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# Alaska Earthquake/ Tsunami Prep

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- Fun with Signal Generators
- The Truth about Narrowbanding
- Helping Youth Discover Amateur Radio
- MT Reviews: CC Radio-SW AM/FM/SW

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Monitoring Times

Vol. 32 No. 9 September 2013


## Alaska Earthquake/ Tsunami Prep ..... 8

**By Todd Dokey KF6AWG**

This time of year media attention is usually focused on the vast eastern coast of the U.S. from Maine to Texas, as tropical storms can spring up out of a gathering low pressure system and churn up a real emergency is just 24 hours.

But, across the U.S. many locations get little or no warning before being hit by a tornado, earthquake or wildfire. Todd Dokey writes of his experiences as a relative newcomer to Alaska, site of some of the most breathtaking scenery and wildest animals found in North America.

This past January, when a 7.5 magnitude earthquake struck off the coast of Alaska, fears of a possible tsunami triggered a region-wide alert where he lives. With visions of Japan's 2009 Fukushima disaster still fresh, residents quickly responded. As a ham, Todd found earlier Field Day, ARES and RACES training would come in handy. But, would that be enough?

*On Our Cover*

*An Alaskan fishing trawler plies the placid waters of the Pacific Ocean, off the coast near Sitka, Alaska, as captured by cover story author Todd Dokey KF6AWG. Beneath this beautiful scene lies the potential for destruction from a massive earthquake-generated tsunami.*

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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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*The AR8200MkIII offers "all mode" reception that includes "super narrow" FM plus wide and narrow FM in addition to USB, LSB, CW and standard AM and FM modes. It also features true carrier reinsertion in USB and LSB modes and includes a 3KHz SSB filter. The data port can be used for computer control, memory configuration and transfer, cloning or tape recording output.*

*A special government version, AR8200MkIII IR features infra-red illumination (IR) of the display and operating keys. The IR illumination function is selectable, allowing operation by users wearing night vision apparatus without removing goggles and waiting for the eyes to re-adjust. Ideal for military, law enforcement and surveillance operators.*

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***No audio is available when the frequency span is set to 20MHz or 40MHz.*
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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*

## *MT* Final Issue to be December, 2013

*MT* Publisher, Bob Grove W8JHD, announced July 25, in an online statement, that the magazine would cease publication as of the December 2013 issue. Bob Grove noted,

"After 33 years of publishing the most informative and lauded magazine on monitoring the radio spectrum, Judy and I are finally going to retire. We are grateful for the dedicated efforts of our fine staff of writers for the excellent work which has kept *MT* alive for all these years. While we know the this will be a disappointment to our readers and writers alike, we realize that a combination of a poorly performing economy, as well as the ready availability of free listening and technical information on the Internet, has reduced sales and subscriptions throughout the market place. I would like to thank our staff personally for their knowledge, dependability, and professionalism in making *MT* the publication that is most often referred to in the radio monitoring hobby. It is a legacy that we have all inherited.

"Any readers concerned about their subscription refund merely needs to contact us by phone (800) 438-8155 or email belinda@grove-ent.com. We will then confirm the subscription expiration date and refund the difference by check or credit card, depending on how it was originally paid."

Bob Grove also explained that the Grove Enterprises catalog will also close its doors at the end of the year. (See related ads in the issue.)

## The Heathkit Legacy

**Longtime reader, Jon Koons, writes:**


"I enjoyed the article on Heathkits (*MT* July, 2013, 'The Heathkit Legacy' by Rich Post KB8TAD). Among other Heathkits I built was the GC-1005 electronic clock in 1973, which has been running (except for a short time in storage when moving) ever since. Forty years…not bad, Heathkit, you were a class act! By the way, I have been a subscriber to *Monitoring Times* since January 1985. Like my Heathkit clock, you just keep delivering!"

**Lou Axeman N8LA writes:**

"I enjoyed reading the two *Monitoring Times* articles about Lafayette Radio (*MT* December, 2012, '60 Years of Lafayette Radio,' and *MT* April, 2013, 'The Lafayette Surprise: Political Intrigue and Radio' both by Rich Post KB8TAD), but your Heathkit article in the July issue really blew me away!

"In 1956, a friend and I, who were 13 years old at the time, both bought AR-3 kits, including cabinets. We both assembled them – he with a soldering gun, I with a wood burning tool – and took them to the ham father of another friend for alignment. His worked perfectly after alignment; mine would not work even after many attempts at re-soldering cold soldered joints, etc. My AR-3 sat in the attic of my parents home until 1964 when an uncle, who was a ham from Pennsylvania and had recently married my mother's sister, took it and finally got it to work, according to some of my relatives.

"I don't recall ever hearing of the 'We won't let you fail' motto before reading your article today. I sort of wish I had heard of it then. My friend, who built the other AR-3, went on to a PhD in physics from Harvard and a career as a physics professor at the University of Chicago. He never became an amateur radio operator. I went into the U.S. Air Force and a career as a tradesman at an auto plant in my home town of Lansing, Michigan.

"I was something of an SWL for decades and finally became a radio amateur in 1976. I have built a few Heathkits that worked: a 1410 keyer and a variable voltage 500 ma power supply. I own a number of pieces of Heathkit equipment: HW-8, HW-9, DX-35, a code practice oscillator that arrived in the mail yesterday, and other pieces in various states of repair. Anyway, your Heathkit article really moved me. Thank you very much!"

**Author Rich Post KB8TAD responds:**

*"Many thanks for your comments, Lou! As Mark Twain once said, 'I can live for two months on a good compliment.' I'm glad you enjoyed the article, especially our shared experience with an AR-3. I'm currently playing with a Heathkit EK-2. Not wanting to use its parts but wanting to experience an earlier stage of that learning kit, I just finished cloning the EK-2A one-tube regenerative circuit. It's just as much fun as I remember of the AR-3."*

**Don Ramos writes:**

"Thank you for the nice article about the legacy of the Heathkit brand in the July issue of *Monitoring Times*. I never built a Heathkit product but I did build several kits sold by Radio Shack back in the 1970s. I built one of their five-tube AM radios and a few transistor 'wireless mike' transmitters. I learned a lot about tuning capacitors and coils by using these kits. I was just a teenager when all this was going on and was not aware of the Heathkit brand since I was restricted to the local stores of the day (Radio Shack, a Lafayette store and a local store called Net Electronics in a small city 10 miles south of downtown Los Angeles where I lived with my parents until I moved away in 1980). No doubt if I knew about Heathkit, I would probably have a few of their kits in my parts boxes today.

"Too bad the kids of today are not more technically-minded and not into building kits. They would learn about the easy-to-understand nature of radio, where your communications can be point-to-point or peer-to-peer, not reliant on telephone central offices or computer servers. You can communicate when cell telephone service is nonexistent or the main power is down. Steve Jobs, as stated in your article, learned electronics this way and one can wonder where the next Mr. Jobs will come from."

**Author Rich Post WB8TAD responds:**

*Thanks for your note on the Heathkit article. I built a couple of the little "P" box kits from Radio Shack and made sure my sons had lots of access to the Shack's 100 and 200-in-one project kits when they were growing up. (I enjoyed those too!) With the new emphasis on do-it-yourself clubs springing up, I think there will be a resurgence of kits especially for kids.*

## More KCBS vs. KBRT Reception Fallout

Cris Alexander, Director of Engineering, Crawford Broadcasting Co., Denver, Colorado, responds to our on-going debate about AM reception in southern California.

"In response to Kriss Larson's missive and [MT Broadcast Bandscan columnist] Doug Smith's reply in the July 2013 issue, we offer the following: KBRT has indeed long had a low-power nighttime authorization from its old island site. Because the resulting coverage reached neither the mainland nor the town of Avalon on the island, we did not use it. The new mainland site and antenna system, however, presents an entirely different situation.

"With 190 watts from the new site in eastern Orange County, KBRT is able to overcome the skywave interference from KCBS and provide a good, listenable nighttime signal into much of eastern Orange County as well as Corona, Riverside and other Inland Empire communities. Our loyal listeners in these densely populated areas have appreciated the new 24-hour local coverage.

