should already be in communication with the distant radio prior to the phone call being made. Once the connection is made to the third party, a conference call is made to the local radio transceiver's cell phone. Upon connection, all phones have the same transmitted and received audio, and the cell patch is in progress.

Using conferencing greatly simplifies the interconnection of all parties. The third party and distant radio transceiver can talk back and forth while the local control operator can also talk to each person using the local cell phone. Although a voice-activated transmitter (VOX) could be used, it is best for the control operator to purposely transfer, transmit, and receive using the cell patch's built-in push-to-talk (PTT) toggle switch.

Cell Patch Unit

The completed cell patch unit is shown in Figure 2. Our cell patch is designed to connect to Icom transceivers that have both transmit and receive audio available on a Foster eight-pin, front-panel connector. The ⅛-inch-style phone plug is for connecting to the cell phone's headphone and microphone jack. A PTT switch is located on the box for transmit control. We found that the headphone/mic access holes in some cell phone protective cases have very small diameters. Fortunately, there is an inexpensive solution using a short extension cable available online. This extension cable's plug diameter is the same size of the stock cell phone headphone connectors, so it works well.

The schematic for the cell patch is shown in Figure 3, along with the parts lists and vendor information. The design simply connects the cell phone microphone connection to the transceiver's receiver output and the cell phone headphone to the transceiver's microphone connection. However, there are some

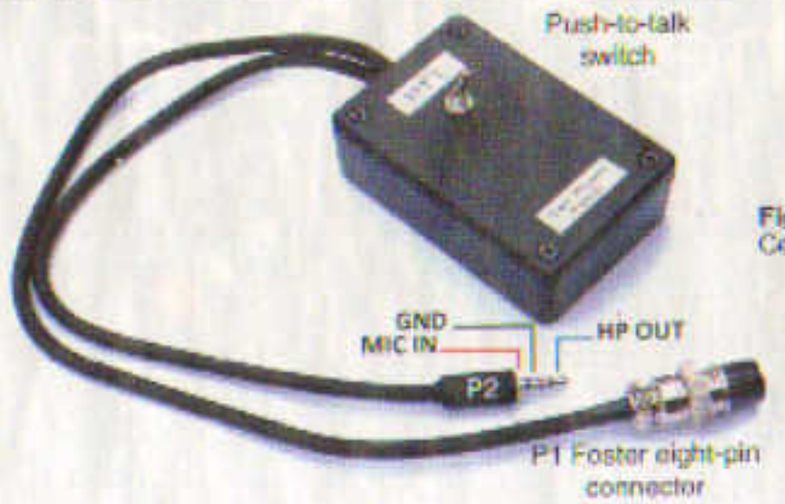

Figure 2 — Cell patch unit.

subtle design features that may not be apparent.

The headphone and microphone signals of the cell phone use three of the four terminals located on the TRRS ⅛-inch plug. The convention for the cell phone connector is the headphone (tip), ground (inner ring), and microphone (innermost contact sleeve). Because the microphone is on the innermost contact, it is best to not use a ⅛-inch plug that is shielded because the plug's case would be the microphone signal.

The signal levels going in both directions need some attenuation so that the cell phone and transceiver are kept within proper audio levels. This is the purpose of the resistors R1, R2, R3, and R4. The resistor R4 is also required so that the cell phone can detect the use of an external headphone/microphone. Otherwise, the cell phone will use its own built-in speaker and microphone.

The audio paths also have capacitors C1 and C2 that are used to block the dc voltages if present on the transceiver and cell phone. These dc voltages are used to provide the voltage necessary for electret microphone elements to function. Capacitor C1 is shown with a polarity in the event one is marked. However, if using the suggested capacitors in the parts list, they are non-polarized, so the polarity on the schematic does not apply.

