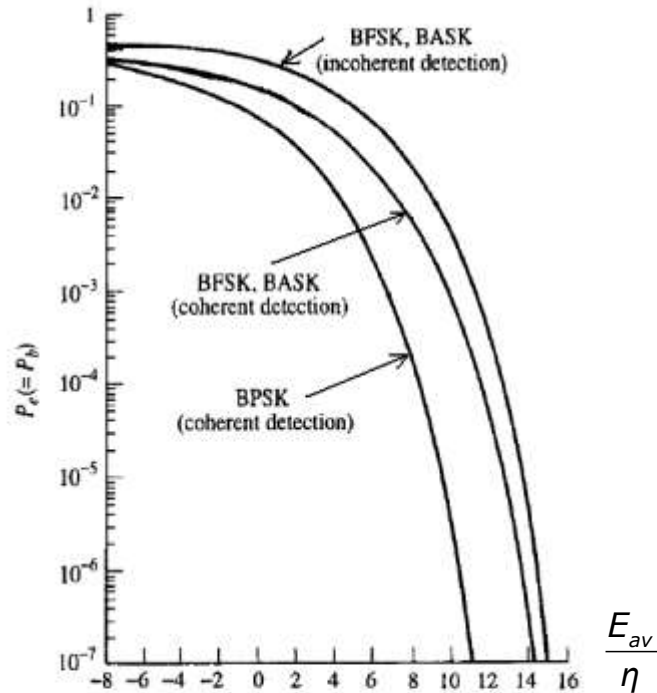## 2.5 COMPARISON OF BINARY KEYING TECHNIQUES

2.5.1   Through the Average Power
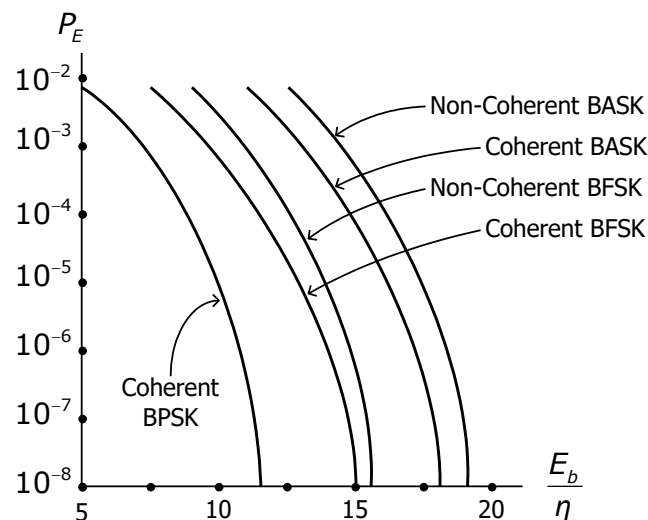
BASK & BFSK have equivalent E_{Avg}, hence the same P_E. BPSK has better performance (less P_E).

As shown:

2.5.2   Through the Peak Power

To get the same P_E, BFSK requires double the power of BPSK but also requires half the power of BASK, as all the energy of BASK transmission is squeezed into only one type of data. As shown:

2.5.3   Through the Spectral Efficiency

If we define Γ as the spectral efficiency of data transmission as:

$$\Gamma = \frac{R_b}{B} \log_2 M \qquad \text{bits/sec/Hz}$$

$M = $ number of levels $= 2^m$ (for binary $M = 2, m = 1$)

$R_b = $ binary data rate (in bps) $= f_0 = \frac{1}{T_0}$

$B = $ the required channel bandwidth of the transmitted signal.

Then the comparison will be:

	Baseband	BASK	BFSK	BPSK
Data Rate (bps)	f_0	f_0	f_0	f_0
Nominal Bandwidth	$\frac{f_0}{2}$	f_0	$2(\Delta_f + f_0)$	f_0
Nominal spectral efficiency (Γ)	2	1	$\dfrac{f_0}{2(\Delta_f + f_0)}$	1

2.5.4   Through Systems

ASK:

o The transmitters of ASK are very easy to build.

o They have the advantage of transmitting no power at 0. Such systems find some applications in short-range miniature telemetry systems.

o The receivers for non-coherent ASK are easy to build. The difference in performance between coherent & non-coherent detection is slight compared to the increase in complexity required. Therefore, coherent detection of ASK is generally not common.

o The decision threshold in the receiver must be adjusted with changes in the levels of the received signal. Therefore, it requires an Automatic Gain Control (AGC).

FSK:

o In contrast to ASK, the FSK systems operate symmetrically about a zero-decision threshold level, regardless of carrier signal strength.

o Transmitters of FSK is slightly more complex than those for ASK.

o Non-coherent FSK receiver is relatively an easy and a popular choice for low to medium data transmission rates.

o FSK requires more bandwidth than ASK & PSK.

PSK:

o The performance of PSK systems are superior to both ASK & FSK systems.

o PSK systems require less transmitted power for a given P_E.

o Synchronous detection is required, and carrier recovery systems are more difficult (therefore more expensive) to build.

The decision of which scheme of the digital modulation to be selected depends on the trade-off between (performance, cost, bandwidth...etc.). In addition (propagation, distortion, fading, non-white noise (e.g. interference), non-Gaussian noise...etc.) may affect the choice.