MRAC Hamateur Chatter

The Milwaukee Radio Amateurs Club

June 2015 Volume 23, Issue 6

One of the World's Oldest Continuously Active Radio Amateur Clubs—since 1917

Presidents' Letter

There is a little housekeeping at this months meeting. Since both Dan N9ASA and I were not able to attend our April meeting, we did not have an election for two directors. We will have a brief business meeting to handle the elections. Then we will have a show and tell program about apps. More and more of us are getting smart phones and tablets that we use in our daily lives. What apps can't you live without in your daily life? These don't have to be ham radio related apps to show. There are so many things that are available for these devices. If you have a PC application that you cannot live without please share it with the group.

Field Day is just two days after our meeting. Konkel Park will again be the site for this years multi club effort. Konkel Park is located at 5151 W Layton Ave. We will start our setup on Friday afternoon at 1pm. Of course this is also weather dependent as to starting right at 1pm. we will have radios listening to both the MAARS and MRAC repeaters frequencies.

This year we are going to use a pneumatic mast instead of the tilt up tower. This should make setup much easier this year for us. This should give us a height of 30 feet for our HF antenna.

Our goal is to check into the MRAC 10 meter and 2 meter nets on Friday evening. This year we will again have the disco tent setup for everyone's enjoyment. The disco tent area may be even bigger this year with an addition of another 12 x 14 tent. This makes for another great social gathering place for use to have fun.

I have applied for a space at the Maker Faire Milwaukee. Once I find out that we have been accepted I will ask for volunteers. This will a great way for us to show off ham radio to the general public. Stay tuned for the details as I have them.

'73 Dave, KA9WXN

MRAC Officers:

Terms Expiring in 2016

- President – Dave, KA9WXN
- V-President– Dan, N9ASA
- Secretary – MBH, KC9CMT
- Treasurer – MBH,,KC9CMT
- Director – Mark, KB9RQZ

Terms Expiring in 2017

- Director – Al, KC9IJJ
- Director – Hal , KB9OZN

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Board of Directors' Minutes

Board of directors meeting called to order at 7.12 pm by Dave Shank, KA9WXN club president.

Director's present: Michael KC9CMT, Dave KA9WXN, Dan, N9ASA.

Absent: Al, KC9IJJ, Hal, KB9OZN, Mark, KB9OZN

Preliminary Discussion: This months meeting was held at Dave's, KA9WXN QTH. The Board of Director's minutes were not published in the Chatter in April. There was no board meeting in March of 2015. The Treasurers report and 2015 annual budget was presented by Michael, KC9CMT. A motion was made by Dan, N9ASA to accept the Treasurers report as read; Dave, KA9WXN, seconded the motion. The January balance ended with $19,644.52 in our Club accounts. We make $8.62 a month in CD interest before taking into account the new CD for $4000 that the club purchased this past March. The motion was passed by unanimous vote. We still will be sending the ARRL Spectrum Defense Fund $100 early in 2015. Work will be done on updating the functionality of the Yahoo group by Dave, WB9BWP. The great Balloon launch was going to be on April 24th, but weather conditions prevented the event. **During the Clubs' summer break, the BOD will meet on August 24th at the Menominee Falls Library.**

We will continue to use the Google spreadsheet for the 2016 swapfest. We will be contacting the Makers group to buy tables for the 2016 swapfest along with American Science & Surplus. We will be printing approx. 1000 fliers for distribution between now and February 2016. Michael, KC9CMT will update the flyer Templet and Email to Dan, N9ASA.

Meeting programs: The club is going to go to a different format this year during the Auction. Purchasers will pay immediately after their winning bid this year. The MRAC/MAARS join picnic will be on August 8th, 2015 at Greenfield park, picnic area number 2, a permit has already been issued for the picnic. The club meeting in June is before field day this year. The meeting program will be on favorite Smart phone apps. What is your favorite app? Dan, N9ASA suggested a meeting program about space weather for September. Dan will look into this. An October meeting about antenna maintenance in preparation for bad weather months was suggested., along with Mesh networks; loading software on wireless access points to gain access to radio bands. Perhaps a program on radio telescopes. A radio fox hunt in conjunction with a cookout or a non-formal discussion was suggested. What are some things that club members can do during July and August, months when the MRAC does not meet.

Field Day: The MARC field day effort will be at Konkel park in Greenfield again in 2015. Dave, KA9WXN has received a permit that secures our spot. Dave will be asking the membership for station captains to help coordinate activities during field day. The board would like to have a working committee on the field day effort for 2016. Invites will be sent out to various individuals to work stations during this years effort. The MRAC will provide food for people that are part of the encampment, not for guests as in past years.

Special Project Committees & Committee reports:

Repeater Report: The Yeasu Fusion repeater that Yeasu gave the club a great deal on, is still on back order due to the west coast shipping strike. The cost of this repeater was a real bargain at $300. Dave, WB9BWP is the repeater trustee and a control operator. The club would like more than one repeater control operator. A club repeater control operator should be a extra class operator to have the kind of privileges that are necessary to operate field day to its fullest extent. The club repeater will be used on May 31 for the UPA foundation bike race.

New Business: There have been discussions with the Menominee Falls library people about our ability to remain in our present location for the clubs Board of Directors' meetings. During the 2015 Makers Fair on Saturday Sept. 26th, and Sunday Sept. 27th, 2015. it would be easy enough to set up an antenna outside the facility, for a special event station. The LeFrog group was mentioned has a partner in this venture. The clubs' anniversary is in 2017. We need to start planning event stations for the entire year. Dave, KA9WXN will attempt to generate interest among the membership in forming a committee to handle planning. The MRAC will be giving South Milwaukee some complimentary tickets for the SMARC Hamfest as prizes. Dave, KA9WXN talked to the people from Gold Medal that does embroidery, such as patches, hats, and jackets. A contest to design a new logo for the club for its 100th year celebration. A free embroidered jacket would go to the winner of the logo contest. Will the logo be for the 100th yr. Or for then on. New logos will be picked by a blind election by the membership. The winner should be picked by the November meeting. 2017 is the 100th anniversary. There has been some talk among the board members regarding a national convention during the 100th anniversary year.

Swapfest Committee: The club would like to promote the 10-10 international radio club. Dan or Dave are going to contact American Science and Surplus about having a table at the MRAC swapfest in 2016. Fliers need to be printed out for the 2016 MRAC/MAARS swapfest and be ready for distribution by the South Milwaukee Hamfest on July 11th . Dan, N9ASA has offered to donate the cost of printing the fliers to the club.

Special Projects: The club needs someone to take over the FM simplex contest for February of 2016. What Swapfests will the club be manning tables at during 2016? Ham radio is on the rise numbers wise, with more retirees and younger people entering the hobby, due to the influx of cheap Chinese HT Radios for sale. The club really needs PR and recruitment. Dan, N9ASA will be heading up a digital radio promotion committee effective, February 2016. The club is hosting some other radio club websites on our web page host sight, at a very small cost to us that will be recovered sometime in the future. Joe, N9UX has postulated about doing another balloon launch in 2016, and what hardware will be needed for APRS tracking. Work needs to start on the 100th anniversary celebration that falls in 2017. The Saturday Sept. 26th, and Sunday Sept. 27th, Makers Faire, which is held in conjunction with Harvest Fair, will be held at the Wisconsin State Fair Park in 2015.

Board of Directors' Minutes

Dave is interested in setting up a display during this event, highlighting amateur radio, to create interest among people not familiar with the hobby, and also publicizing our swapfest and other activities. Right now, MRAC does little to attract new people to our hobby. The MRAC has been placed on a waiting list for the State Adopt A Highway program for Milwaukee County.

Clubs throughout the country need to use the spectrum that they have been given. The 220mhz band is not used very often in the Milwaukee area. A Club calendar is a project that the Board of Directors' would like to pursue. We would like to organize meeting programs far enough in the future that a calendar of programs can be produced. Www.Bldinfourms.net is the Atlantic division directors' site that shares content for club newsletters.

A motion was made to adjourn the meeting at 8:43 pm by Dave, KA9WXN seconded by Dan, N9ASA. Meeting adjourned at 8:43 pm.

Dave will be cleaning up his own home after the meeting.

The Experimenters Bench

Wall Warts & Wall Transformers

The Wall Wart seems to be the neglected power source. Wall warts are small, convenient and have transformer isolation. With line isolation they are free from ground fault shock hazard. The power level and output voltage is ideal for most experimentation, and difficult to specify or obtain "X" capacitors are not required. It has been suggested that wall transformers were coined "wall warts" because they often take up 2 or 3 positions in a power outlet strip, but I say it is simply because they protrude from the wall like a "wart." The name is simply a humorous alliteration.

What is a wall wart?

It is an electrical outlet mounted transformer-isolated low voltage power supply adapter with power cord and barrel connector (now also USB connector). Virtually all types low power AC operated electronic equipment use them in lieu of batteries. They have no power switch and remain live even when the electronic equipment is turned off. In spite of this, power consumption is low. One with a quiescent power dissipation of 1W consumes 9KWH per year or approximately $1.00 per year, depending upon cost of power. While there is a cost of use, it is for a very important, necessary function-equipment safety!

Wall wart Specifications

Wall wart adapters come in various voltage and current ratings (typically 6, 9, 12 or 15V). Some have AC output, while most are DC. A few even have regulated output voltage. Usually, the specifications are molded into the plastic case. The power rating runs from about 4 to 25W. Most contain 50/60hZ transformers—these are relatively heavy. Others are small, lightweight off-line switchers with tiny 100kHZ+ transformers. Since low frequency transformers are relatively expensive due to both material and labor, the off-line switcher versions are gradually taking over. The switcher also lends itself well to the now popular USB power supply standard that requires a regulated 5V.

