Communications Switching Techniques

Dr. Faheem Bukhatwa
Faculty of Computing
GCD
Dublin, Ireland.

Learning outcomes

1. Know about communications switching techniques
2. Be able to explain concepts and ideas
3. Understand and describe each technique
4. Identify advantages and disadvantages of each technique
5. Be able to select most suitable technique
6. Answer related questions

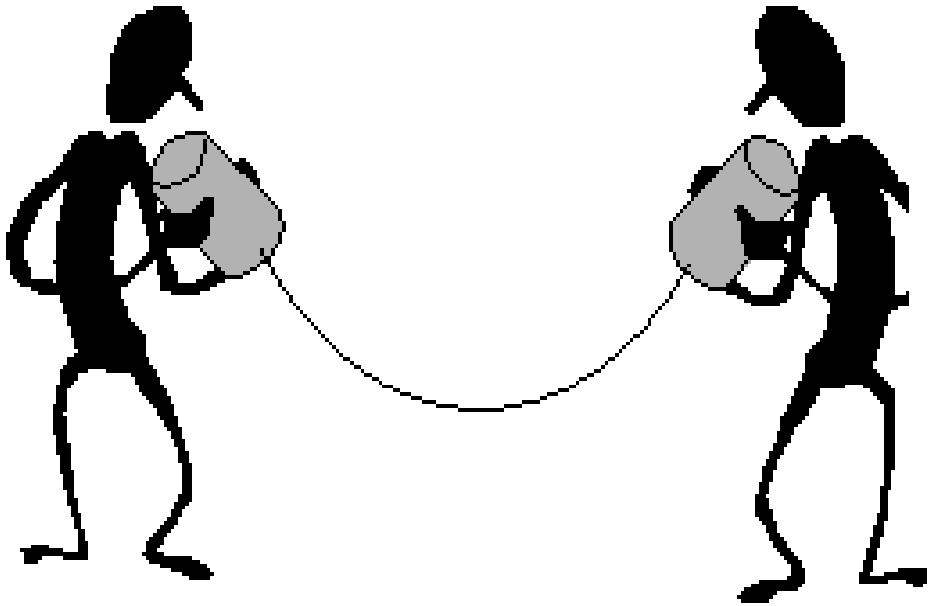
What this lecture covers:

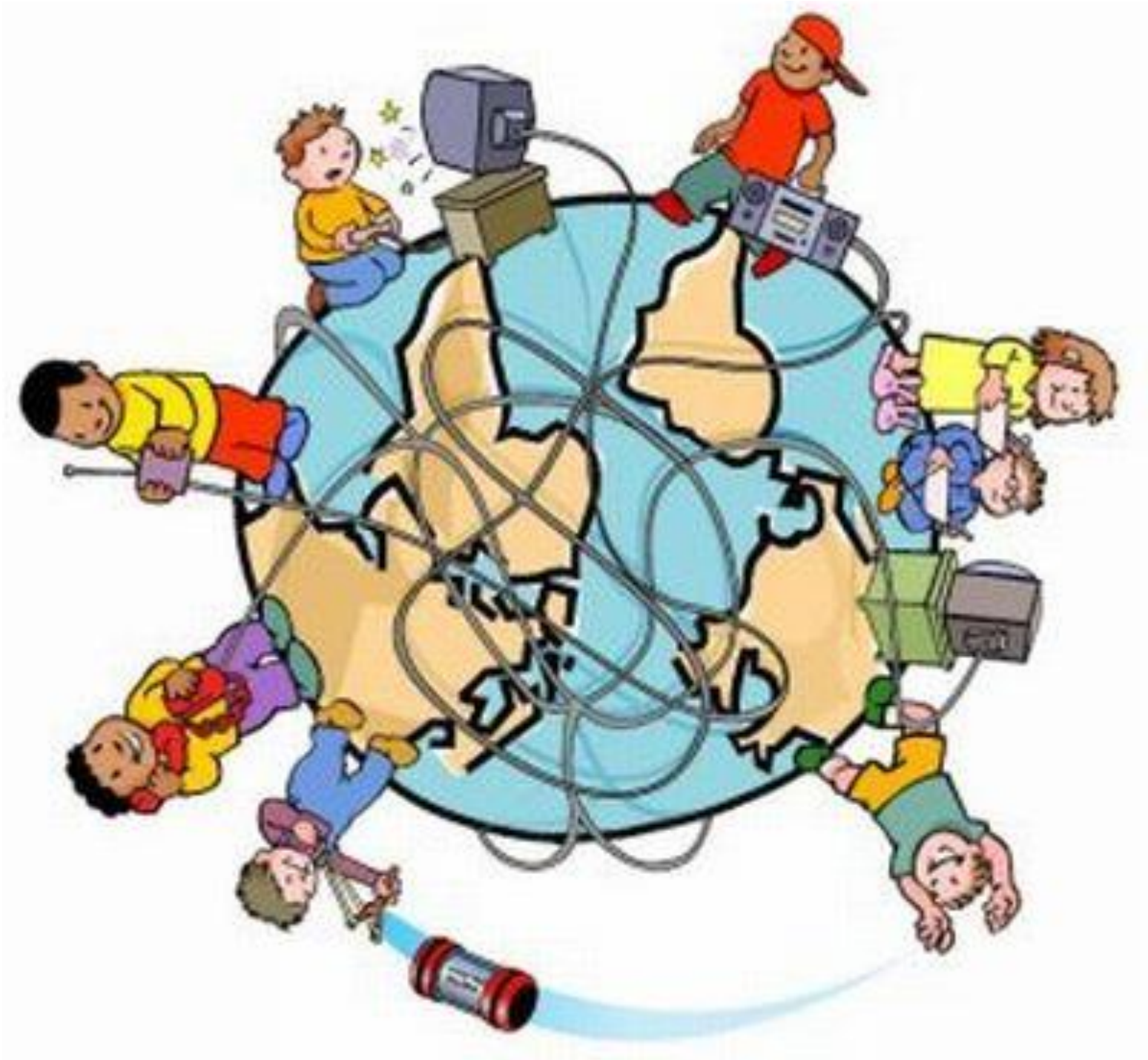
1. Point-to-point & Multipoint connections
2. Message switching technique
3. Datagram switching technique
4. Circuit switching technique
5. Virtual circuit switching technique
6. Advantages and disadvantages of each techniques
7. Questions and answers!!

Switching Techniques

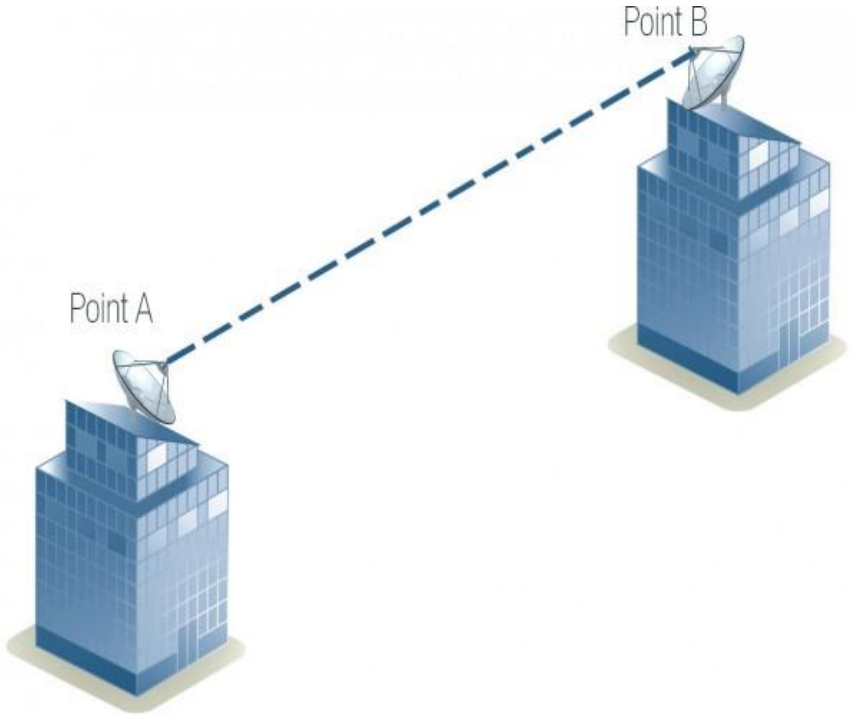
1. Message Switching technique
2. Circuit Switching technique
3. Datagram Switching technique
4. Virtual Circuit Switching technique

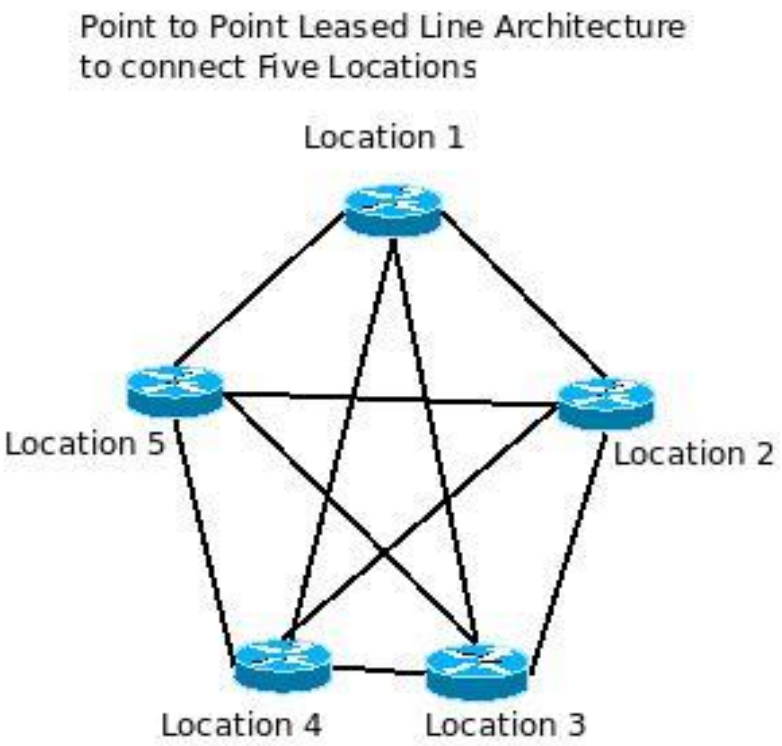
Computer communications





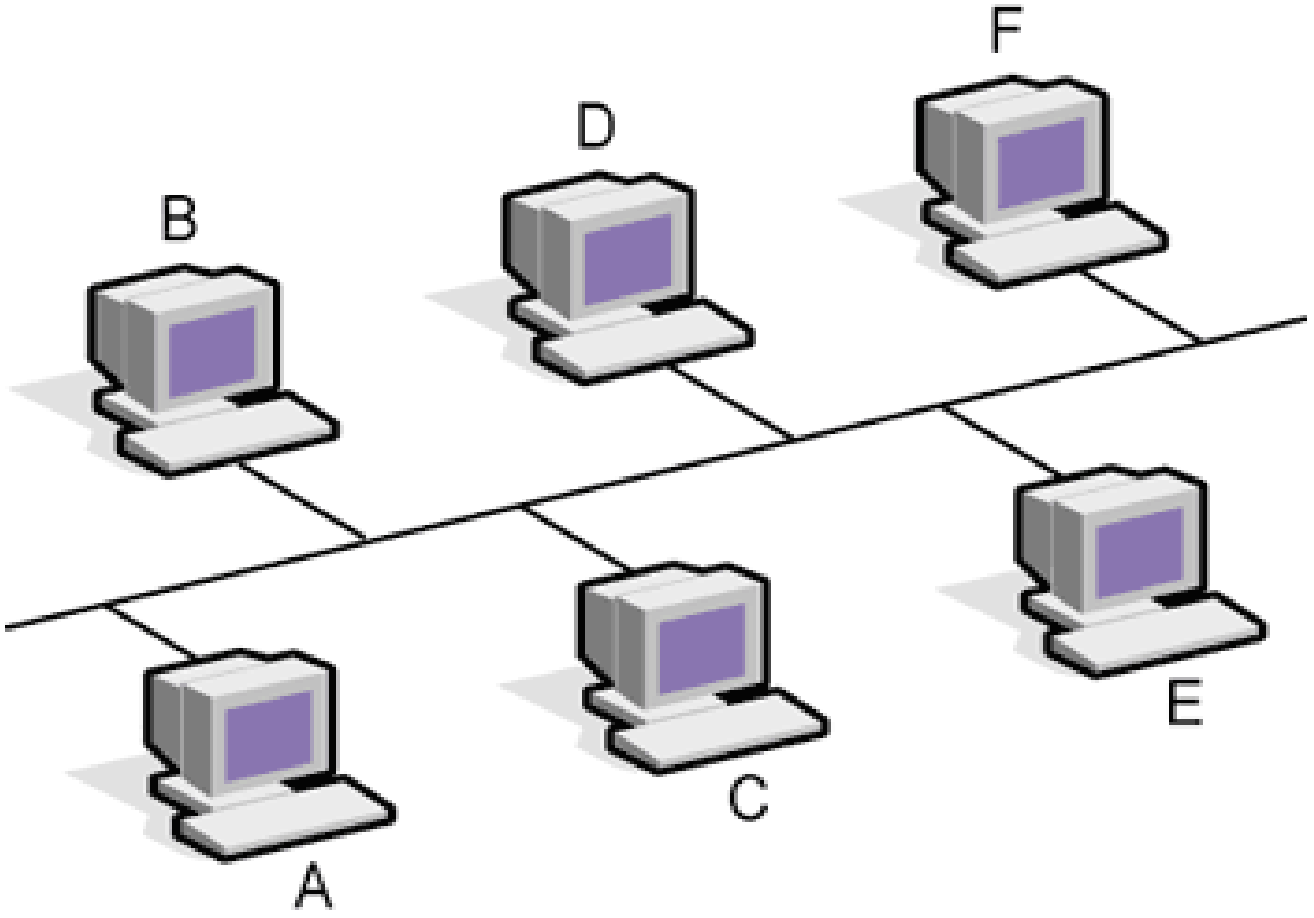
Point to Point Line Configuration

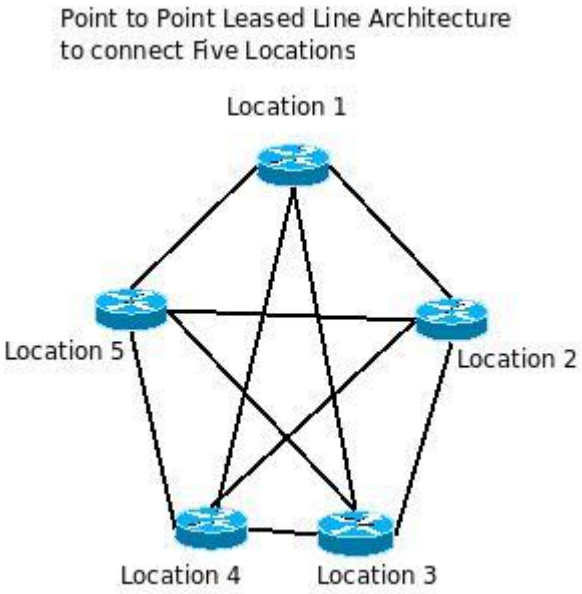


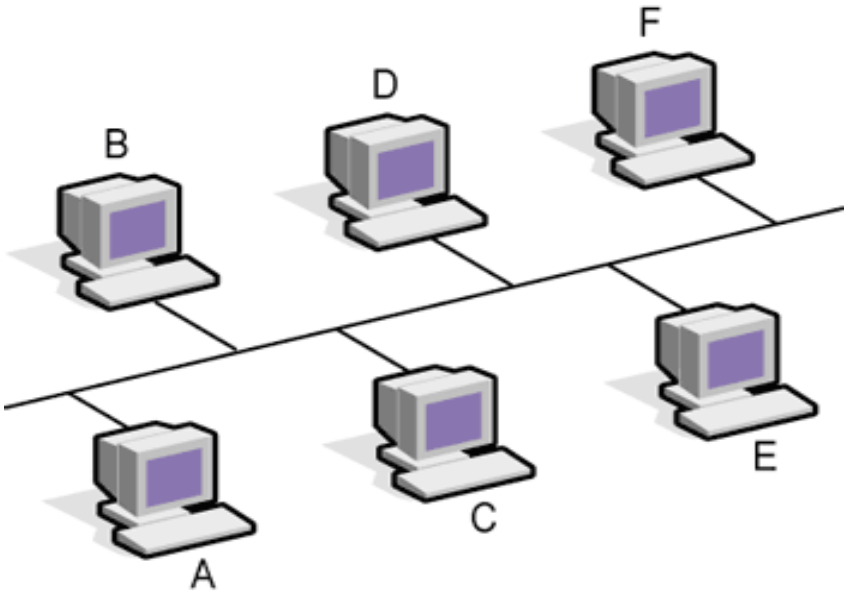


Line Configuration

Multi point (or Multi drop)



