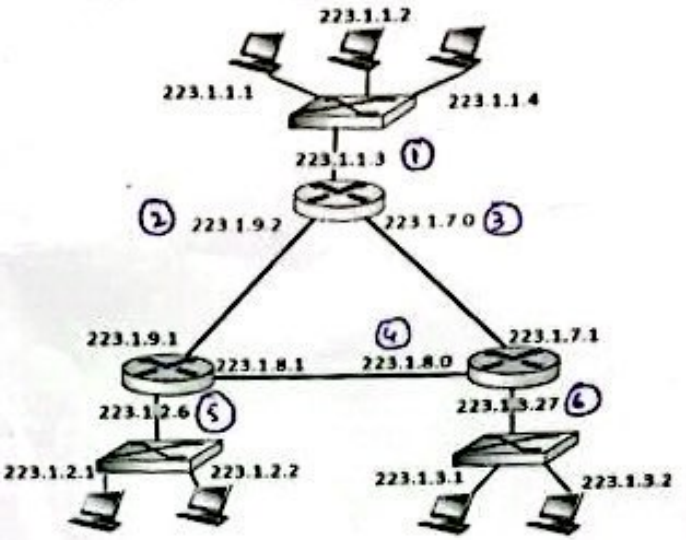
3 + 12 = 15 Marks

...ow given diagram as a corporate network. Answer the following questions.

...w many subnets are there? 6

...hile considering the network prefix (no. of network bits) /24. Provide details against every subnet according to provided format.

Network ID _____, Broadcast ID _____, Subnet Mask _____, First Valid IP _____, Last Valid IP _____, Total no. of Valid IPs of subnet _____.



	Network ID	Broadcast ID	Subnet Mask	First Valid IP	Last Valid IP	Total valid IP of subnet
1)	223.1.1.0	223.1.1.255	255.255.255.0	223.1.1.1	223.1.1.254	254
2)	223.1.9.0	223.1.9.255	255.255.255.0	223.1.9.1	223.1.9.254	254
3)	223.1.7.0	223.1.7.255	255.255.255.0	223.1.7.1	223.1.7.254	254
4)	223.1.8.0	223.1.8.255	255.255.255.0	223.1.8.1	223.1.8.254	254
5)	223.1.2.0	223.1.2.255	255.255.255.0	223.1.2.1	223.1.2.254	254
6)	223.1.3.0	223.1.3.255	255.255.255.0	223.1.3.1	223.1.3.254	254

Final

Q no. 5

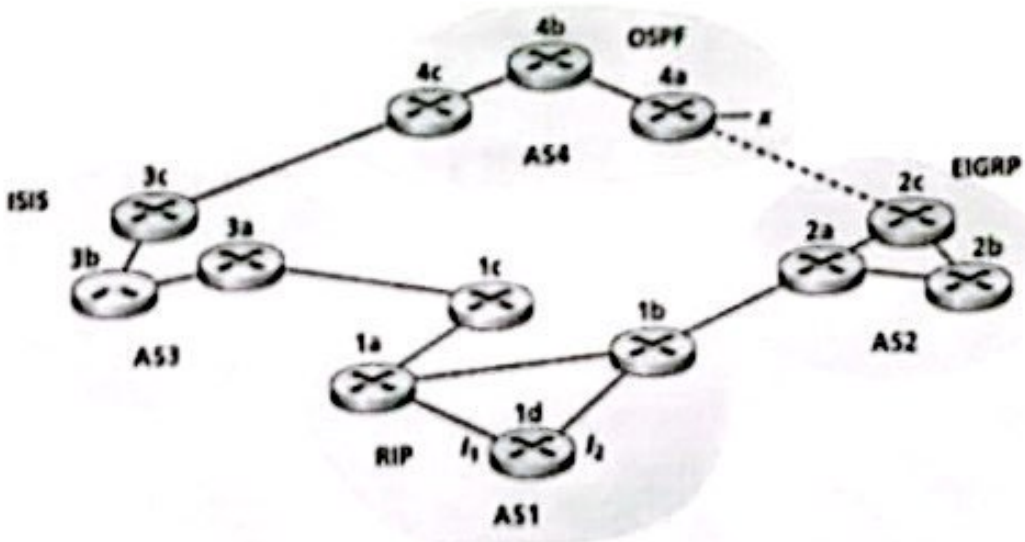
a. What is the reason behind the server being blocked to send data to the client.
As a flow control mechanism when the finite buffer of the client runs out, it sets rwnd to zero in the ACK segment it sends to the server. The server after receiving ack with rwnd=0 will blocked from further sending data to the client.

b. How can the server be unblocked?
Server sends a one byte data segment to the client. if the client has freed some space in the receiving buffer then it will send ack with rwnd>0. Server receiving ack with rwnd>0 will be unblocked.

