

September 2002

Volume 2

Issue 9

SMARCalling



Southwest Missouri Amateur Radio Club <http://www.smarc.org>

P.O. Box 11363 Springfield, MO 65808 PH: 417-886-4152

Annual Club Picnic This Month...

Hello everyone,

We have two goings-on this month, our regular meeting and our annual picnic. We will have a Transmitter Hunt at the picnic, so bring along your HT and a paper clip, or some other means of divining the Fox!

Silver Springs Park is the picnic site, from 11 am to 3 pm. It runs along National between E. Division and E. Scott. We've reserved the pavilion. Oh ya, bring along some munchies too! We'll go over the details at the meeting.

Our meeting this month will comprise of a Heil Sound video, Hamfest update, and a number of "Show and Tell" items. Bring along your new toys so we may all salivate at your good fortune! I'll bring a home made practice code oscillator and a home brew field strength meter with two schematics (one of them works).

-- 73's Erik Weaver, n0ew (n0ew@arrl.net, 869-4947)

THIS MEETING

Sept. 16th, 7 pm
American Red Cross
1835 E. Chestnut

ANNUAL PICNIC

Silver Springs Park

11 am
Sat. Sept. 21st
1100 N Hampton Ave, Spfd, MO

*Hope to see you
and a friend there!*

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HAMFEST, Nov 9th

Bass Country Inn

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Aug Minutes,

Hamfest Update

2, 7

Repeater Lecture

by Michael Blake

n0nqw

3-6

Board Members

8

Visitors Always

Welcome!

SMARC Net Worth Report – As Of 7-31-02

Assets		Funds set aside for	
Checking	\$ 539.78	communication trailer	\$2,375.00
Savings	<u>\$3,698.27</u>		
Total	\$4,238.05	Total Discretionary Funds	\$1,863.05
Income		Expenses	
SMARC Dues	\$210.00	Hamfest Expense	
		Facility Rental	(\$1,488.90)
Other Income	<u>\$5.00</u>	146.640 Phone Line	(\$28.23)
Total Income	\$215.00	Total Expenses	(\$1,517.13)
Overall Total (Income – Expenses) =		(\$1,302.13)	

SMARC Net Worth Report – As Of 8-31-02

Assets		Funds set aside for	
Checking	\$ 534.64	communication trailer	\$2,375.00
Savings	<u>\$3,189.27</u>		
Total	\$3,723.91	Total Discretionary Funds	\$1,348.91
Income		Expenses (cont.)	
Total	\$ 0.00	Hamfest Expense	
Expenses		Fliers	(\$414.06)
Newsletter		Field Day	
Printing	(\$ 20.50)	Notepads	(\$ 3.95)
Stamps	(\$ 37.00)	146.640 Phone Line	(\$28.28)
Sales Tax	(\$ 1.35)	Total Expenses	(\$ 505.14)
Overall Total (Income – Expenses) =		(\$505.14)	

SMARC Meeting Minutes for August 19th 2002...

Members & Visitors Present:

WØKRB, BAREMORE, KEN;
 WB00VB, NANCY SCHANDA;
 WØTLS, SHAFER, LEE;
 N0MBW, CHAMBERS, BILL;
 AK0C, SKIP CRANE;
 K0JZF, JIM PALMER;

WØSUE, BAREMORE, SUE;
 WØODY, MOORE, WOODIE;
 KC0NAV, STEVE SHAFER;
 KB0VKV, LOUISE BUCK;
 KC0KQV, LARRY KAPP;
 N0NQW, MICHAEL BLAKE;

WBØOVC, RON SCHANDA;
 NØEW, WEAVER, ERIK;
 KC0EPD, LORA SMITH;
 K0KXC, DALE LONG;
 WB00NM, BILL HARMON;
 ARNOLD FLETCHER.

July minutes & financial report were approved.August Minutes:

Lee Shafer, w0Tls, our Hamfest Chairman provided us with a detailed update. The site has been reserved at a base cost of \$1,400, and \$88.90 in taxes. This includes 70 tables. Bill Chambers, n0mbw, will obtain 5 tables from his church, which so long as we return in the same condition we receive them will cost zero. "Break 'em, buy 'em." We will offer a \$300 grand prize, most likely a 2M mobile rig, and \$45 in selected door prizes. We will need volunteers to clean up afterwards, or there will be an additional cleaning fee of \$200. Please, contact Lee if you will help with the cleanup, or any other part of hamfest.

