Smart Vehicle Tracking System through IoT

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Authors' contributions

This work was carried out in collaboration between both authors. Author SS designed the study, implement the MQTT protocol with ESB and wrote coding for the connectivity of GPS and mobile devices and wrote the first draft of the manuscript. Author YK managed the analyses of the study, contributed in writing Google map API, making connection with ESB and managed the literature searches. Both authors read and approved the final manuscript.

Short Research Article

ABSTRACT

This study evaluates the importance of connecting objects through the concept of the Internet of things (IoT). There has been an increasing trend in the topic of the Internet of Things in various sectors. Almost all, such as area, devices, the software is connected which all can be accessed remotely or virtually through smart devices. The most typical invention is the smartphone that acts like the computer and sometimes even smarter when connected with web & internet. New term smart homes where all the devices and machinery are connected to ensure that all processes are smart can be extended to a smart village, smart city and smart industry. Here we introduce a vehicle tracking system by using the concept IoT. Message Queuing Telemetry Transport (MQTT) is a protocol commonly used in the IoT platform to share information can be used for both publishings and subscribing data from one end to another. The same technique has been used in the present work to design a simulation to track the exact location of a given vehicle. IOT broker and the smart devices were integrated into the middleware enterprise service bus (ESB) architecture and the simulation was run with numerous geolocations.

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1. INTRODUCTION

The tremendous invention of technology is the Internet which plays a prominent role in all fields such as education, commerce, politics and marketing. Internet is the powerful communication medium and is connected the people in numerous ways. But the new era of the internet is connecting the objects. In the comparison of both, first one changes the communication styles and the second one influences the day to day activities. Precisely, things you can add the ability to communicate, sense touch and control so that it provides the opportunity to collaborate and interconnect things with others. Generally, five senses such as hearing, tasting, seeing, smelling and touching are used for the collaboration among people. Likewise, things get the ability to sense, touch and communicate. This is how the internet of people and internet of things [1] intersect.

A typical IoT concept would be illustrated by the perfect morning, for instance, a smart belt placed in the wrist gives a small vibration to awake a person while monitoring his/her sleeping cycle [2]. Moreover, it alerts other devices to do their process, such as thermostat gets the message to switch off fans and lights and coffee maker starts to make the coffee. The actual integration of IoT handles by IPV6 and MQTT protocols. Message queue telemetry transport (MQTT) [3-6] plays the major role in the communication of devices due it's lightweight, the efficient of bandwidth usage and the minimum consumption of power. It uses the publish-subscribe mechanism as the technique of communication.

MQTT-Broker is the main communication centre of the MQTT scenario. The sender can publish data with a topic. Then Topic contains the routing information for the broker. Receiver subscribes the topic to receive messages. The entire idea of MQTT is to keep senders and receivers independently [7].

2. MQTT PUBLISH/SUBSCRIBE

The mechanism is a bit different from other technologies of communication. Fig. 1 depicts the typical concept of IOT. It refers that pulling data from MQTT broker [3-6] to Client is unnecessary. Therefore, the receiver only subscribes the topics and the broker pushes the data, which exactly matches with the topic. The publisher has the authentication to publish data for the relevant topic, but broker only maintains the information regarding the topic which is in the form of strings. Moreover, the client can subscribe to more than one topic using characters # and +.

2.1 Publish

The client can publish messages, once the MQTT broker connects. The publisher can decide the format of the data (binary, text, XML, JSON). PUBLISH message contains the following attributes.

Topic Name: Designed with simple string followed by slashes. Home/ Bedroom/ Temperature.

Qos: Three levels of service level as 0, 1, 2 ensures the delivery of messages.

Retain Flag: Flag defines whether the last message is saved by the broker for a particular topic.

Payload: Contains the actual message or commands.

Packet Identifier: Identifies the messages uniquely. It is applicable only for the levels greater than 0.

DUP Flag: Indicates the duplication of messages which are needed to be sent.

2.2 Subscribe

Receiving Clients should subscribe to topics to receive a relevant message. Subscriber message is very simple, and it contains the following attributes.

Packet Identifier: Identifies the messages uniquely.

List of Subscriptions: Subscribe message can have plenty of subscriptions. Each subscription identifies by a topic and QoS level.

