

EA5HVK Technical Education

- Jose Alberto Nieto Ros
- EA5HVK since 2011. Extra class license.
- Bachiller (4 years)
- Telecommunication engineer (5 years)

MAIN SUBJECTS

- Analog Electronic
- Digital electronic
- Microwaves
- Filter design
- Microstrip Lines design
- Smith chart (Impedance Matching)
- Electromagnetic theory

- Antenna Theory (Arrays design)
- Digital Signal Processing
- **Digital Communications**
- Optical Communications
- Video and sound systems
- Computer architecture (68000 Micro)
- FPGA Programming (Touchstone)
- Computer Networks

- Radar systems
- Turbo C++ Programming (José Canosa)
- Circuits analysis techniques
- Transmission medium and wave propagation
- Radio transmissions (Microwave Links)
- Control systems (Ogata)
- Introduction to Astronomy
- Introduction to Astrophysics

PRENTICE
HALL
INTERNATIONAL
EDITIONS

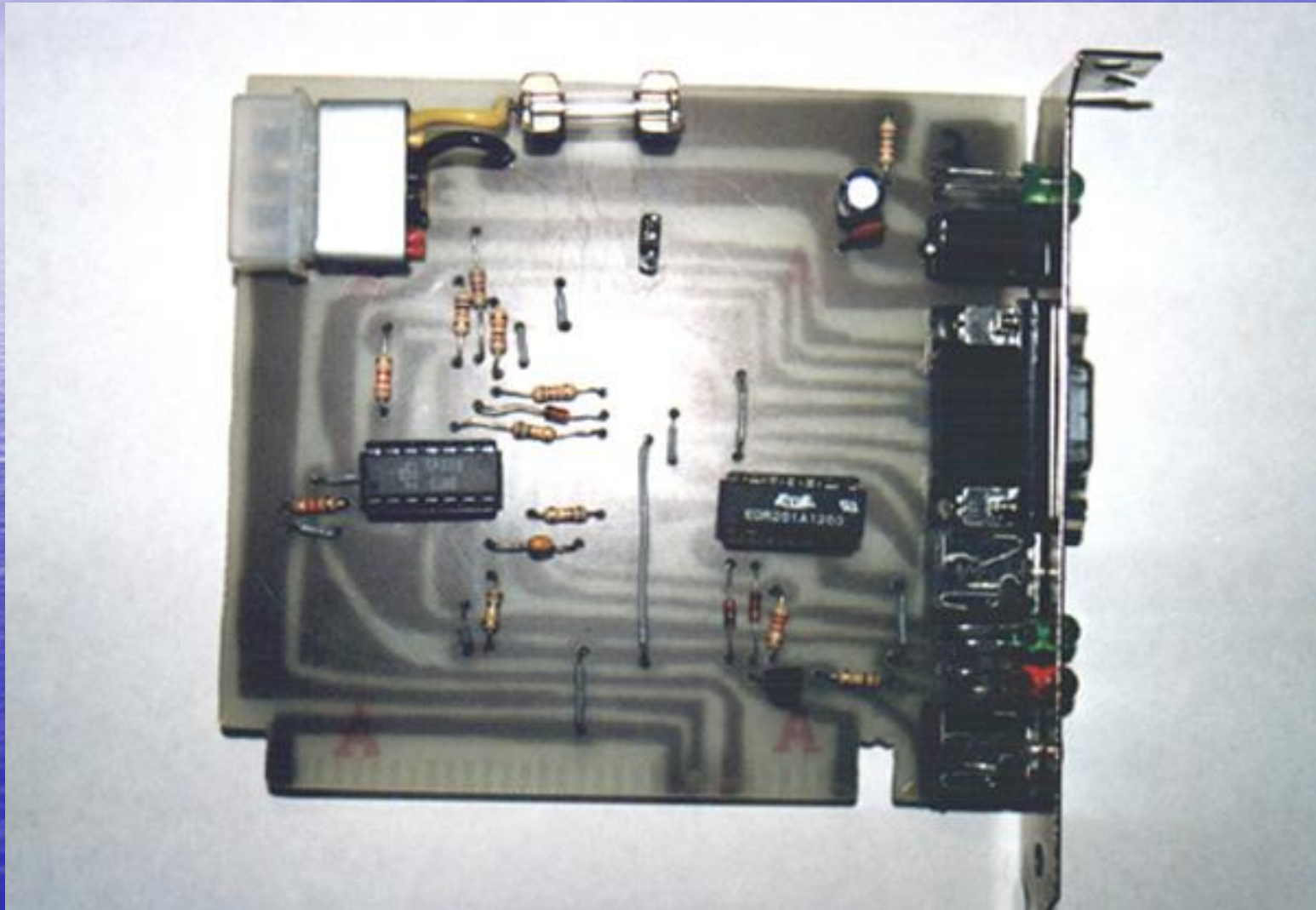


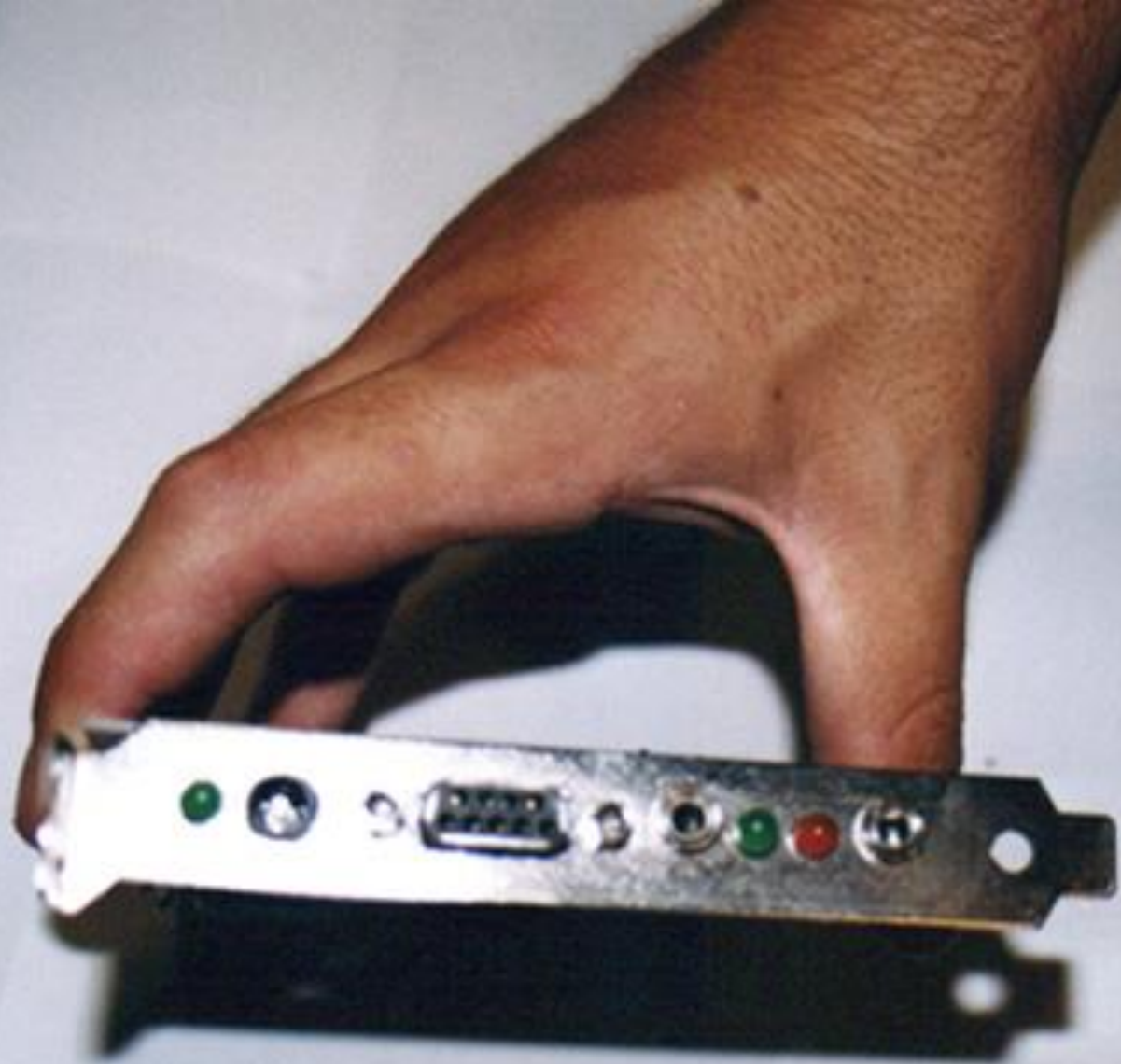
DIGITAL
COMMUNICATIONS
FUNDAMENTALS AND APPLICATIONS

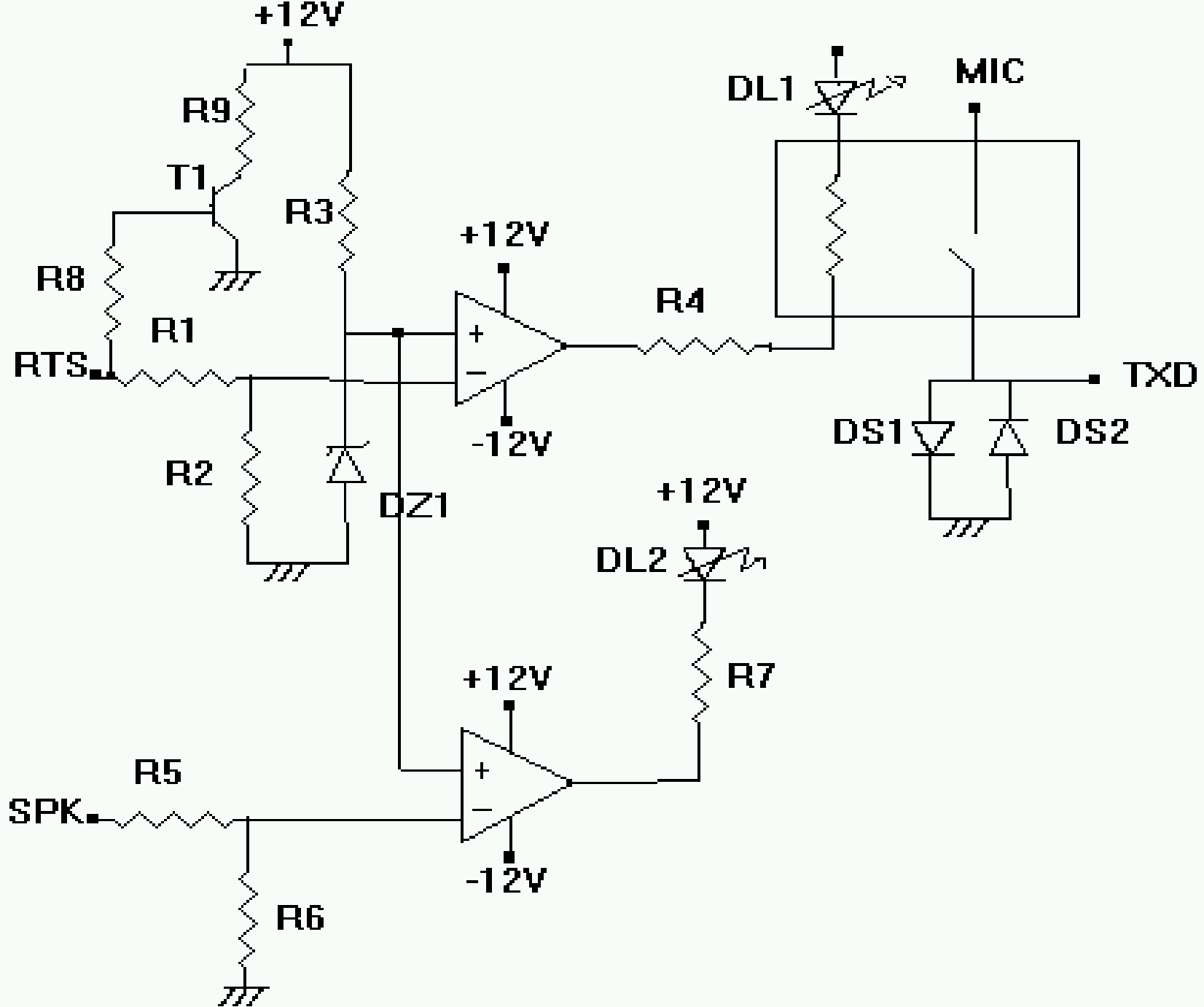
BERNARD
SKLAR



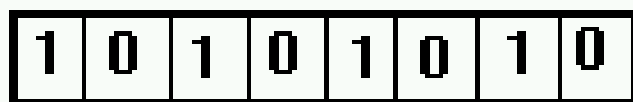
PREHISTORIC VARA







caracter ASCII

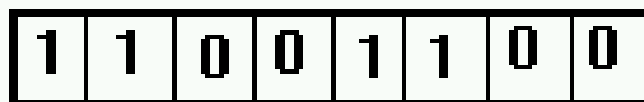


carácter 21

bit de parada

bit de arranque

caracter ASCII



carácter 38

bit de parada

bit de arranque



VARA comes from "The Man Of the VARA"



“The Man of the VARA” is a Superman Spanish version parody



VARA MOTIVATION

- Chat communications have not sense in the present Ham Radio World
- You have all the info previously the QSO
- Some modes need internet for synchronization
- The information trasmitted is not relevant

EMERGENCY COMMS

- Back to the 80's Ham Radio essence
but using the latest digital techniques
- Internet or Telephone is not available.
- The modem must to synchronize by itself.
- The information sent is valuable.






