Mikko Karppinen

Co-founder, CTO and Director of BD

Julius Mong

Head of Business Development

Agenda

- What tools does HbbTV offer?
  - The Core Spec: a rich toolbox of features
  - Main features of various HbbTV specs
- How to implement & deploy HbbTV?
  - What's needed at the head end?
  - How to develop applications for HbbTV
  - Best ways to test HbbTV applications
- How to protect your investment?
  - Conformance considerations
  - Interoperability

WHAT TOOLS DOES HBBTV OFFER?

The Toolbox has features for all

Consumers

- Easy access to premium services without additional devices

Production houses and content owners

- New ways to make TV programs

Broadcasters

- Tools to build big-screen OTT services and increased revenues via Addressable TV
- Real time audience measurement

DVB Network operators

- Extending their capacity and higher platform-as-a-service revenues

Pay TV Operators

- Promotional content instead of "black screen"
- Customer self-care and transactions
- Op-apps

HbbTV has been long in the making

- **2008** - HbbTV (Market Launch)
  - Aimed at rapid time to market (products available late 2009)
- **2010** - HbbTV 1.0
  - National add-ons
- **2012** - HbbTV 1.5
  - Largest device base currently
- **2015** - HbbTV 2.0
  - Replaced by HbbTV 2.0.1
- **2016** - HbbTV 2.0.1
  - U.K., Italy and all new markets are adopting
- **2018** - HbbTV 2.0.2 Specification (2018-02-16)

>10000 different terminals on single market

HbbTV terminal components
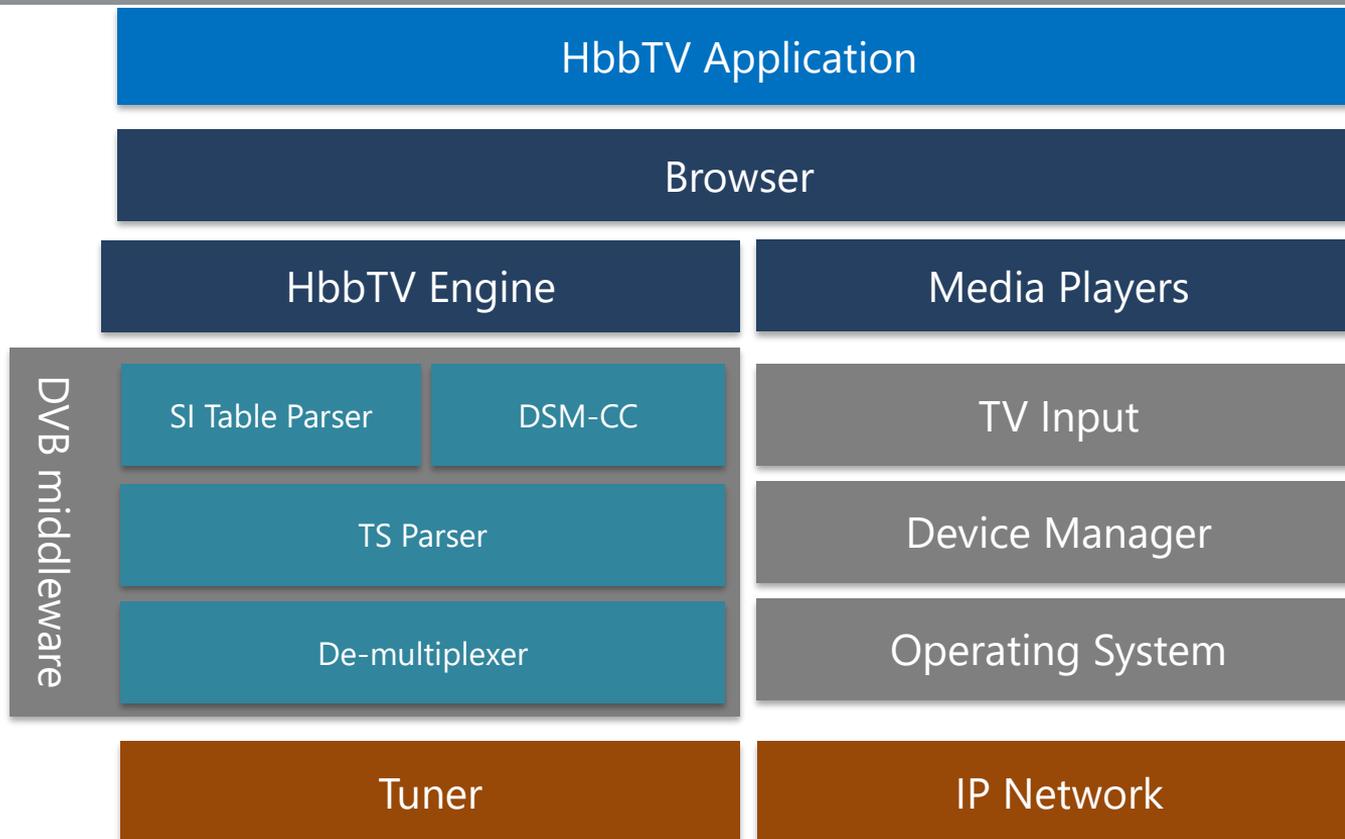
Key features of HbbTV versions

1.1

- Video control APIs
- Access to channel list
- Broadcast service selection
- Access to now/next
- Support for broadcasted applications (DSM-CC object carousels)
- Triggering via DSM-CC stream events
- Security model – trusted & untrusted applications, same origin policy
- Application signalling & lifecycle model

1.5

- Access to EIT Schedule
- MPEG-DASH
- DRM, common encryption

2.0.1

- **HTML5**
- Media Synchronization between broadcast and broadband
- **Companion Screens**
- CI+ 1.4
- Subtitles, with ISOBMFF + TTML
- **DVB-DASH**
- **HEVC video for broadband**
- DSM-CC File system enhancements
- **Advert insertion to VoD content**
- **Push VOD**
- Support for graphics resolutions higher than 1280 × 720
- 'Web Audio' and 'Encrypted Media Extensions'

What's in the latest spec 2.0.2?

