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THE INTERNET OF THINGS

Understanding its origins and impact

PRESENTATION HIGHLIGHTS

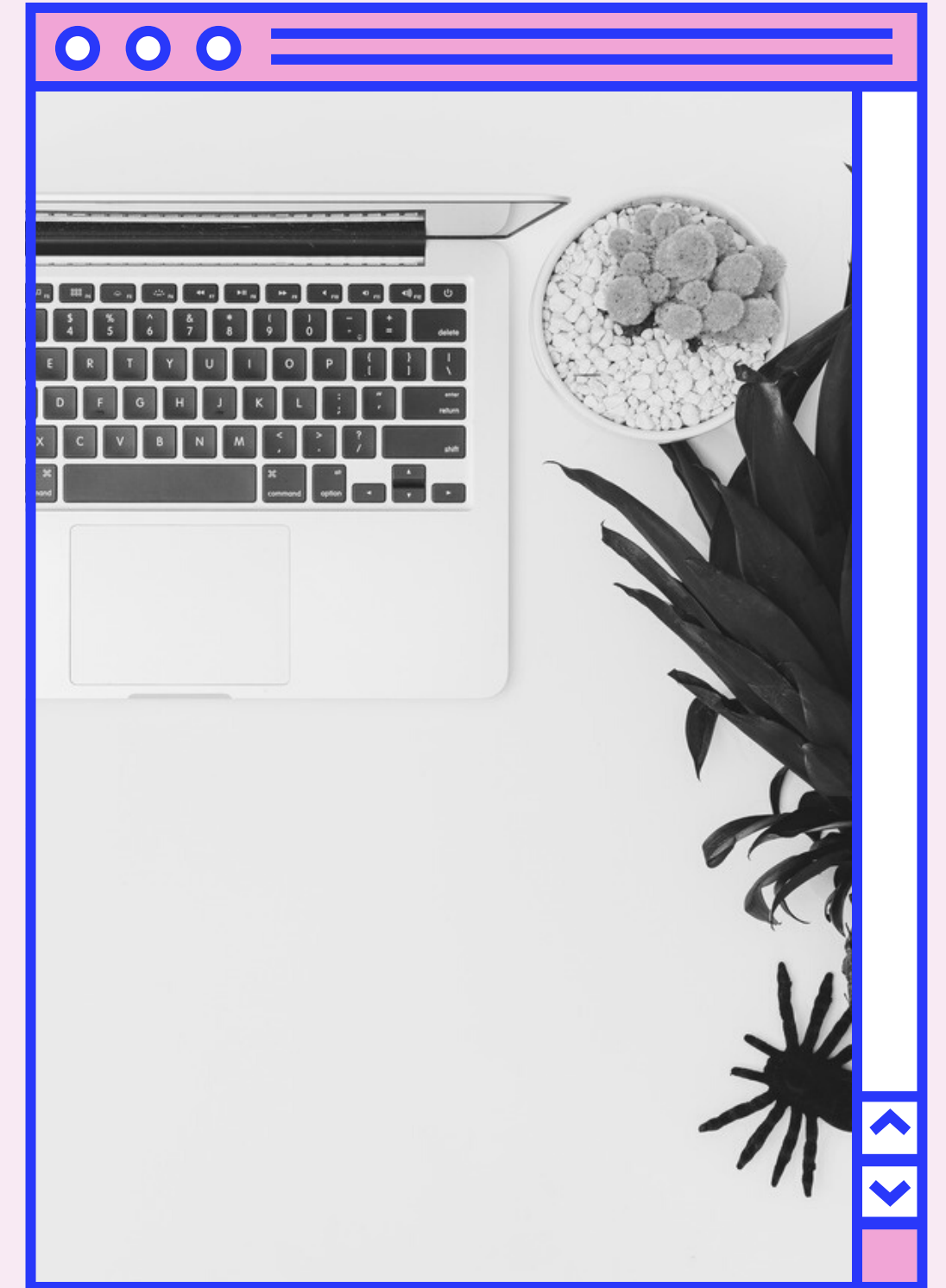
FOCUS AREAS

- Defining the IoT
- How the IoT Works
- IoT Applications
- Development of the IoT
- Benefits of IoT
- IoT Implementation Challenges
- About the Team

A NEW AGE OF INTERCONNECTIVITY

DEFINING THE IOT

What is IOT?



