COURSE FILE

ON

COMPUTER NETWORKS

CourseCode-21CS515PC
III BTech - I SEMESTER
A.Y:2024-2025

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

Course File Contents:

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

DEPARTMENT VISION AND MISSION

Vision:

To become a prominent knowledge hub for learners, strive for educational excellence with innovative and industrial techniques so as to meet the global needs.

Mission:

- To provide ambience that enhances innovations, problem solving skills, leadership qualities, decision making, team-spirit and ethical responsibilities.
- Toimpartqualityeducationwithprofessionalandpersonalethics,so as to meet the challenging technological needs of the industry and society.
- To provide academic infrastructure and develop linkage with the world class organizations to strengthen industry-academia relationships for learners.

DEPARTMENT OF COMPUTER SCIENCE ANENGINEERING (AI&ML)

PROGRAM EDUCATIONAL OBJECTIVES

- PEO1: To attain knowledge, skills, and competencies for futuristic needs required at national and international levels with ethical standards.
- PEO2: To contribute to the development of computer engineering through research.
- PEO3: To display personal growth by pursuing higher studies, professional development courses, and/or engineering certification

PROGRAM SPECIFIC OUTCOMES

- PSO1: An ability to apply concepts computer engineering related to software systems by using modern techniques, programming skills, and tools and theoretical computer science in the modeling and design of computer-based systems.
- PSO2: Ability to secure employment or be an entrepreneur and apply the knowledge and understanding of engineering principles while portraying competencies like teamwork, effective verbal and written communication skills, and a zeal for lifelong learning with an ethical responsibility.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

PROGRAMME OUTCOMES (POs)

A graduate of the AI&ML Program will demonstrate.

- **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, Natural sciences and engineering sciences.
- **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

- **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

- **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- **Project management and finance**: Demonstrate knowledge and understanding of the

  engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments to manage projects.

  Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

Syllubus

B.TECH.CE(SE) **R21 Regulations**

BALAJI INSTITUTE OF TECHNOLOGY & SCIENCE
(UGC-AUTONOMOUS)

21CS515PC- COMPUTER NETWORKS

B.Tech. III Year I Sem.

L	T	P	C
3	0	0	3

Course Objectives

- The objective of the course is to equip the students with a general overview of the concepts and fundamentals of computer networks.
- Familiarize the students with the standard models for the layered approach to communication betweenmachines in a network and the protocols of the various layers.

Course Outcomes

- Gain the knowledge of the basic computer network technology.
- Gain the knowledge of the functions of each layer in the OSI and TCP/IP reference model.
- Obtain the skills of subletting and routing mechanisms.
- Familiarity with the essential protocols of computer networks, and how they can be applied in networkdesign and implementation.

UNIT – I

Network hardware, Network software, OSI, TCP/IP Reference models, Example Networks: ARPANET, Internet. **Physical Layer:** Guided Transmission media: Twisted Pairs, Coaxial Cable, Fiber Optics, Wireless Transmission,the Public Switched Telephone Networks, Mobile Telephone Systems.

UNIT - II

Data link layer: Design issues, Framing, Error Detection and Correction.
Elementary data link protocols: Simplex Protocol, A Simplex Stop and Wait Protocol for an Error-Free Channel, A Simplex Stop and Wait Protocol for Noisy Channel.
Sliding Window Protocols: A One-Bit Sliding Window Protocol, A Protocol Using Go-Back-N, A Protocol Using Selective Repeat, Example Data Link Protocols.
Medium Access sub layer: The Channel Allocation Problem, Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Ethernet, Collision Free Protocols. Wireless LANs, Data Link Layer Switching, BroadBand Wireless, Bluetooth.

UNIT - III

Network Layer: Design Issues, Routing Algorithms: Shortest Path Routing, Flooding, Hierarchical Routing, Broadcast, Multicast, Distance Vector Routing, Congestion Control Algorithms, Internetworking, The Network Layer In The Internet, Quality Of Service.

UNIT - IV

Transport Layer: Transport Services, Elements of Transport Protocols, Connection Management, TCP and UDPProtocols.

UNIT - V

Application Layer –Domain Name System, SNMP, Electronic Mail; The World WEB, HTTP, SMTP, FTP.

TEXT BOOK:

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI

REFERENCE BOOKS:

1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education
2. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TM

:

ACADEMIC CALENDAR

ISO 9001:2015 Certified Institution Estd.:2001

Balaji Institute of Technology & Science

Laknepally (V), Narsampet (M), Warangal District - 506 331, Telangana State, India

(AUTONOMOUS)

Accredited by NBA (UG - CE, EEE, ME, ECE & CSE) & NAAC A+ Grade

(Affiliated to JNT University, Hyderabad and Approved by AICTE, New Delhi)

www.bitswgl.ac.in, email: principal@bitswgl.ac.in, Ph:98660 50044, Fax: 08718-230521

ACADEMIC CALENDAR FOR B.TECH. III-YEAR FOR THE ACADEMIC YEAR 2024-25

B.Tech- III-YEAR I Semester

S.No	Description	Date		Duration
		From	To	
1	1st Spell of instructions	30-07-2024	25-09-2024	9 Weeks
2	First Mid Term Examinations	26-09-2024	28-09-2024	3 days
3	2nd Spell of Instructions	30-09-2024	05-10-2024	1 week
4	Dussehra Recess	07-10-2024	12-10-2024	1 week
5	2nd Spell of Instructions Continuation	14-10-2024	30-11-2024	7 Weeks
5	Second Mid Term Examinations	02-12-2024	04-12-2024	3 days
7	Preparation Holidays & Practical Examinations	05-12-2024	14-12-2024	9 days
8	End Semester Examinations	16-12-2024	28-12-2024	2 Weeks

B.Tech - III-YEAR II Semester

S.No	Description	Date		Duration
		From	To	
1	Commencement of II Semester class work	30-12-2024		
2	1st Spell of Instructions	30-12-2024	26-02-2025	9 Weeks
3	First Mid Term Examinations	27-02-2025	01-03-2025	3 days
4	2nd Spell of instructions	03-03-2025	26-04-2025	8 Weeks
5	Second Mid Term Examinations	28-04-2025	30-04-2025	3 days
6	Preparation Holidays and Practical Examination	01-05-2025	10-05-2025	9 days
7	Summer Vacation	12-05-2025	24-05-2025	2 Weeks
8	End Semester Examinations	26-05-2025	07-06-2025	2 Weeks

24/7/24

PRINCIPAL

Principal

Balaji Institute of Tech & Science

LAKNEPALLY Narsampet-506 331

Copy to:

1. Dean-Academics
2. All Head of the Departments
3. Examination branch

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

Importance of the course

Course Description The main emphasis of this course is on the organization and management of local area networks (LANs). The course objectives include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems. The course introduces computer communication network design and its operations. The course includes the following topics: Open Systems Interconnection (OSI) communication model; error detection and recovery; local area networks; bridges, routers and gateways; network naming and addressing; and local and remote procedures. On completion of the course, the student should be able in part to design, implement and maintain a typical computer network (LAN).

PRE-REQUISITES:

It's expected to have basis knowledge of logic circuits and their applications in digital system.

Course Objectives

1. Describe how computer networks are organized with the concept of layered approach.
2. Implement a simple LAN with hubs, bridges and switches.
3. Describe how packets in the Internet are delivered.
4. Analyze the contents in a given Data Link layer packet, based on the layer concept.
5. Design logical sub-address blocks with a given address block.
6. Decide routing entries given a simple example of network topology
7. Describe what classless addressing scheme is.
8. Describe how routing protocols work.

Course Outcomes

Course Outcomes After the course completion, students will be able to:

CO1: Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.

CO2: Have a basic knowledge of the use of cryptography and network security.

CO3: Specify and identify deficiencies in existing protocols, and then go onto formulate new and better protocols.

CO4: Analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

CO5: Have a working knowledge of datagram and internet socket programming.

CO-PO, CO-PSO mapping and Justification

Mapping ofcourseoutcomes with program outcomes:

High-3 Medium-2 Low-1

CO – PO Mappings

Course name: Computer Networks

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	2	3	3	3	3	2	1	1	2	3	3	2
CO 2	2	3	3	3	3	2	3	1	3	3	3	2
CO 3	2	3	3	3	3	2	3	2	2	3	2	2
CO 4	2	3	3	3	3	2	1	1	2	3	2	2
CO 5	2	3	3	3	3	2	3	2	2	3	2	2
Avg	2	3	3	3	3	2	2.2	1.4	2.2	3	2.4	2

CO – PSO Mappings

Course name: Computer Networks

	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
AVG	3	2

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

CLASS TIME TABLE

Balaji Institute of Technology & Science

Laknepally (V), Narsampet (M), Warangal District - 506 331, Telangana State, India

(AUTONOMOUS)

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Estd.:2001

Dept. of Computer Science &Engineering (AI&ML)

CLASS TIME TABLE

A.Y. 2024-25 (I Sem) Reg (R22)

Class: B.Tech III CSM | **Room No.:405-D** | **w.e.f. :30-07-2024**

DAY	1	2	3	4	1:00-1:40	5	6	7
	9:30 - 10:20	10:20 - 11:10	11:20 - 12:10	12:10 - 01:00		1:40 - 02:30	2:30 - 03:20	3:20 - 04:10
MON	WP	WP LAB - (305D - AIML LAB)			LUNCH BREAK	CN	ML	BEFA
TUE	BEFA	DAA	TUTIER LAB (305D -AIML LAB			ML LAB - (305D - SE LAB)		
WED	WP	CRT- TECHNICAL LAB				ML	BEFA	Counselling/ Association Activity
		*ML	*DAA	*BEFA				
THU	WP	ML	CRT-Aptitude & Reasonning			BEFA	DAA	CN
			*IPR	*ESI-1				
FRI	DAA	CN	CN LAB - (305D-SE LAB)			AECS LAB		
SAT	CN	WP	DAA	ML		CRT-TECHNICAL		
						*CN	*ESI-1	*IPR

SUBJECTS:

DAA : Design and Analysis of Algorithms -Dr.G.Praveen Kumar

ML : Machine Learning -Mrs.M.Vedavani

CN:Computer Networks - Mr.K.Murali Sagar

BEFA:Business Economics&Financial Analysis-Mr.J.Ramesh

PE-1: Web Programming : Mr.S.Santhosh

Intellectual Property Rights(Mandartory Course):Mr.B.Kartheek Kumar

Essence of Indian Knowledge Tradition Part-1(Mandatory Course): Mrs.G.Pavana Kumari

CRT-Aptitude & Reasonning : Mr.B.Samba Shivudu

Venue : Main Seminar Hall

LABS:

Machine Learning Lab :Mrs.M.Vedavani /Mrs.M.Supriya

Computer Networks Lab:Mr.K.Murali Sagar /Mrs.P.Srivalli

Advanced English Communication Skills Lab : Dr.A.Karuna Sree

UI design- Flutter: Mrs.Divya Aitha/Mrs.S.Soujanya

Web Programming Lab : Mr.S.Santhosh /Mrs.L.Bhavya sree

CRT- Technical (Java Full Stack) :Mr.B.Ranjith Kumar

Venue: ECE Seminar Hall

CRT- Technical Lab- Mr.B.Ranjith Kumar

Venue: 407-D T&P Lab

e

PERSONAL TIME TABLE

Mr.K.Muralisagr | **TOTAL-14**

DAY	1	2	3	4		5	6	7
	9:30 - 10:20	10:20 - 11:10	11:20 - 12:10	12:10 - 01:00		1:40 - 02:30	2:30 - 03:20	3:20 - 04:10
MON					LUNCH BREA	IIICSM-CN		
TUE	IIICSM-ML LAB							
WED	IIICSM-CN							
THU								
FRI		IIICSM-CN LAB					IIICSM-CN	
SAT	IIICSM-CN	IICSM-DS LAB						

Method of teaching, Chalk and talk/ppts/NPTEL lectures/cd/innovative teaching method,etc.

- **NPTEL Lectures as Supplementary Material:**

- NPTEL lectures can provide valuable supplementary material, especially for complex topics. Students can review these lectures at their own pace.
- Use in class time to discuss and clarify the topics brought up in the NPTEL lectures.

- **Hands-on Labs and Practical Exercises:**

- Computer networks are inherently practical. Emphasize hands-on labs where students configure routers, switches, and firewalls.
- Use network analysis tools (like Wireshark) to allow students to capture and analyze network traffic.

- **Project-Based Learning (PBL):**

- Assign projects that involve designing, implementing, and troubleshooting networks. This allows students to apply their knowledge to real-world problems.
- Examples: Setting up a small office network, configuring a web server, or implementing network security measures.

- **Inquiry-Based Learning:**

- Encourage students to explore network protocols and technologies through research and experimentation.
- Pose open-ended questions and challenges that require students to investigate and find solutions.

- **Gamification:**

- Use online quizzes and simulations to make learning more engaging.
- Incorporate elements of competition and rewards to motivate students.

- **Collaborative Learning:**

- Group projects and peer-to-peer learning can help students develop their problem-solving and teamwork skills.
- Having students work together to solve network troubleshooting issues is very effective.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (AI&ML)

Lesson Plan & Delivery Report

Subject: Computer Networks — Class: III YEAR I SEM (CSM)

Faculty: Mr.K.Murali Sagar — Regulation: R22

Academic Year: 2024-25(I-Sem) — Commencement of Class Work: 30.07.2024

UNIT I Network Hardware (No. of Classes :15)					
Topics (as per syllabus)	**Subtopics**	**Lect. No.**	**Scheduled Date**	**Topic Delivered Date**	**Remarks**
Network hardware	Network hardware	L1 L2 L3	30.07.2024 31.08.2024 01.08.2024		
	Network software	L3 L4 L5	05.08.2024 06.08.2024 07.08.2024		
	OSI	L6	08.08.2024		
	TCP/IP Reference models	L7	12.08.2024		
	Example Networks: ARPANET, Internet.	L8 L9 L10	1308.2024 14.08.2024 20.08.2024		
Physical Layer	Guided Transmission media, Twisted pairs, Coaxial cable, fiber optics	L11 L12	21.08.2024 22.08.2024		
	Wireless transmission & Revise the Unit-1	L13 L14	27.08.2024 28.08.2024		
	Slip Test-unit-1	L15	02.09.2024		
UNIT II Data Link Layer (No. of Classes :15)					
Data link layer	Design issues	L16	03.09.2024		
	Framing	L17	04.09.2024		

	Error detection and correction	L18 L19	05.09.2024		
Elementary data link protocols	simplex protocol, A simplex stop and wait protocol for an error-free channel	L20	10.09.2024		
	A simplex stop and wait protocol for noisy channel	L21 L22	11.09.2024		
Sliding Window protocols	Sliding Window protocols: A one-bit sliding window protocol, A protocol using Go-Back-N	L23	12.09.2024		
	A protocol using Selective Repeat, Example data link protocols.	L24	16.09.2024		
Medium Access sub layer:	The channel allocation problem, Multiple access protocols: ALOHA	L25	17.09.2024		
	Carrier sense multiple access protocols, collision free protocols	L26	18.09.2024		
	Wireless LANs	L27 L28	19.09.2024		
	Data link layer switching & Revise the Unit-1	L29 L30	20.09.2024 21.04.2024		
Overview	Slip Test-Unit 2	L31	23.09.2024		
UNIT III Network Layer ((No. of Classes :17)					
Topics (as per syllabus)	**Subtopics**	**Lect. No.**	**Scheduled Date**	**Topic Delivered Date**	**Remarks**
Network Layer	Network Layer: Design issues	L32 L33	24.09.2024		
	Routing algorithms: shortest path routing, Flooding	L34	25.09.2024		
First Mid Examinations 26.09.2024 to 28.09.2024 (1Week)					
	Congestion Control Algorithms	L36 L37	30.09.2024 01.10.2024		

		L38			
	Quality of Service	L39 L40 L41	04.10.2024 05.10.2024		
Dussehra Recess 06.10.2024 to 13.10.2024(1 Week)					
	Internetworking	L42 L43 L44	14.10.2024 15.10.2024		
	The Network layer in the internet & Revise the Unit-3	L45 L46 L47	16.10.2024 17.10.2024		
Overview	Slip Test –Unit 3	L48	21.10.2024		
UNIT IV Transport Layer(No. of Classes :09)					
Transport Layer	Transport Layer: Transport Services	L49 L50	21.10.2024 22.10.2024		
	Elements of Transport protocols	L51 L52	23.10.2024 24.10.2024		
	Connection management	L53 L54	28.10.2024		
	TCP and UDP protocols & Revise The Unit -4	L55 L56	30.10.2024 31.10.2024		
	Slip Test -4	L57	04.11.2024		
UNIT V Application Layer(No. of Classes :10)					
Topics (as per syllabus)	**Subtopics**	**Lect. No.**	**Scheduled Date**	**Topic Delivered Date**	**Remarks**
Expert Systems	Domain name system	L58 L59	06.11.2024 11.11.2024		
	SNMP	L60 L61	12.11.2024 13.11.2024		

	Electronic Mail	L62 L63	18.11.2024 20.11.2024		
	the World WEB, HTTP	L64 L65	21.11.2024 25.11.20242 27.11.2024		
	Streaming audio &Video	L66	28.11.2024		
	Revise The Unit -5	L67	02.12.2024		
	Slip Test -5	L68	04.12.2024		

Text Book:

1. Computer Networks -- Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI.

Reference Books:

1. An Engineering Approach to Computer Networks-S. Keshav, 2nd Edition, Pearson Education.
2. Data Communications and Networking – Behrouz A. Forouzan. Third Edition TMH.

Signature of Faculty **HOD**

Lecture Notes

Unit -1

Introduction

An interconnected collection of **autonomous** computers is called a computer network. Two computers are said to be interconnected if they are able to exchange the information. If one computer can forcibly start, stop and control another one, the computers are not autonomous. A system with one control unit and many slaves is not a network, nor is a large computer withremote printers and terminals.

In a **Distributed system**, the existence of multiple autonomous computers is transparent(i.e., not visible) to the user. He can type a command to run a program and it runs. It is up to the operating system to select the best processor, find and transport all the files to that processor, and put the results in the appropriate place.

The user of a distributed system is not aware of that there are multiple processors; it looks like a virtual uniprocessor.Allocation of jobs to processors and filesto disks, movement of filesbetween where they are stored and where they are needed, and all system function are automatic.

With a network, users mustexplicitly log onto one machine,explicitly submit jobs remotely, explicitly move files around and generally handle all the network management personally. The distinction between Network and distributed system lies with software (OS) rather than software.In network user invokes, in distributed system the system invokes.

A network is a setof devices connected by media links. Anode can be a computer,printeror any other device capable ofsendingandreceiving data generated by other nodes onthe network. The links connecting the devices are often called communication channels.

Networks use **Distributed processing,** in which a task is divided among multiple computers. Advantages of Distributed processing are

- Security/Encapsulation
- Distributeddatabases
- Fasterproblemsolving
- SecuritythroughRedundancy
- Collaborativeprocessing

Performance:

Theperformancecanbe measuredin manywaysand dependsonnumberof factors.

- Numberofusers
- Typeoftransmission medium
- Hardware
- Software

Reliability

Thisismeasuredby thefollowingfactors

- Frequencyoffailure
- Recoverytimeofa networkafter a failure.
- Catastrophe.

Security

Networksecurityissuesincludeprotectingdatafromthefollowing

- Unauthorizedaccess
- Viruses

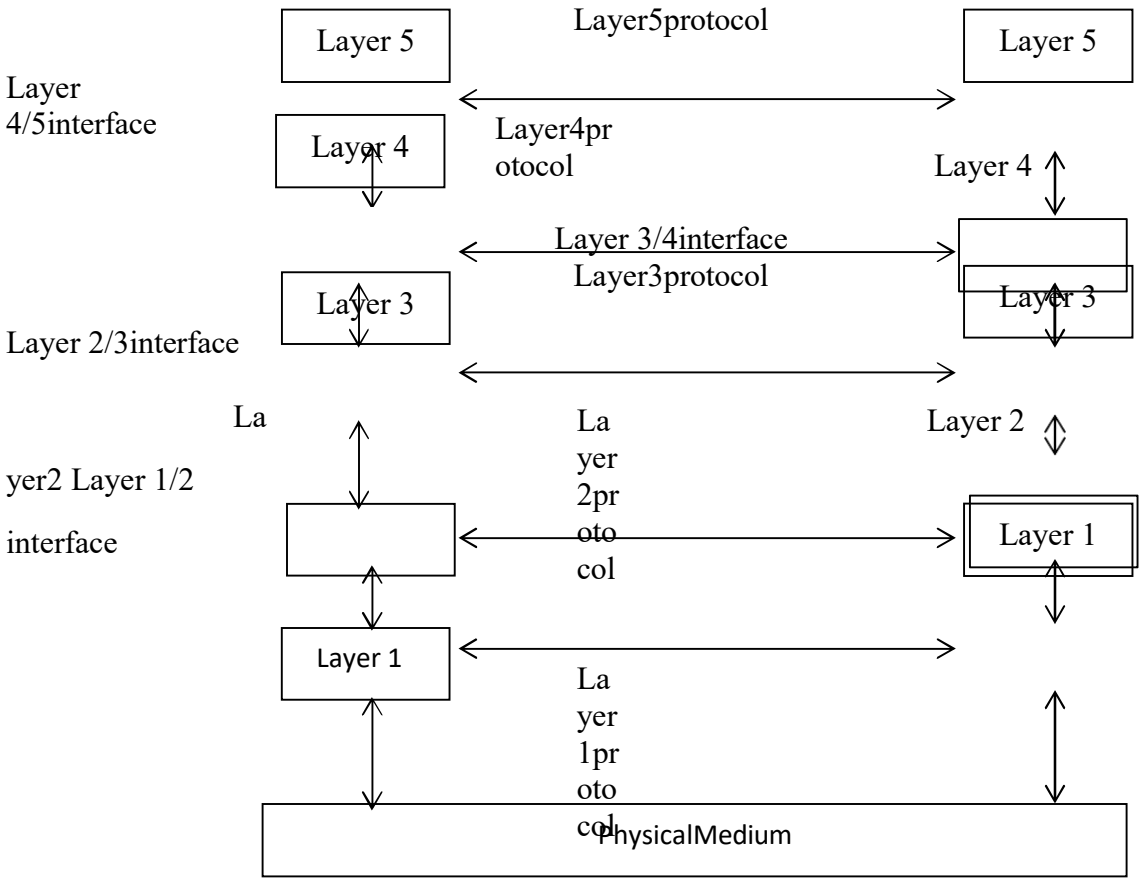
NetworkArchitecture

To reduce the design complexity, most networks are organized as a series of layers or levels, each built upon onthe one belowit.The number oflayers, the name ofeach layer

,the contents of each layer ,and the function of each layer differ from network to network However, in all networks the purpose of each layer is to offer certain services to the higher layers ,shielding those layers from the details of how the offered services are actually implemented.

Layer **n** on one machine carries on a conversation with layer **n** on another machine. The rules and conventions used in this conversation are collectively known as the layer **n Protocol.**

Theentitiescomprisingthecorrespondinglayersondifferentmachinesarecalled**Peers.**



Layers,protocolsand interfaces.

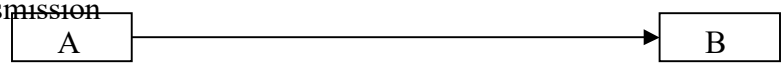
The**interface**defineswhichprimitiveoperationandservicesthelowerlayerofferstothe upper one.

