My mobile ham Radio setup

All the radios in my car and how they work with/against each other

- Radios and Antennas List
- How the radios interact (or interfere) With Each Other

Radios and Antennas List

Radios:

- Yaesu FT-891 HF radio, 1-50MHz, with auto-tuner
- Cobra 18 WX ST II CB radio
- Uniden BCD536HP scanner
- 3x Motorola XTL5000 radios: VHF, UHF and high band 900MHz

Antennas:

- Hustler HQ-27 center loaded CB whip, feeds CB radio and scanner via a Comet CF-360A duplexer
- Mobile Mark A55136TBS-DKM tri-band antenna (VHF/UHF/900MHz), feeds XTL5000's via a Comet CFX-4310C triplexer
- Custom made dual-whip 10/6M HF whip, feeds only the HF radio

Antenna details:

Hustler HQ-27 center loaded CB Antenna:

- Antenna is mounted to a TRAM NMO-to-3/8 stud adapter. The cable is run to the front dashboard, where the CB, scanner, and duplexer are. The duplexer splits the RF at ~40MHz. The low band RF goes to the CB, and the high frequency RF goes to the scanner. This setup disables the weather RX funtion in the CB radio (WX stations are at ~160MHz, sent to scanner instead.)
- This antenna was chosen because of the center load. The car's body panel is too weak to support a full 11M CB whip, and a base loaded antenna filters VHF/UHF RF, harming the RX sensitivity of the scanner. With a center loaded whip, the bottom half of the whip can act as a wideband receiver antenna for the scanner.

Mobile Mark A55136TBS-DKM tri-band antenna:

- Pre-tuned tri-band antenna with some gain on all bands, a good all-rounder to maximize performance of the Motorola radios.
- Triplexer allows all 3 radios to be attached to the same antenna with no interference.

Custom HF whip

- Custom assembly to maximize performance on the common mobile HF bands. BreedLove brass mount (nickle electroplated by me for corrosion resistance) with steel plate backing under the vehicle body panel for added support. Threaded into mount is a clevis "rod end bolt" with a custom welded end stop. Attached to that is a clevis rod end, into which is threaded an 11M CB whip. The whip is also bolted through a 6" piece of flat bar aluminum stock at one end, and at the other end of the bar is a 6M whip. At the top of the 6M whip is another custom part: two hinged standoffs secured to both whips, connected by a length of nylon threaded rod. This acts as a spacer to keep the whips from hitting each other while driving the vehicle.
- The antenna assembly is hinged because the antenna puts the vehicles height at just about 11 feet, too tall for drive-throughs and some low hanging bridges. Attached to the front of the antenna assembly is a linear actuator with 2" of travel, and built-in limit switches. The other end of the actuator is attached to the vehicle body panel. Power for the actuator is run to a dual-position momentary toggle switch on the dashbaord, which when activated, either extends or retracts the actuator, raising or lowering the antenna. Fully retracted, the antenna leans forward, height is about 8 feet. Extended to full, the antenna is fully vertical.
- Aside from the whips and brass BreedLove mount, all the parts are steel, so everything has to be weatherized with paint or grease (WIP, some parts still rust a bit.)
- The dual-whip assembly allows the antenna to be naturally resonant on 10M and 6M, and with the auto-tuner, can tune down to 20M no problem, and 40M with limited sucess (which covers most mobile-friendly HF traffic, good enough for me!)

How the radios interact (or interfere) With Each Other

Radios Working Together

Motorola radios:

The XTL 5000 radios are all of the mid power (50W) variety, all with remote control heads. I chose W3 handheld heads, because they are cheap on eBay, and the all-in-one mic+head combo is a huge space saver, and dash space is at a premium considering I fit 6 radios/scanners onto it somehow.

I do NOT have the correct TIB (transceiver interface board) on the radio units (the ones for W3 heads are very rare and expensive), so the radios are 100% functional except for the power button on the heads, which I bypass by forcing the radio to power on (jumper the BATT+ and IGN pins in the acessory connectors) and use a high-amp relay to cut main battery power to the radios with a switch on the dash.

