Network scanning, Anonymization Networks

CS 1660: Introduction to Computer Systems Security

Ports, Scanning, and Firewalls

How to support multiple applications?

Network layer: moving data between hosts

Transport layer: Abstraction for getting data data to different *applications* on a host

The Transport Layer

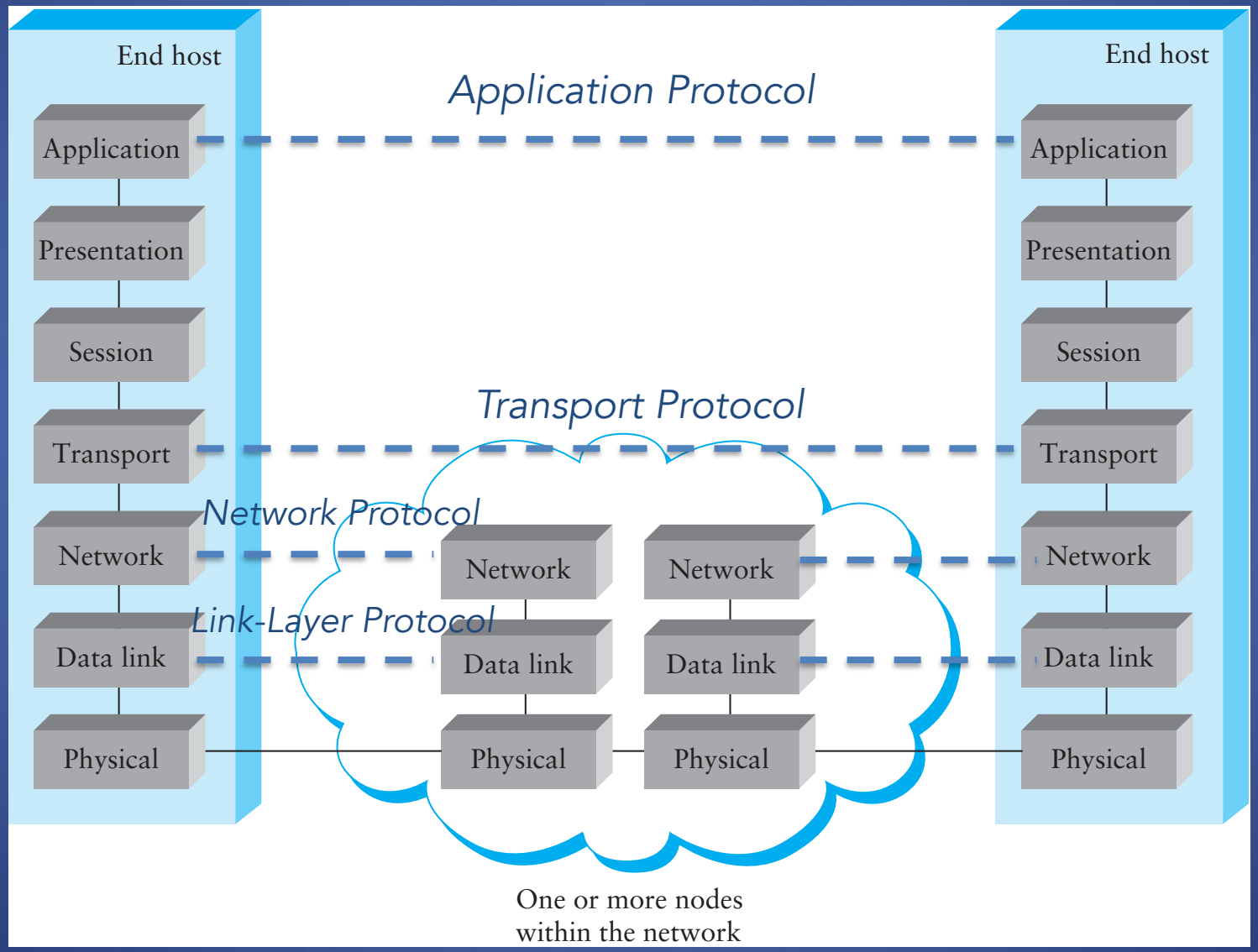
Network layer: moving data between hosts

Transport layer: Abstraction for getting data data to different *applications* on a host

- Multiplexing multiple connections at same IP with port numbers
- Series of packets => stream of data/messages
- May provide: reliable data delivery

Two key protocols: TCP, UDP

From earlier: OSI Model



What’s a port number?

- 16-bit unsigned number, 0-65535
- Ports define a communication *endpoint*, usually a process/service on a host
- OS keeps track of which ports map to which applications

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<u>Port numbering</u>

- port < 1024: "Well known port numbers"
- port >= 20000: "ephemeral ports", for general app. use

Some common ports

Port	Service
20, 21	File Transfer Protocol (FTP)
22	Secure Shell (SSH)
23	Telnet (pre-SSH remote login)
25	SMTP (Email)
53	Domain Name System (DNS)
67, 68	DHCP
80	HTTP (Web traffic)
443	HTTPS (Secure HTTP over TLS)

How ports work

Two modes:

- Applications "listen on" or "bind to" a port to wait for new connections

- Hosts make connections to a particular IP and port

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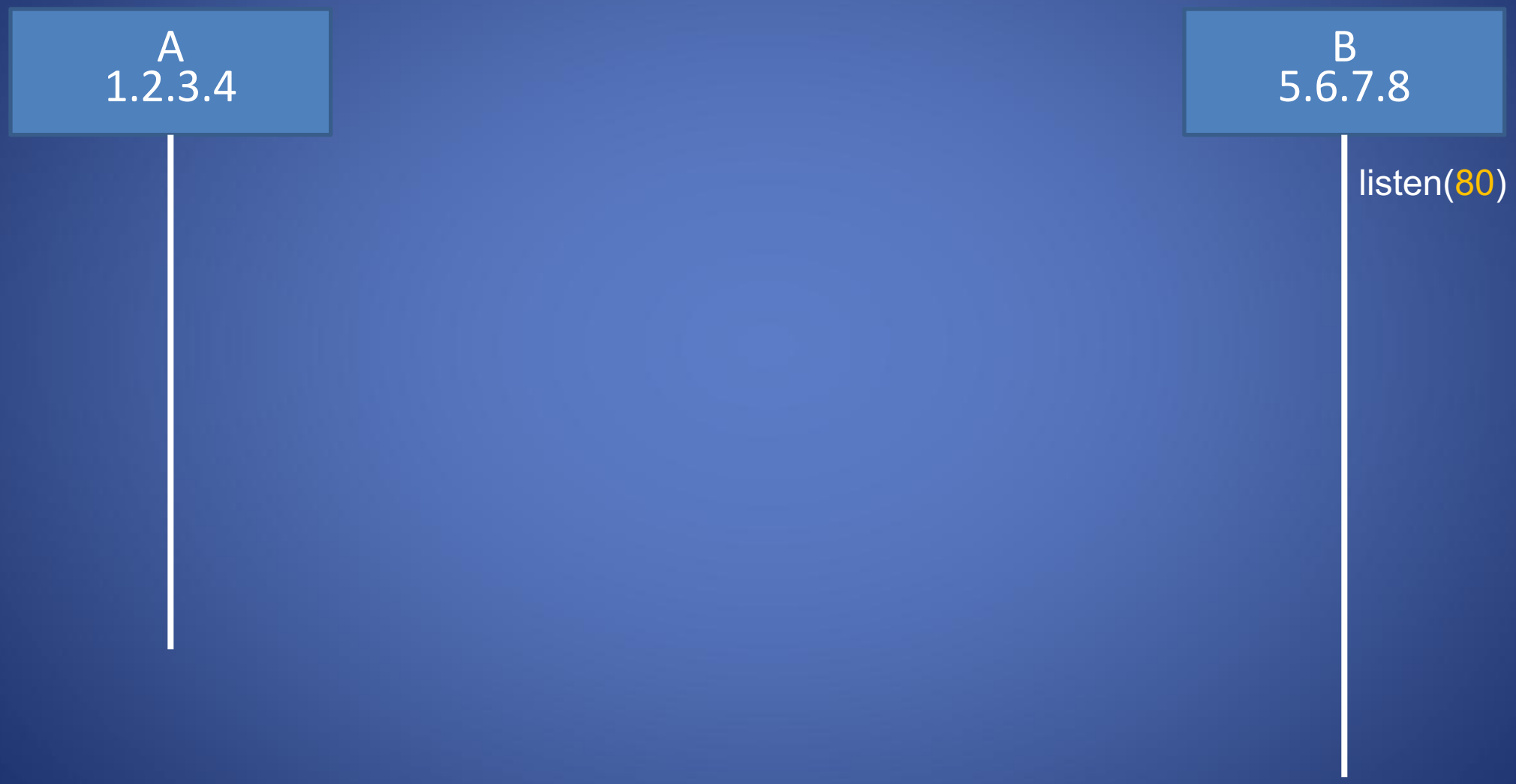
- Applications "listen on" or "bind to" a port to wait for new connections

