

HbbTV

THE FUTURE OF TELEVISION?

by Nicolas Weil

2.0:

Hybrid Broadcast Broadband TV (HbbTV) is only 5 years old, but it has already become the de facto interactive TV standard in many European countries, and is generating a significant traction across the globe. While the current version (1.5) brought a lot of improvements—especially for streaming with the introduction of MPEG-DASH—HbbTV 2.0 is bringing a much more powerful toolset that has the potential not only to take precedence over other Interactive TV standards, but also to change the whole television game.

Solving the Pain Points

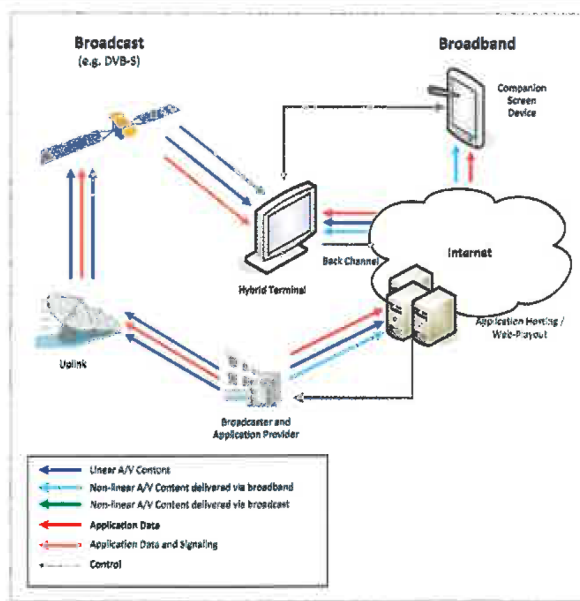
In the late 2000s, the connected TV market was heating up, driving the promise of an intelligent hub able to connect to all audiovisual services. But each TV had its own OS, its own app store, and its own app development process.

Things started to change in 2012, when TP Vision (formerly known as Philips), LG, Panasonic, and Toshiba founded the Smart TV Alliance with the goal of providing a unified SDK for applications development, but still limited to broadband features requiring other SDKs on other TV brands.

While proprietary TV environments provided a suitable option for pure OTT players to reach all devices, it wasn't—and still isn't—a satisfying environment for broadcasters that want to develop connected services tightly bound to the air. Connected TV applications are living in a silo—they can't integrate the live broadcast signal, and each platform uses different streaming formats and DRM, which makes it difficult to standardise content preparation workflows. In parallel to the connected TV app challenges, some broadcasters experienced the difficulties of building second-screen applications: the need for a watermarking SDK, time synchronisation latency, mandatory audio volume to transport the watermarks, and the difficult challenge of getting end users to install specific mobile apps.

HbbTV 2.0—an open specification—was published in February 2015, so it's fair to call it a pretty young technology assembly. But the work done by the HbbTV Specification Working Group on this version of the standard has spread over more than 2 years of intense discussions and synchronisation with the DVB organisation, and the result is a dense specifications document. And the work done on the previous versions also represented several years of work. HbbTV 2.0 leverages the technical basis of versions 1.1 and 1.5 and adds up decisive features that can solve most, if not all, of the pain points mentioned above, and bring the TV experience to a new level.

An overview of an HbbTV 2.0 system



Web Stack Evolution

Many observers used to say that HbbTV was outdated in terms of web technologies it integrated. That was somewhat true, as HbbTV 1.5 still mandates the old HTML4/DOM2/CSS2 family, not even mentioning the CE-HTML tags that have been added to the mix. But version 2.0 intends to propel HbbTV into modernity: HTML5/DOM3 and CSS3 are now the norm, and it integrates many HTML5 satellite specs, such as Canvas 2D or the Web Open Font Format for graphical experiences, WebSockets and Server-Sent Events for the communication capabilities, Web Workers, and Web Storage for the processing capabilities and the data persistence. That's a whole set of features allowing highly dynamic user interfaces. Moreover, they represent a huge boost in terms of reusability of the application code between the desktop web and the TV screen, something that could not be achieved previously. Overall, the evolution of the web stack holds the potential to radically change content providers' views on HbbTV applications, which are usually seen as an evolved version of teletext. Now, the HbbTV applications will be as dynamic and appealing as the best applications available in proprietary TV stores—the only difference is that they don't need to be published on each of those stores individually.

