TCP and FTP

Practice 1

**Information and Communications Technology
Internet Engineering**

TCP (Transport Control Protocol)

- ## Protocol of transport layer
- ## Reliability（assure packet arrived to destination）
  - Retransmit control
- ## Use for File ・Mail・Web Transfer
  FTP   POP   HTTP
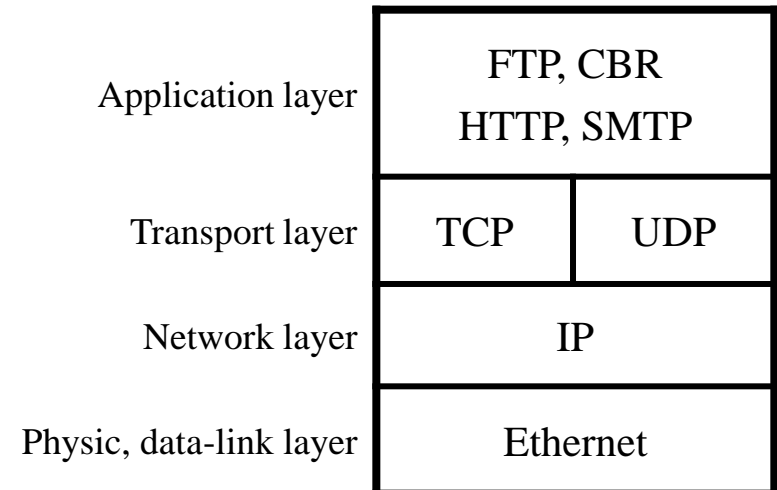   SMTP
          IMAP

