DVBSCENE

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On the cover: The DVB Project celebrates its 30th anniversary this year. Several articles mark the occasion: an interview with DVB chair Peter MacAvock, perspectives on some of the most significant DVB standards, a tribute to DVB's innovative IPR policy, and David Wood's thoughts on DVB's first three decades. See pages 10–16..

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DVB-I and blockchain – a glimpse into the next 30 years?

Emily Dubs
Head of Technology, DVB Project

While it's tempting to focus on past achievements when marking DVB's 30th anniversary, my first thought was to look ahead. Nobody, in 1993, could have accurately predicted what our industry would look like today. And with technology's relentless and exponential evolution, it seems harder than ever to predict where we'll be 30 years from now. But perhaps technology *itself* could do that job. So, I asked ChatGPT about media delivery trends in 2050.

The results of my first prompt were disappointing, being too close to a simple extrapolation of some of the use cases DVB has already captured and is working on, targeting availability way before 2050! When prompted to add other specific technologies into the mix, for example from the telecoms world, the response became more interesting, even if still not groundbreaking. It revolved around the seamless integration of AR (augmented reality) and VR (virtual reality) experiences into traditional broadcasts, enabling things like being able to choose from multiple camera angles or alternate endings.

As I had already been pondering the role that blockchain technologies could play in the relationship between broadcasters and content creators, and more broadly in the content production and delivery chain if combined with DVB-I, I steered the 'discussion' in this direction. This resulted in a compelling proposition:

> "Blockchain technologies complement the advancements of DVB-I by addressing crucial aspects of media delivery, such as content authentication, copyright protection, and monetization. Blockchain's immutable ledger ensures the integrity of content by verifying its origin and preventing unauthorized modifications."

ChatGPT also discussed the way such an approach could support a shift to revenue models based on direct support rather than traditional advertising alone, fostering a more sustainable and fairer ecosystem. And it continued with the benefits of decentralized distribution:

> "The convergence of DVB-I and blockchain technologies also lays the groundwork for a decentralized content delivery ecosystem, [...] reducing the reliance on centralized servers and minimizing downtime risks. This democratized infrastructure empowers smaller content providers and enhances content availability, ultimately enriching the diversity of media offerings available to viewers."

All of this probably still fails to approach a picture of the media delivery landscape 30 years from now, especially because the output of such AI tools remains highly dependent on how we use them. Humans still have a role to play!

Nevertheless, I do believe that our future content delivery ecosystem will take full advantage of the ongoing web3 revolution and in particular blockchain technologies. Let's check the situation again in 10 years' time; in the meantime, I look forward to seeing you at DVB's 30th anniversary party at IBC.

More unconferencing

DVB World 2023 took us back to Brussels last June, when our unconference format once again allowed participants to have fruitful discussions on the topics of most importance to them. See pages 18–19 for some snapshots.

Why not join us for DVB World 2024? We'll have more news on the location and format soon. In the meantime, thanks again to our supporters for this years event:

NEW DVB MEMBERS

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

Allegro DVT, headquartered in France, develops compression and decompression solutions for digital video. The company's products help chip vendors develop and test high-performance video processing ASICs. It also provides digital television testing services to ensure compliance with broadcast standards.

"We are excited to join the DVB Project. It is important for Allegro DVT to collaborate with leading companies in the video industry to contribute to new standards and foster adoption of innovative technologies in video delivery and distribution," said Nouar Hamze, CEO of Allegro DVT. **(allegrodvt.com)**

Telesat is one of the largest and most successful global satellite operators, delivering critical connectivity solutions that tackle the world's most complex communications challenges.

"As we continue to develop our next-generation low earth orbit (LEO) satellite network, we're excited to join the DVB Project to collaborate and contribute to further development of the DVB standards," stated Aneesh Dalvi, Telesat's Director of LEO Landing Stations and Terminal Development. "By incorporating DVB technology into our network, we're ensuring seamless integration for hybrid terrestrial/non-terrestrial networks for connectivity and content delivery." **(telesat.com)**

A word from the PCM chair

Elfed Howells (Huawei)

In the Promotion & Communications Module we are all about making waves, informing others about the things we do and reaching out to worldwide markets. But waves don't just drive the PCM – they also drive the whole of DVB's work.

As we look back on 30 years, we can clearly see those waves, both in terms of the creation of specifications and in their deployment and popularity. But how do the waves start and what does this tell us about the future?

In DVB's history, most waves started when our industry developed a myriad of proprietary methods to fulfil a need, but then realized that a common and interoperable specification was required. This happened with DTT (digital terrestrial television), DTH (direct-to-home satellite), HD/UHD (high and ultra-high definition), and more recently with streaming television.

Looking back, we can be very proud of the waves we've made, which continue to shape our world today, but it's rarely clear to us at the beginning where the next wave is coming from.

Take DVB-I, for example: with hindsight the need is clear, but at the time many did not believe that DVB had any role to play in IP or streaming. With deployments now on the cusp of proliferating worldwide, DVB-I seems set to be an important wave for us for the foreseeable future.

THE NEXT WAVE

Prior to DVB-I, many said that DVB's work was done, with nothing meaningful left to do. How wrong they were! The question remains, however, as to what the next wave will be.

The answer? I don't know, but the moment someone says "our work is done" is the moment a small ripple in the industry catches the wind and slowly but surely starts the next wave of innovation and specification.

Nevertheless, we don't simply need to wait and see which way the wind blows us. DVB's study missions and unconferences help us keep a keen eye on those nascent waves and ensure we are ready for the next.

We currently have three active study missions, four to five other topics under a watching brief, and several new ideas that bubbled to the surface at DVB World in June.

If you are interested in catching these waves, or starting some new ones, join us as we surge forth into the next 10 years.

Zhang Weimin, secretary general of the AVS Industry Alliance, with Elfed Howells, chair of the DVB Promotion and Communications Module

DVB signs liaison with AVS Workgroup

At May's 2023 World Ultra HD Video Industry Development Conference, in Guangzhou, China, DVB collaborated with the AVS Industry Alliance to co-host a workshop updating attendees on their respective specifications, ongoing work and new developments.

The workshop also marked the creation of a formal liaison agreement between the DVB Project and the Audio Video Coding Standards Workgroup of China, which was also granted a copyright licence to translate the DVB-I specification into the Chinese language. DVB was represented at the workshop by Elfed Howells, who chairs the Promotion and Communications Module.

DVB-I DEMOS

During the workshop, several local Chinese companies and academic organizations showed demos of DVB-I combined with innovative technology such as volumetric video, 8K and new streaming protocols. The demos provided clear evidence that DVB-I is playing an important role underpinning innovation in media delivery.

During the second day, DVB participated in a grand ceremony to turn on lights in support of the worldwide UHD industry. Major manufacturers from China, Korea and Japan, along with operators from France and China, also spoke at the event.

On the third day of the conference, DVB TM-I chair Paul Higgs gave a presentation on how DVB-I could be used to provide a path to unify and discover content delivered via IP and/or broadcast.

With the recent addition of the Chinese-developed AVS3 video codec to the DVB codec toolbox, the path for the use of DVB specifications in China becomes easier, and there is now strong interest from the region. Also, as DVB-I deployment progresses in other regions of the world, the TV manufacturers, many of which are based in China, are closely studying the specifications, and are keen to know more.

NEW & UPDATED SPECIFICATIONS

Find the latest published version of every DVB specification in our library: dvb.org/specification

Specification for Service Information (SI) in DVB systems
April 2023 • DVB BlueBook A038r16 (Interim draft EN 300 468 V1.18.1)

Commercial Requirements for Next Generation Video Codecs Phase 2
April 2023 • DVB BlueBook C105

Commercial Requirements for AV1 Addition to the DVB Toolbox
April 2023 • DVB BlueBook C106

Adaptive media streaming over IP multicast (DVB-MABR) – Implementation guidelines and worked examples
June 2023 • DVB BlueBook A181r2

Native IP Broadcasting (DVB-NIP)
July 2023 • DVB BlueBook A180r1

Second Generation DVB Interactive Satellite System (DVB-RCS2); Part 2: Lower Layers for Satellite standard
July 2023 • DVB BlueBook A155-2r3 (Draft EN 301 545-2 V1.4.1)

Dynamic substitution of content in linear broadcast (DVB-TA) – Part 3: carriage and signalling of placement opportunity information in DVB-DASH
July 2023 • DVB BlueBook A178-3r1 (Interim draft TS 103 752-3 V1.1.1)

Service discovery and delivery protocols for a DVB Home Broadcast system (DVB-HB)
July 2023 • DVB BlueBook A179r2

Service Discovery and Programme Metadata for DVB-I
July 2023 • DVB BlueBook A177r5 (Interim draft TS 103 770 V1.2.1)

Implementation Guidelines for DVB-I
July 2023 • DVB BlueBook A184

Adaptive media streaming over IP multicast (DVB-MABR)
July 2023 • DVB BlueBook A176r4 (Interim draft TS 103 769 V1.2.1)

Generic Stream Encapsulation (DVB-GSE); Part 1: Protocol
July 2023 • DVB BlueBook A116-1r1 (Interim draft TS 102 606 V1.3.1)

Commercial Requirements for the use of DVB-RCS2 in Geostationary and Non-Geostationary Systems
July 2023 • DVB BlueBook C107

Specification for the use of Video and Audio Coding in Broadcast and Broadband Applications
July 2023 • TS 101 154 V2.8.1

Metadata generation and deterministic DVB-T-megaframe/DVB-T2-MI stream generation from MPEG-2 Transport Stream(s) for a DVB Single Illumination System (DVB-SIS)
July 2023 • DVB BlueBook A175r1 (Interim draft TS 103 615 V1.2.1)

DVB-I service delivery over 5G Systems; Deployment Guidelines
July 2023 • TS 103 972 V1.1.1

Could DVB-I solve the content-discovery challenge for streaming television?

