Can digital signal be sent over wired / wireless medium???
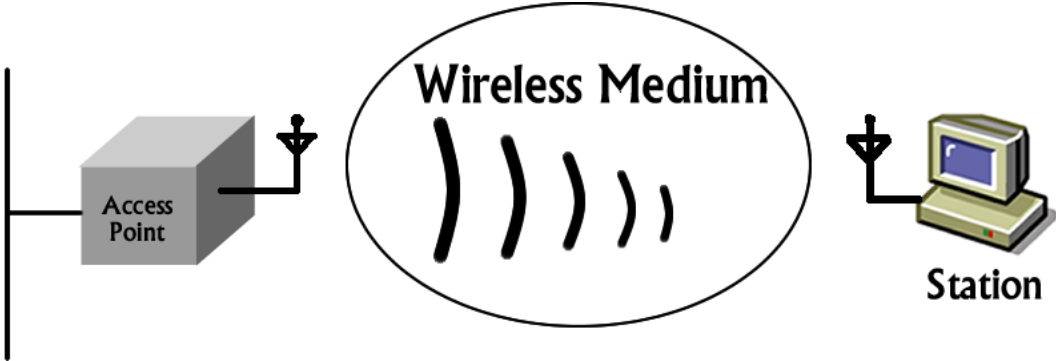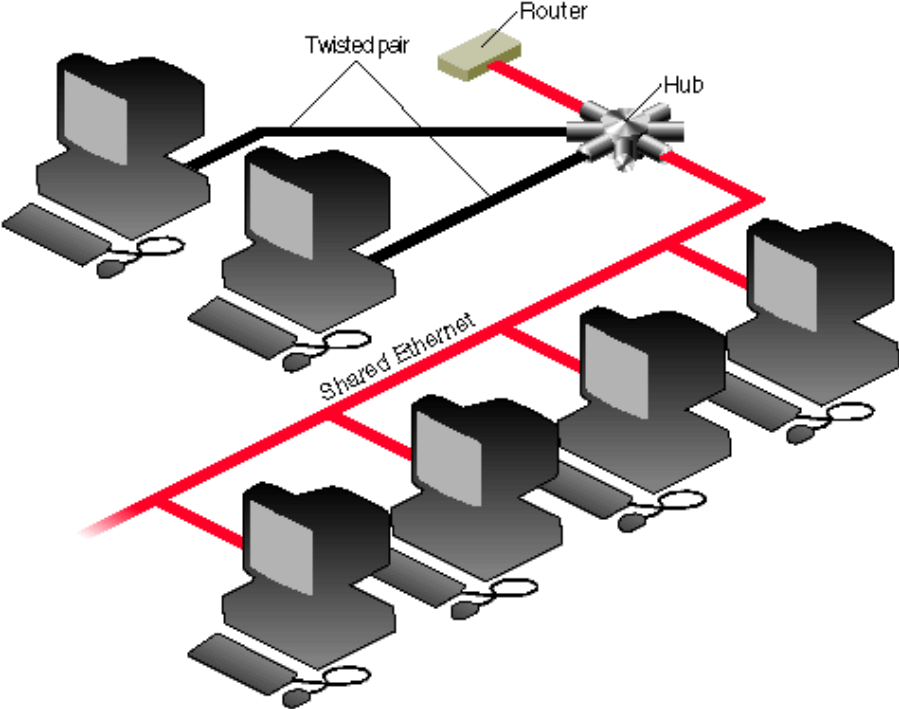
s(t)

τ

$f_0 = 1/T$

T

s(f)

envelope = $|\sin(\pi\tau f)/\pi\tau f|$
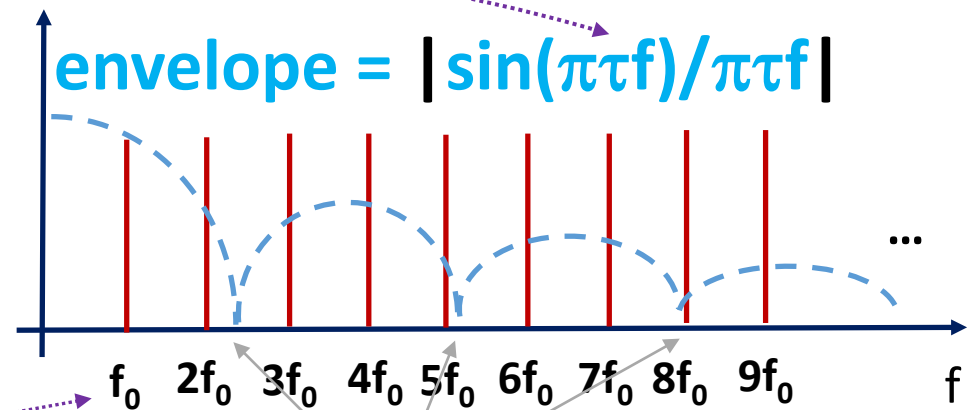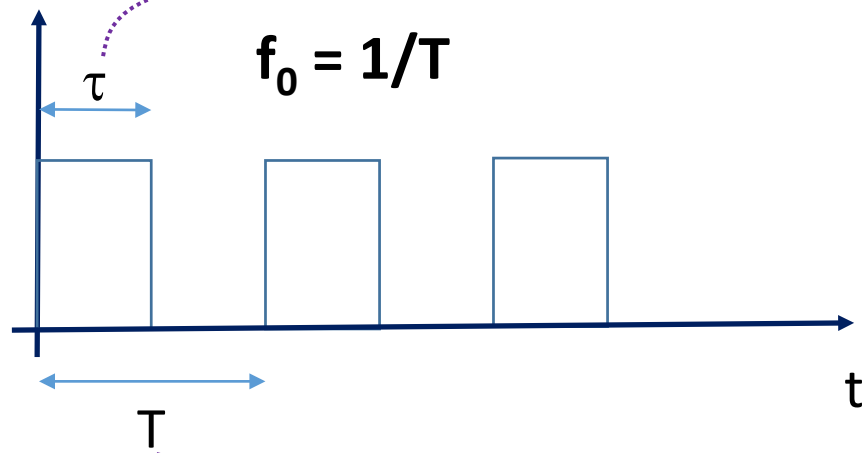
f_0 $2f_0$ $3f_0$ $4f_0$ $5f_0$ $6f_0$ $7f_0$ $8f_0$ $9f_0$ f

...

t

T determines the harmonics.

