The Internet of Things

What Does It Mean?

It is very improbable that you have not heard the term “Internet of Things” being thrown around quite often. You use the Internet of Things (also known as IoT) technologies every day without even knowing it. So what exactly do we mean when we talk about the “Internet of Things”?

According to Wikipedia the Internet of Things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data. The term IoT refers to a system of computing devices in the physical world which have been connected to the internet. These devices can either send or receive data from the internet.

Difference Between IoT Devices and Normal Computing Devices (Computers and Mobile Phone)

- While computers (and by extension smartphones) are general purpose machines able to run different kind of code and software, IoT devices are special purpose devices that contain only the necessary hardware and software to do one task or a set of related tasks.
- IoT devices have another function separate from computing while a computers main work is to run code.

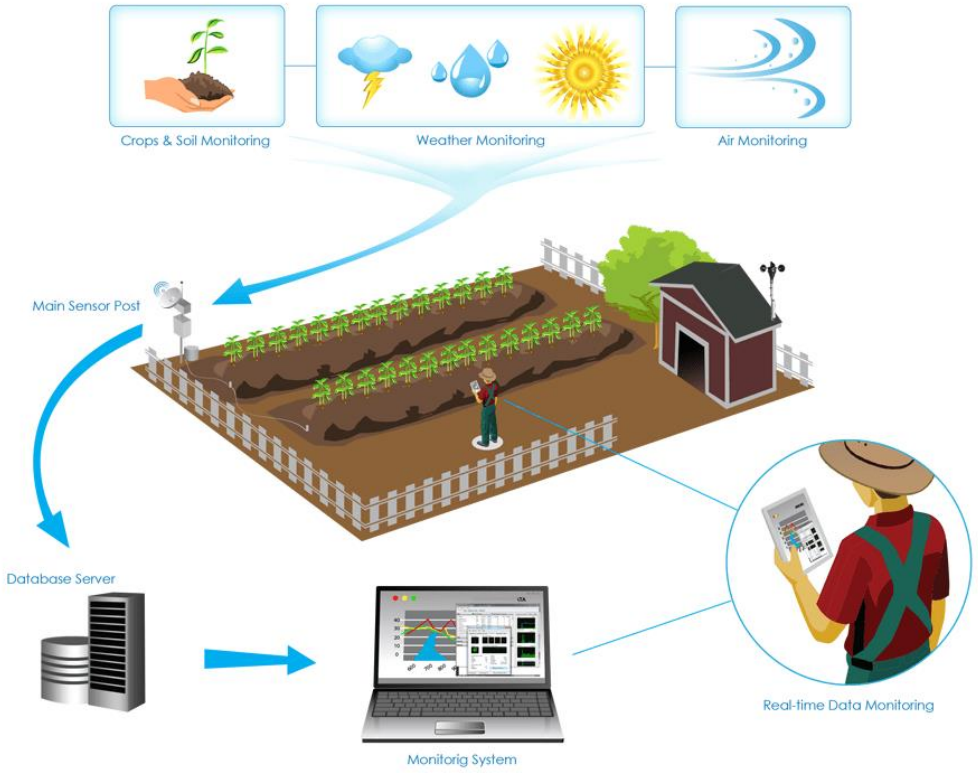
It is Everywhere!

The Internet of Things finds applications in practically every industry. To name a few; manufacturing, infrastructure, transportation, healthcare, agriculture, hospitality, and defence. Anything that is able to receive and send data from the internet (apart from the traditional computers, smartphones and networking devices such as routers) is most likely an IoT subsystem.

Use Cases

The use cases for IoT are endless.

Agriculture



Farmers are using IoT to track equipment location and performance, and increasingly livestock grazing in open pastures. IoT sensors are also determining soil moisture levels to control irrigation systems and minimize water consumption. A farmer could have sensors connected around their farm to monitor and store temperature, humidity and soil moisture levels.

Predictive maintenance

With the use of sensors, cameras and data analytics, managers in a range of industries are able to determine when a piece of equipment will fail before it does. These IoT-enabled systems can sense warning signs, use data to create maintenance timelines and pre-emptively service equipment before problems occur.

Smart metering

A smart meter is an internet-capable device that measures energy, water or natural gas consumption of a building or home. Traditional meters only measure total consumption, whereas smart meters record when and how much of a resource is consumed. Power companies are deploying smart meters to monitor consumer usage and adjust prices according to the time of day and season.