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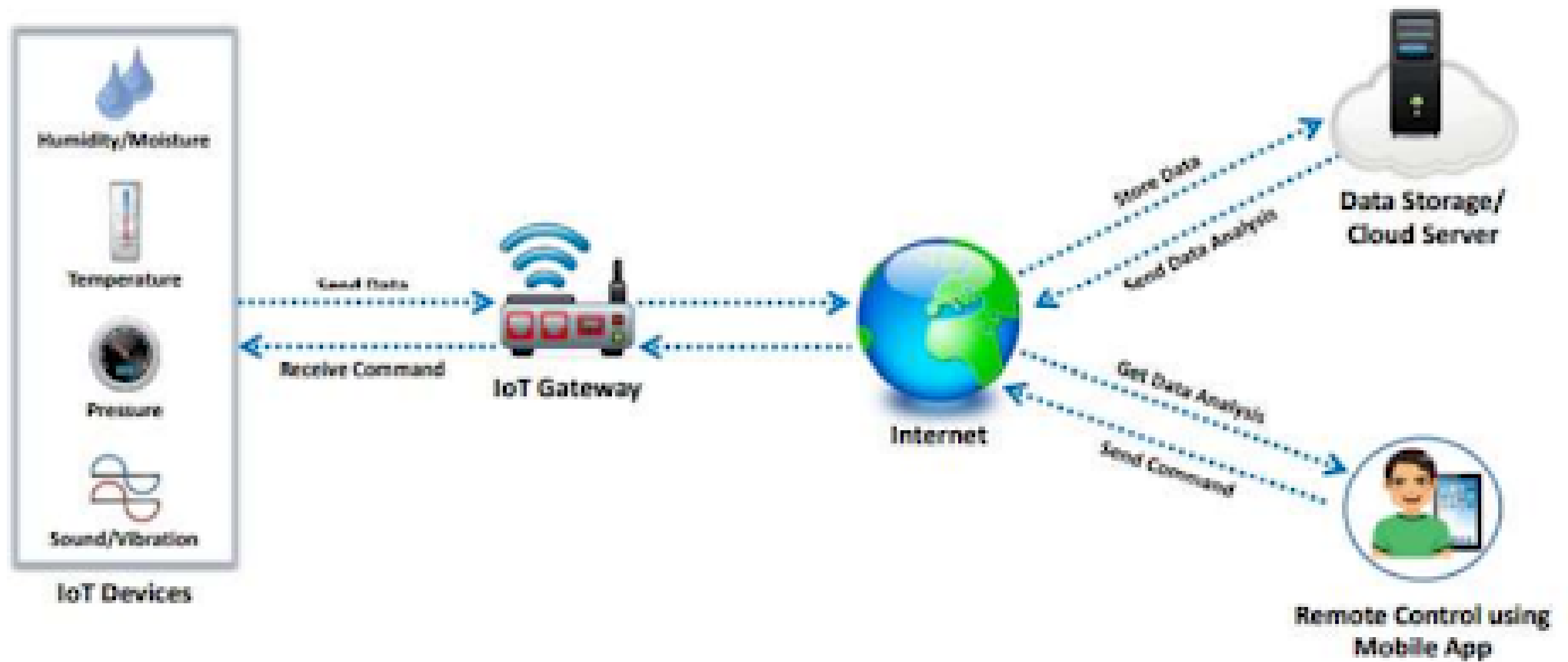
WHAT IS IOT?

Internet of Things (IoT), also known as Internet of Everything (IoE), refers to the network of devices having IP addresses and the capability to sense, collect, and send data using embedded sensors, communication hardware and processors.

