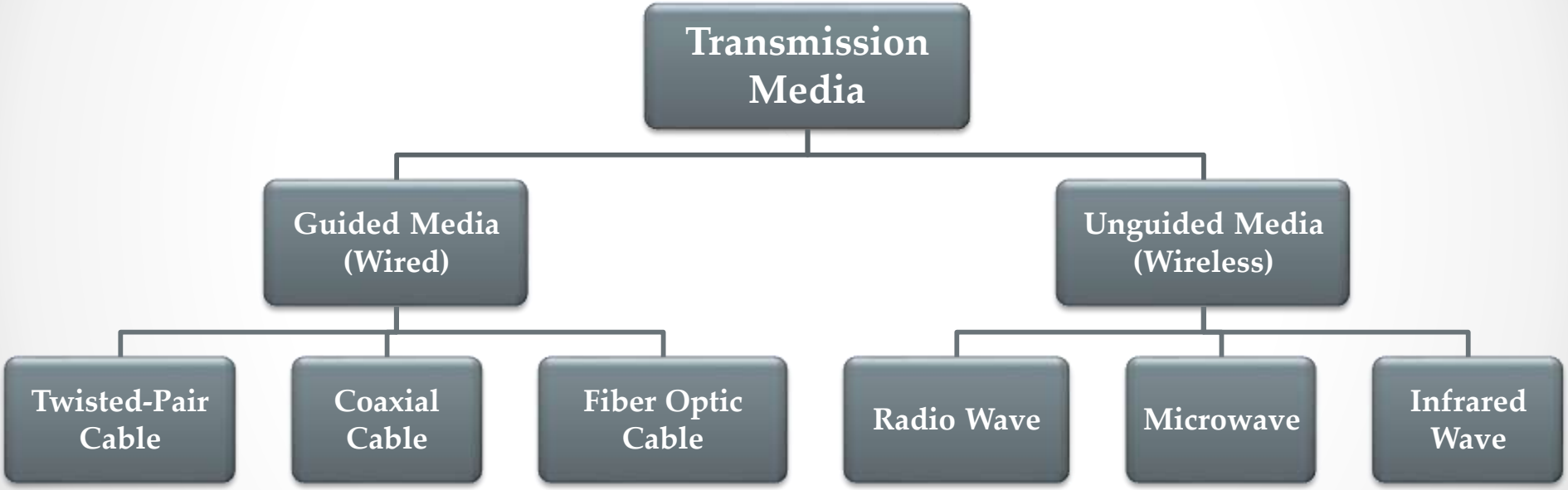
Transmission Media

Transmission Media

- A transmission media can be defined as any medium that can carry information from a source to a destination.



Guided Media

- Guided media are those that provide a wired - channel from one device to another.
- Three Guided media commonly used for data transmission are:

Twisted Pair Cable

Coaxial Cable

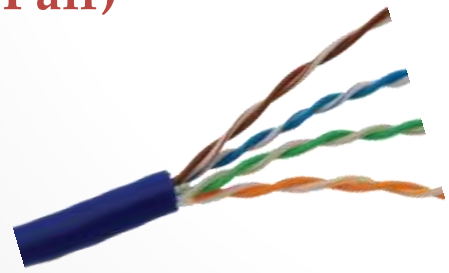
Fiber Optic Cable

Twisted Pair Cable

- Separately insulated
- Twisted together

- It is widely used in different kinds of data and voice infrastructure.
- The use of two wires twisted together helps to reduce crosstalk and electromagnetic induction.
- Two types of twisted pair cable:

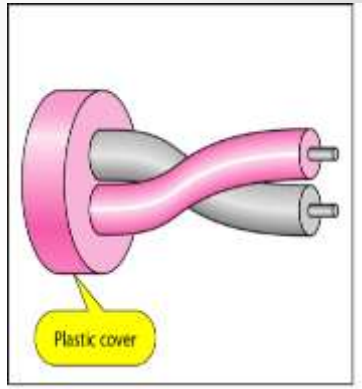
UTP (Unshielded Twisted Pair)



