6LowPAN

- 6LoWPAN (IPv6 over Low-Power Wireless Personal Area Networks)
- a low power wireless mesh network where every node has its own IPv6 address
- This allows the node to connect directly with the Internet using open standards
- reated with the intention of applying the Internet Protocol (IP) even to the smallest devices

Advantages of 6LoWPAN

- Uses Open IP Standards
    - It works great with open IP standard including TCP, UDP, HTTP, COAP, MATT and web-sockets.
- Offers End-To-End IP Addressable Nodes
    - It offers end-to-end IP addressable nodes. There's no need for a gateway, only a router which can connect the 6LoWPAN network to IP.
- Offers Self-Healing, Robust and Scalable Mesh Routing
    - It supports self-healing, robust and scalable mesh routing.
    - Offers one-to-many & many-to-one routing.
    - The 6LoWPAN mesh routers can route data to others nodes in the network.
- Leaf Nodes Can Sleep For a Long Duration of Time
    - In a 6LowPAN network, leaf nodes can sleep for a long duration of time.
- Offers Thorough Support For The PHY Layer
    - It also offers thorough support for the PHY layer which gives freedom of frequency band & physical layer, which can be used across multiple communication platforms like Ethernet, WI-Fi, 802.15.4 or Sub-1GHz ISM with interoperability at the IP level.
- It is a Standard: RFC6282

6LoWPAN basics

- The 6LoWPAN technology utilises IEEE 802.15.4 to provide the lower layers for this low power wireless network system.
- In order to send packet data, IPv6 over 6LowPAN, it is necessary to have a method of converting the packet data into a format that can be handled by the IEEE 802.15.4 lower layer system.
- IPv6 requires the maximum transmission unit (MTU) to be at least 1280 bytes in length. This is considerably longer than the IEEE802.15.4's standard packet size of 127 octets which was set to keep transmissions short and thereby reduce power consumption.
- To overcome the address resolution issue, IPv6 nodes are given 128 bit addresses in a hierarchical manner.

6LoWPAN application

- General Automation
    - There are enormous opportunities for 6LoWPAN to be used in many different areas of automation.
- Home automation
    - There is a large market for home automation.
    - By connecting using IPv6, it is possible to gain distinct advantages over other IoT systems.
- Smart Grid

- Smart grids enable smart meters and other devices to build a micro mesh network and they are able to send the data back to the grid operator's monitoring and billing system using the IPv6 backbone.
- Industrial monitoring
  - Automated factories and industrial plants provide a great opportunity for 6LoWPAN and using automation, can enable major savings to be made.
  - The ability of 6LoWPAN to connect to the cloud opens up many different areas for data monitoring and analysis.

LPWAN

- low-power WAN (LPWAN), a wireless wide area network technology specialized for connecting devices
- LPWAN technologies are designed for
  - machine-to-machine networking environments
  - lower power requirements
  - longer range
  - lower costs than traditional mobile networks.
- the networks are able to support more devices over a larger coverage area than traditional consumer mobile technologies.

Licensed LPWAN

- Licensed LPWANs run on public cellular networks which use the licensed radio spectrum and support the GSM and 3GPP standards.
- Types of licensed LPWAN

  - Narrowband IoT (NB-IoT)

    - developed to enable a wide range of new IoT devices and services.
    - NB-IoT significantly improves
      - the power consumption of user devices,
      - system capacity and spectrum efficiency,
    - uses existing infrastructure of LTE and GSM network providers to facilitate low bandwidth communications for IoT devices.

  - LTE-M

    - Part of Release 13 of the 3GPP standard
    - LTE-M aims to
      - lower power consumption
      - reduce device complexity and cost
      - provide deeper coverage to reach challenging locations
    - This standard will improve upon NB-IoT in terms of bandwidth.
    - It also boasts the highest security of LPWAN technologies.

Unlicensed LPWAN

- Unlicensed LPWAN use radio spectrum that is unlicensed and can be used by anyone

- Types of unlicensed LPWAN
    - LoRaWAN
        - intended for wireless battery operated things in a regional, national or global network.
        - targets key requirements of IoT such as secure bidirectional communication, mobility and localization services.
        - provides seamless interoperability among smart things without the need of complex local installations
    - Sigfox
        - A narrowband (or ultra-narrowband) technology
        - suited best for the lowest bandwidth applications with extremely tight energy budgets
        - it is an entirely separate network for IoT devices