WORKSHOP ON **INTERNET OF THINGS** 67612

Exercise 2

MQTT OVER BSD SOCKET

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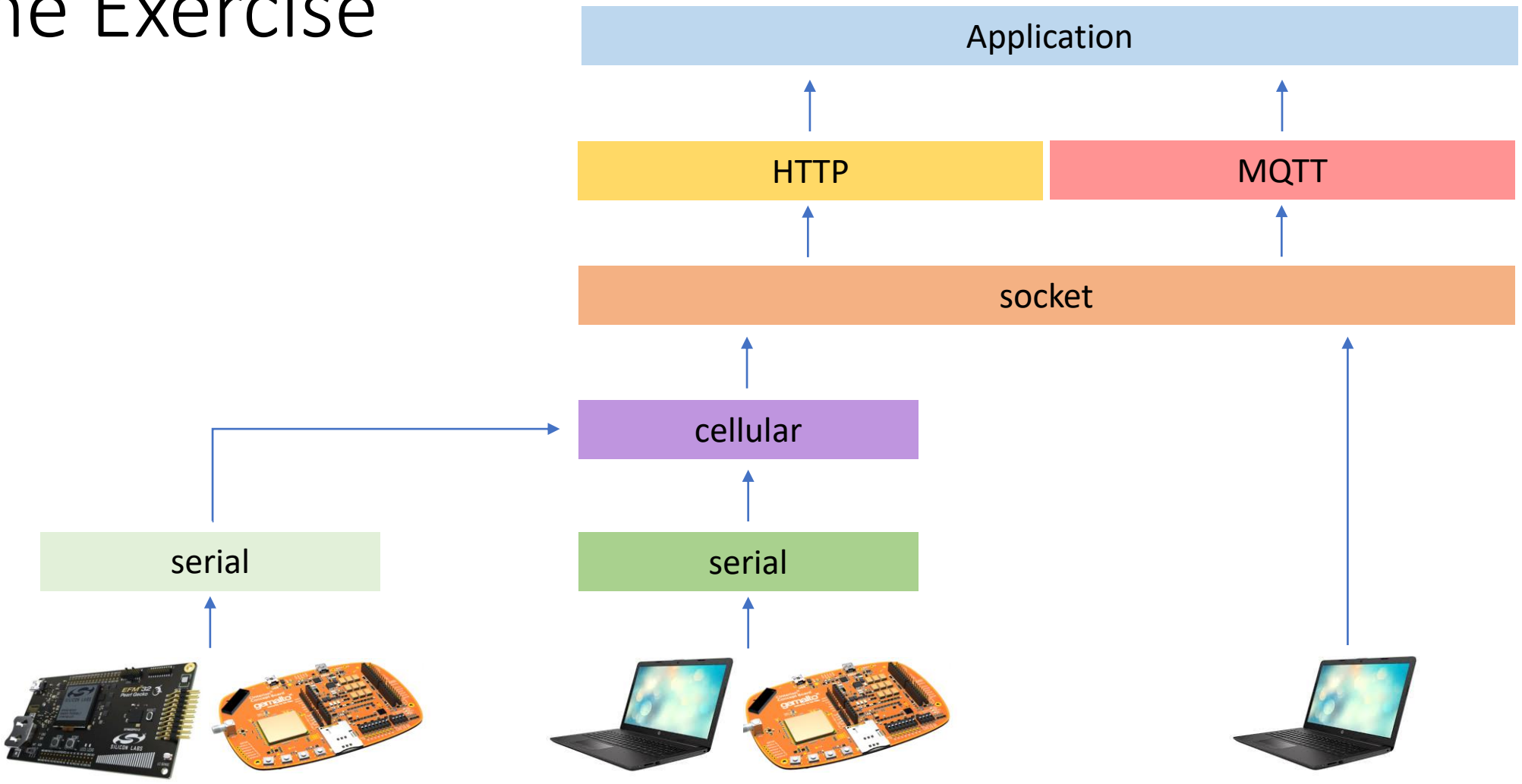
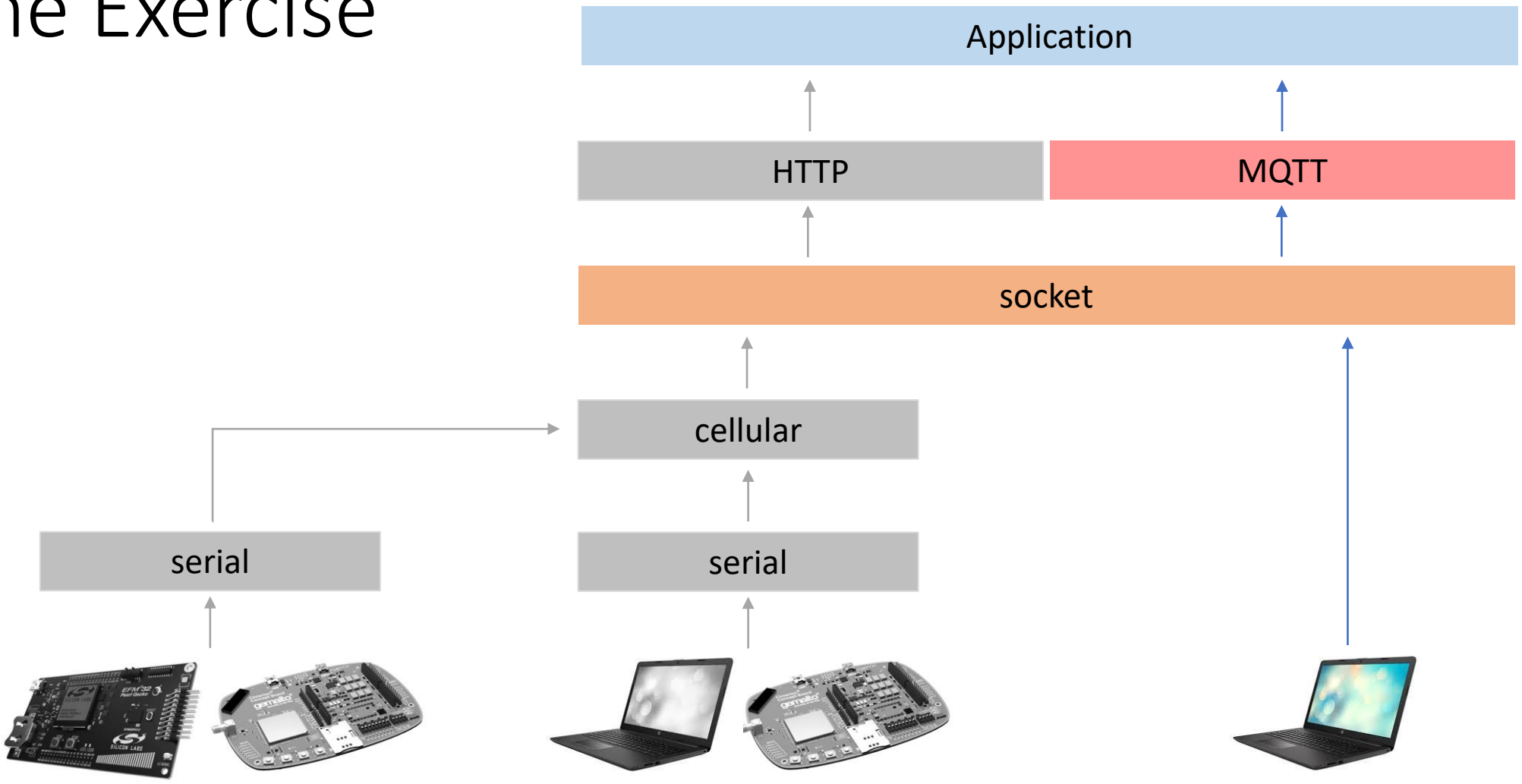
The Exercise



