

## **EMCOMM 101 Basic Equipment Needs for Voice and Digital Field Stations – A Technology Lab**

Presented at “Communication Academy 2010” by Dave Mann (KD7ZYM) and Chris Osburn (KD7DVD)

Presenting the first of the two part series is Dave Mann with a background in commercial television live broadcasting supported by UHF and VHF radio communications and the use of video microwave and satellite communications transmissions.

Dave’s comments:

Welcome to the wonderful world of Ham Radio and congratulations on taking the time to get licensed and volunteering for a roll in Emergency Communications.

I want to take some time to go over what radio equipment is needed to support both UHF and VHF voice communications in a field deployment. Perhaps you already own a VHF hand held radio for the two meter band on ham radio, this is a great start.

In the Greater Puget Sound Area there is a constant need for more and more repeaters to support emergency communications for various served agencies during emergencies. Unfortunately we all can’t share the same repeater for our communication groups at the same time. More and more volunteer organizations are using the 70cm band for additional repeaters during times of need.

Chances are you may use a two meter repeater to check in and then be assigned a frequency in the 70cm repeater band. We have a great group of volunteers that serve many agencies in our region and by using both UHF and VHF we can communicate a plethora of information from the field to our served agencies.

### **HAND HELD RADIO INFORMATION:**

My recommendation for a hand held radio would be for a UHF/VHF radio for use in the field. If you have only a two meter radio it still can be used

and you could make contacts with some one able to relay your emergency communications on 70cm repeaters to your served agency, if needed.

Gosh, which radio should I buy? Well you might get feedback from your emergency communications group as to what they recommend. Another choice would to use the internet and go to eHam <http://www.eham.net> and look at “product reviews” and then make a choice as what to purchase new or used.

Now that we have narrowed down your radio choice lets get started in EMCOMM using with this little hand held electronic widget.

You have spent a good amount of money on your radio, so let’s protect it a bit from the elements and purchase a holster of some type for field use.

The number one problem in the field is you may have to change frequencies, offsets, tones for repeaters or simplex use and all of a sudden your mind goes blank on all the hoops you have to go through to accomplish this little task. The solution is to keep the radio manual of your radio or a copy of it with you during a deployment or have a cheat sheet so you can do this.....and yes, I’m guilty, this bit me on my first deployment, good thing it was a practice.

Talking about frequencies.....you should program in all the frequencies your agency uses into the radio’s memory and make a make a mini list as to where in the radio memory they are located for recall. Some radios use numbers and some have alpha tags. Also it’s a good idea to have a list of regional repeaters and simplex frequencies used for EMCOMM in your deployment kit, you can get them from you served agency or other seasoned members of your group.

A great source for US, Canada and Mexico amateur radio frequency data base is on the internet at <http://www.artscipub.com/repeaters>.

So now we have a hand held radio, with a protective holster, pre-programmed with frequencies and a manual/cheat sheet for field programming. What’s next?

Battery power.....your nice little radio takes a lot of power for a deployment or just for the use of the enjoyment of ham radio. Most radios come with a

rechargeable battery and a wall wart to charge the battery and takes about 12 hours to charge a battery. The bad news is that charged battery will last from 2 hours to 5 hours depending on your transmitting time and power settings.

So you need a spare rechargeable battery, or a battery pack that takes AA batteries.....most packs use 4-6 AA batteries AA batteries are cheap so you will need a pile of them for a back-up. The new lithium AA batteries are a great choice as they have a shelf life of 10years, out last Alkaline batteries about 6-8 times. You can also use rechargeable AA batteries and as with your radio AA battery pack, you have to remember to recharge all your rechargeable batteries at least every three weeks.

On the topic of recharging batteries....you can get a fast charger that works from you 12Volt car battery or 115V ac. This unit will charge a pack in less than ½ hour..

