DFRWS
DIGITAL FORENSIC RESEARCH CONFERENCE

Smart TV Forensics - Digital Traces On Televisions

By

Abdul Boztas, Remko Riethoven and Mark Roeloffs

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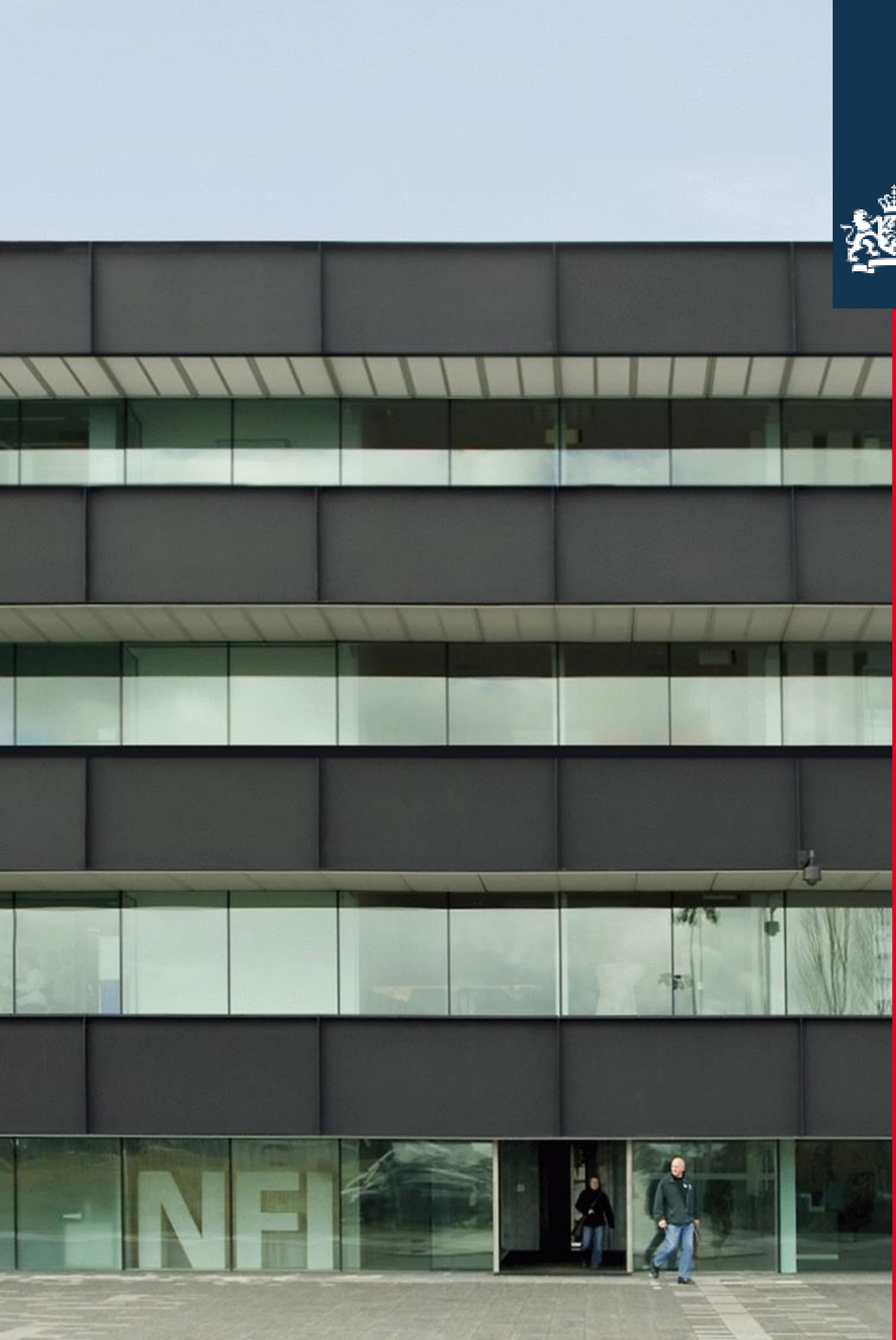

Netherlands Forensic Institute
Ministry of Security and Justice

Smart TV Forensics

A.Boztas
M. Roeloffs

A.Boztas@holmes.nl
M.Roeloffs@holmes.nl

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Agenda

- The NFI
- Introduction
- Material and methods
- Data acquisition
- Data analysis
- Future
- Conclusion

Introduction

Introduction

Research questions:

- *Can a Smart TV be a key component in a digital forensic investigation?*

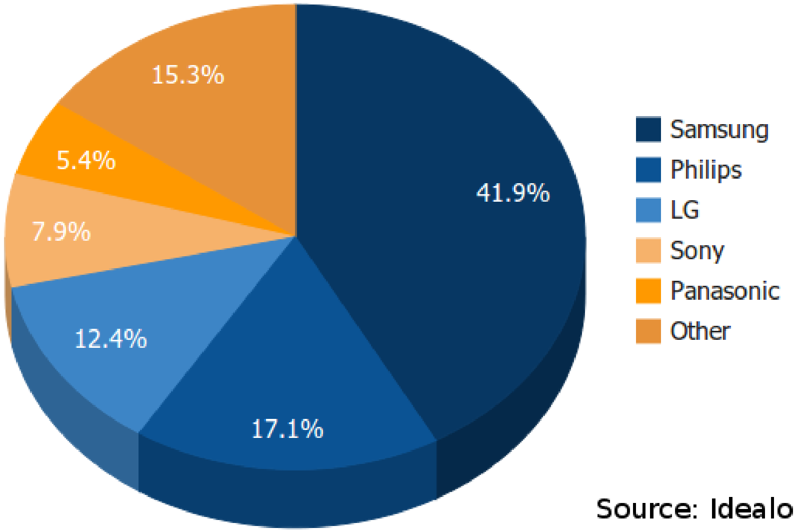
- *Is it possible to acquire data from a Smart TV?*

- *Can a Smart TV contain relevant data?*

Material and Methods

- Literature study
- Selection Smart TV
- Data acquisition
- Data analysis
    - System information and settings
    - Apps
    - Web browsing
    - Photo and multimedia files
    - External media
    - Cloud services
    - Channel information

