

# IG CS Topic 2.1-2.4 Data Transmission

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Data Packets

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## Data Packets

- data is **broken down** into **packets** to be **transmitted**
  - a packet is **a small unit of data**

## Structure of a packet

- a packet contains a **packet header**, a **payload** and a **trailer**

### 1. **Packet Header**

- a section of a packet that contains information about the content of the packet and its destination, which can be broken down into:

#### 1. **Destination address**

- normally an IP address
- states where the packet is to be sent

#### 2. **Packet number**

- the **order** of the packet in the data
- the packets of data may not have all been sent in the correct order
  - hence in destination, when the device has received all the packets, it will rearrange the packet based on the packet numbers to show the data correctly

#### 3. **Originators address**

- normally an IP address
- states where the data has been originally sent
- not used often
  - but can be used to track illegal activities or ask the device to resend the packet when an error occurs

## 2. Payload

- the **actual data** from the file that you are sending

## 3. Trailer

- known as the **footer**
- contains 1) a **marker** indicating that it is the end of the packet  
and 2) the data for **error detection**

## Packet Switching

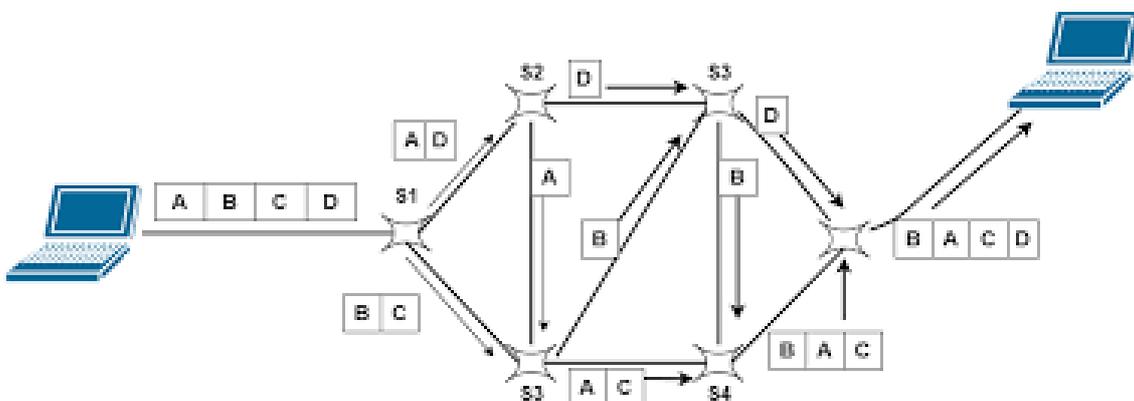
- a method of transmitting data packets across a network
- each data takes an **individual pathway**

Advantages	Disadvantages
No need to tie up a single communications line	Packets can be lost and need to be re-sent
Possible to overcome failed, busy or faulty lines by re-routing	Doesn't work well with real-time streaming
A high data transmission rate is possible	Delay at the destination while waiting for all of the packets to arrive and then reassemble them in the correct order

## Packet Switching Method

*explain how packet switching works.*

1. Data is broken down into **packets**
2. Each packet could take a **different route**
3. A **router** controls the route a packet takes
  - the routing selection depends on the **number of packets** at each router
4. Packets may arrive **out of order**
5. Once the last packet has arrived, packets are **reordered**



# Data Transmission Methods

- there are multiple ways data can be transmitted

## Number of Bits

- remember to refer to bit in your answer...

### 1. Serial data transmission

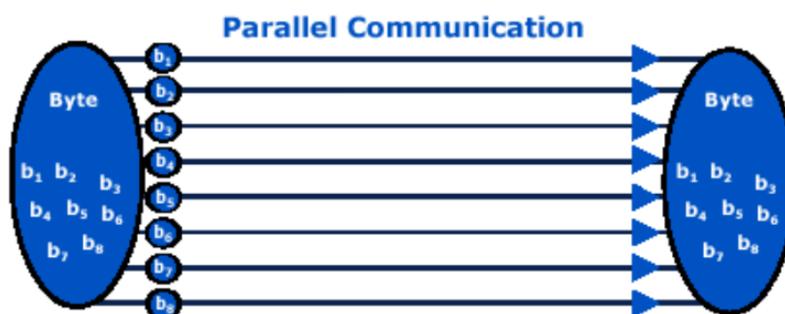
- **one bit** of data is sent at a time over a **single wire**
- used in **long-distance transmission** and transmission that requires the data to be **accurate**
  - example usage includes the **USB**



Advantages	Disadvantages
less chance of data being <b>skewed</b> because data arrives in order of sequence, one bit at a time	the transmission is <b>slow</b> as only one bit is sent at a time
more accurate <b>over a longer distance</b>	<b>start bit</b> and <b>end bit</b> are required to tell the destination when the transmission has started or ended
cheaper to manufacture and buy as only one wire is used	