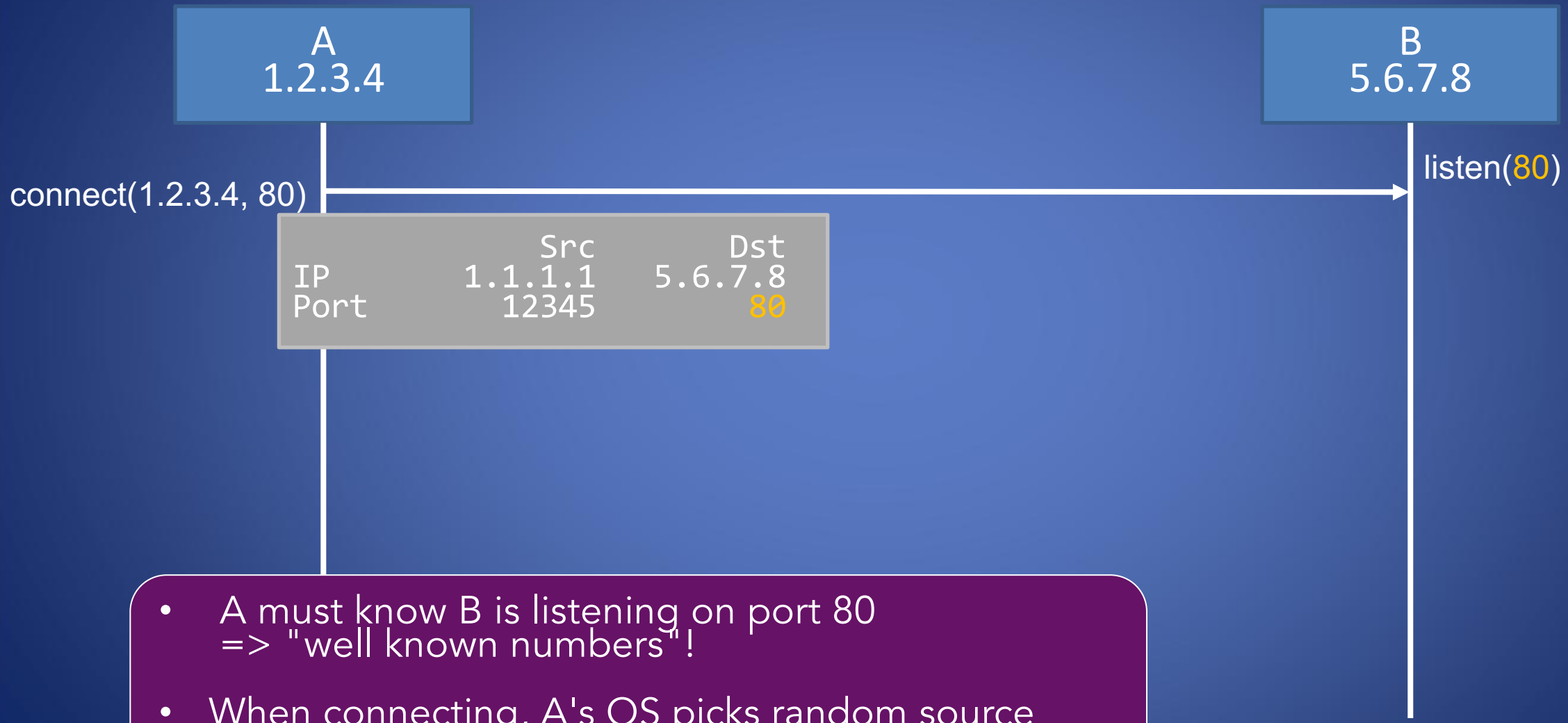
  => Example: webserver listens on port 80

- Hosts make connections to a particular IP and port

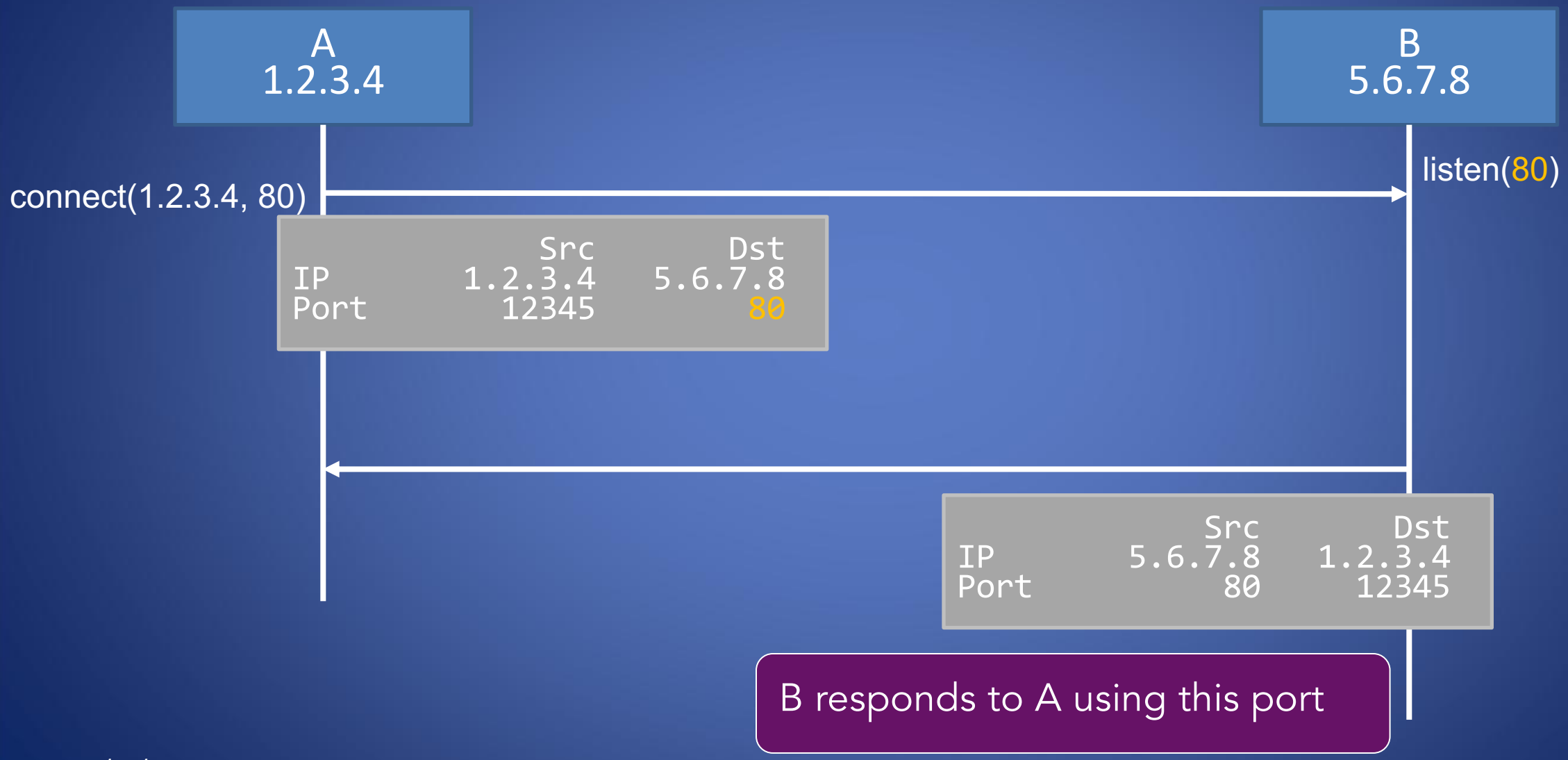
  => Example: client connects to <webserver IP>, port 80

  (eg. 1.2.3.4:80)


A
1.2.3.4
B
5.6.7.8
listen(80)



- A must know B is listening on port 80 => "well known numbers"!
- When connecting, A's OS picks random source port (eg. 12345), used for its side of connection



B responds to A using this port

Sockets

OS keeps track of which application uses which port

Two types:

- Listening ports
- *Connections* between two hosts (src/dst port)

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Socket: OS abstraction for a network connection, like a file descriptor

Socket table maps: port => socket

Want to know more? Take CS1680!

Netstat

```
deemer@vesta ~/Development % netstat -an
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp6       0      0  *.22                   *.*                    LISTEN
tcp4       0      0  *.51036                *.*                    LISTEN
tcp4       0      0  127.0.0.1.9999         *.*                    LISTEN
tcp4       0      0  10.3.146.161.51094     104.16.248.249.443     ESTABLISHED
tcp4       0      0  10.3.146.161.51076     172.66.43.67.443       ESTABLISHED
tcp6       0      0  2620:6e:6000:900.51074 2606:4700:3108::.443   ESTABLISHED
tcp4       0      0  10.3.146.161.51065     35.82.230.35.443       ESTABLISHED
tcp4       0      0  10.3.146.161.51055     162.159.136.234.443    ESTABLISHED
tcp4       0      0  10.3.146.161.51038     17.57.147.5.5223       ESTABLISHED
```

`netstat -an`: Show all connections
`netstat -lnp`: Show listening ports + applications using them (as root)

Transport protocols: TCP, UDP, …

Transport protocol => *how* application exchanges data

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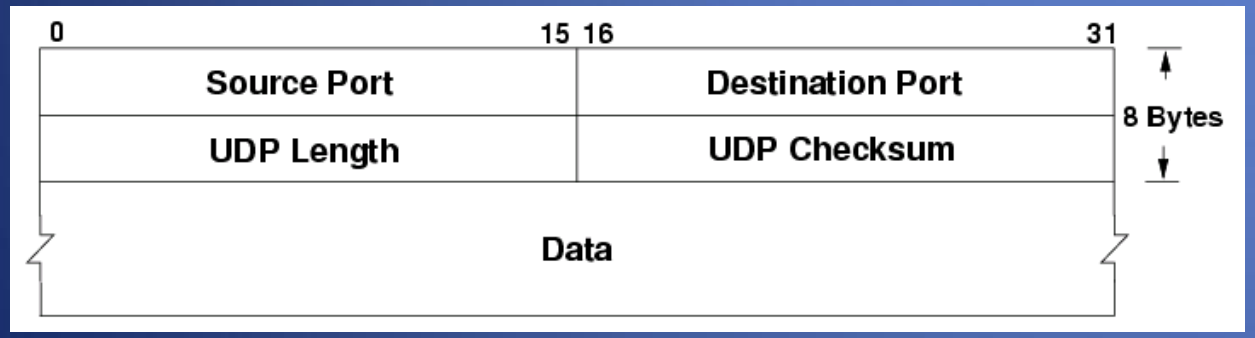

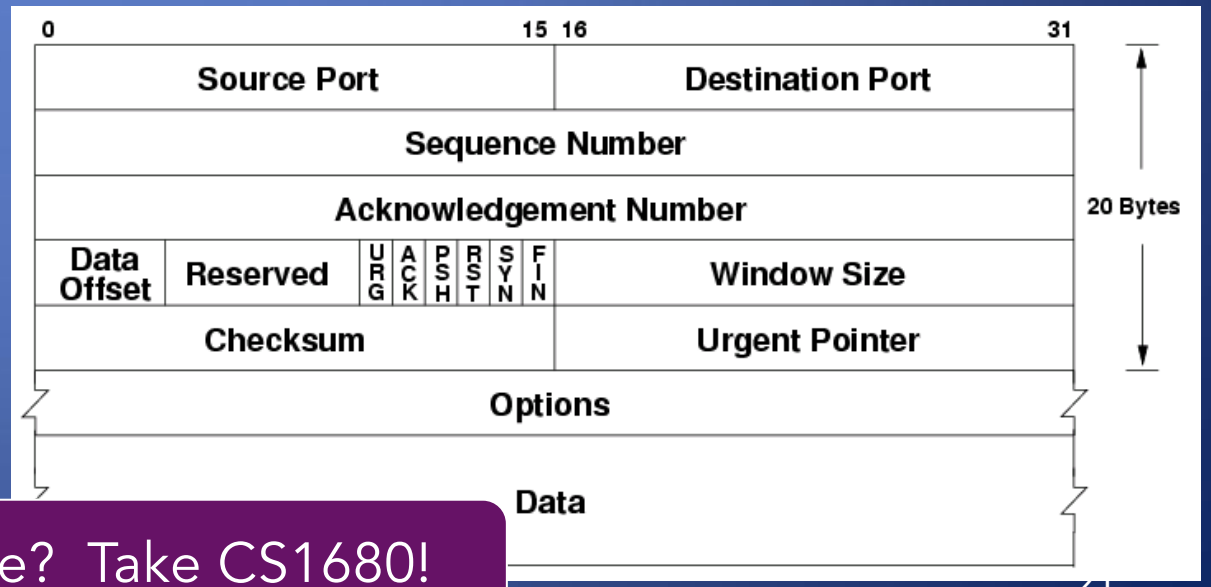

Want to know more? Take CS1680!