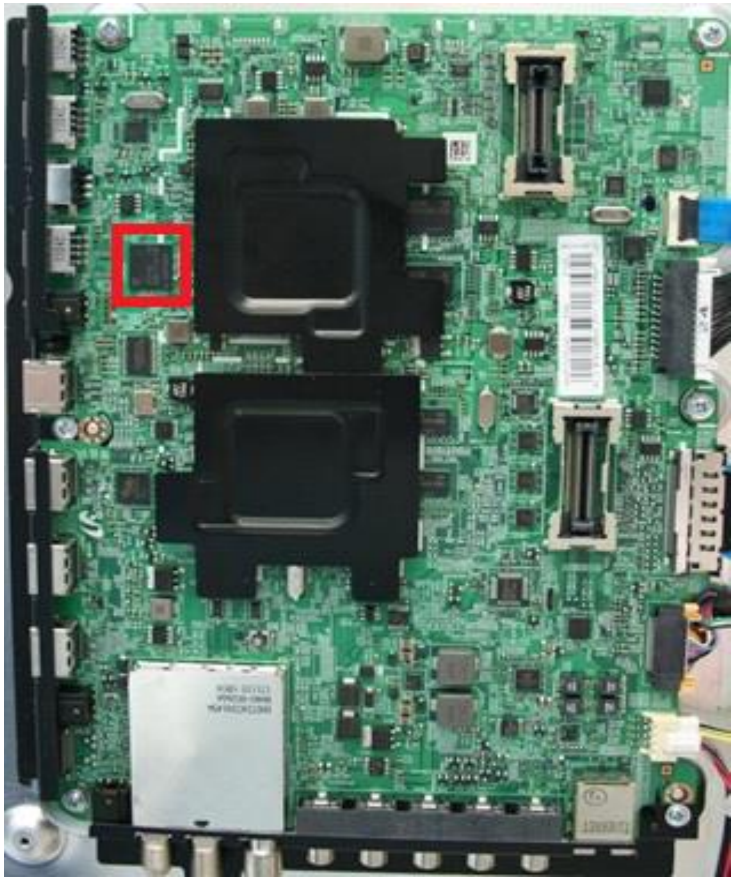
Click Distribution by LCD-TV Manufacturer (Q4 2011-Q4 2012)



Source: Idealo

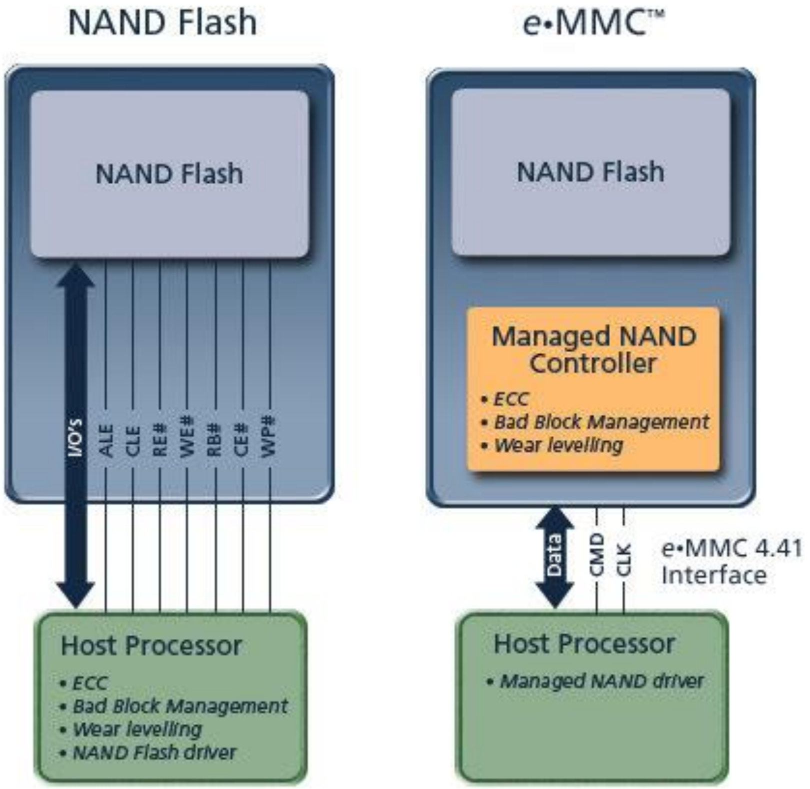
Data Acquisition: NFI Memory Toolkit

- Chip-off
- De-soldering of eMMC chip
- Read out with
- NFI Memory Toolkit II
- This method works on almost all embedded devices, the problem after chip-off is crypto.

