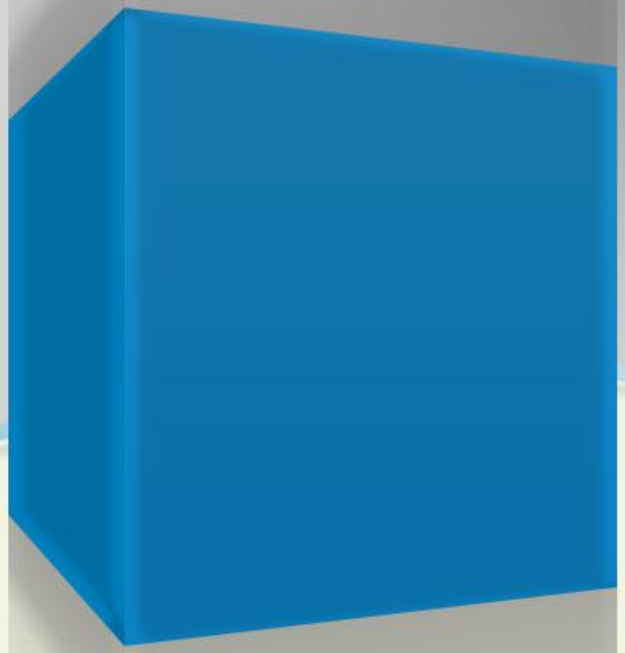
Computer Network Protocols
Data Link Layer



كلية المستقبل الجامعة
قسم هندسة تقنيات الحاسوب
المرحلة الرابعة

By
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Introduction

- *Data-link layer has the responsibility of transferring datagram from one node to physically adjacent node over a link.*

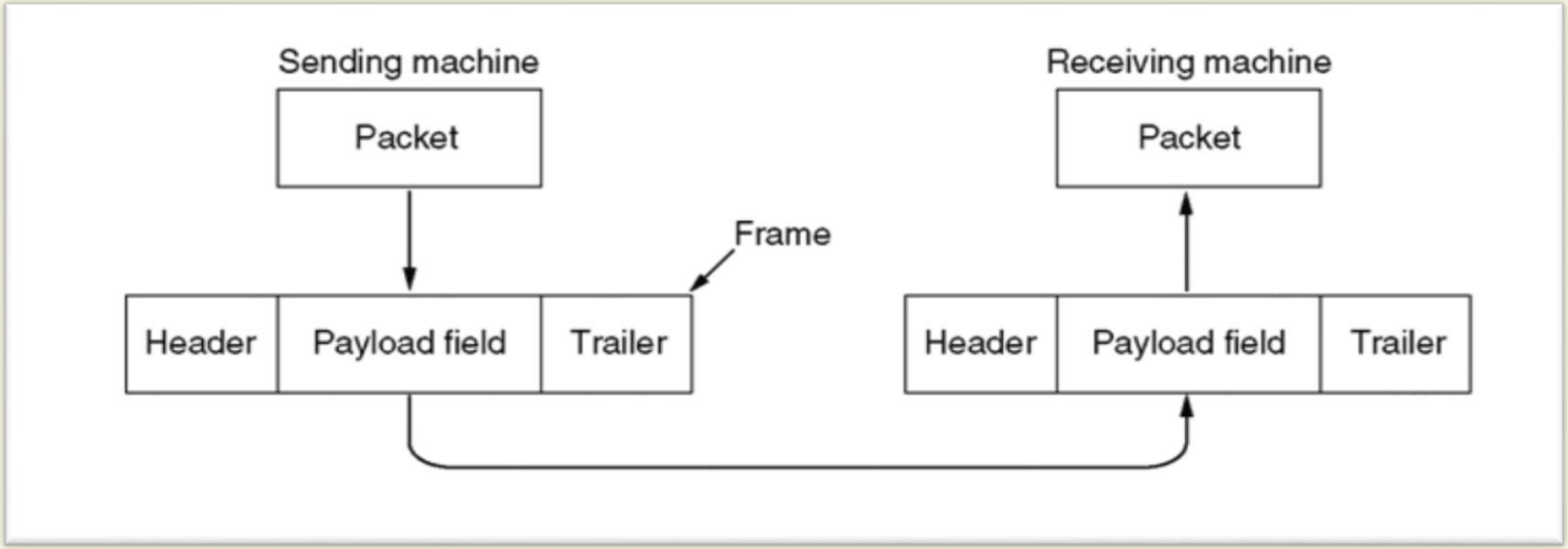
- *The data link layer is divided into two sublayers:* ***Logical Link Control (LLC)*** *and* ***Media Access Control (MAC).***

