

Regional NBEMS NETS

Preparing for Emergency Communications

Chapters

- 1. The Role of the Ionosphere in HF NVIS paths**
- 2. Picking the Optimal Digital Mode for HF EMCOMM**
- 3. The Organization of a HF NBEMS net**
- 4. Hardware Needed for EMCOMM**
- 5. Software Needed for EMCOMM**
- 6. NBEMS Examples: Pa NBEMS data**

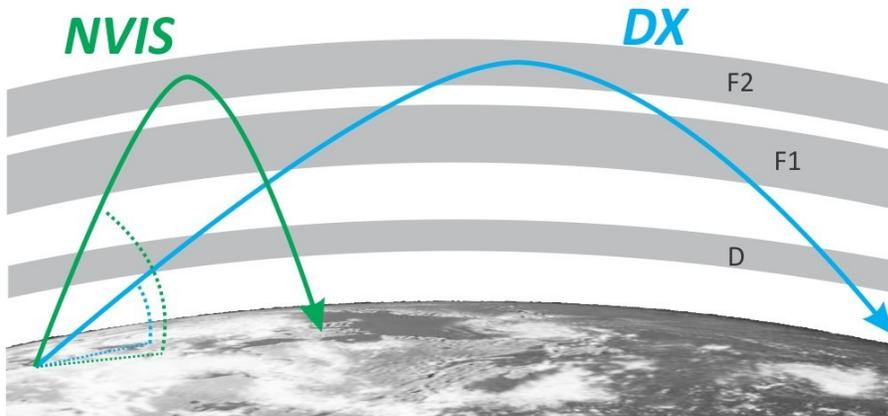
EMCOMM NEEDS: An Overview

One of the most important functions of amateur radio is to support emergency communications (EMCOMM). Over short distances, within a township or a county, simplex VHF/UHF HT's or simplex FM mobile rigs might suffice, augmented by one or more linked FM VHF/UHF repeaters for both phone and data. For continental and inter-continental distances, 20 meters works well during daylight hours and 40m works well in the evenings. But what if emergency communications is needed over the moderate distance 50 to 500 miles, covering an entire state like Pennsylvania? Linking multiple FM repeaters is one option, but that involves complicated and expensive infrastructure that might not be available between counties, especially with power loss in some areas. We also know that 2m and 70cm FM signals from a repeater on a high location might not carry well into the deep valleys in the river beds surrounded by large hills. What about the possibility of using the ionosphere as a kind of giant reflector, connecting multiple stations that are 10-300 miles apart? These HF signals from high angles can penetrate into the deep valleys, allowing communications where repeater signals propagating along the ground fail to reach.

Ch. 1 THE ROLE OF THE IONOSPHERE FOR HF EMCOMMS

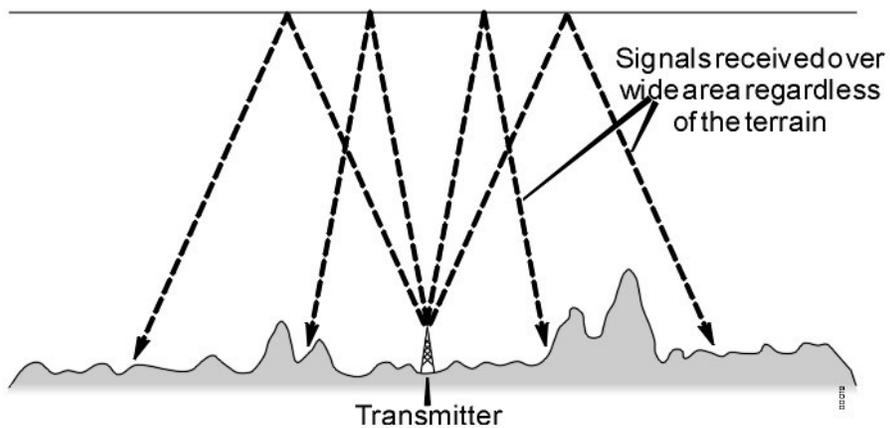
When an RF wave enters the ionosphere, one of several possibilities occurs. The RF wave might be completely absorbed by the lowest altitude **D** layer, turning that RF wave completely into heat, increasing the temperature of those atoms and ions in the D layer. That happens in the daytime for the longer wavelength signals near the commercial AM broadcast band (500 – 1600 kHz) as well as on 160 meters. Much shorter wavelength RF waves (10-30 meters) might get through the D layer without being completely absorbed, but will then be only slightly refracted, to return to Earth hundreds to thousands of miles from the sending station. That type and degree of refraction occurs for the frequencies of 10 MHz - 30 MHz where only the “glancing” RF gets refracted enough to return to Earth's surface; wonderful for inter-continental distances, but not satisfactory for state-wide EMCOMM use. Then the very high frequency RF waves greater than 100 MHz pass through the D, E, and F layers of the ionosphere without any absorption or refraction, leaving the Earth's surface with very little change in direction or intensity.

These RF waves are ideal for SPACE communications and Moon-bounce. What we are seeking for state-wide EMCOMM nets is RF wavelengths that can both get through the D layer without much absorption, and be totally refracted by 180 degrees by the upper ionosphere. Thus only these RF waves return to Earth in a near-vertical path (straight up/straight down). This form of propagation is referred to as “**Near Vertical Incident Skywave**” (NVIS), ideal to cover a state the size of Pennsylvania.



Typical NVIS paths get into the deep valleys. Transmitting antennas need not be on the hilltops

Ionised region



NVIS communications makes use of the refraction property of the ionosphere to connect multiple stations up to a few hundred miles apart. What is known as the **vertically incident “critical frequency”** is that maximum frequency that refracts enough to return to the sender’s location. The NVIS critical frequency hovers around 5-6 MHz in the present 2020 solar cycle; thus, the obvious amateur bands for a NVIS path today would be 60 meters, or 75/80 meters. What we are looking for is that rare wave that can both get through the D layer without being absorbed, but can be completely refracted (not reflected) by the higher E and F layer, and pass again through the D layer back to the sending location. How can hams discover those magical frequencies that we can use for NVIS state-wide EMCOMM? What might this gadget be used for to aid ham radio operators? Hint: think DIGISONDER



IONOSONDERS

A device known as an **ionosonder** is just that apparatus that reveals to us the ideal RF frequency for NVIS communication paths. An Ionosonder consists of a transmitter/receiver/antenna that sends high energy, short-burst pulses of HF waves straight upwards, and then listens for the return pulse or echo, much like ground UHF RADAR is used to detect the location and speed of a car. But unlike RADAR, the HF frequency of the Ionosonder pulse is slowly changed, mapping out what HF frequencies (if any) return to the sending location. The time delay for when a pulse is sent, and its echo is received indicates the distance to the refracting layer (distance = speed times time) reversing the wave’s direction. However, do not think of this like “reflection” from a mirror. The process of returning an RF wave back to the sending

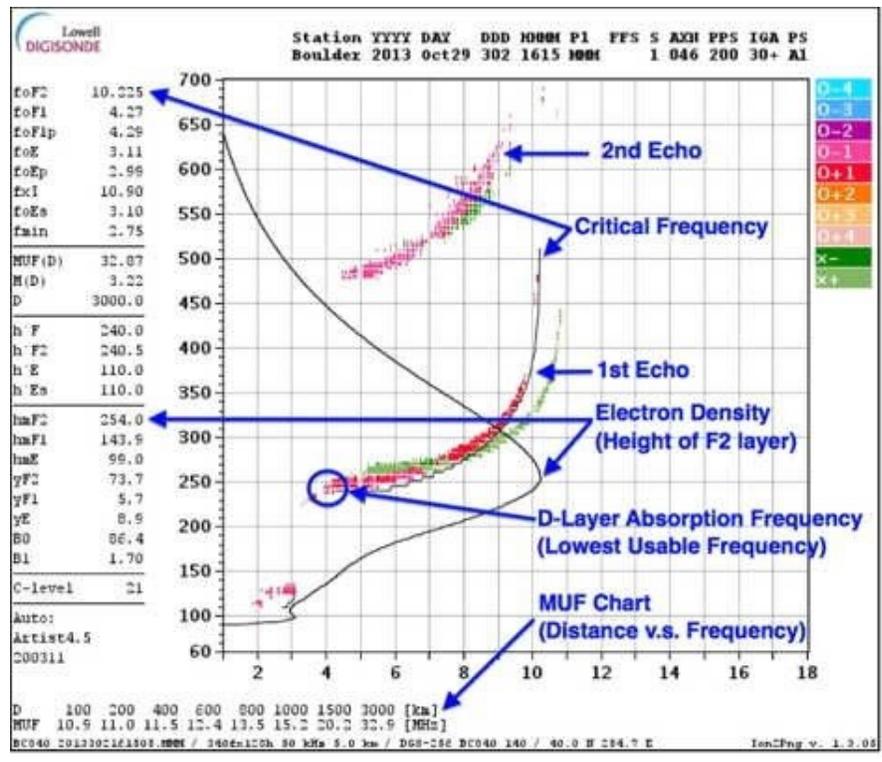
location by the ionosphere is based on **refraction**, not reflection, and takes place over tens of kilometers. Refraction (bending) is the change of speed and direction of any EM wave in a dispersive medium; similar to light passing through a prism. We know a prism can separate out the various colors of white light (sunlight) into red, orange, yellow, green, blue and violet. They do this because different frequencies of light (different colors or wavelengths) have different speeds inside the material of the prism (glass, plastic). We call this refraction property the “index of refraction” as electromagnetic waves only travel in straight lines at a constant speed in a vacuum. The various colors of light thus emerge from the prism at different angles, separating the light into its components. In a similar fashion, RF waves can also be refracted at different angles by the ionosphere, based on their frequency or wavelength. The greater the height of the refracting layer, the longer the time delay, but in very small fractions of a second because the speed of radio waves is so great (300 million meter per second in vacuum).

Figure 1 shows an example of an Ionosonde taken from Boulder Colorado in **2013**, when the solar cycle was very different from 2020. The Y-axis plots **delay time** of the echo pulse, converted to height in kilometers; the X-axis plots **frequency** in MHz. Note the NVIS frequencies on this Ionosonde that return to the sending location are in the range 4–10 MHz, and from a height of about 400 km. This particular ionosonde trace indicates three amateur bands would have been ideal for NVIS paths at the time this trace was taken: 40m, 60m, and 75/80m. The lowest useable frequency for an NVIS path was 4 MHz on this trace. RF below 4 MHz was absorbed by the D layer, and RF above 11 MHz did refract somewhat, but not enough to return to the sender’s location. The frequencies 10 – 30 MHz would refract enough to land hundreds to thousands of miles from the sending station (good for DX). The “**maximum useable frequency**” (**MUF**) is calculated by the trace to be about three times the **vertical critical frequency** (10 MHz) or, in this case, the MUF to return to Earth for DX is about 30 MHz. I’d bet 10m was a great DX band at the moment this Ionosonde was taken in 2013 from Boulder CO.

For more information on “critical frequency” consult: https://en.wikipedia.org/wiki/Critical_frequency

Ionosonde from Boulder Colo Oct 29, 2013 Note the vertical incident “critical frequency” around 10 MHz at this time and the extrapolated MUF at about 30 MHz for stations over 2000 km distant. Propagation was so good at this time that a “second Echo” is shown for frequencies of 5 – 9 MHz, at twice the height (500-600 km) of the first refracting layer (250 – 350 km).