FTP (File Transfer Protocol)
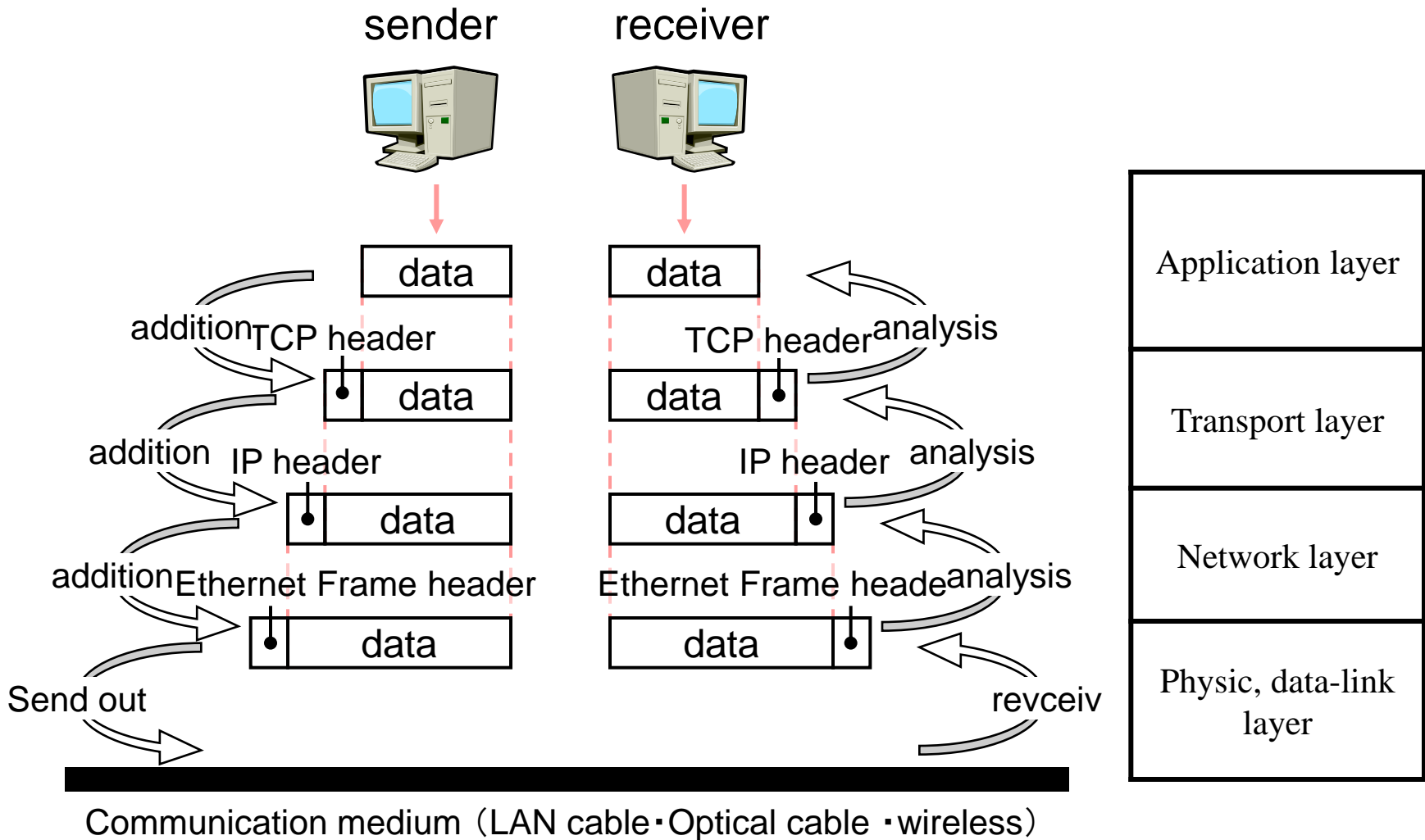
POP (Post Office Protocol)
SMTP (Simple Mail Transfer Protocol)
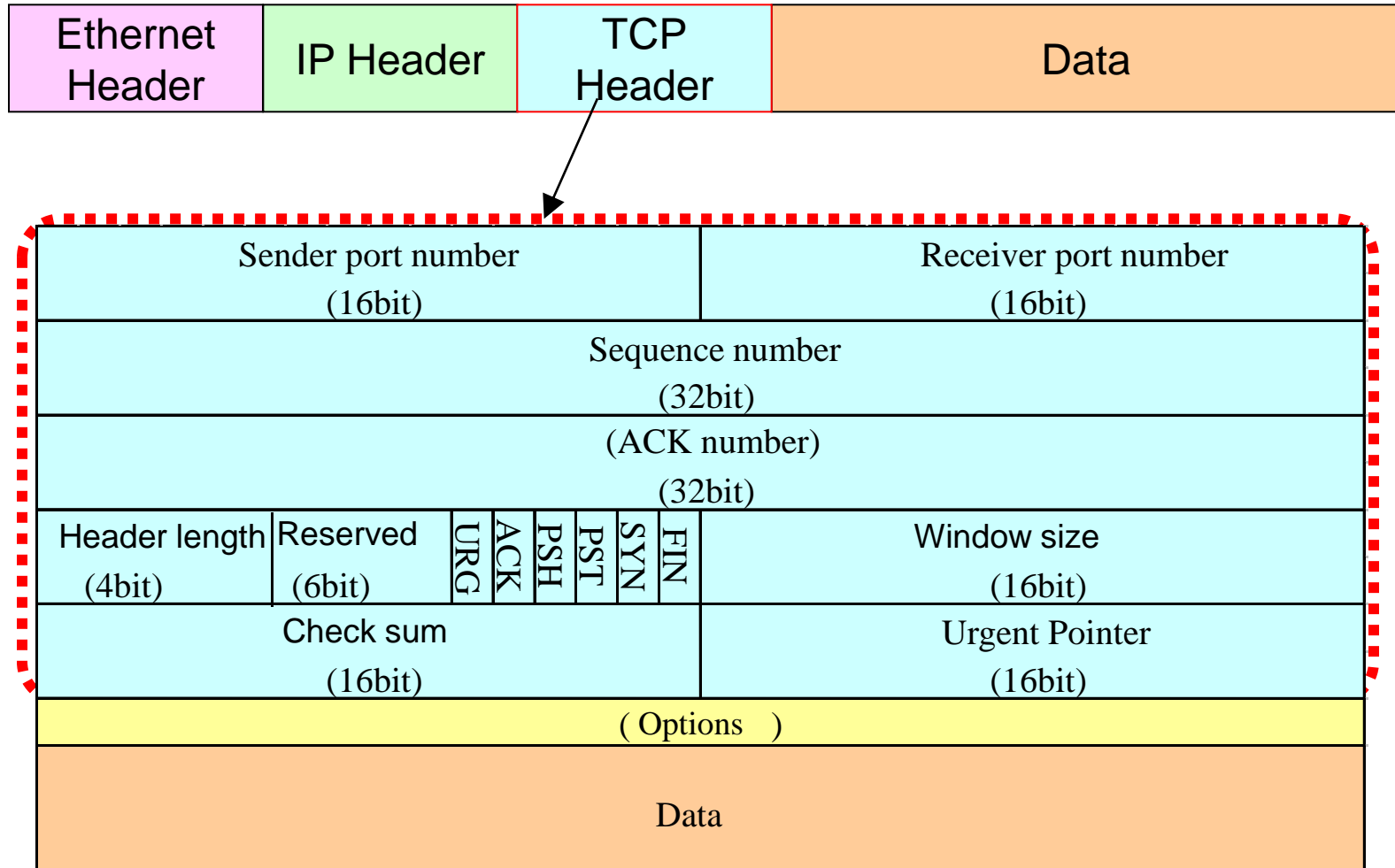IMAP (Internet Message Access Protocol)

