Sound card data modes and NBEMS

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Agenda

- Overview of available digital modes
- Applications to auxiliary communications
- Hardware
- Software
- Demo
Audio samples

- Audio samples for the modes mentioned in the following slides can be found here:
  - Modes supported by fldigi: [http://www.w1hkj.com/FldigiHelp-3.21/Modes/index.htm](http://www.w1hkj.com/FldigiHelp-3.21/Modes/index.htm)
Original digital mode

- CW
  - On-Off keying of the carrier
  - Very narrow bandwidth
  - No error correction
Original digital modes

• RTTY
  ▫ Frequency Shift Keying, typically 170 Hz shift
  ▫ 100% duty cycle
  ▫ As fast as 20 wpm CW
  ▫ Still popular for contesting
  ▫ No error correction
  ▫ Requires:
    • FSK radio and keying circuit or...
    • AFSK using sound card
Hardware decoder modes

- **AX.25 Packet**
  - Error detection, retransmit until it’s correct (ARQ)
  - Store and Forward, digipeaters
  - 1200 baud common, 19,200 baud max
  - Dedicated TNC or sound card packet engine
  - Used on HF (300 baud), VHF (1200 baud), or UHF (9600+ baud)
  - APRS uses Packet
Hardware decoder modes

• AMTOR (aka SITOR)
  ▫ Specialized form of RTTY
    • FSK at 100 baud
  ▫ Error detection and correction, ARQ
  ▫ Hardware or software
  ▫ No longer popular
Hardware decoder modes

- **PACTOR I/II/III**
  - Combination of Packet and AMTOR
  - Error correction, ARQ
  - Can send large files in difficult conditions
  - Hardware only, PACTOR I can be RX w/ software
  - PACTOR II and III are proprietary

- **Clover**
  - PSK, full duplex
  - Proprietary
Sound card modes

- **BPSK 31, 63, 125**
  - QPSK 31, 63, 125
    - Popular for keyboard-to-keyboard QSOs
    - No error correction

- **JT65**
- **JT9**
  - Very weak signal
  - Very slow data rate
Sound card modes

- **Olivia MFSK**
  - Olivia X / Y, X=number of tones, Y=bandwidth
  - Usable with very weak signals
  - Forward Error Correction
Sound card modes

- **MT63**
  - Fast, noise resistant
  - PSK
  - 500 Hz, 1000 Hz, or 2000 Hz
  - Forward Error Correction
  - MT63-2KL takes about 1 minute per kb
WinLink

- World-wide message (e-mail) system that uses radio and the Internet
- Hub and spoke system of Radio Message Servers (RMS) and Common Message Servers (CMS)
  - Users connect to an RMS
  - RMS’s connect to a CMS
- AX.25 Packet on VHF/UHF
- Pactor I/II/III or WinMor on HF
  - WinMor—non-proprietary sound card mode
Auxiliary Communications Applications

- Served agencies have an increasing need for accurate data communications
  - Roster of evacuees
  - Lists of medications
  - Complicated directions to a site
- Error correcting modes a plus
- Must be easy to configure in the field
- We need to provide more than just voice comms from a ham with a handheld radio.
Narrow Band Emergency Message System (NBEMS)

• Uses several programs developed by W1HJK
  ▪ fldigi – general purpose data engine
  ▪ flmsg – messages handling, ARRL Radiograms, ICS forms
  ▪ flarq/flwrap – file transfer, file compression
  ▪ flamp – multi-cast file transfer

• Public License, i.e. free

• Windows, Linux, Mac versions
NBEMS philosophy

• Keep it cheap
• Keep it simple
• Use open source software
• Don’t depend on infrastructure (repeaters, digipeaters, Internet)
• Make it fun
• Any computer, any radio.
What hardware?

- Radio
- Antenna
- Power supply
- Computer (Windows, Linux, Mac)
- Sound card interface
  - On VHF/UHF, can use audio coupling
Sound Card Interface Requirements

- Rx audio from radio to computer sound card
- Tx audio from computer sound card to radio
  - Both Rx and Tx need good audio isolation
  - Easy level adjustments a plus
- PTT
  - VOX will work
  - Hardware keying better
- Built-in USB sound card
  - Use computer’s sound card at your own risk
Sound Card Interface Options

- Homebrew
- BuxComm Rascal GLX ($80)
- Tigertronics SignaLink USB ($120)
- West Mountain Radio RIGblaster Advantage ($200)
- ZLP Electronics various models ($50-240)
- Microham Digikeyer II ($329)
- Timewave Navigator ($375)
Radios with built-in sound cards

- Icom
  - IC-7100
  - IC-7200
  - IC-7600
- Kenwood
  - TS-590
- Yaesu
  - FT-991
How to configure hardware?

- Build or buy a cable to connect sound card interface to radio
- Configure sound card interface
  - Set jumpers
- Install drivers
- Connect USB cable
- Check Windows Device Manager for COM port assignment.
How to configure radio?

