Module: ICP2011
Department: School of Computer Science
Module credit: 10
Organiser: Professor Jianming Tang

1. General Information

Assessment content

The assignment contains 25 review questions, of which each student must answer at least 20.

Contribution of this assessment

This assessment contributes to 20% of the overall module mark.

Submission procedure

A word document containing all your answers to the attempted questions should be submitted on Blackboard by 5:00pm Friday 27th April 2018.

Plagiarism and Unfair Practice

Plagiarised work will be given a mark of zero. Remember when you submit you agree to the standard agreement:

> *This piece of work is a result of my own work except where it is a group assignment for which approved collaboration has been granted. Material from the work of others (from a book, a journal or the Web) used in this assignment has been acknowledged and quotations and paraphrasing suitably indicated. I appreciate that to imply that such work is mine, could lead to a nil mark, failing the module or being excluded from the University. I also testify that no substantial part of this work has been previously submitted for assessment.*

Late Submission

Work submitted within one week of the stated deadline will be marked but the mark will be capped at 40%. A mark of 0% will be awarded for any work submitted 1 week after the deadline.

Acceptable reasons for submitting work late include: Serious personal illness with a doctor's certificate (a self-certified medical note should not be accepted). The death of a relative or close friend. Serious family problems such as divorce, separation and eviction. Examples of unacceptable reasons for failing to submit work on time include: Having exams; Having other work to do; Not having access to a computer; Having computer related problems; Being on holiday; Not being able to find information about a subject.

Marking Scheme

You will be awarded 1.0 mark for each correct answer and maximum 20 marks in total. If more than 20 questions are attempted, top 20 answers will be used in calculating your overall assessment marks. Please remember that marks are provisional until they are confirmed by a board of examiners.

Feedback details

Tutorial lecturers will be taking place on Thursday 3rd May 2018 from 10:00 in MLT.

2. Review Questions

1. **Describe briefly the major differences between pure Time Division Multiplexing (TDM) and Statistical Time Division Multiplexing (STDM).**

   In a TDM network, a TDM frame having a time duration of T seconds is equally subdivided into N time slots, each of which contains B bits for transmitting raw data (including control data) of a user. Work out the raw data rate of the user and the raw data rate of the entire TDM channel.

   Utilising pure time domain multiplexing, User A, User B and User C share a physical TDM channel in the following pattern: AABX AABC AABX AABC, here X indicates an unused time slot. If the transmission bandwidth allocated to User B is 10Mb/s, work out the transmission bandwidths for User A and User C.

2. **A single error digit occurs in the received 16 information digits shown below. If even parity checking is applied for each column/row of the information matrix, based on the given column/row parity digits, correct the error digit received. State briefly the conditions under which the parity checking-based error correction technique fails.**

Column parity digits

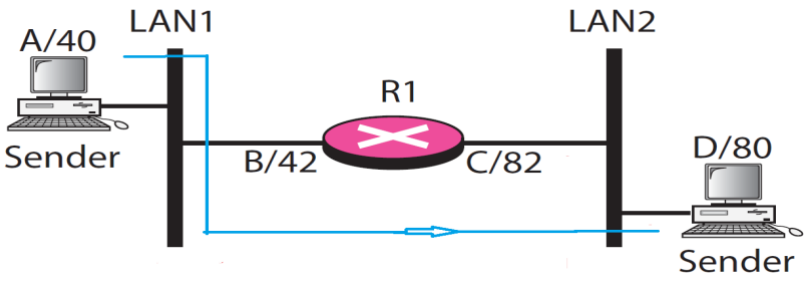
Information	**0**	**0**	**1**	**1**	**1**
	0	**1**	**1**	**0**	**0** **Row parity digits**
	1	**0**	**0**	**0**	**1**
	1	**0**	**1**	**1**	**1**

3. **Draw a diagram to show a typical data network architecture including terminals, access networks and a core network. Describe the relationships between communication architectures and protocols.**

4. **Name all the layers contained in the OSI reference model. Based on the OSI Reference model, match the following to one or more layers of the model: i) Error correction and retransmission; ii) Establishing and monitoring an entire communication connection between users; iii) Route determination; iv) Responsibility for carrying frames between adjacent nodes; v) Communicates directly with user's application programme; vi) Mechanical, electrical and functional interface; vii) Flow control, viii) Reliable process-to-process message delivery; and viv) three packet switching technologies including X.25, Frame Relay and ATM.**

