



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!



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 Administra-
tor 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>



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



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

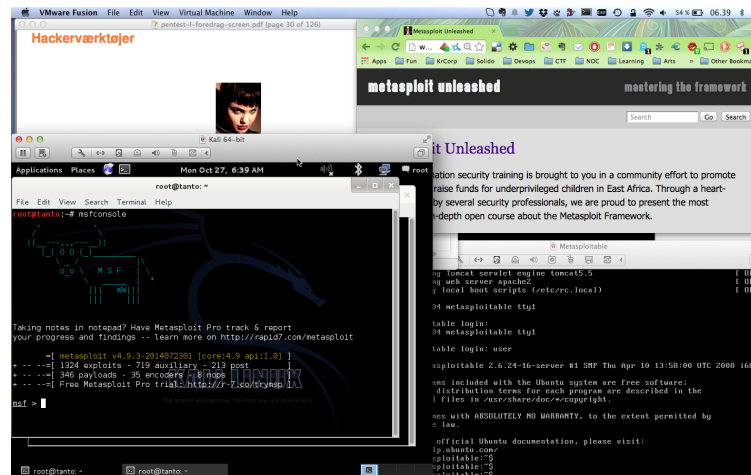
Kali <http://www.kali.org/> brings together 100s of tools

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

Also versions for Raspberry Pi, mobile and other small computers

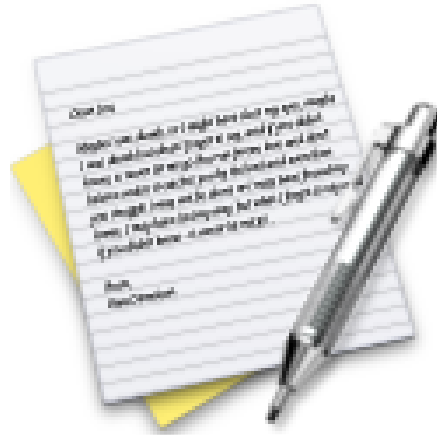
Other pentesting Linux distributions exist, but Kali is very popular

Hackerlab setup



- Hardware: most modern laptops has CPU with virtualization
May need to enable 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

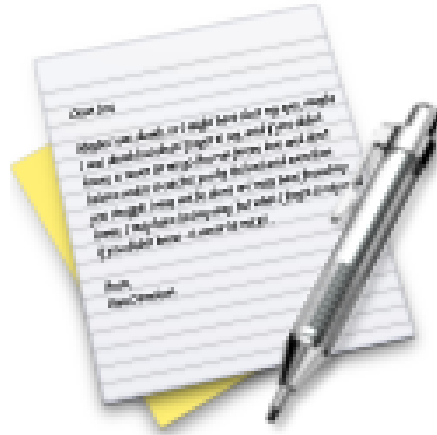


Now lets do the exercise

Wireshark install

which is number **1** in the exercise PDF.