Paul Gray (Omdia)

The big television media story at present is FAST, free ad-supported streaming television. Perhaps what is surprising is how like normal television services it is: linear channels with added on-demand layers. Such channels are bundled as services from (among many others) Pluto TV and Rakuten. Smart TV platform owners such as Samsung, LG Electronics and Roku have now all launched their own services, joining the incumbents of Google, Amazon and Apple who have owned both content and platforms for a while.

Simply considering streaming services, Omdia counts over 3,700 worldwide, including broadcaster catch-up services. At the same time, distribution is becoming ever more of a patchwork. In the United States, National Football League coverage is now shared between seven services, as streaming companies muscle in and buy coverage rights. At the same time, streamers are launching ad-supported tiers to complement their subscription services with a mix of free and ad-supported business models.

ZERO MARGIN HARDWARE

Another dimension that is changing is the position of CE (consumer electronics) brands. Until now they have been largely neutral, aiming to support broadcasters' technical ambitions as new technologies offered a chance to stimulate sales. But the larger CE companies now own platforms and generate revenues from them on advertising, services, and audience data. Already in the United States, the smart TV advertising market is worth more than TV set sales. Brands such as Vizio and Roku sell their hardware at almost zero margin, essentially deriving their profits solely from advertising and data.

While such a situation may be tolerable for companies, the picture for consumers is less rosy. Faced by an explosion of content choice, it is increasingly difficult to search or discover something to watch. In the United States, we track over 1,200 thematic streaming channels. These channels are bundled inside the silos of the individual apps. Finding even a specific movie title may require a repeated process of opening an app, searching, and then repeating in another app.

APP SILOS

With such a profusion of choice consumers will need to be able to browse, search and receive recommendations (including 'surprise me!'). Ultimately what is necessary is a unified data set and a content-centric interface. A consumer-centric approach would also serve many broadcasters and content providers well, as the problem of being hidden in a jungle of content is only getting worse.

Current broadcasters are by no means blameless, with an insistence that consumers enter their app silos through the hatch at the top. Many consumers (especially older ones) solve the problem by channel zapping, but this means much content remains unknown. Younger viewers mix devices so freely and are comfortable with (and primarily use) search and voice control to find what they want.

While brands always dream of being in control and capturing consumers inside their own proprietary systems, the hard truth remains that open, neutral systems tend to innovate faster. Consumers also learn to escape the walled gardens and want content to be presented with their interests at heart, not the provider's. DVB-I could present an opportunity for a level, consumer-centred playing field. A neutral, central hub of information would be the foundation of diversity of discovery and recommendation, from zapping to voice search.

Paul Gray is Senior Research Manager with Omdia. With more than 30 years' industry experience, he leads Omdia's home devices research, spanning television sets, smart home, consumer electronics, and domestic appliances.

Screenshot of the the RTÉ DVB-I proof-of-concept service list combining broadcast and IP services

DVB-I tested at Ireland's RTÉ

The Irish public broadcaster RTÉ ran a proof-of-concept (PoC) to test several DVB-I features that would potentially enable the extension of the popular Saorview (digital terrestrial television) platform to connected devices like smartphones, tablets and laptops.

Using the reference application created for the DVB Project by Sofia Digital, the electronic programme guide (EPG) for the PoC included linear television and radio services delivered over terrestrial (DVB-T) broadcast and over broadband IP. The RTÉ Player, the station's catch-up and on-demand platform, was given its own spot in the EPG, which would allow viewers to jump straight to the player without leaving the EPG.

The PoC allowed RTÉ to confirm several strengths of DVB-I:

- enabling a familiar EPG interface;
- being an open technical standard;
- providing a migration path to a hybrid DTT/IP future;
- support for public media service prominence;
- and the fact that DVB-I integrates with and complements HbbTV.

Pending regulatory approval, further test activities and even a small-scale pilot may follow in due course.

Find more information on the RTÉ/ Saorview DVB-I PoC on the DVB-I website: dvb-i.tv/services

Preparing the way for a full DVB-I market trial in Italy

Marco Pellegrinato (Mediaset)

The Italian DVB-I trial was demonstrated at the 20th European Digital Forum in Lucca in June

In 2022, with the 're-farming' of the 700 MHz band in Italy, many broadcasters lost the capability to broadcast on DTT (digital terrestrial television) networks, due to the lack of spectrum to carry all of the required DVB-T multiplexes. Broadcasters in this situation were allowed to use the LCN (logical channel number) assigned for their DTT service to start linear IP streams, which are made available via an HbbTV app.

This is an interesting opportunity when it comes to the possibilities for a market trial of DVB-I in Italy, building on the technical trial and proof-of-concept that Mediaset and partners have been running since 2019. Since many broadcasters are already reusing their DTT LCN to stream linear channels, via HbbTV, they can use the same approach in the context of a DVB-I trial. It means such an initiative can be open to all broadcasters already licensed to broadcast in Italy using their own LCNs.

It is possible that the regulatory authorities in Italy will soon open a 'technical table' on the matter of DVB-I and HbbTV technology, to define a complete assessment and allotment of possible rules and LCN numbers to deploy DVB-I services in the future. This could lead to the announcement of a new set of rules – in Italian a *delibera* – about the prominence of services, including perhaps some references to DVB-I services.

> "DVB-I offers an opportunity to find another way of reaching our audiences in case we are required to reduce our number of DTT multiplexes."

REGULATORY QUESTIONS

It is a question for the regulator to define what would represent a licensed broadcaster and a licensed streamer (or 'broadbander'), and specifically to decide whether IP-only services would be allowed. Furthermore, there are many reasons why an existing broadcaster might not want to join a DVB-I platform at this stage. These are not technical questions – they are regulatory matters.

For Mediaset, DVB-I offers an opportunity, in the context of the re-farming of the 700 MHz band, and potentially the 600 MHz band in future, to find another way of reaching our audiences in case we are required to reduce our number of DTT multiplexes. This is why we originally started the proof-of-concept and why we are now keen to move towards a real market trial.

Most of the regional or local broadcasters in Italy already serve their own streams via HbbTV. DVB-I, however, could offer a more integrated solution than streaming through individual HbbTV apps. That's because DVB-I provides a user experience that is already familiar to all television viewers. We are cooperating with most of the regional and local broadcasters, specifically under the auspices of their association, *Confindustria Radio Televisioni*, to smooth the way towards the adoption of this new technology.

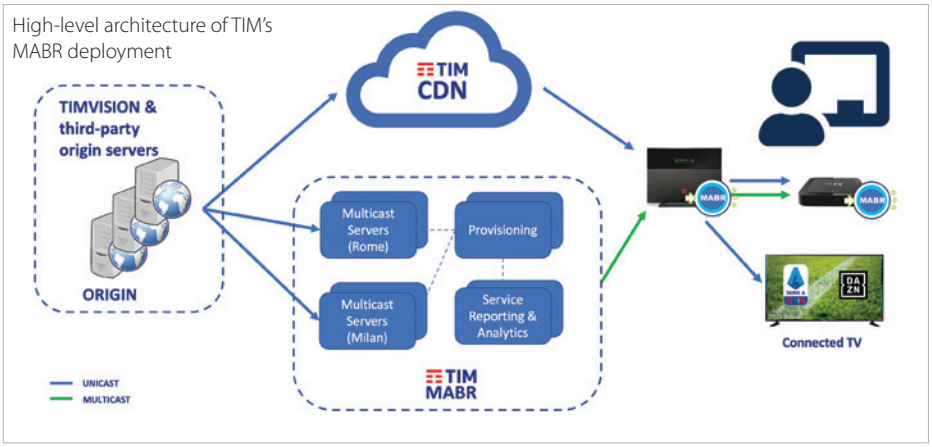
DVB-I AT IBC2023

The DVB booth (1.B73) at this year's IBC Show will again strongly feature demonstrations of DVB-I in operation, in collaboration with several DVB Members. With strong progress in both Italy and Germany (where the second phase of the national DVB-I pilot will soon be launched), visitors will have the opportunity to see both implementations in action.

