Course ID
EIOT5D
Course Duration
5 days

Course Title
IoT-enabling Technologies Training: IEEE 802.15.4, WLLN, ZigBee, WAVE, Next Gen WiFi

Related Courses

- 5G Wireless Training: Layers 1, 2, 3 (5G-TF1, 4-5 days)
- Evolution of LTE to 5G Wireless (5G1, 5 days)
- M2M Course with IoT and LTE (M2MIOTLTE, 2-3 days)
- M2M Training: Machine-to-Machine Communications and Machine Learning (M2M-ML, 3 days)
- WiFi Training in Depth: Technology, Security, Deployment … with M2M, IoT, 5G3IoT Training: In Depth (WIFI-DIVE, 2-5 days)

Aimed At

Planners, strategists, designers, test engineers, deployment and support professionals, operations personnel, network administrators, marketing/sales reps, and others who need IoT-enabling Technologies Training.

Prerequisites

Knowledge of the wireless basics and networking is recommended. Familiarity with Wireshark, used for lab exercises in this course, will be helpful.

Course in a Nutshell

IEEE 802.15.4 underlies most of the technologies used for home automation, smart utility networks, and industrial monitoring/control, so it's the one we study first in this IoT-enabling Technologies Training. Part 2, focused on the Wireless Low-Power Lossy Networks (WLLN), looks at protocols for connecting devices to the Internet (BLE, LR-WPAN, LoRaWAN), protocols that enable applications (ZigBee, Wi-SUN, WirelessHART, ISA100), and protocols that allow IP to work effectively in a lossy environment (6LoWLAN, RPL). Part 3 focuses on ZigBee, a leading standard for connecting wireless sensors in home, utility, and industrial environments. Part 4 discusses the IEEE 802.11p (WAVE) enhancements that enable a Wi-Fi radio to support vehicle-to-vehicle and vehicle-to-roadside-unit communications at vehicular speeds and at a greater range. We conclude with a study of the 802.11 IoT enhancements including 802.11ah Sub 1 GHz (HaLow), 802.11ax High Efficiency WLAN (HEW), 802.11ay Next Generation 60 GHz (NG60), and 802.11az Next Generation Position (NGP).

The hands-on version of this course includes lab exercises using tools such as Wireshark, so the participants should bring their laptops along to the class. The course is available as onsite training or a WebLive™ class taught in several half-day sessions.

Customize It!

Versions tailored to technical and less technical audiences are available. The course may be taught with or without the labs.

It can be offered as a single 5-day course, scheduled in installments, or condensed to a shorter course focused on the technologies that interest you the most.

Course Outline

IoT-enabling Technologies Training Part 1: IEEE 802.15.4 for Low-Rate Wireless Sensor Networks

- Laying the Groundwork
  - The 802.15.4 family of standards
  - Overview of the 802.15.4 Low Rate Wireless Personal Area Network (LR-WPAN) specifications
  - Sensor networks based on 802.15.4
- IEEE 802.15.4 Physical layer (PHY)
  - 802.15.4-2011 frequency bands
  - 8092.15.4-2011 physical layers
  - Physical layer in the 868 and 915 MHz bands
  - Physical layer in the 2.4 GHz band
  - Demonstration: Compare and contrast 802.15.4 and 802.11 channels in the 2.4GHz band
- IEEE 802.15.4g for Smart Utility Networks (SUN)
  - 802.15.4g requirements for smart metering
  - Frequency bands used by the utility industry
  - SUN PHY capabilities IE
  - Compare and contrast the new Multi-Rate physical layers
  - MR-FSK
  - MR-OFDM
  - MR-O-QPSK
- IEEE 802.15.4 MAC Layer
  - PAN coordinators
  - Reduced and full functional devices
  - Non-beacon enabled networks
  - Beacon enabled networks
  - Superframe structure and guaranteed time slots
  - MAC frame format
  - Connecting to an 802.15.4 based sensor network
  - Sending data on an 802.15.4 based sensor network
  - Lab:
    - A look at the 802.15.4 beacon frame
    - A look at the 802.15.4 association process

- IEEE 802.15.4e MAC Layer Enhancements to Support Industrial Environments
  - General MAC enhancements
  - Enhanced beacons
  - Header and payload information elements
  - Multipurpose frames
  - Fast Association (FastA)
  - New MAC behavior modes
  - DSME
  - TSCH

IoT-enabling Technologies Training Part 2: Wireless Low Power and Lossy Networks (WLLNs)

- Laying the Groundwork
  - Applications and services
  - Defining Wireless Low Power and Lossy Networks (WLLN)
  - Wireless technologies
- IEEE 802.15.4 Personal Area Networks
  - Evolution of the 802.15.4 specifications
  - Frequency bands
  - Devices and topologies
  - Beacon and non-beacon networks
  - Frame types and traffic flow
- ZigBee
  - Evolution of ZigBee specifications
  - Network nodes and topologies
  - ZigBee protocol stack
  - ZigBee IP
- Wi-SUN
  - Wi-SUN Alliance and Certification Program
  - 802.15.4e support for industrial applications
  - 802.15.4g enhancements to support SUN
- WirelessHART and ISA 100
  - Wireless sensors for industrial automation
  - Wireless Highway Addressable Remote Transducer (WirelessHART)
  - Standard for Industrial Wireless (ISA-100.11a)
- Bluetooth Low Energy (BLE)
  - Evolution of Bluetooth specifications
  - Operations in the 2.4GHz band
  - Device types and topology
  - Getting connected
  - Frame types and structure
- IPv6 Lower Power WPAN (6LoWPAN)