In order to get higher power for printers and computers, in-line power packs are often used. Anyone who owns an HP printer knows what I am referring to. These also may be used by experimenters.

Barrel connector

There is no standard barrel connector—there are perhaps 10 different versions that look similar, but have various barrel diameters and internal pin dimensions. Also, there is no standard polarity—the center pin may be either positive or negative. To accommodate either polarity, it is not uncommon for DC equipment to have a 2nd bridge rectifier inside the unit. The next time you go to your electronics parts store, stock up on a few garden variety barrel connectors and receptacles—they are inexpensive and will make life easier in the future.

Never discard a wall wart

When discarding electronic equipment, save the wall-wart—it may be just what you need to power your next project. Should it be defective, save the cord and connector. Take the advice of a master pack-rat!

The North American Power Plug

While relatively crude by today's international standards, the North American power plug has an interesting 100year history. Before its invention by Hubbell (about 1910), all lights, appliances and equipment were hard-wired to the electrical mains—rather unthinkable today.

While a brilliant inventor, I am sure that Harvey Hubbell never imagined the wall wart. In his era, there was no need for such a device as just about all equipment was big and klunky, and required lots of power.

Failure Modes

Open primary winding—very common failure mode, especially in 220VAC versions—discard!

End-of-life thermal fuse—this often strange looking, bullet-shaped device opens once and for all upon excessive temperature. It generally means that the transformer has a shorted winding—discard!

Open bridge rectifier—this has happened to me more than once—easy to repair

Open fuse—some have an internal lead-mounted fuse that is easy to repair

Broken wire at strain relief—very common failure—repairable, but generally uglified in appearance

Defective switcher—generally not repairable—discard! Perhaps save the little transformer, inductors, X capacitor opto-coupler and cord for future experimentation.

Repairing the wall wart

Probably only the DC units are repairable. Do not be afraid to look inside—open the case with a hack saw—if you can repair it, glue the case back together with RTV silicon rubber compound. Some actually have cases that are held together with self-tapping screws.

The earliest wall wart

This bell transformer was (I believe) available in the 1960's and was probably the first of the wall warts.

Specifications and regulation data

Wall Wart Specs

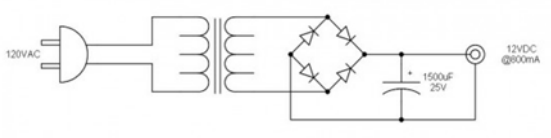
10 WALL WARTS OUT OF MY JUNK BOX
PRIMARY VOLTAGE = 120VAC
TEST FREQUENCY = 60hZ

PIECE #	POWER	STATED SECONDARY VOLTAGE V		RATED LOAD CURRENT	NO LOAD SECONDARY VOLTAGE		% REGULATION	NOTES
1	40VA	12	VAC	3.3A	14.14	VAC	17.8	Bell Transformer
2	12W	9	VAC	780mA	10.74	VAC	19.3	
3	17W	12	VAC	830mA	14.6	VAC	21.7	
4	10W	9	VAC	555mA	10.1	VAC	12.2	
5	4W	7.8	VAC	450mA	10.51	VAC	34.7	
6	5W	12	VAC	130mA	19.48	VAC	62.3	NICAD charger app
7	10W	15	VDC	350mA	19.92	VDC	32.8	
8	4W	5.1	VDC	700mA	5.13	VDC	0.6	Switcher, USB plug
9	25W	12	VDC	800mA	17.07	VDC	42.3	
10	5W	9	VDC	200mA	16.15	VDC	79.4	

wall warts voltage regulation

Voltage regulation (no load to full load) for AC adapters ranges from 12 to 34%. For DC adapters, it is roughly double that or 32 to 80%. This may be seen in the regulation data. The DC adapters have inferior regulation due to the peak detection effect of the input filter capacitor—this is not a serious issue because nothing really operates at no-load, not does anything actually work on AC without rectifiers. For frame of reference (because % regulation tends to be confusing), 0% is perfect and 100% indicates that the voltage drops to half when loaded. Just keep in mind that wall warts tend to be sloppy and the equipment to which it is connected is designed to accept double the specified input voltage safely.

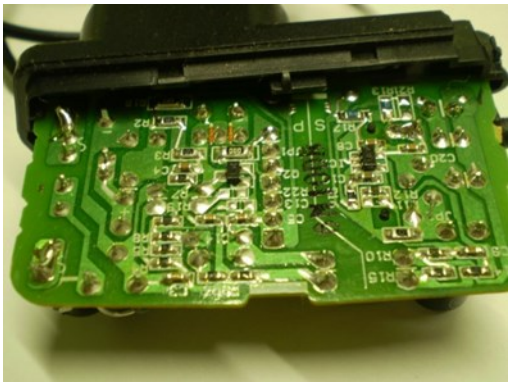
For experimentation, I like the AC versions because I can connect a voltage doubler rectifier to get much higher voltages. Also, if connected to half-wave rectifiers, I can easily obtain ±voltages.



Wall Wart Schematic

A look inside

Visible on the top: X capacitor (right), input rectifiers (2 of the 4 are visible), split bus capacitors, noise filter inductor, switching transistor (Q1), 145°C end of life thermal fuse behind (Q1), ferrite E-core transformer, opto-coupler for feedback (left foreground), schottky rectifier (left), output capacitor (left), and L-C filter (left).



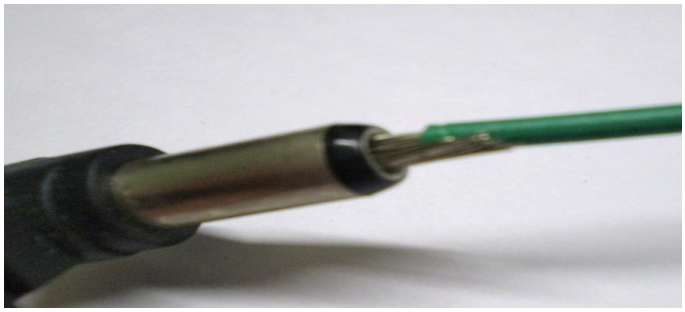
Switcher Bottom

Visible on the bottom: SOT23-5 op amp (right central) and many size 0603 SMD components. No schematic on this one—too complex to trace out for this exercise.

Wall Wart Disassembled

This nice unit was held together with self-tapping screws—just inviting me to take a peek inside. Visible are the transformer, rectifiers and filter capacitor. Absent is a safety bleeder—after the unit is turned off the large capacitor stores a substantial charge for many minutes. An arc occurs if the barrel connector happens to short against conductive material.

Bench test set-up



Connector trick

Connection Detail

Folding the proper stranded wire size back and inserting it into the barrel connector hole is a simple means of making electrical connection for the purpose of evaluation or experimentation.

Surprises

The regulation was worse than I expected especially the DC versions. But the real surprise came from my setup. Did you see the huge 225W Ohmite potentiometer I used for an adjustable load? Well, it took me the longest time to figure out why the pot settings were so different between the AC and DC tests. It turned out to be the reactance of the potentiometer when used as a low-voltage AC load. In fact, the inductive reactance was substantially higher than the resistance and had a profound effect upon the load. It is in effect a low Q air core toroid. I may have studied well and had tons of experience, but do I know it all? no way! Still learning…

ONE GLARING OVERSIGHT!

I hope that some influential person in the industry notices this and actually does something about it-while all wall warts have their specifications clearly indicated, no equipment anywhere (NONE-ZILCH) ever seems to indicate the specifications of the compatible wall wart. How must stuff we are unnecessarily adding to the waste stream each year due to this stupid oversight?

Severe Weather Awareness

Structure and Dynamics of Supercell Thunderstorms

Supercell thunderstorms are perhaps the most violent of all thunderstorm types, and are capable of producing damaging winds, large hail, and weak-to-violent tornadoes. They are most common during the spring across the central United States when moderate-to-strong atmospheric wind fields, vertical wind shear (change in wind direction and/or speed with height), and instability are present. The degree and vertical distribution of moisture, instability, lift, and especially wind shear have a profound influence on convective storm type, including supercells, multicells (including squall lines and bow echoes), ordinary/pulse storms, or a combination of storm types. Once thunderstorms form, small/convective-scale interactions also influence storm type and evolution. There are variations of supercells, including "classic," "miniature," "high precipitation (HP)," and "low precipitation (LP)" storms. In general, however, the supercell class of storms is defined by a persistent rotating updraft (i.e., mesocyclone) which promotes storm organization, maintenance, and severity. More information concerning environmental conditions and the structure of classic and HP supercells is given below. WSR-88D Doppler radar imagery showing the evolution of some supercell events across Kentucky and south-central Indiana are available.

DIFFERENT THUNDERSTORM TYPES

Ordinary: Short-lived (30-60 minutes) storm; generally is non-severe but pulse severe storm is possible; storm moves with mean wind; little or no vertical wind shear/weak winds aloft in environment; chaotic hodograph **(Fig. 1)**; typical in summertime; **buoyancy process important**.

Multicell: Group of cells in different stages of development; can be severe or non-severe; often move with the mean wind; show discreet propagation with new cell growth on the unstable inflow flank; weak-to-strong environmental wind shear/winds aloft; usually a "straight-line" (unidirectional) hodograph indicating speed and/or directional shear conducive for MCSs, squall lines, and bow echoes **(Fig. 1)**; **gust front process important** (balance between convectively-induced low-level cold pool strength and depth under the heavy rain and the ambient low-level wind shear) to trigger new cells.

