**SCRIPT**

**IoT Concepts – What Is IoT Exactly?**

The broadest definition of IoT encompasses anything and everything that connects to the internet, including your smartphone, tablet, desktop and laptop. However, the term is often used in a slightly narrower sense in that the “things” being referred to are other objects that can talk to each other – smart speakers, plugs, lights, heating systems, fridges, cars, etc. – as we have come to assume that smartphones and computers are already internet connected. Strictly speaking, though, the Internet of Things consists of any device with an on/off switch that connects to the internet – mobile phones and all.

**IoT Examples**

The smart fridge always seems to come up in IoT conversations, so let’s start there. Say, for example, you’re driving home from work. Your car is connected to your smartphone, which in turn is connected to your smart fridge at home. Your fridge pings a message to your phone letting you know you’re running low on milk. The message comes up on the dashboard of your connected car, which lets you know where the nearest grocery store is, bringing up a map to give you directions. The store’s shelves are also connected, and, there you go, your car’s dashboard display pings up the message that your preferred brand is in stock. This is the Internet of Things.

In the [workplace](https://itchronicles.com/iot/does-the-iot-bring-new-business-security-risks-to-your-office/), IoT examples include inventory-tracking systems that know when you’re running low on supplies and automatically ordering more. Things like smart desks which alert employees when they’ve been sitting too long is another IoT example.

By now, you should know that IoT is not oly about machines or devices. By the term ‘THINGS’ it even includes us human beings.

In industries like manufacturing, IoT sensors in machines, equipment, productions lines, warehouses and vehicles can enable, for example, predictive maintenance – where the data gathered from these sensors produces real-time maintenance reports to alert an organization if a machine isn’t working properly or a part needs replacing. With a sophisticated Internet of Things system of this nature, the faulty part can be ordered and a field engineer scheduled to make the necessary repairs before any business disruption is caused.

IoT-enabled tags and sensors are also extremely useful in the supply chain – from the factory to the lorry to the warehouse to the shop floor, the Internet of Things can give organizations a single centralized view of precisely where everything is, how efficiently it’s being produced, how quickly it’s being shipped, and how fast it’s selling. (In fact, this is where the Internet of Things began in earnest – see “History of IoT” below.)

In [healthcare](https://econsultancy.com/internet-of-things-healthcare/), everything from ingestible sensors to connected asthma inhalers and contact lenses are now becoming a reality, alerting patients and healthcare professionals alike from inside the body to the state of ongoing health conditions and how medications are being taken.

**Common Branches of IoT**

**Data center**

It is one of the main stages of[**IoT architecture**](https://www.vapulus.com/en/4-stages-of-iot-architecture/)stages. it used in management, monitoring, and automation. IoT products help business to process the overflow of data that will happen in the next few years. also enabling multiple data center locations to be monitored, connected sensors could also help IT better automate tasks like provisioning.

**Supply chain and inventory management**

It used to optimize operations through workflow management, supply chain management, and warehouse management. business can work more effectively by using connected sensors. which inventory types can be grouped into four classifications: raw material, work-in-process, finished goods, and MRO goods.

**Surveillance and security monitoring**

While connecting devices to the network, it became a valuable tool for data collection and becomes a candidate for easier management. they have cameras and electronic systems like doors and sensors that they are then bringing back into a monitoring scheme.

**Contextual product features**

The information that is collected from IoT back to the user as personalized features and contextual cues. IoT plans that targeting new services to customers that do not directly generate revenue such as enhanced product features.

**Mobile device management**

The flow of new data and devices causes some challenges for mobile device management. it allows business to understand how devices are being used and maintained and providing better device tracking.

**Building or facility management**

Using IoT and its sensors and algorithms will enhance the company activity and give it the productivity. For example, and begin booting up the conference-call hardware a few minutes before a meeting starts. By utilizing smart sensors, businesses could save a lot of money on their energy bills.

