



The evolution of digital television. Any device, any delivery, any content.



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#### New solutions for a time of transition

This edition of DVB Scene magazine might be the first in quite a while that you'll also hold *physically* in your hands, whether picked up on your return to the office or at one of the first in-person events after two years. Maybe even at DVB World? If you have the chance to join us in Brussels on 18 May, you will experience something unusual, and unlike traditional DVB World conferences. One could say that the shift from a one-way broadcast style to a new approach enabling interactivity and personalization applies not only to our specifications, but also to how we're approaching our events! You'll better understand what this means in practice if you are one of the lucky participants at this inaugural, somewhat experimental, edition of a completely revamped DVB World. (Find out more: dvbworld.org)

As with any difficult period, the pandemic has fostered innovation and even triggered some necessary upheaval or helped accelerate ongoing changes. The DVB DEMOS online event was born from the lack of tradeshows during the crisis; and the redesigned DVB World adapts to a new world where agility is essential and - above all where the audience (weary of being passively fed with information) transforms into participants actively shaping and intervening in the event's content. And these are only the most visible faces of a nascent revolution, as our chair concludes on page 4, promising deep impact on DVB's work.

Perhaps an early sign of this forthcoming "shake-up" in DVB, the breakthrough Native IP specification (DVB-NIP, see page 5) has just been published. I'm very proud of the huge effort and



**Emily Dubs** Head of Technology, DVB Project

amazing efficiency demonstrated by our Members and the group leaders, who completed the work in a record time. All the more as this comes after the equally impressive and efficient work of the commercial group that defined the requirements for the solution. I'm particularly thrilled to see DVB-NIP come to fruition as I've believed in this concept for a long time and indeed evangelized for it for several years before taking up my current role.

Another good sign for DVB is the high engagement from Members on the important topic of next generation video codecs. Here too, both the technical and commercial groups have worked with high intensity, even hitting the first major milestone earlier than expected: an update of the DVB-AVC specification that includes support for VVC has just been published six months ahead of schedule! (See pages 6–7.)

All of this shows clearly what DVB Members are capable of when everyone is pushing in the same direction. This is a strength we will strive to preserve through the coming period of change.



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## NEW & UPDATED SPECIFICATIONS

DVB documents published since the last issue of DVB Scene include the brandnew DVB-NIP specification for Native IP broadcasting and updates to several other key DVB standards. Also on the list is the second DVB BlueBook in the C-series, denoting commercial requirements, in this case for signalling to support the implementation of the EU's Audiovisual Media Services Directive. All available from: dvb.org/specifications

**Specification for the use of Video and Audio Coding in Broadcast and Broadband Applications (DVB-AVC)** February 2022 • DVB BlueBook A001r19 (Draft TS 101 154 V2.8.1)

Native IP Broadcasting (DVB-NIP) February 2022 • DVB BlueBook A180

Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 2: DVB-S2 Extensions (DVB-S2X) February 2022 • DVB BlueBook A083-2r3 (Draft EN 302 307-2 V1.4.1)

Generic Stream Encapsulation (DVB-GSE); Part 2: Logical Link Control (LLC) February 2022 • DVB BlueBook A116-2r2 (Draft TS 102 606-2 V1.3.1)

Generic Stream Encapsulation (DVB-GSE); Part 3: Robust Header Compression (ROHC) for IP February 2022 • DVB BlueBook A116-3r1 (Draft TS 102 606-3 V1.2.1)

**Commercial Requirements for AVMS Signalling** February 2022 • DVB BlueBook C101

**Adaptive media streaming over IP multicast (DVB-MABR)** January 2022 • DVB BlueBook A176r2 (interim update of TS 103 769 V1.1.1)

Adaptive media streaming over IP multicast (DVB-MABR) – Implementation guidelines and worked examples January 2022 • DVB BlueBook A181

**Service Discovery and Programme Metadata for DVB-I** January 2022 • DVB BlueBook A177r3 (interim update of TS 103 770 V1.1.1)

DVB Companion Screens and Streams (DVB-CSS) part 2: Content ID and Media Synchronization January 2022 • TS 103 286-2 v1.3.1

**Specification for Service Information (SI) in DVB systems** December 2021 • DVB BlueBook A038r14 (Draft EN 300 468 V1.17.1)

**Specification for data broadcasting (DVB-DATA)** December 2021 • DVB BlueBook A027r4 (interim update of EN 301 192 V1.7.1)

**DVB MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks (DVB-DASH)** November 2021 • DVB BlueBook A168r4 (interim update of TS 103 285 V1.3.1)

#### **NEW DVB MEMBERS**

#### Find out how to join the DVB Project by visiting: dvb.org/join



MAINDATA

**EI Towers** is an Italian company operating network infrastructure and integrated services for the broadcast media, mobile telecommunications and public utilities sectors. (www.eitowers.it)

**MAINDATA**, based in Slovakia, builds efficient and scalable television signal delivery solutions – software and hardware – for broadcasters and service providers. (maindatainc.com)

**Peng Cheng Laboratory**, based in Shenzhen, China, is a scientific research institution that undertakes large-scale national strategic tasks in scientific and technological development. (**pcl.ac.cn**)

#### A word from the PCM chair

#### ELFED HOWELLS (HISILICON / HUAWEI)



Despite all the restrictions and constraints of the past two years, the appetite of our Members to promote and

explain the work of DVB to the widest audience has not dimmed.

We had a stunning set of DVB DEMOS in the autumn, followed by the publication of some truly groundbreaking specifications, such as Native IP delivery and the addition of 8K resolution video to our toolbox.

We also released the first demo of the central service list registry for DVB-I, as well as our DVB-I microsite (which you can find at dvb-i.tv).

Since late summer, the Promotion & Communications Module (PCM) has also been working on a major initiative we have dubbed *The Listening Project*, where we've interviewed tens of key companies in the media distribution ecosystem, both DVB Members and nonmembers, with the aim of truly listening to their honest views on our work and on future trajectories for standardization, and also to garner opinions on the role DVB will play in defining the future of media distribution.

As we await the final report, the first indications are fascinating. It's clear that collaboration and interoperability are key, and the DVB has some crucial work to do to help the media distribution industry to adopt our internet-centric ecosystems.

