VHF/UHF Propagation Indicators

Dave Meier N4MW
3205 Covington Pike
Memphis, TN 38128
901-382-4919

The Memphis area now has amateur propagation beacons on nine bands which are intended to provide good propagation indicators for distant stations. More amateur beacons at the fringes of my station reception capability would be helpful. Until this happens, other propagation indicators can be substituted. This paper identifies potential indicators of terrestrial propagation and ranks them according to useability criteria. The VHF and lower UHF (up to 1300 MHz) spectrum segment will be considered.

To be an ideal indicator, transmitters should be moderate to high power, emissions should be coherent enough for narrow band reception, availability should be continuous and frequencies should be within range of amateur equipment. Suffice it to say that there are no ideal indicators. However, there are some meeting most of the criteria. A table listing potential propagation indicators is provided as a means to qualify and compare typical transmissions within various services. There are likely to be notable exceptions even within services deemed poor sources of propagation indicators.

Amateur service beacon transmitters provide fair indicators. The geographical dispersion could be improved through intelligent placement of additional beacons. At present there is no coordinated effort to enhance the service coverage. Also, amateur beacons are restricted to low power levels. The main advantage is the ease of reception with existing equipment. Frequencies are listed in the ARRL Repeater Directory.

Good propagation indicators exist in several other services, television/FM broadcast and aeronautical radionavigation (TACAN). TV/FM broadcast is easy to receive using native broadband modes. Better results can be obtained using narrow band reception such as with a 3 kHz SSB receiver. FM broadcast bandwidth is very wide but can still be detected in a narrow bandwidth during quiet audio periods. Even better results are obtainable using only the TV video carriers, which are easily receivable over significant distances using narrow band techniques. A table of TV carrier frequencies is provided. Since several different stations are sometimes receivable, a directional antenna is recommended. Without a directional antenna, it can be difficult to determine which direction signals are from until they become sufficiently strong to identify the program audio or video. Stations are listed in the North American Radio TV Station Guide, a Sams publication.

The other good indicator, TACAN, is not as easily received as TV but is better dispersed geographically. TACAN stations are intended for use by aircraft in flight so the transmitting antenna structure is near ground level. This will make it difficult to receive any stations more than a few miles away under flat propagation conditions. This "feature"

makes even close stations useful as indicators. Usually TACAN stations are colocated with VOR/ILS navigational aids, which also have potential use as propagation indicators. TACAN, UHF transmissions used by the military for distance and azimuth determination, uses a wide band pulse (the distance part) type of emission which is also amplitude modulated (the azimuth part). Morse identifiers are transmitted at frequent intervals. Location, channel and identifier letters can be obtained from aeronautical charts, which can be purchased at many airports or obtained free from pilots who regularly purchase updated charts and discard old ones. Two types of charts are particularly desireable, the Sectional and WAC types. Sectional charts are more detailed whereas WAC charts cover a wider geographical area. A table is provided to cross reference TACAN channel numbers or VOR/ILS frequencies to corresponding TACAN frequencies.

Equipment requirements depend on the extent of propagation indicators desired. Existing amateur station equipment is all you need to receive amateur beacons. TV/FM broadcasts are receivable using consumer equipment but with severely limited range under average band conditions. To receive TV video carriers in narrow bandwidths, a converter or receiver is necessary. Suitable receivers are available from Yaesu, ICOM, AOR, Grove and others. A less expensive choice is the Yaesu FRG-9600, which covers 60-905 MHz. Used ICOM R7000 receivers, covering 25-2000 MHz, are often advertised for sale in the Ham Trader Yellow Sheets. ICOM now markets the R7100 receiver, also covering 25-2000 MHz. Thr R7100 has 900 memories, enough to program all the TV video and audio carriers and TACAN channels with room to spare. Many of these receivers also allow connection to a TV monitor for TV picture reception. The R7100 allows wideband AM reception for use with TACAN pulse transmissions. Several years ago (two decades) I used a converted APX-6 transponder for TACAN reception, which still could be a cheap alternative approach. My best reception DX using the APX-6 and a ground plane was 109 miles, which my modern equipment has yet to best.

Antennas are available or can be constructed. Commercial wideband omnidirectional antennas are usually vertically polarized. Newtronics/Hustler DSX , ICOM and Comet all sell discone antennas. Creative designs has two models of VHF log periodic antennas which are intended for horizontal polarization. Common TV antennas are useable within their designed frequency ranges.