Supercell: Large severe storm occurring in a significant vertically-sheared environment; contains quasi-steady, strongly rotating updraft (mesocyclone); usually moves to the right (perhaps left) of the mean wind; can evolve from a non-supercell storm; moderate-to-strong vertical speed and directional wind shear in the 0-6 km layer; usually a "curved" hodograph in the lowest 0-3 km and a straight line above **(Fig. 1)**; **dynamic process important** resulting in a steady-state storm (see below).

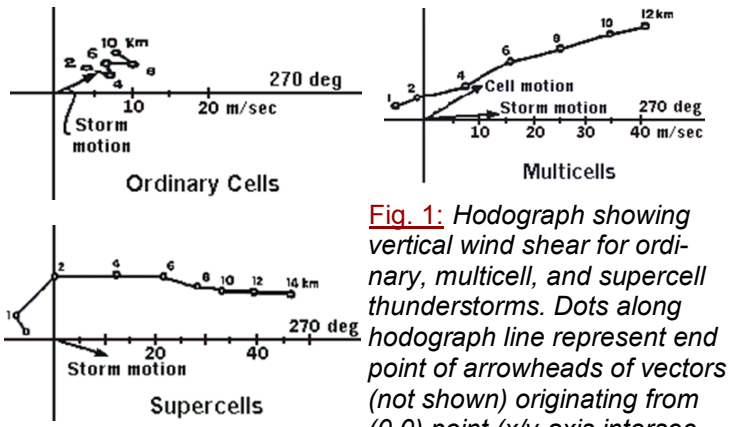


Fig. 1: *Hodograph showing vertical wind shear for ordinary, multicell, and supercell thunderstorms. Dots along hodograph line represent end point of arrowheads of vectors (not shown) originating from (0,0) point (x/y-axis intersection) that reveal wind speed and direction at the indicated height (in km). For example, on supercell hodograph, winds at 1 km altitude are from the southeast, stronger from the south at 2 km, with winds increasing in speed (longer vectors from (0,0) point to each dot) and veering to southwest at higher altitudes. The longer the hodograph, the greater the vertical wind shear. Not only length, but shape of hodograph is important. For example, straight-line hodograph for multicells and curved hodograph for supercells both indicate speed and directional shear. However, curved hodograph indicates presence of a low-level wind maximum (jet) which increases*

storm-relative flow into storm and potential for supercell development. Supercells can evolve from straight-line hodographs as well but are more common with curved hodographs. In contrast, only weak shear is shown for ordinary cells, although if high instability is present, then a severe pulse storm can occur, with hail and/or brief damaging winds

DYNAMICS OF SUPERCELLS; ENVIRONMENTAL CHARACTERISTICS

- **Supercells are not defined by their depth or volume.** They can be large or small, high-topped or low-topped, and can occur anywhere, including the Ohio Valley. They are most common in the central United States. While supercells are not as common as other convective types, they often produce violent weather.

The interaction between updrafts and the vertically-sheared environment strongly controls the degree of organization and severity of convection. Supercells and tornadoes are associated with moderate-to-strong vertical wind shear (and helicity) and moderate-to-high CAPE (instability) (Fig. 2). Rough total wind shear threshold for supercells is 40 kts (20 m/s) in the 0-6 km layer. To determine this threshold, look at the length of the hodograph (which includes speed and directional shear) in this layer, and "lay out" the hodograph along the x-axis to see if it exceeds 40 kts. If so, supercells are quite possible; if not, supercells can still occur given some shear and high CAPE values.

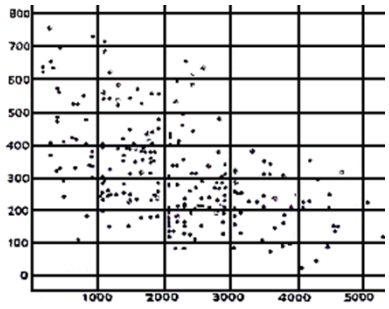


Fig. 2: *Scatter plot of strong and violent supercell tornadoes with respect to 0-2 km helicity (y-axis) values in m2/s2 and CAPE (x-axis) in J/kg. Major tornado outbreaks typically associated with moderate-to-high CAPE (1500-3500 J/kg) AND helicity (150-450 m2/s2). Isolated to scattered tornadoes associated with low CAPE and high helicity (upper left part of plot). Scattered tornadoes associated with high CAPE and low helicity (lower right part of plot).*

- Strong 0-6 km shear (long hodograph) causes high helicity/ high potential for supercell and mesocyclone (rotating updraft) development, but NOT necessarily tornadoes. Mesocyclone strength also is dependent on buoyancy. **Tornado development is dependent on dynamical structure in the storm**. Generally, a supercell/mesocyclone occurring in an environment with significant low-level (0-2 km) curvature in the hodograph (indicating the presence of a low-level jet) is conducive to tornado development.

Vertical wind shear causes the development of dynamic processes in the storm which affect the evolution, strength, longevity, and motion of the supercell. Explanation: 1) Environmental shear results in a rotating updraft as horizontal vorticity is titled vertically into the updraft. 2) The diagnostic pressure equation states that rotation about a vertical axis (rotating updraft) must be balanced by a pressure gradient force pointed toward the center of rotation causing lowered pressure in the middle-levels of a storm where the rotation/updraft is strongest.

- This vertical pressure perturbation leads to an even stronger updraft into the middle-levels, which in turn causes even more rotation (due to vertical stretching) as the updraft speed increases with height, which in turn can feed back and cause an even stronger middle-level pressure perturbation. **The deeper the environmental wind shear, the more efficient the dynamic process should be.**

- This dynamic process results in an enhanced steady-state updraft; **dynamic forces are as important or even more so than buoyancy forces in supporting updraft strength and rotation. The supercell actually can "suck up" air** and continue well into night despite the loss of heating, weaker instability, and dissipation of ordinary cells. The dynamic process also causes high (low) pressure on the upshear/downdraft (downshear/updraft) side of the storm, which results in storm tilt and a right movement of the storm compared to the mean wind.

Dynamic forces eventually can cause the main updraft to split into 2 separate updrafts, i.e., each supercell can develop both cyclonic (on the right flank) and anticyclonic rotation (on the left flank) in the middle-levels. This can cause the storm to split into 2 separate cells, one moving right and the other left of the mean wind. **For a right (left) moving storm, the cyclonic rotation is within the updraft (downdraft) and the anticyclonic rotation is within the downdraft (updraft)** with the tightest reflectivity gradient on the south/east (north) side of the storm coincident with the updraft. A classic example of a splitting storm occurred on **May 28, 1996** over south-central Indiana. The right mover evolved into a classic supercell that produced several tornadoes.

Consider hodographs in evaluating the potential for storm splitting and which cell will dominate. **A straight-line hodograph (unidirectional shear) is more conducive for storm splitting than a curved hodograph in the lowest few kilometers.** Assuming a split occurs, a hodograph with significant curvature (clockwise turning to the shear vectors) in the low-levels promotes a strong right and weak left moving supercell.
The storm relative inflow direction and magnitude are very important. This determines which storm(s) will remain strong/severe. For example, if 2 cells are aligned north-south, both can remain strong despite ground-relative southerly inflow if the storm-relative inflow has an easterly component. Strong inflow speeds promote a stronger updraft strength and more rotation. Strong middle-level storm-relative flow into the supercell also seems to correlate with a strong mesocyclone capable of tornadogenesis in the low-levels.

TORNADO MECHANISMS IN SUPERCELLS

- **Nearly all supercells produce some sort of severe weather (large hail or damaging winds) but only 30 percent or less produce tornadoes.** Thus, one must try to differentiate a tornadic supercell from a non-tornadic one.

- **In the environment, strong 0-6 km shear (long hodograph) and ample buoyancy is needed to generate a significant storm mesocyclone.** Then, the supercell/mesocyclone occurring in **an environment with significant low-level (0-2 km) "curvature" in the hodograph seems to be conducive to tornado development.**

However, tornado development is dependent on the dynamical structure in the storm. **There must be a strong updraft and source of vertical vorticity for strong mesocyclone and tornado development. Environmental horizontal vorticity caused by ambient vertical wind shear is critical to form a rotating updraft (mesocyclone).** The environmental vorticity may be crosswise or streamwise.

However, **tornado formation appears to be related to a storm scale process: the vertical tilting of baroclinically-induced horizontal vorticity**. This process occurs along an outflow boundary associated with the forward flank downdraft **(Fig. 3)**. Along this boundary in or near the low-level hook region on radar, a small-scale circulation occurs as warm environmental air rises on the warm side of the boundary while cold air sinks and undercuts on the cold side, which generates *streamwise* horizontal vorticity along the boundary (note the sense of rotation in **Fig. 3**). This vorticity then is tilted and rapidly accelerated vertically into the storm updraft as the middle-level mesocyclone dynamically "sucks up" low-level air, resulting in a more prominent low-level mesocyclone and likely tornadogenesis. This process sometimes can be seen visually as a tail cloud moving into the hook area from the east, and may be visible on the WSR-88D reflectivity/velocity as an outflow boundary or fine line echo.

The streamwise vorticity associated with this low-level process usually is NOT evident in the environment (i.e., identifiable in a sounding). It is generated through the storm's interaction with the environment. Thus, **marginal ambient wind shear may still support supercells and even tornadoes given the presence of mesoscale/storm-scale interactions, which can greatly increase the local wind shear, helicity, and therefore mesocyclone strength and tornado potential.** Once shear is enhanced and maintained locally in the hook/weak echo region, a series of mesocyclones and tornadoes are possible in the vorticity-rich local environment.

