



INTRODUCTION TO COMMUNICATION TECHNOLOGIES & PROTOCOLS OF IOT:



IOT COMMUNICATION:

- IOT IS THE CONNECTION OF DEVICES OVER THE INTERNET, WHERE THESE SMART DEVICES COMMUNICATE WITH EACH OTHER , EXCHANGE DATA , PERFORM SOME TASKS WITHOUT ANY HUMAN INVOLVEMENT. THESE DEVICES ARE EMBEDDED WITH ELECTRONICS, SOFTWARE, NETWORK AND SENSORS WHICH HELP IN COMMUNICATION. COMMUNICATION BETWEEN SMART DEVICES IS VERY IMPORTANT IN IOT AS IT ENABLES THESE DEVICES TO GATHER, EXCHANGE DATA WHICH CONTRIBUTE IN SUCCESS OF THAT IOT PRODUCT/PROJECT.



BLUETOOTH(BLE)

- THE IEEE STANDARD FOR BLUETOOTH IS IEEE 802.15.1. IT IS A WIRELESS TECHNOLOGY THAT ENABLES SHORT-RANGE COMMUNICATION BETWEEN DEVICES. IT WAS FIRST INTRODUCED IN 1994 BY ERICSSON, AND IT HAS SINCE BECOME ONE OF THE MOST WIDELY USED WIRELESS TECHNOLOGIES IN THE WORLD. BLUETOOTH OPERATES IN THE 2.4 GHZ FREQUENCY BAND, USES FHSS TECHNOLOGY, AND SUPPORTS DATA RATES UP TO 24 MBPS. BLUETOOTH IS WELL SUITED FOR APPLICATIONS THAT REQUIRE LOW POWER CONSUMPTION AND SHORT-RANGE COMMUNICATION.
- ONE OF THE MAIN ADVANTAGES OF BLUETOOTH IS ITS WIDESPREAD ADOPTION. ALMOST EVERY SMARTPHONE, LAPTOP, AND TABLET ON THE MARKET TODAY SUPPORTS BLUETOOTH, WHICH MAKES IT AN ATTRACTIVE OPTION FOR DEVELOPERS WHO WANT TO BUILD IOT APPLICATIONS THAT CAN COMMUNICATE WITH THESE DEVICES. BLUETOOTH IS ALSO RELATIVELY EASY TO USE AND HAS A LOW IMPLEMENTATION COST, WHICH MAKES IT AN ATTRACTIVE OPTION FOR SMALL-SCALE IOT PROJECTS.



BLE

 **Bluetooth®**
Low Energy



 **Bluetooth®**
Classic





- BLUETOOTH LOW ENERGY (BLE) IS A VARIANT OF BLUETOOTH THAT IS DESIGNED FOR LOW POWER CONSUMPTION. BLE WAS FIRST INTRODUCED IN 2010, AND IT HAS SINCE BECOME A POPULAR OPTION FOR WEARABLE DEVICES, HEALTHCARE DEVICES, AND HOME AUTOMATION SYSTEMS. BLE OPERATES IN THE SAME FREQUENCY BAND AS BLUETOOTH AND SUPPORTS DATA RATES UP TO 2 MBPS. BLE IS WELL SUITED FOR APPLICATIONS THAT REQUIRE LOW POWER CONSUMPTION AND PERIODIC DATA TRANSMISSION.
- ONE OF THE MAIN ADVANTAGES OF BLE IS ITS LOW POWER CONSUMPTION. BLE DEVICES CAN OPERATE FOR MONTHS OR EVEN YEARS ON A SINGLE BATTERY, WHICH MAKES IT AN ATTRACTIVE OPTION FOR IOT APPLICATIONS THAT REQUIRE LONG BATTERY LIFE.



- IN THE WLAN INDUSTRY, BLE IS BEING USED IN A VARIETY OF WAYS. FOR EXAMPLE, IT CAN BE USED TO ENABLE PROXIMITY-BASED SERVICES, SUCH AS LOCATION-BASED ADVERTISING OR WAYFINDING. BLE RADIOS CAN BE PLACED THROUGHOUT A BUILDING TO HELP USERS NAVIGATE TO A SPECIFIC LOCATION. BLE CAN ALSO BE USED TO TRACK ASSETS, SUCH AS EQUIPMENT OR INVENTORY, WITHIN A BUILDING.
- ANOTHER USE CASE FOR BLE IN THE WLAN INDUSTRY IS TO ENABLE INDOOR POSITIONING SYSTEMS. BY USING BLE BEACONS, USERS CAN BE LOCATED WITHIN A BUILDING WITH AN ACCURACY OF A FEW METERS. THIS CAN BE USEFUL FOR A VARIETY OF APPLICATIONS, INCLUDING ASSET TRACKING AND REAL-TIME LOCATION-BASED SERVICES.
- JUNIPER MIST SUPPORTS BOTH OF THESE USE CASES USING A TECHNOLOGY CALLED VBLE THAT BUILDS ON BLE. VBLE USES A PATENTED 16-ELEMENT DIRECTIONAL ANTENNA ARRAY AND MOST JUNIPER MIST ACCESS POINTS HAVE IT BUILT-IN.