Streaming Stack Evolution

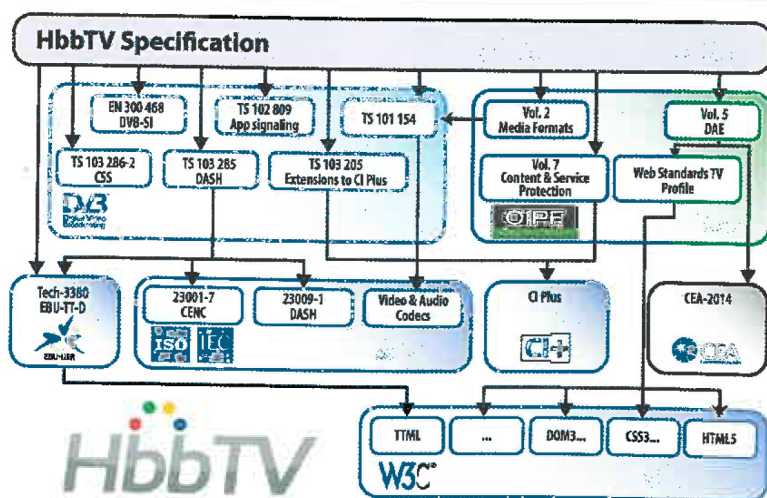
Regarding streaming, HbbTV 1.5 already referenced MPEG-DASH as the exclusive technology. Version 2.0 goes beyond by updating MPEG-DASH to its core specification version 2.0, and introduces the DVB DASH profile (urn:dvb:dash:profile:dvb-dash:2014), which is close to DASH Industry Forum's DASH-IF Interoperability Points—it's basically merging ISO-BMFF Live and on-demand profiles—but with some specificities. For example, DVB DASH goes up to UHDTV Main 10 L5.1, while DASH-265 goes up to 2K Main 10 L4.1 and will be updated to support the same scope as DVB DASH. Convergence between the two approaches is currently happening through continuous exchanges between DVB and

DASH-IF. The same goes for subtitles: after the integration of the new EBU-TT-D format as the reference format in DVB DASH, DASH-IF is considering it also, which is a significant development, as EBU-TT-D has the potential to simplify cross-platform delivery of subtitles while allowing a close integration with broadcast workflows.

There are three other major points where DVB DASH stands out. The first one is the management of multiple audio tracks, where DVB DASH proposes a strong approach to distinguish the different audio adaptation sets, through combined use of role and accessibility descriptors—making it easy to identify audio description tracks, for example.

The second point comes from the fact that DVB DASH has a strong focus on linear TV, with live metadata management. DVB DASH specifies that Content Programme Metadata shall be carried as TVAnytime XML data through EventStream in the manifests, and through Inband-EventStream in media segments—ideally both, as manifest events are good for players entering the stream and inband events work better with already connected players, since there is no latency due to reloading the manifest. When it comes to refreshing manifests, MPD validity expiration events are the proposed trigger.

Finally, DVB DASH defines an interesting mechanism that can be used both for resilience and load balancing between CDNs: the BaseURL element has been extended to support priority and weight parameters. This way, content providers can define a complex set of rules that the DVB DASH player will follow to



The HbbTV 2.0 specification dependencies

retrieve the media segments in a redundant mode and at the same time following the business model derived from hosting costs. This mechanism goes hand-in-hand with a comprehensive set of rules for error handling on the player side, as well as a simple mechanism for error reporting to content providers.