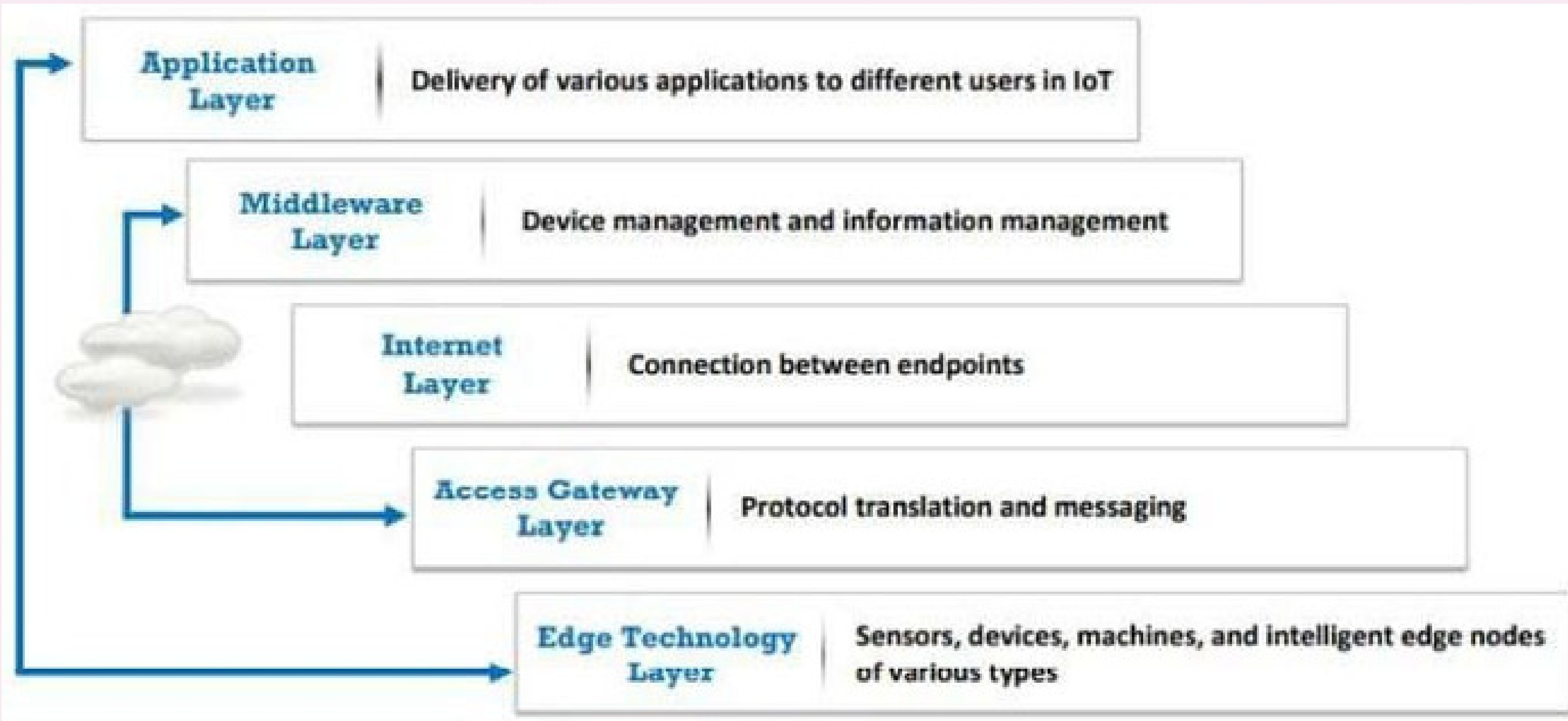
In IoT, the term thing is used to refer to a device that is implanted on natural, human-made, or machine-made objects and has the functionality of communicating over the network.



HOW IOT WORKS?



