

I Know What You Watched Last Sunday



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A New Survey of Privacy in HbbTV

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Marco Ghiglieri

Web 2.0 Security & Privacy 2014 Workshop

In conjunction with the IEEE Symposium on Security and Privacy

What is a Smart Entertainment Device ?

Smart Entertainment Devices

- Smart TVs, Set-Top Boxes, Hi-Fi systems, ...
 - Often as **powerful** as desktop computers
- Interface to the Internet like **Wi-Fi and/or LAN**
- **Cameras, Microphones, Motion Sensors, ...**

In this talk:

Smart TVs & Set-Top Boxes with HbbTV support

What is HbbTV and how does it work ?

HbbTV (Hybrid broadcast broadband TV)

- **HbbTV (Hybrid broadcast broadband TV)**
 - **Pan-European Standard** for the presentation of Internet content on a Smart TV or set-top box (Internet technologies like HTML, CSS and JavaScript)
 - **Almost every new Smart TV** model supports HbbTV
 - Discussions about using HbbTV standard **worldwide**
- Long Term: **Replacement for Teletext**



100 100 ZDFtext Mo 25.07.05 12:39:57	
ZDF Mit dem Zweiten sieht man besser	
London: Neue Anschläge befürchtet	120
Agypten: Fahndung nach Pakistanern	122
Discovery: Start in jedem Fall	125
Lebenslange Haft für Murat-Mörder	127
US-Presse feiert Lance Armstrong	205
DSV-Frauenstaffel holt WM-Silber	207
Basketball: Garris nach Frankfurt	217
12.15 drehscheibe Deutschland	363
13.00 ARD-Mittagsmagazin	364
Inhalt (A-Z)	101
Nachrichten	112
Telefontarif	587
Promi-News	801
TED	Überblick
Index	A-D
Nachrichten	

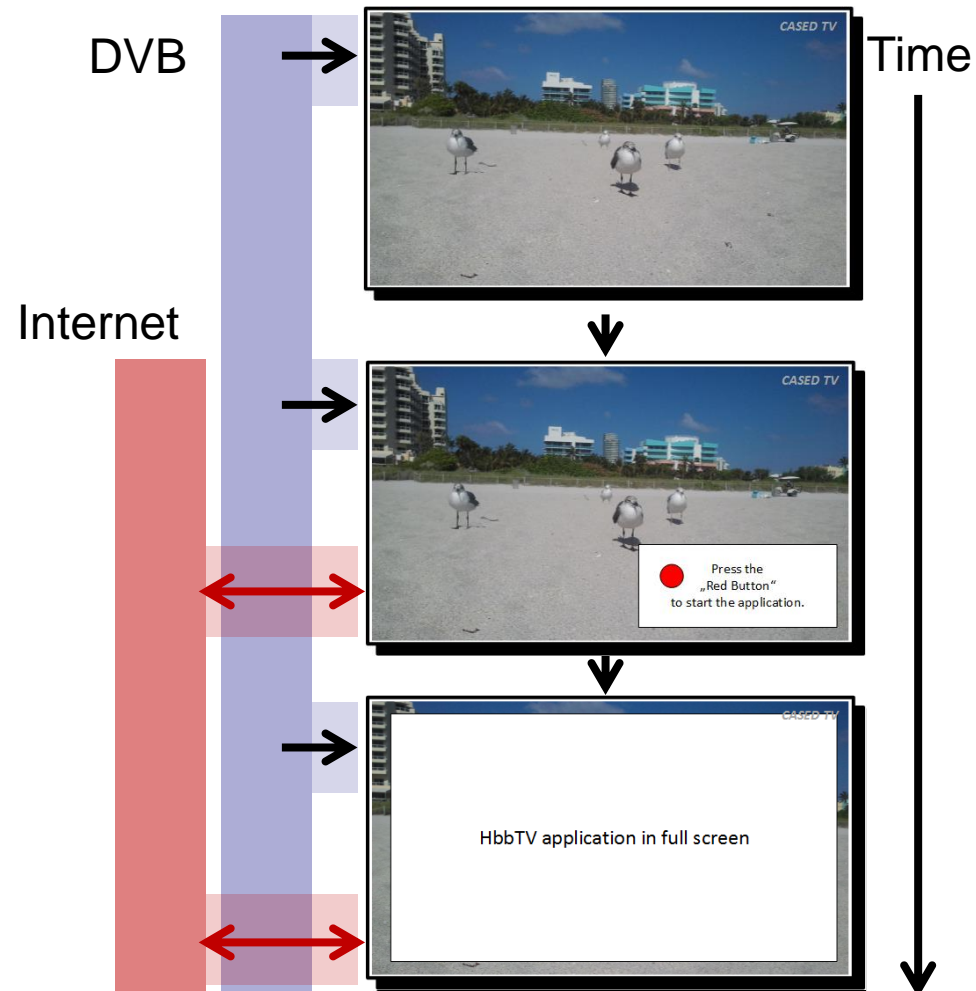
The way from a conventional TV to a Smart TV

