Welcome to

Nmap Hackerworkshop

An evening with Nmap

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Slides are available as PDF, kramse@Github
nmap-workshop.tex in the repo security-courses

Goal

Don’t Panic!

Spend an evening using Nmap tools, multiple tools:

Try different scan types from graphical Zenmap and command line

Try different tools like Nping, Ndiff

Practice real-life scenarios

Enable you to do quality port scans!

NOTE: please read the notes for each exercise, important information!

Hackertools

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

Published in 1995 then a software package SATAN *Security Administrator Tool for Analyzing Networks*

Caused quite a stir and panic, *everybody can hack, the internet will break*

> 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.

Source: `http://www.fish2.com/security/admin-guide-to-cracking.html`

DK Law - Aftale om test af netværk

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 kan betyde:

- At man skal betale erstatning til personer eller virksomheder
- At man får konfiskeret sit udstyr af politiet
- At man, hvis man er over 15 år og bliver dømt for hacking, kan få en bøde – eller fængselsstraf i alvorlige tilfælde
- At man, hvis man er over 15 år og bliver dømt for hacking, får en plettet straffeattest. Det kan give problemer, hvis man skal finde et job eller hvis man skal rejse til visse lande, fx USA og Australien
- Frygten for terror har forstærket ovenstående – så lad være!

Use hackertools!

Hackertools – Using them already? – should use them after this course

Portscans show potential access to your network

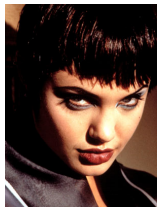
Web test tools and scanners can crawl a site and report problems

Lots of potential weaknesses can be found proactively by using these tools regularly

Note: penetration testing is not a silverbullet

Honeypots can also be used to setup traps for attackers

Hackertools are for everyone!



- Hackers work all the time to break stuff, Use hackertools:
- Nmap, Nping `http://nmap.org`
- Wireshark - `http://www.wireshark.org/`
- Aircrack-ng `http://www.aircrack-ng.org/`
- Metasploit Framework `http://www.metasploit.com/`
- Burpsuite `http://portswigger.net/burp/`
- Skipfish `http://code.google.com/p/skipfish/`
- Kali Linux `http://www.kali.org`

Most popular hacker tools `http://sectools.org/`

Kali Linux the pentest toolbox

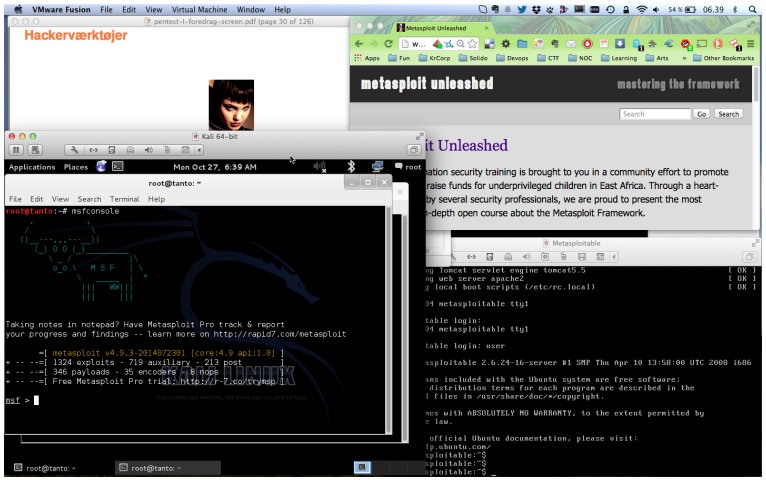
Kali `http://www.kali.org/` brings together 100s of tools

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

Also versions for Raspberry Pi, mobile and other small computers

Other pentesting Linux distributions exist, but Kali is very popular

Hackerlab setup



- Hardware: most modern laptops has CPU with virtualization
  May need to enale it in BIOS
- Software: use your favorite operating system, Windows, Mac, Linux
- Virtualization software: VMware, Virtual box, choose your poison
- Hackersoftware: Kali as a Virtual Machine `https://www.kali.org/`
- Install soft targets: Metasploitable, Windows 2000, Windows XP, ...

Exercise

Now lets do the exercise

Wireshark install

which is number 1 in the exercise PDF.

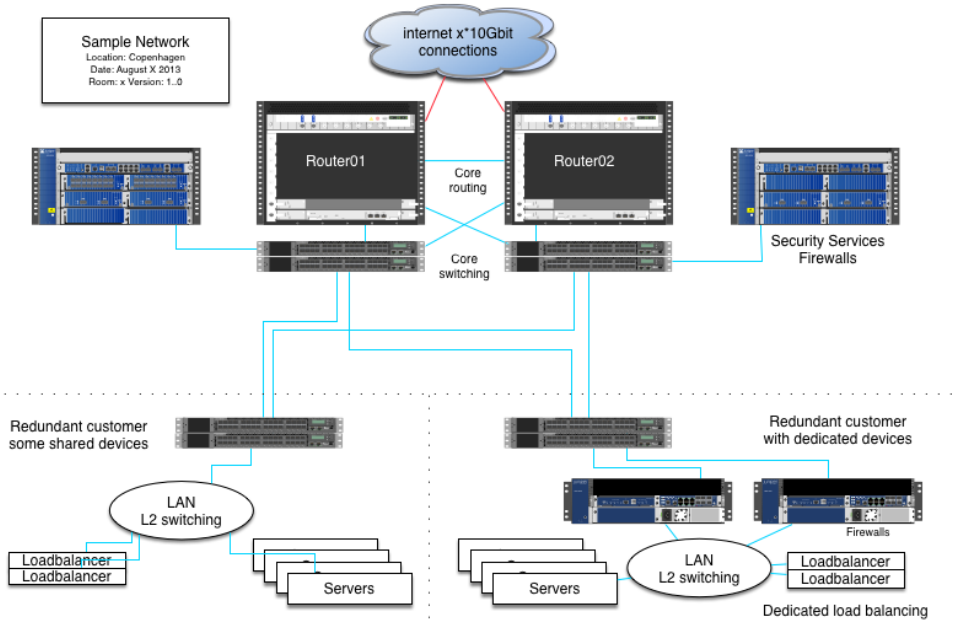
Exercise

Now lets do the exercise

Nmap install

which is number 2 in the exercise PDF.

