

PSTQB SESSION

SW TESTING @ BOSCH AVEIRO

CENTER OF ENGINEERING

BOSCH IN A NUTSHELL

ANA MARGARIDA PEREIRA

Bosch in a nutshell

Our company in figures

In 2021



78.7

billion euros
sales revenue



3.2

billion euros EBIT
from operations



403,000

Bosch associates
worldwide at year-end
(approx.)



440

subsidiaries and regional
companies in more than 60
countries

From Corporate presentation (last updated May 2022)

Bosch in a nutshell

Our business sectors



Mobility Solutions

Braga (XC)



Industrial Technology



**Energy and Building
Technology**

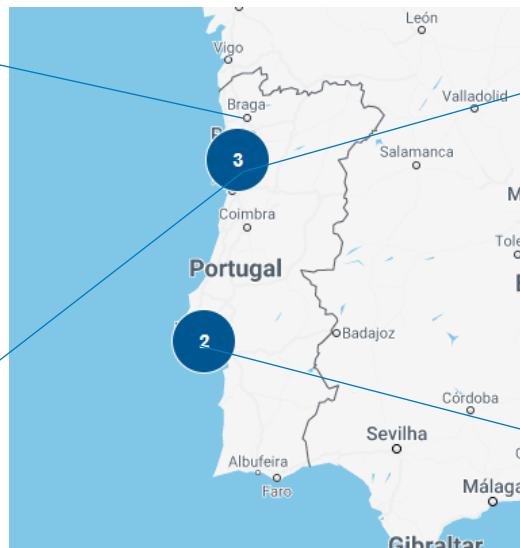
Aveiro (TT) and Ovar (BT)



