to DTT around the world and turn the platform into a lasting success.

Administrations will watch carefully how spectrum is used but broadcasters should not fear for the UHF band as long as DTT remains efficient, vibrant, and popular. Otherwise, there is a risk that further spectrum might be lost.

The review process in the ITU is scheduled to start in 2019, in time for WRC-23. As not all administrations are content with the WRC-15 decisions, some are calling for earlier discussions or changes at the regional or national level. Undoubtedly, the mobile industry will continue its efforts to gain access to the UHF band. This is why the broadcast industry should not be complacent.

[1]The Radio Regulations are an international treaty governing the use of radio frequency spectrum and satellite orbit resources. They define frequency allocations to various radiocommunications services, while frequency assignments and licensing to individual users are a responsibility of the national regulatory authorities. The main task of a WRC is to review and, if necessary, modify the Radio Regulations. WRCs are held every three to four years. The previous one was in 2012 and the next one will take place in 2019. A WRC also decides what will be the agenda of the next one and the necessary studies are conducted in the interim period.

Dynamic Progress

Transitioning Business Models for Broadcasters

Josh Stinehour, Devoncroft Partners

Josh Stinehour is a Principal Analyst with Devoncroft Partners, a provider of market research and strategic consulting services to a wide range of digital media clients and institutional investors.

2015 was a challenging year for technology suppliers in the broadcast sector. Vendor revenue data compiled in the latest version of the IABM DC Global Market Valuation Report (GMVR) shows aggregate declines across broad product segments and geographic regions. Evidence for a more fundamental shift in the broadcast technology sector is apparent when combining the GMVR vendor data with year-over-year customer data from Devoncroft's annual Big Broadcast Survey (BBS). I believe this represents a structural shift in purchasing behavior and is directly attributable to the business model transition occurring across the broadcast industry.

The broadcast industry perfected its highly profitable operating model over decades of purposeful business and technology decisions. A great example is the distribution infrastructure. Fixed expenses for terrestrial transmission, satellite, or fiber were amortized over a well-understood useful life, and there was relatively no marginal cost incurred in distributing content to incremental customers.

In contrast to traditional delivery infrastructure, internet distribution to digital platforms introduces a marginal cost for each new customer. This is one of several important contrasts with traditional approaches. Regardless, internet distribution holds great promise and has been met with enthusiasm for the better part of a decade. Responses to the BBS as early as 2010 indicated broadcasters were anticipating a significant percentage of revenues (around 30%) to transition to new digital platforms over the subsequent three year period. Despite this optimism for revenues from new digital platforms, actual broadcaster revenue breakdowns are analogous to those observed in 2010 – though near-term expectations for the future remain just as optimistic.

Replicating linear business models on digital platforms remains a work in progress. The vast majority of digital offerings operate at a fraction of the scale necessary for existing broadcast business models or only achieve profitability without the burden of having to pay the true cost of the content. In other words, without linear business models paying for the content, digital offerings are money losers.

Events in late 2015 have accelerated this existential issue for the industry. Comments by the Chairman of Disney on the Company's Q2 2015 earnings call regarding subscriber attrition at ESPN initiated a two-week decline in global media stocks. Approximately $100 billion of market value alone was lost among 11 of the largest global media stocks.

Prior to the events of this past August, digital platforms were viewed more as a complement to existing linear models. But competition was inevitable in the long term because broadcast revenues are bounded by what consumers are willing to purchase, governments willing to subsidize, or advertisers willing to support. All of these measures grow with familiar data points such as household formation, economic growth, or disposable income. Any new revenue streams must eventually impact existing revenue streams.

A transition of revenue streams is not the issue. Rather, the problem is the stark contrast in the quality of the revenue streams. Today, a digital subscriber is worth far less than a traditional linear subscriber. Therefore, if digital distribution is to replace linear distribution in any meaningful portion, then it must replace the revenue streams at a comparable aggregate revenue level and at a similar profile of profitability.

The issue of the next decade then is how to transition lucrative linear revenue models into similarly lucrative multi-platform business models – almost certainly to include a meaningful component of terrestrial transmission. New business models will require a fundamentally different technology infrastructure, which in turn has caused the observed structural shift in the broadcast technology market.

This hints at a much longer discussion of how the technology market is shifting and what it means for technology suppliers. The short answer is an interesting 2016 for the broadcast industry.

Market Decline of Media Stocks: August 2015

Precipitated by:
Disney Earnings Call

"I'd like to address an issue that has been receiving a fair amount of interest and attention these days, and that's the rapidly changing media landscape, especially as it relates to ESPN."

Robert A. Iger, *Chairman, Chief Executive Officer, The Walt Disney Company*

Market Capitalization: August 4, 2015 | **Decline in Equity Prices of Public Media Companies During 2-Week Period in August 2015** | Market Capitalization: August 21, 2015

Invitation to Participate

Devoncroft's research initiatives include the annual Big Broadcast Survey, the largest and most comprehensive study of the broadcast technology market.

You are invited to participate in the 2016 Big Broadcast Survey. Your feedback will improve this independent industry reference on sector developments including technology trends, technology installed bases, and vendor brand and product rankings.

To register to receive the 2016 Big Broadcast Survey use the following link: http://dcft.co/BBSREG.

All participants receive a 100 page report on the 2015 Big Broadcast Survey, and as soon as available, a 100+ page summary of the 2016 Big Broadcast Survey. Participants are also entered into a drawing to win one of five prizes.

