Introduction to wireless sensor networks with 6LoWPAN and Contiki

Laurent Segers (lasegers@vub.ac.be)
Several devices “talk” to each other (e.g. web browser with remote server)

Embedded sensor devices with a remote application.
# Communication model – OSI

<table>
<thead>
<tr>
<th>Layer</th>
<th>Function/Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Application Layers</strong></td>
<td></td>
</tr>
<tr>
<td>7: Application</td>
<td>Webbrowsers (i.e. HTTP)</td>
</tr>
<tr>
<td>6: Presentation</td>
<td>Mananges independance of data representation (e.g. encryption)</td>
</tr>
<tr>
<td>5: Session</td>
<td>Manages session between local and remote application (e.g. RPC)</td>
</tr>
<tr>
<td><strong>Packet Layers</strong></td>
<td></td>
</tr>
<tr>
<td>4: Transport</td>
<td>UDP, TCP</td>
</tr>
<tr>
<td>3: Network</td>
<td>Addressing, routing (e.g. IP)</td>
</tr>
<tr>
<td><strong>MAC Layers</strong></td>
<td></td>
</tr>
<tr>
<td>2: Data Link</td>
<td>Medium Access Control</td>
</tr>
<tr>
<td>1: Physical</td>
<td>Wireless, wires, optics</td>
</tr>
</tbody>
</table>
Communication model – OSI

Sender
Packet encapsulation

Receiver
Packet decapsulation

1  Data signal

2  Datalink Header  Network Header  Transport Header  Data

3  Network Header  Transport Header  Data

4  Transport Header  Data

5,6,7
### Wired vs. Wireless communication

<table>
<thead>
<tr>
<th>Wired communication</th>
<th>Wireless communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliable communication</td>
<td>Unreliable communication</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>No wires during deployment</td>
</tr>
<tr>
<td>Gbps speed possible</td>
<td>Mbps speed possible</td>
</tr>
<tr>
<td>Interceptable by other devices</td>
<td></td>
</tr>
</tbody>
</table>

**UDP vs. TCP**

User Datagram Protocol: connectionless datatransmission (no overhead)
Transmmision Control Protocol: connection oriented datatransmission (overhead)
Wireless Sensor networks

Network of smart devices

Collaborate with other nodes in the network

Small devices

Equipped with sensors/actuators

Mostly battery powered

Use a embedded communication protocol

Some sensor networks communicate with the outside world
### 6LoWPAN

**IPv6 protocol for embedded devices**

Compression/decompression at layer 3 → designed for low power consumption
6LoWPAN Topology

IP-network: world wide network (internet)

Edge-router: gateway between sensornetwork and IP network

Embedded sensornetwork (Zx-nodes)
Zolertia Z1 & Contiki

Zolertia

- 92 kB of program flash
- MSP430 microprocessor family
- Digital (interruptable) IO capabilities

Contiki

- Event driven OS
- Targeted for small devices (Zolertia Z1)
- 6LoWPAN stack already included with UDP functionality
Goals

Understand the principles of Contiki

Be able to program a node

Send packets from UDP-client to UDP-server (Contiki)

Send packets from sensor network to the outside world

Analyze network capabilities

Understand difference between single hop and multi hop networks

Be able to understand and decode packet formats