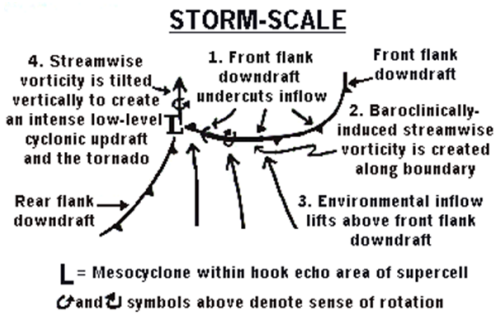


Fig. 3: *Thunderstorm-scale schematic of a supercell-environmental interaction, that can result in the creation of vertical tilted baroclinically-induced horizontal vorticity. This can lead to enhancement of the low-level mesocyclone and possibly tornadogenesis. Text in schematic briefly describes this process.*

WSR-88D REFLECTIVITY SIGNATURES ASSOCIATED WITH SUPERCELLS

For "classic" supercells, a **low-level pendant or hook** often is present on the right rear side of the storm **(Fig. 4)**. Within the hook is a **weak echo region (WER) signifying the location of a strong rotating updraft (mesocyclone).**

The hook is formed through the interaction of the forward flank and rear flank downdrafts with the updraft area. The maximum reflectivity (heavy rain and large hail) core usually is located just north and/or east of the WER. In the downwind (weaker) portion of the low-level reflectivity pattern, a **"V-notch"** or **"enhanced V"** signature may be evident, indicating blocking flow aloft causing some environmental air to move around the storm. An actual supercell thunderstorm, as viewed by the KLVX WSR-88D Doppler radar over north-central Kentucky, is shown in **Fig. 4a**. A vertical cross-section of a typical classic supercell (along line C-D in **Fig. 4**) is shown in **Fig. 5**.

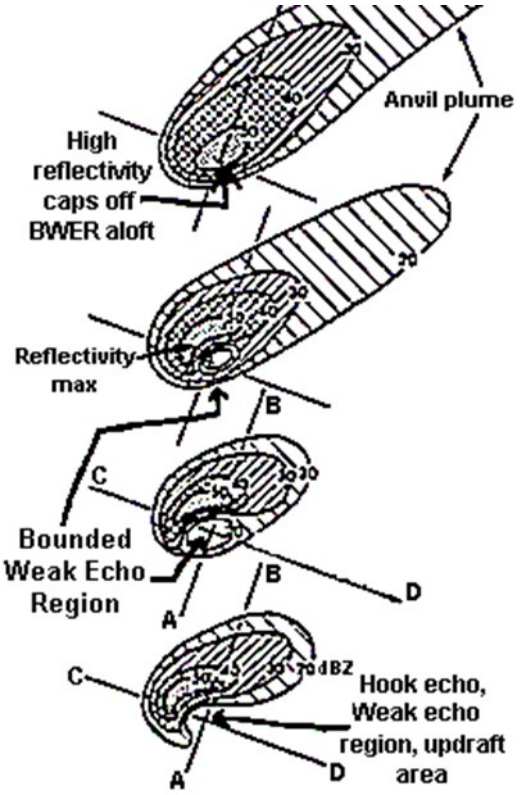


Fig. 4: *Plan view of a typical classic supercell as viewed in radar reflectivity data. Bottom (top) picture represents low-level (upper-level) reflectivity. A weak echo region (WER) is noted in low-levels, a bounded weak echo region aloft (BWER), with echo overhang above the BWER overtop the low-level WER (i.e., storm tilt). A large area of light precipitation and cloud extends well downwind in the upper anvil portion of the storm.*

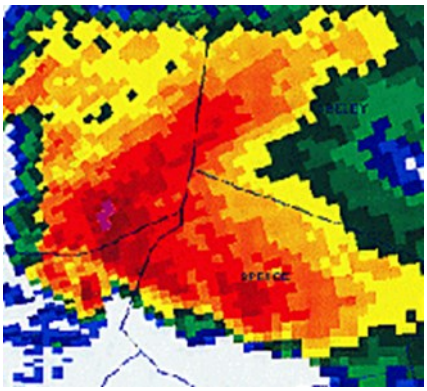


Fig. 4a: *Low-level WSR-88D Doppler radar image of an actual supercell thunderstorm over north-central Kentucky on May 28, 1996. Dark red color represents very heavy rain and hail. A hook echo is seen on the southwest flank of the storm, coincident with a tornado on the ground at this time.*

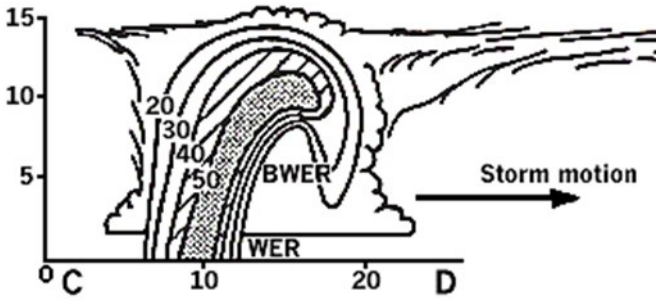


Fig. 5: *Vertical cross-section of a typical classic supercell along line C-D in Fig. 4. The x-axis (y-axis) are horizontal (vertical) distance in km. Reflectivity values in dBZ are shown within the storm. The low-level WER, elevated BWER, echo overhang showing storm tilt, and downwind anvil debris clouds clearly are evident.*

- Above the WER, a **Bounded Weak Echo Region (BWER) (i.e., donut hole)** may be present at higher elevation angles (**Figs. 4 and 5**), indicating overhang in the storm and the location of a strongly rotating updraft. A **persistent** BWER is associated with a significant mesocyclone.

- **High reflectivity often caps off the BWER above it. The top part of the storm (echo top) is shifted over the low-level reflectivity gradient or over the WER** with possible significant anvil debris extending downwind **(Figs. 4 and 5)**.

Heavy Precipitation (HP) supercells: These exhibit **similar features as classic supercells**. However, the **low-levels frequently show a broad high reflectivity pendent or Front Flank Notch (FFN)** (i.e., **kidney bean shape)** on the leading edge of the storm, indicating the location of the WER and rotating updraft **(Fig. 6)**. Mesocyclones for HP storms may be embedded in heavy rain. **HP supercells are not as isolated as "classic" storms, and often may be embedded within squall lines and travel along boundaries.** HP supercells occur in environments with rich low-level moisture and moderate-to-strong wind shear, and are a threat for tornadoes, large hail, damaging winds, and flash flooding. An example of an HP storm embedded within a squall line occurred over south-central Kentucky on **May 18, 1995**.

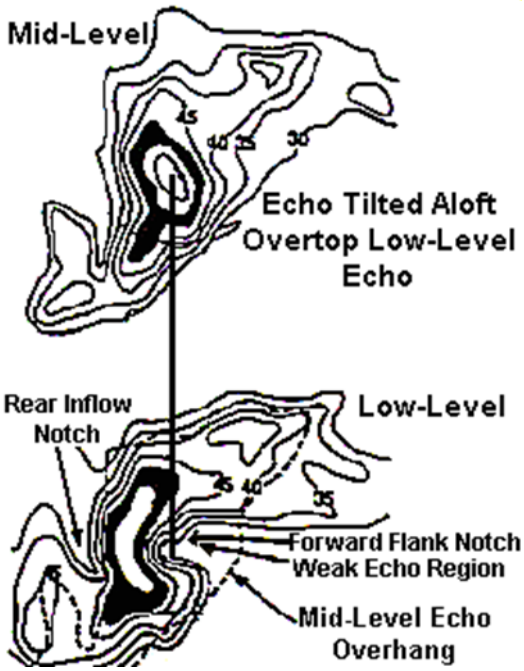


Fig. 6: *Plan view of radar base reflectivity in the low-levels (bottom picture) and middle-levels (top picture) of a typical HP supercell. A WER is present on the forward flank of the storm in low-levels with echo tilt aloft overtop the low-level WER. Highest reflectivity values in low-levels can resemble a kidney bean shape.*

Classic and HP supercells sometimes can evolve into a bow echo as the rear flank downdraft or a rear inflow jet causes the storm to accelerate outward, resulting in a bowing storm with damaging straight-line winds **(Fig. 7)**.

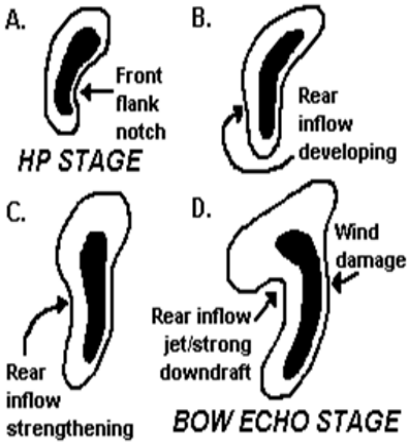


Fig. 7: *Sequence of basic plan view reflectivity schematics showing how a supercell ("A") can transition into a bow echo storm ("D") due to development of a rear inflow jet and/or intense rear flank downdraft from the HP storm.*

Most severe events occur near the updraft/downdraft interface on the right rear (classic) or front flank (HP) part of a storm. The strongest tornadoes often occur as the BWER begins to collapse.

MESOCYCLONE SIGNATURES ASSOCIATED WITH SUPERCELLS

- **Mesocyclone:** A small-scale solid body rotation closely associated with a convective updraft. True supercell mesocyclones (ones associated with tornadoes, e.g., **Fig. 8**) **must meet or exceed established thresholds for shear, vertical extent, and persistence.** For supercells, the following approximate criteria seem to well for Kentucky:

o ***Shear:*** Distance between the maximum inbound and maximum outbound less than equal to 5 nm. Rotational velocity Vr = [(max outbound velocity + max inbound velocity) ÷ 2]: Severe thunderstorm warning: greater than about 20 kts (15 kts) if the storm is less (greater) than 100 nm from the radar site. Tornado warning: greater than about 40 kts (30-35 kts) if the storm is less (greater) than 100 nm away. These values are only approximate, so detailed consideration of storm structure, trends, and trained spotter observations are very important as well.

o ***Vertical extent:*** Shear extends at least 8,000-10,000 ft in the vertical (but shear may NOT extend this high up for low-top storms or distant supercells that still can cause severe weather).

