



Welcome to

## 2. Overview of Enterprise Attacks

KEA Kompetence Computer Systems Security 2019

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Slides are available as PDF, kramse@Github

2-overview-enterprise-attacks.tex in the repo security-courses

# Plan for today



## Subjects

- Get an idea of the MITRE ATT&CK framework
- Do a little hacking using Kali and Metasploit

## Exercises

- Quick port scan intro with Nmap
- Run Armitage Hail-Mary against Metasploitable, describe attacks that succeeded in relation to MITRE ATT&CK framework

# Reading Summary



Read ATT&CK 101 Blog Post

<https://medium.com/mitre-attack/att-ck-101-17074d3bc62>

and browse MITRE ATT&CK web site

<https://attack.mitre.org/>

# Vulnerabilities - CVE



Common Vulnerabilities and Exposures (CVE):

- classification
- identification

When discovered each vuln gets a CVE ID

CVE maintained by MITRE - not-for-profit org for research and development in the USA.

National Vulnerability Database search for CVE.

Sources: <http://cve.mitre.org/> og <http://nvd.nist.gov>

also checkout OWASP Top-10 <http://www.owasp.org/>

# Sample vulnerabilities



CVE-2000-0884

IIS 4.0 and 5.0 allows remote attackers to read documents outside of the web root, and possibly execute arbitrary commands, via malformed URLs that contain UNICODE encoded characters, aka the "Web Server Folder Traversal" vulnerability.

CVE-2002-1182

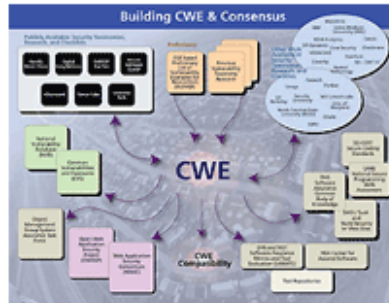
IIS 5.0 and 5.1 allows remote attackers to cause a denial of service (crash) via malformed WebDAV requests that cause a large amount of memory to be assigned.

Source:

<http://cve.mitre.org/-CVE>

And updates from vendors reference these too! A closed loop

# CWE Common Weakness Enumeration



[Enlarge](#)

**CWE™** International in scope and free for public use, CWE provides a unified, measurable set of software weaknesses that is enabling more effective discussion, description, selection, and use of software security tools and services that can find these weaknesses in source code and operational systems as well as better understanding and management of software weaknesses related to architecture and design.

## CWE in the Enterprise

- ▲ [Software Assurance](#)
- ▲ [Application Security](#)
- ▲ [Supply Chain Risk Management](#)
- ▲ [System Assessment](#)
- ▲ [Training](#)
- ▲ [Code Analysis](#)
- ▲ [Remediation & Mitigation](#)
- ▲ [NVD \(National Vulnerability Database\)](#)
- ▲ [Recommendation ITU-T X.1524 CWE, ITU-T CYBEX Series](#)

<http://cwe.mitre.org/>

# CWE/SANS Monster mitigations



## Monster Mitigations

These mitigations will be effective in eliminating or reducing the severity of the Top 25. These mitigations will also address many weaknesses that are not even on the Top 25. If you adopt these mitigations, you are well on your way to making more secure software.

A [Monster Mitigation Matrix](#) is also available to show how these mitigations apply to weaknesses in the Top 25.

ID	Description
<a href="#">M1</a>	Establish and maintain control over all of your inputs.
<a href="#">M2</a>	Establish and maintain control over all of your outputs.
<a href="#">M3</a>	Lock down your environment.
<a href="#">M4</a>	Assume that external components can be subverted, and your code can be read by anyone.
<a href="#">M5</a>	Use industry-accepted security features instead of inventing your own.
<a href="#">GP1</a>	(general) Use libraries and frameworks that make it easier to avoid introducing weaknesses.
<a href="#">GP2</a>	(general) Integrate security into the entire software development lifecycle.
<a href="#">GP3</a>	(general) Use a broad mix of methods to comprehensively find and prevent weaknesses.
<a href="#">GP4</a>	(general) Allow locked-down clients to interact with your software.