Consumer Goods

Bosch Portugal

Our locations and business segments

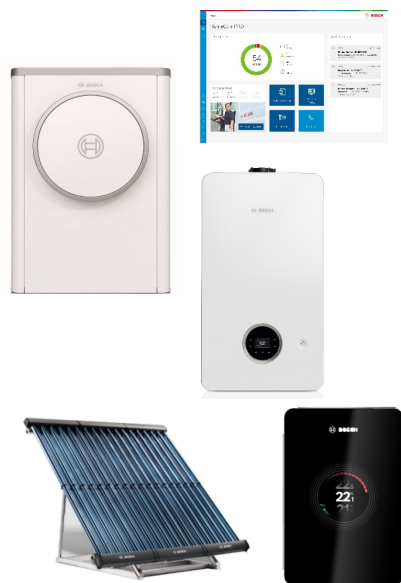


TT IN A NUTSHELL

TT in a nutshell

TT – Our complete product range

*Residential
Heating*



*Merchandise
for Residential Heating*



*Residential/Commercial
Air Conditioning*



*Commercial/Industrial
Heat and Power*



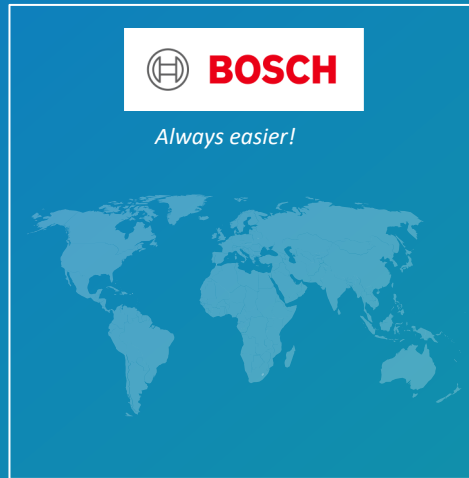
*Residential
Perfect Water*



* From TT company presentation

TT in a nutshell

TT - Global or regional – but always leading



Brazil



Portugal



France



Great Britain



Netherlands



Sweden



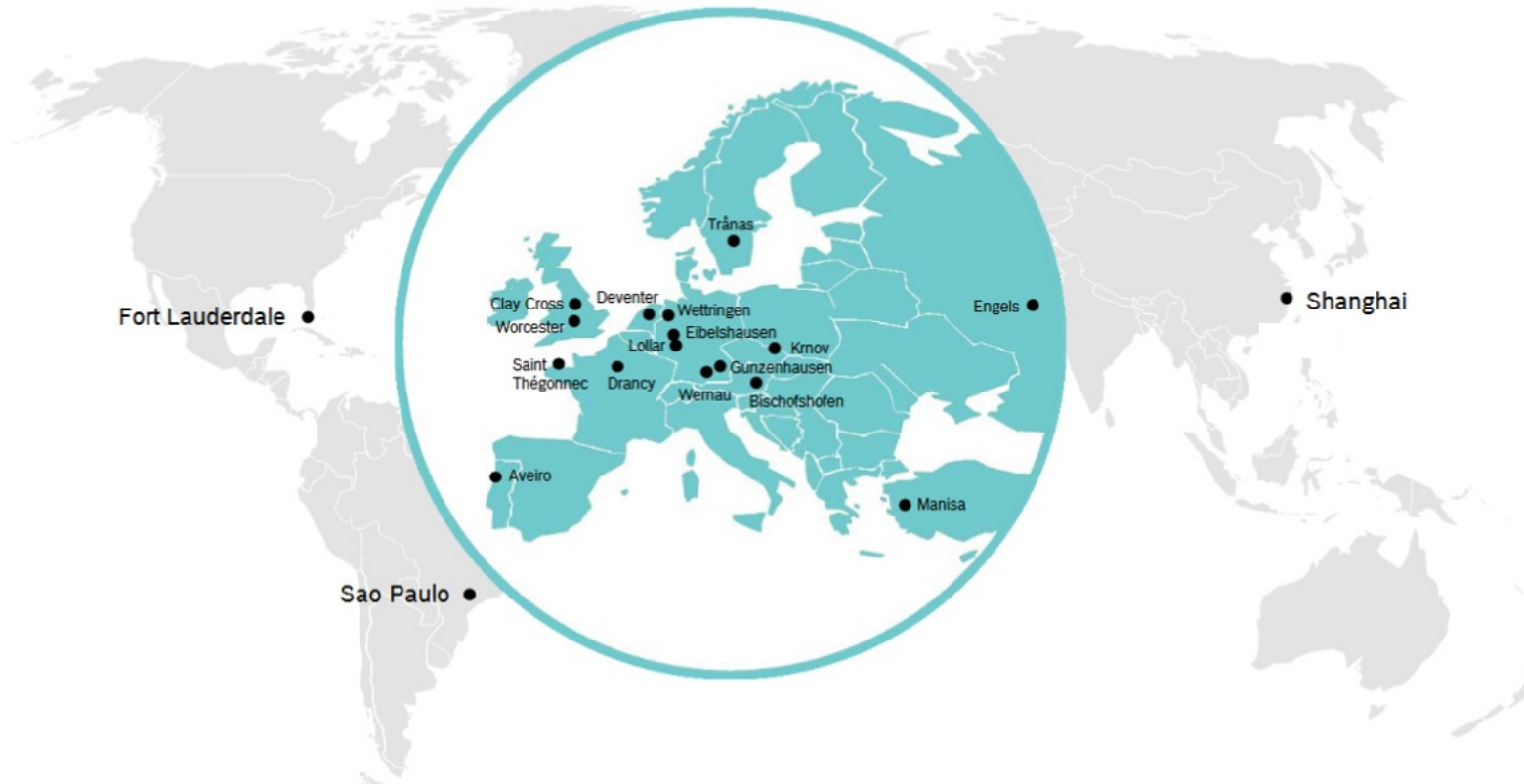
Czech Republic



* From TT company presentation

TT in a nutshell

TT – Our locations



TT in a nutshell

Thermotechnology goes digital

*380,000
connected
devices and
controls*



* From TT company presentation

TT in a nutshell

Bosch Energy Manager



*System control
that optimises
comfort and
energy costs*

Photo-
voltaics

E-car
charging
station

Indoor
heat
pump

Outdoor
heat
pump

Inverter

Household
appliances

Battery
storage system

Indoor
heat
pump

* From TT company presentation

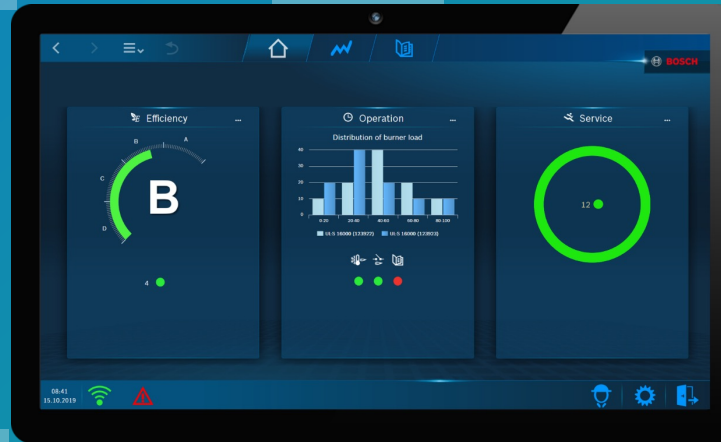
TT in a nutshell

From big data to smart data

Keeping an eye on all energy flows to detect energy losses



Ideal boiler condition – monitored operating behaviour



Wear-and-tear forecasts for optimised maintenance concept

Intelligent data collection and data evaluation



Secure remote connection and alert management

* From TT company presentation

AVEIRO CENTER OF ENGINEERING

Aveiro Center of Engineering

Video CE



Aveiro Center of Engineering Tools and Technologies



EASY CONTROL

REMOTE ROOM CONTROLLER
W/ MOBILE APP – HOW ARE
WE TESTING THEM?

RICARDO CRUZ



Aveiro Center of Engineering

RRCNG Product Overview

Heat Sources



EMS*1 & EMS2

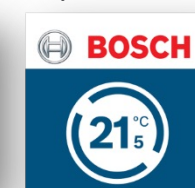
RRCNG



Connectivity
(REST API)

MyBuderus

EasyControl App



Siri



138k+ users



32 countries

HomeMaticIP

OpenTherm,
iRT, On/OFF

EMS1



EasyControl Adapter

Supported Accessories



Control Key K20
(Plux)



Table Stand



eTRV

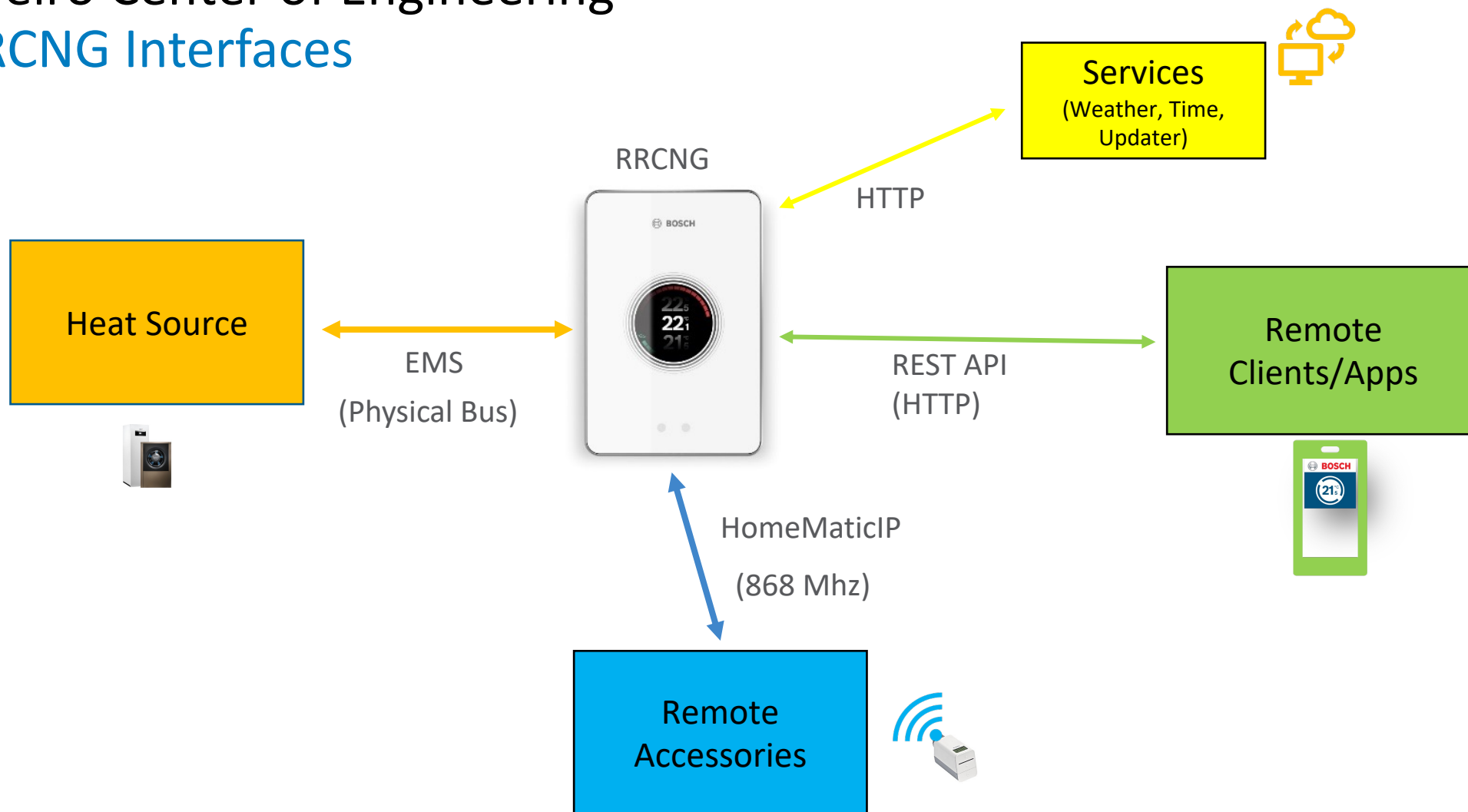


Underfloor
heating
thermostat

*EMS = Energy Management System (Bosch)

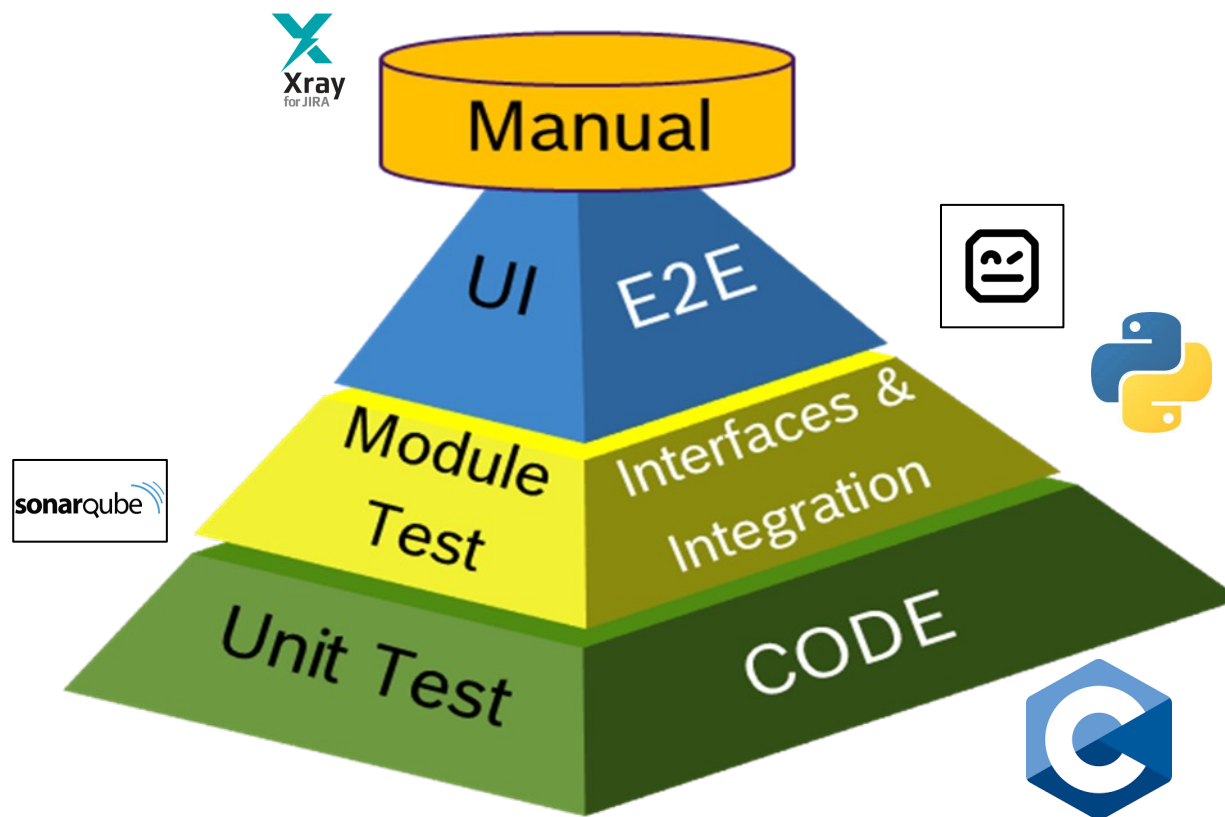
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RRCNG Interfaces