A setoflayersandprotocoliscalled**networkarchitecture**. **Data transfer methods**:

a. Simplexcommunication:

Datawillbetransferredinonedirectiononly.

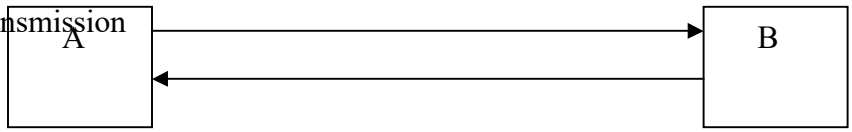
Simplex transmission



Ex:Keyboards, Monitors

.

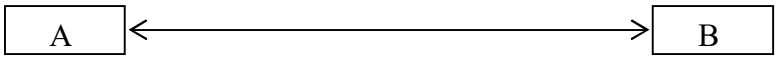
Halfduplextransmission



Ex:Onewaybridgewithtwodirectionaltraffic.

b. Full—duplexcommunication:

Datawillbe transferredinboththedirectionssimultaneously.



Ex:Two-wayroad,wheretrafficwillbethereinboththedirections.

REFERENCEMODELS

TheISO OSI REFERENCE MODEL

In 1947,the International Standards Organization(ISO) proposed a network model that covers all network communications .This model is called Open Systems Interconnection (OSI) model. An open system is a model that allows any two different systems to communicate regardless of their underlying architecture.

The OSI model is built of seven layers: Physical (layer 1), Data link (layer 2), Network (layer 3), Transport (layer 4), Session (layer 5), Presentation (layer 6) and Application layers(layer 7).

Within a single machine, each layer calls upon the services of the layer just below it.layer 3,for example, uses the services provided by layer 2 and provides for layer 4.Between machines layer on one machine communicates with layer x on another machine. This communication is governed by protocols. The processes on each machine that communicate at a given layer are called peer **–to – peer processor.**

the message is unwrapped layer by layer, with each process receiving and removing the data meant for it.

Organizationofthe layers:

Thesevenlayerscanbethoughtofasbelongingtothreesubgroups.Layers1,2,3–arethe network support layers; they deal with the physical aspects of moving data from onr machine to another.Layers5,6,7—canbethoughtofasusersupportlayers:theyallowinteroperability amongunrelatedsoftwaresystems.Layer4,thetransportlayer,ensuresendtoendreliable transmission

while layer 2 ensuresreliable transmission on a single link. The upper layers are implemented almost always in software; lowerlayers are a combination of hard wareand software, where as physical layer is mostly hardware.

FUNCTIONSOFLAYERS:

FunctionsoftheLayers Physical Layer:

- Physicalcharacteristicsofinterfacesandmedia
- Representationofbits.
- Datarate
- Synchronisationofbits
- Lineconfiguration (point topointormultipoint)
- TransmissionMode
- PhysicalTopology

DataLinkLayer:

- Framing
- Physicaladdressing
- Error control
- Flowcontrol
- Access control

NetworkLayer:

- Routing
- Congestioncontrol
- Billing

TransportLayer:

- Service–Pointaddressing
- Segmentationandreassembly
- Flowcontrol
- Errorcontrol

SessionLayer:

-Dialogcontrol
-Synchronization

PresentationLayer:

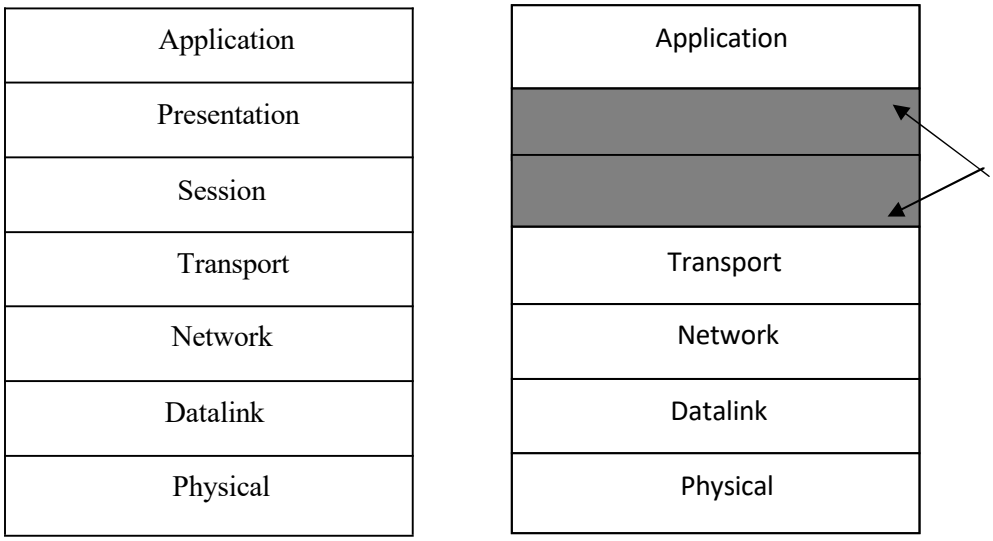
- Dataencoding
- Encryption
- Compression

ApplicationLayer:

- FileTransfer
- Mailservices
- Directoryservices

TCP/IPreferencemodel

OSI TCP/IP



1. VirtualPacket switching 2.Data gramPacket switching

Circuits witching	Datagra mpacket	Virtualp acket
Dedicate dtransmi ssion	Nodedic atedpath	Nodedic atedpath
Continuo us trans mission of data	Transmi ssionofp ackets	Transmi ssionofp ackets
Message sarenotst ored	Packetsa restored	Packets are
Pathwill beestabli shedfor entire conversa tion	Routewil lbeestabl ishedfor each packet.	Routewil lbeestabl ishedfor entire conversa tion
Fixedba ndwidtht ransmiss ion	Dynamic useofban dwidth	Dynamic useofban dwidth

X.25

X.25 isapacketswitchingwidearea network.

It is an interface between DCE and DTE for terminal operation in the packet mode on public data networks.

Itdefineshowapacket-modeterminalconnectedto apacketnetworkfortheexchangeofdata.

Itdescribestheproceduresforestablishingmaintainingandterminatingconnections.

X.25 isknown asasubscribernetwork interface (SNI).

It defineshow the user's DTE communicates with the network and howpackets are sent over that network using DCE's.

Physical Layer:

At thephysicallayer,X.25specifiesaprotocolcalledX.21. This is similar to other physical layer protocols.

Frame Layer:

X.25 provides data link control using a bit orientedprotocol called linkaccessprocedure balanced (LAPB).

PacketLayer:

TheNetworklayerinx.25iscalledthePacketLayerProtocol(PLP).

- This layer is responsible for establishing the connection, transferring data and terminating the connection.
- Itisalsoresponsibleforcreatingthevirtualcircuitsandnegotiatingnetworkservices between two DTEs.
- TheFramelayerisresponsibleformakingaconnectionbetweenaDTEandDCE,the Packet layer is responsible for making a connection between two DTEs.

End-to-Endflowanderrorcontrolbetweentwo DTEsareunderthejurisdictionofthe Packet Layer.

Unit-II

Introduction

The Data Link Layer break the bit streaminto discrete frames and compute the checksum for each frame. When a Frame arrives at the destination, the checksum is recomputed. If the newly computed checksum is different fromone computed contained in the frame, the data link layer knows that an error has occurred and takes steps to deal with it.

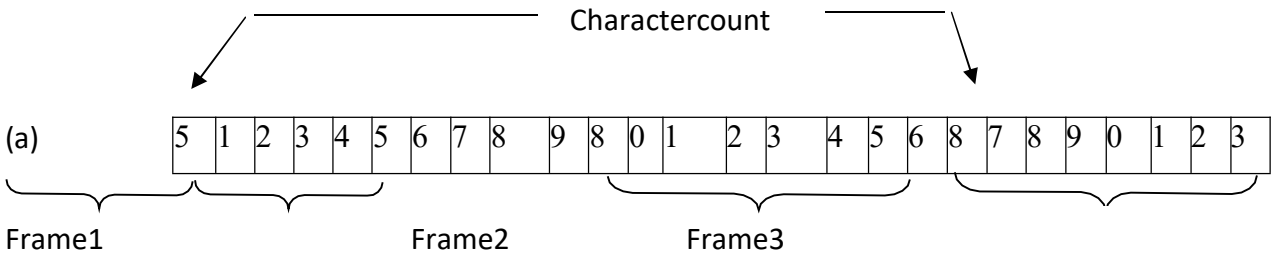
FRAMINGMETHODS

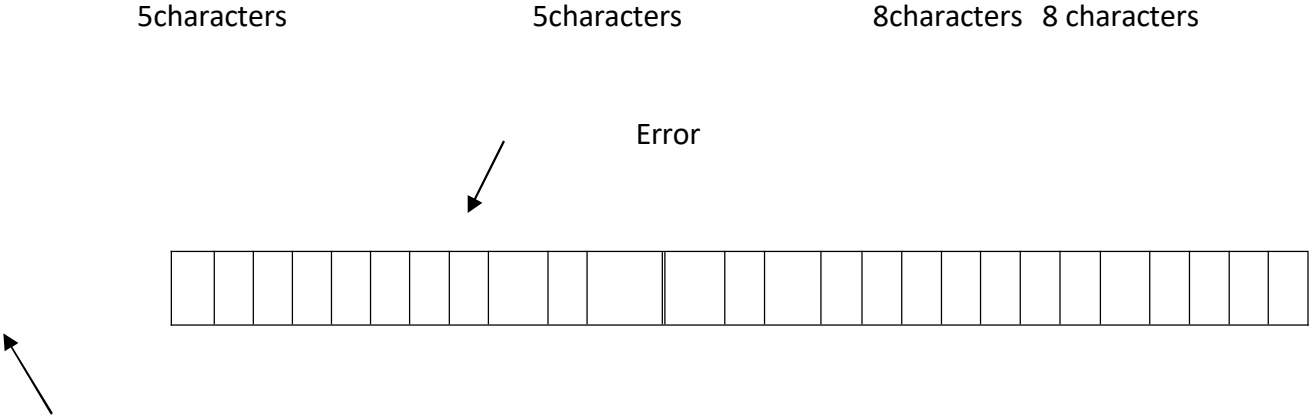
1. CHARATERCOUNTMETHOD
2. STARTINGANDENDINGCHARACTERS,WITHCHARATERSTUFFING
3. STARTING ANDENDINGFLAGS,WITHBIT STUFFING

CHARATER COUNT METHOD:

In this methoda field in the header will be used to specify the number ofCHARACTERS in the frame. When data link layer at the destination sees the character count, it knows how many characters follow and hence where the end of the frame is.

The trouble with this algorithm is that the count can be garbed by a transmission error resulting the destination will get out of synchronization and will be unable to locate the start of the next frame. There is no way of telling where the next frame starts. For this reason this method is rarely used.


Charactercount
(a)
5 1 2 3 4 5 6 7 8 9 8 0 1 2 3 4 5 6 8 7 8 9 0 1 2 3
Frame1
Frame2
Frame3



DisAdv:

1.24bitsareunnecessarilystuffed.

2. Transmissiondelay.

BITSTUFFINGMETHOD

In thismethod everyframe willstartwith a **flag01111110.**

In the data if there are **FIVE** consecutive ONE 's are there then aZERO willbe stuffed.

Ex. The given data is 011110000111111101010011111100111111101100

Thedatawillbesentas

01111110011110000111111**0**1101010011111**0**10011111**0**01100

Stuffedbits

Advantages:

1. Onlyonebitisstuffed.
2. Notransmissiondelay

ERROR–CORRECTINGANDDETECTINGCODES

Network designers have developed two basics strategies for dealing with errors. One way is to include enough redundant information along with each block of data sent, to enable the receiver to deduce what the transmitted data must have been .The other way is to include only enough redundancy to allow the receiver to deduce that an error occurred, but not which error, and have it request a retransmission. The former strategy uses **Error – correcting codes** and the latter uses **Error- detecting codes**.

TheError– correcting and Error-detecting methodsare

1. PARITY METHOD
2. LRCMETHOD(Longitudinalredundancycheck)
3. CRCMETHOD (Cyclic redundancy check)
4. HAMMINGCODE METHOD

PARITYMETHOD

- appendsaparity bitto the endofeachwordin the frame
- Even parityisusedfor asynchronous Transmission
- Oddparityis used forsynchronousTransmission

Ex1.

Charactercode	evenparity	oddparity
1	1	1
1	1	1
0	0	0
0	0	0
1	1	1
0	0	0
0	0	0
	1	0
0	0	0
0	0	0
1	1	1
1	1	1
0	0	0
0	0	0
0	0	0
	0	1

If one bit or any odd no bits is erroneously inverted during Transmission, theReceiverwill detect an error. How ever if two or even no of bits are inverted an undetected error occurs.

Ex3. The Transmitteddatais10011010.The receiveddatais 11011010.

Let both the transmitter and receiver are agreed on EVEN parity.Nowan error will bedetected,since theno ofonesreceived areODD

4. TheTransmitted datais 10011010.Thereceived datais01011010

.

Hamming codes provide another method for error correction. Error bits, called Hamming bits, are inserted into message bits at random locations. It is believed that therandomness of their locations reduces the odds that these Hamming bits themselves would be in error. This is based on a mathematical assumption that because there are so many more message bits compared with Hamming bits, there is a greater chance for a message bit to be in error than for a Hamming bit to be wrong. Determining theplacement and binary value of the Hamming bits can be implemented using hardware,but it is often more practical to implement them using software. The number of bits in a message (M) are counted and used to solve the following equation to determine the number of Hamming bits (H) to be used:

$2^H \geq M + H + 1$

Once the number of Hamming bitsis determined, the actual placement of the bitsinto the message is performed. It is important to note that despite the random nature of the Hamming bitplacements, the exact sample placements must be known and used by both the transmitter and receiver. Once the Hamming bits are inserted into their positions, the numerical values of the bit positions of the logic 1 bits in the original message are listed. The equivalent binary numbers of these values are added in the same manner as usedin previous error methods by discarding all carry results. The sum produced is used as the states of the Hamming bits in the message. The numerical difference between the Hamming values transmitted and that produced at the receiver indicates the bit position that contains a bad bit, which is then inverted to correct it.

Ex. The given data 10010001100101(14-bits)

Thenumberofhammingcodes $2^H \geq M + H + 1$

H=?M=14tosatisfythisequationHshouldbe5i.e.5hammingcode bits should be incorporated in the data bits.

10010001 10H0H1H0H1H

Now count the positions where binary 1's are present. Add using mod 2 operation (Ex-OR). The result will give the Hamming code at the transmitter end.

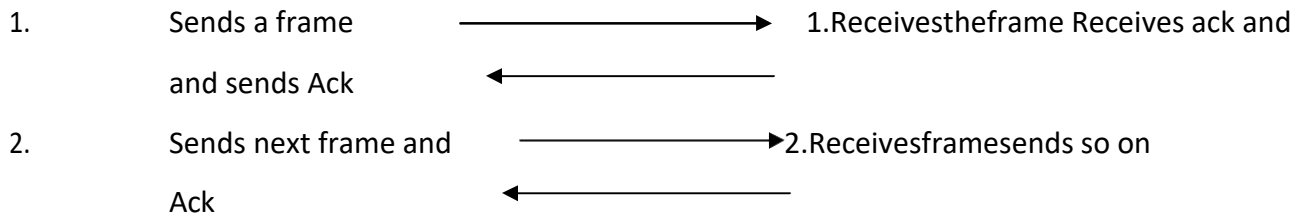
This Hamming code will be incorporated at the places of 'H' in the data bits and the data will be transmitted.

1. **Asimplex stopand waitprotocol:**

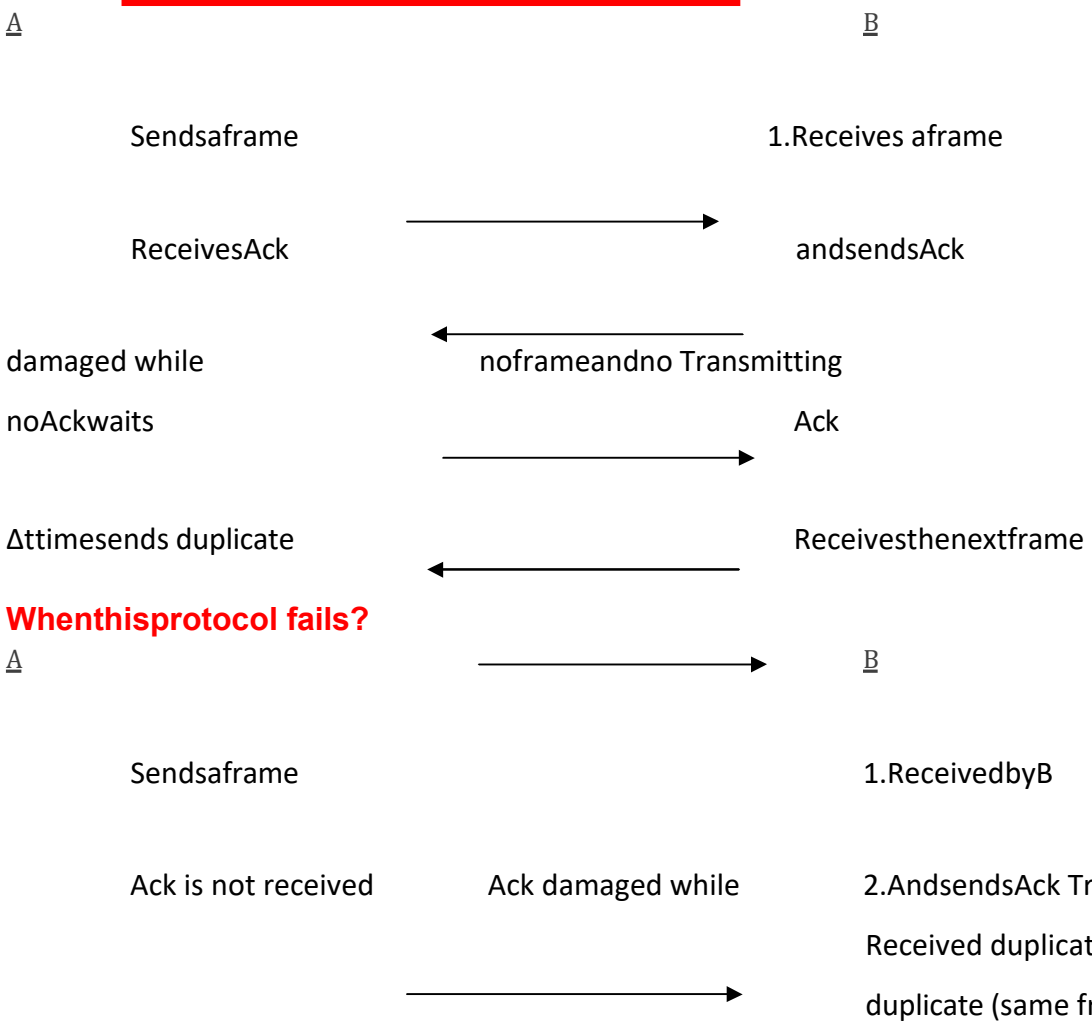
Thefollowingassumptionsaremade

a. Error freechannel.
b. Datatransmissionsimplex.

A B


1. Sends a frame
1.Receivestheframe Receives ack and
and sends Ack
2. Sends next frame and
2.Receivesframesends so on
Ack

3. A simplex protocol for a noisy channel



Whenthisprotocol fails?

At thissituationprotocol failsbecause thereceiverreceivesaduplicateframeand thereis no way to find out whether the receiver frame is original or duplicate. So the protocol fails at this situation.

Now what is needed is some way for the Rx to distinguish a frame and a duplicate. To achieve this, the sender has to put a sequence number in the header of each frame it sends. The Rxcan check the sequence number of each arriving frame to see if itis a new frame or a duplicate.

Here a question arises: What is the minimum number of bits needed for the sequence number?Theambiguityisbetweenaframeanditssuccessor.A 1-bit sequencenumber (0 or 1) is therefore sufficient. At eachinstant of time, the receiver excepts a particular sequence number next. Any arriving frame containing wrong sequence number is rejected as a duplicate. When a frame containing the correct sequence number arrives, it is accepted, passed to the network layer and then expected sequence number is incremented i.e. 0 becomes 1 and one becomes 0. Protocols in which a sender waits for a positive ack before advancing to the next data item are often called PAR (positive ack with retransmission) orARQ (automatic repeat request).

PIGGYBACKING

In most practical situationsthereisaneed of transmittingdatainboth directions.Thiscan be achieved by full duplex transmission. If this is done we have two separate physical circuits each with a 'forward ' and 'reverse' channel. In both cases, the reverse channel is almost wasted. To overcome this problem a technique called **piggy backing** is used.

The technique of temporarily delaying outgoing acknowledgements so that they can be hooked onto the next outgoing data frame is known as **piggy backing**.

However, piggybacking introduces a complication not present with separate acknowledgements. How long should the data link layer wait longer than the sender's timeout period, the frame will be retransmitted, defeating the whole purpose of having acknowledgements. Of course, the data link layer cannot foretell the future, so it must resort to some ad hoc scheme, such as waiting a fixed number of milli seconds. If a new packet arrives quickly, the acknowledgement is piggybacked ontoit; otherwise, if no new packet has arrived by the end of this time period, the data link layer just sends a separate acknowledgement frame.

SLIDINGWINDOWPROTOCOLS

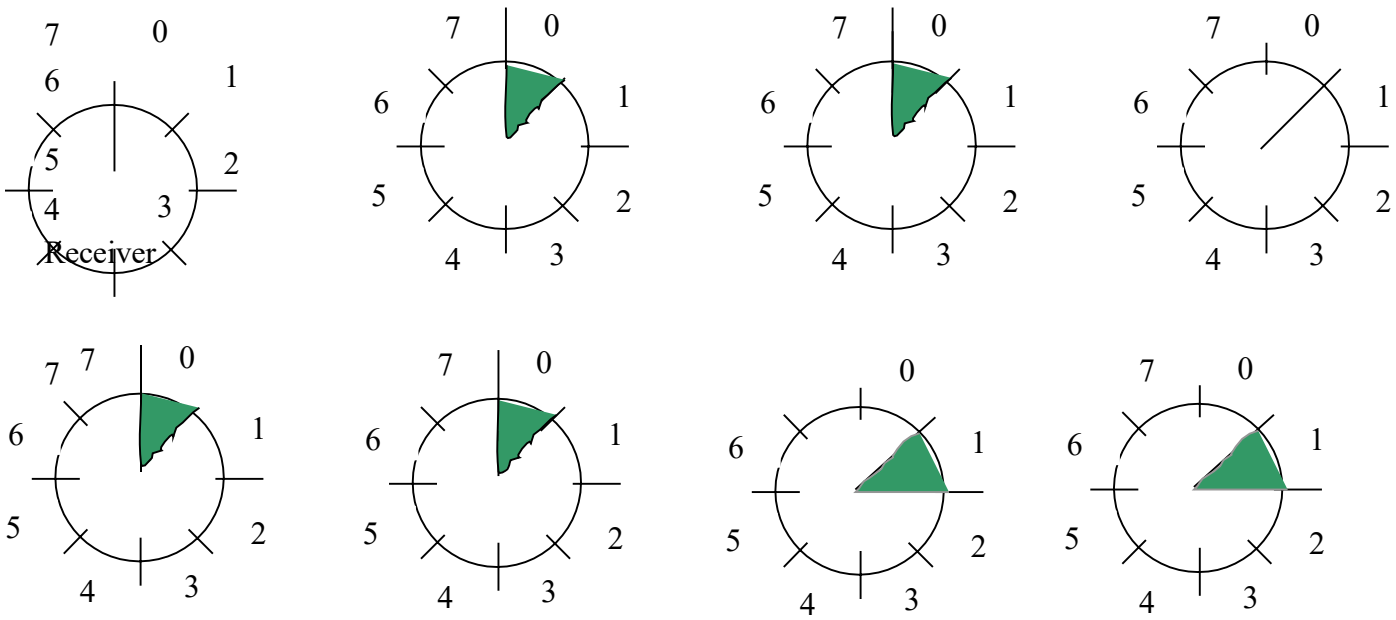
In all sliding window protocols, each outbound frame contains a sequence number, ranging from 0 up to some maximum. The maximum is usually$2^n–1$ so the sequence number fits nicely in an n-bit field. The stop-and-wait sliding window protocol uses n=1, restricting the sequence numbers to 0 and 1, but more sophisticated versions can use arbitrary n.