**Asset management**

They make well-timed investment decisions on behalf of their clients to grow their finances and portfolio. Working with a group of several investors, asset management firms are able to diversify their clients’ portfolios. By tracking usage data, these firms can more accurately predict when something might go wrong with a device, and fix it before the problem leads to production issues or delays.

**Fleet management**

That is responsible for the management of vehicles. Companies use IoT for operating fleets of vehicles are able to better track the vehicle’s journey. People using the sensor packages that are in an iPhone to do analytics.

**Healthcare**

IoT is used in the healthcare field. there are numerous applications in healthcare, from remote monitoring to smart sensors and medical device integration. it is used to keep patients safe and healthy and to improve how physicians deliver care. IoT applications in healthcare:

* Research.
* Devices.
* Care.
* Medical Information Distribution.
* Emergency Care.

**Retail**

[**Commercial IoT applications**](https://www.vapulus.com/en/commercial-application-of-iot/) are various among them retail they used to connect the success of e-commerce with the physical, brick-and-mortar store experience. examples of these applications:

* Automated Checkout.
* Personalized Discounts.
* Beacons.
* Smart Shelves.
* In-store Layout Optimization.
* Robot Employees.
* Optimizing Supply Chain Management.

**Introduction**   
IoT architecture elements vary based on applications of use. Based on this fact, various levels are defined for IoT system. Let us understand these IoT levels with their elements and examples of their usage. Let us take example of air conditioner whose temperature has to be monitored to understand IoT levels.

### IoT Level 1

• This level consists of air conditioner, temperature sensor, data collection and analysis and control & monitoring app.   
• The data sensed in stored locally.   
• The data analysis is done locally.   
• Monitoring & Control is done using Mobile app or web app.   
• The data generated in this level application is not huge.   
• All the control actions are performed through internet.   
• **Example:** Room temperature is monitored using temperature sensor and data is stored/analysed locally. Based on analysis made, control action is triggered using mobile app or it can just help in status monitoring.

### IoT Level 2

• This level consists of air conditioner, temperature sensor, Big data (Bigger than level -1, data analysis done here) , cloud and control & monitoring app.   
• This level-2 is complex compare to level-1. Moreover rate of sensing is faster compare to level-1.   
• This level has voluminous size of data. Hence cloud storage is used.   
• Data analysis is carried out locally. Cloud is used for only storage purpose.   
• Based on data analysis, control action is triggered using web app or mobile app.   
• **Examples:** Agriculture applications, room freshening solutions based on odour sensors etc.

Image Courtesy from Book on Internet of Things by Shriram, Abhishek and Sundaram

### IoT Level 3

• As shown in the figure, this level consists of air conditioner, temperature sensor, big data collection (Bigger than level-1) , cloud (for data analysis) and control & monitoring app.   
• Data here is voluminous i.e. big data. Frequency of data sensing is fast and collected sensed data is stored on cloud as it is big.   
• Data analysis is done on the cloud side and based on analysis control action is triggered using mobile app or web app.   
• **Examples:** Agriculture applications, room freshening solutions based on odour sensors etc.

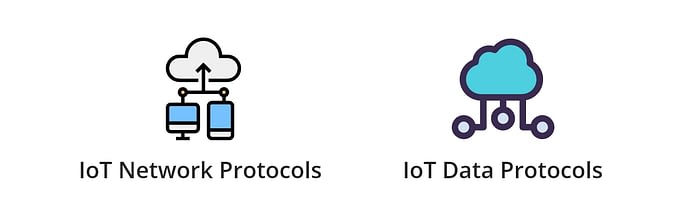
### IoT Level 4

• This level consists of multiple sensors, data collection and analysis and control & monitoring app.   
• At this level-4, multiple sensors are used which are independent of the others.   
• The data collected using these sensors are uploaded to the cloud separately. The cloud storage is used in this level due to requirement of huge data storage.   
• The data analysis is performed on the cloud and based on which control action is triggered either using web app or mobile app.

