e-Assessment and BYOD: Threat Model and Comparison to paper-based Examinations

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Our Project: FLEX

FLEX (Framework for FLExible Electronic EXaminations)

Electronic Examinations on Students' Devices

Motivation

- e-Assessment is a rather new, but actively developing topic for German Institutions of Higher Education [1]

- **FLEX** aims to enable German IHEs to conduct e-Assessment on student owned Devices (→ BYOD)

- However, BYOD introduces (security) concerns as the devices are not fully controlled by the examining institution, including …
  - Equality of Treatment [2]
  - Student Identification / Authorship Attribution
  - Cheating Prevention

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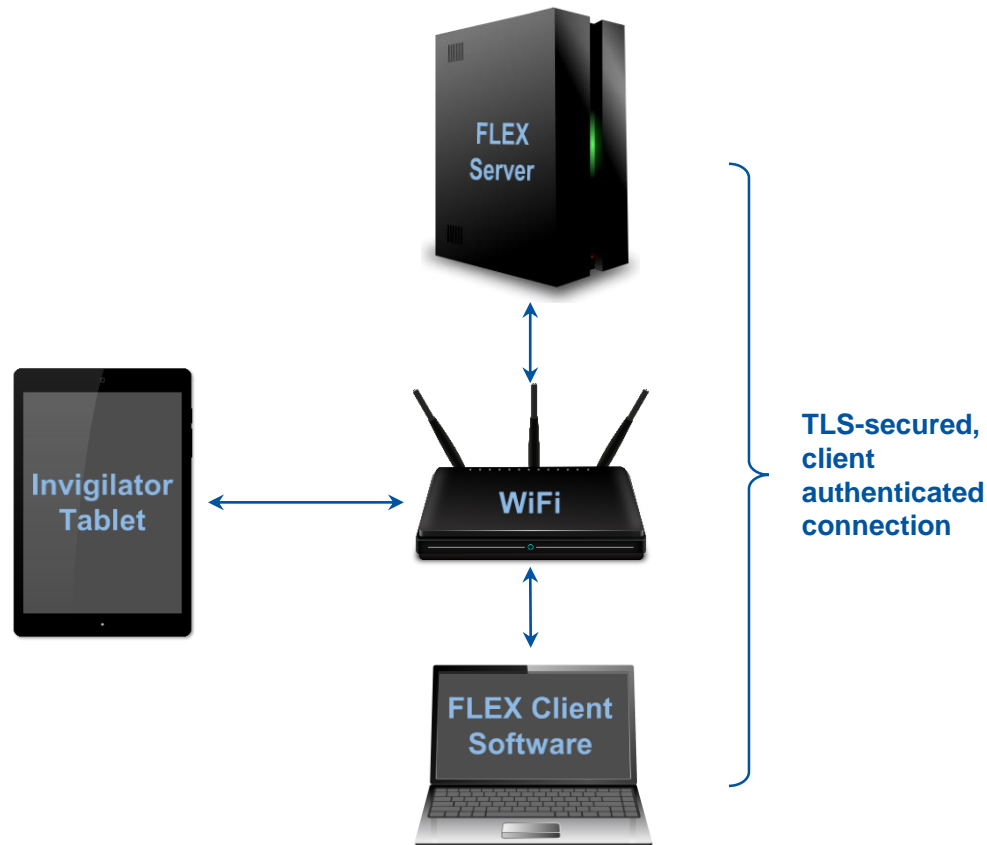 → A Threat Model has to be developed!

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Approach

- The **FLEX** client software monitors itself and its communication channels to detect cheating
  - The students' devices are *untrusted devices*
  - Lockdown does not work reliably in a BYOD setting [3]

- Students are identified using certificates and public key cryptography
  - The private part of the certificate can be used to verify authorship of results
  - The public part of the certificate has to be stored reliably [4]

- There are still invigilators in the room, therefore **FLEX** does not have to handle everything in software, but can inform an invigilator in the exam room
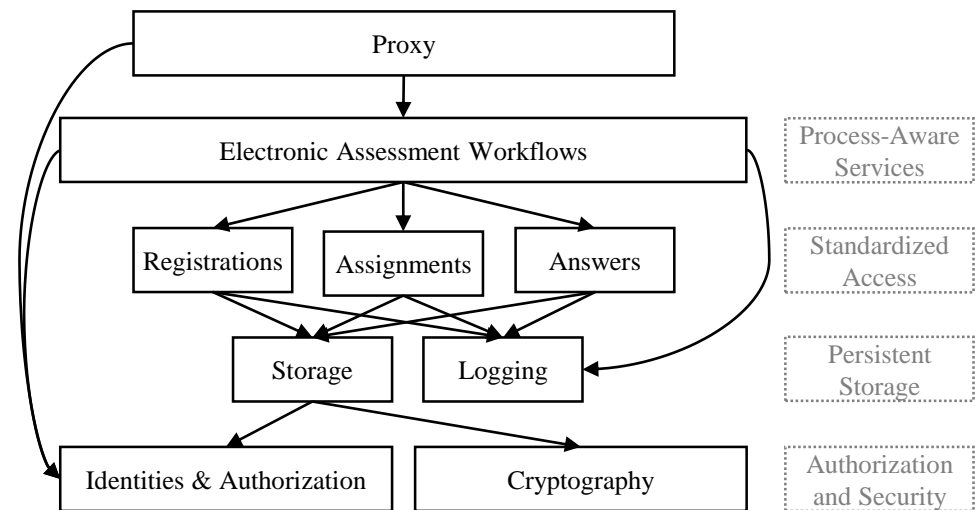
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Basic Architecture

