CASE STUDY ON CRC USED IN ETHERNET AND LAN'S

Bachelor of Technology
In
Electronics & Communication Engineering

By

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Coding Techniques

I

Details

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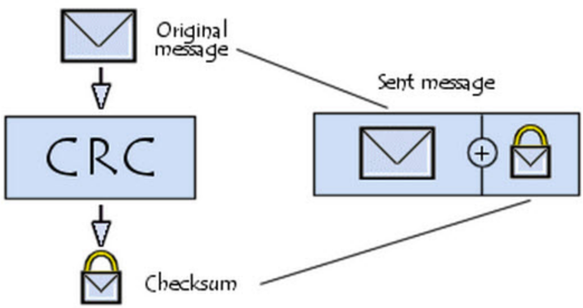
Case Study on Crc Used in Ethernet

I

Intoduction To Crc

The Cyclic Redundancy Check (CRC) is a popular error-detection technique used in data communication. It works by appending a fixed-length checksum to a data message.

The purpose of the checksum is to detect any errors that may occur during transmission, such as bit flips or noise. If the received checksum doesn't match the computed checksum, the data is considered to be corrupted.



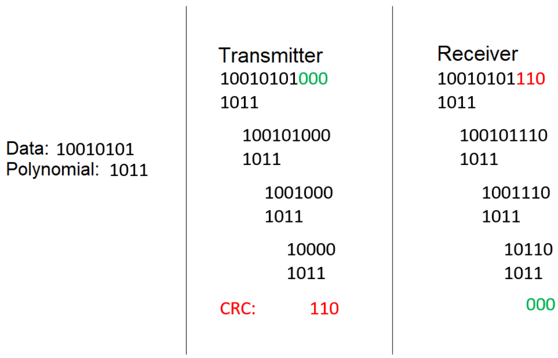
The checksum is generated using a mathematical algorithm that performs modulo-2 division of the message by a predetermined binary value called the generator polynomial.

The generator polynomial is usually a binary number with a high-degree coefficient, representing a large prime number, and low-degree coefficients set to 1.

The choice of generator polynomial determines the effectiveness of the CRC algorithm in detecting errors.

The length of the checksum is determined by the degree of the generator polynomial. The most commonly used CRC checksums are 16-bit and 32-bit long, but longer or shorter lengths can be used depending on the application.

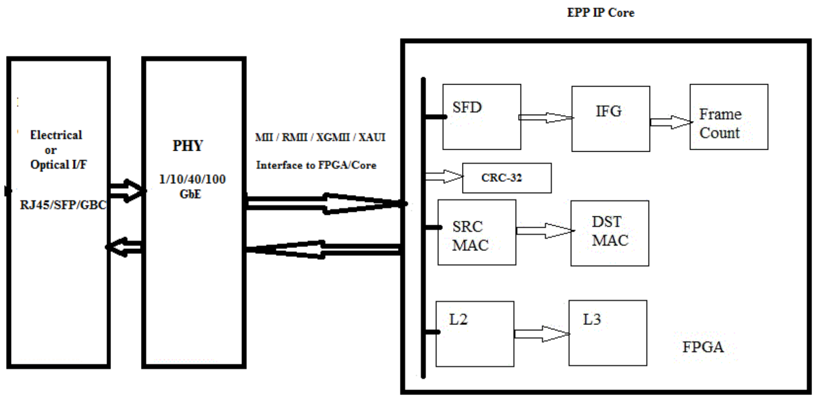
To calculate the checksum, the message is first augmented with zeros equal to the degree of the generator polynomial. The polynomial division is then performed on the augmented message, and the remainder is the checksum.



The sender appends the checksum to the message and transmits it to the receiver. The receiver performs the same calculation on the received message and compares the computed checksum with the received checksum. If they match, the message is considered to be error-free.

The use of CRC provides a simple and efficient way to detect errors in data transmission. It is widely used in various communication protocols, including Ethernet, Wi-Fi, Bluetooth, and USB.

CRC is a low-cost technique that requires minimal processing power, making it ideal for use in high-speed networks. It is also very robust and can detect most common types of errors.

