Computer Networks

CSE 303

Course Instructor

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Unit – II

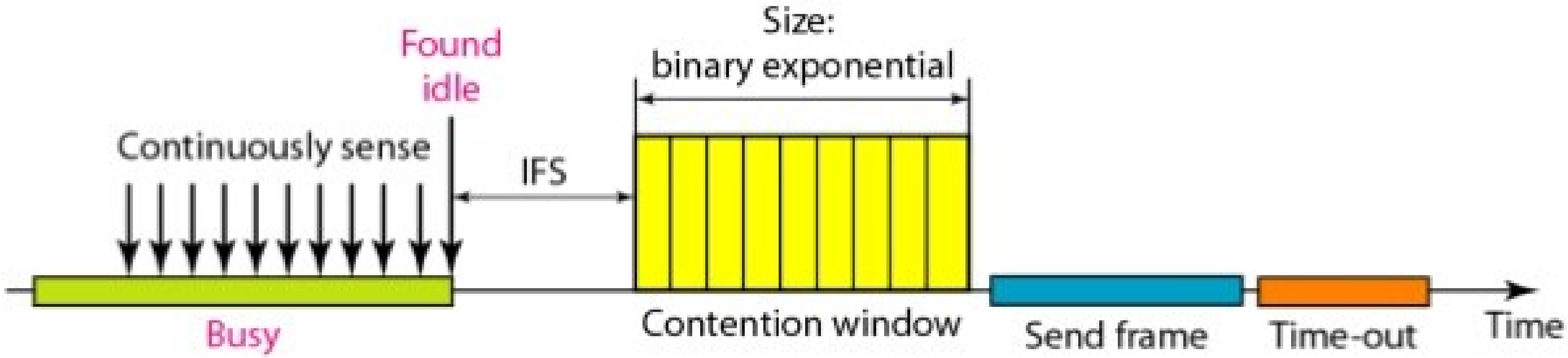
Medium Access Control

Collision Free Protocols

Collision Free Protocols

- Almost all collisions can be avoided in CSMA/CA

- But they can still occur during the contention period.



Collision Free Protocols

- The collision during the contention period **adversely affects the system performance**

- This happens when the cable is long and length of packet are short.

- This problem becomes serious as fiber optics network came into use.

Collision Free Protocols

Note:

- Pure and slotted Aloha, CSMA and CSMA/CD are Contention based Protocols:
  - **Try-if collide-Retry**
  - **No guarantee of performance**

  - What happen if the network load is high?