FLEX Server

Invigilator Tablet

WiFi

FLEX Client Software

TLS-secured, client authenticated connection

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FLEX

- Client Software
  - The software is tested for unauthorized modifications by Remote Attestation [5]
  - It has to be ensured that the execution environment is not a virtual machine [6]

- Server Software
  - The server uses a micro services pattern [7] to reduce the dependencies between different modules of the server architecture

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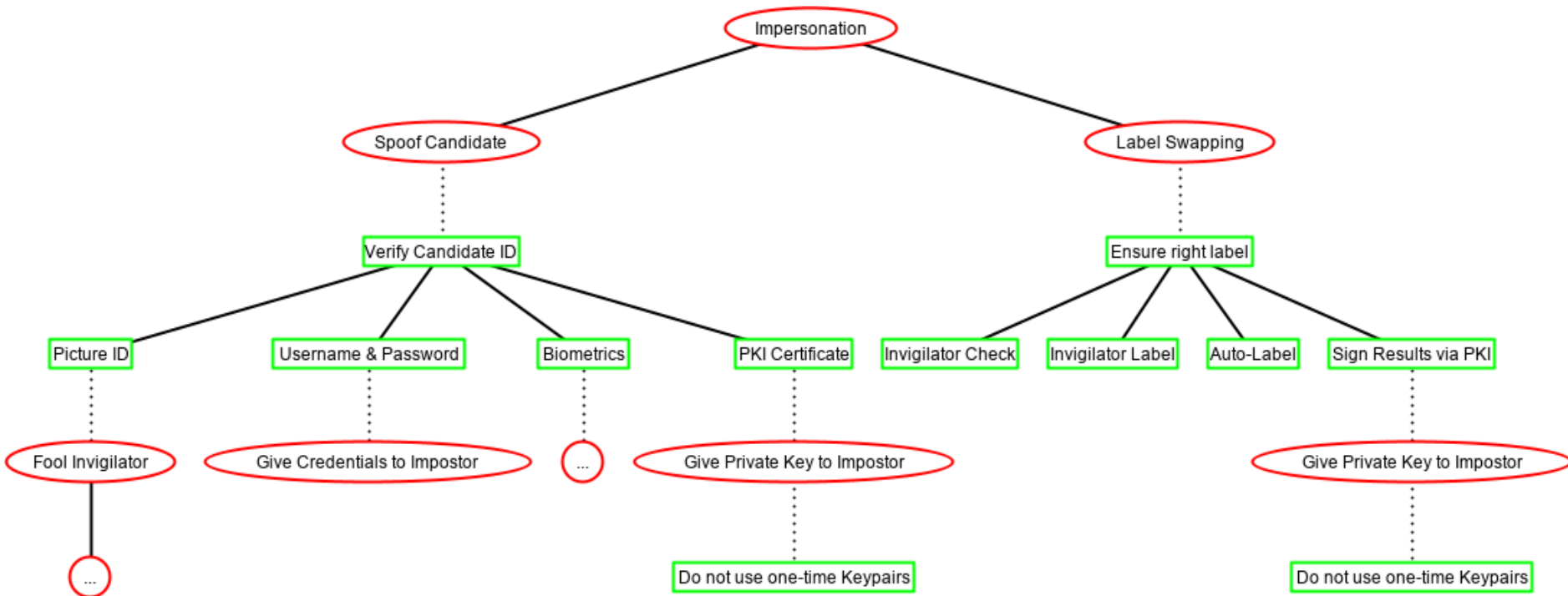# Electronic Examinations on Students' Devices

Threat Model

- Our Threat Model is based on previous work by Sindre and Vegendla [8]

