West Chester Amateur Radio Association - WC8VOA

WC8VOA Repeater System

Presented by

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History Of The Repeater
Timeline

- 1980 – 1981 - WB8ONG (Ron) built first repeater from 2 Yaesu commercial boards.
- 1980 – 1981 – Repeater operational from K8DEV residence on Danbury Rd. in Fairfield Initial frequency was 145.370.
- Purchased cavities which are still in use on present repeater.
- Initial operation from K8DEV used a 9 element vertical beam at 60 ft oriented SSE. Covered to downtown on both interstates.
- Informal group – Fairfield Amateur Radio Tuners (FART) initially supported the repeater operation. Later changed to Fairfield Amateur Radio Association.

History Of The Repeater
Timeline

- WB8ONG had a military surplus VHF amplifier that ran 200 w output class B using a pair of 4CX250B. (About 1950 generation)

- System was moved from K8DEV to present location

  K8QOE (SK) lead a group of club members who helped solve a TV interference problem in the neighborhood caused from the new high power FM station at the site. Neighbors were asking city council to revoke zoning for the tower.

  Station owners provided access to the tower in appreciation for resolving the interference problems with the neighbors.

History Of The Repeater
Timeline

- Initial antenna was a 3 element vertical beam at 80 ft. fed through RG8 coax.
- Hustler collinear vertical replaced the initial antenna at 180 ft. Fed through some salvaged TV aluminum hard line with homebrew fittings made from PL259 and hose clamps.
- Hustler antenna was replaced by a Station Master, and moved to near the top of the tower. Fed by nitrogen filled hardline. (Same as used on the station)
- Repeater was replaced with a Yaesu prototype repeater. Did not include a controller.
- A second prototype replaced this repeater, which had a built in controller. Contained a noisy microprocessor and the receiver board was removed and replaced with the board from the original repeater, and located it in a separate cabinet to get isolation.

History Of The Repeater
Timeline

- Nitrogen hardline was replaced by modern cell phone hardline, which is still in use.
- Yaesu repeater was replaced by a GE Master II repeater, which was used until the beta test Yaesu DR-1 repeater was installed.
- It is still in place as the backup repeater.
- At one point the station operated on split antennas. The antennas were moved down to a lower location due to proposed tower modifications, which did not occur.
- One of the split antennas failed, and operation was put on a single antenna.

Repeater is located on a commercial tower on Mack Road Near Mercy Hospital

The tower was purchased by American Tower who provides free space

WCARA pays a monthly charge for electricity.

Repeater is located inside this building at the base of the tower. There is no environmental control in the building.

Seasonal changes in temperature have not had a noticeable effect on the repeater.

There may be a slight change in the cavities, but that is hard to determine without instrumentation.

WC8VOA appears to be the only operational equipment in the build, with the exception of some equipment that we believe monitors the tower lights.

WC8VOA has two antennas on the tower. They are mounted on side arms to space from the tower.

The upper antenna is in use.

The lower antenna is not operational. It is a dual band, and may have been burned out by two repeaters transmitting at high power simultaneously.

The smaller DR-1X sits atop the previous GE Master II repeater, which is still operational.

Closer view of the DR-1X
Note log book on the repeater. Each visit is recorded with date, purpose, and operator

Cavities used with the WC8VOA repeater.

These are the cavities installed when the original repeater was placed at this location.

Backup Battery – Has a trickle charger connected.

Battery floats on the power system, so there is no drop out if the 120V AC is lost.

Repeater power switch does not control battery. Disconnection is the only way to remove it from the system.

Here are the basic functions of our

repeaters and how we use them.

Except for a brief mention at the end of the program,

it is not going to explain the YSF Wires-X capabilities of the

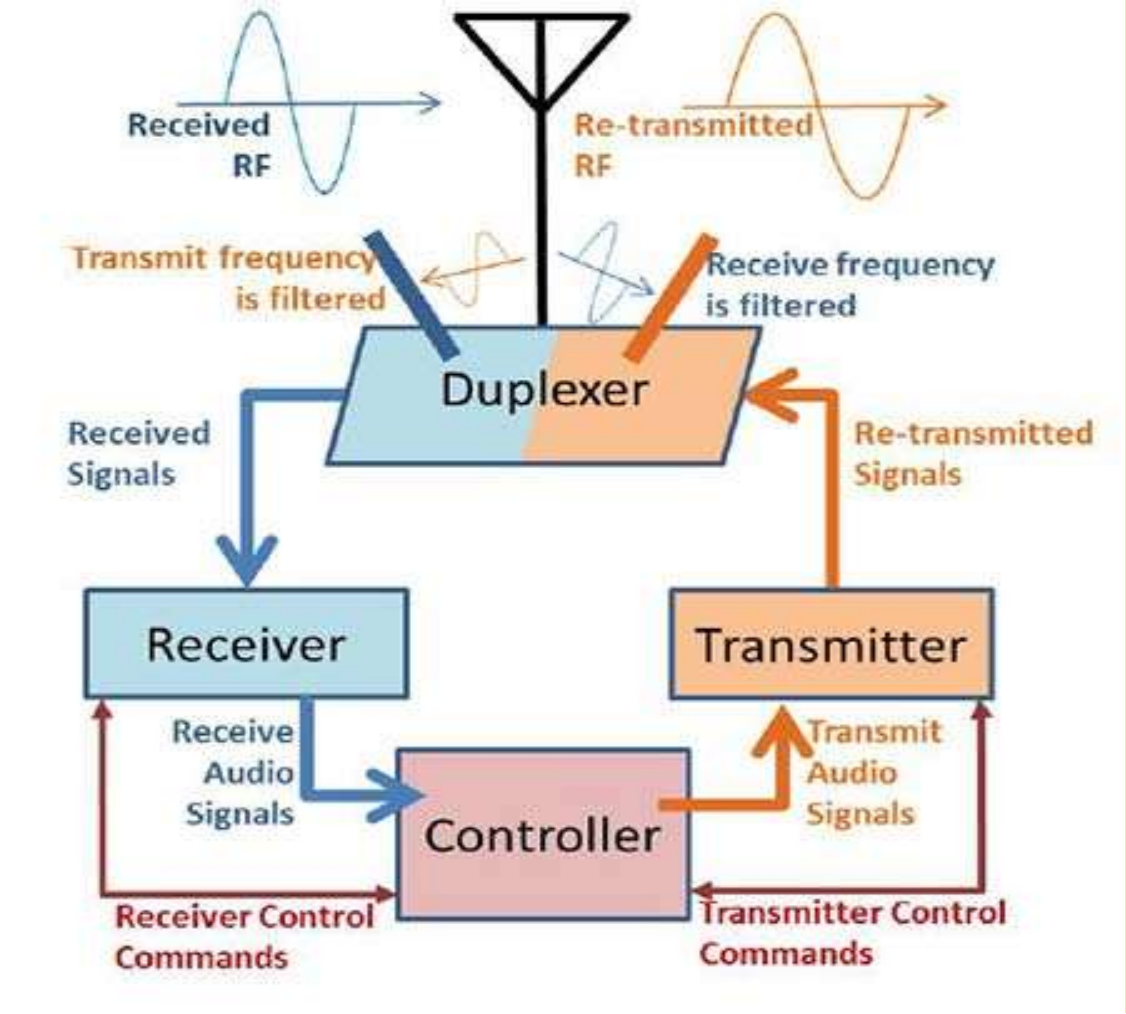
equipment that we have not implemented.

Let's review two terms which sometimes get misinterpreted due to the digital systems coming on line.

Repeater – A system that receives a signal on one frequency and re-transmits it on another frequency. It receives and transmits simultaneously. The WC8VOA 2m repeater receives on 144.790 MHz and transmits on 145.390

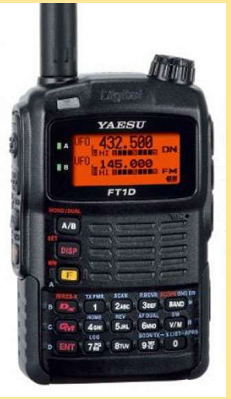
Node – A system that uses a receiver/transmitter operating on one frequency, and capable of only one operation at a time. In digital operation, it is connected to the internet. It feeds a received signal into the internet. It transmits a signal received from the internet. The Jumbo Hot Spot in the operating room is a node. W8XGF operates a YSF node on 145.540 MHz in Hamilton. It is permanently connected to the YSF Ohio Link.

Typical Repeater System



What are the WC8VOA repeaters?

