Computer Networks

BCST -502 BCSP- 502

B.Tech (CSE) 5th Semester

Course Instructor: Dr Bishwajeet Pandey

New 2020 Syllabus

Unit –I

Computer Network: Definitions, goals, components, Architecture, Classifications & Types.Layered Architecture: Protocol hierarchy, Design Issues, Interfaces and Services, ConnectionOriented & Connectionless Services, Service primitives, Design issues & its functionality. ISOOSI Reference Model: Principle, Model, Descriptions of various layers and its comparison with TCP/IP. Principals of physical layer: Media, Bandwidth, Data rate and Modulations

Unit-II

Data Link Layer: Need, Services Provided, Framing, Flow Control, Error control. Data Link Layer Protocol: Elementary &Sliding Window protocol: 1-bit, Go-Back-N, Selective Repeat, Hybrid ARQ. Protocol verification: Finite State Machine Models & Petri net models. ARP/RARP/GARP

Unit-III

MAC Sub layer: MAC Addressing, Binary Exponential Back-off (BEB) Algorithm, Distributed Random Access Schemes/Contention Schemes: for Data Services (ALOHA and Slotted- ALOHA), for Local-Area Networks (CSMA, CSMA/CD, CSMA/CA), CollisionFree Protocols: Basic Bit Map, BRAP, Binary Count Down, MLMA Limited Contention Protocols: Adaptive Tree Walk, Performance Measuring Metrics. IEEE Standards 802 series & their variant.

New 2020 Syllabus

Unit-IV

Network Layer: Need, Services Provided, Design issues, Routing algorithms: Least CostRouting algorithm, Dijkstra's algorithm, Bellman-ford algorithm, Hierarchical Routing,Broadcast Routing, Multicast Routing. IP Addresses, Header format, Packet forwarding,Fragmentation and reassembly, ICMP, Comparative study of IPv4 & IPv6

Unit-V

Transport Layer: Design Issues, UDP: Header Format, Per-Segment Checksum, CarryingUnicast/Multicast Real-Time Traffic, TCP: Connection Management, Reliability of DataTransfers, TCP Flow Control, TCP Congestion Control, TCP Header Format, TCP TimerManagement. Application Layer: WWW and HTTP, FTP, SSH, Email (SMTP, MIME, IMAP), DNS, Network Management (SNMP).

About Course Instructor

- PhD from Gran Sasso Science Institute, Italy
- PhD Supervisor Prof Paolo Prinetto from Politecnico Di Torino, World Rank 13 in Electrical Engineering
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About Course Outline

- UNIT 1: Lecture No 1-4
- UNIT 2: Lecture No 5-11 (Including Lab on Vivado)
- UNIT 3: Lecture No 14-17
- UNIT 4: Lecture No 18-21, Lecture 12-13
- UNIT 5: Lecture No 22-28 (Including Lab on Packet Tracer)
- Lecture No 29-35: Discuss Previous Year Question of UKTU
- Out of 35 Lectures: Some will delivered by Professor From Foreign University

OUTLINE OF LECTURE 16

1. Collision Free Protocols:
   1.1. Basic Bit Map
   1.2. Backup Route Aware Routing Program (BRAP)
   1.3. Binary Count Down