Exercise

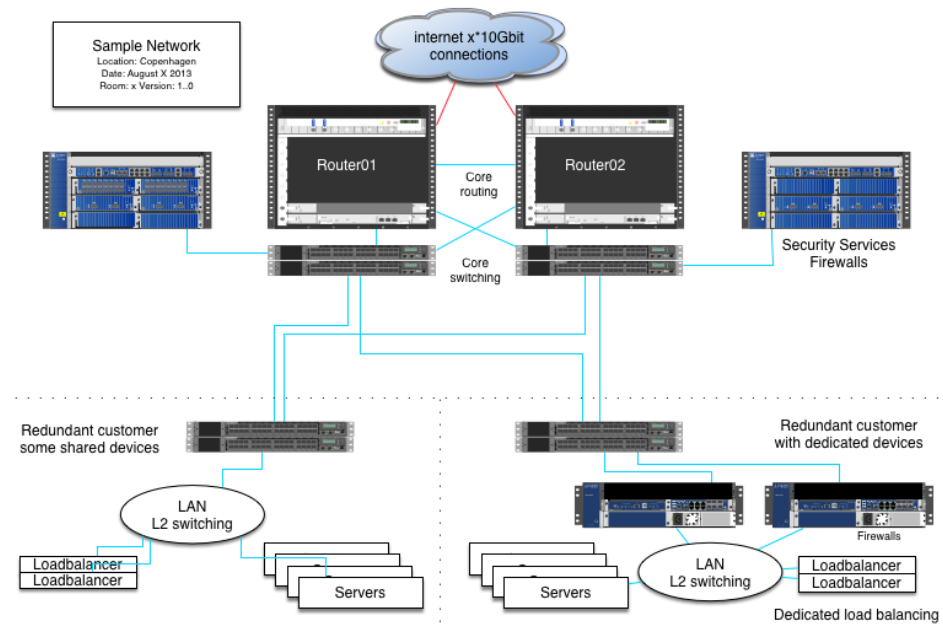


Now lets do the exercise

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?



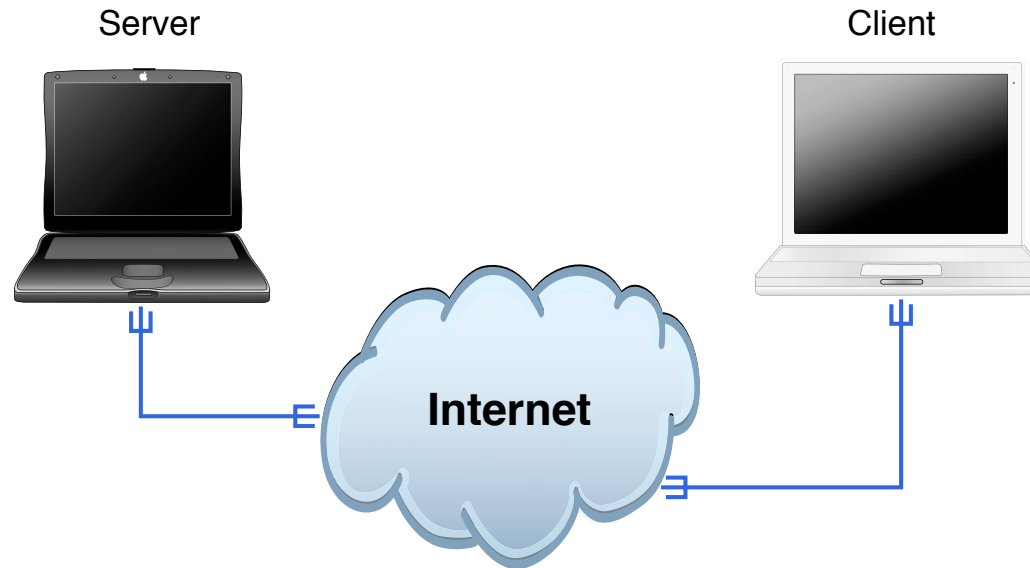
Think like a hacker

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 servers

Roots in academia

Protocols more than 20 years old

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

Trinity breaking in



```
80/tcp    open      http
81/tcp    open      hosts2.nc
10.0.0.1  [nobile]
11 # nmap -v -ss -O 10.2.2.2
11
13 Starting nmap V. 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="210ND101"
Connecting to 10.2.2.2:ssh ... successful.
Re Attempting to exploit SSHv1 CRC32 ... successful.
IP Resetting root password to "210ND101".
System open: Access Level <9>
50 # ssh 10.2.2.2 -l root
root@10.2.2.2's password: █
```

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



OSI Reference Model

Application
Presentation
Session
Transport
Network
Link
Physical

Internet protocol suite


Applications HTTP, SMTP, FTP, SNMP,	NFS
	XDR
	RPC
TCP UDP	
IPv4	IPv6 ICMPv6 ICMP
ARP RARP	
MAC	
Ethernet token-ring ATM ...	

Wireshark – capture and dissect network packets




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News And Events



Join us at SHARKFEST '15!


SHARKFEST '15 will be held from June 22 – 25 at the Computer History Museum in Mountain View, CA.

[Learn More ▸](#)


Troubleshooting with Wireshark

By Laura Chappell
Foreword by Gerald Combs
Edited by Jim Aragon


This book focuses on the tips and techniques used to identify




Wireshark Blog




Cool New Stuff

Dec 17 | By Evan Huus 

Wireshark 1.12 Officially Released!

Jul 31 | By Evan Huus 

To Infinity and Beyond! Capturing Forever with Tshark

Jul 8 | By Evan Huus 


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Enhance Wireshark

Riverbed is Wireshark's primary sponsor and provides our funding. They also make great products.