Scope: select systems for testing



Typical scope targets:

- Routers in front of critical systems and networks - availability
- Firewalls – are traffic flows restricted
- Mail servers – open for relaying
- Web servers – remote code execution in web systems, data download

Halt testing – compromised servers

There can be reason for halting a penetration test

You should stop testing when:

- Breached and compromised systems are found. Dont mess up evidence
- Network is bad, testing will not show correct results

or if the customer wants to halt testing:

- Problems when performing the test
- Crashes in critical systems
- Other crises demand attention

NB: examples only! – always stop testing if customers ask!

Reporting – results

What is in a pentest report:

- Title, Table of contents, – total. 15-30 pages for 5 hosts
- Confidentiality agreement – Write ”Confidential” on each page
- Executive summary – big companies always want this
- Information about the scan done, what was it
- Scope and targets
- Review of all targets – detailed information and recommendations
- Conclusion – may be more technical
- Appendices – various information, Whois info about subnets and prefixes

It is the organisation that ultimately decides which recommendations to follow

What happens now?

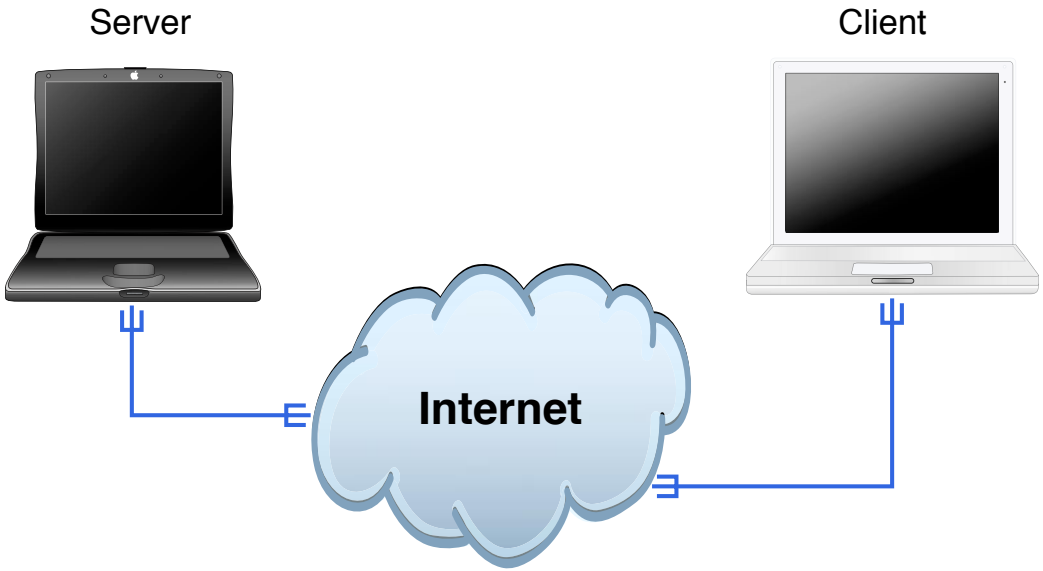
Think like a hacker

Recon phase – gather information reconnaissance

- Traceroute, Whois, DNS lookups
- Ping sweep, port scan
- OS detection – TCP/IP and banner grabbing
- Service scan – rpcinfo, netbios, ...
- telnet/netcat interact with services

