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Spring Security @Traineeship 2019

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What can you expect

1. **Basic security concepts**
   - PKI
   - HTTPS
2. **Authentication methods**
   - Basic auth / OAuth2
3. **Spring Security**
4. **JWT tokens**

Getting acquainted

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whoami

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First project HealthConnect (3y)

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Who are you?

Background?

- Studies
- Stage
- …

Experience with Spring?

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Useful links

Homepage

https://spring.io/

Docs

https://docs.spring.io/spring-security/site/docs/current/reference/htmlsingle/

Single source of truth!

Let’s get started!

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Difference?

Authentication

Authorization

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Difference?

Authentication
-> Who is who

Authorization
-> What a user can do

Public key infrastructure (PKI)

The security backbone of the internet

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Why?

Proof of identity

Persons, devices, services, ...

Encryption

Symmetric & asymmetric

Privacy

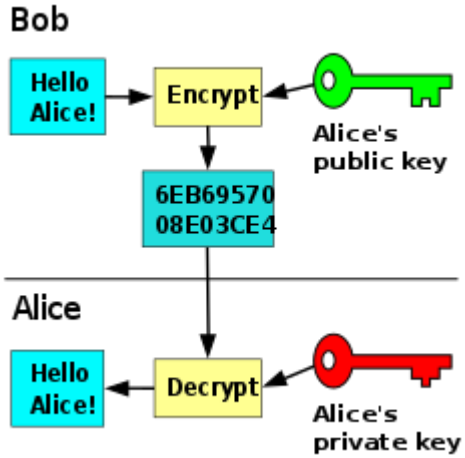
Hide from the gouverment (maybe)

=> **enables HTTPS**

How?

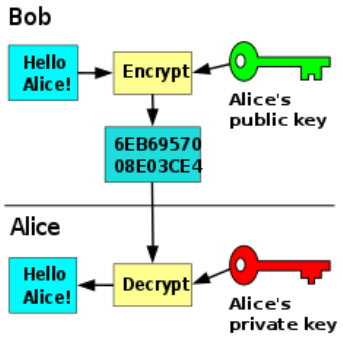
Private and public keys

- Content encrypted with Public Key can only be read by Private Key holder.
- Content encrypted with Private Key can be read by everyone with Public Key.



How?

How do we know that Alice is really Alice and not the NSA?



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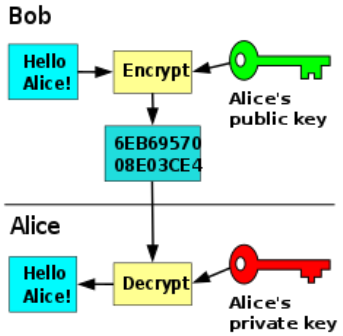


Certificates!

A certificate is a Public Key with more information about the entity (Alice).

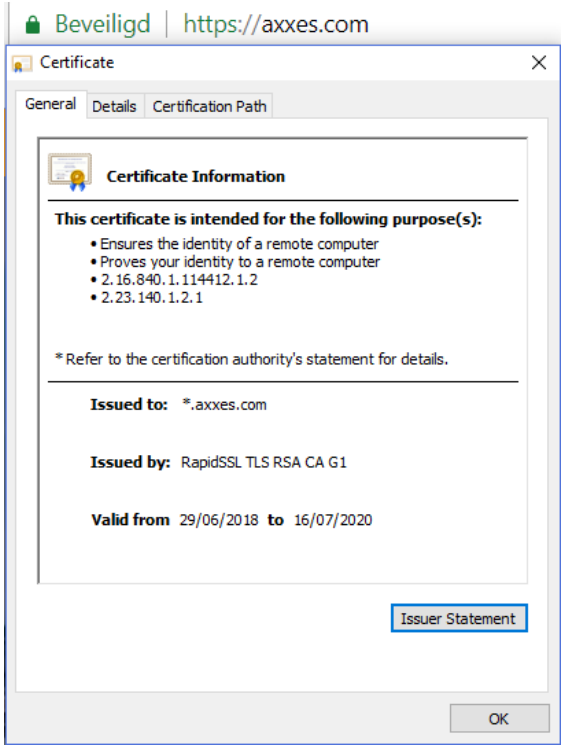
Certificate

Certificates are public keys with more information about the entity

Everyone can create Public/Private keypairs

Certificate authorities (CA) link keypair to entity

- CA's are a business
- Does background check
- Creates certificate
- Browsers trust the CA



