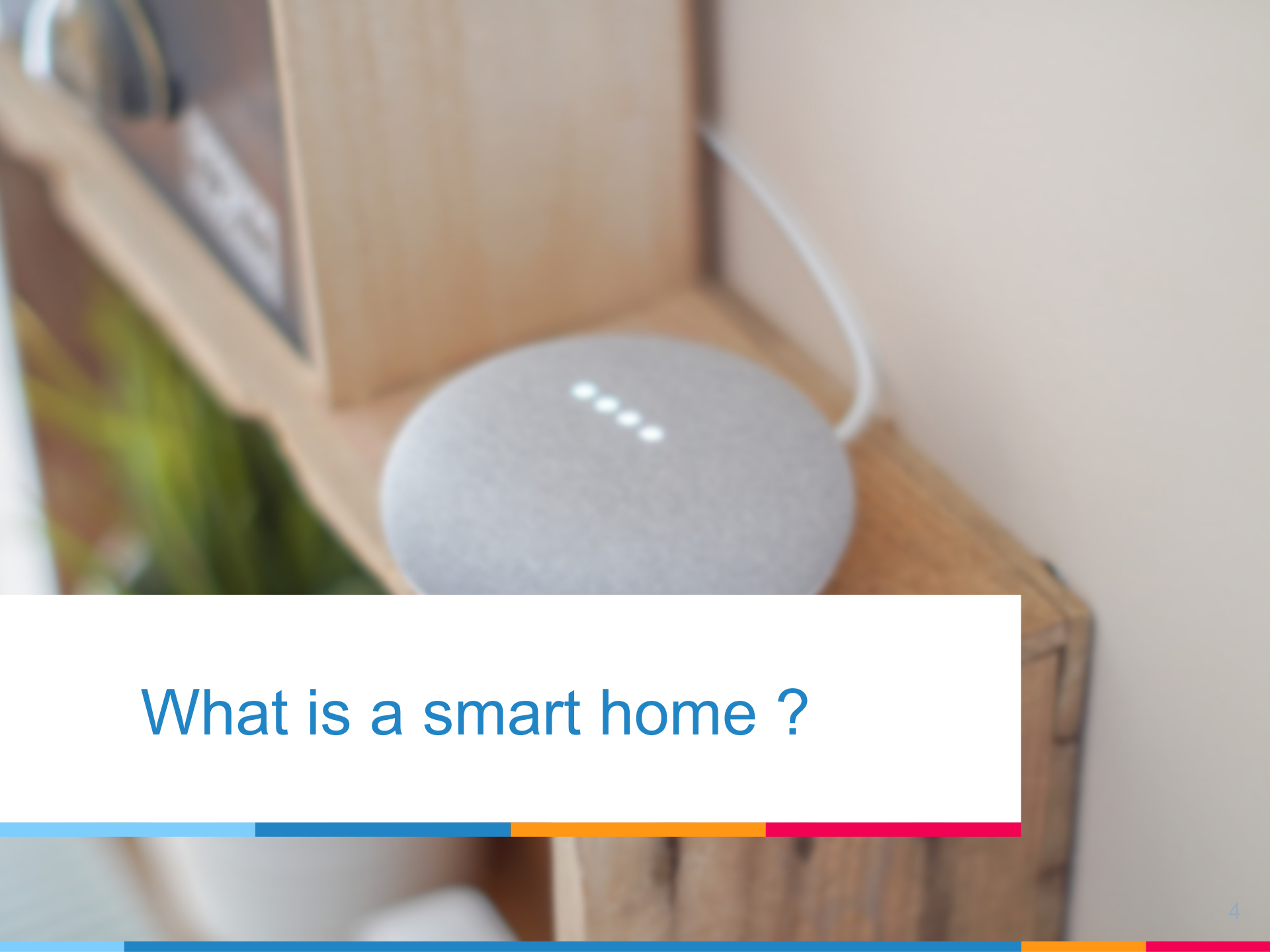
Smart home with renewable energy

Students: Youssef Chaccour, Giuseppe Piacenza, Nicolas Rodier and Hao Xu.
Tutors: Christelle Ecrepont and Thierry Monteil.

Content

1. Introduction and context
2. Our solution
3. Project Management
4. Demonstration
5. Discussion

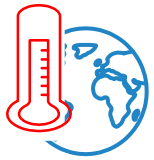
1
INTRODUCTION



What is a smart home ?

Experiment environment

Problems



Environmental and ecological crisis

Energy waste

User apathy when it comes to save energy

Expensive bills and difficulty to monitor our own energy consumption

Other Projects

What is done:

Design of the environment

Useful services

Analysis of the power flow during peak and off-peak periods

Monitoring the user's behaviour and habits

What is left for improvement:

Autonomy of the system

Our Goals

Energy saving

Autonomous house

User involvement

2

OUR SOLUTION

Features Architecture Modelling

Solutions

Energy saving

Autonomous house

User involvement

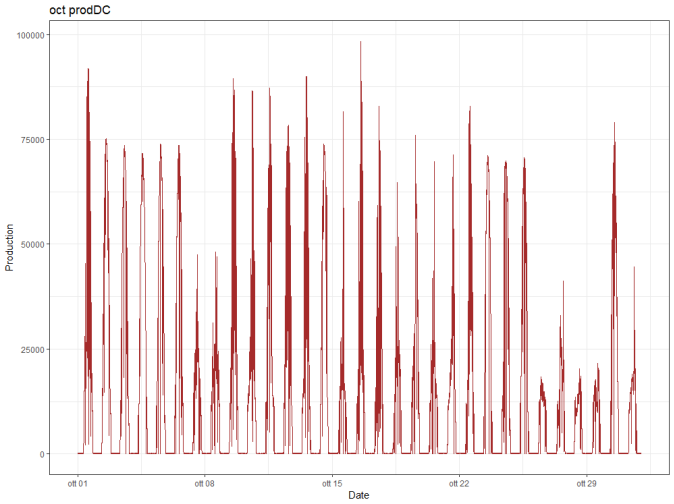
Solution for Energy savings

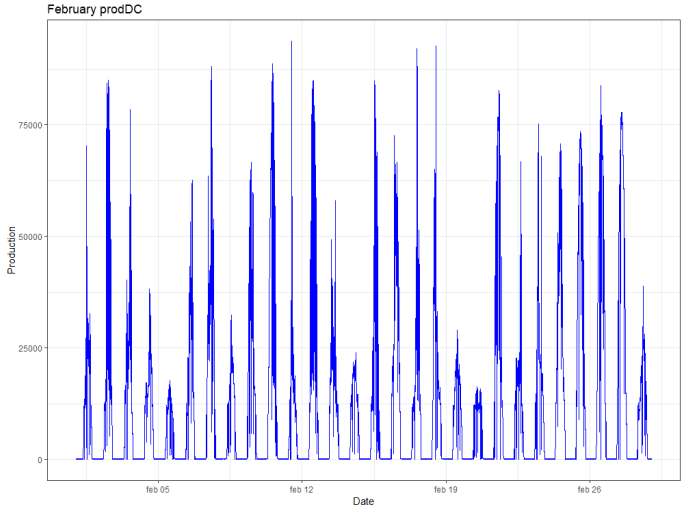
Weather prediction

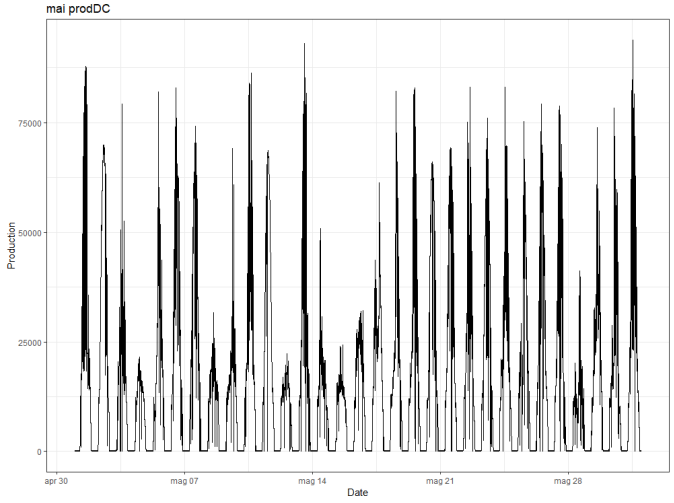
Adaptative threshold

Note energy consumption

