Comparison of digital modulation systems

The three factors that influence the choice of digital modulation system are

- **Bandwidth efficiency:** the number of bits per second that can be transmitted per Hertz of channel bandwidth
- **Error performance:** the probability of making a bit error at the receiver, as a function of the signal-to-noise ratio
- **Equipment complexity:** which effectively corresponds to the cost of the system.

The following table offers a comparison between the different types of signalling methods discussed in this course:

Type	Minimum bandwidth	Error performance	
Baseband signalling			
Unipolar	$R/2$	$\text{erfc}\sqrt{\frac{E_b}{\eta}}$	
Polar	$R/2$	$\text{erfc}\sqrt{\frac{2E_b}{\eta}}$	
Bandpass signalling		Coherent	Noncoherent
OOK	R	$\text{erfc}\sqrt{\frac{E_b}{\eta}}$	$\frac{1}{2}e^{-(1/2)E_b/\eta}$
BPSK	R	$\text{erfc}\sqrt{\frac{2E_b}{\eta}}$	None
FSK	$2\,\Delta f + R$	$\text{erfc}\sqrt{\frac{E_b}{\eta}}$	$\frac{1}{2}e^{-(1/2)E_b/\eta}$
DPSK	$2\,R$	Not used	$\frac{1}{2}e^{-E_b/\eta}$
QPSK	$R/2$	$\text{erfc}\sqrt{\frac{2E_b}{\eta}}$	None
MSK	$2\,1.5R$	$\text{erfc}\sqrt{\frac{2E_b}{\eta}}$	$\frac{1}{2}e^{-(1/2)E_b/\eta}$

In this table, the minimum bandwidth indicates the minimum transmission bandwidth required when R is the bit rate.

Other factors that also influence the choice of modulation method are

- Degree of channel linearity
- Channel delay distortion
- Channel fading
- Tolerance to interfering signals
- Tolerance to intersymbol interference.

Some modulation techniques are better than others if these factors are of importance on a communication channel.