**Quick Start for Fldigi and the NBEMS**
**Emergency Communications Suite**
KB1TCE Rev 30 October 2012

**Purpose**

This document covers the software and hardware required for using the Fldigi suite of software for amateur radio communications. The emphasis is on emergency communications with the core suite of programs: Fldigi, Flwrap and Flmsg. This is not an exhaustive discourse on the NBEMS software. Links are provided for more in-depth information.

**Overview**

The Narrow Band Emergency Messaging System (NBEMS) is designed as a live operator "1 to many" communications system. The programs are all developed by a group of ham programmers led by Dave Freese, W1HKJ. All of the programs and documentation are available at http://w1hkj.com. Windows, Mac and Linux are all supported. His site also has extensive help files.

A brief description of the NBEMS components follows:

**Fldigi** is the modem program and is used for keyboard to keyboard communications using a wide variety of modes including the popular PSK31 plus RTTY, DominoEX, MT63, Olivia, MFSK, Hell, Contestia, Robust PSK (PSKR) and others. Fldigi may be used for casual operating or, with several complementary applications, it may be used for "serious" emergency communications. For NBEMS, Fldigi is used with the following applications:

- **Flwrap** is a program that is used to apply a checksum and optionally compress messages and files for transmission by Fldigi. The checksum is used to confirm the accuracy of the transmitted message. Received messages are automatically saved to a file directory along with a timestamp.

- **Flmsg** is a complete message composition system that includes canned ICS and Radiogram forms along with generic and blank forms. It includes the Flwrap checksum functionality and can be used to transmit spreadsheets in .csv (comma delimited) format. As with Flwrap, incoming messages are automatically saved to a file directory. The option exists to automatically open the file in the Flmsg form window and/or in printer ready html format in your browser window. Flmsg's functionality has increased so substantially that it has pretty much obsoleted Flwrap.

- **Flamp** is a new application that is in testing. Flamp is a program for AMP or Amateur Multicast Protocol. An Flamp session will transmit one or more files with one or more iterations of the transmission. Each file is broken into blocks, each of which has a checksum. The receiving station saves the blocks that pass checksum.

Successive transmissions will fill in the missing blocks provided that the new blocks pass the check sum. After the transmission sequence, the entire file is assembled and may be saved. This document will not cover Flamp – there is a separate quick start for that application.

There are a number of other applications in the suite such as Flrig (a rig control program), Flarq (an ARQ peer to peer message program) and others. These will not be discussed here.

**Hardware Set Up**

The basic equipment requirements include a frequency stable HF SSB radio, computer (XP or later, Linux or Mac-OS) and a suitable audio interface from radio to computer. This document will cover the Tigertronics SignaLink although other interfaces are entirely suitable.

Fldigi is a modem program. The primary purpose of Fldigi is to convert ASCII text into tones that can then be transmitted using a standard SSB transmitter. At the receiving end, Fldigi converts those tones back into readable text.

The SignaLink USB contains its own sound card and interfaces to the PC with a USB cable. Each SignaLink has to be set up for the particular radio you are using. This involves the selection of the radio cable and the setting of some internal jumpers. Radio specific information is available at http://www.tigertronics.com/sl_wire.htm. Each SignaLink comes with detailed set up instructions.

**Software Installation**

- Go to http://www.w1hkj.com/download.html
- Download Fldigi/Flarq (they come together), Flwrap, Flmsg and Flamp. These programs are written for Linux, Windows (XP and later) and Mac OS. This document will use the Windows version for examples.
- When you begin the download you can select "Run" or "Save." Select "Run" and the software will install with its defaults. You can deselect Flarq when installing Fldigi unless you have a specific reason to use it.

For desktop housekeeping, make up a desktop folder and put shortcuts for the above into that folder. This keeps all of the NBEMS icons in one place.

**Configure Fldigi**

- Upon install you should get a screen in which to enter your personal data (call sign, name, QTH, grid locator). If you skip this on install you can do it later. Open Fldigi, go to Configure-Operator and enter your information. Click "Save" and "Close." Set your sound card information. With a SignaLink you will use the SignaLink's internal soundcard. On the Fldigi screen go to the Configure – Sound Card – Devices tab and under "Port Audio" select "USB Audio CODEC." Now click the Settings tab and

click the drop down box for both capture and playback and select the sample rate that has the word "native" next to it. Click "Save," then "Close."

