Amateur Radio Repeaters

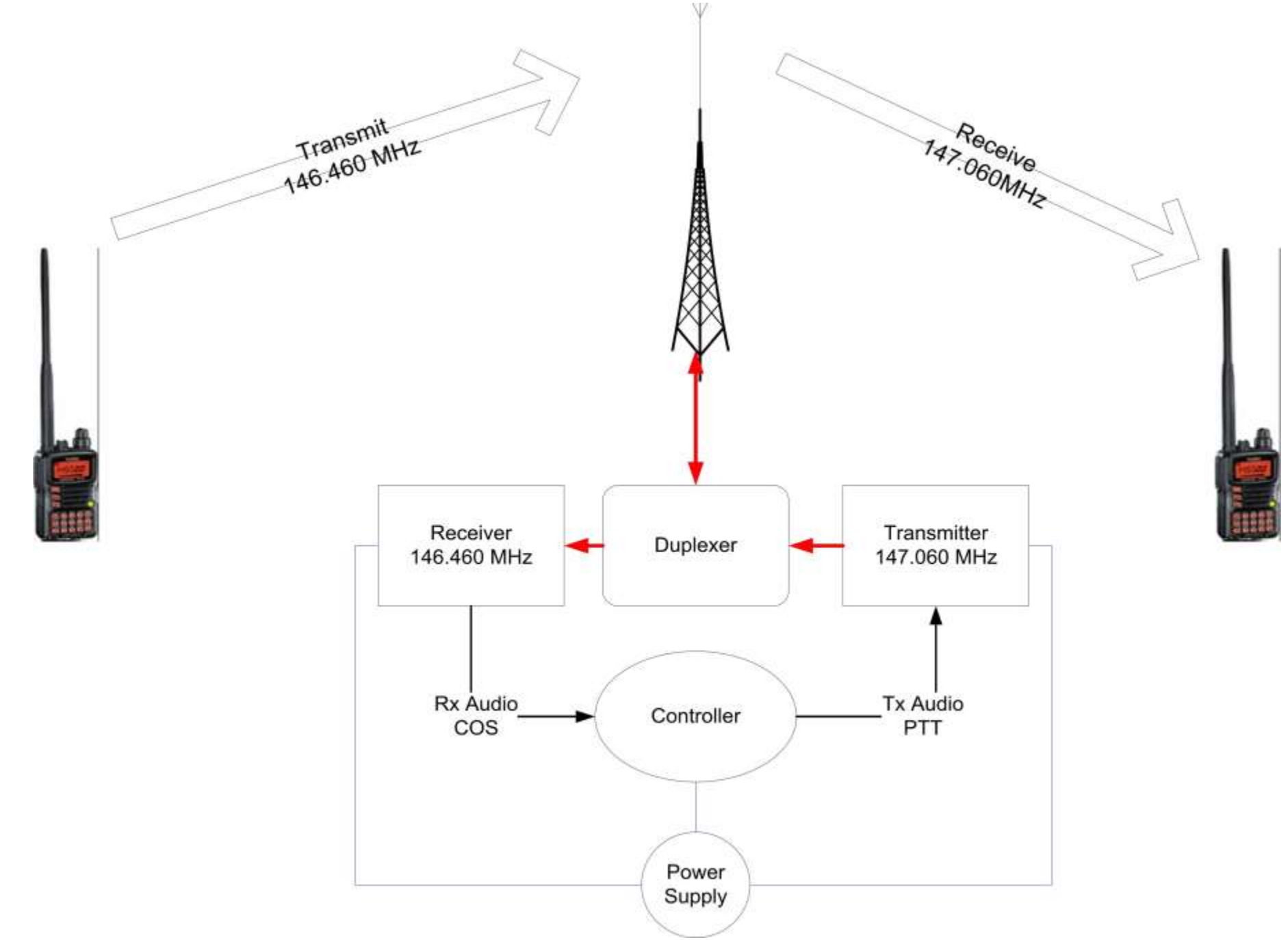
- An introduction to repeater systems

Definition

- A **REPEATER** is a “duplexed” two-way radio system that listens (receives) on one frequency and re-transmits what it hears on a different frequency.
- Repeaters are commonly found on the Amateur Radio VHF & UHF bands, although several can be found on the 10m band.