We are aware of the following DVB-I demonstrations at IBC2023 (Amsterdam, 15–18 September):

- DVB (1.B73)
- European Broadcasting Union (10.D21)
- Eutelsat (1.D59)
- Fincons (5.F30)
- Sofia Digital (1.D98)

Marco Pellegrinato is Standards & Innovation Director at Mediaset and Vice-President of the HD Forum Italia. He has been active within the DVB Project for more than twenty years, with a particular interest in television broadcasting and Interactive standards and technologies.



High-level architecture of TIM's MABR deployment

Italian viewers benefiting from TIM's DVB-MABR deployment

Diego Gibellino (TIM)

Adaptive media streaming over IP multicast, as specified in DVB-MABR (Multicast Adaptive Bit Rate), has the potential to overcome existing barriers to offering live television services to wide audiences over IP in an efficient and scalable way. It allows optimization of traffic in the core and access networks, directly reaching devices in the home network. Properly combined with unicast and CDN (content delivery network) caching mechanisms, which improve performance up to the closest point of presence to the user, multicast can further optimize last-mile delivery without requiring additional infrastructure.

MABR delivery can also dramatically reduce energy consumption, contributing to decreasing the overall carbon footprint of streaming services while saving on energy-related costs. Furthermore, MABR perfectly fits into the DVB-I architecture, complementing unicast delivery where required.

NEW PLATFORM LAUNCHED

In 2021, TIM, the largest broadband access provider in Italy, launched a new delivery platform based on DVB-MABR. This was a key disruptive project driven by the increment in traffic foreseen for the distribution of massive live events in streaming, such as Serie A football matches through a partnership with DAZN.

The platform has been designed and developed with TIM's technology partners Broadpeak and CVE. It leverages multicast support in the TIM network, originally deployed to provide traditional IPTV services, to transparently enhance the distribution of unicast streaming content, with negligible impacts on client-side applications and providing automatic fallback and repair mechanisms.

Redundant multicast servers in Milan and Rome ingest content from origin servers managed by TIM or by third-party providers. Multicast servers are responsible for the conversion of manifest and segment files of live content into a stream suited to multicast distribution. On the client side, multicast gateways convert the multicast stream back into a set of files corresponding to the ABR content, handling synchronization and acting as a proxy for requests sent by the client.

Considering the deployment options defined in DVB-MABR, a model with support for multicast gateways both in home gateways and in the TIM set-top box has been selected and implemented. This choice allowed greater flexibility in the number and kind of client devices that could access MABR content, and at the same time ensured a fast way to initially deploy MABR directly to set-top boxes.

The initial deployment has been progressively extended to support additional kinds of devices (for example, connected TVs) and enhanced functionalities like support for third-party global CDNs (in addition to TIM's CDN) and Dynamic Ad Insertion (DAI). Transport of media presentations in low-latency ABR modes can be supported for events with specific requirements in terms of end-to-end delay (for example, sports events offered also on the digital terrestrial television infrastructure, where major differences in the delay for the streaming service may negatively impact the user experience).

POSITIVE RESULTS

Since the launch of this platform, thousands of live events (some up to UHD resolution with high dynamic range), have been successfully distributed in MABR in Italy, directly by TIMVISION, the OTT streaming service offered by TIM, or in partnership with third-party service providers using TIM to deliver their content across Italy. Metrics collected by the platform and feedback shared by TIM partners have demonstrated that users served by MABR enjoy a more stable service, are less impacted by network congestion events and, in general, benefit from a consistently higher bitrate level, with significant savings for service providers in terms of costs per GB delivered compared to unicast distribution only.

In the context of the DVB-I trial coordinated by Mediaset in Italy, TIM has also integrated MABR capabilities in selected DVB-I services, offering some channels from both Mediaset and TIMVISION in multicast. This has been implemented with a linked HbbTV application able to discover and interact with an MABR agent in the access gateway, completely transparent to the receiver. The experiment has proved that DVB-MABR can be easily integrated in off-the-shelf receiver products by broadcasters and service providers and that it can further aid the transition to an IP-based television ecosystem.

Diego Gibellino is responsible for the Video & TV Technologies laboratories in TIM. He's active in many SDOs and industry forums, representing TIM in ISO/IEC JTC1 SC29, MPEG, 3GPP SA4, MPAI, UNI/CT 512, and UHD Forum Italia. He's a member of the DVB Steering Board.

Spanish pilot shows how DVB-I brings new opportunities for DTT

Álvaro Llorente & José Manuel Menéndez (UPM), Adolfo Muñoz Berrón (RTVE)

Displayed channels (DTT + DVB-I) on the DVB-I compatible TV set

In April 2023, the RTVE (Radiotelevisión Española) Chair at the Universidad Politécnica de Madrid (UPM) presented the first pilot broadcast, at a national level, of DVB-I channels linked to the DTT (digital terrestrial television) signal.

The pilot took place on the UPM campus during the Mutua Madrid Open tennis tournament, offering users the possibility of selecting the individual feed of each of the seven tennis courts through DVB-I channels.

The RGE2 DTT multiplex was received at the campus on UHF channel 41. It carries a total of 14 services: five television and nine radio. Only RTVE's own services were used for the pilot, with the necessary signalling to make use of DVB-I technology added to the NIT (Network Information Table). The NIT is used in the MPEG Transport Stream to signal all the information related to the network and to the organization of the multiplexes.

REFERENCE APPLICATION

The DVB-I specification describes the procedure and the descriptors to be added to the NIT in order to activate DVB-I services and include a link to the DVB-I service list in the transport stream itself. The DVB-I reference implementation was used to create the service list. This reference implementation includes backend components for generating and editing service lists, as well as frontend applications for HbbTV, mobile devices and computers.

The backend allows the available services to be added to the service list, both DTT services and broadband streamed services. For this pilot, the service list linked a total of four DTT services and eight additional services streamed via broadband (the seven courts from the tennis tournament along with tdp UHD).

For each of the different DVB-I services, a set of parameters had to be indicated in order to correctly link the services. In the case of DTT channels, several parameters had to be provided, such as the service name, the service provider, the LCN (logical channel number) field, and various other identifiers. Additionally, the MPEG DASH address for the broadband services had to be detailed. With no national agreement on LCN in Spain, it was possible to use a simplified LCN configuration.

So, the backend of the reference implementation generated the DVB-I service list, an XML file with information on all the available services and how to access them for playback. The web address for this service list was added to the NIT. The seven DTT services, together with the modified NIT, were broadcast from a headend at UPM on UHF channel 44, using the standard official Spanish DVB-T transmission configuration.

Two DVB-I-enabled TV sets were used for reception. After the conventional radiofrequency tuning process, DVB-I service discovery was carried out. This consists of reading the NIT table, obtaining the link to the DVB-I service list, accessing the XML file, and interpreting the information of all the services linked in this list.

After tuning and service discovery, the television channel list included (in a transparent way for the user) both the DTT channels and the internet-delivered channels, in order of appearance according to the LCN value assigned to each when the service list was created. Non-DVB-I compatible TV sets would simply ignore the DVB-I information and show only the DTT channels.

The user was offered 12 services (the four DTT channels plus the eight DVB-I services), and could zap between them using a remote control, without noticing any difference between how they were delivered.

The presentation of the pilot showed how DVB-I can be a complementary technology for broadcasters: linking channels to DTT broadcasts with personalized content, thematic content (e.g., eGaming), or content with other qualities or complexities, such as UHD, virtual reality or multiview.

COLLABORATIVE PILOT

This activity was possible thanks to the collaboration of the members of the Advisory Committee to the RTVE Chair at UPM in technological aspects: Cellnex Telecom, Dolby, Sapec and Televés Corporation (Gsertel, TRedess and Televés). Vestel supplied two commercial TV sets that included the software necessary to correctly interpret the DVB-I signalling. Golumi collaborated in the generation of the MPEG DASH signal and the live UHD signal streaming.