Integration of HbbTV with

- High Dynamic Range (**HDR**) video – both PQ10 and HLG

- High Frame Rate (**HFR**) video, e.g. 100Hz or 120Hz

- Next Generation Audio (**NGA**) – Both AC-4 and MPEG-H audio

Enabling HD and **UHD** content delivery to HbbTV compliant devices

HbbTV Targeted Advertising

Audience monitoring, addressable ads and ad-switching:

LINEAR ADS

PERSONALISED HBBTV ADS

SYNCHRONIZED TRIGGER
TO START PERSONALISED ADS

ÄRRÄLTÄ KESÄJUOMAT

PERSONALISED ADVERT 3

UNWRAP THE WORLD

RASPBERRY LIQUORICE

EURO JACKPOT

LINEAR ADS OR "JINGLE" FOR UNSOLD REGIONALISED BREAKS

HbbTV Task Force working on a TA specification

©

HbbTV extended specifications

- Operator Applications (OpApps)

  - Defines features that operators require in order to use HbbTV an operator middleware platform

- Application Discovery over Broadband

  - Defines how terminals can load HbbTV applications without broadcast signalling

- IP-Delivered Broadcast Channels and Related Signalling of HbbTV Applications

  - Defines how HbbTV terminals can be used with IPTV services. It is applicable to IP-only devices (no DVB-C/S/T tuner)

- Upcoming targeted advertising specification

HOW TO IMPLEMENT HBBTV?
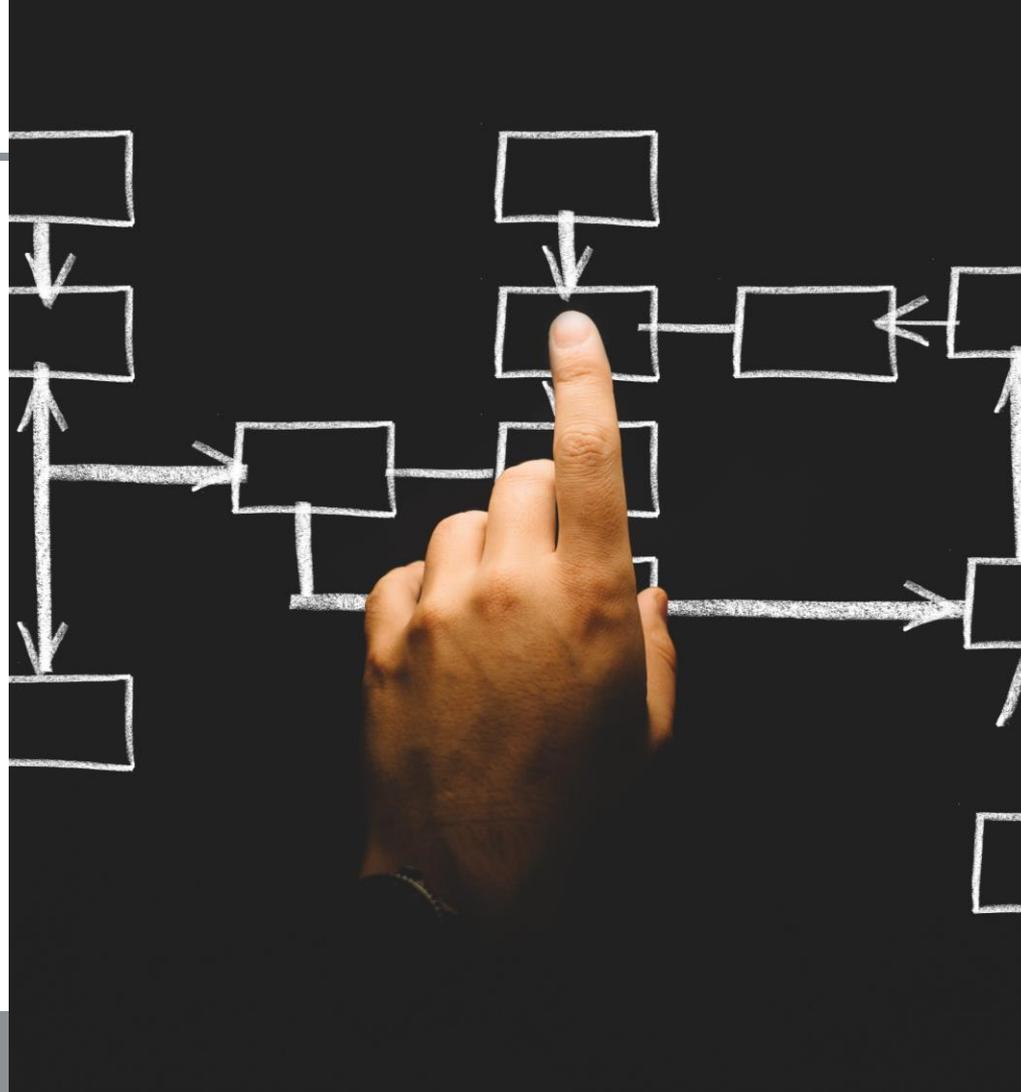
Key deployment stages

1. Ensure **availability** of HbbTV receivers in the market
   - Easy as every major TV and STB vendor has HbbTV solutions
   - Platform specific receiver specification
   - Conformance regime
2. Update the DVB broadcast **signalling**
   - AIT (application signalling)
   - DSMCC Object Carousel (optional)

