TÉCNICO LISBOA

Master Degree in Computer Science and Engineering

Segurança Informática em Redes e Sistemas 24/25

MOTOR IST

Group T27

Diana Goulão | IST1 102531

Mafalda Fernandes | IST1 102702

Miguel Sol | IST1 102710

POINTS OF DISCUSSION

01 Introduction

02 Built infrastructure

03 Secure document format

04 Secure channels and key distribution

05 Security requirements and challenge

06 Demonstration

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INTRODUCTION
OVERVIEW

- Car
- Types of client:
  - Owner
  - Mechanic
  - Manufacturer
- Client operations
- Restrictions

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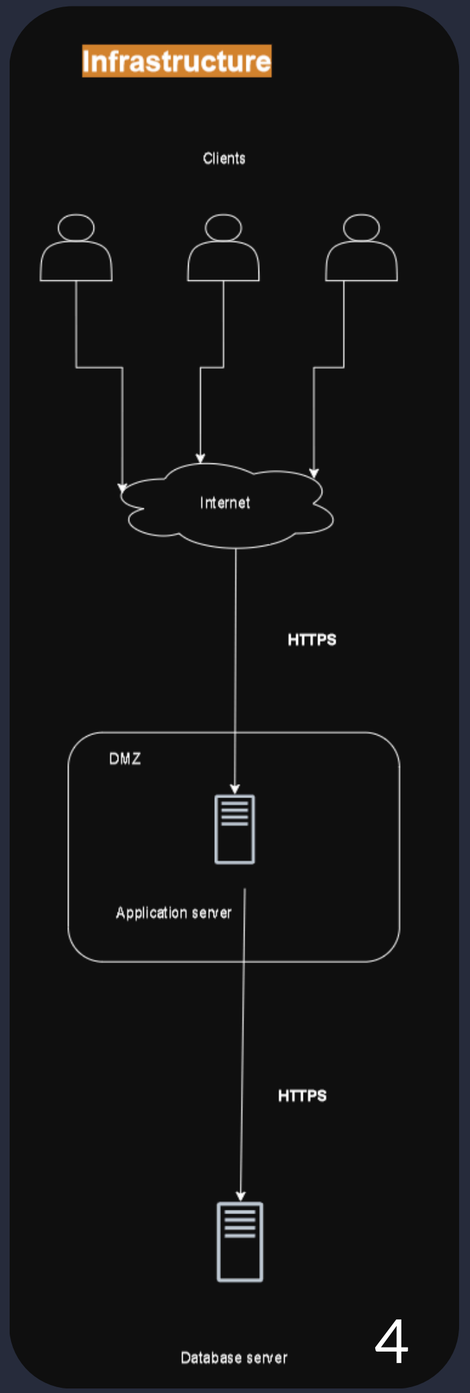
BUILT INFRASTRUCTURE

DataBase Server

Application Server

Clients Server



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SECURE DOCUMENT FORMAT
OVERVIEW

- **Objective:** Ensure data confidentiality, integrity, and authenticity;
- **Development:** Built in Java using Java Crypto;
- **Main Use:** Encryption of car configurations during communications;
- **Features:** CLI support and JSON Object manipulation;

SECURE DOCUMENT FORMAT

PROTECT COMMAND

- **Encryption:** AES for content, RSA for secret key integrity.
- **CLI & Integration:** Results saved to a path or included in the transmitted message.
- **Protect operations**:
  - protecting only with a symmetric key
  - protecting a symetric key with an asymmetric key
  - protecting content encrypted with a symmetric key and the key with an asymmetric key

