ARA 2020 Proposed FD Antenna Plans for Good Performance and Good Interstation Isolation

For the Antietam Radio Association, we need 3 clusters of HF antennas for FD with preferably good isolation between them for phone, digital and CW (+ GOTA & VHF/UHF separately). We operate with up to 5 simultaneous rigs on 80/40/20/15/10 phone. In addition we operate with 1 rig on digital that switches between bands to maximize QSO's, and similarly we operate with 1 rig on CW that switches between bands to maximize QSO's. Per references on isolation, it is proposed for HF to use verticals for one cluster, inverted vees broadside to the verticals in another cluster, and dipoles end to end to the vertical cluster and perpendicular to the inverted vees in a third cluster. This places the 3 clusters of antennas in different polarizations to minimize coupling. The digital and CW antenna clusters operate only with one active band/rig at a time, but the phone antenna cluster needs to support activity on all 5 bands simultaneously. Much of the needed antennas, filters,…. are already available, but some new items will be needed to achieve the best results. It should be possible to achieve 50 to 60 dB of isolation between antenna clusters just by careful antenna orientation and configuration with some limited tuning for isolation during setup. The plan should emphasize performance on 40 and 20 meters which are the most productive bands for QSO's followed by 80/75 meters. Isolation performance on 15 and 10 meters may have reduced priority but these bands also need to be supported.

If isolation can reach about 50 dB or more, it should be possible to operate in the same bands simultaneously with CW, digital and phone. With 100 watts of TX power, 50 dB of isolation will reduce the signal levels to 0 dBm at a victim receiver (-10 dBm with 60 dB of isolation). Test results by the ARRL on a Yaesu FT-950 show 1 dB gain compression or blocking points of about 10 dBm, 0 dBm and -10 dBm for preamp settings of OFF/1/2 with a 20 KHz signal offset. So, with the preamp off and an isolation of 50 dB, the 1 dB compression point is 10 dB higher than the received interference signal and there should be almost no impairment from the interference even while operating in the same bands but with some frequency offset greater than 20 KHz. Supporting simultaneous operations on the same bands is very desirable since phone operates on all or almost all of the HF bands on Saturday along with digital and CW being active, but also with 40 and 20 meters being the most productive bands for QSO's simultaneous operation of phone, digital and CW on the same band is very desirable.

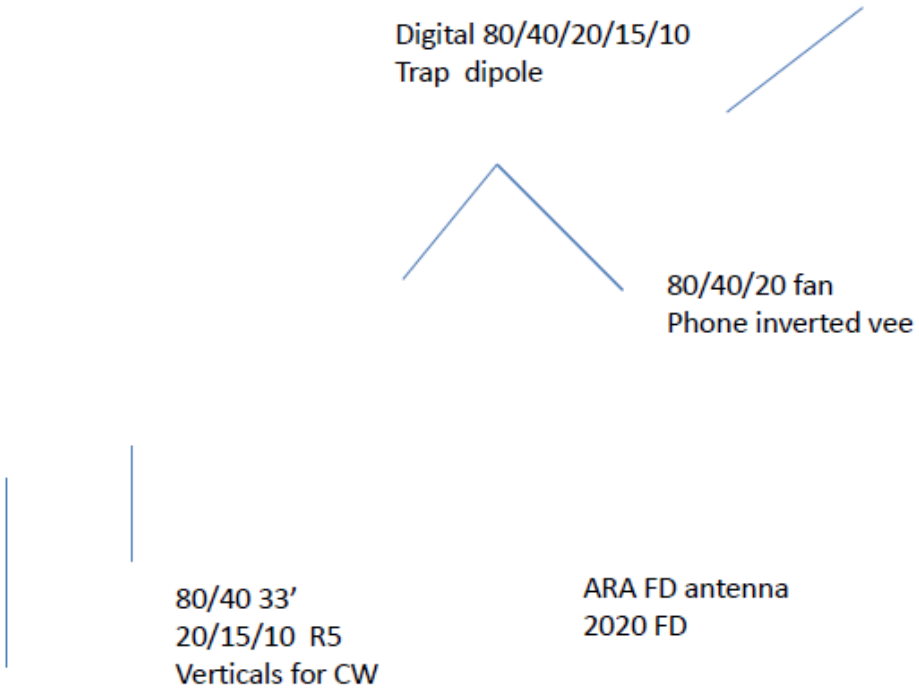
The first priority should be to use TX/RX bandpass filters for all operations to mitigate inter-band interference. These will be available to cover all HF bands and setups (KA2C & WA8EIH). The use of these filters on all rigs should eliminate cross-band interference problems.