While ensuring backward compatibility with MPEG-DASH contents produced for version 1.5, HbbTV 2.0 is gaining with DVB DASH the missing piece that was needed to get linear streaming to a broadcast-grade quality level, if not better in terms of resilience. With the support for Common Encryption and multi-DRM, all the pieces are in place for extensive support of premium video services. Compared to the rather chaotic history of HbbTV 1.5 DASH interoperability, what is the chance that DVB-DASH interop will run more flawlessly? Ignacio Gómez, director of analytics and new projects at RTVE, has spent a lot of time working on HbbTV projects in Spain and is confident that things can go better now.

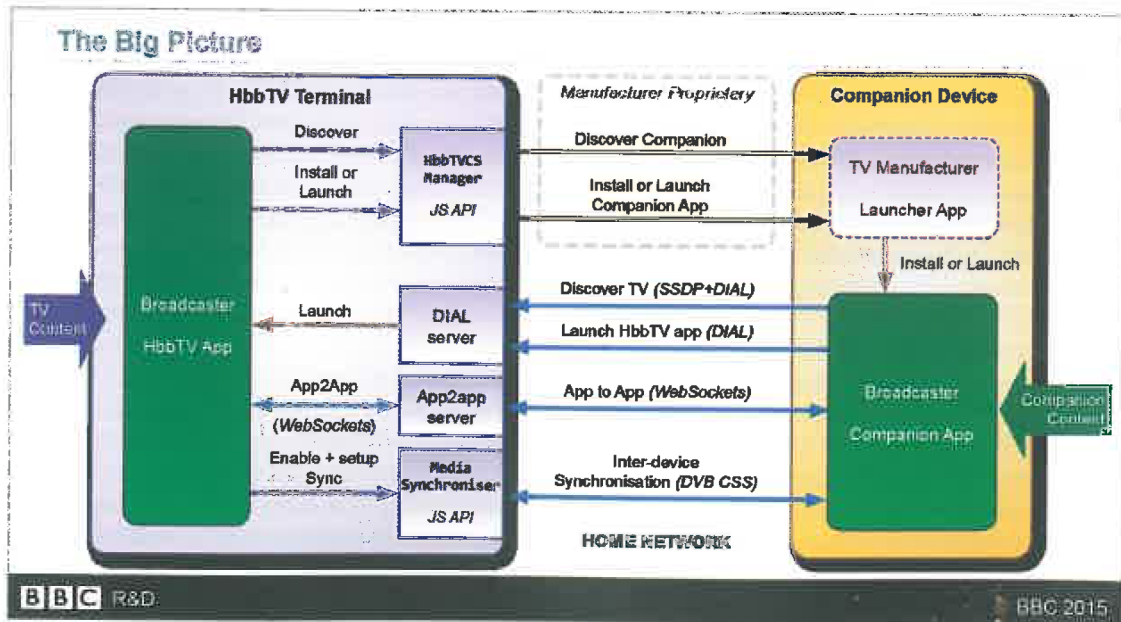
“As opposed to what happened with the HbbTV 1.5 version, this time the test suites for the new version will be available much earlier, and that will surely help,” Gómez says. “However, it is also very important that we as publishers or broadcasters deploy new HbbTV services supporting DVB-DASH, because this is also what encourages manufacturers to work with us, either on a one-to-one basis or through interoperability

workshops, to fix the issues that may arise with their own devices and to ensure that our streams run smoothly.”

Interactivity Stack Evolution

Previous versions of HbbTV already allowed content providers to inject “Do It Now” stream events in the broadcast mux and have the DSM-CC client extract these events on the player side, which could in turn make the extracted data available to HbbTV applications’ JavaScript logic, for use cases such as new questions in play-along quiz games. These events are rather precise in terms of synchronisation, but so far their usage was limited to handle interactions on the first screen. To have the same kind of synced interactions on second screen, content providers so far needed to embed an audio watermark in the broadcast signal and have the mobile device analyse the audio track a few seconds to find the time reference, get the events data from an IP source, and sync it with the broadcast time. Mute your TV and you lose this possibility of interaction. Here HbbTV 2.0 is dramatically changing the game, as the standard mandates every compatible TV to embed a WebSocket server, to which both the HbbTV application and the mobile application can connect easily (through DIAL protocol for the mobile application), pair to each other and exchange messages. If we go back to our Do It Now events use case, the transport path will then be

HbbTV 2.0
interactive features



DSM-CC client > HbbTV application > TV WebSocketServer > Mobile application.