2. Limited Contention Protocols:

   2.1. Adaptive Tree Walk

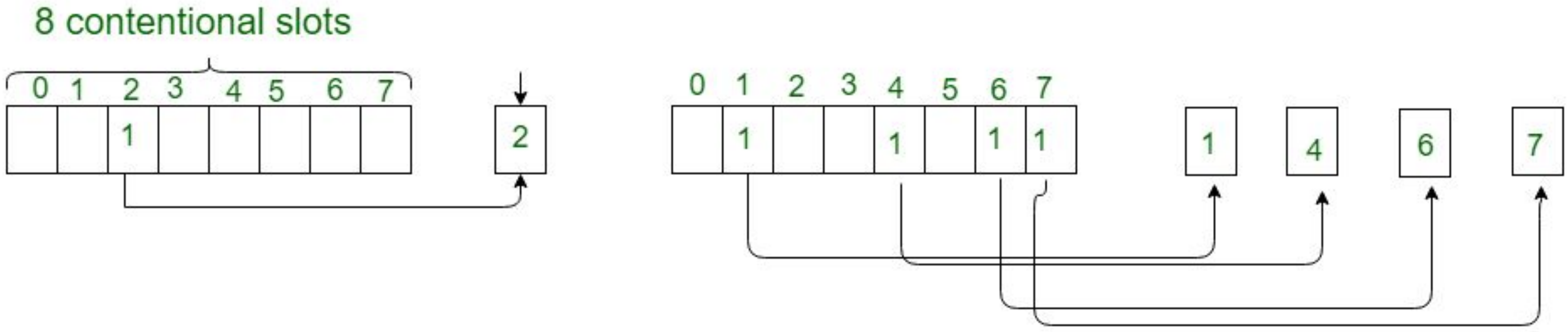
Bit-map Protocol

- Bit-map protocol is a collision free protocol that operates in the Medium Access Control (MAC) layer of the OSI model.
- It resolves any possibility of collisions while multiple stations are contending for acquiring a shared channel for transmission.
- In this protocol, if a station wishes to transmit, it broadcasts itself before the actual transmission. This is an example of Reservation Protocol.

Bit-map Protocol: Working Principle

- In this protocol, the contention period is divided into N slots, where N is the total number of stations sharing the channel.
- If a station has a frame to send, it sets the corresponding bit in the slot to 1.

Bit-map Protocol



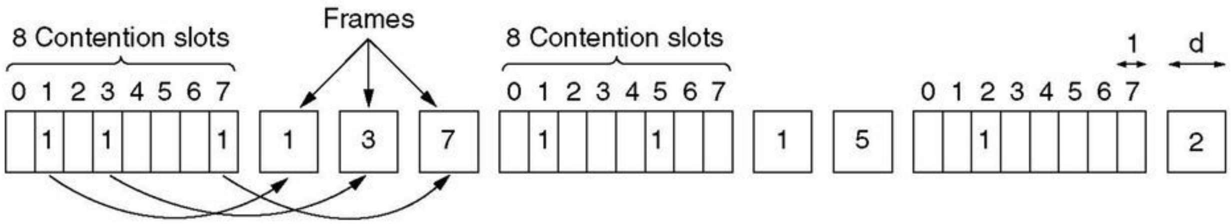
- Suppose that there are 8 stations. So the number of contention slots will be 8. If the stations 1, 4, 6 and 7 wish to transmit, they will set the corresponding slots to 1.

Bit-map Protocol: Working Principle

- Once each station announces itself, one of them gets the channel based upon any agreed criteria.
- Generally, transmission is done in the order of the slot numbers.
- Each station has complete knowledge whether every other station wants to transmit or not, before transmission starts. So, all possibilities of collisions are eliminated.

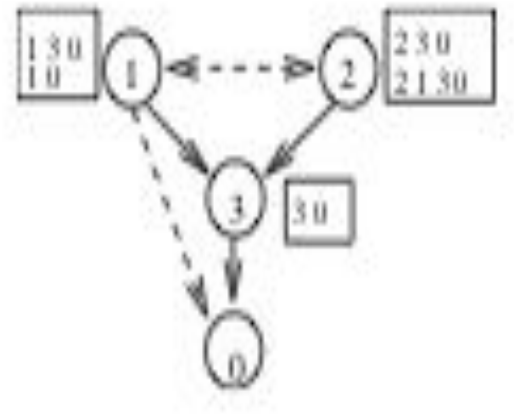
Collision-Free Protocols

The basic bit-map protocol.



Backup Route Aware Routing Program (BRAP)

- BRAP uses best paths and backup/alternate paths to ensure fast failure recovery in networking systems.
- The box around a node represents its routing table.
- The order of the paths indicates the local preference ranking for those paths.
- The solid arrow line represents a link in the best path, while the dashed line denotes a link in an alternative path.