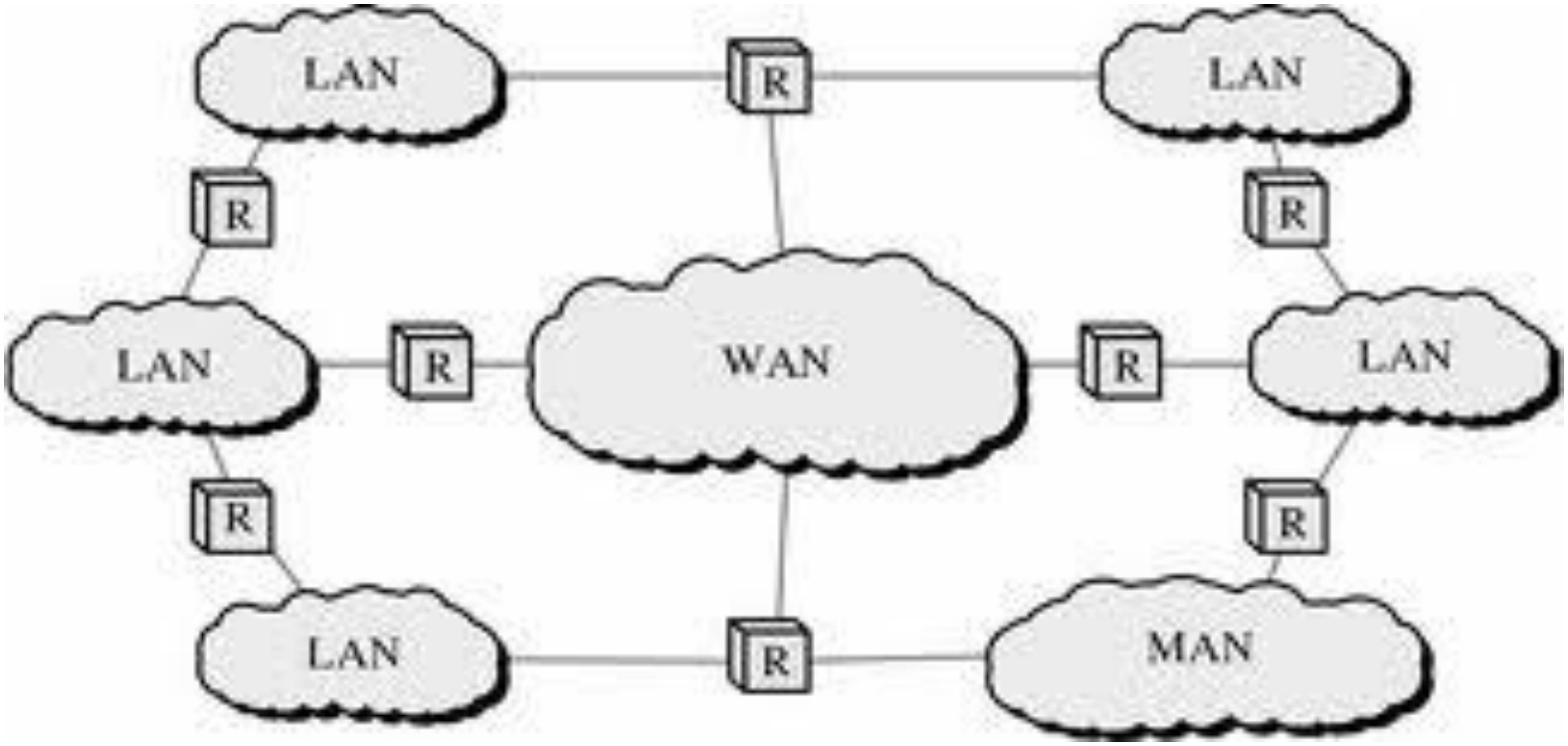


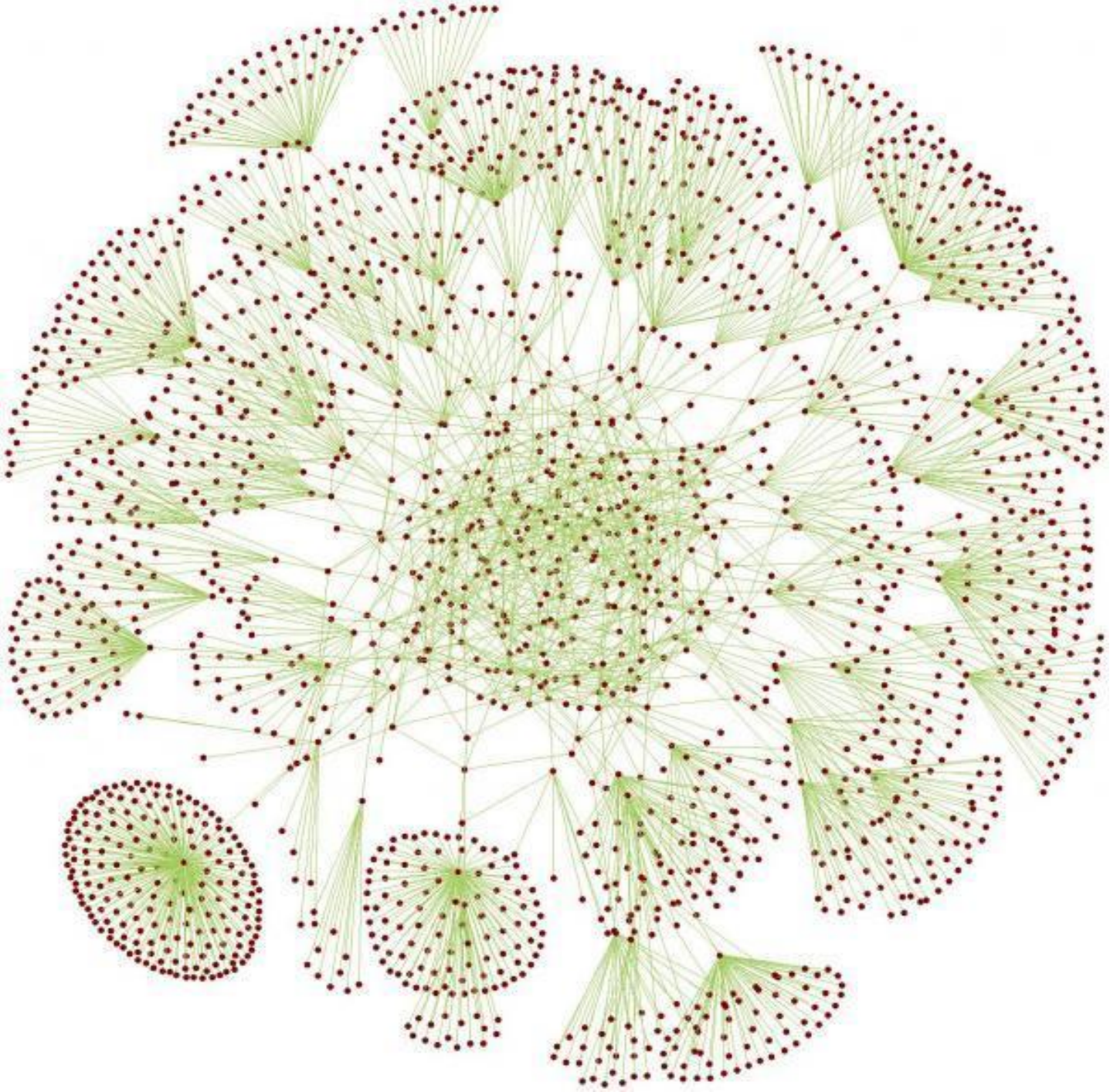


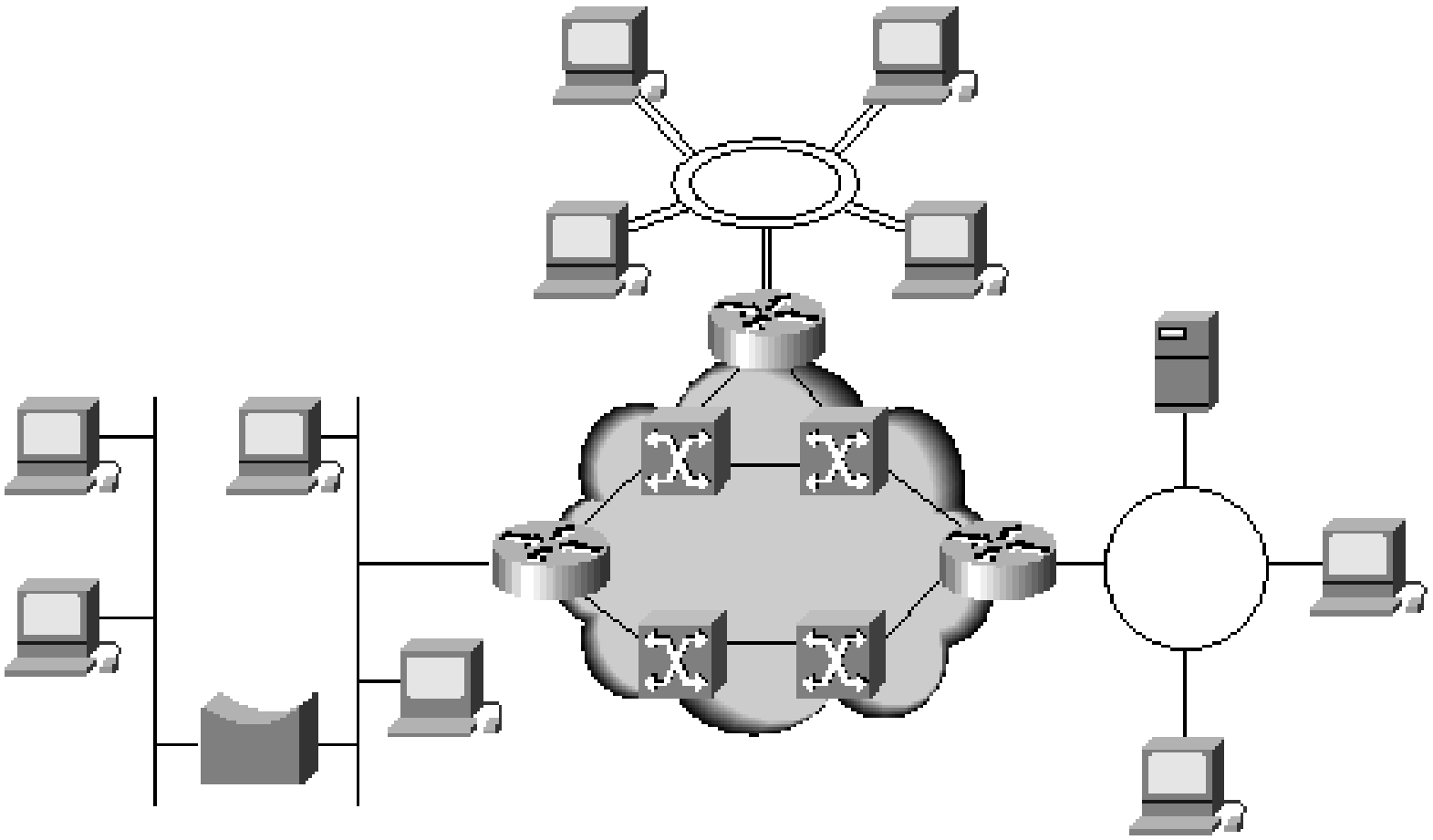
- Cost
- Speed
- Robustness
- Scalability
- Maintenance

- Fault isolation
- Single point of failure
- Link utilisation
- Security
- Latency

