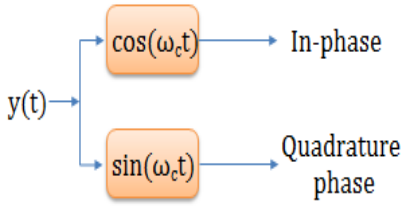
SYMBOL TIMING RECOVERY FOR QPSK (DIGITAL MODULATIONS)

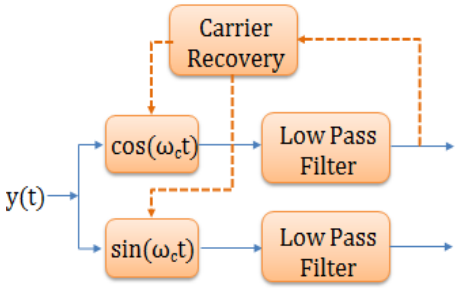
When transmitting data across a communication system, three things are important: frequency of transmission, phase information and the symbol rate.

In coherent detection/demodulation, both the transmitter and receiver posses the knowledge of exact symbol timing and symbol phase (and/or symbol frequency). While everything is set at the transmitter, the receiver is at the mercy of recovery algorithms to regenerate these information from the incoming signal itself. If the transmission is a passband transmission, the carrier recovery algorithm also recovers the carrier frequency. For phase sensitive systems like BPSK, QPSK etc.., the carrier recovery algorithm recovers the symbol phase so that it is synchronous with the transmitted symbol.

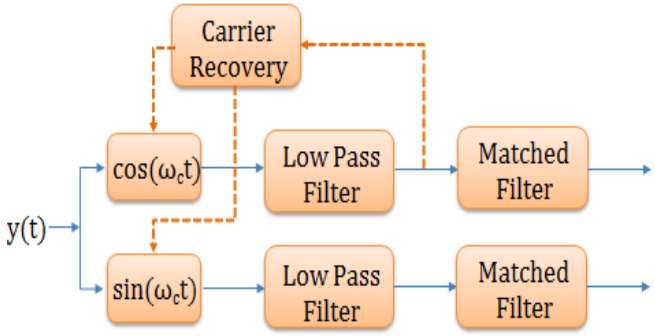
The first part in such a receiver architecture of a MPSK transmitting system is multiplying the incoming signal y(t) with sine and cosine components of the carrier wave.



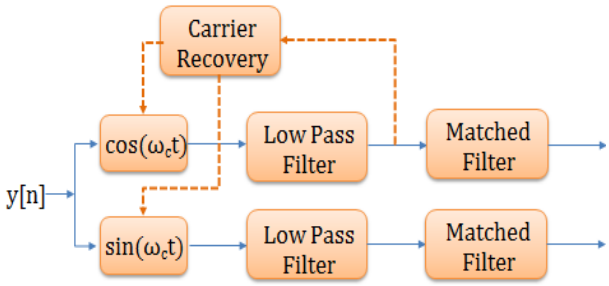
The sine and cosine components are generated using a carrier recovery block (Phase Lock Loop-PLL or setting a local oscillator and tracking the variations).



Once the in-phase and quadrature signals are separated out properly, the next task is to match each symbol with the transmitted pulse shape such that the overall SNR of the system improves.



Implementing this in digital domain, the architecture described so far would look like this (Note the subscript of the incoming signal has changed from analog domain to digital domain – i.e. y(t) to y[n])



In the digital architecture above, the Matched Filter is implemented as a simple FIR (Finite Impulse Response) filter whose impulse response is matched to that of the transmitter pulse shape. It helps the receiver in timing recovery and also it improves the overall SNR of the system by suppressing some amount of noise. The incoming signal up to the point before the matched filter may have fluctuations in the amplitude. The matched filter also behaves like an averaging filter that smooths out the variations in the signal.

Source: http://www.gaussianwaves.com/2013/11/symbol-timing-recovery-for-qpsk-digital-modulations/