Welcome to

1. Overview of Computer Security

KEA Kompetence Computer Systems Security 2025

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Slides are available as PDF, kramse@Codeberg https://codeberg.org/kramse/
1-overview-computer-security.tex in the repo security-courses

Goals for part II

- Introduce the CIA security model
- Get an overview of the context – cyber security landscape

Photo by Thomas Galler on Unsplash

Plan for part II

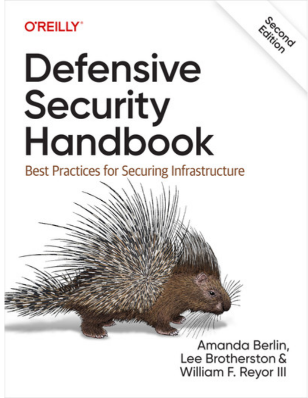
Subjects

- Confidentiality, Integrity and Availability
- Cost-Benefit Analysis
- Risk Analysis
- Human Issues
- Access Control Matrix

Exercises

- Risk Analysis
- Quick port scan intro with Nmap

Reading Summary



DSH chapter 1: Creating A Security Program

DSH chapter 2: Asset Management And Documentation

Goals: Increase Security Awareness

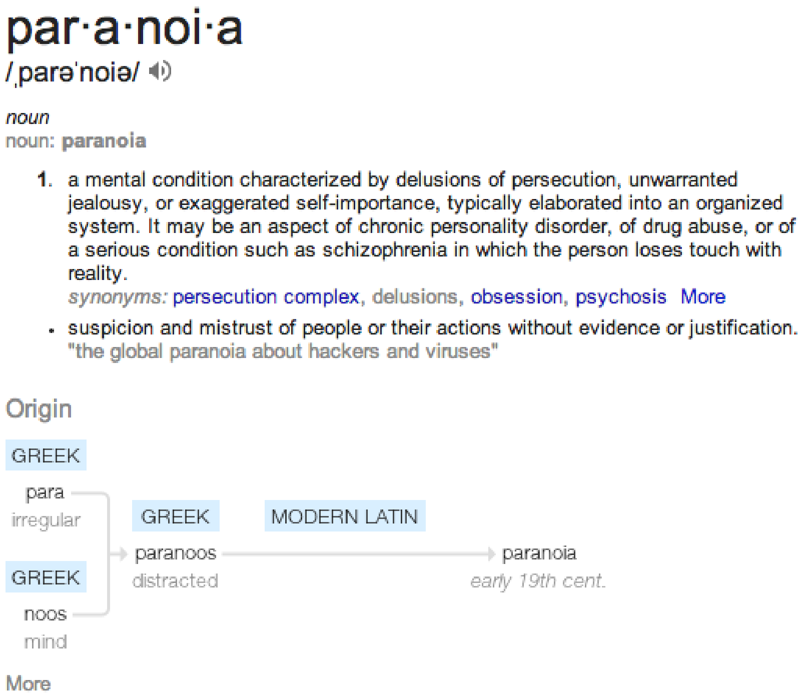
Fact of life: Software has errors, hardware fails

Sometimes software can be made to fail in interesting ways

Humans can be social engineered

We are being attacked by criminals - including paranoid governments

Paranoia defined



par·a·noi·a

/ˌparəˈnoiə/ 🔊

noun

noun: **paranoia**

1. a mental condition characterized by delusions of persecution, unwarranted jealousy, or exaggerated self-importance, typically elaborated into an organized system. It may be an aspect of chronic personality disorder, of drug abuse, or of a serious condition such as schizophrenia in which the person loses touch with reality.
   synonyms: persecution complex, delusions, obsession, psychosis More
   - suspicion and mistrust of people or their actions without evidence or justification.
     "the global paranoia about hackers and viruses"

Origin

GREEK

para
irregular

GREEK

noos
mind

GREEK

paranoos
distracted

MODERN LATIN

paranoia
early 19th cent.

More

Source: google paranoia definition

Face reality

From the definition:

> suspicion and mistrust of people or their actions **without evidence or justification**. **the global paranoia about hackers and viruses**

It is not paranoia when:

- Criminals sell your credit card information and identity theft
- Trade infected computers like a commodity
- Governments write laws that allows them to introduce back-doors - and use these
- Governments do blanket surveillance of their population, implement censorship, threaten citizens and journalist

You are not paranoid when there are people actively attacking you!