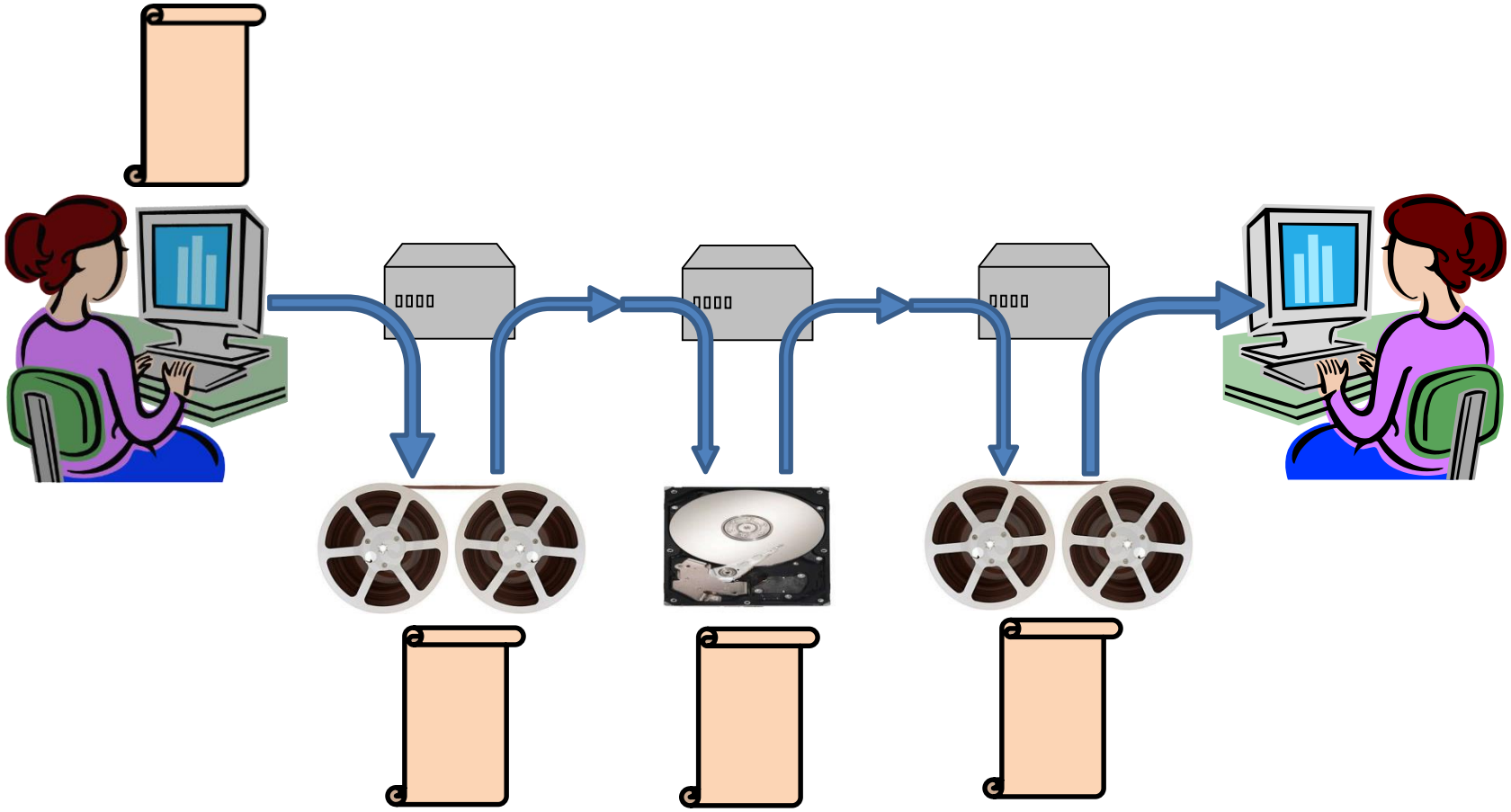
Inter-Networks



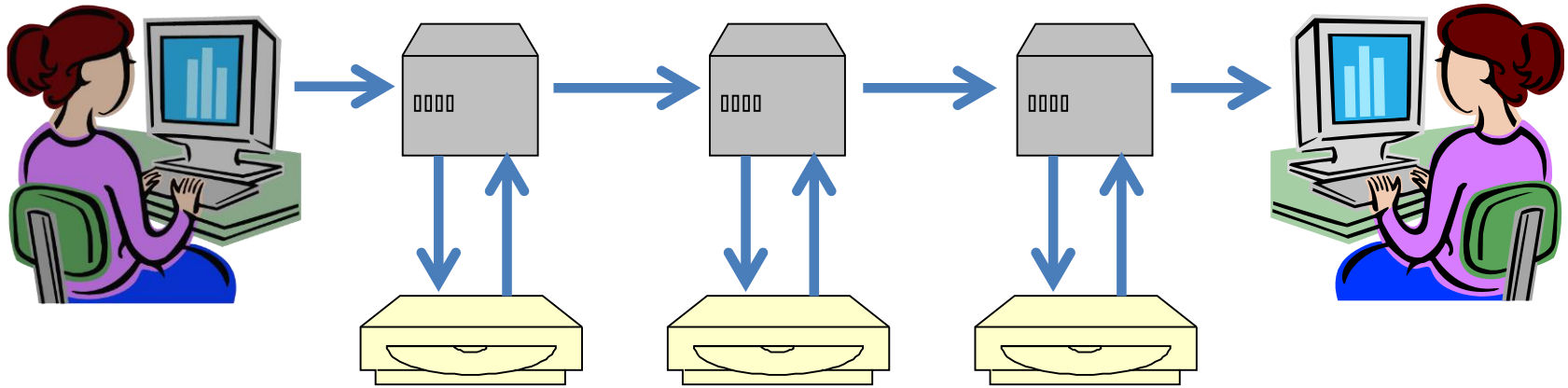




Message switching technique

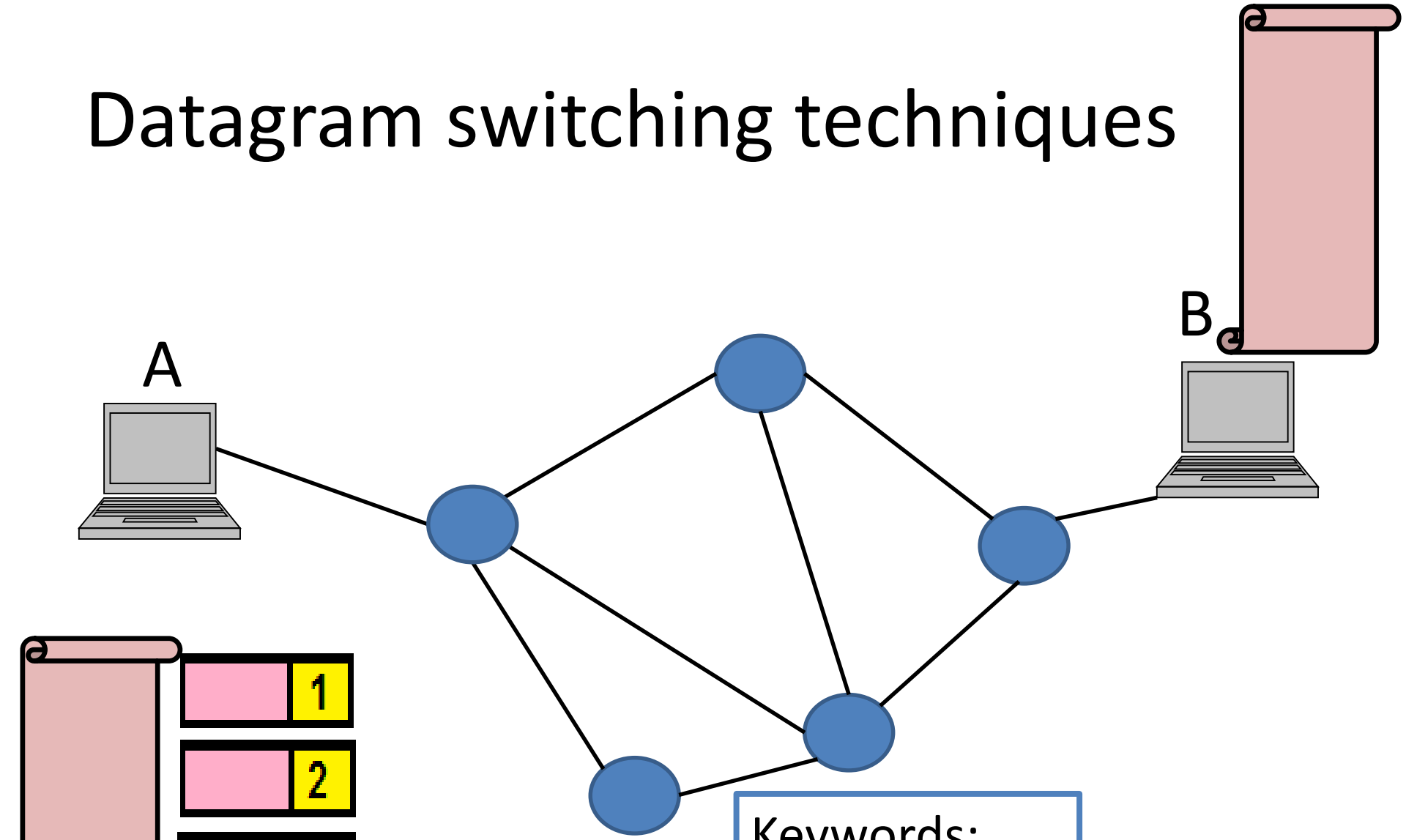


Characteristics of message switching



- A document is sent as one complete unit
- No packets
- Writing at each stage is very slow
- Line is busy for a long time
- High storage requirement for each node

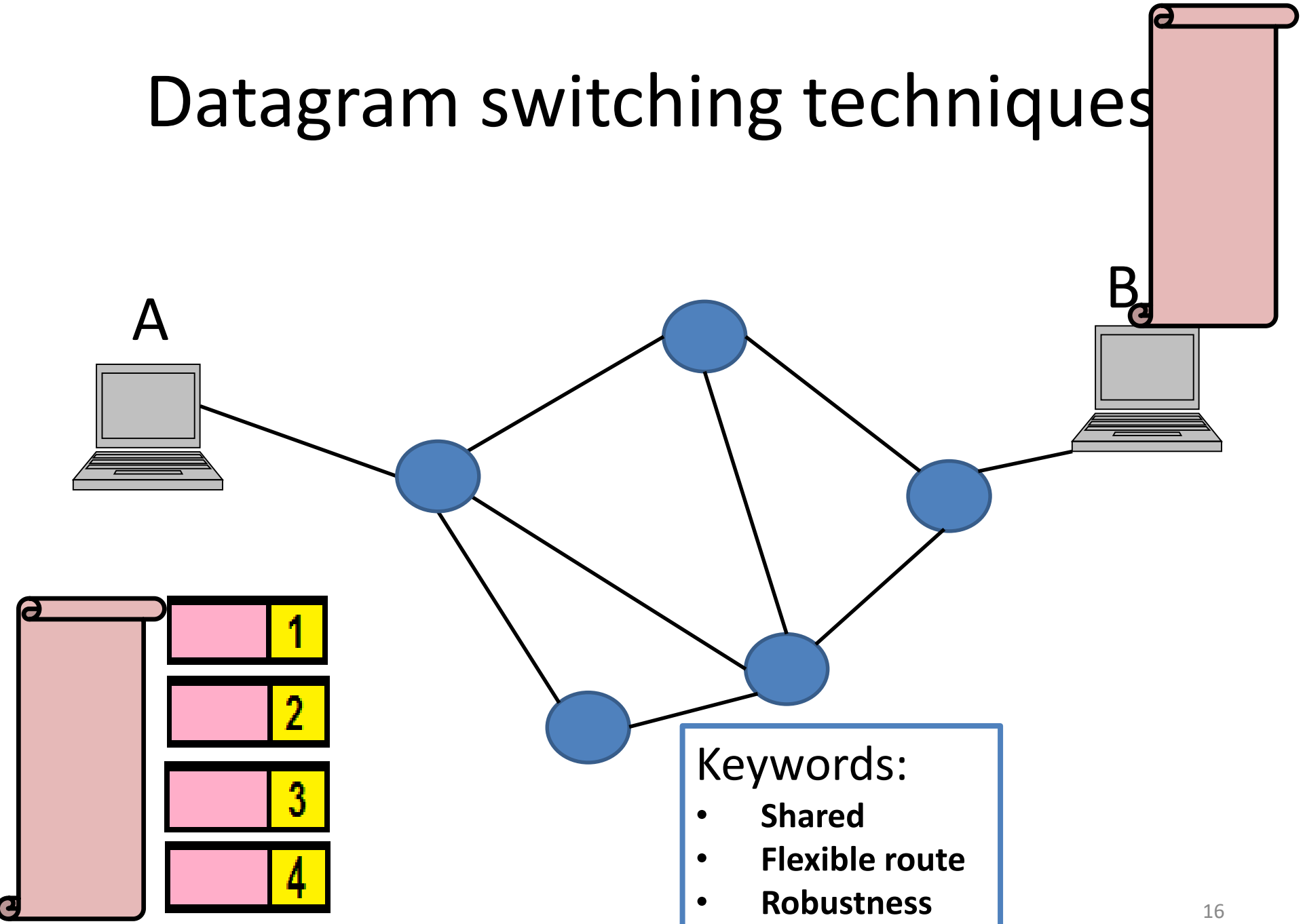
Datagram switching techniques



Keywords:

- **Shared**
- **Flexible route**
- **Robustness**

Datagram switching techniques

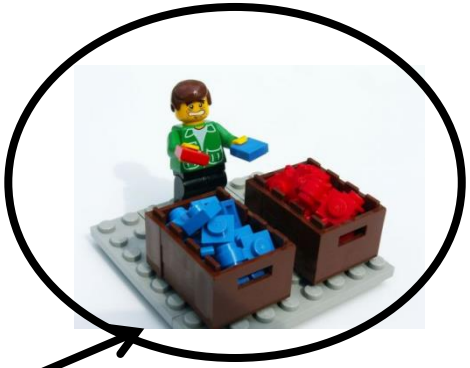


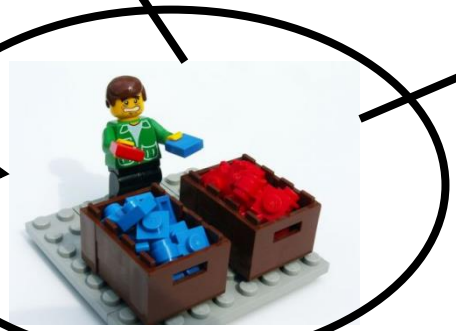
Keywords:

- **Shared**
- **Flexible route**
- **Robustness**

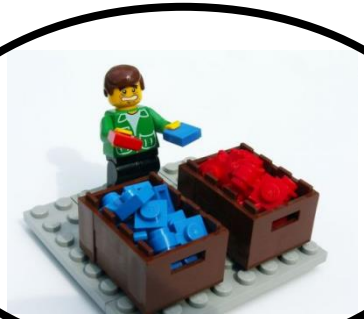
Characteristics of Datagram Switching techniques

1. A document is divided into small units (datagrams or packets or frames or cells)
2. Each datagram is independent of others
3. Each datagram has addresses (source & destination)
4. At each jump the node (Router) decides the best route where to forward the packet
5. Datagrams pass through main memory of all devices
6. Datagrams may follow different routs
7. New calls are never blocked
8. A link is NOT dedicated per call.
9. Each link is shared by many calls.

