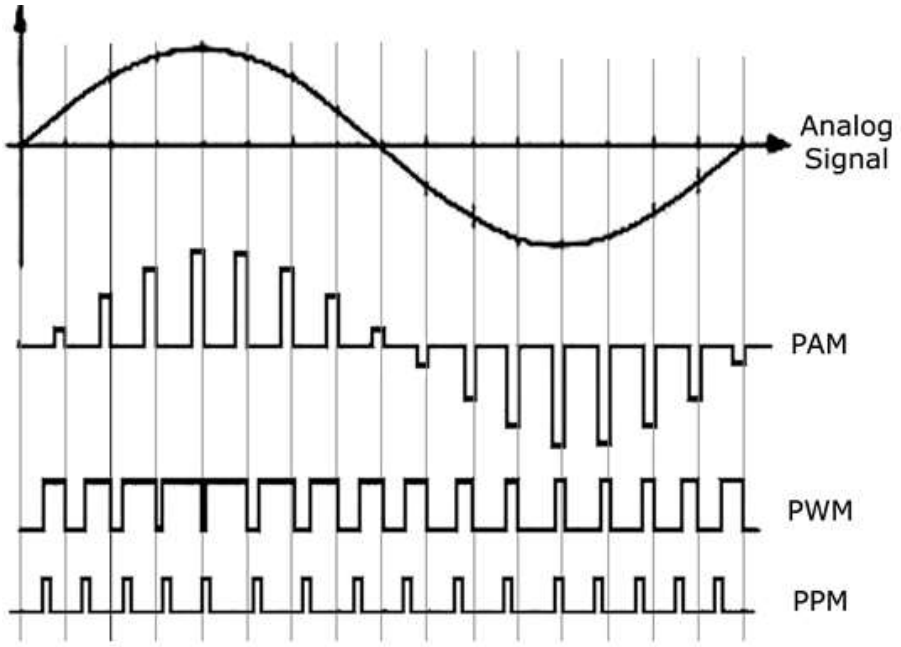
1.3 PULSE MODULATION

Pulse modulation describes the process whereby the amplitude, the width or the position of individual pulses in a periodic pulse train are varied (i.e. modulated) in sympathy with the amplitude of a baseband information signal $m(t)$.



The pulses of PAM have: amplitude=*variable*, width=*fixed*, position=*fixed*.

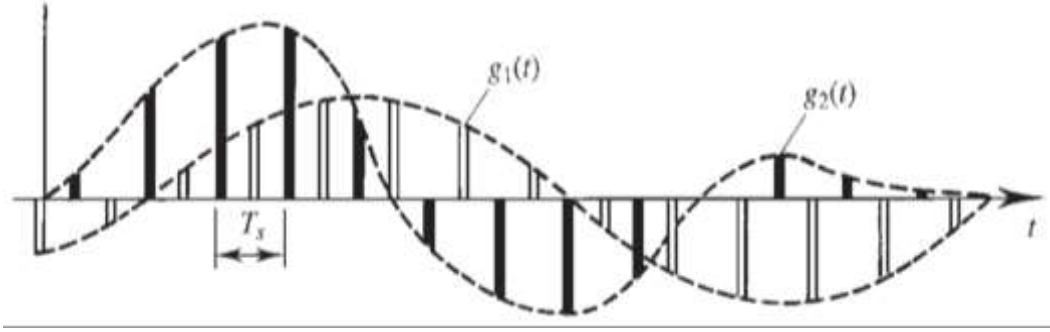
The pulses of PWM have: amplitude= *fixed*, width= *variable,* position=*fixed*.

The pulses of PPM have: amplitude= *fixed*, width=*fixed*, position= *variable*.

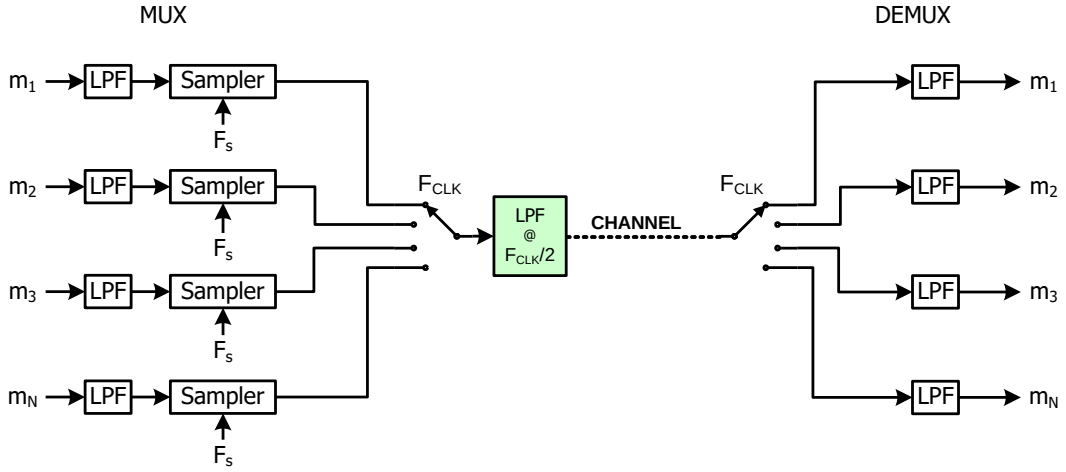
What modulation scheme could be used in a simple TV remote controller?