- Identified Threats
  - **Impersonation**
  - **Assistance / Collaboration**
  - Plagiarism
  - **Using Aids not Allowed for the Exam**
  - Timing Violations
  - Lying to Proctors
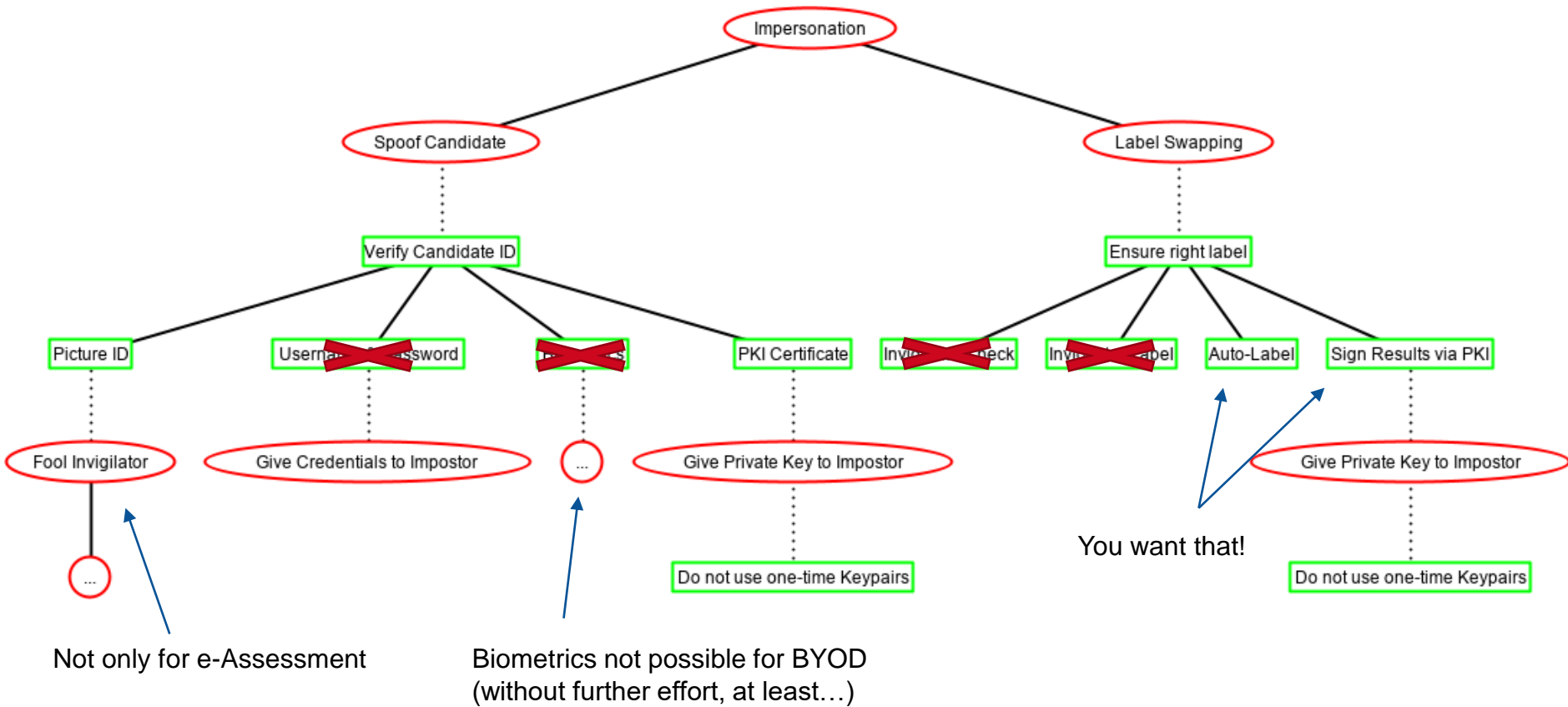 - Smuggling Out the Exam Questions

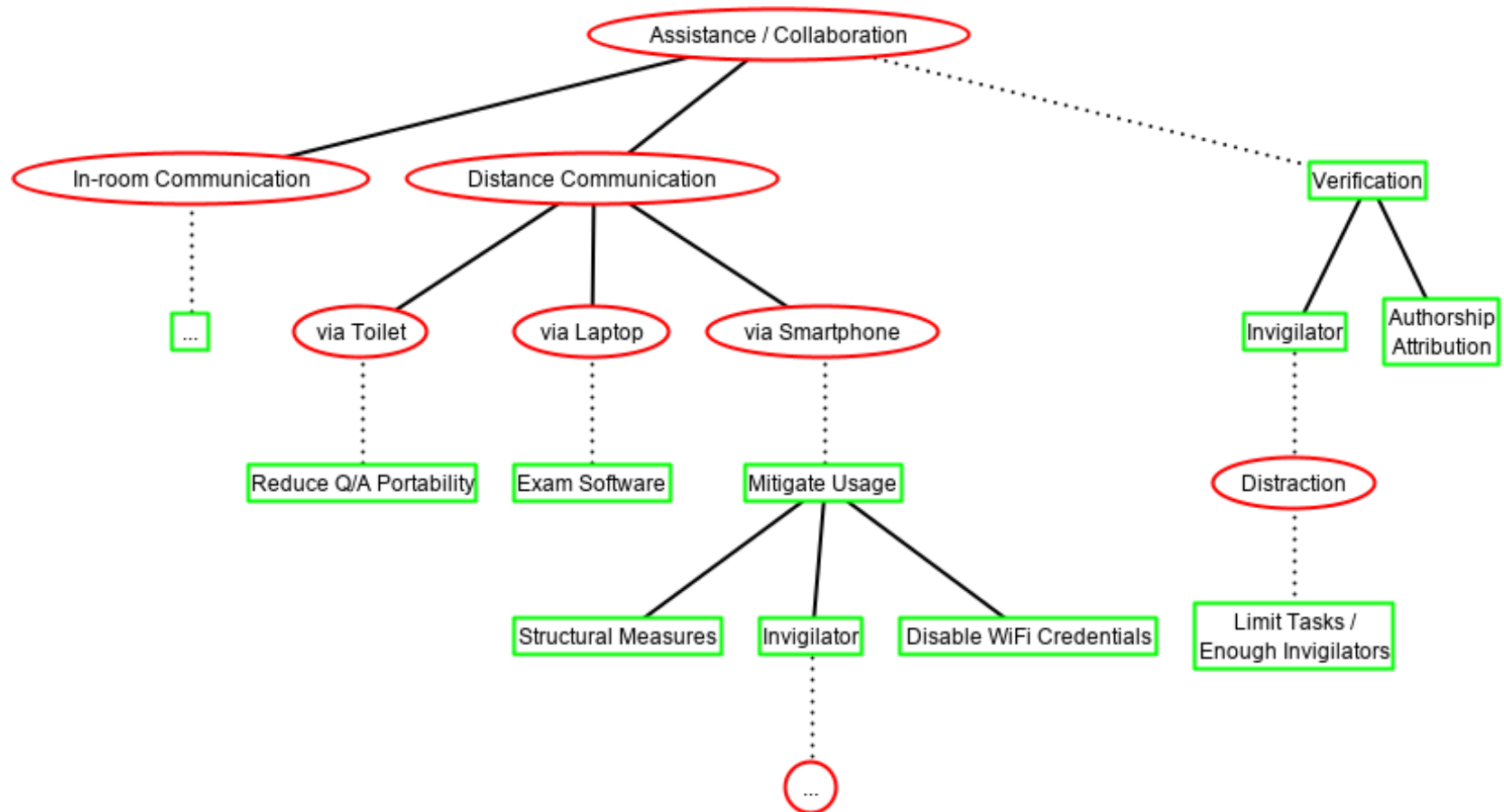# Electronic Examinations on Students' Devices

Threat Model - Impersonation

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RWTH AACHEN UNIVERSITY

Threat Model - Impersonation

Not only for e-Assessment

Biometrics not possible for BYOD
(without further effort, at least…)

You want that!

Threat Model - Assistance / Collaboration

Threat Model - Assistance / Collaboration

Not only for e-Assessment

Works well for special cases, e.g. Programming Assignments [9]

Not only for e-Assessment

Not only for e-Assessment

This is crucial!

That's additional effort, mostly…

That's easy, but not enough…
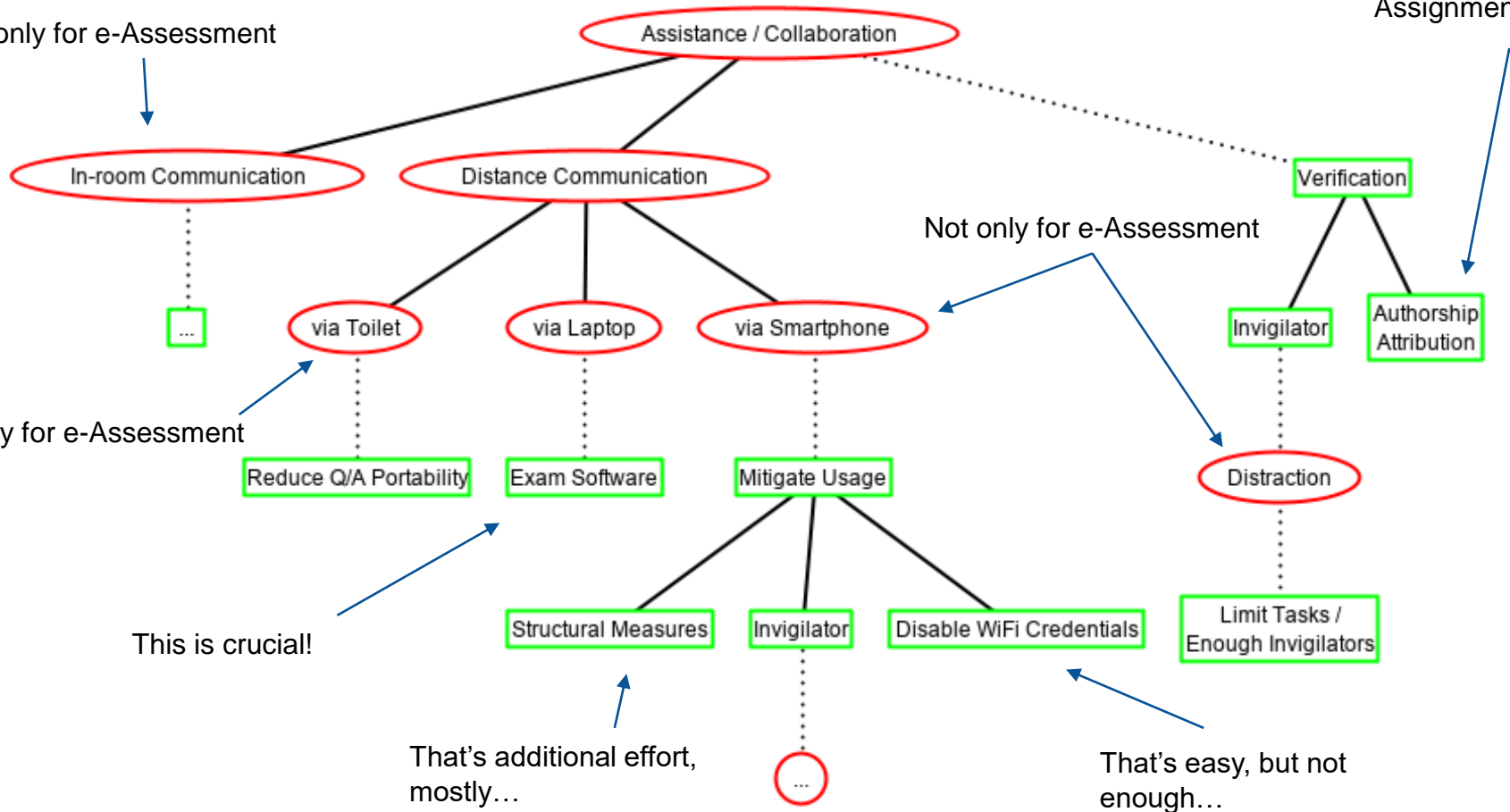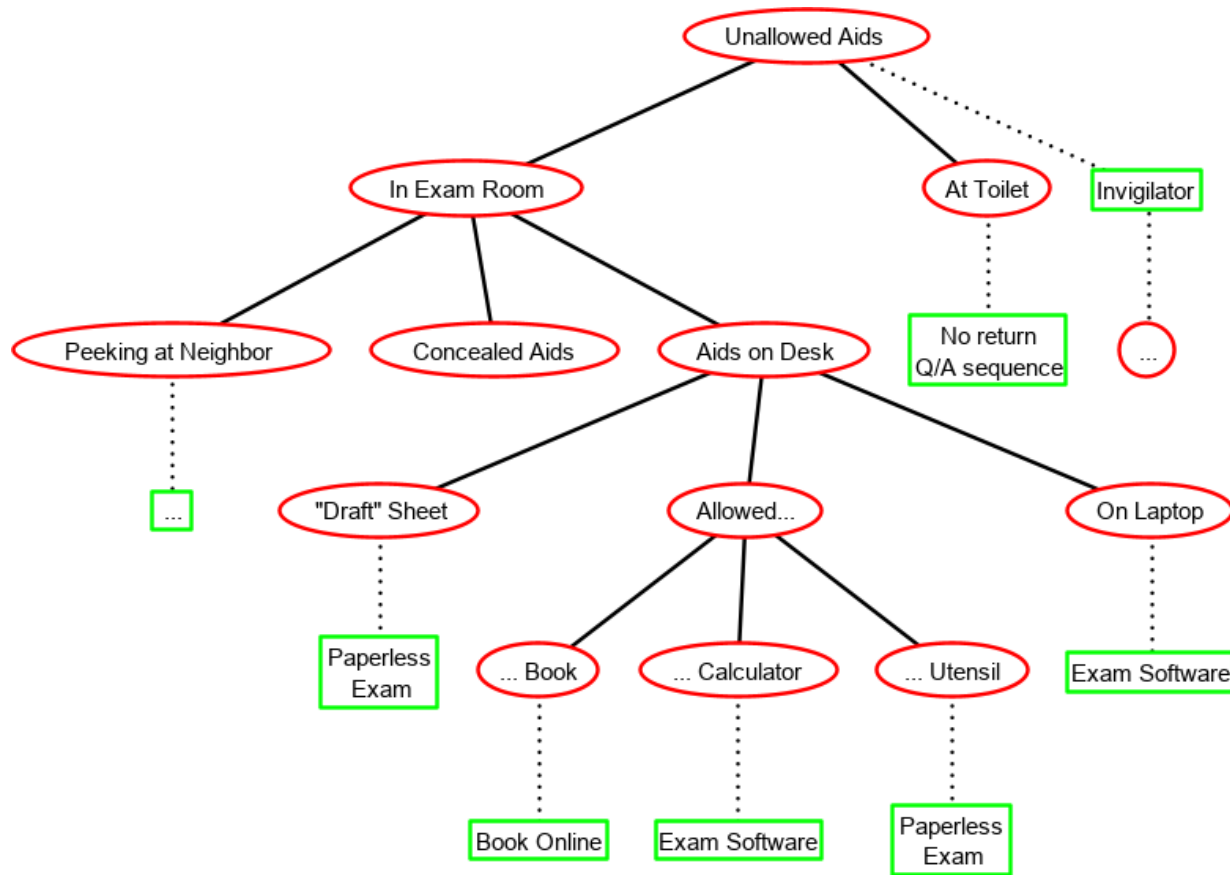
Threat Model - Using Aids not Allowed for the Exam