IOT ARCHITECTURE



IOT APPLICATION AREAS AND DEVICES

Service Sectors	Application Groups	Locations	Devices
Buildings	Commercial/Institutional	Office, Education, Retail, Hospitality, Healthcare, Airports, Stadiums	HVAC, Transport, Fire & Safety, Lighting, Security, Access, etc.
	Industrial	Process, Clean Room, Campus	
Energy	Supply/Demand	Power Gen, Trans & Dist, Low Voltage, Power Quality, Energy management	Turbines, Windmills, UPS, Batteries, Generators, Meters, Drills, Fuel Cells, etc.
	Alternative	Solar Wind, Co-generation, Electrochemical	
	Oil/Gas	Rigs, Derricks, Heads, Pumps, Pipelines	
	Infrastructure	Wiring, Network Access, Energy management	
Consumer and Home	Awareness & Safety	Security/Alerts, Fire Safety, Elderly, Children, Power Protection	Digital Cameras, Power Systems, MID, e-Readers, Dishwashers, Desktop Computers, Washing Machines/Dryers, Meters, Lights, TVs, MP3 Devices, Games Consoles, Alarms, etc.
	Convenience & Entertainment	HVAC/Climate, Lighting, Appliance, Entertainment	
Healthcare and Life Science	Care	Hospital, ER, Mobile, POC, Clinic, Labs, Doctor Office	MRI Machines, PDAs, Implants, Surgical Equipment, Pumps, Monitors, Telemedicine, etc.
	In Vivo/Home	Implants, Home, Monitoring Systems	
	Research	Drug Discovery, Diagnostics, Labs	
Transportation	Non-Vehicular	Air, Rail, Marine	Vehicles, Lights, Ships, Planes, Signage, Tolls, etc.
	Vehicles	Consumer, Commercial, Construction, Off-Highway	
	Trans Systems	Tolls, Traffic mgmt., Navigation	

IOT APPLICATION AREAS AND DEVICES (CONT'D)

Service Sectors	Application Groups	Locations	Devices
Industrial	Resource Automation	Mining, Irrigation, Agricultural, Woodland	Pumps, Valves, Vats, Conveyors, Fabrication, Assembly/Packaging, Vessels/Tanks, etc.
	Fluid/Processes	Petro-Chem, Hydro, Carbons, Food, Beverage	
	Converting/Discrete	Metals, Papers, Rubber/Plastic, Metalworking electronics, Assembly/Test	
	Distribution	Pipelines, Conveyance	
Retail	Specialty	Fuel Stations, Gaming, Bowling, Cinemas, Discos, Special Events	POS Terminals, Tags, Cash Registers, Vending Machines, Signs, etc.
	Hospitality	Hotels Restaurants, Bars, Cafes, Clubs	
	Stores	Supermarkets, Shopping Centers, Single Site, Distribution, Centers	
Security / Public Safety	Surveillance	Radar/Satellite, Environ., Military Security, Unmanned, Fixed	Tanks, Fighter Jets, Battlefields, Jeeps, Cars, Ambulance, Homeland Security, Environment, Monitor, etc.
	Equipment	Weapons, Vehicles, Ships, Aircraft, Gear	
	Tracking	Human, Animal, Postal, Food, Health, Baggage	
	Public Infrastructure	Water, Treatment, Building, Environ. Equip. & Personnel, Police, Fire, Regulatory	
	Emergency Services	Ambulance, Police, Fire, Homeland Security	
IT and Networks	Public	Services, E-Commerce, Data Centers, Mobile Carriers, ISPs	Servers, Storage, PCs, Routers, Switches, PBXs, etc.
	Private Enterprise	IT/Data Center Office, Privacy Nets	