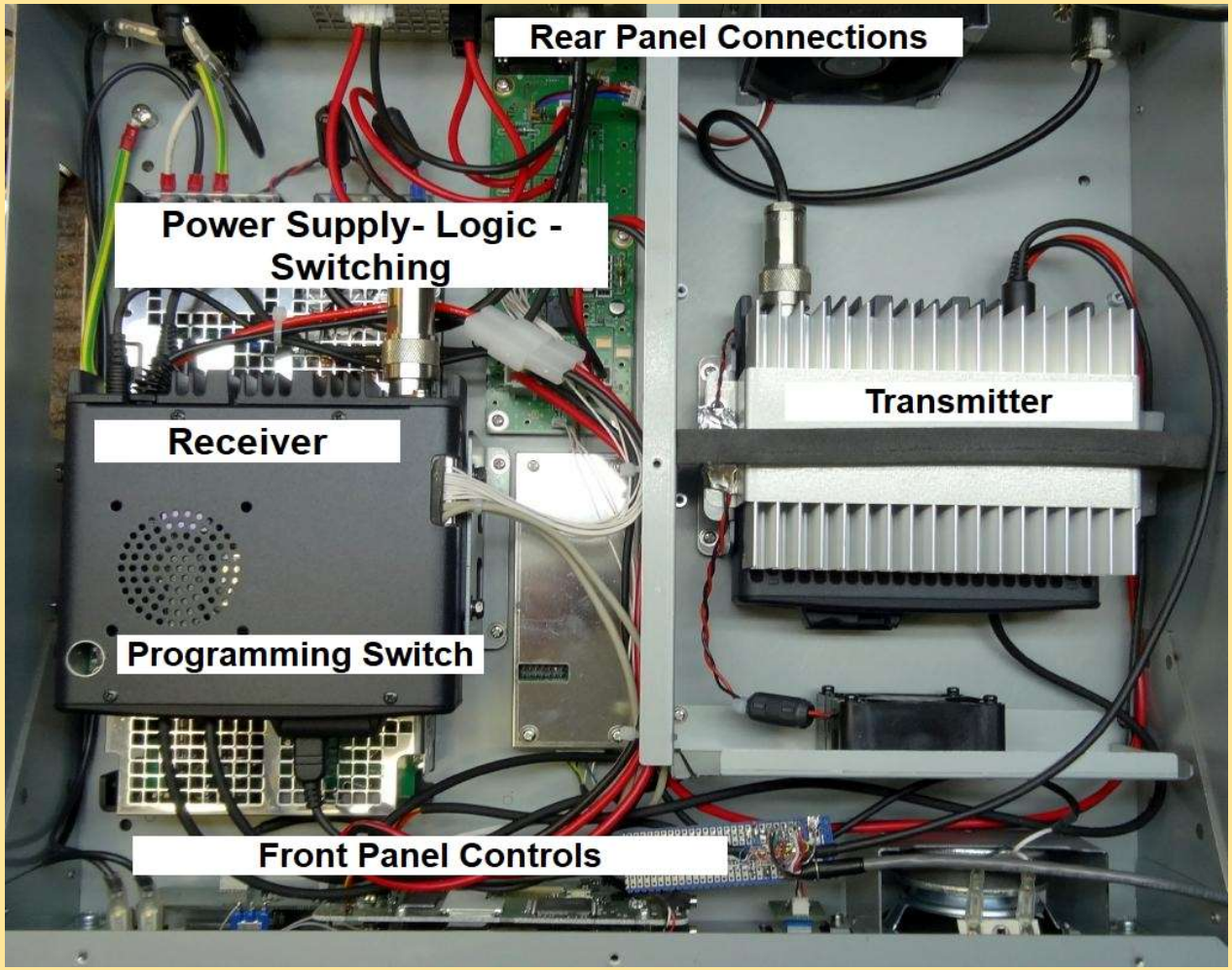
- WCARA was chosen by Yaesu as a beta test site for the DR-1 repeater in 2013
- Yaesu provided the repeater, a FTM-400 dual band FM/Digital transceiver, and a FT-1 dual band FM/Digital handheld.
- After a 1 year test period, the repeater was returned to Yaesu and replaced by a production DR-1X.
- The transceivers remain as our property.
- We purchased a second DR-1X repeater, and installed it as a low level 440 MHz repeater in the Dummy Load Building, with the antenna mounted at 60 ft. on the switch gear.