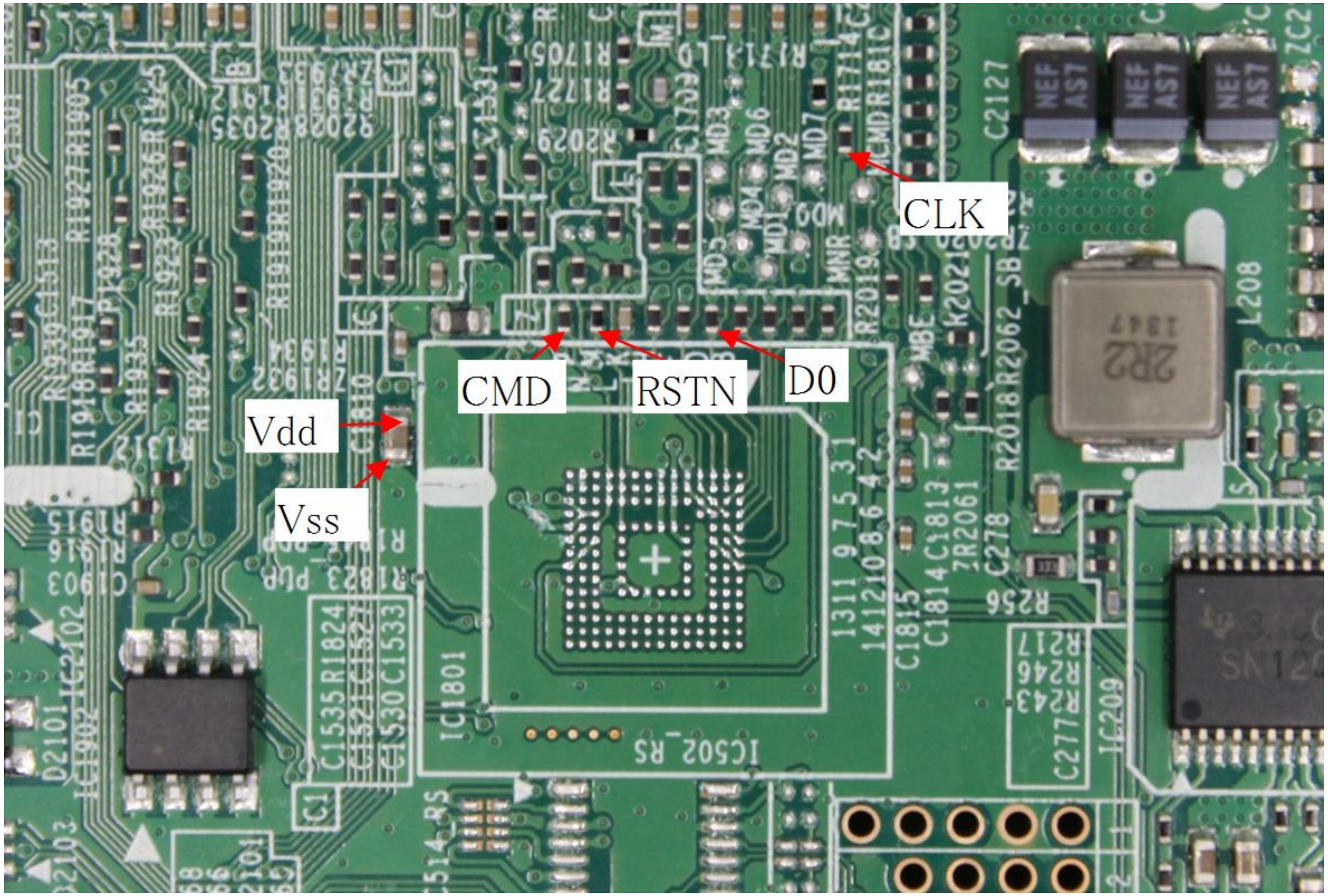


Data Acquisition: the Five-Wire Method

- More and more embedded systems use eMMC chips
- eMMC is roughly the same as an MMC card
- Only three signals + Power Supply required to read
- Controller, a disk image is created, no rough copy of NAND



Data Acquisition: the Five-Wire Method



Data Acquisition: the Five-Wire Method

Does not work yet.
Probably because there are also other chips which start-up and draw current.
Can do it with many other devices

Data Acquisition: App

- Smart TVs are ordinary computers
- Often work with Linux operating system
- Rooting

Data Acquisition: App

- SamyGO forum on the Internet
- Many opportunities for "rooting"
- Possible to use Smart TV as a BitTorrent client, etc.

Data Acquisition

The Five-Wire Method

Quick Method, more research is needed, repeatable

Chip-off

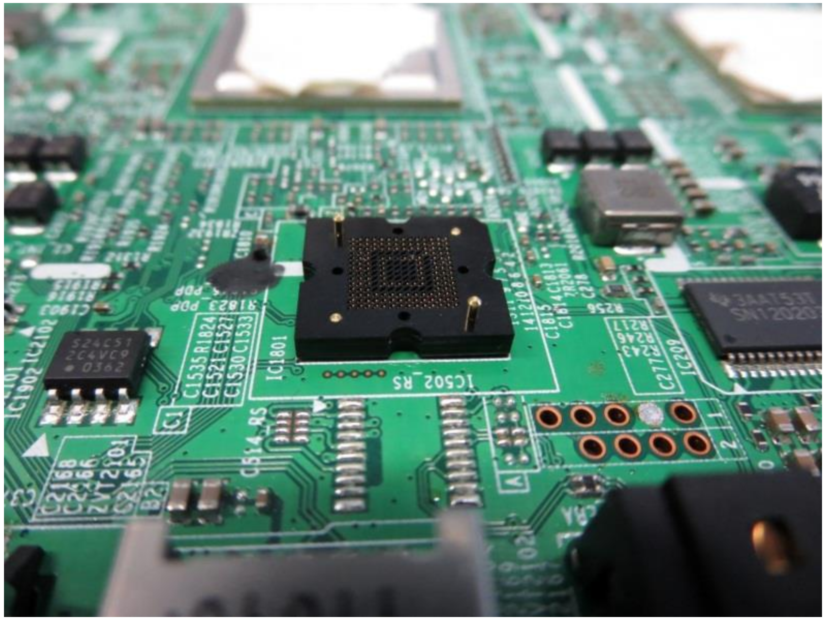
Takes longer time, repeatability is getting better

App

Fast method, but does not work on all firmware

Removable Soldered Memory

Test device now equipped with removable media by using a BGA adapter.



FILE SYSTEM ANALYSIS

File System Analysis

Squashfs

- Read-only
- Software of Samsung Open Source Release Center
- Adjustment image authentication and compression