"While I do not doubt that the result is a "mish-mash" up in Los Angeles and points north and west, it is anything but in many areas.

"Mr. Smith is correct that KCBS is licensed as a class B station. However, such stations are protected at night to their groundwave contour corresponding to the 25 percent exclusion root sum square of the interfering signals, not the daytime groundwave coverage as he indicated. In the case of KCBS, this value is 4.39 mV/m with the interference coming from a number of full-time U.S. and Canadian stations. That groundwave contour does not get within 300 miles of Los Angeles. There is no protection afforded the skywave signals of any class B station, including KCBS.

"While we regret that some Southern California nighttime KCBS listeners are no longer able to hear that station interference-free, we share the FCC's view that local service has priority. We are pleased that KBRT is now able to provide that service 24 hours a day."

# 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.*

## BBG Shambles

The U.S. House Foreign Affairs Committee held a hearing at the end of June to examine the conclusions of two government reports that described the Broadcasting Board of Governors (BBG) as "plagued by infighting" and "dysfunctional." BBG is a quasi-governmental organization charged with overseeing the operations of Voice of America, Radio Liberty, Radio Free Europe and Radio Free Asia as well as Radio and TV-Martí, among others. Opinions of several former BBG officials, voiced during the hearings, clashed on whether or not the BBG was, in fact, dysfunctional or if oversight of BBG should be returned to the State Department.

Private, non-partisan BBG watchdog, the Committee for U.S. International Broadcasting (CUSIB), released a statement following the hearings noting there was no consensus on "how to achieve real reforms at the BBG." CUSIB rejected the idea of putting BBG back in the State Department, noting that, "in our view [it] would destroy all effectiveness and credibility of U.S. international broadcasting and would become a public diplomacy disaster for the United States." The statement noted that BBG had, "woefully insufficient funding to compete with nations such as China and Russia. It is unable to offer good-quality news programming to Iran…"

CUSIB recommended that Congress review the $50 million contract with the Gallup organization and what it termed, "other wasteful spending within the International Broadcasting Bureau (IBB) which uses up the largest portion of the BBG budget. We believe taxpayers' money should be spent on media programs rather than the overblown bureaucracy which contributes to low employee morale."

## Public Safety Radio Follies

An article in the *Las Vegas Sun* from June 18 headlined, "Metro Drops Maligned Radio System, Inks Deal for New One," highlighted the continuing issues with that city's police and fire radio system. According to the article, the Sheriff's Department is scuttling the Desert Sky system due to, "a high number of dropped calls and dead zones." The new contract is with Motorola Solutions in a $26.3 million deal which will provide 5,000 portable and mobile radios to the various public service departments. A Las Vegas Assistant Sheriff was quoted as saying, "…we are confident Motorola will deliver a successful…radio system…"

The Las Vegas Sheriff's Department's faith in Motorola Systems might be premature. Detroit's Chief of Police was appalled with that city's Motorola emergency dispatch system which was out of commission for 15 hours over the Fourth of July holiday. According to the *Detroit News*, the system crash delayed officers responding to 17 priority-one calls and 110 non-priority calls and forced police and firefighters to respond to calls via telephone. It wasn't as if they didn't have a backup system. It was the backup that failed when the main system crashed. According to the article, "The city's $131 million police and fire dispatch system has been controversial since it was launched.... in 2005."

Meanwhile, the city of Scottsbluff, South Dakota, is looking to move its fire and safety repeater to get better coverage. At the current location, according to a story on local TV station, KOTA-TV, emergency crews experience a number of dead spots, including, believe it or not, the Regional West Medical Center.

## Cubesat Grads Cash-In

An article in the July issue of *Wired* details the rise of Skybox, a Silicon Valley startup that plans to launch a constellation of small satellites designed to provide inexpensive high-resolution images of Earth to clients. According to the article, company founders learned their trade at Stanford University working on cubesats, those four-inch by four-inch, short-lifespan satellites that teach students how to build and fly such devices.

Skybox satellites, at 220 pounds, are definitely not cubesats, but with a predicted lifespan of four years and coming in at one-tenth the cost of traditional high-resolution imaging satellites, Skybox hopes it will carve a new niche in the commercial satellite imagery business. But, don't let the California college-kid images fool you; some company founders have ties to the ultra-secretive National Reconnaissance Office as well as Wall Street, too-big-to-fail, banks.

## UHD-TV via Satellite Tested

Several media outlets reported that Intelsat and Ericsson successfully demonstrated the first Ultra High Definition-TV (UHD-TV) transmission over a North American satellite at the end of June. UHD-TV images are 3,840 x 2,160 pixels making it roughly four times the resolution of the current HDTV standard. Viewed on a 55 or 65-inch screen, the images are truly stunning.

The test was done at Turner Broadcasting facilities in Atlanta, Georgia, using Intelsat Galaxy 13. UHD-TV is not 3D-TV, the format requiring viewers to watch with special glasses. UHD-TV is seen as the next step in broadcasting higher definition imagery. Sources say, however, that the number of high-ticket sets expected to be sold will remain very small over the next three years with most such sets being sold in China.

## 2013 ARRL Scholarships Awarded

The ARRL Foundation announced, at the end of June, 82 annual scholarships, through 58 different funds, given to young amateur radio operators totaling more than $110,000. Scholarships are typically in the amount of $1,000 or $2,000 dollars, though a few individual scholarships go as high as $5,000 and many totaling $500 are also awarded. One scholarship, the Goldfarb Scholarship, assists the recipient in receiving a four-year undergraduate degree in engineering, science, medical or business-related fields.

Most such scholarships are open to any male or female, licensed amateur radio operator currently in high school. If you know of a high school student who is also a ham, who could benefit from receiving a scholarship, check out the details of all of the scholarships available through the ARRL Foundation here: **www.arrl.org/scholarship-descriptions.** But, not every kid with a ticket will qualify; some scholarships require applicants to be active in public service amateur radio activities.

## CB Amp Distributor Nailed

Ever wonder why those web sites and truck stops selling illegal CB amplifiers and modified CB sets never get tagged by the FCC? It could be because FCC agents are spread thin tracking down FM pirate radio stations and inspecting the public files of legal, non-commercial, low-power, listener-supported stations. But, not all bootleg CB sellers are immune to FCC scrutiny. In early June the FCC issued a Citation and Order (C&O) to The Enterprise Group of Omaha, Nebraska, makers and sellers of ePowerAmps.

FCC agents were shocked, shocked, to find certified CB sets had been doctored to increase power and expand operating frequencies beyond that allowed by FCC rules. Agents found linear amps, which ranged from 120 watts ($140) to massive 8,200 watt amplifiers ($2,600), designed to operate on the 10 and 12 meter amateur bands. The FCC noted that continuing to offer such products for sale could result in a fine of not more than $16,000 for each such violation or each day of continuing violation.

# Alaska Earthquake/Tsunami Prep

By Todd Dokey KF6AWG

Living in southeast Alaska is always interesting. Killer whales, seals, eagles, ravens, and brown bears (a cousin to the grizzly bear) are abundant. Radio up here is interesting too. The first night I hooked up my HF gear, I heard nothing. Not just a few minor things, but nothing, as in, "I have a short in my coax," nothing. But, within two hours the atmospherics had changed, and I was hearing things all over the hemisphere. I'd never experienced that before.

Another thing I'd never experienced first hand was a bit more jarring. It was the night of January 4, 2013; an earthquake, measuring 7.5 on the Richter scale, struck in the Pacific Ocean, about 200 miles to my south. The town was shaking a bit and there was a rumbling, which is something I'd never heard before in any quake in which I'd been in California. The rumbling was a bit creepy, it sounded like a 1950s science fiction volcano movie.

This reminded me of the 1989 Loma Prieta quake in the San Francisco bay area. From that experience, and living on the Alaska coast, I guessed that we'd have a tsunami evacuation and I wondered how big the quake was, and how far away.

Things moved pretty quickly. I got up and got dressed the minute the quake stopped, and tuned my marine VHF to the National Weather Service (NWS) frequency, since they do the emergency broadcasting with SAME alerts. Then it started.

The phone (of all things) was first. Flashing a warning. It was the NWS message, Tsunami Warning, Mandatory Evacuation to High Ground. No sooner did I say to myself, "It's on! It's the real deal!" than the VHF started to beep, "Station (Juneau NWS) will be on the air momentarily…"

Then they gave the same order. Although I did not feel panic, I must have had some reaction, because I felt a bit lightheaded as I stared at my gear on the bed. One word came to mind, "MOVE!" The NWS messages said that wave arrival time in Sitka was 12:45 a.m. local time. By then, it was already 12:25 a.m. and still there was no word on how big the wave might be.

## "Earthlings, You are Doomed!"

The time to turn off the VHF radio came when the tsunami warning sirens popped off all over town. I grew up with air raid sirens, so that was not too startling, and I expected it. But, these are the new ones, they also talk. It was a little creepy. Again like a 50s science fiction movie, as this deep booming voice kept repeating, "THIS IS A TSUNAMI WARNING. EVACUATE TO HIGH GROUND IMMEDIATELY!" It echoed from multiple devices all up and down Halibut Point Road and beyond. The voice was omnipresent, and although informative, made me a bit more nervous.

*Bald Eagles congregate at Sitka.*

I hear there was panic in places around town, but nothing huge or out of hand, so I guess not everyone had notifications on their phones. Still, the voice was very creepy to me, sounding a lot like, "EARTHLINGS, SURRENDER, YOU ARE DOOMED!"

I stepped into the hallway and turned on the light, lighting up the living room well enough to see. Added effects came from hearing traffic outside as people headed toward the tsunami evacuation point; flashing lights from police cars and fire department vehicles moving about making sure people got where they needed to go. It was all a bit odd, and I took a few breaths, forcing myself to focus.

My main concern was my pets. I at least had their cages, so I began to get them ready. I loaded up the Blazer in the driveway in a sort of "stream of consciousness" state. Pets, survival pack, oh yeah, that bag of toilet paper could come in handy. I also grabbed a zip-lock bag full of cigars an old Navy friend had given me at Christmas.

I had built an SGC 2020 transceiver into a top-loading Pelican case recently. Everything up here is subject to the weather of the southeast Alaskan rain forest, so it seemed to me to be a good idea to have a kit that was waterproof. While I have a Technician Class license and may not have been able to transmit, I knew it would be important to be able to monitor all emergency HF frequencies in order to relay such information to local emergency authorities. As it was, I almost forgot it, but my brain caught me on my way to the car, "Get the radio, stupid, it's ready to go!"

The tsunami evacuation point was up the hill from me, at one of the local schools so, for me, the trip was short. There was enough traffic flowing in from around town that the Sitka Police Department was busy directing people to the remaining open parking.

For others, it was a trip across town. One co-worker picked up a lady and her daughter, who had just moved from North Carolina. They were walking down the street with their possessions in trash bags and said they did not mind walking. He insisted they get in the truck and took them up the hill. Had this been a big wave tsunami, they would not have made it to high ground in time.

When I arrived at the school parking lot, it was getting full and I could see the auditorium area was where most people were. There were cats in cat carriers, dogs on leashes, kids running around, and lots of people. I saw stacks of MREs (Meals, Ready-to-Eat) and other things someone had pre-positioned.

My favorite "emergency" deployed guy, was a motor home that had come up to the parking lot. Generator running, the owner was inside at the dining room table, a cup of coffee at hand and his laptop going. Internet and cell service did not go out, so lots of people were "Facebooking" the event.

After standing around a bit, taking in the situation, I walked over to the EMT truck, which had several members of the Sitka fire department working traffic and dealing with what came up. I spoke to the man in the truck, mentioning that I had a ham radio with me. He was interested and contacted his IC (Incident Commander) by radio, and after a short discussion of my having been in ARES and Races and having worked floods and

CANADIAN ARES NETWORK

| | SSB | | CW | | DIG | |
|---|---|---|---|---|---|---|
| BAND | FREQ | TAC | FREQ | TAC | FREQ | TAC |
| 80 M | 3.675 | Alfa | 3.535 | Golf | 3.596 | Mike |
| 40 M | 7.135 | Bravo | 7.035 | Hotel | 7.096 | November |
| 20 M | 14.135 | Charlie | 14.035 | India | 14.096 | Oscar |
| 17 M | 18.135 | Delta | 18.075 | Juliet | 18.096 | Papa |
| 15 M | 21.235 | Echo | 21.035 | Kilo | 21.096 | Quebec |
| 10 M | 28.235 | Foxtrot | 28.035 | Lima | 28.096 | Romeo |

| EMERGENCY FREQUENCIES | | | |
|---|---|---|---|
| (Emergency FRQ in bold) | | | |
| Description | Frequency | Mode | Time |
| **Alaska Statewide** | **5,167.50** | **USB** | |
| **Canadian Net** | **3,775.00** | **LSB** | |
| **Canadian Net** | **7,050.00** | **LSB** | |
| **Canadian Net** | **21,130.00** | **USB** | |
| AK Prep Net | 14,292.00 | USB | 0830 AST |
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| Bush Net | 7,093.00 | LSB | 2000 AST |
| Motley Group | 3,933.00 | LSB | 2100 AST |

*Panoramic view of the Pacific Ocean from the author's former backyard. The dominant island on the right is Middle Island with the snow-capped Mount Edgecumbe volcano in the background, a Sitka signature item.*

other emergencies back home, they wanted me to see what I could find out.

Fortunately for me, we'd had another alert a month or two prior, when a big quake hit off the coast of Canada that had not required evacuation. At that time, I realized that if I did have to evacuate, I had no idea of any of the emergency frequencies for the region. I made up a card with all the emergency nets on it, from Canada through Alaska.

I pulled out a Hamstick antenna, hooked it onto the mount I'd put on the luggage rack, and then hooked that to black case on the hood of my car. I patched in the gel cell for starters figuring that if this went longer, I could use the vehicle battery.

I switched on the 2020, and the familiar sounds of HF began pouring out of the radio. I searched the Alaska frequencies I had found, and then the Canadian. Then I hit the Alaska Emergency frequency. Then, being diligent, I went back through several cycles and parked on a few frequencies just in case. Then I swept 20 and 40 meters: all quiet. No nets or traffic heard.

I reported back to the department that I found no emergency traffic from known Alaska nets, or Canadian nets. The Alaska Emergency channel (5.167.5 MHz USB) was also quiet. It was then that they asked me to meet with their emergency coordinator the following week to discuss using ham radio in Sitka during a crisis.

We were finally let go around 2:20 a.m. The tsunami wave that reached Sitka, was only about 6 inches above normal wave height, and I got home a while later due to traffic. Once home, I began to review the night's events. What it came down to was that I had about 15 minutes to load out, which made me feel very unprepared. So, I started making a checklist and bundling equipment.

When I lived in California, I responded to several ARES/RACES events, so I was up to speed on what to have ready. Yet, I discovered, that there is a huge difference between being prepared to go assist quickly (react), and the need to bug-out now (act)! I am sure all the tornado alley folks are laughing at me at this point. I was ready, but also not ready.

## Follow-up City-Wide Drill

Within a month or so after the tsunami quake, a multi-agency emergency communications drill was held by the Sitka Fire and Police departments. Other participating agencies included the U.S. Coast Guard, Army National Guard (ANG), U.S. Department of Homeland Security (DHS), U.S. Forest Service, Sitka Mountain Search and Rescue and the Sitka Community Hospital. Sitka City offices also participated, as they are responsible for the electric grid, etc. KCAW radio also participated, bringing their own portable transmitter that could be deployed in an emergency.

The weekend-long event took place at Keet Gooshi Heen school where the group took over a conference room for use as a Command Center. My participation was as "the ham guy."

The final day of the exercise, the one in which I participated, was a full on test of equipment. The DHS had a nice new trailer, which contained a satellite link, generator, computer and networking equipment, and was used to provide WiFi for the Command Center. Air Station Sitka (USCG) was on hand with their rescue helicopter, and also had representatives from Juneau present. They also had a big black box, which was a portable, field radio system.