Figure 1 Ionosonde is from the University of Mass, Lowell, on Oct 29, 2013



12

Forty meters (7 MHz) might have worked well for an NVIS path in this 2013 trace from Boulder Colorado, but today, 2020, 7 MHz is consistently above the vertically incident critical frequency (5-6 MHz). Thus, 40 meter RF in the mid-day hours often results in a daytime “skip zone” or donut-hole path, which would make EMCOMM throughout one state the size of Pennsylvania a challenge at 7 MHz. Sixty meters (5 MHz) may be an ideal band for EMCOMM within Pennsylvania in 2020, but 60m involves sharing five fixed frequencies with other services. That leaves the 75m phone and 80m digital bands as the optimum choice for NVIS in 2020. The PA PEMA phone nets (Western, Central, and Eastern regions) meet on the upper end of 75 meters around 3990 kHz LSB around 9 AM local every Sunday morning. These nets work well and are quite popular, with propagation usually excellent out to 200 miles, but the transfer of

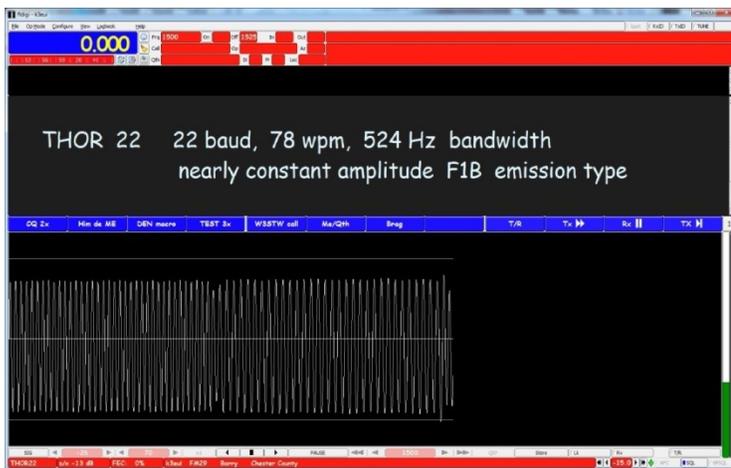
emergency messages by voice is quite inefficient, both in time and in bandwidth. That leaves CW and other digital modes as an option for state-wide HF emergency communications on 80 meters. We all know that CW has its limitations, both in speed (20 wpm) and in accuracy. Modern sound card digital modes with bandwidths around 500 Hz (comparable to CW) can reliably transfer files at 100-200 wpm, with nearly 100% accuracy using basic 100W SSB transceivers and modest antennas on 80m. Most of these sound card modes can demodulate reliably down to $S/N = -10$ dB, far below what most human CW operators can copy. So what are the NBEMS digital mode options for EMCOMM on 80m to cover a region such as Pennsylvania?

Ch. 2 Picking the Optimal Digital Mode

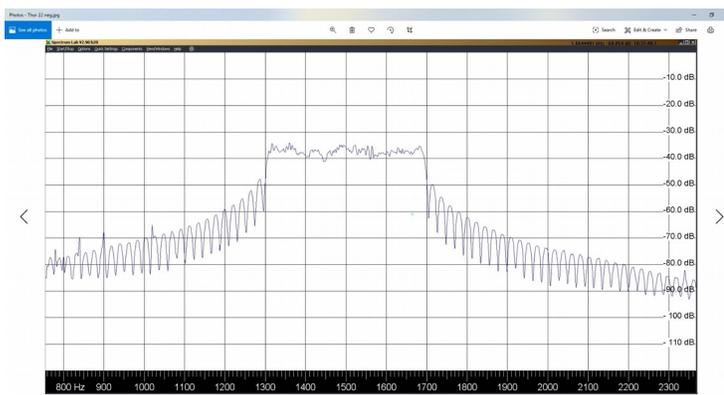
Lots of narrow bandwidth (under 500 Hz) sound card modes work well on a NVIS path. Olivia 8/500 at 30 wpm, and 63 baud, uses 8 tones, sent one at a time, and is one of the most robust sound-card modes, copying stations well below the receiver's noise level, down to -13 dB. However, Olivia has a delay time of a few seconds between when a tone is heard and a character appears on your screen, extending the time to take check-ins for an EMCOMM net. The PA, NJ and NY NBEMS nets experimented with various speeds of Olivia, Contestia, MFSK, IFKP and Domino and finally discovered that **THOR 22** had about the optimal speed (78 wpm at 22 baud, bandwidth 524 Hz) as well as excellent decode ability down to a S/N of -10dB. Thor modes also offer a robust FEC (forward error correction) for improved accuracy. Thor is also more tolerant of stations being 10 to 50 Hz off the net control's frequency. Thor is one of those modes like Domino that uses "**Incremental Frequency Shift Keying**" (**IFSK**) which relies on the change in pitch from one tone to the next tone to determine a symbol, rather than relying on the absolute pitch of a tone such as required with Olivia and MFSK. For sending traffic, nets wanted a mode that moved along faster than THOR 22 but still offered solid copy for a message that lasted one or two minutes. We discovered that **MFSK32** (120 wpm and 625 Hz BW) was about as fast as we could use reliably with the types of noise commonly heard on 80m. If the nets were allowed to use a bandwidth of 2.0 - 2.5 kHz, then MFSK128 (480 wpm) and THOR 100 (352 wpm) would be spectacular traffic modes.

We've experimented with the PSK modes including 8PSK125F (125 baud and over 300 wpm) and with PSK63RC5 (multi-carrier modes at 63 baud) but found too many stations were missing characters during moments of deep fades (QSB) typically found on 80m as the Sun is rising and the ionosphere is warming and becoming less stable. Had we run the net closer to 11-12 noon on 80m, we'd have probably found weaker signals with the D layer of the ionosphere absorbing so much RF at 3.5 MHz. Thus, an optimum time and frequency for a regional NBEMS net turns out to be 80 meters between 6 am and 11 am. During evening hours, the band goes "long" as the Sun goes down, making regional NVIS communications compete with the DX coms. An evening net in Michigan (MIDTN) does have some success at 3582 kHz, but must compete with W1AW CW bulletins at 3581.5 kHz and Winlink just above 3585 kHz. The following traces show the characteristics of each of the popular modes.

THOR 22 is a popular mode for 80m NBEMS nets. It is reasonably fast (78 wpm) for an EMCOMM net (525 Hz) and has effective error detection/correction (FEC). This trace shows an FLDIGI **SIG** view: an "oscilloscope" style view" plotting signal strength (Y) vs. time (X)

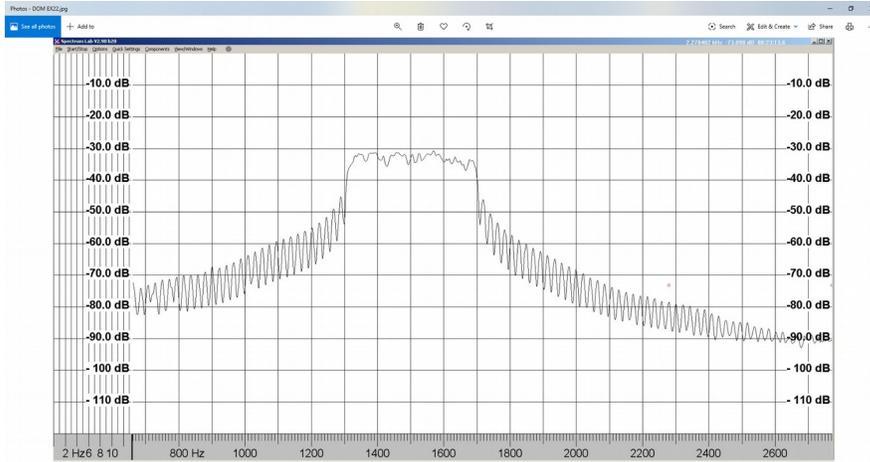


The AUDIO spectrum of THOR 22 is quite well defined (525 Hz) with harmonic "wings"



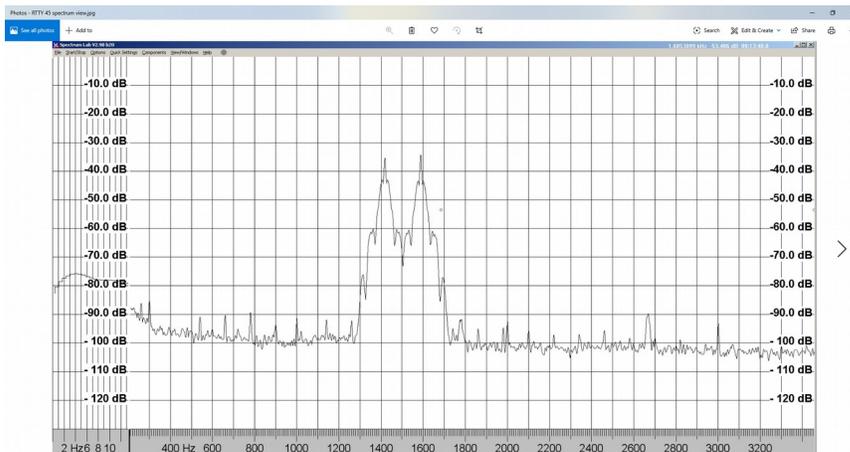
Another popular mode that seems to work well on the early morning 80m NVIS paths is **DOMINO**. **Domino** is another constant amplitude, multiple-tone mode where the tones are sent one at a time. Domino has an **OPTION** of FEC (more robust, but half the speed).

Here is an **AUDIO** spectrum of a **DOM EX22** signal (22 baud, 160 wpm, and 524 Hz bandwidth)



The most common keyboard digital mode on the ham bands used to be **RTTY** (frequency shift keying). Unlike the on/off binary signal of CW, RTTY produces its binary character by shifting the frequency of a single tone creating what are called "MARK/SPACE" signals. The RF from a RTTY signal is on one or the other tone, but never both tones, and never neither tone; classic "frequency modulation".

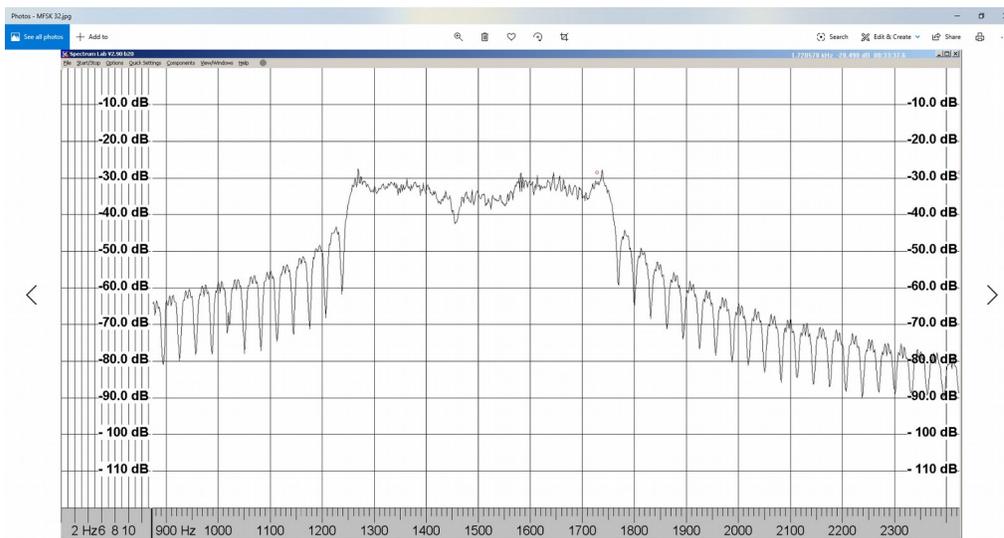
The standard **RTTY - 45** signal is composed of two-tones, 170 Hz apart, at 45 baud (60 wpm) requiring about 400 Hz bandwidth seen in this image. The two tones in this example are centered around 1500 Hz for convenience. RTTY has upper case only, no FEC, and is not suitable for NBEMS traffic. RTTY can be generated in some rigs where DATA signals from your computer or TNC alter the frequency of the VFO; this mode is called FSK RTTY, or "direct" RTTY. RTTY can also be generated by any HF SSB radio by AFSK (audio frequency shift keying) produced by injecting a shifting AUDIO tone into the mic or data port with your rig in USB or LSB mode. The shifting tone can be at any audio pitch on your waterfall, not fixed like in FSK RTTY. Either method can produce identical results to the receiving station.