VARA Tec DATA

- VARA HF is a High Speed HF modem based on OFDM modulation.
- 94 bps Symbol Rate maximum
- Designed for operation within a SSB Bandwidth of 2300 Hz
- Providing uncompressed User Data Rate to 7050 bps
- Fast adaptive 16 speed levels
- Turbo Codification

- Luis EA3OG asked me if it's possible to send emails from a yacht in the Barcelona-Ibiza path.
- In 2017, Lor Kutchins W3QA, President at Amateur Radio Safety Foundation Inc., approved VARA in Winlink.

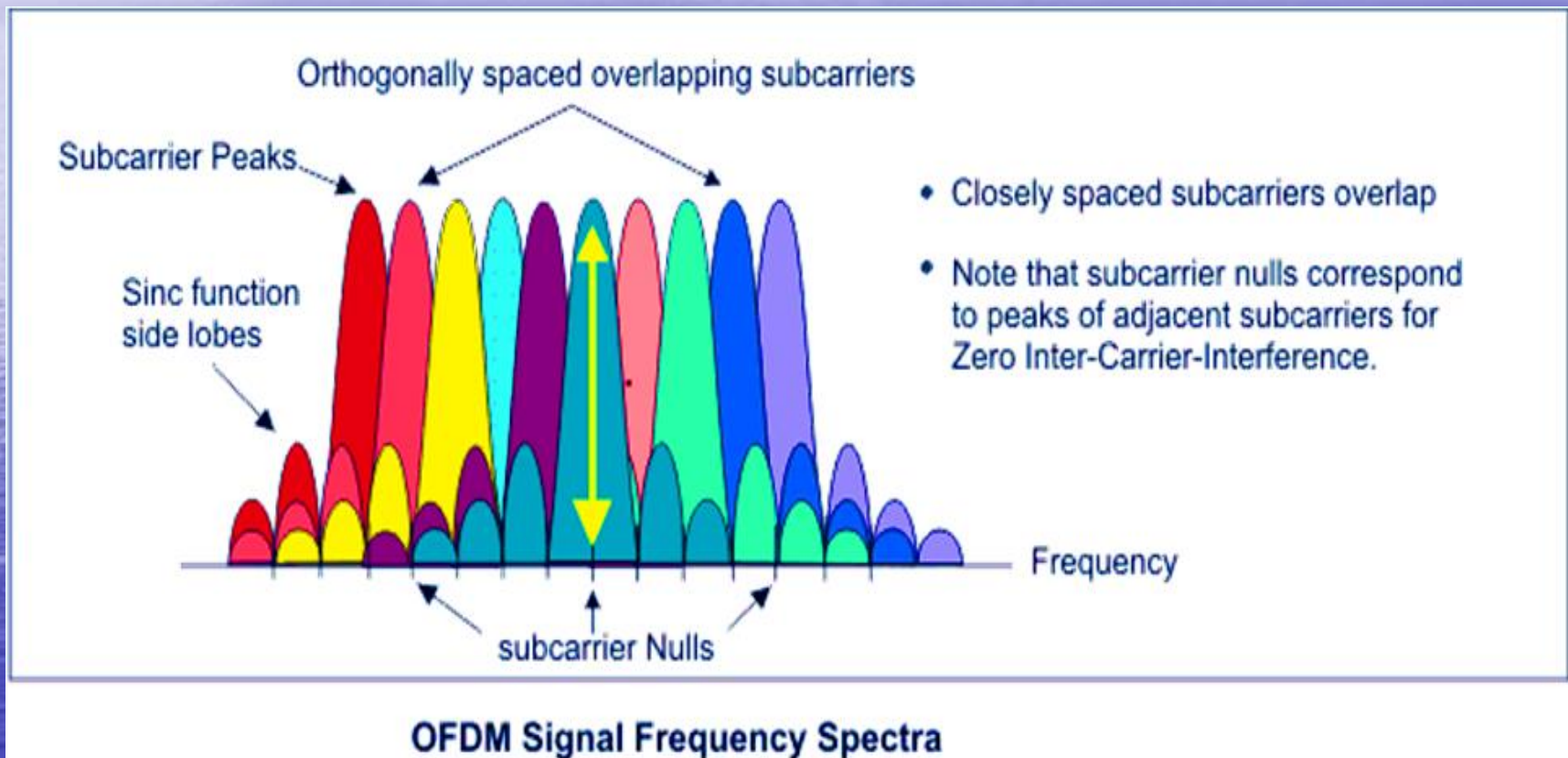
EA5HVK software

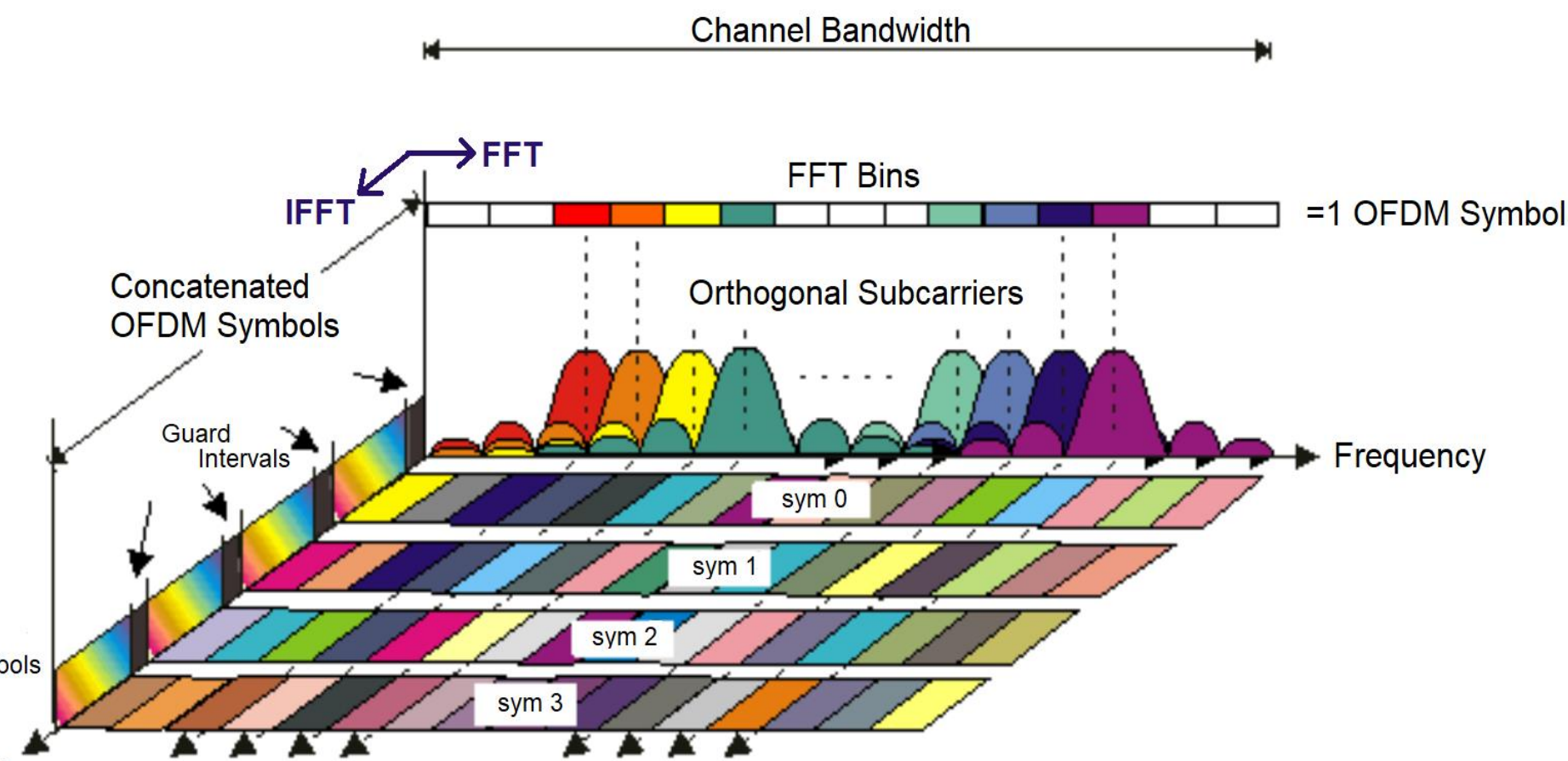
10 January, 2011

-  **VARA HF v4.0.4 (High Performance HF Modem)**
-  **VARA FM v3.1.1 (VARA for FM transceivers)**
-  **VARA SAT v3.1.3 (VARA for Es'Hail-2 (QO-100) Satellite)**
-  **VARA Chat v1.1.9 (Text and File transfer P2P app)**
-  **VARA Terminal v1.1.1 (VARA dumb terminal)**

