

- host:udpport* is a host name or address and a UDP port for some application expecting these sentences.
- formats* is one or more letters representing the formats. If none specified, the default is generic and Kenwood.
- | | |
|---|--|
| N | for \$GPWPL - NMEA generic with only location and name. |
| G | for \$PGRMW - Garmin, adds altitude, symbol, and comment to previously named waypoint. |
| M | for \$PMGNWPL - Magellan, more complete for stationary objects. |
| K | for \$PKWDWPL - Kenwood with APRS style symbol but missing comment. |
| A | for !AIVDM - AIS |

For debugging purposes, you can put “-dw” on the command line to display the sentences. Here is an example with the original packet, an explanation, and the resulting waypoints.

```
[0.4] WQ2H-4>4R3V7W,WIDE1-1,WIDE2-1:`c/ 1#C>/`"47}WQ2H Mobile FT2DX 5W
with a rubber duck!_(<0x0d>

MIC-E, normal car (side view), Yaesu FT2D, Special
N 42 36.7700, W 071 19.0400, 0 MPH, course 339, alt 105 ft
WQ2H Mobile FT2DX 5W with a rubber duck!

$GPWPL,4236.7700,N,07119.0400,W,WQ2H-4*35
$PGRMW,WQ2H-4,32.0,00AA,WQ2H Mobile FT2DX 5W with a rubber duck!*4C
$PMGNWPL,4236.7700,N,07119.0400,W,32.0,M,WQ2H-4,WQ2H Mobile FT2DX 5W
with a rubber duck!,a*6C
$PKWDWPL,131356,V,4236.7700,N,07119.0400,W,0.0,339.0,160616,32.0,WQ2H-
4,/*52
```

Look at the comments in the source file `waypoint.c` for an explanation of the sentences.

9.10 Beaconing

Dire Wolf has several configuration commands for setting up periodic transmissions.

- PBEACON - Position Report with fixed location.
- OBEACON - Object Report
- CBEACON - Handcraft your own Custom beacon
- IBEACON - IGate status
- TBEACON - Tracker beacon with GPS location

9.10.1 Position & Object Beacons

Two configuration commands are available for periodic beacons to announce yourself or other things in your region with fixed positions.

- PBEACON - for a “**position report**.” This is generally used for your own location. It has a fixed position. Later we will discuss TBEACON which gets the location from a GPS receiver.
- OBEACON - for an “**object report**.” This is generally used for other entities. For example, you might want to advertise a nearby voice repeaters so travelers can find it easily. The big difference is that the “object report” contains an **object name**, usually different than your radio call.

These have many options so it would be very cumbersome and error prone to have everything in fixed positions. Instead we use **keyword=value** pairs. The available keywords are:

Best practice is to send routine, unchanging, beacons no more than once each 10 minutes.

Keyword	Description	Example values	Comment
DELAY	Time, in minutes or minutes:seconds, to delay before sending first time. This is relative to when Dire Wolf is started. Default is 1 minute.	1 0:30	One minute after Dire Wolf starts. Half minute.
SLOT	Time, in minutes or minutes:seconds, to transmit after the top of the hour. If this is specified, it overrides any DELAY setting.	1:30	90 seconds after the top of the hour.
EVERY	Time, in minutes or minutes:seconds, between transmissions. Default is 10 minutes. Use an extremely long interval (like 1000000 for around two years) here to get a one time transmission.	10 9:45	Ten minutes. 9 $\frac{3}{4}$ minutes
SENDTO	Radio channel for transmission or “IG” to send to Internet Gateway. Default is the first, or only, radio channel 0. “R” followed by a number simulates signal received on that channel.	1 IG R0	Second radio channel. Internet Gateway. Simulated channel 0 reception.
SOURCE	This replaces the AX.25 source address rather than using the MYCALL value for the channel.		
DEST	Explicit destination field for AX.25 packet. Normally you will want the default which identifies the software version.	Don’t use this option unless you understand the protocol and have a good reason.	“SPEECH”, “MORSE”, and “DTMF” are special cases explained later.
VIA	Digipeater path.	WIDE1-1	Upper case only.