IOT TECHNOLOGIES AND PROTOCOLS

Short-range Wireless Communication	Medium-range Wireless Communication	Long-range Wireless Communication	IoT Operating Systems	IoT Application Protocols
<ul style="list-style-type: none"> Bluetooth Low Energy (BLE) Light-Fidelity (Li-Fi) Near Field Communication (NFC) QR Codes and Barcodes Radio Frequency Identification (RFID) Thread Wi-fi Wi-Fi Direct Z-wave ZigBee ANT 	<ul style="list-style-type: none"> Ha-Low LTE-Advanced 6LoWPAN QUIC <p>Wired Communication</p> <ul style="list-style-type: none"> Ethernet Multimedia over Coax Alliance (MoCA) Power-line Communication (PLC) 	<ul style="list-style-type: none"> Low-power Wide-area Networking (LPWAN) <ul style="list-style-type: none"> LoRaWAN Sigfox Neul Very Small Aperture Terminal (VSAT) Cellular MQTT NB-IoT 	<ul style="list-style-type: none"> Windows 10 IoT Amazon FreeRTOS Contiki Fuchsia RIOT Ubuntu Core ARM mbed OS Zephyr Nucleus RTOS NutTX RTOS Integrity RTOS 	<ul style="list-style-type: none"> CoAP Edge LWM2M Physical Web XMPP Mihini/M3DA

IOT COMMUNICATION MODELS

1

Device-To-Device Model



2

Device-To-Cloud Model



3

Device-to-Gateway Model



4

Back-End Data-Sharing Model



CHALLENGES IN IOT

01

Lack of security and privacy

05

Clear text protocols and unnecessary open ports

09

Interoperability standard issues

02

Vulnerable web interfaces

06

Coding errors (buffer overflow)

10

Physical theft and tampering

03

Legal, regulatory, and rights issues

07

Storage issues

11

Lack of vendor support for fixing vulnerabilities

04

Default, weak, and hardcoded credentials

08

Difficult to update firmware and OS

12

Emerging economy and development issues

THREAT VS OPPURTUNITY

■ If **MISCONFIGURED** and **MISAPPREHENDED**, the IoT poses an unprecedented risk to personal data, privacy and safety



■ If **APPREHENDED** and **PROTECTED**, the IoT can boost transmissions, communications, delivery of services, and standard of living



IOT SECURITY PROBLEMS

APPLICATION

Validation of the inputted string, AuthN, AuthZ, no automatic security updates, default passwords

NETWORK

Firewall, improper communications encryption, services, lack of automatic updates

MOBILE

Insecure API, lack of communication channels encryption, authentication, lack of storage security

CLOUD

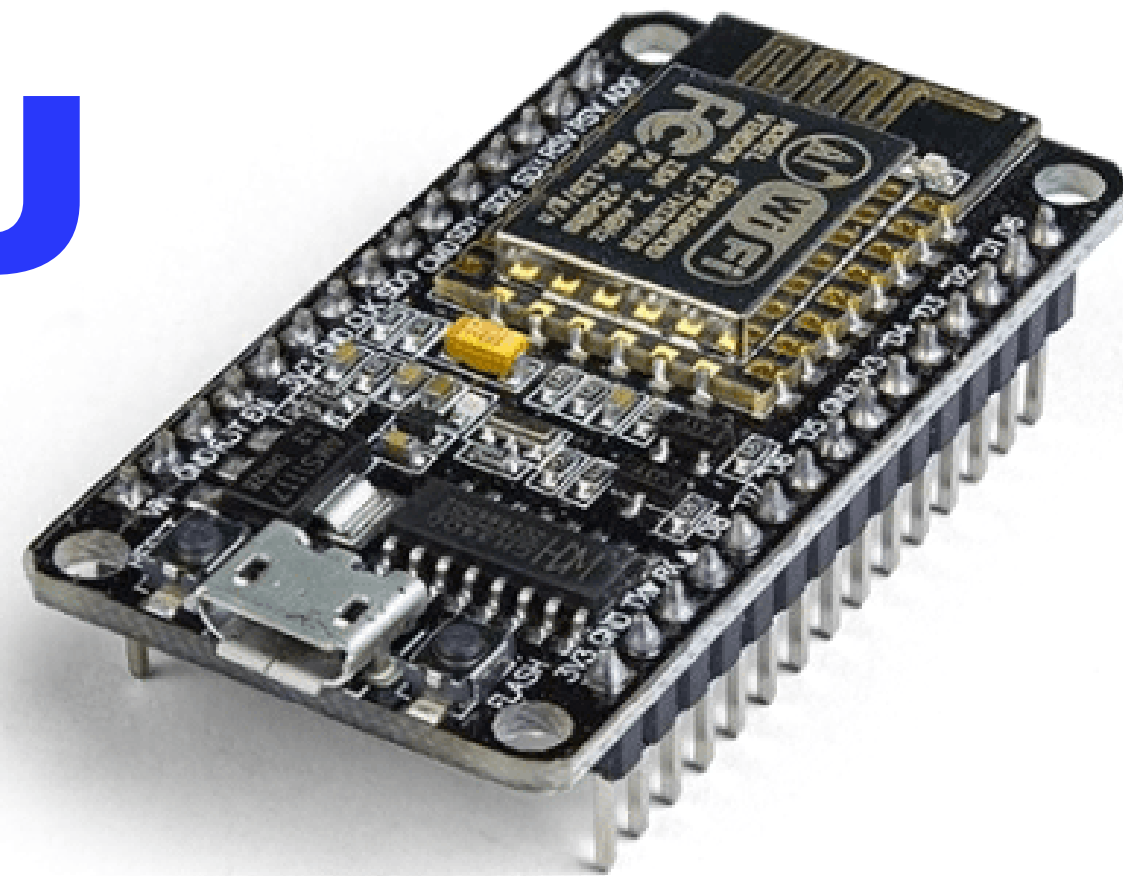
Improper authentication, no encryption for storage and communications, insecure web interface

