

HOMEWORK #3

SOLUTION

1. Multiple users may control the same plug via the web page. If one of them requests to switch on the plug and another one requests to switch off the plug at the same time... *(5 points)*

- i) What will they see in their web pages as responses?

We should assume each HTTP request to be handled in a separate thread regardless of creating a thread per request or use a thread pool. Although we protect the methods in PlugSim with the lock, it is possible to have any interleaving of switch and report calls from multiple users because switching the plug and generating the report are two separate methods. Thus, users may see in the web pages as responses that are consistent with their requests (on for on, off for off) or that are not consistent at all (off for on, on for off)

- ii) In the end, is the plug switched on or off?

It depends on which request was processed later, specifically when the switchOn or switchOff was called.

2. Consider three actions “toggle”, “on”, and “off” that one may apply to a plug. If the actions need to be delivered via messages, discuss among the three delivery guarantees – at least one, exactly once, and at most once – which may or may not cause problems and why. *(5 points)*

Toggle will inverse the current state of the switch (e.g., on = !on). Toggle can only be able to use exactly once since multiple toggle operations could cause conflict and confusion.

On and Off are absolute commands which will set the status to ON or OFF. ON or OFF operations can be sent over via both at least once and exactly once methods, since it won't cause any problem no matter how many times we send the command for one operation. Moreover, since sending the message multiple times can enhance the robustness, ON and OFF may be sent via at most once

method multiple times so that the system will have resistance to the lost message.

3. MQTT messages for the plug power updates for Project 3 only contain the power consumptions in plain text. Design a new power update message format that contains a timestamp of when the power consumption is measured as well as the power consumption. Should the message be published to a different topic? *(5 points)*

In Project 3, the power update message is

Topic= prefix/update/plugName/power and the message is the power consumption in plain text. To improve this, we can use the same topic for the power update. The message can be in JSON plain text:

```
{  
    "PlugName": "abcd",  
    "Power": "12.555",  
    "DeviceDateTime": "2023-01-20T:12:11:34:125Z"  
}
```

No, the message can be published to the same topic.