See the [Monster Mitigation Matrix](#) that maps these mitigations to Top 25 weaknesses.

Source: <http://cwe.mitre.org/top25/index.html>

# Hacker tools



*Improving the Security of Your Site by Breaking Into it*  
by Dan Farmer and Wietse Venema in 1993

Later in 1995 release the software SATAN

*Security Administrator Tool for Analyzing Networks*

Caused some commotion, panic and discussions, every script kiddie can hack, the internet will melt down!

We realize that SATAN is a two-edged sword – like many tools, it can be used for good and for evil purposes. We also realize that intruders (including wannabees) have much more capable (read intrusive) tools than offered with SATAN.

label Source: <http://www.fish2.com/security/admin-guide-to-cracking.html>



# Use hacker tools!



Port scan can reveal holes in your defense

Web testing tools can crawl through your site and find problems

Pentesting is a verification and proactively finding problems

Its not a silverbullet and mostly find known problems in existing systems

Combined with honeypots they may allow better security

# Agreements for testing networks



Danish Criminal Code

Straffelovens paragraf 263 Stk. 2. Med bøde eller fængsel indtil 1 år og 6 måneder straffes den, der uberettiget skaffer sig adgang til en andens oplysninger eller programmer, der er bestemt til at bruges i et informationssystem.

Hacking can result in:

- Getting your devices confiscated by the police
- Paying damages to persons or businesses
- If older getting a fine and a record – even jail perhaps
- Getting a criminal record, making it hard to travel to some countries and working in security
- Fear of terror has increased the focus – so dont step over bounds!

Asking for permission and getting an OK before doing invasive tests, always!

# ISC2 code of ethics



## Code of Ethics Preamble:

- The safety and welfare of society and the common good, duty to our principles, and to each other, requires that we adhere, and be seen to adhere, to the highest ethical standards of behavior.
- Therefore, strict adherence to this Code is a condition of certification.

## Code of Ethics Canons:

- Protect society, the common good, necessary public trust and confidence, and the infrastructure.
- Act honorably, honestly, justly, responsibly, and legally.
- Provide diligent and competent service to principles.
- Advance and protect the profession.

CISSP certified people sign papers to this extent.

<https://www.isc2.org/ethics/default.aspx>

# What happens today?



Think like a blue team member find vulnerable systems

Get basic tools running

- ping sweep, port scan
- OS detection – TCP/IP or banner grab
- Service scan – rpcinfo, netbios, ...
- telnet/netcat interact with services

Exploit: Metasploit, Nikto, exploit programs

Cleanup/hardening not shown but in practice:

- Make a report
- Change and improve systems
- Follow up on critical vulnerabilities
- Change configuration, architecture etc.

Remember to document process, need to show others what you do

# Trinity breaking in



```
80/tcp      open       http
81/tcp      open       https
10.0.0.1 [mobile]
11 # nmap -v -ss -O 10.2.2.2
11
13 Starting nmap U. 2.54BETA25
13 Insufficient responses for TCP sequencing (3), OS detection
13 accurate
14 Interesting ports on 10.2.2.2:
44 (The 1539 ports scanned but not shown below are in state: closed)
51 Port      State      Service
51 22/tcp     open      ssh
58
68 No exact OS matches for host
68
24 Nmap run completed -- 1 IP address (1 host up) scanned
50 # sshnuke 10.2.2.2 -rootpw-"210H0101"
Connecting to 10.2.2.2:ssh ... successful.
Re Attempting to exploit SSHv1 CRC32 ... successful.
IP Resetting root password to "210H0101".
System open: Access Level <9>
Nm # ssh 10.2.2.2 -l root
root@10.2.2.2's password: [REDACTED]
```

Very realistic:

<https://nmap.org/movies/>

[https://youtu.be/51lGCTgqE\\_w](https://youtu.be/51lGCTgqE_w)

# Kali Linux the pentest toolbox



The most advanced penetration testing distribution, ever.