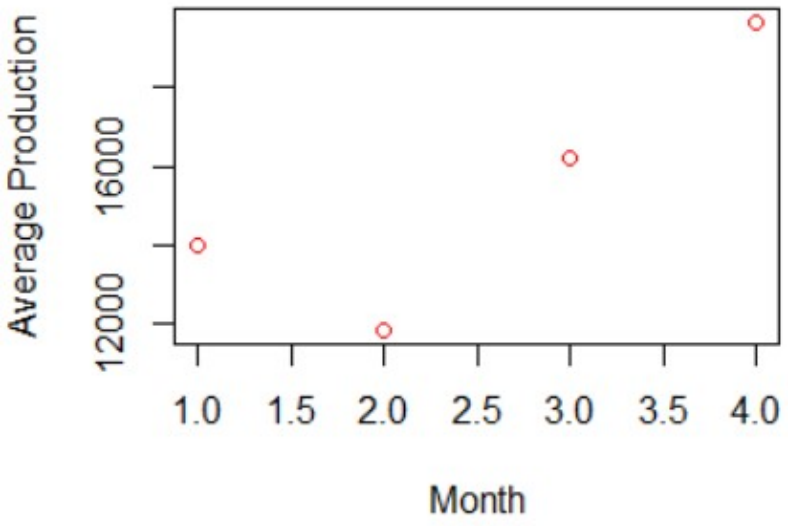
Data Analysis 1/3

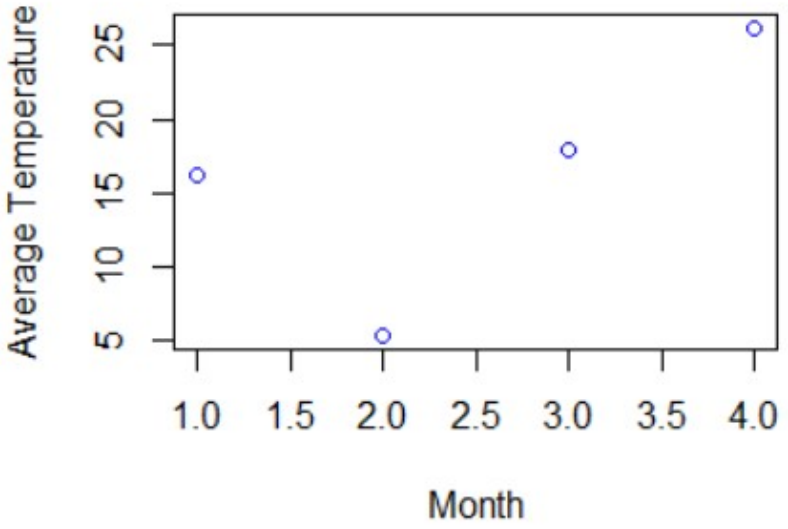




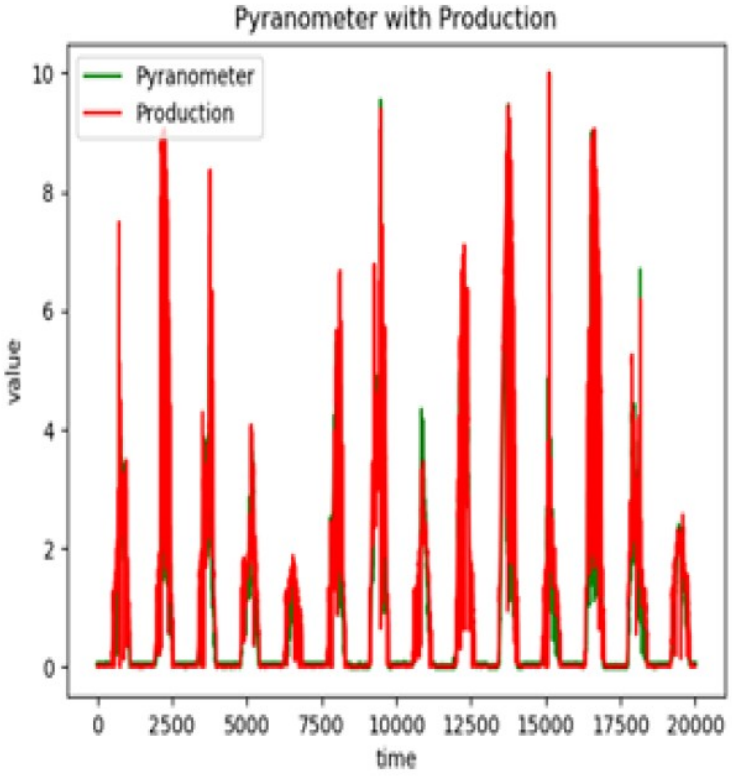


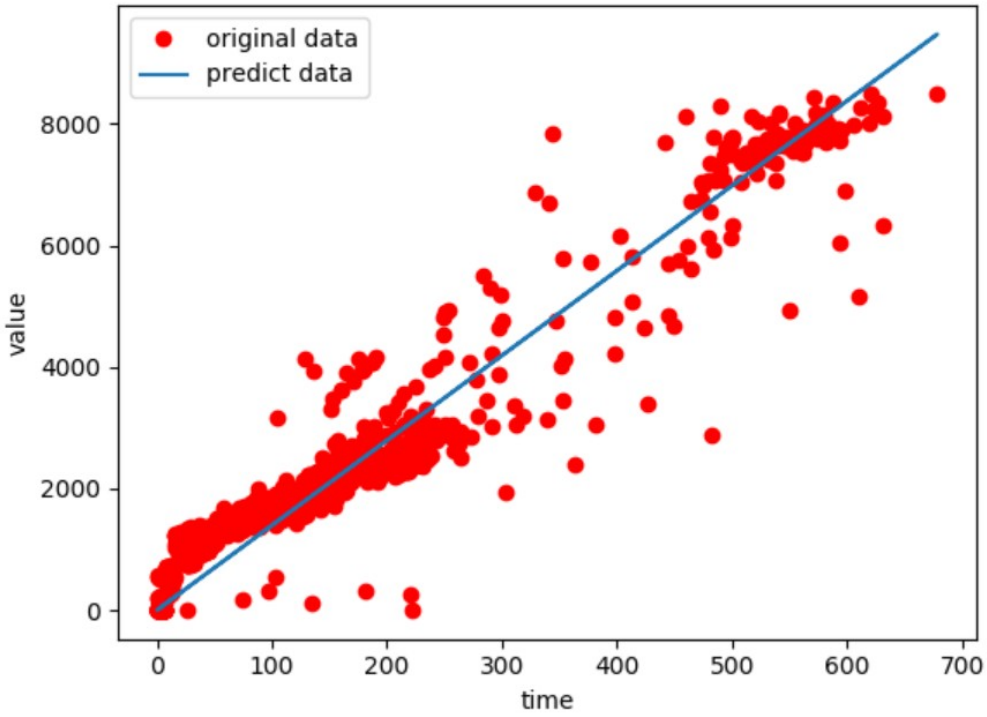
Data Analysis 2/3



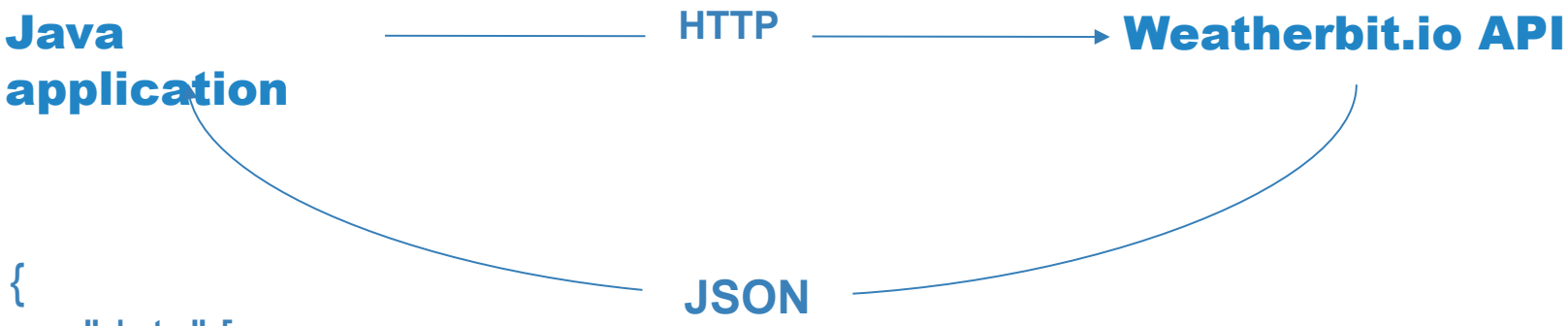


Data Analysis 3/3





Weather prediction




```
{
    "data":[
    { "timestamp_local": "2019-01-22T12:00:00",
    "wind_gust_spd":16.7,
    "wind_spd":6.4,
    …
    "solar_rad": 150.5,
    …
}
```