The Army National Guard unit, in my opinion, had the best overall preparation for the drill. They had brought along some mobile radio equipment and some HT radios that were programmable on the fly. During the administrative meetings of the previous day, they had agreed on an overall band and channel plan, this was programmed into the handheld radios, which made communications much easier between agencies and departments.

One of the ANG's black box radios went into the USCG helicopter and was linked to a matching ground unit. This provided a multi-channel, bi-directional link if needed. For the exercise, various members of each group were scattered about the city and borough. From a team on Harbor Mountain, to some foot patrols on the other side of town on Sawmill Creek road. Mountain Rescue also had foot teams out and, as I recall, the weather was a bit on the rainy side from time to time that day, so it made for a realistic southeast Alaska scenario.

After everyone in the field was in place, a radio check occurred. Communications with the Command Center and between field units was drilled. Then, on notice from the IC, Al Stevens of Sitka Fire, the power was cut off, and we were all to operate on portable power.

There was a generator for the main room and various agencies had their own as well. Since I was running on battery power anyway, I did not need to switch over. There were further exercise components after this, that I did not participate in, and so my final contact with the people in the drill was the after-action meeting that night at Sitka Fire's conference room. The verdict was, that it had all gone off much better than anyone had thought it would.

*Todd's SAME WX Radio*

## Lessons Learned

Even though you may have all the equipment for an event like this, it needs to be in as few bags or packs as possible and all in the same area. It really does need to be as close to the door as it can be, or already in the car. Side trips to this closet or that room, just to grab a duffle bag, is a total waste of your time. So, owning the gear is not enough, it's got to be ready to deploy.

Transporting the pets was a huge time eater. I'm not saying don't take them, but I am saying, be ready so you can move fast. My friends with young children said the same general thing of the kids. They grabbed their gear OK, but it took what seemed like forever to get the kids out of bed, dressed and into the car seats ready to go.

A survival kit for the wilderness is not a bug-out bag. So, I've since spent time equipping the vehicle with various items to use in a protracted stay away from home. I found that, although I could think clearly enough, the extra mental harassment from the sirens, the Voice of Doom notifications, the traffic noises, the panic stricken friends on the phone, and flashing lights sweeping through the room, distracted my attention. So, I put a bug-out checklist by the front door. Do the list, get out in time, alive and prepared.

As for radio equipment, it's best to have what my friend Doc would call a "throw down radio" to take with you. In other words, the radios need to be ready to roll, and possibly, to be sacrificed.

I know, many of us have mobile radios set up, but here it would have done no good to talk on the local 2-meter repeater. I can't reach nearby repeaters due to mountain ranges and island topography. So, for me, 2-meters and 70 cm are out of the picture. Marine VHF is good, since every boat from a skiff to a seiner fisherman, trawler or crabber has VHF. HF becomes the key for long-haul radio traffic into and out of the area.

Reading up on emergency power and other ham radio emergency preparedness is important but requires thinking about fundamentals. A nice "gee-whiz" solar panel or other solution is cool, but is it waterproof? Is it rugged enough to deploy for a long period of time? Have you put it to use in abusive conditions? Would you let your life depend on it? Things that are easy to locate may be more "old school," but they are dependable and available? In an emergency, that may be all you get.

Since the event, I also purchased three SAME radios. One for my office, one next to my bed and one as a gift for a friend who lives on an island off the coast, and did not hear any of the tsunami sirens.

# The Magic Carpet Still Flies!
# Helping Today's Youth Discover Amateur Radio

By Bob Patterson K5DZE

Amateur radio in the U.S. is, by most standards, healthy and well. As of June 2013, licensees of all classes including clubs, total 766,622, placing us firmly in second place in the world behind only Japan.

One issue that continues to be mentioned is the graying of American hams. Exact figures on the average age of amateurs are hard to find, but attend any ham fest, area club meeting, or browse through amateur publications and you will see much more gray hair and very few youngsters. Most figures quoted give the average age of U.S. amateurs at 60 years or slightly older. The one thing we can determine from this is that the average age of U.S. amateurs is increasing. A youthful influx is not joining in at a rate that would mitigate the aging of amateurs.

But, before you think, "Here we go again! Another guy saying ham radio is dying of old age…we are doomed!" I am not saying that at all. Having a high number of middle age and seniors entering amateur radio is *not* a disaster, it's great! What is sad, is that fewer young people are entering our great hobby until later in life. They are missing the wonderful years of discovery that many of us experienced when we were youngsters. Why is this the case?

Some might say that in a modern technological society like ours, amateur radio is not as relevant to young people as it once was. If this is true, why does Japan, which certainly is highly developed, have 1.2 million amateurs? Young people entering amateur radio today will still find that experience gained from active participation in the hobby can often help them find careers in fields either directly or indirectly involved with communications or electronics.

There is still one major strength of our hobby that we often fail to mention. It is simply the *Magic Carpet* of radio communications that allows us to span the world and even participate in space activities. Every time we turn on the radio, we never know where this *Magic Carpet* will take us. This alone is far too important not to share with the youth of today.

So, back to the question. Why don't more young people join in? I believe it's because the youth of today simply do not know what amateur radio is and how it might fit into their lives. This is something we *can* change, and it is something we *ought* to change. It is a legacy that every amateur should want to share.

## Change of Approach

Our current method of bringing new amateurs into the hobby can all too often be a *To Whom It May Concern* approach, promoted on a club website or by word of mouth. We announce that license classes will begin on a given date and at a given place that is convenient to those of us who conduct the classes and who are Volunteer Examiners (VEs). Then we sit back and wait to see who will show up.

Testing often seems to be even more hit or miss. Trying to find three or four VEs who will show up for testing periods as advertised can be a challenge. What's amazing is that we are actually growing using this method! What we are *not doing* is reaching the young folks around us, who know little or nothing about amateur radio.


***Alinco DJ-C7T ($130) is a good entry-level 2-meter/70-cm HT for new hams. (Courtesy: Universal Radio)***

Is it any wonder that relatively few youngsters show up for advertised license classes or testing? If we really want to see young people at ham fests, at Field Day, on our nets and at our club meetings, then we need to change our approach. We need to orient at least some of our efforts directly towards the young people in our own community.

## Assemble a Team

Once you decide to reach out to the young people in your area, you need to assemble a team of three or four dedicated volunteers who will share the effort. This would be an excellent project for a local area amateur radio club to undertake. The team can be a few members of the club who will make this their contribution to the club, but making this a club project is certainly not a requirement. This can be a great project of *any* small group of amateurs who want to get together to make a true *Elmer Team* oriented toward our youth. Perhaps the Saturday coffee and breakfast group could form a team, or some of the guys and gals who meet mornings just to share coffee on the local repeater could make a team.

Team members should be energetic, motivated, and be relatively good speakers. Those experienced in teaching or interacting with groups could use their expertise on such a team. Use guys, gals, seniors or younger amateurs as team members. Young amateurs may not want to teach classes, but they can help support the instructors with preparations, session setup, and as a source to answer questions outside of the formal instruction. *Some youngsters will talk with other young people easier than with seniors.*

Each of the team instructors should have an Extra class license and be a qualified Volunteer Examiner (VE). If you do not have these 'tickets' or qualifications, maybe this project could be the incentive for you to do so. Such qualifications will definitely help you and the team when you begin to promote the program.

Team members might consider submitting to a simple police background check as a base requirement. When you are dealing with youngsters, this can be a strong point to offer organizations that you approach. Let's face it, times have changed; wouldn't you like to know that adults working with your kids were solid, aboveboard citizens? While certainly not required, having an Extra class, VE, and a background check certainly shows your commitment to what you are trying to do.

## Make a Plan

If we want to reach young people and share our interest in amateur radio, we need to make a simple plan and we need to orient our efforts within that plan. A plan might include: Introducing young people to amateur radio by going where they are and offering informational classes designed with youth in mind. Don't wait for them to find you, find them!

Offer classes structured to keep the interest of young people as they go through the process. You can show how amateur radio fits into camping, biking, hiking, boating, contesting, emergency services and more!

Create classes designed to achieve a Technician license, but slip in instructional material leading them toward a General class license.

Offer Morse code (CW) to those who would like to learn this skill. You may be surprised at how many future hams would like to learn CW, provided it was fun and taught in a creative way.

Introduce the "Hams of Tomorrow" to the "Hams of Today" by offering a mentor or Elmer to help students with questions, guidance and assistance as needed. This might be as simple as answering a few questions, or it could be just being a smiling face to show interest and check on a student's progress.

Plan to help the young people to set up a *VHF/UHF Youth Net* or *Teen Net* once they get their licenses. Actively help new, young amateurs establish an *On-The-Air (OTA) Club* that is run by and for young amateurs using their new net as a 'club house.'

## Reaching Potential Young Amateurs

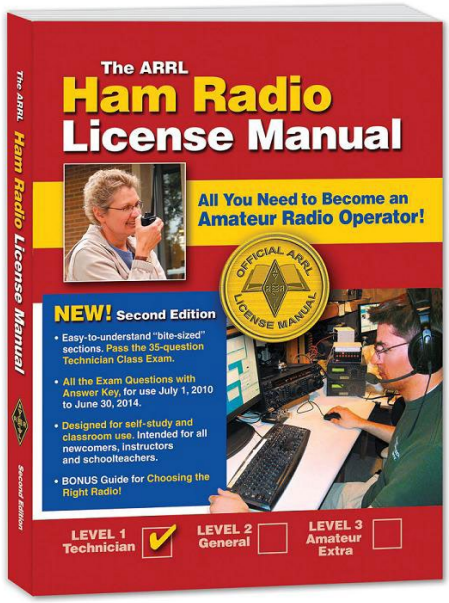
Few young people are going to knock on your door to inquire about amateur radio, in fact, very few probably even know amateur radio exists. OK, where do we go to find youth to tell them what amateur radio is about? Here are a few places to start: Boy Scouts, Girl Scouts, Explorer Scouts, church youth groups and scout equivalent groups, schools (public and private through science clubs or science teachers), home-school co-ops, Boys and Girls Clubs and YMCA.

Go to the *senior leadership* of these organizations and present your team's offer to teach their young people (including the leadership) about amateur radio. Look nice, dress well, and be professional in your visit. Here is where the Extra class license, VE qualifications, and background checks will help you promote your team! Always work with and through an organization's leadership. The more acceptance you get at a higher leadership level, the easier it will be at the unit leadership level.

## Ideas for Your Class

Having a well-organized and well-rehearsed presentation can easily make the difference between the success or failure of your team's efforts. Begin your class preparations by choosing a license manual that is low cost or no cost for students. There are also low-cost Kindle license manuals available which could be great for young people to use since most of them have iPhones, iPads or similar devices that will let them study virtually anywhere and anytime. Just Google "amateur radio license manual" to find one.

Using Power Point can speed up and improve instruction. Couple this with a good lesson plan that shows what is to be covered for each class, have good handouts as necessary, and be ready (early) at the appointed time to insure a good training session. Always have a paper backup to a Power Point presentation so you can continue if the equipment fails.




***ARRL license manual ($30) includes test software. Several Kindle e-book license manuals from individual hams are also available for $8. (Courtesy: ARRL)***

Mix the license test instruction with some interesting information about non-test items such as call sign structure here and overseas, Q-Signals, QSL cards, DX and antennas. Make use of 'show and tell' demos of equipment, QSL cards, and accessories. Think about your audience. Your $5,000 radio might be impressive, but it is surely far outside the reach of a teenager, so show smaller affordable gear, some simple homebrew gear, QRP gear, and some VHF/UHF equipment.

Talk about buying used equipment, repeater operation and protocol, nets, and the fun of using radios while camping or hiking. These are things that young people can see themselves doing with *their* license. PSK31 and other digital modes will likely be of interest since youngsters today do not remember a time without computers! Keep it simple, take the mystery out it!

Before you get to discussion of a *Teen Age Training Net* or and *O-T-A Club*, talk to a local repeater owner/operator and ask about the idea of teenagers using the repeater for one or two hours a week for their own *O-T-A Net/Club Meeting*. Then when you bring this idea up in a training session, you can tell your students the frequency/tone of the repeater and that they have permission to use it for a teenage training net *when* they get their licenses.

All the students have to do is pass their test, get a VHF/UHF radio, and set up a time for the net that is agreeable to the group. Help them elect or choose a Net Control Station (NCS), Net Manager, etc. Be there to help them, but remember it's *their* net/club so let them run with it.

If you choose to do so and you have enough interest, you might offer Morse code classes either before or after a regular session. A certificate or card showing their CW proficiency is a nice touch and this may be their first award for their new ham shack!

Keep the young people's *time* in mind for this optional class, if offered. This instruction can be offered on another night, on a weekend, or after school, if that is what the students want. You might even offer it as Modulated Continuous Wave (MCW) on a local repeater for those who have a radio to hear it. MCW is legal from 6-meters up. Remember, they have to balance their time for school classes, homework, ball games, dates, etc. Meet at their time of availability.

Following the formal class sessions with the students, having some donuts, snacks and soft drinks donated by the local club or student's parents can help provide a lot of one-on-one question-and-answer time and some good informal discussions. Be friendly and get to know the young people who are joining the amateur ranks. Some area stores might help you with snacks to support your efforts if it is for Scouts, church youth groups, etc. If older amateurs do not make an effort to talk to these young people, the young people surely won't feel open to make conversation.

Area radio stores might also provide support for some free advertising and a chance to provide a catalog or equipment brochures. For graduating students, who get their Technician license, area or local radio stores might offer a gift in the form of a discount certificate toward a new HT or antenna, ball cap with their company logo, etc. After all, your team is creating customers *for them* and they want their business!

If your local radio club is sponsoring your team, they could consider giving a free one-year membership to all new licensees or even offer to pay the VE fee for anyone who passes the test on the first try. What the club does is not as important as showing support and saying "Welcome" through some incentive.

## Give Something Back

If the idea of giving something back to amateur radio appeals to you, then by now you have probably already started thinking about how this might work for your hometown. Why not make it a point to discuss the idea at your next amateur radio club meeting? Remember, it only takes two or three other amateurs to join with you to make a team. If there is little interest at your club, then discuss it over coffee with some amateur friends. Regardless, create your own team and make a difference. The *Magic Carpet* still flies today!

*About the Author:*

*Bob Patterson, a retired U.S. Army LTC (Army Aviator) and college administrator, is a regular contributor to Monitoring Times. He has held the same call sign, K5DZE, since he was first licensed in 1956. He spent several years overseas as DA1EZ (Germany) and HL9EZ (Korea). He holds an Amateur Extra license and is an ARRL VE. He has organized and started a number of amateur radio clubs, and remains an active QRP operator preferring CW and PSK31. He enjoys spending time with his family and writing Amazon Kindle books, of which he has published 24 to date.*

# Fun with Signal Generators

By Rich Post KB8TAD
(All photos courtesy of the author)

I recently acquired another service-grade signal generator from the vacuum tube era, a Simpson 415A to go with my Simpson 315. I now have more than a dozen different types including a Heathkit SG-8 and IG-42, an Eico 315 and 324, a couple of Precision E-200-C, several from RCA, including one from their home study electronics course, and even a military URM-25D. With the exception of the URM-25D, the price was right, usually less than ten dollars for one in "as is" condition. Besides the low cost, what is it about a signal generator that has so much appeal to me as well as to other radio experimenters and antique radio enthusiasts?

As a kid, I was fascinated by radio. In eighth grade, I built my first Heathkit, a four band AR-3 radio receiver. It was a superheterodyne that needed alignment. A ham radio operator aligned it for me, but I wanted to learn how to do that myself. Seeing an SG-8 in the Heathkit catalog for about $20, I knew I wanted to build that next. After completion, the kit worked right from the start. I read and re-read the manual section on the circuit and how it worked. I learned that it was a little tunable transmitter.