Today focus on Nmap and processes around portscanning

Internet today



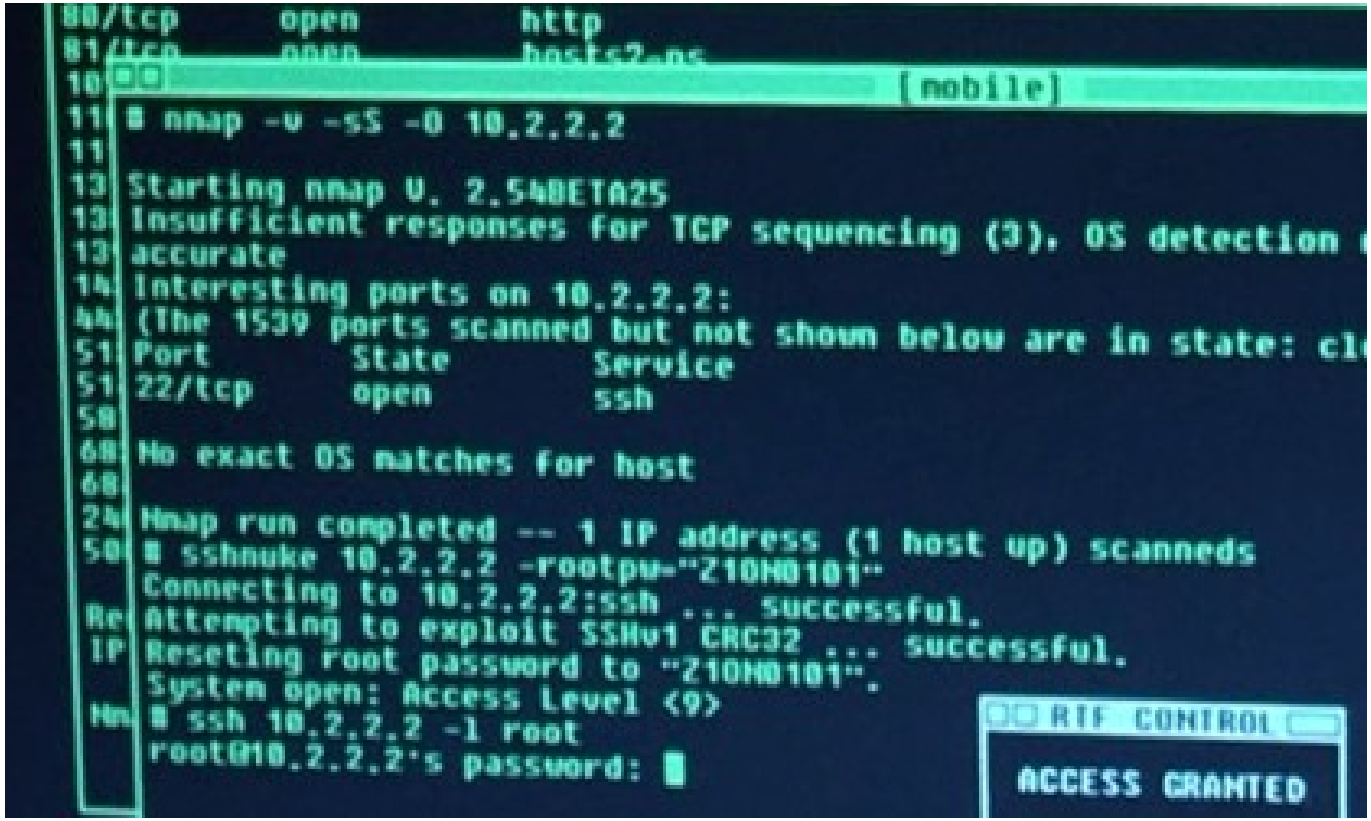
Clients and serves

Roots in academia

Protocols more than 20 years old

HTTP is becoming encrypted, but a lot other traffic is not

Trinity breaking in



Nmap has been featured in twelve movies:

https://nmap.org/movies/

https://youtu.be/51lGCTgqE_w

what is Nmap today

> Nmap ("Network Mapper") is a free and open source (license) utility for network discovery and security auditing.

Initial release September 1997; 20 years ago

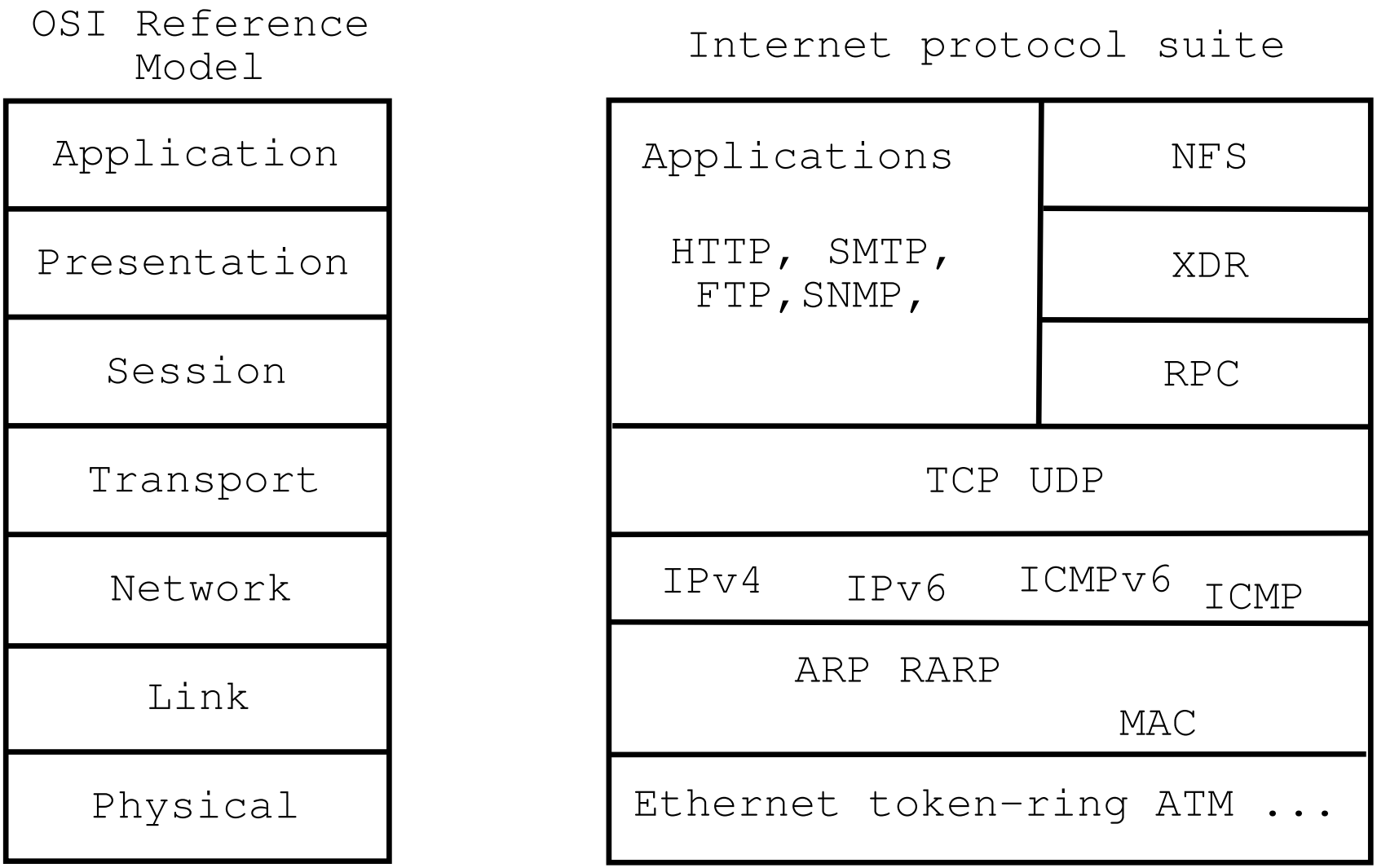
Today a package of programs for Windows, Mac, BSD, Linux, ... source

