Spring Digital Exercise

To: All ECs and DECs

From: Dave Edenfield, W8RIT and John McDonough, WB8RCR

Date: 26-March-2009

Subject: Plans for spring digital exercise

Contents of this document

Objectives of the exercise

Introduction	At the fall EC meeting the possibility of holding a number of smaller exercises during the year focused on specific capabilities was discussed. It was suggested that exercises designed to exploit specific situations, modes or circuits could be educational. Dave, W8RIT, was tasked with designing an exercise we could have quickly, preferably during the first quarter, to examine digital modes.
Understanding the capability	A primary goal of such a test would be to get an understanding of the effectiveness of the various digital modes for use in emergency communications situations across the state. The potential for using digital modes has been raised many times. However, little quantitative data is available to help choose between the many modes available, nor do we really know whether they could be effective across a large number of stations with varying capability.
Gaining familiarity	Such an exercise would also expose more members to these modes. Many amateurs have explored none of the sound card modes, in spite of the fact that they are easily and cheaply set up. Such an exercise should raise awareness of the modes and perhaps motivate some members to develop the capability.
Non Objective	During this exercise we will test the capability, but one criticism of the "keyboard" modes has been that net procedures are not well worked out for these modes. The conduct of this exercise will not give us insight into that specific issue.

Conduct of the exercise

Introduction

In order to obtain meaningful data, a specific process will be required for exercise.

Limited Transmitters

While we would like to have as many participants as possible, constraining the exercise to some reasonable time requires that we limit the number of stations transmitting. We will ask each DEC to appoint one station to represent that District in the test. Ideally that station should be an EOC.

Limited Bands

At the current levels of flux, frequencies above about 5 MHz are not useful for reliable in-state communications. Few EOCs have 1.9 MHz capability. That limits the frequencies to test to the 3.5 MHz band. We will use 3.583.75 MHz (or as close as practical).

Limited Modes

Because of the same time limitations that constrain the number of transmitters, we are also constrained to the number of modes that may be tested.

Exercise Process

Each district will make a transmission at a scheduled time. Other stations, not only the district key stations, but other stations within each district, will copy that station and send reports. (There is a short break in the middle of the schedule.)

Each transmission will consist of prepared text composed by the exercise coordinator. All stations will transmit at 20 watts.

In order to reduce the effect of propagation varying across the period of the test, the runs will be randomized.

Schedule

Time	Mode	District	Time	Mode	District
9:00	MFSK	3	10:53	MT-63	5
9:07	Olivia	2	10:58	MT-63	1
9:14	MFSK	8	11:03	Olivia	SEOC
9:21	Olivia	8	11:08	BPSK-31	5
9:28	Olivia	7	11:13	BPSK-31	6
9:35	MFSK	7	11:18	BPSK-31	2
9:42	MFSK	6	11:23	MFSK	SEOC
9:49	BPSK-31	SEOC	11:28	MFSK	2
9:56	BPSK-31	1	11:33	MFSK	5
10:02	MT-63	6	11:38	Olivia	5
10:08	BPSK-31	3	11:43	MT-63	8
10:14	Olivia	3	11:48	MT-63	3
10:20	MT-63	7	11:53	MFSK	1
10:26	BPSK-31	7	11:58	Olivia	6
10:32	BPSK-31	8	12:03	Olivia	1
10:47	MT-63	SEOC	12:08	MT-63	2

SEOC will make a long MFSK transmission prior to 9 o'clock to help stations to set up. Between scheduled transmissions SEOC will transmit in the upcoming mode to keep the frequency clear and allow stations a chance to set up for the next mode. Should a station be unable to start on time, the schedule will be slid 5 minutes.