- On the Fldigi screen go to Configure – Misc – NBEMS and check "Enable NBEMS data file interface, Open message folder, Open with flmsg. Then click Browse and locate your flmsg.exe file. The path should look like C:\Program Files\flmsg-1.1.23\flmsg.exe. Click "Save" and then "Close." This step will save Flwrap and Flmsg files when received and will also open the Flmsg form when a message in that format comes in.

- On the Fldigi screen go to Configure – Modems – MT63 Tab and check "64-bit (long) interleave" and "8-bit extended characters." Also ensure that "Transmit lower start tone" and "Transmit upper start tone" are selected. The tone duration should be 4 seconds (default). Click "Save," then "Close."

- On the Fldigi screen go to Configure – Waterfall – Display Tab and select "Always show audio frequencies." Click "Save," then "Close."

**The Fldigi Screen**

Below is a screen capture for Fldigi version 1.23.51.
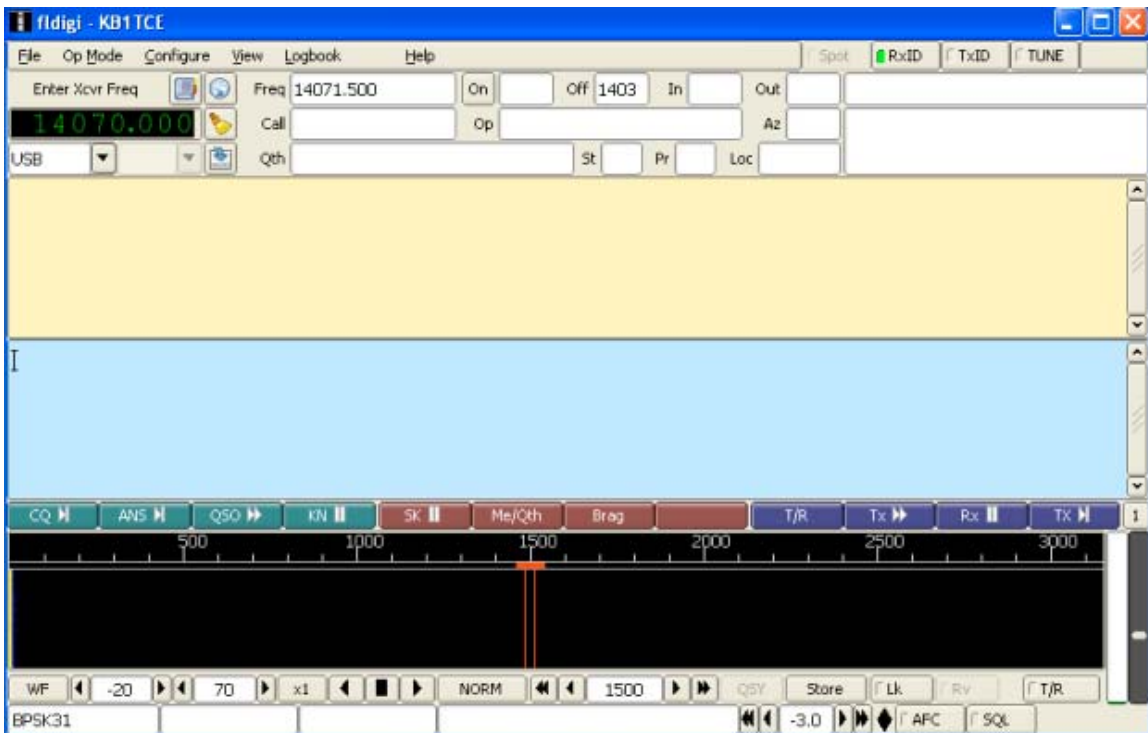
There are far more features than can be covered in this Quick Start. That's what the manual is for. Key points include:

- The beige area is where received text appears.
- The blue area is where text to be transmitted is placed. Some files (e.g. Flwrap) files can be "dragged and dropped" into this area.
- The line of buttons below the transmit panel are macros. These are canned messages that can be used to call CQ, etc. There are four banks of them and all may be customized.
- Below the macros is the waterfall. This shows the digital signals across the 3 kHz radio audio passband. The left edge is the frequency at the radio's dial setting.  The red lines in the waterfall mark the width of the selected mode, in this case, PSK31. A left mouse-click will move these markers anywhere along the waterfall. What is shown is a waterfall center frequency of 1500 Hz. The center frequency is also noted in the box just below the waterfall. The cursor may be moved up or down using the arrows on either side of the center frequency box.
- Fldigi will recognize modes if the RxID box at the top is checked and if the transmitting station is sending a TxID.
- For HF reception, the Squelch (lower right) is left disabled. Generally the AFC feature can also be left disabled.

You will undoubtedly want to customize at least some of the macros. PSK31 users seem to like the macros as they are good for making and verifying lots of contacts without having to do much typing. For more conversational QSOs, I prefer to mostly type the messages in the transmit pane. How to edit and create macros is covered in the Fldigi Help document.

**Soundcard Calibration**

You should calibrate your soundcard. This process corrects for errors in your card's sample rate. There is a very complete procedure at http://www.pa-sitrep.com/NBEMS/fldigi_calibration.htm. There is a companion YouTube video at https://www.youtube.com/watch?v=-1wZ7uIA-Qs.

**Transmit Level Setting**

You must avoid overdriving your radio. For the typical 100 watt PEP SSB rig, begin by setting your power to output the full 100 watts. Then, while monitoring your ALC, with the transmitter connected to a dummy load and with the SignaLink TX level set to minimum, click the "Tune" button at the top right of the Fldigi screen. Increase your TX level until you just see some ALC indication. Then back off a bit. Your power output should be about 50 watts or somewhat less.

You can operate at lower power by reducing the TX level but do not go higher as ALC compression will begin to act and your signal will become distorted and splatter.

**Let's Use It**

The easiest way to get familiar with digital reception is to monitor an active "watering hole" on the HF bands. The PSK31 (actually BPSK31) mode has a large following and can be monitored around the clock on the standard frequencies. (Note: these are not "official" frequencies, there can be changes over time.)

80 meters 3.580 MHz
40 meters 7.070 MHz
30 meters 10.142 MHz
20 meters 14.070 MHz
17 meters 18.100 MHz

Tune to one of these frequencies with the receiver in USB mode (virtually all digital transmissions are in USB mode, even on the lower frequency bands). Set Fldigi's operating mode to BPSK31 using Op Mode – BPSK – BPSK31. If the band is not dead you should see something like the capture shown below.
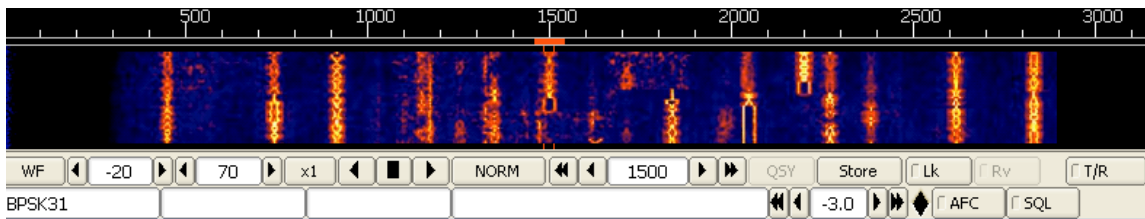


Each of the tracks is a PSK31 signal. If you click on any signal you should see the signal decoded on the receive panel. You may need to adjust your radio or PC's audio level to get an adequate signal on the waterfall. (PSK31 images courtesy of G4UCJ.)

