2 Days Training on

IoT Architecture and Simulation using ns-3

CHAPTER 2 – IoT Architecture and IoT Core Modules

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Introduction

- This chapter starts with a definition of IoT versus machine-to-machine architectures.
- It addresses the architect's role in building a scalable, secure, and enterprise IoT architecture.
- An architect must be able to speak to the value the design brings to a customer.
- The architect must also play multiple engineering and product roles in balancing different design choices.

IoT Ecosystem

- These industries will rely on the hardware, software, and services provided by the bulk of the IT industry.
- Nearly every major technology company is investing or has invested heavily in IoT space.
- New markets and technologies have already formed (and some have collapsed or been acquired).

IoT Ecosystem(2)

- We will touch on nearly every segment in IoT:
  - **Sensors**: Embedded systems, real-time operating systems, energy-harvesting sources, Micro-Electro-Mechanical Systems (MEMs).
  - **Sensor communication systems**: Wireless personal area networks reach from 0 cm to 100 m. Low-speed and low-power communication channels, often non-IP based have a place in sensor communication.
  - **Local area networks**: Typically, IP-based communication systems such as 802.11 Wi-Fi used for fast radio communication, often in peer-to-peer or star topologies.
  - **Aggregators, routers, gateways**: Embedded systems providers, cheapest vendors(processors, DRAM, and storage), module vendors, passive component manufacturers, thin client manufacturers, cellular and wireless radio manufacturers, middleware providers, fog framework providers, edge analytics packages, edge security providers, certificate management systems.

IoT Ecosystem(3)

- We will touch on nearly every segment in IoT:
  - **WAN**: Cellular network providers, satellite network providers, Low-Power Wide-Area Network (LPWAN) providers. Typically using internet transport protocols targeted for IoT and constrained devices like MQTT, CoAP, and even HTTP.
  - **Cloud**: Infrastructure as a service provider, platform as a service provider, database manufacturers, streaming and batch processing manufacturers, data analytics packages, software as a service provider, data lake providers, Software- Defined Networking/ Software- Defined Perimeter providers, and machine learning services.
  - **Data analytics**: As the information propagates to the cloud en-mass. Dealing with volumes data and extracting value is the job of complex event processing, data analytics, and machine learning techniques.
  - **Security**: Tying the entire architecture together is security. Security will touch every component from physical sensors to the CPU and digital hardware, to the radio communication systems, to the communication protocols themselves. Each level needs to ensure security, authenticity, and integrity. There cannot be the weak link in a chain, as the IoT will form the largest attack surface on earth.

IoT vs M2M

- **M2M**: It is a general concept involving an autonomous device communicating directly to another autonomous device.
- Autonomous refers to the ability of the node to instantiate and communicate information with another node without human intervention.
- The form of communication is left open to the application. It may very well be the case that an M2M device uses no inherent services or topologies for communication.
- This leaves out typical internet appliances used regularly for cloud services and storage.
- An M2M system may communicate over non-IP based channels as well, such as a serial port or custom protocol.

IoT vs M2M(2)

- **IoT**: IoT systems may incorporate some M2M nodes (such as a Bluetooth mesh using non-IP communication), but aggregates data at an edge router or gateway.
- An edge appliance like a gateway or router serves as the entry point onto the internet.
- Alternatively, some sensors with more substantial computing power can push the internet networking layers onto the sensor itself.