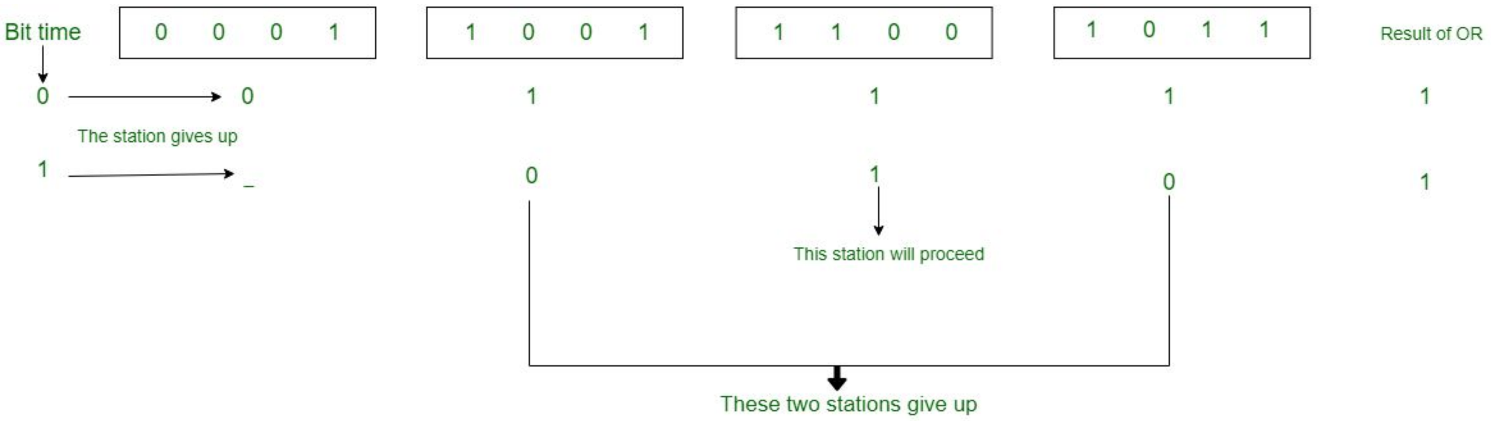
Binary Count Down

- One problem with Basic Bit-Map Protocol is that the overhead is 1 bit per frame per station.
- We can do better by using binary station addresses.
- A station wanting to use the channel now broadcasts its address as a binary bit string in serial fashion.

Binary Count Down

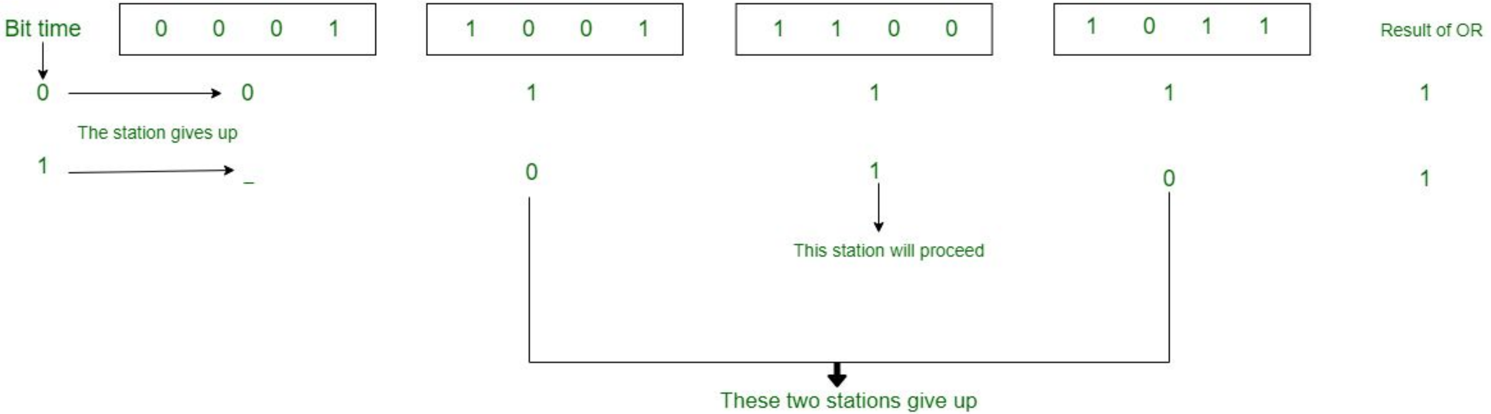
- As soon as a station sees that a high-order bit position that is 0 in its address then, it gives up (meaning some high order station wants to transmit).
- The remaining stations keep sending their addresses on the network, until a winner merges.
- The wining station sends out the frame. The bidding process repeats.