Reporting

Introduction	Dave Edenfield, W8RIT, will collect reports from each district as well as additional monitoring stations.
Contents of report	Transmitting stations will report station city or township, software used, radio used, antenna used, interface used, sound card used and power output. Receiving stations will report receiving station city, software used, radio used, antenna used, interface used, sound card used and percentage of characters received correctly. A receiving station may report only some modes if all modes are not available to that station. Stations using homebrew interfaces should provide a short description of the interface.
Delivery of report	A blank text file with the schedule will be made available on the ARPSC web site. Paste your copy into the appropriate place in the text file and email the result to W8RIT. Prior to the exercise, download the reporting form from: http://www.mi-arpsc.org/downloads/DigitalExerciseReport.txt Email the report to: w8rit@arrl.net
Publication of Results	Results, including analysis, will be published at: http://www.mi-arpsc.org/Exercise_09spring.php

Schedule

Exercise Date	The exercise will be held on Saturday, May 9, 2009 from 9:00 AM until 12:10 PM. There is a short break in the middle of the schedule.
Reports Due	Reports are due to be sent to Dave by May 31, 2009.
Publication of results	Results will be published as they become available.

Technical Requirements

Introduction	In order to obtain meaningful data, we need to all stick to the same standards.
Frequency	All transmissions will occur on 3583.75 kHz center frequency, or as close as practical. This means you will set your transceiver to 3583 or 3582, USB, and place the waterfall cursor on 3583.75 . Setting your transceiver to 3582 would put this frequency close to the center of your passband, but some software forces the location of the MT63 cursor, requiring the 3583 setting. Be sure to familiarize yourself with your equipment ahead of time.
Power Output	All Stations will transmit with an output power of 20 watts PEP. Antenna differences will obviously cause differences in ERP.
Modes	Four modes will be used during the test: • BPSK-31 • Olivia - 16/500 • MT-63 - 500 long • MFSK - 16

Preparation

Introduction	The purpose of this evaluation will be to test the reliability of various soundcard digital modes under various propagation conditions and geographical distances among EmComm stations in Michigan. To maximize your benefit from this test, some preparation would be useful.
Soundcard Interface	One of the first things you must do if you have not done so already is acquire and set up a rig to soundcard interface. There are links for manufacturers and schematics you can build below. Then, download your choice(s) of software. Links are also provided below; most of the software is freeware with occasional mixes of commercial software. You could also calibrate your soundcard per the soundcard manufacturer's and/or software documentation. It is not absolutely necessary, but it would help ensure the accuracy of your station's transmissions.
Software	Download the software of your choice, but be aware that not all of the software may contain all the modes needed for the test. You may need to download and install multiple software programs. Read through the help to make sure you understand the basic operation and how to properly configure the program.
Macros	Once you have downloaded the software of your choice, you may wish to enter in macros to make it easier to send certain text repeatedly. For example, you may wish to enter your callsign in and the "QUICK BROWN FOX" test message I will supply to you.
RX/TX Test	Prior to the test, try to receive (and transmit to) stations to verify your software is configured properly. Depending on your familiarity with these modes, you may want to plan well in advance.
Reporting	Go to http://www.mi-arpsc.org/downloads/DigitalExerciseReport.txt and have the form ready for logging your received text.

During the Test

RF Power	Use 20 watts PEP. Be very careful of your microphone gain. Excessive gain will distort your signal. Do not adjust your RF power at any point through your transmissions. Keep it at one position from the start of the test to the end. Remember that some modes have a higher transmit duty cycle. RTTY is 100% duty cycle and PSK31 is 80% duty cycle. Therefore, it can be easy to damage your transmitter with these duty cycles. Many modes will provide good communications with 5 to 30 W
Antenna	Please use one antenna only throughout the test. Do not switch an antenna in the middle of a test. Use an omni-directional antenna (or one close to omni) if at all possible. If you use a directional antenna it may alter reception strength at stations located in different geographic areas. Use an omni to "level the playing field" and to not introduce any other factors.
Small Adjustments	Turn off your Windows Sounds. If you do not, you may transmit your Windows "ding" and we will hear that affecting your transmission as well. You do this from your Sounds and Audio Devices Properties window > Sounds tab and under the dropdown menu for "Sound scheme" choose "No Sounds". Remember NOT to overdrive your soundcard. Doing so will in many cases cause splatter and unwanted sideband emissions. It may also warrant you an OO card. Follow the directions in the help for the software program. You may need to adjust your microphone gain for the soundcard and/or the radio. Do not have your radio's compressor turned on. If your radio has a notch filter you should understand its effect. Since the single sideband passband represents the entire "band" for some modes, a strong station can affect your AGC making copying difficult. Your notch filter may help you here. However, on some radios, the notch filter may distort the signal sufficiently that it cannot be decoded. Be especially careful of radios with older DSPs. In general, an audio DSP should be turned off, although IF DSP can be useful. Be familiar with your equipment.
Identification	Do not forget to send your callsign at the end of each transmission for obvious reasons.

