Welcome to

Intro to Incident Response - Track B

Summer School in Cyber Security 2022

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Slides are available as PDF, kramse@Github

introduction-incident-response.tex in the repo security-courses

Contact information

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You are welcome to drop me an email

Goals for today

Introduction to incident response. what is an incident and a log? We will discuss what happens when someone visits your network. Starting from initial compromise we will demonstrate how we can identify, process and handle incidents in networks. Using example tools from the Elastic stack we will present deep dives into network data, DNS, introduce computer forensics and how preparation and a structured method will enable companies to handle incidents more effeciently.

Photo by Thomas Galler on Unsplash

Plan for today

13:00 - 13:45 Introduction and basics

13:45 - 14:00 – 15 min do exercises / break

14:00 - 14:45

14:45 - 14:00 – 15 min do exercises / break

15:00 - 15:30

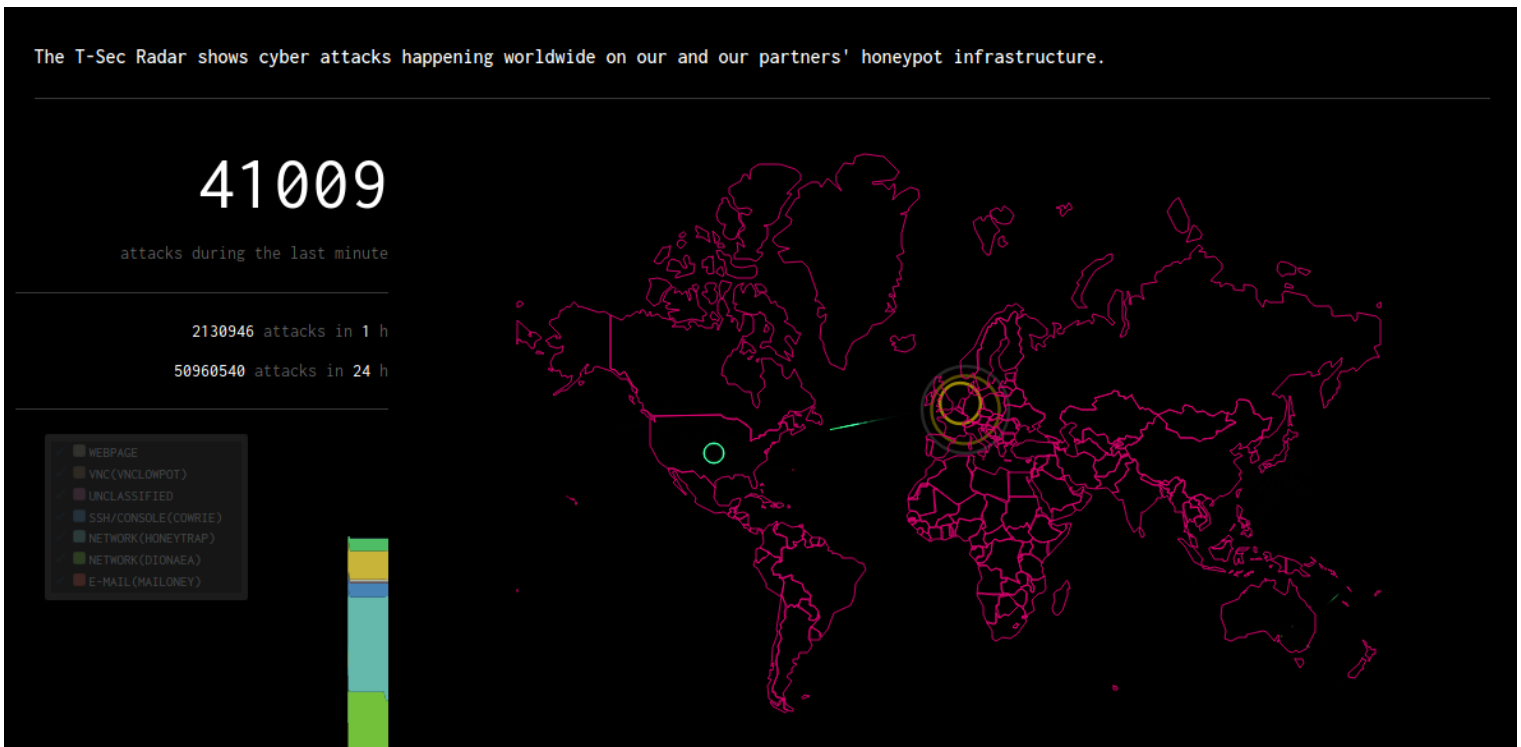
15:30 - 15:45 – Last exercise

15:45 - 16:00 – Summary and conclusions

All slides are in english, exercises in Danish!

Hint: Don't panic if the plan breaks!

Introduction: Attack overview



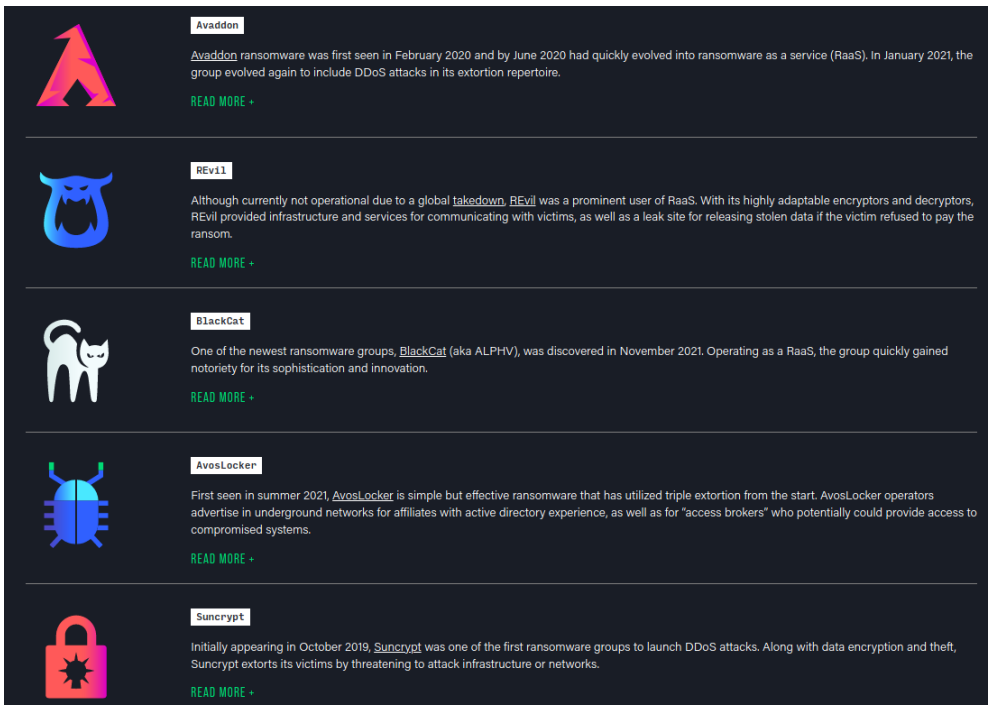
Source: http://www.sicherheitstacho.eu/

DDoS Attacks Still a Problem

Security attacks and DDoS is very much in the media

Source: linkhttps://www.netscout.com/threatreport/global-ddos-attack-trends/

Ransomware Attacks are Common



Avaddon

Avaddon ransomware was first seen in February 2020 and by June 2020 had quickly evolved into ransomware as a service (RaaS). In January 2021, the group evolved again to include DDoS attacks in its extortion repertoire.

READ MORE +

REvil

Although currently not operational due to a global takedown, REvil was a prominent user of RaaS. With its highly adaptable encryptors and decryptors, REvil provided infrastructure and services for communicating with victims, as well as a leak site for releasing stolen data if the victim refused to pay the ransom.

READ MORE +

BlackCat

One of the newest ransomware groups, BlackCat (aka ALPHV), was discovered in November 2021. Operating as a RaaS, the group quickly gained notoriety for its sophistication and innovation.

READ MORE +

AvosLocker

First seen in summer 2021, AvosLocker is simple but effective ransomware that has utilized triple extortion from the start. AvosLocker operators advertise in underground networks for affiliates with active directory experience, as well as for "access brokers" who potentially could provide access to compromised systems.