Binary Count Down



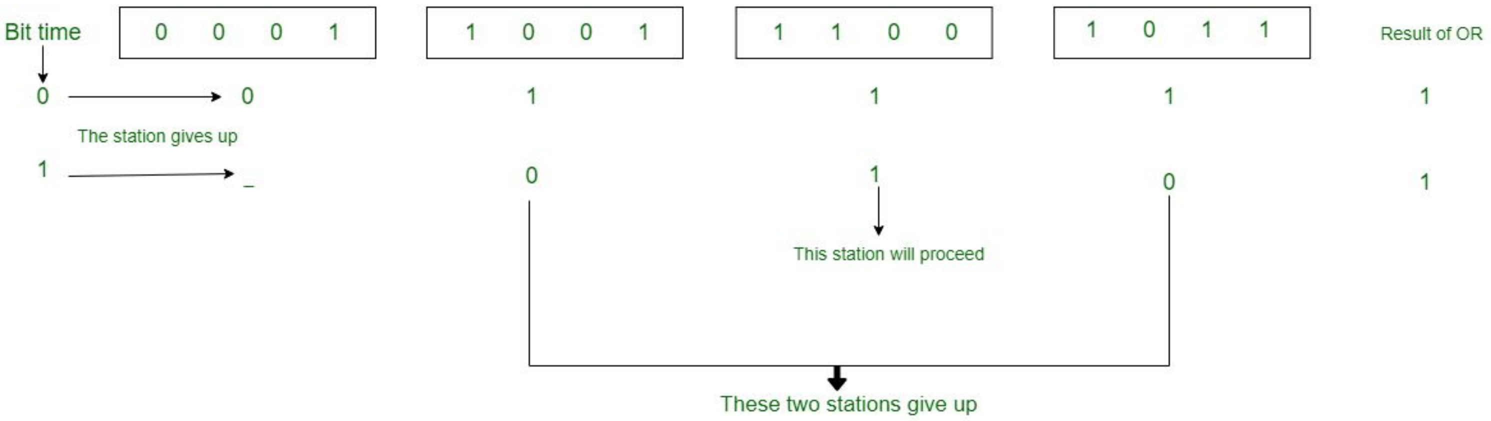
- If these stations 0001, 1001, 1100, 1011 all are trying to seize the channel for transmission.
- All the station at first broadcast their most significant address bit that is 0, 1, 1, 1 respectively.

Binary Count Down



- The most significant bits are ORed together. Station 0001 see the 1 MSB in another station addresses and knows that a higher numbered station is competing for the channel, so it gives up for the current round.

Binary Count Down



- Other three stations 1001, 1100, 1011 continue. The next bit is 1 at station 1100, so station 1011 and 1001 give up. Then station 1100 starts transmitting a frame, after which another bidding cycle starts.

Limited Contention Protocols:

- Collision based protocols (pure and slotted ALOHA, CSMA/CD) are good when the network load is low.
- Collision free protocols (bitmap, binary Countdown) are good when load is high.
- How about combining their advantages?
  - Behave like the ALOHA scheme under light load
  - Behave like the bitmap scheme under heavy load.

Limited Contention Protocols:Adaptive Tree Walk Protocol

- Partition the group of station and 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

Limited Contention Protocols: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
  - in case of conflict, only nodes under a subtree get to try for the next one. (depth first search)

Limited Contention Protocols: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.