Microlab Semester Project

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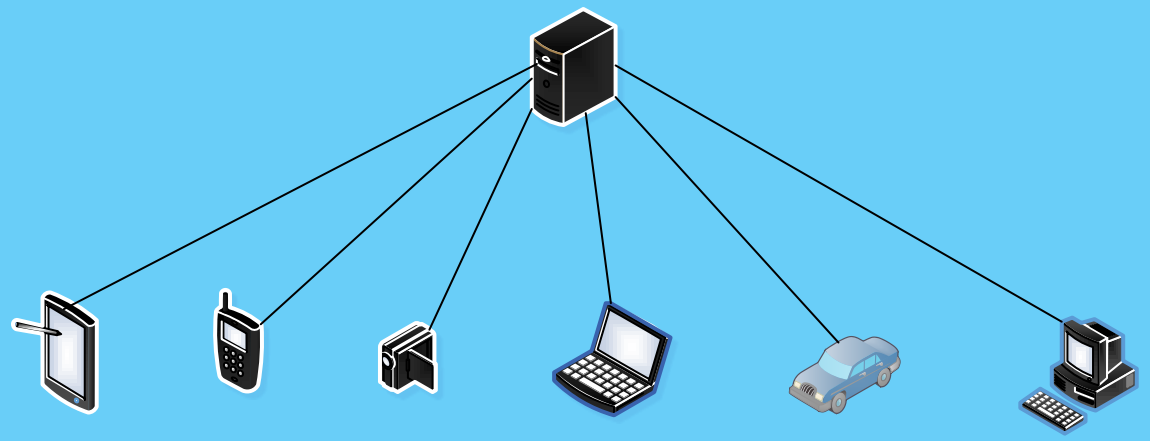
Concept

- Design an IoT network where the nodes are able to send/receive data from a gateway
- Nodes are able to send data to the gateway for faster data processing,taking advantage of the gateway's resources



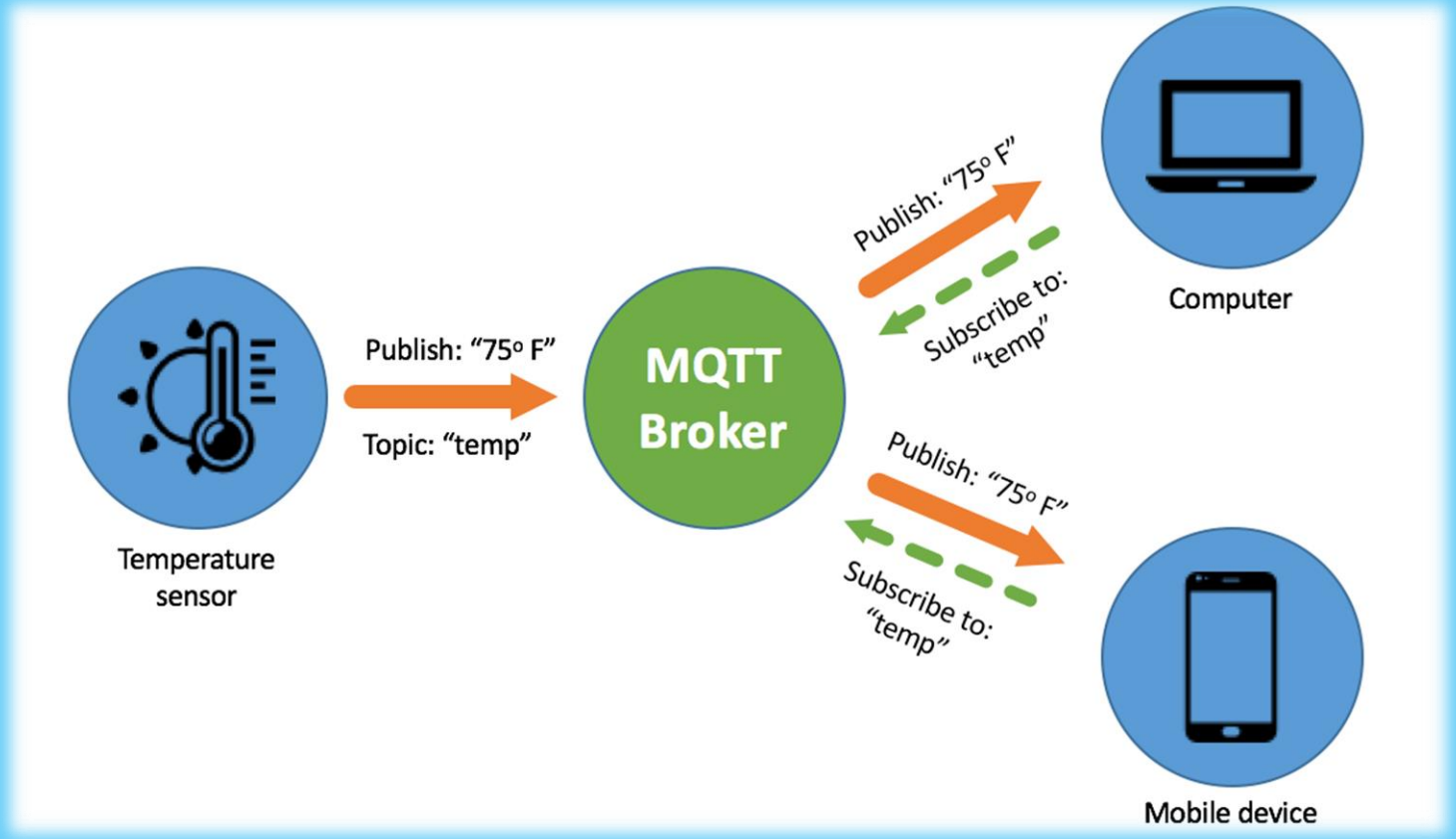
IoT Application Layer Protocols Considered