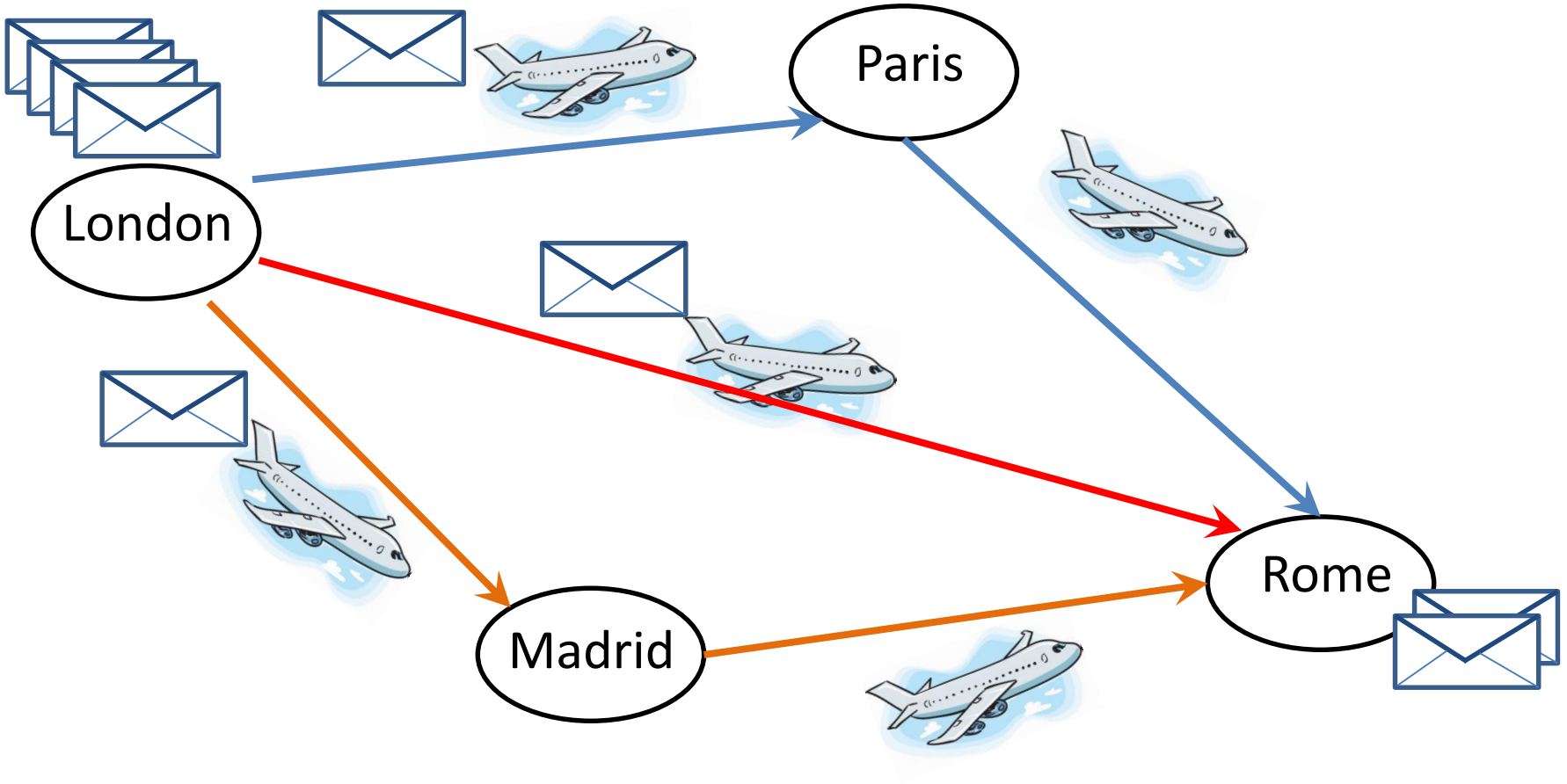




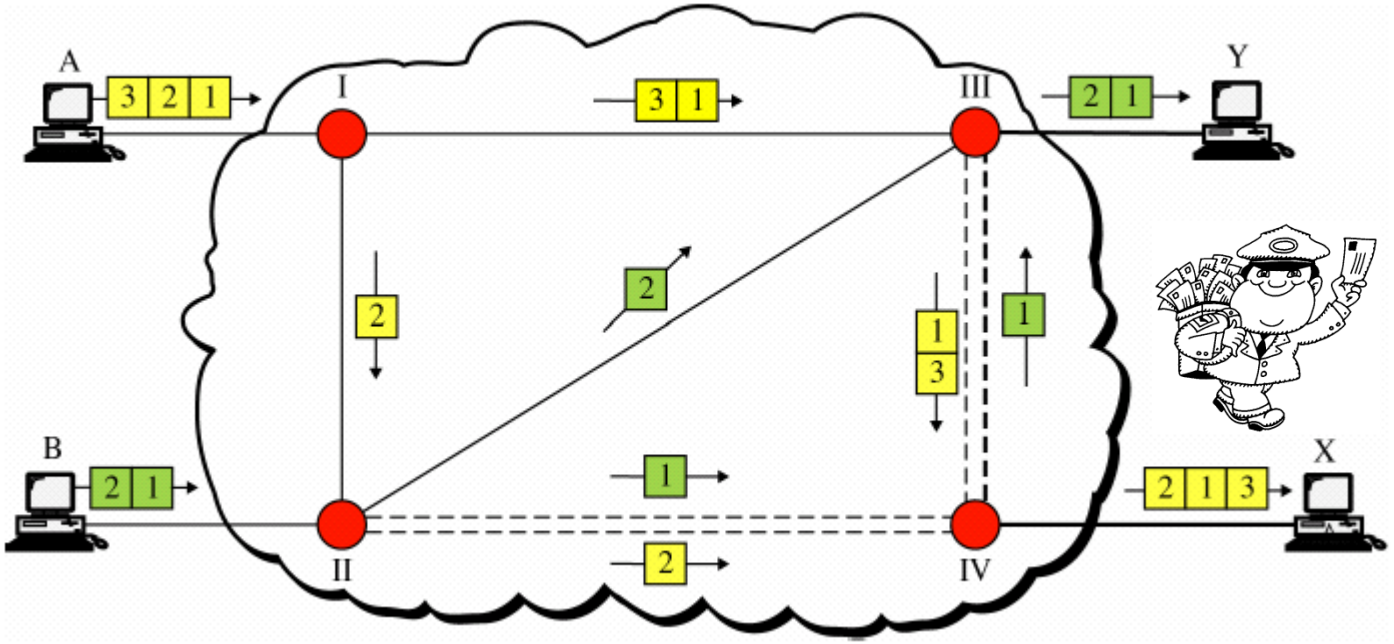
Datagram vs ordinary Post



Ordinary Postal System



Post and datagrams!

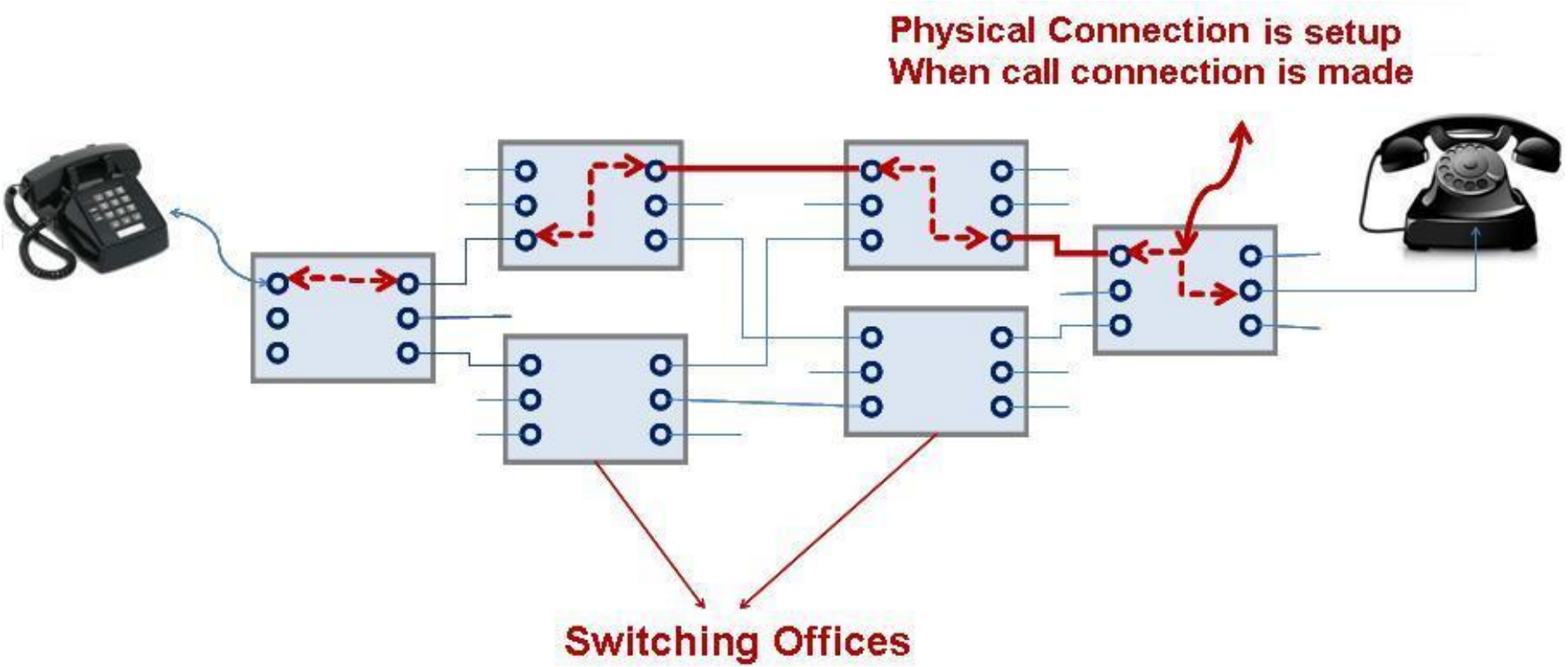


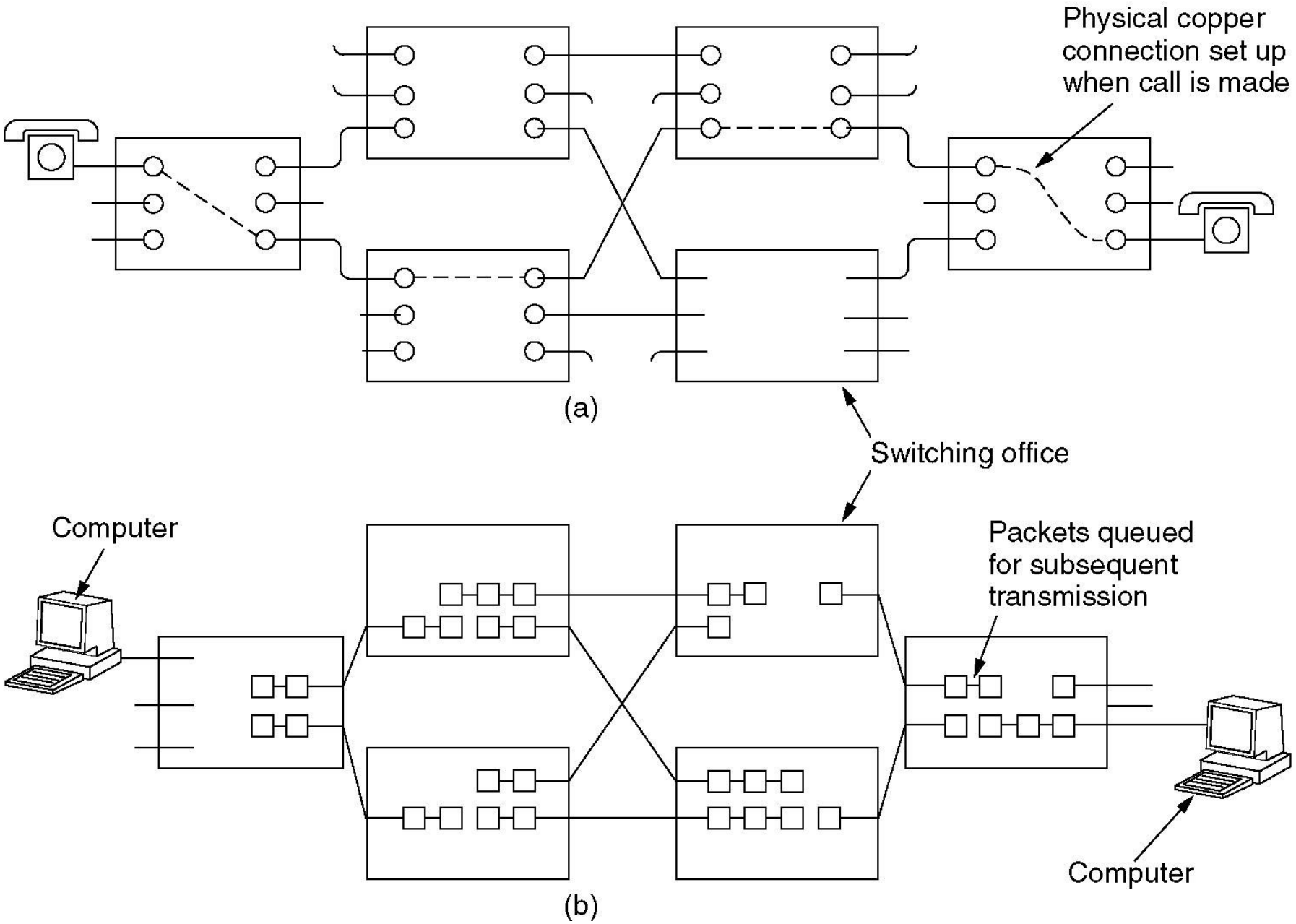
Advantages of datagram switching techniques:

1. More robust. If a link brakes, packets will go in a different route.
2. A call is never blocked
3. Better at traffic balancing and more efficient at using the link capacity, through flexible routing
4. Lighter as a system and easier to implement.
5. No call setup nor call clearing are required.

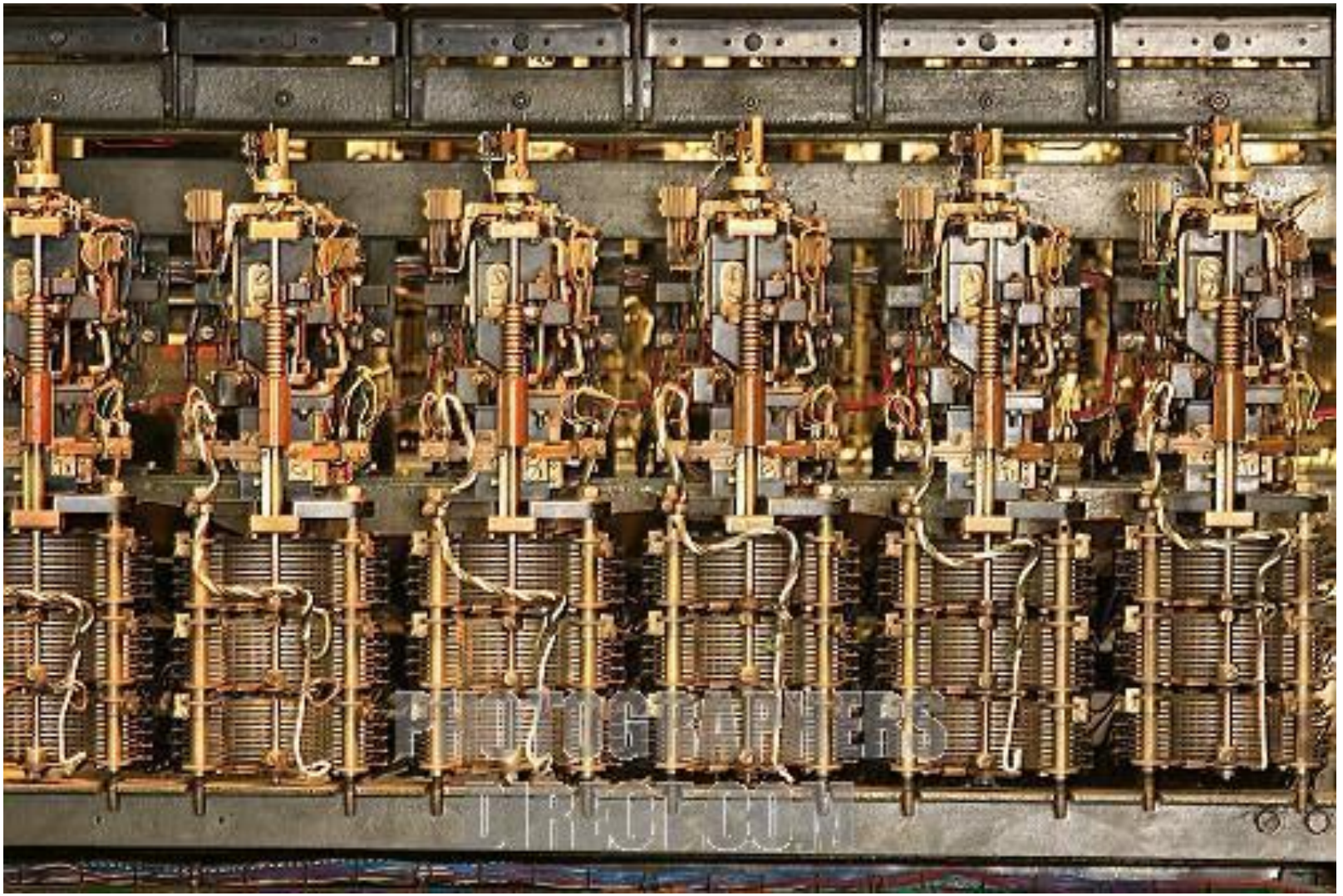
Disadvantages

- Packets may arrive out of sequence
- No acknowledgment of delivery
- No guarantee of quality because users can not be blocked.

