SMART SHOPPING MALL

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OUTLINE

- Introduction
- Big idea
- Vision
- Home Automation Protocol: Zigbee
- Devices & Technologies
- System Architecture
- Scenarios & Implementation
- Conclusion - Our Poster
- Demo
- References

INTRODUCTION

Shopping Malls are not so sustainable...Yeah, that is obvious

BIG IDEA

Automation of processes to use more natural resources such as daylight and rain water

VISION

Smart Lighting

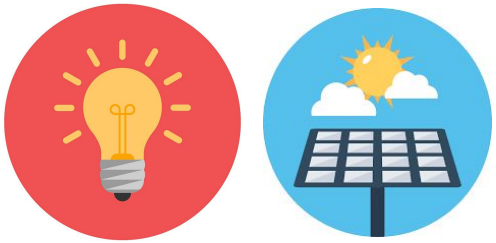
Smart Ventilation

Renewable Energy

Water Management

Waste Management

ELECTRICITY MANAGEMENT



Consumption reduction for

~11% by use of the daylight

~50% by use of mirrors & heliostats

~42% by use of solar panels

… and even more by motion sensors and optimized scheduling

Building model with heliostats

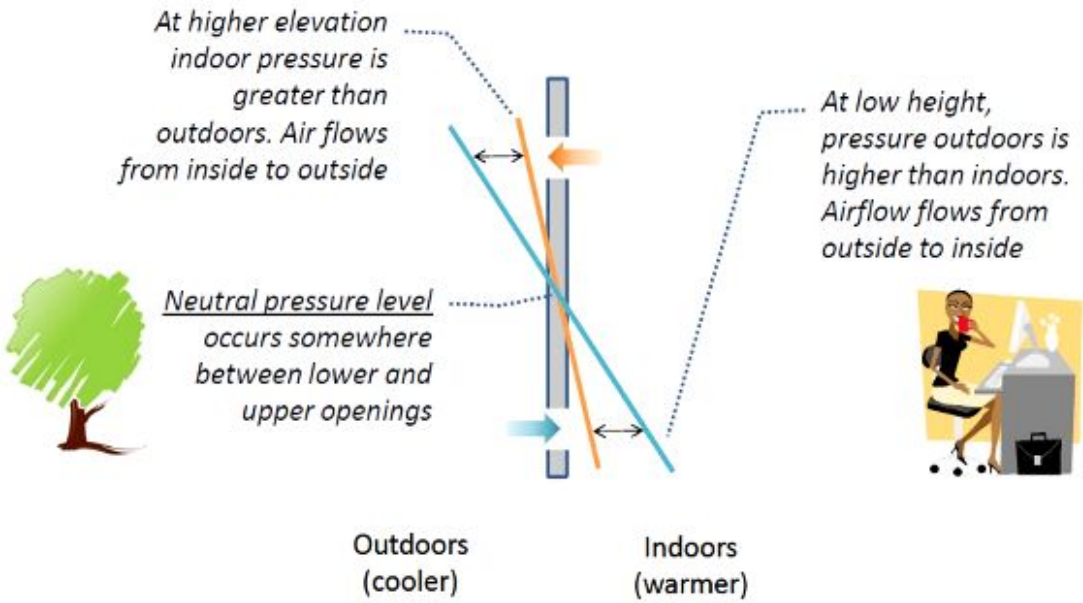
SMART VENTILATION

natural ventilation can provide

23% of total occupied hours

83% of total closing hours

Payback in 3 years



WATER MANAGEMENT

Harvesting rainwater enables

30% consumption reduction

700.000 € savings in 30 years

Payback in 7 years

WASTE MANAGEMENT

Installation of automated vacuum waste collection system

50% Cost reduction

Payback in 5 years

1,170,000€
That’s a lot of money annually

5,830,000 kWh
energy saved

752.000 kg CO_2
emissions reduced

INVESTMENT NEEDED

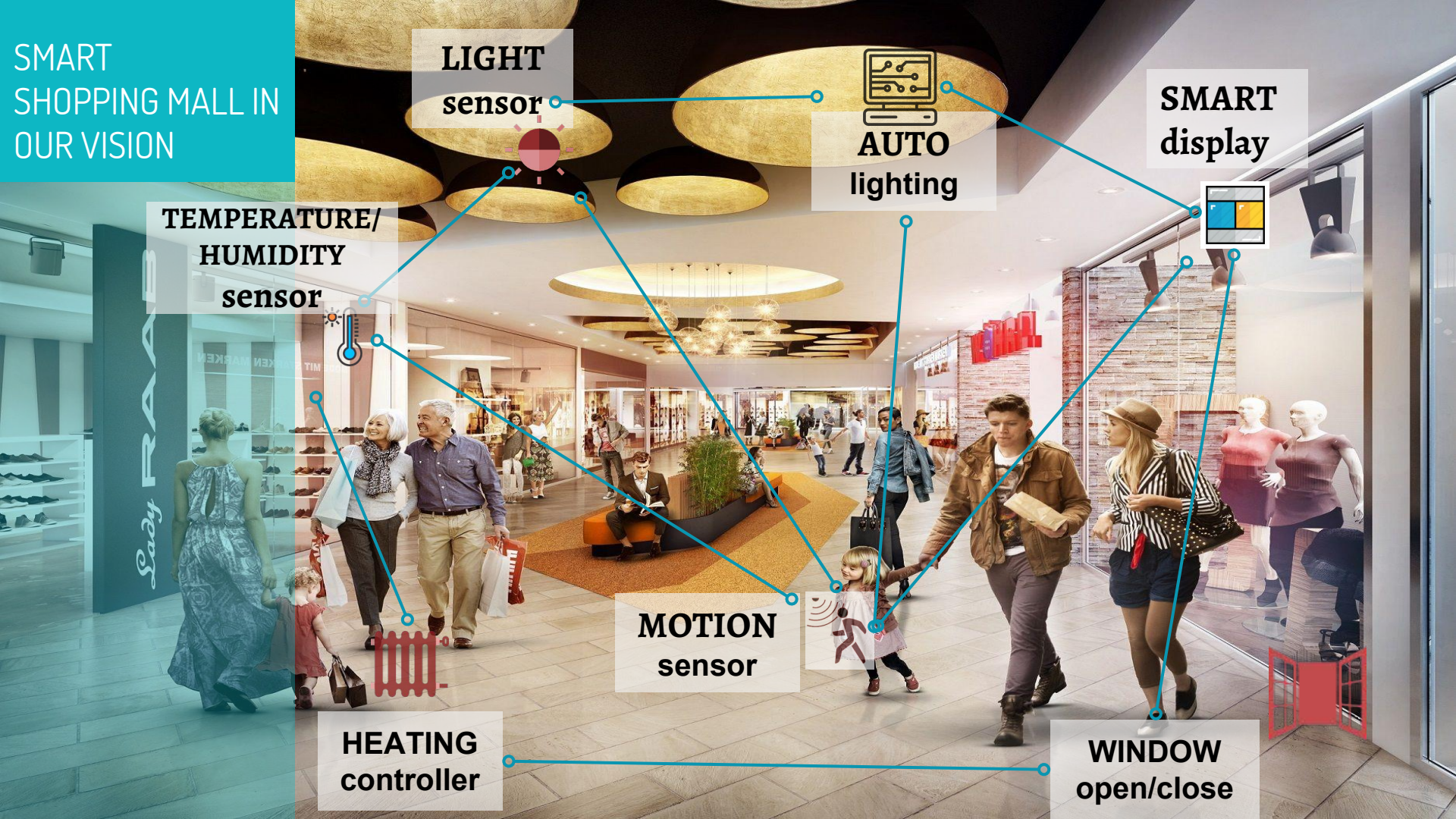
Devices	Price (€)	Quantity	Overall cost
Motion Detector	**70**	**400**	**28.000**
Light Dimmer	**40**	**400**	**16.000**
Temerature/Humidity Sensor	**55**	**400**	**22.000**
FHEM Servers	**300**	**20**	**6000**
Mirrors	**1/m2**	**10.000m2**	**10.000**
Heliostats	**100**	**100**	**10.000**
Solar Panels	**300**	**5000**	**1.500.000**

Overall investment: 1.600.000€

Payback: 1.4 year

SMART SHOPPING MALL CONCEPT

SMART SHOPPING MALL IN OUR VISION



Zigbee Technology

What is Zigbee?

