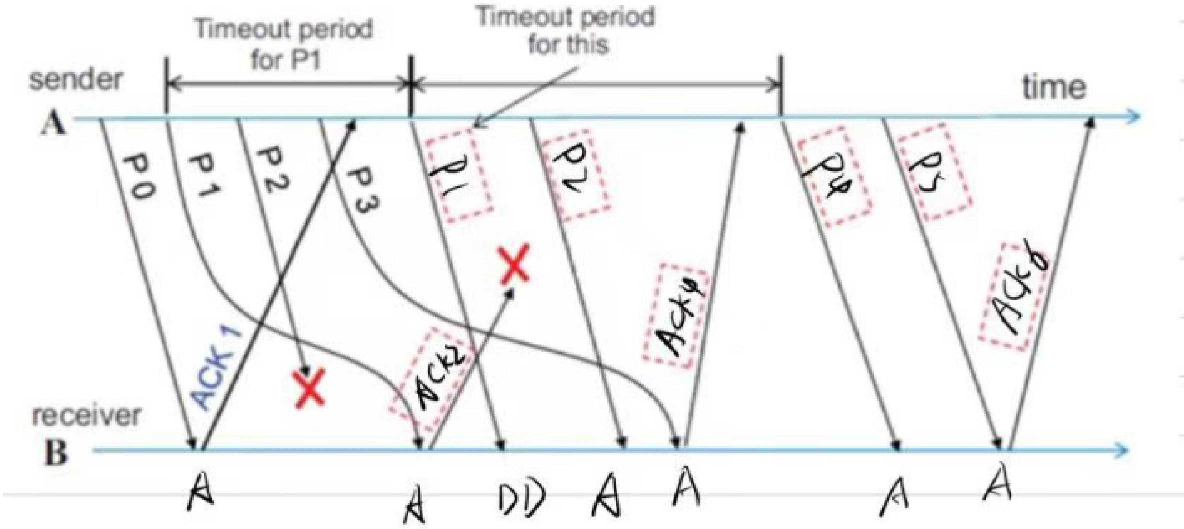
计网第二次作业

1. ARQ



2. Medium Access Control

   a. CSMA/CA协议注重尽可能地降低碰撞发生的概率，不使用碰撞检测，一旦某一个点开始发送一个帧，就会将其完全发送。

   它避免碰撞的方式是：

      1. 所有的站在完成发送之后，必须再等待一段很短的时间（这个时间称为IFS）[同时在这个时间段内继续保持监听状态]才能发送下一帧。
      2. 对于除了检测到信道空闲且这个数据帧是要发送的第一个数据帧以外的所有站点使用退避算法，退避算法如下：当信道从忙态变为空闲态时，任何一个站要发送数据帧时除了要等待一个时间间隔，还要进入争用窗口，计算随即退避时间以便再次试图接入信道。

   综上，CSMA/CA 算法流程为：

   1. 若站点最初有数据要发送(而不是发送不成功再进行重传)，且检测到信道空闲，在等待时间DIFS 后，就发送整个数据帧。
   2. 否则，站点执行 CSMA/CA 退避算法，选取一个随机回退值。一旦检测到信道忙，退避计时器就保持不变。只要信道空闲，退避计时器就进行倒计时。

3. 当退避计时器减到0时(这时信道只可能是空闲的)，站点就发送整个并等待确认。

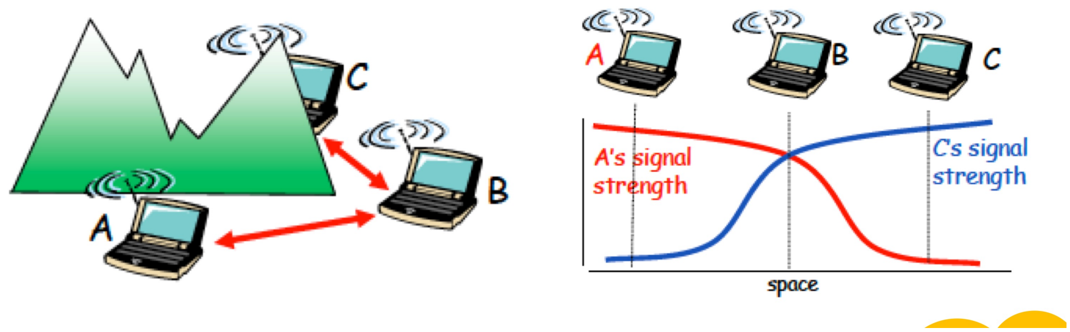
4. 发送站若收到确认，就知道已发送的帧被目的站正确接收。这时如果要发送第二帧，就要从步骤 2)开始，执行 CSMA/CA 退避算法，随机选定一段退避时间。