READ MORE +

Suncrypt

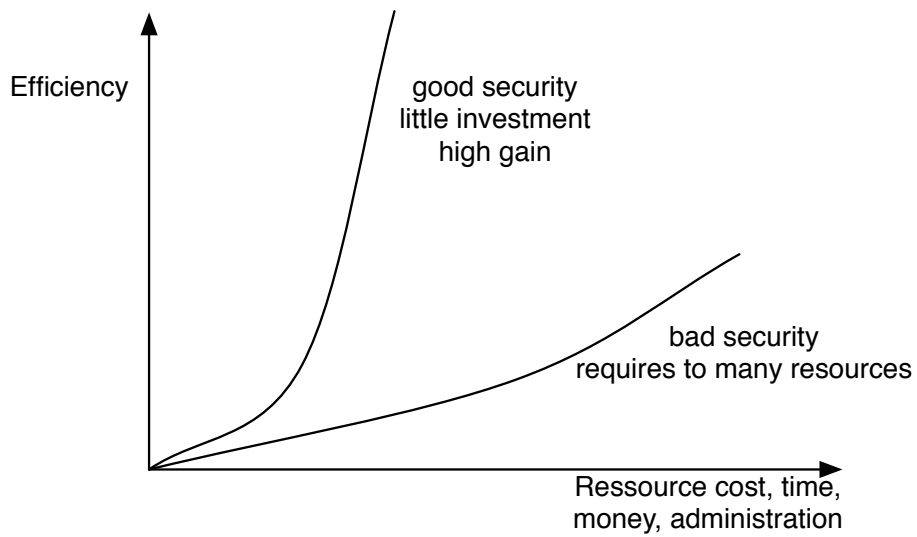
Initially appearing in October 2019, Suncrypt was one of the first ransomware groups to launch DDoS attacks. Along with data encryption and theft, Suncrypt extorts its victims by threatening to attack infrastructure or networks.

READ MORE +

Make sure to backup your data! Test your backups!

Source: linkhttps://www.netscout.com/threatreport/global-ddos-attack-trends/

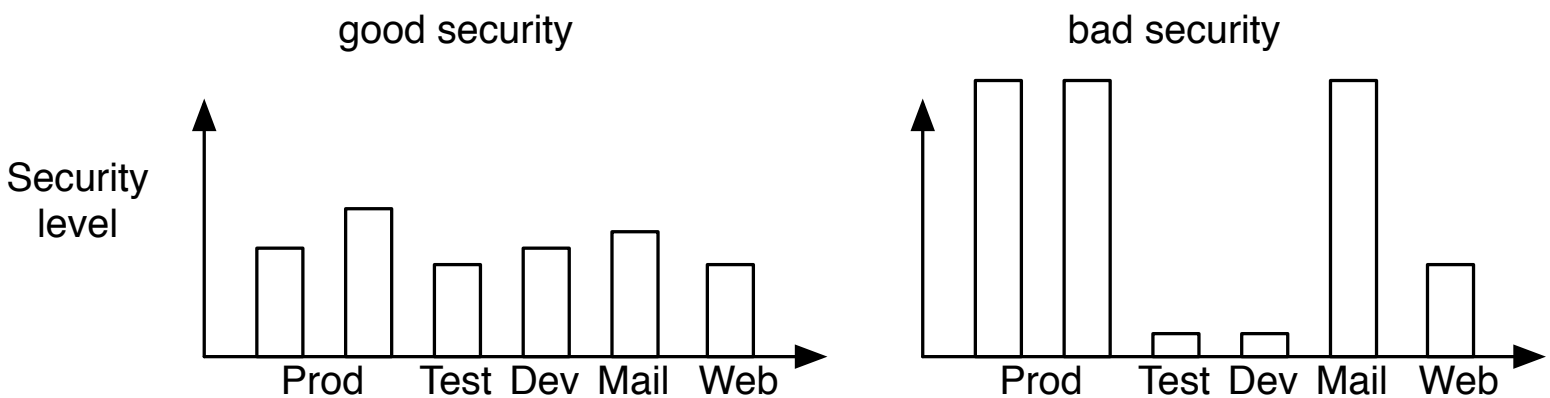
What can we do? – Good security



You always have limited resources for protection - use them as best as possible

Good security comes from structured work

Balanced security



Better to have the same level of security

If you have bad security in some part - guess where attackers will end up

Hackers are not required to take the hardest path into the network

Realize there is no such thing as 100% security

Work together

Team up!

We need to share security information freely

We often face the same threats, so we can work on solving these together

My daily job – Security engineering a job role

On any given day, you may be challenged to:

- Create new ways to solve existing production security issues
- Configure and install firewalls and intrusion detection systems
- Perform vulnerability testing, risk analyses and security assessments
- Develop automation scripts to handle and track incidents
- Investigate intrusion incidents, conduct forensic investigations and incident responses
- Collaborate with colleagues on authentication, authorization and encryption solutions
- Evaluate new technologies and processes that enhance security capabilities
- Test security solutions using industry standard analysis criteria
- Deliver technical reports and formal papers on test findings
- Respond to information security issues during each stage of a project's lifecycle
- Supervise changes in software, hardware, facilities, telecommunications and user needs
- Define, implement and maintain corporate security policies
- Analyze and advise on new security technologies and program conformance
- Recommend modifications in legal, technical and regulatory areas that affect IT security

Source: https://www.cyberdegrees.org/jobs/security-engineer/
also https://en.wikipedia.org/wiki/Security_engineering

Risk management defined

Information Risk Management

Life is full of risk.

Risk is the possibility of damage happening and the ramifications of such damage should it occur. ***Information risk management (IRM)*** is the *process* of identifying and assessing risk, reducing it to an acceptable level, and implementing the right mechanisms to maintain that level. There is no such thing as a 100 percent secure environment. Every environment has vulnerabilities and threats to a certain degree. The skill is in identifying these threats, assessing the probability of them actually occurring and the damage they could cause, and then taking the right steps to reduce the overall level of risk in the environment to what the organization identifies as acceptable.

Source: Shon Harris *CISSP All-in-One Exam Guide*

Security Controls and Frameworks

Multiple exist

- CIS controls Center for Internet Security (CIS) https://www.cisecurity.org
- PCI Best Practices for Maintaining PCI DSS Compliance v2.0 Jan 2019
- NIST Cybersecurity Framework (CSF)
  Framework for Improving Critical Infrastructure Cybersecurity
  https://www.nist.gov/cyberframework
  https://csrc.nist.gov/publications/sp800 - SP800 series
- National Security Agency (NSA)
  https://www.nsa.gov/Research/
- NSA security configuration guides
  https://apps.nsa.gov/iaarchive/library/ia-guidance/security-configuration/
- Information Systems Audit and Control Association (ISACA)
  http://www.isaca.org/Knowledge-Center/

Center for Internet Security CIS Controls

"A goal without a plan is just a wish."
Antoine de Saint-Exupéry

The CIS ControlsTM are a prioritized set of actions that collectively form a defense-in-depth set of best practices that mitigate the most common attacks against systems and networks. The CIS Controls are developed by a community of IT experts who apply their first-hand experience as cyber defenders to create these globally accepted security best practices. The experts who develop the CIS Controls come from a wide range of sectors including retail, manufacturing, healthcare, education, government, defense, and others.

Source: https://www.cisecurity.org/ CIS-Controls-Version-7-1.pdf

Kom igang med CIS

CIS-kontrollerne består af 20 praktiske, pragmatiske kontroller, som er målbare og med direkte henvisning til, hvordan de implementeres samt forslag til, hvilke KPI'er der bør opstilles for målinger.

Forskellen på CIS-kontrollerne og fx ISO27001 er, at du ikke kan blive certificeret efter CIS, men til gengæld opdateres CIS-kontrollerne løbende, og de indeholder prioriterede lister af, hvad du i praksis skal gøre for din cybersikkerhed. Det australske forsvar har fx vist, at hvis man implementerer de første fire kontroller fuldt ud, kan man mitigere op mod 90+% af alt malware.

Dansk artikel fra Deloitte, version 7 men version 8 er ude https://www2.deloitte.com/dk/da/pages/risk/articles/vi-stiller-skarpt-pa-cis-kontroller.html

Overview Diploma in IT-security

Afgangsprojektet (15 ECTS)	
Der udvikles løbende nye valgfag til Diplom i it-sikkerhed. Disse vil løbende blive beskrevet i en allonge (bilag 2) til studieordningen.	
Sikkerhed i it-governance (it-sikkerhedsledelse) (5 ECTS)	Systemsikkerhed (10 ECTS)
Videregående sikkerhed i it-governance (Videregående sikkerhedsledelse) (5 ECTS)	
Softwaresikkerhed (10 ECTS)	
Netværks- og kommunikationssikkerhed (10 ECTS)	

Some of this comes from courses in Diploma in IT-Security / professionsbachelor i IT-Sikkerhed (Pba ITS)

Course Data

Specifically the courses

Course: SIEM and Log Analysis (5 ECTS)

Course Description

From: STUDIEORDNING Diplomuddannelse i it-sikkerhed August 2018
VF4 SIEM og log analyse (5 ECTS)

Indhold
Den studerende lærer om Security information and event management (SIEM), herunder hvordan man kan indsamle, administrere, og søge i sikkerhedshændelsesdata i et større it system (komplekse systemer, IOT deployments, corporate IT).