τ (envelope) determines how much each harmonic contributes to the signal.

Although digital signal has infinite bandwidth most of the signal energy/information is contained in the first 2 lobes!

$f_0 = 1/T$

τ

T

t

envelope = $|\sin(\pi\tau f)/\pi\tau f|$

$f_0 \quad 2f_0 \quad 3f_0 \quad 4f_0 \quad 5f_0 \quad 6f_0 \quad 7f_0 \quad 8f_0 \quad 9f_0$

...

f

zeros - why are they important!?

zeros: whenever $\sin(\pi\tau f)/\pi\tau f = 0$

i.e., whenever $\sin(\pi\tau f) = 0$
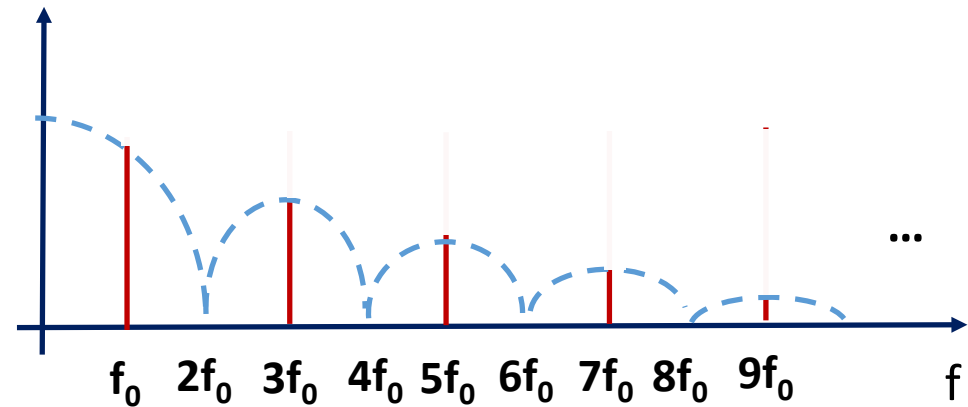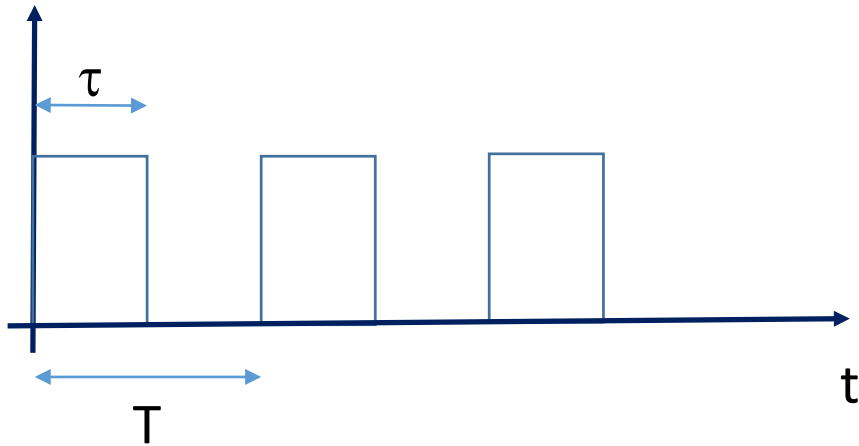
i.e., whenever $\pi\tau f = k\pi$,   k=1, 2, 3, 4, ...

i.e., whenever $f = k/\tau$

zeros: whenever $f = k/\tau$

T – fixed!

$\tau = T/2 = 1/2f_0$

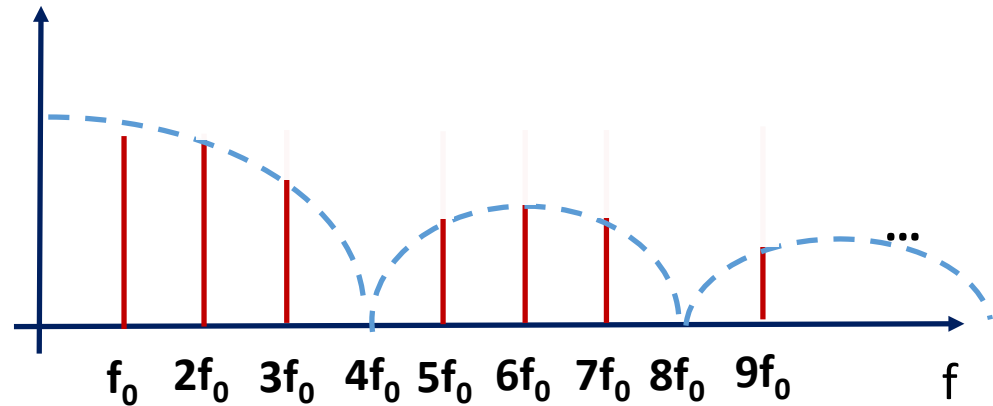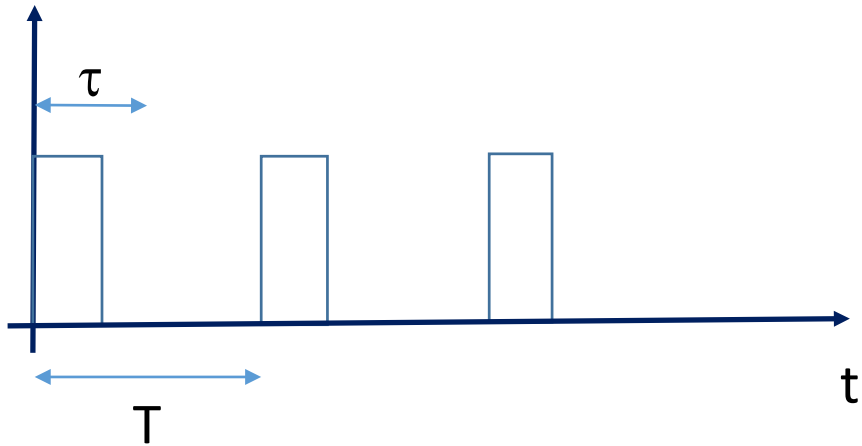**zeros: $f = k/(1/2f_0) = 2kf_0$**

zeros: whenever $f = k/\tau$

T – fixed!