Continued on next page

During the Test, Continued

Receiving

Center frequency- We will use the term center frequency. For our purposes, the definitions will be the center of the transmitted signal. Various soundcard modes have different bandwidths. For example, you may know that PSK31 has a bandwidth of 31 Hz (actually, 31.25Hz). MT-63 has various bandwidths from 500 Hz to 2 kHz. When we specify the center freq is 3583.75 kHz, that would mean that for MT-63 500Hz, the occupied bandwidth as seen on your waterfall would be from 3583.50 kHz to 3584.0 kHz.

AFC- Use your AFC cautiously. In many of the modes you may want to turn on your AFC from the software to help properly track a transmitted signal, once the transmission has begun. Please ensure that you can place your trace in the waterfall, back at the original position, so that you do not miss characters at the start of the next transmission. If there is another close adjacent signal, it may track off and lock on to that unwanted signal. You may lose some time and a portion of the beginning of the desired signal for it to track back to it's proper spot in the waterfall. When the AFC tracking wanders like this it has the undesired action of missing characters in the beginning of the transmission. Don't let the AFC wander with your waterfall trace. The AFC of which I'm speaking is found in the software you choose, and may not be available depending on the mode. It may be best to turn the AFC off and be prepared shortly after receiving the other station to turn it on so it will properly follow that particular station's signal.

Ripple in the passband of your receiver can cause reception issues. You should adjust receive levels so that you see some background "noise" on the waterfall (usually blue). If there are dark regions, you may have unnecessary filters turned on or there may be DSP artifacts. You may wish to tune your receiver so that the desired center frequency is away from these dark areas. You may also wish to test your filter and DSP settings to understand what control you have over this effect.

Keep in mind that when receiving (or in many cases…transmitting), there can be a small (or maybe not so small) latency delay between when you hear and see a station on your waterfall transmitting and the time it takes for you to start decoding text. This will vary from modes and their independent settings like: interleave, bandwidth, or other characteristic.

Reporting

Be sure to paste the received text from your software into the correct place on the form you downloaded from:

http://www.mi-arpsc.org/downloads/DigitalExerciseReport.txt

After the Test

Reporting

Send me via e-mail (w8rit@arrl.net) your saved text files. Let me know details about your station such as:

Software in use

Power output

Antenna in use (type, height, feed line, etc.)

Radio in use

Interface used

Soundcard used

Grading

Each separate transmission will be assigned a percentage. The "QUICK BROWN FOX" test tape that will be supplied you will contain 100 characters. The number of those received correctly will relate directly to a percentage.

Disclaimer

Due to the relatively short period of time the test will take place you should keep in mind some of the factors you may need to adjust for in the future. Some of those factors may be:

- Time of day and how each of the amateur bands behaves
- Seasonal variations of propagation conditions
- What point in the solar sunspot cycle we are in and other solar conditions (i.e. coronal mass ejections, etc.)
- Antennas
- RF power
- Amount of text to be transmitted
- Distance of receiving station from your location
- When switching to another mode may be beneficial for reliable communications