Threat Model - Using Aids not Allowed for the Exam

Not only for e-Assessment

e-Assessment makes
Things **better**!

This is crucial!
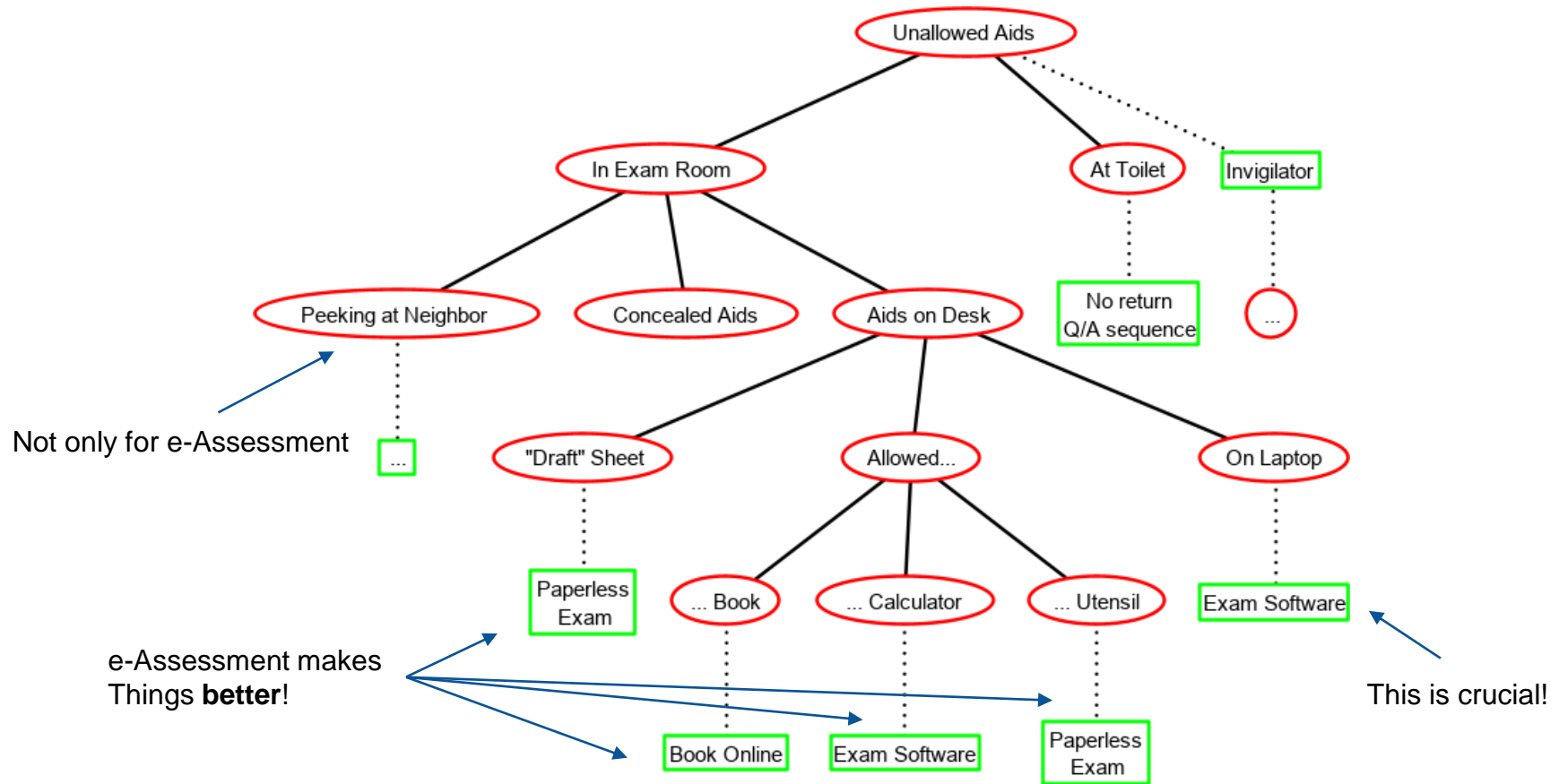
Threat Model - FLEX (1)