To further save dash space, I made a dual-radio setup with the UHF and 900MHz radios. This allows one control head to control two radios, with a button to switch between them. The cables for this are all DIY: the W3 heads use standard RJ45 connectors internally, so I used standard CAT6A cable and RJ45 couplers to run the heads from the trunk of the vehicle to the dashboard. The dual radio setup was accomplished by running the head cable to one radio accessory port, then jumpering 7 of the 8 control wires (everything except for the power wire, only one should be attached to power the head, doesn't matter which) to the other radio's acessory port.

XTL radios DO NOT have speakers built in, and the speaker outputs are NOT grounded, so all 3 radios have their speaker outputs run through small audio transformers, then to a simple resistive summing circuit, which feeds an audio amplifier board, that powers a speaker in my dash. This allows indipendant volume control of all 3 radios.

HF Radio and CB Radio

Since the HF rig and the CB radio both operate in the HF bands, they can interfere with each other. To solve this, I made a custom interface box. The Yaesu HF rig uses an 8-pin DIN connector to drive the auto tuner, and I hijacked the PTT signal from the Yaesu to strategically kill the CB radio.

The custom box has two RJ45 ports. One plugs into the radio, one to the tuner. The ports are a 1:1 passthrough, so the tuner will work even if the box fails. The box taps the power lines for... wel..

power, and the PTT line as a signal input, and powers the status LED's on the RJ45 ports to indicate different statuses (input voltage OK, 5V bus OK, PTT active.)

The box internally has an RF relay, a 5V linear regulator, and a simple op-amp and diode-based OR gate driver for the relay. The relay common and NC contacts are run to two BNC ports on the box. There is also a third BNC port connected to one of the OR gate inputs. Finally, there is a circular DC power jack that is used to interface with the CB radio.

The CB/Scanner radio antenna cable is run throught the RF relay in the custom box. Normally (unpowered), the relay is closed, allowing RF to pass. When an external signal on the third BNC port is received, OR the 5V PTT line on the HF rig is pulled to ground,the OR gate triggers the relay and shorts the CB/scanner cable, disconnecting the antenna.

In addition, the OR gate output is tied to a transistor, which shorts the DC barrel jack on the side of the box. The CB radio has been modified: the microphone on the CB has an "RX" line, and when that line is broken, the receiver in the radio is shut off. I added a port on the back of the CB radio, with a cable run to the DC port on the box. When the box's port is shorted via the transistor, the RX line internal to the CB is cut, completely disabling RX (this is done because the HF rig is very powerful, and presents an interference risk even with the CB RF port shorted.)

RF tap for the CB radio:

As mentioned above, the HF and CB rigs interfere with each other when transmitting. The HF rig interference has been solved, but how about the other way around? The CB may only put out 5W of RF, but the bands are very close, and it's easy for the HF rig to pick up the CB.

To combat this I built custom RF taps: all-aluminum project boxes with two RF ports and a single RCA port on the side.

Inside, there is simply a direct line from one RF port to the other. I pulled the center conductor and insulator out of a short length of RG-58 cable to use as a short. An insulated, thin guage (22 AWG) wire is wrapped around the insulator to make a pickup loop. I needed about 90 turns in 3 layers to get a good enough signal at the CB's power level. The loop is connected to a high speed diode, and a ceramic capacitor, making a half-wave rectifier. This rectified signal directly drives the base of an NPN BJT transistor.

The Collector and Emitter of the transistor are tied directly to the RCA jack on the side of the tap. The function is simple: when RF is present in sufficient quantity, the transistor turns on. I installed this tap in line with the CB antenna. The wiring is not complete, but I installed another RF relay, this time in line with the HF radio antenna. When the CB radio keys, the RF tap transistor turns on, which will trigger the relay and short the HF rig's RF port, limiting interference from the CB radio.

RF Tap for the Motorola Radios:

The Motorola radios have a similar interference problem: when they key, the RF gets into the CB/scanner antenna, and can interfere with the scanner. To solve this, I made a second RF tap,

identical to the one for the CB radio, but with fewer turns on the pickup loop, since the higher frequencies makes the tap more sensitive... I guess? Don't check my math there.

I installed this tap in line with the tri-band antenna for the Moto radios. I ran the trigger port to the third BNC port on my custom HF box, which allows the RF tap to be an external trigger for the CB/scanner circuit mentioned above, and short the scanner's RF port when any of the 3 Moto radios key.