Ozark Mailing will handle the mailing of the one-page fliers being sent out, at a cost of \$230.60. A good deal as they will fold, label and arrange all fliers into zip-code bulk groups for the post office. This reduces the cost of each flier to a range of \$0.186 to \$0.268, depending upon the number of addressees in each group. We are estimating a printing cost of \$0.05453 per flier. Each flier will be one-sided and be printed on a pastel colored paper to help catch the eye. Included on the flier are verbal directions, including our talk-in, a brief description of the event, and a pre-registration form. All this information will be duplicated on the clubs web site. Also on the web site will be the hotel information for those persons interested in staying over night Friday. We have arranged for a number of small discounts. Since attendance at hamfests are not centrally organized (as with a class or family reunion) it is not possible to provide a hotel exact numbers of guests. This in turn eliminates their best rates, but many have agreed to a small price break.

Total expenses for the site and fliers being printed and mailed is \$2,173.50 which is approximately \$800 to \$900 less than in 2001. An appreciable savings. The site is the Expo Center, behind Bass Country Inn on North Glenstone, just north of the North Town Mall. The hall we have reserved is 12,000 square feet with electric hookup availability. Of the 75 planned tables 30 have already been sold to the commercial vendors that have agreed to be present: WB0W with his full setup; Rad-Comm, and D&L, each with six tables. Tables cost \$10 each and there is a \$5 city sales license fee added to the first table. Parties interested in obtaining a table should contact Lee as soon as possible. We expect the remaining tables will be sold out. As there are no other hamfest in our area surrounding our selected date we anticipate high attendance. The date is Nov. 9th with doors opening to the public at 8 AM.

There will be two VE testing sessions and seating is limited so advance registration is strongly recommended, although walk-ins will be accepted provided seats are open. Cost is \$10 and one must bring a photo copy of one's amateur radio license, photo ID, and any previous VE test results which one wishes to *not* take at this session. Contact Erik Weaver, n0ew, for more information.

VOLUNTEERS NEEDED A THIS TIME:

Ticket booth. Registration table. Cleanup crew. VE's. Other positions also need to be filled.

(minutes continued on page 7...)

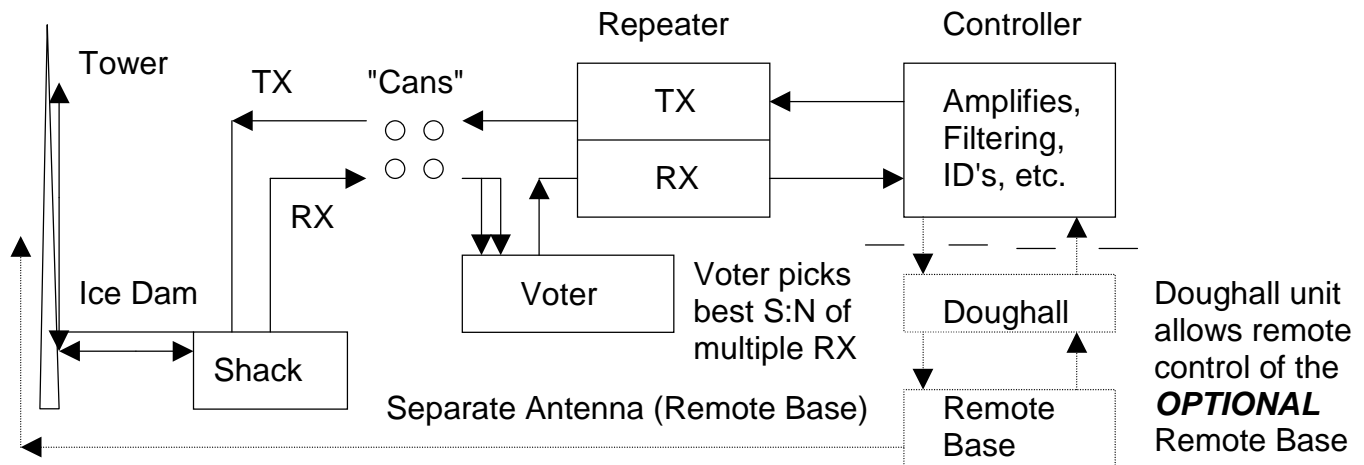
3.963 Every Sunday at 6:15 PM the Missouri Emergency Service Net meets.
 7.263 is the alternate frequency should there be poor propagation on 80-meters

Please join us – it is good practice & interesting!