- Zigbee is open wireless communication standard for WPAN network.
- It is based on a standard network architecture using an OSI model through an IEEE 802.15.4-2006 IP layer.
- ZigBee standard was developed by ZigBee Alliance (Philips, Mitsubishi Electric, Epson, Atmel, Texas Instruments, etc).

Why Zigbee?

Affordable

- Promotes greater energy awareness and control
- Open standard supports competitive marketplace of multiple products that lowers cost through competition
- Years of battery life and ease of maintenance reduce operating costs for service providers

Easy

- Wireless technology eliminates cost and hassle of running wires
- Automatic features simplify use
- Internet connection for greater access and control

Why Zigbee?

Safety

- Easily install wireless sensors to monitor a wide variety of conditions
- Receive notification upon detection of unusual events

Secure

- Device authentications secures networks from neighboring networks

Interoperable

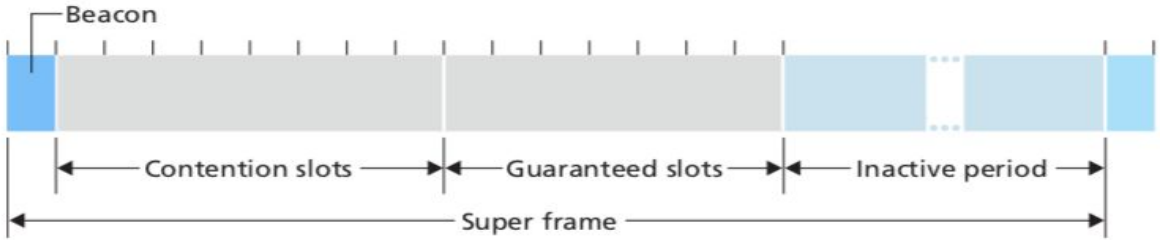
- Interoperability between a variety of products regardless of manufacturer
- Works with other Zigbee networks

Technical features

- Support for multiple network topologies such as point-to-point, point-to-multipoint and mesh networks
- Low duty cycle – provides long battery life
- Low latency
- Direct Sequence Spread Spectrum (DSSS)
- Up to 65,000 nodes per network
- 128-bit AES encryption for secure data connections
- Collision avoidance, retries and acknowledgements

Technical features (Cont'd)