Solutions

Energy savings

Autonomous house

User involvement

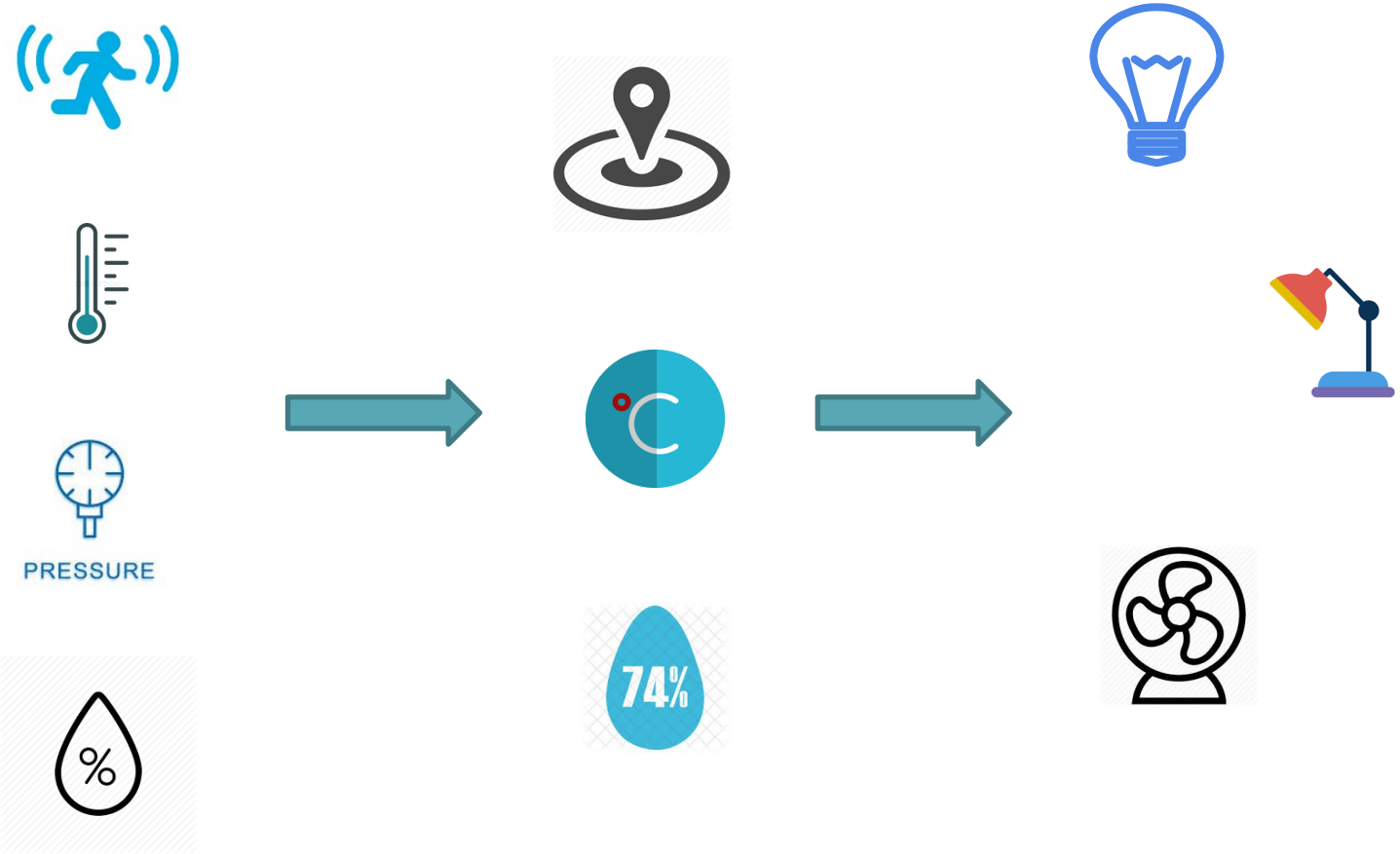
Solution for autonomous house

Measured parameters

User state

Scenarios

Measured Parameters



User states

Events

User comes back home

User leaves home

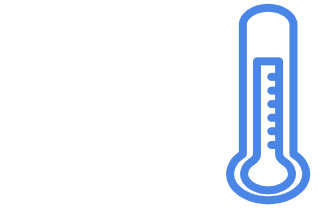
User changes room

States

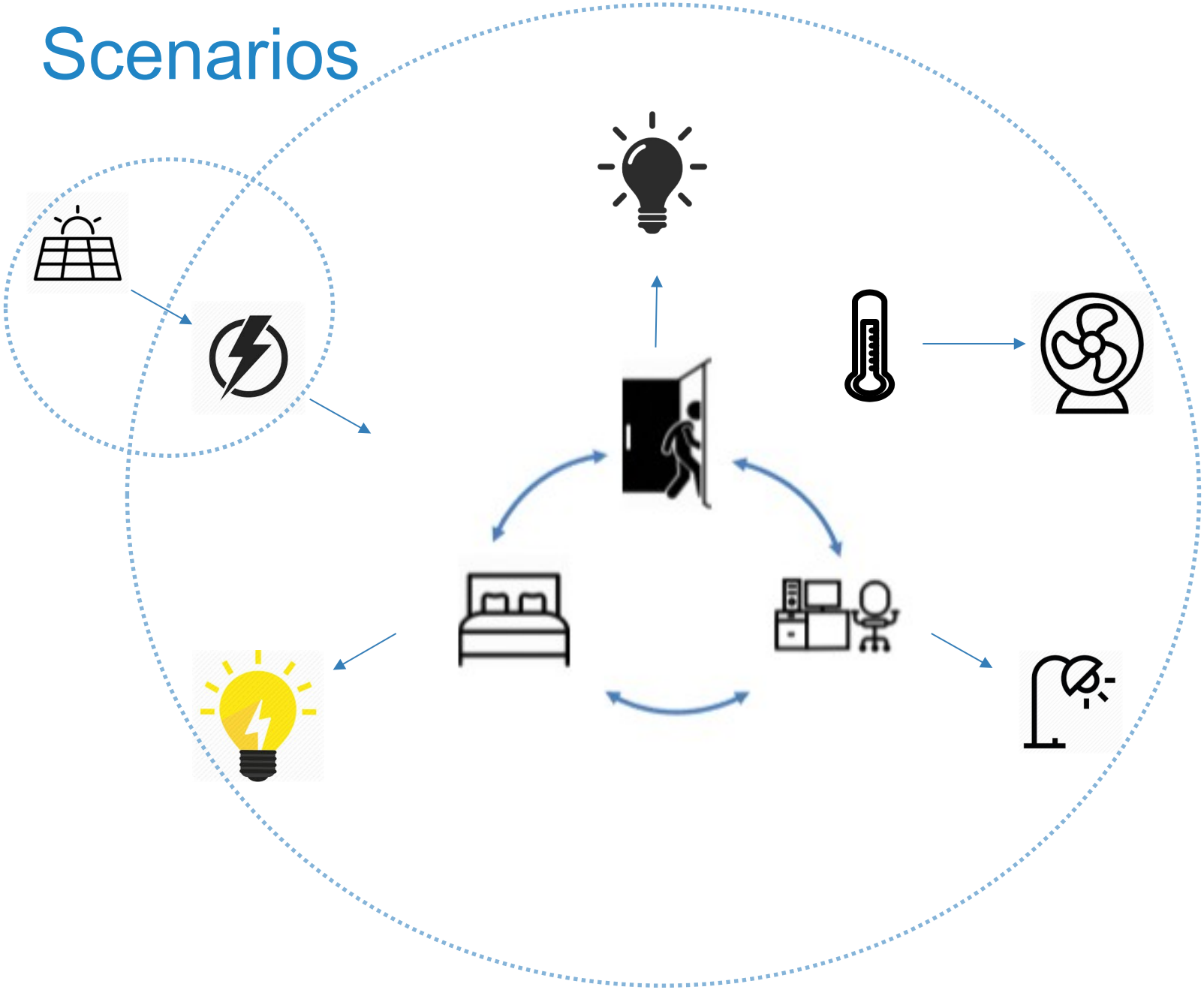
User is outside

User is in the living room