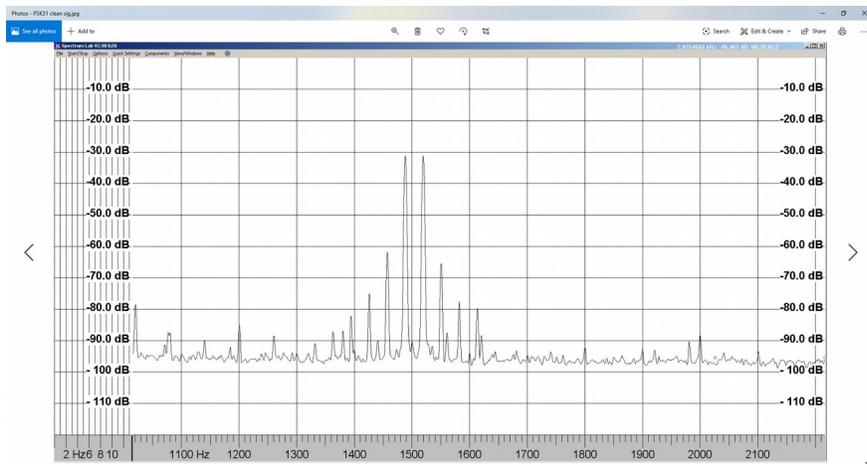
One of the popular EMCOMM modes a few years ago was the very robust **OLIVIA 8-500**. Olivia can decode to very low signal/noise ratios (below -10 dB) but Olivia has long delay times from when tones are heard to when print appears on your screen. Long delay times drag out the time for check-ins on a busy net. **Olivia 8 – 500** has 8 tones, sent one at a time, 63 baud, 500 Hz bandwidth and an overall speed of 30 wpm. It might be the mode of choice for very faint signals under poor propagation.



A popular mode for EMCOMM traffic on 80m is **MFSK-32**, operating at 32 baud, 120 wpm, and a bandwidth of 630 Hz. If permitted, the speed **MFSK-128** (125 baud, 480 wpm, 1920 Hz bandwidth) would yield very fast data traffic, but taking up almost 2 kHz of spectrum is not advised



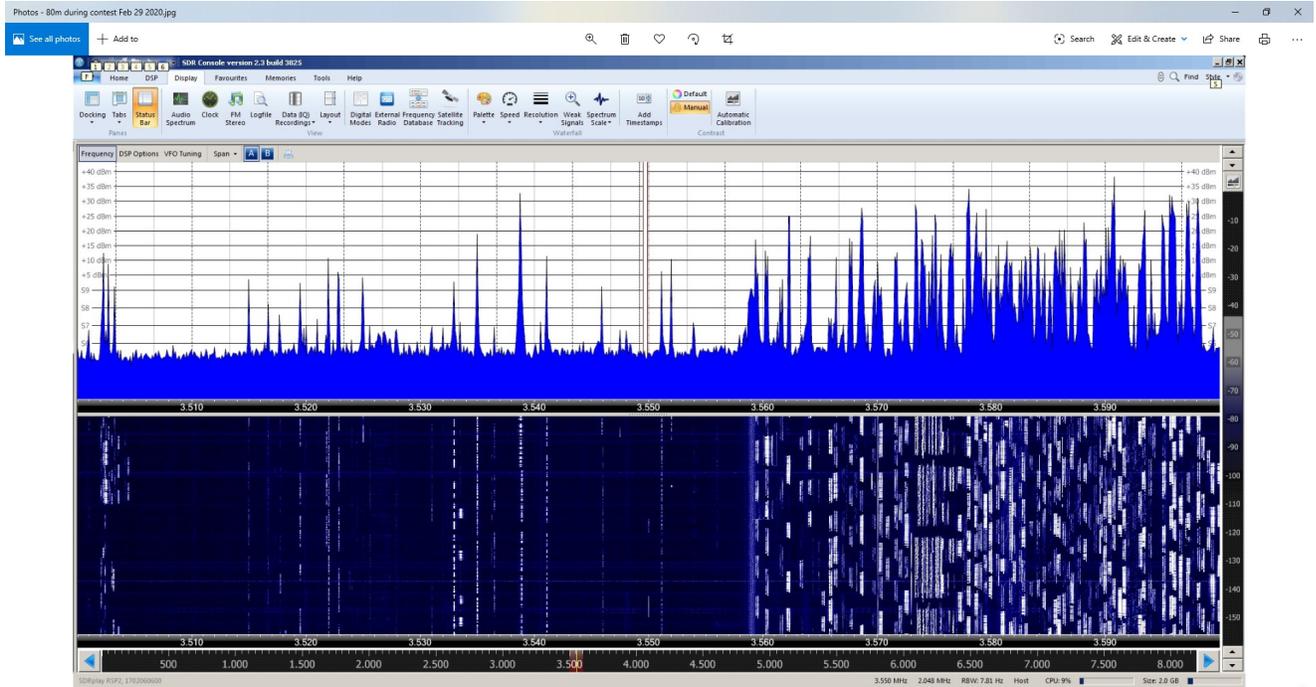
The very popular mode for casual chats on the HF bands is **PSK-31** (BPSK-31) but this mode has no error detection. Signals are very narrow bandwidth (60 Hz) and speeds are faster than most of us can type (50 wpm) but PSK31 is rarely used as the mode on EMCOMM NBEMS nets. Phase-shifting modes often encounter difficulty on 80m NVIS paths when the ionosphere is warming up. The PaNBEMS has experimented with BPSK63F (63 baud, FEC) with mixed success.



The variety of sound-card based digital modes that are available with FLDIGI increases each year, so we continue to explore new modes as conditions change. Fantastic new DX modes like FT8 and FT4 are not suitable for EMCOMM needs. Listen to the digital portion of the 80 meter band (3500 - 3600 kHz) and you are likely to hear a variety of sounds from stations using many digital modes. An SDR capture of the RF spectrum from 3500 to 3600 kHz during mid-morning hours will likely reveal many CW stations from 3500 to 3570 kHz, BPSK31 signals around 3570 kHz, FT8 signals around 3574 kHz (easy to recognize by their 2 second gaps every 15 seconds) JT65 stations near 3576 kHz, JS8CALL stations around 3578 kHz, FT4 stations on 3580 kHz, and perhaps a few RTTY stations scattered everywhere. RTTY stations always dominate during a RTTY contest, but have been replaced with other modes for casual chats. Once in a while you might catch a keyboard QSO using Olivia or MFSK. Tune from 3585 kHz up to 3600 kHz and you will hear some "chirping" sounds of **Winlink** (linked stations) using the modes Winmor, ARDOP, Pactor or VARA. Winlink stations are connected, one-to-one, using the software **RMS Express**, sending radio emails to one another. Virginia now uses Winlink as an EMCOMM mode on a regular basis (KW6GB and the VA Wednesday Winlink Net). Each digital mode serves a different and somewhat unique role in our digital band. You can often identify these modes by their sounds, their spectra, or by where on the band these signals congregate.

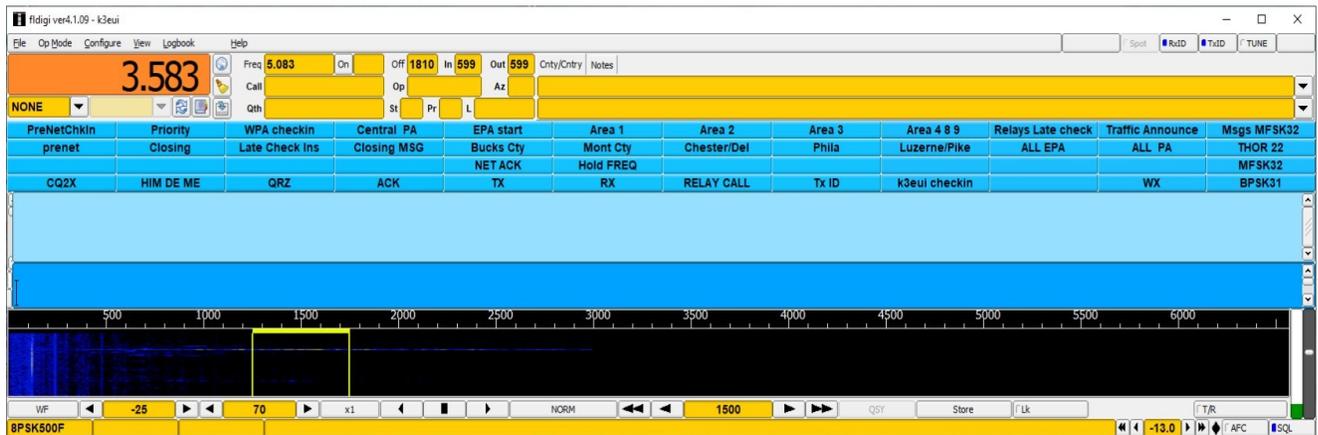
Snapshot of the 80m digital sub-band 3500-3600 kHz during a recent contest (Feb 29, 2020)

Can you identify the various modes by their waterfall trace?



Ch. 3 Organization of a HF NBEMS net

The 80 meter NBEMS digital nets are designed to give operators a chance to practice their digital mode skills and compliment the EMCOMM PHONE and CW Traffic nets that have been around for decades. Check-ins for the PA NBEMS net are organized by the **net control operator** according to regions of the state (EOC's, portable or QRP first, then WPA, then CPA, and then EPA). After all of the in-state check-ins are acknowledged, the control op asks for out of state check-ins by call regions: 1,2,3, then 4,8,9, and Canada, usually checking in stations from a zone of a few hundred miles if propagation permits. Stations not heard directly by net control are then relayed in by other stations into the net. Most net control ops use the “**macros**” (shortcuts) to move the net along, as shown below of K3EUI's 4-line MACRO choices.