- *The LLC sublayer* ***manages communications between devices*** *over a single link of a network.*

- *The MAC sublayer governs* ***protocol access to the physical network*** *medium.*

Main Services Provided by Data link layer

1. *Framing*



2. *Error Control*
3. *Flow Control*

Data Link Layer Protocols

1. ***Elementary Data Link Protocols*** *:The main job of elementary data link layer protocols is to* ***receive packets from network layer***, ***create the frame*** *and* ***send it to physical layer***, *or vice versa. These are some elementary data link layer protocols*:

An Unrestricted Simplex Protocol (SP)	one direction transmitted data
A Simplex Stop-and-Wait Protocol(SWP)	flooding control
A Simplex Protocol for a Noisy Channel(SPN)	limit send and receive between sender and receiver, capacities are limited

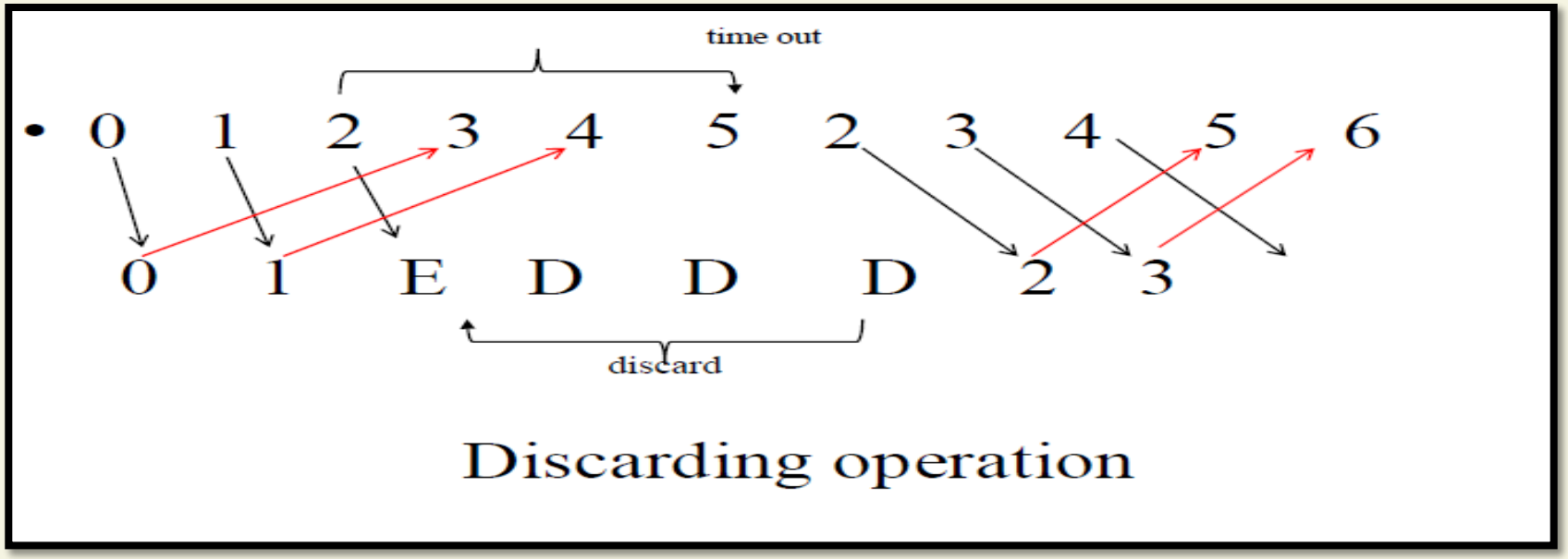
Data Link Layer Protocols

***2. Sliding Window Protocols**: The next three protocols are bidirectional protocols that belong to a class called sliding window protocols.*