As my work schedule allows I will accept 2-Meter relays on the 146.91 (-) PL 162.2 repeater.
 Listen to this frequency on Sunday evenings prior to the Missouri Traffic net (5:45 pm) and the MESN.
 Erik, n0ew

Michael Blake, n0ngw, presented us with an informative lecture on how repeaters function. This was most interesting and included a focus on our club's repeater. Also presented was a brief overview of the newly installed 800 MHz communication system recently installed for the Greene County emergency services, such as police and fire departments.

Typical Repeater Station Set Up



146.91 in Fordland

The antenna is located at a height of 550 feet, and is a vertical di-pole "Omni" with 6 dBi gain. The repeater is listening (RX) at 146.31 and transmitting (TX) at 146.91. The transceiver is a Vertex with 100% duty cycle and a 25 watt output. This output is fed to an amplifier that increases the output to 160 watts (nominal). Coax being used is 7/8 inch foam core hard line.

There are a set of four "cans" (duplexers) which filter the signal going into and out of the antenna into the shack. These are tuned in such a manner that only one frequency is allowed to pass through each side (RX = 146.310; TX = 146.910). They have a minimum of 85 dB isolation. Their purpose is to ensure only the two frequencies which the repeater is to operate on are allowed to pass through them. There is about a 30 watt loss going through the duplexer.

(As a side note, 100 feet of separation between antennas also provides about 85 dB isolation.)

The basic operation on RX is the signal comes down the tower from the antenna and enters the RX side of the cans. This filters all the RF energy and only a frequency of 146.310 is allowed to enter the rest of the system. This repeater does not have a voter, as there is only a single receiving antenna, so the filtered signal goes into the RX side of the repeater's transceiver.

At this point the controller takes over. There are a variety of repeater controllers and the more costly ones allow more sophisticated control of the signal and hardware. The controller handles the automated features such as properly ID'ing the repeater, shaping the RF signal, engaging the amplifier, and such related commands. It is the "brain" directing the operation of the various pieces of equipment in the shack. Many controllers allow remote command setting, as does this one.

On TX, similar functions are engaged, but the TX side of the cans are used so only 146.910 is allowed to pass to the antenna. Measured output to the antenna feed point is approximately 135w.

Greene County ARES meets the 4th Wednesday of each month, 7 PM, at the Brentwood Library (just east of Glenstone & Seminole; 2214 South Brentwood, in the community room). Questions should be directed to Ken Baremore, Greene County ARES EC (w0krb@arrl.net). It's rewarding and fun too.

145.490 (49ers) Repeater

The 49ers repeater is very similar to the 91 repeater except that it has additional features. Two of these additional features were discussed in this program: (1) the "Voter" and (2) the "Remote Base".

Voter

This piece of equipment monitors multiple incoming (RX) signals. Each one is measured for quality of signal and the one signal with the greatest signal to noise ratio (S:N) is the RF signal that is allowed to pass to the rest of the system. There are times when the "voting" is very, very close and there can be some difficulty in selecting which signal to pass. At such times the chosen RX signal can switch back and forth often. This can be a little disconcerting, however it has it's positive attributes in that the repeater can hear, and clearly, many stations it would not otherwise be able to clearly transmit to the listening area served by the repeater.

Remote Base

Remote bases can operate as either, or both, RX/TX. At the shack location each remote base does require a separate antenna. Isolation can be obtained by either using duplexers or maintaining a great enough distance between antennas to achieve the required dB isolation. When sufficient tower space is available distance is the normal choice as it is less expensive, but either approach works.

There is also another piece of hardware desired which works as a controller to the remote base. The 49 repeater uses such a device named a "Doughall". This allows distant control of the remote base via tones.

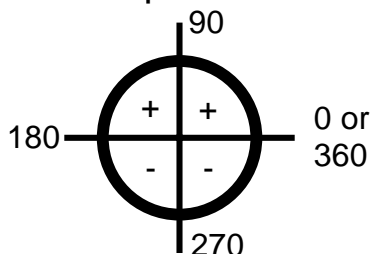
All remote bases do not have to be at the repeater site. The 49 utilizes a number of remote bases as additional receivers. This not only extends the listening range of the repeater, but can allow a repeater to function properly in the event a strong signal is placed on in the vicinity of the repeater. This in fact has just happened at the 49 repeater site. A television transmitter has been added to that tower and it is swamping the receiver to the 49 repeater. By installing various receiving antennas in distant locations the repeater will be able to function normally. (This has happened since Michael gave his presentation. The life of a repeater trustee is not an easy one!)

