

Introduction to IT Security for Data Scientists

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Agenda

- 01 - Welcome, mutual introduction and expectations
- 02 - Introduction to security
- 03 - Current Security Threats
- 04 - Basic Security
- 05 - How to react to a Security Incident
- 06 - How to protect your Assets
- 07 - Good IT security practices
- 08 - Roundup and Feedback

Schedule

Time	What
13:15 – 15:00	Lecture (1h 45min)
15:00 - 15:15	Break
15:15 - 17:00	Lecture (1h 45min)

→ Breaks if needed

01 - Welcome, mutual introduction and expectations

- About us
- Expectations
- About Switch
- What is a CERT

About us

Matthias Seitz

- BSc Computer Science
- Information Security Officer and Product Manager @Switch
- Longtime experience in IT Security

Darja-Anna Yurovsky

- MA Political Science & MSc Digital Forensics
- IT Security Engineer / Incident Response @Switch
- Longtime experience in IT security & Law Enforcement

What is your and our expectation for this Course?



About you

- Which field are you working in?
- Do you know any security processes in your company (e.g. vulnerability patching, incident response)?
- Do you already have some questions about Security?
- Expectations for this course?

About **Switch**

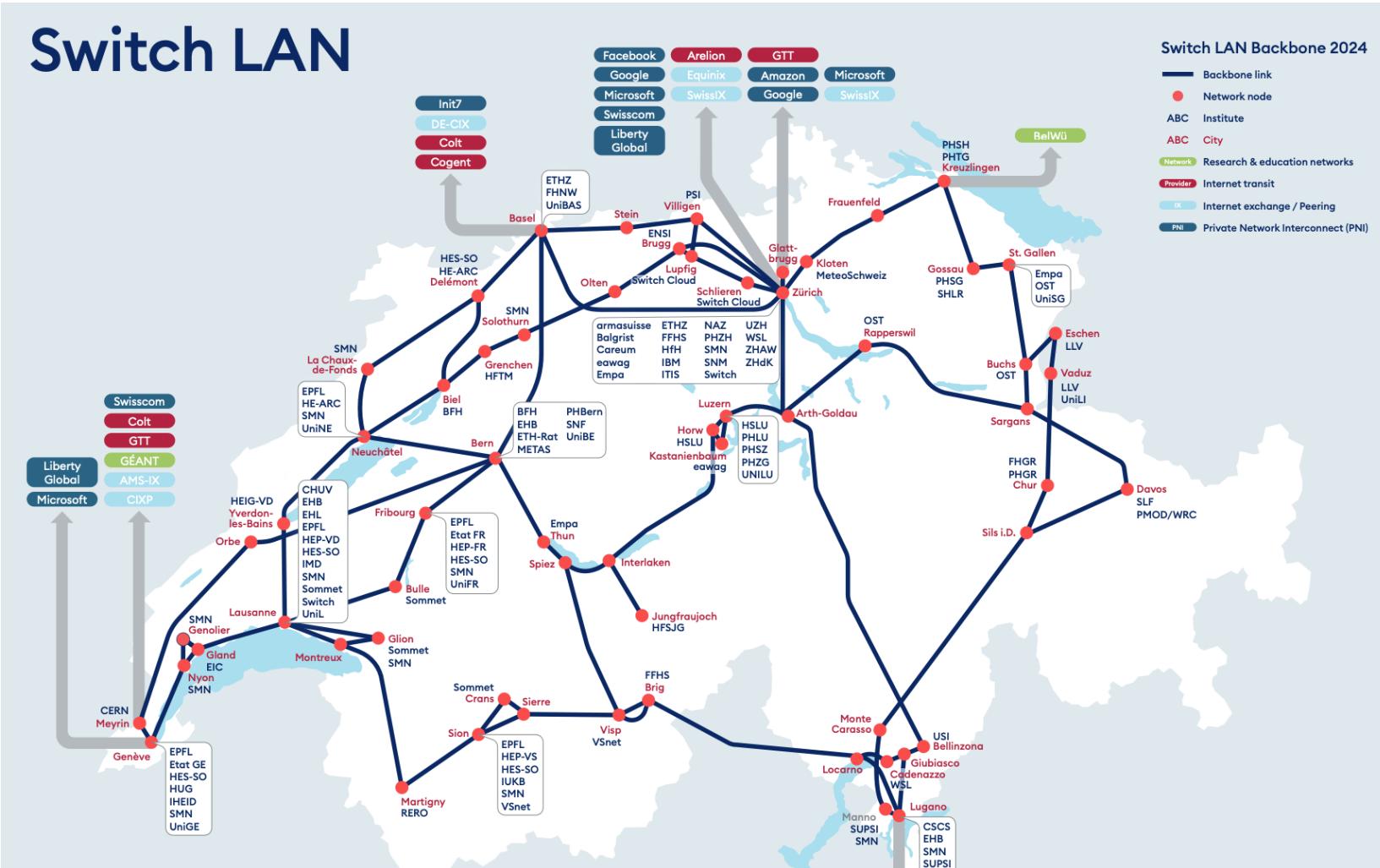
Switch is an integral part of the Swiss academic community.

Based on our core competencies

- Network
- Security
- Identity Management

Switch offers collaboratively developed ICT solutions that empower users in and beyond the academic world to achieve leading edge results in a globally competitive environment.

NREN- National Research and Education Network



CERT – Computer Emergency Response Team

alt. CSIRT (Computer Security Incident Response Team)

Security Incident

a security incident is an undesirable event that threatens operational safety and or disrupts operations

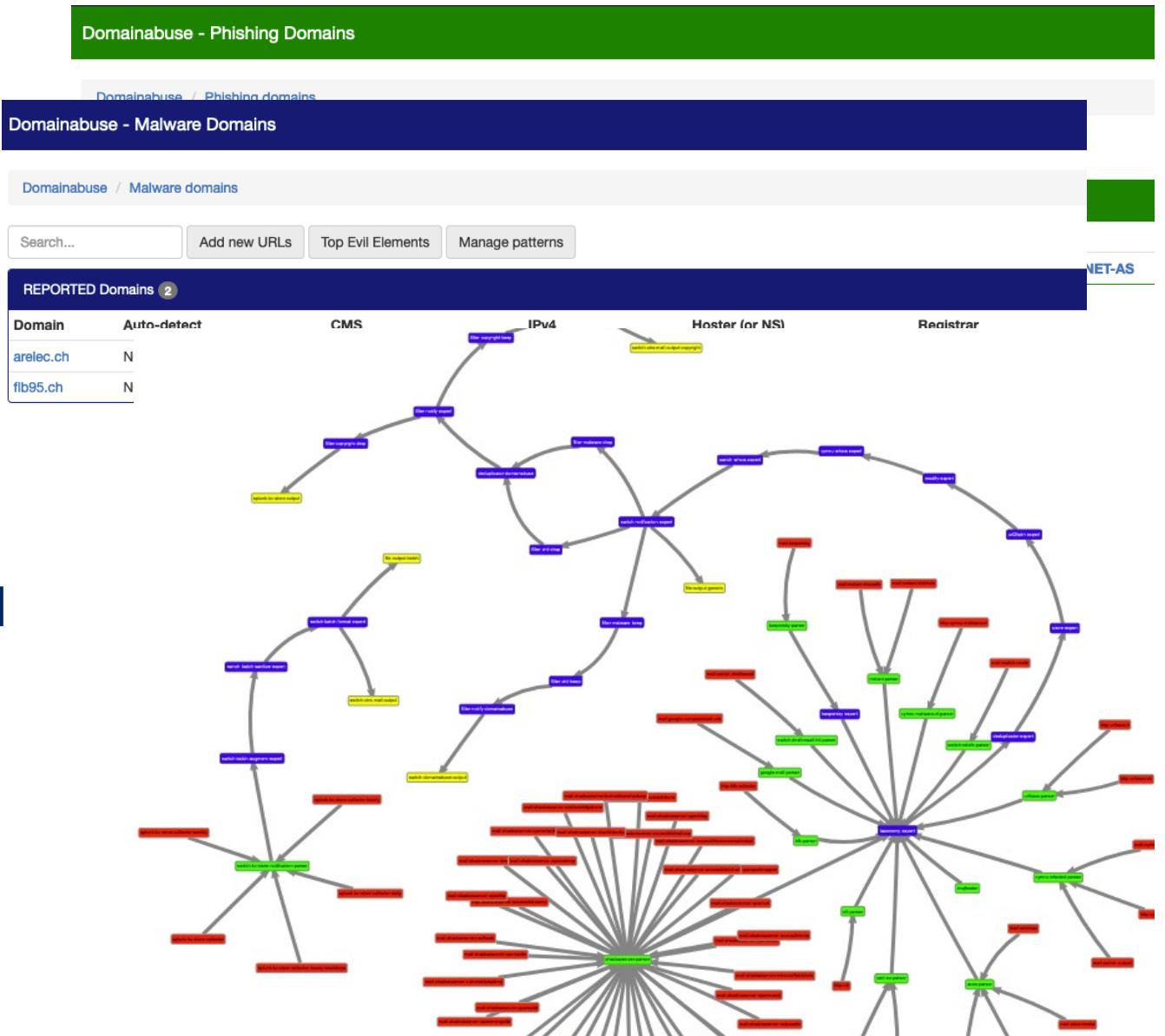
Incident Response

Reactive response to ensure that violations/incident are effectively addressed, contained and restored to normal operation.

The role of data

As part of the Registry
–phishing sites
–fake shops
–infected websites

As part of the CERT and NREN
–malware
–reports of vulnerable services
–reports of open services
–DDoS attacks



02 – Introduction to Security

–Security Facts and Figures

Security is about...

Risks & Threats



Economical Size

Processes & Concepts



Risk and security management process



Information Security

Did you know?



ENISA Threat Landscape 2024



Who are the attackers?

Internal User Error: Users making **mistakes** with configurations which may bring down **critical resources** such as **firewalls**, routers and servers causing wide-spread or departmental company outages.

Opportunistic: These attackers are usually **script kiddies** driven by the desire for **notoriety**

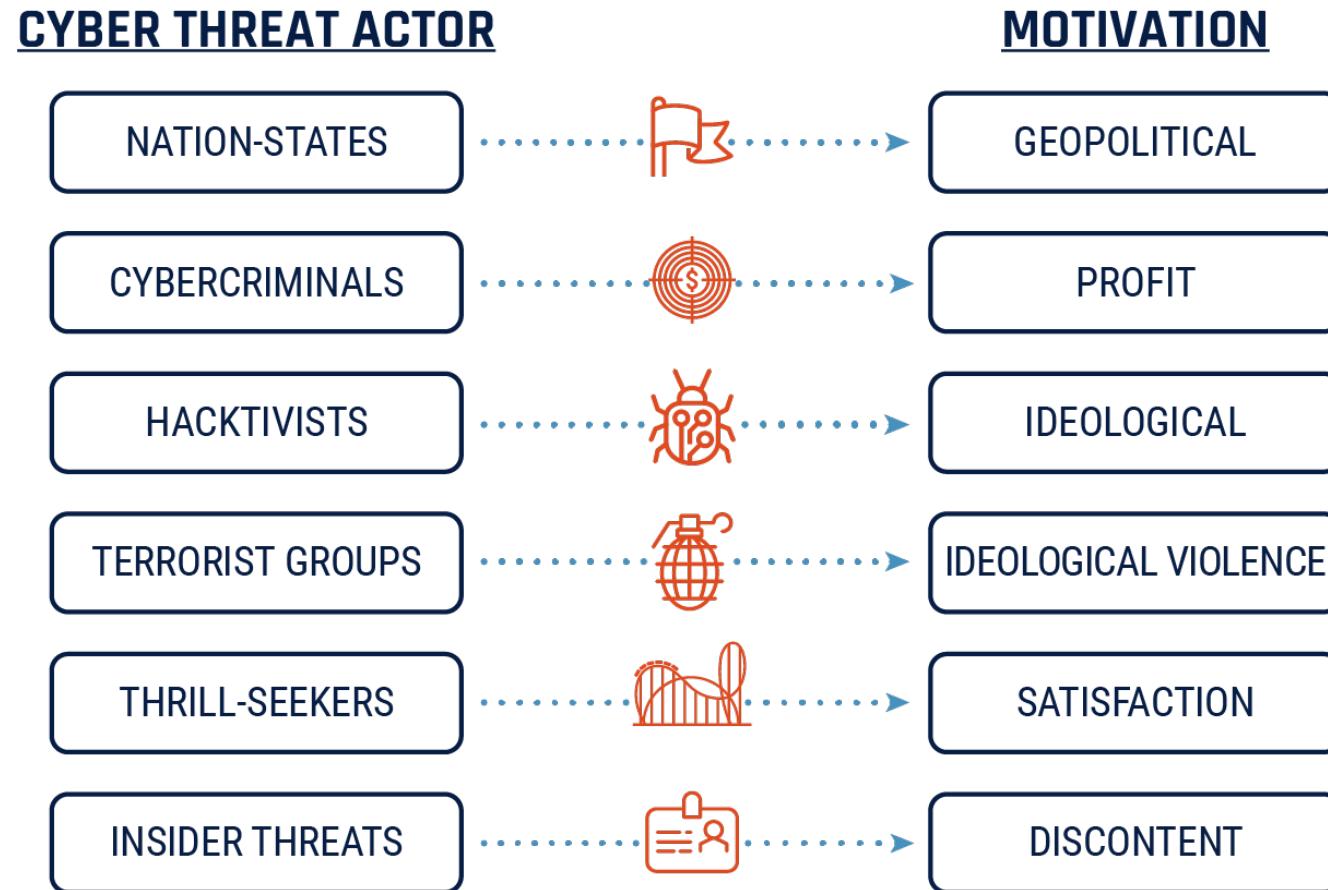
Insider Threat: Insider attackers are typically **disgruntled employees** or ex-employees looking for **revenge** or some type of financial gain.

Hacktivists: These attackers have a **political agenda** and create **high-profile attacks**

Organized Crime: Most often, these cybercriminals engage in **mass attacks** driven by **profits**. Typically looking for social security numbers, health records, credit cards, and banking information.

Government Sponsored: Well funded and often build **sophisticated, targeted attacks**. They are typically motivated by **political, economic, technical, and military agendas**.

Motivation for Threat Actors



How Attackers Work (Att&ck Matrix)

Reconnaissance

Resource Development

Initial Access

Execution

Persistence

Privilege Escalation

Defense Evasions

Credential Access

Discovery

Lateral Movement

Collection

Command and Control

Exfiltration

Impact

Discussion



- What could be the motivation from a malicious actors perspective regarding your company?
- How would they affect your business the most?