Something that works great in the field is a battery pack device that you can plug into your car dash for 12 Volts or have an oversized gel cell or AGM battery. You can power your radio for a day or more depending on the size of the auxiliary battery. A small solar charger could be of some use also...I found a 1Amp charger on E-Bay under “solar power”

New to the market this past year is the MAHA MH-C9000 charger-analyzer for AA and AAA NiMH/NiCD batteries. It has almost endless programming possibilities with 29 selectable charging and discharging rates. The unit has five modes of operation: charge, refresh & analyze, break-in, discharge and cycle which helps remove the memory discharge that builds up in some rechargeable batteries.

This is not a fast charger but will be a great device to maintain all your rechargeable AAA and AA batteries. As a rule I don't promote a product But, this MH-9000 charger-analyzer is a must have. The cost of this charger is in the \$45-55 price range.

Five watts of power from you hand held radio with a rubber ducky antenna doesn't make for a powerhouse for transmitting, you will find it works great for 1-2 miles in the city on simplex but will work wonders with a repeater providing you have a good line of site path for 10/15 miles.

Now comes the single most important thing you can do to improve your radios transmission performance.....get rid of the rubber ducky antenna, and use an auxiliary antenna. First choice might to get an auxiliary antenna whip that is about 18in long that connects to the antenna output. They come with SMA and BNC connectors and will improve you receive and transmit by about ½ . They do make an antenna that has a three foot pull up that works great for a radio with a BNC connection but is not recommended for SMA as it could break off the screw-in connection at the radio if flexed to hard.

Well bigger is better when it comes to antenna's.....so my number one recommendation would to use a J-Pole antenna. Google [J-Pole antenna] on the internet and you will find dozens of sites that show how to make this easy to build antenna. You will need an antenna adaptor cable like a SO-239 to SMA or SO-239 to BNC to attach the J-Pole antenna to your radio. also remember to pack some string or light nylon cord to attach the J-Pole to a window frame, a nail on the wall or hang from a tree or a porch.

This J-Pole antenna should more that double the effectiveness of your radio and you will be able to reach many repeaters you could not with the rubber ducky antenna.

Another antenna would be a mag mount UHF/VHF antenna, again with the proper antenna cable adaptor for stress relief. you can attach it to the roof of a car, a metal filling cabinet, this antenna should again double the effectiveness of you radio.

An Antenna I like for EMCOMM is the ELK Log Periodic Antenna for 2/440. With this antenna you should get a three fold of effectiveness from your hand held radio. Remember as hams we should use the lowest power setting on our radio.....so by lowering the power of your hand held to half power or less you will use less battery power and extend the time you can use your radio from a battery pack. More information on this antenna is on the internet <http://www.elkantennas.com> . This antenna is in the \$100 range and is also very useful with a mobile UHF/VHF radio which will be the next large purchase you will make in Ham Radio equipment. To support the ELK antenna I use a portable tripod and mast.

A nice addition to your radio would be an auxiliary microphone which gets a lot of RF away from your head and if using a rubber duck or 18in whip, you

can hold the radio over your head and get your antenna a few more inches in the air and still be able to talk on the mike at the same time.

When operating in a quiet setting such as a shelter a useful item is an ear phone bud and/or a set of earphones, for a noisy location where you can't hear.

when operating in a noisy environment earphones comes in very handy. Your radio should have a jack for phones and most all auxiliary microphones have a jack in the microphone.

The next step in adding more power to your hand held radio is by adding an amplifier to increase your radio's output from 5Watts to over 35Watts this connects between the antenna output of your radio and an auxiliary antenna. a 12 volt power supply is needed. The one I use is a BD-35 and information can be found at <http://www.mirageamp.com/> for the price you can find a good used UHF/VHF mobile radio and still have the use of your hand held for other communications.

You might add a few antenna adaptors to your kit and need some extra antenna coax cable with fittings. I would say 50Ft of RG-8 or 9913 coax would be great to have in your kit. <http://www.universal-radio.com/CATALOG/cable/coax.html>, show's photos of the various cables and has information on loss factors and comments.

At this point we have the basic gear for a hand held radio for a deployment but there are other things that come in handy in your kit.

I find a LED flashlight with extra batteries, paper and pencil/pen for taking notes, a watch for keeping time, a Leatherman tool, a small VOM meter for checking batteries and for antenna shorts. A fanny pack or small case to store your gear in. A check list of items need for deployment.....as hams we have a tendency to raid our deployment kits for just having fun with our hand held radios.

