

A wide-angle photograph of the Grand Canyon, showing the layered red rock formations and the deep, winding canyon. The sky is blue with scattered white clouds. The text is overlaid on the top half of the image.

AG 7 GK

Digital Modes Workshop

01/22/2019

Digital Mode Agenda

- Why Digital?
- Equipment requirements
- Examples of Modes and Interactive Demos (Bring your stuff)
- Digital Net Planning

Introductions

- Aaron Jones – AG7GK first licensed in 2016 as KI7DUK
- Go around the room:
 - Name and Callsign
 - License level
 - Any goals you care to share in relation to Digital Modes
 - Experience with Digital Modes
 - APRS
 - NBEMS (FLDIGI)
 - WINLINK
 - DX MODES

Why Digital?

- CASE FOR DIGITAL EMCOMM
 - Voice example using NTS Traffic Protocols:
 - St. John's, prepare to copy.
 - Tag 176003, female, 20 - 30, transport helo, red.
 - Now imagine having to transmit and verify that 20, 30, 50 times or more.
 - How long would that take?
 - Not including phonetics, repeats, fills, breaks, and confirmation...
 - 17 minutes.
 - Using a digital mode, we can transmit that data in a fraction of the time... and verify it!
 - 2 minutes 28 seconds.
 - **Maybe you just don't feel like talking to someone!**

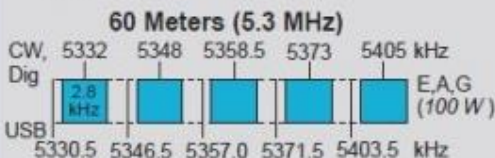
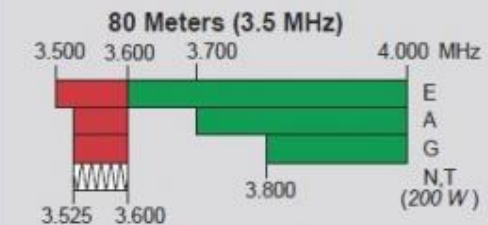
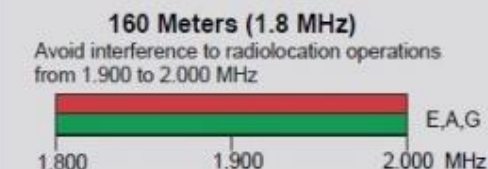
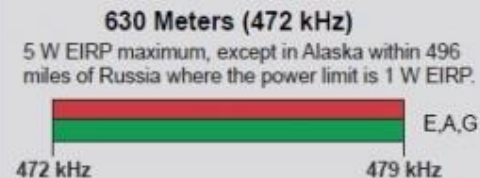
US Amateur Radio Bands

US AMATEUR POWER LIMITS — FCC 97.313 An amateur station must use the minimum transmitter power necessary to carry out the desired communications. (b) No station may transmit with a transmitter power exceeding 1.5 kW PEP.

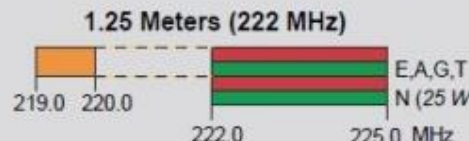
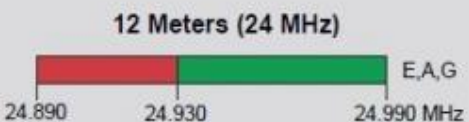
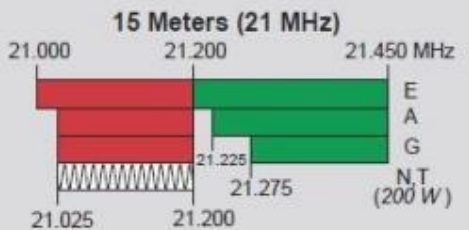
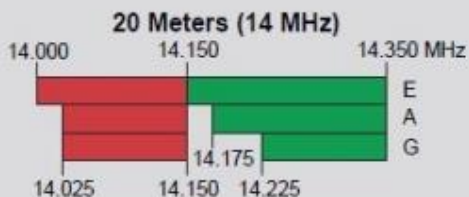
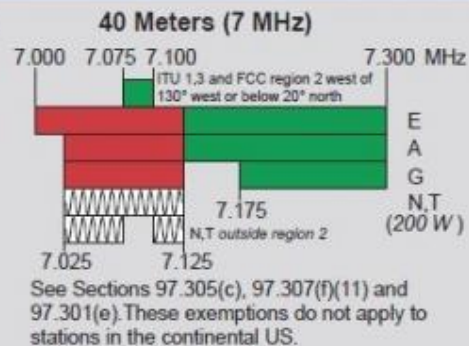


ARRL The national association for AMATEUR RADIO®

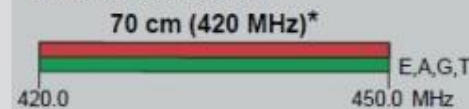
Amateurs wishing to operate on either 2,200 or 630 meters must first register with the Utilities Technology Council online at <https://utc.org/plc-database-amateur-notification-process/>. You need only register once for each band.