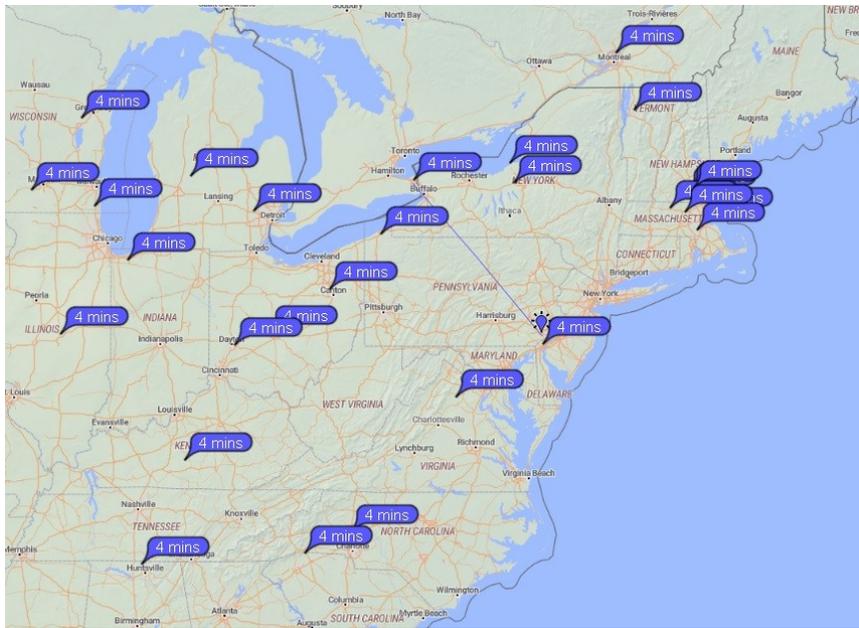


Picking the Optimal Band, Time of Day, and Antenna

The absolute necessity for a regional EMCOMM net is to avoid any skip zone (donut hole) which plagues regional communications on 10m to 40m during the low Sun spot years. Forty meters (fickle forty) often provides reliable daytime communication from 100 to 800 miles, but often has a noticeable midday “skip zone” up to 100 mile. In order to cover the size of a state like Pennsylvania we need reliable NVIS paths from 10 - 300 miles from the net control. During years of high sunspot activity, the PaNBEMS net operated on 40 meters (7072.5 kHz) on Sundays at 11 am local time, but over the past few years, the vertical incident critical frequency has dropped, and so the optimum frequency for short-range NVIS sky waves has shifted to 80 meters and 60 meters. The Pa NBEMS has settled on 80 meters (3583.0 kHz) at

8 - 9 am local time as the best choice of band and time of day. Recently the net started to take out-of-state DX stations at 7:30 AM, resulting in check-ins from Michigan, Wisconsin, and as far south as Florida. See the PSK reporter image to show why 40m is not the optimum frequency for the PA NBEMS net in 2020.

Skip zone on 40 meters. K3EUI sent out a CQ on 40 meters using the mode **FT8** at 1 pm on July 19, 2019 and then monitored which stations received his CQ with PSK Reporter. Note that the majority of stations who copied that CQ were from 200 to 600 miles from Philadelphia, typical of 40m daytime skip with a horizontal dipole antenna 35 ft above ground. Thus, 40m at this moment in the solar cycle, and at this time of day, would not be a good choice for a NBEMS daytime net for Pennsylvania, but might be good band for a wider area of coverage, like the mid-Atlantic region to New England or the Mid-West. Below is a PSK Reporter Trace of stations hearing K3EUI on 40m. Note the absence of stations copying k3eui near Philadelphia

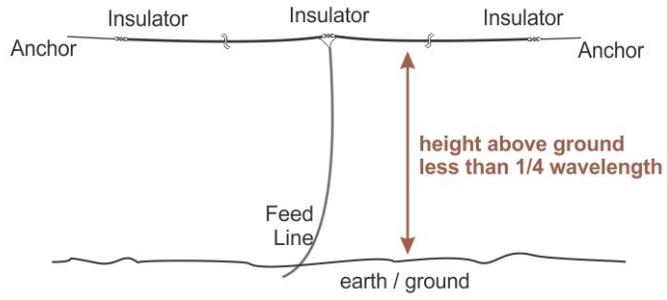


Antennas suitable for NVIS on 80 meters

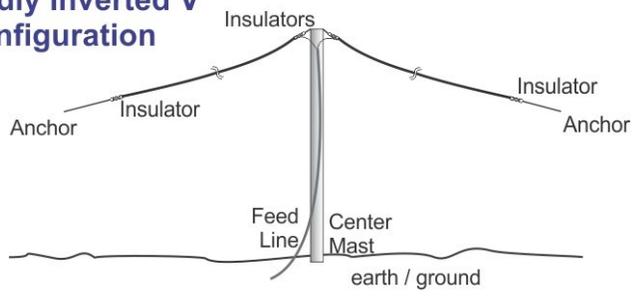
Stations find that regional (300 miles) daytime NVIS sky wave propagation is best accomplished with a half-wavelength horizontal dipole mounted $1/8^{\text{th}}$ to $1/4^{\text{th}}$ wavelength above ground, yielding a high-angle signal, best for an NVIS path. Many operators prefer the “inverted V” arrangement since that requires just one high support. Dipoles 120-140 feet overall length produce good results, independent of whether they are center-fed, off-center fed, or end-fed; only the impedance is determined by where the feedline attaches. A dipole’s resonant frequency is only determined by its overall length (and the presence of nearby objects or ground) and is not determined by where the feed line connects to the antenna. Stations using vertical antennas experience significant loss of high-angle NVIS daytime propagation paths since their maximum signal is along the ground, good only for DX propagation or local ground wave. However, one station usually puts in a good signal into the PaNBEMS using a short vertical antenna from center-city Philadelphia. For additional information on NVIS consult the webpage:

<http://hamwaves.com/nvis/en/index.html>

Flattop Configuration



Mildly Inverted V Configuration



Ch. 4 Hardware needed for 80m NBEMS

The only hardware requirements are to have a stable HF SSB transceiver capable of accepting transmit and receive audio from a sound card. Most modern transceivers have a DATA jack or ACC jack that accepts transmit audio and PTT signaling, and most of these ports include fixed output receive audio as well. As a last resort, you can always pull high level (low impedance) receive audio from a headphone or a speaker jack, and connect your transmit audio and PTT to the rig's front microphone jack. In fact, **RIGBLASTERS** (West Mountain Radio) are designed to hook up to the rig's MIC jack and SPKR jack. The SEND (PTT) function is often accomplished in the computer software via a serial COM port, or a virtual USB-Serial COM port using a USB connection available on more modern computers or radios. On the newest radios, all you need for rig control (CAT) and PTT and audio in/out is a single USB cable between your computer and radio. A last resort for PTT is to use the radio's own data **VOX** circuit, where the presence of transmit audio trips the PTT line, just like voice VOX with a microphone. High precision VFO readouts (to the nearest Hz) and high accuracy VFO calibration are not required, as long as you stay within the legal band limits for your license and for any net, just zero beat the net control operator's frequency on the waterfall. I've operated successfully on 80 meter nets using an older 1990's Kenwood TS50 where the VFO frequency readout was only to the nearest 0.1 kHz. Most HF digital nets begin with a TUNE (steady sine wave) at 1500 Hz on the waterfall, and the net control operator gives instructions about how to check into the net. A typical 100 W PEP transceiver usually runs 20-50 watts constant output on digital modes like THOR and MFSK, and can put out a clean digi signal as long as the **ALC reads zero**. Overdriving a rig's audio to get a few more watts output will result in a poor digital signal. Remember the rule: every doubling of power results in only +3 dB gain (1/2 an S unit).

Digital Signal Processing - do you need it? The short answer is "NO". Often the noise blanker (NB) and noise reduction filtering (NR) only distort the digital signal. Best to use these noise filters on phone and CW. Never use a speech processor (compressor) on your transmit audio; that will guarantee distortion. I often narrow the passband on receive to 1000 Hz (from 1000 – 2000 Hz) just to avoid unnecessary sounds in my headphones, but this rarely improves decoding with FLDIGI. The following pages illustrate some of the author's older radios, which work fine on HF SSB digital sound card modes.

An early 1990's Kenwood **TS50**: a compact HF multi-mode, multi-band transceiver with a Signalink hooked up to the rig's MIC jack and SPEAKER jack. Even the basic SSB PHONE filter of 2.8 kHz works fine on digital modes. Many older compact HF transceivers were not designed with sound card digital modes in mind, and have no exclusive "data jack" but work fine using the MIC and SPKR ports for audio. Be careful not to "overdrive" the audio: ALC should always read ZERO. Note the matching Knwd ANTENNA TUNER below to allow the rig to work with virtually any HF antenna.



USB Low-Noise Sound Card made by *Sound Blaster* that has multiple INPUT / OUTPUT jacks that with the proper RADIO cable, can support digital modes with any HF SSB or VHF/UHF FM radio. I often use a 1:1 isolation transformer with this sound card to avoid ground loops.



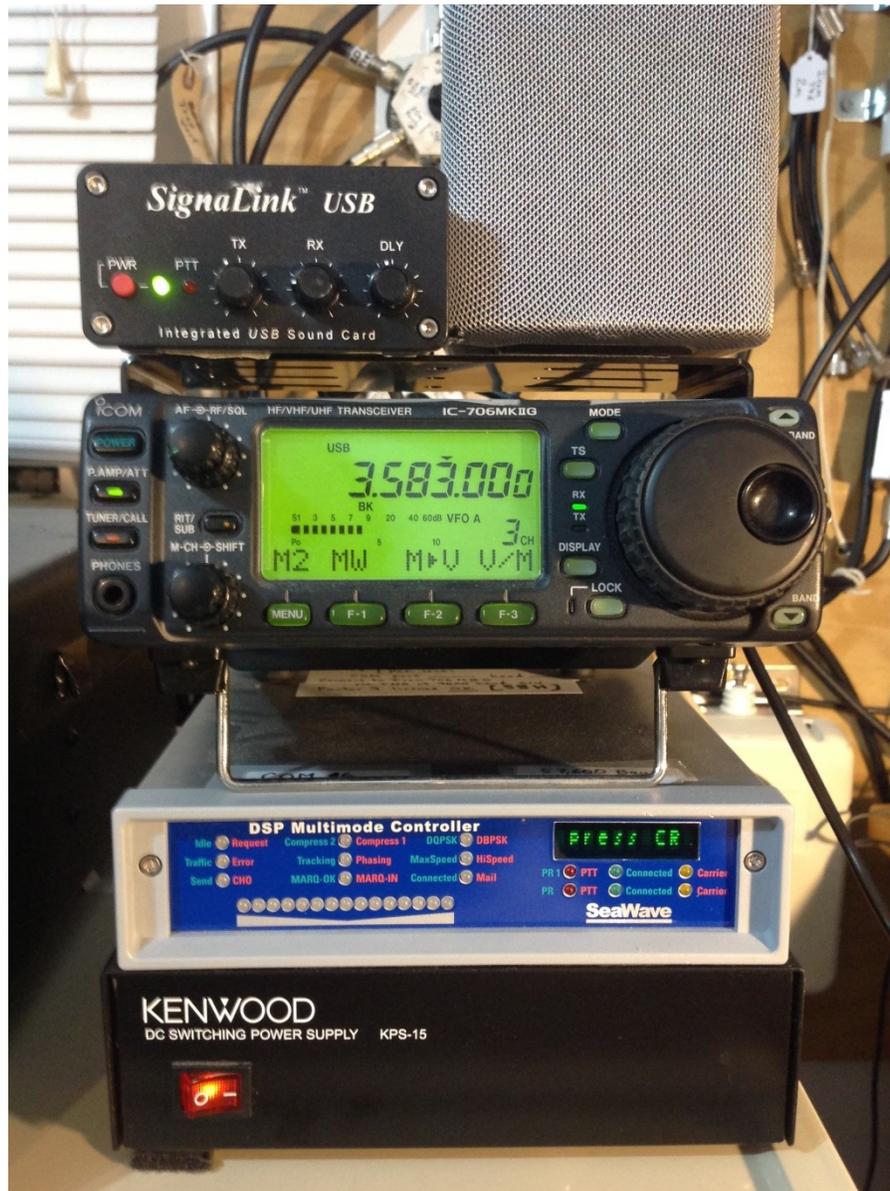
Shielded audio cables with a 1:1 isolation transformer



Icom 725 and classic West Mountain Radio Rigblaster. This is a basic SSB/CW/AM/FM HF transceiver which has a Rigblaster (no sound card) to condition the transmit audio into the rig's MIC jack in front. You can pick LEFT / RIGHT/ BOTH channels for transmit audio. A second switch allows for PTT via a COM port, or you can use VOX for PTT, the same as a SignalLink. The radio's microphone plugs into the Rigblaster's MIC jack. Keying the MIC disables the sound card audio automatically. Receive audio bypasses the Rigblaster, and goes straight from the EXT SPKR jack or HEADPHONE jack to the computer's LINE IN or MIC IN jack. This simple setup works well for a 28 year old radio.