Læringsmål: Viden – Den studerende har viden om og forståelse for:

- Typiske SIEM arkitekturer
- Standard logformater og logtyper for standard systemer og komponenter
- Typiske SIEM produkter
- Juridiske krav til logning og bevarelse af data ifb. forensic analyse

Færdigheder – Den studerende kan:

- Lave en baseline-analyse af en infrastruktur
- Bruge log-data til at identificere infrastrukturkomponenter
- Bruge et værktøj til at analysere system log-data og netværkstrafik til at finde sikkerhedshændelser
- Udvikle "dashboards"og alarmer der viser tegn på hændelser

Kompetencer – Den studerende kan:

- Designe og implementere en SIEM løsning på tværs af diverse produkter
- Træffe beslutninger om hvilke data der skal indsamles i en givne situation
- Identificerer fejl i logopsamlingen
- Deltage i drøftelser på et praktisk og strategisk niveau i forhold til implementering af logmanagement/SIEM

Final word is the Studieordning which can be downloaded from

https://kompetence.kea.dk/uddannelser/it-digitalt/diplom-i-it-sikkerhed

Studieordning_for_Diplomuddannelsen_i_IT-sikkerhed_Aug_2018.pdf

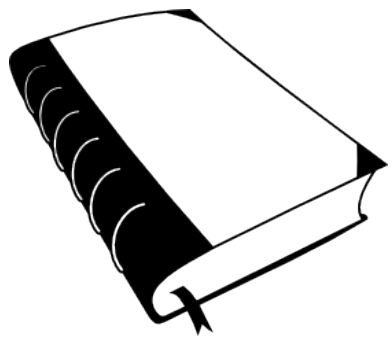
Some keywords relating to this course

Incident Response Logs Events
Analysis Visualization Dashboards Data-driven Security
SIEM architectures frameworks acquire process Zeek
log formats data types databases JSON XML Security Operations Center
(Incident Response) Intelligence R and Python fundamentals
Practical application Building Infosec Ansible Playbooks
Collect, mine, organize, and analyze relevant data sources
Sort data create reporting and monitoring
IP-address Netflow nfdump Elasticsearch real-world knowledge

- Lots of new terms, technologies and tools

Primary literature

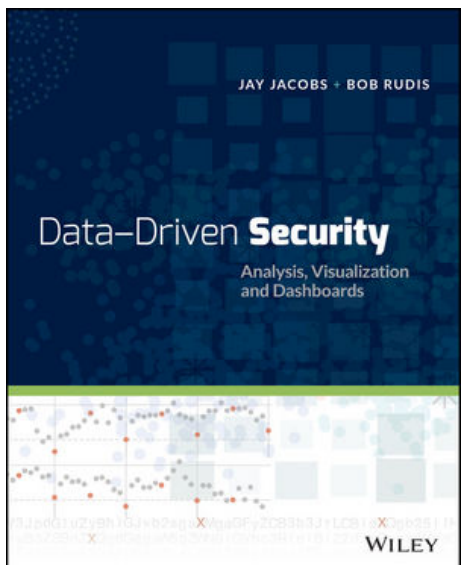
Primary literature – used in courses:



Free graphics by Lumen Design Studio

- *Data-Driven Security: Analysis, Visualization and Dashboards* Jay Jacobs, Bob Rudis ISBN: 978-1-118-79372-5 February 2014 https://datadrivensecurity.info/ - short DDS
- *Crafting the InfoSec Playbook: Security Monitoring and Incident Response Master Plan* by Jeff Bollinger, Brandon Enright, and Matthew Valites ISBN: 9781491949405 - short CIP
- *Intelligence-Driven Incident Response* Scott Roberts ISBN: 9781491934944 - short IDI
- *Security Operations Center: Building, Operating, and Maintaining your SOC* ISBN: 9780134052014 Joseph Muniz - short SOC

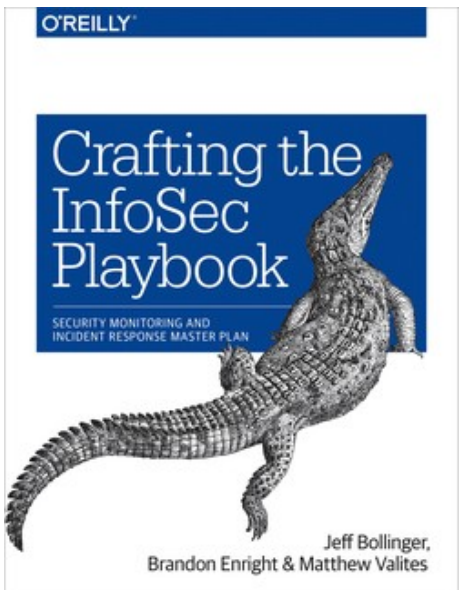
Data-Driven Security: Analysis, Visualization and Dashboards



Data-Driven Security: Analysis, Visualization and Dashboards Jay Jacobs, Bob Rudis
ISBN: 978-1-118-79372-5 February 2014 https://datadrivensecurity.info/ - short DDS

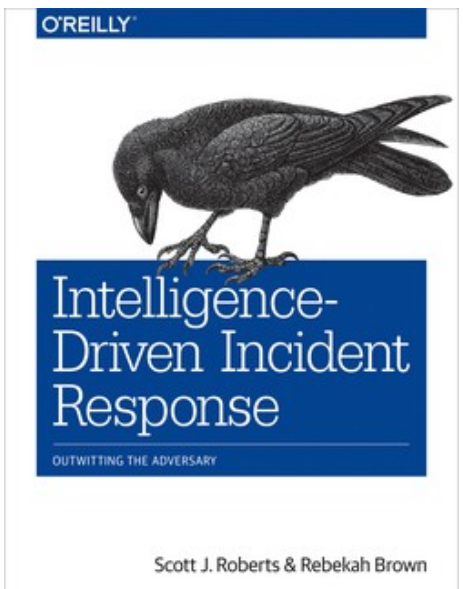
Our main book for this course. We will read a lot from this one.

Crafting the InfoSec Playbook



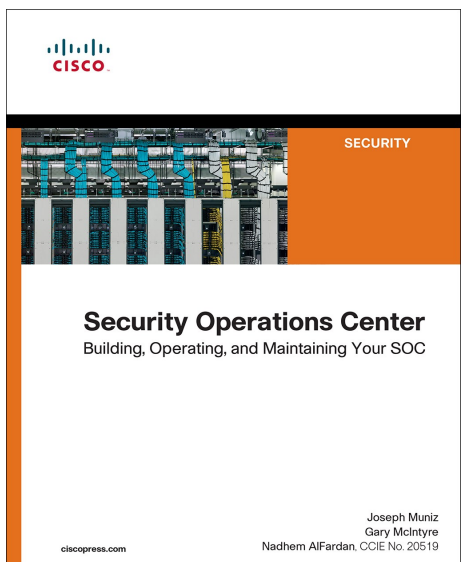
Crafting the InfoSec Playbook: Security Monitoring and Incident Response Master Plan
by Jeff Bollinger, Brandon Enright, and Matthew Valites ISBN: 9781491949405 - short CIP

Intelligence-Driven Incident Response



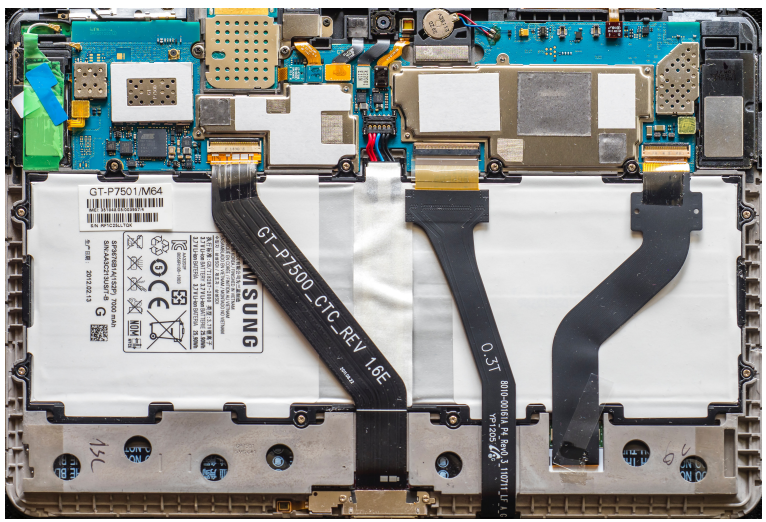
Intelligence-Driven Incident Response
Scott Roberts ISBN: 9781491934944 - short IDI

Security Operations Center



Security Operations Center: Building, Operating, and Maintaining your SOC
ISBN: 9780134052014 Joseph Muniz - short SOC

