

National College of Ireland

**BSc. (Honours) in Computing Year 4 (BSHCIFSC4)**

Terminal Assessment - 2022/2023

**Release: August 2023**

**Due: (4 days after release)**

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**IoT Fundamentals and Development (H8IOTFDEV)**

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**Instructions**

1. This is an open book exam. **ALL Questions must be answered. All questions carry 25 marks.**
2. This exam uses Turnitin to check whether a text is copied from the Internet, from any other source or from peer students. If the lecture notes are used as a source do not copy them directly but rather paraphrase them (put them into your own words). In addition, **you are not allowed to discuss your solution anyone except your lecturer or an appointed member of staff at NCI. If it is found that a student has discussed his/ her solution with others or if the work is plagiarized, the case will be subject to disciplinary procedures and may result in expulsion.**
3. You need to submit the solution of this assignment in your Moodle page at the TERMINAL ASSIGNMENT Link. **You should submit the DOC (or PDF) file by the end of your exam time**.
4. You can use ppt, paint brush, VISIO or draw.io or any other tool to draw a diagram.
5. You can also draw a figure on a piece of paper, take a picture with your mobile phone camera then paste the picture on the DOC. Please ensure that you write below your drawing the question number the drawing corresponds to.
6. Use a single column layout document.
7. Font size for the body of the text should be 12-point Arial.
8. Include student name, student ID and course name at the top of the first page.

The **question number** being addressed must be clearly indicated in the document.

Learning Outcomes:

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| --- | --- |
| LO1 | Analyse and appraise underlining technologies that support Internet of Things (IoT) and M2M communications |
| LO2 | Compare, contrast, and critique M2M communications, assessing the issues that exist and the proposed solutions |
| LO3 | Integrate the wireless technologies to create IoT applications |
| LO4 | Design and develop simulation/emulation scenarios for IoT applications using industry standard network simulator software. |

Question 1

1. What are the hidden and exposed node problems? How have they been addressed using WiFi communication standards?

**(7.5 marks)**

1. Discuss channel allocation for the WiFi 802.11b/g standard. How does it work and what impact can it have on wireless communication within a network?

**(7.5 marks)**

1. Why are the previous two points important to an IoT eco-system? Provide examples where appropriate.

**(10 marks)**

Question 2

1. Using NS-3, develop an application to simulate a TCP-point-to-point connection between two nodes.

**(2.5 marks)**

1. Amend this application to monitor the performance of the TCP connection. Highlight the jitter, loss, throughput, and delay of this connection. Include an XML or PCAP file as evidence of your simulation and calculations.

**(5 marks)**

1. Repeat the above steps with a UDP connection.

**(5 marks)**

1. Compare UDP versus TCP connections in terms of throughput and loss while using 2, 4, and 6 nodes in each simulation.

**(12.5 marks)**

Question 3

1. XMPP and AMQP are both messaging protocols that support IoT applications. How do they function, and what are their similarities and differences? Highlight some examples where each of these are used in real applications.

**(7.5 marks)**

1. What is DDS and why has it been previously associated with industrial IoT applications?

**(7.5 marks)**

1. What issues currently exist in M2M communication? Highlight a solution for each of the issues you have discussed.

**(10 marks)**

Question 4

Write an application to do the following tasks and later answer the related questions on your program:

1. Write an application that uses any sensor to collect data from the outside world.

**(5 marks)**

1. The application should process that data to compute some label. For this part you should describe the format you expect the data to be delivered as well as writing the code to process this data.

**(5 marks)**

e.g:

Thermometer: hot-above 10 degrees

cold -less than 10 degrees

Camera: Face detected and a timestamp

Sending image data (just the face from the image)

IR: Movement detected

1. Your application should publish the label and deliver them to a set of subscriber application that exists somewhere else over the internet. The procedure you use for this step is your choice.

**(5 marks)**

1. From Question 3 part (iii) you were asked to write a program that communicated with many subscribers the labels you identified from your sensor. Describe how this publisher-subscriber communication protocol works.

**(5 marks)**

1. Why did you choose this protocol over any other? Provide examples of some alternatives and the reasons why you didn’t choose them.

**(5 marks)**