LORA

- LORA (LONG RANGE) IS A WIRELESS PROTOCOL THAT IS DESIGNED FOR MACHINE-TO-MACHINE COMMUNICATION. LORA WAS FIRST INTRODUCED IN 2011, AND IT HAS SINCE BECOME A POPULAR OPTION FOR SMART CITY APPLICATIONS, SUCH AS SMART PARKING, WASTE MANAGEMENT, AND ENVIRONMENTAL MONITORING. LORA OPERATES IN THE SUB-GHZ FREQUENCY BAND AND SUPPORTS DATA RATES UP TO 50 KBPS. LORA IS WELL SUITED FOR APPLICATIONS THAT REQUIRE LONG-RANGE COMMUNICATION AND LOW POWER CONSUMPTION.
- LORA DEVICES CAN COMMUNICATE OVER DISTANCES OF SEVERAL KILOMETRES, WHICH MAKES IT AN ATTRACTIVE OPTION FOR IOT APPLICATIONS THAT REQUIRE LONG-RANGE COMMUNICATION. LORA IS ALSO RELATIVELY EASY TO USE AND HAS A LOW IMPLEMENTATION COST, WHICH MAKES IT AN ATTRACTIVE OPTION FOR SMALL-SCALE IOT PROJECTS



LORAWAN

- LORAWAN IS A MAC PROTOCOL DESIGNED FOR LONG-RANGE, LOW-POWER COMMUNICATION BETWEEN IOT DEVICES(IT FITS INTO LOW-POWER WAN OR LPWAN CATEGORY). IT USES THE LORA MODULATION SCHEME TO ENABLE COMMUNICATION OVER DISTANCES OF SEVERAL KILOMETRES. LORAWAN EMPLOYS A STAR-OF-STARS TOPOLOGY, WHERE END DEVICES COMMUNICATE WITH GATEWAYS THAT ARE CONNECTED TO A NETWORK SERVER. THE NETWORK SERVER MANAGES THE NETWORK AND ROUTES MESSAGES BETWEEN END DEVICES AND APPLICATIONS.
- LORAWAN SUPPORTS THREE CLASSES OF DEVICES, EACH WITH DIFFERENT POWER AND LATENCY REQUIREMENTS. HOWEVER, ALL LORAWAN DEVICES MUST BE ABLE TO PERFORM CLASS A FUNCTIONALITY AT A MINIMUM. THIS PROVIDES A BASELINE WHEREBY ALL LORAWAN DEVICES WILL BE ABLE TO PERFORM AT LEAST MINIMAL COMMUNICATIONS WITH ALL OTHER LORAWAN DEVICES.



- **CLASS A**

- ALL DEVICES SUPPORT BI-DIRECTIONAL COMMUNICATIONS SUCH THAT AN UPLINK TRANSMISSION FROM AN END-DEVICE IS ALWAYS FOLLOWED BY TO SHORT DOWNLINK RECEIVE WINDOW. CLASS A DEVICES CANNOT RECEIVE COMMUNICATION FROM THE NETWORK (DOWNLINK) EXCEPT FOR THE TIME DURING THE RECEIVE WINDOW IMMEDIATELY AFTER AN UPLINK. THESE DEVICES CONSUMES THE LEAST POWER.