Audiovisual Updates

Latest Additions to the DVB Toolbox

Ken McCann, Chair, TM-AVC
Virginie Drugeon, Chair, TM-AVC Video Drafting Sub-Group
David Daniels, Co-Chair, TM-AVC NGA Sub-Group

Since the earliest days of DVB, a single unified specification for video and audio coding has been maintained for all applications based on the MPEG-2 Transport Stream, whether delivered by terrestrial broadcasting, satellite, cable or IPTV. This specification was originally made available in 1995 as DVB BlueBook 001 and published by ETSI as TS 101 154. It has subsequently been updated several times to include further options for video and audio coding and it's being revised again in 2016 to add support for two important new features: Ultra High Definition Video Phase 2 (UHD-1 Phase 2) and Next Generation Audio.

What are the technical challenges for UHD-1 Phase 2?

DVB approved new Commercial Requirements for UHD-1 Phase 2 in November 2015. The new DVB UHD-1 Phase 2 format will be an extension to the DVB UHD-1 Phase 1 format that was finalized in 2014. DVB UHD-1 Phase 2 adds two main technical features to Phase 1: High Dynamic Range (HDR) and High Frame Rates (HFR). Both features aim to increase the sense of reality in pictures by representing a greater range of luminance and color in the case of HDR, and improving motion representation in the case of HFR. Both features are technically independent from each other, so that DVB expects that there will be bitstreams that use HDR only, bitstreams that use HFR only, and bitstreams that use both.

While the technical details of the HDR and HFR formats are still under discussion in the DVB TM-AVC group (the Sub-Group of the Technical Module responsible for audio and video coding), some aspects of the new UHD-1 Phase 2 standard have already been identified as working assumptions for the current discussions:

- HEVC is the codec used for all UHDTV applications;
- Progressive video formats only;
- Square pixel resolutions only;
- 10 bits only;
- BT. 2020 color primaries only;
- 4:2:0 chroma subsampling.

Furthermore, the Commercial Requirements state that at least one backwards compatible profile will need to be specified. Backwards compatibility is understood as the capability for new UHD-1 Phase 2 bitstreams to be decodable by already specified and existing UHD-1 Phase 1 receivers (called HEVC UHDTV IRDs in the currently published version of TS 101 154).

DVB TM-AVC has identified four receiver conformance points to be specified in the next revision of TS 101 154 (see Figure 1) after analysis of the DVB Commercial Requirements for UHD-1 Phase 2. The two receiver conformance points in the upper row of Figure 1 extend the existing UHD-1 Phase 1 receiver conformance point with HDR, while the two in the lower row further add HFR. Therefore, although bitstreams will be able to use HDR or HFR independently, it is expected that all HFR capable receivers will also be HDR capable. Furthermore, the first and second columns of Figure 1 differentiate between receivers that can support only backwards compatible bitstreams and receivers that can support only non-backwards compatible bitstreams. Indeed, the Commercial Requirements identified two distinct market segments for UHD-1 Phase 2 with different requirements. Those markets that do not require backwards compatible bitstreams are expected to benefit, in terms of coding efficiency, from using a solution that is not backwards compatible.

There are currently many potential technical solutions for the definition and transmission of HDR signals under discussion in various standardization bodies (such as ITU-R, SMPTE and MPEG). DVB TM-AVC has therefore started an analysis of potential HDR solutions based on a common framework. Both the framework for analysis and the analysis itself are still work-in-progress, as is the exact number of technical HDR solutions to consider.

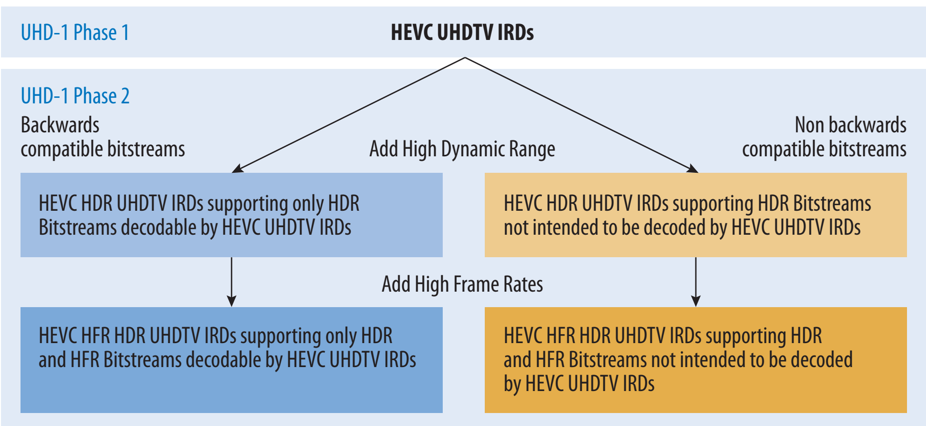
Figure 2 attempts to broadly summarize the different possibilities that have been brought to the attention of TM-AVC so far by grouping solutions in three different classes: single layer solutions, dual layer solutions, and solutions currently under discussion in the MPEG HDR fast track effort that may result in an HDR specific extension to the currently published HEVC specification. The criteria listed in the table are relevant for the TM-AVC effort to draft a specification. Identification of dependencies on other standardization bodies is essential to make sure that the DVB solution will be available in the required timeframe. Other relevant aspects include specification of the bitstream (such as HEVC profile and level, single or dual layer, specification of enhancement layer for dual layer solutions) and signaling of the characteristics of the HDR signal at the video elementary stream level (such as signaling of the transfer function or metadata). The choice and signaling of the transfer function used to grade the HDR content and therefore increase the range of available luminance values is one major discussion point. Two possibilities have been identified: the Perceptual Quantizer Electro-Optical Transfer Function standardized by SMPTE, and the Hybrid Log-Gamma Opto-Electrical Transfer Function standardized by ARIB. Both transfer functions have pros and cons in terms of backwards compatibility and representation of artistic intent.

The situation is easier for HFR since the technical challenges for HFR extension had already been considered during the specification of UHD-1 Phase 1, so that the currently published version of TS 101 154 already covers the basic tools for encoding HFR signals. The main challenges are the specification of the backwards compatible profile that uses temporal scalability and the transmission of the low frame rate base layer and the high frame rate enhancement layer in separate PIDs of the MPEG-2 Transport Stream.

