MONASH UNIVERSITY

School of Computer Science and Software Engineering

CSE3020 Network Technology
Semester 2, 2003

Tutorial 5 - Week 6

Question T5.1 - Explain in terms of data link control and physical layer concepts how error and flow control are accomplished in synchronous time-division multiplexing.

- *Synchronous TDM is a technique to divide the medium to which it is applied into time slots which are used by multiple inputs.*
- *TDM's focus is on the medium rather than the information which travels on the medium. Its services should be transparent to the user. It offers no flow or error control.*
- *Flow and error controls must be provided on an individual-channel basis by a link control protocol.*

Question T5.2 - One of the 193 bits in the DS-1 transmission format is used for frame synchronization. Explain its use.

- *This bit carries a repetitive bit pattern that enables the receiver to determine whether or not it has lost synchronization.*
- *The actual bit pattern is 01010101.... This pattern would be unlikely to occur in digital data.*
- *If a receiver gets out of synchronization it can scan for this pattern and resynchronize.*

Question T5.3 - Twenty-four voice signals are to be multiplexed and transmitted over twisted pair. Assuming each voice signal is 4 kHz, and the guard band is 200 Hz, what is the minimum bandwidth required for FDM? Assuming a bandwidth efficiency (ratio of data rate to transmission bandwidth) of 1 bps/Hz, what is the bandwidth required for TDM using PCM?

- $(4000 \times 24) + (200 \times 23) = 100.6$ *kHz.*
- *With PCM, each voice signal requires a data rate of 64 kbps, for a total data rate of* 24×64 *kbps* $= 1.536$ *Mbps. At 1 bps/Hz, this requires a bandwidth of 1.536 MHz.*

Question T5.4 - How is one TDM signal separated into its original components? Consider both synchronous TDM and statistical TDM implementations.

- *In synchronous TDM, the demultiplexer at the receiver decomposes each frame by discarding the framing bits and extracting each data unit in turn. As a data unit is removed from the frame it is passed to the appropriate receiving device.*

- *In statistical TDM, the demultiplexer at the receiver decomposes each frame by checking the local address of each data unit. The extracted data unit is removed from the frame and passed to the appropriate receiving device.*

Question T5.5 - Ten 9600-bps lines are to be multiplexed using TDM. Ignoring overhead bits, what is the total capacity required for synchronous TDM? Assuming that we wish to limit average line utilization of 0.8, and assuming that each line is busy 50 percent of the time, what is the capacity required for statistical TDM?

- *Synchronous TDM:* $9600\ bps \times 10 = 96\ kbps$.
- *Statistical TDM:* $9600\ bps \times 10 \times \frac{0.5}{0.8} = 60\ kbps$.

Question T5.6 - Briefly describe the basic and primary interface of an Integrated Services Digital Network (ISDN).

From Stallings 6th Edition, page 251-254.

Question T5.7 - ADSL uses FDM to exploit the 1-MHz capacity of twisted pair. Briefly describe the discrete multitone (DMT) transmission technique used in ADSL.

From Stallings 6th Edition, page 266-267.

- *After initialization, the bit stream to be transmitted is divided into a number of substreams, one for each subchannel that will carry data.*
- *The sum of the data rates of the substreams is equal to the total data rate.*
- *Each substream is then converted to an analog signal using QAM.*
- *Each QAM signal occupies a distinct frequency band, so these signals can be combined by simple addition to produce the composite signal for transmission.*