



Error Detection in Computer Networks

Last Updated : 15 May, 2023

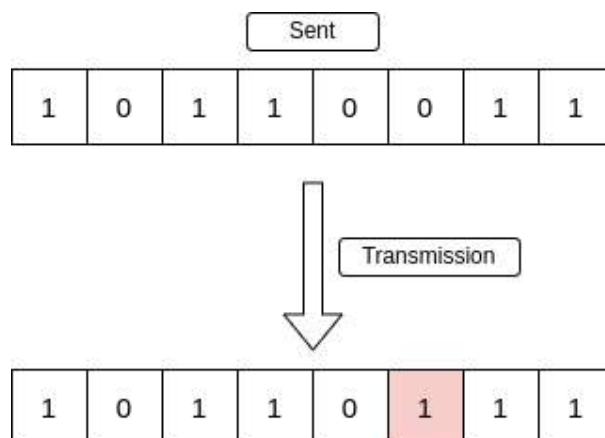
Error is a condition when the receiver's information does not match the sender's information. During transmission, digital signals suffer from noise that can introduce errors in the binary bits traveling from sender to receiver. That means a 0 bit may change to 1 or a 1 bit may change to 0.

Data (Implemented either at the Data link layer or Transport Layer of the OSI Model) may get scrambled by noise or get corrupted whenever a message is transmitted. To prevent such errors, error-detection codes are added as extra data to digital messages. This helps in detecting any errors that may have occurred during message transmission.

Types of Errors

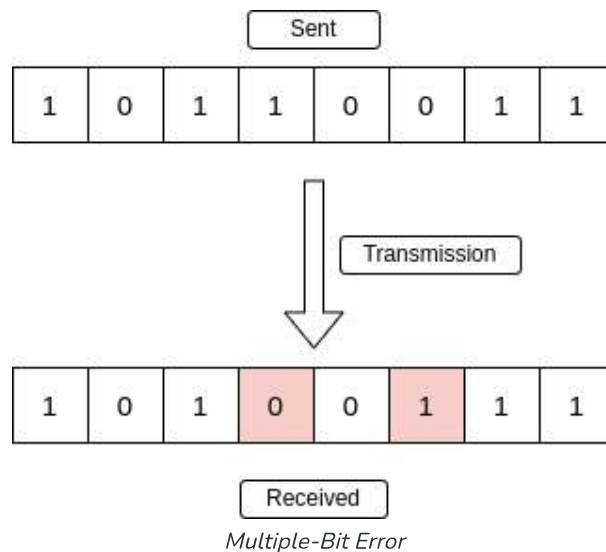
Single-Bit Error

A single-bit error refers to a type of data transmission error that occurs when one bit (i.e., a single binary digit) of a transmitted data unit is altered during transmission, resulting in an incorrect or corrupted data unit.



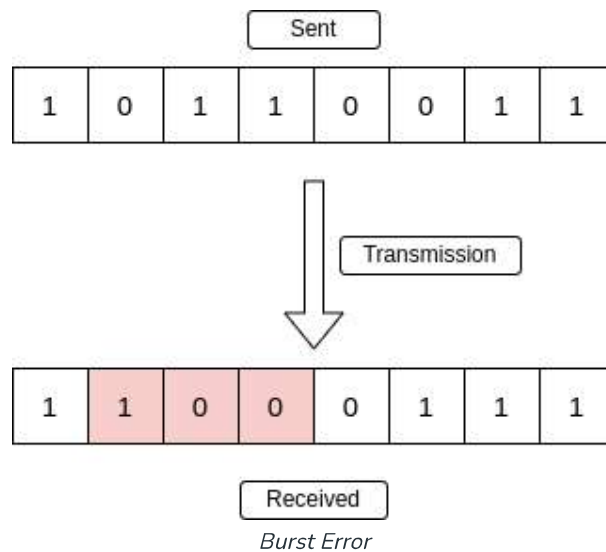
Multiple-Bit Error

A multiple-bit error is an error type that arises when more than one bit in a data transmission is affected. Although multiple-bit errors are relatively rare when compared to single-bit errors, they can still occur, particularly in high-noise or high-interference digital environments.