Q. no. 6

Question 6	3 + 3 = 6 Marks

Consider the network shown below. Suppose there are four autonomous systems AS1, AS2, AS3, and AS4, they are running RIP, EIGRP, ISIS, OSPF respectively for their routing tasks. Although they might use BGP as well for additional routing tasks. Suppose there is no physical link between AS2 and AS4. **Note:** Do must mention BGP variant name for answers.

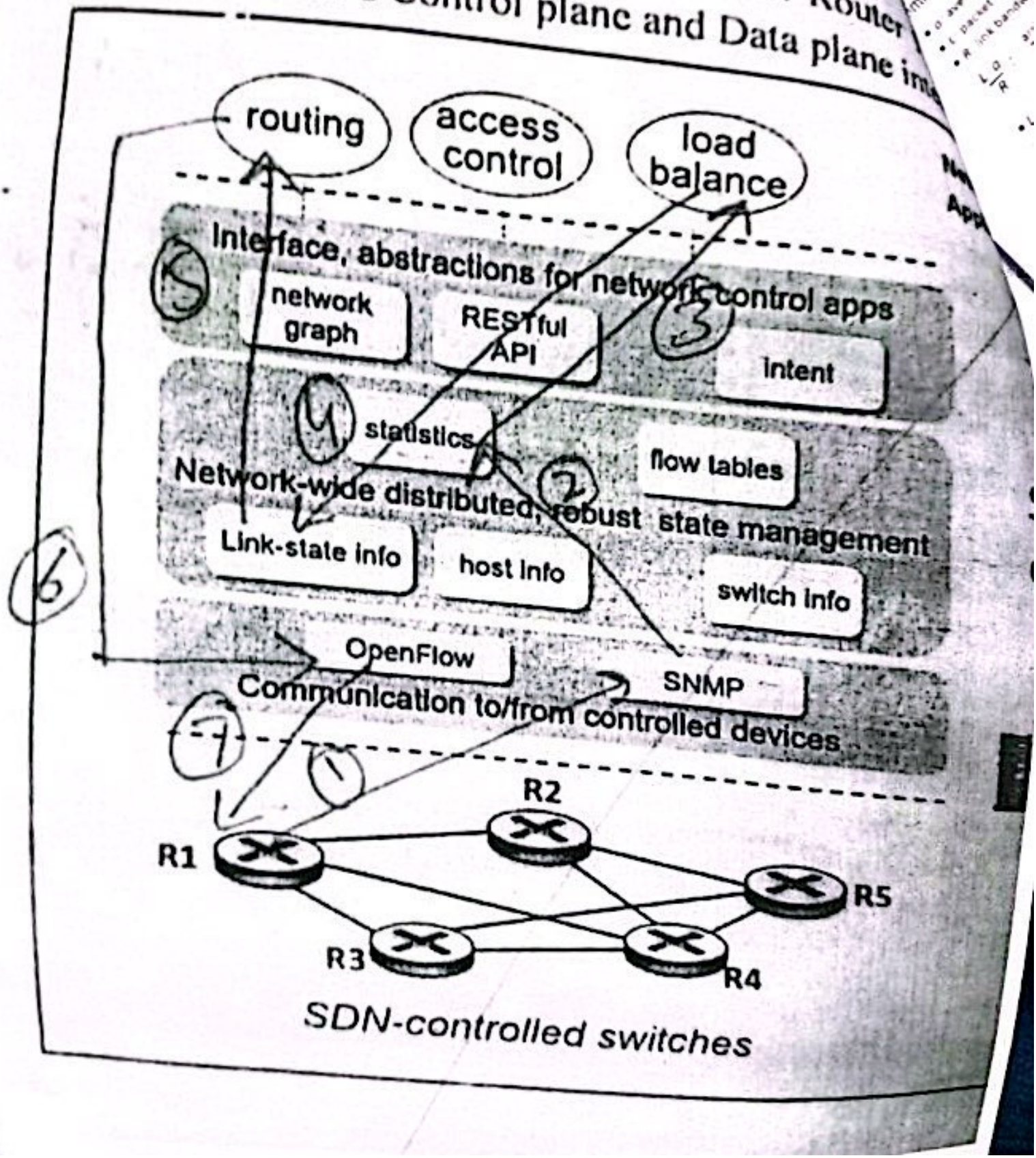


i. Router 4b learns about prefix x from which routing protocol?

OSPF

CLO3

ork with multiple servers and switches managed by an
nd not uniformly distributed. To make the most use of
p incoming traffic across many servers. Bottlenecks and
ic paths in response to real-time load statistics. Router
lancing. Draw an SDN's Control plane and Data plane im



Question 5	CLO3	07 Marks

In a network, a router has an input link with a bandwidth of 100 Mbps (megabits per second). The average packet size is 2000 bits, and the average packet arrival rate is 100 packets per second. Calculate the traffic intensity for this network and comment on the impact on traffic intensity you get.

- a: average packet arrival rate
- L: packet length (bits)
- R: link bandwidth (bit transmission rate)

$\frac{L \cdot a}{R}$: $\frac{\text{arrival rate of bits}}{\text{service rate of bits}}$ *"traffic intensity"*

- $La/R \sim 0$: avg. queueing delay small
- $La/R \to 1$: avg. queueing delay large
- $La/R > 1$: more "work" arriving is more than can be serviced - average delay infinite!

Traffic intensity (ρ) = (Average packet arrival rate * Average packet size) / Link bandwidth

ρ = (100 packets/second * 2000 bits/packet) / (100 Mbps * 10^6 bits/Mbps)=> ~~ρ=0.2~~ → $\rho = 0.002$

Impact of the calculated traffic intensity:

- Traffic intensity is 0.2, which means the link is 20% utilized.
  - There is still 80% of the link's capacity available for additional traffic.
- Traffic intensity ~0: average queueing delay is small.
  - This indicates a relatively low level of congestion at this point.
  - The network is operating well within its capacity.

ii. Router 3a learns about *x* from which routing protocol?

iBGP

iii. Router 1d learns about *x* from which routing protocol?

iBGP

iv. Router 1c learns about *x* from which routing protocol?

eBGP

v. Router 2c learns about *x* from which routing protocol?

iBGP

vi. Router 2c learns about 2a from which routing protocol?

EIGRP

National University of Computer and Emerging Sciences, Chiniot-Faisalabad Campus

FINAL

Course Name:	Computer Networks	Course Code:	CS3001
Degree Program:	BS(CS)	Semester:	Fall 2023
Exam Duration:	135 Minutes	Total Marks:	110
Paper Date:	Wednesday, December 20, 2023	Obtained Marks	
Sections:	A, B, C	No of Page(s):	05
Exam Term & Type:	Final Term I Closed Book	Required Answer Book: No	
Course Instructor	Dr. Umar Aftab and Miss Sumaira Mustafa		

Vetted By: Vetter Signature:

Student: Name:_____ Roll No._____ Section:_____

Instruction/Notes: Attempt all questions. The exam contains two parts Objective (Q1) and Subjective (Q2-Q8) printed on five (05) pages including this title page.

	Q-1 (Obj)	Q-2	Q-3	Q-4	Q-5	Q-6	Q-7	Q-8	Total
Total Marks	40	15	07	08	07	06	12	15	110
Marks Obtained									

Question 2 | CLO2 | 5 + 10 = 15 Marks

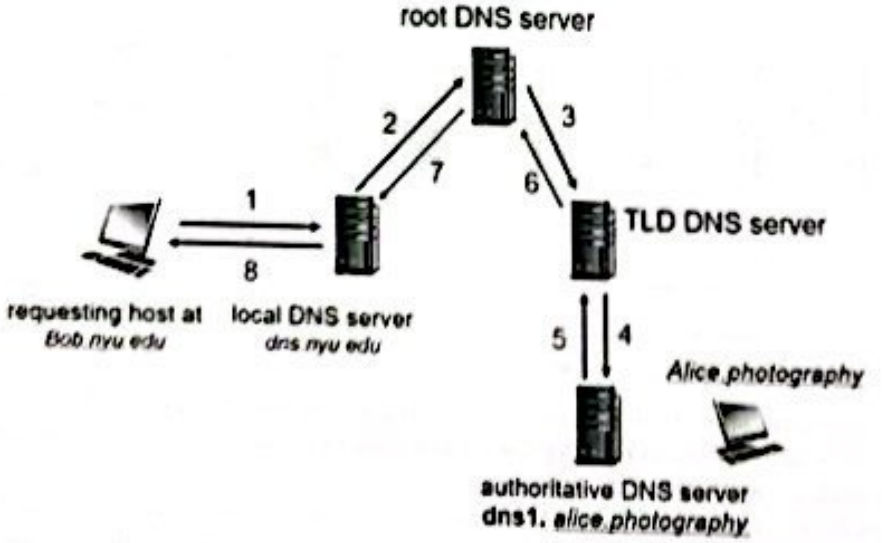
A. Alice wants to register her new website, alice.photography, with an IP address of 192.168.1.100. She contacted her domain registrar for the DNS registry. Write steps, which are required for this task sequentially. [5 Marks]

Register name alice.photography at *DNS registrar* (e.g., Network Solutions)

- provide names, IP addresses of authoritative name server (primary and secondary)
- registrar inserts NS, A RRs into .com TLD server:

i. **(alice.photography, dns1, alice.photography, NS)**
ii. **(dns1. alice.photography, 192.168.1.100 , A)**

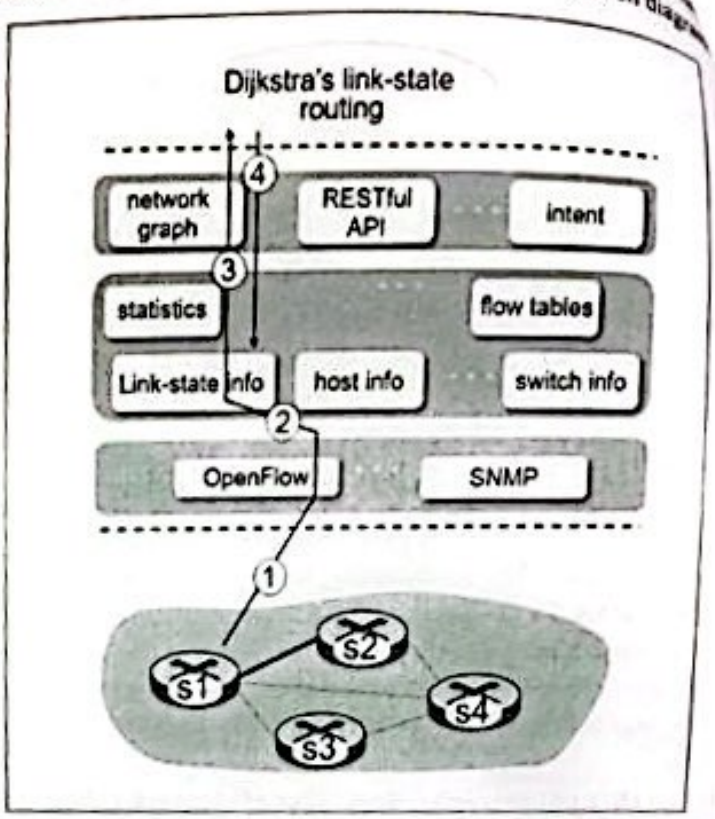
B. Bob wants to visit Alice's website for the first time. He opens his web browser and types "alice.photography" in the address bar. How your browser will fetch this website, assume it is running a Recursive DNS Query. Explain with diagram ONLY. [10 Marks]



Question 3	CLO3

A data center network with multiple servers and switches managed by an SDN controller (Open flow). The burden is variable and not uniformly distributed. To make the most use of available resources and avoid one server, divide up incoming traffic across many servers. Bottlenecks and packet loss can be prevented by modifying the traffic paths in response to real-time load statistics. Router 1 has experienced a congestion triggered for load balancing. Draw an SDN's Control plane and Data plane interaction flow on the given diagram.

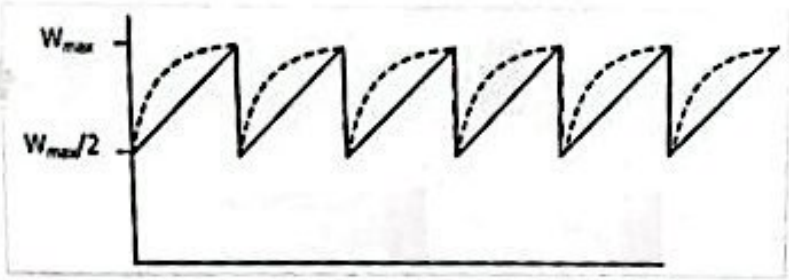
1. S1, experiencing link failure uses OpenFlow port status message to notify controller
2. SDN controller receives OpenFlow message, updates link status info
3. Dijkstra's routing algorithm application has previously registered to be called when ever link status changes. It is called.
4. Dijkstra's routing algorithm access network graph info, link state info in controller, computes new routes
5. link state routing app interacts with flow-table-computation component in SDN controller, which computes new flow tables needed
6. controller uses OpenFlow to install new tables in switches that need updating



Question 4	CLO2	5 + 3 = 08 Marks

TCP CUBIC is commonly used as an alternative to classic AIMD TCP congestion control.

A. With the aid of a diagram showing window size over time, compare how CUBIC differs from classic AIMD TCP congestion control. [5 marks]



B. Considering the diagram used in a) discuss how the CUBIC approach improves performance for a flow on a link with very large bandwidth-delay products. [3 Marks]

Large bandwidth-delay products (BDPs) mean packets take a long time to travel and return, making AIMD's sawtooth pattern inefficient. Frequent halving due to late losses can starve flows of bandwidth.

CUBIC shines in such scenarios:

- The smooth, gradual decrease in window size after packet loss avoids unnecessary starvation.
- The decreasing rate of window growth prevents overshooting and helps find the optimal bandwidth utilization point.
- The "probing window" concept allows small, controlled increases to probe for available bandwidth even when below the current window size.

This combination helps CUBIC achieve smoother and more efficient performance for flows on links with large BDPs.