	Default none.	WIDE1-1,WIDE2-1	No spaces.
MESSAGING	Set the APRS Messaging attribute for a position report. i.e. Data Type Indicator will be "=" instead of "!"	0 1	Default value. Set attribute.
OBJNAME	Name for object, up to 9 characters. Applies only to OBEACON.	EOC Hamfest	Any printable characters including embedded spaces.
LAT	Latitude in signed decimal degrees (negative for south) or degrees ^ minutes hemisphere.	42.619 42^37.14N	Both examples are equivalent.
LONG	Longitude in signed decimal degrees (negative for west) or degrees ^ minutes hemisphere.	-71.34717 71^20.83W	Both examples are equivalent.
AMBIGUITY <i>or</i> AMBIG	Number of lower digits to omit for position ambiguity. Range 0 to 4. Default 0. Can't be used with compressed format.	0 1 2	07120.83 07120.8 07120.
ZONE	Zone with latitude band for UTM coordinates.	19T	
EASTING	UTM coordinate.	307504	
NORTHING	UTM coordinate.	4721177	
ALTITUDE <i>or</i> ALT	Altitude in meters.	90 35000ft	Put common length unit name immediately after the number for other units.
SYMBOL	Two different styles are available: (a) Exactly two characters specifying symbol table / overlay and the symbol code. (b) A substring of the description.	S# "Jet ski"	More details below.
OVERLAY	A single upper case letter or digit overlay character.	S	
POWER	Transmitter power in watts.	50	
HEIGHT	Antenna height, above average terrain, in feet.	20	
GAIN	Antenna gain in dBi.	6	
DIR	One of 8 directions, N, NE, E, SE, S, SW, W, or NW, for a directional antenna. Default is omni-directional.	NE	
FREQ	Where to contact you by voice or radio frequency for some other entity. MHz.	146.955	
TONE	CTCSS tone required for specified radio frequency. Hz.	74.4	
OFFSET	Transmit offset in MHz.	-0.60	MHz.
COMMENT	Name, location, announcements, etc.		DO NOT put frequency, offset,

			tone here in free form text. Use the FREQ, OFFSET, and TONE options so they are in the proper format.
COMMENTCMD	Run specified command and insert result after the fixed part of comment.	rxR_ 'J>+! ()	Original intention was to insert base 91 compressed telemetry.
COMPRESS	Use 1 for compressed format. Note that power/height/gain gets converted to single radio range value in the compressed format. This is not MIC-E format.	0 1	Human readable. Compressed.

Note: Entire configuration item must be on a single line. Some of the examples, below, are on multiple lines due to page width limitation.

Any values containing spaces must be surrounded by quotation marks.

Example: Typical home station. The ASCII character set does not contain the degree symbol so we use ^ instead to separate degrees and minutes. If no symbol is given, it defaults to house. All three of these are different ways to represent the same location.

```
PBEACON LAT=42^37.14N LONG=71^20.83W
PBEACON LAT=42.619      LONG=-71.34717
PBEACON zone=19T easting=307504 northing=4721177
```

The included coordinate conversion utilities can be used to convert one form to the other. In the following examples, the first line is the command you type. The second line is the response.

```
$ IIutm 42.619 -71.34717
UTM zone = 19, hemisphere = N, easting = 307504, northing = 4721177
MGRS = 19TCH12 19TCH0721 19TCH075212 19TCH07502118 19TCH0750421177
USNG = 19TCH02 19TCH0621 19TCH075211 19TCH07502117 19TCH0750321177
```

```
$ utm2II 19T 307504 4721177
from UTM, latitude = 42.618996, longitude = -71.347166
```

Proportional Pathing is a technique to make your information available more frequently, locally, where it would be of greater value, and less often at a longer distance. In this example a Position Report is sent every 10 minutes. Once every 20 minutes, WIDE1-1 is added to the digipeater path. Once every 40 minutes, it is even longer with WIDE2-1 too.

