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Subject: Synchronization in Digital Communication Functional Description

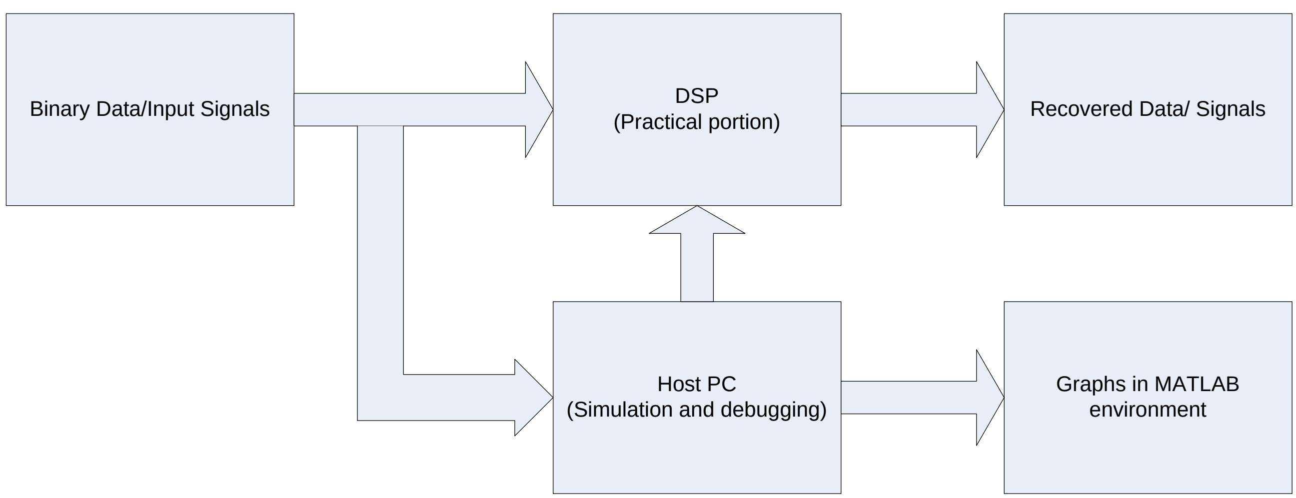
Introduction

In a typical communication system, a modulated signal travels from the transmitter, through the channel to the receiver. The process appears quite simple, but recovering the original signal at the receiver proves to be a very difficult task. Channel attenuation, signal desynchronization, and channel noise are all issues that must be dealt with at the receiver end. In conventional receivers, this process requires a myriad of circuits and subsystems to properly recover the signal.

The purpose of this project is to use a simulation integrated environment such as MATLAB and the Simulink library, to combine all of the traditional receiver subsystems into a one-device solution and implement it using a DSP processor.

Description

There are two parts of the project: an investigation of the communication theory required to properly recover the input signal and the development and application of the code in a DSP chip using Simulink. Fig (1) shows the main system block diagram.



Fig(1) – High Level Block Diagram

The input to the practical system will be a Quadrature Amplitude Modulation (QAM) data signal with the possibility of expanding the scope of the project dependant upon success. QAM uses sine and cosine carriers to place information into the four quadrants of an x-y plane in which the y-axis is sine and the x-axis is cosine. The output of the QAM demodulator will contain the data embedded between the phase and amplitude of the y-axis sine and x-axis cosine.

A Texas Instruments DSP processor is used for the practical application of the design. The machine language will be developed by Code Composer Studio (CCS) based upon the system developed in Simulink. If CCS does not create sufficient code, the program will be changed to generate assembly code which will be modified manually.

Fig(2) shows the system required to recover a QAM input signal that is designed in Simulink and implemented on the DSP.

