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Monitoring Times

Vol. 32 No. 8 August 2013

How to Become an ISS APRS Gateway..8

Receiving, Decoding and Uploading APRS Transmissions from the ISS

By Christopher Friesen VE4CWF

The International Space Station (ISS) is outfitted with amateur radio transceivers as part of the Amateur Radio on the International Space Station (ARISS) program. The ISS crew always have licensed operators onboard, but crew members on the ISS don't regularly operate these stations. Instead, they use them for making carefully planned school contacts or, on a few random occasions, they might make direct contact with a handful of lucky hams.

But, amateur radio on the ISS offers more opportunities for all radio hobbyists because, even though crew members don't use the amateur radio stations very frequently, the equipment is almost always turned on.

One such activity involves transmitting Automatic Packet Reporting System (APRS) packets through the ISS's on-board APRS digipeater. The problem is that there aren't enough ground stations listening in on the activity. As a result, much of the North American land mass remains an ARISS radio dead-zone. Christopher shows you how to help by turning your own station into a Gateway for ISS repeater operations.

On Our Cover

Back-dropped by Earth's horizon and the blackness of space, the International Space Station is featured in this image photographed by an STS-134 crew member on the space shuttle Endeavour after the station and shuttle began their post-undocking relative separation on May 29, 2011. (Photo credit: NASA)

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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

Radios On Holiday

Longtime reader Morgan Little enjoyed the June cover story, "Give Your Radios a Vacation," he writes:

"I'm making a 'travel bag' to give the radio gear a vacation! Harbor Freight has an 11 inch, black canvas tool bag, with inside and outside pockets, that begs to hold my radio gear ($7). I have a FlexTenna that I built from the March 2006 issue of *MT* ('Build the FlexTenna for Wideband Reception,' by Bob Grove W8JHD) and tips from Ron Parks WB5DYG's article from February 2007, 'Get Outta Town.'

"The travel bag can hold my Grundig YB400PE, the FlexTenna (which fits very nicely in a paper towel tube), a 'found' world time zone map I 'liberated' from a telephone book somewhere and Nylon rope for hoisting the FlexTenna (*if* there are trees!). I also have a Bose® headset (noise cancelling for use on airplanes) which works very nicely with the Grundig. I'm looking forward to testing it all... at home and away!"

Send us a postcard, Morgan! – Editor

Also, regarding "Give Your Radios a Vacation," frequent contributor Mario Filippi N2HUN wrote:

"The June issue of *MT* regarding taking the radio on vacation was a great idea. Packing a shortwave receiver or scanner gives one the opportunity to experience reception from different locales and is a change of venue from listening in the confines of the ol' shack. It's sort of like eating food on a picnic, somehow it always tastes better out in the fresh air and away from home!"

Note of Appreciation

Longtime *MT* reader, shortwave listener, ham and communications electronics engineer, Laurin Cavender WB4IVG, from Eton, Georgia writes:

"It hardly seems like more that a year ago that all this started; going to hamfests since the late 1970s, and I know y'all haven't heard from me in a long time (three kids, and six grandkids ago, to be exact), but, I look at *Monitoring Times* today in wonder. You seem to always keep it fresh with ideas and products.

"We've known several other folks who had other similar publications, such as Bill Cheek, or Chuck from Alabama who had the *Computer/Ham* magazine and others such as *Ham Radio, 73* and *Ham Radio Horizons*, which ultimately and untimely bit the biscuit. While there are other publications still around that I occasionally buy, *Monitoring Times* stands head and shoulders above the rest.

"I remember waiting, mouth watering many a time, for these publications, sometimes even buying an advance copy from a supplier instead of waiting for my mailed copy to arrive. That excitement is still there with *Monitoring Times*! Who or what has been heard, where and when? What is coming next? What is the newest trend in communications? What is the up-and-coming technology and what is going away? These and many, many other things make me always await the next issue of *Monitoring Times*.

"While I work daily in cutting-edge, wireless, communications technology, I often find very useful insights and information in *Monitoring Times*. This same information, skimmed or totally missed in trade and industry journals, makes me even more interested in never missing a single issue of *Monitoring Times.*"

MT Publisher Bob Grove W8JHD replies:

"Hi, Laurin! Wow, what a revolution in electronics technology we've experienced together. I don't make the hamfests like I used to, and I do miss them. It's great to hear from you and I'm so pleased to know how advanced in this fascinating field you've become. It's also personally very gratifying to know that I've helped you along the way. Hopefully, I'll see you again in the near future. Best wishes for a happy, discovery-filled life!"

FTA vs. Cable and Satellite-TV

Re: Satellite TV at 50 (*MT*, February 2013) Mike from Arkansas writes:

"I am fairly new to the Ku-band FTA satellite-TV hobby, but have had several years of big-dish C-band FTA enjoyment in the past. I am writing to say that I really enjoyed the February 2013 "Satellite-TV at 50" issue of *MT* and your past articles on FTA such as the January 2012 article on the Manhattan RS-1933 receiver.

"After learning a lot at **www.ftalist.com**, I installed my first, fixed, Galaxy 19 Ku-band dish (a 31 inch Hotdish 75) at my Mom's house for Mother's Day 2012. I have since installed my own fixed Galaxy 19 Patriot 85-E 36 inch elliptical dish at my house this past spring. This came after my Mom and I have discovered what a great and exciting hobby a Galaxy 19 fixed-position FTA can be with the over 200 channels to explore! We really enjoy channel surfing this incredible satellite. My Mom, who is 75 and on a fixed income, turned off her cable TV and saves

over $70 a month now. I also set her up with OTA HDTV antennas in her attic to supplement her FTA dish.

"I have been a longtime reader of *Monitoring Times* and usually pick up my issues at my local Barnes and Noble bookseller. I would like to see you do many more articles on the FTA hobby."

Thanks for the great photos and description of your experiences with FTA satellite-TV. It's one of cheapest and most entertaining parts of the monitoring hobby and well worth the effort. We will certainly continue covering the FTA hobby in future issues. – Editor

Mystery CW Signals

MT Publisher, Bob Grove was recently contacted by Jon Skelley about the source of audible CW signals with this mysterious story:

"I live on a mountain side at about 3,000 feet elevation, facing south. Tuesday afternoon, May 14, I was at my computer when I started hearing Morse code. I assumed something was resonating in my computer. It wasn't. I turned off every electronic device in the room including the fluorescent lights and it continued. I placed my ear right on every device and none were resonating. The code was the three letters, 'SCI,' repeated continuously, which didn't change.

"I moved around and found that the sound was loudest at a point about two feet from the intersection of two walls and not near any solid device or material. The code was not fast, I estimate it as between five and ten words per minute with machine consistency. It continued until eleven thirty that night and then stopped. At one point during the evening, I called a friend who is a computer guru and he could hear it over the telephone, despite the fact that, according to my perception, it was not very loud. Do you have any idea what it was?"

Bob Grove W8JHD replies:

"I'm baffled, but I'm not surprised that the resonance seems to be in space rather than on a wall. I have the same phenomenon from a heated blanket control in my bedroom, and also from a fluorescent light bulb in the bathroom. The most puzzling part is that it was a one-time phenomenon. How about it, readers? Can you come up with an answer?"

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.

WYFR Shortwave Closes

WYFR Family Radio closed its shortwave service June 30 following an announcement June 18. No official reason was given for the closure. The announcement, available on Gayle Van Horn's *Shortwave Central* (http://mt-shortwave.blogspot.com/search/label/WYFR%20Family%20Radio), traced the history of the station which began as brokered time on WNYW in 1972. Their Okeechobee, Florida site began construction in 1976 and grew to 14 transmitters and 24 antennas. There's no word on what will become of the site.

WYFR Family Radio QSL (Courtesy: WYFR)

Greek Gov't Silences Voice of Greece

ERT, the Hellenic Broadcasting Corporation, the state office behind the Voice of Greece, unceremoniously silenced the shortwave broadcaster as well as in-country radio, television and satellite channels June 11. The move was in response to increasing austerity measures demanded by Greece's European Union creditors.

Described as "a haven of waste" by one critic, ERT was known for higher quality programming, though it's been alleged that many of its jobs were patronage positions filled by various administrations. According to widespread news reports, more than 2,500 Greeks lost their jobs in the move thereby adding to that country's growing number of unemployed.

Funded by the public through TV-related taxes, the combined state broadcasters cost nearly $400 million per year to operate. Greece has a mixture of public and commercial radio, TV and satellite channels.

One week after the closure, a Greek court ruled that ERT should stay on the air, at least until the legal issues surrounding the closure were sorted out. According to an article in the *Columbia Journalism Review*, the court ruled that dismissing the 2,566 employees was fair. Though general strikes and massive protests brought Greeks out into the streets in support of ERT programs, as this is written, ERT remains off air. The CJR report quoted one ERT journalist as saying, "In the end, we are all still fired."

Google's Latest Looney Idea

How about, "Balloon powered Internet for everyone!" Crazy? Not really, it proves what can be done if you have several billion dollars cash on hand and a great imagination. That's what's behind Project Loon, launched June 6 on New Zealand's South Island by Google. In the launch, 30 balloons were sent aloft on the 40th parallel south. The balloons carry a payload of electronic weather instruments, solar panels and data transceivers. The plan is to beam Internet to a small group of "pilot testers" whose experiences will be used to "refine the technology and shape the next phase" of the project.

According to a Google website: "Project Loon balloons travel around 20 km above the Earth's surface in the stratosphere. Winds in the stratosphere are generally steady and slow-moving at between 5 and 20 mph, and each layer of wind varies in direction and magnitude. Project Loon uses software algorithms to determine where its balloons need to go, then moves each one into a layer of wind blowing in the right direction. By moving with the wind, the balloons can be arranged to form one large communications network."

Eventually, the project will go global and finally, the estimated five billion people on the planet, who don't have access to high-speed Internet in order to listen to Voice of America, will have a chance to hear it.

Hazards of Storm Chasing

In last month's *Communications* column, *MT* contributor Kevin Parrish related his experiences atop the new World Trade Center tower 1,776 feet above Manhattan. At the end of May Kevin found himself in El Reno, Oklahoma driving in a three vehicle convoy as part of *The Weather Channel's* "Tornado Hunt 2013" team. He wrote:

"I was driving solo as the lead vehicle on Highway-81. We could see a multi-vortex tornado off to the passenger side of the vehicles. We were in constant two-way radio communications with each other when the radio transmission from on-air meteorologist Mike Bettes was heard, 'Go as fast as you can! Go as fast as you possibly can!'

"As we continued moving along Highway-81 my vehicle was lifted slightly airborne and then I came back down with all four wheels on the highway. The winds were tremendous and our 'horizontal' world quickly became one that was surrounded by flying debris and rain. My truck was still moving forward when I got caught in a wind gust that forced me into a ditch on the right hand side of the highway about 100 feet down from the main highway.

"After I came to a complete stop in the ditch, with my rear windows all blown in, the Bettes Mobile passed by me on my left hand side. I had clear enough vision to see the Bettes Mobile go airborne, still in a forward motion, and then make a very sharp bank to the left, cross two lanes of the highway, the center median divider, two more lanes of the highway and then completely disappear from my view. I would estimate that the Bettes Mobile was lifted airborne some 20 to 30 feet… The scene was if someone had placed a spatula underneath the Bettes Mobile and was flipping it over like a pancake.

"Once the winds had subsided, I was able to back up and drive my truck out of the ditch and onto Highway-81. I could see the Bettes Mobile all crushed and mangled in a field out in the distance. Everyone inside the truck had self-extricated and were walking around. The entire team re-grouped and everyone was accounted for with all souls ALIVE!

"However, another group of storm chasers, Tim Samaras, Paul Samaras and Carl Young, were all killed in the El Reno Tornado, which was upgraded by the National Weather Service to an EF-5 classification. It was also said to be the widest tornado ever on record at 2.6 miles wide."

QRO FM Pirate Nailed

According to FCC documents, the Portland, Oregon, field office of the FCC received information that an unlicensed broadcast station on 96.7 MHz was on the air from Woodburn, Oregon. It's hard to imagine that Radio Fresca Uncion, a Spanish language, reform apostolic Christian-based ministry pounding out over 200,000 microvolts per meter at 183 meters could be overlooked. The legal limit for a Part 15 FM broadcaster is 240 microvolts per meter at three meters. At any rate, the FCC issued a Notice of Unlicensed Operation (NOUO) to the station.

AM Pirate Couple with Great Antenna Nailed

An Oswego, Illinois couple were issued a NOUO for operating their pirate AM station on 1600 kHz. According to FCC documents the couple were found to be blasting a signal measured at 8,400 microvolts per meter at 89 meters. Maximum allowable field strength for Part 15 AM is calculated a bit differently than FM. The legal limit at 1600 kHz is 15 microvolts per meter at 30 meters. The big difference in the signal was, as most hams know, the antenna. A legal Part 15 antenna at 1600 kHz, according to FCC rules, is, "a total length of the transmission line, antenna and ground lead (if used) which shall not exceed 3 meters." Well, they got the three meter part correct. According to the FCC, they used, "a vertical whip antenna approximately 3 meters long, mounted atop a 50 foot tower in the backyard."

How to become an ISS Gateway:
Receiving, Decoding and Uploading APRS Transmissions from the International Space Station

By Christopher Friesen VE4CWF

The International Space Station (ISS) is outfitted with amateur radio transceivers as part of the Amateur Radio on the International Space Station (ARISS) program. The crew always contains licensed operators, but crew members on the ISS don't regularly operate these stations. Instead, they use them for making carefully planned school contacts or, on a few random occasions, crew members may make direct contacts.

While school contacts offer radio hobbyists one opportunity to listen in, such contacts are often tele-bridged from the other side of the world. And, only a very few operators will ever contact the ISS crew directly. But, amateur radio on the ISS offers more opportunities for all radio hobbyists because, even though crew members don't use the amateur radio stations very frequently, the equipment is almost always turned on.

QSL cards, like the one shown, are available for radio hobbyists who monitor the transmissions from the International Space Station and provide their national amateur radio association with a complete report. (Courtesy: www.ariss.rac.ca)

Ground-based amateur stations can work the International Space Station by transmitting Automatic Packet Reporting System (APRS) packets through the ISS's on-board APRS digipeater. As the space station passes, at about 7 km/s, covering the distance from horizon to horizon in about 10 minutes, amateur stations have the opportunity to send a packet of data that will be received by the space station and automatically retransmitted back to ground stations.

Similar to the terrestrial APRS system, the APRS data sent to the ISS can be "gated" to the Internet. Steve Dimse K4HG's website, **www.ariss.net**, tracks and displays all the stations that have succeeded in contacting the ISS and have been received by a ground-based Internet Gateway station. His site offers a way to confirm contact and allows amateurs to display their accomplishment. Unfortunately, successful amateurs are concentrated mainly in a few densely-populated areas.

The problem, according to Dimse, is that there aren't enough ground stations listening in on the activity. Much of the North American land mass, according to his site, remains an ARISS radio dead-zone because of this.

"The biggest weakness in the system right now is the lack of Internet Gateways, or IGates," Dimse writes on his site. With some simple equipment, software, knowledge and technique, radio hobbyists can build a functioning receiving station to monitor the ISS as it passes by. Once the station is successfully receiving the packet data, the station can be converted into an Internet Gateway to help strengthen the ARISS APRS system.

Amateur Radio on the ISS

Amateur radio in outer space is nothing new. The Soviet Union's MIR space station contained amateur radio equipment and cosmonauts aboard the station would frequently make contact with ground-based amateurs. Dimse remembers those days fondly.

"For whatever reason, MIR never generated a lot of excitement in the U.S.," Dimse said in an email. "So, it was easy to get through. I began to talk regularly with the cosmonauts, to the point they remembered my name. It was a little odd having a long conversation spread out over weeks in ten minute chunks or one paragraph text messages, but I loved it."

In the mid-1990s, amateur radio began being used aboard space shuttle flights. Dimse said the interest in the U.S. grew to the point that it became difficult to make contact but, since he was based in Florida and already had a functioning satellite station, he was always able to make contact.

With the rise of the ISS program, a new opportunity for amateur radio in outer space emerged. The ARISS program began when amateur radio equipment was transported to the ISS on the Space Shuttle Atlantis's expedition STS-106 in September of 2000. It was a cargo supply mission that prepared the station for its first resident crew, who were also the first to begin using the amateur radio equipment.

Maurice-André Vigneault VE3VIG is a member of the ARISS coordinating committee. He says the ISS has provision for three operating stations.

"One in the cargo module Zaria, one in the service module Zvezda, and one will be set up in the laboratory module Columbus as antennas are already on the outside of that module," Vigneault explained via email.

On-board radios include a 2 meter Erickson handheld, 70 cm Erickson and two VHF/UHF Kenwood D700A radios. These radios currently support a variety of modes and operating frequencies as shown in the frequency chart.

The FM repeater is currently off, but according to Vigneault, all modes operate using the same equipment, which means changing to one mode may disable the other. "Crews choose to turn on whatever facility they provide, whenever power requirement allows," he said.

Other than school contacts, the amateur radio equipment is not operated on any particular schedule. In fact, Vigneault says the crew is kept so busy with the actual work of the space station that they don't have much time to spend at the amateur radio stations. So the equipment remains in the APRS digipeat mode most of the time where, according to Steve Dimse, it can be used by a wide range of radio hobbyists. "The station is in APRS mode almost all of the time, mostly because APRS users use it," he said.

Digital/APRS Action via ISS
Worldwide 2 meter packet uplink 145.825 MHz FM 1k2
Worldwide 2 meter packet downlink 145.825 MHz FM 1k2
Worldwide 70 cm packet uplink 437.550 MHz FM 1k2
Worldwide 70 cm packet downlink 437.550 MHz FM 1k2

Voice:
Region 1 (Europe) voice uplink 145.200 MHz FM
Region 2/3 (North America) voice uplink 144.490 MHz FM
Worldwide downlink 145.800 MHz FM

Crossband Repeater:
Repeater Uplinks 1269.650 MHz FM
437.800 MHz FM
145.990 MHz FM - 67.0 PL (Kenwood)

Repeater Downlink 145.800 MHz FM
437.800 MHz FM (Kenwood)

SSTV using Robot 36 mode: Downlink 145.800 MHz FM

U.S. QSL requests:
ARRL Headquarters
ARISS QSL
225 Main Street
Newington, CT 06111-1494

Canada QSL requests:
Radio Amateurs of Canada
ARISS QSL
720 Belfast Road, Suite 217
Ottawa Ontario
K1G 0Z5

Monitoring the ISS

Monitoring the ISS is not difficult. Any receiver capable of covering the two meter amateur radio band can be used, including amateur radio transceivers and most desktop and hand-held scanners. Reception quality will vary depending on the receiver's sensitivity and the antenna used. To start, an exterior mounted omni-directional antenna, designed for 145 MHz, should be sufficient; Radio Shack's catalog #20-176 VHF-UHF omni-directional ground-plane antenna ($30) is one example.

There are many lightweight, multi-element beam antennas that work well on 2 meters, including the Grove Scanner Beam III ($79). Alternatively, you can build a simple three-element Yagi, small enough and light enough to be hand-held and manually track the ISS as it passes. Amateur radio operators do this for Low Earth Orbiting (LEO) satellites all the time and many suitable designs are available.

In addition to equipment, there are a few other things that need to be understood including knowing when the ISS will make a pass near your ground location, and how to properly tune the receiver through the entire pass.

Fortunately, the ISS travels in a relatively low orbit and, on clear nights, is often visible for its entire pass. But rather than relying on luck or the chance that you might be outside on a cloudless night with your radio, using pass prediction software is the best way to determine when to listen. There are a variety of websites devoted to pass prediction – several are listed in the resources. Use one to determine the best times to listen. High passes, where the ISS reaches its highest point in the sky (between 50 and 90 degrees above the horizon), are best.

The ARISS equipment transmits packet data on 145.825 MHz, but because the ISS is moving so quickly, the effects of Doppler shift causes the frequency received to vary from this center point. The tuned frequency will be high for the beginning of the pass, on frequency when the ISS is at its maximum elevation, and lower as the station moves past your location. Start the pass with your radio tuned to 145.835 MHz and as you hear the noise level increase, meaning the frequency is shifting, re-tune until the ISS is beyond the far horizon.

A radio, antenna and high pass are all you need to successfully monitor the transmissions from the International Space Station but the APRS data is just that: data. As the ISS passes all you will hear are short bursts of incomprehensible digital data transmitted at 1200 Baud.

Occasionally, you might catch the crew engaging in a school contact. Steve Dimse offers this hint, "If you are listening for a packet pass and hear nothing on 145.825 then it is time to tune to the voice frequencies (145.800 MHz). The uplink frequency for school contacts varies and is unpublished, so all you can do is listen to half the conversation, but it is still cool to hear one."

QSL cards are available for reception reports. As Maurice-André Vigneault explains, reception reports can be sent, in Canada, to the Radio Amateurs of Canada (RAC) and in the U.S., to the American Radio Relay League (ARRL).

The ARISS logo. Amateur Radio on the International Space Station is supported by a multi-national organization of amateur radio organizations and operators from the U.S.A., Russia, Japan, Europe and Canada. (Courtesy: www.ariss.rac.ca)

"A well substantiated listener reception report may be acceptable," he said. "Either written or recorded…mention your location, readability, strength, quality of modulation, report any breaks in the transmission." Vigneault says these types of reports are especially important after school contacts as they help the ARISS team track down any technical problems encountered so they can be resolved before the next school contact.

Building a Gateway

Walter Holmes K5WH has been involved with amateur radio satellites for over 20 years including the ISS, which, he says has some great advantages for radio hobbyists. "The ISS has been an exceptional bonus to amateur space operations by being more dependable, using more power to allow easier reception, and very easy to access," he said.

He too has a complete ground station capable of computer tracking and radio control which is why his call sign is always prominently displayed on the **www.ariss.net** website. But, he says, monitoring or working the ISS doesn't require that level of sophistication.

"To provide a simplified gateway for logging received ISS contacts requires a simple computer connected to the Internet and a VHF radio. Also, a packet radio controller (or software to use the existing sound card), a very good VHF vertical antenna, and APRS software that supports uploading the received stations and sending it to the APRS database system," he said.

Steve Dimse echoes the same station requirements. "Any antenna is fine, something that receives FM on 145.825 like a scanner or ham transceiver, a way of decoding the signal, and APRS software to forward the data to the APRS Internet System. Decoding can be done with soundcard software or a dedicated modem called a TNC."

Stations that are already set up to handle terrestrial APRS just need to re-tune for nearby ISS passes while scanner operators and other radio hobbyists interested in building an Internet Gateway will need to find suitable software and become familiar with configuring the appropriate settings. It may take time to get the software configurations and all the hardware connected correctly and functioning together during the passes that the ISS makes over your location. And if you do not have a packet radio TNC or a sound card interface to feed your radio's audio directly into your computer, you can still decode the packets of data and determine who is transmitting. Simply record the audio and feed it into your computer's sound card by playing it near a properly connected microphone.

Packet radio software will decode the data and reveal whose signals you successfully monitored, including the general CQ calls sent by the ISS between reception of packets.

What's Next for ARISS?

Maurice-André Vigneault says the ARISS program is already in a new era with the facilities installed on board and the modes currently in operation. But he says the future is also very exciting as the ISS is scheduled for some equipment upgrades. "[The] ARISS-I Working Group is about to install on the ISS Columbus Module/Lab Module a digital amateur television facility to be used during ARISS school contacts," he said.

The International Space Station orbits the earth approximately 16 times each day and it is always transmitting digipeated APRS data from the earth. The system is not overloaded, so for amateurs, working the ISS is very possible. For other radio hobbyists, depending on your location, there will be three or four good opportunities each day to monitor the transmissions from the ISS.

The more radio hobbyists embrace the opportunities to use and monitor these transmissions, the more attention will be focused on the ARISS program. Hopefully, this will result in more and diverse transmissions, providing even more opportunities to monitor this impressive orbiting laboratory in outer space.

About the Author:

Christopher Friesen is a certified electronics engineering technologist. He currently works as a professional technical editor and freelance writer. He is a lifelong shortwave listener and has been a licensed radio amateur since 2006 holding the Basic qualification with primary interests in operating SSB phone, CW and amateur radio satellites. He can be reached at cfriesencet@yahoo.ca.

WEB RESOURCES

ISS and ARISS:
www.ariss.net, www.ariss.rac.ca and www.issfanclub.com

Pass Prediction:
www.heavens-above.com
www.isstracker.com
http://n2yo.com (click on ISS in sat list at top)
http://spaceflight.nasa.gov/realdata/tracking (requires Java)

Amateur Packet Reporting System (APRS):
www.aprs.org and www.aprs.fi

Packet Software:
www.sv2agw.com/ham/agwpe.htm
www.ui-view.org
f6cte.free.fr/index_anglais.htm

Urban Monitoring: The Trials and Tribulations of a Cliff Dweller

By John Maikisch K2AZ

A Cliff Dweller informally refers to an individual who lives in a large apartment building in an urban environment. I have not always been a cliff dweller. In my previous life, I lived on a little farm and wood lot in a small town (875 people and 1275 cows) in rural Maine. I had the luxury of unlimited space, tall trees to hang wires from and virtually no manmade noise or interference. My antennas included a 75 foot tower with beams covering all amateur radio bands from 40 meters to 70 centimeters, an inverted-L with 128 full sized radials for 80 and 160 meters and some miscellaneous aluminum for my other monitoring activities.

So, you can imagine the culture shock when I moved across the continent to my current habitat. I reside on the fourth floor of a six-story steel frame apartment complex. On the east side of my balcony are the walls of the building, lined with foil-backed insulation. To the west I overlook Puget Sound and the 6,500 foot Olympic Mountain range. The balcony is 25 feet long and the railing is five feet from the outside wall of the building.

There is no place to connect a wire from the balcony and there are strict regulations about what may be placed on the balcony. My listening position is 20 feet on a straight line from the balcony, but needs 75 feet of coax to skirt the walls of the adjoining rooms. Sunspot conditions are dismal and, of course, there is the expected manmade noise issue and nearby high-powered broadcast band stations.

Trial and Error

I still wanted to enjoy my hobby, so I moved ahead like a bull in a china shop and I hope my experiences may be helpful to others under similar circumstances.These evaluations are my own personal perceptions. Do not give them authoritative or scientific value.

My best advice is to get ready for a lot of trial and error. The biggest, well, actually the only, challenge is the antenna. Almost anyone can open a box, pull out a radio and plug it in. At least I thought so until I got my first software defined radio (SDR).

My first antenna was the standard, end-fed, random wire. It wasn't very long (30 feet), slanted at a 45 degree angle and much too close to the building. Performance was predictably poor. It was frequency sensitive and surprisingly noisy.

Next, I tried a small loop. It was not as inconspicuous as the wire, but it was less noisy and directive. I found that I could null out noise and peak signals by rotating the loop, but had to run back and forth from the receiver to the antenna a lot. The noise and target station always seemed to be in the same direction. That setup didn't last long either.

Then I tried a 10 foot vertical, with and without an RF amplifier, later adding two small radials. I won't even comment about that mistake.

After looking around, I decided to try an active antenna. Some people applaud and some hiss at their mention. My first attempt was an LF Engineering H800 active antenna covering 10 kHz to 50 MHz.

The H800 has active "E-probe" components mounted inside a one-inch diameter by two-foot dark grey tube. Its principle assets are its substantial construction and low visibility. It comes with a single hose clamp for mounting, which initially caused me to raise my eyebrows, but actually turned out to be quite adequate.

It has 50 feet of RG174/U coax connected internally at the base with an RCA connector at the far end. LF Engineering deems this connector and coax suitable for the frequency range of the antenna. A BNC connector mounted in the base, to replace the integrated RG174/U, is an available option.

In retrospect, I should have ordered this feature because I needed more than 50 feet of cable lead-in. Instead, I spliced in high quality, low-loss cable at the antenna base. I don't use RG174/U except for short jumpers and interconnects. I haven't used RCA connectors for RF since my old Heathkit days.

The internal amplifier provides more than adequate gain for modern receivers and also matches the impedance of the small antenna element to the 50 ohm coax. As with all active antennas it is susceptible to overload and intermodulation from strong local signals, particularly at the lower frequencies. It is powered by DC voltage fed over the coax from a supplied control box. I replaced the control box with a less noisy and more ergonomic commercial unit.

Initially, the H800 provided fair performance. But, after some experimentation, I decided to upgrade to the H900. The H900 is an improved version of the H800 with some enhancements that are useful to me and some that are not. They both look the same physically and have the same pluses and minuses. This time I ordered the BNC connector option.

The major difference is an improved E-probe internal amplifier. It has lower gain but an improved dynamic range. I won't quote the numerical specifications of each antenna; suffice it to say that it showed a noticeable reduction in overload, intermodulation and interference.

This might, however, not be as evident at a quieter location. To compensate for the lower gain, a supplemental broadband amplifier has been added in the control box which may be switched in or out of line. The E-probe alone has more than enough gain for my receivers, so I did not use the additional amplification and I again installed a replacement Bias-T. Reception was either improving, my ears were getting better, or my expectations were lower.

Before moving on, let me comment on the availability of the H900. I will quote Bill Greely, vice-president of LF Engineering, directly:

"The H-900 was designed for Grove Enterprises, who continue to be the sole distributor of the dual-amp antenna. We have never carried the antenna, only the PDF downloadable instruction sheet for it.The antenna is the non-MIL version of our Navy design used by SPAWR [Space and Naval Warfare Systems Command].To purchase an H-900 directly from LFE, it simply has to contain a modification to consider it custom, typically a BNC input vs. the standard coax feed line." I purchased mine from Grove Enterprises.

I think the H900 beat out the H800, but neither gave me the VLF performance I wanted, so an LF400 entered the scene. This is a VLF version of the H800/H900 designed for reception below 500 kHz. I like the antenna a lot, but now I had three antennas in use for VLF, HF, and VHF and only one feedline. Wideband, multiport splitters with DC power pass-through are hard to find, expensive and lossy. A remote, manually operated antenna switch is inconvenient, so I use a homemade radio-controlled antenna switch and one feed line.

Below 5 MHz, a broadcast band rejection filter is an imperative at this QTH. I selected the Clifton Laboratories Z10020. I had a number of discussions with Jack Smith, Clifton Labs' owner and chief developer, who gave me a lot of help and an education in intermodulation and signal-to-noise considerations and cures. He suggested I try their Z1501F active antenna for 20 kHz to 30 MHz.

Note that the F model of this antenna was not yet listed in their catalog, but can be obtained directly. Care is taken in the selection, testing and screening of the electronic components and it shows in the results. This is a very quiet antenna. One thing should be noted, however. In order to maintain the low intermodulation intercept points and amplifier linearity, the Clifton Laboratories Z1203B coupler must be used with the Z1051F. This is an additional cost.

The Z1051F is of substantial construction, using a waterproof enclosure for the amp and a BNC connector at the base. It comes with either a ten-foot or five-foot extendable whip. The longer whip works better but, to make it nearly invisible I use a six-foot, flat black, .2 to .1-inch tapered, stainless steel rod from the New Ham Store. These whips are nice products and come in various sizes. This antenna works well across its design frequency range and, as of now, is my VLF and HF antenna of choice based on sensitivity, signal-to-noise and invisibility.

Above 50 MHz, I simply use a Diamond Flex whip antenna with a couple of radials and an inexpensive Holland LA-520 in-line amplifier. Hey, it works for me and the amp is surprisingly good for the price.

In my environment I did not see any overriding factors in receiver selection. My current radios of choice are a Uniden BCT-8 TrunkTracker scanner with back-of-radio whip (for local public service and utility stations); the AOR 8600 Mark II with external S-meter (for above 50 MHz); the ICOM R75 and WiNRADiO Excalibur (for below 50 MHz).

To test the waters I first tried a Kenwood R1000. As they say, you get what you pay for. The R1000 was easy to use, a good first receiver and, worth the low price. Also wanting VHF coverage, I added an AOR AR3000A. But, it was not quite a communications receiver and not quite a scanner.

My first SDR was a WiNRADiO WR-G305i. It was better than the R1000, but was too big a jump at that time for a confirmed knob-twisting, button-pusher. An AR8600 Mark II replaced the R1000 and G305. For a DC-to-daylight receiver it gives a good account for itself, but has some quirks. I don't care for the audio quality, tuning dial click or digital S-meter. I find that it's also noisy. A homemade, plug-in, external analog S-meter was an easy addition.

My next move was to upgrade to the WiNRADiO WR-305e SDR; a step up from the G303. By now I was getting used to computer-controlled radios. The WR-305e has a nice user interface and band scope, but audio quality is dependent on your computer's soundcard and speaker performance.

Still not quite comfortable with a state-of-the-art radio, I reverted to an ICOM R75. The R75 is my standard for comparison of other radios and it acts as my knobs-and-buttons security blanket. Its preamps, digital signal processing (DSP) and optional filters give it adequate selectivity, sensitivity and signal to noise ratio even with its internally generated white noise. It also has a line-level audio output jack that works well with my soundcard for digital decoding. It is well worth the reasonable price.

Finally, yet another SDR, the WiNRADiO Excalibur came along. It's probably a keeper, but the jury is still out. Preliminary tests show it to be quiet, sensitive and selective but the learning curve is very long. Every day I discover something new about the radio. I find that the display allocates too much space to three band scopes while squeezing the radio controls into a narrow band at the top of the screen. Many of the controls require drop down menus and sliding scales. I liked the 305 interface better. To help, I customized a gaming keyboard to simplify tuning and other controls.

Well that's it. Setting up a monitoring post on the cliff has been fun, challenging and, at times, frustrating. But, I now enjoy listening on all modes and genre from 30 kHz to 3000 MHz. I still consider it a work in progress and make changes regularly. I hope this review will be helpful to others.

In closing I would like to thank Bob Grove, publisher of *Monitoring Times* for his input and advice along the way on all things radio. Thanks also to Jack Smith for his technical guidance and Bob Greely for his product information and advice.

About the author:

John Maikisch was raised on Long Island, New York. His first exposure to radio came through the Popular-Electronics and Radio-Electronics magazines. In 1958, as a teenager, he took and passed the Amateur Extra exam and while he was at the FCC office got his First Class Commercial Radiotelephone and Second Class Radio Telegraph license. He went off to Georgia Tech to study electrical engineering and later to Columbia for graduate studies. He spent his career in the telecommunications industry at Western Electric, AT&T Bell Labs and Lucent Technologies. In 1998 he retired to Maine. Although he has worked all countries and has 8-band DXCC, his first and still greatest passion is shortwave listening. He has held the call sign W2AZ for fifty years.

Watch International TV on ROKU

By John Biggs

Prior to the advent of Internet streaming, if you wanted to watch international TV programming, you had to set up a C or Ku-band satellite dish, but no longer. If you have a Roku box connected to your TV, you have a portal to television from all over the world. With your existing WiFi connection, you can set up a Roku box and be viewing programming from BBC World Service, Deutsche Welle-TV and many more from just about every corner of the world!

Getting Started

Getting started with Roku is relatively easy. According to Roku support, you must have a broadband Internet service capable of 1.5 Mbps download speed and a wireless router to connect the Roku box to the Internet, or a wired network and an Ethernet cable (for a Roku 3 unit). If you have an HDTV, you will need an HDMI cable to feed the video out to the HDMI input of your HDTV. A standard NTSC TV set will also work using the composite video and audio outputs of the Roku box to the video and audio inputs of the TV set. You will also need to set up a free account with Roku which is part of the set up process when installing the box.

My Roku setup consists of a 32-inch HDTV with a Roku LT box, WiFi connected to a NetGear wireless router which is in turn connected to my cable modem provided by Time Warner Cable. The Roku LT is the cheapest entry into this video streaming system and is a basic box that offers HDMI video (at 720p resolution, which equates to Standard Definition video) and composite video outputs for an older NTSC TV set. It sells for $50 plus shipping from Roku or $55 via Amazon and $60 at Target stores, $50 at Walmart and Best Buy as of publication date.

Roku LT ($50)streaming player with remote features 720p resolution. (Courtesy: Roku)

Moving up in features, for $60 (direct from Roku), plus shipping, the Roku HD offers all that the LT offers with the addition of an instant replay control on the remote, though the resolution is still 720p. For 1080p resolution HDTV

Roku HD ($60) still streams at 720p resolution but offers an instant replay feature on the remote. (Courtesy: Roku)

video quality you need to move up to the Roku 2 XD or the top of the line Roku 3. The $80 (plus shipping) Roku 2 XD has all the features of the lower priced units with the addition of 1080p. The top of the line Roku 3 features 1080p video only, so it works on an HDTV set exclusively. The Roku 3 has both wireless dual-band capability and an Ethernet port for a wired connection in addition to a USB port. The unit also features motion control for games and a remote with a headphone jack. The Roku 3 sells for $100, plus shipping, direct from Roku.

Roku HD3 ($100) top of the line 1080p resolution plus motion control for gaming. (Courtesy: Roku)

One thing to keep in mind is that 1080p resolution uses bandwidth faster than 720p and requires more robust download speeds. You'll also use your bandwidth allowance from your Internet Service Provider faster. Going over the limit may require you to buy additional bandwidth.

Roku LT rear connections. (Courtesy: Roku)

Finding the Channels

Once you've configured your Roku box and connected via your WiFi network, you can start looking for the international channels. Starting in the Roku channel store, scroll down to "International." Within this category, for example, you can find programming from areas such as the Republic of Georgia by way of Rustavi 2; TV shows and movies from Japan and China from Dramafever, and an assortment of international programming available from DishWorld. Programming is available, depending on the channel, either as a live stream or as video on demand. Before adding a channel, keep in mind that some channels in the channel store charge a monthly fee.

Other international programming offered in the channel store includes TV from Malaysia on Bom TV and Malayalam IPTV. Sports, news and entertainment from Africa are available from Africa Live and economic, political and business news is on African Info Media. Moving north to Europe, one can view TV from Italy on ITV Channel which offers a selection of the local programming available from regional TV networks in Italy. You can watch news in German on tageschau.de; other German TV for the whole family is found on Wieder TV.

Romanian TV channels streaming live 24/7 are on Boboc TV. TV from the Republic of Georgia is available from several channels in the channel store. Live public TV is on Georgian Public Broadcaster, and Rustavi 2 offers news, sports, entertainment, and political talk shows. Private TV channels from Georgia can be seen on Imedi TV.

MHz Worldview, another offering in the channel store, has a live stream of English language international programming from a variety of sources around the world. In addition, newscasts from a variety of broadcasters are available on demand on their Roku channel. Sources include CCTV from China, Mac TV from Taiwan, ANI (Asian News International) from New Delhi, India, and ETV from Ethiopia. An assortment of mystery and drama programs are also available for purchase on demand from MHz Worldview. These include titles such as *Detective Montalbano*, *Wallender*, *East West 101* and *The Octopus*.

Programming for a Chinese audience is available from NTD Television, which was founded by practitioners of Falun Gong and is based in New York. Programming is available on a live stream or on several video on demand channels. NTD English, a separate private channel from NTD Television, offers several programs in English available on demand. Global TV offers news, entertainment and cultural viewing for ethnic communities from Vietnam, Laos, Thailand, and Mexico. Live news and entertainment direct from Israel can be found on Israel Live, which has Reshet TV, Channel 2 and Channel 10.

Screen shots from (L-R): Al Jazeera, BBC World, DD (India), Deutsche Welle-TV, and NHK World. (Courtesy: John Biggs)

Private Channels on Roku

Things get interesting when you venture into the private channels. The private channels are channels that are not endorsed by Roku or available through the Roku channel store. Viewing a particular private channel requires a bit of effort but information is available through a Google search on "private channels on Roku."

To gain access to a private channel, first log into your Roku account at **https://owner.roku.com**. You will arrive at My Account where you will scroll down to "Add a Private Channel" in the "Manage Account" section. Enter the specific code for the channel you want and the channel will be added to your channel list on your Roku box. See chart for a list of codes for some of the channels of international TV that are available.

Selected Roku Private Channel Codes

Channel	Code
BBC World News	bbcn
CNN Internationa	CCNI
Israel Live	ISLIVE
Live Station	livestation
NASA-TV	ENDLESSNASA
NHK-World	NHK
Nowhere TV	H9DWC
Onion News Network	ONN
Radio Reference	ENGBH
RT News English	RTNEWS
Telemadrid	MADRID
World Punjabi TV	wpntv

What, in the way of international TV, is available on a private channel? Quite a bit, actually! Live streams, direct from BBC World Service and NHK World from Japan are on private channels. News and features from Russia are available directly from Russia Today. From there, I had to do a bit of searching but found more programming from several providers. Some of the other international broadcasters are available through channels such as Live Station, MHz Networks, Nowhere TV and NTD Television

Here's an example. On Live Station, you can watch Al Jazeera in English or Arabic, Deutsche Welle in English, Spanish or Arabic; Press TV from Iran in English, and France 24, also in English. Nowhere TV offers TV from the UK with BBC News, BBC World News, music on 4 Music as well as Capital TV, and Sky News. RTE News from Ireland and RAI from Italy are additional channels on Nowhere TV. From Asia, Arirang has programming from South Korea and NHK World from Japan, both in English. Spanish TV programming comes from RTVE and Telemadrid. News programming is available on Nowhere TV from CNN International, Euronews and Press TV.

