UNIT IV

IoT PHYSICAL DEVICES AND ENDPOINTS

IoT Device

A "Thing" in Internet of Things (IoT) can be any object that has a unique identifier and which can send/receive data (including user data) over a network (e.g., smart phone, smartTV, computer, refrigerator, car, etc.).

• IoT devices are connected to the Internet and send information about themselves or about their surroundings (e.g. information sensed by the connected sensors) over a network (to other devices or servers/storage) or allow actuation upon the physical entities/environment around them remotely.

IoT Device Examples

A home automation device that allows remotely monitoring the status of appliances and controlling the appliances.

• An industrial machine which sends information abouts its operation and health monitoring data to a server.

• A car which sends information about its location to a cloud-based service.

• A wireless-enabled wearable device that measures data about a person such as the number of steps walked and sends the data to a cloud-based service.

Basic building blocks of an IoT Device

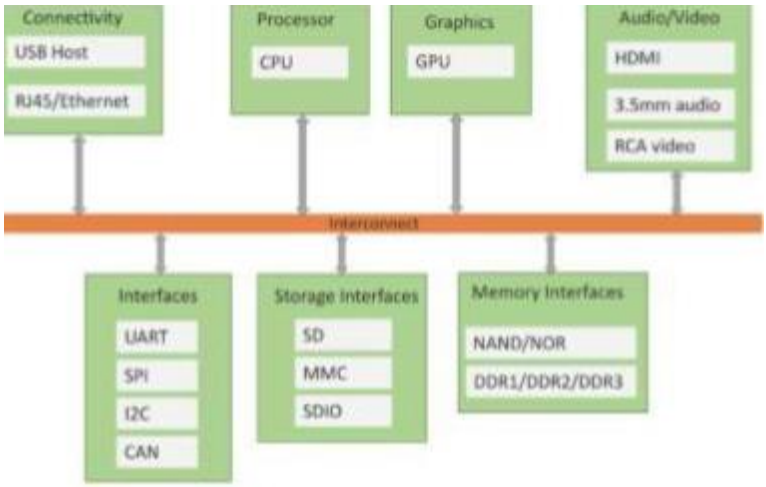
1. **Sensing:** Sensors can be either on-board the IoT device or attached to thedevice.

2. **Actuation:** IoT devices can have various types of actuators attached that allow taking actions upon the physical entities in the vicinity of thedevice.

3. **Communication:** Communication modules are responsible for sending collected data to other devices or cloud-based servers/storage and receiving data from other devices and commands from remote applications.

4. **Analysis & Processing:** Analysis and processing modules are responsible for making sense of the collecteddata.

Block diagram of an IoT Device



Exemplary Device: Raspberry Pi

Raspberry Pi is a low-cost mini-computer with the physical size of a credit card. Raspberry Pi runs various flavors of Linux and can perform almost all tasks that a normal desktop computer can do. Raspberry Pi also allows interfacing sensors and actuators through the general purpose

I/O pins. Since Raspberry Pi runs Linux operating system, it supports Python "out of the box". Raspberry Pi is a low-cost mini-computer with the physical size of a credit card. Raspberry Pi runs various flavors of Linux and can perform almost all tasks that a normal desktop computer can do. Raspberry Pi also allows interfacing sensors and actuators through the general purpose I/O pins. Since Raspberry Pi runs Linux operating system, it supports Python "out of the box".

Raspberry Pi

Linux on Raspberry Pi

1. Raspbian: Raspbian Linux is a Debian Wheezy port optimized for RaspberryPi.

2. Arch: Arch is an Arch Linux port for AMDdevices.

3. Pidora: Pidora Linux is a Fedora Linux optimized for RaspberryPi.

4. RaspBMC: RaspBMC is an XBMC media-center distribution for RaspberryPi.

5. OpenELEC: OpenELEC is a fast and user-friendly XBMC media-centerdistribution.

6. RISC OS: RISC OS is a very fast and compact operatingsystem.

Raspberry Pi Interfaces

1. **Serial**: The serial interface on Raspberry Pi has receive (Rx) and transmit (Tx) pins for communication with serialperipherals.

2. **SPI:** Serial Peripheral Interface (SPI) is a synchronous serial data protocol used for communicating with one or more peripheraldevices.

3. **I2C:** The I2C interface pins on Raspberry Pi allow you to connect hardware modules. I2C interface allows synchronous data transfer with just two pins - SDA (data line) and SCL (clockline).

Raspberry Pi Example: Interfacing LED and switch with Raspberry Pi

```
from time import sleeP import RPi.GPIO asGPIO GPIO.setmode(GPIO.BCM)
#Switch Pin GPIO.setup(25,GPIO.IN) #LEDPin
GPIO.setup(18,GPIO.OUT)
state=false
deftoggleLED(pin):
state = not state GPIO.output(pin,state)
whileTrue:
try:
if (GPIO.input(25) ==True):
toggleLED(pin) sleep(.01)
```

exceptKeyboardInterrupt:
exit()

Other Devices

1. pcDuino

2. BeagleBoneBlack

3. Cubieboard