Adolfo Muñoz Berrón is the director of the Broadcasting Area at RTVE and co-director of the RTVE Chair at UPM. **Álvaro Llorente** is senior engineer at UPM, and **José Manuel Menéndez** is full professor at UPM and co-director of the RTVE Chair at UPM.

Delivering the future of interactive and personalized media at scale

Graham Thomas (BBC R&D and AI4ME Prosperity Partnership)

The media sector is in the midst of a transition from broadcast infrastructure and services to IP. In addition to the challenge of maintaining the scale and resilience of broadcast, we also need to meet audience expectations that internet-delivered content can be personalized and customizable. This includes assembling content to meet particular user needs (such as accessibility), device characteristics (like screen size), audience interests and context (such as the order, duration or prominence of certain sections or overlays), or business needs (such as advert placement or accounting for rights agreements for specific regions).

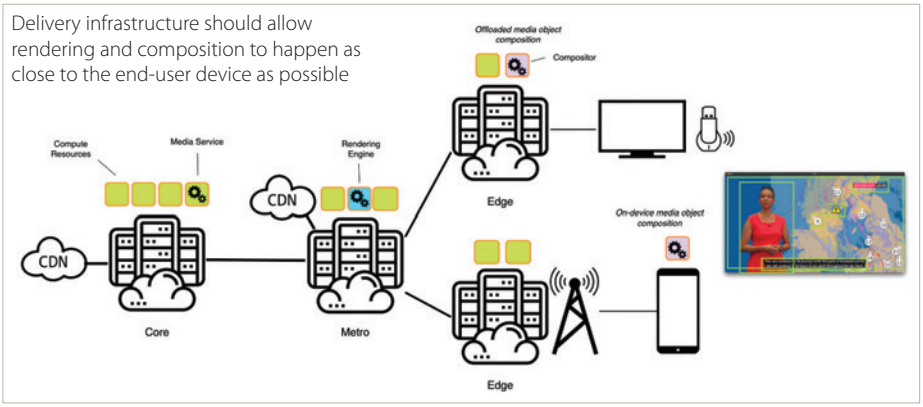
Substantial research that has already been undertaken on object-based media lays the foundation for this, but further capabilities are needed to make it possible to create and distribute truly flexible content on a large scale.

The AI4ME Prosperity Partnership (ai4me.surrey.ac.uk) is laying the foundations for building those capabilities, by addressing key challenges in production and delivery. The partnership is led from the academic side by the University of Surrey and from the industrial side by BBC, with Lancaster University bringing specialist expertise in software-defined networked distributed compute.

LEVERAGING AI

The University of Surrey is developing AI-powered techniques to allow audio and video to be separated into objects (such as individual audio tracks and distinct 'layers' from a video scene) and create metadata describing the scene.

There is a significant overhead to creating object-based content in current production processes, as they are geared towards creating 'finished' programmes rather than the individual components needed to produce flexible content. BBC is investigating potential use cases and production tooling that would be needed to support them, building on the content analysis work from the Surrey team.



Lancaster University is addressing the challenge of delivering and rendering customized content, by working with BBC to develop approaches to intelligently distribute the processing and data through the delivery network, making optimal use of resources in the cloud, edge-compute nodes, and the audience's networks and devices. To render customized content at present, high-end audience devices or large amounts of cloud computing resource are required, making it expensive and impractical to reach large audiences.

THREE KEY TENETS

To deliver highly interactive and personalized media, the infrastructure should be capable of pushing composition and rendering processes further down the delivery network, closer to the user, and re-compose/re-render content when required. But while future media-delivery systems must provide this level of placement flexibility, they will still be bound by the tenets of access-universality, scalability and sustainability.

To enable rich new features *universally* for audiences, AI4ME is looking into approaches to build flexible media applications that can adapt to the end-device capabilities and selectively offload compute-intensive operations to the cloud or edge. For *cost-effective* and *environmentally sustainable* delivery, strategies that allow sharing of compute resources, e.g., GPUs and generated results, will enable a deployment of media-delivery services to *scale sub-linearly* with increasing audience size. Since media-delivery systems will likely span multiple heterogeneous compute targets and networks, intelligent provisioning and orchestration across these are required to fulfil delivery business objectives such as Quality of Experience (QoE) thresholds, and cost/energy KPIs.

As well as addressing the above challenges, BBC and Lancaster University are exploring novel real-time adaptation and optimization techniques to enable delivery systems to gracefully degrade to maintain user QoE and cost/energy budgets as operating conditions and audience sizes change. With these new capabilities, the delivery infrastructure and the content can both flex to meet the audience needs *and* the content provider's distribution objectives.

AI4ME provided input for the DVB Study Mission on Object-Based Media, which will soon publish its final report. This may lead to the development of specifications to support the large-scale distribution of interactive and personalized media.

Graham Thomas is Head of Applied Research, Production at BBC R&D. He contributed this article in collaboration with AI4ME colleagues Rajiv Ramdhany (BBC R&D), Adrian Hilton (University of Surrey) and Nick Race (University of Lancaster).

Hindsight, foresight and insights – Peter MacAvock on DVB's 30 years

Peter MacAvock has been at the heart of the DVB Project since just after its creation, having been hired to run the DVB Project Office in January 1994. He left in 2008 to take up a fulltime position at the European Broadcasting Union but was elected chair of DVB in 2016. DVB Scene caught up with him to discuss the state of DVB on its 30th anniversary.

DVB Scene: You've said this will be your final mandate as DVB's chair. What's the ideal profile for your successor?
Peter MacAvock: Ideally the next chair of the DVB Project will be drawn from a generation of people who didn't know DVB's foundation, who have scant regard for its reputation but recognize its unique selling points. It should be someone who will seek to wipe away the cobwebs and build an organization that's dynamic and diverse. DVB still counts for something but arguably the reason it still counts is its legacy, which is also what weighs it down.

There are many more standards developing organizations, SDOs, in the media space today than there were 30 years ago. Discuss.
There are many, many more. But while DVB looks like a standardization body, it's actually not one. If I look at the way in which similar problems were addressed in other territories, like in the US and Japan, the bodies that produced the technical specifications in those territories were standardization bodies with related mandates, whereas the DVB Project was industry-led and made sure it was, in an effort to dissociate itself from the regulation that might be associated with a standardization mandate. We've been careful to make sure that DVB remains an industry-led specification-producing body that then subsequently standardizes its work outside, in ETSI.

Carter Eltzroth, first chair of the IPR Module, signing the DVB Memorandum of Understanding on behalf of FilmNet

When you came on board a few months after DVB was created, were you aware of these differences?
The process by which the DVB Project came together saw the emergence of the primary difference between DVB and other such groups, namely the Commercial Module (CM). DVB originally proposed to look at delivering HD over terrestrial: the European Launching Group (ELG), chaired by Ulrich Reimers, had produced a report setting out what needed to happen in order to make HD digital terrestrial television (DTT) a reality. The public broadcasters and the ELG made an approach to the pay-TV operators who stipulated that, if they were to support a standardized approach to digital television, it needed to focus on multichannel SD satellite delivery before it focused on HDTV. Ultimately that proved to be the correct approach – there was an economic driver for multichannel satellite SDTV that simply didn't exist for HDTV services.

Right from the outset DVB has asked whether it is commercially sensible to do a particular technology solution. Commercial requirements that were produced at that time looked very much like *commercial* requirements. If you look at the satellite CRs, they focused on dish size, on a typical house installation. They didn't focus on a performance criteria – they focused on cost and convenience.

Are the reasons for DVB's existence different today?
The singular focus the DVB Project had at launch was to allow the industry to shape its own future and its own future was relatively clear at the time. The situation is far more complex now and arguably the industry is undergoing a change that's even more fundamental than those that took place back then, from analogue to digital and from SD to HD.

What we're now seeing is a convergence between two big data delivery systems, telecoms and television. We see the rise of the big tech SVOD streamers operating in an environment that's less regulated than the one in which DVB Members traditionally operate and therefore allows greater flexibility. In terms of their technology choices, they don't look much to the world of standardization; they're looking towards the more vertically integrated app-based approach where user data is very carefully guarded and protected. It's a space where the opportunities for standardization are different and are being met by organizations that are typically outside the media space, like W3C and the IETF.

With this increasingly dominant ecosystem that grew up outside DVB, the broadcast world is having to run to catch up. Is DVB still relevant?

The founding of the DVB Project in Bonn, Germany. Pictured, left to right, are the chair of the Technical Module, Ulrich Reimers, chair of the Commercial Module, John Forrest, and chair of the Conditional Access group, Eamon Lalor

That's a big question. The reason we work so hard for interoperability between services and devices, and the reason a free-to-air market has flourished for decades, is that the economics are based on interoperable technical solutions – I'm not going to call them standards here – and it works. We're seeing a trend where the subscription video-on-demand companies are more and more seeking to develop interoperable, common solutions. They're relearning the value of standardization, not in the formal sense but agreeing on technology choices, which allows a multivendor interoperable ecosystem to build up, and then competing on content and services. It's a lesson we learned years ago.

