Internet of Things: IoT Protocol Architecture

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Session Outline

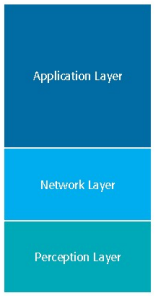
1. IoT Layer Architecture
2. Protocol Architecture of IoT
3. Categorization of IoT protocols
4. Physical/Device and Data Link Layer
5. Network Layer Protocols
6. Transport Layer Protocols
7. Application Protocols

IoT Layer Architecture

Abstract Layered Architecture for IoT (Recap)

❖ The layered architecture models are featured with a three-layer architecture that consisting

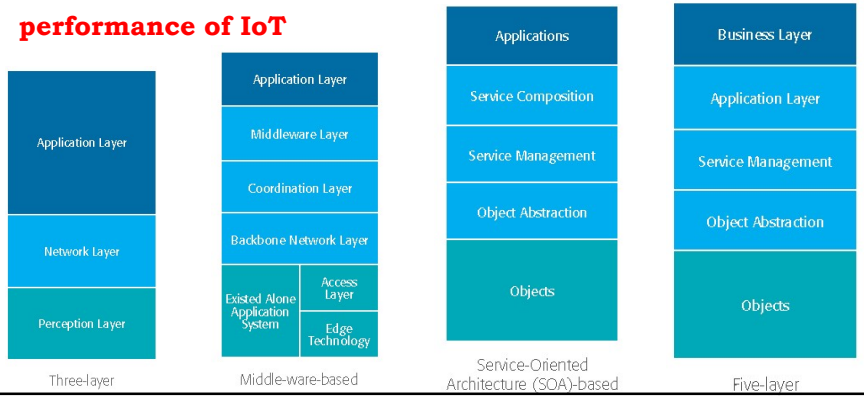
- ✓ **Perception Layer**
- ✓ **Network Layer and**
- ✓ **Application layers.**



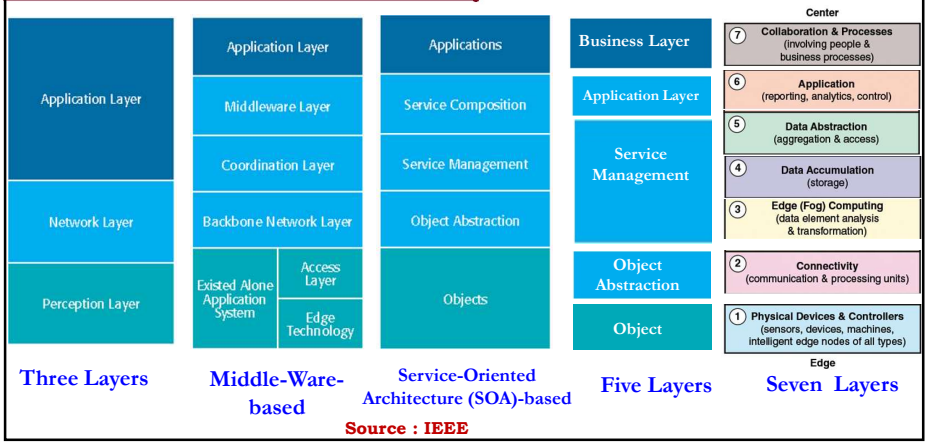
Three-layer

Defining the Layers of the IoT (Recap)

❖ The **Five-layer framework** that relies on the **demand and performance of IoT**