It's also clear that, unlike many others, our reach is truly global: wherever our interviewees were based, they universally knew our work and respect the standards we have produced.

Our task in the coming months is to interpret the feedback received and to capitalize on our store of good will, building on our reputation for uniting the ecosystem.

Our new-format DVB World 2022 will be a chance for us to discuss and debate the findings and our future trajectory, and to build and expand on the conversations we've already started.

The PCM and I look forward to seeing you in Brussels in May – it will be *so* good to meet you all in person again.

# Next generation or paradigm shift?

#### PETER MACAVOCK, CHAIR OF THE DVB PROJECT



Because DVB doesn't have a "3" after it, you might think it's not as good as something that does. After all, DVB-T2 can only be a second-generation technology; right? It's a bit more complicated than that.

Although ATSC 3.0 claims to be an IPonly system, it is also still fundamentally a broadcast system, relying on broadcast networks. Sure, those broadcast networks carry IP, but IP isn't the internet. DVB's latest suite of solutions – with DVB-I and streaming technologies at their heart – are about an internetfirst DVB. This is subtly different but important distinction from an IP-centric approach.

A long time ago, we said in DVB that if there were ever to be a DVB-T3, it

would be a hybrid system combining bidirectional networks with broadcast to exploit the opportunities offered by the fundamental asymmetry of media services. But DVB-T2 is still state of the art: we have just issued an update to the specification to incorporate a clarification and to make it interoperable with the GSE-Lite profile of DVB-GSE (generic stream encapsulation), that is used for our new DVB Native IP solution that offers an alternative to the classic, and still very relevant, MPEG-2 Transport Stream.

Let us be clear, applications such as targeted advertising, service replacement, etc., touted as being possible only with IP-based systems, can all be done using DVB combined with HbbTV. These systems are already installed in every connected TV in Europe and beyond. Wouldn't it be a shame to have to jettison existing equipment to make all these new features possible? Well, you don't need to.

#### WHAT ABOUT BRAZIL?

And what of the latest announcements from Brazil? There, the SBTVD Forum (standing for *Sistema Brasileiro de Televisão Digital*) has been targeting the development of its next generation digital terrestrial television system, a project they called, naturally, TV 3.0. Congratulations are due to them for managing their technology selection process so efficiently. There could be valuable lessons for DVB. The result there will be another broadcast-centric system. We're pleased to see that a range of technologies fostered in DVB – core DVB-T2 technologies, next generation video codecs, DASH with low latency, etc. – were selected.

The thing is, though, these are components in an overall broadcastcentric system – it's the internet-centric system approach that DVB has adopted that shifts the paradigm. At its centre is DVB-I.

Being honest, DVB-I was first conceived as being a way of replicating a broadcast-television viewing experience with online services. Studies done by Ofcom in the UK have shown that combined broadcast/internet service lists are a convenient way of managing a seamless user experience on a TV set for consumers who have access to broadcast and online. This could be particularly useful when managing a transition towards internet-based delivery, or away from classic DTT broadcast. Indeed, there's a place for this in any market transitioning from one distribution technology to another, particularly where one of them is IP. As Brazil proposes to migrate from its current first-generation system to its proposed third- (or is it fourth?) generation system, it could usefully deploy something like DVB-I to ease the transition for viewers.

Competition between standards bodies isn't a DVB priority; it's all about adapting to the challenges of a world dominated by internet-first companies and turning those that aren't yet focused on this into ones that are. As some have pointed out, DVB's muchlauded process, the cornerstone of the way in many standards-developing organizations work, needs to be revolutionized. Some important work is in preparation in DVB that will – hopefully – lead to the biggest shake-up since DVB was founded. Watch this space.

"There's a place for DVB-I in any market transitioning from one distribution technology to another, particularly where one of them is IP."

**Peter MacAvock** is the Chair of the DVB Project. He is also Head of Distribution Platforms and Services at the European Broadcasting Union.

The DVB Native IP technology stack

	1		
Signalling		DV3 DASHI DV3 AVC	
Announcement Channel	D/3	ABR	HTTP
UDP			TCP
IP			IP
DV3GSE		MPE TS	Data Link Layer
D/352X D/3	T2 HEM	D/352	Physical Layer

Broadcast

Broadband

# DVB-NIP: enabling the convergence of OTT and broadcast technologies

#### TOM CHRISTOPHORY (SES) & RÉGIS MOULIN (EUTELSAT)

Approved by the DVB Steering Board in February 2022, the new DVB-NIP specification bridges the gap between broadband and broadcast networks and paves the way for a truly converged media distribution solution.

Digital broadcasting in Europe started on satellite in 1995. Some of the core specifications at that time, notably the original MPEG-2 Systems and DVB Service Information specifications are still in use today, 27 years later, a testament to their success.

In the meantime, the telecoms industry has seen the rise of the internet, the development of high-speed IP networks, the shift towards all-IP for service delivery, and the development of new personal and smart IP devices. All this has led to profound changes in the way that video is commissioned, produced, distributed, monetized and, above all, consumed. New video formats and new devices are designed first and foremost to work in all-IP environments.

#### NATIVE IP BROADCAST

Realizing these changes, in 2020 DVB produced a set of commercial requirements for a new broadcast system *based natively on IP.* This led to the creation of a technical working group including experts from companies covering the entire broadcast ecosystem: broadcasters, network operators, and professional and consumer equipment and chipset manufacturers.

During 2021, the TM-NIP group worked relentlessly to define the core elements of the DVB-NIP specification. It defines a new protocol stack for satellite and terrestrial television broadcasting entirely based on IP and no longer relying on the MPEG-2 Transport Stream layer.

DVB-NIP reuses many of the IP standards previously defined by DVB for broadband networks and adapts or complements these, only where necessary, for use on DVB broadcast networks (see diagram).

DVB-NIP relies on the DVB-I specification for service discovery and programme metadata, the DVB-DASH and DVB-AVC specifications for AV coding and packaging, DVB-MABR for multicast distribution, DVB-GSE (generic stream encapsulation) for link layer adaptation, and finally DVB-S2X and DVB-T2 for physical transport. Additionally, some DVB-HB (home broadcast) functionality is used for inhome distribution scenarios.