Persistence: Coherent rotational signature persists at least 2 volume scans.

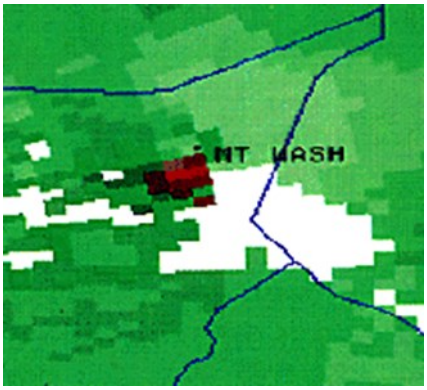


Fig. 8: *WSR-88D storm-relative reflectivity image of a tornado-producing mesocyclone near the town of Mt. Washington in north-central Kentucky (southeast of Louisville) on May 28, 1996. Red (green) colors denote radial winds directed away from (toward) the radar located to the west (left) of the area shown. Thus, a tight, cyclonic (counterclockwise) circulation is shown near Mt. Washington. Just northeast of the town, the lighter shaded green color represents storm-relative flow directed into the mesocyclone, which appears to aid in tornado development and maintenance. The mesocyclone is at the same time and position as the hook echo in the reflectivity image in Fig. 4a above.*

CAUTION: Severe weather and non-supercell tornadoes associated with **squall lines and bow echoes** may still occur, despite these supercell criteria not being met.

- **Tornadoes are most likely during the period of maximum mesocyclone core strength.** Mesocyclones with the smallest diameters and highest rotational velocities (Vr) extending over a deep layer represent the greatest tornadic threat.

- Only about 30 percent or less of mesocyclones that meet supercell criteria produce tornadoes, although **most all** (90 percent or more) **produce some sort of severe weather**.

- **Mature idealized mesocyclone rotational structure in WSR-88D storm-relative velocity data: Low-levels:** Usually see cyclonic convergence (assuming the storm is close enough to the RDA). **Middle-levels:** pure cyclonic rotation (maximum inbound/outbound are on neighboring radials at the same distance from the radar site). **Upper-levels:** cyclonic divergence. **Storm Top:** pure divergence (maximum inbound/outbound are along same radial).

- **Some mesocyclones produce a single rotational core; others produce a series of cores** in a periodic fashion. The first mesocyclone core has a relatively long organizing and mature stage. However, subsequent mesocyclones (if any) can develop and mature much faster in the vorticity-rich convective environment, resulting in a series of mesocyclones and a family of tornadoes.

Multiple mesocyclones can evolve as the rear flank downdraft (mini-cold front) accelerates outward and catches up with the forward flank downdraft (mini-warm/stationary front) resulting in a convective-scale triple point occlusion at the mesocyclone/updraft center. Thus, the original mesocyclone weakens while a new one can spin up rapidly at the triple point **(Fig. 9)**.

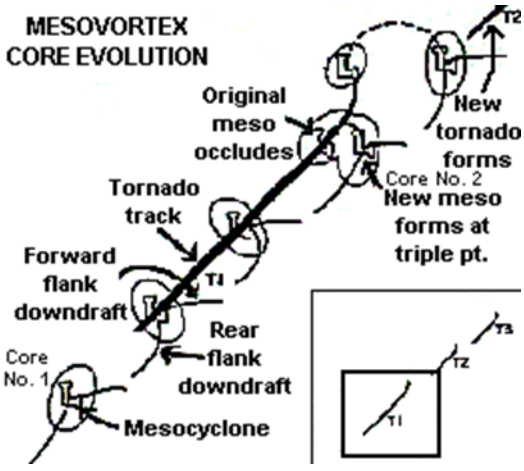


Fig. 9: *Conceptual model of mesocyclone core evolution. The "L" shows the mesocyclone location with convective-scale cold and warm/stationary fronts extending from the meso. The cold front is the leading edge of the rear flank downdraft, while*

Severe Weather Awareness

the warm/stationary front represents the southern edge of the forward flank downdraft from rain-cooled air north of the boundary. The bold lines are tornado tracks. The insert shows tornado family tracks and the small square in the insert is the region expanded in the schematic.

The **Tornado Vortex Signature (TVS)** is a strong, gate-to-gate (adjacent radials on the WSR-88D Doppler radar) shear associated with tornadic scale rotation that meets or exceeds established criteria for shear, vertical extent, and persistence. Identification of a low-level TVS suggests that a tornado may be occurring or may soon develop assuming a favorable reflectivity pattern. However, even without an identified TVS, **mesocyclone identification and reflectivity and storm-relative velocity structure is invaluable in assessing the need for a tornado warning**.

GUIDANCE FOR WARNING DECISIONS FOR SUPERCELLS:

- Always consider as much information as possible, including 1) pre-storm environment; 2) radar reflectivity structure and trends; 3) base and storm-relative velocity, including mesocyclone structure and trends; 4) other pertinent WSR-88D products; 5) storm-scale interactions (within storm environment) causing cell mergers, enhanced shear and rotation, etc.; and 6) spotter reports.

- Do not base a warning decision solely upon mesocyclone strength. Consider the information mentioned above. However, as a rule-of-thumb, if a supercell is identified, including one with only a "weak" mesocyclone, a severe thunderstorm warning should be issued; if a "moderate" or "strong" mesocyclone is indicated and is supported by favorable reflectivity structure and the presence of enhanced low-level storm-relative inflow, a tornado warning should be strongly considered.

Know conceptual models of storm structure thoroughly. For example, even if velocity data are hard to interpret (e.g., range folding, improper dealiasing, weak mesocyclone at far ranges), but reflectivity structure or spotter reports suggest a severe or tornadic storm, issue the appropriate warning at once.

Early Radio: Military Communications

Border Surveillance

Okinawa - In 1964 our twelve-man Special Forces A-Team, A-323, 1st Special Forces Group (Airborne), was stationed at Machinato, Okinawa. During the dark hours of early morning we were loaded onto two trucks, canvas down and secure, and driven to nearby Kadena Air Force Base.

Still under blackout conditions, we were backed into a C-123 Hercules transport where we were allowed to dismount from the vehicles, which they drove back down the ramp and back across the runway. Seconds later, the Hercules' ramp closed and we were on our way to Vietnam.

During the early morning hours we were flying north along the coast of South Vietnam toward our destination, Da Nang. I watched with heightened interest the surf breaking against the white sand beaches along the coast. It looked too peaceful, too serene to be a country at war.

Squalling tires announced our arrival in Southeast Asia. It was 1964, the Year of the Tiger. It would be here in Vietnam that I would learn that "suffering is the one promise that life will keep".

Camp Khe Sanh

We were assigned the mission of building a Special Forces camp at Khe Sanh in the North Western corner of South Vietnam.& The location of the camp was to be up on the plateau under the shadow of the DMZ, just North East of the old abandoned French fort on a hilltop east of the town of Khe Sanh. We were to establish a temporary camp there overlooking Route 9 while the new camp was being constructed.

Up on the plateau the only structure that existed amid the sea of tall grass was 3,900 feet runway constructed of PSP (Perforated Steel Planking). The northernmost Special Forces camp in the country, Camp Khe Sanh would be located just below the North Vietnam boarder and only a few miles east of Laos. We knew that we would be under constant surveillance by the enemy, but then that's why we were there. Their Ops on the mile-high Dong Voi Mep, or Tiger Tooth Mountain and the even higher 7,750 feet Dong Quang Ngai Mountain, would know every move we made. The "secret" war in South Vietnam was heating up, and we were to be a part of it.

In addition to building Camp Khe Sanh, the mission of A-323 was to provide border surveillance in the tri-border area of North and South Vietnam, and Laos. The CIA had already attempted to establish border surveillance through the efforts of local Montagnard tribesmen. We were to bring them together inside a fortified encampment featuring underground concrete bunkers, and a large number of hardened fighting positions that would withstand anything the enemy could throw at us.

In each corner of the new camp we constructed a massive combat bunker housing five separate machine gun positions and an underground ammunition storage area. A communications trench ran the entire perimeter of the camp linking

together all the fighting positions. We worked hard and our progress was steady.

The camp had a platoon of Chinese Nung mercenaries who served as personal bodyguards for the Special Forces soldiers at Khe Sanh. They were outstanding fighters whose pay scale was much higher than that of the CIDG and the regular Vietnamese army. A small squad of Nungs would accompany us on patrols to guard against assassins within the ranks of the CIDG or ARVN.

The local Montagnards were of the Bru tribe. They provided the CIDG battalion that garrisoned the Khe Sanh Special Forces camp. The Bru, like most Montagnards, were animists who believed that living spirits and Yang, the supreme God, existed in nature, such as in the trees, plants, animals, rocks, rivers, mountains, particular tracts of ground and even in the sky. Fear, anxiety and the dread of evil spirits, along with omens from dreams and signs were the dynamic forces that controlled their daily lives, even their very existence. Every minor or major catastrophe was attributed to the spirits. On patrol, the superstitious Bru tribesmen paid particular attention to the presence of birds, monkeys, deer and especially Mr. Tiger. However, the spirits of the sky received the highest attention, because they were regarded as the source of important omens. The Montagnard tribe to the south along the border or our operational area was the Tau-oi who lived in the remote mountainous highlands.

