General Topics

Insecure Design, Components with known Vulnerabilities, Integrity, Logging & Monitoring, WAFs

Rough Overview

1. Introduction
2. Basic Principles and Resources
3. Architecture & Basic Web Procedure
4. Authentication and Session Management
5. Authorization
6. Server and Backend Attacks
7. Remaining Client Attacks
8. >> General Topics <<
9. Conclusions

Design Flaw vs. Implementation Defect

Design Flaw / Insecure Design	Implementation Defect

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Client-side security checks only	

Design Flaw vs. Implementation Defect

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Firmware update integrity isn’t ensured	

Design Flaw vs. Implementation Defect

Design Flaw / Insecure Design	Implementation Defect
Client-side security checks only	Error in a regex for input validation
Credential recovery solely relies on “security questions”	Reset link is guessable
Firmware update integrity isn’t ensured	Digital signature uses outdated/vuln. algorithm

A secure design can still have implementation defects leading to vulnerabilities that may be exploited.

An insecure design cannot be fixed by a perfect implementation as by definition, needed security controls were never created to defend against specific attacks.

https://owasp.org/Top10/A04_2021-Insecure_Design/

How can we prevent design flaws?

Remember our secure design principles?

Economy of Mechanism

Fail-safe Defaults

Complete Mediation

Least Privilege

Least Common Mechanism

Separation of Privilege

Open Design

Psychological Acceptability

- Saltzer and Schroeder, 1975 –

http://web.cs.wpi.edu/~guttman/cs557_website/papers/saltzer1975.pdf
https://adam.shostack.org/blog/the-security-principles-of-saltzer-and-schroeder/

Earn or give, but never assume, trust.

Use an authentication mechanism that cannot be bypassed or tampered with.

Authorize after you authenticate

Strictly separate data and control instructions, and never process control instructions received from untrusted sources.

Define an approach that ensures all data are explicitly validated.

Use cryptography correctly.

Identify sensitive data and how they should be handled.

Always consider the user.

Understand how integrating external components changes your attack surface.

Be flexible when considering future changes to objects and actors.

- IEEE Center for Secure Design, 2014 –

https://ieeecs-media.computer.org/media/technical-activities/CYBSI/docs/Top-10-Flaws.pdf

Secure Design Patterns

Utilize well proven public design patterns, e.g.

- https://docs.microsoft.com/en-us/azure/architecture/patterns/
  - https://docs.microsoft.com/en-us/azure/architecture/patterns/federated-identity
  - …
- https://docs.microsoft.com/en-us/azure/architecture/framework/security/
- https://www.opensecurityarchitecture.org/cms/library/patternlandscape
- https://www.ncsc.gov.uk/search?q=architectural%20pattern
- https://cheatsheetseries.owasp.org/

Yes, a lot of them are actually for network / system design

But they are very useful anyway

Secure Design Patterns

Create your own company-wide design patterns for e.g.