Burst Error

When several consecutive bits are flipped mistakenly in digital transmission, it creates a burst error. This error causes a sequence of consecutive incorrect values.



To detect errors, a common technique is to introduce redundancy bits that provide additional information. Various techniques for error detection include::

1. Simple Parity Check
2. Two-dimensional Parity Check
3. Checksum
4. Cyclic Redundancy Check (CRC)

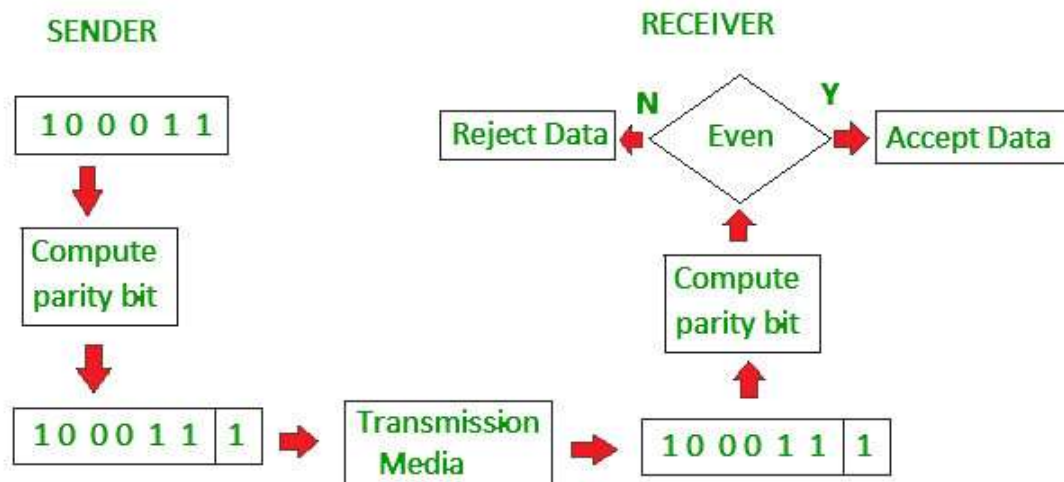
Error Detection Methods

Simple Parity Check

Simple-bit parity is a simple error detection method that involves adding an extra bit to a data transmission. It works as:

- 1 is added to the block if it contains an odd number of 1's, and
- 0 is added if it contains an even number of 1's

This scheme makes the total number of 1's even, that is why it is called even parity checking.



Disadvantages

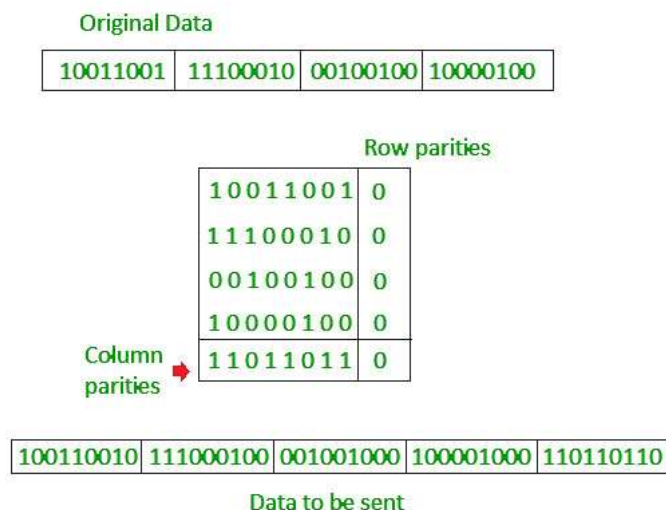
- Single Parity check is not able to detect even no. of bit error.
- **For example**, the Data to be transmitted is **101010**. Codeword transmitted to the receiver is 1010101 (we have used even parity).

Let's assume that during transmission, two of the bits of code word flipped to 1111101.

On receiving the code word, the receiver finds the no. of ones to be even and hence **no error**, which is a wrong assumption.

