Hochschule Albstadt-Sigmaringen
Albstadt-Sigmaringen University

Faculty of Computer Science

1st ITG Workshop on IT Security (ITSec)

Influence of HTTP Header Entries on the Forensic Analysis of Web Browser Artifacts

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Outline

- Albstadt-Sigmaringen University
- Digital Forensics Investigation
- HTTP Header Entries
- Forensic Examination of Web Browser
- Influence on Web Browser Artefacts
- Conclusions and future work

Albstadt-Sigmaringen University

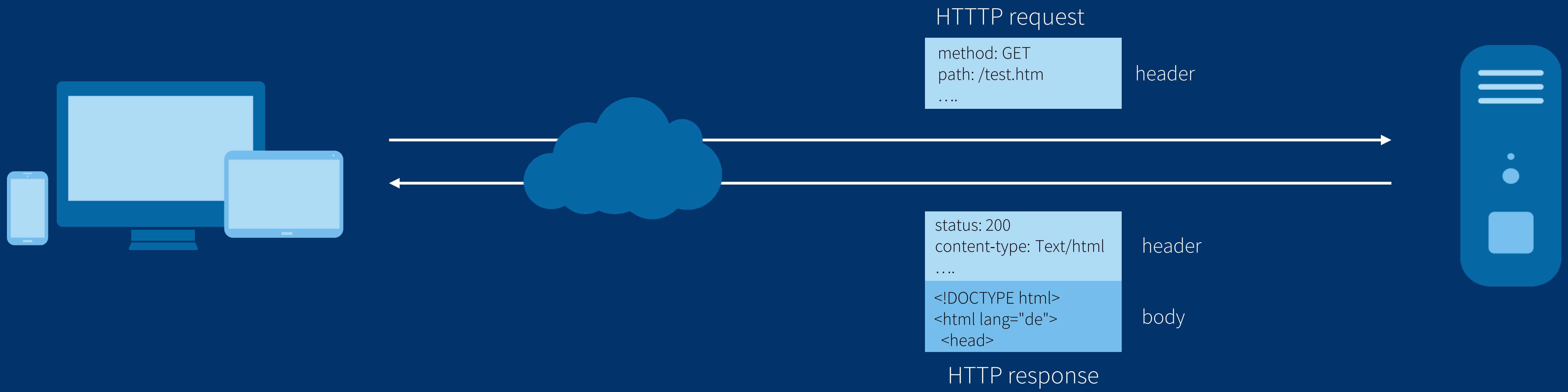
- 2009 to 2012: Software engineer in the field of web development
- Since 2012: Research assistant at the Albstadt-Sigmaringen University
  - Research project SEKT (IT Security & Smart Textiles)
  - Current & former teaching modules (selection):
    - Grundlagen der digitalen Forensik Masterstudiengang IT GRC Management
    - Digitale Forensik Bachelorstudiengang IT Security
    - Internet Grundlagen Masterstudiengang Digitale Forensik
    - Betriebssystemforensik Masterstudiengang Digitale Forensik
    - IT Security 2 Bachelorstudiengang IT Security
    - Informationssicherheit Bachelorstudiengang Wirtschaftsinformatik
    - Internettechnologien Hochschulzertifikatsprogramm
    - Cloud Technologies and Cloud Security Architectures Masterstudiengang IT GRC

Digital Forensics Investigation

- Digital forensics is a branch of forensic science encompassing the recovery and investigation of material found in digital devices, often in relation to computer crime.
- In contradistinction to IT security, the focus of digital forensics is not on the question "What could happen?", but on "What happened?“.
- The focus of a forensic investigation is on the reconstruction of a process and the discovery or processing of anomalies such as manipulated documents (e.g. plausibility or anomalies) or deleted files (e.g. file carving).
- Digital forensic investigations usually follow the standard digital forensic process or phases which are acquisition, analysis and reporting.

HTTP Header Entries

- HTTP header fields are components of the header section of messages in the Hypertext Transfer Protocol (HTTP) [RFC4229]
- HTTP header set by both the client and the server