A One-Bit Sliding Window Protocol(SWP)	1- assign variable 2- define frame 3- accept frame
A Protocol Using Go Back N protocol	Discarding &Buffering
A Protocol Using Selective Repeat (SRP)	accept and buffer delay and effected frame) without ACK

Go Back N Protocol

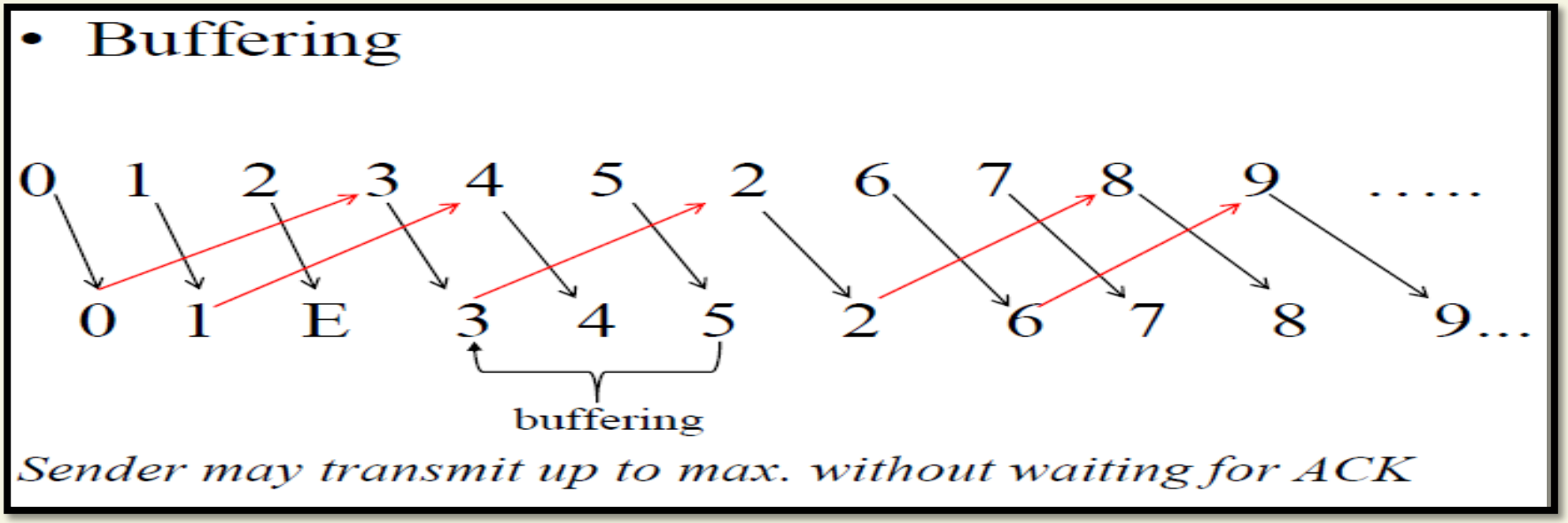
If there is one frame k missing, the receiver simply discards all subsequent frames k+1, k+2…., sending no acknowledgments. So the sender will retransmit frames from k onwards. This can be a waste of bandwidth.



Discarding operation

Selective Repeat Protocol (SRP)

Another strategy is to re-send only the ones that are actually lost or damaged. The receiver buffers all the frames after the lost one. When the sender finally noticed the problem (e.g. no ack for the lost frame is received within time-out limit), the sender retransmits the frame in question.