IoT

Application + Network + Mobile + Cloud = IoT



NODEMCU



WHAT IS NODEMCU ?

The NodeMCU is a \$4 (up to \$10) Wi-Fi module. It allows you to control inputs and outputs as you would do with an Arduino, but it comes with Wi-Fi. So, it is great for home automation/internet of things applications.

So what can you do with this low cost module?

You can create a web server, send HTTP requests, control outputs, read inputs and interrupts, send emails, post tweets, build IoT gadgets and much more.

NODEMCU SPECIFICATIONS

- 802.11 B/G/N PROTOCOL
- WI-FI DIRECT (P2P)
- SOFT-AP
- INTEGRATED TCP/IP PROTOCOL STACK
- BUILT-IN LOW-POWER 32-BIT CPU
- SDIO 2.0, SPI, UART

VARIANTS

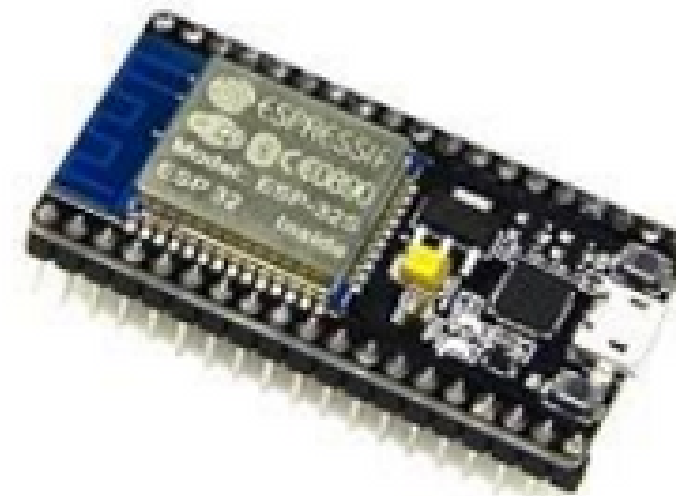
DOIT DEVKIT V1



ESP32 DevKit



ESP-32S NodeMCU



ESP32 Thing



WEMOS LOLIN32



"WeMos" OLED



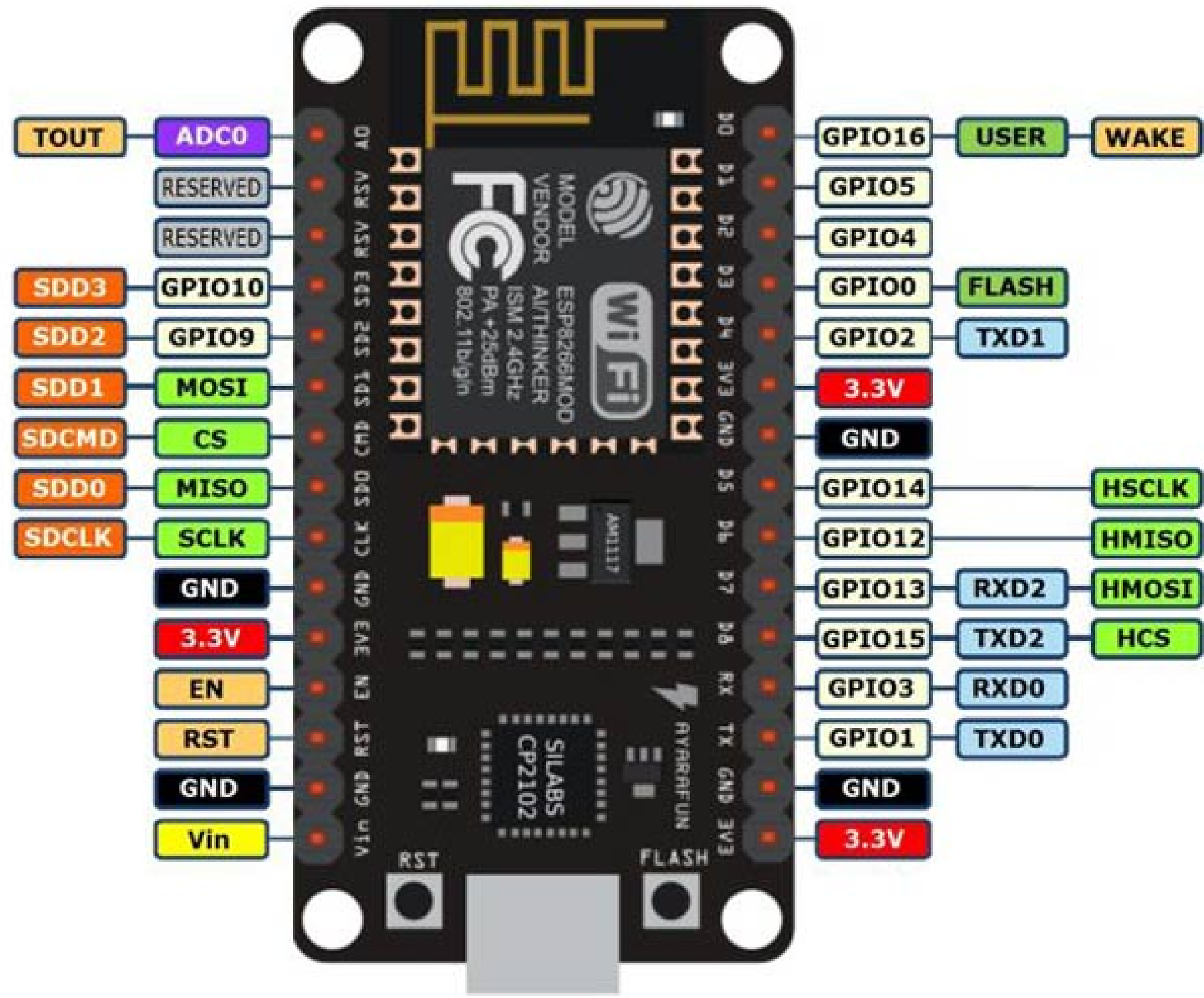
HUZZAH32



Others

(...)

