Integrating Wireless Sensor Networks with the Web

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Internet of Things

Trillions of smart objects connected to the Internet

New scenario for Smart Metering, E-health, Logistics, ...

IP for smart objects

IP for Smart Objects alliance (IPSO)

IETF 6LoWPAN and RPL
Web of Things

REST architecture (URI/JSON/XML/...)
Resource manipulation with HTTP (GET, PUT, POST, ...)

IETF CoAP

HTTP functionalities re-designed for constrained devices
Extra functionalities added
Contributions

CoAP vs HTTP

Benefits of CoAP for power consumption

Web/WSN integration

RESTful WSN accessed from Web Browser
CoAP

Transport Protocol
UDP, low overhead and multicast support

Dual layer
Transaction layer for message exchange
Request/Response layer for resource manipulation
CoAP

**Small message overhead**
Fixed-length compact binary header of 4 bytes

**Observations**
Observation relationship between client and resource
CoAP/HTTP testbed

TmoteSky
CoAP/HTTP Server
ulIPv6/SICSLoWPAN
ContikiMAC

CoAP/HTTP Client
[ubuntu]

[polling frequency = 10’’]

CON GET coap://[mote_ip_address]:61616/readings

ACK CONTENT 2.05
{"sensor":"212:7400:2:202","readings":{"hum":45,"temp":24.5}}
CoAP/HTTP comparison

Traffic
[ bytes transferred per transaction ]

CoAP  154

HTTP  1451
CoAP/HTTP comparison

Power consumption

\[ \text{CoAP: 0.744 mW} \quad \text{HTTP: 1.333 mW} \]

(Evaluation based on Energest output)
Battery lifetime [ days ]

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<tr>
<th></th>
<th>CoAP</th>
<th>HTTP</th>
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<tbody>
<tr>
<td>Lifetime</td>
<td>151</td>
<td>84</td>
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Study case: **Greenhouse monitoring**

The end-to-end system

**GATEWAY** = Ubuntu machine + Contiki router (USB)
3 BUILDING BLOCKS:

the **Non-SQL** database
   CouchDB (JSON storage format) - contains WSN data

the **CoAP-client**
   communicates with the WSN and stores data into
   the database, or passes them to the Web app server

the **Web App server**
   Includes a set of services used to retrieve data:
   - from the CoAP-client for **real-time** polls
   - from the DB for **historical** data and stats
WSN features:

- based on Contiki OS
- mesh topology network
- Tmote Sky motes
- **RPL**: multi-hop, re-routing in case of node failure
- Stack: CoAP/UDP/IPv6/6LowPAN/802.15.4
Hello!
Temperature: **24.5°C**
Humidity: **35%**
@15:34 April 12, 2011

The Web Application

- **browser**
- **HTTP/AJAX**
- **gateway**

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Thanks for your attention