### IoT Level 5

• This level consists of multiple sensors, coordinator node, data collection and analysis and control & monitoring app.   
• This level is similar to level-4 which also has huge data and hence they are sensed using multiple sensors at much faster rate and simultaneously.   
• The data collection and data analysis is performed at the cloud level.   
• Based on analysis,control action is performed using mobile app or web app.

## ****Types of IoT Protocols****



### **IoT Network Protocols –**

IoT network protocols are designed to connect medium to high power devices over the network. IoT network protocols  allow  data communication within the scope of the network.

WiFi, LoRaWAN, bluetooth, zigbee are some of the **popular IoT Network protocols.**

### **IoT Data Protocols –**

IoT data protocols are designed to connect low power IoT devices. Without any internet connection, they are capable of providing end-to-end communication with the hardware.

Though the connectivity in IoT data protocols can be done via a wired or cellular network.

WebSocket, (REST), MQTT, CoAP, AMQP, XMPP are some of the **popular IoT data protocols.**

## ****IoT Communication Protocols 2021 [Updated]****

### 1. **Wifi**

**Standard-** Based on IEEE 802.11n (Commonly used in Homes today)

**Frequencies-** 2.4 GHz and 5 GHz bands

**Range- Approx.** 50meter that can go up to 100 meters

**Data Rates-** 600 Mbps maximum, the most common is 150-200 Mbps. Also depending on the channel frequency used & number of antennas( latest 802.11-ac standard should offer 500 Mbps to 1 Gbps)

It is one of the most popular IoT communication protocols. This connection type works best for the LAN environment and offers fast data transfer. Capable to process large amounts of data, it is the go-to choice for many developers.

As mentioned above, based on IEEE 802.11n standard it is mostly used in homes and various businesses, which offers a range of hundreds of megabit/ sec, which is fine for the file transfers but becomes too power-consuming for many IoT applications.

### 2. **Bluetooth**

**Standard-** Bluetooth 4.2 core specification

**Frequencies-** 2.4 GHz (ISM)

**Range- Approx.** 50-150meter(Smart/BLE)

**Data Rates –** 1 Mbps(Smart/BLE)

Bluetooth is one of the most important short-range communication technologies. It’s suitable to send small chunks of data for personal products like smartwatches.

Highly suitable for mobile devices, it’s the significant IoT protocol. Nowadays the new Bluetooth Low-Energy(BLE) or Bluetooth Smart is what IoT development companies are using for various consumer product markets.

With reduced power consumption, this technology is a real foundation for the IoT. It is scalable and flexible to all market innovations.

### 3. **Zigbee**

**Standard-** Zigbee 3.0 based on IEEE802.15.4

**Frequencies-** 2.4 Ghz

**Range- Approx.** 10-100m

**Data Rates –** 250 kbps

It’s again one of the important protocols. It has some significant advantages in complex systems offering low power operation, high security, robustness & high scalability as well as a position to take advantage of wireless control.  
Like Bluetooth, there is a vast user base of ZigBee.

It is designed especially for industrial sites where low power is required and less for the consumers’ network. With a maximum 1024 number of nodes in the network, Zigbee can transfer data with a range of up to 200 meters, ZigBee can even use 128 bit AES encryption.

### 4. **MQTT**

**Standard-** ISO/IEC 20922

**Data Rates –** Upto 256 Mb in size

MQTT is a lightweight message protocol for sending simple data flows from sensors to applications and middleware.  It works on top of the TCP/IP network for supplying reliable yet simple streams of data.

Though it may work with any network that provides ordered, lossless, & bi-directional connections. The MQTT protocol comprises 3 key elements: subscriber, publisher, and a broker.

It proves to be a better choice for wireless networks that experience occasional bandwidth constraints or unreliable connections. Facebook has used MQTT in the Facebook Messenger for online chat.

**We have a dedicated blog on connecting IoT with MQTT.**

[Explore Now!](https://hashstudioz.com/blog/connecting-internet-of-things-iot-with-mqtt/)

### 5. **OPC- UA**

OPC UA  is one of the most important communication **protocols** for Industry 4.0 and the IoT. It comes under the industrial M2M communication protocol.