Integration of ITU-T & IWF

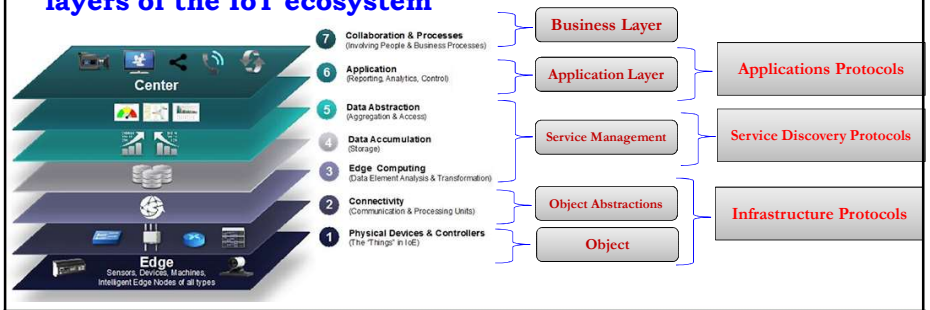


Source : IEEE

Protocol Architecture of IoT

Protocol Architecture of IoT

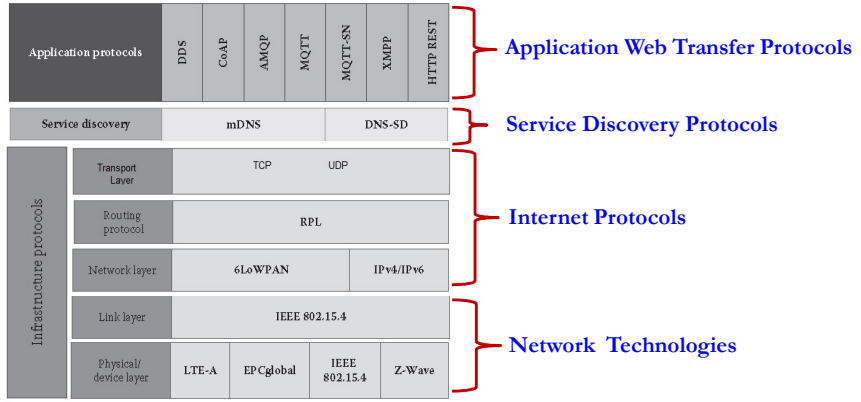
❖ The **various protocols** used for communication in the **various layers of the IoT ecosystem**



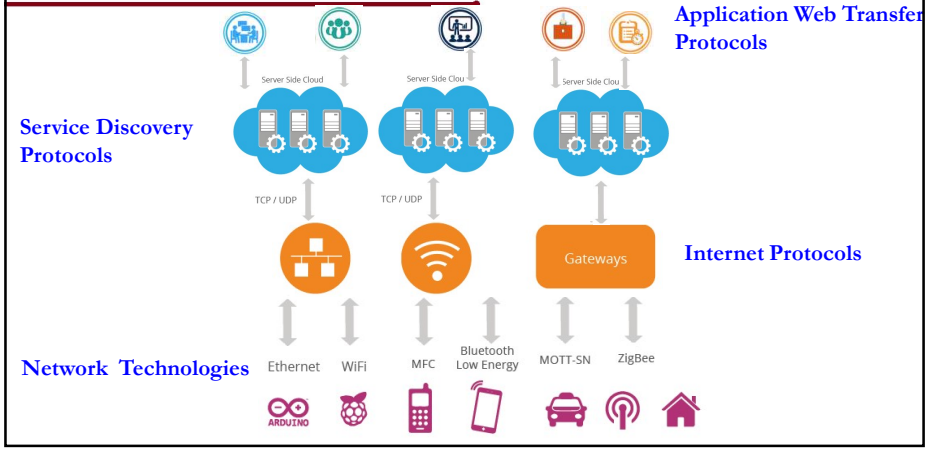
IoT Protocol Standards

- **IoT Protocol standards** help to move **one step forward** towards enhancing the **quality of life**
- **Standards** can be organized into **four categories** together to deliver an **IoT application**

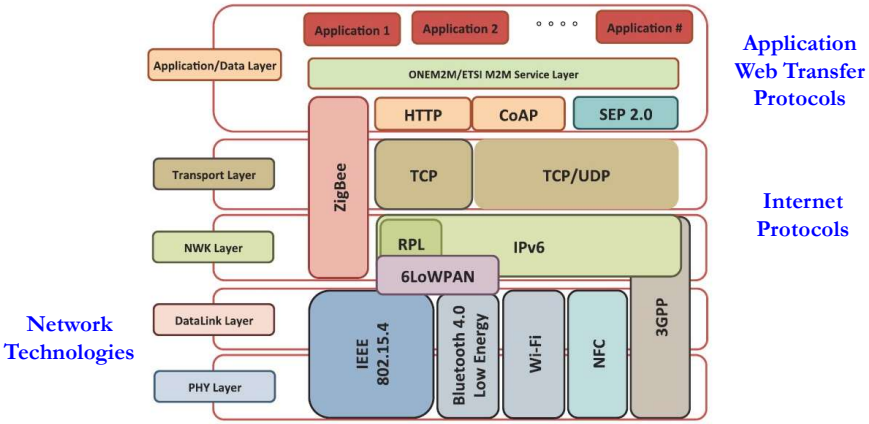
Categorization of IoT protocols.



