

CPT250 - Data Communication and Net-Centric Computing

Study Period 3, 2017

Assignment 1

Due: end of Week 6, 11:59 pm on Sunday October 8, 2017 AEDT (Melbourne time)

Warning regarding Plagiarism

- Please remember that plagiarism and other forms of cheating are considered academic offences, which in turn have academic penalties. The School of Science now routinely uses plagiarism detection software on electronically submitted assignments.
- All other material that is not original must be fully credited. That is, any material that is copied or derived from another source must be clearly identified as such and the original author or source must be identified.
- Sometimes students assist each other with an assignment, but end up working together too closely, so that the students' separate answers have significant parts in common; unless answers were developed independently, they are regarded as plagiarized.
- The minimum penalty for plagiarism is loss of marks for assignment. Please be careful!!!

Introduction and Objectives of Assignment 1

This assignment aims at giving a through understanding TCP/IP Layers, Network addressing, Signals, encoding, Bandwidth, error detection etc. This assignment has **a total of 80 marks** and is worth **20%** of your final score.

This assignment is not a hurdle - rather it contributes towards the practical work component (and thus your final result) for this course.

NOTE: This assignment is to be undertaken individually – no group work is permitted.

Due: end of Week 6, 11:59 pm on Sunday October 8, 2017 AEDT (Melbourne time)

Write all your answers in a .pdf file and submit that file in the Assignment section of Canvas.

You should ensure the file you submit contains your **name** and **student number**. The **file name should be your student number**.

There will be a **late submission period of 5 days** for this assignment, which will expire at **11:59pm on Friday October 13, 2017 AEDT (Melbourne time)**. Late submissions that are received before the end of this late submission period will **attract a late penalty of 10% per day (or part thereof) of the marks awarded on the assignment**, unless a previously submitted application for an extension of time has been approved.

Do NOT leave submitting your assignment until the last day; let alone the last hour or even minute. **You can resubmit many times up until the final cut-off time**. If you leave submissions until it is too late and find you have a problem (e.g. unable to connect) that is entirely your own fault and no special consideration will be given.

You **must** monitor Canvas Discussion section and Announcements for variations and updates to the assignment.

Submissions that are received after the late submission period expires at 11:59pm on Friday October 13, 2017 AEDT (Melbourne time) will not be assessed unless a previously submitted application for an extension of time has been approved.

Your primary resource for assistance with the assignment is the Lecture slides followed by tutorial material and the text book. You can also ask questions in the Discussion. You can also send questions to the Instructor.

Submission deadline extensions

For an extension of any length of time then you should contact the instructor in the first instance to inform them of your intent to apply for an extension of time to submit.

For an initial or subsequent extension of time request on a given assessment where the total length of the extension does not exceed 7 days in total you will need to submit an application for an Extension of time for submission of assessable work accompanied by supporting documentation outlining the situation you have been dealing with.

Such supporting documentation may take the form of (for example) a medical certificate clearly outlining the duration and impact upon your ability to study for an illness, or written testimony from a line manager at your place of work (including contact details for such) in the case of an unexpected (additional) work commitment.

For extensions of time exceeding 7 days, or for a further request for additional time after an extension of time has previously been granted for the same assessment (where the total length of the extension will exceed 7 days), you will need to formally apply for special consideration.

For further information on extensions of time or special consideration you can visit the following page on the RMIT website:

<https://www.rmit.edu.au/students/student-essentials/assessment-and-exams/assessment/adjustments-to-assessment>

If you are experiencing circumstances which have been and/or are likely to be ongoing then it is recommended that you contact the Equitable Learning Services team to discuss your situation - information on the Equitable Learning Services Team and the support they can provide can be found at:

<https://www.rmit.edu.au/students/support-and-facilities/student-support/equitable-learning-services>

Special Note for students who have a current Equitable Learning Plan (ELP)

If you are a student who has an Equitable Learning Plan (ELP) organised by the Equitable Learning Services team then you must negotiate any extension you may require with the instructor well in advance of the submission deadline (at least 72 hours in advance of the on-time submission deadline would be ideal).

Students working under an Equitable Learning Plan are encouraged to maintain regular (weekly) contact with the instructor so that they are aware of your progress and any issues that you may be experiencing - remember that it is easier to provide support and help you work through any issues you may be having if they are raised earlier rather than (for example) close to (or after) a submission deadline.

NOTE: Equitable Learning Plan advisory updated to reflect the recent change in name for Equitable Learning Plans (08/06/2017)

Answer all questions (Total: 80 marks)

Q1. (Total: 12 marks)

(i) (8 marks)

An application at the application layer of a computer wants to send a message containing X bytes via the Internet to another app running in the application layer of another computer. A TCP connection is established between the two computers.