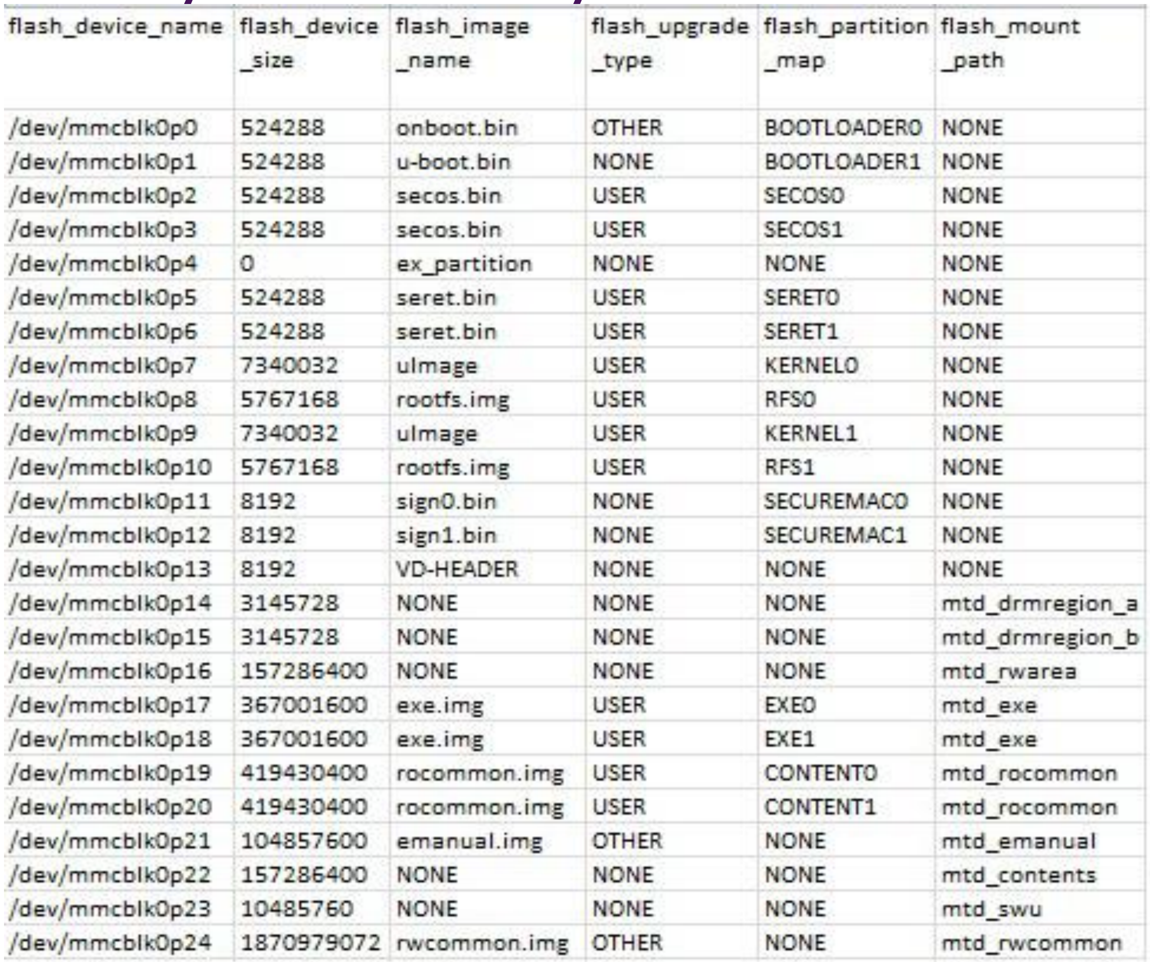
Samsung eMMC

- Samsung chip oriented file system
- Like a BTRFS variant, journaling, snapshotting
- Magic ‵1eMMCFS‵

Partition redundancy

- Some partitions have the same size
- Used to reset software

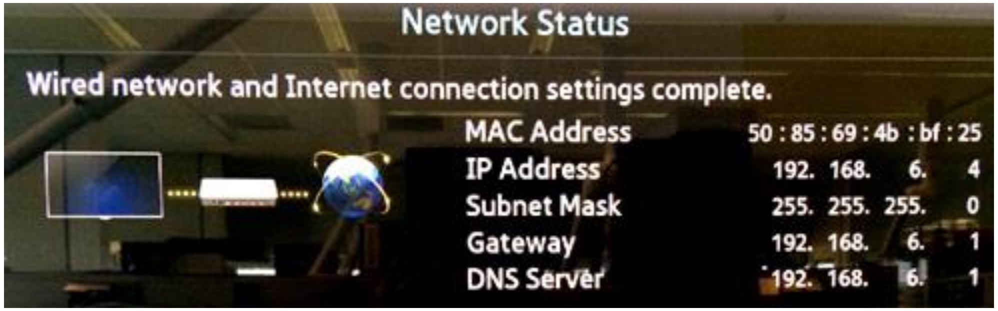
File System Analysis



flash_device_name	flash_device_size	flash_image_name	flash_upgrade_type	flash_partition_map	flash_mount_path
/dev/mmcblk0p0	524288	onboot.bin	OTHER	BOOTLOADER0	NONE
/dev/mmcblk0p1	524288	u-boot.bin	NONE	BOOTLOADER1	NONE
/dev/mmcblk0p2	524288	secos.bin	USER	SECOS0	NONE
/dev/mmcblk0p3	524288	secos.bin	USER	SECOS1	NONE
/dev/mmcblk0p4	0	ex_partition	NONE	NONE	NONE
/dev/mmcblk0p5	524288	seret.bin	USER	SERET0	NONE
/dev/mmcblk0p6	524288	seret.bin	USER	SERET1	NONE
/dev/mmcblk0p7	7340032	uImage	USER	KERNEL0	NONE
/dev/mmcblk0p8	5767168	rootfs.img	USER	RFS0	NONE
/dev/mmcblk0p9	7340032	uImage	USER	KERNEL1	NONE
/dev/mmcblk0p10	5767168	rootfs.img	USER	RFS1	NONE
/dev/mmcblk0p11	8192	sign0.bin	NONE	SECUREMAC0	NONE
/dev/mmcblk0p12	8192	sign1.bin	NONE	SECUREMAC1	NONE
/dev/mmcblk0p13	8192	VD-HEADER	NONE	NONE	NONE
/dev/mmcblk0p14	3145728	NONE	NONE	NONE	mtd_drmregion_a
/dev/mmcblk0p15	3145728	NONE	NONE	NONE	mtd_drmregion_b
/dev/mmcblk0p16	157286400	NONE	NONE	NONE	mtd_rwarea
/dev/mmcblk0p17	367001600	exe.img	USER	EXE0	mtd_exe
/dev/mmcblk0p18	367001600	exe.img	USER	EXE1	mtd_exe
/dev/mmcblk0p19	419430400	rocommon.img	USER	CONTENT0	mtd_rocommon
/dev/mmcblk0p20	419430400	rocommon.img	USER	CONTENT1	mtd_rocommon
/dev/mmcblk0p21	104857600	emanual.img	OTHER	NONE	mtd_emanual
/dev/mmcblk0p22	157286400	NONE	NONE	NONE	mtd_contents
/dev/mmcblk0p23	10485760	NONE	NONE	NONE	mtd_swu
/dev/mmcblk0p24	1870979072	rwcommon.img	OTHER	NONE	mtd_rwcommon