Two-dimensional Parity Check

Two-dimensional Parity check bits are calculated for each row, which is equivalent to a simple parity check bit. Parity check bits are also calculated for all columns, then both are sent along with the data. At the receiving end, these are compared with the parity bits calculated on the received data.



Checksum

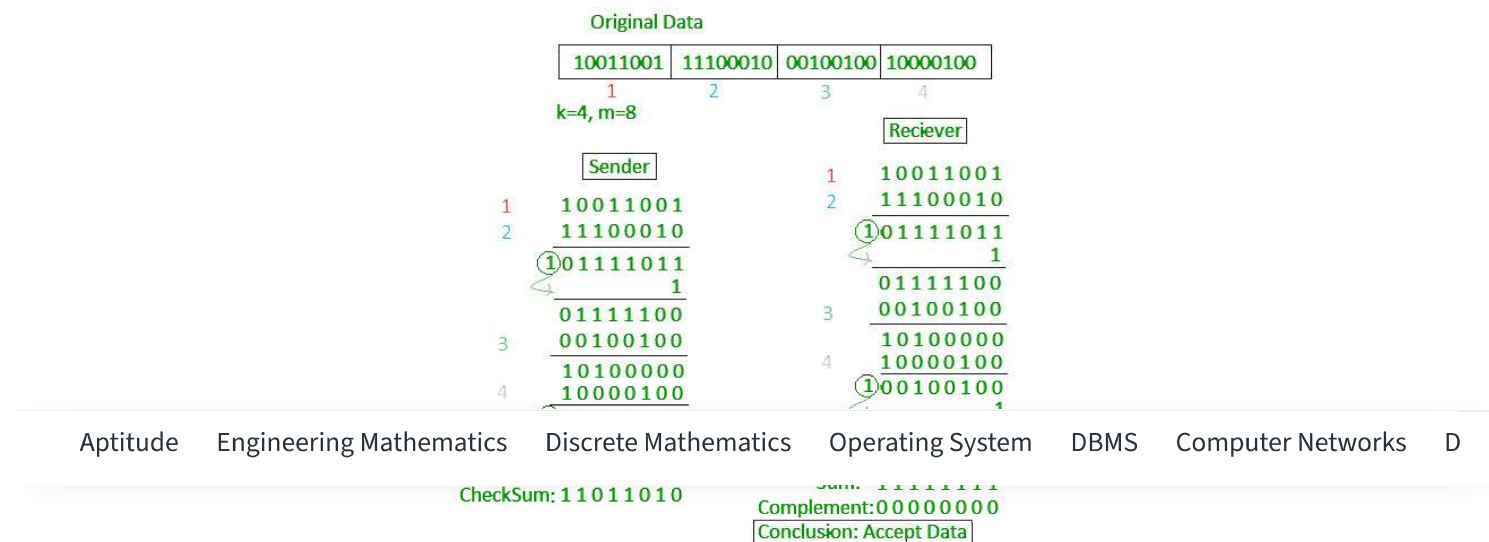
Checksum error detection is a method used to identify errors in transmitted data. The process involves dividing the data into equally sized segments and using a 1's complement to calculate the sum of these segments. The calculated sum is then sent along with the data to the receiver. At the receiver's end, the same process is repeated and if all zeroes are obtained in the sum, it means that the data is correct.

Checksum – Operation at Sender's Side

- Firstly, the data is divided into k segments each of m bits.
- On the sender's end, the segments are added using 1's complement arithmetic to get the sum. The sum is complemented to get the checksum.
- The checksum segment is sent along with the data segments.

Checksum – Operation at Receiver's Side

- At the receiver's end, all received segments are added using 1's complement arithmetic to get the sum. The sum is complemented.
- If the result is zero, the received data is accepted; otherwise discarded.