Definition

- Repeaters are usually located at places of high elevation, enabling the repeater to “see” a long distance.
- Repeater systems use high-efficiency antennas, low-loss feed lines, and transmitters/receivers that are rated for continuous duty.
- The end result is a repeater (or “machine”) that can be accessed by low-power handheld transceivers, allowing the transceiver to communicate clearly over a much farther distance than it can using simplex communications.


Transmit
146.460 MHz
Receive
147.060MHz
Receiver
146.460 MHz
Duplexer
Transmitter
147.060 MHz
Rx Audio
COS
Controller
Tx Audio
PTT
Power
Supply

Receiver

- Receives the incoming signal
- Must be very sensitive
- Must be very selective
- May have CTCSS (or PL) tone decoding
- Provides receive audio
- Provides COS (Carrier Operated Switch) or Squelch signal

Transmitter

- Transmits on desired output frequency
- Must be “robust” – continuous duty cycle
- Accepts PTT signal
- Accepts Transmit Audio

Antenna

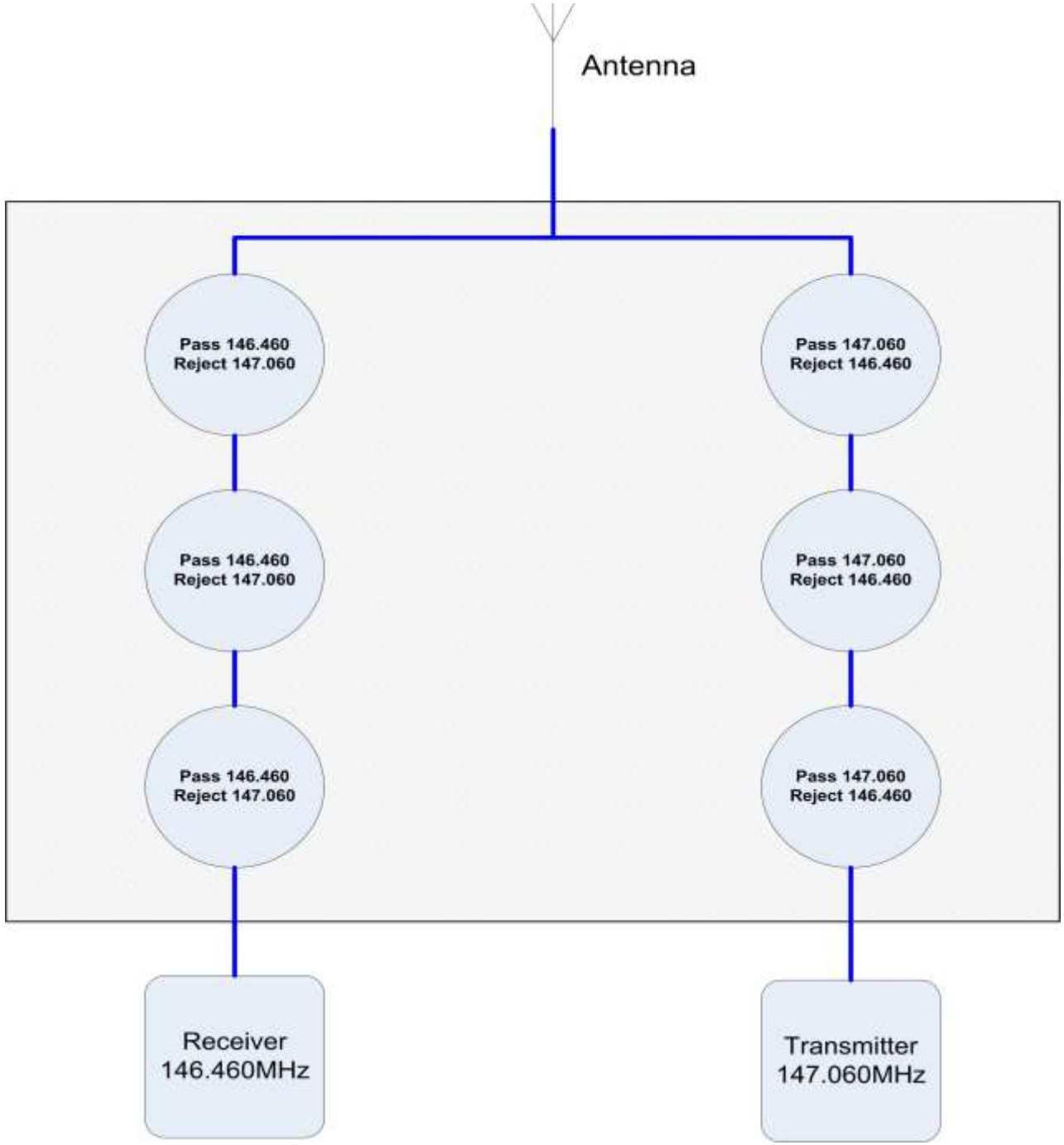
- Most repeaters use a single antenna for transmit & receive
- The antenna is usually “robust” and high-gain
- The antenna is usually mounted as high as possible on the tower structure