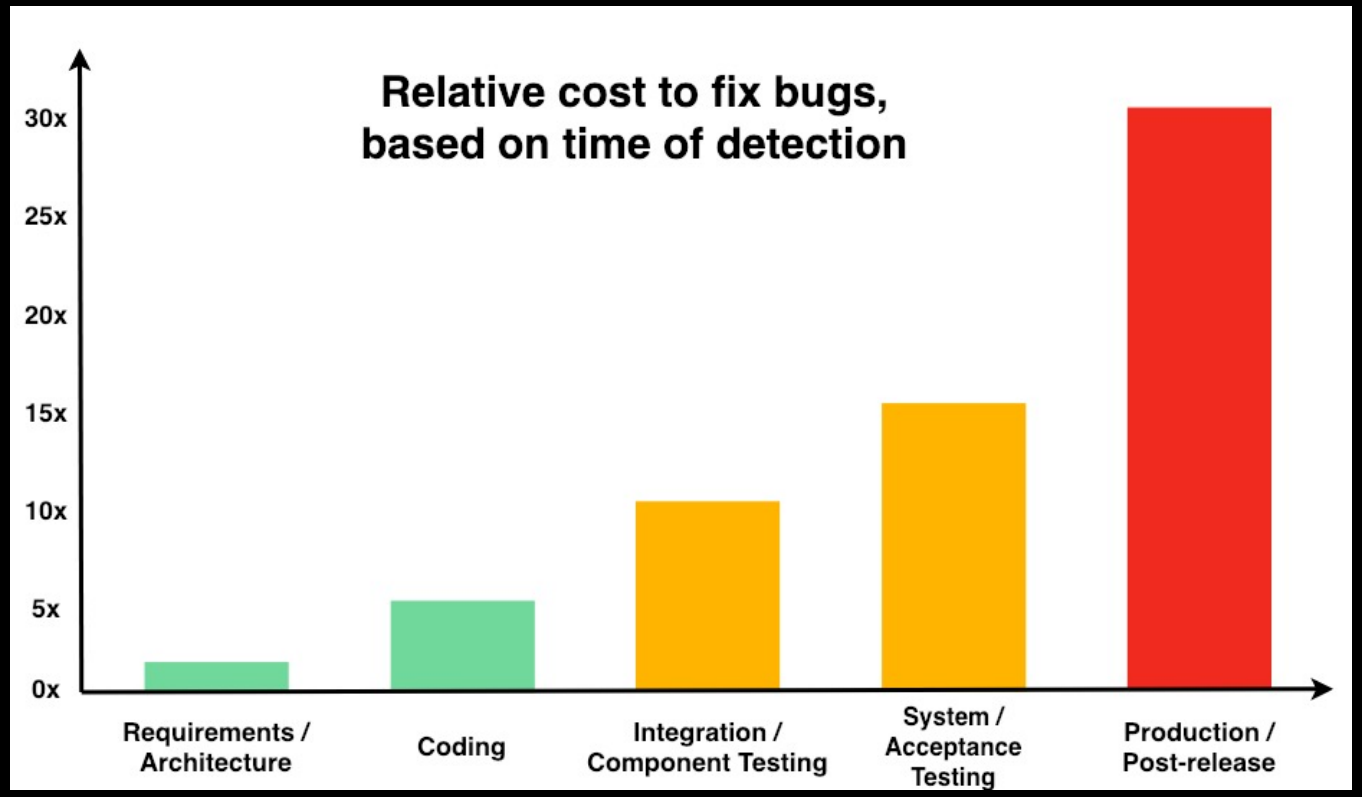
- Authentication
- Session Management
- Authorization
- Input- and Outputhandling
- Logging and Monitoring
- …

Did anybody say Threat Modeling?

Check out my Threat Modeling 101

https://www.slideshare.net/SBA-Research/sba-live-academy-threat-modeling-101-eine-kurze-aber-praxisnahe-einfhrung-by-daniel-schwarz-senior-security-analyst-bei-der-condignum-gmbh

It’s even cheaper to invest in a secure design



https://deepsource.io/blog/exponential-cost-of-fixing-bugs/

Design vs. Architecture

WTF is the difference?

Design vs. Architecture

An application consists of multiple building blocks

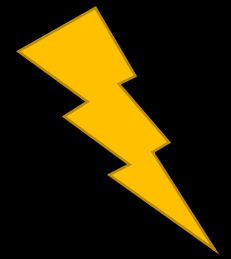
Design
- Every decision to combine these building blocks in a specific way

Architecture
- The most significant design decisions (high cost of change)

All architecture is design, but not all design is architecture.
- Grady Booch

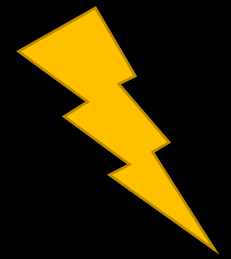
https://static.architectis.je/software-architecture-for-developers.pdf

Insecure Design



Goal	Exploit design flaws to do all kinds of bad stuff
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Insecure Design



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Solution	
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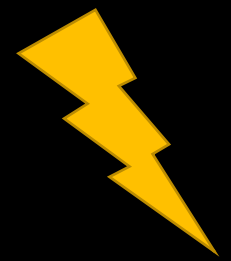

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Solution	Stick to the secure design principles
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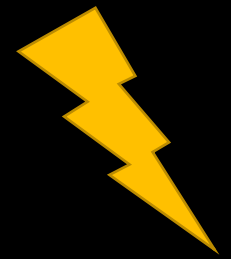