03 – Current Security Threats

- Phishing
- Social Engineering
- Malware
- Ransomware

Phishing

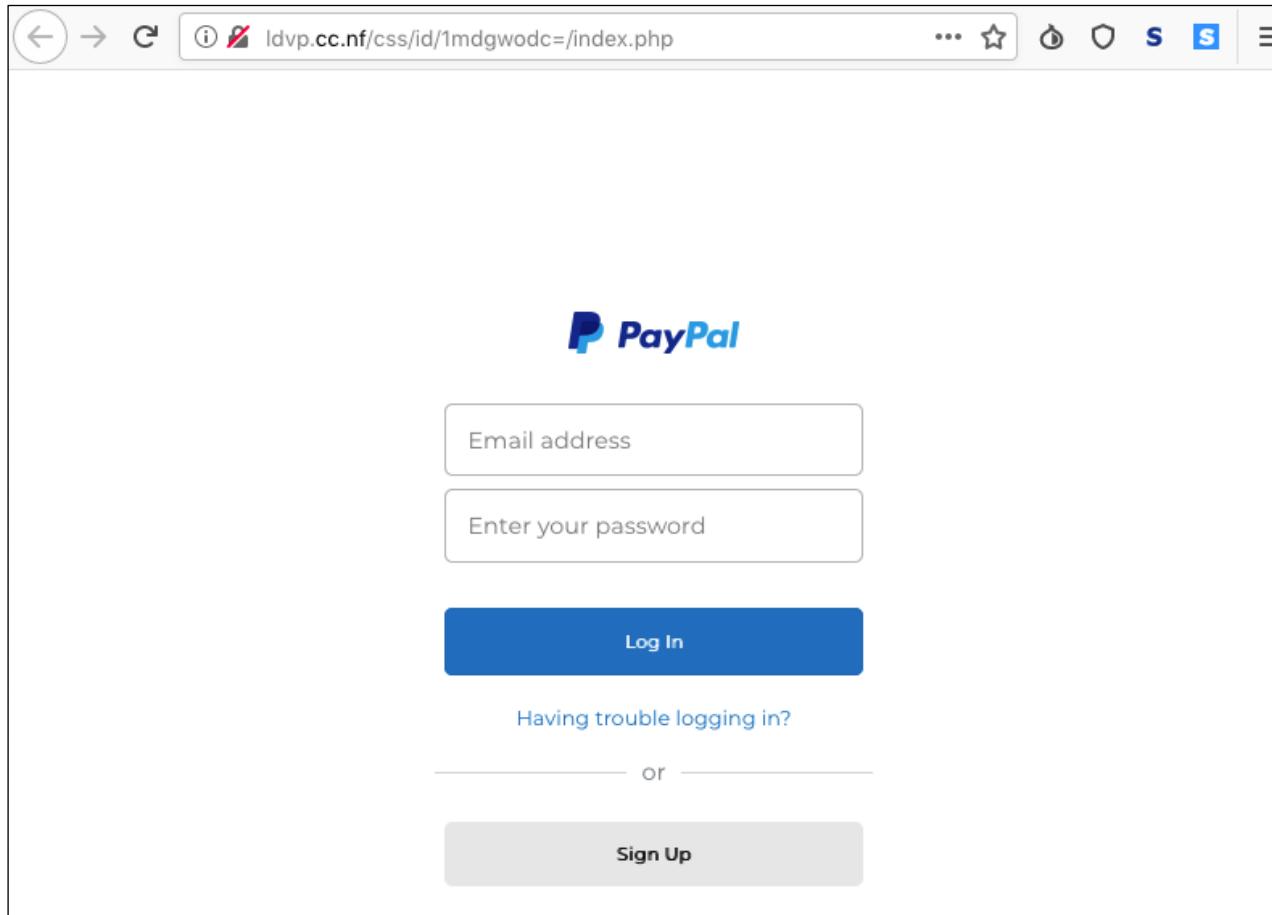


Phishing

“Phishing is a cybercrime in which a target or targets are contacted by email, telephone or text message by someone posing as a legitimate institution **to lure individuals into providing sensitive data such as personally identifiable information, banking and credit card details, and passwords.** The information is then used to access important accounts and can **result in identity theft and financial loss.**”

<http://www.phishing.org/what-is-phishing>

Phishing

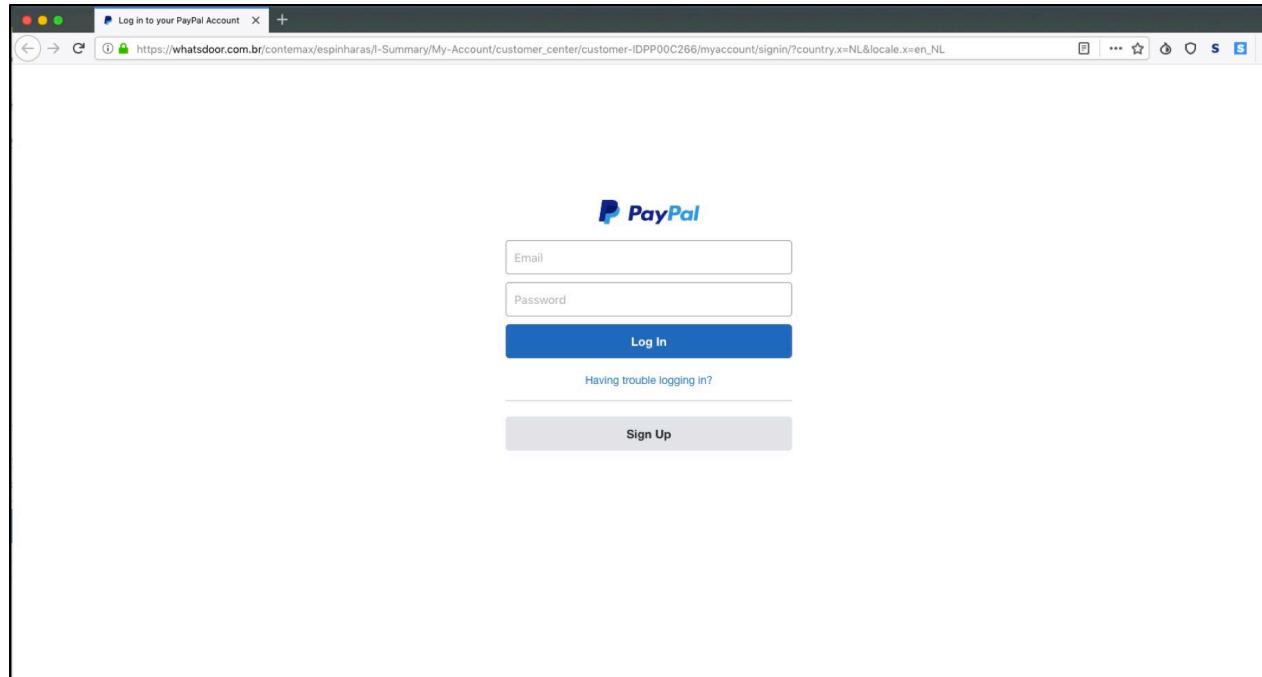


Phishing Types

- Generic Phishing
- Spear Phishing
- CEO Fraud / Whale Phishing

Generic Phishing Attack

- Mass sending: Send to hundreds or thousands of victims
- Language / cultural border are typically ignored
- The goal is typically to gain credit card info and/or to steal monetary values



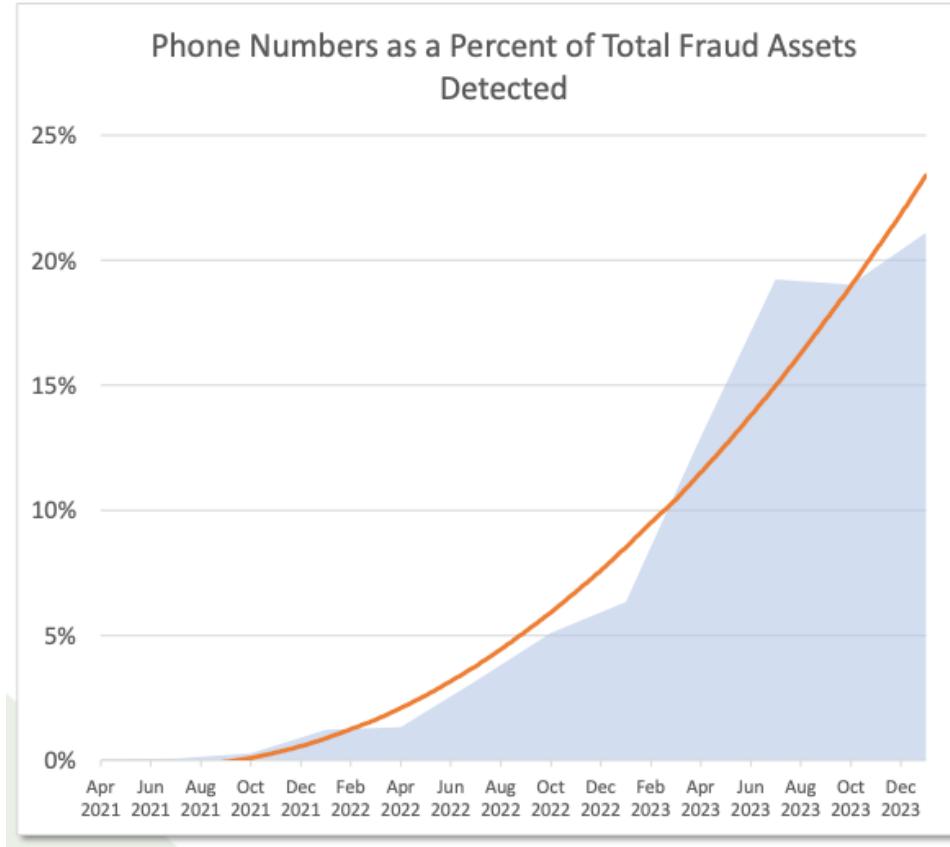
Spear Phishing Attack

- Spear phishing is a targeted attempt to steal credentials from a specific individual
- The individual is typically scouted during targeted research and identified as a possible asset for infiltration
- Spear phishing attempts use malware, keylogger, or email to get the individual to give away the credentials
- **Typically part of a bigger attack (Lateral movement).** Credential stealing for an **APT**.

Whale Phishing

- Phishing attack that is specifically aimed at wealthy, powerful, or prominent individuals
- As such a user becomes the victim of a phishing attack he can be considered a “big phish,” or, alternately, a "whale"
- Whale phishing involves the same tactics used in spear phishing campaigns
- Also known as CEO Fraud, BEC (Business Email Compromise), FPF (Fake President Fraud) or Bogus Boss Email

Phishing - Not only done via mail



APWG Phishing Report 1st Quarter 2024

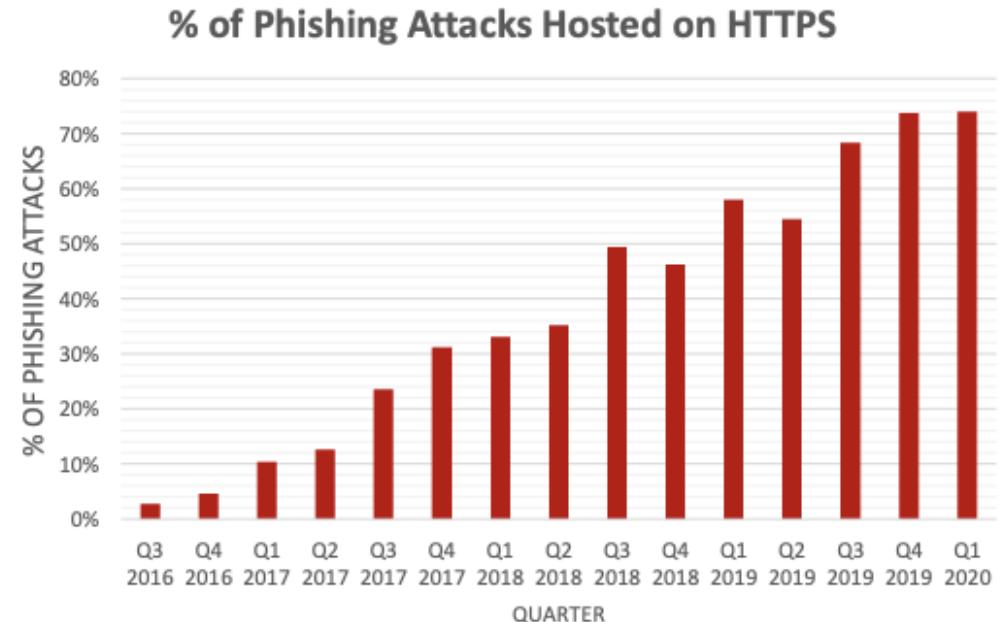
HTTP vs HTTPS

- HTTP stands for Hyper Text Transfer Protocol
- Communication between clients (users) and web servers is done by sending HTTP Requests and receiving HTTP Responses
- HTTP: No Data Encryption Implemented
- Hypertext Transfer Protocol Secure (HTTPS) is an extension of the HTTP protocol. In HTTPS, the communication protocol is encrypted using Transport Layer Security (TLS)

Does HTTPS help against Phishing?

No. HTTPS and HTTP are just the protocols.

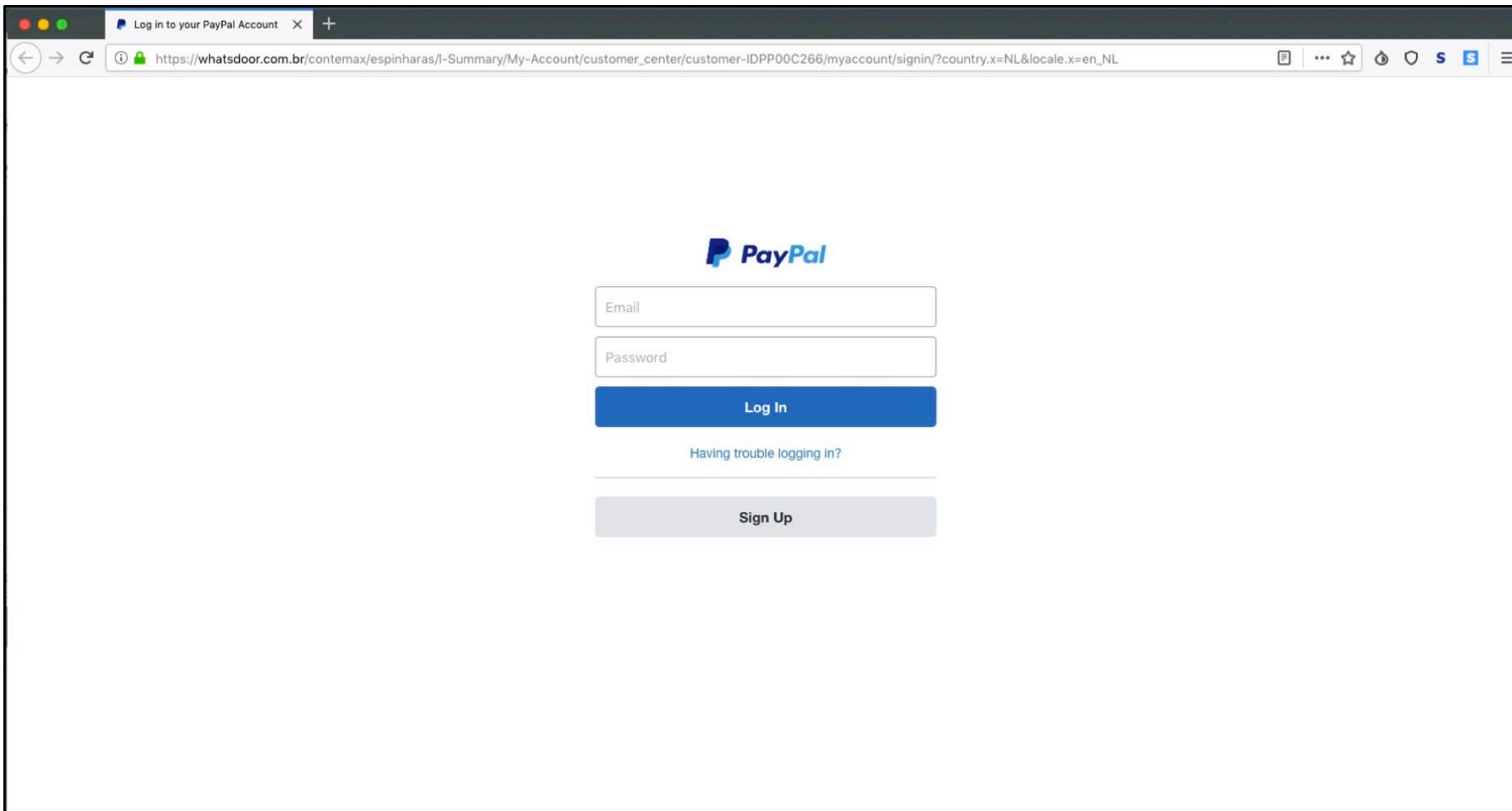
APWG: "In Q1 2020, a new high of 74 percent of sites used for phishing were protected with SSL"