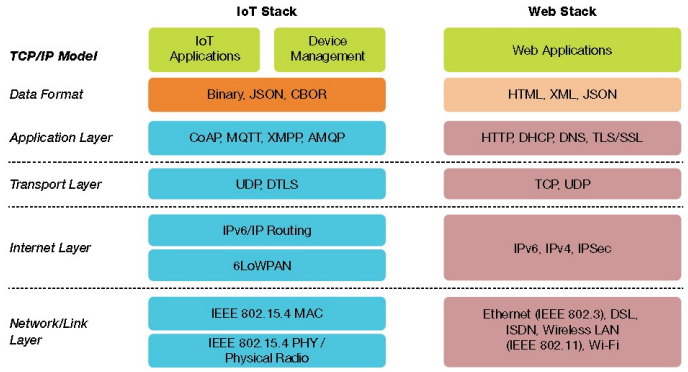
Connection of any Two IoT elements



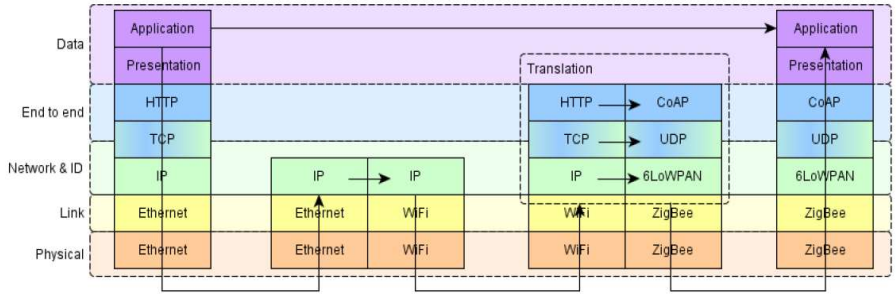
Simplified Stack of IoT Protocols.



Protocol Stack of IoT

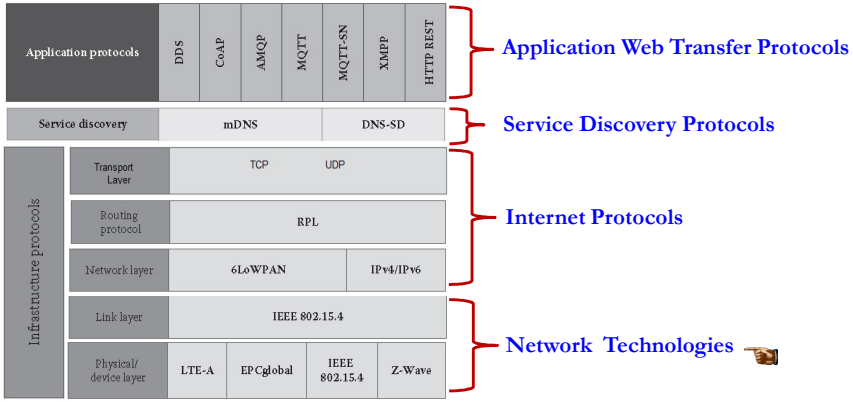


Communication of IoT protocol stacks,



Categorization of IoT protocols

Categorization of IoT protocols.