$\tau = T/4 = 1/4f_0$
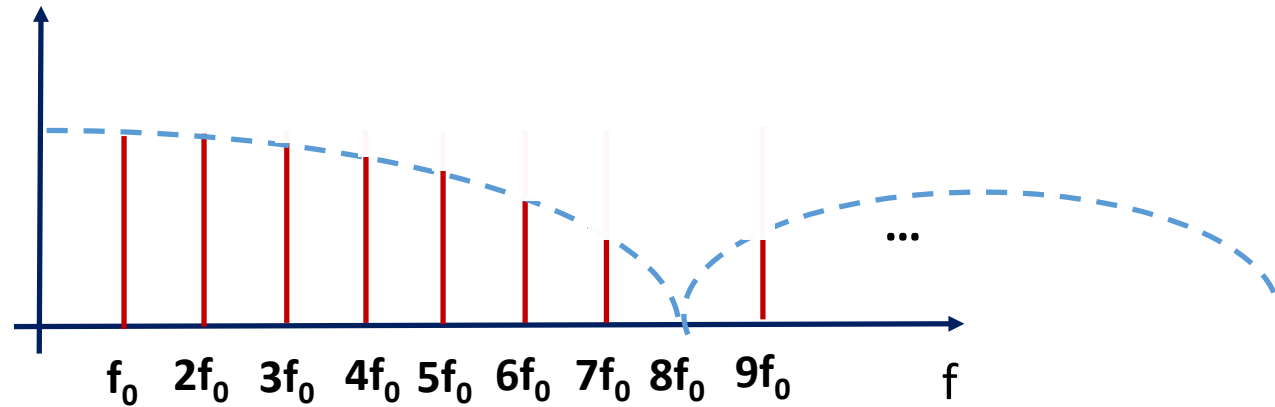
zeros: $f = k/(1/4f_0) = 4kf_0$