Threat Model - FLEX (2)

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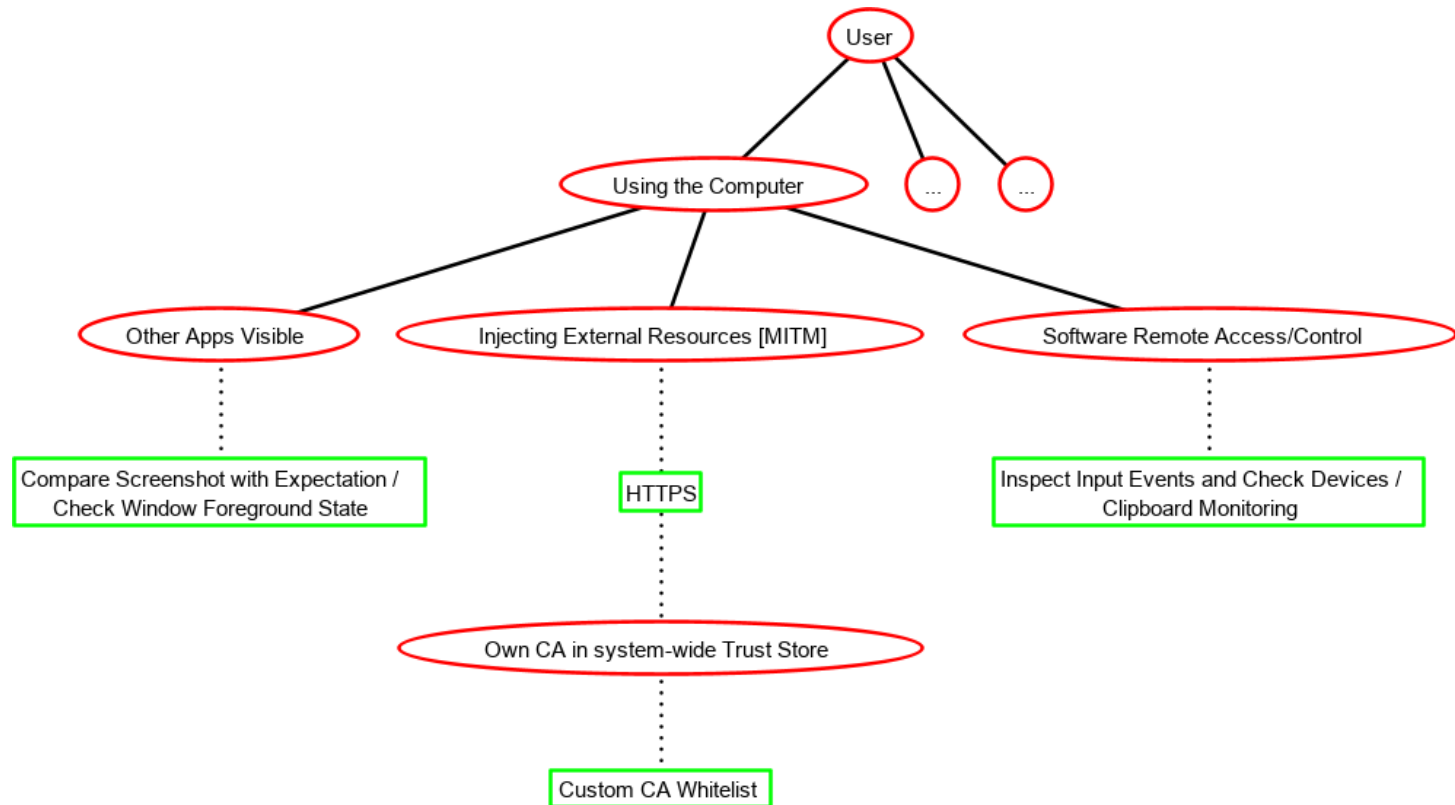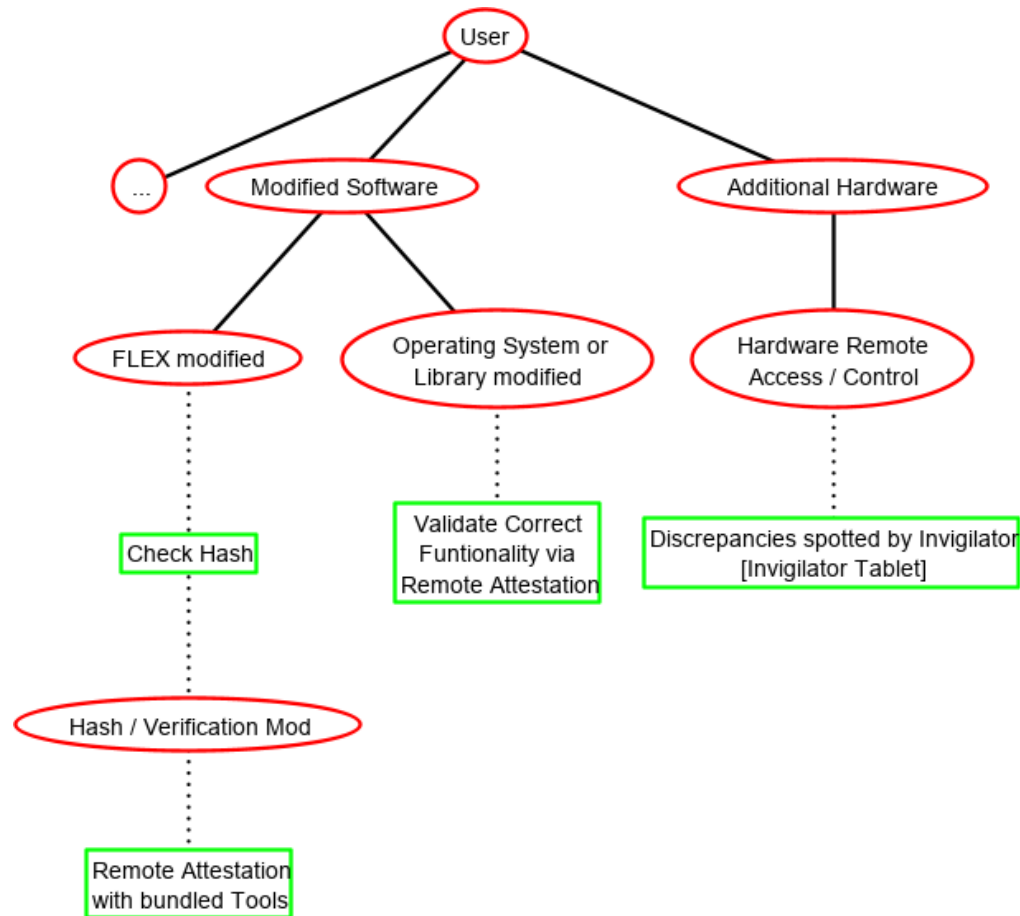
Summary / Outlook