- Beacon frames

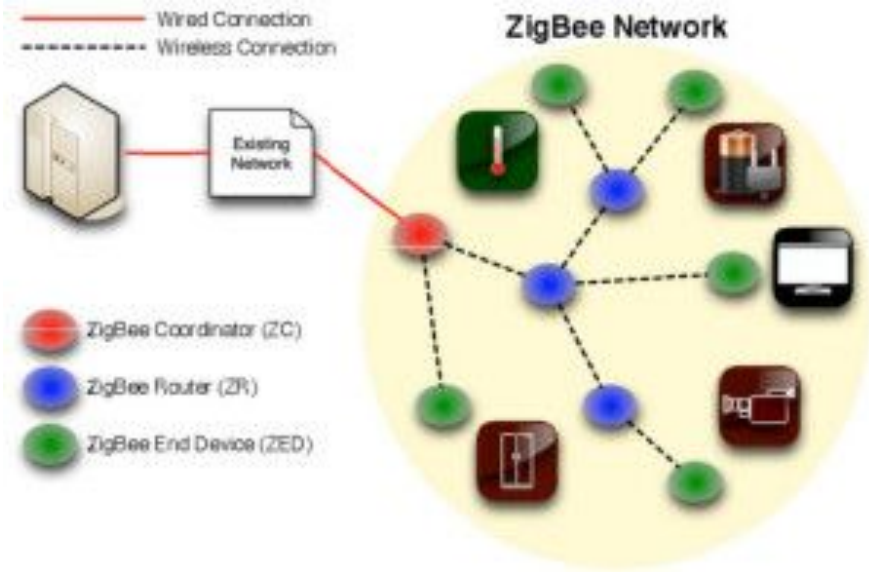


- Link-layer ACK
- CSMA with binary exponential backoff
  - Remember Ethernet, 802.11, France….
- Fixed, Guaranteed allocation of time slots (similar to DOCSIS)

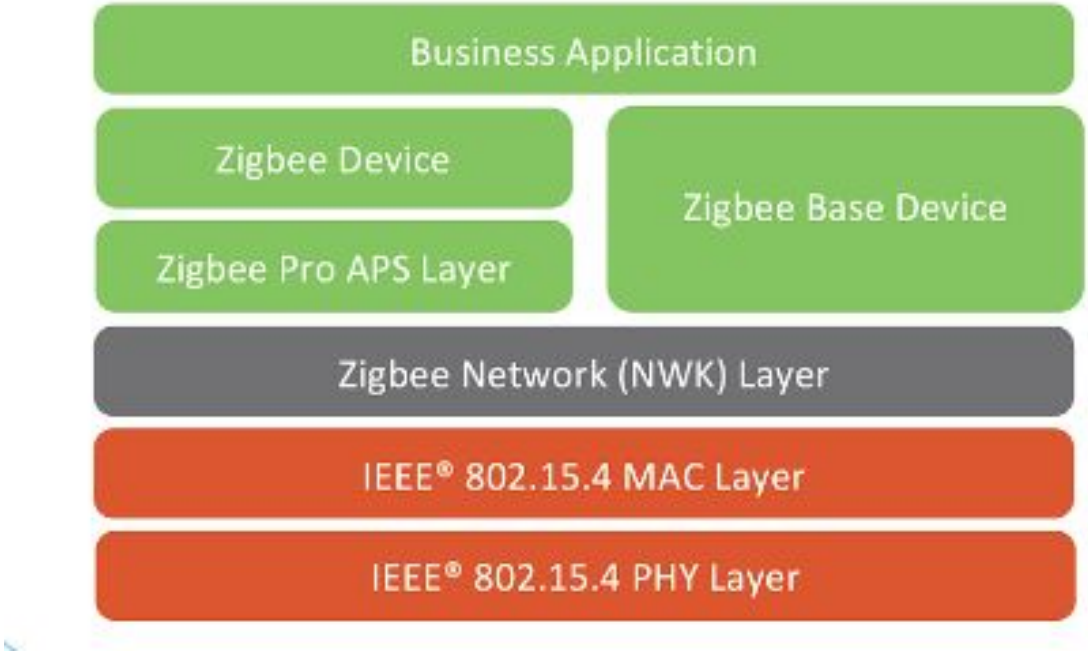
Zigbee Architecture

In Zigbee networks 3 types of devices is used:

- Coordinator
- Router
- End device



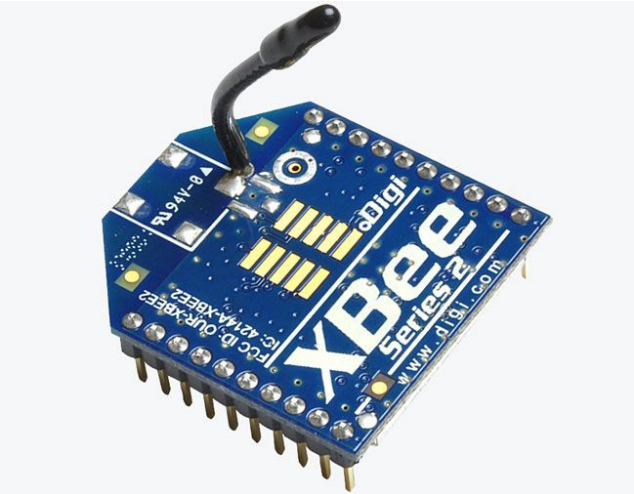
Zigbee Protocol



Operation mode of devices

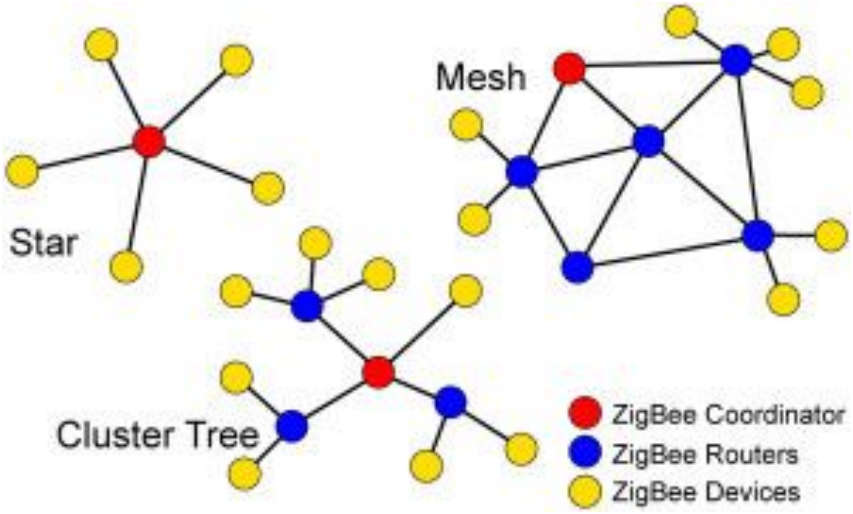
In Zigbee data is transferred in two modes:

- Beacon mode
- Non beacon mode

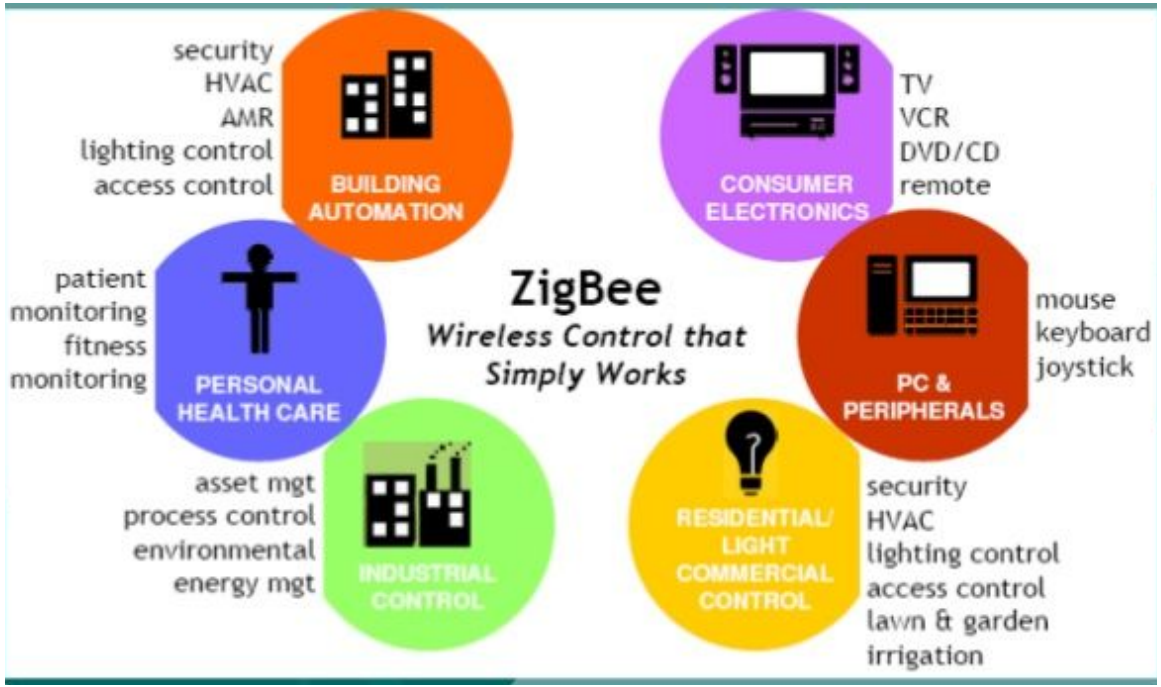


Zigbee Topologies

There are different topologies in Zigbee network, however most used ones are star, mesh, cluster tree.



Where is Zigbee used?



DEVICES & TECH USED

Philips Hue Iris

- Philips Iris is just a lamp.
- It is controlled by the Philips bridge.
- It has different colors.

Philips Phoenix Downlight

- Philips Phoenix is just another lamp.
- It is controlled by the Philips bridge.
- It has different dim levels.

Philips Hue Bridge

- This is a bridge.
- It is 60 euros.
- It is connected to the server using LAN.
- It controls Philips Lamps.

Motion Detector

- This is a motion detector.
- It detects motions.
- It is 70 euros.
- It is a homaMatic device.

Thermometer

- This device gives you temperature and Humidity.
- It is a HomeMatic device.

Wireless Heating Control System

- The FHT 80B Wireless Heating Control System is used for temperature control.
- It is an FS20 device.

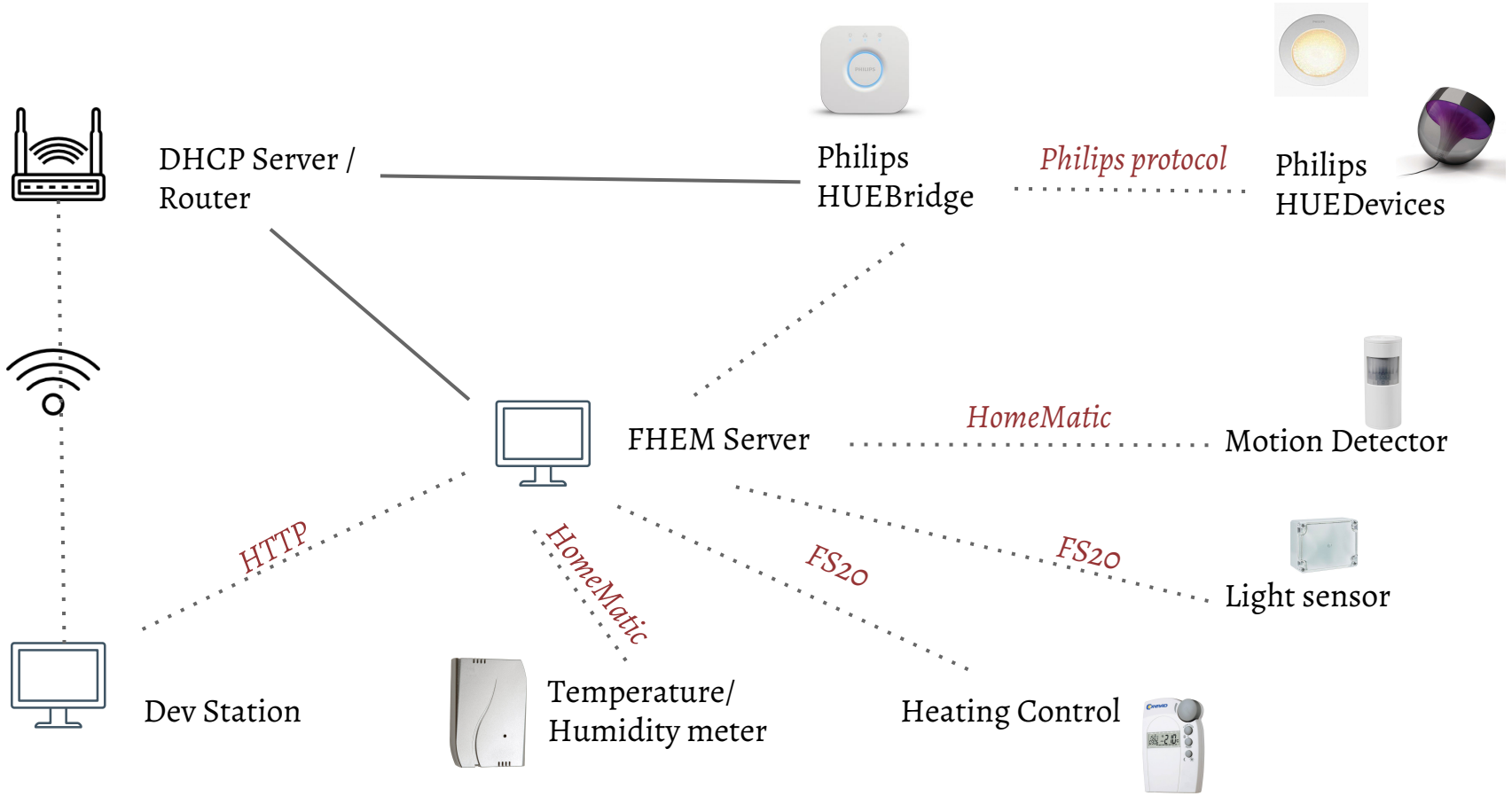
FS20 Twilight Sensor

- The FS20 Twilight Sensor serves to measure the light intensity by changing its resistance with set threshold.
- It is mostly designed for outdoor environments.

Fhem Server

- The Fhem server is a cubie-board with Linux installed on it.
- Fhem server coordinates the whole automation system.
- It has RF antenna for communicating with HomeMatic devices.
- It communicates over FS20 protocol with an extension device.

ARCHITECTURE


DHCP Server /
Router
Philips
HUEBridge
Philips protocol
Philips
HUEDevices
FHEM Server
HomeMatic
Motion Detector
HTTP
HomeMatic
FS20
FS20
Light sensor
Dev Station
Temperature/
Humidity meter