Goal	Exploit design flaws to do all kinds of bad stuff
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Solution	Stick to the secure design principles Utilize proven secure design patterns
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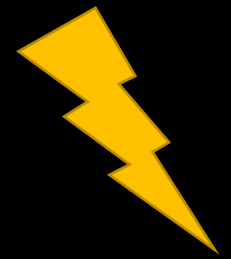

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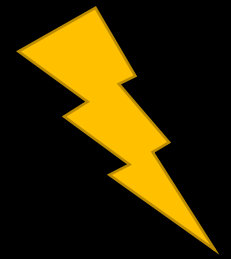

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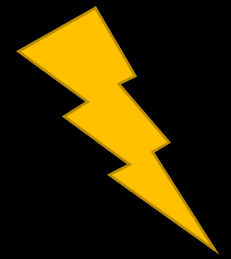

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OWASP Top 10	A04:2021-Insecure Design
(Primary) Violated Principle	„Earn or give, but never assume, trust.“

3rd party components

It’s ok to use 3rd party components

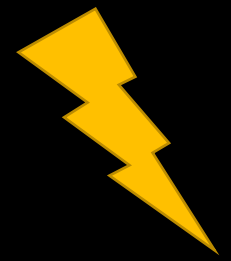
- libraries
- frameworks
- etc.

Just be aware you also include their problems

- e.g. Commons Collection in 2015

And act appropriately

Vulnerabilities in 3rd Party Components



Goal	Compromising an application by exploiting a publicly known vulnerability in one of it’s included components (libraries, frameworks etc.)
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Solution	
OWASP Top 10	
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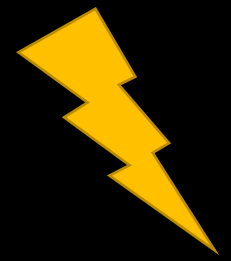
Vulnerabilities in 3rd Party Components



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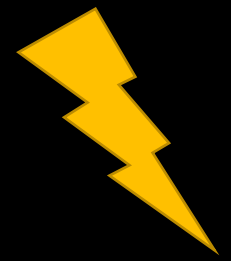

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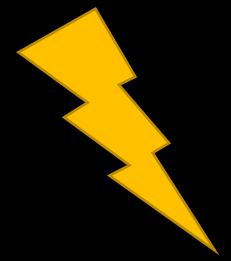