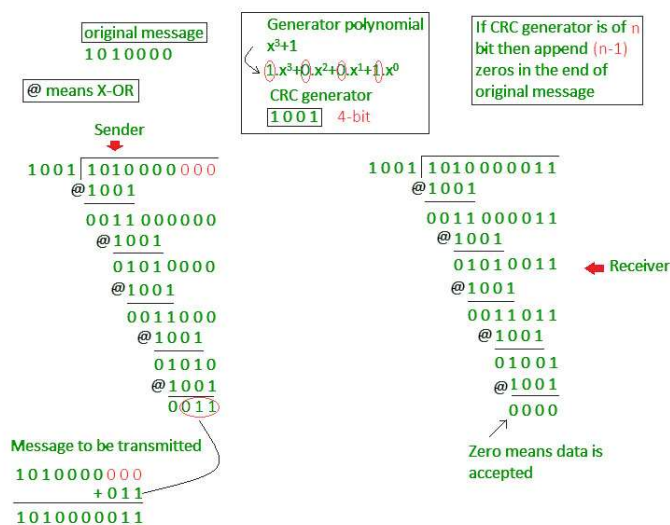
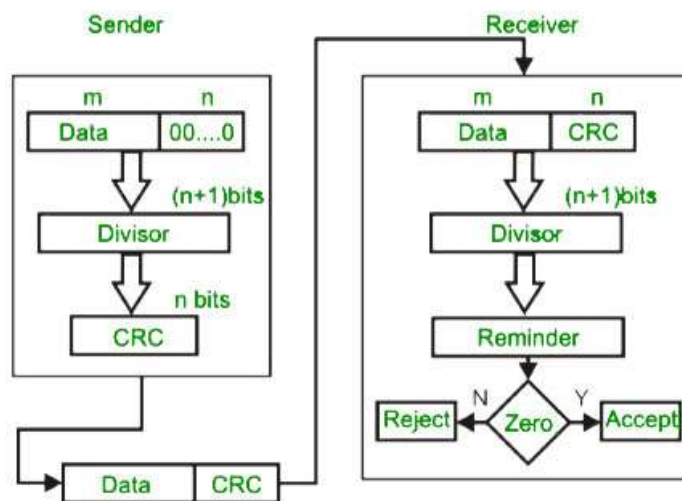


Disadvantages

- If one or more bits of a segment are damaged and the corresponding bit or bits of opposite value in a second segment are also damaged.

Cyclic Redundancy Check (CRC)

- Unlike the 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 the 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.



Example: Previous year GATE questions based on error detection: [GATE CS 2009 Question 48](#) [GATE CS 2007 Question 68](#). This article has been contributed by [Vikash Kumar](#).

Advantages:

Increased Data Reliability: Error detection ensures that the data transmitted over the network is reliable, accurate, and free from errors. This ensures that the recipient receives the same data that was transmitted by the sender.

We use cookies to ensure you have the best browsing experience on our website. By using our site, you acknowledge that you have read and understood our [Cookie Policy](#) & [Privacy Policy](#).

Improved Network Performance: Error detection mechanisms can help to identify and isolate network issues that are causing errors. This can help to improve the overall performance of the network and reduce downtime.

Enhanced Data Security: Error detection can also help to ensure that the data transmitted over the network is secure and has not been tampered with.

Disadvantages:

Overhead: Error detection requires additional resources and processing power, which can lead to increased overhead on the network. This can result in slower network performance and increased latency.

False Positives: Error detection mechanisms can sometimes generate false positives, which can result in unnecessary retransmission of data. This can further increase the overhead on the network.

Limited Error Correction: Error detection can only identify errors but cannot correct them. This means that the recipient must rely on the sender to retransmit the data, which can lead to further delays and increased network overhead.

"GeeksforGeeks helped me ace the GATE exam! Whenever I had any doubt regarding any topic, GFG always helped me and made my concepts quiet clear." - **Anshika Modi | AIR 21**

Choose GeeksforGeeks as your perfect GATE 2025 Preparation partner with these newly launched programs

[GATE CS & IT](#)

[GATE DS & AI](#)

[GATE Offline \(Delhi/NCR\)](#)

Over 125,000+ students already trust us to be their GATE Exam guide. Join them & let us help you in opening the GATE to top-tech IITs & NITs!

Difference between Guided and Unguided Media

Forward Error Correction in Computer Networks

Share your thoughts in the comments

[Add Your Comment](#)

Similar Reads

Forward Error Correction in Computer Networks

Error Correction in Computer Networks

Bit Stuffing error detection technique using Java

Which Layer Called Error Detection Layer?