Icom 706MIIG (HF/VHF/UHF) with SSB/FM/CW/AM modes, complete with a small 15 amp switching power supply, Tigertronics Signalink (USB audio sound card) that connects to a rear DATA port, and a SCS Pactor II Pro TNC for Pactor I,II,III modes with Winlink and CAT control via a COM port. Coupled with an external antenna tuner, this combination of gear is truly a complete shack on a cart.



A classic 1990's Kenwood **TS850** coupled with a Signalink into the rear **DATA** port for both TX and RX audio and PTT functions, along with an MFJ antenna tuner for all band coverage. An **SDRplay2** is used as a "panadapter" (RF spectrum analyzer and waterfall). This is one of my favorite classic setups for HF digital modes.



A more modern **Icom 746Pro** covers all modes, all bands HF thru 2m with a **Rigblaster Advantage** with a built-in USB sound "card". The Rigblaster Advantage sends TX audio into your MICROPHONE port. The Rigblaster Advantage also supplies one COM port which can be used for PTT (send), CAT (rig control) or can key the CW port of your rig using the serial port pin (DTR) as well as PTT (RTS). The Rigblaster sound card is easy to adjust by the three knobs on front: TX, RX, and DELAY if on VOX.



The Icom 7610 This radio does it all, with two independent receivers, and built-in sound card. Thus there is no need of analog audio cables which can pick up RF feedback.



Here is the little sibling of the 7610, the Icom 7300 with fantastic display and built-in sound card. These are quite popular and have a lot of features for what is called a “basic radio”.



Ch. 5 Necessity is the mother of invention: the SOFTWARE

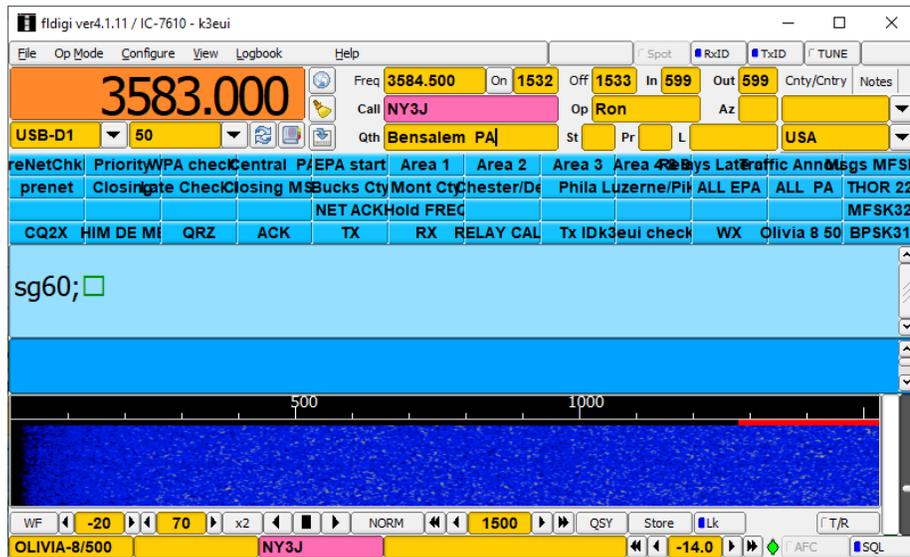
The initials NBEMS stand for “**narrow bandwidth emergency messaging system**” first deployed in Western Pennsylvania in 2008 (QST April 2008 and QST August 2009). NBEMS uses a suite of programs that consists of FLDIGI (Fast Light,Digital) the main operating application, augmented by FLMSG (FL message) and FLAMP (FL Amateur Multicast Protocol). This suite of programs was created and is maintained by Dave Freese, W1HKJ, and a team of developers. The program can run on Windows, Linux, and Mac platforms. Also included are FLRIG for rig control (CAT) as well as logging program FLLOG.

Sample FLDIGI screen with Logging info, Macros, Rx Window, Tx Window, and Waterfall

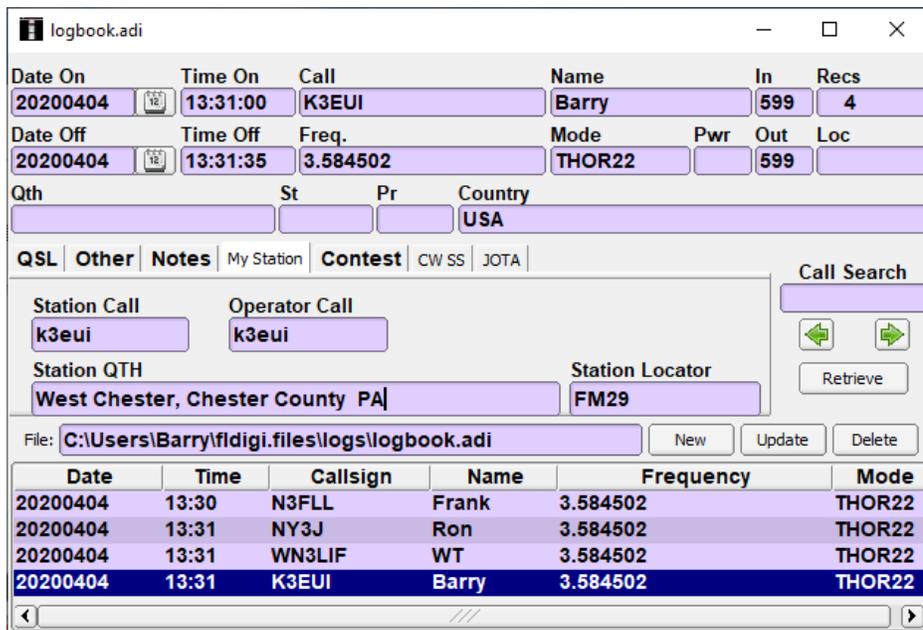
The screenshot shows the FLDIGI software interface. At the top, the frequency is set to 3583.000 MHz. Below this, there are fields for Call (1H9100) and other parameters. A table of macros is visible, with columns for PreNetChkin, Priority, WPA checkin, Central PA, EPA start, Area 1, Area 2, Area 3, Area 4 & 8, Relays Late check, Traffic Announce, and Msgs MFSK32. The main display area shows logging information, including the call sign de KB1BH Skywarn D 41h9100 and the message qi. Below the logging information is a waterfall display showing the frequency spectrum from 500 to 3500 kHz. The waterfall shows a strong signal at 1500 kHz. The interface also includes a status bar at the bottom with various controls and indicators.

PreNetChkin	Priority	WPA checkin	Central PA	EPA start	Area 1	Area 2	Area 3	Area 4 & 8	Relays Late check	Traffic Announce	Msgs MFSK32
prenet	Closing	Late Check Ins	Closing MSG	Bucks Cty	Mont Cty	Chester/Del	Phila	Luzerne/Pike	ALL EPA	ALL PA	THOR 22
CQ2X	HIM DE ME	QRZ	ACK	NETACK	Hold FREQ	RELAY CALL	Tx ID	k3eui checkin	WX	Olivia 8 500	MFSK32
				TX	RX						BPSK31

Set up your LOGBOOK (options) and Rig Control on the MAIN Window of FLDIGI

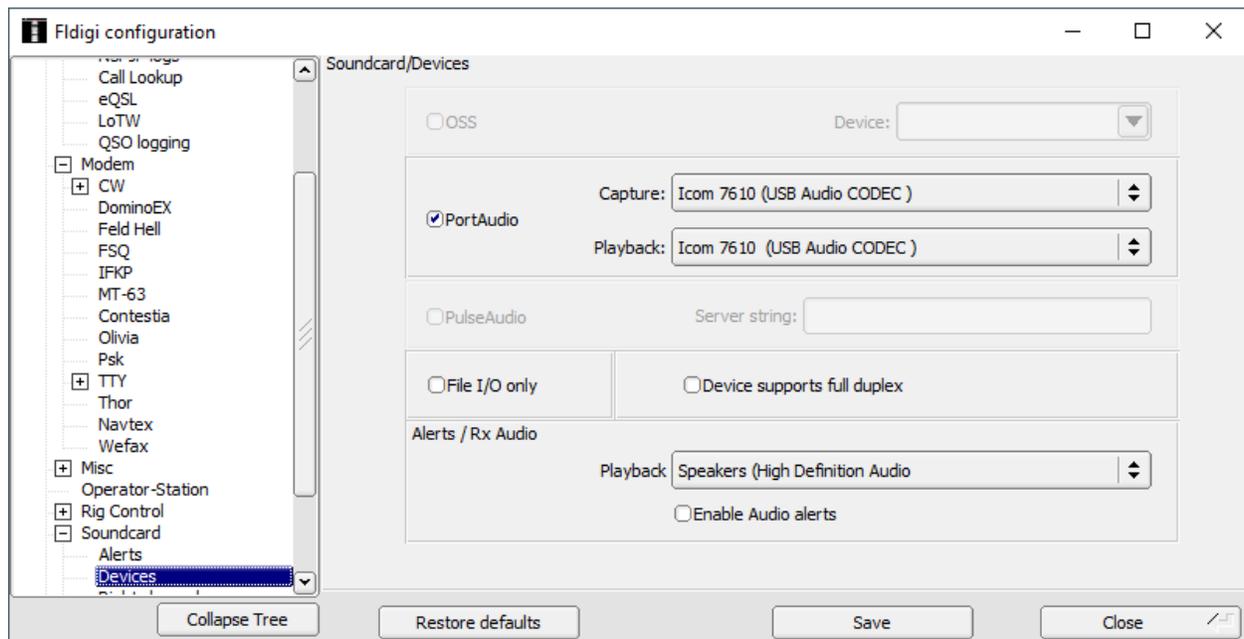


An example of the LOGBOOK VIEW tool to keep track of check-ins to the net



Configuration Settings for Sound card: Port Audio, pick your Capture (RX) and Playback (Tx) device

Note here the Icom 7610 has its own built-in sound codec (avoiding analog cables)



