Oliver Luo
10/13/2020
Sprint 2

Parity

Suppose you want to transmit the following 32-bit sequence:

```
0xBEEFCAFE = 1011 1110 1110 1111 1100 1010 1111 1110
```

Determine the extra bits you would need to transmit if you chose to use a two-dimensional parity algorithm. Use a four row by eight column matrix.

Parity Algorithim: Even Parity

1	0	1	1	1	1	1	0	0
1	1	1	0	1	1	1	1	1
1	1	0	0	1	0	1	0	0
1	1	1	1	1	1	1	0	1
0	1	1	0	0	1	0	1	

You would need 12 extra bits to transmit using block or 2-D even parity.

Link-Layer Protocols

The Ethernet protocol allows multiple hosts to share a connection to one physical link. Explain briefly how Ethernet manages access to the link to ensure that simultaneous transmissions from multiple hosts do not interfere with each other.

Ethernet utlizes something called “CSMA/CD” which stands for *Carrier-sense multiple access with collision detection.* During a transmission from lets say A → C, C decides to transmit all of a sudden, those transmissions will collide and CSMA will stop sending its original transmission right away, send a 32-bit “jamming sequence” to say that a collision has occurred, wait for a small amount of time, then try to transmit again. More specifically, the waiting time will “exponentially backoff” multiple times if failures occur more than once, and it will choose a random multiple of 51.2 microseconds until finally it gives up.

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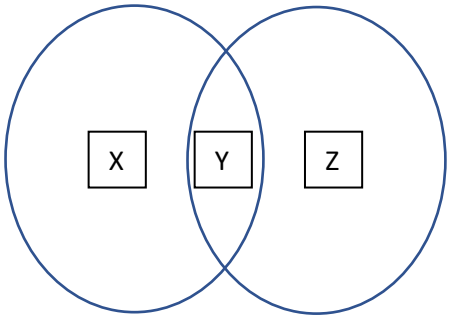
Describe at least two factors that make collision avoidance more challenging in 802.11 networks than in multiple-access wired Ethernets. How is collision avoidance implemented in wireless networks?

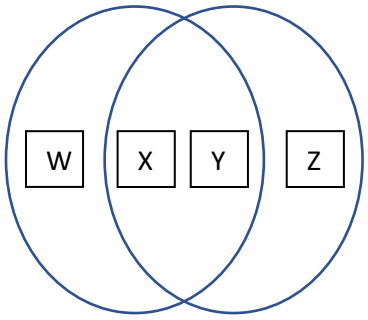
1) You usually can't listen for collisions during a transmission. This is because the power generated by the source or transmitter is much greater than that of the receiver. Furthermore, because it is an "open-air" type of transmission, it is subject to environmental factors like physical obstacles or distance.

   Take for instance below: X wants to send a transmission to Y, and Z also wants to send a transmission to Y. But because X and Z are so far away from each other, they are unable to even check for possible collisions. Both transmissions will collide at Y and go unnoticed.



2) Another similar problem is the fact that it's difficult for any individual node to send transmissions past its immediate left or right nodes. For example below: W would have no qualms about sending to X, but would have trouble getting to Y. Y would be fine seding to X and Z, but would have trouble getting to W etc.

   However, a case that would work is if Y transmits to Z while X transmits to W, this is because both transmissions are going in essentially the opposite directions--they have no chance of colliding based on the model.



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Collision avoidance is implemented using something analogous to CSMA /CD called “CSMA / CA.” The CA stands for collision avoidance rather than collision detection.

As in Ethernet transmissions, the transmitter will first check if there are any other transmissions in the area before sending. But as previously-stated, due to the hidden-node issue, this can’t be the only check it performs. An additional step of sending an “ACK” to the receiver from the sender is required, which if received successfully by the receiver, will reply with another ACK back to the sender (indicating no collision risk).

A further step uses a function called “RTS-CTS” or Ready to Send-Clear to Send. The transmitter will send a packet to the sender (RTS), and the receiver will respond back with another packet (CTS). The key to this strategy is that the packets will tell any in-range receivers to back off for a set amount of time so that they don’t collide with any new transmissions in the current transmission timeframe. Even if a collision does occur during the RTS-CTS phase (the RTS gets sent out with no CTS reply), then just as in Ethernet, the sender will perform exponential backoff retries until either the reply is received or it gives up.

MAC Addresses

Explain the significance of media access control (MAC) addresses in link-layer networks. How is a device’s MAC address set?

The significance of a MAC address in link-layer networks is that it acts as a unique identifier between ethernet hosts. It is a basic and essential part of communicating between hosts on a network.

Furthermore, this 48-bit MAC address is burned onto ROM, which allows for trillions of unique MAC addresses.