What is Infrastructure



- Enterprises today have a lot of computing systems supporting the business needs
- These are very diverse and often discrete systems

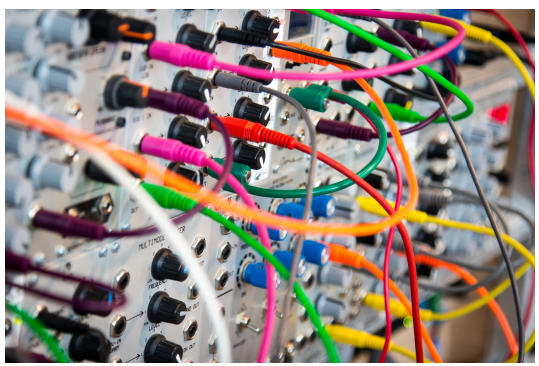
Photo by Alexander Schimmeck on Unsplash

Business Challenges

- Accumulation of software
- Legacy systems
- Partners
- Various types of data
- Employee churn, replacement

Photo by Adam Bignell on Unsplash

Software Challenges



- Complexity
- Various languages
- Various programming paradigms, client server, monolith, Model View Controller
- Conflicting data types and available structures
- Steam train vs electric train

Photo by John Barkiple on Unsplash

SIEM

Security information and event management (SIEM) is a subsection within the field of computer security, where software products and services combine security information management (SIM) and security event management (SEM). They provide real-time analysis of security alerts generated by applications and network hardware.

Vendors sell SIEM as software, as appliances, or as managed services; these products are also used to log security data and generate reports for compliance purposes.[1]

The term and the initialism SIEM was coined by Mark Nicolett and Amrit Williams of Gartner in 2005.[2]

Source: https://en.wikipedia.org/wiki/Security_information_and_event_management

- Note: there are alerting examples towards the bottom of the page, with sources
- Closely related to log management, incident response

SOC

> An information security operations center (ISOC or SOC) is a facility where enterprise information systems (web sites, applications, databases, data centers and servers, networks, desktops and other endpoints) are monitored, assessed, and defended.
>
> ...
>
> A **security operations center (SOC)** can also be called a security defense center (SDC), security analytics center (SAC), network security operations center (NSOC),[3] security intelligence center, cyber security center, threat defense center, security intelligence and operations center (SIOC). In the Canadian Federal Government the term, infrastructure protection center (IPC), is used to describe a SOC.

Source: https://en.wikipedia.org/wiki/Information_security_operations_center

- We have a whole book about SOCs, but I skipped the introductory chapters!
- If you need to build a SOC, that is great source of information

Subjects: Incident Response

Context, what are the threats, what are the answers we want from the SIEM and Logs

What are the common cases, where we use the data?

- Incident Response
- Computer Emergency Response Team (CERT) and Computer Security Incident Response Teams (CSIRT)
- Security Departments
- GDPR Data protection
- Computer Forensics

Incident Handling, phases

The procedures developed for incident response must cover the complete life-cycle

- Preparation for an attack, establish procedures and mechanisms for detecting and responding to attacks
- Identification of an attack, notice the attack is ongoing
- Containment (confinement) of the attack, limit effects of the attack as much as possible
- Eradication of the attack, stop attacker, block further similar attacks
- Recovery from the attack, restore system to a secure state
- Follow-up to the attack, include lessons learned improve environment

Crafting the InfoSec Playbook

This book will help you to answer common questions:

- How do I find bad actors on my network?
- How do I find persistent attackers?
- How can I deal with the pervasive malware threat?
- How do I detect system compromises?
- How do I find an owner or responsible parties for systems under my protection?
- How can I practically use and develop threat intelligence?
- How can I possibly manage all my log data from all my systems?
- How will I benefit from increased logging—and not drown in all the noise?
- How can I use metadata for detection?

Source: *Crafting the InfoSec Playbook: Security Monitoring and Incident Response Master Plan* by Jeff Bollinger, Brandon Enright, and Matthew Valites ISBN: 9781491949405

MITRE ATT&CK framework

MITRE ATT&CK™ is a globally-accessible knowledge base of adversary tactics and techniques based on real-world observations. The ATT&CK knowledge base is used as a foundation for the development of specific threat models and methodologies in the private sector, in government, and in the cybersecurity product and service community.

With the creation of ATT&CK, MITRE is fulfilling its mission to solve problems for a safer world — by bringing communities together to develop more effective cybersecurity. ATT&CK is open and available to any person or organization for use at no charge.

ATT&CK™

Source: https://attack.mitre.org/ Great resource for attack categorization

Incident Response Checklists

Table 3-5. Incident Handling Checklist

	Action	Completed
	Detection and Analysis	
1.	Determine whether an incident has occurred	
1.1	Analyze the precursors and indicators	
1.2	Look for correlating information	
1.3	Perform research (e.g., search engines, knowledge base)	
1.4	As soon as the handler believes an incident has occurred, begin documenting the investigation and gathering evidence	
2.	Prioritize handling the incident based on the relevant factors (functional impact, information impact, recoverability effort, etc.)	
3.	Report the incident to the appropriate internal personnel and external organizations	
	Containment, Eradication, and Recovery	
4.	Acquire, preserve, secure, and document evidence	
5.	Contain the incident	
6.	Eradicate the incident	
6.1	Identify and mitigate all vulnerabilities that were exploited	
6.2	Remove malware, inappropriate materials, and other components	
6.3	If more affected hosts are discovered (e.g., new malware infections), repeat the Detection and Analysis steps (1.1, 1.2) to identify all other affected hosts, then contain (5) and eradicate (6) the incident for them	
7.	Recover from the incident	
7.1	Return affected systems to an operationally ready state	
7.2	Confirm that the affected systems are functioning normally	
7.3	If necessary, implement additional monitoring to look for future related activity	
	Post-Incident Activity	
8.	Create a follow-up report	
9.	Hold a lessons learned meeting (mandatory for major incidents, optional otherwise)	

This checklist is from the NIST document *Computer Security Incident Handling Guide: Recommendations of the National Institute of Standards and Technology*, NIST Special Publication 800-61 Revision 2, August 2012.

CIS Controls also recommend Incident Response

CIS Control 19:

Incident Response and Management Protect the organization's information, as well as its reputation, by developing and implementing an incident response infrastructure (e.g., plans, defined roles, training, communications, management oversight) for quickly discovering an attack and then effectively containing the damage, eradicating the attacker's presence, and restoring the integrity of the network and systems.

Source: Center for Internet Security CIS Controls 7.1 CIS-Controls-Version-7-1.pdf from https://www.cisecurity.org/controls/

Anatomy of an Auditing System

Sample logs from login with Secure Shell (SSH) and performing the command `sudo su -`

```
Jun  5 11:53:15 pumba sshd[64505]: Accepted publickey for hlk from 79.142.233.18 port 43902
 ssh2: ED25519 SHA256:l8OJMcywyBcraJiCWJ06uZ2yzHfu0VuiArqVvlVyfEI

Jun  5 11:53:19 pumba sudo:      hlk : TTY=ttyp2 ; PWD=/home/hlk ; USER=root ; COMMAND=/usr/
```

Example systems: Unix syslog, IBM main frame RACF and Windows Event Logs service

Logs should be protected and considered confidential information

Anatomy of an Auditing System

When data has been gathered it should be analyzed.

Logger functions - collect

Analyzer - analyze it, creating dashboard can provide some insights

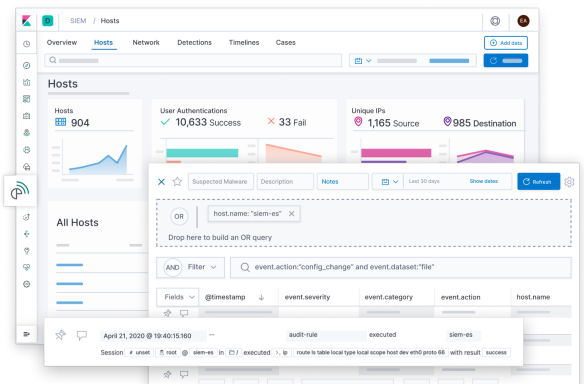
Notifier - report results by email or other means

Example systems Windows Event Logs service can inform of successful and failed logins, both should be collected

Logs should be protected and considered confidential information, by sending it to a centralized system with a high security level protects it

Modern systems exist to take all data from logging and provide high capacity storage, searching and sorting.

Why Elasticsearch



Screenshot from https://www.elastic.co/siem

Recommend building a proof-of-concept infrastructure using the Elastic stack and gather experience with logging. This can be done without a license fee and the organization can then see what works and doesn't. Then using the experiences as input an informed decision can be made, to continue with this as a home grown logging and auditing solution, or buy a premade one.