While it was normally connected by clip leads to radio antenna terminals with a small capacitor, it could send a signal to a radio even without a direct connection. I could switch on the internal modulation and connect a telegraph key between the output clip lead and a piece of wire as antenna and practice sending code to a radio.

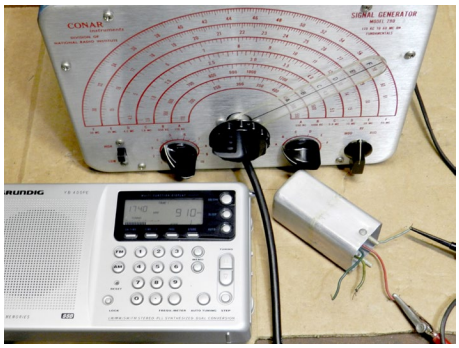
The manual also showed how to inject a signal to check each radio stage. I made sure I had a capacitor at the very tip of the output lead to block any B+ voltage from the radio under test.

## Calibration Accuracy for Alignment

The calibration of the SG-8, like most service-grade signal generators, was less than accurate, but I learned how I could tune the generator to zero beat its signal on top of a radio station, typically a weak signal station whose frequency was known. The signal generator was then accurately tuned to the same frequency as that station and I could make a note of the off-set as compared to the dial indication.

I also learned about harmonics. I had an older Silvertone radio that used an intermediate frequency of 465 kHz. I wanted to make sure the generator was putting out an accurate 465 kHz signal for aligning the IFs. I found a station at 930 kHz which is double that of 465 kHz. Tuning the generator to about 465, I used that second harmonic which was exactly twice 465 to zero-beat on top of that 930 kHz signal.

These days, with accurate, digitally-tuned radios such as my little Grundig YB-400PE, calibration accuracy is even simpler. I just set the Grundig to the desired frequency and tune the generator to zero-beat with a broadcast station at the Grundig's frequency or to maximize the radio's signal strength indicator. Of course, for those who have a frequency counter the question of calibration accuracy is even simpler.




***A Conar 280 signal generator is tuned to exactly 455 kHz as indicated by zero beating its second harmonic at 910 kHz on a Grundig YB-400PE digitally-tuned radio.***

But what else can be done with a simple signal generator? The Heathkit SG-8 had an input for external modulation. I learned that I could feed music from my hi-fi amp speaker output to the external modulation input using a little matching transformer. The signal generator would then broadcast that low-level signal to a nearby radio as a mini-broadcasting station. I clipped an unshielded wire onto the RF output for an antenna and draped that behind the radios I wanted to receive the signal. Fun stuff for a teenager!

## Shortwave Receiver without a BFO

I also used the signal generator as a substitute BFO for a short wave radio without one. Tuning the signal generator either to the IF frequency of the radio or very close to the actual receive frequency would allow me to make SSB signals intelligible. Just draping the output lead near the shortwave antenna wires was usually enough injection, but I could also feed the output to an insulated wire wrapped around the mixer tube.

As an adult, I learned a few more tricks with the signal generator. I had some quartz crystals for specific frequencies but did not know if they were active or not. By now, I had acquired a frequency counter and an oscilloscope. I connected the outer coax shield wires of the scope and the generator together and clipped the crystal between the RF output of the generator and the scope input lead. A direct scope probe can also be used. Tuning the generator frequency very slowly near the crystal frequency caused a very sharp, sudden increase in signal level, as viewed on the scope, as I crossed the resonant point of the crystal. The simple connections made it easy to test a number of crystals.

A friend told me of a time when he needed to trace some intercom wires in the walls of his house to find a break in the wire. He connected his signal generator to one end of the intercom wires and used a pocket transistor radio to trace the wires to the point of the break. I considered that a slick use of a signal generator. If you try this, make sure there is no power on the wires being traced before clipping a signal generator on one end of the wires.

In the June, 1954, issue of *CQ* magazine, Howard Burgess W5WGF wrote an article on various uses of the signal tracer. One of his tips was to use a tracer with a signal generator to determine band pass frequency characteristics of an IF transformer or resonant circuit. For a better result, I prefer to use a signal generator and scope with a low-capacitance probe for this purpose. Excellent scopes are considerably cheaper and more capable than when Burgess wrote that article.

Using the generator and scope to observe the resonance characteristics of the typical tube-radio IF transformer is similar to testing crystals. The primary connections of the IF transformer are connected to the signal generator and the secondary side to the scope. Tuning the generator across the IF transformer's resonant frequency causes an obvious increase in signal level as seen on the scope. The exact resonant frequency for an IF transformer may not be accurate because even the low-capacitance 10X scope probe will affect the actual resonant frequency. The probe causes the typical 455 kHz IF transformer to drop its resonant frequency somewhat, typically about 5 to 10 kHz or more.

I had some loose IF transformers in the junk box. I could determine proper phase relationship between primary and secondary. Proper phasing showed the highest voltage gain at resonance. I could also estimate the approximate band pass. However, I could not determine which terminal side was the primary and which the secondary, so I had to rely on wire color codes or the green paint marks on the IFs for that information. In a mixed set of IF transformers as removed from circuits, I could easily distinguish those in the 400-500 kHz ballpark versus those that were significantly higher, a handy way to check a batch of mixed IFs from the junk box. If you don't have a low-capacitance probe, try a 10,000 ohm resistor at the scope probe tip to limit loading.

## Checking Resonance

The resonant point of just the IF transformer primary or secondary can also be checked individually. Just connect the coax shields of the generator and the scope together and clip the scope low-capacity probe and generator output leads across either the primary or the secondary winding. Using that connection, I was able to determine that one side of a particular IF in the junk box would not peak at the proper frequency. I recall purchasing an auction box lot with some used IF transformers. In hindsight, that IF was probably removed from a radio because it would not peak when aligned, most likely due to "silver migration" disease.

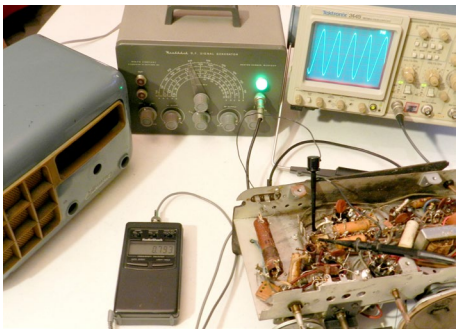
## Silver Migration in IF Transformers

A silver migration problem occurs in smaller IF transformers in vacuum-tube circuits, typically those about three-quarters of an inch wide, using adjustable cores and fixed mica capacitors. Those capacitors have a silver coating on mica sheets but, unlike the typical mica capacitor, which is encased and sealed in an insulating material, the capacitors inside the IF are exposed.

Silver migration is hastened by humidity in the presence of an electrical field. A radio with the IF silver migration problem usually exhibits a continuous loud static or crashing noise that is not reduced when the antenna is disconnected or shorted. However, the noise can be reduced by the volume control. Weaker stations are often totally masked by the noise. I have also seen cases where migration so deteriorates the IF transformer that even without the static, the sensitivity of the radio is extremely reduced and the IFs can no longer be aligned to proper resonance.

The simple scope and signal generator hookup to test an IF transformer primary or secondary can also be used on an IF transformer, still in the circuit of an unpowered radio. I found that to be a valuable quick check.

I had a Hallicrafters 5R34A "Continental" Bakelite radio circa 1951 on the bench and had suspected an advanced case of silver migration.

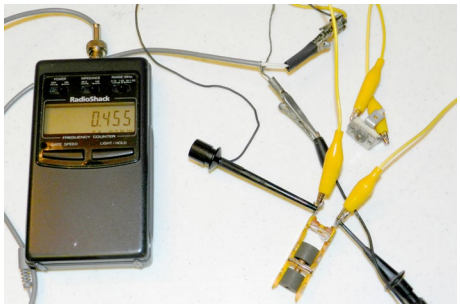


***The first IF primary winding of a Hallicrafters 5R34A "Continental" resonates at nearly 800 kHz indicating a seriously degraded silver mica capacitor but good coil.***

A quick check of both IF transformers in the unpowered set showed both sides of the second IF to be in good order, but the primary of the first IF would not show resonance until the signal generator was at nearly 800 kHz, confirming my diagnosis of a seriously deteriorated silver mica. It took just a few seconds to test each winding. The surprise was that only the primary of one IF was affected. I had expected a problem in both IF transformers.