So is DVB still relevant? Yes, but it needs to fundamentally change the way in which it operates and how it captures its requirements, because arguably it has turned into a ponderous organization that looks and feels more like the classic standardization bodies it sought never to become.

You describe DVB as an industry-led specification-setting body but it is, nevertheless, very tightly associated with standards. Is it effectively a standards developing organization?

One of the unique things about DVB is that standardization is a means to an end; it's not an end in itself. We chose ETSI standardization as a way of solving a problem we had, and indeed there are examples of this even today: the DVB-I spec is in its fifth generation but only one of those has been forwarded to ETSI. So the DVB Project is about creating interoperable solutions to problems. It's not about standardization, even though standardization is the core output of the work the DVB Project currently does. It doesn't have to be.

What will be the biggest challenges for your successor?

Maintaining a relevance in the core sector DVB seeks to serve. DVB is very squarely focused on the television business and while the mobile sector continues to grab all the headlines in terms of innovations, and in terms of profits, people still watch lots of television. The type of television they're watching has shifted greatly over the last 5–10 years – we're now operating in a world where information is at your fingertips and where high-quality media content is available to your whole family in a targeted manner, drawing from a lake of almost unimaginable size. Finding a continued role for DVB in that space is going to be a challenge. It's clear that there may be some difficult decisions for my successor to take.

What will mark the end of the line for the DVB Project?

There is no other forum where the entire media sector value chain, both content providers and technology vendors of all kinds, gather. There have been attempts to create it – and there are local exceptions to this rule – but there's no other place for this ecosystem to meet and to agree on what its common future should be. For DVB to remain relevant it needs to look closely at the processes that have become so cumbersome over the last years. And it needs to identify what the industry sector wants to do with itself, and then set about shaping the interoperable solutions that would facilitate that. It may no longer be a question of doing lots of standardization or even writing lots of specs – it could just be guidelines and profiles of technologies that come from other sectors.

DVB has dominated your professional life up to now. Will it continue to do so?

From a perspective of trying to shape the future of DVB, I would argue that it needs fresh blood. Those with whom I've been consulting over many years may, with the greatest respect, not be the ones that should be consulted on its future. If I were to come back to the DVB Project in ten years' time, I'm not sure there are many individuals that I'm working with now that I'd like to see still there – and I count myself as one of them!


Peter MacAvock in the DVB Project Office circa 1996

Standards that changed the (media) world

For 30 years, the DVB Project has been developing technical specifications for digital television. In addition to being commercially driven, interoperability is a fundamental goal of DVB's work, with the maximum possible commonalities across the different solutions.

While DVB was initially oriented towards Europe, its standards are now used throughout the world, making it a truly global organization. On these pages, we've invited key contributors to DVB's work over the years to write about some of the specifications that were most important to DVB's success.

TRANSPORTING DVB SERVICES

Ulrich Reimers

Let's think back 30 years. DVB was in the process of developing its first specification for digital television – later called DVB-S. The members of the DVB consortium had decided that they would accept standards for audio and video coding designed by the Moving Picture Experts Group (MPEG). But what systems layer should be used for the transport of audio, video (and data)?

The Internet Protocol (IP) and the User Datagram Protocol (UDP) existed already but a Real-time Transport Protocol (RTP) was still unknown. It therefore was quite natural to again look at solutions available from MPEG. The MPEG systems layer offered a solution – or two, to be precise: the Packetized Elementary Stream (PES) and the Transport Stream (TS). The beauty of the TS was that it could be made compatible with the requirements of forward error correction (FEC), so important for transmission over error-prone channels.

For the first-generation DVB systems – DVB-S, DVB-C and DVB-T – a concatenation of a convolutional code and a Reed-Solomon code was found to be the optimal and realistic choice with respect to the implementation cost in TV sets of those days. The Reed-Solomon code based on bytes (B) of eight bits each has an implicit limitation: it exists only up to a length of 255 B. In consequence, a data packet including header, payload, and FEC data must not be longer. PES packets are significantly longer. DVB thus selected a TS packet of 188 B and added an FEC block of 16 B.

All this was not controversial. What was controversial was the question how many individual TS packets would need to be identifiable. A packet identifier (PID) of 13 bits would support identification of 8,192 packets. By some, this number was considered too small – but it was chosen.

ENDURING SOLUTION

In 2000, I thought that it would be time to replace the TS with a solution available in the IP world. A member of my team in Braunschweig therefore developed a solution described in his dissertation "Transmission of Media Content on IP-based Digital Broadcast Platforms", which he presented in 2006. To my surprise, the broadcast community had fallen in love with the TS so deeply that our proposal was not taken up. Some 10 years later, ATSC 3.0 arrived as the first all-IP broadcast standard.

Why is the TS a winner? It was chosen for all DVB broadcast solutions including DVB-S2, DVB-T2, DVB-C2, for ATSC 1.0, for ISDBT-T and for DMB-T: a global solution, really.

THE DVB CODEC TOOLBOX

Paul Szucs

During the infancy of the DVB Project, the MPEG-2 video codec and MPEG-2 Layer II audio codec were the state-of-the-art international standard video and audio codecs from the ISO/IEC and ITU-T-hosted Moving Picture Experts Group. These codecs enabled the compression of video and audio content so that several digital television services could fit into a multiplex that occupied a channel previously occupied by a single analogue television service.

The first edition of DVB BlueBook A001, published in 1996, specified the use of these codecs. With A001 out there, the members of TM-AVC (a subgroup of DVB's Technical Module)

THE PAY-TV DILEMMA

Robin Crossley

One of the key elements in the formation of DVB was the need to bring together differing and sometimes strongly held views about what was needed to create and grow the marketplace. This was particularly the case in the area of the then recently formed pay-TV broadcasters and their juxtaposition with the more traditional public service broadcasters that had been the backbone of broadcasting in Europe since its inception.

The PSBs argued that the market should be 'open' and all reception equipment should be harmonized and standardized across the EU (and indeed the world) in the interests of keeping costs to the consumer as low as possible.

The pay-TV broadcasters, on the other hand, needed to incorporate

thought they could sit back and wait for the next generation of MPEG technologies to emerge, expected around a decade later. But in 2001, Australia came knocking on DVB's door with the request to be able to use a, at the time, proprietary audio codec, namely Dolby AC-3, instead of the MPEG offering, within a DVB-based digital television system. After much deliberation, the first and only fully-fledged DVB 'toolbox' specification was conceived, at that stage offering two choices of audio codec, where the usual aim was to provide one solution for a given task.

NEW GENERATIONS

Successive generations of MPEG video codecs have been adopted in order to facilitate successively higher levels of video experience – H.264/AVC in 2006, H.265/HEVC in 2015, and most recently H.266/VVC, along with AVS3, the "next-generation" video codec primarily for use in China. Audio capabilities have been enhanced with multi-channel surround-sound codecs and configurations and MPEG-H 3D Audio. An important element of the toolbox is the set of audio features for accessibility.

Once adopted, audio and video codecs are not usually ever removed from the toolbox. This acknowledges the fact that different regions of the world are at different stages of technology roll-out. With very few exceptions, all of the codecs and their profiles included in BlueBook A001 are in commercial use somewhere in the world.

The DVB video and audio coding specification truly embodies the commercially driven, flexible, consensus-based approach to developing industry standards. In my humble opinion, DVB-AVC has helped significantly to underpin the overall success of the DVB Project.

CONTRIBUTORS

Ulrich Reimers chaired the DVB Technical Module from the foundation of the DVB Project until 2012. From 1993 to 2020, he was the director of the Institute for Telecommunications Engineering at Technische Universität Braunschweig.

Paul Szucs is vice-chair of the DVB TM-AVC working group. He is Senior Manager, Technology Standards at Sony, a company he has worked with for more than 25 years, focused on standardization, business development and industry alliances.

Vittoria Mignone chairs DVB's TM-S working group, focused on satellite technologies. Since 1992, she has been with the research centre of Radiotelevisione Italiana, where she is currently head of the Fixed and Mobile Networks Department.

Robin Crossley was involved with the DVB Project from its earliest years and chaired the Conditional Access Specialist group. Now retired, he was previously Director of Technology Development at Sky Group having also worked for SES Astra.

Alexander Adolf is vice-chair of the DVB Technical Module and previously led the working group that developed the DVB-SI specification. He has been involved in the DVB Project and in the development of digital television in Germany for more than 25 years.