The advantages of such a mechanism is that no third-party technology is needed anymore, that it's not depending anymore on audio not being muted, and that you can easily develop play-along applications where several players interact in the home network as they are all connected to the same TV's WebSocket server. That's a whole new field of second-screen interactivity development opportunities opening up.

There's also a wide field of applications on the first screen when it comes to ad insertion, as broadcast ads can be replaced by ads delivered over IP that can be dynamically customised on a per-user basis; Fraunhofer FOKUS was demonstrating such a use case since HbbTV 1.5 during the last EBU BroadThinking Conference, with its FAMIUM Multiscreen Advertisement solution.

Multistream Synchronisation

Getting the Do It Now events flow through the WebSocket server might be just fine if you want to trigger interactive events that don't require less timing accuracy than a few tenths of a second, but if you need perfect accuracy, then a more powerful toolset is required. That's why HbbTV 2.0 integrates the DVB CSS protocols (go2sm.com/dvbcss), which are defining how TV and mobile devices can synchronise the playback of several streams across devices. DVB-CSS defines how to discover and associate to each other (CSS-DA, over UPnP), share wall clock information for a perfect synchronisation (CSS-WC, over UDP), exchange broadcast content ID (CSS-CID) and over WebSocket, time the position of the content being displayed (CSS-TS), and trigger DSM-CC Do It Now events (CSS-TE). The companion device gets the synchronised contents URLs from a Material Resolution Service over HTTP (CSS-MRS). The precision of the wall clock allows an accuracy of a few milliseconds; it's therefore possible to stream to the mobile device in an alternative language not included in the broadcast signal. The end user listening on headphones can then experience a clean lip-sync with the TV program.



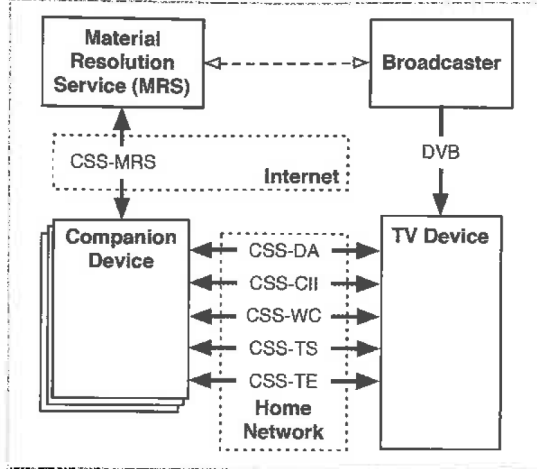
A multiuser play-along HbbTV application (NPO/Angry Bytes) with onscreen game feedback demonstrated at the EBU BroadThinking 2015 Conference

But things get really powerful when it comes to video synchronisation. For instance, when you watch additional camera views on your tablet alongside the main video signal on your TV, HbbTV 2.0 specifies an optional feature allowing the TV to buffer the broadcast signal and align its playback position on an external time reference. While it's not a necessary mechanism when streaming additional audio tracks, it is, for all practical purposes, necessary when syncing with video streams on the second screen, as it's still difficult to rival broadcast latency when streaming video on mobile devices.

Syncing multiple video streams, including a broadcast signal, was previously a real technical challenge; it will soon become a commodity, at least for broadcasters who'd accept a small delay in the signal. But this local buffer on TV is quite similar to the timeshifting features that are commonly deployed on most DTV set-top boxes, so it might not be blacklisted by broadcasters that let the end user risk hearing his neighbour shouting before the TV shows a goal being scored.