The essence of all sliding window protocols is that at any instant of time, the sender maintains a set of sequence numbers corresponding to frames it is permitted to send. These frames are said to fall with in the sending window. Similarly the receiver also maintains a receiving window corresponding to the set of frames it is permitted to accept. The sender's windowand the receiver's windowneed not have the same lower and upper limits, or even have the same size. In some protocols they are fixed in size, but in others they can grow or shrink as frames are sent and received.

The sequence numbers with in the sender's window represent frames sent but as yet not acknowledged.Whenever a newpacket arrives fromthe network layer,itis given the next

highest sequence number, and the upper edge of the window is advanced by one. When an acknowledgement comes in, the lower edge is advanced by one. In this way the continuously maintains a list of unacknowledged frames.

Sender



(a) (b) (c) (d)

(a) Initially (b) After the first frame has been sent c)Afterthefirstframehasbeen received. d) After the first acknowledgement has been received.

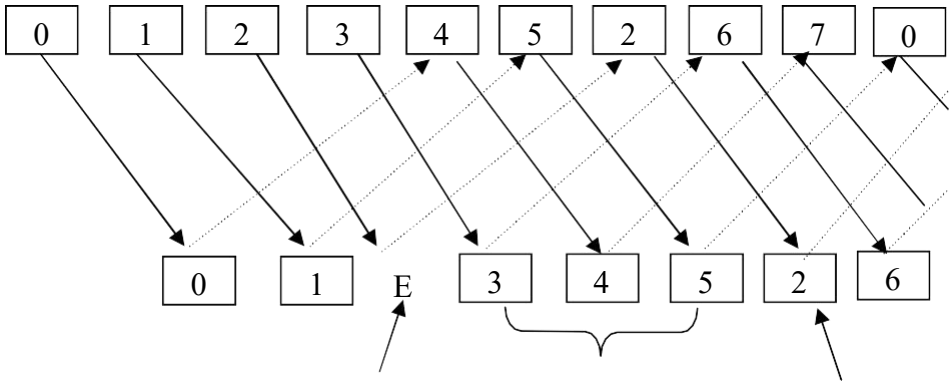
There are two basic approaches to dealing with errors.

1. GoBack'n'
2. SelectiverepeatorSelectiveReject

One way called in **go back n**, the receiver simply to discard all subsequent frames, sending no acknowledgements for the discard frames. In the other words, the data link layer refuses to accept any frame except the next one it must give to the network layer.

Selective Repeat:

Thereceivingdatalinklayer store all the correct framesfollowing thebad frame, not allits successors. If the second try succeeds the receiving data link layer will now have many correct framesinsequence, sotheycanall behanded off to thenetworklayer quicklyand the highestnumber acknowledged.This strategy corresponds to a receiver windowlarger than 1.



or Bufferedby receiver Frames2-5 released

MEDIUM ACCESS CONTROL SUBLAYER(MAC)

Network scan be categories in to two ways

a)Pointto pointb) Broadcastchannel

-Inbroadcastnetwork,thekeyissueishowtosharethechannelamong several users.

-Ex *aconferencecallwithfive people*

-Broadcastchannelsarealsocalledasmulti-accesschannelsorrandomaccess channels.

-Multi-accesschannelbelongtoasublayerattheDLlayercalledtheMAC sublayer.

The Channel Allocation problem:

a) **Staticchannelallocation** inLANs&MANs

i) **FDM** ii)**TDM**

Drawbacks: -1)Channeliswastedif oneormore stationsdonot senddata.

2)Ifusersincreases this willnotsupport.

b) *Dynamicchannelallocation*

i) Pure**ALOHA**&Slotted**ALOHA**

CSMA/CD

ii) CSMA

CSMA/CA

PureALOHA

-1970's Norman Abramson end his colleagues devised this method, used ground –based radio broad costing. This is called the **ALOHA** system.

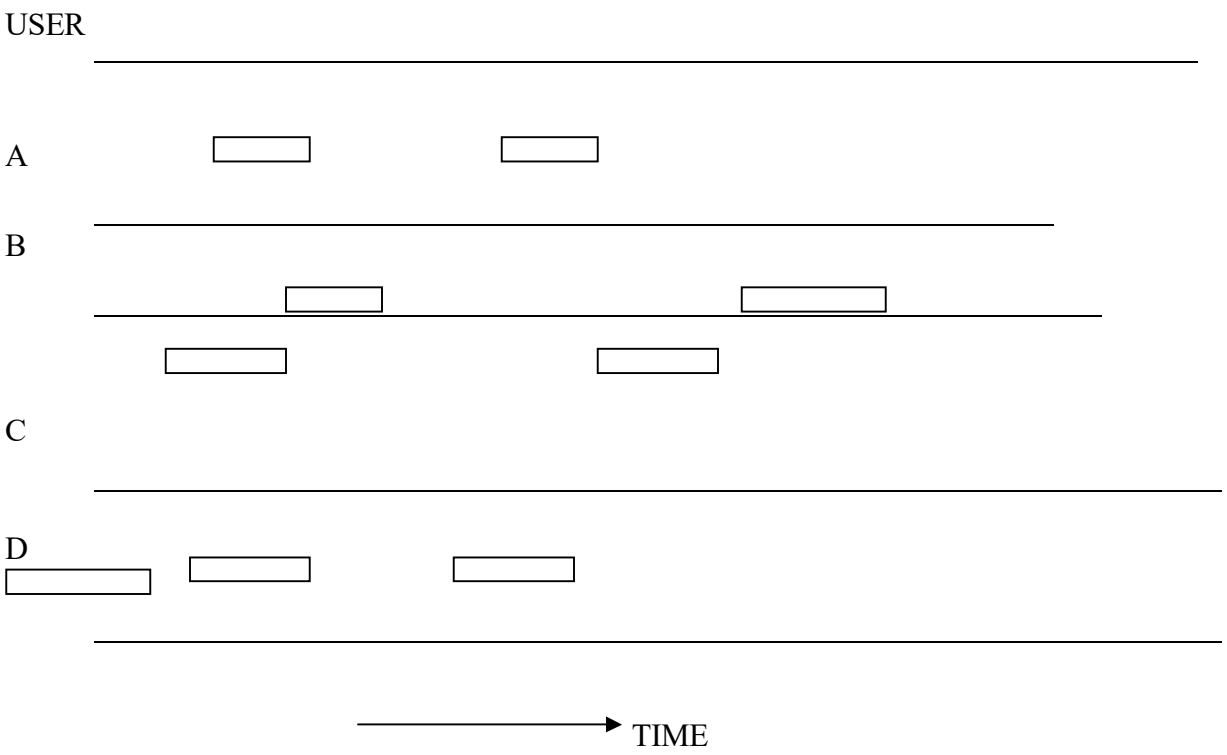
-Thereare two versions ofALOHA: **Pureand Slotted**.

-Pure ALOHA does not require global time synchronization, where as in slotted ALOHAthe time is divided into discrete slots into which all frames must fit.

-Senders willknow through feedback property whetherthe frame is destroyed or not bylistening channel.

-Iftheframewasdestroyed,thesenderwaitsrandom amountoftimeandagainsends the frame.

-Thewaitingtimemustberandomotherwisethesameframewillcollideoverand over.



Framesaretransmittedat completelyarbitrarytimes
-Whenevertwoframestryto occupythe channel at thesametime, therewill bea collision and both will be destroyed.
-Wehavetofind outwhatis theefficiencyofan ALOHAchannel?
-Letusconsideraninfinitecollectionofinteractiveuserssittingattheirsystems(stations).
-Auserwillalways in two states**typingor waiting**.
-Letthe'Frametime' denotesthetimerequiredtotransmit onefixedlengthframe.
-Assumethatinfinitepopulationsofusersaregeneratingnewframesaccordingto possion distribution with mean N frames per frame time.
-If N>1usersaregeneratingframesat ahigherratethanthechannelcan handle.
-Forreasonable throughput 0<N<1.
-Inaddition tonewframes, the stationalso generatesretransmission of frames.
-Old andnewframes are Gperframe time.
-G≥N
-Atlowloadtherewillbefewcollisions, soG~N
-Under all loads, the throughput S = GP_o,where $P_o$is the probability that a frame does not suffer a collision.
-Aframewillnotsufferacollisionifnootherframesaresentwithoneframetimeofits start.
-Let't' bethetime required to senda frame.
-If any other user has generated a frame between time $t_o$and t_o+t, the end of that framewill collide with the beginning of the shaded frame.
-Similarly, any other frame started b/w t_o+t and t_o+2t will bump into the end of the shaded frame.
-Theprobabilitythat'k'framesaregeneratedduringagivenframetimeisgivenbythe possion distribution:

$$P_r[k] = \frac{G^k e^{-G}}{k!}$$

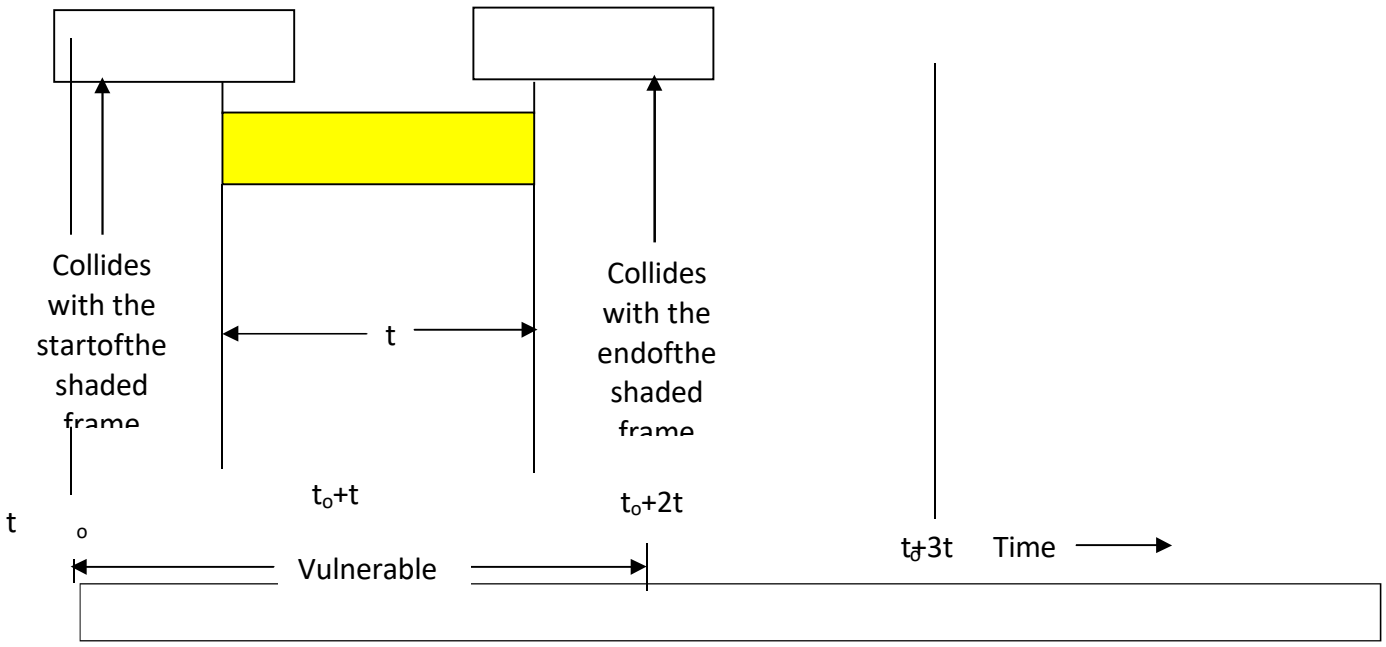
-Theprobabilityofzeroframes is juste^{-G}
-Inanintervaltwoframetimeslong, themeannumberatframesgeneratedis2G.
-Theprobabilityatnoothertrafficbeinginitiatedduringtheentirevulnerableperiodis given by

$$P_o = e^{-2G}$$

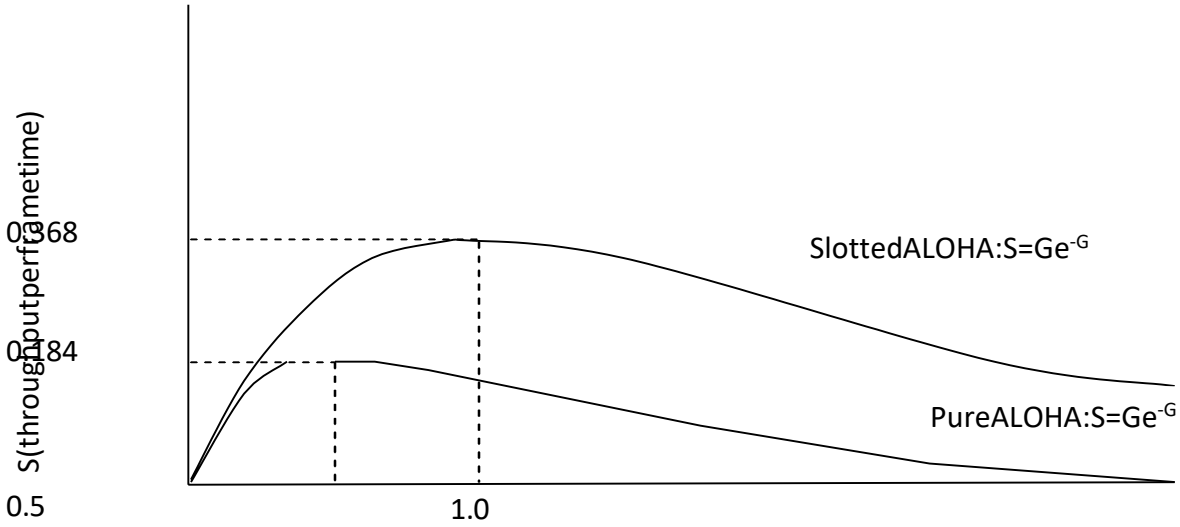
$$S = Ge^{-2G} \qquad [S = GP_o]$$

TheMaximumthroughputoccursatG=0.5withS=1/2e = 0.184

ThechannelutilizationatpureALOHA =18%.



Vulnerableperiodforthe shadedframe



ThroughputversusofferedtrafficforALOHAsystems *Slotted ALOHA*

-In1972, Roberts'devisedamethodfordoubling thecapacityofALOHAsystem.

-Inthis system thetimeis divided intodiscrete intervals, eachintervalcorrespondingto one frame.

-One way to achieve synchronization would be to have one special station emit a pip at the start of each interval, like a clock.

-In Roberts' method, which has come to be known as slotted ALOHA, in contrast to Abramson'spureALOHA;acomputer isnot permitted to send wheneveracarriagereturn is typed.

-Instead,itis requiredto waitforthebeginningofthenextslot.
-Thusthecontinuous pureALOHAis turnedinto adiscrete one.
-Since the vulnerable period is now halved, the of no other traffic during the same slot as our test frame is e^{-G} which leads to

$S=Ge^{-G}$

- At G=1, slottedALOHAwillhavemaximumthroughput.
- SoS=1/eorabout0.368, twicethatofpureALOHA.
- Thechannelutilizationis37%inslotted ALOHA.

Carrier Sense Multiple Access Protocols

Protocols in which stations listen for a carrier (transmission) and act accordingly arecalled carries sense protocols.

PersistentCSMA

When a station has data to send, it first listens to the channel to see if any one else is transmitting at that moment. If the channel is busy, the station waits until it become idle. When the station detects an idle channel, it transmits a frame. If a collision occurs, the station waits a random amount of time and starts all over again. The protocol is called 1- persistent also because the station transmits with a probability of 1 when it finds the channel idle.

The propagation delay has an important effect on the performance of the protocol. The longer the propagation delay the worse the performance of the protocol.

Even if the propagation delay is zero, there will be collisions. If two stations listen the channel, that is idle at the same, both will send frame and there will be collision.

NonpersistentCSMA

In this, before sending, a station sense the channel. If no one else is sending, the station begins doing so it self. However, if the channel is busy, the station does not continually sense it but it waits a random amount of time and repeats the process.

Thisalgorithmsleadstobetterchannelutilizationbutlongerdelaysthen 1-persistent CSMA.

With persistent CSMA, what happens if two stations become active when a third station is busy? Both wait for the active station to finish, then simultaneously launch a packet, resulting a collision. There are two ways to handle this problem.

a)P-persistentCSMAb)exponentialbackoff.

P-persistentCSMA

The first technique is for a waiting station not to launch a packet immediately when the channel becomes idle, but first toss a coin, and send a packet only if the coin comes up heads. If the coin comes up tails, the station waits for some time (one slot for slotted CSMA), then repeats the process. The idea is that if two stations are both waiting for the medium, this reduces the chance of a collision from 100% to 25%. A simplegeneralization of the scheme is to use a biased coin, so that the probability of sending a packet when the medium becomes idle is not 0.5, but p, where $0< p < 1$. We call such a scheme **P-persistent CSMA**. The original scheme, where p=1, is thus called 1-persitent CSMA.

UNIT – III NETWORKLAYER

Functions of NetWork layer

1.Routing2.CongestionControl

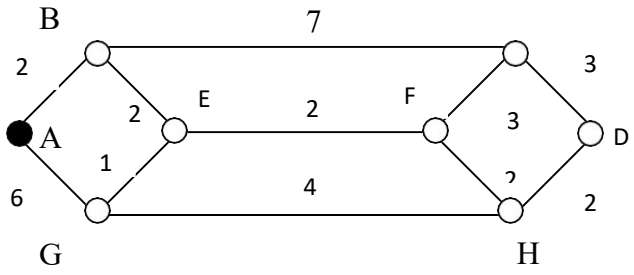
Routing algorithms

The main function of the network layer is routing packets from the source machine to the destination machine. Routing algorithm can be grouped into two major classes. Nonadaptive and Adaptive algorithms.

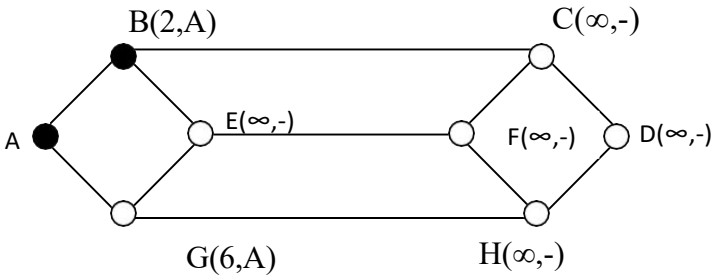
	Nonadaptive	**Adaptive**
1)	Routing decisions are not based on measurements or estimates of the current traffic and topology.	Routing decisions are based on measurements of the current traffic and topology.
2)	The route is computed well in advan	Therouteiscomputeddependson situation.
3)	Whenthenetworkisbootedthe downloaded.	Theroutersarenotdownloaded. routers are
4)	This isastaticrouting.	This is a dynamic routing.

ShortestPath Routing:

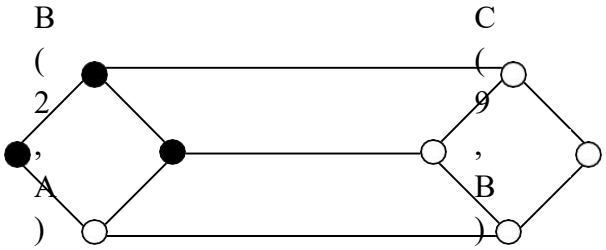
This is a static routing algorithm. The idea is to build a graph of the subnet, with each node of the graph representing a router and each arc of the graph representing a communication line. To choose a route between a given pairof routers, the algorithmjust finds the shortest path between them on the graph.

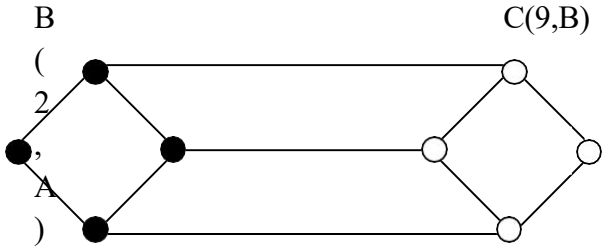


(a)



(b)





A

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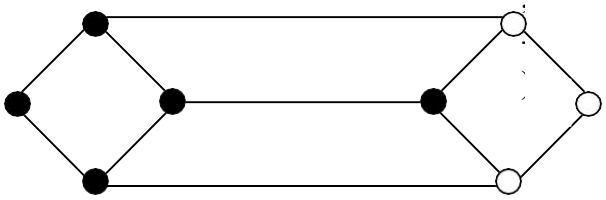

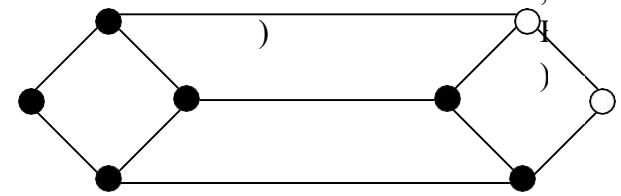

d)

A
)

C(9,B)

A

F
(
6
,
E
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E
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4
,
B
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G
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5,
E
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D
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A

F
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6,
E
)

H
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8,
F
)

One-way ofmeasuring path length is the number ofhops. Using this metric, the paths ABC and ABE are equally long. (Two hops).

AnothermetricistheGeographicdistanceinKilometers.ABCisclearlylongerthan ABE.

Many other metrics are also possible besides hops and physical distance. Each are could be labeled with the mean queuing and transmission delay for some standard test packets as determined by hourly test runs. With this graph labeling, the shortest path is the fastest path,rather than the path with the fewest arc or kilometers.

In most general case, the labels on the arcs could be computed as a function of the distance, bandwidth, average traffic, communication cost, mean queue length, measured delay and other factors.

The shortest path can be calculated using Dijkstra method. Each node is labeled with its distance from thesource along the best known path. Initially, nopaths are known,so all nodes are labeled with infinity. As the algorithm proceeds and paths are found, the labels may change, reflecting better paths. Initially all labels are tentative. When it is discovered that a labelrepresents the shortest path from the source to that node, it is made permanent and never changed thereafter.