- MQTT
  - Publisher Subscriber model
  - TCP
- CoAP
  - HTTP
  - UDP
- XMPP
  - XML
  - Message oriented
- DDS
  - Publisher Subscriber model
  - High performance data exchange
- AMQP
  - Asynchronous
  - Message oriented

Message Queue Telemetry Transport (MQTT)

- Uses Publish/Subscribe mechanism controlled by Broker
- Broker is responsible for distributing messages from Publishers to Subscribers
- TCP
- Supports QoS 0,1,2
- Lightweight
- Low power consumption
- Low bandwidth use
- Easy implementation

Message Queue Telemetry Transport (MQTT)



Project Implementation

- Gateway acts both as Broker(MosquittoMQTT) and MQTT client
- Clients connect to the broker and get a unique client ID from the broker
- Gateway subscribes to all subtopics under the ‘inputCode’ and ‘localCode’ topics
- Client is able to request any program that the gateway offers by publishing to ‘localCode/<clientID>’

Project Implementation

- Client is able to send a program,it’s makefile and input arguments to the gateway by publishing them to ‘inputCode/<clientID>’
- Clients are subscribed to the ‘result/<clientID> topic and await their results there

Gateway Implementation

- Has a synchronized FIFO queue
- All requests are stored in the queue
- If a client sends their own program and makefile the gateway runs the program's makefile and then inserts the request in the queue
- Requests are serviced concurrently
- Threads are created dynamically to match the demand
- Threads pop requests from the queue and service them, publishing the results in the 'results/<clientID>' topic
- Maximum number of concurrent threads equals number of CPU cores

Advantages of this implementation

- Scalable both on client-side and gateway-side
- Multi-threaded
- Supports running client code(any language,not just C/C++)
- Lightweight
- MQTT Libraries are available for most IoT devices
- Supports transfering any file type(ex. images for AI processing)

Improvements

- Add more gateways
- Add dedicated device as broker
- Implement statistical models to anticipate queue time
- Client is able to check every gateway’s load and decides to which gateway to send request
- Support sending multiple files and linking them to run on gateway

Disadvantages of this implementation

- TCP
- May have scalability issues after a certain number of nodes
- May have problems sending big payloads
- Trades security for performance and simplicity since we're working on constrained systems

Thank you very much!