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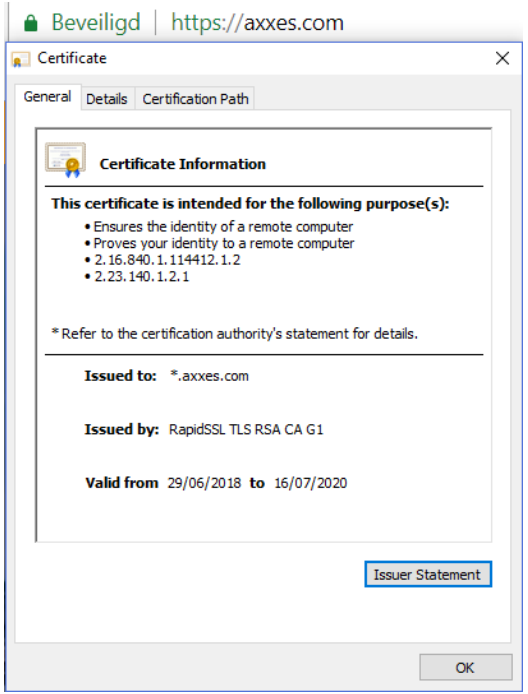
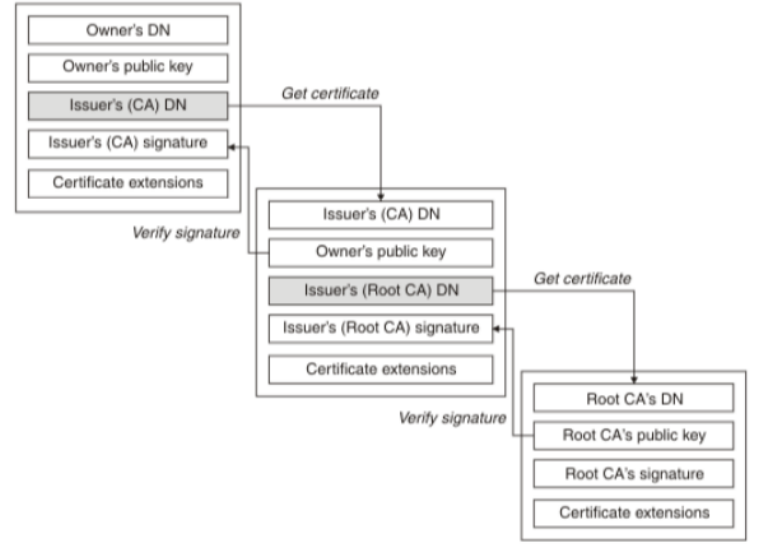
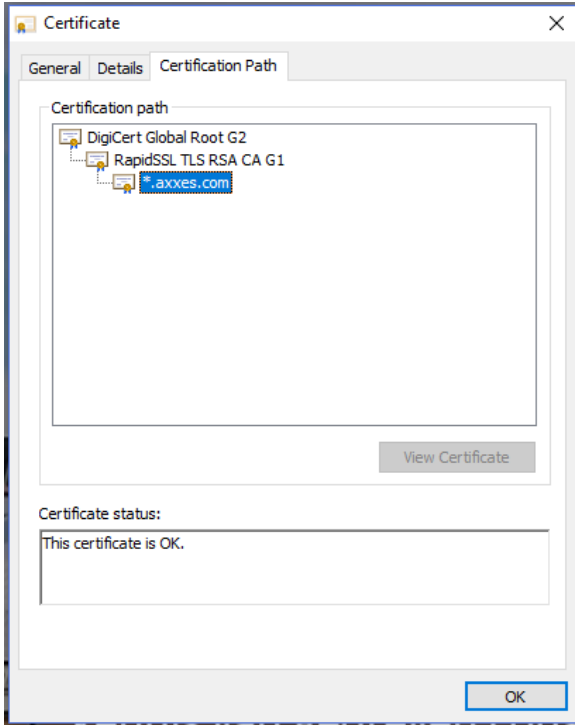
Certificate

How do we know that a certificate is the real certificate?



Certificate chain





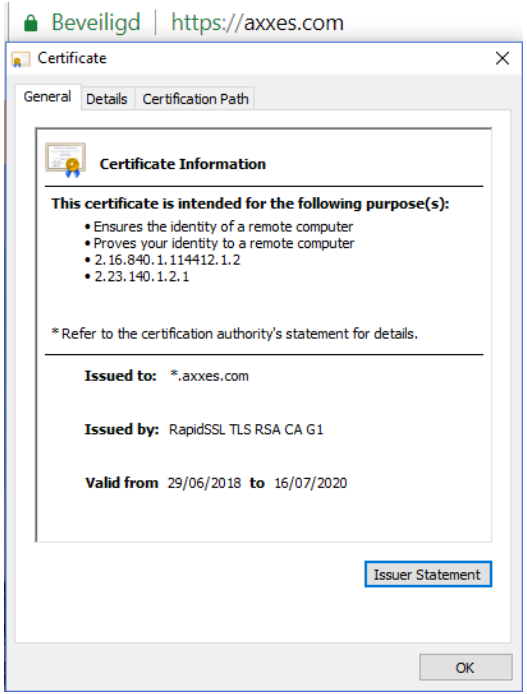
Certificate

Browsers trust CA's

But what if a CA is malicious?

What if a Private key gets stolen?

Bad luck.. Thats why it is also called the web of trust.