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RRCNG Software Test Levels



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RRCNG Testing Mindset

- **Quality**

- “Quality means doing it right when no one else is looking” – H.Ford

- **Reliability**

- The software must be made in such a way that it can operate always on.

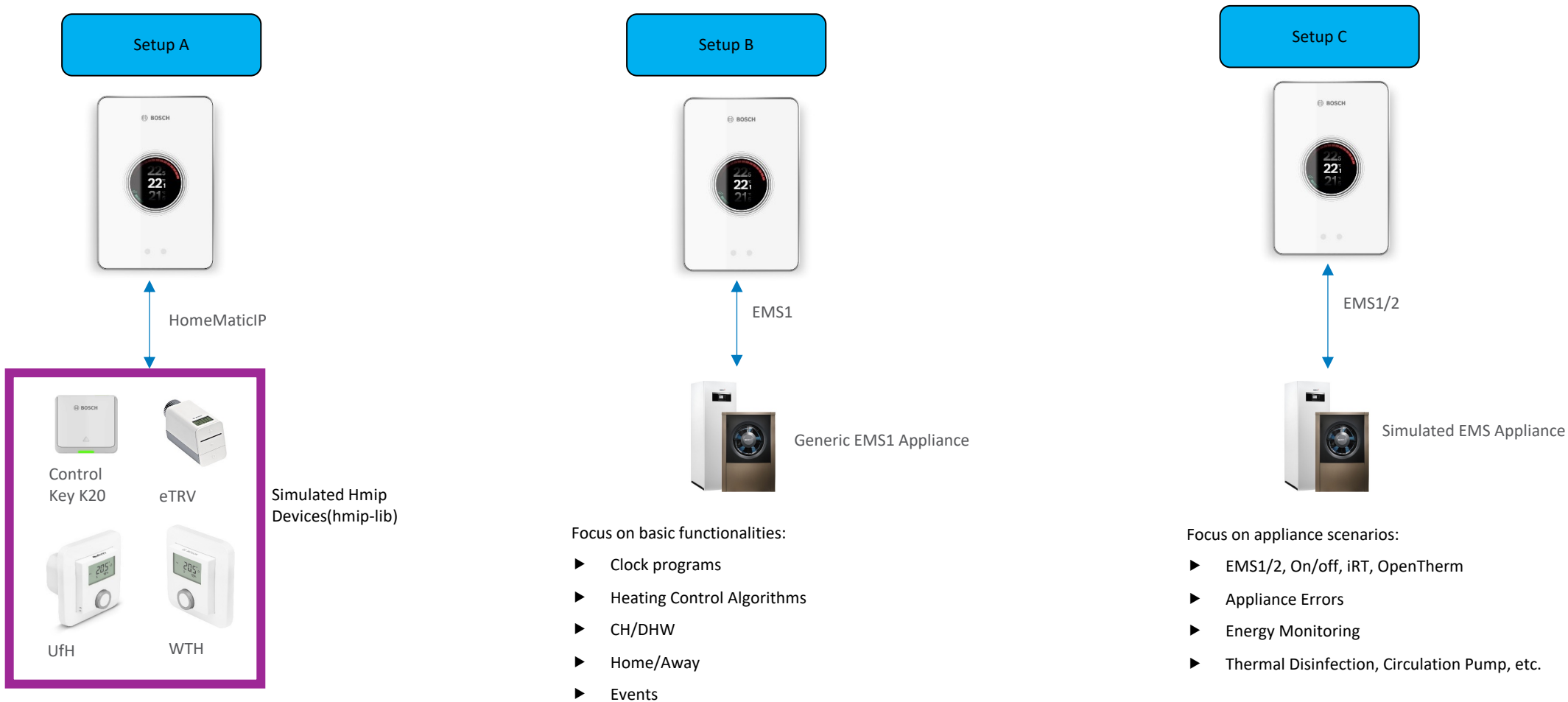
- **Accountability and Transparency**

- Mistakes happen, so it is best to prevent them, find the best way to minimize their risk, facilitate their discovery and potential fix.



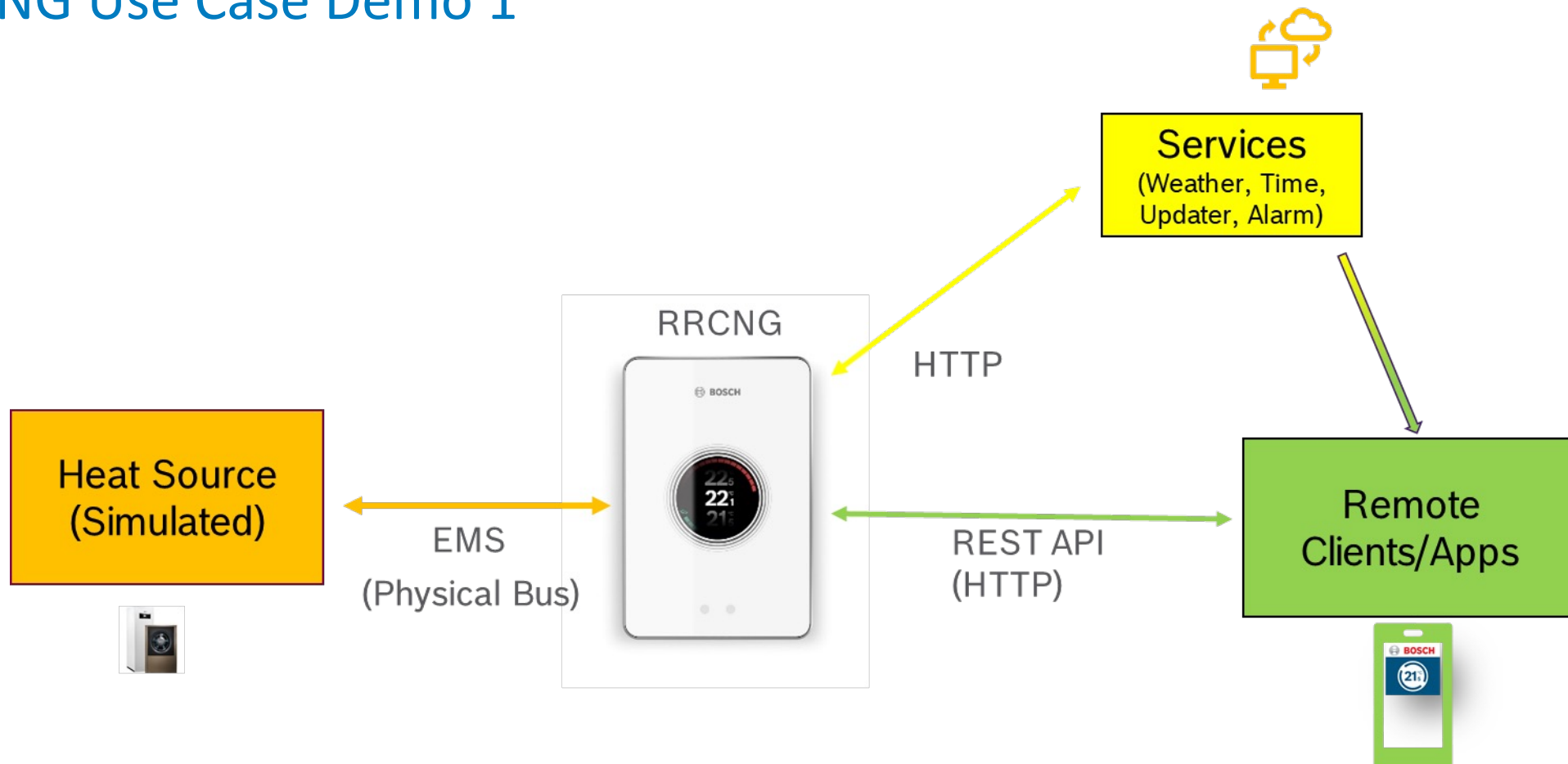
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RRCNG Automated testing physical setups