zeros: whenever $f = k/\tau$

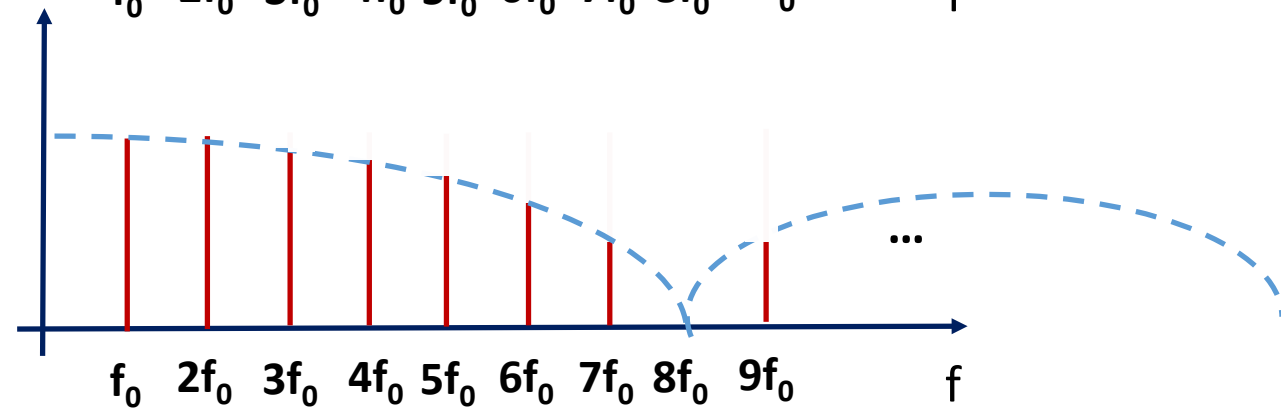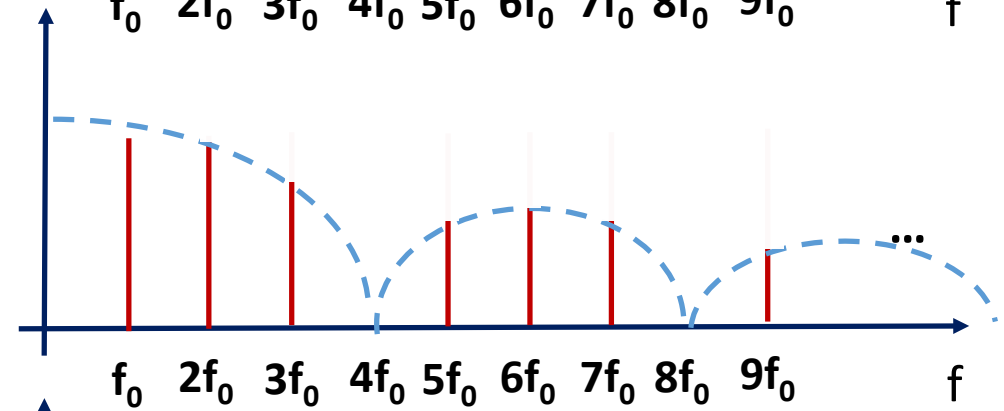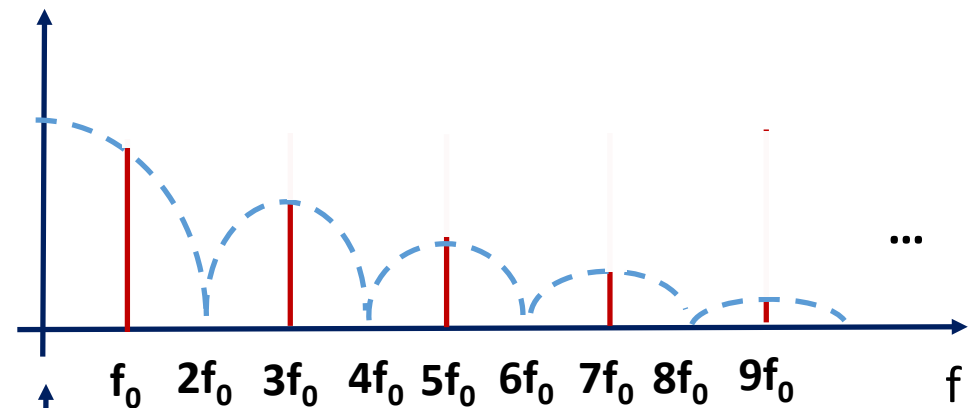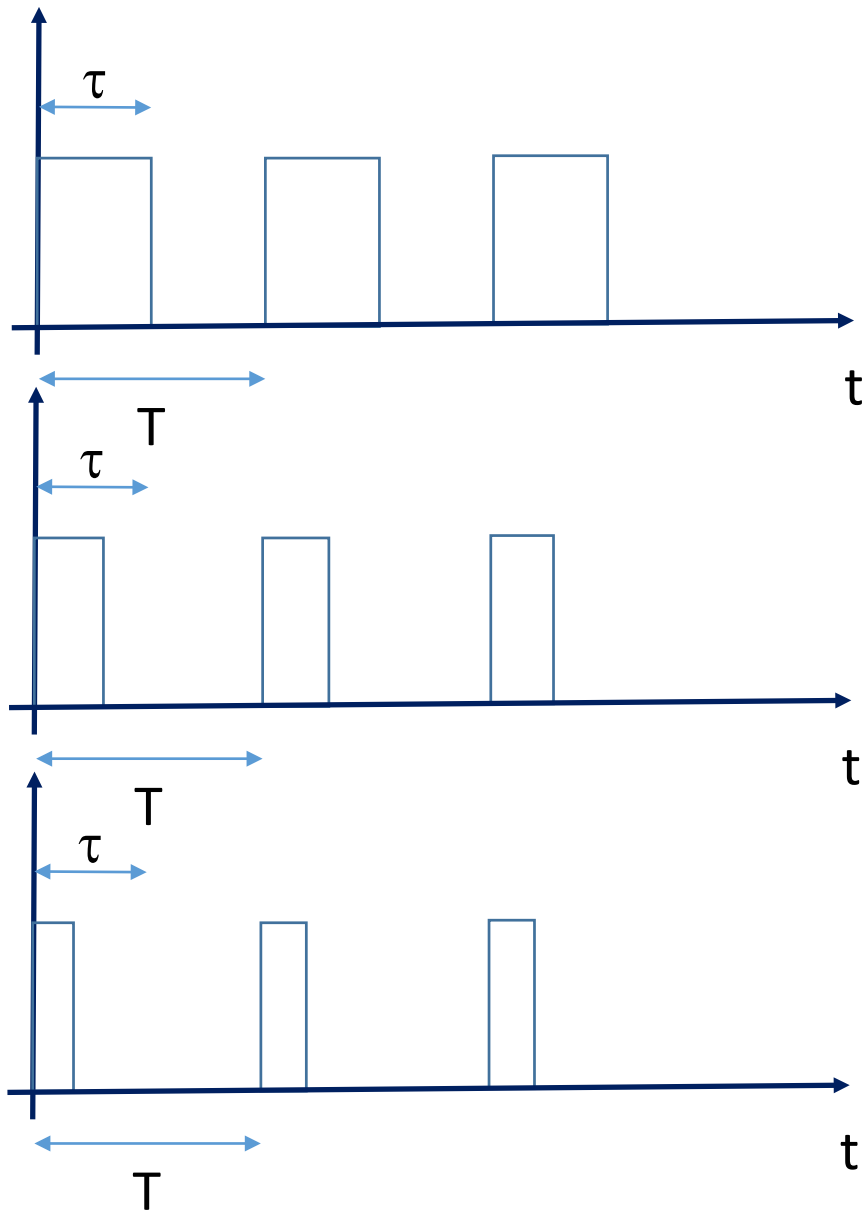**T – fixed!**
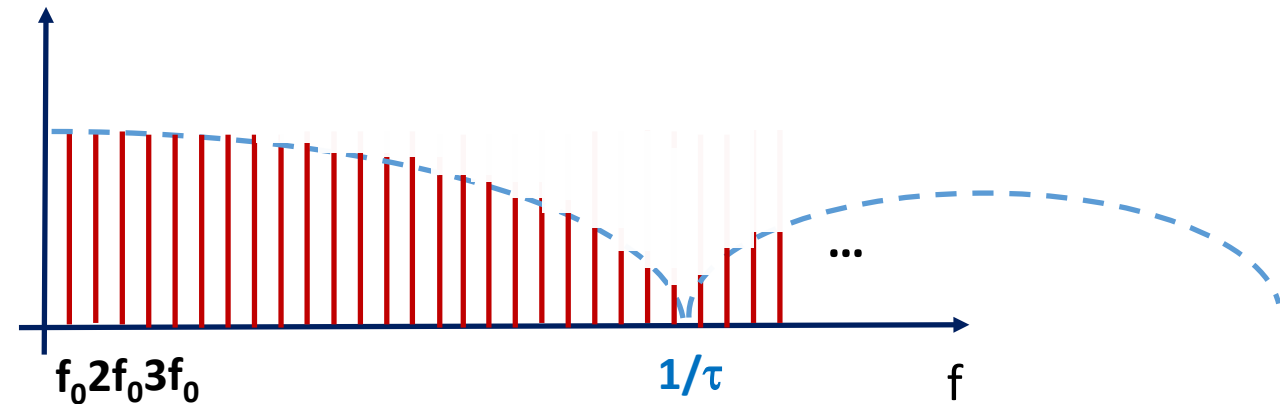
$\tau = T/8 = 1/8f_0$

zeros: $f=k/(1/8f_0)=8kf_0$

As τ→0, higher harmonics become more important.