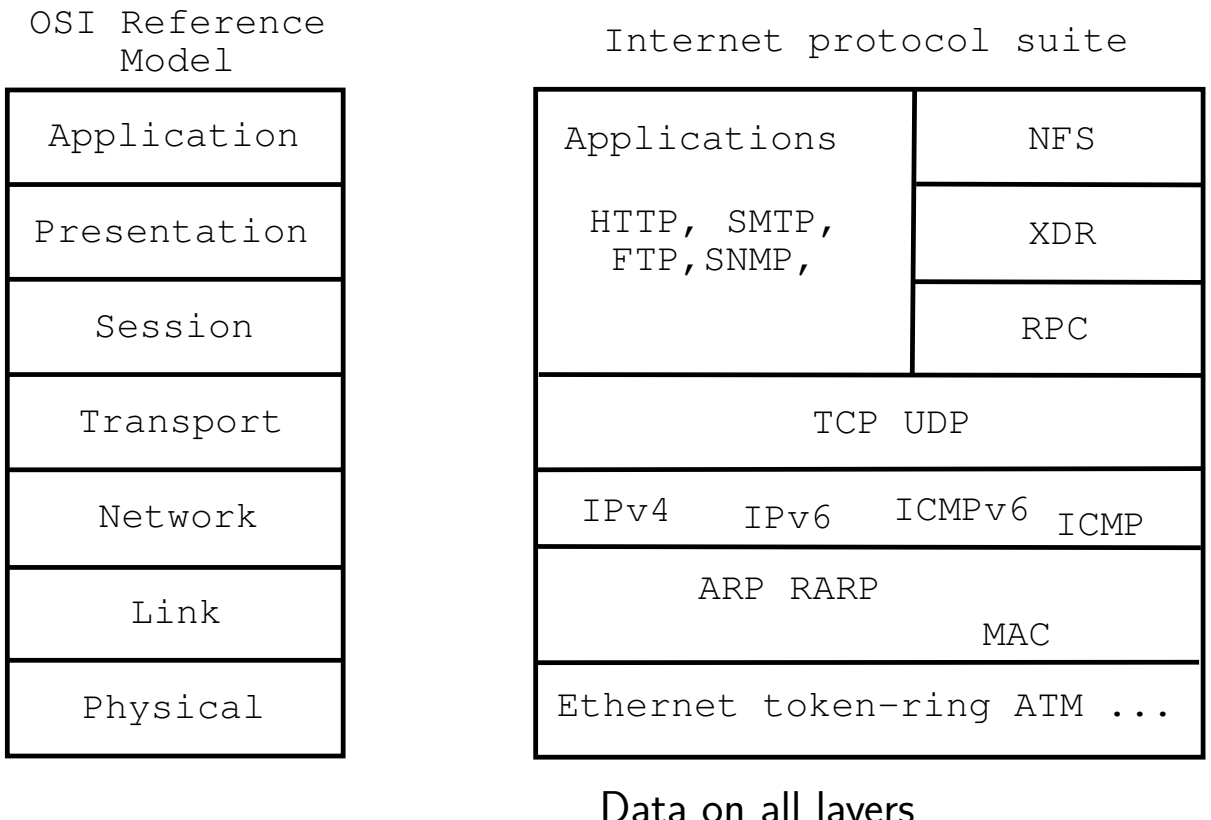
Technologies used in this course

The following tools and environments are examples that may be introduced in this course:

- Programming languages and frameworks Java, Python, regular expressions
- Development environments – choose your own IDE / Editor – I use **Atom**
- Networking and network protocols: TCP/IP, HTTP, DNS, Netflow
- Formats XML, JSON, CSV, raw text, web scraping
- Web technologies and services: REST, API, HTML5, CSS, JavaScript
- Tools like cURL, Zeek, Git and Github
- Message queueing systems: MQ and Redis could be added
- Aggregated example platforms: Elastic stack, logstash, elasticsearch, kibana, grafana, Filebeat
- Cloud and virtualisation Docker, Kubernetes, Azure, AWS, microservices – can be added

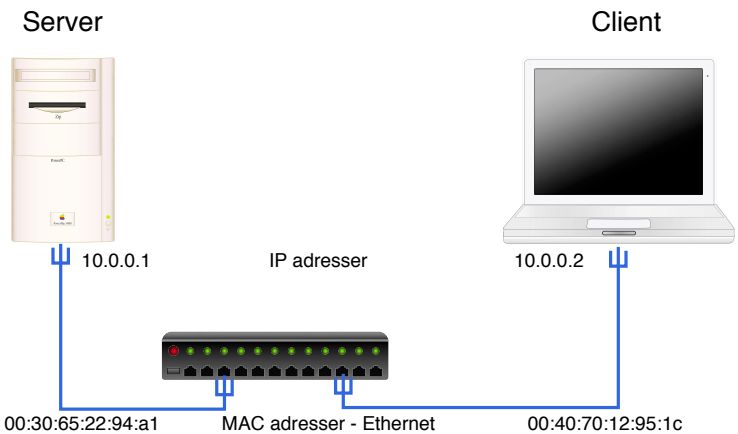
This list is not complete or a promise

OSI and Internet



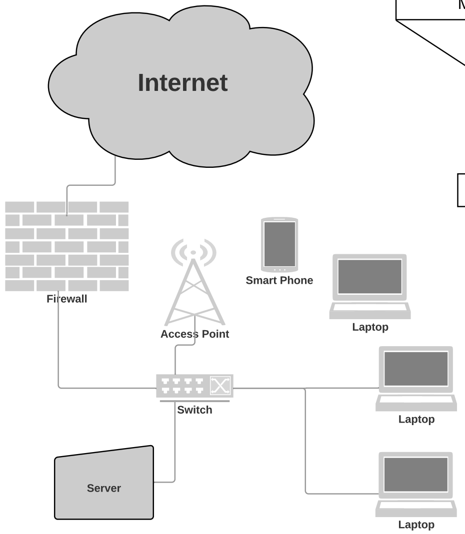
Data on all layers

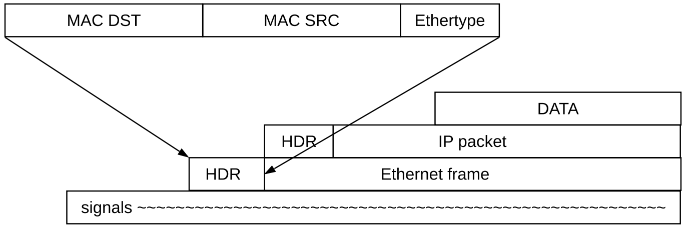
Networking in TCP/IP



- Everything uses TCP/IP today, more or less.
- Clients make requests, receives responses
- HyperText Transfer Protocol (HTTP) is an example
- All devices shown can produce logs and events

Sources: Network overview





Ethernet frames contain packets

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version|  IHL  |Type of Service|          Total Length         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Identification        |Flags|      Fragment Offset    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Time to Live |    Protocol   |         Header Checksum       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                       Source Address                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Destination Address                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Options                    |    Padding    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Example Internet IPv4 Packet Header

- Internet, routers, firewalls, switches, clients and servers (Wi-Fi not shown)

Sources: Strategy for implementing identification and detection

We recommend that the following strategy is used for implementing identification and detection – logging:

- ☐ Enable system logging from servers
- ☐ Enable system logging from network devices
- ☐ Enable logging from client devices
- ☐ Centralize logging
- ☐ Add search facilities and dashboards
- ☐ Perform system audits manually or automatically
- ☐ Setup alerting and notification with procedures

Intrusion Kill Chains

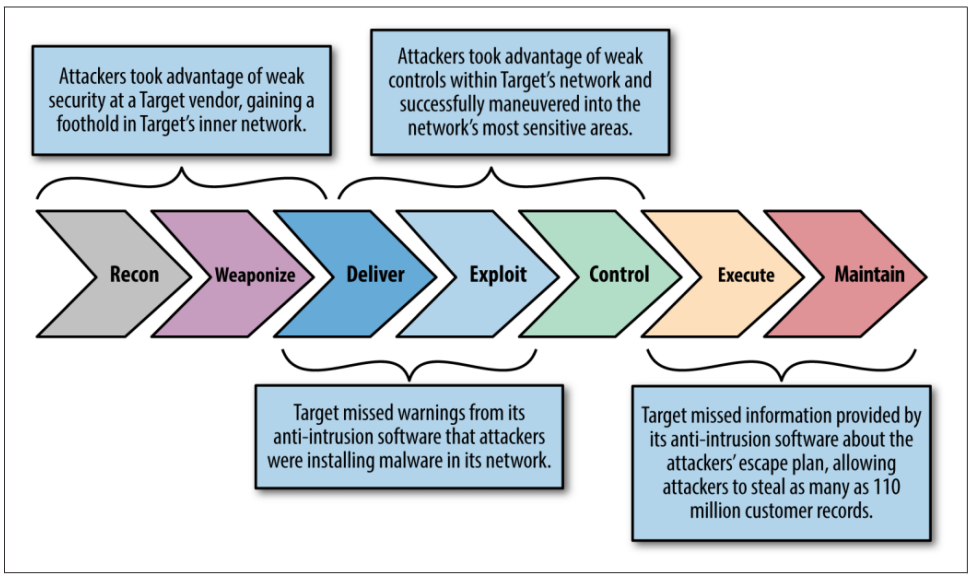


Figure 7-1. The kill chain

- See also *Intelligence-Driven Computer Network Defense Informed by Analysis of Adversary Campaigns and Intrusion Kill Chains*, Eric M. Hutchins , Michael J. Cloppert, Rohan M. Amin, Ph.D. Lockheed Martin Corporation

  https://www.lockheedmartin.com/content/dam/lockheed-martin/rms/documents/cyber/LM-White-Paper-Intel-Driven-Defense.pdf

Detection Capabilities

Security incidents happen, but what happens. One of the actions to reduce impact of incidents are done in preparing for incidents.