3. Create the HbbTV **applications**
   - Author the applications
   - Web application server infrastructure and backend

4. For IP video **delivery**
   - DASH origin server
   - Content Delivery Network (CDN)
   - DRM solution (optional)

Key components
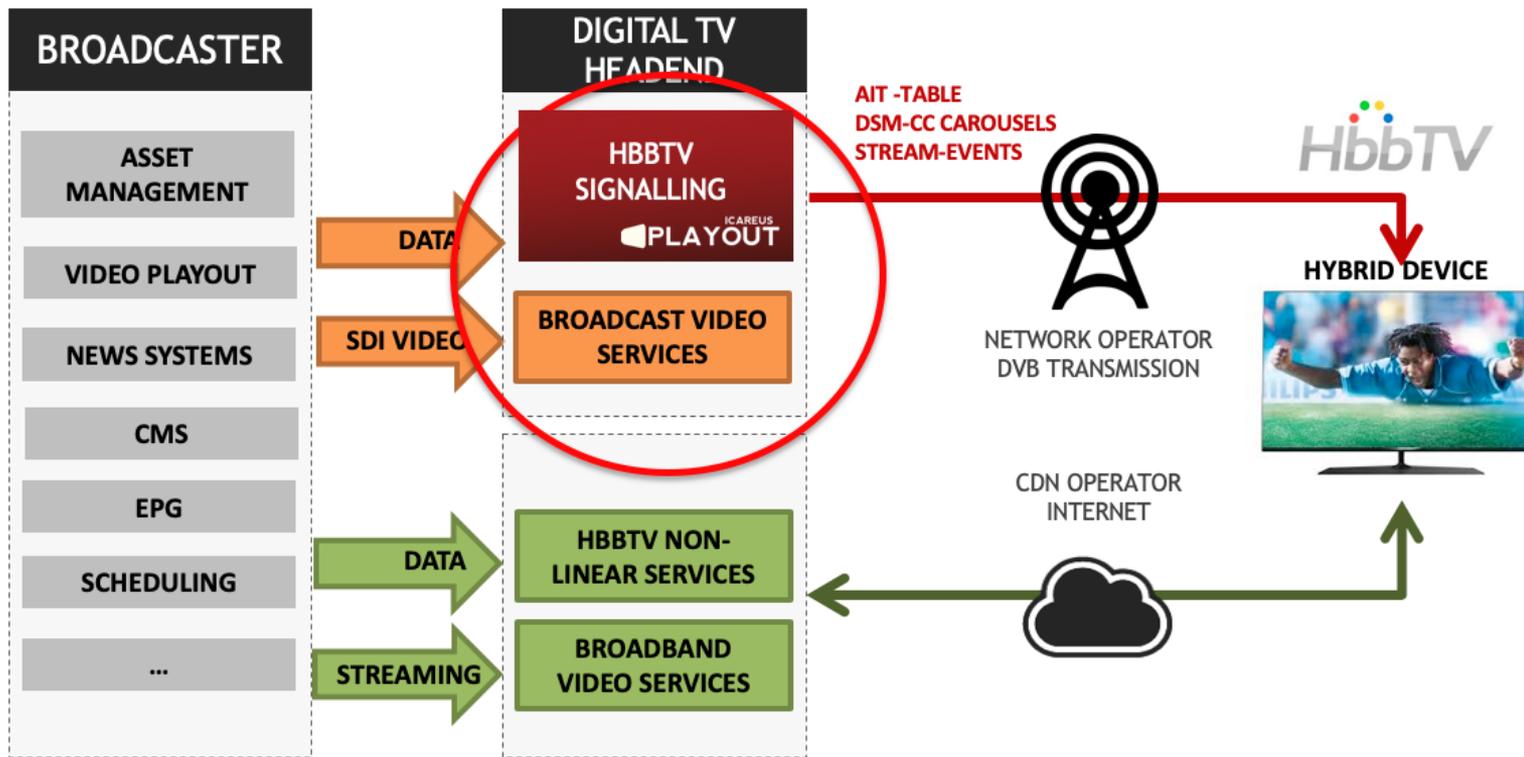
AIT
&
Application
Signalling

Application models
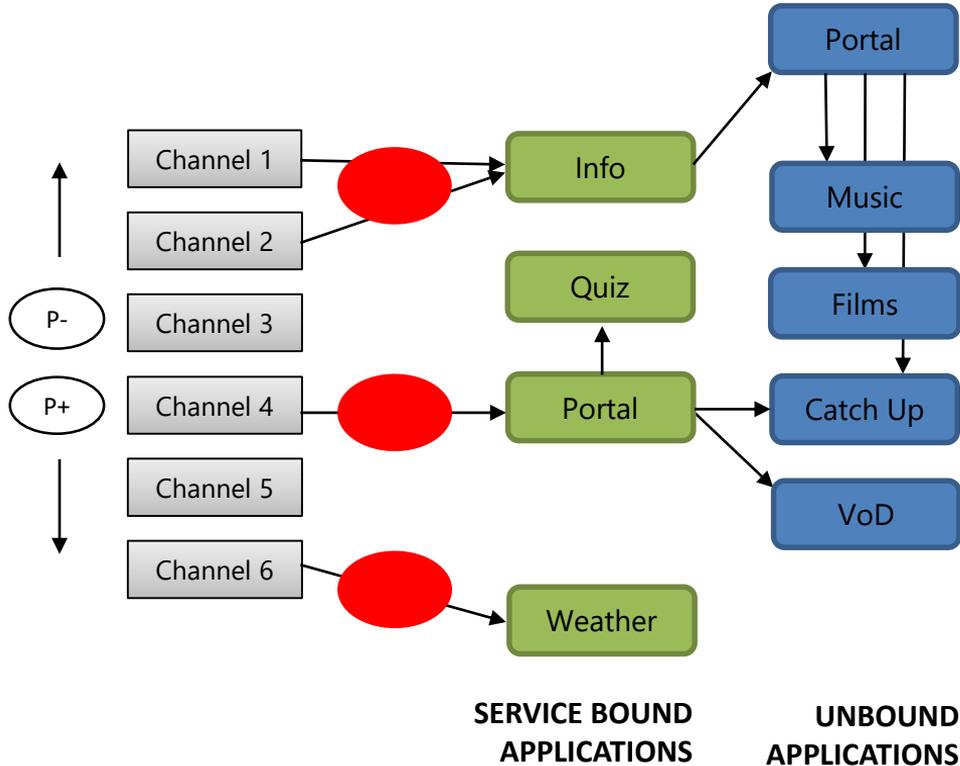
- Applications bound to one service or to several services

- Applications bound to a content item, program

- Applications which are valid while the terminal is connected to a network operator or service platform provider.