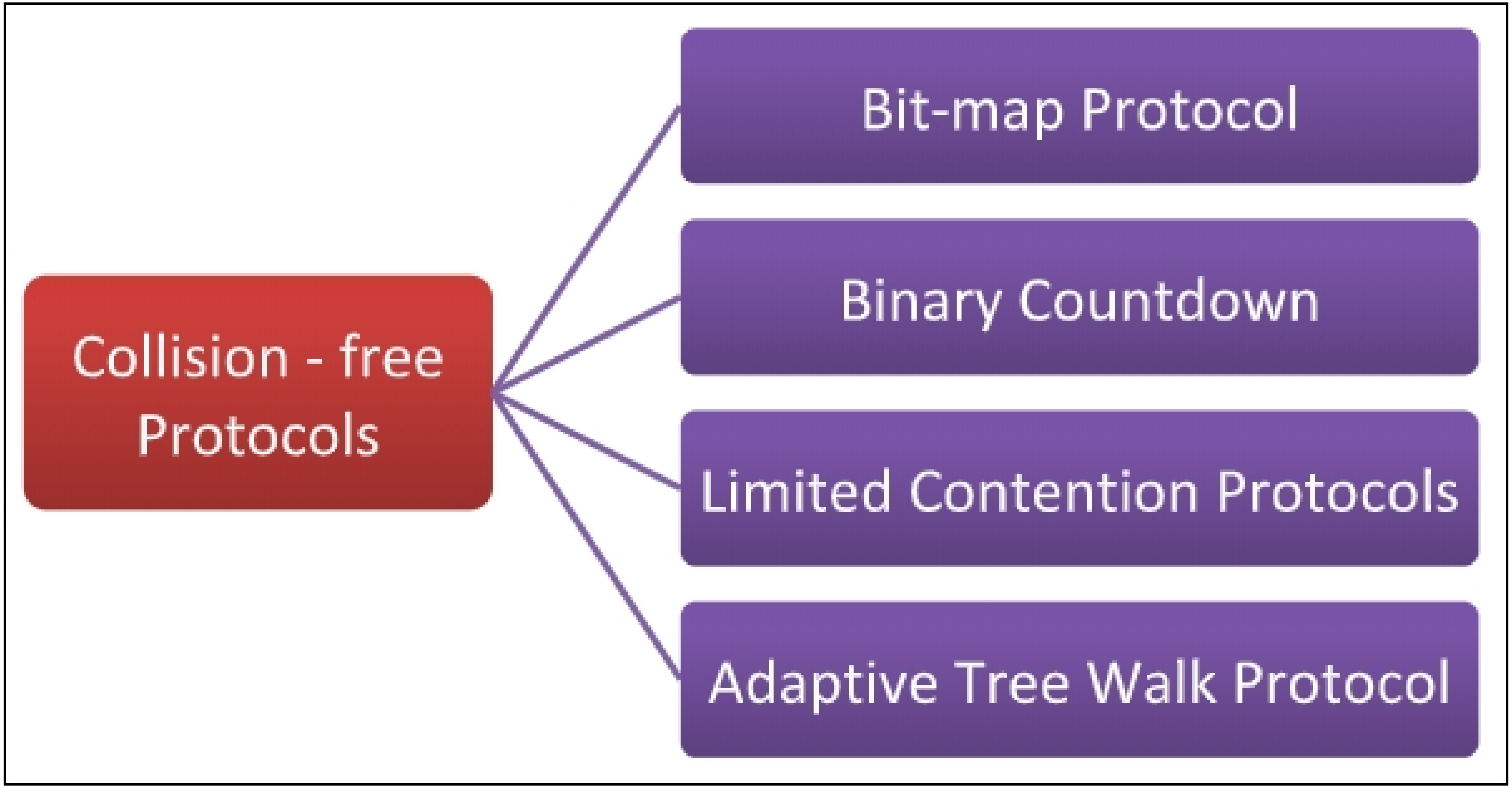
Collision Free Protocols

- However, Collision Free Protocols:
  - **Pay constant overhead** to achieve performance guarantee
  - **Good when network load is high**
- It provides in order access to shared medium so that every station has chance to transfer (fair protocol)

Collision Free Protocols

- Some protocols that resolve the collision during the contention period.
  - Bit-map Protocol
  - Binary Countdown
  - Limited Contention Protocols
  - The Adaptive Tree Walk Protocol

Collision Free Protocols



Collision - free Protocols

Bit-map Protocol

Binary Countdown

Limited Contention Protocols

Adaptive Tree Walk Protocol

Collision Free Protocol

Basic Bit Map

Bit-map Protocol

- Bit map protocol is collision free Protocol.

- It has Two Rounds of transmission cycle
  - First Round (Contention Period)
  - Second Round (Transmission Period)

Bit-map Protocol

First Round (Contention Period)

- each contention period consists of exactly N slots.
- each slot reserved for a particular station

- In this period, each station transmits
  - 1 if it has a frame to transmit
  - 0 if it has no frame to transmit

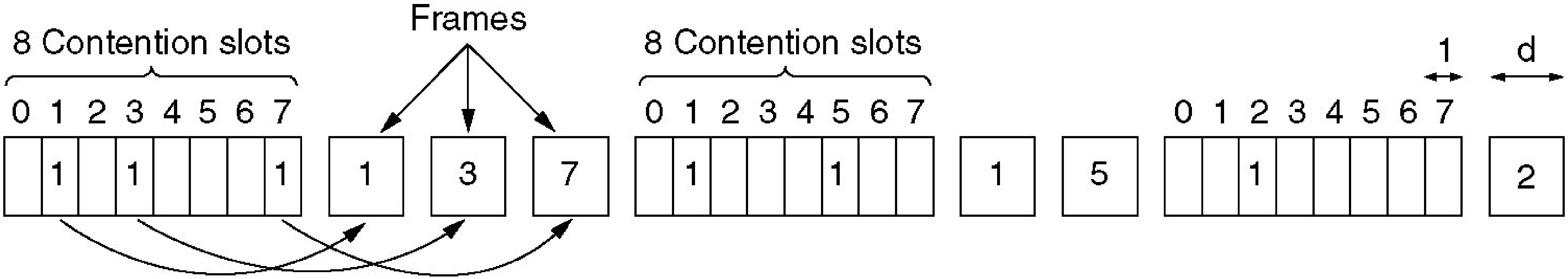
- At the completion of the first round everybody knows who wants to transmit