> *Preparation* for an attack, establish procedures and mechanisms for detecting and responding to attacks

Preparation will enable easy **identification** of affected systems, better **containment** which systems are likely to be infected, **eradication** what happened – how to do the **eradication** and **recovery**.

Data Analysis Skills

Although we could spend an entire book creating an exhaustive list of skills needed to be a good security data scientist, this chapter covers the following skills/domains that a data scientist will benefit from knowing within information security:

- Domain expertise—Setting and maintaining a purpose to the analysis
- Data management—Being able to prepare, store, and maintain data
- Programming—The glue that connects data to analysis
- Statistics—To learn from the data
- Visualization—Communicating the results effectively

It might be easy to label any one of these skills as the most important, but in reality, the whole is greater than the sum of its parts. Each of these contributes a significant and important piece to the workings of security data science.

Source: *Data-Driven Security: Analysis, Visualization and Dashboards* Jay Jacobs, Bob Rudis
ISBN: 978-1-118-79372-5 February 2014 https://datadrivensecurity.info/ - short DDS

Don't use spreadsheets!

- Spreadsheets are great for some tasks, but ...
- They don't scale
- The model can be broken – edit a single formula
- Rounding errors accumulate
- Input and output are limited
- Most functions require manual work

Data overview JSON

> JavaScript Object Notation (JSON, pronounced / d e sən/; also / d e s n/[note 1]) is an open-standard file format or data interchange format that uses **human-readable text** to transmit data objects consisting of attribute–value pairs and array data types (or any other serializable value). It is a very common data format, with a diverse range of applications, such as serving as replacement for XML in AJAX systems.[6]

Source: https://en.wikipedia.org/wiki/JSON

- I like JSON much better than XML
- Many web services can supply data in JSON format

JSON example

```
{
  "first name": "John",
  "last name": "Smith",
  "age": 25,
  "address": {
    "street address": "21 2nd Street",
    "city": "New York",
    "state": "NY",
    "postal code": "10021"
  },
  "phone numbers": [
    {
      "type": "home",
      "number": "212 555-1234"
    },
  ],
}
```

- This is a basic JSON document, new data attribute-value pairs can be added
  Source: https://en.wikipedia.org/wiki/JSON

Python and REST

```
#!/usr/bin/env python
import requests
r = requests.get('https://api.github.com/events')
print (r.json());
```

- Lets try to use some Python to access a REST service.
- We will use the JSONPlaceholder which is a free online REST API: https://jsonplaceholder.typicode.com/
- Start at the site: https://jsonplaceholder.typicode.com/guide.html and try running a few of the examples with your browser
- Then try using the same URLS in the Requests HTTP library from Python, https://requests.readthedocs.io/en/master/

Note about frameworks and libraries

```
import xml.etree.ElementTree as ET
tree = ET.parse('testfile.xml')
root = tree.getroot()

print(root.tag)
print('Nmap version: \t\t{:s} '.format(root.attrib['version']))
print('Nmap started: \t\t{:s} '.format(root.attrib['startstr']))
print('Nmap command line: \t{:s} '.format(root.attrib['args']))

hosts = tree.findall('./host')
for host in hosts:
    print(host.tag)
    print(host.attrib)
    for hostvalues in host:
        print(hostvalues.tag)
        print(hostvalues.attrib)
```

- Dont import JSON or XML using home made programs
- Example uses xml.etree.ElementTree from Python https://docs.python.org/3.7/library/xml.etree.elementtree.html

Convert XML to JSON

```
import xml.etree.ElementTree as ET
import json
def etree_to_dict(t):
    d = {t.tag : map(etree_to_dict, t.getchildren())}
    d.update(('@' + k, v) for k, v in t.attrib.items())
    d['text'] = t.text
    return d

tree = ET.parse('testfile.xml')
root = tree.getroot()
mydict = etree_to_dict(root)
print(type(tree))
print(type(root))
print(type(mydict))

print(mydict)

with open('testfile.json', 'w') as json_file:
  json.dump(mydict, json_file)
```

Converting using Python is easy

Side note: Zeek Security Monitor handles formats differently

Zeek has files formatted with a header:

```
#fields ts      uid     id.orig_h       id.orig_p       id.resp_h       id.resp_p       proto   trans_id
        rtt     query   qclass  qclass_name     qtype   qtype_name      rcode   rcode_name      AA
        TC      RD      RA      Z       answers TTLs    rejected

1538982372.416180 CD12Dc1SpQm42QW4G3 10.xxx.0.145 57476 10.x.y.141 53 udp 20383
0.045021 www.dr.dk 1 C_INTERNET 1 A 0 NOERROR F F T T 0
   www.dr.dk-v1.edgekey.net,e16198.b.akamaiedge.net,2.17.212.93 60.000000,20409.000000,20.000000 F
```

Note: this show ALL the fields captured and dissected by Zeek, there is a nice utility program bro-cut which can select specific fields:

```
root@NMS-VM:/var/spool/bro/bro# cat dns.log | bro-cut -d ts query answers | grep dr.dk
2018-10-08T09:06:12+0200 www.dr.dk www.dr.dk-v1.edgekey.net,e16198.b.akamaiedge.net,2.17.212.93
```

Can also just use JSON now via Filebeat

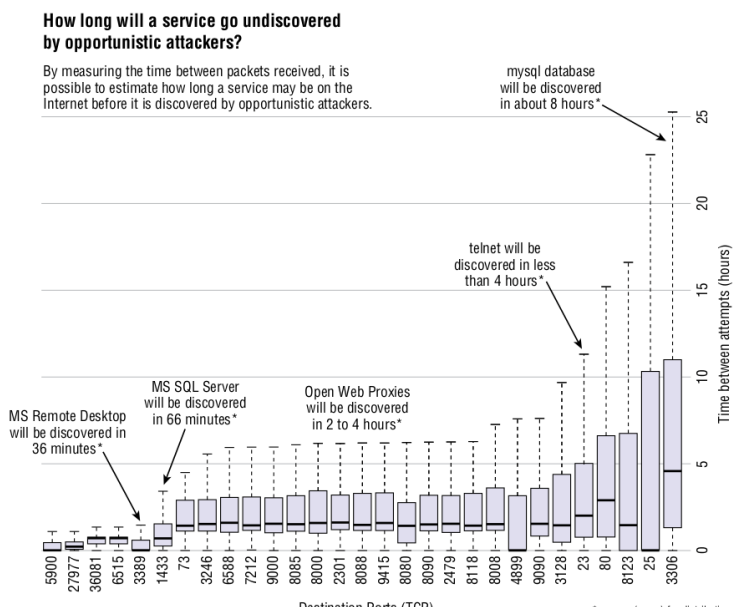
Metadata – enrichment

Metadata	Metacategory: Data
The DNS lookup occurred at a certain time.	Timestamp: 278621182
The internal host sent a DNS PTR request.	Network protocol: DNS PTR
The internal host had a hostname.	Location: Desktop subnet
	Source IP Address: 1.1.1.2
	Hostname: windowspc22.company.com
The internal host resolved an external host.	Location: External
	Destination IP Address: 255.123.215.3
	Hostname: dgf7adfnkjhh.com
The external host was hosted by a dynamic DNS provider.	Network: Shady DDnS Provider Inc.
	ASN: SHADY232
	Reputation: Historically risky network
The remote hostname appeared randomly generated.	Hostname: dgf7adfnkjhh.com
	Category: Unusual, nonlinguistic

