Internet of Things

MODULE 1

Overview of IoT:
Overview of Wireless Sensor Networks,
Overview of Internet of Things,
IoT Conceptual Framework,
IoT Architectural View,
Technology Behind IoT,
Sources of IoT,
M2M Communication.

Design Principles:
IoT/M2M Systems Layers and Design Standardization,
Communication Technologies,
Data Enrichment, Data Consolidation and Device Management at Gateway,
Eg of IoT,
Ease of Designing and Affordability

Internet of Things
Internetwork of Things,
(that enable things to communicate as if they are computing unit)
(wherein things embedded with electronics, hardware, communication)
so that they can be monitored, controlled, coordinated with other devices

IOT is a concept which enables communication between internetworking devices and applications, whereby physical objects ('things') communicate through the Internet

Earliest IOT: RFID (Radio Frequency Identification Device)

Vision of IoT
- Things becoming smart/intelligent and behaving alive
- Smart, Hyperconnectivity

CONCEPTUAL FRAMEWORK

- *Adrian McEwen* and *Hakim Cassimally* equation is a simple conceptualisation of a framework for IoT with connectivity to a web service:

  Physical Object + Controller, Sensor and Actuators + Internet = Internet of Things

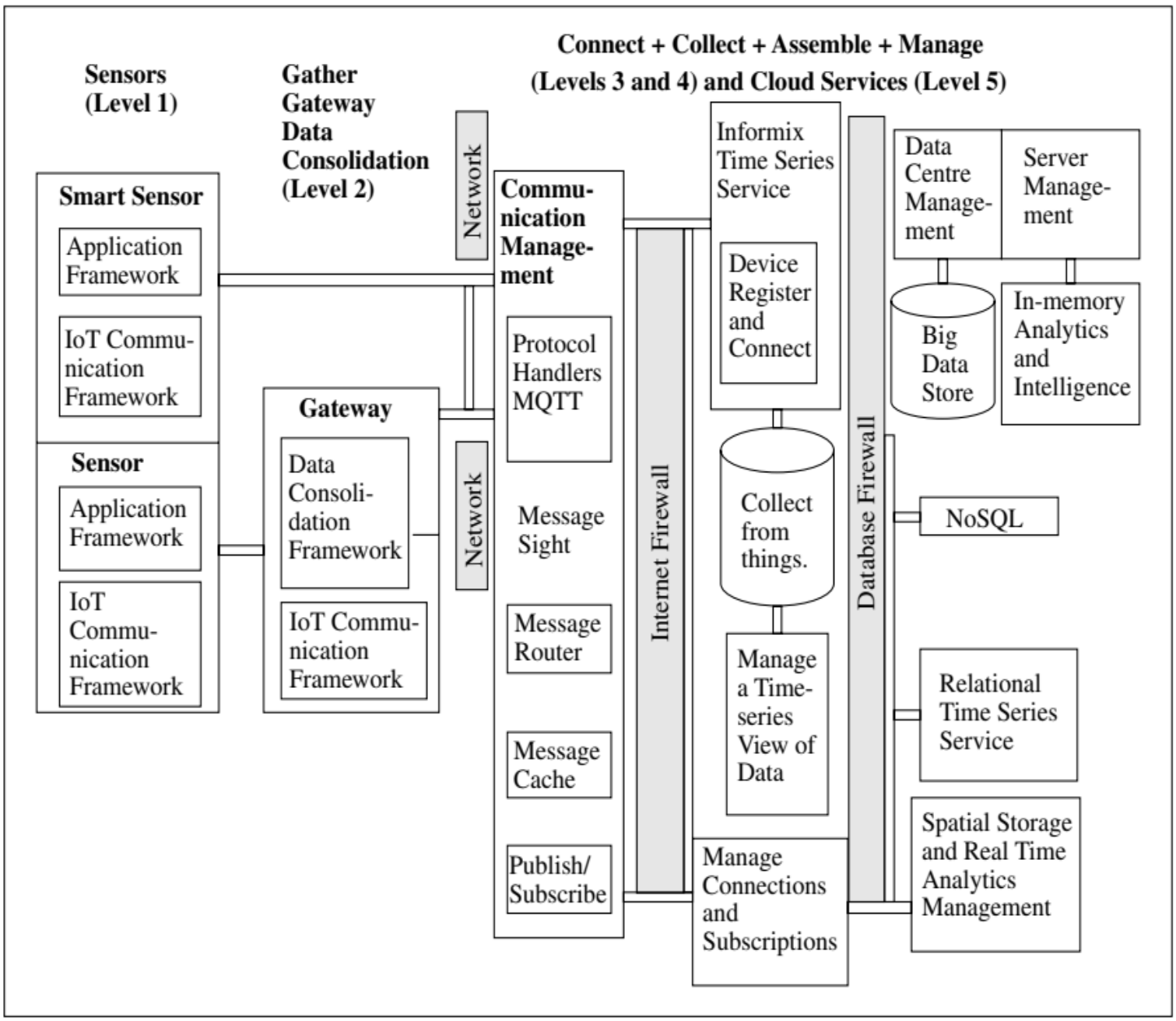
- An equation to conceptualise a general framework for IoT with connectivity to a data centre, application or enterprise server for data storage, services and business processes is:

  Gather + Enrich + Stream + Manage + Acquire + Organise and Analyse = Internet of Things

  Orcale suggested IoT architecture is the basis for this equation.

