



HbbTV TA Phase 2 Explained

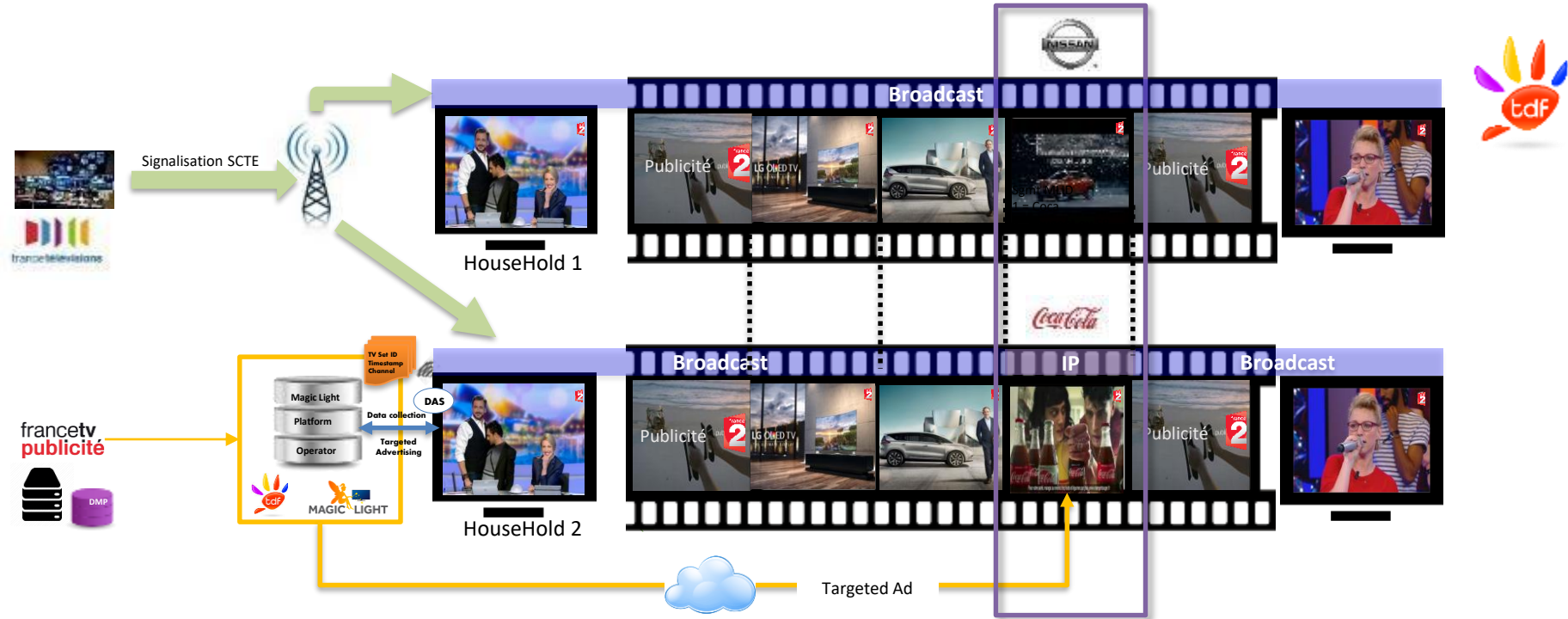
Enabling Targeted Advertising Where "Broadcast" Reaches the TV over HDMI



- What?
 - Enabling *dynamic substitution of ads* in linear broadcast TV with (targeted) ads delivered over broadband *when the linear broadcast TV reaches the TV set over HDMI from a STB*
- Why?
 - Advertising relies on reaching numbers of consumers
 - HbbTV TA phase 1 addresses consumers where linear broadcast TV *reaches TV sets via cable, satellite or terrestrial*
 - In many countries, linear broadcast TV reaches TV sets via a set-top box & an HDMI connection
 - Broadcasters need to be able to reach those consumers too
 - Some STBs support TA but many don't & older ones will never support TA

What? - Dynamic Ad Substitution

(Example by TDF)



How?