PSK31 operators range from careful to sloppy and monitoring PSK31 is a good way to tell a clean signal from one from a station that hasn't done a proper set up. One of the most common problems is overdriving. This causes splattering of the signal as shown below.
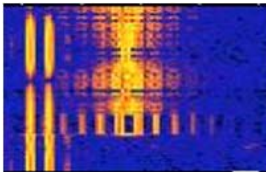


A drifting transmitter (or receiver) is shown by a slanted trace:
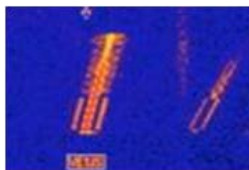
On your receive panel you will also see a lot of random characters, also known as "diddle." These are produced by the background noise that is received along with the signals.

Careful monitoring of PSK31 QSOs will tell you a lot about good and bad digital operating practice and etiquette. While you are monitoring signals, keep the Fldigi Help manual open so that you can explore the other features of the Fldigi program. Be sure to write down your audio control settings so that you can reproduce them later.

Once you are comfortable with the software and the operating procedure, try to make some contacts by either calling CQ or by replying to someone's CQ. Don't hesitate to say you are new at this.

For keyboarding, simply type your text in the transmit panel. It is good practice to put a carriage return above your first line of text. This separates your text from any previous text or diddle. If you are a reasonably fast typist, just type a few words and then hit the "TX" button and continue typing. This reduces "dead air" time. Be sure to place the "RX" command (looks like ^r) at the end of your text. This turns the transmitter off and returns you to receive mode.

**Modes and More Modes**

Fldigi has a menu that consists of dozens of modes. Each mode has its strengths, weaknesses and adherents (and detractors). What it comes down to can be summarized as follows:

- Bandwidth of the signal
- Speed (words per minute)
- Error correction – none, some, lots
- Compatibility with operating frequency and mode: HF SSB, VHF/UHF FM or SSB
- Suitability for prevailing signal-to-noise conditions, multipath effects, etc.
- Applicability to specific tasks such as keyboarding, file transfers, etc.

The following table shows some popular modes with an emphasis on modes that are useful for emergency communications.

| Mode | Baud | WPM | BW (Hz) | S/N | Error Correction | Use |
|---|---|---|---|---|---|---|
| PSK31 | 31.25 | 50 | 31 | | No | Casual Keyboard |
| PSK125R | 125 | 110 | 125 | | Yes | Keyboard |
| | | | | | | |
| CONTESTIA-4-250 | 62.5 | 40 | 250 | -10 dB | Yes | Keyboard |
| CONTESTIA-8-250 | 31.25 | 30 | 250 | -13 dB | Yes | Keyboard |
| CONTESTIA-4-500 | 125 | 78 | 500 | -8 dB | Yes | Keyboard |
| | | | | | | |
| MT63-500 | 5 | 50 | 500 | -8 dB | Yes | File Transfer |
| MT63-1000 | 10 | 100 | 1000 | -5 dB | Yes | File Transfer |
| MT63-2000 | 20 | 200 | 2000 | -2 dB | Yes | FM File Transfer |
| | | | | | | |
| OLIVIA-8-250 | 31 | 15 | 250 | -14 dB | Yes | Keyboard |
| OLIVIA-4-500 | 125 | 40 | 500 | -10 dB | Yes | Keyboard |
| OLIVIA-8-500 | 63 | 30 | 500 | -11 dB | Yes | Keyboard |
| OLIVIA-16-500 | 31 | 20 | 500 | -13 dB | Yes | Keyboard |

The baud is a somewhat antiquated term but the FCC says that we can't exceed 300 baud on HF. Other than the legal issue, the more important parameter is the words per minute. HF typing speeds are fairly low. WPM has to be balanced with bandwidth. Preferably we should stay at or below 500 Hz on HF but brief file transfers at 1000 Hz are ok provided that the frequency is clear.

A very important characteristic is the s/n ratio where the digital transmission can be successfully decoded. Some modes like Contestia 8-250 and Olivia 8-250 perform well way below the noise floor. In fact, you can often be receiving perfect text even though the signal is virtually inaudible.

Some modes have forward error correction (FEC). This means that the signal has some amount of redundancy built in. As a result, pieces of the signal can be lost (fading, static crash, etc.) but the message will be received intact. While no s/n figure is shown for PSK31, it will work at low s/n ratios. The problem is that the lack of error correction makes for many missing or erroneous characters. MT63 has a huge amount of error correction and is very good for sending files.

