

Professional Certificate of Competency in Advanced TCP/IP-Based Industrial Networking

(CAV)

**MODEL ANSWERS**

**DO NOT GIVE TO STUDENTS**

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| **Module number** | Modules 1 to 6 | | |
| **Module name** |  | | |
| **Assessment type** | Assessment 1 | | |
| **Version** | 3 | | |
| **Created by** | EIT | **Date** | 01 February 2021 |
| **Reviewed by** | D. Reynders | **Date** | 13 July 2021 |

Guidelines for Assessors

Students will submit completed assessment tasks via Moodle on or before the submission due date. Some students may have extension requirements which will be noted on Moodle.

As the **assessor**, you are required to assess student submissions and ensure assessments follow the ‘Principles of Assessment’ as well as the ‘Rules of Evidence’. You need to ensure student performance is in line with the relevant assessment criteria, the unit outline, this marking guide/model answers and the Training and Assessment Matrix (TAM).

Assessors are given three weeks to finalise and upload all marking and feedback to Moodle. During the course of the assessment, the assessor may seek clarification from the instructor (if required).

Please refer to Appendix B (Assessor Guide) of the Instructor and Assessor Contract for full details.

1. Students must answer ALL questions. If any questions are not answered the assessor will need to ask the student to resubmit the assessment as their second attempt.
2. All answers must be in the students own words. They must reference all content used from other sources including course materials, slides, diagrams, etc. Do not directly copy and paste from course materials or any other resources. Refer to the referencing section of the [EIT eLibrary](https://moodle.eit.edu.au/course/view.php?id=1054) on Moodle for referencing guides.
3. Copying and pasting is not allowed. The main idea behind written assessments is for the student to learn and understand the material by reading it and answering the questions as stated. Cutting and pasting from internet sites or the resource material does not enhance that learning process. However, appropriate diagrams can be pasted if a student cannot draw them.
4. Students are advised that the best result can be earned by giving concise, brief answers that address the questions as stated.
5. Students must use the Microsoft Word question document for completing their answers by typing the answers after each question without deleting the question. They are asked to make sure that they preserve the original question number format and that they don’t change the question numbers by adding extra lines or deleting existing ones.
6. Students are advised not to add extra pictures, etc. as annexures but add the pictures and diagrams directly into the main answer document by pasting. Hand-drawn sketches can be inserted after scanning but students are asked to ensure that the assessment file size does not become too large (more than 10 MB).
7. Students must refer to all diagrams and pictures, etc. that they have drawn or pasted in. They should not paste them into the document without referring to them in the written answer.
8. If an assessor suspects plagiarism in any student submissions they must report this to the Learning Support Officer immediately.

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| **Modules:** | **Modules 1 to 6** |
| **Assessment type:** | **Assessment 1** |
| **Total marks:** | **160** |