Why do we care?

```
deemer@vesta ~/Development % netstat -an
Active Internet connections (including servers)
Proto Recv-Q Send-Q  Local Address          Foreign Address        (state)
tcp6       0      0  *.22                   *.*                    LISTEN
                                  . . .
```

If a listening port is open, you can send data to an application

=> Defines attack surface on network!

Implications for:

- How to find vulnerable hosts/services
- How we protect them

Port scanning

What can we learn if we just start connecting to well-known ports?

- Applications have common port numbers
- Network protocols use well-defined patterns

```
deemer@vesta ~/Development % nc <IP addr> 22
SSH-2.0-OpenSSH_9.1
```

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```
deemer@vesta ~/Development % nc <IP addr> 22
SSH-2.0-OpenSSH_9.1
```

Port scanners: try to connect to lots of ports, determine available services, find vulnerable services...

nmap

nmap: Widely-used network scanning tool

- Scan ranges of IPs, look for specific open ports
- Scan many ports on specific hosts, learn about available services
- Lots of extensions/scripts...

```
$ nmap -sV -A 172.17.48.44
Nmap scan report for 172.17.48.25
Host is up (0.00065s latency).
Not shown: 997 closed ports
PORT     STATE SERVICE      VERSION
22/tcp   open  ssh          OpenSSH 6.2 (protocol 2.0)
88/tcp   open  kerberos-sec Heimdal Kerberos (server time: 2023-04-25 15:04:20Z)
5900/tcp open  vnc          Apple remote desktop vnc
Service Info: OS: Mac OS X; CPE: cpe:/o:apple:mac_os_x
```

OS/Service discovery

Different OSes use different defaults in packet headers

=> Can use for detection!

	linux 2.4	linux 2.6	openbsd	MACOS X	windows
ttl	64	64	64	64	128
packet length	60	60	64	64	48
initial windows	5840	5840	16384	9000	16384
mss	512	512	1460	1460	1460
ip id	0	random	random	random	increment
enabled tcp opt	MNNTNW	MNNTNW	M	M	MNW
timestamp inc.	100hz	1000hz	unsupported	unsupported	100Hz
sack	OK	OK	OK	OK	OK
SYN attempts	5	5	4	3	3

Large-scale port scanning

Can reveal lots of open/insecure systems!

<u>Examples:</u>

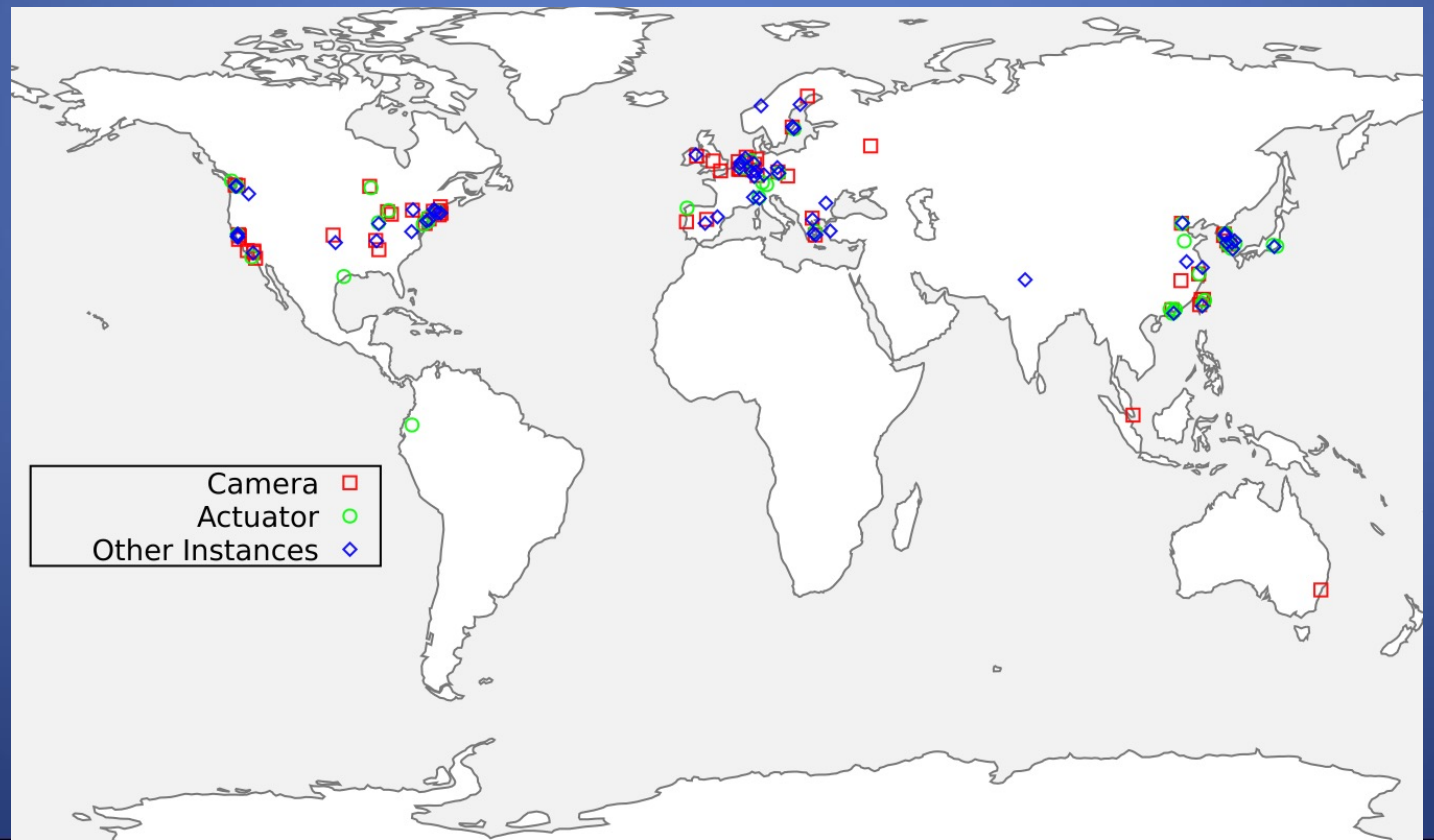
- shodan.io
- VNC roulette
- Open webcam viewers...
- …

Disclaimer

- Network scanning is often very easy to detect
- Unless you are the owner of the network, it’s seen as malicious activity
- If you scan the whole Internet, the whole Internet will get mad at you (unless done very politely)
- Do NOT try this on the Brown network. We warned you.

Scanning I have done

- Scanned IPv4 space for ROS (Robot Operating System)
- Found ~200 “things” using ROS (some robots, some other stuff)



How to defend in the network?

How to defend ports?

Firewall: set of policies to block/monitor access

=> Could be a single box, an OS feature, or a cloud-based service (think CDN)

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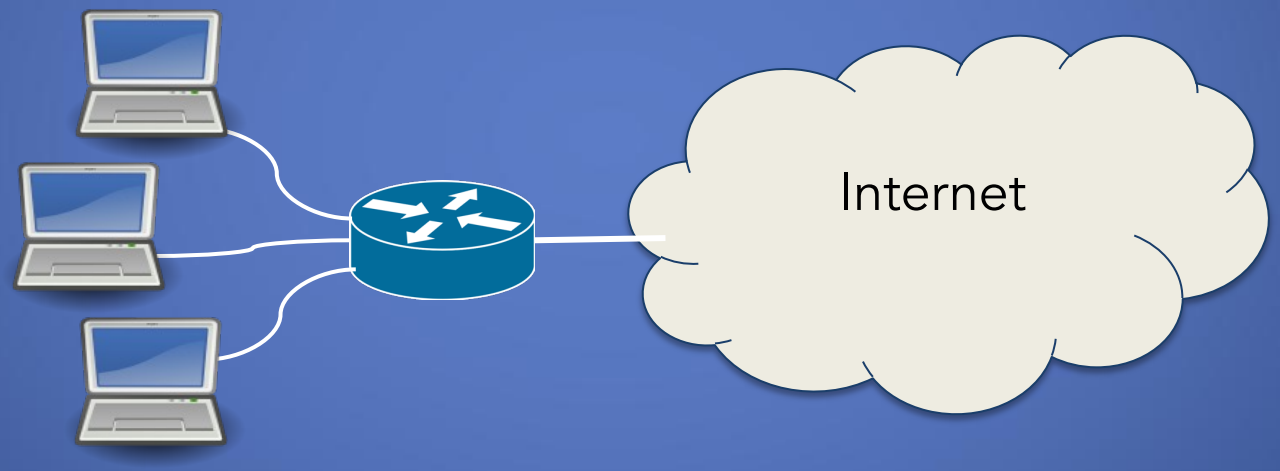

=> Could be a single box, an OS feature, or a cloud-based service (think CDN)

How to defend ports?

Firewall: set of policies to block/monitor access

- Simple: rules based on packet headers
- Expensive: look at packet contents like HTTP headers/data

  $\Rightarrow$ Deep Packet Inspection (DPI)

- Linux: iptables/netfilter: firewall/filtering in the Linux kernel

Firewall policy example: stateless rules

```
[root@Warsprite deemer]# iptables -L -n

Chain OUTPUT (policy ACCEPT)
....