"Once adopted, audio and video codecs are not usually ever removed from the toolbox. This acknowledges the fact that different regions of the world are at different stages of technology roll-out. With very few exceptions, all of the codecs and their profiles included in BlueBook A001 are in commercial use somewhere in the world."

encryption technology into the receiving equipment and insisted on the right to choose their own technology to protect their businesses. Many also felt that the high costs to consumers of reception equipment in the early stages of the market would require direct or indirect subsidy in order to grow the market quickly enough to sustain these high-risk businesses.

Even for the PSBs the need to protect copyright licensing across borders necessitated the use of encryption technology. While the notion of broadcast coverage being limited to the small amount of overspill from terrestrial transmitters might have worked in the pre-satellite world, the pan-European footprint of the new satellites meant that a more robust solution would be needed. This all became known as Conditional Access.

It took many often controversial

and heated discussions among the market players to establish some areas of commonality on which technical standards could be designed.

ALGORITHM & INTERFACE

The first and most essential of those standards became known as the DVB Common Scrambling Algorithm (CSA). An additional challenge was that while the CSA obviously needed to be secure against hacking, it also needed to be not too secure in order to satisfy the needs of various government intelligence services!

The second area on which it was agreed to develop common standards was around the interfaces to the CSA that would allow proprietary and secret encryption technologies to be deployed by pay-TV broadcasters in such a way that the same common DVB set-top box could be used across the EU to maximize economies of scale in manufacturing. This second set of standards became known as SimulCrypt and MultiCrypt.

It is testament to the visionary work of the DVB pioneers that all three of these standards remain in use today. What allowed that to happen? I think it can be summarized in two words, which together are the cornerstone of much of DVB's success over the years: compromise and pragmatism.

Continued overleaf

THE SATELLITE SUCCESS STORY

Vittoria Mignone

Along with the 30th anniversary of the DVB Project itself, in 2023 we also celebrate the 30th anniversary of its first transmission standard, DVB-S. It's difficult to imagine a world without DVB's satellite standards. DVB-S, and the standards that followed it, represented a disruptive paradigm shift, first in media distribution and then for a wide variety of other applications, also covering professional and other emerging markets.

DVB-S was designed to provide DTH (direct-to-home) multi-programme television services, pushing several (instead of one) digital television programmes in a single radio frequency channel/transponder. General-purpose multi-transponder (10–20) telecommunications satellites could be used for television broadcasting, rather than the high-power satellites, with four to five transponders, that had been foreseen by the ITU frequency plan agreed in 1977.

DVB-S was an immediate success, thanks to its flexibility to adapt to the multiple needs of the broadcast industry. Widely adopted for satellite broadcast services around the world, it has also been frequently used also for professional transmissions, driving DVB to extend the specifications to cover contribution applications, such as point-to-point connections between television studios and DSNG (digital satellite news gathering) applications.

Contemporarily, DVB-S 'inspired' the cable and terrestrial broadcasting systems DVB-C and DVB-T, which, based on independent sub-systems, maintained a high level of commonality with DVB-S, thus reducing implementation effort and time-to-market.

SHANNON LIMIT

Ten years later, and with clear worldwide success, in 2003 improvements in channel-coding technology that enabled a performance approaching the Shannon limit motivated DVB to define the second-generation standard for satellite transmissions, DVB-S2, once again followed by the terrestrial and cable specifications. The second generation of DVB standards came together with the general migration of broadcast services towards HDTV (and sometimes 4K UHD), to support the incredible evolution of the consumer TV panels (dimension, resolution and dynamics).

DVB-S2 was defined as a single standard to address several satellite applications, from broadcast to broadband and professional ones, thus enabling the use of mass-market products also for professional or other niche applications. And it was another success story, with broad adoption across all the application sectors.

The excellent performance of the second-generation standard made a disruptive third generation unlikely. Nevertheless, another 10 years later, in 2013, DVB started defining DVB-S2X, the extension of DVB-S2 that introduced additional technologies and features to further optimize the core applications of DVB-S2 and complete the application fields of the standard to cover emerging markets such as mobile applications.

DVB's satellite solutions continue to evolve, most recently adding support for beam-hopping systems and with the initiation of work on adding support for non-geostationary satellite constellations in the second-generation standard for interactive satellite systems, DVB-RCS2. All of this confirms DVB's position as a leader in satellite specifications.

DVB-SI AT YOUR SERVICE

Alexander Adolf

The global success of DVB solutions in the marketplace today is based on, and their design inspired by, the MPEG-2 Transport Stream (TS). It is the foundation that shaped everything. But it was not a foundation that came for free. In the first half of the 1990s, the MPEG-2 family of standards were in the process of being conceived to implement pre-recorded media. It was only after players from the broadcast industry approached the MPEG community that, in addition to the Program Stream (PS), which was to be used on DVD media, the TS for use in live broadcast was added to the MPEG-2 specifications.

Apart from its first unique feature at the time (use of two layers of timeline, allowing the terminating device to precisely reconstruct the timing at the source's input for a smooth presentation), the second big thing about the TS was its layered use of container structures for conveying information about the "core" audiovisual streams in the multiplex. Since DVB calls these *services*, the container structures conveying information about those services were naturally called service information, or SI for short.

The format of these SI containers (named tables and descriptors) uses the type-length-data design pattern, which makes them extensible yet interoperable, since a receiver can use the length information to skip over the data of a type it does not know about. Instead of defining a container for each use case, DVB partitioned the information into small, (sort of) atomic units, which can be combined to gather all the information needed for a given use case. Effectively, DVB's tables and descriptors form a domain-specific language for describing the available audiovisual streams and services. From an implementation point of view this enables an implement-once-use-everywhere approach in that, once the implementation of a given container is tested and done, it can be used in many contexts with minimal new testing effort. A first in the media world.

AGILE RECEIVERS

In addition to these microscopic features, it was also the macroscopic, top-level architecture of DVB-SI that gave it a unique advantage. Television broadcasting happens on many different radio channels, and a receiver can always receive a single channel frequency only. To help 'agile' receiver behaviour, DVB-SI can include information about services on other radio channels, too. This allows the receiver to discover available services more quickly, and to alert the user to things of potential interest on radio channels currently not being received. Another first in the media world. Such architectural patterns would not be picked up by other file and streaming data formats in the media world until much later, and greatly helped the success of DVB technologies in the marketplace.

How an innovative IPR policy underpins DVB's success

Georg Nolte and Roberto Dini

As DVB reaches its 30th anniversary, we celebrate the technological innovations developed by engineers within DVB Member companies and implemented in billions of devices worldwide. But DVB's success lies not solely on the technical skill of these dedicated engineers, but also in the development and management of DVB's innovative IPR (intellectual property rights) policy.

The IPR policy was a comparative latecomer to DVB's governance: it was adopted as an amendment to DVB's Memorandum of Understanding in October 1996 and then formally incorporated into the MoU as its Article 14. Since 1996, the basic terms of the IPR policy have remained constant: *each Member is called upon to grant licences to its patents essential to DVB specifications on terms fair, reasonable and non-discriminatory (FRAND), unless the Member has given notice that it is unable to grant such licences*.

This rule on 'negative disclosure' is a departure from the more commonplace regime adopted by standards bodies, calling for participants affirmatively to declare essential patents with confirmation of FRAND licensing. In addition, DVB's IPR policy provides for:

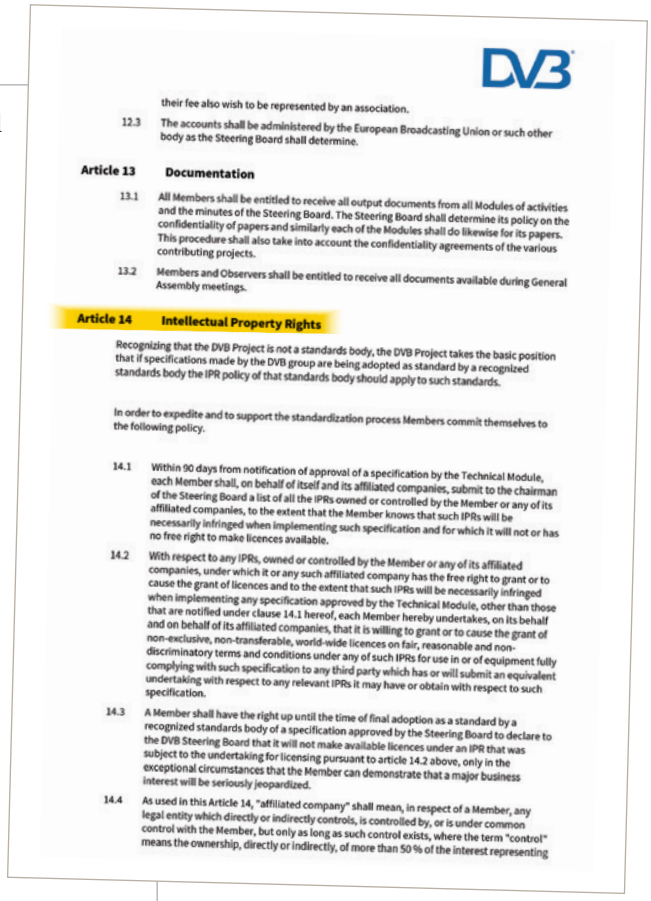
- the speedy formation, after the publication of a DVB standard, of a licensing programme covering the patents essential to that standard (patent pool);
- but if such a pool is not formed, then disputes among DVB Members on patent licensing terms are to be submitted to arbitration.

