

QUESTION 1

a) Describe the range of functions that may be found in a link-layer protocol operating over point-to-point links. Your answer should include:

- i. a description of the link-layer functions you have listed and what purpose they serve
- ii. example mechanisms that implement the functions (full explanations of operation are not required)
- iii. a description of the key elements of a frame and the purpose of these elements

[19 marks]

b) What is data transparency? How can it be provided within a bit-oriented link-layer protocol?

[6 marks]

QUESTION 2

a) A small device is to be used to count vehicles passing a point on the road. It will record the traffic types as a set of bit patterns that have yet to be determined. An initial traffic survey results in the following observation of vehicle types in the traffic:

Vehicle type	% of traffic
car	53
bus	8
van	12
truck	5
motorbike	15
other	7

Devise a set of bit patterns to be used for recording this data. Your bit patterns should form an **instantaneously parseable coding scheme** and approach optimal coding efficiency. Show that your coding scheme is within 16% of the theoretical optimum.

[15 marks]

b) A communication line has a bit error rate of 10^{-4} . Evaluate the error rate expected in the transmission of an 8-bit word on this line.

Evaluate the new undetected error rate for this line if a 9-bit word is used, with the 9th bit being used as a **parity bit**. State the assumptions made for the use of parity check codes and why they are not used for error detection in the transmission of large data frames.

[10 marks]

QUESTION 3

a) Describe the main factors that limit the use of CSMA/CD techniques for constructing large high speed LANs, paying particular attention to the frame-size. By use of numerical examples with data rates of 10Mb/s and 100Mb/s, show how the frame-size may be affected on a CSMA/CD-based LAN that has a length of 2Km (take the speed of electromagnetic propagation to be 2×10^8 m/s).

[10 marks]

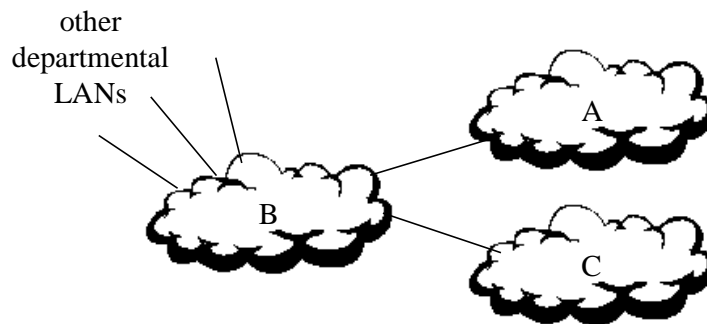
b) Considering your answer to a), how is it that “Fast Ethernet” systems can operate at 100Mb/s and still offer the same frame format as 10Mb/s Ethernet? Illustrate your answer with a numerical example for 100Mb/s.

[6 marks]

c) The figure below shows an on-site campus network set-up:

The clouds A, B, and C represent networks that are used as follows:

- A is a general, low data rate (less than 10Mb/s) departmental LAN, not used for any



special or demanding purposes, but runs many applications that are client-server oriented.

- B is a site-wide backbone used to interconnect many large departmental LANs (assume that all these LANs are used in a similar fashion to network A, i.e. general use). Network B also provides access to some central, campus-wide servers and backup facilities.
- C is a small LAN environment to be used for real-time, multimedia applications and must work in a connectionless environment at data rates up to 100Mb/s.

Suggest suitable technologies for use in each of the networks A, B and C, and briefly list reasons for your choice in each case.