From the creators of BackTrack comes Kali Linux, the most advanced and versatile penetration testing distribution ever created. BackTrack has grown far beyond its humble roots as a live CD and has now become a full-fledged operating system. With all this buzz, you might be asking yourself: - [What's new ?](#)

**KALI LINUX**  
"the quieter you become, the more you are able to hear"

**PENETRATION TESTING,  
REDEFINED.**

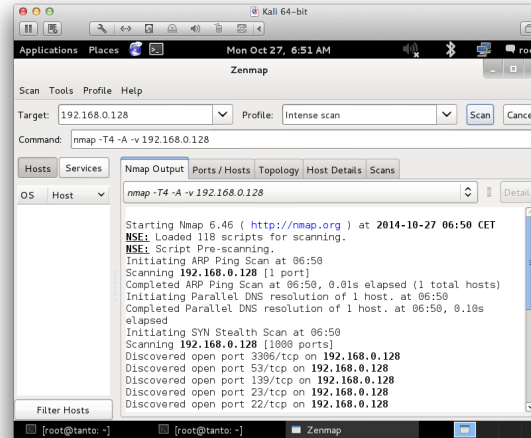
A Project By Offensive Security

Kali <http://www.kali.org/>

100.000s of videos on youtube alone, searching for kali and \$TOOL

Also versions for Raspberry Pi, mobile and other small computers

# Really do Nmap your world



- Nmap is a port scanner, but does more
- Finding your own infrastructure available from the guest network?
- See your printers having all the protocols enabled AND a wireless?

# Basal Portscanning



Hvad er portscanning

Afprøvning af alle porte fra 0/1 og op til 65535

Målet er at identificere åbne porte – sårbare services

Typisk TCP og UDP scanning

TCP scanning er ofte mere pålidelig end UDP scanning

TCP handshake er nemmere at identificere, skal svare SYN

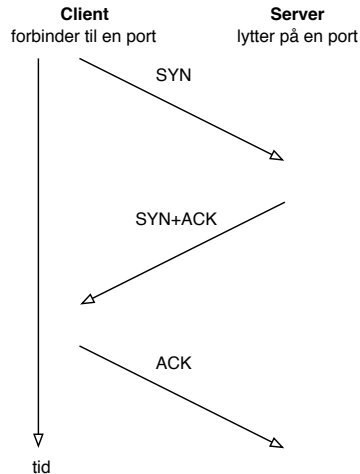
UDP applikationer svarer forskelligt – hvis overhovedet

Svarer på rigtige forespørgsler, uden firewall svares ICMP på lukkede porte

Brug GUI programmet Zenmap mens i lærer Nmap at kende



# TCP three-way handshake



- **TCP SYN half-open** scans
- Tidligere loggede systemer kun når der var etableret en fuld TCP forbindelse – dette kan/kunne udnyttes til *stealth*-scans
- Hvis en maskine modtager mange SYN pakker kan dette fylde tabellen over connections op – og derved afholde nye forbindelser fra at blive oprette – **SYN-flooding**

# Nmap port sweep after webserver



```
root@cornerstone:~# nmap -p80,443 172.29.0.0/24
```

```
Starting Nmap 6.47 ( http://nmap.org ) at 2015-02-05 07:31 CET
```

```
Nmap scan report for 172.29.0.1
```

```
Host is up (0.00016s latency).
```

PORT	STATE	SERVICE
------	-------	---------

80/tcp	open	http
--------	------	------

443/tcp	filtered	https
---------	----------	-------

```
MAC Address: 00:50:56:C0:00:08 (VMware)
```

```
Nmap scan report for 172.29.0.138
```

```
Host is up (0.00012s latency).
```

PORT	STATE	SERVICE
------	-------	---------

80/tcp	open	http
--------	------	------

443/tcp	closed	https
---------	--------	-------

```
MAC Address: 00:0C:29:46:22:FB (VMware)
```