Digital Video Broadcast

- Cable, terrestrial, satellite
- One direction
- Start signal for HbbTV

Internet

- Bidirectional
- HbbTV Red Button
- HbbTV application

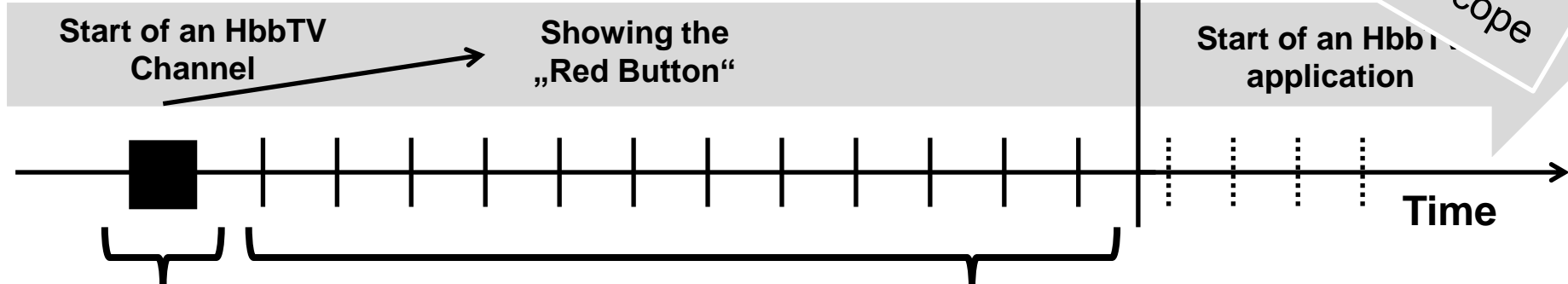
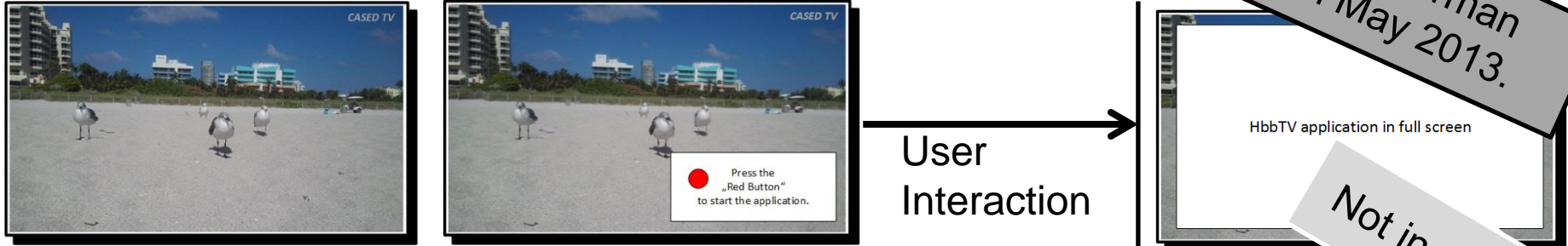




What kind of data is
transferred ?

What kind of data is transferred ?

Already published on a German national conference in May 2013.



Not in scope

Start-Up Requests

- Scripts like (ext.) tracking services
- Images (channel logos)
- HTML, JS, CSS for HbbTV

Periodic Requests

- Preloading of content, tracking and (pers.) advertisements
- Time period 1s – 15 min