若发送站在规定时间(由重传计时器控制)内没有收到确认 ACK，就必须重传该，

b. CSMA/CD 不能用在 无线局域网环境原因如下：

   i. 接收信号的强度往往远小于发送信号的强度，且在无限介质上信号强度的动态变化范围很大，如果还要实现碰撞检测，硬件上的开销过大。

   ii. 在无线通信中，存在“隐蔽站”的问题。如下图所示，A和B可以互相监听，B和C可以互相监听，但是AC之间并不能听到，如果A、C同时给B传送数据，他俩都认为信道是空闲的，但B接收时就会发生冲突。



c. RTS-CTS 机制用于处理隐蔽站问题。如上一问所述，如果发送站使用了这个机制来对信道进行预约，比如：源站要发送数据帧之前先广播一个很短的请求发送 RTS (Request To Send) 控制，它包括源地址、目的地址和这次通信(含相应的确认帧) 所持续的时间，该能被其范围内包括 AP 在内的所有站点听到。若信道空闲，AP广播一个允许发送 CTS (Clear To Send) 控制，它包括这次通信所需的持续时间(从RTS 顿复制),该帧也能被其范围内包括 A 和B 在内的所有站点听到。B 和其他站听到 CTS 后,在CTS 中指明的时间内将抑制发送。这样就可以给源站明确的发送许可，并指示其他站点在预约期内不要发送。，有效地避免了隐蔽站的问题。

d. 一个网桥通过下列方式来获取各个主机的信息

每个网桥有一个（哈希）表，记录哪些主机可以通过哪些接口到达。当网桥第一次被接入网络时，该表为空。网桥使用了一种泛洪算法，对于每个发向未知目 标地址的入境帧，网桥将它输出到所有的端口，但它来的那个输入端口除外。随着时间的 推移，网桥将会样习到每个目标地址在那里。一旦知道了一个目标地址，以后发给该地址 的帧只被放到正确的端口，而不再被泛洪到所有端口。
网桥所用的算法是后向学习法。它们可以看得到每个端口上发送的所有帧。通过检查这些帧的源地址， 网桥就可获知通过那个端口能访问到哪些机器。
当打开、关闭或者移动机器和网桥时，网络的拓扑结构会发生变化。为了处理这种动 态的拓扑结构，一旦构造出一个哈希表项后，帧的到达时间也被记录在相应的表项中。当 一帧到达时，如果它的源地址己经在表中，那么对应表项中的时间值被更新为当前时间。
因此，与每个表项相关联的时间值反映了网桥最后看到该机器发出一帧的时间。在网桥中有一个进程定期扫描哈希表，并且将那些时间值在几分钟以前的表项都清除掉。

e. 交换机是现代网桥的另一个称呼。它们的差异更多地体现在市场上而不是技术方面。 他们是数据链路层的中继系统。他们对收到的帧采用存储转发方式，并使用CSMA/CD来进行冲突检测。对于以太网上的站点来说，交换机是透明的。

   开发网桥时正是经典以太网被广泛使用之际，网桥倾向于连接相对数目较少的局域网，因而端口数也相对较少。现在“交换机”一词更 为流行。此外，现代交换机的安装都使用了点到点链接(例如双绞线)，单个计算机通过双 绞线直接插入到交换机端口，因此交换机的端口数往往有许多个。最后，“交换机”也可作 为一般术语使用。使用网桥，功能是明确的。另一方面，交换机可以指以太网交换机，也可以指一个完全不同类型的转发决策设备，例如电话交换机。

   而集线器是底层物理设备，工作在物理层上，无MAC层协议。它把收到的比特流向所有方向以相同的速率传播出去，且集线器不能隔离冲突域，不采用CSMA/CD，也没有缓冲器。

3. IP Addressing

   a. 62 There are 6 bits used to represent the host, except for the two addresses used to broadcast and represent the network itself.

   b. IP addresses can be divided into three categories: Unicast Address, Groupcast Address, and Broadcast Address.