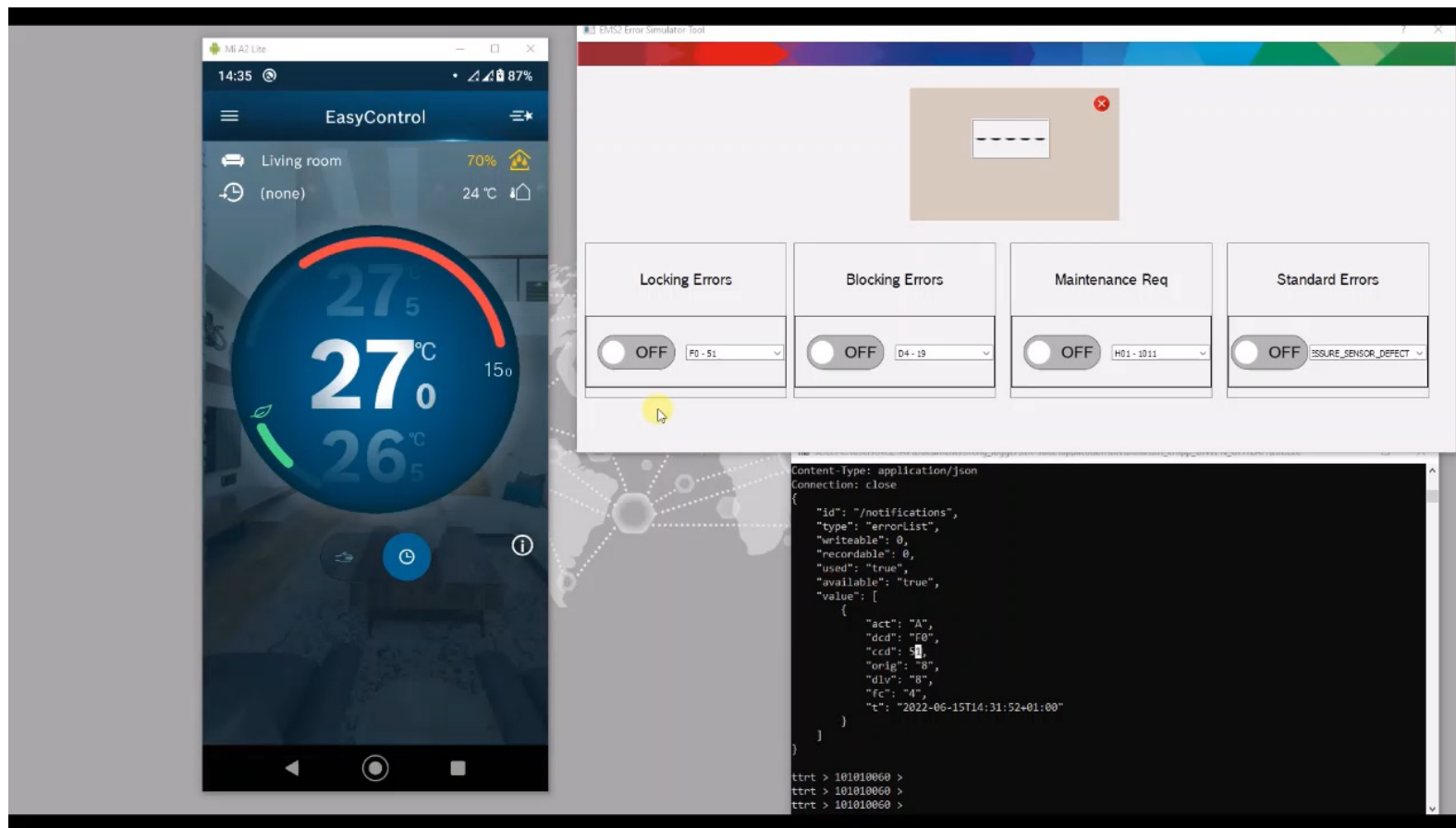
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RRCNG Use Case Demo 1



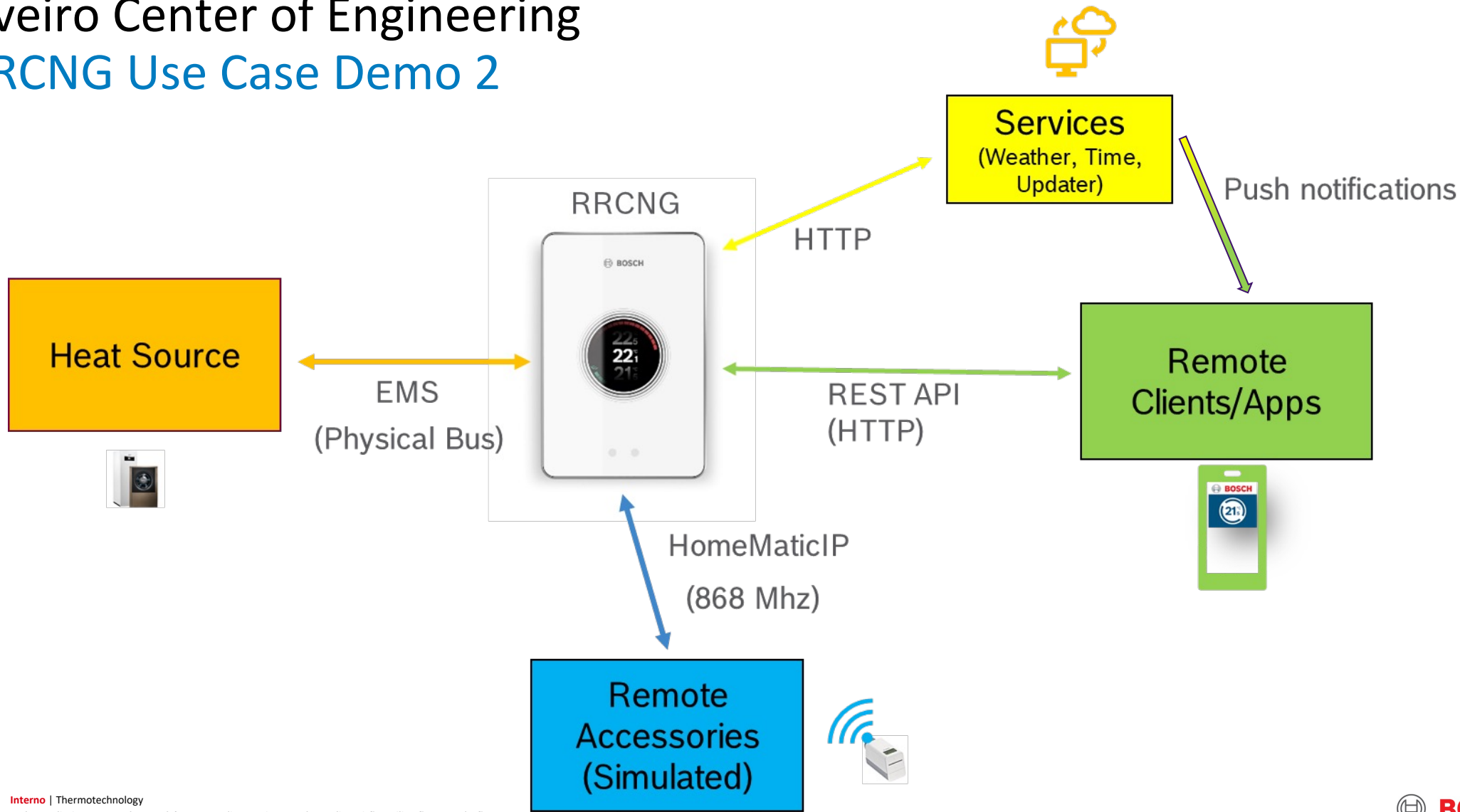
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RRCNG Use Case Demo 1