To support the migration of existing DVB networks, DVB-NIP also defines a backwards-compatible mode for carrying NIP data using DVB-MPE (multiprotocol encapsulation) over MPEG-2-Transport-Stream-based systems.

In addition to providing usage guidelines for the specifications above, DVB-NIP provides new tools for broadcast receivers to rapidly discover channels and services on a broadcast network.

#### RECEIVERS

DVB-NIP receivers are composed of two logical functions: a DVB-NIP gateway and a DVB-NIP client function. The gateway is in charge of receiving broadcast signals and making them available to DVB-NIP clients. The client presents television services to end users and is essentially an off-the-shelf DVB-I client with a DASH player, an optional DRM component and device discovery tools from DVB-HB. Receivers can operate in both bidirectionally connected and unconnected environments.

DVB-NIP covers, with the same broadcast signal, both professional content-distribution applications (to CDN caches, mobile or broadcast tower sites, hotspots, planes, ships, etc.) and consumer applications (DTH to IP inhome devices).

Commercially, DVB-NIP brings several key advantages to the various actors of the broadcast chain, including:

- A reduction in CDN costs as OTT traffic grows, bringing broadcast economics (fixed delivery costs) to large-scale IP distribution.
- Higher quality of service, since broadcast networks do not suffer from traffic spikes due to popular live events.
- A unified headend feeding both broadcast and OTT distribution.
- A common app environment (thus more easily updated) for broadcasters to present both their OTT and broadcast services in an attractive and dynamic way.
- More powerful DRM contentprotection solutions.
- A reduction of the carbon footprint linked to large-scale content distribution.

**Tom Christophory** is General Manager, New Technology and Standards at SES Satellites. **Régis Moulin** is consultant in multimedia management and convergence, representing Eutelsat in DVB's technical work. They are co-chairs of the DVB Technical Module Native IP working group.



# New in the DVB codec toolbox: Versatile Video Coding (VVC)

VIRGINIE DRUGEON (PANASONIC)

For more than 25 years, DVB has maintained a single specification for the use of video and audio coding in broadcast and broadband applications (DVB-AVC, published as ETSI TS 101 154). It defines DVB conformance points for audio and video coding standards, to be used for all DVB delivery methods (terrestrial, satellite, cable, IPTV, DVB-DASH). The specification is currently being revised by the DVB Technical Module's AVC working group to add support for next generation video codecs.

A new revision including VVC (Versatile Video Coding), available as DVB BlueBook A001r19, was approved by the DVB Steering Board in February 2022. While the profiling of VVC for DVB applications as specified in the revised specification can be used for both transport stream and IP-based delivery, some additional DASH-specific constraints are still under discussion and will be integrated into a revision of the DVB-DASH specification.

#### CODING EFFICIENCY

VVC is the latest standard in the family of highly successful video coding standards developed jointly by ISO/ IEC MPEG and ITU-T VCEG. It was published in November 2020 as H.266 by ITU-T and in February 2021 as MPEG-I Part 3 by ISO/IEC.

It is capable of encoding videos with 50% bitrate savings on average for the same subjective quality compared to its predecessor HEVC (High Efficiency Video Coding) for UHD video content with high dynamic range (HDR) video content (Figure 1). This makes VVC the most efficient video-coding technology currently available.

The information shown in Figure 1 is based on work done by the Joint Video Experts Team, where subjective verification tests compared VVC with

HEVC. A set of HDR videos, using both the Hybrid Log-Gamma (HLG) and the Perceptual Quantization (PQ) transfer characteristics, were encoded with the VVC reference software (called VTM) and with the HEVC reference software (called HM). The quality was evaluated subjectively by participants and reported as MOS (mean opinion score) ranging on a scale from "severely annoying" (MOS 1) to "imperceptible" (MOS 10).

Figure 1 shows that UHD HDR sequences compressed at around 8 to 10 Mb/s with VVC have a level of impairment that is estimated as "slightly perceptible" (MOS 8), which corresponds to typical broadcast quality. This level of compression performance would allow, for example, to put as many VVC UHD HDR services in a multiplex as the current number of HD services possible with AVC/H.264.

With its superior coding efficiency, its versatility, and broad industry support, VVC was an obvious choice for selection as one of the technical solutions to the commercial requirements for next generation video codecs.

9,00

8,00 7,00

6,00

5,00 4,00

Overall



Overall

Figure 1: Comparison of coding performances of VVC and HEVC for UHD HDR video content as reported in JVET-W2020 (Source: tinyurl.com/vvc-performance)



Virginie Drugeon is Senior Engineer Digital TV Standardization with Panasonic, based in Frankfurt, Germany. She has been involved in standardization work for several years and became chair of the TM-AVC group in 2018.

-49%

**CONFORMANCE POINTS** 

After analysis of the commercial requirements and technical capabilities of VVC, the TM-AVC group identified four conformance points for interoperability of both transport stream and DVB-DASH delivery. These four conformance points (as illustrated in Figure 2) have been specified in the new revision to DVB-AVC, published as DVB BlueBook A001r19.

The central blue box in Figure 2 shows the baseline conformance point that a DVB receiver must support as a minimum. The detailed parameters are available in BlueBook A001r19.

It is important to note that, while the minimum receiver capability requires support of resolutions up to 3840x2160, content providers can use resolutions of 1920x1080 or less together with HDR transfer characteristics (HLG or PQ) for delivery. Such HD HDR bitstreams are fully covered by the VVC HDR UHDTV-1 conformance point. It is also assumed that all VVC-capable receivers will be HDR-capable, whereby it is mandated that both HLG and PQ transfer characteristics are supported.

On top of that baseline conformance point, three additional conformance points are specified for premium receivers and services:

- The VVC HDR HFR UHDTV-1 conformance point adds support for High Frame Rates (HFR) with 100 Hz and 120 Hz (both fractional and integer);
- The VVC HDR UHDTV-2

-52%



Figure 2: Four conformance points specified for VVC in the DVB-AVC specification

conformance point adds support for higher resolutions of 5120x2880 and 7680x4320;

• The VVC HDR HFR UHDTV-2 conformance point adds support for both HFR and higher resolutions.