Smart metering also helps utilities:

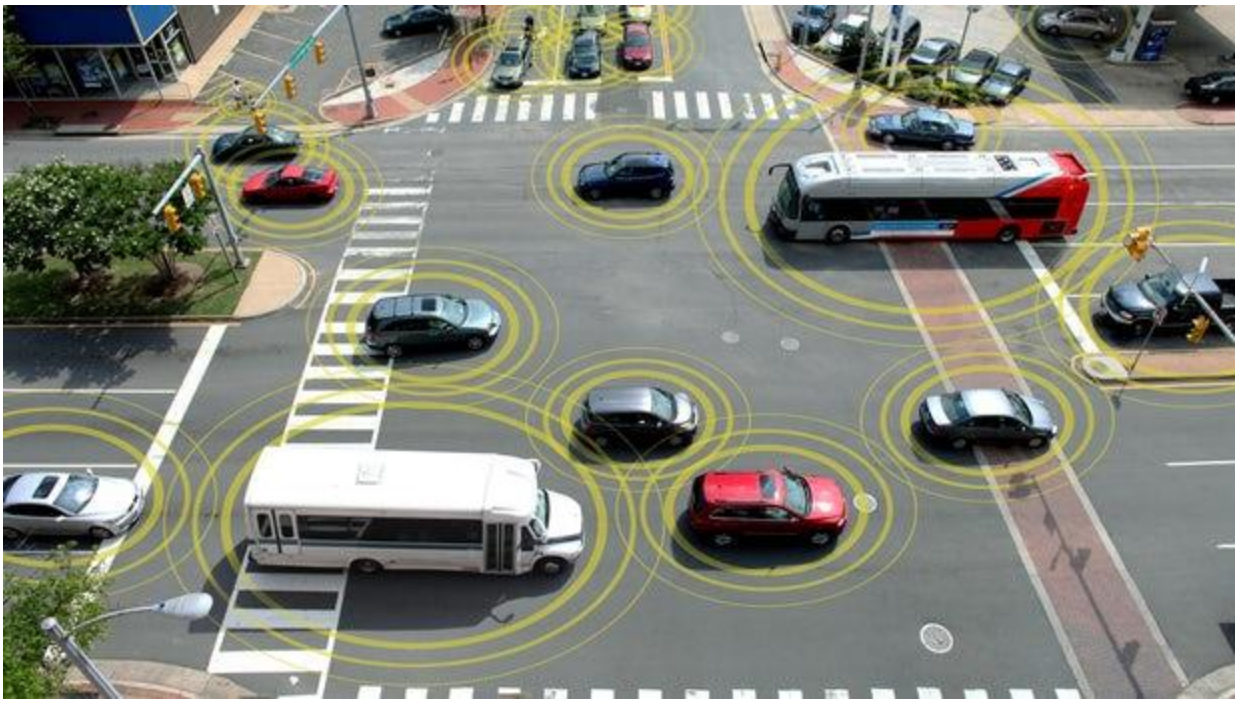
- Reduce operating expenses by managing manual operations remotely
- Improve forecasting and streamline power-consumption
- Improve customer service through profiling and segmentation
- Reduce energy theft
- Simplify micro-generation monitoring and track renewable power

Asset tracking

The goal of asset tracking is to allow an enterprise to easily locate and monitor key assets, including along the supply chain (e.g. raw materials, final products and containers) to optimize logistics, maintain inventory levels, prevent quality issues and detect theft.

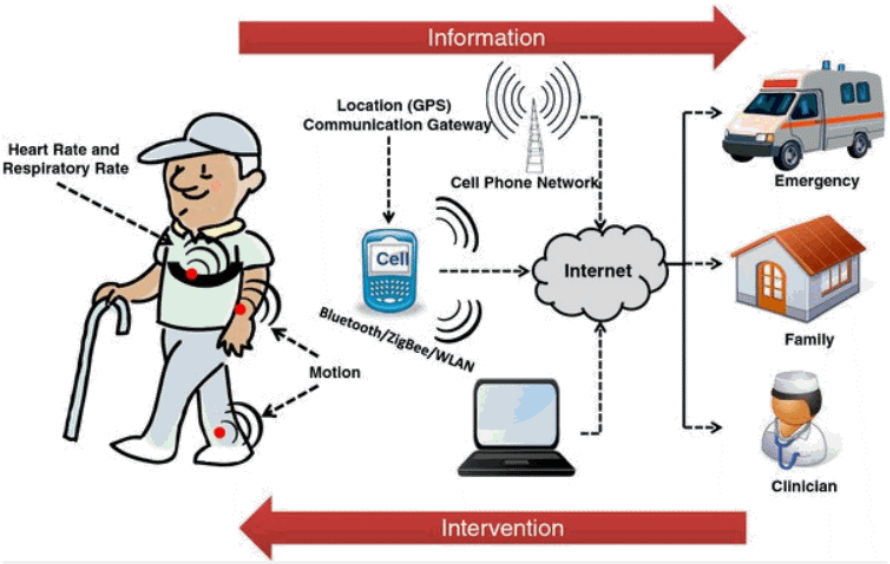
One industry that heavily relies on asset tracking is maritime shipping. On a large scale, sensors help track the location of a ship at sea, and on a smaller scale, they can provide the status and temperature of individual cargo containers. One benefit is real-time metrics on refrigerated containers; these containers must be stored at constant temperatures so perishable goods remain fresh.