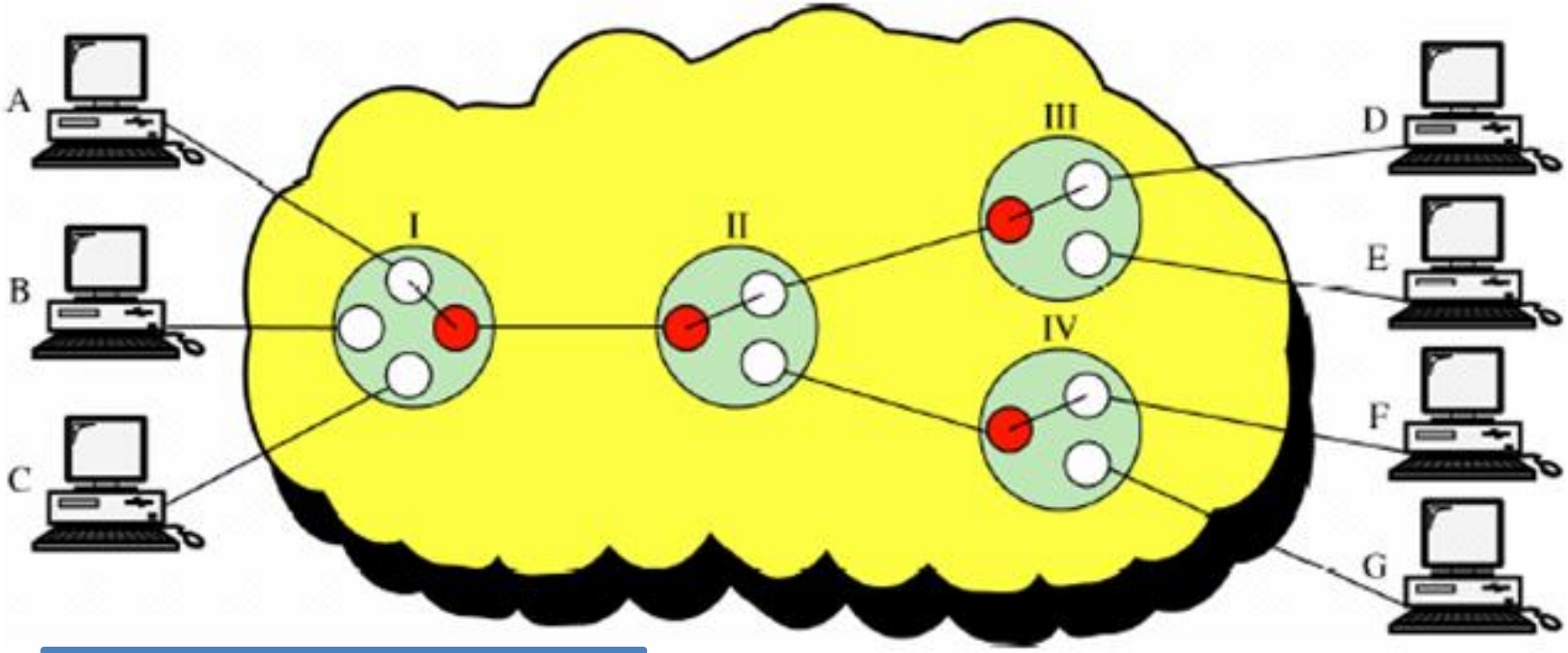

Physical Connection is setup
When call connection is made
Switching Offices


Physical copper
connection set up
when call is made
(a)
Switching office
Computer
Packets queued
for subsequent
transmission
Computer
(b)

Telephone exchange switches



Circuit Switching technique



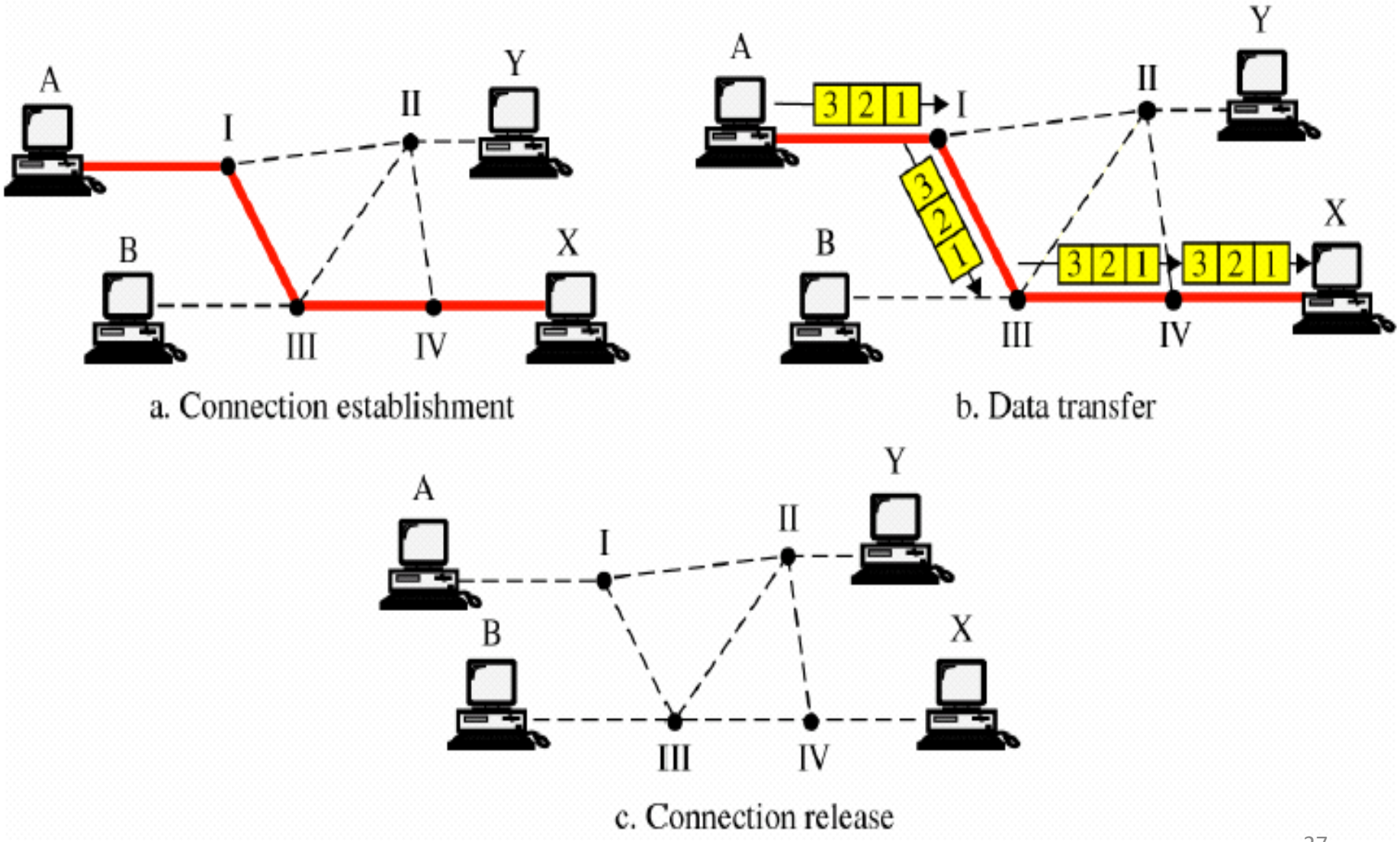
Keywords:

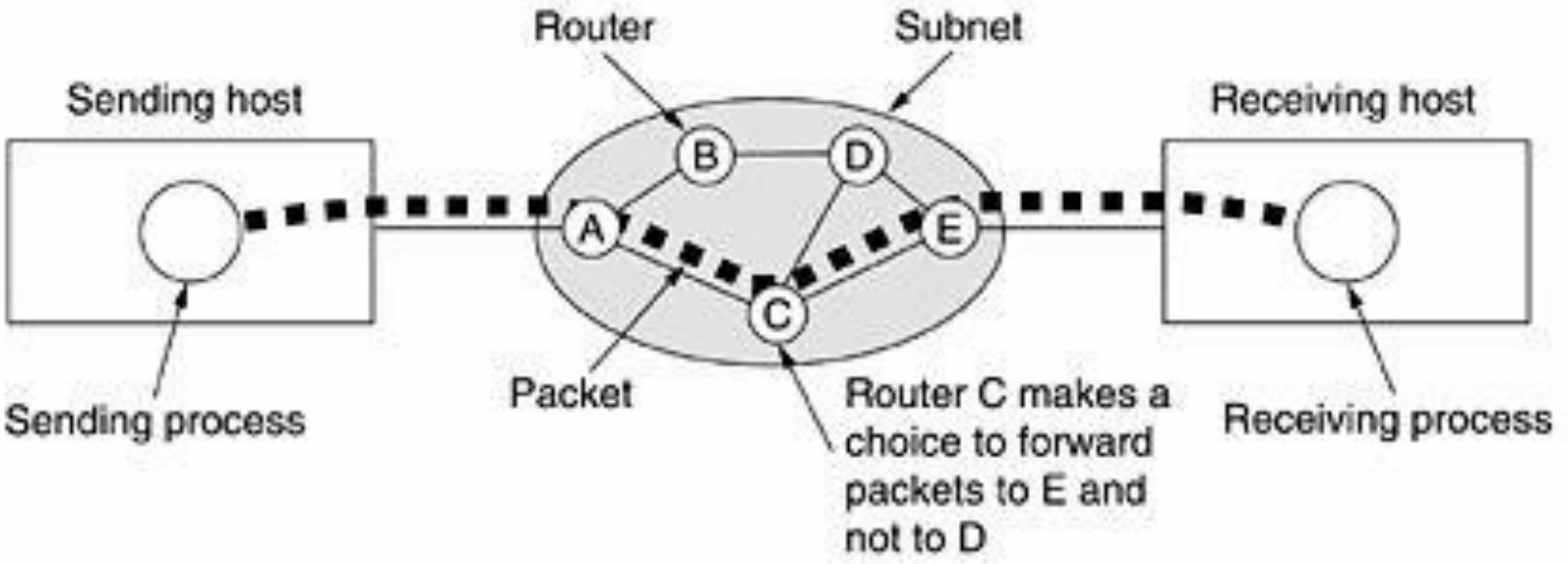
- Dedicated
- Flexible route?

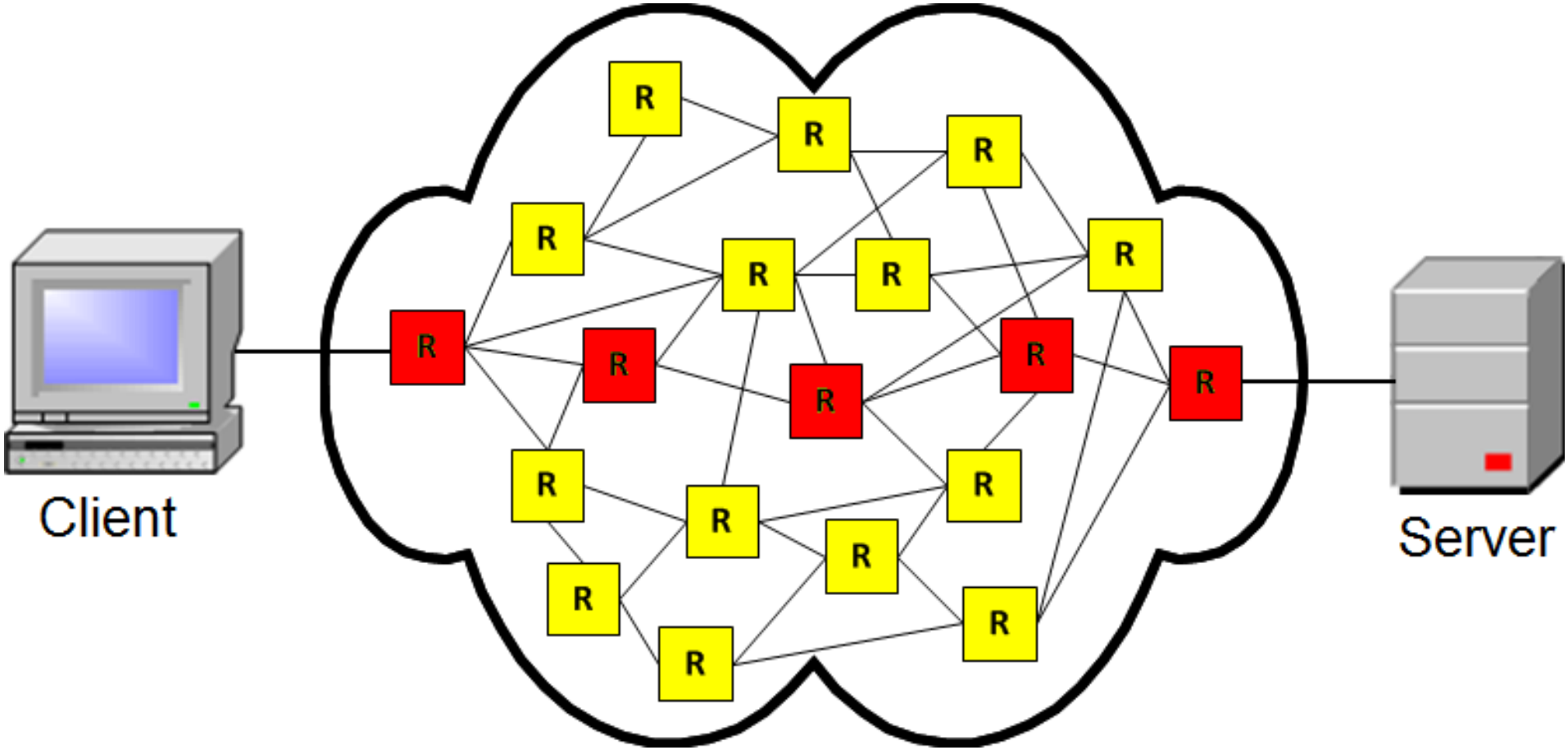
Characteristics of Circuit Switching

1. Three phases: call setup, Data transfer, Call clear
2. Only one route is used per call
3. Once a call is setup, no more delay
4. Line is dedicated for the call and not shared
5. New calls may be blocked or wait for a free line
6. A break any where on the line will end the call