- Combine 2 HbbTV "independent specifications"
 - "Application Discovery over Broadband" phase 2 (ADB2)
 - "Targeted Advertising" phase 1
- *ADB2 enables* basic core HbbTV functionality where linear broadcast TV reaches the TV set over HDMI from a STB
 - Defines use of ATSC 3.0 watermarks in video & audio to launch HbbTV apps
 - Supports stream event API similar to core HbbTV but based on watermark signalling
 - Supports media timeline similar to core HbbTV but based on watermark signalling
 - See <https://www.hbbtv.org/wp-content/uploads/2019/09/HbbTV-SPEC-00446-000-Application-Discovery-over-Broadband-Explained-2019-09-09.pdf>
- TA phase 1 *enables* faster & more precise control of switching broadcast -> ad & back
- Together ADB2+TA (aka TA phase 2) *enable*
 - Launching HbbTV apps in linear broadcast TV reaching the TV via HDMI
 - Apps that have faster & more precise control of switching HDMI->ad & back than given by basic core HbbTV

What Are Independent Specifications?



- HbbTV has 2 types of specifications
 - The core HbbTV spec itself (ETSI TS 102 796)
 - A set of related independent specs
- Independent specs are for features only relevant in *certain* market segments or countries
 - Operator applications (ETSI TS 103 606)
 - IPTV (ETSI TS 103 555)
 - Application discovery over broadband (ETSI TS 103 464)
 - Targeted advertising (TS 103 736)
- In time, some of these may be adopted widely enough to justify inclusion in the core spec

TA Phase 1 and Phase 2 Compared



	Phase 1	Phase 2 (i.e. ADB2+TA)
TV launches HbbTV app from broadcaster	Launching broadcaster app based on signalling in cable / satellite / terrestrial channel	Launching broadcaster app based on watermark carried over HDMI
Preparing for ad placement opportunity	App receives message announcing placement opportunity via stream event API. App makes request to ad decision server & pre-loads ad based on the response.	
App substitutes broadcast ad with (targeted) ad delivered by broadband	Switching from cable / satellite / terrestrial to an advert & back again	Switching from HDMI to an advert and back again
Reporting	App reports back via broadband as ad is watched	
HbbTV specification	ETSI TS 103 736-1 and ETSI TS 103 736-2	Update to ETSI TS 103 464 building on ETSI TS 103 736

Step by Step Walkthrough

1. Broadcaster application launched according to "Application Discovery over Broadband"
2. Broadcaster sends message to app announcing that 'placement opportunity' is near
 - Message payload could be included in video watermark
 - Message payload could be fetched via broadband based on signalling in audio watermark
 - Message payload could be the same as HbbTV TA phase 1
3. App confirms that the terminal can safely replace ad
 - App confirms that terminal capabilities are sufficient
 - App confirms that user environment is configured appropriately (e.g. audio routing)
4. App asks ad decision server for an ad that could be played
 - Response could use existing web advertising standards ("VAST")
5. App preloads ad
 - Preload may be 100% if there's enough RAM / depending on broadcaster / advertiser requirements
 - 100% preload uses Web "Media Source Extensions" API – new to HbbTV in TA phase 1 or HbbTV 2.0.3
6. App tells TV when to switch from HDMI to ad
 - Time based on media timeline reconstructed from audio & video watermarks
 - New "fast media switch API"
7. App manages presentation of ad
 - App monitors watermark presence to detect activity on the STB (e.g. showing EPG) & respond accordingly
8. App reports back on playback of ad
 - Critical otherwise nobody gets paid
9. App switches back from ad to HDMI
 - Also using new "fast media switch API"

Black is TA phase 1, Green is the existing ADB2, Blue is completely new (ADB2+TA)

- Requirements for signalling TA over HDMI developed in DVB
- DVB TA signalling spec updated to add watermarking
 - See [Blue Book A178r1-1](#), section 8, annexes A and B

Audio

- Many audio configurations are possible between STB and TV
 - Some will work fine
 - Some won't work with ADB2 at all
 - Some will give a poor user experience & may result in complaints
 - For more details, see background slides & annex D.1 of the ADB2+TA spec
- Broadcasters need to be careful only to substitute ads when it's safe to do so
 - ADB2+TA spec enables apps to query this

Video

- Video watermark may be visible in the top line of broadcast video
 - Could upset viewers & result in complaints
 - Care required depending on content
 - For more details see section 8.4.2 of DVB [A178-1r1](#) on signalling for TA
- Why use video watermark at all?
 - What happens when consumers use the STB UI while a substituted ad is being played?
 - Risk of frustrated upset viewers & complaints if broadcaster TA app does nothing
 - Combination of video & audio watermarks gives best user experience under these conditions
 - For more details, see background slides & annex D.2 of the ADB2+TA spec

- ADB2+TA is not a perfect solution
 - User experience not as good as TA on the STB would be
 - But of course TA on the STB may not be possible / practical / available / economically viable / ...
 - Updated spec gives broadcaster apps a lot of information about what's going on
 - TA app can be optimised to give the best overall result
 - Unhappy users who complain benefit nobody
 - Broadcasters (or suppliers) will need understanding of the behaviour of the STBs in the markets they address
 - Audio configurations, sound bars, ...
 - Interactions between STB UIs and video watermark
- Consumer messaging & communication is important
 - Legal requirements for consent to process any personal information used for targeting
 - What about the possibility for users to disable dynamic ad substitution?
 - What about providing a visual indication of when a substituted ad is being played?

