Learning objectives of the subject

- Introduce a new vision of communication networks based on ubiquitous networks and low power consumption. An example: sensor networks.
- Introduce what is known as the Internet of Things, and Internet of Things (IOT), presenting the protocols used.
- Offering a new vision of communication networks where simplicity is the key to reducing power consumption and price.
- To complement the theoretical concepts with practical concepts.
- Allow different degree of participation in the course.
## Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>26h</th>
<th>17.33%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>26h</td>
<td>17.33%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>98h</td>
<td>65.33%</td>
</tr>
</tbody>
</table>
# Content

## 1. Organization course. Motivation. focus

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 2h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization, motivation and focus of the course.</td>
<td>Self study: 2h</td>
</tr>
</tbody>
</table>

## 2. Apps

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Key applications of wireless networks such as wireless: home automation and building, agriculture, infrastructure monitoring, &quot;smart cities&quot;, logistics,</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 2h</td>
</tr>
</tbody>
</table>

## 3. Plataforms

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 16h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture of a wireless sensor node: Microcontroller, memory, actuator and transducer, transceiver, antennas, power (batteries, hardvesting).</td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Operating systems (Contiki presentation). Trading platforms: Elements; SoC SIP modules and platforms. Presentation Platform Zolertia (Z1).</td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Lab 1: Configuring and &quot;Hello World&quot;. Configuration programming environment based on a virtualized Debian system that can run on Windows or Mac in September. Compilation and execution of the example &quot;Hello World.&quot;</td>
<td>Self study: 8h</td>
</tr>
<tr>
<td>Lab 2: Ports, LEDs, timers and buttons. use buttons, LEDs and timers in the system Contiki.</td>
<td></td>
</tr>
</tbody>
</table>

## 4. Systems

<table>
<thead>
<tr>
<th>Description:</th>
<th>Learning time: 4h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of existing commercial systems such as Z-Wave, EnOcean, Insteon, ZigBee and IETF proposal (6LoWPAN/IPv6/UDP/CoAP).</td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study: 2h</td>
</tr>
</tbody>
</table>
### 5. Sensors and Actuators

**Learning time:** 8h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 4h

**Description:**  
- Review of different devices that can be connected to convert physical quantities to electrical and vice versa.  

### 6. Interface radio and implications

**Learning time:** 8h  
Theory classes: 4h  
Self study: 4h

**Description:**  
Presentation of the radio interface and their implications. Frequency bands. Current consumption of the node.  
MAC level topology control, organization of nodes. Types of access control mechanisms to the environment.  
Support periods "idle."

### 7. IEEE802.15.4

**Learning time:** 8h  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 4h

**Description:**  
- Description of the radio interface and MAC protocol most used currently in wireless sensor networks. Types of nodes. Frame formats, frame rates, access mechanisms. Use "beacons." Services. Improvements: IEEE802.15.4e, IEEE802.15.4a.  

### 8. Mid term exam

**Learning time:** 8h  
Practical classes: 2h  
Self study: 6h

**Description:**  
Mid term exam
## 9. IPv6

**Description:**
- Addressing and packet format.
- ICMPv6 and Neighbor Discovery.
- 6LoWPAN: adaptation layer between IEEE802.15.4 and IPv6. Header compression, fragmentation and reassembling.

**Learning time:** 12h
- Theory classes: 6h
- Self study: 6h

## 10. Routing Protocols

**Description:**
- Basic Ideas routing in WSN. Proactive. Reactive Diffusion Geographic.
- Example: ROLL.
- Lab 5: Routing. Creating the network and routing.

**Learning time:** 12h
- Theory classes: 4h
- Laboratory classes: 2h
- Self study: 6h

## 11. Transport Protocols

**Description:**
- Lab 6: End-to-end connectivity. TCP and UDP communication in a multi-hop network.

**Learning time:** 8h
- Theory classes: 2h
- Laboratory classes: 2h
- Self study: 4h

## 12. REST based solutions

**Description:**
- HTTP COAP. Using proxies and gateways. Other alternatives.
- Lab 7: Access to information COAP sensor.

**Learning time:** 6h
- Theory classes: 2h
- Laboratory classes: 1h
- Self study: 3h
### 13. Project

**Description:**
Construction of a complex system combining parts that were seen throughout the course: sensors and actuators, wireless communication, use of the Internet protocols (IPv6, UDP / TCP, HTTP / COAP). Groups of 3 or 4 people using at least two sensors data, an actuator and a server connected to the Internet. Must demonstrate sensing data, communication, processing, Internet connectivity and performance as a result of a specific process.

**Learning time:** 47h
- Self study: 47h

### 14. Presentation of selected projects

**Description:**
Presentation of selected projects

**Learning time:** 7h
- Theory classes: 5h
- Self study: 2h

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**Planning of activities**

### PRACTICAL SESSIONS

**Hours:** 14h
- Theory classes: 14h

**Description:**
7 laboratory sessions spread over the course detailed in the syllabus.

### ORAL PRESENTATIONS

**Hours:** 2h
- Theory classes: 2h

**Description:**
Oral presentation of the project developed during the course.

### (ENG) CONTROLS DE RESPONSA CURTA

### EXAM

**Hours:** 1h 30m
- Theory classes: 1h 30m

**Description:**
Evaluation Intermediate / Final.
Qualification system

Final exam: 40%
Partial examination and controls: 15%
Exercises and monitoring of classes: 15%
group project: 15%
laboratory practice: 15%

Bibliography

Basic:


Others resources: