

Internet of Things: An Introduction

Welcome to Current Trends in Information Technology. In this course, we will explore some of the latest and most important concepts and technologies that are shaping our world today.

The internet is one of the most groundbreaking and life-changing technologies of our time. As of 2017, there are already 3.8 billion active internet users. That's about half of the entire human population. The Internet has changed and is still changing the way we do everyday tasks from communicating to learning to entertainment.

It is certainly hard to discuss modern technology, particularly Information Technology without talking about the Internet. That is why it is only fitting that we start our course Current Trends in Information Technology by exploring the next step in the evolution of the Internet. In this module, you will learn about The Internet of Things; what it is, how it started, and how it works.

By the end of this module, you should be able to:

01_Obj01: Define Important Terms About Internet of Things

01_Obj02: Indentify "Things" in Internet of Things

01_Obj03: Identify common types of sensors used to gather information about its environment

01_Obj04: Identify the technologies that are used to connect the Internet of Things

01_Obj05: Identify facts about the Internet and Internet of Things

What is the Internet of Things?

The Internet of Things or IoT is a computing concept in which everyday objects are connected to the Internet. Through wireless Internet connection, these objects can be accessed by us, the users as well as other objects and can be used to perform different tasks.

It is important to note that IoT is not a single technology but a unified concept that incorporates different kinds of computing technologies; the most prominent of which will be discussed in this module.

In the Internet of Things, everyday objects can be parts of online systems that provide us with different kinds of services. For example: CCTV cameras, locks, and sensors installed in a house can be connected to a online security system which can be accessed by the homeowner even if he is not at home and will automatically inform the police in case of a burglary.

History of IoT

The term *Internet of Things* was coined by Kevin Ashton when he was working for Procter & Gamble (P&G) in 1999. As a part of his work in supply chain optimization, Ashton gave a presentation with the goal of attracting P&G's senior management's attention to a new technology called Radio-Frequency Identification or RFID. His presentation was entitled "Internet of Things".

Later on in 2002, Forbes published an article also entitled Internet of Things which quoted Kevin Ashton saying "*We need an internet for things, a standardized way for computers to understand the real world.*"

Since its conception in 1999, Internet of Things has gradually become the widely accepted term that represents all the efforts to merge the physical world with the virtual world by creating an online presence for everyday objects.

What are these "things"?

When you first heard the term *Internet of Things*, one of the first questions that entered your mind was probably "What things?"

It is important to note that the word *thing* has a special meaning in IoT. In the context of IoT, a *thing* is any physical object that can connect to the Internet.

However, IoT does not end with giving physical objects an online presence. On the contrary, it is just the beginning. A “smart object” needs to have a function or a purpose.

“Smart” things

In the context of the Internet of Things, the adjective “smart” means anything that is IoT-based. Keep this in mind because you will be seeing this word a lot in this module and the next.

Sensors

In order to interact with the physical world, first, a smart object needs to gather information about its environment. For this purpose, a smart object needs to have sensors. As the name implies, a *sensor* is a component that detects a specific physical input. The following are common types of sensors with their definitions and examples:

- **Temperature sensor** – detects the temperature of an object or an environment.
Used for: Thermostats, digital thermometers, etc
- **Proximity sensor** – detects motion
Used for: alarm systems, parking sensors etc
- **Optical sensor** – converts light energy into digital signals
Used for: digital cameras
- **Pressure sensor** – converts physical power into electronic signals
Used for: touch screen devices
- **Humidity sensor** – measures the amount of water vapour in the atmosphere
Used for: weather related IoT Devices
- **Accelerometer** – measures acceleration
Used for: running apps, navigation
- **Gyroscope** – uses Earth’s gravity to detect the position or orientation of an object
Used for: 3d motion capture

Actuators

After receiving input from its environment, smart objects can then react or perform appropriate actions. This is done using actuators. An *actuator* is a component or mechanism that turns energy into motion. Basically, actuators comprise the “moving parts” of a smart object. For example, actuators in a CCTV camera allows the user to point it to different directions.

Connecting the Internet of Things

In the past, the only things that could connect to the Internet were computers; machines that are specifically designed to process, transmit, and receive digital information. These computers were big and bulky and needed cables to connect to the internet. Today, because of various advancements in hardware and software technology, computers have become smaller and more compact. More importantly, wireless technologies allow today’s smart devices to connect to networks without having to be plugged into a wall socket. The following are some of the most important technologies that are used to connect the Internet of Things:

IPv6

In order to understand the importance of IPv6 to the Internet of Things, we have to visit the birth of the Internet.

January 1 1983 is known as the day the Internet was born. On this day, the Advanced Research Projects Agency Network (ARPANET) which is the predecessor of the Internet started using the Transmission Control Protocol/Internet Protocol. TCP/IP is the network protocol of the Internet. It is basically the language that is used by the Internet. TCP/IP works by assigning an IP Address to every device that is connected to a network.