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| **PART 1: WRITTEN COMPONENT (120 marks)** | | |
| **Q1** | Describe the size and purpose of the following fields in the Ethernet V2 frame:   1. Preamble 2. Destination Address 3. Type 4. FCS | **(4 marks)** |
| **A1** | Model answer: | |
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| **Q2** | What is a ‘MAC address’? | **(2 marks)** |
| **A2** | Model answer: | |
|  |  | |
| **Q3** | Give four differences between Blue Book (V2) and IEEE 802.3 frames. | **(4 marks)** |
| **A3** | Model answer: | |
|  |  | |
| **Q4** | Describe the following three variants of the IEEE 802.3 standard:   1. IEEE 802i 2. IEEE 802u 3. IEEE 802ab | **(3 marks)** |
| **A4** | Model answer: | |
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| **Q5** | List the media used by the following standards:   1. 1000BaseSX 2. 1000BaseLX 3. 1000BaseT | **(3 marks)** |
| **A5** | Model answer: | |
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| **Q6** | Discuss two alternative connectors used with Industrial Ethernet. | **(4 marks)** |
| **A6** | Model answer: | |
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| **Q7** | Briefly discuss the following protection components used with Intrinsically Safe Ethernet:   1. isolators 2. cables 3. glands 4. connectors | **(4 marks)** |
| **A7** | Model answer: | |
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| **Q8** | 1. Name any four devices that use PoE. 2. What amount of power is available in the IEEE 802.3af and IEEE 802.11at specifications respectively? | **(6 marks)** |
| **A8** | Model answer: | |
|  |  | |
| **Q9** | Write short notes on the following:   1. PPP 2. SLIP 3. PPPoE | **(6 marks)** |
| **A9** | Model answer: | |
|  | | |
| **Q10** | Discuss the IPv4 header structure and its various fields in detail. | **(6 marks)** |
| **A10** | Model answer: | |
|  |  | |
| **Q11** | 1. Draw a neat sketch of the formal classful IP address structure. (Do not copy from a textbook)   Run the ipconfig /all command in your command box (Windows) or similar on your machine.   1. What is your device’s current IP address? 2. From what data can you determine the Network ID? 3. Identify the HostID and NetID for your IP address. | **(5 marks)** |
| **A11** | Model answer: | |
|  |  | |
| **Q12** | List the default subnet masks for the various classes of IP addresses, using the prefix notation. | **(2 marks)** |
| **A12** | Model answer: | |
|  |  | |
| **Q13** | List the IP ranges of private networks. | **(2 marks)** |
| **A13** | Model answer: | |
|  |  | |
| **Q14** | Execute the following commands in the command prompt and snag your outputs.   1. Run getmac and identify your MAC address currently in use. 2. Run arp –a and show the content of your address cache. 3. Run ping and show the responses. | **(3 marks)** |
| **A14** | Model answer: | |
|  |  | |
| **Q15** | Draw an illustration of the various fields in an IPv6 header. (Do not copy / paste from a textbook) | **(3 marks)** |
| **A15** | Model answer: | |
|  |  | |
| **Q16** | Compare the IPv6 multicast, unicast and anycast mechanisms. | **(2 marks)** |
| **A16** | Model answer: | |
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| **Q17** | Give examples of IPv4 and IPv6 link-local addresses, and name a specific scenario where they would be used. | **(2 marks)** |
| **A17** | Model answer: | |
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| **Q18** | 1. Draw a neat sketch showing an ICMPv6 frame. 2. What is the Type number for an Echo Request message? | **(2 marks)** |
| **A18** | Model answer: | |
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| **Q19** | What is the fundamental difference between TCP and UDP? | **(1 marks)** |