1.4 TIME DIVISION MULTIPLEXING (TDM)

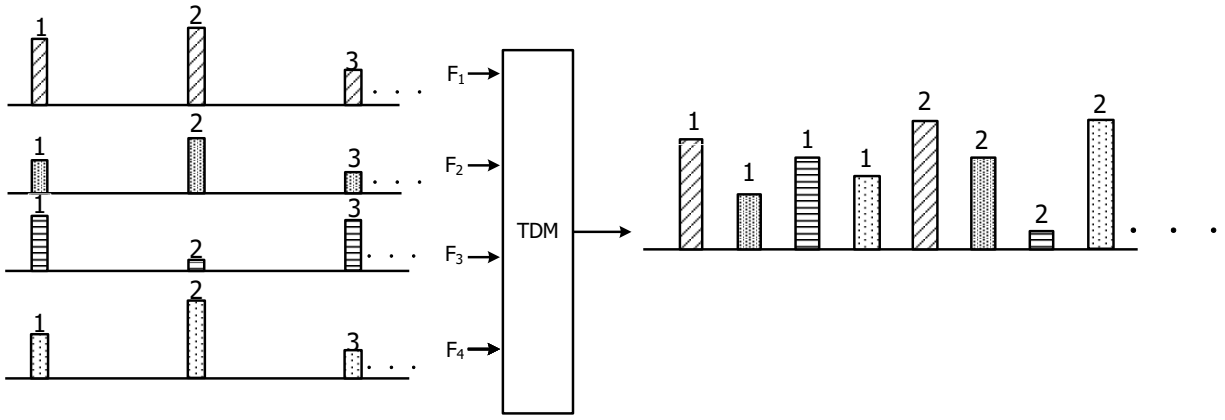
The use of short pulse width in PAM, leaves sufficient spaces between samples for insertion of pulses other sampled signals. The method of combining several sampled signals in a defined sequence is called TDM.



The block diagram below demonstrates the PAM-TDM principle. In this system, 4 different signals are sampled at the same rate (f_s samples per seconds). The clock frequency f_{CLK} must be fast enough to send the all the samples without missing a sample from a signal (in this case $f_{CLK} = 4f_s$. The input signals are pre-filtered to prevent the aliasing. Complete synchronization between MUX and DEMUX is critical for correct reception.

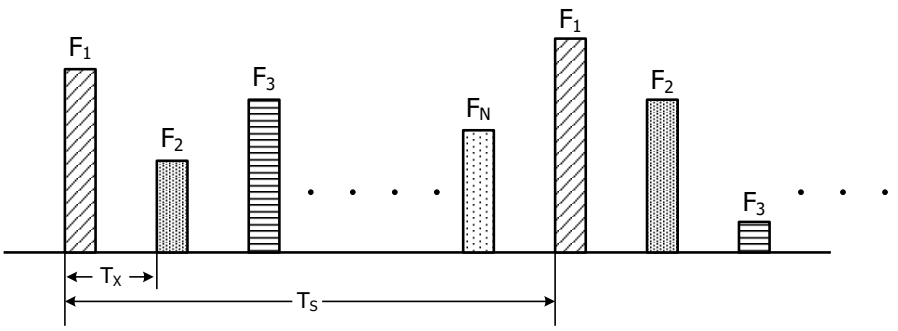


The depiction below illustrates the scenario of multiplexing.



In general, we need to understand the exact design for a TDM system. In the diagram below, let T_x be the time spacing between adjacent samples in a TDM signal. If all input signals are sampled equally at $f_S = 1/T_s$ then $T_x = T_s/N$, where N = number of multiplexed sampled signals. The output TDM stream frequency= clock frequency is

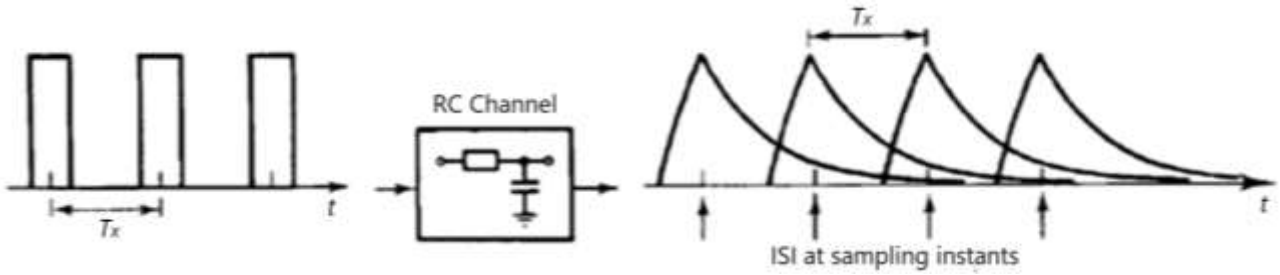
$$R_S = \frac{1}{T_x} = \frac{N}{T_s} = Nf_s$$



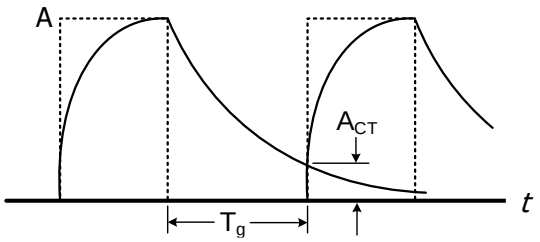
What is the TDMA?

Crosstalk and Guard Times

In addition to ensuring the synchronization, TDM system must avoid inter-channel crosstalk. A TDM signal suffers from crosstalk if the transmission channel results in pulses whose tails overlap into the next time slots of the frame.



If we assume the transmission channel acts like a 1st order LPF, the response to a rectangular pulse is an exponential decay. To reduce the cross talk, the transmitted pulses must be separated by T_g. The guard time T_g is the minimum pulse spacing so that the tail of the pulse decays to a value less than A_{CT} by the time next pulse arrives.



1.5 PULSE SHAPING