

Course ID  
**ZIGBLAB**  
Course Duration  
**2 days**

Course Title  
**ZigBee Hands-on**

**Related Courses**

- WiFi Hands-on (WIFILAB, 2 days)
- Wi-Fi Local Area Network Operation and Security (WIFI-NOS, 4 days)
- Bluetooth: Operation, Security, Applications, and Coexistence (BLUEOP, 3 days)

**Aimed At**

ZigBee engineers, product developers, integrators, testers, managers, support personnel, and other who need to understand how ZigBee works.

**Group Size**

5-25

**Prerequisites**

Some prior exposure to wireless technologies will be helpful but is not required.

**Course in a Nutshell**

Using lecture interspersed with lab work, this workshop will help you acquire a thorough understanding of ZigBee operations necessary for creating the next generation wireless sensor solutions, products, and services. You will study the physical layer and the challenges of operating in short range, low power and lossy environments. You will also gain a detailed understanding of the ZigBee protocol stack and key operational messaging between ZigBee devices.

The lab work will require the participants to bring Windows based laptops to the classroom, and it will use the spectrum analyzer Metageek Chanalyzer 4 and the packet analyzer Wireshark.

**Learning Objectives**

- Discover the challenges of providing connectivity to devices that are operating in highly variable and lossy RF environments
- Build a solid understanding of the IEEE 802.15.4 Wireless PAN standard that was defined to support short range connectivity between devices (the foundation of the ZigBee specification)

- Understand the ZigBee specifications and the evolution to ZigBee Pro. Key features including mesh networking will be discussed.
- Explore the higher layer ZigBee profiles, clusters and attributes that are enabling sensor applications and services
- Describe how ZigBee IP is incorporating the IETF IP protocols including 6LoWPAN and RPL
- Gain insights into the importance of ZigBee and how one can better manage that importance in their job functions

### **Customize It!**

We can customize this course to your technical requirements at little to no additional cost.

### **Course Outline**

- Introduction
  - Learning objectives and course outline
  - Tools used in the course labs
  - Defining low range wireless networks
  - Applications and services
  - Spectrum considerations
- Fundamental of short-range wireless networks
  - Range
  - Channel bandwidth and throughput
  - Modulation and coding
  - Access technologies
  - Interference and coexistence
  - Power consumption

#### **Labs:**

- Introduction to spectrum analyzers
  - Recognize ZigBee signals and channels
  - Sources of interference
  - Avoid interference from Wi-Fi networks
- 802.15.4 Personal Area Networks (PAN)
  - 802.15.4 task groups
  - PAN network topologies and architecture
  - 802.15.4 physical layers
  - Beacon enabled networks

- Non-beacon enabled networks
- Superframes and frame types and traffic flow
- Message exchange

Labs:

- 802.15.4 channel numbers
- Analyze 802.15.4 beacon frames
- The 802.15.4 association process

- ZigBee

- ZigBee applications and services
- ZigBee Alliance
- Protocol stack
- Network topologies and mesh networking
- ZigBee routing protocol
- ZigBee commands and message format
- Exploring the ZigBee message exchange
- Overview of ZigBee applications

Labs:

- Analyze ZigBee beacon frame
- Analyze ZigBee control frames
- Explore ZigBee profiles, clusters, and attributes

- ZigBee IP

- IPv6 Lower Power WPAN (6LoWPAN)
- Adaption format and addressing
- IPv6 routing protocol for LLN
- Routing over Low Lossy Networks (ROLL)

Labs:

- Analyze 6LoWPAN header compression and fragmentation
- Analyze RPL messages

- ZigBee security

- Threats and countermeasures
- 802.15.4 link layer security
- ZigBee network layer security

Labs:

- Review key exchange
- Encrypting and decrypting frames

- Wrap-up
  - Contrasting Wi-Fi, Bluetooth, and ZigBee
  - Course Recap and Q/A
  - Evaluations

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