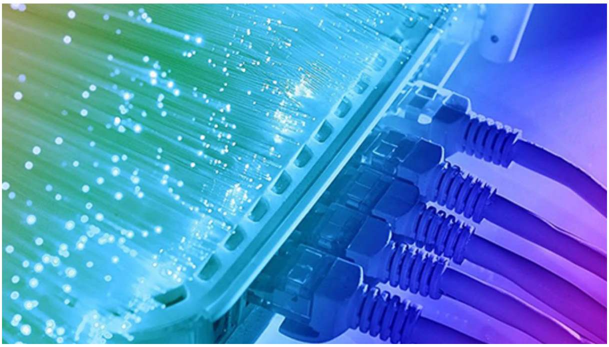


However, CRC is not foolproof and cannot guarantee error-free transmission. It can only detect errors, not correct them. To ensure reliable communication, additional error-correction techniques such as retransmission, forward error correction, or error-correcting codes are often used in conjunction with CRC.

II
Using in Ethernet and lan

Ethernet is a widely used technology for networking computers and other devices in a Local Area Network (LAN). It was first developed in the 1970s by Robert Metcalfe and his team at Xerox Corporation's Palo Alto Research Center (PARC).

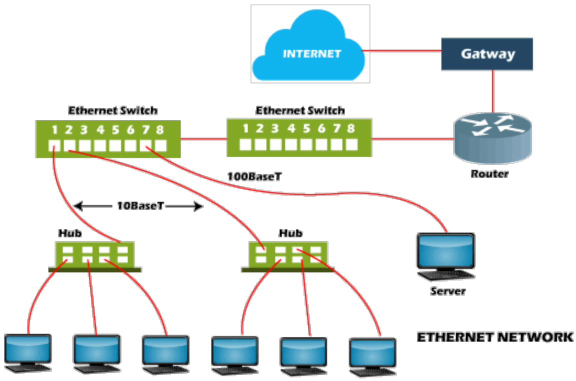
Ethernet uses a protocol called Carrier Sense Multiple Access with Collision Detection (CSMA/CD) to control access to the network. This means that devices on the network listen to the network traffic and wait for a gap before transmitting data. If two devices transmit at the same time, a collision occurs, and both devices wait for a random interval before trying again.



Ethernet operates at various speeds, from 10 Mbps (megabits per second) to 100 Gbps (gigabits per second) and beyond. The most common Ethernet speeds today are 10 Gbps and 100 Gbps.

Ethernet uses a frame-based communication model, where data is transmitted in packets called ”frames”. Each frame contains a preamble, header, payload, and checksum. The preamble and header provide synchronization and control information, while the payload contains the actual data being transmitted. The checksum is used to verify the integrity of the data.

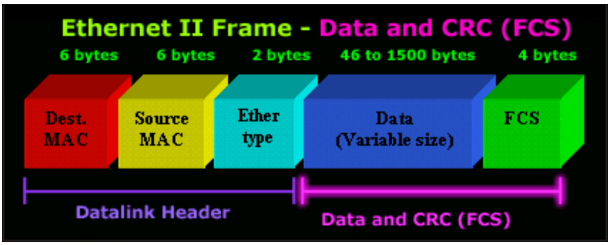
Ethernet is widely used in local area networks (LANs) for connecting computers, printers, servers, and other devices. It is also used in industrial automation systems, data storage systems, and other applications where high-speed data transmission is required.



Ethernet has evolved over the years, with new standards being developed to support faster speeds and new features. For example, the IEEE 802.3 standard defines various Ethernet technologies, including 10BASE-T, 100BASE-TX, and 1000BASE-T, which support speeds of 10 Mbps, 100 Mbps, and 1 Gbps, respectively.

In summary, Ethernet is a widely adopted technology for networking computers and other devices in a local area network (LAN). It uses a frame-based communication model and operates at various speeds, with new standards being developed to support faster speeds and new features. Ethernet is used in a wide range of applications, including LANs, industrial automation systems, and data storage systems.

In Ethernet, data is transmitted in packets called frames. Each frame contains a header and a payload, with the CRC appended at the end.



The Ethernet CRC is a 32-bit checksum generated using a polynomial division algorithm, with a specific generator polynomial chosen to provide maximum error detection capability.

When a computer or device sends a frame over the Ethernet network, it appends the CRC checksum to the end of the frame before transmitting it.