Multiple Frequencies On Same Coax

There are two reasons multiple frequencies will pass on the same coax. DC runs through the entire wire, while AC runs on the outside. This is called "skin effect" (and explains why hard line coax is hollow). Also, RF signals on different frequencies are out of phase with one another, therefore, since their peaks and valleys do not coincide with each other, they do not conflict with one another. However, signals that are 180 degrees out of phase do cancel each other out.

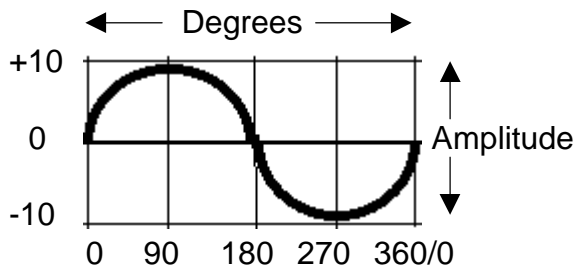
Phase Degrees

When speaking of "phase" or the "degree" of a signal we are referring to a sine wave, which may also be thought of as a circle. If you were to bend a sine wave back onto itself at the 180 degree point, it would complete a circle. This is why 180 degrees is the opposite of 0 degrees (or 360 degrees). Whether one thinks of a RF signal as a circle or a sine wave is a matter of which interpretation is easier to picture when conceptualizing the idea at hand.



The circle to the left has been cut into four equal parts, quadrants, by the two lines crossing it. Starting at the right most edge is 0 (the beginning of the sine wave) and 360 degrees (the end of the sine wave). At the top is 90, the far left is 180, and the bottom is 270 degrees.

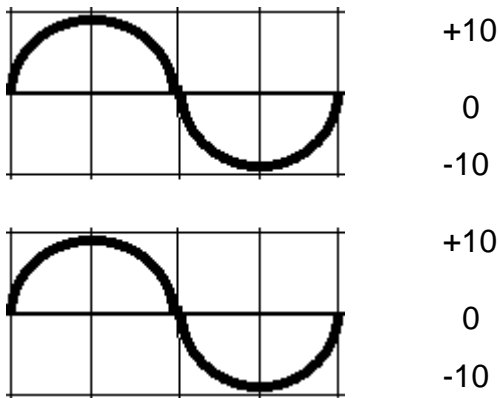
Sine Waves



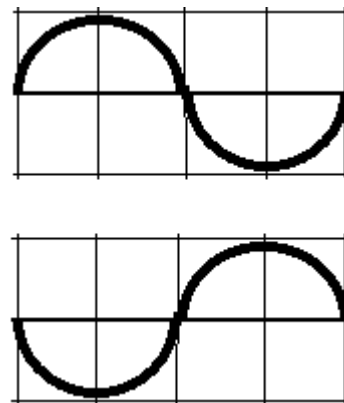
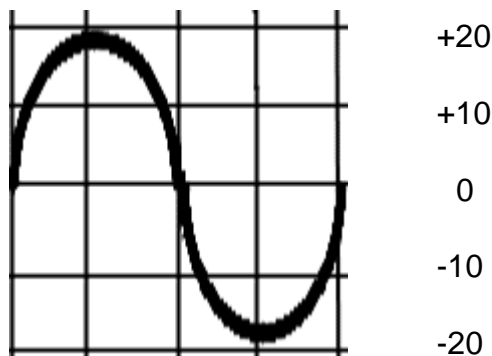
Please note that everything above the horizontal "0" line is positive and everything below is negative. Also note, "0" and "360" degrees are the same! 360 refers to the wave ending and 0 refers to the next wave, newly "born". AMPLITUDE is the vertical axis, and DEGREES is the horizontal axis.

Phase Relationships

The "phase" of RF signals can be critical. Picture the sine wave of each RF signal which we wish to compare. If they lay directly over each other they are completely "in phase" whereas if they are mirror images of one another they are completely "out of phase", which can also be expressed as being "180 degrees out of phase". Below are how these conditions look, and also how two sine waves add together, both while "in" and "out" of phase.



