
Design and Development of IoT Applications

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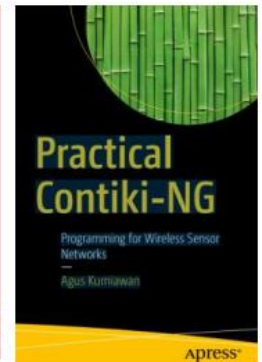
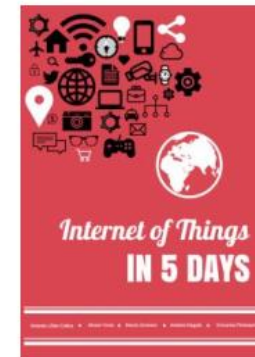
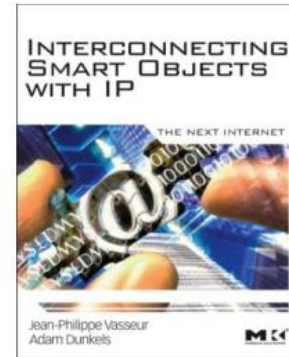
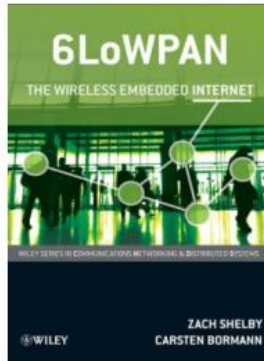
Content

❑ Credit: 3

❑ Grading Policy:

- ❖ Project: **40%**
- ❖ Final Exam: **60%**

❑ References:



- [1] Z. Shelby, C. Bormann, **6LoWPAN: the Wireless Embedded Internet**, Willey Publisher, 2009
- [2] J.P. Vasseur, A. Dunkels, **Interconnecting Smart Objects with IP**, Morgann Kaufmann Publishers
- [3] Antonio Liñán Colina, **IoT in Five days**, IoT Summer School
- [4] Agus Kurniawan, **Practical Contiki-NG Programming for Wireless Sensor Networks**, Apress 2018
- [5] Contiki OS: <http://www.contiki-os.org>

Acknowledgement: The course slides are also prepared in combination with the use of other sources:

- WEI, University of California, Berkeley, USA
- NSWLAN, ComNets, University of Bremen, Germany
- Some content and figures on these slides are taken from <http://6lowpan.net/wp-content> under the Creative Commons Attribution- Noncommercial-Share Alike 3.0 Unported License.

Course Outcomes

- ❑ Students will be able to demonstrate understanding of the following concepts:
 - ❖ WPAN and IEEE 802.15.4 Standard
 - ❖ Technology and Hardware Architectures in WSNs
 - ❖ Embedded Operating Systems for devices
 - ❖ MAC protocols in WSNs
 - ❖ Routing Protocols in WSNs
 - ❖ Industrial standards for IoT applications
 - ❖ Wireless Embedded Internet
 - ❖ Rich experiences in designing live IoT applications

Content

□ Chapter 1: Introduction to WSNs

- ❖ Wireless Sensor Networks
- ❖ Applications
- ❖ Challenges

□ Chapter 2: Technologies and Hardware Architecture

- ❖ Node architecture and HW platforms
- ❖ RF Technologies and IEEE 802.15.4
- ❖ Embedded processing and Sensing
- ❖ Hardware reference designs

Content

❑ Chapter 3: Embedded OS for end-devices

- ❖ Intro to Contiki-OS
- ❖ Programming using Contiki
- ❖ I/O interfaces
- ❖ Networking stack
- ❖ Cooja Emulator

❑ Chapter 4: MAC protocols for WSNs

- ❖ Low-power link
- ❖ Robust communication
- ❖ Radio Duty Cycling
- ❖ Synchronized and Asynchronized Protocols

Content

❑ Chapter 5: Routing in WSNs

- ❖ Multi-hop communication
- ❖ Link characteristics
- ❖ Collection Tree Protocol/DCP
- ❖ Trickle algorithm

❑ Chapter 6: 6LoWPAN and IPv6

- ❖ Challenges in WSNs and IP
- ❖ IPv6 addressing
- ❖ Fragmentation
- ❖ 6LoWPAN Header compression
- ❖ Bootstrapping
- ❖ Border Router

Content

❑ Chapter 7: Industrial IoT standards

- ❖ ZigBee Technology
- ❖ Dynamic Network protocols
- ❖ Backhaul networks for Home Automation
- ❖ Sub-1GHz technology
- ❖ Thread protocol stack

❑ Chapter 8: Wireless Embedded Internet

- ❖ ICMPv6
- ❖ Auto-configuration & Neighbor Discovery
- ❖ IP routing in WSNs: RPL
- ❖ Embedded web – REST/CoAP
- ❖ MQTT-SN
- ❖ Huma-Machine-Interface

Content

❑ Chapter 9: 802.15.4 Link-Layer Security

- ❖ Access Control
- ❖ Message Integrity and Confidentiality
- ❖ 802.15.4 Stack and Protocol
- ❖ Security suites
- ❖ LLSEC in Contiki OS

Content

❑ Chapter 10: Labs/Demos and Assignments

❖ Basic demos:

- Hello world, LED Blinking
- RDC and MAC protocols
- Routing in WSNs: CTP, RPL
- IPv6/6LoWPAN UDP Echo server
- IPv6/6LoWPAN Web Server
- Communication with 6LoWPAN network
- CoAP and MQTT

❖ Advanced demos: (with HW)

- I/O interfaces
- Echo-Server for Multiple Platforms (Cooja, CC2530, CC2538)
- Multicast IPv6
- LWM2M
- MQTT
- Security of IEEE 802.15.4
- Mobility of nodes

❖ Assignments