# Nmap port sweep after SNMP port 161/UDP



```
root@cornerstone:~# nmap -sU -p 161 172.29.0.0/24
Starting Nmap 6.47 ( http://nmap.org ) at 2015-02-05 07:30 CET
Nmap scan report for 172.29.0.1
Host is up (0.00015s latency).
PORT      STATE      SERVICE
161/udp    open|filtered snmp
MAC Address: 00:50:56:C0:00:08 (VMware)

Nmap scan report for 172.29.0.138
Host is up (0.00011s latency).
PORT      STATE      SERVICE
161/udp    closed snmp
MAC Address: 00:0C:29:46:22:FB (VMware)
...
Nmap done: 256 IP addresses (5 hosts up) scanned in 2.18 seconds
```

# Nmap Advanced OS detection



```
root@cornerstone:~# nmap -A -p80,443 172.29.0.0/24
Starting Nmap 6.47 ( http://nmap.org ) at 2015-02-05 07:37 CET
Nmap scan report for 172.29.0.1
Host is up (0.00027s latency).
PORT      STATE      SERVICE VERSION
80/tcp    open      http      Apache httpd 2.2.26 ((Unix) DAV/2 mod_ssl/2.2.26 OpenSSL/0.9.8zc)
|_http-title: Site doesn't have a title (text/html).
443/tcp   filtered  https
MAC Address: 00:50:56:C0:00:08 (VMware)
Device type: media device|general purpose|phone
Running: Apple iOS 6.X|4.X|5.X, Apple Mac OS X 10.7.X|10.9.X|10.8.X
OS details: Apple iOS 6.1.3, Apple Mac OS X 10.7.0 (Lion) - 10.9.2 (Mavericks)
or iOS 4.1 - 7.1 (Darwin 10.0.0 - 14.0.0), Apple Mac OS X 10.8 - 10.8.3 (Mountain Lion)
or iOS 5.1.1 - 6.1.5 (Darwin 12.0.0 - 13.0.0)
OS and Service detection performed.
Please report any incorrect results at http://nmap.org/submit/
```

- Lavniveau måde at identificere operativsystemer på, prøv også `nmap -A`
- Send pakker med *anderledes* indhold, observer svar
- En tidlig og detaljeret reference: *ICMP Usage In Scanning* Version 3.0, Ofir Arkin, 2001

# Heartbleed CVE-2014-0160



## The Heartbleed Bug

The Heartbleed Bug is a serious vulnerability in the popular OpenSSL cryptographic software library. This weakness allows stealing the information protected, under normal conditions, by the SSL/TLS encryption used to secure the Internet. SSL/TLS provides communication security and privacy over the Internet for applications such as web, email, instant messaging (IM) and some virtual private networks (VPNs).

The Heartbleed bug allows anyone on the Internet to read the memory of the systems protected by the vulnerable versions of the OpenSSL software. This compromises the secret keys used to identify the service providers and to encrypt the traffic, the names and passwords of the users and the actual content. This allows attackers to eavesdrop on communications, steal data directly from the services and users and to impersonate services and users.



Source: <http://heartbleed.com/>

# Scan for Heartbleed and SSLv2/SSLv3



## Example Usage

```
nmap -sV -sC <target>
```

## Script Output

```
443/tcp open  https  syn-ack
| sslv2:
|   SSLv2 supported
|   ciphers:
|     SSL2_DES_192_EDE3_CBC_WITH_MD5
|     SSL2_IDEA_128_CBC_WITH_MD5
|     SSL2_RC2_CBC_128_CBC_WITH_MD5
|     SSL2_RC4_128_WITH_MD5
|     SSL2_DES_64_CBC_WITH_MD5
|     SSL2_RC2_CBC_128_CBC_WITH_MD5
|     SSL2_RC4_128_EXPORT40_WITH_MD5
|_
```

```
nmap -p 443 --script ssl-heartbleed <target>
```

```
https://nmap.org/nsedoc/scripts/ssl-heartbleed.html
```

```
masscan 0.0.0.0/0 -p0-65535 --heartbleed
```

```
https://github.com/robertdavidgraham/masscan
```

Almost every new vulnerability will have Nmap recipe

# Exercise



Now lets do the exercise

## Discover active systems ping sweep 10 min

which is number **5** in the exercise PDF.

# Exercise



Now lets do the exercise

## Execute nmap TCP and UDP port scan 20 min

which is number **6** in the exercise PDF.



# Exercise



Now lets do the exercise

## Perform nmap OS detection 10 min

which is number **7** in the exercise PDF.

# Local vs. remote exploits



**Local vs. remote** angiver om et exploit er rettet mod en sårbarhed lokalt på maskinen, eksempelvis opnå højere privilegier, eller beregnet til at udnytter sårbarheder over netværk

**Remote root exploit** - den type man frygter mest, idet det er et exploit program der når det afvikles giver angriberen fuld kontrol, root user er administrator på Unix, over netværket.

**Zero-day exploits** dem som ikke offentliggøres – dem som hackere holder for sig selv. Dag 0 henviser til at ingen kender til dem før de offentliggøres og ofte er der umiddelbart ingen rettelser til de sårbarheder

# Metasploit and Armitage Still rocking the internet



## What is it?

The Metasploit Framework is a development platform for creating security tools and exploits. The framework is used by network security professionals to perform penetration tests, system administrators to verify patch installations, product vendors to perform regression testing, and security researchers world-wide. The framework is written in the Ruby programming language and includes components written in C and assembler.

<http://www.metasploit.com/>

Armitage GUI fast and easy hacking for Metasploit

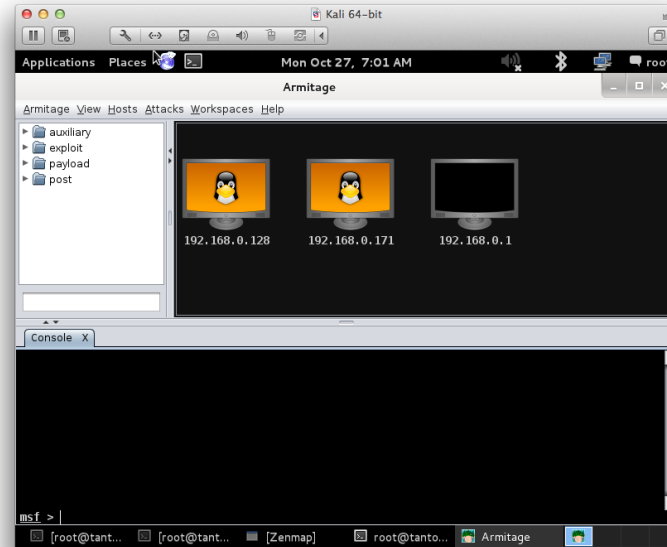
<http://www.fastandeasyhacking.com/> <http://www.offensive-security.com/metasploit>

Main\_Page

Bog: Metasploit: The Penetration Tester's Guide, No Starch Press

ISBN-10: 159327288X - ældre bog, kan undværes

# Demo: Metasploit Armitage



# Get an idea of the MITRE ATT&CK framework



MITRE ATT&CK™ is a globally-accessible knowledge base of adversary tactics and techniques based on real-world observations. The ATT&CK knowledge base is used as a foundation for the development of specific threat models and methodologies in the private sector, in government, and in the cybersecurity product and service community.

With the creation of ATT&CK, MITRE is fulfilling its mission to solve problems for a safer world — by bringing communities together to develop more effective cybersecurity. ATT&CK is open and available to any person or organization for use at no charge.

# ATT&CK™

<https://attack.mitre.org/>

# Exercise



Now lets do the exercise

## Run Armitage - Hail Mary

which is number **8** 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

Most days have less than 100 pages, but some days may have more!

Visit web sites and download papers if needed

Retry the exercises to get more confident using the tools