Source: picture from Crafting the InfoSec Playbook, CIP

Metadata + Context

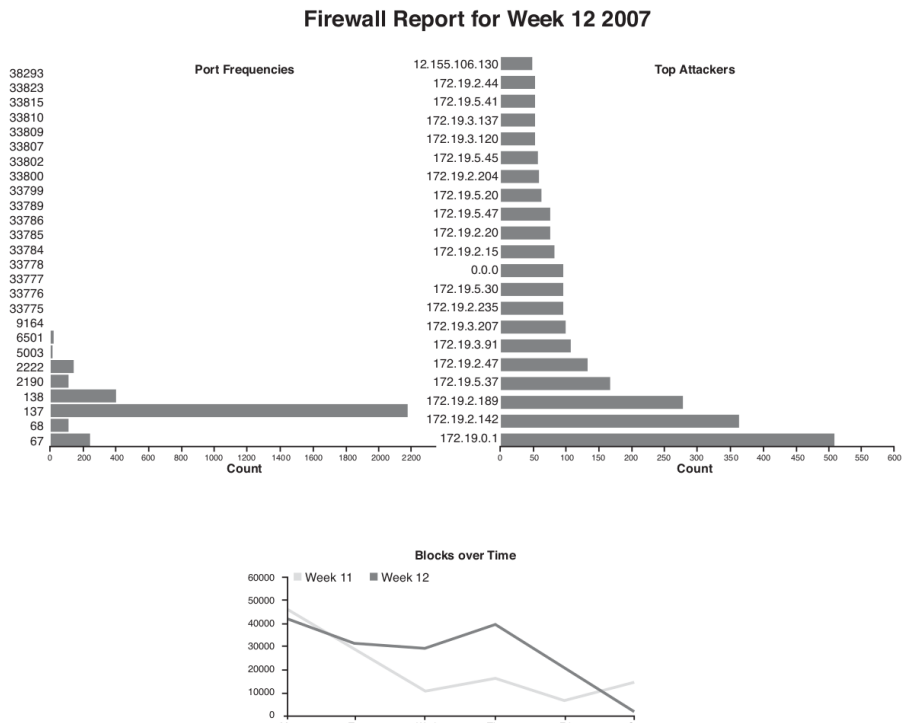
Example plot 6-17



Source: DDS 6. Visualizing Security Data

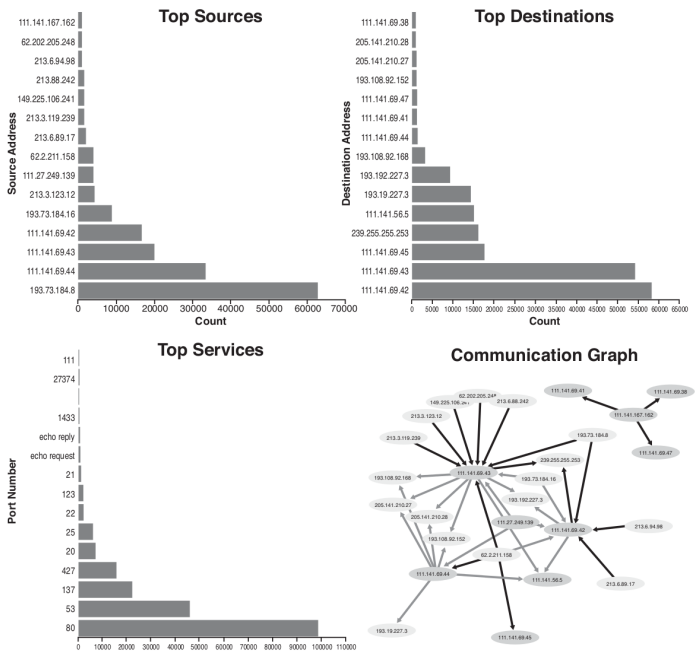
- Interesting graph, and interesting results Changing away from standard ports delay attackers!

Applied Security Visualization examples



Source: Firewall Report in *Applied security visualization*, Rafael Marty, 2009

Applied Security Visualization examples



Source: Network Flow Data in *Applied security visualization*, Rafael Marty, 2009

Drill down process

1. Get an overview
2. Research top talkers,
3. When identified and handled, remove with filter `not host 10.1.2.3`
4. Look at the next ones

Look into details, lookup hostnames – hopefully your tool allows some help

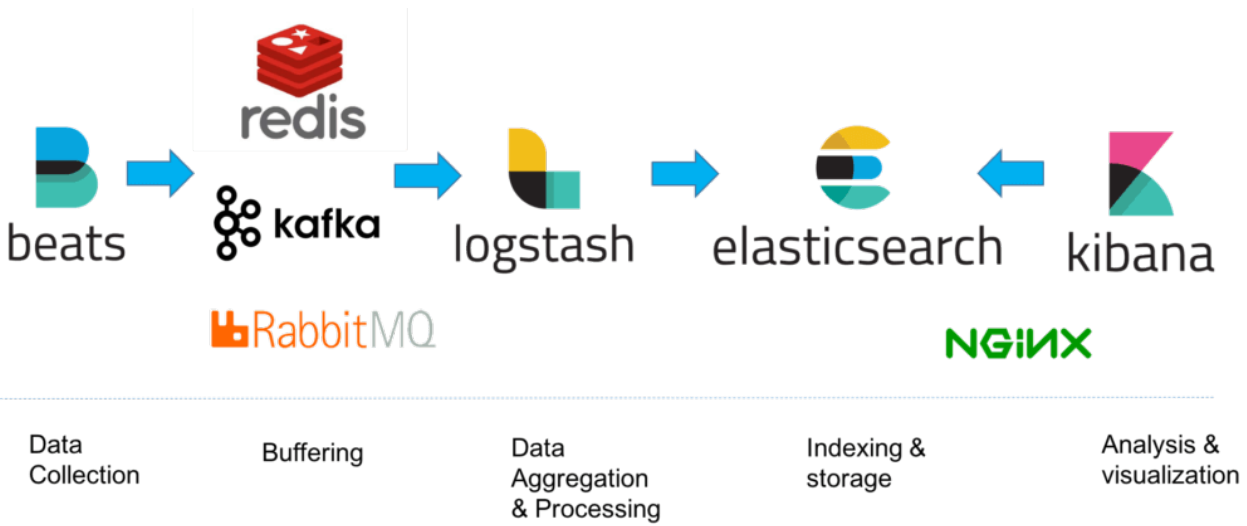
Elasticsearch example systems

> ElasticSearch consumes practically anything you give it and provides straightforward ways to ask it questions and get data out of it. You just need to feed it semi- or unstructured data and fold in some domain intelligence to enable smart indexing. It works its multi-node NoSQL magic in conjunction with a layer of full-text searching to give you almost instantaneous query results even for large amounts of data.
> Source: DDS 8. Breaking Up with Your Relational Database

- Elasticsearch SIEM – from Elastic, including Elastic Common Schema (ECS) https://github.com/elastic/ecs
- Wazuh – agent for clients, log events, integrity protection etc.
- HELK – all-in one hunting system
- ElastiFlow – netflow system
- Arkime (renamed recently from Moloch) – packet capture

Lots of commercial systems, and lots of companies providing cloud logging platform

Architecture



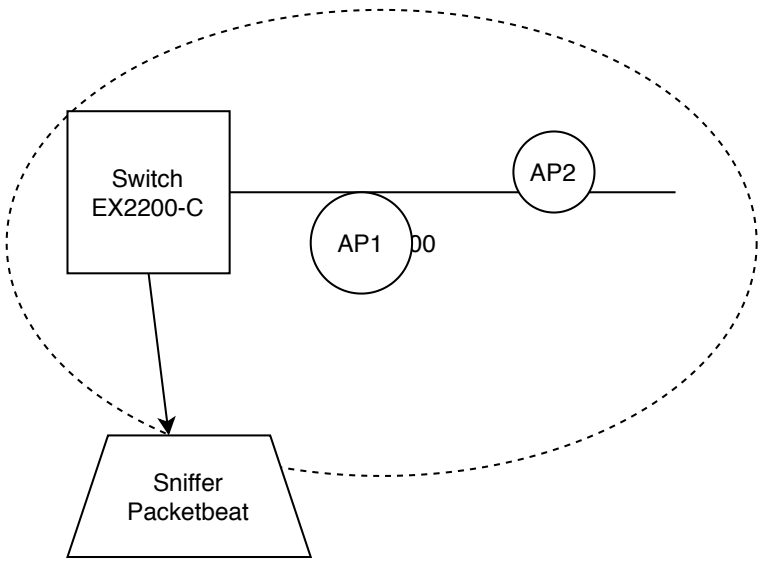
- Real production environments often add some buffering in between
- Allows the ingestion to become more smooth, no lost messages

ElastiFlow

ElastiFlow™ provides network flow data collection and visualization using the Elastic Stack (Elasticsearch, Logstash and Kibana). It supports Netflow v5/v9, sFlow and IPFIX flow types (1.x versions support only Netflow v5/v9).