#### FLEXIBLE CONTENT CONSUMPTION

As a video coding standard of the new generation, VVC also includes new capabilities making it particularly versatile and adaptable to different use cases and content. Two such capabilities are reference picture resampling (RPR) and subpictures.

RPR is an inter-prediction technology that enables the prediction of a picture from already-coded reference pictures of a different resolution. It can be used to simplify switching between DASH segments using a more efficient coding structure, or to enable adaptive changes of resolution within a Transport Stream programme. As such adaptive resolution changes will have an impact on the post-processing design of receivers, DVB has specified some constraints on the usage of RPR and adaptive resolution changes in general to enable use of this feature while restricting the additional implementation and testing burden that it will put on receivers.

VVC subpictures have been designed to enable easy manipulation of rectangular regions of the images within the encoded bitstream itself. In a VVC bitstream encoded using subpictures, extraction or merging of rectangular areas of the video can be performed by removing data from or adding data to the bitstream. This feature enables more efficient implementations of typical personalization and/or accessibility use cases, such as user selection of a view inside a mosaic video or picture-inpicture. The mosaic use case may, for example, allow a free selection by the

#### Status update: Technical Module

PAUL SZUCS (SONY), VICE-CHAIR OF TM-AVC

The DVB TM-AVC working group launched a task force (TF) on next generation video codecs once the associated commercial requirements had reached a stable state with regard to the required technical performance. The TF is tasked with confirming the performance of candidate technologies based on testing done externally to DVB, but with an agreed set of requirements for such testing and their results. Those guidelines are largely based on the video testing guidelines from MPEG, which in turn build upon test procedures from the ITU. Each candidate codec is to provide the tools to enable DVB Members to verify the claimed performance, for example using a reference software platform.

Initially only VVC had passed the criteria for acceptance based on commercial and administrative terms, also having its referenced specification at a sufficiently mature state, hence it was given priority for adoption in the DVB codecs toolbox.

Based on the availability of the referenced specification and test resources, AVS3 is the current focus, with candidate specification text already in a mature state and only subjective testing results to be provided to enable completion of the performance evaluation. AV1 is next in line for evaluation.

#### Status update: Commercial Module

JASON POWER (DOLBY), CHAIR OF CM-AVC

Back in June 2021, the Commercial Module group on audio and video coding (CM-AVC) finalized commercial requirements for the first phase of DVB work on next generation video coding. This triggered work in the technical module to consider VVC, AVS3 and AV1, and led to the series of updates planned for 2022 to the DVB specifications for broadcast and broadband delivery.

CM-AVC is now considering requirements for a potential second phase of work on next generation video coding. The key use cases being explored all involve the goal of delivering higher resolution services in a manner that offers coding efficiency gains but that also maintains a degree of backwards compatibility with existing legacy receivers. Work to identify commercial requirements is expected be completed in the first half of 2022.

user of different cameras installed in a football stadium.

Usage of subpictures would allow composition of a sign-language video within a main video directly in the coded bitstream, therefore removing the need for two decoders at the receiver when offering accessibility services. Users who are not interested in the picturein-picture feature would not perform any bitstream manipulation and would simply consume the main video as is, offering a level of personalization of the service.

Adoption of VVC into the DVB codec toolbox shows that DVB is still at the forefront of technology development, offering to its users the best video-coding performance available for immersive video formats. With the versatility of VVC, DVB is evolving towards more flexible ways to encode and consume video content.



Screenshot of the DVB-I website, dvb-i.tv

# DVB-I: who manages the service list?

#### WILLIAM COOPER (INFORMITV)

With conventional digital television services, whether cable, satellite or terrestrial, the receiver tunes to one or more multiplexes that carry signalling information about the channels they broadcast. This has essentially limited the discovery of services to specific delivery systems. But what if some or all channels are delivered over a broadband connection, potentially over the open internet?

DVB-I supports services delivered over either existing broadcast networks or over fixed or mobile broadband networks, in any combination. It caters for broadcast and broadband convergence by specifying an online directory system that can describe available services out of band, independent of the distribution network. Using widely adopted web protocols, a compatible device or application can request a list or lists of available services, based on country, language, genre, provider or device capabilities. These can be used to access relevant services or applications and obtain further information about the programmes they provide.

"It's not a transmission standard," emphasizes Emily Dubs, the Head of Technology at the DVB Project. "It's not about delivery. It's about discovery, a way of harmonizing hybrid services distributed over different networks."

#### **ENABLING THE TRANSITION**

This approach enables a consistent and coherent user experience, seamlessly integrating broadcast channels, received over cable, via satellite, or over the air, with services that are delivered online, to provide enhanced audio and video quality, regionalization, and special interest or occasional services. It facilitates both free and subscription models. It also supports services delivered on demand. It can enable devices without a conventional television tuner, such as phones and tablets, to access audiovisual services using the familiar model of channels.

DVB-I therefore provides a way of transitioning existing services, currently enjoyed by billions of users, to an internet-enabled future that works with any available network. Significantly, it supports this without requiring changes to existing transmission systems. As such, DVB-I enables an evolutionary transition to hybrid services, without requiring big bets to be placed on nextgeneration infrastructure.

"We see standardization as a great benefit to the industry because it allows many providers to deliver services across different ecosystems," says Peter MacAvock, the DVB Chair. "There's not much rocket science behind it but the implications are far reaching."

#### POLICY CHALLENGES

The challenge is not so much technical as political and commercial, since determining any lists of approved programming providers could be highly contentious. While incumbents might prefer such lists to be limited to licensed broadcasters, DVB-I also opens opportunities for any number of niche services, as are already seen on the internet, which could appeal to viewers globally but presents policy challenges.

As with other DVB standards, the aim is not to dictate any specific business model or user experience but to provide a toolkit that offers sufficient flexibility for broadcasters, service providers and device manufacturers to differentiate their offering.