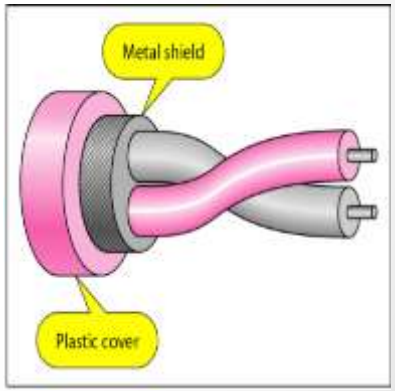
STP (Shielded Twisted Pair)

Twisted Pair Cable – Cont…

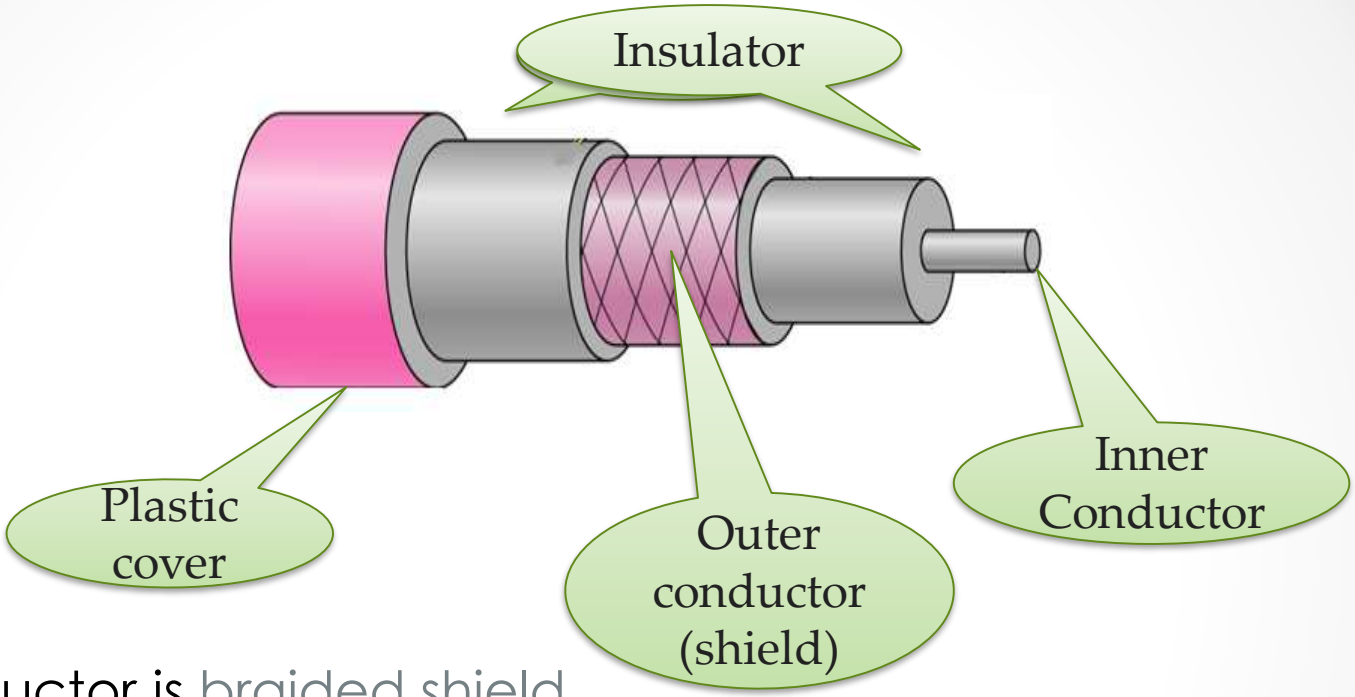
- UTP(Unshielded Twisted Pair)
  - Ordinary telephone wires
  - Less expensive
  - Weak immunity against noise & interferences
  - Most used in two categories: Cat-3 & Cat-5
  - Used in laboratory



- STP(Shielded Twisted Pair)
  - An extra metallic shield on each pair
  - Relatively more expensive
  - Better performance than UTP
  - Used in exterior network(outside of building).