General, Advanced, and Amateur Extra licensees may operate on these five channels on a secondary basis with a maximum effective radiated power (ERP) of 100 W PEP relative to a half-wave dipole. Permitted operating modes include upper sideband voice (USB), CW, RTTY, PSK31 and other digital modes such as PACTOR III. Only one signal at a time is permitted on any channel.



*Geographical and power restrictions may apply to all bands above 420 MHz. See *The ARRL Operating Manual* for information about your area.



All licensees except Novices are authorized all modes on the following frequencies:

2300-2310 MHz	10.0-10.5 GHz ‡	122.25-123.0 GHz
2390-2450 MHz	24.0-24.25 GHz	134-141 GHz
3300-3500 MHz	47.0-47.2 GHz	241-250 GHz
5650-5925 MHz	76.0-81.0 GHz	All above 275 GHz

‡ No pulse emissions

KEY

Note: CW operation is permitted throughout all amateur bands.

MCW is authorized above 50.1 MHz, except for 144.0-144.1 and 219-220 MHz.

Test transmissions are authorized above 51 MHz, except for 219-220 MHz

- = RTTY and data
- = phone and image
- = CW only
- = SSB phone
- = USB phone, CW, RTTY, and data
- = Fixed digital message forwarding systems only

- E = Amateur Extra
- A = Advanced
- G = General
- T = Technician
- N = Novice

See *ARRLWeb* at www.arrl.org for detailed band plans.

ARRL We're At Your Service

ARRL Headquarters:
860-594-0200 (Fax 860-594-0259)
email: hq@arrl.org

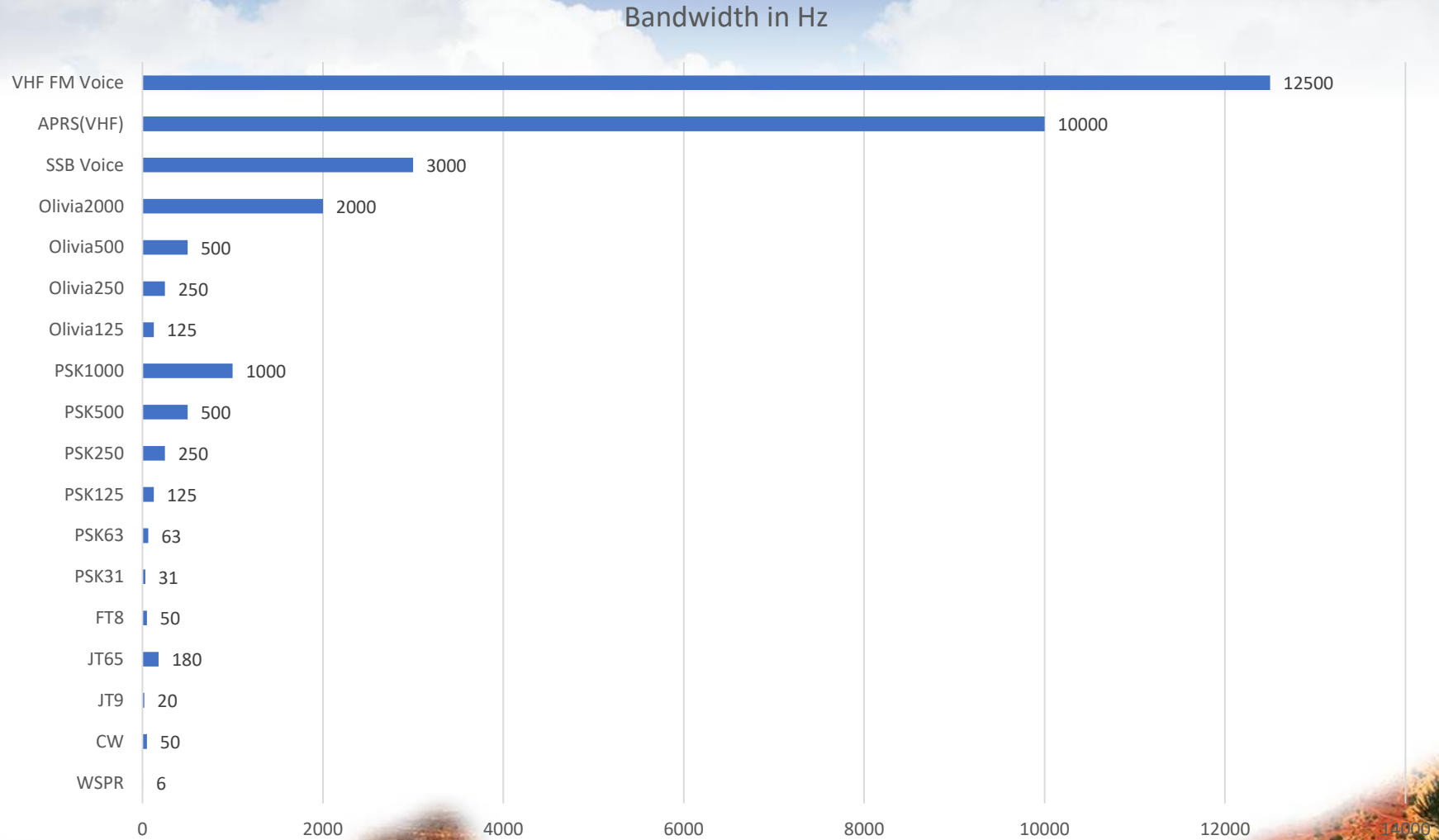
Publication Orders:
www.arrl.org/shop
Toll-Free 1-888-277-5289 (860-594-0355)
email: orders@arrl.org