<http://www.aprs.org/newN/ProportionalPathing.txt>

```
PBEACON DELAY=1 EVERY=40 LAT=42^37.14N LONG=71^20.83W
PBEACON DELAY=11 EVERY=40 VIA=WIDE1-1 LAT=42^37.14N LONG=71^20.83W
PBEACON DELAY=21 EVERY=40 LAT=42^37.14N LONG=71^20.83W
PBEACON DELAY=31 EVERY=40 VIA=WIDE1-1,WIDE2-1 LAT=42^37.14N LONG=71^20.83W
```

Suppose you had 6 GPS location trackers which you wanted to report once a minute. Transmit collisions are likely if they all send at random times. You can avoid collisions by assigning each a particular time slot. For example, the first will transmit exactly on the hour. The second, 10 seconds later. The third, 10 seconds after that, and so on. The sequence repeats after a minute.

<i>Tracker 1:</i>	TBEACON SLOT=0:00 EVERY=1:00
<i>Tracker 2:</i>	TBEACON SLOT=0:10 EVERY=1:00
<i>Tracker 3:</i>	TBEACON SLOT=0:20 EVERY=1:00
<i>Tracker 4:</i>	TBEACON SLOT=0:30 EVERY=1:00
<i>Tracker 5:</i>	TBEACON SLOT=0:40 EVERY=1:00
<i>Tracker 6:</i>	TBEACON SLOT=0:50 EVERY=1:00

Of course, correct operation depends on the system clock being accurate. If a Linux or Windows machine has Internet access, it should set its clock automatically using the Network Time Protocol (NTP). If you happened to be using a Raspberry Pi, as a Tracker, the clock can be set from the GPS receiver. The NTP daemon is configured to obtain time information from the GPS daemon (GPSD). This is explained in the Raspberry Pi APRS Tracker document.

Time Slotting is only useful if you have a large number of coordinated devices beaconing rapidly. There is no point in using it with a single system.

The easy way to specify a symbol is with a substring of the description. Examples:

```
PBEACON LAT=42^37.14N LONG=71^20.83W SYMBOL="Jet Ski"
PBEACON LAT=42^37.14N LONG=71^20.83W SYMBOL="digi" OVERLAY=S
```

A list of all symbols available can be printed by running direwolf with the “-S” (upper case S) command line option.

For more precise control, you can specify exactly two characters with a particular pattern. The first character indicates:

/	= primary symbol table
\	= alternate symbol table
A-Z 0-9	= alternate symbol table with specified overlay.

These two are equivalent:

```
PBEACON LAT=42^37.14N LONG=71^20.83W SYMBOL=\# OVERLAY=S
PBEACON LAT=42^37.14N LONG=71^20.83W SYMBOL=S#
```

Object reports are normally used to report something other than yourself.

To advertise a voice repeater in your neighborhood, use something like:

```
OBEACON OBJNAME=WB1GOF LAT=42^34.61N LONG=71^26.47W SYMBOL=/r
FREQ=146.955 OFFSET=-0.600 TONE=74.4 COMMENT="www.wb1gof.org"
```

Remember it must be a single line in the configuration file even though it is two lines on this page. Note how “/r” was used to get the repeater symbol. If you used “SYMBOL=repeater”, it would end up matching the “Mic-E Repeater” description and the symbol code would come out as “/m.”

```
$ direwolf -S | grep -i repeater
/m      LM      77  AB177  Mic-E Repeater
/r      LR      82  AB182  Repeater
I0      AOI     AB0164C IRLP repeater (I0)
```

Sometimes you will want to mention that you are listening to some voice frequency. It is important to use the FREQ, OFFSET, and TONE options as shown so everything is in the standardized format. Some radios, such as the TM-D710 or FTM-350, have a “tune” or “qsy” button which will set the radio’s frequency/offset/tone from a properly formatted object report.

The transmit offset often causes confusion. When it appears in the packet, it is in units of 10 kHz. “500” means 5 MHz. “060” means 600 kHz. A complete description can be found here:

<http://www.aprs.org/info/freqspec.txt>

Newcomers, who don’t take the time to research recommended practices, will just stick all of this in free-form text in the comment. It is easily read by a human but computer applications probably won’t be able to extract the information because it is not in the standard format.