Set up your "macros" in advance to speed up a QSO and net traffic

Macro editor - C:\Users\Barry\fdigi.files\macros\NBEMS Barry macros.mdf

Macro Text

<TX>
<CLRRX>

QST QST de Pa NBEMS net
de net control k3eui barry west chester PA

Now calling for any pre-net checkins from outside of PA
and any PA stations unable to check in at 0800 hr

Please check in with your call twice, your name, county if in Pa or State,
and QTC if you have traffic, QRU if no traffic

example: net de k3eui k3eui barry chester epa qtc 1 net

No need for TxID with THOR 22 while checking in

Call now for early pre-net checkins
de k3eui k ^r

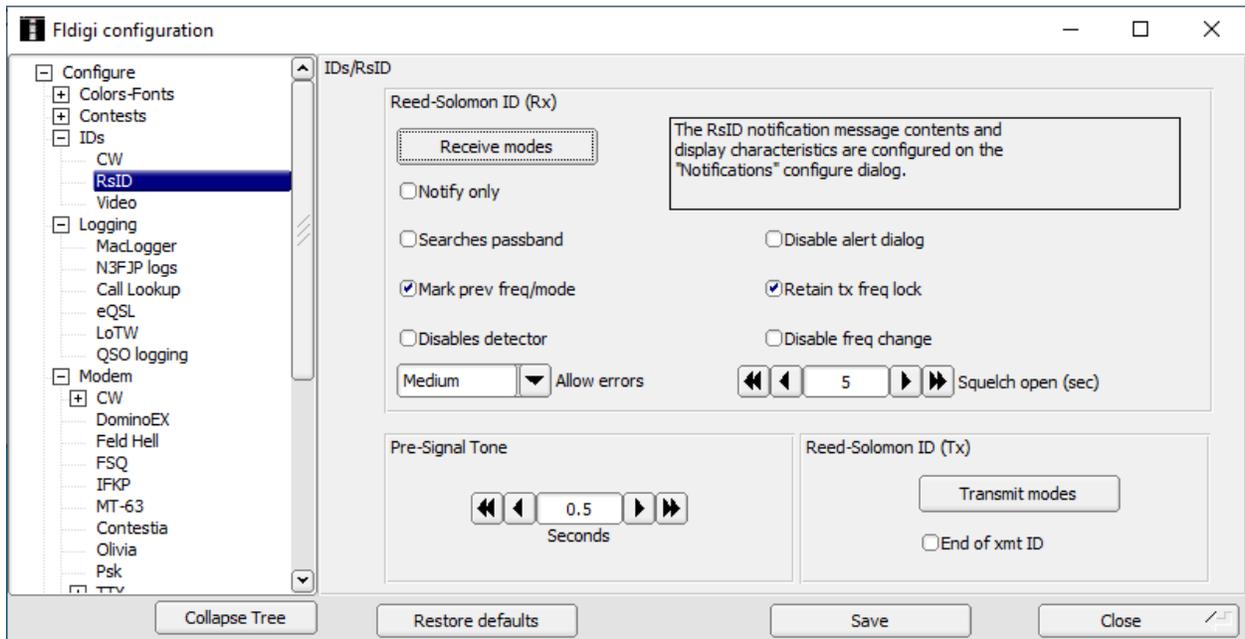
Select Tag

- <MODEM:PSK300C2>
- <MODEM:PSK500C4>
- <MODEM:PSK800C2>
- <MODEM:PSK1000C2>
- <MODEM:QPSK31>
- <MODEM:QPSK63>
- <MODEM:QPSK125>
- <MODEM:QPSK250>
- <MODEM:QPSK500>
- <MODEM:8PSK125>
- <MODEM:8PSK125FL>
- <MODEM:8PSK125F>
- <MODEM:8PSK250>
- <MODEM:8PSK250FL>
- <MODEM:8PSK250F>
- <MODEM:8PSK500>
- <MODEM:8PSK500F>
- <MODEM:8PSK1000>
- <MODEM:8PSK1000F>
- <MODEM:8PSK1200F>
- <MODEM:OLIVIA>
- <MODEM:OLIVIA-250/8>
- <MODEM:OLIVIA-500/8>
- <MODEM:OLIVIA-500/16>
- <MODEM:OLIVIA-1000/8>
- <MODEM:OLIVIA-1000/32>
- <MODEM:OLIVIA-4/125>
- <MODEM:OLIVIA-4/250>
- <MODEM:OLIVIA-4/500>
- <MODEM:OLIVIA-4/1K>
- <MODEM:OLIVIA-4/2K>
- <MODEM:OLIVIA-8/125>
- <MODEM:OLIVIA-8/250>
- <MODEM:OLIVIA-8/500>
- <MODEM:OLIVIA-8/1K>
- <MODEM:OLIVIA-8/2K>
- <MODEM:OLIVIA-16/500>
- <MODEM:OLIVIA-16/1K>
- <MODEM:OLIVIA-16/2K>
- <MODEM:OLIVIA-32/1K>
- <MODEM:OLIVIA-32/2K>
- <MODEM:OLIVIA-64/500>
- <MODEM:OLIVIA-64/1K>
- <MODEM:OLIVIA-64/2K>
- <MODEM:RTTY>
- <MODEM:RTTY-170.45.45:5>
- <MODEM:RTTY-170.50.50:5>

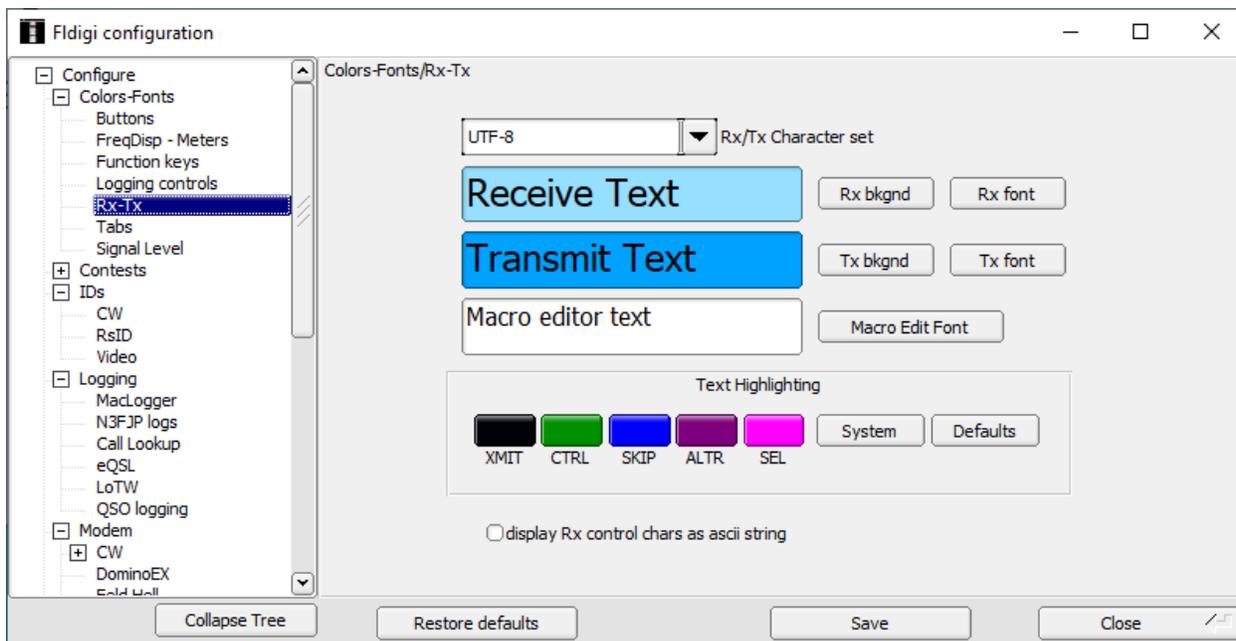
Macro Button Label PreNetChkIn

Apply Close

The RxID and TxID features offer an automatic **mode identifier** signal at the start of each transmission, enabling beginners to tune in to the proper mode



You have a variety of FONTS, FONT SIZE and FONT COLOR to choose from in each Window



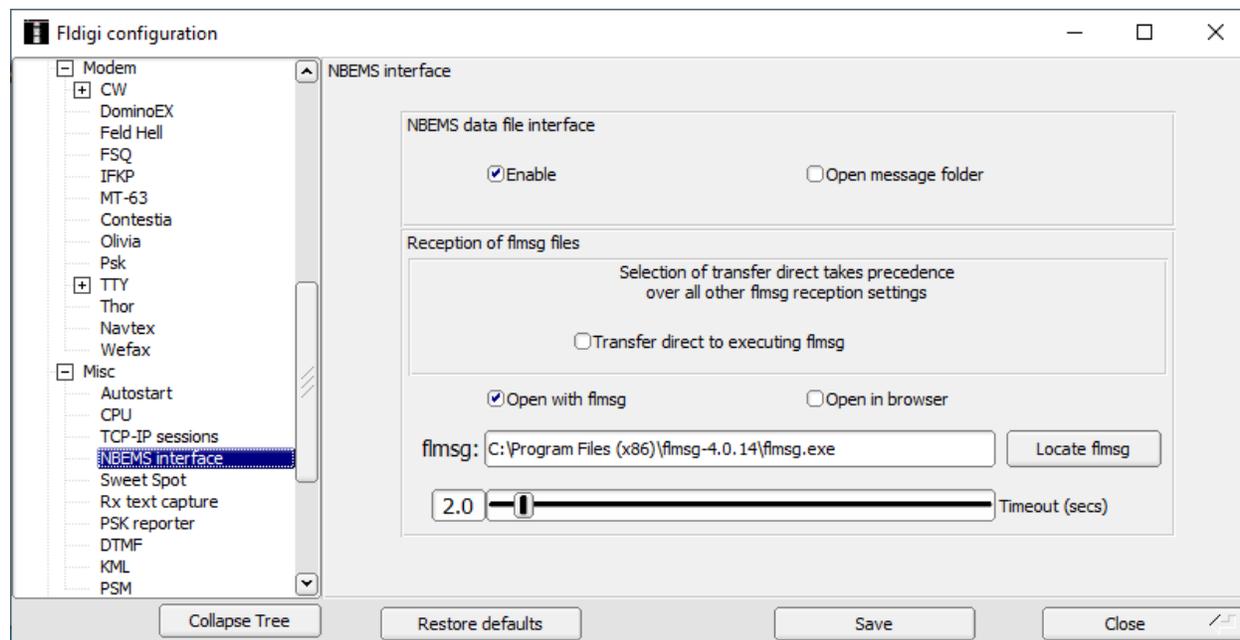
Sending Messages with FLMSG

FLMSG formats, including CSV spreadsheets, ICS forms, MARS forms, ARRL Radiograms, American Red Cross, and Severe Weather Report forms. Using MFSK32 even allows us to send small images in black/white or color. If the FLMSG message is received with no errors, it opens with the same FLMSG FORM that created it.