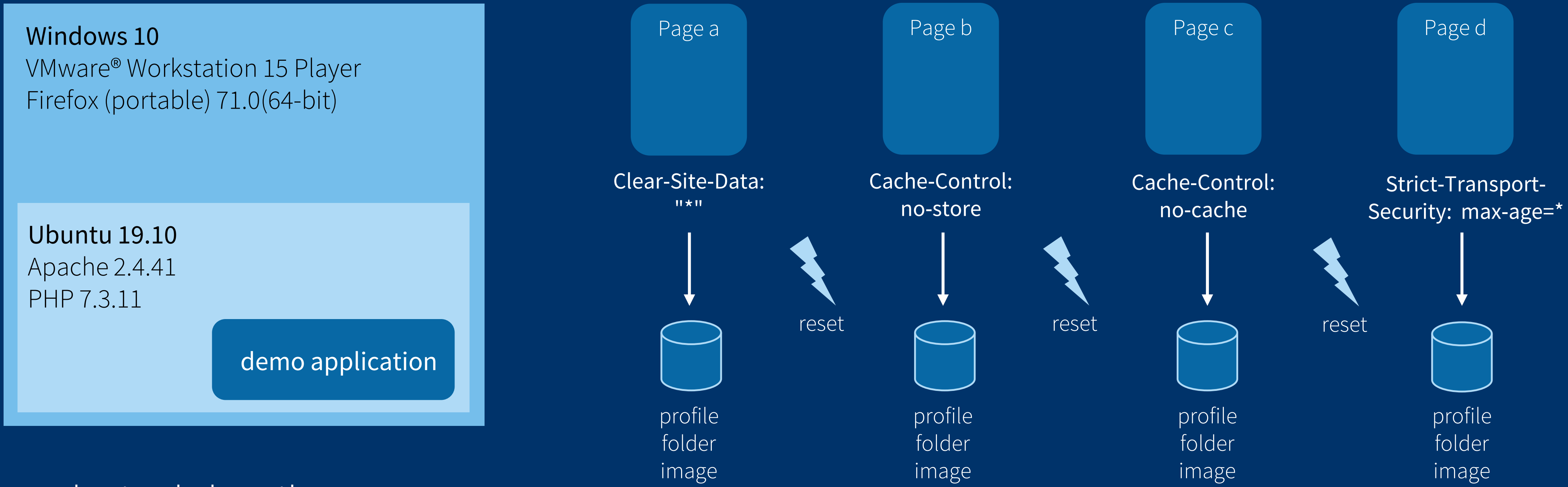
- Headers have been selected that change the behavior of the web browser when caching

Forensic Examination of Web Browser

- The forensic investigation of the web browser is of great importance, since many actions are carried out through it.
- There are certain measures to make investigations more difficult, such as “private browsing” mode or special configurations.
- However different web technologies can influence the generation of the traces. If these influences are not known, essential traces are overlooked or wrong conclusions are drawn.

- Research questions
  - *R1* Which header entry has influence on the storage of the data on the client?
  - *R2* Which header entry generates additional information outside the chronicle?

Influence on Web Browser Artifacts



Windows 10
VMware® Workstation 15 Player
Firefox (portable) 71.0(64-bit)

Ubuntu 19.10
Apache 2.4.41
PHP 7.3.11

demo application

- Technical details:
  - Host: Windows 10 (Version 1903) with VMware® Workstation 15 Player (Version 15.5.1)
  - VM: Ubuntu 19.10 with Apache (Version 2.4.41) and PHP (Version 7.3.11)
  - Firefox portable with hard drive cache and no start page

Influence on Web Browser Artifacts

Reference

- HTML, CSS, Favicon, WOFF2 Font

HTML	CSS	Image	External Font
saved	saved	saved	saved

Cache-Control [A]

- `Cache-Control: no-cache`

HTML	CSS	Image	External Font
saved	saved	saved	saved

Influence on Web Browser Artifacts

Cache-Control [B]