Flexible, powerful, and free!

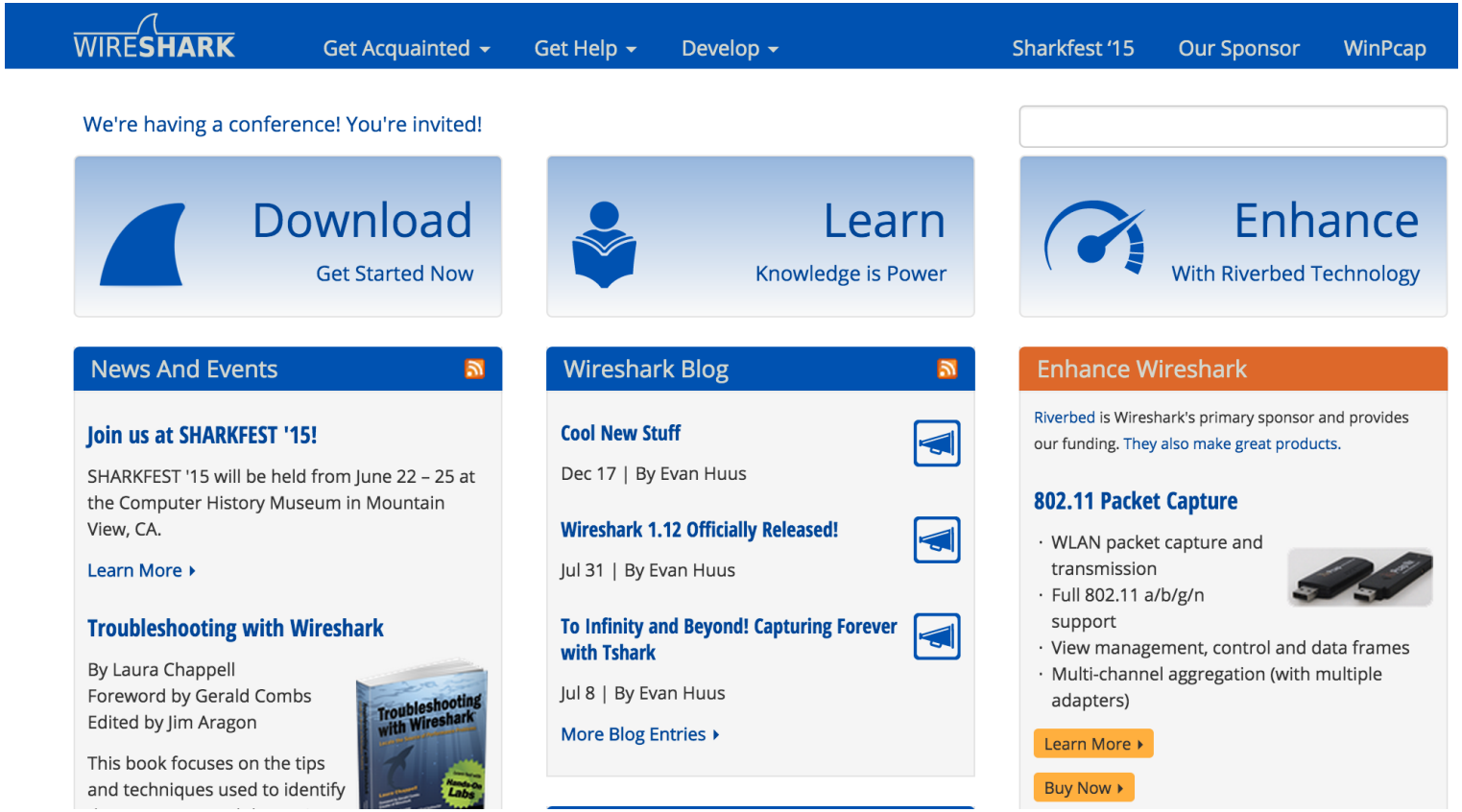
Lets check release notes, 7.70 pt. http://seclists.org/nmap-announce/2018/0

