

Single-Bit Parity revealing and alteration using Hamming Code 7-Bit representation

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Abstract- Data transmission also data communication or digital communications is the transfer of data (a digital bit stream or a digitized analog signal) over a point-to-point or point-to-multipoint communication channel. During the transmission of data there is chance of getting mistakes. As we transfer the large amount of data from transmitter to the receiver in the form of digital data always there is large amount of chance for the error data transmission. The errors that may be

Index Terms- Hamming code, error detection, error Correction.

I. INTRODUCTION

Organizations rely heavily on the ability to share information throughout the organization in an efficient and productive manner. Computer networks have allowed for this technology and are now a part of almost every business. An organization has two options when it comes to setting up a network. They can use a completely wired network, which uses networking cable to connect computers, or they can use a wireless network, which uses radio frequencies to connect computer. Wireless networks have allowed organizations to become more mobile; therefore, organizations are now using a combination of both wired and wireless networks.

II.WIRED COMMUNICATION

Wired communication refers to the transmission of data over a wire-based communication technology. Examples include telephone networks, cable television or internet access, and fiber-optic communication. Also waveguide (electromagnetism), used for high-power applications, is considered as wired line. Local telephone networks often form the basis for wired communications that are used by both residential and business customers in the area.

- Most of the networks today rely on the use of fiber-optic communication technology as a

means of providing clear signaling for both inbound and outbound transmissions.

- Fiber optics are capable of accommodating far more signals than the older copper wiring used in generations past, while still maintaining the integrity of the signal over longer distances.

III.WIRELESS COMMUNICATION

Wireless communication is one of the most important mediums of transmission of information from one device to other devices. In this technology, the information can be transmitted through the air without requiring any cable or wires or other electronic conductors, by using electromagnetic waves like IR, RF, satellite, etc. In the present days, the wireless communication technology refers to a variety of wireless communication devices and technologies ranging from smart phones to computers, tabs, laptops, Bluetooth Technology, printers. This article gives an overview of wireless communication and types of wireless communications.

IV.TYPES OF WIRELESS COMMUNICATION

The different types of wireless communication mainly include,

- IR wireless communication,
- satellite communication,
- broadcast radio, Microwave radio,
- Bluetooth,
- Zigbee

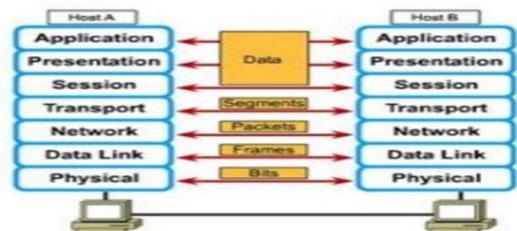


Fig (1) transmission process

The above figure shows that how the data will be transmitted from one transmitter to the receiver. The figure shows an OSI model. This model divides the transmission network into seven layers named as application layer, presentation layer, session layer, transport layer, network layer, data link layer and physical layer.

V.HAMMING CODE

Transmission of data from the transmitter which having the efficient data to the receiver should be send very secretly and it should be converted into other format which can be understandable by the sender and the receiver. For this reason we will convert the data into encoded format. This code will be further decoded for getting the original message. The most common types of error-correcting codes used in RAM are based on the codes devised by R. W. Hamming. In the Hamming code, k parity bits are added to an n-bit data word, forming a new word of n+k bits. The bit positions are numbered in sequence from 1 to n+k. Those positions numbered with powers of two are reserved for the parity bits. The remaining bits are the data bits. The code can be used with words of any length. Before giving the general characteristics of the Hamming code, we will illustrate its operation with a data word of eight bits. Consider, for example, the 8-bit data word 11000100. We include four parity bits with this word and arrange the 12 bits as follows:

Bit position
 1 2 3 4 5 6 7 8 9 10 11 12
 P1 P2 P4 P8 1 0 0 1 0 0

The 4 parity bits P1 through P8 are in positions 1, 2, 4, and 8, respectively. The 8 bits of the data word are in the remaining positions. Each parity bit is calculated as follows:

$$P_1 = \text{XOR of bits (3, 5, 7, 9, 11)} = 1 \oplus 1 \oplus 0 \oplus 0 \oplus 0 = 0$$

$$P_2 = \text{XOR of bits (3, 6, 7, 10, 11)} = 1 \oplus 0 \oplus 0 \oplus 1 \oplus 0 = 0$$

$$P_4 = \text{XOR of bits (5, 6, 7, 12)} = 1 \oplus 0 \oplus 0 \oplus 0 = 1$$

$$P_8 = \text{XOR of bits (9, 10, 11, 12)} = 0 \oplus 1 \oplus 0 \oplus 0 = 1$$

Recall that the exclusive-OR operation performs the odd function. It is equal to 1 for an odd number of 1's among the variables and to 0 for an even number of 1's. Thus, each parity bit is set so that the total

number of 1's in the checked positions, including the parity bit, is always even.

The 8-bit data word is written into the memory together with the 4 parity bits as a 12-bit composite word. Substituting the 4 parity bits in their proper positions, we obtain the 12-bit composite word written into memory:

Bit position 1 2 3 4 5 6 7 8 9 10 11 12
 0 0 1 1 1 0 0 1 0 1 0 0

When the 12 bits are read from memory, they are checked again for errors. The parity of the word is checked over the same groups of bits, including their parity bits. The four check bits are evaluated as follows:

- C1 XOR of bits (1, 3, 5, 7, 9, 11)
- C2 XOR of bits (2, 3, 6, 7, 10, 11)
- C4 XOR of bits (4, 5, 6, 7, 12)
- C8 XOR of bits (8, 9, 10, 11, 12) Bit

A 0 check bit designates an even parity over the checked bits, and a 1 designates an odd parity. Since the bits were written with even parity, the result, C8C4C2C1 0000, indicates that no error has occurred. However, if the 4-bit binary number formed by the check bits gives the position of the erroneous bit if only a single bit is in error. For example, consider the following three cases:

Bit position
 1 2 3 4 5 6 7 8 9 10 11 12
 0 0 1 1 1 0 0 1 0 1 0 0 No error
 1 0 1 1 1 0 0 1 0 1 0 0 Error in bit 1
 0 0 1 1 0 0 0 1 0 1 0 0 Error in bit 5

In the first case, there is no error in the 12-bit word. In the second case, there is an error in bit position number 1 because it changed from 0 to 1. The third case shows an error in bit position 5 with a change from 1 to 0. Evaluating the XOR of the corresponding bits, we determine the four check bits to be as follows:

	C ₈	C ₄	C ₂	C ₁
No error	0	0	0	0
Error in bit 1	0	0	0	1
Error in bit 5	0	1	0	1

Thus, for no error, we have C= 0000; with an error in bit 1, we obtain C= 0001; and with an error in bit 5, we get C =0101. Hence, when C is not equal to 0, the decimal value of C gives the position of the bit in error. The error can then be corrected by

complementing the corresponding bit. Note that an error can occur in the data or in one of the parity bits. The Hamming code can be used for data words of any length. In general, for k check bits and n data bits, the total number of bits, $n+k$ that can be in a coded word is at most $2^k - 1$. In other words, the relationship must hold. This relationship gives as the number of bits for the data word. For example, when $k=3$, the total number of bits in the coded word is, $n+k \leq 2^3 - 1 = 7$ giving $n \leq 7 - 3 = 4$. For $k=4$, we have $n+k \leq 2^4 - 1 = 15$, giving $n \leq 11$. Thus, the data word may be less than 11 bits, but must have at least five bits; otherwise, only three check bits will be needed. The relationships for $k=3$ and $k=4$ justify the use of four check bits for the eight data bits in the previous example.

The grouping of bits for parity generation and checking can be determined from a list of the binary numbers from 0 through $2^k - 1$. The least significant bit is a 1 in the binary numbers 1, 3, 5, 7, and so on. The second significant bit is a 1 in the binary numbers 2, 3, 6, 7, and so on. Comparing these numbers with the bit positions used in generating and checking parity bits in the Hamming code, we note the relationship between the bit groupings in the code and the position of the 1-bits in the binary count sequence. Each group of bits starts with a number that is a power of 2—for example, 1, 2, 4, 8, 16, and so forth. These numbers are also the position numbers for the parity bits.

VI. CONCLUSION

From the above results it can be concluded that the hamming code can detect the errors in the received file. The checking is done by comparing the value of the check bits with the original value of bits that exist in the file. It is used for single bit error correction. This method is not preferable if there is more than single error. The checking is done by comparing the value of the check bits with the original value of bits that exist in the file.

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