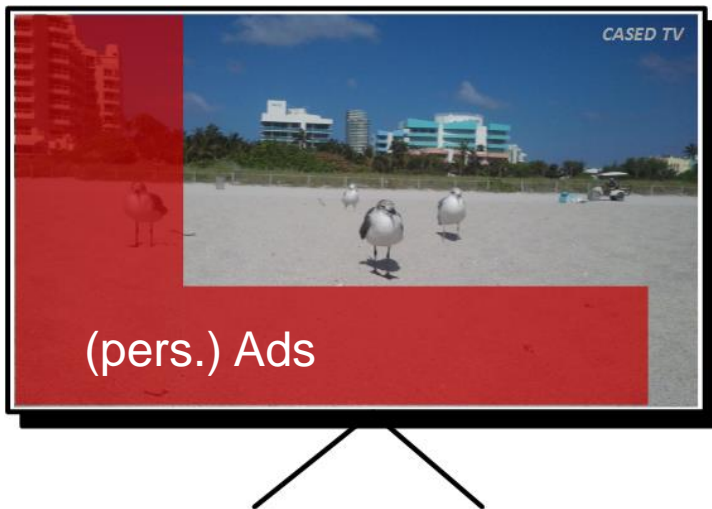
How can the collected data be used ?

Consumers may be tracked

- **Disclaimer:** We do not know if this data is processed.
- **But**, tracking services are not **just for fun** implemented !
- Data is sent **before** consumers use the **HbbTV functionality**
 - **Before pressing the „Red Button“**
- **Broadcasting stations and other third parties** are able to track consumers while **watching TV or listening to radio**

Personalized Advertisements can be shown

- **Possibility to show personalized ads to user**
 - On one channel we saw this already.



- **Change the running program in (almost) real time**

Summary of Results in the Smart TV Scenario

	2012	2014	Trend
Number of Channels	11	26	↑
Channels with Tracking Services (3rd party)	7	8	↑

2012: June – Dec. 2012
2014: January & Feb. 2014

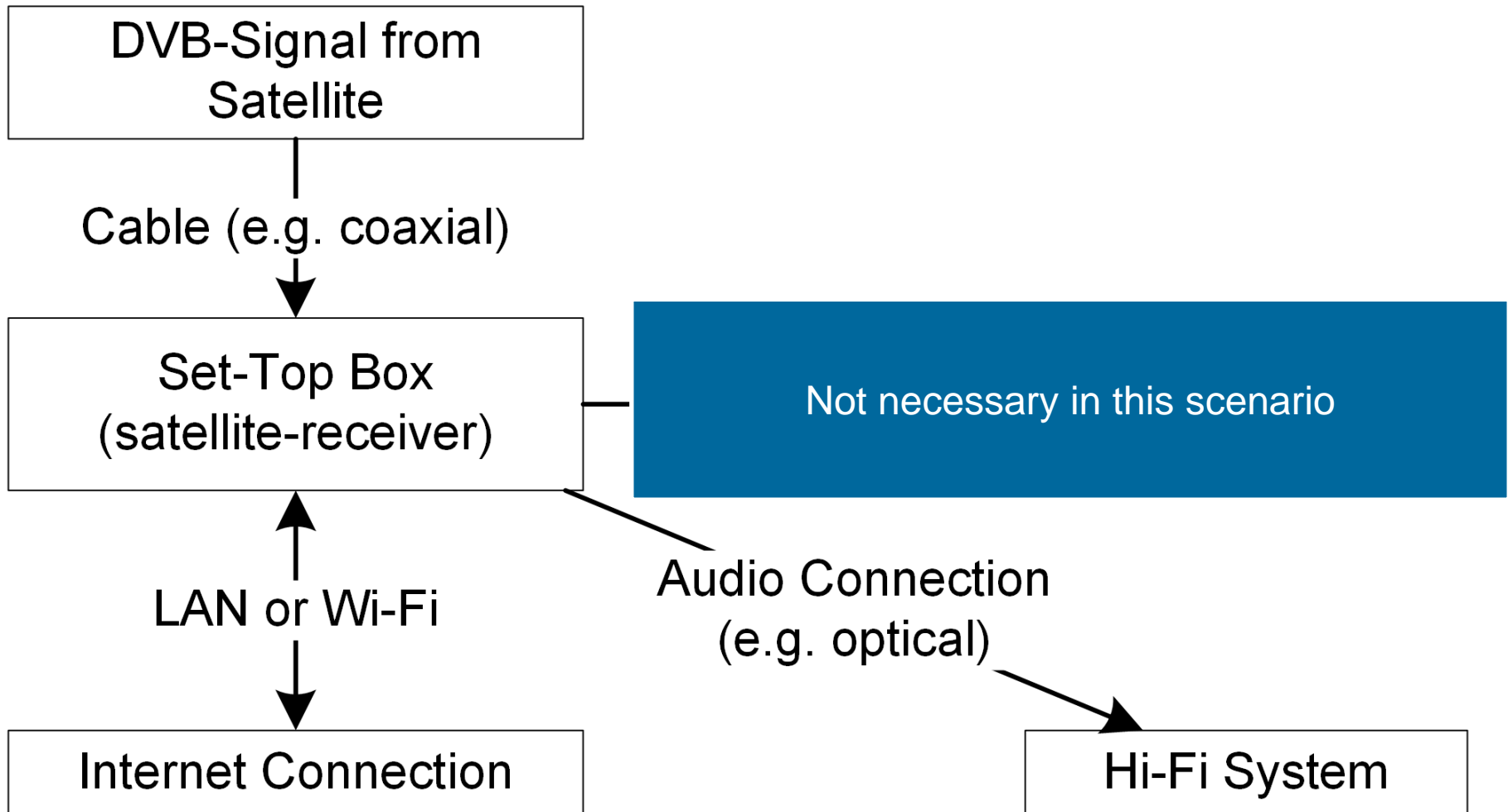
- Some channels we have checked in 2012 have improved their traffic
 - ARD, Pro Sieben, Sat.1, Kabel.1, Puls 4 Austria
 - Bibel TV deactivated HbbTV
- New channels in this survey used tracking services
 - RTL , VOX, RTL2, sonneklar.tv, QVC, RTVE
 - Trackers found were INFOnline, IVW, Google Analytics, etracker and Scorecard Research
- More details can be found in the article