Bonus info: you can help Nmap by submitting fingerprints

OSI og Internet modellerne

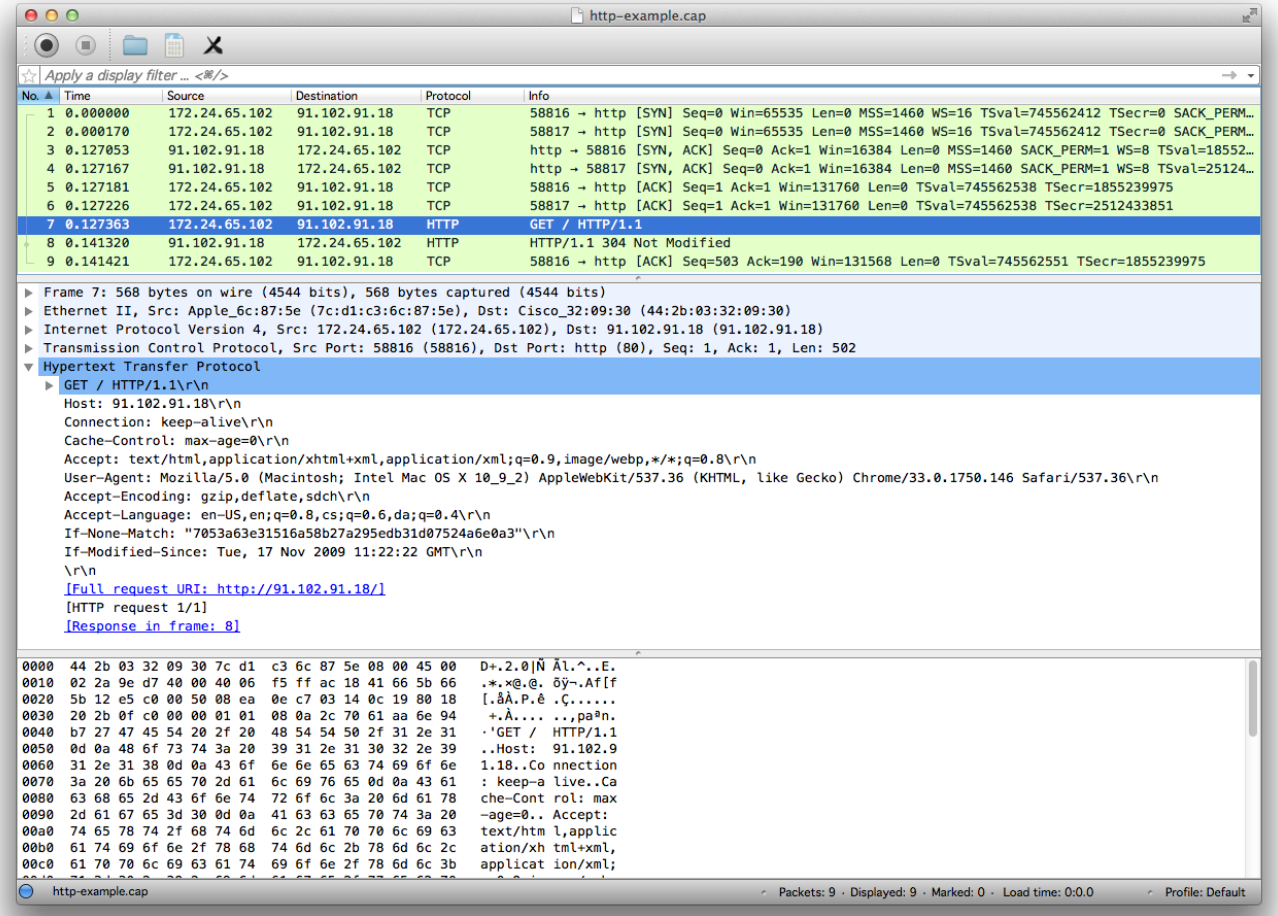


Wireshark – capture and dissect network packets



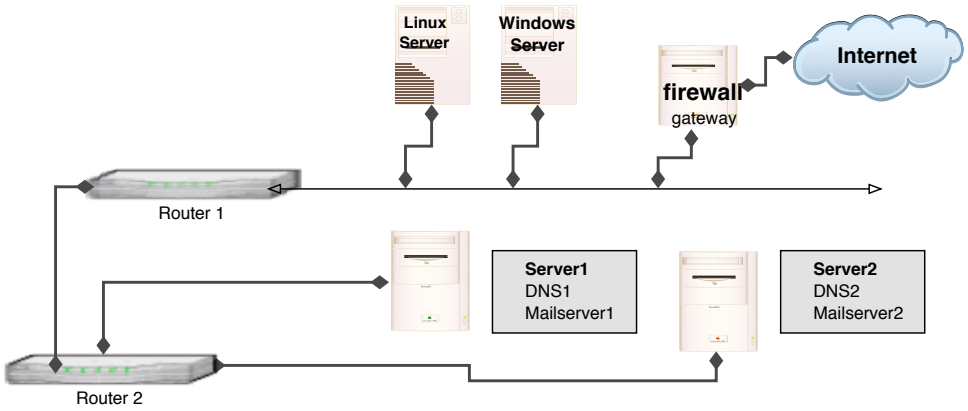
https://www.wireshark.org

Using Wireshark



Filtering is a basic but advanced function

Network mapping



Using traceroute and similar programs it is often possible to make educated guess to network topology

Time to live (TTL) for packets are decreased when crossing a router

when it reaches zero the packet is timed out, and ICMP message sent back to source

Default Unix traceroute uses UDP, Windows tracert use ICMP

traceroute – UDP

```
 #  tcpdump -i en0 host 10.20.20.129 or host 10.0.0.11
tcpdump: listening on en0
23:23:30.426342 10.0.0.200.33849 > router.33435: udp 12  [ttl 1]
23:23:30.426742 safri > 10.0.0.200:  icmp: time exceeded in-transit
23:23:30.436069 10.0.0.200.33849 > router.33436: udp 12  [ttl 1]
23:23:30.436357 safri > 10.0.0.200:  icmp: time exceeded in-transit
23:23:30.437117 10.0.0.200.33849 > router.33437: udp 12  [ttl 1]
23:23:30.437383 safri > 10.0.0.200:  icmp: time exceeded in-transit
23:23:30.437574 10.0.0.200.33849 > router.33438: udp 12
23:23:30.438946 router > 10.0.0.200: icmp: router  udp port 33438 unreachable
23:23:30.451319 10.0.0.200.33849 > router.33439: udp 12
23:23:30.452569 router > 10.0.0.200: icmp: router  udp port 33439 unreachable
23:23:30.452813 10.0.0.200.33849 > router.33440: udp 12
23:23:30.454023 router > 10.0.0.200: icmp: router  udp port 33440 unreachable
23:23:31.379102 10.0.0.200.49214 > safri.domain:  6646+ PTR?
200.0.0.10.in-addr.arpa. (41)
23:23:31.380410 safri.domain > 10.0.0.200.49214:  6646 NXDomain* 0/1/0 (93)
14 packets received by filter
0 packets dropped by kernel
```

