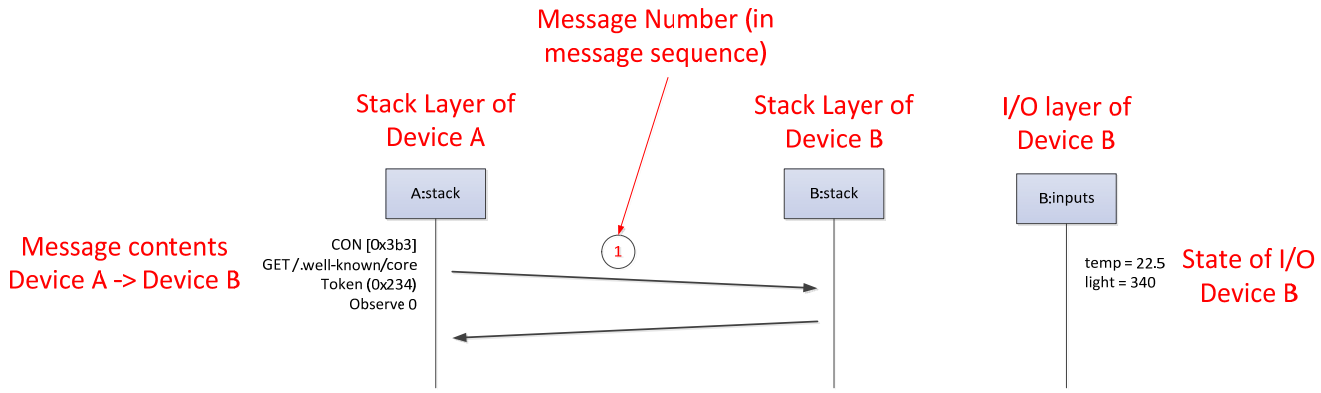
Exam . 90 Minutes 24. January 2016

Name_____

Points:

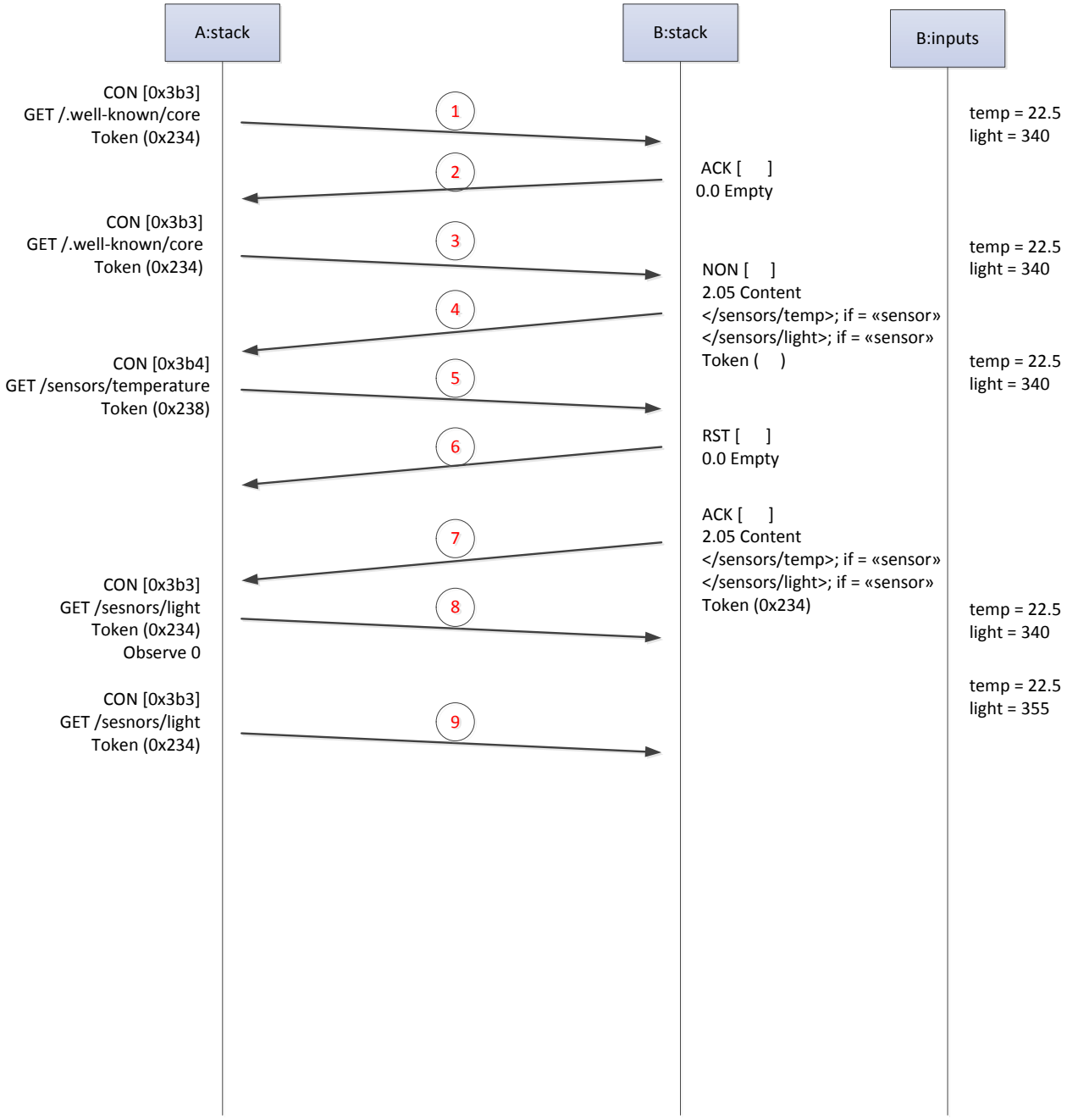
Exercise	Max. Points	Points Achieved	Grade Tests
1	28		
2	30		
3	15		
4	5		
Total	73		
Grade			