User is in the bed room



Scenarios



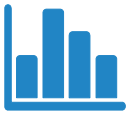
Solutions

Energy saves

Autonomous house

User involvement

User involvement

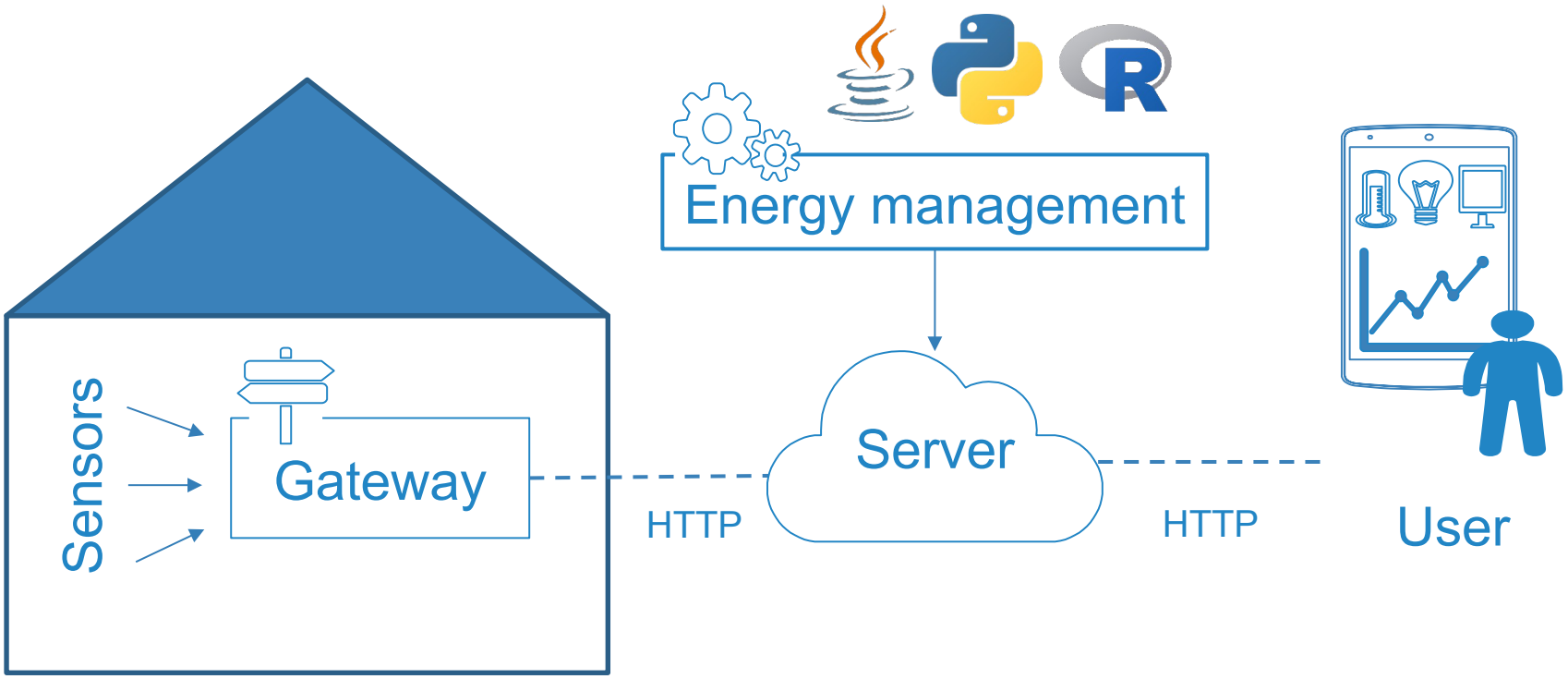


Monitor the energy consumption

Keep a control over the system with minimum effort

Give feedback to the system

Architecture



OM2M Connecting things

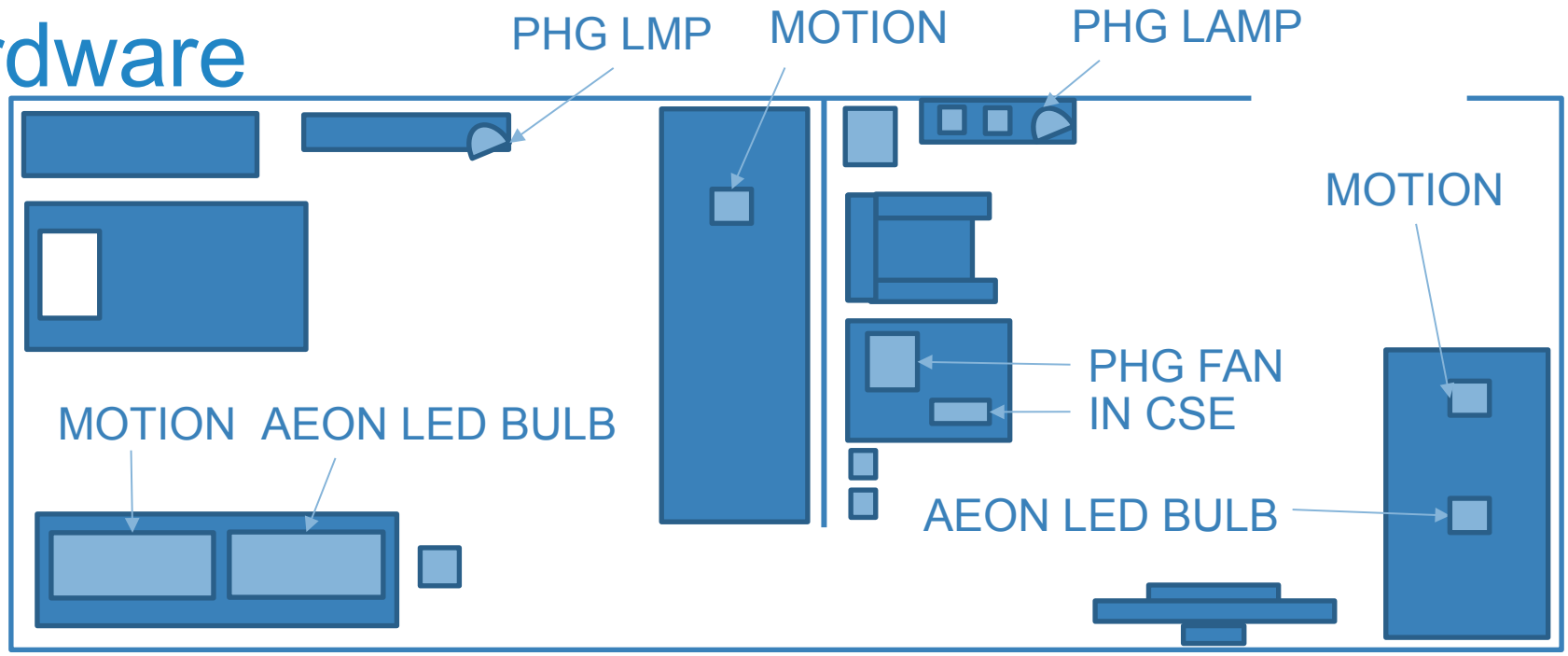
Why use OM2M

