INTERNET OF THINGS

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INTERNET OF THINGS

Outline

- Introduction
- Topics
- Summary

INTERNET OF THINGS

Introduction

- Purpose
- Simple definition
- History
- Things
- Networking

INTERNET OF THINGS
Introduction

- Purpose
  - To provide a brief overview of subject areas related to “The Internet of Things”
  - To spark inspiration for future topics at IOT SIG meetings

INTERNET OF THINGS
Introduction

- Simple definition
  - Network connection of objects embedded with technology and sensors that allows them to share information.
  - This is generally considered to focus on objects extra to conventional networks of computers but does not necessarily exclude them

INTERNET OF THINGS
Introduction

- History
  - 1969 ARPANET (UCLA - Stanford)
  - 1982 TCP/IP standard forms backbone
  - 1982 Coke machine at CMU
  - 1989 HTTP/WWW, Tim Berners Lee
  - 1990 toaster controlled by internet
  - 1993 coffee maker monitored on internet
  - 1998 stock market fountain, Mark Weiser
  - 1999 D2D Bill Joy
  - 1999-2003 Auto ID Labs, RFID tags, Kevin Ashton

INTERNET OF THINGS
Introduction

- History
  - 2000 LG Refrigerator, bar code and rfid scanning
  - 2005 Nabaztag (hare) wifi device (echo-like)
  - 2008 IPSO Alliance of “smart object” firms
  - 2010 Bluetooth Low Energy (LE)
  - 2011 IPv6 expanded addressable space
  - 2011 Nest thermostat
  - 2013 Google glass

INTERNET OF THINGS
Introduction

- Things
  - Household: light bulbs, thermostats, refrigerators, alarm clocks, security alarms, video monitors, entertainment/communications ...
  - Wearable: watches, fitness bands, health monitors, clothing/jewelry, VR headsets ...
  - Sensors: smart utility meters, weather stations ...
  - Devices: handhelds, computers, routers ...
  - Transportation: cars, buses, trains, traffic control, parking...

INTERNET OF THINGS
Introduction

- Networking
  - Mostly low power, short range, wireless, mesh type networks
  - Bluetooth Low Energy (BLE), Zigbee, Near Field Communications (NFC)
  - WiFi and ethernet to internet
  - RFID and QR codes

INTERNET OF THINGS

Outline

- Introduction
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INTERNET OF THINGS

Topics

- Architecture Areas
- Subject Areas

INTERNET OF THINGS
Topics

- Architecture Areas
  - Wireless Networks*
  - Standards
  - Single Board Computers*
  - Security and Privacy*
  - Inventory*
  - Ambient Intelligence*
  - Blockchain*
  - Fog computing*

* = personal interest

INTERNET OF THINGS
Topics

- Architecture Areas
  - Wireless Networks
    - Bluetooth Low Energy (BLE)
    - Bluetooth mesh
    - ZigBee
    - Z-Wave
    - Near Field Communications (NFC)

INTERNET OF THINGS
Topics

- Architecture Areas
  - Standards
    - Getting light bulbs to work with hubs and remotes
    - Open Connectivity Foundation (OCF)
    - IoTivity – an open source project to develop interoperability guidelines

INTERNET OF THINGS
Topics

- Architecture Areas
  - Single Board Computers
    - Arduino
    - Raspberry Pi
    - Odroid
    - Beaglebone
    - Banana
    - Hummingboard
    - Firefly
    - Orange

INTERNET OF THINGS
Topics

- Architecture Areas
  - Security and Privacy
    - Often not a design concern
    - No updating function
    - Unanticipated connection combinations
    - Low understanding of wifi vulnerabilities

INTERNET OF THINGS
Topics

- Architecture Areas
  - Inventory
    - RFID tracking
    - Constant monitoring
    - Pervasive use (everything will be inventoried)
    - Use for anti-counterfeiting on nano-scale
    - [blockchain]

INTERNET OF THINGS
Topics

- Architecture Areas
  - Ambient Intelligence
    - Electronic environments that are responsive to the presence of people and support their needs
    - Characteristics:
      - Integrated into environment
      - Aware of situation
      - Can be tailored
      - Anticipate and adapt
    - Likely to be managed by intelligent agents

INTERNET OF THINGS
Topics

- Architecture Areas
  - Blockchain
    - Internet Of Trusted Things
    - Authenticate device identity
    - Device transaction journal
    - Supply chain validation

INTERNET OF THINGS
Topics

- Architecture Areas
  - Fog computing (edge computing)
    - Reduced latency
    - More precise control
    - Greater availability
    - Real time analytics
    - Time savings
    - Cost savings
    - Security and privacy improvements

INTERNET OF THINGS
Topics

- Subject Areas
  - Home Automation
  - Wearable Technology
  - Health and Medical
  - Transportation
  - Infrastructure
  - Manufacturing
  - Agriculture
  - Energy

INTERNET OF THINGS
Topics

- Subject Areas
  - Home Automation
    - Lights, thermostat, appliances, security
    - Hubs
    - User interface (Echo, Home)

INTERNET OF THINGS
Topics

- Subject Areas
  - Wearable Technology
    - Watch, hearing aid, panic button, fitness
    - Clothing
    - 3D printing (fabrics)
    - Health/medical sensors
    - Augmented reality (glasses, visors, contacts)

INTERNET OF THINGS
Topics

- Subject Areas
  - Health and Medical
    - Patient health monitoring: fitness bands, vital signs, pacemakers, falls,
    - Emergency notification
    - Smart beds
    - Prosthetics
    - [blockchain]

INTERNET OF THINGS
Topics

- Subject Areas
  - Transportation
    - Autonomous driving
    - Traffic control
    - Toll collection
    - Fleet management
    - [blockchain]

INTERNET OF THINGS
Topics

- Subject Areas
  - Infrastructure
    - Bridges, railways, wind farms
    - Quality of service
    - Maintenance
    - Incident management
    - Smart city

INTERNET OF THINGS
Topics

- Subject Areas
  - Manufacturing
    - Supply chain and inventory management
    - Process control
    - Predictive maintenance
    - Quality improvement

INTERNET OF THINGS
Topics

- Subject Areas
  - Agriculture
    - Environmental sensors
    - Pest control
    - Irrigation control
    - Growth monitoring
    - Field by field → plant by plant
    - Multi-crop complex farming
    - [blockchain]

INTERNET OF THINGS
Topics

- Subject Areas
  - Energy
    - Efficiency and conservation
    - Metering
    - Feedback to generation process
    - Production improvement

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INTERNET OF THINGS

Summary

- Numbers
- Education courses
- Books

INTERNET OF THINGS
Summary

- Numbers
  - 2015 connected devices = 13.4 billion
  - 2020 connected devices = 20 billion?
  - 2025 connected devices = 80 billion?

  - 2015 money spent on IOT = $700 billion
  - 2019 money spent on IOT = $1,300 billion?

(different sources offer different estimates)

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Summary

- Educational courses
  - Coursera courses: https://www.coursera.org/specializations/internet-of-things
  - Udemy courses: https://www.udemy.com/topic/internet-of-things/
  - edX courses: https://www.edx.org/course?search_query=+iot

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Summary

- Books
  - "The Amazon Way on IoT" by John Rossman
  - “What to Do When Machines Do Everything” by Frank, Roehrig, Pring
  - “The Inevitable” by Kevin Kelly

INTERNET OF THINGS

Summary

- Discussion

- The end