App delivery use cases

1.   Broadcasted Application

Application works without Internet connection

2.   Broadband Application

Application requires Internet connection

resulting application entry point
dvb://1.2.3.b4/application/index.html
http://suite.icareus.com/application/index.html

AIT table and versioning

AIT Table defines HbbTV Applications

1. Is sent in MPEG2 transport stream tables

2. defines the HbbTV applications that are on-air

3. One AIT table can contain several applications

4. Defines the HbbTV version / profile to require to run the application

```
<mhp:mhpVersion>
  <mhp:profile>0</mhp:profile>
  <mhp:versionMajor>1</mhp:versionMajor>
  <mhp:versionMinor>1</mhp:versionMinor>
  <mhp:versionMicro>1</mhp:versionMicro>
</mhp:mhpVersion>
```

Broadcasting Applications

DSM-CC

DSM-CC

Digital Storage Media Command and Control
For delivering data repeatedly in a continuous cycle

Allows data to be pushed from a broadcaster to multiple receivers by transmitting a data set repeatedly in a standard format

MPEG-2 DSM-CC (ISO13818-6) Object Carousel

Typical features:

- Real-time generation of object carousels
- Support for dynamic updates of carousel data
- Advanced algorithm for maximum throughput
- Definable application and file weighting and prioritization
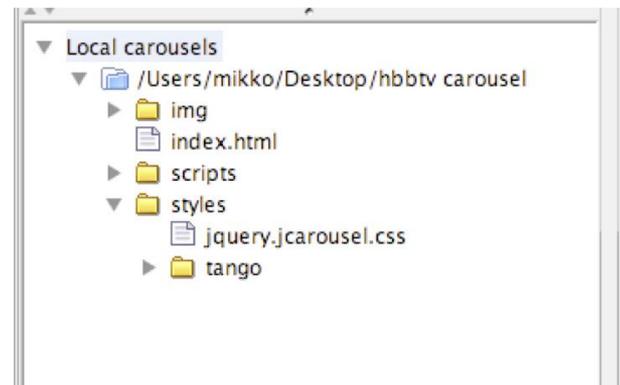
Synchronisation & Applications

Synchronisation

Stream events are used to synchronise an application with an MPEG stream

Normal Play Time of A/V streams can be used to synchronise stream-events if needed

HbbTV Application needs to "listen to" stream events and the logic what happens when it is received is application specific

There are two types of stream events:

1. **DIN events.** "Do It Now" events are fired manually or via API calls

2. **NPT events.** "Normal Play Time" events require an NPT stream that is used for synchronising an application with NPT of a media clip and they require the carousel to be synchronised with an AV stream

HbbTV Application Development

Based on web, enhanced with broadcast

In addition to standard web technologies HbbTV provides

- **Video control APIs**
- **Access to channel list**
- **Broadcast service selection**
- **Support for broadcasted applications (DSM-CC object carousels)**
- **Application signalling & lifecycle model**
- Access to now/next (EIT-pf) + Schedule
- Triggering via DSM-CC stream events
- Security model – trusted & untrusted applications, same origin policy
- Media Synchronization
- Push VOD
- Companion Screen integration
- Subtitling

HbbTV apps vs web pages

Similarities

- **Written in HTML**
- **Cascading Style Sheets (CSS)**
- **JavaScript**
- **Images: SVG, JPEG, PNG and GIF**
- A dynamic DOM, combined with XMLHttpRequest
- AJAX-style changes to the current application or web page without necessarily replacing the entire document

Differences

- **Usability and UX is completely different**
- **Broadcast dictates the access to apps**
- **Application created and terminated in a different manner to a web page**
- **User is in a sandbox controlled by the app developer**
- Application context includes information about the state of an application
- Resources are limited
- Resources are shared with terminal
- Limitations on cross-domain content

Autostart application behaviour

- **Autostart application is the door to HbbTV, controlled by the broadcaster**

- 1) Displaying a **"Red Button"** notification to inform the user that the application is available

- 2) Displaying **no user interface**

- 3) Displaying their **full user interface** (usually only used on radio and data services)

```xml
<?xml version="1.0" encoding="utf-8" ?>

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">

<html xmlns="http://www.w3.org/1999/xhtml">
<head>
        <link rel="stylesheet" type="text/css" href="global.css" media="all"/>
        <script type="text/javascript" src="hbbtv.js"></script>
</head>
<body onload="initialize();show();">

        <div style="visibility: hidden; width: 0; height: 0;">

                <object type="application/oipfApplicationManager" id="appMan"></object>

                <object type="application/oipfConfiguration"></object>
        </div>
        <div id="safe_area">
                <div class="headline">HbbTV test page.</div>
        </div>
</body>
</html>
```

The user experience basics

1. **Safe area and Display model**
   - 80-95% of TV screen is usable for your content
   - Layered display model mandated by HbbTV
2. **Colors**
   - Pure white hurts the eye, generates halos and distractions
   - Avoid "hot" saturated colours
3. **Fonts and Typography**
   - Viewers read the text 3m away
   - Not all type-faces are readable on TV screen
4. **Animations, Effects and Transparency**
   - Big differences between models on how well TV performs
   - Processing power of TVs do not increase with new models
   - Use transparency with care, support on old models vary
5. **Navigation & Remote control**
   - Navigation is SLOW in TV compared to mouse/keyboard → frustration
   - Leave the number buttons alone!
   - Don't rely on "back" -button

DASH DRM reference application
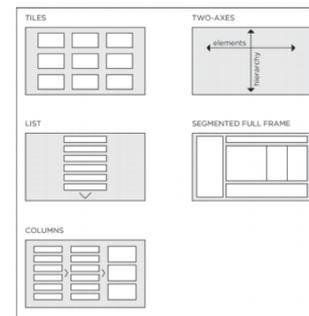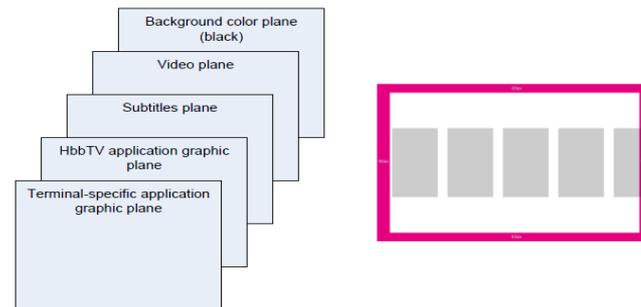
HbbTV application and sample content to showcase the HbbTV technology together with MPEG-DASH and DRM

- Includes a complete workflow with free & open source MPEG-DASH content creation tools (with and without DRM)

- Also includes an HbbTV client application with video catalogue of sample content, including the video player made compatible with receivers having support for HbbTV 1.5 and HbbTV 2.0.1 specifications

https://www.hbbtv.org/resource-library/developer-support/

Developing for HbbTV

Application Frameworks

- MPAT – WordPress platform
- BBC TAL (TV Application Layer)
- React Native
- Commercial frameworks

Development Tools

- Pick your favorite
- Eclipse, Aptana, …
- Browser plugins

Server Side

- PHP, Java, Node.js, dot.net,…
- Streaming platforms

Test Environment

- Later…

Delivering apps over broadband

High peaks on Launcher application → channel changes

High peaks on synchronized advertising → teaser loads

Big difference of load between night and prime-time → scaling

Key take aways:

1. Minimize dynamic content

2. Use static HTML for applications as much as possible, templates that can be configured

3. Separate application and static servers

4. Utilize CDN or reliable networks to avoid bottlenecks

HbbTV Application Testing

Key points on testing your app platform

1. Must have real broadcast environment

2. Devices from all major brands per country

3. Staging servers

4. Streaming servers for video testing

Steps to approach testing

1. Browsers and plugins

2. Validators

3. Lab with Real TVs

4. Interoperability workshops

Initial testing on PC

FireHbbTV (only supported on legacy Firefox)

Firebug

- Inspect HTML and modify style and layout in real-time
- JavaScript debugger
- analyze network usage and performance

Web development toolbar

- Adds various web developer tools to the browser.

HybridTV Viewer

- Extension to deal with HbbTV,CE-HTML,BML,OHTV webpages

Chrome DevTools

- Inspect HTML and modify style and layout in real-time
- JavaScript debugger
- analyze network usage and performance

TV Emulator on PC

Vewd TV Emulator allows you to test and debug apps, as it contains a full implementation of Vewd Core and the Vewd Media Player Module that can run on your own PC.

https://www.vewd.com/products-services/vewd-tv-emulator/

Validators

W3C HTML Validator

For basic HTML issues and pre-proofing your HTM

http://validator.w3.org/

IRT HbbTV Validator

http://hbbtv-live.irt.de/validator/

HbbTV DASH validator for conformancy

https://github.com/Dash-Industry-
Forum/Conformance-Software

Lab testing

It is vital to test HbbTV in real broadcast conditions

Get as many TVs as possible!

Video streaming platform for live+on-demand recommended

Example: Icareus Playout PC100

- For Lab environment
- Generates a full multiplex output via RF –signal
- Directly connected to a HbbTV receiver

Going to production

DEVELOP

DEPLOY

TEST

>10000
different terminals on single market
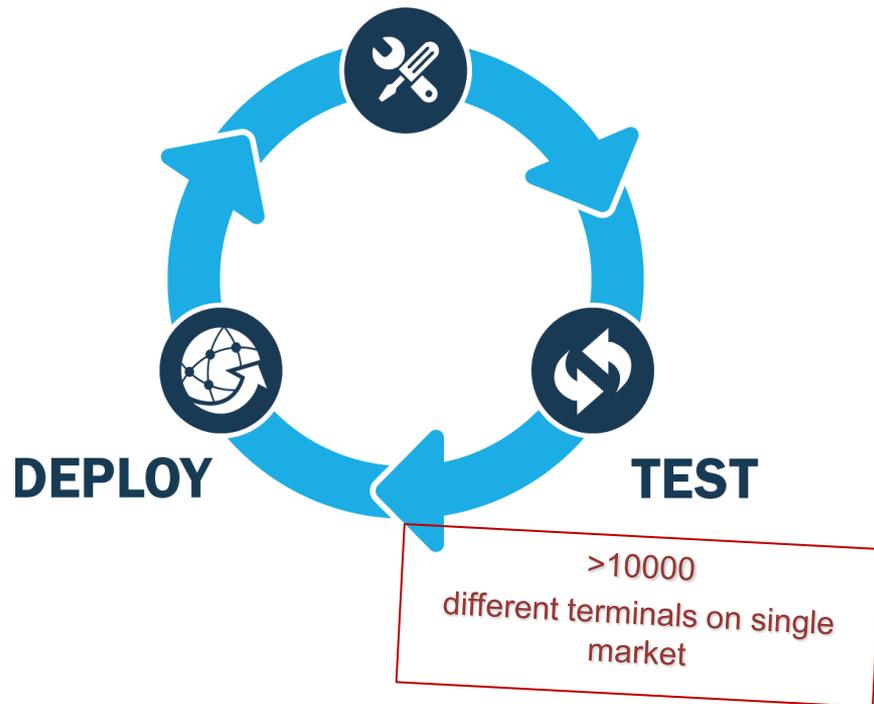
1. It is impossible to test on all TVs in the market
2. Once in production, keep monitoring the app and gather feedback
3. Develop, test and improve
4. Repeat!

HOW TO PROTECT YOUR INVESTMENT?

All about User eXperience

Bad UX
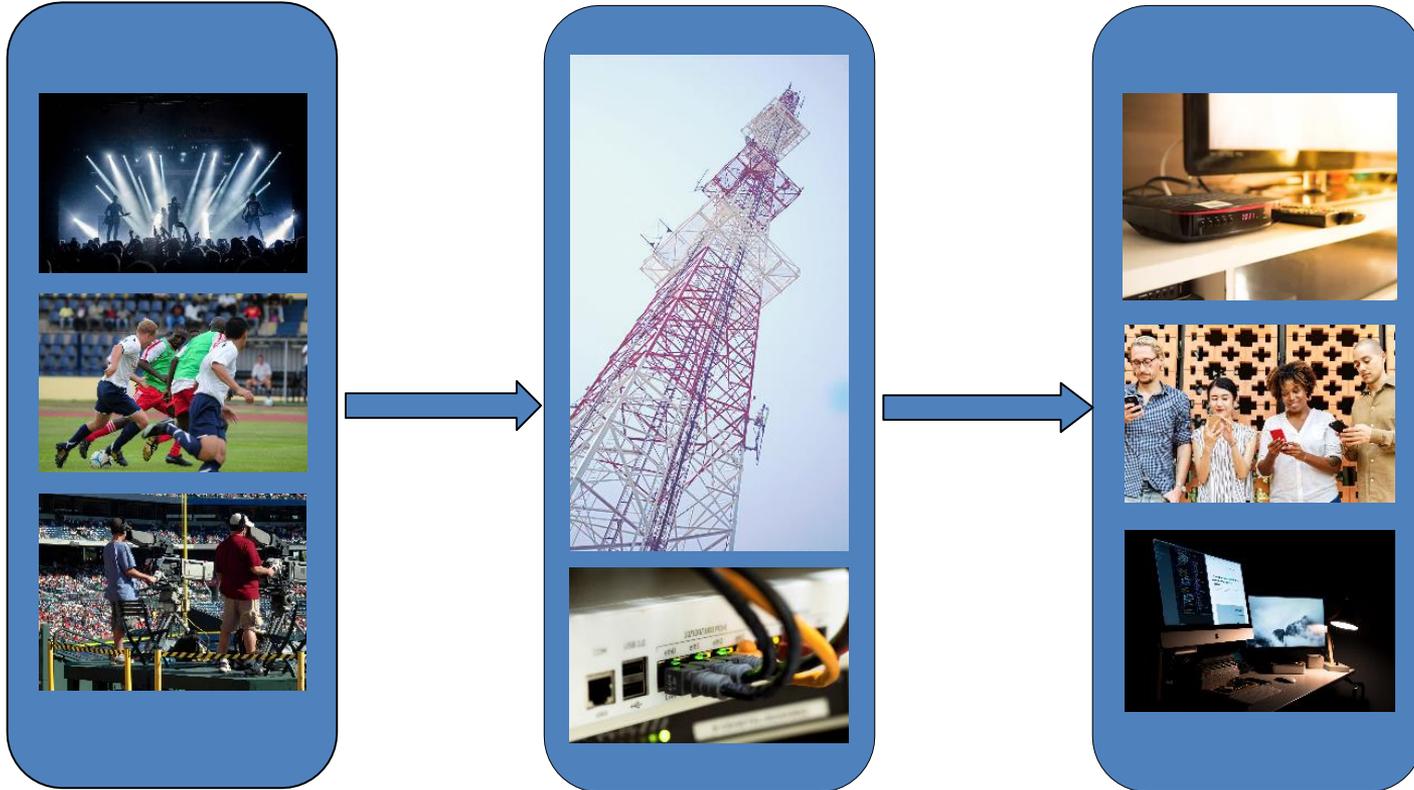
- Different platform requirements