### 2. Parallel data transmission

- **multiple bits** of data are sent at a time using **multiple wires**
- used in **short-distance** or **fast** transmissions
  - example usage includes **connecting a computer to a printer**
- it is often limited to **5 meters**



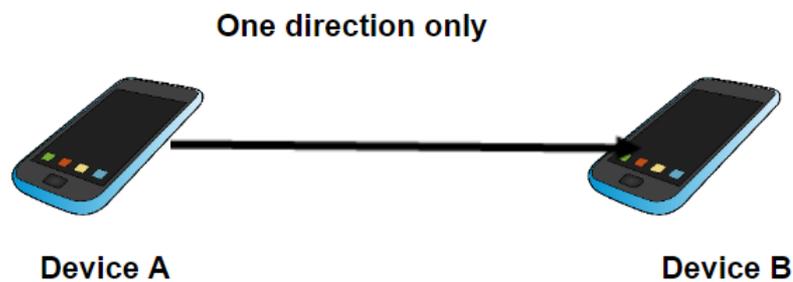
Advantages	Disadvantages
the transmission is <b>fast</b> as data is sent multiple bits at a time	high chance of data being <b>skewed</b> as packets do not arrive in the destination in order
match to underlying hardware - computers internally use parallel circuits	more chance of <b>data interference</b> over long distances, less accurate in transmission
	more expensive in purchasing

## Directions

- the usages depend on the purpose

### 1. Simplex

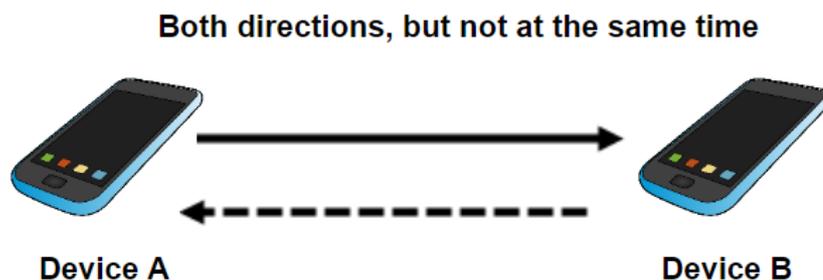
- data is transmitted in **one direction only**



- it has **no traffic issues** and the **full capacity** of the transmission line can be used
- however, two devices cannot communicate in simplex mode

### 2. Half-duplex

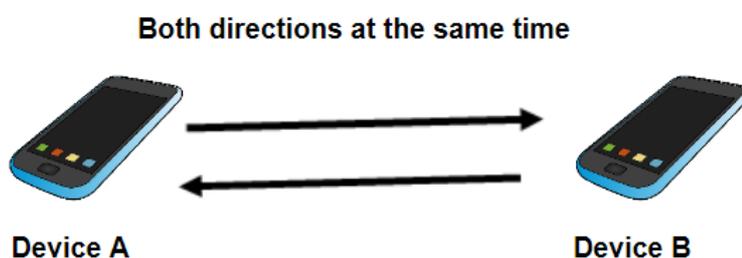
- data can be transmitted in **both directions**, but only **one direction** at a time



- data is **transmitted in both sides** and **troubleshooting** is easy
- however, there will be **delay** in half-duplex, making it **slow**

### 3. Full-duplex

- data is transmitted in **both directions**, at **the same time**



- data is transmitted at a **very fast** speed then the other methods and there is **no delay** in communication
- however, no proper **bandwidth utilization** as the same line is used for sending and receiving at the same time

Basis Of Compression	Simplex	Half Duplex	Full Duplex
<b>Direction of Communication</b>	Data transmitted only in one direction at a time	Signals can be transmitted on both side, but not at the same time	Signals can be transmitted on both sides at the same time.
<b>Send / Receive</b>	The sender only send data	The sender can be sent and receive but not at the same time	The sender can send and receive data at the same time
<b>Performance</b>	Worst performance	Better performance	Best performance
<b>Example</b>	Keyboard	Walkie-talkie	Telephone

- the transmission method combines a type of "number of bits" and a type of "directions"
  - e.g., half-duplex serial data transmission / simplex parallel data transmission

## Universal Serial Bus (USB)

- **Universal Serial Bus** is an industry-standard that is used to transmit data
- A **USB** interface includes items such as **USB port** (USB 接口), **USB cable** (USB 线), **USB device** (USB 设备)
  - USB device includes **USB Memory stick** (U盘)
- USB uses **serial** data transmission that can be either **half-duplex** or **full-duplex**

Advantages	Disadvantages
<b>impossible</b> to connect a USB device incorrectly as the connector only fits one way	the length of the USB cable is limited normally to <b>5 meters</b>
it is an <b>industry standard</b> so any devices you buy can connect to an USB	the transmission speed isn't as fast as other types of connections such as <b>ethernet</b>
supported by <b>many operating systems</b>	does not have an <b>unlimited lifespan</b>
<b>faster</b> transmission compared to wireless	
devices are automatically <b>detected</b> and <b>configured</b> when initially attached	