Like MQTT, it is a platform-independent standard through which various types of systems and devices can communicate by sending request and response messages between the clients and servers.

At hashstudioz, We have used it to integrate the sensor of monitoring devices for valves and their electric actuators.

Picking the right IoT protocol may mean everything to your business’s IoT project. We assure you it’s done right!!

### 6. **Cellular**

**Standard-** GSM/GPRS/EDGE(2G), UMTS/HSPA(3G),  LTE(4G)

**Frequencies-** 900/1800/1900/2100MHz

**Range- Approx.** 35km max for GSM, 200 km max for HSPA

**Data Rates (For avg download)-** 35-170 kbps

**Cellular IoT protocols**need not pre-established gateways to create a coverage area.

Hence preferable for a regional, country-wide, or even transcontinental scale.

Though cellular networks capable of facilitating massive flows of data, cellular-enabled IoT devices use a ton of power.

Whenever there is a requirement to connect objects like the streetlights, parking meters, and hospitals or the myriad industrial applications like manufacturing and agriculture units then cellular protocols can enhance the connectivity.

The infrastructural simplicity combined with the emergence of 5G makes cellular communication protocols a go-to choice.

### 7. **Z wave**

Source: <https://z-wavealliance.org/>

**Standard-** Z-wave Alliance

**Frequencies-** Various

**Range- Approx.** 30m

**Data Rates –** 0.3 to 50 Kbps

This wireless communication protocol is based on low power RF communication technology

Highly preferable for home automation products such as lamp controllers, sensors among many others.

It’s very scalable enabling control for up to 232 devices.

Based on the **mesh network topology**, Z-Wave based devices can attain a communication distance of up to 40 meters, with the additional ability of messages to Hop up between up to 4 nodes.

It covers layers from physical to application for **network communications**.

### 8. **NFC (Near Field Communication)**

**Standard-** ISO/IEC 18000-3

**Frequencies-** 13.56MHz (ISM)

**Range- Approx.** 10cm

**Data Rates –** 100-420 kbps

NFC is one of the popular communication protocols these days. With the huge market share of smartphones, this protocol allows customers in making contactless payments through their smartphones.

The protocol uses electromagnetic induction between two loop antennas located within each other near the field. This way it extends the capability of contactless card technology and facilitates devices to share information at a distance that is less than 4cm.

NFC allows two communication modes

* **Passive communication mode**: In this mode, only one **NFC** device generates an RF field. The second device referred to as the target uses a technique called load modulation to transfer the data back to the primary device/initiator.
* **Active Communication mode:** In this mode of communication, both NFC devices generate an RF signal on which the data is carried.

### 9. **LoR**aWAN

**Standard-** LoRaWAN

**Frequencies-** Various

**Range- Approx.** 2.5 km( Urban environment), 15 km (Suburban environment)

**Data Rates –** 0.3 to 50 Kbps

Lora is a long-range radio wide area network that provides low-cost mobile security to IoT, Smart cities, and Industrial applications. It’s optimized for low power consumption and supports a large network of millions of devices.

Smart street lighting is a practical example, where the street lights are connected with the LoRa gateway that uses the LoRaWAN protocol.

It has the feature to detect the signals below the noise level along with builtin **security** and GPS-free positioning.

### 10. **SigFox**

**Standard-** Sigfox

**Frequency-** 900Mhz

**Range-** 30-50km(rural environments), 3-10km(urban environments)

**Data Rates –** 10- 1000bps

Sigfox communication is aimed at the low-cost M2M application areas where wide-area coverage is required.

The SigFox wireless interface allows any communications requiring a minimum amount of power consumption. So if you are looking for a better choice for remote devices that need to be run on battery power for very extended periods without the need for any battery changes or maintenance, then go for SigFox communication protocol.

It has bidirectional functionality and is used in IoT infrastructure including:

* Home and consumer goods
* Transportation – this can include automotive management
* Energy-related communications like smart metering
* Retail including PoS, shelf updating, etc