Useful Links

Software

Fldigi - http://www.w1hkj.com/Fldigi.html

Ham Radio Deluxe - http://www.ham-radio-deluxe.com/

MixW - http://www.mixw.net/

Digipan - http://www.digipan.net/

Gmfsk – http://gmfsk.connect.fi

MultiPSK - http://f6cte.free.fr/index_anglais.htm

Frequency Lists

http://n1su.com/digital.html

http://home.att.net/~n8st/freq.html

Interfaces

Some sources for commercial interfaces:

http://www.mfjenterprises.com

http://www.westmountainradio.com/

http://www.tigertronics.com/

http://www.timewave.com

http://www.nue-psk.com

http://www.microham.com/

http://www.buxcomm.com

Other

Examples of what different modes sound like:

http://www.wb8nut.com/digital.html

http://www.kc0tks.org/index.php?option=com_content&task=view&id=38&Itemid=45

Constructing an Interface

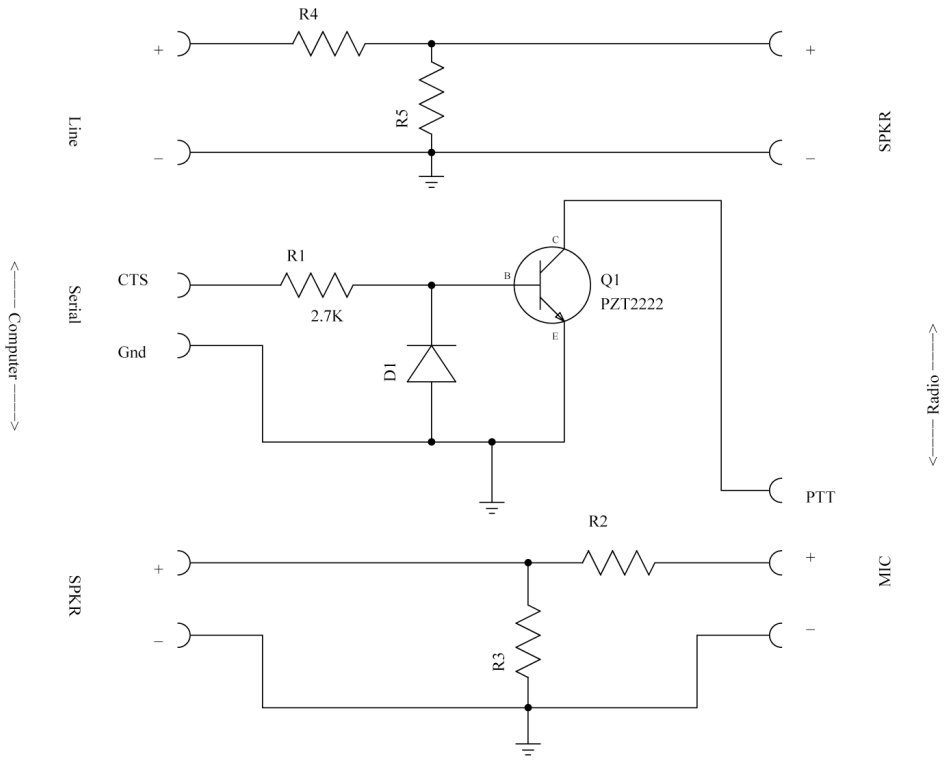
Introduction

Many amateurs construct their own interface. It is simple, and requires no special skills or hard to get parts. The best interfaces use transformers and optical isolators to isolate the transceiver from the computer. However, the correct transformers are often difficult to find and isolation is rarely required.

Construction

The interface described here is very simple. Construction is not at all critical and any technique can be used. WB8RCR employed islander construction for both his home station and the SEOC. Islander is well suited to the simple circuit.

The circuit



The resistor pairs R2/R3 and R4/R5 are selected to make the level adjustments on the PC software as easy as possible. The values depend on the radio, computer and software. Generally, 100 ohms is a good starting point for R3 and R5. The other resistors should typically be between 100 and 1000 times as large. These values are very non-critical; in fact, R4 can be replaced with wire and R5 omitted, although this may make level adjustment on the PC a little critical.

Any NPN switching transistor may be substituted for the 2222.

Printed Circuit

A PC board file for an SMT version of this interface (without R4/R5) is available at http://arpsc.mi-nts.org/downloads/SoundCardInterface.pdf. This is WB8RCR's mobile/portable interface.