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für Angewandte Wissenschaften

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Swiss Cyber Storm 2016 – Turbo Talk

Client TLS Testing

Detecting Obfuscated JavaScripts

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About the Information Security Research Group

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- Part of InIT at ZHAW
  - InIT: Institute of Applied Information Technology
  - ZHAW: Zurich University of Applied Sciences
- 3 professors/lecturers, 8-10 researchers
- Main activity: Applied research projects with industrial / academic partners
  - ≈20 large R&D projects during the past 10 years (mostly CTI and EU)
- One key research area: Automated security analysis and security testing

Client TLS Testing

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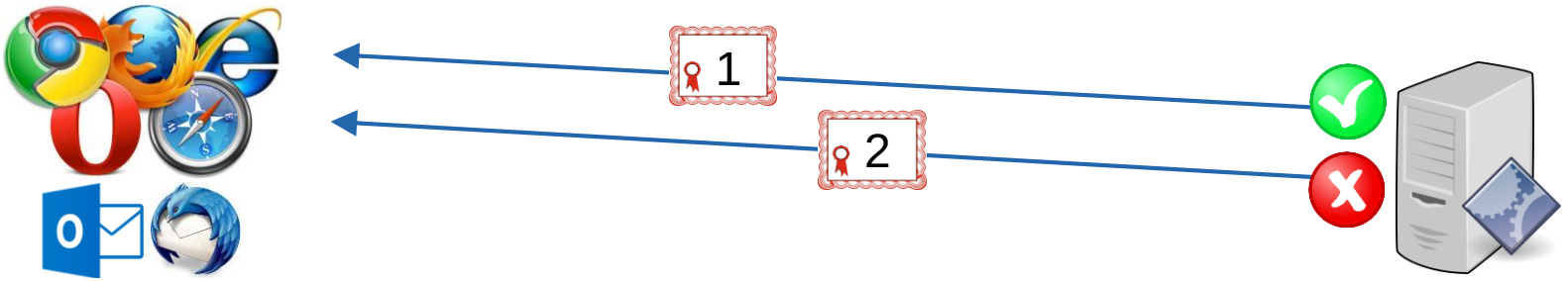
- Motivation
  - TLS is the most widely used secure communication protocol
  - Several services and tools to test the security of TLS servers
  - Only few tools to test the security of client-side TLS implementations and configurations
- Goal: Develop a powerful tool for client TLS testing
  - Current focus on testing the processing of server certificates
  - Very security-critical component as wrong handling of certificates may allow e.g. MITM attacks



Use any TLS client application to be tested

Testing tool runs as TLS server application

Client TLS Testing – Tool Usage in Practice

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```
rema:tcal marc$ python3 tcal.py www.tcal.test -c x509
Generating x509 test certificates...
100.0% of all test certificates generated
Waiting for test start
```

Now the client application to test can initiate repeatedly TLS sessions with the testing tool and during each TLS session, a certificate test case is carried out:

```
Running Test: WeakRsa512Key
Description: Valid certificate with a weak 512-bit rsa-key
Server ready, listening on port 1025 for TLS connection...
Connection established to remote client 127.0.0.1:64037
Test passed
```

Passed means the behavior is according to the RFC / no security problem