In the above diagram,let the weightsrepresents the distance. Tofind out the shortest path from A to D. We start by marking A as permanent. The examine each one with the distance to A, relabeling each one with the distance to A. Whenever a node is relabeling also label it with the node from which the probe was made. After examingeach ofthe nodes adjacent toA, examineall the tentatively labeled nodes in the whole graph and make the one with the smallest label permanent. This one becomes the new working node.

Thesameprocedureisadoptedtoallthenodesandtheshortestpathisfound.

Flooding:

This is a static algorithm. In this, every incoming packet is sent out on every outgoing line except the one it arrived on. Flooding will generate vast numbers of duplicate packets, some measures have to take to dump the duplicate packets. One such measure is to have a hop countercontained in the header of each packet, which is decremented at each hop, with the packet being discarded when the counter reaches zero. The hop counter should be initialized to the length of the path from source to destination. If the sender does not know how long the path is it can initialize the counter to full diameter of the subnet.

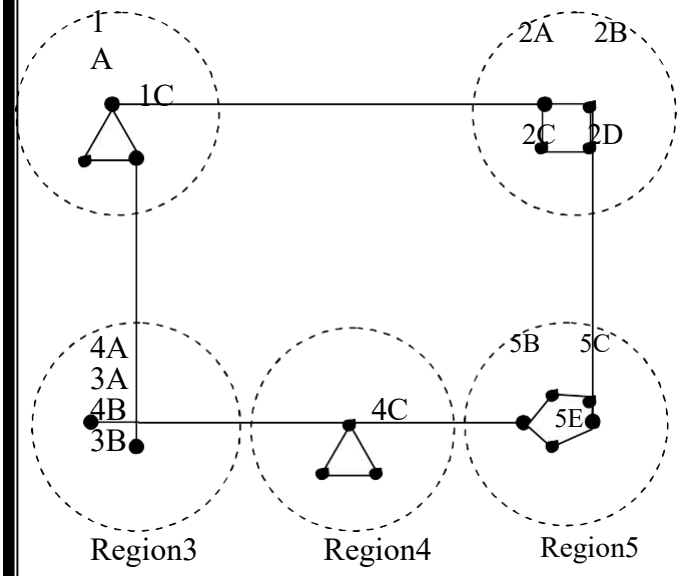
A variation of flooding is ‘Selective Flooding’. In this the routers do not send everyincoming packet on every line, instead only on those lines that are going approximately in theright direction which leads to the destination.

HierarchicalRouting:

As network grow in size, the router routing tables grow proportionally. Not only more memory consumed by ever increasing tables, but more CPU time is needed to scan them more bandwidth is needed to send status reports about them

Consider a two level hierarchy with five regions as shown in fig. one router needs 17 entries for one table. The network contains 17 routers. So the total no. of entries will be 17 x 17. This is for when we are not using hierarchy.

For Ex. The router 1A consists of entries as shown infig.(c). Hierarchical routing has reduced the table from 17 to 7 entries.



(a)

Full table for 1A

Dest.	Line	Hops
1A	-	-
1B	1B	1
1C	1C	1
2A	1B	2
2B	1B	3
2C	1B	3
3A	1C	4
3B	1C	3
3C	1C	2
4A	1C	3
4B	1C	4
4C	1C	4
5A	1C	4
5B	1C	5
5C	1B	5
5D	1C	6
5E	1C	5

(b)

Hierarchical table for 1A

Dest.	Line	Hops
1A	-	-
1B	1B	1
1C	1C	1
2	1B	2
3	1C	2
4	1C	3
5	1C	4

(c)

GeneralPrinciplesOfCongestionControl:

Thecongestion controlcanbedonebytwo methods

Open loop Closedloop

Open loop: These solutions attempt to solve the problem by good design, to make sure that it does not occur in the first place. Once the system is up and running, midcourse corrections arenot made.

Tools for doing open-loop control include deciding when to accept new traffic, deciding when to discard packets and which ones, and making scheduling decisions at various points inthe network.

In contrast,closed loop solutions arebased on theconcept of afeedback loop.Thisapproach has three parts when applied to congestion control:

1. Monitorthe systemtodetectwhenandwherecongestion occurs.
2. Passthisinformation to placeswhereaction canbe taken.
3. Adjustsystemoperation tocorrectthe problem.

CongestionPreventionPolicy:

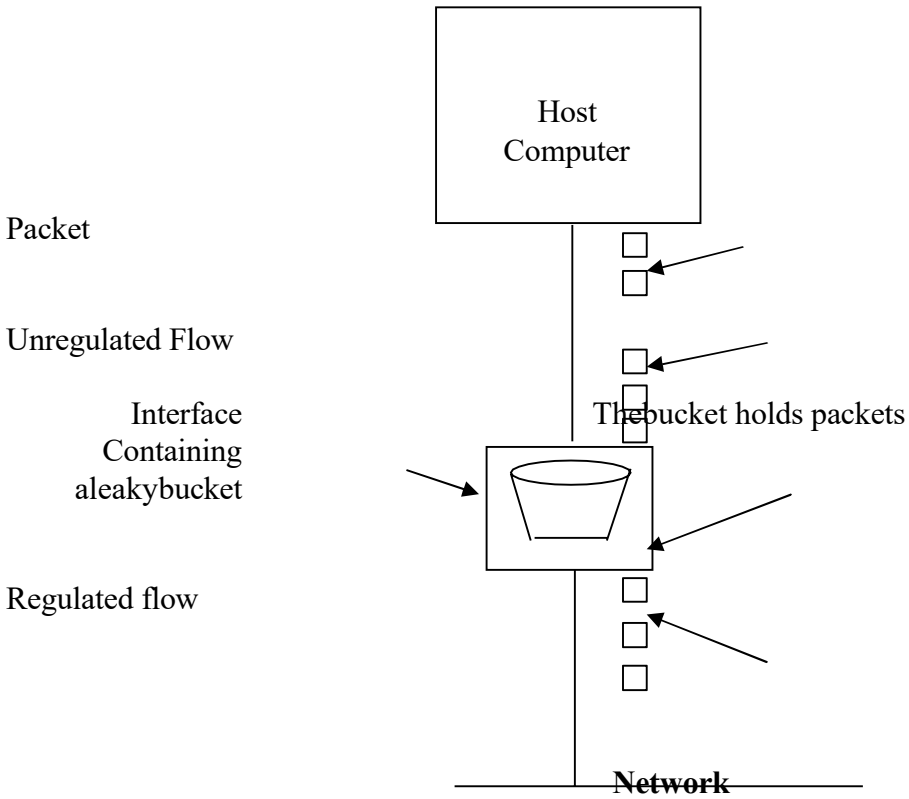
TrafficShaping:

One of the main causes of congestion is that traffic is often bursty. If hosts could be made to transmit at a uniform rate, congestion would be less common. Another open loop method to help manage congestion is forcing the packets to be transmitted at a more predictable rate. This approachtocongestionmanagement is widely usedin ATM networks andis calledtraffic shaping.

Monitoring a traffic flow is called traffic policing. Agreeing to a traffic shape and policing it afterward are easier with virtual circuit subnet than with datagram subnets.

LeakyBucketAlgorithm

Imagine a bucket with a small hole in the bottom. No matter at what rate water enters the bucket, the outflow is at a constant rate, , when there is any water in the bucket, and zero when the bucket is empty. Also, once the bucket is full, any additional water entering it spills over the sides and is lost.



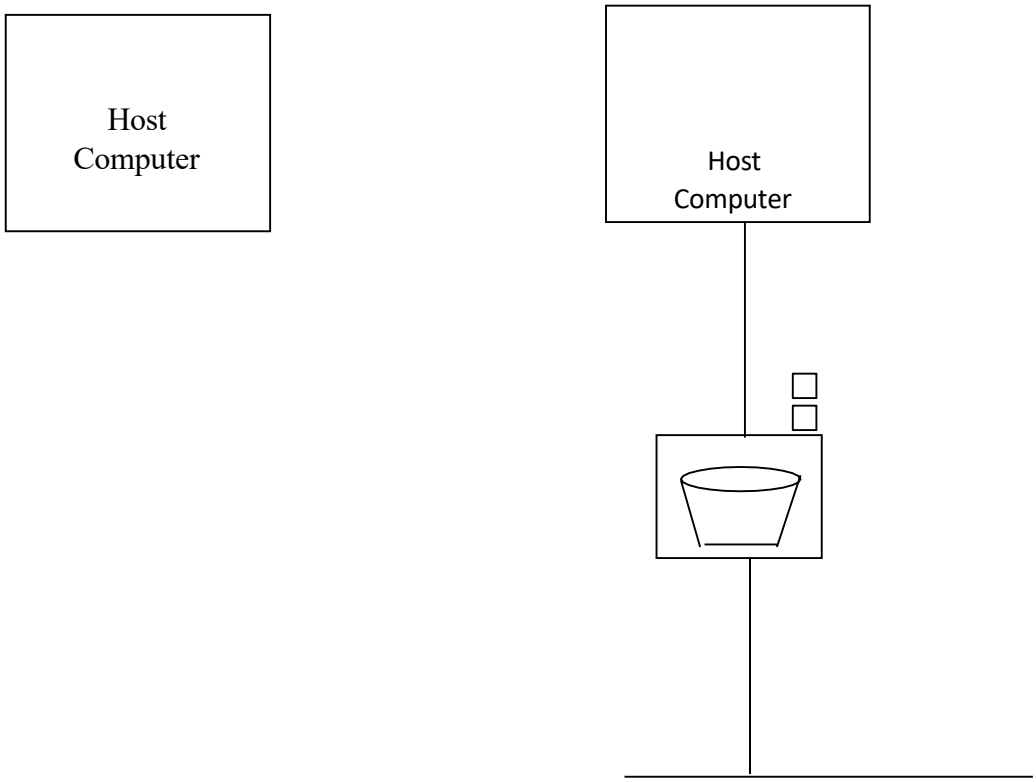
The same idea can be applied to packets, as shown in fig. Conceptually, each host is connectedto the network by an interface containing a leakybucket, that is, a finite internal queue. If a packet arrives at the queue when it is full, the packet is discarded. In other words, if one or more processes within the host try to send a packet when the maximum numbers are already queued, the new packet is unceremoniously discarded. This arrangement can be built into the hardware interface or simulated by the host operating system.

The host is allowed to put one packet per clock tick onto the network. Again, this can be enforced by the interfacecard orby the operating system.Thismechanismturns an unevenflowof packets from the user processes inside the host into an even flow of packets onto the network, smoothing out bursts and greatly reducing the chances of congestion.

Implementing the original leaky bucket algorithm is easy. The leaky bucket consists of a finite queue. When a packet arrives, if there is room on the queue it is appended to the queue; otherwise, it is discarded. At every clock tick, one packet is transmitted (unless the queue is empty).

TheTokenBucketAlgorithm:

The leaky bucket algorithm enforces a rigid output pattern at the average rate, no matter how bursty the traffic is. For many applications, it is better to allow the output to speed up somewhat when large bursts arrive, so a more flexible algorithm is needed, preferably one that never loses data. One such algorithm is the **token bucket algorithm**.

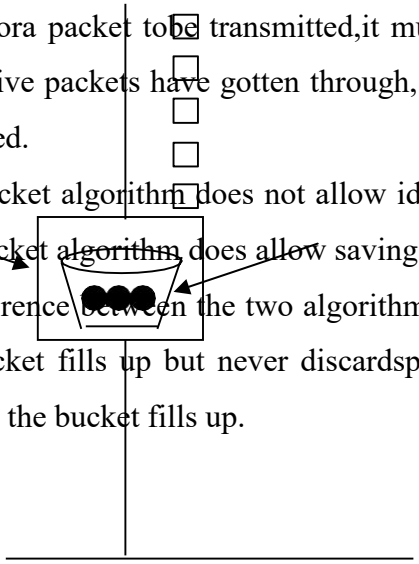


One token is added to the bucket every T

Thebucket holds tokens

Networks (a) **Networks** (b)

Inthisalgorithm,theleakybucket holdstokens,generated byaclockattherateofonetokenever T sec. In figure (a), we see a bucket holding three tokens, with five packets waiting to be transmitted.Fora packet tobe transmitted,it mustcaptureand destroyone token. Infigure(b), we see that three of the five packets have gotten through, but the other two are stuck waiting for two more tokens to be generated.



The leaky bucket algorithm does not allow idle hosts to save up permission to send large bursts later. The token bucket algorithm does allow saving, up to the maximum size of the bucket, n.

Another difference between the two algorithms is that the token bucket algorithm throws away tokens when the bucket fills up but never discardspackets. In contrast, the leaky bucket algorithm discards packets when the bucket fills up.

At the network layer, TCP/IP supports the internetwork protocol .IP, in turn, contains four supporting protocols:ARP ,RARP ,ICMP,and IGMP.

IP is the transmission mechanism used by the TCP/IP protocols. It is an un –reliable and connectionlessdatagram protocol —a best effort delivery service. This is like a post office service. The post office does its best to deliver the mail but does not always succeed. If an unregistered letter is lost. it is up to the sender or would recipient to discover the loss and rectify the problem. The post office itself does not keep track of every letter and cannot notify a sender of loss or damage. An example ofa situation similar to pairing IP with a protocol that contains reliability functionsisa self addressed ,stamped postcardincluded ina lettermailed through thepost office. when the letter is delivered , the receiver mails the postcard back to the sender to indicate success. If the sender never receives the postcard, he or she assumes the letterwas lost and sends out another copy.

IP transports data in packets called Datagrams,each of which is transported separately. Datagrams may travel along different routes and may arrive out of sequence or duplicated. IPdoes not create virtual circuits for delivery.

Datagram

Packets in IP layer are called Datagrams. A Datagram is a variable length packet(upto 65,536 bytes) consisting of two parts : Header and Data. The header can be from 20 to 60 bytes and contains information essential to routing and delivery.

VersionThe first field defines the version number of the IP. The current version is 4(IPv4),with binary value 0100.

Header length (HLEN) The HLEN field defines the length of the header in multiples of four bytes .The four bits can represent a number between 0 to 15,which,when multiplied by 4,gives a maximum of 60 bytes.

Service Type.The service type field defineshow datagram should be handled. It includes bits that define the priority of the datagram. It also contains bits that specify the type of service the sender desires such as the level of throughput, reliability, and delay.

Total Length Thetotal length field defines the total length ofthe IP datagram. It is a two-byte field (16 bits) and can define up to 65,535 bytes.

Identification The identification field is used infragmentation. A datagram, when passing through different networks, may be divided into fragments to match the network frame size. When this happens, each fragment is identified with a sequence number in this field.

Flags The bits in the flags field deal with fragmentation (the datagram can or can not be fragmented; can be first, middle, or last fragment; etc.).

Fragmentation offset The fragmentation offset is a pointer that shows the offset of the data in the original datagram (if it is fragmented).

Time to live The time to live field defines the number of hops a datagram can travel before it is discarded. The source host, when it creates the datagram, sets this field to an initial value. Then, as the datagram travels through the Internet, router by router, each router decrements this value by 1. If this value becomes 0 before the datagram reaches its final destination, the datagram is discarded. This prevents a datagram from going back and forth forever between routers.

ProtocolTheprotocolfield defines which upper-layerprotocoldata are encapsulated indatagram (TCP, UDP, ICMP etc.).

Header Checksum This is a 16-bit field used to check the integrity of the header, not the rest of the packet.

Source address The source address field is a four-byte (32-bit) Internet address. It identifies the original source of the datagram.

DestinationaddressThedestinationaddressfieldisafour-byte(32-bit)Internetaddress.It identifies the final destination of the datagram.

OptionsTheoptionsfieldgivesmorefunctionalitytoIPdatagram.Itcancarryfieldsthatcontrol routing,timing,management,andalignment.

ADDRESSING

In addition to the physical addressthe internet requires an additional addressing convention : an address thatidentifies the connection of a host to its network.

EachInternetaddressconsistsof4bytesdefiningthreefields:classtype,netid,andhosted.

These partsarevarying lengthsdependingon theclassofthe address.

CLASSES

Therearecurrentlyfivedifferent classes:

They are ClassA, Class B**,**ClassC,ClassD,ClassE Class A:

Thiscanaccommodatemorehostssince3bytesarereservedforHOSTID.ClassAwillbegin with 0 .

ClassB:
Thiswillstartwith**10**andHost id willhave2bytes length. ClassC :

Thiswillstartwith110**and**Hostidwillhave1byte length. ClassD:

Thiswillstartwith**1110.**ThisisreservedfOr**Multicastaddresses.**

ClassE:
Thisisreservedforfeatureuseandwillstartwith**1111.**

Ex. forclasses

1. 01111011100011111111110011001111

Theaddressisstartingwith0.HenceitisClass A.

2. 10011101100011111111111100110011111

Theaddressisstartingwith10.HenceitisClassB.

3. 1101110110001111 1111110011001111

Theaddressisstarting with110.Hence itisClass C

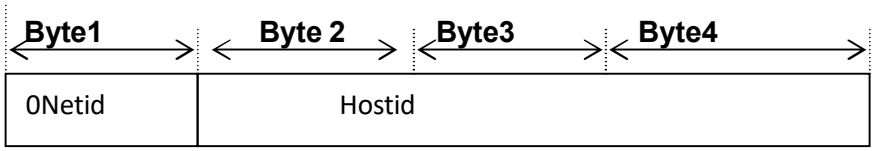
4. 11101011100011111111100 11001111

Theaddressisstartingwith1110.HenceitisClassD.

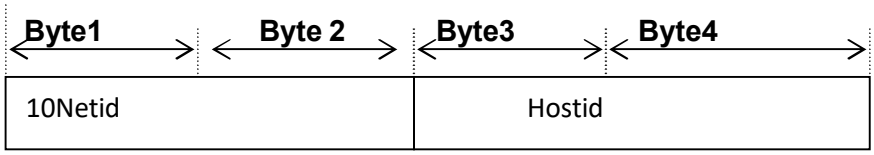
5. 11110101100011111111110011001111

Theaddressisstartingwith1111.HenceitisClass**E.**

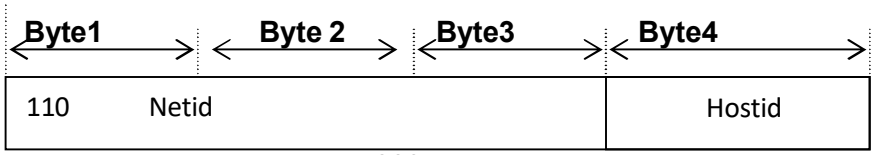
CLASS A:



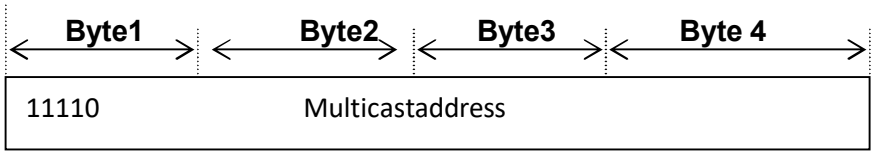
CLASSB:



ClassC:



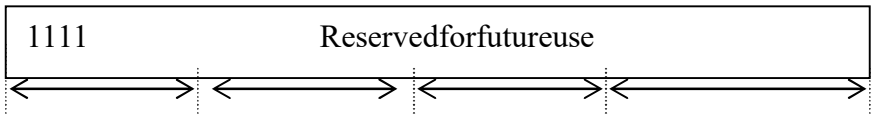
ClassD: **000**



ClassE:

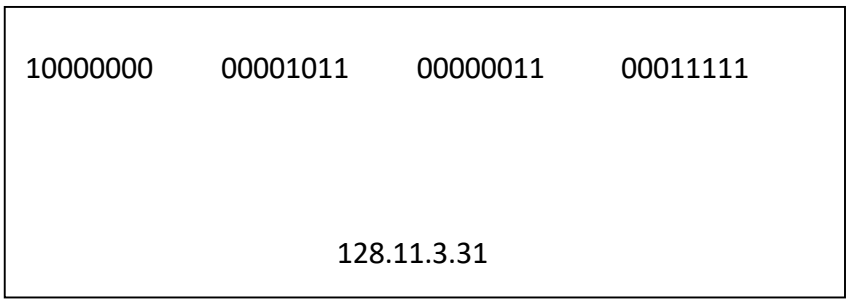
000

Byte1 Byte2 Byte3 Byte4



Dotted-DecimalNotation:

Tomake32bitformshorterandeasiertoread,Internetaddressesareusuallywrittenindecimal formwithdecimalpointsseparatingthebytes—dotted—decimalnotation.



IPaddressesindecimalnotation Classranges of Internet address

	From	To	
ClassA	0.0.0.0	127.255.255.2555	←
ClassB	128.0.0.0	191.255.255.255	←
ClassC	192.0.0.0	223.255.255.255	←
ClassD	224.0.0.0	239.255.255.255	←
ClassE	240.0.0.0	255.255.255.2555	←

Example:

Findtheclass ofeach address

a. 4.23.145.90
b. 227.34.78.7
c. 246.7.3.8
d. 129.6.8.4
e. 198.76.9.23

Thefirstbytedefinestheclass.

a. Thebinary equivalentfor 4is 0000 0100.Since thefirstbitis0,itisCLASS A.
b. Thebinaryequivalentfor227is11100011.Sinceit isstartingwith111,itisCLASSD.
c. Thebinaryequivalentfor246is11110110.Sinceit isstartingwith111,itisCLASSE.
d. The binary equivalentfor 129 is10000001. Since it is starting with10,it is CLASS B.
e. Thebinaryequivalentfor198 is11000110.Since itisstarting with110 ,itisCLASSC.

Example:

Findthenetidandhostedforeachaddress:

a. 4.23.145.90
b. 227.34.78.7
c. 246.7.3.8
d. 129.6.8.4
e. 198.76.9.23

Firstfindtheclassandthen netidandhosted.

a. ClassA, netid :4, hosted : 23.145.90

b. Class D,nonetidorhosted;

c. ClassE ,no netid,orhosted;

d. ClassB,netid:129.6,hosted :8.4;

e. ClassCnetid:198.76.9hostid23 ;

TCP/IP supportsfourotherprotocolsinthenetworklayer:**ARP,RARP,ICMP,andIGMP.**

Addressresolutionprotocol(ARP)

The address resolution Protocol associates an ip address with physical address. On a typical physical network, such as a LAN, each device on a link is identified by a physical or station address usually imprinted on the network interface card.(NIC)

Physical address have local jurisdiction and can be changed easily. For example, if the NIC on a particular machinefails, the physical address changes. The IP address,on the other hand ,have universaljurisdictionand cannot be changed. ARP is used to find the physical address of the node when its Internet address is known.

Anytime a host or a router needs to find the physical address of another host on its network, it formats an ARP query packet that includes the IP address and broadcast it over the network. Every host on the network receives and processes the ARP packet, but only theintended recipient recognizes its internet address and sends back its physical address. The host both to its cache memory and to the datagram header, then sends the datagram on its way.

ReverseAddressresolutionprotocol(RARP)

The RARP allows a host to discover its internet address when it knows only its physical address. The question here is ,why do we need RARP? A host is supposed to have its internet address stored on its hard disk !

RARP works much like ARP. The host wishing to retrieve its internet address broadcasts anRARP query packet that contains its physical address to every host on its physical network. A server on the network recognizes the RARP packet and returns the host's internet address.

InternetControlMessageProtocol(ICMP)

The Internetcontrolmessageprotocolisamechanismusedbyhostsandrouterstosend notification of datagram problems back to the sender.