Physical/Device and Data Link Layer

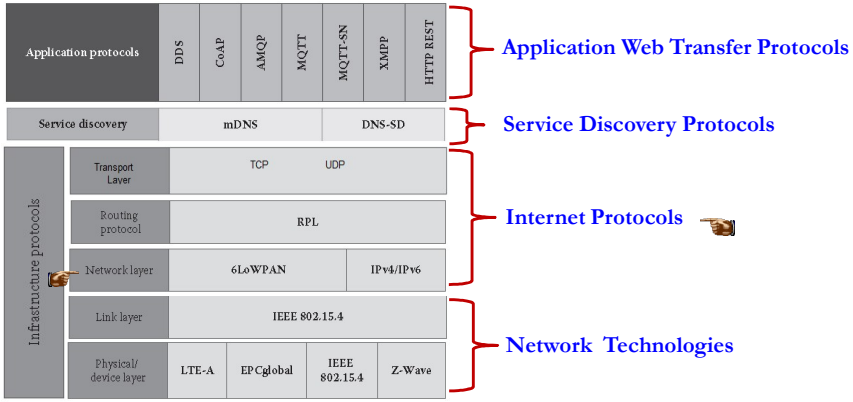
IoT Device/Data Link Protocol

- There are **different datalink protocols** that were proposed for **usage of IoT.**
  - **IEEE 802.15.4**
  - **IEEE 802.11 AH**
  - **Wireless HART**
  - **Z-Wave**
  - **Bluetooth Low Energy**
  - **Zigbee Smart Energy**
  - **DASH7**
  - **Home Plug**
  - **G.9959**
  - **LTE-A**
  - **LoraWAN**
  - **Weightless**

Observation…

- Generally, the most **widely used standards protocols** in IoT are **IEEE 802.15.4, Bluetooth ZigBee and IEEE 802.11ah**
  - ✓ It is the easiest to **use these protocols**, as already widely adopted **infrastructure protocols of IEEE 802.11** for wireless applications
- Newly arising **LoRaWAN** seems to be promising for **various applications** as well.

Categorization of IoT protocols.



Network Layer Encapsulation Protocols

Network Layer Encapsulation Protocols

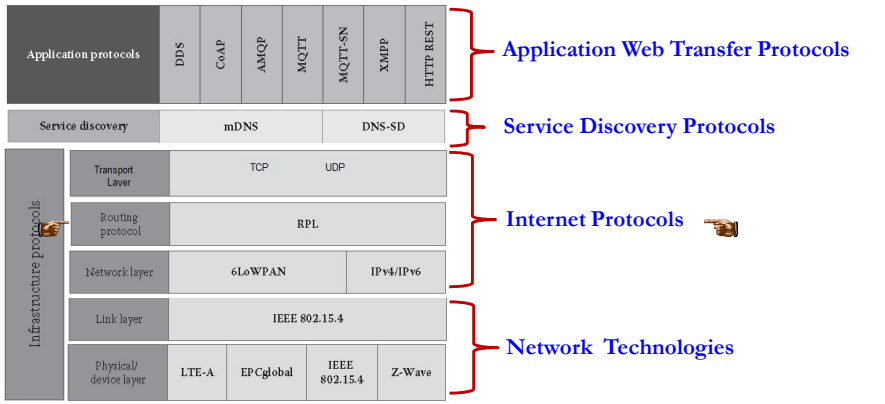
- **One problem** in IoT applications is that
  - ✓ **IPv6 addresses** are too long and **cannot fit in most IoT**
  - ✓ **Datalink frames** which are **relatively much smaller.**
- IETF developed a **set of standards** to **encapsulate IPv6 datagrams** in **different datalink layer frames** for use in **IoT applications**.

Network Layer Encapsulation Protocols

- we will discuss these **mechanisms briefly.**
  1. **6LoWPAN**
  2. **6TiSCH**
  3. **6Lo**
  4. **IPv6 over Bluetooth Low Energy**
  5. **IPV6 Over 802.11**

Network Layer Routing Protocols

Categorization of IoT protocols.

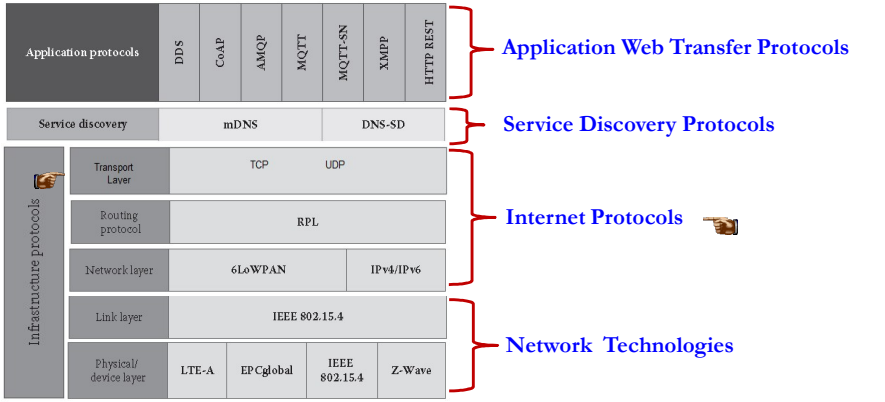


Routing Protocols

- Some of the **Routing Protocols** in the network layer are
  1. **Routing Protocol for Low-Power and Lossy Networks (RPL)**
  2. **Adhoc On-Demand Routing Protocol (AODV)**
  3. **CORPL, or cognitive RPL**
  4. **Channel-Aware Routing Protocol (CARP)**

Transport Layer Protocols

Categorization of IoT protocols.