Low TTL, UDP, high ports above 33000 = Unix traceroute signature

Basic port scanning

What is a port scan

Testing all values possible for port number from 0/1 to 65535

Goal is to identify open ports, listening and vulnerable services

Most often TCP og UDP scan

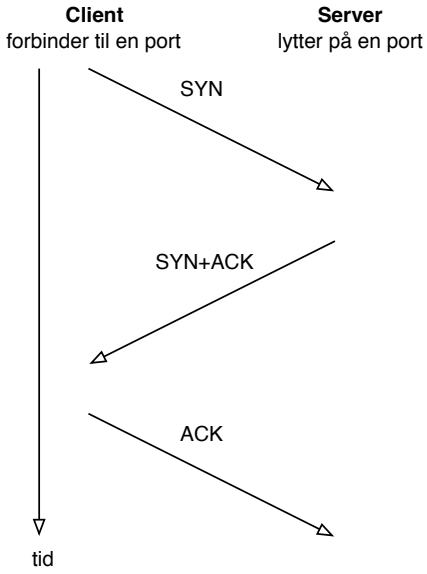
TCP scanning is more realiable than UDP scanning

TCP handshake must respond with SYN-ACK packets

UDP applications respond differently – if they even respond
so probes with real requests may get response, no firewall they respond withb ICMP on closed ports

Use the GUI program Zenmap while learning Nmap

TCP three-way handshake



- **TCP SYN half-open** scans
- in the old days systems would only log when a full TCP connection was setup – so doing only half open it was a *stealth*-scans
- Today system and IDS intrusion detection can easily monitor for this
- Sending a lot of SYN packets can create a Denial of Service – **SYN-flooding**

Exercise

Now lets do the exercise

Lookup Whois and DNS data

which is number 3 in the exercise PDF.

Exercise

Now lets do the exercise

Capturing network packets

which is number 4 in the exercise PDF.

Ping and port sweep

Scans across the network are named sweeps

Ping sweeps using ICMP Ping probes

Port sweep trying to find a specific service, like port 80 web

Quite easy to see in network traffic:

- Selecting two IP-adresser not in use
- Should not see any traffic, but if it does, its being scanned
- If traffic is received on both addresses, its a sweep – if they are a bit apart it is even better, like 10.0.0.100 and 10.0.0.200

Pro tip: a Great network intrusion detection engine (IDS), is Suricata `suricata-ids.org`

Nmap port sweep for web servers

```
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 for 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
```

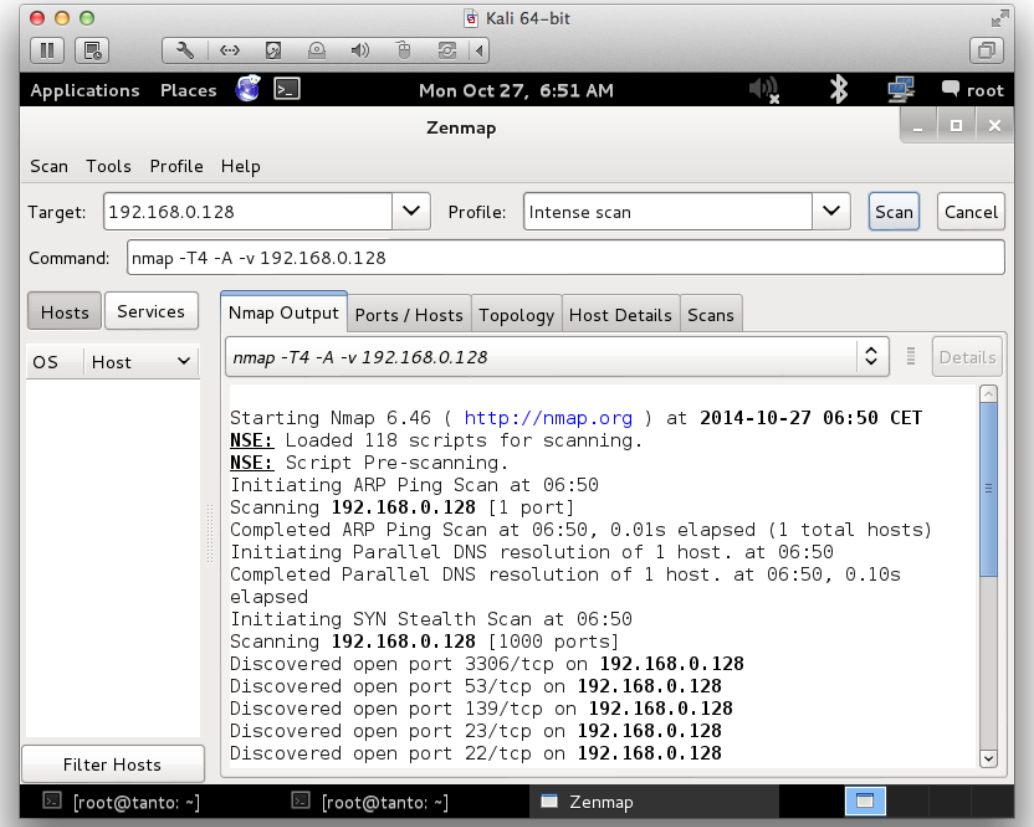
More reliable to use Nmap script with probes like –script=snmp-info