- Another equation which conceptualises the general framework for IoT using the cloud based services is:

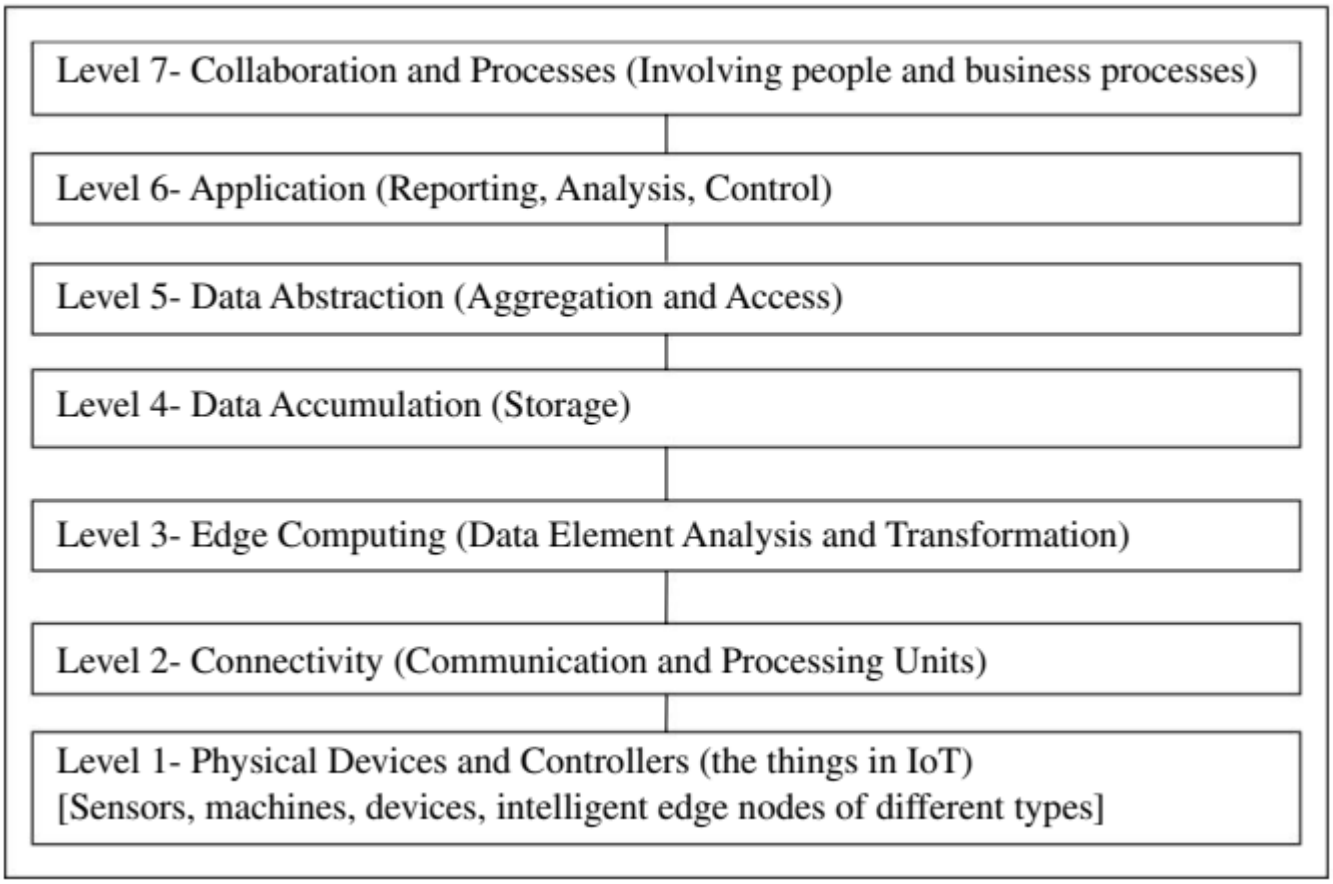
  Gather + Consolidate + Connect + Collect + Assemble + Manage and Analyse = Internet of Things