A short distance to our west, North Vietnamese Army units were hard at work developing the complex overland supply system known as the Ho Chi Minh trail by which supplies and soldiers were moved from North Vietnam into parts of South Vietnam. This 8,000-mile trail network ran mostly through dense, mountainous forests. Depending upon the distance individual NVA units had to cover; it could take from several weeks to several months to reach their final destination. It took the equivalent of two entire infantry divisions just to secure this maze of trails and roads. Besides thousands of workers, the transportation network depended on numerous rest stations and countless agricultural plots to maintain it self. In 1964, some 18,000 North Vietnamese regulars worked their way south, arriving at various locations in South Vietnam. It was our job to maintain surveillance on their activities.

Shortly after our arrival, it was my turn to take out a patrol. We were to patrol south twenty klicks along the Laotian border, starting from Route 9 at Lang Vei. Fortunately, my patrol partner was Staff Sergeant Ratchford P. Haynes, a professional soldier and veteran of the Mobile Training Team White Star in Laos. He was also our senior team communicator. I always felt secure with Haynes because he commanded with a great deal of cool objectivity, sharp reflexes, and self-confidence in his own judgement. He was a man who was always in complete control of the situation.

Prior to our departure, we had to check out our tough Bru tribesmen and their equipment. I looked into each man's dark, weathered face, noticing the high cheek-bones, the broad nose and the short, stocky physique. They had powerful shoulders and arms, promising reserves of strength and endurance that would prove beneficial during the long patrols against the enemy. I noticed that they always wore smiles on their faces, almost as if they alone understood the humour of war.

A few had tattooed faces, pierced ears and upper teeth that had been filed down. Their bright, almond coloured eyes expressed a wildness that lurked just beneath the surface. Most were much smaller than we Americans, measuring around five feet four inches tall. The Bru were good troops, well disciplined, and eager to learn.

The Long Patrol

We moved through an open, vast expanse of high grass that spread across the hills toward a mist covered mountain ridgeline over 5,000 feet high. In places the grass was over our heads, hiding us as we moved through it. When we finally reached the crest of the mountain, we left the grass and entered the dense, shadowy forest. The vegetation at ground level soon thinned-out as the overhead grew taller. I heard a constant chattering of birds above us, busily hunting for food among the higher branches. I looked up and spotted several, some with scarlet-striped backs, other with yellow underbellies. I couldn't help but notice how the Bru eagerly watched to see in which direction the birds flew off. When I asked them what this meant, they told me that it was an omen. If the birds flew to the right, it was a good sign. But if they flew to the left, it meant that there was impending danger ahead. If this had happened the Bru would have immediately returned to Khe Sanh. They fervently believed that the spirits had sent such omens to them in the form of a sign or a dream to warn them of good or evil in their futures.

The trees above us, reaching to heights of 80 feet or more, formed a continuous, impenetrable canopy. A second, lower level formed another ceiling about 50 feet above us. The combined effect of the double overhead canopy filtered out the sunlight, causing our surroundings to be in constant shadow.

We moved up and down the steeply sloped ridgelines, following a well-worn trail. Frequently shifting our rucksacks, we struggled across deep ravines, stepping across cool, gurgling mountain streams. And as always the sounds of the birds, monkeys and insects was with us. The sharp yap of barking deer, the sudden hair-raising scream of a jungle peacock, or the distant cough of a hunting tiger – each day was a new experience, each night brought new terrors. Except for the rising hordes of persistent mosquitoes, we would soon grow to feel comfortable in the jungle.

One evening, on the western promontory of a mountainous ridge, we watched a splendid panorama of undulating emerald green hills, over shadowed by a setting red sun dropping slowly beneath the horizon. It was a breathtaking view that none of us present would ever forget.

The next day we watched the fog in the valleys below us break up in the warming early morning sun. We could see the Sepone River winding like a dark snake beneath us. Day after day we patrolled through the dark, black shadows of the virgin forest in pursuit of the enemy. We were high in the country, and the air was crisp and fresh, unlike the dank, cloying air down in the lowlands. Occasionally, we would come upon small wooded structures in unlikely spots in the middle of the jungle. Our 'Yards told us that they were placed there by unseen primitive mountain tribesmen as temples to placate evil spirits who lurked there. We looked at them but did not touch them.

Our Bru's seeing that we were curious, had warned us not to go near them. The miniature temples guarded sacred places that were integral parts of the religions of mountain hunter past and present.

We also ran across well-prepared ambush positions that, fortunately for us, were unoccupied at the time. Our point men had to be extremely careful to avoid walking up on the enemy soldiers from behind, or blundering into an "occupied" ambush position. We found where the enemy had emplaced sharpened bamboo stakes in the undergrowth along the trails, usually opposite the prepared ambush positions. Anyone attempting to take cover outside the kill zone would find himself the main course of jungle shish kebab.

Sign Cutting in the mountains

We knew that there had been people in the area ahead of us. We found tracks in the trail and physical warnings cut into trees. They were for our benefit and warned us that we would die if we went any further. But we were also forced to pay heed to other warnings. An animal track, like a single imprint of a deer's split hoof, found on a the trail at the wrong time or facing the wrong direction, would be an evil omen that would send our Bru tribesmen heading home. They believed that to ignore such a warning would bring disaster on all. It could result in meeting the devil, or being killed by a snake or eaten by a tiger. We soon found one such sign, a skull and crossbones cut into the trunk of a large tree. Nothing came from it because it was meant for Ratchford and me. Haynes grinned when he saw it, and warned me that I had better not go any further.

Well away from the trail, a soldier's wary eyes spotted fresh yellow-colored human faces. The files still on it indicated that it was fresh. I watched as the Bru tribesmen pressed it with a stick, and picked at it, pointing to the outside and then the inside. He spoke to my South Vietnamese counterpart, remarking that since the surface was the same as the inside in colour and consistency, then it was fresh. The enemy was not very far away. When I pointed to the strips of red in the stool, one of the Vietnamese told me that it was peppers that had been eaten with the soldier's meal. NVA faces characteristically neither smelled nor looked like ours. From the large size, colour and lack of odor of this particular sample, we could tell that the enemy soldiers in the area were getting plenty of the wrong foods to eat. Their diet had to consist of large amounts of cellulose roughage, which is not readily digested by the human body. This accounted for the large size and composition of their stools, and the anemic NVA soldiers existing on a very plain diet of rice and other local plants. Since we had a lot of protein and iron in our diets, our own stools appeared dark and smelled rather strong, forcing us to bury them while on patrol.

Our scouts found an occupied rest station just across the border in Laos, next to the Sepone River. There were three longhouses and a number of lesser structures located in a grove of tall trees along the river. For some reason the enemy soldiers were all-relaxing in a single longhouse. They had been singing when our scouts first spotted them, but by the time the rest of our patrol had moved up the enemy appeared to be engaged in some sort of meeting. There were no guards observed along the river side of the rest area, so we approached from that direction.

After observing the situation, we decided to booby trap their rest area, specifically the building where the meeting was going on, so that they could not get out without suffering heavy casualties.

Setting up patrol security on the east side of the river, we sent a team out to find a rendezvous point where we could move to and remain overnight after we finished with the enemy at the rest area. Then we selected two men to infiltrate the enemy rest camp and set up the booby traps.

At dusk the two men silently bellied up to the slow-moving river. With the security team observing the sand embankment that marked the narrow edge of the enemy rest area, the two men slipped into the rest area and stealthily made for the opposite shore. With just their heads showing above the waterline, they progressed quickly across the stream and disappeared into the shadows of the NVA encampment. Several long minutes later, we saw them reappear along the river bank and begin their trip back across. When they reached us they quickly reported that they had successfully booby-trapped the area without being spotted. Tempted to stay for the fireworks, we decided that discretion was the better, and left immediately for our rendezvous point.

A day later, a scout on point was moving ahead of us when he spotted men across the river. He signaled back to us that we had company on the other side of the water. In a crouch, we hurried to a pre-designated area to our rear and set up a hasty ambush on a bend in the river. We deployed quickly but carefully, selecting our positions in the darkness of the triple canopy jungle. The Bru were excited and had a look of triumph on their faces.

My patrol partner whispered for me to initiate the ambush. My blood ran cold in my veins as we waited for the enemy to appear. We had selected a good spot. The vegetation on our side of the river ran right up to the water.

Finally, the enemy patrol appeared. Their scouts were alert searching the jungle for possible danger. They moved slowly, studying the terrain to their front a long time before moving up. Then I realized that they were going to cross the river – right in front of us – less than 50 metres away. Surprisingly, their attitude suddenly became more relaxed, almost casual, as they reached the river and started across in mass, weapons slung over their shoulders. I was shocked to see that they were not sending their scouts ahead of the main force.

Slowly, I checked my weapon to make sure the selector switch was set for semi-automatic fire. I took quick stock of my surroundings, noticed that there was almost no wind. The sun was high and behind us, forcing the enemy to look directly into it, and then into the dark shadows where we lay hidden. All the elements for a devastating ambush were in our favor.

I continued watching until I saw what appeared to be the last man in the enemy formation coming down the steep sloping bank across the river. I settled into a comfortable position and carefully picked my target. I eased the safety off my M-2 carbine and snugged it tighter against my shoulder.

I could almost feel the Bru hidden around me waiting, ready to fire. Lining up my target over the front sight, I leaned into the butt of my carbine, took a deep breath and squeezed off the shot.