HTTP (Hyper Text Transfer Protocol)

Application layer	FTP, CBR HTTP, SMTP
Transport layer	TCP | UDP
Network layer	IP
Physic, data-link layer	Ethernet

Hierarchy Architecture

sender   receiver

data   data

addition TCP header   TCP header analysis

data   data

addition IP header   IP header analysis

data   data

addition Ethernet Frame header   Ethernet Frame header analysis

data   data

Send out   revceiv

Communication medium （LAN cable・Optical cable ・wireless）

| Application layer |
| Transport layer |
| Network layer |
| Physic, data-link layer |

TCP Packet, TCP Header

Ethernet Header	IP Header	TCP Header	Data

| Sender port number (16bit)		Receiver port number (16bit)
Sequence number (32bit)		
(ACK number) (32bit)		
Header length (4bit)	Reserved (6bit)	URG ACK PSH PST SYN FIN	Window size (16bit)
Check sum (16bit)		Urgent Pointer (16bit)
(Options)		
Data		

TCP Header

- ## Sequence Number
  - Indicate the position of sent data
  - It add the number of bytes whenever data sent

   (※ In ns-2, it increase 1 when a data was sent)

- ## Acknowledge (ACK) number
  - Sequence number of data should be received
    - Data which have sequence number from 1 to ACK number should be received
    - If the sequence number of next send data is equal to reply ACK number, normal communication is done

      (※ In ns-2, the sequence number is continue and the receive data have the maximum value. It means that, if the sequence number of sent data match to ACK number, the communication has no fault)