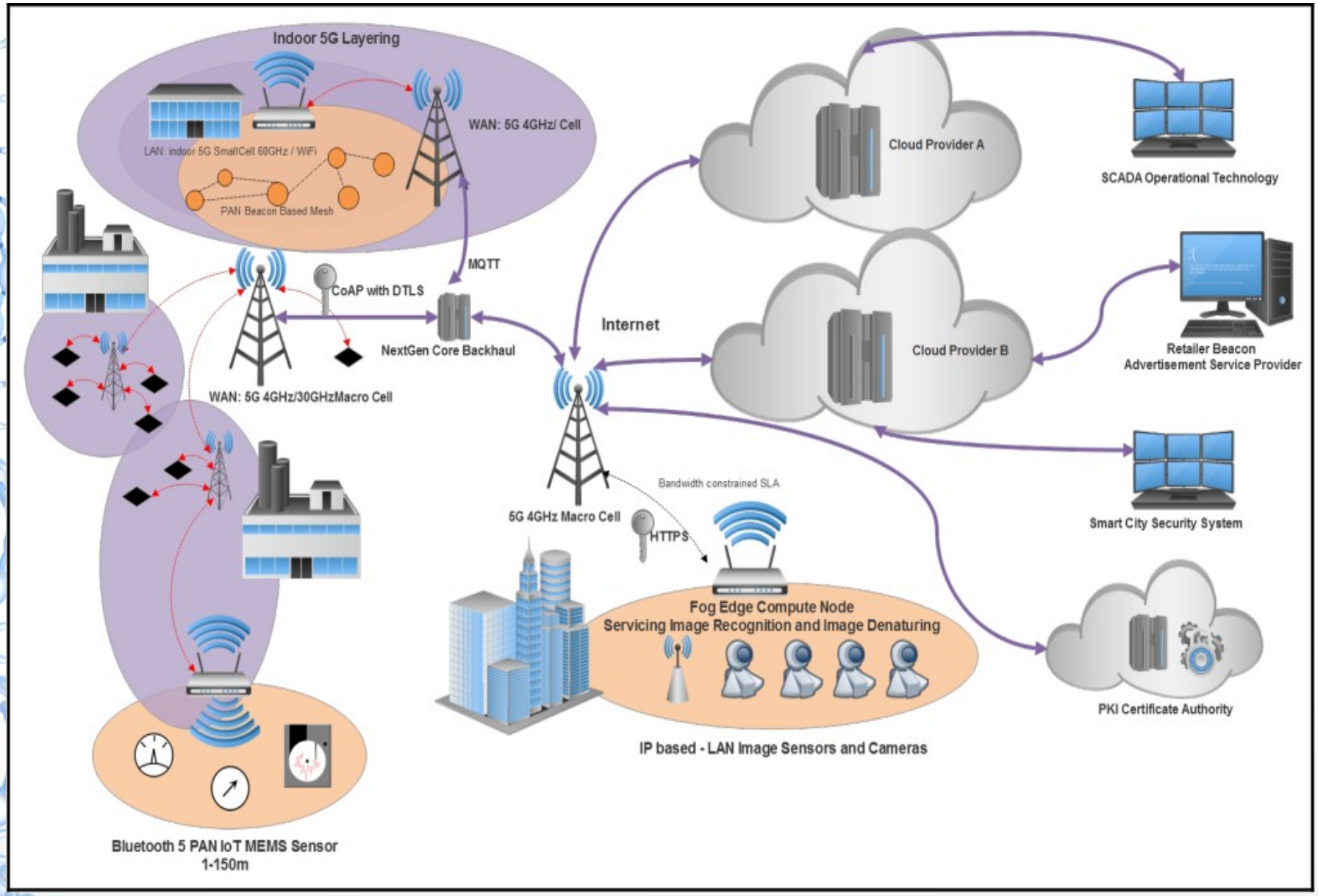
The Value of 'IoT' Network

$$\sum_{i=1}^{n} V_{i,j} = \sum_{i=1}^{n} \sum_{k=1}^{m} \frac{B_{i,j,k} - C_{i,j,k}}{(1 + r_k)^{t_k}}$$

Where:

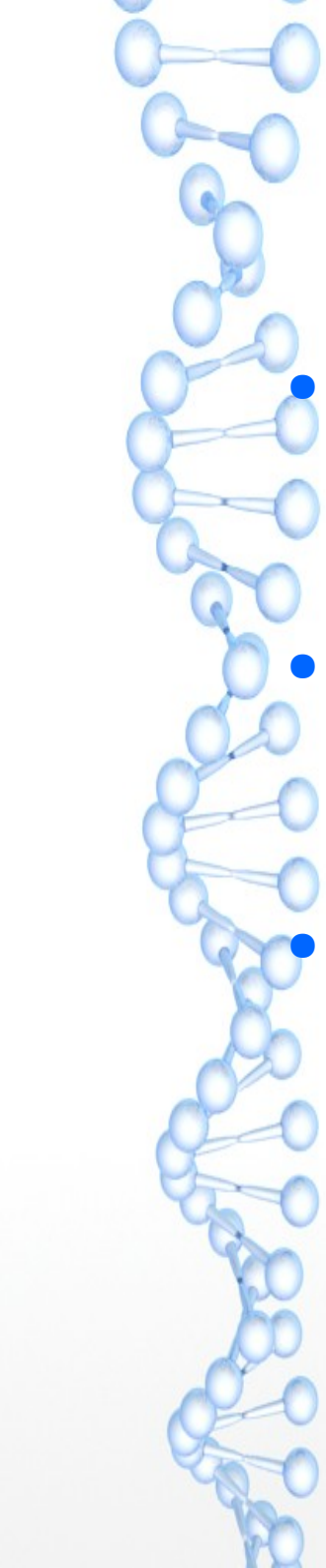
- $V_{i,j}$: Represents the present value of the network for device i on network j
- i: An individual user or device on the network
- j: The network itself
- k: A single transaction
- $B_{i,j,k}$: The benefit that value k will bring to device i on network j
- $C_{i,j,k}$: The cost of a transaction k to a device i on network j
- r_k: The discount rate of interest to the time of transaction k
- t_k: The elapsed time (in years) to transaction k
- n: The number of individuals
- m: The number of transactions

IoT Architecture



The Role of An Architect

- In this book, we are targeting the IoT architect that need to have knowledge from the parts that will be covered in this text.
  - Sensing and Power
  - Data Communication
  - Internet Routing and Protocols
  - Fog and edge compute,analytics and machine learning.
  - Threat and Security in IoT



Summary

- This course will bridge the spectrum of technologies that comprise the IoT.
- We summarized the domains and topics covered in this chapter.
- An architect must be cognizant of the interactions between these disparate engineering disciplines to build a system that is scalable, robust, and optimized.