CS535 HW3 | Jiankun Dong

1. OIL Pipeline: It flows in only 1 direction, therefore it's **Simplex**

River: flows (for most rivers) only one direction. **Simplex**

Walkie-talkie: **Half-Duplex**, only 1 user talk at a time.

4.

$$\text{Data rate} = 60 \text{ img/sec} \times (3840 \times 2160 \text{ pixel/img} \times 24 \text{ bits/pixel})$$

$$= 60 \text{ bits/sec} \times 1.99 \times 10^8$$

$$= 1.194 \times 10^{10} \text{ bits/sec}$$

$$= \boxed{11.94 \text{ Gbps}}$$

13. It applies for both copper wire & high-quality single-mode optical fiber. (Assuming the copper wire also has low noise).

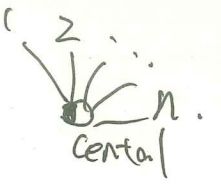
14. Sample Rate = $2 \times 6\text{MHz} = 12 \text{ samples/s} \times 10^6$.

∵ four-level digital single

∴ $\sqrt{4} = 2$ bits/sample

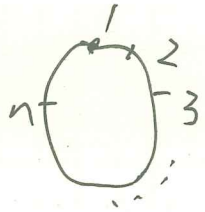
∴ $2 \times 12 \times 10^6$ sample/s $\times$ bits/sample = **24 Mbps**.

47. Star topology :



Best Case : 2 hops
Average Case : 2 hops
Worst Case : 2 hops.

Bi-directional ring :



Best case : 1 hop (neighbor)
Average case : $\frac{n}{4}$ hops
Worst case : $\frac{n}{2}$ hops (opposite)

fully-interconnected :

Best case : 1 hop
Average case : 1 hop
Worst case : 1 hop.

49. each transmittion : p+h. (bits)

Time for source to send all data:

Total transmitting = $\frac{x}{p} \cdot \frac{1}{b} \cdot (p+h)$ ~~(for each hop.)~~

$= \frac{x}{b} + \frac{h}{pb} x$

~~$\therefore T_{total} = (k-1) T_{Total\ transmittion}$~~

Hop time:

$T_{hop} = (k-1) \cdot \frac{p+h}{b} = \frac{h}{b}(k-1) + \frac{(k-1)p}{b}$

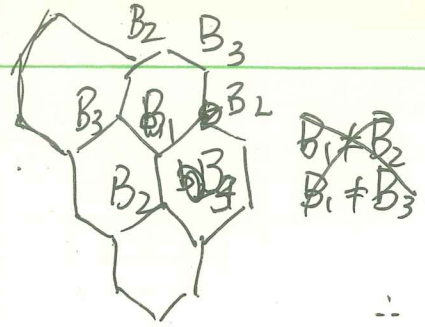
$\because \frac{x}{b}$ and $\frac{h}{b}(k-1)$ are constant, ~~the best case set~~ the best case: the last packet finish transmittion when ~~the~~ the second-to-last packet finishes 1st hop.

&& $x >> hp$ $\therefore \frac{x}{b} >> \frac{h}{b}(k-1)$

$\therefore$ when $\frac{hx}{pb} = \frac{k-1}{b} p$ we have min delay

$\therefore p^2 = \frac{h}{k-1}$ $\boxed{p = \sqrt{\frac{h}{k-1}}}$

50.



$B_1 \neq B_2$

$B_1 \neq B_3$

$B_1 \cap B_2 = \phi$

$B_1 \cap B_3 = \phi$

$\therefore$ we can split 840 frequencies into 3 groups/sets

$\therefore$ each cell can use $\frac{840}{3} = \boxed{280}$ frequencies.

56. (Assuming max load on all customer at the same time).

Total downstream $= 2\text{Mbps} \times 5000$

$= 10^4 \text{Mbps}$.

$\therefore$ Cables needed $= 10^4 \text{Mbps} / 100\text{Mbps} = 100$ cables.

$\because$ Fiber rate $\approx 100\text{Gbps} > 10^4 \text{Mbps}$.

$\therefore$ only need 1 fiber cable

$\therefore$ Connect 100 coaxial ~~cables~~ cables into 1 fiber cable.

Additional: HDLC:

Mechanisms:

Policies:

See next page.

HDLC : hex flag seq : 0x7E

when under asynch : hex ESC 0x7D

mechanism :

3 Types of 'PDU'/frames :

① I-frame : info frame. (first bit '0')

② S-frame : supervisory frame (first bits '10') } of control fame.

③ U-frame : un-numbered frame. (first bits '11') }

send policies :

After sending the frame, the reciever can respond with RR. to gave positive acknowledgement to receive I frame with number N(R).

Or if its buffer is full, it can send RNR (reciver not ready) to keep current frame but ~~pa~~ pause further transmition. It can also REJ (reject) the frame w/ number N(R), which rejects frames starting from N(R). Or a SREJ (selective reject) to pickout frame N(R) to be retransmitted.

The sender only send ~~frame~~ new/next frame when it got RR.