Connected vehicles



These are computer-enhanced vehicles that automate many normal driving tasks – in some cases, even driving themselves. Cameras, radar and lasers are among the sensors feeding information into the differential GPS. Cameras let the car's computers see what's around it, while radar allows vehicles to see up to 100 meters away in the dark, rain, or snow. Lasers, which look like a spinning siren light, continuously scan the world around the car and provide the vehicle with a continuous, 3-D omnidirectional view of its surroundings.

Healthcare



IoT in Remote Health Monitoring

IoT can be used in monitoring blood pressure and heart rate, for example, and even automatically alerting emergency personnel when they detect problematic readings—or to send help when an elderly person has fallen and can't get up.

Homes

Connected devices include TVs, refrigerators, lights, thermostats, smoke detectors and other sensors, security systems and much more. Hotels have long pioneered using IoT for room keys. You could hook up a camera subsystem in your fridge that checks which food items are used up and sends you a text alert. Or maybe you want your umbrella to tell you whenever it's going to rain as you are about to leave your house.

Smart parking:

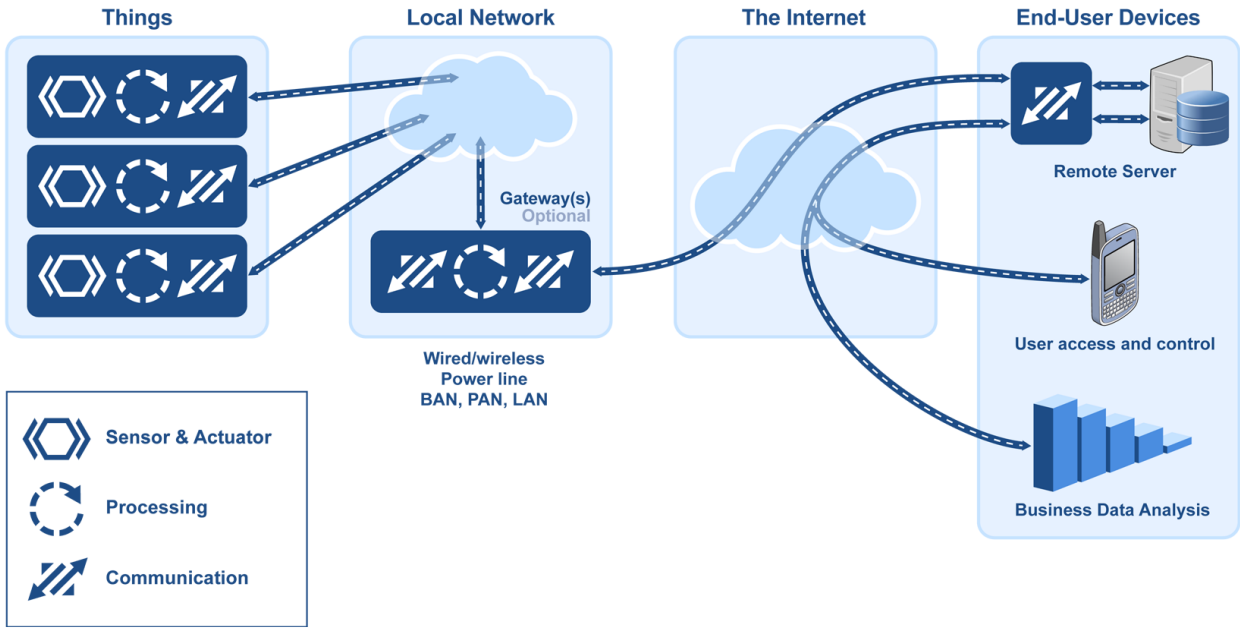
Sensors can be used to sends a message when a vehicle arrives or leaves a parking spot. This can be combined with an app to find a free parking spot

Environment monitoring

IoT allows for the collection of sound, temperature, pollution, radiation, humidity readings. This can be used to create valuable insights in combination with geolocation

How Does it all Work?