Very good coverage

Horizontal platform

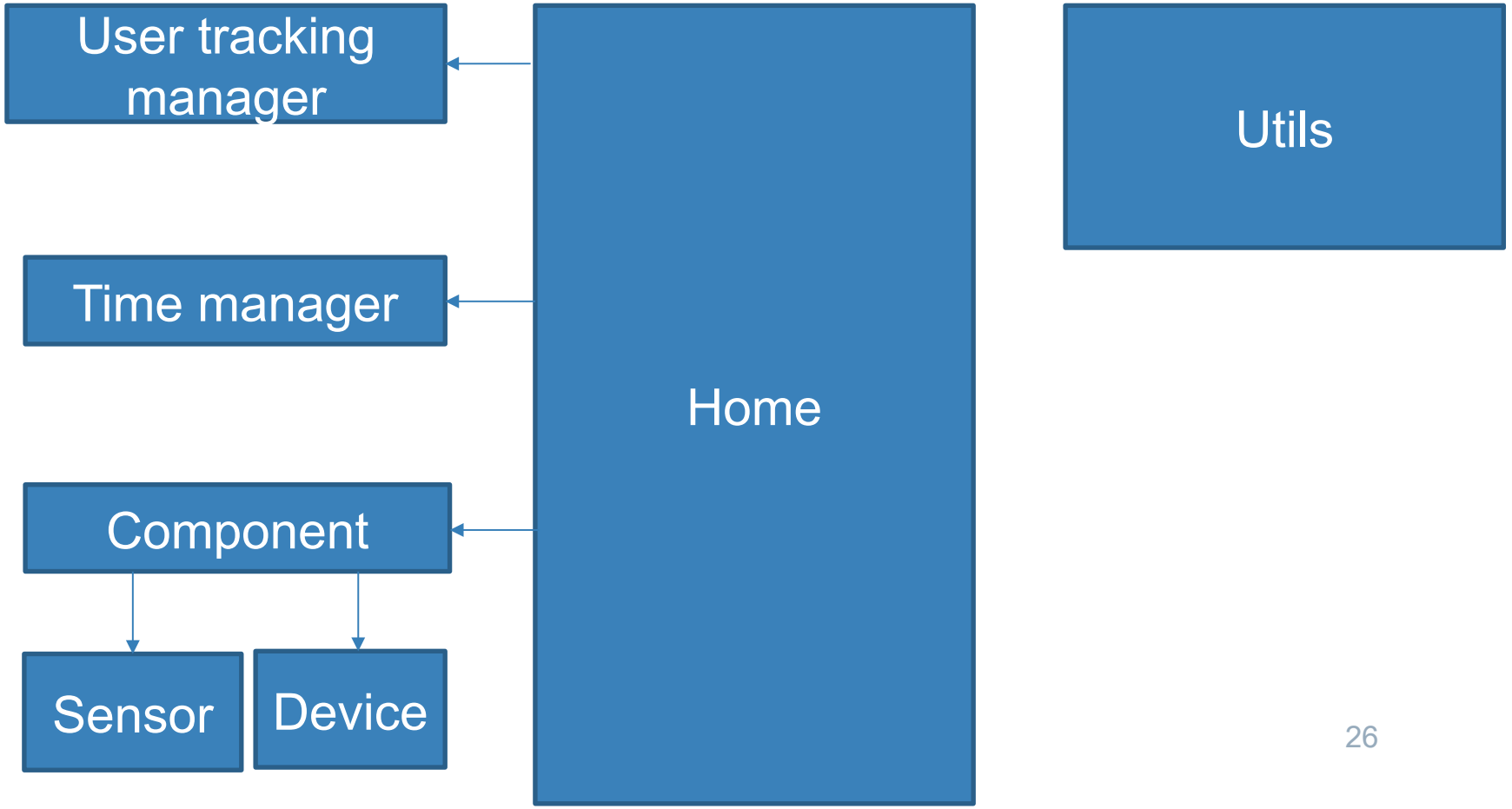
Flexibility

Hardware

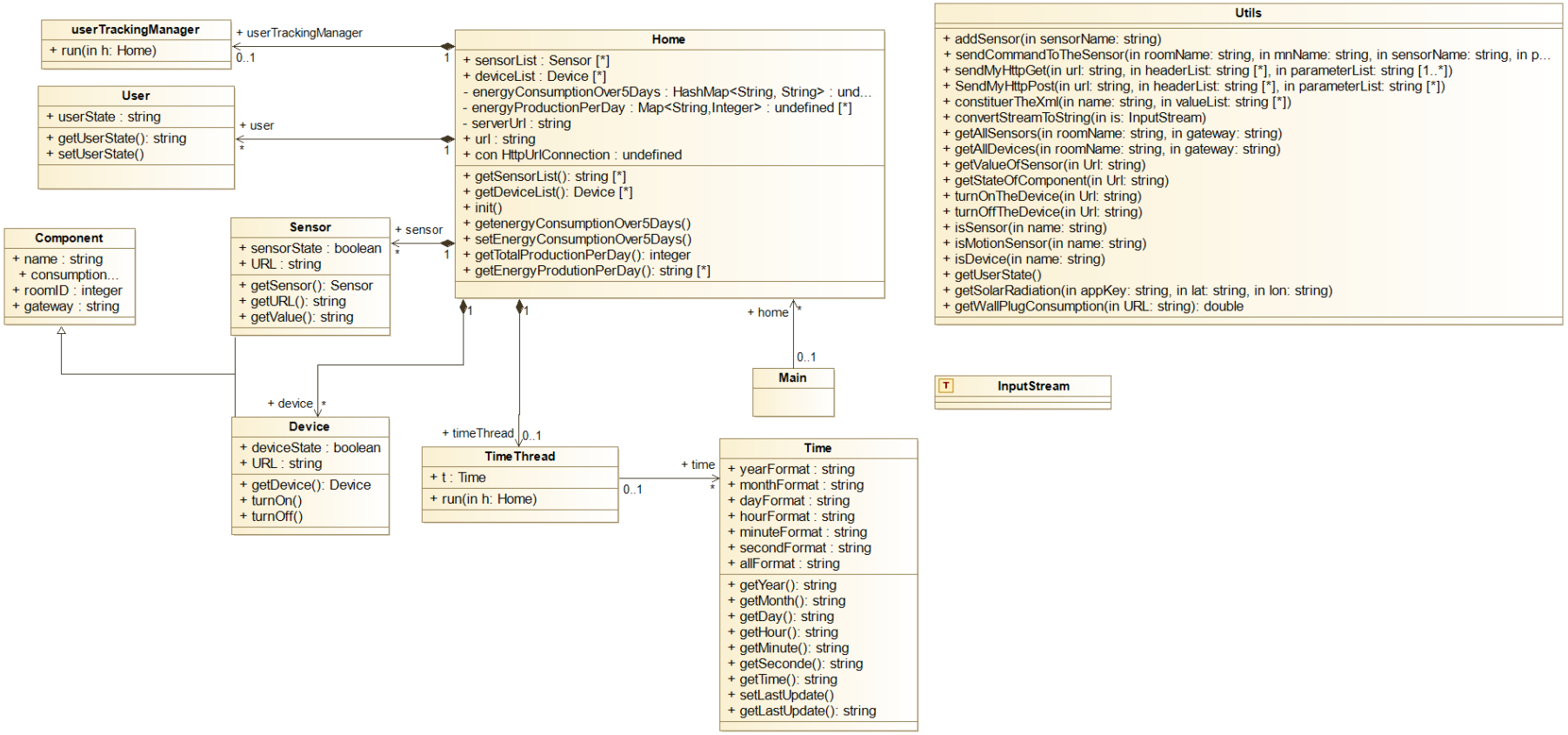


ROOM	AE	Function
Living room	IN-CSE	Connection with server
	Lamps – light sensors	Light control
	Fan – temperature sensors	Temperature control
	Motion sensors	User motion detection
Bed room	Lamps – light sensors	Light control
	Fan – temperature sensors	User motion detection