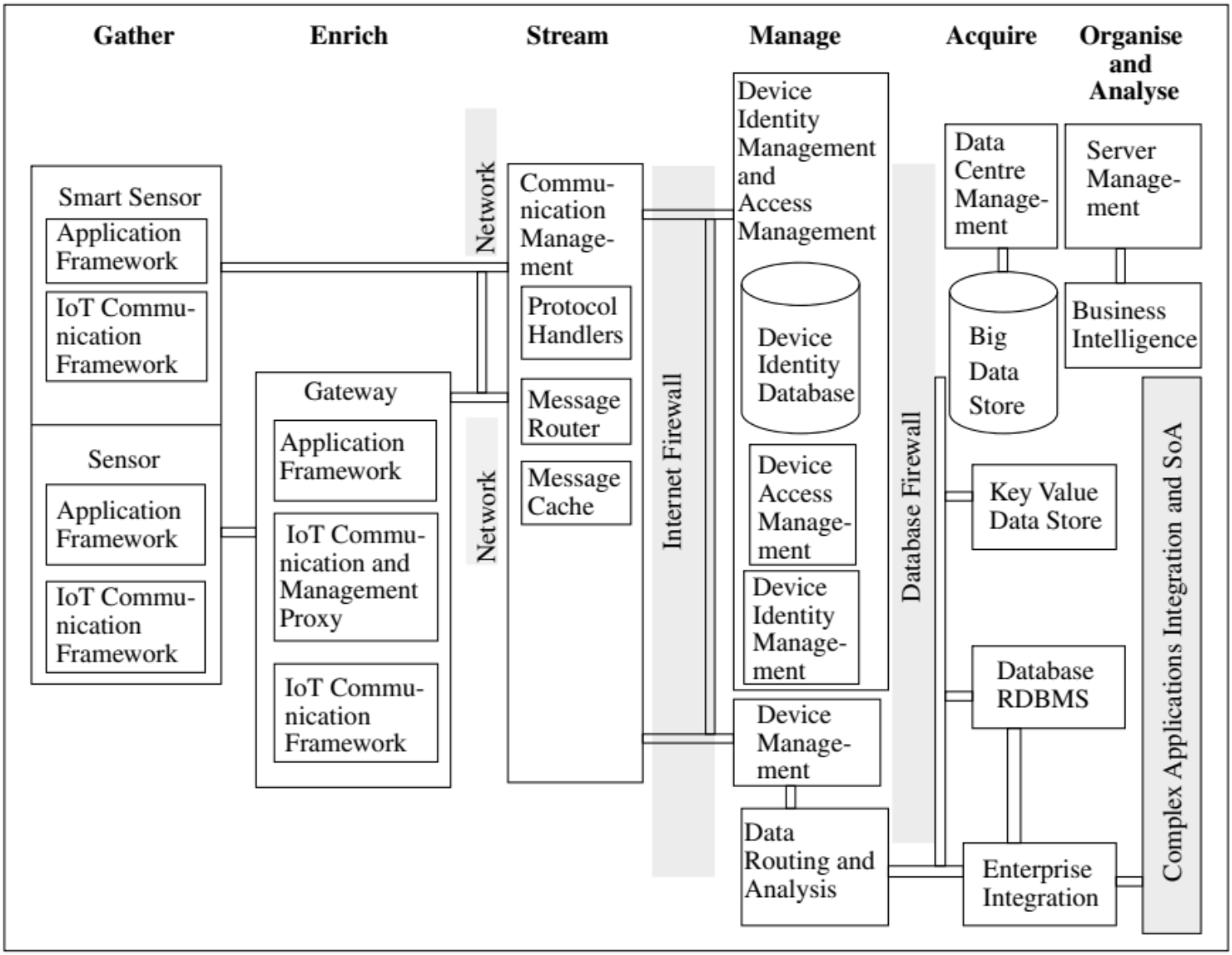
(IBM)

ARCHITECTURAL VIEW

(Cisco 7 levelled view)



REFERENCE MODEL
(Oracle)



1.4 TECHNOLOGY BEHIND IoT

LO 1.4 Describe enabler technologies which are used in designing of: (i) IoT devices, (ii) communication methods between devices and remote server, cloud and applications

The following entities provide a diverse technology-environment and are examples of technologies, which are involved in IoT.