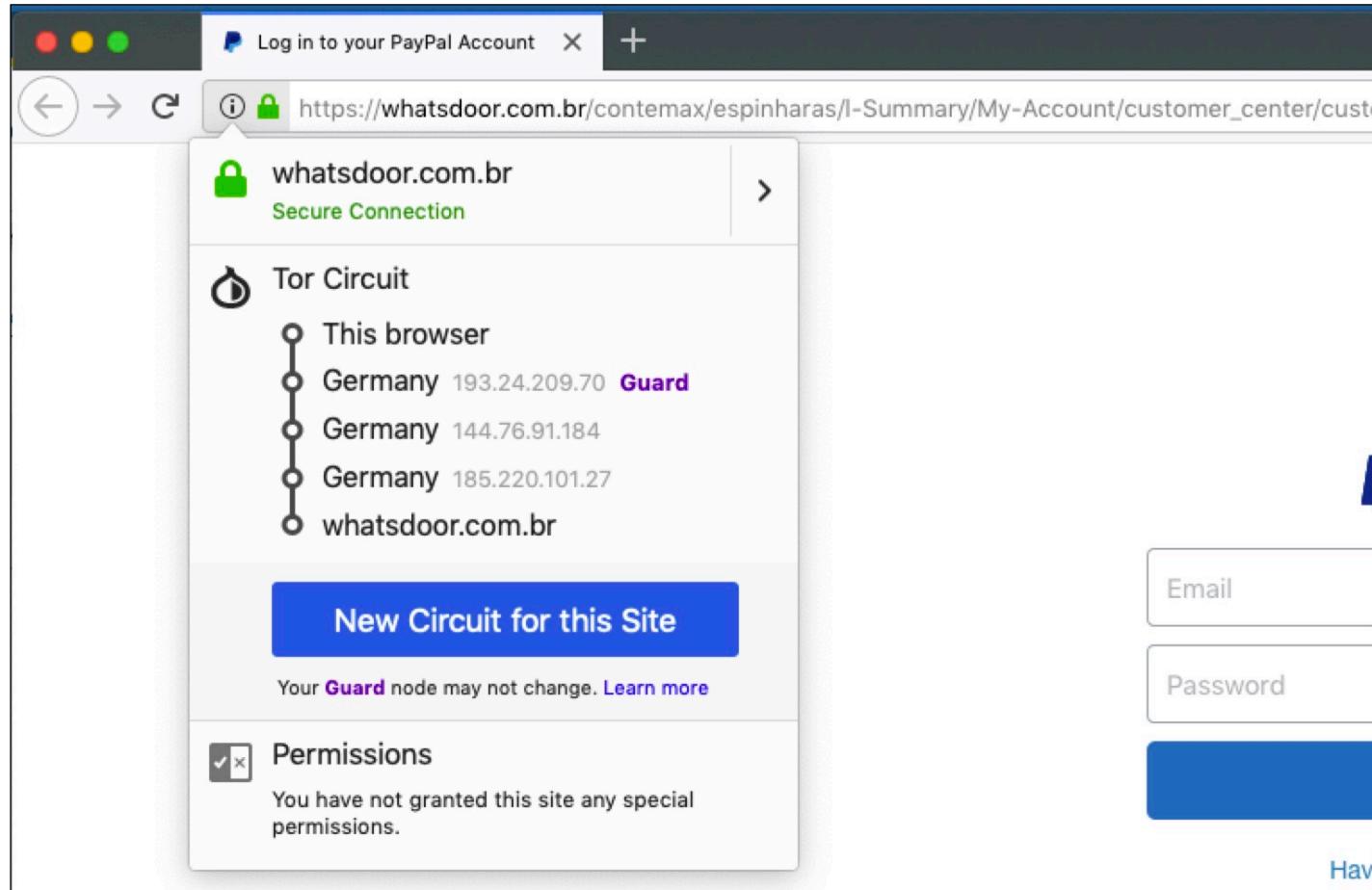
Source:

https://docs.apwg.org/reports/apwg_trends_report_q1_2020.pdf

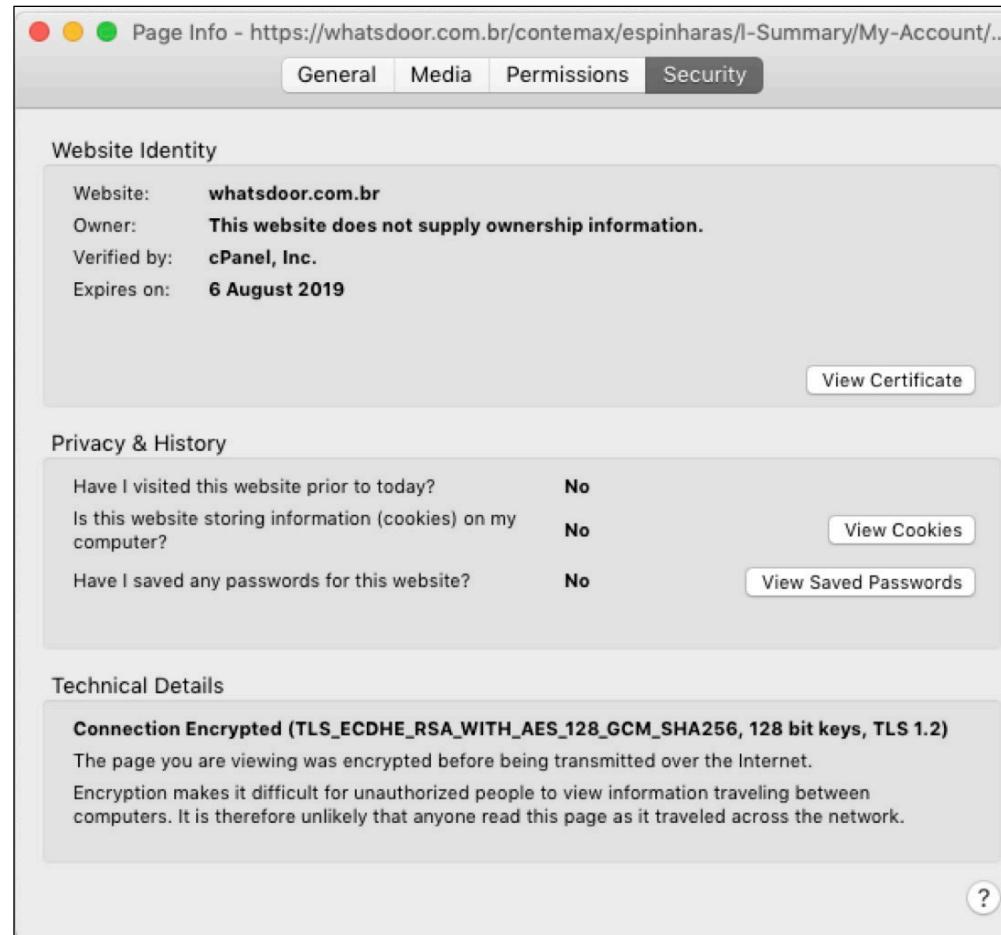
Phishing and HTTPS



Phishing and HTTPS



Phishing and HTTPS



Phishing

The screenshot shows the cPanel WHM Features List interface. The left sidebar lists various management options, and the main content area is titled "Manage Service SSL Certificates". It includes sections for Overview, Free cPanel-signed certificate, Service SSL Certificates, and a warning about self-signed certificates.

Manage Service SSL Certificates

Created by Documentation, last modified on Jul 16, 2018

For cPanel & WHM version 68

(WHM >> Home >> Service Configuration >> Manage Service SSL Certificates)

Overview

This interface allows you to manage certificates for your server's services. For example, you can manage certificates for the following services:

- Exim (SMTP).
- POP3 and IMAP.
- The cPanel services (cPanel & WHM and Webmail).
- Your FTP server.
- iOS Mail Push Notifications (APNs).

SSL certificates allow your web server to identify itself to the computers that access it.

You can use any of the following types of certificates to secure your server's services:

- A free cPanel-signed hostname certificate.
- A certificate that you obtained from a certificate authority (CA).
- A self-signed certificate.

Warning:

We recommend that you **do not use** self-signed certificates. They are **not** as secure as certificates from a CA. Any server could claim to be your server with a self-signed certificate because they do not use a third-party verification system. To remedy this, use certificates from a CA, which verifies that users are securely connected to your server.

Phishing Checks

The screenshot shows the VirusTotal interface for a URL check. The main panel displays a summary card with a large '11' indicating 11 engines detected, a 'Community Score' bar, and a globe icon. Below this, a table provides detailed information about the URL:
https://whatsdoor.com.br/contemax/espinharas/l-Summary/My-Account/customer_center/customer-IDPP00C266/myaccount/signin/?country.x=NL&locale.x=en_NL
Status: 404, Content Type: text/html, Date: 2019-06-08 13:32:08 UTC (a moment ago).
The DETECTION tab is selected, showing results from various engines:

Engine	Result
AegisLab WebGuard	! Phishing
BitDefender	! Phishing
CRDF	! Malicious
Kaspersky	! Phishing
OpenPhish	! Phishing
Spamhaus	! Phishing
Avira (no cloud)	! Phishing
CLEAN MX	! Phishing
ESET	! Phishing
Netcraft	! Malicious
Sophos AV	! Malicious
Fortinet	! Spam

<https://www.virustotal.com>

Phishing Checks

Website Monitoring Website Firewall Website Backups Knowledgebase Support

https://whatsdoor.com.br/contemax/espinharas/l-Su...

Site Issue 404 Not Found **Site is Blacklisted** by Google Safe Browsing and others Request Cleanup

Scan info
https://whatsdoor.com.br/contemax/espinharas/l-Summary/My-Account/customer_center/customer-IDPP00C266/myaccount/signin/?country.x=NL&locale.x=en_NL

IP address: 98.142.100.250 CMS: Unknown
Hosting: Unknown Powered by: PHP 5.4.45
Running on: Apache More Details

Minimal Low Medium High Critical Security Risk

Site Issue Detected
https://whatsdoor.com.br/contemax/espinharas/l-Summary/My-Account/customer_center/customer-IDPP00C266/myaccount/signin/?country.x=NL&locale.x=en_NL Unable to scan the page. 404 Not Found

Outdated Software Detected
PHP under 5.6.40 Vulnerabilities on PHP 5.6

Your site is blacklisted and needs immediate attention. Web authorities are blocking traffic because your website is unsafe for visitors. [Sign up](#) to secure your site with guaranteed malware and blacklist removal.

<https://sitecheck.sucuri.net/>

Report Phishing

The screenshot shows a web page with two main sections separated by a vertical line. On the left, under the heading "Have you found a **phishing site**?", there is a form to report a URL. On the right, under the heading "Did you receive a **phishing e-mail**?", there is a section to forward an email to a specific address. A small illustration of a key fob hangs from the vertical line between the two sections.

Have you found a **phishing site** ?

Report phishing websites using the following web form:

URL ...

REPORT

Did you receive a **phishing e-mail** ?

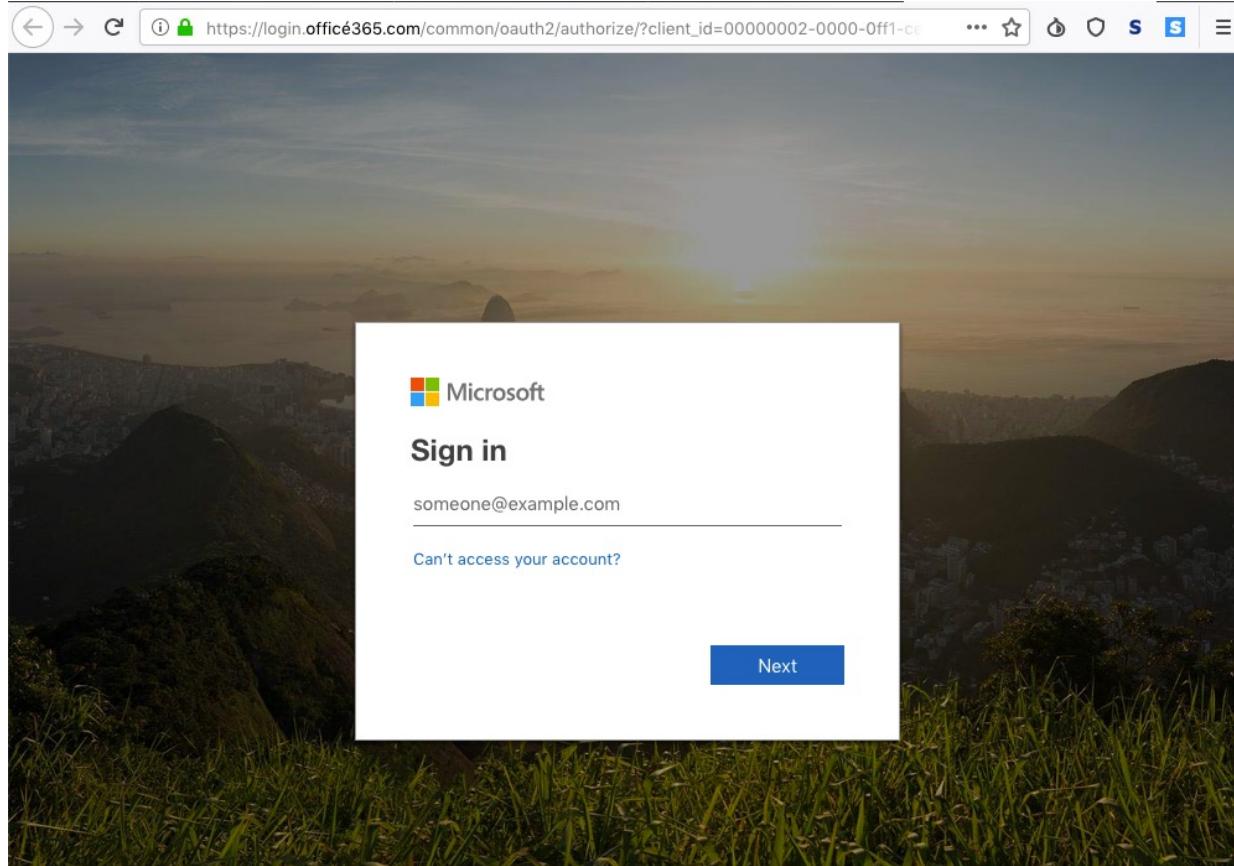
Forward it to

reports@antiphishing.ch

Attention: This mailbox is being processed by a machine in an automated way. If you have an inquiry and / or wish to receive a feedback from the National Cyber Security Centre NCSC, please use incidents@ncsc.ch instead or use our [NCSC reporting form](#).

<https://www.antiphishing.ch>

Advanced Phishing



Page Info - https://login.office365.com/common/oauth2/authorize/?client_id=00000002-0000-0ff1-cc... General Media Permissions Security

Website Identity

Website:	login.office365.com
Owner:	This website does not supply ownership information.
Verified by:	Let's Encrypt
Expires on:	29 July 2019

View Certificate

Privacy & History

Have I visited this website prior to today?	No
Is this website storing information (cookies) on my computer?	No
Have I saved any passwords for this website?	No

View Cookies View Saved Passwords

Technical Details

Connection Encrypted (TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256, 128 bit keys, TLS 1.2)
The page you are viewing was encrypted before being transmitted over the Internet.
Encryption makes it difficult for unauthorized people to view information traveling between computers. It is therefore unlikely that anyone read this page as it traveled across the network.