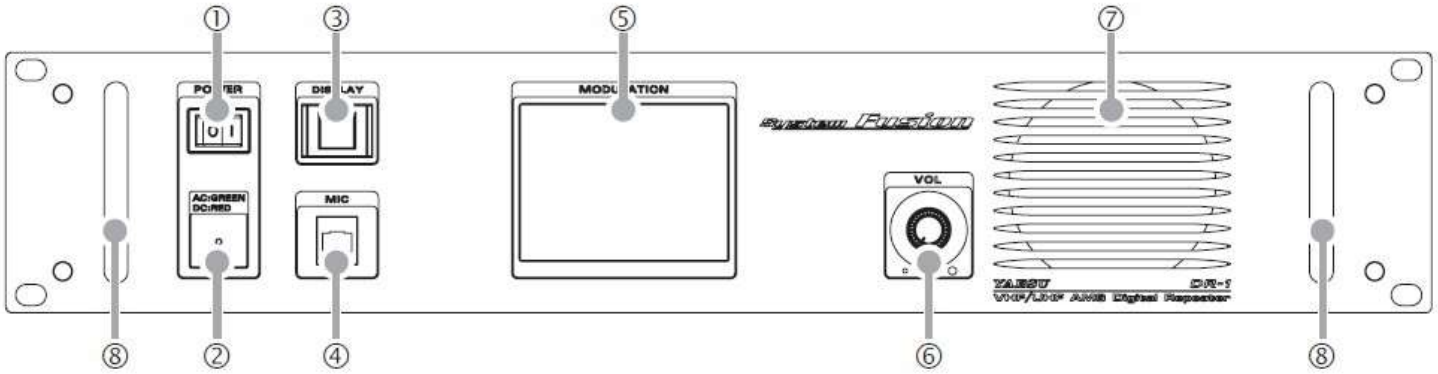


The 440 MHz is a commercial antenna donated by member
Herb Biermann – KC8RKM
Herb ran a communication service for many years

This Is How The Repeater Looks On The Inside

It is two FTM-400 units with power supply and logic/switching circuits





① POWER switch
Press "|" side to switch the radio on, and "O" side to switch the radio off.

② Power supply monitor (LED indicator)
- When the indicator illuminates in green, the power is supplied from the AC IN jack.
- When the indicator illuminates in red, the power supply is backed up through the BACKUP terminals (12 V DC).

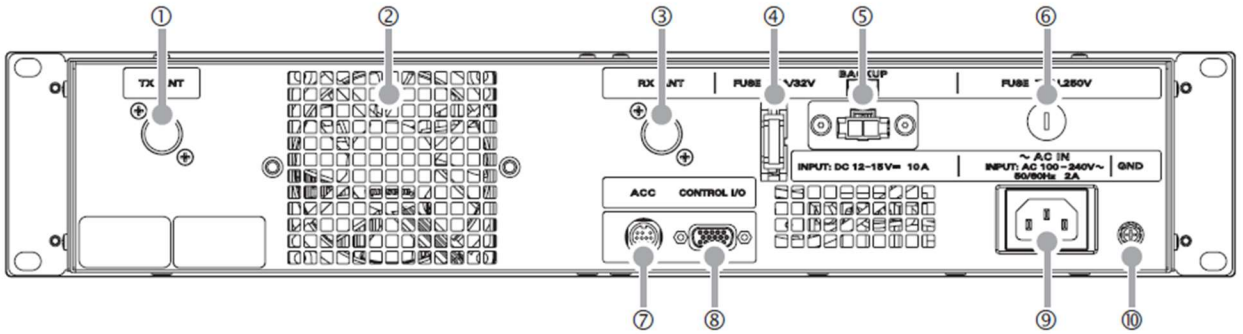
③ DISPLAY button
Press to switch the display on and off.

④ MIC jack
Insert the plug of the optional microphone to this 6-pin modular jack.
(This jack is also used during the base mode in the remote operation (see page 23))

⑤ Touch panel display

⑥ VOL knob
The audio volume of the received (up link) signal will increase when the knob is turned in a clockwise direction and decrease when turned in a counter-clockwise direction.

⑦ Speaker
The internal speaker is located here.



① TX ANT terminal
Connect to the transmitting antenna (down link) with the coaxial cable.
The output impedance requirement is 50 ohms.

② Air outlet for cooling fan

③ RX ANT terminal
Connect to the receiving antenna (up link) with the coaxial cable.
The input impedance requirement is 50 ohms.

④ FUSE 15A jack
A 15 A fuse for the DC power supply through the BACKUP terminals is attached.

⑤ BACKUP terminals
Connect to the 12 V DC power supply.

⑥ FUSE 5A jack
A 5 A fuse for the AC power supply through the AC IN jack is attached.

⑦ ACC jack
Connect to a personal computer with the provided PC connection cable “SCU-20”.