      Unicast Address：192.168.1.10

      Groupcast Address：224.0.0.1

Broadcast Address：192.168.1.255 subnet mask:255.255.255.0

c. The working principle of ARP is as follows: When host A wants to send an IP datagram to a certain host B on the same local area network, it first checks its ARP cache to see if there is the IP address of host B. If it exists, it can find out the corresponding hardware address, and then write this hardware address into the MAC frame, and send the MAC frame to this hardware address through the local area network. If not, it will encapsulate and broadcast an ARP request packet using the destination MAC address FFFF-FF-FF-FF-FF (broadcasting), so that all hosts on the same local area network receive this ARP request. When host B receives the ARP request, it sends an ARP response packet (unicasting) to host A, which contains the mapping of host B's IP and MAC addresses. After host A receives the ARP response packet, it writes this mapping into the ARP cache, and then sends the MAC frame according to the hardware address found.

4. Routing:Dijkstra

    a. pseudo code is as follow

```
function Dijkstra(Graph, source):
    dist[source] ← 0                           // Initialization
    create vertex set Q

    for each vertex v in Graph:
        if v ≠ source
            D[v] ← INFINITY                 // Unknown distance from source to v
            P[v] ← UNDEFINED                // Predecessor of v

        Q.add_with_priority(v, dist[v])


    while Q is not empty:                      // The main loop
        u ← Q.extract_min()                    // Remove and return best vertex
        for each neighbor v of u:              // only v that are still in Q
            alt ← dist[u] + length(u, v)
            if alt < dist[v]
                dist[v] ← alt
                prev[v] ← u
                Q.decrease_priority(v, alt)

    return dist, prev
```

- `Graph` is a graph, where each edge has a weight (the length of the edge).
- `source` is the node from which the shortest paths to all other nodes are calculated.
- `D` holds the shortest distance from the source to each vertex.
- `P` is an array to reconstruct the shortest path.
- `Q` is a priority queue of all nodes in the graph. The priority of a node in is the current best guess of the distance from `source` to that node.

b.

4.b

step	set N	D(B) P(B)	D(C) P(C)	D(D) P(D)	D(E) P(E)	D(F) P(F)
0	A	4, A	1, A	∞	∞	∞
1	A, C	3, C	1, A	∞	4, C	∞
2	A, C, B	3, C	1, A	8, B	4, C	12, B
3	A, C, B, E	3, C	1, A	5, E	4, C	7, E
4	A, C, B, E, D	3, C	1, A	5, E	4, C	6, D
5	A, C, B, E, D, F	3, C	1, A	5, E	4, C	6, D

1. we cannot directly use Dijkstra's algorithm in its standard form. This is because Dijkstra's algorithm is designed to find the shortest path based on additive weights, where the total path cost is the sum of individual link costs. However, in the case of finding the most reliable path, the total reliability of a path is not simply the sum of the individual BERs, but a product of the reliability of each link.

   In order to solve the problem ,we need to change how edge weights are calculated.Instead of summing weights, multiply the reliabilities (1 - BER) of each link along a path.

5.

cycle	n(B) D(B)	n(C) D(C)	n(D) D(D)	n(E) D(E)	n(F) D(F)
0	(· ∞)	(· ∞)	(· ∞)	(· ∞)	(· ∞)
1	(A, 4)	(A, 1)	(B, 8)	(C, 4)	(E, 7)
2.	(C, 3)	(A, 1)	(E, 5)	(C, 4)	(D, 6)
3.	(C, 3)	(A, 1)	(E, 5)	(C, 4)	(D, 6)

6.

a) FIFO Queue :

- Banks: In the bank, the earlier you come, the sooner you get to resolve your issue.
- Supermarkets: The FIFO method calculates the cost of inventory in the same order a business purchases it.

b) Priority Queue:

- Hospitals: More seriously ill patients are attended to before others in the queue.

c) Round Robin:

- Operating Systems: In Round-robin scheduling, each ready task runs turn by turn only in a cyclic queue for a limited time slice.For interactive systems, using the RR algorithm can make users feel that a computer is always serving them.

d) Weighted Fair Queue (WFQ):

- Network Scheduling: WFQ is a network scheduling algorithm. It allows schedulers to specify, for each flow, which fraction of the capacity will be given.
- Haidilao dining guest seating arrangement：There are three types of guests: those who made a reservation and arrived on time, those who made a reservation but arrived overtime, and those who queued up without a reservation. For all seats, most of them are allocated to people who make reservations, and a small part is used for people who queue up to call. A priority queuing policy will be adopted for guests who have reserved seats but arrive after timeout. Allocate most of the seats in the queue to this group of guests.Different guests have different priorities, but all guests will be served