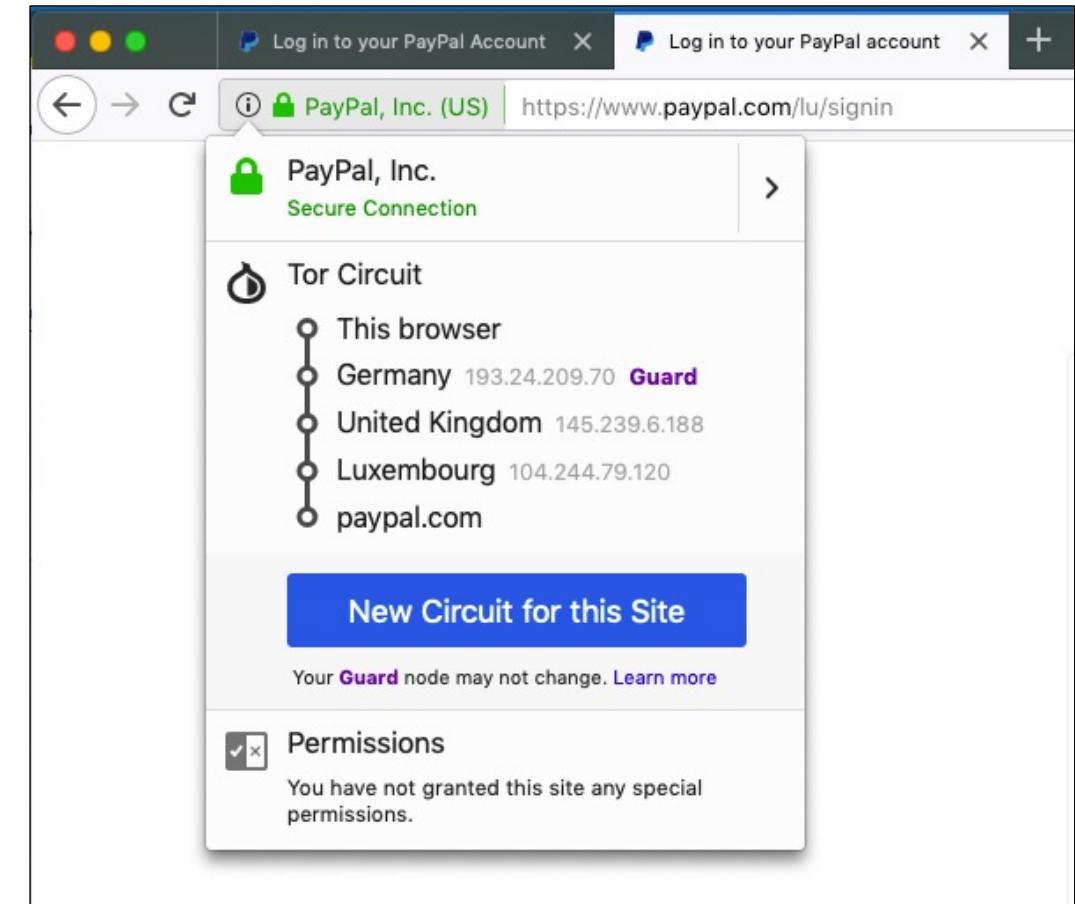
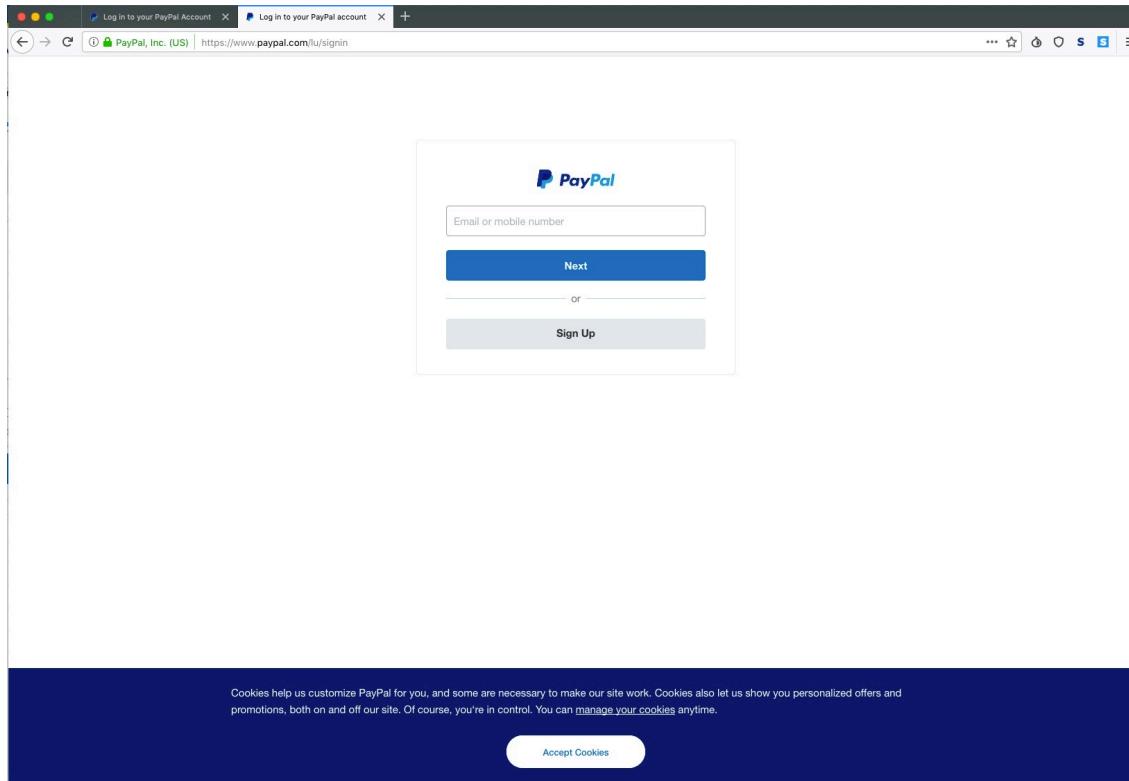
Advanced Phishing

<https://login.xn--offic365-f1a.com>

Punycode

- Is a way to **represent International Domain Names (IDNs) with the limited character set (A-Z, 0-9)** supported by the domain name system.
- For example, "münich" would be encoded as "mnich-kva".
- An IDN takes the punycode encoding, and adds a "xn--" in front of it.
- "münich.com" would become "xn--mnich-kva.com".
- Punycode rendering depends on the browser. Firefox will display it as a look-alike domain

SSL / TLS Certificates



SSL / TLS Certificates

Page Info - https://www.paypal.com/lu/signin

General Media Permissions Security

Website Identity

Website: www.paypal.com
Owner: PayPal, Inc.
Verified by: DigiCert Inc
Expires on: 18 August 2020

[View Certificate](#)

Privacy & History

Have I visited this website prior to today? No
Is this website storing information (cookies) on my computer? No [View Cookies](#)
Have I saved any passwords for this website? No [View Saved Passwords](#)

Technical Details

Connection Encrypted (TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256, 128 bit keys, TLS 1.2)
The page you are viewing was encrypted before being transmitted over the Internet.
Encryption makes it difficult for unauthorized people to view information traveling between computers. It is therefore unlikely that anyone read this page as it traveled across the network.

?

Certificate Viewer: "www.paypal.com"

General Details

This certificate has been verified for the following uses:

SSL Client Certificate
SSL Server Certificate

Issued To

Common Name (CN) www.paypal.com
Organization (O) PayPal, Inc.
Organizational Unit (OU) CDN Support
Serial Number 01:5B:DA:66:5F:C4:4B:75:17:B6:88:2C:1E:AB:D4:DC

Issued By

Common Name (CN) DigiCert SHA2 Extended Validation Server CA
Organization (O) DigiCert Inc
Organizational Unit (OU) www.digicert.com

Period of Validity

Begins On 14 August 2018
Expires On 18 August 2020

Fingerprints

SHA-256 Fingerprint 57:BD:41:24:4C:39:74:6F:04:E9:35:46:55:63:90:47:
31:C0:A2:5E:42:28:CF:23:C1:D7:B1:A6:5D:CF:AB:01
SHA1 Fingerprint E8:20:7A:27:8C:BE:D4:D9:7F:44:32:89:E7:6B:13:DD:CE:58:50:F6

Close

Certificates

Certificate Manager

X

Your Certificates People Servers **Authorities**

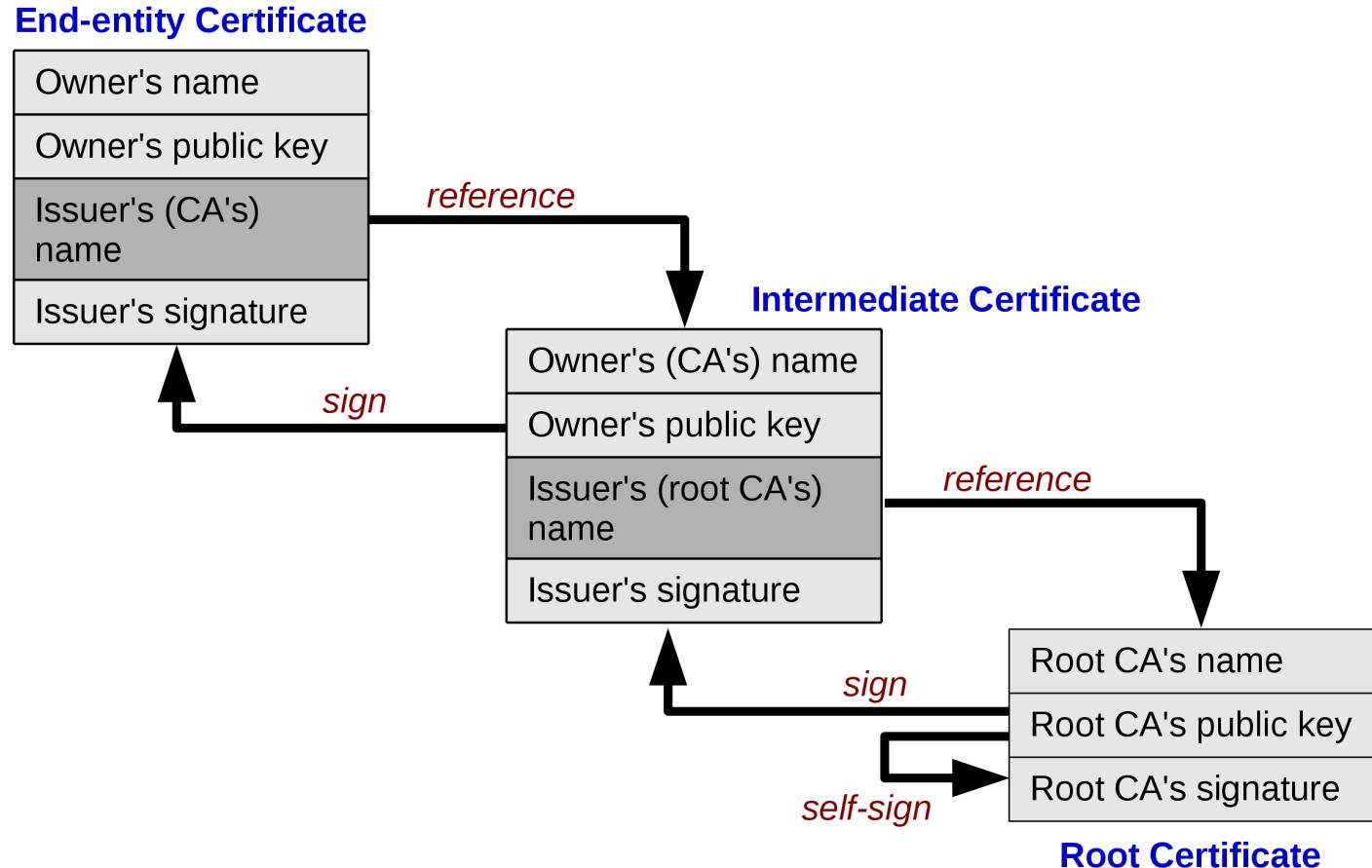
You have certificates on file that identify these certificate authorities

Certificate Name	Security Device
DigiCert Inc	
DigiCert Assured ID Root CA	Builtin Object Token
DigiCert Trusted Root G4	Builtin Object Token
DigiCert Global Root CA	Builtin Object Token
DigiCert Assured ID Root G3	Builtin Object Token
DigiCert High Assurance EV Root CA	Builtin Object Token
DigiCert Global Root G2	Builtin Object Token
DigiCert Assured ID Root G2	Builtin Object Token

View... **Edit Trust...** **Import...** **Export...** **Delete or Distrust...**

OK

Chain of Trust and Root CA's



Social Engineering?



Hacking people – how?



Social Engineering Tools

-  Information Gathering  Investigation on site
-  Tailgaiting  Network check
-  Dumpster Diving  Shoulder Surfing
-  Wing (wo)man  Manipulation (pressure, fear, charme, temptation)
-  Eavesdropping

3 tips to fight tricksters

Take your time



Reality Check



Check back



Malware

Malicious Software

designed to damage or disrupt information systems and data

AND / OR

gain unauthorized access to a network

Classification Malware

Stealers

Sniffer
Password
Grabbers
Keyloggers

Replicators

Virus
Worm

Autonomous

Rootkit
Logical bomb

Remote

Ransomware
Scareware
Backdoor
Bots

Cyber Kill Chain



source: <https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html>

Malware Trends



source: <https://any.run/malware-trends/>

RedLine Stealer

- Underground forums sale (100/150\$)
- Harvests information from browser (credentials, auto-complete, credit card info, fingerprint, cryptocurrency)



Emotet

- Historically banking malware
- Organized in botnet -> C2
- Back door & infection with payloads
- Today: infrastructure as a service (IaaS) for
- Delivering of malware to infected systems
- Taken down by authorities in January 2021 -> back in November 2021



Wanna Cry

- Encrypts data (ransomware) -> cryptoworm
- Target Microsoft Windows systems
- Exploit EternalBlue by NSA
- 2017 unprecedented scale of attack
- Hospitals and health services
- Kill Switch



Malware

Demo <https://hybrid-analysis.com>

<https://helgrind.Switch.ch/joesandbox/index.php/analysis/665042>

Ransomware



Definition



Ransom

Malware



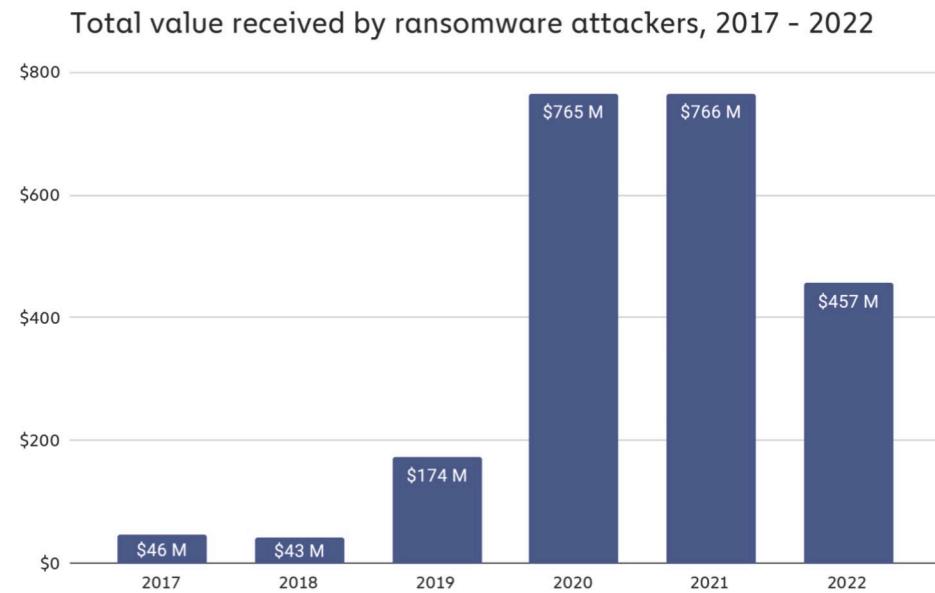
Malware that infects a system and then locks out the user until he pays a sum of money to unlock his data.

Key Points Ransomware

- Generally perceived as one of the biggest IT risks
- widespread and aimed attacks
- ransom often depends on annual revenue
- ransomware-as-a-service: different operators
- variety of initial access vectors and TTPs
- Ransomware attacks are also data breaches (double extortion)
- Ransomware attacks can also affect OT/IoT
- OS independent Ransomware
- Virtual machine based rootkits (VMBRs) and hypervisor exploits for cloud providers
- supply chain attacks

Ransomware in 2023

- most serious threat for organizations
- highly scalable, low barrier, endless vectors
- mature software and infrastructure offered as a service with easy UI
- Homepage of perpetrators with SLA and leaked data
- RaaS: Ransomware as a Service
- Comfort of crime from the couch



The Development of Ransomware

Proto-ransomware: encrypted files, but pretend to be something else like licence or corruption, fix files for a **fee**

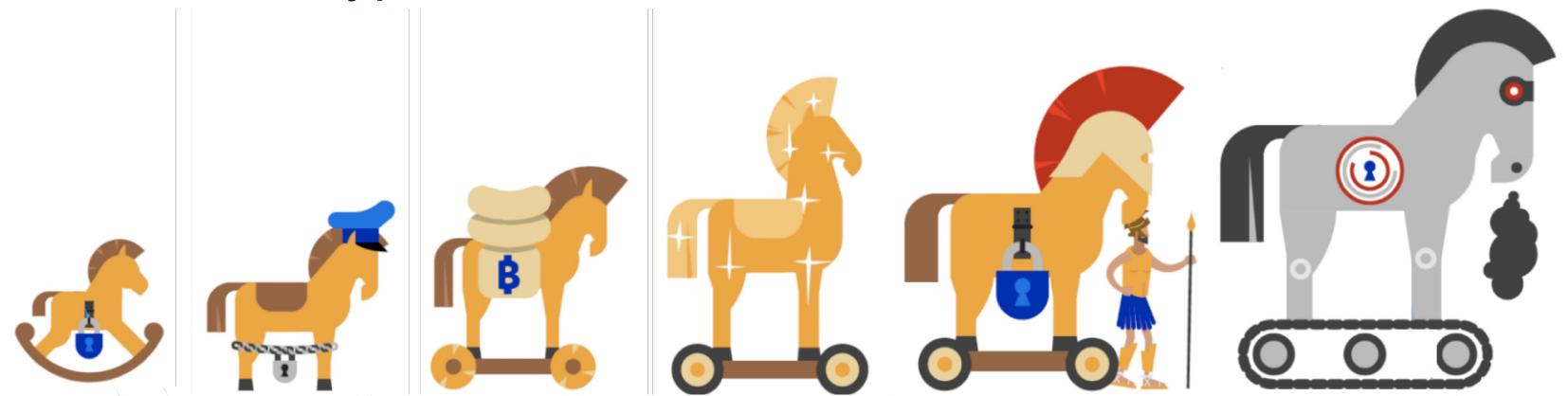
Police themed: Locked screens, pretending to be somebody and victims pay a “**fine**” to use device again

Bitcoin Boom: Use of crypto currency for all transactions

Gold rush: large and untargeted campaigns (i.e. Wanna Cry)

Big-game hunting: targeting big organizations for large payout

Ransomware 2.0: encryption and threat to leak stolen data, double extortion



Ransomware Types

Locker Ransomware

- Locks access to operating system, applications, network
- Software for unblocking access
- Data not changed
- recovery is easier

Crypto Ransomware

- Encryption of data using a cryptographic method
- Password or software for decryption
- Only vulnerabilities in applied cryptography allow decryption
- All devices affected that have network access and data

How it works (Crypto)



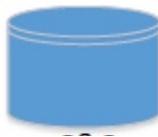
victim



victim-pc



C&C server



C&C
database

11. payment is made

1. attack vector for access
2. malware is executed
3. Domain of the C&C server is determined via Domain Generation Algorithm
4. programme code is reloaded
5. Individual ID is generated and transmitted
8. Data is provided with a lock (encrypted with the public key) and C&C server notified on success
10. Warning message with payment instructions is displayed
13. The lock can be opened with the key (data is decrypted)

6. Cryptographic key pair is generated. Public key is transmitted to the victim PC

9. Bitcoin payment address is generated and transmitted to the warning message with victim PC

12. Checks whether payment has been received and, if successful, transmits the key to the private ID

7. Private key (for decryption) and ID are secured

Business model

- Very worthwhile
- High level of victim suffering
- Recovery costs are higher than ransom Targeted OSINT of victims
- Anonymity of BTC
- Double extortion (stolen data and encryption)
- Costly incident for companies



1.1. Company revenue search

Find company website

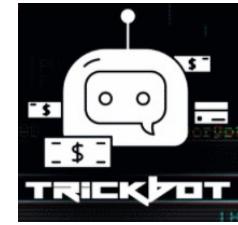
Google: website+revenue (mycorporation.com+revenue)
("mycorporation.com" "revenue")

Check more than one website if possible

Business model – RaaS (Ransomware as a Service)



Access



Dropper / Recon



Money
Laundering

Clop Ransomware at Maastricht University

Time (2019)	Movement
Oct	First Breach by Phising
Nov	Lateral Movement (System with failed Patches)
23. Dec	Ransomware attacks and Displays Message
24. Dec	Contact Fox-IT for
26. Dec	Police has been notified
30. Dec	University decides to pay 217'000 \$ in Bitcoins

sources:

<https://www.rijksoverheid.nl/documenten/rapporten/2020/02/05/reactie-universiteit-maastricht-op-rapport-fox-it>

<https://portswigger.net/daily-swig/ransomware-attack-maastricht-university-pays-out-220-000-to-cybercrooks>

PS: Some Members of the Group behind CLOPS have just been arrested <https://www.youtube.com/watch?v=PqGaZgepNTE>

Clop Ransomware at Maastricht University

NEWS

Dutch university wins big after Bitcoin ransom returned

Maastricht University has doubled its money thanks to a ransomware attack three years ago. The university plans to help struggling students with its new funds.



© Gudrun Petersen/Joker/picture alliance

Key Points: Current Security Topics

- There are different types of phishing
- Report phishing if you can
- Ransomware is a big Threat
- Malware as a Service

04 – Basic Security

- Vulnerabilities and CVE
- Patching and workarounds
- Security Standards

Vulnerabilities

“A security flaw, glitch, or weakness found in software code that could be exploited by an attacker (threat source).”

(from NIST)

Software is and will most likely never be without flaws

=> Everyone will be affected more or less by vulnerabilities

Common Vulnerabilities and Exposure (CVE)

CVE is a **dictionary** of common names for **publicly known cybersecurity vulnerabilities**. CVE's common identifiers - called CVE Identifiers - make it easier to share data across separate network security databases and tools, and provide a baseline for evaluating the coverage of an organization's security tools.

CVE is:

- One name for one vulnerability or exposure. Also
- One standardized description for each vulnerability or exposure
- A dictionary rather than a database
- The way for disparate databases and tools to “speak” the same language
- The way to interoperability and better security coverage
- A basis for evaluation among tools and databases. Free for public download and use.
- Industry-endorsed via the CVE Numbering Authorities (CNAs), CVE Editorial Board, and CVE-Compatible Products

Dictionary available at <https://www.cve.org/>

Source: <https://cve.mitre.org/docs/cve-intro-handout.pdf>

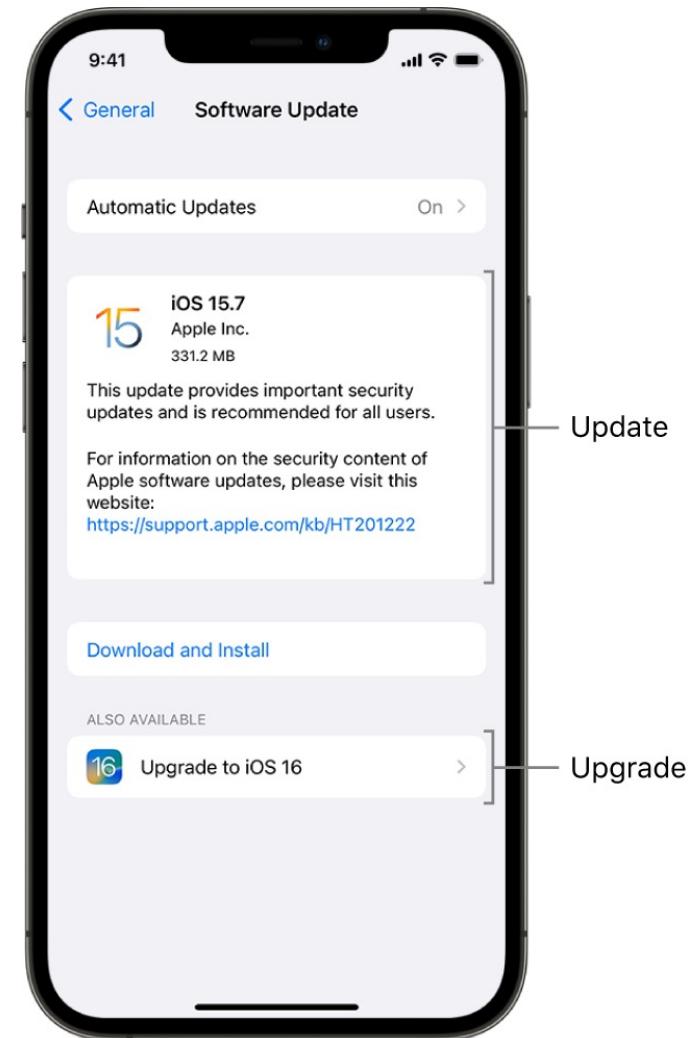
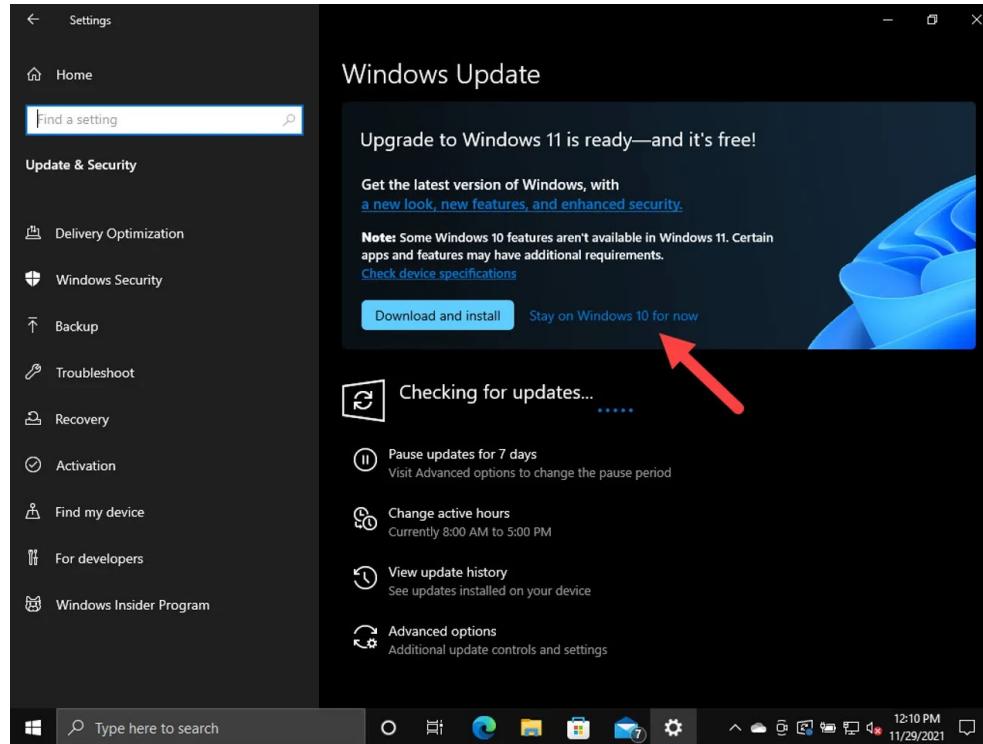
CVE - Tasks

- Visit the CVE dictionary website
- How many CVE records (aka vulnerabilities) are listed in total in the CVE directory?
- Search for all publicly known vulnerabilities for the software SugarCRM.
 - How many records do you find?
 - From which year is the first CVE entry?

Patching and Workarounds

- A patch is an additional piece of software that can be installed to fix the affected software and close the vulnerability.
- The development of a patch can take time: Hours to weeks
- If there is no patch available, in some cases the software vendor will describe a «workaround» to disable the vulnerable part of the software.
- Patch Tuesday: 2nd Tuesday of the month. Time when many big software vendors regularly release software patches for their software products.
- Subscribe to your software vendors Security advisories

Software Update (aka patching) Examples



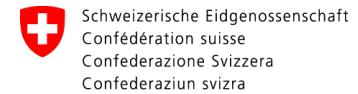
Patching and Workarounds: Task

- Search for the Debian security mailing advisories (debian-security-announce)
- Locate the Subscribe / Unsubscribe form
- Which date has the latest posting on the debian-security-announce mailing list?

Security Standards

- ICT minimum standard from the BWL
- NIST cybersecurity framework (National Institute of Standards and Technology)
- BSI (Federal Office for Information Security)
- ISO/IEC 27001 (International Organization for Standardization)
- CIS (Center for Information Security)

ICT Minimum Standard



Created by the «Bundesamt für wirtschaftliche Landesversorgung»

«Each individual business and organisation has a fundamental responsibility to protect itself. However, wherever the functioning of critical infrastructures is affected, the state also has a responsibility, based on its remit as laid down in the Federal Constitution, and on the National Economic Supply Act. This Minimum ICT Standard is an expression of the responsibility of the state to protect its citizens, its economy, and its institutions and public administration.

It is **recommended that operators of critical infrastructures implement this Minimum ICT Standard. This document nonetheless provides any interested business or organisation with a decision-making guide and specific instructions for improving its own ICT resilience.**»

https://www.bwl.admin.ch/bwl/en/home/themen/ikt/ikt_minimalstandard.html

ICT Minimum Standard

3 Sections

- Introductions
- Implementations
- Assessment

Assessment

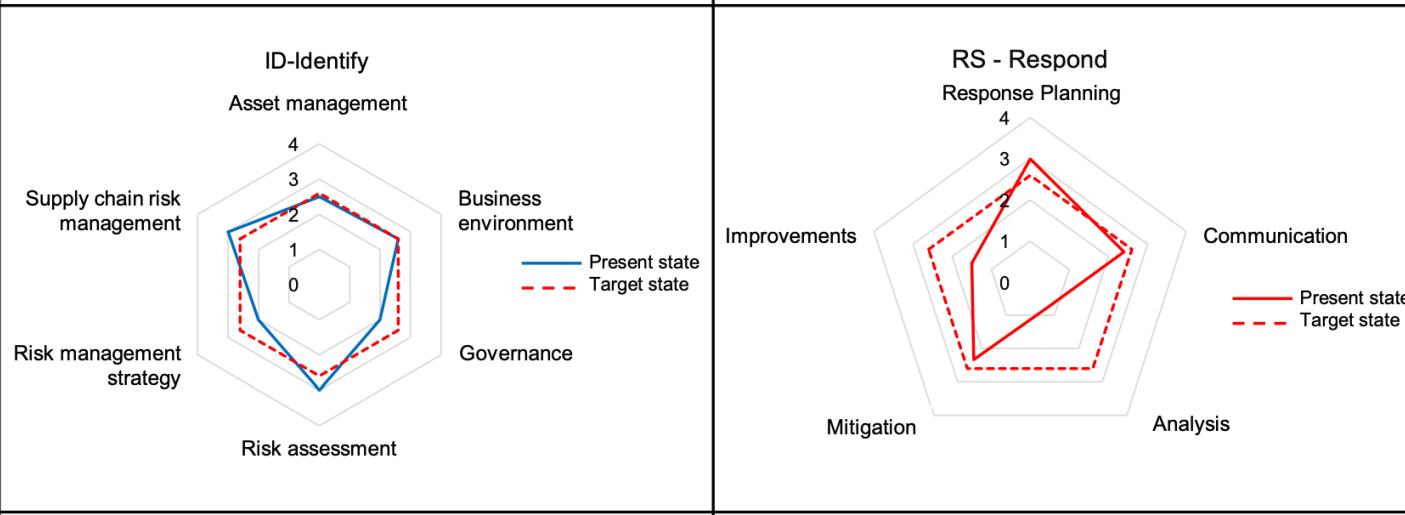
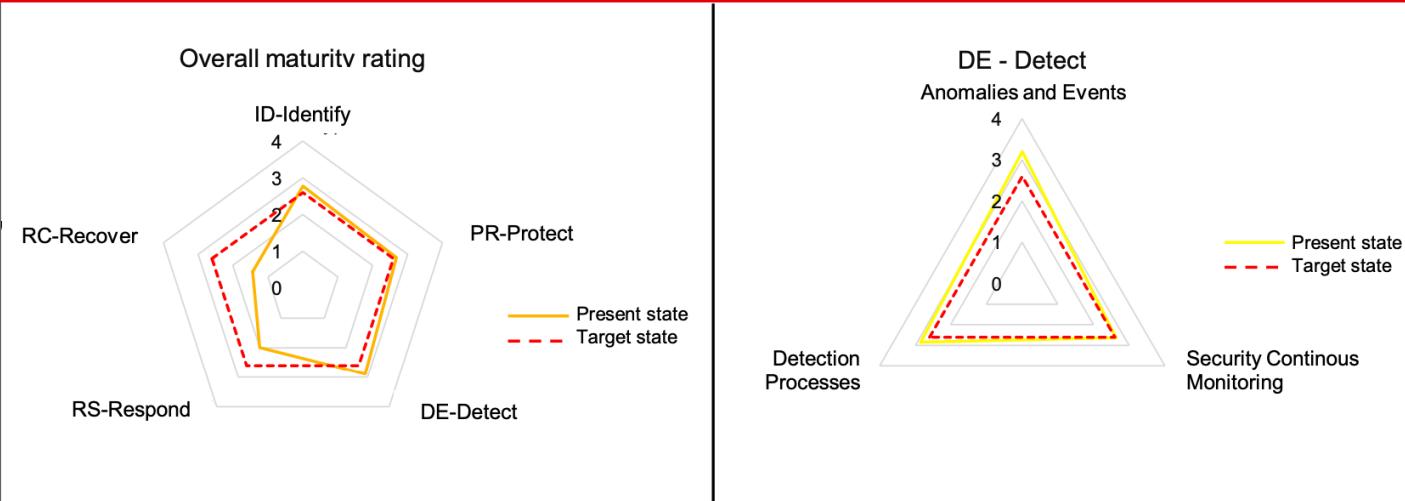
Assessment: Define the «Target state» and compare it with the «Current state» of the ICT landscape

2023_IKT-Minimalstandard-Assessment.Tool

https://www.bwl.admin.ch/dam/bwl/en/dokumente/themen/ikt/excelblatt_minimalstandard.xlsx.download.xlsx/2023_IKT-Minimalstandard-Assessment.Tool-1.1-2023_Revision%205_E_D_F_I.xlsx

Assessment

Example of how an assessment is evaluated.



Standards – Task 1

- Download the current (2023) version of the ICT minimum standard
- In «**Section 1 – Introduction**» Read the subchapter «**Vendor management**» in the chapter «Elements of a defence-in-depth strategy»
- What procedure can help to minimise the risk regarding vendors?

Standards – Task 2

- In «**Section 2 – Implementation**» Read the subchapter «**Asset management**» in the chapter «Identify»
- What are the 6 tasks regarding asset management if you want to fulfill the ICT minimum standard?

Key Points: Basic Security

- Publicly known Security vulnerabilities are collected in CVE dictionaries
- Regularly patch your systems
- Don't reinvent the wheel => Use existing standards as templates and orient yourself to these standards
- The ICT minimum standard is popular in Switzerland

05 – How to react to a Security Incident



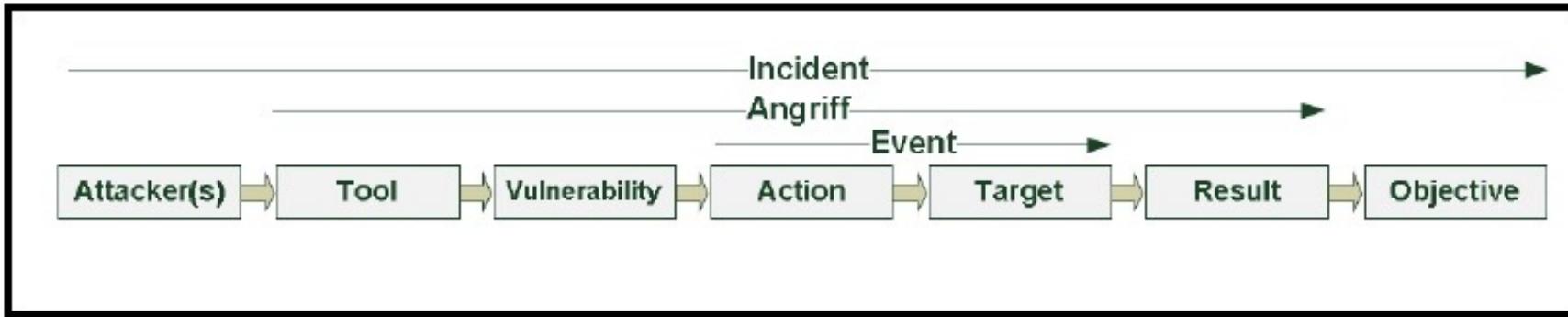
Definition Security Incident

Ein Ereignis, das tatsächlich oder potenziell die Vertraulichkeit, Integrität oder Verfügbarkeit eines Informationssystems oder der Informationen, die das System verarbeitet, speichert oder überträgt, gefährdet.

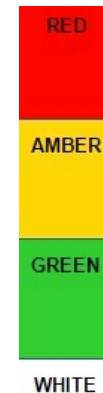
Gruppe	Auswirkungen	Beispiele
Major	sehr hoch	DDoS, Ransomware
Moderate	hoch	Trojaner Verteilung, unautorisierte Veränderungen im System
Minor	normal	Spam, Copyright

CERT – Computer Emergency Response Team

Common incident taxonomie

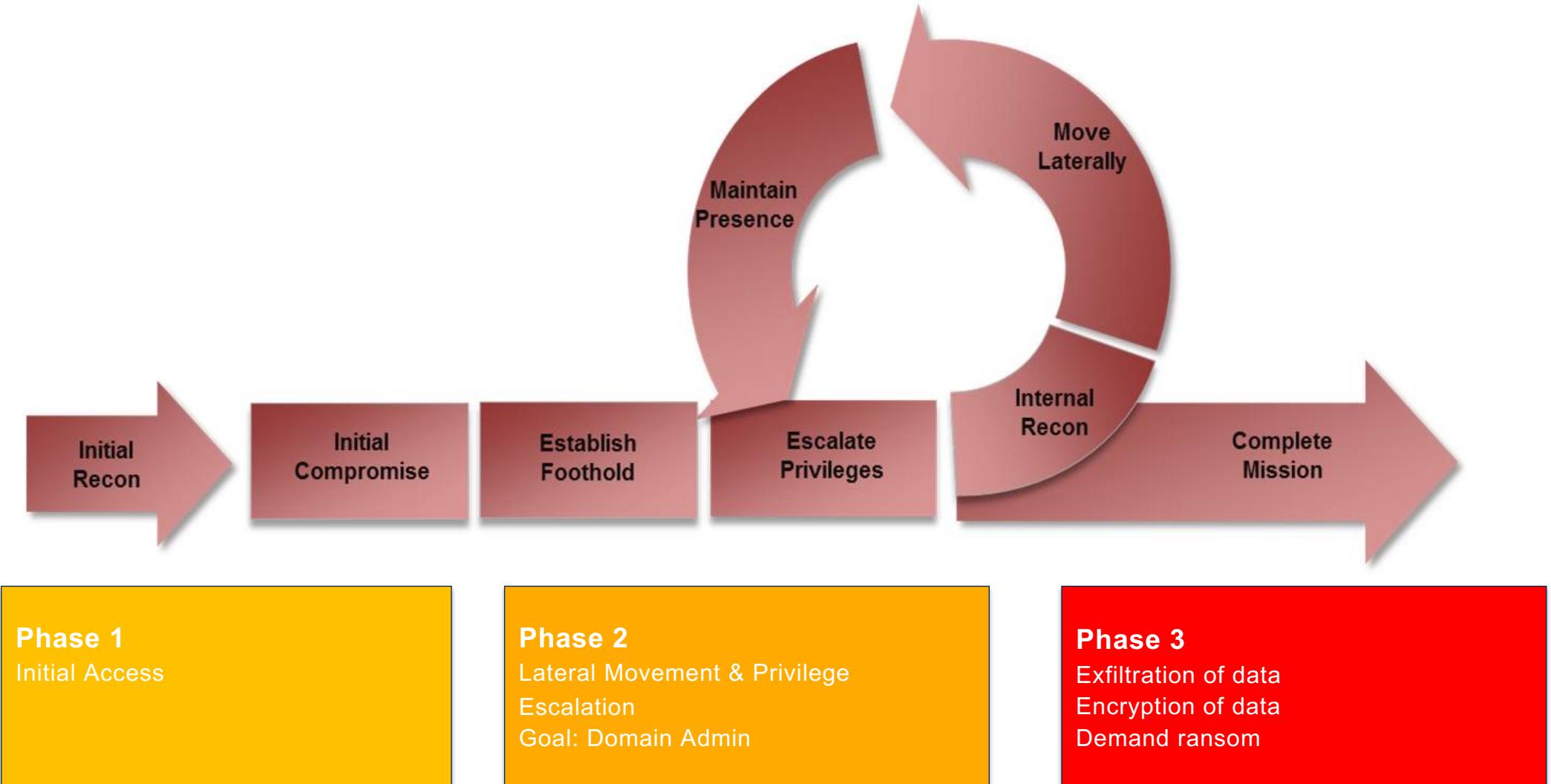


Classification of information (e.g. TLP)



<https://github.com/MISP/misp-taxonomies/>

Cyber attack lifecycle



The 3 Stages

Prevent

- General Rules
- Protection Requirements Analysis
- Defense in Depth

Detect

- Security Monitoring
- Network Monitoring
- Threat Hunting

Respond

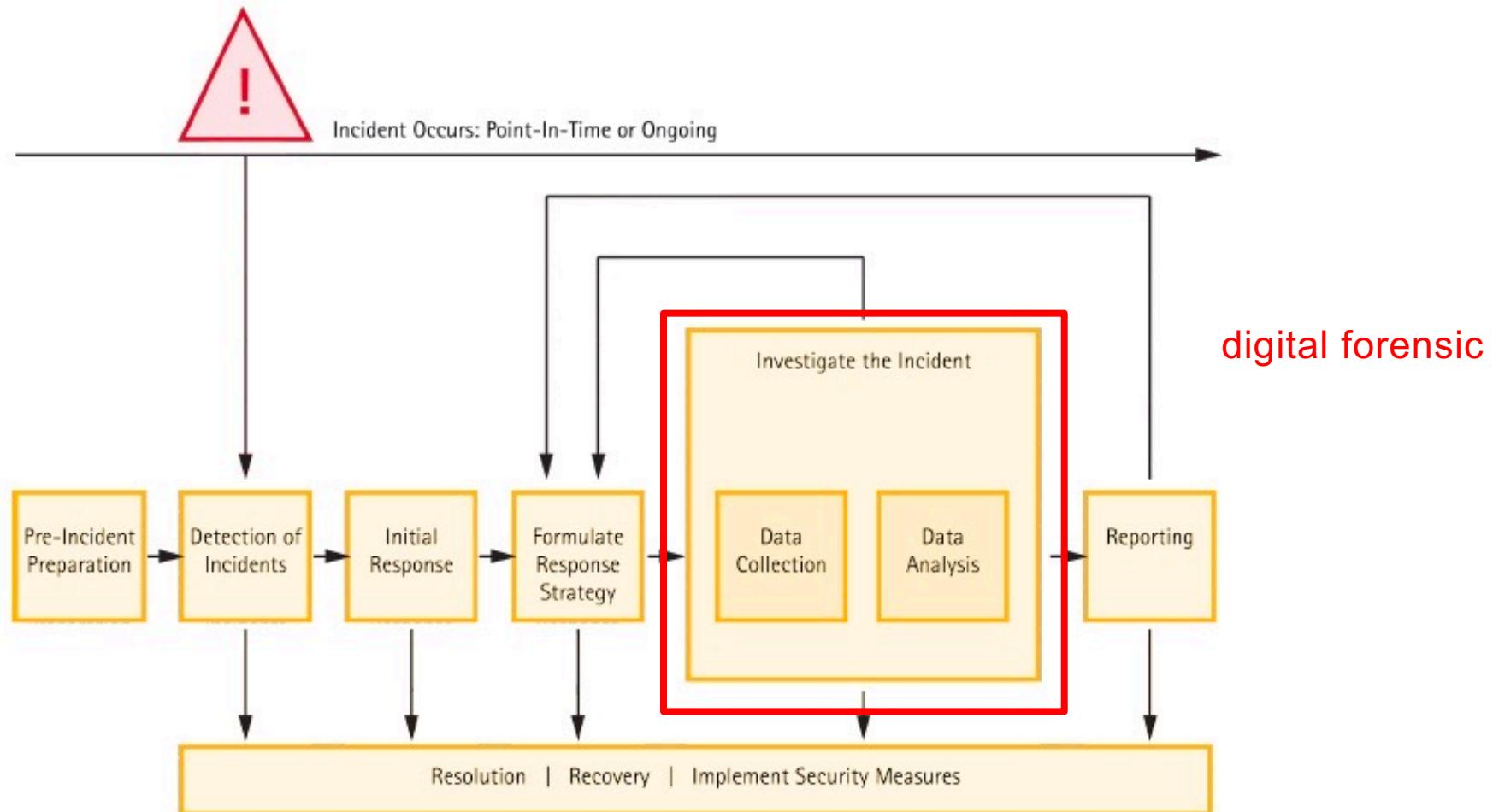
- Emergency Response Plan
- Ransomware Playbook

The real costs of an attack

- paying the ransom is only the beginning
- downtime
- reputational damage
- establish new security measures in the organization
- prevention is much cheaper as recovery
- ransomware is always the last step (RaaS)
- the question is not if but when



Incident Response Process



Example Incident Response at Switch-CERT

The image displays two news articles from Swiss media outlets. The left article is from the website "watson.ch" dated 05.10.2020, featuring a large headline "Universität in Neuchâtel von Cyberangriff betroffen - «Arbeiten unmöglich»" and a sub-headline "Hacker stehlen Gehalt von Schweizer Hochschulen". It includes a snippet of text: "Mehrere Hochschulen in der Schweiz sind von Hackern angegriffen worden. Die Angreifer zweigten eine sechsstellige Summe von Lohnzahlungen ab." The right article is from the website "IT-MARKT" dated 19.09.2022, featuring a large headline "Liechtenstein ist nach Cyberattacke seit drei Wochen offline". Both articles mention ransomware attacks on Swiss universities.

watson 
Schweiz International Wirtschaft Sport Leben Spass Digital Wissen Blogs Quiz Videos Promotionen
DE | FR 

Digital > Ransomware > Universität in Neuchâtel von Cyberangriff betroffen

Universität in Neuchâtel von Cyberangriff betroffen - «Arbeiten unmöglich»

Die Westschweizer Bildungsricht alle Computersysteme Schon wieder Cyberangriff auf Hochschule in Neuenburg

Von Keystone-sda/paz, 4. Juli 2022 um 17:38

IT-SICHERHEIT

Hacker stehlen Gehalt von Schweizer Hochschulen

Mehrere Hochschulen in der Schweiz sind von Hackern angegriffen worden. Die Angreifer zweigten eine sechsstellige Summe von Lohnzahlungen ab.

05.10.2020

IT-MARKT

NEWS STORY DOSSIERS VIDEO SPECIALS EVENTS NETZWITZIG

JÜRNEY

are im Fürstentum Liechtenstein ist nach Cyberattacke seit drei Wochen offline

WN

9.2021 - 10:24 Uhr ver Wettisbach (Watson)

– vom 15. auf den 16. August wurde die Uni Liechtenstein gehackt.
– sind viele IT-Systeme weiter offline. Das Beispiel anderer – der Folgeschäden mehrere Monate dauern

DOSSIER Von APTs bis Zombies Cybersecurity 19.09.2022 - 12:33 Uhr

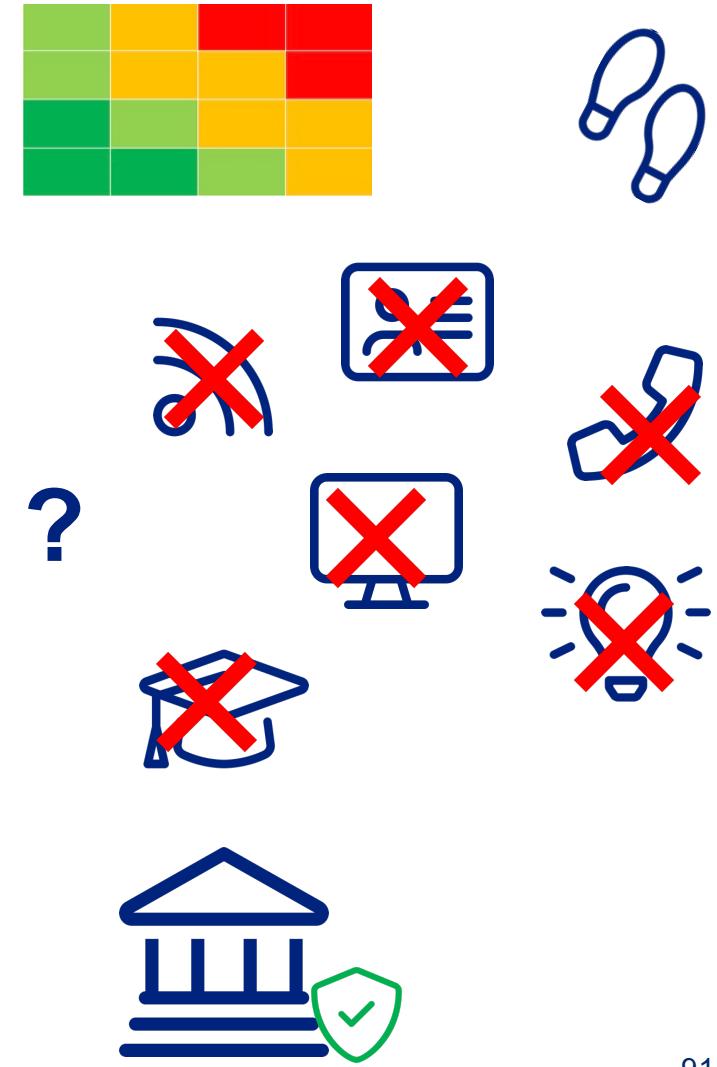
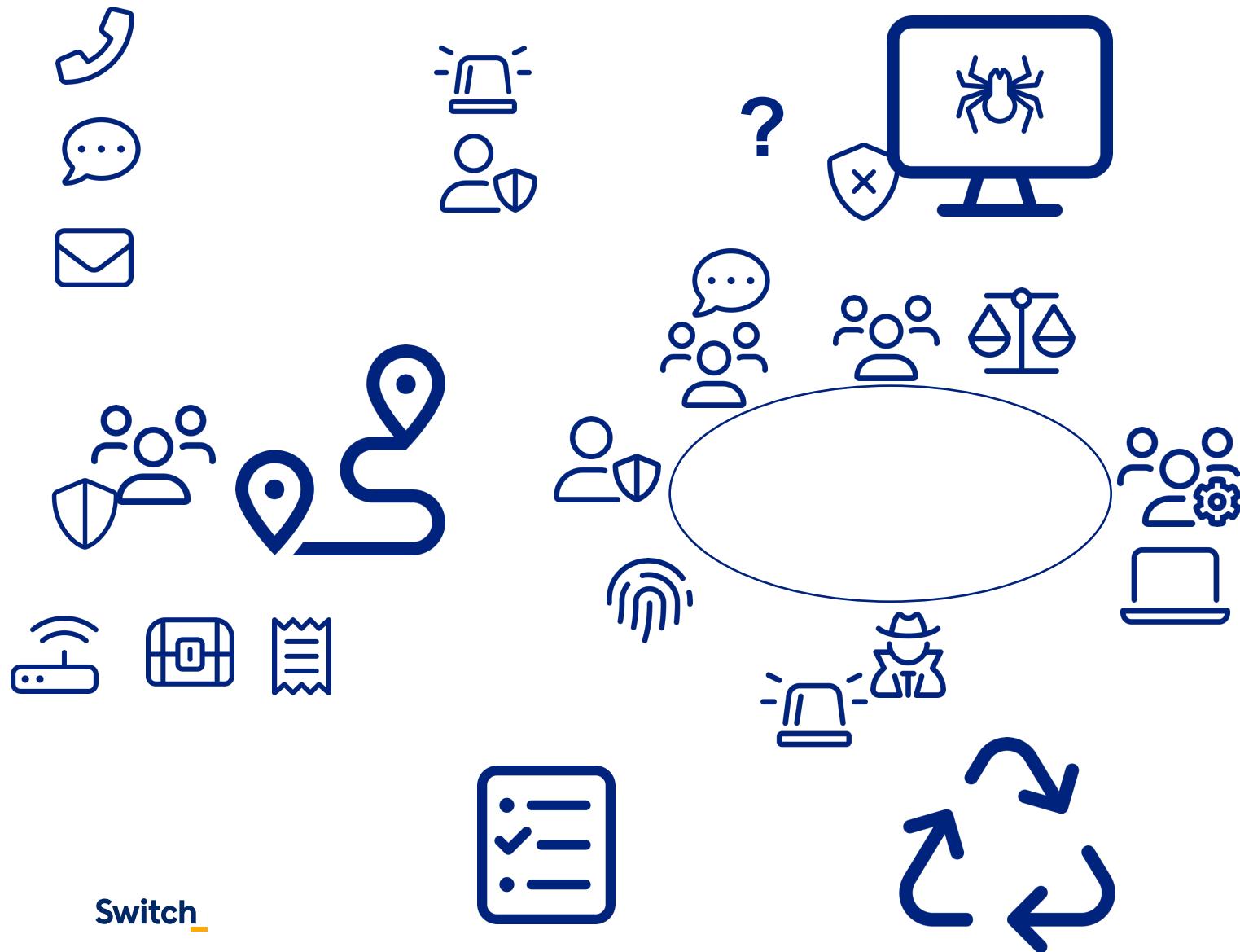
Hochschulen wurden Opfer von Cyber-

(Quelle: Mika Baumeister/Unsplash)

10 - Mittels Phishing-Mails haben sich unbekannte Hacker Zugang an mehrerer Schweizer Hochschulen verschafft und so hr als 100'000 Franken erbeutet.