UltraHD and Push VOD

While HbbTV 2.0 doesn't dictate the support of HEVC and UltraHD resolutions in TV sets, it supports it fully. Any TV that supports HEVC for broadcast must also support HEVC for broadband delivery. This means that even if the DTV delivery chain is not ready for UltraHD in a given country, the TVs can still benefit from UltraHD over HEVC by connecting to OTT services delivering the



streams over IP, in DVB DASH or in 1.5-compliant MPEG-DASH as we do today. Through the DVB-CSS mechanisms mentioned before, it also means that IP could be used to complement the 1080p broadcast signal and bring the synced UltraHD version of the program being watched. This could be a great facilitator of UltraHD development in the transition phase to terrestrial/satellite UltraHD delivery, which can take several years from now to finish.

In the meantime, content providers will also be able to distribute UltraHD contents overnight, through broadcast-based push VOD services, as HbbTV 2.0 offers this new optional delivery channel for ISO-BMFF files protected by CENC, using the HbbTV File Delivery Protocol (FDP), which encapsulates data in TS packets and ensures delivery with optional FEC and recovery HTTP URLs. So far, push VOD services have had limited success worldwide, but we can expect that broadband bandwidth limitations for UltraHD on-demand streaming will foster the growth of such services, as they have the capability to deliver buffer-free streams to end users.

The Hub for All Content Types

With the new DVB DASH profile and more powerful hybrid and interactive features, HbbTV 2.0 can grab a strong position in the broadcasters' world by blending together live broadcast, PVR, catch-up, VOD, and even pay-per-view. The keys for a successful mix will probably be that broadcast and IP delivery can complement each other transparently as the QoS will be guaranteed equally whatever the transport means,

and that the contents are perfectly synchronised and linked from a metadata perspective. This last aspect is not covered by the specification; a broadcaster's know-how is needed when it comes to content cross-referencing and contextual content suggestions. If it's well-executed and transparent to end users, the hybridisation of broadcast and broadband channels opens up the way for the creation of many additional IP channels to complement the main broadcast channel on a permanent or event-based basis. No more spectrum limitations, only new programmatic opportunities.

Risk Factors

While there is no doubt of the fact that HbbTV 2.0 carries a lot of significant innovations, there is also no guarantee that it will succeed quickly—as its worst enemy is also the HbbTV industry itself. Since its first generation in 2010, HbbTV has certainly scored a lot of points against the proprietary smart TV environments, as we can see today with Samsung joining the HbbTV club, but this success is limited by intrinsic characteristics of the ecosystem.

First, there is no upgrade plan for the hardware as we know it in the "classical" OTT world, where devices get a continuous life for several years through OS updates.

Jon Piesing, director of standardisation at TP Vision and chair of the HbbTV Specification Working Group, explains: "It's not that there's a lack of upgrade capability—all TVs have a software upgrade mechanism. It's the lack of business models to fund upgrades beyond bug fixes."

Indeed, margins are very low and manufacturers are heavily dependent on their suppliers; they don't control all the pieces of the technical puzzle, and they buy the minimum support duration for the components they use. Introducing new versions of HbbTV usually requires a big jump in terms of TV architecture, so we won't see any upgrade from 1.5 to 2.0 on the TVs and the STBs—exactly as we saw between 1.1 and 1.5. It means that HbbTV 2.0 installed basis will come only from new units.

Even if it were possible from a technical standpoint to upgrade the devices, it would be difficult for human reasons, as manufacturers tend to keep only a small engineering team to work on support for a deployed TV generation after it's launched—it's always for fixing bugs but never for implementing new features. This *modus operandi*

generates interoperability problems, as the engineers usually have a short window for fixing the main problems between the CES announcements and the commercial launch of the TV generation in late spring. After that, the majority switches to the next TV generation development. Thus, most of the interoperability insurance is provided in the initial development time by the test suite that is used to validate the TV interop. And sometimes these test suites are not fully baked when the development happens. Let's take the example of live MPEG-DASH streaming; it was in the scope of HbbTV 1.5 but not included in the 1.5 test suite, so the manufacturers implemented on-demand DASH support and extrapolated from the DASH spec for the live part of it, as it was almost impossible to produce live DASH streams when the first 1.5 generation was produced in 2012. The result is that few of the 2013 and 2014 TV models correctly supported live DASH, and now it's very difficult to get those models upgraded by the manufacturers.

