6. DIGITAL MODES – AI6JB

Chapter 6 Digital Modes

ARRL General Class
Sections 6.1

Basics of Digital Modes: Where to Find Digital Activity

Communications are digital modes if info is exchanged as individual characters encoded as digital bits … Morse Code (CW), radioteletype, PSK31, FT8, D-STAR, DMR, slow-scan TV, etc.

Digital modes are restricted to CW/data segments of each HF band *

- Found near top of CW segment
- Example: On 20 meters, most PSK signals are near 14.070 MHz. RTTY and other digital modes are found above that between 14.070 and 14.112 MHz. See Table 6.1.

** CW isn't formally restricted anywhere in the ham bands*

Digital Modes Overview

Data rates and bandwidths specified by FCC rules

Digital codes not specified by the FCC must be public

Radioteletype (RTTY) – originally used mechanical teleprinters but migrated to computer sound cards

PSK31 – good weak signal mode using low transmitter power and very narrow bandwidth (computer sound card)

PACTOR – stands for PACket Teletype Over Radio

WINMOR – stands for WINdows Messaging Over Radio

Packet Radio – common on the VHF and UHF bands (1200 & 9600 baud)

Table 6.1: Digital Signal Band Plan (HF Bands)

Band (meters)	Frequency Range (MHz)	Notes
160	1.800 – 1.810	FT8 is on 1.840 MHz
80	3.570 – 3.600	
60	5332, 5348, 5358.5, 5373, 5405 kHz	Channel center frequencies
40	7.070 – 7.125	RTTY DX calling frequency 7.040
30	10.130 – 10.150	
20	14.070 – 14.0995 and 14.1005 – 14.112	PSK31 calling frequency 14.070
17	18.100 – 18.110	
15	21.070 – 21.110	
12	24.920 – 24.930	
10	28.070 – 28.189	

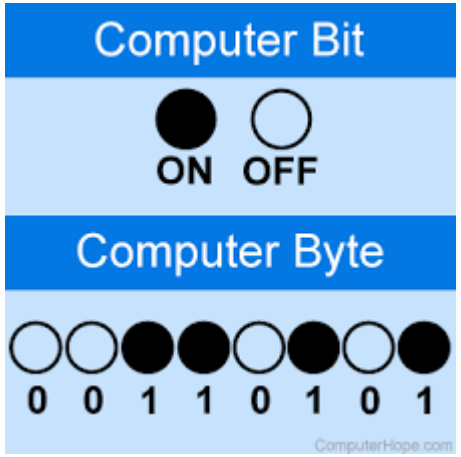
Definitions

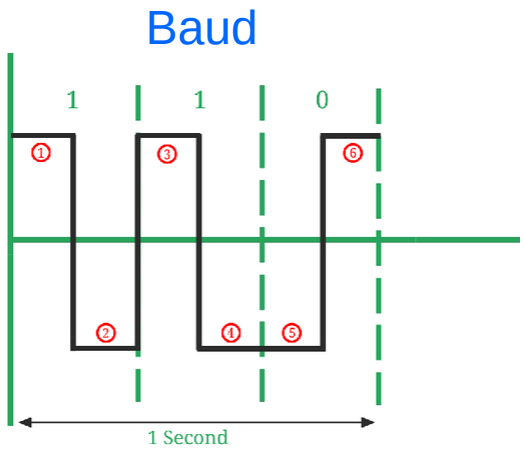
Air link: the part of the comm system that involves radio transmission and reception of signals

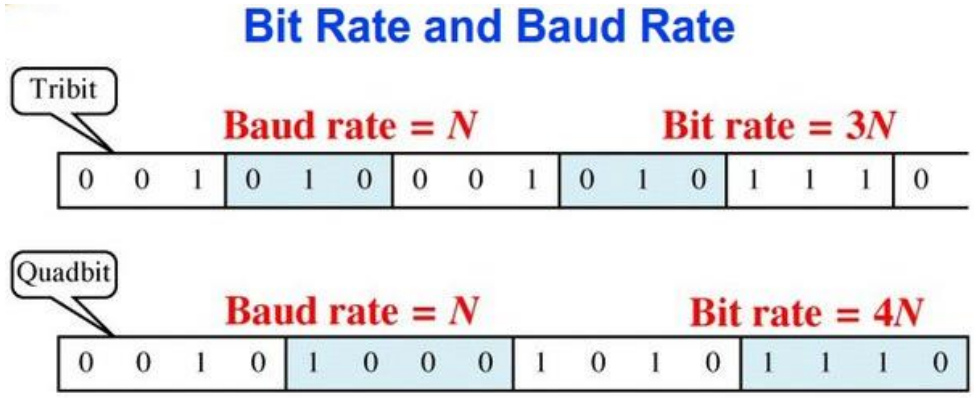
Bit: the fundamental unit of data; a 0 or 1 representing all or part of a binary number

Bit rate: number of digital bits/second sent from one system to another

Baud(s): number of symbols/second sent from one system to another







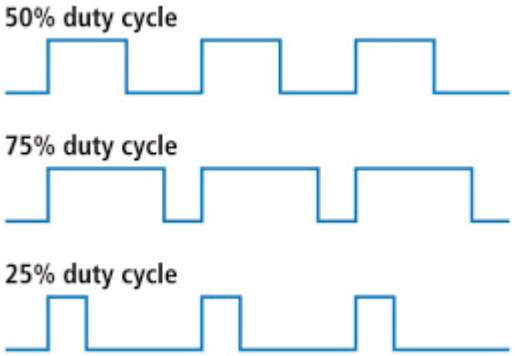
Definitions

Duty cycle: ratio of time that transmitter is on to the total time
(on plus off time)

Protocol: rules that control the method used to exchange data between systems (e.g. AX.25 for packet)

Mode: combination of a protocol with a modulation method

- e.g. PSK31, RTTY, FT4/8, Pactor



CLARIFICATION: *Digital voice modes* are regulated as voice emissions by the FCC. Examples include; D-STAR, Yaesu's System Fusion, AOR's digital voice system, FreeDV, and Motorola's DMR.

Frequency Shift Keying (FSK)

VFO = variable frequency oscillator

Individual bits of data encoded as tones

- As data are transmitted, different tone frequencies are used

The frequencies in a two-tone FSK signal are called mark and space

- Space represents 0, mark represents 1

In “direct” FSK, the frequency of the transmitter’s VFO is controlled by a digital data signal from the computer

Audio FSK (AFSK) – audio tones modulate an SSB or FM transmitter through the mic input

Multiple FSK – more than 2 tones are used to create more codes

Phase Shift Keying (PSK)

Most common type of phase shift is to invert one of the tone waveforms (shifting phase 180°)

Rapid changes in phase can be heard from human ear as a raspy noise of buzz – the signature of PSK signals on the air received by a CW or SSB receivers (sort of like the sound on an old computer modem)

QUESTIONS?

ONLINE EXAM REVIEW AND PRACTICE QUESTIONS:

http://www.arrl.org/examreview