Example Incident Response



How to react to a Security Incident

Contact the right person within your organisation

- CISO
- Security Officer, SOC, CERT
- IT department
- CEO, Marketing / Communication

Get external support if necessary

- Incident Response Specialists, Forensic Experts, CERT/CSIRT

Report the Security Incident

- NREN organisations: Switch-CERT (<https://www.Switch.ch/security/contact/>)
- NCSC(<https://www.govcert.admin.ch/report/>)

Press charges (against unknown)

- <https://www.kkpks.ch/de/organisation/polizeikorps>

How to React to a Security Incident



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

National Cyber Security Centre NCSC

[Homepage](#) [Contact](#) [Glossary](#) [Site map](#) | [DE](#) [FR](#) [IT](#) [EN](#)

NCSC
What's your report about?

An email/a text message/a WhatsApp message

A phone call

Social media

A computer/a smartphone/a tablet/a system

An online advertisement (goods, job) or an online purchase

A website/a web service/a web platform

Financial damage

Extortion

Report directly

Suisse ePolice

For certain offences, it is possible to file a online criminal complaint. You cannot file a complaint via Suisse ePolice if you are resident in one of the following cantons: AG, BS, GE, JU, NW, OW, SH, SO, TI, UR, VD, VS.

I would like to file a criminal complaint

How to React to a Security Incident

The screenshot shows the homepage of the KKPKS (Konferenz der kantonalen Polizeikommandanten) website. The header features the KKPKS logo and the text "KONFERENZ DER KANTONALEN POLIZEIKOMMANDANTEN". Below the header, there are language links "DE | FR" and a "Members Login" button. The main navigation menu includes "Startseite", "Aktuell", "» Organisation", "Wer wir sind", "Leitbild", "Mitglieder", "Präsident", "Vorstand", "Generalsekretariat", "Konkordate", "» Polizeikorps", "Partner & Links", "Kontakt", "Impressum", and "Datenschutz". The current page is "Polizeikorps", indicated by the bolded text in the menu. The page content displays three entries for different cantonal police forces, each with a shield logo and the name: "Kantonspolizei Aargau" (with a blue and white shield), "Kantonspolizei Appenzell Innerrhoden" (with a black bear shield), and "Kantonspolizei Appenzell Ausserrhoden" (with a black bear shield). A search bar is located in the top right corner.

<https://www.kkpks.ch/de/organisation/polizeikorps>

06 – How to Protect your Assets

- CIA Triad
- Methods to ensure
 - Confidentiality
 - Availability
 - Integrity
- Secure Authentication

Information Security

The term “information security” means **protecting information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction** in order to provide (A) **integrity**, which means guarding against improper information modification or destruction, and includes ensuring information nonrepudiation and authenticity; (B) **confidentiality**, which means preserving authorized restrictions on access and disclosure, including means for protecting personal privacy and proprietary information; and (C) **availability**, which means ensuring timely and reliable access to and use of information.

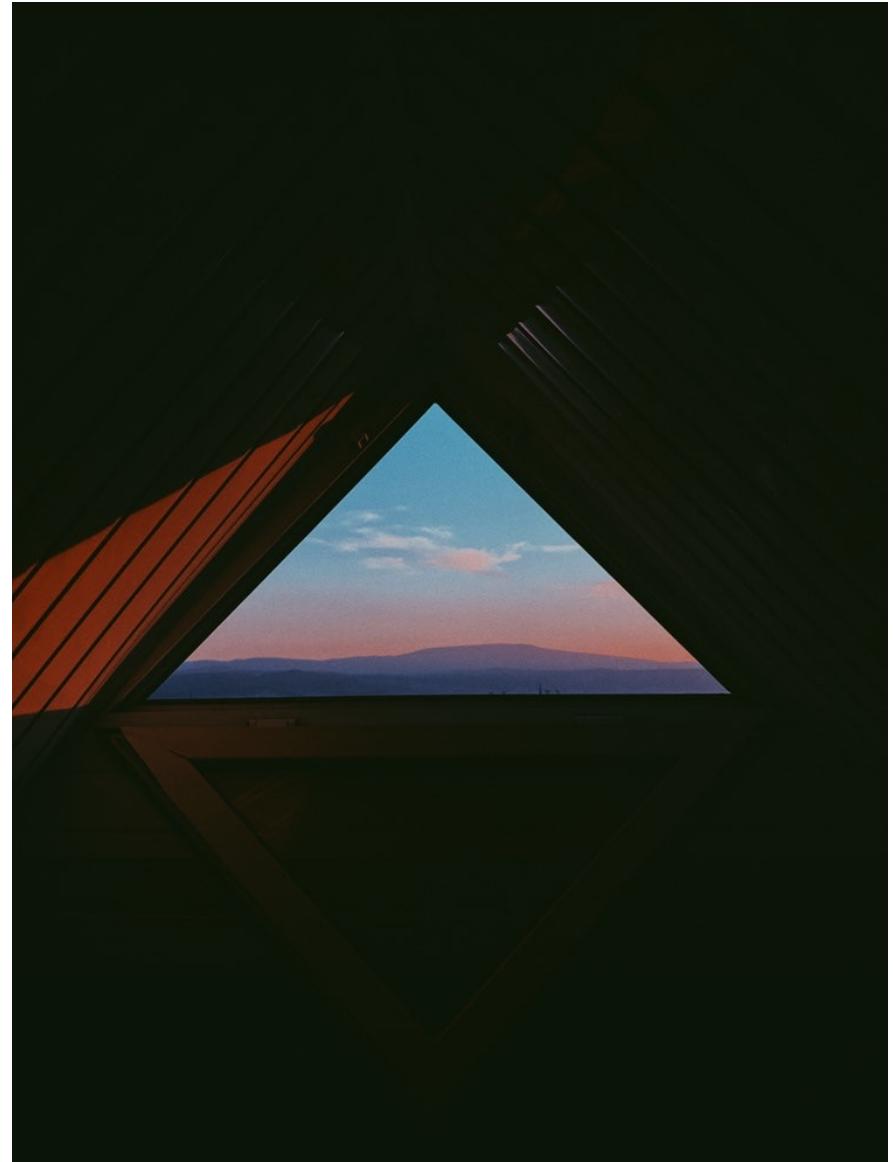
<https://www.law.cornell.edu/uscode/text/44/3542>

The CIA triad

The “CIA triad.” CIA stands for:

- Confidentiality** through preventing access by unauthorized users.
- Integrity** from validating that your data is trustworthy and accurate.
- Availability** by ensuring data is available when needed.

<https://www.ibm.com/blogs/cloud-computing/2018/01/16/drive-compliance-cloud/>



CIA triad example



The CIA triad

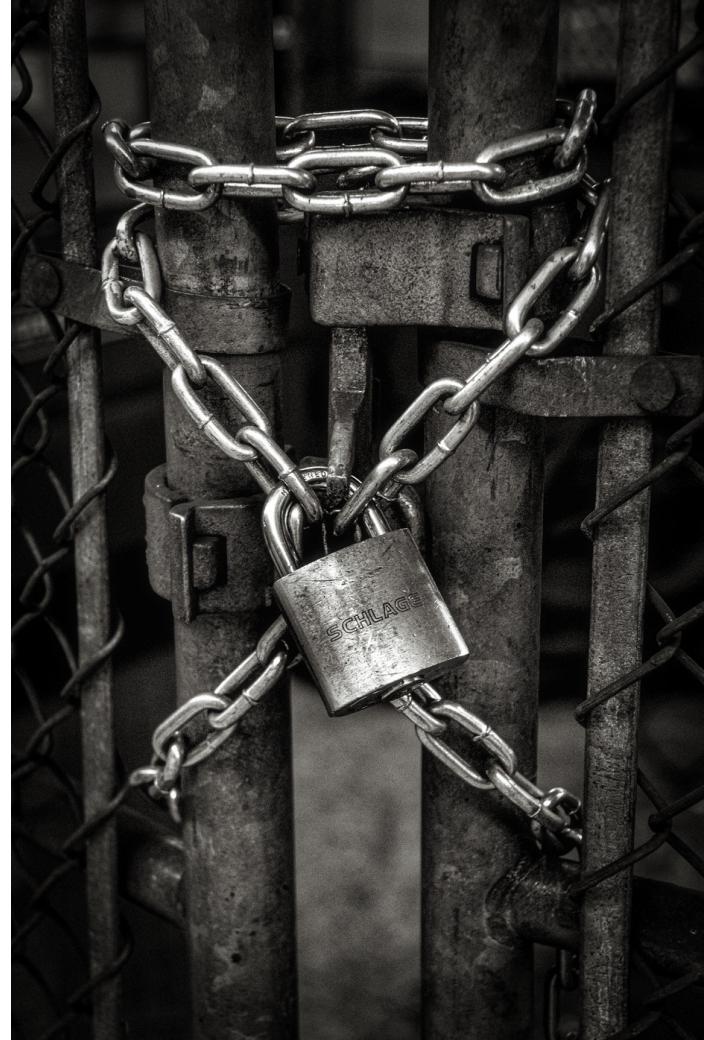
Situation: General hospital and a specialised hospital. A patient has to be transferred to the specialised hospital. All available information from the patient should be transferred from the general hospital to the specialised hospital.

From the CIA point of view:

- Confidential:** No one except the authorised persons (doctors, medical staff) is able to view the transmitted information.
- Integrity:** The information is fully transferred and no data has been altered.
- Availability:** The systems that the doctors / staff will access will be available at all times.

Methods to ensure Confidentiality

- Data encryption and authentication
- Encryption of the data in transit
- Using User IDs, passwords and other methods to access the encrypted data
- Extra measures (extreme form):
Air gapped computers,
disconnected storage devices
hard copy only



Methods used to ensure Integrity

- Maintaining the **consistency, accuracy, and trustworthiness** of data over its entire life cycle
- Data must not be changed in transit, and steps must be taken to ensure that data cannot be altered by unauthorised people
 - File permissions and user access controls
 - Version Control Systems (VCS)
- Detect changes
 - Cryptographic checksums

Methods used to ensure Integrity

- HMAC: Hash-based message authentication code**
- Is a specific type of message authentication code (MAC) involving a cryptographic hash function and a secret cryptographic key
- MD5, SHA-256, SHA-3, ...

```
macbook:~ seitz$ echo -n "Hi all" | shasum -a 256  
e6cf54f1c0d4ec54e879ae23f41f87c7361550d7b385d20bd2ba4e9c6064a71a -  
macbook :~ seitz$ echo -n "Hi all1" | shasum -a 256  
005a9b72487248c324348c754b7b7a695dd6b98aa0058ff6363f365763d11e8d -
```

Methods used to ensure Availability

- Redundant hardware
- Fully maintained hardware and software
- Keep up to date with all necessary system upgrades and updates
- Ensure to have enough bandwidth to and from the systems
- Remove bottlenecks
- Hot failover
- RAID
- Planed (Disaster recovery plan - DRP) and trained disaster recovery.
- Backups
 - Geographically-isolated location
 - Fireproof, waterproof safe
- Measures against DDoS



Authentication and Authorisation

Authentication (Who you are): The process of determining whether someone or something is who or what it declares itself to be.

- “Are you really person X?”
- Technical methods: Login Form, HTTP authentication, HTTP digest, X.509 certificate, ...

Authorisation (What you can do): Decides if you have permission to access a resource

- Methods: Access controls for URLs, Secure objects and methods, Access control lists (ACLs)

Authentication and Authorisation



Factors for Authentication

Something you **know**

- Operating system password
- Credit Card PIN
- Safe pin
- Smartphone unlock combination
- Secret handshakes



Factors for Authentication

Something you **have**

- Physical objects
- Keys
- Smartphones
- Smart Cards
- USB drives
- Token devices



Factors for Authentication

Something you **are**

- Fingerprint
- Palm
- Iris
- Retina
- Blood
- DNA



Factors for Authentication

(Somewhere you are)

- Related to your location
- IP address



Factors for Authentication

(Something you do)

- Gestures
- Related to something you know



Multifactor Authentication (MFA)

- Combining two or three factors from the previous categories
- More secure because an attacker needs multiple skills to breach an account
- Attacker needs to perform **multiple successful attacks simultaneously**
- Famous example: 2FA
- If available: You should use 2FA

Multi factor authentication - Examples



Paper: “Evaluating Login Challenges as a Defense Against Account Takeover”

“In this paper, we study the efficacy of **login challenges at preventing account takeover** These secondary authentication ... trigger in response to a suspicious login or account recovery attempt. Using Google as a case study ... preventing over 350,000 real-world hijacking attempts stemming from automated bots, phishers, and targeted attackers. We show that knowledge-based challenges prevent as few as 10% of hijacking attempts rooted in phishing and 73% of automated hijacking attempts. **Device-based challenges provide the best protection, blocking over 94% of hijacking attempts rooted in phishing and 100% of automated hijacking attempts.**”

<https://ai.google/research/pubs/pub48119>

Google's automatic, proactive hijacking protection

“if we **detect a suspicious sign-in attempt** (say, from a new location or device), we’ll ask for **additional proof** that it’s really you. This proof might be confirming you have access to a trusted phone or answering a question where only you know the correct response.“

“If you’ve signed into your phone or set up a recovery phone number, we can provide a similar level of protection to 2-Step Verification via device-based challenges. We found that an **SMS code sent to a recovery phone number helped block 100% of automated bots, 96% of bulk phishing attacks, and 76% of targeted attacks.** On-device prompts, a more secure replacement for SMS, **helped prevent 100% of automated bots, 99% of bulk phishing attacks and 90% of targeted attacks.**“

<https://security.googleblog.com/2019/05/new-research-how-effective-is-basic.html>

