

How Not to Build a Remote SO2R Contest Station—Part 2

Part 1 of this article, which appeared in the January/February issue of NCJ, focused on remote site selection considerations and issues to ponder before beginning a remote station project. Part 2 will emphasize connectivity, equipment and some really cool remote control devices now available for this new and exciting contesting frontier.

History Does Repeat Itself

You may recall my admonition in Part 1 to select a remote site with 24/7/52 paved road access. Due to new road issues and a solar-related glitch (which rainfall prevented me from even making the one hour hike up the mountain to resolve) I was QRT from the remote site for 10 days. Please remember that Mr Murphy shows up when least expected and seems to love visiting remote stations. I encourage you to firmly inculcate Golden Rule No 1 of remote station building, which I initially overlooked: 24/7/52 access, regardless of weather conditions.

Connecting to the Remote Site

Most remote station operators use the Internet to connect from point A to point B. Various software is available to remotely control a radio and handle audio. While this may be fine for casual operating, serious contesting — especially QRQ CW radio-sport — demands a much lower latency factor than current Internet technology offers, especially when it comes to the audio part of the food chain. The primary latency issue in this instance involves the time it takes — typically a matter of milliseconds — for the received audio to return from the remote site to the control point, so I can hear the station I'm working and monitor the CW sidetone.

I am primarily a CW contester. Since there was no telephone service to Locust Peak, the challenging goal was to somehow achieve a latency factor of 5 ms or less. I explored various UHF/VHF gear possibilities, but for SO2R remote, this approach was viewed as too much of a hassle.

The technical guru at my ISP suggested I use the same 5 GHz wireless bridge units they deploy to bring high-speed wireless Internet into this rural area, including my home. Coincidentally, the manufacturer of



Figure 1 — My initial tickets to remote contesting paradise



Figure 2 — K6XX (top) and K6HJU complete the Air Breeze installation.

the units (Airaya) is conveniently located here in South Silicon Valley. As good fortune would have it, the company also had a tiny new 12 V power module available to directly run the remote site unit from battery power. Sometimes in life, ya get lucky.

The Airaya units have been in service 24/7 for 18 months now and are extremely reliable. They also have a built-in encryption scheme that offers security that goes beyond the standard user ID and password system. I highly recommend their equipment.

Since I would need a computer in the remote food chain, another serendipitous moment occurred as ASUS had just released its mini Eee PC units to the marketplace. The smallest one only consumes about 21 W, compared to a more watt-greedy notebook, laptop or desktop. I found the unit's solid-state drive extremely appealing. This meant no conventional hard drive to crash, especially in the middle of a contest. I purchased two units, one for each end of the remote link. The result, after some trials and tribulations (see reference Web site for details) was an incredibly low 1 ms latency factor.

Estimating Solar Power Needs

Those entertaining a true off-the-grid remote station project take heed: My gross underestimation of solar panel and battery system needs resulted in premature battery exhaustion. Even after installing additional solar panels and batteries, a power shortfall remained while operating longer contests during inclement weather.

The solar system vendors I initially contacted were clueless about Amateur Radio. If I could back up and start all over again, I would not have made *any* solar/battery system decisions until I had fully digested an article I wish I could have seen several years earlier. I discovered this valuable resource far too late in a commercial radio publication. A PDF of *Designing Solar Power Systems for FM Translators* is on my reference Web page, with the permission of the publisher.

The basic principles the article outlines apply to estimating power needs for an off-the-grid remote contest station, with some adjustments needed in the mix due to the unique requirements of remote contesting. I hope this article will help others, so they do not make many of the same mistakes I did.

Wind Power

As road access issues continued, I decided that adding wind power might be a solution to some of my solar/battery system power woes. A small Air Breeze model purchased many months ago was finally installed by K6HJU and K6XX on



Figure 3 — The initial SO1R remote station in the tiny camper on Locust Peak



Figure 4 — Locust custom patch boxes for Remoterig connections

a small BX tower at one end of the new mini-barn shack. Since months of remote weather station data showed an absence of high wind speeds, the Air Breeze (www.airbreeze.com) was selected because it kicks in at very low wind velocities. The slick PentaMetric battery monitoring system (www.bogartengineering.com) offers a direct Ethernet module for remote monitoring of solar panel, wind turbine and overall battery bank operations. A unit is on site and ready to install whenever the latest road repairs can be done.

Critter Control

I had read some posts on the NCCC reflector regarding problems with critters chewing through coax runs at various members' home stations located in mountainous or rural areas. In more than six months of remote operation on Locust Peak, I felt fortunate not to have had similar problems. Then, during one trip to the mountain, I discovered that about two feet of one of the solar panel's heavy UV resistant cables had been chewed through to the bare copper. Two lengths of used LMR-400 also had been hit. The latter were part of a more than 200 foot run from the camper shack down the hill to the new "Godzilla" tower boom for my experimental two element staggered 40 and 80 meter inverted V wire Yagis.

Fortunately, I discovered the damage just in the nick of time, before running 175 foot lengths of CAT5 Ethernet cable and #8 wire pair from the new mini-barn shack to directly power the Airaya wireless bridge that needed to remain powered up at the camper. I decided that I'd be better off installing these cables inside gray PVC conduit sections. Multiple 45° angle PVC sections facilitated direct entry into the camper and mini-barn cable pass-throughs. I inserted steel wool around the PVC to thwart critter entry. From now on, all coax, rotator or other kinds of cables will go inside PVC as well.

The Agonies and the Ecstasies

When I bought my first — of eventually five — Kenwood TS-480 transceivers in 2004, it was love at first sight. The Kenwood design folks deserve a medal for the unique separate control panel adjustable mounting stand, which makes for ergonomic ecstasy when operating. The display is beautiful, and two of these jewels side by side for SO2R are a small footprint on the desk, plus minimal eye and hand movement is needed between radios panels. That is one of the ecstasies.

An agony was that for years I ran around with a vision in my head of someday, somehow, being able to use the separated transceiver control head at home with the rig's body at a remote location. I kept mak-

ing periodic inquiries to various technical folks, but no one knew how (or if) this could be done. In sheer frustration, I clung to the vision (see the reference Web page for the full story).

It would be years until I ultimately discovered W4MQ's new Internet Remoting Toolkit (www.w4mq.com/toolkit/index.html), which incorporates *IP-Sound* to handle audio and would enable remoting a TS-480 as I had envisioned. Another

ecstasy moment! Unfortunately, only one instance of each can be installed on a single computer, so SO2R remote plans remained on the back burner, as I forged ahead to pursue, at least temporarily, getting an SO1R remote station on the air.

When I got the IRT up and running, however, I could not get rid of the terrible-sounding artifacts experienced with CW audio, no matter how much I fiddled with various *IP-Sound* adjustments. So, I

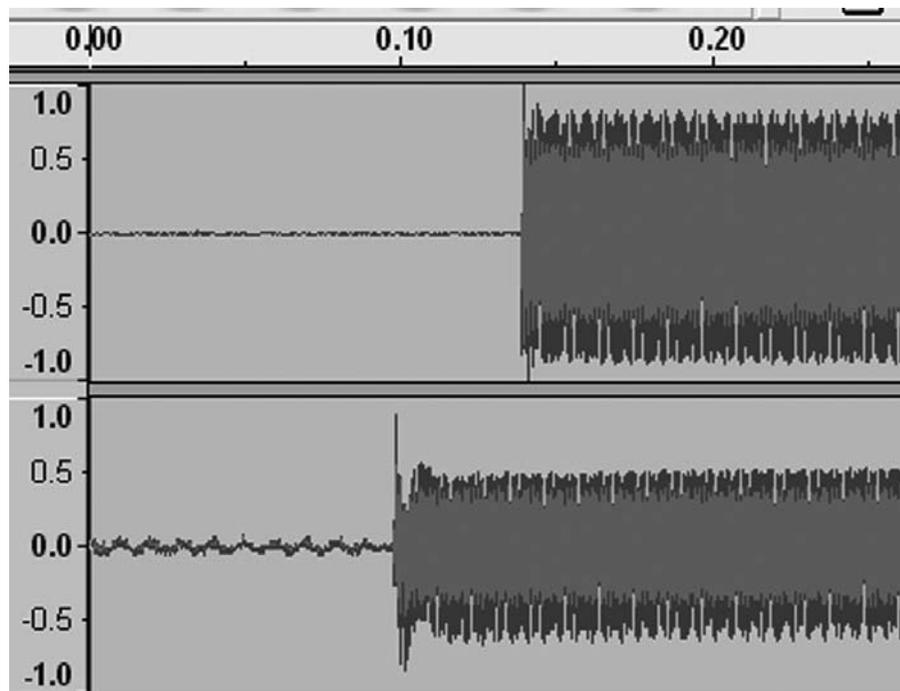


Figure 5 — A WWV test indicated about a 40 ms remote latency audio factor.



Figure 6 — The temporary kitchen table SO2R remote control setup

hobbled along through periods of mixed agony and ecstasy for what seemed like an eternity, enduring unruly delays in CW contesting and periodic crashes of the IRT — both always very embarrassing in the middle of a contest QSO.

Then, weird CW keying problems manifested, making it sound as if I'd ramped up my exchange to 60 WPM, necessitating many contest exchange repeats. It also turned out that the little ASUS computers didn't have enough horsepower to lessen the analog-to-digital processing time required by *IP-Sound*. Despite my low 1 ms latency link, audio delays back to the home station using *IP-Sound* were about 300 ms. The agonies and ecstasies of remote contesting continued.

Remote Station Angels

The *Bible* mentions the appearance of *angels*. Let me tell you about three remote station angels who appeared to me. The first two were fellow NCCC members, while the third was in Sweden (which makes sense, as I am half-Swedish).

Rick, N6XI, suggested that a WinKeyer (www.k1el.com) might solve my remote keying problems, and he loaned me the initial RS-232 unit he had built. I connected it to the USB-to-serial four-port hub on the remote computer, and it completely eliminated the nasty problem I (and those who had worked me in contests) had endured for months. Rick also built my WinKeyer USB units, one of which has continued working flawlessly on Locust Peak. The other has gone on various contest outings but is destined for eventual insertion into the remote food chain at the home station.

Enter Remoterig by SM2O

After suffering through so many embarrassing crashes of the IRT and struggling for months with the audio A/D conversion latency and CW quality issues associated with *IP-Sound*, another remote miracle occurred. Out of the blue, Andy, AE6Y (P49Y), sent me an e-mail to suggest that I might be interested in a new device called "Remoterig" (www.remoterig.com/) by Mike, SM2O, for Locust Peak. Clicking on the embedded URL was like having a giant truck of cold 807s show up in the middle of a desert on a 120° day. I immediately started corresponding with Mike, who was extremely helpful. I consider him another remote station angel.

These small but *mighty* Remoterig units are the most incredible pieces of equipment for remote contesting that I've seen. Fellow NCCCer Rick, N6RK, did the original unit tests for me. He reported that when using one of these devices to connect over the Internet to his remote site, audio latency was cut in half compared to *IP-Sound*, even

without using the most aggressive settings. I was further impressed that Rick reported absolutely crystal clear audio quality on CW, with no artifacts. *Hallelujah!*

To better facilitate interfacing with a DX Doubler and to make any future changes either at the remote site or at home, I designed a patch box system which Rick said he could easily build for me using off-the-shelf components from The Home Depot of all places (it has faceplates with pre-punched RJ-45/RJ-11 holes as well as jacks, enclosure boxes and inexpensive

CAT5 jumper cables).

We also were able to provide various enhancement suggestions to Mike for simplifying connectivity by adding more RJ-45/RJ-11 jacks to the Remoterig units, as well as software-related feedback to include provisions for CW keying from contest logging software. Many of these ideas have been incorporated into the new Remoterig II versions and software updates. Thanks, Mike! The Remoterig units with built-in audio handling are the greatest thing since sliced bread.



Figure 7 — The remotely controlled solenoid for powering on the computer



Figure 8 — New SO2R remote setup using Remoterig interface units at one end of new mini-barn shack desk

Thanks to my 1 ms latency remote link, when I tune the VFO dial, there is no absolutely no difference from having the TS-480 control head connected directly to the rig body with the standard short cable. It is absolutely amazing! Even without trying the more aggressive (ie, lower latency) codec settings, the return remote audio latency is about 40 ms, which is phenomenal compared to nearly 300 ms while running *IP-Sound* on the ASUS computers. In my wildest dreams I would not have expected such incredible performance.

I've been hesitant to mess with any settings because everything now is working great. My remote audio quality reports on SSB have been excellent, and I have not had a single crash with either Remoterig unit since installation. Martti, OH2BH, also recently installed a Remoterig system, and I highly recommend Remoterig to any contesteer considering a remote station.

Kitchen Table SO2R Remote

Since I'm single, the initial SO1R remote control point gear remained on my kitchen table. Once I excitedly installed the second TS-480 and both Remoterig units in the now very crowded camper on Locust Peak, I could hardly wait to get home and make the infamous *smoke test*. When I finally turned on the two Locust Peak radios remotely and had my small-footprint kitchen table SO2R remote system actually working, it was sheer ecstasy! I then had Spook the carpenter build me a small platform, which I painted black, so the DX Doubler from the former home SO2R setup could reside above two TS-480 remote control heads. The Remoterig control units and patch boxes also fit below the DX Doubler.

SO2R Remote Operation

Until I move the KRC2 Band Decoder units, ICE419a band-pass filters and Array Solutions SixPak from the previous home SO2R installation to Locust Peak, I'm doing a few creative workarounds to operate SO2R remote. With 100 W I have no SO2R remote operating problems without the band-pass filters. Band changes are accomplished via *TR4W* on the remote computer via RS-232 connections to each of the TS-480 rig bodies. Windows *Remote Desktop* gives me access to *TR4W* on Locust Peak, and, at present, I'm still sending CW remotely via the home ergonomic keyboard.

Since both TS-480s have dual antenna connections, I use these in conjunction with an Array Solutions TwoPak and TwoPak Plus to switch antennas via a slick direct Ethernet DIN Relay unit with built-in Web server from DLI (www.dinrelay.com/). The latter also serves to turn the LDG AT-200 Pro tuner on or off. The tuner is set for auto

tune. When needed, the DIN Relay also can activate the remote-controlled solenoid I mounted on the ASUS Eee PC. Since the PC does not have Wake-on-LAN BIOS on the motherboard, I had to figure out some way to physically actuate the computer's power button via remote control if it went QRT due to the undersized solar battery system running out of juice, something that occurred far too frequently. Eventually I discovered RSHUT PRO (www.rshut.com), which enables me to remotely hibernate and wake up the ASUS on Locust Peak. The solenoid remains in place as a Domsday switch in reverse.

A direct Ethernet Web Power Switch with built-in Web server, also from DLI, remotely controls ac power outlets from the small 150 W inverter needed for the ASUS and NetGear Ethernet switch. A larger inverter awaits installation. Eventually it will handle rotator controllers and various other equipment. The weather station is a Peet Brothers ULTIMETER 100, which can be read remotely via the computer, and a TRENDnet TVIP-410 PTZ Web cam with built-in Web server will be re-installed from the previous camper location, where it worked very well. Several RIGrunners and most of the other items mentioned previously are wall mounted in the mini-barn battery room, with interior wall feed-through access for cables to the new remote "shack" room. The musical equipment Gator case rack awaits installation of the ICE 419a units and a shelf for the KRC2s, SixPak controller and the remote DX Doubler. Rotator controllers will go on the top, and the ASUS will move to the desk.

TR4W

The official contest logging software of my Locust Peak SO2R remote station

is now *TR4W* (www.tr4w.com). Dmitriy has been taking his *TR4W* contest logging software, which is based on the N6TR *TR LOG* program, to new heights. Although I am primarily a CW kinda guy, I plan to write an article about some of the extremely cool SSB contesting features I'd requested and that Dmitriy incorporated into *TR4W*. These include *unlimited* SSB message capability and an automatically generated .txt file "hit list" for more effective management of pre-recorded .wav file tasks associated with operating SSB in full automation mode. Thanks, Dmitriy, for grasping the vision and implementing these enhancements.

Field Day-Style Antennas

For a number of reasons, the Locust Peak SO2R remote station is considered a temporary ionospheric research project installation. Only AB-1342 and AB-577 portable military masts plus Rohn 25 towers with large heavy welded base plates utilizing long anchor rods will be used. Until Phillystran guy lines are installed, temporary guy lines are 5/16-inch heavy Dacron rope wrapped around the trunks of oak trees (don't try this at home!). Miraculously, everything put up so far made it through the winter, and it's "so far so good" this year.

Due to road repair delays, mini-barn alterations and other factors, many antennas remain to be installed. Even after 18 months, the initial "test" TH-3JR at 27 feet on an AB-1342 is still the primary antenna for 20, 15 and 10. It's supplemented by a CAROLINA WINDOM® 160, which also covers 30, 17 and 12 meters. The experimental two element 40 meter and two element 80 meter fixed wire Yagis have definitely helped on those bands, but I also



Figure 9 — SO2R remote control integrated with the control point SO1R rig

look forward to finally installing the C31-XRN, four element 20/15/10 monobanders and a 30/17/12 tribander, plus a dedicated antenna for 160 along with my new KD9SV reversible Beverage system for receive. A really cool direct Ethernet control relay board from NCD will be used to remotely switch the Beverages and provide proper 75 Ω resistor terminations on the unused reversible Beverage legs. It also will feed into the KD9SV DX-Pedition II unit with QSK, also needed to provide separate receive antenna capability for one of the TS-480s.

The Locust Peak SO2R remote station will be primarily for domestic contests and is not intended to compete with the multi-multi big guns. I prefer to go play "DX" station during a DX contest or two anyway, as well do more IOTA expeditions as Sunspot Cycle 24 ramps up.

I finally removed all SO2R remote station equipment off the kitchen table and integrated it along with what is now an SO1R station at home. With the *three* TS-480 control heads side by side, I've been able to quickly make some interesting signal strength comparisons on different bands at different times of the day and night. Locust Peak definitely rocks when it comes to low-angle propagation.

The Future of SO2R Remote Contesting

To paraphrase a hit song from years ago, the future of SO2R remote contesting looks so bright, "I gotta wear shades." Amateur Radio equipment manufacturers, especially those who make gear for contesting, need to put on their time travel sunglasses and visit the future, which is already here and now. For a number of reasons, I find that RS-232 and even USB connectivity is so *dinosaur-ish* compared to state-of-the-art direct Ethernet gear with built-in Web servers.

For me, Amateur Radio and contesting still need to be a hands-on, turn-the-VFO (and other knobs) type of experience. If I had to try operating a QRQ CW contest in either SO1R or SO2R remote mode using software remote control versus being able to fondle my TS-480 control heads at home, I would most likely QRT and take up Scrabble. Since I have no loud local QRM that might require Inrad filters, I can experience the joy of physically having my hands on two *real* radio-control panels, and that alone is worth the price of admission.

Many folks have asked me what I think of the TS-480 as a contest radio. I guess having the top DX single band (20 meters) score in the 2009 ARRL International DX Contest (CW) with a TS-480, 400 W amp and A3S tribander as VP2VVA is a pretty good answer.

I predict a dramatic increase in the number of SO1R and SO2R remote station projects. Major DX contest rules allow a control operator to be in a different DX entity than the physical remote station. Unfortunately, contest QSOs made with these types of "crossover entity" remote stations are invalid for DXCC credit. An appropriate revision to the DXCC rules regarding remote stations is warranted. A copy of my request to revise the DXCC rules is at www.k6vva.com/dxccrules.

Final Admonitions

In spite of how well you may plan things, be prepared to still make many extra trips to Ace Hardware, The Home Depot, RadioShack and similar places where you will certainly get on a first-name basis with everyone there. Memorizing the telephone number of your nearest HRO store also will come in handy. Above all, the more non-technical you are (ie, like me), you will need to be extremely persistent in confronting the numerous unexpected remote station-related adversities that *will* occur. This goes double for SO2R remote. Trust me on this one.

References and Acknowledgements

The Web page with URLs for the solar/battery system planning article and equipment items mentioned in this article is at www.k6vva.com/remotestuff. This site also includes additional photos and minisagas relating to the Locust Peak project, along with acknowledgements to fellow hams and others who helped make a basic form of SO2R remote contesting a reality.

Rick "The Locust" Hilding, K6VVA, is a co-founder of the Northern California Contest Club and a member of the First Class CW Operators Club and the A-1 Operator Club. He volunteers as an ARES "Emergency Responder" and sponsors the annual Locust QSO Party (LQP), with NCJ subscriptions as awards. He is also a Screen Actors Guild member, musician, songwriter and ventriloquist. Rick's favorite contest is the CW North American Sprint. He typically can be found getting his Thursday Night Contesting fix in the weekly NCCC NS events. Contact Rick at remoteso2r@k6vva.com.

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