Protocol features

- TCP/IP protocol is used to establishing the connection between node

- One- to – many message distributions are achieved by the publish/subscribe mechanism
- Message delivery worked under three qualities (QOS)

  o "At most once" where messages are delivered through the best qualities (Message loss can occur. Because the recipient does not acknowledge to the sender and sender does not have the mechanism to save and resend the message.
  o "At least once" where the messages are delivered at least once. Sender saves the message until gets the acknowledgement from the receiver. It allows multiple sent of messages.
  o "Exactly once" where each message is delivered only once to the intended recipients. It is the highest level of service by the MQTT. It allows the safest delivery in a slow mode. It establishes a four-part handshake between receiver and sender to ensure the high quality of services.

3. MQTT CONNECTING WITH THE OUTSIDE WORLD

Every protocol needs another, that is the basis behind alltechnologies. MQTT [4] also need other protocols such as HTTP,HL7, FIX, SMTP to meet the requirement of send/retrievephenomena. So,

it is a need for a component, which incorporates all protocols as a combined solution. in the enterprise software application, this component plays a major role to connect multiple architecture and services, which is known as enterprise service bus (esb) [3]. there can be plenty of esbs available in the it market. but here we use wso2esb, because it provides an open source and light weightmiddleware. it allows the users from different platforms and enable the combined architecture. apart from the esb, mosquitto broker can be also used as a mqtt broker.

4. ENTERPRISE SERVICE BUS (ESB)

An Enterprise Service Bus (ESB) [8] is an architecture. According to Fig. 2, It integrates various application and services through a set of rules. In another word, it is called middleware. The major duty of an ESB [3] is to work with different kind of applications and platforms by having a communication bus in the middle which has a variety of point to point connections like a client-server model. And also, it offers the flexibility to talk to each other. Generally, it meets all the challenges of service-oriented architecture (SOA). It provides high–level protocol communication as well. The concept of ESB is to avoid spaghetti integration between the applications. It placed in middle and monitor every node and allows a flexible path to troubleshoot through creates loose coupling among the services.
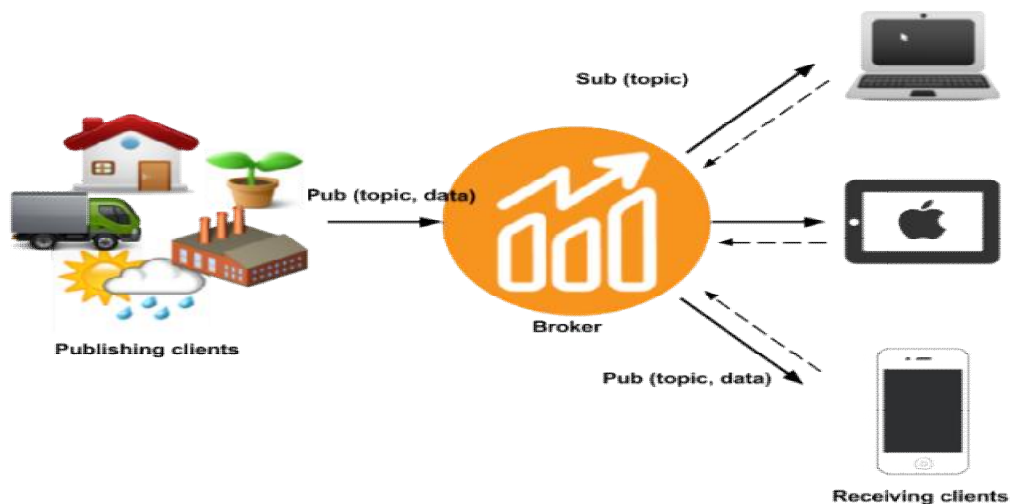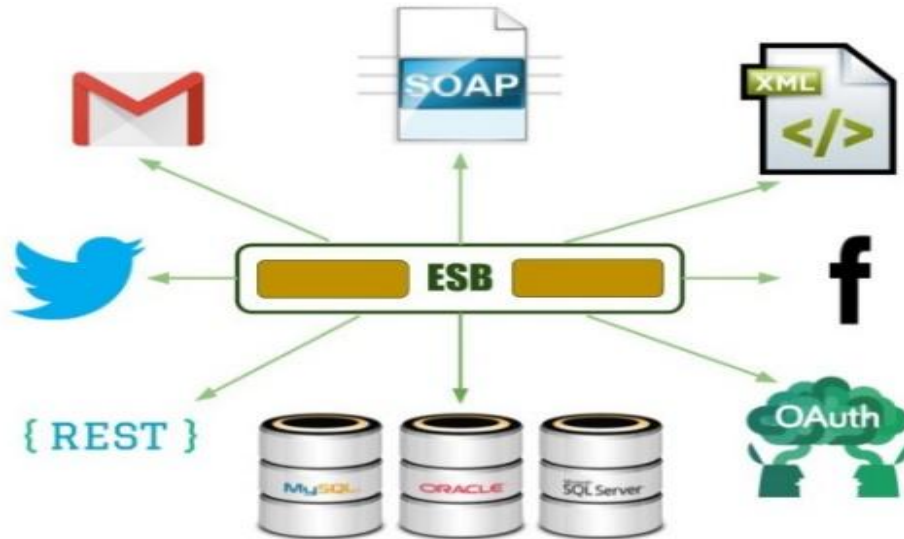

