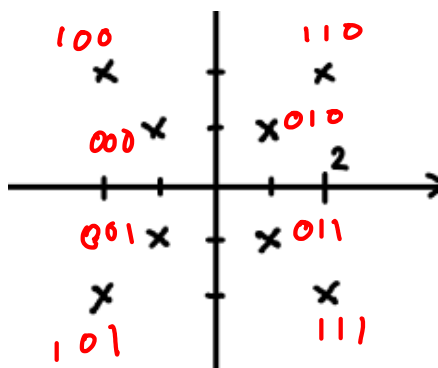


Solutions to Assignment 5

Question 1

The modulation scheme varies both the amplitude and phase of the carrier. Since eight (8) different symbols are defined, $\log_2(8) = 3$ bits are transmitted per symbol. The minimum distance between any two transmitted symbols (the two in each quadrant) is $\sqrt{1^2 + 1^2} = \sqrt{2}$ Volts. See below for one possible gray-coded mapping of bits for each point in the constellation.



Question 2

Uncompressed surveillance video is constant bit rate (CBR) traffic so TDMA (for twisted pair) or FDMA (for co-ax) would be suitable multiple-access techniques.

Requests from electronic door locks would be bursty and so CSMA would be the most suitable multiple-access technique.

Question 3

The generator polynomial used by the scrambler of the calling (originating) ITU-T V.34 modem is $1 + x^{-18} + x^{-23}$.

23 shift register bits are required to implement this scrambler (the x^0 term is the input).

Each input bit error causes three errors in the output so the BER increases by a factor of 3 (assuming

low-enough error rates that errors do not cancel).

Question 4

There are four 7-bit codewords. The number of bits per codeword is $n = 7$. There are $\log_2(4) = 2$ bits transmitted per codeword and so $k = 2$. Comparing each pair of codewords (there are 4×3 pairs), the minimum number of bits different between any two codewords is $d = 3$. This code can thus correct up to one ($\text{floor}((d-1)/2)$) error and detect up to 2 ($d-1$) errors.

Question 5

The learning router fills its forwarding table using the source addresses. After the three frames in the question, the forwarding table will contain entries for destinations 83, a6 and 32 at ports 1, 2 and 3 respectively.

A frame with destination address 93 will not have an entry in the table and will be sent to all ports (flooded). A frame with destination 32 will be output on port 3 and a frame with destination 83 will be output on port 1.

Question 6

RFC 1149 is not a serious proposal, it is a joke. The date, April 1, is traditionally (in North America) known as "April Fools Day".

Question 7

Using `nslookup` for `www.google.com` will typically provide multiple results.

A typical result of using the `ping` utility to measure the delay to a Google server is shown below:

```
PING www.google.com (173.194.79.147) 56(84) bytes of data.  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=1 ttl=43 time=131 ms  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=2 ttl=43 time=131 ms  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=3 ttl=43 time=130 ms  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=4 ttl=43 time=131 ms  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=5 ttl=43 time=131 ms  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=6 ttl=43 time=131 ms  
64 bytes from pb-in-f147.1e100.net (173.194.79.147): icmp_req=7 ttl=43 time=131 ms
```

In the example above the value of the TTL field is 43. Assuming google.com's servers are initializing their IP header TTL field to 64, the frame has been forwarded $64-43=21$ times before reaching its destination. Other results will be different.

If the ICMP echo request TTL field is set to 2 less than the hop count computed above, no responses are received because the ping request is dropped before reaching its destination. If the TTL field is set to 2 more than the expected response is received.