Television for an Indian audience may be seen on several live channels on World Punjabi TV, which is based in Renton, Washington. News is available on Day & Night News and DD News, which also has a newscast in English. Religious programming, reflecting the different sects in India is on 24/7 on Gurbani, Krishna TV, and Sikh Channel USA. Children's programming can be found on Kid's TV (naturally!). Music videos of popular Indian music is available on the World Punjabi Channel (within the World Punjabi Channel private channel), and entertainment on 10X Jalwa.

In addition to the previously mentioned private channels, you can also access private channels direct from the source. For example, BBC World News is available as a private channel on Roku with a live stream 24 hours a day. In addition, NHK World from Japan is also on a private channel with a live stream of news and features. Russia Today (RT), broadcasts live from studios in Moscow and Washington, D.C. RT News, which is now available in the Roku channel store, is their 24/7 English news channel focusing on international headlines and RT America, which is a private channel, broadcasts from Washington, D.C., with news reports, feature programs and talk shows.

Drama, Movies and More

Movies and entertainment shows can be found on several channels in the Roku channel store and on private channels. Dramafever, available through the channel store, has television dramas from Korea, Asian TV shows and movies, and also Latin American Telenovelas (Spanish language soap operas). Korean dramas can also be viewed on K Drama. Asian Crush offers popular Asian feature films and documentaries, anime, action and art house films. Crunchyroll is another video service that offers anime, live-action titles, and Korean TV dramas in addition to movies from China, Japan, Korea and Singapore. They also offer crime dramas, family shows, comedies, action movies, and movies in many other categories.

For fans of TV shows such as "Doc Martin" or "Downton Abbey," the best of British television is available on Roku through Acorn TV. Meanwhile, fans of movies from India can watch movies in Malayalam, Tamil, Kannada, and Telugu languages. Action, dramas, comedies, romance movies in those languages are available in addition to Tamil movies from the past in the "Old is Gold" section. A wide selection of featured movies in Malayalam and Tamil can be seen on Bollyverse.

Technology fans will appreciate being able to watch episodes of This Week in TECH (TWiT), AmateurLogic, a U.S./Australian production about amateur radio, and TED Talks among a host of others.

So, What are You Waiting For?

As you can see, there are a wide variety of international television options available on your Roku box. If you have considered a Free-to-Air (FTA) satellite system, but for one reason or another cannot install the equipment, a Roku box may be your ticket to worldwide television. Searching for new offerings reminds me of the old days of searching for international programming on a C/Ku-band satellite dish, except searching is much easier now with the Internet and a Google search! As I mentioned earlier, by entering "Roku private channels" into Google you can find regularly updated listings of new and existing private channels. The Roku channel store is also a place to check often for new international channels.

I've just scratched the surface in terms of what is available internationally on Roku, and, just like the old satellite days, channels regularly come and go. I hope I've generated some interest in the options available to users of a Roku box. Being a long-time shortwave listener and gadget freak, when I discovered what was available on Roku, I knew I had to get one! Since I started writing this article, I've purchased another Roku LT for a bedroom HDTV. With a small investment and a few minutes of set up time, you too can be watching the world on your Roku box. MT

2013 Dayton Hamvention®:
A Glimpse into the (Open) Future of Radio

By Thomas Witherspoon K4SWL

For the fifth year running, I had the pleasure of attending the Hamvention® this past May. It's become an annual event for me as I attend on behalf of my non-profit organization, Ears To Our World (ETOW), at an inside exhibitor's booth. It gives me the chance to speak not only with hundreds of radio enthusiasts, but also with fellow exhibitors. Sometimes, if I have the time, I might look about for a treasure or two.

While every Hamvention has common threads–an active flea market, new product announcements, fascinating forums and, of course, questionable spring weather–the 2013 Hamvention riffed on three themes this year; themes which might just mark new trends in our ever-evolving radio hobby.

The first theme marks a change in the way we live, as well as define radio (and DXing specifically); the second marks a decade of radio innovation in the realm of software definition; and the third marks the future and longevity of radio as a hobby.

Andromace Enterprises sells Arduino products, their booth had a constant crowd browsing their wide selection.

Remote (Rig) Control

Let's face it: many radio enthusiasts live in high-density neighborhoods, apartment buildings, and the like in which antennas are restricted, and/or the sheer amount of Radio Frequency Interference (RFI) drowns out weak stations. Many have chosen to move to lower

Each year the Dayton Hamvention draws large numbers of SWLs who inevitably make their way to C.Crane's booth with radios on display.

maintenance full-service living accommodations due to personal economics, health concerns, advancing age, or just to have a simpler, easier life. But this shouldn't limit enthusiasm for the enduring radio hobby. There are also medical reasons some hams choose not to interact directly with the hobby yet continue to "play radio." I know an avid DXer, recently fitted with a pacemaker, who cannot hang around strong RF. Fortunately for him and hams like him, solutions to these problems are plentiful and getting less expensive by the day, via remote rig access.

At Dayton this year, I saw several vendors who specialize in remote rig control and I also heard many people discussing it. The great thing is that a wide array of options exist. With faster Internet connections, mobile broadband, and a wide selection of remote rig control options, you can easily operate a station from nearly anywhere, if you have an Internet connection. Systems are so efficient that you can run your rig from a remote Wi-Fi hotspot, or even from your phone.

Remote Control...by Phone

One vendor in the Hamvention's Hara Arena, RemoteShack.com, offers what is possibly the simplest way to remotely connect: by telephone. And, I'm not talking about an Android or iOS based smartphone; just a *regular telephone*. Here's how it works: you simply dial a dedicated phone number assigned to your radio, follow voice prompts, and use the number pad on your phone to control your rig. The system will remotely turn everything on and off and control basic rig functions. In truth, I'm a little skeptical of this approach as I'm not certain how easy it might be to tune and work stations via your phone. All the same, this might be the right choice for some.

The Youth Forum is so popular, and so professionally presented, it's challenging to find free seats in the conference room.

Remote Control...by PC

Sierra Radio Systems had one of the more robust PC-controlled stations I saw at Dayton. Their system is made of several components which work together to give you full control of your rig, amp, and radio components remotely. Their HamStack Microcontroller allows you to control your equipment from any web-enabled PC; you can literally control everything.

Full, Front-end Remote Control

For those who want full, front-panel control of their radios, in other words, a "real radio" experience so complete that even the power button will turn the rig off and on – look no further than the Elecraft K3/0 Mini, introduced at Dayton. The K3/0 Mini is basically a slim-line, front panel of Elecraft's K3 transceiver without all of the transceiver internals. Using the RemoteRig 1258 MkIIs (RRIGSET) to join the K3/0 mini to your K3 at home (or off-site), the remote end offers a "real radio" experience. I've used a K3/0 remotely before from a portable 3G Wi-Fi hotspot. Remarkably, there is little to no latency (lag time) in the connection, even using CW.

The Elecraft K3/0 Mini is a slim-line faceplate that, when used with the RemoteRig 1258 MkIIs, can completely control your K3 remotely.

Software Defined Radios (SDRs)

The number of software-defined radios available increases each year, and for good reason: SDRs are affordable, flexible and powerful. This year at the Hamvention, I found more SDR vendors and innovators than in any previous year. While it's beyond the scope of this article to include all of them, two exhibitors in particular caught my attention.

The Peaberry V2

One SDR vender was David Turnbull AE9RB, who hosted an unassuming, nearly bare table in the East Hall. Other than a banner hanging on the back panel of his booth, there was only David, a MacBook and his amazing little SDR kit, the Peaberry V2, a beautifully-designed, four-band, all-mode, QRP SDR transceiver kit. With four pole filters and strong attenuation outside the ham bands, it promises uncompromised performance in its design.

Dave Turnbull (AE9RB) holding his amazing Peaberry V2 SDR transceiver kit.

What's really amazing is that it can be purchased for only $150. To be clear, I know of no other QRP transceiver (kit or otherwise) with four bands, that's all-mode (not CW-only, for example) available for just $150. The only catch – and it may be a deal-breaker for many of us – is that Dave's Peaberry V2 is a surface mount kit; it's *not* for the beginner.

Still, I think the Peaberry V2 is one of the most exciting, inexpensive innovations offered at the 2013 Dayton Hamvention. David told me that the design goal of the Peaberry V2 was "to make an inexpensive ham transceiver kit, with predictably great performance, that can be used with all open-source and free applications." Wow. I think we'll be hearing more from David in the near future.

CommRadio CR-1

While many SDRs rely on a computer for control and to unlock functionality, the recently introduced CommRadio CR-1 stands apart from the crowd in this respect. The CR-1 is a stand-alone, fully self-contained SDR in the form of a compact, full-featured, tabletop receiver. I had the pleasure of meeting Don Moore, owner of CommRadio and designer of the CR-1, at the Hamvention. Don is actually an aircraft avionics designer who decided to build a shortwave radio up to his own standards. The result? The CR-1.

From the CR-1's OLED display and anodized aluminum tuning knob, to the gold-plated circuit board pads, Don built this radio for *performance* and *longevity*. While the CR-1 is fully self-contained and portable (with an internal battery), Don plans to update the firmware so that the CR-1 can be connected to a PC to unlock further SDR potential. Based on the crowd surrounding Don, I wouldn't be surprised if he sold all the units he brought to Dayton. *[Editor's note: Read Thomas' complete review of the CR-1 in the First Look column in this issue.]*

Open Source

The most fascinating trend in electronics engineering, in my opinion, is open source technology. This is where communities of technology developers work toward a common cause: making a product that has little or no proprietary interest. A product designed to be modified and tweaked is one that reveals the connection between user and developer.

At Dayton this year, we learned that even traditional amateur radio manufacturers are beginning to lean toward open source standards. Here's a case in point: the new Ten-Tec model 506 Rebel.

Ten-Tec announced the Model 506 Rebel during the Dayton Hamvention this year and it garnered a great deal of interest. The Rebel 506 is a two-band (40 and 20 meter) QRP transceiver with four watts of output power and a simple design. Or, so it would seem. What's under the hood, however, is a transceiver built on the chipKIT™ Uno32™, which means that anyone who knows or is willing to learn the venerable Arduino compatible code can modify this simple radio to do things *even the manufacturer* never dreamed up. At $199, it's a relatively inexpensive investment, especially since the "base" QRP radio (meaning, the unaltered base code) delivers a very capable QRP transceiver. I had the pleasure of beta testing one of these rigs just prior to Dayton, and enjoyed several CW ragchews via this remarkable little piece of technology.

Search through the extensive Hamvention outdoor flea market for long and you'll find irresistible boat anchors like this Hallicrafters SX-71.

What's amazing about making an open source Arduino code-based rig is that radio enthusiasts across the globe can develop their own code, their own functionality, and easily share it with others. So, *even if you don't care to learn Arduino compatible code,* you can download others' shared code packages and load these on your Rebel to test drive, in essence "carbon copying" onto *your* rig whatever the most innovative imagination out there has to offer.

I think other manufacturers should take note of what Ten-Tec is offering. With the Rebel, they're attracting the popular "maker" crowd into the hobby: by simply creating a transceiver based on a programming language and controller they know very well.

And, in case you're wondering how many uses Arduino might have in the ham radio market, look no further than the overwhelming popularity of Leigh L. Klotz, Jr. WA5ZNU's book, "Ham Radio for Arduino and PICAXE: Where Ham Radio Meets Open-Source Electronics." This book was so popular, its first run sold out by the end of the Hamvention. It is literally chock-full of Arduino-inspired projects for the amateur radio operator.

It's also becoming increasingly easy to purchase Arduino products and accessories at the Dayton Hamvention. Indeed, the vendor Andromace Enterprises had a crowd around their booth every time I passed it. They offered an impressive array of products, books, and accessories for Arduino projects.

Is the Hamvention a litmus test of an open future for radio? ARRL, RSGB, and other national amateur radio associations take note: *Open source technology IS the future of amateur radio.*

If you are over 29 years old, then you most likely remember a time before the Internet, before the open, accessible, and free exchange of information over a network of impromptu groups and communities that can crowd-source ideas and champion innovation. Individuals who can take an idea from ethereal concept to tangible creation. If you are in your teens or twenties, however, then you have never known a time when events like the Dayton Hamvention were the only venues for the exchange of ideas and innovations, when an annual pilgrimage was required to widen the exploration of your hobby.

Young radio enthusiasts, hobbyists like some of us who modify and generally void warranties, have grown up in an environment with an inherent open source philosophy. And, why not? When I see vendors like Ten-Tec introducing an open-source QRP transceiver, vendors like Andromace Enterprises selling a variety of Arduino boards, shields, and accessories, and authors like Leigh L. Klotz, whose book on Arduino code sold out of print, Dave Turnbull who is selling a four-band SDR transceiver for under $150 and uses open-source control software, and Hamvention newcomers who don't yet have a license, but have been drawn in from the maker crowd, I know I am witnessing the future of radio. These are sure signs that radio has applications in the 21st century, applications that meld *vintage* and *reinvention*.

Hams are the sort of people who grew up actively voiding our parent's appliance warnings by opening up machines to see how they worked...and how we might "fix" them. This curiosity is still alive, as Carol Perry (WB2MGP), who hosts the youth forum each year at the Dayton Hamention, confirmed. In fact, the youngest presenter this year was *ten year old* Gary Bailey (KD0TRO), whose topic was "Radios and Components I Have Built and Tested." Good stuff. What's more, this generation has an advantage the previous generations didn't; collaboration with the World Wide Web.

We would be wise to feed this collaborative environment, and retailers would be wise to produce products that are both affordable and highly adaptable. Ten-Tec's entry into the QRP market is clearly a step in the right direction.

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Tourist Scanning Upstate New York

Summertime often means travel to popular tourist destinations. This month we take a look at two counties in the state of New York and examine current and planned public safety radio systems serving those areas.

Among the top ten attractions in the United States is Niagara Falls, located on the border between western New York state and the Canadian province of Ontario. The three individual waterfalls, Horseshoe, American and Bridal Veil, together spectacularly drain more than 750,000 gallons of water each second from Lake Erie into Lake Ontario. Niagara Falls State Park, the country's oldest state park, and the surrounding area attract more than 20 million visitors each year.

The American side of the falls are located in Niagara County, in the far western part of New York, north of Buffalo. The county is home to about 200,000 people and has significant hydroelectric generation facilities.

For radio history buffs, there is a statue honoring electrical pioneer Nikola Tesla on Goat Island, which is located in the Niagara River between the Bridal Veil and Horseshoe Falls and lies within Niagara Falls State Park. The government of Yugoslavia donated the statue in 1976. Another Tesla monument may be found in Queen Victoria Park on the Canadian side of the falls. Tesla designed the first hydroelectric power generation station at Niagara Falls.

❖ Niagara County Public Safety

Much of the public safety radio traffic in Niagara County can be found on conventional analog channels.

Frequency	Description
33.02	Lewiston Highway Department
37.18	County Public Works
39.18	Sheriff
39.34	Sheriff
39.46	Law Enforcement
42.14	State Police
45.16	County Services
45.44	State Emergency Management Office
45.48	Niagara Frontier Transportation Authority
45.72	County Highway Department
45.88	County Fire (Mutual Aid)
46.06	County Fire (Dispatch)
46.22	County Fire (Channel 2)
46.36	County Fire
46.44	Lockport Fire Department
47.14	State Department of Transportation
47.22	State Department of Transportation (Car-to-Car)
47.30	State Department of Transportation
47.32	State Department of Transportation (Base)
47.34	State Department of Transportation
47.40	State Department of Transportation (Mobiles)
47.54	Ridge Animal Hospital
47.92	County Water District
151.025	County Highway Department
151.115	County Highway Department
151.775	Lockport Memorial Hospital
154.100	Niagara Public Works
154.415	Lockport Fire (Dispatch)
154.515	De Graff Memorial Hospital
154.665	State Police (Car-to-Car)
154.695	State Police (Alerts and Emergencies)
154.755	Sheriff (Dispatch)
155.145	Lockport Public Works
155.160	Niagara Falls Emergency Services
155.175	Hospital Emergency Administrative Radio (HEAR)
155.220	County Emergency Medical Services
155.250	Law Enforcement
155.340	County Emergency Medical Services
155.370	Statewide Law Enforcement
155.475	Nationwide Law Enforcement
155.505	State Police (Troop A Base)
155.535	State Police (Troop A Mobiles)
155.565	State Police (Investigators)
155.685	Niagara Falls State Park (Police)
155.820	Niagara Falls Public Works
156.090	Sheriff
156.120	Niagara Falls State Park (Police)
158.760	Niagara Falls Public Works
158.850	Niagara Police (Dispatch)
158.865	County Services
158.970	Lewiston Police
159.195	Niagara Falls State Park (Police)
159.225	State Department of Environmental Conservation (Police)
159.435	State Department of Environmental Conservation
423.8375	County Fire (Training)
423.8625	Volunteer Fire Departments
423.8875	County Public Health
424.0250	New York Power Authority
425.2625	Emergency Medical Services and Air Operations
425.2875	County Fireground
425.3125	County Fire Operations 1
425.3375	County Fire Operations 2
425.3625	County Fire Operations 3
425.3875	County Fire Mutual Aid
425.4375	County Fire Police
425.4625	County Fire (Dispatch)
453.5375	Sheriff
453.7875	Sheriff
460.125	Niagara Falls Police (Channel 2)
460.375	Niagara Falls Police (Dispatch)
460.525	Niagara Falls Fire Department
460.550	Ambulance Service
460.575	Niagara Falls Fire Department
460.6125	County Fire
460.1250	Niagara Falls Police
460.3750	Niagara Falls Police (Dispatch)
460.5250	Niagara Falls Fireground
460.5500	Twin City Ambulance (Dispatch)
460.5750	Niagara Falls Fire (Dispatch)
463.5875	Niagara Falls Memorial Center
464.0625	Niagara Falls Memorial Center
467.9875	Ambulance Service
852.0125	County Water (Telemetry Data)
852.4625	Niagara Frontier Transportation

The Niagara Falls International Airport has a number of assigned frequencies in the aviation band:

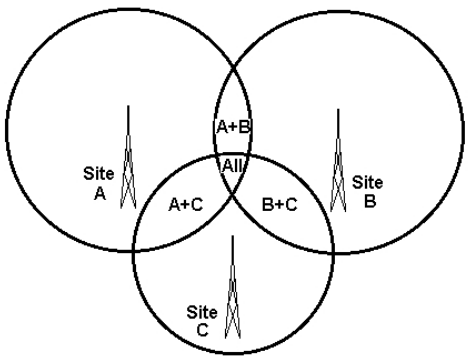
Frequency	Description
118.50	Control Tower
119.25	Clearance Delivery
120.80	Automated Terminal Information Service
121.70	Ground Control
122.95	Unicom
126.15	Approach and Departure

The Niagara Frontier Transportation Authority (NFTA) operates an EDACS (Enhanced Digital Access Communications System) trunked radio network serving the Buffalo and Niagara areas. Voice traffic on the network is in analog format and is simultaneously broadcast ("simulcast") from repeater sites located in the cities of Lancaster, Buffalo and Boston.

❖ Simulcasting

Simulcast means that the same information is transmitted on the same frequency from each repeater site at the same time. Although it may be somewhat wasteful of radio resources, it does ensure that a radio will be able to participate in any conversation on the system regardless of where it might be located. The alternative would be for a conversation to be transmitted from a repeater site only if a participating radio is actually using that site, but such an arrangement is more complicated than simulcasting.

Simulcast Overlapping Coverage



To see the trade-off, imagine that a dispatcher wants to talk to a particular person. In a simulcast system, the dispatcher can simply make the call to the person's radio without regard to where it might be located. Because every transmission is sent from every repeater site, as long as the radio can hear at least one site, the user will hear the transmission. The inefficiency comes in because the transmissions that are sent from other repeater sites at the same time, the ones the radio cannot hear, are wasted as far as the system is concerned.

In contrast, without simulcasting a dispatcher would need to know through which repeater site a transmission should be made in order for the radio to hear it. This means that the location of the radio is now important, at least to the degree of keeping track of which repeater site the radio can hear. This tracking is typically done automatically by each radio in the system via a registration process called *affiliation*.

When a radio is first turned on, or comes within range of a new repeater site, it transmits a control message to the system, letting it know that it is now communicating with that particular repeater site. The system records this affiliation and checks it every time a conversation takes place. If the affiliated radio is supposed to be part of the conversation, the system allocates a radio frequency pair on that repeater site so that the radio can participate. If there is no participating radio affiliated with a repeater site, that site does not transmit the conversation and can use the radio frequency pair for other traffic.

Affiliation adds complexity to the system but allows a more efficient use of radio frequencies across the system, since repeater sites do not have to transmit conversations if they don't have affiliated radios. As it turns out, cellular telephone systems use a similar scheme. Your phone registers with the nearest cell site, informing the system where you can be reached. When someone dials your number, the system looks up your number in an affiliation list to find out which cell site it should use to communicate with your phone. The cell system does not waste resources transmitting your call over sites that you cannot receive.

For scanner listeners, simulcast transmissions are not wasted. Because a conversation will be broadcast on the same frequency everywhere in the simulcast coverage area, a scanner located anywhere in that area will be able to receive the conversation even if there is no radio affiliated with the nearest repeater site.

❖ Niagara Frontier Transportation Authority

Each frequency used by an EDACS network is identified by a Logical Channel Number (LCN). It is important that each frequency is programmed into the scanner in the correct LCN order. The NFTA frequencies and their corresponding LCNs are as follows:

LCN	Frequency
01	851.5375
02	851.9625
03	852.5125
04	852.9625
05	851.6625
06	852.0875
07	852.9375
08	852.4625
09	852.4125
10	851.9875
11	852.1875

Talkgroups in an EDACS network can be identified in one of two ways, either by a hierarchical Agency-Fleet-Sub-fleet (AFS) scheme or the familiar flat numbering system common to other trunked systems. As we discussed in this column last month, the first two digits of an AFS identifier indicate an agency or department. The remaining numbers after the hyphen indicate the individual fleet and sub-fleet within that agency.

Talkgroups on the NFTA system include the following:

Decimal	AFS	Description
291	02-043	NFTA Maintenance
295	02-047	NFTA Maintenance
529	04-021	Bus (Dispatch)
530	04-022	NFTA Maintenance
531	04-023	Bus (Control)
532	04-024	Bus Maintenance
533	04-025	Bus (Control)
534	04-026	Bus Tow Trucks
535	04-027	Bus Maintenance
536	04-030	Bus Maintenance
539	04-033	Bus Garage
545	04-041	Rail (Control)
546	04-042	Rail (Maintenance)
547	04-043	Rail
550	04-046	Rail
555	04-053	NFTA Maintenance
561	04-061	Airtrans Van
562	04-062	Van Service
563	04-063	Airtrans Van
785	06-021	Airport Maintenance
787	06-023	Airport Maintenance
788	06-024	Airport Emergency Medical Services
789	06-025	Airport Parking Lot Shuttle Vans
790	06-026	Bus Maintenance
791	06-027	Airport Fire (Dispatch)
803	06-043	Airport Field Office
805	06-045	Airport Parking Lot Shuttle Vans
1025	08-001	Parking Lot Emergency Phones
1057	08-041	Police (Dispatch for Rail and Bus)
1058	08-042	Police (Dispatch for other than Rail and Bus)
1059	08-043	Police (Rail and Bus)
1061	08-045	Police
1062	08-046	Police (Tactical)
1063	08-047	Police
1064	08-050	Airport Emergency Medical Services

❖ Genesee County, New York

Bordering Niagara County to the southeast is Genesee County, which awarded Harris Corporation an $8 million contract in May to replace its existing public safety radio system. The new system will be based on APCO Project 25 (P25) standards and is expected to provide coverage to at least 95% of the county from vehicle-mounted

radios and at least 90% from "on-hip" portable radios. At least 300 of those radios will be capable of providing encrypted communications using the P25 AES (Advanced Encryption Standard) encryption protocol.

Genesee County lies between the cities of Buffalo and Rochester and is home to just over 60,000 residents, with a quarter of them living in the county seat of Batavia. The county currently operates a Motorola Type II SmartNet system from three repeater sites located in the towns of Batavia, Pavilion and Pembroke. Like the Niagara Frontier Transportation Authority system, it operates as a simulcast system where each site transmits the same information on the same frequency at the same time.

❖ Genesee County Public Safety

All of the traffic on the Genesee County system is in analog format, so nearly any scanner capable of tracking trunked activity will be able to monitor it. The system uses the following six frequencies: 851.0125, 851.4625, 851.9125, 852.3625, 852.8125 and 853.03750 MHz. The license granted by the Federal Communications Commission (FCC) for these frequencies, identified under call sign WPQF924, lists two additional frequencies.

The first frequency, 852.0875 MHz, is transmitted from a repeater site in Le Roy at significantly lower power than the trunked frequencies, apparently enough to cover the town and perhaps a bit of the surrounding area. In any case, it has a much smaller coverage area than the other repeater sites and operates as a conventional (non-trunked) channel.

The second frequency, 852.9875 MHz, is transmitted from each repeater site at a somewhat lower power level and does not appear to be part of the trunked system due to a different emission designator. An emission designator is a short sequence of numbers and letters that identifies some of the key parameters of a transmission. The regular trunked system frequencies have the designator 16K0F3E.

Breaking it down, the first four characters of "16K0" mean that the transmission occupies a bandwidth of 16.0 kHz, which fits nicely within a standard 800 MHz channel of 25 kHz. The "F" means that the signal is Frequency Modulated (FM). The "3" is a code that indicates that there is a single channel containing analog information and the "E" means the information is in the form of voice or music. So, a designator of 16K0F3E describes an analog FM voice channel.

852.9875 MHz is listed with an emission designator of 20K0F2D. The "20K0" describes a signal occupying 20.0 kHz of bandwidth. "F" we already know means FM. The "2" is a code for a single channel that contains digital information and the "D" means it is a data transmission. This channel, if it complies with the FCC license, is a digital data channel rather than an analog voice channel. These two frequencies will be incorporated into the new P25 system.

Talkgroups on the current system include a mix of county and local agencies, as listed below:

Decimal	Hex	Description
16	001	Law Enforcement All-Call
48	003	Sheriff (Dispatch)
80	005	Sheriff (Investigator)
112	007	Sheriff (Operations)
144	009	Sheriff (Administration)
176	00B	Sheriff (Special Deputies)
208	00D	Sheriff (Probation)
240	00F	Sheriff (Countywide)
272	011	Batavia Police (Dispatch)
304	013	Batavia Police (Investigations)
432	01B	Fire All-Call
464	01D	County Fire and Emergency Medical Services (Dispatch)
496	01F	County Fire (Command)
528	021	County Emergency Medical Services
560	023	County Fireground 1
592	025	County Fireground 2
656	029	Highway All-Call
688	02B	County Highway
752	02F	Batavia Public Works
816	033	Sheriff (Car-to-Car)
848	035	Mutual Aid (Base-to-Base)
880	037	Sheriff (Jail)
912	039	Emergency Management Agency (Main)
1072	043	Batavia Fireground
1264	04F	Batavia Public Works (Work Group 1)
1296	051	Batavia Public Works (Work Group 2)
1328	053	Batavia Public Works (Work Group 3)
1360	055	Batavia Public Works (Work Group 4)
1488	05D	County Highway (Work Group 1)
1520	05F	County Highway (Work Group 2)
1552	061	County Highway (Work Group 3)
1584	063	County Highway (Work Group 4)
1616	065	County Facilities Management
1648	067	County Fire Water Supply
1680	069	County Fire Safety
1712	06B	County Fire Police
1776	06F	Emergency Management Agency (Working Group 1)
1808	071	Emergency Management Agency (Working Group 2)
1840	073	Emergency Management Agency (Working Group 3)
1872	075	New York State Police (Car-to-Car)
1936	079	County Parks
1968	07B	Ambulances to Hospital
2032	07F	Patch to Orleans County
2064	081	Emergency Management Agency (Event Group 1)
2096	083	Emergency Management Agency (Event Group 2)
2128	083	Emergency Management Agency (Event Group 3)
2160	087	Emergency Management Agency (Event Group 4)
2192	089	Emergency Management Agency (Event Group 5)
2224	08B	County Nursing Home
2512	09D	County Fire Battalion (West)
2544	09F	County Fire Battalion (Center)
2576	0A1	County Fire Battalion (East)

The town of Le Roy is located in northeast Genesee County and is the birthplace of Jell-O, a powdered gelatin with added flavoring. At the center of town lies the Village of Le Roy, covering 2.7 square miles and about 4,400 residents. The town and the village both have talkgroups on the county system.

Decimal	Hex	Description
368	017	LeRoy Police (Dispatch)
720	02D	Town of Le Roy Highway Department (Supervisors)
784	031	Village of Le Roy Public Works (Dispatch)
944	03B	LeRoy Department of Public Works
1200	04B	Village of Le Roy Public Works (Work Group 1)
1232	04D	Village of Le Roy Public Works (Work Group 2)
1392	057	Town of Le Roy Highway Department (West)
1424	059	Town of Le Roy Highway Department (Center)
1456	05B	Town of Le Roy Highway Department (East)

There is also some county fire conventional (non-trunked) activity in the low band.

Frequency	Description
46.12	Fire/EMS Dispatch (simulcast with 800 MHz TRS)
46.22	Fireground Mutual Aid

❖ Summer Storms

Summer can also bring about thunderstorms and other severe weather. Regardless of whether you're on the road or staying close to home, it's a prudent idea to program the seven National Weather Service (NWS) frequencies into your scanner. Some models already have some kind of weather alert feature, but if your unit lacks such a capability, set aside a bank to hold the following VHF (Very High Frequency) frequencies that broadcast the National Oceanic and Atmospheric Administration (NOAA) Weather Radio All Hazards (NWR) information:

162.400
162.425
162.450
162.475
162.500
162.525
162.550

If the sky looks threatening or if you just want to check the forecast, a few minutes listening to the nearest NWR station can provide valuable information. You can find more information about NWR and a list of the more than 1,000 transmitters at **www.nws.noaa.gov/nwr.**

As a reminder, I welcome your comments, questions, and reception reports via email at *danveeneman@monitoringtimes.com*. You can also find more information about scanners and trunking on my web site at **www.signalharbor.com.**

ASK BOB
GENERAL QUESTIONS RELATED TO RADIO

Bob Grove, W8JHD
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Q. *What type of computer is required to operate a modern, wide-frequency coverage, software defined receiver (SDR)? (J.J. Owens, NC)*

A. Modern computers have the punch right off the shelf. For example, WiNRADiO suggests for their top-of-the line G39DDC *Excelsior* a PC with a 2 GHz CPU, running XP®, Vista®, or Windows® 7. A slow computer might encounter reduced scanning speeds, freezing of images, and interrupted spectrum displays.

Q. *Will a bird sitting on a transmitting antenna suffer RF burns, or would it be unharmed as when sitting on an AC power line where there is no ground return? James H. Monagle, KC9QYC, Evansville, IN)*

A. The primary considerations include transmitting power, frequency, and what part of a wavelength the bird is perched on. Consider the bird as a highly-resistive conductor of a given wavelength. If that length is non-resonant at the transmitting frequency, the coupling it would have to electrical power would be minimal. Depending on where it's sitting in terms of wavelength, it could sense some RF burning on its loose foot, but it could never be electrocuted because RF currents are conducted on the surface of the conductor; they don't go through the inner organs.

Since the size (resonant wavelength) of most birds would be in the UHF range, power levels would be quite low for the birds to suffer consequential injuries, and at HF where power levels are larger, the small birds would receive minimal electrical coupling to the wire.

Q. *Did narrowbanding require licensees to change their frequencies? Do I have to change frequency entries into my scanner for agencies I already have? (Frank Klos, National City, CA)*

A. No, none of the current licensees have to change frequencies, only the bandwidth of their transmitted signal. Your frequency entries may remain as they are.

Q. *Is there a good vertical mast plan for portable SWL antennas, possibly in five-foot sections of PVC pipe? Could it easily support the popular and inexpensive, 24-foot, Grove FlexTenna and, could the base be at ground level? (Morgan Little, email)*

A. Yes, during empirical experimentation with lengths, I found the combination of two, end-fed, parallel wires, 24 and 19 feet long, worked well for an SWL antenna. Telescoping sections of PVC pipe would support the wires, even up through their common centers, and it would be eminently transportable. You may need cord to guy the mast depending on how sturdy the PVC joints are. And yes, the bottom end can be right at earth level. No ground is required.

Q. *I need to replace the balun transformer that comes with the Grove Scanner Beam with one of my own. Is that a 300 ohm twin lead to 75 ohm F connector? (David, email)*

A. It sure is. These are universal, wide-frequency-coverage balun transformers originally made for the TV industry.

Q. *A question occurred to me while watching the live TV coverage following the Boston tragedy. Why don't these journalists carry handheld scanners to hear what the police are actually saying? (Judy May, W1ORO, Union, KY)*

A. The on-air reporter is required to deliver concise, brief encapsulations of events, not listen to constant interruptions while he is live. Remember, the reporter is part of a news team in one or more vans loaded with gear, including scanners which are intently monitored. The earbud he is wearing feeds him vital updates in a timely fashion to be incorporated into his previously-rehearsed reports. It's a lot smoother that way.

Q. *I am looking for a couple of VHF/UHF hand-held transceivers with digital scanning ability for public safety bands. I have looked at the BCD396XL and it's a great scanner which I may need to get separately in addition to the transceivers rather than all in one single handheld. (Keith Montague, email)*

A. All the VHF/UHF hand-helds I know of have the frequency extension merely as a receive convenience with the functions the HT would normally have in its licensed use. Ham dual-band HTs wouldn't include digital unless it's some ham-related mode which none of the public safety systems use.

Scanners, on the other hand, may include APCO P-25 digitization, but only the lowest level (unencrypted); DES and AES encrypted digital signals will not be decoded. Better scanners will, however, track the major modes of trunking.

Q. *I just bought an item advertised as "reconditioned." Does that have a legal meaning? (Mark, IL, email)*

A. Similar terms frequently interchanged include "used," "refurbished," "remanufactured," "recycled," "repaired" and "like new." While there may be minor cosmetic blemishes, the implication is that it has been tested and repaired as needed to meet original factory specifications.

Q. *With the FCC's narrowbanding trunking mandates producing tons of junked VHF and UHF transceivers, what can they be used for? And, what does the FCC do with all the unused original frequency authorizations? (J.J. Owens, NC)*

A. Typically, large lots of surplus radios are offered at auction to the highest bidder. The radios may be used by non-government services such as business and ham radio, salvaged for repair parts, or even exported to non-FCC-regulated countries worldwide.

So far as frequencies currently allocated to government services, these may continue to be used for government licensing which meets new narrowband standards, or reassigned for emergency secondary use (that's just a guess), or we may see future reallocation of the bands to other growing services.

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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Europe: Utility Happy Hunting Ground

When shortwave listening gets boring in California, as it only too frequently does, there is always Europe. No, not via nature's ionosphere, which only works for a few hours a day, but by the artificial one also known as the Internet.

The proliferation of online radios has given all of us deprived souls a nice set of ears on this interesting continent. The best one of these, of course, is the WebSDR (Web-based Software Defined Radio) maintained by the Amateur Radio Club at the University of Twente in the Netherlands. It is massively multi-user, and it hears everything.

For a start, the latest version covers the whole band from essentially zero to 30 MHz. Judging from their chat box, it's now as much of a utility receiver as one for hams. It used to require the Java runtime module, but after the security warnings on that one, they added code that allows it to work without it on some browsers including Chrome, Safari, and Firefox.

While it's hardly a high-end system, it's well engineered and in a great spot. The Netherlands is well situated for radio propagation, which is why so many utility fans live there. All of the many surrounding countries have militaries, coast guards, rescue centers, airports, and all of the other services. These are all in a geographical area that's about the same size as the U.S. and Canada. Therefore, a lot of stations are on.

The Web address of this radio is **http://websdr.ewi.utwente.nl:8901**. Also, there are many other SDRs and single-user remote receivers to be found with some quick Googling around.

Of course, listeners on the U.S. East Coast don't need an artificial ionosphere. The real one is quite capable of hopping the Pond in a single bound.

What to Find

Starting with plain voice radio, the aero bands remain active. "Shanwick," a contraction of Shannon, Ireland, and Prestwick, UK, is still working aircraft in its North Atlantic area of responsibility. Oceanic air traffic control is in something of a state of flux, with frequencies being added in 2011, but also competition from the Future Air Traffic System (FATS) in 2013. Recently logged frequencies include 2872, 4675, 5616, 5649, 5598, 6622, and 8879 kHz. All of these are upper sideband (USB).

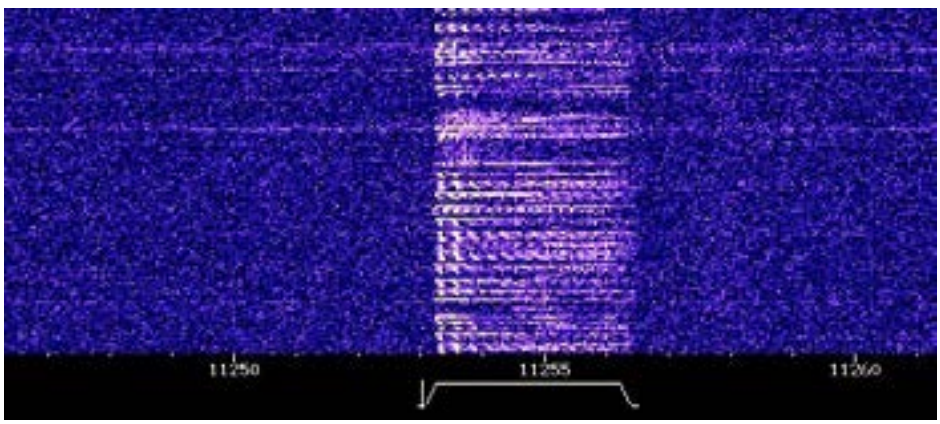
"Shannon Volmet" is a separate station which broadcasts continuous aviation weather bulletins for European airports. Volmet is from the French, sort of, and it means "flying weather." Unlike most other stations of this type, Shannon is always on. The frequencies are 3413, 5505, 8957, and 13264 kHz, all USB.

A similar Volmet broadcast is made by the UK Royal Air Force. This one has also given a few recent surprises, including a brief appearance on frequencies that are usually Royal Navy FAX. 11253 kHz USB is most definitely active, since it's coming out of this editor's speaker at time of writing. The other known frequency, 5450 kHz, is often a data transmission instead.

Europe also still has a great deal of Morse code. It's usually on-off keyed "continuous wave" (CW), though sometimes Russia uses a frequency-shifted variant. Much of it is sent by machines, making it easy to copy the same way. The speeds also make it a good test of one's ability to copy by ear.

A good place to start is with the well-known 4XZ. This station is believed to be from the Israeli Navy, but its signals are surprisingly loud throughout Europe and sometimes into the U.S.. Most of the time, the content is standard, military-style, message preambles, followed by the messages in five-letter code groups. Between each of these, the station usually identifies with, "VVV DE 4XZ 4XZ." "VVV," as most people already know, is the standard test group. "DE" is the procedural signal for "from."

Along with the machine-perfect sending, 4XZ is also recognizable by its use of the "break" signal twice, as in "dahdididididah dahdididididah." Most stations only send it once.



Royal Air Force transmissions.

4XZ usually simulcasts on several frequencies, though not all are always heard at once. Recent hits include 2860.1, 4331, 4595, 6379, and 6607 kHz.

Moving into Baudot radio teletype (RTTY), one finds continuous activity from the German meteorological office. This is DWD, a German-language acronym for "Deutscher Wetterdienst." There are two different broadcasts, both using powerful transmitters at a historic site near Pinneberg, northwest of Hamburg.

Program One is on 4583 kHz with call sign DDK2, plus 7646 (DDH7), and 10100.8 (DDK9). The 10 MHz is often audible clear out here in California. Program Two is on 147.3 (DDH47), 11039 (DDH9), and 14467.3 (DDH8). All frequencies use a speed of 50 baud. All use a shift of 450 hertz, except for 147.3, which is 85. Languages are German and English, both in the standard RTTY character set known as ITA-2 (International Telegraph Alphabet-Number Two).

Needless to say, this is the tiny tip of a very large iceberg. Europe really is the happy hunting ground.

The Magic Flute?

2013 has its first bona fide short wave mystery. It's a collection of funny noises that appear on several frequencies in the maritime mobile bands. So far, everyone is stumped.

Basically, there are three signals. One, which has been called the "Snake Charmer Flute," glides between around 30 discrete pitches, which can be anywhere from approximately 700 to 2200 hertz (Hz).

The second one greatly resembles the first, except that it steps instantly between the pitches. The effect is like a slowed down version of multiple frequency shift keying. It's as if a musician played staccato instead of legato.

In both cases, the quantized pitches never shift more than two or three steps at once, and the direction of the shift is unpredictable. The result sounds like a drifting audio tone, moving slowly and randomly up and down. In both cases, the duration of any particular pitch can vary, but in standard lengths that also appear to be quantized.

The third funny noise is a simple audio sweep, from 600 to 2600 Hz, making three sweeps per second. There's no missing this one. It sounds like an old science fiction sound effect, or a misbehaving car alarm.

All of this has been logged on the following frequencies: 14756, 16926.5, 17299, 17383, 19281.5 and 22819 kHz. As is often the case, "Token" out in California has made some of the best observations. He has noted that these are the dial frequencies at which the audio never drifts out of a standard voice pass band in upper-sideband mode. Since these are all licensed as

voice channels, this is important.

Any of the three waveforms can appear on any frequency, singly or (rarely) in combination, though the sweeper seems to be most common on 22819. All of these seem to be about equally audible in Europe and the United States.

Here's where it gets interesting. All of these frequencies are on or very close to channels used by maritime coastal stations. The lowest five show up in Federal Communications Commission records as licensed to WPG. This is a new coastal station in Indiana, which is owned by a former Globe Wireless executive.

The highest frequency, 22819 kHz, does not show up on WPG's license, but it does appear as a transmit frequency for WLO in Alabama. It's the shore side of a international USB working channel, namely number 2242. The ship side is 22123 kHz.

Here in the U.S., Token has made some measurements of dual-path propagation times, via direct and "long path" (clear around the planet). The difference can reveal the approximate distance of the transmitter from the receiver. The results are consistent with both WPG and WLO.

However, there is considerable evidence that one or more European coastal stations are also transmitting similar signals on these frequencies. 22819 kHz is much too loud on the remote Netherlands receiver to be coming from WLO late at night there. The same might be true for 16926.5 kHz. HEB, in Switzerland, and LFI, in Norway, have been suggested.

One would have to conclude that all of this is too widespread just to come from some kind of spurious emission or circuit malfunction. These can produce drifty tones, but usually without stepped frequencies. In addition, the sweeper just seems too purposeful for that.

Perhaps this is just a test, or some new proprietary mode, or both, or neither. Perhaps it is something way stranger. Since we are dealing with shortwave radio here, there may never be a sure answer.

ABBREVIATIONS USED IN THIS COLUMN

AFB.....Air Force Base
ALE.....Automatic Link Establishment
AM.....Amplitude Modulation
BOM.....Australian Bureau of Meteorology
Camslant.....Communications Area Master Station, Atlantic
Camspac.....Communications Area Master Station, Pacific
CW.....On-off keyed "Continuous Wave" Morse telegraphy
DHFCS.....Defence High Frequency Communications Service
DSC.....Digital Selective Calling
EAM.....Emergency Action Message
FAX.....Radiofacsimile
FSK.....Frequency-Shift Keying
HFDL.....High Frequency Data Link
HFGCS.....High Frequency Global Communications System
HM01.....Cuban AM hybrid voice plus digital
ID.....Station identification
LDOC.....Long-Distance Operational Control
LSB.....Lower Sideband
M89.....Chinese military 4-character calls
MARS.....U.S. Military Auxiliary Radio System
MFA.....Ministry of Foreign Affairs
MX.....Generic for Russian single-letter beacons/markers
NAT.....North Atlantic oceanic air control, families A-F
Navtex.....Navigational Telex
NOAA.....U.S. National Oceanic and Atmospheric Administration
Pactor.....Packet Teleprinting Over Radio, modes I-IV
RAF.....UK Royal Air Force
RTTY.....Radio Teletype
Selcal.....Selective Calling
Sitor.....Simplex Telex Over Radio, modes A & B
UK.....United Kingdom
Unid.....Unidentified
U.S.....United States
USAF.....U.S. Air Force
USCG.....U.S. Coast Guard
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 ().

129.1 DCF49-European power control, Mainflingen, Germany, FSK data at 0759 (Ary Boender-Netherlands).

135.6 HGA22-European power control, Lakihagy, Hungary, FSK data at 0801 (Boender-Netherlands).

139.0 DCF39-European power control, Burg, Germany, FSK data at 0744 (Boender-Netherlands).

299.5 688-Differential Global Positioning System beacon, North Foreland, UK, corrections in minimum-shift keying, at 1731 (Boender-Netherlands).

518.0 K-Corfu Radio, Greece, Sitor-B Navtex at 2144. L-Rogaland Radio, Norway, Sitor-B Navtex at 2153 (Boender-Netherlands).

2000.0 New York Volmet, aviation weather for Northeast U.S. airports, still on this undocumented frequency, at 1412 (Mario Filippi-NJ).

2070.4 BPLEZS-German Federal Police, Cuxhaven, working BP22 (Police Boat *Neustrelitz*), ALE at 1518 (Boender-Netherlands).

2142.5 ZHID-German Customs Boat *Hiddensee*, calling ZLST, Customs Control Post, Cuxhaven, ALE at 0238 (Boender-Netherlands).

2500.0 WWV-U.S. National Institute of Standards and Technology, CO, AM standard time and frequency signals, not usually audible this low, at 0213 (Filippi-NJ).

2505.0 BPLEZS-German Federal Police, Cuxhaven, calling BP26 (Police Boat *Eschwege*), ALE at 1800 (Boender-Netherlands).

3642.0 3A7D-Chinese military CW calling marker (M89), calling DKG6; similar on 4474, 8110, 10518, and 11312; at 1849 (MPJ-UK).

3831.0 ZLST-German Customs, Cuxhaven, calling ZRUE (Customs Boat *Priwall*), ALE at 2109 (Boender-Netherlands).

4084.0 "V"-Russian Navy CW channel marker (MX), Khiva, also on 4150 and 7027.5, at 2156 (Boender-Netherlands).

4208.0 "A"-TAH, Istanbul Radio, Turkey, Sitor-B Navtex formatted bulletins in Turkish, at 0221 (Filippi-NJ).

4235.0 NMF-USCG, Boston, MA, clear FAX satpic of U.S. East Coast, then Atlantic surface analysis chart, at 0358 (Filippi-NJ).

4325.9 "R"-MX, Izhevsk, CW ID at 2044 (MPJ-UK).

4419.0 EAVA-Russian military net control station, CW comm checks with KAMZ, S7ET, and 6NSD, at 2006 (MPJ-UK).

4426.0 NMN-USCG Camslant Chesapeake, VA, Caribbean and tropical weather in "Iron Mike" voice, at 0350 (Filippi-NJ).

4557.7 "D"-MX, Odessa, Ukraine; also on 5153.7, 7038.7, and 16331.7; CW at 2333 (MPJ-UK).

4610.0 GYA-UK Royal Navy, Northwood, UK, FAX upper-level chart with the details missing, at 0142 (Filippi-NJ).

4675.0 Bodo-Nat-D, Norway, selcal JM-ES for unknown aircraft, at 2200 (Michel Lacroix-France). *[Two similar aircraft use this selcal. -Hugh]*

4897.8 "L"-MX, St. Petersburg, also on 5156.8 and 8497.8, CW at 1218 (MPJ-UK).

5150.0 VTK-Tuticorin Naval Radio, India, coded CW message in 4-figure groups, at 2015 (MPJ-UK).

5153.8 "P"-MX, Kaliningrad, also on 10871.8, CW at 0310 (Filippi-NJ).

5153.9 "S"-MX, Severomorsk, CW at 2031 (MPJ-UK).

5258.0 BP24-German Federal Police boat *Bad Bramstedt*, calling ZLST, Cuxhaven, ALE at 0403 (Boender-Netherlands)

5433.0 SAB-Göteborg Radio, Sweden, digital ID in GlobeFSK marker, at 2022 (Boender-Netherlands).

5596.0 LUXD-Russian Military net control, passing CW message in 5-letter groups to LOZI and PVAN, similar on 8138 and 8622, at 2020 (MPJ-UK).

5680.0 Kinloss Rescue-UK Aeronautical Rescue Coordination Centre, Scotland, position from USB w/Sierra 125 (RAF Sea King helo), heard on University of Twente web radio, at 2028 (MDMonitor-Netherlands Remote).

5708.0 ICZ-USAF, Sigonella Air Base, Italy, passing ALE text message to unknown station, at 2339 (Boender-Netherlands).

6318.0 KLB-ShipCom, WA, CW ID in Sitor-A marker, at 0318 (Filippi-NJ).

6340.5 NMF-USCG, Boston, MA, FAX satellite image at 0400 (PPA-Netherlands).

6352.5 WHL-KielRadio Global Maritime Network, St. Augustine, FL, CW ID "CQ DE WHL" in Pactor-I marker, at 0400 (PPA-Netherlands).

6399.0 ZSC-Cape Town Radio, South Africa, ID in GlobeFSK marker, at 0356 (PPA-Netherlands).

6416.5 XSS-UK DHFCS, Forest Moor, ALE link check with XDD; also on 12230, 14485.5, and 18403.5; at 0736 (Boender-Netherlands).

6586.0 New York-Caribbean air route control, selcal check with unknown Sunwing Airlines flight, at 0218 (Allan Stern-FL).

6622.0 Gander Radio-NAT-F, new routing for Lufthansa 427, at 0053. Gander, selcal check with Air Canada 814, at 0118 (Stern-FL).

6628.0 Santa Maria-NAT-E, Azores, selcal HR-AM to KLM 792, a B777 reg PH-BQB, at 0330 (PPA-Netherlands).

6661.0 "04"-HFDL ground station, Riverhead, NY, position from Avianca 855, at 0340 (PPA-Netherlands).

6668.0 768-Georgian military, ALE link check with 344, at 1938 (Boender-Netherlands).

6685.0 Korsar-Russian Air Force, Pskov, with Davlenie (Air Transport, Taganrog), both working 76748, an IL-76 reporting landing, at 2023 (MDMonitor-Netherlands).

7027.5 "V"-MX, Khiva, Uzbekistan, CW ID at 1900 (MPJ-UK).

7475.0 FAAMRB-U.S. Federal Aviation Administration, MD, attempting ALE contact with FAAOEX, OK, and FAAASO, GA, at 1732 (Jack Metcalfe-KY).

7594.5 OEY61-Austrian military, ALE link check with OEY, at 1000 (Boender-Netherlands).

7615.0 Georgia CAP 217-U.S. Civil Air Patrol, net control taking check-ins by region, many answers, at 0105 (Filippi-NJ).

7720.0 UL53-Algerian military, ALE link checks with UL5 and UL55, at 2125 (Boender-Netherlands).

7850.0 CHU-Canadian National Research Council, Ottawa, standard time signals in USB with carrier, at 1200 (Eddy Waters-Australia).

7906.0 Unid-Possibly Vietnam, female with weather in Vietnamese, at 1150 (Waters-Australia).

8056.0 773RDA2LANET-Possible U.S. Army 773rd Military Police, LA, calling 773RDA2LANET; also on 10321, 13427.5, and 14654.5; at 1416 (Metcalfe-KY).

8305.5 563176000-Singapore flag cargo vessel *Navarra* (9V8593), contacting SAB, Göteborg, Sweden (on 8489), in GlobeFSK, at 1408 (MPJ-UK).

8317.5 248738000-Maltese flag cargo vessel *AM Larafale* (9HA2490), passing ID and position to LFI, Rogaland, Norway (on 8683.5), in GlobeFSK, heard on University of Twente web radio, at 2231 (Hugh Stegman-Netherlands Remote).

8416.5 NMF-USCG, Sitor-B weather and Navtex-formatted bulletins about cable operations, at 0205 (Filippi-NJ).

8462.0 9MR-Malaysian Navy, Johor Bahru, RTTY test loop at 1927 (PPA-Netherlands).

8502.0 NMG-USCG, New Orleans, LA, "Iron Mike" voice with Atlantic weather, at 0336 (Filippi-NJ).

8503.9 NMG, FAX satpic interrupted for three minutes, also on 12789.9, at 0205 (Filippi-NJ).

8550.0 CTP-Portuguese Navy, Oeiras/Palhais, RTTY Notice to Allied War Ships marker with listening frequencies, at 0213 (Filippi-NJ).

8720.4 9MG-Penang Radio, Malaysia, identifier in GlobeFSK marker, at 2009 (PPA-Netherlands).

8776.0 SVO-Olympia Radio, Greece, news in Greek, at 2002 (PPA-Netherlands).

8806.0 XSG-Shanghai Radio, China, female voice reading traffic list, at 2005 (PPA-Netherlands).

8861.0 Dakar-African air route control, Senegal, working Air Portugal TAP17, an A330 reg CS-TOE, at 1947 (PPA-Netherlands).

8879.0 Mumbai-Indian Ocean air route control, India, working Garuda 981, at 1955 (PPA-Netherlands).

8888.0 Novosibirsk Volmet, female voice with aviation weather in Russian, at 1942 (PPA-Netherlands).

8918.0 New York-Caribbean air route control, giving KLM 724 a Santa Maria primary frequency of 5598, and backup of 3016, at 0038 (Stern-FL).

8942.0 TC-JNF-Turkish Airlines A330, flight TK0713, HFDL log-on with Shannon, at 2122 (MPJ-UK).

9025.0 MCC-USAF, McClellan AFB, CA, ALE text with OFF, Offutt AFB, NE, at 0610 (Boender-Netherlands).

9054.0 Unid-female with 5-letter groups in Chinese, at 0945 (Waters-Australia).

9155.0 Unid-Cuban AM "hybrid" mode (HM01), female machine voice alternating with data transmissions, at 1035 (Waters-Australia).

10066.0 RP-C8602-Philippine Airlines flight PR0131, an A319, HFDL log-on with Hat Yai, Thailand, at 2122 (MPJ-UK).

10087.0 SU-GCE-Egyptair flight 956, an A330, HFDL with Krasnoyarsk, Russia, at 1841 (PPA-Netherlands).

10128.0 W0ERE/BCN-Amateur propagation beacon in grid square EM69 (IN), CW ID loop giving power as 3 watts, at 1425 (Filippi-NJ).

10965.0 MOBE3F-French Air Force E-3F, calling 202E3F, another E-3F, ALE at 1449 (Lacroix-France).

11030.0 VMC-Australian BOM, Charleville, FAX wind analysis at 0637 (PPA-Netherlands). VMC, FAX Sea Surface Analysis at 1215, then schedule at 1218 (Filippi-NJ).

11090.0 KVM70-NOAA, Honolulu, HI, FAX infrared satellite image, at 0650 (PPA-Netherlands).

11175.0 Manifold- U.S. military, working Offutt HFGCS regarding status of other players, at which point "Cheyenne Mountain" (North American Aerospace Defense Command, aka NORAD), came up on frequency to report the others were temporarily off-air, at 0010 (Tony Agnelli-FL). Andrews-USAF HFGCS control, Andrews AFB, MD, SKYKING broadcast at 0017 (Gary Cohen-NY).

11178.0 Arkada 25-Polish Air Force, calling PLF042, no joy, at 1052 (MDMonitor-Netherlands).

11181.0 ICZSPR-USAF Secure Internet Protocol Routed Network (SIPRNET), Sigonella, Italy, ALE link checks with JDG (Diego Garcia) and JDGSPR (SIPRNET, Diego Garcia), at 1417 (Boender-Netherlands).

11184.0 GTI215-Atlas Air B747 freighter, HFDL log-on with Reykjavik, Iceland, at 1241 (Lacroix-France).

11205.0 Tascomm-UK military Terrestrial Air-Sea Communications, Forest Moor, selcal check AP-DL with Ascot 6623, an RAF C-17 reg ZZ175, at 1607 (MDMonitor-Netherlands).

11220.0 Andrews-USAF, setting up data modem with News Room, at 1103 (MDMonitor-Netherlands). Lajes, came from 11175 with P-3C YB 761, handed aircraft off to Ascension (USAF, Ascension Island) for a patch to Whidbey Duty Office regarding return to base for inoperative radar, at 2324 (Stern-FL).

11300.0 Mogadishu-African air route control, Somalia, working Air France 3591, a B777 reg F-GZNG, at 1928 (PPA-Netherlands).

11318.0 "13"-HFDL ground station, Santa Cruz, Bolivia, uplink to N974AV, an Avianca A330, at 0609 (PPA-Netherlands).

11360.0 76754-Russian Air Force IL-76T transport, called Korsar (Pskov), answered by Proselok (Bryansk), reported departure, at 1357 (MDMonitor-Netherlands).

11396.0 Jakarta-Southeast Asian air route control, Indonesia, working Jetstar 132, a Jetstar Asia A320 reg 9V-JSS, at 1907 (PPA-Netherlands).

11407.0 AFA6BU-USAF MARS, AR, came from 13927 with B-52H Hammer 41, for a patch to Minot AFB Bomber Ops, at 1647 (Stern-FL).

12168.0 B02MEJOC-U.S. National Guard Joint Operations Center, ME, ALE sounding at 2014 (Metcalfe-KY).

12362.0 VMW-Australian BOM, Wiluna, weather for northern territories at 1751 (PPA-Netherlands).

12412.5 NOJ-USCG, Kodiak, AK, FAX ice chart at 0347 (Filippi-NJ).

12431.0 PRATICA01-Italian Financial Police, Pratica di Mare Air Base, calling DEROSA, ALE at 0746 (Patrice Privat-France).

12577.0 005030001-Australian Rescue Coordination Centre, DSC call to 564336000, Singapore flag oil tanker *Varada Blessing* (9V8943), at 2030 (PPA-Netherlands).

12581.5 XSV-Tianjin Radio, China, CW ID in Sitor-A marker, at 1835 (PPA-Netherlands).

12584.5 WLO-ShipCom, AL, CW ID in Sitor-A marker, at 0631 (PPA-Netherlands).

12590.5 KLB-ShipCom, WA, CW ID in Sitor-A marker, at 2334 (Robbie Spain-WY).

12613.0 XSQ-Guangzhou Radio, China, Sitor-A "quick brown fox" test, at 2006 (PPA-Netherlands).

12786.0 NMC-USCG Camspac Point Reyes, CA, FAX West Coast satellite image, at 0146 (Filippi-NJ).

13026.0 WHL-KielRadio Global Maritime Network, St. Augustine, FL, CW ID "CQ DE WHL" in FSK marker, at 2330 (Spain-WY).

13110.0 WLO-ShipCom, AL, "female" machine voice with weather and lookout for missing vessel, parallel on 13152, at 1122 (Filippi-NJ).

13182.0 XSQ, Female working ship on 12335, in Chinese, at 1755 (PPA-Netherlands).

13200.0 Offutt-USAF, NE, SKYKING broadcast at 0928 (PPA-Netherlands).

13270.0 "06"-HFDL ground station, Hat Yai, Thailand, uplink to B-5906, an Air China A330, at 1806 (PPA-Netherlands).

13282.0 Honolulu Volmet, HI, Pacific aviation weather at 0330 (Filippi-NJ). Hong Kong Volmet, China, machine voice with aviation weather, at 1846 (PPA-Netherlands).

13435.0 HM01, alternating voice numbers and data transmissions of file 34584437.txt, AM at 0700 (PPA-Netherlands).

13499.0 10111-Moroccan government; ALE net with 1118, 2011, 2524, and 1324; at 1244 (MPJ-UK).

13528.0 "C"-MX, Moscow, also on 16332, repeating ID at 0721 (Waters-Australia).

13528.2 "F"-MX, Vladivostok, also on 16332.2, CW ID at 0727 (Waters-Australia).

13528.3 "K"-MX, Petropavlovsk-Kamchatskiy, also on 16332.3, CW ID at 0935 (Waters-Australia).

13528.4 "M"-MX, Magadan, CW ID at 0937 (Waters-Australia).

13550.5 ZKLF-Auckland Radio, New Zealand, grainy FAX schedule, at 1134 (Filippi-NJ).

13564.0 GNK-Legal, very low-powered, "Hifer" beacon, WI, CW ID at 0103 (Filippi-NJ).

13927.0 AFA6BU-USAF MARS, AR, attempting patch for B-52H Hammer 41, then went to 11407, at 1640 (Stern-FL).

14349.0 APPLEF-Unknown, possibly Taiwan Navy, calling AFFECT in LSB ALE, also on 17470, at 0655 (Waters-Australia).

14375.0 HM01, alternating voice and data in AM, at 0640 (PPA-Netherlands).

14531.7 Unid-Egyptian MFA, Sitor-A selcal to XBVP, Rome, at 1818 (PPA-Netherlands).

15016.0 Unid-USAF HFGCS, missed ID at end of EAM, at 2324 (Spain-WY).

15867.0 LNT-USCG Camslant, calling J37, USCG MH-60T #6037, ALE at 1517 (Privat-France).

16026.7 Egyptian MFA, Sitor-A selcal to XBVM, Germany, at 1004 (PPA-Netherlands).

16035.0 Unid-Kyodo news relay in Singapore region, FAX Japanese newspaper at 60/576, also on 17430, at 0852 (PPA-Netherlands).

16086.7 Egyptian MFA, Sitor-A selcal to KKVU, Accra, Ghana, at 0936 (PPA-Netherlands).

16252.5 OEY80-Austrian Army, Villach, working OEY61, Syria, at 1141 (MPJ-UK).

16285.0 STAT151-Tunisian Police, calling STAT12, ALE at 0727 (PPA-Netherlands).

16402.0 ABA-Maltese Maritime Squadron Headquarters, Floriana, calling AB2, Patrol Boat P-22, ALE at 1145 (MPJ-UK).

16630.5 636090306-Liberian flag container ship *E.R. Santiago* (ELWP5), connecting to Globe Wireless in GlobeFSK, at 2031 (Privat-France).

16804.5 3FAV3-Panamanian flag vessel *Magnolia Ace*, DSC call to Shanghai Radio, at 1602 (Boender-Netherlands).

16907.5 JFC-Misaki Prefectural Fishery Radio, Japan, short text FAX, at 1700 (PPA-Netherlands).

16947.7 9MG-Penang Radio, Malaysia, identifier in GlobeFSK marker, at 1707 (PPA-Netherlands).

16971.0 JSC-Kyodo News, transmitter in Kagoshima Prefecture, Japan, FAX news in Japanese at 0345 (John Maikisch-WA).

16976.8 JFK-Shimonoseki Fisheries Radio, Japan, hand sent CW all-stations call, at 1730 (PPA-Netherlands).

17093.7 AQP7-Pakistan Navy, Karachi, CW marker, also on 17094.5, at 1014 (PPA-Netherlands).

17103.2 XSG-Shanghai Radio, weather in English, at 0913 (PPA-Netherlands).

17931.0 Holloway-Ethiopian Airlines LDOC, Addis Ababa, working Ethiopian 920, at 1623 (PPA-Netherlands).

17961.0 Brisbane-Indian Ocean air route control, Australia, calling flight C132 enroute to the Cocos Islands, at 0822 (Waters-Australia).

17967.0 N856FD-FedEx B777 freighter, flight 27, position for Al Muharraq HFDL, Bahrain, at 1647 (PPA-Netherlands).

19418.4 Unid-North Korean MFA, 600/600 ARQ, at 0945 (PPA-Netherlands).

19647.7 Unid-Egyptian MFA, Cairo, messages to unknown embassy in Arabic Sitor-A, at 0745 (Waters-Australia).

21937.0 2K0605-AeroGal A320 reg HC-CJM, working Molokai HFDL, HI, at 0106 (Stegman-CA).

21997.0 "13"-Santa Cruz HFDL, Bolivia, position from CM137, at 1819 (PPA-Netherlands).

22569.0 DZO-Philippine maritime station, CW ID in Pactor marker, at 0600 (Waters-Australia).

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JORN Ionospheric Sounder

For well over a year, a number of monitors have noted an unusual ionospheric sounder that is probably connected to the Australian Ministry of Defense's JORN Over-the-Horizon Radar (OTHR) project at Jindalee (see resources below).

Sounders are propagation measuring devices that use a variety of techniques, usually rapid frequency sweeps across a band of frequencies or pulsed waveforms at different spot frequencies, to determine the extent to which the ionosphere above them reflects those signals back to earth. Most HF listeners are familiar with the brief "fwip" as a frequency sweep or "chirp-sounder" passes through their radio's passband at a rate of 100 or 200 kHz per second.

A sounder's transmitter usually has a co-located or remote receiver tracking it. At some frequencies at a given time of day, signals sent by the transmitter will not be reflected back to earth by the different layers of ionosphere above it, which provides information about the Minimum and Maximum Usable Frequency (MUF). Listeners use these measures as an indication of the prevailing HF conditions and the frequency below or above which communication to a given location at a certain time of day will not be possible.

The JORN sounder is a narrowband (3 kHz) variety which steps down in frequency by approximately 1 MHz from 25 MHz to at least 5 MHz. On each channel, the sounder sweeps the 3 kHz 64 times at 16 different rates, from fastest to slowest. The whole process takes about a minute to complete. In between each set of sweeps is a brief carrier burst perhaps used for synchronization purposes. You can hear an audio clip of the sounder by checking the link in the resources section below. The current list of channels is as follows:

20974, 19974, 18992 (18988), 17860 (17864), 16992, 15992, 14968, 13974 (13952),
12988 (12992), 11992 (11966), 10984 (10988), 9932, 8992, 7992 & 6992 kHz

Note that the sounder appears to be frequency agile, in that it listens to the channel before and during a transmission and will jump to another close-by frequency to avoid interference, denoted by the frequencies listed in parentheses above. Typically, this jump is in discrete steps of 4 kHz. Recently, I was waiting on 13974 kHz for the sounder to start on its usual channel. When it had nearly completed its third sweep, the infamous and very powerful Chinese "Fire Dragon" (or Firedrake) jammer appeared. The sounder simply stopped in mid-cycle, jumped to 13952 kHz and re-started its third sweep as if nothing at all had happened. Times and days of operations seem erratic, but 1400 UTC has been a consistently good time to hear this interesting signal recently.

Rivet Decoder Development Moves Ahead

News from Ian Wraith, developer of the excellent and free Rivet data decoding software, tells of improvements to the program. The very active 200 bd/1000 Hz synchronous FSK system with 288 bit frames used by Russian Intelligence and Diplomatic stations continues to move towards a full decode of the traffic.

Ian remarks, "Big progress with this one. I at last understand (partly at least) how the different elements of some blocks are interleaved. I'm now recovering a 5 digit link identity, a number that is usually the same and which I think serves the same purpose as the well-known '11177' header group in Russian traffic, a date (day of the month) and a message serial number. So these look a lot like the old Russian Intelligence and Diplomatic RTTY messages really. I'm not recovering the actual encrypted traffic, since this could take many forms and may even be binary. Also, I believe each block also has some form of error correction, but I don't understand that yet either."

Rivet's ability to decode the 100 bd/200 Hz FSK system employed by ships on the Globe Wireless network to send GPS (Global Positioning System) fixes has also improved. "We [Ian is working with a maritime HF listener in this project] have worked out which packet contains the ship's MMSI (Maritime Mobile Service Identity) number and are making some progress with this. Globe Wireless appear to be using a modified BCD (Binary Coded Decimal) scheme to encode the MMSIs within 6 bytes of data. However, I'm not 100 percent sure on this and there is still work to do."

Build 61 of Rivet, released in early May, contained the majority of these improvements, and I have already noted a number of listeners reporting ship names and positions to the UDXF (Utility DXer's Forum) email list as a result of Ian's steady progress. I plan to cover more details of the Globe Wireless network in a future column.

Meanwhile, the Russian 200 bd/1000 Hz FSK transmissions from Moscow, mentioned by Ian, continue to be very active throughout the day and night and usually deliver consistently strong signals to the U.S. These transmissions are probably scheduled and take place on the hour and repeat at 20 and 40 minutes past the hour thereafter, day and night. Each repeat is approximately 2 MHz lower in frequency than the previous channel. Here are some recently active frequencies:

10158, 10231, 11109, 11167, 12196, 13473, 14671, 14826, 15708, 15963, 16141, 16186, 16243, 16286, 16321, 16329, 16351, 16637, 18394, 18476 and 18563 kHz

Russian Intelligence and Diplomatic XPA2 MFSK System

One of the well-known and frequently heard digital systems decoded by Rivet is a slow (8 baud) 14 tone, narrowband AFSK (Audio Frequency Shift Keying) system used by Russian Intelligence and Diplomatic Services. The ENIGMA (European Numbers Intelligence Gathering and Monitoring Association) group code-named this mode XPA2, part of a family of polytonal systems employed by the Russians over the years. Like the 200 bd/1000 Hz system mentioned above, the powerful Moscow transmitters usually deliver very strong signals to the U.S., though XPA2 tends to be a rarer catch these days.

XPA2 is sent using an AM transmitter, so the receiver can either be switched to AM or to SSB with zero-beat to receive the messages. XPA2 employs a simple 14 tone library as follows:

Tone (Hz)	Function
995	Space
1035	Low start tone
1055	End tone
1075	Repeat
1085	Fig 0, End tone
1105	Fig 1
1135	Fig 2, sync tone
1145	Fig 3
1155	Fig 4
1165	Fig 5
1175	Fig 6, sync tone
1205	Fig 7
1225	Fig 8
1235	Fig 9, High start tone

Decoder synchronization is achieved by sending an initial sequence of Figure 2 and Figure 6 tones ten times and Rivet will automatically correct any mistune. Messages are composed of five figure groups. The first three groups are padded with zeroes in the beginning when needed and comprise a three or four-figure serial number, the number of groups to be sent, and a five-figure decode key. The transmission completes with a sequence of alternating Figure 0 (1085 Hz) and end (1055 Hz) tones, sent ten times. Null or "no traffic" messages use the format "0xxxx 00001 00000 10140" and if the next message is to be sent during the same broadcast, the groups "00000 00000" separate the two messages.

Recent channels carrying XPA traffic include: 5864, 6823, 7462, 7523, 7623, 7941, 8062, 8063, 8123, 9051, 9084, 9243, 9276, 9288, 9362, 10476, 11488, 11576, 12217, 13427, 16061, 16213, 16281, 17419, 17441, 18667 & 18767 kHz

Resources:

JORN Sounder Audio - dl.dropboxusercontent.com/u/301213/JORNSounder.wav
JORN Wikipedia Page - en.wikipedia.org/wiki/Jindalee_Operational_Radar_Network
Rivet Download Page - borg.shef.ac.uk/rivet/

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Are Small Antennas 'Good?'

Now that I own a high-performance, "trail-friendly" transceiver, Elecraft's Mighty Mini KX3, I have been spending a lot more time thinking up ways to take the little powerhouse into the field. And, because of this rekindled interest, I've been spending a lot more time lurking in a variety of "outdoorsy" online watering holes.

I quietly marvel at the guys and gals who gleefully portage their radio gear, no matter how heavy or lightweight, into the backcountry or to the top of some local Summits-on-the-Air. It's all good, but I did plenty of that stuff as a youngster. Today, my idea of "roughing it" tends toward a 40-foot diesel motor home with an attached crank-up tower! Unfortunately, I don't yet own such a beast, but a lifetime of spending $2 a week on the lottery has to pay off one of these days, right?

Fantasies aside, what spurred me to write this month's column is the sheer volume of beginner-level forum conversations I came across marveling at the "awesome performance" of a few specialized, physically small antennas. In addition to portable use, many of the participants, mostly inexperienced new hams with brand-new, low-power transceivers, were trying to decide between these antennas for fixed station use, as well.

In the interest of full disclosure, the two antennas are the Buddipole™ (a lightweight, highly configurable, portable, tripod-mounted dipole/vertical antenna system that can cover 40-2 meters in a wide variety of configurations via various loading coils and baluns), and the AlexLoop (a portable magnetic loop antenna with several variants) that can be used fixed, portable or even pedestrian mobile.

Now, before you rush to your PC to fire off a batch of fervent hate mail, you should know that I would be thrilled to own either antenna, and that I'm actually quite a booster. Each is well made from high-quality parts and backed by caring, quality-oriented individuals who are themselves enthusiastic users and developers of their respective products. It doesn't get any better than that!

There's absolutely nothing "wrong" with either antenna, especially when they're used in the situations and environments for which they're designed. But it's important to understand that *any* physically small antenna usually suffers *greatly* when compared to full-size counterparts. That's doubly so when you factor in height above ground (although magnetic loops are often less-hindered by low mounting height).

Small Antenna Origins

In general, Buddipole-style antennas got their start when someone took two mobile whip antennas, mounted them back-to-back (fed as a dipole, no car body required) and attached them to the top of an extendable "painter's pole." Today's Buddipole is a modern, highly evolved portable antenna system that allows the two antenna elements to be configured as dipoles (horizontal or vertical), Vs (inverted or not), or verticals/inverted Ls (one element vertical, the other horizontal). The materials, hardware, mast systems and transport bags make for a sexy, versatile antenna.

Compared to a full-size dipole or loop, however, it's still *teeny*, and on bands below 20 meters, it's typically installed very low to the ground. No amount of engineering can (yet) overcome the laws of physics that punish most small, low antennas.

Magnetic loops, of which the AlexLoop is a flexible, versatile and portable version, are much more mysterious. They typically work very well at ground level, often performing on par with typical wire antennas that are mounted much higher. These special, exotic loops, however, have super-narrow bandwidths (requiring tedious tuning and retuning, even for slight frequency changes), cover limited frequencies and are usually restricted to relatively low power levels. Unless you build your own *giant* mag loop for the low bands, efficiency at 20 meters and down is very low.

I plan to cover mag loops in more detail in a future column, so I won't get into too many facets of these fascinating antennas, except to say that they're comprised of electrically small loops (usually one turn that's less than one quarter-wavelength circumference at the lowest frequency of operation) that are resonated by a fixed or variable capacitor; simple tuned circuits!

This "quick and dirty" drive-on mast mount isn't backpack friendly, but it's foolproof and amazingly rigid. (NT0Z Photo)

At these small sizes (a typical 20-10 meter mag loop has a 1-meter diameter), even the tiniest amount of electrical resistance can seriously degrade performance, so low-resistance, large-diameter copper or aluminum tubing is preferred, as are vacuum-variable or wiper-less "butterfly" air-variable capacitors. The best-performing loops have few or no soldered joints (too resistive), and even the capacitor plates are welded to minimize resistances measured in milliohms! Oh, and with only 100 W of RF, the tuning capacitor may have to handle 5,000 volts without arcing! At 1.5 kW? Just forget about it!

For our purposes, think of mag loops as exotic, compact, low power, multiband antennas that can be tedious to use, but can put out a surprisingly big signal even when mounted only a foot or two above the ground (or while sitting on the kitchen table). For *certain* circumstances, potentially awesome. For *every* circumstance, potentially not.

Let's Get Small

In general, full-size antennas for 20 -10 meters are "reasonably compact," while their low-band counterparts are anything but. A 10-meter dipole (or the driven element of a 10-meter beam) measures about 16 feet end to end. As expected, the size of a 20-meter dipole or beam element is double that, about 32 feet. An 80-meter dipole or beam element, however, measures 133 feet, with 160-meter versions coming in at a staggering 260 feet!

The elements for quarter-wave verticals are about half the size of their respective dipoles, which means that a 40-meter vertical measures about 33 feet, 80 meters about 66 feet, and 160 meters about 133 feet.

There are many ways to reduce the physical size of antenna elements without drastically reducing their efficiency, but there are no free lunches here! To reduce the size of a vertical or dipole element, you could add inductance (a loading coil), capacitance (a capacitance hat) or a parallel wire or length of tubing (linear loading), to name just a few. In general, the smaller the antenna, when compared to "full size," even if you can match it perfectly to your radio, the worse it performs.

You could add a large loading coil and a massive capacitance hat to an eight-foot piece of aluminum tubing to make it perfectly resonant at 80 meters. When you connected your rig, SWR meter and feed line, everything would look good, and you'd be able to hear signals on the band and make contacts. The antenna's efficiency, however, would be between 1-3 %, so if you put 100 W into the antenna, it will radiate only 1-3 W! What I've just described, by the way, is a typical mobile antenna for 80 meters. In case

you've always wondered why more ops don't work the low bands from their vehicles, now you know! Regardless of the "magic" used to match the antenna, because of the antenna's small size, efficiency is still dismal.

Conversely, on 10 meters, where a full size, quarter-wave vertical is about 8 feet, a mobile whip *isn't short at all* and pays no efficiency penalty based on size! A car-mounted 8-foot whip is a full-size antenna, which is why it's perfect for easy, successful, mobile operation (when propagation cooperates, anyway).

If you could mount a 33-foot "whip" on your car, it, too, would be full size and work accordingly (RF grounding considerations aside). But that's not really practical, so we are forced to use smaller antenna elements and various techniques to make them resonant (or other impedance-matching techniques to convince our transmitters to put out full power).

If we could build 160-meter Yagis with 16-foot elements and "magical" loading coils, everybody would have one. But we can't; they just don't work. Until we can build antennas from room-temperature superconductors or exploit unconventional or previously unknown antenna modalities (magnetic loops?) there are various practical limitations on how small we can make an antenna and still provide "reasonable" efficiency. There's no getting around it: Small is small.

❖ The Low Down

No ham radio book or magazine is complete without at least a few antenna performance charts, even if they only appear in ads. And we're conditioned through repeated exposure to expect certain radiation patterns for dipole, vertical and beam antennas. What many hams don't realize, however, is that those radiation patterns assume certain conditions that your particular antenna may never approach!

If you want to *regularly* work DX, for example, pay close attention to antenna height, because at heights of less than a half-wavelength or so, the classic radiation pattern for traditional dipoles, loops and Vs degrades horribly, and take-off angles increase dramatically. Radiation efficiency isn't affected nearly as much because "all" of the RF still gets radiated. Unfortunately, much of it is being radiated in unexpected, less-useful directions (pretty much straight up!).

Heights of between a half-wavelength and one wavelength provide the classic radiation patterns and take-off angles we've come to expect, so if your 80-meter dipole isn't 120 to 240 feet off the ground, instead of the classic bidirectional, figure-eight radiation pattern and moderately-low take-off angles, the actual pattern is probably almost omnidirectional, with very high take-off angles. You can still make contacts, of course, but the performance will never approach expectations.

On the high bands, life is much easier. A half-wavelength on 10 meters is only 5 meters—about 16 feet. So if your Yagi or dipole is between 16 and 32 feet above ground, the full measure of expected performance, directivity and take-off angles are yours! That's why I sized the mast/antenna spreaders for my 6-meter,

This is what happened when I found an umbrella-style outdoor clothesline contraption on closeout at the local Man Mall: a two-wavelength horizontal loop for 6 meters that can easily be furled and unfurled for Field Day and hilltopping (prototyping stage). With only a single-section conduit mast, the wire loop (at the very top) is 16-18 feet above the ground. On 6 meters that's nearly a full wavelength, making this a "no compromise" gain antenna that doesn't need to be rotated. See text. (NT0Z Photo)

two-wavelength horizontal loop to position the loop at least 16 feet high, which is almost one wavelength at 50 MHz (see photo).

Vertical antennas (an often excellent answer to the extreme height requirements for dipoles and Vs) are tremendously influenced by soil conductivity and radial configurations. Every antenna is influenced by nearby environmental objects, which is another reason to ignore the expected radiation patterns of antennas in attics,

Having trouble finding a variable capacitor that will handle 15,000 V for your latest QRO magnetic loop antenna? Bob Leschyna VE3UK, of Lakeshore, Ontario, did, too, so he had to build one (and enlist his son, Mason VE3SG, to model it)! (VE3UK photo)

next to buildings, etc. They're just not accurate.

There are endless factors that influence antenna performance if we dig deep enough, and some hams and engineers spend entire lifetimes peeling away the layers of this very complex situation. The low-hanging fruit, however, is easy to identify: If you're concerned about making consistent, non-local contacts on the HF bands, physically small antennas mounted close to the ground are *the worst possible choices*! If other options exist, *try them first*!

❖ Portable Antennas at Home—Why?

The Buddipole and the AlexLoop are designed for portable operation, and they work perfectly well in that context. If you've hiked to the top of a 7,000-foot summit, a well-made, self-contained, easy to deploy antenna system will easily put QSOs in the log (especially if there are no trees or other structures that might support an antenna). But in the same way that you could cook Sunday dinner on a Sterno-powered backpacking stove, why would you forego the much more capable conventional stove in your kitchen?

Beginners are especially vulnerable to the exciting stories told by swashbuckling, adventurous hams, so why wouldn't they want to use one of these nifty little antennas at home and bask in some of that glory? Well, the laws of physics, for starters! An empty pocketbook, for another!

So, in response to the forum query about which antenna to use at home, as a beginning ham with a QRP transceiver, which read, "Buddipole or AlexLoop?," I heartily say, "Neither!", unless other potentially better-performing and less expensive options have been exhausted!

Any antenna, even a horribly inefficient one, works pretty well on top of a 7,000-foot "tower." Many hams have "accidentally" made contacts while using dummy loads as antennas. And in the July 2000 issue of *QST*, N6BT showed how he worked hams on *every continent* on 10 meters by running 100 W to a light bulb mounted on a four-foot-tall wooden post. He used a ferrite choke balun to isolate the coaxial feed line from the antenna, which was essentially the tungsten filament of the light bulb! Even though some RF energy undoubtedly radiated from the coax, he made a compelling point!

Gooch's Paradox (RF Gotta Go Somewhere!) is appropriate here, and whatever your antenna, some RF will be radiated. But why shoot yourself in the foot if you don't have to? As a lifelong QRPer, who's had to use indoor antennas for the past decade, I'm all too familiar with how well "compromise" antennas work (or don't). If I had any chance at all to put up a conventional antenna, say a multiband dipole fed with ladder line, I'd take it in a heartbeat and save the sexy travel antennas for trips and outings.

If however, because of deed restrictions or iron-clad spousal decrees, a mag loop or a travel antenna turns out to be your best (or only) option, by all means use it at your home QTH (and on the road). Any antenna is better than no antenna, an even an 80-meter vehicle whip is way better than a light bulb!

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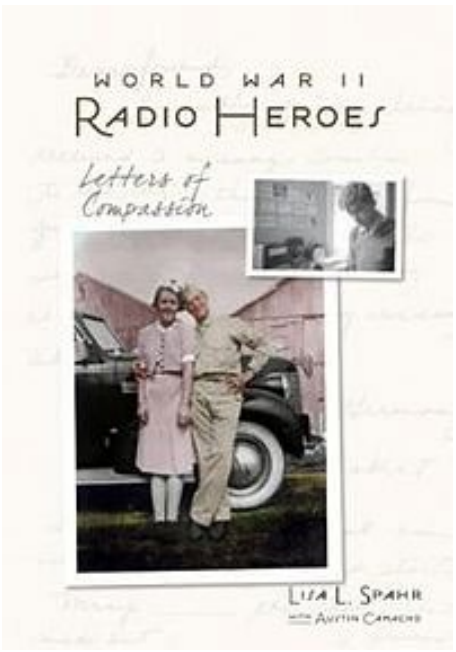
WWII Radio Heroes and Whatever Happened to 2 Meters?

It's been said that shortwave broadcasting was a precursor of today's Internet and social media. While telephone service was widespread by the time of the Second World War, not everyone had a phone and long-distance calls were prohibitively expensive. And, even though local radio stations may have been part of a national network such as NBC, CBS or Mutual, people who wanted to know the news firsthand listened via shortwave radio.

During World War II international shortwave broadcasting became the best way in North America to follow the progress of the war. It was during this time that the BBC earned its reputation for global reporting. The Axis were active on the shortwave bands as well. One such effort by Nazi propagandists attempted to demoralize those back home by regularly running shortwave programs in English, and aimed at North American audiences, that featured interviews with American Prisoners of War (POWs).

Instead of demoralization, avid shortwave listeners turned the propaganda into a home-front morale booster, taking it upon themselves to contact the families of those interviewed in an effort to alert them to the fact that their loved ones were in fact still alive, though prisoners. Contact was done through the use of penny postcards and three cent letters.

Author Lisa L. Spahr's grandfather, known to her as Pappy, had been such a POW. She accidentally discovered the role that U.S. shortwave listeners (SWLs) and hams (who were prohibited from transmitting for the duration of the war, but were avid SWLs) had played in telling of her grandfather's imprisonment. Her discovery came after sifting through the contents of her late grandfather's "war trunk," an attic repository of his WWII memorabilia.



WWII Radio Heroes: Letters of Compassion, second edition. (Courtesy: Lisa L. Spahr)

Among the contents she found were not only letters he received from home, as well as letters he wrote to his anxious family, but dozens of letters from people no one in the family had ever heard of before. She writes about how the family knew of his capture:

"The word of Pappy's capture was relayed to my great-grandmother, Martha, in two ways: a telegram from the War Department received May 8, 1943 at 6:09 a.m., and 83 postcards and letters from radio listeners all across the country, the first of which was postmarked on May 8, 1943 at 5:30 p.m. – *the same day as the official telegram!*"

The back cover of the book reprints that first postcard to Ms. Spahr's great-grandmother from a complete stranger who was also a compassionate letter writer:

"Your son Robert is a prisoner of war in Germany, captured in Tunisia. I heard this message tonight, on the shortwave broadcast from Germany…"

Similar broadcasts were made from Japan and, heard by hundreds of SWLs, relayed in detail to the families of those mentioned in the broadcasts. According to an article in the Minneapolis *Tribune*, excerpted in the book, one listener was so intent on getting all of the details, he bought a "recording machine" and, by the time the article was published, had 138 master recordings and 200 other transcriptions of such broadcasts. He had written some 450 letters to families.

Such private dedication was not unusual. The book tells of one such group of monitors in Ohio known as Short Wave Amateur Monitors (SWAM) who were organized to listen to specific programs at specific times and take notes on the POWs mentioned.

A woman from Sacramento who, "worked full-time as a secretary for the state, listened each night and took the messages down in shorthand, all 8,450 of them, and sent messages on to waiting families."

A New York man, monitoring the broadcasts, "sent more than 10,379 letters during the course of the war to POW families." Many, who didn't monitor and transcribe the messages, helped financially by providing postage, stationary, recording devices, radios or cash to help in the effort. Often such donations were noted in the letters to the POW families to let them know the extent of their support.

The messages, many of which are photographically reproduced in the books, are poignantly written in studied longhand with the plea that their intrusion into such a private tragedy not be misunderstood. Some write apologetically for "accidentally tuning into German broadcasts," in explaining how such information came to them. Many writers note that they themselves have family members missing in action and hope to receive similar letters of support in the future.

Ms. Spahr's attic discovery changed her life. With the original publication of the book in 2007 more information on more listeners and their activities came to her attention, so much so that a second edition has just been released that has doubled the size of the original book from 97 pages to 210. It's also led her on a quest to get Congressional recognition for the WWII-era shortwave monitors and amateur radio operators who participated in this effort. The book has a list, updated as of February 2013, of more than 280 such people. She also hopes to interest a filmmaker into producing a documentary on the subject and to interest Hollywood in using this story as the basis of a movie.

WWII Radio Heroes is a glimpse into the less publicized side of WWII-era shortwave radio and an extraordinary look at the resourcefulness and compassion of ordinary Americans who set up an *ad hoc* social network, long before those words were ever coined, to aid families on the home front, in their desperate time.

World War II Radio Heroes: Letters of Compassion Second Edition ($16, paperback) is priced at $13.36 with free shipping on Amazon. A preview of the Kindle edition of this book ($9.99) and additional paperback ordering information may be found here:
www.amazon.com/World-War-Radio-Heroes-Compassion/dp/0976218178

Midland 75-822 CB radio with WX radio ($80). Is this the only way to know what local traffic conditions are like? (Courtesy: Midland Radio)

Meida interviews with the author and other material is updated regularly at her website **www.powletters.com**. Ms. Spahr may be reached at author@powletters.com.

❖ Whatever Happened to 2 Meter Repeaters?

When I was first licensed in 1988 (as KC-4GQA) the Novice Enhancement program was new and allowed Novice licensees voice privileges on HF for the first time. We were given a portion of 10 meters just at the time of some of the best solar activity ever. Morning openings into Europe and Africa, afternoon chats across all of the U.S. and Canada and evening openings into the Pacific, including Japan and Australia, were a daily occurrence in the summer of 1988. But, Novices were not allowed on VHF or UHF. For that, we had to upgrade to Technician Class.

FCC rules changed to allow Novices, upon receiving a Certificate of Successful Completion of Examination (CSCE) at the testing session, to immediately operate the nearest repeater signing with the /AT tacked to the call sign until the actual FCC license upgrade would arrive (usually one month later) in the mail. As a result, many a would-be Tech licensee came to the testing session with an HT juiced and loaded with the local repeater inputs. Every ham in every town knew when the testing sessions were over as rookie operators descended on the local repeaters, fumbling with their HTs and call signs.

The excitement was well deserved. Hams had earned special communications privileges not enjoyed by the general public that included using their mobile and HT 2 meter rigs to access phone patches installed in repeaters. This technology allowed them to make phone calls directly from their cars or anywhere they could take their HTs – unheard of 25 years ago except for the wealthy who had costly mobile phones installed in their upscale autos. Some repeaters had direct access to the local 911 call center that made hams a valuable police auxiliary, reporting accidents, downed trees, hazardous weather, etc.

Using tone-pads on the microphones of their mobile rigs or on the front of their HTs, hams could access other repeater functions, including voice mail storage, automated signal reports, time and temperature reports, cross-band linking and the possibility to link with other repeaters for extended coverage. It was pretty advanced stuff and the many local repeaters in our area were in active use.

Then came the cell phone, followed closely by cheaper cell phones, followed by unlimited calling plans, that seemed to chase away the 2 meter activity. This was my own case. In the 1990s my wife got her Tech license just so that we could communicate during the daily commute and it was a useful tool in that respect. But, the minute that cell phones and their liberal calling plans became cheap enough, the 2 meter HT was abandoned (though the license has been faithfully renewed).

Theories abound on Web forums as to the cause of perceived inactivity on the repeaters. These range from the aforementioned increased cell phone use, but also include the increase in the number of repeaters that dilute participating hams by scattering them to more numerous 2 meter and 440 MHz area repeaters than ever. The proliferation of repeaters necessitated the use of access tones to keep nearby repeaters from interfering. Without knowing the tones used, some may have been excluded from using existing repeaters.

Some suggest that closed repeaters, where access is limited to club members, further dilutes the numbers. Some say that certain cliques of hams take over certain repeaters and non-clique members are discouraged from joining in. Others say that talking on a 2 meter repeater is simply too boring: Where's the action? Where's the DX? Where's the interest?

Another theory is that the advent of all-band, all-mode transceivers, has made it so that more hams are using more of the 2 meter band for simplex communications, including SSB, CW and digital modes and don't even need a repeater. New modes on HF have captured the interest of hams hams as well; a ham can't be on a 2 meter repeater and HF at the same time. And, the ever-so-slight uptick in sunspot activity has the DX bug biting again; hams who might otherwise be rag-chewing on the repeater have joined the DX pile-ups.

Another suggested reason for inactivity is that in-car audio options are so numerous and so interesting, compared to 15 years ago, that even licensed hams would rather be listening to Web-based radio streaming, Sirius/XM satellite radio, podcasts and Audible.com.

Recently, just as I got onto an Interstate highway to get into town, I was forced to a complete stop in a traffic jam. We were stopped for so long that folks got out of their cars and walked dogs along the median strip. I flipped through the local repeaters: nothing. To my chagrin, had I bothered to bring along the CB, I could have known long before not to get on the Interstate, but to take an alternate route.

I thought at the time, "Would it be so hard to have a ham club organize a group to stand watch, at least during daylight hours, monitoring the action on a scanner, CB 19 and web-based traffic-cams, and to give directions to local tourist sites to hams passing through?" Wouldn't such a plan automatically bring a local repeater back to life? I'll bet the state Department of Transportation would even put up a sign: Traffic and Tourist info: 146.76 MHz. Non-hams could listen in with a scanner.

What about where you live? Is 2 meter repeater activity down, compared to previous years, where you are? If so, why? In my area, hours can go by before any traffic, other than the automatic repeater ID, is heard on some of the half-dozen repeaters. Is it the case where you live? Let me know at *editor@monitoringtimes.com.*

Alinco DJ-V57T 2 meter/440 cm HT ($130). Can't 2 meter repeaters be used to monitor local traffic conditions in your city? (Courtesy: Universal Radio)

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www.doghousecharlie.com/radio

Cold War Remnants and New SW Voices

I miss the Cold War. Yeah, I'm the one. One of the joys of listening to the shortwave bands in the "good old days" was listening to the over-the-top rhetoric from Tirana, Albania and Pyongyang, North Korea (among others). Tirana was especially "fun." Enver Hoxha's regime never really got over its crush on Joseph Stalin. The propaganda was heavy-handed and spread with a big trowel.

One of the more interesting listening experiences took place in 1978. I had become interested in politics at that time and wrote a letter to each of the then major political parties in Canada. Two contacted me in person: The Progressive Conservatives and the Marxist-Leninists! The Marxist chap came over to the house and I turned on **Radio Tirana** for him. He was thrilled. I was amused, which made him less than thrilled. Oh well.

Back in the Cold War days, there was a whole science of "Kremlinology," people would read the tea leaves as it were, trying to figure out who was ascendant in the power structure by where they were placed in group photos, how often they were mentioned, and in what context. A lot of this is done today in regards to North Korea, or as I call it, The Land of the Rising Grandson. In today's world, the **Voice of Korea** in Pyongyang is among the last of the old Cold War propaganda outlets. Give it a shot at 1000 UTC on 11710 kHz or at 1300 UTC on 9435 and 11710 kHz.

Map of South Korea (Courtesy: cia.gov)

Sadly, I find reception to be very poor in my location, so it is rare indeed when I manage to hear this station. In the meantime, I try to listen to their counterparts across the DMZ in Seoul for news of this often tense region in order to figure out what is happening in the North.

KBS World Radio still maintains a service to North America at 1300 UTC on 15575 kHz. The one hour program in English has a number of very good features. For those interested in the geo-political issues of the Korean Peninsula, tune in to **KBS World News** at the top of the hour weekdays. One should also check out *Korea, Today and Tomorrow* in the last 15 minutes of the UTC Thursday broadcast, and *Current Affairs in Focus* during the last 15 minutes of the Friday UTC broadcast.

Pop music, and Korea, are indelibly linked. There are not too many people who have not noted the phenomena of South Korean pop star Psy and his megahit "Gangnam Style." One of the best music programs on the shortwave bands originates in Seoul on UTC Sundays with *Korean Pop Interactive*. Each week the best of Korean pop music, or K-Pop, is presented. The music scene in Korea is a happening place. "Gangnam Style," like it or not, sure beats "The Song of Kim Il-Sung."

In June and July Keith Perron's **PCJ Media** was testing to Asia, Europe and North America. The test transmissions featured episodes of *Focus Asia Pacific* and *The Happy Station* program. Hopefully, by the time you read this, a regular schedule of transmissions of these popular programs will be in place. The *Happy Station* on **Radio Nederland** even pre-dated the Second World War, so it's nice to have it back on the air on shortwave. The June tests were heard on UTC Sundays from 1300 to 1400 UTC on 11835 kHz via Trincomalee, Sri Lanka beamed to Southeast and East Asia; from 1300 to 1400 UTC on 5955 kHz via Nauen to Europe; and from 0000-0200 UTC Monday June 10 on 9925 kHz via Nauen to North America. By all accounts the latter was well heard in the target area. Victor Goonetilleke noted that many reception reports were received for all transmissions. In an age when many broadcasters are abandoning shortwave, it's nice to see some broadcasters still embracing the medium. Kudos to Keith Perron in Taiwan for his efforts in bringing quality programming to the shortwave bands.

At one time **Deutsche Welle** was a radio station which was very easily heard on shortwave in North America, for hours at a time. Today, not so much. DW still sends programs over the airwaves to Africa, and if the radio gods are willing, one can still hear lots of quality programming from this important nation in Europe.

The main program for the region is *AfricaLink*, a daily, 25 minute program featuring stories to and about Africa. In June, the program covered the concerns about the health of former South African President Nelson Mandela and the difficulties faced by journalists trying to cover the story. Foreign media have few local contacts or sources and they overcome major and minor inconveniences to try to "get the story." The ethics of some of the coverage was also talked about. As the program host mentioned, the discussion was reluctantly turning to Mandela's legacy, interviewing Ethiopian and South African academics about his place in history.

Another major story featured in the program was about the negotiations between the Malian government and the Tuareg rebels who have been fighting in the north of the country. The question was raised as to whether the current treaty would allow elections to go forward in the country in July and August. The situation is complicated because neither the separatists nor the government can claim to speak for all people in their respective regions.

World Day Against Child Labor was highlighted, with interviews with a Ghanaian politician. In the last few minutes of the program, titled *Opinion*, listeners are invited to text, email, phone, or send a letter to the program in response to the opinion question. One such question was "Should Nelson Mandela's doctors be allowed to brief the world on his condition?" As discussed in the program, news was being tightly controlled by ruling African National Congress (ANC) officials.

Africa rarely gets the coverage it deserves, unless as the old saying goes, "If it bleeds, it leads." This is a fantastic program. The Malian flies under the radar in North America as do too many other stories of this region. Tune in to **Deutsche Welle's** *AfricaLink* at five minutes past the hour during **DW** weekday broadcasts to Africa. Between 1900 and 2200 UTC, try 11800, 11865, 12070 and 15275 kHz (19-20 UTC for the later frequency).

Another **DW** program, which was once quite popular, is *Pulse*, the "youth culture" magazine. Each program packs a lot into thirty minutes. An edition in June featured the experiences of German-born Turks who are travelling to Turkey for the first time. The children and grand-children of Turkish guest workers of the 70s and 80s are returning to Turkey in increasing numbers.

Other stories included the attraction to Germany of international students due to the abundance of research money, the private sponsorship of German universities, and the heart-warming story of a 16-year old Vietnamese wheelchair-bound girl who won the *Vietnam's Got Talent* competition. Whether you are young, or young at heart, the program has a lot to offer for all listeners. You can hear it UTC Tuesdays on the half-hour, after the aforementioned *AfricaLink*.

VoA sports presenter, Sonny Young. (Courtesy: voanews.gov)

Speaking of broadcasts to Africa, a fun program to listen to for sports fans, is the **Voice of America's** *Sonny Side of Sports*. Listen to the *Sonny Side of Sports* during *Africa News Tonight* weekdays at 1630 and 1830 UTC, and an expanded half hour edition on Fridays at 1730 UTC. Sonny Young has hosted the program since 1999 and has become, in my mind, the Willis Conover of sports. When I think **VoA** sports, I think of Sonny Young. He makes listening to the sports results fun! At the same time, he is very professional; bringing a wealth of knowledge and enthusiasm to the African and world sports scene. Check out the *Sonny Side of Sports* and see what you think! Try for it on 15580 kHz.

Gayle Van Horn, W4GVH
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QSLs on Parade

A.J. Janitschek, Director of Radio Free Asia's Program and Operations Support, reminds our *MT* readers, there's still time to add to your QSL card collection. The card highlights the International Broadcasting Bureau (IBB) transmitter site in Saipan, used for RFA programs. RFA programs are also broadcasts from IBB sites in Biblis (Germany), Iranawilla (Sri Lanka), Kuwait, Lamertheim (Germany) and Tinian (Northern Mariana Islands). The 7.4 acre site has three curtain antennas which carry programming to China, Korea, Southeast Asia and Tibet. This edition is RFA's 50th QSL overall and will be used to confirm all valid RFA reception reports to August 31, 2013.

More information on Radio Free Asia, including the current broadcast frequency schedule is available at **www.rfa.orgRFA**. By-hour listings are included in *MT*'s monthly edition of MTXpress. Reception reports are encouraged and welcomed from listeners and may be submitted online by following the QSL Reports link at **http://techweb.rfa.org** or via email to: *qsl@rfa.org*. Postal reports can be mailed to: Reception Reports, Radio Free Asia, 2025 M. Street NW, Suite 300, Washington, D.C. 20036, USA.

Have an interesting QSL card to share with readers? Your QSL cards are always welcome in the pages of *Monitoring Times*. Images should be scanned at 300 dpi or higher to achieve a clear copy. E-QSLs are also accepted, and either method can be sent to me at *gaylemt@brmemc.net*. Information should include station frequency, length of time received, station address or station's email address. For those without scanning capabilities, your cards will be scanned and returned to you promptly. Send your cards to: *Monitoring Times*, QSL Report QSLs, 7540 Hwy 64 West, Brasstown, NC 28902.

AMATEUR RADIO

Canada-VE3DC, 7 and 14 MHz. Full data color Hamilton Amateur Radio Club card, signed by Rick. Received in a ARRL bureau packet. (Van Horn)

France-F4GHW, 10 MHz/JT65-mode. Full data color scenery/logo card, signed by Chris Bataille. Received in a ARRL bureau packet (Larry Van Horn, NC)

Greece-SV2CBN-21 MHz/JT65-mode. Full data color cartoon/logo card, signed by Philopimin Makotsis. Received in a ARRL bureau packet. (Van Horn)

LONGWAVE

Iceland-Gufuskálar 189 kHz. Blue letterhead page, signed by Sigrun Hermannsdottir, International Relations, plus noted envelope's Reykjavik postmark. Received in 35 days after several follow ups with enclosed CD of station's signal to the Chief Engineer. Station address: Icelandic National Broadcasting Service, Efstalete 1 IS, 150 Reykavik, Iceland (Patrick Martin, Seaside, OR)

MEDIUM WAVE

São Tomé e Principe, 1530 kHz AM, IBB Transmitting Station. Full data Pinheira E-QSL. Received in 20 days from Mrs. Helena de Menezes, Secretary at *hmenezes@sto.ibb.gov* Station address: IBB Relay Station São Tomé, Caixa Postal 522, São Tomé, São Tomé e Principe. (Al Muick, PA/HCDX)

WVBG, 1490 AM kHz. *Newstalk 1490*. No data hand-written letter, signed by Dailon Huskey, Operations Manager. Email: *dailon@vicksburgv105.com*. Received in 12 days for a SASE and an AM report on DX Test. Station address: 801 Clay Street Suite 3, Vicksburg, MS 39183 (or) P.O. Box 46, Vicksburg, MS 39181. (Bill Wilkins, Springfield, MO) Streaming audio at **www.newstalk1490.com**

NEW ZEALAND

Radio New Zealand International, 9700 kHz. Full data color E-QSL from Adrian Sainsbury, Frequency Manager. Received for an E-report to *info@rnzi.com* Station address: P.O. Box 123, Wellington, NZ . (Larry Zamora, Garland, TX) Streaming/on-demand audio **www.rnzi.com**

NORTHERN CYPRUS

Radio Bayrak International, 6150 kHz. Full data personal letter and card *The Best in the Nation*, signed by Mustafa Tosun, Department Head of Transmissions. Large envelope containing assortment of station souvenirs. Received in 472 days from initial report and 12 days from follow up. Station address: Radio Bayrak International. P.O. Box 417, Lefkasa via Mersi 10, Turkey. (Rich D'Angelo, PA/WWDXC-Top News) At editorial deadline, station reported as inactive on shortwave. Streaming audio available **www.brtk.net** and **www.brtk.eu**

PERU

Radio Cultura Amauta, 4955 kHz. No data confirmation email response from Germán Santillana. *radioamauta@hotmail.es* Received in nine days for a Spanish report, and mint postage. Station address: Jr. Cahuide 278, Huata (Casilla 24) Peru. (Muick).

UNITED ARAB EMIRATES

Radio Taiwan International relay via Abu Dhabi, 13620 kHz. Full data color Taiwan scenery card unsigned, noted as UAE relay. Broadcast schedule, report forms, pennant and postcards enclosed in packet. Received in 55 days for an English report. Station address: 55 Pei An Road, Taipei 10462, Taiwan (or) P.O. Box 123-199 Taipei 11199, Taiwan. (Sam Wright, Biloxi, MS) Streaming/on-demand audio **www.rti.org.tw**

UTILITY

International Waters-PHJU Stena Transit (RO-RO) 2187.5 kHz. Full data prepared QSL card stamped and signed. Received in 85 days for a utility report. QSL address: Stena Line, Postbus 2, 3150 AA Hoek van Holland, Netherlands. (Patrick Robic, Austria/UDXF)

Japan-JFC-Misaki Fishery Radio, 8616 kHz. Full data verification letter. Received in 26 days for a utility report. Station address: Kanagawa Prefectural Fishery Information Radio Station JFC, Kanagawa-ken Suisan Gijutsu Center, 1-7 Harumi-Machi, Mura-City, Kanagawa pre, 238-0232, Japan. (Robic).

Macedonia-PT Skopje, Non Directional Beacon, 295 kHz. Full data prepared card signed, and stamped as verified. Received in 46 days for a utility report. Station address: M-NAV, P.O. Box 9, 1043 Petrovec, Macedonia (Robic).

Montenegro-DAN, Non Directional Beacon, 312 kHz. Partial data E-QSL from Goran Kosutic, Systems Engineer/Navigation System. Received in 29 days for a utility report to *kl@smatsa.rs* (Robic)

WBII, USS Orleck Ship Museum, 14268 kHz USB. Partial data color USS Orleck certificate, signed by Donald J. Martin WA5VDM. Received in 38 days for a SWL report for Armed Forces Day special event. SASE, $1.00U.S and photo postcard. Station address: SW Louisiana ARC, Box 7244, Lake Charles, LA 70606 (Wilkins).

WUG-2B (former WUG-231) U.S. Corps of Engineers, 6823 kHz USB. Full data scenery card, signed by Jim Pogue. Received in 49 days for a SWL report for Armed Forces Day special event, SASE, and $1.00U.S. Station address: USACE Memphis District Office, Attention: Jim Pogue, Public Affairs Office, Rm. B-202, 167 N. Main St., Memphis, TN 3803-1894. (Wilkins).

WW2IND, Indiana War Memorial, 14270 kHz USB. Full data USS Indianapolis card, signed by Chuck Worell. Received in seven days for a SWL report for Armed Forces Day special event, SASE, $1.00US, and photo postcard. Station address: 41 N. Meridian, Indianapolis, IN 46204 (Wilkins).

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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Additional Contributors to This Month's Shortwave Guide:

Thank You to …

BCL News; Cumbre DX; DSWCI/DX Window; Hard-Core DX; DX Mix News 782-786; WWDX Club/Top News.

Alokesh Gupta, New Delhi, India; Babul Gupta, India; Derek Kickbush/Australia HCJB Global Voice; Drita Cico/R Tirana; Brenda Constantino/WYFR; Dan Elyea, WYFR; Nigel Holmes/R Australia; George Baxter/ R Australia; Zacharias Liangas, Thessaloniki, Greece; Georgi Bancov/Balkan DX; Ivo Ivanov, Bulgaria; Sean Gilbert UK/WRTH; Wolfgang Bueschel, Stuttgart, Germany

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	9965na		
0000 0030	USA, VO America	7430va	9790va	12015va 17820va
0000 0043	India, AIR/Natl Channel	9425do	9470do	
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 0100	Anguilla, Caribbean Beacon/Univ Net	6090ca		
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	China, China R International	6020as		6075as 6180as 7350as 7415as 9570na 11790as 11885as 13750as 15125as
0000 0100	China, Xizang PBS	4905do	4920do	6130do 7385do
0000 0100 1st fa	Finland, Scandinavian Weekend R	6170eu		
0000 0100	Germany, HCJB Germany	3995eu	7365eu	
0000 0100 Sun	Germany, Mighty KBC Radio	7375eu		
0000 0100	Germany, R 6150	6070eu		
0000 0100	Guatemala, R Verdad	4055do		
0000 0100	Guyana, Voice of Guyana	3290do		
0000 0100	Honduras, R Luz y Vida	3250do		
0000 0100	Malaysia, RTM/Traxx FM	7295do		
0000 0100	Micronesia, V6MP/Cross R/Pohnpei as	4755		
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	Solomon Islands, SIBC	9545do		
0000 0100	Spain, R Exterior de Espana	6055na		
0000 0100	Thailand, R Thailand World Svc	15275na		
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/Irondale AL	11520af		
0000 0100 twhfas	USA, WHRI Cypress Crk SC	5920va		
0000 0100	USA, WINB Red Lion PA	9265am		
0000 0100	USA, WRMI Miami FL	9955am		
0000 0100	USA, WTWW Lebanon TN	5085sa	5830na	
0000 0100	USA, WWCR Nashville TN	4840eu	5935af	6875eu 7520ca
0000 0100 irreg	USA, WWRB Manchester TN	3185na		3215na
0000 0100 Sun/irreg	USA, WWRB Manchester TN	5050na		
0030 0100	Australia, ABC/R Australia	17750va		
0030 0100 twhfa	Serbia, International R Serbia	9685na		
0030 0100	USA, VO America	9325va	15290va	
0030 0100	USA, WHRI Cypress Crk SC	7315ca		

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 Sun	Serbia, International R Serbia	9685na		
0100 0130	Vietnam, VO Vietnam/Overseas Svc	12005na		
0100 0200	Anguilla, Caribbean Beacon/Univ Net	6090ca		
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	China, China R International	6020as		6175eu 6180as 9410eu 9470eu 9535as 9570na 9580na 9675eu 11870as 15125as 15785as
0100 0200	China, Xizang PBS	4905do	4920do	6130do 7385do
0100 0200	Cuba, R Havana Cuba	5040ca	6000na	6165na
0100 0200 1st fa	Finland, Scandinavian Weekend R	6170eu		
0100 0200	Germany, HCJB Germany	3995eu	7365eu	
0100 0200 Sun	Germany, Mighty KBC Radio	7375eu		
0100 0200	Germany, R 6150	6070eu		
0100 0200	Guatemala, R Verdad	4055do		
0100 0200	Guyana, Voice of Guyana	3290do		
0100 0200	Honduras, R Luz y Vida	3250do		
0100 0200	Malaysia, RTM/Traxx FM	7295do		
0100 0200	Micronesia, V6MP/Cross R/Pohnpei as	4755		
0100 0200	New Zealand, R New Zealand Intl	15720pa		
0100 0200 DRM	New Zealand, R New Zealand Intl	17675pa		
0100 0200	Russia, VO Russia	9665ca		
0100 0200	Solomon Islands, SIBC	9545do		
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, Overcomer Ministry	3185na		
0100 0200	USA, VO America	7430va	9780va	15205as
0100 0200	USA, WBCQ Monticello ME	7490na		9330na
0100 0200 fas	USA, WBCQ Monticello ME	5110na		
0100 0200	USA, WEWN/Irondale AL	11520af		
0100 0200 twhfa	USA, WHRI Cypress Crk SC	5920va		
0100 0200	USA, WHRI Cypress Crk SC	9860na		
0100 0200	USA, WINB Red Lion PA	9265am		
0100 0200	USA, WRMI Miami FL	9955am		
0100 0200 irreg	USA, WRNO New Orleans LA	7506na		
0100 0200	USA, WTWW Lebanon TN	5085sa	5830na	9479na
0100 0200	USA, WWCR Nashville TN	3215eu	4840na	5935af 7520ca
0100 0200 irreg	USA, WWRB Manchester TN	3185na		3215na
0100 0200 Sun/irreg	USA, WWRB Manchester TN	5050na		
0130 0200 twhfas	Albania, R Tirana	9850va		
0130 0200 twhfa	USA, VO America	9820va		
0130 0200 mtwhf	USA, WRMI/R Slovakia Intl relay	9955am		
0140 0200	Vatican City State, Vatican R	11730as		15470as

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

0200 0230	Thailand, R Thailand World Svc	15275na		
0200 0230	USA, WRMI/R Prague relay	9955am		
0200 0300	Anguilla, Caribbean Beacon/Univ Net	6090ca		
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	China, China R International			11770as
	13640as			
0200 0300	China, Xizang PBS	4905do		4920do
	6130do	7385do		
0200 0300	Cuba, R Havana Cuba	6000na		6165na
0200 0300	Egypt, R Cairo	9720na		
0200 0300 1st fa	Finland, Scandinavian Weekend R			6170eu
0200 0300	Germany, HCJB Germany	3995eu		7365eu
0200 0300	Germany, R 6150	6070eu		
0200 0300	Guatemala, R Verdad	4055do		
0200 0300	Guyana, Voice of Guyana	3290do		
0200 0300	Honduras, R Luz y Vida	3250do		
0200 0300	Malaysia, RTM/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	Philippines, R Pilipinas Overseas Svc			11880me
	15285me	17820me		
0200 0300	Russia, VO Russia	9665ca		
0200 0300	Solomon Islands, SIBC	9545do		
0200 0300	South Korea, KBS World R			9580sa
	9690as			
0200 0300	UK, BBC World Service	15310as		17790as
0200 0300	USA, AFN/AFRTS	4319usb		5765usb
	12759usb	13362usb		
0200 0300	USA, Overcomer Ministry	3185na		5890va
0200 0300	USA, WBCQ Monticello ME			7490na
	9330na			
0200 0300 fas	USA, WBCQ Monticello ME			5110na
0200 0300	USA, WEWN/Irondale AL	11520af		
0200 0300	USA, WHRI Cypress Crk SC			5920va
	7315ca	9860na		
0200 0300	USA, WINB Red Lion PA	9265am		
0200 0300	USA, WRMI Miami FL	9955am		
0200 0300 irreg	USA, WRNO New Orleans LA			7506na
0200 0300	USA, WTWW Lebanon TN	5085sa		5830na
0200 0300	USA, WWCR Nashville TN	3215eu		4840na
	5890ca	5935af		
0200 0300 irreg	USA, WWRB Manchester TN			3185na
	3195na			
0200 0300 Sun/irreg	USA, WWRB Manchester TN			5050na
0215 0230	Nepal, R Nepal	5005do		
0215 0300	Myanmar, Myanma R	9731do		
0215 0300	Sri Lanka, SLBC	9770as		
0230 0300	India, AIR/Delhi	6030do		
0230 0300	India, AIR/Delhi	4870do		
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 0310	India, AIR/Delhi	6030do		
0300 0320	Vatican City State, Vatican R			15460as
0300 0325 Sun	Swaziland, TWR Africa	3200af		
0300 0330	Egypt, R Cairo	9720na		
0300 0330	India, AIR/Delhi	4870do		
0300 0330	Myanmar, Myanma R	5985do		
0300 0330	Philippines, R Pilipinas Overseas Svc			11880me
	15285me	17820me		
0300 0330	Sri Lanka, SLBC	9770as		
0300 0330	Vatican City State, Vatican R			7360af
	9660af			
0300 0356	Romania, R Romania Intl	7350na		9645na
	17830as			
0300 0356 DRM	Romania, R Romania Intl	15340as		
0300 0400	Anguilla, Caribbean Beacon/Univ Net			
	6090ca			
0300 0400	Australia, ABC/R Australia	9660va		15160pa
	15415va	17750va		21725va
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	China, China R International			9690am
	9790na	11770as	13750as	15110as
	15120as	15785as		
0300 0400	China, Xizang PBS	4905do		4920do
	6130do	7385do		
0300 0400	Cuba, R Havana Cuba	6000na		6165na
0300 0400 1st fa	Finland, Scandinavian Weekend R			6170eu
0300 0400	Germany, R 6150	6070eu		
0300 0400	Guatemala, R Verdad	4055do		
0300 0400	Guyana, Voice of Guyana	3290do		
0300 0400	Honduras, R Luz y Vida	3250do		
0300 0400	Malaysia, RTM/Traxx FM	7295do		
0300 0400	Micronesia, V6MP/Cross R/Pohnpei			4755
	as			
0300 0400	New Zealand, R New Zealand Intl			15720pa
0300 0400 DRM	New Zealand, R New Zealand Intl			17675pa
0300 0400	Russia, VO Russia	9665ca		
0300 0400	Solomon Islands, SIBC	9545do		
0300 0400 mtwhf	South Africa, Channel Africa			3345af
	5980af			
0300 0400	Taiwan, R Taiwan Intl	6115as		15320as
0300 0400	Turkey, VO Turkey	6165as		9515va
0300 0400	UK, BBC World Service	12095as		15365as
0300 0400	USA, AFN/AFRTS	4319usb		5765usb
	12759usb	13362usb		
0300 0400	USA, Overcomer Ministry	3185na		5890va
0300 0400	USA, VO America	4930af		6080af
	9885af			
0300 0400	USA, WBCQ Monticello ME			7490na
	9330na			
0300 0400	USA, WEWN/Irondale AL	11520af		
0300 0400	USA, WHRI Cypress Crk SC			7385na
	9825eu			
0300 0400	USA, WRMI Miami FL	9955am		
0300 0400 irreg	USA, WRNO New Orleans LA			7506na
0300 0400	USA, WTWW Lebanon TN	5085sa		5830na
0300 0400	USA, WWCR Nashville TN	3215eu		4840na
	5890ca	5935af		
0300 0400 irreg	USA, WWRB Manchester TN			3185na
	3195na			
0300 0400 Sun/irreg	USA, WWRB Manchester TN			5050na
0330 0400	Iran, VOIRI/VO Justice	13650eu		15470eu
0330 0400	Vietnam, VO Vietnam/Overseas Svc			6175na

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

0400 0427	Iran, VOIRI/VO Justice	13650eu		15470eu
0400 0430	USA, WHRI Cypress Crk SC			7385na
0400 0457	Germany, Deutsche Welle	9470af		12045af
0400 0457	North Korea, VO Korea	7220as		9445as
	9730as	11735ca	13760sa	15180sa
0400 0458	New Zealand, R New Zealand Intl			15720pa
0400 0458 DRM	New Zealand, R New Zealand Intl			17675pa
0400 0500	Anguilla, Caribbean Beacon/Univ Net			
	6090ca			
0400 0500	Australia, ABC/R Australia	9660va		12080pa
	15160pa	15240va	15415va	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	China, China R International			13750as
	15120as	15785as	17730va	17855va
0400 0500	China, Xizang PBS	4905do		4920do
	6130do	7385do		
0400 0500	Cuba, R Havana Cuba	6000na		6165na
0400 0500 1st fa	Finland, Scandinavian Weekend R			6170eu
0400 0500	Germany, Deutsche Welle	5905af		
0400 0500	Germany, R 6150	6070eu		
0400 0500	Guatemala, R Verdad	4055do		
0400 0500	Guyana, Voice of Guyana	3290do		
0400 0500	Malaysia, RTM/Traxx FM	7295do		
0400 0500	Micronesia, V6MP/Cross R/Pohnpei			4755 as

0400 0500	Solomon Islands, SIBC	9545do
0400 0500 mtwhf	South Africa, Channel Africa	3345af
0400 0500	UK, BBC World Service	11940af 12095as 15365as 15420af
0400 0500 DRM	UK, BBC World Service	3955eu
0400 0500	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
0400 0500	USA, Overcomer Ministry	3185na 5890va
0400 0500	USA, VO America	4930af 4960af 6080af 9885af 12025af
0400 0500	USA, WBCQ Monticello ME	9330na
0400 0500	USA, WEWN/Irondale AL	11520af
0400 0500	USA, WHRI Cypress Crk SC	9825me
0400 0500	USA, WRMI Miami FL	9955am
0400 0500	USA, WTWW Lebanon TN	5830na
0400 0500	USA, WWCR Nashville TN	3215eu 4840na 5890ca 5935af
0400 0500 irreg	USA, WWRB Manchester TN	3185na
0400 0500 irreg	Zimbabwe, VO Zimbabwe	4828af
0430 0500 mtwhf	Swaziland, TWR Africa	3200af
0430 0500	USA, VO America	4930af 4960af 6080af 12025af
0455 0500 irreg	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 0530	Germany, Deutsche Welle	9800af 15275af
0500 0530	Japan, R Japan/NHK World	5975as 11970af
0500 0530	Vatican City State, Vatican R	11625af 13765af
0500 0557	North Korea, VO Korea	13650as 15105as
0500 0600	Anguilla, Caribbean Beacon/Univ Net	6090ca
0500 0600	Australia, ABC/R Australia	9660va 12080pa 13630pa 15415va 21725va
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	China, China R International	11710af 11895as 15465as 15350as 17505va 17730va 17855va
0500 0600	China, Xizang PBS	4905do 4920do 6130do 7385do
0500 0600	Cuba, R Havana Cuba	6010na 6060na 6125am 6165na
0500 0600 1st Sat	Finland, Scandinavian Weekend R	5980eu
0500 0600	Germany, R 6150	6070eu
0500 0600	Guatemala, R Verdad	4055do
0500 0600	Guyana, Voice of Guyana	3290do
0500 0600	Malaysia, RTM/Traxx FM	7295do
0500 0600	Micronesia, V6MP/Cross R/Pohnpei as	4755
0500 0600 DRM	New Zealand, R New Zealand Intl	11675pa
0500 0600 irreg	Nigeria, VO Nigeria	15120af
0500 0600	Solomon Islands, SIBC	9545do
0500 0600 mtwhf	South Africa, Channel Africa	7230af
0500 0600 mtwhf	Swaziland, TWR Africa	4775af
0500 0600 Sat/Sun	Swaziland, TWR Africa	3200af 4775af
0500 0600	Swaziland, TWR Africa	9500af
0500 0600	UK, BBC World Service	3255af 5875af 6005af 6190af 7355af 11945af 15420af
0500 0600 DRM	UK, BBC World Service	3955eu
0500 0600	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
0500 0600	USA, Overcomer Ministry	3185na 5890va
0500 0600	USA, VO America	4930af 6080af 12025af 15580af
0500 0600	USA, WBCQ Monticello ME	9330na
0500 0600	USA, WEWN/Irondale AL	11520af
0500 0600	USA, WHRI Cypress Crk SC	9825me
0500 0600	USA, WRMI Miami FL	9955am
0500 0600	USA, WTWW Lebanon TN	5830na
0500 0600	USA, WWCR Nashville TN	3215eu 4840na 5890ca 5935af
0500 0600 irreg	USA, WWRB Manchester TN	3185na
0500 0600 irreg	Zimbabwe, VO Zimbabwe	4828af
0515 0530	Rwanda, R Rep Rwandaise	6055do
0530 0556	Romania, R Romania Intl	9700eu 17760pa 21500pa
0530 0556 DRM	Romania, R Romania Intl	11875eu
0530 0557	Germany, Deutsche Welle	9800af
0530 0600	Australia, ABC/R Australia	17750va
0530 0600 irreg	Congo Dem Rep, R Kahuzi	6210do
0530 0600	Germany, Deutsche Welle	15275af
0530 0600	Nigeria, FRCN Abuja	7275do
0530 0600	Thailand, R Thailand World Svc	17770eu
0535 0547	New Zealand, R New Zealand Intl	15720pa
0548 0600	New Zealand, R New Zealand Intl	11725pa

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	15440af 17800af
0600 0657	North Korea, VO Korea	7220as 9445as 9730as
0600 0700	Anguilla, Caribbean Beacon/Univ Net	6090ca
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	China, China R International	11710af 11870me 15140me 15350as 17505va 17710as
0600 0700	China, VO the South China Sea	13660as
0600 0700	China, Xizang PBS	4905do 4920do 6130do 7385do
0600 0700 irreg	Congo Dem Rep, R Kahuzi	6210do
0600 0700	Cuba, R Havana Cuba	6010na 6060na 6125am 6165na
0600 0700 1st Sat	Finland, Scandinavian Weekend R	5980eu
0600 0700 wa/irreg	Germany, Hamburger Lokalradio	7265eu
0600 0700	Germany, R 6150	6070eu
0600 0700	Guyana, Voice of Guyana	3290do
0600 0700	Malaysia, RTM/Traxx FM	7295do
0600 0700	Micronesia, V6MP/Cross R/Pohnpei as	4755
0600 0700 DRM	New Zealand, R New Zealand Intl	9890pa
0600 0700	New Zealand, R New Zealand Intl	11725pa
0600 0700	Nigeria, FRCN Abuja	7275do
0600 0700 irreg	Nigeria, VO Nigeria	15120af
0600 0700	Russia, VO Russia	21800pa 21820pa
0600 0700 DRM	Russia, VO Russia	11830eu
0600 0700	Solomon Islands, SIBC	9545do
0600 0700 mtwhf	South Africa, Channel Africa	7230af 15255af
0600 0700	Sudan, VO Africa/Sudan R	9505af
0600 0700	Swaziland, TWR Africa	4775af 6120af
0600 0700	UK, BBC World Service	6005af 6190af 7355af 9860af 12095af 15105af 15420af 17640af
0600 0700 DRM	UK, BBC World Service	5875eu 7325eu
0600 0700	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
0600 0700	USA, Overcomer Ministry	3185na 5890va
0600 0700	USA, VO America	6080af 12025af 15580af

0600 0700	USA, WBCQ Monticello ME	9330na
0600 0700	USA, WEWN/Irondale AL	11520af
0600 0700	USA, WHRI Cypress Crk SC	9825me
0600 0700	USA, WRMI Miami FL	9955am
0600 0700	USA, WTWW Lebanon TN	5830na
0600 0700	USA, WWCR Nashville TN	3215eu 4840na 5890ca 5935af
0600 0700 irreg	USA, WWRB Manchester TN	3185na
0600 0700 irreg	Zimbabwe, VO Zimbabwe	4828af
0615 0700 Sat	USA, WHRI Cypress Crk SC	9825me
0630 0645 mtwhfa	Vatican City State, Vatican R	15595me
0630 0700	Germany, Deutsche Welle	15440af 17800af
0630 0700	Vatican City State, Vatican R	13765af 15570af
0657 0700	Germany, TWR Europe	6105eu

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

0700 0730	Myanmar, Myanma R	5985do
0700 0745 Sat/Sun	Canada, Bible VO Broadcasting	5945eu
0700 0750	Austria, TWR Europe	7400eu
0700 0750	Germany, TWR Europe	6105eu
0700 0758	New Zealand, R New Zealand Intl	11725pa
0700 0758 DRM	New Zealand, R New Zealand Intl	9890pa
0700 0800	Anguilla, Caribbean Beacon/Univ Net	6090ca
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	China, China R International	11895as 13660as 13710eu 15350as 15465as 17480va 17490eu 17540as 17710as
0700 0800	China, Xizang PBS	4905do 4920do 6130do 7385do
0700 0800 irreg	Congo Dem Rep, R Kahuzi	6210do
0700 0800 1st Sat	Finland, Scandinavian Weekend R	5980eu
0700 0800 wa/irreg	Germany, Hamburger Lokalradio	7265eu
0700 0800	Germany, R 6150	6070eu
0700 0800	Guyana, Voice of Guyana	3290do
0700 0800	Malaysia, RTM/Traxx FM	7295do
0700 0800	Micronesia, V6MP/Cross R/Pohnpei as	4755
0700 0800	Nigeria, FRCN Abuja	7275do
0700 0800	Russia, VO Russia	13785as 17500as 21800pa 21820pa
0700 0800 DRM	Russia, VO Russia	11830eu
0700 0800	Solomon Islands, SIBC	5020do 9545do
0700 0800 mtwhf	South Africa, Channel Africa	9625af
0700 0800	Swaziland, TWR Africa	4775af 6120af 9500af
0700 0800	UK, BBC World Service	6190af 11770af 12095af 13660af 15400af 15420af 17640af 17830af
0700 0800 DRM	UK, BBC World Service	5875eu 7325eu
0700 0800	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
0700 0800	USA, Overcomer Ministry	3185na 5890va
0700 0800	USA, WBCQ Monticello ME	9330na
0700 0800	USA, WEWN/Irondale AL	11520af
0700 0800	USA, WRMI Miami FL	9955am
0700 0800	USA, WTWW Lebanon TN	5830na
0700 0800	USA, WWCR Nashville TN	3215eu 4840na 5890ca 5935af
0700 0800 irreg	USA, WWRB Manchester TN	3185na
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 0900	Anguilla, Caribbean Beacon/Univ Net	6090ca
0800 0900	Australia, ABC/R Australia	5995as 7410va 9475as 9580pa 9710va 11945va 12080pa 15240va
0800 0900	Bhutan, Bhutan BC Svc	6035do
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	China, China R International	11620as 11895as 13710as 15350as 15465as 17480va 17490eu 17540as
0800 0900	China, Xizang PBS	4905do 4920do 6130do 7385do
0800 0900 irreg	Congo Dem Rep, R Kahuzi	6210do
0800 0900 1st Sat	Finland, Scandinavian Weekend R	6170eu
0800 0900 Sat/Sun	Germany, Mighty KBC Radio	6095eu
0800 0900	Germany, R 6150	6070eu
0800 0900	Guyana, Voice of Guyana	3290do
0800 0900 Sat	Italy, IRRS Shortwave	9510va
0800 0900	Malaysia, RTM/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	Nigeria, FRCN Abuja	7275do
0800 0900 irreg	Nigeria, VO Nigeria	15120af
0800 0900 mtwhfs	Palau, T8WH/World Harvest R	9930as
0800 0900	Russia, VO Russia	13785as 17500as 21800va 21820pa
0800 0900 DRM	Russia, VO Russia	9850eu 11830eu
0800 0900	Solomon Islands, SIBC	5020do 9545do
0800 0900 Sun	South Africa, Amateur R Today	7205af 17660af
0800 0900 mtwhf	South Africa, Channel Africa	9625af
0800 0900	South Korea, KBS World R	9570as
0800 0900	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
0800 0900	USA, Overcomer Ministry	3185na 5890va
0800 0900	USA, WBCQ Monticello ME	9330na
0800 0900	USA, WEWN/Irondale AL	11520af
0800 0900 mtwhfs	USA, WHRI Cypress Crk SC	11565pa
0800 0900	USA, WRMI Miami FL	9955am
0800 0900	USA, WTWW Lebanon TN	5830na
0800 0900	USA, WWCR Nashville TN	3215eu 4840na 5890ca 5935af
0800 0900 irreg	USA, WWRB Manchester TN	3185na
0815 0830	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
0830 0900	India, AIR/External Svc	7250as 7340as 9595as 11620as
0850 0900 smtwhf	Singapore, TWR Asia	15200as

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

0900 0910	Pakistan, R Pakistan	11570eu 15265eu
0900 0930	Mongolia, VO Mongolia	12085as
0900 0930 smtwhf	Singapore, TWR Asia	15200as
0900 1000	Anguilla, Caribbean Beacon/Univ Net	6090ca
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	China, China R International	11620as 13790as 15270eu 15350as 17490eu 17570eu 17650pa 17750as

0900 1000	China, Xizang PBS	4905do 4920do 6130do 7385do
0900 1000 irreg	Congo Dem Rep, R Kahuzi	6210do
0900 1000 1st Sat	Finland, Scandinavian Weekend R	6170eu
0900 1000 Sat/Sun	Germany, Mighty KBC Radio	6095eu
0900 1000	Germany, R 6150	6070eu
0900 1000	India, AIR/External Svc	7250as 7340as 9595as 11620as
0900 1000	Malaysia, RTM/Traxx FM	7295do
0900 1000	Micronesia, V6MP/Cross R/Pohnpei as	4755
0900 1000 3rd Sun	Netherlands, XVRB/Music Museum	6045eu
0900 1000 DRM	New Zealand, R New Zealand Intl	9890pa
0900 1000	New Zealand, R New Zealand Intl	9700pa
0900 1000	Nigeria, FRCN Abuja	7275do
0900 1000 irreg	Nigeria, VO Nigeria	9690af
0900 1000	Palau, T8WH/World Harvest R	9930as
0900 1000	Russia, VO Russia	21800va 21820va
0900 1000 DRM	Russia, VO Russia	9850eu 11830eu
0900 1000	Solomon Islands, SIBC	5020do 9545do
0900 1000 mtwhf	South Africa, Channel Africa	9625af
0900 1000	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
0900 1000	USA, Overcomer Ministry	3185na 5890va
0900 1000	USA, WBCQ Monticello ME	9330na
0900 1000	USA, WEWN/Irondale AL	11520af
0900 1000 Sun	USA, WHRI Cypress Crk SC	11565pa
0900 1000	USA, WRMI Miami FL	9955am
0900 1000	USA, WTWW Lebanon TN	5830na
0900 1000	USA, WWCR Nashville TN	4840na 5890ca 5935af 15825eu
0900 1000 irreg	USA, WWRB Manchester TN	3185na
0930 1000 fs	China, VO the Strait	6115do
0930 1000 Sun	Italy, IRRS Shortwave	9510va
0930 1000	Saudi Arabia, BSKSA/External Svc	15250af

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

1000 1000	USA, KNLS Anchor Point AK	9655as
1000 1020 mtwhf	Singapore, TWR Asia	11840pa
1000 1030	Japan, R Japan/NHK World	9625as 9695as
1000 1030 Sat	Singapore, TWR Asia	11840pa
1000 1030	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as
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, Caribbean Beacon/Univ Net	11775ca
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	China, China R International	11610as 11620as 11635as 13590as 13620as 13720as 13790pa 15190as 15210pa 15350as 17490eu
1000 1100	China, Xizang PBS	4905do 4920do 6130do 7385do
1000 1100 irreg	Congo Dem Rep, R Kahuzi	6210do
1000 1100 1st Sat	Finland, Scandinavian Weekend R	6170eu
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	India, AIR/External Svc	7250as 7340as 9595as 11620as
1000 1100 irreg	Indonesia, VO Indonesia	9526pa
1000 1100 Sun	Italy, IRRS Shortwave	9510va
1000 1100	Malaysia, RTM/Traxx FM	7295do
1000 1100	Micronesia, V6MP/Cross R/Pohnpei	4755as
1000 1100	Nigeria, FRCN Abuja	7275do
1000 1100 irreg	Nigeria, VO Nigeria	9690af
1000 1100	Russia, VO Russia	11530as 12030as
1000 1100 DRM	Russia, VO Russia	9850eu
1000 1100	Saudi Arabia, BSKSA/External Svc	15250af
1000 1100	Solomon Islands, SIBC	5020do 9545do
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 5890va
1000 1100 Sat	USA, Overcomer Ministry	15420am
1000 1100	USA, WBCQ Monticello ME	9330na
1000 1100	USA, WEWN/Irondale AL	11520af
1000 1100 Sun	USA, WHRI Cypress Crk SC	11565pa
1000 1100 Sun	USA, WINB Red Lion PA	9265am
1000 1100	USA, WRMI Miami FL	9955am
1000 1100	USA, WTWW Lebanon TN	5830na
1000 1100	USA, WWCR Nashville TN	4840na 5890ca 5935af 15825eu
1000 1100 irreg	USA, WWRB Manchester TN	3185na
1030 1100	Iran, VOIRI	21505va 21640va
1059 1100	New Zealand, R New Zealand Intl	9700pa
1059 1100 DRM	New Zealand, R New Zealand Intl	9890pa

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

1100 1105	Pakistan, R Pakistan	11570eu 15265eu
1100 1115 mwh	Australia, HCJB Global Australia	15490as
1100 1127	Iran, VOIRI	21505va 21640va
1100 1130 Sun	Canada, Bible VO Broadcasting	21480as
1100 1130	India, AIR/External Svc	7250as 7340as 9595as 11620as
1100 1130 f/DRM	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 1200	Anguilla, Caribbean Beacon/Univ Net	11775ca
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 Sat	Canada, Bible VO Broadcasting	21480as
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	China, China R International	5955as 11660as 11795as 13650as 17490eu
1100 1200	China, Xizang PBS	4905do 4920do 6130do 7385do
1100 1200 irreg	Congo Dem Rep, R Kahuzi	6210do
1100 1200 1st Sat	Finland, Scandinavian Weekend R	6170eu
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/Traxx FM	7295do
1100 1200	Micronesia, V6MP/Cross R/Pohnpei	4755as
1100 1200	New Zealand, R New Zealand Intl	9700pa
1100 1200 DRM	New Zealand, R New Zealand Intl	9890pa
1100 1200	Nigeria, FRCN Abuja	7275do
1100 1200 irreg	Nigeria, VO Nigeria	9690af
1100 1200	Russia, VO Russia	11530as 12030as 15670as
1100 1200 DRM	Russia, VO Russia	9850eu
1100 1200	Saudi Arabia, BSKSA/External Svc	15250af

1100 1200	Solomon Islands, SIBC	5020do 9545do
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 5890va
1100 1200 Sat	USA, Overcomer Ministry	15420am
1100 1200	USA, WBCQ Monticello ME	9330na
1100 1200	USA, WEWN/Irondale AL	11520af
1100 1200 Sun	USA, WHRI Cypress Crk SC	7315ca
1100 1200 Sun	USA, WINB Red Lion PA	9265am
1100 1200	USA, WRMI Miami FL	9955am
1100 1200	USA, WTWW Lebanon TN	5830na
1100 1200	USA, WWCR Nashville TN	4840na 5890ca 5935af 15825eu
1100 1200 irreg	USA, WWRB Manchester TN	3185na
1115 1145 f	Canada, Bible VO Broadcasting	21480as
1130 1145 smtha	Australia, HCJB Global Australia	15490as
1130 1145 f	USA, Eternal Good News	15525as
1130 1200	Guatemala, R Verdad	4055do
1130 1200 f	Vatican City State, Vatican R	17590me 21560me
1130 1200	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as

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

1200 1225	Saudi Arabia, BSKSA/External Svc	15250af
1200 1230	Japan, R Japan/NHK World	9695af 11740as
1200 1259	New Zealand, R New Zealand Intl	9700pa
1200 1300	Anguilla, Caribbean Beacon/Univ Net	11775ca
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	China, China R International	6010as 9460as 9600as 9645as 9730as 11650as 11660as 11690va 11980as 13645as 13650eu 17490eu 17630eu
1200 1300	China, Xizang PBS	4905do 4920do 6130do 7385do
1200 1300 irreg	Congo Dem Rep, R Kahuzi	6210do
1200 1300	Ethiopia, R Ethiopia/Natl Svc	9705do
1200 1300 1st Sat	Finland, Scandinavian Weekend R	6170eu
1200 1300 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1200 1300	Germany, R 6150	6070eu
1200 1300	Guatemala, R Verdad	4055do
1200 1300	Malaysia, RTM/Traxx FM	7295do
1200 1300	Nigeria, FRCN Abuja	7275do
1200 1300 irreg	Nigeria, VO Nigeria	9690af
1200 1300 Sat/Sun	Palau, T8WH/World Harvest R	9930as
1200 1300	Papua New Guinea, R Fly	3915do 5960do
1200 1300	Russia, VO Russia	11530as 15670as
1200 1300	Solomon Islands, SIBC	5020do 9545do
1200 1300	UK, BBC World Service	5875as 6195as 9740as 11750as
1200 1300	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
1200 1300	USA, KNLS Anchor Point AK	7355as
1200 1300	USA, Overcomer Ministry	9370na 9980va
1200 1300	USA, VO America	7575va 9510va 12075va 12150va
1200 1300	USA, WBCQ Monticello ME	9330na
1200 1300	USA, WEWN/Irondale AL	15610eu
1200 1300	USA, WHRI Cypress Crk SC	9795am
1200 1300	USA, WRMI Miami FL	9955am
1200 1300	USA, WTWW Lebanon TN	5830na
1200 1300	USA, WWCR Nashville TN	7490af 9980ca 13845na 15825eu
1200 1300 irreg	USA, WWRB Manchester TN	3185na
1215 1300	Egypt, R Cairo	17870as
1230 1245 smtwhf	Australia, HCJB Global Australia	15340pa
1230 1300	Bangladesh, Bangla Betar	15105as
1230 1300	South Korea, KBS World R	6095as
1230 1300	Thailand, R Thailand World Svc	9390as
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	North Korea, VO Korea	9435na 11710na 13760eu 15245eu
1300 1400	Anguilla, Caribbean Beacon/Univ Net	11775ca
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	China, China R International	5955as 9570na 9730as 9760pa 9765va 9870as 11660as 11760pa 11980as 13610eu 13755as 17630eu
1300 1400	China, Xizang PBS	4905do 4920do 6130do 7385do
1300 1400 irreg	Congo Dem Rep, R Kahuzi	6210do
1300 1400 1st Sat	Finland, Scandinavian Weekend R	6170eu
1300 1400 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1300 1400	Germany, R 6150	6070eu
1300 1400	Guatemala, R Verdad	4055do
1300 1400 irreg	Indonesia, VO Indonesia	9526as
1300 1400	Malaysia, RTM/Traxx FM	7295do
1300 1400	New Zealand, R New Zealand Intl	6170pa
1300 1400	Nigeria, FRCN Abuja	7275do
1300 1400 irreg	Nigeria, VO Nigeria	9690af
1300 1400	Papua New Guinea, R Fly	3915do 5960do
1300 1400	Russia, VO Russia	12030as 15670as
1300 1400 DRM	Russia, VO Russia	9850eu
1300 1400	Solomon Islands, SIBC	5020do 9545do
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	USA, KJES Vado NM	11715na
1300 1400	USA, Overcomer Ministry	9370na 9980va
1300 1400 Sat/Sun	USA, VO America	7575va 9510va 12075va 12150va
1300 1400	USA, WBCQ Monticello ME	9330na
1300 1400	USA, WEWN/Irondale AL	15610eu
1300 1400 Sat/Sun	USA, WHRI Cypress Crk SC	9795am 9840na
1300 1400	USA, WRMI Miami FL	9955am
1300 1400	USA, WTWW Lebanon TN	9479na
1300 1400	USA, WWCR Nashville TN	7490af 9980ca 13845na 15825eu
1300 1400 irreg	USA, WWRB Manchester TN	9370na
1320 1400	India, AIR/Natl Channel	9425do 9470do
1330 1400 f	Clandestine, JSR Shiokaze	6020as
1330 1400	India, AIR/External Svc	9690as 11620as 13710as
1330 1400	Vietnam, VO Vietnam/Overseas Svc	9840as 12020as

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

1400 1425 mtf	Singapore, TWR Asia	15190as
1400 1430 f	Clandestine, JSR Shiokaze	6020as
1400 1430	Japan, R Japan/NHK World	11705af 15735as
1400 1430	Laos, Lao National R	6130as
1400 1430 h	Singapore, TWR Asia	15190as
1400 1430	Thailand, R Thailand World Svc	9950as
1400 1435 sw	Singapore, TWR Asia	15190as
1400 1445 Sun	USA, Pan Am Broadcasting	15205as
1400 1500	Anguilla, Caribbean Beacon/Univ Net	11775ca
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	China, China Natl R/CNR11	4905do 4920do 6130do
1400 1500	China, China R International	5955as 9765va 9870as 11665me 11675as 11765as 13710eu 13740na 17630eu
1400 1500	China, Xizang PBS	4905do 4920do 6130do 7385do
1400 1500 irreg	Congo Dem Rep, R Kahuzi	6210do
1400 1500 1st Sat	Finland, Scandinavian Weekend R	5980eu
1400 1500 wa/irreg	Germany, Hamburger Lokalradio	7265eu
1400 1500 Sat/Sun	Germany, Mighty KBC Radio	6095eu
1400 1500	Germany, R 6150	6070eu
1400 1500	Guatemala, R Verdad	4055do
1400 1500	India, AIR/External Svc	9690as 11620as 13710as
1400 1500	India, AIR/Natl Channel	9425do 9470do
1400 1500	Malaysia, RTM/Traxx FM	7295do
1400 1500	New Zealand, R New Zealand Intl	6170pa
1400 1500	Nigeria, FRCN Abuja	7275do
1400 1500 irreg	Nigeria, VO Nigeria	9690af
1400 1500	Oman, R Sultanate of Oman	15140eu
1400 1500	Russia, VO Russia	4960va 9900me 11530as 12030as 15670as
1400 1500	Solomon Islands, SIBC	5020do 9545do
1400 1500	South Korea, KBS World R	9640as
1400 1500	UK, BBC World Service	11890as 15310as
1400 1500 DRM	UK, BBC World Service	5845as
1400 1500	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
1400 1500	USA, KJES Vado NM	11715na
1400 1500	USA, Overcomer Ministry	9370na 9980va 13810va
1400 1500 mtwhf	USA, Overcomer Ministry	9655eu
1400 1500 fas	USA, Overcomer Ministry	9655eu
1400 1500 mtwhf	USA, VO America	7575va 12120as 12150va
1400 1500	USA, VO America	4930af 6080af 15580af
1400 1500	USA, WBCQ Monticello ME	9330na
1400 1500 Sat	USA, WBCQ Monticello ME	15420na
1400 1500	USA, WEWN/Irondale AL	15610eu
1400 1500 Sun	USA, WHRI Cypress Crk SC	9795am 9840na 21600af
1400 1500	USA, WINB Red Lion PA	13570am
1400 1500	USA, WJHR Intl Milton FL	15550usb
1400 1500 Sat/Sun	USA, WRMI Miami FL	9955am
1400 1500	USA, WTWW Lebanon TN	9479na
1400 1500	USA, WWCR Nashville TN	7490af 9980ca 13845na 15825eu
1400 1500 irreg	USA, WWRB Manchester TN	9370na
1415 1430	Nepal, R Nepal	5005do
1415 1430 mtwhfa	USA, Pan Am Broadcasting	15205as
1415 1500	India, AIR/External Svc	9910as 11670as
1420 1455	Swaziland, TWR Africa	6025af
1430 1500	Australia, ABC/R Australia	9475va 11835as
1430 1500 Sat	Canada, Bible VO Broadcasting	17495as
1430 1500	India, AIR/Delhi	4870do
1430 1500 Sun	Palau, T8WH/World Harvest R	15550as

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

1500 1530	Australia, ABC/R Australia	11835as 12065pa
1500 1530	Australia, HCJB Global Australia	15340pa
1500 1530	India, AIR/Delhi	4870do
1500 1530	India, AIR/External Svc	9910as 11670as
1500 1530 Sun	Italy, IRRS Shortwave	15190va
1500 1530	Vietnam, VO Vietnam/Overseas Svc	7285as 9840as 12020as
1500 1550	New Zealand, R New Zealand Intl	6170pa
1500 1557	North Korea, VO Korea	9435na 11710na 13760eu 15245eu
1500 1600	Anguilla, Caribbean Beacon/Univ Net	11775ca
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	Bhutan, Bhutan BC Svc	6035do
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	China, China R International	5955as 6095me 7325as 7395as 9720me 9800as 9870as 13640eu 13740na 15245eu
1500 1600	China, Xizang PBS	4905do 4920do 6130do 7385do
1500 1600 irreg	Congo Dem Rep, R Kahuzi	6210do
1500 1600 1st Sat	Finland, Scandinavian Weekend R	5980eu
1500 1600	Germany, R 6150	6070eu
1500 1600	Guatemala, R Verdad	4055do
1500 1600	India, AIR/Natl Channel	9425do 9470do
1500 1600	Malaysia, RTM/Traxx FM	7295do
1500 1600	Nigeria, FRCN Abuja	7275do
1500 1600 irreg	Nigeria, VO Nigeria	15120af
1500 1600	Russia, VO Russia	4960va 6185as 9900me
1500 1600	Solomon Islands, SIBC	5020do 9545do
1500 1600 mtwhf	South Africa, Channel Africa	9625af
1500 1600	UK, BBC World Service	7565as 9410as 11675as 11890as 12095as 15420af
1500 1600 DRM	UK, BBC World Service	5845as
1500 1600	USA, AFN/AFRTS	4319usb 5765usb 12759usb 13362usb
1500 1600	USA, KNLS Anchor Point AK	9920as
1500 1600	USA, Overcomer Ministry	9370na 9980va 13810va
1500 1600 mtwhf	USA, Overcomer Ministry	9655eu
1500 1600 fas	USA, Overcomer Ministry	9655eu
1500 1600	USA, VO America	4930af 6080af 7540va 7575va 12120va 12150va 15580va 17895va
1500 1600	USA, VO America	6140as 9400as 9760as
1500 1600	USA, WBCQ Monticello ME	9330na
1500 1600 Sat	USA, WBCQ Monticello ME	15420na
1500 1600	USA, WEWN/Irondale AL	15610eu
1500 1600	USA, WHRI Cypress Crk SC	17510eu
1500 1600	USA, WINB Red Lion PA	13570am
1500 1600	USA, WJHR Intl Milton FL	15550usb
1500 1600 Sat/Sun	USA, WRMI Miami FL	9955am
1500 1600	USA, WTWW Lebanon TN	9479na
1500 1600	USA, WWCR Nashville TN	9980ca 12160af 13845na 15825eu
1500 1600 irreg	USA, WWRB Manchester TN	9370na
1525 1555 Sat/Sun	Swaziland, TWR Africa	6025af
1530 1545	India, AIR/External Svc	9910as
1530 1550 smtwhf	Vatican City State, Vatican R	11850af 15110as

1530 1550 smtwhf/DRM Vatican City State, Vatican R 17550as
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, VOIRI 13780va 15515va
1530 1600 Mongolia, VO Mongolia 12015as
1530 1600 Myanmar, Myanma R 5985do
1530 1600 Sat Vatican City State, Vatican R 11850as 15110as 17550as
1551 1600 New Zealand, R New Zealand Intl 7330pa
1551 1600 DRM New Zealand, R New Zealand Intl 6135pa

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

1600 1627 Iran, VOIRI 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 Palau, T8WH/World Harvest R 15505as
1600 1630 Vietnam, VO Vietnam/Overseas Svc 7220me 7280eu 9550me 9730eu
1600 1650 DRM New Zealand, R New Zealand Intl 6135pa
1600 1650 New Zealand, R New Zealand Intl 7330pa
1600 1657 North Korea, VO Korea 9890va 11645va
1600 1700 Anguilla, Caribbean Beacon/Univ Net 11775ca
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 Bhutan, Bhutan BC Svc 6035do
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 China, China R International 6060as 7235as 9570af 11900af 11940eu 11965eu 13760eu 15250va
1600 1700 China, Xizang PBS 4905do 4920do 6130do 7385do
1600 1700 Clandestine, R Dialogue 12105af
1600 1700 irreg Congo Dem Rep, R Kahuzi 6210do
1600 1700 Egypt, R Cairo 15345af
1600 1700 irreg Ethiopia, R Ethiopia/Intl Svc 7235va 9560va
1600 1700 1st Sat Finland, Scandinavian Weekend R 5980eu
1600 1700 Germany, R 6150 6070eu
1600 1700 Guatemala, R Verdad 4055do
1600 1700 India, AIR/Natl Channel 9425do 9470do
1600 1700 Malaysia, RTM/Traxx FM 7295do
1600 1700 Nigeria, FRCN Abuja 7275do
1600 1700 Russia, VO Russia 4960va 6035as 6185as 9490as
1600 1700 Solomon Islands, SIBC 5020do 9545do
1600 1700 South Korea, KBS World R 9515eu 9640as
1600 1700 Taiwan, R Taiwan Intl 9440as 15485as
1600 1700 UK, BBC World Service 3255af 6190as 7565as 9410as 11675as 11890as 12095as 15420af 17640af 17830af
1600 1700 DRM UK, BBC World Service 5845as
1600 1700 USA, AFN/AFRTS 4319usb 5765usb 12759usb 13362usb
1600 1700 USA, Overcomer Ministry 9370na 9980va
1600 1700 USA, VO America 4930af 6080af 15580af
1600 1700 USA, VO America 11915va 13570af 15470va 17895va
1600 1700 USA, WBCQ Monticello ME 9330na
1600 1700 Sat USA, WBCQ Monticello ME 15420na
1600 1700 USA, WEWN/Irondale AL 15610eu
1600 1700 USA, WHRI Cypress Crk SC 21630af
1600 1700 USA, WINB Red Lion PA 13570am
1600 1700 USA, WJHR Intl Milton FL 15550usb
1600 1700 Sat/Sun USA, WRMI Miami FL 9955am
1600 1700 USA, WTWW Lebanon TN 9479na
1600 1700 USA, WWCR Nashville TN 9980ca 12160af 13845na 15825eu
1600 1700 irreg USA, WWRB Manchester TN 9370na
1600 1700 irreg Zimbabwe, VO Zimbabwe 4828af
1615 1630 Vatican City State, Vatican R 15595me
1630 1700 China, Xizang PBS 4905do 6200do
1630 1700 mwf Indonesia, AWR Asia/Pacific 15360as
1630 1700 m South Africa, Amateur R Today 3230af
1630 1700 Turkey, VO Turkey 15520as
1630 1700 mtwhf USA, VO America 11905af
1630 1700 mtwhf USA, VO America/S Sudan in Focus 9490af 11655af 13870af
1651 1700 New Zealand, R New Zealand Intl 730pa
1651 1700 DRM New Zealand, R New Zealand Intl 6135pa

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

1700 1710 irreg Congo Dem Rep, R Kahuzi 6210do
1700 1710 Pakistan, R Pakistan 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, Amateur R Today 3230af
1700 1730 Turkey, VO Turkey 15520as
1700 1730 Vietnam, VO Vietnam/Overseas Svc 9625eu
1700 1745 DRM New Zealand, R New Zealand Intl 6135pa
1700 1745 New Zealand, R New Zealand Intl 7330pa
1700 1756 DRM Romania, R Romania Intl 9535eu
1700 1756 Romania, R Romania Intl 11740eu
1700 1800 Anguilla, Caribbean Beacon/Univ Net 11775ca
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 China, China R International 6090as 6140as 6165me 7235as 7265af 7410as 7420as 9570as 9695eu 11900af 13570eu 13760eu
1700 1800 China, Xizang PBS 4905do 4920do 6130do 7385do
1700 1800 Clandestine, SW R Africa 4880af
1700 1800 Egypt, R Cairo 15345af
1700 1800 1st Sat Finland, Scandinavian Weekend R 5980eu
1700 1800 Germany, R 6150 6070eu
1700 1800 Guatemala, R Verdad 4055do
1700 1800 India, AIR/Natl Channel 9425do 9470do
1700 1800 Malaysia, RTM/Traxx FM 7295do
1700 1800 Nigeria, FRCN Abuja 7275do
1700 1800 Russia, VO Russia 4960va 6035as 6185as 9420as
1700 1800 DRM Russia, VO Russia 9820as
1700 1800 Solomon Islands, SIBC 5020do 9545do
1700 1800 mtwhf South Africa, Channel Africa 15235af
1700 1800 Sudan, VO Africa/Sudan R 9505af
1700 1800 Sat/Sun Swaziland, TWR Africa 3200af
1700 1800 Taiwan, R Taiwan Intl 15690af
1700 1800 UK, BBC World Service 3255af 6190 f 6195as 9410as 12095af 15400af 15420af 17795af 17830af
1700 1800 DRM UK, BBC World Service 5845as
1700 1800 USA, AFN/AFRTS 4319usb 5765usb 12759usb 13362usb
1700 1800 USA, Overcomer Ministry 9370na 9980va
1700 1800 USA, VO America 6080af 11795af 15580af 17895af
1700 1800 USA, WBCQ Monticello ME 9330na 15420na

1700 1800	USA, WEWN/Irondale AL	15610eu
1700 1800	USA, WHRI Cypress Crk SC	21630af
1700 1800	USA, WINB Red Lion PA	13570am
1700 1800	USA, WJHR Intl Milton FL	15550usb
1700 1800 Sat/Sun	USA, WRMI Miami FL	9955am
1700 1800	USA, WTWW Lebanon TN	9479na 9930sa
1700 1800	USA, WWCR Nashville TN	9980ca 12160af 13845na 15825eu
1700 1800 irreg	USA, WWRB Manchester TN	9370na
1700 1800 irreg	Zimbabwe, VO Zimbabwe	4828af
1720 1740 Sat/Sun	USA, VOA/Studio 7	4930af 5940af 15455af
1730 1800	Australia, ABC/R Australia	6080as
1730 1800	Philippines, R Pilipinas Overseas Svc	9915me 11720me 15190me
1730 1800 mtwh	USA, VOA/Studio 7	4930af 5940af 15455af
1730 1800	Vatican City State, Vatican R	11625af 13765af 15570af
1745 1800	Bangladesh, Bangla Betar	7250eu
1745 1800	India, AIR/External Svc	7550eu 9445va 9950eu 11580af 11670eu 11935af 13695af 17670af
1745 1800 mtwhf	Swaziland, TWR Africa	3200af
1746 1800	New Zealand, R New Zealand Intl	9615pa
1746 1800 DRM	New Zealand, R New Zealand Intl	6135as

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

1800 1805	China, Xizang PBS	4905do 4920do 6130do 7385do
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	USA, VO America	6080af 15580af 17895af
1800 1830 Sat/Sun	USA, VO America	4930af
1800 1830 f	USA, VOA/Studio 7	4930af 5940af
1800 1836	New Zealand, R New Zealand Intl	9615pa
1800 1836 DRM	New Zealand, R New Zealand Intl	6135pa
1800 1857	North Korea, VO Korea	13760eu 15245eu
1800 1900	Anguilla, Caribbean Beacon/Univ Net	11775ca
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, Bangla Betar	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	China, China R International	6175eu 9600eu 13760eu
1800 1900	Clandestine, SW R Africa	4880af
1800 1900 1st Sat	Finland, Scandinavian Weekend R	6170eu
1800 1900	Germany, R 6150	6070eu
1800 1900	Guatemala, R Verdad	4055do
1800 1900	India, AIR/External Svc	7550eu 9445va 9950eu 11580af 11670eu 11935af 13695af 17670af
1800 1900	India, AIR/Natl Channel	9425do 9470do
1800 1900 fas	Italy, IRRS Shortwave	7290va
1800 1900	Kuwait, R Kuwait	15540va
1800 1900	Malaysia, RTM/Traxx FM	7295do
1800 1900	Nigeria, FRCN Abuja	7275do
1800 1900 irreg	Nigeria, VO Nigeria	7255af
1800 1900	Philippines, R Pilipinas Overseas Svc	9915me 11720me 15190me
1800 1900	Russia, VO Russia	4960va 9900va
1800 1900	South Korea, KBS World R	7275eu
1800 1900 Sat/Sun	Swaziland, TWR Africa	3200af
1800 1900	Swaziland, TWR Africa	9500af
1800 1900	Taiwan, R Taiwan Intl	6155eu
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, Overcomer Ministry	9370na 9980va
1800 1900	USA, WBCQ Monticello ME	9330na 15420na
1800 1900	USA, WEWN/Irondale AL	15610eu
1800 1900	USA, WHRI Cypress Crk SC	9840na 21630af
1800 1900	USA, WINB Red Lion PA	13570am
1800 1900	USA, WJHR Intl Milton FL	15550usb
1800 1900 Sat/Sun	USA, WRMI Miami FL	9955am
1800 1900	USA, WTWW Lebanon TN	9479na 9930sa
1800 1900	USA, WWCR Nashville TN	9980ca 12160af 13845na 15825eu
1800 1900 irreg	USA, WWRB Manchester TN	9370na
1800 1900 irreg	Zimbabwe, VO Zimbabwe	4828af
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	9635as
1830 1900 irreg/DRM	Nigeria, VO Nigeria	15120af
1830 1900	Serbia, International R Serbia	6100eu
1830 1900	South Africa, AWR Africa	11840af
1830 1900	Turkey, VO Turkey	9785eu
1830 1900	USA, VO America	4930af 15580af
1830 1900 mtwhf	USA, VOA/Studio 7	5940af 15455af
1837 1900	New Zealand, R New Zealand Intl	9615pa
1837 1900 DRM	New Zealand, R New Zealand Intl	9630pa
1845 1900 irreg	Guinea, RTV Guinee	7125do

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

1900 1915 Sun	Canada, Bible VO Broadcasting	9635as
1900 1930	Germany, Deutsche Welle	11800af 11865af 15275af
1900 1930	Philippines, R Pilipinas Overseas Svc	9915me 11720me 15190me
1900 1930	Turkey, VO Turkey	9785eu
1900 1930	USA, VO America	4930af 9850af 15580va
1900 1930	Vietnam, VO Vietnam/Overseas Svc	7280eu 9730eu
1900 1945	India, AIR/External Svc	7550eu 9445eu 9950eu 11580af 11670eu 11935af 13695af 17670af
1900 1950	New Zealand, R New Zealand Intl	9615pa
1900 1950 DRM	New Zealand, R New Zealand Intl	9630pa
1900 1957	North Korea, VO Korea	7210af 9875va 11635va 11910af
1900 2000	Anguilla, Caribbean Beacon/Univ Net	11775ca
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	China, China R International	7295va 9435af 9440af
1900 2000	Egypt, R Cairo	15290af
1900 2000 1st Sat	Finland, Scandinavian Weekend R	6170eu
1900 2000	Germany, R 6150	6070eu
1900 2000	Guatemala, R Verdad	4055do
1900 2000	India, AIR/Natl Channel	9425do 9470do
1900 2000 irreg	Indonesia, VO Indonesia	9526eu
1900 2000	Kuwait, R Kuwait	15540va
1900 2000	Malaysia, RTM/Traxx FM	7295do
1900 2000	Micronesia, V6MP/Cross R/Pohnpei	4755as
1900 2000	Nigeria, FRCN Abuja	7275do

1900 2000 irreg	Nigeria, VO Nigeria	7255af		
1900 2000	Solomon Islands, SIBC	5020do	9545do	
1900 2000 mtwhf	Spain, R Exterior de Espana	11615af		9665eu
1900 2000	Swaziland, TWR Africa	3200af		
1900 2000	Thailand, R Thailand World Svc			9390eu
1900 2000	UK, BBC World Service	3255af	6190af	
	11810af	12095af	15400af	15420af
	17795af			
1900 2000	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
1900 2000	USA, Overcomer Ministry	9370na	9980va	
1900 2000	USA, VO America	7485va		
1900 2000	USA, WBCQ Monticello ME			15420na
1900 2000 at	USA, WBCQ Monticello ME			7490na
1900 2000	USA, WEWN/Irondale AL	15610eu		
1900 2000	USA, WHRI Cypress Crk SC			9840na
	21630af			
1900 2000	USA, WINB Red Lion PA	13570am		
1900 2000	USA, WJHR Intl Milton FL	15550usb		
1900 2000 Sat/Sun	USA, WRMI Miami FL	9955am		
1900 2000	USA, WTWW Lebanon TN	9479na	9930sa	
1900 2000	USA, WWCR Nashville TN	9980ca	12160af	
	13845na	15825eu		
1900 2000 irreg	USA, WWRB Manchester TN			9370na
1900 2000 irreg	Zimbabwe, VO Zimbabwe	4828af		
1905 1920 Sat	Mali, ORTM/R Mali	9635do		
1930 1957	Germany, Deutsche Welle	11865af	15275af	
1930 2000	Iran, VOIRI	9400eu	9715eu	11750af
	11885af			
1930 2000	South Africa, RTE R Worldwide			5820af
1930 2000 Sun	USA, Pan Am Broadcasting	9515af		
1930 2000	USA, VO America	4930af	15580as	
1951 2000 DRM	New Zealand, R New Zealand Intl			11675pa

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

2000 2020 tf	Belarus, R Belarus	7255eu	11730eu	
2000 2027	Iran, VOIRI	9400eu	9715eu	11750af
	11885af			
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, VO America	4930af	15580af	
2000 2030	Vatican City State, Vatican R			11625af
	13765af			
2000 2050 DRM	New Zealand, R New Zealand Intl			11675pa
2000 2057	Germany, Deutsche Welle	11865af		
2000 2100	Anguilla, Caribbean Beacon/Univ Net			
	11775ca			
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	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	China, China R International			5960eu
	5985af	7285eu	7295va	9440af
2000 2100	China, Xizang PBS	4905do	4920do	
	6130do	7385do		
2000 2100 f	Clandestine, JSR Shiokaze	6075as		
2000 2100	Cuba, R Havana Cuba	11760am		
2000 2100 1st Sat	Finland, Scandinavian Weekend R			6170eu
2000 2100	Germany, Deutsche Welle	11800af	12070af	
	15275af			
2000 2100	Germany, R 6150	6070eu		
2000 2100	Guatemala, R Verdad	4055do		
2000 2100	India, AIR/Natl Channel	9425do	9470do	
2000 2100	Kuwait, R Kuwait	15540va		
2000 2100	Malaysia, RTM/Traxx FM	7295do		
2000 2100	Micronesia, V6MP/Cross R/Pohnpei			4755as
2000 2100	New Zealand, R New Zealand Intl			11725pa
2000 2100	Nigeria, FRCN Abuja	7275do		
2000 2100	Solomon Islands, SIBC	5020do	9545do	
2000 2100 Sat/Sun	Spain, R Exterior de Espana			9570af
2000 2100	UK, BBC World Service	11810af	12095af	
	15400af			
2000 2100	USA, AFN/AFRTS	4319usb	5765usb	
	12759usb	13362usb		
2000 2100	USA, Overcomer Ministry	7490am	9370na	
	9980va			
2000 2100	USA, WBCQ Monticello ME			15420na
2000 2100 mtwhf	USA, WBCQ Monticello ME			7490na
2000 2100	USA, WEWN/Irondale AL	15610eu		
2000 2100 Sun	USA, WHRI Cypress Crk SC			17510va
2000 2100	USA, WINB Red Lion PA	13570am		
2000 2100	USA, WJHR Intl Milton FL	15550usb		
2000 2100 Sat/Sun	USA, WRMI Miami FL	9955am		
2000 2100	USA, WTWW Lebanon TN	9479na	9930sa	
2000 2100	USA, WWCR Nashville TN	9980ca	12160af	
	13845na	15825eu		
2000 2100 irreg	USA, WWRB Manchester TN			9370na
2000 2100 irreg	Zimbabwe, VO Zimbabwe	4828af		
2020 2100	Belarus, R Belarus	7255eu	11730eu	
2030 2045	Thailand, R Thailand World Svc			9390eu
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, VO America	4930af	6080af	
	15580af			
2030 2100 Sat/Sun	USA, VO America	4940af		
2030 2100	Vietnam, VO Vietnam/Overseas Svc			7220me
	7280eu	9550eu	9730eu	
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	Serbia, International R Serbia			6100eu
2100 2130	South Korea, KBS World R			3955eu
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	North Korea, VO Korea	13760eu	15245eu	
2100 2200 irreg	Angola, Angolan Natl R	7217af		
2100 2200	Anguilla, Caribbean Beacon/Univ Net			
	11775ca			
2100 2200	Australia, ABC/R Australia	9500va	9660va	
	11650va	11695va	13630pa	15515va
2100 2200	Belarus, R Belarus	7255eu	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	China, China R International			5960eu
	7205af	7285eu	7325af	7415eu
	9600eu			
2100 2200	China, Xizang PBS	4905do	4920do	
	6130do	7385do		
2100 2200	Egypt, R Cairo	11890eu		
2100 2200 1st fa	Finland, Scandinavian Weekend R			6170eu
2100 2200	Germany, Deutsche Welle	11800af	11865af	
	12070af			
2100 2200	Germany, R 6150	6070eu		
2100 2200	Guatemala, R Verdad	4055do		
2100 2200	India, AIR/External Svc	7550eu	9445eu	
	9910pa	11620pa	11670eu	11740pa
2100 2200 DRM	India, AIR/External Svc	9950eu		
2100 2200	India, AIR/Natl Channel	9425do	9470do	
2100 2200	Malaysia, RTM/Traxx FM	7295do		
2100 2200	Micronesia, V6MP/Cross R/Pohnpei			4755
	as			

2100 2200	Nigeria, FRCN Abuja	7275do	
2100 2200	Solomon Islands, SIBC	5020do	9545do
2100 2200 Sat/Sun	Spain, R Exterior de Espana		9570af
	9665eu		
2100 2200 mtwhf	UK, BBC World Service	9915af	11810af
	12095af		
2100 2200	USA, AFN/AFRTS	4319usb	5765usb
	12759usb	13362usb	
2100 2200	USA, Overcomer Ministry	7490am	9370na
	9980va		
2100 2200	USA, VO America	6080af	15580af
2100 2200 Sun	USA, WBCQ Monticello ME		7490na
2100 2200	USA, WEWN/Irondale AL	15610eu	
2100 2200 Sun	USA, WHRI Cypress Crk SC		17510va
2100 2200 m	USA, WINB Red Lion PA	9265am	
2100 2200	USA, WJHR Intl Milton FL	15550usb	
2100 2200 Sat/Sun	USA, WRMI Miami FL	9955am	
2100 2200	USA, WTWW Lebanon TN	9479na	9930sa
2100 2200	USA, WWCR Nashville TN	6875eu	9350af
	9980ca	13845na	
2100 2200 irreg	USA, WWRB Manchester TN		3215na
	9370na		
2100 2200 irreg	Zimbabwe, VO Zimbabwe	4828af	
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 2245	Egypt, R Cairo	11890eu	
2200 2256	Romania, R Romania Intl	7430eu	9540eu
	9790as	11940as	
2200 2300	Anguilla, Caribbean Beacon/Univ Net		
	6090ca		
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	China, China R International		9590as
2200 2300	China, Xizang PBS	4905do	4920do
	6130do	7385do	
2200 2300 1st fa	Finland, Scandinavian Weekend R		6170eu
2200 2300	Germany, R 6150	6070eu	
2200 2300	Guatemala, R Verdad	4055do	
2200 2300	Guyana, Voice of Guyana	3290do	
2200 2300	India, AIR/Natl Channel	9425do	9470do
2200 2300	Malaysia, RTM/Traxx FM	7295do	
2200 2300	Micronesia, V6MP/Cross R/Pohnpei		4755
	as		
2200 2300	New Zealand, R New Zealand Intl		15720pa
2200 2300 DRM	New Zealand, R New Zealand Intl		17675pa
2200 2300	Nigeria, FRCN Abuja	7275do	
2200 2300	Russia, VO Russia	9465ca	
2200 2300	Solomon Islands, SIBC	5020do	9545do
2200 2300	South Korea, KBS World R		11810eu
2200 2300	Turkey, VO Turkey	9830va	
2200 2300	USA, AFN/AFRTS	4319usb	5765usb
	12759usb	13362usb	
2200 2300	USA, Overcomer Ministry	7490am	9370na
	9980va		
2200 2300 smtwh	USA, VO America	5915va	7480va
	7575va	12150va	
2200 2300	USA, WBCQ Monticello ME		7490na
2200 2300	USA, WEWN/Irondale AL	15610eu	
2200 2300 Sat/Sun	USA, WHRI Cypress Crk SC		11775eu
2200 2300 Sat/Sun	USA, WRMI Miami FL	9955am	
2200 2300	USA, WTWW Lebanon TN	9479na	9930sa
2200 2300	USA, WWCR Nashville TN	6875eu	9350af
	9980ca	13845na	
2200 2300 irreg	USA, WWRB Manchester TN		3215na
	9370na		
2230 2300	China, Xizang PBS	4905do	
2230 2300	Indonesia, AWR Asia/Pacific		15320as
2230 2300	USA, VO America	5820va	7460va
	9570va		
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, Caribbean Beacon/Univ Net		
	6090ca		
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	China, China R International		5915as
	5990ca	7350eu	7410as 11690as
	11790as	11955as	
2300 0000	China, Xizang PBS	4905do	4920do
	6130do	7385do	
2300 0000	Cuba, R Havana Cuba	11880af	
2300 0000	Egypt, R Cairo	9965na	
2300 0000 1st fa	Finland, Scandinavian Weekend R		6170eu
2300 0000	Germany, R 6150	6070eu	
2300 0000	Guatemala, R Verdad	4055do	
2300 0000	Guyana, Voice of Guyana	3290do	
2300 0000	India, AIR/External Svc	6055as	9690as
	9705as	11710as	13605as
2300 0000 DRM	India, AIR/External Svc	11645as	
2300 0000	India, AIR/Natl Channel	9425do	9470do
2300 0000 c	Malaysia, RTM/Traxx FM	7295do	
2300 0000	Micronesia, V6MP/Cross R/Pohnpei		4755
	as		
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	Solomon Islands, SIBC	5020do	9545do
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, Overcomer Ministry	9370na	9980va
2300 0000	USA, VO America	5895va	7480va
	7575va	12150va	
2300 0000	USA, VO America	5820va	7460va
	9490va	11840va	
2300 0000	USA, WBCQ Monticello ME		7490na
2300 0000 Sat/Sun	USA, WBCQ Monticello ME		5110na
2300 0000	USA, WEWN/Irondale AL	15610eu	
2300 0000 Sat/Sun	USA, WHRI Cypress Crk SC		11775eu
2300 0000 mtwhfs	USA, WHRI Cypress Crk SC		7315ca
2300 0000 m	USA, WINB Red Lion PA	9265am	
2300 0000	USA, WTWW Lebanon TN	9479na	9930sa
2300 0000	USA, WWCR Nashville TN	6875eu	9350af
	9980ca	13845na	
2300 0000 irreg	USA, WWRB Manchester TN		3215na
	9370na		
2300 2305	Nigeria, FRCN Abuja	7275do	
2300 2315 smtwh	Moldova, R PMR/Transistria		9665eu
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		

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New North Atlantic HF Aero Frequencies Added

During times of rising world tensions, especially when the United States military is involved, knowledgeable military radio hobbyists will turn to monitoring HF aeronautical frequencies to get a handle on the situation. If you know what military aircraft are being moved into the theater of a crisis, you will have a better understanding of the level of operations being conducted by our military in that theater.

The HF frequencies of choice for this type of monitoring are the MWARA or Major World Air Route Area frequencies. Vast areas of the world lack the necessary VHF communication systems needed to provide reliable radio coverage between aircrews and air traffic controllers. This lack of coverage is generally due to remote locations where VHF communications are impractical, for example, much of the airspace over the Atlantic and Pacific oceans. To compensate for this lack of VHF coverage, these MWARA HF frequencies have been allocated for air traffic control of all aircraft.

Worldwide there are 15 MWARAs that cover Africa (AFI), Caribbean (CAR), Central East Pacific (CEP), Central West Pacific (CWP), East Asia (EA), Europe (EUR), Indian Ocean (INO), Middle East (MID), North Atlantic (NAT), North Central Asia (NCA), North Pacific (NP), South America (SAM), South Atlantic (SAT), Southeast Asia (SEA) and the South Pacific (SP).

If you monitor the North Atlantic MWARA family of frequencies, you will find a wide variety of activity including airline, charter, business (biz) and military aircraft using various HF frequencies.

FAA ARTCC Control Room (Courtesy FAA)

For various reasons, some technical, others economical, environmental, physical and natural, coverage via MWARA HF frequencies of a wide area by a single station with equipment located in a single place is impractical. In areas such as the North Atlantic, the use of these HF frequencies by several stations is necessary because they provide long-range communications coverage, not only for air-to-ground voice communications, but also for the broadcast of weather information.

In the NAT MWARA there are six aeronautical stations, one for each of the Oceanic Flight Information Regions (FIR), responsible for air-to-ground communications. They are Bodo Radio (Norway, Bodo ACC), Gander Radio (Gander, Newfoundland, Canada, Gander OACC), Iceland Radio (Iceland, Reykjavik ACC), New York Radio (USA, New York OACC), Santa Maria Radio (Portugal, Santa Maria OACC) and Shanwick Radio (Ireland, Shanwick OACC). In addition to these six aeronautical stations there are two other stations that operate on NAT frequencies: Canarias Radio, which serves Canarias ACC and Arctic Radio serving Edmonton, Winnipeg and Montreal ACC.

FAA ARTCC RCAG Site (Courtesy FAA)

All NAT MWARA HF frequencies are organized into six groups known as families, These families are identified as NAT Family A, B, C, D, E and F. Each family contains a range of frequencies from each of the HF aeronautical routed frequency bands allocated to the North Atlantic network.

Also, from a sub-network regional and domestic (RDARA) frequencies for Portugal and Ireland (Regions 1/1E), Santa Maria Radio and Shanwick Radio have defined a range of frequencies for use within Santa Maria FIR; Family H.

Los Angeles ARTCC (Courtesy FAA)

Shanwick Radio has also picked up some additional frequencies for their new I and J families mentioned below.

A recent Notice to Airmen (NOTAM) passed along information about the new frequencies for NAT families H, I and J.

"In addition to published HF frequencies, additionally on a tactical basis, Shanwick Radio will operate on regional and domestic air route area RDARA frequencies. These frequencies are used individually or by common network agreement between the NAT aeronautical stations."

Table One is a complete list of the nine NAT frequency families and aeronautical ground stations associated with each family of frequencies.

Table One – NAT Family Stations/Frequencies (all communication in USB)

A	Gander, Newfoundland (Gander Radio); Bohemia, New York (New York Radio); Vila do Porto, Azores (Santa Marie Radio); Shannon, Ireland (Shanwick Radio*): 3016, 5598, 8906, 13306 and 17946 kHz
B	Gander Radio; Reykjavik, Iceland (Iceland Radio), Shanwick Radio: 2899, 5616, 8864, 13291 and 17946 kHz
C	Gander Radio, Iceland Radio, Shanwick Radio: 2872, 5649, 8879, 11336, 13306 and 17946 kHz
D	Bodo, Norway (Bodo Radio); Gander Radio, Iceland Radio, Shanwick Radio, Arctic Radio (**): 2971, 4675, 8891, 11279, 13291 and 17946 kHz
E	Canarias Radio (***), New York Radio, Santa Maria Radio: 2962, 6628, 8825, 11309, 13354 and 17946 kHz
F	Gander Radio, Shanwick Radio: 3476, 6622, 8831, 13291 and 17946 kHz
H	Santa Maria Radio, Shanwick Radio: 2965, 3491, 5583, 6556, 6667, 10021, 10036 and 11363 kHz
I	Shanwick Radio: 2860, 2881, 2890, 3458, 3473, 3488, 5484, 5568, 6550, 6595 and 10066 kHz
J	Shanwick Radio: 2869, 2944, 2992, 3446, 3473, 4651, 4666, 4684, 5460, 5481, 5559, 5577, 6547, 8843, 8954 and 11276 kHz

Frequency 13306 kHz is shared between Families A and C
Frequency 13291 kHz is shared between Families, B, D and F
Frequency 17946 kHz is shared by all the Families
Frequency 13354 kHz is shared with RDARA 5 and 7

(*) Shanwick is the Air Traffic Control (ATC) name given to the area of International Airspace which lies above the northeast part of the Atlantic Ocean. Prior to 1966, the United Kingdom and Ireland both provided ATC and communications services in the same area of the North Atlantic. The air/ground communication station at Ballygirreen, near Shannon, worked with the ATC center at Shannon and the communication station at Birdlip, Gloucestershire worked with the ATC center at Prestwick, Ayrshire, Scotland. This caused duplication of work and an agreement was reached between the U.K. and Irish governments where Prestwick and Ballygirreen would work as one unit. Prestwick assumed the ATC function and Ballygirreen assumed responsibility for communications. The name Shanwick originated when SHANnon and PrestWICK, the original ATC providers, were combined.

(**) Arctic Radio is not a NAT family station.

(***) Canarias Radio is not a NAT family station. It is included in these listings as an interface between the North Atlantic and Africa MWARAs.

❖ ARTCC Update

This month we will continue our FAA Air Route Traffic Control Center tour with a look at the frequencies used by the Los Angeles ARTCC (Table Two) and New York ARTCC (Table Three). I want to remind regular readers of this column to please be patient; we will get around to the ARTCC covering your area as soon as space and current events allow. Note: All frequencies listed in Table One are in MHz and mode is AM.

And that does it for this month. Until next time 73 and good hunting.

North Atlantic OCA Airspace (Courtesy IVAOUS)

Table Two: Los Angeles ARTCC RCAG Frequency List

RCAG Freq V/U Pair MHz	RCAG Location (ICAO Identifier)	Sector Number/ Name: Notes
118.025/317.400	Nelson, Nevada (QQF)	Sector 53/Hi
118.825/236.825	Seligman, Arizona (QXP)	Sector 57/Hi
118.825/269.125	Seligman, Arizona (QXP)	Sector 57/Hi
119.050/269.500	San Luis Obispo, California (SBP)	Sector 15/Lo
	Santa Barbara, California (SBA)	Sector 15/Lo
119.950/277.400	Mount Laguna, California (QRW)	Sector 30/Hi (Oceanic Sector)
	Pleasants Peak, California (QX7)	Sector 30/Hi (Oceanic Sector)
124.200/343.600	Nelson, Nevada (QQF)	Sector 07/Lo
	Cedar City, Utah (CDC)	Sector 07/Lo
124.625/377.100	Keller, California (QKP)	Sector 16/Hi
	Mount Potosi, Nevada (QMP)	Sector 16/Hi
	Tonopah, Nevada (THH)	Sector 16/Hi
124.850/319.200	Seligman, Arizona (QXP)	Sector 08/Lo
	Nelson, Nevada (QQF)	Sector 08/Lo
125.125/281.475	Lebec, California (QXA)	Sector 29/Hi
125.275/351.700	Palmdale, California (ZLA)	Sector 18/Lo(will change to 351.675)
	Whittier, California (QWT)	Sector 18/Lo
125.650/346.400	Mount Laguna, California (QRW)	Sector 12/Lo
	Ontario, California (ONT)	Sector 12/Lo
125.725/351.900	Barstow, California (QQQ)	Sector 38/Hi
125.800/307.100	Saddle Peak, California (QMM)	Sector 04/Lo
126.350/290.200	Bartsow, California (QQQ)	Sector 20/Lo
	Riverside, California (RAL)	Sector 20/Lo
	Twentynine Palms, California (TNP)	Sector 20/Lo
126.525/346.300	Santa Barbara, California (SBA)	Sector 25/Hi
126.775/307.800	Yuma, Arizona (YUM)	Sector 31/Hi
	Julian, California (JLI)	Sector 31/Hi
127.100/317.700	Bakersfield, California (BFL)	Sector 03/Lo
127.350/346.300	Peach Springs, Arizona (PGS)	Sector 36/Hi
	Nelson, Nevada (QQF)	Sector 36/Hi
	Cedar City, Utah (CDC)	Sector 36/Hi
127.525/371.850	Blythe, California (BLH)	Sector 40/Hi
	Julian, California (JLI)	Sector 40/Hi
128.075/323.200	Peach Springs, Arizona (PGS)	Sector 35/Hi
128.150/285.600	Mount Laguna, California (QRW)	Sector 10/Lo
	Twentynine Palms, California (TNP)	Sector 10/Lo
128.375/263.000	Lebec, California (QXA)	Sector 27/Hi
128.600/291.700	Mount Laguna, California (QRW)	Sector 09/Lo
132.150/338.300	Santa Barbara, California (SBA)	Sector 28/Hi (Oceanic Sector)
132.500/284.700	Barstow, California (QQQ)	Sector 17/Lo
	Palmdale, California (ZLA)	Sector 17/Lo
132.600/351.800	Saddle Peak, California (QMM)	Sector 13/Lo
132.625/352.050	Mount Potosi, Nevada (QMP)	Sector 34/Hi
132.850/322.400	Baldwin Hills, California (QXT)	Sector 21/Lo
	Pleasant Peak, California (QX7)	Sector 21/Lo
133.200/348.650	Seligman, Arizona (QXP)	Sector 39/Hi
	Twentynine Palms, California (TNP)	Sector 39/Hi
133.550/279.600	Barstow, California (QQQ)	Sector 37/Hi
133.750/353.650	Palm Springs (Edom Hill), California (PSP)	Sector 19/Lo
	Pleasant Peak, California (QX7)	Sector 19/Lo
134.475/269.050	Blythe, California (BLH)	Sector 60/Hi
134.575/354.100	San Pedro, California (QLA)	Sector 22/Lo
	Santa Catalina, California (SXC)	Sector 22/Lo
	Mount Laguna, California (QRW)	Sector 22/Lo
134.650/360.650	Barstow, California (QQQ)	Sector 06/Lo
	Nelson, Nevada (QQF)	Sector 06/Lo
135.250/257.675	Grand Canyon, Arizona (GCN)	Sector 33/Hi
	Cedar City, Utah (CDC)	Sector 33/Hi
135.300/372.000	Lebec, California (QXA)	Sector 26/Hi
135.500/327.100	Santa Barbara, California (SBA)	Sector 14/Lo
135.550/299.200	Grand Canyon, Arizona (GCN)	Sector 32/Super Hi
	Seligman, Arizona (QXP)	Sector 32/Super Hi
	Cedar City, Utah (CDC)	Sector 32/Super Hi
-------/284.700	Barstow, California (QQQ)	Sector 17/Lo
-------/307.150	Cedar City, Utah (CDC)	High Military
-------/369.900	Baldwin Hills (QXT) and Barstow (QQQ), California	Military TSU
-------/369.900	Mount Potosi, Nevada (QMP)	Military TSU

Table Three: New York ARTCC RCAG Frequency List

RCAG Freq V/U Pair MHz	RCAG Location (ICAO Identifier)	Sector Number/Name: Notes
118.725/-------	Elk Mountain, Pennsylvania (AVP)	Sector ZNY Area
118.975/307.800	Colts Neck, New Jersey (COL)	Sector 68/Dixie-L (ex-381.600)
119.100/229.400	Bermuda Airport, Bermuda (BER)	ATC A/D Services
120.025/292.125	Joliett, Pennsylvania (QPG)	Sector 26/LRP-L
121.125/-------	Douglaston, New York (JFK)	Sector 86/Atlantic-L/H (Simulkey Nantucket, Massachusetts)
121.325/273.600	North Mountain, Pennsylvania (IPT)	Sector 49/SFK-H
123.625/279.550	North Mountain, Pennsylvania (IPT)	Sector 93/SWD-L
124.625/278.300	Flint Hill, Pennsylvania (ABE)	Sector92/PTW-L(ex-135.750)
124.775/346.275	Big Flat, Pennsylvania (HAR)	Sector 08/Brnan-SH
124.900/-------	Williamsport, Pennsylvania (IPTB)	Sector 91/A/D Control
125.325/282.300	Matawan, New Jersey (QPI)	Sector 56/JFK-H (has or will change to 354.050)
125.925/284.750	Barnstable, Massachusetts (EWB)	Sector 65/Joboc-H (ex-381.650)
126.025/-------	Atlantic City (ACY)	Sector 82/OC1/Kathy-SH
126.025/285.550	Manteo, North Carolina (MQI)	Sector 82/OC1/Kathy-SH (This is a New York ARTCC oceanic choke point sector)
127.175/350.300	Matawan, New Jersey (QPI)	Sector 42/ETX-H
127.400/-------	Douglaston, New York (QDG)	Sector A/D
127.725/270.250	Williamsport, Pennsylvania (IPT)	Sector 72/SEG-H
128.000/239.050	Joliett, Pennsylvania (QPG)	Sector 26/LRP-L
128.300/353.500	Ship Bottom, New Jersey (QPO)	Sector 66/Manta-L (ex-134.550)
128.500/-------	Bermuda Airport, Bermuda (BER)	ATC Services
128.500/-------	Elk Mountain, Pennsylvania (AVP)	Sector 50/Spare-L
128.575/379.275	North Mountain, Pennsylvania (IPT)	Sector75/MIP-H(ex-269.100)
132.100/339.800	Flint Hill, Pennsylvania (ABE)	Sector 39/Parke-L
132.150/282.350	North Mountain, Pennsylvania (IPT)	Sector 74/BWZ-L (ex-133.500)
132.175/307.275	Elk Mountain, Pennsylvania (AVP)	Sector 34/ULW-H (ex-298.900)
132.200/322.400	Big Flat, Pennsylvania (HAR)	Sector 27/MDT-L
132.500/322.500	Joliett, Pennsylvania (QPG)	Sector 11/Hyper-L
132.600/285.500	Huguenot, New York (HUO)	Sector 35/HUO-L
132.875/306.200	Philipsburg, Pennsylvania (PSB)	Sector 73/PSB-H
133.000/239.000	Bermuda Airport, Bermuda (BER)	ATC Services
133.150/290.400	Sparta, New Jersey (SAX)	Sector 36/SAX-L
133.175/285.650	Lancaster, Pennsylvania (LRP)	Sector Area Workload-H (Sectors 9/10/11)
133.350/372.000	Sayre, Pennsylvania (ELM)	Sector 50/CFB-L
133.475/270.300	Big Flat, Pennsylvania (HAR)	Sector 10/HAR-H
133.500/354.000	Barnegat, New Jersey (ACY)	Sector 86/Atlantic-H (ex-132.150)
133.525/290.525	Wilmington, North Carolina (ILM)	Sector 83/OC2 , Fairr-H (This is a New York ARTCC oceanic choke point sector)
134.325/323.300	Millville, New Jersey (MIV)	Sector09/EMI-H(ex-381.450)
134.375/-------	Douglaston, New York (JFK)	Sector 86/Atlantic-L/H
134.450/363.200	Elk Mountain, Pennsylvania (AVP)	Sector 51/LHY-L
134.600/290.200	Flint Hill, Pennsylvania (ABE)	Sector 55/ARD-L
134.800/338.300	Philipsburg, Pennsylvania (PSB)	Sector 91/FQM-L
135.450/335.600	Modena, Pennsylvania (MXE)	Sector25/MXE-L(ex-127.425)
135.650/322.475	Huguenot, New York (HUO)	Sector 35/HUO-L

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The (Possible) Demise of Analog AM

DXers are, of course, quite familiar with IBOC/HD-Radio®. Blocks of what sounds like noise are broadcast on frequencies either side of a station's regular analog signal. Most radios receive the analog signal in the middle. The digital signals on either side are tuned by HD receivers.

The HD-Radio standard allows for an all-digital mode. The analog signal in the middle disappears and the entire bandwidth is used for digital transmission. No station is currently broadcasting in all-digital mode. There's a very good reason for that: most listeners don't have an HD receiver. Any station broadcasting in all-digital mode would simply disappear, as far as most of its audience is concerned.

Last time, we reported on FCC Commissioner Ajit Pai's AM revitalization initiative. AM owners are taking another look at all-digital AM IBOC as one way of addressing AM's problems. An all-digital AM station may lose all its audience, but if the station's programming is simulcast on another station in analog mode, it may not matter.

We didn't really know what would happen with all-digital IBOC because no extensive testing had been done. Late last year, CBS offered the use of their station WBCN-1660 in Charlotte, North Carolina for more comprehensive all-digital tests.

WBCN is a fairly generic AM station; it's non-directional day and night, with 10,000 watts daytime and 1,000 watts after sunset. Because WBCN is non-directional, only one tower is used. That tower has an "electrical height" of 90.7°. That's a pretty generic antenna. Hams reading this column would recognize it as a quarter-wave, ground-mounted vertical. WBCN has been operating in hybrid IBOC mode for some time (transmitting digital and analog signals simultaneously).

Tests were performed both during the day and at night, both indoors and on car radios. For mobile tests, a Ford Focus with the original Sync HD-Radio was used. Indoor tests used an Insignia Narrator tabletop receiver, and were tested in a number of residences and businesses in the Charlotte area.

Theory has it that digital reception is perfect, until you reach a certain threshold signal strength. At that point, reception stops. It's called "falling off the cliff." The mobile tests reflected this theory. Reception was solid until a certain point was reached, at which point it would stop altogether. At this point, in the normal hybrid mode, the receiver would switch to analog and you'd hear a noisy analog signal. Because there was no analog signal in these tests, the station would disappear altogether.

During the day, reliable, mobile all-digital reception continued out to a distance of about 45 miles along the major highways leaving Charlotte in most directions. Reception to the east and southeast was limited to 25 miles. This was blamed on noisy power lines.

At night, reliable mobile reception was limited to about 12 miles in all directions. They noted nighttime coverage was limited to some degree by interference from another station on the same frequency. They weren't expecting that on an expanded-band station, but I believe most DXers would have expected this interference!

The FCC attempts to protect Class B stations like WBCN from daytime interference in any area where they deliver at least 2 mV/m of signal. That's a distance of roughly 15 miles. In practice, all-digital reception was considerably more reliable. At night, they attempt to protect to the point where 0.5mV/m is received. Due to the reduced nighttime power of WBCN this distance is also about 15 miles. This target was not met. Again, Ibiquity blames this on interference from another station on the same frequency.

Mobile reception involved automated testing over hundreds of sample points but it was impractical to conduct indoor testing at that many locations. Fifteen indoor sites were tested, at distances between 1.7 and 25 miles from the tower. During the day, digital reception was reliable at 11 sites, intermittent at one, and missing at three. At night, only the ten closest sites were tested. Reception was reliable at seven of these sites and missing at three. Ironically, one of these sites was in the CBS Radio studios, only two miles from the tower! On the other hand, it should be noted that reliable digital reception was found at six sites where analog reception was fair to poor. Because of the noise-free characteristic of digital audio, the station would have sounded much better in digital at these sites.

Ibiquity & CBS engineers faced an interesting dilemma when testing in all-digital mode. When we say an analog AM station is authorized to use a power of 10,000 watts, we mean the "carrier" signal is transmitted at 10,000 watts. The analog "sidebands" containing the audio add to this power. In all-digital mode, there is no carrier. Engineers had to develop a method for measuring the digital power of the test station.

First, the station was operated in analog mode with no audio present, leaving only the carrier. The transmitter power, averaged between the carrier and the (non-existant) sidebands, was measured and marked on the meter. Then, the transmitter was switched to all-digital mode and the digital power adjusted to obtain the same reading. Television engineers have faced this issue since we switched to digital transmission in 2009.

While making these measurements, they also found that it was not possible to completely confine the digital transmission to the spectrum called for in the IBOC standard. Theory suggests that an all-digital mode should not generate the interference to stations on adjacent frequencies that the current hybrid mode generates. It appears that real, all-digital stations may in fact cause some interference. However, this interference is fairly minimal. An all-digital IBOC station remains a far better neighbor on the dial, when compared to a hybrid mode station.

WQSV-790, tower/transmitter site, now silent. (Doug Smith)

I don't see any surprises in this report. I expected that the all-digital mode would work quite well, and it does. It was intended to match the coverage of the analog station, and for the most part it does. Indeed, in many indoor sites all-digital provides better reception than analog.

Of course, this digital reception comes at a large price. Any station that switches to all-digital mode immediately loses most of its audience. This may not be as much of an impediment as it looks. Modern multiple-ownership rules allow one company to own more than one AM station in the same city. Might we see CBS switch WBCN permanently to all-digital operation, while broadcasting the same programs in analog on co-owned WFNZ-610?

❖ AM Revitalization, or Not?

FCC Commissioner Ajit Pai continues to make news with his "AM Radio Revitalization Initiative." In May, Commissioner Pai met the owners of WRDN-1430 kHz, Durand, Wisconsin. WRDN is a 2,000-watt Class D station located about 80 miles east of Minneapolis. As a Class D station, a "daytimer," WRDN's nighttime power is limited to 150 watts, and that night service is not protected from interference.

Commissioner Pai published letters he received from WRDN, and supporting letters from other residents of Durand. Brian Winnekins of WRDN repeated six common suggestions for AM improvement. Three of these he regards as too expensive for many small stations to implement. FM translators must, in many cases, be "hopped"

into a community. As I've reported in this column, that involves expensive engineering work and filing fees. Converting WRDN to IBOC would require expensive transmitter replacement, and few Durand residents have HD Radios. Moving WRDN to an expanded FM band would again require expensive transmitter replacement. And almost nobody in Durand has an FM radio that will tune much below 88MHz.

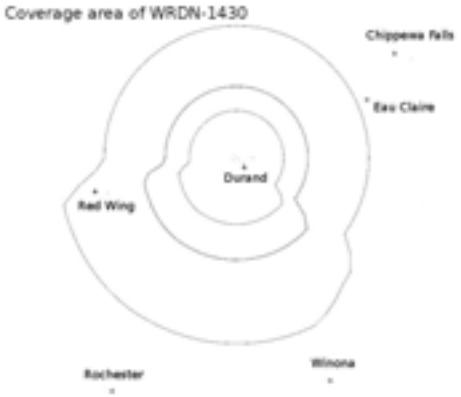
Winnekins had three other suggestions he believes are more practical but, I'm afraid I'll have to disagree!

First, he suggests the Commission enforce Part 15. Part 15 contains the rules that prohibit anything that doesn't have a license from interfering with licensed services. Noisy power lines, computers that radiate noise, and other similar devices make AM reception nearly impossible in many modern homes. It's all contrary to the Part 15 rules, but those rules are almost completely unenforced.

I would agree with Mr. Winnekins that strict enforcement of Part 15 would greatly improve AM reception. Unfortunately, I also believe it's politically impossible. Additional shielding and filtering would add a few pennies to the cost of consumer electronic gear, and to the maintenance budgets of electric utilities. Those companies' lobbying budgets are far greater than can be matched by small AM stations. Strict enforcement of Part 15 would probably result in lobbyists decimating the Part 15 restrictions long before it would clean up the AM band.

Second, he suggests the National Radio Systems Committee's (NRSC) bandwidth limitations be repealed. To avoid adjacent-channel interference, current rules limit an AM station's audio response to 9 kHz. Repealing that limitation would allow higher fidelity. The problem is that, as Mr. Winnekins notes in his letter, most receivers limit their response to about 3 kHz. The FCC can certainly allow stations to broadcast a full-fidelity signal, but it's unlikely they could force receiver manufacturers to build sets that can receive it.

Third, as we hear so often from daytime stations like WRDN, Mr. Winnekins asks why he must reduce power at night to protect another station hundreds of miles away? In his case, the protected station in question is KZQZ, St. Louis. WRDN believes the minimum nighttime power for any AM station should be 2,000 watts. They believe any resulting interference will happen only in fringe areas, outside the stations' local areas.



Daytime coverage area of WRDN-1430 kHz. (Doug Smith, from FCC records)

One of the WOR-710 towers, showing the wiring necessary for the aircraft warning lights. (Doug Smith)

No experimentation is necessary to see what would happen if we tried this. Class C stations are allowed to use the same power day and night and these stations are protected from daytime interference. It is then assumed that, since they don't interfere with each other during the day, they won't interfere at night either.

Class C stations operate on six specific frequencies. Try listening to some of these Class C frequencies at night: 1230, 1240, 1340, 1400, 1450, and 1490 kHz. If you can separate any station more than ten miles away, out of the noise, you're doing a lot better than I! Indeed, the first AM station to get permission to use an FM translator was a Class C station. Obviously, allowing all AM stations to use their daytime facilities at night is *not* the magic bullet for limited nighttime coverage!

❖ Last-minute LPFM news

As I was wrapping up this month's column, the FCC announced a Low Power FM (LPFM) filing window for late October. Applications for new broadcast stations of any class are only accepted during these brief windows of time. There hasn't been a filing window for LPFM stations since 2001. If you're interested in starting a new station in your community, you'd better get started now!

STATION REPORT:

Stations deleted:

Dadeville, Alabama	1560	WDLK
Middleton, Idaho	1400	KXIV
Vancleve, Kentucky	730	WMTC
Lakeview, Oregon	1230	KQIK
Carnegie, Penna.	1590	WZUM
Ebensburg, Penna.	1580	WRDD
Washington, Penna.	1110	WZKV
Santa Clara, Utah	1290	KNFC
Wainwright, Alberta	830	CKKY to 101.9 FM
St. Boniface, Manitoba	1050	CKSB to 88.1 FM
Cartwright, N.L.	570	CBNK to 93.9 FM
Fort McPherson, N.W.T.	690	CBQM to 99.9 FM
Fort Providence, N.W.T.	1230	CBQC to 98.9 FM
Fort Simpson, N.W.T.	690	CBDO to 107.5 FM
Hudson, Ontario	1340	CBQW to 95.3 FM
Sioux Lookout, Ontario	1240	CBLS to 95.3 FM
Weymontachie, Que.	750	CBFA-3 to 92.3 FM

TECHNICAL CHANGES:

Applications filed for frequency changes:

Destin, Florida	1140	WNWF from 1120; 3,000/12 ND

Stations moved to new frequencies:

Milan, New Mexico	1090	KQNM from 1110

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.

http://naob-advocacy.informz.net/naob-advocacy/archives/archive_3195011.html N A B Labs article on the WBCN all-digital test.

http://fjallfoss.fcc.gov/edocs_public/attachmatch/DOC-321501A1.pdf Commissioner Pai's statement on WRDN-1430.

http://www.reelcountry1430.com WRDN's website.

Iden Rogers K6JHQ
idenrogers@monitoringtimes.com

Oceanic Crossings: VHF-HF Transitions

Transoceanic flights leaving the U.S. use VHF frequencies starting at the departure airport. They continue to use VHF frequencies after becoming airborne while communicating with departure control at the associated TRACON (Terminal Radar Approach Control) facility. Shortly thereafter, they are handed off to the area ARTCC (Air Route Traffic Control Center) facility, still on VHF frequencies.

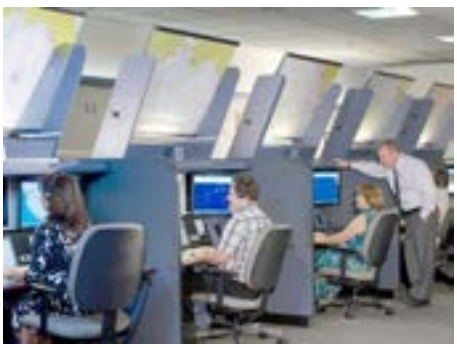
Since VHF provides only line-of-sight communications out to about 150 to 200 miles, it is not suitable for transoceanic flights. Shortwave (HF) frequencies, however, are able to propagate over hundreds, even thousands, of miles taking advantage of ionospheric skip.

The pilot is assigned a primary and a secondary HF frequency. This can occur in a several ways. Once assigned, the pilot switches to HF from VHF at about the coastline. Upon approaching land near the end of the crossing, the oceanic radio operator will assign a change back to a VHF frequency. Let's take a closer look!

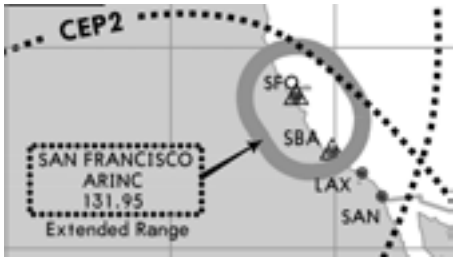
First, What is ARINC?

Aeronautical Radio, Inc., is a company involved in a number of things, but one is as an intermediary between pilots and ATC (Air Traffic Control) during transoceanic flights. The following is from *ARINC Voice Services Operating Procedures Handbook, 2.1.1 International Service.*

"Radio operator positions are equipped with computer workstations consisting primarily of a terminal and keyboard as part of the Air/Ground System (AGS) and a radio and telephone communications system. The latter is comprised of radio and frequency selection, SELCAL, antenna selection, telephone, and various other communications features. Nearly 80 percent of international services are conducted in support of the FAA. ARINC Communications Centers handle over two million ATC messages and position reports per year. The remaining 20 percent, over 500,000 messages, are AOC (Airline Operational Communications) in nature."



ARINC radio operators. Courtesy ARINC.



Portion of ARINC-1 VHF Radio Networks chart showing long range coastal VHF site and the frequency. (Courtesy Jeppesen/ARINC)

In the western U.S. the ARINC operators identify as "San Francisco" and as "New York" in the eastern U.S.

Checking in with ARINC

There are several ways that an aircraft can request HF frequencies for an oceanic crossing. This is from the same handbook and under *2.2.1.5 HF Radio Checks*: "An HF radio check should be made with an ARINC Communications Center prior to departure or while airborne prior to entering U. S. oceanic airspace. An HF ramp check at selected airports may be arranged by calling an ARINC Communications Center on an international VHF network or a domestic VHF network. The radio operator responding to the call will provide the appropriate frequency for the HF communication check. HF frequencies for ramp/SELCAL checks may also be coordinated by calling the NYC or SFO via landline. When calling, state the aircraft location, call sign, SELCAL, and destination; request a primary and secondary frequency for an HF check."

Frequency Request Examples using HF

The following took place when the airliner, United Flight XXX (the exact flight number is unimportant here), was westbound over western Wyoming, further inland than I would have expected.

Airliner on 8843 kHz: *San Francisco, United XXX*. ARINC operator: *United XXX, San Francisco*. Airliner: *Good morning, San Francisco, United XXX, we are proceeding from Chicago O'Hare to Honolulu. We will be CPDLC today. The registration is November XXX, SELCAL Quebec Romeo Delta Juliet, requesting HF frequencies.* ARINC: *United XXX, primary 8843, secondary 13354 and at 140 west, primary 8915, secondary 13354.* Airliner: *8843, 13354 backup, 140 west we'll go 8915, 13354 backup*. ARINC transmits SELCAL tones QR-DJ. Airliner: *Good SELCAL, United XXX, thank you*. ARINC: *San Francisco*.

Just after hearing that, I went to FlightAware at **http://flightaware.com/** and entered the United flight number in the search box near the top center of the screen to see where it was when it made the call. This yielded a nice flight track graphic with the airliner's position.

This next example was when an airliner was still on the ground at Los Angeles International (KLAX).

Hawaiian Airlines pilot on 8843: *San Francisco, Hawaiian XXX*. San Francisco ARINC Operator: *Hawaiian XXX, San Francisco*. Pilot: *Hawaiian XXX, CPDLC this afternoon, Los Angeles to Honolulu, Registration November XXX, SELCAL Bravo Foxtrot Charlie Juliet, requesting primary, secondary, and SELCAL*. ARINC transmits SELCAL tones BF-CJ. Pilot: *Good SELCAL check and I presume this is primary, need secondary*. ARINC Operator: *Secondary is 5574 and at 140 west, 8915, secondary 13354, go ahead*. Pilot: *OK, thank you. This is primary, secondary 5574, 140 west, 8915, secondary 13354 for Hawaiian XXX, Thanks*.

Frequency Request Examples using VHF

Here are two examples of aircraft that departed inland, away from the coast – one from McCarran International Airport in Las Vegas, Nevada (KLAS) and the other from Hartsfield-Jackson International in Atlanta, Georgia (KATL). Both airliners were destined for Honolulu and left the mainland from over northern California. Both called in when near the coastline on VHF frequency 131.950, common for much of California.

The ground side of the communications, the ARINC operator, could not be received by this column editor at a distance of 130-plus miles so just the pilot side is presented here. The pilot "read-back" can fill in the missing blanks.

Omni Air Express Pilot: *San Francisco Radio, OMNI XXX*. Pilot: *We are enroute to Honolulu today, your HF frequencies, our SELCAL is Foxtrot Kilo Lima Mike*. Pilot: *8843, 5574, we are out of Las Vegas going to Honolulu*.

Delta Pilot: *San Francisco Radio, Delta XXX on three one nine five* (short for 131.950). Pilot: *Delta XXX, we are at Flight Level 380,*

we are going to be CPDLC, destination Honolulu, aircraft registration November XXX looking for HF frequencies. Pilot: *SELCAL is Charlie, Juliet, Alpha, Golf*. Pilot: *8843, 5574 and at 140 west, 8915, 13354 for Delta XXX*.

As mentioned, Hawaii-bound flights over northern California can and do use 131.950 at about the coastline to get HF frequencies. A listener in the San Diego, California area reported receiving calls to ARINC for HF crossing frequencies on 128.900, 130.400, 130.800, and 131.950.

If you live in other coastal areas of the U.S., it may take a bit of detective work to figure them out. The *ARINC-1 VHF Radio Networks* chart could be of some assistance. See: www.arinc.com/sectors/aviation/aircraft_operations/commercial_aviation/voice_data_comm/air_ground_data/radio_svc/jepp_charts.html. At this same link, please also see *ARINC-3 HF Atlantic/Caribbean Coverage* and *ARINC-4 HF Pacific Coverage* for HF and some VHF frequencies.

Portion of North Pacific Route Planning Chart showing waypoint CUNDU on track R465.

❖ Hand-off back to VHF

When an aircraft is approaching the U.S. mainland, ARINC operators on HF will give the initial VHF contact frequency changeover point in a couple of different ways.

In this first example, the operator on 8843 kHz, near the end of this exchange, calls out a longitude that crosses the R465 tract. Airliner: *San Francisco, Alaska XXX, position on eight eight*. ARINC operator: *Alaska XXX, San Francisco*. Airliner: *Alaska XXX, expect* (to pass) *CUNDU zero three three nine* (time UTC), *Flight Level three seven zero, estimate* (passing) *CREAN zero four three two, CINNY next, temperature minus five two, wind three three five diagonal one seven, fuel one seven decimal five, go ahead*. ARINC: *Alaska XXX, copied all. At 127 west contact Oakland Center one three four decimal one five*. Airliner: *At 127 west we will call Oakland one three four decimal one five, Alaska XXX*. ARINC: *San Francisco*.

In this example, a waypoint is called out. ARINC: *….At EDSEL, contact Los Angeles* (Center) *on one three two decimal one five, go ahead*. Airliner: O*K, thirty-two fifteen at EDSEL, United XXX*. ARINC: *San Francisco*. EDSEL is a waypoint along the R577 tract.

A list of paper charts for sale are found here: **http://faacharts.faa.gov/Catalog.aspx?a=AERO+NOS+PUB+OCEANRT**. The chart I was referring to is listed as PORC-NEAZ - PACIFIC RTE CHT NE FLAT. The charts show tracts by number and the named waypoints along them that you hear on the radio. The waypoints have five letters, are pronounceable, but can be a little strange as you can see (CUNDU, CREAN, CINNY, EDSEL).

On the West Coast for listeners within VHF range, try these frequencies for eastbound aircraft approaching land: Los Angeles Center 132.150, Oakland Center 134.150, and Seattle Center 135.15 and maybe 132.075. For listeners on either coast, the ARINC operator will call out a VHF frequency on HF.

Monitoring the VHF-HF-VHF transitions can be fun if you are able to receive both well. Even if you live way inland, it can still be fun to monitor transoceanic aircraft on HF to see how much and how far you can catch.

❖ Aircraft Listening and Me

I first started listening to aircraft communications decades ago in addition to amateur radio and other radio hobbies. I used a military surplus BC-639 receiver for VHF aircraft frequencies. Some years after that I added a surplus URR-35 for military aircraft on UHF. This was years before scanners had arrived on the scene.

Scanners that did eventually appear did not include aircraft frequencies. Some of you old timers may remember Radio Communications Monitoring Association (RCMA) or may have even belonged to it. It became a rather large nationwide scanner club with a newsletter prior to the Internet. At one of our large monthly meetings in Orange County, California, I took a poll of the audience and most really did want aircraft capability in future scanners. Another RCMA founding father, Bob Leef, approached the scanner radio manufacturers with our survey results and urged them to consider adding aircraft listening capability. Sure enough, scanners appeared that included the VHF aircraft band for starters. I would like to think that we helped to push that along. It would have happened eventually without our encouragement.

Aircraft listening is different from public safety listening since it is in a three-dimensional environment and one where a great deal of effort is invested in not having planes run into each other. It can be in the form of vectoring aircraft to avoid conflicts, calling out other area traffic, altitude changes, speed changes, departure timing, etc. Controllers do their best to make everything fit together nicely on those highways in the sky and with relatively few air mishaps.

Another thing about aircraft communications is that it is quite a different language compared to public safety monitoring. It can take some study getting used to. It isn't like "Man down at 5th and Main." It is more on the order of "American Four Nine One, turn left heading one niner zero to join the one six right localizer." I, for one, really do like figuring all this out.

Aircraft listening isn't just learning how to understand the main points of the quick-paced pilot-controller exchanges but can also include gaining an understanding of radar, transponders, squawk codes, ADS-B, SELCAL tones, navigation and navaids (electronic navigational aids), barometric pressure, the different ways that altitude can be called out, how runways are numbered, airport diagrams and taxiway numbering, aeronautical charts, the various controller positions, controller position / sector consolidation during periods of low activity, aviation weather, air traffic management, emergency beacons, aircraft registrations and call signs, the National Airspace System, ARINC and transoceanic monitoring, all kinds of codes and identifiers, and more.

The very fortunate thing is that there are volumes of references written for pilots, for air traffic controllers, and other FAA employees. These are accessible to aircraft listeners as well. It can take quite a bit of study to have a well-rounded understanding of the subject. It can also be viewed like the game of chess. One can learn the moves of the various pieces and play basic games or one can dig rather deeply into game strategy.

Not everyone will be as interested in digging into all this as I am, but the hobby of "aircraft communications listening" can be so much more than just actual listening. If you are into Internet sleuthing for hard-to-find information as entertainment in itself, there certainly is no end to the opportunities. To make listening more enjoyable, having some understanding of all the various topics mentioned above makes actual listening far more interesting, enjoyable, and readily understandable.

Over the years, I have visited a number of large and small airports. I found that it can help to put a face on centers of activity that we listen to on the radio. I have also been fortunate enough to have gone on tours of the Los Angeles Air Route Traffic Control Center (ARTCC) in Palmdale, California. I have been on two or three small-group tours of the Ontario (California) TRACON facility before it was integrated into the large SoCal TRACON. Add to this, visits to a few control towers and they were all wonderful and informative experiences. Unfortunately, in this post-911 era, strolling around airports and visiting FAA facilities is less possible. Seeing controllers at work helped to complete the overall picture of aero communications listening for me. There seeming is no end to this wonderful hobby, well, if you are a radio nut like I am.

❖ The Planes Column and Me

I have found that being the *Monitoring Times* Planes column editor to be enjoyable, interesting, and a learning experience. Some topics required a considerable amount of research. I like to explain things and the Planes column has given me such an opportunity. I have been writing the column since 2004 and it is simply time to move on. My health is good and my radio hobbies are as strong as ever. I wish all of you good listening for a long time to come. Perhaps we will run into each other sometime out there, somewhere, in the hobby radio world.

Kevin O'Hern Carey, WB2QMY
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Checking Your Station

The month of August, at least here in North America, typically does not present stellar longwave conditions. There's still some DX to be heard, especially in the early morning hours, but natural static (QRN) often rages, and we have to dig out signals that were clear just a couple of months ago. While on-the-air conditions may be challenging, this is an excellent time for working on new antennas or making repairs to existing systems.

The tasks of re-securing cables, sealing entrance points, or hanging new antennas are best done now, rather than in the middle of inclement weather. This month I'll point out some things to check at your station to be sure you're ready for another season of longwave DX.

Cable Entrance Points: The point where your antenna feedline, ground, and control cables enter your home is especially vulnerable. No matter what grade of sealant you used originally, it is subject to drying out or pulling away from wall surfaces, given enough time. Give special attention to this area, and re-seal it as necessary. It's also a good idea to arrange outdoor cables with a "drip loop" so that any rainwater running down the wires encounters an "uphill" section of several inches just before entering the wall. In this way, rainwater will run off the lowest point of the loop instead of rushing against the wall where, chances are, it will eventually find its way inside.

Ground Connections: With lightning on the minds of many, proper grounding of antennas becomes paramount. While nothing can protect against a direct strike, a good ground is an essential first step in protecting your equipment against surges, making your installation safer overall. Inspect all ground connections to make sure they are clean and tight, and ensure that all wires are connected to a single point ground, preferably with no splices along the way. As with most cabling, ground wires should be as short and direct as possible. Do you want to delve into the subject of lightning protection in greater depth? Be sure to check out the three-part series posted by the folks at DX Engineering. You can reach the series by followingthis link: **http://tinyurl.com/ofooz6h.**

Antenna Feedline Connections: Outdoor connections are among the most vulnerable links in an antenna system. Wind, snow, rain, ice, and baking sun all take their toll. Take a close look at all of your antennas to see if the coax or feedline attachment points are in good shape and weather-tight. Don't want to leave the ground to do your checks? A good pair of binoculars can be a useful inspection tool.

Anchor Points and Support Ropes: Several years ago, I came to believe that the re-hanging of wire antennas every few years was a normal and expected activity. That was before I started using black Dacron® rope and a halyard/pulley arrangement at the end of my wire antennas. What a difference this little bit of extra effort can make! Dacron rope is highly resistant to sun damage, and the pulley/weight arrangement allows an antenna to sway gently in the wind, with the counterweight rising or falling as necessary to keep a constant tension.

For a pulley, you can use one of the types made for outdoor clotheslines or marine use, and your counterweight can be fashioned from a plastic jug filled with sand. I've had a dipole antenna up for years with this stress-relieving arrangement, and I recommend it highly. Check your favorite radio supply house and hardware store for the items you need to build or repair an outdoor antenna. Universal Radio has an excellent selection of supplies at **www.universal-radio.com/catalog/antsup.html**. Grove Enterprises also has antenna switches, connectors and splitters at **www.grove-ent.com.** Looking for screw-in ceramic end-insulators? I've discovered that Tractor Supply stores are an excellent source for these and can be found in their electric fence supply section. Don't overlook their fence wire for possible antenna use, either.

Tidying Up the Shack: OK, I know this is supposed to be about outside work, but every now and then, it becomes necessary to "clean house" in the radio room itself. This point was driven home to me when I once tried to get on the air with my trusty DX-100 transmitter for an AM phone net. I don't fire up the old rig often, but when I do, I usually just apply power, touch up the adjustments, and I'm good to go.

Airfield Beacon LLX, 353 kHz, Lyndonville, Vermont (File Photo)

This day was different. The wattmeter wasn't showing any power output, and the usual relays were not activating. After a bit of troubleshooting (and missing the check-in period for the net) I discovered that several coaxes in my shack had been switched around to accommodate a temporary setup weeks earlier. I had forgotten exactly what was changed, and as I looked at the maze of wires, I decided it was time to "start over" with my shack wiring. As Earl Nightingale, author of the famous recording "Lead the Field" said, it was a case of "constructive discontent," and it prompted me into action.

I removed all rigs from the table, cleaned the surface to get rid of the considerable dust build-up, and then proceeded to reinstall each rig, neatly re-wiring, re-dressing, and labeling all of my cable runs as I went along. It was a liberating experience! Everything works fine now, and if a problem does develop, I'm in a better position to resolve it. I have since followed up with a basic drawing of all cabling, which is filed with my station records for future reference.

While I was at it, I established an "AUX" position on my rig/antenna switch, which is routed to a spare area of my table where I can set up a "theme" station for temporary use (antique, military surplus, QRP, homebrew rig, etc.) and then rotate it out for something different when I'm ready for a change. Getting things in order inside goes a long way toward improving your on-air experience, whether chasing beacons or working HF DX!

❖ Mailbag

John Maikisch K2AZ (WA) sent a list of his latest loggings from the Seattle area. He writes: "Kevin, I enjoy your longwave columns. It is interesting to read the tidbits from other listeners and I always find some useful information. I moved to Seattle from Maine in 2005. My current situation left me with severe antenna and equipment restrictions and marginal results. I recently came across your column and thought I'd give longwave a try. I found this spectrum to be very intriguing. I find it somewhat like my past success on the 160 meter ham band in that it takes a lot more perseverance, patience, and skill than just using sophisticated equipment.

"My gear is limited to an IC-R75 receiver, a Palomar converter, a Clifton Labs BCB rejection filter (essential equipment) and a Clifton Labs 1501F antenna (an amazing antenna for its size). In less than a month I logged nearly 100 beacons in the Northwest U.S., Alaska and Canada, the usual NAVTEX outlets and other AM and digital signals. Your column has been able to help me demystify some of these. I'm sure there are more gems here than I am aware of, and in all honesty there is also good information in the other *MT* columns on unusual LF stations. Keep

up the good work, we appreciate it." *[Editor's note: Read John's account of apartment DX in this month's feature, "Urban Monitoring: The Trials and Tribulations of a Cliff Dweller."]*

Hi John, and good to hear from you! The longwave band certainly holds many gems for DXing. I often make the point that it would be hard to find any other 500 kHz slice of spectrum with more variety than that offered by longwave. Sounds like you are having some great success with your setup, and we welcome loggings at any time. I wish we received more west coast loggings, but it seems that 70 percent or so of what I get are east of the big river. Yours are especially welcome.

Seattle, WA Loggings

kHz	ID	ST/PR	CITY
60	WWVB	CO	Ft. Collins
200	UAB	BC	Anahim Lake
200	YJ	BC	Victoria
214	LU	BC	Abbotsford
216	GRF	WA	Ft. Lewis
218	PR	BC	Prince Rupert
223	YKA	BC	Kamloops
227	CG	BC	Castlegar
236	YZA	BC	Ashcroft
240	BVS	WA	Skagit
242	XC	BC	Cranbrook
242	ZT	BC	Port Hardy
245	HE	BC	Hope
251	YCD	BC	Nanaimo
257	LW	BC	Kelowna
260	YSQ	BC	Atlin
264	SZT	ID	Sandpoint
266	VR	BC	Vancouver
269	YK (A)	BC	Castlegar
272	XS	BC	Prince George
274	CAN	WA	Bremerton
284	FHR	WA	Friday Harbor
290	YYF	BC	Penticon
296	PWT	WA	Brenerton
317	VC	SK	La Ronge
326	DC	BC	Princeton
328	LAC	WA	Ft. Lewis
332	LBH	OR	Portland
332	VT	SK	Buffalo Narrows
335	CVP	MT	Helena
338	PBT	CA	Red Bluff
338	ZU	AB	Whitecourt
341	DB	YT	Destruction Bay
344	FCH	CA	Fresno
344	XX	BC	Abbotsford
348	MNC	WA	Shelton
350	NY	BC	Enderby
353	RNT	WA	Renton
358	SIT	AK	Sitka
359	BO	ID	Boise
359	YQZ	BC	Quesnel
362	BF	WA	Seattle
365	AA	MN	Fargo
368	SX	BC	Cranbrook
368	ZP	BC	Sandspit
368	ZVR	BC	Vancouver
371	ITU	MT	Great Falls
374	EX	BC	Kelowna
375	FS	NT	Ft. Simpson
378	UX	NU	Hall Beach
382	AW	WA	Arlington
382	YE	BC	Nelson
385	WL	BC	Williams Lake
389	YWB	BC	Kelowana
394	DQ	BC	Dawson Creek
395	YL	MB	Lynn Lake
400	QQ	BC	Comox
404	MOG	CA	Montague
406	YLJ	SK	Meadow Lake
408	MN	WA	Moses Lake
411	RD	OR	Redmond
414	LYI	MT	Libby
518	NAVTEX	CA	Pt. Reyes
521	INE	MT	Missoula

End Notes

Sound vs. Radio: A common misconception at frequencies below 20 kHz or so is that sound waves and radio waves are essentially the same thing. In fact, sound waves are the result of air pressure modulations that move our eardrums, while radio energy is electro-magnetic in nature. Both are measured in kHz and that probably contributes to the confusion.

To further complicate things, it is true that electro-magnetic energy at such low frequencies can be detected by electronic high gain audio amplifiers, and this is the basis for most whistler receivers on the market today. Nevertheless, such energy is still electro-magnetic/radio and not airborne sound at all. The most that can be said is that this is radio energy occurring at frequencies normally associated with sound. The type of energy is entirely different between the two, however.

New ID Resource: A new online resource has been discovered for identifying NDBs and other aviation Navaids: www.fltplan.com. I like the way information is presented at this Web site. Once you're at the home page, just select "Navaids and Fixes" on the left pane. You are then routed to a page allowing searches by location, first letter of the beacon name, or by the first character of the identifier. I typed in "A" to find my local AVN/344, and there it was, just a few scrolls down the list. Clicking on AVN brought up full information for the beacon, its coordinates, and who's responsible for maintaining it. I also searched by states to get a listing of all beacons in New York state. You do not need to be a registered user of the site to access this level of data. Be sure to give this site a try!

Marc Ellis, N9EWJ
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Electrolytic Replacement 101

(All graphics courtesy of the author)

You've just gone to your radio collection and turned on a set that you haven't listened to for awhile. The tubes begin to glow as usual, but after a few minutes a loud raspy buzz issues from the loudspeaker instead of the ball game or concert you had expected to hear. It's much louder than the receiver's normal audio and is unaffected by the volume control or any other control on the radio. You can't hear your station at all or perhaps only as a distorted mutter. The sound is ghastly, but relax! You have encountered an open electrolytic capacitor, a problem that is one of the easiest to diagnose and repair in a vintage radio.

Electrolytic capacitors are part of the power supply that converts the alternating current from your wall outlet into the direct current needed by other circuits in the radio for proper and quiet operation. A chart of what happens in the power supply is shown here.

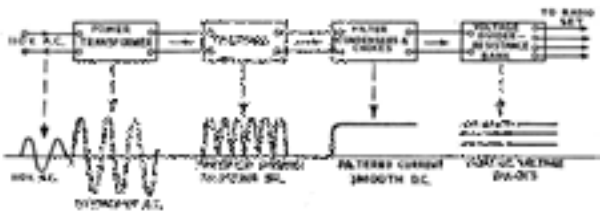


Chart showing action of a receiver power supply, including rectification and filtering.

The AC from the wall outlet (in this old drawing it's labeled as 110 volts instead of the present-day 117) is first stepped up, by the power transformer, to the higher voltage needed by the radio circuitry. The stepped-up voltage then passes through the rectifier tube, where it is changed to pulsating DC. It is DC because it never crosses below the axis and becomes negative, but its value rises and falls, following the pattern of the original AC waveform. It is this pulsating DC that you hear as noise when an electrolytic becomes open.

Cleaning up the pulsating DC so that it becomes smooth DC is the work of the filter network, which consists of a choke and one or more capacitors (called condensers in this old drawing). From there, the smooth DC passes to the radio circuits, where it is maintained at the different voltages required by various resistor networks.

When one of the filter capacitors fails, it will become shorted, leaky or open. If it shorts out, and this is not discovered in time, the rectifier tube, and even the power transformer, could be burned out. If it becomes open or leaky, then one is treated to the ear-splitting rasp.

Enter the Electrolytic

When these AC power supplies were first developed, capacitors available for use were rated at no more than a few uF. To obtain the necessary filtering action, such capacitors had to be paired with heavy, electrically large, chokes.

With the advent of electrolytic capacitors, values of 20-50 uF were readily and inexpensively available. This meant that the filter choke could become very much smaller. Sometimes the choke was dispensed with entirely, replaced by a power resistor. And often, before permanent magnets replaced speaker field coils, the field coil was used to perform double duty as the power supply choke.

The larger capacitances available with the electrolytics simplified radio construction, thereby saving costs, but these components are not as stable as the paper or oil/paper capacitors that preceded them. The latter might well last for the life of the radio while the former frequently did not. To see why, let's take a look at capacitor construction.

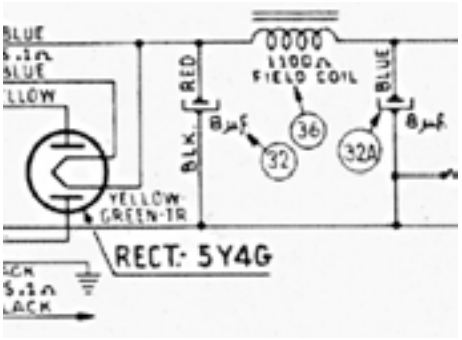
A capacitor contains two electrodes; these are usually long lengths of foil set one atop the other with a strip of paper or plastic film, acting as an insulator, or "dielectric," sandwiched between them. The "sandwich" is then rolled into a tight cylinder with a lead brought out from each of the foils for connection to the circuit.

The rating of the capacitor will depend on the total area of foil as well as the thickness and composition of the dielectric. Sometime in the early 1930s, capacitors with a new type of dielectric came on the market. It was a damp chemical paste called the "electrolyte." When an electric current is passed through the paste, a very thin layer of oxide is deposited as a dielectric. Its characteristics are such that very high values of capacitance can be attained.

However, the electrolyte in these "electrolytic capacitors" can dry out over time causing an open or short circuit. It's not unusual for this to happen once, or even a couple of times, during the life of the radio. Any serious collector/restorer of vintage radios will find himself replacing electrolytic filter capacitors, and occasionally the older non electrolytic, fairly often during his pursuit of the hobby, which brings us to the point of this article.

Identifying the Filter Caps

Radios with AC power supplies began to replace battery radios in the late 1920s. The filter capacitors in those radios, usually not electrolytic, are frequently sealed in blocks with



Schematic showing filter system of a typical 1930s receiver. Capacitors are 8 uF; speaker field serves as filter choke.

the other capacitors used in the set. These often require great patience to find and remove. They will be part of another discussion some time in the future. By and large, the capacitors you will mainly be concerned with will be in radios of the 1930s to1960s.

Most radios will have at least two electrolytic filter capacitors as well as a third electrolytic used as a cathode bypass for the audio output stage. More often than not, all three (or more) capacitors will be contained in one cylindrical multi-section package. In smaller radios, such as those AC-DC sets commonly referred to as "All American Fives," the capacitor will probably be in a cardboard case fastened under the chassis. It will be the largest capacitor in the set and readily identifiable by the color-coded leads connecting to the different sections.

In larger sets, the multi-section electrolytic is likely to be in a large cylindrical enclosure mounted on top of the chassis. The case might be cardboard or metal with either color-coded leads extending down under the chassis or marked terminals accessible from beneath.

With any of these electrolytics, the codes for the various capacitances and voltages are generally marked on the case, as is the common, or negative, lead or terminal. When replacing

Some typical electrolytic capacitors.

electrolytic, observing the proper polarity is critical. If reversed, the capacitor will be destroyed as soon as power is applied. More on this later.

In some early 30s sets you might come upon filter capacitors with small capacities (maybe as low as 2 uF) and no polarity markings. These are pre-electrolytics; just large paper or oil capacitors. Such capacitors in that size are now rare, but you can replace them with electrolytics. Just use the closest available size, probably 10 uF. However, you do have to be concerned about the polarity of the replacements. Study the schematic! Usually the negative side of a filter capacitor goes to ground – but not always!

As mentioned, beginning with the early 1930s and up through the 1960s or later, your defective capacitor will probably be part of a multi-section unit. You could disconnect the bad section and substitute an individual capacitor. And, you might possibly find that a previous serviceman has done just that in the past. But if one section is bad, then the others are suspect and replacing the entire unit is highly recommended.

❖ Making the Replacement

Your chances of finding a multi-section electrolytic with the exact combination of capacitance and voltage ratings for your set are slim to negligible. Back in the era of tube electronics, the parts catalogues had pages of these items in myriad combinations. Now, it wouldn't pay even to try. Your best bet will be to replace all the sections with their appropriate individual replacements.

Modern capacitors are so much smaller than the originals that it is easy to find space for them under the chassis. The old can may be left in place to preserve the authentic appearance of the chassis. But those who are sticklers for accuracy might want to clean out the can and install a set of modern capacitors inside.

When making the transition to individual capacitors, first make sure you understand the original wiring! Study the information on the original enclosure carefully. If the enclosure is a metal can, then chances are that the can itself is the common negative lead for all the capacitors inside.

In that case, the can was probably grounded to the chassis through its fasteners. That means that the negative lead from each of your replacement capacitors can be connected to any convenient ground point on the chassis. The positive leads, of course, are to be connected to the same circuit points where their original counterparts were connected.

It's best to disconnect and replace the original leads one at a time to avoid confusion. In cases where the positive lead from a replacement capacitor is not long enough to reach its circuit point, you'll probably want to mount a terminal lug at some convenient spot to make a splice.

However, not all metal capacitor cans are grounded! Occasionally the manufacturer's circuit design calls for the common negative to be isolated from ground. In this case, the can will be insulated from ground in some way and there will be a separate negative lead or terminal.

You'll need to install a terminal lug and connect it to the same circuit point from which you will disconnect the negative lead from the capacitor. The negative leads from all the replacement capacitors can now be connected to the new terminal lug. As before, the positive leads from the replacements are connected, one at a time, in place of each original lead as it is disconnected. Of course if the "can" is really a cardboard tube, then there will definitely be an individual negative lead and you'll need to proceed as you would in the case where a metal capacitor can is insulated from the chassis.

❖ Capacity and Voltage Ratings

While individual electrolytic capacitors are still on the market with a good choice of capacity and voltage ratings, it's not always possible to find the exact values you need. Here, the restorer should not hesitate to make substitutions. There's probably more latitude within the specs of filter capacitors than with most other radio components.

When it comes to capacity, if you are trying to replace an oddball size, don't hesitate to substitute the next larger commonly available one. For instance, you can use a 40 uF capacitor unit to replace a 30 uF unit. Of course, you wouldn't want to consider using a smaller one, such as a 20 uF capacitor.

Making substitutions in working voltage is a little more of a grey area. Clearly, using a capacitor with a smaller working voltage than the original is an invitation to disaster. When it comes to substituting capacitors with larger ratings, there is some room for discussion.

An engineer will tell you that electrolytics are designed to develop their full capacity at full working voltage, so, reducing the voltage applied to the capacitor will also reduce its capacity.

While granting the truth of this, I wouldn't hesitate, say, to substitute a 450-volt capacitor for a harder-to-find 250-volt unit. That might involve some capacity loss, but my gut tells me that the difference would not be significant. However, using, say a 450-volt unit to substitute for a 160-volt capacitor in an AC-DC set would be pushing the envelope a little too far!

❖ Capacitor Re-Forming

Since the formation of the oxide dielectric in an electrolytic capacitor depends on the voltage applied, long-disused electrolytics that might fail because of deteriorating dielectric can sometimes be rejuvenated by "re-forming" them. For instance, starting up a vintage set, with its original electrolytics in place, for the first time could cause the capacitors to fail. However, if the set were to be plugged into a Variac and the line voltage were to be raised slowly, a questionable dielectric layer could be enhanced to the point where the capacitors would be safe to operate once more.

I've never seen a discussion about how long to spend bringing an old set up to voltage for the first time. And, I haven't thought about it a lot myself because I (and I realize this is heresy for some) usually recap a set before starting it up. I have done it a few times when the radio was very clean and had obviously been stored under good environmental conditions. Then I slowly increased the line voltage over a period of about an hour while monitoring B plus voltage to make sure that it also was rising.

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Saving Your Radio Astronomy Data

One of the interesting challenges for amateur radio astronomers is the amount of data that quickly fills up your hard drive storage. Many of the projects previously described in this column have shown graphs created automatically using software that converts your received signals into some form of digital files. Graphs help show what's going on. Programs such as SpectraVue, Spectrograph, or Radio-SkyPipe II have several data saving options that automate the capture of images, audio, etc.

In the chart below, I have listed the software I use most often with comments on their data saving options. The software listed in the chart is free except for the full-featured version of Radio-SkyPipe II. I use the full-featured version of SkyPipe II for its ability to FTP (File Transport Protocol) files to a remote web server. This list is not exhaustive, there are other software packages that can do these chores.

SpectraVue works with my RF-Space SDR-14 and SDR-IQ receivers as well as with the FUNCube Pro+ SDR Dongle used as a 'microphone' input. Bob Grove covered the FUNCube's capabilities in the April 2013 edition of *Monitoring Times*.

These programs offer a variety of features to suit your recording needs. They all have useful functions for more than radio astronomy. Check out their web sites for details.

❖ Callisto Solar Monitoring Updates

Dual detection of a type-3 solar burst occurred recently with my e-Callisto receiver and on Whit Reeve's almost identical setup in Anchorage, Alaska. One neat way to verify the occurrence of these events is by checking or receiving the alerts via SWPC Product Subscription Service at **SWPC.Products@noaa.gov**. They also have a lot of predictive products for all kinds of solar events that affect radio.

Here's an excerpt from an e-mail report I received for 245 MHz radio storms:

Radio Events Observed 16 Apr 2013
A. 245 MHz Bursts

Start	End	Peak Flux	Time of Peak	Duration
0930	0930	170	0930	0000
1107	1107	110	1107	0000
1121	1122	110	1121	0001
1130	1130	140	1130	0000

B. 245 MHz Noise Storms

Start	End	Peak Flux	Time of Peak
1129	1130	160	1130

Note the times are in UTC and the peak flux SFU (Solar Flux Units). A SFU is defined as a specific amount of power over a given area. One SFU = 10,000 Janskys. As a reference, 1 Jansky = 10^{-26}Watts m^{-2} Hz^{-1}.

In this case, the above times occur earlier than sunup and sundown at my location. The folks on the other side of the earth have a shot at them. Working with data worldwide regularly lets you fine-tune your UTC/local time conversion skills.

❖ Noise Sources

If you pursue weak signals, one of the main questions is, how sensitive is your receiver? Antenna amplifiers can overcome such things as line-loss, but the main goal for radio astronomy systems is to amplify without adding very much noise. That's the goal of a good LNA (Low Noise Amplifier). I recently added a TMA (Tower Mounted Amplifier) purchased from W. D. Reeve in Anchorage, Alaska (he also built my Callisto receiver).

The TMA system offers a single or dual LNA package. Each LNA is rated at approximately 20 dB of gain and 1.2 dB NF (Noise Figure) and has a frequency range of about 10 to 1000 MHz. The receiver has an 8 dB NF and, when combined with the TMA's LNA NF, the final NF is about 3.0 dB which is very good. With the lower noise figure, you can detect weaker signals that would otherwise be buried in a receiver or amplifier with a high noise figure.

There are several ways to evaluate the noise figure and overall sensitivity of your system, so it helps to have a calibrated noise source. I have used one, purchased from RAS (Radio Astronomy Supplies), and it's calibrated in degrees Kelvin, or K. Mine is rated at 147,706 K. Noise conversions usually use 290 K as a room temperature reference. Using a conversion program, the ENR (Excess Noise Figure) is 27.1 dB.

When doing some testing on my Callisto setup recently, I was asked to provide a 15 dB ENR source. If you are looking for a noise source, see if you can get one that is rated at the 15 dB ENR level. Since mine was too 'hot,' I had to acquire some attenuators to knock my source down to a level below 27.1dB.

Most noise sources are broadband but you will want to verify that it covers the band in which you're interested. I found a calibrated noise source with an output of 15 dB ENR that is rated from 10 to 1420 MHz available from RF Design in England. It's a Model RFD 2315-15 dB ENR, that should cover most amateur radio and astronomy applications.

❖ SBSpectrum

SBSpectrum is a freeware program available to the amateur community. It's designed for monitoring Doppler shifts of signals and related ionospheric propagation. The program, by Peter Martinez, is called "Dopplergrams on the Soundcard." You have to join Yahoo's Dopplergram group in order to access the program. One limitation I found was that there was no auto-save. I sent a quick note to the author wondering if that feature could be added and it was done promptly.

As an experiment, I have started posting each Dopplergram that gets created here in Roswell, New Mexico, while monitoring WWV on 20 MHz, to my Web site via FTP. You can view them by accessing the FTP folder at **ftp.roswellmeteor.com/sbspectrum**. The anonymous login does not work on this site. You can use the following login and password which gives you read-only rights to these files. Login: **meteorguest** password: **Guest10.** I will be experimenting with the settings so, expect some changes to the Dopplergrams.

The WWV site is about 600 miles north of Roswell and I am using a simple horizontal dipole cut for 20 MHz. I use a FUNCube Pro+ SDR USB dongle receiver with SpectraVue, SBSpectrum, and Argo software. Argo sends the current graphic to the site and can be accessed via **www.roswellmeteor.com**.

❖ Using DTV Carriers for Meteor Detection

An accessible activity that several of you have inquired about is a technique for listening or detecting meteor activity by radio. You

Software	Graphics	Audio	Charts	Data
SpectraVue by Moetronix	Screen Captures to file as JPG, PNG or BMP	WAV files Demodulates	Screen captures	Saves FFT or Continuum as CSV Excel file
Spectrograph by Jim Sky	Saves image as a still and movie		Spectrum	Works with SDR-14 Radio
Radio-SkyPipe II By Jim Sky	Graphs	WAV files	FTP images	Lots of logging options
Spectrum Lab By DL4YHF	Screen shots	Saves audio, FFT, images	Screen captures	Does RMOB with conditional file such as SPmeteor
Spectrogram 16 By Dave Horne	Screen capture as a JPG/ BMP	WAV files Up to 700 GB	Stopping chart, WAV and JPG file	Saves as a delimited text file
QRSS Viewer-ArgoBy I2PHD	Saves current screen	No	Saves screen as a BMP or JPEG	No
SBSpectrum By Peter Martinez	Allows manual/auto capture of the Dopplergram'sscreen.	No Audio save.	Determined by Sample Interval	Auto-save added recently

may have experimented with it in the past and used the powerful analog TV carrier signals to capture Doppler 'pings' using SSB tuned to one of the carrier frequencies.

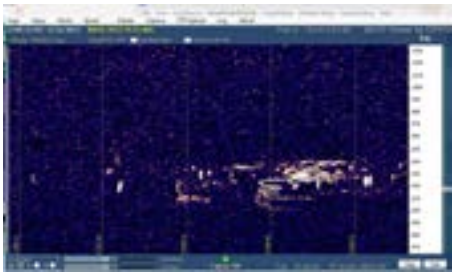
In 2009, when the U.S. converted to digital TV (DTV), the old, faithful, analog signals went away. However, there is a digital carrier that can be used. The digital carriers may be somewhat lower in power, but are detectable. Here are some of the lower digital TV carrier frequencies useful for meteor detection using forward scatter:

DTV Ch.	Carrier MHz
2	54.310
3	60.310
4	66.310
5	76.310
6	82.310

Tune one kHz lower when in USB mode. For channel 2, I dial 54.309 MHz and run the monitoring software tuned to around 1000 Hz. You want to find a DTV channel that you can't normally hear except when an echo is generated by a meteor and, with monitoring software, you can log the echoes. I use the free software, Spectrum Lab, which displays a spectrum or 'waterfall' that can be changed to see only a narrow audio range of perhaps 400 Hz. And, with a text file loaded into the 'conditions' directory and activated after suitable modifications, it can display and/or log all of the detected bursts.

If you have heard of *Radio Meteor Observing Bulletin* (RMOB) by Pierre Terrier, this will create compatible text files that list each meteor detected, the hours' totals, and durations. Below is an Excel chart created from several days of logging on DTV channel 2 during the Lyrids meteor shower in April, 2013. The vertical axis represents counts per hour and the horizontal axis, the date/time in YYYYMMDDHH. Be aware that not all detected activity is related to the Lyrids. However, many of the more prolific storms show a notable increase in intensity and occurrence of meteors.

ARGO software makes it easy to log and FTP the echoes as a JPG or BMP graphic file. Below is a JPG file taken during the Lyrids shower during April 22, 2013.



1.9 Meter Dish Project Update

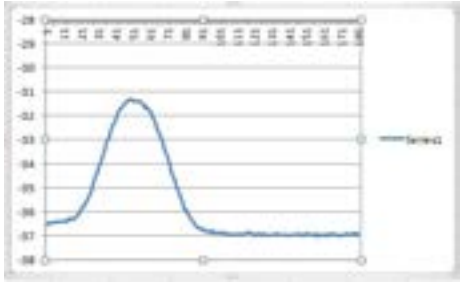
In recent columns I have highlighted the 1.9 meter, roof-mounted, microwave dish I acquired which originally operated in the 11 GHz band. I decided to give it a try on 1420 MHz. I had earlier bought a 1420 MHz feed and 1420 LNA (Low Noise Amplifier) from Radio Astronomy Supplies. But, since the feed support for the dish was designed to be used as an offset feed, rather than a prime-focus feed (mounted above the center of the dish), I had to do some calculating.

The focal distance is close to 48 inches. The gain of the dish is about 27 dB and the beam-width at 1420 MHz is 7 degrees. The dish-mount is fixed but adjustable fairly easily up and down in elevation. To align it with the sun, I stuck a card over the feed opening and placed a small circular mirror at the center of the dish. Several minutes before solar noon (1855 UT on that date) I eyeballed the reflection on the feed cover and adjusted the dish until the sun's reflection was centered.

Reflected image of the sun by mirror almost centered.

Sun Almost Overhead

A quick look at the received signal on SpectraVue indicated I had a significant increase. SpectraVue saves the peak and continuum data each minute, tagged with the exact date and time. Below is a chart created from the CSV data imported into an Excel spreadsheet with the continuum data for that run.



The vertical numbers are the continuum levels (dB) over time, the horizontal line, in minutes, starting from the selected block of data. The curve peaks very close to the Solar Noon transit at 18:55 UT (12:55 Local MDT).

SpectraVue's manual (version 3.18, January 27, 2013) indicates the continuum mode displays the total power over the entire frequency span versus time. You can control the time period between logging each measurement. When saving the files as a CSV (comma delimited text) you have the option of where to save the data, and how often, down to fractions of seconds with the newest version. The continuum mode works well with slowly changing signal levels. Each reading is created as a separate file. I use an Excel import file routine that combines all of the selected files or folders into the spreadsheet where I then create a graph from the data.

LMR-400 low-loss coax cable connects the dish's LNA back to the shack. However, the results above point the way to more improvements. Motorized control? Another LNA?

The receiver currently being used is a FUNCube Dongle Pro tuned to 1420 MHz. SpectraVue recognizes it as a sound card/microphone. I set the bandwidth to its maximum of 80 kHz. The FunCube doesn't have any hardware front-end filtering and is probably not ideal. But, as a "get-familiar-with-the-dish" test, I have found it educational. While trying for some weaker signals, I got to wondering if I could place the FunCube close to the feed and LNA – to reduce cable losses. Since the FUNCube is a USB device, I found a USB/CAT5 extender at Black Box (Model IC282A $85) that is powered strictly with the PCs USB port and supports a CAT5 Ethernet cable up to a distance of 130 feet.

Potentially this scheme could save expensive coax. But, it could also generate RFI that may be harmful to other monitoring activities. I used a portable AM/FM radio to scan the CAT5 cable and found some interference close to the wire. At one or two feet away, background noise seemed to be normal. More testing will be needed to confirm the pros and cons. The FUNCube sends the detected data as an 80 kHz stream. This should have fairly low-loss on typical CAT5 cable. The signal is decoded by the SpectraVue software on the PC; more testing is in the mill.

Radio Astronomy History Buffs

If you're interested in the history of radio astronomy, check out the book *Serendipitous Discoveries in Radio Astronomy* edited by K. Kellerman and B. Sheets. The book represents the proceedings of a Workshop held at the National Radio Observatory at Green Bank, West Virginia in 1983. What is unique about this book is that it includes lots of photos and transcribed conversations and personal insights. Almost the entire Karl Jansky family attended the conference. And, the book has numerous chapters by the pioneers of radio astronomy. I bought my copy used from ABE Books. Keep listening up!

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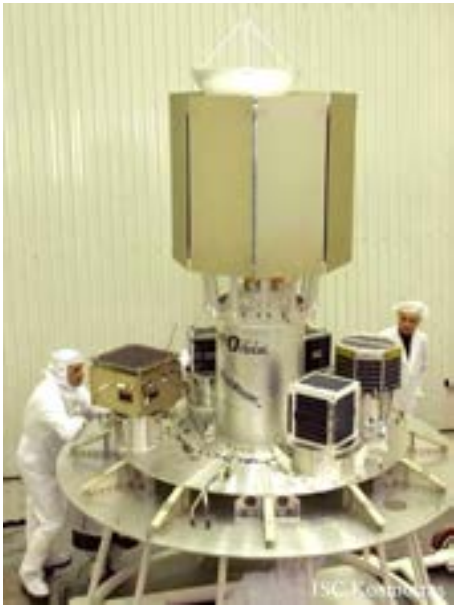
Amateur Radio Satellite Update

Let's once again shine the spotlight on one of AMSAT's remaining FM "Easy Sats" and highlight yet another Cubesat still in orbit and operational at press time. However, as I've repeatedly said before, it's important to remember that because the lifetimes of these satellites (particularly the Cubesats) are relatively short, those satellites may not still be operating by the time you read this.

❖ SAUDISAT 1C (SO-50)

With the demise of AMSAT's AO-51 satellite, along with the "on again, off again" nature of AMRAD's venerable AO-27 satellite (currently "off" at this writing), there is really only one FM "Easy Sat" left in orbit and consistently operational: SAUDISAT 1C (SO-50), successfully launched on December 20, 2002 into a 625 by 692 km, 64-degree inclination orbit from the Baikonur Cosmodrome in Kazakhstan. It was a project of the Space Research Institute of the King Abdulaziz City for Science and Technology in Saudi Arabia.



SAUDISAT 1-C (mounted at the right foreground) sits atop its launching structure just prior to launch (Courtesy: ROSCOSMOS)

SO-50 carries several experiments, including a Mode J FM amateur repeater experiment operating on a 145.795 MHz uplink and 436.795 MHz downlink. The repeater is available to amateurs worldwide as power permits, using a 67.0 Hertz CTCSS (PL) tone on the uplink for on-demand activation. SO-50 also has an on-board 10-minute timer that must be armed before use.

Thus, in order to "turn on" the bird (if it isn't already turned on) you must first transmit an initial carrier with a PL tone of 74.4 to arm the timer, and then a 67.0 Hz tone for access. The repeater consists of a miniature VHF receiver with a sensitivity of about -124 dBm and an IF bandwidth of approximately 15 kHz.

The receive antenna is a 1/4 wave vertical whip mounted in the top corner of the spacecraft. The receive audio is filtered, conditioned and then gated in the control electronics prior to feeding it to the 250 milliwatt UHF transmitter. The downlink antenna is a 1/4 wave whip mounted in the bottom corner of the spacecraft and canted inward at 45 degrees.

Unfortunately, the comparatively low power transmitter carried aboard SO-50 means that some form of gain antenna (such as an Arrow hand-held cross polarized Yagi or the Elk 2m/440 hand-held Log Periodic antenna discussed in previous columns) may be required to successfully hear the downlink while attempting to work through the satellite.

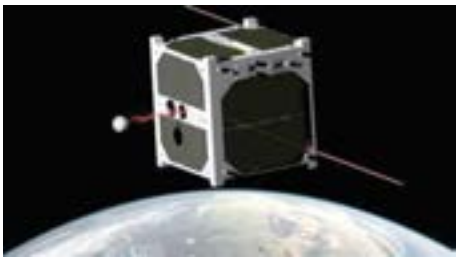
The upper stage shroud that covered SAUDISAT 1-C during launch (Courtesy: ROSCOSMOS)

SAUDISAT 1-C is launched on a Dnepr rocket from the Baikonur Cosmodrome in Kazakhstan (Courtesy: ROSCOSMOS)

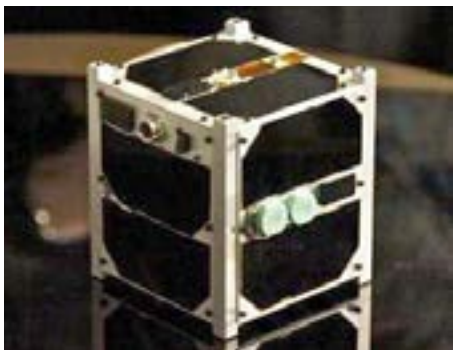
❖ ESTCube-1

Estonia's first Cubesat, ESTCube-1 (carrying the amateur radio call sign ES5E/S) was successfully launched aboard a VEGA launch vehicle from the ESA Spaceport in Kourou in French Guiana on May 7, 2013. Approximately 12 hours after launch the ESTCube-1 team posted a status report on their Web site that received telemetry packets were indicating that the satellite had fully charged its batteries and was working nominally.

Built by students at the University of Tartu in Estonia, ESTCube-1's primary mission is to test electric solar wind sail technology…a novel space propulsion technology that could someday revolutionize transportation within the Solar System. Sometime during its mission ESTCube-1 will be commanded to deploy a 10-meter long conductive electro-dynamic tether. The force interacting with the tether will then be measured.

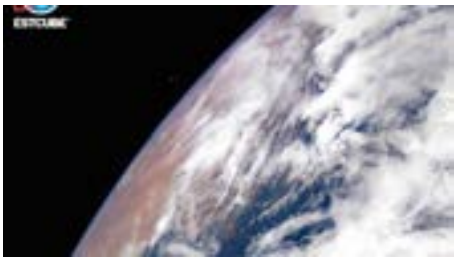


Artist's concept of how ESTCube-1 might look on orbit (Courtesy: Tartu University)



The flight model of ESTCube-1 (Courtesy: Tartu University)

ESTcube-1 emits a Morse code beacon on 437.250 MHz. A 9.6 kbps AX.25 telemetry beacon can also be activated on 437.505 MHz using the digital call sign ES5E-11.



The first photo snapped by ESTCube-1 from orbit (Courtesy: Tartu University)

SELECTED FREQUENCY AND MODE DATA:

SATELLITE	Uplink (MHz)	Downlink (MHz)	Mode
SAUDISAT 1C (SO-50)	145.850	435.795	FM Voice (67.0 Hz CTCSS Tone For Access)
ESTCube-1		437.250 437.505	CW Telemetry 9.6 kbps AX.25

Soon after launch, ESTcube-1's camera team, lead by the University of Tartu Computer Technology graduate student Henri Kuuste, noted that the satellite's onboard camera was also working perfectly on orbit along with all the other subsystems needed for taking photos from space. The first image was captured on May 15 over the Mediterranean Sea. The photo showed a portion of the Mediterranean Sea along with the Sahara desert, and Tunisia.

Also, soon after launch, the entire ESTCube-1 team was invited to a reception by the Rector (President) of the University of Tartu to celebrate the successful launch of the satellite. You can watch a video (in English) of the ceremony at **www.uttv.ee/naita?id=17163**

Other information (along with photos and videos) about the satellite is contained on the ESTcube Web site at: **www.estcube.eu/en.** Technical details about the satellite (including the various emission characteristics of the beacons) are shown at: **www.estcube.eu/en/radio-details**.

❖ FOX-1A Has a Launch Date!

At long last, NASA announced on May 13, 2013 that AMSAT's Fox-1A spacecraft has now been officially assigned a berth on the ELaNa XII mission with a expected orbit of 470 x 780 km at about 64 degrees inclination. This orbit has a lifetime of about 11 years. The actual launch date has now been tentatively set for sometime in November, 2014.

The engineering model of FOX-1A's Internal Housekeeping Unit (IHU) was broadcasting greetings on 2m at the 2013 Dayton Hamvention®. (Courtesy: Author)

In follow-up conversations with NASA, AMSAT has also learned that Fox1-A's ride to orbit will be on the National Reconnaissance Office's (NRO) L-55 mission that will fly on an Atlas V vehicle launched out of Vandenberg, AFB near Lompoc, California.

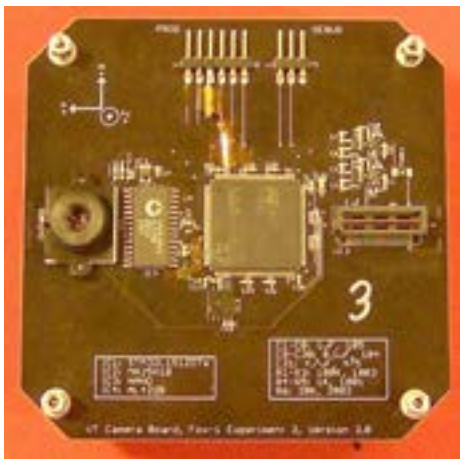
NRO missions are generally classified. However, AMSAT has been told that, as a secondary payload, Fox-1's orbital drop-off point will be substantially different from that of the "paying customer." Information on the Atlas V launch vehicle can be found at: **en.wikipedia.org/wiki/Atlas_V.**

FOX-1A's Internal Housekeeping Unit (IHU) on display at this year's Dayton Hamvention. (Courtesy: Author)

In other Fox-1A news, AMSAT Vice-President of Engineering, Tony Monteiro AA2TX, reported that the software development team had recently activated the Fox-1 system software on the satellite's Internal Housekeeping Unit (IHU). The IHU is the main computer (the "brains") of the satellite and features a 32-bit, STM32L microprocessor.

An engineering model of the operating IHU card was shown in the AMSAT Engineering booth at the 2013 Dayton Hamvention®. Passers-by could also tune their FM hand-held radios to FOX-1A's 2 meter downlink and hear the uploaded greeting message from its IHU voice encoder.

The Fox-1 Engineering Team now plans to deliver the satellite for integration with the launch vehicle sometime during May, 2014. Commenting on that delivery date, Tony noted that, "While this date is later than we had hoped, it is well within the normal variance of ELaNa launch dates and the extra time will be most welcome for additional satellite testing."



A close up view of FOX-digital camera board that was on display at this year's Dayton Hamvention. (Courtesy: Author)

Speaking at Dayton, AMSAT President Barry Baines said that, "AMSAT's focus on STEM education and development of a Cubesat platform capable of flying a science mission with a reliable communications link has resulted in the selection of Fox-1 in the third round and RadFxSat (Fox-1B) in the fourth round of NASA's Cubesat Launch Initiative."

Needless to say, all of this is very exciting news for the AMSAT community and really puts the focus on both finishing the satellite and developing the ground station software to fully use it, once it's launched.

❖ Planned Modes of Operation

Fox-1A and the Fox-1B missions are based on similar system architecture. Both satellites will include a U/V (Mode B) FM analog transponder. AMSAT's experimenters hope that FOX-1A's 2-meter downlink should be even easier to hear than its (now defunct) cousin, AO-51.

That's because both satellites are being specifically designed so people can work through the satellite using just a dual-band HT and an "arrow-type" hand-held antenna. Telemetry will be sent via a sub-audible voice downlink using slow speed FSK with forward error correction. The satellite is also slated to support a high-speed digital data mode.

A free telemetry decode program (called "FoxTLM") is now under development and will be made widely available to decode and display both the low-speed telemetry and the high-speed data downlink on Fox-1. Plans are also in the works to build an updated version of the software for FOX-1B (RadFxSat).

❖ Support for Science

All Fox Cubesat are designed to host advanced science payloads to support future science missions. This is accomplished by using a technique pioneered by AMSAT in its MICROSAT series first launched in the early 1990s. Called "TSFR" (This Space For Rent) this feature leaves up to four (of the ten) stacked circuit boards of the FOX satellite spacecraft design open to accommodate science payloads. Hopefully, this approach will help AMSAT to continue to qualify for NASA ELaNa (free) launches in the future.

For example, Fox-1A will carry a JPEG digital camera experiment being built by students and staff at Virginia Polytechnic Institute and State University (Virginia Tech). Virginia Tech's camera will operate when the satellite is in the high-speed digital data mode and is designed to take one photo each minute.

The Fox-1B (RADFxSat) satellite will carry a space radiation experiment from Vanderbilt University. Their Low Energy Proton Experiment (LEPE) will detect single-event upsets in on-board memory devices and will operate all the time. Experiment data will be downlinked with the satellite's telemetry.

CommRadio CR-1

By Thomas Witherspoon K4SWL

New products on the radio receiver market these days tend to be SDRs (Software Defined Radios). And it's a good thing: by reinterpreting radio digitally, it helps ensure that radio will have a place in this century. Moreover, I'm a big fan of SDRs, as they typically offer a lot of performance for the price. In fact, my main receiver these days is the WiNRADiO Excaliber SDR. It's the receiver I use for the bulk of my radio recordings as well as for band scanning.

SDRs often look like a small box with power button, antenna connections, usually computer connections, and, well, that's about it. Many refer to the SDR as a "little black box." SDRs don't require a display; rather, they rely on your PC for this and all other functions.

When I first heard that CommRadio was introducing a new SDR, designed and built in the United States, I expected a similar product, in the form of a small black box. Instead, I encountered a display, tuning knob, volume control, and several front panel buttons; in essence, a small, stand-alone, self-contained, battery-operated, SDR tabletop receiver! Needless to say, this was unexpected.

First Impressions

When I saw the CR-1 for the first time in person, I was simply amazed by its construction. Being a fan of modest, simple designs, the CR-1 is all that and, for lack of a better word, "cute." But, don't be fooled by the cuteness factor; the CR-1 is a *very* solid product, and a tough one. The case is made of 20 gauge steel, the front panel is machined aluminum, and the tuning knob is black, anodized aluminum. Four substantial resin feet lift the CR-1 a full inch off the desktop, making the height of the controls comfortably accessible, and providing excellent stability while tuning or pressing buttons on the front face.

The OLED display is small, only measuring 1.5 inches wide by three-quarters of an inch high, but the resolution is extremely crisp and easy to read, even at a distance or outdoors. All of the relevant information (frequency, filter width, mode and S-meter) is accommodated by the modest display.

But what about the operation of this unit? Fortunately, I met Don Moore, president of CommRadio, at the Dayton Hamvention® this past May and he kindly arranged to provide a CR-1 for review.

Operation

The CommRadio CR-1, I'm happy to report, is a pleasure to operate. I was able to intuit all of the receiver functions without consulting the owner's manual even once, a major plus. To turn on the radio, you simply push the volume control knob, the OLED screen displays a "welcome" message, and you're in business! The CR-1 also defaults to the last used frequency, mode, and filter settings, which is convenient.

There is no numeric keypad for direct frequency entry, only a tuning knob and buttons which allow you to move through the bands. To compensate for a lack of keypad, the CR-1 has a few unique features:

The tuning knob is adaptive to your tuning speed, the faster you tune the encoder, the more it will increase its tuning steps.

Tuning to a specific frequency is easy: simply push the tuning knob once to highlight the frequency cursor, and then rotate the encoder to reposition the cursor, and press again to lock the position. You can also use the right/left arrow keys to reposition the frequency cursor.

By setting the automatic tuning mode, the CR-1 will automatically change the mode and tuning steps to coincide with standard band plans. You can set the CR-1 to change bands according to the amateur radio or shortwave broadcast meter band plans.

The tuning knob, while not large, is appropriately sized for the front panel of the receiver. Though not noticeably weighted, a good thing for a small tuning knob, it's accurate, responsive, comfortable to use for long periods of time, and the finger dimple is perfectly sized for operational ease.

Switching modes is simply a matter of pressing the dedicated MODE button on the front panel of the CR-1, then cycling through options with the right/left arrow keys.

Filters

The CommRadio CR-1 has a good selection of filters which appear to be well-chosen for the appropriate modes:

CW: 500 Hz, 1.0, 1.8, 2.6 kHz
SSB: 1.8, 2.6 kHz
AM: 5, 7.5, 15, 25 kHz
Non-Broadcast FM 15, 25 kHz
FM Broadcast 200 kHz

The DSP filters have typically sharp skirts; I've heard no noticeable ringing in CW. Of course, it would have been a nice touch if the filters were variable; still, the existing filters widths are quite effective.

Audio

The CommRadio CR-1 has a bottom-mounted internal 2.5-inch diameter, commercial-grade, Mylar cone speaker. I find that the downward reflecting speaker with a one inch clearance under the radio makes for pleasant audio fidelity. Audio out of the speaker is not as robust as I would like, as it lacks bass response, but the audio produced is clear and crisp. I imagine it would produce intelligible audio even in a noisy environment. But, the CR-1 also has a port for an external speaker and an internal amplifier that will deliver 0.8 watts into an 8 ohm speaker.

A separate headphone jack is conveniently located on the left side of the CR-1's front panel. It delivers about 40 mW into 16 ohms – more than enough for the various headphones I've tested it with. Audio fidelity is excellent, though I have noticed a faint white noise in my review unit; a detectable high-pitched hiss via my CR-1-connected headphones. It seems to be present at the same low volume even when the volume control is turned down completely; I suspect it may be some noise in the headphone amplifier. The noise does not interfere with listening at all, but audiophiles will certainly notice it. A future firmware revision to the headphone gain chain may fix this.

❖ CR-1 Performance on the Bands

Shortwave

The CR-1 is an excellent shortwave receiver. How do I know? Because I pitted it against every HF receiver and transceiver I have on hand (which amounts to quite a few) and it held its own with regards to sensitivity and selectivity. It ran fairly neck-and-neck with my Alinco DX-R8, which is a remarkably good receiver. I imagine it would hold its own against the Icom R75 as well, although it lacks many of the R75's features. Yet it's priced well below a new R75.

While the CR-1's automatic gain control (AGC) copes with weaker signals and selective fading, I would still like to see among its features selectable USB/LSB sync detection. This is a tool I often use to eliminate an encroaching signal on a sideband and I suppose it's possible that this could be included in a future firmware revision. My Alinco DX-R8 also lacks sync detection, however, so in fairness I can't say this feature should be expected at this price point.

Mediumwave/Longwave

The CR-1 could receive all of my local AM stations with ease, but weaker stations were more problematic. This could have been a limitation of my large horizontal delta loop antenna; based on the receiver specs, I imagine this would improve greatly with a proper MW antenna. But it's worth noting that I was using the HF/MW BNC connector on the back, not the higher impedance port for long wire antennas, which might have produced different results. On longwave I found I could copy many of our local airport beacons.

VHF/UHF

As a bonus, the CR-1 provides wideband continuous coverage from 64 - 225 MHz and 438-468 MHz, which includes the FM broadcast band, aircraft, marine, amateur radio/public service, and GMRS/FRS frequencies. While I did not spend a great deal of time exploring these portions of the VHF/UHF spectrum, I did find that the CR-1 easily tuned in all my local FM broadcast stations, my local airport tower frequency, and a few amateur repeaters. The squelch control works very well. Note that the CR-1 has a separate UHF/VHF BNC connector on the back panel. In this review, I simply used a telescopic whip with elbow joint to tune through the band and it's a great portable accessory.

Summary

I took the following review notes of the CommRadio CR-1 from the moment I first turned it on.

Pros

Wide receiver coverage (LW, MW, SW, FM BC/VHF/UHF)
Good shortwave sensitivity
Tuning ease (see con)
Multiple, standard antenna connections (VHF/UHF, HF, HF/MW)
Simple, intuitive operation; barely requires a manual
Selectable tuning modes (amateur/shortwave) adapt modes/steps to band plan
Well-chosen filter widths, no ringing (see con)
Small form factor; compact, sturdy design, *perfect for travel*
Built-in battery option, with excellent life (as much as 8-10 hours)
Separate headphone jack (front) and external speaker jack (rear)
Flexible power source (USB or 6-18 VDC)
Future updates will include IQ out
Durable, tough chassis, secure ports, gold-plated circuit board pads

Cons

No sync detector
Bandwidth not variable (see pro)
No direct frequency entry (see pro)
No noise blanker
Very slight white noise hiss can be heard over headphones (slated to be fixed with the next firmware update)

❖ Conclusion

The CR-1 puts me in mind of a smaller, updated, and more functional Lowe or Palstar receiver; it has a basic, simple design, yet it has all of the important features you would expect from a receiver in this class. Moreover, it has the distinct advantage of being an SDR; firmware updates can address customer requests, and functionality added and tweaked as needed.

While medium wave performance is fairly average, shortwave sensitivity and selectivity are very good, indeed. The CR-1 copes well with both blowtorch stations and weak signal DX. Though my WiNRADiO Excalibur has a slightly lower noise floor, the CR-1 holds its own at half the cost.

The CommRadio CR-1 might just be the perfect radio for DXers who like to travel. I travel frequently, and I like to travel light. You'll never see me check in luggage at an airport; my carry-on bag (with radio, of course) is sized to fit in the most restrictive of overhead compartments, like those in many turbo-prop commuter planes. And the CR-1 fits *perfectly* in my small carry-on.Though I leave them attached, the feet can be removed, thus reducing its size even further. I don't even worry about extra protection for it, since it's built like a little tank!

Best yet, since the CR-1 was designed by an aircraft avionics manufacturer, the built-in battery contains less than 1gm of lithium, therefore is well within the limits regulations currently impose. What's more, should your battery deplete, the CR-1 can be powered by a standard USB connection.

In short, the CommRadio CR-1 is a fun little radio and in my opinion well worth its approximate $500 price tag. Moreover, functionality may further improve; for example, May 2013 firmware updates included a built-in, functional CW reader and international frequency steps.

CommRadio is planning an update later this summer which will produce IQ-out via the headphone jack, and on a date to be determined, we may even see IQ from the USB port. If these are added, the CR-1 will connect to your sound card or USB port, and external SDR application functionality will further expand.

The CR-1 has a lot of features, and a lot of potential, in a small, sturdy form, always a good formula for a successful radio. And, because of this, even though I currently have a number of portable receivers and transceivers, I've decided to save up for a CR-1 of my own.

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Radio Free Apple

It was a matter of time, wasn't it? We all knew that Apple would throw their hats into the Internet radio ring when the time was right. If there is one thing to be said of Apple, it is that if they aren't the first to do something, they will usually wait until they can enter the market with a splash.

Here we are, a few months away from the release of the newly redesigned iOS 7 operating system that promises to provide a much more sleek and refined interface for iOS users. Along with the new design, iTunes Radio will take flight. Is this another Apple home run? Will they revolutionize the way we listen to music all over again?

Aimed directly at those currently using Pandora and Spotify, iTunes Radio will provide users with a free service (currently only available in the U.S.) to create 'stations' based upon an artist or song of their choosing – just like those other services. iTunes Radio will be featured on all iOS devices capable of using the new iOS 7 and Apple TV. Everything is scheduled for a fall, 2013 release.

As with those currently using Pandora, Spotify or Slacker, iTunes Radio will allow you to skip songs or "like" a song, to fine tune the selection of songs presented to you, and let you buy directly from the iTunes Store any songs you hear that you particularly enjoy. There will be advertising in the basic version of iTunes Radio. However, those who are willing to shell out $24.99 for the iTunes Match service, can enjoy ad-free music. Also, iTunes Match will provide storage space for your music and other content in Apple's iCloud service. You can store up to 25,000 songs with iTunes Match (both those bought through their store and those in your existing collection).

As with all things Apple, there will be those who move squarely into the iTunes Radio corner, so there will be some shift in the industry towards Apple. However, I don't know how many average users will be tossing their Pandora accounts aside.

For one thing, you are limited to devices using iOS. That means my Kindle Fire, my Sony Blu-Ray player and my Roku are still going to be pumping tunes out through Pandora.

For another, Pandora users already have quite a few stations they have cultivated and pruned so they play exactly the types of songs they want to hear. Will they want to start all over? For someone like me, it is the same reason I haven't logged in to the Jango account I created months ago: my Pandora stations are working just fine, thank you.

The standard thinking among many in the tech-industry press is that for folks new to Internet radio and Apple die-hards, iTunes Radio will likely be the same revelation everyone else experienced the first time they created a new station on Pandora. For the rest, it will probably just be another icon on their iOS device they open every once in a while.

I don't personally expect any larger revelations to come from iTunes Radio initially. However, Apple is great at evolving a product over time. It will be interesting to see what they are able to do in later versions.

Personally, if they combined a Pandora-type service with something like iHeartRadio or TuneIn, where you can listen to stations you create, or an actual radio station, that is something I would be excited to see; an all-inclusive, one-stop spot for all things Internet radio. I guess that one will stay on my wish list for a little while longer.

❖ Pandora Pinches Pennies

Speaking of Pandora, the company recently announced they had agreed to purchase KXMZ-FM in Rapid City, South Dakota. This marks the first foray into terrestrial broadcasting from the Internet radio giant. However, Pandora isn't turning its focus away from Internet broadcasting; this all comes down to Internet royalty fees.

You may remember that I had previously discussed how Pandora has lobbied Congress, the Recording Industry Association of America (RIAA), and anyone who is willing to listen, that Internet-only broadcasting was paying exorbitantly higher fees than terrestrial radio stations were having to pay.

Adding insult to Pandora's perceived injury, was a deal reached just last year between broadcasters and one of the "big three" song publishing companies. In the deal ASCAP, which helps make sure songwriters are compensated for their efforts, reached a deal with terrestrial broadcasters that offered them lower copyright royalty rates on their Internet radio offerings since they also had a terrestrial broadcast.

Pandora and other Internet-only services cried foul, as they claimed this gave folks like radio giant Clear Channel's iHeartRadio a competitive advantage over Pandora, which was paying higher rates since they had no terrestrial stations in their offering.

By buying the South Dakota station, Pandora now should qualify for lowered copyright royalty rates for their Internet radio station service, by combining it with the royalty rates they are paying from the terrestrial station. It isn't a huge savings, but the real benefit for Pandora is in the message they are sending to publishing companies which, they say, have been "bullying" them with higher rates.

It is an interesting strategy and may open the door for other Internet-only radio providers to follow suit, if it makes financial sense for them to do so. If nothing else, it adds another twist in the battle between terrestrial and Internet radio for supremacy.

GlobalNet Links

Apple unveils iTunes Radio - **http://techcrunch.com/2013/06/10/itunes-radio/**

Why did Apple's iTunes Radio fall short of the hype? - **www.latimes.com/business/technology/la-fi-tn-apple-itunes-radio-hype-20130611,0,5570535.story**

Apple's iTunes Radio - **www.apple.com/itunes/itunes-radio/**

iTunes Radio vs. Pandora - **http://reviews.cnet.com/8301-19512_7-57588579-233/itunes-radio-vs-pandora/**

Apple's iTunes Radio service: 3 things to know - **www.usatoday.com/story/tech/personal/2013/06/11/apple-itunes-radio/2411867/**

Pandora to buy radio station to piggyback onto cheaper costs - **http://news.cnet.com/8301-1023_3-57588837-93/pandora-to-buy-radio-station-to-piggyback-onto-cheaper-costs/**

What's NEW

Tell them you saw it in Monitoring Times

Larry Van Horn, New Products Editor

New MFJ Power Supplies Now Available

Most hams will tell you that, as they continue to build their shacks with new radio capability, the one purchase that they make regularly is an additional power supply or two. MFJ recently added two new power supplies to their line – MFJ 4128 and MFJ-4230MV switching power supplies.

The MFJ-4128 can power your HF, VHF, or UHF mobile or base transceiver with an output of 28 Amps maximum and 25 Amps continuously at 13.8 VDC.

This basic power supply has all of the output connectors you will ever need. The unit has five-way binding posts for high current rigs and quick connectors for low current accessories. It also has a low, seven amperage cigarette lighter plug, perfect for powering small accessories.

It is lightweight (only four pounds), compact (7-inches wide, 2.25-inches high and 7.5-inches deep), so it can also be carried on your business and vacation trips to far away and exotic locations.

The 4128 features over-voltage and over-current protection systems and has a quiet internal cooling fan with "fan on" LED. It features a selectable AC input voltage from 85 to 135 VAC or from 170 to 260 VAC, so you can literally take it around the world.

The MFJ-4230MV is billed as the world's most compact switching power supply that also has a meter and adjustable voltage control. A simple front-panel, push-button switch lets you

choose either the Amp meter or Voltmeter.

At just 5-inches wide, 2.5-inches high and 6-inches deep, it weighs only three pounds. It's the perfect pack-n-go power supply for Field Day, DXpeditions, camping, hiking or to pack for your next business trip or vacation to some faraway place.

MFJ-4230MV gives you 25 Amps continuously or 30 Amps surge at 13.8 VDC. The voltage is front-panel adjustable from 4 to 16 volts. This power supply also has a selectable input voltage from 120 or 240 VAC at 47 to 63 Hz, and an excellent 75 percent efficiency rating with extra low ripple and noise; less than 100 mV.

A whisper-quiet fan cools by convection and forced air cooling. Normal airflow around the power supply is continuous and a heat sensor increases the fan speed when the temperature rises above 70 degrees Celsius.

DC output is available via the five-way binding posts on the back of the MFJ-4230MV so you can power your equipment with ease.

All MFJ switching power supplies are protected by MFJ's famous "No Matter What," one-year limited warranty. MFJ will repair or replace (at their option) your switching power supply for one complete year.

The MFJ-4128 sells for $85 and the MFJ-4230MV sells for $90. For more information, to order, or for your nearest dealer, call 800-647-1800 or see **www.mfjenterises.com**.

Free Weather Software Available

As we approach the peak of the hurricane season here in North America, up-to-date information is important to all of us. I'm always on the lookout for good weather software and I have found some that has been developed by Scott Davis N3FJP.

WXWarn is easy to use free weather software that will monitor National Weather Service (NWS) warnings, watches, forecasts, etc., and alert you (by audio and visually) as new ones are issued. You can monitor the whole U.S., your state, county or list of counties. You can also monitor and screen for specific alerts. This configurable software will also display up to 12, real-time weather graphics that you can configure for content and size! This software is designed to download and parse weather data published by the NWS.

The WXWarn software gives you a clear picture of any weather event and severe weather predictions, near or far, at a glance. WXWarn will also optionally provide pleasant weather audio alerts as new NWS updates are issued that meets the criteria you set.

This software is entirely free, with a small advertising window on the main display, or, if you would like to eliminate the ads and free up screen space for weather images, you can register the program for $7.00. You can register this software by credit card or via PayPal.

While you are at Scott's website, check out his other free software package:

WXSpots is a free software package that all responsible weather enthusiasts are welcome to use. The software runs on your PC and connects to a server so that you can join the WXSpot weather community. All observed reports of severe (and routine) weather are relayed to everyone connected. WXSpots will also connect to your home weather station and automatically report when you are experiencing strong winds. Reports can be screened by state, county or a list of counties. The WXSpots community includes weather hobbyists, SkyWarn observers, meteorologists, meteorology students, and those interested in severe weather observations.

In addition to observed reports, WXSpots includes messaging features so that everyone can talk about the weather they are seeing and share links and information on forecasts and thoughts on future weather developments.

WXSpots provides:

- The ability to communicate real-time, first hand observations and messages quickly and efficiently anywhere.
- The ability to add the eyes of SkyWarn enthusiasts who aren't amateur radio operators.
- An automated, historical record of recent observations.
- Audio alerts that can be specified by the user, based on location.
- Messaging features that allow communication with a specific individual, group or all connected users.
- The ability to provide data from your home weather station.

WXSpots will run on all flavors of Windows from Windows 95 through Windows 7. The program requires very little CPU power

or RAM and should run just fine on any PC capable of running Windows. If you have an old laptop collecting dust that you would like to use for WXSpots, as long the PC can connect to the Internet it should be just fine.

For more information on both of these software packages visit Scott's website at **www.wxspots.com**.

The Copper J-Pole Adapter

The copper J-pole, also called the copper cactus, is a classic, low-cost, easy to build, two meter or 70 cm antenna for the beginner as well as the more experienced ham. However, when attaching the SO-239 or N chassis-type connector to the J-pole, there has been no solid, efficient, good-looking way to make that firm connection. The connector is typically attached to the side of the J-pole with only one screw, making it insecure and causing an unnecessary loop in the coax.

Now Dennis Bartholomew AF6TR offers a kit to help with the assembly of a two meter or 70 cm copper J-pole antennas. His products provide a very professional looking and functional method of securely attaching the SO-239 or N connector to the J-pole. The adapter is machined from solid brass and is designed to be soldered to the base of the antenna. The SO-239 or N connector can then be attached to the adapter, making a very secure connection point. In addition to the SO-239 and N connector, an adapter is offered for use with three-quarters inch copper tubing. The larger tubing is commonly used for six meter antennas.

The kit includes all of the hardware you need to assemble your J-pole, except the copper tubing and some fittings, which are available at all home supply stores.

You can get more information or order the kit from the developer's website **www.jpoleadapter.webs.com**

Hands-On Radio Experiments

QST's monthly *Hands-On Radio* column, written by Ward Silver N0AX, is one of the most-read sections of that magazine. Wireless technology continues to develop rapidly and radio experimenters are eager to discover what makes their radios work. Even seasoned experts will encounter new approaches to practical methods, new explanations for familiar topics and new ideas that will enhance your understanding of the radio art. Step-by-step, Silver expertly leads you through each experiment. And, you'll make discoveries along the way.

ARRL's *Hands-On Radio Experiments* Volume 2 gathers all of the columns over the past five years, from 2008 through 2012, and has 60 short electronics experiments, designed to increase your understanding of basic radio fundamentals, components, circuits and design:

- Electronic Fundamentals
- Simulation
- Antennas and Transmission Lines
- Electronic Circuits and Components
- RF Techniques
- Practical Construction

This publication includes a complete parts list for all experiments in volumes one and two.

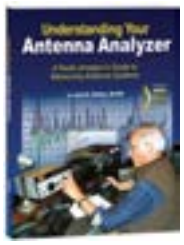
Speaking of volume one, published in 2008, it has 61 short electronics experiments, designed to increase your understanding of basic radio fundamentals, components, circuits and design:

- Radio and Electronic Fundamentals
- Semiconductor Basics
- Building Block Circuits
- Power Supplies
- Filters
- Oscillators and Buffers
- Transmission Lines & Impedance Matching
- Workshop & Design Techniques

These experiments first appeared in *QST* magazine's *Hands-On Radio* column from 2003-2008.

The first volume of this series sells for $20 and the latest edition is available for $26.

Understanding Your Antenna Analyzer



Antenna analyzers are one of the most important pieces of equipment in an amateur radio station. Designed to measure impedance or standing wave ratio (SWR), the properly used antenna analyzer determines the details of an antenna's tuning characteristics and helps maximize its performance. Even the simplest antennas can benefit from using one, and your success on the air may depend on it, but only if you understand and avoid the common pitfalls.

Understanding Your Antenna Analyzer is an introduction to the various types of analyzers available, their component parts, how they operate and how to utilize them to get the best possible data. It discusses how to adjust your antenna, enhance your antenna analyzer and the ways certain analyzers can be used as general purpose test instruments in an amateur radio lab.

This new ARRL publication, by Joel R. Hallas W1ZR, includes:

- Why Measure Antennas?
- Making Antenna Measurements
- Information Available from an Antenna Analyzer
- Hooking it Up and Making it Play
- Adjusting Your Antenna
- Taking the Feed Line Into Account
- Other Antenna Analyzer Applications
- Enhancing Your Antenna Analyzer
- A Survey of Available Antenna Analyzers

This new 128-page software cover publication sells for $26.

To find out more about any ARRL publications, call their Publication Team toll-free in the U.S. 1-888-277-5289, Monday through Friday from 8:00 A.M. to 5:00 P.M. Eastern time [Outside U.S. 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**.

The 2013 WRTH Bargraph Frequency Guide Released

World Radio TV Handbook or WRTH is the most accurate and complete guide to the world of radio on LW, MW, SW and FM, available in any form. The company that produces the printed WRTH has just released a CD with details of the A13 season that takes part of the print information, international broadcasts on LW, MW and SW and domestic SW, and displays it as a graphic color bargraph.

The WRTH Bargraph Frequency Guide has been designed to give the maximum information in a clear and easy to read format. It is supplied as a pdf.

Text columns show the frequency of the broadcasts in kHz; the names of the stations making the broadcasts or the broadcasters responsible for the broadcasts (you can tell international from domestic broadcasts at a glance, as stations making domestic broadcasts are shown in Italic type); the transmitter site code for international broadcasts and the country code for domestic transmissions; and the power of the transmitter in kW.

Each entry also has a color bar. These color bars show the duration of each broadcast in UTC on the 24-hour clock. The color of the bar shows the language of the broadcast. Eighteen languages are identified by different colored bars, with the color and language shown at the bottom of the page. Other languages, or combinations of languages, are shown above a buff-colored bar. Information above the bar also gives the target area or country at which the broadcast is aimed; an indication of the days on which the broadcast is made; and symbols showing if the broadcast is inactive, irregular, of variable frequency, or used for DRM broadcasts.

You can use these pages to identify a broadcast you have heard on a specific frequency, or you can scan the color bars to find broadcasts in your chosen language at a particular UTC time. You can also use the "Find" function in Adobe Acrobat to search the pdf for frequencies, stations, or sites.

The disk also includes a list of abbreviations used in the bargraph, along with decoding tables for international transmitter sites and countries or geographical areas. These are also supplied as pdfs. There is also a sortable list of transmitter sites in the Excel format on the CD.

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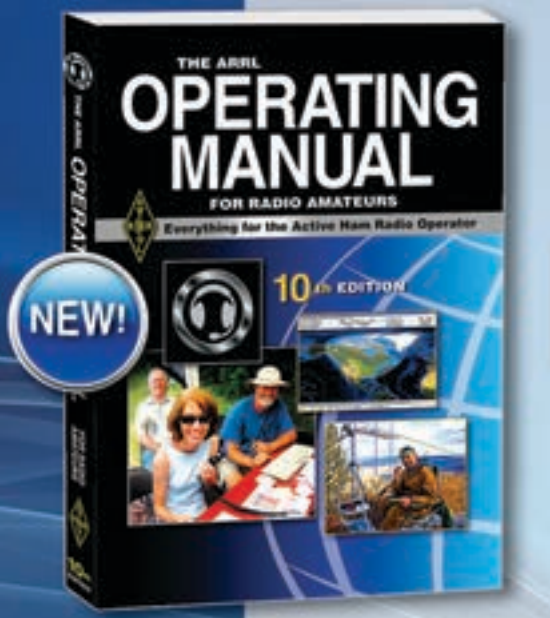

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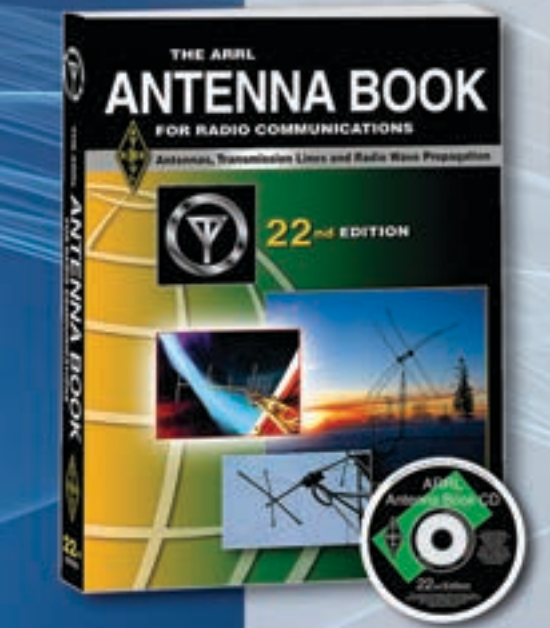

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