

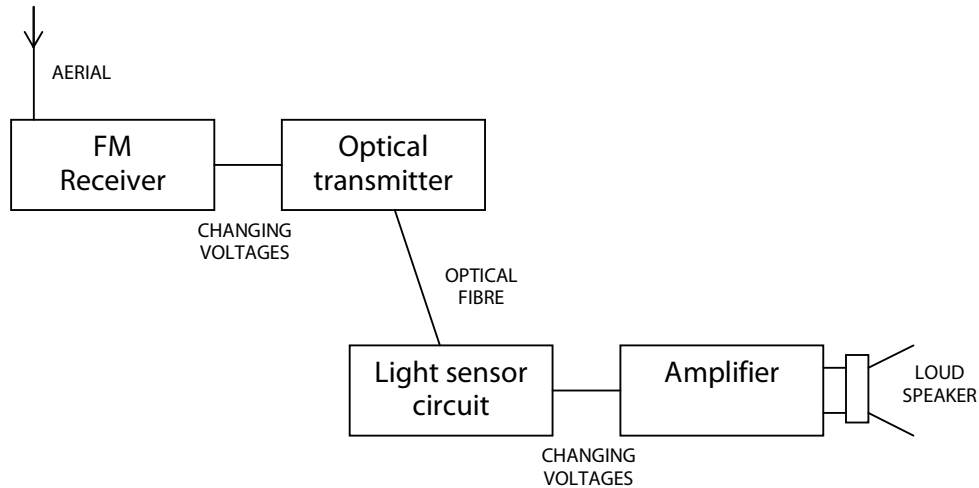
## Chapter 3: Signalling

The world has become a smaller place due to increased use of signalling. Signals are usually transmitted in electric circuits by changing voltage, either as analogue signals or digital signals.

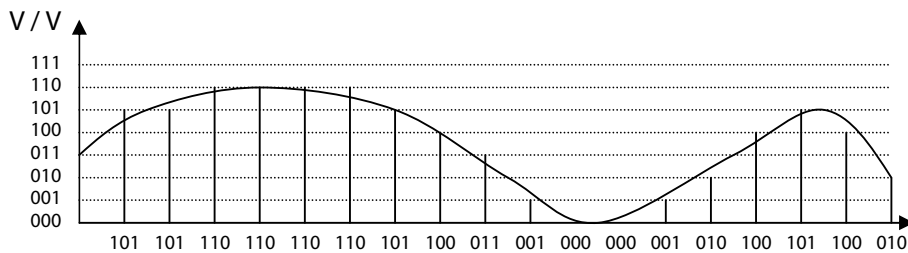
FM = frequency modulation, where the frequency of the signal changes.

AM = amplitude modulation, where the amplitude of the signal changes.

### Transmitting a signal using a fibre optic cable



Sampling is the process of dividing up the wave form into equal time intervals and taking a reading at each of these.



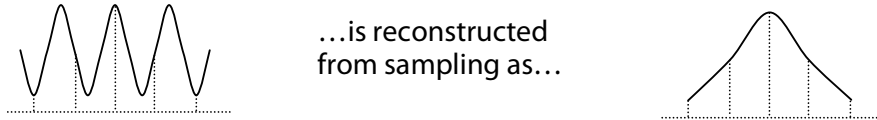
This demonstrates quantisation errors as there are only 8 possible levels in three bit sampling. Increasing the number of bits sampling would give lower quantisation errors.

A telephone using 8 bit sampling which gives 256 levels and an audio CD-ROM 16 bit sampling which gives 65,536 levels of sampling.

Where  $l$  is the number of bits per sample and  $f$  the sample frequency,  $b$  the bit-rate is given by  $b = l \cdot f$ .

The bit-rate for an audio CD is therefore  $\sim 705,000$  bits  $s^{-1}$ . As error correction is also incorporated into audio CDs it is likely several MB of data will be transferred every second.

### Aliasing



Due to sampling not being frequent enough a much lower frequency is reconstructed. This effect can be seen as car wheels appear to go backwards under street lamps and helicopter blades turn backwards in films. To counter aliasing at least two samples must be taken per oscillation like below.