802.11 Packet Capture

- WLAN packet capture and transmission
- Full 802.11 a/b/g/n support
- View management, control and data frames
- Multi-channel aggregation (with multiple adapters)

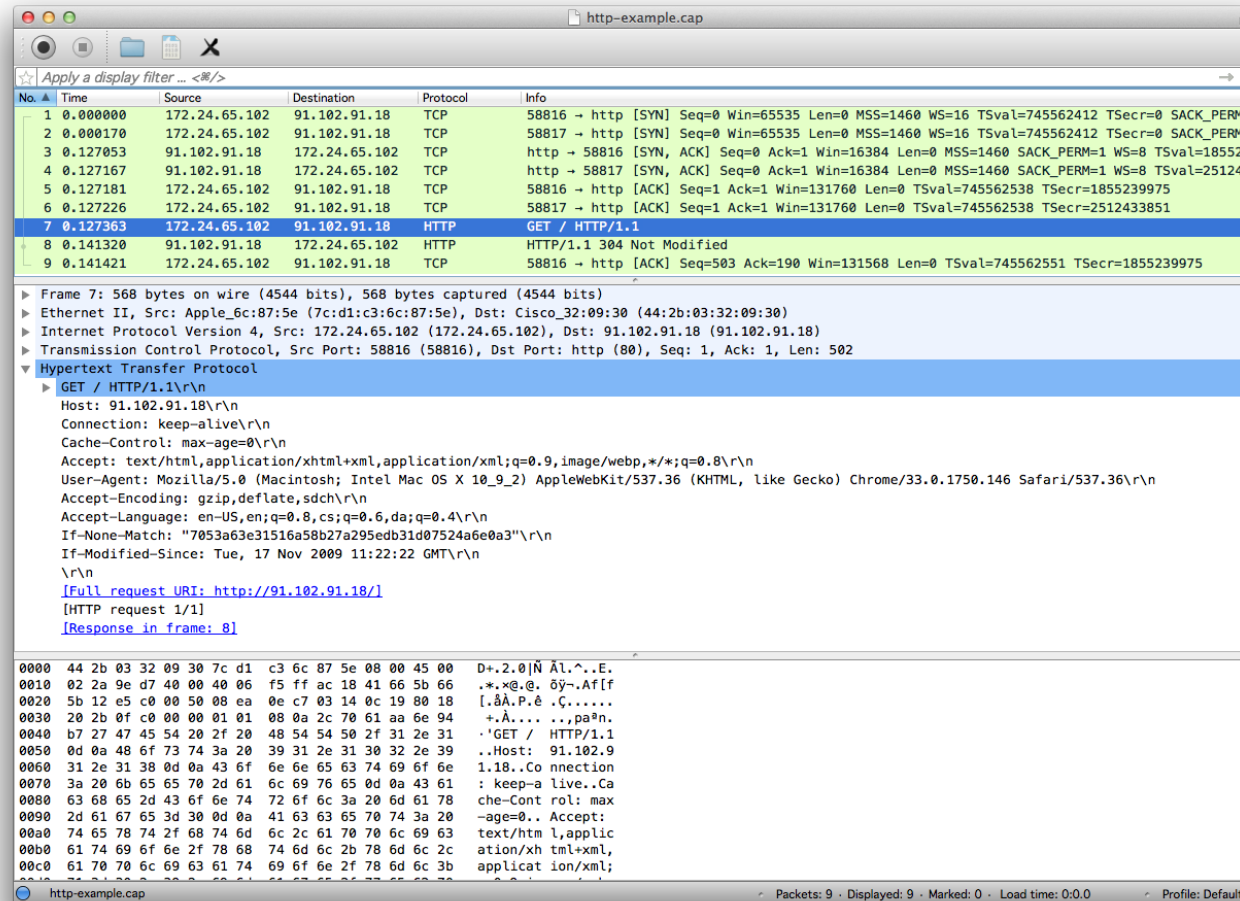


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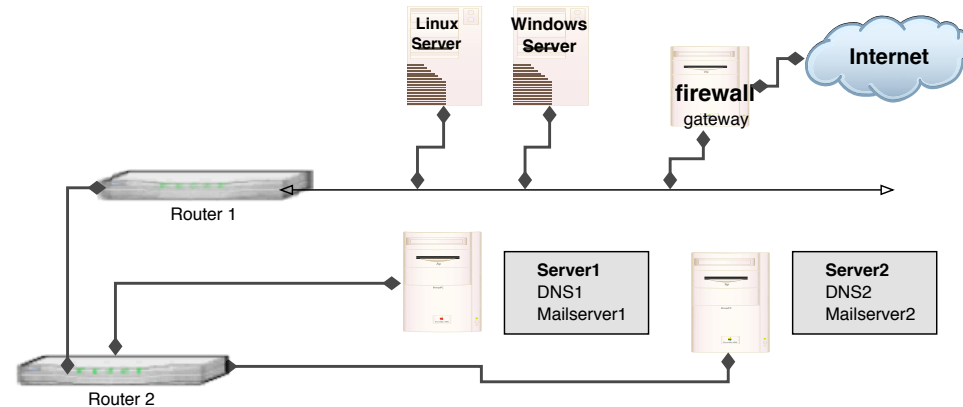