I have found it useful to put together a three ring binder with information for my served agency for emergency communications. Message forms, frequency lists with offsets and tones used by your served agency, phone numbers used by your agency and members, e-mail addresses, list of gear

for radio deployment, training notes and the second part is survival gear which we did not include in the presentation.

To find out more about other ideas on putting together a kit or kits for emergency communications Google [Ham Radio Go Kits] as you will see there are a lot of ideas of how to put a kit together, look over all the ideas and put together something you think would work for you and talk it over with others in your communications group.

It's nice to carry everything in every Ham Radio Go Kits ideas published but in an emergency earthquake or storm situation you might not have the use of a large car or truck to transport your gear, you may be on foot. Besides radio gear, your kit will consist of personal survival equipment, food, water and portable shelter in place gear. The trick is trying to get everything in a nice compact deployment package that can be used in responding to an emergency communications assignment.

### **MOBILE RADIO KIT 50 WATTS +**

We have looked over the use of hand held radio's roll in deployment, and have found some things that make them more efficient. Now it's time to put together a full size UHF/VHF Mobile Radio Kit for voice communication.

I have put together a basic mobile radio kit in a box along with a portable antenna system and would like to take some time to share with you the contents and their use. The only addition would be to take a 12 Volt AGM battery or gel cell battery to power the radio should AC power not be available. This would be the radio part of your go kit ready to grab and dash for an emergency communication assignment. A battery charger would be a nice addition to the kit and will need 115 Volt AC power source.

I have used this kit for several communication drills with the Seattle ACS emergency group and have found it to be very efficient. The mobile radio in this kit is a dual band UHF/VHF radio with a 50 Watt output and can handle a heavy duty use to transmit communications traffic.

Any commercial mobile Ham Radio that has FM, 2 meter and 440 bands can be used for this kit. I chose a used radio I picked up at a Ham Flea market. Again you want a dual band radio as both bands are used here in the Puget Sound Area and are starting to be used nationally as well.

I mounted the radio on an aluminum plate along with a AC Power supply, and a extension speaker plus a 115 Volt AC power strip.

I converted the radio power connector and the AC power supply to Anderson Power Pole connectors that are becoming the standard for ham radio. Google [Anderson Power Pole] for more information on this connector and it's use. With the power pole connector it is easy to change the AC supply to a Battery supply.

You need a back-up for 12 Volt power and having a cable to attach to a car battery with Anderson Power Pole could come in handy in an emergency situation.

I have converted all my 12 Volt gel cell and AGM batteries to Anderson Power poles as well as battery chargers.

This is a good time to program in all the frequencies you agency uses for EMCOMM and make a list of the frequencies and location on your radio's memory banks. Things do change in emergency's and you might be asked to change to new frequencies in the field or serve another agency.

Again have the Radio Manual or cheat sheet for programming your radio, should you forget how to program in frequencies, repeater offsets and tones used by your emergency communication group.

Additional items I find helpful is a set of earphones if you need to operate in a noisy area or might have to set up in an area where you radio's speaker could disturb others. A clock for logging time of communications traffic and a LED battery powered light and a AC extension cord. Carry a small tool kit a Leatherman tool is great and slip in a Volt Ohm Meter, great for testing for voltage and electrical wiring problems.

We have the basic radio set-up together so it time to put together the antenna system. I carry a dual UHF/VHF mag mount antenna and the ELK Antenna with supporting mast that we looked at in the hand held radio presentation. I carry 50 feet of 9913 low loss antenna cable with PL-255 connectors and some extra RG-58 coax cable with connectors and adaptors. In my kit I have barrel connectors to connect antenna cables together and some BNC converters if needed.

Again antennas the bigger the better...more gain in the antennas the lower power you can operate your radio on which gives you more operating time from your batteries. Some times lower power doesn't do the trick and you might need your mobile radio's full power along with a high gain antenna for receiving and transmitting in the field.