What can we expect from Next Generation Audio?

While the video experts are working on

Figure 1. Four receiver conformance points identified for UHD-1 Phase 2 specification



bringing us closer to creating realistic pictures, some might argue that in the audio world we are already there. But there are still some limitations to be overcome, and the work on Next Generation Audio (NGA) aims to address these. So, what is NGA? Well, NGA is a complete rethink of how audio is produced and delivered, increasing the functionality that can be delivered to the listener, while simplifying the process of production. NGA systems deliver audio as Scene or Object based streams, making it possible to deliver audio and a description of how that audio relates to the soundstage.

In the home, both Scene (also known as Higher Order Ambisonics) and Object based audio systems are loudspeaker agnostic, adapting the rendering to the local speaker and the room's geography and ambience. In the case of a Scene based encoder, the soundfield is captured as a representation of the actual sound pressure map. In the case of Object based audio, a series of audio objects are captured. For example, for an orchestra these objects may be the soloist, the strings section, the percussion section, the hall and audience, etc. For each object, its exact placement in the sound field is also captured.

This allows new use cases to be supported, such as providing improved accessibility by increasing the dialogue object above the ambience. It also supports personalization of the audio within limits set by the broadcaster, giving an immersive experience by allowing a broader soundstage to be rendered in the home and the possibility to better adapt to the device on which the audio is played. Of course, as the audio is rendered by the listening device according to what it knows about the setup in the home, best use can be made of a user's speaker placement and traditional stereo and surround can easily be replicated without the need for multiple mixes to be produced in the studio.

The work on including NGA in TS 101 154 is still in its early stages, with a particular focus on one specific commercial requirement, namely Audio Codec Performance Evaluation. This requirement is the first time that the DVB has tried to crystallize such an evaluation, and as such it is challenging the keenest minds in the business with questions such as what is better: a codec that perfectly reproduces the tone of the sound but puts it above your head when it should be to the right of the soundstage or one that puts it in exactly the right place but sounds a bit fuzzy?

When do we plan to be finished?

The goal is to complete the revised version of TS 101 154, including support for both UHD-1 Phase 2 and Next Generation Audio, in time for approval at the October Technical Module meeting. This is a tough timescale, requiring face-to-face TM-AVC meetings every two months as well as approximately two conference calls per week to progress the details of the video and the audio work. But if the level of dedication and collaboration that has been demonstrated so far can be maintained, we can do it!

Ken McCann is a director and founder of Zetacast, an independent technology consultancy company specializing in digital TV and related areas. Ken has chaired the DVB technical group responsible for audio-visual coding specifications (TM-AVC) since its inception over 20 years ago.

Virginie Drugeon is an engineer at Panasonic AVC Langen Development Center near Frankfurt, Germany. Her main areas of work include video coding, digital TV and related areas. She leads the Sub-Group responsible for drafting the text of the DVB Ultra High Definition Video standard.

David Daniels is a Senior Technologist at Sky plc. in London, and has been an active member of the DVB for many years. In that time he has chaired a number of groups and currently Co-Chairs the TM-AVC NGA Sub-Group.

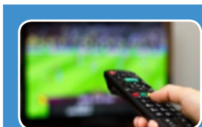
Figure 2. Summary of HDR solutions under consideration in TM-AVC

	Single Layer solutions (class of solutions using current HEVC Main 10 Profile with content graded using a new transfer function)	Dual Layer solutions (class of solutions that use scalable coding technologies)	HDR extensions to HEVC (class of solutions discussed in the MPEG HDR fast track for improved HDR coding efficiency)
Number of solutions in that class that are currently under consideration	At least 2	At least 2	At least 5
Dependencies on other standardization bodies	SMPTE, ARIB, MPEG/ITU-T (either already published or technically stable references available)	SMPTE, MPEG/ITU-T (already published references) ETSI (under development, only relevant for one of the solutions under discussion)	MPEG/ITU-T (under development)
Transfer function	Two are under consideration: HLG OETF or PQ EOTF	Typically based on PQ EOTF	Unclear for now
Coding technology	HEVC Main 10 (either edition already published or edition to be published shortly depending on the solution)	Either SHVC Scalable Main 10 or another profile of HEVC (unclear for now) depending on the solution	Potentially another profile of HEVC (unclear for now)
Metadata	Optional SEI messages such as Mastering Display Color Volume, Color Remapping Information, Content Light Level	Unclear for now	Unclear for now
Backwards compatibility to DVB UHD-1 Phase 1 receivers	Yes if HLG OETF is used No if PQ EOTF is used	Yes	Both are under consideration

Figure 3. Next Generation Audio

Accessible

Descriptive Audio, Dialog Enhancement, Multiple Language



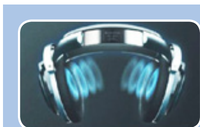
Personalized

Modify the presentation to the listener's preference

Immersive

Put the consumer in the action and the venue

Lifelike experience



Adaptable

Optimal playback on every device

On A Mission

Beyond the Transport Stream

Dr. Simon T Jones, Chair, SB SMG-BTS

Dr. Simon Jones is TV Architect, BT Technology, Service and Operations. His work includes architectural responsibility for BT's consumer TV service, BT TV, and wholesale TV services, and Media & Broadcast products. Simon's current interests include next generation television presentation and distribution formats. He has contributed to the launch of many of BT TV services the latest being BT Sport Ultra HD. He is actively involved in TV standardization and represents BT in DVB and also the UK's Digital TV Group.

The DVB Steering Board has launched a new Study Mission Group 'Beyond the Transport Stream'. The group's objective is to provide a report which will give guidance to the DVB on the future roles of the MPEG Transport Stream (TS) and IP based mechanisms in DVB systems.