In addition to a reference application, the DVB Project has commissioned a proof of concept for a central service list registry to facilitate the validation and deployment of compatible devices. Does that mean that the DVB is planning to operate a centralized service list, as some have proposed? This has been a matter of lively debate among DVB members. The Chair of the DVB Project says he is reluctant to impose a cumbersome central registry and develop the infrastructure around the specification. "I would rather see that developed by osmosis," he said, "and if there is a sound business case and a market out there, it doesn't need to be done by the DVB Project."

#### AUTHORIZED SERVICES

DVB Services Sàrl currently allocates unique identifiers for some broadcast services. However, any list of services, or even lists of lists, immediately raises questions about criteria for inclusion or ranking and opens the door to many legal issues. One possible solution would be a federated system that allows a level of national control of regulated lists of appropriately authorized services, while also permitting users to access other channels.

Regulators like Ofcom in the UK are positive about the potential of DVB-I but are not inclined to pick technology winners, preferring to leave that to the



**Dr William Cooper** is an independent consultant who has worked at the intersection of broadcast and broadband television and video for two decades, advising on technology strategy and service implementation. He edits the free weekly Connected Vision newsletter available from informity.com.

market. Yet in licensing broadcasters and online services within their jurisdiction, many national regulators already maintain lists of authorized services. They are also concerned with ensuring the accessibility and appropriate prominence of public services. Broadcasters may be keen to preserve their current position, rather than compete directly with other nonbroadcast services, including those of major multinational media companies. In that sense, regulated service lists may be to their strategic advantage, ensuring that users are able to access their services on a range of devices and displays.

Sky has already brought to market an entirely vertically integrated system in the form of Sky Glass, which has required considerable investment. Some leading consumer electronics manufacturers are offering their own online channel lists with proprietary approaches. Those with market power may prefer to promote proprietary solutions, but the television market has generally benefitted from published standards and interoperability. The risk is that, left to their own devices. consumers will lose the convenience of common standards that have enabled an open and competitive market.

#### UK, GERMANY, ITALY

The Digital TV Group in the United Kingdom has yet to adopt a formal position on DVB-I. It is not specified in the latest version of requirements for digital terrestrial television, D-Book 12.6. However, the DTG has developed a DVB-I Test Suite (see page 11), recognizing that interoperability testing will be a critical factor in driving widespread adoption of the standard.

There have been some technical trials among some public service broadcasters in Germany. Generating the appropriate metadata turned out to be relatively simple. There are plans for a further pilot project. The aim is to demonstrate additional value for users, with a hybrid offering, preferably aggregating multiple services. Now the objective is to determine how such a system might operate in practice. The Deutsche TV-Plattform association has a delivery task force which will produce a paper providing possible approaches for introducing DVB-I in the German market.

In Italy, the adoption of DVB-I is being driven by broadcasters that can see the benefits of standardization. The UHD Book 2.0, published by the UltraHD Forum Italia and Confindustria Radio Televisioni, specifies DVB-I support for the discovery of linear services delivered over DVB-DASH, as well as methods to retrieve electronic programme data for those services. This is subject to the ratification of the DVB-I specification as an ETSI standard, which has already been achieved, and proof of concept trials by major Italian broadcasters, leading to the creation of a new profile to be used for the certification of compliant receivers. Once this is in place there will be an 18-month sunrise period for it to become a requirement. Mediaset is leading a technical trial, in conjunction with TIMvision, the online video service of Telecom Italia, with the participation of other partners, including LG, TP

Vision and Vestel.

The DVB Project is also building bridges between the broadcast and mobile worlds with the 5G Media Action Group to enable the commercial deployment of television services based on fifth-generation mobile networks. A joint task force is working on the combination of 5G systems with DVB solutions, based on using the DVB-I specification for service discovery.

Many stakeholders recognize the value of technical trials to inform the market. While some seem to be adopting a wait and see approach, one of the attractions of DVB-I is that it does not require a critical mass of services and devices to establish its credibility. It is relatively easy for the various parties involved to gain experience and capabilities, without significant risk or investment. It does not require major infrastructure deployments to develop, evaluate and validate how it could work in practice, in preparation for future developments in television and video distribution.

# Image: Description of the service o

In September 2021, the DVB Project Office launched dvb-i.tv, a new microsite dedicated to DVB-I. The aim is to provide clear information about the benefits of implementing DVB-I, along with links to useful resources.

Initial feedback has been positive: the website analytics show that the site has had thousands of visitors from around the world and several interested stakeholders have expressed how useful the site has been to inform discussions in their country.

A new section was added in November to provide information about DVB-I services, with an initial focus on trials and pilots. It includes details about the activities in Germany, Italy and Iran and will be updated regularly as these and other deployments evolve.

We are grateful to the sub-group of Promotion & Communications Module participants who helped to develop the content for the site.



# Building a central service list registry

#### JUHA JOKI (SOFIA DIGITAL)

Around June last year, the DVB Project initiated a project aimed at building and trialling a central service list registry (CSR) for DVB-I. All DVB-I clients require a means to find one or more service lists to operate correctly. These lists can be provided from an application called a service list registry. The DVB-I specification also defines a CSR, potentially accessible to all DVB-I client devices and providing information on a wide set of service lists known to that registry.

Following the publication of a request for proposals, Sofia Digital was selected to build the reference CSR. The work began in September 2021, with the first public release made at the beginning of November.

The first phase of the project was

scheduled to be completed in two releases, one for the initial testing of the CSR and the second suitable for demonstration at the IBC tradeshow, which had been scheduled for December. As had happened previously with the DVB-I reference client project, the pandemic forced the cancellation of IBC. Still, the work continued and the project is now close to completion.

*Find a link to the public repository at: dvb.org/dvb-i* 

The application is delivered as a modern web app managing the service list registry and the query API for data retrieval, which is implemented using the cutting-edge Vue3 javascript framework. The framework enables quick and clean development and an easy-to-follow application structure, while utilizing all the possibilities of a modern javascript framework. It is a far cry from PHP.

The project is divided into three modules, the front end, the back end and the API:

- Front end the web user interface for adding and editing service lists and providers and managing the registry users.
- Back end used by the front end to access the CSR database.
- API the query interface used by the DVB-I clients themselves to access the CSR and retrieve information from it. A standard SQL database (mariaDB)

is used, while the back end and the API use node.js as the runtime environment. The front end uses yarn, both as the development server and the production build creator. The production build can then run on any web server, such as nginx.