In the kit carry your agencies various forms for EMCOMM traffic, a log for your field transmissions. Have a supply of paper and lots of pens, pencils and a notebook with your groups field procedures.

And last take some time to use your go kit radio package and practice with it in the field. You don't have to have an EMCOMM drill after all this is a ham radio, enjoy the hobby. Remember to have a copy of your ham license with your kit, it proves you are a licensed amateur radio operator.

Now it's time I turn this presentation over to my co-host Chris Osburn, KD7DVD, who will give an introduction to the wonderful world of digital communications. Using what you have learned about setting up radio equipment for a field station Chris will add computers, modems, GPS units and Software plus a heck of lot of knowledge to make it all work.

With a background in Computer Science he will take you to understanding technology beyond voice transmissions over amateur radio. A way to send long complex EMCOMM messages and tracking field information with APRS and interfacing radio and the Internet.

## **DIGITAL COMMUNICATIONS:**

To err is human, we are taught, but to really screw things up you need a computer. Amateur radio communications is no exception. We use computers to control our radios, help us keep our contest logs and to make funny noises that are interpreted by other computers in faraway lands as data. In the EMCOMM environment, the most important use of a computer (and not just in amateur radio) is to send messages. In other words, email.

We'll concentrate on what you need to use packet radio to send and receive email using the Airmail client and the Winlink 2000 network. If we have



time at the end, we can talk about using APRS for asset tracking and as an alternate way to send messages.

We need a number of things to get a packet radio station on the air. Item Number One is a radio. Dave has given you a lot to think about in choosing a radio and everything he told you is true on the digital side of the street. Just about any radio will do the trick for what we have ahead. Many radios, across manufacturers, have a standardized packet radio port. I haven't seen an HT with one, yet, but most modern mobiles and base station radios have a 6-pin DIN plug in the back for this purpose. This makes cabling simpler. The radio I have today is an ICOM IC-208H. A friend of mine built out this box. It holds a gel cell battery and the connections are all externalized out one side. The radio is under \$300 brand new, works on the 2m and 70cm bands and will support 1200 baud and 9600 baud packet well enough for EMCOMM work and casual use. I have a ten-year-old IC-207H (this radio's predecessor) as part of an APRS digipeater station. The point is, you don't need anything fancy. That old radio in the garage you just replaced with the gizmo of the year will do the trick.

The next item on the list is a TNC, a Terminal Node Controller. Think of this as a modem for radios. Like a telephone modem, the TNC will take the digital content from your computer, turn it into analog noise, and hand it to the radio to transmit. Then the TNC will take the noise received in response and turn it back into a message your computer will handle. Airmail was originally written for sending mail on the HF bands using PACTOR, so all of the kilobuck SCS PTC units will work with it (and they'll even work as VHF/UHF packet modems, too). If you don't have \$1000, you can scare up a Kantronics KPC-3 for about \$200 new or hit the flea markets for used gear. The old, venerable PK-232 PAKRATT is supported as well. You can see I have the SCS modem I borrowed from my HF setup.

While the author of Airmail says it isn't supported, the ACS Science Department is working on eliminating the TNC altogether, using the computer's sound card as a packet modem. If you go that route, you'll also need something to switch your radio's PTT line. The famous Rigblaster sound card interface will do that. You can also breadboard something out of your junk box.

Let me mention here one of amateur radio's dirty little secrets: we can't do any of the wonderful wireless work we do without having a couple of miles

of cabling behind the desk. This dismays me; if I have a super power, it's the ability to tangle any cable within a ten foot radius of my head. Things are easier with the standardized packet port. Often, the TNC manufacturer will have a suitable cable in stock (for around \$50) and you can plug in and go. But it pays to be prepared to roll your own. The TNC and radio manuals should have pinout diagrams sufficient to building your own cable. You just need a few parts and a soldering iron.

You'll also want to score a few USB/RS-232 serial adapters. The radio world still thinks RS-232 serial is the state of the art, but two out of three laptops coming off the assembly line today don't have a serial port at all. They'll have three or four USB ports, though, so get yourself a couple of adapters. I like the kind with pigtails, they reduce stress on the USB sockets. \$15-\$20 for the pigtail, you can also get units that supply multiple RS-232 ports if you have multiple devices to control.