> ...the workshop explored the role of IP in the context of broadcast (or push) content delivery.

The current TV world contains a well-established, largely TS based, broadcast infrastructure and IP broadband and mobile networks that are continually growing to meet the ever increasing demand for video over IP. Is it possible for these approaches to coexist to their mutual advantage whilst retaining the benefits of both means of distribution? The DVB market has evolved to a point where increasingly Terrestrial, Cable and Satellite networks deliver to truly hybrid DVB receivers. The newer receivers typically support horizontal market middleware like HbbTV or proprietary, also HTML based solutions. These hybrid receivers combine TS based broadcast and IP delivered video, with data delivery, to support rich feature services that include interactive TV, dynamic advertising, catch-up TV and video on-demand, to only name a few.

In May 2015 the DVB, in conjunction with IRT (Institut für Rundfunktechnik GmbH) held a workshop to review DVB's approach to the delivery of TV and on-demand services to consumers, using native IP and other technologies in addition to, or in place of traditional MPEG Transport Streams (TS) that have worked well over the last 20 years.

The 'Beyond the Transport Stream' workshop explored the role of IP in the context of broadcast (or push) content delivery. Although the next steps were not defined, it was clear that the role of IP and the possibility of a common protocol stack could not be ignored. The desire to help define these next steps led the DVB Steering Board to establish a Study Mission and set its terms of reference. This Study Mission is open to all DVB Members and will meet during 2016 and report back to the Steering Board. The Study Mission is tasked to provide information, in the form of a report, which will help DVB decide what, if any, steps to take.

DVB in conjunction with IRT held a one day workshop in May 2015 that examined DVB's approach to the delivery of TV and on-demand services to consumers using native IP and other technologies in addition to, or in place of, traditional MPEG Transport Streams. This workshop led the DVB Steering Board to establish the Beyond the Transport Stream Study Mission Group.

At a high level it is expected that the report will identify use-cases and scenarios that either cannot be supported, or cannot be delivered efficiently, using existing standards in typical DVB market configurations. It will further analyze, group and categorize these use-cases and scenarios to identify broad themes, common issues and areas requiring further work. Where more work seems called for, the report will investigate whether an integration or coexistence between TS based and IP based infrastructure would seem preferable, or whether simple, backwards compatible improvements to the TS based stack might address the theme or issue just as well. Where neither of these seems sufficient to address use-cases or scenarios, the report will consider whether there is a compelling case for DVB to move to an alternative to TS to satisfy these use-cases or scenarios.

The Beyond the TS Study Mission is chaired by Simon Jones of BT (British Telecommunications), with Alexander Adolf representing LG Electronics as Vice-Chair. All members of DVB are invited to participate and the details of the group's work will be published on the DVB website as usual.

Convergence Test Bed

DVB-T2 & LTE Trials At IRT in Germany

Clemens Kunert, Institut für Rundfunktechnik GmbH

Clemens Kunert joined the Institut für Rundfunktechnik in 1988. Currently his main activities are in the field of mobile broadcasting (DVB-T and DVB-T2) and future telecommunication systems such as LTE. He holds several patents and is keen to contribute to the challenging developments in the area of 5G.

In preparation for the launch of DVB-T2 in Germany, IRT has been conducting a field trial since August 2014, in close cooperation with the Bavarian Broadcast Company (Bayerischer Rundfunk), to examine the behavior of a DVB-T2 preoperational network. The aim is to find suitable configurations to balance out reception quality for indoor and portable scenarios with capacity and transmission costs, respectively. It will be one of the first T2 networks using HEVC.

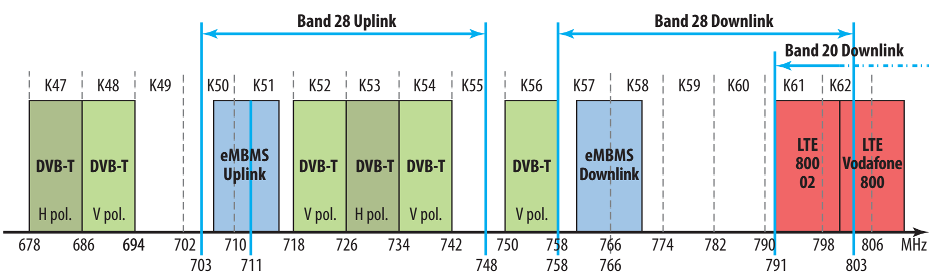
Since March 2014, IRT has been leading a collaborative research project called IMB5 (Integration von Rundfunk und Mobilfunk in LTE/5G), funded by the Bavarian Research Foundation. Project partners are IRT, Bayerischer Rundfunk, Nokia Networks, Fraunhofer IIS, Rohde & Schwarz, the University of Erlangen and BMW. In two eMBMS (evolved Multimedia Broadcast Multicast Service) trial networks, in Munich and Erlangen, the project is examining the possibility of broadcasting AV content over a mobile network with a broadcast network topology using LTE eMBMS technology. While both the trials in Munich (T2 and eMBMS) have transmitter sites in common, the emitted power levels are different.

The DVB-T2 test bed in Munich enables the examination of the relatively new and more efficient MPEG-H Part 2 HEVC (H.265) video encoding in a real environment. Furthermore, it allows manufacturers of DVB-T2 receivers, encoders, multiplexers and modulators to test and optimize their devices. On the RF side, a plurality of settings is possible, in particular to analyze the portable and mobile reception. The northeast area of Munich, which is covered by Bayerischer Rundfunk's three test transmitters, is particularly suitable as it contains metropolitan, suburban and rural development with varying topographies.