Now let's extrapolate this lifecycle on the first generation of HbbTV 2.0 models that will be launched in spring 2016. During the first year there will be no official test suite available, only unofficial test suites, for schedule reasons. Given the wide range of features and the complexity of HbbTV 2.0, there is a good chance that some problems will slip through the cracks and will have to be fixed afterward, with the same limitations on human resources. So the 2016 generation of HbbTV 2.0 TV sets might be a bit of a risky investment for consumers. The HbbTV consortium has been trying to mitigate such problems by dedicating a larger effort to building test assertions throughout the specifications writing process. But will that be sufficient to guarantee that early unofficial test suites will prevent major flaws? And how can manufacturers guarantee that they won't sell wonky devices to customers?

Keith Potter, vice president of product strategy at Digital TV Labs, looks back on the DASH test suite problem that crippled HbbTV 1.5, and how it might compare to HbbTV 2.0.

"Yes, it took longer than the HbbTV Association would have liked to get DASH test cases released, but prior to this the industry effectively standardised on Digital TV Labs Ligada iSuite for HbbTV DASH test suite," he says. "This test suite combined with the Ligada DRM test suite has enabled successful deployments of DASH with HbbTV for example in the Freeview Plus deployments in Australia and New Zealand. The Digital

TV Labs DASH test cases are now part of the official HbbTV Association test suite. DVB-DASH is an important part of HbbTV 2.0 and is addressed in the new test suite, but there are other complex new features in HbbTV 2.0. Digital TV Labs is building tests for companion screen discovery using DIAL, remote launching of companion screen applications, and remote application to application communication. Also, new tests related to the synchronisation of applications and content across devices, multistream synchronisation, and for improved support for applications to synchronise to video in HbbTV 2.0."

When asked about the potential danger of final test suites being available only in 2016, versus the complexity of the new standard's version, Potter provides some detail on the test suites' incremental development cycle. "The HbbTV Association has interoperability as one of its top priorities and has learnt a lot from the previous HbbTV 1.5 introduction," he says. "Digital TV Labs is already working on the HbbTV 2.0 test suite after being awarded part of the tender by the HbbTV Association. For HbbTV 2.0, new test cases will be made available to HbbTV members as they are approved in advance of the full release of the complete HbbTV 2.0 test suite. It is the nature of any new standard that adopters will be deploying the technology as test materials are being developed."

Potter continues: "As we saw for early HbbTV 1.5 adoption in France and Spain, platform operators have engaged with Digital TV Labs to build test suites prior to the official test suite release. For HbbTV 2.0, Digital UK contracted Digital TV Labs to build a test suite as part of our Ligada iSuite for HbbTV industry standard HbbTV test tool, covering the specific features of the new standard they regarded as important and manufacturers are using this now. Typically these 'advance' test suites and then incorporated into the official HbbTV association test suite at a later date. The degree of test coverage for any standard is a function of time and money, and will never be perfect. Where operators are early adopters, are using optional parts of the specifications or have mission-critical services using a specific part of the specification, they will often procure additional test cases to allow early access of test materials to ensure interoperability."

Regarding the 2.0 test suite maturity and completeness, Potter is confident. "HbbTV has learned from previous test suite programs and is putting

a lot of money and effort into the HbbTV 2.0 test suite," he says. "The test specification, development, and test approval processes have all been matured and streamlined. A huge amount of work was put in by the HbbTV Association to develop the test assertions and prioritise test coverage. The HbbTV Association is growing fast in line with global adoptions. There are always interoperability issues with any standard, but with more resources put into test, more HbbTV manufacturers, more HbbTV app developers and the burgeoning of real HbbTV broadcasts, interoperability issues will be quickly overcome."

Let's hope he's right.