Heating Control

SCENARIOS

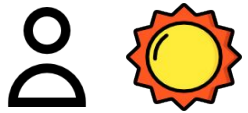
IMPLEMENTED SCENARIO (1)

Adjust the lightning system based on user movement, natural light and temperature inside the shopping mall.

IMPLEMENTED SCENARIO (1)
cont.

If  set  dim50%

If  set  dim90%

If  set  dim0%

If  set  dim10%

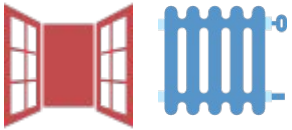
Otherwise set  dim10%

If  set 

If  set 

IMPLEMENTED SCENARIO (2)

Warning in case of wasting energy from using heater

If  *blink* 

IMPLEMENTATION

Reading device values

Trigger an event/action using FHEM notify feature

```
HM_doorsensor {
  my $door = ReadingsVal("HM_doorsensor", "state", 0);
  my $heater = ReadingsVal("FHT_2563", "actuator", 0);
  if ($door eq "open" && $heater ne "0%") {
   fhem "set PhilipsBridgeofUS_HUEDevice2 blink 10"
  } else {
   fhem "set PhilipsBridgeofUS_HUEDevice2 off"
  }
}
```

WHAT did we learn?

- “Home Sweet Automation Home”: setting up server, connect and integrate devices.
- Troubleshooting:
  - *If* “not_working” *then* **RESTART**
  - *If* “not_responsding” *then* **RESTART**
  - Otherwise: **RESTART**
- Teamwork: “**FIGHT, DON’T BITE**”

POSTER

SMART SHOPPING MALL

11 % ELECTRICITY SAVING FOR LIGHTING
50% ELECTRICITY SAVING BY MIRROR
30% WATER SAVING
42% SAVING WITH SOLAR PANELS

Let’s take a look

Shall we?

Make sure you’re ready to wait for the winter!

”

THANKS!

Any questions?

You can find more info at

- http://codecamp.fi/doku.php/homeautomation2018/group3/