Membership/Circulation Desk:
www.arrl.org/membership
Toll-Free 1-888-277-5289 (860-594-0338)
email: membership@arrl.org

Getting Started in Amateur Radio:
Toll-Free 1-800-326-3942 (860-594-0355)
email: newham@arrl.org

Exams: 860-594-0300 email: vec@arrl.org

Bandwidth



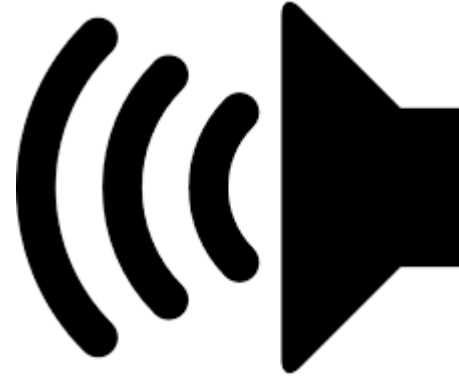
Note: Not “necessary bandwidth” as defined by ITU

Equipment

- Computer OR Tablet / Phone
- Cables
- Radio with APRS
- GPS
- RADIO
- TNC or Soundcard
- Pactor Modem (In case of Network modes like Winlink)

HT Acoustical Coupling

- <http://www.w1hkj.com/vk2eta>
- Tablet / Phone / Computer
- Apps:
 - Android SSTV
 - AndFLMSG
 - Droid PSK
- HT with HT specific cables
 - Baofeng HT
- APRS Specific Setup
 - HT
 - MOBILINK TNC and Cable
 - APRS Droid



HT / Audio Cable

- Tablet / Phone / Computer
- Apps:
 - Android SSTV
 - AndFLMSG
 - Droid PSK
- HT with HT specific cables
 - Baofeng HT
 - Baofeng BT Tech APRS Cable using VOX PTT OR
 - Custom Audio interface cable to trigger PTT
- APRS Specific Setup
 - HT
 - MOBILINK TNC and Cable
 - APRS Droid



Basestation

- Computer / Tablet
- Soundcard either built in or USB
- Apps:
 - MMSSTV
 - FLDIGI- FLMSG-FLRIG
 - WSJTX
 - WSJT-X JTAlertX
- Bastation
- Any Antenna – Mag Loop, Dipole, Vertical, anything to get a signal in and out



Warning about Duty Cycle

- Reduce your power!
 - Unlike SSB, these modes either run at 100% duty cycle, or use multiple tones sensitive to intermodulation distortion!
 - Be kind to your finals!
 - Keep **peak** power out well below key-down CW maximum to minimize distortion.
 - Keep ALC to zero
- Turn off speech processing or compression

Software

- WSJTX – used for FT8, JT Modes, WSPR, and Meteor Scatter
- MMSSTV – Used for Slow Scan TV
- FLDIGI – Many modes and options with companion software such as:
 - FLAMP - Amateur Multicast Protocol (One to Many Transmission of Files)
 - FLMSG – Message sending, one to many including CSV data, Text, Images, Radiograms, and many ICS related Emcomm forms
 - **ANDFLMSG** – Android version of FLMSG
 - Other FL related software
- Winlink RMS Express
- APRS Software (Many versions for all platforms)

Propagation Websites

- PSKreporter.info: <https://pskreporter.info/pskmap.html>
 - Use the stats page to see what modes are happening: <https://pskreporter.info/cgi-bin/pskstats.pl>
- Wsprnet for WSPR results; <http://wsprnet.org/drupal/wsprnet/map>
OR alternative: <http://wspr.aprsinfo.com/>
- Hamspots.net: <https://hamspots.net/>
- APRS.fi: <https://aprs.fi>
- Online listing of hosted SDR receivers, great for verifying your signal on voice OR digital: <http://websdr.org/>

NBEMS / FL “Suite”

- Narrow Band Emergency Messaging System
- <http://www.w1hkj.com/NBEMS/NBEMS.ppt>
- Software (All free):
 - FLDIGI – Main application for mode selection, rig control, QSO’s
 - FLAMP – Application for sending files in chunks, allows for retries and relays of missing chunks
 - FLMSG – Your go-to application for sending text and forms (Radiograms)
 - **ANDFLMSG** – Android version
 - FLRIG – Rig control application if you have a CAT control interface to your RIG

NBEMS - Demo

- FLDIGI Interactive Demo
- ANDFLMSG on a tablet and Handheld using Acoustic Coupling