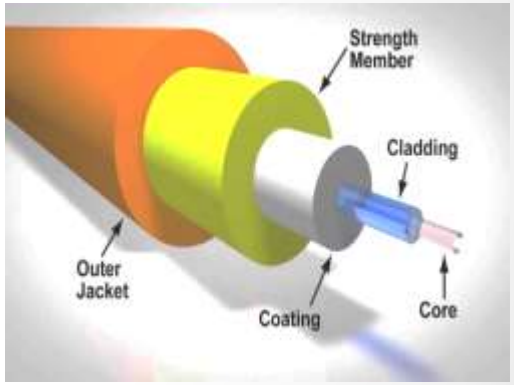
Coaxial Cable

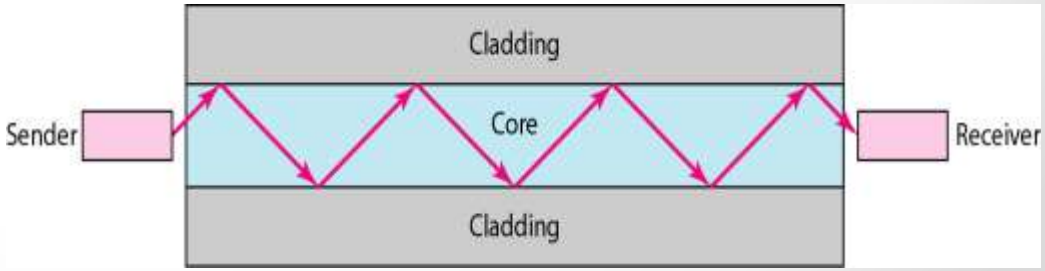


- Outer conductor is braided shield.
- Inner conductor is solid metal.
- Separated by insulating material, and whole cover by plastic cover.
- Used in television, long distance telephone transmission.
- High bandwidth and excellent noise immunity.

Fiber Optic Cable

- A fiber-optic cable is made of glass or plastic and transmits signals in the form of light.
- Light travels in a straight line as long as it is moving through a single uniform substance.
- It is surrounded by a cladding of less dense glass or plastic so, difference in density of the two materials must be such that a beam of light moving through the core is reflected off the cladding instead of being refracted into it.
- It use reflection to guide light through a channel.
- Small size & Weight
- Used in high bandwidth network
- High data rate & lower attenuation

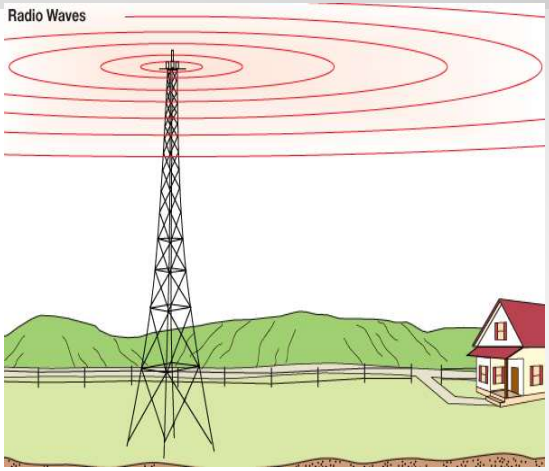




Unguided Media

- Unguided media transmit electromagnetic waves without using a physical conductor.
- This type of communication is often referred to as wireless communication.
  1. Radio wave
  2. Microwave
  3. Infrared Wave

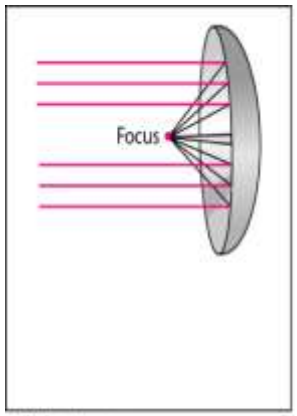
Radio wave



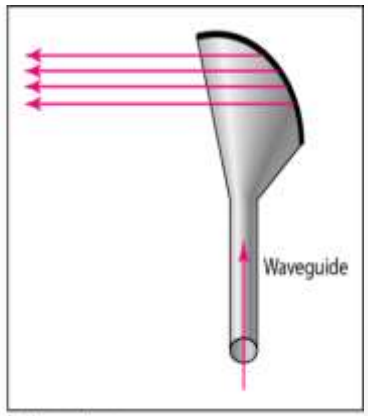
- Are (electromagnetic)waves
- Highly regulated
- Omni directional antennas
- The sending and receiving antennas need not be aligned.
- Frequency Range:3KHz – 1GHz.
- It used for multicast communications, AM and FM radios and cordless phones use Radio waves for transmission.