- FCC: 300 baud symbol rate limit
- Handicap or indifferent ??
- Symbol rate is not a limitation for baud rate

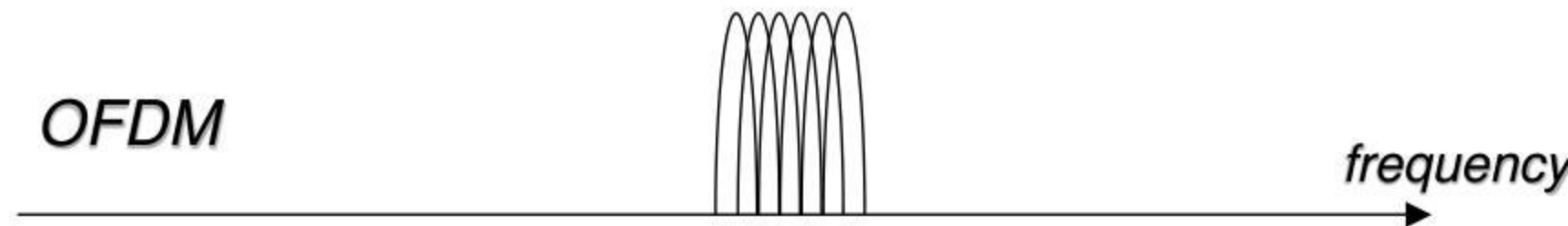
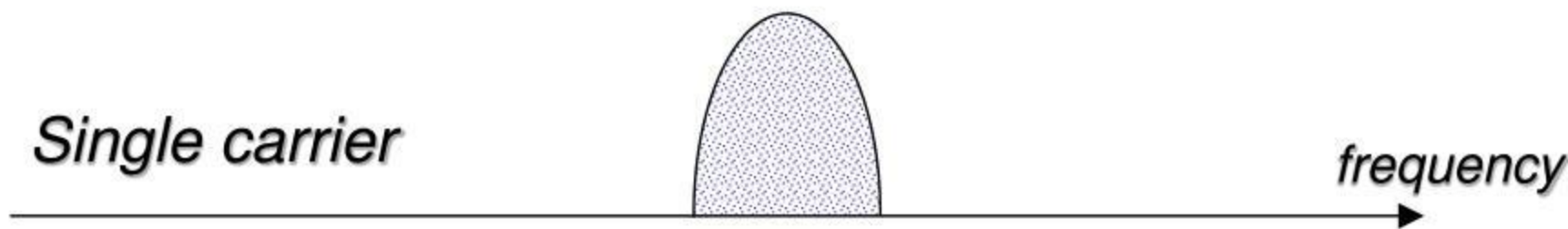
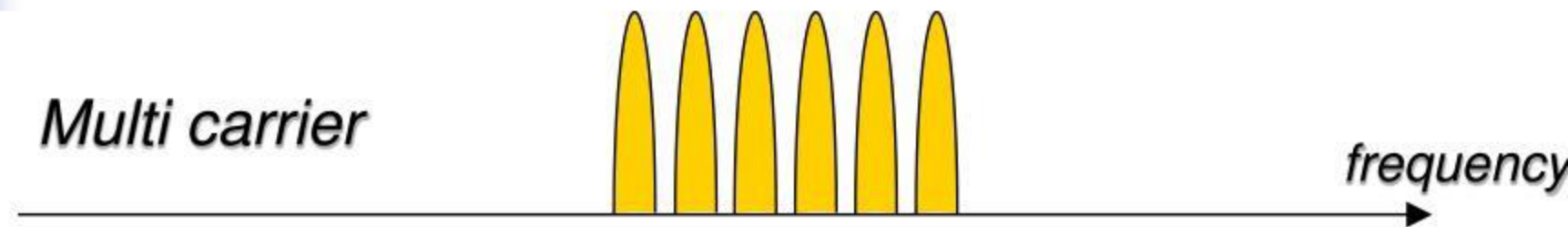
VARA OFDM SPECTRE