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/
```

- Low-level way to identify operating systems, also try/use `nmap -A`
- Send probes and observe responses, lookup in table of known OS and responses
- Techniques known since at least: *ICMP Usage In Scanning* Version 3.0, Ofir Arkin, 2001

Portscan using Zenmap GUI



Zenmap included in the full Nmap package `https://nmap.org`

Exercise

Now lets do the exercise

Discover active systems ping sweep

which is number 5 in the exercise PDF.

Exercise

Now lets do the exercise

Execute nmap TCP and UDP port scan

which is number 6 in the exercise PDF.

Exercise

Now lets do the exercise

Perform nmap OS detection

which is number 7 in the exercise PDF.

Exercise

Now lets do the exercise

Perform nmap service scan

which is number 8 in the exercise PDF.

Exercise

Now lets do the exercise

Nmap full scan

which is number 9 in the exercise PDF.

Experiences gathered

Lots of information

Reveals a lot about the network, operating systems, services etc.

I use a template when getting data

- Respond to ICMP: □ echo, □ mask, □ time
- Respond to traceroute: □ ICMP, □ UDP
- Open ports TCP og UDP:
- Operating system:
- ... (banner information)

Beware when doing scans it is possible to make routers, firewalls and devices perform badly or even crash!

Exercise

Now lets do the exercise

Reporting HTML

which is number 10 in the exercise PDF.

Exercise

Now lets do the exercise

Nping check ports

which is number 11 in the exercise PDF.

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/`

Heartbleed is yet another bug in SSL products

What versions of the OpenSSL are affected?
Status of different versions:

* OpenSSL 1.0.1 through 1.0.1f (inclusive) are vulnerable
* OpenSSL 1.0.1g is NOT vulnerable
* OpenSSL 1.0.0 branch is NOT vulnerable
* OpenSSL 0.9.8 branch is NOT vulnerable

Bug was introduced to OpenSSL in December 2011 and has been out in the wild since OpenSSL release 1.0.1 on 14th of March 2012. OpenSSL 1.0.1g released on 7th of April 2014 fixes the bug.

It's just a bug - but a serious one

Heartbleed hacking