Microwave

- Use directional antennas - point to point line of sight communications.
- Microwave communication.
- Used for unicast communication such as cellular telephones, satellite networks.
- Frequency Range: 1GHz – 300GHz. Categorized as (i) Terrestrial and (ii) Satellite.



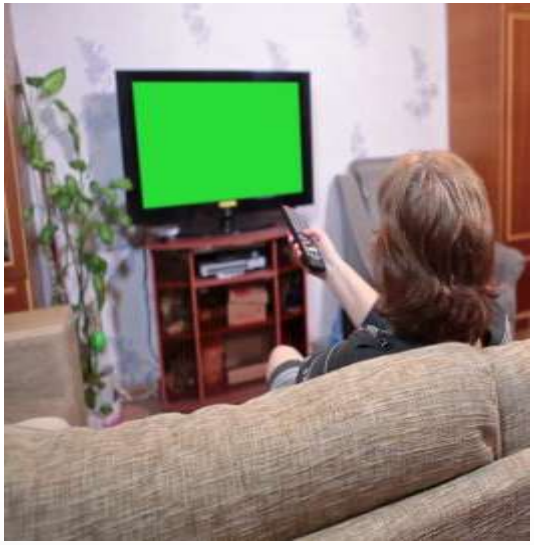
a. Dish antenna



b. Horn antenna

Infrared wave

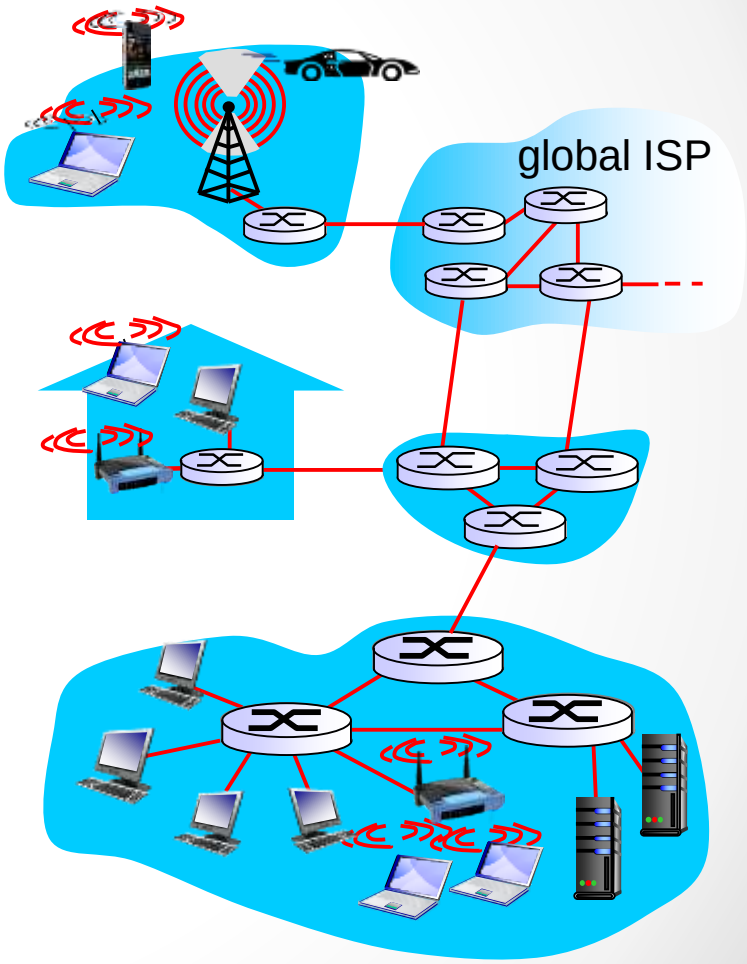
- Infrared signals can be used for short-range communication in a closed area using line-of-sight propagation
- Used on televisions, tv remote, wireless speaker and automatic door etc.
- Relatively directional
- Cheap, easy to build but they do not pass through solid objects



Data Link Layer

Introduction

- Host and routers are as nodes.
- Communication channels that connect adjacent nodes along communication path, its called links.
  - Wired links
  - Wireless links
  - LANs
- In this layer, Packet is form of frame from encapsulate datagram.
- This layer has responsibility of transferring datagram from one node to physically adjacent node over a link.