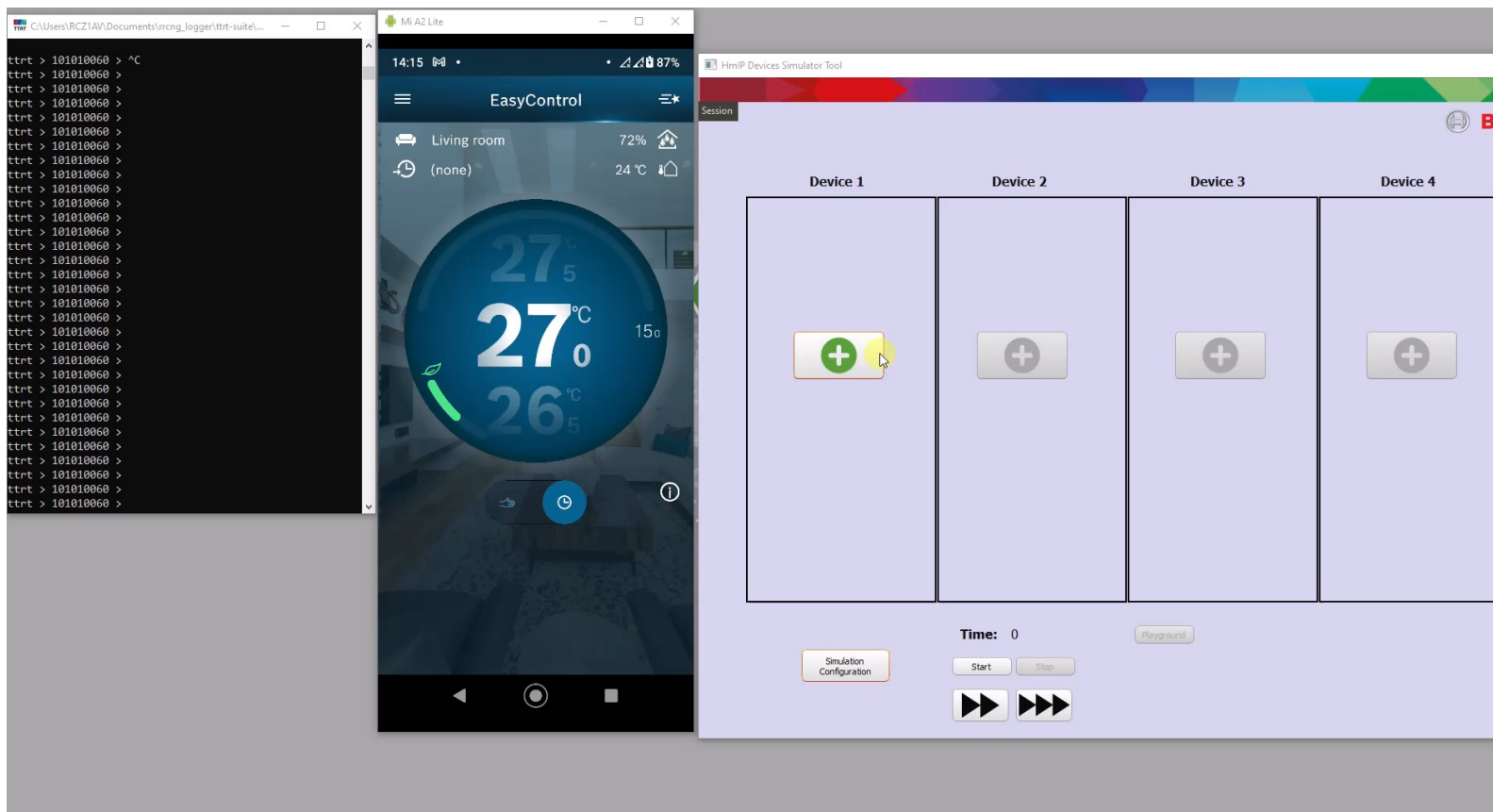
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RRCNG Use Case Demo 2



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RRCNG Use Case Demo 2



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RRCNG Component Simulation with Robot Framework Keywords

```
# Simulate error conditions for the different eTRVs (battery + valve state)
eTRV create and send status frame 0xababab low_bat=True valve_state=6
```



```
# Change zone open window status to open
eTRV create and send status frame 0xababab window_state=1 usermode=0 temperature_setpoint=12
# Check if indeed it's open
Zone 1 open window detection status should be open
# Check if OWD icon is shown
Icon is shown window_open
```

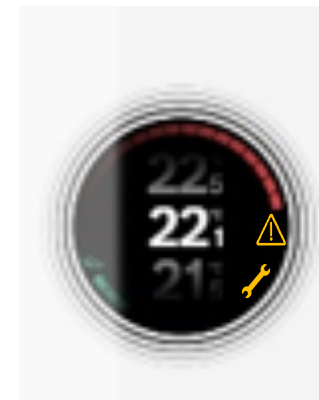


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RRCNG Component Simulation with Robot Framework Keywords

```
# Simulate 3 EMS1 appliance errors (Locking+ Maintenance + Thermal Disinfection)
Set EMS1 appliance error and broadcast DT24 5 C7 40 ⚠️
Set EMS1 maintenance request and broadcast DT28 2 7 1 🔧
Set EMS1 DT52 Appliance Error Flags 3 ${True}
```

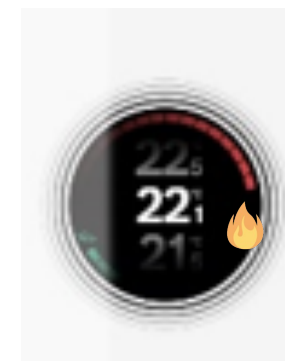
```
# Check HMI
Icon is shown maintenance
Icon is shown locking
```



```
Set EMS1 actual power ${70}
Set EMS1 DHW status flag ${False}
Set EMS1 CH status flag ${True}
Set EMS1 flame indication and broadcast DT24 ${True}
```



```
Icon is shown ch on
```