The second priority should be to orient CW, phone and digital antennas for at least some isolation with CW since CW generates the worst interference issues and use resonant dipoles or inverted vees with baluns to largely eliminate coaxial radiation (do not use G5RV's or non-resonant antennas with tuners) and verticals. Any coaxial radiation will distort the intended polarization of each antenna cluster.

A more complete plan would be to combine antennas for phone into 2 clusters or shared antennas; 1) 80, 40 and 20 meters; and 2) 15 and 10 meters using tri/diplexers and high performance bandpass filters. This reduces the number of antennas considerably as well as the number of coaxial runs and this allows better control of antenna isolation with CW and digital.

And finally, using a multi-band dipole for digital will allow the optimization of nulling CW to digital coupling, and should provide good support for simultaneous operation in the same bands. A dipole also provides some isolation for nearby verticals at the pavilion for GOTA stations and 15 and 10 meters phone.

Phone operation needs the widest bandwidth antennas. That may be easiest to achieve with inverted vees, especially for 75 meters, so plan on inverted vees for phone. Digital needs the smallest bandwidth, but preferable can operate with low SWR and an efficient design on all bands, so a trap dipole is good. Then use verticals for CW which has bandwidth needs in the middle. Especially on 80 meters, a vertical will be a 33' fiberglass pole with a loading coil, and the bandwidth on 80 meters may only be 50 to 75 KHz. That is enough for CW, but is not good for phone.



The antenna clusters need to be in a line to achieve polarity isolation across all bands and combinations of antennas. Then use verticals for the first cluster, inverted vees (helps with bandwidth on 80 meters and tuning end points for isolation) for a second cluster, and a trap dipole for the 3rd position.

We propose the use of shared antennas for phone for 80/40/20 which helps to align antennas for isolation with digital and CW, minimizes coaxial feeds, and reduces antenna setup. We will use an 80/40/20 meter fan inverted vee with a triplexer. For 15 and 10 meters phone, we will use a vertical antenna near the pavilion (rely on bandpass filters & coordination in time to help isolation with CW). By

using inverted vees for phone (80/40/20), a dipole for digital placed end to end to the phone inverted vees, and verticals for CW placed broadside to the inverted vees, isolation is maximized for the spatial separation that is possible, but we should also maximize the spatial separation. Assume horizontal beams are used for 6 & 2 meters offset from the center of the setup which is separated by polarity from the CW antennas, and has good distance to the phone and digital antennas and is also separated well by filters.

This Figure shows how the 3 clusters for the primary antennas for phone, digital and CW can be arranged at the ARA FD site. The phone antennas using an 80/40/20 meter fan inverted vee are placed near the center of the setup and the center feedpoint of the antenna is about 100 feet from the emergency comms trailer (probably need 150' of coax to connect to the center point of the antenna and to make the entrance into the trailer. The CW antennas are placed about 250 feet to the southeast of the phone antennas, and the digital antennas are placed about 150 feet to the northeast of the phone antennas. This forms a line and the space is largely open between the antennas. This should support good isolation with polarization separation.

We propose using homebuilt bandpass filters for 80/40/20/15/10 meters for digital, CW and 15 and 10 meters phone built by KA2C providing about 30 dB of isolation between bands (but about 15 dB for 15 &

10 meters to the adjacent bands). We propose using an 80/40/20 meters commercial triplexer and filters for 80, 40 and 20 meters phone to achieve very high isolation (more than 60 dB's) between rigs on different frequency bands operating simultaneously with a shared fan inverted vee antenna.