Modelling


User tracking manager
Time manager
Component
Sensor
Device
Home
Utils

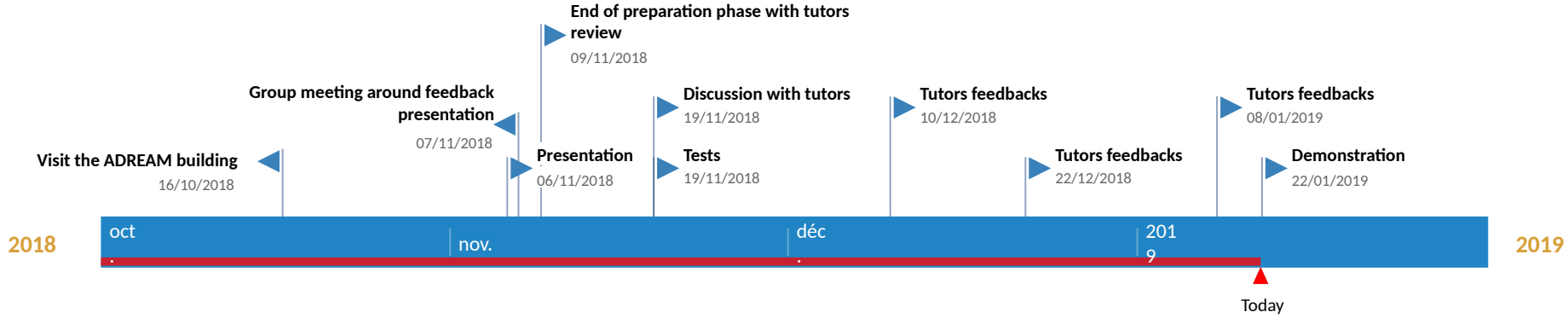
Modelling

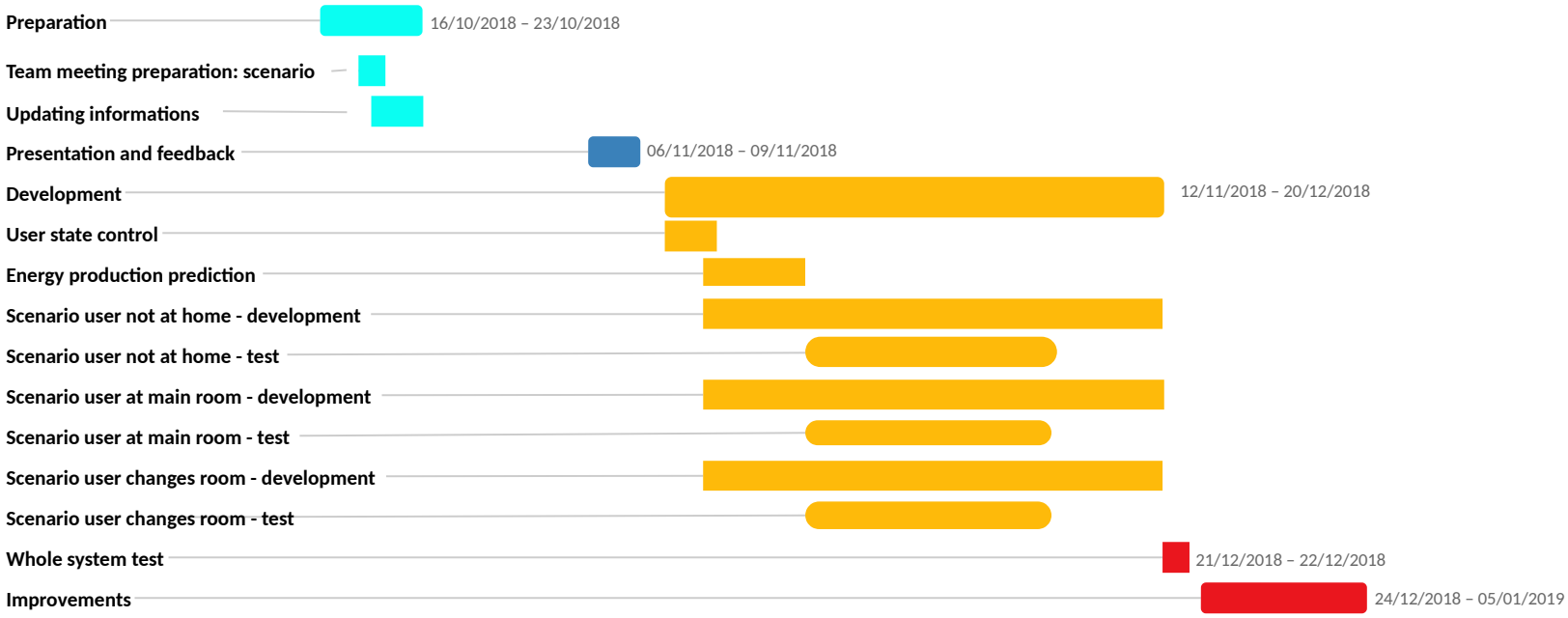

userTrackingManager
+ run(in h: Home)
+ userTrackingManager
0..1
1
Home
+ sensorList : Sensor [*]
+ deviceList : Device [*]
- energyConsumptionOver5Days : HashMap<String, String> : und...
- energyProductionPerDay : Map<String,Integer> : undefined [*]
- serverUrl : string
+ url : string
+ con HttpUrlConnection : undefined
+ getSensorList(): string [*]
+ getDeviceList(): Device [*]
+ init()
+ getenergyConsumptionOver5Days()
+ setEnergyConsumptionOver5Days()
+ getTotalProductionPerDay(): integer
+ getEnergyProdutionPerDay(): string [*]
User
+ userState : string
+ getUserState(): string
+ setUserState()
+ user
*
1
Utils
+ addSensor(in sensorName: string)
+ sendCommandToTheSensor(in roomName: string, in mnName: string, in sensorName: string, in p...
+ sendMyHttpGet(in url: string, in headerList: string [*], in parameterList: string [1..*])
+ SendMyHttpPost(in url: string, in headerList: string [*], in parameterList: string [*])
+ constituerTheXml(in name: string, in valueList: string [*])
+ convertStreamToString(in is: InputStream)
+ getAllSensors(in roomName: string, in gateway: string)
+ getAllDevices(in roomName: string, in gateway: string)
+ getValueOfSensor(in Url: string)
+ getStateOfComponent(in Url: string)
+ turnOnTheDevice(in Url: string)
+ turnOffTheDevice(in Url: string)
+ isSensor(in name: string)
+ isMotionSensor(in name: string)
+ isDevice(in name: string)
+ getUserState()
+ getSolarRadiation(in appKey: string, in lat: string, in lon: string)
+ getWallPlugConsumption(in URL: string): double
Component
+ name : string
+ consumption...
+ roomID : integer
+ gateway : string
Sensor
+ sensorState : boolean
+ URL : string
+ getSensor(): Sensor
+ getURL(): string
+ getValue(): string
+ sensor
*
1
1
1
+ home
*
0..1
Main
InputStream
+ device
*
Device
+ deviceState : boolean
+ URL : string
+ getDevice(): Device
+ turnOn()
+ turnOff()
+ timeThread
0..1
TimeThread
+ t : Time
+ run(in h: Home)
0..1
+ time
*
Time
+ yearFormat : string
+ monthFormat : string
+ dayFormat : string
+ hourFormat : string
+ minuteFormat : string
+ secondFormat : string
+ allFormat : string
+ getYear(): string
+ getMonth(): string
+ getDay(): string
+ getHour(): string
+ getMinute(): string
+ getSeconde(): string
+ getTime(): string
+ setLastUpdate()
+ getLastUpdate(): string

