INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

VLSI Technology (AV 323)
Electronics and Telecommunication Engineering (VI SEM)
Assignment: Total Marks 20
Date: 17-04-2023

You are allowed to make assumptions with proper justification. There is no part marking. If there is any mistake in the unit or there is a significant step jump, the mark will be considered Zero.

1. A MOS capacitor has metal gate with 5.17eV work function, 100nm SiO_2 and n type Silicon substrate with doping $10^{16}/cm^3$.
   a. If the oxide is having positive fixed oxide charge density of $10^{11}/cm^2$ then calculates the flat band voltage.
   b. Sketch the band diagram when -0.5 V is applied to gate terminal, with substrate.
   c. Sketch the electric field from gate region, going through oxide and into Si (Construct X-Y graph with Electric field on Y axis and distance from gate, going down into substrate, on X axis). There is no need to compute magnitude of electric field; however, you should plot an accurate qualitative representation of electric field behavior.
   d. Corresponding to this the electric field, construct an X-Y graph with Charge density on Y axis and distance from gate on X axis.
   a) State and justify (with proper reasons) whether the MOS capacitor is an accumulation, depletion, weak inversion or strong inversion region.

Mark: 4+4+4+4+4

1. **Given:**

εo =8.854 ×10-14 F/cm

εs=12 for Silicon

Intrinsic carrier concentrations of Si is 1.5 ×1010/ cm3

εox=4 for SiO2

Surface potential and Si potentials are similar.

4.05+0.56+0.36

AV 322 : POWER ELECTRONICS
TEST – II

Time: 60 minutes | *Answer all questions.* | *Maximum marks:30* | *Date: 07 Mar, 2023*

Note : Use linear approximation for all waveforms.

1. The two switch forward converter shown in Fig.1 is operating with the following parameters: Input voltage (Vs)=100V, Load resistance R=2 Ω, L=24 μH. Duty ratio D=0.4. Switching frequency is 50KHz. Primary magnetizing inductance is 4mH. The switches S1, S2, D1 and D2 have a voltage drop of 1V in the ON-state. The diodes D3 and D4 may be considered ideal. Turns-ratio Np:Ns= 1 : 0.25. Evaluate the output voltage and efficiency of power conversion.

(10marks)

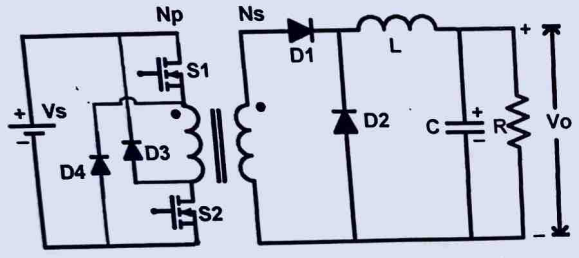


Fig.1

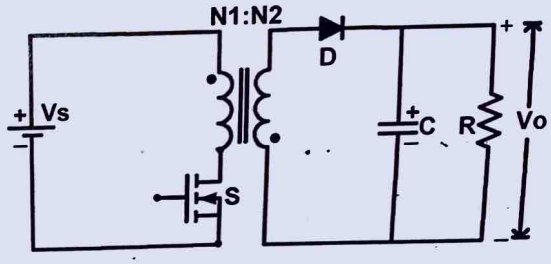


Fig.2

2. A flyback converter operating in DCM is shown in Fig.2. It delivers a voltage of 15V to the load of R=10 Ω Vs=48V. The secondary winding conducts for one half of the OFF time of the active switch (S). The switching frequency is 20KHz. Turns ratio N1:N2= 1:0.5.
   (a) Evaluate primary inductance and secondary inductance.
   (b) Sketch the waveforms of primary current and secondary current and mark all salient points.

(10 marks)

3. The Cuk converter shown in Fig.3 operates in CCM with the following parameters:
   Switching frequency Fs = 100 KHz, Duty ratio D=0.4, Vs=120V, R=10 Ω, L1=54μH, L2=270μH.
   (a) Sketch the waveforms of currents through the MOSFET and diode and mark all salient points.
   (b) If the diode has a forward voltage drop of 0.8 V and MOSFET has an ON-state voltage drop of 0.9V, evaluate the conduction losses in diode and MOSFET. Ignore the effect of switch non-idealities on output voltage while calculating the losses.

(10 marks)

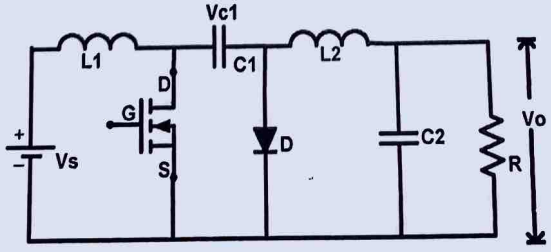


Fig.3

AV322 – Power Electronics: Test-2 April 2023

1. Fig. 1 shows a pulse width modulated H-bridge inverter and its output voltage waveform. The waveform has half- wave symmetry and quarter-wave symmetry.
   (a) Prove that the output voltage will not have 3rd harmonic for all possible values of 'θ'.
   (b) Determine the value of 'θ' if 5th harmonic has to be eliminated from output voltage.
   (c) Evaluate the total harmonic distortion of the output voltage under the condition given in 1(b).

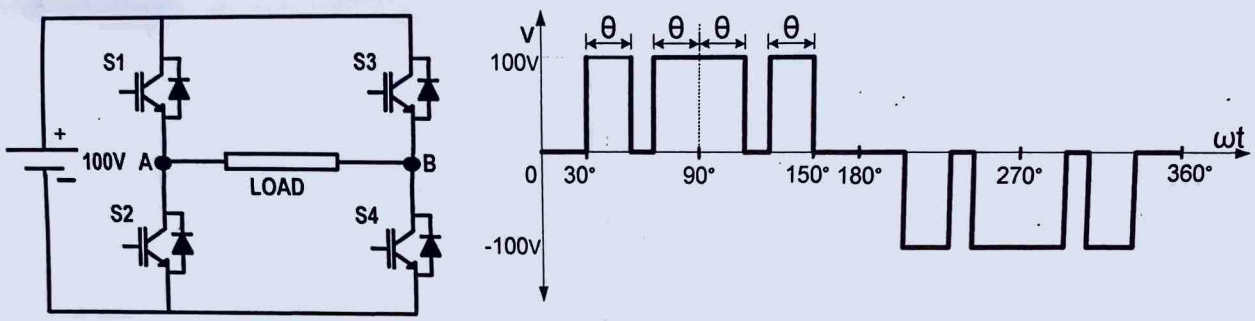


Fig.1

2. A two quadrant drive is shown in Fig.2 . The armature resistance of the motor is 0.6 Ω. Vs=300V. Initially the motor is running at 1200 RPM in the forward motoring mode, drawing a current of 60A. The converter operates at a duty ratio of 0.8 in this mode. Regenerative braking is now employed to bring down the speed to 600 RPM in the forward direction at a constant armature current of 30 A. The field current is kept constant under all conditions. All components are considered to be ideal.
   (a) Determine the range of duty ratio variation during the regenerative braking.
   (b) Evaluate the total power returned to the source due to regenerative braking.

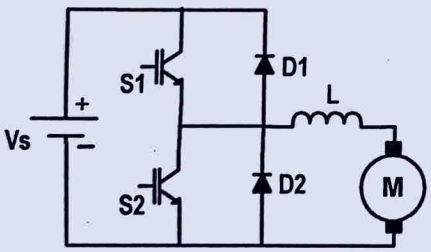


Fig.2

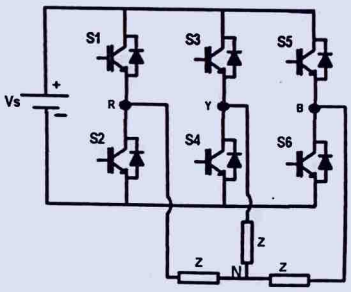
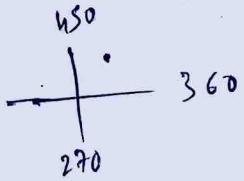


Fig.3

3. A three-phase inverter operated in square wave mode at 50 Hz and supplying a balanced star connected R-L load is shown in Fig.3. Input DC voltage (Vs) = 300V.
   Evaluate the total harmonic distortion (THD) of the phase voltage (V_{RN}).



AV324 - Class Test 2 (5 marks)

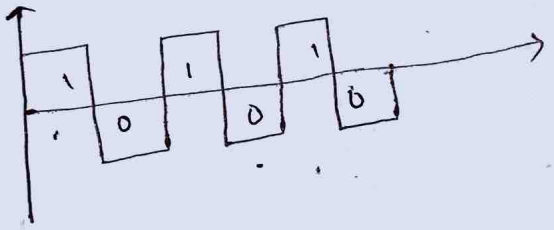
24/5

Name: Bharadwaj Boddu
SC Code: SC20B085

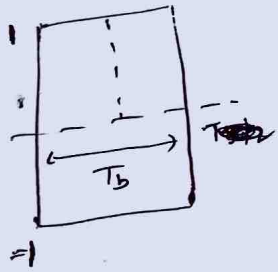
1. (5 marks) Consider a baseband digital communication system that uses a rectangular pulse shape of duration Tb (the bit time) and amplitude 1 for transmitting a 1. The negative pulse shape is used for transmitting a 0.
a) Draw a representative eye diagram of the baseband signal at the transmitter (for a "random" sequence of 0s and 1s).
Assume that timing synchronization is achieved at the receiver for (b), (c), and (d)
b) Suppose the baseband signal is passed through a baseband channel with impulse response $\delta(t) + 0.6\delta(t - 1)$. Draw a representative eye diagram of the baseband channel output.
c) Now, suppose at the output of the channel we have a noise signal N(t) added to the channel output. The noise signal N(t) is IID and at every time N(t) is uniformly distributed in [-0.1,0.1]. Draw a representative eye diagram of the baseband channel output. Do you think the receiver will make errors in this case using the usual detector studied in class? (Answer Yes/No)
d) The noise signal N(t) is IID and at every time N(t) is uniformly distributed in [-0.5,0.5]. Draw a representative eye diagram of the baseband channel output. Do you think the receiver will make errors in this case using the usual detector studied in class? (Answer Yes/No)

A.

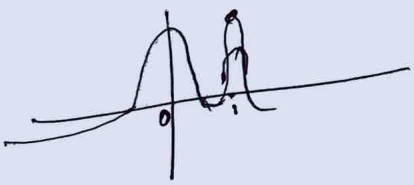
a) Let Random sequence be 101010, T_b - bit time

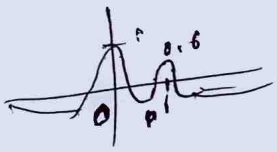


Eye diagram

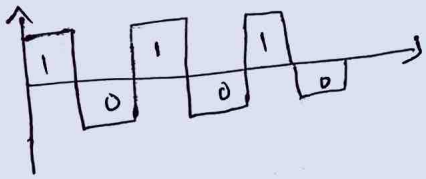


b) $\delta(t) + 0.6\delta(t-1)$

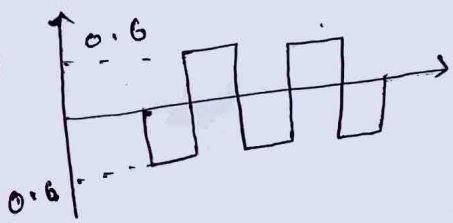


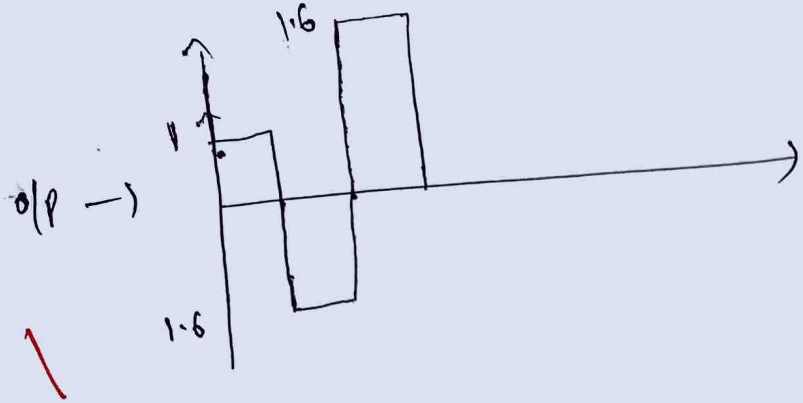


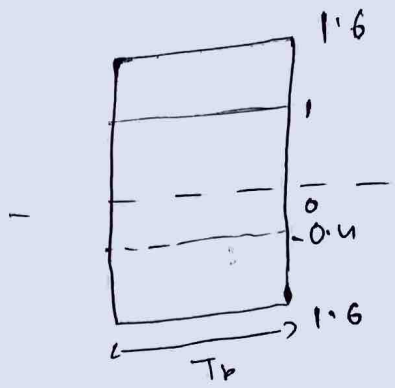
Baseband signal on passing $\delta(t)$



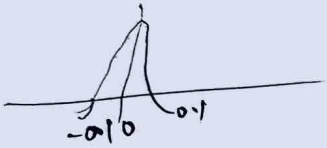
$0.6\delta(t-1)$

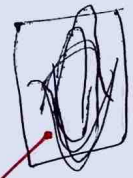






c) ~~0~~ IID from $[-0.1, 0.1]$



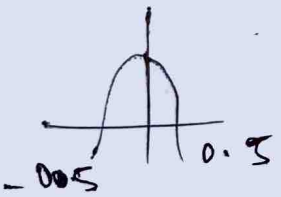


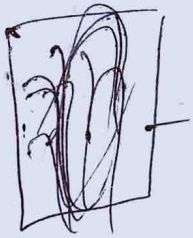
Eye diagram will come like this

Yes. More errors

d) $N(0, 1)$ - $[-0.5, 0.5]$ As here interval increased

Eye diagram will be more disturbed here





Yes. more errors will be than first case

Indian institute of Space Science and Technology

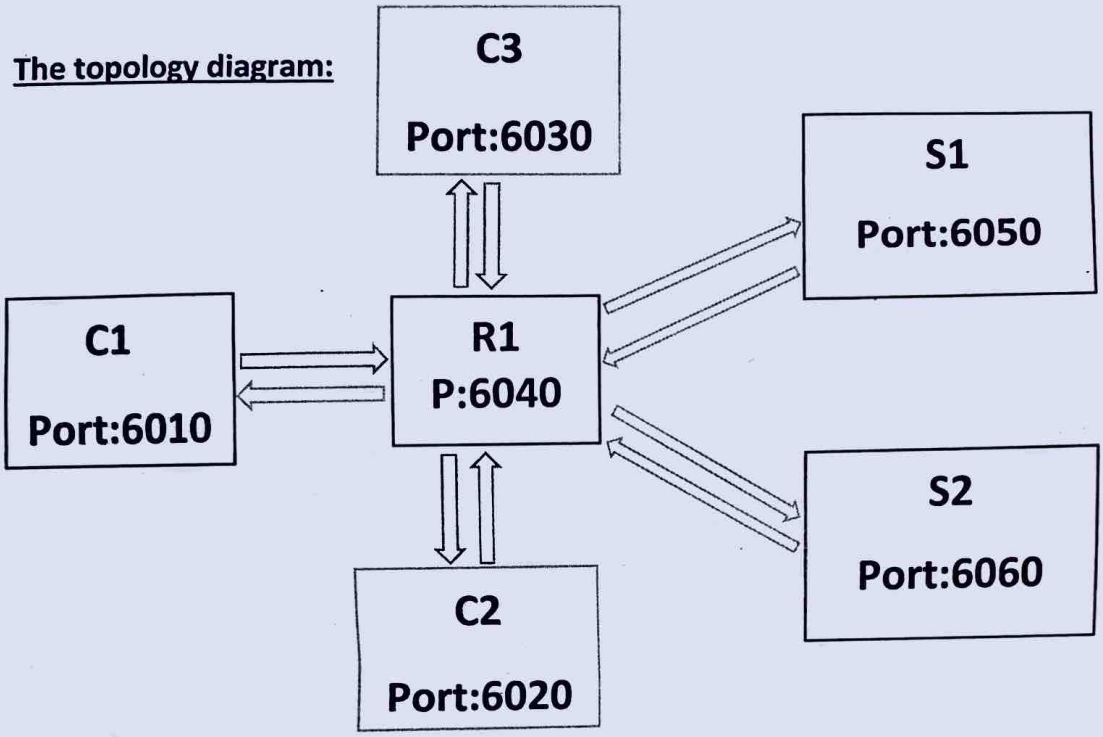
AV 341: Computer Networks Lab Exam

Date: 16/05/2023 **Final Exam** **Duration: 2.5 hr**

Name: SC Code:

Q.DF2345: Create an application layer network topology and router implementation as shown in the figure below with the following requirements.

The topology diagram:



1. All communication between the clients and servers will be performed using UDP.
2. Node 'R1' is the router responsible for forwarding packets between clients and servers. R1 maintains a routing table that specifies the next hop for each destination address.
3. C1, C2, and C3 are the clients that will send requests to the servers. Each client has a unique port number that will be used to send and receive packets.
4. S1 and S2 are the servers that host two application services. Each server has a unique port number that will be used to receive requests and send responses.
5. To distinguish between the different types of packets, design three packet formats:

Instructions:

1. Routing table at R1:

Match fields			Action	Timeout
Type	Source Port	Destination Port	Forward to	In seconds
1	Any client	6050	Destination Port	-
2	Any client	6060	Destination Port	-
3	Any client	6060	6050	-
3	6050	6060	Destination Port	-
1	6050	Any client	Destination Port	-
2	6060	Any client	Destination Port	-

Routing table can be implemented using structure. When a packet comes to R1, the packet is matched in routing table and according to instruction field the packet is forwarded to destination.

Match fields: to match against packets. These consist of the port numbers and packet type.
Type: It can be 1, 2, or 3 according to different applications.
Source Port: Port number of clients or servers where packet is generated
Destination: Port number of clients or servers where packet is going to transmit
Data: Can be message from clients or results from servers
Action: Packet forwarding port number
Timeout: maximum amount of time or idle time before rule is expired.

2. Packet structure:

Type	Source Port	Destination Port	Data

Each packet in the communication need to follow above packet structure.
Type: It can be 1, 2, or 3 according to different applications.
Source Port: Port number of clients or servers where packet is generated
Destination: Port number of clients or servers where packet is going to transmit
Data: Can be message from clients or results from servers

3. S1 server offers one services which is summing the digits. To sum the digits of a number, you add up each individual digit in the number. For example, if the number is 1234, you would sum the digits by adding 1 + 2 + 3 + 4, which equals 10. The sum of the digits of the number 1234 is 10. **The packet type of this service is '1'.**
4. S2 server offers one services which is finding the product of the digits. To find the product of the digits of a number, you multiply each individual digit in the number. For example, if the number is 1234, you would find the product of the digits by multiplying 1 x 2 x 3 x 4, which equals 24. The product of the digits of the number 1234 is 24. **The packet type of this service is '2'.**

5. If a client wants both results, then **the packet type of this service is '3'.** Here, the request from client transmits to S1 1st, after getting the results from S1, the data and results transmit to S2 through R1 (routing table). From S2 both results are transmitted to respective clients.

6. Clients can send the message only to 'R1'.

7. R1 forwards all the message S1 or S2.

8. Further, S1 and S2 process the message and send back the results to R1 and R1 forwards the results to respective clients.
9. The appropriate packet headers should be defined and implemented according to packet structure to identify the source and destination.

Hints: 'R1', 'S1', and 'S2' must use multiprocessing or multithreading.

Indian institute of Space Science and Technology

AV 341: Computer Networks Lab Exam

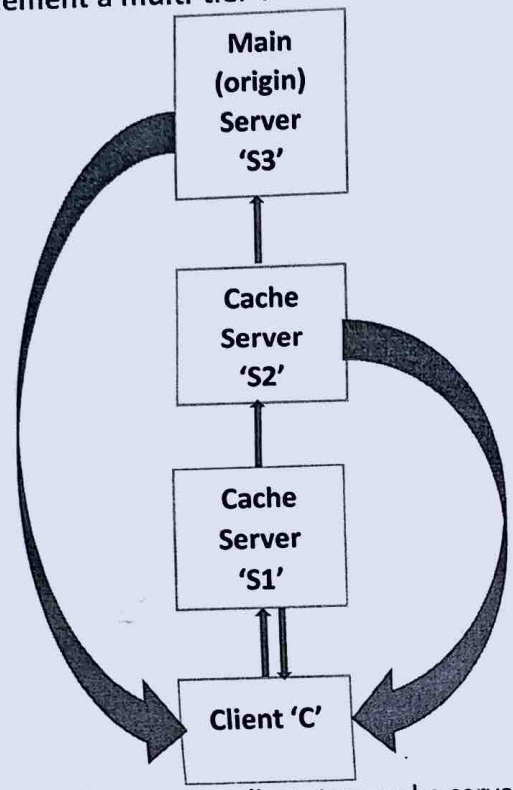
Final Exam

Date: 16/05/2023 **Duration: 2.5 hr**

SC Code: SC 20 B098

Name: N. Chetan pavan Sai

Q.CD3345: Implement a multi-tier web-caching mechanism over UDP.



1. Implement and set up one client, two cache servers, and one main (origin) server using C-based programming and socket programming:

- Create four separate C programs for the client, two cache servers, and main server.
- In each program, create a socket and bind it to a specific port number.
- Use the socket to listen for incoming requests from other programs.
- Use the socket to send requests/responses to other programs.

2. Implement a caching system on the two cache servers that cache frequently searched files:

- When a cache server receives a request for a file, it checks if the file is already present in its cache.
- If the file is present, the cache server sends it to the requesting client.
- If the file is not present, the cache server sends a request to the 2nd cache server.
- If the file is present in the 2nd cache server's cache, it is retrieved and sent back to the requesting cache server and client.
- If the file is not present in any of the caches, the main server is contacted to retrieve the file.

3. Configure the caching system to operate in a multitiered fashion, with a local cache on the 1st cache server, second tier cache on the 2nd cache server, and original files in the original server:

- When a cache server receives a request for a file, a check is in its own cache for the file.
- If the file is present, the cache sends the file to the requesting client. If the file is not present, the cache forwards the request to the second cache server.
- The second cache server checks its cache for the file. If the file is present, second cache replies with the file to the requesting client. If the file is not present, the second cache sends a request to the main (origin) server.
- The main server retrieves the requested file and sends it to the requesting client.

4. Implement the UDP protocol for communication between the client, cache servers, and the origin web server:

- Use the UDP protocol for all communication between the client, cache servers, and main server.
- Ensure that all programs are able to receive and send UDP packets using the sockets.

Indian institute of Space Science and Technology

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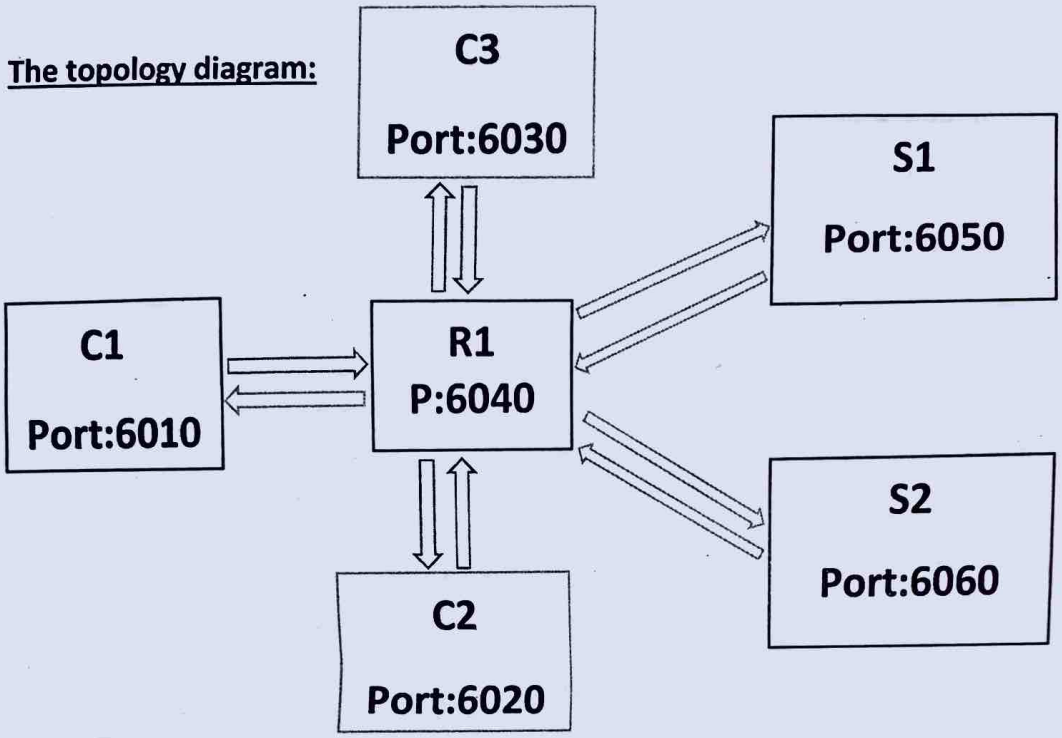

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