Error Detection Code - Checksum

Computer Networks - GATE CSE Previous Year Questions

Computer Networks | Set 5

Computer Networks | Set 3

Computer Networks | Set 4

Computer Networks | Set 12



GeeksforGeeks

Article Tags : [Data Link Layer](#) , [Computer Networks](#)

We use cookies to ensure you have the best browsing experience on our website. By using our site, you acknowledge that you have read and understood our [Cookie Policy](#) & [Privacy Policy](#).



A-143, 9th Floor, Sovereign Corporate Tower, Sector-136, Noida, Uttar Pradesh - 201305



Company

About Us
Legal
Careers
In Media
Contact Us
Advertise with us
GFG Corporate Solution
Placement Training Program

Languages

Python
Java
C++
PHP
GoLang
SQL
R Language
Android Tutorial
Tutorials Archive

Data Science & ML

Data Science With Python
Data Science For Beginner
Machine Learning Tutorial
ML Maths
Data Visualisation Tutorial

Explore

Hack-A-Thons
GfG Weekly Contest
DSA in JAVA/C++
Master System Design
Master CP
GeeksforGeeks Videos
Geeks Community

DSA

Data Structures
Algorithms
DSA for Beginners
Basic DSA Problems
DSA Roadmap
Top 100 DSA Interview Problems
DSA Roadmap by Sandeep Jain
All Cheat Sheets

HTML & CSS

HTML
CSS
Web Templates
CSS Frameworks
Bootstrap

We use cookies to ensure you have the best browsing experience on our website. By using our site, you acknowledge that you have read and understood our [Cookie Policy](#) & [Privacy Policy](#).

[NLP Tutorial](#)[Deep Learning Tutorial](#)[LESS](#)[Web Design](#)[Django Tutorial](#)

Python Tutorial

[Python Programming Examples](#)[Python Projects](#)[Python Tkinter](#)[Web Scraping](#)[OpenCV Tutorial](#)[Python Interview Question](#)

Computer Science

[Operating Systems](#)[Computer Network](#)[Database Management System](#)[Software Engineering](#)[Digital Logic Design](#)[Engineering Maths](#)

DevOps

[Git](#)[AWS](#)[Docker](#)[Kubernetes](#)[Azure](#)[GCP](#)[DevOps Roadmap](#)

Competitive Programming

[Top DS or Algo for CP](#)[Top 50 Tree](#)[Top 50 Graph](#)[Top 50 Array](#)[Top 50 String](#)[Top 50 DP](#)[Top 15 Websites for CP](#)

System Design

[High Level Design](#)[Low Level Design](#)[UML Diagrams](#)[Interview Guide](#)[Design Patterns](#)[OOAD](#)[System Design Bootcamp](#)[Interview Questions](#)

JavaScript

[JavaScript Examples](#)[TypeScript](#)[ReactJS](#)[NextJS](#)[AngularJS](#)[NodeJS](#)[Lodash](#)[Web Browser](#)

Preparation Corner

[Company-Wise Recruitment Process](#)[Resume Templates](#)[Aptitude Preparation](#)[Puzzles](#)[Company-Wise Preparation](#)

School Subjects

[Mathematics](#)[Physics](#)[Chemistry](#)[Biology](#)[Social Science](#)[English Grammar](#)[World GK](#)

Management & Finance

[Management](#)[HR Management](#)[Finance](#)[Income Tax](#)[Organisational Behaviour](#)

Free Online Tools

[Typing Test](#)[Image Editor](#)[Code Formatters](#)[Code Converters](#)[Currency Converter](#)

We use cookies to ensure you have the best browsing experience on our website. By using our site, you acknowledge that you have read and understood our [Cookie Policy](#) & [Privacy Policy](#).

More Tutorials

Software Development

Software Testing

Product Management

SAP

SEO - Search Engine Optimization

Linux

Excel

GeeksforGeeks Videos

DSA

Python

Java

C++

Data Science

CS Subjects

@GeeksforGeeks, Sanchhaya Education Private Limited, All rights reserved