Bit-map Protocol

Second Round (Transmission Period)

- Stations transmit according to the order formed in the first round
- There will never be any collisions
  - because everyone agrees on who goes next.
- Protocols like this in which the desire to transmit is broadcasting for the actual transmission are called **Reservation Protocols.**

Bit-map Protocol



Bit-map Protocol Performance Analysis

- For analyzing the performance of this protocol,
  - We will measure time in units of the contention bits slot, with a data frame consisting of d time units.

- Under low load conditions:
  - the bitmap will simply be repeated over and over
  - due to lack of data frames.

Bit-map Protocol Performance Analysis

- Under high load conditions:
  - All the stations have something to send all the time
  - The N bit contention period is prorated over N frames
  - This yielding an overhead of only **1 bit per frame**.
  - **If the N is higher, overhead will be high.**
  - **How about the Station Wait Time??**

Collision Free Protocol

Binary Countdown

Binary Countdown

- This is used to overcome the overhead 1 bit per binary station.

- In binary countdown, **binary station addresses** are used.

- A station wanting to use the channel broadcast its address as **binary bit string starting with the high order bit**.

- All addresses are assumed of the **same length**.

Binary Countdown

Example to illustrate the working of the binary countdown.

- In this method, different station addresses are read together

- This decide the priority of transmitting.

- If these stations **0001, 1001, 1100, 1011** all are trying to seize the channel for transmission.

Binary Countdown

- All the station at first broadcast their most significant address bit

- that is **0, 1, 1, 1** respectively.

- The most significant bits are read together.
  - i.e., **0 1 1 1**

Binary Countdown

- Station 0001 see the 1 MSB in another station address

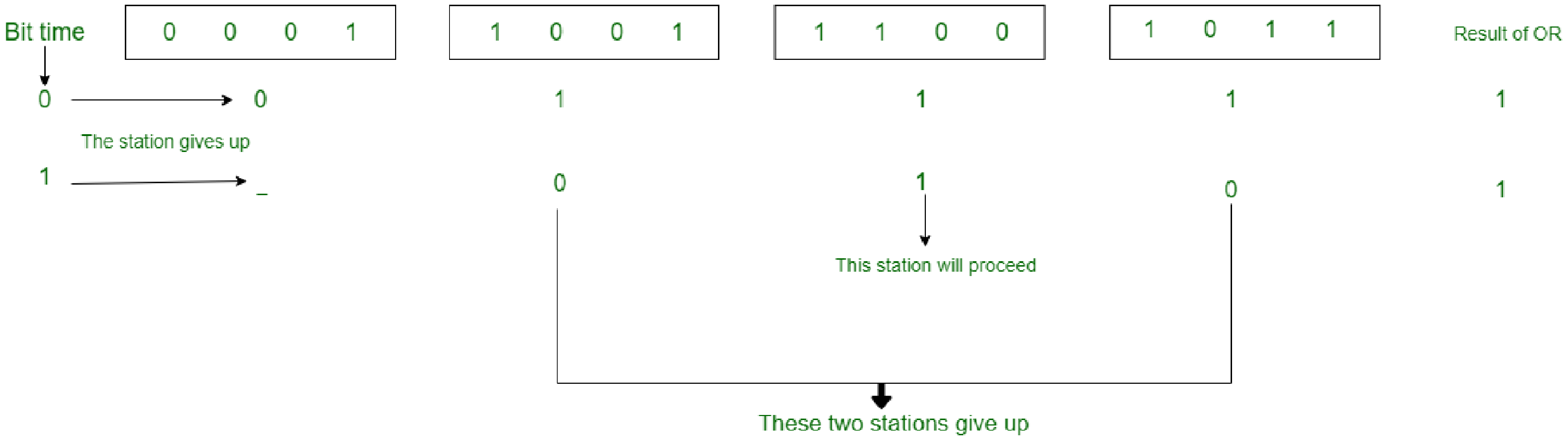
- Station 0001 understands that a higher numbered station is competing for the channel

- So, it gives up for the current round.