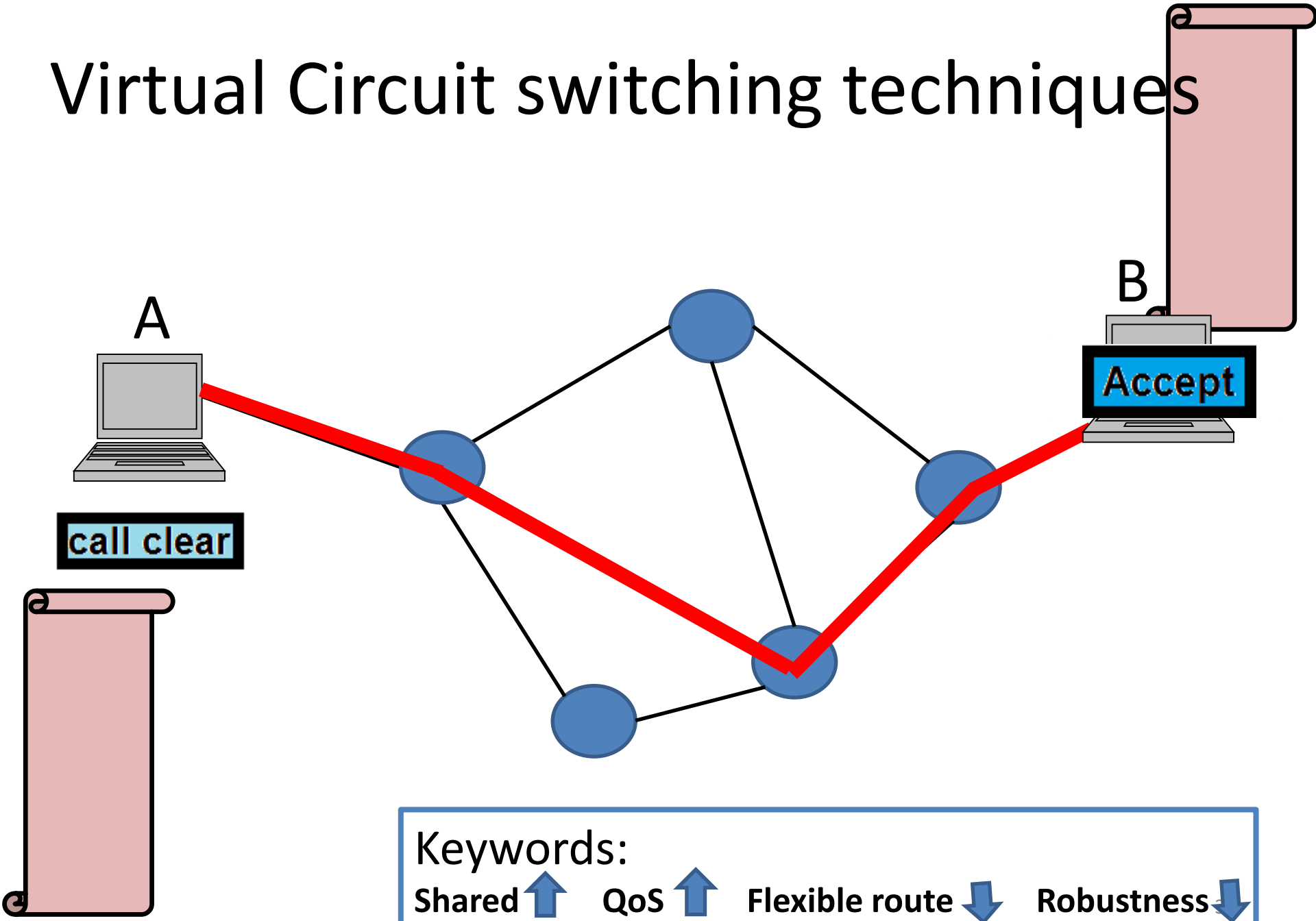
- Virtual circuit approach:




Router
Subnet
Sending host
Receiving host
B
D
A
E
C
Sending process
Packet
Router C makes a choice to forward packets to E and not to D
Receiving process


R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
R
Client
Server

Virtual Circuit switching techniques



Keywords:

Shared ↑ **QoS** ↑ **Flexible route** ↓ **Robustness** ↓


RUSSIA
NORWAY
SWEDEN
ESTONIA
LATVIA
LITHUANIA
BELORUSSIA
KAZAKHSTAN
POLAND
UKRAINE
GERMANY
FRANCE
BELGIUM
AUSTRIA
HUNGARY
MOLDAVIA
GEORGIA
AZERBAIJAN
ARMENIA
IRAN
CROATIA
BOSNIA & HER.
SERBIA
BULGARIA
TURKEY
SPAIN
PORTUGAL
GREECE
SYRIA
IRAQ
MOROCCO
ALGERIA
TUNESIA
SAUDI ARABIA


NORWAY
SWEDEN
RUSSIA
ESTONIA
LATVIA
LITHUANIA
DENMARK
IRELAND
UNITED KINGDOM
THE NETHERLANDS
BELGIUM
GERMANY
POLAND
BELORUSSIA
KAZAKHSTAN
UKRAINE
CZECH REPUBLIC
SLOVAKIA
MOLDAVIA
FRANCE
AUSTRIA
HUNGARY
SWITZERLAND
SLOVENIA
ROMANIA
GEORGIA
AZERBAIJAN
ARMENIA
CROATIA
ITALY
BOSNIA & HER.
SERBIA
BULGARIA
IRAN
PORTUGAL
SPAIN
MONTENEGRO
KOSOVO
ALBANIA
MACEDONIA
TURKEY
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SYRIA
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CYPRUS
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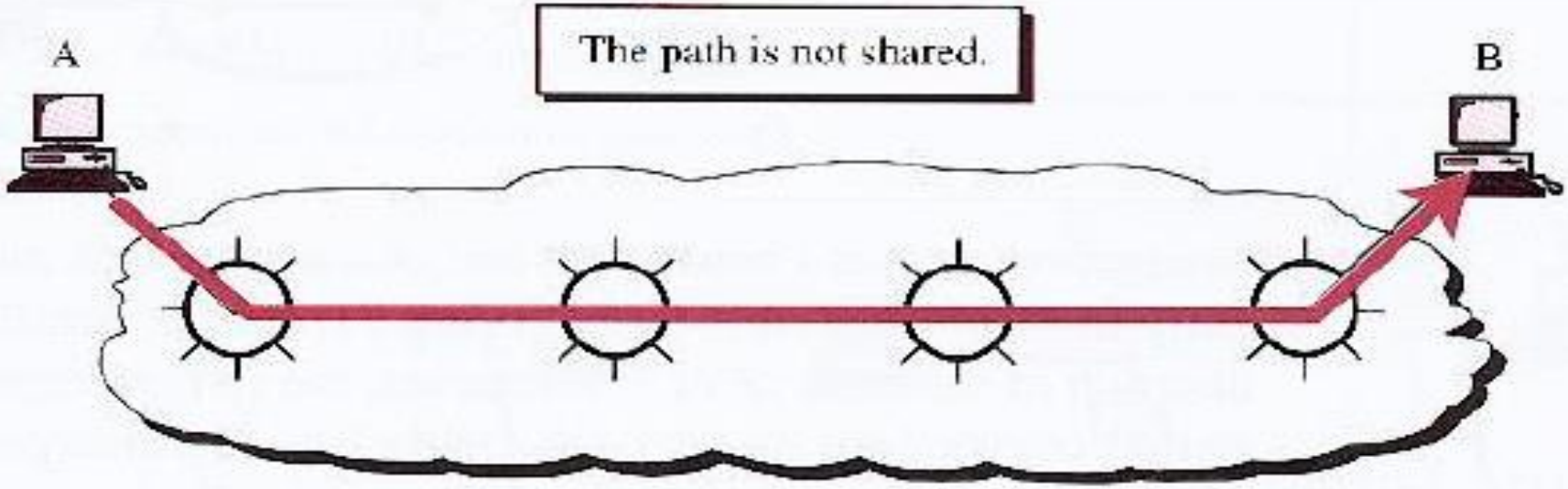
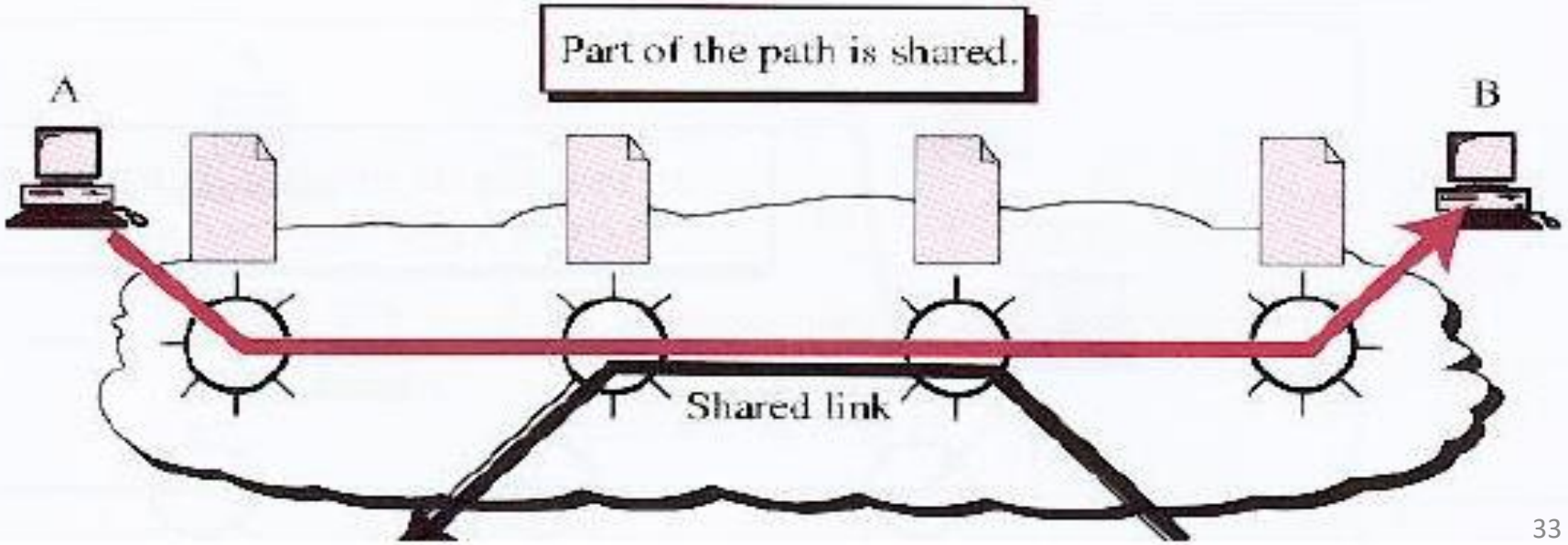
ALGERIA
TUNESIA
SAUDI ARABIA



a. Circuit-switched connection



Characteristics of Virtual circuit switching techniques

1. Three phases: (call setup, Data transfer, Call clear)
2. A document is divided into small units (packets or cells)
3. For a call, all packets follow the same route
4. Line is NOT dedicated for a call,
5. Line is shared with other calls.
6. If no capacity is available, new calls have to wait
7. A call may be blocked (if no line capacity is left)
8. A break any where on the line will end the call
9. Links are shared between many calls

Advantages of Virtual Circuits over datagram techniques

1) Quality of service is guaranteed (new calls can be blocked)
2) Routing is done only once during call setup, subsequent data follows the same route 
3) Packets are more likely to arrive in the correct sequence.
4) Packet headers are smaller (no addresses) therefore placing less requirements on routers
5) Error detection and acknowledgements are built in
6) Easier for accounting (we know who is calling who)

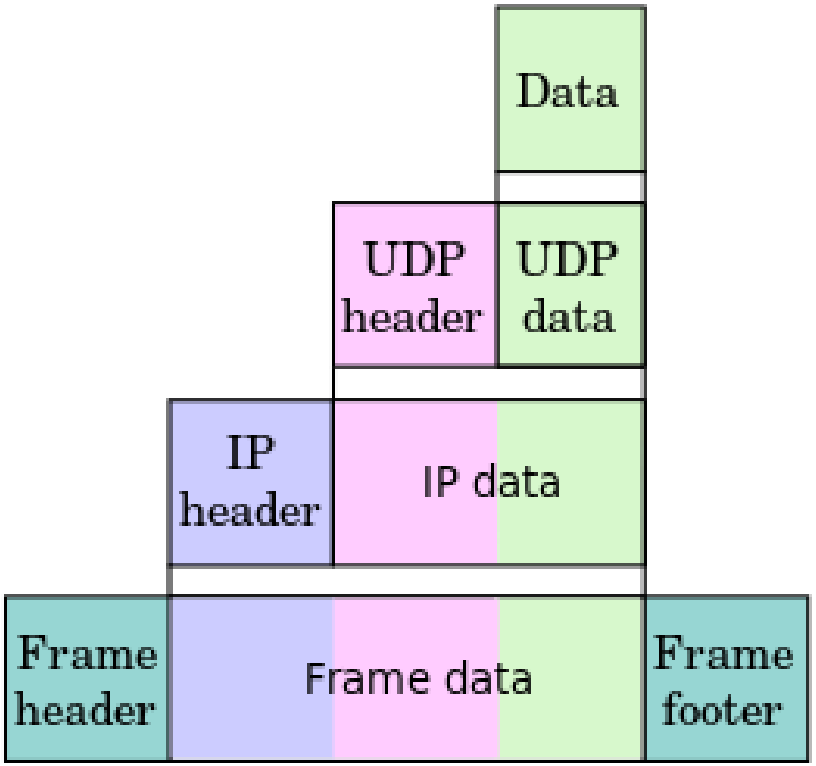
Advantages of datagram switching technique

1) Lighter as a system and easier to implement.
2) Better at traffic balancing and more efficient at using link transmission capacity.
3) More Robust in case of link failures.
4) No call setup nor call clearing are required.

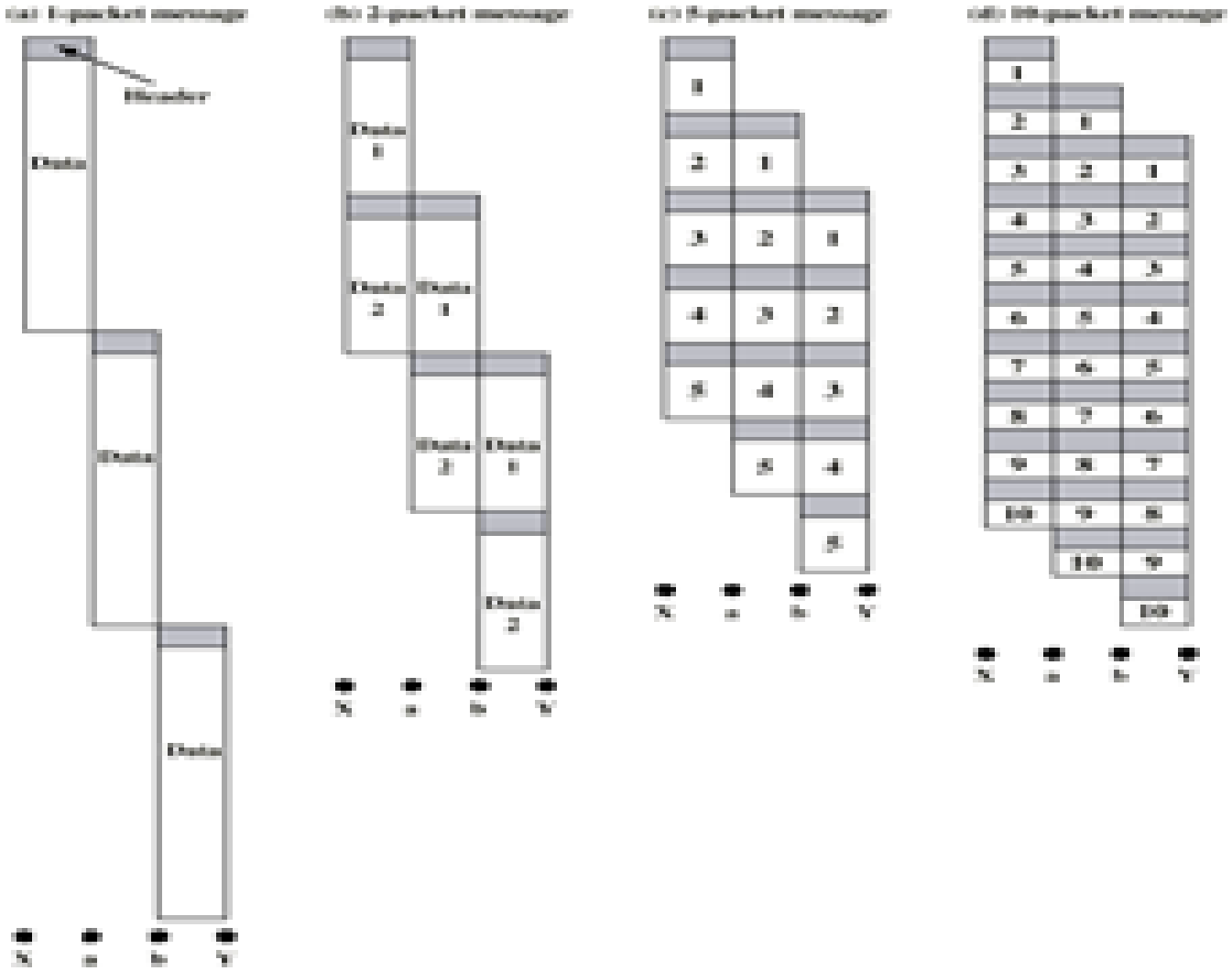
What size packet is the best?