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Web of trust

Certificate issues

Recently in Kazachstan

https://tweakers.net/nieuws/155336/isps-kazachstan-moeten-https-verkeer-onderscheppen-op-last-van-overheid.html

Iranian hacker

https://tweakers.net/nieuws/76444/iran-gebruikt-nederlands-certificaat-om-gmail-te-onderscheppen.html

HTTPS

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HTTPS made simple

1. **Browser** asks server for certificate
2. **Browser** checks certificate (do I trust the CA?)
3. **Browser** creates new encryption key and sends it to the server (encrypted with public key from certificate)
4. **Server** decrypts encryption key with private key
5. Connection is now secured with encryption key

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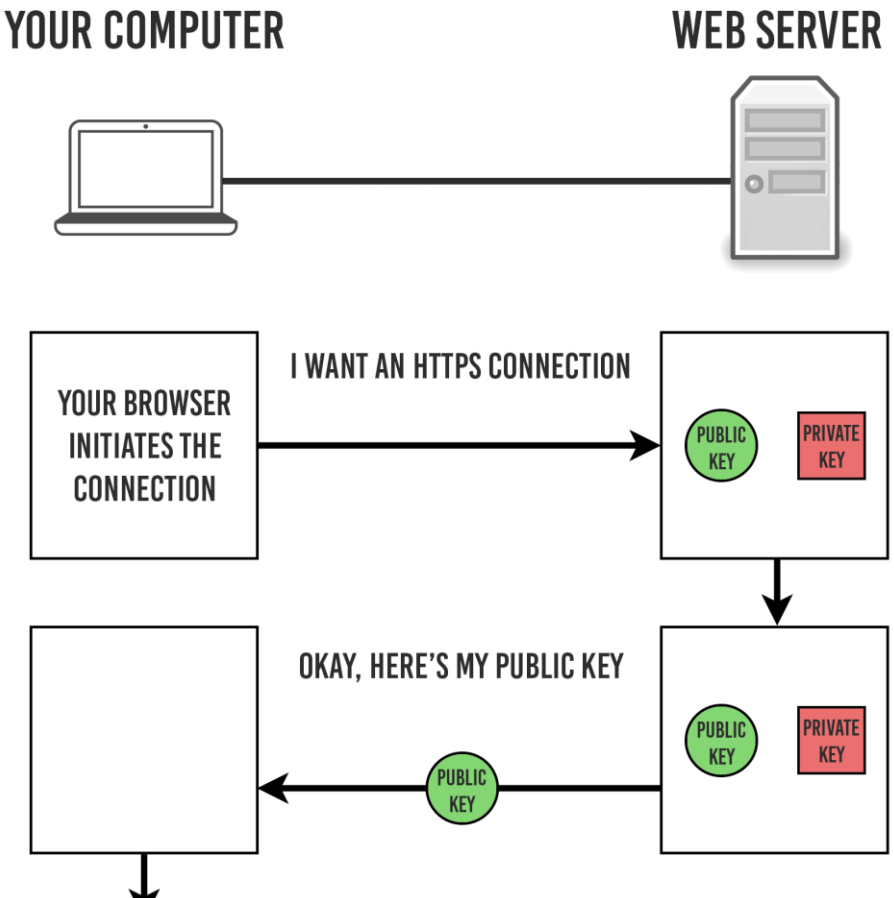
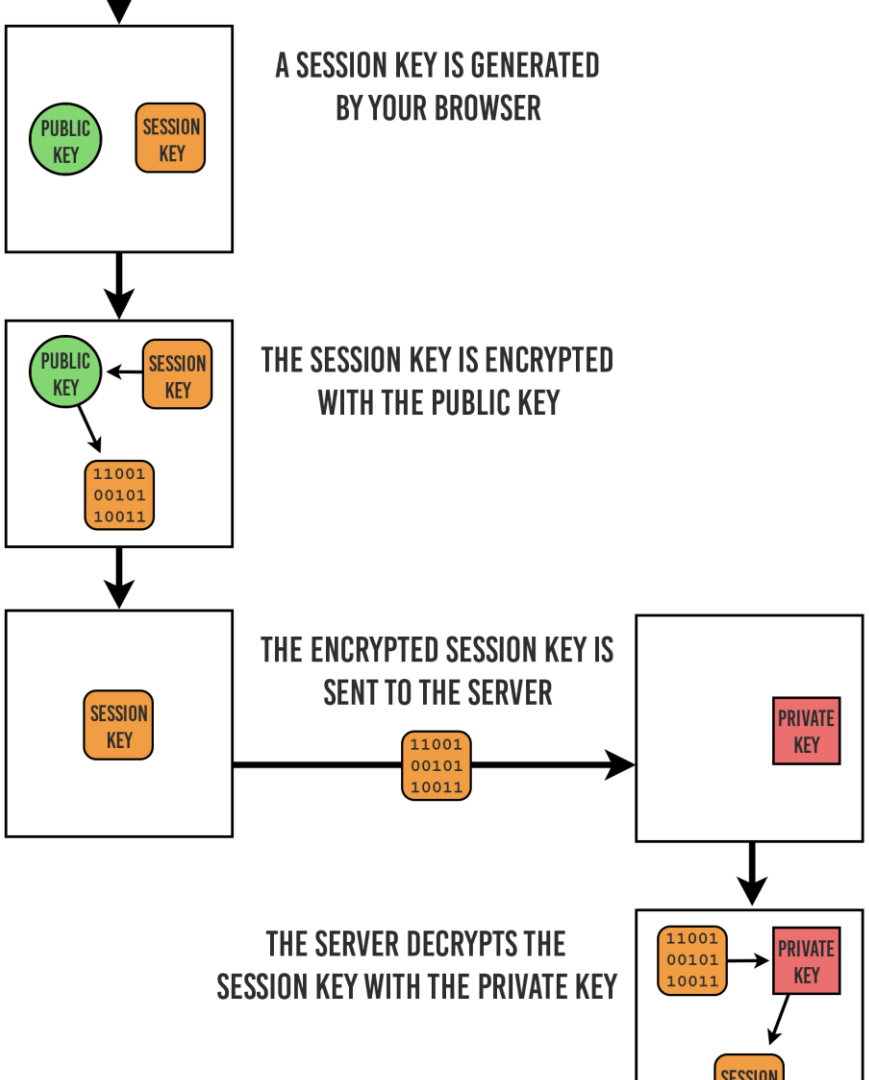
HOW HTTPS ENCRYPTION WORKS




