Introduction to IoT

Internet of Things: Internet of Things (IoT) is a concept which enables communication between internetworking devices and applications, whereby physical objects or 'things' communicate through the Internet. The concept of IoT began with things classified as identity communication devices. Radio Frequency Identification Device (RFID) is an example of an identity communication device.

Internet of Things means a network of physical things (objects) sending, receiving, or communicating information using the Internet or other communication technologies and network just as the computers, tablets and mobiles do, and thus enabling the monitoring, coordinating or controlling process across the Internet or another data network.

Or

Internet of Things is the network of physical objects or 'things' embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and/or other connected devices. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

IoT Vision: Internet of Things is a vision where things (wearable watches, alarm clocks, home devices, surrounding objects) become 'smart' and function like living entities by sensing, computing and communicating through embedded devices which interact with remote objects (servers, clouds, applications, services and processes) or persons through the Internet or Near-Field Communication (NFC) etc.

IoT CONCEPTUAL FRAMEWORK

Generally, IoT consists of an internetwork of devices and physical objects wherein a number of objects can gather the data at remote locations and communicate to units managing, acquiring, organizing and analyzing the data in the processes and services. A general framework consists of the number of devices communicating data to a data centre or an enterprise or a cloud server. The IoT framework of IoT used in number of applications as well as in enterprise and business processes. (Suggested by Oracle)

Gather + Enrich + Stream + Manage + Acquire + Organize and Analyze = IoT with connectivity to data center, enterprise or cloud server

1. At level 1 data of the devices (things) using sensors or the things gather the pre data from the internet.
2. A sensor connected to a gateway, functions as a smart sensor (smart sensor refers to a sensor with computing and communication capacity). The data then enriches at level 2, for example, by transcoding at the gateway. Transcoding means coding or decoding before data transfer between two entities.

3. A communication management subsystem sends or receives data streams at level 3.

4. Device management, identity management and access management subsystems receive the device's data at level 4.
5. A data store or database acquires the data at level 5.
6. Data routed from the devices and things organises and analyses at level 6. For example, data is analysed for collecting business intelligence in business processes.

Gather + Consolidate + Connect + Collect + Assemble + Manage and Analyze = IoT with connectivity to cloud services (Suggested by IBM)

1. Levels 1 and 2 consist of a sensor network to gather and consolidate the data. First level gathers the data of the things (devices) using sensors circuits. The sensor connects to a gateway. Data then consolidates at the second level, for example, transformation at the gateway at level 2.
2. The gateway at level 2 communicates the data streams between levels 2 and 3. The system uses a communication-management subsystem at level 3.
3. An information service consists of connect, collect, assemble and manage subsystems at levels 3 and 4. The services render from level 4.
4. Real time series analysis, data analytics and intelligence subsystems are also at levels 4 and 5. A cloud infrastructure, a data store or database acquires the data at level 5.

IoT ARCHITECTURAL VIEW

An IoT system has multiple levels. These levels are also known as tiers. A model enables conceptualization of a framework. A reference model can be used to depict building blocks, successive interactions and integration. A reference model could be identified to specify reference architecture. Several reference architectures are expected to co-exist in the IoT domain.

CISCO seven leveled reference model

Level 1- Physical Devices and Controllers (the things in IoT) [Sensors, machines, devices, intelligent edge nodes of different types]
Level 2- Connectivity (Communication and Processing Units)
Level 3- Edge Computing (Data Element Analysis and Transformation)
Level 4- Data Accumulation (Storage)
Level 5- Data Abstraction (Aggregation and Access)
Level 6- Application (Reporting, Analysis, Control)
Level 7- Collaboration and Processes (Involving people and business processes)

An architecture has the following features:
● The architecture serves as a reference in applications of IoT in services and business processes.
● A set of sensors which are smart, capture the data, perform necessary data element analysis and transformation as per device application framework and connect directly to a communication manager.
- A set of sensor circuits is connected to a gateway possessing separate data capturing, gathering, computing and communication capabilities. The gateway receives the data in one form at one end and sends it in another form to the other end.

● The communication-management subsystem consists of protocol handlers, message routers and message cache.
● This management subsystem has functionalities for device identity database, device identity management and access management.
● Data routes from the gateway through the Internet and data centre to the application server or enterprise server which acquires that data.
● Organization and analysis subsystems enable the services, business processes, enterprise integration and complex processes

Standards for an architectural
framework for the IoT have been developed under IEEE project P2413. IEEE working group is working on a set of guidelines for the standards. IEEE suggested P24133 standard for architecture of IoT. It is a reference architecture which builds upon the reference model(s). The reference architecture covers the definition of basic architectural building blocks and their integration capability into multi-tiered systems.
P2413 architectural framework4 is a reference model that defines relationships among various IoT verticals, for example, transportation and healthcare. P2413 provides for the following:

● Follows top-down approach (consider top layer design first and then move to the lowest)
● Does not define new architecture but reinvent existing architectures congruent with it
● Gives a blueprint for data abstraction
● Specifies abstract IoT domain for various IoT domains
● Recommends quality ‘quadruple’ trust that includes protection, security, privacy and safety
● Addresses how to document
● Strives for mitigating architecture divergence(s)