Feed Line

- Most repeaters do NOT use standard coaxial cable
- Standard coax has too much loss!
- Repeaters use “hard line” which is much more efficient and more durable than standard coax

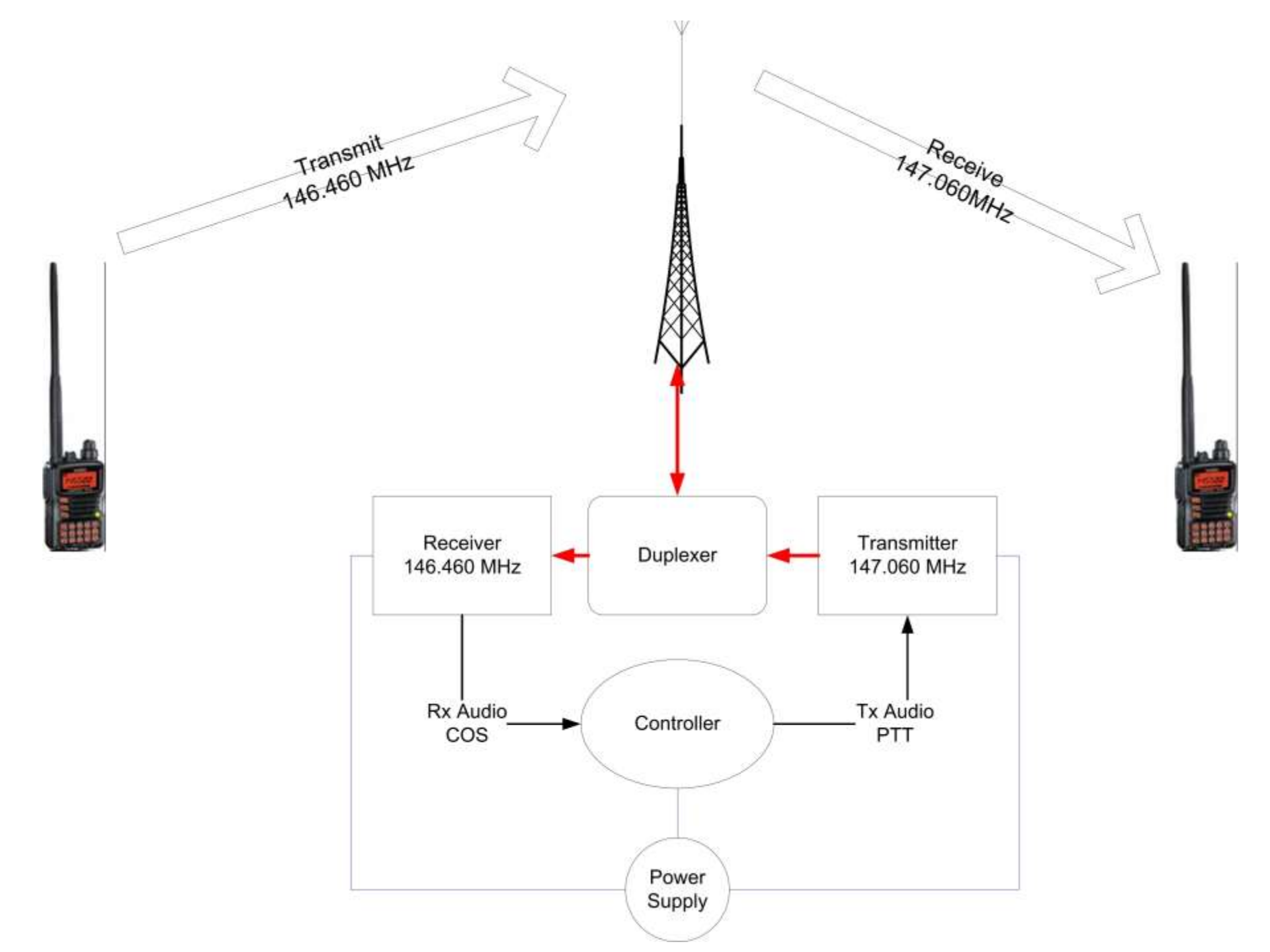
Duplexer

- Allows single-antenna operation for transmit & receive
- Also known as “Cans” or “Cavities”
- Most duplexers are a pass & notch filter – on the Tx side they pass the Tx frequency while notching the Rx frequency – on the Rx side they pass the Rx frequency while notching the Tx frequency


Antenna
Pass 146.460
Reject 147.060
Pass 146.460
Reject 147.060
Pass 146.460
Reject 147.060
Pass 147.060
Reject 146.460
Pass 147.060
Reject 146.460
Pass 147.060
Reject 146.460
Receiver
146.460MHz
Transmitter
147.060MHz

Controller

- The “Brains” of the repeater
- Identifies the repeater (CW or Voice)
- Provides courtesy (go ahead) tones
- Provides timers for transmit & receive
- Provides phone patch (interconnect)
- Provides linking capability to other radios & repeaters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Repeater Operation

- Offsets must be used so the repeater input and output frequencies are different
- Standard offsets for Amateur Radio in-band repeaters are:
  - 10m (29MHz) = 100kHz
  - 6m (50MHz) = 500kHz
  - 2m (146MHz) = 600kHz
  - 1.3m (220MHz) = 1.6MHz
  - 70cm (440MHz) = 5MHz
  - 33cm (900MHz) = 25MHz
  - 23cm (1200MHz) = 12MHz
  - 13cm (2400MHz) = 20MHz

Repeater Operation

