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Solutions 5

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Chapter 5 P5

Consider the 4-bit generator, *G*, shown in Figure 5.8, and suppose that *D* has the value 11111010. What is the value of *R*?

- CRC
- Modulo two operation
- G: 4-bit ⇒ R: 3-bit

R=110

```
        1 1 1 0 0 1 1 0
1001 ) 11111010000
       1001
        1101
        1001
         1000
         1001
            1100
            1001
             1010
             1001
              110
```

Chapter 5 P10

Suppose four active nodes—nodes A, B, C, and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability *p*. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

- What is the probability that node A succeeds for the first time in slot 4?
- What is the probability that some node (either A, B, C, or D) succeeds in slot 2?
- What is the probability that the first success occurs in slot 4?
- What is the efficiency of this four-node system?

- What is the probability that node A succeeds for the first time in slot 4?

$p = (1 - p(A))^3\, p(A)$, Where $p(A)$ = probability that A succeeds in a slot

$p(A) = p(A\ transmits\ and\ B\ does\ not\ and\ C\ does\ not\ and\ D\ does\ not)$
$= p(A\ transmits)\ p(B\ does\ not\ transmit)\ p(C\ does\ not\ transmit)$
$p(D\ does\ not\ transmit)$
$= p(1 - p)\ (1 - p)\ (1 - p) = p(1 - p)^3$

Hence,

$$p = (1 - p(A))^3\, p(A) = (1 - p(1 - p)^3)^3\, p(1 - p)^3$$

Understand slotted ALOHA is the point

- What is the probability that some node (either A, B, C, or D) succeeds in slot 2?

p(A succeeds in slot 2) = $p(1 - p)^3$

p(B succeeds in slot 2) = $p(1-p)^3$
p(C succeeds in slot 2) = $p(1-p)^3$
p(D succeeds in slot 2) = $p(1-p)^3$

p(either A or B or C or D succeeds in slot 2) = $4\,p(1-p)^3$

Understand slotted ALOHA is the point

- What is the probability that the first success occurs in slot 4?

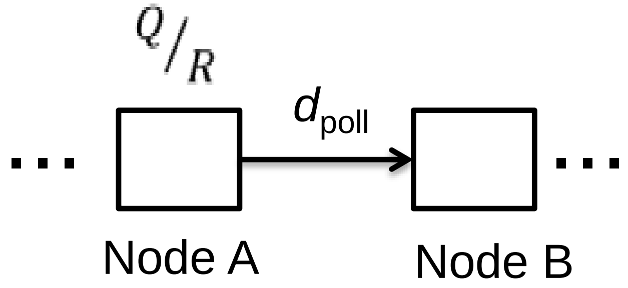
p(some node succeeds in a slot) = $4\,p(1-p)^3$
p(no node succeeds in a slot) = $1 - 4\,p(1-p)^3$

Hence, *p(first success occurs in slot 4)*
= *p(no node succeeds in first 3 slots) p(some node succeeds in 4th slot)*
= $(1 - 4\,p(1-p)^3)^3\; 4\,p(1-p)^3$

- What is the efficiency of this four-node system?

efficiency = *p(success in a slot)* = $4\,p(1-p)^3$

Consider a broadcast channel with N nodes and a transmission rate of R bps. Suppose the broadcast channel uses polling (with an additional polling node) for multiple access. Suppose the amount of time from when a node completes transmission until the subsequent node is permitted to transmit (that is, the polling delay) is d_{poll}. Suppose that within a polling round, a given node is allowed to transmit at most Q bits. What is the maximum throughput of the broadcast channel?



The duration of a polling round $N(Q/R + d_{poll})$

The number of transmitted bits NQ

The throughput is

$$\frac{NQ}{N(Q/R + d_{poll})} = \frac{R}{1 + \frac{d_{poll}R}{Q}}$$

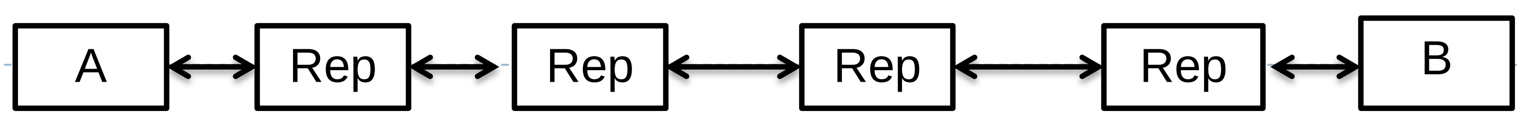
Chapter 5 P19

Suppose two nodes, A and B, are attached to opposite ends of a 900m cable, and that they each have one frame of 1,000 bits (including all headers and preambles) to send to each other. Both nodes attempt to transmit at time *t* = 0. Suppose there are four repeaters between A and B, each inserting a 20-bit delay. Assume the transmission rate is 10 Mbps, and CSMA/CD with backoff intervals of multiples of 512 bits is used. After the first collision, A draws *K* = 0 and B draws *K* = 1 in the exponential backoff protocol. Ignore the jam signal and the 96-bit time delay.