This brings us to the central point of the discussion. The computer! For EMCOMM, you'll want to look into something you can deploy with. There are a couple of schools of thought as to what makes a computer "deployable."

Position one is the machine has to be tough. I'd love to be able to show you one of Panasonic's Toughbook laptops, but I'm unemployed right now and they start at about \$2000. The other tough option is the XO laptop from the One Laptop Per Child project. Getting yourself one of these will set you back \$400, half of which is tax deductible because implicit in the deal is you buying one for a child in a third-world country. The mate to this one is, I believe, in Mongolia somewhere. The XO has no moving parts and is water resistant. Also, the screen is tiny, it's hard to type on and it doesn't run Windows.

Position two is the machine has to be cheap. We don't need a lot of power here, anything capable of running Windows 95 is able to run Airmail. Further, if your computer gets destroyed during a deployment, you won't feel as bad if it's a cheapie. The computer I'm using today is brand new, I got it at Costco for \$300. I expect that they'll be sold out ten minutes after the end of the session today...

This computer runs Windows. Most ham radio software runs under Windows and Airmail is no exception. We can talk about ways of running

Airmail under Linux or on a Mac. But consider what your relief operator might have to do if the computer crashes and you're a mile away in the rehab tent sound asleep. That guy won't thank you for leaving him with a complicated setup that he can't reboot on his own.

So, now the software. Airmail was written by Jim Corenman, KE6RK, who lives on a 50-foot sailboat at an undisclosed location in the San Juans. Airmail's prime focus is on using PACTOR over HF to get mail to and from the sail boat when he's far away from land. Airmail works with the Winlink 2000 system of amateur stations, and the Sailmail system on the commercial side. Sailors love redundancy, and Airmail has capability to access Winlink servers with VHF/UHF packet radio, like I'm doing here, and directly over the internet with no radio at all. It will also support point to point connections outside the Winlink system. Once it's set up and running, the interface is straightforward. In fact it's just like email. It *is* email!

Airmail is popular, but it's closed source and it's maintained only by Jim in whatever time he has available for it. The Winlink management would like to move away from his program in favor of Paclink. Paclink is a middleware solution that interfaces your favorite mailer to the radio network by acting as a POP and SMTP server. The ACS science department is looking into that option as well. Paclink will allow all the computers on a network to share the radio link, allowing multiple workstations. It's under a rapid development cycle (read: not entirely stable yet) but a version does exist for Linux.

I encourage you to try Airmail, using the internet access feature to connect to the Winlink network. The Winlink website has the settings. Once you manage that setup, adding a radio will seem like a snap.

During the recent snowstorms, ACS was asked if they could help with some medical transportation needs. Several members with 4x4s helped out getting folks to the doctor and to dialysis appointments. Following that, we've been wondering whether APRS, the automatic position reporting system, would be a useful capability to add to the list.

APRS is a packet-radio based system for local tactical communications. A mobile packet station, combined with a GPS unit, can be a vehicle tracker. Even without the GPS, APRS can be used to send short messages and locate points of interest, which might include the location of a flood, a missing

bridge or a note that a specific area is unaffected. In the case of the snowstorms, we would track vehicles as they drove around and note impassable streets. Search-and-rescue teams can be tracked this way, and the message/bulletin feature can disseminate weather alerts.

APRS coverage is enhanced by using digipeaters. If you've never done packet before, digipeaters are one way of getting your message out beyond the VHF horizon. You would specify a list of known nodes, up to eight, to forward your message along for you. This wasn't all that great a system for packet QSOs or connecting to bulletin board systems, but it works pretty well for APRS. Instead of having to find out what the digipeater's name is, APRS uses the generic name WIDEn-N. Usually, you'll send your packet via a WIDE2-2 digipeater. The first digi will repeat it as a WIDE2-1 packet and the next digi will repeat it as a WIDE2-0 packet. Once that last number drops to zero, the packet isn't repeated anymore. This keeps your packet from QRMing the APRS network three states away. If you can't get to a WIDE2-2 digi, try the path WIDE1-1,WIDE2-1. The first digi will act as a fill-in to get your packet into the WIDE2 network. Since you've already had one hop, all you really need is one more, which is why WIDE2-1 follows WIDE1-1. As always, your mileage will vary, but these settings work well in our area.