At the TCP layer, 20 bytes of header information will be added to the message.

At the IP layer, another 20 bytes will be added.

The IP packet in turn goes inside an Ethernet frame that has 18 bytes of header information.

Calculate the percentage of the transmitted bits in the physical layer correspond to the actual message information, if:

- a) X = 90 bytes **(2 marks)**
- b) X = 550 bytes **(2 marks)**
- c) X = 1250 bytes **(2 marks)**
- d) If the application continues to send a continuous stream of X-byte messages, which X value from those given in a), b), c) would you choose to send if your only interest was efficient use of the link. Show your value for X and explain why you choose that value. **(2 marks)**

Show all calculations (numerical results rounded to 2 decimal places where possible)

(ii) (4 marks)

An application wants to send 1.7 Megabyte of data via TCP/IP. Suppose the maximum IP packet size is 1500 bytes and each IP packet contains the following:

- 20 bytes of TCP segment header
- 20 bytes of IP packet header
- Original data to be sent

Calculate and answer the following questions:

- a) Totally, how many IP packets will be required to send all 1.7 Megabyte of data **(2 marks)**
- b) How many percent of overhead bytes (out of the original 1.7 megabytes of data) at the IP layer will be required to send all 1.7 Megabyte of data. **(2 marks)**

Use 1 MB = 10^6 bytes

Show all your calculations (numerical results rounded to 2 decimal places where possible)

Q2. (Total: 25 marks)

(i) (6 marks)

In this question, we will investigate if the number of IPv4 and IPv6 are enough when we consider future demands for network addresses.

The following are estimates of the population of major regions of the world in the year 2025 that we will use for calculation in the questions below:

- Africa 1421 millions
- South America 670 millions
- North America 352 millions
- Asia 4689 millions
- Russia 336 millions
- Europe 542 millions

a) Calculate the total number of addresses available in IPv4 based solely on the total number of bits of an IPv4. **(1 mark)**

b) Using the above population data, complete the following tasks:

- calculate the estimated population of the planet in the year 2025 **(0.5 mark)**
- calculate to 2 decimal places how many addresses can be assigned to each person in the world using the number of IPv4 calculated in a) **(0.5 mark)**

c) Consider a proposal for 80 IP addresses to be assigned to each person. Is this possible using IPv4? **(1 mark)**

Repeat these questions for IPv6:

- Calculate the total number of addresses available **(1 mark)**
- Calculate to 2 decimal places how many addresses can be assigned to each person **(1 mark)**
- Consider a proposal for 80 IP addresses to be assigned to each person. Is this possible using IPv4? **(1 mark)**

(ii) (9 marks)

You are a system admin for a big company which has a network address of Class A. In the current year, this company has a network of 950 subnets in their worldwide locations. The company estimates that the number of subnet will increase 5% each year for the next 3 years and you are required to make room for the maximum number of host addresses per subnet.

(Hint: https://en.wikipedia.org/wiki/Exponential_growth)

Design an appropriate subnet mask taking into account the specified growth for the next 3 years. (Show the address of the subnet mask you calculate both in binary and in dotted-decimal notation)

Where applicable, your solution must be biased towards growth in LANs rather than hosts.

Show all your calculations (numerical results rounded to 2 decimal places where possible)

(iii) (10 marks)

The mobile app start-up company AppWorld wants a subsection of the company's existing LAN to create a dedicated test environment not accessible to other users. The system admin has allocated the subnet 192.168.21.165/27 and asked you to determine the following information to undertake setting up of the computers within the subnet.

- a) Decimal and Binary representation of the subnet mask **(2 Marks)**
- b) Address of the subnet **(2 Marks)**
- c) Broadcast Address **(2 Marks)**
- d) First usable IP address **(2 Marks)**
- e) Last usable IP address **(2 Marks)**

Q3. (Total 26 marks)

(i) (Total: 6 marks)

For this question, assume that no data compression is used.

Calculate the bit rate necessary for transmitting in real time:

- a) Video resolution of 1280×720, 16 bits / pixel, 60 frames / second. **(2 marks)**
- b) 4k video at a resolution of 3840 x 2160, 3 bytes / pixel, 50 frames / second **(2 marks)**

Calculate the time (in minutes) to download:

- A 30-minute video clip of quality as stated in (b) over a 10 Mbps modem? **(2 marks)**

Show all your calculations (numerical results rounded to 2 decimal places where possible)

(ii) (Total 2 marks)

A Time Division Multiplexing (TDM) system handles 20 one-way digitized voice channels. It takes 16 bit samples from each one and adds one extra bit for framing. It does this 12000 times a second. Calculate the bit rate (or data rate) at the output of the system.