These two sine waves are "in phase" and the resulting wave when "blending" them together is shown below...



These two sine waves are "out of phase" and the resulting wave when "blending" (adding) them together is shown below...

Note that adding two sine waves that are "in phase" with one another results in a sine wave of double amplitude (left).

Note that adding two sine waves which are "180 degrees out of phase" results in a "sine wave" that is a flat line, "0" amplitude (above).

What does this have to do with repeaters?

To "cancel" (make a straight line) multiple sine waves (RF signals), you feed a RF signal back into the coax. This cancels out the offending frequency. This is directly related to our "cans" (duplexers) which our repeaters use to ensure only desirable signals as passed.

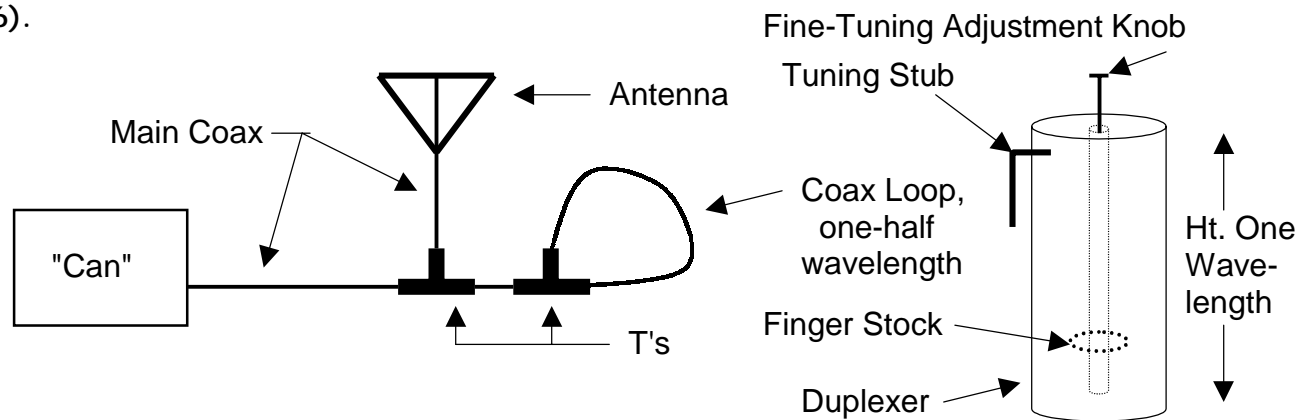
Early Notch Filter Design

An early design of a notch filter is shown below. The antenna feeds the RF signal down the coax toward the duplexer ("can"). Along the way an alternate path has been created by the insertion of two "T" connectors and a looped length of coax. RF energy will follow the path of least resistance, so any wavelength that matches this loop in frequency will divert through the loop, rather than by-passing the loop.

The "coax loop" is measured to be exactly one-half wavelength (sine wave) of the targeted frequency. This is "180 degrees out of phase" and will have the effect of canceling the frequency with which this wavelength is resonant. This canceling takes place as the energy re-enters the main coax as it leaves the loop, blending with the energy present (TX or RX) in the coax connection between the antenna and the "can".

Basically, the RF signal was delayed, in time, one-half sine wave by going through the loop on its way to the can. When this mixes with the energy in the more direct path to the can, it will be equal to its original sine wave in (absolute) amplitude, but exactly opposite in sign (for example, a signal that enters the antenna with an amplitude of +10, will have a (delayed) signal with -10 amplitude coming out of the loop, and when added to the main coax, result in cancellation ($+10 + -10 = 0$) of the RF signal at that resonant frequency).

It is critical to take into consideration the "velocity factor", however. This velocity factor is often 0.66 of the speed of light, but all coax does vary. This velocity factor is the result of friction slowing the RF energy wave traveling through the coax wire. This is compared to the distance the same frequency wavelength would travel in outer space, where there is no friction. The difference is reduced to a percentage, and expressed in decimal form ($66\% = 0.66$).



Duplexer

We actually use duplexers ("cans") on our repeater, as do most people. While similar in operating theory the actual physical means of achieving these ends are in fact different, as is the specific goal (a "notch" filters out a specific frequency and a "can" passes a specific frequency). We did not spend much time discussing these finer points. But the tuning stub on the side of the duplexer performs a function related to the notch filter above.

