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The following paragraphs describe some Ham digital " chat " modes. High rate digital modes for file transmission as CLOVER, PACTOR I and II or HF Packet are not covered here.

Definitions:

* " ARQ " means " Synchronous transmission and automatic repetition request",

* " FEC " means " Forward error correction ",

* " PSK " means " Phase Shift Keying ", " DBPSK ": " Differential Binary PSK " and " DQPSK ": " Differential Quadrature PSK ",

* " FSK " means " Frequency Shift Keying ",

* " ASK " means " Amplitude Shift Keying ",

* " Coherent " means that the value of the phase of the signal is always known (followed by a PLL. Coherence is compulsory in BPSK but not in DBPSK.

* the ratio S/N is the ratio Signal power to Noise power (defined in a given bandwidth),

* the baud rate is equal to the number of changes of the signal, per second. The speed in bps (bits per second) is equal to the baud rate if it is transmitted one bit at each change of the signal (with a DBPSK modulation, for example). With a DQPSK modulation, the speed in bps would be equal to 2 times the baud rate and so on,

* for determination of speed in wpm (word per minute), a word is, by convention, composed of 6 characters (5 meaningful characters + a space). A character is composed of x bits, with x between 5 bits (32 possibilities) and 8 bits (256 possibilities), in general,
Note: the minimum speed for a " chat mode " is about 20 wpm (depending of the ham). Below 20 wpm, the operator waits for the end of transmission of the character buffer.

* " Varicode " is the opposite of " fixed length code ": as in Morse the character length in bits depends on the occurrence of this character in the literature. It must be noted that the Varicode of PSK31 is not the same as the one of PSKFEC31...,

* all Hellschreiber modes are " Fuzzy " modes. The rules to be " Fuzzy " are:
  - the transmitter uses no coding,
  - the receiver does not decide when data is present,
  - the receiver does not decide what data is present.

These modes are only manually readable. In fact, the hypothesis has been brought foward that human eye/brain character recognition in its context was better than what a computer could do,

Performances:

The following paragraphs describe explicity the performances of digital " chat " modes.

* CW (Morse): the basic digital mode. It's the more common and it may be employed either alone or at the head or in the end of an experimental digital transmission (at 20 wpm, it has the same role as the " Basic English " which is supposed to be understood by everyone). It is very powerful if decoded by a human being but not so good if decoded by a computer,
In VLF (136 kHz), very slow CW modes are used (QRSS and DFCW).
The CCW (coherent CW) is a digital mode using the Morse code, which allows to be efficiently decoded by a computer but also by a human being.

* RTTY Baudot: the oldest (if we except Morse) and not the best...

As a binary FSK signal, this mode is very influenced by the " selective fading " which is an ionospheric multipath effect,

* ASCII: used by Hams at 110 bauds, this mode is still less reliable than RTTY Baudot because its transmission speed is larger but it allows the use of small or accented letters and permits quick QSO.

* AMTOR (SITOR): is an improvement of the RTTY Baudot mode with error-detecting and correcting system. Initially designed for communications between a coast station and a ship (SITOR), it has been adapted to Ham (AMTOR) by Peter Martinez.

* In HF conditions, DBPSK modes as BPSK31, PSK63 or PSK10 are not so good as equivalent FSK modes (except RTTY Baudot) because of the variations of phase due to ionospheric Doppler modulation. However, they are very sensitive in the noise and don't need much bandwidth (energy is concentrated in one peak so a lot of different QSO may exist in the same AF band). That makes a big advantage: they are easy to localize and to tune. A rule is: the lower the baud rate, the better on noise the mode is but more sensitive to Doppler modulation the mode is (in other words, bigger the time of a symbol is and more the Doppler modulation has time to modify phase).
Moreover, if baud rate is too high (>100 bauds), the time overlap between different paths (0 to 5 ms) becomes a big difficulty to separate successive phases.
An exception is the MT63 which is a low baudrate BPSK mode but in 64 tones (and not in only one).

The PSKFEC31, PSKAM10/31/50 modes try to solve this problem by repeating each bit (PSKFEC31) or each character (PSKAM(10)), the probability to have two false bits or characters in the same time being much weaker than the one to have only one false bit or character. PSK63F and PSK125F correct a lot of errors thanks to a powerful convolution code.

It must be noted, however, that comparisons between high rate modes (CLOVER, PACTOR I, PACTOR II, G-TOR, HF PACKET) show that PSK modes (2, 4, 8 or 16PSK) would be far more powerful than FSK modes in good conditions and equivalent under bad conditions.

* DQBPSK as QPSK31 is not so sensitive as DBPSK for QRP QSO, but may lower the number of errors thanks to its convolutional code,

* the FSK modes (MFSK8, 16, THROB and THROBX) are very robust in HF conditions (for a standard QSO, there are less errors than a transmission through a PSK mode) but as they need much transmission band, it's difficult to tune weak signals (energy is not concentrated in only one peak as PSK modes so weak signals are not visible in noise). Code correction and interleaving improve the quality of transmission against transitional burst errors but add a decoding delay...
A special FSK mode, the JT44 is designed for EME (" Earth - Moon - Earth ") paths where extremely weak signal communications are necessary due to the great path losses.
Another special mode in " differential FSK ", the Jason, is more specifically designed for LF band conditions where very low speeds are the rule due to the very weak apparent transmission power.
The new mode Domino, in "differential FSK", can support a very large frequency drift speed (ideal for VHF or old transceivers).

* Hellschreiber modes are, in general, good because the characters recognition is done by the user. The basic mode is the Feld Hell. Nevertheless, the way the characters are presented and transmitted may big differences between these modes. The PSK Hell, and FM Hell modes are very good. For QRPP beacon transmissions, the SlowFeld is ideal.
The Hell-80 is quick (5 characters/sec) and uses a FSK modulation as Fax.
It must be noted that other Hellschreiber modes exist as the FSK Hell, the Duplo Hell, the C/MT Hell, the S/MT Hell etc...

Specifications of many of these modes may be found in the Help section of the program Multipsk, downloadable from the following WEB site: http: //members.aol.com/f6cte/
Moreover, it will be found, yet in the Multipsk Help, many frequencies used by Hams for digital modes.