Fig. 1. Publish and subscribe mechanism of IOT broker
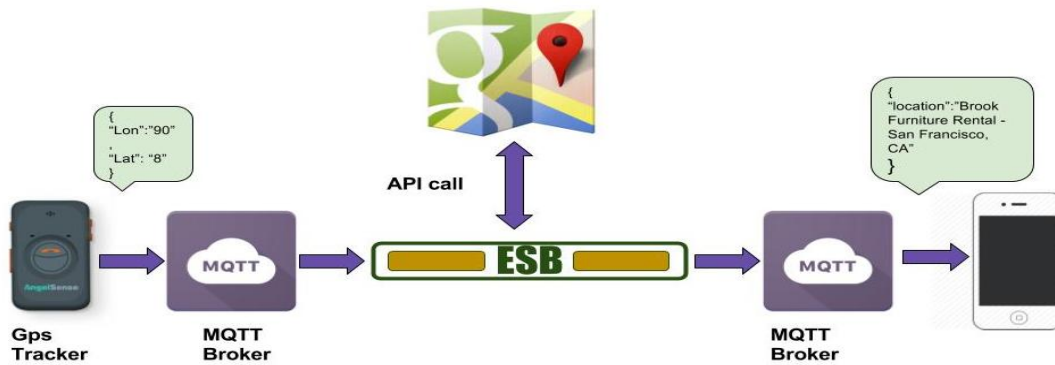
Fig. 2. Architecture of ESB

Fig. 3. Smart vehicle tracking system explained with MQTT broker and ESB

5. METHODOLOGY

A smart vehicle tracking system which helps to identify the exact location of a vehicle is proposed here. We extended the idea of the weather tracking system, introduced by WSO2 using MQTT protocol [9-11,3]. For the first step, we can fix a tracker which able to emits GPS information (longitude and latitude) about a place where the vehicle stands or travels. Emitted location details will be published to MQTT Broker. The mobile phone which is placed apart is subscribed with the topic of MQTT Broker to receive information about the vehicle. In between ESB calls Google map API and gets the detail of the exact given location. Fig. 3 explained the whole idea of the scenario.

6. RESULTS AND DISCUSSION

A simulation over1000 randomly selected geolocations with six different smart devices including apple, windows and android operating systems are carried out. It is found that more than, 85% of correct locations were published by MQTT broker to the smart devices. Comparisons with other devices android platform subscribed the topics more precisely presented.

Table 1. Number of data published

Devices	Number of geolocations	Number of subscriptions
Android smartphone	200	192
Apple smartphone	200	178
Windows smartphone	200	189
Android tablet	200	190
Apple I pad	200	182
Windows tablet	200	193

7. CONCLUSION

This study presents a series of analyses on the importance of connecting objects under the concept of the Internet of Things (IOT) [12]. The ESB plays as a bridge between objects and web services to bring data from one end to another. It is proven that ESB can connect independent objects and the MQTT can be used as an IOT protocol to publish and subscribe data.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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