Google's automatic, proactive hijacking protection

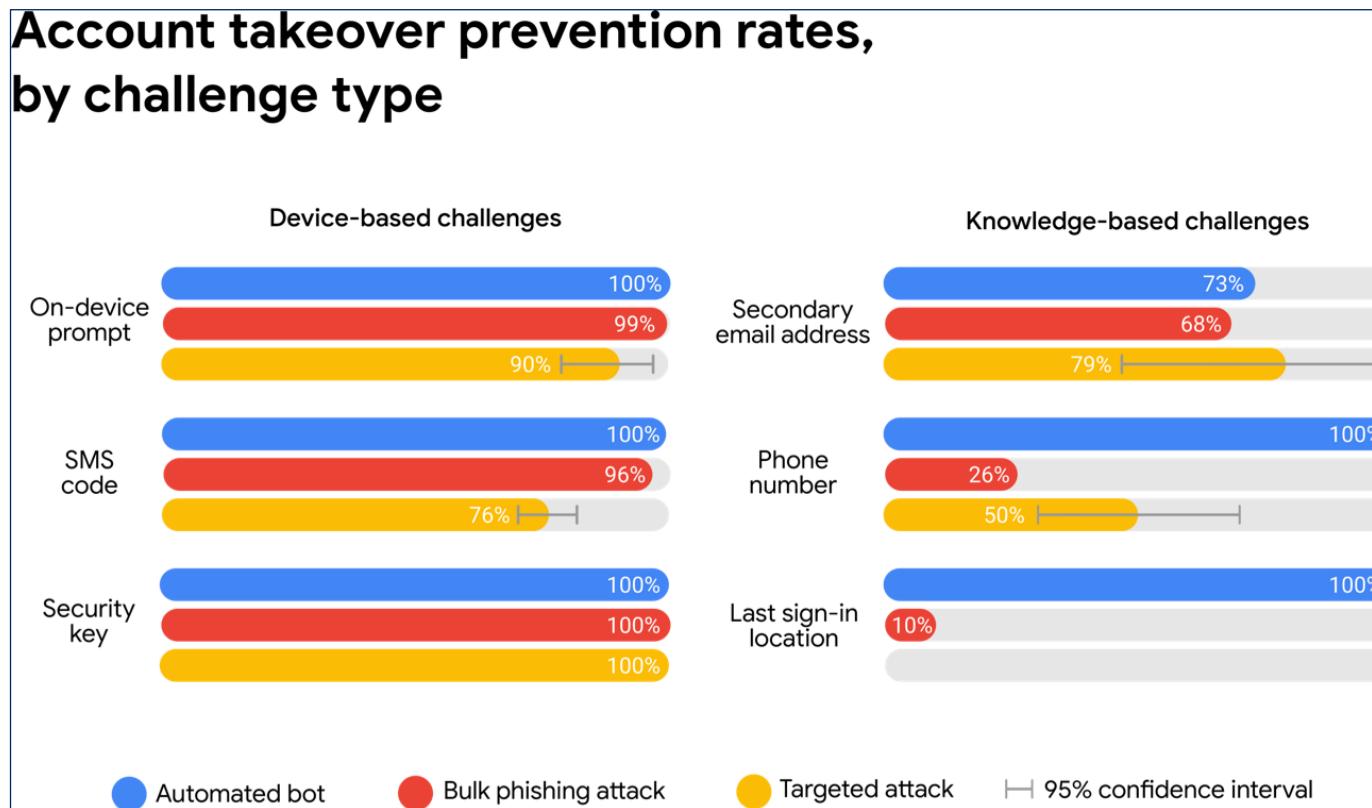


Image Source: <https://security.googleblog.com/2019/05/new-research-how-effective-is-basic.html>

Key Points: How to protect your assets

The CIA Triad

Use different factors and more than one to protect your assets

Authentication (Who you are) and Authorisation (What you can do)

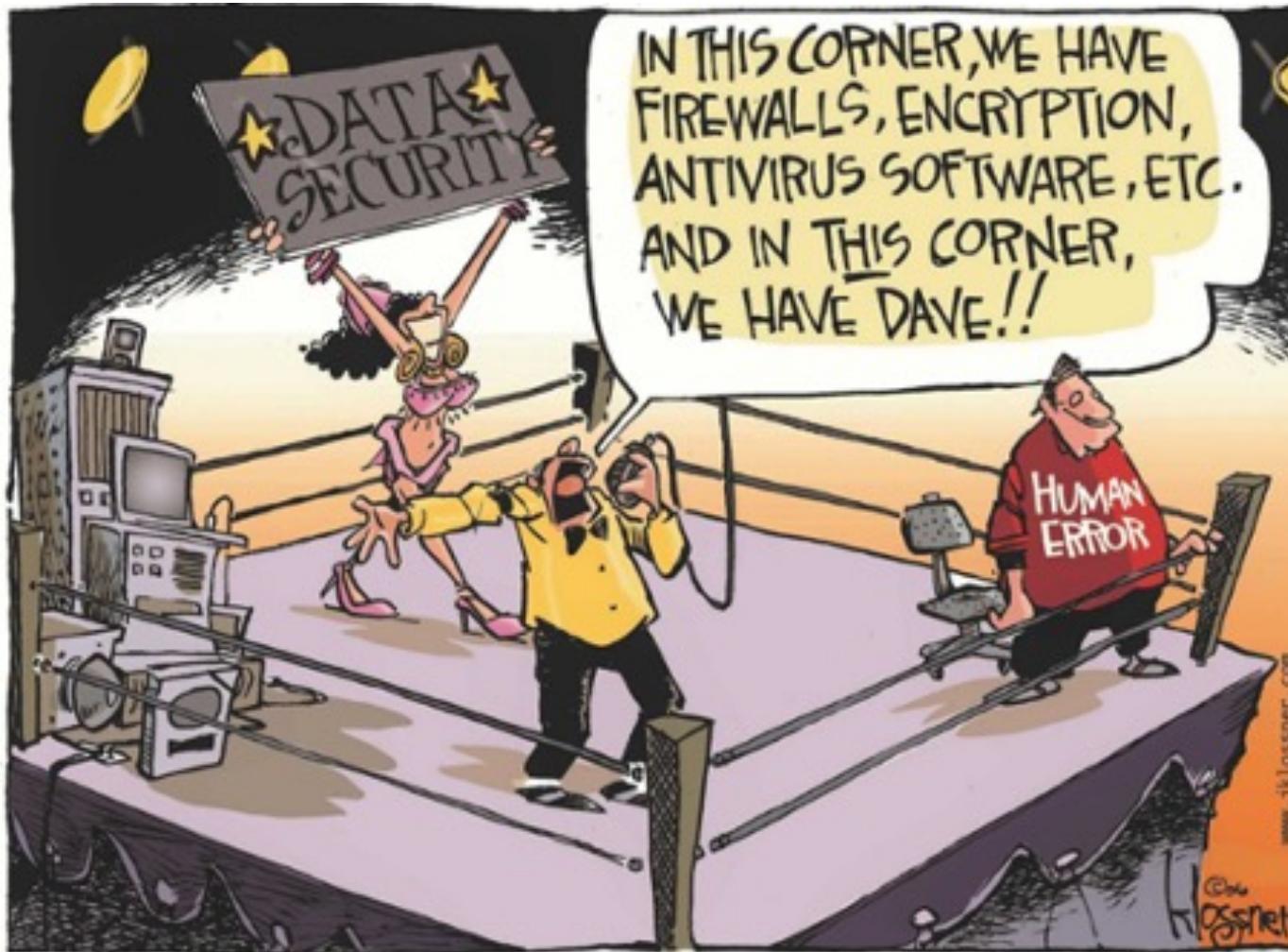
07 – Good IT Security Practices

- Awareness
- Passwords

Our Message to you:

You are the most important link in the Chain of Security!

The Human Factor



Awareness

Training/Education

Teaching and practising
(new) skills and the
theory behind them

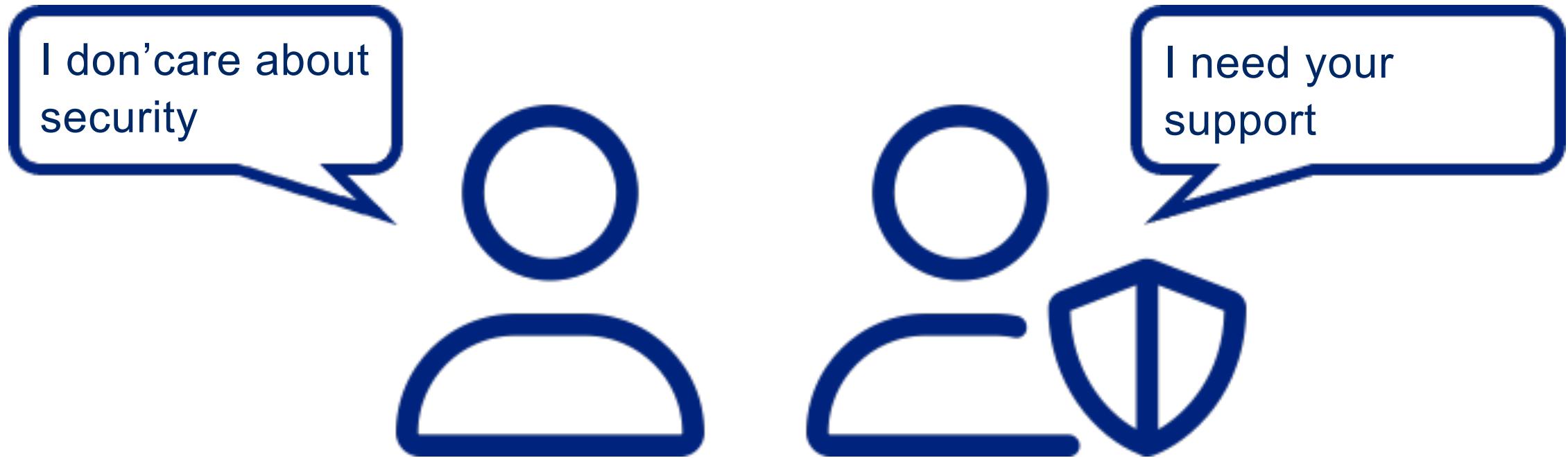


Awareness

Raise awareness
and interest in a
particular topic

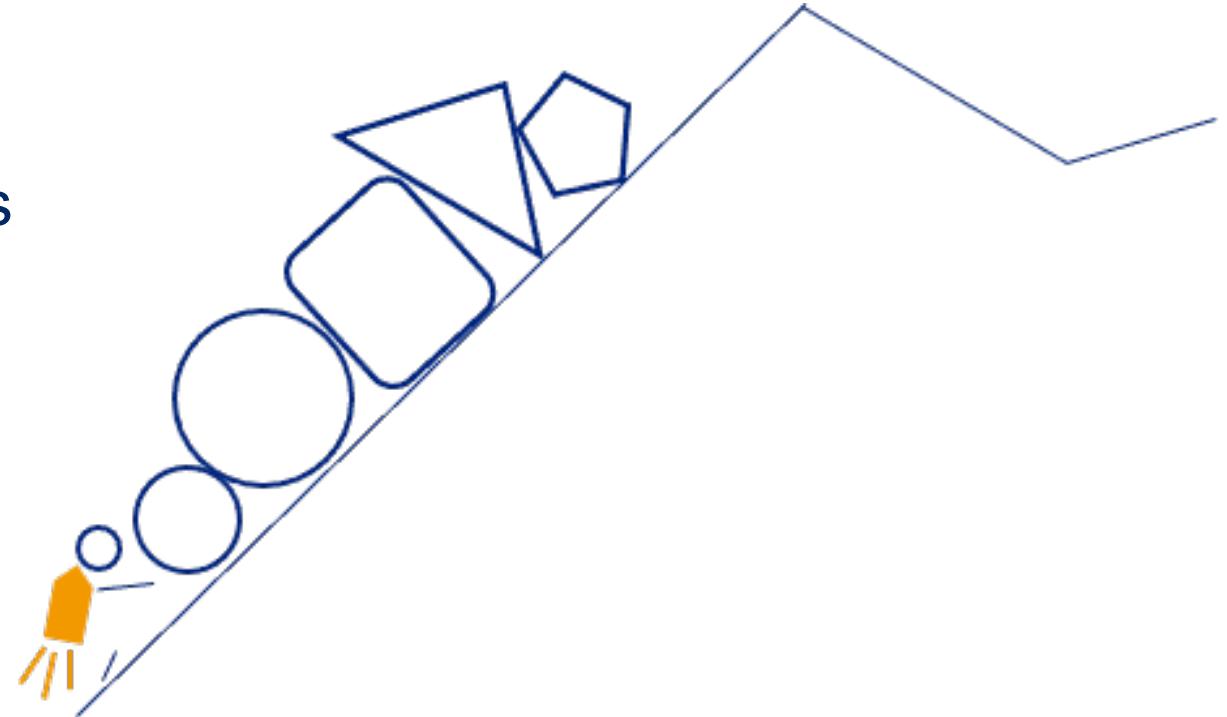
Processes/Tools
Enable and support
safe action

Mutual Understanding



Best Practice with Password (NIST Standard)

- Use longer, complex passwords
- expiration of passwords
- Unique passwords
- Check compromised passwords
- MFA
- Use a Password Manager!**

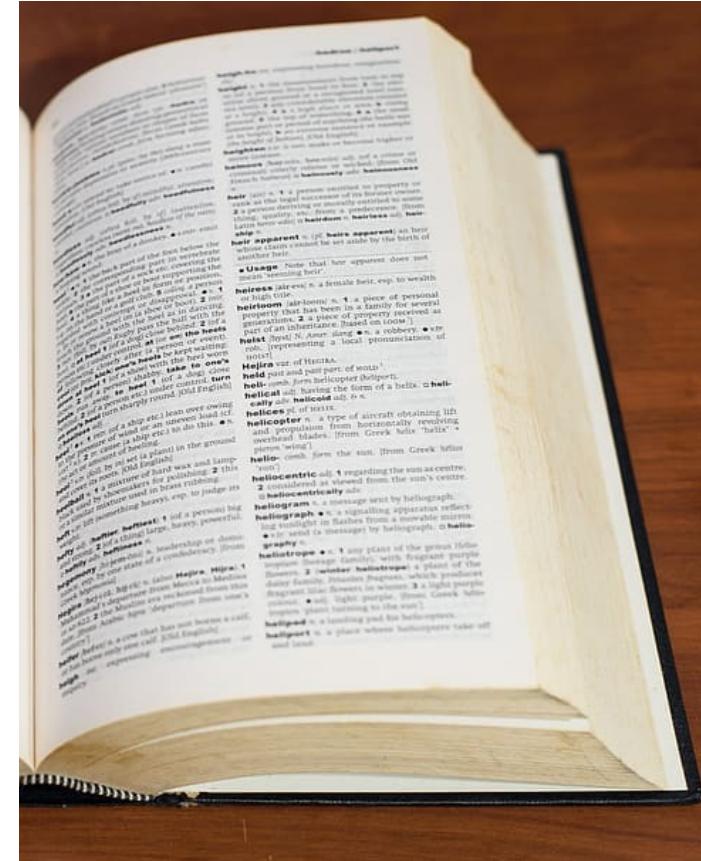


<https://haveibeenpwned.com/>

How attacker find bad passwords

- Passwords are Stored as hashes
- Brute Force
- Dictionary Attack
- Rainbow Tables (precalculated Hashes)
- Rule Based Dictionary | Brute Force

source:
<https://securityboulevard.com/2020/05/a-brief-summary-of-nist-password-guidelines/>
<https://pages.nist.gov/800-63-3/sp800-63b.html>



Password Leaks and Checks

Latest Password Leak June 2021 (RockYou2021)

Have i been pwned?

<https://haveibeenpwned.com/>

Hashcat Hands-on



Responsibility/Criminal Liability/Prosecution

Hacking Article 143^{bis} StGB

-  [Unauthorised access to a data processing system](#)
-  [Art. 143^{bis}](#)

¹ Any person who obtains unauthorised access by means of data transmission equipment to a data processing system that has been specially secured to prevent his access shall be liable on complaint to a custodial sentence not exceeding three years or to a monetary penalty.

² Any person who markets or makes accessible passwords, programs or other data that he knows or must assume are intended to be used to commit an offence under paragraph 1 shall be liable to a custodial sentence not exceeding three years or to a monetary penalty.

Responsibility/Criminal Liability/Prosecution

-  **Damage to data**
-  **Art. 144^{bis}**

1. Any person who without authority alters, deletes or renders unusable data that is stored or transmitted electronically or in some other similar way shall be liable on complaint to a custodial sentence not exceeding three years or to a monetary penalty.

If the offender has caused major damage, a custodial sentence of from one to five years may be imposed. The offence is prosecuted ex officio.

2. Any person who manufactures, imports, markets, advertises, offers or otherwise makes accessible programs that he knows or must assume will be used for the purposes described in paragraph 1 above, or provides instructions on the manufacture of such programs shall be liable to a custodial sentence not exceeding three years or to a monetary penalty.

If the offender acts for commercial gain, a custodial sentence of from one to five years may be imposed.

Key Points: Good IT Security Practices

Security is not only a technical problem

You can help your company to be safe

Use a Password-Manager

08 – Roundup and Feedback

Please fill out the Feedback form from the University of Bern

Switch