Finally, there is a new risk coming with HbbTV 2.0: the options. "We try very hard to limit optional features to fundamental device hardware differences—e.g. PVR or mass storage," Piesing says. Still, previous versions had only some optional features, but the 2.0 version has many more, starting with HEVC support and ranging from broadcast signal buffer to push VOD. This means that the fragmentation risk is not negligible, between entry-level and high-end models, thus reducing the opportunity for content providers to have the exact same service run everywhere, or at least requiring them to consider graceful service degradation strategies.

Market Penetration

How strong can HbbTV 2.0 become worldwide? Let's start with the current state of deployments. Europe is the original playground of HbbTV: 80% of the TV lineup is HbbTV-compliant in France (a million connected HbbTVs), while in Germany we can find 10 million connected devices and

97% of the TV lineup. In Spain there are probably around 3 million deployed devices, and there are several hundred thousand users in other countries. Almost all of the countries in Western Europe are in production with HbbTV or migrating from old interactive TV standards to HbbTV. The move is expanding to Eastern Europe and Russia, as well as Africa, the Middle East, and in Australia, where HbbTV 1.5 replaced MHEG-5. Some countries are already implementing HbbTV 2.0, starting in the U.K., where the Freeview Play service will soon include on-demand content through an HbbTV 2.0-based platform, instead of MHEG-5 which was used in previous Freeview applications. In Italy, the migration from MHP to HbbTV 2.0 started in late 2014 and publication of the corresponding HD-Book 4.0 specification is expected in early 2016.

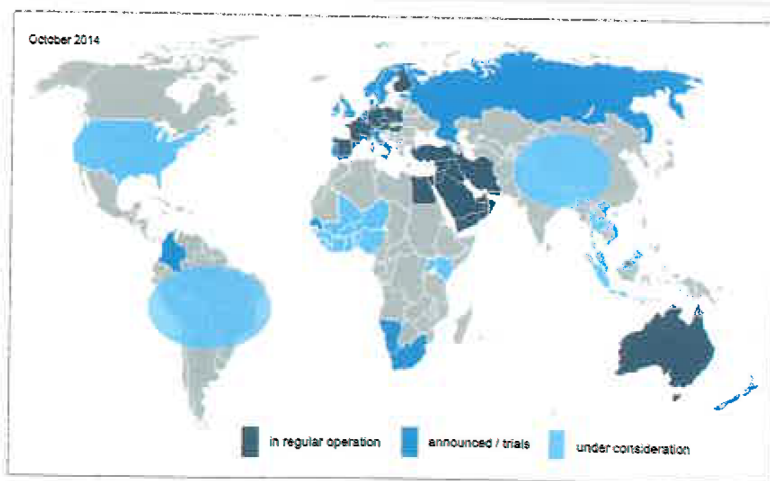
"I believe all countries using either MHEG-5 or MHP have indicated they will be migrating to HbbTV 2," Piesing says. "Indeed they will be some of the first adopters of HbbTV 2.0."

HbbTV 2.0 is now making its way to the U.S., as version 3.0 of the ATSC specification will include all of the HbbTV 2.0 features except the signalling API. Approval of the new standard is expected in 2016. This is a great recognition of the work done on HbbTV 2.0 and it will be a great booster for the standard when it starts to deploy in American TVs, giving TV manufacturers another reason to invest in HbbTV development as the effort can be amortised across several continents.

While HbbTV is very popular in some countries, HbbTV services aren't necessarily available on all networks. In June, the German media regulation commission stated that platform operators

are not obliged to deliver TV channels' HbbTV services alongside the broadcast signal. That's why organisations like NPO (The Netherlands Broadcast Organization) and TNO (The Netherlands Organization for Applied Scientific Research) are working on an HbbTV application discovery over broadband solution that prevents the HbbTV services from being jeopardised by an absence in the broadcast mux or by an intermediary set-top box. It's using the DVB service name

HbbTV worldwide expansion as of October 2014



to identify the channel, cascaded DNS queries to retrieve the AIT from a server, and the HbbTV app over HTTP.