5. **As shown in the diagram below, computer A sends a message to computer D via LAN1, Router R1 and LAN2. Each device has a pair of addresses (logical and physical) for each connection. The logical addresses are indicated using letters and the physical addresses are indicated using numbers. Assume that the communication is between a process running at computer A with port address a and a process running at computer D with port address j,**

- **Draw diagrams to show the contents of packets/frames at layer 4, layer 3 and layer 2 for both computer A and computer D.**
- **Describe the data encapsulation process performed at layer 4, layer 3 and layer 2 in computer A.**
- **If the physical destination address of a frame is corrupted during the transmission, what happens to the frame? How can computer A be informed about such a situation?**
- **The data link layer can detect errors between hops. Explain why other error control mechanisms are still required at layer 4.**



6. **Why can the use of TCP in conjunction with IP ensure the proper message delivery to the destination? Draw a diagram to show the relationship between a TCP segment and an IP datagram.**

7. **An ATM switch switches incoming cells using both VCI and VPI numbers. If a transmission link consists of two ATM switches and three virtual paths, draw a diagram to show how a VCI = 20 at the input side of the link is ended with a VCI = 9 at the output side of the transmission link. All other VCI and VPI numbers are arbitrary.**

8. **What are the main differences between two primarily used protocols: TCP and UDP?**

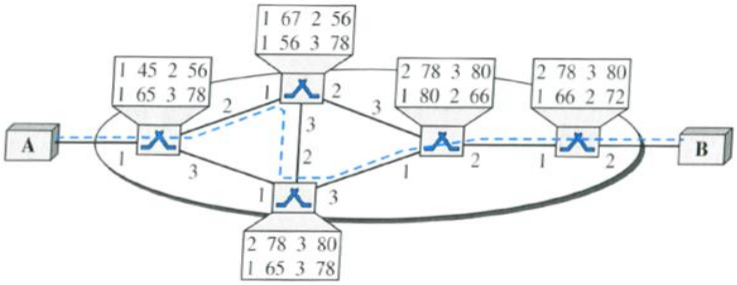
9. **How does packet switching work? What are the main differences between connection-oriented packet switching and connectionless packet switching?**

10. **Explain whether or not a routing table in a connectionless packet switched network can have two entries with the same destination address.**
    Can a switching table in a connection-oriented packet switched network have two entries with:
    i) the same input VPI?
    ii) the same incoming VCI?
    iii) the same incoming VPI and VCI pair

11. **What are the main differences between packet switching and circuit switching? Transmission of information in any networks involves end-to-end addressing and sometimes local addressing (such as VCI). For various networks at different communication stages such as setup, data transmission and teardown, complete the unshaded sections of the table below using one of the two addressing mechanisms including "end-to-end" and "local".**

Network Type	*Communication Stage*		
	Setup	*Data Transmission*	*Teardown*
Circuit switching			
Connectionless packet-switching			
Connection-oriented packet-switching			

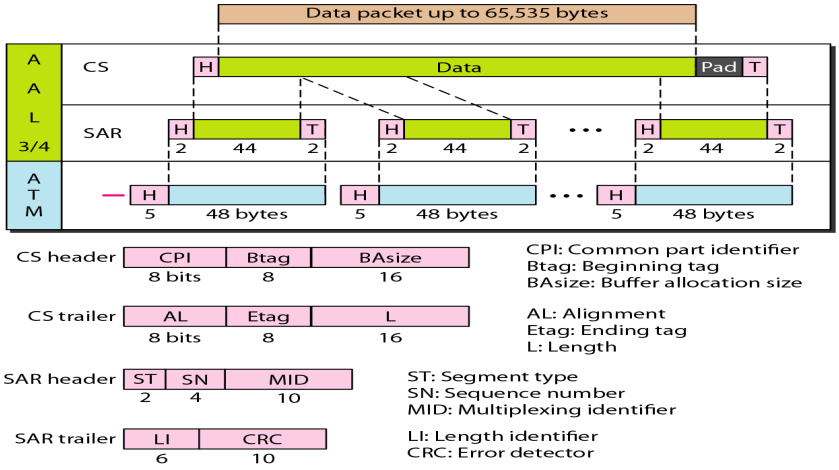
12. Explain why frame relay can operate in a multi-protocol environment. In a Frame Relay network illustrated below, a virtual connection (dashed line) is established between A and B. Show the Data Link Connection Identifier (DLCI) for each link.



13. Compare the characteristics of packet switching networks including X.25, Frame Relay and ATM in terms of payload error control, latency, packet size, data transmission capacity and types of traffic supported.