What is the one-way propagation delay (including repeater delays) between A and B in seconds? Assume that the signal propagation speed is 2 * 10^8 m/sec.

$$\frac{900m}{2\cdot 10^{8}\, m/\sec} + 4\cdot\frac{20bits}{10\times 10^{6}\, bps} = (4.5\times 10^{-6} + 8\times 10^{-6})\sec$$

$$= 12.5\mu\sec$$



Chapter 5 P19

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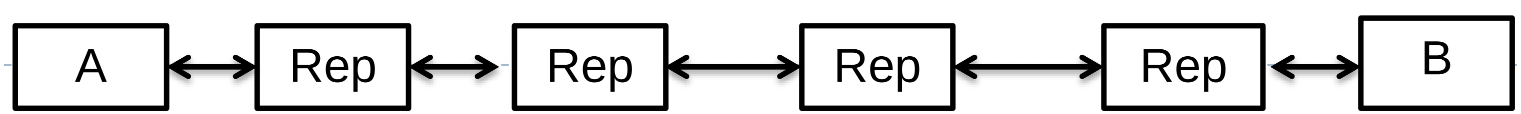
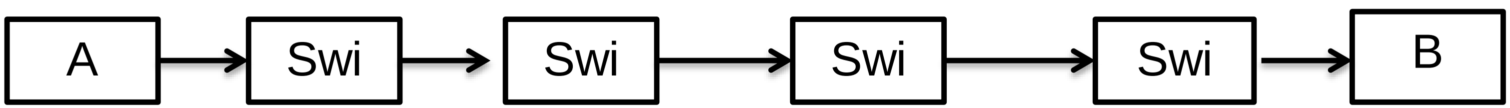
$T_{transmit} = 100us$

At what time (in seconds) is A’s packet completely delivered at B?

- At time 0, both A and B transmit.
- At time t= 12.5us, A detects a collision, transmission is stopped.
- At time t=25us, last bit of B 's jam signal arrives at A, enter backoff phase.
- At time t=37.5us, first bit of A's retransmission arrives at B.
- At time t=137.5us, A's packet is completely delivered at B.



Now suppose that only A has a packet to send and that the repeaters are replaced with switches. Suppose that each switch has a 20-bit processing delay in addition to a store-and-forward delay. At what time, in seconds, is A's packet delivered at B?

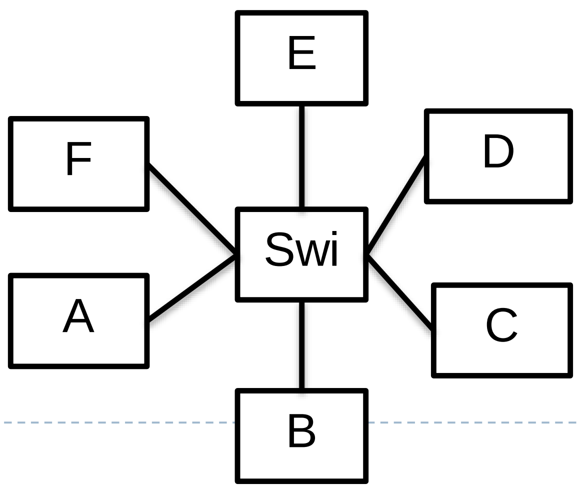


T = propogation delay + 4*20-bit processing delay + transmission delay(A) +store-and-forward delay(Switches)

= 12.5us + 100us+4*100us = 512.5us.

Chapter 5 P22

Let's consider the operation of a learning switch in the context of Figure 5.24. Suppose that *(i)* A sends a frame to D, *(ii)* D replies with a frame to A, *(iii)* E sends a frame to D, *(iv)* D replies with a frame to E. The switch table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers.



Chapter 5 P22

Action	Switch Table State	Link(s)	Explanation
A sends a frame to D	Switch learns interface corresponding to MAC address of A	B, C, D, E, and F	Since switch table is empty, so switch does not know the interface corresponding to MAC address of D
D replies with a frame to A	Switch learns interface corresponding to MAC address of D	A	Since switch already knows interface corresponding to MAC address of A
E sends a frame to D	Switch learns the interface corresponding to MAC address of E	D	Since switch already knows the interface corresponding to MAC address of D
D replies with a frame to E	Switch table state remains the same as before	E	Since switch already knows the interface corresponding to MAC address of E

Q&A

- Thanks！

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