PUBLIC KEY
SESSION KEY
A SESSION KEY IS GENERATED BY YOUR BROWSER
PUBLIC KEY
SESSION KEY
11001 00101 10011
THE SESSION KEY IS ENCRYPTED WITH THE PUBLIC KEY
SESSION KEY
THE ENCRYPTED SESSION KEY IS SENT TO THE SERVER
11001 00101 10011
PRIVATE KEY
THE SERVER DECRYPTS THE SESSION KEY WITH THE PRIVATE KEY
11001 00101 10011
PRIVATE KEY

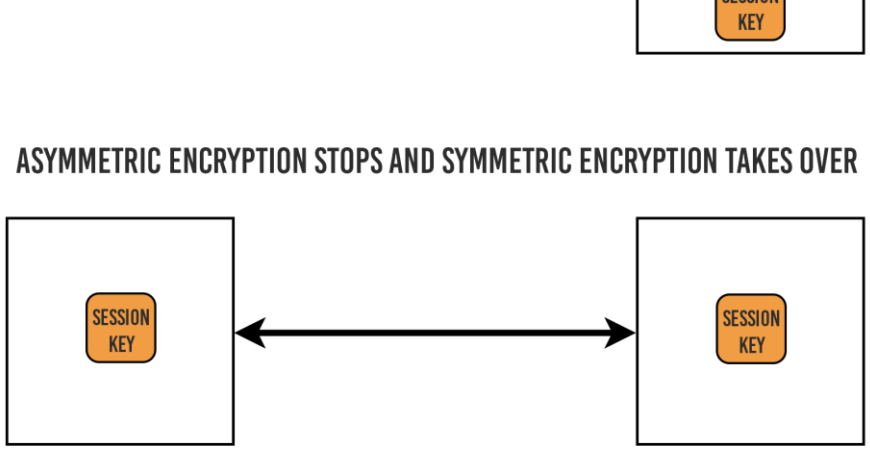


Image source: https://tiptopsecurity.com/how-does-https-work-rsa-encryption-explained/#!prettyPhoto

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HTTPS made simple

Why not use private and public key for security?

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HTTPS explained in detail

The First Few Milliseconds of an HTTPS Connection:

http://www.moserware.com/2009/06/first-few-milliseconds-of-https.html

Security mechanisms

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Security mechanisms

- Basic authentication
- Digest authentication
- Oauth 1
- Oauth 2

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Security mechanisms

- Basic authentication
- Digest authentication
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- Oauth 2

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Basic authentication

- Username + password in plain text to the server
- Encoded base64 (not secure)
- Sent with every request
- Unsafe over HTTP, HTTPS somewhat safe

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Basic authentication

```
GET /secured HTTP/1.1
Authorization: Basic dXNlcjpzdXBlci1zZWN1cmVk
User-Agent: PostmanRuntime/7.16.3
Accept: */*
Cache-Control: no-cache
Host: localhost:8080
Accept-Encoding: gzip, deflate
Connection: keep-alive
```

Base64 decode: dXNlcjpzdXBlci1zZWN1cmVk -> user:super-secured

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Small exercise

What is the username and password for this website?

```
GET /secured HTTP/1.1
User-Agent: PostmanRuntime/7.16.3
Accept: */*
Cache-Control: no-cache
Host: localhost:8080
Authorization: Basic dXNlcjpzdXBlci1zZWN1cmVk
Accept-Encoding: gzip, deflate
Connection: keep-alive
```

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Digest Authentication

- Username + password encrypted to the server
- Sent with every request
- Use of nonce
- Encrypted with MD5, not considered safe anymore
- Created to use over HTTP for lack of HTTPS

How does Spring do it?