I heard a resounding "SLAAAP" as the explosive impact of the round mangled the lungs of the NVA soldier I had shot. More empty brass casings flew from my carbine as I continued to select targets and fire. I couldn't hear my own shots over the din of thunder kicked up by my companions hidden along the river bank. Taking a second to look up over my gun sight, I could clearly see the looks of horror and surprised on the faces of the NVA soldiers caught in mid-stream. Bodies were dropping everywhere as our ambush chewed through the tightly packed enemy. The NVA groped for their weapons, trying to get them off their shoulders and into play as geysers erupted all around them. Disoriented, many stood frozen in terror, unable to react – until it was their turn to stop a bullet. There was a rush of sound as the firing came so fast and furious that it blended into a continuous roar, drowning out everything else. The effect was shattering. The enemy formation was shredded as the water of the Sepone River turned red.

Wounded enemy soldiers began to reach the opposite shore, but were quickly picked off by Bru sharpshooters as they staggered up the bank. There was no return fire.

Finally, the last surviving NVA was on his hands and knees, his head drooping downward. He struggled once to get up, then slowly collapsed, rolling weakly onto his side in the water. Then it was over. The ambush had not lasted more than three minutes. Now there was only silence, except for the eerie ringing that persisted in our ears. Trapped in the river, the enemy column had had no chance. What I had just witnessed and participated in hurt me in my heart and soul. The image was locked forever in my mind. I said a silent prayer that I would never find myself on the receiving end of such an ambush. Slowly, without thinking, I fed another magazine into my carbine.

Dead men littered the stream and its opposite shore. The river ran red with blood as far downstream as I could see. Except for the sound of weapons being reloaded, a lingering silence hung over the scene. The smell of cordite… and death…was everywhere. For the first time, I realized that this war was going to be close and personal. I silently resolved to myself that, just like the warriors we led, I would take notice of anything and everything during the rest of my tour in Vietnam.

I would not let my eyes overlook anything. I would always be ready for the unexpected. I had just witnessed the results when one wasn't.

Now we had to worry about getting home before a larger enemy force found us and attempted to get a little payback. We knew they would try to think like us, to second-guess what we would do and which way we would go. We told our rear guard to alert us immediately if there was any indication that we were being followed. This would give us time to arrange another ambush.

We decided to take the long way back to Khe Sanh, heading farther inland from the border before turning north. We would head due east deep into the mountains, until we reached the Bru village of Huong Hoa located on the south side of Route 9, just below the last bridge in South Vietnam.

A cold chill had found its way up the back of my neck. I had little doubt that the NVA would ambush the route we came down on, hoping that we would return the same way. The wind had picked up, and it looked like rain might be on the way. Its arrival meant that we would leave a discernible trail wherever we went. Armed with this knowledge, we climbed high into the rugged, wild mountains.

We moved quickly but with extreme caution. The awareness that we were being pursued spurred us beyond our fatigue. In places the jungle was almost too thick to permit our passage, but we forced our way through. We knew that we couldn't lose the enemy soldiers tracking us, but hopefully we would be able to stay far enough ahead of them to avoid contact. I could sense that everyone was on hyper-alert when, late in the day we moved into a densely vegetated low valley. The thick undergrowth sliced our hands and faces as we fought our way through. Finally, we broke out at the edge of a slow moving stream that proved to be the tributary we were looking for. It led north to the larger river that passed by the village of Huong Hoa.

That evening we contacted an aircraft flying overhead and had the pilot relay a message that we badly needed an aerial re-supply of food and ammunition. With our rations nearly gone we had been forced to forage for lemon grass, bamboo shoots, the core of an occasional banana tree, and colocassia roots to mix with our remaining rice supply. It barely sustained us.

The ambush at the stream had expended much of our ammunition, making a second fire-fight a risky proposition. The re-supply would go a long way toward restoring our chances of surviving the mission.

The next day we discovered a clearing with a cultivated plot along the edge. Someone had planted taro and manioc. The condition of the plants indicated that whomever was maintaining the garden plot had to be nearby. A quick but thorough search of the area turned up an NVA rest station made up of several empty huts. It was being looked after by a single Montagnard family; a man, his pregnant wife and a crippled boy. We told them that they would have to come with us to Khe Sanh for interrogation, a fact which they seemed to accept without complaint.

We moved on, travelling in total silence at a pace that was progressive but not tiring. Our rations were depleted and our situation was becoming desperate. We followed the river, weapons at the ready, always searching ahead for signs of movement or enemy forces waiting in silent ambush.

River Crossing

Later that day, we arrived at a ford where we were able to cross the river. This was the spot we had given the pilot co-ordinates for our re-supply drop on the day before. Now we had to hope that it was on the way.

The loud roaring of the river, along with a gusty wind that had come up at mid-morning, made it difficult to hear anything else. The suddenly, I heard the faint hum of an aircraft engine to the northeast. I could see nothing but the sound was unmistakable. The aircraft was coming in low and fast, and then it was there, right over us, an Australian CV-2. The pilot banked sharply, searching for our marker panels. When he spotted our signal, he levelled out, descending to treetop level, free-dropping the supplies as he passed overhead. In seconds, the plane was out of sight and sound. When we broke open the bundles, we discovered that the free-drop had destroyed most of the food supplies. Disappointed, we salvaged what we could, divided it among the members of the patrol then pushed on across the river.

The torrent, which was moving more swiftly along this part of the river, was chest deep. We sent a security team across the river ahead of the main patrol while the rest of us formed a human chain to aid in traversing the turbulent waters. On the other side, we formed back up and moved quickly away from the river, climbing higher into the forest. Even though our rear security had spotted no one on our back trail, we still had the feeling that we were not alone in the bush.

Suddenly, the cacophony of normal jungle sounds ceased. It was so immediate that it was clearly noticeable. This meant danger to us. Someone or something was coming toward us, trespassing in the natural environment of the forest. I thought it was the enemy until I spotted the swirling grey-black clouds pushing out of the east, and felt the sudden gust of a stiff, cool breeze against my face. We were in for a savage jungle thunderstorm, and we had little time to prepare. In the silence before the fury hit we moved into the protection of a cluster of large trees, intermingled amid a jumble of ancient boulders. We would wait out the storm there.

We heard the rumbling of distant thunder and saw the flashes of jagged lightening against the darkening sky. Then a strong guest of wind came up and the storm was upon us, shaking the tops of the trees, making them dance back and forth in the driving rain and the bolts of lightening.

Whispers spread quickly among the Bru. The superstitious tribesmen muttered fearfully about Bok Claik, the storm spirit – an evil omen of some dreadful thing to come. The thunderstorm was this evil spirit announcing his presence. I felt an immense sense of relief that the NVA had not yet found us, because our Bru had just lost a great portion of their fighting effectiveness.

The force of the storm increased, as the giant trees swayed all the way down to their roots. Raindrops, falling horizontally, were driven into us like bullets designed to cause pain but not injury or death. The cold water plastered our uniforms to us, as our body heat began to escape out into the storm. As the total darkness of night closed in, the tempest finally passed over us and was gone.

The rain brought leeches in great numbers. We soon felt them invading our flesh as they located every opening in our clothing. There was little we could do but play the role of unwilling hosts. We would have to deal with them in the light of day, and our vengeance would be great.

Two days later, again out of food, we had reached the limit of our endurance. We had to stop, find something to eat, and rest a while before we would be able to go on. We holed up in the shelter of a shallow draw along the river. Higher up the stream we located a few deep pools of water trapped in erosion pockets among the rocks. In the pools, large fish could be seen suspended above the bottom. We sent out a few two-man teams to collect them with the "old reliable"

Early Radio: Military Communications

fishing technique of soldiers everywhere – DuPont spinners. The final results were far greater than expected. Soon the teams had returned with large quantities of concussion-stunned fish.

The Bru's built a number of small, scattered cooking fires, and waited until they had been reduced to coals. Then they cooked the fish, using a number of methods; baking them in mud cocoons, grilling them over heated rocks, or boiling them in their helmets. Cooking was risky, but forging ahead without the nutrition was a sure bet for disaster. The cooking fires burned themselves out as the night closed over.

The next day we emerged from the cloud-covered forest, out of the mist that surrounded us, and finally onto the open ridges overlooking the longhouses of Huong Hoa. Immediately, a feeling of safety and well being settle over us. We had beaten the odds…the jungle…and the enemy.

We moved down toward the village. There remained only one more river to cross before reaching the open expanse of Route 9, and then on to the escarpment of the Khe Sanh plateau.

As we crossed the river in borrowed native log canoes, our rear security team reported spotting an enemy tracker, a shadowy figure standing back on the edge of the forest, watching us. Our fatigue and hunger were now forgotten. We were on the final leg of our odyssey.

When we reached camp, we heard that Hanoi Hannah had mentioned how busy the boys at Khe Sanh had been out on patrol along the border. She was talking about us. It was nice to know that someone really cared.

ARRL Field Day
June 27-28, 2015
Field Day Primer

Field Day, the MRAC's premier annual operating event, is open to the general public. This live training session prepares amateur radio operators to be able to set up and operate a station during less than ideal conditions in an emergency. It is also a contest with points and awards for contacting other participants. The contest encourages all to participate, while the experience gained pays off when a real emergency occurs.
With our influx of new and prospective amateur radio operators, an introduction to general operating procedures and the N3FJP software that we use to log contacts is in order.

Our Field Day site will have several operating positions—each with a radio, antenna, power source and a logging computer. Our Field Day Captain Dave, KA9WXN, will coordinate each position to operate on a specific band and mode to avoid interference with each other.
Each position is ideally manned by a team of two—one does the operating and the other logs contacts on the computer. The team members can exchange roles and will appreciate occasional relief by other operators. To learn good communicating skills, observe a smooth operating team, then offer to help logging and operating.

Field Day Rules: Read the full Field Day rules. We may contact other stations once on phone, once on CW (Morse code) and once on one digital mode on each band. We must log the other station's correct exchange information for the contact to be valid. This includes the station call sign, the number of transmitters at the site and class of operation, and the ARRL section.