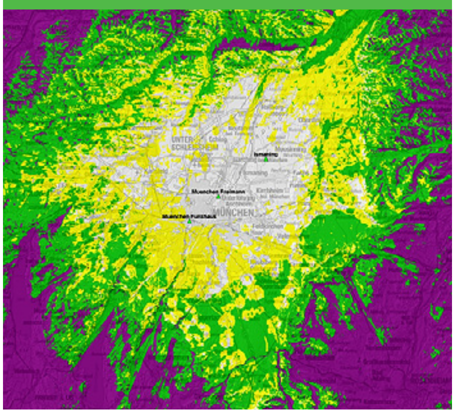
In striking distance of the transmitter sites, there are several motorways where test drives at higher speeds were performed successfully. Three types of mobile receivers were examined with different modulation parameters at different vehicle speeds. The results demonstrated a very good mobile reception performance using DVB-T2. In addition, HEVC enabled encoders and multiplexers were tested in laboratory services to determine the compatibility and stability of all elements of the signal chain as well as an estimation of the prospective quality level and spectrum needs. This will allow broadcasters to select the appropriate and most cost efficient equipment for the forthcoming regular service. The latest tests will include the performance of recently available statistical multiplexers. CE manufacturers can also use the signals to verify receiver compatibility. The test field for DVB-T2 will be available up until the launch of the regular DVB-T2 services by private broadcasters in mid-2016 and by public broadcasters in the period of 2017 to 2019.

The IMB5 project aims mainly at a possible convergence of broadcast and mobile technologies by combining the advantages of both worlds. A common architecture should enable the efficient provisioning and access to linear and nonlinear content simultaneously for both individual and mass consumption. An openly standardized and globally available air interface in mobile devices, like smartphones, would most likely lead to a universal mass market for affordable mobile devices with broadcast reception. The eMBMS functionality presents the key to achieving this goal. The capabilities and limitations of the current LTE eMBMS specification for setting up a nationwide large-cell broadcast network and for creating optimized system architecture for eMBMS based networks will be investigated within the duration of the project. The most interesting aspect, however, lies in the establishment of a Single Frequency Network (SFN) setup. Large-cell SFNs are widely operated in traditional broadcast networks, while IMB5 employs that concept in mobile networks for the first time. It is expected that the SFN mode will lead to an increase of the maximal available data throughput in mobile networks. The results so far affirm that a SFN mode is functional, depending on the location of the user equipment in relation to the distance to the transmitter sites. In other words, there are improvements or degradations concerning the relationship between the contributing and the interfering portion of the received field-strength in the coverage area in the test bed. This is not surprising, because the guard interval actually used for the eMBMS transmission is too short to suit the needs of the Inter Site Distance of the test bed. Therefore, a further step is the definition of input for modifications of the 3GPPP standardization of eMBMS (e.g., the increase of the guard interval). In addition some requirements of the public broadcasters such as free-to-air reception (e.g., without SIM card), receive-only mode and a High Tower High Power implementation will also be addressed.

Frequency Allocation for LTE/eMBMS (blue) Trial (only)



DVB-T2 Trial: Coverage Prediction
K43, 650 MHz, Munich: Transmitter Funkhaus, Freimann and Ismaning
RF-Parameter: 64 QAM, 3/5, 16K, GI 19/128, PP2



No Coverage > 95% | Portable Out > 95%
Fixed > 95% | Portable In > 95%

A Bright Future

DVB-S2X and DVB-RCS2 and Next Generation Internet Access Via Satellite

David Peilow, Chair, CM-RCS

First commercialized in the 1980s, two-way connectivity to private networks and the internet via satellite is a market which has shown accelerated growth in the past decade, first in North America but latterly in Europe and other regions of the world as High Throughput Satellites have come online. In addition to the long-established markets for VSAT (Very Small Aperture Terminals) such as corporate networks, satellite has enjoyed increasing success as a consumer internet access technology as equipment costs have fallen and bandwidth available increased. DVB has long had a presence in this market, with DVB-S and DVB-RCS standards being used in VSAT terminals for over 15 years, and over a million terminals have been sold which use DVB technology.

As terrestrial broadband access technologies have become commonplace in the developed world, consumer expectations of high speed connectivity, ubiquitous Wi-Fi access and more content-rich internet services have also become prevalent. However, such expectations have not always been matched by service availability and consumers in suburban and rural environments have frequently been left out of the revolution in access speeds enjoyed by their neighbors in towns and cities. This is a market ideal for satellite provision.

Early consumer satellite internet access services often used spare capacity on wide beam Ku-band satellites designed and optimized for DTH television services. As such, bandwidth was often limited and contention ratios were high, which was necessary for embryonic satellite internet service providers to be able to compete with broadcasters for access to the same transponders. Consequently, throughput was often poor and data volumes restricted – satellite internet quickly gained a reputation among consumers as being the "service of last resort".