NBEMS - Demo

Using FLRIG if you have CAT control, otherwise set your frequency on your Radio

145550.000

Note Frequency at Offset

Set rig to 145550.000 Digital

VIDEIO Macro

RxID & TxID On

Frequency offset selected in Waterfall

TX Locked

Squelch ON

FLMSG Running

Squelch Slider to avoid garbage decodes

The image shows two overlapping software windows. The top window is 'flrig IC-7100' with a menu bar (File, Config, Memory, Help) and a frequency display showing '145550.000'. Below the frequency are various control sliders and buttons like 'ATT', 'Pre-1', 'NB', 'AN', 'Pwr', 'Vol', 'A/B', 'Split', and 'PTT'. The bottom window is 'fldigi ver4.0.17 / IC-7100 - AG7GK' with a menu bar (File, Op Mode, Configure, View, Logbook, Help) and a frequency display also showing '145550.000'. It features a waterfall display at the bottom and various control buttons. A third window on the right is 'FLMSG-4.0.7' with a menu bar (File, Form, Template, Config, AutoSend, ARQ) and a status bar showing 'NOT CONNECTED'. Red arrows point from text annotations to specific elements in all three windows.

SSTV DEMO

- A single image is converted to individual scanned lines and those lines sent as variable tones between 1500 and 2300 Hz
- A color image takes about 2 minutes to transmit, depending on mode. Some black and white modes can transmit an image in under 10 seconds
- Uses for Emcomm? Pictures of flooding, storms, damage, wellness checks, documentation.
- Many options for PC, MAC, Linux, Android and IOS software

SSTV

- SSTV Software “MMSSTV”
- Captured on 145.500 Mhz VHF from International Space Station from Russian Cosmonauts celebrating 40 years in space
- Fun mode for sending pictures and various software options for computer, Android, and IOS

The screenshot displays the MMSSTV software interface. At the top, the window title is "AG7GK (AG7GK.MDT) - MMSSTV Ver 1.13A". The menu bar includes "File", "Edit", "View", "Option", "Profiles", "Program", "RadioCommand", and "Help". Below the menu bar are tabs for "Sync", "RX", "History", "TX", and "Template".

The main display area is split into several sections:

- Left Panel:** A large image of a received SSTV frame. It features a collage of photos and text celebrating the 40th anniversary of the International Space Station (ISS). The text includes "Владимир Джанибеков, Dzigitdemidijn Gürragcsaa" (23th March 1981 - Soyuz 28 - Salut 6) and "Леонид Попов, Dumitru Prunaria" (14th May 1981 - Soyuz 42 - Salut 6). The bottom of the image says "INTERKOSMOS 40th YEARS" and "Serie 9 - 6:12".
- Right Panel:** A control panel for the receiver. It includes a "RX Mode" dropdown menu with options: "Auto", "Robot 36", "Robot 72", "PD120", "Scottie 1", "Scottie 2", "ScottieDX", "Martin 1", "Martin 2", and "SC2 180". Below this is a "Log" section with fields for "Call" (K7VEY), "His" (595), and "My". There are also fields for "Name" and "Qth", and a "Note" field. A "QSL" field is present with sub-fields for "RxID", "TxID", and "RBC".
- Bottom Panel:** A DSP (Digital Signal Processing) section with buttons for "AFC", "LMS", "QSO", "Data", "Find", "Clear", and "List". A numerical display shows "3.573".
- Footer:** A status bar showing "S.templates 1 | 2 | 3 | 4", "Show with template" (checked), "Draft" (checked), and "1/25".

At the bottom of the interface, there is a grid of thumbnail images. The first row includes: "QSSSTV AG7GK", "CQ AG7GK", "K7VEY 595", and a blank space. The second row includes: "AG7GK ARIZONA", a collage of photos, and a blank space.

JT Modes (JT65, JT9, FT8)

- Origin: Created by Joe Taylor W1JT in 2003 for EME work
 - A way to have a QSO using a computer
 - A weak signal digital communications mode for Amateur Radio
 - A Multi-Frequency Shift Keying scheme employing Forward Error Correction with 65 tones
- Bandwidth: 50-180 hz
- Prevalence: Predominant modes for DX contacts
- Equipment requirements: HF Radio, Soundcard(ext/int), Computer, Rpi can work, WS-JTX software, other options exist
- Pros: Widespread, with FT8 very fast QSO's, SNR resilience
- Cons: Not conversational

JT Modes (JT65, JT9, FT8)

- Exchange with TAIWAN
- 30 Meters
- Very weak signal, BV1EK reported my signal at -18 SNR and I reported his at -14

The screenshot displays the WSJT-X software interface. At the top, a 'Wide Graph' shows a spectrum plot with a frequency range from 500 to 2500 kHz. Below this, the 'Band Activity' table is visible, listing received signals with columns for UTC, dB, DT, Freq, and Message. The table shows several signals, including one from Taiwan (BV1EK PL05) at 14:43:00. The interface also includes a 'Log QSO' section with a 'Monitor' button, a 'Generate Std Msgs' section with a list of call signs, and a 'Receiving' status bar at the bottom. The system tray at the bottom right shows icons for VOAProp, WSJT-X - JTAlertX, WSJT-X, and WSJT-X - Shortcut.