SECURE DOCUMENT FORMAT

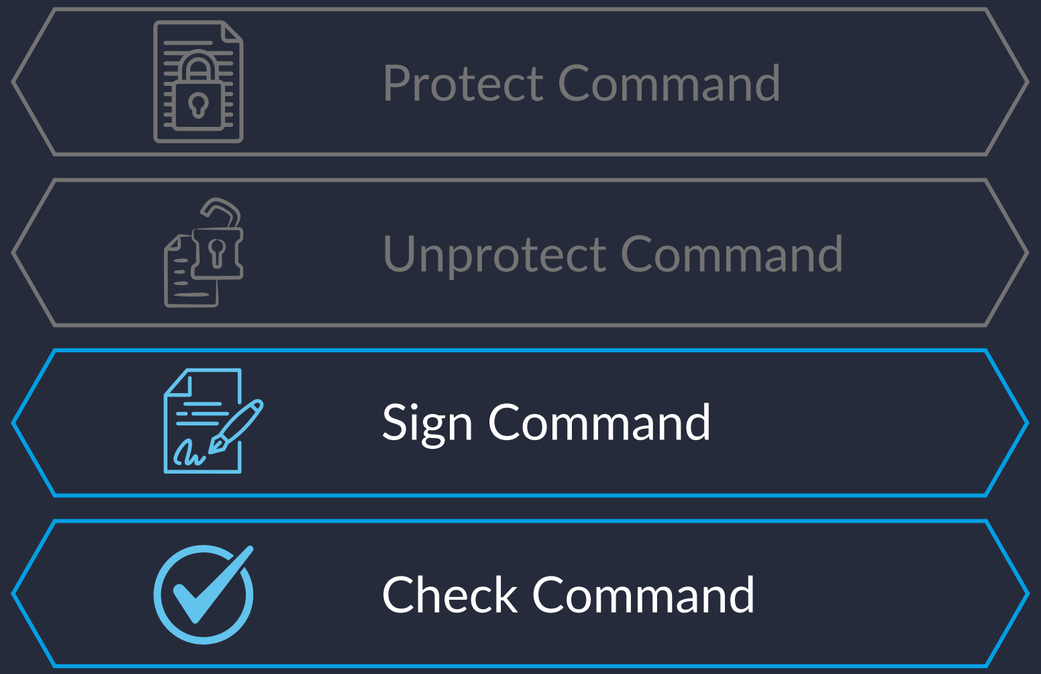
UNPROTECT COMMAND

- **Decryption:** Secret key to decrypt content, asymmetric key to decrypt secret key.
- **CLI & Integration:** Results saved to a path or returned.
- **2 modes:**
  - Unprotect with only asymmetric (RSA)
  - Unprotect with asymmetric (RSA) and symmetric (AES)

SECURE DOCUMENT FORMAT

SIGN AND CHECK COMMANDS

- **Sign:** Private Key and JSON object, also uses “SHA256withRSA” algorithm.
- **Check:** Public Key and JSON object.
- **CLI & Integration:** Results saved to a path or returned.



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SECURE CHANNELS
KEY DISTRIBUTION

SECURE CHANNELS

KEY DISTRIBUTION

- **Car Key Analogy:**
  - Symmetric key (car.key) mimics a real car key;
  - sharing is physical or assumes possession.
- **Key Distribution:**
  - Private keys for users; server holds public keys for verification.
  - Symmetric key only shared physically, ensuring security.

SECURE CHANNELS

SECURE CHANNELS

- **TLS:**
  - **Confidentiality**
  - **Data Integrity**
  - **Authentication**
  - **Protection against attacks like Man in the Middle and Replay attacks**
- **Ficticious CA**