zeros: whenever $f = k/\tau$

τ - fixed
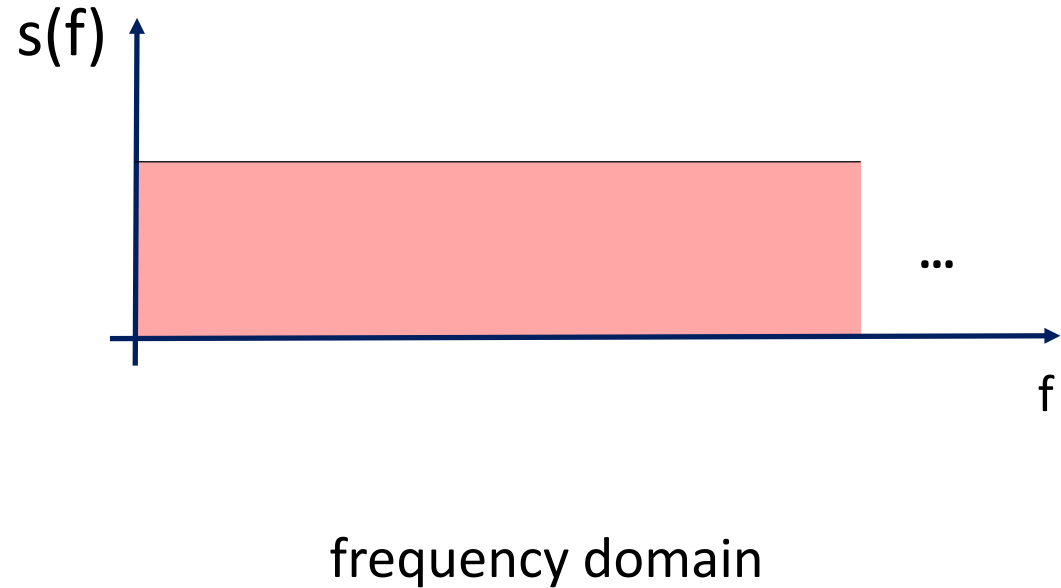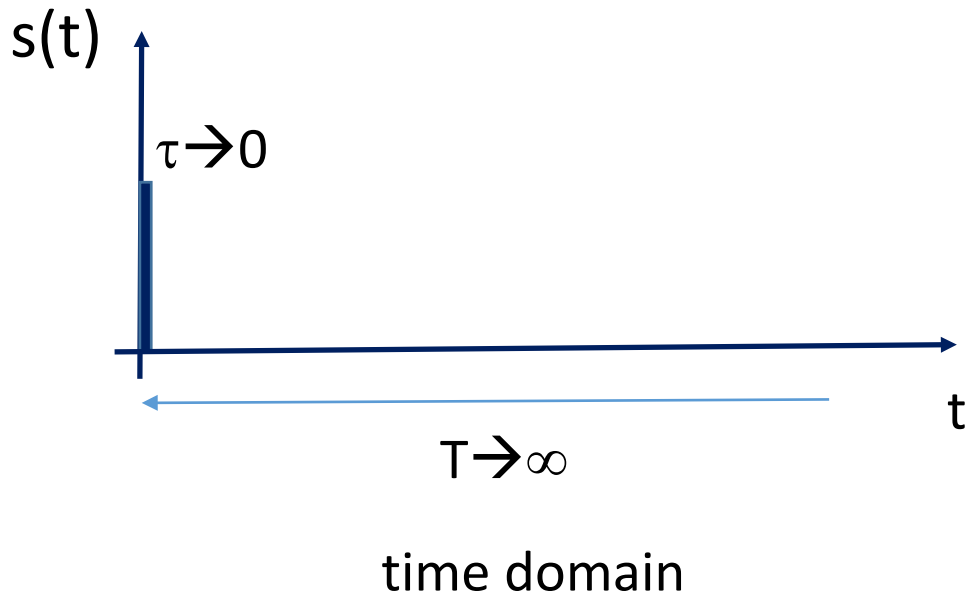
$T \nearrow \Rightarrow f_0 = 1/T \searrow$

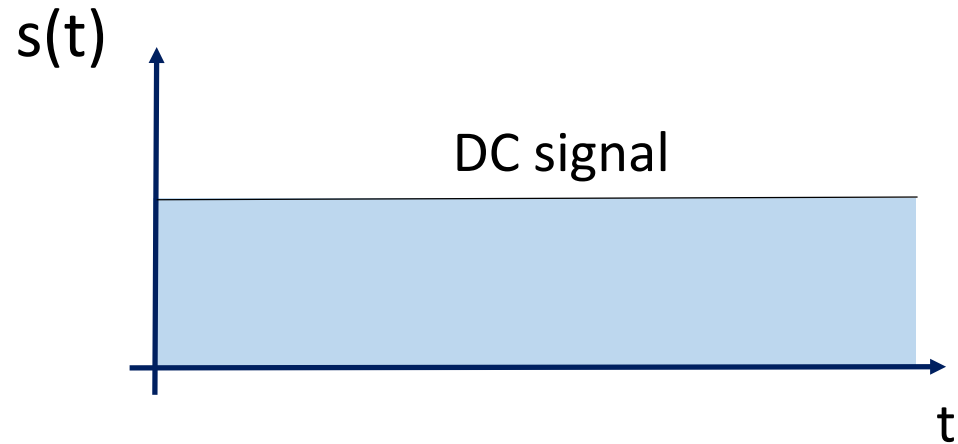As T→∞, signal spectrum becomes 'more dense'.

$$\tau \rightarrow 0$$

$$T \rightarrow \infty \implies f_0 \rightarrow 0$$

s(t)