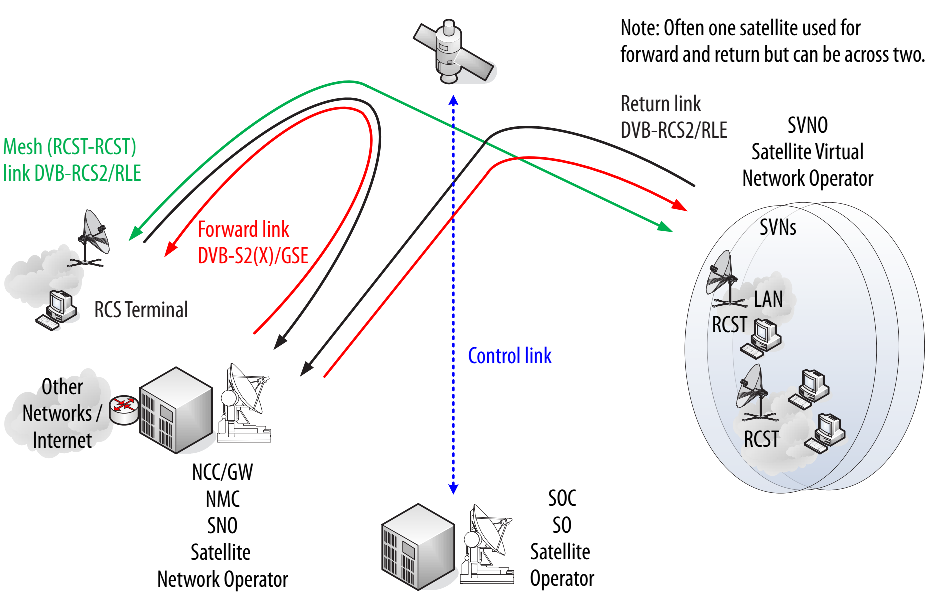
Recognizing the vast potential untapped market and frustration that contemporary satellite services were providing at the time, operators such as Wildblue (now Viasat) and Hughes in North America, and later Avanti Communications and Eutelsat in Europe planned a new generation of satellites using spot beam technology and Ka-band frequencies, where there is little to no competition with broadcasters and other users and consequently bandwidth is plentiful and cheaper. The adoption of DVB-S2 in the forward link for greater spectral efficiency and frequency reuse from spot beams enabled total throughputs of tens to hundreds of Gigabits per second, and these became the first examples of what are now known as High Throughput Satellites (HTS).

The success of this new class of satellite spurred the industry into launching HTS systems addressing other markets, such as airborne and maritime internet access, government communications, professional services (such as portable terminals for TV journalists), cellular backhaul for 3G and 4G LTE services, and low bitrate SCADA applications such as 'Internet of Things. Furthermore, operators are targeting new regions where climatic conditions are more challenging for reliable use of higher frequencies, such as in South America, and the industry is starting to discuss the use of Q/V band – a part of the radio spectrum above Ka where atmospherics are even more challenging for reliable links – in order to provide even more throughput to customers.

However, the success of HTS has also not come without its problems. Uptake has been highest where consumers have a high awareness of the applications broadband can provide and are prepared to pay for the service (typically suburban areas underserved by DSL and cable). This has led to some spot beams reaching saturation while other areas are under utilized, with no way for operators to reposition the capacity where it is needed in the short term. Furthermore, terrestrial access has also continued to increase both its speed and coverage with headline rates of tens or more megabits per second being commonplace in developed markets and on-demand video becoming the norm, putting pressure on satellite to match both the speed and volume of data offered at consumer price levels. This is both a challenge and an opportunity – impressive headline DSL speeds drop off rapidly with line length, creating rings of underserved customers around the aggregation point and forming a new 'digital divide' reminiscent of that between broadband and dial-up users a decade ago.

The industry recognized that a new generation of terminals and access technologies is needed to best utilize the coming generation of HTS satellites and match the features of terrestrial services. Such terminals are required to offer throughputs of tens of Mbit/s in the downstream direction and up to 10 Mbit/s in the upstream direction. They need to operate on satellites where the transponder

Main roles in a DVB-RCS2 interactive satellite network



bandwidth is 250 or 500 MHz, rather than the 45 or 54 MHz carriers that are common in the DTH world, in order to maximize the benefits of statistical multiplexing and allow single carrier per transponder operation. They need to support higher spectral efficiencies that are possible with Ka-band and spot beam satellites, but also cope with the higher dynamic range that comes from using higher frequencies. They need to intelligently distribute the growing volume of video content. Finally, they need to be cheaper and easier to install, with greater emphasis on integration both of functions at the silicon level and in the overall design of the equipment.

With this in mind, DVB created two standards which were designed wholly or in part to support the development of such equipment. DVB-RCS2 was published in 2012 and standardizes a more efficient MF-TDMA return link (30% more efficient than DVB-RCS), with a specification that recognizes the need for interoperability at many layers of the OSI model – not just the waveform, but the transport of TCP/IP over satellite and aspects of the whole system. The standard contains numerous profiles, recognizing that consumer, corporate, government and other markets require different subsets of the core standard. DVB-S2X was published in 2014 and is already becoming well known in the broadcast world, but also contains features that optimize the forward link capabilities of interactive systems such as a high granularity of 'MODCODs' (modulation scheme and FEC rate) that benefits terminals capable of Adaptive Coding and Modulation (ACM, enabling optimal spectral efficiency as link conditions change), low roll off, support for wideband carriers and time-slicing to use HTS transponders, superframes, support for GSE and support for Very Low SNR operation down to -10 dB. This latter option is designed to enable terminals to remain connected to a gateway in a very high dynamic range fade environment, such as that seen by airborne terminals and terminals in high rain-fade areas such as the tropics. Such deep rain-fades only last a few seconds but are problematic for systems where a large number of terminals might fade simultaneously. Very Low SNR mode maintains control signaling during the fade, thus avoiding significant delay while the terminal population re-establishes its link with the hub.

The publication of these two new state-of-the-art standards has enabled the satellite industry to design a new generation of equipment to match the offers of terrestrial services, but efficient waveforms by themselves are only part of the answer. New ASICs such as the SX-3000 from Satixfy integrate an entire terminal into a System on Chip, supporting 500 MSymbol/sec carriers in forward and return link, DVB-S2X and RCS2, extended Very Low SNR capability and sufficient system resources to run the operating system and higher level functions. The result of this is a terminal that can be completely integrated into the satellite antenna, with only an Ethernet connection required to the user's computer or network for power and data. Not only does this drive down equipment cost, but installation becomes more feasible for installation by the end user or by DTH installers more familiar with antennas used for television reception.