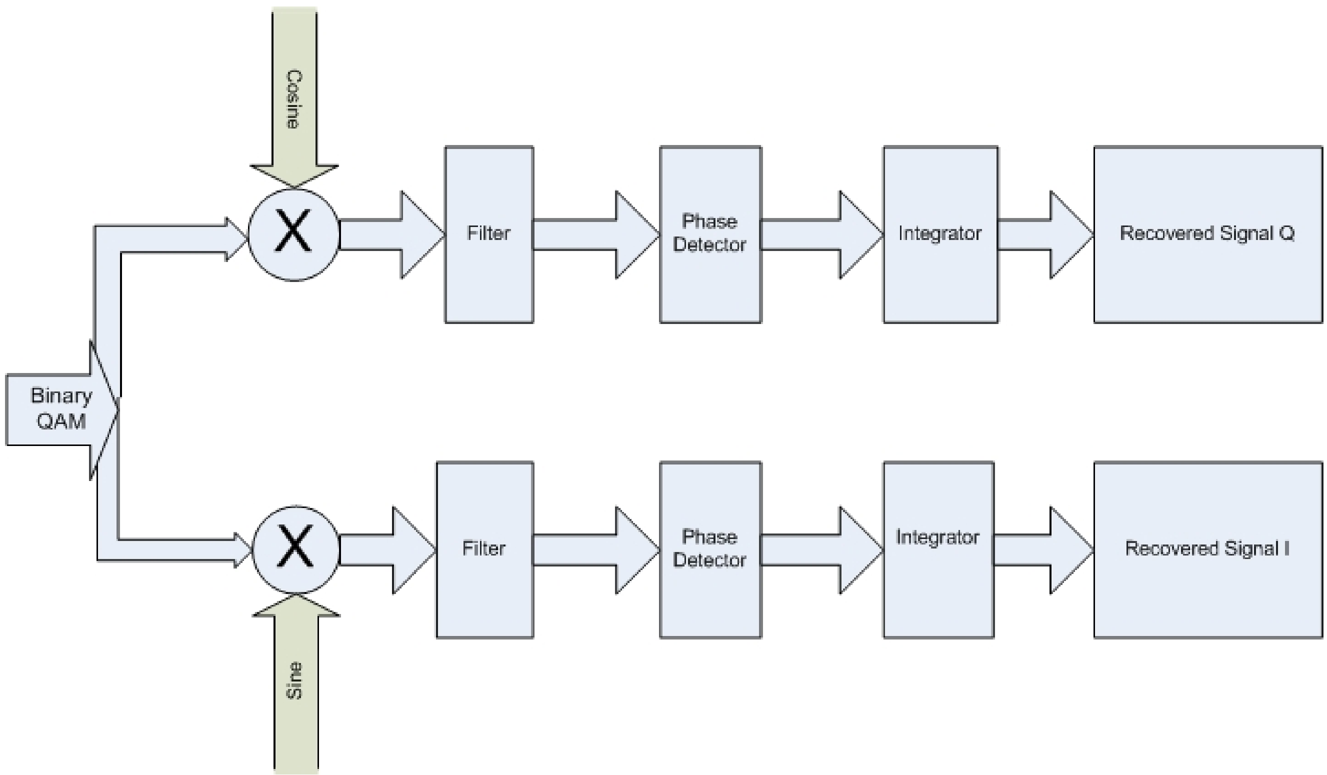


Fig (2) – QAM Recovery Program Flow

The practical system is a real time signal regeneration system. During this process, the system will be responsible for recovering a binary signal from a predetermined QAM input, then for a random QAM input. The QAM signal is split into two streams, one removes the cosine carrier through multiplication and the other removes the sine carrier through multiplication.

Both paths then complete the following tasks. First a band-pass filter isolates the desired signal. Next a phase detection circuit, such as a phase lock loop, in conjunction with an integrator detects the data signal.

There are several issues that need to be addressed in the design, mainly the phase difference between a QAM transmitter and receiver. In real time, the phase between the transmitter and receiver is unknown. For example, assume there is a 90 degree phase in the carriers, then the recovered I and Q signals will be reversed, resulting in false data recovery.