Reliability Insurance by ACK

Sequence number

Sender

1 2 3

Data Packet ACK

Receiver

Next is 2 Next is 3 Next is 4

ACK Number
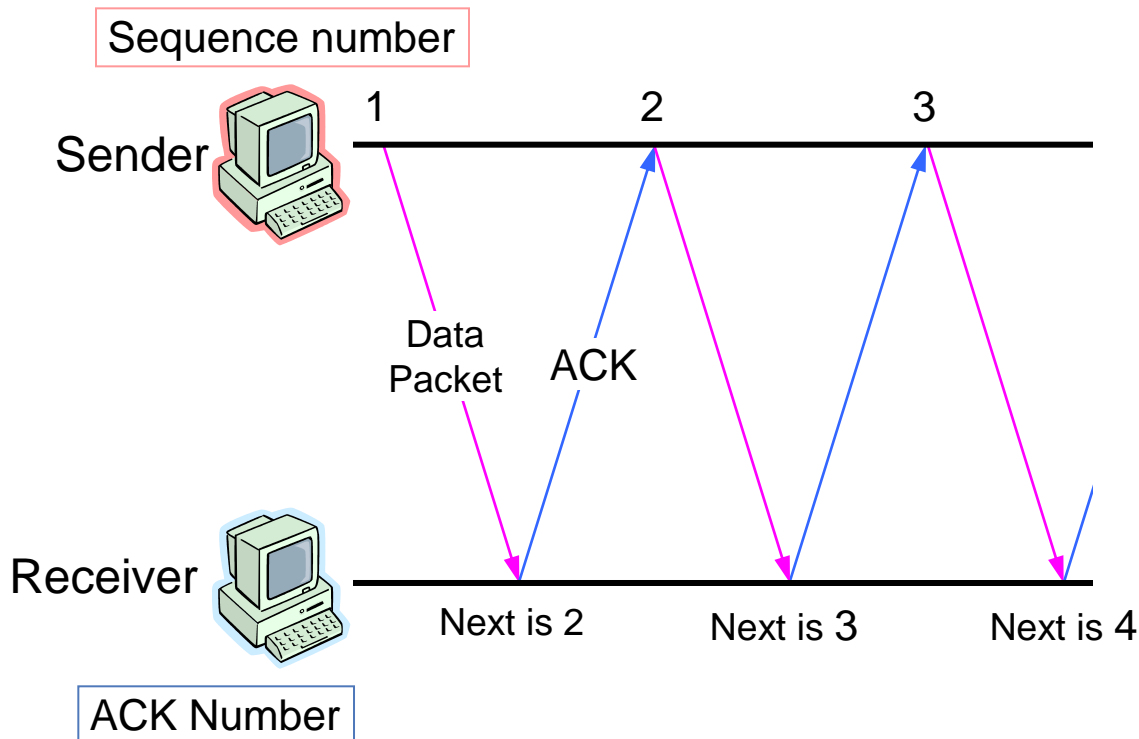
If one ACK is responded whenever receiving one segment, the efficiency is not good
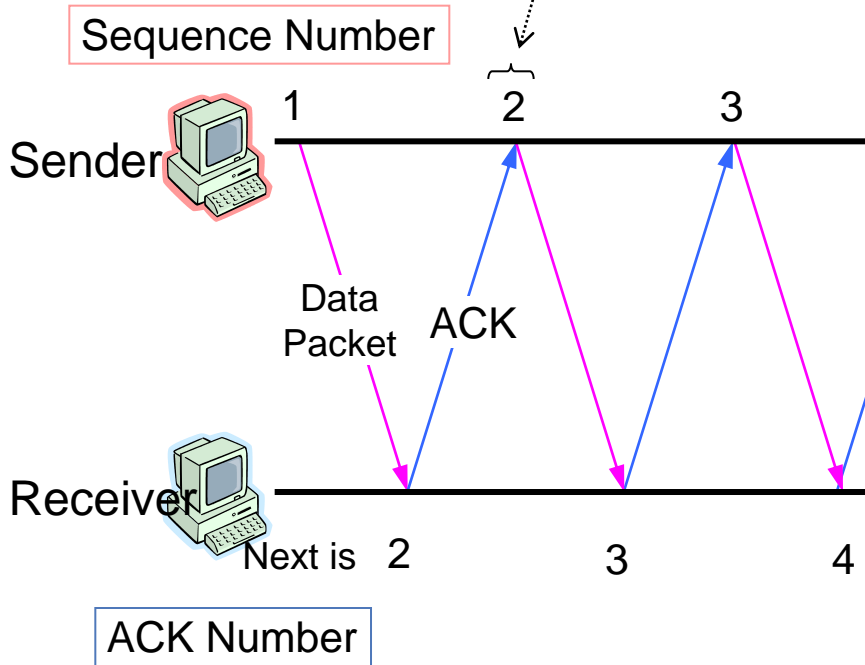→ Use ACK for bigger receiving data ?