Chain INPUT (policy ACCEPT)
target     prot opt source               destination
DROP       tcp  --  0.0.0.0/0            0.0.0.0/0           tcp dpt:80
DROP       tcp  --  0.0.0.0/0            0.0.0.0/0           tcp dpt:3389
DROP       *        138.16.0.0/16        0.0.0.0/0
DROP       *        138.16.0.0/16        0.0.0.0/0
ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
```

Default: accept traffic except…

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DROP       *        138.16.0.0/16        0.0.0.0/0
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ACCEPT     all  --  0.0.0.0/0            0.0.0.0/0
```

Default: accept traffic except...

Drop packets from specific hosts

Drop packets arriving on specific ports

Firewall policy example: stateful rules

Default: drop traffic except...

```
[root@Warsprite deemer]# iptables -L -n

Chain INPUT (policy DROP)
target     prot opt source      destination

ACCEPT     all  --  0.0.0.0/0   0.0.0.0/0   state RELATED,ESTABLISHED
           tcp  --  0.0.0.0/0   0.0.0.0/0   tcp dpt:22 state NEW recent: SET name: SSH side: so
DROP       tcp  --  0.0.0.0/0   0.0.0.0/0   tcp dpt:22 state NEW recent: UPDATE seconds: 60
                                                hit_count: 8 T0.0.0.0/0   state NEW tcp dpt:22

ACCEPT     tcp  --  0.0.0.0/0               udp  --  0.0.0.0/0   0.0.0.0/0   state NEW udp dpt:
DROP       udp  --  0.0.0.0/0   0.0.0.0/0   udp dpt:53 recent: UPDATE seconds:
                                                hit_count: 15 name: LDNS side: source mask: 25



ACCEPT     tcp  --  0.0.0.0/0   0.0.0.0/0   state NEW tcp dpt:53
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ACCEPT     tcp  --  0.0.0.0/0   0.0.0.0/0   state NEW tcp dpt:443
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```

Allow new connections only to certain ports

Rate-limiting on high-traffic ports

After scanning: what else can you do?

After scanning: what else can you do?

Starting point for more attacks

- Scans may indicate unprotected services
- Fingerprinting info may show services vulnerable to known exploits

=> Automated tools to do this at scale (eg. Metasploit)

metasploit community

Project - Test | Account - jondoe | Administration | Community

Overview | Analysis | Sessions 2 | Campaigns | Web Apps | Modules | Tags | Reports | Tasks

Home > Test > Hosts

Go to Host | Delete | Scan | Import | Nexpose | Modules | Bruteforce | Exploit | New Host

Hosts | Notes | Services | Vulnerabilities | Captured Evidence

Show 10 entries

	IP Address	Name	OS Name	Version	Purpose	Services	Vulns	Notes	Updated	Status
	10.1.95.80		Unknown		device		1		2 minutes ago	Looted
	10.1.95.113	vmware-bavm	Linux vmware-bavm 2.6.12-9-686 #1 Mon Oct 10 13:25:32 BST 2005 i686		device		1	1	3 minutes ago	Shelled
	10.1.95.253		Konica Printer		printer	1			5 minutes ago	Scanned

Showing 1 to 3 of 3 entries

First | Previous | 1 | Next | Last

RAPID7

Anonymization networks

Internet Censorship

- Control or suppression of the publishing or accessing of information on the Internet
- Carried out by governments or by private organizations either at the behest of government or on their own initiative
- Individuals and organizations may engage in self-censorship on their own or due to intimidation and fear.
- Comparitech Internet Censor map 2022
  - https://www.comparitech.com/blog/vpn-privacy/internet-censorship-map/

Filtering vs. Censoring

ContentBarrier

www.example.com

Google

ContentBarrier

ContentBarrier

Your request has been blocked by ContentBarrier.

This web site has been blocked because it matches the following forbidden category: **Sex/Pornography**.

If you think this web site does not match this category, please submit this URL.

You can ask your parent or your administrator to unlock this web site (a password will be required).

Submit this link | Allow this web site...

intego

ContentBarrier is a trademark of Intego.

Tails - W... | Tails - Ru... | filtered w... | Problem l... | 中国政府... | Problem l... | Probl...

www.bbc.com/zhongwen/simp/

Search

The connection was reset

The connection to the server was reset while the page was loading.

- The site could be temporarily unavailable or too busy. Try again in a few moments.
- If you are unable to load any pages, check your computer's network connection.
- If your computer or network is protected by a firewall or proxy, make sure that Firefox is permitted to access the Web.