I recommend we have appropriate paranoia (DK: passende paranoia)

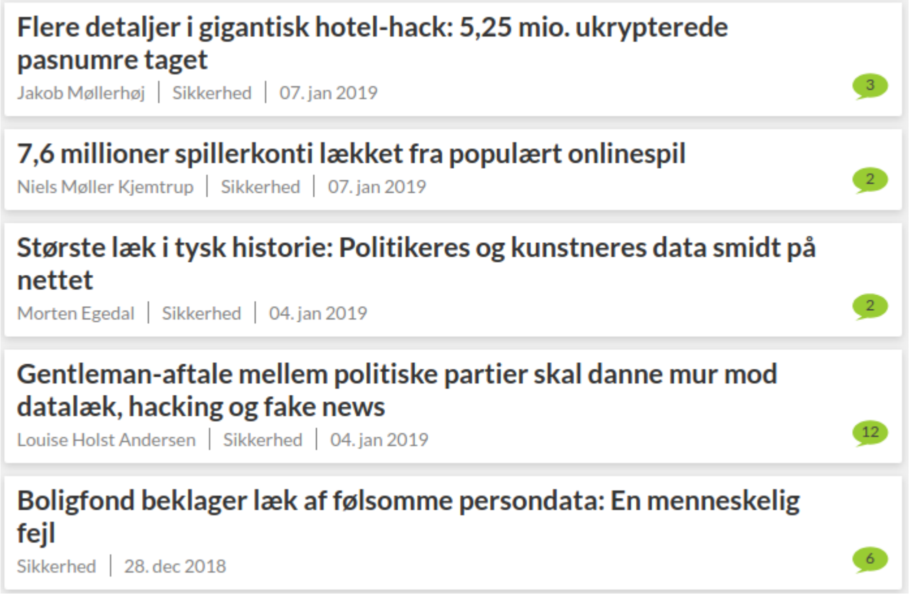
Overlapping Security Incidents

New data breaches nearly every week, these from danish news site version2.dk

Problem, we need to receive data from others

Data from others may contain malware

Have a job posting, yes
- then HR will be expecting CVs sent as .doc files



Flere detaljer i gigantisk hotel-hack: 5,25 mio. ukrypterede pasnumre taget
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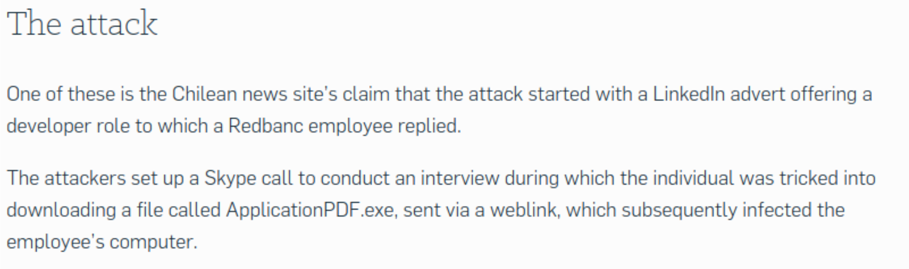
Sikkerhed | 28. dec 2018 6