<https://www.wireshark.org>

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

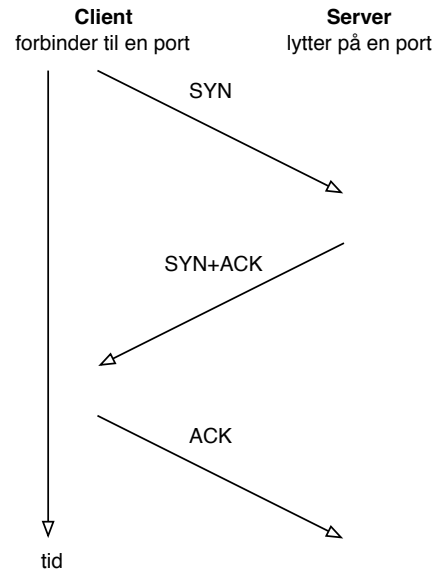
TCP scanning is more realiable than UDP scanning

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

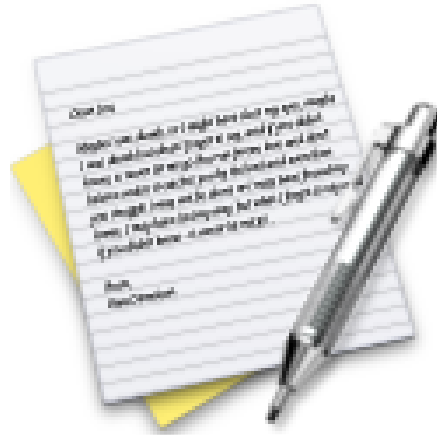
Use the GUI program Zenmap while learning Nmap