| **A19** | Model answer: | |
|  |  | |
| **Q20** | After establishing a connection with a server, a TCP client sends 100 bytes of data with a sequence number of 11301.  Assuming that the message is received successfully, what acknowledgement number could the server return? | **(3 marks)** |
| **A20** | Model answer: | |
|  |  | |
| **Q21** | What is the difference between well-known, registered, and ephemeral ports, and which numbers are reserved for each category? | **(2 marks)** |
| **A21** | Model answer: | |
|  |  | |
| **Q22** | 1. Name four functions of TCP. 2. Explain the use of the following flags in the TCP header:    1. SYN    2. ACK    3. FIN    4. RST | **(4 marks)** |
| **A22** | Model answer: | |
|  |  | |
| **Q23** | 1. List three applications of UDP. 2. Under which conditions will the value contained in the ‘Message Length’ field in the UDP header be equal to 8? | **(4 marks)** |
| **A23** | Model answer: | |
|  | | |
| **Q24** | 1. List two functions of HTTP. 2. Which two ports are used by FTP (and for what purposes)? 3. What is the purpose of DNS? 4. How does DynDNS differ from DNS? 5. What are the key components of SNMP? | **(5 marks)** |
| **A24** | Model answer: | |
|  |  | |
| **Q25** | Explain in your own words, the purpose of each of the following: *(Please do not copy/paste. One sentence each will do)*   1. BootP 2. DHCP | **(2 marks)** |
| **A25** | Model answer: | |
|  | | |
| **Q26** | What is APIPA and when is it used? | **(2 marks)** |
| **A26** | Model answer: | |
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| **Q27** | Describe the basic operation (and difference between) L2 and L3 Ethernet switches. | **(2 marks)** |
| **A27** | Model answer: | |
|  |  | |
| **Q28** | What is the basic difference between Ethernet hubs and switches? | **(2 marks)** |
| **A28** | Model answer: | |
|  | | |
| **Q29** | What is the difference between Ethernet bridges and switches? | **(1 marks)** |
| **A29** | Model answer: | |
|  |  | |
| **Q30** | What is the basic difference between L3 Ethernet switches and routers? | **(1 marks)** |
| **A30** | Model answer: | |
|  |  | |
| **Q31** | A client with MAC address ‘a’ and IP address 10.0.0.1/8 sends a packet to its Default Gateway with MAC address ‘b’ and IP address 10.0.0.100/10. The router then uses its other port with MAC address ‘c’ and IP address 202.168.0.100/24 to forward the packet to the server with MAC address ‘d’ and IP address 202.168.0.1/24.  List the source/destination MAC addresses as well as source/destination IP addresses for a packet captured on the link between the client and the router. | **(4 marks)** |
| **A31** | Model answer: | |
|  |  | |
| **Q32** | Describe, briefly, the essence of each of the STP variants. Please use your own words, and do not copy and paste. Additional browsing / on-line research is suggested. | **(3 marks)** |
| **A32** | Model answer: | |
|  |  | |
| **Q33** | Draw and explain the various fields of an IEEE 802.3p/Q Ethernet frame. | **(4 marks)** |
| **A33** | Model answer: | |
|  |  | |
| **Q34** | List the 5 elements of QoS. | **(5 marks)** |
| **A34** | Model answer: | |
|  |  | |
| **Q35** | Explain the basic operation of an HSR network as per IEC 62439-3. | **(2 marks)** |
| **A35** | Model answer: | |
|  |  | |
| **Q36** | What do you understand by the term PRP? | **(2 marks)** |
| **A36** | Model answer: | |
|  |  | |
| **Q37** | Describe, in your own words, the basic operation of IEEE802.1X. | **(4 marks)** |
| **A37** | Model answer: | |
|  |  | |
| **Q38** | Explain, briefly, in your own words, the concept (and implementation) of Link Aggregation as per IEEE802.3ad. You may have to do some additional online research here. | **(4 marks)** |
| **A38** | Model answer: | |

