

CS359: Computer Network Lab
Assignment 7
Date: 15th March, 2021

Objective

Write a program for error detection using Cyclic redundancy check(CRC). Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.

Cyclic redundancy check(CRC)

An error detection mechanism in which a special number is appended to a block of data in order to detect any changes introduced during storage (or transmission). The CRC is recalculated on retrieval (or reception) and compared to the value originally transmitted, which can reveal certain types of error. For example, a single corrupted bit in the data results in a one-bit change in the calculated CRC, but multiple corrupt bits may cancel each other out.

A CRC is derived using a more complex algorithm than the simple CHECKSUM, involving MODULO ARITHMETIC (hence the 'cyclic' name) and treating each input word as a set of coefficients for a polynomial.

- CRC is more powerful than Vertical redundancy check(VRC) and Longitudinal redundancy check(LRC) in detecting errors.
- It is not based on binary addition like VRC and LRC. Rather it is based on binary division.
- At the sender side, the data unit to be transmitted is divided by a predetermined divisor (binary number) in order to obtain the remainder. This remainder is called CRC.
- The CRC has one bit less than the divisor. It means that if CRC is of n bits, divisor is of $n+1$ bit.
- The sender appends this CRC to the end of data unit such that the resulting data unit becomes exactly divisible by predetermined divisor *i.e.* remainder becomes zero.
- At the destination, the incoming data unit *i.e.* data + CRC is divided by the same

number (predetermined binary divisor).

- If the remainder after division is zero then there is no error in the data unit & receiver accepts it.
- If remainder after division is not zero, it indicates that the data unit has been damaged in transit and therefore it is rejected.
- This technique is more powerful than the parity check and checksum error detection.
- CRC is based on binary division. A sequence of redundant bits called CRC or CRC remainder is appended at the end of a data unit such as byte.

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 the 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.

CRC Generator

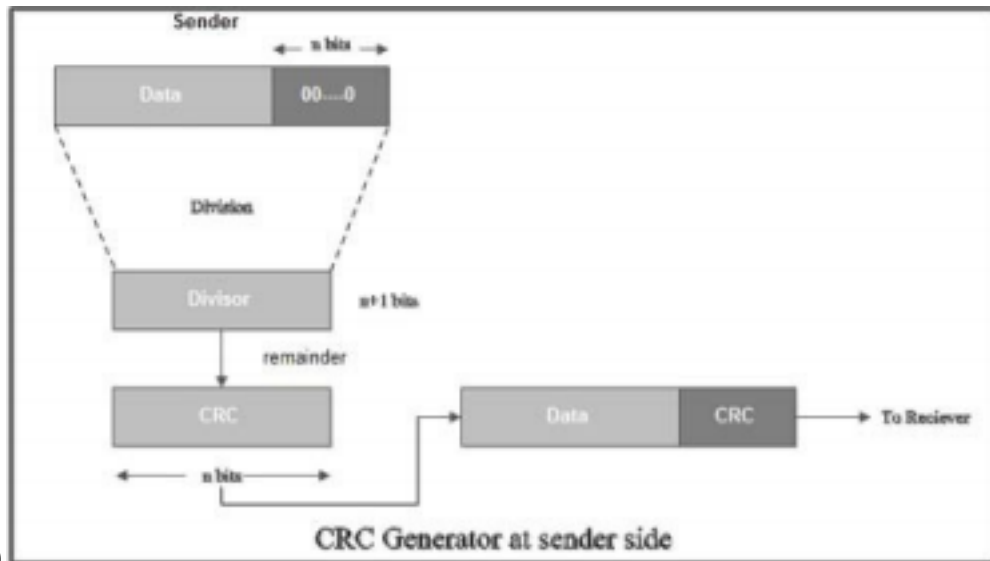
The various steps followed in the CRC method are

1. A string of n as is appended to the data unit. The length of the 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, the string of n Os appended to the data unit is replaced by the CRC remainder (which is also of n bit).
4. The data unit + CRC is then transmitted to the 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 the remainder is non-zero then there is an error in data and receiver rejects it.

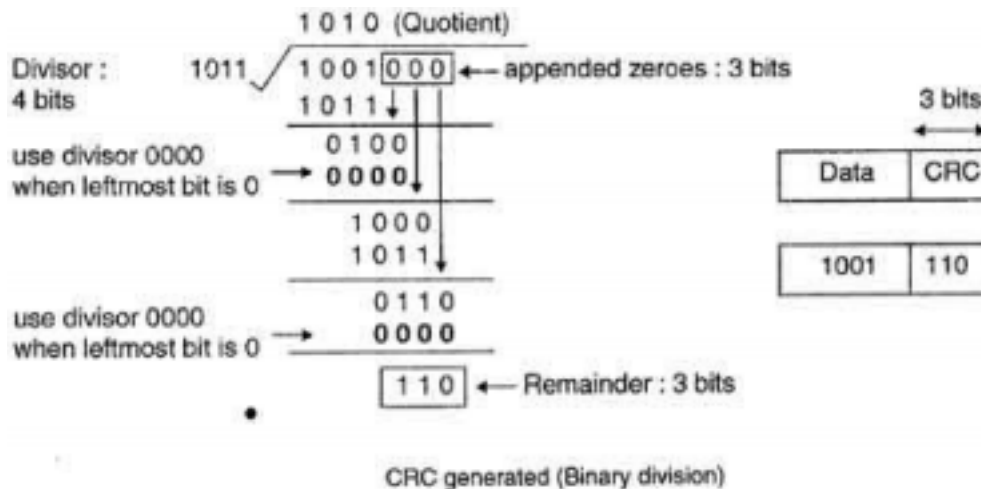
- For example, if data to be transmitted is 1001 and the predetermined divisor is 1011.