<http://aprs.org/localinfo.html> recommends using the frequency as part of the object name. For example a voice repeater might be:

```
OBEACON OBJNAME=146.955ma LAT=42^34.61N LONG=71^26.47W SYMBOL=/r
FREQ=146.955 OFFSET=-0.600 TONE=74.4 COMMENT="www.wb1gof.org"
```

You must use something unique in the last two character positions to avoid name collisions. Specifying the frequency might seem redundant, because it is implied by the object name, but I don’t know if any radios or other APRS applications will extract the frequency from the object name. If we search aprs.fi for “146.955*” we find several repeaters using this convention, with varying levels of compliance.

Search results for 146.955*			
Found 6 targets:			
Show selected			
callsign	age	comment	
<input type="checkbox"/> 146.955-	 2m20s	T000 R40m NET730Sun	
<input type="checkbox"/> 146.955	 19m58s	T088 http://smrs.us	
<input type="checkbox"/> 146.955R	 14m59s	TOff R30m Net Th8pm Mg3rdMo	
<input type="checkbox"/> 146.955IN	 21s	W9SMJ/R T131.8 Galveston	
<input type="checkbox"/>	 46d 15h25m - 141.3 W0WX System Fusion		
<input type="checkbox"/> 146.955MN	 138d 31m	PL 156.7. RF linked to the 147.225 repeater for nets and wx actions.	
Show selected			

The “-“ suffix on the first name was probably meant to mean negative transmit offset. Wrong. The “-“ at the beginning of the 5th comment was probably another attempt at the same thing. Wrong again. As mentioned earlier the offset should be “-060”.

The first three have the PL tone in the proper format. The last three have the PL tone in the wrong format. It should be “T” with the three digit integer part of the tone frequency. The decimal part can be found in the table of standard values. “Toff” can be used to mean none.

Here is one possible way to send messages through the International Space Station. It is similar to “UNPROTO CQ VIA ARISS” on some other TNCs.

```
PBEACON delay=00:01 every=00:30 symbol="/" lat=32^39.30N long=097^23.06W
comment="Hello from Texas, sutton.matthew@gmail.com" via=ARISS
dest=CQ messaging=1
```

Send a weather report with position:

1. Some other application periodically creates a file, called wxnow.txt, in the standard format. (See <http://wiki.sandaysoft.com/a/Wxnow.txt>) This is the same format used in the APRS weather report packet.
2. Configure a position beacon which inserts the last line, from the file, into the comment field. In this particular case, it is very important that you don’t use COMMENT, POWER, HEIGHT, GAIN, FREQ, OFFSET, or any other options that would put anything else in the comment part. The weather report needs to be in a very specific format.

Linux version:

```
PBEACON LAT=42^37.14N LONG=71^20.83W SYMBOL="weather station"
COMMENTCMD="tail -1 wxnow.txt"
```

Windows version:

```
PBEACON LAT=42^37.14N LONG=71^20.83W SYMBOL="weather station"
COMMENTCMD="powershell -command get-content wxnow.txt -tail 1"
```

The result would be:

```
WB2OSZ-15>APDW15:!4237.14N/07120.83W_272/010g006t069r010p030P020h61b10150
```

As a sanity check, we run it through the **decode_aprs** utility.

```
$ echo 'WB2OSZ-15>APDW15:!4237.14N/07120.83W_272/010g006t069r010p030P020h61b10150' | decode_aprs
WB2OSZ-15>APDW15:!4237.14N/07120.83W_272/010g006t069r010p030P020h61b10150
Weather Report, WEATHER Station (blue), DireWolf, WB2OSZ
N 42 37.1400, W 071 20.8300
wind 11.5 mph, direction 272, gust 6, temperature 69, rain 0.10 in last hour, rain 0.30
in last 24 hours, rain 0.20 since midnight, humidity 61, barometer 29.98, ""
```

See separate document **Weather-Station.pdf** for more information about sending Weather Reports.

The **symbols-new.txt** file is still evolving. You can download the latest from
<http://www.aprs.org/symbols/symbols-new.txt>

9.10.2 Custom Beacon

For unusual situations, or if you enjoy composing obscure APRS packets by hand, the custom beacon type is available.