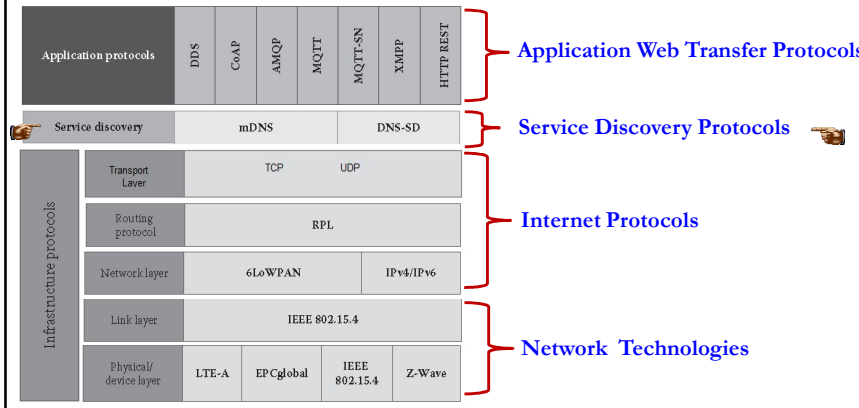


The Internet Transport Protocols

- We can create a transport-layer protocol by combining a set of services.
- The Internet transport layer has two main protocols
  1. **User-Datagram Protocol (Connectionless protocol)**
  2. **Transmission Control Protocol (Connection-oriented Protocol)**

Device or Service Discovery Protocols for IoT

Categorization of IoT protocols.



Service Discovery Protocols

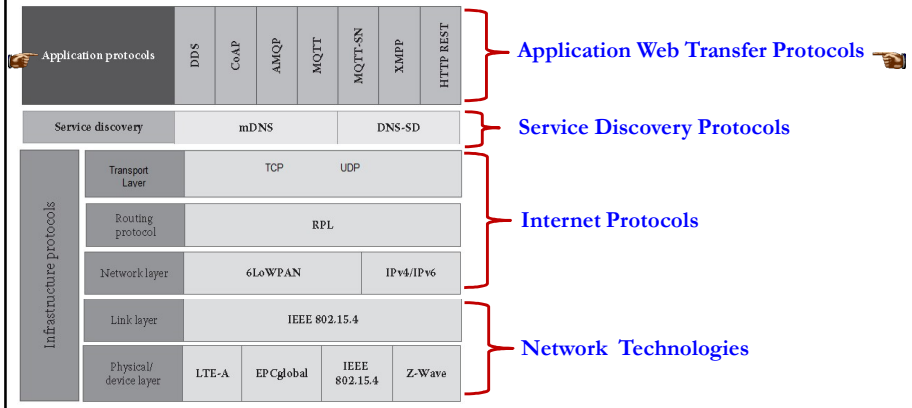
- The **high scalability** and the **huge number of devices**, which form a **part of the IoT ecosystem**
- It is mandate to have the **resource management mechanism** that has the capability to **register and discover the services** in a **self-configured, dynamic, and an efficient way**

Service Discovery Protocols

- The protocols that are prominently used in the **IoT service discovery space** are the following:
  1. **Multicast domain name system (mDNS)**
  2. **DNS service discovery (DNS-SD)**
  3. **Simple service discovery protocol (part of UPnP)**

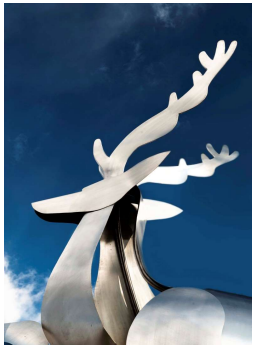
Application Protocols

Categorization of IoT protocols.



Application Protocols

- Some of the **Application layer protocols** are
  1. **Message Queue Telemetry Transport (MQTT)**
  2. **Extensible Messaging and Presence Protocol (XMPP)**
  3. **Advanced Message Queuing Protocol (AMQP)**
  4. **Constrained Application Protocol (CoAP)**
  5. **Data Distribution Service (DDS)**



Thank U