or the other way

Attackers used a LinkedIn job ad and Skype call to breach bank's defences



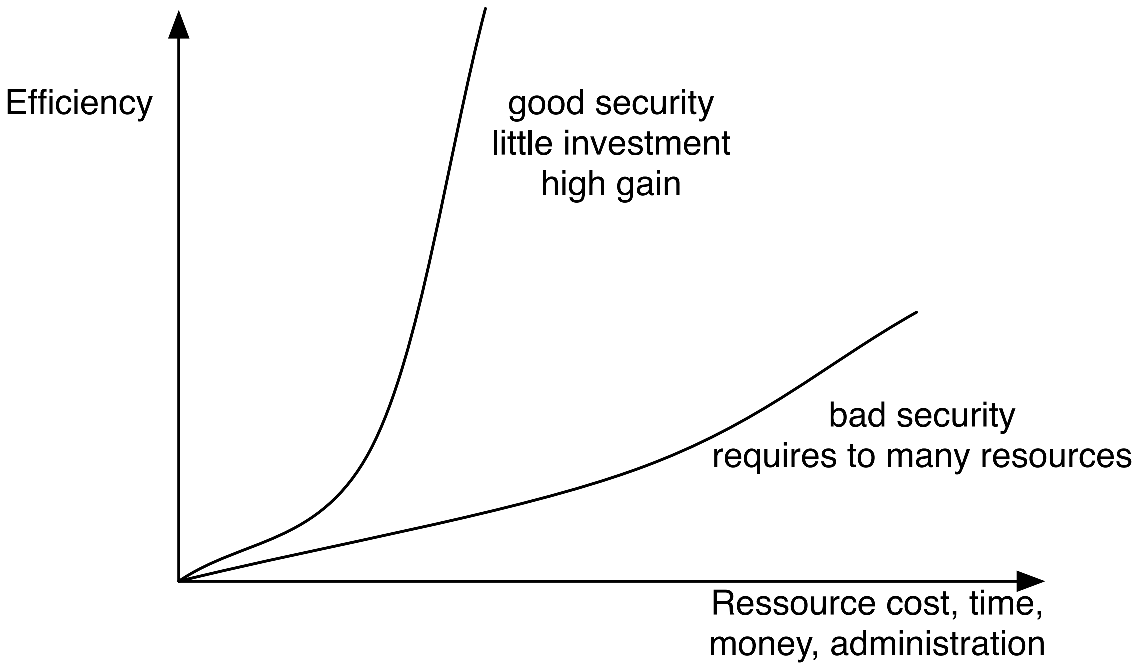
The attack

One of these is the Chilean news site's claim that the attack started with a LinkedIn advert offering a developer role to which a Redbanc employee replied.

The attackers set up a Skype call to conduct an interview during which the individual was tricked into downloading a file called ApplicationPDF.exe, sent via a weblink, which subsequently infected the employee's computer.

https://nakedsecurity.sophos.com/2019/01/21/attackers-used-a-linkedin-job-ad-and-skype-call-to-breach-banks-defences/

Good security



You always have limited resources for protection - use them as best as possible

Recommendations

Keep updated!

- read web sites, books, articles, mailing lists, Twitter, ...

Always have a chapter on security evaluation

- any process must have security, like RFC Request for Comments have

Incident Response

- you WILL have security incidents, be prepared

Write down security policy

- including software and e-mail policies

Advice

Use technology

Learn the technology - read the freaking manual

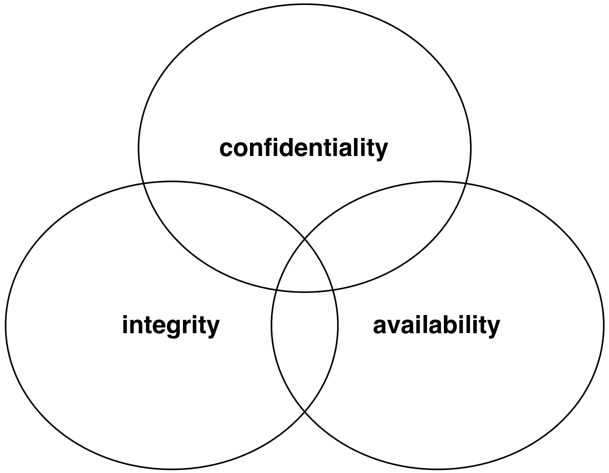
Think about the data you have, upload, facebook license?! WTF!

Think about the data you create - nude pictures taken, where will they show up?

- Turn off features you don't use
- Turn off network connections when not in use
- Update software and applications
- Turn on encryption: IMAP**S**, POP3**S**, HTTP**S** also for data at rest, full disk encryption, tablet encryption
- Lock devices automatically when not used for 10 minutes
- Dont trust fancy logins like fingerprint scanner or face recognition on cheap devices

But which features to disable? Let the security principles guide you

Confidentiality, Integrity and Availability



We want to protect something

Confidentiality - data kept a secret

Integrity - data is not subjected to unauthorized changes

Availability - data and systems are available when needed

What is data?

Personal data you dont want to loose:

- Wedding pictures
- Pictures of your children
- Sextapes
- Personal finances

Source: picture of my son less than 24 hours old - precious!

Security is a process

Remember:

- what is information and security?
- Data kept electronically
- Data kept in physical form
- Dont forget the human element of security

Incident Response and Computer Forensics reaction to incidents

Good security is the result of planning and long-term work

Security is a process, not a product, Bruce Schneier

Source for quote: https://www.schneier.com/essays/archives/2000/04/the_process_of_secur.html

Work together

Team up!