I hope that this paper will promote increased activity by encouraging all of us to look beyond the amateur bands for indications of enhanced propagation conditions. We should all do our part to eradicate for the "dead band syndrome". If you can suggest other services or specific signals not covered here as good propagation indicators, please share your discoveries with the rest of us.

Potential Propagation Indicators in the US VHF/UHF Spectrum

Frequency Range (MHz)	Typical Services	Typical Emissions	Radiated Power	Relative Constancy	Indicator Potential
30-50	Commercial/Government	FM	low	intermittent	poor
50-54	Amateur (beacons 50.06-50.08)	CW	low	continuous	fair
54-72	Broadcast	TV	high	continuous	good
72-76	Commercial/Government	FM	low	intermittent	poor
76-88	Broadcast	TV	high	continuous	good
88-108	Broadcast	FM (150 kHz)	low	continuous	good
108-118	Aeronautical navigation	AM	low	continuous	good
118-136	Aeronautical Communication	AM	low	intermittent	poor
136-138	Satellite	FM (50 kHz)	low	intermittent	poor
138-144	Government	FM	low	intermittent	poor
144-148	Amateur (beacons 144.275-144.300)	CW	low	continuous	fair
148-174	Commercial/Government	FM	low	intermittent	poor
174-216	Broadcast	TV	high	continuous	good
216-222	Commercial/Government	FM	low	intermittent	poor
222-225	Amateur (beacons 222.050-222.060)	CW	low	continuous	fair
225-400	Military aeronautical	AM	low	intermittent	poor
400-420	Government	FM	low	intermittent	poor
420-450	Amateur (beacons)	CW	low	intermittent	poor
450-470	Commercial/Government	FM	low	intermittent	poor
470-886	Broadcast	TV	high	continuous	good
886-902	Commercial (trunked/cellular)	FM	low	intermittent	poor
902-928	Amateur (beacons)	CW	low	intermittent	poor
928-962	Broadcast STL	FM (wide)	low	intermittent	poor
962-1215	Aeronautical radionavigation (TACAN)	AM (Pulsed)	moderate	continuous	good
1215-1240	Government	Pulse	low	intermittent	poor
1240-1300	Amateur (beacons)	CW	low	continuous	fair

Notes:
This is not intended to be a comprehensive breakdown of services.
Radiated average power levels are: low = <1000, moderate >1000/<10,000, high >10,000 watts.
Other considerations such as geographical dispersion and frequency reutilization should also be considered.
Generally, good indicators use moderate/high power, are continuous and are well dispersed geographically.
Broadcast station listings are published in book form.
TACAN frequencies can be derived from aeronautical chart data and a frequency table.
Amateur beacons are listed in The ARRL Repeater Directory.

US Television Transmitter Frequencies

Channel	Video	Audio
2	55.250	59.750
3	61.250	65.750
4	67.250	71.750
5	77.250	81.750
6	83.250	87.750
7	175.250	179.750
8	181.250	185.750
9	187.250	191.750
10	193.250	197.750
11	199.250	203.750
12	205.250	209.750
13	211.250	215.750
14	471.250	475.750
15	477.250	481.750
16	483.250	487.750
17	489.250	493.750
18	495.250	499.750
19	501.250	505.750
20	507.250	511.750
21	513.250	517.750
22	519.250	523.750
23	525.250	529.750
24	531.250	535.750
25	537.250	541.750
26	543.250	547.750
27	549.250	553.750
28	555.250	559.750
29	561.250	565.750
30	567.250	571.750
31	573.250	577.750
32	579.250	583.750
33	585.250	589.750
34	591.250	595.750
35	597.250	601.750
36	603.250	607.750
37	609.250	613.750
38	615.250	619.750
39	621.250	625.750
40	627.250	631.750
41	633.250	637.750
42	639.250	643.750

Channel	Video	Audio
43	645.250	649.750
44	651.250	655.750
45	657.250	661.750
46	663.250	667.750
47	669.250	673.750
48	675.250	679.750
49	681.250	685.750
50	687.250	691.750
51	693.250	697.750
52	699.250	703.750
53	705.250	709.750
54	711.250	715.750
55	717.250	721.750
56	723.250	727.750
57	729.250	733.750
58	735.250	739.750
59	741.250	745.750
60	747.250	751.750
61	753.250	757.750
62	759.250	763.750
63	765.250	769.750
64	771.250	775.750
65	777.250	781.750
66	783.250	787.750
67	789.250	793.750
68	795.250	799.750
69	801.250	805.750
70	807.250	811.750
71	813.250	817.750
72	819.250	823.750
73	825.250	829.750
74	831.250	835.750
75	837.250	841.750
76	843.250	847.750
77	849.250	853.750
78	855.250	859.750
79	861.250	865.750
80	867.250	871.750
81	873.250	877.750
82	879.250	883.750
83	885.250	889.750