Excellent descriptions of the various modes are in "Digital Modes – Sights and Sounds" at http://www.w1hkj.com/FldigiHelp-3.21/Modes/index.htm.

**The Flwrap Utility**

As noted before, Flwrap "encapsulates" a text file and applies a checksum. Fldigi at the receiving station will recognize the header and will automatically place the received file in a folder at C:\Documents & Settings\UserName\NBEMS.files\WRAP\recv. The file will have a date/time stamp and the extension .txt.wrap.

To create a Wrap file you first must produce a plaintext file using Wordpad. Do not use formatted text or a program like MS Word. The formatting significantly increases the file size for no useful purpose.

Once the file has been created (example, fox.txt) you may proceed in either of two ways: Grab the file icon with your mouse and pass it over the Flwrap shortcut icon. You will see a message stating that your file was wrapped successfully and a new file fox.txt.wrap will appear.
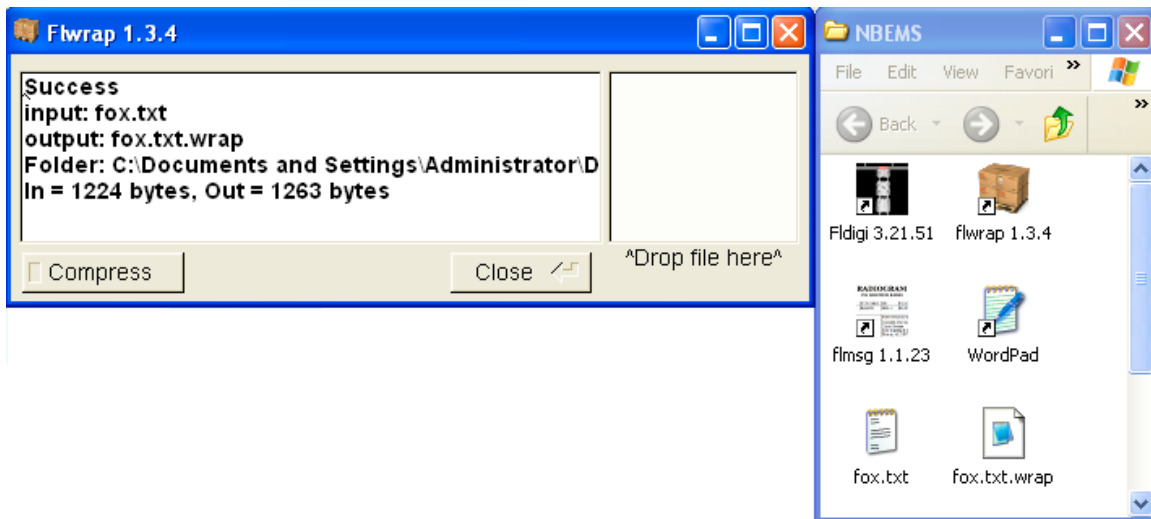


You can also double click on the Flwrap icon to open the dialog box and then drag the text file into the "Drop file here" box.

The dialog states that the file was successfully wrapped and gives the original and new file sizes.

You can also compress a file. For larger files (over about 3k) this will shrink the file size. It also renders the file more difficult to monitor by casual eavesdroppers.

Now, all you have to do is drag the wrap file into your Fldigi transmit window, put a "RX" tag at the end of the file and hit the "TX" button.

On the receiving station's Receive panel the file (fox.txt) will look like:

[WRAP:beg][WRAP:crlf][WRAP:fn fox.txt] (body of file) [WRAP:chksum A96A][WRAP:end]

The bracketed items indicate the beginning of the Wrap file, a line feed, the checksum (A96A for this file) an the end of the Wrap file.