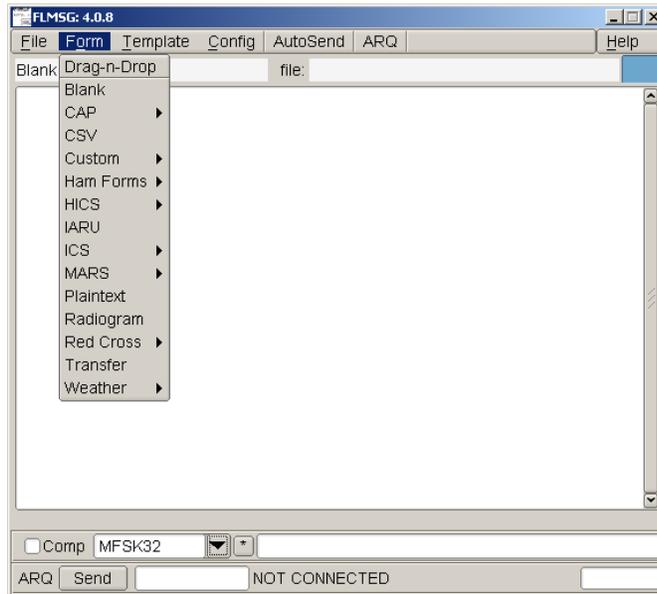
FLDIGI must first be configured to know where the **FLMSG.exe** is on your hard drive.

This is a critical step to allow you to OPEN received FLMSG traffic.

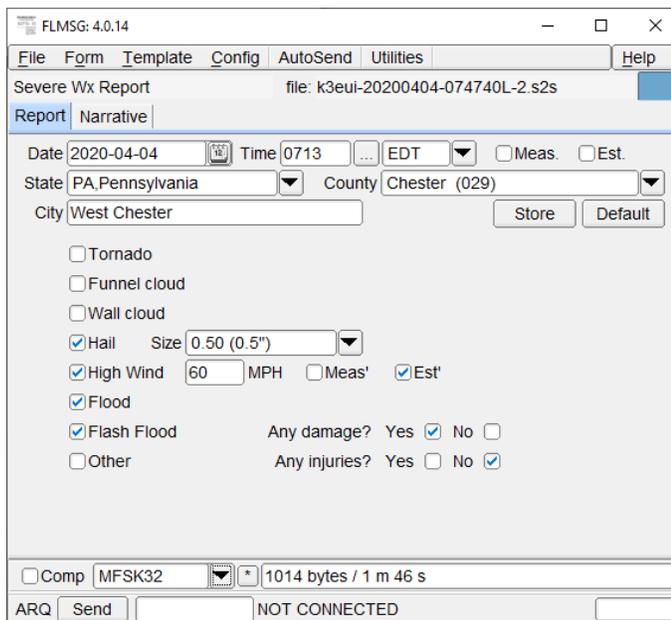
If you need to PRINT messages, then check the **Open In Browser** option



Variety of FLMSG forms available with FLDIGI



Here is a WX SEVERE storm report



ICS 213 messages are very common for EMERGENCY COMS

FLMSG: 4.0.14.01

File Form Template Config AutoSend Utilities Help

ICS-213 report file: default.213

Originator Responder

Inc: inciden 001

To PaNBEMS Pos. EMCOMM net

Fm K3EUI Pos. Pa NBEMS net manager

Sub. TEST

Message: Date 2020-04-05 Time 1159L

This is a test for propagation from Philadelphia to Pittsburgh on a frequency of 3583 kHz using the op mode THOR 22.

App'd Barry k3eui Pos. Pa NBEMS net manager

Comp MFSK32 * 469 bytes / 55 secs

ARQ Send NOT CONNECTED

ICS-206 Medical Forms

FLMSG: 4.0.14

File Form Template Config AutoSend Utilities Help

ICS-206 report file: default.206

Med Plan Transport Ambulance Hospital Med' Proc'

Incident Name Date Prepared Time Prepared

Operational Period:

Medical Aid Stations	Location	Paramedics
		<input type="checkbox"/>

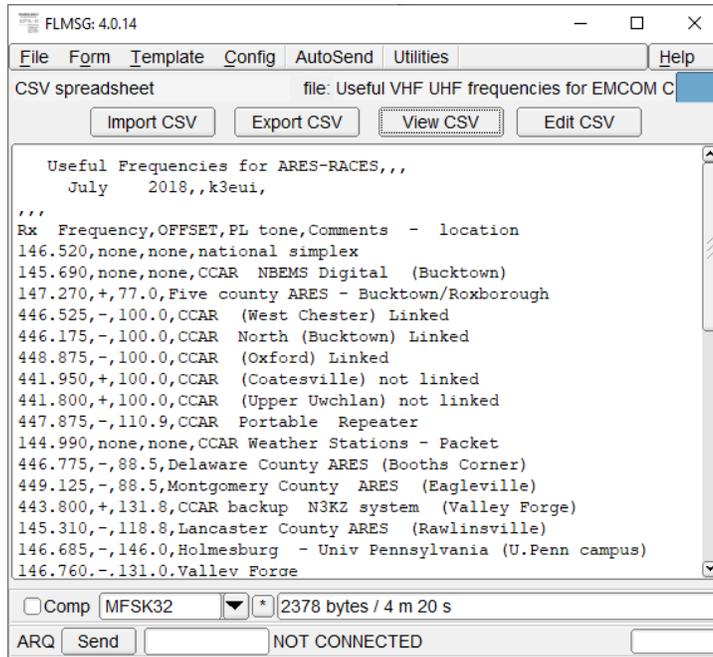
Preparer Reviewer

Comp OLIVIA-8/500 *

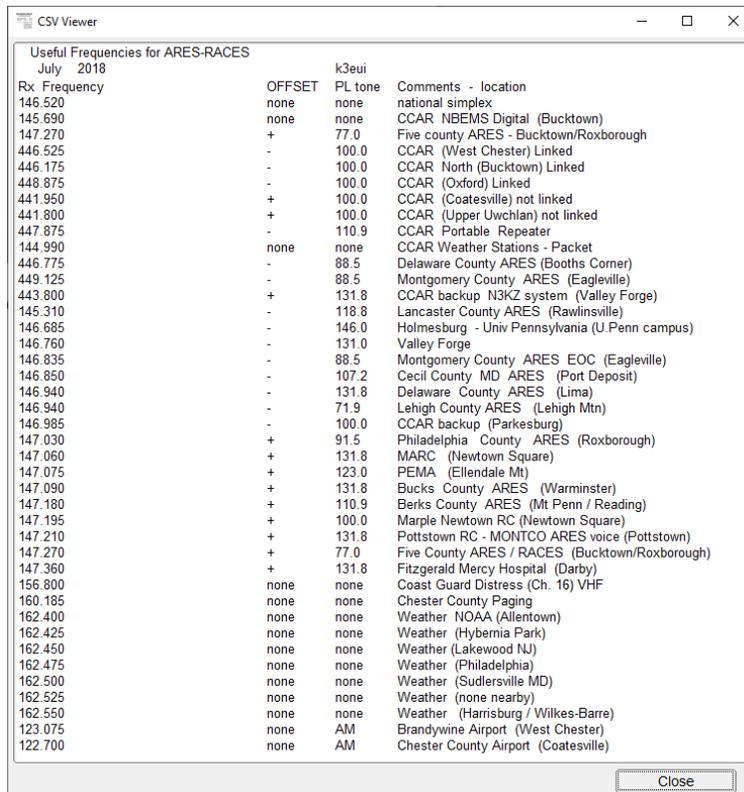
ARQ Send NOT CONNECTED

FLMSG can send a spreadsheet as a "CSV" file

Here is a complete list of repeaters in the greater Philadelphia region



The file is easier to read when set up as a spreadsheet view:



You have a number of "Custom" files: Chester County Daily Shelter Report

127.0.0.1:8080/
127.0.0.1:8080

Getting Started
Chester County, PA C... Coronavirus COVID-19...

Facility: Sender's call:

Time original report:

Shelter Population	Supplies Needed:															
<p>Current number of people in shelter: <input type="text" value="12"/></p> <p>New registrations today: <input type="text" value="5"/></p> <p>Total number of registrations: <input type="text" value="17"/></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Item:</th> <th style="width: 30%;">On Hand:</th> <th style="width: 40%;">Needed:</th> </tr> </thead> <tbody> <tr> <td>Cots:</td> <td><input type="text" value="25"/></td> <td><input type="text" value="0"/></td> </tr> <tr> <td>Blankets:</td> <td><input type="text" value="25"/></td> <td><input type="text" value="0"/></td> </tr> <tr> <td>Comfort Kits:</td> <td><input type="text" value="5"/></td> <td><input type="text" value="0"/></td> </tr> <tr> <td>Cleanup Kits:</td> <td><input type="text" value="5"/></td> <td><input type="text" value="0"/></td> </tr> </tbody> </table>	Item:	On Hand:	Needed:	Cots:	<input type="text" value="25"/>	<input type="text" value="0"/>	Blankets:	<input type="text" value="25"/>	<input type="text" value="0"/>	Comfort Kits:	<input type="text" value="5"/>	<input type="text" value="0"/>	Cleanup Kits:	<input type="text" value="5"/>	<input type="text" value="0"/>
Item:	On Hand:	Needed:														
Cots:	<input type="text" value="25"/>	<input type="text" value="0"/>														
Blankets:	<input type="text" value="25"/>	<input type="text" value="0"/>														
Comfort Kits:	<input type="text" value="5"/>	<input type="text" value="0"/>														
Cleanup Kits:	<input type="text" value="5"/>	<input type="text" value="0"/>														
<p>Meals served: Date: <input type="text" value="April 7"/></p> <p style="padding-left: 40px;">Breakfast: <input type="text" value="15"/></p> <p style="padding-left: 40px;">Dinner: <input type="text" value="15"/></p> <p style="padding-left: 40px;">Total: <input type="text" value="30"/></p> <p style="padding-left: 40px;">Snacks: <input type="text" value="5"/></p> <p style="padding-left: 40px;">Special diet Requirements: <input type="text" value="2 vegetarian 1 g"/></p>	<p>Have unusual situation: <input type="text" value="2 allergy problems"/></p> <p>Need medical assistance: <input type="text" value="none serious"/></p> <p>Need mental health: <input type="text" value="none"/></p> <p>Security issue; called 911 / 146.88 : <input type="text" value="no"/></p> <p>Need security: <input type="text" value="no"/></p>															
<p>Staff:</p> <p>Red Cross Volunteer staff: <input type="text" value="2"/></p> <p>Red Cross Paid staff: <input type="text" value="1"/></p> <p>Facility staff: <input type="text" value="2"/></p> <p>Other staff: <input type="text" value="0"/></p> <p>Time of count: <input type="text" value="7 pm"/></p>																
<p>Safety, Security and Housekeeping check: Date & Time: <input type="text" value="March 29 7 pm"/></p>																
<p>Comments:</p> <div style="border: 1px solid black; padding: 5px; min-height: 100px;"> <p>***** THIS IS A DRILL *****</p> <p>We have three families with children, ages 2 to 8</p> <p>We have two families with pets: 2 dogs and 1 cat</p> <p>Everyone is comfortable</p> <p>Radio reception from the shelter to W3EOC is superb via the 2m link</p> </div>																
<p>Received by: <input type="text" value="Barry k3eui"/></p>																
<p>Received Date & Time: <input type="text" value="April 7 7 pm"/></p>																