Since 1996, no negative disclosure (giving notice of a FRAND opt-out) has ever been delivered to DVB and DVB is unaware of any Member invoking the arbitration provision (while DVB standards have remained relatively litigation-free). Indeed, given the comparative absence of contention, and the history of successful pooling discussed below, it is surprising that DVB's standards appear to be included in the proposed EU Regulation on Standard Essential Patents.

FOSTERING PATENT POOLS

On patent pooling, the IPR policy calls for the formation of a "voluntary agreed-upon joint licensing programme" by at least 70 percent of the Members holding patents essential to a DVB specification. To encourage the early launch of the formation process, DVB introduced pool fostering to bring together DVB Members and others that have a well-founded belief that they hold patents essential to a recently adopted specification. It is the responsibility of this group to select a licensing administrator to complete pool formation and then administer the pool.

There are many reasons that brought DVB Members, shortly after DVB's launch, to adopt an IPR policy that includes patent pool formation. Many of these reasons are valid today. First, the speedy completion of a pool covering a critical mass of essential patents gives early assurance to implementers of the licensing landscape and a key approximation of total associated royalties. This clarity on royalties and licensing terms makes DVB standards more attractive to implementers compared to competing standards. Second, a pool as a 'one-stop shop' reduces the administrative burden of patent licensing, for both licensees and licensors. Moreover, since the mid-1990s, regulators have set out a legal framework within which patent pools can operate.



their fee also wish to be represented by an association.

12.3 The accounts shall be administered by the European Broadcasting Union or such other body as the Steering Board shall determine.

Article 13 Documentation

13.1 All Members shall be entitled to receive all output documents from all Modules of activities and the minutes of the Steering Board. The Steering Board shall determine its policy on the confidentiality of papers and similarly each of the Modules shall do likewise for its papers. This procedure shall also take into account the confidentiality agreements of the various contributing projects.

13.2 Members and Observers shall be entitled to receive all documents available during General Assembly meetings.

Article 14 Intellectual Property Rights

Recognizing that the DVB Project is not a standards body, the DVB Project takes the basic position that if specifications made by the DVB group are being adopted as standard by a recognized standards body the IPR policy of that standards body should apply to such standards.

In order to expedite and to support the standardization process Members commit themselves to the following policy.

14.1 Within 90 days from notification of approval of a specification by the Technical Module, each Member shall, on behalf of itself and its affiliated companies, submit to the chairman of the Steering Board a list of all the IPRs owned or controlled by the Member or any of its affiliated companies, to the extent that the Member knows that such IPRs will be necessarily infringed when implementing such specification and for which it will not or has no free right to make licences available.

14.2 With respect to any IPRs, owned or controlled by the Member or any of its affiliated companies, under which it or any such affiliated company has the free right to grant or to cause the grant of licences and to the extent that such IPRs will be necessarily infringed when implementing any specification approved by the Technical Module, other than those that are notified under clause 14.1 hereof, each Member hereby undertakes, on its behalf and on behalf of its affiliated companies, that it is willing to grant or to cause the grant of non-exclusive, non-transferable, world-wide licences on fair, reasonable and non-discriminatory terms and conditions under any of such IPRs for use in or of equipment fully complying with such specification to any third party which has or will submit an equivalent undertaking with respect to any relevant IPRs it may have or obtain with respect to such specification.

14.3 A Member shall have the right up until the time of final adoption as a standard by a recognized standards body of a specification approved by the Steering Board to declare to the DVB Steering Board that it will not make available licences under an IPR that was subject to the undertaking for licensing pursuant to article 14.2 above, only in the exceptional circumstances that the Member can demonstrate that a major business interest will be seriously jeopardized.

14.4 As used in this Article 14, "affiliated company" shall mean, in respect of a Member, any legal entity which directly or indirectly controls, is controlled by, or is under common control with the Member, but only as long as such control exists, where the term "control" means the ownership, directly or indirectly, of more than 50 % of the interest representing

The DVB Memorandum of Understanding, which must be signed by all Members

One other feature is attractive to patent owners: the pool structure is well suited to the 'innovation loop' through which technology companies have a mechanism for efficient return on their inventions, a royalty stream that they in turn can reinvest in further research and development.

Several patent pools have been formed around DVB standards. DVB has fostered pools alongside several pool administrators, including Sisvel. Because of the success of these efforts, DVB now promotes pool fostering, bringing its experience to other standards bodies and to regulatory authorities.

Georg Nolte (Panasonic) is chair of DVB's IPR Module and **Roberto Dini** (Sisvel) is its vice-chair. Each writes here in his individual capacity, acknowledging also the contribution of Carter Eltzroth, Legal Director DVB, notably on the early history of DVB's IPR policy. For a detailed treatment of this history, see his *Commentary on Article 14 of the DVB MoU* (dvb.org/ipr-commentary).

David Wood around the time of DVB's creation

DVB at 30 – still ahead of the game?

David Wood (EBU)

The light went on in the early 1990s. Buoyed up by the common worldwide standard for digital SDTV and HDTV production, the world now needed common standards for delivering them digitally to Mr and Mrs Joe Public. Common delivery standards looked 'win-win' – bigger markets for consumer products and fewer risks for the public, manufacturers, and content makers.

Set against that – convenient or not – was that technology constantly improves, so a fixed delivery standard can become out of date. A non-European friend told me at the time: "If the specification doesn't sell or becomes out of date, you just call it Version 1.0, and go from there".

Back then, we asked ourselves in DVB how we could do better. How could we maximize the usefulness and longevity of a new standard? Part of the answer was the group's structure, proposed by Robin Crossley – then with SES Astra – to first decide what a new system needed to be, and must do, to succeed commercially. Once this was done, a common technical specification using the latest technology could be written to match. This pattern has been followed ever since. True, companies that have a stake in certain technologies sometimes try to sway the commercial requirements in their favour, but taken overall, collective decision-making means that the system has worked well. Standards that are likely to be commercially successful are agreed.

> "Media-standards-making is hard and complex, but necessary and worthwhile – we are shaping society."

The technical specifications themselves have been prepared with the help of masterly chairs such as Ulrich Reimers, the first chair of the DVB Technical Module, who truly lifted the output of the project to the summit of Everest.

DVB specifications have often, but not always, been successful. There is more to achieving success. You need to persuade services to take them up; and, once available, achieve a tipping point for public use. In spite of ups and downs, DVB's 30-year record is among the best in the world.

TAKING LONGER

But the first systems to be standardized in any field are the simplest and fulfil the most obvious needs. As time goes on, we need more sophisticated systems, and standards necessarily take longer to agree. Fact: today it is taking longer to agree DVB specifications than it did in the early years of the project.

Media delivery mechanisms are also evolving. The 'ware' becomes more 'soft' and less 'hard'. The commonality needed, though not exclusively, moves toward software, operating systems and aggregators.