Link Layer Services

- **Framing**
  - Encapsulate datagram into frame.
  - Adding header and trailer.
- **Link Access**
  - "MAC" addresses used in frame headers to identify source and destination. It is different from IP address.
- **Reliable Delivery**
  - If this layer protocol provides reliable delivery service, it guarantees to move each network-layer datagram across the link without error.
  - A link-layer reliable delivery service can be achieved with acknowledgments and retransmissions.
- **Flow Control**
  - Pacing between adjacent sending and receiving nodes.

Link Layer Services – Cont…

- Error Detection & Correction
  - Errors caused by signal attenuation and noise.
  - Receiver detects presence of errors.
  - Sender send signal for retransmission or drops frame.
  - Receiver identifies *and corrects* bit error(s) without resorting to retransmission.

Error Detection & Correction Technique

- Techniques for error detection
  - Parity Check
  - Checksum Method
  - Cyclic Redundancy Check

Parity Check

- One extra bit is sent along with the original bits to make number of 1s either even in case of even parity, or odd in case of odd parity.
- For example, if even parity is used and number of 1s is even then one bit with value 0 is added. This way number of 1s remains even.
- If the number of 1s is odd, to make it even a bit with value 1 is added.

Parity Check – Cont…

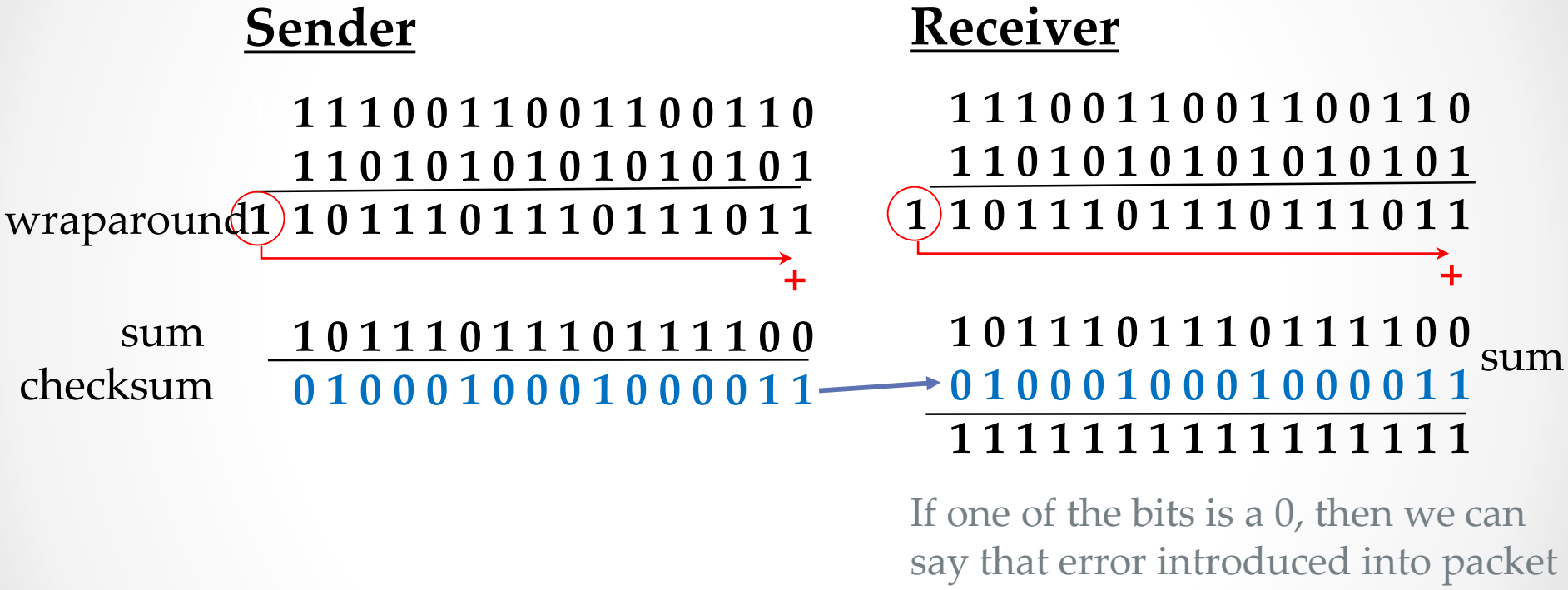
- Receiver counts the number of 1s in a frame. If the count of 1s is even and even parity is used, the frame is considered to be not-corrupted and is accepted.
- If the count of 1s is odd and odd parity is used, the frame is still not corrupted.
- If a single bit flips in transit, the receiver can detect it by counting the number of 1s.
- But when more than one bits are erroneous, then it is very hard for the receiver to detect the error.