UTC	dB	DT	Freq	Message	UTC	dB	DT	Freq	Message
143830	-12	0.3	1905	~ KAPUA BV1EK RRR	143830	-13	0.2	1752	~ CQ ZS2EZ KF26
143830	-17	0.1	1921	~ CQ ZS2EZ KF26 S. Africa	143200	-13	0.2	1752	~ CQ ZS2EZ KF26
143900	-18	-0.6	1437	~ CQ AJ4HW EM75 ~U.S.A.	143230	-13	0.2	1752	~ CQ ZS2EZ KF26
143900	-15	0.3	1507	~ RX9JX BV1EK 73	143315	-18	0.1	1753	~ ZS2EZ KB0GUS EM28
143930	-16	-0.6	1436	~ CQ AJ4HW EM75 ~U.S.A.	143930	-16	0.3	1507	~ CQ BV1EK PL05 a1
143930	-16	0.3	1507	~ CQ BV1EK PL05 a1 Taiwan	143945	6	0.1	1507	~ BV1EK WBOFTY DM99
143930	-18	0.1	1921	~ CQ ZS2EZ KF26 S. Africa	143930	-16	0.3	1507	~ CQ BV1EK PL05 a1
143945	6	0.1	1507	~ BV1EK WBOFTY DM99	144015	Tx		1507	~ BV1EK AG7GK DM43
144000	-15	0.1	1921	~ CQ ZS2EZ KF26 S. Africa	144045	Tx		1507	~ BV1EK AG7GK DM43
144100	-17	-0.6	1432	~ CQ AJ4HW EM75 ~U.S.A.	144115	Tx		1507	~ BV1EK AG7GK DM43
144100	-14	0.1	1916	~ WA0JIM ZS2EZ RRR	144145	Tx		1507	~ BV1EK AG7GK DM43
144130	-16	0.1	1916	~ WA0JIM ZS2EZ 73	144215	Tx		1507	~ BV1EK AG7GK DM43
144230	-14	0.3	1510	~ AG7GK BV1EK -18	144230	-14	0.3	1510	~ AG7GK BV1EK -18
144230	-17	0.1	1915	~ CQ ZS2EZ KF26 S. Africa	144245	Tx		1510	~ BV1EK AG7GK R-14
144300	-16	0.3	1513	~ AG7GK BV1EK RRR	144300	-16	0.3	1513	~ AG7GK BV1EK RRR
144300	-14	0.2	1914	~ CQ ZS2EZ KF26 S. Africa	144315	Tx		1513	~ BV1EK AG7GK 73
144330	-16	0.3	1515	~ AG7GK BV1EK 73	144330	-16	0.3	1515	~ AG7GK BV1EK 73

FT8CALL New Software

- New software being built TODAY
- Uses FT8 Protocol but allows keyboard to Keyboard Conversational Style
- Integrated with APRS to allow location updates and EMAIL-2 directed messages
- Getting Popular but get ready to WAIT, very slow.

The screenshot displays the FT8CALL software interface, a derivative of WSJT-X by K1JT. The window title is "FT8Call de KN4CRD (v0.5.2-devel) a derivative of WSJT-X by K1JT". The interface includes a menu bar (File, Configurations, Save, Window, Help) and a main display area with several panels:

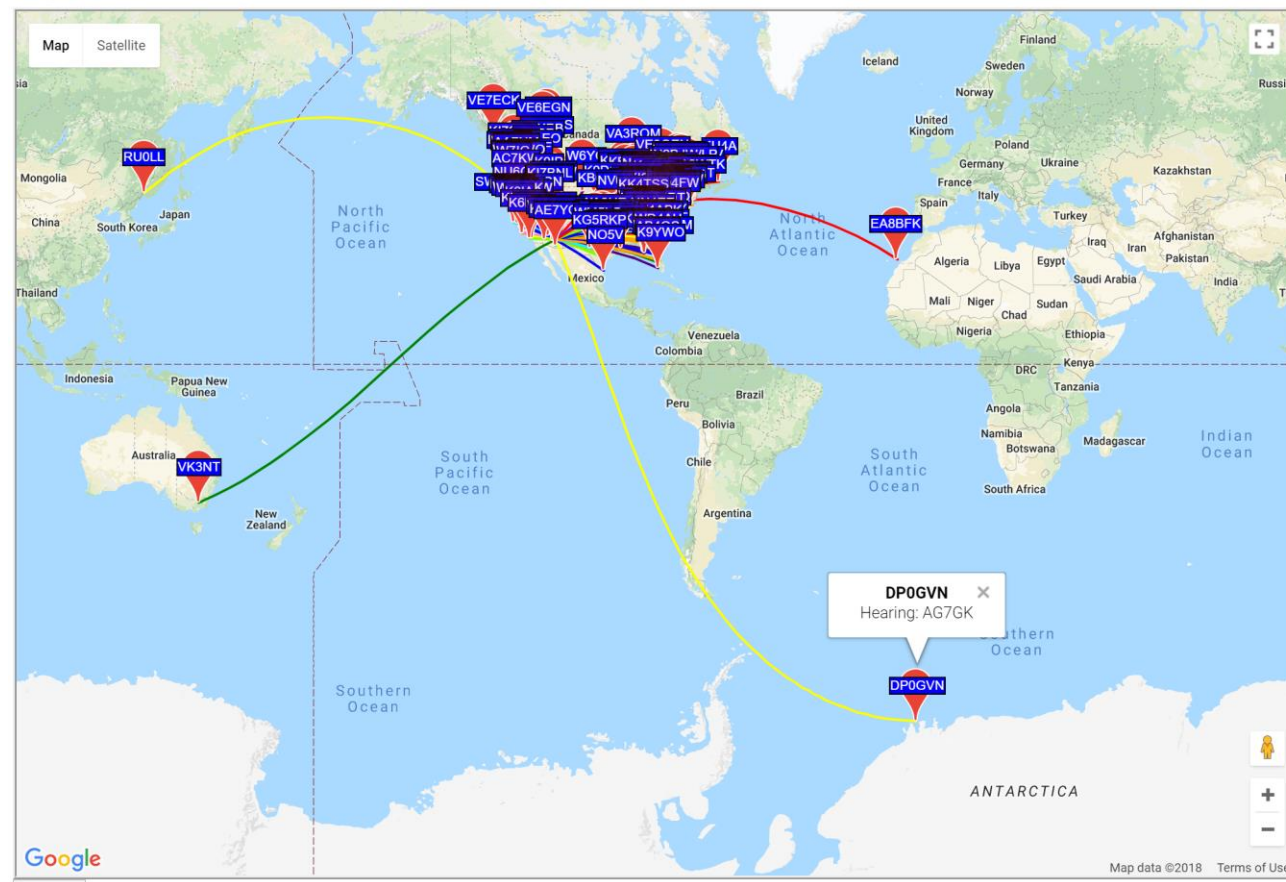
- Top Left:** A dropdown menu set to "40m", a frequency display showing "7.078 000" and "1295 Hz".
- Top Center:** Call sign "AG7GK - DM43", date "2018 Sep 05", time "00:28:43", and "Next Beacon: paused".
- Top Right:** Control buttons for "RX", "TUNE", "SPOT", "AUTO", "BCN", and "LOG".
- Middle Left:** A list of contacts with columns for frequency, mode, distance, and call sign. The list includes entries like "915 (2m) -12 W0ALA: AG7GK ACK → W0ALA: ALLCALL? →", "940 (3m) -11 N8XEF: BEACON EM99 N8XEF: BEACON EM99 →", and "1007 (now) -06 ... → W8MDG: VE3FWF UR SIG ALSO +12 FB JOB →".
- Middle Right:** A message log showing a series of messages, including "00:24:14 - (1001) - K7TP: AG7GK ACK →", "00:24:14 - (1091) - KD7WPQ: AG7GK ACK →", and "00:25:14 - (1000) - W8MDG: VE3FWF FB".
- Bottom Left:** A "CAT" (Catalpa) display showing a waterfall plot of the frequency spectrum. The x-axis represents frequency in Hz (500 to 2500), and the y-axis represents signal strength in dB (-50 to 80). A vertical red line indicates the current frequency.
- Bottom Center:** A control panel with buttons for "CQ", "Reply", "Macros", "Directed", "Send", and "Halt". Below these are various settings like "Bins/Pixel 4", "Start 0 Hz", "Offset 1295 Hz", "N Avg 1", "Palette Adjust...", "Flatten", "Ref Spec", "Cumulative", and "Smooth 1".
- Bottom Right:** A status bar showing "Receiving", "FT8CALL", "Last Tx: AG7GK: W0ALA SNR -12", and "13/15 WD:4m".

WSPR (Demo)

- Origin: 2008 by Joe Taylor
 - The Weak Signal Propagation Reporter
 - An automated system designed for sending and receiving low-power transmissions to test propagation paths on the MF and HF bands.
 - The program can decode signals with S/N as low as -28 dB
- Bandwidth: 6 hz
- Antenna propagation at: <http://wsprnet.org/drupal/wsprnet/map> OR <http://wspr.aprsinfo.com/>
- Equipment requirements: HF Radio, Soundcard(ext/int), Computer, Rpi can work, WS-JTX software, other options exist
- Pros: Great for seeing where your signal is going
 - "WSPR is about 11 dB better than ear-and-brain CW.
 - "For most operators, the difference is more like 15 dB."

WSPR (Demo)

Map



OTHER Digital “Systems”

APRS

- VHF 144.39 MHz simplex
- Utilizes “Digipeaters”
- Requires TNC or software (Many options)
- Good for short text messages
- Map/ Location awareness