How does HbbTV on digital satellite radio work ?



Architecture of a Typical Satellite Environment



Background: Data may be Used to Count Number of Listeners

- One satellite radio sender group (over 20 radio channels) uses HbbTV to deliver information to people listening to radio on a Smart TV
- If the set-top box is only connected to an Hi-Fi system the HbbTV notification is loaded from the Internet
 - → Hidden counting of people is possible

Results in the Radio Scenario

- Analyzed in January and February 2014
- Over **20 radio channels** deploy HbbTV
- The broadcasting provider also operates many TV channels: ARD group.
 - It is possible to **create a profile** of a consumer consisting of a chain of channels
 - For example: Turn to Channel 1, Channel 2, Radio Channel 2, Radio Channel 1,...

What can a consumer do ?

What can a consumer do ?

Deactivate data services or disconnect your TV or set-top box

- No Smart TV anymore, no Internet Radio

We have developed a method to protect users' privacy

What can be done by manufactures or broadcasting stations ?

Short Term:

Modification of HbbTV applications

Long Term:

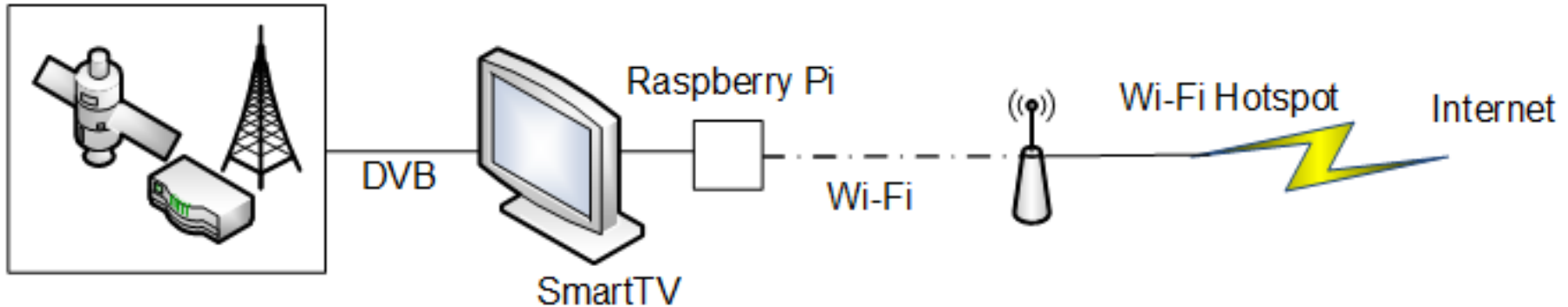
Modification of the HbbTV standard

Raspberry Pi as Protection Gateway

Firstly introduced at IEEE CCNC
2014 in January.