KEY DISTRIBUTION

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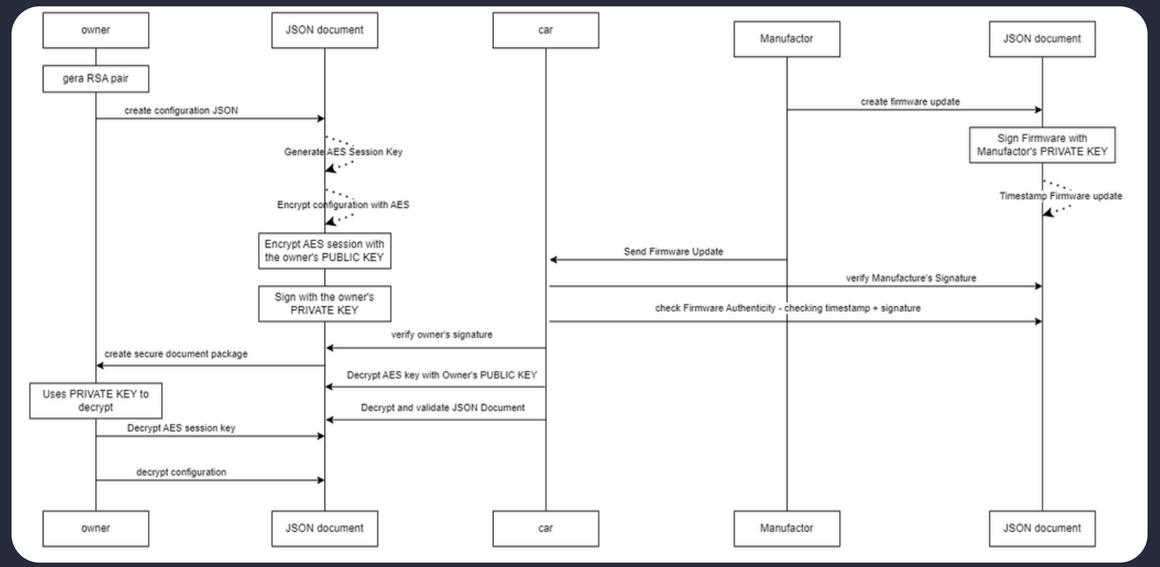
SECURITY REQUIREMENTS
OVERVIEW

- [SR1: Confidentiality] The car configurations can only be seen by the car owner.
- **[SR2: Integrity 1] The car can only accept configurations sent by the car owner.**
- [SR3: Integrity 2] The car firmware updates can only be sent by the car manufacturer.
- [SR4: Authentication] The car manufacture cannot deny having sent firmware updates.



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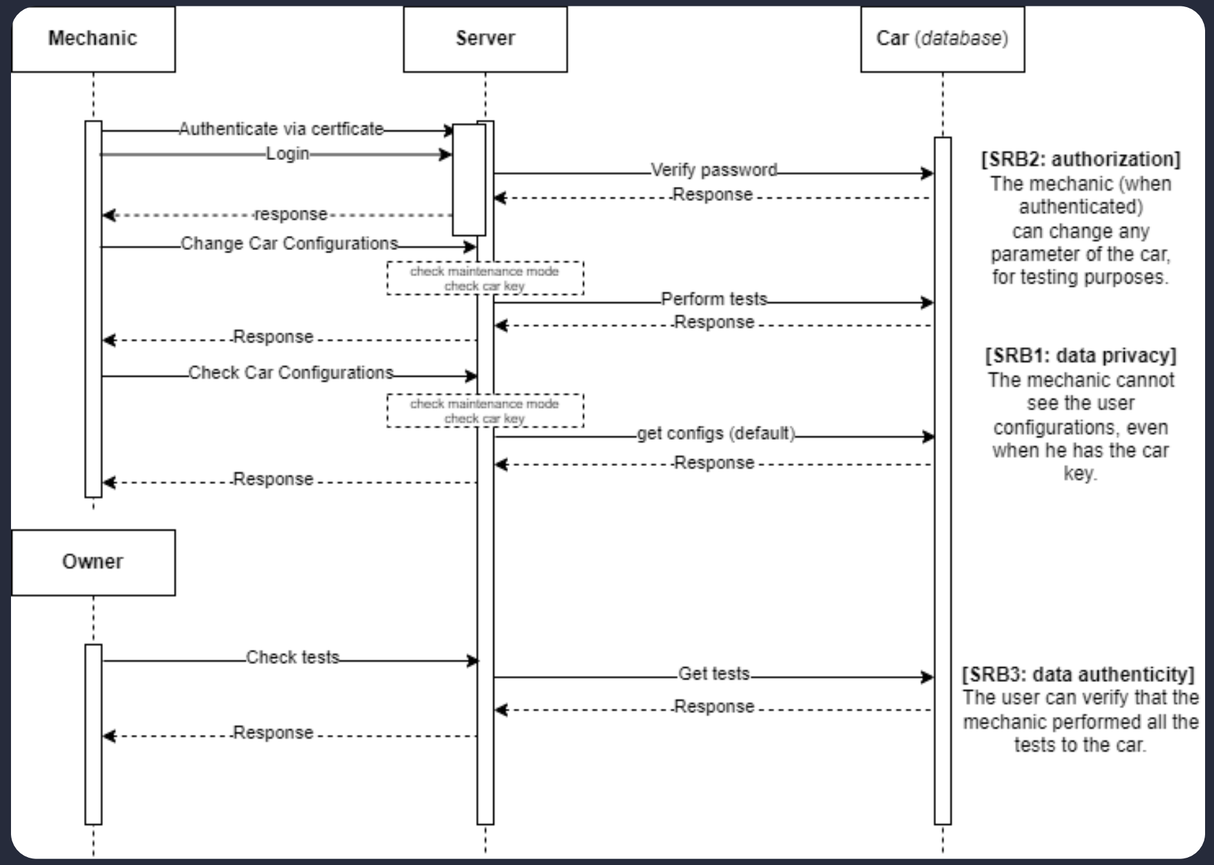
SECURITY CHALLENGE
OVERVIEW