The Exercise



The Exercise

- Initiate an internet connection
- Connect to MQTT broker & publish LWT
- Publish MQTT messages
- Subscribe and receive MQTT message
- Print the progress of the communication

Guidance

- Use wolfMQTT library: https://github.com/wolfSSL/wolfMQTT
- Use the library without MQTT5, TLS, MQTT-SN, and preferably without the non-blocking option as well. In general, avoid any unnecessary library optional “defines” (unless you to work more)
- To use the library, download it to your computer (VM), copy the necessary files to your project, and add them to the compilation (makefile or cmake)

Guidance cont’d

- Create MQTTClient.c file with the following callback functions (check examples/mqttnet.c and examples/mqttnet.h for ideas):

Guidance cont’d

```
/*
 * Connects the socket to the broker,
 * to the given host and port.
 * Returns 0 on success, and a negative number otherwise
 * (one of MqttPacketResponseCodes)
 * timeout_ms defines the timeout in milliseconds.
 */
static int NetConnect(void *context, const char* host, word16 port,
int timeout_ms)
```

Guidance cont’d

```
/*
 * Performs a network (socket) read from the connected broker,
 * to the given buffer buf, and reads buf_len bytes.
 * Returns number of read bytes on success, and a negative number
 * otherwise (one of MqttPacketResponseCodes).
 * timeout_ms defines the timeout in milliseconds.
 */
static int NetRead(void *context, byte* buf, int buf_len, int
timeout_ms)
```

Guidance cont’d

```
/*
 * Performs a network (socket) write to the connected broker,
 * from the given buffer buf, with size of buf_len.
 * Returns the number of sent bytes on success,
 * and a negative number otherwise (one of MqttPacketResponseCodes)
 * timeout_ms defines the timeout in milliseconds
 */
static int NetWrite(void *context, const byte* buf, int buf_len,
int timeout_ms)
```

Guidance cont’d

```
/*
 * Closes the network (socket) connection to the connected broker.
 * Returns 0, and a negative number otherwise
 * (one of MqttPacketResponseCodes)
 */
static int NetDisconnect(void *context)
```

Guidance cont’d

- Add MQTTClient.h file with the following functions and implement them in MQTTClient.c:

Guidance cont’d

```
/*
 * Initializes the Net interface for communication
 */
int MqttClientNet_Init(MqttNet* net, MQTTCtx* mqttCtx)
```

Guidance cont’d

```
/*
 * De-Initializes all that was allocated by MqttClientNet
 */
int MqttClientNet_DeInit(MqttNet* net)
```

Guidance cont'd

- Usage of `void *context` is optional, although recommended
- MqttPacketResponseCodes defined in wolfMQTT/wolfmqtt/mqtt_types.h
- Usage of `MQTTCtx` (defined in wolfMQTT/examples/mqttexample.h) is optional and can be replaced with any other struct or set of variables
- If you use `MQTTCtx`, it can be helpful to copy it to MQTTClient.h
- Copying `MQTTCtx` to MQTTClient.h may require copying `MQTTCtxState` as well
- Initializing the Net interface basically means assigning `MqttNet` struct with the previously defined callbacks (`NetConnect`, `NetRead`, `NetWrite`, `NetDisconnect`)

Guidance cont’d

- Implement the previously defined files and functions
- Use ex1 socket interface (you can fix it, modify, re-implement, and share)
- Write main.c function that:
  - Initiates an internet connection and connects to a broker (also, uses LWT)
  - Subscribes to a topic
  - Publishes two messages to the broker
  - Receives a message
  - Publishes another message
  - Disconnects from the broker and exits the program
  - Prints the results of every step
  - If error occurs, disconnect and clean, if possible, and exit