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

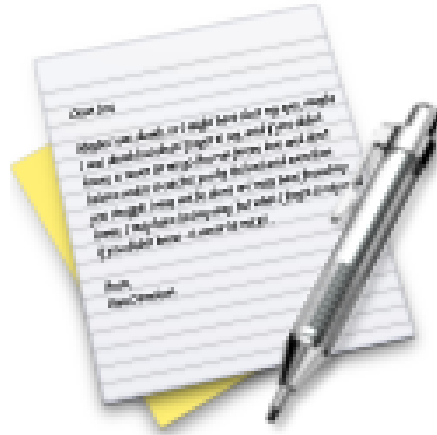


Now lets do the exercise

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`

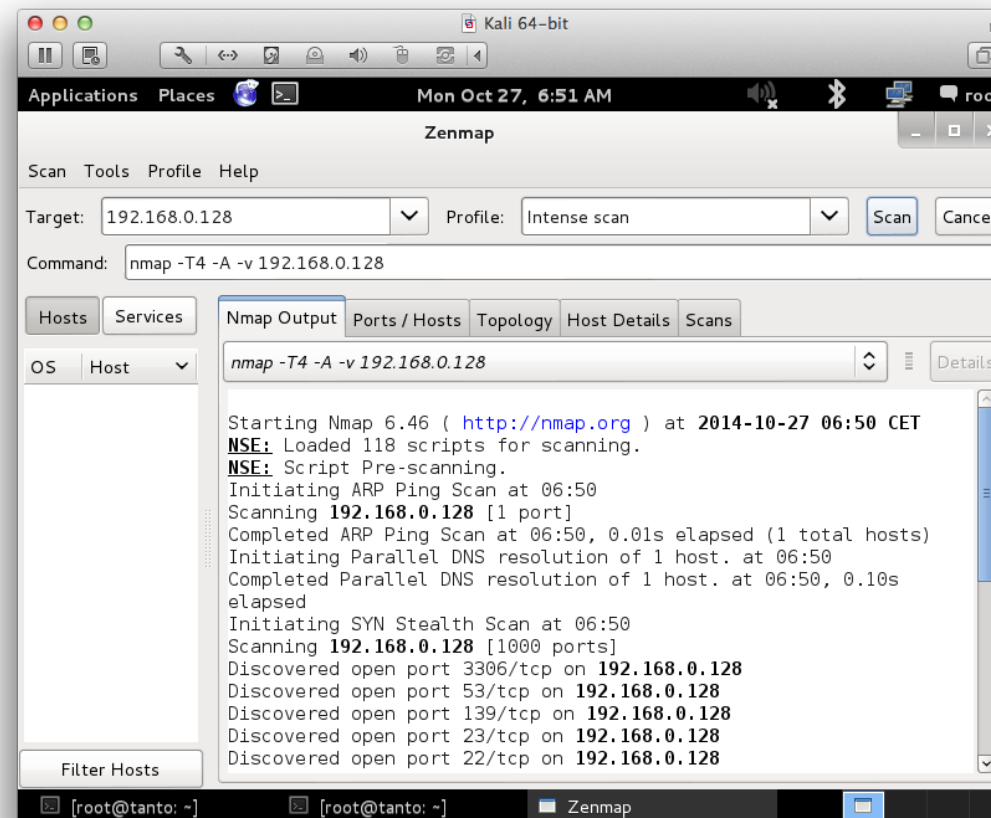
Nmap Advanced OS detection



```
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/
```

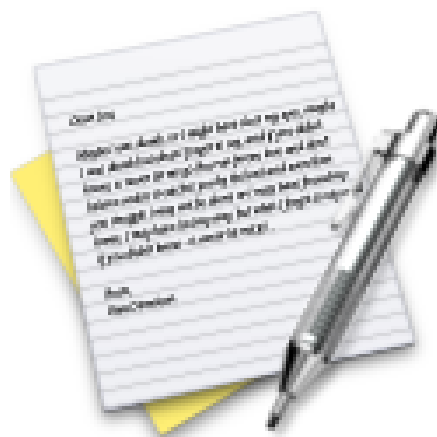
- Low-level way to identify operating systems, also try/use `nmap -A`
- Send probes and observe responses, lookup in table of known OS and responses
- Techniques known since at least: *ICMP Usage In Scanning Version 3.0*, Ofir Arkin, 2001