#### SCALABLE SYSTEM

One important goal of the project was to build a system capable of growing to a full-blown global environment capable of serving millions of clients per hour. Vue.js and node.js certainly make this possible, but for an old horse like SQL an additional tool called Redis was deployed, to act as the cache for the query API, and to avoid hitting the SQL database unnecessarily. Redis is an 'in-memory database' and it can be enabled and configured for the query API based on the instructions that are provided in the project's GitHub repository. The repository also provides all the necessary components to deploy and test the system on a local server and it can act as a good tutorial for setting up a modern web app with these components.

For those who can't set up their own server, a test server fulfilling the requirements and very soon ready for live demonstrations, is available via https://csr.dtv.fi/. The query API, with the Redis cache implemented, can be accessed from https://csr.dtv.fi/api/ query. For interesting performance comparisons, the cache can be disabled.

The project contributors are waiting anxiously for the results of real-world testing, which will begin soon.



**Juha Joki** has many years' experience in DVB and HbbTV technologies. At Sofia Digital he is currently in charge of DVB broadcast products, and testing and certification services for DVB and HbbTV.

# Putting DVB-I interoperability to the test



DTG Testing and OnScreen Publishing have joined forces to create an end-toend platform for the demonstration, evaluation and testing of DVB-I, based on OnScreen Publishing's Metadata Manager and client apps. They have used this to create the DTG DVB-I Test Suite, a complete set of tools and metadata for testing DVB-I client devices. We talked to Ranjeet Kaur (DTG Testing) and Gordon Maynard (OnScreen Publishing).

### Describe the DVB-I platform you've built.

**Gordon:** This is a fully-featured platform for DVB-I including a service list registry, service lists, content guides and broadcast streams. We also have multiscreen client apps for demonstrating DVB-I on hybrid TVs and handheld devices. The platform can include live broadcast and programme streams to test 'real world' scenarios. We were pleased to have the opportunity to show the platform to broadcasters, regulators and manufacturers at a recent DTG reception and this led to a lively discussion about the benefits and challenges of implementing DVB-I.

## What are the benefits of DVB-I to viewers?

**Gordon:** DVB-I allows the integration of broadcast, streaming and on-demand programming into a single user interface with potential for a greater choice of services, whether delivered over broadcast or broadband, 5G and beyond.

What are the benefits of DVB-I to service providers and manufacturers? Gordon: DVB-I provides a standardized

way of delivering OTT and hybrid services. This enables service providers to achieve maximum customer reach via all OTT devices and fast onboarding for new content providers. IP standardization helps manufacturers to build compliant and interoperable devices.

#### How does testing DVB-I differ from other broadcast conformance regimes?

**Ranjeet:** DVB-I can be implemented at international level with no national

boundaries; it also embraces many delivery methods and covers various types of devices and apps; and country profiles may add even more complexity. We have taken this into account while developing the DTG DVB-I Test Suite, focusing on scenarios for meeting the base requirements of DVB-I across all OTT devices and platforms. Countryspecific profiles can exist as an add-on component to generic level conformance. This makes ensuring interoperability and conformance effective and efficient, allowing CE manufacturers and app developers to launch products with confidence.

## Do you see the need for a centralized compliance body for DVB-I?

**Ranjeet:** The success of DVB-I will rely on interoperability and conformance to industry standards. This can be achieved by harmonizing the requirements as much and as early as possible. Our experience of implementing DVB-I has led us to believe that there should be a centralized group that could administer and manage requirements of the industry. Its role would be to make the development and testing process efficient for manufacturers and service providers.

#### What do you see as the main challenges for broadcasters and manufacturers in deploying DVB-I?

Ranjeet: If open-market service lists are to be created, service providers and receiver makers will be implementing the DVB-I spec separately. This is a big change from the OTT model, where client and server are developed in parallel. To achieve this level of interoperability, developers of receivers and apps will have to implement the entire specification, which has been designed to support many methods of delivery. We believe that rigorous testing will be required, which is why our DVB-I Test Suite includes a full set of structured tests with comprehensive reference metadata and broadcast streams. Once these challenges are overcome, DVB-I offers the industry a standardized means of implementing fully hybrid delivery and allows viewers to access a wider range of linear and on-demand programming using a familiar TV interface.

**Gordon Maynard**, founder of OnScreen Publishing, has many years' experience of delivering innovative services based on both DVB and IP standards. As DTG Testing Head of Delivery, **Ranjeet Kaur** manages the infrastructure and technical integrity of all testing operations, conformance regimes and new product and service development including the DTG DVB-I Test Suite. DVB SCENE | MARCH 2022



# How DVB's latest generation of specifications will drive future media delivery

#### EMILY DUBS (DVB PROJECT)

"DVB's new IP-centric ecosystem embraces broadband and mobile standards that, combined with the power of broadcast, can offer an ideal media delivery paradigm for all players."

DVB's overarching objective remains to provide solutions for the media delivery industry to capitalize on new technologies and market opportunities. These solutions take the form of technical specifications that address diverse market needs while collectively offering pathways to a new media delivery paradigm based on open standards. So, what does this new paradigm look like and how do these specifications all fit together?

The key to an optimized modern media-delivery system is a smart harmonization of service and content metadata, acting as an abstraction layer between the services themselves and the networks. This means any type of service can be easily discoverable on any kind of device, no matter the delivery network being used.

With such an approach, users can access, in a seamless way and through unified interfaces, linear or non-linear services, service enhancements (such as higher resolutions or immersive audio experiences), specific audio tracks, or accessibility features matched to both the user's needs and the capabilities of the device used. And operators can freely decide whether a service (or version of a service) is best delivered via broadcast, multicast or unicast, optimizing their network costs and capacity.

This new paradigm is built around the DVB-I service discovery specification,

which is at the heart of DVB's IP-centric ecosystem. Used in combination with other DVB specifications – DVB-DASH for low-latency streaming, DVB-MABR for multicast, DVB-NIP for IP-based broadcast delivery – DVB-I is a powerful tool for the media industry. It can unify traditional DVB networks and those using other technologies, including 5G and any future IP-based delivery system, allowing them to be used seamlessly and intelligently.