```
06b0: 2D 63 61 63 68 65 0D 0A 43 61 63 68 65 2D 43 6F  -cache..Cache-Co
06c0: 6E 74 72 6F 6C 3A 20 6E 6F 2D 63 61 63 68 65 0D  ntrol: no-cache.
06d0: 0A 0D 0A 61 63 74 69 6F 6E 3D 67 63 5F 69 6E 73  ...action=gc_ins
06e0: 65 72 74 5F 6F 72 64 65 72 26 62 69 6C 6C 6E 6F  ert_order&billno
06f0: 3D 50 5A 4B 31 31 30 31 26 70 61 79 6D 65 6E 74  =PZK1101&payment
0700: 5F 69 64 3D 31 26 63 61 72 64 5F 6E 75 6D 62 65  _id=1& card_numbe
0710: XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX   r=4060xxxx413xxx
0720: 39 36 26 63 61 72 64 5F 65 78 70 5F 6D 6F 6E 74   96&card_exp_mont
0730: 68 3D 30 32 26 63 61 72 64 5F 65 78 70 5F 79 65   h=02&card_exp_ye
0740: 61 72 3D 31 37 26 63 61 72 64 5F 63 76 6E 3D 31   ar=17&card_cvn=1
0750: 30 39 F8 6C 1B E5 72 CA 61 4D 06 4E B3 54 BC DA   09.l..r.aM.N.T..
```

- Obtained using Heartbleed proof of concepts – Gave full credit card details
- ”Can XXX be exploited” – yes, clearly! PoCs ARE needed
  Without PoCs even Akamai wouldn’t have repaired completely!
- The internet was ALMOST fooled into thinking getting private keys
  from Heartbleed was not possible – scary indeed.

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

Nmap Scripting Engine NSE scripts

which is number 12 in the exercise PDF.

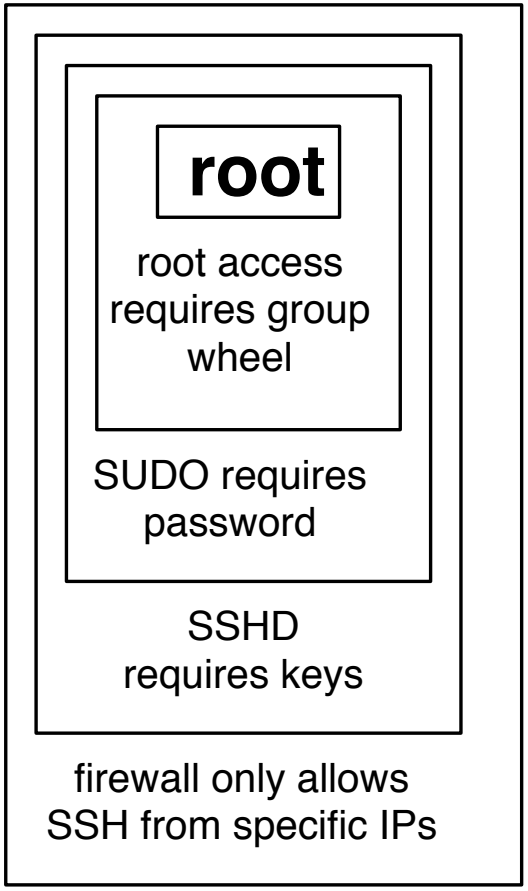
Exercise

Now lets do the exercise

Bonus: write NSE script

which is number 13 in the exercise PDF.

Defense in depth - multiple layers of security

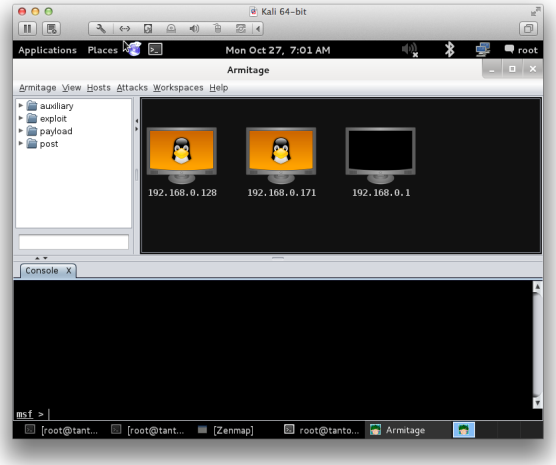


Multiple layers of security!

The Exploit Database

http://www.exploit-db.com/

Metasploit and Armitage Still rocking the internet



http://www.metasploit.com/

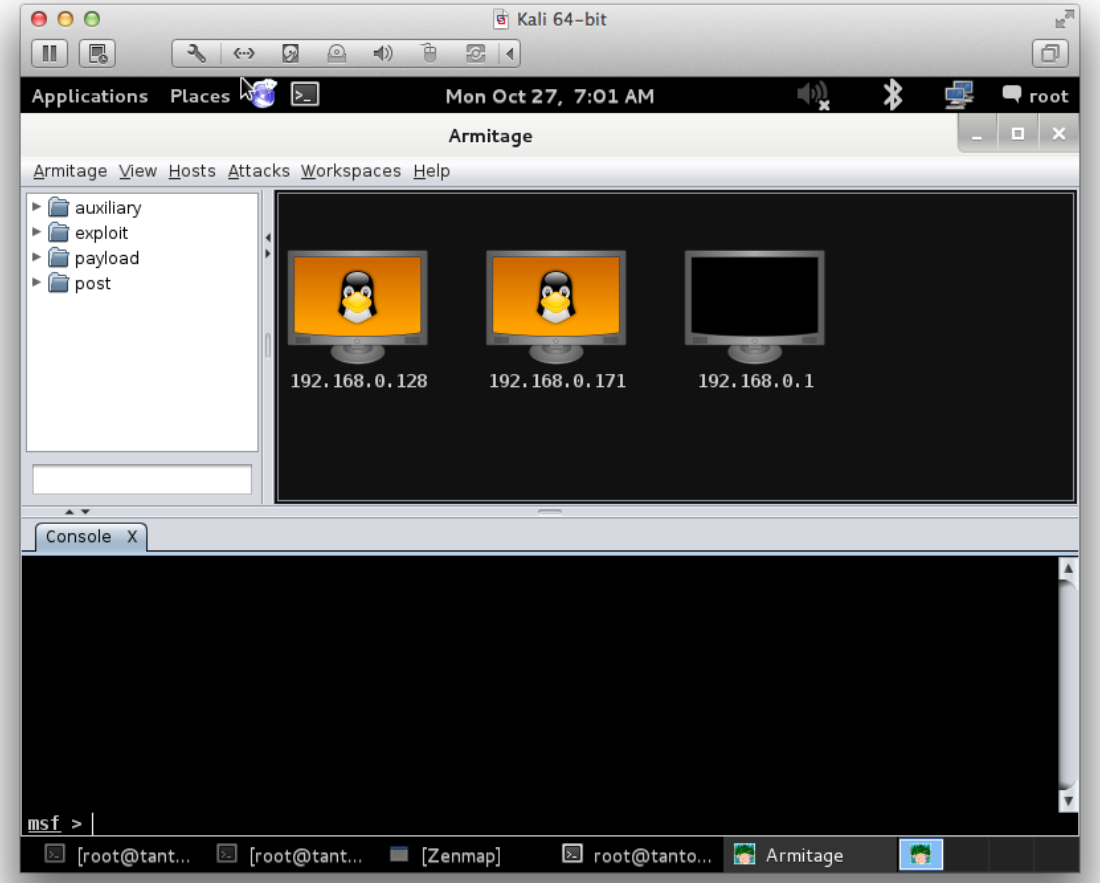
Armitage GUI fast and easy hacking for Metasploit

http://www.fastandeasyhacking.com/

Recommened training Metasploit Unleashed

http://www.offensive-security.com/metasploit-unleashed/Main_Page

Demo: Metasploit Armitage



Exercise

Now lets do the exercise

Try Nmap from Metasploit

which is number 14 in the exercise PDF.

Security devops

We need devops skillz in security

automate, security is also big data

integrate tools, transfer, sort, search, pattern matching, statistics, ...

tools, languages, databases, protocols, data formats

Use Github! So many libraries and programs that can help, maybe solve 90% of your problem, and you can glue the rest together

Example introductions:

- Seven languages/database/web frameworks in Seven Weeks
- Elasticsearch the definitive guide

We are all Devops now, even security people!

Questions?

Henrik Lund Kramshøj hlk@zencurity.dk

Need DDoS testing or pentest, ask me!

You are always welcome to send me questions later via email

Did you notice how a lot of the links in this presentation use HTTPS - encrypted