Implement Window Control
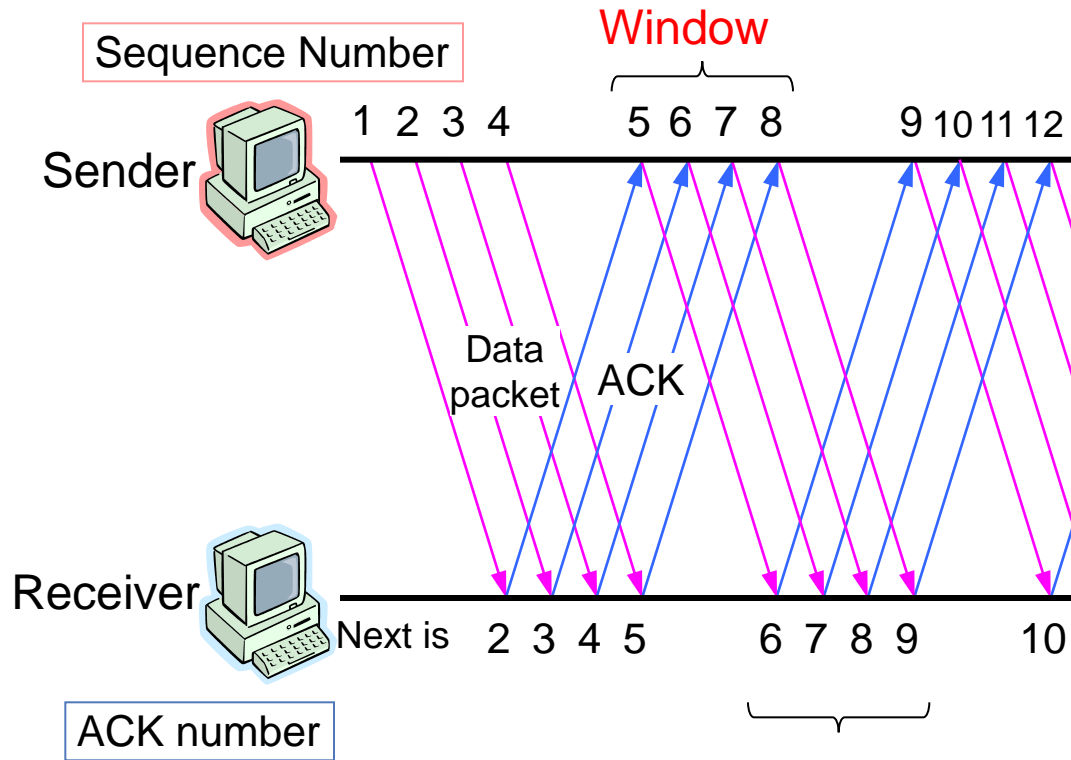
No waiting ACK for sent segment but send a number of segment

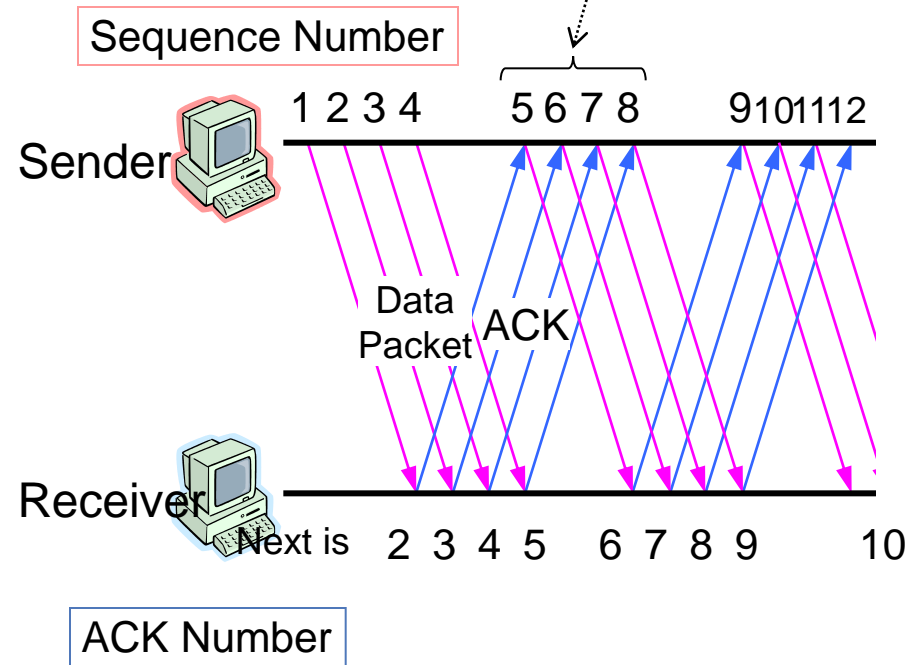※ Window size：number of segment can be sent without waiting for ACK