Manufacturers have also recognized the importance of standardized interfaces with telcos' and ISPs' existing management and billing systems. One lesson learned from first generation systems is that if satellite is to become part of the standard offering of ISPs, it must be understandable to their systems and network operations staff. The next generation of equipment will incorporate such 'northbound interfaces' and satellite will become just another access method to service providers.

Over the last 12 months there has been a flurry of activity in the DVB community, with product launches and announcements from Advantech Wireless, ASat, Broadcom, Comtech EFData , EMC Satcom Technologies, Fraunhofer, iDirect, Newtec, Satixfy , ST Microelectronics, Thales Alenia Space and Work Microwave all supporting DVB-S2X and/or RCS2. Furthermore, there are many on-going projects including, for the first time, interest from the consumer electronics industry: EMC and Arabsat announced a service called TRIO which will integrate a DVB-RCS2 modem into a TV set-top box to enable provision of 10 Mbit/s broadband and TV services to households across the Middle East and Africa, and CE manufacturers in the Far East taking an interest in RCS2 consumer terminals, recognizing the growth potential of the VSAT market and the need to interoperate with any ISP's gateway.

Overall, the future of DVB standards for internet access via satellite has never been brighter. DVB-S2X and RCS2 systems are being installed worldwide and the industry has dozens of HTS satellites planned or under contract. The first satellite boasting over 1 Terabit per second of throughput is on the horizon. New equipment is able to support hundreds of thousands of users per gateway hub and millions per network. Emerging markets such as Africa, China, India and South America have the potential to bypass terrestrial access technologies and roll out satellite internet access to tens of millions of users. Airborne internet access is taking off and by its very nature requires interoperability between regional systems as aircraft move from one operator to another. And the Internet of Things is another growth area where satellite can play a large part. DVB is well prepared to support these new markets.

David Peilow has been chair of the DVB CM-RCS working group since 2008 and is General Manager of Satlabs EEIG, an industry organization formed to promote and oversee interoperability testing of satellite terminals. He works as a Ground Segment Engineer at the European Space Agency in the Telecoms and Integrated Applications group at Harwell in the UK.

1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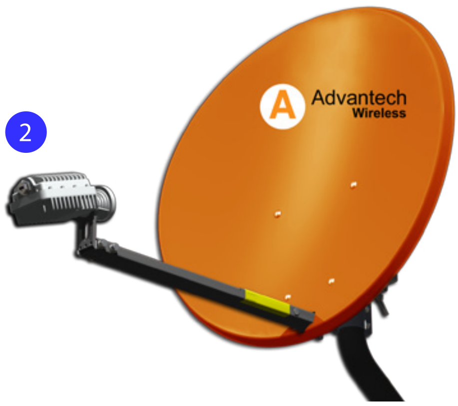


3


1 EMC's TRIO set-top box combines a DVB-RCS2 modem with direct to home TV reception.
2 Advantech's Ka-8000 terminal integrates all modem and terminal functions into the antenna, with a single Ethernet connection to the end user.
3 The Satixfy reference terminal integrates a DVB-S2X and RCS2 ASIC onto a board smaller than a smartphone.

Waiting for the Bus

DVB-CI+ 2.0

Alexander Adolf, Vice-Chair, TM

Alexander Adolf is an independent consultant in digital broadcast technology through his company Condition-ALPHA. He is the representative to DVB for LG Electronics. As Chair of the DVB TM-CI-Plus technical working group he lead the development of CI+ 2.0 . Since 2000, he has been Chair of the TM-GBS and in January he was appointed Vice-Chair of the DVB Technical Module.

If you attended DVB World in Copenhagen last year, you will have an insight into the upcoming DVB-CI+ 2.0 standard. This article provides an update on the recent developments and unveils further details of the technology involved.

The most visible update to CI+ 2.0 will be the use of a new connector: the Universal Serial Bus (USB). This will not only bring down the implementation costs for TV sets by removing the single purpose PCMCIA interface, but it will also bring even higher data rates by taking advantage of the capabilities of USB 2.0 (240 Mbit/s full duplex), up to 3.1 Gen 2 (5 Gbit/s full duplex). Standard USB device discovery and description allows CAMs and hosts to offer various interface speed options, and still interoperate.

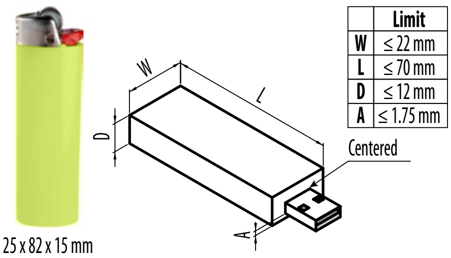
USB CAMs will also work to the power limitations of high-power bus powered USB devices. This means that hosts are not required to feature specific 'CI+ enabled' USB sockets, but as per the speed and power characteristics could be able to accommodate a USB CAM in any of its USB 2.0 or 3.1 sockets.

Besides the electrical characteristics and protocol, space restrictions in the back of a slim flat-panel TV set are a restraining factor. The DVB-CI+ 2.0 specification therefore defines a mechanical bounding box, within which the USB CAMs will fit. Figure 1 shows this bounding box, along with a well-known object for size comparison.

On the protocol side, all of the upper layers of DVB-CI+ are retained (see Figure 2). This means that there will be no need to develop an entirely new CI+ stack. Instead, existing implementations can be ported to the new USB transport.

Apart from being able to retain the larger part of the existing CI+ stack, we also took the opportunity to introduce some enhancements for conveying protected content between CAM and host. As of CI+ 2.0, there is only a single mechanism for covering single-stream and multi-stream data, as well as TS and sample data. This implies removal of the encapsulation of ISOBMFF data into TS packets.

