

4.6-2 Suppose that a signal $x[n]$ is sampled at a rate $F_s = 1$ kHz.

- (a) Determine an expansion factor L and compression factor M that result in a signal that reduces the sampling rate by 60% to $0.4F_s$. Choose L and M to be coprime.

Let $L = 2$ and $M = 5$ then the sampling rate F_s will change to be $\frac{L}{M} F_s = \frac{2}{5} F_s = 0.4F_s = 400\text{Hz}$

- (b) Show that ordering the expander before the compressor requires each component to operate at faster sampling rates than if the compressor is ordered before the expander.

If f_s is our sampling frequency at 1kHz. Then by expanding by a factor of $L = 2$ we are now operating at a frequency of $2 * 1\text{kHz} = 2\text{kHz}$. Then when we compress by a factor M we are operating at a frequency of $\frac{2\text{kHz}}{5} = 400\text{Hz}$

Now if we compress first by an example of $M = 5$ we will be operating at a frequency of $\frac{1\text{kHz}}{5} = 200\text{Hz}$. Then expanding by a factor of $L = 2$ brings us to $200\text{Hz} * 2 = 400\text{Hz}$.

By expanding first we are requiring our components to operate at a faster 2kHz frequency.