- Non-compliant receivers

- Complaints and calls

- Brand damage

- Bad press

- Apps inconsistent behaviours

- Updates not supported

- Can't handle new services / network changes

- EPG not displayed properly

- Poor interoperability

Importance of Conformance

Conformance models

Do Minimum

Free uncontrolled market

- Receiver issues in field
- Platform brand damage
- Inability to add new services
- Interactive applications impossible to write
- Lots of bad receivers
- Potentially costly to fix!

Self Discipline

Manufacturer certifies they conform

- Test suite made available to manufacture
- Audit process lab or p
- Good u
- Non-co in the f

Full Control

Manufacturer submits receivers for testing

- Test suite made available to manufacturers
- Local or "hosted" cert lab

The approaches are not mutually exclusive and are often combined in a number of ways depending on the specific market conditions.

Typical conformance model
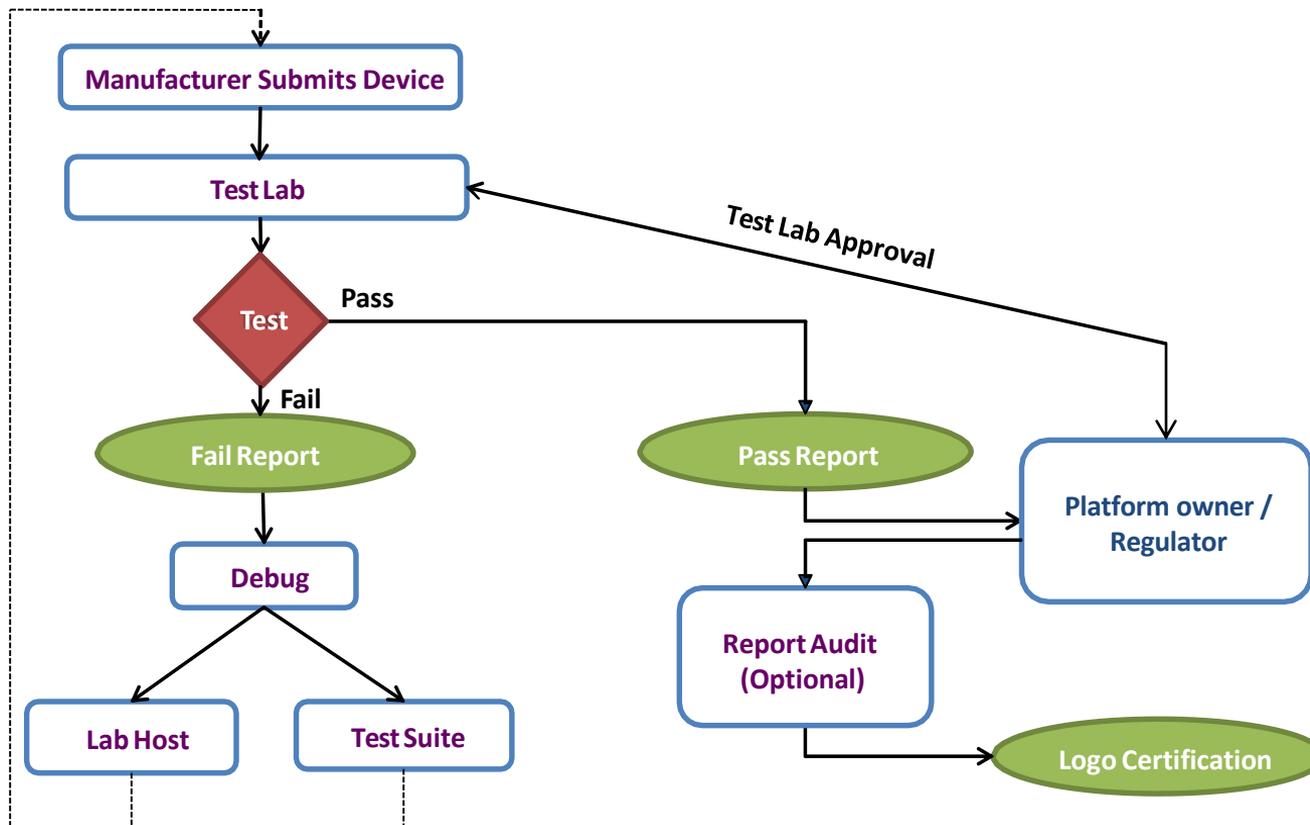
Importance of test coverage
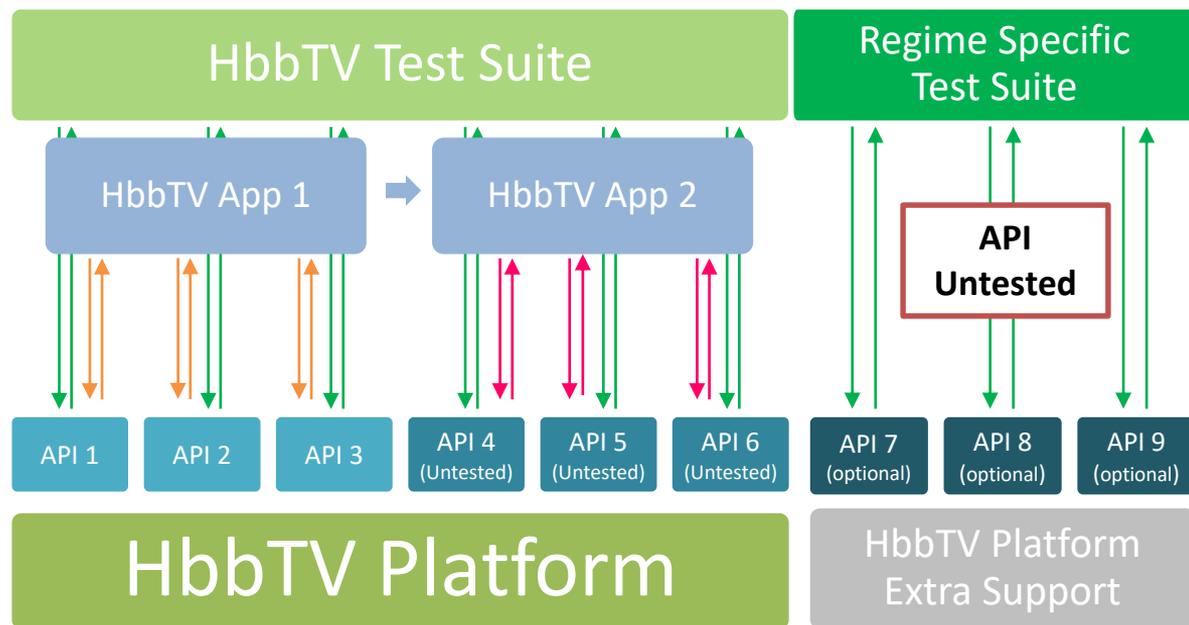
HbbTV Test Suite covers core features