Data Analysis: System and Network Information

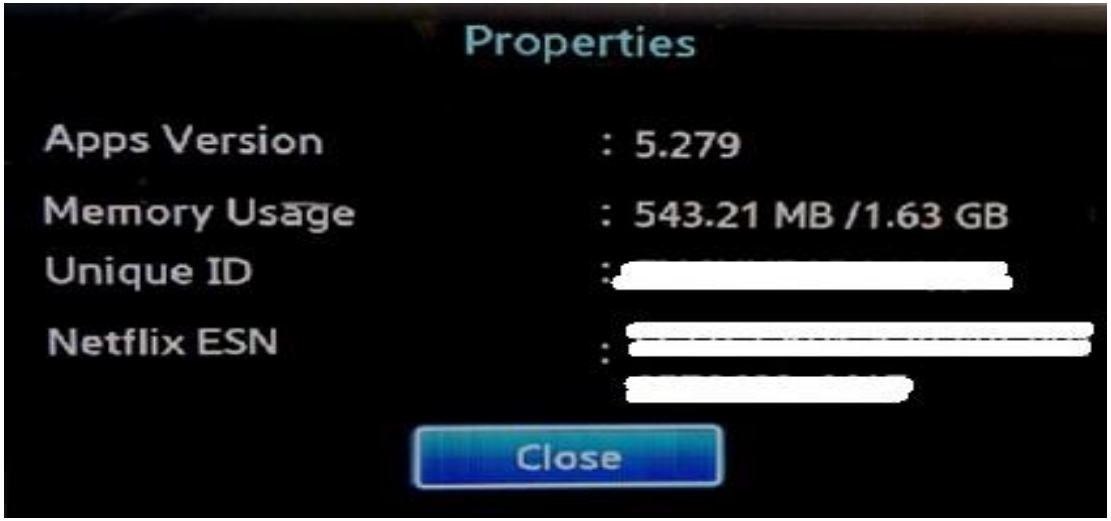
- Device name
- Connected devices
- Network information
- Smart functionalities



Network Status

Wired network and Internet connection settings complete.

```
MAC Address     50 : 85 : 69 : 4b : bf : 25
IP Address      192.  168.    6.    4
Subnet Mask     255.  255.  255.    0
Gateway         192.  168.    6.    1
DNS Server      192.  168.    6.    1
```



Properties

```
Apps Version        :  5.279
Memory Usage        :  543.21 MB /1.63 GB
Unique ID           :  [redacted]
Netflix ESN         :  [redacted]
```

Data Analysis: System and Network Information

- System information:
  - Serial number
  - Model
  - Brand
  - Unique ID
  - etc.

- Network information:
  - Information about network name
  - IP-addresses
  - Bluetooth devices
  - MAC-address

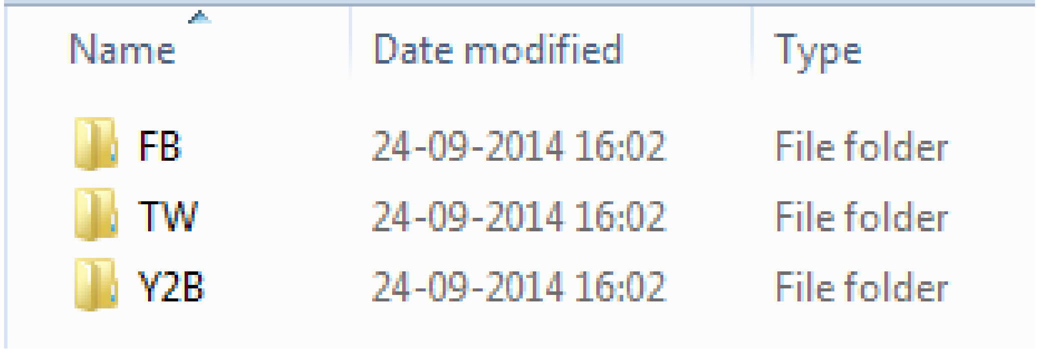
Data Analysis: Apps

- Facebook
- Twitter
- YouTube, etc.

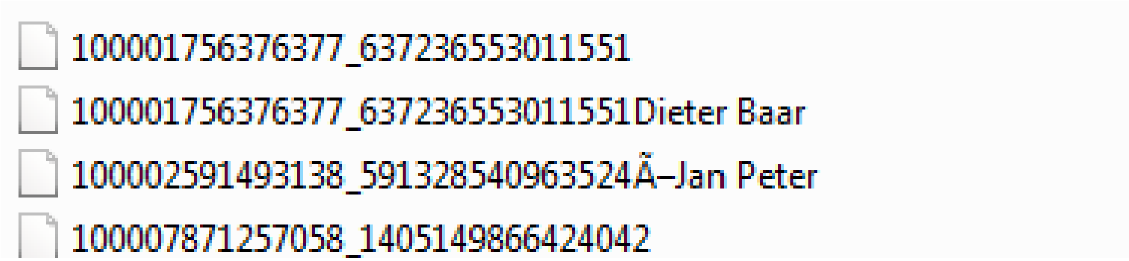
Data Analysis: Apps

- Name
- Date
- Screenshots
- User related information

Data Analysis: Apps



Name	Date modified	Type
FB	24-09-2014 16:02	File folder
TW	24-09-2014 16:02	File folder
Y2B	24-09-2014 16:02	File folder