IP is an unreliable and connectionless protocol. ICMP allows IP to inform a sender if a datagram is undeliverable. A datagram travels from router to router until it reaches one that candeliver it toits final destination.Ifarouter is unabletorouteor deliver thedatagram becauseof unusual conditions or due to congestion, ICMP allows it to inform the original source.

ICMP uses echo test/reply to test whether a destination is reachable and responding. It also handles both control and error message, but its sole function is ti\o report problems, not correction them. A datagram carries only source and destination address. For this reason ICMP can send message only

to the source, not to an intermediate router.

InternetGroupMessageProtocol(IGMP)

Ip addressing supports multicasting. All 32-bit IP addresses that start with 1110(class D) are multicast addresses. With 28 bits remaining for the group address, more than 250 million addresses are available for assignment. Some of these addresses are permanently assigned.

The IGMP has been designed to help a multicast router identify the hosts in a lan that are members of a multicast group. It is a companion to the IP protocol

UNIT – IV TRANSPORTLAYER

Introduction

The transport layer is the core of the OSI model. Protocols at this layer oversee the delivery of data from an application program on one device to an application program on another device. They act as a liaison between the upper-layer protocols (session, presentation, and application) and the services provided by the lower layers.

Dutiesofthe transport layer:

QualityofService

Thetransportprotocolimprovesthe QoS (Qualityof Service)providedbythenetworklayer. Following are the QoS parameters:

Connectionestablishmentdelay:

The connection establishment delay is the amount of time elapsing between a transport connection being requested and the confirmation being received by the user of the transport service. It includes the processing delay in the remote transport entity. As with all parameters measuring a delay, the shorter the delay, the better the service.

Connectionestablishmentfailureprobability:

The connection establishment failure probability is the chance of a connection not being established within the maximum establishment delay time, for example, due to network congestion, lack of table space somewhere, or other internal problems.

Throughput:

The throughput parameter measures the number of bytes of user data transferred per second, measured over some time interval. The throughput is measured separately for each direction.

Transitdelay:

The transit delay measures the time between a message being sent by the transport user on the source machine and its being received by the transport user on the destination machine. As with throughput, each direction is handled separately.

TheResidualerrorratio:

Measures the number of lost or garbled messages as a fraction of the total sent. In theory, the residual error rate should be zero,since it is the job of the transport layer to hide allnetwork layer errors. In practice it may have some (small) finite value.

The Protection parameter provides a way for the transport user to specify interest in having the transport layer provide protection against unauthorized third parties (wiretappers) reading or modifying the transmitted data.

ThePriorityparameterprovidesawayforatransportusertoindicatethatsomeofits

connections are more important than other ones, and in the event ofcongestion, to make surethat the high-priority connections get serviced before the low-priority ones.

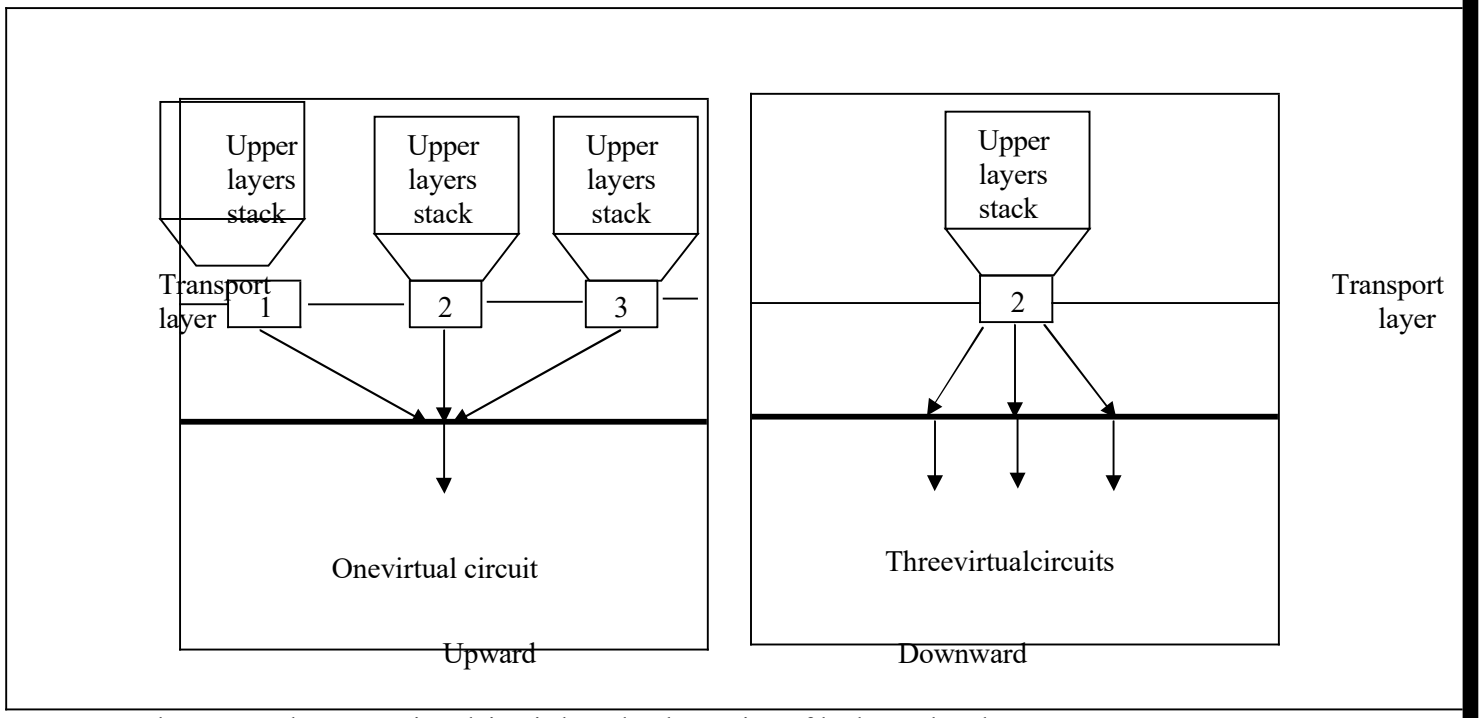
Finally, the Resilience parameter gives the probability of the transport layer itself spontaneously terminating a connection due to internal problems or congestion.

FlowControl

Like the data link layer, the transport layer is responsible for flow control. However, flow control at this layer is performed end-to-end rather than across a single link. Transport layer flow controlalso uses a slidingwindow protocol.However, thewindow at the transport layer canvary insize to accommodate buffer occupancy.

Multiplexing

To improve transmission efficiency, the transport layer has the option of multiplexing. Multiplexing at this layer occurs two ways: upward, meaning that multiple transport layer connections use the same network connection, or downward, meaning that one transport-layer connection uses multiple network connections.



Thetransportlayerusesvirtualcircuitsbasedontheservicesofthe lowerthreelayers.

Normally, the underlying networks charge for each virtual circuit connection. To make more cost-effective use of an established circuit, the transport layer can send several transmissions bound for the same destination along the same path by upward multiplexing. This means if theunderlying network protocol has a high throughput, for example in the range of 1 Gbps, and the user can create data only in the range of Mbps, then several users can share one network connection.

Downward

Downward multiplexing allows the transport layer to split a single connection among several different paths to improve throughput (speed of delivery). This option is useful when theunderlying networks have low or slow capacity. For example, some network layer protocols have restrictionson the sequence numbers that can be handled. X.25 uses a three-bit numbering code, so sequence numbers are restricted to the range of 0 to 7 (only eight packets may be sent before acknowledgment is required). In this case, throughput can be unacceptably low. To counteractthis problem, the transportlayer can opt to use more than one virtual circuitatthenetwork layer to improve throughput. By sending several data segments at once, delivery is faster.

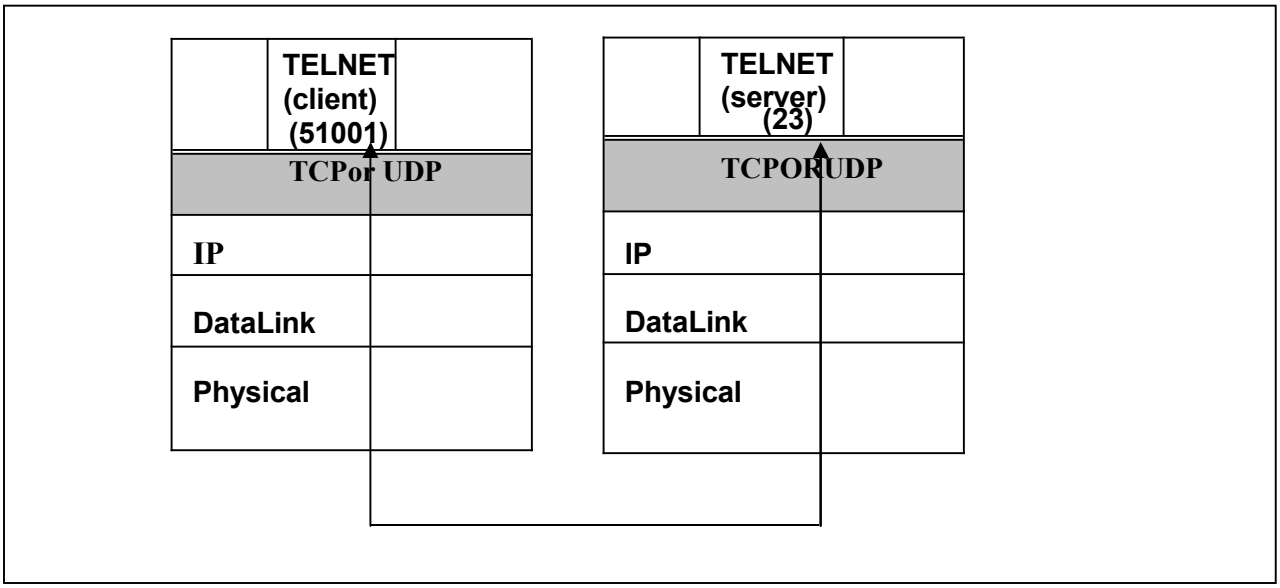
ARPA established a packet-switching network of computers linked by point-to-point leased lines called Advanced Research Project Agency Network(ARPANET) that provided a basics for early research into networking. The conventions developed by ARPA to specify how individual computers could communicate across that network became TCP/IP.

The transport layer is represented in TCP/IP by two protocols:TCP and UDP. Of these, UDP is similar; it provides nonsequenced transport functionality when reliability and security are less important than size and speed.

The transport protocols of the TCP/IP suite define a set of conceptual connections to individual process called protocol ports or, more simply, ports. A protocol port is a destination point (usuallya buffer) for storing data for use by a particular process.

The IP is a host-to-host protocol, meaning that it can deliver a packet from one physical device to another. TCP/IP's transport level protocols are port-to-port protocols that work on top of the IP protocols to deliver the packet from the originating port to the IP services at the start of a transmission, and from the IP services to the destination port at the start end.

FigurePortaddresses



Each port is defined by a positiveinteger addresscarried in the header of atransport layer packet. AnIP datagram uses the host's 32-bitInternet address. A frame at the transport level uses the process port address of 16 bits, enough to allow the support of up to 65,536(0 to 65535) ports.

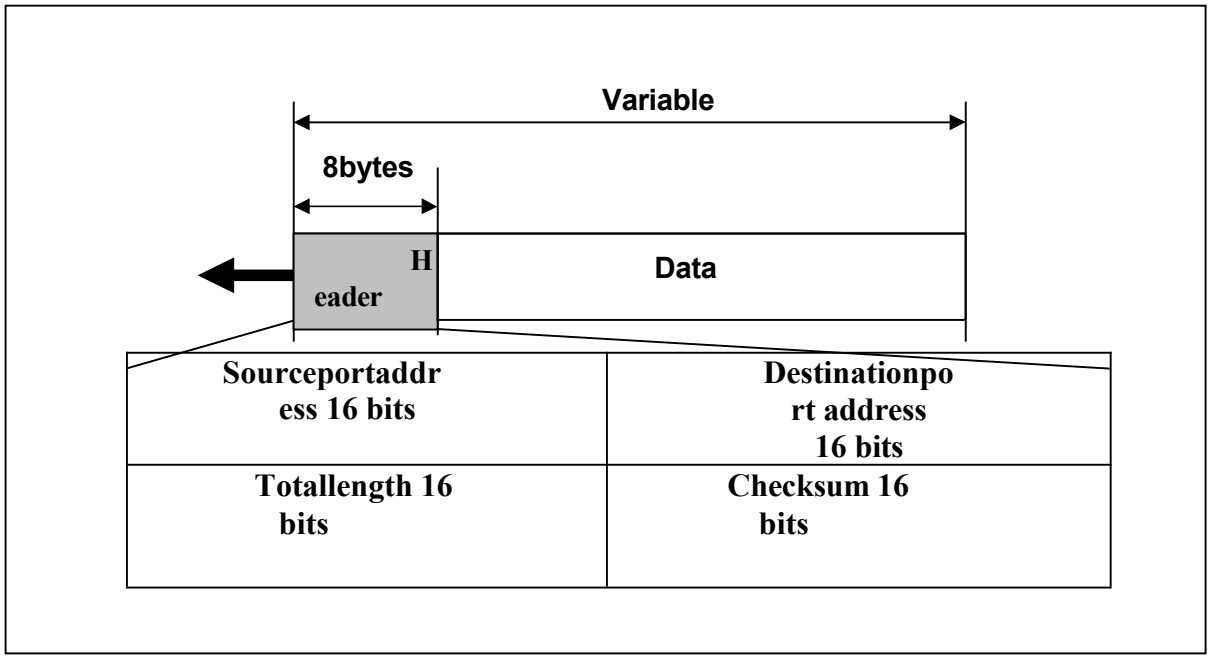
USER DATA GRM PROTOCOL(UDP)

The user datagram protocol (UDP) is the simpler ofthe two standard TCP/IP transport protocols.It is an end-to-end transport level protocol that adds only port addresses, check sum error control, and length

informationto the data from the upper layer. The packet produced by theUDP is called a user datagram .

- **Source port address.** The source port address is the address of the application program that has created the message.
- **Destination port address.** The destination port address is the address of the application program that will receive the message.
- **Totallength.**The totallengthfielddefinesthetotallengthoftheuserdatagraminbytes.
- **Checksum.**Thechecksumisa16-bitfieldusedinerrordetection.

FigureUDPdatagramformat



UDP provides only the basic functions needed for end-to-end delivery of a transmission. It does not provide any sequencing or recording functions and cannot specify the damaged packet when reporting an error (for which it must be paired with ICMP). UDP can discover that an error has occurred; ICMP can then inform the sender that a user datagram has been damaged and discarded. Neither, however, has the ability to specify which packet has been lost. UDP contains only a checksum; it does not contain an ID or sequencing number for a particular data segment.

TransmissionControlProtocol(TCP)

The Transmission Control Protocol (TCP) provides full transport layer services to applications. TCP is a reliable stream transport port-to-port protocol. The term stream, in this context, means connection-oriented: a connection must be established between both ends of a transmission before either may transmit data. By creating this connection, TCP generates a virtual circuit between sender and receiver

that is active for the duration of a transmission.(connections for the duration of an entire exchange are different, and are handled by session functions in individual applications.) TCP begins each transmission by altering the receiver that datagrams are on their way(connection establishment)andends each transmission witha connection termination.In this way, the receiver knows to expect the entire transmission rather than a single packet.

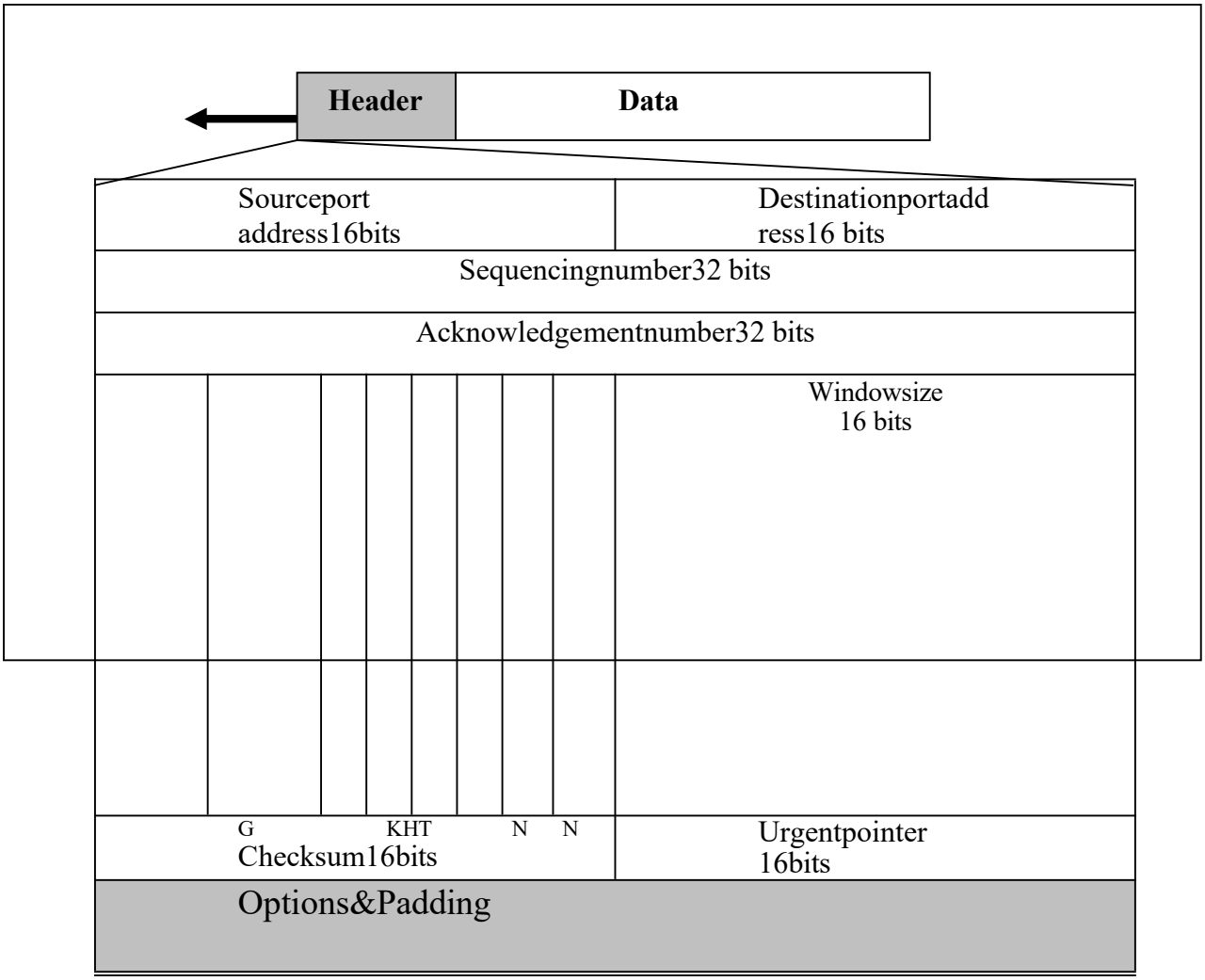
IP andUDPtreatmultiple datagramsbelonging toasingle transmissionasentirelyseparateunits, unrelated to each other. The arrival of each datagram at the destination is therefore a separate event, unexpected by the receiver. TCP, on the other hand, as a connection-oriented service, is responsibleforthe reliabledeliveryofthe entire streamof bits containedin the messageoriginally generated by the sending application. Reliability is ensured by provision for error detection and retransmission of damaged frames; all segments must be received and acknowledged before the transmission is considered complete and the virtual circuit is discarded.

At the sending end of each transmission, TCP divides long transmissions into smaller data units and packages each into a frame called a segment. Each segment includes a sequencing number for reordering after receipt, together with an acknowledgement ID number and a window-sizefield for sliding window ARQ. Segments are carried across network links inside of IP datagrams as it comes in and reorders the transmission based on sequence numbers.

TheTCPSegment

The scope of the services provided by TCP requires that the segment header be extensive. A comparison of the TCP segment format with that of a UDP user datagram shows the differences between the two protocols. TCP provides a comprehensive range of reliability functions but sacrifices speed (connections must be established, acknowledgments waited for , etc.).Becauseof its smaller frame size, UDP is much faster than TCP, but at the expense of reliability. A brief description of each field is in order.

FigureTCPSegmentformat



- **Source port address.** The source port address defines the application program in the source computer.
- **Destination port address.** The destination port address defines the application programin the destination computer.
- **Sequence number.** A stream of data from the application program may be divided intotwo or more TCP segments. The sequence number field shows the position of the data in the original data stream.
- **Acknowledgement number.** The 32-bit acknowledgement number is used to acknowledge the receipt of data from the other communicating device. This number isvalid onlyif theACK bit in the controlfield(explained later)isset.Inthiscase,itdefinesthe byte sequence number that is next expected.
- **Header Length (HLEN).** The four-bit HLENfield indicatesthe number of 32-bit (four-byte) words in the TCP header. The four bits can define a number up to 15.This is multiplied by4 to give thetotal

number of bytes in the header. Therefore, the size ofthe header can bea maximumof 60 bytes (4x15).Since the minimum required size of the header is20 bytes, 40 bytes are thus available for the options section.

- **Reserved.**Asix-bitfieldisreservedforfutureuse.
- **Control.** Each bit of the six-bit control field functions individually and independently. A bit caneitherdefinetheuseofasegmentorserveasavalidityscheckforotherfields.The

UNIT5

ApplicationLayer

Thelayerwhereallthe applicationsarefoundiscalledApplicationlayer.

Application-LayerParadigms

TraditionalParadigm:Client-Server

Thetraditionalparadigmiscalledthe**client-serverparadigm**.

Inthisparadigm,theserviceproviderisanapplicationprogram,calledtheserverproce ss;it runs continuously, waiting for another application program, called the client process, to make a connection through the Internet and ask for service.

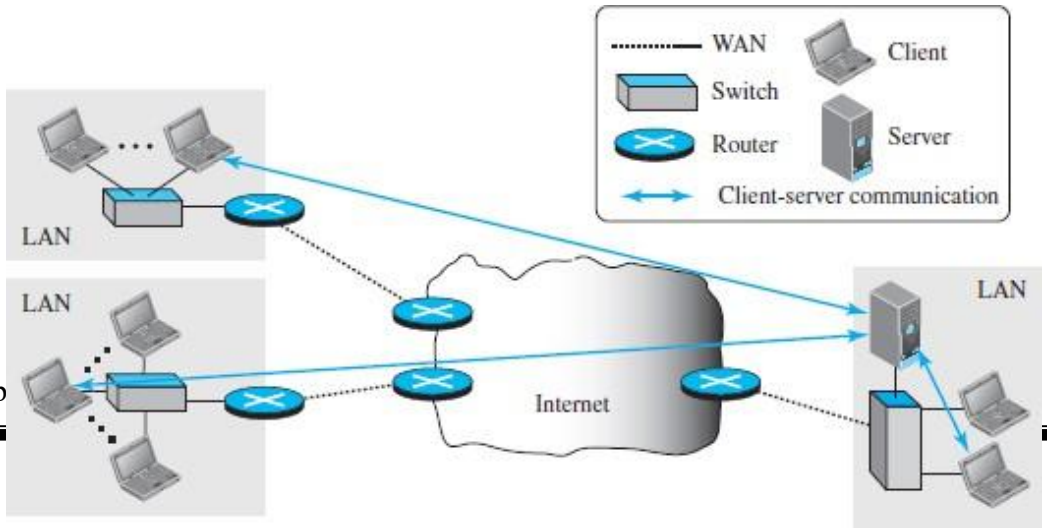
Normallyfewserverprocessesareavailablethatcanprovideaspecifictypeofservice, but there are many clients that request service from any of these server processes.