Portscan using Zenmap GUI



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

Exercise

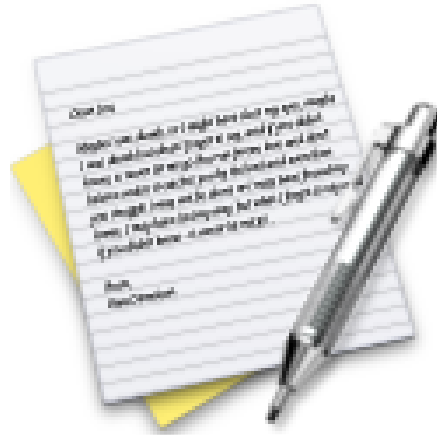


Now lets do the exercise

Discover active systems ping sweep

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

Exercise

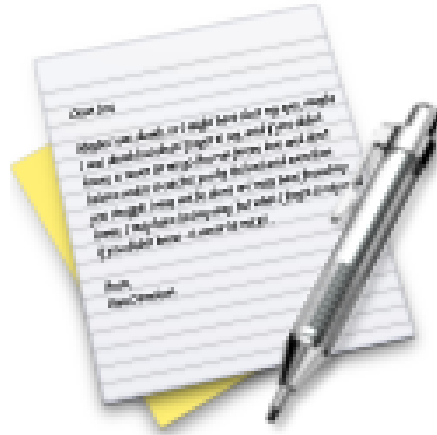


Now lets do the exercise

Execute nmap TCP and UDP port scan

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

Exercise

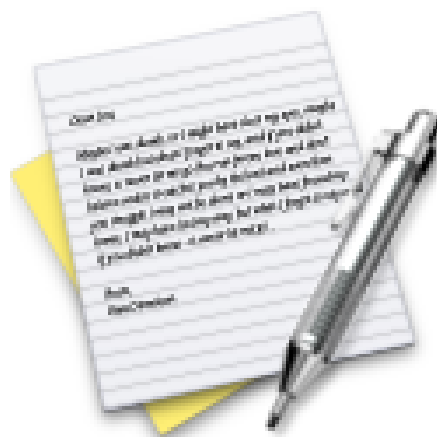


Now lets do the exercise

Perform nmap OS detection

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

Exercise

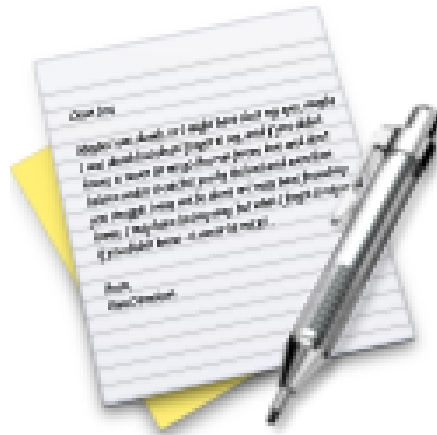


Now lets do the exercise

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

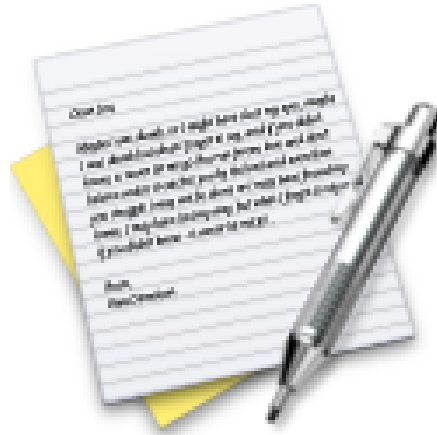
Reveals a lot about the network, operating systems, services etc.

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

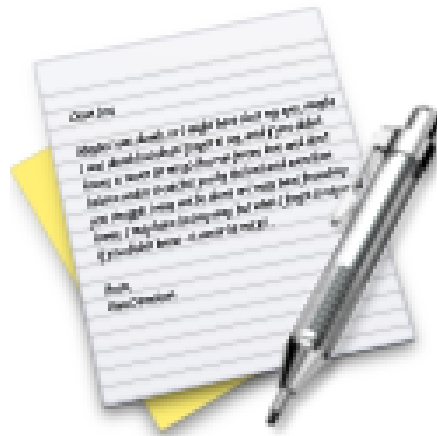


Now lets do the exercise

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 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

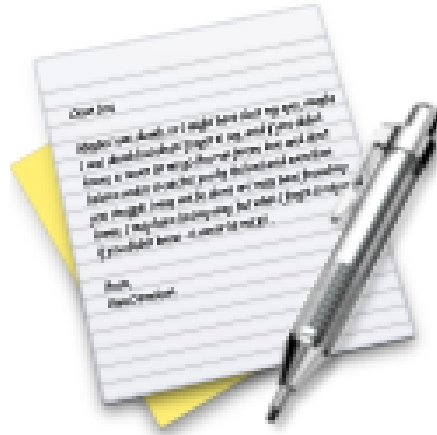
```
443/tcp open  https    syn-ack
| sslv2:
|   SSLv2 supported
|   ciphers:
|     SSL2_DES_192_EDE3_CBC_WITH_MD5
|     SSL2_IDEA_128_CBC_WITH_MD5
|     SSL2_RC2_CBC_128_CBC_WITH_MD5
|     SSL2_RC4_128_WITH_MD5
|     SSL2_DES_64_CBC_WITH_MD5
|     SSL2_RC2_CBC_128_CBC_WITH_MD5
|_    SSL2_RC4_128_EXPORT40_WITH_MD5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