Figure 1: The mechanical bounding box for DVB-CI+ 2.0 CAMs, compared to the well-known lighter



The move to USB also enabled us to upgrade the network connectivity for the CAM from CI+ 1.4 low-speed communications (LSC), to a native network connection for the CAM via the Ethernet emulation mode of the USB communications device class (CDC EEM). This will enable many more internet use-cases, and provides a much improved CAM player mode support due to direct, high speed network access.

Despite all these improvements, it is still possible to easily map data between a CI+ 2.0 host and a PCMCIA CAM, so that an adapter as shown in Figure 3 can be used. This will allow the decoupling of the market introduction of USB hosts from that of USB CAMs.

The new USB form factor currently exists in a draft specification document in the TM-CI-Plus Sub-Group. What still lies ahead before its publication as DVB BlueBook A173-1 and subsequently as an ETSI specification, is a validation and verification (V&V) exercise for the USB functionality of CI+ 2.0. This is to make sure that USB CICAMs will behave well 'out in the wild' in the presence of USB hubs, various other USB devices, and USB host implementations. Since the number of deployed USB devices is enormous, this will be an important exercise to ensure that no interoperability issues will arise, and for DVB CICAMs to be good USB citizens.

Figure 2: Re-use of protocol layers between DVB-CI+ 1.4 and 2.0

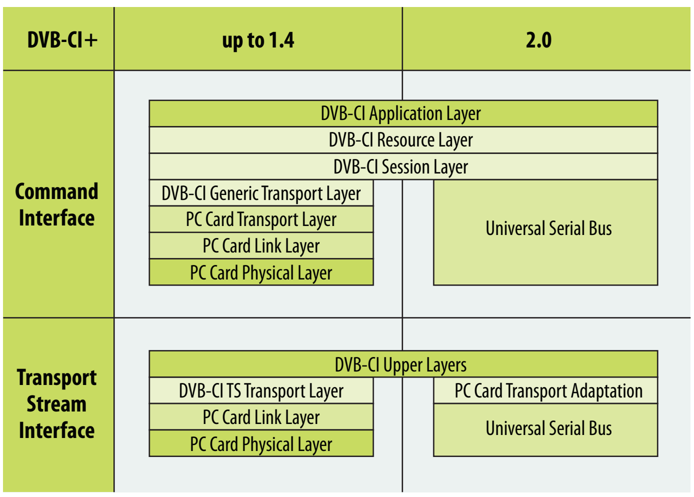
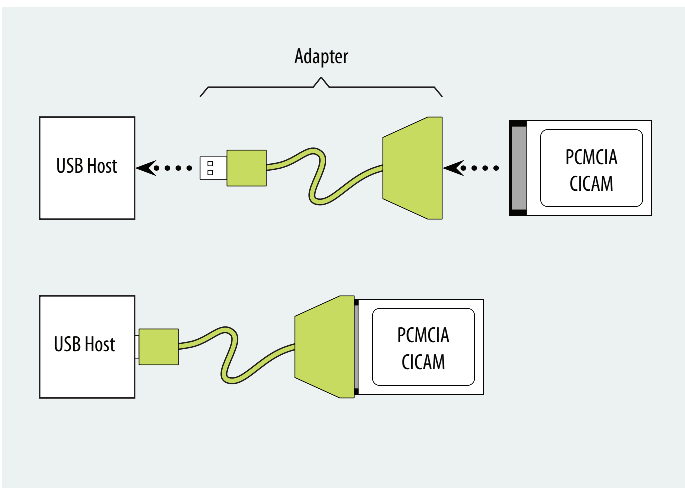


Figure 3: Adapter to connect legacy PCMCIA CAMs to USB hosts



Meet the TM

As noted in this issue of DVB Scene, this is a very busy period for the DVB Technical Module (TM). With the recent completion of the Commercial Requirements for UHD-1 Phase 2, these now pass to the TM to specify the necessary technology to fulfill the Requirements. The UHD-1 Phase 2 work will focus on High Dynamic Range, Wider Color Gamut, Higher Frame Rates and Immersive Audio Coding.

The TM provides the necessary technical expertise that delivers the digital standards produced by DVB. It works in conjunction with the Commercial Module, which establishes the necessary Commercial Requirements to produce the DVB standards. It delivers specifications for one or more standards via the Steering Board to the recognized standards setting entities, notably the EBU/ETSI/CENELEC Joint Technical Committee.

Following the retirement of Nick Wells as Chair of the TM in September of last year, a new team has taken over the TM. Kevin Murray was elected his successor in October 2015. At the same time Muriel Deschanel, who served as Vice Chair of the TM for over three years, announced that she would be vacating the position. Then, following a 'Call for Candidates' in January, the TM has elected Alexander Adolf and Alberto Morello as Vice Chairs of the Module.

Kevin Murray joined the research group DMV In 1997 which later became part of NDS before its acquisition by Cisco. He is a System Architect in SPVSS (Service Provider Video Software and Solutions), actively engaged in a range of research and standards areas related to the television experience. In DVB, Kevin has served as Chair for both the DVB Technical Module's Ad-Hoc Group on File Formats and TM-CSS (Companion Screen and Streams).

Alexander Adolf works as an independent consultant in digital broadcast technology through his company Condition-ALPHA and is the LG Electronics representative in DVB. As Chair of the TM-GBS working group, he was the editor of the DVB-GSE suite of specifications. He was also Chair the DVB TM-CI-Plus technical working group in the development of CI+ 2.0.

Dr. Alberto Morello is Director, Research and Technology Innovation Centre, RAI-Radiotelevisione Italiana. Dr. Morello has been a member of a number of EBU, ITU-R and DVB groups and has participated in various European projects. He was Chair of the DVB Ad-Hoc groups which defined the technical specifications for the DVB-S, DVB-DSNG, DVB-S2 and S2X systems, and actively participated to the development of the T, T2, H, NGH specifications.

Kevin Murray

Alexander Adolf

Dr. Alberto Morello

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