NODEMCU PINOUT



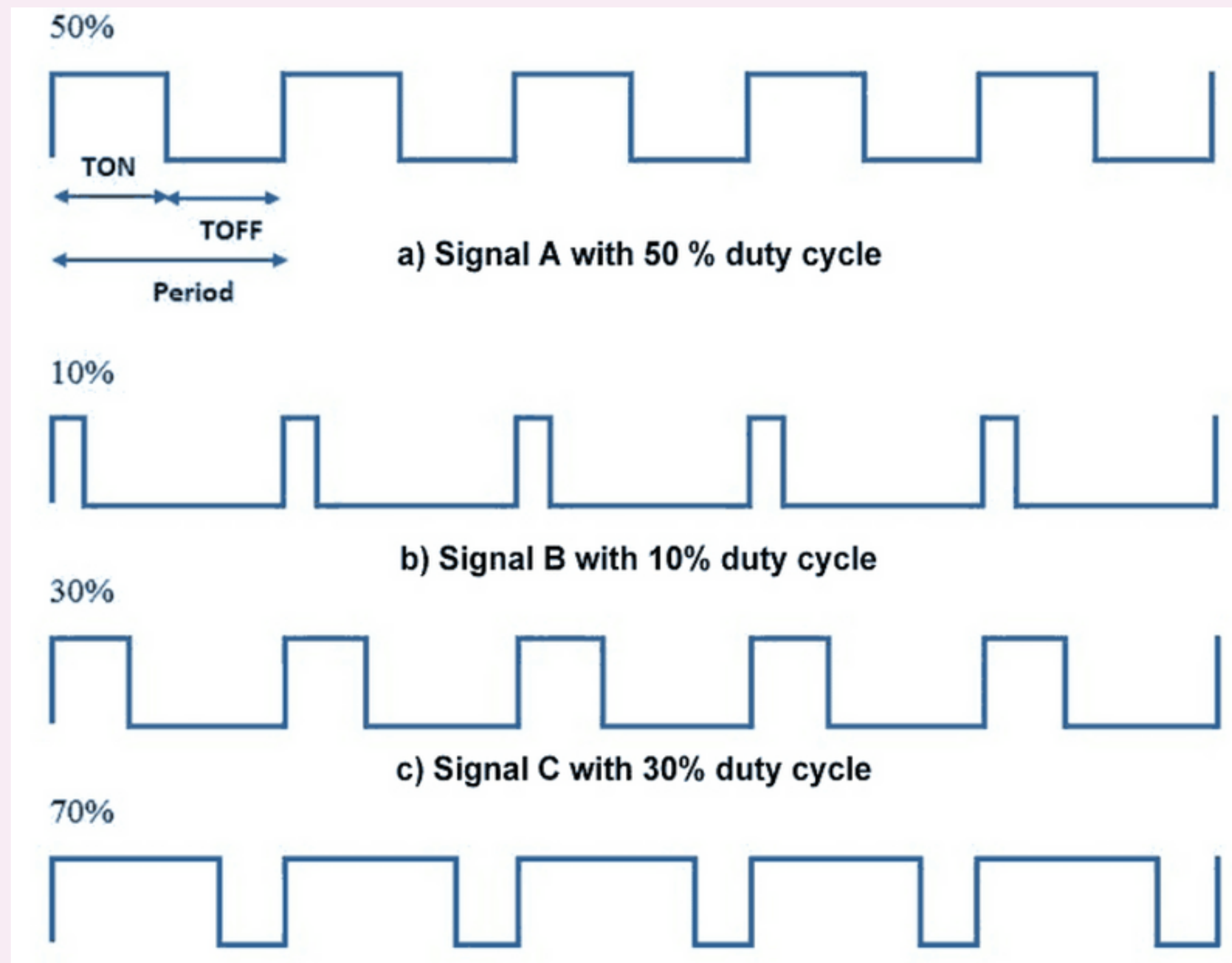
PWM

Pulse Width Modulation (PWM) is a technique by which the width of a pulse is varied while keeping the frequency of the wave constant.

A period of a pulse consists of an ON cycle (VCC) and an OFF cycle (GND). The fraction for which the signal is ON over a period is known as a duty cycle.

Through the PWM technique, we can control the power delivered to the load by using the ON-OFF signal. The PWM signals can be used to control the speed of DC motors and to change the intensity of the LED. Moreover, it can also be used to generate sine signals. Pulse Width Modulated signals with different duty cycle are shown below.

PWM(CONT.)





LED BLINK SIMULATION