We need to share security information freely

We often face the same threats, so we can work on solving these together

Goals of Security

Prevention - means that an attack will fail

Detection - determine if attack is underway, or has occured - report it

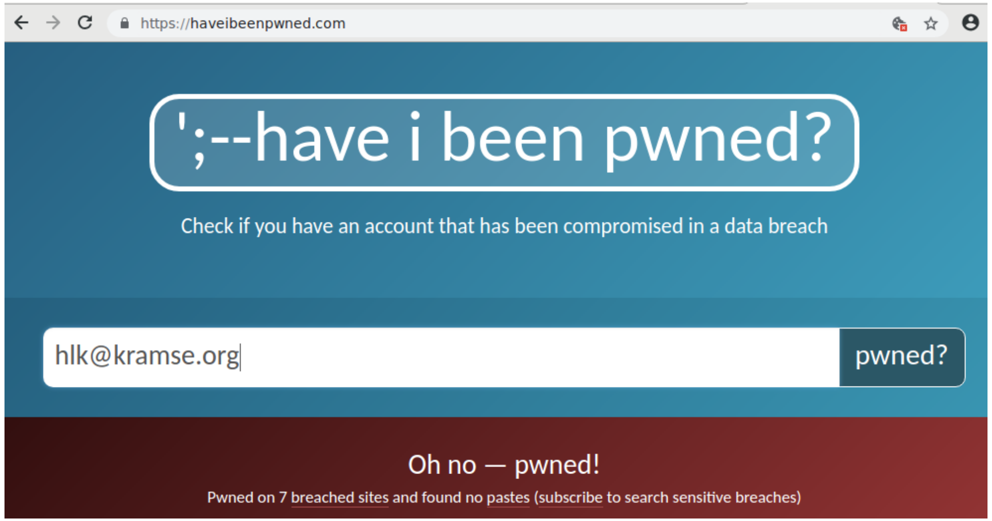
Recovery - stop attack, assess damage, repair damage

Policy and Mechanism

Definition 1-1. A *security policy* is a statement of what is, and what is not, allowed.
Definition 1-2. A *security mechanism* is a method, tool or procedure for enforcing a security policy.

Quote from Matt Bishop, Computer Security section 1.3

Your data has already have been owned by criminals



https://haveibeenpwned.com

';--have i been pwned?

Check if you have an account that has been compromised in a data breach

hlk@kramse.org

Oh no — pwned!

Pwned on 7 breached sites and found no pastes (subscribe to search sensitive breaches)

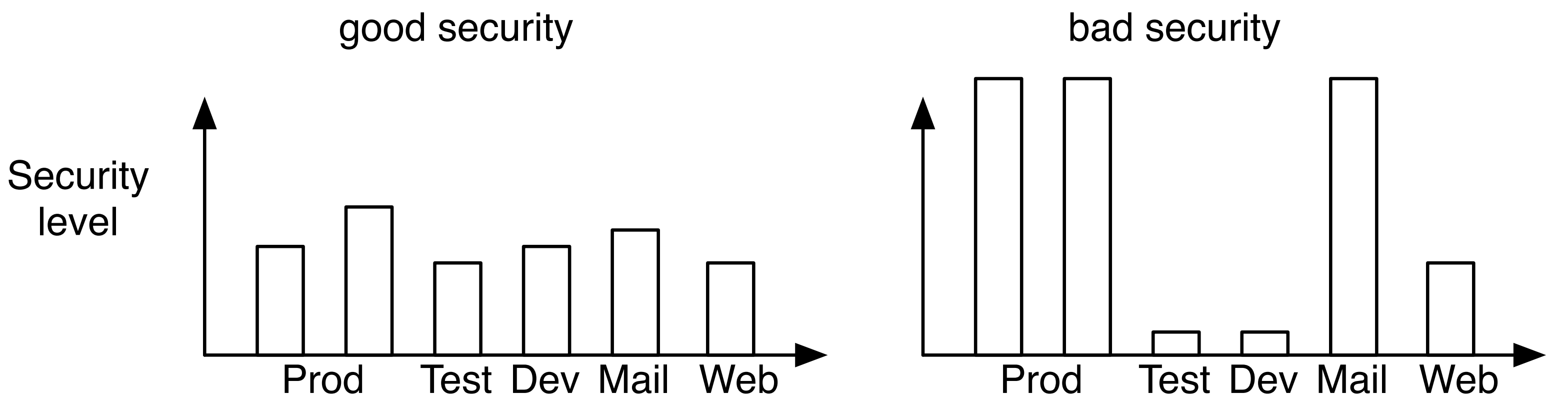
Your data is already being sold, and resold on the Internet