Winlink

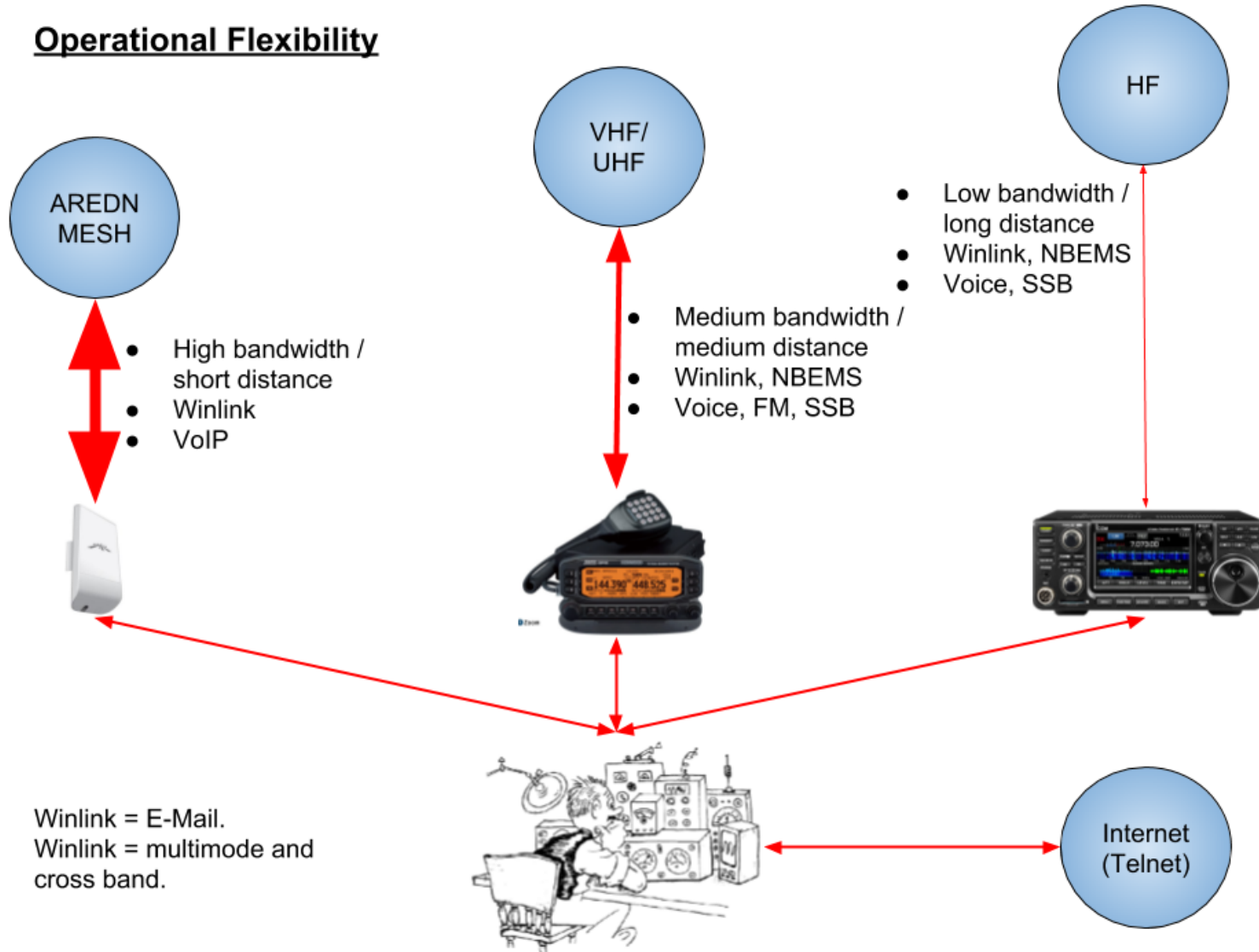
- VHF 145.01 MHz simplex and certain HF
- Utilizes RMS packet and HF packet stations
- Requires TNC or software (RMS Express)
- Email and File attachments

NBEMS/FLDIGI

- Can utilize any VHF/UHF simplex freq, repeaters, HF
- Can use “acoustic coupling” for interface but hardwired interfaces more reliable
- Good for text messages, forms, files