Small, cheap, easy to install

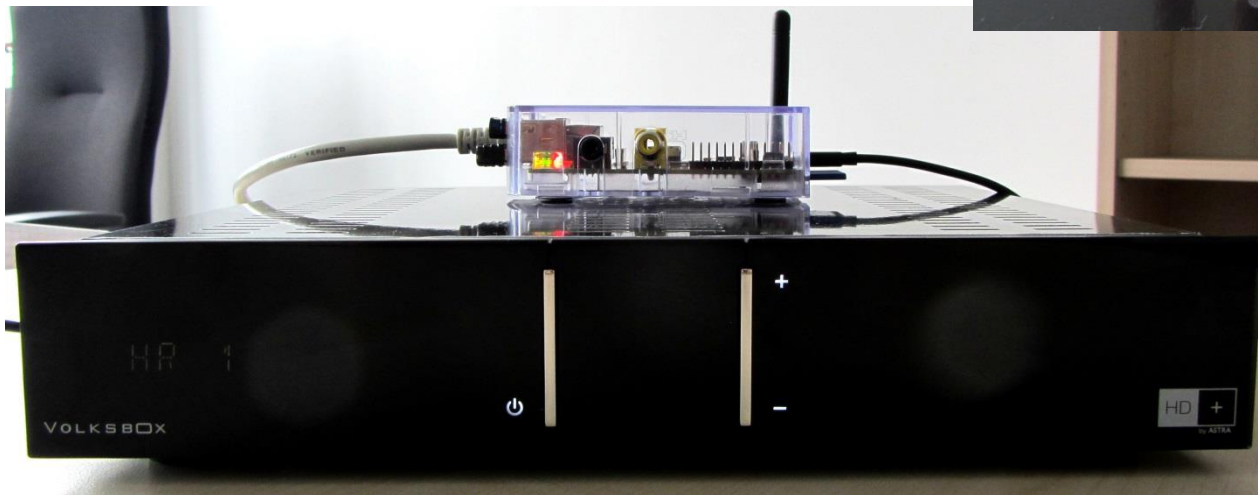
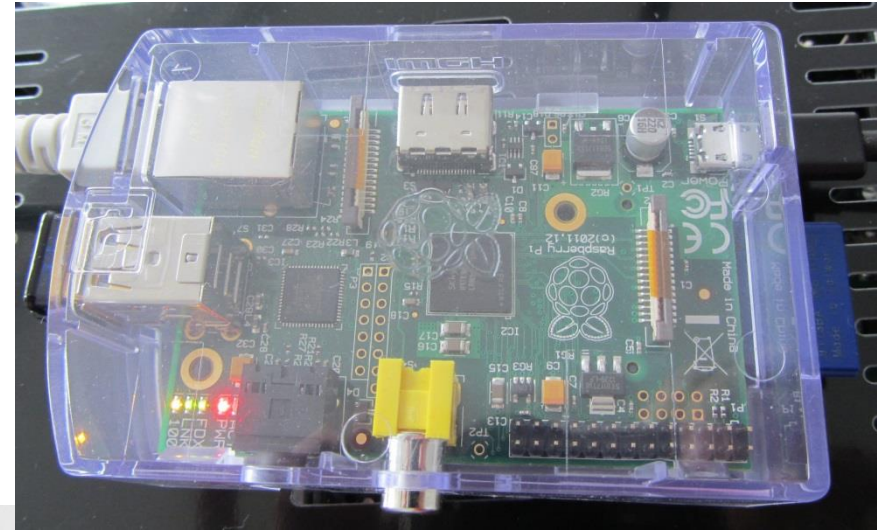
Compatible with the HbbTV
standard



Raspberry Pi connected to the Set-Top Box



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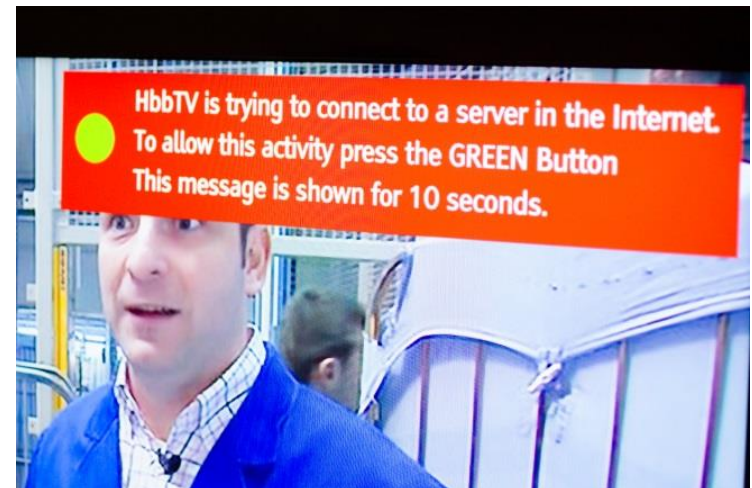