⑧ CONTROL I/O connector

Befor

Type here to search

Short Listing – Current Digital Modes

YSF – Yaesu System Fusion – WC8VOA

D-Star – Icom

P25 – Initially developed for Public Safety

DMR – Digital Mobile Radio

NXDN

POCSAG

Basic Operating Parameters for YSF

Terminology gets confusing in all of the digital modes.
For Yaesu System Fusion (YSF) there are 3 basic modes of operation.

FM – Operates just like all FM systems. An analog frequency modulated carrier.

YSF Digital – A digital (0's & 1's) signal frequency modulating a carrier.

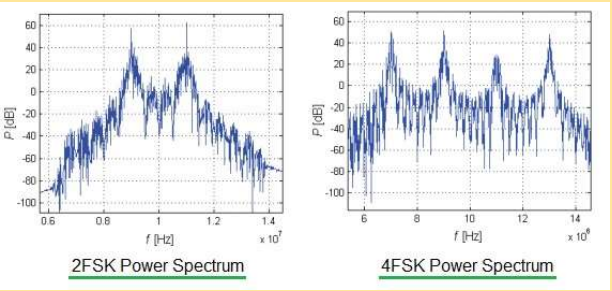
YSF Wires-X - A **YSF Digital** signal connected to the YSF internet system either through a repeater or a node.
Yaesu transceivers are put in this mode by pressing and holding the DX key.

The YSF internet system is controlled by Yaesu Japan

YSF – Yaesu System Fusion
Uses C4FM Modulation
Constant Envelope 4 Level Frequency Modulation
(C4FM was not developed by Yaesu – It is the modulation technique used in P25 protocol)

Repeater Capabilities

Dual Band Operation – 2m & 440 MHz (No cross band)



FM & Digital Transmission (Voice & Data)
FM mode uses full 12.5 KHz bandwidth
Digital mode uses half for data & half for voice

Multiple Power Levels – 50 Watt Maximum

Fixed or Automatic Mode Switching

Details Of Repeater Mode Operating Parameters

AUTO: Both RX/ TX modes are automatically selected from one of the four operating modes (DN, VW, DW and FM) to match the characteristics of the received signal. This is the current AMS operation.

TX FM FIXED: The RX mode is automatically selected from one of the four operating modes, but the TX mode is fixed to FM.

TX DN FIXED: The RX mode is automatically selected from one of the four operating modes, but the TX mode is fixed to the ‘DN’ (Digital Voice Narrow) mode.

TX VW FIXED: The RX mode is automatically selected from one of the four operating modes, but the TX mode is fixed to the ‘VW’ (Digital Voice Wide) mode.

How We Are Using The Repeaters

- Set to Automatic Mode – FM and YSF Digital
  No tone required for FM access

FM does transmit a 123.0 tone. Set receiver FM tone/squelch to exclude digital signal
Digital mode does not use standard PL tones

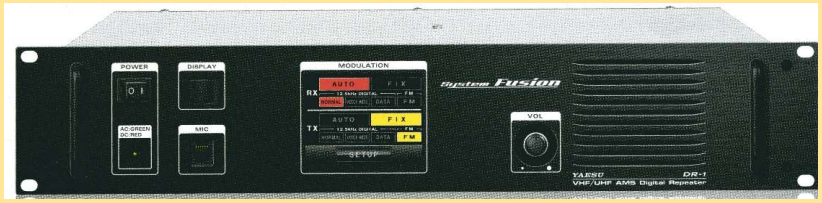
- Set to Maximum Power Output

- Time out set to 5 minutes on the 2m repeater, and 3 minutes on the 440 MHz repeater

- 2 m repeater has battery backup

Repeater Control

- **The built in controller is programmed from the front panel – No remote programming**



- **Programmable Functions**

Frequency
Operating Mode
Squelch
Transmit Power
Transmit Deviation
PL Tone Signals
Digital Squelch Code - DSQ
Repeater ID – CW
Time Out Timer

- **External controllers that can be attached to the DR-1X**

Arcom – R210
S-Com 7330

Remote Control Capabilities

There are no remote control capabilities with the native DR-1X controller

except inhibiting and re-initializing transmit.