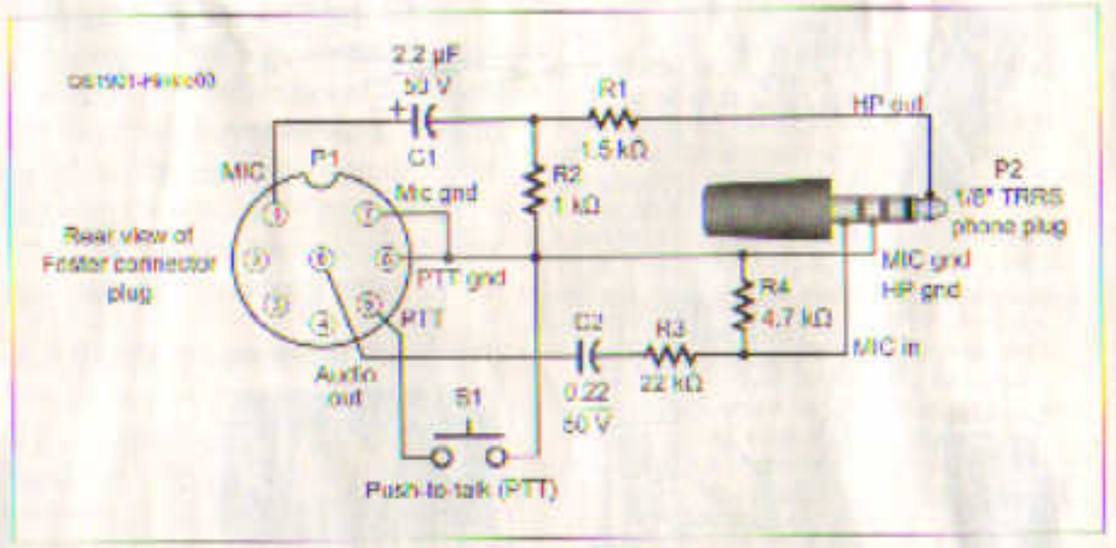

Figure 3 — Cell patch schematic.
C1 — 2.2 µF 50 V 10% X7R capacitor
C2 — 0.22 µF 50 V 10% X7R capacitor
P1 — Foster eight-pin plug. Universal Radio Inc. item no. 2112
P2 — TRRS cell phone plug, Mouser item no. 490-SP-35401
R1 — 1.5 kΩ 5% ¼ W resistor
R2 — 1 kΩ 5% ¼ W resistor
R3 — 22 kΩ 5% ¼ W resistor
R4 — 4.7 kΩ 5% ¼ W resistor
S1 — SPST toggle switch
Project box — 3.3 × 2.2 × 0.8 inches, Hammond Mfg. P/N 1591XXMSBK, Mouser item no. 546-1591XXMSBK
Extension cable — 3.5-millimeter TRRS male-to-female audio adapter for mobile credit card reader, Cellet model no. 420900 (Amazon)

Finally, the PTT switch is used to provide the connection to the PTT pin on the transceiver. We originally used a pushbutton but found it much easier to have a toggle switch. The control operator must keep the switch in the off position when the phone patch is not in use. Always remove the cell patch from the transmitter circuit once the phone patch is completed.

If adapting the cell patch to a different radio manufacturer, there are several simple changes to the diagram. First, check the transceiver's microphone connector and change the pin numbers accordingly for transmit audio, receive audio, PTT, and ground. If the receiver's audio is not available from the microphone connector, then connect this signal to the receiver's speaker or headphone jack using the appropriate connector.

We housed our cell patch in a small Hammond plastic project box. All components apart from the PTT toggle switch were mounted on a small perforated circuit board (PC board) and wired point-to-point. Component layout is not critical.

Using Cell Patch

It is fairly simple to initially set up the cell patch. Take the radio cable and plug it into the radio's microphone jack. Next, plug the other cable into one of two local cell phones. Using the second local cell phone, call the first phone. This establishes the primary connection. We suggest using a transmitter dummy load when initially setting up the patch.

Put the cell patch in transmit by throwing the switch on the breakout box. Adjust the radio receiver's audio out and microphone gain levels for normal operation by speaking and listening on the second phone while looking at the transceiver meters to adjust levels. Finally, using the second cell phone, call the third party into a conference call. The third party will be automatically patched into the radio.

Certain precautions with cell patches must be explained to the third party. Let them know that they are being transmitted live over the air with limited privacy, and the limitations on what kind of messages can be passed. They also need to say "over" to indicate the transfer of the conversation to the other party. Finally, inform them that music cannot be played or business transactions conducted. The cell patch session must be quickly terminated if any of the above rules are broken.

Conclusion

The cell patch is both versatile and practical. It is useful in the normal sense of the traditional phone patch where a station on the radio is connected through your station to a person on the telephone. In an emergency event, setting up the cell patch for field or mobile radio operation will enable contact by emergency personnel to a point with cell phone reception.

While phone patches may be archaic in some ways, recent emergencies have shown us that cell phone coverage is easily disrupted by severe storms. Amateur Radio operators equipped with a cell patch will be better prepared to provide emergency communications when the next disaster strikes.

Photos by the authors.

Amateur Extra-class licensee and ARRL Life Member Gene Hinkle, K5PA, also serves as a Volunteer Examiner. He earned an MSEE from the University of Texas at Austin and is an IEEE Senior Life Member. Gene began experimenting with ham radio at a very young age, which led to his career in RF engineering. Recently retired from a radio technology company specializing in radio-geolocation, Gene is also a retired professional engineer in Texas. He enjoys working CW, low-bandwidth digital, and making DX contacts. His website, **www.k5pa.com**, shows his interests, photographs, and many publications.

Jim Milliner, WB2REM, has been a ham radio operator for over 50 years. He is an avid DXer, world traveler, and licensed psychologist. He first began experimenting with remote control linking in the 1980s and published the first article on the subject, "The Missing Link," in the September 1986 issue of *73 Magazine*. In addition, his remote link was featured in a portion of the 1988 ARRL video, "The New World of Amateur Radio." In June 1995, *QST* published his article, "The WB2 'REMote' Link," which presented a hardware solution to remote linking. He has written other related articles for *QST* and ones pertaining to his profession and the current state of Amateur Radio for *CQ Amateur Radio* magazine.

For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

New Products

Andress Technologies K7NV Mast Clamps for Rotators Now Available at DX Engineering

DX Engineering now carries one of Kurt Andress', K7NV, signature upgrades: the Mast Clamps for rotators. They are direct bolt-on replacements for the stock M2 OR-2800 or Yaesu DXA series rotator mast clamps, significantly improving the mast connection to the rotator and preventing mast slippage that can result with larger array setups. The mast-gripping pressure of these clamps can be adjusted by applying more torque to the included fasteners.

Clamp assemblies have a clearance hole in the center to fit over the bolt and bushing that holds the rotator output shaft up to the base plate of the OR-2800. The mast clamp plate has separate holes drilled for M2 or Yaesu rotators. The clamps accommodate 2-inch-diameter masts. They are compatible with either 6-inch round or 6 × 8 inch oval OR-2800 base plates, as well as the heavy-duty Yaesu DXA series.

Bolt kits for mounting K7NV Mast Clamps to either M2 OR-2800 or Yaesu DXA rotators are available separately from DX Engineering. Visit **www.dxengineering.com** for more information.