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INTERNET OF THINGS (IoT)

AN OVERVIEW OF IOT & IOT ARCHITECTURE

1.1) Overview or an IoT

The Internet of Things, or IoT, refers to the set of devices and systems that interconnect real-world sensors and actuators to the Internet. This includes many different systems, including

- Internet-connected cars
- wearable devices including health and fitness monitoring devices, watches, and even human implanted devices;
- smart meters and smart objects;
- home automation systems and lighting controls;
- smartphones that are increasingly being used to measure the world around them; and
- wireless sensor networks that measure weather, flood defenses, tides and more.

The growth of the number and variety of devices that are collecting data is incredibly rapid.A study by Cisco1 estimates that the number of Internet-connected devices overtook the human population in 2010, and that there will be 50 billion Internet-connected devices by 2020.

There are of course two key aspects to the IoT: the devices themselves and the server-side architecture that supports them. In fact there is often a third-category as well; in many cases there may be a low power gateway that performs aggregation, event processing, bridging, etc. that might sit between the device and the wider Internet.

In both cases, the devices probably have intermittent connections based on factors such as GPRS connectivity, battery discharging, radio interference, or simply being switched **off.**

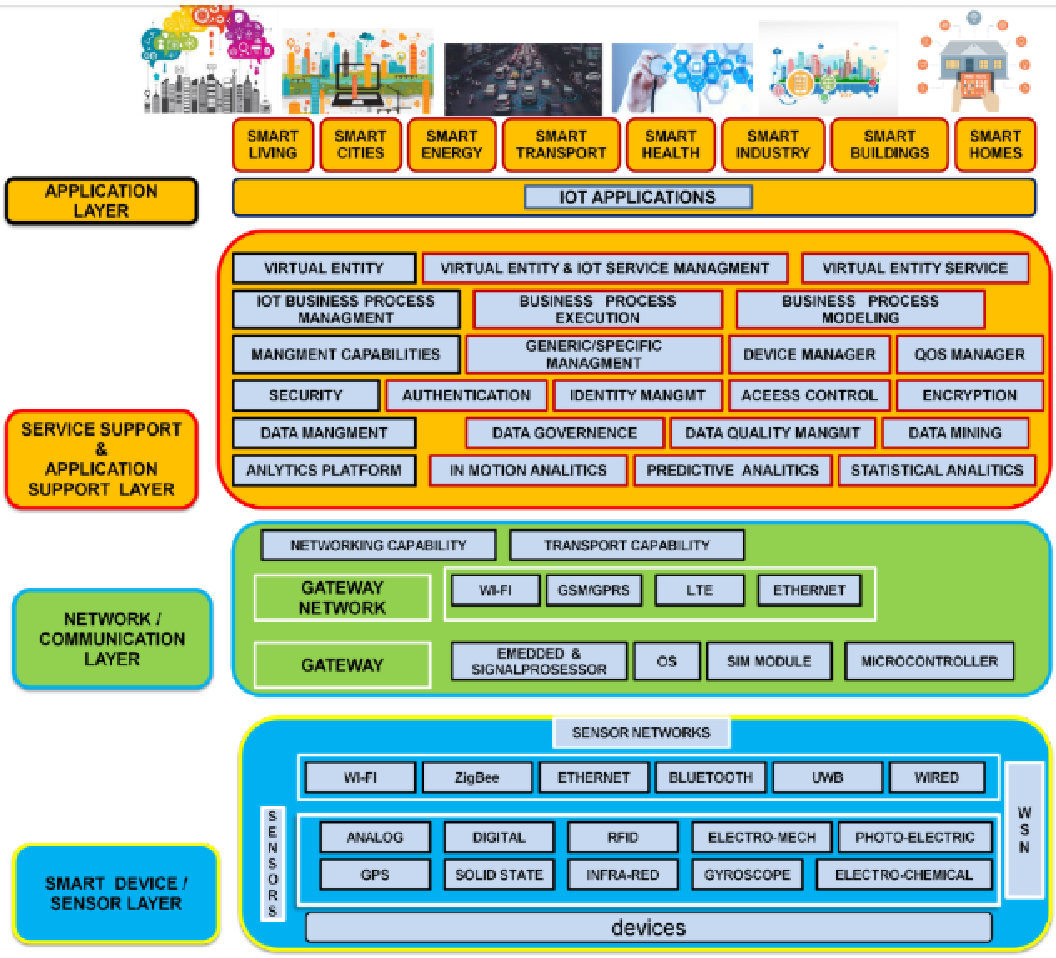