- Hardware (Arduino Raspberry Pi, Intel Galileo, Intel Edison, ARM mBed, Bosch XDK110, Beagle Bone Black and Wireless SoC)
- Integrated Development Environment (IDE) for developing device software, firmware and APIs
- Protocols [RPL, CoAP, RESTful HTTP, MQTT, XMPP (Extensible Messaging and Presence Protocol)]
- Communication (Powerline Ethernet, RFID, NFC, 6LowPAN, UWB, ZigBee, Bluetooth, WiFi, WiMax, 2G/3G/4G)
- Network backbone (IPv4, IPv6, UDP and 6LowPAN)
- Software (RIOT OS, Contiki OS, Thingsquare Mist firmware, Eclipse IoT)
- Internetwork Cloud Platforms/Data Centre (Sense, ThingWorx, Nimbits, Xively, openHAB, AWS IoT, IBM BlueMix, CISCO IoT, IOx and Fog, EvryThng, Azure, TCS CUP)
- Machine learning algorithms and software. An example of machine-learning software is GROK from Numenta Inc. that uses machine intelligence to analyse the streaming data from clouds and uncover anomalies, has the ability to learn continuously from data and ability to drive action from the output of GROK's data models and perform high level of automation for analysing streaming data.[6]

Major Components of IOT System

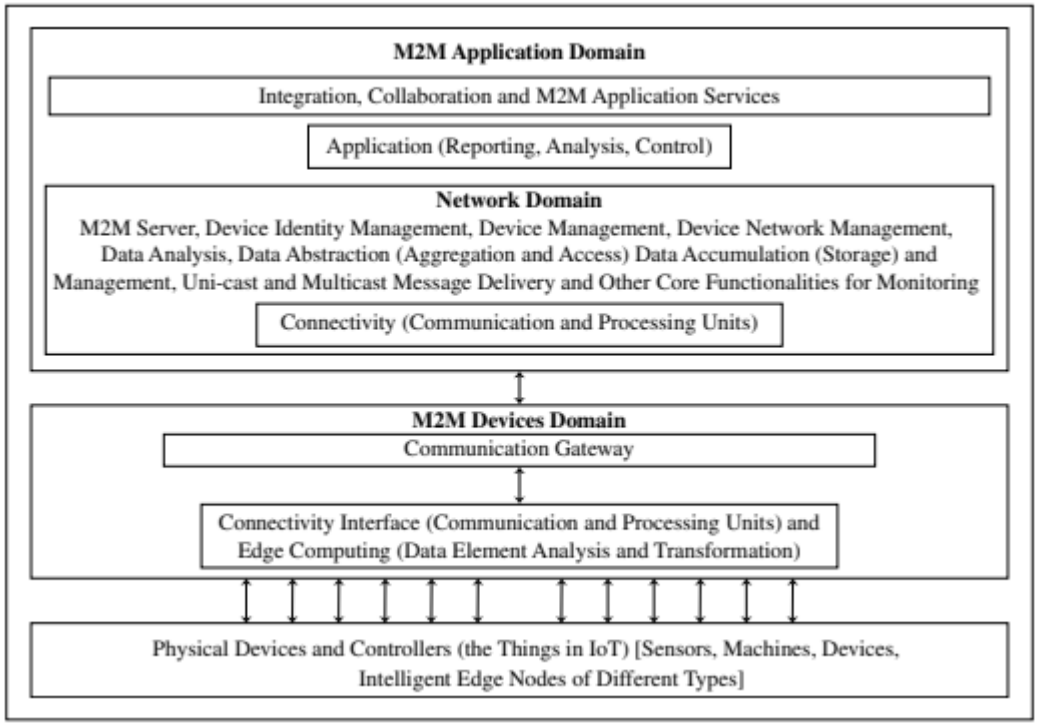
1.4.2 Major Components of IoT System

Major components of IoT devices are:

1. **Physical object** with embedded software into a hardware.
2. **Hardware** consisting of a microcontroller, firmware, sensors, control unit, actuators and communication module.
3. **Communication module:** Software consisting of device APIs and device interface for communication over the network and communication circuit/port(s), and middleware for creating communication stacks using 6LowPAN, CoAP, LWM2M, IPv4, IPv6 and other protocols.
4. **Software** for actions on messages, information and commands which the devices receive and then output to the actuators, which enable actions such as glowing LEDs, robotic hand movement etc.

SOURCES of IOT

M2M Communication



UNIT 2:

Machine-to-Machine Communication;
Message Communication Protocols: Message Queue Telemetry Transport (MQTT)

UNIT 3:

Internet of Things Privacy, Security and Governance-Introduction,
Overview of Activity Chain Governance,
Privacy and Security Issues,
Contribution From FP7 Project,
Security and Privacy Challenge in Data Aggregation for the IoT in Smart Cities-Security,
Privacy and Trust in Iot-Data Platforms for Smart Cities,
First Steps Towards a Secure Platform,
Smartie Approach

FP7 iCore Access Framework (iCore Contribution)

IoT@Work Capability Based Access Control System (IoT@Work Contribution)

MQTT (Message Queueing Telemetry Transport)