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RRCNG Component Simulation with Robot Framework Keywords

```
# Include one eTRV
Include and verify inclusion of eTRV with MAC 0xababab and SGTIN 3014f711a000005538591235 in zone 1
Synchronize eTRV after inclusion 0xababab
Receive and acknowledge eTRV parameter settings sequence 0xababab valve_error_pos=15

Device 2 battery should be ok

# Now we simulate an error in appliance sim by setting locking flag (bit 5), display code and cause code.
Set EMS1 appliance error and broadcast DT24 5 C7 40

# Set and send low battery flag to true on eTRV status
eTRV create and send status frame 0xababab low_bat=True
Device 2 battery should be low

# Try for 30s to retrieve error from /notifications
wait until keyword succeeds 30x 1s Check GEL contents 0 2 C7 40
wait until keyword succeeds 30x 1s Check GEL contents 1 2 A84 1870
Icon is shown locking
Icon is shown maintenance

# Clear low battery flag from status message
eTRV create and send status frame 0xababab low_bat=False
Device 2 battery should be ok
```

SYSTEM TESTING

INTEGRATING COMPLEX SYSTEMS AND SHIPPING
THEM TO THE CUSTOMER

BRUNO PINHO

Aveiro Center of Engineering

System Testing team activities

System Test Coordination, Test and Release

- Complex system projects over different departments
- Generate transparency between system and product interfaces
- Alignment between design requirements with test contents, schedule and release

System Integration

- Components, concepts, technologies and systems are combined to verify and validate early

Complexity Management

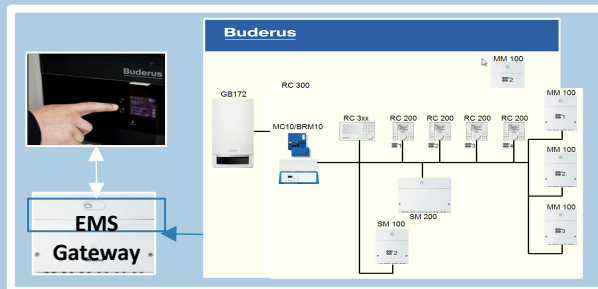
- Development of tools for our internal (Compatibility KG and ECU Simulator) and external customers (QST for installers)

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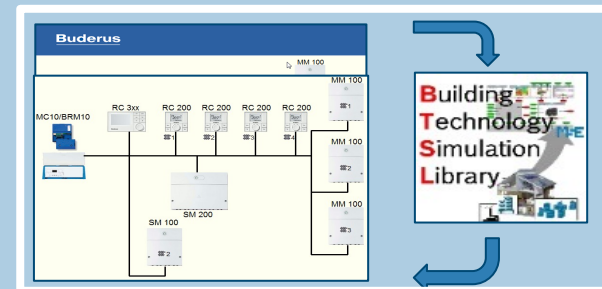
Automated and Manual Testing Setups



Hardware set-up (HiL)



Hybrid set-up (virtual & HW)

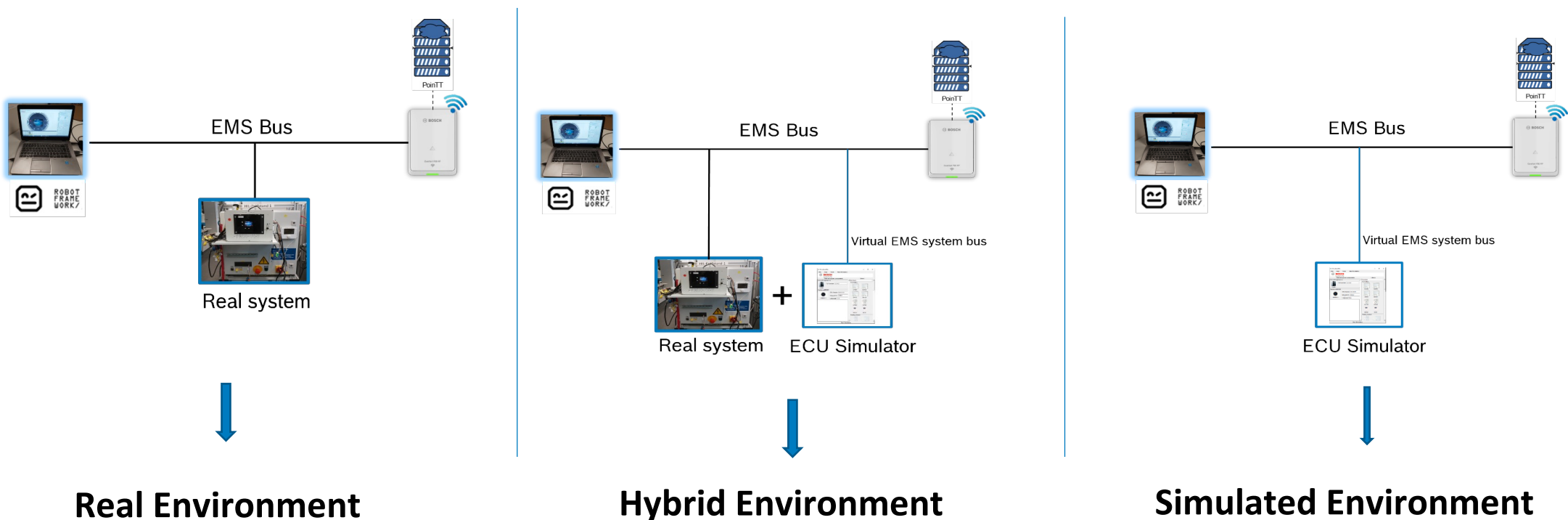


Virtual set-up (SiL)



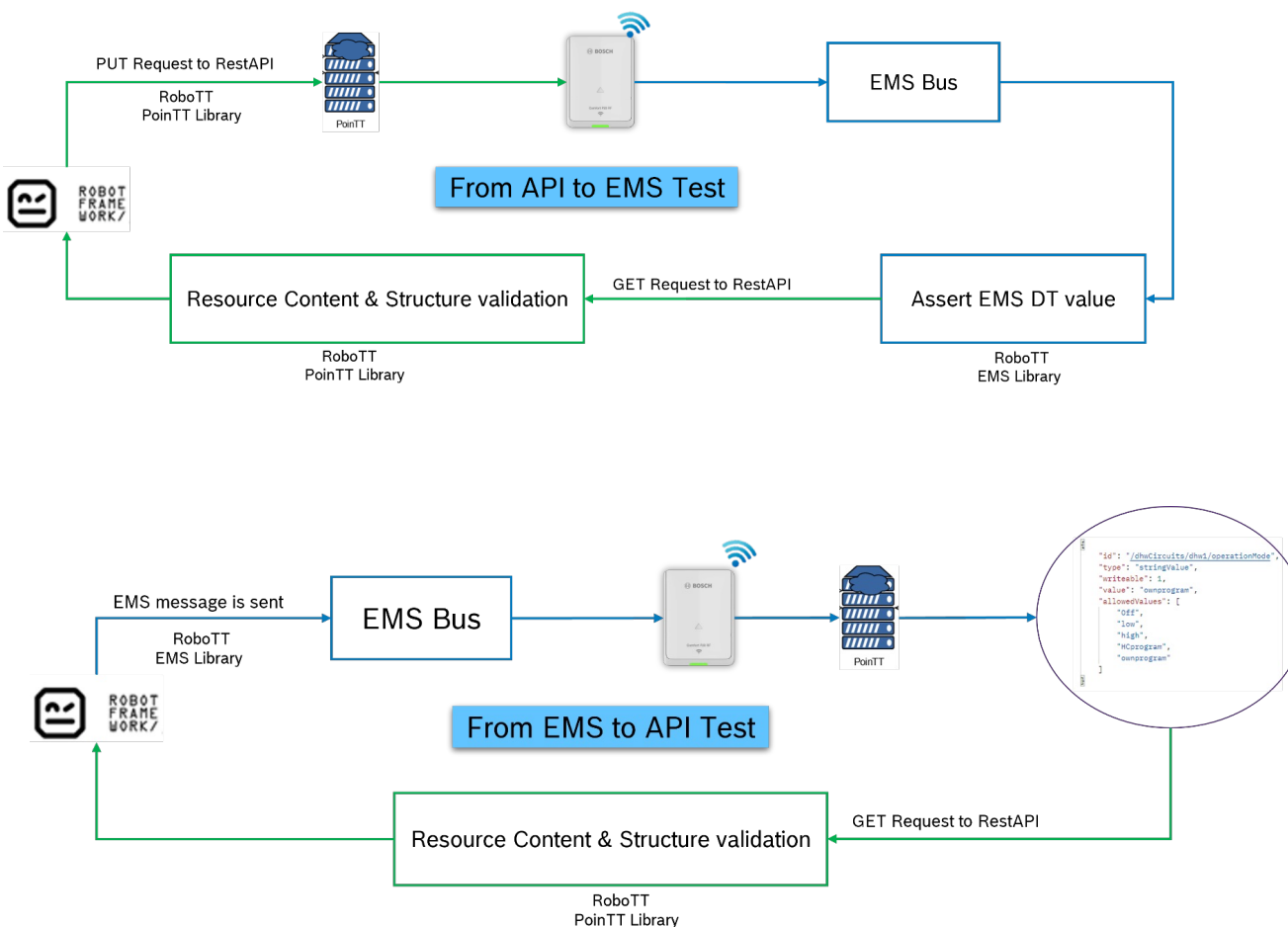
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System Gateway – Interface Regression Testing (Infrastructure)