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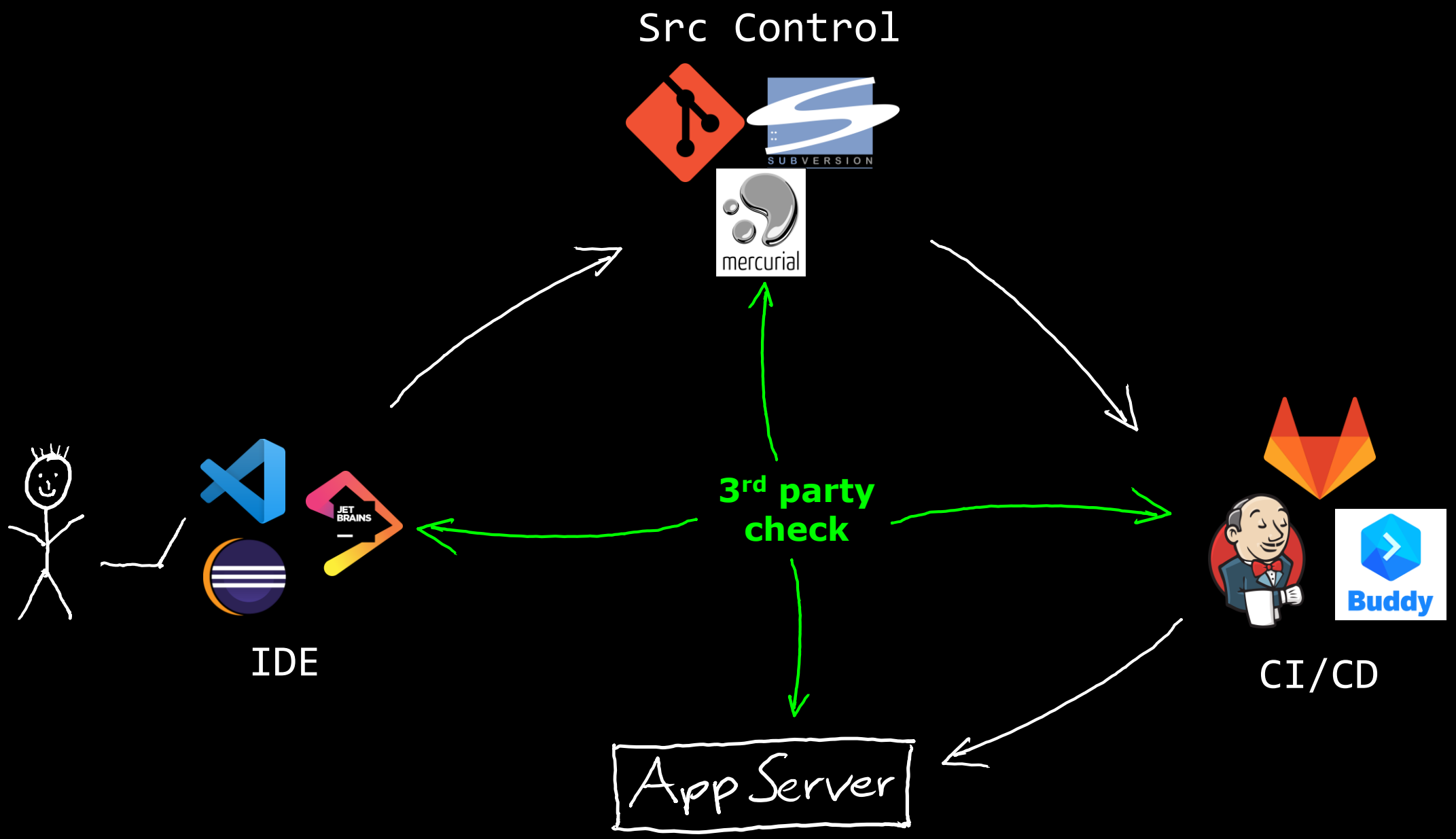
Src Control
SUBVERSION
mercurial
3rd party check
JET BRAINS
IDE
Buddy
CI/CD
App Server

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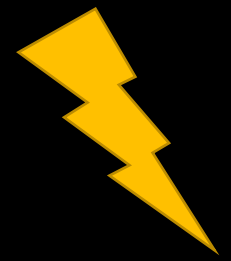

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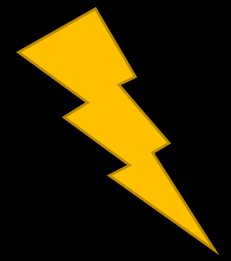

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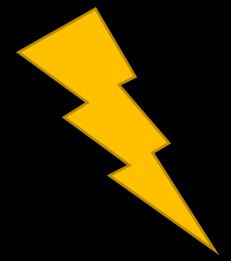

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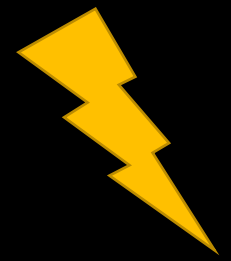

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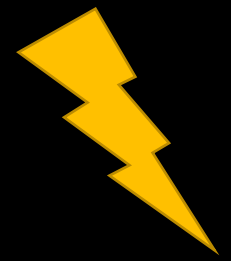
OWASP Top 10	A06:2021-Vulnerable and Outdated Components
(Primary) Violated Principle	