#### TRANSITION TO HYBRID

Our vision is thus to enable a transition. for media delivery, to an IP-based or more likely – a hybrid media delivery landscape. Here, broadcast is used to transmit mainstream content to large audiences across a wide footprint, while unicast technologies are used for interactivity and personalization as well as for enhancing core services. The same applies to future, massively data-hungry, virtual experiences - think metaverse that will also need to rely on broadcast for mass delivery of core common elements since unicast infrastructure is already struggling to keep pace with the exponentially increasing data traffic.

By offering a powerful aggregation solution, thanks to DVB-I and its associated specifications, DVB's new IPcentric ecosystem embraces broadband and mobile standards that, combined with the power of broadcast, can offer an ideal media delivery paradigm for all players.



Here we see DVB-I underpinning a truly converged media delivery ecosystem targeting the full range of end-user devices. IP-based delivery is handled via broadcast, multicast and unicast networks, combined seamlessly with existing MPEG-2 Transport Stream-based broadcast networks. DVB's audio and video coding specification (DVB-AVC) provides a further layer of interoperability, benefiting manufacturers, operators and end users alike.



**Emily Dubs** has been Head of Technology for the DVB Project since January 2020. She has spent more than 20 years in the digital television industry across a variety of roles, including with Thomson Video Networks (now Harmonic), TeamCast (now ENENSYS Technologies) and SmarDTV/Neotion.



Simplified view of harmonized DAS (digital ad substitution) signalling for TA and legacy receivers

# RTL's migration to targeted advertising with DVB-TA

#### FRANK HEINEBERG (RTL DEUTSCHLAND)

Since the television advertising business is going digital, addressable TV (ATV) is one of the defining topics of the future for RTL Deutschland. With its adtech and media sales company smartclip, RTL has been successfully performing single ad substitution as well as the substitution of full ad breaks on linear RTL channels since 2019. However, this workflow - based on DSM-CC1 stream-event signalling and HbbTV 1.5+ receivers is not standardized and is limited due to a lack of signalling accuracy and unsatisfactory switching duration, which requires start/landing zones in the linear programme.

With the release of the complementary DVB and HbbTV specifications for targeted advertising (TA), a standardized approach for seamless and precise substitution of advertising in linear television in horizontal markets has been defined. These improvements are based on TEMI<sup>2</sup> timeline support and the new "fast media switch" API.

The first operational phase of ad

substitution using DVB-TA signalling on RTL channels is scheduled for the first half of 2022. The migration path to DVB-TA is a challenging, complex custom integration into the broadcast infrastructure.

The DVB-TA system setup in the playout is based on two main considerations regarding the signalling of placement opportunities (POs): Backwards compatibility: for some time to come, RTL will maintain the control of the DSM-CC stream-event generator for HbbTV legacy devices via an API, in order not to lose any reach. New stream events plus the TEMI timeline for DVB-TA terminals will now be added, considering that both legacy and DVB-TA terminals must be covered by just one stream event packet identifier (PID) for a television channel. Correct timing of the POs is provided by calibrated delay units. Future-proof: as a straightforward approach in the playout automation software, additional ATV distribution paths like ad-stitching for streaming applications and potentially watermark

insertion (using HbbTV Application Discovery over Broadband Phase 2 – ADB2) shall be fed with the same markers in one source signal. To achieve this 'harmonized signalling' approach, an intelligent concept for using the stream event payload data has been developed, which is aligned end-to-end from automation software via an HbbTV app to the ad-server configuration.

With regard to the distribution infrastructure, the existing encoding and multiplexing hardware has been expanded to enable conversion of the upstream SCTE-104 messages to downstream SCTE-35 messages and DVB-TA signalling. The same setup is in place for all backup devices and scenarios. As changes to the playout automation software and the distribution hardware are always a bit like open-heart surgery, the system setup was modified in several phases in Q3 and Q4 2021. It is still being tested intensively to achieve maximum compatibility and to avoid errors and side effects in the distribution chain.

#### RECEIVERS

Finally, the decisive factors of the migration path are HbbTV-TA receivers and the HbbTV-TA application. The good news is that the TV sets are already available, as RTL is working with the set manufacturers to drive the roll-out of HbbTV-TA in Germany. Functional off-air tests with test TA apps were successfully passed and have demonstrated that linear content can be precisely switched to addressable content via broadband internet – and vice versa – on HbbTV-TA TV sets.

The HbbTV ATV SDK, embedded in RTL's broadcast-related HbbTV app, is developed and run by smartclip. This new ATV/TA SDK can differentiate between legacy and TA stream events and sends corresponding ad requests to the ad server. Pre-loaded substitute ads will be overlaid on the linear ad breaks using HbbTV-TA profile #2.

RTL's migration path to DVB-TA has begun. DVB-TA and HbbTV-TA are the first open ATV standards and therefore important milestones in addressability.

<sup>1</sup> Digital storage media command and control, a well-established toolkit for control channels in MPEG-2 transport streams <sup>2</sup> Timeline and external media information

> king on RTL on

**Frank Heineberg** is Senior Manager for Programme Distribution at RTL Deutschland, where he is working on various new technology projects. He has been involved with DVB activities since 2014 and represents RTL on the DVB Steering Board.

# Sustainability of media distribution at the core of DVB's work

#### CHRISTOPHE BURDINAT (ATEME)

"Serving as a universal, multi-network service layer for television distribution, DVB-I is the key to a fully streamlined delivery chain."

The energy used for media distribution, and the related carbon footprint, have emerged, finally, as major questions for the television industry. While initial studies evaluate the cumulative impact of media consumption (see DVB Scene, Issue 58), industrial alliances such as Greening of Streaming have begun gathering key players to share best practices.

Not surprisingly, the streamlining of television delivery, as targeted by DVB, goes hand in hand with this essential requirement of sustainability. In other words, DVB brings key tools to cut waste and optimize network usage. The driving forces here are the emergence of DVB-I, the more widespread use of multicast, with DVB-MABR, and the introduction of new and significantly more efficient codecs such as Versatile Video Coding (VVC).