Some markets use optional HbbTV behaviours

If you have a partially tested HbbTV Platform, it may work with some but not all apps

Extra tests can be required to get full coverage

There are always platform specific requirements – extra test suite therefore very useful

HbbTV test suite & other test suites

HbbTV Association
- **Official HbbTV Test Suite**

Country Regimes
- **UK Freeview Play**
- **Italy Tivu**
- **Germany Media Broadcast**
- **France TNT 2.0**
- **Spain TDT Hibrida**
- **NZ Freeview Plus**
- **AU Freeview Plus**
- **Croatia HAKOM**

DRM
- **Marlin**
- **PlayReady**

"Extra" HbbTV Tests
- **Eurofins HbbTV1.1/1.5/2.0.1**
- **DASH Pro Network Simulation**
- **CI Plus**
- **Performance**
- **Live App Portal**
- **Dolby + DTS**

Ligada Project: Ligada Demo

eurofins

Home Help

Proje
6 test
0 p
0 test
3 test

Notes

Tests

Gene

org

org.h

org

org

E

E

Ligada iSuite

Test ID: org.hbbtv_MDEVSYNC1784 - In Progress

eurofins | Digital Testing

Stop Test and Back to Index | Get Test Code↗ | Network Activity↗

Assertion Text

The application on the terminal has initialised a MediaSynchroniser object using the initMediaSynchroniser method, providing a media object presenting an MPEG DASH presentation as the master media. The application has enabled inter-device synchronisation, and a connection has been established to the CSS-TS endpoint of the master terminal with where the initial setup-data message sent to the master terminal requested a DASH Period Relative timeline and the master terminal has sent back a Control Timestamp indicating that the timeline is available. The timeline requested has a tick rate of 100 ticks per second or greater. When the timing of presentation indicated by the value of the Control Timestamp is compared to the timing of presentation of the master media as observed by monitoring the light and/or sound emitted then it is found to be accurate to within plus or minus the sum of 10ms and the current error bounds in estimating the Wall Clock of the master terminal (using the CSS-WC protocol)

Specification References

HBBTV - 1.3.1
Chapter 13.8.2.4
Control Timestamps sent by the MSAS function of the master terminal to slave terminals and CSAs shall, when the synchronisation timeline is available, represent the timing of presentation of the master media by the master terminal. [...] When a Control Timestamp is representing a timing of presentation with respect to the reference point for timestamping, it shall do so to within plus or minus the minimum synchronisation accuracy defined in clause 9.7.4.

HBBTV - 1.3.1
Chapter 9.7.4
The minimum accuracy for multi-stream and inter-device synchronisation for a given terminal is the largest of: * 10ms (being the duration of 1/2 a frame of video at 50fps); * the duration of 1/2 tick of any timeline selected (during the corresponding initMediaSynchroniser() or addMediaObject() method call) by the HbbTV application for any of the streams under the control of the MediaSynchroniser object; * the duration of 1/2 tick of the Synchronisation timeline (see clause 13.4.3.2) if inter-device synchronisation is being performed.

HBBTV - 1.3.1
Chapter 13.4.2
For multi-stream and inter-device synchronisation, the terminal shall support the use of the

Test Step 0
Application initialised

Information
Network speed set to: 99.000000 Mbps.

Test Step 1
A reference to the MediaSynchroniser object was obtained.

Test Step 2
A reference to the HTML media element object was obtained.

Specification References

18:48
29/08/2018

Building Conformance

Steps to conformance

- Author a <u>good</u> spec and Publish it

- Selecting a conformance model

- Consider types of devices (TV? STB? Mobiles involved?)

- Define test suite to support the conformance regime

- Keep up to date with changes in standards specifications

- Technical support services for the test material licensees

- Use of trademark logo for TV platform?

- Publicise the conformance / certification program!