Software used on Raspberry Pi

- Linux based: Mitmproxy
- Custom script
 - Dynamic Detection of HbbTV applications

```
<object type="application/oipfApplicationManager"  
id="oipfAppMan"></object>
```

```
>> HEAD http://hbbtv.sat1.de/service/redbutton_s1.php  
- 307 text/html [no content] 5.35MB/s  
HEAD http://hbbtv.sat1.de/service/redbutton_s1.php  
- 307 text/html [no content] 5.71MB/s  
HEAD http://192.168.111.1/overview.hbbtv  
- 200 application/vnd.hbbtv.xhtml+xml [no content] 3.66kB/s  
GET http://hbbtv.sat1.de/service/redbutton_s1.php  
- 307 text/html 70B 8.53MB/s  
GET http://192.168.111.1/overview.hbbtv  
- 200 application/vnd.hbbtv.xhtml+xml 1.16kB 26kB/s  
GET http://192.168.111.1/hbb.css  
Event log  
192.168.111.2:33555: transparent to 192.168.111.1:80  
192.168.111.2:33555: transparent to 192.168.111.1:80  
192.168.111.2:33555: disconnect  
-> handled 1 requests  
192.168.111.2:33556: connect  
192.168.111.2:33556: transparent to 192.168.111.1:80  
192.168.111.2:33556: transparent to 192.168.111.1:80  
192.168.111.2:33556: disconnect  
-> handled 1 requests  
[1/36] ?;help [*:8080]  
[showhost] [script:hbbtv/redirect-zdf.py]
```



Next Tasks / Future Work

- Development of a system that can measure the viewing behavior with PET (Privacy Enhancing Technologies)
- The number of Smart Devices is increasing !
More research for the right level of protection is required.
- Long Term: Security Gateway for the Smart Home

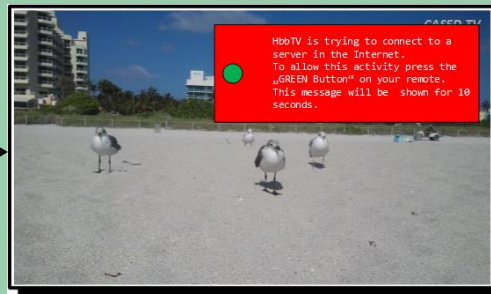
The End: The Talk at a Glance

- HbbTV is a **great functionality**
- **Much data** is transferred before consumers use HbbTV
- The methods and techniques used should be more privacy-friendly
- **Simple Protection System with Raspberry Pi**

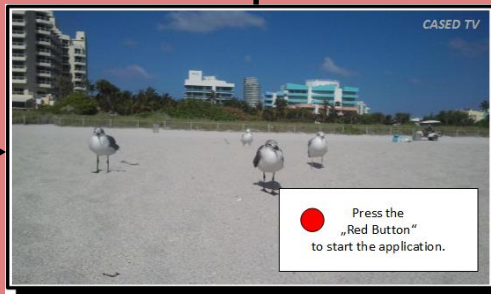
No traffic to the Internet



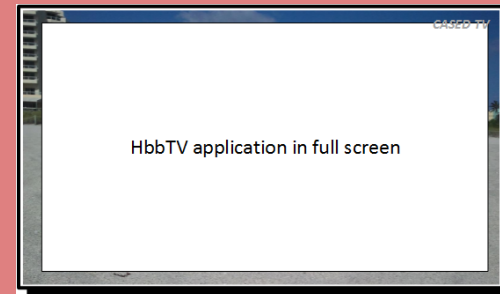
No user
interaction



Green
Button



HbbTV Internet traffic



Red
Button

Contact



Marco Ghiglieri, M.Sc.

Technische Universität Darmstadt

Security in Information Technology

Mornewegstraße 30

64293 Darmstadt, Germany

<http://www.sit.informatik.tu-darmstadt.de/>

marco.ghiglieri@sit.tu-darmstadt.de

Appendix

The references can be found in the publication „I Know What You Watched Last Sunday“ and are not listed here.

List of Photographers/Source of Pictures

- Slide 1: Erik Tews/CASED
- Slide 5: Teletext/Wikipedia EN
- Slide 6,7,8,11,13,19,20,21,23: Marco Ghiglieri/CASED