Point to Point Protocol (PPP)

Point - to - Point Protocol (PPP) *is a communication protocol of the data link layer that is used to transmit data* ***between two directly connected (point-to-point) computers****. The main features are:*

1. ***Carry network data of any network layer protocol at the same time***
2. ***Error detection (no correction)***
3. ***has a very simple mechanism for error control(A CRC field is used to detect errors)***
4. ***Does not provide flow control***
5. ***Connection life, signal link, negotiator***

Media Access control Protocols

Medium access *is a* ***mechanisms*** *that allow users to* ***access a common medium or channel****. There are three broad classes of MAC protocols, these are:*

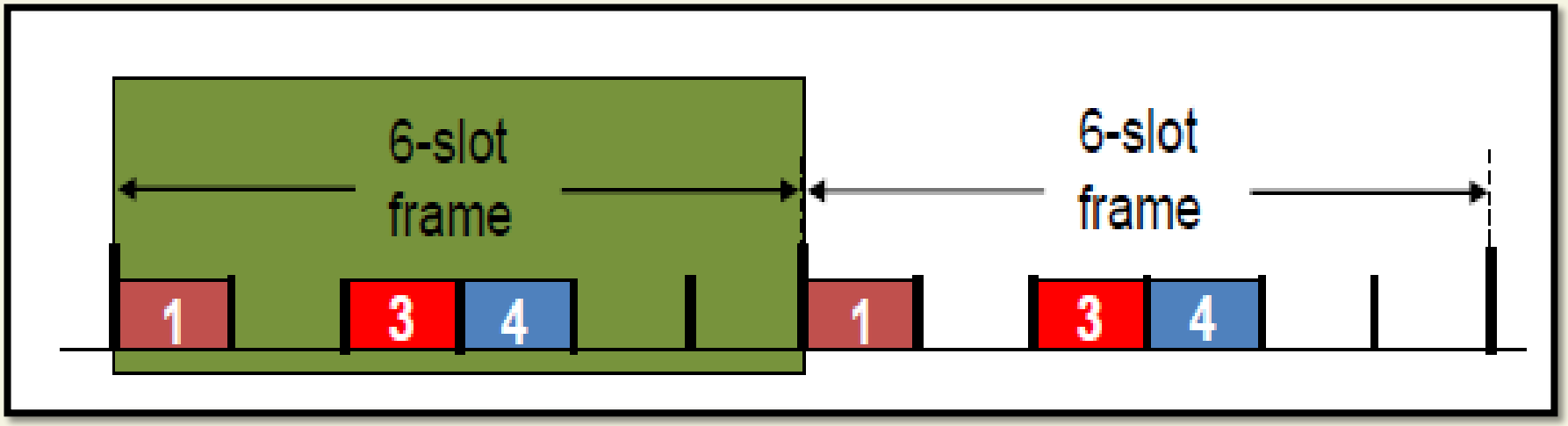
1. ***Channel Partitioning***
   - *divide channel into smaller "pieces" (time slots, frequency, code)*
   - *allocate piece to node for exclusive use*

2. ***"taking turns"***
   - *nodes take turns, but nodes with more to send can take longer turns*

3. ***Random Access***
   - *channel not divided, allow collisions*
   - *"recover" from collisions*