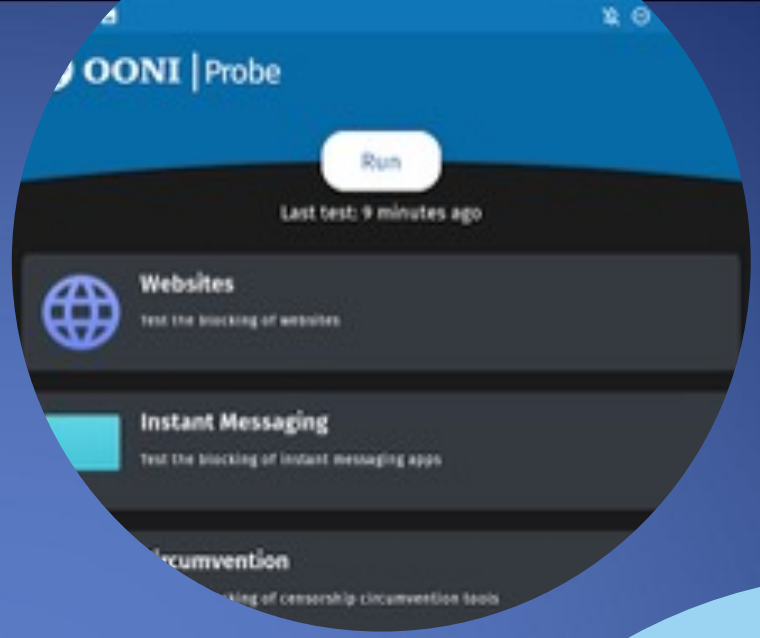
Try Again

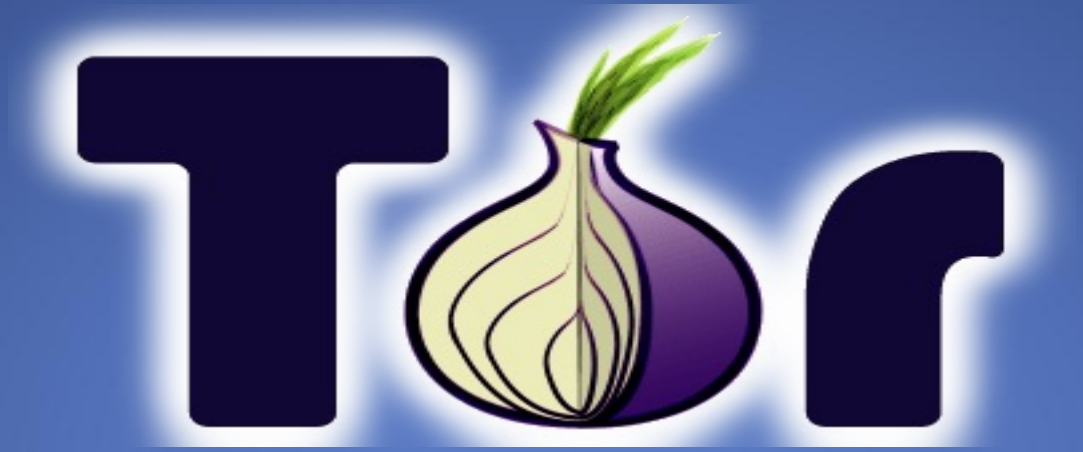
Censoring Techniques

- DNS blacklist
  - DNS does not resolve domain names or returns incorrect IP addresses, e.g., www.google.com returns 'page not found‘
- IP blacklist
  - For sites on a blacklist, the censoring system prevents connection attempts
- Keyword blacklist
  - The censoring system scans the URL string (e.g., search terms) and interrupts the connection if it contains keywords from a blacklist

OONI

- **Open Observatory of Network Interference**
- a project that monitors internet censorship globally
- https://ooni.org/





The Onion Router

Overview

- First the US Naval Research Laboratory, then the EFF and now the Tor Project (www.torproject.org)
- Access normal Internet sites anonymously, and Tor hidden services.
- Locally run SOCKS proxy that connects to the Tor network.
- *"Tor is free software and an open network that helps you defend against a form of network surveillance that threatens personal freedom and privacy, confidential business activities and relationships, and state security known as traffic analysis."* [TOR project website]

Anonymity

- Preventing identification within a group
  - E.g., departmental VPN, home NAT router
  - Group should be as large as possible
- Preventing association of action and identity
  - E.g., distributed denial of service by hidden attacker

Mix

Trusted router, Rose

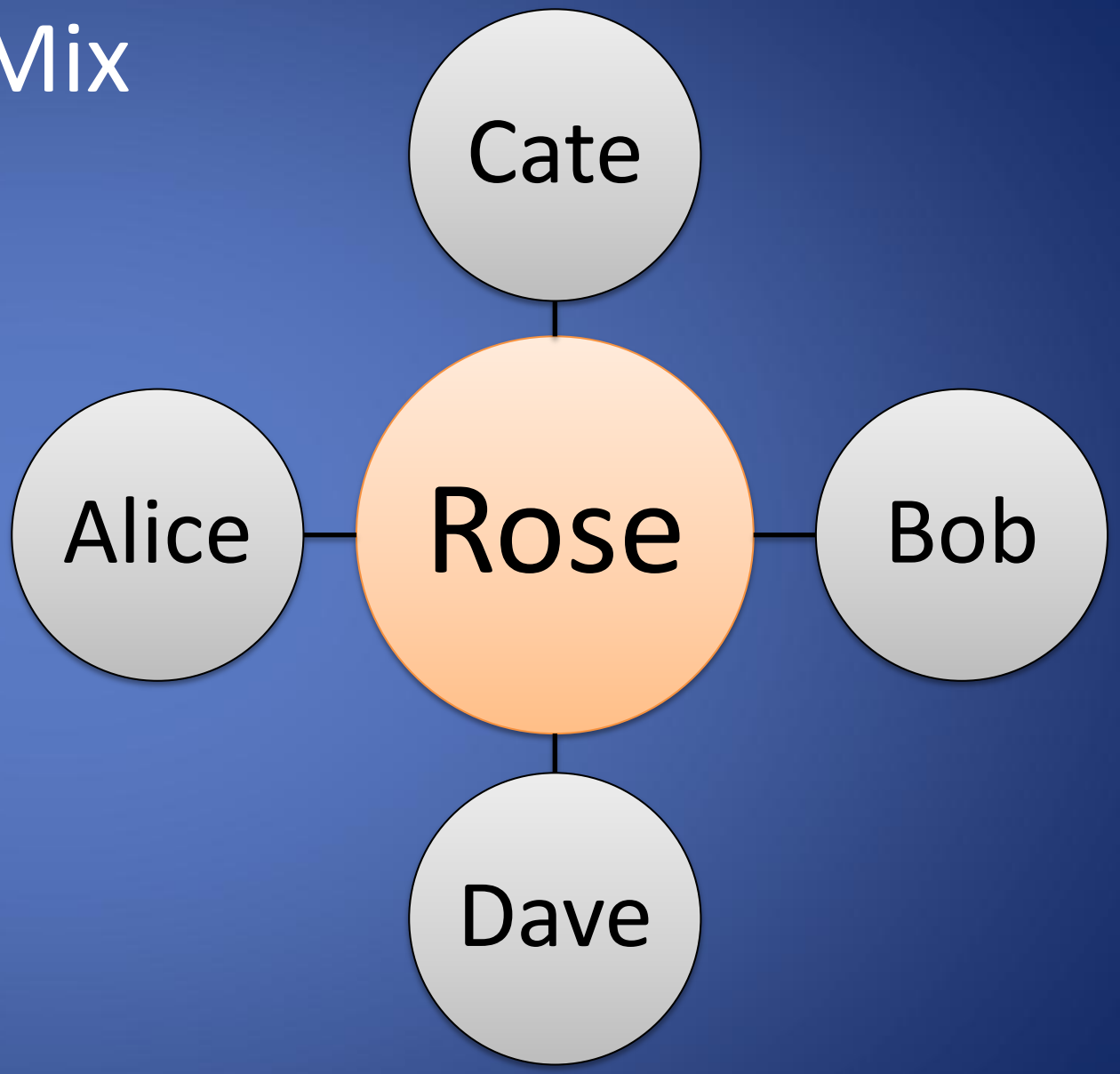
Public-key encryption

Message from Alice to Bob via Rose

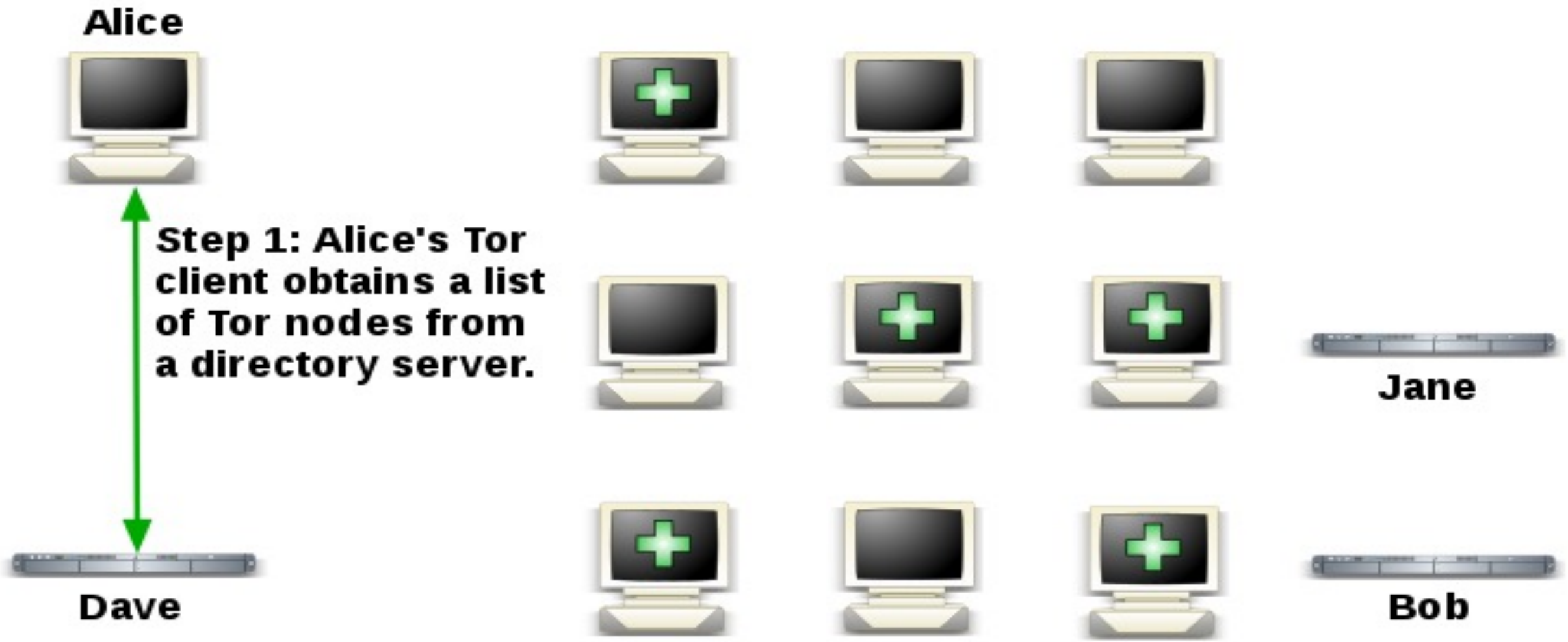
$$E_{KR}(Bob, E_{KB}(M))$$

Precautions

- Fixed message size
- Continuous communication
- Dummy messages
- Chain of mixes

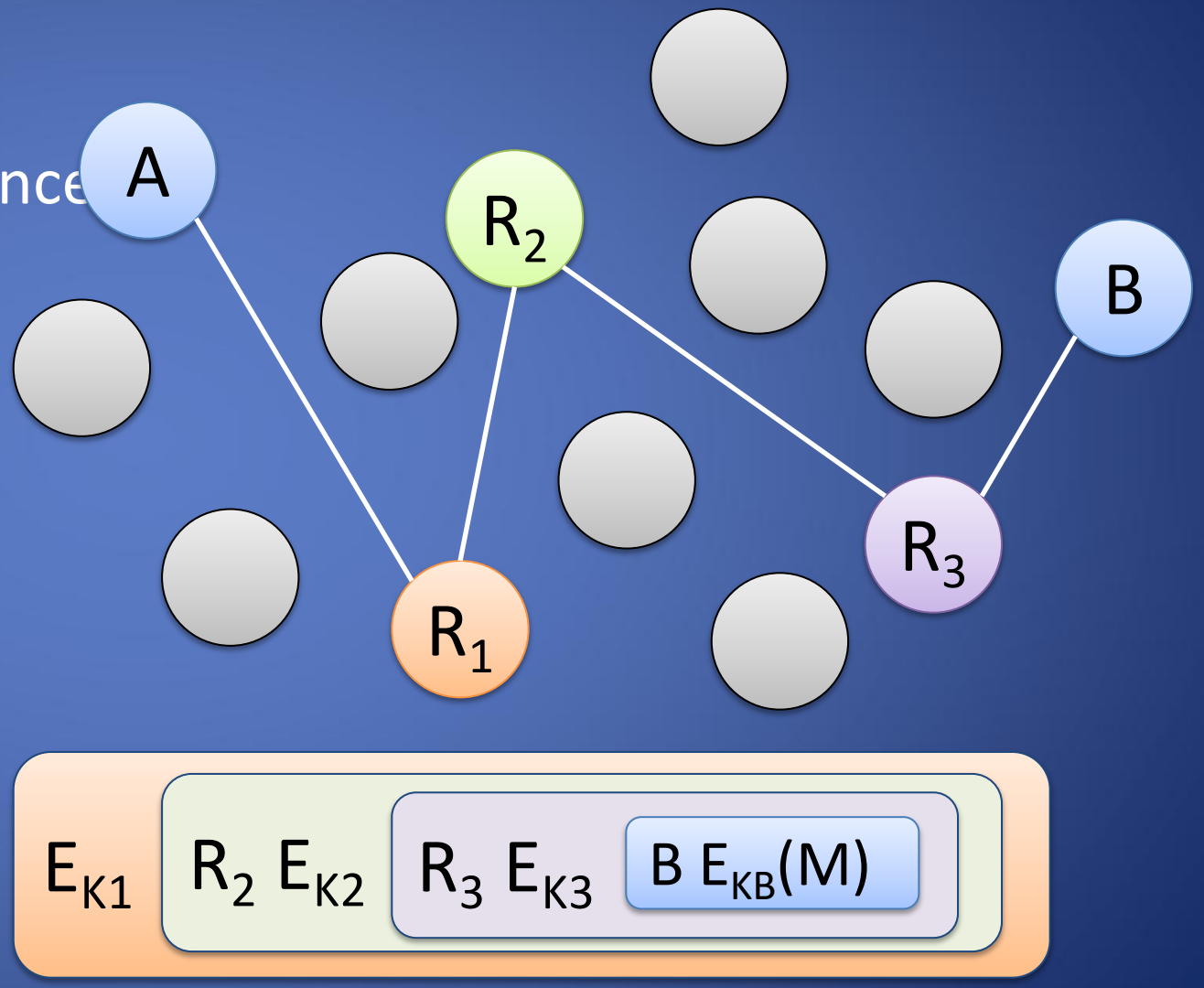


How Tor Works: 1



Onion Routing

- Group of routers
- Message sent via random sequence of routers
- Layered encryption
  - Build onion inside out
- Routing
  - Peel onion outside in
- Each router knows previous and next



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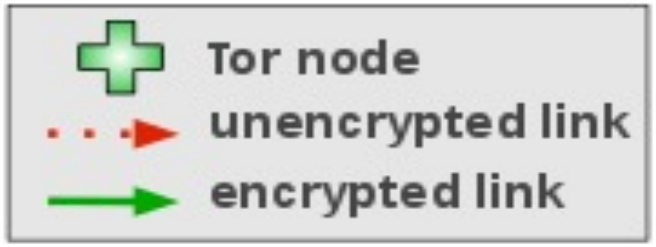
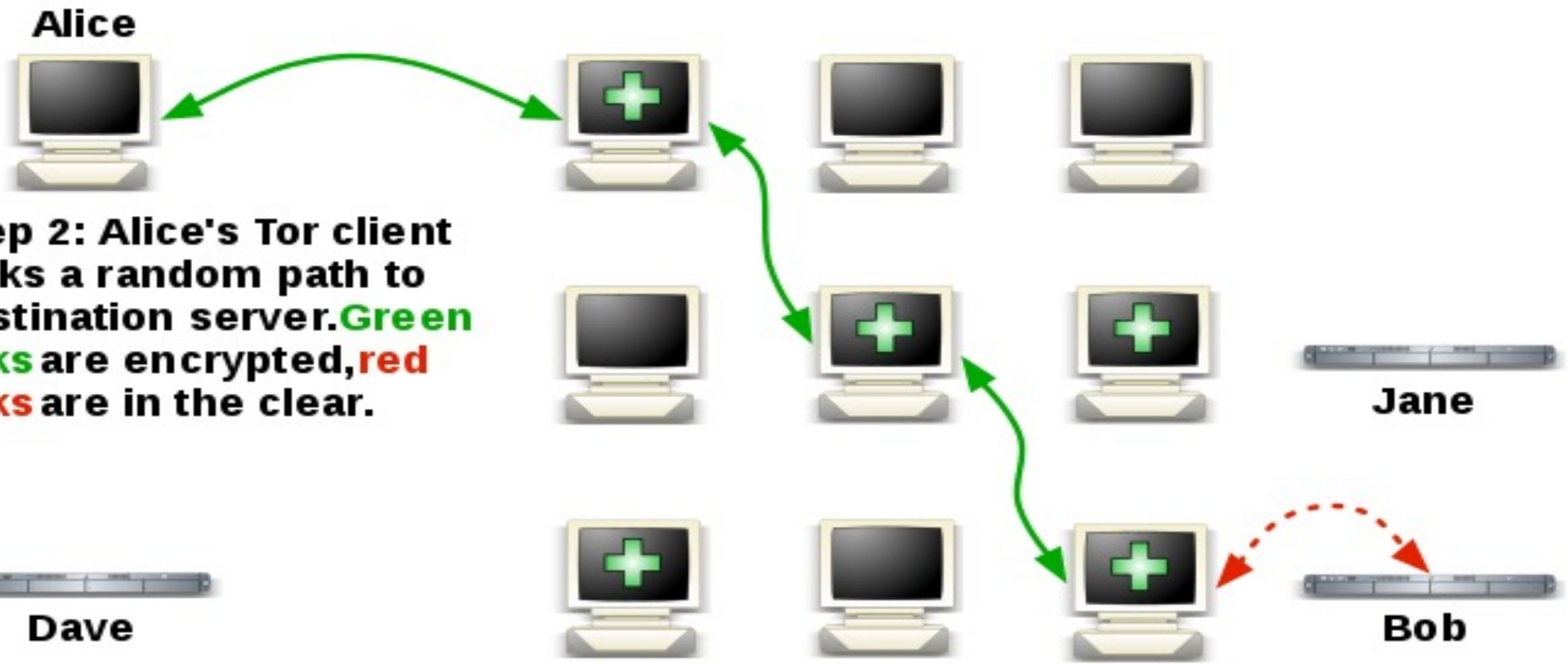
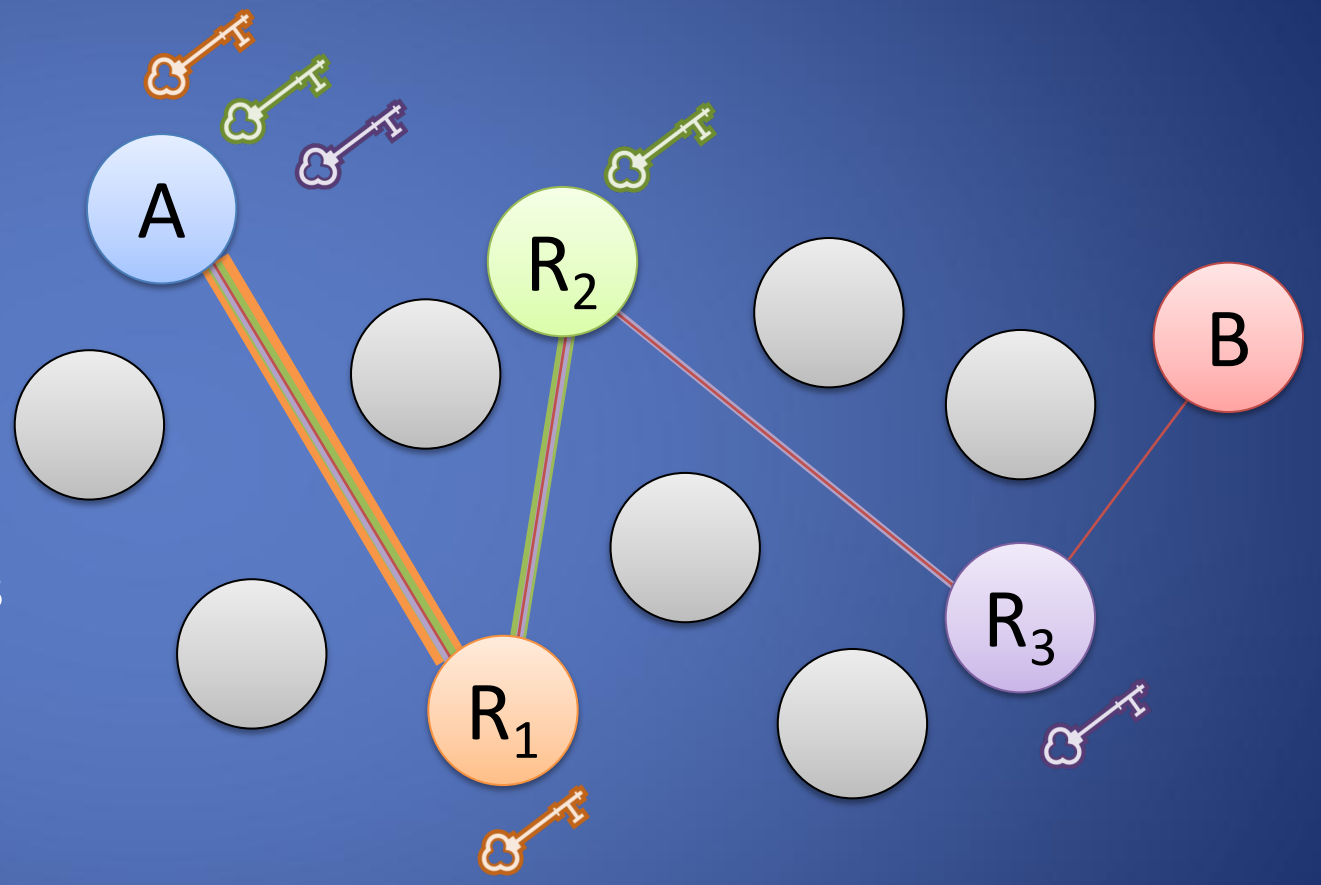




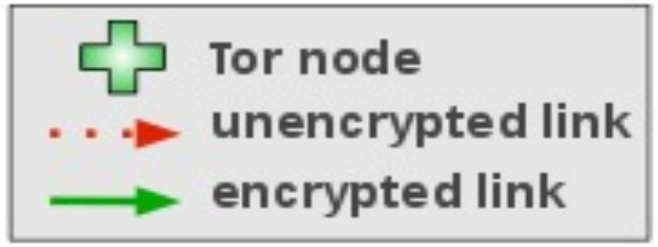
Step 2: Alice's Tor client picks a random path to destination server. Green links are encrypted, red links are in the clear.

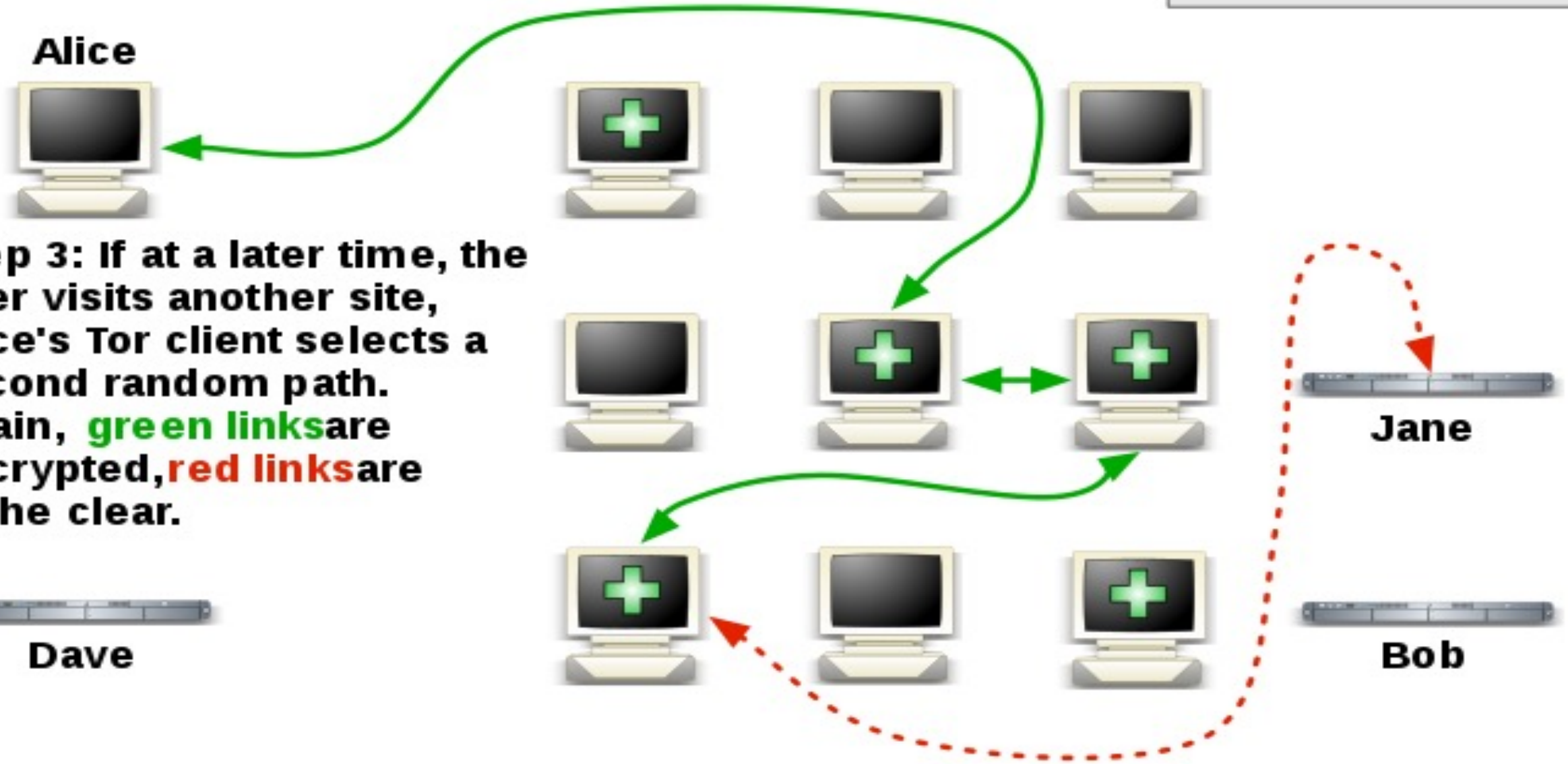
Onion Routing in Practice

- Do not encrypt final hop
  - Encryption may be done by application (e.g., https)
- Source sets up
  - Random circuit (route)
  - Symmetric keys shared with routers
- Data tunneled to final router over circuit



How Tor Works: 3





Step 3: If at a later time, the user visits another site, Alice's Tor client selects a second random path. Again, green linksare encrypted,red linksare in the clear.

Types of relays on the Tor network

Guard and Middle relay(non-exit relays)

- Guard relay first relay in the chain of 3 relays building a Tor circuit
- Middle relay acts as an intermediate hop between the Guard and exit

Exit relay

- Final relay in a Tor circuit
- Eg: A website will see the exit relay IP instead of the real IP address of the Tor user
- Greatest legal exposure and liability of all the relays

DEMOS

- www.eff.org/pages/tor-and-https
- torproject.org
- Guard, middle, Exit nodes
- Exit nodes list
  - https://check.torproject.org/torbulkexitlist

Applications/Sites

- Hidden services
  Normally websites, but can be just about any TCP connection

- Tor Hidden Service Example (Hiddenwiki) :
  http://zqktlwi4fecvo6ri.onion
- Duckduckgo.com -
  https://duckduckgogg42xjoc72x3sjasowoarfbgcmvfimaftt6twagswzczad.onion/
- Facebook www.facebookcorewwwi.onion/

- .onion TLD v2:
  - non-mnemonic,
  - 16-character alpha-semi-numeric hashes
  - automatically generated based on a public key when a hidden service is configured
  - “vanity address” possible with expensive computation

  https://blog.torproject.org/v2-deprecation-timeline/

TOR Analysis

Advantages

- Tunnel, through a SOCKS proxy, allows to work any protocol.
- Three nodes of proxying, each node not knowing the one before last, makes very difficult to find the source.

Problems

- Slow (high latency)
- Exit node?
- Semi-fixed Infrastructure: possible to block all Tor relays listed in the Directory. Bridged node.
- Fairly easy to tell someone is using it from the server side