Fldigi will automatically open the recv folder when a Wrap file comes in – you don't have to go looking for it. The screen capture below shows how you go about reading (extracting) the file.
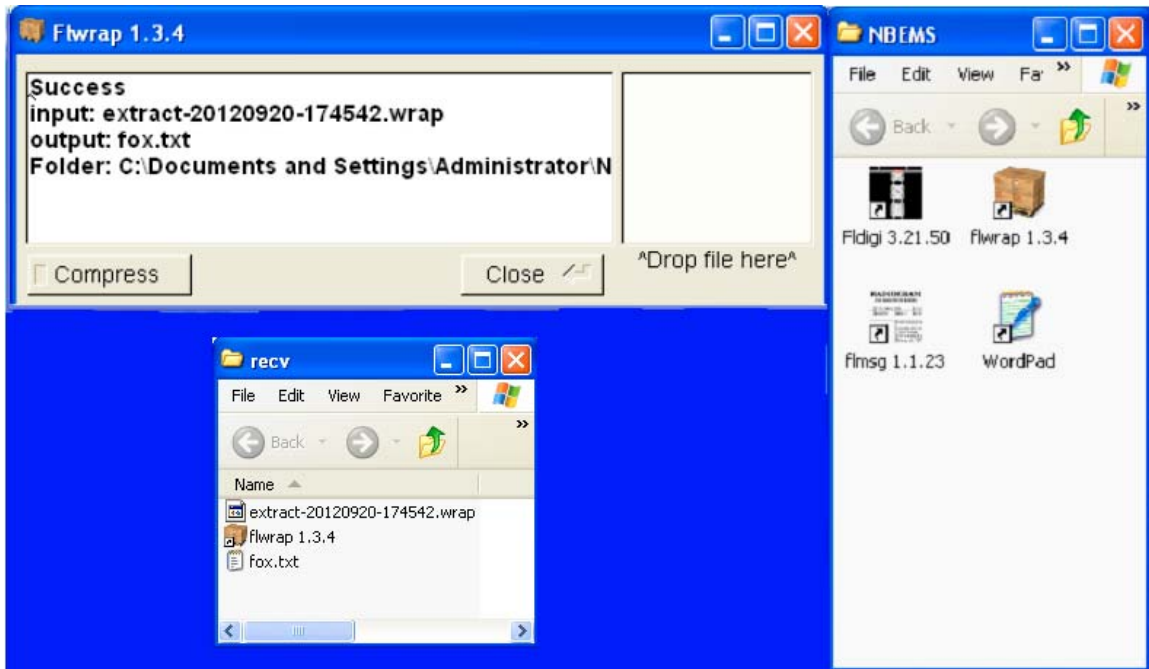


The file appears as "extract-20120920-174542.wrap. For convenience, I placed a Flwrap short cut icon in the recv folder. Grab the wrap file with your mouse and pass it over the Flwrap icon. This will cause the top screen to open showing that the file was extracted successfully. The fox.txt file will then appear in the recv folder.

You can also double click on the Flwrap icon to open the dialog screen and then drag the wrap file to the box marked "Drop file here." This has the same functionality.

So, what if the checksum fails? You get this message:
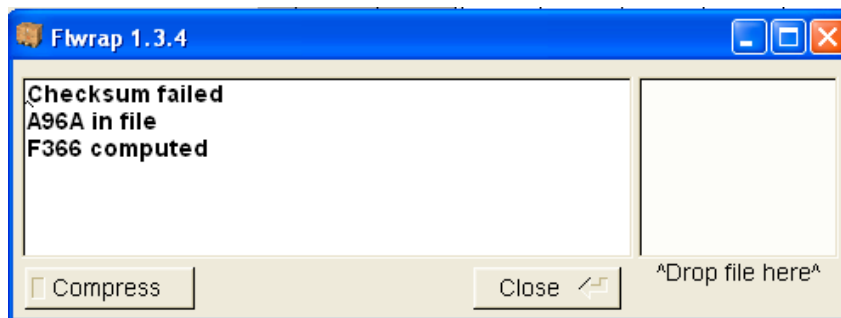


You can still read the Wrap file. Just open it in Wordpad. The error may be insignificant or it could be of consequence if the message, for example, contains a lot of data.

If the file was compressed, Flwrap will decompress the file.