Frequency-Time Representative of an OFDM signal

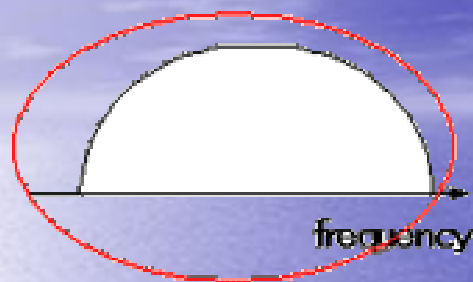
Spectrum comparison for same data rate transmission



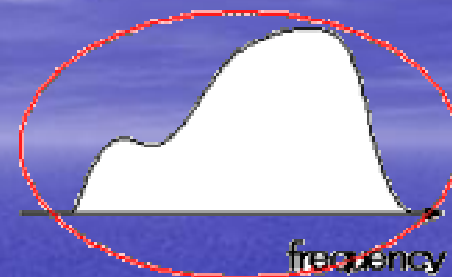
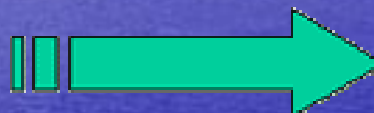
ADVANTAGES OF OFDM

- Multipath delay spread tolerance
- Immunity to frequency selective fading channels
- Efficient modulation and demodulation
- High transmission bitrates
- Flexibility
- Easy equalization
- High spectral efficiency
- Resiliency to RF interference
- Lower multi-path distortion

Spectrum of single-carrier

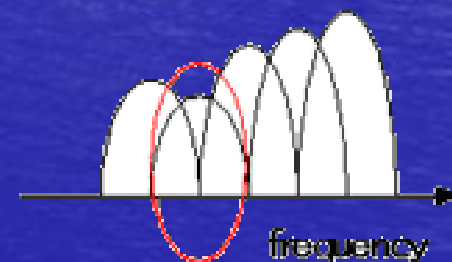
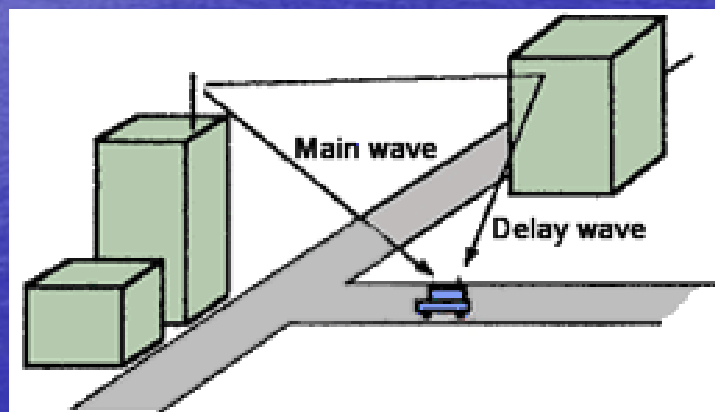
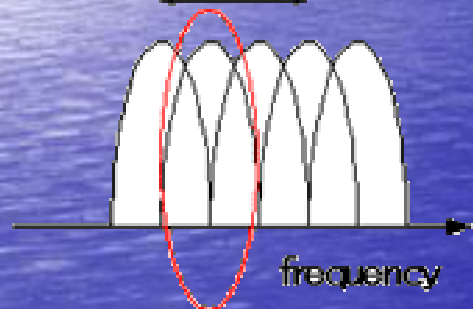


Channel
(frequency selective fading)



Large distortion
for whole spectrum

Spectrum of multi-carrier (OFDM)



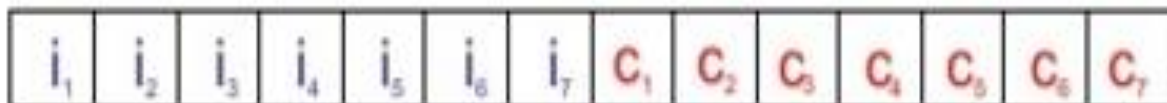
Simple attenuation
for each narrow spectrum

Overview of FEC

FEC = Forward Error Correction

– Why Forward? It is subjective...