4
Project management

Initialization

Calendar


End of preparation phase with tutors review
09/11/2018
Group meeting around feedback presentation
07/11/2018
Discussion with tutors
19/11/2018
Tutors feedbacks
10/12/2018
Tutors feedbacks
08/01/2019
Visit the ADREAM building
16/10/2018
Presentation
06/11/2018
Tests
19/11/2018
Tutors feedbacks
22/12/2018
Demonstration
22/01/2019
2018
oct
nov.
déc
2019
Today


Preparation
16/10/2018 – 23/10/2018
Team meeting preparation: scenario
Updating informations
Presentation and feedback
06/11/2018 – 09/11/2018
Development
12/11/2018 – 20/12/2018
User state control
Energy production prediction
Scenario user not at home - development
Scenario user not at home - test
Scenario user at main room - development
Scenario user at main room - test
Scenario user changes room - development
Scenario user changes room - test
Whole system test
21/12/2018 – 22/12/2018
Improvements
24/12/2018 – 05/01/2019

Calendar expansion

Date	Phase	
16/10-23/10	Preparation	Visiting the ADREAM building ,first team meeting
06/11-09/11	First presentation	Presentation of the Scenarios, feedback from the tutors
11/11-28/11	Development step 1	
11/11-21/11	Confirm the Architecture	Confirm the needs of the clients , determine the technic
22/11-27/11	Java Client based on OM2M	Management of the sensors
	Python programming	Energy prediction
28/11	First Test	

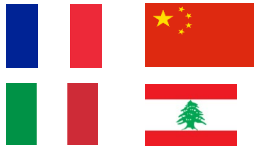
Calendar expansion

Date	Phase	
04/12	Second Presentation	Project review, poster
05/12-22/12	Development step 2	Complete the scenarios, the second test, and the discussion with the tutors to guarantee the involvement of the clients during the project, set up in the laas building before the presentation
22/01	Final Presentation	
	Presentation at the IOT days	

Resources

Team diversity

- 2 computer science students
- 1 electronic and telecommunication student
- 1 electrical engineer and former project manager



Equipment

- Laas Hardware (sensors, gateway and server)

Facility

Planning Risks

1-Identified risks

2-Qualitative and quantitative risk analysis

3-Risk response

Planning Risks

Impact / Probability	- -	-	~	+	++
++					
+					
~			4	1	
-			5	2	3
- -					

1- Misunderstanding of the user needs

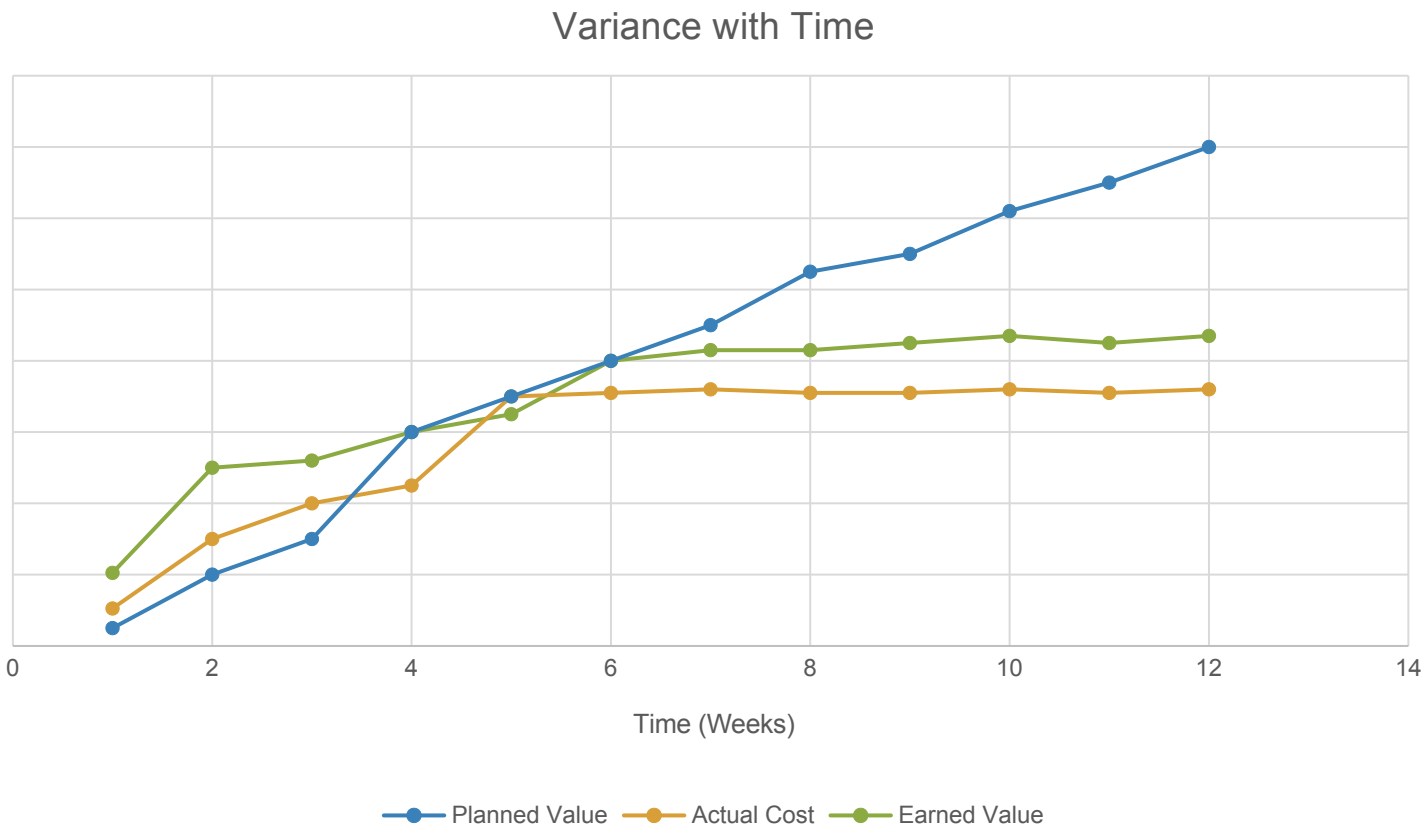
2- Can not finish the tasks on time

3- Architecture lacks flexibility

4- Simulation Risk

5- Hardware Support fail

Executing, Monitor and Control



Closing

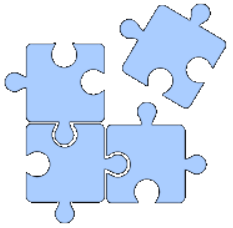
5
DEMONSTRATION

6
Discussion of the Experimental results

Discussion

Goals

Standards



Thanks!

Any questions?