1.2) IoT Architecture

Because of outstanding opportunities IoT promises, more organizations seek for the inclusion of its products in their business processes. However, when it comes to reality, this brilliant idea appears too complicated to be implemented — given the number of devices and conditions needed to make it work. In other words, the problem of establishing a reliable architecture of the Internet of Things inevitably enters the stage.

Among all, to deal with the whole variety of factors affecting IoT architecture, it's easier and more effective to find a reliable provider of IoT solutions. This decision will significantly reduce the number of resources spent on the way. Though it's possible to comprehend the process of creating software, the practical application of its stages contains too many nuances and aspects to be described in simple words. Because of that, use this guide for establishing a proper understanding of what's going on during IoT architecture — but consider referring to the specialist to make this process actually happen. This decision will facilitate getting the needed result and guarantee being a satisfied client of a software development company.

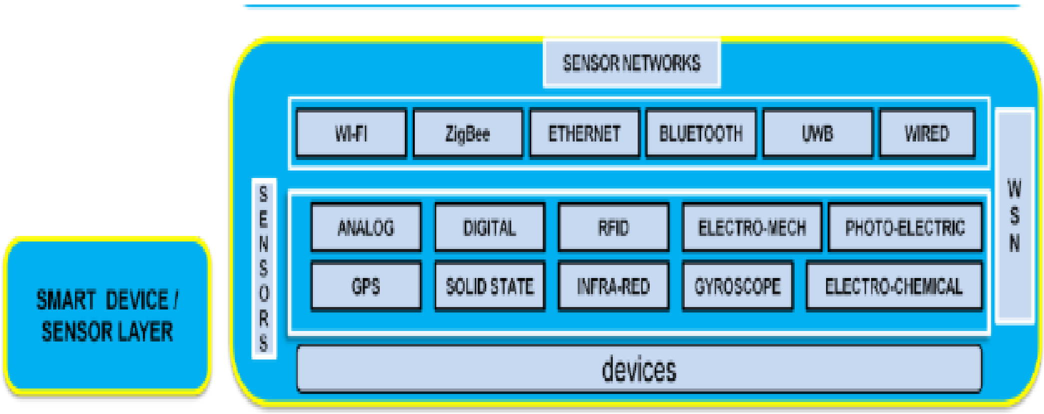
We have different models of architecture designs. On those we are discussing 4 layer architecture models and 7 layer architecture models. Let us discuss those models.

1.2.1) 4 Layer architecture model:-



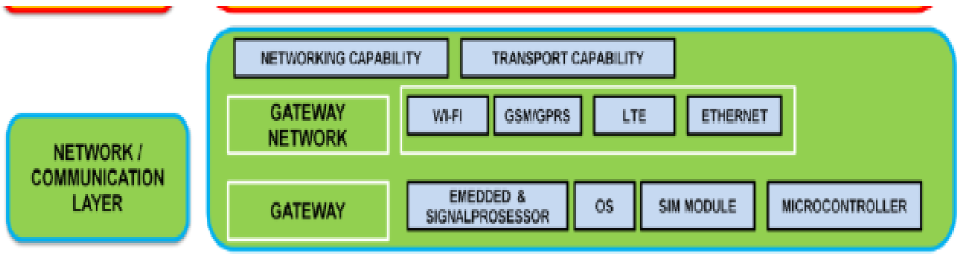
1.2.1.1) A. smart device/sensor layer:

The lowest layer is made up of smart objects integrated with sensors. The sensors enable the interconnection of the physical and digital worlds allowing real-time information to be collected and processed. There are various types of sensors for different purposes. The sensors have the capacity to take measurements such as temperature, air quality, speed, humidity, pressure, flow, movement, and electricity, etc. In some cases, they may also have a degree of memory, enabling them to record a certain number of measurements. a sensor can measure the physical property and convert it into a signal that can be understood by an instrument. Sensors are grouped according to their unique purpose such as environmental sensors, body sensors, home appliance sensors, and vehicle telematics sensors, etc. Most sensors require connectivity to the sensor gateways. This can be in the form of a Local Area Network (LAN) such as Ethernet and Wi-Fi connections or Personal Area Network (PAN) such as ZigBee, Bluetooth, and Ultra-Wideband (UWB). For sensors that do not require connectivity to sensor aggregators, their connectivity to backend servers/applications can be provided using Wide Area Network (WAN) such as GSM, GPRS, and LTE. Sensors that use low power and low data rate connectivity, they typically form networks commonly known as wireless sensor networks (WSNs). WSNs are gaining popularity as they can accommodate far more sensor nodes while retaining adequate battery life and covering large areas.



1.2.1.2) Gateways and Networks

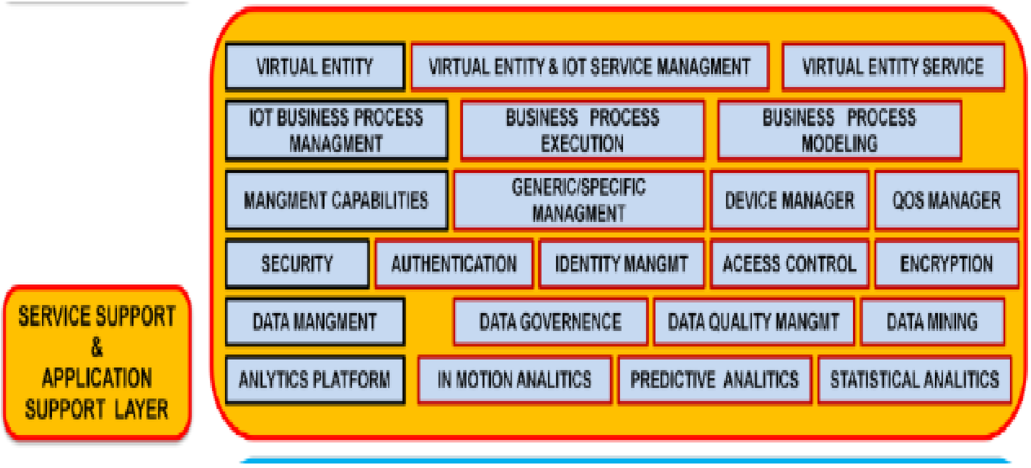
A massive volume of data will be produced by these tiny sensors and this requires a robust and high performance wired or wireless network infrastructure as a transport medium. Current networks, often tied with very different protocols, have been used to support machine-to-machine (M2M) networks and their applications. With demand needed to serve a wider range of IoT services and applications such as high-speed transactional services, context-aware applications, etc, multiple networks with various technologies and access protocols are needed to work with each other in a heterogeneous configuration. These networks can be in the form of private, public, or hybrid models and are built to support the communication requirements for latency, bandwidth or security. Various gateways (microcontroller, microprocessor...) & gateway networks (WI-FI, GSM, GPRS…)



1.2.1.3) Management Service Layer

The management service renders the processing of information possible through analytics, security controls, process modeling, and management of devices. One of the important features of the management service layer is the business and process rule engines. IoT brings connection and interaction of objects and systems together providing information in the form of events or contextual data such as temperature of goods, current location and traffic data.

Some of these events require filtering or routing to post- processing systems such as capturing of periodic sensory data, while others require a response to the immediate situations such as reacting to emergencies on patient's health conditions. The rule engines support the formulation of decision logics and trigger interactive and automated processes to enable a more responsive IoT system. In the area of analytics, various analytics tools are used to extract relevant information from massive amounts of raw data and to be processed at a much faster rate. Analytics such as in- memory analytics allows large volumes of data to be cached in random access memory (RAM) rather than stored in physical disks.

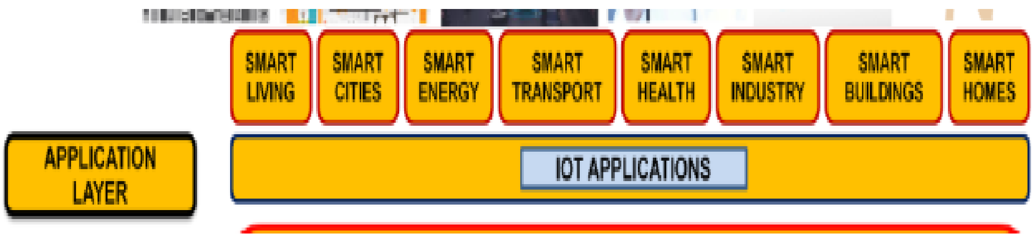


In-memory analytics reduces data query time and augments the speed of decision making. Streaming analytics is another form of analytics where analysis of data, considered as data-in-motion, is required to be carried out in real time so that decisions can be made in a matter of seconds. Data management is the ability to manage data information flow. With data management in the management service layer, information can be accessed, integrated and controlled. Higher layer applications can be shielded from the need to process unnecessary data and reduce the risk of privacy disclosure of the data source. Data filtering techniques such as data anonymisation, data integration and data synchronization, are used to hide the details of the information while providing only essential information that is usable for the relevant applications. With the use of data abstraction, information can be extracted to provide a common business view of data to gain greater agility and reuse across domains.

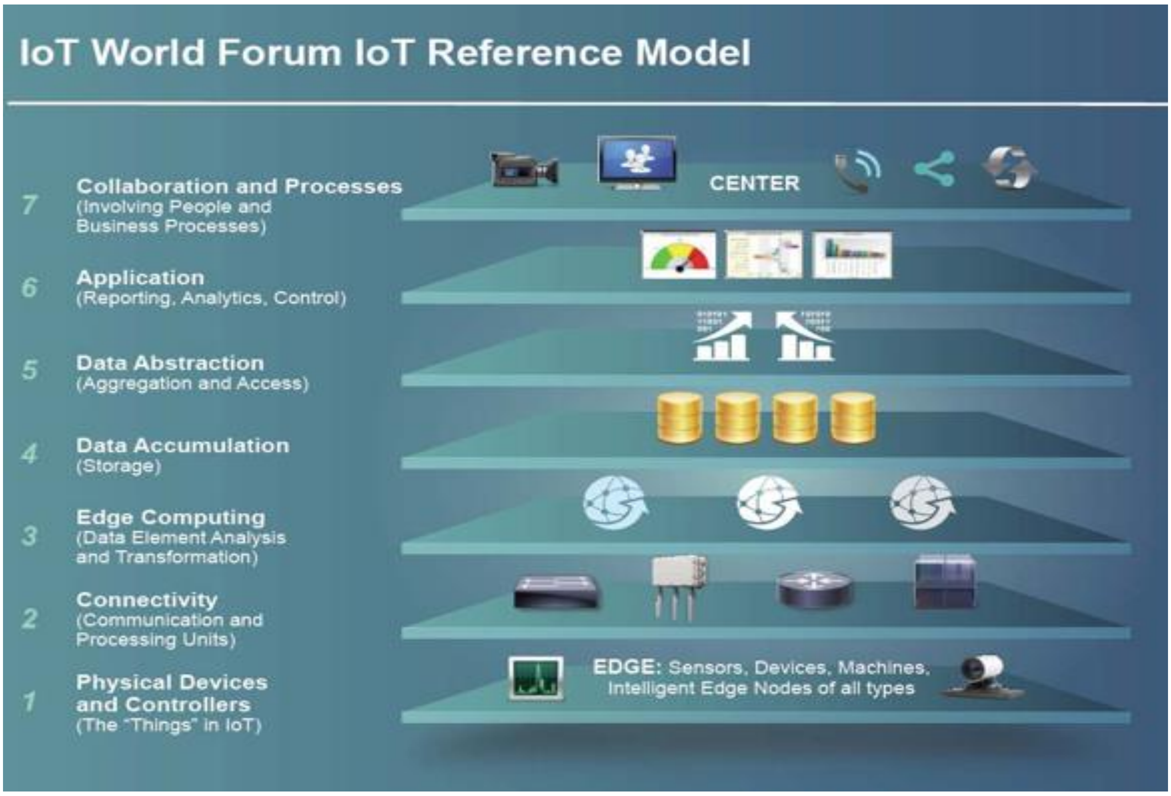
Security must be enforced across the whole dimension of the IoT architecture right from the smart object layer all the way to the application layer. Security of the system prevents system hacking and compromises by unauthorized personnel, thus reducing the possibility of risks.

