**UNIVERSITY OF CAPE COAST**

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**DEPARTMENT OF COMPUTER SCIENCE & I.T**

**NETWORKING II : CSC 415**

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**Error detection in synchronous and asynchronous transmission**

The occurrence of a data bit error in a serial stream of digital data is an infrequent occurrence. An error occurs in digital transmission systems when a bit is altered between transmission and reception; that is a binary 1 is transmitted and a binary 0 is received or vice versa.

Two general types of error which occur are:

**Single bit error**

This error is an isolated error condition which alters one bit but does not affect nearby bits.

**Burst error**

A burst error of length B is a contiguous sequence of B bits in which the first and last bits and any number of intermediate bits are received in error. Thus, in an error burst, there is a cluster of bits in which a number of errors occur, although not necessarily all of the bits in the cluster suffer an error.

**Error Detection**

All the error detection techniques work on the following principle. For a given number of bits, additional bits that constitute an error-detection code are added by the transmitter. This code is calculated as a function of the other transmitted bits. Typically for a data block of ‘k’ bits, the error-detection algorithm yields an error detection code ‘n-k’ bits where(n-k)!k. the error-detection code also referred to as the ‘check bits’, is appended to the data block to produce a frame of n bits which is then transmitted. The receiver performs the same error-detection calculations on data bits and compare this value with the value of the incoming error-detection code. A detected error occurs if and only if there is a mismatch.

**Error Detection Algorithms**

Asynchronous Data Error Detection methods:

**Parity Error Detection**

This Parity works by adding an additional bit to the end of a block of data or to each character word transmitted. The value of this bit is selected so that the character has an even number of 1s (Even parity) and an odd number of 1s (Odd parity). However, if two (or any even number) of bits are inverted due to error, an undetected error occurs. Typically, even parity is used for synchronous transmission and odd parity is used for asynchronous transmission. The use of parity bit is not a full proof, as noise impulses are often long enough to destroy more than one bit, particularly at high data rate.

**Vertical Redundancy Check/ Longitudinal Redundancy Check**

This parity can be extended to allow single-bit error correction to take place in a received data stream. By having the ability to correct an error,a receiver would not require a message to be retransmitted, but could do the correction itself. The trade-off in using an error-correction scheme is that an additional character has to be sent with the message and additional software and/or hardware must be used to create and interpret that character. For asynchronous data transmission, that character is known as the longitudinal redundancy check(LRC) character. Using a VRC/LRC system, the message is sent with each character containing the regular even-parity bit known as the VRC bit. As with error-detection schemes, any mismatch between transmitted and received VRCs indicates that the character contains a bad data bit.

Synchronous Data Error methods follows:

**Cyclic Redundancy Check**

Cyclic redundancy check is one of the most common powerful checks. For a block of k bits, a transmitter generates an n bit frame check sequence (FCS). It transmits k + n bits which exactly divisible by some predetermined number. The receiver divides frame by that number, if no remainder, it is assumed to have no error.

**Checksum Error Detection**

Another method of error detection uses a process known as checksum to generate an error-detection character. The character results from summing all the bytes of a message together, discarding and carry-over from the addition. Again, the process is repeated at the receiver and the two checksums are compared. A match between receiver checksum and transmitted checksum indicates good data. A mismatch indicates an error has occurred.

**Error Correction**

In order to correct the detected errors, a data block is usually required to be transmitted. This is not appropriate for wireless applications. Bit error rate is high which causes lots of re-transmission. When propagation delay long (satellite) compared with the transmission time, resulting in re-transmission of frame in error plus many subsequent frames. In order to prevent re-transmission, it is appropriate to correct errors based on bits received.