Years ago, a radio repairman would just replace bad IF transformers. New replacements are now scarce. It is not that difficult to open the bad IFs, remove the offending silver mica capacitors, and rebuild the IF transformer with a new capacitor either inside the shield or, my own preference, under the chassis.

The same signal generator and scope check can be used to verify that the repaired IF transformer primary or secondary will resonate properly with a temporary capacitor clipped into place before reinstalling the transformer. That temporary capacitor can be a variable compression trimmer whose value in picofarads can then be read for a permanent fix.




***Testing an IF transformer winding to determine capacitance needed at 455 kHz resonance by adjusting a trimmer capacitor on clip leads. With the ferrite slug at its center, the needed cap measured 180 pF. With the slug at its extremes, the needed cap ranged between 160 and 202 pF.***

In the same manner as testing the primary or secondary of an IF, other resonant circuits can also be checked. The resonance of the antenna section of the typical tuning capacitor can be readily checked in an unpowered radio. With the coax shields of the signal generator and the scope connected together, the generator output lead is connected to the variable cap stator and the scope input is connected to the rotor, typically the radio chassis. Moving the capacitor with the tuning knob will vary the resonant point as observed on the scope. Shorts or poor and intermittent rotor contacts can be easily found.

## Fixing up Nice, Old, Service-Grade Signal Generators

Most of the signal generators I have repaired have problems similar to radios of the tube era; dirty connections and controls, bad capacitors, and an occasional drifty resistor. Bad tubes and power supply problems other than electrolytic capacitors are rare because signal generators typically have seen much less use than a radio of the same age. Applying contact cleaner such as a bit of Deoxit to the bandswitch contacts, the potentiometers and tube pins and their sockets solves many problems. Wax and other leaky tubular capacitors, and possibly the electrolytic, should be replaced. The test leads should be checked for proper connections. I suggest replacing the power cord with a 3 wire version with safety ground.

I once deliberately purchased a cheap Eico 324 in awful cosmetic condition. It had a large Hallicrafters knob on it that was worth the two dollars I paid for the piece. After swapping knobs, I wanted to see what it would take to make the Eico perform. After cleaning all contacts and carefully powering it up, I found that the audio modulation did not work. Replacing the two capacitors connected to the audio inductor repaired the piece. I replaced the other wax caps as well. A thorough scrubbing of the front panel and spray-painting the cabinet made it look decent again. I still use it.

## Experiments in AM Broadcasting

The Simpson 315 is unusual since it is has a separate 6C5 oscillator tube and a 6K6 as buffer/power amp. It used a separate transformer for screen modulation of that 6K6. That transformer had three windings, one of which was open. I doubted that I could find a replacement, so I decided to have some fun with the piece. I replaced the open transformer with a reversed audio output transformer and fed it with audio from an amplifier. I also bypassed the attenuator and directly fed a home-brew loading coil and 10 foot piece of wire from the 6K6 plate capacitor as a simple broadcaster.

Going outside with a portable radio, I found I could still hear the signal at over 250 feet from the house. I estimated the power input to be several times what was allowed for a Part 15 broadcaster. I was surprised at the result but, not wanting to break the rules for Part 15, I quickly shut the Simpson down! I have since located a proper substitute for that transformer.

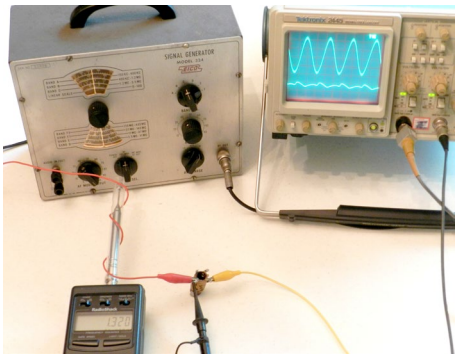
I checked my URM-25D to test its capability as a broadcaster. I found it works extremely well with no conversion needed. It has both a high level output and a standard, low-level output of 0.1 volt at 50 ohms. The high level jack provides 2 volts of signal at 500 ohms impedance. That's about 8 milliwatts of RF out, about 40 times the power at the standard output. The high level output is still within Part 15 rules. Keeping the modulation level to a maximum of 50 percent on peaks makes for a nice-sounding signal.

Nearly any signal generator with a external modulation input can be used as a simple broadcaster. To maximize the signal strength for this purpose, I feed the normal low impedance RF output into a simple loading coil and then connect 10 feet of wire for an antenna.

A simple capacitor compression trimmer can be added in series between the coil and the antenna wire to increase the self-resonant frequency or in parallel between that antenna side of the coil connection and signal generator ground to decrease the resonant frequency. The resonant point can easily be seen as a voltage gain using a low-capacitance probe at the antenna and coil connection point. The scope pattern at resonance will be a relatively clean sine wave as compared to the normal harmonic-rich output of the signal generator which seldom looks like


***A gathering of service-type signal generators. Foreground left to right; Tenma 72-585, Olson TE-188, Supreme 570, Eico 324, Heathkit SG-6, Leader LSG-17. Middle row left to right; Precision E-200C, Realistic TK-100, Simpson 315, Simpson 415A, Superior 660. Top left to right, Heathkit SG-8, Heathkit IG-42, Heathkit G-1, Lafayette KT-208, Superior TV-50A, Paco G-30***

a sine wave. Harmonics will be reduced to minimum at the resonant point. Feeding the signal generator with an external audio input results in a useful, low-powered experimental broadcaster.



***Natural resonance of 244 microhenry loading coil and 10 feet wire (left clip lead) is 1320 kHz. The scope dual trace shows Eico 324 signal generator output (lower trace) and loading coil sine wave output (upper trace)***.

Using an Eico 324 signal generator and an oscillator coil of 244 microhenries from a parts radio, I found that the natural resonant frequency was 1320 kHz. I noticed that if I fed the resonant coil and antenna at exactly half that frequency, my frequency counter would still show the same resonant frequency.

That makes for a simple demonstration of a resonant circuit's ability to double as is often done in transmitter finals. The scope patterns can be shown to new hams, who are learning the basics, to teach about resonant circuits and frequency doubling or tripling stages.

My personal favorite signal generator for conversion to broadcaster is a Superior Instruments Genometer TV-50. The TV-50 was heavily advertised on the back pages of *Popular Electronics* during the mid-1950s. The circuit used what were surplus computer tubes at the time. That was a lucky choice. The TV-50 uses a 6B1000, a dual control tube perfected by IBM and its vacuum tube suppliers for computer use.

Dual control tubes make about the best tube-based Part 15 AM broadcaster, as determined by a number of experimenters on the Antique Radio Forum. The dual control tube is capable of 100 percent modulation with minimal distortion. I substituted another dual control tube, a directly plug-compatible 6AS6 for the 6B1000, removed the connections for the attenuator, modified the screen voltage and fed the external modulation input with speaker-level audio from a small transistor amp.

Since I bypassed the attenuator resistors, the signal generator output had a higher impedance. I fed the RF output to a small, external Pi-network made from a broadcast ferrite antenna and a couple of trimmer capacitors to maximize the signal voltage at my frequency of choice and eliminate harmonics.

A simple L-network as described above with a loading coil and a parallel trimmer capacitor would probably have worked as well. The result was an excellent broadcaster. Details and schematic for my TV-50 modifications can be found at the website link in the footnotes. For home brewers, the Antique Radio Forum has several broadcaster designs, primarily using dual control tubes. A link to a schematic and discussion is also in the footnotes.

I had read on the Net of a modified Eico 315 signal generator re-purposed as a regenerative receiver. Since a regenerative receiver circuit can be viewed as a controlled oscillator, such conversion is possible. The positive feedback path for a regenerative receiver circuit is varied by an added control so that the circuit can be adjusted to just below the point of oscillation. At that point, the regenerative receiver has tremendous amplification and can receive AM if a radio signal is injected on the input grid by way of a small capacitor to an antenna. The set can also receive CW and SSB at just beyond the point of oscillation.