This is a confidential procedure

Control Operators K8DEV, KE8CIE & WBØNPN have the codes for both repeaters

Note – The procedure does not use PL tones

Common Procedure For Using The Repeaters

- Program your **YSF** transceiver to the repeater frequency

145.390 (-) for 2m
443.650 (+) for ¾ m

- Set tone squelch to 123.0 to avoid hearing the digital signal in FM mode

- Set the transceiver mode – Use Dx key

Automatic – Select either FM, DN or VW with a flashing bar above
FM Locked – Select FM with no flashing bar above.
Digital Locked – Select DN or VW with no flashing bar above

- Non-YSF transceivers – Program the repeater frequencies and tone squelch to 123.0

- Monitor the S-meter before transmitting in FM to make sure there is no digital QSO in progress

Repeater Capabilities Never or Rarely Used

Digital Data Transmission – Repeater can transmit data and video files.
WBØNPN has a digital camera microphone used for demonstration purposes

- Connection to the internet – Used for updating the repeater software and connection to the Yaesu Wires-X system

(No internet connection available at the 2m site. Repeater must be removed for any updating or take a laptop with the update to the repeater)

- Functioning on the Wires-X system

(More at the end of the program)

Net Operation

- **FM Portion Of The Net –** Operates like any QSO. Repeater is in Automatic mode, and is receiving and re-transmitting FM signals

- **Digital Portion Of The Net**

Participants change their transceivers to locked digital (DN) operation.
This prevents a FM signal from changing the transceiver mode.
Depending on the transceiver, the display will show call sign and name if programmed.

Some transceivers have built in GPS and/or the capability to program latitude & longitude
Some displays have the capability to display distance and compass direction.

The advantage of a digital amateur signal is the same as a digital TV signal
What is heard as a noisy FM signal will be perfect copy in digital mode

FTM-400 Display Showing Contact's Bearing & Distance

This illustrates that YSF in digital mode is transmitting both the voice data and the GPS data for this display.

Display Showing GPS Satellites Detected At WB0NPN

Brief Wires-X Review

Wide-coverage Internet Repeater Enhancement System

Terminology

- **Node –** Repeater or simplex transceiver connected to the Internet via a PC or direct

- **Local Node –** A repeater or simplex transceiver located within communication range of your station and connected to the internet via a PC or direct

- **Rooms –** (Better Term – Talk Group)

A digital ID method that enables users to form groups representing a special interest
World Wide Room – Operators wanting DX would digitally connect to this room
Ohio Link – For general coverage in Ohio
Any user can connect to any room –Communication only between stations on the same room

Getting WC8VOA Operational On Wires-X

- Create a connection to the internet – Since we don't have internet at the 2m repeater site, this excludes using that repeater.

- It is possible to use the 440 MHz repeater as we have internet at the VOA site, but the communication range is limited.

- Use the FTM-400 in the operating room as the internet interface and relaying through the 2m repeater for node operation.

- Our equipment requires using a HRI-200 Yaesu interface, which was donated to WC8VOA by R&L at the start of the program.

Why Wires-X Has Not Been Implemented

- Lack of interest. Not many club members have YSF digital equipment, nor has there been much interest expressed in exploring digital.

- Connection to the YSF digital system means any station can connect to WC8VOA, just like EchoLink. However – this locks the repeater into digital format for the length of the connection

- Since most of the activity is in FM mode, this might not be acceptable to the majority of members.

WC8VOA Equipment Status

- **Repeater –** Current repeater production is the DR-2X. The club twice reviewed the program to replace our DR-1X's with the new repeater, and rejected the discounted price offer. The new repeater offers easier connection to the internet and Wires-X system.

- **FTM-400 –** This has been superseded by the FTM-400XD, which brings features compatible with the DR-2X to the unit, and the capability to function as a node without the HRI-200.

- **FT-1D Handheld –** Has the capability to operate on the Wires-X system. The FT-3DR has a color display and compatible with the DR-2X enhanced capabilities.

If the club is satisfied with our present operating setup, then no changes need be made to our equipment. There may be updates that can be applied, but nothing has appeared necessary.

How Can You Experiment With YSF

- Go buy a YSF handheld or mobile. Get on a local node or install a hotspot.

- Since that will involve several hundred dollars, an alternative is to borrow the club's FT-1D handheld. KE8CIE will manage the checkout – He just got designated for this responsibility Connection of the handheld to an outside antenna may be necessary, depending on distance from the repeater. An adapter cable is included with the handheld to facilitate the connection.

- Get on the club hot spot located in the operating room. There is a short instruction sheet by the unit, with instructions on how to connect to it and program with the PI-Star software.

- Either the FTM-400 or the FT-1 can be used for this connecton

- Bring your own YSF or DMR unit. The Pi-Star software permits cross modeing.

Let’s See What This Is All About

The 440 MHz repeater is on the table, and two handhelds are available.

Try them out, and see how the repeater actually functions.

Try both FM and digital

Watch the front panel as it switches.