Binary Countdown

- Other three stations 1001, 1100, 1011 continue.
- The next station at which next bit is 1 is at station 1100,
- so station 1011 and 1001 give up because there 2nd bit is 0.
- Then **station 1100 starts transmitting a frame**
- After which **another bidding cycle starts**.

Binary Countdown



Bit time

0 0 0 1

1 0 0 1

1 1 0 0

1 0 1 1

Result of OR

0 → 0 1 1 1 1

The station gives up

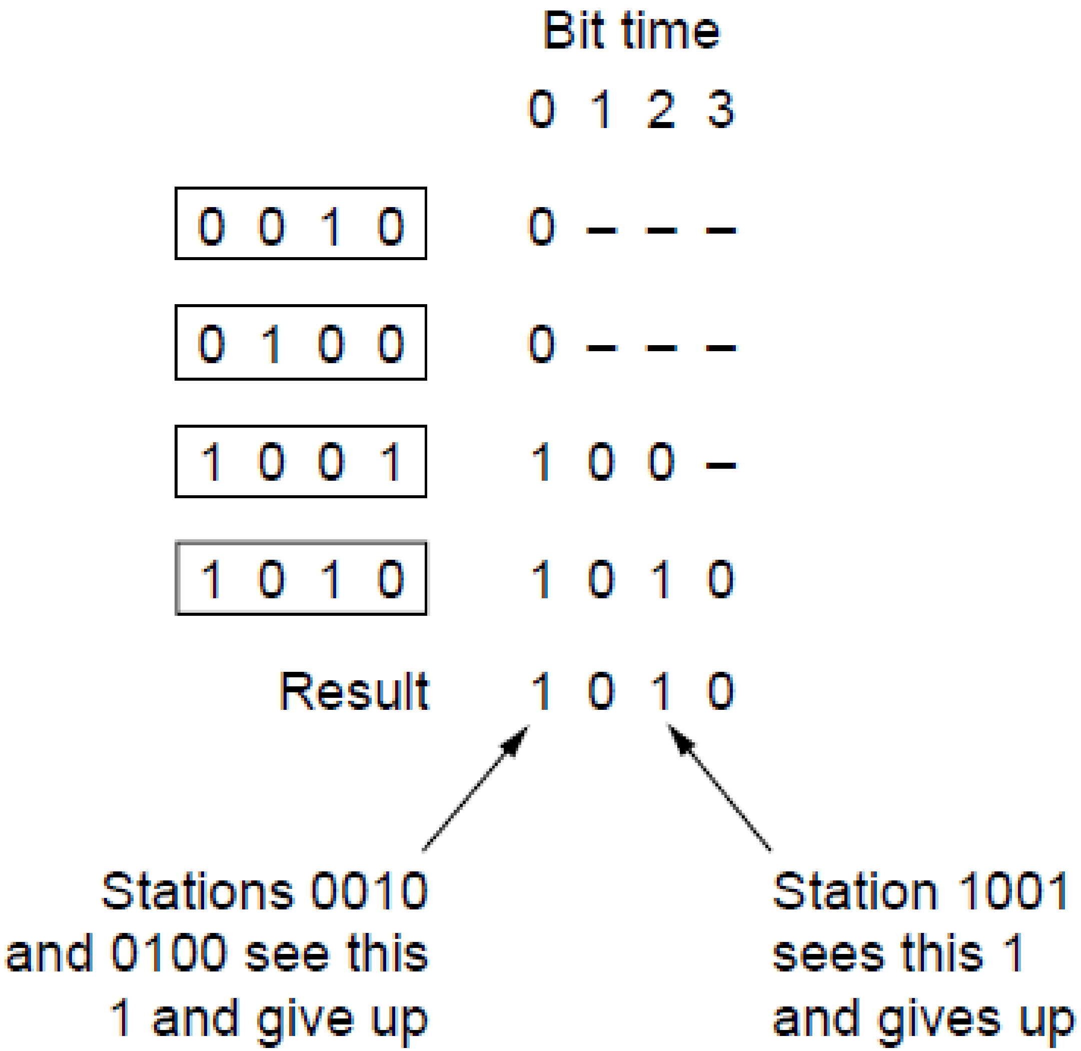
1 → _ 0 1 0 1

This station will proceed

These two stations give up

Binary countdown

Binary Countdown



	Bit time 0	1	2	3
0 0 1 0	0	–	–	–
0 1 0 0	0	–	–	–
1 0 0 1	1	0	0	–
1 0 1 0	1	0	1	0
Result	1	0	1	0