Information: Key to communication diagrams



Question 1: Communication protocols (A) (28P)

Study the communication sequence diagram below and answer the questions that follow:



Questions:

a.) What protocol is used between the two devices? (1P)
CoAP

b.) In terms of the communication protocol, what is device A and B? (2P)
Device A is a CoAP client, B a CoaP server

c.) Explain the fields precisely of message number 1 (6P)
It's a confirmable message (1P) with a message ID of 0x3b3 (1P)
It uses the GET method (1P) to get all the resources offered by the server (1P)
The transaction token is 0x234 (1P)
The client does not want to observe this resource (1P)

d.) Fill in the missing information of message number 2 (1P)
The server will ACK the message so the message ID is 0x3b3 (1P)

e.) Explain the relationship, if any, between messages 3, 4 and 7 (3P)
Device B considers message 3 to be a duplicate of message 1 (1P)
Message 4 is therefore a response to message 1 (1P)
Message 7 is the response to message 3 (1P)

f.) Fill in the missing information in messages 4, 6 and 7 (4P)
Message 4 -> non(0x3b3), token (0x234) (2P)
Message 6 -> RST(0x3b4) (1P)
Message 7 -> ack(0x3b3) (1P)

g.) What kind of message is message 6 and what is its purpose? (2P)
Reset message (1P) usually sent when the server can't handle incoming requests for some reason (1P)

h.) Is there anything wrong with message 5? (1P)
The resource sensors/temperature does not exist

i.) Explain message 8 precisely (3P + 1P)
It's a confirmable message (1P) which gets the resource light (1P) and also requests to observe this resource (1P) The message ID is the same as other messages but after a time is OK to use (1P)

j.) How would you expect the sequence to end? (5P)
A response with the current light value (340) nd an acceptance of the observation request or the light value (340) and a refusal of the observe request (3p each)
A response to message 9 with the current light value (355) (1P)
A message to the client with the current light value (355) generated due to observe condition (1P)

Question 2: Communication protocols (B) (20P)