    - Benefits of 6LoPAN
    - Adaption format
    - Header compression
- IPv6 Routing Protocol for LLN
    - Routing challenges in a lossy environment
    - Routing over Low Lossy Networks (ROLL)
    - Route Creation and Recovery
- Log Range Wide Area Network (LoRaWAN)
    - Distinguishing between LoRa and LoRaWAN
    - LoRa Alliance
    - Chirp Spread Spectrum
    - End device classes
    - Frame format

IoT-enabling Technologies Training Part 3: ZigBee

- Laying the Groundwork
    - What is ZigBee
    - ZigBee products and services in the market today
    - The role of the ZigBee Alliance
    - The evolution of the ZigBee specifications
    - The ZigBee protocol stack
- IEEE 802.15.4 LR-WPAN
    - Overview of the 802.15.4 Wireless Personal Area Network (WPAN) specifications
    - Frequency channels and bandwidth
    - Non-beacon enabled and beacon enabled networks
    - PAN ID and addressing
    - MAC frame format
- ZigBee Network Layer
    - Network nodes and topology
    - ZigBee beacon frame
    - ZigBee and ZigBee Pro feature comparison
    - Assigning network addresses
    - Mesh networking
    - Connecting to a ZigBee network
    - ZigBee network layer frame types and format
    - Network packet format
    - Hands-on labs
        - ZigBee beacon frames
        - ZigBee control frames
- ZigBee IP
    - Why ZigBee IP
    - Comparing ZigBee Pro and ZigBee IP network topologies
    - Network discovery over low power and lossy networks

- IPv6 Routing Protocol for LLN (ROLL)
- Routing mechanisms
- Routing Protocol for LLN (RPL)
- IPv6 Lower Power WPAN (6LoWPAN)
- Hands-on labs
    - 6loWPAN header compression and fragmentation
    - RPL messages used to form a network

IoT-enabling Technologies Training Part 4: IEEE 802.11p Wireless Access in Vehicular Environments (WAVE)

- Laying the Groundwork
    - Intelligent Transportation Systems (ITS)
    - Vehicular Communications Systems (VCS)
    - Dedicated Short Range Communications (DSRC)
    - Vehicular standards activities
    - WAVE protocol stack
    - Lab:
        - Understanding the WAVE protocol layers
- IEEE 802.11p WAVE Physical Layer (PHY)
    - The 5 GHz frequency band
    - WAVE channels and permitted power levels
    - Adapting Wi-Fi to work in vehicular environments
    - 802.11p physical layer characteristics
    - International variances
    - Labs:
        - A look at the channel information
- IEEE 802.11p WAVE MAC Layer
    - Operating outside the context of a BSS
    - MAC header settings for WAVE operations
    - Synchronizing 802.11p operations
    - New timing and information management frame
    - Implementing 802.11e EDCA mechanisms to multi-channels
    - Carrying higher level information in vendor specific action frames
    - Labs:
        - A look at 802.11p enabled beacon frames
        - A look at 802.11p QoS data frames
        - A look at 802.11p vendor specific management frames
- IEEE 1609.4 WAVE Multi-Channel Operations
    - Control and service channels (CCH/SCH)
    - Multi-channel operations
    - Channel access schemes
    - Time synchronization and guard intervals
    - MLME primitives support to the network layer

- IEEE 1609.3 WAVE Network Services
  - Device roles
  - WAVE Service Advertisement (WSA)
  - Provider Service Identifier (PSID)
  - User priorities versus service priorities
  - WAVE Short Message Protocol (WSMP)
  - Illustration: Toll collection
  - Labs:
    - A look at the WAVE Service Advertisement (WSA) frame
    - A look at the WAVE Short Message Protocol (WSMP)
- Sending IP Traffic
  - IP service information extension fields
  - WAVE Routing Advertisement (WRA)
  - IP Data exchange
  - Labs:
    - A look at the WAVE Routing Advertisement (WRA) frame

IoT-enabling Technologies Training Part 5: Next Generation 802.11 WLANs

- Next generation wireless network requirements and user cases
  - IEEE 802.11 standard evolution process
  - Introducing:
    - 802.11ah: Sub 1 GHz (HaLow)
    - 802.11ax High efficiency WLAN (HEW)
    - 802.11ay Next Generation 60 GHz (NG60)
    - 802.11az Next Generation Positioning (NGP)
- 802.11ah sub 1 GHz
  - Compare and contrast 802.11ah with 802.11ac
  - Physical layer attributes to support longer range
  - MAC layer changes to support IoT device connectivity
- 802.11ax High Efficiency WLAN (HEW)
  - Comparing 802.11ac and 802.11ax
  - Resource Units (RU's)
  - Supporting outdoor environments
  - Data rate and spectral efficiency measurements
  - Impact of UL-MU-MIMO
- 802.11ay Next Generation 60 GHz (NG60)
  - Extending 802.11ad capabilities
  - Channel bonding and aggregation Enhanced Directional Multi-Gigabit (EDMG)
  - Beacons and channel access

    - Implementing DL MU-MIMO
- 802.11az Next Generation Positioning (NGP)
    - Introduction to Location Based Services (LBS)
    - Current 802.11 capabilities (TM and FTM)
    - Use case (Reference Material)
    - Leveraging SU-MIMO and MU-MIMO

Course Recap and Discussion

DCN V.mTR.f