- **[SRB1: data privacy]** The mechanic cannot see the user configurations, even when he has the car key.
- **[SRB2: authorization]** The mechanic (when authenticated) can change any parameter of the car, for testing purposes.
- **[SRB3: data authenticity]** The user can verify that the mechanic performed all the tests to the car.



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DEMONSTRATION

LOGIN

Client

```
Welcome to the System!
Please select your client type:
1. User
2. Manufacturer
3. Mechanic
4. Exit
1
You selected: User
Please enter your password: VyXeCrCxpEQDInzt5yAf
Please enter your id:
owner1
Successfully Authenticated
```

Database

```
[INFO]
[INFO] --- exec-maven-plugin:1.6.0:java (default-cli) @ databa
$2a$10$eMatFjbBuBaP7Tpw.ACaYOKqANYL0A/WESyeeDwFrMEvSaR75BvsC
```

```
t27motorist_db=> select * from owner;
 ownerid |      name      |                          password_hash
---------+----------------+------------------------------------------------------------
 owner1  | João Silva     | $2a$10$eMatFjbBuBaP7Tpw.ACaYOKqANYL0A/WESyeeDwFrMEvSaR75BvsC
 owner2  | Maria Oliveira | d3d9446802a44259755d38e6d163e820
(2 rows)
```

Server

```
Peer certs: [Ljava.security.cert.X509Certificate;@61324cf9
Connected entity's certificate subject: CN=DB,O=Internet Widgits Pty Ltd,ST=Some-State,C=AU
Database connected.
Peer certs: [Ljava.security.cert.X509Certificate;@577cfa3b
Connected entity's certificate subject: CN=USER,O=Internet Widgits Pty Ltd,ST=Some-State,C=AU
Waiting for authentication
user Authenticated
```