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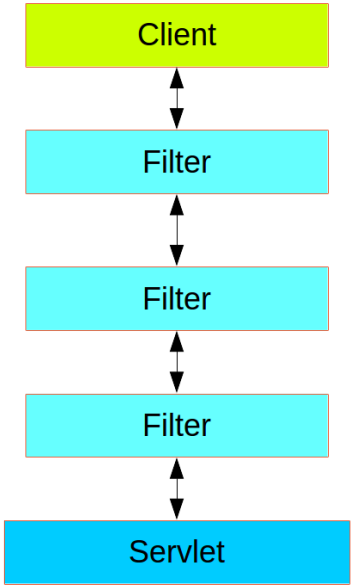
Spring internals



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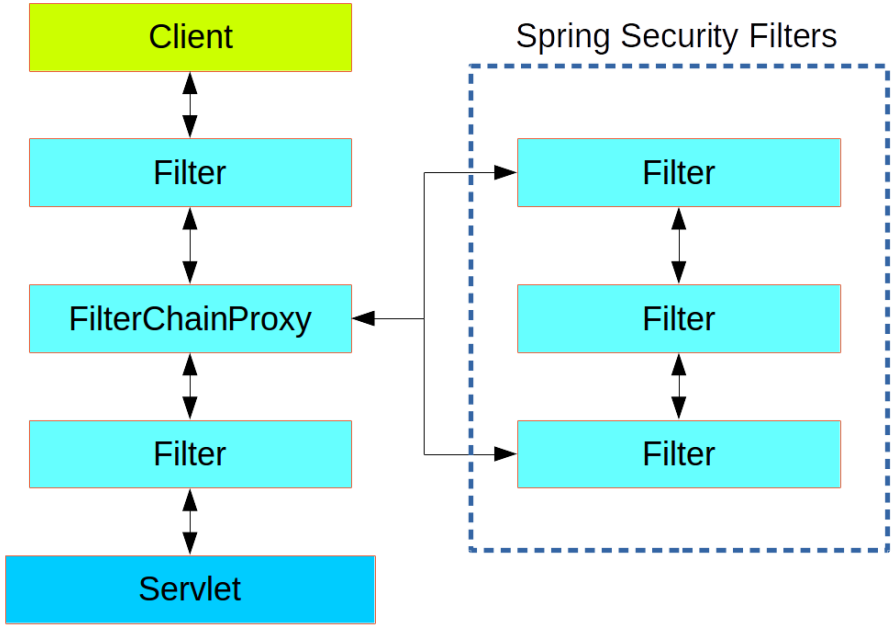
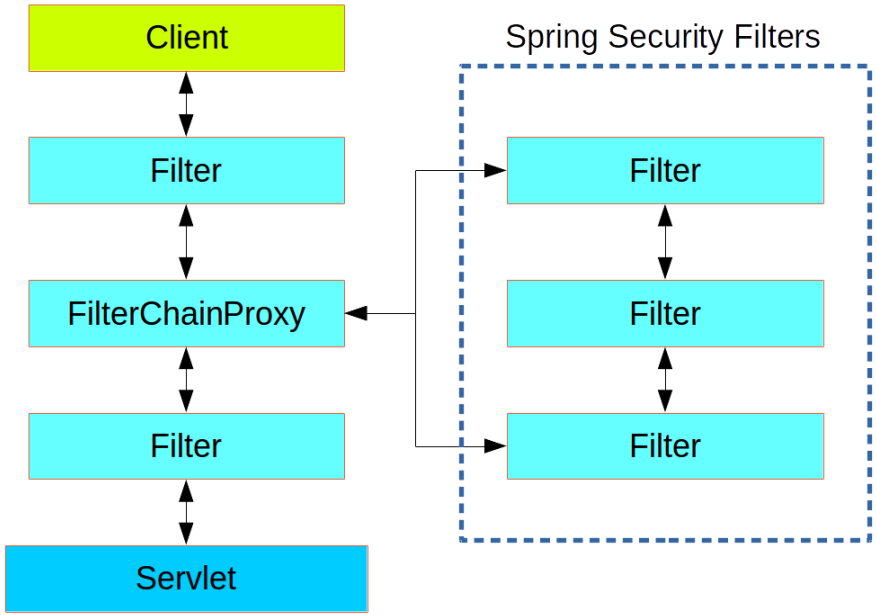
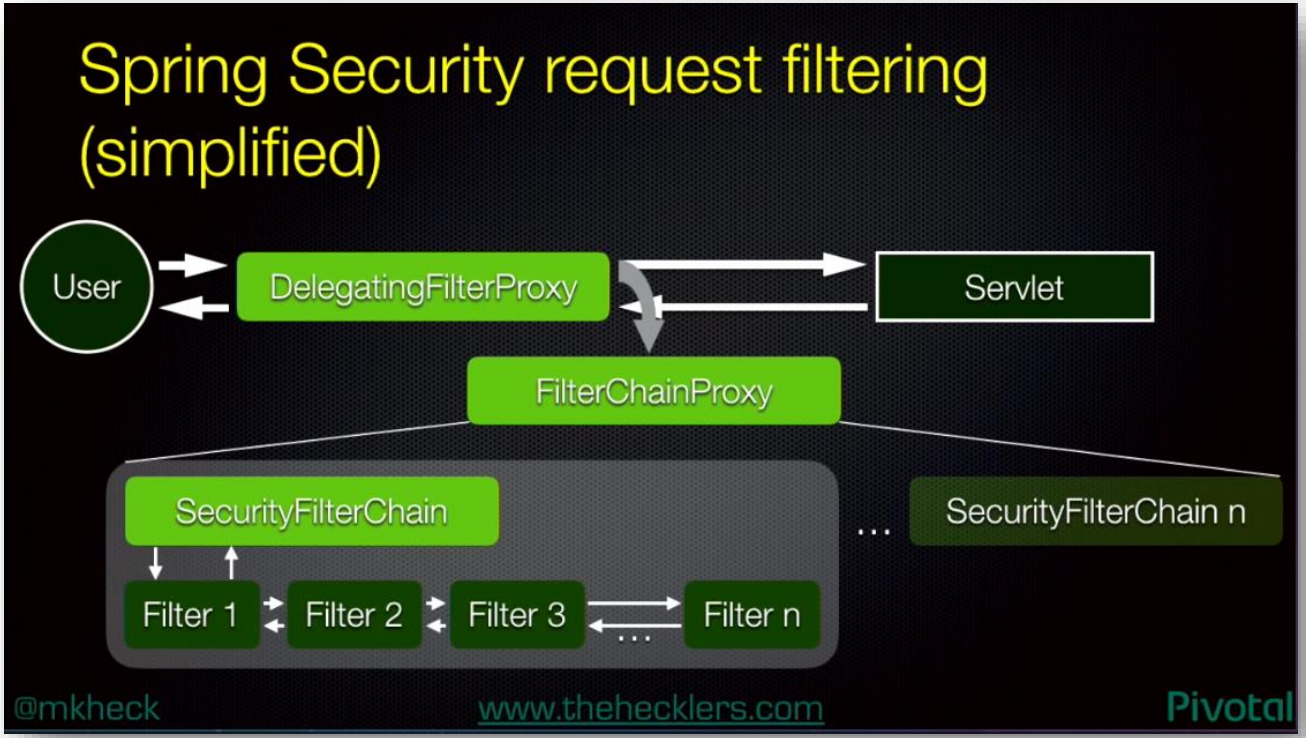
Spring internals



Spring internals



Spring internals



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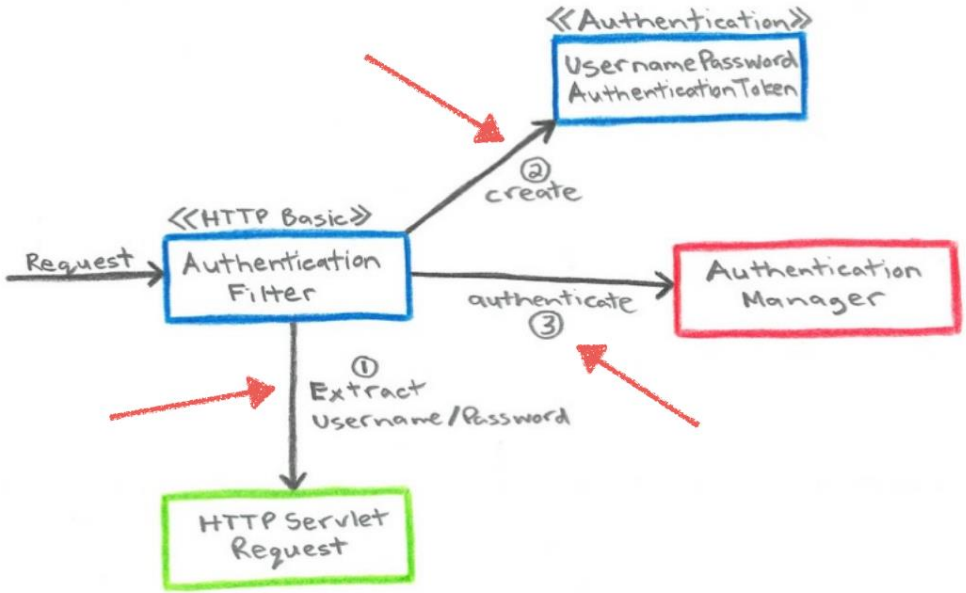
Spring internals



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Spring config

```
@Configuration
@EnableWebSecurity
public class CustomWebSecurityAdapter extends WebSecurityConfigurerAdapter {
```

STEP 1:

Add annotation

STEP 2:

Run

STEP 3:

Spring magic

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Spring config

```
@Configuration
@EnableWebSecurity
public class CustomWebSecurityAdapter extends WebSecurityConfigurerAdapter {
```

STEP 1:

Add annotation

STEP 2:

Run

STEP 3:

Spring magic

Creates one security filter chain!

