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.

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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
- MTech from Indian Institute of Information Technology, Gwalior
- Visited 32 Countries Across The Globe
- Written 200+ Research paper with 193 Researcher from 63 Universities
- Scopus Profile: https://www.scopus.com/authid/detail.uri?authorId=57203239026
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- Contact: gyancity@gyancity.com, +91-7428640820 (For any help @ BIAS and Guidance for future MS from Europe and USA after BIAS)

Course Objectives

- The course aims to develop an understanding of the fundamentals of Computer Network among the students

- The course explores different components of computer network, types of protocols, modern network technologies and their applications.

Course Outcomes

After completing this course the student will be well equipped with the following concepts:

1. The student will be able to recognise the technological trends of Computer Networking.
2. The student will be able to discuss the key technological components of the Network and evaluate the challenges in building the network and find solutions for the same.
3. The student could understand the basic computer network technology as an isolating concept.

Course Outcomes

4. The student will be thorough in concepts of Data Communication system and its components

5. The student will be able to identify and distinguish between different types of network topologies and protocols.

6. The student will have in depth knowledge of the the layers of the OSI model and TCP/IP and will able to explain the function(s) of each layer.

Course Outcomes

7. The student will be able to identify the different types of network devices and their functions within a network

8. The student would have the skill to understand the building skills of subnetting and routing mechanisms.

9. Upon familiarity with the above concepts the student will be able to assist in network design and its implementation in real time.

About Course Outline

- UNIT 1:
  - Theory Lecture No 1-4, Lecture 29
  - Lab on Vivado: Lecture 9-11
- UNIT 2: Theory Lecture No 5-8
- UNIT 3: Theory Lecture No 14-18
- UNIT 4:
  - Theory Lecture No 12-13, 19-21, 36
  - Lab on Packet Tracer and C: Lecture 24-28
- UNIT 5: Theory Lecture No 30-35
- Student Assignment Presentation: 22-23
- Lecture No 37-42: Discuss Previous Year Question of UTU

OUTLINE OF LECTURE 34

- TCP Timer Management
- Application Layer:
  - WWW and HTTP
  - FTP

TCP Timer Management

- TCP uses several timers to ensure that excessive delays are not encountered during communications.
- Several of these timers are elegant, handling problems that are not immediately obvious at first analysis.
- Each of the timers used by TCP, which reveal its role in ensuring data is properly sent from one connection to another.

TCP Timer Management

- **TCP implementation uses four timers –**
  - **Retransmission Timer**
  - **Persistent Timer**
  - **Keep Alive Timer**
  - **Time Wait Timer**

Retransmission Timer

- Retransmit lost segments, TCP uses retransmission timeout (RTO).
- When TCP sends a segment the timer starts and stops when the acknowledgment is received.
- If the timer expires timeout occurs and the segment is retransmitted.
- RTO (retransmission timeout is for 1 RTT) to calculate retransmission timeout we first need to calculate the RTT(round trip time).

Types of Retransmission Timer

- **Measured RTT(RTTm):**The measured round-trip time for a segment is the time required for the segment to reach the destination and be acknowledged, although the acknowledgment may include other segments.
- **Smoothed RTT(RTTs):**It is the weighted average of RTTm. RTTm is likely to change and its fluctuation is so high that a single measurement cannot be used to calculate RTO.
- **Deviated RTT(RTTd):**Most implementation do not use RTTs alone so RTT deviated is also calculated to find out RTO.

Retransmission Timeout

- RTO calculation – The value of RTO is based on the smoothed round-trip time and its deviation. Most implementations use the following formula to calculate the RTO:
- `Initial value -> Original (given in question)`
- `After any measurement -> RTO=RTTs + 4*RTTd`

Persistent Timer

- To deal with a zero-window-size deadlock situation, TCP uses a persistence timer.When the sending TCP receives an acknowledgment with a window size of zero, it starts a persistence timer.
- When the persistence timer goes off, the sending TCP sends a special segment called a probe. This segment contains only 1 byte of new data.
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Persistent Timer

- It has a sequence number, but its sequence number is never acknowledged; it is even ignored in calculating the sequence number for the rest of the data.
- The probe causes the receiving TCP to resend the acknowledgment which was lost.