Channel partitioning MAC protocols

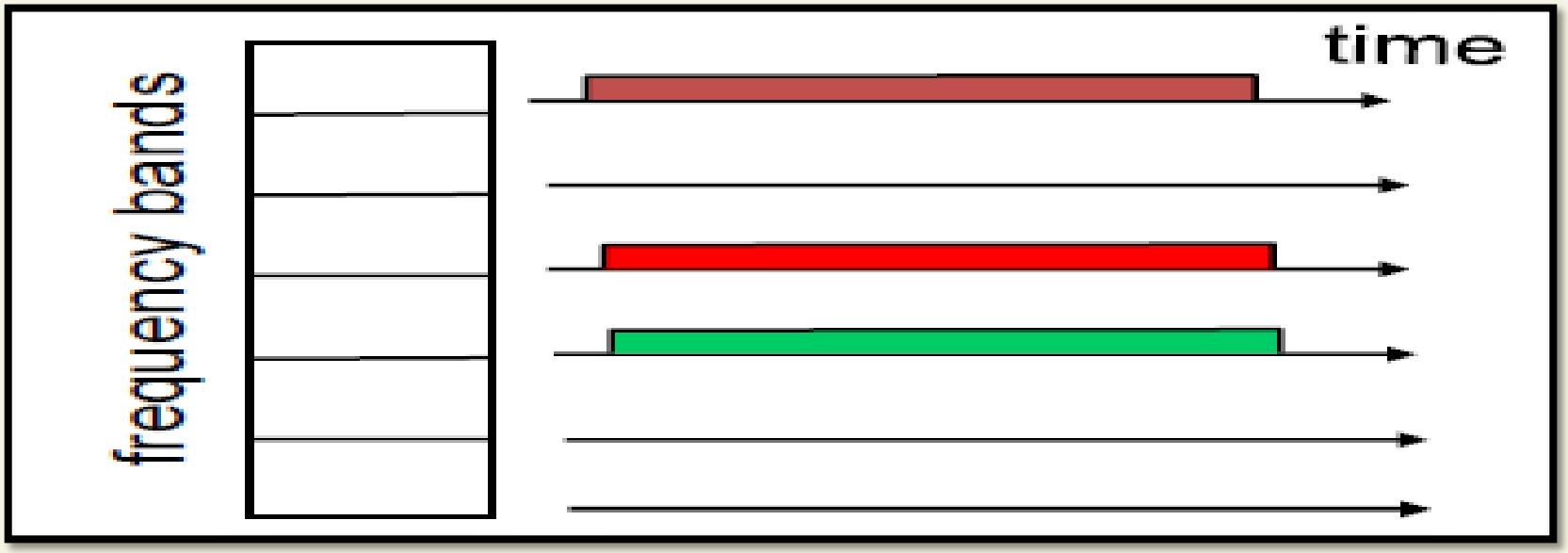
1. ***Time Division Multiple Access (TDMA)***
   - *Access to channel in "rounds"*
   - *Each station gets fixed length slot (length = pkt trans time) in each round*
   - *Unused slots go idle*



Channel partitioning MAC protocols

2. Frequency Division Multiple Access (FDMA)

- *Channel spectrum divided into frequency bands*
- *Each station assigned fixed frequency band*
- *Unused transmission time in frequency bands go idle*



Taking Turns MAC Protocol

1. ***Polling***
   - *master node "invites" slave nodes to transmit in turn*
   - *typically used with "dumb" slave devices*

Access Method

Whenever multiple users have ***unregulated access to a single line****, there is a danger of* ***signals overlapping and destroying each other****. Such overlaps is called* ***collisions****.*

Access method is a mechanism used to

1. ***coordinate traffic***
2. ***minimize the number of collisions that occur***
3. ***maximize the number of frames that are delivered successfully.***

The access mechanism protocol used in an Ethernet is called ***Carrier Sense Multiple Access (CSMA)*** *standardized in IEEE 802.3, and then this protocol developed to carrier sense multiple access with collision detection (CSMA/CD)*