$\tau \rightarrow 0$

$T \rightarrow \infty$

t

time domain

s(f)

...

f

frequency domain

'Single spike' signal in time dom. has a 'continuous' characteristics in freq. dom.
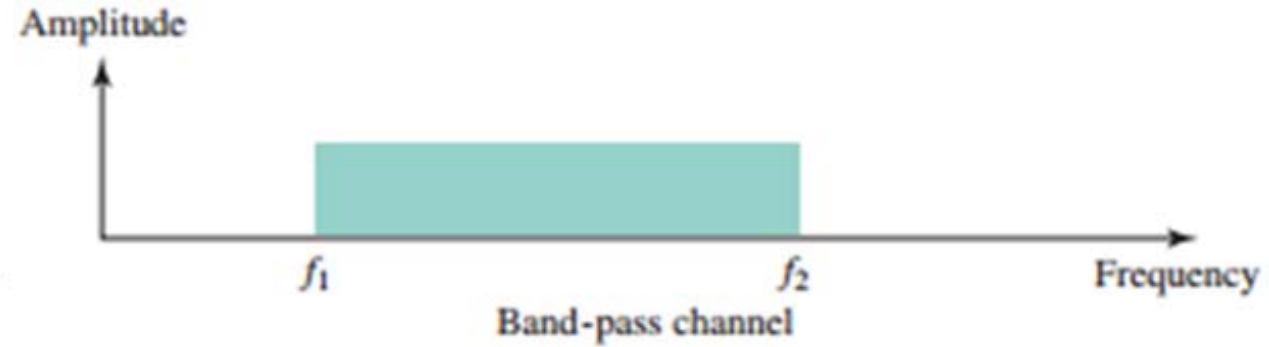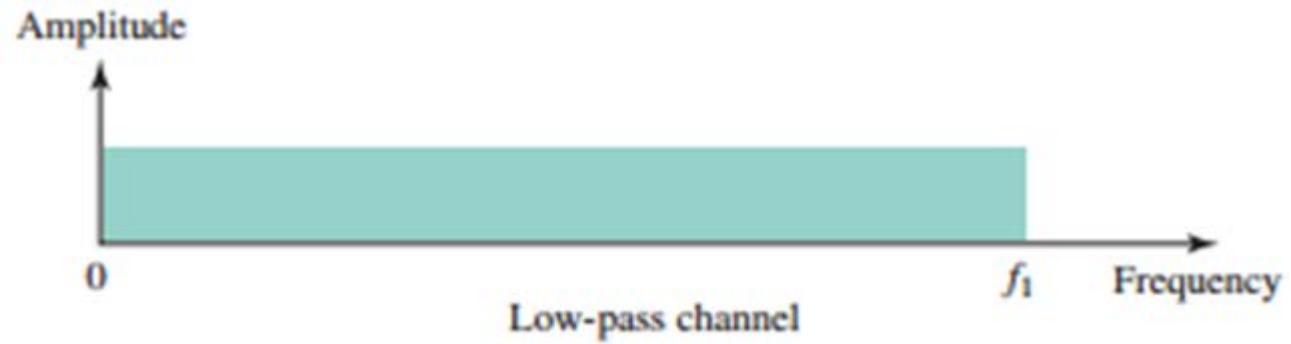
s(t)

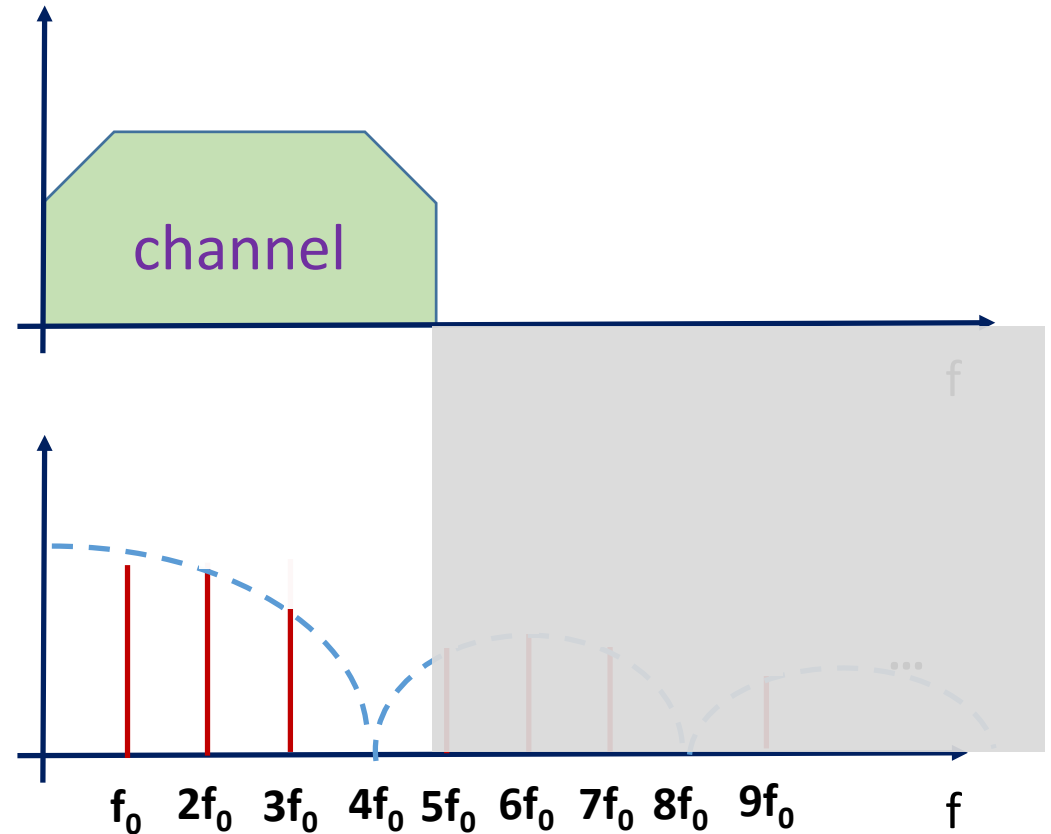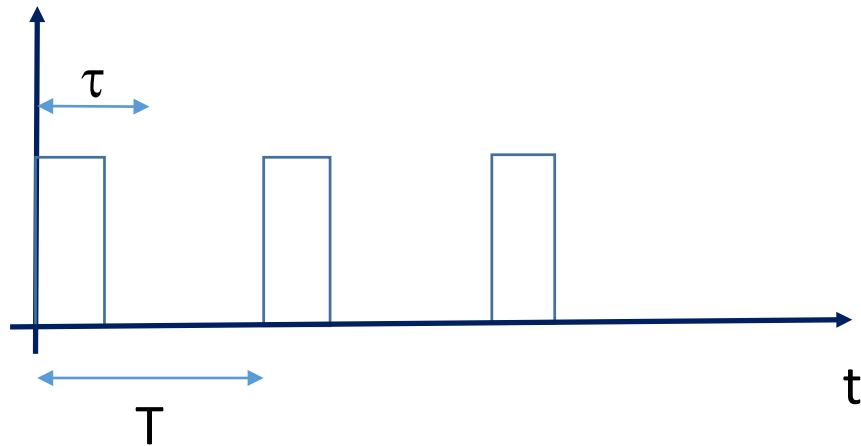DC signal