Source: Picture and text from https://github.com/robcowart/elastiflow

Packetbeat



- By installing packetbeat and doing network mirroring from the network switch, we can gather a lot of information
- Packetbeat supports Elastic Common Schema (ECS) https://www.elastic.co/beats/packetbeat
- ICMP (v4 and v6) DHCP (v4) DNS HTTP AMQP 0.9.1 Cassandra Mysql PostgreSQL Redis Thrift-RPC MongoDB Memcache NFS TLS SIP/SDP (beta)

Attack Lifecycle

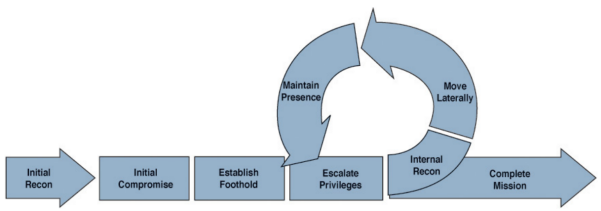


Figure 7-1 *Targeted Attack Lifecycle*

> Many breaches discovered are caused by a system having a known vulnerability exploited before it is properly patched.

Source: Mandiant's Targeted Attack Lifecycle, SOC chapter 7. vuln management

- Chapter contains lots of references
- Also chapter links inventory controls with active discovery tools and mitigating
- Mentions Threat Feeds, which should be integrated into SIEM and/or organizations
- You need to stay up-to-date on current threats, and be able to search for signs in your own network

Conklusion: chaos and and panic

- We started out fine, structured approach!
- We got interrupted ... which happens a lot
- We didn't finish! Again this is very common in real life
- Microsoft alone release patches and updates for more than 100 vulnerabilities a month
- All software has security problems, and need updates!

Incident Log and financial

Take a piece of paper or a computer

- We just got interrupted in our important job with the CIS controls
- We now need to fill out an Incident Log and calculate the cost
- When an incident happens it must be dealth with effeciently
- If you don't have security procedures it will often be longer lasting and more expensive

March 2021: ProxyLogon/ProxyShell CVE-2021-26855 CVSS:3.0 9.1 / 8.4

In March 2021, both Microsoft and IT Professionals had a major headache in the form of an Exchange zero-day commonly known as ProxyLogon. The vulnerability, widely considered the **most critical to ever hit Microsoft Exchange**, was quickly exploited in the wild by suspected state-sponsored threat actors, with US government and military systems identified as the most targeted sectors. **Ransomware variants such as DoejoCrypt were soon actively exploiting unpatched Exchange instances**, attempting to monetise the vulnerability.

A follow-up exploit, dubbed ProxyShell, was evolutionary in nature and targeted on-premise Client Access Servers (CAS) in **all supported versions of Exchange Server.** Due to the **remotely accessible nature of Exchange CAS, any unpatched instances would be vulnerable to Remote Code Execution. High profile victims included the European Banking Authority and the Norwegian Parliament.**

Source - for this description:
https://chessict.co.uk/resources/blog/posts/2022/january/2021-top-security-vulnerabilities/

ProxyLogon CVE-2021-26855 CVSS:3.0 9.1 / 8.4

ProxyLogon is the formally generic name for CVE-2021-26855, a vulnerability on Microsoft Exchange Server that allows an attacker bypassing the authentication and impersonating as the admin. We have also chained this bug with another post-auth arbitrary-file-write vulnerability, CVE-2021-27065, to get code execution. All affected components are vulnerable by default!

As a result, **an unauthenticated attacker can execute arbitrary commands on Microsoft Exchange Server through an only opened 443 port!**

Sources: https://proxylogon.com/
https://msrc.microsoft.com/update-guide/vulnerability/CVE-2021-26855

June 2021: PrintNightmare CVE-2021-34527 CVSS:3.0 8.8 / 8.2

In June, Microsoft released a critical security update to address weaknesses in the Printer Spooler service on Windows desktop and server platforms. Unfortunately, it was released out-of-band outside of the standard patch Tuesdays due to the severity. Microsoft even released patches for Windows 7, an supported operating system that does not normally receive updates.

Initially categorised by Microsoft as a local privilege escalation on Windows, security researchers subsequently identified an additional **Remote Code Execution (RCE)** vector resulting in an updated advisory from Microsoft. As ever, the ability to test and deploy patches in a time-sensitive manner is key to minimising the impact of such vulnerabilities.

Additionally, PrintNightmare had the additional horror factor of dropping during the **summer holiday season in the northern hemisphere**. Our consultants continue to see systems vulnerable to PrintNightmare on client engagements, which can be trivially leveraged to obtain privilege escalation on unpatched Windows systems.

Source - for this description:
https://chessict.co.uk/resources/blog/posts/2022/january/2021-top-security-vulnerabilities/

See also https://msrc.microsoft.com/update-guide/vulnerability/CVE-2021-34527

Note: this incident happened during summer time, vacations etc, double the cost.

September 2021: ForcedEntry

Apple didn't escape the wrath of critical zero-day vulnerabilities in 2021, with ForcedEntry made public in September. The concern was not just that it could escape in-built sandbox controls and be leveraged against **almost all iOS versions at the time**, but also that it was in the form of a **one-click exploit meaning that no user interaction was needed**. A threat actor would simply require the target victim's phone number or email address to send a weaponised GIF. **Furthermore, iMessage was affected on macOS and watchOS, giving the exploit a significant attack surface of well over a billion devices.**

An analysis released at the end of 2021 confirmed a highly complex exploit which is believed to have been created by the NSO Group, creators of the Pegasus platform, albeit with the sophistication of nation-state actors. Given the nature of the attack and the level of complexity, high profile individuals are likely to be the intended targets of such exploits, only used sparingly against targeted victims.

Source - for this description:
https://chessict.co.uk/resources/blog/posts/2022/january/2021-top-security-vulnerabilities/

See also https://en.wikipedia.org/wiki/FORCEDENTRY

November 2021: Log4Shell

It would not be possible to discuss 2021 in the context of vulnerabilities without the mention of Log4Shell. **A widely used Java-based logging library caused headaches for Security professionals worldwide**. Many scrambled to quantify their use of Log4j within their estates.

A zero-day exploit quickly followed, confirming the worst - **Remote Code Execution (RCE) was indeed possible.** However, what made the nature of the vulnerability even more challenging was the ability to exploit a backend logging system from an unaffected front end host. For example, an attacker can craft a weaponised log entry on a mobile app or webserver not running Log4j. The attacker could make their way through to backend middleware itself running Log4j, which significantly extends the attack surface of the vulnerability.

The NCSC even took the step of recommending the update was immediately applied, whether or not Log4Shell was known to be in use. As is commonly the case with critical vulnerabilities, two successive Log4j patches were subsequently released in the week following the original addressing Denial of Service (DoS) and a further RCE. This further increased workloads of Security and IT teams just as they thought the worst of 2021 had been and gone.

Source - for this description:
https://chessict.co.uk/resources/blog/posts/2022/january/2021-top-security-vulnerabilities/

See also https://en.wikipedia.org/wiki/Log4Shell

March 2022: Dirty pipe Linux CVE-2022-0847

This is the story of CVE-2022-0847, a vulnerability in the **Linux kernel since 5.8** which allows overwriting data in arbitrary read-only files. This leads to **privilege escalation because unprivileged processes can inject code into root processes.**

It is similar to CVE-2016-5195 “Dirty Cow” but is easier to exploit.

The vulnerability was fixed in Linux 5.16.11, 5.15.25 and 5.10.102.

Sources: https://dirtypipe.cm4all.com/ https://thestack.technology/dirty-pipe-exploited-linux-vulnerability-cve-2022-084
https://access.redhat.com/security/cve/CVE-2022-0847

April 2022: Lenovo UEFI

> ESET researchers have discovered and analyzed three vulnerabilities affecting various Lenovo consumer laptop models. The first two of these vulnerabilities – CVE-2021-3971, CVE-2021-3972 – affect UEFI firmware drivers originally meant to be used only during the manufacturing process of Lenovo consumer notebooks. Unfortunately, they were mistakenly included also in the production BIOS images without being properly deactivated. These affected firmware drivers can be activated by attacker to directly disable SPI flash protections (BIOS Control Register bits and Protected Range registers) or the UEFI Secure Boot feature from a privileged user-mode process during OS runtime. It means that exploitation of these vulnerabilities would allow attackers to deploy and successfully execute SPI flash or ESP implants, like LoJax or our latest UEFI malware discovery ESPecter, on the affected devices.

Source:

also: https://www.welivesecurity.com/2022/04/19/when-secure-isnt-secure-uefi-vulnerabilities-lenovo-consumer-laptops/

See also: https://www.bleepingcomputer.com/news/security/lenovo-uefi-firmware-driver-bugs-affect-over-100-laptop-mo