```
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

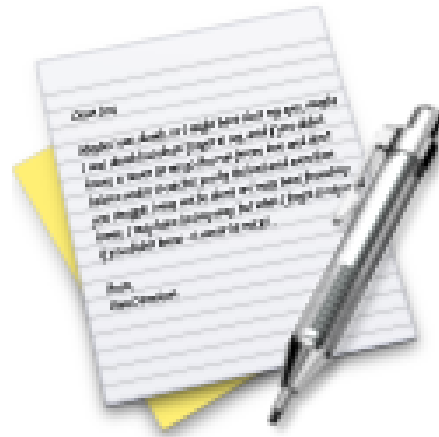


Now lets do the exercise

Nmap Scripting Engine NSE scripts

which is number 12 in the exercise PDF.

Exercise

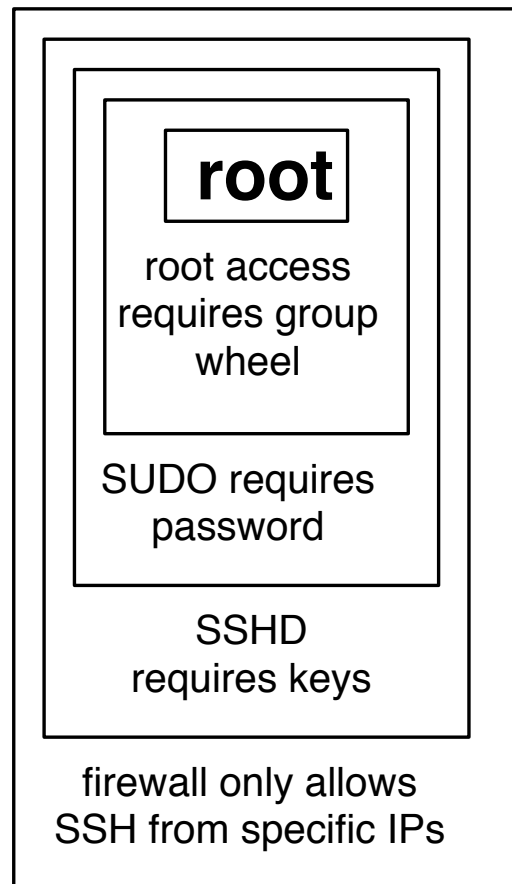


Now lets do the exercise

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



EXPLOIT

0 a t a b a s e

Currently Archiving
10343
Exploits

[home] [news] [remote] [local] [web] [dos] [shellcode] [papers] [search] [D] [submit]

[rss]

The Exploit Database

The ultimate archive of exploits and vulnerable software - A great resource for vulnerability researchers and security addicts alike. Our aim is to collect exploits from submittals and mailing lists and concentrate them in one, easy to navigate database.

We are running a general cleanup on the DB and have changed our submission policy - please **check it out** before submitting exploits to us.

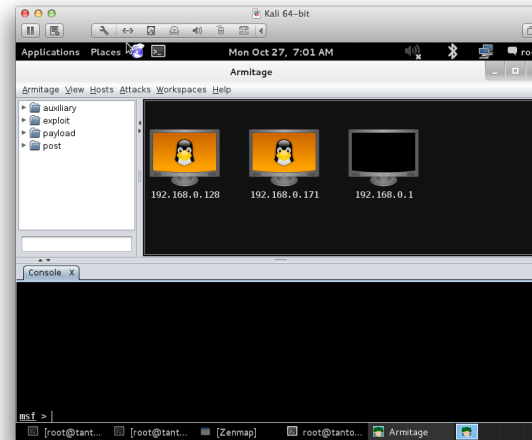
Due to recent DOS attacks, our application downloads are now captcha protected.