The receiving computer or device then calculates its own CRC checksum for the received frame and compares it to the checksum received with the frame. If the two values match, the frame is considered error-free. If the values do not match, an error has occurred during transmission, and the frame is discarded.

The use of CRC in Ethernet ensures reliable communication over the network, reducing the likelihood of data corruption and transmission errors.

CRC is also used in LANs, which are networks that connect devices within a local area, such as a building or campus. Like Ethernet, LANs use CRC to detect errors in data transmission.

In LANs, the CRC algorithm is typically used in conjunction with other error-correction techniques, such as retransmission, to ensure reliable communication over the network.

The use of CRC in Ethernet and LANs has significantly improved the reliability and robustness of data communication over these networks, making them an integral part of modern computing and communication systems.

Overall, the CRC algorithm is an effective and widely used technique for error detection in Ethernet and LANs, providing a simple and efficient way to ensure reliable communication over these networks.

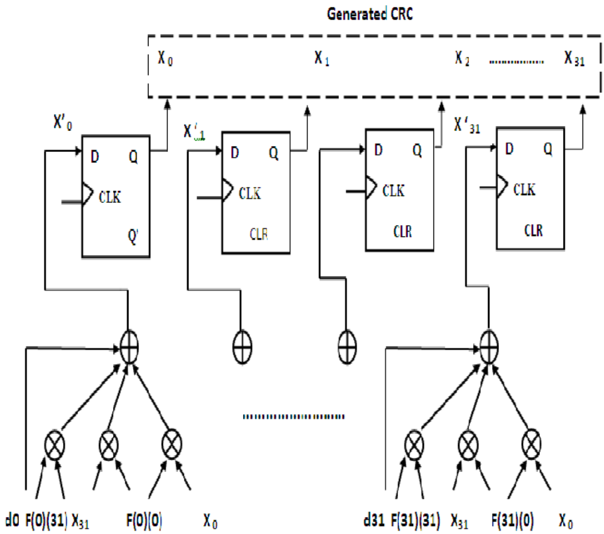
III
About CRC Algorithm

The CRC algorithm in Ethernet is a polynomial division technique that generates a 32-bit checksum value based on the data in the Ethernet frame. The polynomial used in the calculation is the IEEE 802.3 standard polynomial, which has a degree of 32 and is represented in binary notation as 10000010110100001.

The CRC checksum is generated over the entire Ethernet frame, including the preamble, header, and payload. The preamble is a sequence of alternating 0s and 1s that synchronizes the receiver's clock with the incoming data. The header contains information about the source and destination addresses, the type of protocol being used, and the length of the payload. The payload is the actual data being transmitted.

The CRC algorithm works by dividing the input data by the generator polynomial and generating a remainder. The remainder is then appended to the input data to form the checksum value. The receiver performs the same calculation on the received data and compares the resulting checksum value to the transmitted value. If the two values match, the data is assumed to be error-free; otherwise, an error is detected, and the data is discarded.

The Ethernet CRC algorithm is a relatively simple and efficient method for error detection. It requires minimal processing power and resources, making it suitable for use in a wide range of Ethernet applications.



To mitigate these issues, some Ethernet protocols use additional error detection mechanisms, such as Forward Error Correction (FEC) or redundancy checks. FEC is a technique that adds redundant information to the data to allow for error correction, while redundancy checks involve adding extra bits to the data to detect errors.

Overall, CRC is a crucial component of Ethernet communication, providing a fast and efficient means of error detection. It is used in a wide range of Ethernet applications, including local area networks, wireless networks, and industrial automation systems. While it has some limitations, the Ethernet CRC algorithm remains a reliable and widely adopted standard for error detection in Ethernet frames.