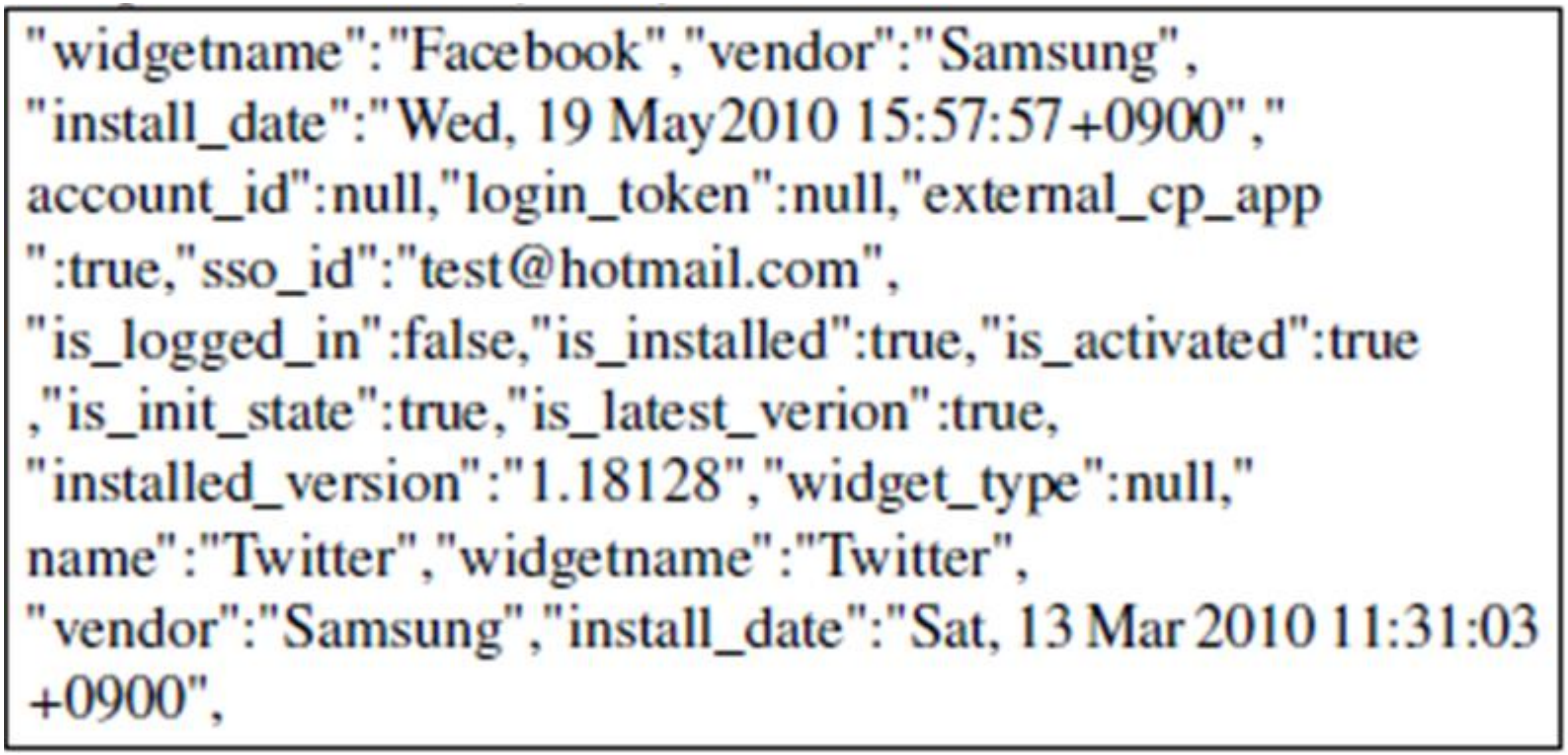
100001756376377_637236553011551

100001756376377_637236553011551Dieter Baar

100002591493138_591328540963524Ã–Jan Peter

100007871257058_1405149866424042

Data Analysis: Apps



```
"widgetname":"Facebook","vendor":"Samsung",
"install_date":"Wed, 19 May2010 15:57:57+0900","
account_id":null,"login_token":null,"external_cp_app
":true,"sso_id":"test@hotmail.com",
"is_logged_in":false,"is_installed":true,"is_activated":true
,"is_init_state":true,"is_latest_verion":true,
"installed_version":"1.18128","widget_type":null,"
name":"Twitter","widgetname":"Twitter",
"vendor":"Samsung","install_date":"Sat, 13 Mar 2010 11:31:03
+0900",
```

Data Analysis: Web Browsing

- Visited websites
- Web history
- Information about search machines
- Bookmarks
- Cookies
- etc.

Data Analysis: Web Browsing

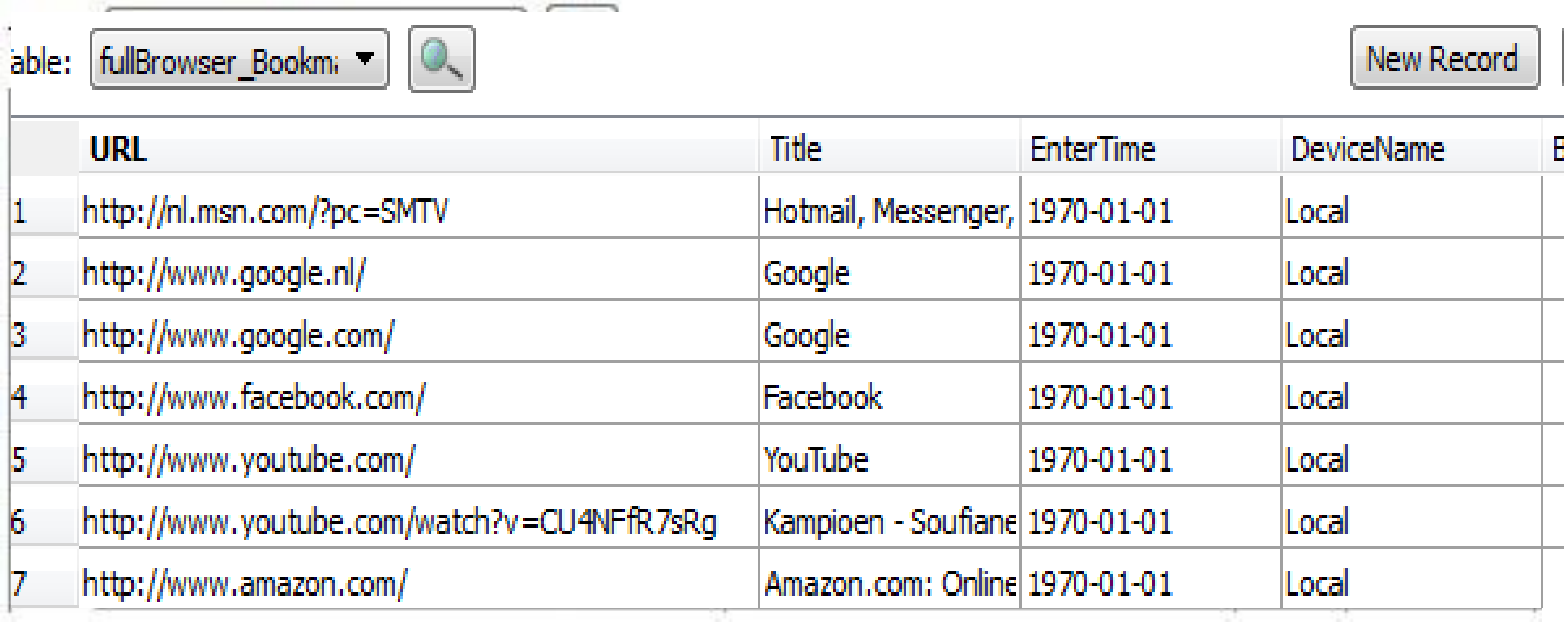
settings.db located in p24/webkit/WebBrowser.

- SQLite database
- Contains 14 tables

Relevant tables:

- FullBrowserHistory:
- fullBrowser_HiddenHistory:
- fullBrowser_Bookmark:
- fullBrowser_Search:

Data Analysis: Web Browsing



	URL	Title	EnterTime	DeviceName	E
1	http://nl.msn.com/?pc=SMTV	Hotmail, Messenger,	1970-01-01	Local	
2	http://www.google.nl/	Google	1970-01-01	Local	
3	http://www.google.com/	Google	1970-01-01	Local	
4	http://www.facebook.com/	Facebook	1970-01-01	Local	
5	http://www.youtube.com/	YouTube	1970-01-01	Local	
6	http://www.youtube.com/watch?v=CU4NFfR7sRg	Kampioen - Soufiane	1970-01-01	Local	
7	http://www.amazon.com/	Amazon.com: Online	1970-01-01	Local	

Data Analysis: Picture and Multimedia Files

- The file .CM.db located in p22
- SQLite database
- Contains 20 tables
- Information about audio, pictures and video files
- When files are opened, played etc.