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Spring config

Global configuration

```
@Override
protected void configure(HttpSecurity http) throws Exception {
    http
            .authorizeRequests()
            .antMatchers("/resources/**", "/signup", "/about").permitAll()
            .antMatchers("/admin/**").hasRole("ADMIN")
            .antMatchers("/db/**").access("hasRole('ADMIN') and hasRole('DBA')")
            .anyRequest().authenticated()
            .and()
            .httpBasic();
```

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Spring config

Global configuration

```
@Override
protected void configure(HttpSecurity http) throws Exception {
    http
            .antMatcher("/admin/**")
            .authorizeRequests()
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            .anyRequest().authenticated()
            .and()
            .httpBasic();
```

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Spring config

Local configuration

```
@Secured("USER")
public String secure() {
    return "Hello Security";
}
```

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TODO

- Enable spring security
- Enable basic authentication
- Disable session cookie
  - Configure once with HttpSecurity
  - Configure once with method annotations

Url	Secured	Role
/unsecured	no	/
/secured	yes	Any
/secured/admin	yes	ADMIN

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How to access authenticated user?

Autowire in controller

```
@GetMapping("/auto-wire")
public ResponseEntity<SimpleDto> securedUser(final Authentication authentication) {
    service.doSomething(authentication);
    ...
}
```

Not that good.. we have to pass the object to every method call.

Controller -> service -> black hole -> dao

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How to access authenticated user?

Static method

```
@GetMapping("/auto-wire")
public ResponseEntity<SimpleDto> securedUser() {
    final Authentication authentication = SecurityContextHolder.getContext().getAuthentication();
}
```

Possible to use static method everywhere. (controller, service, dao)

However static methods are not test friendly...
And not extendable

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TODO

- Fetch username from security context
  - Once with autowire
  - Once with static method

URL	Response
/secured/username	{ "value": "username: admin" }

- What is returned when you fetch the name for an unsecured endpoint? (without sending authentication headers)

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How to access authenticated user?

Facade pattern + static method + autowire

1. Declare Facade

```
@Component
public class AuthenticationFacade {

    public Authentication getAuthentication() {
        return SecurityContextHolder.getContext().getAuthentication();
    }
```

2. Autowire and use

```
@GetMapping("/facade")
public ResponseEntity<SimpleDto> securedUser() {
    final Authentication authentication = this.authenticationFacade.getAuthentication();
```

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How to access authenticated user?

Facade pattern + static method + autowire

Possible to autowire anywhere (but don't do that)

Easy to test (mock)

Extentable, add any method to the facade

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TODO

Fetch username from security context using facade.

URL	Response
/secured/username	{ "value": "username: admin" }

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Another step further...

Using facade in annotations

```
@GetMapping("/{summaryId}/preview")
@PreAuthorize("@authenticationFacade.hasPermission('DOCUMENT', 'READ')")
public ResponseEntity<byte[]> downloadPreview(@PathVariable final Long summaryId) {
```

Uses The Spring Expression Language (SpEL) -> whole new topic

https://www.baeldung.com/spring-expression-language

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How to access authenticated user?

Using facade in annotations

```
@Configuration
@EnableGlobalMethodSecurity(prePostEnabled = true)
public class GlobalMethodSecurity extends GlobalMethodSecurityConfiguration {

}
```

To use SpEL you have to add another annotation.

~~ Spring magic

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TODO

Create your own method to check the role

```
@GetMapping("/{summaryId}/preview")
@PreAuthorize("@authenticationFacade.hasRole('USER')")
public ResponseEntity<byte[]> downloadPreview(@PathVariable final Long summaryId) {
```

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Security mechanisms

- Basic authentication
- Digest authentication
- Oauth 1
- Oauth 2

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Idea behind Oauth 1&2

OAuth provides a method for users to grant third-party access to their resources without sharing their passwords. It also provides a way to grant limited access (in scope, duration, etc.).

OAuth allows notifying a resource provider (e.g. Facebook) that the resource owner (e.g. you) grants permission to a third-party (e.g. a Facebook Application) access to their information (e.g. the list of your friends).