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System Gateway – Interface Regression Testing (Technical Concept)



Robott-K30-Pi Log

2023-03-01 09:00

8.96s / 1.94s Avg

Report

Test Statistics

Critical Tests	Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
All Tests		14	14	0	02:27:05	
Statistics by Suite						
Remote (CRM operation modes) (SuiteMax)		14	0	0	02:27:05	Pass/Fail
Statistics by Site						
Remote (Test Cases)		14	14	0	02:26:42	
Automation Test Cases		14	14	0	02:29:34	
Automation Test Cases - Back-mix		14	14	0	02:29:34	
Automation Test Cases - CRM		14	14	0	02:29:34	
Automation Test Cases - Back-mix Remote CRM Operation		14	14	0	02:29:34	
Automation Test Cases - CRM		14	14	0	02:29:34	

Test Execution Log

CRM

Robott-K30-Pi

Full Name: Remote (CRM operation modes) (SuiteMax)

Description: Critical tests for CRM operation modes

Source: C:\robott\src\test_cases\remote_k30_pi\CRM

Start / End / Elapsed: 2023-03-01 09:00:26 / 2023-03-01 09:27:05 / 02:26:39.0100

14 test total, 14 passed / 0 failed

CRM

Test Case: CRM SIMULATION ENV

Full Name: CRM (CRM operation modes) (SuiteMax)

Description: CRM operation modes

Source: C:\robott\src\test_cases\remote_k30_pi\CRM\CRM

Start / End / Elapsed: 2023-03-01 09:00:26 / 2023-03-01 09:00:26 / 00:00:00.0000

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CRM

Test Cases

Full Name: CRM (CRM operation modes) (SuiteMax)

Description: CRM operation modes

Source: C:\robott\src\test_cases\remote_k30_pi\CRM\CRM

Start / End / Elapsed: 2023-03-01 09:00:26 / 2023-03-01 09:00:26 / 00:00:00.0000

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CRM

Back-mix

Full Name: CRM (CRM operation modes) (SuiteMax)

Description: CRM operation modes

Source: C:\robott\src\test_cases\remote_k30_pi\CRM\CRM

Start / End / Elapsed: 2023-03-01 09:00:26 / 2023-03-01 09:00:26 / 00:00:00.0000

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CRM

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14 test total, 14 passed / 0 failed

CRM

CRM

Full Name: CRM (CRM operation modes) (SuiteMax)

Description: CRM operation modes

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CRM

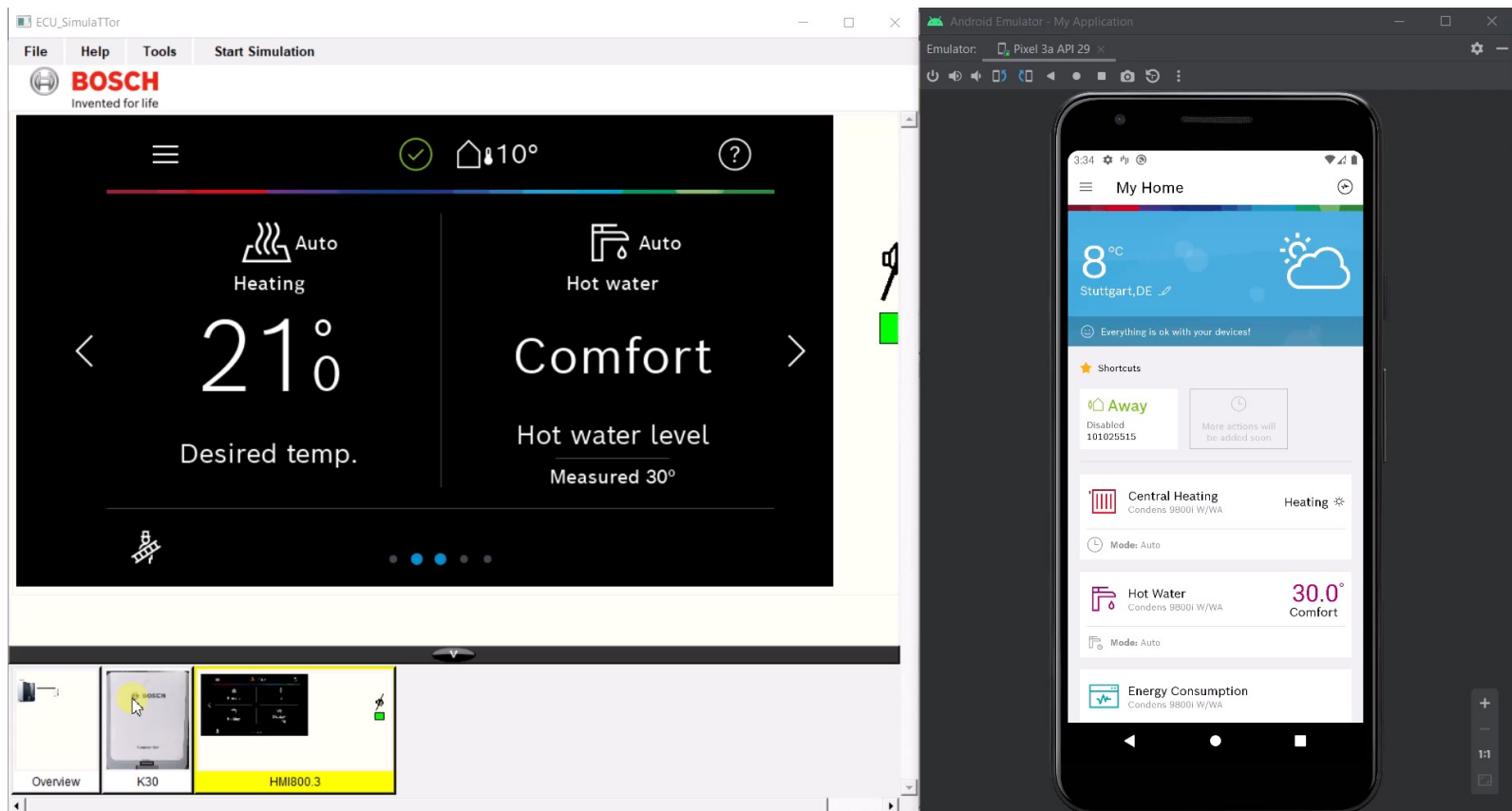
CRM

Full Name: CRM (CRM operation modes) (SuiteMax)