- Utilizing the right countermeasures, the security of e-Assessment is not worse then for paper-based Examinations
  - For certain situations, e-Assessment can improve the security
  - For most situations, e-Assessment is capable of providing the same level of security as paper-based Examinations
  - Working and reliable exam software is crucial

- The **FLEX** project aims to provide Institutes of Higher Education with a software framework that enables them to carry out e-Assessment reliably in a BYOD setting
  - Different challenges are tackled
    - Student Identification / Authorship Attribution
    - Cheating Prevention
    - Equality of Treatment [2]
  - **FLEX** is still in development, next steps will be alpha- and beta testing
  - It is planned to release a first version of **FLEX** around mid of 2019

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Thanks for your attention! ☺
Bedankt voor uw aandacht! ☺

Are there any questions or comments?

Sources

[1] Hochschulforum Digitalisierung: The Digital Turn: Hochschulbildung im digitalen Zeitalter (2016) https://hochschulforumdigitalisierung.de/sites/default/files/dateien/Abschlussbericht.pdf

[2] B. Küppers, R. Zameitat, U. Schroeder: e-Assessment: Ensuring Equality of Treatment in a BYOD-Setting, EUNIS 2018, Book of Proceedings (2018) http://www.eunis.org/eunis2018/papers/

[3] Søgaard, T. M.: Mitigation of Cheating Threats in Digital BYOD exams, Master's Thesis (2016) https://brage.bibsys.no/xmlui/handle/11250/2410735

[4] Küppers, B.; Politze, M.; Schroeder, U.: Reliable e-Assessment with git: practical considerations and implementation, EUNIS 2017, Book of Proceedings (2017) http://dx.doi.org/10.17879/21299722960

[5] Garay, J. A. and Huelsbergen, L.: Software Integrity Protection Using Timed Executable Agents, Proceedings of the 2006 ACM Symposium on Information, Computer and Communications Security, pp. 189-200 (2006)

[6] Hoffman, N.: VM Checking and Detecting (2014) http://securitykitten.github.io/vm-checking-and-detecting/

[7] Namiot, D.; Sneps-Sneppe, M.: On Micro-services Architecture, International Journal of Open Information Technologies (2014)

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Sources

[8] Sindre, G. & Vegendla, A. (2015) E-exams versus paper exams: A comparative analysis of cheating-related security threats and countermeasures; Norsk Informasjonssikkerhetskonferanse (NISK) 2015, ISSN: 1894-773

[9] J. Opgen-Rhein, B. Küppers, U. Schroeder: AN APPLICATION TO DISCOVER CHEATING IN DIGITAL EXAMS, Koli Calling '18, Proceedings of the 18th Koli Calling International Conference on Computing Education Research (Koli Calling '18), Article 20, 5 pages, DOI: 10.1145/3279720.3279740

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