Keep Alive Timer

- A keepalive timer is used to prevent a long idle connection between two TCPs.
- If a client opens a TCP connection to a server transfers some data and becomes silent the client will crash.
- In this case, the connection remains open forever. So a keepalive timer is used.

Keep Alive Timer

- Each time the server hears from a client, it resets this timer. The time-out is usually 2 hours.
- If the server does not hear from the client after 2 hours, it sends a probe segment.
- If there is no response after 10 probes, each of which is 75 s apart, it assumes that the client is down and terminates the connection.

Time Wait Timer

- **Time Wait Timer –** This timer is used during tcp connection termination. The timer starts after sending the last Ack for 2nd FIN and closing the connection.
- *After a TCP connection is closed, it is possible for datagrams that are still making their way through the network to attempt to access the closed port.*

Time Wait Timer

- *The quiet timer is intended to prevent the just-closed port from reopening again quickly.*
- The **quiet timer** is usually set to twice the maximum segment lifetime (the same value as the Time-To-Live field in an IP header), ensuring that all segments still heading for the port have been discarded.

Application Layers: OSI Model

- The application layer abstraction is used in both of the standard models of computer networking: the Internet Protocol Suite and the OSI model.
- As for the application layer specifically, this layer is what deals with protocols such as FTP and Telnet that relate to the handling of IP traffic. Web browsers, SNMP protocols and HTTP protocols, or HTTP's successor HTTPS, are other examples of application layer systems.

WWW

- The **World Wide Web** or simply Web has been with us for almost thirty years. With all these years, there must be a great history of it.
- Lots of historical activities have taken place within it and quite a number of them are worth remembering.

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The first proposal for the World Wide Web was written in 1989

- A British engineer and a scientist by the name Sir Tim Berners-Lee wrote the first proposal of what would become the World Wide Web in 1989.

- Currently, the engineer is the director of the World Wide Web Consortium (W3C).

Mosaic web browser was launched in 1993

- 1993 is believed to be a very important year in the history of the World Wide Web.
- It was the year which the Mosaic web browser was launched. This was a graphical web browser that was developed by a team of experts at the National Center for Supercomputing Applications at the University of Illinois.

The first website went live on August 6 1991

- Berners-Lee and a team of other engineers who worked at CERN launched the first ever website in 1991.
- the domain name of the site is http://info.cern.ch and its landing page had only 153 words.
- This was historic as it marked a new beginning of the World Wide Web where hypermedia information can be easily accessed.

Archie was the first search engine

- Archie was the first-ever search engine. It went live in 1990. From there, other search engines such as Google, and Yahoo were developed.

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Difference Between WWW and Internet

- Most of us think of the WWW and the internet to be synonymous in nature.
- Although closely linked to each other, there is a difference between the two.
- While the World Wide Web is a layer using different protocols on the internet, the internet facilitates global communication between devices.

HTTP

- HTTP (Hypertext Transfer Protocol) is the set of rules for transferring files, such as text, graphic images, sound, video, and other multimedia files, on the World Wide Web.
- As soon as a web user opens their web browser, the user is indirectly making use of HTTP.

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HTTP

- HTTP is an application protocol that runs on top of the TCP/IP suite of protocols (the foundation protocols for the Internet).
- The latest version of HTTP is HTTP/2, which was published in May 2015.
- It is an alternative to its predecessor, HTTP 1.1, but does not it make obsolete.

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HTTP vs HTTPS

- HTTPS (HTTP over SSL or HTTP Secure) is the use of Secure Sockets Layer (SSL) or Transport Layer Security (TLS) as a sublayer under regular HTTP application layering.
- HTTPS encrypts and decrypts user HTTP page requests as well as the pages that are returned by the Web server.
- The use of HTTPS protects against eavesdropping and man-in-the-middle (MitM) attacks. HTTPS was developed by Netscape.