

Course Name: A Level (2nd Sem)

Subject: DCN

Topic: Error Detection and Correction contd.

Date: 23-04-20

Cyclic Redundancy Check (CRC):

- CRC is the most effective error detecting technique.
- Unlike checksum scheme, which is based on addition, CRC is based on binary division. In CRC, a sequence of redundant bits, called cyclic redundancy check bits, are appended to the end of data unit so that the resulting data unit becomes exactly divisible by a second, predetermined binary.
- At the destination, the incoming data unit is divided by the same number. If at this step there is zero remainder, the data unit is assumed to be correct and is therefore accepted. A non-zero remainder indicates that the data unit has been damaged in transit and therefore must be rejected.

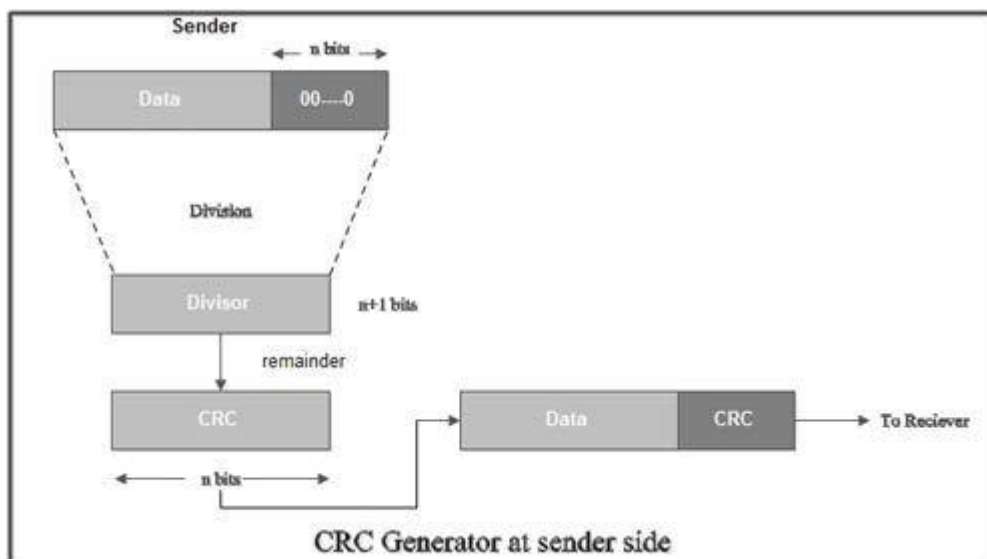
Requirements of CRC:

A CRC will be valid if and only if it satisfies the following requirements:

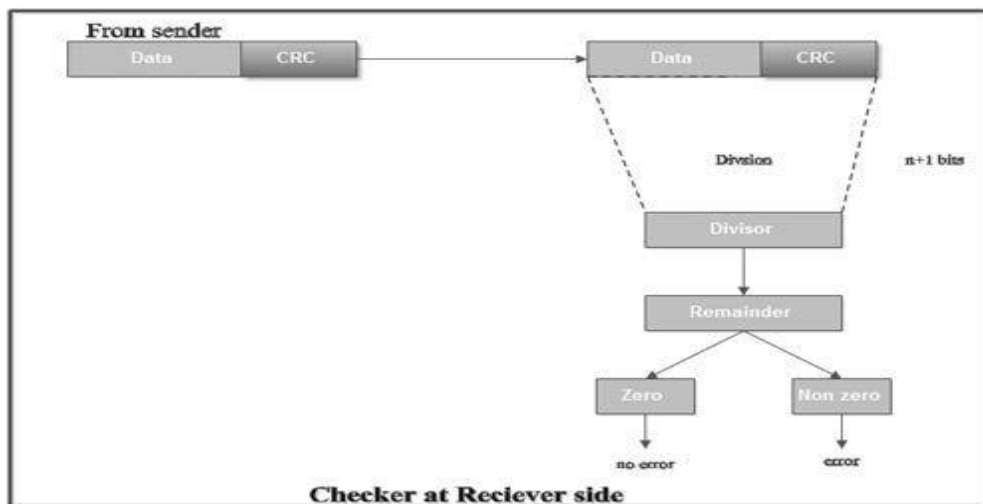
1. It should have exactly one less bit than divisor.
2. Appending the CRC to the end of the data unit should result in the bit sequence which is exactly divisible by the divisor.

The various steps followed in the CRC method are:

1. A string of n as is appended to the data unit. The length of predetermined divisor is $n+1$.
2. The newly formed data unit i.e. original data + string of n as are divided by the divisor using binary division and remainder is obtained. This remainder is called CRC.

