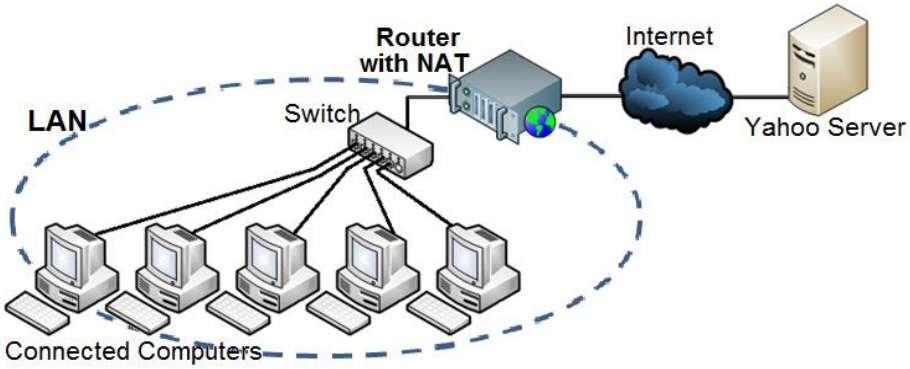
University of Technology
Department of Computer Sciences
Final Examination 2011-2012

Subject: ***Principles of Network Algorithms*** *Year:* ***2011- 2012***
Division: ***Network Management – 1st Class*** *Time:* ***3 Hours***
Examiner: ***Dr.Mazin S. Ali*** *Date:* ***22 / 5 /2012***

Answer 6 Questions Only

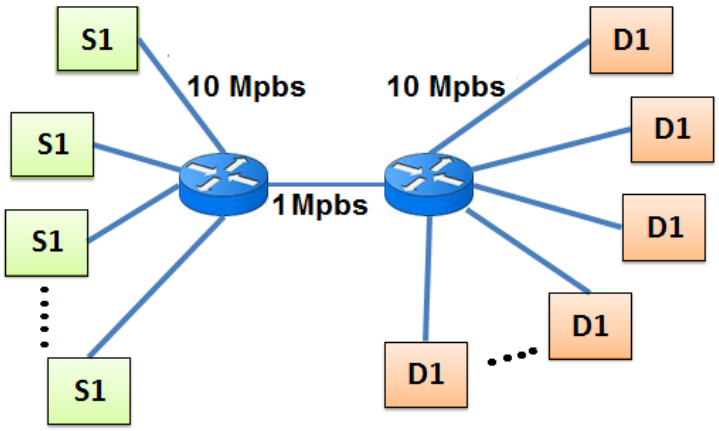
Q1: If we have the following network diagram, and if the connected computers have been assigned with 192.168.0.x as a private IPv4 Addresses:



Answer the following:

1. Address all the connected computers with IPv4 Addresses. **(4 marks)**
2. Address the network Gateway with IPv4 Address. **(1 mark)**
3. Assign suitable Public IPv4 Addresses with Dynamic NAT. **(5 marks)**

Q2: A: If we have the following network; In your opinion, is there a problem in packet traffic? Then if there is a problem, why it occurs and how can be solving it. **(5 marks)**



B: Why we use Ping tool? And how can be used under Windows OS? **(5 marks)**

يتبع في الصفحة التالية...

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Q3: Compare between the following (Choose **5** only): **(2 marks for each one)**

1. HUB and Switch Devices.
2. TCP and UDP protocols.
3. Switch and Router Devices.
4. IP v4 and IP v6.
5. FIFO and MUCF schedule algorithms.
6. Distance-Vector (DV) and Link-State Routing (LS) Protocols.

Q4: Define the following higher-level core network protocols (Choose **5** only):
(2 marks for each one)

1. ICMP (Internet Control Message Protocol).
2. OSPF (Open Shortest Path First).
3. RTP (Realtime Transport Protocol).
4. SMTP (Simple Mail Transfer Protocol).
5. IP Protocol (Internet Layer- IP Protocol).
6. Dual-Stack Protocols Approach.

Q5: Define the following routing concepts (Choose **5** only): **(2 marks for each one)**

1. Adaptive Routing.
2. Routing Table Shadow (Local) Copy.
3. MUCF (Most Urgent Cell First) Schedule Routing Algorithm.
4. Screening Router.
5. Stable Marriage Algorithms.
6. Routing Table Lookup.

Q6: According to the following Router specifications:

- Input / Output Ports (Number of Linecards) are 8 Ports.
- Combined Input and Output Queued (CIOQ) Switches.
- Crossbar Interconnection Switching Fabric.
- Line-rate is 1Gb/s.
- 50 User maximum.
- Network Centric Bandwidth.

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- Routing Transaction's Prefixes:-

a : 0*	b : 01000*	c : 011*	d : 1*
e : 100*	f : 1100*	g : 1101*	h : 1110*

Answer the following:

a. Draw (with brief description) the high-level of Decentralize Router Architecture. **(4 marks)**
b. What is the Speed-Up of your designed Decentralize Router? **(1 mark)**
c. Construct the 1-Bit Trie Prefixes Tree. **(2 marks)**
d. Construct the Compressed 1-Bit Trie Prefixes Tree. **(3 marks)**

Q7: According to the following Router specifications:

- Input / Output Ports (Number of Linecards) are 8 Ports.
- Combined Input and Output Queued (CIOQ) Switches.
- Crossbar Interconnection Switching Fabric.
- Line-rate is 2.5Gb/s.
- 75 User maximum.
- User Centric Bandwidth.
- Routing Transaction's key:-
  "bear", "bell", "bid", "ted", "bull", "buy", "sell", "stock", and "stop".

Answer the following:

a. Draw (with brief description) the high-level of Centralize Router Architecture. **(4 marks)**
b. Calculate the Capacity of your designed Decentralize Router. **(1 mark)**
c. Construct the 1-Bit Trie Keys Tree. **(2 marks)**
d. Construct the Compressed 1-Bit Trie Keys Tree. **(3 marks)**

- Good Luck -

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Solutions

Q1

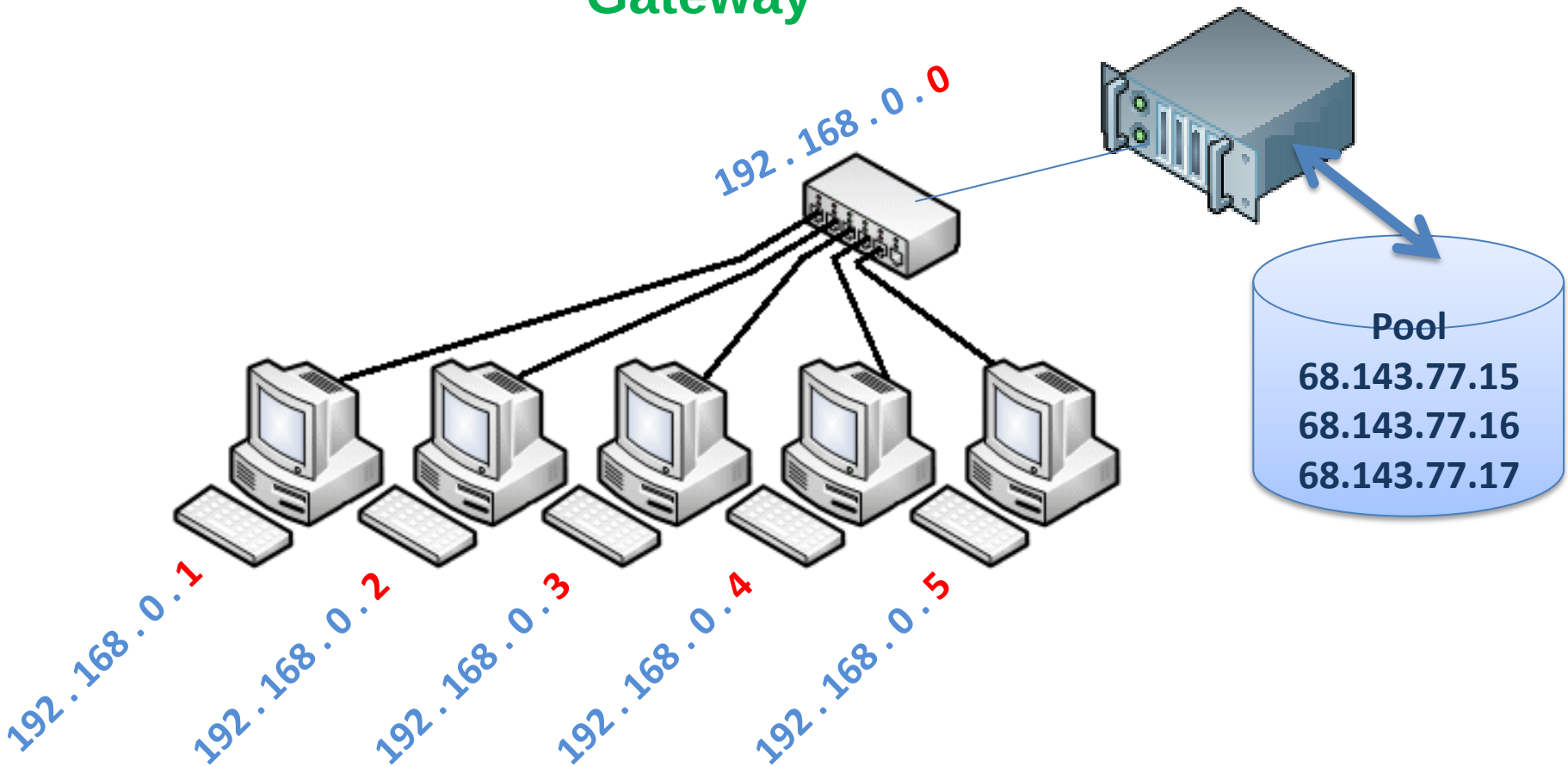
Class C

192 . 168 . 40 . 3 **IP Address**

255 . 255 . 255 . 0 **Subnet Mask (/24)**

AND

192 . 168 . 40 . 0 **Gateway**



Q2/ A:

The basic idea is how to congested network with many users.

So there are 2 problems will be appears:

- How can allocate bandwidth fairly between the users
- How can control queue size and hence delay

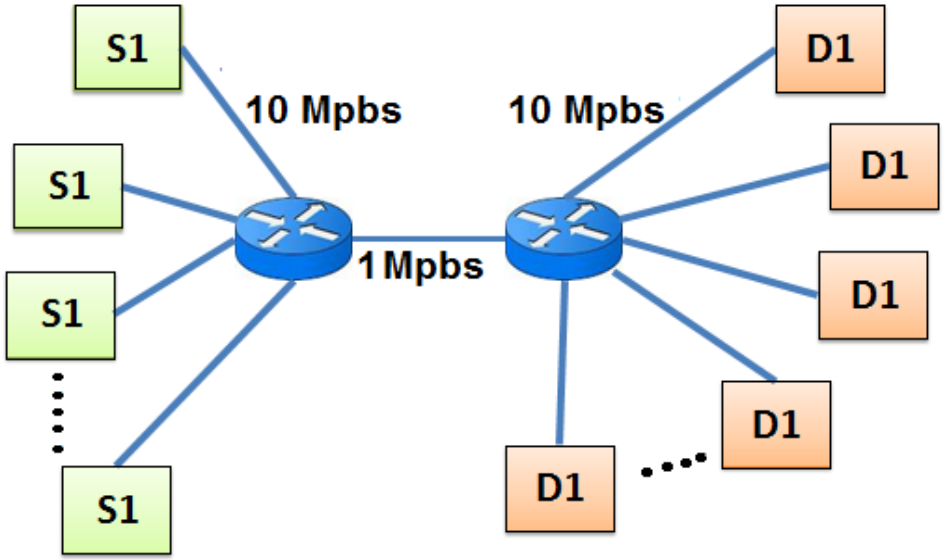
To solve the problems we need to partitioning the bandwidth, however we have 2 approaches, can select any one of them:

Network-Centric

We can divide the bandwidth depending on number of users (frequency division).

User-Centric

We can divide the bandwidth depending on time (time division).



Q2/ B:

Ping is a useful tool for testing, it’s dealing with ICMP to test the reachability of a host on a network and to measure the round-trip time for messages sent from the host to a destination computer.

On any machines running Windows x, ping can be accessed via a DOS prompt.

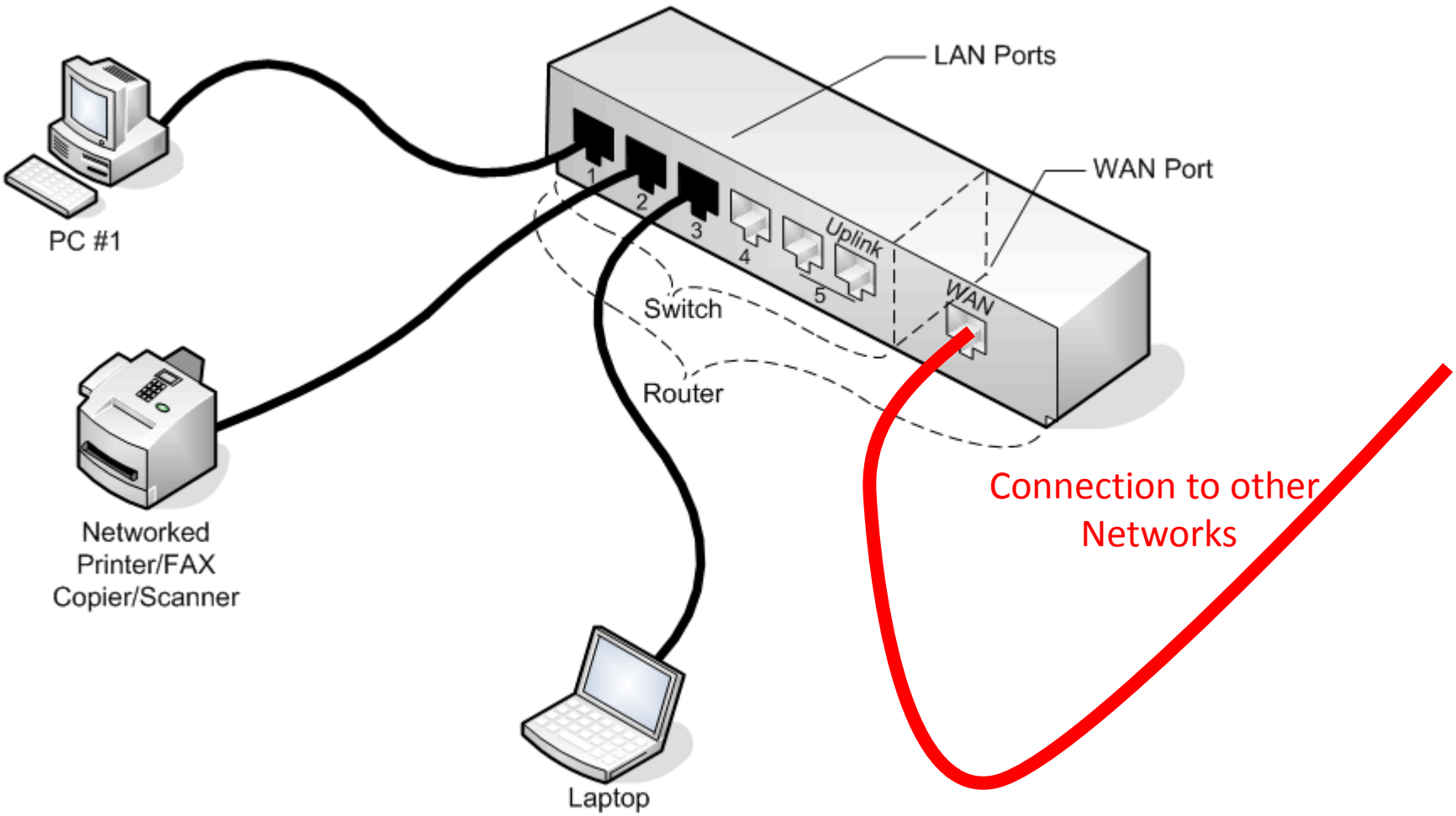
Select "Run..." from the Start menu and type command "cmd". Once you're at the DOS prompt, type "ping Host-Address".

```
ping   yahoo.com
```

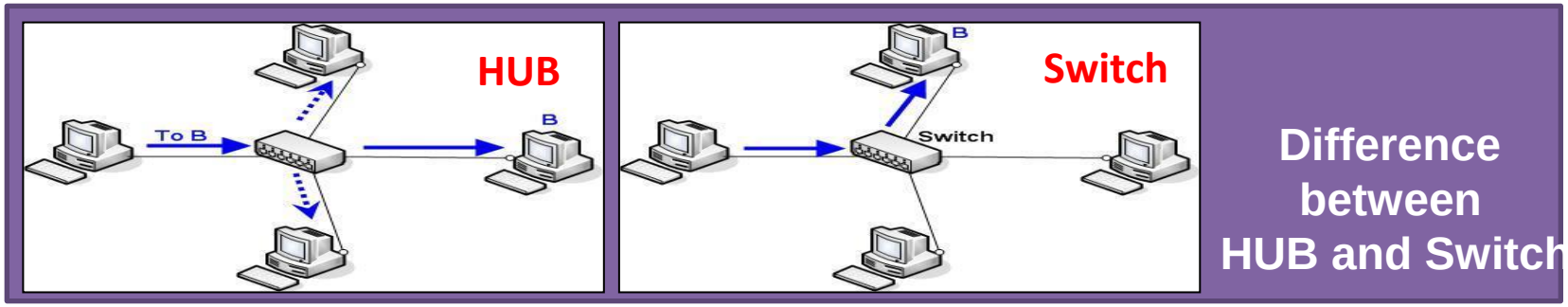
```
# ping yahoo.com
    PING yahoo.com (204.71.202.160): 56 data bytes
    64 bytes from 204.71.202.160: icmp_seq=0 ttl=246 time=108.0 ms
    64 bytes from 204.71.202.160: icmp_seq=1 ttl=246 time=102.3 ms
    64 bytes from 204.71.202.160: icmp_seq=2 ttl=246 time=102.6 ms
    64 bytes from 204.71.202.160: icmp_seq=3 ttl=246 time=105.5 ms
    64 bytes from 204.71.202.160: icmp_seq=4 ttl=246 time=103.9 ms
    --- yahoo.com ping statistics ---
    5 packets transmitted, 5 packets received, 0% packet loss
    round-trip min/avg/max = 102.3/104.4/108.0 ms
```

Q3:

Switch and Router



Q3:



TCP is a reliable connection-oriented protocol, that offers error correction when deliver the stream originating on one machine to the other machine in the network.

UDP is an unreliable connectionless protocol, that deliver stream originating on one machine to the other machine in the network based one-shot philosophy.

Since the 4.2 billion IPs of **IPv4** will not be enough in the near future with the development and the rapid increase of users of computer, phones, gaming consoles and many other devices which connected to Internet.
This has been the development of the **IPv6**, which can distribute approximately 6 trillion IPs.

Queuing the packets as packet-by-packet under a stable **FIFO** (**First In First Out**) schedule algorithm.
Queuing the packets based their most urgent packets under a unstable **MUCF** (**Most Urgent Cell First**) schedule algorithm.

Distance-Vector (DV) Routing Protocol (**Simple and efficient in small networks and require little management, but it have count-to-infinity problem**).
Link-State (LS) Routing Protocol (**More scalable for use in large networks, but more complex**).

Q4:

1. **ICMP:** It's used by the computer Oss to send error messages indicating
2. **OSPF:** It's an adaptive network routing protocol which operating within a single autonomous system
3. **RTP (Realtime Transport Protocol):** It's an application protocol to delivering audio and video over networks
4. **SMTP (Simple Mail Transfer Protocol):** It's an application protocol for e-mail transmission between devices
5. **IP** defines an official packet format and provides IP Addresses
6. all of Servers must be available over both IPv4 and IPv6, and much of Internet devices will run IPv4 and IPv6 simultaneously (this called **Dual-Stack approach**).

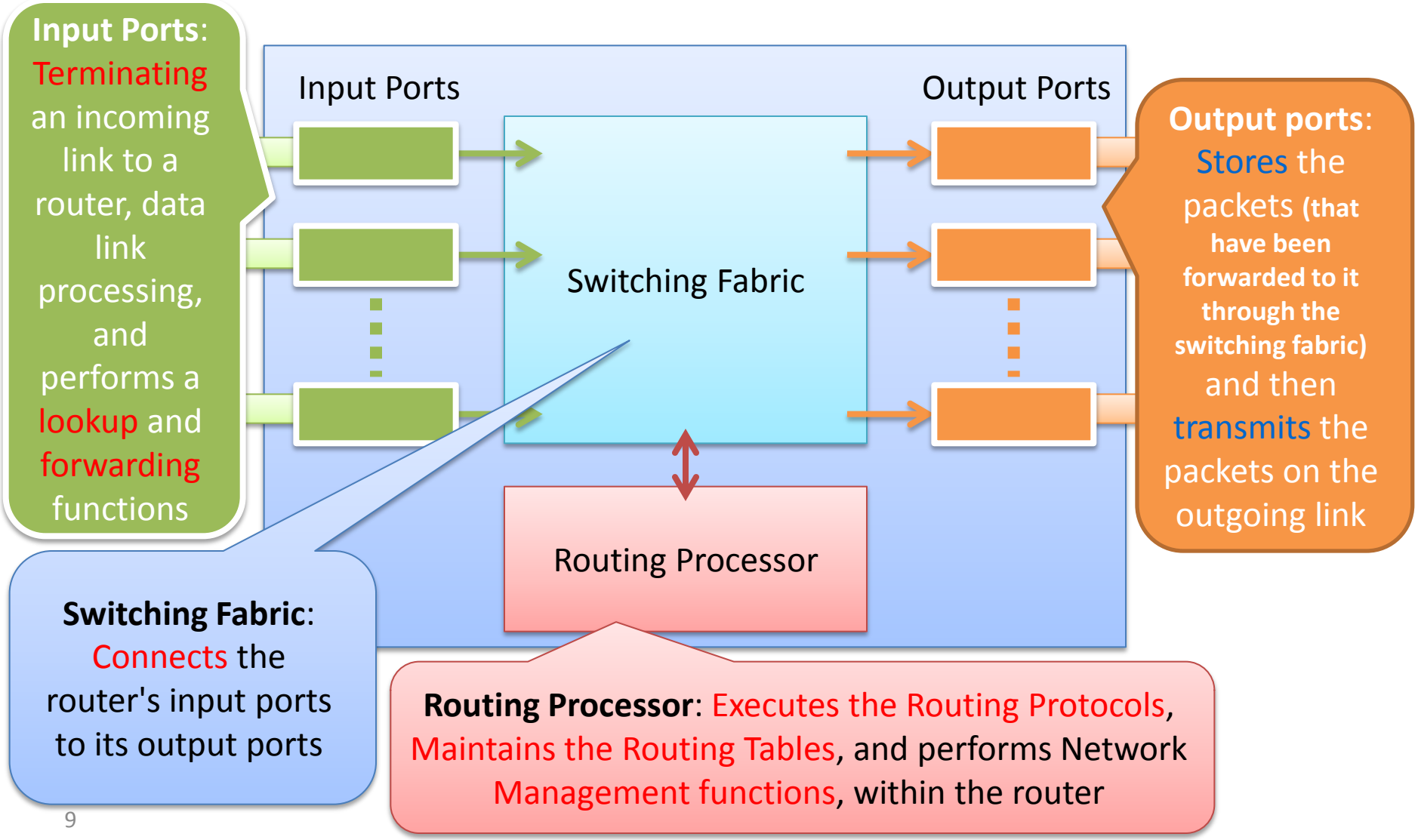
Q5:

1. Dynamic Routing (Adaptive Routing): The system adds routs to the routing table automatically, the adaptation is allow to rerouting the routing table when automatically
2. A shadow copy (local copy) of the routing table is stored at each input port and updated (as needed) by the routing processor. With shadow copies (local copies) of the routing table, the switching decision can be made locally, at each input port, without invoking the centralized routing processor.
3. Queuing the packets based their most urgent packets under a unstable **MUCF** (Most Urgent Cell First) schedule algorithm
4. **Screening Router**: it's a router that performs packet filtering to see whether a packet is part of an existing stream of traffic. Also, it can filters each packet based only on information contained in the packet itself.
5. Most, if not all, switch scheduling algorithms use stable marriage algorithms (SMAs) like "Gale-Shapley Algorithm (GSA)".
6. The routing table (routing metrics, or routing distances) contains information about the topology of the network immediately around the router.

Q6:

3. Router Architecture

A high-level view of Router Architecture is shown below.



Q6: const.

Suppose we consider switches with fabric speedup of S, so the fabric speedup for CIOQ equles **$1 < S \ll N$**

CIOQ

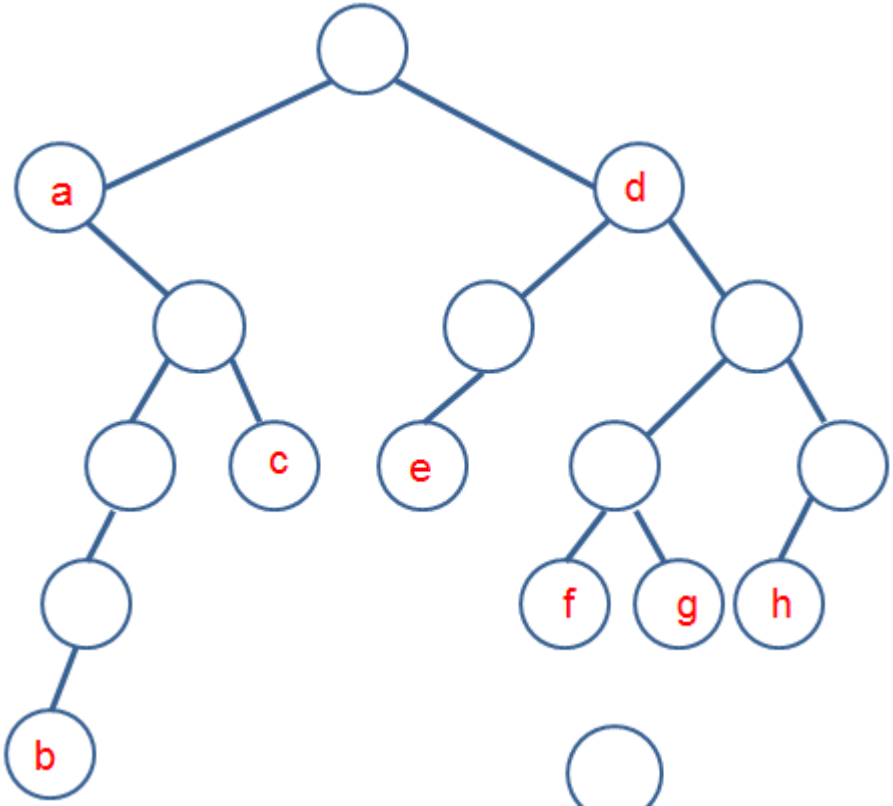
Speedup = 2--5 ?
Inexpensive

Good performance

Q6: const.

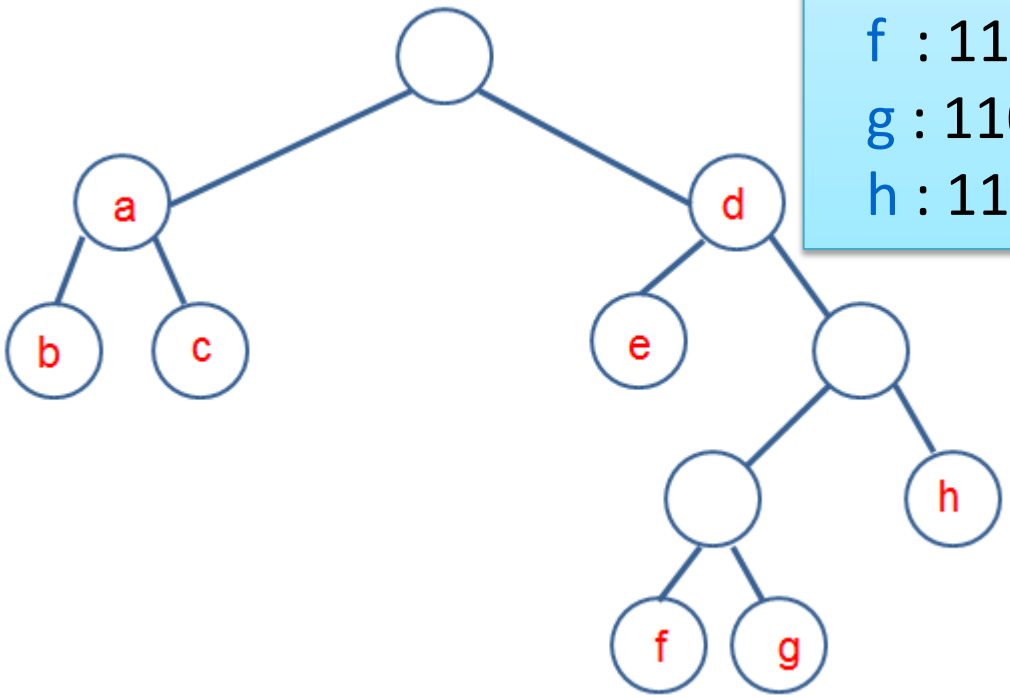
Prefixes:

- a : 0*
- b : 01000*
- c : 011*
- d : 1*
- e : 100*
- f : 1100*
- g : 1101*
- h : 1110*



Compressed 1-Bit Trie Prefixes:

- a : 0*
- b : 00*
- c : 01*
- d : 1*
- e : 10*
- f : 1100*
- g : 1101*
- h : 111*



Q7:

Capacity of Router = N x R **(measured by packets per second)**

N = number of linecards (Typically 8 - 32 per chassis)

R = line-rate (1Gb/s, 2.5Gb/s, 10Gb/s, 40Gb/s, 100Gb/s)

8 X 2.5Gb/s = **<u>20</u>**