Operational Flexibility

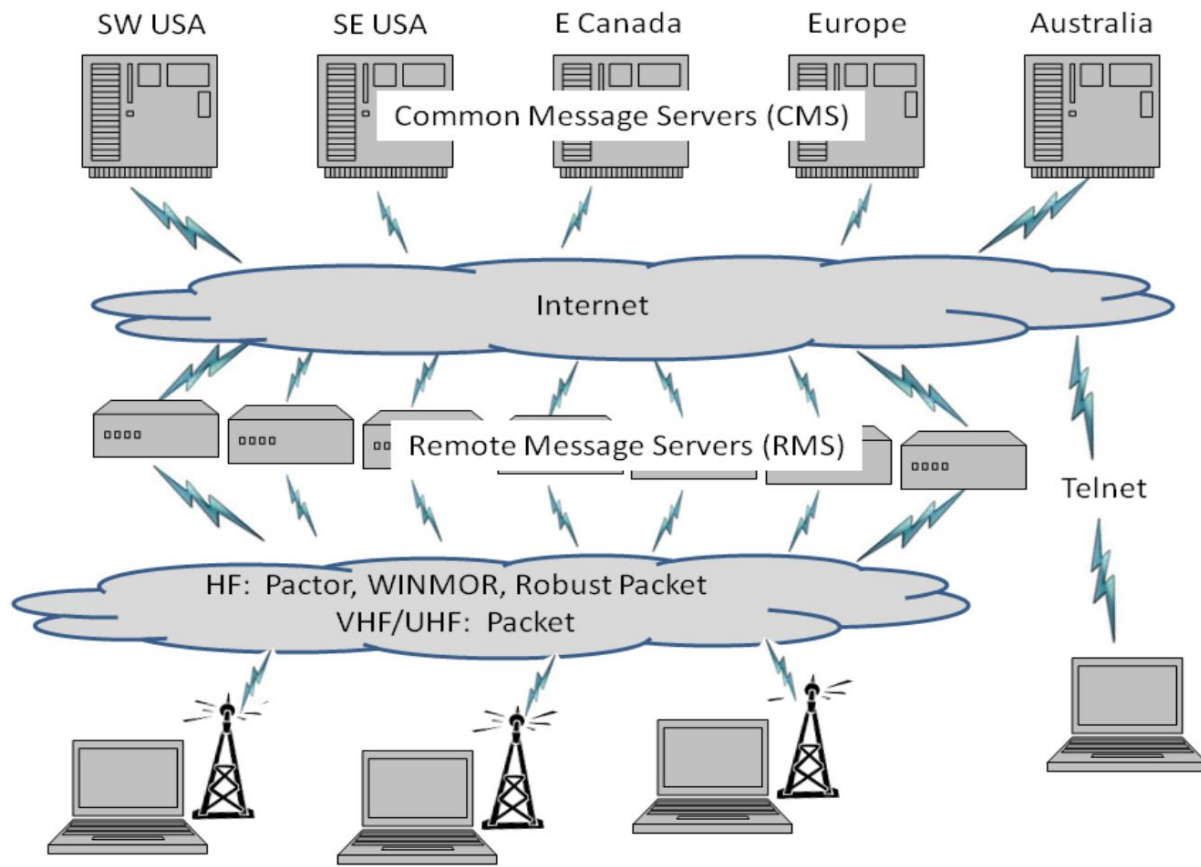
Operational Flexibility



Winlink

- Worldwide system for sending e-mail via radio
- Provides e-mail from almost anywhere in the world.
- Adopted for contingency communication by many government agencies
- Used by infrastructure-critical NGOs such as International & American Red Cross, Southern Baptist Disaster Relief, DHS Tiered AT&T Disaster Response & Recovery, FedEx, Bridgestone Emergency Response Team, etc.
- VHF and HF options
- Hardware: Computer, TNC or Pactor Modem, RMS Express Software, Radio
- Pros: Pactor is very fast for HF, reliable, has peer-to-peer options
- Cons: Reliant on internet in normal operation, complexity

Winlink



APRS (Demo)

- **A**utomatic **P**acket **R**eporting **S**ystem
- Original Developed in 1984 to Map Navy Positions, with availability of GIS in the 90's became feasible for GPS integration
- The system is based on the AX25 Packet protocol, and was developed by Bob Bruninga WB4APR, a senior research engineer at the United States Naval Academy.
- North American frequency is usually 144.390, though operable at UHF, 6 meters and some HF
- Mostly a one-to-many system, though there are some one-to-one applications
- Public service and events, search and rescue, emergency services

Digital Net Discussion

- Interest
- Names / signup
- Examples
- Goals
- Netiquette
- Lessons Learned
- HF and VHF?

Useful Websites

- Comprehensive Guide to NBEMS / FLDIGI, equipment setup, instructions, etc:
<http://gblakesl.net/ARES/Basic-NBEMS-Workshop.pdf>
- Presentation on Winlink:
[http://www.philsherrod.com/Winlink/Winlink RMS Express.pdf](http://www.philsherrod.com/Winlink/Winlink_RMS_Express.pdf)
- Excellent Presentation on NBEMS and FLDIGI:
https://www.jeffreykopcak.com/drive/ham_radio/digital_modes/vhf_uhf_nbems_an_introduction_using fldigi_and flmsg_presentations/vhf_uhf_nbems.pdf
- Presentation on JT Modes:
<http://www.informationtechnologies.com.au/files/JT65%20Presentation.pdf>
- WSPR Presentation: [https://www.powershow.com/viewht/1a4552-ZDc1Z/What is WSPR powerpoint ppt presentation](https://www.powershow.com/viewht/1a4552-ZDc1Z/What_is_WSPR_powerpoint_ppt_presentation)
- Meteor Scatter Introduction: [Link](#)

More Useful Websites

- APRS: <http://www.aprs.org/APRS-mobile.ppt>
- A PRACTICAL EVALUATION AND COMPARISON OF SOME MODERN DATA MODES: <http://www.qsl.net/zl1bpu/MFSK/datmodes2.pdf>
- ARRL presentations on NBEMS (Narrow Band Emergency Message System) with FLDIGI
 - [http://www.arrl.org/files/file/On%20the%20Air/Tutorials/Introduction to NBEMS ARRL.pdf](http://www.arrl.org/files/file/On%20the%20Air/Tutorials/Introduction%20to%20NBEMS%20ARRL.pdf)
 - [http://www.arrl.org/files/file/On%20the%20Air/Tutorials/Advanced NBEMS 3 0.pdf](http://www.arrl.org/files/file/On%20the%20Air/Tutorials/Advanced%20NBEMS%203%200.pdf)
 - <http://www.w1hkj.com/NBEMS/NBEMS.ppt>
- Digital Mode Comparisons from FLDIGI Help files: <http://w1hkj.com/FldigiHelp-3.21/Modes/Compare.htm>
- Signal ID Wiki – listing of all digital signals, explanations, samples:
<https://www.sigidwiki.com/wiki>

Nerd Reading