  http://www.irongeek.com/i.php?page=security/detect-tor-exit-node-in-php

Identify TOR traffic

Default configuration:

- Local
  9050/tcp Tor SOCKS proxy
  9051/tcp Tor control port
  8118/tcp Privoxy
- Remote
  443/tcp and 80/tcp mostly
  Servers may also listen on port 9001/tcp, and directory information on 9030

Clicker Question (2)

How To Block Tor? Attackers can block users from connecting to the Tor network, in which way?

A. Blocking the directory authorities
B. Blocking all the relay IP addresses in the directory
C. Filtering based on Tor's network fingerprint
D. Preventing users from finding the Tor software
E. All the above

Clicker Question (2) - Answer

How To Block Tor? Attackers can block users from connecting to the Tor network, in which way?

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Bridge relays

- Rather than signing up as a normal relay, you can sign up as a special “bridge” relay that is not listed in any directory.
- No need to be an “exit” (so no abuse worries), and you can rate limit if needed
- Integrated into Vidalia (GUI)
- https://bridges.torproject.org/ will tell you a few based on time and your IP address
- Mail bridges@torproject.org from a gmail address and you’ll receive a few in response

Tails

- Privacy for anyone anywhere
- Linux live distro focused on Privacy
- Use the Internet anonymously and circumvent censorship
  - Tor network
- Leave no trace
  - No persistent data on the computer you are using unless you ask it explicitly
- Use state-of-the-art cryptographic tools
  - E.g., https everywhere addons

What We Have Learned

- Anonymization network
- Filtering vs. Censoring
- The Onion Router (TOR)
- Hidden Service (Dark web)
- Bridge Relays

Extra content on pentesting/firewalls

Policy Actions

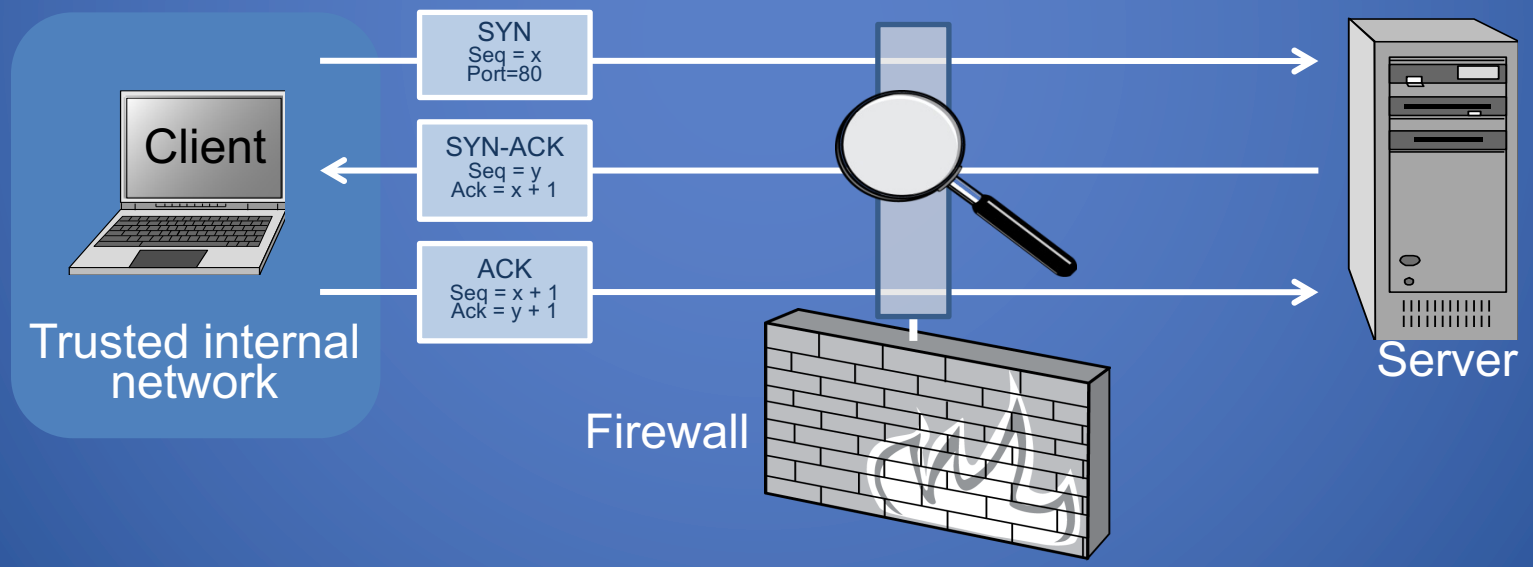
- Packets flowing through a firewall can have one of three outcomes:
  - **Accepted:** permitted through the firewall
  - **Dropped:** not allowed through with no indication of failure
  - **Rejected:** not allowed through, accompanied by an attempt to inform the source that the packet was rejected
- Policies used by the firewall to handle packets are based on several properties of the packets being inspected, including the protocol used, such as:
  - TCP or UDP
  - the source and destination IP addresses
  - the source and destination ports
  - the application-level payload of the packet (e.g., whether it contains a virus).

Firewall Types

- **packet filters (stateless)**
  - If a packet matches the packet filter's set of rules, the packet filter will drop or accept it
- **"stateful" filters**
  - it maintains records of all connections passing through it and can determine if a packet is either the start of a new connection, a part of an existing connection, or is an invalid packet.
- **application layer**
  - It works like a **proxy** it can “understand” certain applications and protocols.
  - It may inspect the contents of the traffic, blocking what it views as inappropriate content (i.e. websites, viruses, vulnerabilities, ...)

Stateless Firewalls

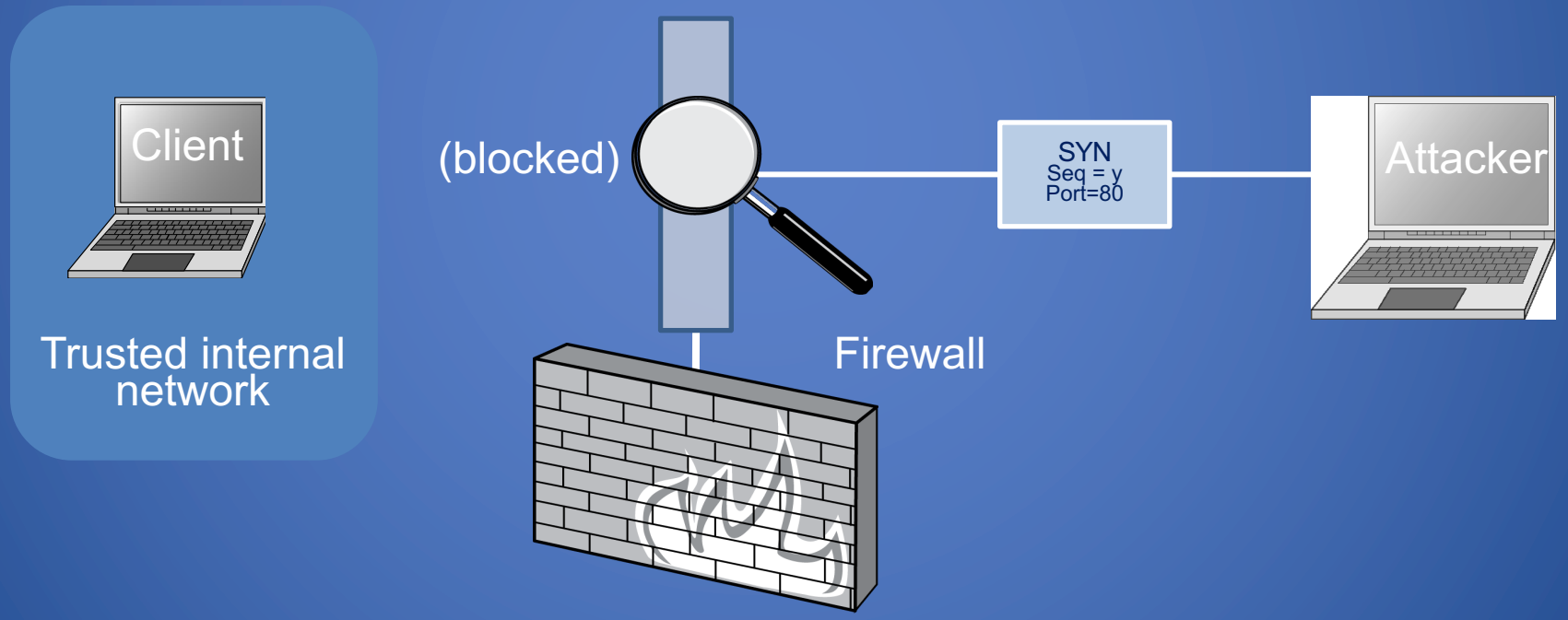
A stateless firewall doesn't maintain any remembered context (or "state") with respect to the packets it is processing. Instead, it treats each packet attempting to travel through it in isolation without considering packets that it has processed previously.



Allow outbound SYN packets, destination port=80
Allow inbound SYN-ACK packets, source port=80

Stateless Restrictions

- Stateless firewalls may have to be fairly restrictive in order to prevent most attacks.



Allow outbound SYN packets, destination port=80
Drop inbound SYN packets,
Allow inbound SYN-ACK packets, source port=80

Stateful Firewalls

- **Stateful firewalls** can tell when packets are part of legitimate sessions originating within a trusted network.
- Stateful firewalls maintain tables containing information on each active connection, including the IP addresses, ports, and sequence numbers of packets.
- Using these tables, stateful firewalls can allow only inbound TCP packets that are in response to a connection initiated from within the internal network.

Linux Firewall

- iptables manage IP table rules
  - Iptables: –L to list active rules, –A *chain* to add rule
    –D *chain* to delete rule, –F to flush rules
- Stop ping
  - $ sudo iptables -A INPUT -p icmp --icmp-type echo-request -j REJECT