We propose using a vertical (Camelion MPAS2 vertical or hamsticks or other) for 15 and 10 meters phone located near the pavilion, and an 80/40/20 meters multiband fan inverted vee for 3 phone stations with balun at about 30 ' using existing 30' to 40' fiberglass mast (KA2C)

For digital, we propose an 80/40/20/15/10 meters trap dipole at 25 to 30' with 2 end supports using metal masts. This allows easy optimization of isolation with CW and phone setups and operation on all bands with a resonant antenna. Resonant antenna operation supports using the bandpass filters with good performance. For best isolation with CW, this dipole should also be slightly tilted (raise the end towards the CW verticals by about 10 degrees).

Summary of antenna setups for phone, digital and CW:

PHONE ANTENNAS:

For the phone station – place multi-band fan inverted vee in the center of the site:

- 80/40/20 fan inverted vee (use a new wide spread fan inverted vee?) use existing 40' fiberglass mast (KA2C) at about the 30' height + balun
- Run a single coax (low loss BuryFlex) about 150' from the antenna balun to the emergency van
- 80/40/20 triplexer 200 watts (WA8EIH)
- 80/40/20 bandpass filters 200 watts (WA8EIH)
- Place triplexer and 3 BP filters in the emergency van
- Place 80 meters rig in the van
- Run 2 (low loss BuryFlex) coaxes to the pavilion from the van and place the 40 and 20 meters rigs in the pavilion (bands can be easily switched between the van and the pavilion)
- Place 15 and 10 meters phone in the pavilion and use a nearby vertical using Camelion MPAS2 or hamsticks or other verticals
- Need rope for guying and for each of the 6 wire ends of the inverted vee
- Need a pulley and rope to pull up the antenna center

DIGITAL ANTENNAS:

For the digital station – place the antenna at one end of the site to the northeast:

- Use an 80/40/20/15/10 meters trap dipole - The design is based on this plan using coaxial traps: http://degood.org/coaxtrap/
- Use 2 end supports at 30 and 25 feet using metal masts for slight antenna tilt with a 40' portable metal mast owned by the club and a 25 foot metal mast by KA2C
- Use homebrew bandpass filters
- Add a balun to couple into the dipole & minimize coaxial radiation
- Need 2 pulleys and 2x 70 foot ropes to raise each end of the dipole
- Need about 400 feet of guy rope

CW Antennas:

For the CW station – place a 2-band 80/40 meter vertical at the other end of the site to the southwest and broadside to the phone and digital antennas, and place a 20/15/10 meter vertical about 100 feet away towards the phone antenna cluster and broadside also:

- Use existing 40 meters vertical with an 33’ MFJ fiberglass pole & antenna wire with 8 radials and add a loading coil & impedance transformer for 80 meters
- Use existing Cushcraft R5 or MA5VA for 20/15/10 mounted on a steel post
- Use homebrew bandpass filters
- Need about 200 feet of light guy rope to stabilize the 33 foot vertical for 40 and 80 meters
- Use 100 foot RG-8X coaxes to a utility trailer where the CW rig and operations will be placed
- For 80 meters
    - Insert inductor of about 24 uHenries or a miniductor with 2 inch diameter and 36 turns in 4.5” (8 TPI) at antenna base and tune
    - The impedance on 80 meters at resonance will only be about 12 ohms with this arrangement. We will select the impedance transformer in the coupling for proper matching which uses a large 2” toroid with 2 windings

For the GOTA station – place verticals with hamsticks near the pavilion.

Antenna placement, setup and frequency and isolation tuning procedures (Do this mostly on Friday)

- Antennas can be setup in parallel, but at predetermined positions to maximize isolation. We plan to setup (primary antennas) on Friday before FD to tune/check the antennas for resonance & isolation.
- Each station cluster checks/tunes antennas independently for resonance. Generally start with lowest freq antenna and move up in frequency except for the trap dipole which is opposite
- Once all antennas are setup and tuned for frequency, then tune positions for isolation
- Transmit QRP power from CW antenna starting on 80 meters & move end positions for phone inverted vee for 80 meters to minimize the signal. Repeat for 40 meters and 20 meters which have independent ends allowing independent tuning for isolation.
- Check isolation for the digital trap dipole. Check phone to digital coupling for isolation.
- Suggest setting up a 2 meter simplex freq and using HT's for setup and operating coordination.
- Suggest appointing an operations & interference monitor/coordinator to record operations during Field Day and to record interference events to allow real time mitigation and also to document clearly any problems that occur even after the efforts to eliminate interference