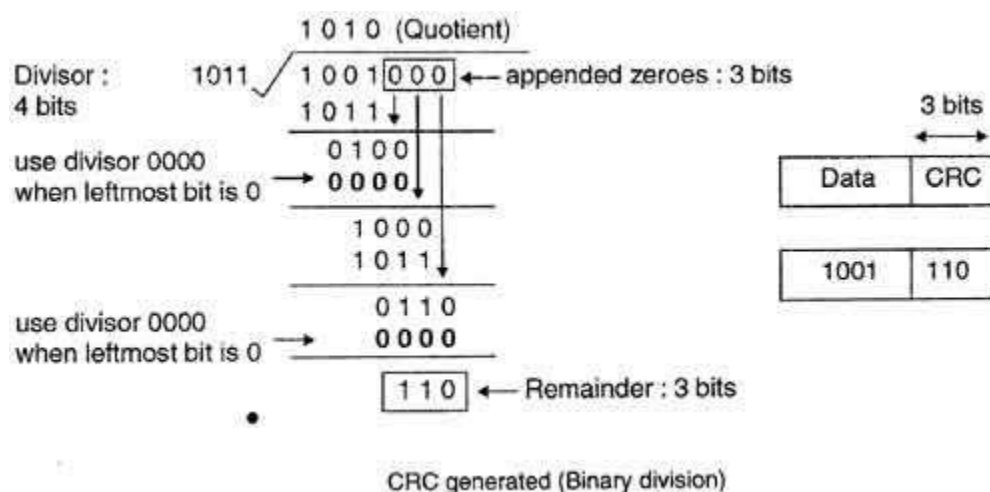


3. Now, string of n 0s appended to data unit is replaced by the CRC remainder (which is also of n bit).
4. The data unit + CRC is then transmitted to receiver.
5. The receiver on receiving it divides data unit + CRC by the same divisor & checks the remainder.
6. If the remainder of division is zero, receiver assumes that there is no error in data and it accepts it.
7. If remainder is non-zero then there is an error in data and receiver rejects it.



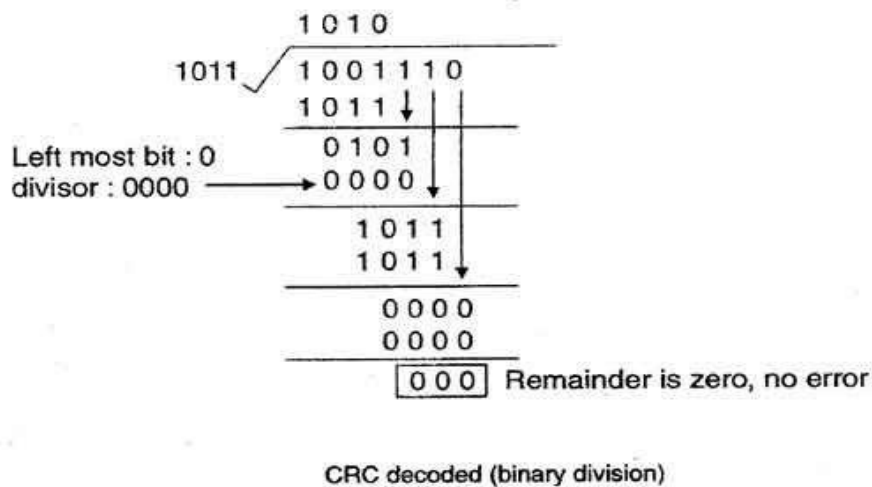
For **example**, if data to be transmitted is 1001 and predetermined divisor is 1011. The procedure given below is used:

1. String of 3 zeroes is appended to 1011 as divisor is of 4 bits. Now newly formed data is 1011000.
2. Data unit 1011000 is divided by 1011.



3. During this process of division, whenever the leftmost bit of dividend or remainder is 0, we use a string of 0s of same length as divisor. Thus in this case divisor 1011 is replaced by 0000.
4. At the receiver side, data received is 1001110.

5. This data is again divided by a divisor 1011.
6. The remainder obtained is 000; it means there is no error.



Exercises:

1. A bit stream 1101011011 is transmitted using the standard CRC method. The generator (divisor) is 10011. What is the actual bit string transmitted? Show the process at both sender's and receiver's end.
2. A bit stream 10011101 is transmitted using the standard CRC method. The generator is 1001.
 - What is the actual bit string transmitted?
 - Suppose the third bit from the left is inverted during transmission. How will receiver detect this error?