DEMONSTRATION

CHANGE CAR CONFIG

Client

- Insert data not encrypted
- Send encrypted data

```
select what you want to change:
1. AC
2. Seats
3. Finish and send new configuration
4. Cancel all changes
Your choice: 2

Select seat position to change:
1. Seat position 1
2. Seat position 3
3. Go back
Your choice: 1
Enter value for Seat position 1: 6
Seat position 1 value added: 6

Select seat position to change:
1. Seat position 1
2. Seat position 3
3. Go back
Your choice: 3

Select what you want to change:
1. AC
2. Seats
3. Finish and send new configuration
4. Cancel all changes
Your choice: 3
Owner changed the config to: {"configuration":{"seat":[{"pos1":"6"},{"pos3":"1"}],"ac":[{"out1":"1234"},{"out2":"123
tyh+VRK7UsIrzuM60SbCkrDlP0ZGoab5Di0jwyZqFojunhFuKSRHbm5Dc16i6bqRXoE3d3pWbrMGhR7xB6bEddpHx+dOoIhpfYFXYwWZxMM3SEN7z5I3
BdXOf+WzHbA+ODiiKwun/KXRSG73s/OYXNZug+QHIy12SNS/RCRIwLtc/KOw2HJh0MbQoWTBh3WB8nwKWCpK3qYEGkthX9oJ7w0Aw=="}
Encrypted new config to send to database: {"configuration":"Moadj8ErGD86DWuZ7O4k23z7ueRr1smbwmkaoMh2QX8nb3GMTVhLP86n
5mlpuqnqkOZCueXGZJp6ygOApS/SJqCfLyCek2+pIwc30DwMtyh+VRK7UsIrzuM60SbCkrDlP0ZGoab5Di0jwyZqFojunhFuKSRHbm5Dc16i6bqRXoE3
mJZOz5XyVHidoB4gRi0bwXPllGajuc4JQ74TpWhjBLae90HjBdXOf+WzHbA+ODiiKwun/KXRSG73s/OYXNZug+QHIy12SNS/RCRIwLtc/KOw2HJh0Mb(

Changing car configuration...
Configuration changed successfully.
```

Database

- Received encrypted confinguration
- Store encrypted configuration

```
New config to set:
{"configuration":"Moadj8ErGD86DWuZ7O4k23z7ueRr1smbwmkaoMh2QX8nb3GMTVhLP86nm87
c30DwMtyh+VRK7UsIrzuM60SbCkrDlP0ZGoab5Di0jwyZqFojunhFuKSRHbm5Dc16i6bqRXoE3d3p
ae90HjBdXOf+WzHbA+ODiiKwun/KXRSG73s/OYXNZug+QHIy12SNS/RCRIwLtc/KOw2HJh0MbQoWT
```

```
 configid | carid | is_default | userid |         timestamp          |
                                                                                              configuration_details

----------+-------+------------+--------+----------------------------+------------------------------------------------------------
---------------------------------------------------------------------------------------------------------------------------------
---------------------------------------------------------------------------------------------------------------------------------
        1 | car1  | t          | owner1 | 2024-12-01 08:05:00        | {"configuration":"Moadj8ErGD86DWuZ7O4k2wzcqXsRPIKE9hM6gpesyE98fciPbyb+8P
FRwRHaKI="}
        2 | car2  | t          | owner2 | 2024-12-05 10:15:00        | {"configuration":"Moadj8ErGD86DWuZ7O4k2wzcqXsRPIKE9hM6gpesyE98fciPbyb+8P
FRwRHaKI="}
        3 | car1  | f          | owner1 | 2025-01-08 00:03:39.557348 | {"configuration":"Moadj8ErGD86DWuZ7O4k23z7ueRr1smbwmkaoMh2QX8nb3GMTVhLP8
HJq057WY=","signature":"SvWFO5mlpuqnqkOZCueXGZJp6ygOApS/SJqCfLyCek2+pIwc30DwMtyh+VRK7UsIrzuM60SbCkrDlP0ZGoab5Di0jwyZqFojunhFuKSRHbm5Dc16i6bqRXo
7z5I3UrohG/AWqEG/fx/V/uRG5JMqmJZOz5XyVHidoB4gRi0bwXPllGajuc4JQ74TpWhjBLae90HjBdXOf+WzHbA+ODiiKwun/KXRSG73s/OYXNZug+QHIy12SNS/RCRIwLtc/KOw2HJh0M
(3 rows)
```

RESULTS
CONCLUSION

WHAT WE HAVE LEARN

- How to implement security in the exchange of sensitive information
- Security in communication between servers on the same network and with external clients

WHAT WE DIDN'T IMPLEMENT

- Check signatures
- Possibility of having more than one owner

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