The timing, transmission channel, and digipeater via path are the same as for the position and object beacons. The difference is that you can put anything you want in the information part. The first character of the information part is the data type indicator.

Keyword	Description	Example values	Comment
DELAY	Time, in minutes or minutes:seconds, to delay before sending first time. Default is 1 minute.	1 0:30	One minute. Half minute.
SLOT	Time, in minutes or minutes:seconds, to transmit after the top of the hour. If this is specified, it overrides any DELAY setting.	1:30	90 seconds after the top of the hour.
EVERY	Time, in minutes or minutes:seconds, between transmissions. Default is 10 minutes.	10 9:45	Ten minutes. 9 ¾ minutes

SENDTO	Radio channel for transmission or “IG” to send to Internet Gateway. Default is the first, or only, radio channel 0. “R” followed by a number simulates signal received on that channel.	1 IG R0	Second radio channel. Internet Gateway. Simulated channel 0 reception.
SOURCE	This replaces the AX.25 source address rather than using the MYCALL value for the channel. This is useful for sending more than 5 telemetry values. Use a different station id for each set of 5 analog values.		
DEST	Explicit destination field for AX.25 packet. Normally you will want the default which identifies the software version.	Don’t use this option unless you understand the protocol and have a good reason.	“SPEECH”, “MORSE”, and “DTMF” are special cases explained later.
VIA	Digipeater path. Default none.	WIDE1-1 WIDE1-1,WIDE2-1	Upper case only. No spaces.
INFO	Handcrafted “information” part for packet. This is a constant value. This option is applicable only to CBEACON which allows you to put whatever you want in the Information part.		
INFOCMD	Command to generate “information” part for packet. This allows each to be different as determined by a user-supplied script. This option is applicable only to CBEACON which allows you to put whatever you want in the Information part.		

A couple examples:

```
CBEACON dest=SPEECH info="Club meeting tonight at 7 pm."  

CBEACON info="!4237.14NS07120.83W#PHG7140Raspberry Pi digipeater"  

CBEACON infocmd="/bin/date +'The current time is %T'"
```

Note: INFO and INFOCMD provide the contents for the entire Information field. It would not make sense to use these with other beacon types which construct the Information field. If you want to insert something extra into them, use COMMENT or COMMENTCMD.

See “APRS Telemetry Toolkit” documentation for more examples for COMMENTCMD and INFOCMD.

9.10.3 IGate Status Beacon

IGate stations will often send occasional status reports with statistics. It doesn't make sense to use this if the IGate feature has not been configured.

The timing, transmission channel, and digipeater via path are the same as for the other types of beacons already described. Any other options, not listed below, will be ignored.

Keyword	Description	Example values	Comment
DELAY	Time, in minutes or minutes:seconds, to delay before sending first time. Default is 1 minute.	1 0:30	One minute. Half minute.
SLOT	Time, in minutes or minutes:seconds, to transmit after the top of the hour. If this is specified, it overrides any DELAY setting.	1:30	90 seconds after the top of the hour.
EVERY	Time, in minutes or minutes:seconds, between transmissions. Default is 10 minutes.	10 9:45	Ten minutes. 9 ¾ minutes
SENDTO	Radio channel for transmission or "IG" to send to Internet Gateway. Default is the first, or only, radio channel 0. "R" followed by a number simulates signal received on that channel.	1 IG R0	Second radio channel. Internet Gateway. Simulated channel 0 reception.
SOURCE	This replaces the AX.25 source address rather than using the MYCALL value for the channel.		
DEST	Explicit destination field for AX.25 packet. Normally you will want the default which identifies the software version.	Don't use this option unless you understand the protocol and have a good reason.	"SPEECH", "MORSE", and "DTMF" are special cases explained later.
VIA	Digipeater path. Default none.	WIDE1-1 WIDE1-1,WIDE2-1	Upper case only. No spaces.

