14.2.2 Internet of Things Facts

The internet of things (IoT), also known as the internet of everything (IoE), is a system of connected computing devices and objects that use unique identifiers and send data over a network without requiring human interaction. Many industries are using IoT to operate more efficiently and better serve their customers. Important key features of IoT include connectivity, sensors, artificial intelligence, small devices, and active engagement.

This lesson covers the following topics:

- IoT components
- IoT architecture
- IoT application areas and devices

IoT Components

IoT technology comprises four primary components: devices, gateway systems, data storage systems using the cloud, and remote control through mobile apps.

Component	Description
Devices	IoT devices are built with sensors that capture data. These sensors can be included in such devices as cameras, GPS systems, temperature reading equipment, and heart monitoring equipment. The sensors in the device collect data and send it to the cloud.
Gateway system	In order to send data to the cloud, IoT devices need a connection of some kind. They could be connected via cellular, satellite, Wi-Fi, Bluetooth, LPWAN, or Ethernet. Each connection type offers different advantages and disadvantages regarding bandwidth, range, and power consumption. We will talk more in depth about these later in the lesson.
Data storage	Once the data reaches the cloud, it is processed and analyzed by software. Examples include that the temperature reading is checked, trespassers are detected on the security camera video feed, and your location is determined on a GPS device. After the received data is processed completely, the result or conclusion is sent to the device application server and interface.
Remote control	This is when the user has a chance to interact with the device. App notifications, emails, and texts make the information gathered by the device available to the user. Using predefined rules set up by the user, the device can take action on its own instead of waiting for a command from the user. Another way of interacting with an IoT device is through an interface such as an app that allows the user to check on the system at any time without being prompted by the device itself. Often, users are able to give commands to IoT devices. In most cases, IoT devices can perform certain actions automatically.

IoT Architecture

With so many devices operating in one system that is connected with other processes, IoT needs a well-defined and effective architecture to function properly. To meet this requirement, the IoT has been structured into an architecture of layers. The layers help track the system's consistency. There are five layers: edge technology, access gateway, internet, middleware, and application.

Layer	Description
Edge technology	The edge technology layer includes all the hardware parts in the IoT system. This means the sensors, RFID tags, readers, and others. This sensor hardware collects the data for the IoT device. The amazing thing about these sensors is that they’re capable of converting the sensory information they capture into data for analysis. Some devices, known as acting devices, take action immediately based on the sensory input.
Access gateway	The access gateway layer is very important because the huge amount of information gathered on the first step is collected and then compressed to an optimal size for transmission and processing. This is also the stage when the data is converted to a digital form. This layer takes care of message routing, message identification, and subscription.
Internet	The internet layer is the main bridge between two endpoints in an IoT system. It connects devices to other devices, the cloud, the gateway, and backend data sharing. This is when the data that was prepared in the previous step is sent to the middleware layer. Some systems may conduct advanced analytics and pre-processing during this stage.
Middleware	The middleware layer covers the processes that happen in the cloud. It allows in-depth processing, data management, device management, data aggregation, data filtering, device information discovery, access control, and revision for feedback. This layer acts as the interface between the hardware and application layers; that’s why it’s called the middleware layer. Once all the quality standards and requirements are met, the processed and analyzed data is ready to be sent back to the devices.
Application	The application layer is the last one in the IoT architecture. Its primary responsibility is to deliver the analyzed and processed data from the previous step to the end user. Then the user checks the data it receives and manages it with new commands to the devices

	or sensors. The process then restarts from the beginning.

IoT Applications

You will find IoT technology in many places. Some applications of IoT devices are thermostat, lighting systems, and security systems for homes and buildings; pacemakers, surgical equipment, and telemedicine for hospitals and clinics; smart watches and training bracelets; water distribution and traffic management for cities; and smart grids with automatic electric distribution to save resources and power.

Examples of Industrial Internet of Things (IIoT) devices are monitor that track health of cattle; monitoring the humidity and composition soil for farming; increasing production and managing quality control as part of vehicle-to-vehicle, vehicle-to-roadside, and vehicle-to-pedestrian communication for transportation; and advertisement and product monitoring for retail.