- Remember ADB and TA are separate, independent specs
 - Not part of the natural evolution of the core HbbTV spec
- Dialog required between broadcasters & manufacturers about their implementation
 - Care needed to avoid a "Catch 22"
 - Broadcasters wait for manufacturers to put devices in the market before using the technology
 - Manufacturers wait for broadcasters to put services on-air before supporting it in devices
 - Nothing happens
- Assuming TA phase 1 is a success
 - Builds momentum, goodwill & mutual credibility for introducing ADB2+TA
 - Many commercial relationships for TA phase 1 seamlessly move forwards to ADB2+TA
 - Apps & technical infrastructure from TA phase 1 are largely re-usable for ADB2+TA

- HbbTV has published the ADB2+TA spec and approved unit test descriptions
 - 57 test unit test descriptions for requirements added in the update
 - 123 test unit test descriptions from ADB2 for watermark controlled app launching, lifecycle, media timeline, stream events
- Next steps
 - Create unit tests based on unit test descriptions
 - Review unit tests
 - Run unit tests on early implementations
 - All of these need resources and / or money!
 - Companies that want to use ADB2+TA will need to contribute

Background Material

Some Care Required by
Broadcasters

Some Care Required by Broadcasters (1)

Audio



- Many audio configurations are possible between STB and TV
 - Some won't work with ADB2 at all
 - Some will give a poor user experience & may result in complaints
- STB delivers audio over HDMI to TV
 - If volume controlled on TV, no problems expected
 - Includes deployments where STB remote is programmed to generate correct audio RC codes for the TV
 - If volume controlled on STB, risk of complaints
 - Audio from ads substituted on TV will be different volume from linear broadcast audio
 - Audio from ads being louder risks complaints & perhaps regulatory action
 - Broadcaster TA app should not substitute ads when HDMI volume control is on STB
- STB delivers audio direct to amplifier or sound-bar
 - e.g. direct optical connection, direct S/PDIF connection, HDMI (e)ARC without system audio control
 - If audio does not reach TV at all, broadcaster TA app will not be started
 - If audio goes to TV & is muted on TV, broadcaster TA app should not substitute ads as user will see video of ad but hear original (un-substituted) audio
- STB and TV both deliver audio to amplifier or sound-bar using HDMI (e)ARC controlled by HDMI CEC system audio control
 - TV can use system audio control to switch sound-bar input from STB to TV at start of ad and back to STB at end of ad
 - No problems expected

Audio

- Summary
 - Broadcasters need to be careful only to substitute ads when it's safe
 - ADB2+TA spec enables apps to query this
 - Broadcasters may want to collect / obtain market data about how STBs are connected to audio systems in their markets
 - How many consumers have sound-bars?
 - How many STB remote controls can be configured to generate TV remote control codes for volume up/down & mute?
- For more details, see annex D.1 of the ADB2+TA spec

Some Care Required by Broadcasters (3)

Video



- Video watermark may be visible in the top line of broadcast video
 - Could upset viewers & result in complaints
 - Depends on the content
 - Limiting its use to ad breaks delivers most of the benefits & minimises the risks
- What happens when consumers use the STB UI while a substituted ad is being played?
 - Risk of frustrated upset viewers & complaints if broadcaster TA app does nothing
 - If consumer presses Guide button & broadcaster app does nothing, consumer only sees EPG when ad finishes
 - A full screen EPG that hides video watermark will be detected & reported to app for action
 - Broadcaster TA app can cut short a substituted ad
 - If consumer presses pause & broadcaster app does nothing, consumer only sees pause when ad finishes
 - Loss of audio watermark while video watermark continues will be detected & reported to app for action
 - Broadcaster TA app can pause substituted ad & resume when audio watermark returns
- For more details, see annex D.2 of the ADB2+TA spec

Background Material

Step by Step Walkthrough Details

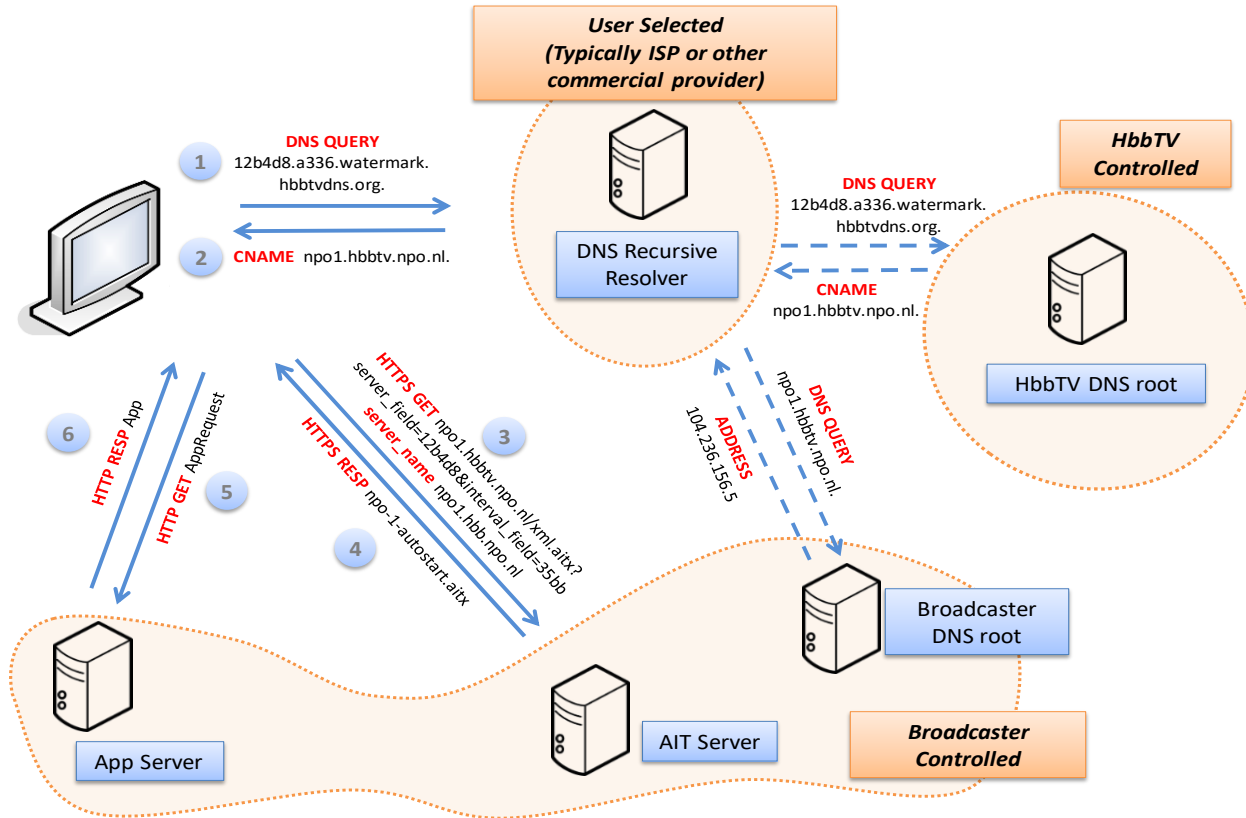
Broadcaster application launched according to "Application Discovery over Broadband"



1. Broadcaster inserts watermark(s) into video and audio before delivery to network operator
2. Video and audio encoded by either broadcaster or network operator
3. Network operator delivers video and audio to STB
4. STB decodes video and audio and overlays any local UI (EPG, ...)
5. STB sends decoded video, audio & any UI to TV via HDMI
6. TV set detects presence of audio & perhaps video watermark in signal received by HDMI
7. TV set sends internet DNS query to watermark.hbbtvdns.org including information from audio watermark (see diagram on next slide)
8. watermark.hbbtvdns.org returns reference to broadcaster server
9. TV set sends query to broadcaster server with information from audio watermark
10. Broadcaster server returns reference to broadcaster app server
11. TV set sends query to broadcaster app server
12. Broadcaster app server returns reference to HbbTV XML AIT incl. URL of first page of app
13. TV set loads and runs the app starting with the first page

All according to ADB2 aka TS 103 464 V1.2.1 – nothing new here
Description of internet DNS is simplified for clarity

Broadcaster application launched according to "Application Discovery over Broadband"