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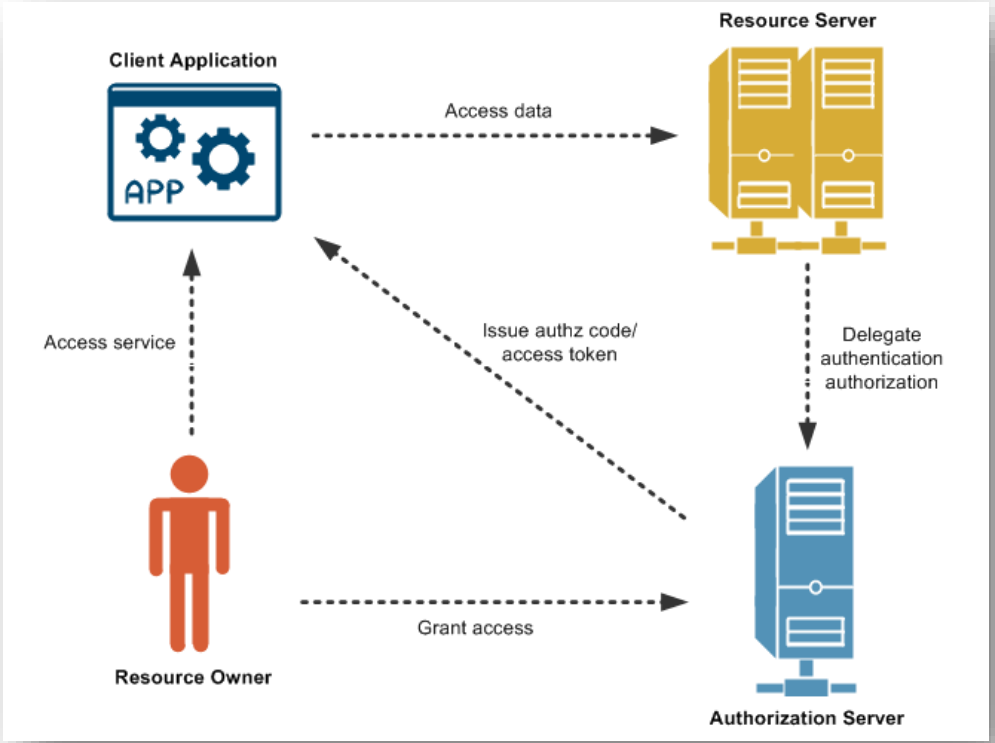
Oauth 1 vs Oauth 2

- Oauth 2 is a replacement building on the ideas of Oauth 1
- Better suited for non-browser applications
- Oauth 2 lacks cryptography and trusts on HTTPS
  - Makes it less complicated
- Short lived tokens
  - Is this safe?

Oauth 2 actors



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Oauth 2 tokens

- Gives access to the resources (like session tokens)
- Has to be valid
- Is linked to a user (e.g. in the database)
- Can contain data about the user

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JSON Web Token (JWT)

- Self-contained
- Consists of claims, things that are true
- Published by authorization server (e.g. Google or your own app)
- Signed with PRIVATE key
- Can be verified with PUBLIC key


```
{
  "iss": "Google",
  "exp": 1536779503,
  "jti": "vPrU7-mAEj2Lh9k7ubPpBg",
  "iat": 1536776503,
  "nbf": 1536776383,
  "firstName": "Gert-Jan",
  "lastName": "Heireman",
  "City": "Lille",
  "Role": "Admin"
}
```

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JSON Web Token (JWT)

- 1. Go to www.jwt.io and paste following token:

eyJraWQiOiJUaGlzIGlzIHRoZSBrZXkiLCJhbGciOiJSUzI1NiJ9.eyJpc3MiOiJHb29nbGUiLCJleHAiOjE1MzY3Nzk1MDMsImp0aSI6InZQclU3LW1BRWoyTGg5azd1YlBwQmciLCJpYXQiOjE1MzY3NzY1MDMsIm5iZiI6MTUzNjc3NjM4MywiZmlyc3ROYW1lIjoiR2VydC1KYW4iLCJsYXN0TmFtZSI6IkhlaXJlbWFuIiwiQ2l0eSI6IkxpbGxlIiwiUm9sZSI6IkFkbWluIn0.O_7_R-kpn6wRodXv_ru_9WT8OgJK97B9RpUIahfHMvRbEn0wHp-A4_e6sCgbwhDWqFHz50pB8gxPw_RgA0zX-Ue9tVAO_tJtzcPfn8OymorC81_QR1gtf_y_9gkFGvCcUyZfpPGhOUN0Wvi90iUY8fu0IMoqoT9KfXYF_IR7thKI-t2M0-egwx-hZyf74uq9O0-NdwwSvpJ2GdlZDE8Zntz5J6xDzGwRuRoDmF_PvHIw10zB7VNBJLjnuWy7u4n797F6_QBtonvgQIryprCazUcZMSZ2ZMfmTovNuXdkIt6CqdS-97q1JBEqjfUhFjkTRCAUhu0JHHnyqcl-6NO8GA

- 2. Use PUBLIC key to verify JWT token

-----BEGIN PUBLIC KEY-----
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAnkMJizKC1Io6zAozs3cq4nT3PCxr0cWbVgK+Nb2mIHtCkwjxEYctFBlqesmy96+oDAKayMiDdwdxd9WvtwN6juWOtQuRxN96JM5lN0V2sOUmpUObs7QfDhCJFjaSaxM81zbcXmMKQ4j1NsOFIG6sPgg3lNn3vdcIBLPMZxIFqKoEYqMEIoq+h2kvH5f2y2VvJCNML8GMNBvcU6v8u1qCPcenVhJesliGrGE2mcQ15/r3rq9W/EmeKOhbatI8plsdWd+H+nj5NsdP/kEWaC5Vkp2yXCdCU6AmzjjnU1PP+z5S5+hX887/I2sqLh+KzxIIOPvE7DK7EjinUGZMa3DcewIDAQAB-----END PUBLIC KEY-----

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The End