Panel 1

Fourier Series: FFT

Every periodic function is a sum of sin and cos

$$f(t) = a_0 + \sum_{j=1}^{\infty} a_j \cos\left(\frac{2\pi j t}{p}\right) + b_j \sin\left(\frac{2\pi j t}{p}\right)$$

Fact: Every transmission facility looses power when transmitting signals

- if power loss was uniform, signal would be reduced in amplitude only, same shape could easily boost
- if power loss was dependent on frequency signals become distorted

1

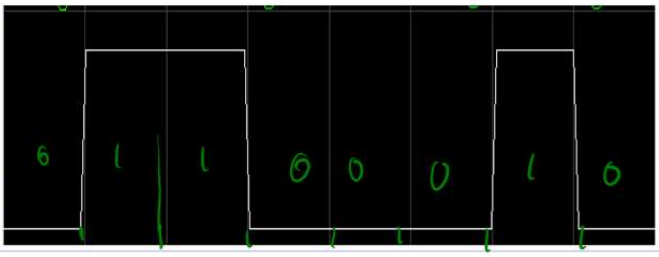
Panel 2

Fact: All transmission facilities diminish signals depending on frequency!

Usually, higher frequencies are distorted more eventually cut-off (to limit bandwidth to customer)

Ex: Want to transmit "b" = 01100010 with period 0.01 sec. 800 bps

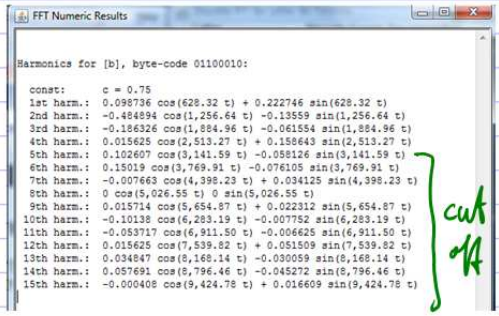
8 bits per 1/100 sec => 800 bits per sec / 100 Bps




2

Panel 3

A Fourier analysis of this signal shows it contains higher and higher frequencies:




If we apply a 3000 Hz filter, low-pass, all freq. above 3000 Hz are cut off

⇒ signal becomes distorted

3

Panel 4

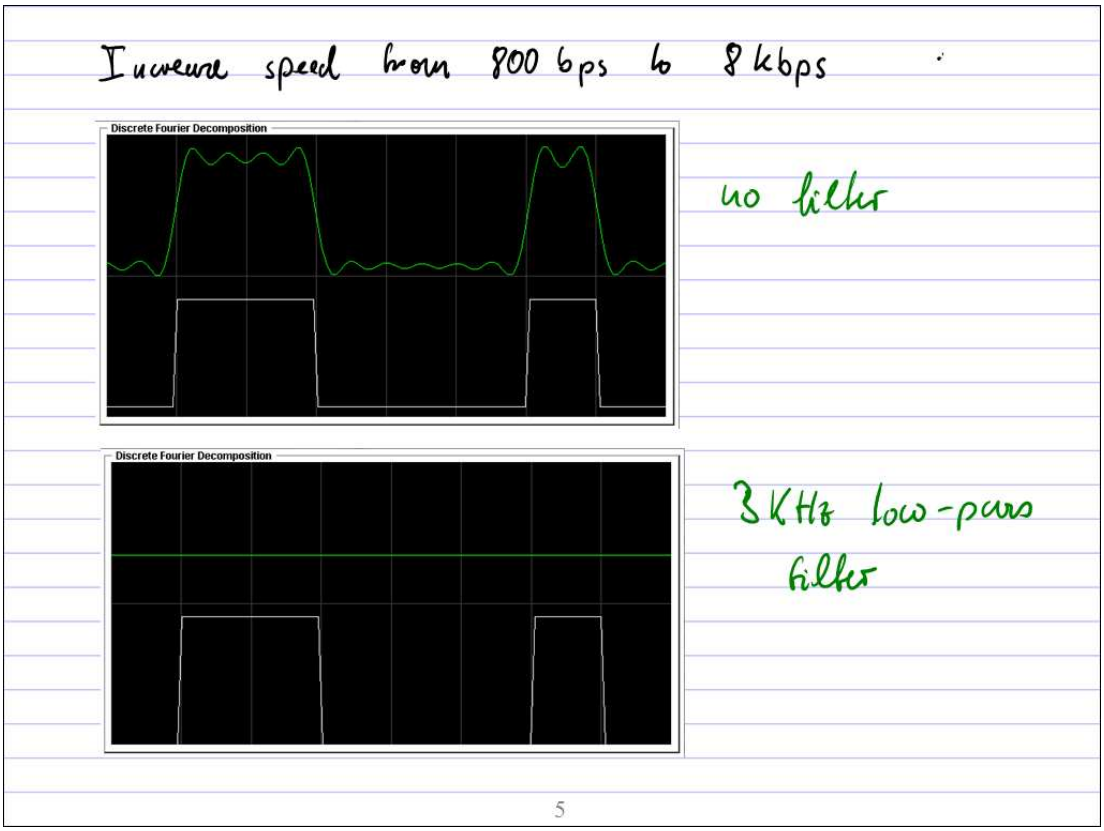
8 bit signal "b" at period 0.01 secs = 800 bps