time domain

t

s(f)

...

frequency domain

f

'Single spike at f=0' characteristics in freq. domain corresponds to a continuous/DC signal in time domain.

Low-pass channel   vs.   Band-pass channel
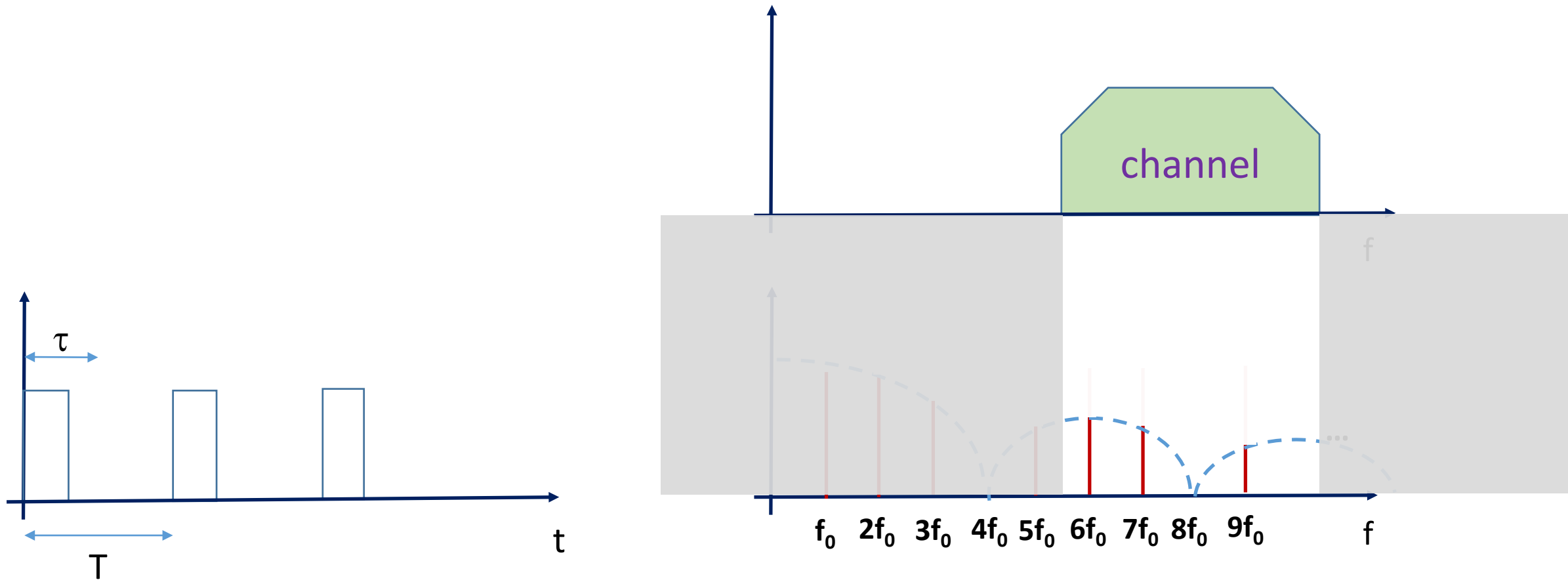
What happens with digital signal when sent through low-pass channel??
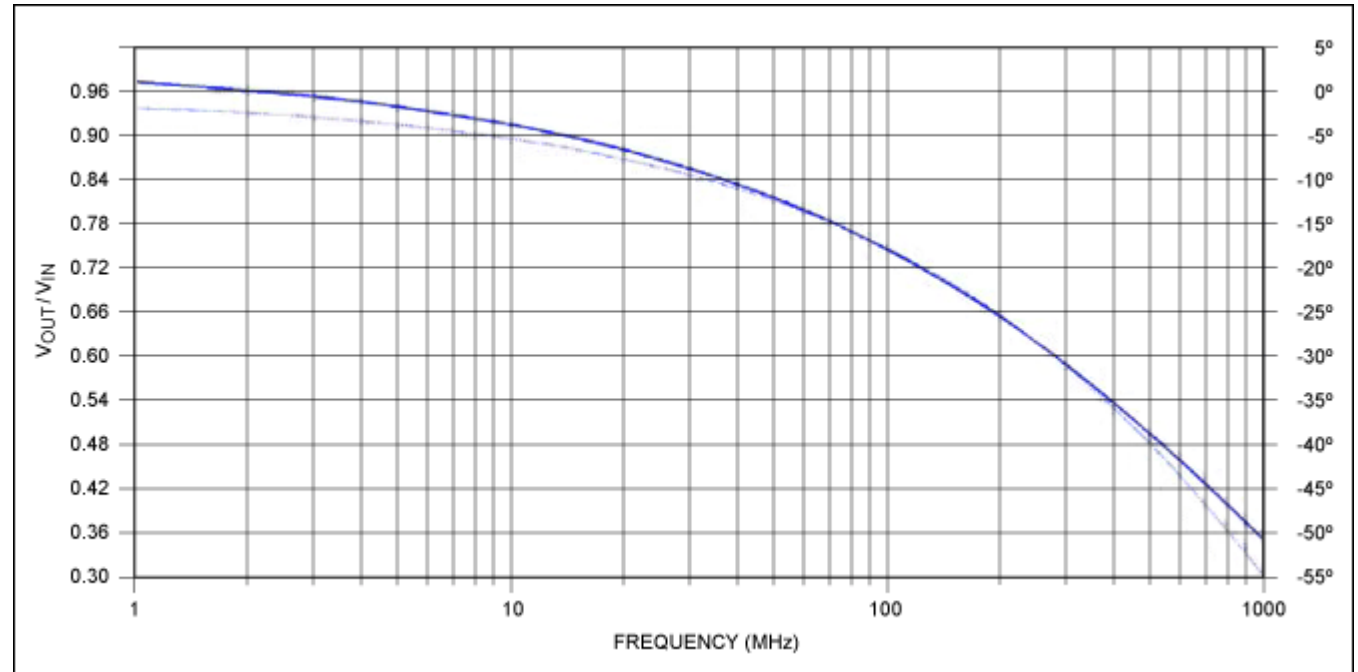