Checksum

- Data is divided into k segments each of m bits.
- Sender Side: Segments are added using 1's complement arithmetic to get the sum.
- Sum is complemented to get the checksum.
- Checksum segment is sent along with the data segments.
- Receiver Side: All received segments are added using 1's complement arithmetic to get complemented sum.
- If the result is zero, the received data is accepted; otherwise discarded.

Checksum - Example

- **Add two 16-bit integers word**



If one of the bits is a 0, then we can say that error introduced into packet

Note : when adding numbers, a carryout from the most significant bit needs to be added to the result

Cyclic Redundancy Check

- CRC is the most powerful and easy to implement technique.
- CRC is based on binary division.
- In CRC, a sequence of redundant bits, are appended to the end of data unit so that the resulting data unit becomes exactly divisible by a second, predetermined binary number.
- At the destination, the incoming data unit is divided by the same number.
- If at this step there is no remainder, the data unit is assumed to be correct and is therefore accepted.
- A remainder indicates that the data unit has been damaged in transit and therefore must be rejected.
- The binary number, which is (r+1) bit in length, can also be considered as the coefficients of a polynomial, called Generator Polynomial.

original message

1 0 1 0 0 0 0

@ means X-OR

Generator polynomial

x^3+1

$1.x^3+0.x^2+0.x^1+1.x^0$

CRC generator

1 0 0 1 4-bit

If CRC generator is of n bit then append (n-1) zeros in the end of original message

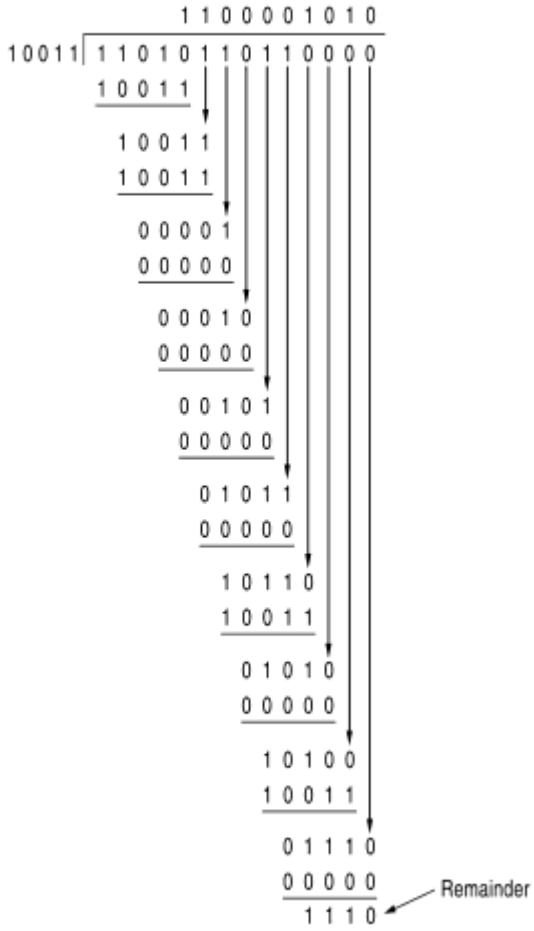
CRC – Example:1

CRC – Example:2

Frame : 1101011011

Generator: 10011

Message after 4 zero bits are appended: 11010110110(0



Transmitted frame: 11010110111110