Relevant tables:

- PhotoTable
- MusicTable
- VideoTable
- FileTable
- p22/RecentlyPlayed contains files with .mta extension.

Data Analysis: Picture and Multimedia Files

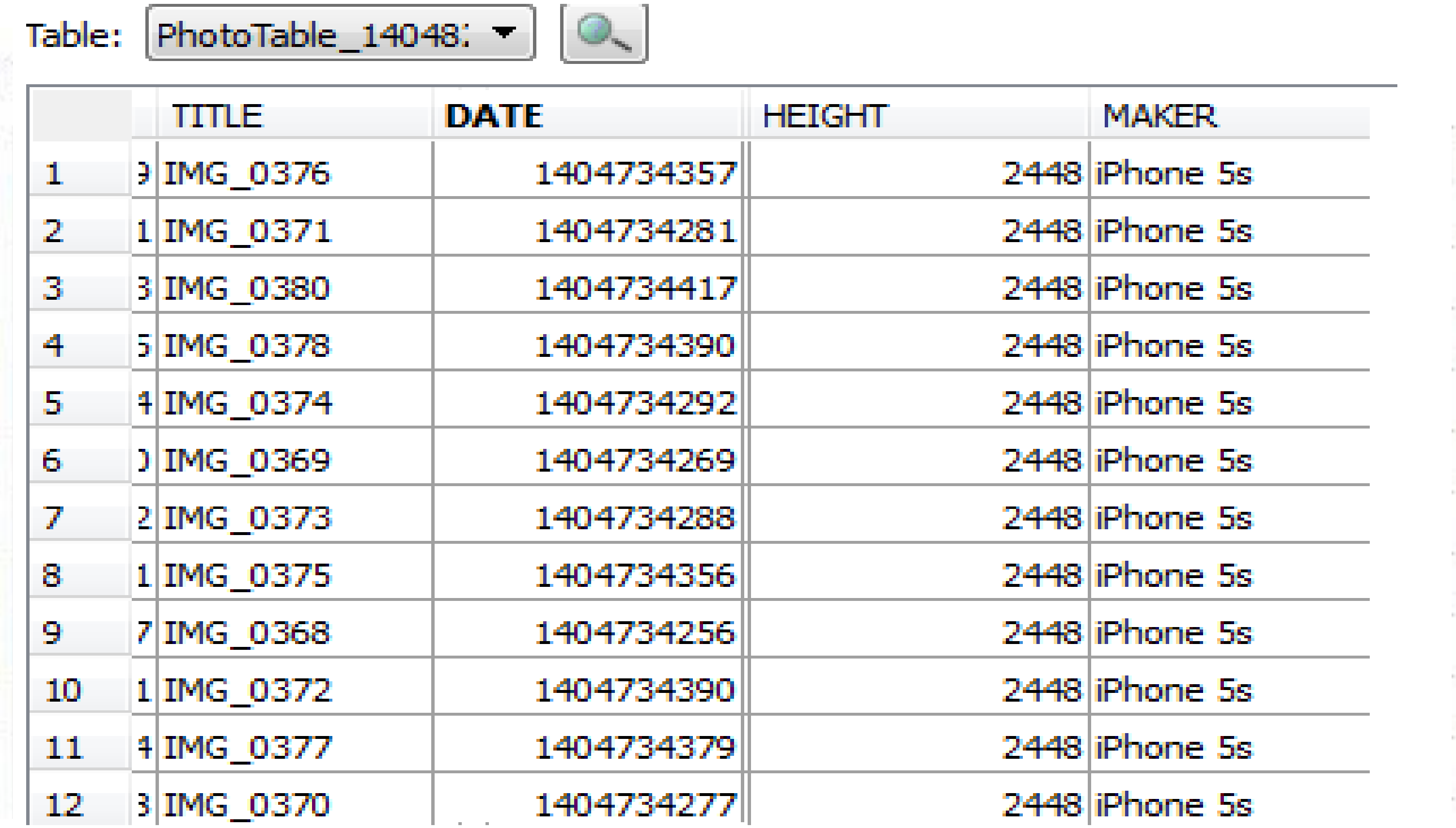


Table: PhotoTable_14048

		TITLE	DATE	HEIGHT	MAKER
1	9	IMG_0376	1404734357	2448	iPhone 5s
2	1	IMG_0371	1404734281	2448	iPhone 5s
3	3	IMG_0380	1404734417	2448	iPhone 5s
4	5	IMG_0378	1404734390	2448	iPhone 5s
5	4	IMG_0374	1404734292	2448	iPhone 5s
6	)	IMG_0369	1404734269	2448	iPhone 5s
7	2	IMG_0373	1404734288	2448	iPhone 5s
8	1	IMG_0375	1404734356	2448	iPhone 5s
9	7	IMG_0368	1404734256	2448	iPhone 5s
10	1	IMG_0372	1404734390	2448	iPhone 5s
11	4	IMG_0377	1404734379	2448	iPhone 5s
12	3	IMG_0370	1404734277	2448	iPhone 5s

Data Analysis: External Media Artifacts

- Device0013.db located in p22
- SQLite database
- Contains one table TABLE_DEVID
- Information about USB flash drives