Stop reusing passwords, use a password safe to generate and remember

Check you own email addresses on https://haveibeenpwned.com/

Go ahead try the web site - hold up your hand if you are in those dumps

Balanced security



Better to have the same level of security

If you have bad security in some part - guess where attackers will end up

Hackers are not required to take the hardest path into the network

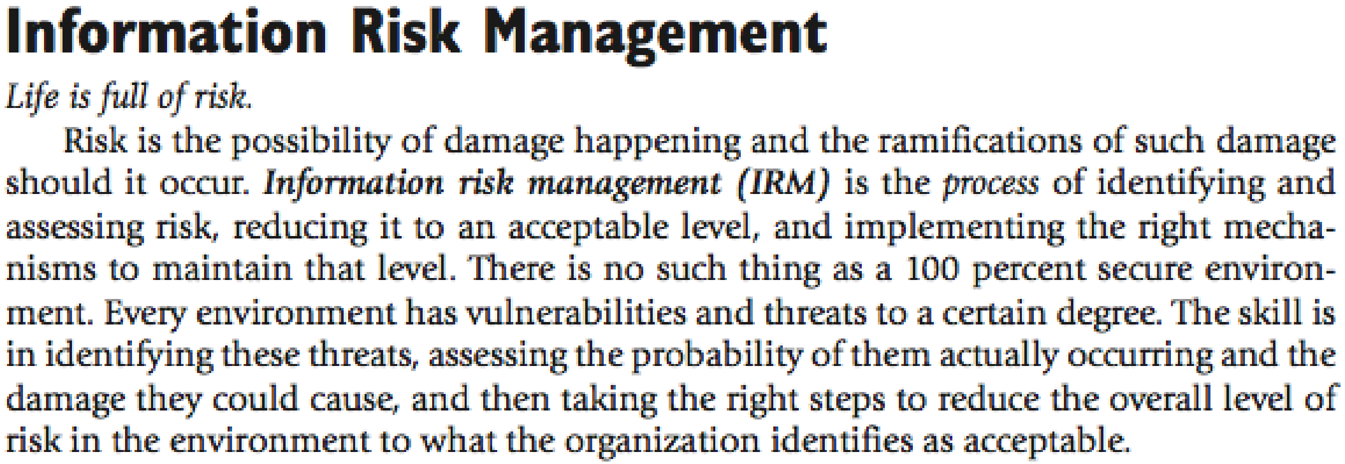
Realize there is no such thing as 100% security

Cost-Benefit Analysis

Benefits of computer security must be weighed against value of assets

Often more expensive to add security mechanisms to a system, than designing them in

Risk management defined



Information Risk Management

Life is full of risk.

Risk is the possibility of damage happening and the ramifications of such damage should it occur. ***Information risk management (IRM)*** is the *process* of identifying and assessing risk, reducing it to an acceptable level, and implementing the right mechanisms to maintain that level. There is no such thing as a 100 percent secure environment. Every environment has vulnerabilities and threats to a certain degree. The skill is in identifying these threats, assessing the probability of them actually occurring and the damage they could cause, and then taking the right steps to reduce the overall level of risk in the environment to what the organization identifies as acceptable.

Source: Shon Harris *CISSP All-in-One Exam Guide*

Quantitative Risk Assessment

> In **quantitative risk assessment an annualized loss expectancy (ALE) may be used to justify the cost of implementing countermeasures to protect an asset.** This may be calculated by multiplying the single loss expectancy (SLE), which is the loss of value based on a single security incident, with the annualized rate of occurrence (ARO), which is an estimate of how often a threat would be successful in exploiting a vulnerability.

Quote from https://en.wikipedia.org/wiki/Risk_assessment

Annualized Loss Expectancy

The annualized loss expectancy (ALE) is the product of the annual rate of occurrence (ARO) and the single loss expectancy (SLE). It is mathematically expressed as:

$$ALE = ARO \times SLE$$

Suppose that an asset is valued at $100,000, and the Exposure Factor (EF) for this asset is 25%. The single loss expectancy (SLE) then, is 25% * $100,000, or $25,000.

The annualized loss expectancy is the product of the annual rate of occurrence (ARO) and the single loss expectancy.

For an annual rate of occurrence of one, the annualized loss expectancy is 1 * $25,000, or $25,000.

For an ARO of three, the equation is: ALE = 3 * $25,000. Therefore: ALE = $75,000

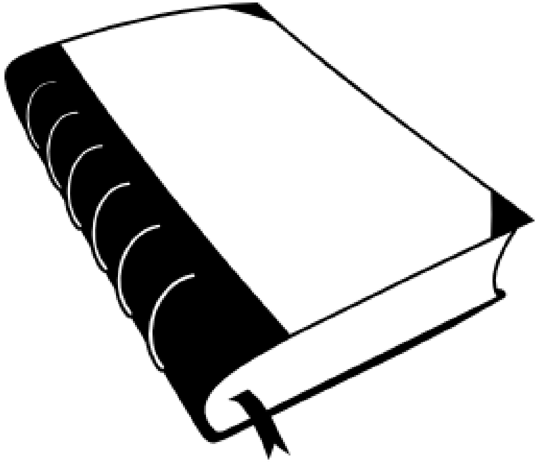
Example from:
https://en.wikipedia.org/wiki/Annualized_loss_expectancy
https://en.wikipedia.org/wiki/Single-loss_expectancy

Qualitative risk analysis

> **Qualitative risk analysis** is a technique used to quantify risk associated with a particular hazard. Risk assessment is used for uncertain events that could have **many outcomes and for which there could be significant consequences.** Risk is a function of probability of an event (a particular hazard occurring) and the consequences given the event occurs. Probability refers to the likelihood that a hazard will occur. **In a qualitative assessment, probability and consequence are not numerically estimated, but are evaluated verbally using qualifiers like high likelihood, low likelihood, etc.** Qualitative assessments are good for screening level assessments when comparing/screening multiple alternatives or for when sufficient data is not available to support numerical probability or consequence estimates. Once numbers are inserted into the analysis (either by quantifying the likelihood of a hazard or quantifying the consequences) the analysis transitions to a semi-quantitative or quantitative risk assessment.

Quote from https://en.wikipedia.org/wiki/Qualitative_risk_analysis

Fokus: Asset management



Free graphics by Lumen Design Studio

- Specielt relevant for mellemstore til store organisationer
- Hvilke assets har vi?
- Hvordan sikrer vi at vi ikke mister værdierne

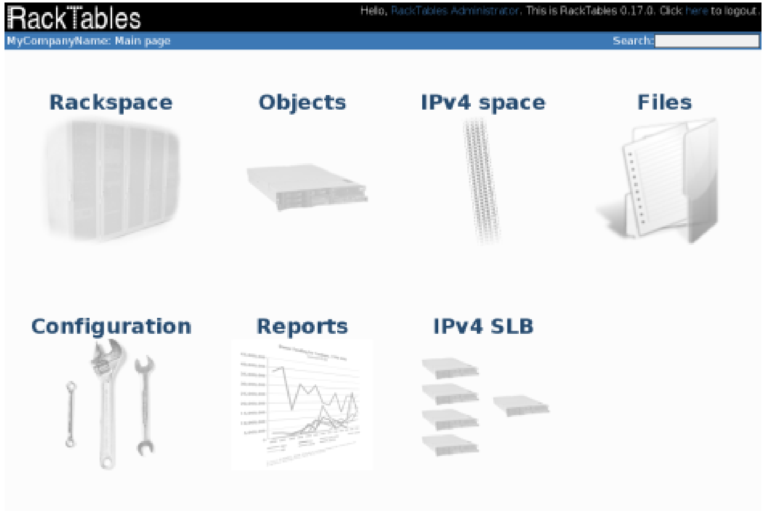
Hvad er asset management

> CIS Control 1:
> Inventory and Control of Hardware Assets Actively manage (inventory, track, and correct) all hardware devices on the network so that only authorized devices are given access, and unauthorized and unmanaged devices are found and prevented from gaining access.

Source: https://www.cisecurity.org/

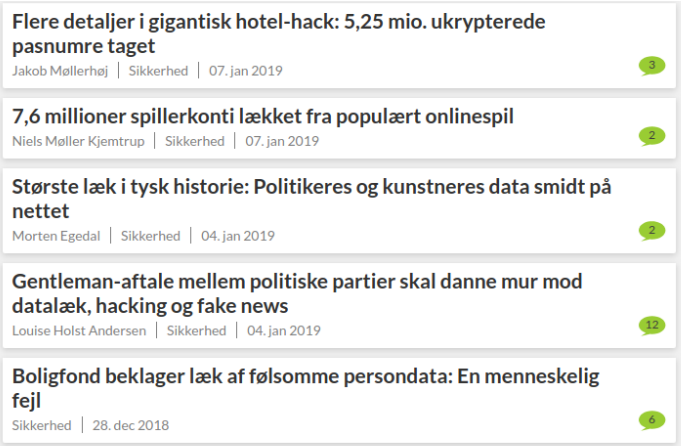
- Hardware - både indkøbte, opkoblede, udlånte, stjålne ...
- Software - licenser, indkøb, brug, opgraderingspriser
- Virtuelle arkiver
- ...

Hardware asset management



- Der findes mange systermer
- Det anbefales at bruge specialiserede systemer, a la RackTables:
  Have a list of all devices you've got, Have a list of all racks and enclosures, Mount the devices into the racks, Maintain physical ports of the devices and links between them

Software asset management - virtuelle arkiver



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Sikkerhed | 28. dec 2018 6

- Software - licenser, indkøb, brug, opgraderingspriser
- Virtuelle maskiner - er en server et asset, eller er det data?
- IP adresser
- Data arkiver - GDPR

Human Issues and Organizational Problems

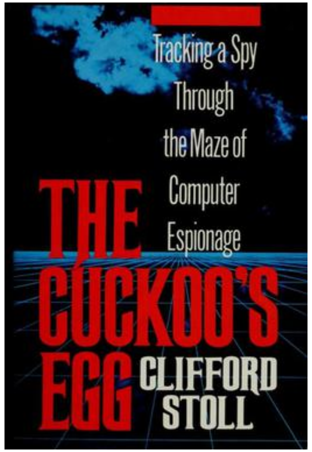
Returning to resources, it takes a lot of resources and people to secure systems:

- Time
- Money
- Skilled resources for designing, implementing, administer, monitor
- Computing resources

Often threats are focussed on outsiders, but insider threat can be common

Dont try to fix people problems with tech

Cuckoo's Egg 1986 A real spy story



Cuckoo's Egg: Tracking a Spy Through the Maze of Computer Espionage,
Clifford Stoll

During his time at working for KGB, Hess is estimated to have broken into 400 U.S. military computers
Source: https://en.wikipedia.org/wiki/Markus_Hess

Morris Internet Worm - 30 years ago

Used multiple vulnerabilities:

- Sendmail Debug functionality, we have similar things and Google Hacking
- Buffer overflow in fingerd, we still have those
- Weak passwords/password cracking, list of 432 words and /usr/dict/words, same problem today
- Trust between systems rsh, rexec, think Domain Admin today
- Found new systems using /etc/hosts.equiv, .rhosts, .forward, netstat ...

Also known as the Morris Internet Worm

The Internet Worm Program: An Analysis
Purdue Technical Report CSD-TR-823, Eugene H. Spafford

Resulted in creation of the CERT, http://www.cert.org

Internet Worms history repeats itself

Camouflage, tried to hide, malware today hides as well

- Program name set to 'sh', looks like a regular shell
- Used fork() to change process ID (PID)
- Worms in the 2000s spread quickly, like Code Red 2001 to approx 350.000 systems in a week
- SQL Slammer "It spread rapidly, infecting most of its 75,000 victims within ten minutes."

New malware today can use the same strategies

Except a lot of malware tries to stay hidden, less noisy

Using a small password list of 50 words it is possible to create your own botnet with 100.000s

Access Control Matrix Model

Access Control Matrix model describes rights of subjects over all entities in a matrix

Example The Unix system read, write, execute for files, devices, processes

Everything is a file, sort of

A directory write permission allows one to rename files

Unix superuser root can access all files, processes etc.

Trusted Computing Base

Definition 20-6. A *trusted computing base* (TCB) consists of all protection mechanisms within a computer system – including hardware, firmware, and software – that are responsible for enforcing a security policy

Quote from Matt Bishop, Computer Security

Keeping this small, simple and understandable help keeping systems more secure.

Example the Qubes OS depend on few security-critical components:
https://www.qubes-os.org/doc/security-critical-code/

DSH book Chapter 1: Creating a Security Program

> Creating or improving upon a security program can be a daunting task. With so many facets to consider, the more initial thought and planning that is put into the creation of this program, the easier it will be to manage in the long run. In this chap- ter, we will cover the skeleton of a security program and initial administrative steps.

Source: *Defensive Security Handbook: Best Practices for Securing Infrastructure*, Lee Brotherston, Amanda Berlin
ISBN: 978-1-491-96038-7

- We will now look into this book and the first chapter
- And why it is recommended – very practical while being quite short

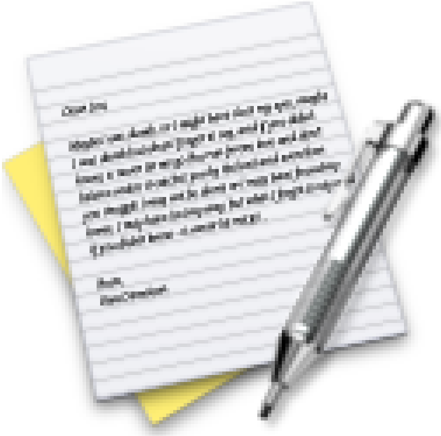
DSH book Chapter 2: Asset Management and Documentation

> As a whole, **asset management** is not an information security function. However, there are definitely components to it that assist in **strengthening the overall security posture**. It is one of the most **difficult verticals to cover**. Without proper asset man- agement, an environment **cannot be protected** to its full potential. It is impossible to protect assets that are **unknown**. In larger networks, it is **next to impossible** to completely be aware of each and **every device that is connected** or every piece of software the users may have installed. However, with the **correct security controls in place, it becomes much easier.**

Source: *Defensive Security Handbook: Best Practices for Securing Infrastructure*, Lee Brotherston, Amanda Berlin ISBN: 978-1-491-96038-7 (bold by me)

- We will now look into the second chapter
- Then afterwards we will look into how to produce an asset list of what is connected to the network using Nmap
- Today we will mostly run Nmap, focus on output – later we can get into details how it works

Exercise

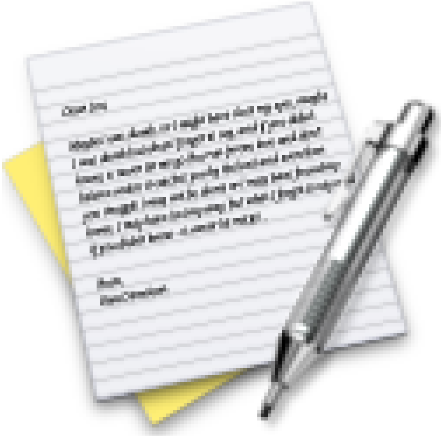


Now lets do the exercise

⚠ Discover active systems ping and port sweep 15min

which is number **11** in the exercise PDF.

Exercise

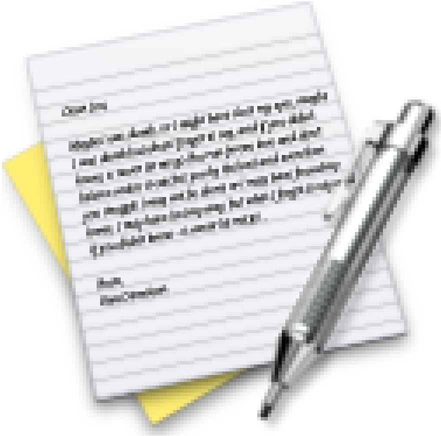


Now lets do the exercise

⚠ Execute nmap TCP and UDP port scan 20 min

which is number **12** in the exercise PDF.

Exercise



Now lets do the exercise

⚠ Perform nmap OS detection 15min

which is number **13** in the exercise PDF.

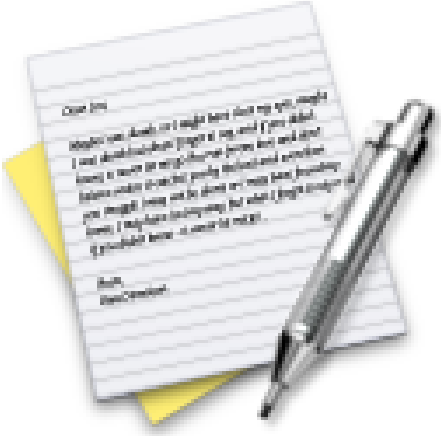
Exercise

Now lets do the exercise

ℹ Nmap full scan - 15min

which is number **15** in the exercise PDF.

Exercise

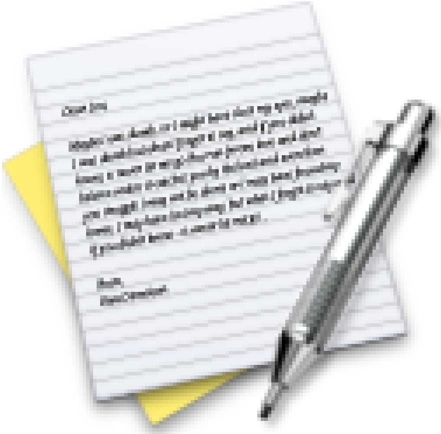


Now lets do the exercise

ℹ Reporting Nmap HTML 10min

which is number **16** in the exercise PDF.

Exercise



Now lets do the exercise

ℹ Nmap Scripting Engine NSE scripts 20min

which is number **18** in the exercise PDF.

For Next Time

Think about the subjects from this time, write down questions

Check the plan for chapters to read in the books

Visit web sites and download papers if needed

Retry the exercises to get more confident using the tools