A couple examples, to send over radio:

```
IBEACON
IBEACON DELAY=30 EVERY=30 VIA=WIDE1-1
```

You might want to send this directly to the APRS-IS server rather than over the radio. Use the SENDTO option like this:

```
IBEACON SENDTO=IG
```

You might want to simply display the statistics locally and not send them to anyone else. This can be accomplished with:

```
IBEACON SENDTO=R0 VIA=NOGATE
```

This simulates reception on radio channel 0. This option was originally added for testing how particular packets would be handled without actually sending them over the air. The beacon content will be processed as if it had been heard over the radio. It will be displayed on the screen and captured in a log file if configured. Putting NOGATE in the via path will prevent the IGate from passing this packet along to the APRS-IS server.

The information part of the packet will look something like this:

```
<IGATE,MSG_CNT=2,PKT_CNT=0,DIR_CNT=10,LOC_CNT=35,RF_CNT=45,UPL_CNT=122,DNL_CNT=456
```

It contains several identifier / value pairs.

MSG_CNT	Number of APRS “messages” from the Internet Server which have been transmitted over the radio.
PKT_CNT	Number of other (non-message) packets from the Internet Server which have been transmitted.
DIR_CNT	Number of stations heard directly (without going through any digipeaters) during the past 30 minutes.
LOC_CNT	Number of “local” stations which IS-to-RF packets are expected to reach. This is based on the via path specified for IGate transmission. For example, if the path was WIDE2-2, packets could travel up to 2 digipeater hops. LOC_CNT is the number of stations heard with this number of used digipeater addresses or fewer.
RF_CNT	Number of stations heard in the past 30 minutes regardless of the number of digipeater hops along the way.
UPL_CNT	Number of packets which have been uploaded to the Internet Server. Most of them probably came from the radio but it is also possible to generate beacons and send them to the Server rather than transmitting them. (i.e. “SENDTO=IG” option)
DNL_CNT	Number of packets which have been downloaded from the Internet Server. The number actually transmitted (sum of MSG_CNT + PKT_CNT) can be lower due to filtering and transmit rate limiting.

MSG_CNT and LOC_CNT are from the original APRS specification.

PKT_CNT, DIR_CNT, and RF_CNT followed precedent set by APRSISCE32.

UPL_CNT and DNL_CNT are unique to this software.

9.10.4 Tracker Beacon

Information from a GPS receiver can be used to report the location of a moving entity.

First you must use either the **GPSNMEA** (all platforms) or **GPSD** (Linux only) configuration items to establish communication with the GPS receiver.

The Tracker Beacon (**TBEACON**) command has the same options as the Position Report Beacon (**PBEACON**), above, except latitude, longitude, course, and speed are obtained from the GPS receiver. If you specify **ALTITUDE** greater than 0, the actual altitude will be taken from the GPS location.

Example: Driving around in a car.

```
TBEACON DELAY=0:30 EVERY=2:00 VIA=WIDE1-1 SYMBOL=car
```

This will wait 30 seconds then transmit once every 2 minutes after that.

In this case, the **FREQ** options can be used to indicate that you are listening to a certain voice channel.

```
TBEACON SYMBOL=car FREQ=146.955 OFFSET=-0.600 TONE=74.4
```

Some APRS-equipped radios have a TUNE button which will set the voice frequency to the frequency specified in a packet. This feature will not work if the frequency is not in the proper format.

9.10.5 SmartBeaconing™

A fixed transmission schedule might not be ideal. If you are moving quickly, you might want to send position updates more quickly. If sitting still, there is no reason to transmit very often. Sending redundant information over and over just clutters up the radio channel. A display application which tries to calculate the current position from the last known location and “dead reckoning” is thrown way off when there is a change of direction.

SmartBeaconing™ adjusts the timing based on speed and changes in direction. It's the same technique used by Kenwood, Yaesu/Standard, and in many other applications. These 3 examples are all equivalent. In the first example, reasonable defaults are supplied for use in a land vehicle. In other two, all parameters are specified.

```
SMARTBEACONING
SMARTBEACONING 60 1:30      5 30        0:10 30 255
SMARTBEACONING 60 0:90      5 0:1800    0:10 30 255
```

Remember that a beacon time of just a number is interpreted as minutes. So if you want 1800 seconds, be sure to write it as “0:1800”.

What do the numbers mean?

- Fast Speed & Fast Rate -- For speeds above 60 MPH, a beacon will be sent every 1 ½ minutes.