uses 15 sin/cos terms

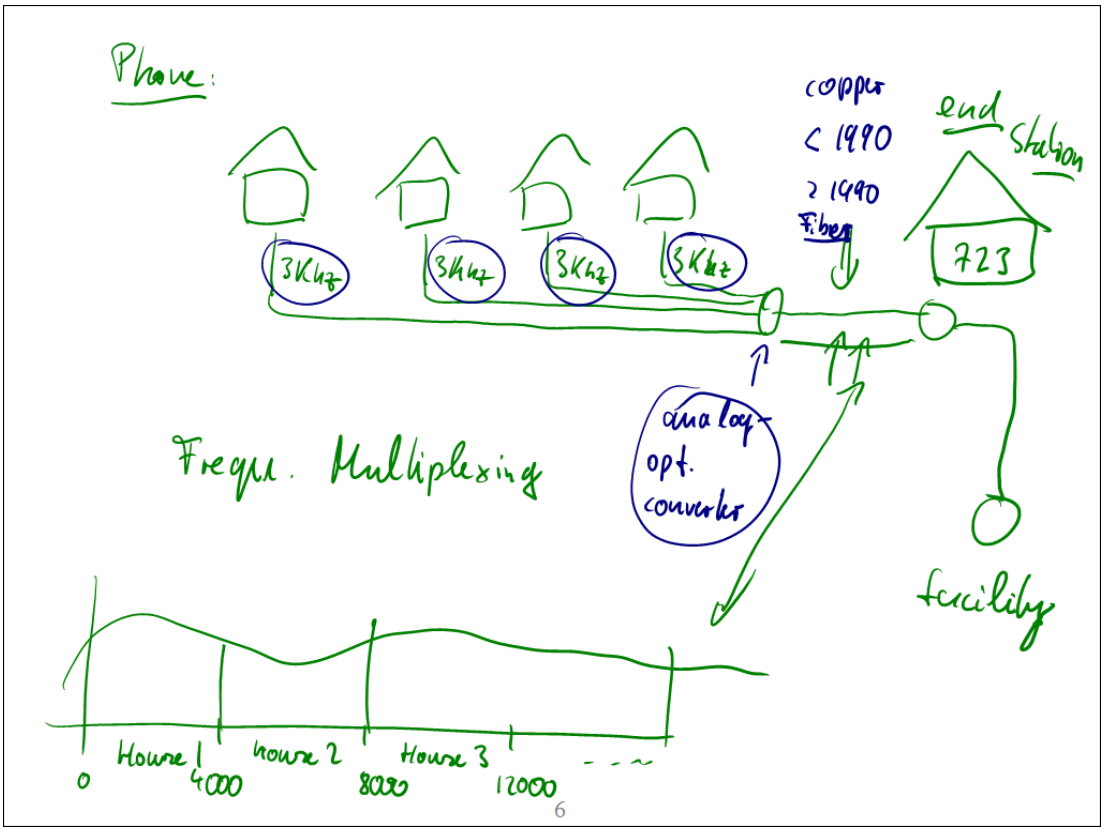

3 KHz (low-pass filter)

4

Panel 5




Panel 6



Panel 7

## The Nyquist Theorem

Universal Fact: There is a limit to transmission speed depending on some factor

≈ Nyquist established theorem in 1924

## Nyquist Theorem:

Next time

7