**Compression**

Compression is a way to make the transmitted files smaller. A compressed wrap file will look like this:

[WRAP:beg][WRAP:lf][WRAP:fn
fox.txt][b64:start]AUxaTUEAAATIXQAAAAQABoLH6X95Dy8Kd5VLrTDSd
2KMc8VpRMno1HceKd7EOaJUGRwWKH7D
Z+dNPHP/VctCgZCbgyNST0ndHTaTghpA5XvKte5H3YvOn7pBD/RDfkAtbxN
p9KzS9g60hOXr
PlQ+s2sqw4T4mJeLcQ==
[b64:end][WRAP:chksum B477][WRAP:end]

The Flwrap header and footer are readable but the text of the file has been modified with a compression algorithm. Please note that this is not encrypted or (to use the FCC nomenclature) obscured. The algorithm is public and anyone with Flwrap can decompress the file.

For more information on Flwrap, please refer to the help file at http://www.w1hkj.com/download.html.

**The Flmsg Utility**

Messages and files sent using Flmsg are wrapped as part of the process of sending the message. Flmsg actually has pretty much made Flwrap obsolete.

Flmsg contains a number of standard forms: ICS, ARRL Radiogram, Red Cross, MARS, etc. For the sake of brevity, this document will concentrate on the two general purpose forms for sending messages and spreadsheets. Here is a message that has been composed in the Plaintext Message form:
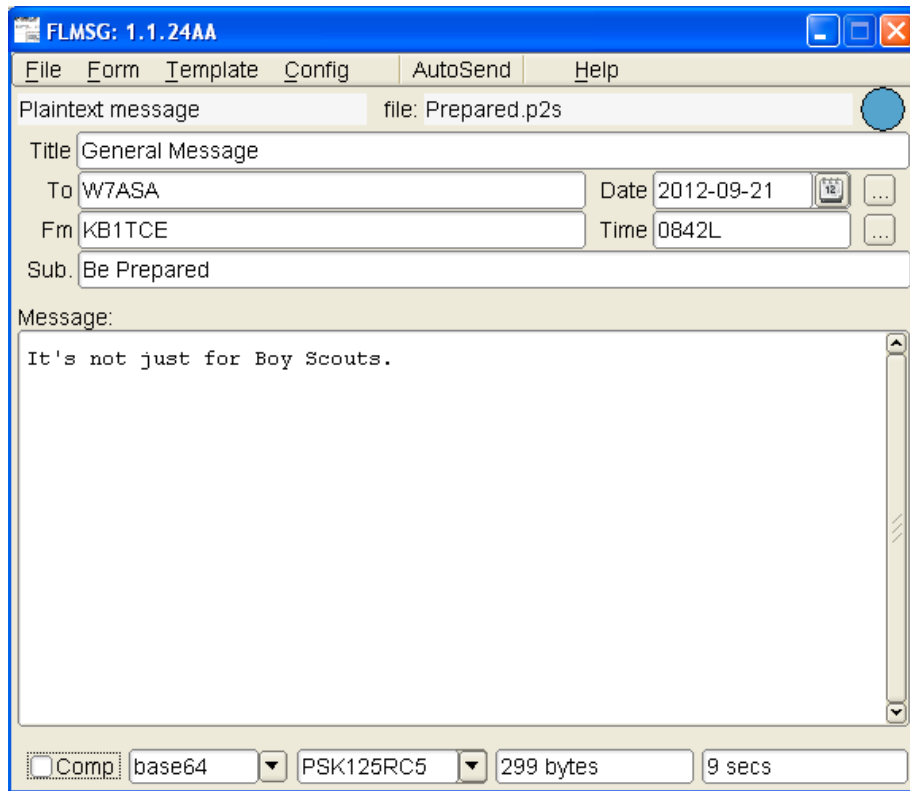
Each one of the form types has its own file extension, p2s in this case. This tells Fldigi that a specific type of Flmsg file is being received. At the receiving end the proper form will automatically open with the text as shown above, exactly as transmitted.

If the received Flmsg fails checksum, the dialog will notify you that it failed and whether or not you wish to proceed.

Once the message has been typed, it has to be saved. Click File – Save As to save. File are saved in C:\Documents & Settings\UserName\ICS\messages

A new set of features in Flmsg is contained at the bottom of the form. When you select the transmit mode, Flmsg will calculate the time required to send the message. You may also compress the file using base 64, 128 or 256 encoding. Compression is normally used to minimize the transmission time. The file size is also shown.