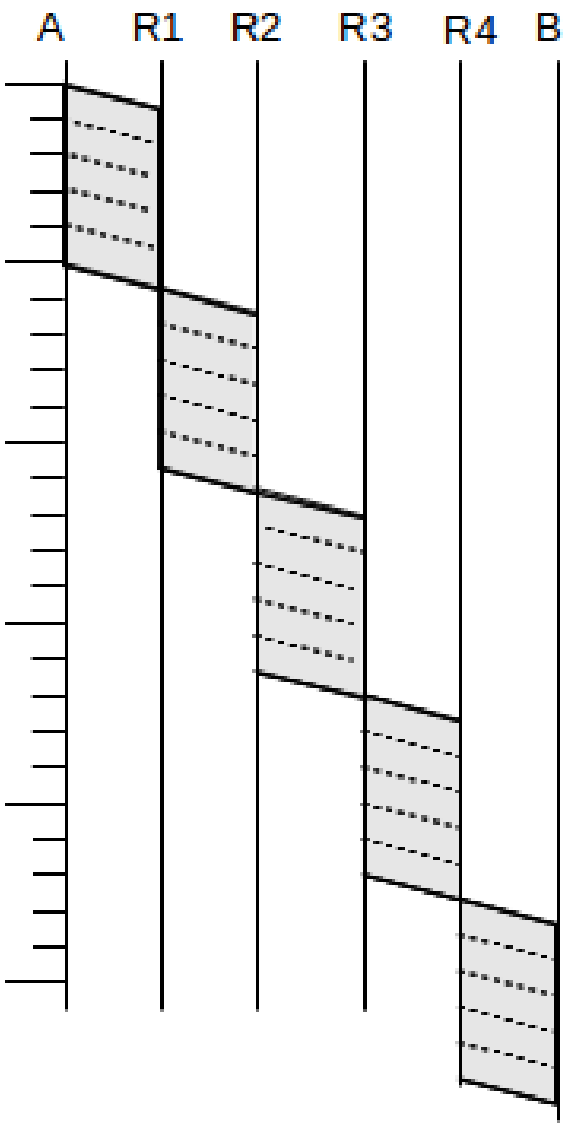
- The smaller the packet the more efficient but,
- But only down to a specific size where any smaller size packets become less efficient again.

What size packet is the best?

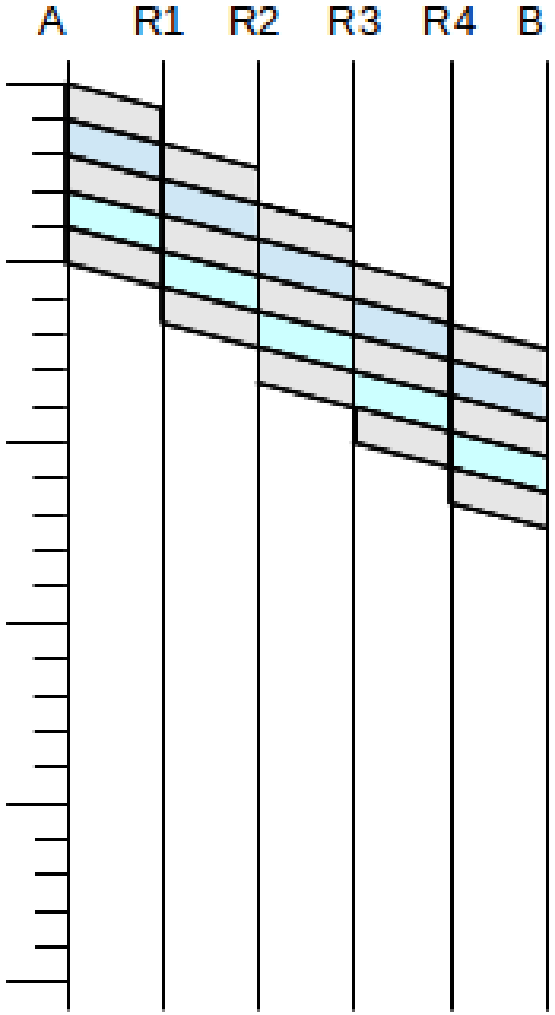


- Remember the header is a redundant overhead carried with the user data.





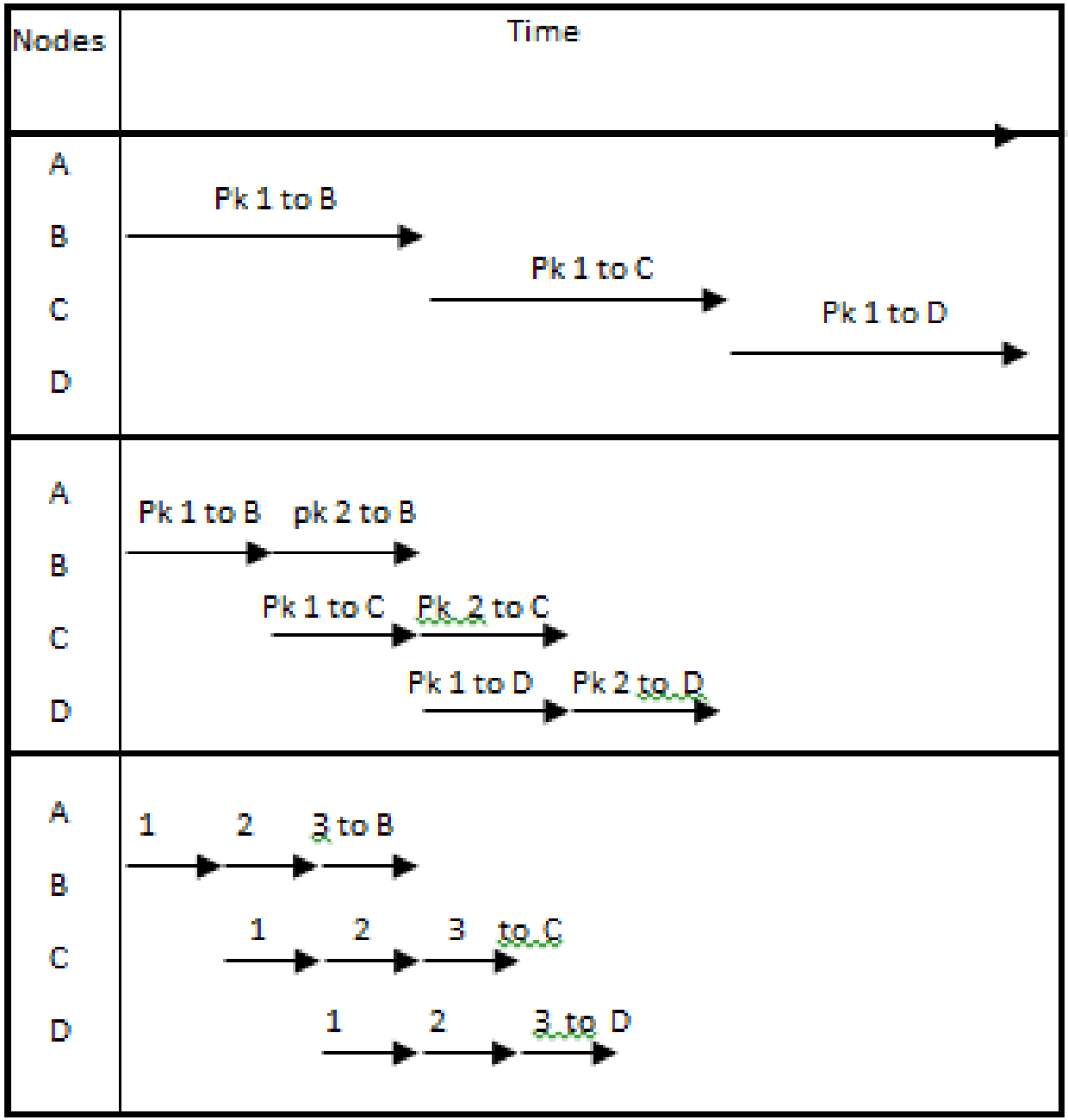
One large packet over five links



Five smaller packets over five links

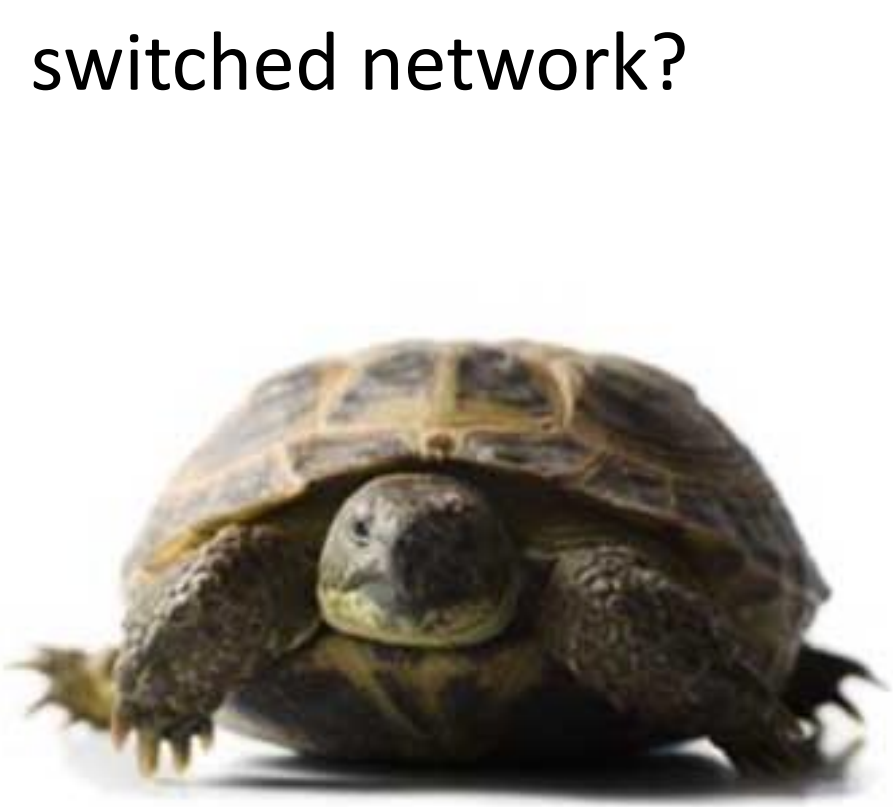
Packet size

- If the sent packet consists of 33 octets (3 of header plus 30 of data), then
  - Packet is first transmitted from station X to node *a* (Figure a).
  - When the entire packet is received, it can then be transmitted from *a* to b.
  - When the entire packet is received at node b, it is transferred to station Y.
  - The total transmission time at the nodes is 99 octet-times
    (33 octets X 3 packet transmissions = 99 Octet-times).
- So if we break up the message into more packets (Packet + Control info)
- So because of overlapping in transmission, the total transmission time of 2 packets drops to 72 octet-times, for 5 packets it drop to total of 63
- However, this process of using more and smaller packets eventually results in increased, rather than reduced, delay as in Fig d;
- This is because each packet contains a fixed amount of header, and more packets means more of these headers.
- We did not consider processing and queuing delays at each node.
- Extremely small packet size (53 octets) can result in an efficient network design.


Nodes
Time
A
B
C
D
Pk 1 to B
Pk 1 to C
Pk 1 to D
A
B
C
D
Pk 1 to B
pk 2 to B
Pk 1 to C
Pk 2 to C
Pk 1 to D
Pk 2 to D
A
B
C
D
1
2
3 to B
1
2
3
to C
1
2
3 to D

Question 01

- When will a datagram packet switched network be faster to use than a virtual circuit switched network?



Question 2

- Is a datagram switched network better or is a virtual circuit switched network better for a user to watch a streamed video?

Question 03

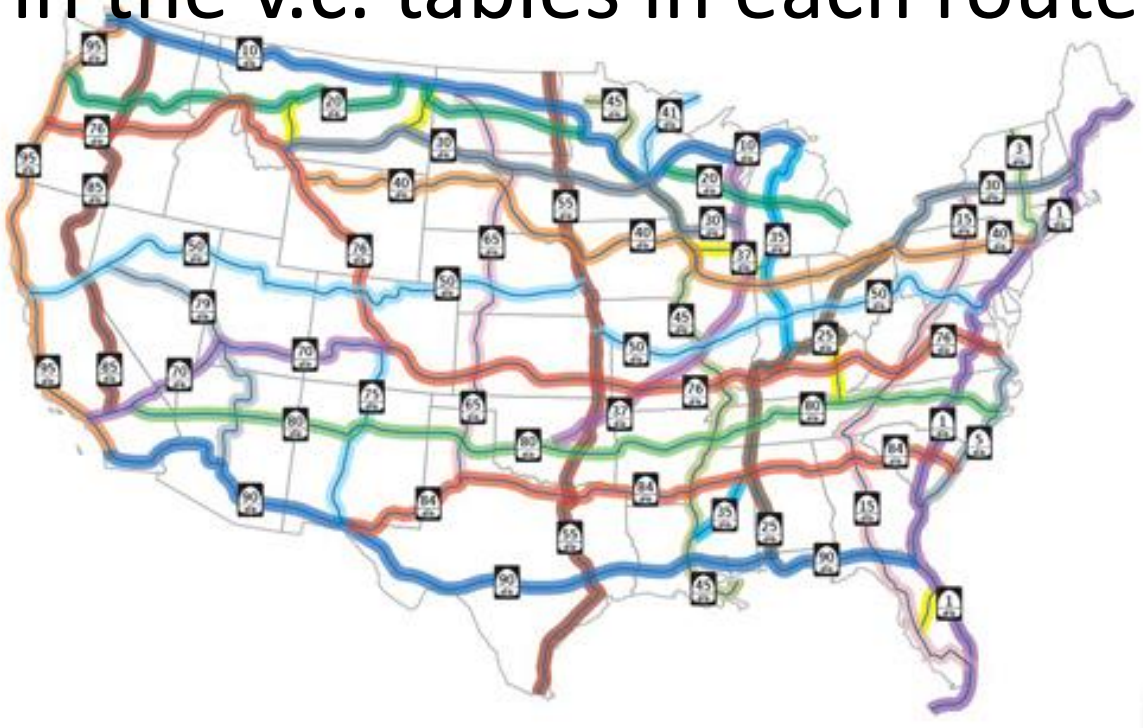
Which switching technique has larger headers?