Digital signal will 'pass through', but will be distorted.

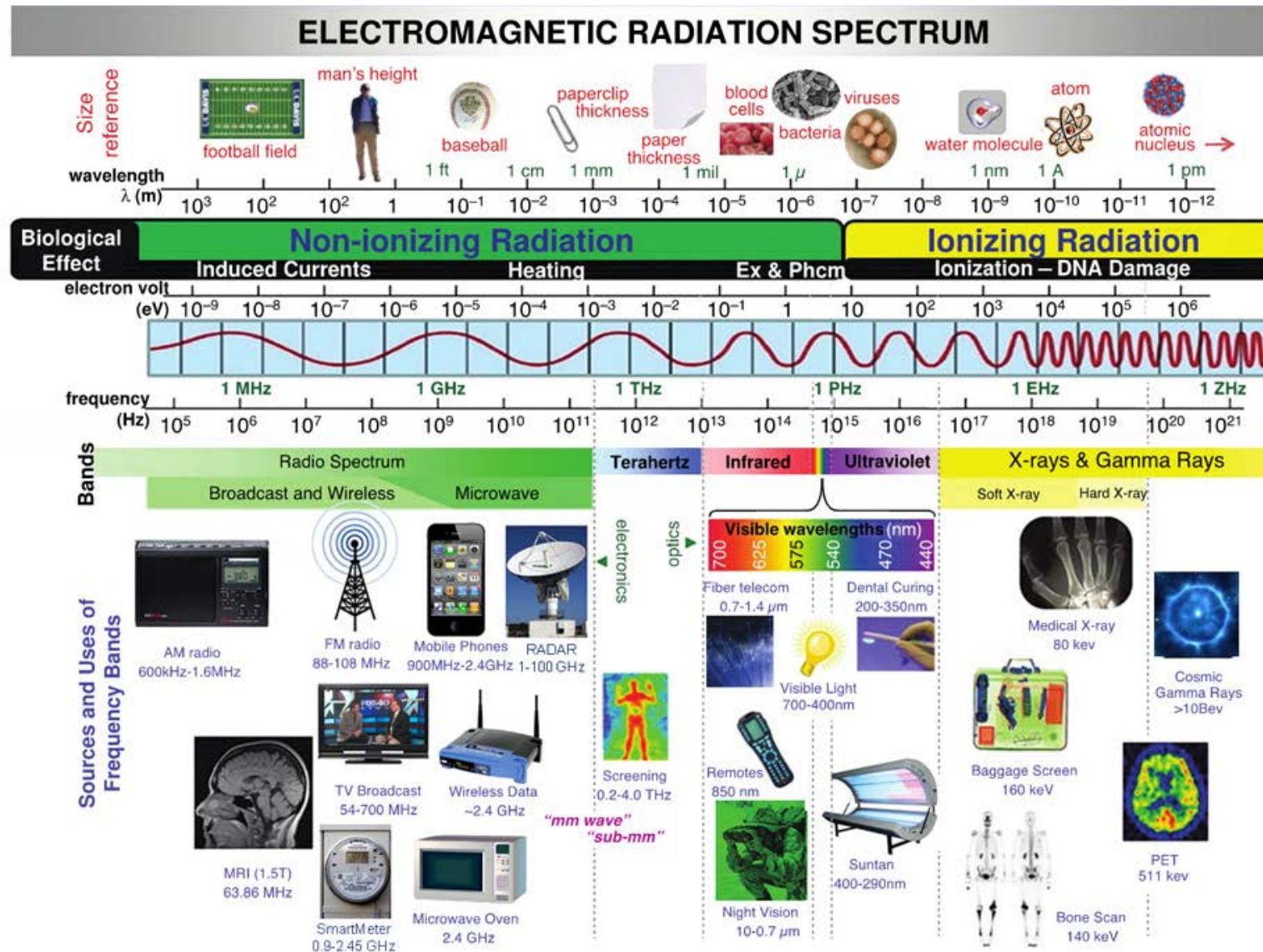# What happens with dig. signal when sent through band-pass channel??

Received signal will not be recognizable.

What happens with dig. signal when sent through coaxial cable??

Coax. cable is a low-pass channel/medium
– can support digital transmission
(in one direction at the time).

What happens with dig. signal when sent through wireless medium??

Baseband transmission   vs.   Broadband transmission

Digital signals are sent as direct digital pulses applied to the wire.

Digital signals are modulated as radio-frequency (RF) analog waves that use different frequency ranges.