- `Cache-Control: no-store`

HTML	CSS	Image	External Font
not saved	saved	saved	saved

Clear-Site-Data

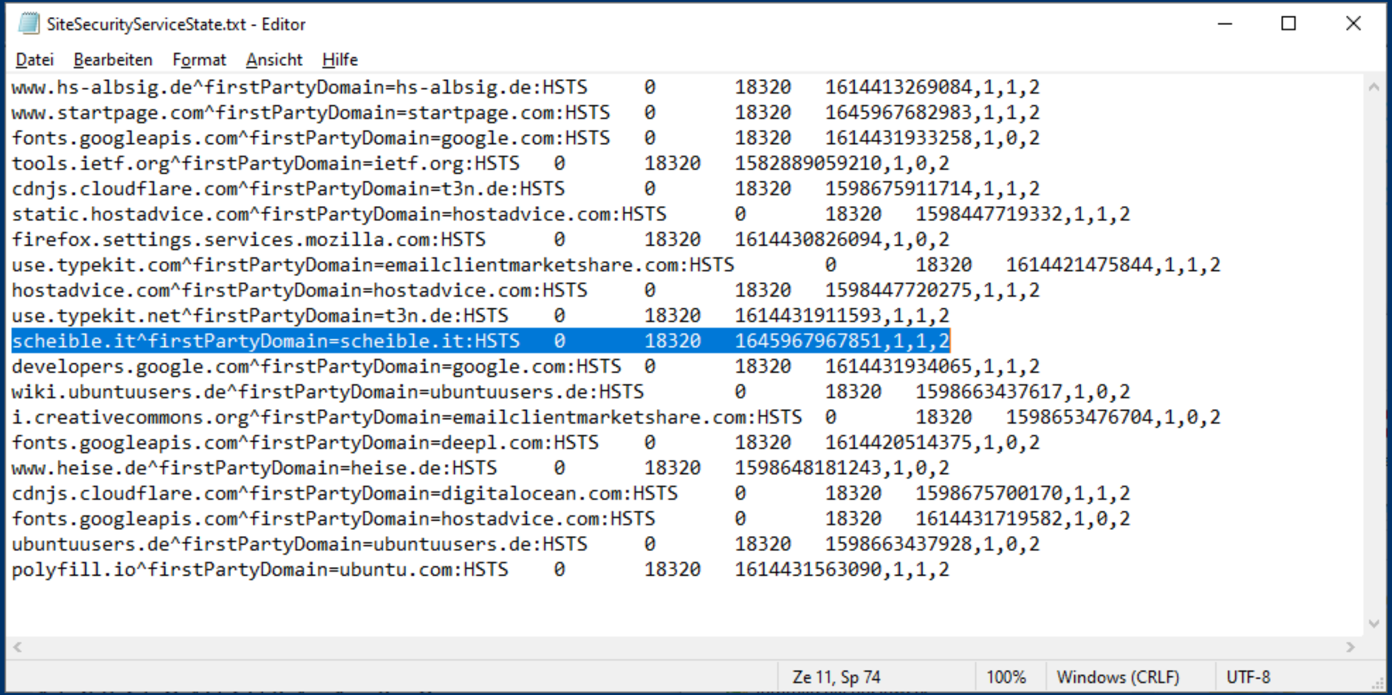
- `Clear-Site-Data: "*"`

HTML	CSS	Image	External Font
not saved	saved	saved	saved

Influence on Web Browser Artifacts

HTTP Strict-Transport-Security

- `Strict-Transport-Security: max-age=63072000`
- HSTS entries are not saved in the places.sqlite



```
www.hs-albsig.de^firstPartyDomain=hs-albsig.de:HSTS     0       18320   1614413269084,1,1,2
www.startpage.com^firstPartyDomain=startpage.com:HSTS   0       18320   1645967682983,1,1,2
fonts.googleapis.com^firstPartyDomain=google.com:HSTS   0       18320   1614431933258,1,0,2
tools.ietf.org^firstPartyDomain=ietf.org:HSTS   0       18320   1582889059210,1,0,2
cdnjs.cloudflare.com^firstPartyDomain=t3n.de:HSTS       0       18320   1598675911714,1,1,2
static.hostadvice.com^firstPartyDomain=hostadvice.com:HSTS      0       18320   1598447719332,1,1,2
firefox.settings.services.mozilla.com:HSTS      0       18320   1614430826094,1,0,2
use.typekit.com^firstPartyDomain=emailclientmarketshare.com:HSTS        0       18320   1614421475844,1,1,2
hostadvice.com^firstPartyDomain=hostadvice.com:HSTS     0       18320   1598447720275,1,1,2
use.typekit.net^firstPartyDomain=t3n.de:HSTS    0       18320   1614431911593,1,1,2
scheible.it^firstPartyDomain=scheible.it:HSTS   0       18320   1645967967851,1,1,2
developers.google.com^firstPartyDomain=google.com:HSTS  0       18320   1614431934065,1,1,2
wiki.ubuntuusers.de^firstPartyDomain=ubuntuusers.de:HSTS        0       18320   1598663437617,1,0,2
i.creativecommons.org^firstPartyDomain=emailclientmarketshare.com:HSTS  0       18320   1598653476704,1,0,2
fonts.googleapis.com^firstPartyDomain=deepl.com:HSTS    0       18320   1614420514375,1,0,2
www.heise.de^firstPartyDomain=heise.de:HSTS     0       18320   1598648181243,1,0,2
cdnjs.cloudflare.com^firstPartyDomain=digitalocean.com:HSTS     0       18320   1598675700170,1,1,2
fonts.googleapis.com^firstPartyDomain=hostadvice.com:HSTS       0       18320   1614431719582,1,0,2
ubuntuusers.de^firstPartyDomain=ubuntuusers.de:HSTS     0       18320   1598663437928,1,0,2
polyfill.io^firstPartyDomain=ubuntu.com:HSTS    0       18320   1614431563090,1,1,2
```

Conclusions and future work

Conclusions

- HTTP header entries can influence the expected traces
- New relevant traces are created by HTTP header entries

Future work

- Examine more web technologies with regard to their impact on forensic investigation
  - Comprehensive demo application
    - Can be used for teaching
    - Or for the evaluation of tools

Questions or suggestions?

Thank you very much for your attention!

- Live demonstration:
  https://lab.scheible.it/web-forensics/httpheaders/

- Presentation:
  https://scheible.it/itg-itsec_httpheaders