Our exchange information will be our number of transmitters (to be determined when we start), our class is Alpha (A for portable station with 100% emergency power), and our ARRL section is Sierra Victor (SV for Sacramento Valley). For example, if we have 4 transmitters, our exchange would be

Here is an example of a typical Field Day phone exchange:	**Here is a typical Field Day CW or digital exchange:**
• **W9RH**: *"CQ Field Day, Whiskey nine Romeo Hotel, Field Day"* • **W1AW**: *"Whiskey One Alpha Whiskey"* • **W9RH**: *"W1AW, Copy my Four Alpha, Sierra Victor"* • **W1AW**: *"QSL. Copy my Five Alpha, Connecticut"* • **W9RH**: *"QSL, Thanks. This is W9RH. Field Day."*	• **W9RH**: *"CQ FD DE W9RH W9RH"* • **W1AW**: *"W1AW"* • **W9RH**: *"W1AW DE W9RH 4A 4A SV SV"* • **W1AW**: *"QSL 5A 5A WI WI* • **W9RH**: *"QSL TU W9RH FD"*

"**Four Alpha Sierra Victor**" on voice or "**4A SV**" on CW and digital modes . **Learn and use the ITU phonetic alphabet** when needed for clarity, and only ask for repeats of (or provide) information that was not copied correctly the first time. We would log the above contact exchange as "**W1AW 5A CT**"

Our software, the N3FJP ARRL Field Day Contest Log, networks the computers at all our positions, lists all the Field Day section multipliers (color coding those that have been worked), flags duplicate entries (contacts with stations on the same band and mode) and summarizes the activity for log submission.
Field Day is a low stress way to get into operating a station, and there are plenty of experienced people willing to help the beginner. It is fun, you get lots of fresh air and good food—with priority given to the operators!

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Open to the Public
Drop in visitors welcome
For info E-mail:
w9rh@arrl.net

Field Day: MAARS and MRAC at Konkel Park in Greenfield, which is located at 5151 W Layton Ave, on June 27 and 28.

Name of Net, Frequency, Local Time	Net Manager
Badger Weather Net (BWN) 3984 kHz, 0500	W9IXG
Badger Emergency Net (BEN) 3985 kHz, 1200	NX9K
Wisconsin Side Band Net (WSBN) 3985 or 3982.5 kHz, 1700	KB9KEG
Wisconsin Novice Net (WNN) 3555 kHz, 1800	KB9ROB
Wisconsin Slow Speed Net (WSSN) 3555 kHz, Sn, T, Th, F, 1830	N1KSN
Wisconsin Intrastate Net - Early (WIN-E) 3555 kHz, 1900	WB9ICH
Wisconsin Intrastate Net - Late (WIN-L) 3555 kHz, 2200	W9RTP
ARES/RACES Net 3967.0 kHz, 0800 Sunday	WB9WKO
* Net Control Operator needed. Contact Net Manager for information.	

Next Regular Meeting

The next meeting will be on Thursday, June 25th, at 7:00PM. We meet in the Fellowship Hall of Redemption Lutheran Church, 4057 N Mayfair Road. Use the south entrance. Access the MRAC Yahoo group for important details about the February Meeting.

Meeting Schedule:

September, 24th 2015 - 7 pm

Please do not call the church for information!

The MRAC/MAARS join picnic will be on August 8th, 2015 at Greenfield park, picnic area number 2.

Club Nets

Please check in to our nets on Friday evenings.

Our ten meter SSB net is at **8:00 p.m.** at **28.490 MHz USB** Our two meter FM net follows at **9:00 p.m**. on our repeater at **145.390 MHz** with a minus offset and a **PL of 127.3 Hz.**

Visit our website at: **www.w9rh.org**

Or phone (414)-459-9741

Chatter Deadline

The **DEADLINE** for items to be published in the **Chatter** is the **15th of each month**. If you have anything (announcements, stories, articles, photos, projects) for the 'Chatter, please get it to me before then.

You may contact me or Submit articles and materials by e-mail at: W9rhmrac@Gmail.com

or by Post to:

Michael B. Harris

807 Nicholson RD

South Milwaukee, WI 53172-1447

VE Testing:

July 25th, 9am—11:30am

No testing: June, August, or December

Location: Amateur Electronic Supply Time: 9:30 AM (Walk-ins allowed)

ALL testing takes place at: Amateur Electronic Supply 5720 W. Good Hope Rd. Milwaukee, WI 53223

Area Swapfests

June 21st Six Meter Club of Chicago
Location: Wheaton, IL
Type: ARRL Hamfest
Sponsor: Six Meter Club of Chicago
Website: http://k9ona.com

July 11th Swapfest '15 Location: Oak Creek, WI
Type: ARRL Hamfest
Sponsor: South Milwaukee ARC
Website: http://www.qsl.net/wa9txe

MRAC Working Committees

100th Anniversary:

- • Dave—KA9WXN
- Dan—N9ASA

Net Committee:

- Pancho, K9OFA

Field Day

- Dave—KA9WXN,
- Al—KC9IJJ

FM Simplex Contest

- Joe – N9UX
- Mark - AB9CD

Ticket drum and drawing

- Tom – N9UFJ

Newsletter Editor

- Michael-KC9CMT

Proofreader

- Pancho-KA9OFA

Webmaster

- Dave, KA9WXN

Refreshments

- Hal—KB9OZN

Membership Information

The Hamateur Chatter is the newsletter of MRAC (Milwaukee Radio Amateurs' Club), a not for profit organization for the advancement of amateur radio and the maintenance of fraternalism and a high standard of conduct. MRAC Membership dues are $17.00 per year and run on a calendar year starting January 1st. MRAC general membership meetings are normally held at 7:00PM the last Thursday of the month except for November when Thanksgiving falls on the last Thursday when the meeting moves forward 1 week to the 3rd Thursday and December, when the Christmas dinner takes the place of a regular meeting. Club Contact Information

Our website address **http://www.w9rh.org**

Telephone **(414)-459-9741**

Address correspondence to:

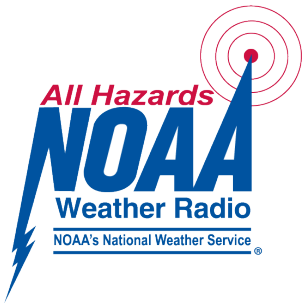
MRAC, PO Box 26233, Milwaukee, WI 53226-0233

Email may be sent to: **w9rh@arrl.net .** Our YAHOO newsgroup:

http://groups.yahoo.com/group/MRAC-W9RH/

CLUB NETS:

- The Six Meter SSB net is Thursday at 8:00PM on 50.160 MHz USB
- Our Ten Meter SSB net is Friday at 8:00PM on 28.490 MHz ± 5 KHz USB.
- Our Two Meter FM net follows the Ten meter net at 9:00PM on our repeater at 145.390MHz - offset (PL



The MRAC HamChatter is a monthly publication of the Milwaukee Radio Amateurs' Club. Serving Amateur Radio in Southeastern Wisconsin & all of Milwaukee County
Club Call sign – W9RH
MRAC Website: http://www.W9RH.org
Editor: Michael B. Harris, Kc9cmt, kc9cmt@Earthlink.net

Milwaukee Area Nets

Mon.8:00 PM 3.994 Tech Net

Mon.8:00 PM 146.865- ARRL Newsline

Mon.8:00 PM 146.445+ Emergency Net

Mon.8:00 PM 146.865- Walworth County ARES net

Mon. 8:00 PM 442.100+ Railroad net, also on EchoLink

Mon.8:45 PM 147.165- ARRL Audio News

Mon. 8:00 PM 442.875+ WiARC net also on EchoLink 576754

Wed. 8:00 PM 147.270+ Racine County ARES net

Wed. 9:00 PM 145.130+MAARS SwapNet, Allstar FM-38

Thur. 8:00 PM 50.160, 6 Mtr SSB Net

Thur. 8:00 PM 443.800+ Tech Net

Thur. 9:00 PM 146.910+ Computer Net

Fri. 8:00 PM 28.490 MRAC W9RH 10 Mtr SSB Net

Fri. 9:00 PM 145.390+ W9RH 2 MTR. FM Net

Sat. 7:30 AM MW Classic Radio Net , Frequency—3885 AM

Sat. 8:00 PM 146.910+ YL's Pink HAMsters Net

Mon. 8:30 PM 146.820 Waukesha ARES Net on the 1st, 3rd, and 5th Monday of each month.

Mon. 9:00 PM 147.165– Milwaukee County ARES Net

Tue.9:00 AM 50.160 6. Mtr 2nd Shifter's Net

Tue. 9:00 PM 145.130+ MAARS Hand Shakers Net

Tue. 8:00 PM 7.035 A.F.A.R. (CW)

Wed. 8:00 PM 145.130+MAARS Amateur Radio Newsline

Wed. 8:00 PM 147.045+ West Allis ARC net

Wed. 8:00 PM 28.365Mhz 10/10 International Net

Sat. 9:00 PM 146.910+ Saturday Night Fun Net

Sun 8:00 AM, State ARES Net 3967/3977.5/145.470

Sun 8:30 AM 3.985 QCWA (Chapter 55) SSB net

Sun 9:00 AM 145.565+ X-Country Simplex Group

Sun 8:00 PM 146.910+ Information Net

Sun 8:00 PM 28.365 10/10 International Net (SSB)

Sun 9:00 PM 146.910+ Swap Net

Daily: Milwaukee — Rag Chew Net: 7:00 AM, 3850 SSB + Florida Net 7 am, 14.290 mhz.

2meter repeaters are offset by 600KHz - - 70 centimeter repeaters are offset by 5 MHz

SSB frequencies below 20 meters are LSB and for 20 Mtr and above are USB.