APRS at 1200 baud has a standard frequency on 144.39 MHz. Since we all use the same frequency, we need to be careful about how much data we spit out. Keep digipaths short and beacons as infrequent as possible while still supporting the mission.

A number of folks in the area are using APRS at 9600 baud, on VHF and UHF. I won't go into that now, see me after or drop me an email if you're interested in working with it.

For your car, I highly recommend the Kenwood TM-D710A. This combines a dual-band mobile rig with a built-in TNC and a lovely display screen. The radio doesn't have a mapping feature, but it will pass any data to your GPS unit, displaying other stations on the GPS map screen.

There is an internet backbone to APRS, so you can get started without getting any radio gear. APRS is junk-box friendly; if you can get any radio and TNC wired up, you'll be ready to go for hardware. All you need is a bit of software to make the maps look pretty.

The three most popular APRS packages are:

Xastir: runs under Linux, and is very versatile. The user interface isn't the greatest and it's tricky to set up. Xastir will load maps from the internet on the fly. If you're running Debian or Ubuntu Linux, you can install it using the *apt-get* command.

UI-View: This is the most popular program for the Windows world. You can supply your own map images or integrate it with Precision Mapping Streets and Traveler from Undertow Software. UI-View is shareware. The author is a Silent Key now, and the shareware fee is a donation to your favorite cancer society. UI-View is also very popular for running digipeaters, especially for linking two or more channels. The mapping software is available separately for \$50.

APRSPoint: Also for Windows. Of the three, this one seemed to be the easiest to get going. It comes bundled with Microsoft MapPoint 2004 for about \$75.

We talked about the Kenwood mobile radio, there are also a couple of hand-held options for APRS:

The Kenwood TH-D7A(G) has serial ports for connecting a GPS and a computer, or you can enter your location by hand. You can send text messages with it. Available only second hand, Kenwood stopped production last year.

The Yaesu VX-8R has a GPS receiver available as an option, you can see it here connected to the speaker/mic. It works great as a tracker and for sending messages, but you can't connect it to a computer like you can the D7.

## **WEB SITES:**

Some more sites on the internet for equipment is: Arrow Antennas <http://www.arrowantennas.com/> and I like the Universal Radio site at

<http://www.universal-radio.com/CATALOG/> this site has pictures of all the options and accessories for all new radio gear. They charge shipping and you pay no sales tax ordering over the internet....should a sales tax be charged in the future on internet sales you can phone in a tax free out of state order.

Another equipment supplier I like is Ham Radio Outlet  
<http://www.hamradio.com/> free shipping on orders over \$100 and they have a store in Portland, internet and phone orders are tax free.

More information on EMCOMM go kits and digital communication are on the eHam web site under forums <http://www.eham.net/forums/> .

Looking for used equipment <http://swap.qth.com/> and <http://www.qrz.com/>

ARRL Publications of interest: <http://www.arrl.org/>

*The ARRL Emergency Communications Handbook*  
*ARRL'S VHF Digital Handbook* by Steve Ford, WB8IMY  
*APRS Moving Hams on Radio and the Internet*  
by Stan Horzempa, WA1LOU  
*Emergency Power for Radio Communications*  
by Michael Bryce, WB8VGE  
*ARRL Field Resources Manual*  
*The ARRL Emergency Communications Library*  
a CD on voice & digital information, plus software

Airmail is available for free download at <http://www.siriuscyber.net/>  
More information about the Winlink network is at <http://www.winlink.org/>  
For APRS software:

Xastir: <http://www.xastir.org/>

UI-View: <http://www.ui-view.org/>

Precision Mapping Streets and Traveller:

<http://www.undertowsoftware.com/PMSAT/PMSAT.htm>

APRSPoint: <http://www.aprspoint.com/>

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