**IoT Lab 2**

**Aim: IoT 2 - Basic of Network (CoAP, MQTT) and Cloud (ThingSpeak).**

**Theory:**

**1. Networking Protocols for IoT**

**1.1 Message Queuing Telemetry Transport (MQTT)**

**Definition:** MQTT is a lightweight messaging protocol designed for low-bandwidth, high-latency, or unreliable networks, making it ideal for IoT applications.

**Working:**

* Uses a **publish-subscribe model**, where devices (clients) publish messages to topics, and other clients subscribe to those topics.
* A **broker** (e.g., Mosquitto) manages message distribution between clients.
* Works on **TCP/IP** and typically uses port **1883** (unencrypted) or **8883** (with SSL/TLS encryption).

**Advantages:**

* Low bandwidth consumption
* Supports Quality of Service (QoS) levels (0, 1, and 2)
* Retained messages for offline clients

**Example Use Case:**

* A smart water meter sending real-time water flow data to a cloud server via MQTT.

**1.2 Constrained Application Protocol (CoAP)**

**Definition:** CoAP is a lightweight web protocol optimized for IoT devices, designed to work in constrained environments over UDP.

**Working:**

* Uses a **request-response model**, similar to HTTP but optimized for low-power devices.
* Works on **UDP** (default port **5683**) for reduced overhead and faster communication.
* Supports methods like **GET, POST, PUT, DELETE**, similar to HTTP.

**Advantages:**

* Low power consumption
* Works efficiently over lossy networks
* Can be used with RESTful APIs

**Example Use Case:**

* A temperature sensor sending periodic updates to a cloud server using CoAP.

**2. Cloud Platform for IoT – ThingSpeak**

**2.1 Introduction to ThingSpeak**

ThingSpeak is an IoT analytics platform that allows users to collect, analyze, and visualize data from sensors and devices in real time. It is widely used for IoT projects due to its integration with MATLAB for advanced data processing.

**2.2 Features of ThingSpeak**

* **Data Logging:** Stores real-time sensor data.
* **Visualization:** Graphs and dashboards for analyzing data trends.
* **Alerts & Triggers:** Sends notifications based on threshold values.
* **Integration with MATLAB:** For advanced data analysis and predictions.
* **Public & Private Channels:** Secure data sharing options.

**2.3 How ThingSpeak Works?**

1. Create an account on **ThingSpeak** and set up a **channel**.
2. Devices send data to the ThingSpeak cloud via **HTTP (REST API)** or **MQTT**.
3. ThingSpeak processes and stores the data.
4. Users can visualize the data using graphs or export it for further analysis.

**Example Use Case:**

* Sending real-time water flow sensor data to ThingSpeak for monitoring and analysis.

**Conclusion:**

MQTT and CoAP are key networking protocols in IoT for transmitting data efficiently based on specific use-cases and constraints. ThingSpeak provides a powerful, user-friendly cloud environment for collecting, analyzing, and visualizing IoT data in real time.