Question 4

- Which techniques can block new calls?

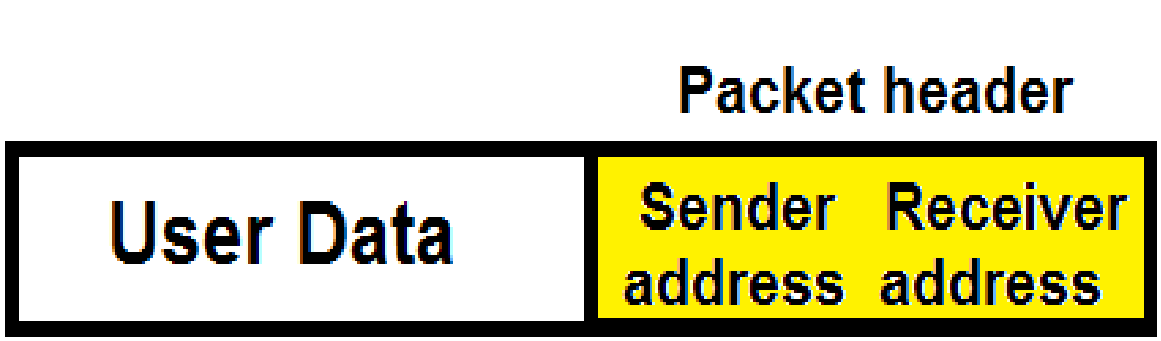
Question 05

In which technique a route is established during call set up in the network between sender and receiver by making appropriate entries in the v.c. tables in each router?

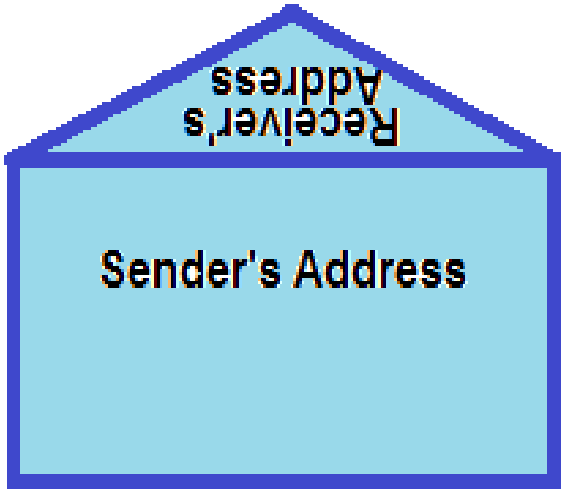


Question 06

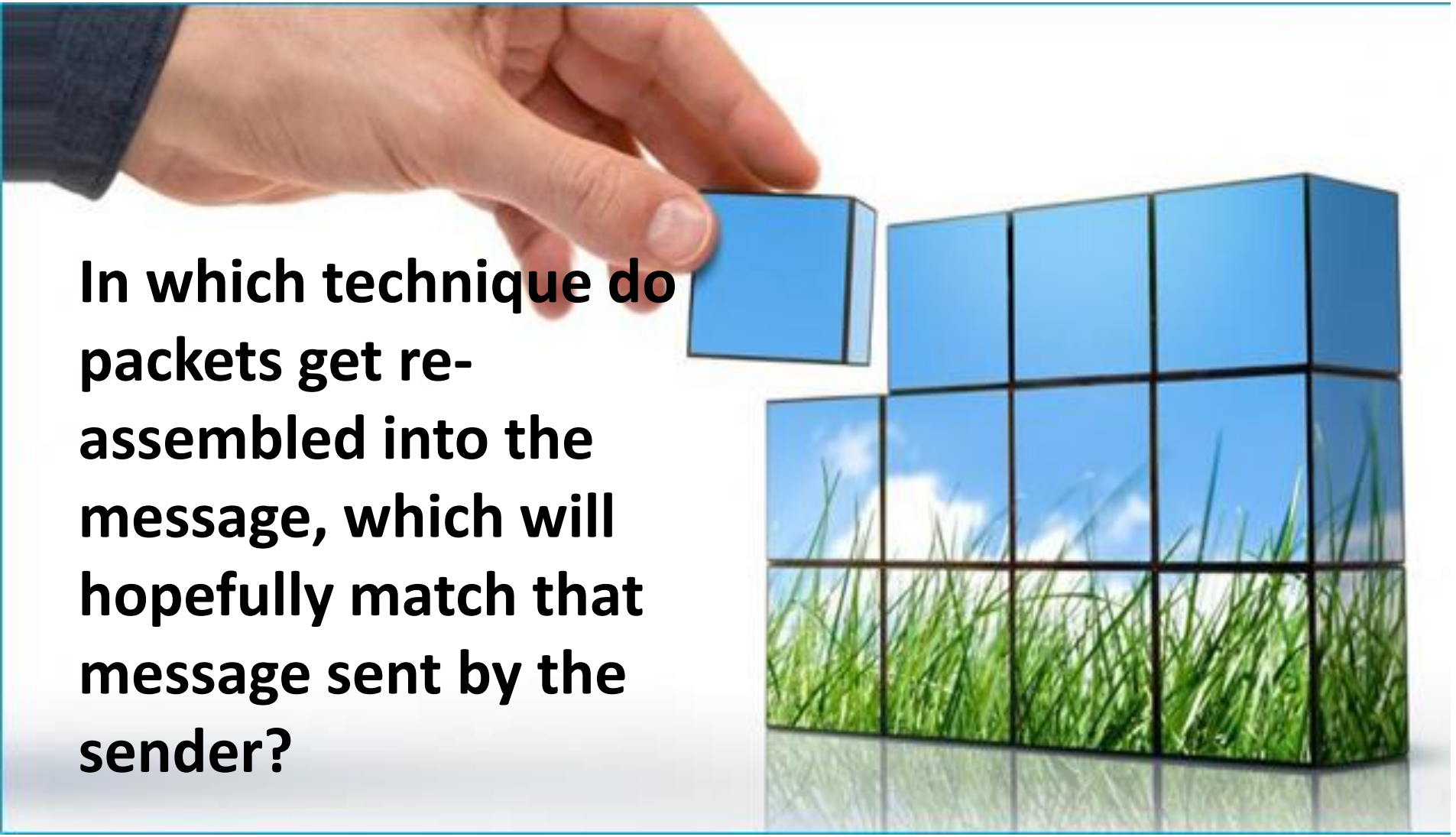
In which technique does each packet contains the sender's and receiver's addresses and some other information?



Datagram or data packet



Question 07



In which technique do packets get re-assembled into the message, which will hopefully match that message sent by the sender?

Question 08

Which technique directly supports the implementation of the Internet Protocol?

Question 09

Which technique is more suitable for remote live video and music over the net?

Question 10

Which technique do successive packets from same sender to same target may follow different routes through the network?

Question 11

Which technique do successive packets from same sender to same target must follow different routes through the network?

Question 12

Which technique states that if a link along the route fails, then the communication call will fail?

Question 13

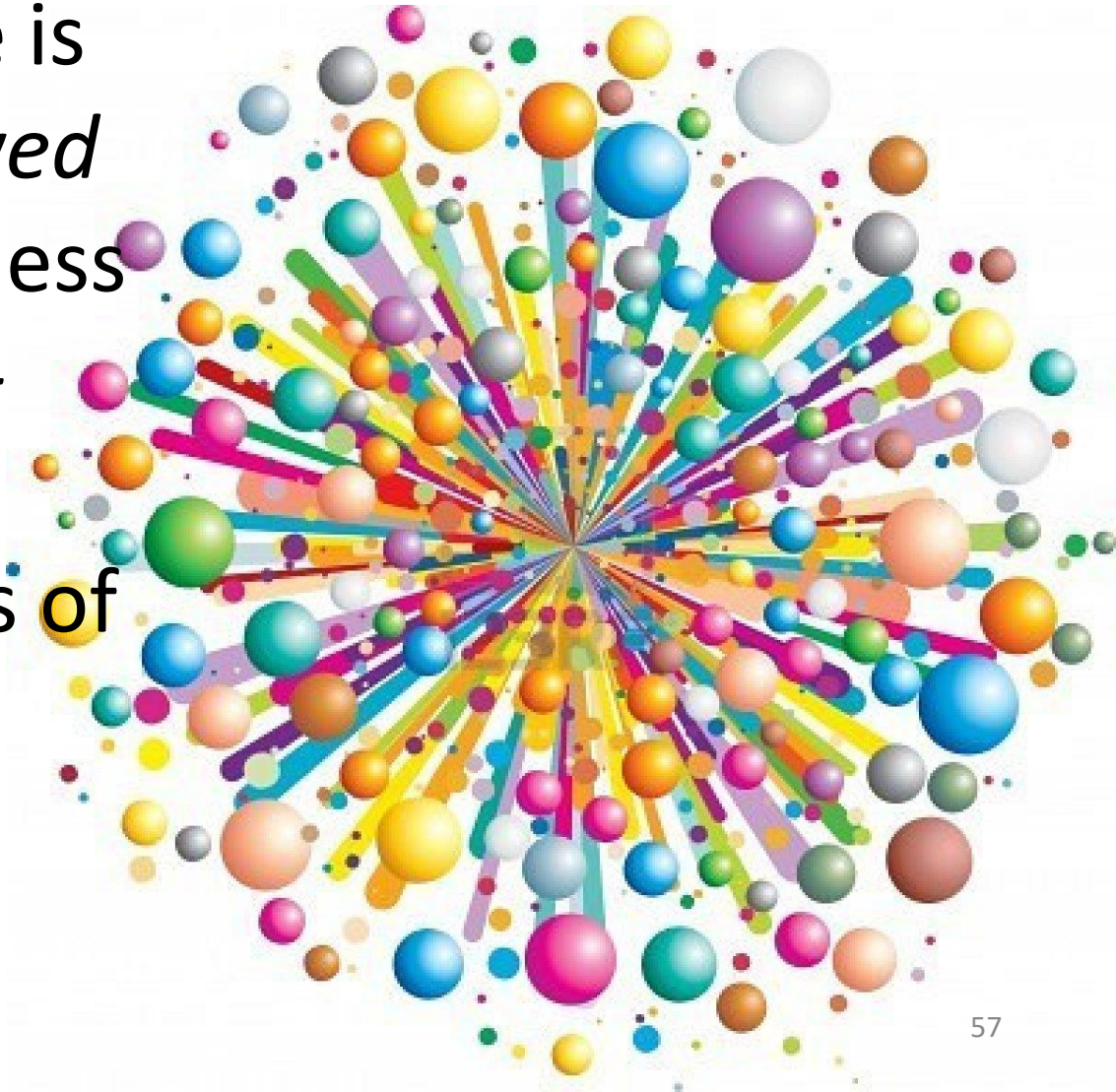
Which technique requires that a call set up must be performed before data can be sent?

Question 14

Which technique is flexible? i.e. routing will change as traffic loads in the network change?

Question 15

Which technique is ideal for *short-lived* bursts of traffic; less suitable for *long-lived and*/or *interactive* bursts of traffic?



Question 16

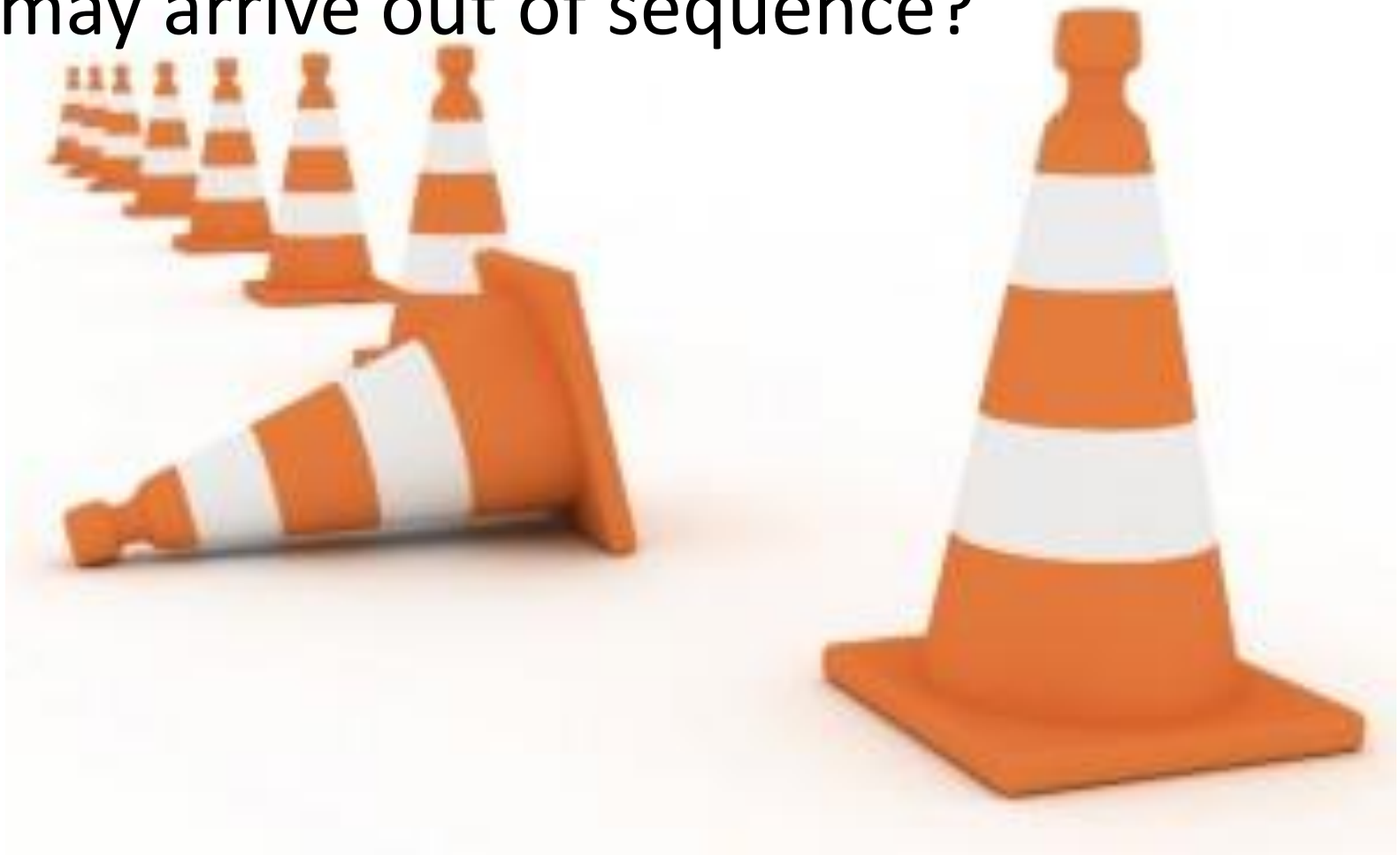
Which technique is the fastest to transmit large amounts of data?

Question 17

Which technique is the most inefficient of the three at utilizing the links or transmission capacity?

Question 18

In which technique is it likely that packets may arrive out of sequence?



Question 19

Which technique uses acknowledgments of packets received as an integral part of its operation?

Question 20

Which technique is more suited for broadcasting or advertising?

Question 16

In which service is the quality of service (QoS) guaranteed?

Call Terminated