Stations 0010 and 0100 see this 1 and give up

Station 1001 sees this 1 and gives up

***A dash indicates silence.**

Collision Free Protocol

Limited Contention Protocols

Limited Contention Protocols

- **Collision/Contention based protocols are good**, When?
    - if the network load is low.
    - Less collisions under low load.
    - Protocols: pure and slotted ALOHA, CSMA/CD

- **Collision free protocols are good,** When?
    - if the network load is high.
    - Channel utilization is better at high load.
    - Protocols: bitmap, binary Countdown

Limited Contention Protocols

- How about combining their advantages:
  - Behave like the ALOHA scheme under light load.
  - Behave like the bitmap scheme under heavy load.

Collision Free Protocol

Adaptive Tree Walk Protocol

Adaptive Tree Walk Protocol

Core Idea:

- Partition the stations into groups
- Limit the contention for each slot.

- Under **light load**, everyone can try for each slot like aloha
- Under **heavy load**, only a group can try for each slot

Adaptive Tree Walk Protocol

How do we do it:

- treat every stations as the leaf of a binary tree
- First slot (after successful transmission), all stations can try to get the slot (under the root node).
- If no conflict, fine.
- Else, in case of conflict, only nodes under a sub-tree get to try for the next one. (depth first search)

Adaptive Tree Walk Protocol

Slot-0 : C*, E*, F*, H* (all nodes under node 0 can try which are going to send), conflict

Slot-1 : C* (all nodes under node 1 can try}, C sends

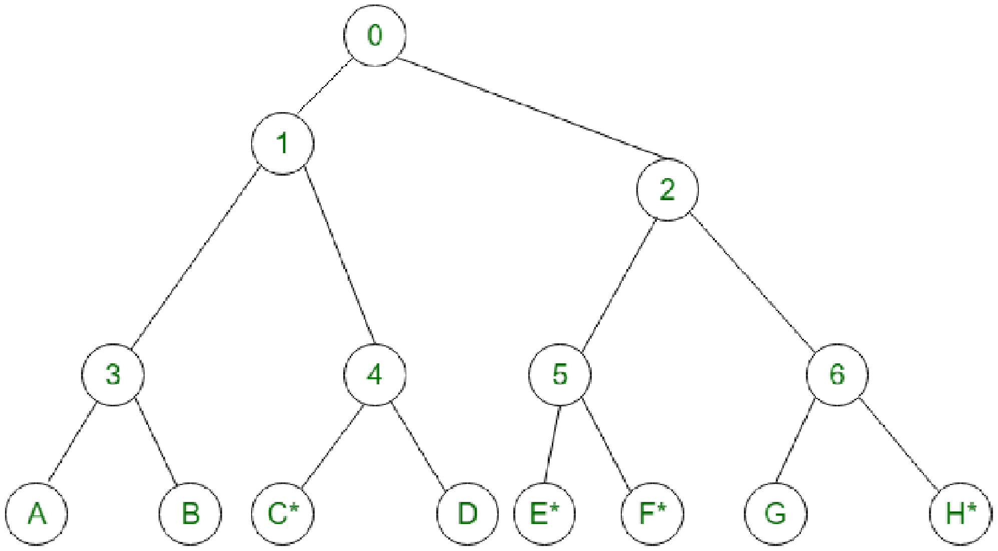
Slot-2 : E*, F*, H*(all nodes under node 2 can try}, conflict

Slot-3 : E*, F* (all nodes under node 5 can try to send), conflict

Slot-4 : E* (all nodes under E can try), E sends

Slot-5 : F* (all nodes under F can try), F sends

Slot-6 : H* (all nodes under node 6 can try to send), H sends.



#DONE!

thank you