IoT is Made of Embedded Devices

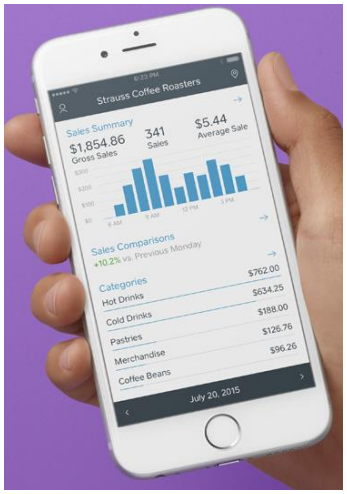


When it comes to IoT, the following definitions are useful to understand:

- ***Sensors***-this is basically a device that detects events in the physical world. Sensors are dumb components that in most cases produce voltages or some other quantity, in proportion to what they are measuring. There all kinds and manners of sensors; temperature, pressure, humidity, altitude, gas, light etc. Even cameras are primarily sensors! Sensors are always attached to a microprocessor unit, forming a sensor node. A sensor node is a subsystem consisting of sensors, microcontrollers or microprocessors, power supply and some communication mechanism. The sensor collects this information from the environment, the microprocessor interprets and processes to make sense of the data and the communication mechanism transmits the data to the internet.
- ***Actuators***-Remember we said that sensors collect data from the physical world, well what if we want to control some behaviour remotely? Actuators are basically components used to move or control a system. In the example of the ceiling fan, actuators are used to change the direction and speed of the blades accordingly.
- ***IoT Communication Network***-This refers to the mode at which these 'things' communicate to the internet. Such technologies include Ethernet, Wi-Fi, GSM, LoRaWAN, Bluetooth etc. Devices may combine several communication technologies in order to

send and receive data from the internet. For example, Bluetooth cannot be used directly to connect to the internet. The sensor node might be connected to a Bluetooth gateway which is in turn connected to an Ethernet network and thus able to communicate with the internet.

- ***IoT Cloud***- This is the system that the 'things' are so interested in connecting to. The cloud basically refers to computing resources that can be accessed over the internet. Instead of storing your files on your computer, you could store them on Google Drive and access them from anywhere as long as there is an internet connection. Same scenario for IoT. Sensor nodes are collecting massive amounts of data that needs to be stored somewhere. The IoT cloud offers this somewhere. The IoT cloud is not only used for storage but applications that use this data can also run on the cloud. Back to our ceiling fan example, you could run an application (on the cloud) that assesses the temperature sent room the ceiling fan. This application could periodically check the data coming from the app and automatically adjust the speed and direction of the fan without you ever having to do anything. Another aspect of the IoT cloud is analytics. IoT devices collect huge amounts of data. We need to make sense of this data to enable us to make informed decisions from it. That is where data analytics comes into play.
- ***Dashboard***- Users may need a platform to display information collected (and analytics) and a way to control their devices. This can either through a web interface or through a mobile phone app (Android or iOS).



It's not just Hype

IoT is everywhere, its use cases are limited only by our imagination. It basically consists of interconnected devices or 'things' that can send and receive data through the internet. It finds application in almost all industries known to man. One of the key features of IoT is that it is customized towards a specific use as per the particular need. The application of IoT technology can only continue to grow. In fact, It is estimated that by 2020 there will be a total of 50 billion connected devices and $267B will be spent on IoT technologies, products and services [1] [2]. It is then no wonder then that the likes of Amazon, IBM, GE, Cisco, Google, and Microsoft are investing big on IoT. So pay attention, the Internet of Things is not just hype, it is the real deal and it is here to change your life!

References

[1] Forbes, [Online]. Available: https://www.forbes.com/sites/louiscolumbus/2017/01/29/internet-of-things-market-to-reach-267b-by-2020/#31b21573609b.

[2] IEEE, [Online]. Available: https://spectrum.ieee.org/tech-talk/telecom/internet/popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated.