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Give Your Radios a Vacation!

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Monitoring Times

Vol. 32 No. 6 June 2013

Radio Takes a Holiday

This year *MT* invites you to take a break. Not from radio, just from your usual home surroundings. And, what could be better than leaving the heat and humidity stateside and going due north to Canada?

Our feature stories this month all have a Canadian connection: Thomas Witherspoon shows that beautiful scenery, shortwave listening and amateur radio can be had in Prince Edward Island. Dual citizen Keith Baker explains the dos and don'ts of operating north of the border with or without a Canadian call sign. And, native Canadian and longtime and *MT* columnist, Ron Walsh, actually heads south to the USS North Carolina for his winter vacation, just in time for the annual North Carolina QSO Party.

Regardless of where you might end up this summer, consider taking your portable shortwave radio or QRP transceiver. You never know when there'll be a lull in the vacation action or that an amazing opportunity will present itself. Sometimes the unplanned radio holiday can be the most memorable.

When you do head out this summer, take a few photos of your location and your operating position. You could earn a spot in the *MT* "Postcard from Summer 2013" which we will be happy to include in future Letters columns.

Bon voyage!

On Our Cover

Former Marconi Station and lighthouse at Pointe-à-la-Renommée overlooking the mouth of the St. Lawrence River on the northeastern tip of Quebec's Gaspé peninsula. (Photo by Thomas Witherspoon K4SWL)

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Continuously amazing, the AR6000 professional grade receiver features:

- 40 kHz ~ 6 GHz coverage with no interruptions
- Multimode AM, FM, WFM, FM Stereo, USB, LSB and CW
- Tuning steps of 1 Hz up to 3.15 GHz; 2 Hz from 3.15 ~ 6 GHz
- Receiver is programmable and manageable through a USB computer interface
- Up to 2,000 alphanumeric memory channels
- Analog S-meter, large tuning dial, front panel power, volume & squelch controls
- Direct frequency input
- Fast Fourier Transform algorithms
- An SD memory card port can be used to store recorded audio
- Two selectable antenna input ports plus optional remote antenna selector

Add to the capabilities of the AR6000 with:

- Optional APCO-25 decoder
- Optional interface unit enables remote control via the internet
- Optional I/Q output port allows capture of up to 1 MHz onto a computer hard drive or external storage device

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to the editors

editor@monitoringtimes.com

This column is open to your considered comments. Opinions expressed here are not necessarily those of Monitoring Times. Your letters may be edited or shortened for clarity and length. Please mail to Letters to the Editor, 7540 Hwy 64 West, Brasstown, NC 28902 or email editor@monitoringtimes.com

Happy monitoring!

Ken Reitz, Editor

Marine Frequencies on HF

Bob Frazer from Belfast, Maine, writes:

"Having lived by the sea here in New England, Ron Walsh's articles have always been of particular interest to me despite that his area is the Great Lakes. In the April issue of *MT* he has a listing of the 2 MHz shore stations dated December 26, 2012. I was quite surprised to see an old friend, WOU, among the stations.

"When I lived in Massachusetts, south of Boston, WOU was a familiar station to me. It was built in June, 1936 at Brant Rock as Bell's first radiotelephone station. It was primarily for fishermen to call their home ports to find the prices of their catches. It was so successful that WOX, New York City, followed in July 1937.

"I often listened to their broadcasts on 2506 kHz until the station went off the air in the early 1980s due to the ever increasing use of marine stations on VHF. Even the familiar radio towers were removed. I wonder just how accurate this listing is as I never heard of the WOU call going to another station, let alone Boston."

Ron Walsh VE3GO responds:

Thank you for the reply to my request in the April column. I got the listings from a web site in the UK that was said to be accurate up to Dec. 2012. However, I could not verify the U.S. listings and I even contacted Richard Dillman, at the MRHS in California, for information. I was hoping readers could verify these listings.

*There are still several Canadian east coast marine stations using 2598 and 2749 kHz for weather broadcasts. Their complete listings are available in the Canadian Government Publication "Radio Aids to Marine Navigation." This is available for free on line (**www.ccg-gcc.gc.ca/eng/ccg/mcts_radio_aids**). I have tried to get frequencies from as wide an area as possible and value any information readers can supply.*

Death of SW? Why not!

David Baltes from Buffalo, New York writes:

"It was with great interest that I read in the December 2012 *MT*, Hugh Stegman's 'Utility World.' The question was asked, 'Is Shortwave Dead?' Mr. Stegman explained the few negative changes to the hobby in recent years (we all know the names of those stations that are no longer with us), but summed up the segment of the column by saying shortwave radio is alive and well.

"Well, as an 'SWL' with more than thirty years of experience, I'd like to answer the above question as: 'It should be!' It pains me to think this way, and I'll tell you the reason why.

"In June 2011 I sent a reception report to Radio Australia which, in part, read, 'On the morning in question at the bottom of the hour, the signal became so weak, and the interference so great, that I ceased listening.'

"I received that all important verification card the following October. A 'sticky note' was attached to it that read: 'Sir, please don't insult me with such a paltry reception report, with barely legible writing.' Ironically, I couldn't make out the signature on the card's reverse. Needless to say, I would have gladly accepted a failed attempt at receiving that all important 'veri.' Is this what shortwave radio has come to?"

December, 2012 MT

Memories of another Radio Catalog Company

Tom Bailey W0EAJ from Denver, Colorado writes:

"Re: 'Sixty Years of Lafayette Radio' by Richard Post KB8TAD in December, 2013 *MT*, I vividly remember the end of 23-channel CBs. I was in Denver, with Burstein-Applebee (B-A), running the service department in 1977, and we were told we'd have to work late that last day, as all of the 23s had to be sold (not given away) by midnight of December 31st. I honestly don't know how many the stores sold up to that moment, but it was one heck of a lot of 'em.

"There were Royce, Midland, Pace, Panasonic, and many that I can't recall. The Panasonic came as an AM/FM auto radio, with the CB built in – a great idea – but double-sided PC boards were not in great use, being relatively new, and we had tons of problems with them, to the point that they were mostly not reparable. Pace had a clever little closed-circuit RCA jack to use an external speaker, but one side of the jack was hot, so for vehicle-chassis mounted speakers, it provided a lovely ground-loop, which fried the radio.

"I recall we worked hard to get all the 23s out the door, as it was illegal to sell them after midnight December 31. (Incidentally, we later noticed that the 23s had more output power than the 40s). The market pretty much dried up the next week, and never came back.

"I'm currently trying to put together the history of BA, but having waited too long to do it, many of the 'old gang' are gone to the great warehouse in the sky, and it's amazing to me, how many former employees really don't care to talk of it. This past year, I was given a 1956 B-A 'buyer's guide', which is a hard-bound book of every manufacturer's products, bought and resold by BA, in one place. A terrific reference for many other things."

Look for Tom's article on Burstein and Applebee in a future issue of Monitoring Times. – Editor.

What's the Frequency, and Can I put it in the Log?

Daniel Rubine from Altoona, Pennsylvania writes:

"You're listening to a football game on 540 kHz and it IDs as ESPN. Then, on the top of the hour ESPN goes to 1040 kHz. Even though you're still on 540 kHz would you call this another channel to put in your log book? Sometimes a channel will ID one or more frequencies and call signs. Can they be entered into my log book?"

MT's Broadcast Bandscan columnist Doug Smith W9WI responds:

There aren't any real rules for AM DX. Most DXers count whatever they're comfortable with. There are, after all, no large cash prizes or lucrative endorsement contracts! I will say most DXers would not count both 540 and 1040 if their dial remained on 540. Here in Nashville, Sports Radio "The Game" broadcasts simultaneously on 830 AM, 97.5 FM, and 102.5 FM. The ID is "WQZQ 830 Goodlettsville, W248BM 97.5 Murfreesboro, WPRT-FM 102.5 Pegram." If I hear that announcement on 830 AM, the only transmitter I'm hearing is WQZQ and that's the only one I'd count.

One Reader's Appreciation

Robert Gulley AK3Q/AAR4IS from Bellevue, Kentucky, writes:

"While I am sure you get a lot of mail complimenting your fine publication, I must add my appreciation as well. Being an enthusiast of almost every aspect of the radio hobby, I find every issue packed with interesting things. There is not an issue which goes by that I do not try something new based on the articles contained in that issue, whether new utility monitoring, shortwave monitoring, or software/web links, etc. The list is long for each issue.

"I truly appreciate your broad range of coverage, and think you have the best magazine on the market, and I receive about 6 radio magazines per month. I like the magazine so much I purchased the back issue CD collection recently, simply because I know it will pay for itself many times over in useful information. I don't mean to sound like I am gushing, just letting you know what a fine job you all do and I, for one, truly appreciate your efforts."

COMMUNICATIONS

by Ken Reitz KS4ZR

Communications is compiled and edited by Ken Reitz KS4ZR (kenreitz@monitoring-times.com) based on clippings and links provided by our readers. Many thanks to this month's fine reporters: Anonymous, Bob Grove, Norm Hill, Lynn Kelly, Steve Karnes, and Larry Van Horn.

Major FCC Shakeup in Offing

FCC Chairman Julius Genachowski announced in late March that he was stepping down after a tenure lasting four years, opening speculation as to who would replace him. It's unlikely, given the list of presumed favorites to take his place, that there will be much change in the direction of the Commission. Long dominated by cable-TV and more recently wireless industry leaders, the public may expect more of the same from whichever candidate is chosen.

The Genachowski-led FCC was generally praised by industry for its push to improve Internet service to rural America. But there was room for criticism as well regarding the LightSquared debacle, the clumsy handling of a future TV spectrum auction and the uncertain policy of Internet neutrality.

Among the top contenders for the post are sitting FCC commissioners, including Mignon Clyburn (whose father is a U.S. Congressman) and Jessica Rosenworcel (who has the backing of 37 U.S. Senators for the post). The appointment of either would not require confirmation by the Senate because they are already sitting FCC commissioners. If one of the two is chosen, it would be the first time the Commission would be headed by a woman.

The top candidate, however, remains Tom Wheeler, former president of the National Cable and Telecommunications Association (NCTA), the nation's largest cable-TV lobby, and later the head of CTIA, the national lobbying organization for the cellular phone industry.

Exiting through the FCC's well-oiled Commission-to-Industry revolving door, it will be interesting to see where Mr. Genachowski goes next. Previous FCC chairman Michael Powell, son of former U.S. Secretary of State Colin Powell, is now head of the aforementioned NCTA.

FCC Commissioner Cheerleads Return of AM

At the National Association of Broadcasters (NAB) show in early April, newly minted FCC Commissioner Ajit Pai hosted a panel looking into ways to make the AM broadcast band relevant in the digital age. His comments on suggestions to improve the band were similar to those explored for years by *MT*'s Broadcast Bandscan columnist, Doug Smith W9WI, including an all out switch to digital transmissions (and "sunsetting" analog AM broadcasts), synchronous transmissions (multiple low-power transmitters to cover local areas), increasing station power, moving AM stations to low-power FM translators, etc. Solutions to the band's underlying problems which include decreasing listenership (thanks to WiFi radio, iPads, MP3 players and smartphones), plummeting ad revenues and increasing interference from "unintentional radiators," remain unresolved.

Reassessment of FCC RF Exposure Limits

At the end of March, the FCC issued a First Report and Order (R&O) Notice of Proposed Rulemaking (NPR) regarding the reassessment of RF exposure limits. Last summer the U.S. Government Accountability Office (GAO) made the recommendation that the FCC revisit rules, most of which haven't been updated in 17 years and many of which are 10 years old, regarding exposure limits of various RF emitting devices, now ubiquitous in modern society throughout the world.

The Report notes, "the Commission invites health and safety agencies and the public to comment on the propriety of our general present limits and whether additional precautions may be appropriate in some cases, for example with respect to children. We recognize our responsibility to both protect the public from established adverse effects due to exposure to RF energy and allow industry to provide telecommunications services to the public in the most efficient and practical manner possible."

The study promises to be a thorough examination of all types of fixed, mobile and portable, high and low power transmitters and to revisit rules regarding Maximum Permissible Exposure (MPE) and allowable Specific Absorption Rate (SAR), "including limits for both whole-body and partial body exposure based on criteria published by the National Council on Radiation Protection and by the American National Standards Institute/ Institute of Electrical and Electronic Engineers (ANSI/IEEE)."

Comment date is 90 days after date of publication in the Federal Register. Reply comment date is 150 days after date of publication in the Federal Register. The entire report may be read here: **http://transition.fcc.gov/Daily_Releases/Daily_Business/2013/db0329/FCC-13-39A1.pdf**

Nebraska Emergency Radio Flops

An article in the Scottsbluff (Nebraska) *Star-Herald* from March 26 reported on a state legislator's promise to "get to the bottom of failures and other problems plaguing a new statewide emergency radio system."

According to the article, the state of Nebraska kicked in more than $17 million to improve their state-wide public service radio system that failed several crucial real-life tests. One such incident involved injuries to state troopers and local deputies. At one point officers were forced to use their personal cell phone to communicate. Another incident involved poor communications when crews were battling wild fires in northern Nebraska last summer.

The article noted that users had filed more than 480 problem reports over the nine months prior to the article's publication and that the state trooper's union had filed a formal labor grievance in February contending that the system was unsafe and should be replaced.

CA Radio System's Money/ Interoperability Issues

What has become a national poster-child for problems with public service radio systems continues to play out in Oakland, California. An article, titled "Dispute Shuts out Oakland from East Bay Radio System," in the *Oakland Tribune* from early April noted that feuding on the part of various regional authorities and the use of competing and separately funded systems has led to bickering between Oakland and nearby East Bay communities over the circumstances under which Oakland can join the East Bay radio system. East Bay wants Oakland to pay nearly $1 million to join and cough up $1.4 million per year thereafter for "maintenance costs." Even if reconciliation is reached on the money issue, system experts aren't sure the two competing systems will be totally compatible.

Ohio Ham Warned on 6925 kHz Operations

According to FCC documents issued April 11, on April 2 "The Detroit Office received information that an unlicensed broadcast radio station on 6925 kHz was allegedly operating in Hilliard, Ohio." Using direction-finding techniques the signal was found at a residence in Hilliard.The Notice of Unlicensed Operation (NOUO) named Michael Rohde KD8MVH, a General Class licensee, as the operator of the pirate shortwave station. The frequencies 6925 and 6930 kHz are longtime shortwave pirate locations on which stations may be heard nearly every night of the year.

More Unlicensed Follies

A signal, interfering with NASA's reception of telemetry on 2390 MHz in Mojave, California, was traced to an "AV transmitter" at a residence in Mojave. When agents unplugged the device the interference stopped. The resident received an NOUO.

Under FCC rules, Part 15 FM transmitters are allowed to transmit unlicensed signals of 250 uV/m (microvolts per meter) at a distance of three meters. Anything higher than that constitutes "unlicensed operation" and subjects the transmitter operator and/or property owner to fines and confiscation of offending equipment.

Pirate FM operators in Honolulu, Hawaii (operating at 173,317 uV/m) and Sommerville, Massachusetts (operating at 123,583 uV/m); and one AM operator from Everett, Washington (operating on 1700 kHz at 6,400 uV/m) were closed down by FCC agents in the 30 days prior to publication deadline.

Give Your Radios a Vacation!

By Thomas Witherspoon K4SWL

(All photos courtesy of the author)

Morning view from cabin.

If you're like me, a vacation (or for that matter, any kind of travel) is an excellent reason to pack up your radio gear. I nearly always travel with a shortwave radio, and typically with some portable recording equipment. If space allows, I also pack a small QRP transceiver, specifically, my Elecraft KX1, even if I know my opportunities to get on the air may be limited. But on an *extended* family vacation? Well, that affords some excellent *hamcation* possibilities!

Last June, our family had a golden opportunity: to spend an entire month in an off-grid cabin on the eastern coast of Prince Edward Island, Canada, some 2,500 miles from our home in the U.S.

Permit me to paint a picture of this little spot of paradise: the rustic cabin is nestled on a 22-acre site on a beautiful eastern bay. From the cabin's large front windows, facing the bay, there is a long-range view of Panmure Island and, further still, of the Georgetown marina. As the site is wooded to the rear of the cabin, the environ feels very isolated from the rest of the world; no other homes or outbuildings are visible.

Although off-grid, this little cabin sports simple versions of all of the comforts of home: propane gas meant that we always had hot water, a working refrigerator/freezer, and light after sunset in the form of two wall-mounted gas lanterns. Meanwhile, running water was provided by a unique "on demand" petroleum-powered pump.

Interior RCI Sackville Transmission site.

While to some readers, this may not sound like paradise, this charming cabin gave our family a front-row view of nature's varied character, from the shimmering sunsets over PEI's famed terra cotta sands or the last stormy lashes of Hurricane Debbie, to the front-yard wildlife in the form of woodpeckers, owls, gulls, egrets, foxes, mink, and even "Black-Eyed Susan," our resident raccoon. "Off-grid," meanwhile, afforded all of us a refreshing break from those electronic devices we often become so attached, with the exception of radios, of course!

On the return route, we planned to take a driving tour of the Gaspé region of Quebec via the New Brunswick Acadian coastline. Having made the decision to spend four weeks in the little cabin, I instantly started preparing my radio equipment.

Preparations

As you can imagine, an isolated, off-grid cabin poses some serious power-supply challenges for a radio hobbyist, but the benefit is a completely RFI-free zone. In truth, not only was I ready for the challenge, I was enthusiastic about it!

It's worth noting that on most days of the week I wear two hats: that of radio hobbyist and that of radio-based humanitarian organization director, Ears To Our World (ETOW). At ETOW, we work in classrooms located in very remote, rural and impoverished parts of the world, delivering appropriate support technologies, such as radios, to those who need them most. While in the isolated setting, I charged myself with the task of testing some of our solar and self-powered technologies, specifically, a portable power pack made by GoalZero called the Escape 150, and several portable panels and chargers made by the U.S. manufacturer PowerFilm Solar.

Living in an off-grid cabin for a month would give me the necessary time to evaluate the charge/discharge times and simulate the "real life" usage these items would experience in the developing world. Fortunately, as a radio hobbyist, I had the means to put that power-pack to the test! My two radio-inspired passions combined harmoniously in this venture.

All told, all the radio equipment and power supplies I packed consumed no more space in our van than two standard suitcases. Even after packing, we found we had room to spare, the children in their car seats had plenty of room to swing their feet. So, we set our compass on due north, and set out!

Two Nights in Sackville, New Brunswick

En route to Prince Edward Island, it's hard to miss the (now) former Radio Canada International transmission site in Sackville, New Brunswick. The massive site, with its array of curtain antennas and large sign, has been a fixture on the Trans-Canada Highway. Only a few months earlier, I had learned that RCI had been dealt devastating cuts by the CBC and that Sackville's days were numbered. As a result, I felt I had to make a pilgrimage to the site before it was dismantled.

I arranged to tour the site and was warmly greeted in Sackville. Though the staff were dealing with the oppressive news of the (then) pending cuts, they were bravely doing their professional best to carry out their duties as usual. The site was immaculate, the transmitters humming. On my tour, I took as many photos as my digital camera would hold.

Arriving at the Cabin

After leaving Sackville for Nova Scotia, we took the Wood Islands ferry across the Northumberland Strait and arrived at our cabin well before dinner time. The morning after arriving, I sprayed myself down with a little insect repellent and spent an hour installing an inverted V antenna. That's the great thing about temporary QRP antennas: no soldering required. I simply fed my antenna with ladder line, used a PVC T-joint as a center insulator and large plastic buttons for the insulators at the end of the legs of my antenna. I held the whole thing together with wire nuts and black electrical tape. Because it was electrically sound and balanced, it worked like a charm. Indeed, I didn't even worry about the length of the radiating elements since I had my Elecraft T1 auto antenna tuner on hand.

That Sunday morning, I set up my entire ham radio and shortwave listening station all before my family was ready to venture out for the day. That afternoon, I worked stations in the U.S., Canada, and many of the islands in the Caribbean. I was delighted, to say the least.

Off-grid Ham Fun

My Elecraft K2 and Elecraft T1 combination was working beautifully on all bands down to 80 meters. I found that, even with heavy use, the K2 required very little of my 30 aH battery. Each day

I charged the battery with two of my foldable 5 watt PowerFilm Solar panels fed in parallel (equating to 10 watts). I never ran out of power for the K2 and had enough surplus to easily power some 12V LED lanterns, as well.

I was most impressed with the performance of my solar-powered Elecraft K2. No doubt the very close proximity of salt water (perhaps 200 feet from the antenna) and the height of my antenna helped. I even found that I punched through a couple of pile-ups. Some kind operators also noted me on DX watch lists, and I found myself on the other end of mini pile-ups. Most encouraging were the numbers of other QRP stations I worked, even on SSB. In short, I was having a great time!

SWLing

I brought four receivers with me on this trip, the plan being to compare their reception: a Winradio Excalibur, Bonito RadioJet, Sony ICF-7600GR, and a Tecsun PL-380. Shortwave radio listening in this coastal spot was nothing short of amazing. In my band-scanning, I heard many of the international stations audible from my southern U.S. home such as Voice of Greece, All India Radio, Radio France International, the BBC World Service, and Radio Australia.

Though I planned to do some serious 2 MHz spectrum captures on my WinRadio Excalibur, I had not taken one thing into account: the amount of noise that the built-in modified sine wave inverter on the GoalZero Escape 150 generated. It overwhelmed the Excalibur and rendered listening useless. I could have easily remedied this, had I realized that the input on the WinRadio receiver required a steady 12VDC; I could have used an appropriate battery and never bothered with the inverter. The RadioJet, meanwhile, performed quite well, though my laptop's battery had a hard time supporting itself and the receiver for more than an hour without the need of a total recharge. While the GoalZero Escape 150 power pack performed very well with DC usage, the inverter could drain a full charge in less than two hours of use.

Any given morning during that vacation, you would find me lounging in front of the cabin's large glass windows, often watching the sunrise, and listening to CKZN in St. John's, Newfoundland, on 6,160 kHz; a CBC Radio One shortwave relay in Newfoundland. Though I can hear CKZN back home when conditions are just right, it's faint. On PEI, however, it was armchair listening as I sipped my morning java.

Marconi Stations

I even got to relive a little radio history in our travels. On PEI we visited the Marconi Station at the Cape Bear Lighthouse. According to lighthouse staff, this little station was one of the first (they will claim, *the* first) to receive the distress call from the Titanic. An amazing bit of history from this wind-battered, rusting little lighthouse perched on the edge of a small cliff now being undercut by the Atlantic waters, as are so many along that eroding coast. The station tour includes a lot of radio history to this effect, but unfortunately the radio operation display is completely inaccurate: I seriously doubt any Marconi operator used a *Heathkit* to hear the Titanic distress signal. (Consequently, if any generous radio historians have a Marconi station they would like to donate, this deserving Lighthouse Society would greatly appreciate the fitting gift.)

Charlottetown ARC members relax prior to Field Day commencing. From left to right: Chris Vessey VY2CRV, Richard Burke VY2RB and Andy Speelman VY2AS.

On the final leg of our trip, we visited another Marconi Station at a breathtakingly beautiful lighthouse, Pointe-à-la-Renommée, where it stands on a bluff overlooking the mouth of the St. Lawrence on the very northeastern tip of Quebec's Gaspé peninsula. This station, sited by Marconi in 1904, has many historic displays with original photographs spanning the decades, copy from messages sent and received, and a guided history of the station. Pointe-à-la-Renommée also features a very respectable collection of telegraph keys and Marconi console receivers. But the red lighthouse itself is the real showstopper, with its gorgeously-faceted crystal above a charming lighthouse keeper's house and cluster of outbuildings on the green, wind-swept bluff dotted with wild strawberries, and surrounded by the dark blue Atlantic waters far below.

Field Day with the Charlottetown Amateur Radio Club

Field Day coincided with our summer vacation, too, and I hated to miss hanging out with my local ham buddies on my favorite event day of the year. I decided to attempt to turn this relative misfortune into an opportunity: before we left on vacation, I did a bit of research and learned that there would be a Field Day event near Charlottetown, PEI, only twenty minutes from where we were staying. The stars had clearly aligned.

On Field Day, I was greeted most warmly by the good folks at the Charlottetown ARC. They instantly took me in as one of their own, offering food and drink, and chatting with me as if I had always been a part of their club. Best of all, when Field Day officially began, they put me on the mic on 20 meters. Evidently, they decided it would be fun to hear me announcing their call sign on the air in my southern accent. They got what they asked for! From the moment I took the mic, I had almost an instant pile-up; not because of my accent, however, but because Charlottetown offered one of the few stations on PEI, and the opportunity for participants to log the Maritime section.

I spent the better part of Saturday with them and hated to leave. Upon returning to the cabin and my family, I found that my artistic wife had created a little birthday present for me: a watercolor painting of my Vibroplex single-lever paddle. Truly, the key to my heart. (Ahem!) It was a wonderful Field Day, after all.

Looking Back

Both the family vacation and my personal "hamcation" were a treat and I'm ready to do this all again in the near future. Having such an extended stay made all of the difference, as I didn't have to squeeze radio in, nor was it in competition with our other plans. Rather, radio became the thing I turned to when we were relaxing in the cabin, when my kids were drawing or playing, and my wife painting or reading, during our laid-back interludes between exploratory outings and adventures.

I did learn a few things about playing radio completely off-grid. First of all, my QRP field events (like Field Day) had me totally prepped for off-grid ham radio. In fact I didn't forget a single connector, battery, tool or accessory. Setting up my outdoor wire antenna was a simple matter and I had fun on the bands, even though propagation wasn't always perfect.

A little water color gift from my artist wife.

What did surprise me was the number of times I turned to my portable shortwave radios over my PC-controlled receivers. Simply put, a good portable radio connected to a random length wire antenna gave the right amount of performance vs. battery consumption. Though the SDRs performed better when hooked up to my inverted V, they used quite a lot of battery resources since both my laptop and the receiver had to be powered.

Capturing spectrum on a very RF quiet island location is very appealing, but to make it work, would require that I bring a separate 12V DC power supply and spare laptop batteries. With a modest PV system to recharge the batteries, it would also require constant planning, deciding when and where to listen, in order to recharge.

Most of all, I discovered that no matter where you go, as a ham radio operator, you will find others in your fraternity who will take you in. Field Day is one of my favorite days of the year and spending it with the good folks of the Charlottetown PEI Radio Club made it all the better.

Hamcations don't have to be month-long ventures, however. Even squeezing a little radio time in can be fun. A portable shortwave radio tucked into your suitcase on an extended business trip or a portable QRP transceiver on a week at the beach can add to your holiday fun, and if you're lucky, create a few memories, and possibly even friends.

Thomas Witherspoon's previous article was a review of the Elecraft KX3 which appeared in the May issue of MT. His blog is **www.swling.com**.

Amateur Radio Operating... Canadian Style

By Keith Baker KB1SF/VA3KSF (All photos courtesy of the author)

The summer travel season is here and many U.S. amateur radio operators will soon be traveling north and would like to bring along their ham gear to operate in Canada. It used to be that operation in Canada by a U.S.-licensed ham (and vice versa) required lengthy written permission from government officials in the visited country. Today, there is a treaty in place for such operation; there's no longer any need for U.S. or Canadian hams to do anything other than adhere to a few simple "rules of the road" while operating in each other's country.

As a U.S. citizen now permanently residing in Canada (I hold both U.S. and Canadian call signs) I can explain how Canadian hams are licensed as well as what U.S. and Canadian hams have to do to freely operate in each other's country. I'll also discuss how U.S. amateurs who might wish to obtain a permanent Canadian license and call sign can do that as well.

U.S.-Canada Reciprocal Agreement

Those who already have a U.S. or Canadian amateur radio license can freely operate in each other's countries thanks to Treaty Series 1952 No. 7 — Operation of Certain Radio Equipment or Stations, Convention between Canada and the United States of America.

U.S. amateurs who desire to operate in Canada must bring proof of their U.S. citizenship, along with a copy of their FCC-issued license. They must also abide by the rules contained in Industry Canada RBR-4, a part of the Regulations by Reference (RBRs) and Radio Information Circulars (RICs) that, together make up Canada's version of the FCC Part -97 for the Amateur Radio Service. A complete list of RBRs and RICs governing the Amateur Radio Service in Canada can be found at: **www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf05478.html**

Briefly, a U.S. amateur who is qualified to send and receive in Morse code at a speed of at least 5 wpm may operate an amateur station in Canada in accordance with the provisions applicable to the holder of an Amateur Operator's Certificate with Basic, Morse Code (5 wpm) and Advanced Qualifications. This grants them essentially unrestricted (i.e. "Extra Class") amateur radio operating privileges in Canada.

A U.S. amateur who is *not* qualified to send and receive in Morse code may operate an amateur station in Canada in accordance with provisions applicable to the holder of the Amateur Operator's Certificate with Basic Qualifications.

Unfortunately, this means that so-called "no code" U.S. General and Extra Class licensees will be restricted to VHF and above during their visits to Canada. This is one of the drawbacks to the FCC's decision to do away with all forms of Morse testing for U.S. hams. By doing so, they left U.S. hams with no option to obtain a Morse endorsement for reciprocal licensing credit with a number of countries that still require Morse proficiency for HF privileges.

There is no need for paperwork or other formalities when hams wish to operate while exchanging visits between Canada and the United States. Under the terms of the 1952 reciprocal operating treaty, visitors simply have to identify their stations using their home country call signs followed by a call area suffix (for example, VE3FRV/W9 or N9CFX/VE3). The only other requirement is that sometime during their on-air conversation, they need to briefly state their geographical location as nearly as possible by city and state (or city and province).

Canadian Hams Visiting the U.S.

Under the terms of the 1952 treaty, Canadian amateurs operating in the U.S. have the same privileges as they do at home, but with some limitations. All operations must be in accordance with FCC Part 97 Rules, and particularly, such operation must not exceed the U.S. band (and sub-band) edges. What's more, all FCC mode restrictions must be followed.

The American Radio Relay League (ARRL) and Radio Amateurs of Canada (RAC) web sites are good sources of information useful to Canadian amateurs visiting the U.S. and vice versa. A color chart (in .pdf format) on the ARRLs web site at: **http://arrl.org/files/file/Hambands_color.pdf** lists the U.S. band limits available to the various classes of license holders in the U.S. Likewise, the RAC web site offers information for U.S. hams visiting Canada on their web site at: **http://www.rac.ca/en/amateur-radio/regulatory/operating-in-canada**

Legal Requirements

You must be a citizen of the country that issued your amateur license or certificate in order to take advantage of this special U.S./Canada agreement. A Canadian citizen who holds a U.S. call sign cannot legally use his or her U.S. call sign while in Canada. Likewise, a U.S. citizen who holds just a Canadian certificate must also obtain a U.S. license in order to operate legally in the U.S. What's more, if you hold licenses from both countries (as I do) when you are in Canada you must use the call sign shown on your Canadian Certificate and, when you are in the U.S., you must use the call sign on the license issued to you by the FCC.

The same rules apply to permanent residents of either country. For example, as a U.S. citizen, if you become a permanent legal resident of Canada (as I am), you must obtain a Canadian Certificate and Canadian call sign to legally operate in Canada. Conversely, Canadian citizens who elect to permanently reside in the U.S. must obtain an FCC-issued U.S. license and call sign.

Now, keeping track of multiple call signs (and where you are transmitting from at the moment) can sometimes get a bit confusing. For example, while riding as a passenger in the family auto the other day, I began a conversation on a local 2 meter FM repeater using my U.S. call sign on the U.S. side of the border only to end that same conversation using my Canadian call sign on the Canadian side of the border while I was waiting in line to pass through Canadian customs!

At the Border

As you prepare to cross the U.S.-Canadian border with your radio equipment, make sure you have a copy of your U.S. or Canadian license readily available to show the officer at the

The international Blue Water Bridge between Port Huron, Michigan and Point Edward, Ontario forms the second busiest land border crossing between Canada and the United States. It's also a great place to monitor Great Lakes shipping traffic with your scanner!

Larry Parker VA3EDY shows off one of his home-brew, multi-band mobile/portable HF antennas for Field Day. Note the high-tech antenna mount made from a discarded aluminum clothesline!

customs booth if they ask for it. More often than not, you won't be asked to show it. I also keep a copy of the U.S.-Canadian reciprocal operating treaty with me just in case I'm questioned. Most customs and immigration officials on both sides of the border are well familiar with the reciprocal treaty for our service and I have yet to have any difficulty routinely going back and forth across the border with my radios. You might also be surprised to find the border agent is also a ham; a lot of them are!

When entering Canada or (or re-entering the U.S.) U.S. residents will be asked to show some valid proof of citizenship. Birth certificates and simple photo ID driver's licenses are no longer sufficient for U.S. residents to re-enter the U.S. Valid proof of your citizenship can be in the form of a passport or a so-called "enhanced" state driver's license (that is, one with an imbedded RFID chip).

Chet Lataweic VE3CFK assembles an HF beam antenna for the 2009 Lambton County (Canada) Radio Club's Field Day.

Participants in a U.S.-Canada frequent border crossing program called NEXUS (**http://www.goborder.com**) can use that card to cross as well. However, I've found that even while using my NEXUS card, I've occasionally been asked to also produce my passport and/or Canadian permanent resident card to officials at the border. The reason for this is that both Canadian and U.S. immigration officials are primarily interested in knowing your citizenship, your reason for travel and how long you plan to be visiting as you cross. It's also a good idea to turn your radio off while speaking with border officials at the customs and immigration booth as you cross. The fewer questions and distractions your behavior generates while speaking with officials, the better.

Will My Radio Equipment Be Taxed?

In short, your own personal radio gear should pass into and out of Canada both tariff and tax-free. However, if you are bringing either new or used amateur radio equipment of any kind into Canada from the United States that will be staying in Canada (such as a gift for a Canadian ham or, if you are a Canadian resident, a new purchase from the States for yourself) you'll need to declare those items to Canadian customs.

Under the terms of the North American Free Trade Agreement (NAFTA) between our two countries, amateur radio equipment imported into Canada for your own use (or for someone else) is currently exempt from all tariffs. However, those items are still subject to both provincial and/or Canadian national sales tax. After you have declared such items to a Canadian customs agent at the border, you will most likely be asked to state the value of such items and, depending on what they are worth, you may be required to pay Canadian sales tax on the item.

What About Other Electronics?

While the use of unlicensed shortwave receivers, Family Radio Service transceivers and "cellular blocked" scanners are legal in Canada, the use of radar detectors in most Canadian provinces is strictly prohibited. Similarly, firearms are also strictly controlled in Canada. If you have firearms or other weapons with you, they absolutely must be declared as you cross. So, unless you are on a Canadian hunting trip, it's probably best to also leave all such items at home.

And, while the use of a mobile GPS unit (if it is firmly attached to the vehicle) is allowed in Canada, adjusting one while you are driving may invite a traffic fine for "distracted driving." Therefore, it's best to leave the "GPS navigator" duties to one of your passengers.

As I noted earlier, some provinces in Canada have recently enacted very strict motor vehicle laws that expressly prohibit "non-hands-free" electronic devices from being used while driving. While these laws are all aimed at curbing cell phone usage and texting while operating a motor vehicle, many provinces have not (yet) fully exempted amateur radio operation from such laws. In addition, while some provinces, Ontario for example, have given their own hams a limited "grace period" to go "hands free," unfortunately, they have not (yet) afforded visiting U.S. hams the same courtesy.

This means that simply listening to your ham radio, scanner or cell phone while in a motor vehicle in most Canadian provinces is perfectly legal. However, in many provinces, if you are also the driver of the vehicle, it's a good idea to pull over to the side of the road and come to a complete stop if you also want to make a transmission using your ham radio or cell phone. Besides avoiding a stiff traffic fine (upwards of CDN $500), this action just makes good sense from a safety standpoint.

The bottom line here is that it's best to check with the Ministry of Transport of the individual Canadian province(s) you intend to visit on your trip to ascertain the legality of amateur radio operation and cell phone use while also operating a moving vehicle.

Getting a Canadian Call Sign

There may come a time when you'd like to obtain your own Canadian Amateur Radio Certificate. This can be done for any number of reasons, including frequent travel to Canada and a desire to "fit in" with local hams, the desire to obtain a foreign-based license and call sign to operate as a DX station from some remote part of the frozen north, or simply to have yet another "piece of paper" to hang on the shack wall.

The first requirement is that you must have a permanent postal mailing address somewhere in Canada where Industry Canada can get postal mail to you. This can be a "borrowed" physical address from the home of a friend or relative, or it can be another mailing address such as a Canadian post office box or a Canadian UPS Store address. The only other requirement is that you cannot be a representative of a foreign government; you do not need to be a citizen or a permanent resident of Canada in order to obtain a Canadian Certificate of Proficiency in Amateur Radio.

How are Canadian Radio Amateurs Certified?

Industry Canada is the Canadian government department responsible for all amateur radio licensing, certification and examiner accreditation in Canada. Authority to operate radio apparatus in the Amateur Radio Service in Canada (using a Canadian call sign issued by Industry Canada) is given to holders of an Amateur Radio Operator Certificate with Basic Qualification. Other qualifications available along with the Basic Amateur Radio Operator Certificate are the Morse Code and Advanced Qualifications.

Also, because the actual licensing documents are called "Certificates of Proficiency in Amateur Radio," once applicants obtain these various qualifications, they then become "certified" to operate in the Amateur Radio Service

in Canada, rather than simply being "licensed." This subtle difference in semantics sets Canadian amateurs apart from many of their "licensed" brethren elsewhere in the world.

In years past, hams in Canada were issued two separate authorizations; an Amateur Radio Operator Certificate and a radio station license. The Certificate was issued for life and had no fee associated with it; the radio station license (with the call sign) was issued on a yearly basis and a renewal fee was charged.

However, on April 1, 2000, Industry Canada combined these two documents into a single authorization: the Certificate of Proficiency in Amateur Radio with its various qualifications. The "new" Certificate is issued for life and has no fee associated with it. And, although it's no longer necessary for Canadian amateurs to renew their Certificates annually, they are still required to inform Industry Canada within 30 days of any change in their permanent mailing address.

The Basic Qualification

Obtaining a minimum passing score (70%) on a 100-question examination for the Basic Qualification grants the applicant most operating privileges above 30 MHz with a 250-watt power limit. This closed book, written examination is usually taken first, as it must be successfully completed in order to obtain a Canadian call sign. The test covers mostly rules and regulations and some (very basic) electronic and radio theory. It is roughly equivalent in content and comprehensiveness to the U.S. Technician and U.S. General Class examinations combined.

In July 2005, operating privileges in the HF bands (below 30 MHz) with a 250-watt power limit were also granted with this qualification alone if it was obtained prior to April 2, 2002 or, if the exam was taken after April 2, 2002, by achieving (or having proof of) an "Honours" (Canadian spelling) score (80% or greater) on a Basic exam.

Canadian amateurs who met any of these criteria were granted the same operator privileges as the holder of an Amateur Radio Certificate of Proficiency with a Basic with Honors Qualification if they could demonstrate that they attained a mark of 80% or above on their Basic examination. A Basic with Honours Certificate grants the holder access to all frequencies (including HF) authorized by the International Telecommunications Union (ITU) for the Amateur Radio Service.

Although the FCC has dropped all forms of Morse testing, Canadian amateurs can still take a 5 word per minute sending and receiving exam. If this test is successfully passed, they can also have that endorsement shown on their Certificate of Proficiency.

Obtaining the Basic plus the Morse code qualification gives Canadian hams additional privileges below 30 MHz with a 250-watt power limit. It includes access to the High Frequency (HF) amateur radio bands that allow for worldwide communications.

The Advanced Qualification

For those Canadian-certified amateurs who wish to operate with higher power; build and/or operate home-brew transmitters; administer exams to others; control stations remotely or sponsor a repeater or club station, such privileges are granted by obtaining an Advanced Qualification. These are all activities specifically withheld from Basic Certificate holders. And, as you might guess, the closed book, 50-question, written theory exam for the Advanced Qualification is more technical than the Basic exam. It can only be taken once an applicant has successfully passed the Basic test and it is roughly equivalent in content and comprehensiveness to the U.S. Amateur Extra class exam.

Industry Canada has now provided Canadian amateurs with a number of different options to obtain HF privileges. These include obtaining a Basic Certificate with Honors Qualification, obtaining a Basic Certificate with a Morse Code Qualification, and/or a Basic Certificate with an Advanced Qualification.

Differences Between U.S. and Canadian Regulatory Systems

Unlike in the U.S., where smaller and smaller slivers of artificially "walled off" frequency spectrum are arbitrarily withheld from U.S. hams based on their license class or operating mode, Canadians hams are regulated predominantly by operating bandwidth.

This means that, Canadian hams, even those with "Basic with Honours" HF privileges, are free to operate in any mode (and on any frequency) allowed by the International Telecommunications Union (ITU) for our Amateur Radio Service. Just as long as the bandwidth of their emission does not exceed what the ITU proscribes for that portion of the amateur spectrum they are certified to operate in.

On most of our HF bands, this means that Canadian hams can go to any frequency within the ham bands and operate in any mode, just as long as their transmissions occupy less than 6 kHz of emission bandwidth (except 1 kHz for 10 MHz). This also means that there are no regulated sub-bands (or sub-sub-bands) based on license class and operating mode for the amateur service in Canada. Rather, the differences between certificate classes in Canada are based primarily on safety and non-interference considerations. Industry Canada does this by withholding that short "laundry list" of additional (primarily operational) advanced privileges from Basic Certificate holders until they can demonstrate (by successfully completing an Advanced Qualification examination) that they are technically and operationally qualified to handle them.

So, How do I get my Canadian Certificate?

A large section of the Radio Amateurs of Canada (RAC) web site at **http://www.rac.ca/en/amateur-radio/regulatory/examinations/** contains detailed information regarding all aspects of the Canadian amateur radio examination and certification process. The site also includes links to other sources that offer printed self-study guides and commercial (computer-based) examination preparation materials.

In addition, the Toronto Emergency Communications Group has recently assembled an excellent online Basic amateur radio course that is freely available in multiple .PDF format lessons, or as a complete downloadable file from their web site at: **http://www.emergencyradio.ca/course/**. The course can be used as a standalone document for exam preparation, or as an additional quick study guide to supplement more detailed printed works.

Requesting a Canadian Call Sign

Canada is one of the few industrialized countries in the world that still encourages applicants for an initial amateur radio license to request their choice of call sign without additional charge. Prospective call signs can be selected from a list of those available as shown in the Canadian Amateur Radio Available Call Signs List at **http://apc-cap.ic.gc.ca/pls/apc_anon/query_avail_cs$.startup** When you successfully pass your exam, you'll be asked by your examiner to indicate your first, second and third choice(s) in the appropriate block(s) on your application form.

Taking your Canadian Exam

As with the U.S., most applicants for a Canadian Certificate of Proficiency in amateur radio take their exams from one of Industry Canada's many accredited volunteer examiners. These are licensed hams who volunteer their services to Industry Canada by conducting examinations for applicants who reside in their local area. A complete list of accredited examiners can be found at: **http://www.rac.ca/en/amateur-radio/regulatory/examinations/examiners/.**

However, unlike the U.S., only one accredited examiner is needed to administer and grade Canadian certificate exams, much the same way our old Novice tests used to be administered in the U.S. In fact, I took and passed all of my Canadian exams (Basic, Morse Code and Advanced) from the same examiner while he and I were seated around the kitchen table in his home!

After the Exam

Once your examiner notifies Industry Canada of your test score and other personal information, you will receive an E-mail back from Industry Canada asking you to verify your three call sign choices. Once you send that information back to them, your new Canadian call sign should show up in the Official Canadian Call Sign Database (**http://apc-cap.ic.gc.ca/pls/apc_anon/query_amat_cs$.startupys**) within a day or two. In some cases, depending on Industry Canada's workload, this process can take less than a day. I recently administered a Canadian Basic exam to a new candidate and he had his new official Canadian call sign assigned to him that same day!

MT

Big Signals, Big Ship

By Ron Walsh VE3GO

(All photos courtesy of the author)

Deep inside the battleship *USS North Carolina*, a radio operator concentrates intensely on the receiver in front of him. The state of the art, 22 tube, RCA receiver, known as an RBB, tunes from 4 to 18 MHz. The receiver, built in 1941, is connected to a large vertical antenna near the smoke stack of the vessel. He carefully tunes the bands, checking several known frequencies, until he comes on the frequency 6.070 MHz. He carefully tunes in the signal and listens intently. The voice on the radio is giving target information. The signal content is written down so that an accurate reception report can be made. He could almost feel the huge 16 inch guns turn to be ready to fire at the targets.

Just then a touch on the shoulder from Allan Pellnat KX2H reminds me that it is 2013 and I am a guest aboard the battleship memorial. The station is CFRX, the shortwave service of CFRB, from Toronto, Ontario and ironically, the target information is actually a news article about the Target chain of stores coming to Canada this year. We are not in the South Pacific but in the harbor of Wilmington, North Carolina.

I had been waiting for over a year to visit the radio rooms on the battleship, areas not normally open to the public. Allan and I had corresponded and set up the chance for my visit during the annual North Carolina QSO party and to come back again to gather details for this article. The honor to actually operate from this museum ship was one I was not going to pass up. Few get the chance to see and actually use some of the original equipment from World War II. As a marine history enthusiast and a radio enthusiast, this was a chance of a lifetime.

I met some of the volunteers last year and they put me in contact with the Azalea Coast Amateur Radio Club (ACARC) which maintains the communication equipment aboard the ship. I had three purposes in mind as I went aboard. I wanted to actually see the original radio rooms and operate aboard. Second, I wanted to do an article about the ship and the communications that were used in the 1940s.

However my third purpose was the most important to me. Don Cudney VE3WDC had given me a flash-proof WWII Navy Morse key for helping him with his equipment. I could think of no better place for the key than aboard this naval memorial ship in a restored radio room. Allan had already told me they would love to have the key for the ship and had done some research about it. I also had a collection of old, black radio knobs of various sizes that I thought they might be able to use. Allan, is involved with the Antique Wireless Association and he is sure they will find a home.

Ship History

The *USS North Carolina*, BB55, has quite a history and is a fitting memorial to the brave sailors of World War II. Her keel was laid in October 1937 and was the first U.S. battleship constructed in 16 years. Along with her sister ship, *USS Washington*, BB56, they comprised the North Carolina class of battleship. The ship was commissioned on April 9, 1941 and was considered the world's greatest sea weapon.

She was armed with nine 16-inch guns, twenty 5-inch guns and many antiaircraft weapons. She carried a crew of 144 officers and 2,195 enlisted men which included about 100 marines. She started in the Atlantic but was transferred to the Pacific theater of operations. She participated in every major Pacific naval offensive and received 15 battle stars. She was in action from the Guadalcanal landings of August 7-9, 1942 to the bombardment of the Japanese Home Islands from July 10 to August 15, 1945. She was reported sunk by the enemy six times but she survived many close calls. On September 15, 1942 she sustained her only hit of the war when a torpedo hit the port side. Ship's repair crews kept her with the fleet and by the end of the war she had only suffered 10 casualties and had 67 of her crew wounded.

However, as most people know, the era of the battleship had come to an end and the aircraft carrier had become the main weapon of the navy. The ship served as a training vessel for midshipmen but was decommissioned

TBM transmitter.

Restored RBB receiver.

on June 27, 1947. The ship was in the Inactive Reserve Fleet, at Bayonne, New Jersey until 1958. When the scrapping announcement was made, a statewide campaign was launched by the citizens of North Carolina to bring the ship back home. The *Save Our Ship* (SOS) campaign saved the vessel and on October 2, 1961 she was taken to her present berth in Wilmington. The ship was dedicated on April 29, 1962 as North Carolina's memorial to its World War II veterans and the 10,000 residents of North Carolina who died in the war.

Museum

The ship is a self-sustaining museum and receives no tax money. Their multi- million dollar annual budget is entirely raised by the staff of the memorial. The majority of this comes from the more than 200,000 visitors who cross her gangplank every year.

Having had a chance to talk to Kim Robertson Sincox, Director of Museum Services, and Heather Loftin, Promotions Director, I am impressed by the effort that goes into financing this well maintained memorial. They run many extra tours that illustrate the firepower, power plants and damage control aboard the ship. Twice a year they do the "Hidden Tour," where people can see parts of the ship not open to the public. This includes the radio rooms where members of the ACARC explain the radio equipment.

If anyone is interested in donating to the hull restoration of the vessel, you may make a donation through the Friends of the North Carolina organization. All donations are tax deductible as allowed by law. Their mailing address is P. O. Box 480 Wilmington, North Carolina 28401. You can phone 910-251-5797 extension 2045, or you can donate online at **http://battleshipncfriends.org/Friends-Donation-P24.aspx**. If you particularly want the donation to go to radio restoration you indicate this when you make your donation.

When the Forestry Minister of Mynamar (Burma) visited the ship and learned of its importance, a donation of two tractor trailer loads of the finest teak as well as eight trailer loads at a low price to restore the decks of the ship was arranged. A local company, Dean Hardwoods, dried and prepared the wood for the operation. Many people work behind the scenes donating time and money to keep this ship in superb shape.

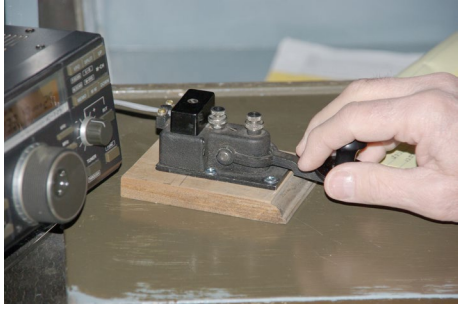
Radio Operations

The number of volunteers who help this ship is amazing. For example, one group that has contributed greatly to the ship is the ACARC. Their members have restored the radio rooms and much of the equipment to the state they were in when the ship went into service. What they refer to as Radio 1 is where the banks of receivers were. Radio traffic was heard here and passed on to the cryptographic room which is right next door. Several restored, original receivers can be seen as you tour the ship. Each desk has a switch and a Morse key used to activate the transmitters which were kept in what is referred to as Radio 2. Transmitters lined both sides of this room when the ship was operational.

The club has restored several transmitters along one wall. The transmitters were powered by their own generators which are in a room nearby. These too have been and are being restored so the original equipment can be put on the air. The generators were used to produce the 3,000 volts which was needed on the plate of the 861 transmitting tubes. As far as they know, this is the only museum ship to use the original transmitters on the air.

I met several members of the club but mainly spoke to Allan Pellnat KX2H, Jack Jacobs WD4OIN and Norman Clements KI4KSY. The club originally had an R-7 vertical on the stack and operated special events

Allan Pellnat KX2H operating CW.



Donated flash proof WWII Morse key in use.

from the bridge area. Since this was part of the public tour, Kim Robertson Sincox suggested they might want to restore the actual radio rooms. The club took on the challenge and they tried to activate the original antennas. Trying to connect to 60 years old wiring was quite a challenge. There is a huge patch board that would allow any antenna to be connected to any of the radio centers on the ship. Although there are two main set ups, there were others throughout the ship so that, in case the main centers got damaged, communications could be maintained.

For some reason, many of the transmission cables were cut off at the smoke stacks so a lot of tracking had to be done. As Allan said, they have no idea of the impedance of these old lines but they do work well. The coaxial cable used is different from today's RG 2123 etc. The dielectric is not solid but is actually Bakelite beads. They had quite a time getting connectors on the cables. Their latest project according to Norm, is to connect across two feed lines so a long wire can be brought into use. The modern transceivers work well on the old antennas as you will see later in this article.

Jack, along with Carl Filipiak started the work, and Allan, Norm and the late Bill Usher joined them. The TBM4 transmitter was the first item they undertook to restore. Checking wiring for bad insulation, cleaning all the switches and contacts, and reseating all the plug-in components, such as resistors, was a major undertaking. The generators had to be lubricated as well as having brushes and armatures tested. It took over a year, with several failures, until the transmitter was functioning. The first signal went out on November 27, 2001.

The most memorable contact with this transmitter took place on January 28, 2002. They worked W1SRR using the TBM. This was Richard "Mac" McCullough who was a "plank holder" and a radio operator on the ship. A plank holder is someone who joined the ship when she was commissioned and left her when she was decommissioned. This was the first contact on the equipment in 60 years.

On May 30, 2006 the TDE transmitter was activated. This is a smaller unit that was put on the ship in 1944. Again, the first contact was with W1SRR. You have to respect these hard working gentlemen as they arranged for Mac's son to bring him to the battleship. Allan said they almost had to carry him down the ladders but they got him to the radio rooms where he could actually make some contacts on the restored equipment. You can still see the smile on their faces as they remember Mac operating the sets. There is an original chalkboard in Radio 2 that still has the dates of the contacts with Mac. Unfortunately Mac became a silent key two years ago. The TBK-7 transmitter was brought to life in 2009.

Several of the RCA receivers have been restored. There are three types including the RBA (for 500 kHz and below), the RBB (for 500 kHz to 4 MHz) and the RBC (for 4 to 18 MHz). These rigs were restored in Arizona and work well. I was surprised at the sensitivity and selectivity of the radios. In fact, their analog calibration was quite accurate.

I guess I will always be an SWL as I could not keep my hands off the receiver. When I get back there, I plan to do some real listening on these sets. I listened to CFRX as stated earlier as well as CHU on 7.850 and 14.670 MHz. I never hear the 14.670 signal at home. The story of moving this 100 pound receiver from Radio 1 two decks above is well worth hearing.

Restored receiver bank in radio 1.

The generators are the problem at the present. They are down so the original transmitters are silent for a while. A local repair shop has done many hours of work on these at very low financial return to get them back into working condition. They even sent one armature to Florida to be rebuilt. They want the station to be run as original.

They had a problem replacing brush caps on these generators. They could not get them, but a local community college, Cape Fear Tech, had their students make many of them as a project. One of the field pots had the ceramic break and they had no replacement so a local amateur made replacements out of wood.

As you look around you see many vintage pieces of equipment. A three foot high TDQ transmitter grabs your attention. This was the VHF unit and I would not want to run this mobile in my car. Nearby there are Hallicrafters S20R and S27 receivers.

On the 65th anniversary of the signing of the surrender documents in Tokyo Bay, the *USS North Carolina* used their original transmitter to make a contact with the *USS Missouri* on which the document was signed. The operator, Charlie Vaughn K4UWH, is the son of an operator from the North Carolina. The operator on the *Missouri* was the son of a man who went ashore under the covering fire of the *North Carolina*. Charlie is currently president of the ACARC.

Norm, Jack and Allan have many stories about the work they did on the ship. They usually stop working on the ship in late May and return in October as the ship has no air conditioning and you can imagine how hot a

steel ship gets in the North Carolina sun.

Jack told me about the time they thought they would get some air by forcing air through the ducts. He said they turned on the fans and the dust that came out of there was so bad they had to abandon the room. He said it took two weeks to just clean the room.

Allan, Jack and Norm are ex-AT&T employees so they also undertook to repair the paging system on the ship. It took them two years to rewire the hundreds of speakers on the ship. However, now people can be paged and period radio programs are played over the system. They also used their knowledge to repair the ship's telephone system. You can now call around the ship using the original phones. I could have spent days talking to these three gentlemen, hearing their tales of the work on the ship. Allan has a vast knowledge of radio history as well.

QSO Party Operations

The NC QSO Party team consisted of Jay Barton N3QH, Allan Pellnat KX2H, Ron Walsh VE3GO, Bill Morine N2COP, Bob Kiehlmeier WA3IRG, Bob Froelich KK4KSY, Jack Jacobs WD4OIN, Norman Clemmons KI4YSY, Jim Kapetski K3DEP, Jeff Wingfield KI4JDE, and Dean Webb KK4DRQ.

The tube supply room which was untouched from 1947.

My day began with an invitation to join the Azalea Club at the K&W Cafeteria in Wilmington for breakfast. I enjoyed meeting Allan and others with whom I had corresponded. I passed the promised Morse key to Allan. We then proceeded to the ship.

The battleship is impressive as you make the turn off Highway 17. Her size and camouflage paint scheme captures your attention immediately. I was pleased to have a guide as we wove our way through doors and decks. I was shown Radio 1 and 2 as well as the generator room.

When it was time for the contest to begin we returned to Radio 1, where the 20 meter SSB station was set up and the cryptographic room where the 40 and 15 meter operations took place. Some test calls were made on 20 meters and then the contest began. The ship uses the call NI4BK, its original call sign, on the ham bands.

As I was watching the operation, the second 20 meter contact was VE3BRK. This was my late father's call now held by my brother Bert. He asked if I was there and they turned the mic over to me. It was a thrill to work Bert from the ship. He would be coming to Myrtle Beach in March and we got to show him the station. I am sure he enjoyed seeing the equipment as much as I did. About an hour later, I was operating and VE3GHK called me. George and I have been radio enthusiasts since we were in high school.

I took a break and had lunch. I then went with Allan to Radio 2 where the CW station was set up. It was great to connect my key to the transceiver and operate CW from the ship. I made about 20 contacts including some DX in Europe. I returned to the SSB set up and did some more contesting. I was happy to work many stations including Bill VE3CLQ, Tim VA3TIC and Dave VE3DZE from Kingston.

The old verticals work very well and it was great to be in a pileup where stations were trying to work me for a change. Once the ship signs on there are always plenty of stations who want the contact. The team made 592 contacts on the Saturday, 72 of which were on CW. While taking a break from operating I had fun showing some of the people touring the ship the radio rooms and explaining what the club was doing.

I was also pleased to meet Bill Morine N2COP, the North Carolina Section Manager for ARRL. He is a very active section manager and it was great to see him operating in the contest. I was also pleased to see the president of the Grand Strand Amateur Radio Club, Bob Froelich KK4KSY there. I have enjoyed working with this Myrtle Beach Club and volunteer for their marathon communications. He was enjoying operating and I am sure more of their members will be operating from the ship in the future.

You can be a guest operator on board. The only thing is they ask is that you pay admission to the ship to help out. In fact, if your club wants to operate onboard, it can be arranged.

As luck would have it, Jeff Wingfield KI4JDE, was also part of the group. He just happens to be the Rear Commander of the Waterway Radio and Cruising Club. They operate the Waterway Net on 7.268 kHz at 0745 ET every day. This is their 50th anniversary and I got a lot of information for my July column. You never know who you will meet at an amateur radio gathering.

The contest ended near suppertime and I reluctantly took leave of the group and the ship. Believe me, I could have spent a long time there and will certainly be back. I have been invited for next year and plan to do more operating; I want to make more CW contacts in particular. Allan has already mounted the key I donated on a piece of wood from an old radio cabinet. Hopefully, it will be used for many contacts.

Help

If you have any radio artifacts from the WWII era, be sure to contact the Azalea Coast Amateur Radio Club to see if they can be used on the ship. The club is in particular need of 861 transmitting tubes. Their supply is running low and any help obtaining some would be appreciated. I have already contacted the Communications and Electronics Museum here at the Canadian Forces Base in Kingston to see what we can find. You can find out more about the ship at their website **www.battleshipnc.com**. The Azalea Coast Amateur Radio Club is at **www.ac4rc.org**. Using Google you can search Radio Restoration USS North Carolina for many sites giving info and photos.

Norm showing the generators.

Ship's verticals still in use.

Amateur radio operators are known as a friendly group and the Azalea Coast Amateur Radio Club certainly exemplify that. I applaud their efforts to keep the battleship *USS North Carolina* on the air and maintain the original equipment of the ship. Do not pass up a chance to tour the ship and also take the opportunity to operate from aboard, you will surely enjoy the experience. Look for the ship on Museum Ships Day in July. I will be trying to add VE3GO to their list of contacts. And, I also will be trying for an SWL report using my old Hallicrafters S38 and a long wire.

The author would like to dedicate this article to Bill Usher AG4PA, who spent many hours in restoration of the radio equipment aboard the USS North Carolina.

Dan Veeneman
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North Carolina's VIPER Network

The clock is ticking on old radio systems. Besides the difficulties involved in interoperating with newer systems, the aging equipment suffers from technology obsolescence. Critical parts that eventually fail are a challenge to fix, since replacements are in short supply. Manufacturers move on to newer products, eventually dropping service and support for old equipment. Imagine trying to find, for example, a new motherboard for a computer that you bought in 1985. Now imagine that the motherboard is part of a critical system upon which thousands of lives depend.

The State of North Carolina operates a statewide public safety radio network called VIPER, the Voice Interoperability Plan for Emergency Responders. The oversight agency for the VIPER system is the North Carolina State Highway Patrol, who is working with the Department of Crime Control and Public Safety to implement the network. Although the concept of a statewide radio system had started to take shape by 1994, VIPER began with the purchase of a Motorola 800 MHz trunked radio system in Raleigh for the Special Olympics games in December of 1999. The Highway Patrol used that as the foundation for their statewide network.

As far back as 1995, a state report recognized that incompatible radio systems were preventing state officials from communicating with local agencies and hindered the ability of neighboring public agencies to work with each other. Subsequent hurricanes, floods, and the radio failures during the events of 9/11 served as reminders that a robust, seamless emergency radio capability was critical for saving lives and property.

The State decided to base VIPER on Motorola trunking technology, since it allowed easy integration with a number of pre-existing Motorola systems, including South Carolina, which has a SmartZone system that is owned, operated and controlled by Motorola. That system started as a partnership between South Carolina and South Carolina Natural Gas (SCNG), but due to a lack of funds to improve or expand the system, the state opted to privatize the system. However, adoption has been slow due to a user fee of $75 per radio, which many South Carolina agencies are reluctant to pay.

❖ Design Goals

Among the many design goals for VIPER was the ability to support both the old analog-only radios as well as the newer digital APCO Project 25 technology. The majority of public safety radios in use at the time were analog only, so to be cost-effective VIPER had to allow their use. However, agencies that were upgrading or didn't already have radios would be strongly encouraged to purchase P25-compliant digital radios. Eventually, after a sufficient amount of time had passed and existing users had upgraded to P25, VIPER would transition to a completely digital network and no longer support analog users.

The original VIPER plan had two stages. The first stage, called Tactical, was a short-term solution to provide interoperability between existing incompatible local communications systems by connecting them together in a piece-wise fashion. Seventeen communications gateways across the state used the State Highway Patrol microwave data network to link dispatch locations and emergency operations centers. The second stage, called Strategic, was to replace these different systems with a single, comprehensive network that would allow automatic and routine interoperability without any kind of manual intervention. This 800 MHz network would expand on the Raleigh system and the State Highway Patrol system in Wake County. It would use Project 25 standards, which were (and still are) promoted by federal authorities as the preferred solution for public safety radio operations.

VIPER was originally planned to have about 240 towers providing coverage for at least 95 percent of North Carolina at street level from a 3-watt portable radio; however at this point just over 200 repeater sites are on the air. Even when completed, VIPER will require local agencies to determine in-building signal penetration for their own operating area and to take responsibility for any improvements needed to ensure complete coverage, including additional repeater sites and microwave links.

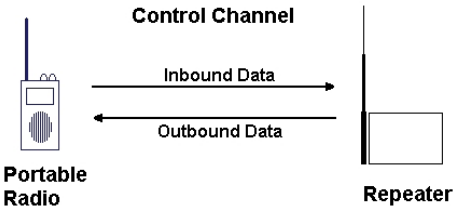
Coverage is always a challenge, especially in less populated areas of the state. For example, Wilkes County in the western part of the state has a population of almost 70,000 people in an area of about 750 square miles. Based on a recent environmental impact statement, the Federal Emergency Management Agency (FEMA) will pay for the construction of a 140-foot tower on Rendezvous Mountain in Millers Creek that will provide coverage for Wilkes County and parts of the surrounding area.

FEMA will also pay for the construction of a 280-foot tower in Roxboro, intended to provide coverage for Person County. The county is located along the Virginia border, covers nearly 400 square miles and is home to about 40,000 people.

More than 65,000 radios are registered on the network from 260 different public service and safety agencies. Although each of these agencies have at least one dedicated talkgroup on the system, the statewide nature of VIPER allows that agency to communicate from anywhere there is a repeater site within radio range. The previous local systems could provide coverage only within the relatively small service areas of each system. Here is where the current trouble lies.

❖ Control Channels

Repeater sites communicate with radios across a pair of radio frequencies. The repeater site transmits to radios on the *outbound* frequency and receives from radios on the *inbound* frequency. A repeater site typically has several pairs of frequencies operating at the same time, with the majority of them carrying voice traffic. However, at least one pair is used to control the operation of the radios within range of the repeater site. This is called a *control channel* and it carries short digital messages to and from the repeater. Don't let the description confuse you; even though the control channel moves information in digital form, the voice traffic may be in analog or digital form.



Messages carried on Motorola trunked radio control channels are packaged into individual packets called "signaling words." Outbound signaling words (OSW) originate from the repeater site and are transmitted to all the radios tuned to the outbound control channel. Inbound signaling words (ISW) originate from an individual radio and are transmitted to the repeater site on the inbound control channel frequency.

In a typical exchange, a user wants to speak with everyone in talkgroup A. That user selects talkgroup A on his or her radio and presses the push-to-talk button. The radio transmits a channel assignment request message on the inbound control channel frequency. This message is in the form of an ISW and contains a number that uniquely identifies the radio as well as another number that represents talkgroup A. The repeater site receives the ISW and forwards it to a computer called a central controller that supervises the operation of the repeater site. The computer examines the ISW, sees that it is a channel assignment request and looks for a voice channel pair that is not in use. If it cannot find a free pair, meaning all of the available voice channels are currently assigned to other talkgroups, the computer sends a "busy" message back to the radio in the form of an OSW on the outbound control channel. The "busy" message contains the unique radio identifier sent in the original request, so upon receipt of that OSW the user's radio emits a "blat" telling him or her that there are no available channels over which to communicate.

If the computer does find a free channel pair, it assigns that pair to talkgroup A and sends

an OSW back to the radio containing a channel grant message along with a number indicating the frequencies of the assigned pair.

❖ Status Words

The original design of the signaling words goes back to the 1970s when Motorola was developing their original trunking product. They needed a way to communicate commands and instructions between a repeater site and a radio but were limited by a number of factors, including processing power and memory space in handheld radios of the time. These limitations led to some design decisions made more than 30 years ago that create operational limitations even today.

The OSWs and ISWs as originally designed are each a fixed length, meaning that each signaling word can carry only a limited amount of information. The word itself is just a sequence of binary digits ("bits") where each bit can have only one of two values, either a '0' or a '1'.

For the first generation of Motorola trunked radio systems, referred to as Type I, the ISW was always 21 bits long and the OSW was always 27 bits long. The first 16 bits of the ISW contained the identification of the transmitting radio, sometimes called an "address," composed of a fleet number, a sub-fleet number, and an individual radio identifier. The remaining 5 bits indicated the type of request or message that the radio was sending. The 27 bits of the OSW were divided into three parts: 16 bits for an identifier, 1 bit indicating whether the 16-bit identifier referred to an individual radio or a group of radios, and 10 bits for the type of instruction or message being sent.

Outbound Status Word

Fleet ID	Talkgroup	Individual ID	Individual or Group	Message
16 bits			1 bit	10 bits

The second generation of Motorola trunked radio product line, referred to as Type II, eliminated the fleet/sub-fleet hierarchy and introduced the concept of a talkgroup, allowing any radio to be part of any conversation. In order to allow customers a smooth upgrade path, Type II equipment had to be backward compatible with Type I radios that were already in the field. Type II radios used the same ISW and OSW message formats but added some new 5-bit and 10-bit instructions. In addition, Type II systems could send sequences of two or three OSWs to convey additional information.

In a Type I system, the unique radio address was always 16 bits, regardless of how the fleets and sub-fleets were arranged. Because the message formats carried over into Type II systems, the address length remained 16 bits. This means that the maximum number of unique radio identifiers in a Type II system is limited 65,536. The actual number is 65,534, since two of those identifiers are reserved for system use.

A report from late last year showed that 65,388 radios were registered on the VIPER network. This means that VIPER is almost at its maximum capacity. That same report showed more than 3,100 unfilled requests for unique radio identifiers from numerous counties and agencies - requests that cannot be satisfied because of a technical limitation carried over from a decades-old design.

The VIPER plan calls for an eventual transition to a fully digital Project 25 system, including P25 trunking standards. This means the control channels at each repeater site would change from a legacy Motorola 3600-baud format to a 9600-baud P25 format. Project 25 supports twice as many individual radio identifiers, immediately relieving the current address limitation. However, it also means that existing radios that can only support Motorola Type II will no longer function on the network. This creates a financial hardship and administrative headache for a significant number of current VIPER users.

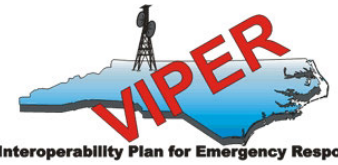
Money is also a challenge. A transition to Project 25 will also require at least $23 million, which is not fully funded. Even without the transition, another $26 million is needed to finish the remaining 40 or so repeater sites that are not yet operational. The state also needs an additional $4 million a year to operate and maintain the network, above and beyond what the legislature has already approved.

To date the system has cost about $140 million, with roughly three-quarters of that coming from the Department of Homeland Security and the remainder from the state and various federal grants.

❖ VIPER

VIPER is a made up of four Motorola Type II SmartZone systems connected via an additional Motorola product called Omnilink. Each SmartZone covers a geographic region of that state and has a separate system identifier.

Zone	Area	System ID
1	Piedmont East	6038
2	Piedmont West	C123
3	Eastern	C508
4	Western	C92D

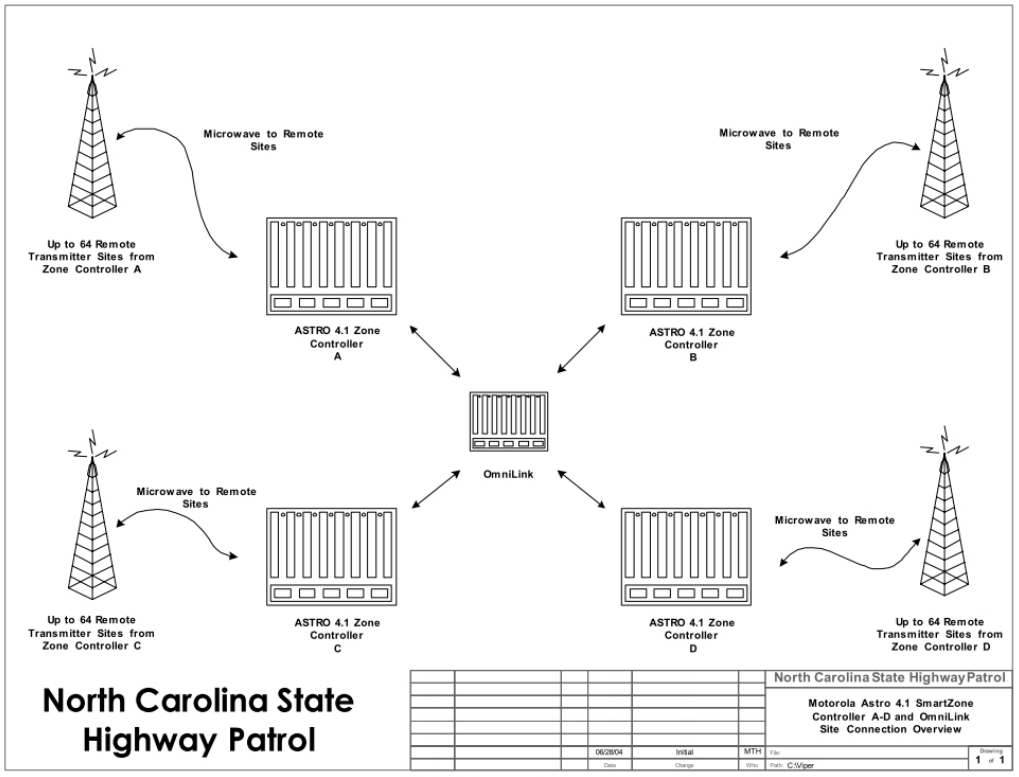


Voice Interoperability Plan for Emergency Responders

As you can imagine, the network has an enormous number of frequencies and talkgroups. Here is a small slice from Wake County in Zone 1, from what was once part of the original State Highway Patrol system. The following frequencies are in use in the area: 851.3875, 851.6125, 856.3375, 857.1125, 859.3875, 866.0375, 866.2000, 866.2625, 866.2875, 866.4625, 866.5375, 866.6250, 866.6750, 866.7625, 866.9625, 867.1500, 867.2625, 867.3750, 867.5375, 867.7875, 867.9625, 868.1500, 868.2000, 868.2625, 868.5375, 868.5625, 868.6500 and 868.7875 MHz.

Below are listed some common talkgroups for the area.

Decimal	Hex	Description
4368	111	Alcohol Tobacco and Firearms (Raleigh)
5568	15C	State Capitol Police (Dispatch)
5584	15D	State Capitol Police



VIPER Network

5600	15E	State Capitol Police (Investigations)
5616	15F	State Capitol Police (Investigations)
5632	160	State Capitol Police (Administration)
5648	161	State Capitol Police (Tactical 1)
5664	162	State Capitol Police (Tactical 2)
5680	163	State Capitol Police (Tactical 3)
6768	1A7	Wake County Sheriff (Detention 1)
6800	1A9	Wake County Sheriff (Detention 2)
6832	1AB	Wake County Sheriff (Detention 3)
13312	340	State Highway Patrol (Troop C District 3)
14352	381	State Department of Transportation
14384	383	State Department of Transportation
15072	3AE	State Department of Transportation (Wake County)
19888	4DB	Raleigh/Wake County (statewide)
19904	4DC	Raleigh/Wake 911 (statewide)
22864	595	Drug Enforcement Administration (Raleigh)
25776	64B	Raleigh Durham International Airport (Talkgroup C)
25808	64D	Raleigh Durham International Airport (Talkgroup F)
25840	64F	Raleigh Durham International Airport (Operations 2)
25872	651	Raleigh Durham International Airport (Operations 3)
25904	653	Raleigh Durham International Airport (Security)
25936	655	Raleigh Durham International Airport (Central)
25968	657	Raleigh Durham International Airport (Police Dispatch)
26032	65B	Raleigh Durham International Airport (Police)
26064	65D	Raleigh Durham International Airport (Police)
26128	661	Raleigh Durham International Airport (Emergency)
26224	667	Raleigh Fire patch to Wake County Fire Departments
26800	68B	Wake County Public Safety Event 5
26832	68D	Wake County Public Safety Event 6
26864	68F	Wake County interoperability with Harnett County
26896	691	Wake County interoperability with Johnston County
32000	7D0	Wake County Sheriff (All Call)
32016	7D1	Wake County Sheriff (Dispatch 1)
32032	7D2	Wake County Sheriff (Dispatch 2)
32048	7D3	Wake County Sheriff (Dispatch 3)
32064	7D4	Wake County Sheriff (Dispatch 4)
32080	7D5	Wake County Sheriff (Supervisor 1)
32096	7D6	Wake County Sheriff (Supervisor 2)
32112	7D7	Wake County Sheriff
32128	7D8	Wake County Sheriff
32144	7D9	Wake County Sheriff
32160	7DA	Wake County Sheriff
32240	7DF	Wake County Sheriff (Criminal Investigations Division 1)
32256	7E0	Wake County Sheriff (Criminal Investigations Division 2)
32272	7E1	Wake County Sheriff (Criminal Investigations Division 3)
32288	7E2	Wake County Sheriff (Criminal Investigations Division 4)
32304	7E3	Wake County Sheriff (Criminal Investigations Division 5)
32320	7E4	Wake County Sheriff (Criminal Investigations Division 6)
32384	7E8	Wake County Sheriff (Mutual Aid 1)
32400	7E9	Wake County Sheriff (Mutual Ops 2)
32416	7EA	Wake County Sheriff (Mutual Ops 3)
32432	7EB	Wake County Sheriff (Mutual Ops 4)
32496	7EF	Wake County Sheriff (Warrant Service)
32512	7F0	Wake County Sheriff (Transport)
32528	7F1	Wake County Sheriff (Command)
32544	7F2	Wake County Sheriff (Car-to-Car)
32816	803	Wake County Fire (Dispatch 1)
32832	804	Wake County Fire (Dispatch 2)
32976	80D	Wake County Fire Departments (North)
32992	80E	Wake County Fire Departments (South)
33008	80F	Wake County Fire Departments (East)
33024	810	Wake County Fire Departments (West)
33040	811	Raleigh Fire Department (Hazardous Materials 1)
33056	812	Wake County Fire (FireCom)
33072	813	Raleigh/Wake County Fire Departments (Emergency)
33088	814	(Alerts, simulcast on VHF 154.190 MHz)
33600	834	Wake County Public Safety Event 1
33616	835	Wake County Public Safety Event 2
33632	836	Wake County Public Safety Event 3
33648	837	Wake County Public Safety Event 4
33984	84C	Raleigh Fire Department (Dispatch)
34000	84D	Raleigh Fire Department (Alerts, Simulcast on 154.370 MHz)
34032	84F	Raleigh Fire Department (Battalion 1)
34048	850	Raleigh Fire Department (Battalion 2)
34064	851	Raleigh Fire Department (Battalion 3)
34080	852	Raleigh Fire Department (Battalion 4)
34112	854	Raleigh Fire Department (Administration 1)
34128	855	Raleigh Fire Department (Administration 2)
34144	856	Raleigh Fire Department (Fire Prevention 1)
34160	857	Raleigh Fire Department (ire Prevention 2)
34192	859	Raleigh Fire Department (Training 1)
34208	85A	Raleigh Fire Department (Training 2)
34224	85B	Raleigh Fire Department (Maintenance 1)
34240	85C	Raleigh Fire Department (Maintenance 2)
34288	85F	Raleigh Fire Department (Hazardous Materials 2)
34320	861	Wake County Public Safety Event 7
34336	862	Wake County Public Safety Event 8
34352	863	Wake County Public Safety Event 9
34368	864	Wake County Public Safety Event 10
34416	867	Emergency Medical Services (Dispatch 1)
34432	868	Emergency Medical Services (Dispatch 2)
34576	871	Emergency Medical Services (Common)
34736	87B	Emergency Medical Services (Emergency Room)
34800	87F	Emergency Medical Services (Administration City)
34816	880	Emergency Medical Services (Administration North)
34832	881	Emergency Medical Services (Administration South)
34848	882	Emergency Medical Services (Administration East)
34864	883	Emergency Medical Services (Administration West)
35024	88D	Emergency Medical Services (Emergency)
35168	896	Emergency Medical Services (Alerts, simulcast on VHF 156.225 MHz)
36208	8D7	Raleigh Durham International Airport (Talkgroup A)
36224	8D8	Raleigh Durham International Airport (Talkgroup B)
36256	8DA	Raleigh Durham International Airport (Talkgroup D)
36272	8DB	Raleigh Durham International Airport (Talkgroup E)
36304	8DD	Raleigh Durham International Airport (Operations Dispatch)
36400	8E3	Raleigh Durham International Airport (Police)
36432	8E5	Raleigh Durham International Airport (Police)
36448	8E6	Raleigh Durham International Airport (Police)
36560	8ED	Wake County (Animal Control 1)
36576	8EE	Wake County (Animal Control 2)
40016	9C5	Raleigh Police (Northwest Dispatch)
40032	9C6	Raleigh Police (North Dispatch)
40048	9C7	Raleigh Police (Northeast Dispatch)
40064	9C8	Raleigh Police (Southeast Dispatch)
40080	9C9	Raleigh Police (Downtown Dispatch)
40096	9CA	Raleigh Police (Southwest Dispatch)
40112	9CB	Raleigh Police (Northern Units Status)
40192	9D0	Raleigh Police (Southern Units Status)
40208	9D1	Raleigh Police (Northwest Tactical 1)
40224	9D2	Raleigh Police (North Tactical 1)
40240	9D3	Raleigh Police (Northeast Tactical 1)
40256	9D4	Raleigh Police (Southeast Tactical 1)
40272	9D5	Raleigh Police (Downtown Tactical 1)
40288	9D6	Raleigh Police (Southwest Tactical 1)
40304	9D7	Raleigh Police (Northwest Tactical 2)
40320	9D8	Raleigh Police (North Tactical 2)
40336	9D9	Raleigh Police (Northeast Tactical 2)
40352	9DA	Raleigh Police (Southeast Tactical 2)
40368	9DB	Raleigh Police (Downtown Tactical 2)
40384	9DC	Raleigh Police (Southwest Tactical 2)
40400	9DD	Raleigh Police (Special Operations)
40432	9DF	Raleigh Police (Operations 5)
40448	9E0	Raleigh Police (Operations 6)
40464	9E1	Raleigh Police (Operations 7)
40480	9E2	Raleigh Police (Operations 8)
40496	9E3	Raleigh Police (Operations 9)
40512	9E4	Raleigh Police (Operations 10)
40528	9E5	Raleigh Police (Operations 11)
40544	9E6	Raleigh Police (Operations 12)
40704	9F0	Raleigh Police (Records)
40720	9F1	Raleigh Police (Academy 1)
40736	9F2	Raleigh Police (Academy 2)
51424	C8E	Federal Bureau of Investigation (Raleigh)
62480	F41	Domestic Preparedness and Readiness Region (Wake County)

ASK BOB
GENERAL QUESTIONS RELATED TO RADIO

Bob Grove, W8JHD
bobgrove@monitoringtimes.com

Q. *I want to combine two remote active antennas, one that works best at VLF and the other that works best at HF so I can get the entire 10 kHz-30 MHz range. Since they both have 10 kHz-30 MHz frequency coverage, I am concerned about how to connect them to one transmission line without causing phase interaction. (John K2AZ)*

A. Anytime you combine two antennas you run the risk of changes in directivity and gain. If two identical antennas are separated by enough distance and are in phase, you can get a theoretical maximum of 3 dB gain. If they are out of phase, they can null or even cancel a signal. At the very low frequencies, due to the long wavelengths, physically close antennas – within a small fraction of the wavelength – shouldn't exhibit that problem. But at the upper HF range, separating them by only a few feet can make a difference.

To isolate the two frequency bands from one another, I would suggest putting a 2 MHz low-pass filter on the VLF antenna and a 2 MHz high-pass filter on the shortwave antenna. Close mounting shouldn't be a problem. If the supply voltage requirements are the same there should be no problem feeding them both through one common coax line. If there are equal line lengths combining the two antennas, you shouldn't experience nulling.

Q. *The battery in my watch died recently; it was a Maxell SR920SW. My nearby drugstore suggested a Nuon 370. Are there any battery equivalency charts online? (Mark Burns, Terre Haute, IN)*

A. Yes, and perhaps the best for coin cells is posted by Maxell: It shows the replacement that you requested and many more: **www.maxell.co.jp/e/products/materials/replacement_e.pdf**.

An expanded list for all types of batteries may be found on Wikipedia: **http://en.wikipedia.org/wiki/List_of_battery_sizes**.

Q. *I understand that a horizontal wire antenna receives best at a 90 degree angle to the transmitted signal, but aren't transmitted signals bounced off the ionosphere at random angles? (Carl Harden)*

A. When radio signals bounce from the ionosphere, it's primarily their polarization (horizontal vs. vertical) that gets scrambled. The dominant signal strength still favors one compass direction. However, the directivity of a dipole is not razor sharp. The maximum signal 90 degrees off the sides of the wire gradually rolls off as you change the angle of the dipole away from the signal until a sharp null loses the signal off the ends of the wire.

Q. *I am in the process of assembling a remote RF controlled antenna switch. It would be easiest to just use the miniature relays already on the receiver board. Do you think they would work OK for RF switching at LF, HF and VHF? I could solder coax directly to the relay and shield them with copper tape. I tested one of the relays in my coax line and did not see any noticeable loss but wanted to get your experienced opinion before I went ahead with modifying the board. (John Maikisch K2AZ)*

A. Small relays work fine for LF right on up through the lower VHF range, but contact lengths become lossy as frequencies go higher. Without close shielding spaced alongside the contacts, the characteristic impedance changes, and the reactance and radiation can cause signal loss. Emulate the shielding as best as possible, then simply compare weak VHF/UHF signals with and without the relay, as you have done. You can't beat that strategy.

Q. *On many older multiband radio sets such as my 1960s Hitachi, there is a "MB" band that spreads from 1.6 to 4.5 MC. Do you know what "MB" stood for? (Dean, CA)*

A. Marine Band (and that's not the military musical ensemble!).

Q. *What are the typical adjustable, quarter-wave whip lengths for 2 meters, 220 MHz and 440 MHz? If not extended to correct length, is there an issue to the transceiver when transmitting? What is the maximum power for the Grove telescoping whip? (Mark, Germantown, WI)*

A. Typically, you would adjust it to a quarter wavelength for the frequency on which it is to be used:
146 MHz = 19 inches
220 MHz = 13 inches
440 MHz = 6 inches

The formula is to divide 2808 by the frequency in MHz to give you the length in inches. You can also divide 936 by the frequency in MHz to give you a 3/4 wavelength antenna with a couple of dB gain. Thus, that 19" antenna can also be used at 440 MHz. An inch or so one way or another won't make much difference.

Mismatched lengths will compromise weak-signal reception and reduce power output during transmit. Hand-held transceivers won't hurt the antenna at all. While 50 watts or so will be fine with the Grove telescoping whip, you don't want to be that close to a portable antenna with that kind of power.

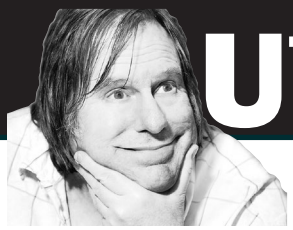
Q. *Can hams and other electronics hobbyists transmit their walkie-talkies at air shows? Airports? Hot-air balloon events? (James Monagle KC9QYC, Evansville, IN)*

A. Yes. The general rule here is that such intercommunication is allowable unless it is expressly prohibited, such as construction sites where accidental explosive detonation could be triggered, or government and scientific listening posts where all environmental electronics are carefully controlled. Such protected locations will be posted.

Q. *What is a galvanometer? (Mark, IL)*

A. It is an extremely sensitive DC ammeter used to indicate the flow of minute current levels.

Questions or tips sent to Ask Bob, c/o MT are printed in this column as space permits. Mail your questions along with a self-addressed stamped envelope in care of MT, or e-mail to bobgrove@monitoringtimes.com. (Please include your name and address.)



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Are Broadcast and Utility Converging?

It's been a gloomy year for North American shortwave broadcast (SWBC) listeners, with one major transmitting site after another closing down. Clearly, Western Hemisphere broadcasting needs something new. Now direct-printing text transmissions, of all things, may be it.

Over this same period, we've seen increasing experimentation with digital teleprinting modes, originally from ham radio weak-signal work, but done on broadcast transmitters with much bigger signals. This has caused some very unfamiliar noises to be heard on the SWBC bands.

While all of these waveforms were designed for single-sideband amateur equipment, this is accomplished merely by sending computer audio to the input. This means that, while it might seem rather strange, the amplitude modulated (AM) transmitters used for SWBC, will also work with the right kind of engineering. It looks a little odd on the receiver waterfall, watching one's favorite digital mode on both sidebands, but the results are the same.

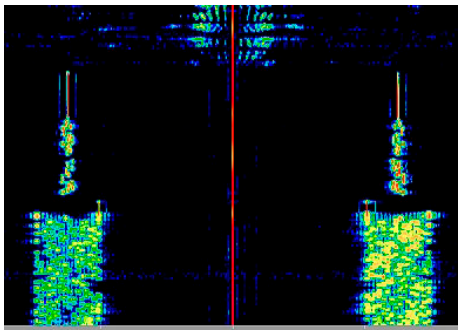
All this seems to have started in an unlikely place, namely the Cuban numbers transmissions from outside Havana. The Cubans went through several ham radio modes and modulation schemes, finally settling on the strangest and most obscure of the lot. Therefore, it's now all in AM, using an otherwise forgotten ham experiment called Redundant Digital File Transfer (RDFT).

VOA logo sent in MFSK32. (Decode by the author)

SWBC stations tend to prefer a relatively new, open-source, ham program named Fldigi. It's available to all, as a free download, for several different operating systems. This is found at www.w1hkj.com/Fldigi.html. The latest update is the one to have.

Fldigi looks simple, but in fact it is extremely complex. It will do a huge number of things, depending on how deeply involved one wants to get. Unlike most ham freeware, it's extremely well documented, though there is still a steep learning curve.

While this month's column deals with Fldigi, there is no reason other multi-mode ham radio programs can't be used. This editor hasn't tried Patrick Lindecker's MultiPSK yet, but there's no reason it shouldn't work just fine on everything except one formatting function and perhaps the image mode.



Distinctive double-sideband. AM display (Author)

❖ Fldigi on SWBC

Last May WBCQ went first, with a 50-kilowatt (kW) transmitter in the Northeastern U.S. This was followed, starting in November, by a European station called The Mighty KBC. This one has done occasional weekend tests ever since, on 5855, 6095, 7375, and 9450 kilohertz (kHz) AM. Not all frequencies are used at once.

In March of 2013, activity really picked up. PJC International aired some text propagation forecasts on 9955 kHz AM, using the facilities of 50 kW WRMI in Florida. WRMI continues a "digital ID," where the station's call sign is sent in a brief data burst.

Around this same time, the Voice of America (VOA) began its 30-minute broadcast called VOA Radiogram, and it's becoming the big gun here.

VOA Radiogram uses many of Fldigi's text and image modes, and sometimes the formatting features in an add-on called Flmsg. All this is programmed by a ham, Dr. Kim Andrew Elliott, who explains what is happening. It comes from VOA's historic Greenville, North Carolina "B" site, which is now named the Edward R. Murrow Transmitting Station.

The initial VOA Radiogram broadcast in mid-March drew a surprisingly large response worldwide. Since then VOA has added a weekly schedule. It repeats a half-hour program four times each weekend, on an 80 kW AM transmitter.

The schedule, in Coordinated Universal Time (UTC), is as follows: Saturday, 1600, 17860 kHz; Sunday, 0230, 5745 kHz; Sunday, 1300, 6095 kHz; and Sunday, 1930, 15670 kHz. The two low frequencies are beamed southward, and the two higher ones toward Western Europe. All anyone would want to know is at their blog: http://voaradiogram.net/.

Reception reports are welcome, even from within the U.S. So are copy, screen shots, and general feedback. Some people have done an amazing job with small portable receivers, simply sending the earphone jack audio to a laptop computer.

❖ Receiving SWBC Digital Content

As mentioned, this is just audio. Fldigi, and the others, use the sound card in the computer. Traditional receivers send their analog audio output to this hardware. Software-defined radios (SDRs) use "virtual" sound card programs for the same purpose. The program documentation discusses the best ways to do this.

One can practice on the various ham waveforms. The most common is PSK31, a binary phase shift mode found most afternoons on 14070 kHz. These signals, however, are in upper sideband (USB).

VOA's blog posts frequently refer to an "RSID." This is a public-domain creation of the aforementioned Patrick Lindecker of MultiPSK fame. Standing for Reed-Solomon Identification, it uses a standard set of digital codes to identify the mode of the following transmission.

Hams don't use the RSID as much as they should, but VOA does. In practice, it's a life saver, allowing quick setup of the right mode on the right audio frequency.

Some of these digital modes tolerate noisy and fading AM channels better than others. Here in California, The Land that Short Wave Forgot, that's the only kind of SWBC channel one ever hears. It's evident that the modes using MFSK (Multiple Frequency-Shift Keying) are much more robust than those using PSK (Phase-Shift Keying).

One MFSK mode allows picture transmission. The images come through well, with the same kind of "fuzzy" response and noise one expects from older analog modes such as radiofax and slow-scan television (SSTV).

❖ What's the Future?

It will be interesting to see where all this is going. As Elliott says, shortwave transmitters remain useful tools for dissemination of text when the Internet is unavailable or censored. Right now, this is more of a techno geek curiosity, but then so were entertainment radio and television when they started. Meanwhile, it's fun using utility techniques to receive broadcasts.

❖ Hollywood does the Numbers

By the time this column is read, the new John Cusack movie called *The Numbers Station* will have run theatrically. It is just what the title implies: an action thriller set at a mythical, British numbers station.

Of course, real numbers stations tend to be hidden away on various government antenna farms, out in the middle of nowhere. They are automated, and about as interesting to watch as

moss growing.

While the broadcasts are compelling in their sheer opacity, they too are just the daily functioning of various agencies. Programming comes from very ordinary people in very ordinary facilities. Presumably, the few real messages among the dummies go to deep-cover recruits in very ordinary jobs with access to confidential information.

However, that doesn't sell tickets. The movie version is appropriately tarted up. Cusack plays the usual washed-up spy, with a violent past (good for flashbacks), and no future. He gets posted to a routine assignment, guarding a beautiful blonde woman who encrypts and broadcasts high-priority instructions to 007 types worldwide.

Needless to say, things immediately go terribly wrong. The fate of the Western world hangs on whether or not Cusack and the blonde can regain control of the station after armed attackers hack its computers to order the Good Guys to do the will of the Bad Guys.

While it all looks pretty hokey, at least the simulated broadcast audio sounds quite a bit like the real thing. One thinks immediately of the old "Counting Station" run by the U.S. Central Intelligence Agency, with its four-figure groups. That one was in Spanish, though, and it's been gone for years.

It also sounds a little like the British "Lincolnshire Poacher" and "Cherry Ripe." These were at least in English, though they used five-figure groups. They've also been off the air for quite some time.

It's impossible to comment on the quality of this movie. The trailer, though, is on YouTube, and it's good campy fun. The link is: www.youtube.com/watch?feature=player_detailpage&v=rFZS3spi0Xw.

ABBREVIATIONS USED IN THIS COLUMN

ALE ..... Automatic Link Establishment
AM ..... Amplitude Modulation
ARQ ..... Automatic Repeat reQuest
Camslant ..... Communications Area Master Station, Atlantic
Camspac ..... Communications Area Master Station, Pacific
COTHEN ..... Customs Over-The-Horizon Enforcement Network
CROSS ..... French for regional search and rescue center
CW ..... On-off keyed "Continuous Wave" Morse telegraphy
DSC ..... Digital Selective Calling
EAM ..... Emergency Action Message
FAX ..... Radiofacsimile
FM ..... Frequency Modulation
HFDL ..... High-Frequency Data Link
HFGCS ..... High-Frequency Global Communications System
HM01 ..... Cuban Intelligence, alternates voice & digital
ID ..... Station identification
LDOC ..... Long-Distance Operational Control
LSB ..... Lower Sideband
M01 ..... Unknown agency, CW and modulated CW numbers
M01b ..... M01 persistent message variant
M18 ..... Russian military time strings
MARS ..... U.S. Military Auxiliary Radio System
Meteo ..... Meteorological; weather office
MX ..... Generic for Russian single-letter beacons/markers
NAT ..... North Atlantic oceanic air control, families A-F
NCS ..... U.S. National Communications System
NDB ..... Non-Directional Beacon (Aero).
NOAA ..... U.S. National Oceanic and Atmospheric Administration
Pactor ..... Packet Teleprinting over Radio, modes I-IV
RDFT ..... Redundant Digital File Transfer
RTTY ..... Radio Teletype
S28 ..... Russian voice messages on "UVB-76"
Selcal ..... Selective Calling
SHARES ..... SHAred RESources, U.S. Federal frequency pool
Sitor ..... Simplex Telex Over Radio, modes A & B
TACAMO ..... TAke Charge And Move Out
UK ..... United Kingdom
Unid ..... Unidentified
U.S. ..... United States
USAF ..... U.S. Air Force
USCG ..... U.S. Coast Guard
VC01 ..... Chinese "Voice Chip" data broadcast
Volmet ..... Scheduled, formatted, aviation weather broadcasts

All transmissions are USB (upper sideband) unless otherwise indicated. All frequencies are in kHz (kilohertz) and all times are UTC (Coordinated Universal Time). "Numbers" stations have their ENIGMA (European Numbers Information Gathering and Monitoring Association) designators in ().

515.0 OS-NDB, Ohio State University, Columbus, Morse ID at 0248 (Mario Filippi-NJ).

523.0 JJH-NDB, Johnstown, NY, Morse ID at 0246 (Filippi-NJ).

526.0 ZLS-NDB, Stella Maris air field, Bahamas, Morse ID at 0325 (Filippi-NJ).

1650.0 WQEA 211-Burlington County Radio, Mt. Holly, NJ travelers' information station rebroadcasting NOAA weather from KIH 28 in Philadelphia, male and female machine voices, at 1323 (Filippi-NJ). CROSS Corsen-French Atlantic rescue center, weather in French at 1806 (PPA-Netherlands).

1797.0 SDJ-Stockholm Radio, Sweden, navigation warnings via Gislövshammar, in Swedish, at 1812 (PPA-Netherlands).

2000.0 New York-New York Volmet, aviation weather on confirmed new frequency, parallel on 3485, at 0305 (Filippi-NJ).

2070.4 BP23-German Federal Police Patrol Boat *Bad Düben* (#23, DBIG), ALE and data with BPLEZS, police net control in Cuxhaven; also on 2505, 3850, and 4618; at 2326 (MPJ-UK).

2142.5 ZLST-German Customs Control Post, Cuxhaven, working ALE and data with ZHEL, Customs Cruiser *Helgoland* (DBQL), also on 3595 and 3831, at 2224 (MPJ-UK).

2187.5 002570100-Tjome Radio, Norway, calling 002191000 (Lyngby Radio, Denmark), at 2102 (PPA-Netherlands).

2598.0 VCG-Canadian Coast Guard, Rivière-au-Renard, maritime bulletins at 0443 (Filippi-NJ).

2628.0 IQA-Augusta Radio, Italy, female machine voice with weather in Italian, at 1949 (PPA-Netherlands).

2680.0 Unid-Probably Cagliari Radio, Italy, weak female voice with CW interference from 4XZ, at 0317. 4XZ-Israeli Navy, Haifa, usual fast CW marker followed by numbered messages in 5-letter groups, at 0420 (Filippi-NJ). 4XZ, CW messages in progress; parallel on 4331, 4595, 6379, and 6607; at 2038 (Ary Boender-Netherlands).

2748.0 YQI-Constanta Radio, Romania, navigation warnings at 1952 (PPA-Netherlands).

2749.0 VCS-Halifax Coast Guard Radio, Canada, male voice with ID and "Notices to Shipping," at 0247 (Filippi-NJ).

2761.0 OSU-Oostende Radio, Belgium, male voice in what sounded like German-accented Dutch, at 0251 (Filippi-NJ).

3226.0 XDD-UK military, working XSS, control in Forest Moor, ALE at 2204 (MPJ-UK).

3511.1 201-Unknown CW numbers station (M01b), CW callup CW 201 392 30 and message; also on 3512.3, 4606.1, and 4607.3; at 1932 (MPJ-UK).

3526.2 582-M01b, CW callup 582 392 30, then message in 5-figure groups, parallel on 4586.1, at 2002 (MPJ-UK).

3536.1 420-M01b, CW callup 420 392 30 and message, also on 4591.4, at 1910 (MPJ-UK).

3643.8 771-M01b, CW callup 771 527 30, also on 3646.1 and 3647.3, at 2015 (MPJ-UK).

3853.0 DDH3-German Weather Office, Pinneberg, FAX surface analysis chart at 0536 (Filippi-NJ).

3924.0 Plymouth Safety-UK Royal Air Force, passing altimeter setting to "A-0-U," at 1958 (MDMonitor-Netherlands WebSDR).

4073.0 Russian pseudo time station (M18), continuous CW time strings (UTC+4), 2036 (Boender-Netherlands).

4209.5 TAH-Istanbul Radio, Turkey, Sitor-B navigation bulletins at 0223 (Filippi-NJ).

4317.9 NMG-USCG, New Orleans, LA, FAX satellite image at 0203 (Filippi-NJ).

4325.9 "R"-Russian military, Izhevsk, single-letter channel marker (MX), at 2039 (Boender-Netherlands).

4426.0 NMN-USCG Camslant Chesapeake, VA, live female voice with weather forecasts, at 0516 (Filippi-NJ).

4571.1 477-M01b, CW callup 477 392 30 and message, also on 4572.3, at 2042 (MPJ-UK).

4586.3 DEK88-German Red Cross, calling DEK8812 in Pactor-I, at 2125 (PPA-Netherlands).

4610.0 GYA-UK Royal Navy, Northwood, FAX surface temperature and dew point chart, at 0415 (Filippi-NJ).

4625.0 MDZhB-Russian military group call (S28), buzzes and strategic priority voice messages at start of large exercise; all with call, numbers, and Russian code words such as AVTOKAD, EVTINIYa, DVOROVYJ, and many others; starting at 0829 (Boender-Estonia Remote).

4627.0 31V3-Swedish military, exchanging ALE text messages with 32V1, at 2014 (PPA-Netherlands).

4780.0 Golden Pirate-Indiana Joint Forces High-Frequency Radio Net, LSB radio checks with Bloomington Armory and others, at 1308 (Jack Metcalfe-KY).

5020.0 463-M01, same source as M01b, modulated CW callup 463 568 30, then repeated message in 5-figure groups; similar in straight CW on 5021, 5030, 5474, and 5475; at 1800 (PPA-Netherlands).

5150.0 VTK2-Tuticorin Naval Radio, India, "VVV VVV VVV VTK2" marker, CW at 2028 (Boender-Netherlands).

5450.0 RAF Volmet-UK Royal Air Force, female machine voice with Middle Eastern airport weather, at 0324 (Filippi-NJ).

5598.0 Santa Maria-NAT-A, Azores, selcal and voice with American 36, New York also on frequency, at 0547 (Filippi-NJ).

5670.0 Colombo-South East Asia air route control, Sri Lanka, calling Springbok 278 (South African Airways), at 2047 (MDMonitor-Netherlands).

5680.0 Kinloss Rescue-UK Aeronautical Rescue Coordination Centre, USB working G-MCGB (UK Coast Guard rescue helo), at 1345 (MDMonitor-Netherlands).

5687.0 DHM 91-German Air Force transport headquarters, Münster, selcal check BM-PS with GAF 817, an A310 number 10+21, at 1734 (MDMonitor-Netherlands).

5732.0 OPB-U.S. Drug Enforcement Administration OPBAT (Operations, Bahamas and Tortugas) on COTHEN, raised J08 (USCG MH-60J helo) in ALE, then voice as Panther working Juliet 08, at 0045 (Tony Agnelli-FL).

5811.1 158-M01b, CW callup obliterated by strong broadcast, also on 5812.3, at 1615 (MPJ-UK).

6261.0 579-M01, CW callup 579 30 and message, parallel 6260, at 1500 (MPJ-UK).

6314.0 NMF-USCG, Boston, MA, Sitor B weather at 0141 (Filippi-NJ).

6519.0 WLO-ShipCom, AL, female machine voice with tropical weather, at 0507 (Filippi-NJ).

6640.0 New York LDOC, patching Hawaiian Airlines 22 to Medlink for an injured passenger, at 0305 (Allan Stern-FL).

6685.0 Korsar-Russian Air Force, Pskov, radio checks with Davlenie (Taganrog) and Proselok (Bryansk), also on 11360, at 1805 (MDMonitor-Netherlands).

6732.8 Unid-Unknown station with hand-sent CW gibberish, could pick out "JULLIE" and "DOODSTSTAF" several times, then started repeating "ITS ABOUT THE MONEY, HONEY, X," at 1917 (Hugh Stegman-Netherlands WebSDR).

6733.0 IDR-Italian Navy, Rome, working Mission 0106, an unknown aircraft, at 1704 (MDMonitor-Netherlands).

6754.0 Trenton Military-Canadian Forces Volmet, male machine voice with ID and Canadian airport weather, at 0546 (Robbie Spain-WY).

6761.0 Reach 44-USAF Air Mobility Command transport, air-to-air comms with Reach 45, at 0133 (Stern-FL).

6848.0 G3W-Chilean Navy, calling CA2, ALE at 0045 (Filippi-NJ).

6876.5 575 Bravo-TN National Guard emergency net control, working 575 Charlie and others, at 1440 (Metcalfe-KY).

6917.5 "L"-Malfunctioning Russian single-letter marker (MX), repeating string "LLLLLZ," also on 8497.8, CW at 0711 (Boender-Netherlands).

7480.0 ARC51-American Red Cross, calling ARCKCMO (Kansas City, MO), also on 7697, ALE at 1810 (Metcalfe-KY).

7642.0 4NQAFA-USAF MARS station AFA4NQ, calling 3PBAFA, voice call AFA3BP, ALE at 0402 (Filippi-NJ).

7880.0 DDK3-German Weather Office, Pinneberg, FAX surface chart at 0435 (Filippi-NJ).

7904.0 Unid-Chinese Robot (VC01) rapid-fire machine numbers at 0614 (Boender-Hong Kong Remote).

7910.6 Murmansk Meteo, Russia, FAX weather chart at 1910 (PPA-Netherlands).

8023.0 087CDCS51-VA Dept. of Health, Richmond, calling 002CDCNHQ, U.S. Centers for Disease Control headquarters, ALE at 1825 (Metcalfe-KY).

8029.0 TRL5-Russian Air Force bear net, CW single-letter markers and calling CWK7, at 1738 (PPA-Netherlands).

8140.0 BMF-Taipei Meteo, Taiwan, FAX satpic at 1924 (PPA-Netherlands).

8319.0 Unid-Unknown FAX station, possibly in Europe, weak but sounded like a satpic, at 0500 (Filippi-NJ). *[This gets reported occasionally, always with satpics. ????-Hugh]*

8414.5 636092055-Liberian flag oil tanker *Santa Ana* (A8VX9), DSC distress relay to 007600125, Callao Radio, Peru for 232352000, UK flag fishing vessel *Westella* (MHUE4) at 0516 (PPA-Netherlands).

8686.0 WHL-Global Link Network (Swisscom) node, St. Augustine, FL, Pactor-I markers with periodic CW ID, also on 13024.5, at 0204 (Filippi-NJ) *[FCC licensee is AugTec, LLC.-Hugh]*

8764.0 NMC-USCG Camspac Pt. Reyes, CA, weather in "Iron Mike" voice, at 0439 (Spain-WY).

8806.0 WLO-ShipCom, AL, female machine voice with weather, at 0611 (Spain-WY).

8819.0 Tashkent Volmet, Uzbekistan, aviation weather at 1956 (PPA-Netherlands).

8843.0 N882WT-Gulfstream V bizjet registered to Qualcomm Inc., checking two radios with San Francisco "on eight eight," at 1814 (Stegman-CA).

8912.0 NAS-USCG cutter *Escanaba* (WMEC 907), COTHEN ALE sounding at 2039 (PPA-Netherlands).

8933.0 AAL949-American Airlines flight, patch via New York LDOC to American Air Headquarters regarding maintenance issues, at 1120 (Agnelli-FL).

8939.0 Rostov Volmet, aviation weather in Russian, at 1657 (MDMonitor-Netherlands).

8977.0 HC-CJM-AeroGal A320 flight GLG604, HFDL position for Reykjavik, at 2329 (MPJ-UK).

8992.0 Real Lion-U.S. military, working Offutt HFGCS, NE, at 2344 (Mark Morgan-OH).

9007.0 Trenton Military-Canadian Forces, Ontario, radio checks and weather for an unknown aircraft, at 0024 (Filippi-NJ).

9065.0 Unid-New Cuban "hybrid mode" (HM01), RDFT file transfers announced by old Spanish machine voice, AM at 0803 (PPA-Netherlands).

10063.0 N448AV-Avianca A320, flight AVA8532, HFDL position for Panama, at 2341 (MPJ-UK).

10075.0 VT-IFD-IndiGo A320, flight 6E0207, HFDL log-on with Al-Muharraq, Bahrain, at 2325 (MPJ-UK).

10780.0 King 55-USAF HC-130P, radio check with Cape Radio, Cape Canaveral Air Force Station, at 1645 (Metcalfe-KY).

10805.0 "3-I-H"-U.S. military with EAM, also on 11850, at 1952 (Metcalfe-KY).

11030.0 VMC-Australian Bureau of Meteorology, Charleville, noisy FAX schedule at 1218 (Filippi-NJ).

11039.0 DDH9-German Weather Office, Pinneberg, test loop in 50/425 RTTY with ID, then weather in German, at 1300 (Filippi-NJ).

11090.0 KVM70-NOAA, HI, clear FAX East Pacific surface analysis, at 0357 (Filippi-NJ).

11175.0 Diego Garcia-USAF HFGCS, Indian Ocean, test count at 1145. Offutt-USAF HFGCS, Offutt AFB, NE, taking Envelope, unknown U.S. military, to 11220 for a patch, at 1825 (Stern-FL). Raven 96-USAF or Air National Guard, any-station call for radio check on "triple-one seventy-five," raised unknown station at 2245 (Morgan-OH).

11178.0 PLF25-Polish Air Force, working Arkada 25 in Polish, at 1122 (Michel Lacroix-France).

11193.0 Moscow Radio-LDOC, working 82309, a Russian Air Force AN-124 transport, at 1313 (MDMonitor-Netherlands).

11205.0 Tascomm-UK military Terrestrial Air-Sea Communications, closing out radio watch with unknown aircraft, at 1305 (MDMonitor-Netherlands).

11220.0 Offutt-USAF HFGCS, came from 11175 with Envelope, made a patch to Offutt AFB order wire controller, at 1833 (Stern-FL).

11232.0 Trenton Military-Canadian Forces, weather for Canforce 2563, at 1807 (Stern-FL).

11279.0 Gander-NAT-D, Canada, working Qatari 87, a Qatar Airways B777 reg A7-BAJ, at 1354 (PPA-Netherlands).

11318.0 Syktyvkar Volmet, aviation weather in Russian, at 1233 (MDMonitor-Netherlands).

11354.0 Priboj-Russian Air Force, Moscow, working 526947, a Russian Navy AN-26 also working Novator, Murmansk, at 1600 (MDMonitor-Netherlands).

11430.0 ALPHARESEAU-French "Alpha" net, calling TWLRESEAU, EFCRESEAU, and SDVRESEAU, ALE at 0958 (PPA-Netherlands).

11474.1 NCS018-Unknown NCS auxiliary station, NE, CW SHARES net callup at 1748 (Metcalfe-KY).

12239.0 Echo Whiskey-U.S. Navy exercise, air defense tracking net with several units using single-letter calls, at 0830 (Agnelli-FL). *[Call sign changed to X-ray Whiskey a few hours later when other units joined.-Hugh]*

12577.0 004122100-Shanghai Radio, China, DSC call to 413896000, Chinese flag bulker *Sheng Wang Hai* (BRNJ), at 1211 (PPA-Netherlands).

12579.0 NRV-USCG, Guam, Sitor-B weather and bulletins, at 1527 (MPJ-UK).

12581.0 XSV-Tianjin Radio, China, CW ID in Sitor-A marker, at 1531 (MPJ-UK).

12613.0 XSQ-Guangzhou Radio, China, CW ID in Sitor-A marker, at 1304 (Filippi-NJ).

12637.5 XSG-Shanghai Radio, China, CW ID in Sitor-A marker, at 1533 (MPJ-UK).

12687.0 HEB-Global Link Network node, Berne, Switzerland, CW ID in Pactor-I markers, also on 13024.5, at 1839 (Filippi-NJ).

12755.0 ZCPE-Cayman flag oil tanker *Stena Antarctica*, DSC safety test with Charleville-Wiluna Rescue Coordination Centre, Australia, at 1424 (MPJ-UK).

12789.9 NMG-USCG, New Orleans, clear FAX 48-hour surface chart, at 1320 (Filippi-NJ).

13128.0 TAH-Istanbul Radio, Turkey, ID in Turkish, then weather, at 1759 (PPA-Netherlands).

13155.0 Tuff 35-USAF B-52, working Tuff 45 at 1805 (Metcalfe-KY).

13270.0 New York Volmet, weather for Philadelphia airport, at 0441 (Spain-WY).

"06"-HFDL ground station, Hat Yai, Thailand, uplink to JA08MC, a Starflyer Airlines A320, at 1735 (PPA-Netherlands).

13927.0 AFA9AY-USAF MARS, CA, patch to Patuxent River for Artel 61 (spelled call sign), a U.S. Navy E-6B TACAMO who had previously been Shadow 20, at 2202 (Stern-FL).

14396.5 KNY98-NCS, TX, in SHARES Administrative Network with KLM 569C (Veterans Affairs, CA), KTQ318 (Environmental Protection Agency, DC), others, at 1504 (Metcalfe-KY).

14399.0 "C-0-W"-U.S. military, EAM at 1734 (Metcalfe-KY).

14502.5 B04MEAFRC-ME National Guard Armed Forces Reserve Center, Brunswick, also on 15000 *[Programming mistake?-Hugh]*, ALE sounding at 1541 (Metcalfe-KY).

14556.0 RIW-Russian Navy headquarters, Moscow, calling vessels RFE70 and RFX56, CW at 1121 (PPA-Netherlands).

14681.5 WJO-UT National Guard, West Jordan, active with AME (American Fork) and SAI (St. George), ALE at 1602 (Metcalfe-KY).

15000.0 "Italcable"-"Experimental" time station, Viareggio, Italy, music and time announcements in reduced-carrier upper sideband, at 1123 (PPA-Netherlands).

16014.2 RFVI-French Forces, Le Port, La Réunion, ARQ message on circuit RUN to Djibouti, at 1430 (MPJ-UK).

16331.7 "D"-Russian Navy cluster beacon (MX), Odessa, CW ID at 1412 (Filippi-NJ).

16332.3 "K"-MX, Petropavlovsk-Kamchatskiy, CW ID at 0119 (Filippi-NJ).

16635.0 Unid-Cuban hybrid mode (HM01), open AM carrier followed by alternating Spanish machine voice and data transmissions, at 0925 (Agnelli-FL).

17955.0 Canarias-African oceanic air route control, Canary Islands, taking position and altitude request from unreadable aircraft, at 1020 (Agnelli-FL).

18012.0 Circus Vert-French Air Force headquarters, Villacoublay, working unknown aircraft at 1257 (MDMonitor-Netherlands).

18594.0 LGV-USCG Cutter *Legare* (WMEC 912), COTHEN ALE sounding at 1543 (MPJ-UK).

20890.0 J42-USCG MH-60 helo #6042, COTHEN ALE sounding at 1541 (MPJ-UK).

23006.0 AVS-U.S. Civil Air Patrol, special headquarters call "Avenging Spirit," ALE sounding at 1355 (MPJ-UK).

30740.0 Unid-Unknown fast-talking taxi/limo dispatcher, in a busy room with several other voices, numbers and street names in Spanish and (briefly) English, FM with a 107.2 hertz guard tone, at 1933 (Stegman-CA).

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Fingerprinting Russian Naval Broadcasts with Rivet

I've mentioned the excellent (and free) Rivet decoder a few times over the past months (see the August and November 2012 editions of this column for more details) and Ian Wraith, its developer, continues to add new features and refinements. As a reminder, a couple of things make Rivet an unusual decoder. First, it is written in the Java programming language which enables it to be distributed as a single "executable" file that can be run on multiple operating systems without any changes, provided you install the appropriate version of Java for your computer. Rivet works perfectly here whether I use Mac OS X or Windows XP. Second, the decoder doesn't need to be tuned accurately. Rivet works out where the signal is placed in the audio passband of your receiver and decodes it appropriately.

The latest version of the program also allows triggers to be set so that certain actions can be taken when a given pattern of bits is received. This is most useful when used in conjunction with Rivet's ability to output the raw bits of the decoded signal. Using a trigger would, for example, allow detection of the NATO KG84 encryption pattern and appropriate action to be taken.

Among the dozen or so modes that Rivet is capable of decoding, is the venerable Russian Navy 50 bd synchronous FSK teletype system codenamed BEE, 36-50 or T600 to call it by its proper modem name. BEE has been covered in detail in the March 2009 edition of this column and many of the frequencies mentioned there remain in use today.

While BEE transmissions are encrypted, Rivet will display the synchronization sequence used to begin a message, the session encryption key and the data itself, including the number of characters sent and errors received as a summary. The "0x" prefix denotes hexadecimal (base 16) character coding. Here is a typical example:

10:35:04 AM Message Start
Sync 0x1414bebe952
Session Key is 0x25 0x26 0x32 0x0e 0x4c 0x1c 0x51 0x61 0x64 0x25
0x62 0x51 0x0d 0x2c 0x0e 0x1a 0x2a 0x46 0x32 0x68 0x70 0x43 0x23 0x43 0x4a 0x07
0x70 <EOM><EOM><EOM>
End of Message (20 characters in this message 0 of these contained errors)

This level of decoding gives us some useful tools to help us determine which stations use the same synchronization sequences and if the same messages are broadcast from multiple stations, something that is to be expected with a network of transmitters capable of reaching ships worldwide. You can think of this as a kind of digital fingerprinting. BEE stations generally come in two varieties, the first of which can idle for many hours before sending traffic and those stations that come alive solely for the duration of the message or messages to be sent, as follows:

Continuously idling stations: 5242, 5398, 10236, 10712, 11524, 12592, 12610, 14436, 14581, 16207, 16234, 17088, 19688, 19936, 20536 and 21764 kHz
"Send when traffic" stations: 8076, 11468, 12590, 14411, 17460, 18107, 18764, 19210, 20096, 20268, 22392, 22413 and 22864 kHz

I slowly worked my way through these channels, copying the sequences used by each. I found three in use across most stations, as follows:

0x1414bebe952: generally used with long messages of several hundred characters by stations that only transmit when traffic is ready
0x1414bebe64c: generally used with short messages of 40 to 50 characters by stations that only transmit when traffic is ready
0x1eb41eb2952: generally used with long messages of several hundred characters by stations that idle between messages

Other monitors have also reported sequences of "0x180c4ebb9b" and "0x8d76eb0372" though I have yet to see these myself, possibly because these stations direct messages to a different region of the world. Most of the channels audible here on the east coast of the U.S. are sent from the naval transmitters at Moscow, Severomorsk (near Murmansk), Kaliningrad, Khiva and Sevastopol, probably all of which are designed to cover the Atlantic, Arctic and Black Sea fleets. Here is a sequence of a number of messages sent during transmissions on 16112 kHz (a station that does not idle) during 1st March 2013:

10:35:04 AM Message Start
Sync 0x1414bebe952
Session Key is 0x25 0x26 0x32 0x0e 0x4c 0x1c 0x51 0x61 0x64 0x25
0x62 0x51 0x0d 0x2c 0x0e 0x1a 0x2a 0x46 0x32 0x68 0x70 0x43 0x23 0x43 0x4a 0x07
0x70 <EOM><EOM><EOM>
End of Message (20 characters in this message 0 of these contained errors)
10:48:18 AM Message Start
Sync 0x1414bebe64c
Session Key is 0x0e 0x25 0x19 0x34 0x25 0x58 0x32 0x58 0x13 0x0b
0x68 0x68 0x43 0x15 0x58 0x43 0x16 0x4c 0x0d 0x16 0x16 0x2a 0x46 0x0e 0x15
0x23 0x2a 0x68 0x31 0x32 0x15 0x26 0x25 0x23 0x70 0x25 0x70 0x64 0x4a 0x0d 0x0e
0x62 0x70 0x13 0x2c 0x07 0x34 0x2a 0x16 0x43 0x0d <EOM><EOM><EOM>
End of Message (44 characters in this message 0 of these contained errors)
11:08:19 AM Message Start
Sync 0x1414bebe64c
Session Key is 0x0e 0x25 0x19 0x34 0x25 0x58 0x32 0x58 0x13 0x0b
0x68 0x68 0x43 0x15 0x58 0x43 0x16 0x4c 0x0d 0x16 0x16 0x2a 0x46 0x0e 0x15
0x23 0x2a 0x68 0x31 0x32 0x15 0x26 0x25 0x23 0x70 0x25 0x70 0x64 0x4a 0x0d 0x0e
0x62 0x70 0x13 0x2c 0x07 0x34 0x2a 0x16 0x43 0x0d <EOM><EOM><EOM>
End of Message (44 characters in this message 0 of these contained errors)

You can easily see that the second and third messages are the same and that two synchronization sequences are in use. By copying traffic from other channels like this, it is also easy to determine that the same message is often sent out from multiple outlets at different times. BEE signals are audible the world over, and I would be most interested in what readers can hear elsewhere. For example, west coast U.S. listeners should be able to compare the results above with stations covering the Pacific.

❖ Rivet and Globe Wireless FSK

Another mode receiving attention from Rivet is the 100 bd, 200 Hz shift FSK signal used by ships contracted to Globe Wireless for position reporting. Most of the work deciphering these signals has been done from first principles as the mode remains proprietary. Ian, with the help of some other listeners, has been able to piece together most of the protocol, the meaning of most of the packet types sent, and can now decode the GPS fixes. The remaining work now is focused on identifying the MMSI number in the protocol, something that will then allow Rivet to identify the ship sending the traffic. If Rivet can't determine the packet's meaning, it is simply dumped in binary to the screen as such:

11:06:54 AM GW (Type=5 count=0 Subtype=41): 100101 001010011111101111101011011001100110011001 11011001111101

No doubt that more listening will determine the meaning of many of these unidentified packets. Globe Wireless uses duplex channels, where ships transmit on one frequency and the coast station on another. Patience is required if you want to catch these 100 bd reports because it is the slowest and least used mode in the Globe Wireless network, most traffic being sent now with the faster OFDM (Orthogonal Frequency Division Multiplex) mode. However, parking on a busy ship channel will often yield results within an hour or so. Here's a good example of a position report (the binary bit dumps removed for clarity):

16:28:50 <<<<<<$GLOBE,162816,A,5224.830448.7822 ,E,000.0,020213,03.2,W

Here are some frequency ranges occupied mainly by Globe Wireless ship channels:

4100-4200, 6200-6300, 8300-8400, 12300-12500, 16500-16700, 19800-19900, 22150-22300 and 25080-25180 kHz

Globe Wireless stations are located around the world, so you should be able to find plenty of activity wherever you are and during any time of the day and night.

That's it for this month, but do please keep sending your letters, emails and requests for what you'd like to see this column cover in future editions.

Resources

Rivet Decoder Download and Help Page: **borg.shef.ac.uk/rivet/**

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A $20 SDR for Your Shack?

(All photos courtesy the author)

Back in the day, I lusted after the expensive HF/VHF/UHF receivers typified by ICOM's all-mode IC-R7000 (now IC-R8500), which covered 25 MHz to 2 GHz (minus some cell phone frequencies on the non-export models). Having listened, at one time or another, to just about every kind of signal on the HF bands, I vividly imagined printing maps uncovered by eavesdropping on weather satellites; surreptitiously listening in on military aircraft, and spacecraft comms (including the space shuttles); police, fire and public safety comms, of course; analog cell phones (against the rules, but still fun back in the day); and even relatively mundane aircraft traffic from nearby airports.

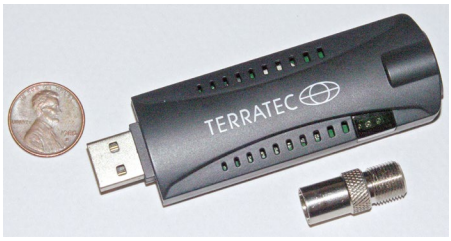
Having grown up on HF, the frequencies above 30 MHz seemed ever-so seductive and mysterious. And the rigs themselves, covered with knobs, switches and buttons, had large visual displays that showed off those forbidden frequencies in "extra-long" digits. I was used to seeing 7.040 on my digital dial, but 1700.040 was somehow unimaginable! For a few short weeks in the 1990s I owned an AOR AR-3000 receiver which, while covering most of the frequencies in question, looks and works more like a scanner than an IC-R7000 "communications receiver," but someone soon "made me an offer I couldn't refuse," and the '3000 found a new home. Until this year, I didn't own anything that could receive above 6 meters (weather radios, stereos, TVs and a packed away C-band satellite receiver excepted).

In those intervening years I discovered that truly high-performance DC-to-daylight receivers are pretty rare (much rarer than their HF counterparts), but the price tags on *any* radios that can tune those frequencies often go as high as their proverbial dials. Knowing that, I never got around to spending the money on a modern receiver for the ultra-short wavelengths.

Until a couple months ago, that is, when I finally decided to investigate the DVB dongle craze that's been sweeping the internet. "Cheap and Easy SDR," a comprehensive article on how to wrangle a DVB-SDR in the January 2013 issue of *QST* by Robert Nickels, W9RAN, couldn't have showed up at a better time. For less than $20, I reasoned, how could I go wrong?

❖ DVB Dongles: Not Just for TV Anymore

Powered by the USB port on your PC, these "DVB-T dongles" are software defined radio "systems on a stick" about the size of large USB thumb drives, ostensibly used to receive digital television signals in parts of Europe, South America and Asia. Thanks to hacker and DVB kernel developer Antti Palosaari, however, the DVB dongles can now be used with a wide range of free software to make a decent, dirt-cheap, all-mode SDR that covers roughly 60-2200 MHz (or 25-1700 MHz, depending on specifics)!



Terratec Tstick+ DVB-T dongle

Thanks to Palosaari, the dongles can dump raw I/Q data (the magic that makes software-defined radios possible) to the host PC in the form of 8-bit digital samples at up to 2.4 million samples per second. That translates to a sub-$20 SDR that can receive all modes and display a 2-MHz-wide swath of RF on its band scope with a dynamic range of nearly 50 dB!

The most-used dongles pair a Realtek 2832U quadrature sampling detector with an Elonics E4000 tuner. Because of surging interest in these devices, other tuners such as the Rafael Micro R820T are now supported, and more tuners will follow.

The dongle has an antenna connector on one end and a USB connector on the other. RF signals go in one side and raw I/Q data goes out the other, to the PC. Because the dongle hardware doesn't know (or care) what type of modulation is being used on any incoming signal, it's all simply passed on to the PC.

Thanks to dozens of free SDR software packages, your inexpensive "dongle SDR" can receive AM, AM-synchronous, FM (wide and narrow), USB, LSB, ISB, DSB, CW—all the modes we know and love. Plus, support is emerging for obscure modes such as APCO 25, INMARSAT, ADS-B, and more.

Wow! And just when you think things can't get any better, for about $30 you can build or buy a simple front-end converter to add VLF, MF and HF coverage That was sweet icing on the cake for me! My own SDRs from FlexRadio and Elecraft set the performance and value bars awfully high, and I have certainly gotten used to their benefits (and a few drawbacks) in recent years, but nothing really tops the value proposition of a $20 experimenter-friendly SDR that tunes everywhere, in every mode! I took the plunge!

❖ What to Buy, and Where

After some initial research, I headed to eBay to look for suitable DVB dongles and found about a million! Sorting the listing by price, I looked for the magic words: 2832U and E4000 (not all dongles use these internal parts, and although they may still work, I thought it safest to stick with "known quantities"). For the princely sum of $18, as shown in the photo, eBay seller "nooelec" sent me a Terratec Tstick+ dongle (with the required innards), a "Euro TV to Type-F" adapter, a telescoping antenna with suction cup, a driver disk (not useful for SDR applications) and a user manual.

Nooelec, which also sells assembled HF up-converters for these little SDRs, seems to be making a name for itself, as I have seen comments from many hams on various mailing lists and reflectors about this vendor. There are many other places to purchase the required hardware, and prices range from $17 to $39 at press time. I chose Nooelec because it had a good feedback score and, unlike most eBay listings for DVB dongles, the items were shipped from the U.S. and not China, which can add a couple of weeks to the turnaround. Mine took two days!

The only really challenging part of the whole process was the device drivers. The ones on the included disk are only for DVB-T reception; for *Windows* PCs, anyway, the "Zadig" USB drivers are required (the "hacked" SDR drivers that make this all possible).

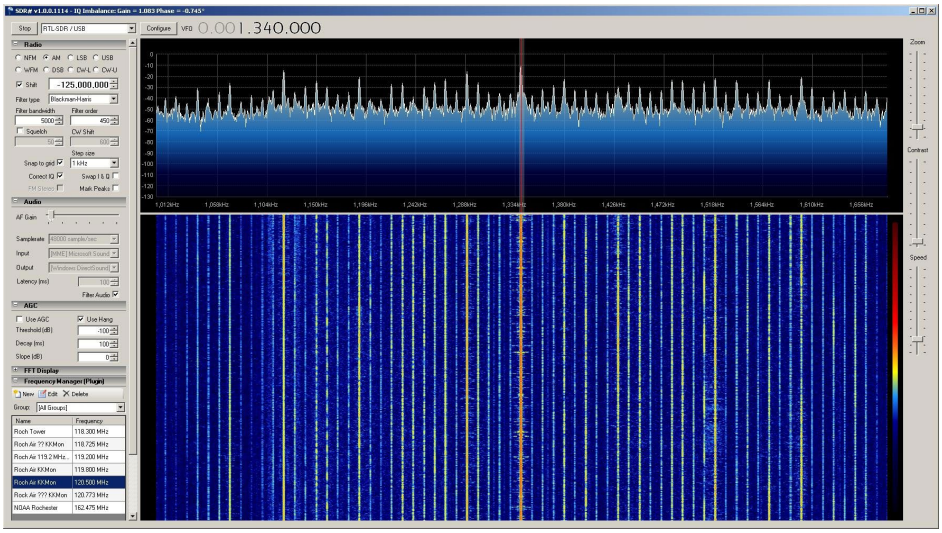
Once installed, it was simple to set up and use a variety of SDR software packages. My favorite so far is *SDR#* (pronounced "SDR sharp") with *HDSDR* coming in second. There are many that I haven't yet sampled, including *GNU Radio*, a *Linux*-based package that, among other things, may let me configure the DVB dongle as an SDR-based spectrum analyzer.

❖ It's Alive!

SDR#, one of the most powerful, feature-rich packages available for DVB-SDRs, is also one of the easiest to use. It's a clickable EXE file that doesn't require installation. With my dongle connected to its telescopic whip, I fired it up and tuned to the strongest VHF signal source in the neighborhood: the FM broadcast band. Sure enough, there were signals there, and they looked and sounded great!

I messed with the software controls a bit, some of which aren't terribly intuitive, and soon set off to receive signals from something a bit more exotic. A nearby airport provided plenty of AM action and an opportunity to calibrate the receiver. You didn't think that an $18 radio designed to receive wideband TV signals would have a "dead accurate" synthesizer, did you?

To test, I tuned to the airport's AM beacon at 120.5 MHz (which sounded fine) and switched the receiver to LSB (which sounded off-frequency). *SDR#* has a built-in calibration tool, so I kept the displayed frequency on the dot and started clicking the tool's adjuster button. Thirty-one clicks later I had a zero-beat in



All of those perfectly-spaced lines on the waterfall can only be the AM broadcast band.

LSB. A quick switch to USB verified the same. My dongle was off frequency by 31 parts per million, which I later learned is in the middle of the usual 10-50 ppm range. Now I could enter frequencies numerically and have a reasonable expectation that they'd be correct. Yep, that's the airport control tower at 118.3 MHz, right where it's supposed to be!

❖ Time to Get Down

Tuning VHF signals was fun and interesting, and it highlighted the fact that I still had a lot to learn about maximizing the performance and usefulness of my DVB SDR. Plus, I really wanted to use the receiver at HF, so I picked up a front-end converter kit designed by Bob, W9RAN, the author of the *QST* article that got me started on this project in the first place.

The "RANverter," available from **www.hayseedhamfest.com/sdr.html**, is a simple up-converter that uses an NE602 active mixer and a 125 MHz oscillator module to convert 0-60 MHz to 125-185 MHz, which can be received by the dongle. The converter has two antenna ports, one for HF and one for VHF and up. Thanks to an onboard relay, when DC power is switched off, the converter passes the VHF antenna through to the dongle. With DC switched on, the HF antenna is on line and the converter is powered. Simple.

Building the converter was easy except for soldering the 125 MHz oscillator module; the only surface-mount part. Although it's a "large" SMT part, I had a Perfect Storm of challenges: bad solder, a bad soldering iron tip and "bad" eyesight! In the end, the module was soldered and tested, but because of the trauma that it suffered I can assure you that these modules are *very durable*!

The RANverter worked as advertized. Although it's not yet packaged (see the photo), I tested it on my wooden desktop, tuning in AM and shortwave broadcast stations, WWV and plenty of ham QSOs on several bands. The audio has the wonderful clarity that only comes from direct-conversion receivers and, despite the little rig's inherent dynamic range limitations, I found it to be absolutely usable.

In addition to the synthesizer/LO calibration adjustment, with a single click *SDR#* lets me subtract 125,000,000 (the converter's LO frequency in hertz!) from the radio's displayed frequency when the converter is in use, so all frequencies read as expected (10 MHz is displayed as 10 MHz and not 135 MHz). Because the frequency offset is so granular, when I measure the converter's *exact* frequency I can enter it one digit at a time for much greater accuracy.

I just *had* to use the SDR on the air so, with the RX still unpackaged and unfiltered, I kludged up a manual T/R switch and fired up a crystal-controlled, 250-mW QRP TX I had built 20+ years ago. At 3 AM there wasn't a lot of activity on 7.040 MHz (my lone 40-meter crystal), so I worked a buddy across town who stays up late on weekends like I do. The experience wasn't wonderful, but it was inspiring. My primitive T/R switch left a lot to be desired, and there's no provision for muting the SDR, so I'm going to have to work on that a bit. But I have no doubt that, once packaged and sorted, the DVB-SDR will be perfectly usable for QSOs.

❖ The Best is Yet to Come

DVB-SDRs, and the derivative designs already in the works, are in their toddler stage, so there are plenty of rough edges and lots of room for experimentation. Because of the hardware used and the fact that DVB-SDRs are essentially "hacked and repurposed" devices that were never intended for high-performance amateur radio applications, you'll have to work around some limitations.

These 8-bit dongles have a maximum dynamic range of about 48 dB, which is 30-50 dB "worse " than a typical modern HF transceiver. I expected that to be insurmountable, but it turned out to be rather insignificant. The cure is a switchable attenuator or an adjustable pot at the antenna, which works like a basic RF gain control.

There are plenty of AGC options, but none that are really ideal. The AGC systems in modern ham radios are the product of 75+ years of tweaking and refining, and their DVB dongle counterparts aren't really in the same ballpark. To make matters even more confusing, each of the dongle's main chips (the quadrature detector and the tuner) has its own selectable, internal AGC system, as does the SDR software itself. The dongles also have adjustable RF gain settings that are software addressable. That's a lot of AGC and amplification action!

To achieve maximum RF sensitivity, many users recommend using *no AGC* and manually riding the gain (like the good old days!). Experiment and use whatever settings work best for you.

Similarly, because the dongles were never designed for narrowband RF performance, the front-end noise figures are not optimal. An RF amp with a decent noise figure and dynamic range placed ahead of the dongle's RF input isn't a bad idea. To handle images and out-of-band signals, various filters may also be required.

Building your dongle and any accessory circuits into shielded enclosures is also a good idea, as is placing ferrite chokes on USB or accessory power leads.

As mentioned, TX/RX switching and muting are still a bit of a challenge, but one that experimenters are working on!

Of great interest to me is the basic design of the SDR software that drives these little radios. *SDR#*, for example, my favorite to date, is superbly capable and has many options and features that I haven't even touched on. Its core designer, Youssef Touil, has been described as an "algorithm guy," and it shows, as *SDR#* seems like DSP software that happens to speak radio, and not radio software that happens to speak DSP (like FlexRadio's *PowerSDR*, for example, which screams, "I'm a radio!").

SDR# supports an expandable, plug-in-friendly design and is in some manner "skinnable," so the initial design can evolve (and has). Hey, this is free software and an essentially free radio. That *has* to be worth *some* experimenting, right?

Considering that SDR systems are the probable future of all radio, experimenting with a $20 DVB-SDR is the least expensive way to enjoy your own DC-to-daylight, all-mode radio and I encourage you to do so. I can hardly wait for what comes next. If you win the lottery, however, ICOM's superb IC-R9500 weighs in at a cool $13,000 (650 times as expensive)!

RESOURCES:

Info: "Cheap and Easy SDR," by Robert Nickels, W9RAN, Jan 2013 *QST* (a Google search for the title will net a pdf version); **http://sdr.osmocom.org/trac/wiki/rtl-sdr; http://rtlsdr.org/softwarewindows**;

DVB-T dongles: **www.nooelec.com; www.ebay.com**

Windows USB Drivers: **http://sourceforge.net/projects/libwdi/files/zadig**

Software: **www.sdrsharp.com; www.hdsdr.de; www.gnuradio.org**

Converters: **www.hayseedhamfest.com; http://blog.kf7lze.net/tag/up-converter**; **www.nooelec.com/store/software-defined-radio.html**; **www.george-smart.co.uk/wiki/FunCube_Upconverter**

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Mohu OTA Antenna: A Low-profile, Roof-top or Attic TV Antenna

Greenwave Scientific, Inc., is a company based in Raleigh, North Carolina, doing business as Mohu. The company, according to their web site, was co-founded by Mark Buff, whose research included "the development of 'low and no-profile' antenna systems for military ground vehicles," and Russ Winstead, who worked at IBM for 19 years as part of the development team responsible for IBM's first laptop, the Thinkpad.

Their most recent product is an active, low-profile, roof-top or attic TV antenna, called SKY-HDTV, that could solve a lot of problems for viewers who are cord-cutters (kicking the cable/satellite-TV habit), condo-dwellers (where outside antennas are frowned upon), or folks just looking to cure various reception ills that still plague off-air TV viewers even in the miracle digital age.

A New Approach

As the digital TV switch loomed in June 2009 there were few alternatives to the large aluminum VHF/UHF Over-the-Air (OTA) TV antenna that had changed little throughout the decades. At the time there was a lot of confusion regarding whether or not any VHF channels would remain, so many OTA viewers bought UHF-only antennas, only to find that the FCC had changed its mind and would let some VHF-TV stations remain on VHF after the switch.

Some traditional antenna companies offered reception-compromise antennas that covered UHF channels and added a few shortened VHF elements to cover the upper VHF-TV channels. But, there was a problem. Such antennas were large, much larger than Home Owner's Associations (HOAs) might allow. There had to be a way to devise a smaller antenna that covered what was left of the OTA channels that the FCC had been gleefully stripping away to sell to mobile broadband and Public Service interests.

One approach came from longtime outdoor TV antenna maker Winegard, which offered their Squareshooter SS-1000 (unamplified) and SS-2000 (amplified) compact antennas. They were a sensation because they were so small (about 16 inches square) and the unobtrusive gray plastic box could easily be hung on an outdside wall, balcony, etc., and not be spotted by HOA enforcers as an actual outdoor antenna.

The SS-2000 works well but has two drawbacks: it's designed only for UHF-TV channels and its 60º beamwidth and 13 dB front to back ratio makes it highly directional; it must be mounted on a rotator if TV signals come to your home from different directions. The Mohu has solved those issues handily.

SKY-HDTV Antenna in Action

The SKY-HDTV antenna comes complete with everything you'll need to do a normal installation: the antenna, 30 feet of coax cable, mounting pole and hardware; a three foot USB cable, USB power injector and power cube. If you need to run more than 30 feet of coax Mohu recommends that you buy the extra cable length and connector (though you will lose a slight amount of gain in doing so). They also recommend that you can use a splitter to feed two separate TV sets with one SKY-HDTV antenna.

The SKY-HDTV can be mounted in place of an existing UHF-only antenna but the mounting pole that comes with the antenna is smaller than most TV antenna masts. While most mounting clamps will accommodate the smaller size, it may be a better idea to disconnect the old antenna, leaving the coax ready for the new antenna and take down the old mount. You can put the SKY-HDTV mount in its place (wood screws are provided to let you mount the antenna to a gable-end or wooden eave) with little effort. Just be sure to observe the numerous safety warnings concerning mounting outdoor antennas. If you don't feel you're up to the job, hire a TV antenna installer to do the installation, it's far cheaper than winding up in the hospital!

The SKY-HDTV, despite its plastic case, is weatherproof. The two halves of the antenna, where they are joined, are sealed with a black rubber gasket, preventing rain from getting into the antenna itself. A weather boot to cover the outside coax fitting is also provided. Don't forget to allow a "drip loop," letting the coax dip below the place on the outside wall where the coax enters your home. This lets rain slide off the coax and not run into the entry hole.

Mohu SKY-HDTV antenna (Courtesy: Mohu)

Once the mount is secured to the wall, mount the antenna and connect the existing coax cable to the antenna. Mohu notes that the antenna must only be mounted in a horizontal position.

Inside the house feed the other end of the coax to the "power injector," that's a device that combines the small amount of voltage needed to power the antenna's amplifier (it's fed through the coax to the antenna) with the TV signal coming down from the antenna which goes into your TV set. One plus for this antenna is that a USB connector is also supplied in the event that your TV has a powered USB port. If your TV has such a connection, you can dispense with the power cube (one less thing to plug into the wall).

To avoid getting disgruntled calls from disappointed TV viewers Mohu recommends that the SKY-HDTV antenna is mounted either in your attic (above the electrical noise and interference from inside your home) or mounted outside (it comes with a multi-angular mount). Attic-mounting will ensure that the antenna virtually lasts forever. Naturally, my first inclination was to test this antenna by simply leaning it against the glass of a second story window. The results were quite good.

With the Winegard SS-2000 amplified UHF antenna, channel 12 (over 42 miles away) was, of course, not received. But, with the Mohu SKY-HDTV it came in perfectly and at the same time the antenna was pulling in UHF stations from the same direction as channel 12 as well as those from stations 20+ miles away in the opposite direction. This means that the SKY-HDTV can be used in most cases without a rotator. To find out which direction the stations in your area are check, out their connection to TV Fool: **www.gomohu.com/tv-for-free/**

Next, I tried the antenna in a first floor room with a TV that normally has the Winegard Squareshooter-2000 attached. Results were comparable with those using the SS-2000, except that, with the lack of elevation achieved in the second story window, VHF channel 12 was missing. I also had to move the SKY-HDTV around to different positions to achieve the same results.

Winegard SS-2000 antenna (Courtesy: Winegard)

Attic-mounted SKY antenna (Courtesy: Mohu)

Finally, I moved the antenna outside, where it's intended to be used, replacing a standard VHF/UHF aluminum antenna with the SKY-HDTV antenna on the gable-end of the house at about 25 feet. The advantage was in the SKY antenna engineering. By aiming the antenna in the direction of most stations over 40 miles away it was also able to receive stations 25 miles away in the opposite direction, something the standard aluminum antenna was not able to do without a rotator.

One of the most significant things about this antenna is its ability to deal with multi-path distortion which happens when a signal from a particular transmitting antenna arrives at the receiving antenna at slightly different times because of being bounced off nearby mountains, hills, or buildings. Multi-path, in the old analog TV days, showed up on the TV screen as "ghost" images, sometime two or three of the same main image. There was no cure for multi-path and viewers simply put up with the oddity. The problem with multi-path today is that digital receivers, sensing multiple signals arriving at the antenna, can't cope with the confusion and either display sporadic images perfectly or no images at all (despite the signal meter showing the presence of a strong signal).

❖ Variability among Receivers

One thing that all consumers should know is that not all TV sets, even in the digital era, are equal. Just as sets will vary in picture quality from brand to brand, some sets will also perform better at receiving than others. Once I had the SKY-HDTV antenna mounted in the air outside, I brought in other sets to see which worked better.

I've been increasingly impressed with the Vizio brand; they're cheaper than most, have many useful features (including online streaming of popular video and audio services) and seem to perform as well as far more expensive sets. Pitting a Vizio set against a Sharp Aquos model, the Vizio won hands down on reception capability and picture quality. A small, portable set also performed better than the Sharp model.

I also used the SKY-HDTV with a stand-alone digital converter box which lets consumers watch DTV on old analog TV sets. Results were the same as with the TV sets, though not all digital converter boxes are equal either. So, when you're buying your next TV check out the reception capabilities, it may determine just how well your antenna appears to work! Opt for streaming features as found on Vizio and other brands. The future of OTA-TV is in how the set streams, not just on what it receives over the air.

❖ Bottom Line

With a list price of $180, the SKY-HDTV is not cheap, though it's discounted to $170 at their website (which includes free shipping). But then, neither is cable or satellite-TV. Cord-cutters will see this antenna pay for itself in the first few months after they drop their subscription. City-dwellers coping with multi-path distortion will appreciate curing this ill and will likely be happy to pay the extra price to have clear reception. Urban, suburban and even rural OTA-TV viewers wanting to improve their reception will find this antenna worth the price.

And, if you're comparing the cost of a traditional VHF-UHF OTA TV antenna ($43 for the smallest one at Radio Shack) with the SKY-HDTV, you'll have to include the cost of a mast-mounted pre-amp ($50 at Radio Shack); a rotator (another $60 at Radio Shack), and don't forget to add the 30 feet of coax and rotator cable (another $50 at Radio Shack). The low-profile, no-maintenance, no moving parts SKY-HDTV is looking pretty good!

All of Mohu's products can be purchased from Mohu direct via their web site below and, according to their web site, will be available in most major retail chains by the end of 2013. I would also expect more downward movement on the price as retail competition for this capable antenna heats up. For more information or to order, call toll free at 1-855-4-GOMOHU or visit their web site at **www.gomohu.com.**

Gable mounted SKY-HDTV antenna. Of the old antenna supports needed for the previous antenna, only one is needed for the extremely lightweight SKY-HDTV antenna. A longer replacement mounting pipe will put it higher above the roofline. (Courtesy: Author)

PROGRAMMING SPOTLIGHT

WHAT'S ON WHEN AND WHERE?

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Summer Shortwave DX Challenges

June has arrived and with it warmer weather and longer days. There is nothing better than to fire up the shortwave radio, and tune in some exotic locale on a warm summer night. This month we shine the Programming Spotlight on some great programming in the "wee hours."

These days it's getting harder to be a shortwave listener, but it's also potentially great to be a DXer, simply because it's almost all DX out there now. It all depends on whether you look at things as a glass half empty or a glass half full. There are still many programming gems out there, they just are harder to find. But at the same time, like actual gemstones they stand out all the more because of their relative scarcity. I still like listening regularly to some stations.

My infatuation with the **Voice of Greece** and its great music (9420 kHz, local evenings) is well documented. Serbia continues to surround its information programming with some fabulous music as well (0000-0130 9685 kHz). **WYFR** (most evenings, 6115 kHz) is a bit of a shadow of its former self. It is pretty much wall to wall music of the Christian variety now. It is also kind of sad to hear Harold Camping these days. A stroke he suffered last year, shortly after his rapture prediction fell through, has really debilitated him. Going 0 for 3 on Rapture predictions hasn't done him or his radio station much good either.

In these days of disappearing shortwave radio stations, it is nice to be able to count on a few long standing broadcasters, that continue to be heard on the international bands. One of the best of these, and most popular, is **Radio New Zealand International**. Broadcasting from a small country, off the right coast of Australia, and despite a relatively small population and small budget, **RNZI** packs a powerful daily schedule with an incredible variety of programming.

Tune in from 0458 UTC on 11725 kHz, for three hours of interesting programming from both the domestic network (**Radio New Zealand National**), and **RNZI** itself. Each hour, on the hour, one can hear **RNZI** news. As can be expected, the focus of these newscasts is on Asia-Pacific stories. It's an opportunity to become more informed about a region that goes unreported here in North America.

For in depth news of the Pacific region, and those island nations particularly close to New Zealand (both geographically and politically), tune in UTC Saturdays at 0505 UTC for *Tagata o te Moana*, a weekly program of news and reports from places like Samoa, the Cook Islands and others. It is an interesting and well produced program, presented by Don Wiseman. Along with feature reports, they also play a lot of great music from the region.

Following *Tagata o te Moana*, and the news, one can hear a fascinating **RNZ National** program called *Great Encounters.* The program is a collection of in depth interviews selected from **Radio New Zealand National's** feature programming during the week. A recent edition aired interviews with Andrew Rose, author of a book about Royal intrigue, and Emily Tow Jackson, on the youth criminal justice system in Connecticut. Very informative and entertaining indeed, as one would expect from this popular public broadcaster.

After the 0700 News on UTC Saturdays, one can hear *Saturday Night with Peter Fry,* a program which promises "music, reminiscences and entertainment, including your requests." Fry reminds me of longstanding **BBC Radio Wales** broadcaster Dewi Griffiths. He seems to concentrate on music from yesteryear. An April program opened with a biography of Broadway, film and television star Howard Keel and some Andy Williams-like music, dedicated to a listener turning 93 years of age! When reception is good it is a delightful accompaniment to a late night session of radio listening, especially if you like your listening easy.

Radio Australia on Saturday mornings often broadcasts games from the Australian Football League (AFL), which those in the know refer to "Footy." These weekly games are like a combination of *Hockey Night in Canada* and *Football Sunday*. The play-by-play announcers are certainly enthusiastic. I have watched a game or two on television and it seems to be a combination of rugby, football and a few other interesting elements. To be honest, I don't really understand all the finer points of the game, still it is hard not to get caught up in the excitement of those calling the game. As a Canadian, I have always thought what Footy needs is for the players to play the games on skates, but I digress. Footy matches can often be heard on Saturdays around 1000 UTC, check them out if you ever get a chance. At other times one can hear the fabulous *Saturday Night Country* program, hosted by Felicity Urquhart. Country music is big in Australia. Olivia Newton John got her start in this genre. Try 9580 kHz at 1100 UTC Saturdays, for a weekly look at the Australian country music scene.

Radio Australia and **Radio New Zealand International** continue to offer first rate programming. Not bad for two countries with about 14 million people between them.

Listeners of a certain vintage, will remember the days of the Cold War, when one couldn't help but trip over multiple frequencies from radio stations on both sides of the Iron Curtain. Those days are gone for the most part, but Cuba apparently did not get the message. Four frequencies for **Radio Havana** were counted while listening one evening, between 0500 and 0700 UTC, including 6010, 6060, 6125 and 6165 kHz.

And, just as a reminder that the Cold War is not over in all respects, duelling it out with these four Cuban frequencies is **Radio Marti** on 6030 kHz, in Spanish. As someone with a smattering of high school French, the Spanish programming is not that hard to follow. I don't always know exactly what they are talking about but its fun to listen to nonetheless. Is it effective? **Voice of America** thinks so.

Speaking of Spanish language broadcasts, in April, I was hearing some interesting stuff around 0430 UTC. After **Radio Japan** in Spanish closed down on 5910 kHz, I could hear another station emerge from underneath the Japanese transmission. Presumably it was **Alcaravan Radio** from Colombia, which was putting an acceptable signal into Southern Ontario. It featured some pretty nice Latin American music, and some spoken word programming as well.

German was once a language very easily heard on the shortwave bands. These days? Not so much. Germany has ceased broadcasting on shortwave; however **Austrian Radio ORF** can be heard from 050-0615 daily. The Austrian accent is interesting, subtly different from High German. Give it a listen on 6155 kHz and see if you notice the difference.

CFRX 6070 kHz has been putting out a great signal overnight (although I should point out that I am only about 40 miles, as the crow flies, from the transmitter). For some time, **CFRX**, which relays the programming of **CFRB** 1010 in Toronto, was carrying comedy programming overnight. Recently, 820 **CHAM** in Hamilton has gone to a comedy format 24/7, so **CFRX** is now carrying "Best of" programming from their daytime schedule, and several nights each week one can hear *Loveline* with Dr. Drew and Mike. An April edition of the program examined the "swinger" lifestyle. Apparently I have lived a sheltered life. *Loveline* can be heard between 0600 and 0800 UTC Tuesday through Saturday. If you want to call in, just dial 1-800-LOVE-191.

WHRI in Cypress Creek puts out a fairly good signal on 7385 kHz between 0300 and 0500 UTC. One can often hear some frankly excellent contemporary Christian music via this broadcast. It is well worth checking out.

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QSLing Your Way

Not every station has a website or a link for online reception reports. If postal costs have forced you to QSL on a budget, consider a narrower view. Specializing in verifications from stations or certain types of stations is a good alternative. Perhaps you could place power limitations on the stations you verify. For instance, verify only those stations transmitting with 20 kilowatts or less total power. Or, you may just want to verify a favorite country or region. QSLing a favorite program, or collecting special commemorative cards issued by stations is another alternative. If you enjoy contesting, several broadcasters run contests from time to time, and a few have annual essay contests with trips awarded to their country. By sending in a reception report you might be rewarded with a nice prize for your efforts.

If faith-based broadcasts interest you, remember that the number of worldwide religious broadcasters continues to expand. I specialize in QSLing clandestine and stations broadcasting in the tropical band. These represent some of my favorite QSL cards, pennants and letters in my collection.

One aspect of medium wave DXing is collecting verifications from DX Tests. Amateur radio operators are the masters for special events, contesting, "Islands on the Air" (IOTA), Field Day and much more.

QSLing clandestine, utility band stations, and shortwave broadcast will keep you busy sending reception reports for many years to come. Finally, take a tip from some ham radio DX enthusiasts and try QSLing only those stations you hear in a particular shortwave meter band. Maybe you can't afford to QSL everything you hear, but you can still stay in the QSL game by specializing and doing it your way.

AMATEUR RADIO

Cayman Islands-Sundial Cove Villa, ZF2OE, 12/17/80 meters SSB. Full data color pool side photo card of operators. Received in two years via ARRL. Website: **www.zf2oe.com** (Larry Van Horn, NC)

Japan-JG1WNO, 21 MHz JT65. Full data color call sign/logo card, initialed. Received in 16 months via ARRL. (Van Horn)

Rwanda-9X0ZM. Full data color *Rwanda-The Land of a Thousand Hills* card, signed by QSL Manager. Received in 22 days via QSL Manager JO1CRA, plus $2.00US and a nested Euro envelope. (Van Horn).

Russia-RZ0CQ, JT65. Full data color scenery card of village and basilica, signed by Vladimir N. Vlasov. Received in one year via ARRL (Van Horn).

MEDIUM WAVE

Mozambique-Rádio Moçambique, Emisora Provincial de Sofala, Beira-Dondo, 873 kHz AM. Partial data e-QSL from José Licumbre, Chief Engineer. Received in 40 days after follow up report. Station address: Rádio Moçambique, Rua da Rádio n. °2, Caixa Postal 2000, Maputo, Mozambique. (Vashek Korinek, South Africa/playdx). Streaming audio at **www.rm.co.mz**

KFAB 1110 kHz AM *News Radio 1110*. Date/frequency QSL, signed by Greg Gade, Director of Engineering, plus station material. Received in 234 days after follow up report (542 total). Station address: 5010 Underwood Ave., Omaha, NE 68132 USA. (Al Muick, PA/HCDX) Streaming audio via iHeart Radio link at **www.kfab.com**

WHK 1420 AM *News-Talk*. Full data e-QSL with transmitter photo from Brett Patram, Chief Engineer. Received in six days for an email report to *bpatram@salemcleveland.com*. Station address: 4 Summit Park Drive Suite 150, Independence, OH 44131-6921 USA. (Muick) Streaming audio via tunein link at **www.whkradio.com/**

WHKW 1220 kHz AM. *The Word*. Full data verification letter, signed by Brett Patram, Director of Engineering, plus photos of transmitter site. Received in 14 days for a CD report. Station address: 4 Summit Park Drive, Suite 150, Independence, OH 44131-6921 USA. (Patrick Martin, Seaside, OR) Streaming audio **www.whkwradio.com/**

WPOP 1410 kHz AM. *Connecticut's Sport Leader*. Date/frequency station logo card, signed by Richard Waegl, Chief Engineer. Received two days from follow up (145 days total). Station address: 10 Columbus Blvd., Hartford, CT 06106 USA. (Muick) Streaming audio: **www.foxsportsradio1410.com/**

WQLR 1660 kHz AM *The Fan*. Full data verification letter, signed by Peter Tanz, VP Operations. Received in 91 days for a CD report. Station address: 4200 West Main, Kalamazoo, Michigan 49006 USA (Martin). Streaming audio **www.1660thefan.com**

ROMANIA

Radio Romania International, 7325 kHz. Full data color card of Milhail Jora Concert Hall, unsigned. Received for an English report. QSL address: P.O. Box 1-111, 014700 Bucuresti, Romania. Online reception report link and streaming audio at: **www.rri.ro/.** (Dan Amoroso Media, PA)

R. Romania QSL (Courtesy: Dan Amoroso)

SOMALILAND

Radio Hargeisa, 7120 kHz. Date/frequency notation on photo montage QSL card. Received in 15 days. QSL address: Baldur Drobnica, Colsultant (DJ6SI), Zedernweg 6, D-50127 Bergheim, Germany. (John M. Wilkins, Wheat Ridge, CO/Cumbre DX).

UTILITY

Brazil-PPE, Standard Time and Frequency Station, 10.000 MHz. Full data verification letter, initialed. Received in 46 days for an English/Portuguese utility report. Station address: PPE Observatorio Nacional, Rua General Jose Cristino 77, São Cristovão, 20921-400 Rio de Janeiro, RJ, Brazil (Sam Wright, Biloxi, MS)

Croatia-Split Radio 518 kHz. Full data verification letter, signed by Z. Bracic. Received in seven days for a utility report. Station address: Plovput d.o.o.Split, Sektor sigurnosti plovidbe, Obala Lazareta br.1, Split, Croatia. (Patrick Robic, Austria/UDXF).

Germany-MNW Non Directional Beacons, 338 kHz/MNE-Muenchen 369 kHz. Stations verified with full data cards, signed by R. Dietzel. Received in 50 days for two utility reports. Station address: DFS Deutsche Flugsicherung GmbH, Center Niederlassung Sued, SIS/RS, Nordallee 34, 85356 Muenchen-Flughafen, Germany (Robic).

Germany-DCF77 Standard Time and Frequency Station, 77.5 kHz. Full data PTB QSL card and verification letter, signed by Dr. Andreas Bauch. Received in 37 days for a utility report. Station address: Physikalische-Technische Bundesanstalt, Postfach 33 45, 38023 Braunschweig, Germany (Harry A Weber, Oak Lawn, IL).

QSL Aluna ship (Courtesy: German Wikipedia)

International Waters-Josef Moebius (Dredger) 2187.5 kHz. Partial data letter stamped with ship's seal and signed by P. Mertnkat, Naut. Insp. QSL address: Moebius Dredging GmbH, Reeperbahn 1, 20359 Hamburg, Germany (Robic).

ICLIP- AIDA Aluna (Cruise Ship) 8415.5 kHz. Full data prepared QSL card stamped, signed, and returned as verified. Received in 16 days for a utility report. QSL address: AIDA Cruises, Fleet Management, Am Strande 3d, 18055 Rostock, Germany (Robic)

Sweden-DNPI-Nils Holgersson, 2187.5 kHz. Full data prepared QSL card stamped, signed and returned as verified. Received in 30 days for a utility report. QSL address: TT Line, Hamngatan 9, 23122 Trelleborg, Sweden (Robic).

How to Use the Shortwave Guide

0000-0100 twhfa USA, Voice of America 5995am 6130ca 7405am 9455af

① ② ⑤ ③ ④ ⑥ ⑦

CONVERT YOUR TIME TO UTC

Broadcast time on ① and time off ② are expressed in Coordinated Universal Time (UTC) – the time at the 0 meridian near Greenwich, England. To translate your local time into UTC, first convert your local time to 24-hour format, then add (during Daylight Saving Time) 4, 5, 6 or 7 hours for Eastern, Central, Mountain or Pacific Times, respectively. Eastern, Central, and Pacific Times are already converted to UTC for you at the top of each hour.

Note that all ***dates***, as well as times, are in UTC; for example, a show which might air at 0030 UTC ***Sunday*** will be heard on ***Saturday*** evening in America (in other words, 7:30 pm Eastern, 6:30 pm Central, etc.).

Not all countries observe Daylight Saving Time, not all countries shift at the same time, and not all program scheduling is shifted. So if you do not hear your desired station or program, try searching the hour ahead or behind its listed start time.

FIND THE STATION YOU WANT TO HEAR

Look at the page which corresponds to the time you will be listening. English broadcasts are listed by UTC time on ① , then alphabetically by country ③, followed by the station name ④. (If the station name is the same as the country, we don't repeat it, e.g., "Vanuatu, Radio" [Vanuatu].)

If a broadcast is not ***daily***, the days of broadcast⑤ will appear in the column following the time of broadcast, using the following codes:

Codes	
s/Sun	Sunday
m/Mon	Monday
t	Tuesday
w	Wednesday
h	Thursday
f	Friday
a/Sat	Saturday
occ:	occasional
DRM:	Digital Radio Mondiale
irreg	Irregular broadcasts
vl	Various languages
USB:	Upper Sideband

CHOOSE PROMISING FREQUENCIES

Choose the most promising frequencies for the time, location and conditions.

The frequencies ⑥ follow to the right of the station listing; all frequencies are listed in kilohertz (kHz). Not all listed stations will be heard from your location and virtually none of them will be heard all the time on all frequencies.

Shortwave broadcast stations change some of their frequencies at least twice a year, in April and October, to adapt to seasonal conditions. But they can also change in response to short-term conditions, interference, equipment problems, etc. Our frequency manager coordinates published station schedules with confirmations and reports from her monitoring team and *MT* readers to make the Shortwave Guide up-to-date as of one week before print deadline.

To help you find the most promising signal for your location, immediately following each frequency we've included information on the target area ⑦ of the broadcast. Signals beamed toward your area will generally be easier to hear than those beamed elsewhere, even though the latter will often still be audible.

Target Areas

af:	Africa
al:	alternate frequency (occasional use only)
am:	The Americas
as:	Asia
ca:	Central America
do:	domestic broadcast
eu:	Europe
me:	Middle East
na:	North America
pa:	Pacific
sa:	South America
va:	various

Mode used by all stations in this guide is AM unless otherwise indicated.

MT MONITORING TEAM

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Thank You to …

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SHORTWAVE BROADCAST BANDS

kHz	Meters
2300-2495	120 meters (Note 1)
3200-3400	90 meters (Note 1)
3900-3950	75 meters (Regional band, used for broadcasting in Asia only)
3950-4000	75 meters (Regional band, used for broadcasting in Asia and Europe)
4750-4995	60 meters (Note 1)
5005-5060	60 meters (Note 1)
5730-5900	49 meter NIB (Note 2)
5900-5950	49 meter WARC-92 band (Note 3)
5950-6200	49 meters
6200-6295	49 meter NIB (Note 2)
6890-6990	41 meter NIB (Note 2)
7100-7300	41 meters (Regional band, not allocated for broadcasting in the western hemisphere) (Note 4)
7300-7350	41 meter WARC-92 band (Note 3)
7350-7600	41 meter NIB (Note 2)
9250-9400	31 meter NIB (Note 2)
9400-9500	31 meter WARC-92 band (Note 3)
9500-9900	31 meters
11500-11600	25 meter NIB (Note 2)
11600-11650	25 meter WARC-92 band (Note 3)
11650-12050	25 meters
12050-12100	25 meter WARC-92 band (Note 3)
12100-12600	25 meter NIB (Note 2)
13570-13600	22 meter WARC-92 band (Note 3)
13600-13800	22 meters
13800-13870	22 meter WARC-92 band (Note 3)
15030-15100	19 meter NIB (Note 2)
15100-15600	19 meters
15600-15800	19 meter WARC-92 band (Note 3)
17480-17550	17 meter WARC-92 band (Note 3)
17550-17900	17 meters
18900-19020	15 meter WARC-92 band (Note 3)
21450-21850	13 meters
25670-26100	11 meters

Notes

Note 1	Tropical bands, 120/90/60 meters are for broadcast use only in designated tropical areas of the world.
Note 2	Broadcasters can use this frequency range on a (NIB) non-interference basis only.
Note 3	WARC-92 bands are allocated officially for use by HF broadcasting stations in 2007
Note 4	WRC-03 update. After March 29, 2009, the spectrum from 7100-7200 kHz will no longer be available for broadcast purposes and will be turned over to amateur radio operations worldwide

0000 UTC - 8PM EDT / 7PM CDT / 5PM PDT

0000 0030	Egypt, R Cairo	9965am	11510al	
0000 0045	India, AIR/External Svc	9690as	9705as	
	11710as	13605as		
0000 0045 DRM	India, AIR/External Svc	11645as		
0000 0056	Romania, R Romania Intl	9700na	11955na	
0000 0057	China, China R International		6005eu	
	6020as	6180eu	7350as	7415as
	9425as	9570as	11650as	11790as
	11885as			
0000 0100	Anguilla, University Network		6090na	
0000 0100	Australia, ABC/R Australia	9660va	12080pa	
	15240va	15415va	17795pa	19000va
	21740va			
0000 0100	Australia, NT VL8A Alice Springs		4835do	
0000 0100	Australia, NT VL8K Katherine		5025do	
0000 0100	Australia, NT VL8T Tennant Creek		4910do	
0000 0100	Canada, CFRX Toronto ON	6070do		
0000 0100	Canada, CFVP Calgary AB	6030do		
0000 0100	Canada, CKZN St Johns NF		6160do	
0000 0100	Canada, CKZU Vancouver BC		6160do	
0000 0100 Sun	Germany, Mighty KBC Radio		7375eu	
0000 0100	Germany, R 6150	6070eu		
0000 0100	Malaysia, RTM Kajang/Traxx FM		7295do	
0000 0100	Micronesia, V6MP/Cross R/Pohnpei		4755	
	as			
0000 0100	New Zealand, R New Zealand Intl		15720pa	
0000 0100 DRM	New Zealand, R New Zealand Intl		17675pa	
0000 0100	Russia, VO Russia	9665ca		
0000 0100	Spain, R Exterior de Espana		6055na	
0000 0100	Thailand, R Thailand World Svc		13745na	
0000 0100	UK, BBC World Service	5970as	6195as	
	9410as	9740as	11750as	12095as
	15335as	15755as	17685as	
0000 0100	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
0000 0100	USA, Overcomer Ministry	3185na		
0000 0100	USA, WBCQ Monticello ME		7490na	
	9330na			
0000 0100 fas	USA, WBCQ Monticello ME		5110na	
0000 0100	USA, WEWN/EWTN Irondale AL		11520af	
0000 0100	USA, WHRI Cypress Creek SC		5920eu	
	7315ca	9860va	9895na	
0000 0100	USA, WINB Red Lion PA	9265ca		
0000 0100	USA, WRNO New Orleans LA		7505na	
0000 0100	USA, WTWW Lebanon TN	5085sa	5830na	
0000 0100	USA, WWCR Nashville TN	4840eu	5935af	
	6875eu	7520ca		
0000 0100	USA, WWRB Manchester TN		3185na	
	3215na			
0000 0100	USA, WYFR/Family R	6115am		
0030 0100	Australia, ABC/R Australia	17750va		

0100 UTC - 9PM EDT / 8PM CDT / 6PM PDT

0100 0115 mtwha	Australia, HCJB Global Australia		15400as	
0100 0115 Sat/Sun	Canada, Bible VO Broadcasting		9490as	
0100 0130	Vietnam, VO Vietnam/Overseas Svc		12005na	
0100 0157	China, China R International		6020as	
	6075eu	6175eu	7350as	9410as
	9420na	9570na	9580as	11650as
	11885as			
0100 0200	Anguilla, University Network		6090na	
0100 0200	Australia, ABC/R Australia	9660va	12080pa	
	15160pa	15240va	15415va	17750va
	17795pa	19000va		
0100 0200	Australia, NT VL8A Alice Springs		4835do	
0100 0200	Australia, NT VL8K Katherine		5025do	
0100 0200	Australia, NT VL8T Tennant Creek		4910do	
0100 0200	Canada, CFRX Toronto ON	6070do		
0100 0200	Canada, CFVP Calgary AB	6030do		
0100 0200	Canada, CKZN St Johns NF		6160do	
0100 0200	Canada, CKZU Vancouver BC		6160do	
0100 0200	Cuba, R Havana Cuba	5040ca	6000na	
	6165na			
0100 0200 Sun	Germany, Mighty KBC Radio		7375eu	
0100 0200	Germany, R 6150	6070eu		
0100 0200	Malaysia, RTM Kajang/Traxx FM		7295do	
0100 0200	Micronesia, V6MP/Cross R/Pohnpei		4755	
	as			
0100 0200	New Zealand, R New Zealand Intl		15720pa	
0100 0200 DRM	New Zealand, R New Zealand Intl		17675pa	
0100 0200	Palau, T8WH/World Harvest R		17800as	
0100 0200	Russia, VO Russia	9665ca		
0100 0200	Taiwan, R Taiwan Intl	11875as		
0100 0200	UK, BBC World Service	12095as	15310as	
0100 0200	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
0100 0200	USA, BBG/VO America	7430va	9780va	
	11705va			
0100 0200	USA, KJES Vado NM	7555na		
0100 0200	USA, Overcomer Ministry	3185na		
0100 0200 mtwhf	USA, Overcomer Ministry	7490na		
0100 0200	USA, WBCQ Monticello ME		7490na	
	9330na			
0100 0200 fas	USA, WBCQ Monticello ME		5110na	
0100 0200	USA, WEWN/EWTN Irondale AL		11520af	
0100 0200	USA, WHRI Cypress Creek SC		7315ca	
	9605eu	9860va		
0100 0200	USA, WINB Red Lion PA	9265ca		
0100 0200	USA, WRNO New Orleans LA		7505na	
0100 0200	USA, WTWW Lebanon TN	5085sa	5830na	
0100 0200	USA, WWCR Nashville TN	3215eu	4840na	
	5935af	7520ca		
0100 0200	USA, WWRB Manchester TN		3185na	
	3215na			
0100 0200	USA, WYFR/Family R	6115am		
0115 0120 mtwhf	Kyrgyzstan, Kyrgyz Radiosu		4010do	
0120 0200	Myanmar, Thazin R	6030do		
0120 0200 mtwhfa	Sri Lanka, SLBC	6005as	9770as	15745as
0130 0200 twhfas	Albania, R Tirana	9850va		
0130 0200 twhfa	Serbia, International R Serbia		6190eu	
0140 0159	Vatican City State, Vatican R		7410as	
	9560as			

0200 UTC - 10PM EDT / 9PM CDT / 7PM PDT

0200 0230	Thailand, R Thailand World Svc		15275na	
0200 0230	USA, KJES Vado NM	7555na		
0200 0257	China, China R International		11785as	
	13640as			
0200 0300	Anguilla, University Network		6090na	
0200 0300 twhfa	Argentina, RAE	11710am		
0200 0300	Australia, ABC/R Australia	9660va	12080pa	
	15160pa	15240va	15415va	17750va
	17795pa	19000va		
0200 0300	Australia, NT VL8A Alice Springs		4835do	
0200 0300	Australia, NT VL8K Katherine		5025do	
0200 0300	Australia, NT VL8T Tennant Creek		4910do	
0200 0300	Canada, CFRX Toronto ON	6070do		
0200 0300	Canada, CFVP Calgary AB	6030do		
0200 0300	Canada, CKZN St Johns NF		6160do	
0200 0300	Canada, CKZU Vancouver BC		6160do	
0200 0300	Cuba, R Havana Cuba	6000na	6165na	
0200 0300	Egypt, R Cairo	9720na	9315al	
0200 0300	Germany, R 6150	6070eu		
0200 0300	Malaysia, RTM Kajang/Traxx FM		7295do	
0200 0300	Micronesia, V6MP/Cross R/Pohnpei		4755	
	as			
0200 0300	New Zealand, R New Zealand Intl		15720pa	
0200 0300 DRM	New Zealand, R New Zealand Intl		17675pa	
0200 0300	Palau, T8WH/World Harvest R		17800as	
0200 0300	Philippines, R Pilipinas Overseas Svc		15285me	
	17700me	17820me		
0200 0300	Russia, VO Russia	9665ca		
0200 0300	South Korea, KBS World R		9580sa	
	9690as			
0200 0300 mtwhfa	Sri Lanka, SLBC	6005as	9770as	15745as
0200 0300	UK, BBC World Service	15310as	17790as	
0200 0300	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
0200 0300	USA, Overcomer Ministry	3185na		
0200 0300 mtwhf	USA, Overcomer Ministry	7490na		
0200 0300	USA, WBCQ Monticello ME		7490na	
	9330na			

0200 0300 fas	USA, WBCQ Monticello ME	5110na
0200 0300	USA, WEWN/EWTN Irondale AL	11520af
0200 0300	USA, WHRI Cypress Creek SC 7315sa 9860va	5920eu
0200 0300	USA, WINB Red Lion PA	9265ca
0200 0300	USA, WRNO New Orleans LA	7505na
0200 0300	USA, WTWW Lebanon TN	5085sa 5830na
0200 0300	USA, WWCR Nashville TN 5890ca 5935af	3215eu 4840na
0200 0300	USA, WWRB Manchester TN 3195na	3185na
0200 0300	USA, WYFR/Family R	6115am
0215 0227 Sun	Nepal, R Nepal	5005do
0215 0300	Myanmar, Myanma R	9731do
0230 0300	Myanmar, Myanma R	5985do
0230 0300	Vietnam, VO Vietnam/Overseas Svc	12005na
0255 0300 Sun	Swaziland, TWR Africa	3200af

0300 UTC - 11PM EDT / 10PM CDT / 8PM PDT

0300 0320	Vatican City State, Vatican R	15460as
0300 0325 Sun	Swaziland, TWR Africa	3200af
0300 0327	Vatican City State, Vatican R 11625af	9660af
0300 0330	Egypt, R Cairo	9720na 9315al
0300 0330	Myanmar, Myanma R	5985do
0300 0330	Philippines, R Pilipinas Overseas Svc 17700me 17820me	15285me
0300 0330 Sat	Sri Lanka, SLBC	6005as 9770as 15745as
0300 0356	Romania, R Romania Intl 17830as	7350na 9645na
0300 0356 DRM	Romania, R Romania Intl	15340as
0300 0357	China, China R International 9690na 9790as 11785as 15110as 15120as	9460am 13620as
0300 0400	Anguilla, University Network	6090na
0300 0400	Australia, ABC/R Australia 15415va 17750va 21725va	9660va 15160pa
0300 0400	Australia, NT VL8A Alice Springs	4835do
0300 0400	Australia, NT VL8K Katherine	5025do
0300 0400	Australia, NT VL8T Tennant Creek	4910do
0300 0400	Canada, CFRX Toronto ON	6070do
0300 0400	Canada, CFVP Calgary AB	6030do
0300 0400	Canada, CKZN St Johns NF	6160do
0300 0400	Canada, CKZU Vancouver BC	6160do
0300 0400	Cuba, R Havana Cuba	6000na 6165na
0300 0400	Germany, R 6150	6070eu
0300 0400	Malaysia, RTM Kajang/Traxx FM	7295do
0300 0400	Micronesia, V6MP/Cross R/Pohnpei as	4755
0300 0400	New Zealand, R New Zealand Intl	15720pa
0300 0400 DRM	New Zealand, R New Zealand Intl	17675pa
0300 0400	Oman, R Sultanate of Oman	13600af
0300 0400	Palau, T8WH/World Harvest R	17800as
0300 0400	Russia, VO Russia	9665ca
0300 0400 mtwhf	South Africa, Channel Africa 5980af	3345af
0300 0400	Taiwan, R Taiwan Intl	15320as
0300 0400	Turkey, VO Turkey	6165as 9515va
0300 0400	UK, BBC World Service	12095as 15365as
0300 0400	USA, AFN/AFRTS 12759usb 13362usb	4319usb 5765usb
0300 0400	USA, BBG/VO America 9885af	4930af 6080af
0300 0400	USA, Overcomer Ministry	3185na
0300 0400 mtwhf	USA, Overcomer Ministry	7490na
0300 0400	USA, WBCQ Monticello ME 9330na	7490na
0300 0400	USA, WEWN/EWTN Irondale AL	11520af
0300 0400	USA, WHRI Cypress Creek SC 7385sa 9825va	6175ca
0300 0400	USA, WINB Red Lion PA	9265ca
0300 0400	USA, WRNO New Orleans LA	7505na
0300 0400	USA, WTWW Lebanon TN	5085sa 5830na
0300 0400	USA, WWCR Nashville TN 5890ca 5935af	3215eu 4840na
0300 0400	USA, WWRB Manchester TN 3195na	3185na
0330 0400	Iran, VO Islamic Rep of Iran/VO Justice 13650eu 15470eu	
0330 0400	Vietnam, VO Vietnam/Overseas Svc	6175ca

0400 UTC - 12AM EDT / 11PM CDT / 9PM PDT

0400 0427	Iran, VO Islamic Rep of Iran/VO Justice 13650eu 15470eu	
0400 0430	USA, WHRI Cypress Creek SC	7385eu
0400 0457	China, China R International 13620va 15120as 17725va	9460na 17855va
0400 0457	Germany, Deutsche Welle	9470af 12045af
0400 0457	North Korea, VO Korea 9730as 11735ca 13760sa	7220as 9445as 15180sa
0400 0458	New Zealand, R New Zealand Intl	15720pa
0400 0458 DRM	New Zealand, R New Zealand Intl	17675pa
0400 0500	Anguilla, University Network	6090na
0400 0500	Australia, ABC/R Australia 15160pa 15240va 15415va	9660va 12080pa 21725va
0400 0500	Australia, NT VL8A Alice Springs	4835do
0400 0500	Australia, NT VL8K Katherine	5025do
0400 0500	Australia, NT VL8T Tennant Creek	4910do
0400 0500	Canada, CFRX Toronto ON	6070do
0400 0500	Canada, CKZN St Johns NF	6160do
0400 0500	Canada, CKZU Vancouver BC	6160do
0400 0500	Cuba, R Havana Cuba	6000na 6165na
0400 0500	Germany, Deutsche Welle	5905af
0400 0500	Germany, R 6150	6070eu
0400 0500	Malaysia, RTM Kajang/Traxx FM	7295do
0400 0500	Micronesia, V6MP/Cross R/Pohnpei as	4755
0400 0500	Palau, T8WH/World Harvest R	17800as
0400 0500 mtwhf	South Africa, Channel Africa	3345af
0400 0500 Sun	Sri Lanka, SLBC	6005as 9770as 15745as
0400 0500	UK, BBC World Service 12095as 15365as	3955va 11945af 15420af
0400 0500	USA, AFN/AFRTS 12759usb 13362usb	4319usb 5765usb
0400 0500	USA, BBG/VO America 6080af 9885af	4930af 4960af 12025af
0400 0500	USA, Overcomer Ministry	3185na 5890na
0400 0500 mtwhf	USA, WBCQ Monticello ME	7490na
0400 0500	USA, WBCQ Monticello ME	9330na
0400 0500	USA, WEWN/EWTN Irondale AL	11520af
0400 0500	USA, WHRI Cypress Creek SC 11635va	6175ca
0400 0500	USA, WINB Red Lion PA	9265ca
0400 0500	USA, WRNO New Orleans LA	7505na
0400 0500	USA, WTWW Lebanon TN	5085sa 5830na
0400 0500	USA, WWCR Nashville TN 5935ca 15285af	4840eu 5890na
0400 0500	USA, WWRB Manchester TN 3195na	3185na
0415 0420 mtwhf	Kyrgyzstan, Kyrgyz Radiosu	4010do
0430 0500	Myanmar, Thazin R	9460do
0430 0500 mtwhf	Swaziland, TWR Africa	3200af
0430 0500	USA, BBG/VO America 6080af 12025af	4930af 4960af
0430 0500	USA, WHRI Cypress Creek SC	6175ca
0455 0500 mtwhf	Nigeria, VO Nigeria	15120eu
0459 0500	New Zealand, R New Zealand Intl	11725pa
0459 0500 DRM	New Zealand, R New Zealand Intl	11675pa

0500 UTC - 1AM EDT / 12AM CDT / 10PM PDT

0500 0527	Germany, Deutsche Welle	5905af 9470af
0500 0527	Vatican City State, Vatican R 13765af	7360af
0500 0530	Germany, Deutsche Welle	9800af 12045af
0500 0530	Japan, R Japan/NHK World 11970af	5975as
0500 0557	China, China R International 11880as 15350as 15465as 17540va 17725va 17855va	7220as 17505va
0500 0557	North Korea, VO Korea	13650as 15105as
0500 0600	Anguilla, University Network	6090na
0500 0600	Australia, ABC/R Australia 13630pa 15415va 21725va	9660va 12080pa

0500 0600	Australia, NT VL8A Alice Springs	4835do
0500 0600	Australia, NT VL8K Katherine	5025do
0500 0600	Australia, NT VL8T Tennant Creek	4910do
0500 0600	Bhutan, Bhutan BC Svc 6035do	
0500 0600	Canada, CFRX Toronto ON 6070do	
0500 0600	Canada, CKZN St Johns NF	6160do
0500 0600	Canada, CKZU Vancouver BC	6160do
0500 0600	Cuba, R Havana Cuba 6010na 6060na 6125am 6165na	
0500 0600	Eqt Guinea, Pan Am BC/R Africa	15190af
0500 0600	Germany, R 6150 6070eu	
0500 0600	Malaysia, RTM Kajang/Traxx FM	7295do
0500 0600	Micronesia, V6MP/Cross R/Pohnpei as	4755
0500 0600	Myanmar, Thazin R 9460do	
0500 0600	New Zealand, R New Zealand Intl	11725pa
0500 0600 DRM	New Zealand, R New Zealand Intl	11675pa
0500 0600 mtwhf	Nigeria, VO Nigeria 15120af	
0500 0600	Palau, T8WH/World Harvest R	17800as
0500 0600 mtwhf	South Africa, Channel Africa	7230af
0500 0600	Swaziland, TWR Africa 3200af 9500af	
0500 0600	UK, BBC World Service 3255af 3955va 5875af 6005af 6190af 7355af 11945af 15420af	
0500 0600	USA, AFN/AFRTS 4319usb 5765usb 12759usb 13362usb	
0500 0600	USA, BBG/VO America 4930af 6080af 12025af 15580af	
0500 0600	USA, Overcomer Ministry 3185na 5890na	
0500 0600	USA, WBCQ Monticello ME	9330na
0500 0600	USA, WEWN/EWTN Irondale AL	11520af
0500 0600	USA, WHRI Cypress Creek SC 7385af 11635va	7315af
0500 0600	USA, WTWW Lebanon TN 5085sa	5830na
0500 0600	USA, WWCR Nashville TN 3215eu 5890ca 5935af	4840na
0500 0600	USA, WWRB Manchester TN	3185na
0502 0600	Swaziland, TWR Africa 6120af	9500af
0515 0530	Rwanda, R Rep Rwandaise 6055do	
0530 0556	Romania, R Romania Intl 9700eu 21500pa	17760pa
0530 0556 DRM	Romania, R Romania Intl 11875eu	
0530 0557	Germany, Deutsche Welle 9800af	
0530 0600	Australia, ABC/R Australia 17750va	
0530 0600	Germany, Deutsche Welle 12045af	
0530 0600	Thailand, R Thailand World Svc	12015eu

0600 UTC - 2AM EDT / 1AM CDT / 11PM PDT

0600 0627	Germany, Deutsche Welle 15275af	
0600 0630	China, Xizang PBS 6025do 6130do 9580do	
0600 0630	Germany, Deutsche Welle 12045af	17800af
0600 0630	Myanmar, Thazin R 9460do	
0600 0657	China, China R International 11750af 11770me 11880as 13645as 15145as 15350as 15465as 17505va 17540as 17710va	
0600 0657	North Korea, VO Korea 7220as 9445as 9730as	
0600 0700	Anguilla, University Network	6090na
0600 0700	Australia, ABC/R Australia 9660va 11945va 13630pa 15240va 15415va 17750va 21725va	
0600 0700	Australia, NT VL8A Alice Springs	4835do
0600 0700	Australia, NT VL8K Katherine	5025do
0600 0700	Australia, NT VL8T Tennant Creek	4910do
0600 0700	Canada, CFRX Toronto ON 6070do	
0600 0700	Canada, CFVP Calgary AB 6030do	
0600 0700	Canada, CKZN St Johns NF	6160do
0600 0700	Canada, CKZU Vancouver BC	6160do
0600 0700	Cuba, R Havana Cuba 6010na 6060na 6125am 6165na	
0600 0700	Eqt Guinea, Pan Am BC/R Africa	15190af
0600 0700	Germany, R 6150 6070eu	
0600 0700	Malaysia, RTM Kajang/Traxx FM	7295do
0600 0700	Micronesia, V6MP/Cross R/Pohnpei as	4755
0600 0700 DRM	New Zealand, R New Zealand Intl	11675pa
0600 0700	New Zealand, R New Zealand Intl	11725pa
0600 0700 mtwhf	Nigeria, VO Nigeria 15120af	
0600 0700	Palau, T8WH/World Harvest R	17800as
0600 0700	Russia, VO Russia 21800pa	21820pa
0600 0700 DRM	Russia, VO Russia 11830eu	
0600 0700 mtwhf	South Africa, Channel Africa 15255af	7230af
0600 0700	Swaziland, TWR Africa 3200af 9500af	6120af
0600 0700	UK, BBC World Service 5875eu 6005af 6190af 7325eu 9410af 9860af 12095af 15105af 15420af 17640af	
0600 0700	USA, AFN/AFRTS 4319usb 12759usb 13362usb	5765usb
0600 0700	USA, BBG/VO America 6080af 15580af	12025af
0600 0700	USA, Overcomer Ministry 3185na	5890na
0600 0700	USA, WEWN/EWTN Irondale AL	11520af
0600 0700	USA, WHRI Cypress Creek SC 7385af 11635va	7315sa
0600 0700	USA, WTWW Lebanon TN 5830na	
0600 0700	USA, WWCR Nashville TN 3215eu 5890ca 5935af	4840na
0600 0700	USA, WWRB Manchester TN	3185na
0617 0630 Sun	Nepal, R Nepal 5005do	
0630 0657	Vatican City State, Vatican R 13765af	11625af
0630 0700	Germany, Deutsche Welle 15440af	17800af
0630 0700 wa	Germany, Hamburger Lokalradio	7265eu

0700 UTC - 3AM EDT / 2AM CDT / 12AM PDT

0700 0730	Myanmar, Myanma R 5985do	
0700 0745 Sat/Sun	Canada, Bible VO Broadcasting	5945eu
0700 0757	China, China R International 11785as 11880as 13645eu 15125as 15350as 15465as 17490eu 17540as 17710as	
0700 0758	New Zealand, R New Zealand Intl	11725pa
0700 0758 DRM	New Zealand, R New Zealand Intl	11675pa
0700 0800	Anguilla, University Network	6090na
0700 0800	Australia, ABC/R Australia 7410va 9475as 9660va 9710va 11945va 12080pa 13630pa 15240va	
0700 0800	Australia, NT VL8A Alice Springs	4835do
0700 0800	Australia, NT VL8K Katherine	5025do
0700 0800	Australia, NT VL8T Tennant Creek	4910do
0700 0800	Canada, CFRX Toronto ON 6070do	
0700 0800	Canada, CFVP Calgary AB 6030do	
0700 0800	Canada, CKZN St Johns NF	6160do
0700 0800	Canada, CKZU Vancouver BC	6160do
0700 0800	Eqt Guinea, Pan Am BC/R Africa	15190af
0700 0800 wa	Germany, Hamburger Lokalradio	7265eu
0700 0800	Germany, R 6150 6070eu	
0700 0800	Malaysia, RTM Kajang/Traxx FM	7295do
0700 0800	Micronesia, V6MP/Cross R/Pohnpei as	4755
0700 0800	Palau, T8WH/World Harvest R	17800as
0700 0800	Russia, VO Russia 13785as 17500as 21800pa 21820pa	
0700 0800 DRM	Russia, VO Russia 11830eu	
0700 0800 mtwhf	South Africa, Channel Africa	9625af
0700 0800	Swaziland, TWR Africa 3200af 9500af	6120af
0700 0800	UK, BBC World Service 5875eu 6190af 7325va 11770af 12095af 13660af 15400af 15420af 17640af 17830af	
0700 0800	USA, AFN/AFRTS 4319usb 12759usb 13362usb	5765usb
0700 0800	USA, Overcomer Ministry 3185na	5890na
0700 0800	USA, WEWN/EWTN Irondale AL	11520af
0700 0800	USA, WHRI Cypress Creek SC 7315af 7385af	5920eu
0700 0800	USA, WTWW Lebanon TN 5830na	
0700 0800	USA, WWCR Nashville TN 3215eu 5890ca 5935af	4840na
0700 0800	USA, WWRB Manchester TN	3185na
0730 0744	Vatican City State, Vatican R	15595va

0730 0800	Australia, HCJB Global Australia	15490as
0759 0800	New Zealand, R New Zealand Intl	9700pa
0759 0800 DRM	New Zealand, R New Zealand Intl	9890pa

0800 UTC - 4AM EDT / 3AM CDT / 1AM PDT

0800 0830	Australia, HCJB Global Australia	15490as
0800 0830	Australia, NT VL8A Alice Springs	4835do
0800 0830	Australia, NT VL8K Katherine	5025do
0800 0830	Australia, NT VL8T Tennant Creek	4910do
0800 0850	Austria, TWR Europe 7400eu	
0800 0850	Germany, TWR Europe 6105eu	
0800 0857	China, China R International	9415as
	11785as 11880as 15350as 15465as	
	15625va 17490eu 17540as	
0800 0900	Anguilla, University Network	6090na
0800 0900	Australia, ABC/R Australia 5995as	7410va
	9475as 9580pa 9710va 11945va	
	12080pa 15240va	
0800 0900	Canada, CFRX Toronto ON 6070do	
0800 0900	Canada, CFVP Calgary AB 6030do	
0800 0900	Canada, CKZN St Johns NF	6160do
0800 0900	Canada, CKZU Vancouver BC	6160do
0800 0900	Eqt Guinea, Pan Am BC/R Africa	15190af
0800 0900	Germany, R 6150 6070eu	
0800 0900 Sat	Italy, IRRS Shortwave 9510va	
0800 0900	Malaysia, RTM Kajang/Traxx FM	7295do
0800 0900	Micronesia, V6MP/Cross R/Pohnpei as	4755
0800 0900	New Zealand, R New Zealand Intl	9700pa
0800 0900 DRM	New Zealand, R New Zealand Intl	9890pa
0800 0900 mtwhf	Nigeria, VO Nigeria 15120af	
0800 0900	Palau, T8WH/World Harvest R	9930as
	17800as	
0800 0900	Russia, VO Russia 13785as	17500as
	21800va 21820pa	
0800 0900 DRM	Russia, VO Russia 9850eu	11830eu
0800 0900 mtwhf	South Africa, Channel Africa	9625af
0800 0900 Sun	South Africa, R Mirror Intl 7205af	17570af
0800 0900	South Korea, KBS World R	9570as
0800 0900	USA, AFN/AFRTS 4319usb	5765usb
	12759usb 13362usb	
0800 0900	USA, KNLS Anchor Point AK	7355as
0800 0900	USA, Overcomer Ministry 3185na	5890na
0800 0900	USA, WEWN/EWTN Irondale AL	11520af
0800 0900	USA, WHRI Cypress Creek SC	5920eu
	7385af 11565pa	
0800 0900	USA, WTWW Lebanon TN 5830na	
0800 0900	USA, WWCR Nashville TN 3215eu	4840na
	5890ca 5935af	
0800 0900	USA, WWRB Manchester TN	3185na
0815 0827	Nepal, R Nepal 5005do	
0830 0900	Australia, NT VL8A Alice Springs	2310do
0830 0900	Australia, NT VL8K Katherine	2485do
0830 0900	Australia, NT VL8T Tennant Creek	2325do
0850 0900 mtwhf	Guam, KTWR/TWR Asia 15200as	

0900 UTC - 5AM EDT / 4AM CDT / 2AM PDT

0900 0910	Pakistan, R Pakistan External Svc	11570eu
	15265eu	
0900 0930 mtwhf	Guam, KTWR/TWR Asia 15200as	
0900 0930	Mongolia, Voice of Mongolia	12085as
0900 0957	China, China R International	9415as
	15210as 15270eu 15350as 17490eu	
	17570eu 17650eu 17690va 17750va	
0900 1000	Anguilla, University Network	6090na
0900 1000	Australia, ABC/R Australia 9580pa	11945va
0900 1000	Australia, NT VL8A Alice Springs	2310do
0900 1000	Australia, NT VL8K Katherine	2485do
0900 1000	Australia, NT VL8T Tennant Creek	2325do
0900 1000	Canada, CFRX Toronto ON 6070do	
0900 1000	Canada, CFVP Calgary AB 6030do	
0900 1000	Canada, CKZN St Johns NF	6160do
0900 1000	Canada, CKZU Vancouver BC	6160do
0900 1000 Sat/Sun	Germany, Mighty KBC Radio	6095eu
0900 1000	Germany, R 6150 6070eu	
0900 1000	Malaysia, RTM Kajang/Traxx FM	7295do
0900 1000	Micronesia, V6MP/Cross R/Pohnpei as	4755
0900 1000 DRM	New Zealand, R New Zealand Intl	9890pa
0900 1000	New Zealand, R New Zealand Intl	9700pa
0900 1000 mtwhf	Nigeria, VO Nigeria 9690af	
0900 1000	Palau, T8WH/World Harvest R	9930as
	15400as	
0900 1000	Russia, VO Russia 21800va	21820va
0900 1000 DRM	Russia, VO Russia 9850eu	11830eu
0900 1000 mtwhf	South Africa, Channel Africa	9625af
0900 1000	USA, AFN/AFRTS 4319usb	5765usb
	12759usb 13362usb	
0900 1000	USA, Overcomer Ministry 3185na	5890na
0900 1000	USA, WEWN/EWTN Irondale AL	11520af
0900 1000	USA, WHRI Cypress Creek SC	6195ca
	7385af 11565pa	
0900 1000	USA, WTWW Lebanon TN 5830na	
0900 1000	USA, WWCR Nashville TN 4840na	5890ca
	5935af 15285eu	
0900 1000	USA, WWRB Manchester TN	3185na
0930 1000 fs	China, VO the Strait 6115do	
0930 1000 Sun	Italy, IRRS Shortwave 9510va	

1000 UTC - 6AM EDT / 5AM CDT / 3AM PDT

1000 1000	USA, KNLS Anchor Point AK	7355as
1000 1018 mtwhf	Guam, KTWR/TWR Asia 11840pa	
1000 1030 Sat	Guam, KTWR/TWR Asia 11840pa	
1000 1030	Japan, R Japan/NHK World	9625as
	9695as	
1000 1057	China, China R International	5955na
	7215as 11640as 13590as 13720as	
	15190as 15210pa 15350as 17490eu	
	17690va	
1000 1057	North Korea, VO Korea 11710ca	11735as
	13650as 15180sa	
1000 1058	New Zealand, R New Zealand Intl	9700pa
1000 1058 DRM	New Zealand, R New Zealand Intl	9890pa
1000 1100	Anguilla, University Network	11775na
1000 1100	Australia, ABC/R Australia 9580pa	12065pa
1000 1100 Sat/Sun	Australia, ABC/R Australia 5995as	6080as
	6150as 9475va 9710va	12080pa
1000 1100	Australia, NT VL8A Alice Springs	2310do
1000 1100	Australia, NT VL8K Katherine	2485do
1000 1100	Australia, NT VL8T Tennant Creek	2325do
1000 1100	Canada, CFRX Toronto ON 6070do	
1000 1100	Canada, CFVP Calgary AB 6030do	
1000 1100	Canada, CKZN St Johns NF	6160do
1000 1100	Canada, CKZU Vancouver BC	6160do
1000 1100 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1000 1100	Germany, R 6150 6070eu	
1000 1100	India, AIR/External Svc 7270as	13605as
	13695pa 15030as 15410as 17510pa	
	17895pa	
1000 1100	Indonesia, VO Indonesia 9526va	
1000 1100 Sun	Italy, IRRS Shortwave 9510va	
1000 1100	Malaysia, RTM Kajang/Traxx FM	7295do
1000 1100	Micronesia, V6MP/Cross R/Pohnpei	4755as
1000 1100 mtwhf	Nigeria, VO Nigeria 9690af	
1000 1100	Palau, T8WH/World Harvest R	9930as
	17800as	
1000 1100	Russia, VO Russia 11530as	12030as
1000 1100 DRM	Russia, VO Russia 9850eu	
1000 1100	Saudi Arabia, BSKSA/European Pgm	15250as
1000 1100 mtwhf	South Africa, Channel Africa	9625af
1000 1100	UK, BBC World Service 6195as	9740as
	15285as 17760as 21660as	
1000 1100	USA, AFN/AFRTS 4319usb	5765usb
	12759usb 13362usb	
1000 1100	USA, Overcomer Ministry 3185na	5890na
1000 1100	USA, WEWN/EWTN Irondale AL	11520af
1000 1100	USA, WHRI Cypress Creek SC	6195ca
	7385af 11565pa	
1000 1100	USA, WTWW Lebanon TN 5830na	
1000 1100	USA, WWCR Nashville TN 4840na	5890ca
	5935af 15285eu	
1000 1100	USA, WWRB Manchester TN	3185na

1000 1100	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as
1030 1100	Iran, VO Islamic Rep of Iran	21505va 21640va
1059 1100	New Zealand, R New Zealand Intl	9655pa
1059 1100 DRM	New Zealand, R New Zealand Intl	9890pa

1100 UTC - 7AM EDT / 6AM CDT / 4AM PDT

1100 1105	Pakistan, R Pakistan External Svc	11570eu 15265eu
1100 1115 mwh	Australia, HCJB Global Australia	15400as
1100 1127	Iran, VO Islamic Rep of Iran	21505va 21640va
1100 1130 Sun	Canada, Bible VO Broadcasting	7470as
1100 1130 DRM/f	Japan, R Japan/NHK World	9760eu
1100 1130 Sat/DRM	South Korea, KBS World R	9760eu
1100 1130	Vietnam, VO Vietnam/Overseas Svc	7285as
1100 1156	Romania, R Romania Intl 15210eu	15430eu 17510eu 17670af
1100 1157 Sat	Canada, Bible VO Broadcasting	7470as
1100 1157	China, China R International	5955as 9570as 11650as 11795as 13590as 13645as 13665as 13720as 17490va
1100 1200	Anguilla, University Network	11775na
1100 1200	Australia, ABC/R Australia 5995as	6080as 6140as 6150va 9475as 9580pa 11945va 12065pa
1100 1200 DRM	Australia, ABC/R Australia	12080pa
1100 1200	Australia, NT VL8A Alice Springs	2310do
1100 1200	Australia, NT VL8K Katherine	2485do
1100 1200	Australia, NT VL8T Tennant Creek	2325do
1100 1200	Canada, CFRX Toronto ON	6070do
1100 1200	Canada, CFVP Calgary AB	6030do
1100 1200	Canada, CKZN St Johns NF	6160do
1100 1200	Canada, CKZU Vancouver BC	6160do
1100 1200 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1100 1200	Germany, R 6150	6070eu
1100 1200 Sun	Italy, IRRS Shortwave	9510va
1100 1200	Malaysia, RTM Kajang/Traxx FM	7295do
1100 1200	Micronesia, V6MP/Cross R/Pohnpei	4755as
1100 1200	New Zealand, R New Zealand Intl	9655pa
1100 1200 DRM	New Zealand, R New Zealand Intl	9890pa
1100 1200 mtwhf	Nigeria, VO Nigeria	9690af
1100 1200	Palau, T8WH/World Harvest R	9625as 9930as
1100 1200	Russia, VO Russia 11530as	12030as 15670as
1100 1200 DRM	Russia, VO Russia	9850eu
1100 1200	Saudi Arabia, BSKSA/European Pgm	15250as
1100 1200 mtwhf	South Africa, Channel Africa	9625af
1100 1200	Taiwan, R Taiwan Intl 7445as	9465as
1100 1200	UK, BBC World Service 6195as	9740as 15285as 17760as
1100 1200	USA, AFN/AFRTS 4319usb	5765usb 12759usb 13362usb
1100 1200	USA, Overcomer Ministry 3185na	5890na
1100 1200	USA, Overcomer Ministry	13570as
1100 1200	USA, WEWN/EWTN Irondale AL	11520af
1100 1200	USA, WHRI Cypress Creek SC	7315ca 9795as 11565pa
1100 1200	USA, WTWW Lebanon TN	5830na
1100 1200	USA, WWCR Nashville TN 4840na	5890ca 5935af 15285eu
1100 1200	USA, WWRB Manchester TN	3185na
1115 1145 f	Canada, Bible VO Broadcasting	7470as
1130 1145 smtha	Australia, HCJB Global Australia	15340as
1130 1200 Sun	USA, WINB Red Lion PA 13570ca	
1130 1200	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as
1130 1200 f	Vatican City State, Vatican R	17590va 21650va

1200 UTC - 8AM EDT / 7AM CDT / 5AM PDT

1200 1230	Japan, R Japan/NHK World	9695af 11740as
1200 1230	Saudi Arabia, BSKSA/European Pgm	15250as
1200 1257	China, China R International	5955as 7250as 9460as 9600as 9645as 9730pa 9760as 11760as 11980as 12015va 13655eu 13790eu 17490eu
1200 1258	New Zealand, R New Zealand Intl	9655pa
1200 1300	Anguilla, University Network	11775na
1200 1300	Australia, ABC/R Australia 6080as	6140as 6150va 9475as 9580pa 11945va
1200 1300 DRM	Australia, ABC/R Australia 5995as	
1200 1300	Australia, NT VL8A Alice Springs	2310do
1200 1300	Australia, NT VL8K Katherine	2485do
1200 1300	Australia, NT VL8T Tennant Creek	2325do
1200 1300	Canada, CFRX Toronto ON 6070do	
1200 1300	Canada, CFVP Calgary AB 6030do	
1200 1300	Canada, CKZN St Johns NF	6160do
1200 1300	Canada, CKZU Vancouver BC	6160do
1200 1300	Ethiopia, R Ethiopia/Natl Svc	9705do
1200 1300 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1200 1300	Germany, R 6150	6070eu
1200 1300	Malaysia, RTM Kajang/Traxx FM	7295do
1200 1300 mtwhf	Nigeria, VO Nigeria	9690af
1200 1300	Palau, T8WH/World Harvest R	9930as 9960as
1200 1300	Papua New Guinea, R Fly	3915do
1200 1300	Russia, VO Russia 11530as	15670as
1200 1300	UK, BBC World Service 5875as	6195as 9740as 11750as
1200 1300	USA, AFN/AFRTS 4319usb	5765usb 12759usb 13362usb
1200 1300	USA, BBG/VO America 7575va	9510va 12075va 12150va
1200 1300	USA, KNLS Anchor Point AK	7355as 9615as
1200 1300	USA, Overcomer Ministry	3185na
1200 1300 mtwhf	USA, Overcomer Ministry	5890na
1200 1300	USA, Overcomer Ministry	13570as
1200 1300	USA, WBCQ Monticello ME	9330na
1200 1300	USA, WEWN/EWTN Irondale AL	11520af
1200 1300	USA, WHRI Cypress Creek SC	9795na 9840as 11565pa
1200 1300 Sun	USA, WINB Red Lion PA 13570ca	
1200 1300	USA, WTWW Lebanon TN 5830na	
1200 1300	USA, WWCR Nashville TN 7490af	9980ca 13845na 15285eu
1200 1300	USA, WWRB Manchester TN	3185na
1215 1300	Egypt, R Cairo 17870as	
1230 1245 smtwhf	Australia, HCJB Global Australia	15400pa
1230 1300	Bangladesh, Bangladesh Betar/Ext Svc	15105as
1230 1300	South Korea, KBS World R	6095as
1230 1300	Thailand, R Thailand World Svc	9720as
1230 1300	Turkey, VO Turkey 15450va	
1230 1300	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as

1300 UTC - 9AM EDT / 8AM CDT / 6AM PDT

1300 1330	Egypt, R Cairo 17870as	
1300 1330	Japan, R Japan/NHK World	15735as
1300 1330	Turkey, VO Turkey 15450eu	
1300 1357	China, China R International	5995as 7300na 9570as 9655pa 9730va 9765as 9870as 11760as 11900as 11980as 13670eu 13790eu
1300 1357	North Korea, VO Korea 9435na	11710na 13760eu 15245eu
1300 1400	Anguilla, University Network	11775na
1300 1400	Australia, ABC/R Australia 5940as	6150va 9580pa 12065pa
1300 1400 DRM	Australia, ABC/R Australia 5995as	
1300 1400	Australia, NT VL8A Alice Springs	2310do
1300 1400	Australia, NT VL8K Katherine	2485do
1300 1400	Canada, CFRX Toronto ON 6070do	
1300 1400	Canada, CFVP Calgary AB 6030do	
1300 1400	Canada, CKZN St Johns NF	6160do
1300 1400	Canada, CKZU Vancouver BC	6160do
1300 1400 Sat/Sun	Germany, Mighty KBC Radio	6095eu

1300 1400	Germany, R 6150	6070eu
1300 1400	Indonesia, VO Indonesia	9526va
1300 1400	Malaysia, RTM Kajang/Traxx FM	7295do
1300 1400	New Zealand, R New Zealand Intl	6170pa
1300 1400 mtwhf	Nigeria, VO Nigeria	9690af
1300 1400	Palau, T8WH/World Harvest R	9965as 11705as
1300 1400	Papua New Guinea, R Fly	3915do
1300 1400	Russia, VO Russia	12030as 15670as
1300 1400 DRM	Russia, VO Russia	9850eu
1300 1400	South Korea, KBS World R	9570as 15575na
1300 1400	Tajikistan, VO Tajik	7245va
1300 1400	UK, BBC World Service	5875as 6195as 9740as 15310as 17790as
1300 1400	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
1300 1400 Sat/Sun	USA, BBG/VO America	7575va 9510va 12075va 12150va
1300 1400	USA, KJES Vado NM	11715na
1300 1400 mtwhf	USA, Overcomer Ministry	9980na
1300 1400	USA, Overcomer Ministry	15370na
1300 1400	USA, WBCQ Monticello ME	9330na
1300 1400	USA, WEWN/EWTN Irondale AL	15610va
1300 1400	USA, WHRI Cypress Creek SC	9795na 9840as 9930af 11565pa
1300 1400 Sun	USA, WINB Red Lion PA	13570ca
1300 1400	USA, WTWW Lebanon TN	9479na
1300 1400	USA, WWCR Nashville TN	7490af 9980ca 13845na 15285eu
1300 1400	USA, WWRB Manchester TN	9370na
1315 1345	Bangladesh, Bangladesh Betar/Ext Svc	7250as
1330 1400 f	Clandestine, JSR/Shiokaze/Sea Breeze	5910as 5985as 6135as
1330 1400	India, AIR/External Svc	9690as 11620as 13710as
1330 1400	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as
1345 1400 f	Australia, HCJB Global Australia	15400pa

1400 UTC - 10AM EDT / 9AM CDT / 7AM PDT

1400 1415 Sun	USA, Pan Am Broadcasting	15205as
1400 1425 mtf	Guam, KTWR/TWR Asia	15190as
1400 1430 f	Clandestine, JSR/Shiokaze/Sea Breeze	5910as 5985as 6135as
1400 1430 h	Guam, KTWR/TWR Asia	15190as
1400 1430	Japan, R Japan/NHK World	11705af 15735as
1400 1430	Laos, LNR Natl Svc/Vientane	6130do
1400 1430	Palau, T8WH/World Harvest R	11705as
1400 1430	Serbia, International R Serbia	9635eu
1400 1430	Thailand, R Thailand World Svc	9950as
1400 1435 sw	Guam, KTWR/TWR Asia	15190as
1400 1457	China, China R International	5955as 7300na 9460as 9765pa 9795as 9870as 11665eu 13625as 13685as 13740va 17630va
1400 1500	Anguilla, University Network	11775na
1400 1500	Australia, ABC/R Australia	5940as 5995va 9580pa 12065pa
1400 1500	Australia, NT VL8A Alice Springs	2310do
1400 1500	Australia, NT VL8K Katherine	2485do
1400 1500	Australia, NT VL8T Tennant Creek	2325do
1400 1500 Sun	Canada, Bible VO Broadcasting	17495as
1400 1500	Canada, CFRX Toronto ON	6070do
1400 1500	Canada, CFVP Calgary AB	6030do
1400 1500	Canada, CKZN St Johns NF	6160do
1400 1500	Canada, CKZU Vancouver BC	6160do
1400 1500	Eqt Guinea, Pan Am BC/R Africa	15190af
1400 1500 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1400 1500	Germany, R 6150	6070eu
1400 1500	India, AIR/External Svc	9690as 11620as 13710as
1400 1500	Malaysia, RTM Kajang/Traxx FM	7295do
1400 1500	New Zealand, R New Zealand Intl	6170pa
1400 1500 mtwhf	Nigeria, VO Nigeria	9690af
1400 1500	Oman, R Sultanate of Oman	15560af
1400 1500	Palau, T8WH/World Harvest R	9965as
1400 1500	Russia, VO Russia	4960va 9900me 11530as 12030as 15670as
1400 1500	South Korea, KBS World R	9640as
1400 1500	UK, BBC World Service	5845as 11890as 15310as
1400 1500	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
1400 1500 mtwhf	USA, BBG/VO America	7540va 7575va 12150va
1400 1500	USA, BBG/VO America	4930af 6080af 15580af
1400 1500	USA, KJES Vado NM	11715na
1400 1500	USA, KNLS Anchor Point AK	7355as 9615as
1400 1500 mtwhf	USA, Overcomer Ministry	9980na 13570ca 13810me
1400 1500	USA, Overcomer Ministry	9370va 9460eu
1400 1500	USA, WBCQ Monticello ME	9330na
1400 1500 Sat	USA, WBCQ Monticello ME	15420na
1400 1500	USA, WEWN/EWTN Irondale AL	15610va
1400 1500	USA, WHRI Cypress Creek SC	9795na 9840as 9960as 11565pa
1400 1500 Sun	USA, WINB Red Lion PA	13570ca
1400 1500	USA, WJHR Intl Milton FL	15550 lsb
1400 1500	USA, WRNO New Orleans LA	7505na
1400 1500	USA, WTWW Lebanon TN	9479na
1400 1500	USA, WWCR Nashville TN	7490af 9980ca 13845na 15285eu
1400 1500	USA, WWRB Manchester TN	9370na
1415 1427	Nepal, R Nepal	5005do
1415 1430	USA, Pan Am Broadcasting	15205as
1425 1455	Swaziland, TWR Africa	6025af
1430 1445 Sun	USA, Pan Am Broadcasting	15205as
1430 1500	Australia, ABC/R Australia	9475va 11665va
1430 1500 Sat	Canada, Bible VO Broadcasting	17495as
1430 1500	China, China Business R	6190do 7220do
1430 1500	China, China Natl R/CNR11	4905do 4920do 6130do
1430 1500	Palau, T8WH/World Harvest R	15500as

1500 UTC - 11AM EDT / 10AM CDT / 8AM PDT

1500 1530	Australia, ABC/R Australia	11665va 12065pa
1500 1530	Australia, HCJB Global Australia	15400pa
1500 1530 Sun	Germany, R Santec	15190as
1500 1530 Sun	Italy, IRRS Shortwave	15190va
1500 1530	USA, WHRI Cypress Creek SC	9795af
1500 1530	Vietnam, VO Vietnam/Overseas Svc	7285as 9840as 12020as
1500 1550	New Zealand, R New Zealand Intl	6170pa
1500 1557	China, China R International	5955as 6095eu 7325eu 7405as 9435me 9525as 9650as 9720eu 9785eu 9870na 13685af 13740eu 17630af
1500 1557	North Korea, VO Korea	9435na 11710na 13760eu 15245eu
1500 1600	Anguilla, University Network	11775na
1500 1600	Australia, ABC/R Australia	5940as 5995va 7240pa 9475va
1500 1600	Australia, NT VL8A Alice Springs	2310do
1500 1600	Australia, NT VL8K Katherine	2485do
1500 1600	Canada, CFRX Toronto ON	6070do
1500 1600	Canada, CFVP Calgary AB	6030do
1500 1600	Canada, CKZN St Johns NF	6160do
1500 1600	Canada, CKZU Vancouver BC	6160do
1500 1600	Eqt Guinea, Pan Am BC/R Africa	15190af
1500 1600 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1500 1600	Germany, R 6150	6070eu
1500 1600	Malaysia, RTM Kajang/Traxx FM	7295do
1500 1600 mtwhf	Nigeria, VO Nigeria	15120af
1500 1600	Palau, T8WH/World Harvest R	9905as 15500as
1500 1600	Russia, VO Russia	4960va 6185as 9900me

1500 1600 mtwhf	South Africa, Channel Africa	9625af
1500 1600	UK, BBC World Service 5845as 7565as 9410as 11675as 11890as 12095af 15420af	
1500 1600	USA, AFN/AFRTS 4319usb 5765usb 12759usb 13362usb	
1500 1600	USA, BBG/VO America 4930af 6080af 7540va 7575va 12150va 15580va 17895va	
1500 1600	USA, KJES Vado NM 11715na	
1500 1600 mtwhf	USA, Overcomer Ministry 9980na 13570ca 13810me	
1500 1600 Sat	USA, Overcomer Ministry 15420na	
1500 1600	USA, WBCQ Monticello ME	9330na
1500 1600 Sat	USA, WBCQ Monticello ME	15420na
1500 1600	USA, WEWN/EWTN Irondale AL	15610va
1500 1600	USA, WHRI Cypress Creek SC 9795na 9840as 17510va 21630af	
1500 1600 Sun	USA, WINB Red Lion PA 13570ca	
1500 1600	USA, WJHR Intl Milton FL 15550 lsb	
1500 1600	USA, WRNO New Orleans LA	7505na
1500 1600	USA, WTWW Lebanon TN 9479na	
1500 1600	USA, WWCR Nashville TN 9980ca 12160af 13845na 15285eu	
1500 1600	USA, WWRB Manchester TN	9370na
1525 1555 Sat/Sun	Swaziland, TWR Africa 6025af	
1530 1545	India, AIR/External Svc 9910as	
1530 1549 smtwhf	Vatican City State, Vatican R	7485as
1530 1550 smtwhf	Vatican City State, Vatican R	15595as
1530 1550 smtwhf/DRM	Vatican City State, Vatican R	15775as
1530 1600	Afghanistan, R Afghanistan 7200as	
1530 1600	Australia, ABC/R Australia 11660as 11880va	
1530 1600 DRM	Belgium, The Disco Palace 15775as	
1530 1600 Sat	Canada, Bible VO Broadcasting	17600as
1530 1600 smtwa	Germany, AWR Europe 15335as	
1530 1600	Iran, VO Islamic Rep of Iran 13780va 15515va	
1530 1600	Mongolia, Voice of Mongolia	12015as
1530 1600	Myanmar, Myanma R 5985do	
1530 1600	USA, WHRI Cypress Creek SC	9965na
1530 1600 Sat	Vatican City State, Vatican R 7585as 15595as	
1530 1600 Sat	Vatican City State, Vatican R	15775as
1551 1600	New Zealand, R New Zealand Intl	6170pa
1551 1600 DRM	New Zealand, R New Zealand Intl	7440pa

1600 UTC - 12PM EDT / 11AM CDT / 9AM PDT

1600 1627	Iran, VO Islamic Rep of Iran 13780va 15515va	
1600 1630	Australia, ABC/R Australia 9540as	
1600 1630 DRM	Belgium, The Disco Palace 15775as	
1600 1630	Indonesia, AWR Asia/Pacific	15360as
1600 1630	Myanmar, Myanma R 5985do	
1600 1630 Sun	USA, WINB Red Lion PA 13570ca	
1600 1630	Vietnam, VO Vietnam/Overseas Svc 7220va 7280va 9550va 9730va	
1600 1650 DRM	New Zealand, R New Zealand Intl	7440pa
1600 1650	New Zealand, R New Zealand Intl	6170pa
1600 1657	China, China R International 6060as 6155as 7235af 7255af 7420af 7435eu 9435eu 9460eu 9570eu 9600eu 9875as	
1600 1657	North Korea, VO Korea 9890va 11645va	
1600 1658	Taiwan, R Taiwan Intl 9440as 15485as	
1600 1700	Anguilla, University Network	11775na
1600 1700	Australia, ABC/R Australia 5940as 5995va 7240pa 9475va 11660as 11880va	
1600 1700	Australia, NT VL8A Alice Springs	2310do
1600 1700	Australia, NT VL8K Katherine	2485do
1600 1700	Canada, CFRX Toronto ON 6070do	
1600 1700	Canada, CFVP Calgary AB 6030do	
1600 1700	Canada, CKZN St Johns NF	6160do
1600 1700	Canada, CKZU Vancouver BC	6160do
1600 1700	Egypt, R Cairo 15345af	
1600 1700	Eqt Guinea, Pan Am BC/R Africa	15190af
1600 1700	Ethiopia, R Ethiopia/External Svc 7235af 9558af	
1600 1700 wa	Germany, Hamburger Lokalradio	7265eu
1600 1700 DRM	Germany, Mighty KBC Radio	9755eu
1600 1700	Germany, R 6150 6070eu	
1600 1700	Malaysia, RTM Kajang/Traxx FM	7295do
1600 1700	Palau, T8WH/World Harvest R 9905as 15500as	
1600 1700	Russia, VO Russia 4960va 6070as 6185as 9490as	
1600 1700	South Korea, KBS World R 9515eu 9640as	
1600 1700	UK, BBC World Service 3255af 5845as 6190as 7565as 9410as 11675as 11890as 12095af 15420af 17640af 17830af	
1600 1700	USA, AFN/AFRTS 4319usb 5765usb 12759usb 13362usb	
1600 1700	USA, BBG/VO America 4930af 6080af 15580af	
1600 1700 mtwhf	USA, Overcomer Ministry 9980na	
1600 1700	USA, Overcomer Ministry 9370va	
1600 1700	USA, WBCQ Monticello ME	9330na
1600 1700 Sat	USA, WBCQ Monticello ME	15420na
1600 1700	USA, WEWN/EWTN Irondale AL	15610va
1600 1700	USA, WHRI Cypress Creek SC 9795na 9840as 21630af	
1600 1700	USA, WJHR Intl Milton FL 15550 lsb	
1600 1700	USA, WRNO New Orleans LA	7505na
1600 1700	USA, WTWW Lebanon TN 9479na	
1600 1700	USA, WWCR Nashville TN 9980ca 12160af 13845na 15285eu	
1600 1700	USA, WWRB Manchester TN	9370na
1630 1700 mwf	Indonesia, AWR Asia/Pacific	15360as
1630 1700 m	South Africa, R Mirror Intl 3230af	
1630 1700	Turkey, VO Turkey 15520as	
1630 1700 mtwhf	USA, BBG/VO America/S Sudan in Focus 9490af 11655af 13870af	
1630 1700 Sat/Sun	USA, WINB Red Lion PA 13570ca	
1651 1700	New Zealand, R New Zealand Intl	9700pa
1651 1700 DRM	New Zealand, R New Zealand Intl	7285pa

1700 UTC - 1PM EDT / 12PM CDT / 10AM PDT

1700 1710	Pakistan, Azad Kashmir R 3995do	4790do
1700 1710	Pakistan, R Pakistan External Svc 11570eu 15265eu	
1700 1715 tf	Canada, Bible VO Broadcasting	15215me
1700 1730	Australia, ABC/R Australia 11660as	
1700 1730 h	Canada, Bible VO Broadcasting	15215me
1700 1730 m	South Africa, R Mirror Intl 3230af	
1700 1730	Turkey, VO Turkey 15520as	
1700 1730	Vietnam, VO Vietnam/Overseas Svc	9625eu
1700 1750 DRM	New Zealand, R New Zealand Intl	7285pa
1700 1750	New Zealand, R New Zealand Intl	9700pa
1700 1756 DRM	Romania, R Romania Intl 9535eu	
1700 1756	Romania, R Romania Intl 11740eu	
1700 1757	China, China R International 6090as 6100as 6140as 6155eu 6165as 7205af 7255as 7410as 7420af 7425eu 7435af 9460eu 9570eu	
1700 1758	Taiwan, R Taiwan Intl 15690af	
1700 1800	Anguilla, University Network	11775na
1700 1800	Australia, ABC/R Australia 5995va 9475as 9500va 9580pa 11880va	
1700 1800	Australia, NT VL8A Alice Springs	2310do
1700 1800	Australia, NT VL8K Katherine	2485do
1700 1800 Sat/Sun	Canada, Bible VO Broadcasting	15215me
1700 1800	Canada, CFRX Toronto ON 6070do	
1700 1800	Canada, CFVP Calgary AB 6030do	
1700 1800	Canada, CKZN St Johns NF	6160do
1700 1800	Canada, CKZU Vancouver BC	6160do
1700 1800	Egypt, R Cairo 15345af	
1700 1800	Eqt Guinea, Pan Am BC/R Africa	15190af
1700 1800	Germany, R 6150 6070eu	
1700 1800	Malaysia, RTM Kajang/Traxx FM	7295do
1700 1800	Palau, T8WH/World Harvest R	9905as
1700 1800	Russia, VO Russia 4960va 6070as 6185as 9420as	
1700 1800 DRM	Russia, VO Russia 9820as	

1700 1800 mtwhf	South Africa, Channel Africa			15235af
1700 1800	Swaziland, TWR Africa	3200af		
1700 1800 Sat/Sun	Swaziland, TWR Africa	3200af		
1700 1800	UK, BBC World Service	3255af	5845as	
	6190af	6195as	9410as	12095af
	15400af	15420af	17795af	17830af
1700 1800	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
1700 1800	USA, BBG/VO America	6080af	11795af	
	15580af	17895af		
1700 1800 mtwhf	USA, Overcomer Ministry	9980na		
1700 1800 Sat	USA, Overcomer Ministry	15420na		
1700 1800	USA, Overcomer Ministry	9370va	9625me	
1700 1800	USA, WBCQ Monticello ME		9330na	
1700 1800 Sat	USA, WBCQ Monticello ME		15420na	
1700 1800	USA, WEWN/EWTN Irondale AL		15610va	
1700 1800	USA, WHRI Cypress Creek SC		9795na	
	9840as	21630af		
1700 1800 Sat/Sun	USA, WINB Red Lion PA	13570ca		
1700 1800	USA, WJHR Intl Milton FL	15550	lsb	
1700 1800	USA, WRNO New Orleans LA		7505na	
1700 1800	USA, WTWW Lebanon TN	9479na		
1700 1800	USA, WWCR Nashville TN	9980ca	12160af	
	13845na	15285eu		
1700 1800	USA, WWRB Manchester TN		9370na	
1715 1729	Vatican City State, Vatican R		11935va	
1730 1757	Vatican City State, Vatican R		11625af	
	13765af	15570af		
1730 1800	Australia, ABC/R Australia	6080as		
1745 1800	Bangladesh, Bangladesh Betar/Ext Svc			
	7250eu			
1745 1800	India, AIR/External Svc	7550eu	9445va	
	9950eu	11580af	11670eu	11935af
	13695af	17670af		
1751 1800	New Zealand, R New Zealand Intl		9700as	
1751 1800 DRM	New Zealand, R New Zealand Intl		7285as	

1800 UTC - 2PM EDT / 1PM CDT / 11AM PDT

1800 1815 Sat	Canada, Bible VO Broadcasting			11855as
1800 1815 Sat	Canada, Bible VO Broadcasting			9430me
1800 1830	Japan, R Japan/NHK World			9590af
	11885af			
1800 1830 irreg	Tanzania, Zanzibar BC/VO Tanzania			11735do
1800 1830	USA, BBG/VO America	6080af	15580af	
	17895af			
1800 1830 Sat/Sun	USA, BBG/VO America	4930af		
1800 1830	Vietnam, VO Vietnam/Overseas Svc		7280eu	
	9730as			
1800 1850	New Zealand, R New Zealand Intl		9700pa	
1800 1850 DRM	New Zealand, R New Zealand Intl		7285pa	
1800 1857	China, China R International		6100eu	
	7405eu			
1800 1857	North Korea, VO Korea	13760eu	15245eu	
1800 1858	Taiwan, R Taiwan Intl	3965eu		
1800 1900	Anguilla, University Network		11775na	
1800 1900 mtwhf	Argentina, RAE	15345eu		
1800 1900	Australia, ABC/R Australia	6080as	9475as	
	9500va	9580pa	9710va	11880va
1800 1900	Australia, NT VL8A Alice Springs		2310do	
1800 1900	Australia, NT VL8K Katherine		2485do	
1800 1900	Bangladesh, Bangladesh Betar/Ext Svc			
	7250eu			
1800 1900 Sat/Sun	Canada, Bible VO Broadcasting			15215me
1800 1900 Sun	Canada, Bible VO Broadcasting			6130eu
1800 1900	Canada, CFRX Toronto ON	6070do		
1800 1900	Canada, CFVP Calgary AB	6030do		
1800 1900	Canada, CKZN St Johns NF		6160do	
1800 1900	Canada, CKZU Vancouver BC		6160do	
1800 1900	Eqt Guinea, Pan Am BC/R Africa		15190af	
1800 1900	Germany, R 6150	6070eu		
1800 1900	India, AIR/External Svc	7550eu	9445va	
	9950eu	11580af	11670eu	11935af
	13695af	17670af		
1800 1900 fas	Italy, IRRS Shortwave	7290va		
1800 1900	Kuwait, R Kuwait	15540eu		
1800 1900	Malaysia, RTM Kajang/Traxx FM		7295do	
1800 1900 mtwhf	Nigeria, VO Nigeria	15120af		
1800 1900	Russia, VO Russia	4960va	9900va	
1800 1900	South Korea, KBS World R		7275eu	
1800 1900	Swaziland, TWR Africa	3200af	9500af	
1800 1900 Sat/Sun	Swaziland, TWR Africa	3200af		
1800 1900	UK, BBC World Service	3255af	6190af	
	7375as	11810af	12095af	15400af
	15420af	17795af		
1800 1900	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
1800 1900	USA, KJES Vado NM	15385pa		
1800 1900 mtwhf	USA, Overcomer Ministry	9980na		
1800 1900	USA, Overcomer Ministry	9370va	9625me	
1800 1900	USA, WBCQ Monticello ME		9330na	
1800 1900 Sat	USA, WBCQ Monticello ME		15420na	
1800 1900	USA, WEWN/EWTN Irondale AL		15610va	
1800 1900	USA, WHRI Cypress Creek SC		9840na	
	15180af	21630af		
1800 1900	USA, WINB Red Lion PA	13570ca		
1800 1900	USA, WTWW Lebanon TN	9479na		
1800 1900	USA, WWCR Nashville TN	9980ca	12160af	
	13845na	15285eu		
1800 1900	USA, WWRB Manchester TN		9370na	
1815 1845 Sun	Canada, Bible VO Broadcasting			9430me
1830 1845 Sat	Canada, Bible VO Broadcasting			6130eu
1830 1845	Rwanda, R Rep Rwandaise	6055do		
1830 1900 Sun	Canada, Bible VO Broadcasting			9635me
1830 1900 mtwhf/DRM	Nigeria, VO Nigeria			15120af
1830 1900	South Africa, AWR Africa	11840af		
1830 1900	Turkey, VO Turkey	9785eu		
1830 1900	USA, BBG/VO America	4930af	15580af	
1851 1900	New Zealand, R New Zealand Intl		11725pa	
1851 1900 DRM	New Zealand, R New Zealand Intl		15720pa	

1900 UTC - 3PM EDT / 2PM CDT / 12PM PDT

1900 1930	Germany, Deutsche Welle	11800af	11865af	
	15275af			
1900 1930	Turkey, VO Turkey	9785eu		
1900 1930	USA, BBG/VO America	4930af	9850af	
	15580af			
1900 1930	Vietnam, VO Vietnam/Overseas Svc		7280va	
	9730va			
1900 1945	India, AIR/External Svc	7550eu	9445eu	
	9950eu	11580af	11670eu	11935af
	13695af	17670af		
1900 1957	China, China R International		7295va	
	9440af			
1900 1957	North Korea, VO Korea	7210af	9875va	
	11635va	11910af		
1900 2000	Anguilla, University Network		11775na	
1900 2000	Australia, ABC/R Australia	6080as	9500va	
	9710va	11660va		
1900 2000	Australia, NT VL8A Alice Springs		2310do	
1900 2000	Australia, NT VL8K Katherine		2485do	
1900 2000	Canada, CFRX Toronto ON	6070do		
1900 2000	Canada, CFVP Calgary AB	6030do		
1900 2000	Canada, CKZN St Johns NF		6160do	
1900 2000	Canada, CKZU Vancouver BC		6160do	
1900 2000	Egypt, R Cairo	15290af		
1900 2000	Eqt Guinea, Pan Am BC/R Africa		15190af	
1900 2000	Germany, R 6150	6070eu		
1900 2000	Indonesia, VO Indonesia	9526va		
1900 2000	Kuwait, R Kuwait	15540eu		
1900 2000	Malaysia, RTM Kajang/Traxx FM		7295do	
1900 2000	Micronesia, V6MP/Cross R/Pohnpei		4755as	
1900 2000	New Zealand, R New Zealand Intl		11725pa	
1900 2000 DRM	New Zealand, R New Zealand Intl		15720pa	
1900 2000 mtwhf	Nigeria, VO Nigeria	7255af		
1900 2000	Palau, T8WH/World Harvest R		9905as	
1900 2000 mtwhf	Spain, R Exterior de Espana		9665eu	
	11615af			
1900 2000	Swaziland, TWR Africa	3200af		
1900 2000 Sat/Sun	Swaziland, TWR Africa	3200af		
1900 2000	Thailand, R Thailand World Svc		9585eu	
1900 2000	UK, BBC World Service	3255af	6190af	
	11810af	12095af	15400af	15420af
	17795af			

1900 2000	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
1900 2000 mtwhf	USA, Overcomer Ministry	9980na 13570ca
1900 2000	USA, Overcomer Ministry	9370va 9625me 9835af 13570ca
1900 2000 Sat/Sun	USA, Overcomer Ministry	9980na
1900 2000	USA, WBCQ Monticello ME	9330na 15420na
1900 2000 twhfa	USA, WBCQ Monticello ME	7490na
1900 2000	USA, WEWN/EWTN Irondale AL	15610va
1900 2000	USA, WHRI Cypress Creek SC	9840na 15180af 21630af
1900 2000	USA, WINB Red Lion PA	13570ca
1900 2000	USA, WTWW Lebanon TN	9479na 9930sa
1900 2000	USA, WWCR Nashville TN	9980ca 12160af 13845na 15285eu
1900 2000	USA, WWRB Manchester TN	9370na
1905 1920 Sat	Mali, ORTM/R Mali	9635do
1930 1957	Germany, Deutsche Welle	11865af 15275af
1930 2000	Iran, VO Islamic Rep of Iran	9400eu 9715eu 11750af 11885af
1930 2000	Serbia, International R Serbia	6100eu
1930 2000	USA, BBG/VO America	4930af 15580as
1930 2000 Sun	USA, Pan Am Broadcasting	9685af

2000 UTC - 4PM EDT / 3PM CDT / 1PM PDT

2000 2027	Iran, VO Islamic Rep of Iran	9400eu 9715eu 11750af 11885af
2000 2027	Vatican City State, Vatican R	11625af 13765af
2000 2030 mtwhfa	Albania, R Tirana	7465va
2000 2030	Australia, ABC/R Australia	6080as 9500va
2000 2030	Egypt, R Cairo	15290af
2000 2030 Sat/Sun	Swaziland, TWR Africa	3200af
2000 2030	USA, BBG/VO America	4930af 15580af
2000 2030 mtwhf	USA, Overcomer Ministry	13570ca
2000 2030 Sun	USA, Pan Am Broadcasting	9685af
2000 2057	China, China R International	5960eu 5985af 7285eu 7295va 7415eu 9440af 9600eu 11640eu 13630eu
2000 2057	Germany, Deutsche Welle	11865af
2000 2100	Anguilla, University Network	11775na
2000 2100	Australia, ABC/R Australia	9580pa 11650va 11660va 12080pa 15515va
2000 2100	Australia, NT VL8A Alice Springs	2310do
2000 2100	Australia, NT VL8K Katherine	2485do
2000 2100	Australia, NT VL8T Tennant Creek	2325do
2000 2100	Belarus, R Belarus	6155eu 11730eu
2000 2100	Canada, CFRX Toronto ON	6070do
2000 2100	Canada, CFVP Calgary AB	6030do
2000 2100	Canada, CKZN St Johns NF	6160do
2000 2100	Canada, CKZU Vancouver BC	6160do
2000 2100 f	Clandestine, JSR/Shiokaze/Sea Breeze	5910as 5965as 6110as
2000 2100	Cuba, R Havana Cuba	11760am
2000 2100	Eqt Guinea, Pan Am BC/R Africa	15190af
2000 2100	Germany, Deutsche Welle	11800af 12070af
2000 2100	Germany, R 6150	6070eu
2000 2100	Kuwait, R Kuwait	15540eu
2000 2100	Malaysia, RTM Kajang/Traxx FM	7295do
2000 2100	Micronesia, V6MP/Cross R/Pohnpei	4755as
2000 2100 DRM	New Zealand, R New Zealand Intl	15720pa
2000 2100	New Zealand, R New Zealand Intl	11725pa
2000 2100	Palau, T8WH/World Harvest R	9905as
2000 2100 Sat/Sun	Spain, R Exterior de Espana	9570af
2000 2100	UK, BBC World Service	9915af 11810af 15400af
2000 2100	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
2000 2100	USA, Overcomer Ministry	9370va 9980na
2000 2100 mtwhfa	USA, WBCQ Monticello ME	7490na
2000 2100	USA, WBCQ Monticello ME	9330na 15420na
2000 2100	USA, WEWN/EWTN Irondale AL	15610va
2000 2100	USA, WHRI Cypress Creek SC	15180eu 17510af 21630af
2000 2100	USA, WINB Red Lion PA	13570ca
2000 2100	USA, WTWW Lebanon TN	9479na 9930sa
2000 2100	USA, WWCR Nashville TN	9980ca 12160af 13845na 15285eu
2000 2100	USA, WWRB Manchester TN	9370na
2030 2045	Thailand, R Thailand World Svc	9535eu
2030 2056 DRM	Romania, R Romania Intl	9800eu
2030 2056	Romania, R Romania Intl	11745na 11975eu 13800na
2030 2100	Australia, ABC/R Australia	9500va 11695va
2030 2100	Turkey, VO Turkey	7205va
2030 2100	USA, BBG/VO America	4930af 6080af 15580af
2030 2100 Sat/Sun	USA, BBG/VO America	4940af
2030 2100	Vietnam, VO Vietnam/Overseas Svc	7220va 7280va 9550va 9730va
2045 2100	India, AIR/External Svc	7550eu 9445eu 9910pa 11620pa 11670eu 11740pa
2045 2100 DRM	India, AIR/External Svc	9950eu

2100 UTC - 5PM EDT / 4PM CDT / 2PM PDT

2100 2130	Australia, NT VL8A Alice Springs	2310do
2100 2130	Australia, NT VL8K Katherine	2485do
2100 2130	Australia, NT VL8T Tennant Creek	2325do
2100 2130	Austria, AWR Europe	11955af
2100 2130	Turkey, VO Turkey	7205va
2100 2150	New Zealand, R New Zealand Intl	11725pa
2100 2150 DRM	New Zealand, R New Zealand Intl	15720pa
2100 2157	China, China R International	5960eu 7205af 7285eu 7405af 7415eu 9600eu
2100 2157	North Korea, VO Korea	13760eu 15245eu
2100 2200	Angola, R Nac de Angola/Intl Svc	7217af
2100 2200	Anguilla, University Network	11775na
2100 2200	Australia, ABC/R Australia	9500va 9660va 11650va 11695va 13630pa 15515va
2100 2200	Belarus, R Belarus	6155eu 11730eu
2100 2200	Canada, CFRX Toronto ON	6070do
2100 2200	Canada, CFVP Calgary AB	6030do
2100 2200	Canada, CKZN St Johns NF	6160do
2100 2200	Canada, CKZU Vancouver BC	6160do
2100 2200	Egypt, R Cairo	11890eu 12050al
2100 2200	Eqt Guinea, Pan Am BC/R Africa	15190af
2100 2200	Germany, Deutsche Welle	11800af 11865af 12070af
2100 2200	Germany, R 6150	6070eu
2100 2200	India, AIR/External Svc	7550eu 9445eu 9910pa 11620pa 11670eu 11740pa
2100 2200 DRM	India, AIR/External Svc	9950eu
2100 2200	Malaysia, RTM Kajang/Traxx FM	7295do
2100 2200	Micronesia, V6MP/Cross R/Pohnpei	4755 as
2100 2200	Palau, T8WH/World Harvest R	9905as
2100 2200 Sat/Sun	Spain, R Exterior de Espana	9570af 9665eu
2100 2200	Syria, R Damascus	9330va
2100 2200 mtwhf	UK, BBC World Service	9915af 11810af 12095af
2100 2200	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
2100 2200	USA, BBG/VO America	6080af 15580af
2100 2200	USA, Overcomer Ministry	9370va
2100 2200 Sat/Sun	USA, Overcomer Ministry	9980na
2100 2200	USA, WBCQ Monticello ME	7490na 9330na
2100 2200	USA, WEWN/EWTN Irondale AL	15610va
2100 2200	USA, WHRI Cypress Creek SC	15180eu 17510af 17540af
2100 2200	USA, WINB Red Lion PA	9265ca
2100 2200	USA, WTWW Lebanon TN	9479na 9930sa
2100 2200	USA, WWCR Nashville TN	6875eu 9350af 9980ca 13845na
2100 2200	USA, WWRB Manchester TN	3215na 9370na
2130 2200	Australia, NT VL8A Alice Springs	4835do

2130 2200	Australia, NT VL8K Katherine	5025do
2130 2200	Australia, NT VL8T Tennant Creek	4910do
2151 2200	New Zealand, R New Zealand Intl	15720pa
2151 2200 DRM	New Zealand, R New Zealand Intl	17675pa

2200 UTC - 6PM EDT / 5PM CDT / 3PM PDT

2200 2230	India, AIR/External Svc	9910pa 11620pa 11670eu 11740pa
2200 2230 DRM	India, AIR/External Svc	9950eu
2200 2230	Serbia, International R Serbia	6100eu
2200 2245	Egypt, R Cairo	11890eu 12050al
2200 2256	Romania, R Romania Intl	7430eu 9540eu 9790as 11940as
2200 2257	China, China R International	5915eu
2200 2300	Anguilla, University Network	6090na
2200 2300	Australia, ABC/R Australia	9660va 9855as 12080pa 13630pa 15240va 15415va 15515va
2200 2300	Australia, NT VL8A Alice Springs	4835do
2200 2300	Australia, NT VL8K Katherine	5025do
2200 2300	Australia, NT VL8T Tennant Creek	4910do
2200 2300	Canada, CFRX Toronto ON	6070do
2200 2300	Canada, CFVP Calgary AB	6030do
2200 2300	Canada, CKZN St Johns NF	6160do
2200 2300	Canada, CKZU Vancouver BC	6160do
2200 2300	Eqt Guinea, Pan Am BC/R Africa	15190af
2200 2300	Germany, R 6150	6070eu
2200 2300	Malaysia, RTM Kajang/Traxx FM	7295do
2200 2300	Micronesia, V6MP/Cross R/Pohnpei as	4755
2200 2300	New Zealand, R New Zealand Intl	15720pa
2200 2300 DRM	New Zealand, R New Zealand Intl	17675pa
2200 2300	Russia, VO Russia	9465ca
2200 2300	South Korea, KBS World R	11810eu
2200 2300	Taiwan, R Taiwan Intl	6115na 15440na
2200 2300	Turkey, VO Turkey	9830va
2200 2300	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
2200 2300 smtwh	USA, BBG/VO America	5915va 7480va 7575va 12150va
2200 2300	USA, Overcomer Ministry	5900eu 9370va 9980na
2200 2300	USA, WBCQ Monticello ME	7490na 9330na
2200 2300	USA, WEWN/EWTN Irondale AL	15610va
2200 2300	USA, WHRI Cypress Creek SC	11775af 15180af 17510af
2200 2300	USA, WINB Red Lion PA	9265ca
2200 2300	USA, WTWW Lebanon TN	9479na 9930sa
2200 2300	USA, WWCR Nashville TN	6875eu 9350af 9980ca 13845na
2200 2300	USA, WWRB Manchester TN	3215na 9370na
2230 2300	China, Xizang PBS	4905do
2230 2300	Indonesia, AWR Asia/Pacific	15320as
2230 2300	USA, WYFR/Family R	6115am
2245 2300	India, AIR/External Svc	9690as 9705as 11710as 13605as
2245 2300 DRM	India, AIR/External Svc	11645as

2300 UTC - 7PM EDT / 6PM CDT / 4PM PDT

2300 0000	Anguilla, University Network	6090na
2300 0000	Australia, ABC/R Australia	9660va 9855as 12080pa 15240va 15415va 17795pa 19000va 21740va
2300 0000	Australia, NT VL8A Alice Springs	4835do
2300 0000	Australia, NT VL8K Katherine	5025do
2300 0000	Australia, NT VL8T Tennant Creek	4910do
2300 0000	Canada, CFRX Toronto ON	6070do
2300 0000	Canada, CFVP Calgary AB	6030do
2300 0000	Canada, CKZN St Johns NF	6160do
2300 0000	Canada, CKZU Vancouver BC	6160do
2300 0000	Cuba, R Havana Cuba	11880af
2300 0000	Egypt, R Cairo	9965am 11510al
2300 0000	Germany, R 6150	6070eu
2300 0000	India, AIR/External Svc	6055as 9690as 9705as 11710as 13605as
2300 0000 DRM	India, AIR/External Svc	11645as
2300 0000	Malaysia, RTM Kajang/Traxx FM	7295do
2300 0000	Micronesia, V6MP/Cross R/Pohnpei as	4755
2300 0000	New Zealand, R New Zealand Intl	15720pa
2300 0000 DRM	New Zealand, R New Zealand Intl	17675pa
2300 0000	Russia, VO Russia	9465ca
2300 0000	UK, BBC World Service	3915as 6195as 7490as 9740as 9890as 11850as 12010as
2300 0000	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
2300 0000	USA, BBG/VO America	5895va 7480va 7575va 12150va
2300 0000	USA, Overcomer Ministry	9370va
2300 0000 mtwhf	USA, Overcomer Ministry	9980na
2300 0000	USA, WBCQ Monticello ME	7490na 9330na
2300 0000 Sat/Sun	USA, WBCQ Monticello ME	5110na
2300 0000	USA, WEWN/EWTN Irondale AL	15610va
2300 0000	USA, WHRI Cypress Creek SC	5920eu 7315eu 11775va 15180va
2300 0000	USA, WINB Red Lion PA	9265ca
2300 0000	USA, WTWW Lebanon TN	5085na 9479na
2300 0000	USA, WWCR Nashville TN	6875eu 9350af 9980ca 13845na
2300 0000	USA, WWRB Manchester TN	3215na 9370na
2300 0000	USA, WYFR/Family R	6115am
2300 2315 mtwhf	Moldova, R PMR/Pridnestrovye	9665eu
2300 2357	China, China R International	5915as 5990ca 6145na 7350eu 7415as 9535as 11790as
2330 0000	Australia, ABC/R Australia	17750va
2330 0000 Sat/Sun	Indonesia, AWR Asia/Pacific	17650as
2330 0000	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as

Afghanistan, R Afghanistan ..... www.rta.org.af
Albania, R Tirana ..... http://rtsh.sil.at/
Algeria, R Algerienne ..... www.radioalgerie.dz/
Angola, R Nac de Angola/Canal A ..... www.rna.ao/
Angola, R Nac de Angola/Intl Svc ..... www.rna.ao/
Anguilla, University Network ..... www.worldwideuniversitynetwork.com/
Argentina, RAE ..... www.radionacional.gov.ar
Armenia, Public R of Armenia ..... www.int.armradio.am
Australia, ABC NT Alice Springs ..... www.abc.net.au/radio/
Australia, ABC NT Katherine ..... www.abc.net.au/radio/
Australia, ABC NT Tennant Creek ..... www.abc.net.au/radio/
Australia, ABC/R Australia ..... www.radioaustralia.net.au
Australia, HCJB Global Australia ..... www.hcjb.org.au
Australia, R Symban ..... www.radiosymban.com.au
Austria, AWR Europe www.awr2.org
Austria, Radio O1 Intl http://oe1.orf.at
Austria, TWR Europe ..... www.twr.org
Bahrain, R Bahrain ..... www.radiobahrain.fm
Bahrain, R Bahrain/Gen Prg ..... www.radiobahrain.fm
Bangladesh, Bangladesh Betar/Ext Svc ..... www.betar.org.bd/
Bangladesh, Bangladesh Betar/Home Svc ..... www.betar.org.bd/
Belarus, Belaruskaje Radyjo 1 ..... www.radiobelarus.tvr.by/eng
Belarus, R Belarus ..... www.radiobelarus.tvr.by/eng
Bolivia, R Em Camargo ..... www.radiocamargo.com.bo
Bolivia, R Fides ..... www.radiofides.com
Bolivia, R Illimani/R Patria Nueva ..... www.patrianueva.bo
Bolivia, R Panamericana ..... www.panamericana-bolivia.com
Bolivia, R Pio XII www.radiopio12.org
Bolivia, R Santa Ana ..... www.ifrabolivia.org
Bolivia, R Santa Cruz ..... www.ifrabolivia.org
Brazil, Educadora/Braganca ..... www.educadora.com.br
Brazil, R Alvorada/Londrina ..... www.radioalvorada.am.br/
Brazil, R Alvorada/Paritins ..... www.alvoradaparitins.com.br/
Brazil, R Aparecida ..... www.radioaparecida.com.br
Brazil, R Bandeirantes ..... www.bandeirantes.com.br
Brazil, R Brasil ..... www.brasilcampinas.com.br
Brazil, R Brasil Central ..... www.agecom.go.gov.br/
Brazil, R Caiari ..... www.radiocaiari.com/
Brazil, R Cancao Nova ..... www.cancaonova.com
Brazil, R Capital ..... www.radiocapitalrio.com.br
Brazil, R Capixaba ..... www.radiocapixaba.com.br
Brazil, R Clube do Para ..... www.radioclubedopara.com.br
Brazil, R Congonhas ..... www.radiocongonhas.com.br
Brazil, R Cultura do Para ..... www.portalcultura.com.br
Brazil, R Cultura Filadelfia ..... www.radiofiladelfia.com.br
Brazil, R Cultura/Araraquara ..... www.radiocultura.net/
Brazil, R Difusora do Amazonas ..... www.difusoramanaus.com.br/
Brazil, R Difusora Roraima ..... www.radiororaima.com.br/
Brazil, R Difusora/Caceres ..... www.difusoracaceres.com.br/
Brazil, R Difusora/Londrina ..... www.radiodifusoradelondrina.com.br/
Brazil, R Difusora/Macapa ..... www.difusora.ap.gov.br
Brazil, R Educadora/Guajara Mirim ..... www.educadora.com.br
Brazil, R Educadora/Limeira ..... www.educadora.com.br
Brazil, R Gaucha ..... www.rdgaucha.com.br
Brazil, R Gazeta ..... www.casperlibero.edu.br
Brazil, R Guaiba ..... www.radioguaiba.com.br
Brazil, R Guaruja Paulista ..... www.radioguarujaam.com.br
Brazil, R Guaruja/Florianopolis ..... www.radioguaruja.com.br
Brazil, R Iguatemi ..... www.radioterra.am.br
Brazil, R Imaculada Conceicao ..... www.miliciadaimaculada.org.br/
Brazil, R Inconfidencia ..... www.inconfidencia.com.br
Brazil, R Itatiaia ..... www.itatiaia.com.br/
Brazil, R Maria ..... www.radiomaria.net.br
Brazil, R Marumby ..... www.radiomarumby.com.br
Brazil, R Meteorologia Paulista ..... www.radioibitinga.com.br
Brazil, R Mundial ..... www.radiomundial.com.br
Brazil, R Nacional da Amazonia ..... www.radiobras.gov.br
Brazil, R Nove de Julho www.radio9dejulhocom.br
Brazil, R Novo Tempo ..... www.radionovotempo.org.br/
Brazil, R Record ..... www.radiorecord.com.br
Brazil, R Rural ..... www.radioruraldesantarem.com.br/
Brazil, R Trans Mundial ..... www.transmundial.com.br
Brazil, R Voz Missionaria ..... www.gideoes.com.br/
Brazil, Super R Alvorada ..... www.radioalvoradaac.com.br
Brazil, Super R Boa Vontade ..... www.boavontade.com
Brazil, Super R Deus e Amor/Curitiba ..... www.superradiodeuseamor.com.br
Brazil, Super R Deus e Amor/Rio de Janeiro ..... www.superradiodeuseamor.com.br
Canada, Bible Voice Broadcasting ..... www.biblevoice.org/
Canada, CFRX Toronto ON ..... www.cfrb.com
Canada, CFVP Calgary AB www.classiccountryam1060.com
Canada, CKZN St Johns NF ..... www.cbc.ca/listen/index.html
Canada, CKZU Vancouver BC ..... www.cbc.ca/bc
China, Beibu Bay R ..... www.bbrmedia.com
China, China Huayi BC ..... www.chbcnews.com
China, China Natl R/CNR11 ..... www.cnr.cn
China, China Natl R/CNR13 ..... www.cnr.cn
China, China R International ..... www.cri.cn
China, Nei Menggu PBS ..... www.nmrb.cn
China, Quinghai PBS ..... www.qhradio.com
China, Quinghai PBS-1 ..... www.qhradio.com
China, VO Pujiang ..... www.cnr.cn
China, VO Shenzhou ..... www.cnr.cn
China, VO the Strait ..... www.vos.com.cn
China, VO Zhonghua ..... www.cnr.cn
Clandestine, Awdalradio ..... www.awdalradio.com
Clandestine, Badr Radio ..... www.badrradio.com
Clandestine, Dem VO of Burma ..... www.dvb.no/
Clandestine, EDC Sudan R Svc/Darfur Pgm ..... www.sudanradio.org
Clandestine, Furusato no Kaze ..... www.rachi.go.jp
Clandestine, Ginbot 7 Dimts R www.ginbot7.org
Clandestine, JSR/Shiokaze/Sea Breeze ..... www.chosa-kai.jp
Clandestine, Khmer Post Radio ..... www.thekhmerpost.com
Clandestine, Minghui R ..... www.mhradio.org
Clandestine, North Korea Reform R ..... www.nkreform.net
Clandestine, Open R for North Korea ..... www.nkradio.org
Clandestine, R Biafra London ..... www.radiobiafralondon.com/
Clandestine, R Dabanga ..... www.radiodabanga.com
Clandestine, R Damal/VO Somali People ..... www.radiodamal.com
Clandestine, R ERGO ..... www.radioergo.org
Clandestine, R Free Chosun ..... www.rfchosun.org/
Clandestine, R Free North Korea ..... www.fnkradio.com
Clandestine, R Free Sarawak ..... www.radiofreesarawak.org
Clandestine, R Hoa-Mai ..... www.radiohoamai.us
Clandestine, R Miraya FM ..... www.mirayafm.org
Clandestine, R Tamazuj ..... http://radiotamazuj.org
Clandestine, R VO Kurdistan ..... www.radiokurdistan.net
Clandestine, R VO the People ..... www.radiovop.com
Clandestine, R Xoriyo ..... www.radiooxoriyo.com
Clandestine, Sawtu Linjila/VO the Gospel ..... www.lutheranworld.org/
Clandestine, Sound of Hope R Intl ..... http://sohnetwork.com/
Clandestine, SW R Africa ..... www.swradioafrica.com
Clandestine, VO Asena ..... www.assenna.com
Clandestine, VO Democratic Alliance ..... www.erit-alliance.com
Clandestine, VO Eritrea ..... www.mahta.net
Clandestine, VO Iranian Kurdistan ..... www.rdkiran.com
Clandestine, VO Martyrs (Freedom) ..... www.vomkorea.co.kr
Clandestine, VO Oromo Liberation/SBO ..... www.oromoliberationfront.org/sbo.html
Clandestine, VO Tibet ..... www.vot.org/
Clandestine, VO Wilderness ..... www.cornerstoneusa.org
Clandestine, Zimbabwe Comm R/R Dialogue ..... www.zicora.com
Colombia, Salem Stereo ..... www.salemstereo.com
Congo Dem Rep, R Kahuzi ..... www.radiokahuzi.com
Croatia, Croatian R/HS-1 ..... www.hrt.hr/
Croatia, VO Croatia ..... www.hrt.hr/
Cuba, R Havana Cuba ..... www.radiohc.cu/
Cuba, R Rebelde ..... www.radiorebelde.cu
Cyprus, (Northern) R Bayrak Intl ..... www.brtk.cc
Cyprus, Cyprus Broad Corp ..... www.cybc.com.cy
Djibouti, RDTV de Djibouti ..... www.rtd.dj
Dominican Rep, R Amanecer Intl ..... www.radioamanecer.org
Ecuador, HCJB/LV de los Andes ..... www.radiohcjb.org
Ecuador, R El Buen Pastor ..... www.saraguros.com/radio.php
Egypt, R Cairo ..... www.ertu.org
Egypt, R Cairo/R VO of the Arabs ..... www.ertu.org
Eqt Guinea, Pan Am BC/R Africa ..... www.radiopanam.com/
Ethiopia, Amhara State Reg R ..... www.amma.gov.et
Ethiopia, R Ethiopia/External Svc ..... www.erta.gov.com
Ethiopia, R Ethiopia/Natl Svc ..... www.erta.gov.com
Ethiopia, R Fana ..... www.radiofana.com
Ethiopia, R Oromiya ..... www.orto.gov.et
Finland, Scandinavian Weekend R ..... www.swradio.net
France, R France International ..... www.rfi.fr/
Gabon, Africa No. 1 ..... www.africa1.com
Georgia, R Abkhazia ..... www.apsua.tv
Germany, AWR Europe www.awr2.org/
Germany, Christliche Wissenschaft www.awr2.org/
Germany, Deutsche Welle ..... www.dw.de
Germany, HCJB Global Voice ..... www.radiohcjb.org
Germany, Lutherische Stunde ..... www.lutherischestunde.de
Germany, Mighty KBC Radio ..... www.kbcradio.eu/
Germany, R 6150 ..... www.radio-6150.de
Germany, R Dardasha 7 ..... www.dardasha7.com
Germany, TWR Europe ..... www.twr.org
Greece, R Stathmos Makedonias www.ert3.gr/
Greece, Voice of Greece www.ert3.gr/
Greece, Voice of Greece ..... www.voiceofgreece.gr/
Guam, AWR Asia/Pacific www.awr2.org/
Guam, KTWR/TWR Asia ..... http://nea.ktwr.net/
Guatemala, R Verdad ..... www.radioverdad.org
Guinea, R Familia FM ..... www.familiafm.com
Guinea, RTV Guinee ..... www.rtg-conarky.com/
Guyana, Voice of Guyana ..... www.ncnguyana.com

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Blog: http://mt-milcom.blogspot.com
Twitter: MilcomMP

Update on Monitoring the UHF Milsats

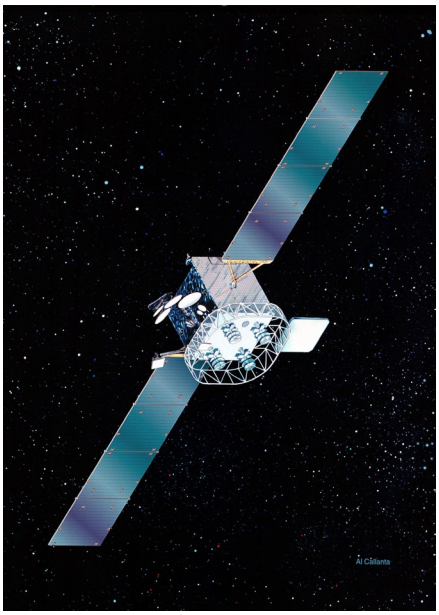
For some radio hobbyists, the mere mention of monitoring frequencies transmitted from space by any orbiting satellite brings on a certain level of trepidation. Others enjoy filling their speakers with all sorts of exotic and unique communications from quite a number of military satellites. As I have written in past pages in *Monitoring Times*, and our former sister publication, *Satellite Times*, "If satellite reception was easy, everyone would be doing it."

This aspect of the radio hobby is not easy or for the faint of heart. It will require some study on your part, the purchase of some good quality receiving equipment, and in some cases, even designing and building your own antennas for the various military satellite bands you want to monitor. Depending on the equipment and antennas you have at hand right now, satellite monitoring can be either a snap or, for some, "mission impossible."

Milsat Monitoring 411

Unlike conventional scanner monitoring, where you put up a wideband antenna that lets you receive signals across the entire tuning range of your scanner, satellite monitoring is a bit of a different animal.

Satellite downlink frequencies (signals transmitted from the satellite back to earth) have weaker transmit powers than their terrestrial counterparts in the VHF/UHF spectrum. They usually require some sort of gain antenna and/or pre-amplifier to pull in these weaker signals. If we use a gain antenna, that usually equates to a directional antenna that will have to be aimed properly at the satellite we want to monitor.



U.S. Navy UFO Milsat (Courtesy: DoD)

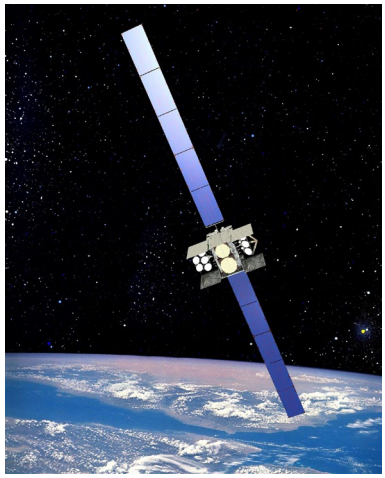
Fortunately, most military satellites we are interested in monitoring are in geostationary orbits (GEO) above the equator. From a ground observer's point of view, these satellites appear to be stationary at one point in the sky, so aiming a directional antenna at them will be easy. We can use a satellite tracking computer program, such as the Obitron (See Table Three) software package, to work out the point angles to any of the known U.S. milsats in geostationary orbit.

If it is a non-geostationary satellite that you want to monitor, things can get a bit more complicated. Higher gain antennas have a narrower frequency response and antenna beam widths; we will have to steer the antenna and track the satellite for proper reception. This is especially critical on faster moving, Low Earth Orbiting (LEO) satellites. You are going to have to accurately point the antenna array at the satellite as it moves across the sky to get a quality signal to the receiver.

The bottom line here is that one satellite monitor setup will not necessarily get them all. You will have to have use a different antenna and even a separate receiver/external amplification setup for each satellite band you want to monitor.

The Short Course on Locating Milsats in Orbit

There are quite a few military satellites in GEO/High Elliptical Orbit (HEO) that have UHF downlinks. Your first task is to locate them so you can accurately point your directional antennas. Table 1 lists the latest intelligence on which birds are in orbit and/or active and where they are located.



DSCS III Milsat (Courtesy: DoD)

One of the easiest ways to verify which FLTSATCOM/UFO milsat band plan is visible at your location is to check the fleet broadcast downlink channels that are operational 24/7. I use the following fleet broadcast channels as beacons for antenna and equipment alignment: 250.350 250.450 250.550 250.650 MHz.

You should correlate any of the fleet broadcast frequencies you receive above with the Fleet/UFO band plans mentioned in this column. This will help you to locate additional frequencies to monitor from your location.

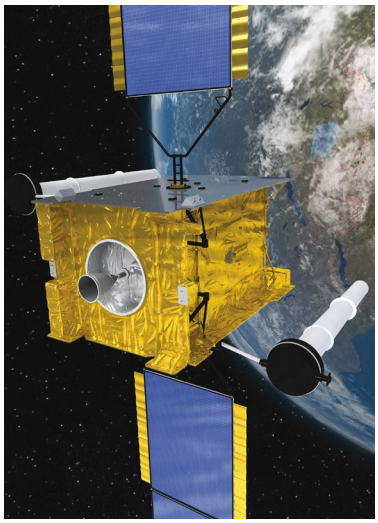
You will find a list of miscellaneous U.S. and international milsat downlinks in Table 2. These downlinks offer you an opportunity to monitor transmissions from a wide variety of orbiting communications platforms from the United States, NATO and other countries. If you need the current band plans for the FLTSATCOM and UFO milsats, check out Tables 3 and the links on our *Milcom Monitoring Post* blog.

Finally . . .

Give milsat listening a try and be sure to drop us a report of what you hear from your location. If you have a multi-mode VHF/UHF receiver, a decent pre-amp, coax and antenna system, you may be surprised at some of the satellites and communications coming from them that you can monitor.

There are a lot of military communications audible to the radio hobbyist throughout the HF/VHF/UHF spectrum. By adding the capability to monitor the UHF milsats, you will get a deeper appreciation for not only the sheer amount of military traffic that takes place throughout the entire radio spectrum, but also the possibly of filling in the gaps of what you hear on other portions of the radio spectrum.

If you like to experiment with other forms of radio listening, consider giving milsat monitoring a try. It can provide you with a truly out-of-this world listening experience.



UK Skynet 5AMilsat (Courtesy: EADS)

Table One: Active Milsats and Orbital Locations

Geostationary Milsats

Name	Longitude (Inclination)	Country, UHF Downlink Frequency Notes
Skynet 4C (UK)	1.6° W (12°)	Table 2 – UHF transponder
SDS 3-6/NRO L-27 (USA-227)	10.0° W (5°)	Table 2 – UHF downlinks
WGS 3 (USA-221)	12.0° W	No known UHF transponders
FLTSATCOM 8 (USA-46)	15.1° W (11°)	Table 3 for link to band plan Bravo
Skynet 5C (UK)	17.8° W	Table 2 – Several UHF transponders
UFO 7 (USA-127)	22.5° W (6°)	Table 3 for link to band plan Papa
SDS 3-F7 (USA 236)	30.2° W (5°)	Table 2 – UHF downlinks
Skynet 4F (UK)	33.8° W (7°)	Table 2 – Several UHF transponders
Milstar DFS 1/1-F1 (USA-99)	39.0° W (9°)	Table 2 for frequency information
DSCS 3-F14/B6 (USA-170)	52.50° W	One UHF single channel transponder (SCT)
Milstar DFS 6/2-F4 (USA-169)	90.0° W (4°)	Table 2 for frequency information
UFO 5 (USA-111)	99.8° W (8°)	Table 3 for link to band plan November
UFO 6 (USA-114)	105.2° W (7°)	Table 3 for link to band plan Quebec
DSCS 3-F10/B13 (USA-134)	130.0° W (6°)	One UHF single channel transponder (SCT)
DSCS 3-F13/A3 (USA 167)	135.4° W (1°)	One UHF single channel transponder (SCT)
SDS 3-F3/NRO L12 (USA-162)	141.0° W (6°)	Table 2 – UHF downlinks
Milstar 1-F2 (USA 115)	150.0° W (9°)	Table 2 for frequency information
MUOS 1 (2012-009A)	176.7° W	UHF Transponder package (probably a 300 MHz and higher downlink),
UFO 4 (USA-108)	177.8° W (6°)	Table 3 for link to band plan Oscar
UFO 8 (USA-138)	171.4° E (5°)	Table 3 for link to band plan Papa
Optus and Defense C1 (Australia	Optus C1/D)	156.0° E Six UHF transponders
Milstar DFS-4/2-F2 (USA-157)	152.9° E	Table 2 for frequency information
DSCS 3-F9/B7 (USA-113)	149.3° E (7°)	One UHF single channel transponder (SCT)
DSCS 3-F11/B8 (USA-148)	103.7° E (3°)	One UHF single channel transponder (SCT)
Feng Huo 2 (China)	101.54° E (3°)	UHF downlinks, current frequencies unknown
FLTSATCOM 7 (USA-20)	100.0° E (13°)	Table 3 for link to band plan Charlie
SDS 3-2/3-F5/NRO L10 (USA-155)		91.9° E (5°) Table 2 – UHF downlinks
SDS 2-F2 Quasar 2 (USA-67)	75.1° E (15°)	Table 2 – UHF downlinks
UFO 10 (USA-146)	72.4° E (5°)	Table 3 for link to band plan November or Quebec
Intelsat 22	72.1° E	Carries an Australian Defense Force UHF package, frequencies unknown
Leasat 5	72.1° E (10°)	Australian Defense Force leased satellite, band plan Whiskey
UFO 11 (USA-174)	71.5° E (3°)	Table 3 for link to band plan November or Quebec
ComsatBW-1 (Germany)	63.0° E	Table 2 – Several UHF transponders
DSCS 3-F12/B11 (USA-153)	56.7° E (3°)	One UHF single channel transponder (SCT)
Skynet 5B (UK)	52.75° E	Table 2 – Several UHF transponders
Skynet 5D (UK)	52.69° E	Table 2 – Several UHF transponders
NATO 4B (NATO)	35.00° E (10°)	Table 2 – Two UHF transponders
Skynet 4E (UK)	32.12° E (8°)	Table 2 – Several UHF transponders
Milstar 2-F3 (USA-146)	30.00° E (5°)	Table 2 – UHF transponders
UFO 2 (USA-95)	28.80° E (9°)	Table 3 for link to band plan Oscar, status?
Sircal 1 (Italy)	16.25° E (5°)	Table 2 – UHF transponders
ComsatBW-2 (Germany)	13.20° E	Table 2 – UHF transponders
Sircal 1B (Italy)	11.79° E	Table 2 – UHF transponders
Skynet 5A (UK)	6.00° E	Table 2 – UHF transponders

Milsats in High Earth Orbit (HEO)

SDS 2-F4 (USA-125)/Capricorn/NROL 5 (23945)	No longer transmitting
SDS 3-F1 (USA-137)/Capricorn (25148)	No longer transmitting
SDS 3-F4 (USA-179)/Nemesis/ NROL 1 (28384)	UHF downlinks
SDS 3-F5 (USA-198)/Scorpius/NROL 24 (32378)	UHF downlinks (band plan Delta)
TacSat 4 (DoD Milsat) (37818)	Table 2 – UHF transponders
Meridian 1 (Russian) (29668)	Table 2 – UHF downlinks
Meridian 2 (Russian) (35008)	Table 2 – UHF downlinks
Meridian 3 (Russian) (37212)	Table 2 – UHF downlinks
Meridian 4 (Russian) (37398)	Table 2 – UHF downlinks
Meridian 6 (Russian) (38995)	Table 2 – UHF downlinks

Satellites in Low Earth Orbit (LEO)

NOSS 2-2 (C/D/E) (USA-74/76/77) (21800)	Table 2 – One UHF downlink
NOSS 2-3 (C/D/E) (USA-120/121/122) (23908/23936)	Table 2 – One UHF downlink
Bernie/Singleton 3 (USA-81) (21949)	Table 2 – One UHF downlink

Table 2: Known Milsats UHF Downlinks and Band Plans

(Note: All frequencies in this article are in MHz)

Bernie/Singleton 3 (USA 81) .258.150

ComsatBW-1/2 .....243.625 244.275 248.750 249.400 250.900 251.775 253.750 254.775 255.775 259.150 259.425; Other possible frequencies 244.975 248.175 255.450 255.500 259.250

Intelsat IS-22.....243.800 251.600 252.300 253.975 254.025 254.500 254.575 254.600 254.625 254.650 255.650 255.675 257.575 257.600 257.775 260.550 265.675 265.850 267.975 260.025

Meridian (Russia) .....483.500 483.750 484.00 and 277.400-278.400; 278.400-279.400

Milstar.....243.785 and 243.825, FHSS/Waterdrops 52 kHz bandwidth transponder. Four AFSATCOM II-R channels frequency hopped; 75 bps and one fleet broadcast transmitter BPSK 1200 bps channel, UHF downlink 243.750-243.850 and UHF uplink 335.600-339.600 MHz. Fleet broadcast downlinks at 253.500 and 253.425 (ex-253.400 MHz)

NATO 4B .....253.950 and 257.450

Navy NOSS 250.150

SDS HEO band plan Delta 243.695-243.760

SDS HEO band plan Echo.....243.855-243.920

SDS GEO 250.075 251.325 256.475 258.775 262.675 263.225 263.250 267.550 268.675

SDS HEO.....251.275 251.700 256.375 258.800

Sircal 1 (Italy) 252.200-252.350; 258.150-258.300; 267.100-267.250

Sircal 1B (Italy).....252.400 252.450 252.500 252.550 252.625 259.975 260.025 260.075 260.125 260.175 267.875 267.950 268.000268.050 268.100; Other possible frequencies 252.600 and 252.625

TacSat 4 .....249.600 252.950 253.000 254.125

UFO-F11 Extended band plan.248.825 249.375 251.900 252.000 253.600 253.700 253.800 255.400 256.900 257.000 257.100 258.500 262.000 262.050 263.600 263.700 265.400 265.500 266.900 268.200 268.300 268.400 269.700 269.800

UK Skynet 4C 254.200

UK Skynet 4E.....254.150 257.550 257.650

UK Skynet 4F 254.075 257.425 257.505

UK Skynet 5A 245.850 249.480 249.530 249.850 250.100 250.200 253.750 253.930 257.600 261.100

UK Skynet 5B.....245.200 249.840 249.880 250.140 250.160 254.830 257.900 261.150 262.500

UK Skynet 5C 245.800 249.450 249.500 249.550 249.910 249.918 250.130 254.000 256.600 262.200

UK Skynet 5D 245.950 247.380 249.900 249.950 250.150 253.400 256.450 257.900 260.900 262.200

UK Skynet Other Reported Frequencies 245.900 246.500 249.870 250.180 253.430 253.650 253.675 253.725-253.980 254.025 254.050 254.100-254.150 254.175 254.225-254.350 254.730 257.175-257.400 257.450-257.500 257.525 257.575 257.625-257.850 261.2785 261.350 262.825

Unknown satellites.....248.825 254.950 261.400 261.425 261.975 262.950

Satellite Spectrum Holes.....243.675-243.775 243.825 243.850 243.950 244.000 244.050 244.150 248.850 248.900 248.950 249.000 249.050 249.100 249.150 249.200 249.250 249.300 249.350 249.625 249.650 250.225 250.750 253.050 254.075 254.100 254.150 257.550 260.350 260.400 260.450 260.500 260.550 260.600 260.650 260.700 260.750-260.850 260.950 262.825 263.375 267.825 267.925 268.925

Table 3: Milsat Monitoring Resource Guide

Down East Microwave (Antennas)	**www.downeastmicrowave.com**
Grove Enterprises (Antennas)	**www.grove-ent.com/scannerantennas.html**
Homebrew 4-element Yagi for 260 MHz (German)	**www.satellitenwelt.de/yagi260mhz.htm**
Larry's Milcom Monitoring Post Blog:	
The FLTSATCOM Milsat Constellation	**http://tinyurl.com/bpuwaya**
The UFO Milsat Constellation	**http://tinyurl.com/d93troe**
Mike McCants' Satellite Tracking TLE Zip Files	**www.prismnet.com/~mmccants/tles/**
NORAD Two-Line Element Set Format	**http://celestrak.com/NORAD/documentation/tle-fmt.asp**
Orbitron Satellite Tracking Software	**www.stoff.pl/**
Robert Christy's Zarya	**www.zarya.info/Frequencies/FrequenciesAll.php**
Satellite Orbit Determination	**http://satelliteorbitdetermination.com/**
Satellitenwelt (German) Satellite World	**www.satellitenwelt.de/**
Satellitenwelt (German) Frequency List	**www.satellitenwelt.de/freqlisten.htm**
UHF Milsat GEO/HEO frequencies	**www.satellitenwelt.de/UHF_MilSat_Bands.pdf**
UHF-Satcom.com	**www.uhf-satcom.com/**

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http://americanbandscan.blogspot.com

Death of the Car Radio?

(All photos courtesy of the author)

Blogger Eric Rhoads triggered considerable discussion, and a fair amount of panic, with an article he posted on Radio Ink Tank back in March. In the article, he quoted a conference speaker as stating AM/FM radios would no longer be standard in the vehicles of two auto manufacturers within two years, and would be gone from ALL new cars within five years. The theory, is that younger listeners no longer listen to radio. They use Pandora, iTunes, and downloaded MP3 files.

It turns out the quote was inaccurate, but maybe not as inaccurate as the traditional radio industry might wish. GM and Ford did both write to assure the industry they have no near-term plans to remove AM/FM radio from their new vehicles. And Mr. Rhoads published a correction, indicating that what the speaker actually said was that traditional radio would not be disappearing any time in the next five to ten years.

That's the good news. The bad news is that the speaker did say that traditional AM/FM radio will disappear from new vehicles eventually.

The stereotype is that it's teenagers and 20-somethings who are no longer using radio. I'm not at all convinced that stereotype is valid. I'm afraid my 20s passed by a long time ago, but I can't remember the last time I've listened to a commercial radio station that wasn't DX. Most of my listening is either to NPR or to a community station in my Wisconsin hometown, the latter over the Internet.

Many new cars already come with the ability to stream Internet radio services. Others include satellite radio. Sockets on the dashboard allow playback of music from one's iPod or or other MP3 player. Some units have a USB port, so you can play music files from a "thumb drive." Of course, our cars have been playing CDs (and before that, cassettes) for a long time.

The conventional wisdom is that most radio listening happens in the car, on the way to or home from work. The eventual loss of the mobile audience may be very bad news for the stations we all chase.

❖ AM Revitalization: More Recommendations

Last December, we reported FCC Commissioner Ajit Pai's "AM Radio Revitalization Initiative." Commissioner Pai had a few recommendations, and news of the initiative has spurred other writers to present many more.

For many AM stations, land costs are an issue. An AM station requires a ground system, which extends a "quarter wavelength" around the tower. At the middle of the dial, this "quarter wavelength" is about 250 feet. Stations requiring a multiple-tower directional antenna, and/or operating on lower frequencies, may require a much larger ground system.

Property taxes are often an issue. Many AM sites were built 50 years ago on cheap land at the very fringes of the city. Today, that land is often in the middle of a well-to-do suburb. The value of that land has skyrocketed, and with it, the taxes. It's common for a station to lease, not own, its tower site. As the value of the land increases, so does the cost of leasing that land. There's also an "opportunity cost;" does it make sense to use ten acres of land to operate a radio station worth $1 million, if selling the property to developers would bring $3 million?

However, moving an AM station is often impossible. The FCC has antenna efficiency regulations that require towers to be of a minimum height. These regulations also establish the minimum size of the ground system. If the FCC requires your tower to be at least 250 feet tall, and the Town of Podunk won't allow any tower taller than 150 feet, that nice chunk of land in Podunk is going to be off-limits.

Moving a station also triggers something called the "rachet clause." The technical facilities at the new site must reduce interference to existing stations by at least 10 percent. There are two ways to comply. One is to simply reduce power. Obviously, that doesn't help the station's signal! The other is to reduce power in the direction(s) of other stations on the frequency, by using a more directional antenna system. You still reduce coverage in those directions, and hope there aren't any important populations in those areas.

WKFN-540, Clarksville, Tennessee. Three dots near the top are for an unidentified FM station.

Commenters have suggested eliminating this rachet clause. They have also suggested eliminating the requirement that a station provide a strong signal across its "city of license." And, a proposal has been made to eliminate the minimum antenna efficiency and minimum ground system requirements.

On the other side of the equation, obviously one of AM's largest problems is noise from devices that aren't designed to be radio transmitters. On Radio World, Chris Imlay suggests the FCC needs to get this noise under control. On my commute to work, I lose the signal of the local NPR AM station (15,000 watts, 20 miles away) to severe power line noise. Anyone who's DXed from a car has run into the same problem.

One Pennsylvania DXer encountered one of the issues Imlay wrote about. When he replaced a defective flourescent light ballast, the new ballast caused interference to AM signals. It also clobbered FM and TV reception! FCC regulations allow ballasts installed in businesses to radiate more interference than those installed in residences. Unfortunately, it's difficult to tell what kind of ballast you're buying.

More than 600 AM stations can now also be heard on FM, over low-powered "translator" stations. Here in middle Tennessee alone, we have five of these arrangements. FM translators are limited to a maximum power of 250 watts, but due to the lower interference levels on the FM dial, they frequently have much better coverage than the AM stations they rebroadcast.

But in many cities, there are more AM stations which would like to have FM translators than there are translators to buy. The FCC only accepts applications for new stations during "filing windows." The last translator filing window was held in 2003. Many long-suffering AM stations can't wait another ten years for relief.

One answer is to move a translator from another place. This isn't quite as easy as it may sound. The FCC recognizes two types of moves. A move is considered a "minor change" if the station could not operate from the old site and the new one at the same time without interfering with itself. For example, moving a translator to a tower on the other side of the street would be a "minor change." A move is considered a "major change" if the station could operate from both sites simultaneously without interference. Moving a translator from Chicago to Atlanta would be a "major change."

Major changes can only be requested during filing windows. Imagine you have an unneeded translator in Beloit, Wisconsin. And, you have an AM station that could use a translator, located in Milwaukee 75 miles away. You could move the translator, but you'll be waiting ten years for FCC approval.

In this particular case, the licensee moved the translator in "hops." Starting on 99.5 at Beloit in 2007, the translator "hopped" through five frequencies and five cities, moving along Interstate 43 until it reached 97.9 at the Milwaukee suburb of West Allis in April 2011. A final move into Milwaukee itself is pending.

This isn't a very advantageous way to do it, to say the least! Each "hop" required filing an application with the FCC and paying the appropriate fee. Commission staff had to process

the application at each hop. A facility had to be built and operated at each site, even though the licensee had no intention of actually serving towns like Darien, Como, and East Troy along the path.

The licensee was quite lucky he was able to find an available frequency at each step. If he'd made it halfway to Milwaukee and then found no frequency available for the next step, he'd be stuck. He'd be stuck even if there was a perfectly clear frequency waiting for him in Milwaukee once the "hops" were done.

AM advocates have recommended lifting the major change filing window requirement. An FM translator could request any move at any time and, as long as it wouldn't interfere with other existing stations, the move would be approved. A move like this one could be handled in a single hop.

WEGI-1370, Fort Campbell, Kentucky. Two dots near the top are WEGI-FM 94.3.

❖ Missing Signals

Last time, I reported a 50,000-watt, clear-channel station at risk of going permanently silent. WDCD-1540, Albany, New York, had been off since April 1, 2012. Their license would have automatically expired on April 1 of this year if they hadn't returned to the air. In late March, they did return, simulcasting WDCD-FM. Rumor has it the AM station is for sale so AM 1540 at Albany will live, at least for now. So will Little Rock's KAAY-1090, which also returned to the air this spring. However, three powerful Canadian stations are in fact gone.

CKUA-580 came into being in 1927, when the University of Alberta acquired a commercial station with unfortunate call letters which I can't print in this column. It was operated by various agencies of the Alberta government until 1994, when it was handed over to a private non-profit organization.

In the 1970s CKUA expanded into FM, and installed FM transmitters across the province. Today, it reaches the vast majority of the province over a network of 15 FM frequencies. A small corner of the province is reached only by AM 580.

Many AM stations, both in Canada and the U.S., haven't seen much maintenance lately. Earlier this year, Radio-Canada's station at Windsor, Ontario left 540 AM, taking over the former English-language transmitter on 1550. The 540 kHz transmission facility required expensive repairs so the CBC found it more cost-effective to use the idle 1550 kHz facility.

Two major sources of interference to AM radio.

CKUA-580 was in a similar situation. Their AM site requires $1,000,000 in safety upgrades. Furthermore, it operates on land leased on a year-by-year basis. It makes little sense to spend money upgrading a station which could be forced to move in a few months. The cost of moving, estimated by the station at $5,000,000, is simply not within CKUA's means.

CKOT-1510 was the last daytime-only station in Canada. They acquired an FM relay in 2007 and finally decided it made little sense to leave the AM station on the air. Daytime-only broadcasting never was very popular in Canada. I could only find nine daytime-only stations in a 1967 list. The next-to-last Canadian daytimer was probably CJMR-1190, Mississauga. When CFGM moved from 1320 to 640, CJMR took over the 1320 frequency and is now a full-time operation.

CKSB-1050 is the Radio-Canada ("French CBC") station for Winnipeg. CKSB has been simulcast on a low-powered station on 90.5 FM for a few years. The demise of analog TV has made it possible for Radio-Canada to move the FM station to 88.1 and greatly increase power. And, as in so many other places in Canada, the AM transmitter is no longer necessary. This station made the trip to Milwaukee most nights – now, I suppose we'll be hearing Toronto's CHUM.

STATION REPORT

NEW STATIONS:

Applications filed for new stations:

Red Oak, N. Carolina	1190	9,200/1,000 DA-N

Permits granted for new stations:

Draper, Utah	780	1,000/250 DA-2 (near Salt Lake City)

New stations on the air:

Bethel Heights, Ark.	1340	KFMD; 1,000/1,000 ND (near Springdale)

DELETIONS:

Stations deleted:

Edmonton, Alberta	580	CKUA
Vancleve, Kentucky	730	WMTC
St. Boniface, Man.	1050	CKSB (going to 88.1 FM)
Tulita, N.W.T.	920	CBQI (going to 100.9 FM)
Tillsonburg, Ontario	1510	CKOT
Ebensburg, Penna.	1580	WRDD

ND: non-directional
ND-D: non-directional, only operates daytime
DA-N: directional at night only
DA-D: directional during daytime only
DA-2: directional all hours, two different patterns
DA-3: directional day, night and critical hours, three different patterns

Web links for this month's column:

americanbandscan.blogspot.com
My AM DX blog.

ericrhoads.blogs.com/ink_tank/2013/03/a-cold-harsh-reality-for-radio.html
Eric Rhoads' blog post on the future of AM

www.radioworld.com/Default.aspx?TabID=64&articleid=217276
Chris Imlay's comments about electrical noise and AM

edocket.access.gpo.gov/cfr_2009/octqtr/pdf/47cfr73.182.pdf
FCC standards for authorizing new AM stations. No, I can't read them either!

www.ckua.com/02/19/13/CKUA-AM-Signal/landing.html?blockID=666821&feedID=7375
Why CKUA-580 is going silent.

Ernest Robl
ernestrobl@monitoringtimes.com

Listening at Work Limits and a PTC Update

"Train 352, you have authority to enter Mr. Jones' limits and proceed through at track speed. All personnel and machines are in the clear."

That type of call, from personnel in the field to a train approaching a major work zone along the track may become more common as railroads strive to expand capacity for both passenger and freight services.

Railroads are a growth industry. You may have some difficulty convincing those who do not follow transportation closely, but it's true.

Coal traffic is off slightly due to a variety of factors, but while debates drag on about the construction of new pipelines, crude oil traffic by rail is up sharply, as is movement of a wide variety of supplies used for both oil and gas drilling.

Railroads had a major retrenchment in the 1970s and 1980s, when even many railroad managers had doubts about the future of railroading. But, after a major change in the regulatory climate, traffic and demand have been on an upswing ever since. And, increased interest in passenger services, both for long-distance trains and for regional commuter services, has only added to strains on existing infrastructure.

While there are still occasional abandonments of (typically short and remotely located) rail lines, new tracks are constantly being laid. And, even some previously idled lines have been reactivated. One reason this is often largely invisible to the general public is that these are usually not new routes, though new spurs to serve new industries do add to the mix, rather these are additional tracks in existing corridors.

This new feed mill near Kinston, in eastern North Carolina required an unloading loop of about a mile of track, which had just been completed in 2010 when this photo was made from a passing train. The mill has since been receiving trains of up to 60 cars of grain.

A Norfolk Southern intermodal train with double-stacked containers rolls past the passenger platform at High Point, North Carolina, the highest point on this busy mainline between Greensboro and Charlotte. Intermodal continues to be a growth sector for railroads, but more passenger trains also add to demands on railroad infrastructure.

Take for example the rail corridor between Raleigh and Greensboro in my home state of North Carolina. On this relatively short single-track line, which is of course part of a larger rail network, there are currently four major sidings of about two miles in length each. In addition, some double-track leaving Raleigh and entering Greensboro.

But, as this is being written, work is underway on building two additional major sidings, one between Raleigh and Durham and the other between Durham and Greensboro.

Okay, on such projects, what can you hear on the radio?

While much of the work on major projects is often done by contractors, there is always a railroad track supervisor in charge of the site.

All trains traveling that line are issued a track bulletin at their departure point, describing the work zone in terms of "from milepost x to milepost y" and, listing the times during which "work limits" are in effect.

Approaching trains need to be prepared to stop short of the work limits. But, typically, once they come within radio range, they will call the supervisor at the site for further instructions. Those instructions may be to wait short of the limits – train crews always have to be aware of where they are stopping a longer train, as they may be blocking road crossings – or to proceed, either at normal or reduced speed.

The site supervisor gets a "lineup" of trains that are expected to operate and will make every effort to have work scheduled around those trains, particularly scheduled passenger trains.

But, some projects, such as installation of a new mainline switch, or even replacement of an aging bridge, may take the better part of a day or more and even require that some trains be cancelled that day.

At the same time, the site supervisor acts as a mini-dispatcher, keeping track of men and equipment that may need to enter the work area. Each crew or machine will get permission to work in the area and then release that permission when they are in the clear.

The supervisor then needs to ensure that all men and equipment are in the clear and that the track is in suitable condition before allowing a train movement.

At these locations you not only get good insights into the building of railroad infrastructure but you'll also hear a great increase in the amount of radio traffic. Much of that traffic also provides insights into over-all operating

At the so-called Hopson Road project between Durham and Raleigh, North Carolina, contractors are just starting to stage their equipment and supplies in early April of 2013. This project involves a curve realignment (for faster passenger train speeds) and the addition of a passing siding for the railroad and a grade-separation for crossing with busy Hopson Road. Rails have already been brought in, but these are relatively light rails. With new construction, such as new sidings, the new tracks are sometimes built with lighter rails, which are then swapped out for heavier rails once on-track equipment can be brought in.

patterns, as all trains have to identify themselves and the site supervisor juggles demands for construction work with the need to keep trains moving.

So, for the two major projects closest to my home in central North Carolina, I'll not only be keeping an eye on construction progress but also listening in on the railroad operating picture.

❖ PTC Update

A loud groan, followed by a long wistful pause. That was the initial reaction of Norfolk Southern (NS) CEO Wick Moorman when, at a railroad conference in North Carolina in March, he was asked about the current status of government mandated positive train control (PTC).

I've covered PTC in previous columns, but, for those new to the subject, here's a quick recap: In response to a deadly crash in California in 2008, where a passenger train ran a red signal and collided head-on with a freight train, Congress mandated that railroads install technology that would try to avoid such problems caused by human error. While the basic idea sounded simple, implementation of the mandate has proven anything but that.

After Moorman caught his breath, he noted that while railroads were spending hundreds of millions of dollars of their own money – Congress provided *no* money for this mandate – progress has been slow because of both the massive amount of work (computer programming, installation of equipment on locomotives and in the field) and the fact that this is simply not mature technology.

Yes, there have been automated train stop (ATS) systems in the past, some of which are still in use, but the current mandate includes the incorporation of GPS technology, which adds a much greater level of complexity.

And, all that complexity has to be dealt with through standards that apply to all railroads and all equipment manufacturers, as locomotives of the major railroads may operate anywhere in North America on the rails of other companies.

I've mentioned in a previous column that railroad officials have told me (off the record and not for attribution) that there are places, particularly in mountainous terrain, where full GPS reception is a problem, and the system's resolution is only about the distance between two parallel tracks. And, if the system cannot tell on which of two parallel tracks a train is, it has real problems. Of course, there are other ways to determine track occupancy, but, again, that adds complexity.

So, even in areas where railroads already use radio code line, data packets to send instructions to signals and switches and report track occupancy, you'll see additional antennas going in for communication of PTC data between the ground and trains.

The bottom line, as Moorman presented it earlier this year: PTC will be in operation on some lines, but railroads are unlikely to meet the end of 2015 deadline for widespread implementation of PTC.

❖ More Sources

From time to time, I've listed sources for additional background information on railroad operations. Today we'll look at *Mass Transit* and *Metro* magazines.

These are the two main trade magazines for the public transportation sector in North America. Like most trade magazines, they are controlled circulation publications, meaning that if you "qualify" by working in a related field, including working in any area of government that deals with transportation, you get the publications for free. (You won't find these specialty publications on any newsstands.)

But, both magazines also have extensive web sites – **www.metro-magazine.com** and **www.masstranswitmag.com** – with lots of news coverage and access to magazine articles. (In the past, though it's been a few years, I wrote multiple articles for both magazines, and you may be able to find those in their online archives.)

Yes, the magazines cover more than rail transit, including buses, paratransit services, and similar subjects. Some news focuses on administrative changes in transit agencies.

But, typically about one third to one half of each issue focuses on rail transit, ranging from light rail to heavy rail (subways and elevated trains) to commuter rail (passenger operations in urban areas on freight railroad tracks). And even Amtrak and Via (Canada's equivalent to Amtrak) long-distance trains get some coverage, particularly in the discussion of urban train stations and their connections to regional transportation networks.

Both magazines have free electronic newsletters that you can subscribe to on their web sites. Again, some of the content of these newsletters will include subjects other than rail.

But both magazines provide lots of useful coverage of the issues affecting mass transportation in urban areas.

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Hitting the Road

Taking your gear on the road can be a great way to add new stations to your log. Not only can a geographic change present new signals, but even a short trip away from home can help if you are plagued by noise. By far, the most common complaint I hear from listeners is noise, both natural (QRN) and man-made (QRM). While there isn't a lot we can do about natural static, other than choose our listening times carefully, man-made noise is another story.

In the past I've covered ways of locating and curing static problems, but I'll take an entirely different approach this month: Leaving the noise behind! In case you haven't guessed, I'm talking about DXpeditions. Hams are famous for these events. They pack up their gear and head for exotic lands with the sole purpose of putting a station on the air. Often, they are the only station operating from the chosen location, much to the joy of award-chasing hams "back home." Listeners can also have DXpeditions. Their trips won't necessarily take them to exotic lands (although they might), but just getting away from urban centers can be equally rewarding.

Location, Location

Finding the right spot for your DXpedition is a key to success. Unlike VHF and higher frequencies, a hilltop location is not strictly necessary. This is due to longwave's ground-hugging characteristics. In fact, a low, waterside location can be optimal, especially when you're seeking signals on the other side of that body of water. Location will depend to some degree on whether you're going with a large group, or plan to have only a few attendees. In its simplest form, an event can be held by pitching a tent and setting up a small table to hold equipment. This arrangement is well suited to warmer climates when the weather is fair.

For larger gatherings, indoor accommodations are the preferred choice. For several years, I joined a group of DXers that used a large cabin in the lower Adirondacks during the month of November. Since it was the off-season for camping, the cost was very reasonable. The site included smaller cabins for sleeping, arranged around a main building that served as the listening quarters. Such a setup allowed around-the-clock DXing during any weather.

Try to pick a location at that is far away from high voltage electric lines and does not have fluorescent or sodium-vapor lights nearby. (It may be possible to have such lights turned off during your event.) Before committing to a given location, I recommend surveying the site with a portable receiver to check for noise. While this does not guarantee quiet conditions at the time of your event, it will give you some idea of what to expect and may help avoid unpleasant surprises.

Pre-visits also allow you to evaluate the possibilities for installing temporary antennas. For conventional wire antennas, you'll want to have some sturdy trees within 100 feet or so to secure your line. Users of active antennas or loops may only require a small post driven into the ground. By the way, when using wire antennas, don't feel that you must string out a half-mile of wire for acceptable performance. I've found that under the quieter conditions of a DXpedition, just 75-150 feet of wire is usually sufficient. (In fact, many portables suffer overloading when too long an antenna is used.)

Gear Checklist

Here is a brief checklist of things you may want to take on your DXpedition (besides your receiver, of course). The list is intended as a starting point, and can be customized to fit your needs:

Antenna wire, insulators, rope
Headphones
Reference books (beacon directory, maps, *MT*, manuals, etc.)
2-meter handheld, cell phone
Sleeping bag, pillow
Rain gear
Flashlight
Battery-powered alarm clock
Toiletries
Log sheets
Pens/Pencils
Food, snacks
A good non-radio book
Camera
Audio recording device
Small parts & equipment (fuses, connectors, electrical tape, multimeter, hand tools, etc.)

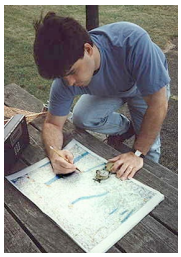
In warm climates, a DXpedition can be as simple as this tabletop setup. Be sure to include the snacks!

Communications

As noted in the checklist, it is desirable to have some form of two-way communication while on a DXpedition. Wired phones may not be readily available, so I suggest taking along your handheld transceiver if you're a ham, as well as a cell phone. Two-way communication was invaluable at an event I attended a few years ago where cell coverage was spotty. We needed to report a fire, and using a 2-meter radio, we contacted a distant ham who alerted the local authorities. As the local fire siren began to wind up, I knew that ham radio had done its job once again. Don't always count on cell phones.

The Big Day

If you're attending a DXpedition, I recommend getting there early. For weekend events, I try to arrive on Friday afternoon while there is still daylight left. This allows time for setting up stations, stringing antennas and getting the bugs worked out of the installation. As other DXers arrive, welcome them to the site and offer to assist them with their equipment and antennas.



No time for a full DXpedition? Consider tracking down some beacons in your local area.

Before long, a brief meeting should be held to introduce the participants, discuss emergency procedures, food arrangements, facilities, etc. Beyond that, there's not much more to be said. The rest of the time is yours to tune the bands as you like. I think you'll find, as I have, that it's hard to beat the quieter conditions and camaraderie offered by a DXpedition. I also find it to be an excellent time to go through your equipment manual trying out some of those features you don't always have time to use at home. Have fun, and be sure to send some pictures to *Below 500 kHz*!

Loggings and Mailbag

Ken Alexander VE3HLS (ON) has been working with a software-defined receiver (SDR) and loop antenna lately, and is having great success (see loggings chart). He says he nearly fell out of his chair when he looked up SI and found that it was from Greenland. He was even more amazed to get *two* beacons from B.C., as the path to B.C. is tougher than to Greenland, which is at least partway across water.

SDR Loggings fromOntario

kHz	ID	Location	Distance (km)
204	YFY	Iqaluit, NU	2,289.1
206	QI	Yarmouth, NS	1,080.0
207	CL	Charlo, NB	1,092.8
208	YSK	Sanikiluaq, NU	1,383.1
212	SJ	St John, NB	1,085.3
215	ZWW	Winnipeg, MB	1,488.2
216	ME	Matane, QC	1,051.1
233	GP	Gaspe, QC	1,263.3
254	5B	Gunisao Lake, MB	1,614.9
260	YAT	Attawapiskat, ON	1,005.4
266	YZX	Greenwood, NS	1,140.5

269	UDE	Delta, MB	1,571.3
279	SI	Simiutaq, GRL	2,841.6
280	QX	Gander, NL	1,961.8
281	CA	Cartwright, NL	1,944.3
284	RT	Rankine Inlet, NU	2,234.4
304	ZQM	Mocton, NB	1,171.8
305	YQ	Churchill, MB	1,905.7
317	VC	La Ronge, SK	2,208.2
320	TY	Tyler, TX	1,902.4
323	UWP	Argentia, NL	2,000.1
326	FC	Fredericton, NB	1,029.5
339	YFT	Makkovik, NL	1,891.5
344	YGV	Saint-Pierre, QC	1,372.1
350	DF	Deer Bay, NL	1,764.4
350	NY	Enderby, BC	3,021.0
356	AY	St Anthony, NL	1,914.3
363	1F	Bathurst, NB	1,130.0
364	ZHZ	Halifax, NS	1,259.9
370	YBV	Berens River, MB	1,535.6
370	GR	Magdalen Is, QC	1,406.4
371	GW	Kuujjuarapik, QC	1,249.2
378	HO	Hopedale, NL	1,860.4
387	6E	Grand Manan, NB	1,006.6
390	JT	Stephenville, NL	1,658.7
395	YL	Lynn Lake, MB	2,067.3
396	YPH	Inukjuak, QC	1,600.0
396	JC	Rigolet, NL	1,883.6
397	ZST	St John, NB	1,073.7
399	ZHD	Dryden, ON	1,181.9
400	QQ	Comox, BC	3,456.7
402	MQ	Miquelon, FR	1,818.6
399	4M	Red Sucker Lake, MB	1,512.9
406	YLJ	Meadow Lk, SK	2,375.7
413	YHD	Dryden, ON	1,198.2
420	TU	Tupelo, MS	1,362.7
520	F9	Miramachi, NB	1,134.4

Van Wilshire N1VW (IN) also submitted a set of loggings, and writes: "These catches were all made in SE Indiana over a 90-minute period on the night of March 26th, 2013 between 2130 and 2300 Eastern time. I used my FRG-100 and dipole antenna, which is oriented N-S and up about twenty five feet. I might recommend for the new beacon-chaser that a very slow tuning rate be used...patience is a virtue here. I have my best luck when using upper or lower sideband, a pair of headphones, and tuning *very* slowly. Also, I recommend tuning over the same part of the band at different times, as conditions can change a lot in 30 minutes. An empty space on one sweep might contain a station a few minutes later.

"I would also like to mention that I started out some years ago using a paper log only when logging NDB stations. After a while, that got to be rather ungainly, and for a small fee, I purchased Alex Wiecek's WWSU logging program. It is easy to use, and contains a database of thousands of NDBs. I still use a paper log as a backup, but the WWSU program is primary."

kHz	ID	Location
198	DIW	Dixon, NC
206	QI	NS
216	CLB	Wilmington NC
233	QN	Nakina, ON
245	YZE	Gore Bay, ON
248	FRT	Spartanburg, SC
248	WG	Winnipeg, MB
250	UGS	Albany, OH
257	YXR	Earlton, ON
260	YAT	Attawapiskat, ON
263	CVM	Alton, IL
272	YQA	Muskoka, ON
273	ZV	Sept-Iles, Quebec
278	ADG	Adrian, MI
329	AAA	Lincoln, IL
340	YY	Mont Joli, QC
344	JA	Jacksonville, FL
346	THJ	Laurel, MS
351	MSQ	Stevensburg, VA
351	YKQ	Waskganish, QC
353	QG	Windsor, ON
353	VV	Greensboro, GA
355	YWP	Webequie, ON
358	TNY	Fayetteville, TN
360	HIT	Sandersville, GA
362	SB	Sudbury, ON
362	SUR	Fitzgerald, GA
363	RNB	Milliville, NJ
366	YMW	Maniwaki, Quebec
368	ZYZ	Toronto, ON
371	AZ	Vicksburg, MI
371	GW	Kuujjuarapik, Quebec
371	PUR	Marshall, MO
373	AEA	South Hill, VA
375	7B	St. Thomas, ON
376	ZIN	Great Inagua, Bahamas

Longtime contributor Perry Crabil W3HQX (VA) writes with some interesting details on direction-finding stations:

"At one time the U.S. Navy operated a series of radio compass stations along the Atlantic, Gulf, and Pacific coasts of the U.S. Using precision loop antennas, these stations provided bearing and position information to ships at sea on a wavelength of 800 meters (375 kc). There were two types of radio compass stations. Independent stations supplied bearing information only. Harbor entrance radio compass stations were a group of three stations around a harbor. One of the three was the control station for the group and received bearings from the other two by landline.

"By plotting all three bearings on a nautical chart of the area, the control station determined the latitude and longitude of the ship and transmitted it on 800 meters. The ship station used Morse code and Q signal QTE? (What is my bearing?) or QTF? (What is my position?) on 800 meters to initiate its request to the radio compass or control station. When given the signal K, the ship station transmitted the Morse letters MO repeatedly for 60 seconds, then stood by for receiving the QTE or QTF report.

"While monitoring long wave marine frequencies from my QTH in Washington, DC, prior to WWII, I occasionally heard such exchanges. Although I have no logs from that period, these compass stations were part of groups along the East Coast.A Google search for Radio Compass Stations will turn up several sites with information about radio compass stations as far back as 1922, mostly as partial PDF files."

Marc Ellis, N9EWJ
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Firing up a Radiola III

It has been some time since we worked on a radio much older than 1938 vintage and I think it's time to change that. What I have in mind is a cute little set that came out in 1924, at the height of the radio boom, and which received such wide acceptance that over one hundred thousand sets were manufactured. I'm talking about the RCA Radiola III.

Not only was the Radiola III reasonably sensitive and selective, it was economical. Its low ($30) selling price made it easy to own and the use of the newly released WD-11 tube made it easy to operate.

Unlike the '01-A tubes in general use in broadcast sets up to that time, the WD-11 had an oxide-coated filament that operated effectively from an inexpensive and disposable 1.5-volt dry cell. The '01-A, on the other hand, had a thoriated tungsten filament that was usually powered by a lead-acid auto-style battery that had to be regularly taken to the local garage for recharging.

The Radiola III as Received

The Radiola III was also a little different both physically and electronically. Physically, most sets of the era had a conventional cabinet and front panel, while the Radiola's panel was set into the top of its small (7.75 inches x 6.5 inches x 5 inches high) box-like cabinet. Its three-foot battery cable was long enough so that the required array of batteries could be tucked away on the floor or a low shelf. The most striking difference electronically, as we will see, is the use of variometers (variable inductors) in applications where most radios used variable capacitors.

The Circuit

As the schematic of Figure 1 shows, The receiver's two WD-11 tubes are wired as a regenerative grid leak detector followed by a stage of audio amplification. Except for the jumble of coils representing the two variometers, the circuit is quite simple.

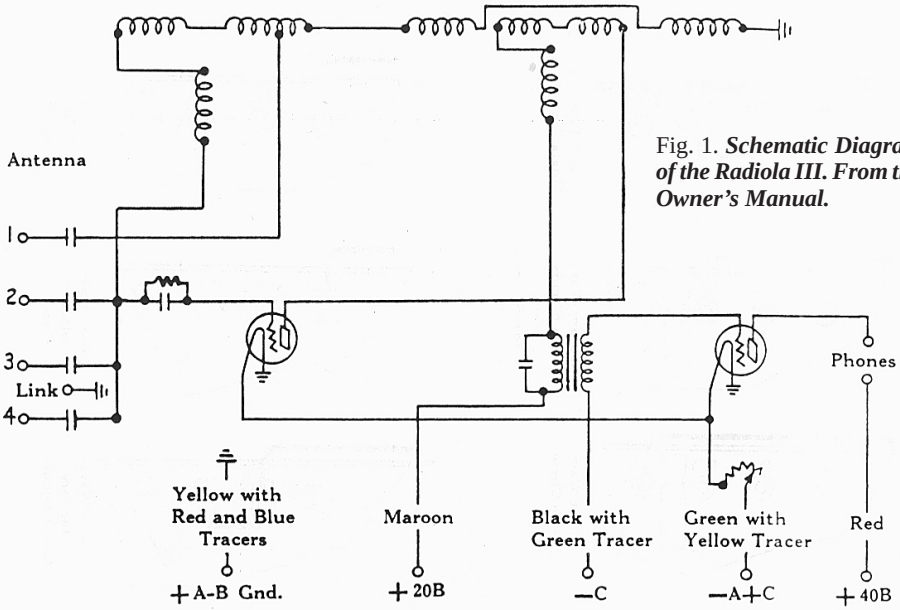


Fig. 1. ***Schematic Diagram of the Radiola III. From the Owner's Manual.***

I'm not going to try to sort out the jumble except to say that variometers control inductance by rotating a coil within a coil or coils. In the case of the Radiola III, the two variometers are built as a single unit on a cylindrical form 3.25 inches in diameter by 5.25 inches long.

The two rotating coils are built into opposite ends of the form and the fixed coils, of course, are wound over it. The shaft of one rotating coil is connected to the "Station Selector" pointer and the other to the "Amplification" pointer. There is only one other control on the radio, a filament rheostat labeled "Battery."

By varying the inductance between the plate and grid circuits of the first WD-11, the "Amplification" control varies the feedback, or regeneration, in the tube. We'll be talking more about how this control is used a little later.

The station selector tunes in stations by varying the inductance across one of the four fixed capacitors (numbered one through four in the schematic) to which the radio's antenna happens to be connected, more about that later. This is opposite to the usual tuning practice in which fixed coils are tuned with variable capacitors.

Battery Connections

The batteries used to power up the Radiola III took up more room than the radio itself. Figures 1 and 2 show how they are connected to the battery cable and how the wires from the cable are connected to the radio. The batteries provide voltage to light the tubes ("A" batteries), power the plate circuits of the detector and audio amplifier tubes ("B" batteries) and provide grid bias for the audio amplifier tube ("C" battery).

The "A" batteries were the tall cylindrical jobs (see Figure 2) giving 1.5 volts. They might have been labeled "Radio 'A' Battery" or — as sold in hardware stores for such things as powering doorbells — simply "No. 6 Dry Cell." I don't believe they are sold any longer and I will

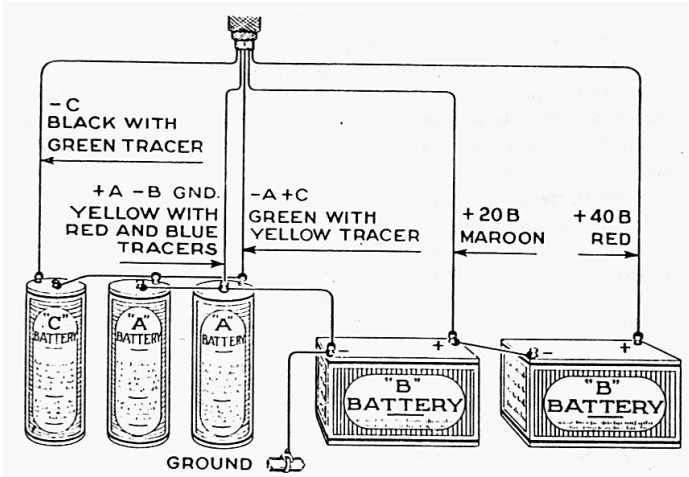


Fig. 2. ***Hookup of the "A," "B," and "C" Batteries. From the Owner's Manual.***

have to improvise. The illustration shows two of them paralleled to provide long life.

The "battery" control on the radio panel is a rheostat designed to keep the filament voltage on the tubes optimal and constant throughout the life of the batteries. By design, these filaments are rated at 1.1 volts, a little less than the 1.5 volts supplied by a fresh dry cell. The rheostat is always set at the lowest voltage that provides good reception. As the dry cells are used up and the voltage drops, it remains above the 1.1 volt rating of the tube filaments for some time so there is still leeway for the rheostat to be adjusted for best performance.

The filaments of the two tubes draw 500 mA between them and, while it might be a bit of a stretch, I think I could draw that current from a couple or three paralleled alkaline flashlight cells for long enough to test the radio.

Plate voltage was supplied by two 22.5-volt radio batteries in series. 22.5 volts was picked off at the center point to power the detector plate and the full 45 volts was fed to the plate of the audio amplifier tube.

This type of battery has also gone away, but the current draw in this application is very low and I think I may get by, for testing, with six series-connected 9-volt transistor batteries with a center tap taken from the middle. Series resistors in the detector and amplifier plate leads would be used to reduce the excess voltage.

The bias, or "C" battery is shown on the diagram as a single No. 6 dry cell but the battery drain here is absolutely minimal and a single flashlight cell–even an "AA" size–should easily do the job.

❖ Antenna Connections

The antenna connections to this radio are going to look quite strange to the modern eye. If a modern set requires an antenna, it's simply connected to the post or posts provided for it and that's that, except possibly for tweaking an antenna trimmer. Not so with the Radiola III. It has four antenna binding posts and a metal link that can either be left open (Figure 3) or connected in two different configurations (Figure 4). The tuning range and selectivity of the set depend on how the antenna and link are connected.

The heavy black wire in all drawings is the lead-in from the antenna. Drawings 1 through 3 and drawings 5 and 6 are for any antennas.

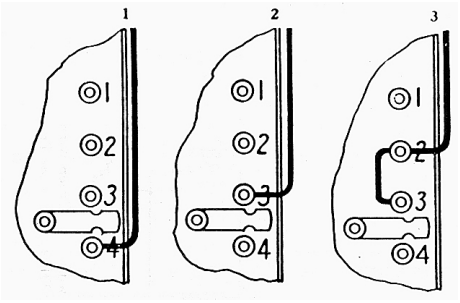


Fig. 3. ***Possible Antenna Hookups With Link Open. From the Owner's Manual.***

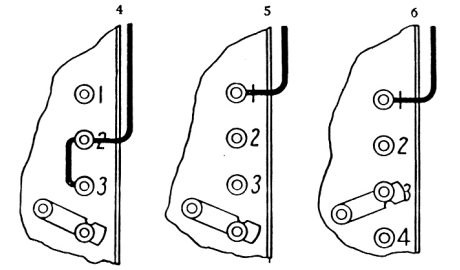


Fig. 4. ***Possible Antenna Hookups With Link Closed. From the Owner's Manual.***

Drawing 4 is for very small antennas. Drawings 5 and 6 offer enhanced selectivity. The tuning range for the configurations in the various drawings is as follows:

830-1500 kHz	(2) 625-1200 kHz	(3) 535-950 kHz
(4) 520-1070 kHz	(5) 800-1540 kHz	(6) 470-970 kHz

❖ A First Look Around

I began my first work session on the Radiola III by checking the tubes. I was particularly interested in doing that, because not only are the filaments of the WD-11s used in the set known to be fragile, but the tubes are also quite rare. Replacements, if available at all, can cost as much as $100..

My tube tester lacks the data or the special socket required to handle a WD-11, so I had to be satisfied with just checking the filaments, which fortunately were good. The four-pin base of this tube has one large pin and three small ones instead of the usual two and two arrangement. The reason, for the difference I suppose, was to prevent the tube from being accidentally plugged into an 01-A socket, which could easily blow the filament to smithereens.

There are several different approaches to creating a substitute for the WD-11 from more common tube types, and many of them are covered in an article by D. K. Owens that appeared in *The Old Timer's Bulletin* for August 2003, published by The Antique Wireless Association.

As of this writing, it's available on line at **www.antiquewireless.org/otb/wd-11.htm**

The next item I wanted to check was the audio transformer that couples the detector output to the audio amplifier input. This component is quite often found to have an open winding. Removing the radio from the cabinet required only taking out two screws and feeding the battery cable back into the case as the chassis was pulled free.

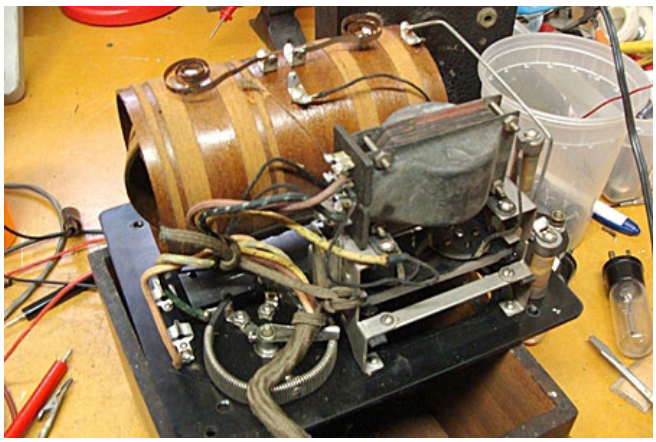
Once inside, I was very pleased to see that the innards of this 85-year old unit looked fresh and clean — practically mint. No sign of those seed hulls, paper shreds and corroded parts suggesting that the radio had been a rodent nest at some time in its past. The other thing that struck me was how little this radio looked like a consumer set — in fact, how little it looked like a radio! About the only parts obviously recognizable as belonging in a consumer radio were the tube sockets and the audio transformer. From its battleship construction, it t looked more like a piece of military hardware from the last century.

With the chassis exposed, I got out my VOM and began checking the transformer for continuity. I measured about 700 ohms at the primary and 10 k at the secondary. The second reading looks suspiciously large to me — perhaps suggesting a spot that has started to corrode but hasn't yet opened up. I'll see what happens when I power up the radio

Should a replacement transformer be needed, the Hammond Manufacturing Co. of Canada has been making substitute Radiola transformers for some time. If you need one, visit their web site at **www.hammondmfg.com/radiola1.htm** You'll find complete physical and electrical specifications as well as a listing of dealers all over the world that carry Hammond products. The price is in the $40 range.

By the way, the Hammond unit has a turns ratio of 1:3, which is quite different from the 1:13 or so that I measured on my transformer. So it seems quite likely that I'll be in the market for a replacement before completing this project.

See you next time, when we'll be putting together some battery packs so we can apply power to the Radiola III.



The Radio on the Bench, Opened up for Inspection

Dan Farber, AC0LW
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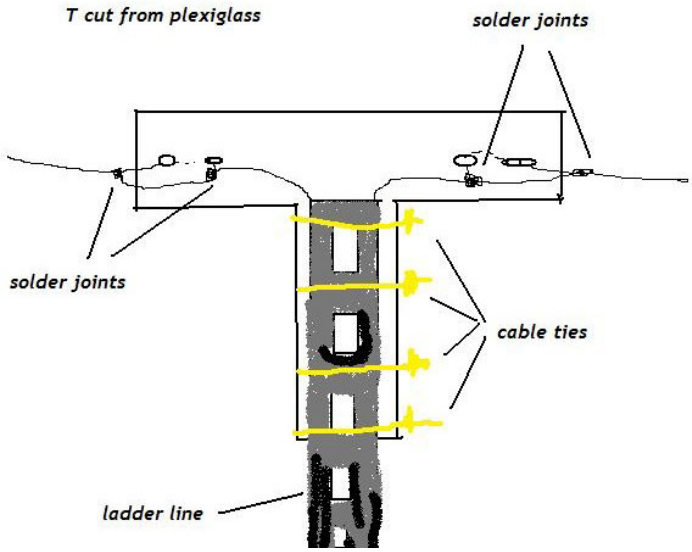
Getting It Together, Keeping It Real: *A Little Care and Feeding Pays Off*

Welcome back, my friends. The stormier part of the year is upon or approaching many of us, and it's my task as your HF antenna columnist to nag you about how secure your antennas are. Of course, some antennas have a lot more structural integrity than others; commercially-built verticals and beams, for example, are more likely to survive a microburst than that invisible longwire made of #30 wire you put up in the old oak with your slingshot. I'll focus this time around on making wire antenna systems more robust and longer-lived.

❖ Caught Up in the Middle

It seems to me that the greatest liability of any two-wire-feed wire antenna, be it dipole, loop, Windom, what have you, is the *center insulator.* There are just too many things to go wrong if they aren't engineered well. We need rock-solid *mechanical* attachment of all three devices, the two legs and the feedline, that resist Mother Nature's attempts at dismantling. And, we need excellent *electrical* connection of the three devices that resists corrosion and weathering.

I am told that there are a number of good center insulators on the market. In my forty-odd years of fiddling with antennas, I have only gotten around to trying one commercially-made unit, the excellent fiberglass one at the center of my MFJ 1777, a 102 foot ladder line-fed dipole. (OK, *doublet.* Sheesh!) MFJ sells this insulator separately too, of course. It's nothing fancy, just a flat slab of fiberglass with holes and slots, but the design is durable and dependable. The ladder line is threaded through slots, giving a very high pull-strength strain relief.



Homemade Plexiglas center insulator. Drill holes to loop the wires; strap the ladder line solidly to the stem of the T with cable ties. (Drawing by author)

Remember that not only weather but the feed line's own weight, are trying to disassemble the system at all times. The other major link in the sturdiness chain are the element ends being looped through holes in the insulator; all the weather and weight strain goes on the knot that forms the loop, leaving a stress free loop to solder the feedline to. When MFJ assembled the system, they actually closed the loops with some nice little crimps that have proved to be very reliable, although I freely admit I have closed the knot many times on home-made antennas with nothing more than a good hot flowing solder joint, and usually got away with it.

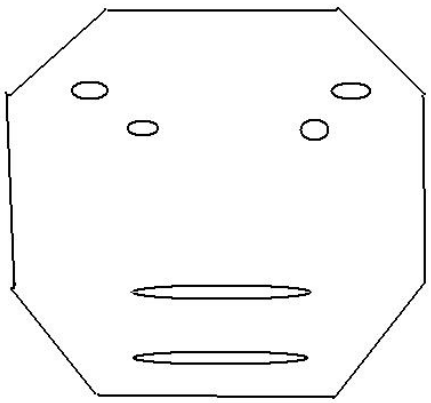
Of course, you can roll your own, too. One of the easiest is a "T" cut from Plexiglas or Lexan. I was always too unskilled to slot the stuff to feed ladder line through, so I cheated and used wire ties, simply strapping the flat 450 ohm line solidly against the stem of the "T" in several places. If you make the stem close to the same width as the line, this works even better. The crossbar can be drilled for the element wires; you can drill one hole and make a loop, or drill several and thread the wire in and out, making a nice strain relief. You can use wire ties to help secure the elements, too; it's cheap extra security.

All is for naught, though, if you don't get good solid solder joints where the feedline connects to each element. If you think about it, these two solder joints are the biggest potential liability in your entire radio system, since they are the hardest ones to inspect and repair. Once a 102 foot dipole is hauled into the air, you'd kind of like to leave it up there if you can get away with it. That's why you need to think about making it ultra-reliable first.

Some people like to englob these solder joints in silicone of one sort or another, feeling that it improves their weather survival. It's a laudable notion; however, my many years' experience as a tech in food-processing plants says that even the best silicone, sealants, rubber, paint, what have you, don't stand much chance against daily hosing and moistening and heating and cooling and flexing. Over the long haul, the solder joint made well to begin with lasts about as long as anything man-made can outdoors. If you feel you must use sealant, plan on lowering the antenna to inspect, and probably replace, the goop annually or even semi-annually.

❖ When You Get to the End, Hang On!

End insulators are a little more straightforward. Now we're down to just two mechanical joints, the looped end of the wire and the nylon rope that hangs the structure from something tall, which for most of us most of the time is a tree of some sort. Again, for the wire it will be hard to beat tying the knot with a good hot



Center insulator design used by MFJ. Upper quadrant holes enable loops in antenna wires; lower quadrant slots make solid strain-relief for ladder line. (Drawing by author)

View of two loop "knots," before and after soldering. Get the joint good and hot and flow plenty of solder into nooks and crannies. (Photo by author)

flowing solder joint. There are a bazillion end insulators on the market; and you can readily make your own, like from scraps of the Plexiglas you cut up to make the center insulator. Anything solid and nonconductive, with holes for wire and rope, will serve. Use your imagination; remember, you want *light, tough, and weatherproof*. Plastic, glass and ceramic are awfully hard to beat.

Black nylon rope is marvelous stuff. I use 3/16 inch, which is light, strong, and not overly visible. (Yeah, it'd be nice if they made it in clear, or sky-blue…) I remember trying all sorts of stopgaps, like clothesline and binder twine, in my teens. Nylon rope weathers well, is strong, and is not expensive.

It might be worth pointing out that if you're hanging a loop, you'll still use end insulators, only now they become corner insulators. Ideally the wire will pass smoothly and unobstructed through the insulator (no knot!), allowing the structure to flex in the wind.

❖ Don't Get All Uptight

The biggest mistake we make when hanging these copper spiders in the air is a tendency to pull them too tight. I think this might derive from looking at textbooks too hard; one gets the subconscious notion after awhile that the radio waves will leap onto, and off, only elements that are perfectly straight lines! I can't imagine how many times over the years I scrambled up and down trees and hauled the soldering gun out in the yard and re-tied knots and cussed and grumbled, before I figured out that Mother Nature wasn't the culprit, it was my unholy alliance with Father Physics; here, let's load these wires way up on tensile strength and *then* turn the weather loose on them! Once I got it through me noggie that sagging wires work just fine as antenna elements, it was simple to let off a bit on the ropes and re-tie them up out of vandals' reach. Now, when the winds blow, the wires have a much better chance to survive, since they're not already bowstring-tight. Since I tumbled to this incredibly simple notion, I have *never* had another wire antenna come down at Mother Nature's hands; and I live in Kansas, folks, so I have some notion of what "the weather" can be like. Hurricanes we may not get, at least technically; but snow, ice, wind, rain, blistering sunlight, all routinely use the Kansas plains for target practice. And of course there's the occasional "twister" to keep us all on our toes.

❖ Get It Done

Maybe some of this seems a bit obvious and simple. I know that I personally would have had a lot less grief with wire antennas over the years if I'd caught on to some of these "common sense" ideas sooner. Hopefully, my readers will take it to heart, cluck their tongues sadly over my denseness, and go out and build a wire antenna right the first time, and spend time in the shack making QSOs rather than trying to break their necks climbing that dratted oak tree again. Be safe out there, and happy operating!

Kent Britain
kentbritain@monitoringtimes.com

A Look at Radar Transponder Antennas

(All graphics courtesy of the author)

The earliest radar transponders go back to 1940 and the Battle of Britain. The British 'Chain Home' radar network had trouble telling the Messerschmitts from the Spitfires, so an amplifier was added to certain British aircraft. A very simple system shown in Figure 1 is just an antenna on the bottom of the plane, an antenna on the top of the plane and a 20 dB gain 80 MHz amp between the two. They used 80 MHz or so because that was the frequency band of most of the long range British radar installations of the time.

The radar operator would ask a particular squadron to identify, the pilot would turn on the amplifier, the radar pulse would be received, amplified and retransmitted. Now his spot on the radar scope would get much brighter and the radar operator knew who was who.

As the war progressed transponders got more and more sophisticated, responding on different frequencies and in different ways so the enemy couldn't pretend to be one of your planes.

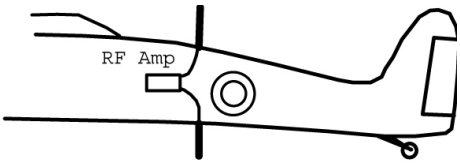


Figure 1: RAF Fighter with the first Radar Transponder

Today the FAA's Long Range Radars operate more with transponders than with 'skin paints," that is, the actual radar echo off the plane is rarely used these days.

Today, the aircraft transponder hears the pulse from the FAA radar, returns the pulse amplified along with an extensive packet of data giving the plane's identification, height, direction of travel, speed and other data. Photo 1 shows an actual commercial airliner L-Band transponder currently undergoing testing. It is amazing that with current technology they can get 400 watts out of such a small package.

In recent years, listening to these commercial radar transponders has become a common hobby activity allowing monitors to have their own "virtual radar." Photo 2 shows a prototype antenna for the Traffic Collision Avoidance System (TCAS) used with the aircraft's transponder. The transponders even talk with other airplanes to look for possible collision situations then warn the pilots to take evasive action.

Photo 1: 400 Watt Peak Power Aircraft L-Band Transponder

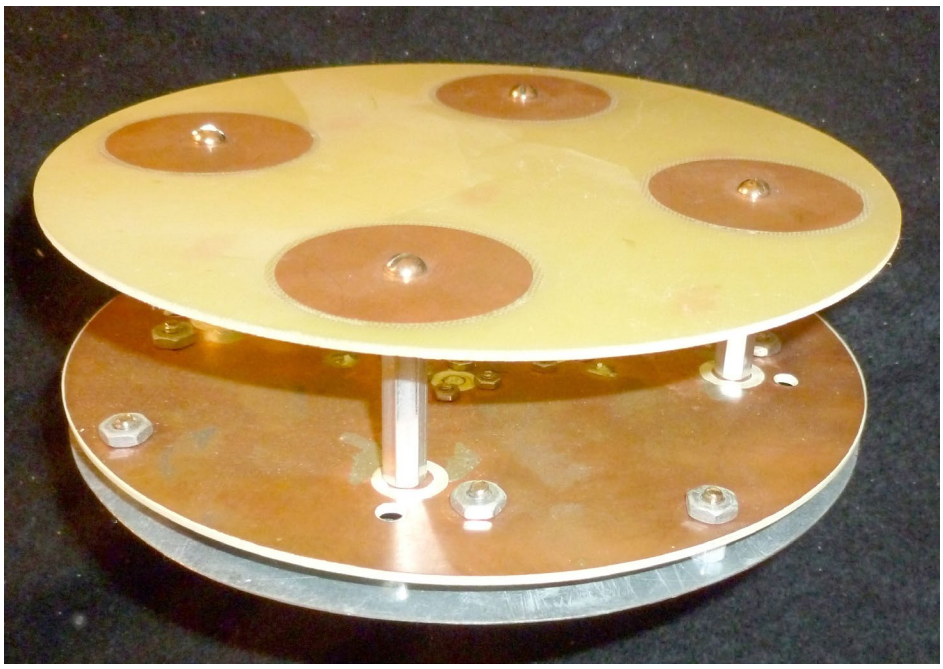


Photo 2: Prototype Aircraft Transponder Antenna

Between the two bottom layers are the phasing lines that give the antenna four direction patterns. This allows the transponder to know what direction the interrogation came from and respond back in that same direction with the airplane's height, speed, direction of travel, and identification. If you're an HF lis-

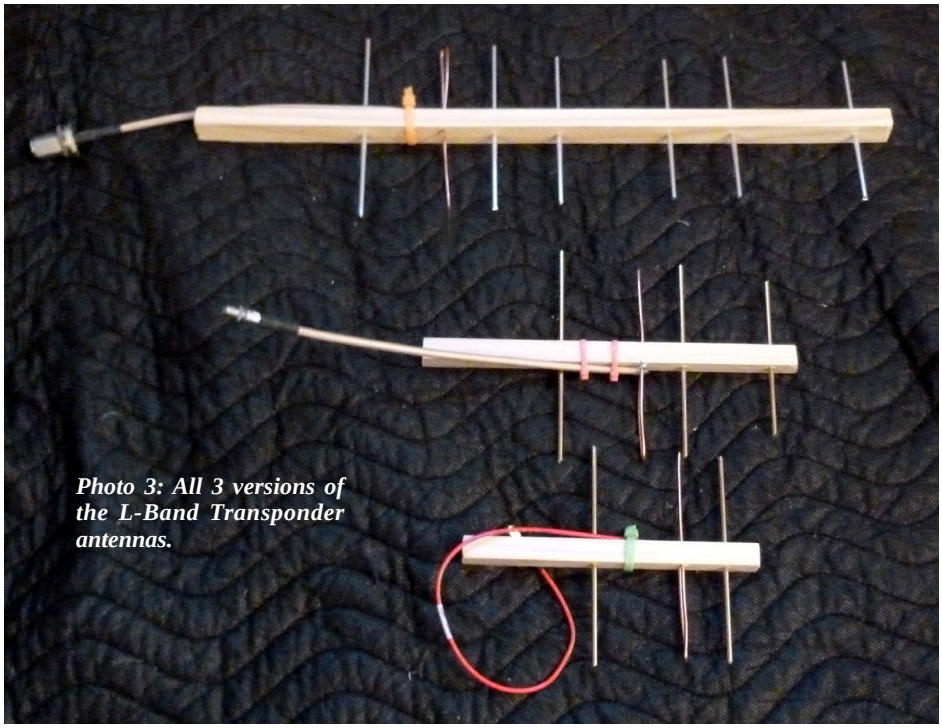


Photo 3: All 3 versions of the L-Band Transponder antennas.

tener, you may think that these looks a heck of a lot like a 160 meter vertical with a capacitance hat. You're right! But, this is a 1 GHz vertical with a capacitance hat. It really helps to keep the antenna low profile to reduce drag on the aircraft.

Photo 3 shows a family of Yagi antennas for the radar transponder frequencies. Compared to the typical ground plane antenna, the extra gain of the Yagi will help overcome much of the coax loss you have in typical coax at 1080 MHz. You can also use the longer Yagi's to favor a particular direction. That is, if you live in the northeast and you are more interested in traffic over New York City, then point the antenna towards Kennedy and La Guardia airports. Would you like to know what's over the Atlantic? Point the antenna to the northeast. As you can see in Figure 2, the 3 element still picks up signals from the other directions, just not quite as far. The 7 element antenna has the most directional gain. For best results mount the antenna vertically.

❖ Construction

The elements can be most any rod or wire about 1/8 inch in diameter. Aluminum ground rod wire, #10 bare copper wire, brass/copper hobby tubing and welding rod have all been used. It is easier to solder on the coax if the driven element is made from copper wire or bronze welding rod. The boom needs to be a non-conducting material. I find plain old wood works best. One-half inch by one-half inch or

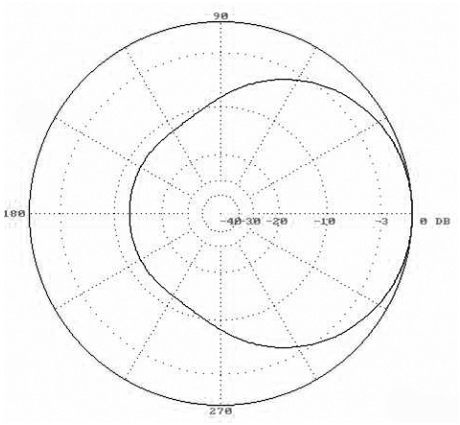


Figure 2: Pattern of the 3 Element Yagi

one-half inch by three-quarters inch are good sizes.

Most of my simple antennas are mounted inside my attic, some for over 20 years now, but some waterproofing is recommended if you plan to mount one of these outside. Spar varnish is by far the best water-proofer. But one of the water sealers or even good old house paint can be used. There is a lot to be said for painting your antennas a light gray color. All my outside antennas are painted a light gray and I think it keeps down neighbor questions.

Be sure to put some RTV silicone caulk or similar material around where the coax and the driven element come together. The coax braid is very good at wicking

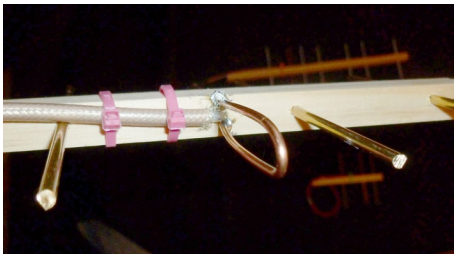


Photo 4: How to attach the coax.

water back down the coax, and we don't want that. Photo 4 shows how to connect the coax cable to the antenna.

The reflector element is the reference point for the position of the other elements. All positions are their distance from the reflector and all dimensions are in inches

As always we welcome feedback from our readers and especially topics for future columns. The quickest way to contact me is **kentbritain@monitoringtimes.com** or snail mail to the QRZ.COM address for WA5VJB. Summertime is here, time to get some more antennas in the air!

3 Element Gain 6 dBi							
Element Position	0	1.9	2.8				
Element Length		5.1	Fig	4.75			
4 Element Gain 7 dBi							
Element Position			0	1.9	2.8	4.8	
Element Length			5.3	Fig	4.9	3.9	
7 Element Gain 10 dBi							
Element Position	0	1.9	3.1	4.7	7.5	9.0	12.1
Element Length	5.25	Fig	4.75	4.3	4.2	4.2	4.1

AOR LA400 and LA800 Loop Antennas

By Bob Grove W8JHD (All photos courtesy of author)

This month *Monitoring Times* takes a first look at two new AOR Active Antennas – the AOR LA400 and LA800 Loop Antennas.

Loop antennas are popular among serious AM band DXers and many shortwave broadcast listeners. Their sharp directivity allows them to be mounted in an orientation that minimizes interference, both from co-channel broadcasters as well as local electrical interference, and which favors desired signal bearings. Typical loops can be rotated to favor specific signal sources.

All receiving antennas can be subdivided into two classes, active and passive. Active antennas are equipped with amplification devices, while passive antennas depend entirely upon their hardware configuration for gain.

Among active antennas are simple whips with base-mounted preamplifiers like L&F Engineering's H800 and H900, and loops with integrated amplification like the AOR LA-400 and LA-800 reviewed in this article. Some models have remote tuning (like the two AOR units) while others are integrated with the loop mounted vertically on top of the tuner/amplifier box.

AOR LA400 Active Antenna Package Contents – The AOR LA400 comes with the remote-mountable loop, tunable preamplifier, AC wall adapter, BNC RF cable, LAN control cable, and operator's manual.

AOR LA400 Active Antenna Control Box – The control box has a front panel power switch, band switch, and fine tuning control. A BNC connector atop the case permits direct loop attachment or accommodation for a remote cable

The advantage of the remote loop design is its ability to be positioned away from the listening position in a location of less interference and/or better signal pickup. The entire loop/control box assembly may be suspended from a glass window with a user-provided suction cup hook.

❖ AOR LA400 Active Loop Antenna

AOR recently released a new small footprint active antenna – the AOR LA-400 magnetic loop. The "magnetic" reference alludes to the fact that a radio wave is electromagnetic, possessing both electric (positive and negative voltages) as well as magnetic (north and south polarization) properties.

The wire loop of the LA-400 antenna is actually enclosed in an aluminum shield which prevents the intrusion of the electric component in the arriving wave front, but allows the ingress of the magnetic portion of the field. The major advantage of such field discrimination is its resistance to local noise interference which may be predominantly electric in nature.

❖ Let's Take a Look

The compact LA-400 is capable of receiving signals from 10 kHz through 500 MHz, a substantial bandwidth, indeed. It comes with about 3-1/2 feet of BNC/BNC coaxial cable to interconnect the control box with the receiver, handy for use with many new wide-frequency-coverage receivers which utilize BNC connectors. If you're using a shortwave-only receiver, you'll probably need a BNC/PL-259 adapter. An AC wall adapter is provided to power the 20 dB amplifier.

The 12 inch loop is plugged directly into the top of the control box, but for remote mounting, the user may substitute up to 65 feet of coaxial cable to interconnect the loop with the control box. Such remote mounting will also require the short LAN control cable to be replaced by a longer cable.

The front panel sports a power switch, a rotary band switch, and a fine tuning control. Four positions of the band switch allow selection of frequency bands from 150 kHz to 30 MHz. A fifth position selects a broadband amplifier allowing untuned reception continuously from 10 kHz through at least 500 MHz.

❖ Now, Let's Try it Out!

With the LA-400 sitting on my radio bench, I plugged its output into my WiNRADiO G39DDCe wide coverage receiver. As with any indoor antenna, I knew this would not be an interference-free location.

Table One: LA400 Magnetic Loop Antenna Specifications

Frequency Range	10 kHz - 500 MHz
Unaligned Range	10 kHz - 150 kHz and 30 MHz - 500 MHz
Gain	20dB minimum
Operating Temperature	14 to 140 deg F
Power Requirements	9-15 VDC, 80mA @ 12VDC
Antenna Impedance	50 ohms
Sizes:	
Loop	12 inches (305mm diameter
Loop Element	12-inches (W) x 14.4-inches (H) x 1.5-inches (D)
Control Box	4.6 inches (W) x 2.3-inches (H) x 4.4-inches (D)
All Assembled	11.8-inches (W) x 16.7-inches (H) x 4.33-inches (D)
Weight: Loop Element 7.7 ounces and Control Box 10.5 ounces	
Supplied Accessories: 12-inch control cable (LAN type); AC power supply; BNC (F)/BNC (F) RG-58U coaxial cable (38-inch), and a printed user manual.	

Note: LA400 is not intended for transmit purposes and is not waterproof (for indoor use only).

My first experiment was to test the directivity of the loop on local AM broadcasters. Selecting the broadband mode, the loop exhibited its expected bidirectional pattern from the lowest frequencies well into shortwave. Above that, the pattern becomes distorted with the loop finally behaving more like an omnidirectional whip

antenna at VHF and UHF.

Within the tunable range, the adjustable selectivity is quite sharp, an advantage to avoid receiver overloading from the amplified antenna, always a concern for multi-band portable radios with their notoriously limited dynamic range.

The claim of at least 20 dB gain holds true throughout the specified frequency range of the LA-400, and while the upper frequency limit is advertised as 500 MHz, we found the unit usable through at least 900 MHz in its passive (unamplified) state.

While the LA-400 certainly does work well as a desktop antenna, the abundance of interference emitters in a modern indoor environment would dictate moving the loop to a window sill or other less electrically-abusive location.

The AOR LA-400 (ANT75) active loop antenna is available for $520 plus shipping and handling from Grove Enterprises.

❖ AOR LA800 Active Loop Antenna

While most other loops concentrate on one narrow portion of the radio spectrum, the new LA800 from AOR, like its LA400 cousin mentioned above, is also a very broadband device. Receiving signals over a large swath of spectrum from 10 kHz to 500+ MHz, it is especially suitable for the newer generation of wideband receivers with only one antenna input.

The loop is a husky 31.5 inches in diameter, constructed of inch-wide, thick walled aluminum pipe. But it's light weight, only three pounds including its secure, weather-tight, ABS plastic control box.

AOR LA800 Active Antenna Package Contents

The kit of materials as shown in the accompanying photos includes the loop and control box assembly, 33 feet of RG-58/U coax cable with BNC connectors, 33 feet of control cable, the amplified remote tuner unit, AC power supply, and two U-bolts for mounting the loop control box to a mast pipe.

❖ Operating the Unit

As with any outdoor antenna, it's best to secure this AOR loop to an outdoor pole away from electrical wires. Since the aluminum pipe

AOR LA800 Active Antenna on Pole

(actually a Faraday shield) permits only the magnetic field to reach the inner antenna wires, it is naturally resistant to local electrical interference.

The outdoor assembly is ruggedly constructed and resistant to a variety of hostile weather conditions including temperature (-18 to +140 degrees Fahrenheit).

Once operational, the loop should be turned in a direction which either rejects local electrical interference on the shortwave and medium wave broadcast-band frequencies or which favors the greater number of desired signals. Some listeners install their loops on a lightweight TV rotator to allow it to be remotely adjusted to face incoming signals from any direction.

Although the LA800 specifications show a 10 kHz to 500 MHz operational frequency range, like the LA400 we reviewed above, we found that our review sample worked well up to at least 900 MHz with only a small reduction in gain.

AOR LA800 Active Antenna Control Box

But the frequency-tunable preselector circuitry only works from 150 kHz to 30 MHz and it is razor sharp. Above and below that swath of spectrum, the assembly functions as a broadband preamplified antenna.

The loop directivity is confined to frequencies below about 30 MHz; much above that and it's omnidirectional, like a whip.

The integral 20 dB preamplifier is powered by 9-16 VDC as provided by the supplied AC wall adapter. Current drain is 14-100 mA depending on the band chosen.

AOR LA800 Active Antenna ABS Plastic Box with Top Element Circuitry

❖ A Word of Caution

A common mistake made by hams is to accidentally transmit when the active loop is connected to a transceiver. Even the briefest event can cook the preamp transistors. Such damage is most easily characterized by a distinct loss of signal strength across the entire spectrum. Naturally, this misuse is not covered under warranty.

❖ Let's Check it Oout

With the loop dangling from my wife's porch plant hook, I connected the cable to a wide-frequency-coverage receiver. When the power pushbutton is pressed on the LA800 control unit, a blue pilot light is illuminated indicating successful power-up.

There is no gain control. A six-position switch determines the band to be monitored, and a rotatable control knob peaks the desired center frequency anywhere in the 150 kHz-30 MHz range. Tuning is razor sharp, requiring a delicate touch for exact setting.

I found reception to be very adequate on all bands. Even at the upper VHF/UHF ranges, performance compared very favorably to a dedicated, elevated VHF/UHF antenna.

Although the LA800 may seem pricey, you're paying for quality of construction, performance, and unusually wide frequency coverage.

The LA800 (DS-LA800) is available for $770 plus shipping and handling from Grove Enterprises.

Table Two: LA800 Super Loop Antenna Specifications

Size	Loop Element 31.5-inches (W) x 38.1-inches (H) x 3.3-inches (D) and Control Box 4.7-inches (W) x 1.5-inches (H) x 4-inches (D), Loop size Diameter 30.7-inches (to the pipe center)
Frequency Range	10 kHz - 500 MHz; Aligned range 150 kHz - 30 MHz (Five band selectable) and Unaligned range 10 kHz - 150 kHz/30 MHz - 500 MHz
Weight (Approximate)	Loop Element 49.4 ounces (Excluding mount U-bolts) and control box 8.5 ounces
Total Gain	20dB minimum
Supplied accessories	AC power supply; control cable (LAN type) 35 feet; BNC (F)/BNC (F) RG-58U coaxial cable 35 feet; two U-bolts for mast-mounting, and a printed user manual.

Loyd Van Horn, W4LVH
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Twitter: @GlobalnetMT

WiFi Radio for the Financially Challenged

I tend to be one of those everything-in-moderation kind of people, with one exception: technology. I don't know what it is about all of the various gadgets and devices that are out there, but I love them all. Maybe it is part of growing up in a household where there were always amateur radio projects and computers around, way before the Internet was even a twinkle in our eyes.

Among my techno-additions is WiFi radio. I currently have five WiFi radios in my house, not counting computers or mobile devices. The bad part about loving technology the way that I do – and I know most of you do as well – is that it can be a bit on the expensive side.

Luckily for me, I inherited my father's keen sense of seeking out the freebies. As such, I have found ways to take advantage of WiFi radio, without the need to break the bank. Everything, from a basic computer or mobile device setup to building my own WiFi radio device, can be done with relatively little money or extensive technological expertise.

Hello, Computer!

Most of us have started out in WiFi radio by accessing streams through a desktop or laptop computer and many still stream stations this way. However, the recent explosion in the popularity of mobile devices and tablets has shifted the focus to a more portable experience.

I still use my computer to listen to streams. As I type this column I have a Pandora station streaming some relaxing music by Miles Davis. If you're like most of our readers you already have a computer, so you are halfway there. Now all you need are some speakers. How expensive you go here really depends on your personal tastes for audio quality. I have two studio monitors hooked into a passive subwoofer which is then routed to a vintage Optimus audio-video receiver. This gives me the solid bass audio quality that I prefer, while still giving me plenty of control over volume, as well as the ability to route additional audio sources through my speakers.

There are obvious downsides to being tethered to your computer or even a laptop. First, that desktop doesn't exactly fit in the palm of your hand, or have the ability to be easily moved into other rooms or outside, if so desired.

There are work-arounds for this too. For instance, I use Apple's AirPlay function on my Apple TV device to route audio from my iTunes library on my computer through my home theater system in the living room. This gives me rich, full audio that I can hear from just about any point in the house. Another bonus is that there is a remote control app that I have downloaded for my iPhone that allows me to change songs, volume and more, directly through my phone. This way, as long as my phone can access my WiFi network, I have complete control over my audio.

AirPlay isn't the only service that allows you to route audio through your various home audio systems. There is also DLNA, which is available in many devices from video game consoles and Blu-ray players, to kitchen appliances and smartphones. This allows the streaming of content such as music, video and photos through a WiFi connection.

All We Hear is Radio WiFi

If using a computer or mobile device isn't what you had in mind, you can always go the route of buying a WiFi radio to stream audio. There are many devices available that won't break the bank, too!

There are several models available that check-in in the $80-$150 range. Here in my home, I have one of these models, the C. Crane WiFi radio. I use it in my radio shack to compare streams to mediumwave radio stations I am trying to DX, as well as to listen to radio stations around the globe.

How expensive you go in purchasing your WiFi radio is really up to you, as there are certainly many different options available that run the gamut of price ranges.

But, with a little elbow grease and some knowledge gathered on the Internet, you can go even cheaper in your search of Internet radio.

If You Can't Join Em', Build 'Em

As an amateur radio operator, one of the things I love about the hobby is the spirit of ingenuity; that drive for doing-it-yourself. That same approach can be found with WiFi radio too! There are several different plans and tutorial videos that can be found online for building your own WiFi radio using a specific ASUS WiFi router. Combined with a USB soundcard, you can turn the router into a computer-controlled WiFi radio. There are even apps available for most smartphones that will allow you to control the router remotely. The devices needed for this type of setup will typically cost $50, especially if you do some shopping around. There are a number of bits of free software you will need to download to make the configurations needed to stream the audio through the router. However, most of the how-to videos and online plans step you through this bit of the process, you don't have to have a degree in networking to be able to pull it off.

From there, all you need is a connection to some speakers and voila, DIY WiFi radio! In the tutorial video included below in my GlobalNet links table, this user even soldered his audio connection to run through a table-top AM/FM/cassette jukebox-style radio.

ASUS WiFi Router (Courtesy: Asus)

The possibilities really are endless for what you can do with the WiFi radio once you have the router/soundcard setup. I have seen everything from people connecting small PC speakers to the device, to building elaborate wood enclosures with amplifiers and large speakers.

There are plenty of additional options out there for setting up streaming audio on the cheap. A simple online search will turn up tons of options for you! Are you using a homebrew setup that you want to share? Email me at globalnetmt@gmail.com and I will share your ideas with your fellow-readers!

GLOBALNET LINKS

How to make a $50 WiFi Radio - **http://archive.org/details/HowToMakeACheapWifiRadio**
MightyOhm Article on the $50 WiFi radio - **http://mightyohm.com/blog/2010/09/how-to-make-a-cheap-wifi-radio/**
Google Shopping Results – WiFi Radio - **www.google.com/#q=wifi+radio&hl=en&safe=off&sa=X&tbs=vw:l,p_ord:p&tbm=shop&ei=TedhUduuJJLM9gTpyYCoAw&ved=0CHEQuw0oAg&bav=on.2,or.r_cp.r_qf.&bvm=bv.44770516,d.eWU&fp=771c685802055dd1&biw=1870&bih=982**
DLNA.org - **www.dlna.org**
Apple AirPlay - **www.apple.com/airplay/**

What's NEW

Tell them you saw it in Monitoring Times

Larry Van Horn, New Products Editor

Kenwood Introduces the TS-990S

Kenwood USA unveiled a new top-quality amateur radio transceiver, the TS-990S, at this year's Dayton Hamfest in May. The TS-990S features dual receivers, allowing for simultaneous reception on different bands, and a full down-conversion configuration, new mixer technology and multiple roofing filters for maximum close-in dynamic range. The unit has been engineered for ease of operation and, with a dual TFT display and intelligent panel design, users will enjoy a new level of renowned Kenwood sound quality.

The TS-990S incorporates the new Double Balanced Grounded Switch Type, a pre- selector function to vary tuning frequency to achieve a +40 dBm IP3 and includes bandpass filters that dampen interference. Kenwood has deployed five types of narrowband High-IP roofing filters for a new level of automated selectability, while retaining a high degree of manual switching capability. This transceiver is ideal for the physical demands of DX-peditions and competitions with highly stable transmitter performance, maximized cooling through a heat sink with swage fins and fans for the power supply, final unit and antenna tuners and a built-in automatic antenna tuner designed for high-speed operation.

Designed for maximum intuitive operation, the dual TFT displays mean users can monitor the target signal and the peripheral area without losing focus and easily customize the sub-band display with four different view modes. The main screen is touch-sensitive for quick QSY and a new split function button pad allows fast setting.

The Kenwood Sky Command System II enables full-duplex operation with improved functionality such as visual confirmation of HF frequency on the LCD panel. Control via TNC (AX.25) enables more access to HF functions: XIT, mode switching, split-frequency operations on/off, memory shift, and frequency step selection. The transporter sends out its pre-programmed call sign via CW every 10 minutes.

Current availability and pricing for the TS-990S have not been released at press time for what the company is billing as their top-of-the-range flagship model in the Kenwood amateur radio line-up.

Table One: TS-900S Published Specifications

General

Frequency Range (Transmitter): 1.8-2.0, 3.5-4.0, 5.1675, 5.25-5.45, 7.0-7.3, 10.1-10.15, 14.0-14.35, 18.068-18.168, 21.0-21.45, 24.89-24.99, 28.0-29.7 M, 50.0-54.0 MHz
Frequency Range (Receiver Main Band): 0.13-30 MHz and 50-54 MHz; VFO: Continuous 30 kHz-60 MHz
Modes: A1A (CW), J3E (SSB), F1B (FSK), G1B (PSK), A3E (AM), F3E (FM)
Frequency Stability: Within ±0.1 ppm within the unit usable temperature range 32 °F~122 °F (0° to +50°C)
Antenna Impedance: 50 ohms; Antenna Tuner Load Range 16.7 to 150 ohms
Standard Voltage: AC 120V (60 Hz); Supply Voltage Range AC 90V to 132V/180V to 264V
Power Consumption: At transmit (maximum) 720VA or less; At receive (no signal) 120VA or less
Dimensions: Without projections 18.11 (W) x 6.50 (H) x 15.75 (D) inches; Including projections 18.11 (W) x 7.17 (H) x 17.68 (D) inches
Weight: Approximately 54.01 lbs

Transmitter

Output power: CW/SSB/FSK/PSK/FM (AM) 200 W (50 W)
Modulation: SSB: Balanced, AM: Low Power, FM: Reactance
Maximum frequency deviation (FM): Wide: ±5 kHz or less, narrow: ±2.5 kHz or less
Spurious emissions: HF (Harmonics): -60 dB or less; HF (others): -50 dB or less; 50 MHz: -66 dB or less
Carrier suppression: -60 dB or less; Unwanted sideband suppression -60 dB or less
Transmit Frequency Response: Within -6 dB (300 ~ 2700 Hz)
Microphone Impedance: 600 ohms
XIT Variable Range: ±9.999 kHz (both transmit and receive)

Receiver

Circuit Types/Intermediate Frequencies
- Main: Double Superheterodyne: 1st IF 8.248 MHz; 2nd IF (FM) 24 kHz/455 kHz
- Sub 1: Double Superheterodyne: 1st IF 11.374 MHz; 2nd IF (FM) 24 kHz
- Sub 2: Triple Superheterodyne 1st IF 73.095 MHz; 2nd IF (FM) 10.695 MHz; 3rd IF (FM) 24 kHz/455 kHz

Sensitivity (Typical)
- SSB, CW, FSK, PSK (S/N 10 dB): 0.5 µV (130-522 kHz); 4 µV (522-1705 kHz); 0.2 µV (1.705-24.5 MHz); 0.13 µV (24.5-30 MHz); 0.13 µV (50-54 MHz)
- AM (S/N 10 dB) 6.3 µV (130-522 kHz); 32 µV (522-1705 kHz); 2 µV (1.705-24.5 MHz); 1.3 µV (24.5-30 MHz); 1.3 µV (50-54 MHz)
- FM (12 dB SINAD) 0.22 µV (28-30 MHz); 0.22 µV (50-54 MHz)

Image Rejection Ratio (50 MHz): 70 dB (60 dB) or less; IF Rejection Ratio 70 dB or less
Selectivity
- SSB: (Low: 200 Hz / High: 2800 Hz) 2.4 kHz or more (-6 dB); 4.4 kHz or less (-60 dB)
- CW, FSK, PSK: (Width: 500 Hz) 500 Hz or more (-6 dB); 1.2 kHz or less (-60 dB)
- AM: (Low: 100 Hz / High: 3000 Hz) 6.0 kHz or more (-6 dB); 12 kHz or less (-50 dB)
- FM: 12 kHz or more (-6 dB); 25 kHz or less (-50 dB)

Notch Filter Attenuation: 60 dB or more (Auto), 70 dB or more (Manual)
Beat Cancel Attenuation: 40 dB or more
Audio Output: 1.5 W or more at 8 ohms impedance
Note: Kenwood Sky Command System II is a registered trademark of JVC Kenwood Corporation in the U.S.

New go2MONITOR Release is Available

The go2SIGNALS company has released a new version of their go2MONITOR software package. Besides many small improvements, version 1.2 contains the following new functions:

- Support for new receivers including: R&S EM100, RFspace SDR-14, RFspace SDR-IQ, IZT R3xxx, GEW gRx-LAN, WiNRADiO WR-G31DDC and WR-G39DD, and ExtIO driver support (experimental).
- Application settings dialog with various user-settings for display, fonts and GUI behavior
- New function for choosing effective bandwidth of the input file
- Support for displaying results using alternative Alphabets
- IQ-Input bandwidth up to 1 MHz (depends on RX)

You can download the latest go2MONITOR brochure from the company website at **www.go2signals.ch/home/downloads.html**.

Grove Enterprises is the exclusive U.S. dealer for the following go2SIGNAL products: go2MONITOR, go2DECODE, go2RECORD and go2ANALYZE. For more information and pricing contact Grove Enterprises, 7540 Highway 64 West, Brasstown NC 28902, Phone 828-837-9200, Fax 828-837-2216, *belinda@grove-ent.com* or visit the company website at **www.grove-ent.com**.

InnovAntennas Introduces "The Ultimate Limited Space Antenna"

InnovAntennas, Ltd. (UK) and InnovAntennas America, Inc. recently announced the immediate availability of the new DESpole™ multiband antenna line for the amateur radio market.

The DESpole line employs technology developed for InnovAntennas' high performance OPDESTM (Opposing Phase Driven Element System) Yagi antennas. Amateur radio operators who are living with space restrictions yet want multiple band convenience and full size performance in a reduced size antenna will find

the DESpole a revelation. DESpole is a also a great option for hams who already have an antenna system but are looking to add more bands to their arsenal with modest additional size and weight without sacrificing performance.

The DESpole antenna's unique bent-element geometry delivers a natural 50-ohm impedance without any loss-inducing (and bandwidth compromising) matching coils or capacitors. Open sleeve design techniques are used to enable operation on two or three bands, depending on the model. Only one feed line is required for any DESpole and the reduced "wingspan" of this compact antenna allows use on a lower frequency band than might be possible with a (longer) straight dipole element.

InnovAntennas partner William Hein AA7XT, said "hams with limited space and/or limited budgets will find the DESpole provides dramatically improved performance over the usual 'go to' antennas for hams living with restrictions such as multiband verticals: higher gain, better signal to noise figures, wider bandwidth and the ability to maintain performance including SWR when wet including snow and ice."

InnovAntennas founder Justin Johnson G0KSC, said "InnovAntennas strives to sell only the absolute best, no compromise antennas and accessories. The DESpole brings the exciting technology from our high performance Yagi line to the ham that doesn't have room for a big antenna array, but still wants to put out a big signal."

In addition to the precise electromagnetic design provided by the latest modeling software, each DESpole design is subjected to sophisticated mechanical analysis to ensure long term reliability in all types of environments. Aerospace grade aluminum and marine grade (A4316) stainless steel materials are employed throughout. Additionally, where needed, UV protected Kevlar guy support cables are used.

Ten DESpole models are currently available with additional models to follow later this year. Further information is available at **www.DESpole.com**.

You can contact the U.S. dealer for the DESpole antenna, InnovAntennas America, Inc. via snail mail at 479 South 16 ½ Road, Glade Park CO 81523, Telephone 888-998-8541 and via their website at **www.InnovAntennas.us**.

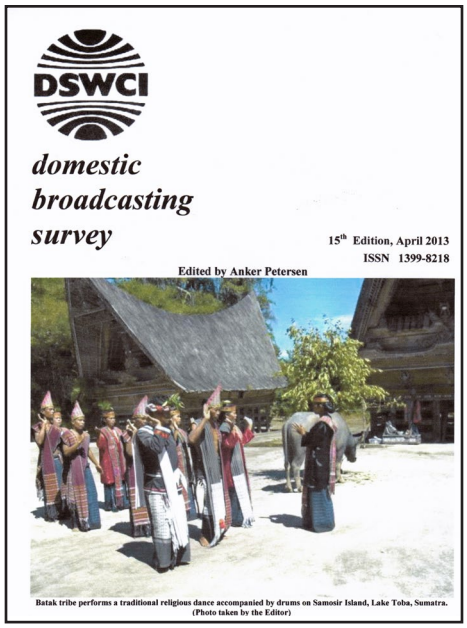
DSWCI Domestic Broadcasting Survey 15

The 56 year old Danish Short Wave Club International, which has experienced DXers in 29 countries, has just issued the 15th edition of their annual *Domestic Broadcasting Survey*. This survey, which is edited by DSWCI Chairman Anker Petersen, is divided into three parts:

Part 1 – The 41st edition of the Tropical Bands Survey covering all active broadcasting stations transmitting in the 2300 to 5700 kHz frequency range, including clandestine stations.

Part 2 – Domestic stations on international shortwave bands above 5700 kHz broadcasting to a domestic audience.

Part 3 – Deleted frequencies between 2 and 30 MHz which have not been reported heard during the past five years but may reappear.



This new *Survey* is based upon monitoring by DWSCI members, information from a variety of official sources and from various radio hobby DX-bulletins. A13 schedules have been included for many of the stations in this publication when available. In order to make the *DBS* reliable, monitors worldwide checked throughout the period from April 2012 to March 2013, verifying if each of the 640 station frequencies in the list were on the air.

All buyers of *DBS-15* get a username and password to the monthly updates on the tropical bands published as *Tropical Bands Monitor* on the club website. Similar historical data is available from 2005, 2006, 2007, 2008, 2009, 2010, 2011 and 2012 to anyone on the website.

The 23 page A-4 size *DBS-15* is available by e-mail in Adobe pdf-format (about 400 kB). A limited number is also available printed on paper.

Pricing and ordering information is available on the DWSCI website at **www.dswci.org/tbm/**. You can also contact the club via snail mail at DSWCI, c/o Bent Nielsen, Egekrogen 14, DK 3500 Vaerloese, DENMARK.

Where Ham Radio Meets Open-Source Electronics

Microcontroller technology has exploded in popularity among ham radio operators. The new generation of single-board microcontrollers is easier than ever to use, bringing together hardware and software for project-building radio amateurs can easily dive into. With inexpensive microcontroller platforms such as the popular open-source Arduino board readily available parts, components and accessory boards, the possibilities are limitless: beacon transmitters, keyers, antenna position control, RTTY and digital mode decoders, waterfall displays, and more.

Editor Leigh L. Klotz, Jr. WA5ZNU has assembled this first edition of Ham Radio for Arduino and PICAXE published by the ARRL to help introduce the ham radio community to the fun and rewards of experimenting with microcontrollers. Klotz and many other contributors have designed projects that will enhance your ham radio station and operating capabilities. Or, take it to the next step, using these projects as a launch pad for creating your own projects.

Projects in this new publication include: APRS Data Logger; QRSS Beacon; Multimode Transmitter Shield; High Voltage, High Frequency, and High Temperature Data Logger; Receive-Only, Low-Power APRS iGate; PICAXE Keyer and CW Beacon Keyer; Solar Tracker; Nanokeyer; Handheld Radio Talk Timer; APRS Messenger; DTMF Controlled SSTV Camera; APRS Display; Waterfall. SWR Scanner and more projects using the Arduino, PICAXE, and AT tiny microcontrollers.

This 352 page soft cover book is available from the ARRL for $35.

Wearable ARRL

And speaking of the ARRL, the world's most famous amateur radio station W1AW turns 75 in September. To celebrate this milestone the ARRL has released a t-shirt, commemorative challenge coin, pin and more to honor the anniversary of this historic amateur radio station.

When you purchase one of the 75th anniversary W1AW t-shirts, $5 from every shirt purchased goes directly to the W1AW Endowment Fund.

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To order from ARRL call their Publication Team toll-free in the US 1-888-277-5289, Monday through Friday from 8 AM to 5 PM Eastern time [Outside US telephone (860) 594-0355]. You can also contact the ARRL, the National Association for Amateur Radio ® via snail mail 225 Main Street, Newington, CT 06111-1494 USA, or visit their website at **www.arrl.org**.

Books and equipment for announcement or review should be sent to What's New, c/o Monitoring Times, 7540 Highway 64 West, Brasstown, NC 28902. Press releases may be faxed to 828-837-2216 or emailed to Larry Van Horn, *larryvanhorn@monitoringtimes.com*.

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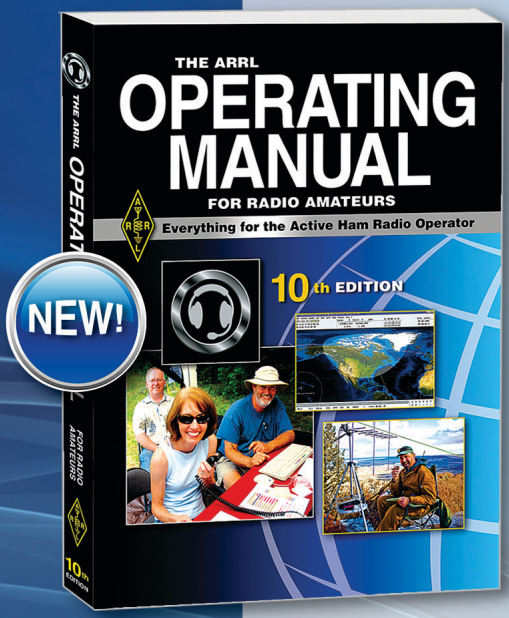

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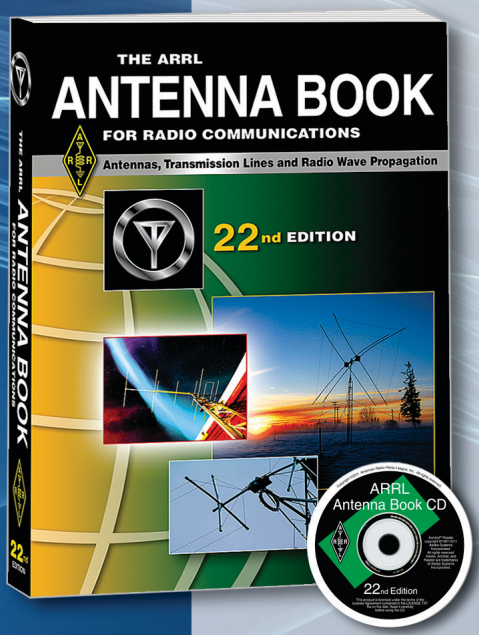

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