Improvement speed by Window Control

- Adjust rate by change window size

Window Size = 1 segment case

Sequence Number

Sender

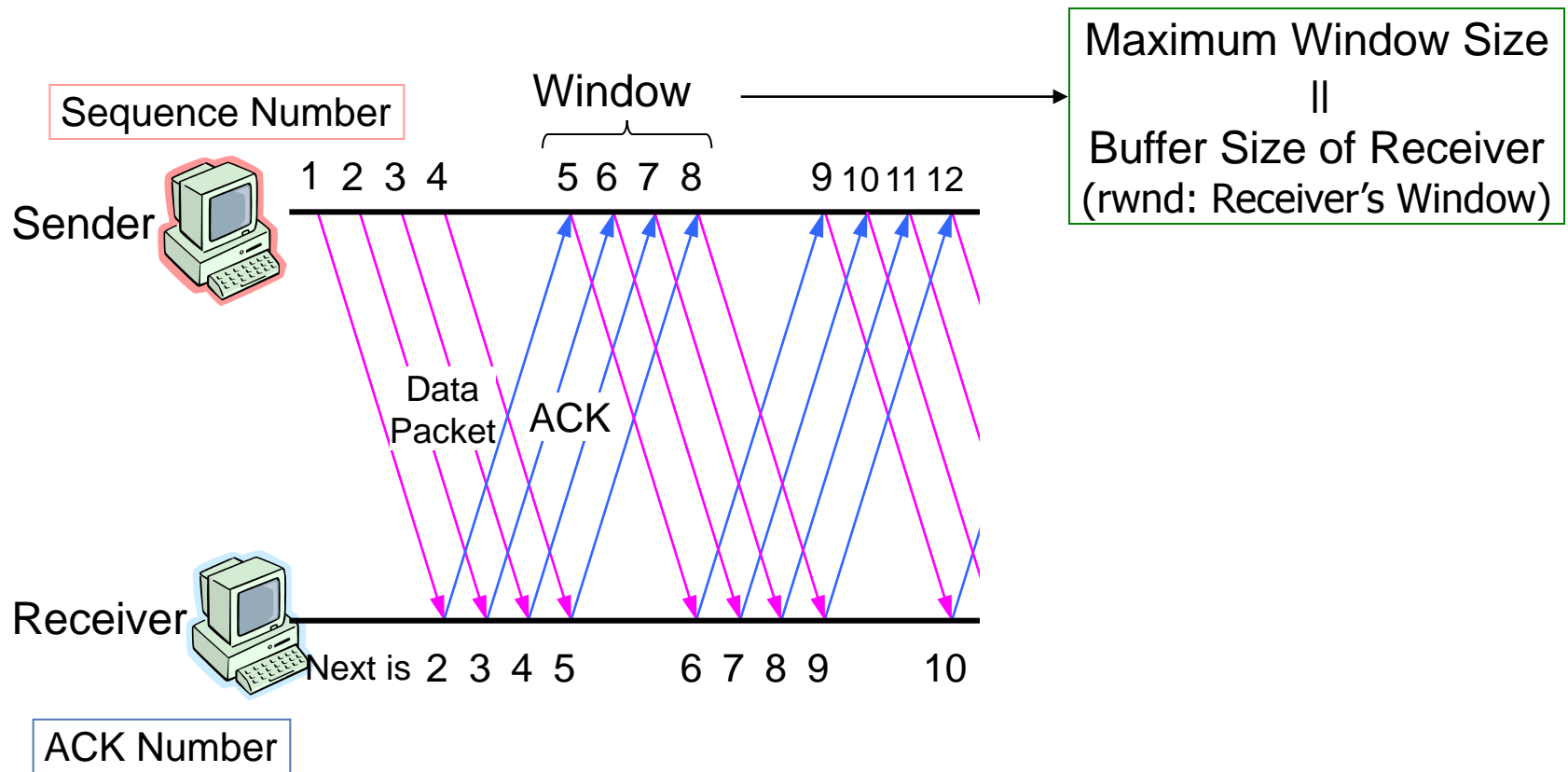1   2   3

Data Packet   ACK

Receiver

Next is   2   3   4

ACK Number

Window Size = 4 segment case

Sequence Number

Sender

1 2 3 4   5 6 7 8   9 10 11 12

Data Packet   ACK

Receiver

Next is   2 3 4 5   6 7 8 9   10

ACK Number

Maximum Window Size

- Window Size = 4 segment

Maximum Window Size
||
Buffer Size of Receiver
(rwnd: Receiver's Window)