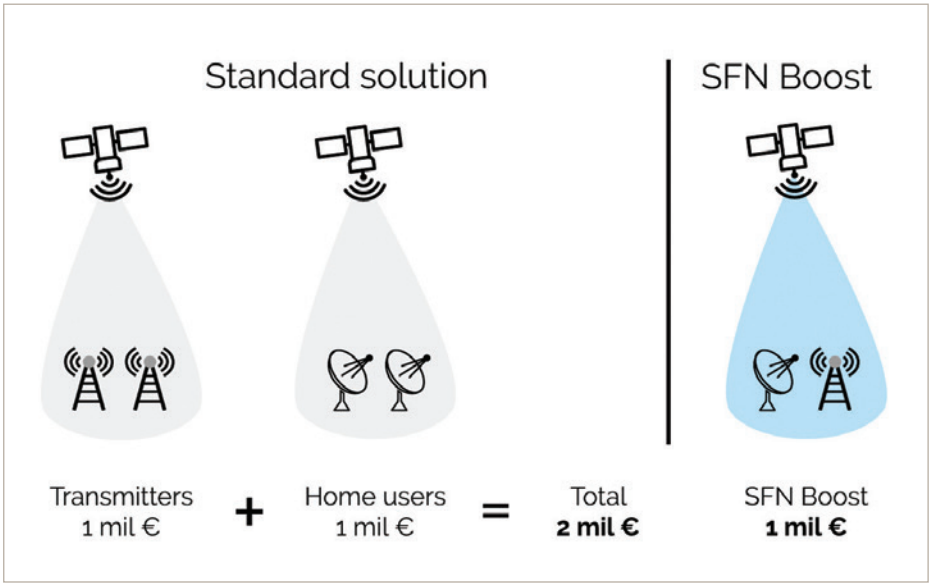
Does DVB have the best arrangements to agree common standards for today's and tomorrow's world? Is this two-stage system still the best for the age and technology of cooperative content, cooperative networks of broadcast and internet, cloud, and AI? We know well that the only permanent thing in our world is change. Many standards bodies today have difficulties agreeing 'single' standards. But, in a running-code world, there may be less need to do so.

Media-standards-making is hard and complex, but necessary and worthwhile – we are shaping society. We are doing a job that must be done. We must never stop asking ourselves how our methods and procedures can be more effective, but that is different from not doing the job. We need a system that brings market competition, and I personally haven't thought of a better approach that the current DVB system. Maybe someone out there has one.

David Wood is a consultant to the EBU Technology & Innovation department. He has chaired several standardization groups in the ITU and the DVB Project over many years and was the very first head of the DVB Project Office.

Optimizing satellite signal delivery based on DVB-SIS

Dušan Statelov (MAINDATA)



Single frequency networks (SFNs) are groups of terrestrial television transmitters that operate on the same frequency. They typically cover a large geographical area. SFNs offer several advantages for broadcasters, such as more efficient spectrum usage and reduced interference. However, SFNs also pose some challenges. For example, the television signals emitted by different transmitters must be identical bitwise. On top of this, to enable regional variations of content, such as regional programmes or advertisements, the satellite signal used to deliver the television signal to terrestrial SFN transmitters must be transmitted separately for each region. This can become very expensive especially where there are many regions.

To address these challenges, DVB created a specification called DVB-SIS (Single Illumination Satellite), which was adopted as a standard by ETSI in 2018 (published as TS 103 615 V1.1.1). The standard defines a method for transmitting a single satellite signal simultaneously to homes (DTH, direct-to-home) and terrestrial television transmitters (DTT, digital terrestrial television). It also allows DTT transmitters to insert regional content.

DVB-SIS is a valuable standard that enables broadcasters to keep satellite transmission bandwidth and costs to an absolute minimum, as all signals are transmitted just once, eliminating any multiplication of the content. This is where the name, single illumination, comes from. DVB-SIS can enable satellite capacity savings of up to 95%. The standard is built on a distributed architecture, where the terrestrial signals are generated at the television transmitter side (i.e., after satellite transmission). There, the signal is generated using deterministic re-multiplexing based on precise global navigation satellite system (e.g., GPS) time stamps (referred to as *PCR [abs]* in the standard), which are inserted at the satellite headend.

SFN BOOST

DVB-SIS covers many common use cases, but some are out of scope. To address broadcasters' additional configuration needs, under an EU-funded project called SFN Boost, MAINDATA has contributed to the development of a solution, which extends DVB-SIS by adding regional advertisements and a centralized architecture.

Inserting regional advertisements allows advertisers to target audiences more effectively, with the potential for reduced costs and/or increased revenues. SFN Boost allows broadcasters to transmit a single beam via satellite to multiple regions and insert region-specific television advertisements at the transmitter sites. The same technology also supports Emergency Warning System (EWS), which can broadcast urgent messages to the public in case of emergencies.

SFN Boost also gives broadcasters the option to choose between centralized and distributed architecture. The centralized version uses a patented method that performs in-depth content analysis across multiple layers and compresses duplicated packets. The centralized architecture complements and enhances the DVB-SIS standard by offering additional features. For example, it does not rely on GPS synchronization, thus meeting government requirements for critical infrastructure independence. Moreover, it can transmit the control stream via any distribution path, which provides more flexibility and redundancy. Finally, it supports plug-and-play installation of adapters into existing DVB-T2 installations.

DVB-SIS is a great standard that provides single beam transmission to DTH and DTT and enables regionalization. Building on the standard, SFN Boost can provide regional advertisements and other valuable features that make it a comprehensive solution for SFNs.

EUROPEAN UNION
European Regional Development Fund
OP Integrated Infrastructure 2014 – 2020

The project "Improvement of the distribution of satellite TV signal to terrestrial TV transmitters" (SFN Boost) is co-financed by the European Union.

Dušan Statelov is the founder and CEO of MAINDATA, a company that provides innovative media delivery solutions to global markets. He contributed to the definition of commercial requirements for DVB-SIS as well as to the development of the technical standard. He the author of several patents including one for centralized SFN Boost.

Opening circle at DVB World 2023

DVB World's unconference delivered once again

DVB World returned to the Maison de la Poste in Brussels last June and returned to the unconference format, with 120+ participants building an agenda together on the morning of the event. Thirty-six pitches led to a total of 27 sessions held in parallel across five hour-long rotations. It was intense!

Planning has already begun for next year's event, which is likely to return to its traditional slot during March. The unconference format will be retained but will be complemented by the addition of a set of conference presentations the afternoon before, adding even more value for attendees.

DVB Members and event attendees can access all the session reports from DVB World 2023 at dvbworld.org/hub

Above: Peter Lanigan (TP Vision) preparing to pitch a session on DVB-I spec developments.
Below: Guillaume Bichot (Broadpeak) hosting a session on SVTA open caching.

Participants were free to choose the sessions of most interest to them – while some topics were more popular than others, engagement levels at all sessions were very high



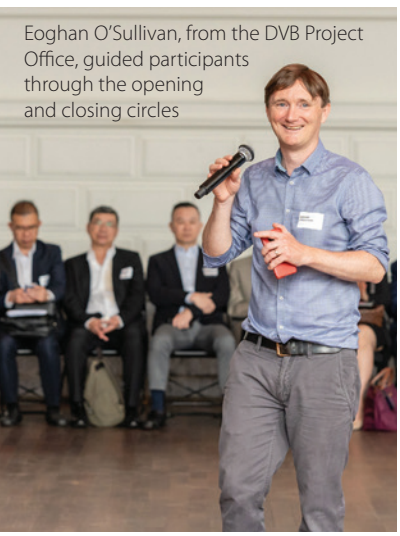
A trio of 'pitchers': Xinrui Yang (Huawei), Emily Dubs (DVB Project) and Arthur Vinchon (Allegro DVT)

Richard Lindsay-Davies (DTG) and Peter MacAvock (EBU) placing their sessions on the agenda

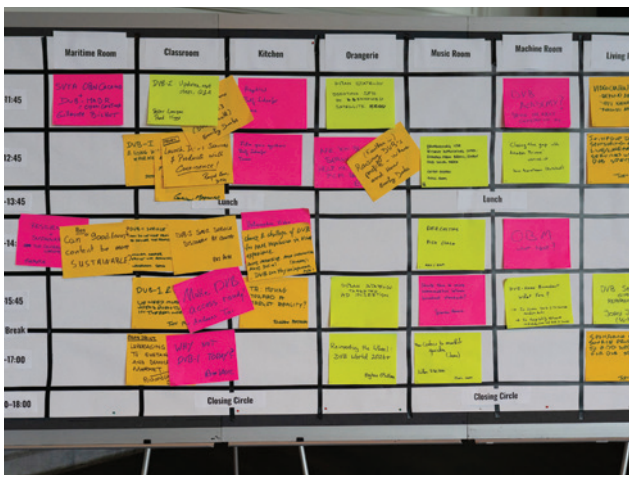
Ten companies signed up as DVB World supporters: Broadpeak, Eutelsat, Huawei, InterDigital, Inverto, MAINDATA, Redge Media, Sisvel, Unified Streaming and V-Nova

Several sessions were accompanied by live demonstrations, including this DVB-NIP demo presented here by Frederic Roelens (Inverto)

Yann Barateau and Ralph Edeine (both Eutelsat) hosted a discussion on the benefits of DVB-NIP



Eoghan O'Sullivan, from the DVB Project Office, guided participants through the opening and closing circles



The freshly built agenda (above left), which was transferred to the online unconference hub shortly after the opening circle, was the focus of much scrutiny!

Our Members. And you?

dvb.org/join