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| **PART 2: PRACTICAL COMPONENT (40 marks)**  The exercise, software and other documentation referred to has been uploaded to Moodle. Also see instructions for accessing the Remote Lab facility. Please contact your instructor if you experience any difficulties.  If you are new to this, see the additional notes. You need to be able to ‘ping’ another device. This can be another computer on your home network, even your broadband router. Alternatively, you can ping a site on the Internet. You may have problems if using a 3G/4G connection, please contact your lecturer.  If you don’t have Wireshark yet, just download the latest version from the Internet [here](http://www.wireshark.org/download.html) and install. Make sure that you install ‘winpcap’ as well, when prompted.  In order to snag your results (as jpg files), there are many screen capture programs on the Internet. There are good free ones such as ‘Screenhunter’ or Jing. When you install free software, always choose the ‘advanced’ option and uncheck all boxes that wat you to install toolbars etc. Snagit by Techsmith is excellent but will cost you some money and you probably do not need the editing function anyway.  The easiest way to use the snag program is to set it up to save the captured image on the clipboard, and then insert the image into your document with Cntl-C, Cntl-V.  When requested to capture a header, capture only that (i.e. set up your screen capture software to capture a ‘region’. Please do not capture the entire screen as it is difficult to read.  If you want to change your IP address, but are not sure how to do it, just Google how to set your ip address as well as your Operating System and version thereof.  There are many videos for Wireshark on the Internet, especially on Wireshark University. | | |
| **Q39** | **Network Layer Protocols: IPv4**  Run arp –a from the Command Prompt in order to view the contents of the ARP cache. The details pertaining to your ADSL router will already be there.  If you are using another computer for a target device and it does not appear in the cache yet; just ping it and the details (IP/MAC addresses) will appear.  Snag the ARP Cache. | **(3 marks)** |
| **A39** | Model answer: | |
|  |  | |
| **Q40** | **Network Layer Protocols: IPv4**  There are two ways of doing the following exercise.   1. If you are using another computer, you have to make sure its details have been removed from the ARP cache. You can wait a while for this to happen (3-20 minutes depending on your Operating System), or you can remove it with the arp command and using the ‘-d’ switch. To check all the possibilities (‘switches’) type arp /? You can then start Wireshark, ping the other machine, and Wireshark will capture the ARP messages. 2. If you are using the ADSL router for this exercise, be aware that the system will restore its entry in the ARP cache as fast as you delete it. However, this is still done by means of ARP messages; the only *caveat* is that you need to have Wireshark running before you delete the ADSL router entry in the cache     After invoking the ARP messages, look at the top part of the Wireshark display. There will be two ARP messages; an ARP Request emanating from your PC, and an ARP Response. Now look at the middle part of the screen and expand the ARP headers in turn (double-click or click on the [+]). Notice that in the first one (broadcast to ff:ff:ff:ff:ff:ff) the one MAC address is missing. This is what your PC is looking for. In the second ARP message this info is supplied (although source and destination have been transposed).   1. Snag the ARP *Response* packet (the second packet in the pair of ARP messages, (NOT the ARP Request). (2 marks) 2. What is the MAC address of the second device? (1 mark)   Now go back to the top of the screen: select one of the ICMP *Echo* *Response (*a.k.a. *Echo Reply)* Messages. This is an incoming response to your ‘ping’. Note the three headers: the Ethernet header, the IP header, and the ICMP header. Go to the middle section of the screen, expand all the headers, and confirm the MAC addresses and IP addresses involved here.  *Always ignore the first line on the centre section of Wireshark, as this relates to OSI layer 1 and only gives statistics for the raw data.*   1. What is the ICMP type (the first field in the ICMP header)? Give both the number and its meaning. (1 mark) 2. What is the data content of ping message carried (i.e. the stuff following the ICMP header? Give the answer in ASCII. See the right-hand side of the bottom section of the Wireshark display. Hex is on the left; ASCII on the right. (2 marks) 3. Snag the expanded IP header only and paste it below. (2 marks) 4. Snag the expanded ICMP header only and paste it below. (2 marks) | **(10 marks)** |
| **A40** | Model answer: | |
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| **Q41** | **Network Layer Protocols: IPv6**  Work through Exercise 15(b) (IPv6 supplement) and answer the following questions.   1. Snag your *ipconfig /all* result and paste it in here. (2 marks) 2. What is the IPv6 address of the network interface (e.g. Ethernet) you are currently using? (2 marks)   Generate IPv6 packets with Ostinato as per Exercise 15(b).   1. Capture any IPv6 frame, snag the header, and paste it in here. (2 marks) 2. For the header above, supply the following details: (4 marks) 3. Version 4. Traffic class 5. Flow label 6. Payload length 7. Next header 8. Hop limit 9. Source IP address 10. Destination IP address | **(10 marks)** |
| **A41** | Model answer: | |
|  |  | |
| **Q42** | **Host-to-Host and Application Layer Protocols**  Work through Exercise 16 (TCP/IP) and do the following (no need to snag any screens other than the two mentioned below:   1. Snag the triple handshake and paste it in below (2 marks) 2. Snag an HTTP header and paste it in below (2 marks) 3. Work through exercise 16(b) (UDP) 4. Snag a UDP header, and paste it here: (2 marks) | **(6 marks)** |
| **A42** | Model answer: | |
|  | | |
| **Q43** | **Switching**  Work through Exercise 38 (Managed Switch) and paste your results here. SS1 refers to Screenshot 1 etc. There is no need to do the SNMP section at the end of Exercise 38.  Paste SS1, SS2, SS3, SS4, SS5 below.    The exercises are sometimes moved between labs, so the lab number in the instructions may not be correct. Just do a search on Electromeet. | **(5 marks)** |
| **A43** | Model answer: | |
|  |  | |
| **Q44** | **Advanced Switching**  You are designing an Industrial network with three switches and, because of the need for a high degree of availability, you need to build in redundancy via a ring. In this regard your switches MUST conform to IEC 63439-3.  The switches are approximately 500m apart, and each switch has a maximum of 4 devices attached to it.  Identify the specific switch you would use (find one on the Internet).  Please copy and paste the URL so the assessor can check the switch specifications. You may also paste a screenshot of the switch.  Explain how you would interconnect the switches (including which ports you would use).  Note that conformance to HSR (IEC 62439-3) will be clearly shown on the switch’s data sheet. If it does not say HSR then the switch does not support it. | **(6 marks)** |
| **A44** | Model answer: | |

**END OF ASSESSMENT**