1.2.1.4) Application Layer

The IoT application covers "smart" environments/spaces in domains such as: Transportation, Building, City, Lifestyle, Retail, Agriculture, Factory, Supply chain, Emergency, Healthcare, User interaction, Culture and tourism,Environment and Energy.



1.2.2) 7 Layer architecture :



Physical Devices and Controllers – The model calls this layer the "things" of the internet of things. Unfortunately, this layer is a little ambiguous. One one hand, the "things" are the assets being managed. From a system design perspective, the "things" are the sensors and devices that are directly managed by the IoT architecture. These two are not often identical, at least not yet, as many assets ("things") under management will not yet have integrated sensors and Edge Node intelligent elements integrated. So, we should think of this layer as consisting of the "things" themselves and the sensors and Edge Node devices connected to them, as well as a more modern class of "things" with integrated sensors and Edge Node functionality.

It is worth noting that in the later case, and where connecting to existing field assets, there can be significant design effort to connect the sensors and Edge Node intelligent hardware as well as in mapping these systems to any management or intelligence that may exist in legacy assets (unless they are just "dumb" assets that need instrumentation).

An important IoT concept, Edge Intelligence, to allow low latency reaction to field events and to allow higher levels of autonomy and distributed processing, needs to be implemented at this layer.

Connectivity – This layer spans from the "middle" of an Edge Node device up through transport to the cloud. Many alternatives can be used for communications and this layer includes the mapping of field data to the logical and physical technologies used as well as the backhaul to the on premise or cloud and the next layer, Edge Computing.

In deployment, this layer can use a single solution or multiple technologies, depending on the need. Field Area Networks (FANs) alternatives can include wired, cellular, LPWAN, and many other wireless options, as well as multi-tired solutions, and can be built out of private, public, or a mix of private and public transport solutions.

Edge Computing – The next layer in the World Forum Model architecture is Edge Computing, or more properly "Cloud Edge" or "Cloud Gateway" computing. Required to some degree in any IoT system this layer interfaces the data and control plains to the higher layers of cloud, SaaS, or enterprise software layers. Protocol conversion, routing to higher layer software functions and even "fast path" logic for low latency decision making will be implemented at this layer.

Data Accumulation – Given the Velocity, Volume and Variety that IoT systems can provide it is essential to provide incoming data storage for subsequent processing, normalization, integration, and preparation for upstream applications. While part of the overall "data lake" architecture, this layer of the architecture serves the intermediate storage of incoming storage and outgoing traffic queued for delivery to lower layers. This layer may be implemented in simple SQL or may require more sophisticated Hadoop & Hadoop File System, Mongo, Cassandra, Spark or other NoSQL solutions.

Data Abstraction – In the data abstraction layer we "make sense" of the data, collecting "like" information from multiple IoT sensors or measurements, expedite high priority traffic or alarms, and organize incoming data from the data lake into appropriate schema and flows for upstream processing. Similarly application data destined for downstream layers is reformatted appropriately for device interaction and queued for processing.

A key architecture element for larger high performance deployments is a publish / subscribe or data distribution service (DDS) software framework to simplify data movement between Edge Computing, Data Accumulation, Application Layer, and User Processes. Whether this is a high performance service or a simpler message bus this infrastructure simplifies implementation and improves performance for all but the simplest applications.

Application Layer – This layer is self explanatory and is where control plane and data plane application logic is executed. Monitoring, process optimization, alarm management, statistical analysis, control logic, logistics, consumer patterns, are just a few examples of IoT applications.

Collaboration and Processes – At this layer, application processing is presented to users, and data processed at lower layers is integrated into business applications. This layer is about human interaction with all of the layers of the IoT system and where economic value is delivered. The challenge at this layer is to effectively leverage the value of IoT and the layers of infrastructure and services below and leverage this into economic growth, business optimization and/or social good.