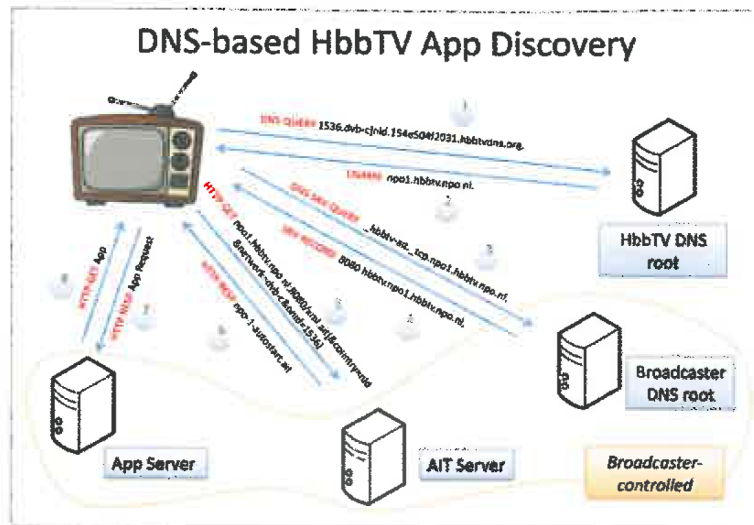
"The HbbTV signal is not present for the majority of customers, although it's increasing," says Rob Koenen, principal consultant at TNO. "The major factor here is the set-top box. Even if there is a signal in the mux, many people watch TV through a STB and most (although not all) of the currently deployed STBs do not support HbbTV. Some support it in principle (Horizon), but the provider turns it off." The HbbTV Application Discovery Over Broadband specification is currently being finalised and should soon be applicable to all HbbTV versions, where needed.

"Independent App Discovery will apply to all versions of HbbTV, also to 1.1 and 1.5," Koenen says. "Certainly the 1.5 version will be relevant for some more time. Whether it is optional or mandatory is unclear at this point, but I note that as a general rule, HbbTV does not make things optional (a few things are conditional upon other features in the terminal, such as local storage). Regardless of whether it is optional or mandatory, I expect it to be supported in markets that can use it."

This sounds like a great way of circumventing regulations restrictions and ensuring HbbTV a universal coverage across all DTV/IP/cable/sat delivery means, which is not the case even in countries where HbbTV is highly popular.

It is clear that HbbTV 2.0's new features carry a great potential of innovation for upcoming services, if broadcasters are ready to embrace disruption of traditional broadcast approaches and take advantage of the IP power to provide richer user experience. But the broadcasters' first consideration when thinking of preparing a 2.0 service might be to evaluate the importance of the legacy installed base.

"I'd say in Spain we're in a situation halfway between Italy, which will jump straight to HbbTV 2.0, and Germany, where there's such a large base of HbbTV 1.0 and 1.5 receptors deployed that they have to think twice about wholeheartedly embracing the new version of the standard,"



The architecture of HbbTV application discovery over broadband

Gómez says. "Since we yet don't have such a large base of deployed HbbTV sets, we can look forward to the new features without obsessing so much about backwards compatibility."

Where the deployment of new generation services is realistic, what will be the key attraction factors for broadcasters?

"I believe the first and foremost welcome feature will be the new ad insertion capabilities," Gómez says. "In order for HbbTV to succeed in Spain we need to find ways to persuade the private networks to deploy HbbTV services and for it to happen monetisation is a must. Then, the use of HTML5 and H.265, even though these are features already supported by plenty of manufacturers in their Smart TV platforms (HbbTV is playing catch up here). And the possibility to synchronise devices and content in order to create more engaging and participatory TV experiences, such as the TV Ring pilot which was launched for the Eurovision Song Contest."

In terms of lifecycle, can we imagine that HbbTV 2.0 services will run for a decade from now? Piesing is rather positive on this point: "HbbTV 2.0 apps and content can be delivered for many years after TV sets implement something more recent [than what they currently have]."

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