  - $ sudo iptables -A INPUT -p icmp --icmp-type echo-request -j DROP
  - $ sudo iptables –F
- For practicing:
  - https://tryhackme.com/room/redteamfirewalls

What Is a Penetration Testing?

- Testing the security of systems and architectures from the point of view of an attacker (hacker, cracker …)
- A “simulated attack” with a predetermined goal that has to be obtained within a fixed time

Authorization Letter

- Detailed agreements/scope
  - Anything off limits?
  - Hours of testing?
  - Social Engineering allowed?
  - War Dialing?
  - War Driving?
  - Denials of Service?
  - Define the end point
- Consult a lawyer before starting the test

Closed Box vs. Open Box

- It treats the system as a closed/opaque box, so it doesn't explicitly use knowledge of the internal structure.

- It allows one to peek inside the "box", and it focuses specifically on using internal knowledge of the software to guide the selection of test data

Practical Techniques – Penetration Testing

1) Gather Information
2) Scan IP addresses
3) Fingerprinting
4) Identify vulnerable services
5) Exploit vulnerability (with care!)
6) Fix problems ?

Fingerprinting

- What web server is running?
- What accounts have I found?
- What services are running?
- What OSes are running?
- Who is logged in?
- Is there available information on the web site?

Identify Vulnerable Services

- Given a specific IP address and port, try to gain access to the machine. Report all known vulnerabilities for this target.

- Nessus

- Nexpose

- …

Vulnerability scanning

Nessus is the leader tool in vulnerability scanning

- There are two components :
  - **nessusd** server with ‘plugins’ list of known vulnerabilities (there are different kinds of subscription depending on how old the plugins are)
  - **nessus** is the front end of the tool. There are several version for windows and linux systems

Introduction to Nessus

- Created by Renaud Deraison
- Currently Maintained by Tenable Network Security
- Uses the NASL Scripting language for it's plugins (currently over 13,000 plugins!)
- Price is still Free! But no more open source
- Register to obtain many NASL plugins (7 day delay).
- Or Purchase a Direct Feed for the Latest!

Nessus Features

- Client/Server Architecture
- SSL/PKI supported
- Smart Service Recognition
  - (i.e. FTP on 31337)
- Non-Destructive or Thorough Tests
- Vulnerability Mapping to CVE, Bugtraq, and others
- Vulnerability Scoring using CVSS from NIST.

DebianEtchMini - VMware Workstation

File Edit View VM Team Windows Help

DebianEtchMini | Windows 2000 Server

Applications Places Desktop Ita 23:54

Nessus "NG" Report

Subnet

192.168.10

Host

192.168.10.110

Port

smtp (25/tcp)
netbios-ssn (139/tcp)
netbios-ns (137/udp)
ms-lsa (1028/udp)
microsoft-ds (445/tcp)
https (443/tcp)
http (80/tcp)
general/udp
general/tcp
general/icmp
exosee (1027/tcp)
epmap (135/udp)
epmap (135/tcp)
cap (1026/tcp)
blackjack (1025/tcp)

Severity

Security Warning
Security Note
Security Hole

The remote host is vulnerable to a denial of service attack in its SMB stack.

An attacker may exploit this flaw to crash the remote host remotely, without any kind of authentication.

Solution : http://www.microsoft.com/technet/security/bulletin/ms02-045.mspx
Risk factor : High
CVE : CVE-2002-0724
BID : 5556
Other references : OSVDB:2074

Save report... | Close window

user@debian: ~ | [user@debian: ~] | Nessus Setup | Nessus "NG" Re... | user@debian: ~

Tool	UNIX	Windows	TCP scan	UDP scan	Host discovery	Port scanner	OS fingerprinting	DOS	Anonimity level
SATAN	x		x		x	x		x	Medium
SARA	x		x			x		x	Medium
Nessus	x		x	x	x	x			Medium
Advanced IP scanner		x	x		x				Medium
Advanced port scanner		x	x			x			Medium
Strobe	x		x		x	x			Medium
Udp_scan	x			x	x	x			Low
Netcat	x		x	x	x	x			Low
Xprobe	x		x		x		x		Low
SoftPerfect Network Scanner		x	x		x	x			Low
Angry IP Scanner		x	x		x	x			Low
GFI LANGuard Network Scanner	x	x	x		x	x			Low
Superscan		x	x	x	x	x			Medium
Scanmastender Standard	x	x	x	x		x			Medium

Exploit vulnerability

- Try to exploit detected vulnerabilities, for example:
  - Buffer overflow
  - Heap overflow
  - SQL injection
  - Code injection
  - Cross-site scripting
- Metasploit is a framework that allows to test attacks

DebianEtchMini - VMware Workstation

File Edit View VM Team Windows Help

DebianEtchMini | Windows 2000 Server

Applications Places Desktop

user@debian: ~

File Edit View Terminal Tabs Help