Broadcaster Sends Message to App Announcing that Placement Opportunity is Near



- 2 very different mechanisms
 - Audio / video watermark includes a 1 bit "query_flag" to signal there's an event
 - App needs to fetch event data via broadband
 - Video watermark (not audio) can include \leq 256 bytes of event data
 - Some concerns that this may be visible to consumers
- Broadcaster app registers to receive events using existing stream event API
 - Either or both mechanism
- Broadcaster sends event data (e.g. SCTE-35 payload)
 - Either embedded in video watermark or
 - Made available on web server & then change "query_flag" in the watermark
- App receives stream event
 - For "query_flag" events, app then fetches actual event data from web server
- App acts on event data

All according to ADB2 aka TS 103 464 V1.2.1 – nothing new here

App Confirms That the Terminal can Safely Replace Ad



- Broadcaster app queries existing HbbTV XML device capabilities for critical dependencies
- Signalled capabilities include
 - ATSC 3.0 video watermark detection
 - ATSC 3.0 audio watermark detection
 - Broadband delivered video overlaying HDMI delivered video
 - Monitoring ATSC 3.0 video/audio watermarks while playing broadband-delivered video
 - Scaling HDMI delivered video
 - Terminal audio output is local speakers, HDMI (e)ARC+System Audio Control, disabled, other
 - Audio received over HDMI is uncompressed PCM or compressed
- See flow chart in section D.1 of ADB2+TA for example of how broadcaster app can use these

App Asks Ad Decision Server for an Ad That Could be Played

- Request format is private to ad decision server
 - App will be adapted for the ad decision servers used by the broadcaster
 - Typically an HTTP GET request with a number of parameters
- Response likely uses existing web advertising standards ("VAST")
 - See
 - https://github.com/InteractiveAdvertisingBureau/VAST_Samples and
 - https://github.com/InteractiveAdvertisingBureau/VAST_Samples/blob/master/VAST%204.1%20Samples/Inline_Simple.xml
 - See also section 5 of DVB TA [TR 103 752-2](#)
- App may need to be adapted for how ad decision server uses VAST
 - e.g. how many media files are returned & how to choose one

All according to regular HbbTV TA – nothing new here

- Preloading the ad is necessary for a fast switch from broadcast (HDMI) to broadband
 - Preload may be 100% if there's enough RAM
 - Some advertisers may require this so there's no risk of ad playback stalling due to network
 - Playback of ads from RAM uses Web "Media Source Extensions" API
 - Ads may also be only partly preloaded
 - e.g. if the ad is too large or the wrong format to preload
 - Playback may just use HTML5 video element

All according to regular HbbTV TA – nothing new here

- Watermark media timeline
 - TV constructs a media timeline for HDMI based on reception of video & audio watermarks
 - Audio watermark has a 1.5s heartbeat
 - Apps sees a 'watermark media timeline' based on watermark timeline but with offset applied
 - e.g. converted to time since 00:00 UTC on 1 Jan 1970
 - Based on additional data in the XML AIT for the app
- video/broadcast object representing HDMI input
 - Reduced functionality wrt v/b object representing regular broadcast
 - Allows app to scale & position HDMI video in an HTML5 UI

- Uses the "fast media switch API" introduced in HbbTV TA
 - Switch from
 - video/broadcast object representing HDMI input
 - Switch to
 - HTML5 media element for preloaded ad
 - Switch at
 - Appropriate time in watermark media timeline
 - e.g. a time from a field in the SCTE-35 information in the stream event announcing the placement opportunity
- Same API as HbbTV TA but different parameters

- Applications should register for `ratechange` events, `timeupdate` events and `WatermarkStateChange` events
 - Combinations of these inform the app about actions taken on the STB
- Examples
 - Use of local PVR on STB
 - Pause -> `ratechange`
 - Skip forwards / back -> `timeupdate`
 - Showing a full screen graphical UI (e.g. EPG) -> `WatermarkStateChange`
- See clause D.2 of ADB2+TA for more details

- App can monitor HTML currentTime property to report on ad playback
 - e.g. when currentTime >0, >0.25 of ad duration, >0.50 of ad duration & >0.75 of ad duration
 - e.g. "ended" event for end of ad playback
- Nothing special about HbbTV here
 - Completely standard HTML5
 - Timing of when "ended" is generated may be less predictable with hardware video & audio decoders in TV than software decoders in a desktop PC

- Also uses the "fast media switch API" introduced in HbbTV TA
 - Switch to
 - video/broadcast object representing HDMI input
 - Switch from
 - HTML5 media element for preloaded ad
 - Switch at
 - Natural end of advert (rather than specific time)
- Same API as HbbTV TA but different parameters