- CTCSS (Continuous Tone Coded Squelch System) tones are sometimes required to access a repeater
- CTCSS is also known as “PL” (Private Line - Motorola) or “CG” (Channel Guard - GE) or simply “Tone Squelch”
- Tone Squelch allows the repeater to respond to ONLY those stations that are transmitting the correct tone
- The use of Tone Squelch greatly reduces interference problems from natural and man-made sources
- Almost all amateur radio transceivers are capable of producing CTCSS tones

Repeater Operation

- A repeater may have a telephone line interconnect – a “Phone Patch”
- Phone patches are usually “open” to all users of the repeater
- A DTMF pad on the transmitter is necessary to control the phone patch and to dial the desired phone number!

Repeater Etiquette

- **LISTEN FIRST!!!**
- **LISTEN AGAIN!!!**
- **LISTEN SOME MORE!!!**
- **KEEP LISTENING!!!**
- **LISTEN!!!**

Repeater Etiquette

- Leave a small time gap before transmitting (or replying) – Use the repeater's courtesy beeps!
- If more than two operators are on the repeater, indicate which operator is to continue the conversation
- Keep PTT time short – The repeater has timers that will disable the repeater if PTT time is too long (typically 5-10 minutes)
- Identify yourself using your FULL call sign at the beginning and end of your time on the repeater (including using the phone patch). If your session goes longer than 30 minutes, identify yourself again