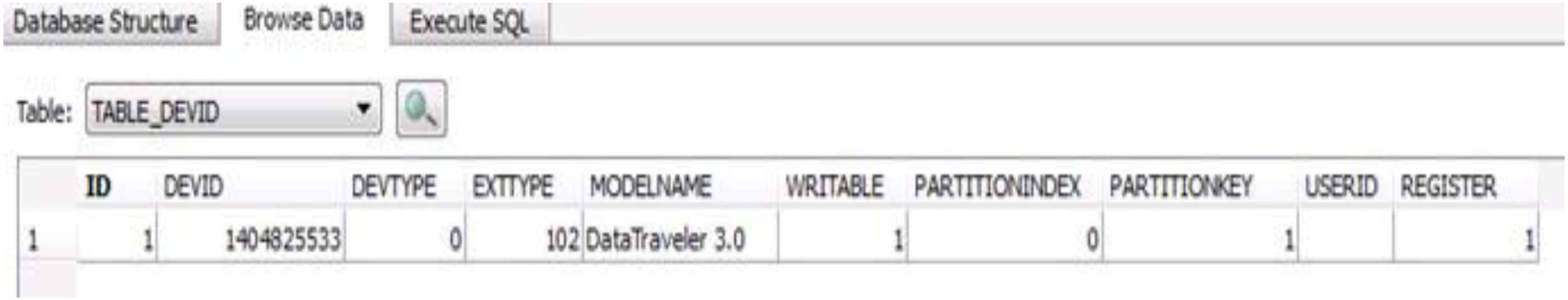


Table: TABLE_DEVID

	ID	DEVID	DEVTYPE	EXTTYPE	MODELNAME	WRITABLE	PARTITIONINDEX	PARTITIONKEY	USERID	REGISTER
1	1	1404825533	0	102	DataTraveler 3.0	1	0	1		1

Data Analysis: TV Channels

- p16/map-AirA, map-AirD, map-CableA, map-CableD, map-SateD
- p22/.EPG.db; SQLite database and contain Electronic Program Guide
- Due to time constraints not further investigated

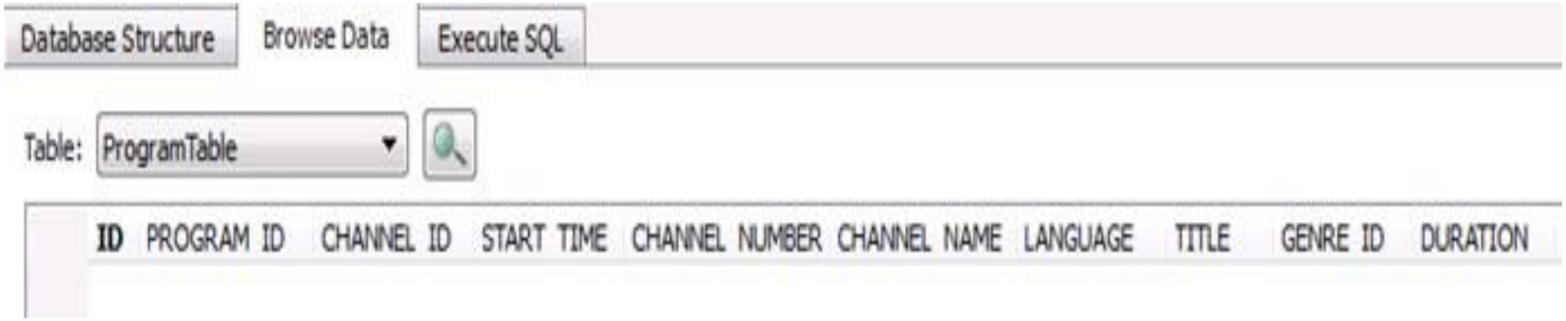


Table: ProgramTable

ID	PROGRAM ID	CHANNEL ID	START TIME	CHANNEL NUMBER	CHANNEL NAME	LANGUAGE	TITLE	GENRE ID	DURATION

Data Analysis : Cloud services

- URL
- Pictures
- Videos
- Username
- etc.,

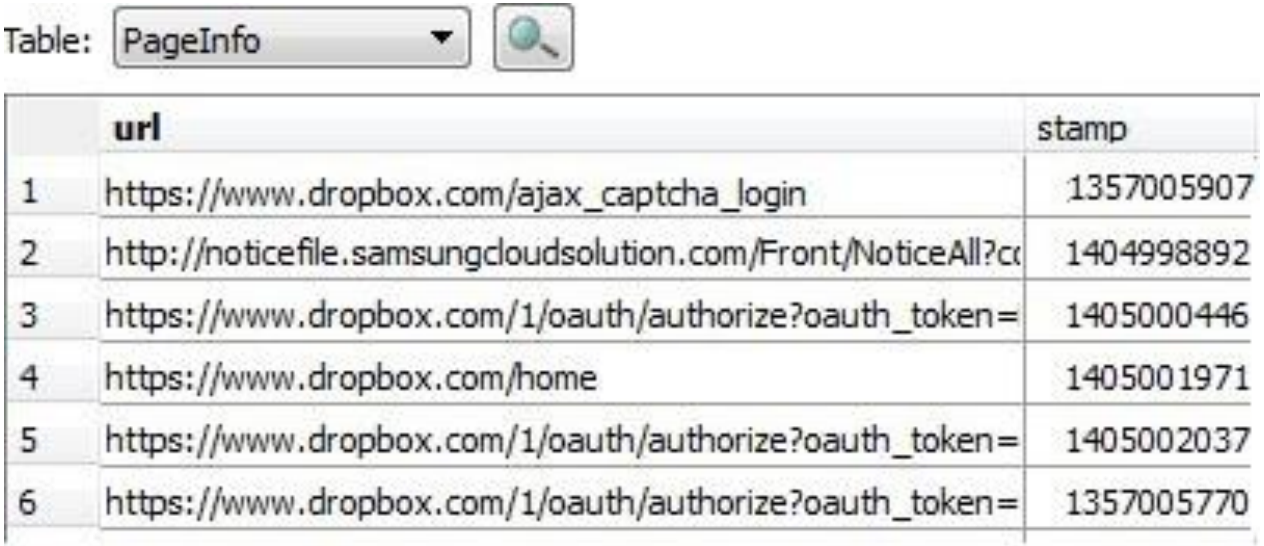


Table: PageInfo

	url	stamp
1	https://www.dropbox.com/ajax_captcha_login	1357005907
2	http://noticefile.samsungcloudsolution.com/Front/NoticeAll?cc	1404998892
3	https://www.dropbox.com/1/oauth/authorize?oauth_token=	1405000446
4	https://www.dropbox.com/home	1405001971
5	https://www.dropbox.com/1/oauth/authorize?oauth_token=	1405002037
6	https://www.dropbox.com/1/oauth/authorize?oauth_token=	1357005770

Conclusion

- A Smart TV is actually a computer and can be investigated with the same forensic toolset
- Acquiring data is possible
- A Smart TV can contain relevant data
- Relevant information is usually saved in SQLite databases
- Malicious users can abuse a Smart TV for viewing child pornography, communication, botnet, etc.

Future

- Further investigation of the five-wire method
- Investigate other makes and models Smart TV
- Extensive data analysis research
- Develop an app for acquiring data
- Make memory dump
- Analyse network activity

Questions