Theserverprocessmustberunningallthetime;theclientprocessisstartedwhentheclie nt needs to receive service.

forexample,atelephonedirectorycenterinanyareacan beaserver;asubscriberthat calls and asks for a specific telephone number can be thought of as a client.

Thedirectorycenter mustbereadyandavailableallthetime;thesubscribercancallthe center for a short period when the service is needed.

Figure(below)showsanexampleofa**client-servercommunication**inwhichthreeclients communicate with one server to receive the services provided by this server.



Comp

Fig:clientserverparadigm..[Source:DataCommunicationsandNetworkingbyBehrouzA. Forouzan]

Peer-to-Peerparadigm

Inthisparadigm,thereisnoneedforaserver processtoberunningallthetimeandwaiting for the clientprocesses to connect. Theresponsibilityissharedbetweenpeers.Acomputerconnected totheInternetcanprovideserviceatonetimeandreceiveserviceatanother time. A computer can even provide and receive services at the same time.

Figure(below)showsanexampleofcommunicationinthisparadigm.

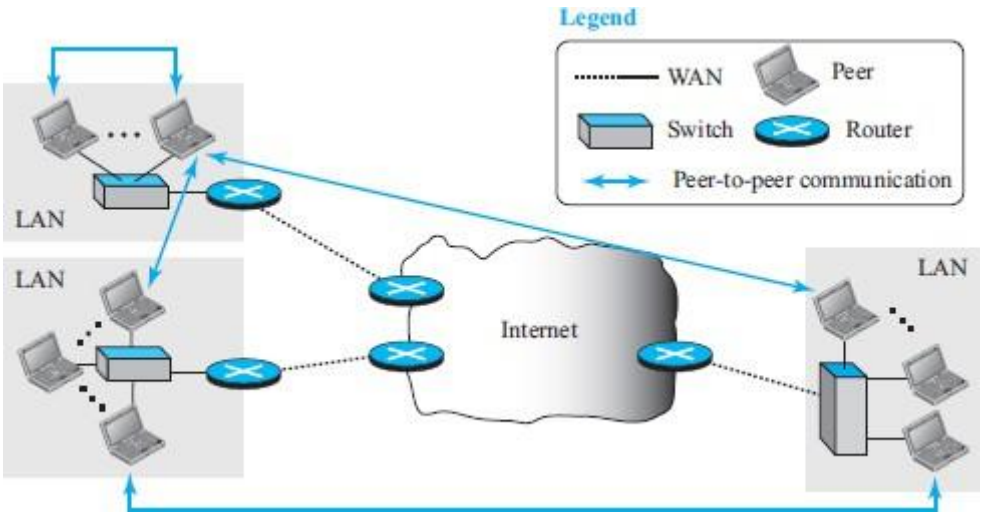


Fig:peertopeerparadigm..[Source:DataCommunicationsandNetworkingby BehrouzA. Forouzan]

Communicationbyphoneisapeer-to-peeractivity;nopartyneedsto waitfortheotherparty to call.

Thepeer-to-peerparadigmcanbeusedinasituation,whensomecomputersconnectedto the Internet have something to sharewith each other.

Forexample,if anInternetuserhasafileavailabletosharewithotherInternetusers,there is no need for the file holder to become a server and run a server processall the time waiting for other users to connect and to get the file.

CLIENT-SERVERPROGRAMMING

Inaclient-serverparadigm,communicationattheapplicationlayerisbetweentworunning application programs called **processes**: a client and a server.

Aclientisarunningprogramthatinitializesthecommunicationbysendingarequest;a server is another application program that waits for a request from a client.

Theserverhandlestherequestreceivedfromaclient,preparesa result,andsendstheresult back to the client.

Thelifetimeof aserverisinfinite:itshouldbestartedand runforever,waitingforthe clients. The lifetime of a client is finite,itsends a finite number of requests to the corresponding server, receives the responses, and stops.

ApplicationProgrammingInterface

If weneedaprocesstobeabletocommunicatewithanotherprocess,weneedanewsetof instructions to tell the lowest four layers of the TCP/IP suite to open the connection, send and receive data from the other end, and close the connection.

Asetofinstructionsofthistypeiscalledasan**applicationprogramminginterface(API)**. An interface in programming is a set of instructions between two entities. In this case, one of the entities is the process at the application layer and the other is theoperatingsystemthatencapsulatesthefirstfourlayersoftheTCP/IPprotocolsuite.

Acomputer manufacturerbuildthefirstfourlayersofthesuiteintheoperatingsystemand include an API.

Here,theprocessesrunningattheapplicationlayerareabletocommunicatewiththe operating system when sending and receiving messages through the Internet.

SeveralAPIshavebeendesignedforcommunication.Threeamongthemarecommon: **socketinterface,TransportLayerInterface**(**TLI**),and **STREAM**.

SocketInterface

Socketinterfacestartedintheearly1980satUCBerkeleyaspartofaUNIXenvironmen

Thesocketinterfaceisasetofinstructionsthatprovidecommunicationbetween the

application layer and the operating system,

Itisasetofinstructionsthatcanbeusedbyaprocesstocommunicatewithanotherproce ss.

For example, in most computer languages, like C, C++, or Java, we have several instructionsthatcanreadand write datato othersourcesandsinkssuchasakeyboard(a source), a monitor (a sink), or a file (source and sink).

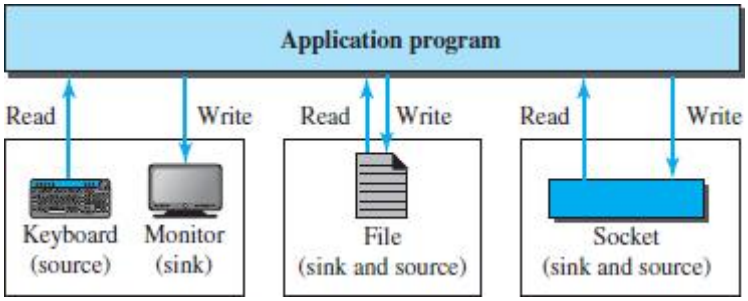


Fig:Socketformat.[Source:DataCommunicationsandNetworkingbyBehrou zA. Forouzan]

Inapplicationlayer,communicationbetweenaclientprocessandaserverprocessisth e communication between two sockets.

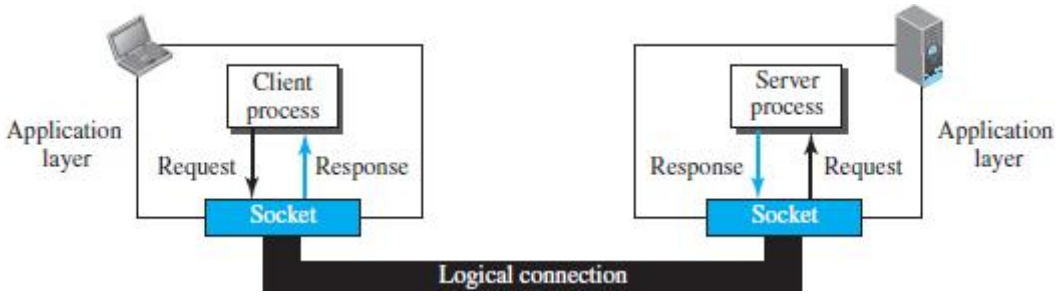


Fig:Socketinprocesstoprocesscommunication.[Source:DataCommunicatio nsand Networking by Behrouz A. Forouzan]

SocketAddresses

Theinteractionbetweenaclientandaserveristwo-waycommunication.

In a two-way communication, we need a pair of addresses: local (sender) and remote (receiver).Thelocaladdressinonedirectionistheremoteaddressintheotherdirection and vice versa.

Since communication in the client-server paradigm is between two sockets, we need a pair of**socketaddresses**forcommunication:alocalsocketaddressandaremotesocketaddress.

Asocketaddressshouldfirstdefinethecomputeronwhichaclientoraserverisrunning. A computer in the Internet is defined by its IP address.

FindingSocketAddresses

Howcanaclientoraserverfindapairofsocketaddressesforcommunication? The situation is different for each site.

ServerSite

Theserverneedsalocal(server)andaremote(client)socketaddressforcommunication.

Local Socket Address The local (server) socket address is provided by the operating system.TheoperatingsystemknowstheIPaddressofthecomputeronwhichtheserver process is running. The port number of a server process, needs to be assigned. Iftheserverprocessisastandardonedefinedbytheinternetauthority,aportnumberis already assigned to it.

Forexample,theassignedportnumberforaHypertextTransferProtocol(HTTP)isthe integer 80, which cannot be used by any other process.

RemoteSocketAddress

Theremotesocketaddressforaserveristhesocketaddressoftheclientthatmakesthe connection. Since the server can serve many clients, it does notknowpreviously,theremotesocketaddressforcommunication.

The server can find this socket address when a client tries to connect to the server. The clientsocketaddress,whichiscontainedintherequestpacketsenttotheserver,becomes the remote socket address that is used for responding to the client.

WorldWideWeb

The Web was first proposed by Tim Berners-Lee in 1989 at *CERN*†, theEuropean OrganizationforNuclearResearch,toallowseveralresearchersatdifferentlocations throughout Europe to access each others' research

hecommercialWebstartedin1990s.

he**webpages,**aredistributedallovertheworldandrelateddocumentsarelinkedtogether. Today, the Web is used to provide electronic shopping and gaming.

ArchitectureofWWW

TheWWWisadistributedclient-serverservice,inwhichaclientusinga browsercan access a service using a server.

Theserviceprovidedisdistributedovermanylocationscalledsites.

A web page can be simple or composite. A simple web page has no links to other web pages;acompositewebpagehasoneormorelinkstootherwebpages.Eachwebpageis a file with a name and address.

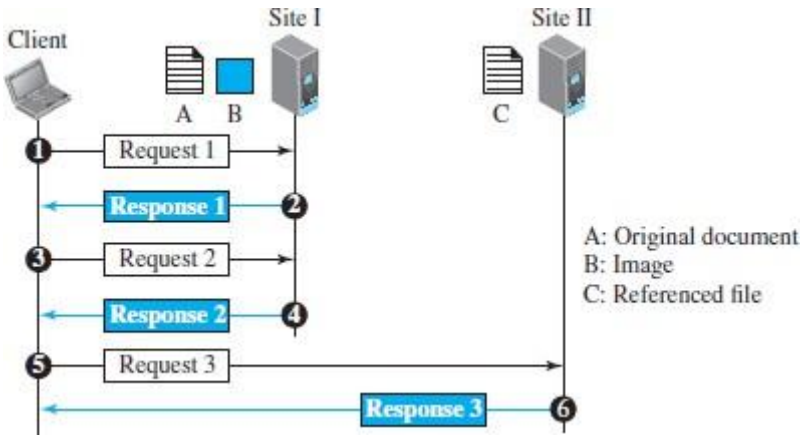


Fig:Thewebarchitecture..[Source:DataCommunicationsandNetworkingby BehrouzA. Forouzan]

Thefirsttransaction(request/response)retrievesacopyofthemaindocument(fileA), which has references (pointers) to the second and third files.

When a copy of the main document is retrieved and browsed, the user can click on the referencetotheimage toinvokethesecondtransactionandretrieve a copyof theimage (file B).

If theuserneedsto see thecontentsofthereferencedtextfile,shecanclickonitsreference (pointer) invoking the third transaction and retrieving a copy of file C.

WebClient(Browser)

Avarietyofvendorsoffercommercial **browsers**thatinterpretand displayaweb page,and all of them usethe same architecture.

Each**browserhasthreeparts**:acontroller,clientprotocols,andinterpreters.

Thecontrollerreceivesinputfromthekeyboardorthemouseandusestheclient programs to access the document.

Afterthedocumenthasbeenaccessed,thecontrollerusesoneoftheinterpreterstodisplay the document on the screen.

The client protocolcan be one of the protocols described later, such as HTTP or FTP. The interpreter canbe HTML, Java, or JavaScript, depending on the type of document.

SomecommercialbrowsersincludeInternetExplorer,NetscapeNavigator,andFirefox.

WebServer

The web page is stored at the server. Each time a request arrives, the correspondingdocumentissenttotheclient.Toimproveefficiency,serversnormally store requestedfiles in a cache in memory; memory is faster to access than a disk.

UniformResourceLocator(URL)

Awebpage,asafile,needstohave auniqueidentifiertodistinguishitfromotherweb pages.

URLisastandardforspecifyinganykindofinformationontheinternet. URL defines four things: protocol, host computer, port and path.

Protocol. Itistheclient-serverprogramthatweneedtoaccessthewebpage.

ExampleprotocolisHTTP(HyperTextTransferProtocol)andFTP(FileTransfer Protocol).

Host. ThehostidentifiercanbetheIPaddressoftheserverortheuniquename given to

the server. IP addresses can be defined in dotted decimal notation.

Port. The port, a 16-bit integer, is normally predefined for the client-server application. For example, if the HTTP protocol is used for accessing the web page, the well-known port number is 80. However, if a different port is used, the number can be explicitly given.

Path. The path identifies the location and the name of the file in the underlying operating system.

Theformatofthisidentifiernormallydependsontheoperatingsystem.

InUNIX,apathisasetofdirectorynames followedbythefile name, all separated by a slash.

For example, /top/next/last/myfile is a path that uniquely defines a file named my file, storedinthedirectorylast,whichitselfispartof thedirectorynext,whichitselfisunder the directory top.

Tocombinethesefourpiecestogether,the **uniformresourcelocator(URL)**isused.It uses three different separators between the four pieces.

WebDocuments

ThedocumentsintheWWWcanbegroupedinto threebroadcategories:static, dynamic,and active.

StaticDocuments

Staticdocumentsarefixed-contentdocumentsthatarecreatedandstoredinaserver. The client can get a copy of the document only.

Thecontentsintheservercanbechanged,buttheusercannotchange them.

Whenaclientaccessesthedocument,acopyof thedocumentissent.Theusercan thenuse a browser to see thedocument.

Staticdocumentsarepreparedusingoneofseverallanguages:HyperTextMarkupLa nguage (HTML), Extensible Markup Language (XML), Extensible StyleLanguage (XSL), and Extensible Hypertext Markup Language (XHTML).

DynamicDocuments

A**dynamicdocument** iscreatedbyawebserverwheneverabrowserrequeststhe document.

Whenarequestarrives,thewebserverrunsanapplicationprogramorascriptthatcreate s the dynamic document.

The server returns the result of the program or script as aresponse to the browser that requestedthedocument.Becauseafreshdocumentiscreatedforeachrequest,thecont ents of a dynamic document may vary from one request toanother.

Asimpleexampleofadynamicdocumentistheretrievalofthetimeanddatefromaserv

er.

Timeanddatearekindsofinformationthataredynamicinthattheychangefrommomentto moment. The client can ask the server to run a program such asthe date program in UNIX and send the result of the program to the client.

ActiveDocuments

Formanyapplications,weneedaprogramora scripttobe runattheclientsite.These arecalled **active documents.**

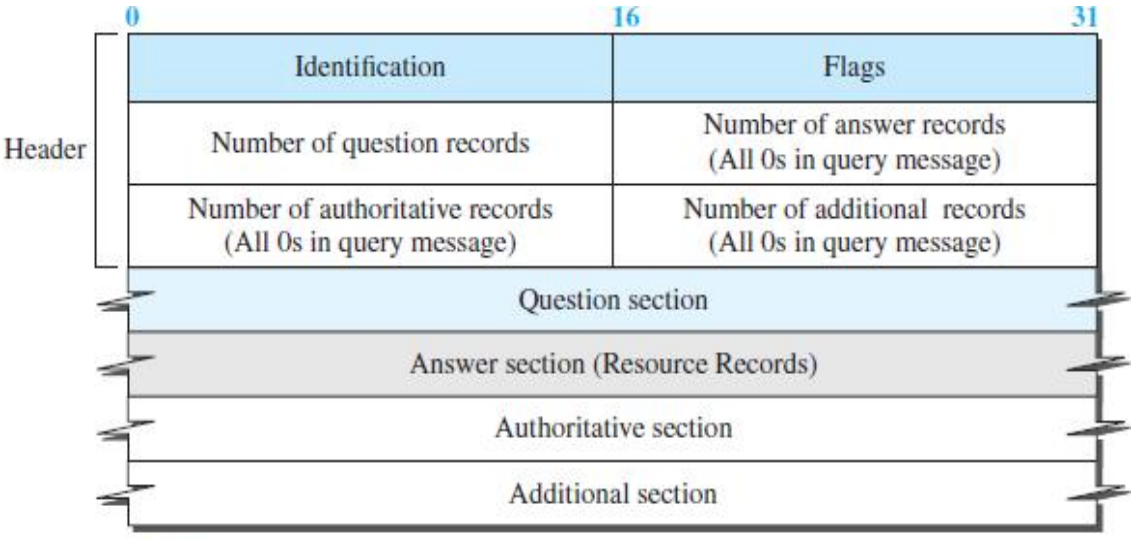
For example, if we want to run a program that createsanimated graphics on the screen or a programthatinteractswiththeuser.The programdefinitelyneeds toberunatthe clientsite where the animation or interaction takes place.

Whenabrowserrequestsanactive document,theserversendsa copyof thedocumentora script.

The document is then run at the client (browser) site. One wayto create an activedocument istouseJavaapplets,a programwritteninJavaontheserver.Itis compiledandreadytobe run. The document is in bytecode (binary) format.

DNSMessages

Togetinformationabouthosts,DNSusestwotypesof messages:*query*and *response*.Bothmessageshavethesameformatasshowninfigure.



Note:
The query message contains only the question section.
The response message includes the question section,
the answer section, and possibly two other sections.

Comp

Fig:DNSmessages[Source:DataCommunicationsandNetworkingbyBehrouz A. Forouzan]

Mid question papers

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MID-I Examination, Sept - 2024
Course: B. Tech, Branch-CSE, Year: III-(CSE, AIML&DS) Semester-I
Subject: Computer Networks
Duration: 60 Minutes, Max Marks: 30

PART–A

Answer Any four Questions **[4*5=20 M]**

1. What are the different types of error detection methods? Explain the CRC error detection techniques using generator polynomial x4+x3+1 and data 11100011.
2. Discuss Guided and Unguided transmission media in detail?
3. What is network topology? Explain various network topologies?
4. Explain Stop and wait ARQ mechanism in detail?
5. Explain about Static &dynamic channel allocation?
6. Explain shortest path routing algorithm with an example?

PART –B

Multiple Choice Questions: **5 Marks**

1. Computer Network is [ ]

   A. Collection of hardware components and computers

   B. Interconnected by communication channels

   C. Sharing of resources and information

   D. All of the Above [ ]

2. Protocols are

   A. Agreements on how communication components and DTE's are to communicate

   B. Logical communication channels for transferring data

   C. Physical communication channels sued for transferring data

   D. None of above

3. How many layers does OSI Reference Model has? [ ]

   A. 4

B. 5

C. 6

D. 7

4. The IP Address is 192.168.1.1 belongs to which class ? [ ]

a. Class A

b. Class B

c. Class C

d. Class D

5. Which layer is fourth layer from physical layer in the OSI model? [ ]

a. Session Layer

b. Data link Layer

c. Transport Layer

d. Network Layer

6. Which of the following coming under unguided transmission media? [ ]

a. Wireless

b. Optical Fiber

c. Twisted Pair

d. Copper wire

7. The term LAN stands for? [ ]

a. Local Area Net

b. Local Aera Network

c. Local Array Network

d. Local Array Net

8. What is single bit error ? [ ]

a. Only one bit

b. Two bit

c. Three Bit

d. Multiple Bit

9. What is Multiple Bit Error ? [ ]

a. Two or more bits

b. Two or more Consecutive Bits

c. One bit

d. Three Bits

10. Consider the following message M=1010001101. The CRC for this message using divisor polynomial $x^5+x^4+x^2+1$ is [ ]

A. 011100
B. 010110
C. 101011
D. 101100

Fill in the blanks: **5 Marks**

1. Data communications protocols are _____governing the orderly exchange of data within the network or a portion of the network.
2. TCP/IP stands for _____.
3. _____ converts Analog signal into Digital Signals and vice-versa.
4. Examples of data link protocols for Local Area Networks _____.
5. Parity Bits digits how to find in hamming code and write the formula _____
6. In Elementary of Data Link protocol ,For Noiseless channel in simplex stop and wait protocol example_____
7. For Noisy channel in stop & wait protocol ,sender window size _____
8 Full form of ARQ_____.
9. _____is a bit-oriented code-transparent synchronous data link layer protocol developed by the International Organization for Standardization (ISO).
10. Even Parity Bits total 1 should be _____.

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Balaji Institute of Technology & Science
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MID-II Examination, December - 2024
Course: B. Tech, Year: III-(CSE, AIML&DS) Semester-I
Subject: Computer Networks
Duration: 120 Minutes, Max Marks: 30

PART–A

Answer Any four Questions **[4*5=20 M]**

1. Give a brief notes on FTP, HTTP and SMTP Protocols in Application Layer?
2. Explain Hierarchical Routing Algorithm?
3. What is Flooding and explain Broadcast Routing Algorithm in Network Layer?
4. Compare TCP and UDP along with header formats?
5. Write a short Notes on a) DNS b) Resource Records c) Email
6. List the Characteristics of Transport Layer? and explain Transport Services?

PART –B

Multiple Choice Questions: **5 Marks**

7. Computer Network is [ ]
   A. Collection of hardware components and computers
   B. Interconnected by communication channels
   C. Sharing of resources and information
   D. All of the Above [ ]

8. Protocols are
   A. Agreements on how communication components and DTE's are to communicate
   B. Logical communication channels for transferring data
   C. Physical communication channels sued for transferring data
   D. None of above

9. How many layers does OSI Reference Model has? [ ]
   A. 4

B. 5

C. 6

D. 7

10. The IP Address is 192.168.1.1 belongs to which class ? [ ]

e. Class A

f. Class B

g. Class C

h. Class D

11. Which layer is fourth layer from physical layer in the OSI model? [ ]

e. Session Layer

f. Data link Layer

g. Transport Layer

h. Network Layer

12. Which of the following coming under unguided transmission media? [ ]

e. Wireless

f. Optical Fiber

g. Twisted Pair

h. Copper wire

7. The term LAN stands for? [ ]

e. Local Area Net

f. Local Aera Network

g. Local Array Network

h. Local Array Net

8. What is single bit error ? [ ]

e. Only one bit

f. Two bit

g. Three Bit

h. Multiple Bit

9. What is Multiple Bit Error ? [ ]

e. Two or more bits

f. Two or more Consecutive Bits

g. One bit

h. Three Bits

10. Consider the following message M=1010001101. The CRC for this message using divisor polynomial $x^5+x^4+x^2+1$ is [ ]

E. 011100
F. 010110
G. 101011
H. 101100

Fill in the blanks: **5 Marks**

1. Data communications protocols are _____governing the orderly exchange of data within the network or a portion of the network.
2. TCP/IP stands for _____.
3. _____ converts Analog signal into Digital Signals and vice-versa.
4. Examples of data link protocols for Local Area Networks _____.
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6. In Elementary of Data Link protocol ,For Noiseless channel in simplex stop and wait protocol example_____
7. For Noisy channel in stop & wait protocol ,sender window size _____
8 Full form of ARQ_____.
9. _____is a bit-oriented code-transparent synchronous data link layer protocol developed by the International Organization for Standardization (ISO).
10. Even Parity Bits total 1 should be _____.

Code No: 125DT **R15**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, January/February - 2023
COMPUTER NETWORKS
(Computer Science and Engineering)

Time: 3 hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART - A

(25 Marks)

1.a)	What are the uses of Computer Network?	[2]
b)	What is piggy backing technique? When and why is it used?	[3]
c)	What is bit stuffing? Give an example.	[2]
d)	What is the use of gateway and router?	[3]
e)	What is optimality principle?	[2]
f)	Write a brief note on store and forward packet switching.	[3]
g)	What is tunneling?	[2]
h)	Give a short note on IP addresses.	[3]
i)	What is the function of transport layer?	[2]
j)	What is the use of HTTP and FTP protocols?	[3]

PART - B

(50 Marks)

2.	Explain various layers and their functions of TCP/IP reference model.	[10]
	OR	
3.	Explain the stop-and-wait protocol and selective repeat protocol.	[10]
4.	Explain the CSMA/CD protocol in detail.	[10]
	OR	
5.	Describe the need and use of various network devices.	[10]
6.	Explain the working principle of the Hierarchical routing protocol.	[10]
	OR	
7.	Explain the token bucket algorithm. Write down its advantages and disadvantages.	[10]
8.	Discuss IMCP and DHCP protocols in detail.	[10]
	OR	
9.	Explain the elements of transport protocol.	[10]
10.a)	Explain the TCP service model.	
b)	Draw the TCP header and explain various fields.	[5+5]
	OR	
11.	Explain the TELNET and DNS in detail.	[10]

---ooOoo---

R15/R13

Code No: 125DT/115DT

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2021
COMPUTER NETWORKS
(R15-Common to CSE, IT; R13-Common to CSE, IT)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
- - -

1.a) Describe TCP/IP reference model with a neat diagram and compare TCP/IP with ISO-OSI reference model.
b) What are the advantages of Fiber optic cables? Enumerate the functionalities of Fiber Optic Cables with a neat diagram. [8+7]

2.a) What is CRC? Discuss about CRC method for error detection with suitable example.
b) Explain about Go, Back_N sliding window protocol. List out its drawbacks. [7+8]

3.a) Differentiate Pure ALOHA and Slotted ALOHA.
b) Compare and contrast the network devices repeaters, hubs, bridges and switches. [7+8]

4. What is the functionality of Ethernet MAC sub layer? Explain each field in Ethernet Frame with a neat diagram. [15]

5.a) Explain about hierarchical routing algorithm with suitable example.
b) Discuss about count-to-infinity problem. How to overcome it? [7+8]

6. What is Congestion? How to avoid congestion? Explain about Token bucket algorithm for traffic shaping with a neat diagram. [15]

7.a) Explain about DHCP protocol frame format in detail.
b) What are the benefits of ICMP protocol? [8+7]

8.a) What is DNS? Explain DNS structure for Internet.
b) What is the sliding window protocol involved in TCP connection? Discuss. [7+8]

---ooOoo---

Unit-wise Important questions

SHORT ANSWER QUESTIONS

UNIT – I

1 Define Network.
2 Explain different types of networks.
3 Describe Why are protocols needed.
4 Describe Access point.
5 State the goals of networks.
6 Describe the importance of networking.
7 List two advantages of layering principle in computer networks.
8 Classify different types of Layers.
9 Define the responsibilities of data link layer.
10 Enumerate the types of errors.
11 Explain the role of ARPANET in computer networks.
12 Discuss two points to improve the performance of network.
13 Define redundancy.
14 List different types of Transmission Media.
15 Describe Why are standards needed.
16 Explain briefly about MAN.
17 Explain about Sliding Window Protocol.
18 Explain briefly about WAN.
19 Define peer-to-peer process.
20 Describe an internet.
21 Define Intranet.
22 Define Extranet.
23 Explain briefly about LAN.
24 Describe the advantages of a multipoint connection over a point- to-point connection.
25 List out the available detection methods.
26 Discuss the responsibilities of the data link layer in the Internet model.
27 How do the layers of the Internet model correlate to the layers of the OSI model?
28 Differentiate four basic topologies.
29 Define CRC.

30 List the advantages of CN.

31 List the networks Applications.

32 Define checksum.

UNIT – II

1 Define ALOHA.

2 List out advantage of token passing protocol over CSMA/CD protocol.

3 Define MAC.

4 List the drawbacks of token ring topology.

5 Define Ethernet.

6 Write about pure alloha.

7 Explain slotted alloha.

8 Explain the two techniques for implementing Ethernet switches.

9 Define Bridge.

10 Define Hub.

11 Define Router.

12 Explain in what situations contention based MAC protocols are suitable.

13 What is vulnerable period? How it affects the performance in MAC protocols?

14 List three categories of multiple access protocols.

15 Define CSMA and CDMA.

16 Define parameter 'a'. How does it affect the performance of the CSMA protocol?

17 Explain how performance is improved in CSMA/CD protocol compared to CSMA protocol.

18 Explain how throughput is improved in slotted ALOHA over pure ALOHA.

19 Explain Vulnerable Time.

20 Distinguish between pure alloha and sloted alloha.

21 Define Bandwidth.

UNIT – III

1 Explain Design Issues Of Network layer.

2 List network support layers and the user support layers.

3 Define the functions of store and forward packet switching.

4 Illustrate shortest path.

5 Define Flooding.

6 Explain Optimality principle.

7 Define the functions of MAC.

8 Define protocol data unit.

9 Explain Congestion Control.

10 Define virtual circuit.

11 List out responsibilities of network layer.

12 Define datagram.
13 Explain how broadcast and multicast address is represented in IP addressing scheme.
14 List some of the unicast routing protocols.
15 Differentiate between Datagram and datagram networks.
16 Define routers.
17 Differentiate between virtual circuit and virtual circuit networks.
18 List out functions of IP.
19 Explain what is meant by routing algorithm.
20 Define hirarical routing.
21 Define Flooding.
22 Define Link state Routing.
23 State Leaky bucket.
24 Explain Choke packet.
25 Define packet switching.
26 State circuit switching.
27 Illustrate the routing strategies.

UNIT – IV

1 List out functions of transport layer.
2 Define Multi-protocol router.
3 List out duties of the transport layer.
4 Define IPV4.
5 Differentiate between network layer delivery and the transport layer delivery.
6 Define IP Address.
7 Define quality of service.
8 Explain Subnet Mask?
9 Define ICMP?
10 Explain design issues of transport layer?
11 Describe Datagram.
12 Define IMCP.
13 State two protocols available at transport layer.
14 List out various congestion avoidance techniques.
15 Distinguish between Contention and Congestion.
16 Define Tunnelling.
17 State the four major aspects of reliable delivery at the transport layer.
18 Explain how check sum is calculated in TCP.
19 Explain source quench
20 State the use of RARP
21 Define RARP.

22 Explain DHCP.

23 Explain about Transport Layer Services.

UNIT – V

1 Explain Internet Transport Protocols.

2 Define UDP.

3 State advantages of stateless server of HTTP.

4 Define message Formatting.

5 Define TCP.

6 Differentiate between FTP & HTTP.

7 Explain TCP segment Header.

8 Explain Sliding Window Protocol.

9 List two applications of Application Layer .

10 Explain DNS Name Space.

11 List the advantages of Email.

12 Define SMTP.

13 Explain the concept of Telnet.

14 Define FTP.

15 Explain MIME.

16 Illustrate the use of MIME Extension.

17 Explain WWW.

18 Define Lossy Compression and Lossless Compression.

19 Explain crash Recovery.

20 Define Multiplexing.

LONG ANSWER QUESTIONS

UNIT - I

1 Explain how are OSI and ISO related to each other?

2 Illustrate some of the factors that determine whether a communication system is a LAN or WAN?

3 List the responsibilities of the data link layer in the Internet model.

4 Suppose a computer sends a frame to another computer on a bus topology LAN. The physical destination address of the frame is corrupted during the transmission. What happens to the frame? How can the sender be informed about the situation? Explain?

5 List three types of transmission impairment.

6 Distinguish between baseband transmission and broadband transmission.

7 Explain the categories of networks.

8 Explain ISO/OSI Reference model with neat diagram.

9 Define topology and explain the topologies of the network.

10 Explain error detection and error correction techniques.
11 Explain the flow control mechanism.
12 Explain about OSI Model
13 Explain the TCP/IP layers
14 Explain error control mechanism.
15 Explain about transmission media?

UNIT – II

1 State the functions of MAC.
2 How performance is improved in CSMA/CD protocol compared to CSMA protocol? Explain?
3 How CSMA/CA differs from CSMA/CD. Explain in brief?
4 Explain in details about the access method and frame format used in Ethernet and token ring.
5 Explain the working of carrier sense multiple access protocol.
6 Discuss pure and slotted alloha
7 Explain the types of bridges in detail.
8 How a Token Ring LAN does operate? Discuss that can be used to set up wireless LAN's.
9 List and briefly discuss the two different basic transmission technologies.
10 List the four basic network topologies and explain them giving all the Relevant features.
11 Explain the sliding window protocol
12 explain Noisy channel
13 Explain Noiseless channel
14 Compare and contrast a controlled access protocol with a channelizing protocol.
15 Explain Go back n protocol

UNIT – III

1 Define switching. Explain Virtual circuit switching techniques.
2 Explain Packet switching technique in detail.
3 Explain Internet Protocol with the neat block diagram of IP header format.
4 Discuss about Address Resolution Protocol.
5 Explain about Internet Control Message Protocol.
6 Describe its routing functionality in detail.
7 Write short notes on flooding
8 Explain the various congestion control mechanism in detail.
9 Explain the Link State routing algorithm with an example.
10 Describe the Routing Information protocol and Distance vector routing protocol.
11 Explain the Datagram delivery and Forwarding in Internet Protocol.
12 Explain the two approaches of packet switching techniques.
13 Define Routers and explain the type of routers.
14 Explain fragmentation

10 Explain error detection and error correction techniques.
11 Explain the flow control mechanism.
12 Explain about OSI Model
13 Explain the TCP/IP layers
14 Explain error control mechanism.
15 Explain about transmission media?

UNIT – II

1 State the functions of MAC.
2 How performance is improved in CSMA/CD protocol compared to CSMA protocol? Explain?
3 How CSMA/CA differs from CSMA/CD. Explain in brief?
4 Explain in details about the access method and frame format used in Ethernet and token ring.
5 Explain the working of carrier sense multiple access protocol.
6 Discuss pure and slotted alloha
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8 How a Token Ring LAN does operate? Discuss that can be used to set up wireless LAN's.
9 List and briefly discuss the two different basic transmission technologies.
10 List the four basic network topologies and explain them giving all the Relevant features.
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12 explain Noisy channel
13 Explain Noiseless channel
14 Compare and contrast a controlled access protocol with a channelizing protocol.
15 Explain Go back n protocol

UNIT – III

1 Define switching. Explain Virtual circuit switching techniques.
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3 Explain Internet Protocol with the neat block diagram of IP header format.
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5 Explain about Internet Control Message Protocol.
6 Describe its routing functionality in detail.
7 Write short notes on flooding
8 Explain the various congestion control mechanism in detail.
9 Explain the Link State routing algorithm with an example.
10 Describe the Routing Information protocol and Distance vector routing protocol.
11 Explain the Datagram delivery and Forwarding in Internet Protocol.
12 Explain the two approaches of packet switching techniques.
13 Define Routers and explain the type of routers.
14 Explain fragmentation

15 Describe tunneling

UNIT - IV

1 Explain internetworking
2 Explain IP
3 Write short notes on ARP
4 Describe the Adaptive and Nonadaptive routing algorithm
5 Explain RARP
6 Explain ICMP
7 Explain fragmentation
8 Explain the connection establishment.
9 Describe tunneling
10 Explain congestion control algorithms in detail.
11 Explain leaky bucket and token bucket algorithm.
12 Explain IPV4 and IPV6
13 Explain congestion avoidance techniques in detail.
14 List major types of networks and explain.
15 Illustrate data units at different layers of the TCP / IP protocol suite.

UNIT – V

1 List different Data types used for Presentation formatting.
2 Define two methods of HTTP.
3 Define Big-endian format and little-endian format.
4 Describe the role of the local name server and the authoritative name server in DNS.
5 Define Domain Name Service (DNS) and explain in detail about the domain hierarchy and name servers.
6 Explain in detail about the working principles of Simple Network Management Protocol (SNMP) .
7 Discuss how the Simple Mail Transfer Protocol (SMTP) is useful in electronic mail.
8 Describe in detail about the World Wide Web (WWW)
9 Explain the working principle of FTP in detail with neat diagram.
10 Explain the WWW in detail.
11 Differentiate between ARP and RARP.
12 Explain the specific purposes of the DNS, HTTP, SMB, and SMTP/POP application layer protocols.
13 Compare and contrast client/server with peer-to-peer data transfer over networks.
14 Explain three domains of the Domain Name Space.
15 Differentiate between primary server and secondary server.

Tutorial problems with blooms mapping

Here's a set of problems categorized by these levels:

1. Remembering (Recall Facts)

- **Problem 1:** Define the following terms in the context of computer networks:
  - IP Address
  - Router
  - DNS
  - OSI Model
  - Bandwidth
- **Problem 2:** List the seven layers of the OSI model in order.

2. Understanding (Explain Ideas or Concepts)

- **Problem 3:** Explain the differences between TCP and UDP. When would you prefer to use one over the other?
- **Problem 4:** Describe the concept of subnetting in networking and why it is important.
- **Problem 5:** Explain how a router functions in a network and how it differs from a switch.

3. Applying (Use Information in New Situations)

- **Problem 6:** Given an IP address 192.168.1.1/24, calculate the network address and the broadcast address.
- **Problem 7:** You are tasked with setting up a local network for a small office with 50 devices. How would you assign IP addresses to ensure optimal network performance and scalability?
- **Problem 8:** In a network that uses DHCP, explain how a client would acquire an IP address.

4. Analyzing (Break Information into Parts to Explore Relationships)

- **Problem 9:** Given a simple network diagram with switches, routers, and hosts, identify the potential points of failure in the network and suggest troubleshooting steps.
- **Problem 10:** Analyze the potential performance issues in a network that uses wireless connections for all devices. What factors would affect performance and how could they be mitigated?
- **Problem 11:** Compare the different routing algorithms used in computer networks (e.g., Distance Vector, Link State). Analyze the pros and cons of each.

5. Evaluating (Justify a Decision or Course of Action)

- **Problem 12:** After studying two different protocols (e.g., IPv4 and IPv6), evaluate which one would be more suitable for a growing organization that plans to expand its network over the next 10 years.
- **Problem 13:** Critique the use of NAT (Network Address Translation) in large networks. What are the advantages and potential drawbacks?
- **Problem 14:** Evaluate the effectiveness of firewalls in securing a corporate network. Under what circumstances would other security measures (e.g., Intrusion Detection Systems) be necessary?

6. Creating (Use Information to Create New Ideas or Products)

- **Problem 15:** Design a simple network for a company with three departments (HR, IT, and Finance). Ensure that there are security measures in place to prevent unauthorized access between departments.
- **Problem 16:** Create a simulation of a computer network using a network simulation tool (e.g., Cisco Packet Tracer, GNS3). Include devices such as routers, switches, and end systems, and configure the network to ensure communication across different subnets.
- **Problem 17:** Propose an improvement plan for a network that experiences slow data transmission between geographically dispersed offices. Consider issues such as latency, bandwidth, and routing strategies.

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DEPARTMENT OS CSE (AI&ML)

B.TECH III-I SEM — SUBJECT: Computer Networks

Unit wise Assignment Questions

Q.No	Question	Marks	level.of Blooms Taxanomy	CO
	UNIT-1			
1	Explain the seven layers of OSI model?	5	Understand(L2)	1
2	Explain each layer of TCP/IP model in detail.	5	Remember(L1)	1
3	Compare OSI and TCP/IP models ?	5	Understand(L2)	1
4	Discuss each transmission media in detail	5	Analyze(L4)	1
5	What is packet switching? Discuss store-and-forward transmission of packet switching.	5	Understand(L1)	1
	UNIT-2			
1	Define flow control. Explain Go-Back-N ARQ with suitable example. How is it different from Stop-and-Wait ARQ?	5	Remember(L1)	2
2	model.	5	Understand(L2)	2
3	protocol?	5	Remember(L1)	2
4	Explain the point to point to protocol (PPP) with example.	5	Understand(L2)	2
5	How does the system correct error after error detection?	5	Analyze(L4)	2
	UNIT-3			
1	What do you mean by routing? Differentiate between Non-adaptive algorithm and adaptive algorithm.	5	Analyze(L4)	3
2	Discuss distance-vector routing algorithm with example.	5	Remember(L1)	3
3	Explain the purpose of subnetting and also explain the subnet	5	Understand(L2)	3
4	Explain the Internet Control Message Protocol (ICMP)?	5	Understand(L2)	3
5	What do you mean by IP datagram fragmentation?	5	Remember(L1)	3
	UNIT-4			
1	Explain the congestion control principle and its approaches.	5	Remember(L1)	4
2	How does multiplexing increases transmission efficiency? Ex	5	Understand(L2)	4
3	Differentiate between transport layer and network layer	5	Understand(L2)	4
4	What is connectionless transport? Differentiate TCP with UDI	5	Analyze(L4)	4
5	What are the causes of congestion? Discuss leaky bucket algorithm.	5	Remember(L1)	4
	UNIT-5			
1	Why do we need DNS? Discuss different fields in the DNS message.	5	Analyze(L4)	5
2	Discuss HTTP in detail.	5	Understand(L2)	5
3	Discuss different services provided by DNS.	5	Remember(L1)	5
4	Explain the principles of application layer protocols.	5	Analyze(L4)	5

List of students

IIICSM –I SEM

Sl. No.	Roll Number	Name of the Candidate
1	22C31A6601	ADEPU SUDHEER KUMAR
2	22C31A6602	AJMEERA KUSUMA SRI
3	22C31A6603	ALIKANTI SURAJ KUMAR
4	22C31A6604	AMAROJU RAVALI
5	22C31A6605	ANANDHAPU SRAVANI
6	22C31A6606	A. SAHODAR REDDY
7	22C31A6607	BABBERA RAVALI
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11	22C31A6611	BYRI TEJASWINI
12	22C31A6612	CHITTIMALLA SRI RAM
13	22C31A6613	DASARI CHETHANA
14	22C31A6614	D. MURALIKRISHNA
15	22C31A6615	DHARAVATH BHUMIKA
16	22C31A6616	DOMMATI DIVYA
17	22C31A6617	D.SAI KALYANI
18	22C31A6618	DUPAKI SIJJU VARMA
19	22C31A6619	GANGARAPU AKSHAYA
20	22C31A6620	GANGULA VAGDEVI
21	22C31A6621	GUGULOTHU SARITHA
22	22C31A6622	GUNTI SRIKANTH
23	22C31A6623	GURRAM BHARGAV
24	**22C31A6624**	**J. AJAY KUMAR**
25	22C31A6625	K. SHIVAVARAPRASAD
26	22C31A6626	KANNE NARESH
27	**22C31A6627**	**KURAKULA MAHENDER**
28	22C31A6628	KURAPATI ASHRITHA
29	**22C31A6629**	**LOKATI PAVAN**
30	22C31A6630	MADISHETTY VIJAYKUMAR
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42	22C31A6642	MOHAMMAD MUSKAN
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53	22C31A6653	PITTA ANJI
54	22C31A6654	PITTA VINAY
55	22C31A6655	POLU INDU
56	22C31A6656	RATHNA RAKESH
57	22C31A6657	RAVULA PRABHAS
58	22C31A6658	SADA ASHOK
59	22C31A6659	SAMBAR VINAY
60	22C31A6660	SAYED SANIYA
61	22C31A6661	SHENKESHI SRIJA
62	22C31A6662	SRIRAM VARA LAXMI
63	22C31A6663	THODUPUNURI SHARVANI
64	22C31A6664	YARA GANESH
65	23C35A6601	BATHIKA DILEEP
66	23C35A6602	GUGGILLA SRIKAR
67	23C35A6603	KOKKONDA SRINITHA
68	23C35A6604	POLABOINA PAVAN SAI
69	23C35A6605	RAINI MARUTHI
70	23C35A6606	TALLA SAGAR

Scheme and solution of internal tests.

5. Evaluation Scheme:

Component 1	Mid Semester Examination	20
Component 2	Assignment Evaluation	10
Component 3**	End Term Examination**	70
	Total	**100**

** The End Term Comprehensive examination will be held at the end of semester. The mandatory requirement of 75% attendance in all theory classes is to be met for being eligible to appear in this component.

MID-1

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Course - B.Tech. Branch - CSM (AI&ML), Year & Sem: III/ I
Subject:Computer networks
Name of the Faculty:Mr.K.Murali sagar

Q.No.	Answer any four questions.	Marks	Level of Bloom Taxonomy	CO
1	Explain the CRC error detection technique using x4+x3+1 and data 11100011	5	Understand	CO1
2	Discuss the guided and unguided media in detail ?	5	Understand	CO2
3	What is network topology ? Explain various network topologies ?	5	Remember	CO1
4	Explain stop ands wait ARQ mechanism in detail ?	5	Remember	CO2
5	Explain about static and dynamic channel allocation ?	5	Analyze	CO2
6	Explain shortest path routing algorithm in detail ?	5	Analyze	CO3

Scheme of Evaluation

III - B.Tech

Mid-1 September-2024

Branch- CSM

Subject- Computer Networks

Max Marks-
Theory -
Objective -
total -

Part - A -[20M]

1Q. Explain the CRC error detection using x^4+x^3+1 and data 1110011

Sol:- CRC Error detection method [2]
solution for problem [3]

2Q. Discuss Guided & unguided media?

Sol: · Definition of Guided media & unguided media [2]
Examples [1]
Explanation of examples [2]

3Q. What is network topology ? Explain various network topology

Sol:- Definition of topology [1]
Star [1]
Bus [1]
Ring [1]
Mesh [1]

4. Explain Stop and Wait ARQ Protocol in detail?

Sol: About Stop and wait protocol [3]
About ~~ARQ~~ mechanism [2]

5. Explain about Static and dynamic Channel allocation?

Sol: Channel allocation problem [1]
Static Channel allocation. [2]
dynamic channel allocation [2]

6. Explain shortest path Routing Algorithm in detail?
shortest path

Sol: · Routing Algorithm Definition [1]
· Explanation & Example [4].

MID-2

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EVALUATION PROCESS: MID –II, December 2024

Course - B.Tech. Branch - CSM (AI&ML), Year & Sem: III/ I

Subject: COMPUTER NETWORKS

Name of the Faculty:Mr.K.Murali Sagar

.No.	Answer any four questions.	Marks	Level of Bloom Taxonomy	CO
1	Give a brief notes on FTP, HTTP,SMTP ,Protocols in application Layer ?	5	Understand	CO5
2	Explain Hierarchical Routing Algorithm ?	5	Understand	CO3
3	What is Flooding and explain Broadcat Routing Algorithm in Network Layer ?	5	Remember	CO3
4	Compare TCP and UDP Along with header format ?	5	Remember	CO4
5	Write short notes on a) DNS b) Resorce Records c) Email	5	Analyze	CO5
6	List the Characteristics of Transport Layer ?and explain Trsport Services ?	5	Analyze	CO4

Scheme of Evaluation

III - B.Tech - I sem

Mid-I December-2021

Subject: Computer Networks

Max Marks : 30
Theory : 20
Quiz : 10
total : 30

PART-A : Marks [20]

1Q: Give a brief note on FTP, HTTP & MTP protocol in application layer?
protocol def [0.5M]

Sol:- FTP Protocol [1.5M]
HTTP protocol [1.5M]
SMTP protocol [1.5M]

2Q: Explain Hierarchical Routing Algorithm in detail

Sol: Routing Hierarchical routing Definition [2M]
explanation of Example [4M]

3Q: What is flooding and Explain Broadcast routing algo?

Sol: Flooding Definition [3M]
Broadcast routing [3M]
Example

4Q Compare TCP and UDP header format.

Sol:- TCP Header format [2.5M]
UDP Header format [2.5M].

5Q:- Write short notes on (a) DNS (b) Resource Records (c) Email.

Sol:- DNS Explanation [2M].
Resource records explanation [2M]
Email explanation [1M].

6Q:- List the characteristics of Transport Layer ? and explain transport services?

Sol:- Transport layer responsibilities [2M].
Explanation of Transport Layer services [3M].

Result analysis for internal exams (tests) with respect toCOs-POs

Mid 1: Markssheet. :

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Course - B.Tech. Branch - CSM (AI&ML), Year & Sem: III/I

Subject:Computer networks

Name of the Faculty: Mr.K.Murali sagar

Q.No.	Answer any four questions.	Marks	Level of Bloom Taxonomy	CO
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3	What is network topology ? Explain various network topologies ?	5	Remember	CO1
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5	Explain about static and dynamic channel allocation ?	5	Analyze	CO2
6	Explain shortest path routing algorithm in detail ?	5	Analyze	CO3

Sl. No.	Roll Number	Name of the Candidate	Marks Awarded						Part - B (Theory-20)	Part - A (Quiz-10)	A+B=30
			Q1	Q2	Q3	Q4	Q5	Q6			
1	22C31A6601	ADEPU SUDHEER KUMAR	5	5	4			5	19	10	29
2	22C31A6602	AJMEERA KUSUMA SRI	5	5	5	4			19	10	29
3	22C31A6603	ALIKANTI SURAJ KUMAR	4	4	4		0		12	9	21
4	22C31A6604	AMAROJU RAVALI	3	4	4	5			16	10	26
5	22C31A6605	ANANDHAPU SRAVANI		4	5	5	4		18	10	28
6	22C31A6606	A. SAHODAR REDDY			5			2	7	9	16
7	22C31A6607	BABBERA RAVALI		3	4		5		12	7	19
8	22C31A6608	BANDAM KEERTHI REDDY			4	4		1	9	9	18
9	22C31A6609	BANDI NAMRATHA		5	5	5		4	19	10	29
10	22C31A6610	BISUPAKA NITHIN							0	5	5

11	22C31A6611	BYRI TRIASWINI	2	2	5			3	12	7	19
12	22C31A6612	CHITTIMALLA SRI RAM							0	5	5
13	22C31A6613	DASARI CHETHANA		5	3	4	4		16	9	24
14	22C31A6614	D MURALIKRISHNA		5			2		7	7	14
15	22C31A6615	DHARAVATH BHUMIKA	5	4	5		4		18	8	26
16	22C31A6616	DOMMATI DIVYA		4		1			5	5	10
17	22C31A6617	D SAI KALYANI		5	5	4	4		18	10	28
18	22C31A6618	DUPAKI SIJU VARMA			2				2	8	10
19	22C31A6619	GANGARAPU AKSHAYA		3	4		4		11	8	19
20	22C31A6620	GANGULA VAGDEVI		4	2	2		4	12	10	22
21	22C31A6621	GUGULOTHU SARITHA	5	5	4	3			17	10	27
22	22C31A6622	GUNTI SRIKANTH		2					2	1	3
23	22C31A6623	GURRAM BHARGAV		4	2	2	1		9	10	19
24	22C31A6624	J. AJAY KUMAR	Absent								0
25	22C31A6625	K. SHIVAVARAPRASAD	4	5		3	3		15	6	21
26	22C31A6626	KANNE NARESH		5	5		4		14	10	24
27	22C31A6627	KURAKULA MAHENDER	Absent								0
28	22C31A6628	KURAPATI ASHRITHA	5		5	5	5		20	10	30
29	22C31A6629	LOKATI PAVAN	Absent								0
30	22C31A6630	MADISHETTY VIJAYKUMAR				2			2	5	7
31	22C31A6631	MALAKUMMARI SHIVA			3		2		5	6	11
32	22C31A6632	MANDA VIGNAN		3	1	1			5	2	7
33	22C31A6633	MANDALA BHAVITHA		5	5			5	15	8	23
34	22C31A6634	MANEM MAHENDAR	5	5	5		3		18	10	28
35	22C31A6635	MD SANIYA	5			4		3	12	10	22
36	22C31A6636	MEKALA SOUJANYA	5			4	3	3	15	10	25
37	22C31A6637	MERUGU KALYAN			2		1		3	3	6
38	22C31A6638	MERUGU SAI SHIVA	4	5	5			5	19	10	29
39	22C31A6639	MD ALTAF HUSSAIN		5		2	2		9	3	12
40	22C31A6640	MD ARSHINAAZ			5	5		5	15	10	25
41	22C31A6641	MD GHOUSE KHAN		5		4			9	3	12
42	22C31A6642	MOHAMMAD MUSKAN		5		3	3	1	12	10	22
43	22C31A6643	MOHAMMED SOHAIL		4	2	2	1		9	9	18
44	22C31A6644	MORAPAKA MANIKANTA		1					1	5	6
45	22C31A6645	M SRI SAI MADHURVIND		5	5	3		2	15	6	21
46	22C31A6646	MUTHUNURI SUNIL	3		5	2		4	14	10	24

47	22C31A6647	N. RISHIVARDHAN		5	2	2	1		10	5	15
48	22C31A6648	NALAMASA NAVEEN		4		1			5	5	10
49	22C31A6649	NALLELLA DEVIKA		5	5	3	3		16	9	25
50	22C31A6650	PALLE JAYARAM	5		5	4	1		15	9	24
51	22C31A6651	PATTABI SHRUTHI		3	5	4	4		16	10	26
52	22C31A6652	PENDRA ASHOK		4		3			7	10	17
53	22C31A6653	PITTA ANJI		4		3			7	9	16
54	22C31A6654	PITTA VINAY	2		4		1		7	10	17
55	22C31A6655	POLU INDU	5		5		4	4	18	10	28
56	22C31A6656	RATHNA RAKESH		5	4		3		12	10	22
57	22C31A6657	RAVULA PRABHAS		4	3	4	4		9	15	24
58	22C31A6658	SADA ASHOK		2		2			4	10	14
59	22C31A6659	SAMBAR VINAY	5		5	5		4	19	10	29
60	22C31A6660	SAYED SANIYA		4	5	3	2		14	10	24
61	22C31A6661	SHENKESHI SRIJA		3	3	1		4	11	9	20
62	22C31A6662	SRIRAM VARA LAXMI	4		3	1	1		9	9	18
63	22C31A6663	THODUPUNURI SHARVANI		3	3		1		7	7	14
64	22C31A6664	YARA GANESH		4	3	2	2		11	10	21
65	23C35A6601	BATHIKA DILEEP		4	4	2			10	9	19
66	23C35A6602	GUGGILLA SRIKAR		3	3		2		8	9	17
67	23C35A6603	KOKKONDA SRINITHA		3	5			4	12	7	19
68	23C35A6604	POLABOINA PAVAN SAI	1	5	3			4	13	8	21
69	23C35A6605	RAINI MARUTHI		3	2	4		3	12	8	20
70	23C35A6606	TALLA SAGAR		4			3		7	8	15

MID –II

ISO: 9001:2015 Certified Institution Estd: 2001

Balaji Institute of Technology & Science

Laknepally, Narsampet, Warangal - 506331

(AUTONOMOUS)

Accredited by NBA (UG – CE, EEE, ME, ECE & CSE) & NAAC A+ Grade

(Affiliated to JNTUH, Hyderabad and Approved by AICTE, New Delhi)

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EVALUATION PROCESS: MID –II, December 2024

Course - B.Tech. Branch - CSM (AI&ML), Year & Sem: III/ I

Subject: COMPUTER NETWORKS

Name of the Faculty: Mr.K.Murali Sagar

Q.No.	Answer any four questions.	Marks	Level of Bloom Taxonomy	CO
1	Give a brief notes on FTP, HTTP,SMTP ,Protocols in application Layer ?	5	Understand	CO5
2	Explain Hierarchical Routing Algorithm ?	5	Understand	CO3
3	What is Flooding and explain Broadcat Routing Algorithm in Network Layer ?	5	Remember	CO3
4	Compare TCP and UDP Along with header format ?	5	Remember	CO4
5	Write short notes on a) DNS b) Resorce Records c) Email	5	Analyze	CO5
6	List the Characteristics of Transport Layer ?and explain Trsport Services ?	5	Analyze	CO4

Sl. No.	Roll Number	Name of the Candidate	Marks Awarded						Part - B (Theory-20)	Part - A (Quiz-10)	A+B=30
			Q1	Q2	Q3	Q4	Q5	Q6			
1	22C31A6601	ADEPU SUDHEER KUMAR	5		4	5	5		19	8	27
2	22C31A6602	AJMEERA KUSUMA SRI		5	5	4	5		19	7	26
3	22C31A6603	ALIKANTI SURAJ KUMAR	5		4	5		4	18	7	25
4	22C31A6604	AMAROJU RAVALI	3	3			3	3	12	8	20
5	22C31A6605	ANANDHAPU SRAVANI	4	5	4	4			17	7	24
6	22C31A6606	A. SAHODAR REDDY	3	4		4			11	7	18
7	22C31A6607	BABBERA RAVALI	2	5	3	5			15	9	24
8	22C31A6608	BANDAM KEERTHI REDDY		4	3	3	1		11	8	19
9	22C31A6609	BANDI NAMRATHA		5	5	3	4		17	8	25
10	22C31A6610	BISUPAKA NITHIN	4		5	5		4	18	8	26

11	22C31A6611	BYRI TEJASWINI	4	2				3	9	7	16
12	22C31A6612	CHITTIMALLA SRI RAM	4	3		5	3		15	7	22
13	22C31A6613	DASARI CHETHANA		3	3	3			9	8	17
14	22C31A6614	D. MURALIKRISHNA		5	5		5	5	20	8	28
15	22C31A6615	DHARAVATH BHUMIKA	4		3	1		1	9	8	17
16	22C31A6616	DOMMATI DIVYA	4		4	5		5	18	9	27
17	22C31A6617	D.SAI KALYANI	3	3		3			9	9	18
18	22C31A6618	DUPAKI SIJU VARMA	5	4		2		2	13	7	20
19	22C31A6619	GANGARAPU AKSHAYA	4		5	5	5		19	7	26
20	22C31A6620	GANGULA VAGDEVI	4	5		4	3		16	8	24
21	22C31A6621	GUGULOTHU SARITHA		2	3		2	2	9	8	17
22	22C31A6622	GUNTI SRIKANTH		2	3	2	2		9	8	17
23	22C31A6623	GURRAM BHARGAV		4	4	4		2	14	8	22
24	22C31A6624	J. AJAY KUMAR	Absent								0
25	22C31A6625	K. SHIVAVARAPRASAD	5	5	5		4		19	8	27
26	22C31A6626	KANNE NARESH	3	3		1		1	8	8	16
27	22C31A6628	KURAPATI ASHRITHA	4	4			5	5	18	8	26
28	22C31A6629	LOKATI PAVAN	Absent								0
29	22C31A6630	M. VIJAYKUMAR	2		3	2			7	7	14
30	22C31A6631	MALAKUMMARI SHIVA	2		3		1	1	7	7	14
31	22C31A6632	MANDA VIGNAN		5	4		3		12	3	15
32	22C31A6633	MANDALA BHAVITHA		4	3		5	5	17	7	24
33	22C31A6634	MANEM MAHENDAR	5	5		5	3		17	5	22
34	22C31A6635	MD SANIYA		5	5			4	14	6	20
35	22C31A6636	MEKALA SOUJANYA	3	4		3		4	14	8	22
36	22C31A6637	MERUGU KALYAN		5		3		4	12	6	18
37	22C31A6638	MERUGU SAI SHIVA		5	5	5	5		20	8	28
38	22C31A6639	MD ALTAF HUSSAIN	3		3	3	4		13	7	20
39	22C31A6640	MD ARSHINAAZ		3	3	3	3		12	8	20
40	22C31A6641	MD. GHOUSE KHAN		4		4		2	10	8	18
41	22C31A6642	MOHAMMAD MUSKAN	4		4	4		3	15	8	23
42	22C31A6643	MOHAMMED SOHAIL		4	5	5		3	17	8	25
43	22C31A6644	MORAPAKA MANIKANTA		5	3				8	7	15
44	22C31A6645	M.SRI SAI MADHURVIND	3	5	3		5		16	4	20
45	22C31A6646	MUTHUNURI SUNIL	5		5	4		4	18	6	24
46	22C31A6647	N. RISHIVARDHAN		3	3	3	3		12	5	17

47	22C31A6648	NALAMASA NAVEEN		3	2		5	3	13	5	18
48	22C31A6649	NALLELLA DEVIKA		3	5		5	5	18	9	27
49	22C31A6650	PALLE JAYARAM	4	3		5		5	17	8	25
50	22C31A6651	PATTABI SHRUTHI	4	3		4	4		15	7	22
51	22C31A6652	PENDRA ASHOK		4	3		4		11	7	18
52	22C31A6653	PITTA ANJI		4	4	4	4		16	8	24
53	22C31A6654	PITTA VINAY		3	3	3		3	12	9	21
54	22C31A6655	POLU INDU	5		4	3		5	17	9	26
55	22C31A6656	RATHNA RAKESH	5		4	4		3	16	8	24
56	22C31A6657	RAVULA PRABHAS		5		5	4	4	18	8	26
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62	22C31A6663	THODUPUNURI SHARVANI		3	2		4		9	8	17
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65	23C35A6602	GUGGILLA SRIKAR		4	3		4		11	9	20
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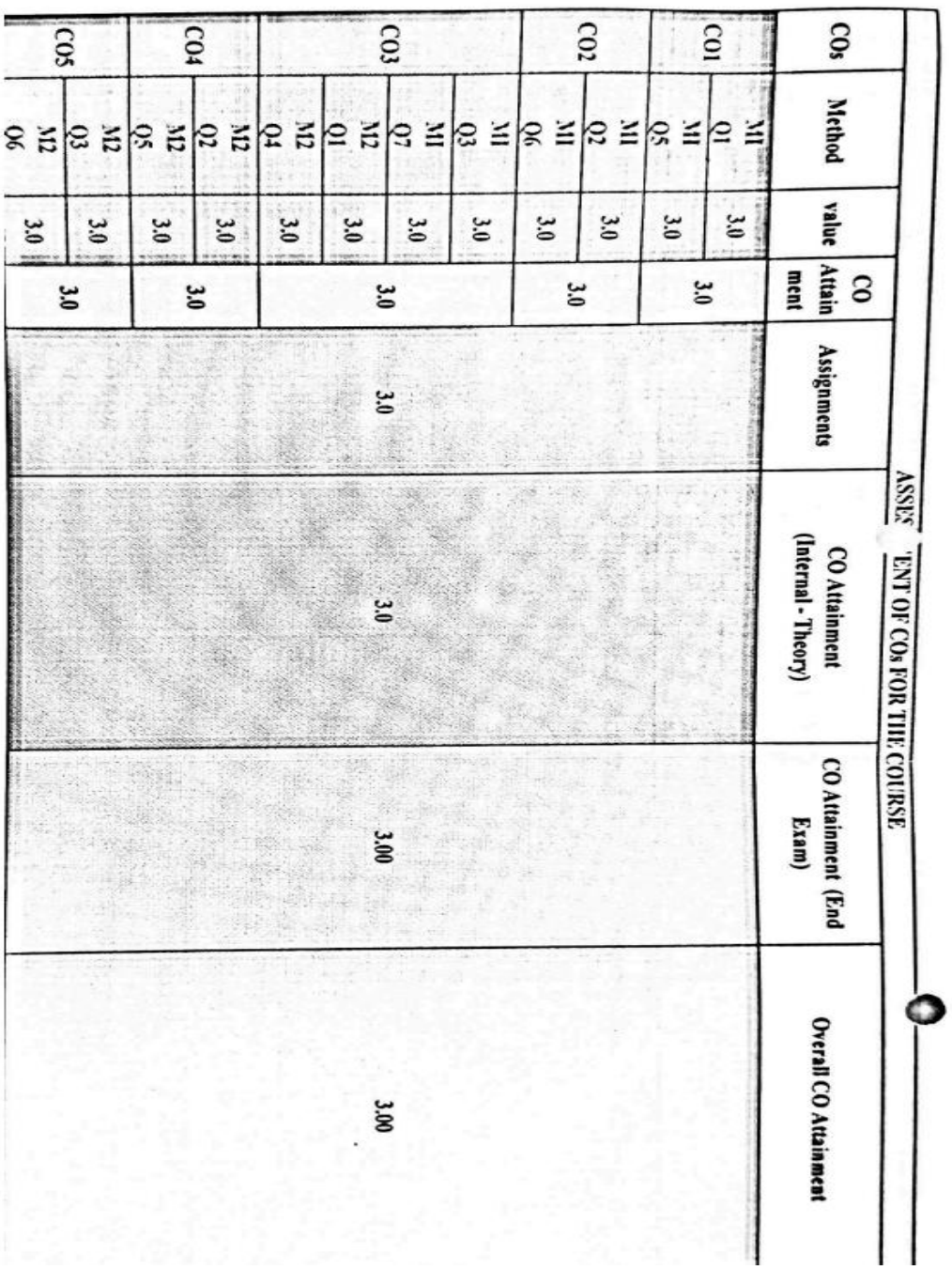
67	23C35A6604	POLABOINA PAVAN SAI	4		4		4		12	8	20
68	23C35A6605	RAINI MARUTHI	3			4	3		14	8	22
69	23C35A6606	TALLA SAGAR	3		3	3			9	8	17

Sign.of Subject Teacher Sign.ofHOD Dean(Academics) Principal

CO and PO attainment sheet



ASSESSMENT OF COs FOR THE COURSE

COs	Method	value	CO Attainment	Assignments	CO Attainment (Internal - Theory)	CO Attainment (End Exam)	Overall CO Attainment
CO1	M1 Q1	3.0	3.0				
	M1 Q5	3.0					
CO2	M1 Q2	3.0	3.0				
	M1 Q6	3.0					
CO3	M1 Q3	3.0	3.0	3.0	3.0	3.00	3.00
	M2 Q7	3.0					
	M2 Q1	3.0					
	M2 Q4	3.0					
CO4	M2 Q2	3.0	3.0				
	M2 Q5	3.0					
CO5	M2 Q3	3.0	3.0				
	M2 Q6	3.0					

GATE/competitive exam questions

GATE SYLLABUS

Computer Networks

Question: - 15%(Average)	**Marks: 15/100(Average)**

Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Here are some examples of GATE-level questions from the subject of Computer Networks:

1. Basic Concepts

Q: Which of the following is the main difference between a router and a switch?

- A) A router operates in the data link layer, whereas a switch operates in the network layer.
- B) A router forwards packets based on IP addresses, whereas a switch forwards frames based on MAC addresses.
- C) A router operates in the transport layer, whereas a switch operates in the application layer.
- D) A router performs error detection, whereas a switch performs flow control.

Answer: B) A router forwards packets based on IP addresses, whereas a switch forwards frames based on MAC addresses.

---

2. OSI and TCP/IP Models

Q: Which layer of the OSI model is responsible for establishing, maintaining, and terminating connections between devices?

- A) Transport Layer
- B) Network Layer
- C) Session Layer
- D) Data Link Layer

Answer: C) Session Layer

---

3. IP Addressing

Q: What is the subnet mask for a network with the address 192.168.1.0/24?

- A) 255.255.0.0
- B) 255.255.255.0
- C) 255.255.255.255
- D) 255.0.0.0

Answer: B) 255.255.255.0

4. Routing Algorithms

Q: In which type of routing algorithm does each router maintain a complete map of the entire network topology?

- A) Distance Vector Routing
- B) Link State Routing
- C) Path Vector Routing
- D) Flooding

Answer: B) Link State Routing

---

5. TCP and UDP

Q: Which of the following is true about TCP?

- A) It is a connectionless protocol.
- B) It provides reliable data transmission.
- C) It does not use flow control mechanisms.
- D) It does not guarantee data order.

Answer: B) It provides reliable data transmission.

---

6. Flow Control

Q: The sliding window protocol in data link layer ensures:

- A) Error-free communication
- B) Reliable data delivery
- C) Flow control
- D) Multiplexing

Answer: C) Flow control

---

7. Error Detection

Q: In which layer of the OSI model does the cyclic redundancy check (CRC) error detection technique primarily work?

- A) Physical Layer
- B) Data Link Layer
- C) Network Layer
- D) Transport Layer

Answer: B) Data Link Layer

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8. Congestion Control

Q: In TCP congestion control, what does the congestion window size determine?

- A) The number of bits that can be sent in a window.
- B) The number of packets that can be sent before acknowledgment.
- C) The size of the retransmission queue.
- D) The number of errors in the transmission path.

Answer: B) The number of packets that can be sent before acknowledgment.

---

9. Subnetting

Q: Given the IP address 172.16.0.0/16, how many possible subnets can be created if 4 bits are borrowed from the host portion of the address?

- A) 16 subnets
- B) 32 subnets
- C) 64 subnets
- D) 256 subnets

Answer: C) 64 subnets

---

10. Network Security

Q: Which protocol is used for secure communication over the Internet by encrypting data?

- A) HTTP
- B) FTP
- C) SSL/TLS
- D) SMTP

Answer: C) SSL/TLS

References, Journals, websites and E-links if any

Textbooks

1. Data Communication & Networking by Forouzan, Tata McGraw Hill.
2. Computer Network, 4e, by Andrew S. Tenenbaum, Pearson Education/ PHI.
3. Data Communication and Computer Networks, by Prakash C.Gupta, PHI.
4. Networking Ali-in-one Desk Reference by Doug Lowe, Wiley Dreamtech

Reference Book:

1. Computer Networking: A Top-Down Approach featuring the Internet, 3e by James F.Kurose.
2. Computer Network by Godbole, Tata McGraw Hill.
3. Computer Networking, by Stanford H. Rowe, Marsha L. Schuh

Other readings and relevant websites

S. No.	Link of Journals, Magazines, websites and Research Papers
1.	https://www.geeksforgeeks.org/computer-network-tutorials/
2.	https://onlinecourses.nptel.ac.in/noc18_cs38
3.	http://www.nptelvideos.in/2012/11/computer-networks.html