- **CLASS B**

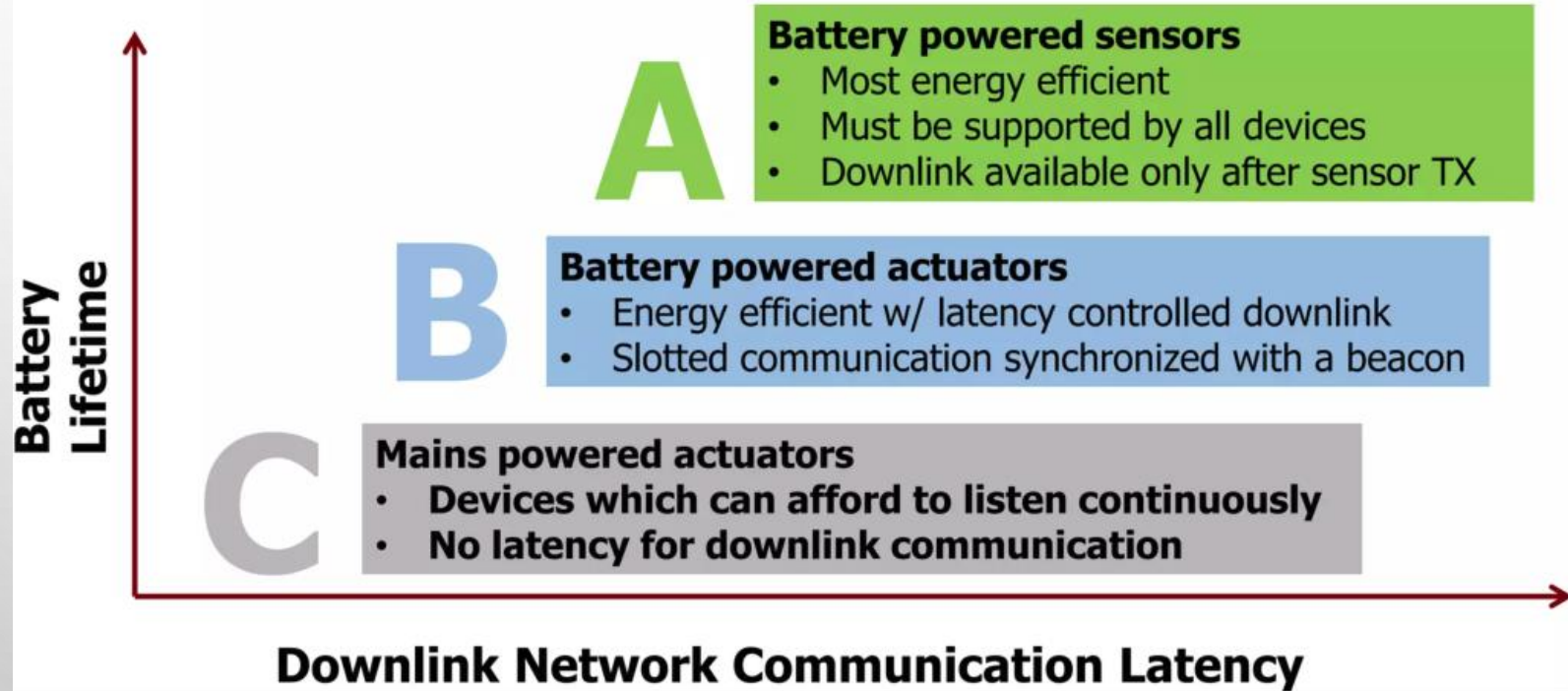
- THESE DEVICES PROVIDE MORE RECEIVE WINDOWS. A SYNCHRONIZATION BEACON IS SENT FROM THE GATEWAY TO PROVIDE A SCHEDULING FOR THE RECEIVED WINDOWS. THESE DEVICES CONSUME MODERATE POWER.

- **CLASS C**

- THESE DEVICES HAVE OPEN RECEIVE WINDOWS. THEY ARE UNABLE TO RECEIVE WHEN TRANSMITTING, BUT OTHER THAN TIME, THEY CONTINUOUSLY LISTEN FOR MESSAGES FROM THE NETWORK. THEREFORE, THEY CONSUME THE MOST POWER.



LoRaWAN Device Classes





- LORAWAN USES AN ADAPTIVE DATA RATE (ADR) MECHANISM TO OPTIMIZE THE DATA RATE (FROM 0.3 KBPS TO 50 KBPS) AND POWER CONSUMPTION OF END DEVICES. ADR ADJUSTS THE DATA RATE AND TRANSMISSION POWER OF END DEVICES BASED ON THE QUALITY OF THE COMMUNICATION LINK AND THE DATA RATE REQUIREMENTS OF THE APPLICATION.
- LORAWAN ALSO INCLUDES SECURITY FEATURES SUCH AS END-TO-END ENCRYPTION, DEVICE AUTHENTICATION, AND MESSAGE INTEGRITY CHECKING. THESE FEATURES ENSURE THAT COMMUNICATION BETWEEN DEVICES IS SECURE AND CAN ONLY BE ACCESSED BY AUTHORIZED PARTIES.
- LORAWAN OPERATES IN DIFFERENT FREQUENCY BANDS DEPENDING ON THE REGULATORY DOMAIN. THESE BANDS INCLUDE 430 MHZ, 433 MHZ, 868 MHZ, AND 915 MHZ IN COMMON USE.
- OVERALL, LORAWAN IS AN ATTRACTIVE OPTION FOR IOT APPLICATIONS THAT REQUIRE LONG-RANGE, LOW-POWER (A POTENTIAL 10-20-YEAR BATTERY LIFETIME) COMMUNICATION AND A LARGE NETWORK INFRASTRUCTURE. ITS OPEN STANDARD AND GROWING ECOSYSTEM MAKE IT A POPULAR CHOICE AMONG DEVELOPERS WHO WANT TO BUILD SCALABLE AND INTEROPERABLE IOT SOLUTIONS.
- HERE ARE SOME EXAMPLES OF LORAWAN



Smart Environment



Smart Metering





WIFI

- [WIFI](#) IS A WIRELESS COMMUNICATION PROTOCOL. WIFI USES THE STAR NETWORK TOPOLOGY, AND THE ACCESS POINT CAN BE USED AS A GATEWAY TO THE INTERNET.
- EACH ACCESS POINT CAN CONNECT TO A MAXIMUM OF 250 DEVICES, AND MOST COMMERCIALY AVAILABLE SOLUTIONS SUPPORT UP TO 50 DEVICES. THE 802.11-B/G/N OPERATES ON 2.4GHZ AND PROVIDES 150-200 MBPS DATA RATE IN THE HOME OR OFFICE ENVIRONMENT, TYPICALLY AT A RANGE OF 50 METERS.
- THE LATEST 802.11-AC STANDARD WORKS ON 5GHZ AND PROVIDES A 500MBPS-1GBPS DATA RATE.

