- *CSMA (carrier sense multiple access)*

CSMA: listen before transmit

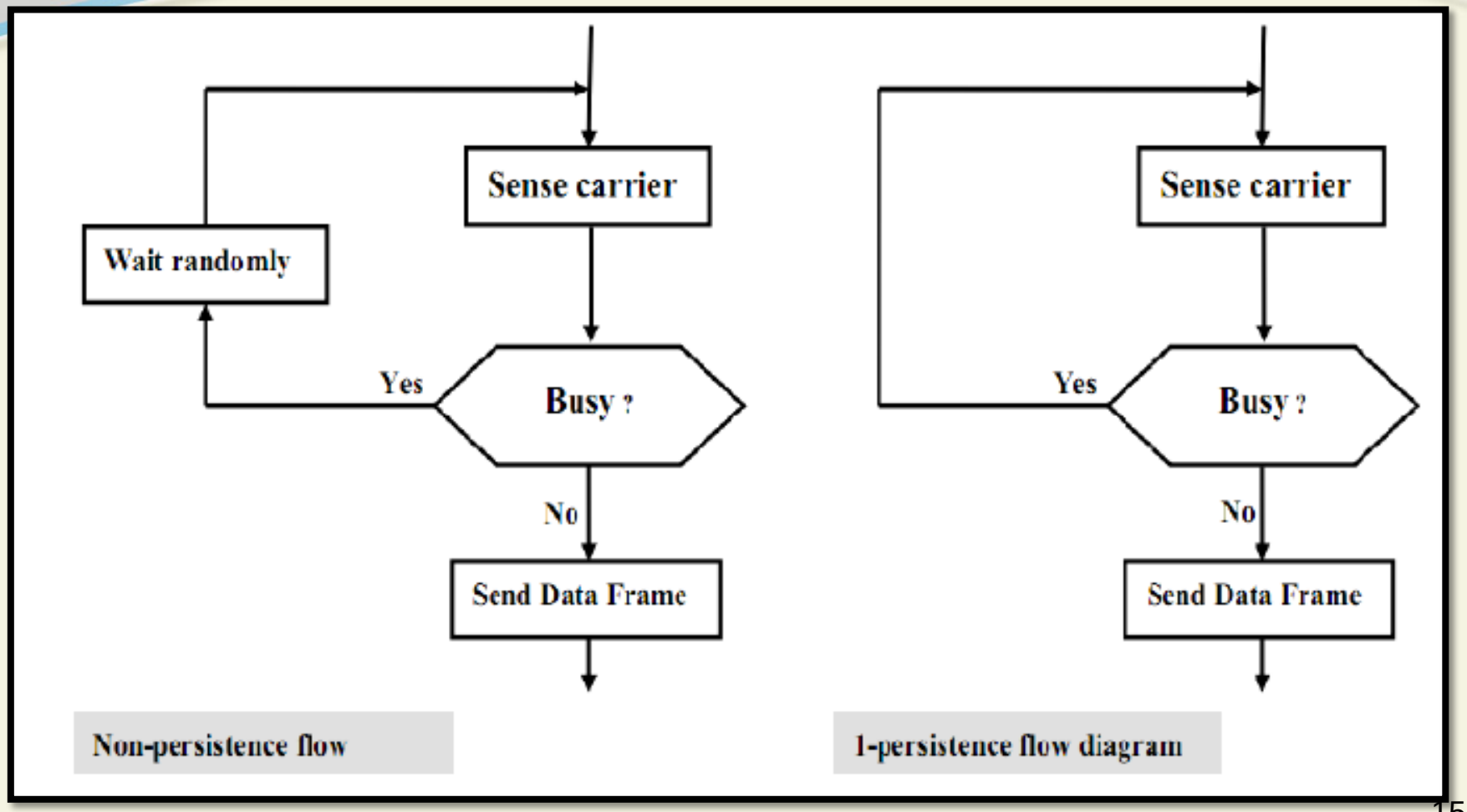
- *If channel sensed idle: transmit entire frame*
- *if channel sensed busy, defer transmission*

Carrier Sense Strategies

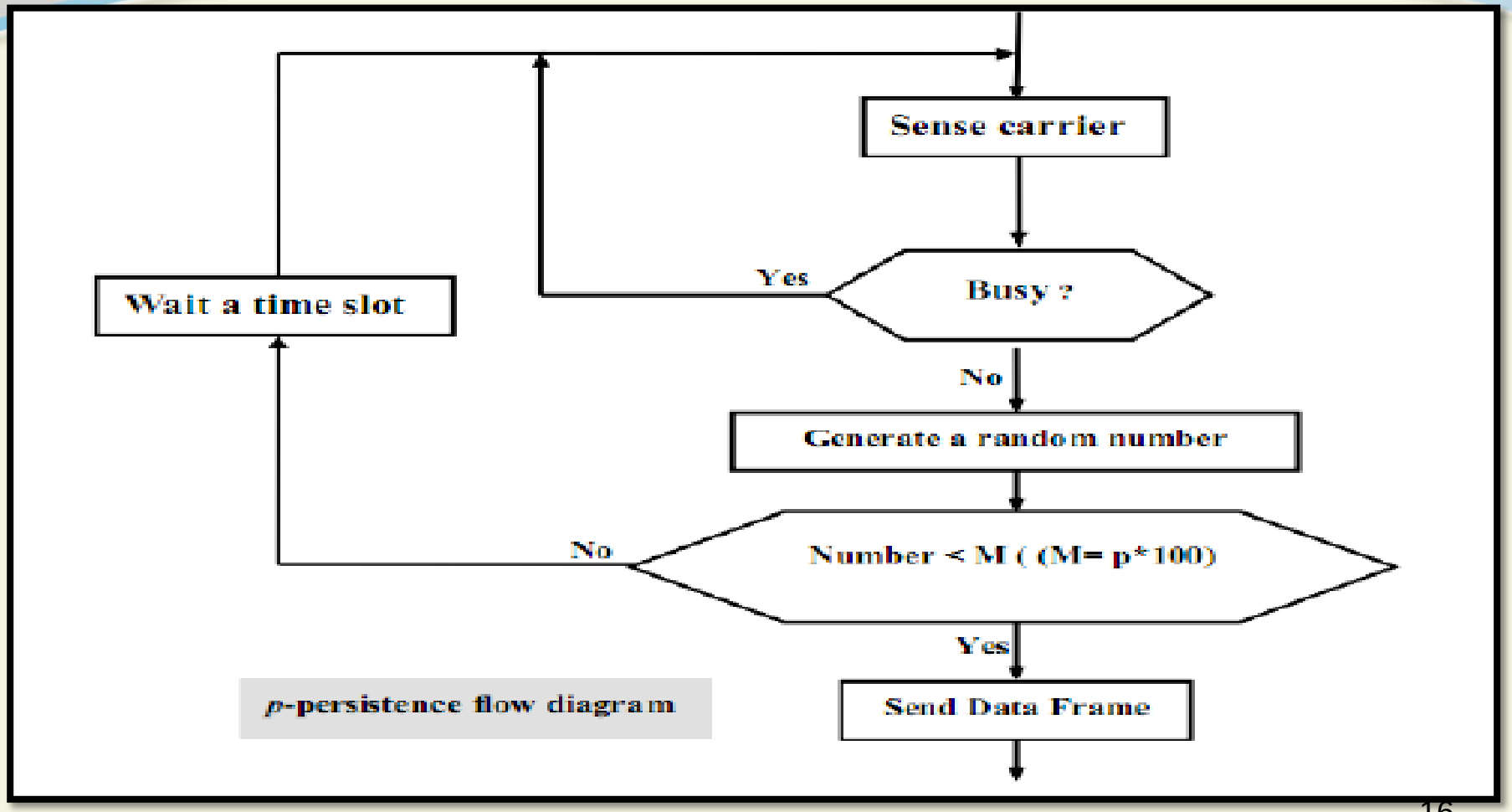
Carrier Sense: *when a station in an Ethernet network has data to transmit, it first see the network if it is use by other stations this is carrier sense, there are three carrier sense persistence strategies, these are:*

Non-persistence	senses the line if it is idle it sends immediately if the line busy ,it waits a **random time** then sense the line again this method reduce the chance of collision but it also reduced network efficiency.
1-persistence	After the station finds the line idle it sends its data immediately (with probability 1) this method increases the chance of collision.
p-persistence	**After the station finds the line idle it may transmit or no**. here the probability of sending is defined by P and probability of refusing is (1-P) for example if p=0.3 then station sends with 30% of the time and refusing 70% of the time. The station generates a **random number** between 1 and 100 if the number generated is less than 30 the station sends its data else it waits one slot time before sensing the medium again this method reduces the chance of collision and increasing network efficiency.

Carrier Sense Strategies



Carrier Sense Strategies



p-persistence flow diagram

Address Resolution Protocol (ARP)

The delivery of a packet to a host or a router requires two levels of addressing: ***logical address (IP)*** *and* ***physical address (MAC)****.*

The ***Address Resolution Protocol (ARP)*** *is a communication protocol used for* ***discovering the link layer address (****MAC address) associated with a given internet layer address (IP). Therefore,*

- ***ARP Maps IP addresses to MAC addresses***
- ***ARP Request is a broadcast but ARP reply is Unicast.***
- ***ARP tables contain the MAC and IP addresses of other devices on the network***

ARP Operation Processes

*Suppose that we have a **source called A** want to send data to **destination called B***

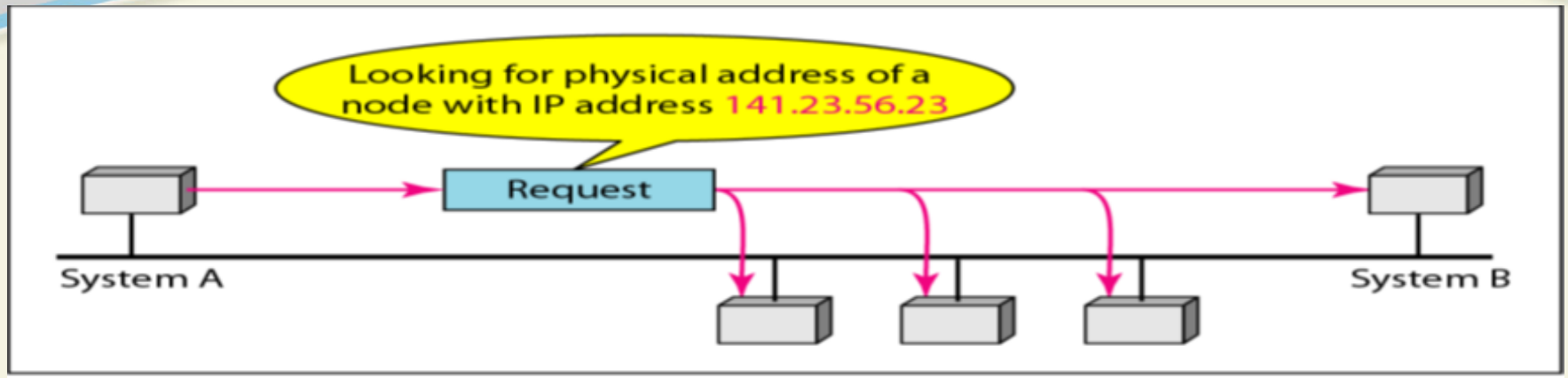
1. ***A** wants to send datagram to **B***
   - ***B's MAC** address **not** in A's ARP table.*

2. *A **broadcasts ARP query** packet, containing B's IP address*
   - *dest MAC address = FF-FF-FF-FF-FF-FF*

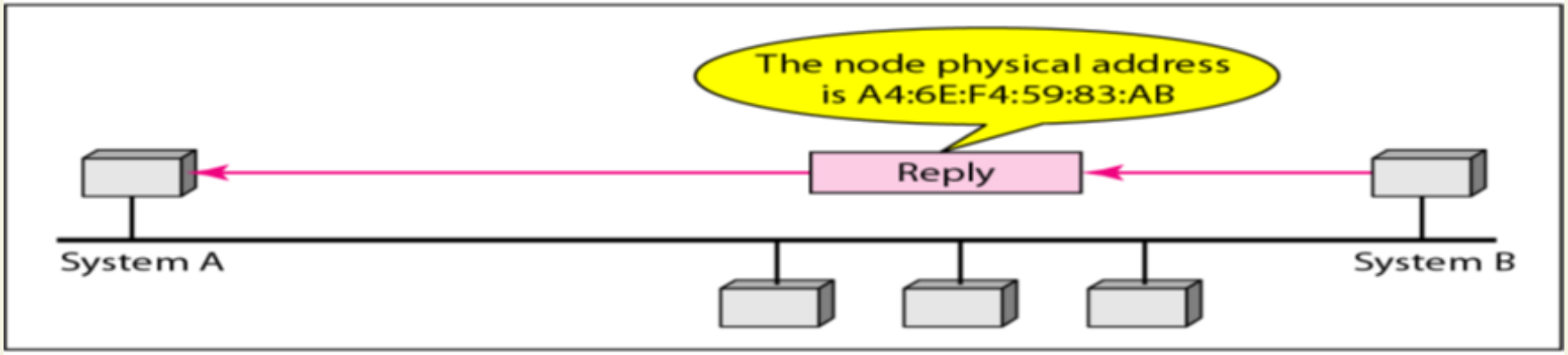
3. *All nodes on the network receive ARP query*

4. *B receives ARP query packet, replies to A with its (B's) MAC address*
   - *Reply frame sent to A's MAC address (**unicast**)*

ARP Operation Processes



a. ARP request is broadcast



b. ARP reply is unicast

End Of Lesson 1

Thanks For Listening