IV

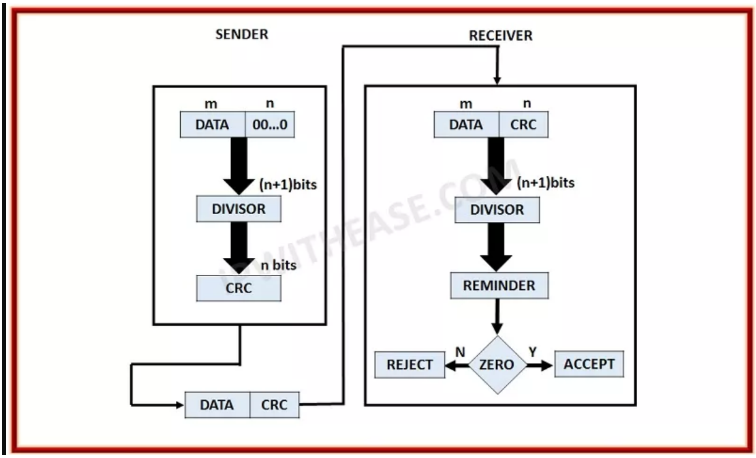
Advantages And Disadvantages

2.4.1 Advantages:

- **Efficient and effective:** CRC is an efficient and effective method for detecting errors in data communication. It can detect most common types of errors, making it a reliable technique for ensuring data integrity.
- **Low-cost:**The CRC algorithm is a low-cost technique that requires minimal processing power, making it ideal for use in high-speed networks.
- **Simple to implement:**The CRC algorithm is simple to implement and can be easily integrated into existing communication protocols.
- **Widely used:**CRC is a widely used technique and is supported by many communication protocols, making it a popular choice for ensuring data integrity.

2.4.2 Disadvantages:

- **No error correction:**CRC can detect errors in data transmission, but it cannot correct them. Therefore, additional error-correction techniques may be necessary to ensure reliable communication over the network.



- **Limited error detection:** While CRC can detect most common types of errors, it may not detect more complex errors, such as those caused by hardware failures or environmental factors.

V
Applications:

- **Ethernet:**CRC is used in Ethernet to ensure reliable data communication over the network. The Ethernet CRC is a 32-bit checksum generated using a polynomial division algorithm, with a specific generator polynomial chosen to provide maximum error detection capability.

- **Local Area Networks (LANs):**CRC is also used in LANs, which are networks that connect devices within a local area, such as a building or campus. In LANs, the CRC algorithm is typically used in conjunction with other error-correction techniques, such as retransmission, to ensure reliable communication over the network.

- **Wireless communication:**CRC is commonly used in wireless communication protocols, such as Wi-Fi and Bluetooth, to ensure reliable data transmission over the wireless network.

- **Storage systems:**CRC is used in storage systems, such as hard drives and solid-state drives, to ensure data integrity and prevent data corruption.

  Overall, CRC is a widely used and effective technique for error detection in data communication. While it has some limitations, it is an essential tool for ensuring reliable communication over networks and storage systems.

VI
Conclusion:

In conclusion, the CRC algorithm plays a critical role in ensuring data integrity in Local Area Networks (LANs) and Ethernet communication. It is a fast and efficient method of error detection, requiring minimal processing power and resources, making it suitable for use in a wide range of applications, While CRC is a reliable and widely adopted standard for error detection in Ethernet frames, it is vulnerable to certain types of errors, such as those caused by synchronization problems or network congestion. To mitigate these issues, some Ethernet protocols use additional error detection mechanisms, such as Forward Error Correction (FEC) or redundancy checks.

Overall, the Ethernet CRC algorithm remains a critical component of Ethernet communication, providing a fast and efficient means of error detection that is widely used in LANs and other Ethernet applications. Its reliability and efficiency make it a crucial factor in ensuring data integrity and reducing data transmission errors.

VII
Acknowledgment

This work was supported by Indian Institute of Information Technology Nagpur to promote research and innovation on CRC Used in Ethernet and LAN's under the guidance of Dr. Rashmi Pandhare

VIII

References:

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   This paper presents a method for improving the error correction capability of CD recording systems by using RS coding.

2. "Efficient CRC Computation for Network Communications" by Li Li, et al.

   This paper proposes a novel CRC algorithm that reduces the computational complexity of CRC checksum generation and verification for high-speed network communication. The proposed algorithm can achieve significant performance gains while maintaining error detection capability.

3. "Performance Evaluation of CRC Algorithms in Network Communication Systems" by Jia Liu, et al.

   This paper presents a comparative performance evaluation of several CRC algorithms for network communication systems.

4. "An Efficient CRC Algorithm for Data Storage Systems" by Junfeng Hu, et al.

   This paper proposes a new CRC algorithm that is optimized for data storage systems, such as hard drives and solid-state drives. The proposed algorithm reduces the computational complexity of CRC checksum generation and verification, making it suitable for use in high-speed data storage systems.