- USB for most digital modes
- Receive
  - Turn off noise reduction, notch filter, noise blanker
  - Fast AGC
  - Use IF bandwidth adjustment with caution
- Transmit
  - Turn off compression
  - Turn off equalization
  - Adjust sound card level and mic gain for minimum ALC action
  - Medium power
Acoustic interface

- No sound card interface needed
- Use any radio
- Hold radio speaker to computer mic
- Hold radio mic to computer speaker
- Manual PTT
- Works well on VHF/UHF FM
  - Even through repeaters
- Use MT63-2KL mode.
fldigi

- fldigi=Fast, Light, Digital
- Uses sound card to decode received signals and encode transmitted signals
- Keys radio (if supported by interface)
- Old, slow computers work fine
- Designed for keyboard-to-keyboard comms
- Macros eliminate repetitive typing
**flmsg**

- **Built-in templates for common message formats:**
  - ARRL Radiograms
  - ICS forms
  - Custom templates
- **Uses check-sums ensure accuracy**
  - Sending station computes check-sum for sent message and inserts check-sum into message
  - Receiving station computes check-sum for received message and compares to sent check-sum
  - If check-sums match, error-free message
  - If check-sums don’t match, resend message
- **flmsg can automatically open received messages.**
How to configure software?

- Download and install fldigi
  - Configure settings
- Download and install flmsg
  - Configure settings
fldigi set-up wizard—Operator info
fldigi set-up wizard—Audio devices
fldigi set-up wizard—Transceiver
(only if your sound card interface has transceiver control)
fldigi set-up wizard—Tabular data
(not necessary for NBEMS)

<table>
<thead>
<tr>
<th>Tabular data sources</th>
<th>Timestamp</th>
<th>Size</th>
<th># reco</th>
<th>WWW</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMO stations</td>
<td>N/A</td>
<td>N/A</td>
<td>0</td>
<td>ned_boss.txt</td>
</tr>
<tr>
<td>Weather buoys</td>
<td>N/A</td>
<td>N/A</td>
<td>0</td>
<td>station_table.txt</td>
</tr>
<tr>
<td>Weather ships</td>
<td>N/A</td>
<td>N/A</td>
<td>0</td>
<td>Tor-Stats-Ship.csv</td>
</tr>
<tr>
<td>Argos &amp; Iridium</td>
<td>N/A</td>
<td>N/A</td>
<td>0</td>
<td>wmo_list.txt</td>
</tr>
<tr>
<td>Navtex stations</td>
<td>N/A</td>
<td>N/A</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

http://www.w1hkj.com/support_files/
fldigi addl set-up—Modems—MT63
fldigi addl set-up—RSID

fldigi configuration

Reed-Solomon ID (Rx)
- Receive modes
- Notify only
- Searches passband
- Mark prev freq/mode
- Disables detector
- Allow errors
- Medium
- Disable alert dialog
- Retain tx freq lock
- Disable freq change
- Squelch open (sec)

Pre-Signal Tone
- Transmit modes
- End of xmt ID

Restore defaults
Save
Close
fldigi addl set-up—RSID enable

- Enable RxID on main window
- Enable TxID on main window
flmsg set-up—Personal

![flmsg config window](image)

- **Call**: W9BU
- **Tel**: 317-410-7721
- **Name**: Bob Burns
- **Addr**: 
- **City/St/Zip**: 
- **Email addr**: w9bu@arrl.net
flmsg set-up—Date/Time
Configure fldigi for NBEMS
Advanced topics

- Using flarq/flwrap for file transfer
  - Binary files
- Using flamp for multi-casting
- Sound card calibration
- Packet for local VHF/UHF
  - OutpostPMM
- Promote local activity.
Practice, practice, practice

• Check into nets
  ▫ IN DTN, 3.5840 +1 kHz, Mon-Fri 9:00am, Olivia 8/500 *
  ▫ IN ARES DN, 3.5840 +1 kHz, Wed 8:30pm, Olivia 8/500
  ▫ MI DTN, 3.5830 MHz +1 kHz, Tue/Thu/Sat 7:00pm, Olivia 8/500 *
  ▫ KY DN, 3.5850 MHz +1 kHz, Wed 8:30pm, Olivia 8/500 *
  ▫ OHDEN, 3.585 MHz +1 kHz, Tue 8:00pm, Olivia 8/500 *
  ▫ PA NBEMS Net, 3.5835 MHz +1 kHz, Sun 10:00am, Olivia 8/500
  ▫ PA NBEMS Net, 7.0730 MHz +1 kHz, Sun 11:00am, Olivia 8/500
  ▫ US East NBEMS Net, 7.0360 MHz +1.5 kHz, Wed 7:00pm, Olivia 8/500

* May use other modes
On-line resources

- tigertronics.com
- w1hkg.com
- arrl.org/nbems
- FSD-218
  - arrl.org/files/file/Public%2520Service/fsd218.pdf
- wpaares.org
- youtube.com/user/davekle38sp
- youtube.com/user/StanislausCountyARES
- oliviamode.com
- wb8nut.com/digital
Demo

• Using two stations on 80m with dummy loads and sound card interfaces
  ▫ Establish communications
  ▫ One station sends message
  ▫ Other station sends reply

• Using two stations on 2m with antennas, one station using acoustic coupling
  ▫ One station sends message
  ▫ Other station sends reply