- Use wolfMQTT/examples/mqttclient/mqttclient.c for implementation ideas

Guidance cont'd

- Message #1, published by the MQTT client to the broker
- Payload of message #1:

```
{
    "Student1ID":"<student-1-id>",
    "Student2ID":"<student-2-id>",
    "Student1Name":"<student-1-name>",
    "Student2Name":"<student-2-name>",
    "Identifier":"<generate-some-id>"
}
```

Topic of message #1:

`huji_iot_class/2021_2022`

- Create some `Identifier` (can be hard coded), string and/or number, and use it in the payload of message #1 and in the topic of message #2 and the subscribed topic

Guidance cont’d

- Message #2, published by the MQTT client to the broker
- Payload of message #2:

```
{
    "CurrentTimeUTC":<seconds-since-epoch>
}
```

- Topic of message #2:

```
huji_iot_class/2021_2022/<Identifier>
```

Guidance cont’d

- Subscribe to:

`huji_iot_class/2021_2022/<Identifier>/recv/#`

- Receive any message published by the other client. Don’t proceed until a message is received (or disconnected)

Guidance cont’d

- Message #3, published by the MQTT client to the broker
- Payload of message #3:

```
{
    "DisconnectedGracefully":true
}
```

- Topic of message #3:

```
huji_iot_class/2021_2022/disconnect
```

Guidance cont’d

- LWT message payload:

```
{
    "DisconnectedGracefully":false
}
```

- LWT message Topic:
- `huji_iot_class/2021_2022/disconnect`

Guidance cont’d

- Example:
- Message #1 is published to `huji_iot_class/2021_2022` with payload: `{"Student1ID":"311016331","Student2ID":"04980382","Student1Name": "Samyon Ristov","Student2Name":"Yair Poleg","Identifier":"1337"}`
- Message #2 is published to `huji_iot_class/2021_2022/1337` with payload: `{"CurrentTimeUTC":1634330266}`
- Message received from `huji_iot_class/2021_2022/1337/recv` or `huji_iot_class/2021_2022/1337/recv/bye` with a random payload
- Message #3 is published to `huji_iot_class/2021_2022/disconnect` with payload: `{"DisconnectedGracefully":true}`
- Before disconnecting, error occurs, and LWT is published to `huji_iot_class/2021_2022/disconnect` with payload: `{"DisconnectedGracefully":false}`

Guidance cont'd

- Work (connect, send, receive) with the following broker:
  - Host: broker.mqttdashboard.com
  - Port: 1883 (port 8000 is used only for web-sockets)
  - http://www.hivemq.com/demos/websocket-client/
- Additional tools to monitor and debug your MQTT session:
  - **mosquitto - https://mosquitto.org/**
  - Tools that are described here: https://ubidots.com/blog/top-3-online-tools-to-simulate-an-mqtt-client/)
    - MQTTLens
    - MQTT.fx
    - MQTT-Spy

Guidance cont’d

- Connect:
  - No username and password
  - Keep alive = 60
  - Clean session = 0
  - Generate any client-id
  - Use LWT
- LWT:
  - QoS = 1
  - No retain message
- Publish:
  - QoS = 1
  - No retain message
- Subscribe:
  - QoS = 1

Exercise #2

- Work & submit in pairs
- Make sure that your submissions works on the VM (try importing it as a new project)
- Deliverables:
  - Provide all the project files, and/or export the project
  - Create makefile or CMakeLists.txt (in CLion).
  - A README file with your names, email addresses, IDs and adequate level of documentation of the deliverables and software design-architecture-flow description
  - If anything special is needed (compilation instructions and environment requirements), add it to the README
- Pack all the deliverables as .zip or .tar and upload to Moodle
- Deadline: 1.11.19, 23:59
- The grade will be based on code's functionality, description, and clear implementation

Contact

- Moodle's 'Workshop Discussions' forum is the best place for questions.

- But if needed, contact us personally:
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