Questions:

a.) What protocol is used between the two devices? (1P)
MQTT

b.) What transport protocol does this protocol rely on? (1P)
TCP

c.) In terms of the communication protocol, what are devices A, B and C? (3P)
Device A and C are MQTT clients, B is an MQTT broker

d.) Explain message 1 precisely (3P)
The client publishes a message without a format to a topic /sensor/temp (1P) with a quality of service 0 (shoot and forget) (1P) and instructs the broker not to retain a copy of this message (1P)

e.) Explain the relationship between messages 2, 3 and 5 (4P)
(2) A publishes to a topic with QoS 2 asking the broker to retain the message for future subscribers (1P). (3) At a later time C subscribes to the topic with QoS 1. (1P) (5) the retained message is transmitted to the client with QoS1 (downgrade) (2P)

f.) What is the purpose of the message tuple 9 and 10? (1P)
To prevent the timeout on the broker from disconnecting client A

g.) How do you expect the sequence to end? (4P)
B PUBACK's the PUBLISH from A. (1P) B PUBLISH the topic to C (1P) with RETAIN = 0 (1P). C PUBACK's the PUBLISH (1P)

h.) What is the purpose of the "last will and testament" feature of the protocol? (1P)
If a publisher disconnects/timeout's then the broker will publish the last will and testament so that the subscribers know.

i.) How does a potential subscriber know what topics are available? (2P)
He doesn't (1P) but a central catalogue (HyperCAT could provide this information) (1P)

Question 3: Data Handling (19P)

The following time-series data: 2, 3, 1, 3, 1, 4, 2, 3

Has a mean (μ) of 2.375 and a standard deviation (σ) of 0.992 leading to a normalised time series of

-0.378, 0.630, -1.386, 0.630, -1.386, 1.638, 0.378, 0.630

Using this information and the table below:

β_i \ a	3	4	5	6	7	8	9	10
β_1	-0.43	-0.67	-0.84	-0.97	-1.07	-1.15	-1.22	-1.28
β_2	0.43	0	-0.25	-0.43	-0.57	-0.67	-0.76	-0.84
β_3		0.67	0.25	0	-0.18	-0.32	-0.43	-0.52
β_4			0.84	0.43	0.18	0	-0.14	-0.25
β_5				0.97	0.57	0.32	0.14	0
β_6					1.07	0.67	0.43	0.25
β_7						1.15	0.76	0.52
β_8							1.22	0.84
β_9								1.28

Table 3: A lookup table that contains the breakpoints that divide a Gaussian distribution in an arbitrary number (from 3 to 10) of equiprobable regions

a.) Calculate the PAA series with N = 4 (4P)

`0.126, -0.378, 0.126, 0.126`

b.) Calculate the symbolic string (SAX) using an alphabet of 3 (4P)

bbbc

c.) What is the point of PAA representation (3P)?

Reduces (1P) the time series by aggregation (1P) building block for SAX (1P)

Why is this form of aggregation interesting and what is its relevance to Internet of Things (3P)?

Interesting because it reduces a series of numbers to searchable strings in large amounts of data (1P) Relevance – IoT assumes huge amounts of data which need to be searched and the use of this could also reduce the traffic between devices. (2P)

Question 4: General Questions (25P)

a.) What's the difference between oneM2M and OSGi? (2P)
oneM2M is a device management framework used to manage the device during deployment. OSGi is a software services lifecycle management SW.

b.) A device supporting CoAP, LWM2M and ipso boots. The device is one of a couple of hundred used to monitor temperature, moisture and oxygen levels in a vineyard and connects to a single server. Describe the application of one LWM2M object and one IPSO object to this use case. (4P)
Some opinions on how the chosen objects should be initlaised and why the objects are chosen in the first place.

c.) What is the following and what does it tell us? (9P)

```
{"e":
        [ { "n": "temperature", "v": 27.2, "u": "Cel" },
        { "n": "humidity", "v": 80, "u": "%RH" }],

        "bn": "http://[2001:db8::2]/",
        "bt": 1320078429,
        "ver": 1
}
```

It's a SenML (1) json (1) structure that tells us the value of a sensor In this case n -> name , v = value u = unit (3P). There are two sensors (1P) and some general information such as the name (ULI) of a device (1P) the timestamp (1P) and the version number (1P)

d.) Explain how Linux implements the principle of a zero-copy stack (6P)

Linux implements a data structure (1P) called skbuf that holds the information necessary to process the frame and the contents of the frame as well (2P). this is instantiated once on reception (1P) subsequent layers make a clone of this structure (1P) without copying the actual data (1P).

e.) Why doesn't linux implement a triple buffer (5P)
A triple buffer implements three buffers where the reader reads from one and the writer writes alternately into one of the other two (2P). It ensure that a reader always get the latest information (1P) and so is better suited to isochronous data (1P). Linux is built for handling TCP/IP so there is no gain. (1P)