Show all your calculations (numerical results rounded to 2 decimal places where possible)

(iii) (Total 9 marks)

In Time Division Multiplexing (TDM), when the data rates of the input sources are not equal, there are 3 techniques that allow those sources to be multiplexed using TDM. Describe those 3 techniques. For each of the three techniques, write a short paragraph (maximum 10 sentences) to describe what it is, how it is used and a diagram with a numerical example to illustrate each technique. Your diagram must have all the features as shown in the given diagram below.

Marks will be given as followed:

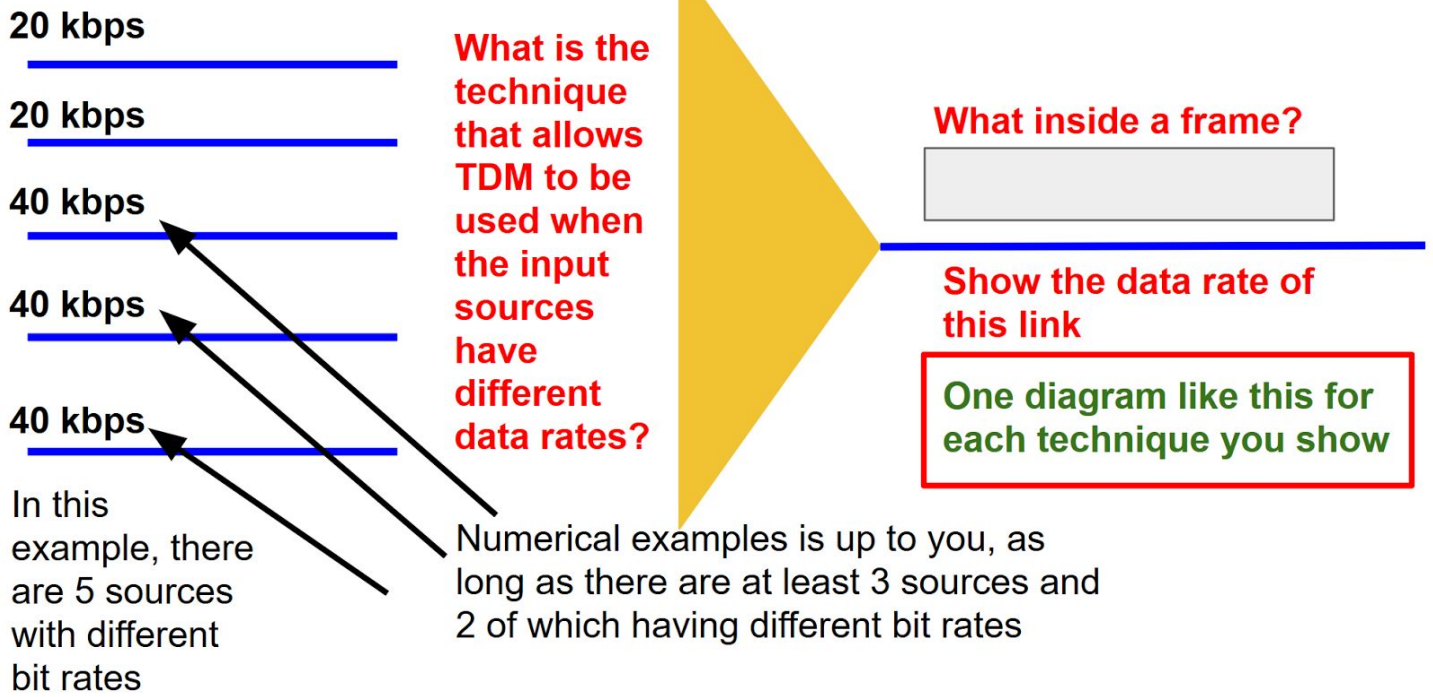
Total: **9 marks (3 marks for each technique)**

For each technique

- Show the name of the technique, describe what it is, how it is used **(1.5 mark)**
- A diagram with numerical example **(1.5 mark)**

(see the sample diagram in the next page)

TDM



(iv) (Total: 9 marks)

Encode the data stream 1001101011 using the following encoding formats:

- a) NRZ-L (3 marks)
- b) Bipolar-AMI (3 marks)
- c) Differential Manchester (3 marks)

Hand drawn or scanned diagrams will not be accepted (0 Marks)

Diagrams drawn free hand on a computer will not be accepted (0 Marks)

You can use either Excel or Word (or equivalent software). Marks will be deducted for poor presentation.

In encodings where the bit preceding the first bit may be high or low, use high.

Q4 (Total 17 marks)

Given a bit stream sequence of 11101101 and a pattern 101101001

- a) Obtain CRC check bits using base 2 and shifted poly method (9 marks)
- b) Also, obtain CRC on the receiver side (both base 2 and shifted poly) (8 marks)