Maintain quality control

- Use automation:

  - Test builds of apps on devices

  - Test devices with your HbbTV services

  - Continuous monitoring of live services

- Set up / appoint a Test Lab for audit

- Police the market for non-conformant devices

- Work closely with all stakeholders (manufacturers, broadcasters, network operators, etc.)

Typical types of testing

- ✓ App Testing

- ✓ Receiver (& Companion Device) Testing)

- ✓ Field Testing

- ✓ Interop Testing

App
Issues

Receiver
Issues

Field
Issues
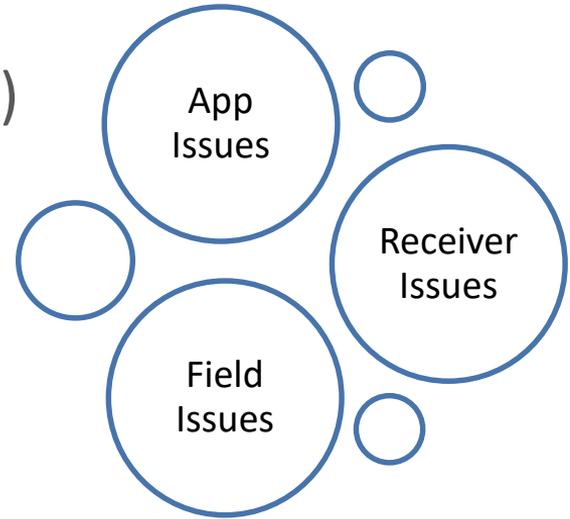
Observed Problems

Interoperability workshops

Meetings between CE vendors, broadcasters, operators and app developers

Testing of:

- Operational apps, new ones and prototype apps

- Device development and production models

- CE vendors bring engineers and latest models

Great way to debug apps / device SW

HbbTV Association has an Interoperability Task Force who organises plug-fests with the help of IRT in Germany

Regional workshops, e.g. Digita in Finland, DTG in UK

FINAL THOUGHTS

Summary
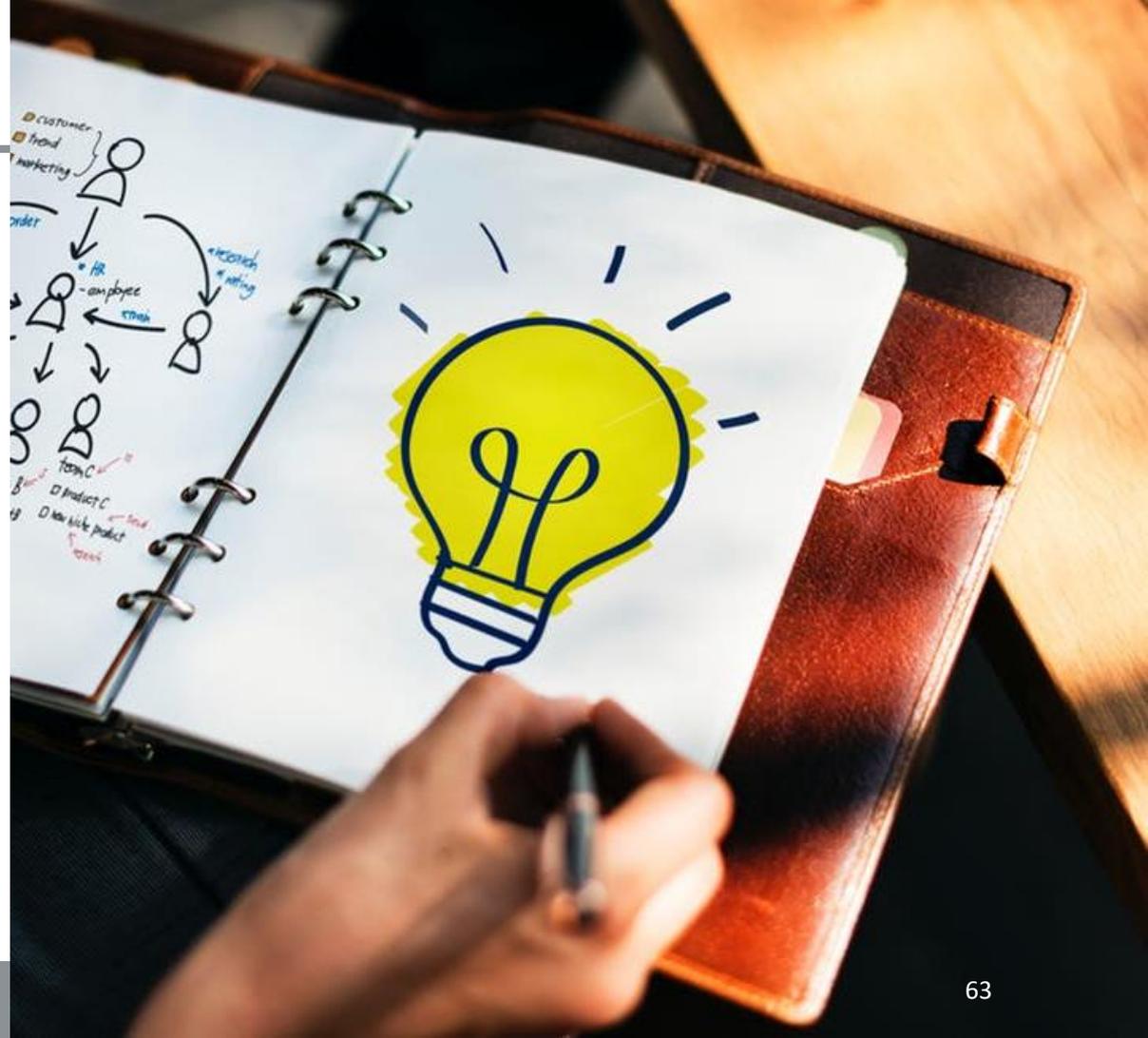
- HbbTV offers a great set of tools and features

- Lots of resources available to develop and test apps

- Widely adopted standard across the world

- Mature HbbTV software and hardware already exist

- Well established test regimes exist and can be learned from

- Variety of different approaches to testing and certification

  – Use the Official Test Suite

  – Use a country / platform specific regime (and test suite)

Ask the experts, don't reinvent!

Mikko Karppinen

Mikko.karppinen@icareus.com

+358415015993

Skype: mtkarppi

Julius Mong

JuliusMong@eurofins.com

+447787048966

Skype: jxm96c