```
Running Test: MultipleCnInvalidFirst
Description: Subject contains multiple CN-entries.
Server ready, listening on port 1025 for TLS connection...
Connection established to remote client 127.0.0.1:53129
Test failed
```

Failed means not compliant with the RFC / potential security problem

- +120 certificate tests integrated, covering various aspects of certificates and certificate chains

Client TLS Testing – Web-based Service

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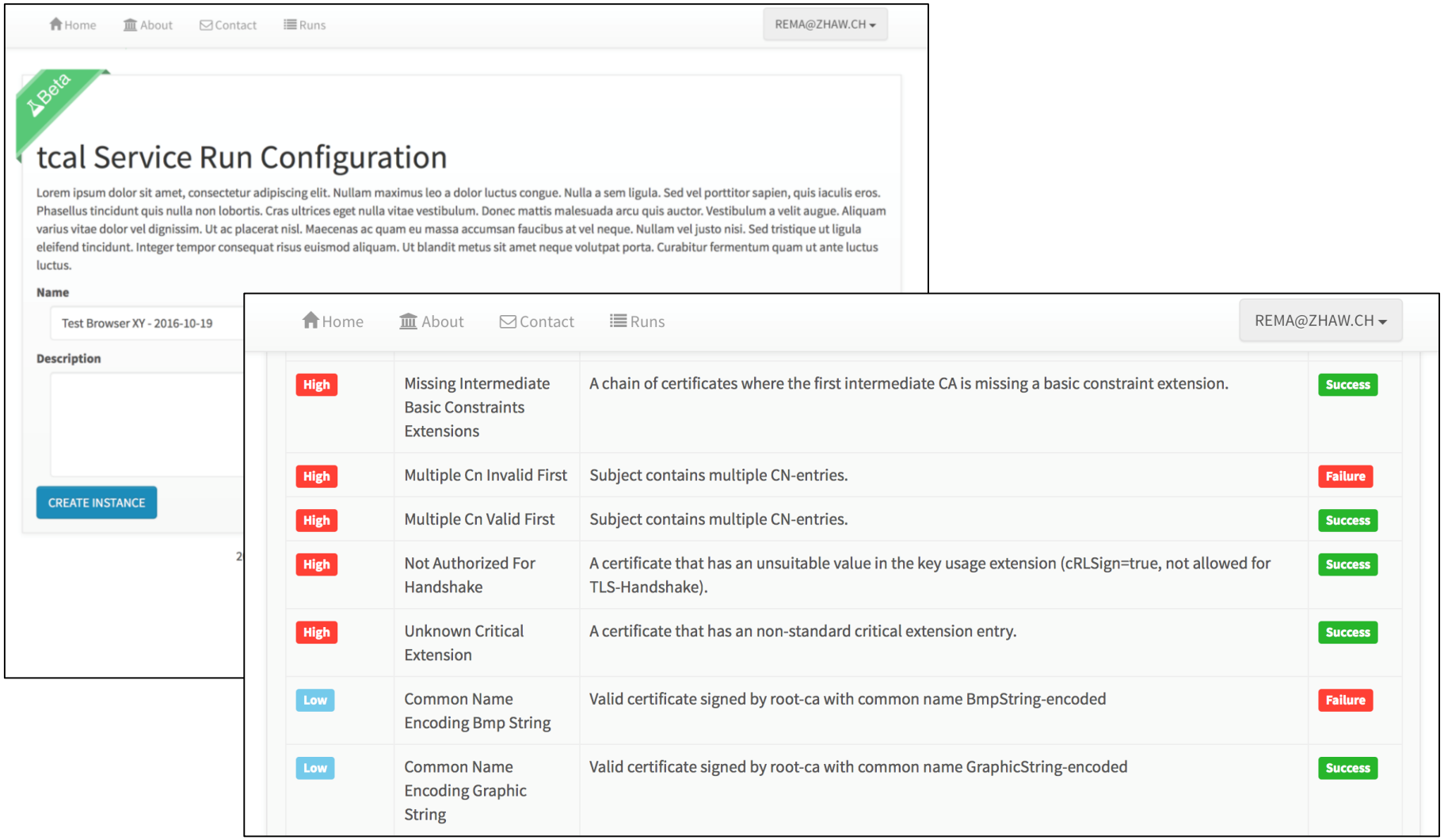

Client TLS Testing – Status and Outlook

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- Current status and next steps
  - Tool works well to efficiently test client-side TLS implementations
  - Systematically test all widespread browsers and TLS libraries with the goal to find security problems
- Future plans
  - Public release of the testing tool
    - Provide Web-based service / release tool as open source software
  - Extend with further tests, e.g. TLS protocol fuzzing
- Thanks to all people involved!
  - Stefan Berhardsgrütter, Lucas Graf, Damiano Esposito (InIT)
  - Tobias Ospelt (modzero)

Detecting Obfuscated JavaScripts

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- Motivation
  - JavaScript is often used as an attack vector to deliver malware
    - XSS vulnerabilities, Web-based malware distribution (drive-by),...
  - Detection using signature-based approaches are not ideal, easy to circumvent e.g. by obfuscating JavaScripts
  - Most malicious JavaScripts are obfuscated
  - Benign JavaScripts are usually not obfuscated
- If obfuscated JavaScripts can be reliably detected, this serves as a good first indicator whether a script is malicious / benign
- Goal of the project: Find a method to classify JavaScripts as obfuscated / non-obfuscated with high accuracy
  - Based on a machine learning approach

Detecting Obfuscated JavaScripts – Data Set

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- Having a large, representative data set with correctly labelled samples is key to machine learning

- Out data set consists of +100'000 JavaScripts
  - From different sources: top global websites, JavaScript libraries, MELANI (malicious samples)
  - Includes samples from more than 10 different obfuscators

- The data set was used to train different binary classifier
  - The trained classifier takes any JavaScript as input and classifies it as obfuscated / non-obfuscated

Detecting Obfuscated JavaScripts – Classification Performance

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		AP	BPM	BDT	DF	DJ	LDSVM	LR	NN	SVM
Non Obfuscated	p	80.46%	92.44%	99.06%	98.50%	97.93%	93.53%	78.31%	95.64%	81.65%
	r	66.31%	78.03%	98.97%	98.14%	98.10%	88.40%	68.28%	90.02%	66.82%
	F1	72.70%	84.63%	99.01%	98.32%	98.02%	90.89%	72.95%	92.74%	73.50%
	s	7752	7752	7752	7752	7752	7752	7752	7752	7752
Obfuscated	p	89.21%	92.61%	99.65%	99.37%	99.36%	96.14%	89.68%	96.68%	89.39%
	r	94.54%	97.73%	99.68%	99.49%	99.30%	97.92%	93.58%	98.61%	94.90%
	F1	91.80%	95.10%	99.67%	99.43%	99.33%	97.02%	91.59%	97.63%	92.07%
	s	22842	22842	22842	22842	22842	22842	22842	22842	22842

Fig. 1. Performance of the classifiers to classify non-obfuscated and obfuscated scripts, using all features.

- Boosted Decision Tree performed best to solve the problem
- Two important values to assess the performance of trained machine learning models are precision and recall
  - With BDT, we could achieve values of 99% or better
  - Less than 1 out of 100 JavaScripts is classified incorrectly

Detecting Obfuscated JavaScripts – Conclusions and Outlook

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- Key Findings
  - Machine learning works well to classify obfuscated / non-obfuscated JavaScripts
  - Machine Learning is no magic solution: correctly classifying a script that uses an obfuscator not present in the training set is much more difficult
  - Try it out: http://jsclassify.azurewebsites.net/

- Future work
  - Our classifier serves as a good indicator for malicious / benign JavaScripts, but the ultimate goal is to have a classifier that outputs malicious / benign
  - Main obstacle: Number of malicious samples in the data set is currently not representative enough (only about 2'700 samples)

- Publications
  - S. Aebersold, K. Kryszczuk, S. Paganoni, B. Tellenbach, T. Trowbridge. Detecting Obfuscated JavaScripts Using Machine Learning. ICIMP 2016
  - B. Tellenbach, S. Paganoni, M. Rennhard. Detecting Obfuscated JavaScripts from Known and Unknown Obfuscators using Machine Learning (under review)