



# IoT Overview

## Course Outline for a 1-day Training

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# 1. Objectives

The course should provide a broad picture of IoT so that participants understand the “what, why and how” of IoT. To appreciate IoT, an application-oriented outline is deemed suitable. There will be demonstrations to give participants a first-hand experience of IoT. Non-technical folks, software programmers, entrepreneurs, designers, app developers, managers and business decision makers are expected to attend this training. Hence the content should not be too technical or include hands-on exercises.

# 2. Course Outline

1. What is IoT?
  - a. The Internet of yesterday
  - b. A definition of IoT
  - c. Compare a traditional application and an IoT-enabled application
  - d. Demo #1: Smart watering within a mesh network
  - e. Overview of IoT components
    - Sensors and actuators
    - Connectivity: wired and wireless
    - Platform: software, APIs, visualization tools
    - Analytics: insights, correlations, smart decisions
    - Application: a unified end-to-end solution
  - f. IoT Architecture
    - How the components interconnect
    - Interfaces
    - Centralized vs distributed architectures
  - g. A brief history of IoT
  - h. Alternative terms of IoT and their nuances
  - i. Reasons for IoT now
    - Dropping cost of electronics
    - Advances in microcontrollers and sensor technology
    - Availability of open source software, tools and platforms
    - Pervasiveness of Internet, ubiquitous Wi-Fi and cloud computing

- Popularity of smartphones and mobile Internet
  - License-free open standardized protocols
- h. Market predictions, growth estimates and opportunities
- Number of connected devices and size of the market in terms of revenue
  - Opportunities in software for Indian companies
  - Opportunities in hardware platforms and integrated end-to-end solutions
2. Applications of IoT
- a. Everyday applications vs smart applications
  - b. Typical verticals
  - c. An in-depth view of a consumer application
  - d. Demo #2: Control a light within a Wi-Fi LAN
  - e. An in-depth view of an industrial/enterprise application
  - f. An in-depth view of an outdoor application
  - g. Products and IoT-enabled services already deployed commercially
  - h. Demo #3: Monitor water level in a tank and send alarms at low/high thresholds
3. Technical Aspects of IoT
- a. Sensors
    - Types, technology, cost, form factors and packaging
    - R&D centers and manufacturers in India and overseas
    - Parameters: range, bias, non-linearity, dynamic error, response time, drift, noise, digitization error, operating conditions
  - b. Actuators
    - Types, technology, cost, form factors and packaging
    - R&D centers and manufacturers in India and overseas
    - Parameters: response time, reliability, capability, operating conditions, lifetime
  - c. Wireless nodes
    - Types: dumb, filter and preprocess, autonomous decision maker
    - Commercial nodes
    - Manufacturers of microcontrollers
    - Hardware interfacing standards/practices: GPIO, I2C, SPI, UART, USB, Micro SD, JTAG
    - Prototyping platforms

- Demo #4: Pass around some notes with sensors for participants to look at
- d. Wireless technologies and mesh routing
  - Short range, medium range and long range
  - Frequency bands, bandwidth and data rates
  - Power consumption
  - Manufacturers of wireless modems and application processors
- e. Data in the cloud
  - A definition of cloud
  - Gateway interfaces from mesh network to the Internet
  - Demo #5: Pass around a gateway for participants to look at
  - Requirements of a cloud platform
  - Commercial IoT-enabled cloud platforms
- f. The application perspective
  - Device cost, power consumption, wireless range
  - Processing, memory, sensor capability
  - Data reporting periodicity, duty cycles, data rates, packet size
  - Standby current and battery life
  - Transmission latency and response times
  - Network density, reliability, scalability, robustness
- g. Demo #6: A teardown of Nest thermostat
  - Sensors and actuators
  - Wireless technologies and chipsets
  - User interfaces and control
  - Cloud platform and analytics
  - The bottomline: reports of savings for consumers
- 4. IoT Security
  - a. Example scenarios and why this is a big concern
  - b. Security on the traditional Internet
  - c. Security in wireless and cellular networks
  - d. Elements of making IoT secure
- 5. Emerging Protocols and Standards
  - a. Current products across verticals and why standardize

- b. Where is standardization required
- c. Alliances and consortiums for standardization
- d. Some possibilities of cooperating or competing standards

### 3. Demo Details

#### 1. Demo #1: Smart watering within a mesh network

Monitor soil humidity in a pot and alert owner when pot becomes too dry or when water is added. Also monitor temperature and light levels in the pot. Sensor readings reach the gateway via IEEE 802.15.4 mesh routing. Gateway sends sensor data for cloud storage and analysis. Alerts are SMS messages sent to a cell phone. Alerts are triggered from the cloud.

#### 2. Demo #2: Control a light within a Wi-Fi LAN

The light bulb will go into a socket which will be screwed to a white wooden panel. All the electronics will be on one side of the panel. From the other side, you can only see the socket and the bulb. We need a smartphone or tablet that will access a web server on a Wi-Fi-enabled gateway. Gateway will use IEEE 802.15.4 to switch on/off a remote light bulb.

#### 3. Demo #3: Monitor water level in a tank and send alarms at low/high thresholds

Monitor water level in a small tank and send level data to cloud. Water level monitoring will be done using a pressure sensor connected to a WiSense node. Over IEEE 802.15.4, the node will send the levels to the gateway box that will use the GSM modem to send SMS. SMS alerts are sent when water level goes above or below thresholds.

#### 4. Demo #4: Pass around some motes with sensors for participants to look at

WiSense motes can be used. Other motes capable of Wi-Fi or BLE can also be used.

#### 5. Demo #5: Pass around a gateway for participants to look at

WiSense gateway boxes prepared for demo can be used.

#### 6. Demo #6: A teardown of Nest thermostat

We are not actually showing the hardware. The teardown is based on slides.