Code bits are added (directly or indirectly) to the information bits, creating redundancy in the transmitted symbols



i_x = information bits

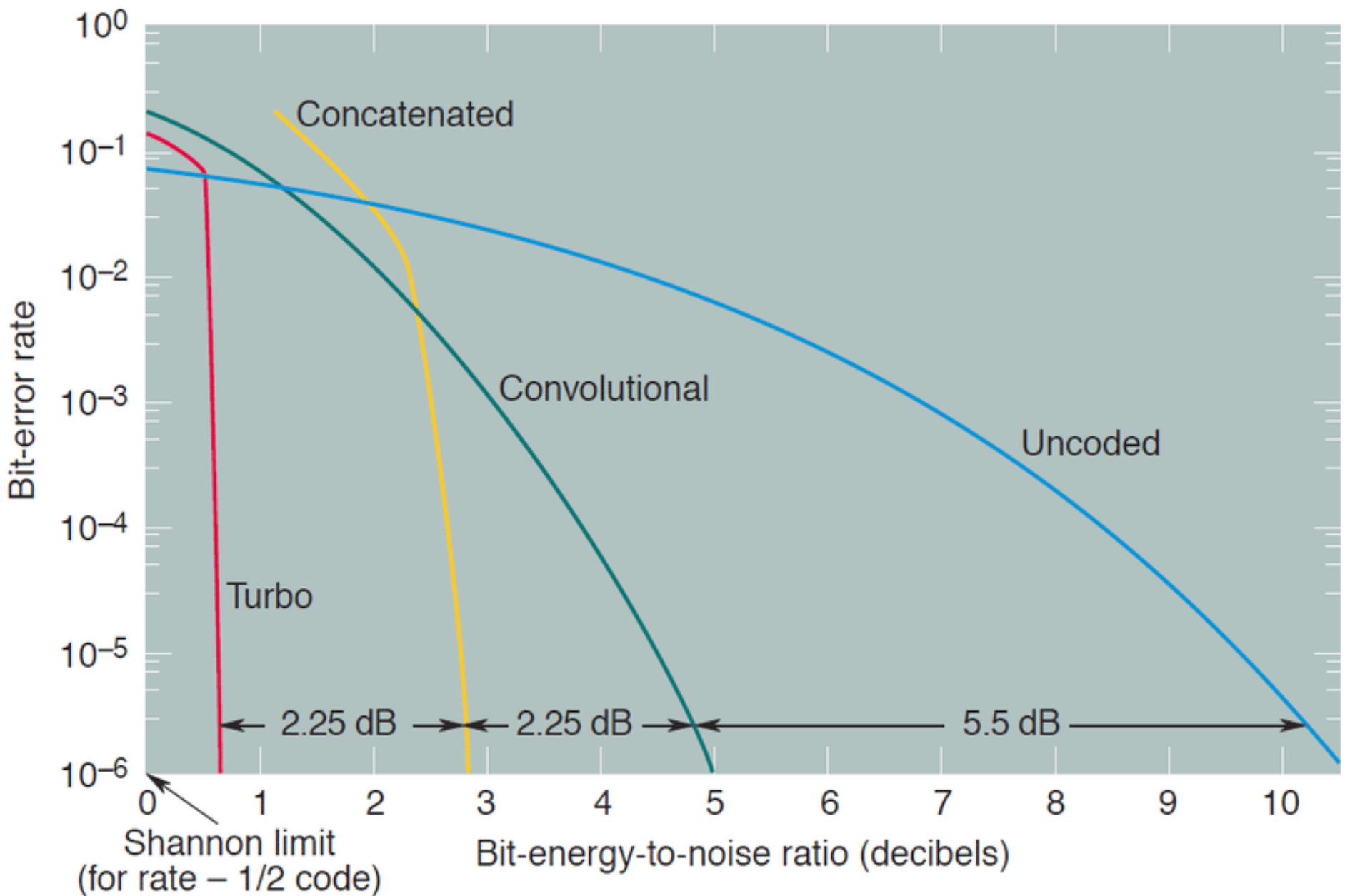
C_x = code bits

Overview of FEC (cont' d)

Fundamental flavors of FEC:

- Old-school
 - Block Codes (BCH, Reed-Solomon)
 - Convolutional Codes (Viterbi decoding)
- New-school
 - Turbo Codes (1993)
 - BER performance of 10^{-5} at an E_b/N_0 of 0.7dB using only a 1/2 rate code⁵
 - Much excitement over this development
 - Most modern FEC work is in this field

[5] C. Berrou, A. Glavieux, and P. Thitimajshima, "Near Shannon limit error-correcting coding and decoding: turbo codes," *Proceedings of ICC '93*, (Geneva, Switzerland), pp. 1064-1070, May 1993.



Turbo Codes in Practice

- Turbo codes have made steady inroads into a variety of practical applications
 - deep space
 - mobile radio
 - digital video
 - long-haul terrestrial wireless
 - satellite communications
- Not practical for real-time, voice