

Comparisons of various beacon relevant MGMs in the VUSHF range.

Parameter	JT4	JT65	JT9	Opera	PI4	WSPR
Native application	QSOs (microwave)	EME and tropo/iono scatter QSOs	LF-MF QSOs	HF QSOs in combination with web	VUSHF beacons	HF QSOs
Hardware complexity	Difficult	Difficult	Difficult	Easy	Difficult	Difficult
Time synchronized/sensitive	Yes	Yes	Yes	No	Yes	Yes
Message length (characters)	13	13	13	6	8 (or 14 if combined)	6 (+4+2)
Message formatting	Free	Free or formatted	Free or formatted	Formatted	Free or predefined	Formatted
Duration of one message [s]	47	47 (JT65A/B/C) 23 (JT65_2)	119 - 264	31 - 3916	24	111 (WSPR-2) 886 (WSPR-15)
Sensitivity in 2500 Hz bandwidth [dB]  Numbers may not be based on the same way of measuring/calculating the sensitivity, e.g. 100% error free decoding or 50%. Therefore direct comparisons may be difficult.	-23,6	-24 (JT65A/B/C) -21 (JT65_2)	-26 (JT9-1) -29 (JT9-2)	-20 (Op05) -23 (Op1) -26 (Op2) -30 (Op4) -34 (Op8) -37 (Op16) -41 (Op32) -44 (Op64)	-22,2	-28 (WSPR-2) -37 (WSPR-15)
Minimum sequence length incl. CW (12 WPM/60 LPM) and carrier [min]	2	2 (JT65A/B/C) 1 (JT65_2)	4?	1	1	4?
Typical mixed mode sequence	Even min: JT4+Carrier Odd min: CW+Carrier	Even min: JT65A/B/C+Carrier Odd min: CW+Carrier Same: JT65_2+CW+Carrier	Any at all? Even cycle: JT9 Odd cycle: CW+carrier	Opera+CW+Carrier (Op05) Other modes different each minute	PI4+CW+Carrier Identical every minute	Any at all? Even cycle: WSPR Odd cycle: CW+carrier
CW decoder issues	Medium	High	Probably high?	?	Low	Probably high?
General robustness towards path and equipment irregularities	Good	Medium	Poor	Good to impossible	Good	Poor
Robustness towards meteor scatter	Good	Poor	Poor	Good to impossible	Good	Poor

Robustness towards aurora	Unknown	Impossible	Impossible	?	Good	Impossible
Robustness towards rain scatter	Good	Impossible	Impossible	?	Unknown - good?	Impossible
Robustness towards aircraft scatter	Good	?	?	Probably good to impossible?	Good	Good
Robustness towards EME	Good	Good	Impossible	Probably good to impossible?	Unknown - good?	Impossible? (1 QSO?)
Shortest known signal duration decoded [s]	?	?	?	?	11 (via MS)	?
Tuning center frequency [Hz]	1270	1270	1250	1500	800	1500
Fits inside 1 kHz beacon structure, audio freq. span: 550 Hz to 1550 Hz, if CW at 800 Hz	Yes (JT4A to ~F) No (JT4G)	Yes (JT65B, ~2) No (JT65C, ~2)	Yes	Yes	Yes (PI4) No (PI4-80) No (PI4-96) No (PI4-120)	Yes
Tone spacing [Hz]	156 (JT4F) 315 (JT4G)	5 (JT65B, ~2) 11 (JT65C, ~2)	<2	0	234 (PI4) 469 (PI4-80) 563 (PI4-96) 703 (PI4-120)	<2
Bandwidth [Hz]	477 (JT4F) 949 (JT4G)	353 (JT65B) 703 (JT65C) 355 (JT65B2) 705 (JT65C2)	<16	<8	709 (PI4) 1412 (PI4-80) 1694 (PI4-96) 2115 (PI4-120)	<6
Sample rate [Hz]	11025	11025	12000	Unknown	12000	12000
Decoder	WSJT (No decoding in odd min for typical sequences)	WSJT (JT65A/B/C no decoding in odd min for typical sequences)	WSJT (No decoding in typical sequence odd cycle)	Opera	PI-RX	WSPR (No decoding in typical sequence odd cycle)

The robustness is not only related to the protocol but also to the decoder used. Furthermore, is it not unlikely that a certain protocol may work out a few times under optimum conditions - "lucky punch." However, in communications it is all about link probability, i.e. how often will the link be open - is it 1%, 10%, 50%, 90% or 99% of the time etc. There are no free lunches when it comes to sensitivity, speed, flexibility and robustness.

If it is not about evaluating a certain protocol, which may be perfectly legitimate, then the application should come first.