HTML Test Log Report

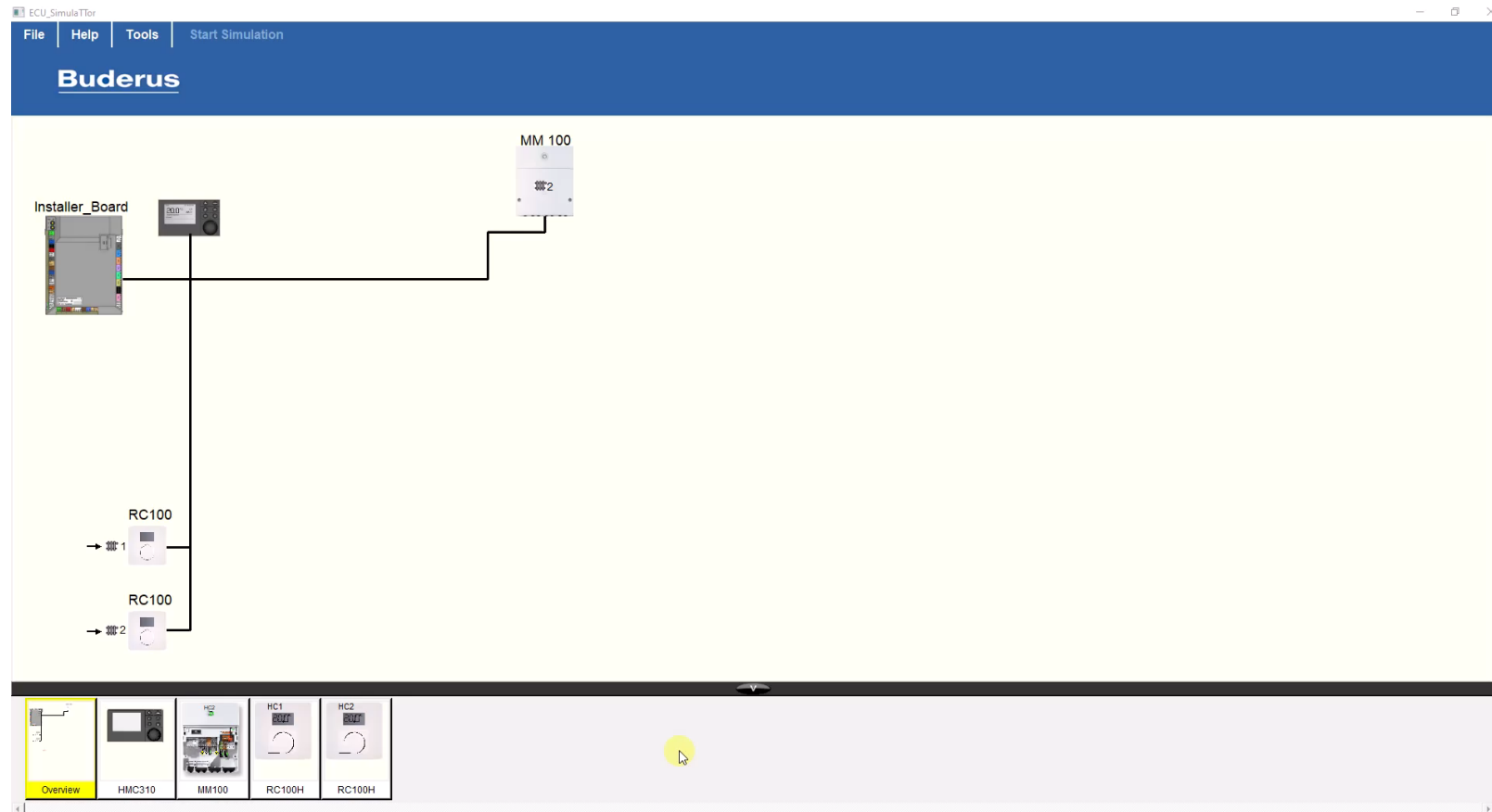
Aveiro Center of Engineering

System Gateway – Interface Regression Testing (Virtualization)



Aveiro Center of Engineering

Testing tools in action



Aveiro Center of Engineering

IoT - End to end testing



CLOSING

Aveiro Center of Engineering

At Bosch, you will be part of...

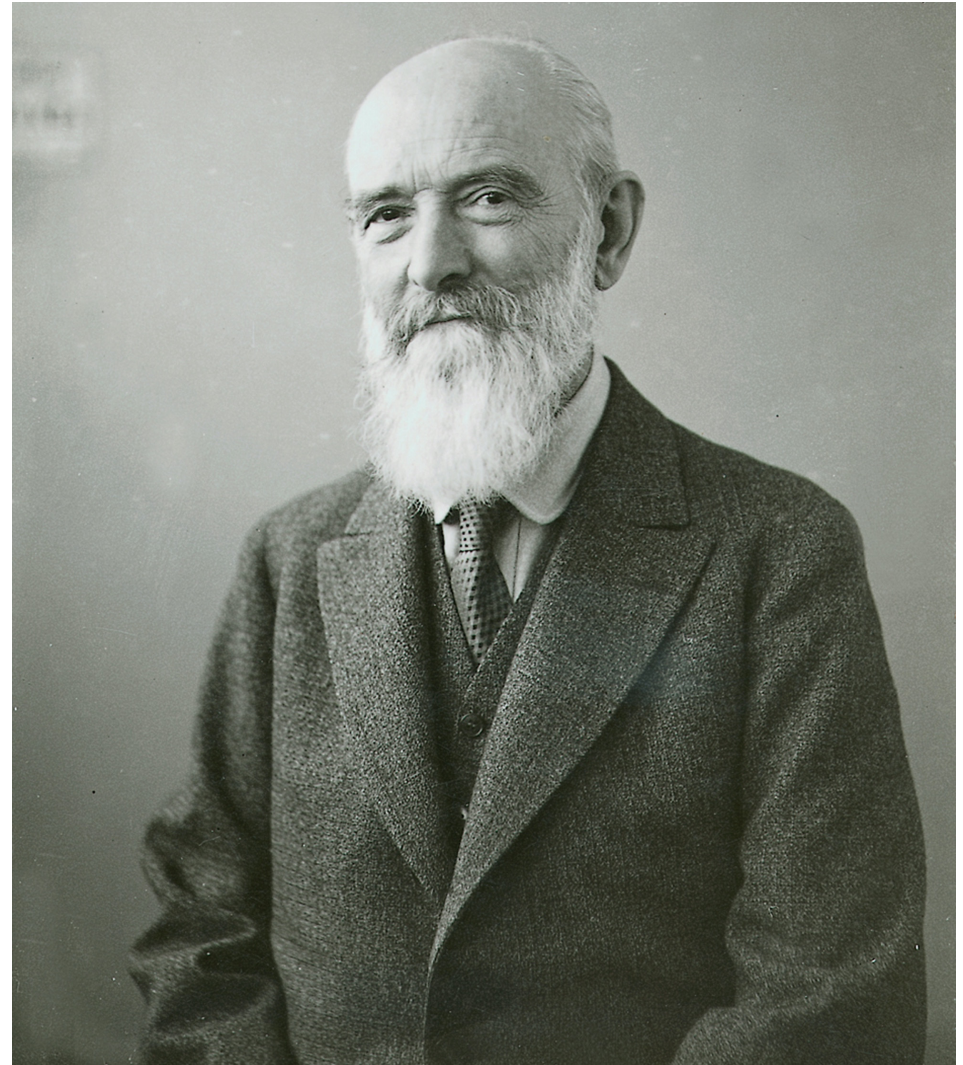
- ▶ an innovative powerhouse that is actively shaping our technological future,
- ▶ a diverse global family whose expertise covers both the physical and digital worlds and who knows how to leverage their combination for the greatest benefit to users;
- ▶ a values-driven company that is committed to improving quality of life worldwide and preserving the planet for future generations.

And if that's not enough, it's a really nice place to work, too!



“We should all strive to improve on the status quo: none of us should ever be satisfied with what has been achieved, but should always endeavor to do better.”

Robert Bosch, 1861–1942



Contacts

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