#### STREAMLINED DELIVERY

The first target in making television more sustainable is the fragmentation of the ecosystem. Until now, two heterogeneous tracks have evolved independently: on one side, the MPEG-2 Transport Stream is used for content distribution over traditional broadcast (DTT, satellite...) while, on the other side, adaptive bitrate streaming formats are serving connected devices over broadband. To maintain their audience, services are provided in many flavours



The great DVB streamlining, towards a universal and energy-saving TV delivery chain

with non-homogenous technologies, leading to a lot of redundancy in terms of equipment, services and networks. This redundancy represents significant waste in data centres and networks. Serving as a universal, multi-network service layer for television distribution, DVB-I is the key to a fully streamlined delivery chain.

A second aspect is the emergence of multicast/broadcast capabilities in 5G. Unlike typical point-to-point communication, this avoids the need to duplicate the signal for each end user and thus saves significant network resources and transmission power. These capabilities will be perfectly complemented by the DVB-I service layer and DVB-MABR, to deliver television efficiently to mobile devices, car entertainment systems or home TV sets via fixed wireless access. The recently launched collaboration between DVB and the 5G Media Action Group will reinforce this vision, leading to guidelines and reference tools around these use cases.

Last, but not least, next generation video codecs are now firmly on the agenda at DVB and 3GPP. The first to be added to the DVB toolbox is VVC. Issued in mid-2021 and developed by

JVET, a joint group of ITU-T and ISO/IEC, VVC will provide around 50% bandwidth saving compared to its predecessor HEVC for a similar quality of experience. Being more complex, VVC consumes more power during the encoding phase but the huge savings in transmission power arising from the reduced bandwidth demand will weigh much more in the balance sheet.

#### NESTED PROJECT

Gathering Ateme, ENENSYS Technologies, IETR, Orange and Viaccess-Orca, the NESTED collaborative project (from New vidEo STandards for Enhanced Delivery) is built around the need for sustainability. Funded by the French region of Brittany, NESTED is developing an endto-end solution for television

distribution by combining DVB-I, DVB-MABR and VVC and validating this overall approach. While the partners already showcased the integration of these technologies during the DVB DEMOS 2021 event, work is now progressing on their industrialization and the overall gain evaluation.

With the forthcoming support of IP distribution over satellite with DVB-NIP, also leveraging DVB-I and DVB-MABR, DVB is fulfilling its objective of a network-agnostic service layer, streamlining the entire distribution chain and preventing energy waste.



**Christophe Burdinat** is Director – Technologies and Standard at Ateme. With more than 15 years of experience in the mobile broadcast industry, he is a regular delegate at 3GPP and the DVB Project, where he chaired the Commercial Module's MABR Task Force. His expertise covers multicast ABR, DVB-I, 5G broadcast, and OTT service distribution. He is also a happy member of the NESTED project.



Components of the metaverse

# The metaverse: much more than meets the eye

#### AXEL NACKAERTS (IMEC)

The "metaverse", a term coined by Neil Stephenson in his 1992 novel Snow *Crash*, is a recurring theme in science fiction literature. It denotes a real-time immersive, interactive and dynamic virtual environment, that people can access through AR/VR (augmented or virtual reality) and haptic technology. People meet for work and entertainment in the metaverse, which is basically acting as an alternate reality. The metaverse is not an application, but an enabler and context for applications to operate in. There is only one metaverse, though it does not need to be a globally unified or integrated space. It will most likely consist of a multitude of separate subspaces, interconnected using global open standards, and accessible to all similar to the principles governing the internet and websites.

#### MORE THAN VISUALS

The metaverse is far more than an immersive user interface for conventional content. To be accepted as an alternate reality, it needs to merge multimedia streams and real-time data from Internet-of-Things devices with virtual digital twins of machines, vehicles or cities, human avatars and AIbased intelligent agents. It also needs a feedback loop to control machines in the real world, an economic system for real or virtual ownership, licensing and cost accounting, and a robust, secure and privacy-preserving core communication protocol.

The diagram above shows some of the components we will need to build the metaverse. For example, when users from different parts of the world visit a virtual store, they might want to see the avatars of at least a few other customers. These avatars range from simple 3D models to complex, dynamic and interactive customers, requiring code execution beyond graphics rendering. The avatars are not a part of the shop itself, so the users and the services hosting the avatars need to exchange real-time data.

Complex user and machine interaction requires lots of computations. To enable a smooth shopping experience with low latency, these computations should be performed very fast. The stringent latency requirements will necessarily shift part of the computation closer to the user or real-world machines, into the communication network itself, and potentially down to the extreme edge. Also, the immense growth of data flow will require a compressed representation of the data, multi-level data integration and fast reaction loops, with peer-to-peer communication and state propagation. Most of this is invisible to the user, but central to the backbone infrastructure. The metaverse will be built on the global adoption of distributed computing, data exchange standards, portable code and object interaction protocols.

#### WATCH, EXPERIENCE, INTERACT

Today, we watch video on screens in physical places, where we experience - alone or together - content that is displayed as intended by the producers. The metaverse can emulate this by projecting content on a virtual screen. Users *watch* this content with other people in the same virtual space. It will gradually allow to *experience* the same content, to be truly part of the audience, and finally *interact* with it, as actors are enhanced by intelligent agents. This implies moving from 2D or pseudo-3D encoding to object-based 3D data capture, encoding, composition and rendering. Productions will work with a mixture of RGB, point clouds and depth-maps, polygon- or voxel-based<sup>1</sup> 3D objects, to fully rigged dynamic objects coupled to intelligent agents. To enable the exchange of this information among content creators, globally accepted object-based encoding standards are needed, tightly linked with a system of distributed digital ownership, licensing, and digital rights management.

<sup>1</sup> A voxel is a unit of graphic information that defines a point in three-dimensional space.

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**Axel Nackaerts** is Program Manager Artificial Intelligence at imec, Belgium. His main interests are sustainable computing for AI, cyber-physical systems, system of systems, and the global convergence towards the metaverse.



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