14. Describe the functionalities of each layer of the ATM standard.

15. The ATM Adaptation Layer (AAL) of the ATM standard is defined to have four versions to support various types of communications. The diagram given below shows the AAL3/4 version and the structures of corresponding headers and trailers at various sub-layers. Based on the figure, answer the following questions:



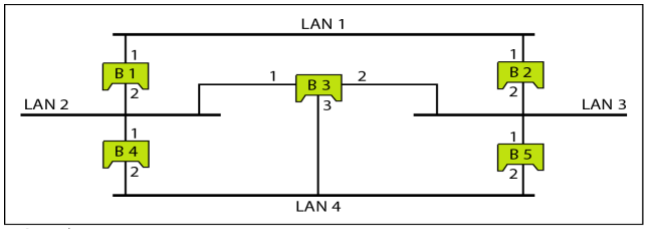
i) If there are 47787 bytes of data coming into the Convergence Sub-layer (CS), how many padding bytes are required? How many data units are passed from the Segmentation and Reassembly (SAR) sub-layer to the ATM layer? How many ATM cells are produced?

ii) Work out the minimum number of ATM cells may be produced from an input packet, and work out the maximum number of ATM cells may be produced from an input packet.
iii) how many times the same Btag/Etag are repeated?
iv) In the AAL2 version, work out the value of the LI part in the CS header and the value of the SF part in the SAR header.

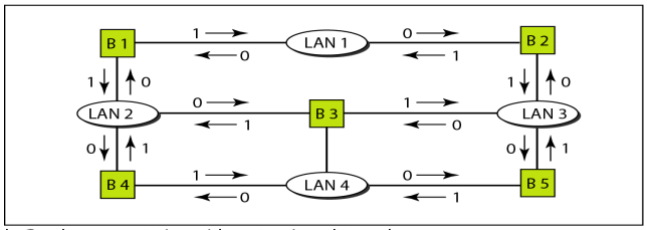
16. What are the main differences between baseband and broadband transmission in LANs. For tree, bus, ring and star topologies, name the topology (or topologies) commonly used in broadband and baseband LANs.

17. Draw four diagrams of the most common LAN topologies. Explain briefly how the Tree topology is configured and operated.

18. Two diagrams illustrated below show a physical system with four LANs and five bridges [figure (a)] and its graph representation with cost assigned to each arc [figure (b)]. If bridge B1 is selected as the root bridge, draw a diagram to show the spanning tree of the system, and identify all the blocking ports after applying the spanning tree procedure. In figure (a), if bridge B1 is still selected as the root bridge and bridge B2 is removed, draw a diagram to show the spanning tree of the corresponding system. In figure (a), if bridge B5 is selected as the root bridge, draw a diagram to show the spanning tree of the corresponding system.



a. Actual system



b. Graph representation with cost assigned to each arc

19. Token passing and CSMA/CD are the two main LAN access methods adopted in practice. Describe briefly how these two methods work.

20. In a CDMA/CD network with a data rate of 10Mb/s, the minimum frame size is found to be 512 bits for the correct operation of the collision detection process. What is the minimum frame size if we increase the data rate to 100Mb/s?

21. Why can bridges solve traffic problems encountered in LANs. Describe the procedure of how a new bridge to automatically build up its dynamic table that maps addresses to ports.

22. Describe briefly the key functionalities of bridges. What are the main differences between bridges and routers?

23. Explain briefly why three transmission windows may be used in optical fibre communications systems. Describe briefly how a virtual communication path is created between two arbitrary users in an optical wide area network.

24. In WDM optical networks, ITU has introduced a new layer known as the optical layer into the OSI Reference model. The optical layer sits at the bottom of the OSI layer stack. What are the key functionalities of the optical layer? Name all the sub-layers contained in the optical layer.

25. The TCP congestion control technique consists of three phases including slow-start, congestion avoidance and congestion detection. If the maximum window size is 32 segments, and the corresponding threshold is 16 segments, answer the following five bullet questions and briefly explain each of your answers:

- **What is the size of the congestion window after round 3?**
- **What is the size of the congestion window after round 5?**
- **If a time-out occurs when the congestion window size is 20, what is the new threshold? Which phase should the TCP congestion control move to?**
- **What is the size of the congestion window after round 12?**
- **If a three-acknowledgement event occurs when the congestion window size is 12, what is the new threshold? Which phase should the TCP congestion control move to?**