Solutions to Midterm Exam 2

Question 1

This question was badly worded. The intent was for the student to compute the rate differences between a payload PDH rate and the SONET payload rate as reflected in chagnes to the H1/H2 bytes but that was not what the question actually asked.

If the question is interpreted literally, the difference between the SONET rate and the payload rate depends on the multiplex level. For an STS-1 for example, the SONET line rate is $90 \times 9 \times 8 \times 8$ kHz $=$ 51.84 Mb/s and payload rate is $87 \times 9 \times 8 \times 8$ kHz $=$ 51.112 Mb/s (excluding the Path overhead) or $86 \times 9 \times 8 \times 8$ kHz $=$ 49.536 Mb/s (including the Path overhead).

(a) The value of H1/H2 in the transport overhead of a SONET frame points to the start of the data in the payload area (actually, to the payload overhead).

The difference in data rates (in bytes) is given by the rate at which the pointer changes.

A difference of 2 bytes each millisecond means the payload rate is $\frac{2\times 8}{10^{-3}} = 16$ kbps different than the SONET link rate.

A difference of 1 byte each millisecond means the payload rate is $\frac{1\times 8}{10^{-3}} = 8$ kbps different than the SONET link rate.

However, interpreted literally, the rate difference for an STS-1 is $51.84 - 49.536 = 2.304$ Mb/s.

(b) The pointer increases when the payload arriving during a frame duration contains one more more byte of data than can be transmitted. Thus the payload rate must be greater than the SONET transport rate. Conversely, if the pointer decreases then the payload rate must be lower.

Interpreted literally, however, the payload rate is lower because it does not include the overhead bytes.

(c) The OC-1 SONET rate is 51.84 Mb/s. An increase of 2 bytes per millisecond means the payload rate is be 16 kb/s higher or 51.856 Mb/s. A decrease of 1 byte per millisecond means the payload rate is 8 kbps slower or 51.832 Mb/s

Interpreted literally, however, the payload rate is as computed above, 49.536 Mb/s.

Question2

To encapsulate a PPP frame flag characters (0x7e) are added before and after the data. A header with an address field of 0xff, a control field of 0x03 and a protocol field (0x29 in this case) is added[1]. After the payload a 16-bit CRC (0x00, 0x00 in this case) is added. Within the payload any flag or PPP escape characters (0x7d) as escaped and the subsequent character is XOR'ed with 0x20.

The five bytes:

```
0x00, 0x08, 0xf3, 0x7d, 0x5e
```

would be framed as:

```
0x7e, 0xff, 0x03, 0x29, 0x00, 0x08, 0xf3, 0x7d, 0x5d, 0x5e, 0x00, 0x00, 0x7e
```

and the five bytes:

```
0x00, 0x08, 0xf3, 0x7e, 0x5e.
```

would be framed as:

```
0x7e, 0xff, 0x03, 0x29, 0x00, 0x08, 0xf3, 0x7d, 0x5e, 0x5e, 0x00, 0x00, 0x7e.
```

[1] Since the LS bit of the protocol field is 1 this field is 8 bits instead of 16 bits long.