The *Internet Protocol Address* or IP Address is a unique set of numbers that is used to identify devices that are connected to a

network. IP Address works a lot like your home address. When you send a letter, you write your own address in the envelope. Without it, the recipient will not be able to send you a reply.

The IP address does the same thing for you in an online network. When you go to a website, you are basically requesting to have some information sent to you. Because you have a unique identification in the form of an IP address, the website will know where to send the data.

Internet Protocol version 4 or IPv4 is the version of the Internet Protocol that was use when ARPANET switched to TCP/IP. To this day, IPv4 is still the most widely used IP version in the world.

An IPv4 address looks like this:

172.16.254.1

An IPv4 address is 32 bits long. It consists of 4 decimal numbers separated by dots. Each decimal number has the range of 0 to 255. This allows for 4 billion combinations which means that there are 4 billion possible IPv4 addresses.

During the early days of the Internet, 4 billion IP addresses seemed like a lot but as Internet users grew in numbers, it became apparent that soon, 4 billion addresses will not be enough. A

In the 1990's, the Internet Engineering Task Force (IETF) which is an international community responsible for developing Internet standards started designing and developing the Internet Protocol version 6 or IPv6.

IPv6 addresses have a size of 128 bits. It is composed of eight groups of four hexadecimal digits separated by colons (:))

Note: Hexadecimal digits are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.

for Internet service providers to fully convert to IPv6. It will also be costly for consumers to replace their devices with IPv6 compatible ones. Another reason is that there is no urgent need to switch to IPv6. It is theoretically possible to run out of IPv4 addresses but presently, it's still not a major threat. IPv4 is still functional and reliable.

This however, is expected to change in the future mainly because of IoT. It is foreseen that billions of things will eventually be connected to the Internet. Eventually, the 4 billion address limit of IPv4 will be reached and the world will have no choice but to switch to IPv6.

Wireless

The Internet of Things needs to be *ubiquitous* which means it has to be available everywhere at any given time. This will not be possible without the ability to wirelessly connect to the Internet. The following are some of the major wireless technologies that are being used in IoT:



File:WiFi Logo.svg. (n.d.). Retrieved July 20, 2017, from https://en.wikipedia.org/wiki/File:WiFi_Logo.svg Public Domain

WiFi is one of the most common wireless technologies today. It is primarily used to connect devices such as laptops, tablets and smart phones to Internet routers, forming a local network.

The name WiFi is not an acronym but rather a play on words with Hi-Fi or high fidelity which is to refer to high-quality audio reproduction in speakers and stereos.



House. (n.d.). File:BluetoothLogo.svg. Retrieved July 20, 2017, from <https://en.wikipedia.org/wiki/File:BluetoothLogo.svg> Public Domain

Bluetooth is wireless technology that is ideal for exchanging information over short distances. Today, Bluetooth is commonly used to connect peripheral devices such as wireless keyboards, mice, and speakers to laptops and mobile phones. Recently, it's also being used to connect wearables such as smart watches to smart phones.

Bluetooth is named after Harald "Bluetooth" Gormsson a Viking king of Denmark and Norway in the 10th Century.



Zigbee Alliance. (n.d.). Zigbee Logo. Retrieved July 20, 2017, from <http://www.zigbee.org/>

Zigbee is a wireless technology designed for *machine to machine* or M2M communication. Zigbee is ideal for IoT applications because it is inexpensive and does not require a lot of power to operate. According to the Zigbee Alliance, "*Zigbee allows devices to last for years on a single battery.*"

The name Zigbee was inspired by the waggle dance or motion that is done by honey bees to give directions to one another.



Z-wave.com. (n.d.). Z-Wave Logo. Retrieved July 20, 2017, from <http://www.z-wave.com/>

Z-Wave is a wireless technology that is primarily designed for home automation. According to the Z-Wave Alliance: *“The Z-Wave protocol is an interoperable, wireless, RF(Radio Frequency)-based communications technology designed specifically for control, monitoring and status reading applications in residential and light commercial environments.”*

Glossary of Terms

IoT – or Internet of Things is a computing concept in which everyday objects are connected to the Internet.

SMART – In the context of the Internet of Things, it means anything that is IoT-based.

SENSOR – is a component that detects a specific physical input.

ACTUATOR – is a component or mechanism that turns energy into motion.

IP ADDRESS – or *Internet Protocol Address* is a unique set of numbers that is used to identify devices that are connected to a network.

WiFi – is one of the most common wireless technologies today.

BLUETOOTH – is wireless technology that is ideal for exchanging information over short distances.

ZIGBEE – is a wireless technology designed for *machine to machine* or M2M communication.

Z-WAVE – is a wireless technology that is primarily designed for home automation

WIRELESS - does not use wires to connect between network nodes

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Links to Videos and Readings

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