Vulnerabilities in 3rd Party Components



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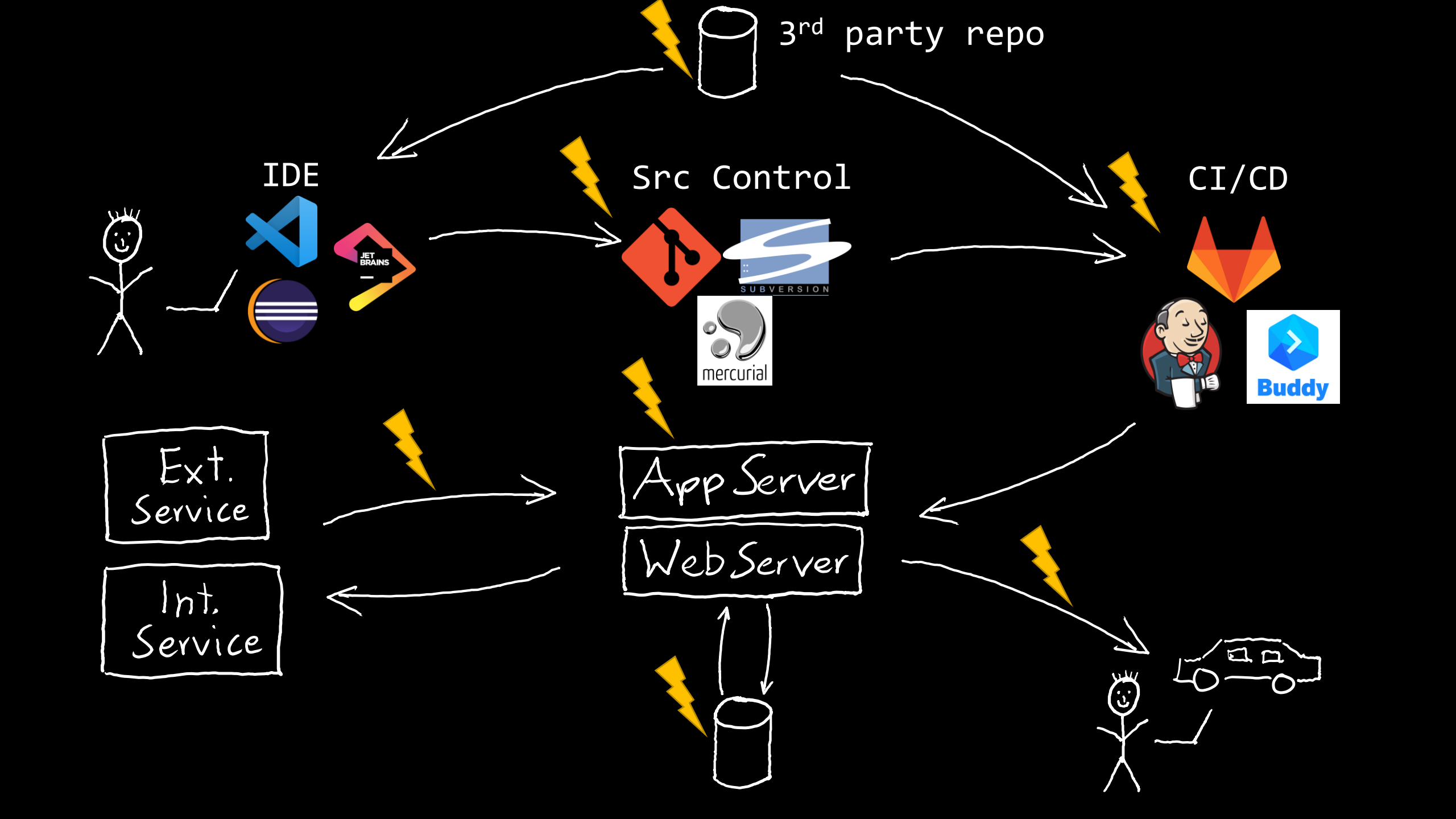
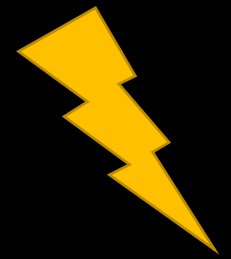
let‘s talk about integrity

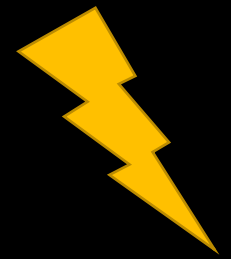

3rd party repo
IDE
Src Control
CI/CD
JET BRAINS
SUBVERSION
mercurial
Buddy
Ext. Service
Int. Service
App Server
Web Server

Software and Data Integrity Failures



Goal	Manipulate the application itself or the application’s data.
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Software and Data Integrity Failures



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How	Diverse manipulation options along the whole application lifecycle
Solution	
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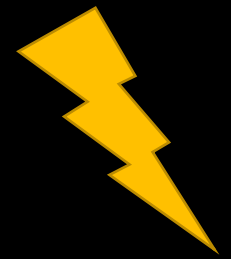
Software and Data Integrity Failures



Goal	Manipulate the application itself or the application’s data.
How	Diverse manipulation options along the whole application lifecycle
Solution	Review process (e.g. 4 eyes principle) for all code changes
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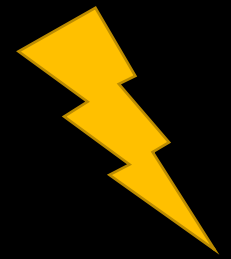
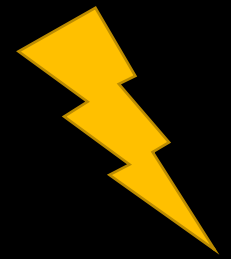
Software and Data Integrity Failures



Goal	Manipulate the application itself or the application’s data.
How	Diverse manipulation options along the whole application lifecycle
Solution	Review process (e.g. 4 eyes principle) for all code changes Strict access control for CI/CD pipeline and servers / DBs
OWASP Top 10	
(Primary) Violated Principle	

Software and Data Integrity Failures



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Solution	Review process (e.g. 4 eyes principle) for all code changes Strict access control for CI/CD pipeline and servers / DBs Obtain 3rd party components from trusted sources only
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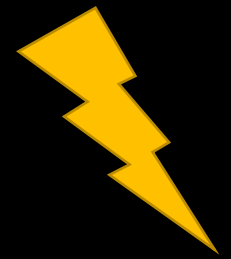
Software and Data Integrity Failures



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Solution	Review process (e.g. 4 eyes principle) for all code changes Strict access control for CI/CD pipeline and servers / DBs Obtain 3rd party components from trusted sources only Use TLS for all communication
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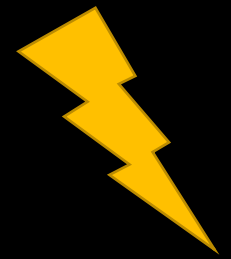
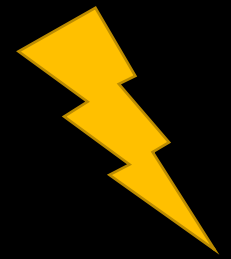
(Primary) Violated Principle	

Software and Data Integrity Failures



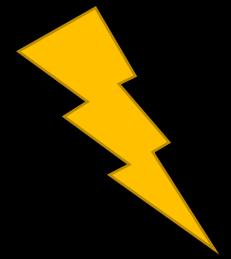
Goal	Manipulate the application itself or the application’s data.
How	Diverse manipulation options along the whole application lifecycle
Solution	Review process (e.g. 4 eyes principle) for all code changes Strict access control for CI/CD pipeline and servers / DBs Obtain 3rd party components from trusted sources only Use TLS for all communication Explicitly ensure integrity (e.g. via digital signatures) for updates / software packages critical data serialized data streams
OWASP Top 10	
(Primary) Violated Principle	

Software and Data Integrity Failures



Goal	Manipulate the application itself or the application’s data.
How	Diverse manipulation options along the whole application lifecycle
Solution	Review process (e.g. 4 eyes principle) for all code changes Strict access control for CI/CD pipeline and servers / DBs Obtain 3rd party components from trusted sources only Use TLS for all communication Explicitly ensure integrity (e.g. via digital signatures) for updates / software packages critical data serialized data streams
OWASP Top 10	A08:2021-Software and Data Integrity Failures
(Primary) Violated Principle	

Software and Data Integrity Failures



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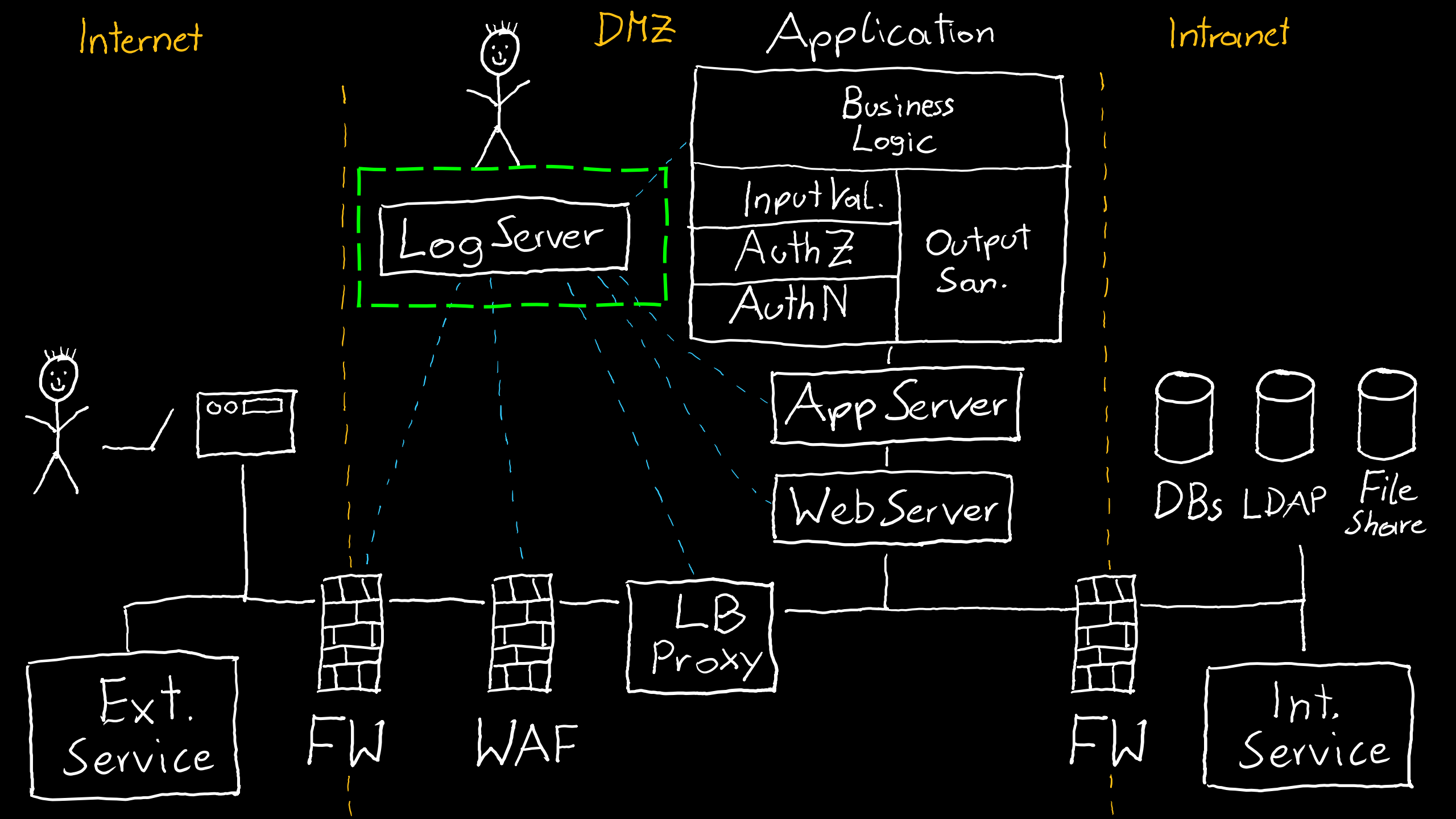
OWASP Top 10	A08:2021-Software and Data Integrity Failures
(Primary) Violated Principle	„Define an approach that ensures all data are explicitly validated.“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DMZ
Application
Intranet
Log Server
Business Logic
Input Val.
AuthZ
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Web Server
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File Share
LB Proxy
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FW
WAF
FW
Int. Service

Security Logging and Monitoring Failures

Goal	Hide attacks and go unnoticed.
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Security Logging and Monitoring Failures

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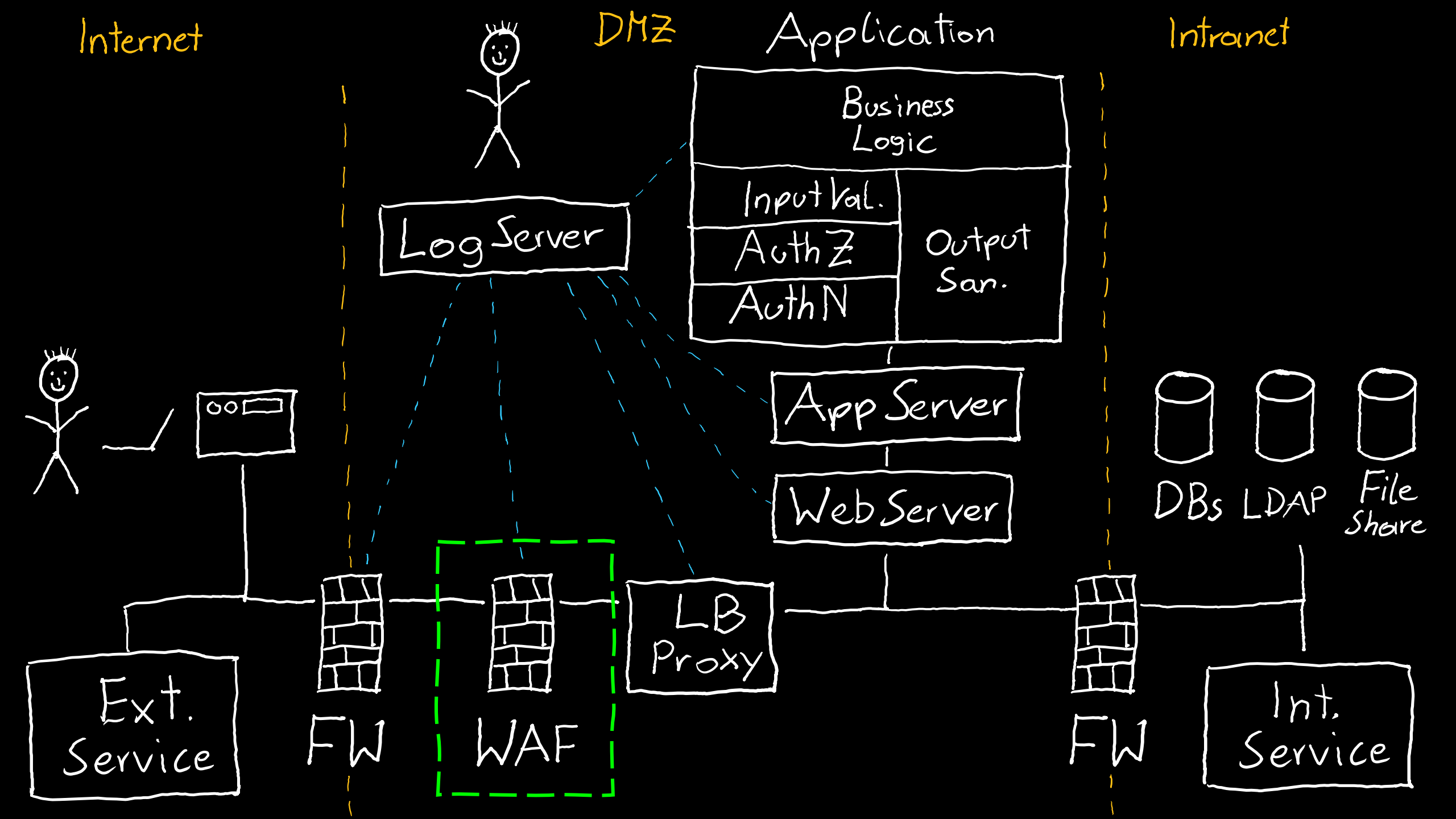
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Web Application Firewalls

Monitors and filters HTTP traffic

- mainly operates on predefined ruleset and/or learning mode

Do not rely on a WAF as your primary defense mechanism

- many circumvention techniques, exploits etc. available

Valid usage

- additional protection (2nd line of defense) against common web application attacks, e.g. SQLi, XSS, Bruteforcing etc.
- quick temporary fixes
- centralized AV scan for file uploads
- protection of legacy applications
- web application IDS

Always configure them properly!

Key messages

- A secure design is worth the money
- Explicitly ensure the integrity of your software (components) and your critical data
- Be aware of your included 3rd party components and their current security status
- Implement structured, consistent and centralized logging and monitoring
- Use WAFs for the right purpose