Remote Exploits

Date	D	A	V	Description	Plat.	Author
2010-01-27	D	A	✓	CamShot v1.2 SEH Overwrite Exploit	windows	tecnik
2010-01-25	D	-	✓	AOL 9.5 Phobos.Playlist 'Import()' Buffer Overflow Exploit (Meta)	windows	Trancer
2010-01-22	D	A	✓	IntelliTamper 2.07/2.08 (SEH) Remote Buffer Overflow	windows	loneferret
2010-01-21	D	-	✓	EFS Easy Chat server Universal BOF-SEH (Meta)	windows	FB1H2S
2010-01-20	D	-	✓	AOL 9.5 ActiveX 0day Exploit (heap spray)	windows	Dz_attacker
2010-01-19	D	-	✓	Pidgin MSN <= 2.6.4 File Download Vulnerability	multiple	Mathieu GASPARD
2010-01-18	D	A	✓	Exploit EFS Software Easy Chat Server v2.2	windows	John Babio

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

Metasploit and Armitage Still rocking the internet



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

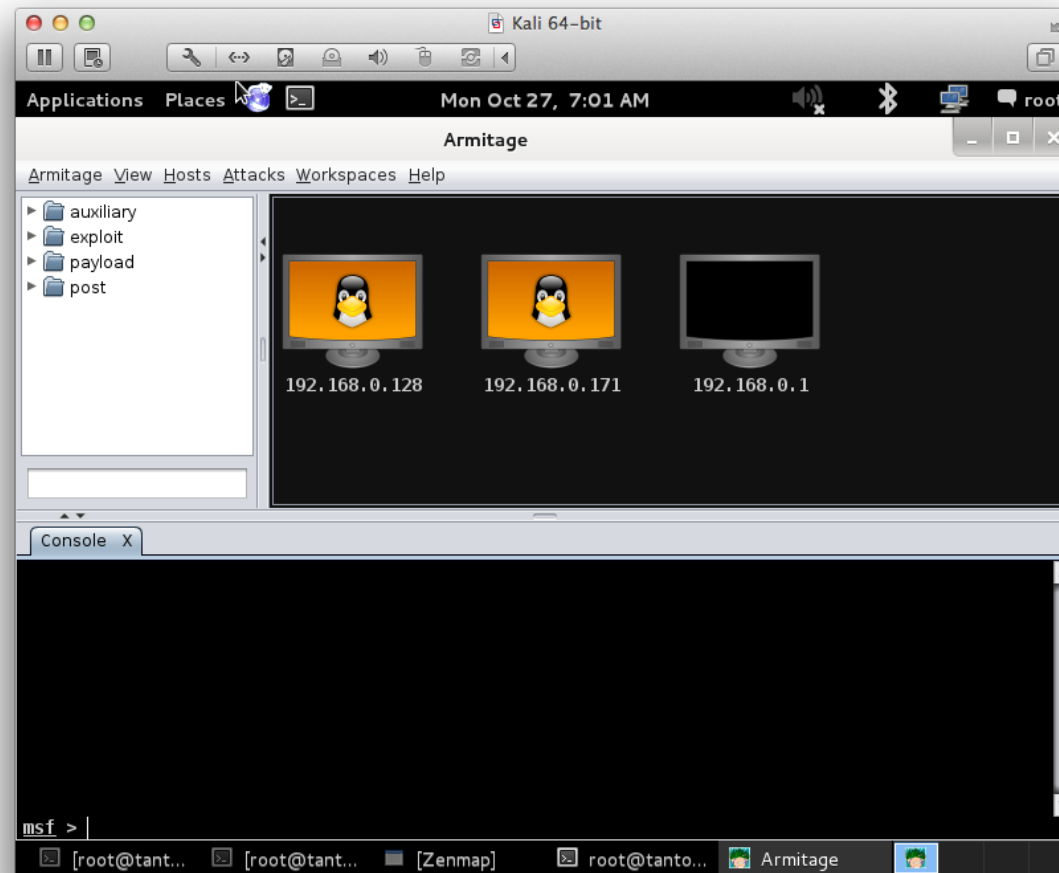
Armitage GUI fast and easy hacking for Metasploit

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

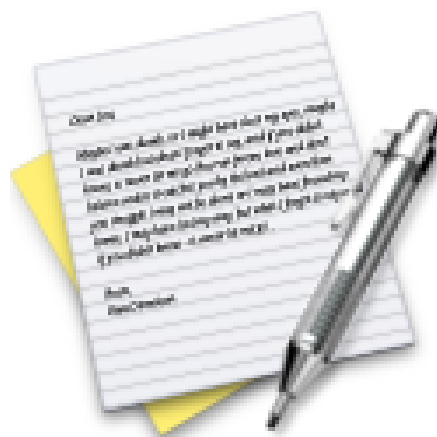
Recommended training Metasploit Unleashed

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?



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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