Notes:
Stations may be staggered plus or minus 10 kHz.
Video frequencies are AM picture carriers, 1.25 MHz inside the channel.
Audio frequencies are FM sound carriers..
Video and audio frequencies are always 4.5 MHz apart in the US.
All channels are 6 MHz wide, including audio sidebands,
picture upper sideband and picture vestigal lower sideband.

TACAN DME Ground Transmitter Frequencies

Use	DME Channel	VOR (MHz)	DME (MHz)
Military	1		962
	2		963
	3		964
	4		965
	5		966
	6		967
	7		968
	8		969
	9		970
	10		971
	11		972
	12		973
	13		974
	14		975
	15		976
	16		977
TVOR	17	108.0	978
ILS	18	108.1	979
TVOR	19	108.2	980
ILS	20	108.3	981
TVOR	21	108.4	982
ILS	22	108.5	983
TVOR	23	108.6	984
ILS	24	108.7	985
TVOR	25	108.8	986
ILS	26	108.9	987
TVOR	27	109.0	988
ILS	28	109.1	989
TVOR	29	109.2	990
ILS	30	109.3	991
TVOR	31	109.4	992
ILS	32	109.5	993
TVOR	33	109.6	994
ILS	34	109.7	995
TVOR	35	109.8	996
ILS	36	109.9	997
TVOR	37	110.0	998
ILS	38	110.1	999
TVOR	39	110.2	1000
ILS	40	110.3	1001
TVOR	41	110.4	1002
ILS	42	110.5	1003

Use	DME Channel	VOR (MHz)	DME (MHz)
TVOR	43	110.6	1004
ILS	44	110.7	1005
TVOR	45	110.8	1006
ILS	46	110.9	1007
TVOR	47	111.0	1008
ILS	48	111.1	1009
TVOR	49	111.2	1010
ILS	50	111.3	1011
TVOR	51	111.4	1012
ILS	52	111.5	1013
TVOR	53	111.6	1014
ILS	54	111.7	1015
TVOR	55	111.8	1016
ILS	56	111.9	1017
HVOR	57	112.0	1018
	58	112.1	1019
	59	112.2	1020
	60	112.3	1021
	61	112.4	1022
	62	112.5	1023
	63	112.6	1024
	64	112.7	1151
	65	112.8	1152
	66	112.9	1153
Military	67		1154
	68		1155
	69		1156
	70		1157
	71		1158
	72		1159
	73		1160
	74		1161
	75		1162
	76		1163
HVOR	77	113.0	1164
	78	113.1	1165
	79	113.2	1166
	80	113.3	1167
	81	113.4	1168
	82	113.5	1169
	83	113.6	1170
	84	113.7	1171

Use	DME Channel	VOR (MHz)	DME (MHz)
HVOR	85	113.8	1172
	86	113.9	1173
	87	114.0	1174
	88	114.1	1175
	89	114.2	1176
	90	114.3	1177
	91	114.4	1178
	92	114.5	1179
	93	114.6	1180
	94	114.7	1181
	95	114.8	1182
	96	114.9	1183
	97	115.0	1184
	98	115.1	1185
	99	115.2	1186
	100	115.3	1187
	101	115.4	1188
	102	115.5	1189
	103	115.6	1190
	104	115.7	1191
	105	115.8	1192
	106	115.9	1193
	107	116.0	1194
	108	116.1	1195
	109	116.2	1196
	110	116.3	1197
	111	116.4	1198
	112	116.5	1199
	113	116.6	1200
	114	116.7	1201
	115	116.8	1202
	116	116.9	1203
	117	117.0	1204
	118	117.1	1205
	119	117.2	1206
	120	117.3	1207
	121	117.4	1208
	122	117.5	1209
	123	117.6	1210
	124	117.7	1211
	125	117.8	1212
	126	117.9	1213

Notes:
TACAN - TACtical Air Navagation
DME - Distance Measuring Equipment
TVOR - Terminal VHF OmniRange
ILS - Instrument Landing System
HVOR - High altitude VHF OmniRange