```
#     # ####### #####    ##     ####   #####   #         ####   # #####
##   ## #       #     #  #  #   #       #     # #       #     # #    #
# ## # #####     #    #     #  ####   #     # #       #     # #    #
#     # #       #    ######       # #####   #       #     # #    #
#     # #       #    #     # #     # #       #       #     # #    #
#     # #######   #    #     #  ####   #       #######  ####   #    #


       =[ msf v3.0
+ -- --=[ 176 exploits - 104 payloads
+ -- --=[ 17 encoders - 5 nops
       =[ 30 aux

msf > use windows/smb/ms05_039_pnp
msf exploit(ms05_039_pnp) > set RHOST 192.168.10.110
RHOST => 192.168.10.110
msf exploit(ms05_039_pnp) > set TARGET 0
TARGET => 0
msf exploit(ms05_039_pnp) > set PAYLOAD windows/meterpreter/bind_tcp
PAYLOAD => windows/meterpreter/bind_tcp
msf exploit(ms05_039_pnp) > exploit
```

Pen Testing tools

- Often open source and a with a limited free version
- A good starting point is using a Linu
- The most used distribution is **Kali L**
  - an open-source, Debian-based Linux distribution.
    - Penetration Testing,
    - Computer Forensics
- https://tools.kali.org

When Things Get Tough

Target machines

- You can find in the competitions like Capture The Flags
- In this tutorial we use Metasploitable 2 released by Rapid7
  - Rapid 7 manages Metasploit Framework

- Usually the target machines are in

Enumeration with Nmap (Network Mapper)

Port Division
- open, closed, filtered, unfiltered, open|filtered and closed|filtered

Scanning techniques
- -sS (TCP SYN scan)
- -sT (TCP connect() scan)
- -sU (UDP scans)
- -sA (TCP ACK scan)
- -sW (TCP Window scan)
- -sM (TCP Maimon scan)
- --scanflags (Custom TCP scan)
- -sI <zombie host[:probeport]> (Idlescan)
- -sO (IP protocol scan)
- -sN; -sF; -sX (TCP Null, FIN, and Xmas scans)
- -b <ftp relay host> (FTP bounce scan)

```
notwist@notwist:~$ nmap localhost

Starting Nmap 4.20 ( http://insecure.org ) at 2007-04-02 15:5
Interesting ports on localhost (127.0.0.1):
Not shown: 1691 closed ports
PORT     STATE SERVICE
22/tcp   open  ssh
80/tcp   open  http
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
631/tcp  open  ipp
3306/tcp open  mysql

Nmap finished: 1 IP address (1 host up) scanned in 0.213 seconds
notwist@notwist:~$
```

Identify active hosts and services in the network

- **ping sweep** useful to identify targets and to verify also rogue hosts
- Ex:
  - nmap -v -sP 10.0.2.0/28
    - -sP Ping scan.
- **port scanning** useful to identify active ports (services or daemons) that are running on the targets
- Ex:
  - nmap -v -sT 10.0.2.*x*
    - -sT normal scan
    - -sS stealth scan –sV services