The procedure given below is used:

String of 3 zeroes is appended to 1011 as a divisor is of 4 bits. Now newly formed data

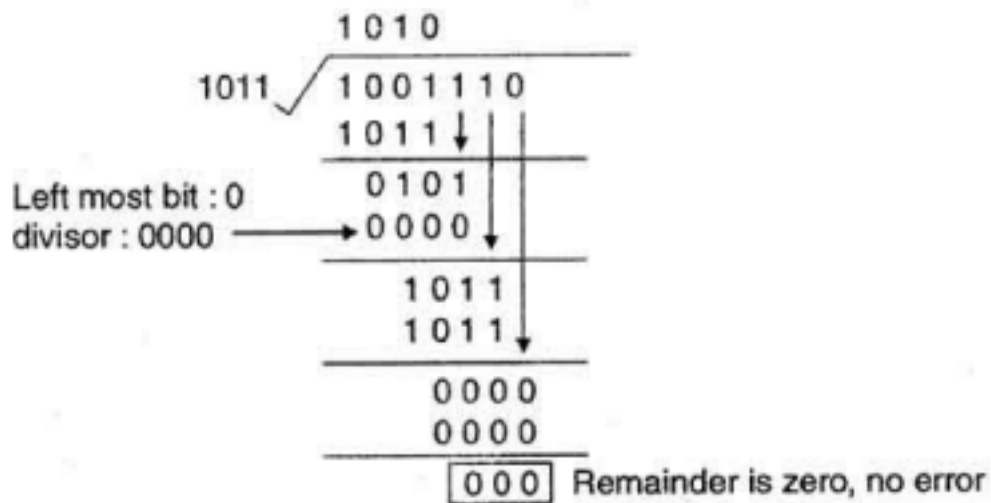
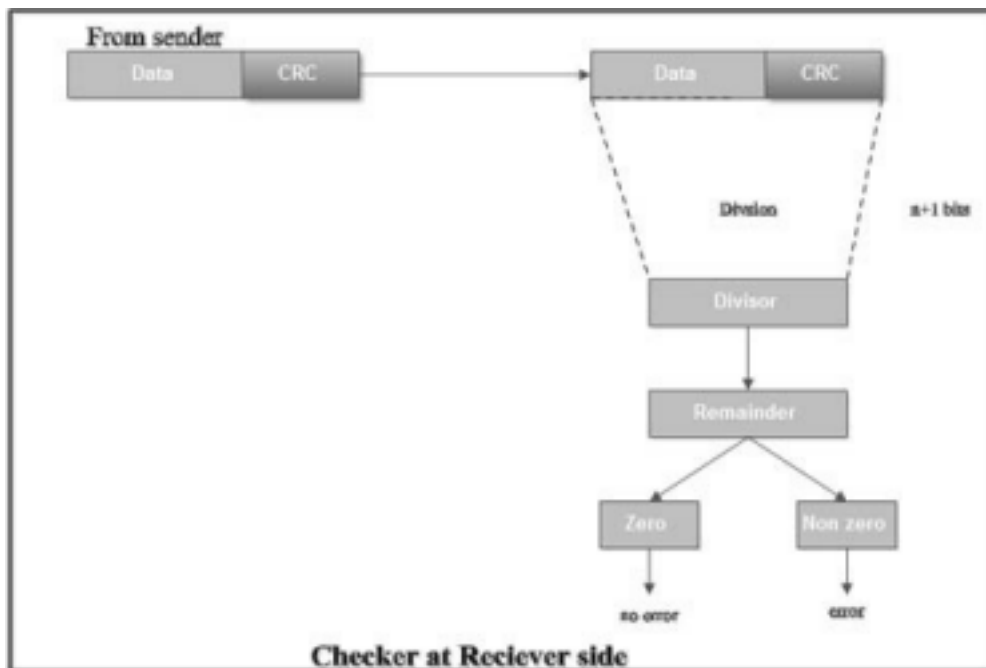


is 1011000



CRC Checker

1. Data unit 1011000 is divided by 1011.
2. 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.
3. At the receiver side, data received is 1001110.
4. This data is again divided by a divisor 1011.
5. The remainder obtained is 000; it means there is no error.



CRC decoded (binary division)

Performance

CRC is a very effective error detection technique. If the divisor is chosen according to the previously mentioned rules, its performance can be summarized as follows:

- CRC can detect all single-bit errors
- CRC can detect all double-bit errors (three 1's)
- CRC can detect any odd number of errors.
- CRC can detect all burst errors of less than the degree of the polynomial.
- CRC detects most of the larger burst errors with a high probability.