And Weather Report Forms

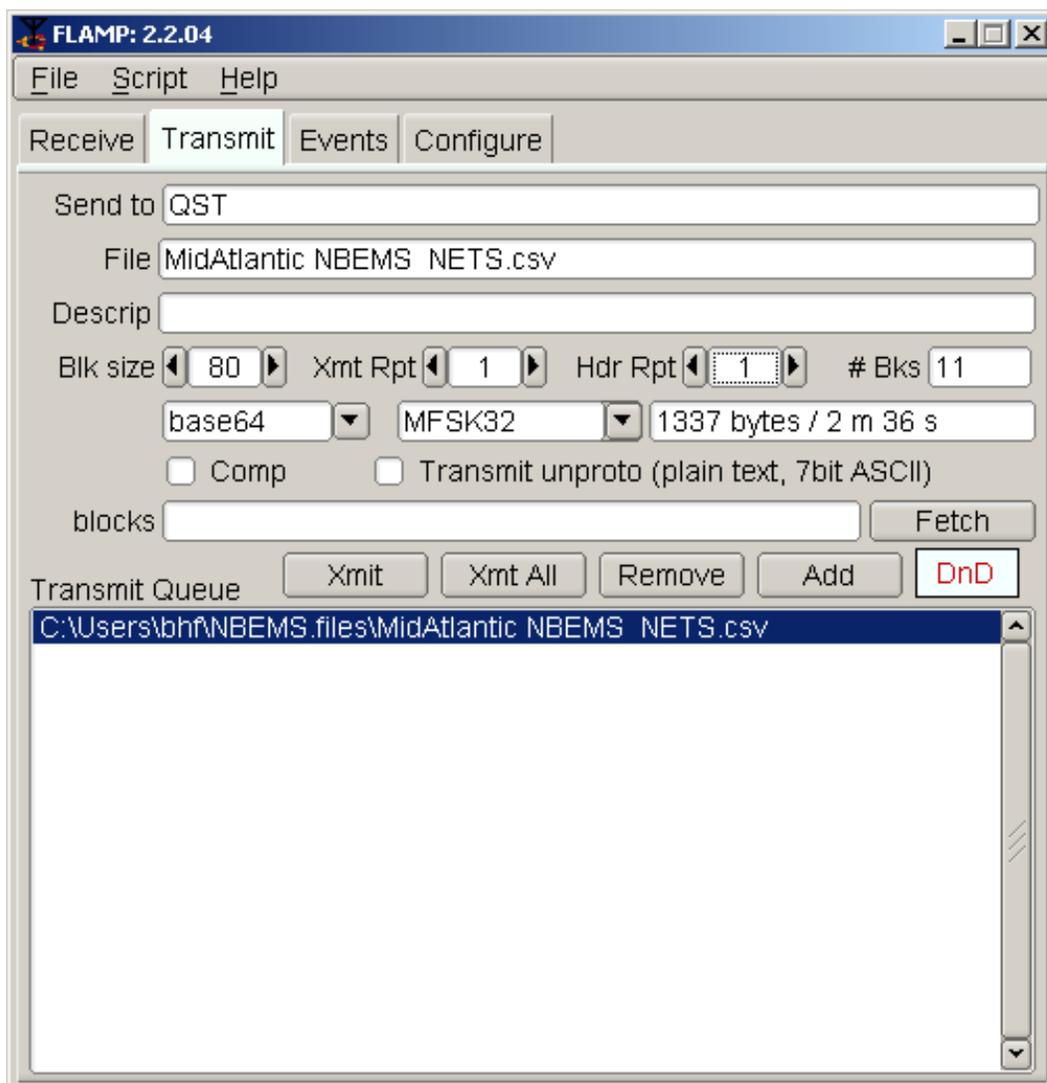
CURRENT LOCAL WEATHER CONDITIONS	
Call sign: <input type="text" value="k3eui"/>	Observer Name: <input type="text" value="Barry"/>
Date: <input type="text" value="mm / dd / yyyy"/>	Report Time: (local): <input type="text" value="-- : -- --"/>
Location: <input type="text" value="Street names or known closest landmark"/>	
City: <input type="text" value="west chester"/> State: <input type="text" value="pa"/> ZIP: <input type="text" value="19382"/>	County: <input type="text"/> Altitude: <input type="text"/> feet
Current Conditions: Check all that apply <input type="checkbox"/> CLEAR <input type="checkbox"/> RAIN <input type="checkbox"/> THUNDER STORM <input type="checkbox"/> HAIL <input type="checkbox"/> DARK <input type="checkbox"/> SNOW <input type="checkbox"/> TORNADO <input type="checkbox"/> HURRICANE <input type="checkbox"/> FOG <input type="checkbox"/> CLOUDY	
Temperature <input type="text"/> °F	Humidity: <input type="text"/> % Dewpoint <input type="text"/> °F
Barometer <input type="text"/> in/hg	Three hour trend <input type="radio"/> RISING <input type="radio"/> STEADY <input type="radio"/> DROPPING
Cloud cover description: <input type="text"/>	
Wind Speed: <input type="text"/> mph <input type="text" value="Estimated"/> Direction From: <input type="text" value="Select Direction"/>	Or enter actual Azimuth <input type="text"/>
Wind Gusts: <input type="text"/> mph	Wind Gusts MAX: <input type="text"/> mph Estimating Wind speeds
Rain per HR: <input type="text"/> inches	Rain previous day: <input type="text"/> Rain Total: <input type="text"/> inches for season
Snow per HR: <input type="text"/> inches	Snow past 24 hours: <input type="text"/> inches Water Content: <input type="text"/>
National Weather Service Alerts: <input type="text" value="NONE Issued"/>	
Notes: (optional) Anything of importance, damages noted, or weather type not indicated in above form. <input type="text"/>	
Form Concept by KF5SMH Version 1.4. Edits by KA1VGM, NY3J and W6FQX This Version December	
<input type="button" value="Submit Form"/>	

HOW ARE LONGER MESSAGES SENT: FLAMP

FLAMP allows the net to send larger files that are broken up into smaller “**BLOCKS**” of data.

Each BLOCK has its own checksum, with BLOCK size determined by the sender. When a station misses a block or two, and sends a “REPORT” of missing blocks, the originating station only needs to resend the “missing” (bad) BLOCKS, not resend the entire message, thus saving time.

FLAMP: MidAtlantic NBEMS nets 1337 bytes sent in 2m 36 seconds with 11 blocks with MFSK32



Ch. 6 NBEMS Net Structure

NBEMS nets are structured the same as EMCOMM PHONE and CW nets. There is a net control station (NCS) whose job is to manage the net in an organized way. At the start of a net, the net control will send a steady **TUNE** signal (sine wave of 1500 Hz) for a few seconds which other stations use to **zero beat** the frequency of the NCS on the waterfall. NCS will then turn on the FLDIGI **TxID** (transmit identifier) which consists of a short MFSK signal which notifies all stations of the **mode** and waterfall **frequency**. FLDIGI then automatically sets up the receiving station's FLDIGI to the correct frequency and mode. It works well, even with beginners. You need not learn to recognize the sound or the spectral shape of these digital modes; it is all done automatically for you. NCS will usually use **macros** built into FLDIGI to send out formatted text with just a push of the mouse button. The macros consist of instructions and check in procedures. Check in stations will normally not use TxID which might change the net's frequency. Net control usually turns on a frequency "lock" option so that the net frequency will return to the original setting the next time the NCS transmits. This will prevent the net from drifting up and down in frequency.

The PA, NJ, and NY NBEMS nets

If you happen to live in the Mid-Atlantic region of the country and tune your VFO between 3583-3585 kHz (USB, VFO dial frequency) at 0800 hr on the weekends, you are likely copy one of the mid-Atlantic NBEMS nets. If you set your digi mode program to **THOR 22**, you will likely pick up one of the three Mid-Atlantic NBEMS nets which now use **THOR 22** as their check-in mode. The NY NBEMS meets on Saturday at 0800 hr on 3584.0 kHz. The Pa NBEMS meets Sunday 0800 hr on 3583.0 kHz, and the NJ NBEMS meets Sunday at 0930 hr on 3584.5 kHz. These are regional (state) digital mode nets specializing in preparing for emergency communications over a region of a few hundred miles. If you catch the nets during the traffic phase, then try the mode **MFSK32** to decode the traffic transmissions. MSK32 is a bit faster and wider than THOR22 but the two modes sound similar; each mode sends one tone at a time, with multiple pitch options spaced quite close together. The bandwidth of THOR 22 and MFSK32 is about 500 - 700 Hz on the waterfall, with signals always centered at 1500 Hz on the waterfall.

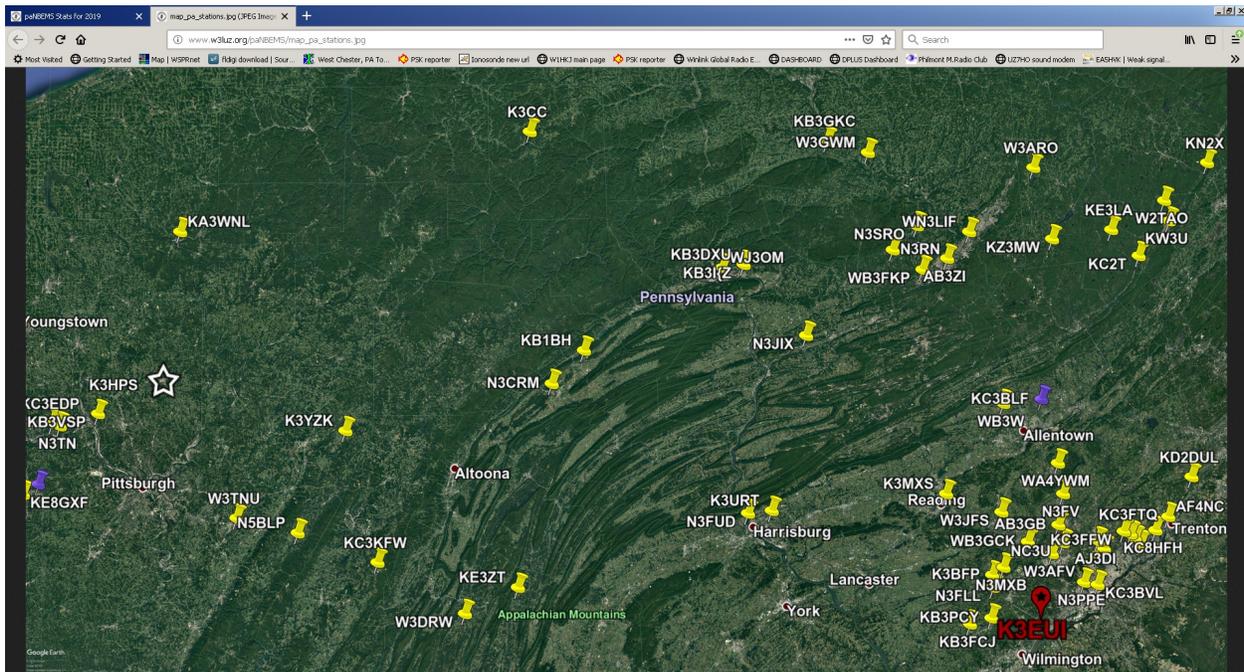
The Pa NBEMS net has been in operation for a few years and its following has now grown so that we usually have more than sixty check-ins for each Sunday 80 meter net. The map below shows the stations who regularly check in from Pennsylvania, but we normally have check-ins from as far as New England to Florida, and often as far west as Ohio, Michigan, and Wisconsin.

Details on the net statistics of the PANBEMS are kept by WN3LIF and can be found at

http://www.w3luz.org/paNBEMS/2019_paNBEMS_stats.html For additional information on

the PA NBEMS net see <https://groups.io/g/panbems>

Map of PA NBEMS checkins from Pennsylvania (provided by WN3LIF)



Barry Feierman k3eui West Chester PA