Midterm 2014

1. (a) Baseline wander problem occurs in NRZ encoding. The problem is that too many consecutive 1s or 0s cause the average amplitude level variable, inducing bit error.
   1111… ⇒ $A_{avg}\uparrow$; 0000… ⇒ $A_{avg}\downarrow$

   (b) NRZI solves the problem of consecutive by a transition from the current signal if the data value is 1 (while staying at the current signal if the data value is 0)

   (c) 4B/5B encoding scheme uses 4 bits of data encoded in a 5-bit code, and its 5-bit codes are selected to have no more than one leading 0 and no more than two trailing 0s. Thus, it never gets more than three consecutive 0s.

   (d) The sender inserts 0 after five consecutive 1s.

   011111~~110~~

   ⇒ 0111110110

   ↑

   The receiver then delete 0 that follows five consecutive 1s.

   (e) The computation is based on addition. First add up all the words that are transmitted and then transmit the result of sum. Apart from that, a negative integer $-x$ is using ones complement arithmetic of a integer x.

2. (a) IPv4 (b) 65535 bytes (c) TTL (time to live) was set to a specified number of second that the packet would be allowed to live. Now, it became a hop count, letting us to know its rounting path.

   (d) A demultiplexing key identifying the higher-level protocol like TCP or UDP.

   (e) The starting of the data in 8-byte chunks, helping the fragmented data be correctly reassembled.

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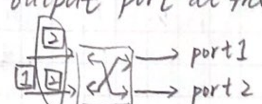
   (d) No, the head-of-line blocking in FIFO queue limits the throughput.
   If several different input ports are destined for the same output port at the same time, only one can be forwarded. ⇒ HOL blocking



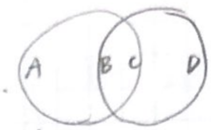
   (e) Yes, Batcher network arranges elements by implementing merge sort, helping that there is no collisions occurred in Banyan network since the element are sorted. Thus, Batcher-Banyan network can realize all the permutations.

4. (a) Since propagation delay means two nodes may not hear each other's transmission, collision would still occur.

   (b) $51.2\mu s \times 10\,\text{Mbps} = 512\,\text{bit} = \underline{64\ \text{bytes}}$ #

   (c) Once an adapter detects a collision and stops its transmission, it waits a certain amount of time and trys again. Each time it tries to transmit but fail, the adapter doubles the waiting time and selects a specified time to try again. For example, the adapter first delay either 0 or $51.2\mu s$, selected at random. If it fails again, it then waits 0, $51.2\mu s$ or $102.5\mu s$, $153.6\mu s$ before trying again. this $k \times 51.2\mu s$, which $k = 0 \dots 2^n - 1$, n is for n-th time transmits

5. (a) Suppose A and C want to communicate with B. Since A and C are unaware of each other, the collision on B may occur.



(b) Suppose B communicate with A. Since C can hear B's transmission, it would be a mistake for C to conclude that it can't transmit to D. C's transmission will not interfere with A's receiving.

(c) The sender transmits a Request to Send (RTS) frame to receiver. The receiver replies with a Clear to Send (CTS) frame. Any node seeing CTS frame knows that it is close to the receiver and can not transmit for the period of time.

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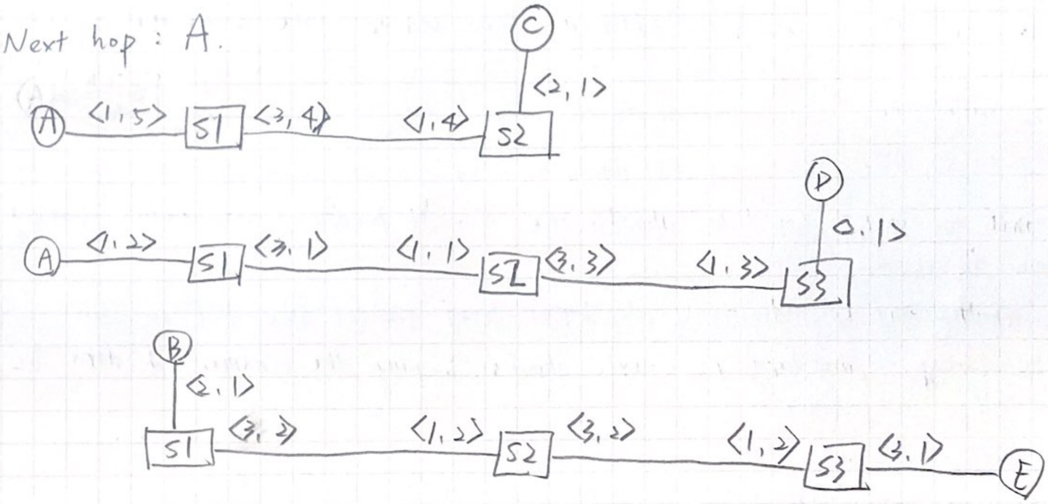
8. Next hop : A.

9.



10.

(a) Probability that given node has success in a slot $= p(1-p)^{N-1}$

Probability that "any" node has a success $= N\cdot p(1-p)^{N-1} = f(p)$

Compute $f'(p)=0$ to find the maximum : $f'(p) = N(1-p)^{N-1} + Np(N-1)(1-p)^{N-2}(-1)$

$$f'(p) = N(1-p)^{N-2}\left((1-p)+p(1-N)\right) = N(1-pN)(1-p)^{N-2} = 0 \Rightarrow p=\frac{1}{N}$$

$$\therefore \lim_{N\to\infty} N\cdot p(1-p)^{N-1} = \lim_{N\to\infty}\left(1-\frac{1}{N}\right)^{N-1} = \lim_{N\to\infty} e^{\ln\left(1-\frac{1}{N}\right)^{N-1}}$$

$$\ln\left(1-\frac{1}{N}\right)^{N-1} = (N-1)\ln\frac{N-1}{N} = \left.\frac{\ln\frac{N-1}{N}}{\frac{1}{N-1}}\right|_{N\to\infty} \underline{\underline{\text{Hospital's rule}}} \ \frac{\frac{N}{N-1}\cdot\frac{N-(N-1)}{N^2}}{\frac{-1}{(N-1)^2}} = \left.\frac{1-N}{N}\right|_{N\to\infty} = -1$$

$$\therefore \lim_{N\to\infty} e^{\ln\left(1-\frac{1}{N}\right)^{N-1}} = \lim_{N\to\infty} e^{-1} = \underline{\frac{1}{e} \doteqdot 37\%}$$

(b) ?