The duplexer changes the Inductance, L , or Capacitance, C , and the phase of the RF signals passing through it in such a manner that only the selected frequency emerges from it and all other frequencies are filtered. The Tuning-stub is shorted to ground. The Inductance is adjusted to pass the desired frequency. The height of the "can" is one wavelength. These cans are factory set to a user-chosen pass frequency, and then fine tuned once on the user's site to account for such things as the tower and other nearby metallic structures.

MINUTES: End of meeting topics of interest brought to our attention by Michael Blake, n0nqw...

Several months ago Mike told us about a repeater controller that allowed multiple MP3 wave-files to be up-loaded to the repeater via phone lines. He was asked for an update. Sadly there has not been anything new on this topic. It is a prototype under development, and while promising, there is no expected release date, and no way for us to know when to expect one to be available for purchase.

The 911-Center once had an amateur radio antenna and feed line running into the building. As Mike recalls it is up about 60 feet and has coax access (SO-239) in the basement. It was suggested that we may wish to follow up on this and try to determine if it still exists, and whether it does or not, attempt to resume drill operations utilizing this location.

The old 200 foot tower is being replaced by the new 350 foot tower that carries the 800 MHz system on it. When the old tower is taken down we will lose an antenna. It is suggested we should begin to make contacts to approve the relocation of this antenna onto the new tower. At this time we have no antennas on the new tower, and in general there is not much interest in the ham radio service by those promoting the new 800 MHz system. They do not believe it can fail, and by extension, there will be no future need for amateur radio operators, in their opinion. We hams, of course, know of examples of similar systems failing, such as happened in NYC on 9-11-01 and the weeks following.

800 MHz Trunk System – A Brief Overview

The 800 MHz Trunk System being installed in Greene County has 25 available frequencies and is currently utilizing 18 of these. These frequencies are effectively all used at the same time. This sharing of frequencies is controlled by a central computer which is constantly monitoring a single "data channel", and it makes all the decisions as to which remote radio is tuned to which frequency.

Each remote radio has several frequencies that may be selected.

Each government agency is considered as a distinct Department Group, such as the Police Dept., Fire Dept., Animal Control, Administration, etc. Each of these distinct Department Groups also may have several additional "Talk Groups" for their internal designation. For example the Fire Dept. has a "Greene County" talk group, and each individual fire station has its own "talk group".

The logic behind this recognizes that animal control only needs two radios, whereas the police department needs 200 radios and the fire department needs another 200 radios. It makes very little sense to provide each of these Department Groups with their own single frequency. Animal control would have quite a lot of unused talk-time whereas the police and fire departments would at times be very congested and unable to effectively communicate.

Using this as a tiny example, in a trunking system there could still only be three frequencies used (plus a 4th data frequency), but all three are available to all three of the Department Groups at any given moment. This allows all the under-utilized talk-time on the animal control frequency to be used by the police and fire departments, thereby relieving the congestion with their communications.

Continuing with our tiny example, when a person keys their radio a signal is sent on the data channel to a central computer, which is constantly listening to all frequencies and tracks all radios assigned to its area of control. It recognizes the specific radio keying up, knows which talk-group it is currently assigned to, and prior to relaying the signal, sends out a signal on the data channel to all radios currently on that talk-group, telling these radios to which frequency to tune. Then the computer sends out the keying-radio's message on this just-assigned frequency. This happens each time a person keys their radio. Everything is centrally controlled. This allows the maximum use of all the available frequencies and provides for minimum congestion.

The system works great provided one can afford the radios and the central computer, and data channel, remain within proper working perimeters. It also means that when central failure happens, it will happen across the board and there will be zero communications.

2002 Board Members ...

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Note: All board members may be reached by email at: ["theircall"@smarc.org](mailto:theircall@smarc.org) , except for Louise Buck.

Public Welcome!
Please, join us!

Hamfest, Nov. 9th
Bass Country Inn
just north of the
North Town Mall

SMARCalling is a monthly newsletter published by and for the Southwest Missouri Amateur Radio Club, Inc. All submissions for publication must be received by the last day of the previous month. SMARCalling reserves the right to edit all submissions for spelling and, when necessary, length. All comments on SMARCalling may be made to editor@smarc.org or by direct mail.

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