Provisional GNSS synchronised on off keying protocol 'OOK48'

Transmit

Messages are sent one character at a time at a rate of one character per second.

The start of each 1 second timeslot is defined by the GNSS derived 1PPS signal.

Each 1 Second timeslot is divided into 9 equal periods of 1/9th second each.

The first 8 periods are used to send the 4 from 8 coded version of the character.

The 8 bits of the 4 from 8 value are sent MSB first. A one is sent as Key Down. A Zero is sent as Key Up.

The 9th period is sent with Key Up and does not form part of the character. It is to allow the receiver time to decode and display the character. The 9th period can also be shortened or lengthened as needed by the receiver to maintain sync with the 1PPS signal.

Ascii characters from 32 (space) to 95 (_) are mapped to the 70 available 4 from 8 values.

Lower case letters are mapped to their upper case equivalent.

A CR character is used to define the end of the message.

The last 5 of the 4 from 8 values are currently unused but could be used for additional control characters if needed.

Messages are repeated for as long as the transmission lasts. There is no gap between repeats.

Message length is not defined but each message ends with a CR character. This would allow a short message like a report to be repeated rapidly many times. Typical longer lengths would be about 15 to 30 characters taking 15 or 30 seconds to send.

Receive

My experimental system does the following...

Reception of each character starts on the GNS derived 1PPS signal. The ADC DMA sampling is started by this signal.

1024 ADC Samples are repeatedly taken using DMA at a sample rate of 9216 samples per second. Each capture therefore takes 1/9th of a second or one bit period.

As each capture becomes available the following is done
Apply Hanning window.
FFT transform.
Calculate the 512 Bin Magnitudes. Each bin is 9 Hz wide.
Use some of these bins to display the Spectrum and Waterfall.

Search 11 bins either side of the 999Hz bin to find the largest magnitude. This will return the magnitude of the 1KHz tone if it is present or the magnitude of the noise floor if not. Searching 11 bins either side allows for mis-tuning or drifting of up to 100 Hz.

Save this magnitude in an 8 element array for later decoding.

After 8 captures.

Find the mean of the 8 captured magnitudes and use this as a threshold to analyse each of the 8 values. Generate a 1 if above the threshold and a 0 if below to form an 8 bit value.

Convert valid 4 from 8 values back to ASCII and display the character on the screen. If the value is not a valid 4 from 8 value then display a Question Mark.

4 from 8 value to ASCII mapping is shown in the next table.

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4 From 8	Ascii	Char	4 From 8	Ascii	Char
15	13	CR	135	66	B
23	32	Space	139	67	C
27	33	!	141	68	D
29	34	“	142	69	E
30	35	#	147	70	F
39	36	$	149	71	G
43	37	%	150	72	H
45	38	&	153	73	I
46	39	‘	154	74	J
51	40	(	156	75	K
53	41	)	163	76	L
54	42	*	165	77	M
57	43	+	166	78	N
58	44	,	169	79	O
60	45	-	170	80	P
71	46	.	172	81	Q
75	47	/	177	82	R
77	48	0	178	83	S
78	49	1	180	84	T
83	50	2	184	85	U
85	51	3	195	86	V
86	52	4	197	87	W
89	53	5	198	88	X
90	54	6	201	89	Y
92	55	7	202	90	Z
99	56	8	204	91	[
101	57	9	209	92	\
102	58	:	210	93	]
105	59	;	212	94	^
106	60	<	216	95	_
108	61	=	225	Spare	Spare
113	62	>	226	Spare	Spare
114	63	?	228	Spare	Spare
116	64	@	232	Spare	Spare
120	65	A	240	Spare	Spare