Sequence Number

Window

1 2 3 4   5 6 7 8   9 10 11 12

Sender

Data Packet   ACK

Receiver

Next is 2 3 4 5   6 7 8 9   10

ACK Number

Retransmission Control (Time Out)

Fixed period RTO
(Retransmission Time Out)

Sender

1   1   2

Packet loss

Receiver
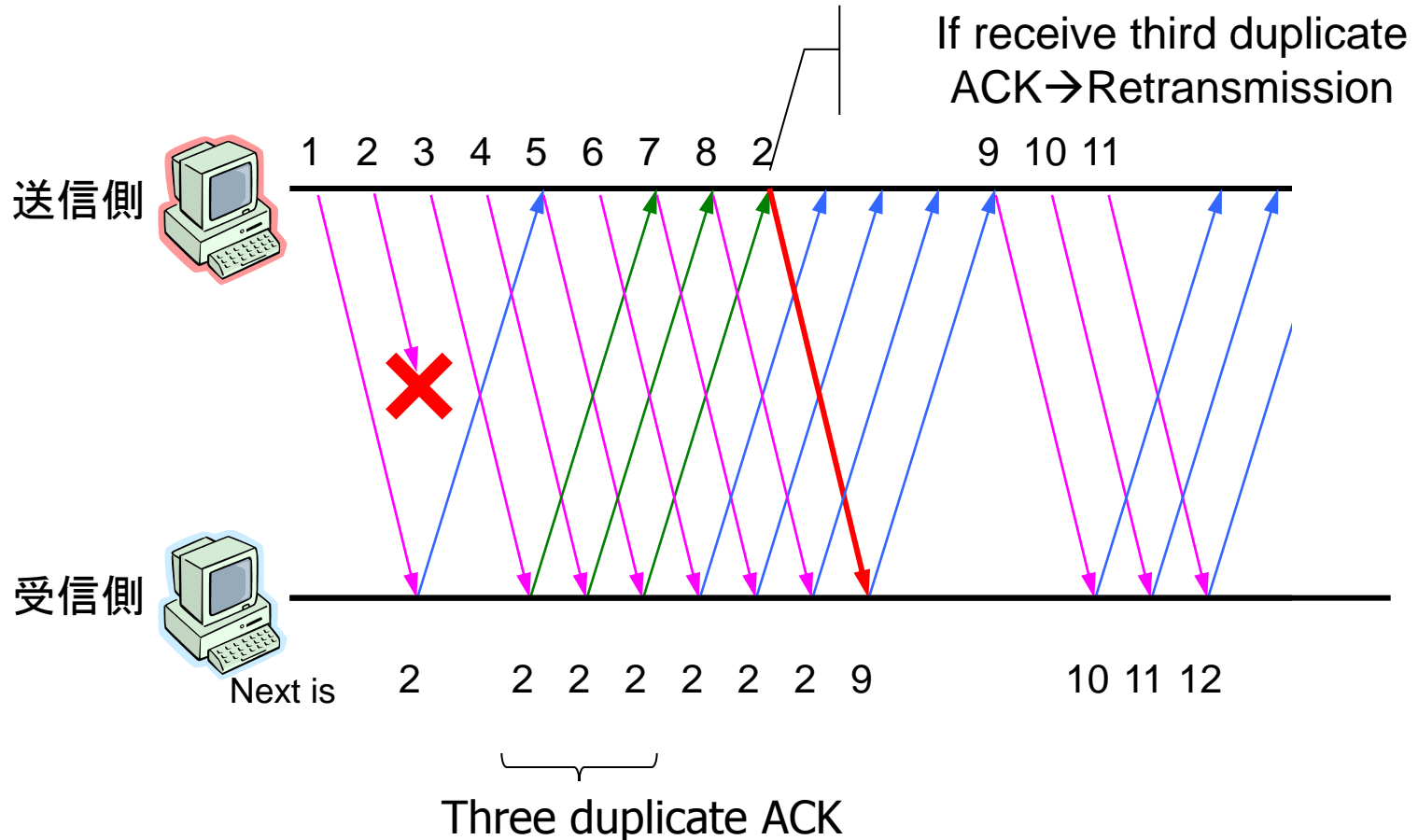
Next is
2
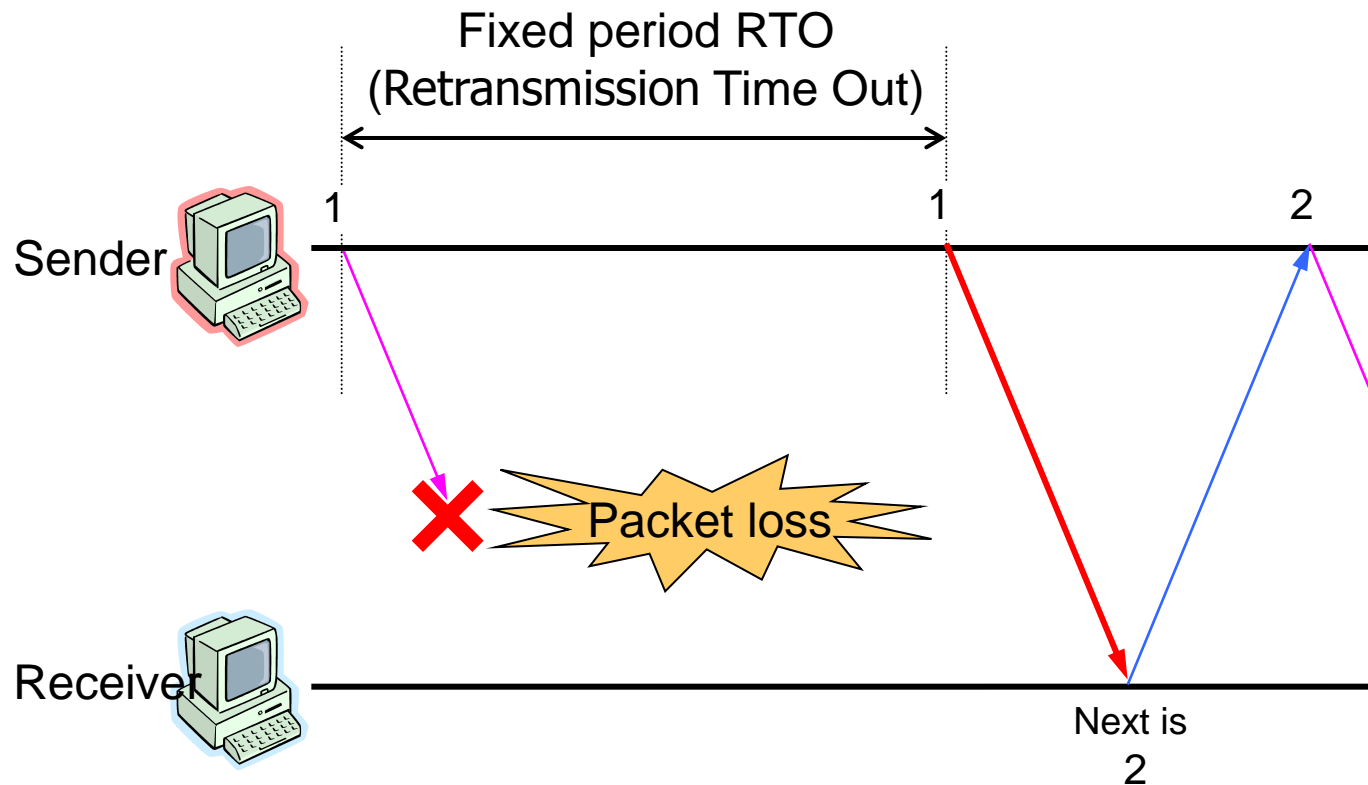
If the ACK of a packet doesn't response within RTO, that packet is considered loss →**Retransmission**

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Retransmission Control (duplicate ACK)

If receive third duplicate
ACK→Retransmission

1 2 3 4 5 6 7 8 2   9 10 11

送信側

受信側

Next is   2   2 2 2 2 2 2 9   10 11 12

Three duplicate ACK

If receive three same ACK then packet is considered loss
→**retransmission**

Experiment 1-3

(Bottle Next link)

Band Width: Bw

0

4

2

3

40Mbps

40Mbps

FTP/TCP

1

5

FTP	Download
TCP Agent	TCPSink Agent
Network → Router → Network	