The csv spreadsheet form is shown below. The comma separated format is a pure text file format and is one of the Save As options for any standard spreadsheet program. To load a spreadsheet simply click "Import CSV" and the file will appear in the window. When you save the file it will be with the Flmsg spreadsheet extension c2s.
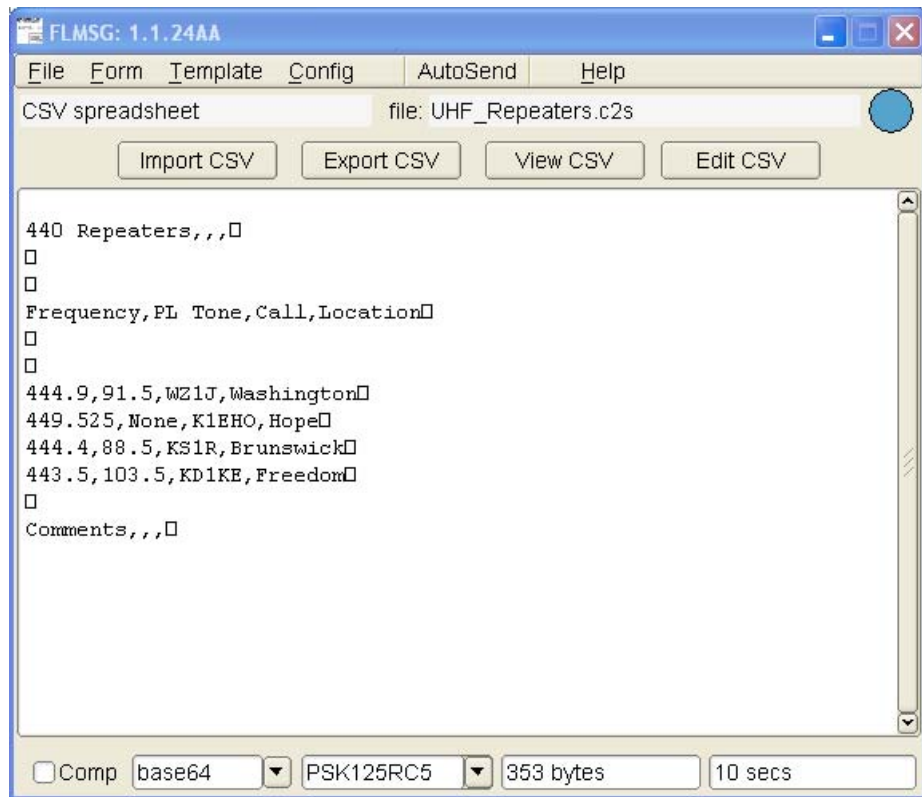
A received c2s spreadsheet file may be exported to csv with the "Export CSV" button. You may also view the spreadsheet or edit it.

A very long and detailed Flmsg Help file is available at http://www.w1hkj.com/download.html

**Addendum: Audio Coupling**

Instead of using an electronic interface such as the SignaLink, you can also use your radio and computer's microphones and speakers to transfer the audio information. This works well with the MT63 modes on VHF/UHF FM but is far less reliable with HF modes. Setting levels is more trial and error than when using a dedicated interface but this capability can be important when in the field and provides a good way to get started without any extra expenditures.

- Turn off your Windows sounds. You don't want Bill Gates' bleeps and burbles to go out over the air. Go to Control Panel – Sounds and Audio Devices – Sounds and select "No Sounds."
- While you are in there set your mic and speaker audio levels to "typical" positions. You don't want the MT63 tones screeching at you.  Have the PC speaker adjusted to about the volume that your normally speak when transmitting. When you hold the radio's mic about the same distance from your speaker as you have your mouth then you should be ok. For receiving, if your radio's speaker is some distance (a few ft) from the computer's mic, turn off your squelch and turn up your computer's record level to the point where you see the noise clearly on Fldigi's waterfall. You don't want to overdrive. Copy will be much better at low audio levels. You will have to experiment to find the correct settings for consistent copy and transmission.

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