I decided to convert a Superior TV-50A (a very different circuit from the TV-50 noted above). I added a potentiometer to control the screen voltage of the oscillator tube. The main problem I encountered was that the signal generator had too high a level of feedback. The feedback windings were designed to be optimal for an oscillator, not a regenerative radio. I tacked resistors across the feedback windings to limit the feedback level and was able to make the regenerative radio circuit work reasonably well for portions of two bands but the result was not that stable or smooth, probably because the feedback windings were still not optimal for a regenerative set. I have had better results with completely homebrew regenerative sets and abandoned that project. However I may go back to it and see if I can tame the circuit, possibly by reducing the B+ voltage. That's part of the fun of being a radio experimenter.

Let me know of your fun adventures with service-type signal generators. Send an e-mail to **kb8tad@gmail.com**.

### Resources:

Details and schematic for modifying a Superior Genometer TV-50 as a Part 15 broadcaster **www.ohio.edu/people/postr/bapix/TV50.htm**

Links to the discussion and schematic of the most recent version of the homebrew, dual-control tube Part 15 broadcaster on the Antique Radio Forum can be found at the bottom of the same page **www.ohio.edu/people/postr/bapix/TV50.htm**

## *Getting the Facts Straight:*

# Narrowbanding, Digitization and Encryption are Three Different Things

By Bob Grove W8JHD

There seems to be considerable confusion among some scanner listeners as to the impact of new technologies on their reception of radio transmissions. I'd like to thank communications consultant Scott Grimmett of Industrial Communications in Spokane, Washington, for his hands-on observations as he serves his two-way radio clients. Thanks, too, to FCC officials who provided additional insights.

Narrowbanding simply means that the actual width of spectrum that a data, tone, or voice signal occupies, must not exceed 12.5 kHz. It is expected that sometime in the future this bandwidth may be further reduced to 6.25 kHz utilizing digital technology.

Digitization means that instead of the classic reproduction of a sound (analog) being imposed on the carrier wave, the components of those sounds are broken into thousands of data bits which are then reassembled by the receiver into the original sound.

The federally-recommended digital transmission system for interoperability among different agencies at a scene of disaster is called Project 25 (P25). This is an "open algorithm," that is to say it is not proprietary, and more and more scanners are including it.

Encryption ("scrambling") is a method of disguising the contents of a signal in a manner that interception cannot be decoded without the proper key. It can be done with traditional analog transmissions and modern digital communications.

One petulant reader insists that by the end of this year, scanner monitoring will be over. Nothing could be further from the truth. Let's take a look at a few more false notions being propagated and replace them with reality:

**Myth 1: Bandwidth narrowing will reduce range by as much as 60 percent.**

Fact: With "plain vanilla" analog FM systems, the reduction could be about 30% according to FCC engineers, reducing clarity on fringe reception, but with modern digital modulation techniques, range reduction can be minimized. The theoretical 3 dB loss can also be compensated for with higher antennas, higher gain antennas, and higher power.

**Myth 2: An even-narrower bandwidth reduction to 6.25 kHz will be mandated by 2015.**

Fact: The FCC hasn't even hinted at a date, and 15-20 years is more likely. The majority of public safety agencies are using traditional analog radios, and will have spent billions of dollars conforming to the 12.5 kHz plan. They wouldn't be in the mood to shell out billions more so soon.

**Myth 3: Narrowbanding will require scanners to have their frequencies reprogrammed.**

Fact: Narrowbanding has no effect on currently licensed frequencies. The bandwidth reduction from 25 kHz to 12.5 kHz merely allows additional licensees to be more closely spaced in this heavily-used part of the radio spectrum.

**Myth 4: All VHF/UHF licensees using 25 kHz bandwidths will have to reduce their bandwidths to 12.5 kHz or less.**

Fact: No, this affects only FCC Part 90 Private Land Mobile licensees in the 150-174 and 421-512 MHz bands. These include law enforcement, firefighting, emergency medical, transportation departments, mass transit agencies including railroads, community watches, schools and school buses, public utilities, business and industrial land mobile, and radiolocation..

Users *not* subject to narrowing their bandwidth include amateur radio, aeronautical services, marine radio, General Mobile Radio Service (GMRS), Citizens Band (CB), Family Radio Service (FRS), Multiple Use Radio Service (MURS), broadcasting, exclusive paging channels, and any service outside the 150-174 and 421-512 MHz bands.

Licensees on the new 700 MHz public safety band are presently required to implement 6.25 kHz bandwidth by 2017, but because of the number of protests being directed toward the FCC by these new licensees, postponement of that date is expected.

Licensees on the 700 MHz band who use interoperability channels must do so in the P25 mode, and if they elect to encrypt, it must be AES.

Many waivers beyond last January's time limit have extended licensees' conformation of the change from several months to several years, but it's not clear when the FCC may begin enforcement. When and if they do, it's most likely going to be on those non-conforming licensees who ignored the narrowbanding order and didn't even bother to ask for a waiver.

**Myth 5: Licensees are being required to change from analog to digital modes which I can't hear on my scanner.**

Fact: No conversion from analog to digital mode is required. A 25 kHz bandwidth analog signal must merely be narrowed to no more than 12.5 kHz. This slightly reduces audio recovery on a scanner, so you simply turn up the volume. Some scanners have audio gain control (AGC) to automatically equalize the sound levels.

**Myth 6: The FCC requires public safety communications to switch to digital P25 encryption.**

Fact: There is no FCC requirement that public safety must use either digital P25 or encryption. To do this would mean an expenditure of billions of dollars nationwide during a depressed economy.

**Myth 7: Digital transmissions will be scrambled.**

Fact: Many agencies prefer open voice communications because of its audio quality and lower cost. For digital communications, P-25 is the most accepted mode, and scanners are allowed to decode it.

**Myth 8: Digital Encryption Standard (DES), long used for scrambling sensitive communications, is now disallowed; only the more recent Advanced Encryption Standard (AES) can be used.**

Fact: Any previous mode of encryption, including DES and speech inversion, are still allowed on non-federal-government radio systems. If a federal agency chooses to use encryption, it must be AES because of its inherent immunity to being hacked. However, interoperability is more important and not all agencies would be AES P25 equipped.

**Myth 9: There is a nationwide effort to put all public safety communications on statewide trunking networks so that they can uniformly scramble their communications making them unlistenable on scanners.**

Fact: This is paranoid nonsense. There is no such effort. While many law enforcement departments don't like the bad guys listening in on their enforcement activities, and EMS personnel would like privacy when they are discussing personal aspects of patients, fire departments don't have any problem with it. For example, North Carolina's 850 MHz VIPER network currently has 650,000 users, including local, county, state, and federal law enforcement agencies. Current estimates are that less than one percent of their communications are encrypted.

If statewide systems elect to use encryption like AES, their communications cannot be monitored by scanners. But with narrowbanding having cost so much, and not all agencies having AES encryption, the threat of total encryption on a statewide network is unlikely.

**Myth 10: Federal grants to public safety agencies require the purchase of radios with encryption.**

Fact: No, they don't. They only require that they can run in P25 digital mode for interoperability. If the grantee requests encryption, then it must be AES.

### In conclusion

Your scanner is not an antique. What you are hearing now is very likely what you will be hearing a year from now. While there is always the prospect of change, when such a change affects large numbers of people or institutions which have to be coordinated, it takes quite a while.

MT

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# Scanning for "I-Call" Transmissions

Normally, when we monitor a trunked radio system, we listen for conversations occurring on talkgroups, which are groups of users with a common purpose or organizational structure. Each talkgroup has a unique number that the system uses to identify it. This is the number that appears on the scanner's display when the talkgroup is active.

Each radio in a trunked system also has a unique identifying number that differentiates it from all other radios. Transmissions originating from a radio include this number so that the system can identify which specific radio is transmitting. Some systems also use this number to validate or authenticate the radio, deciding whether to allow the radio to access the system or not. Such validation can be done by checking the radio's identifying number against a "white list" of all legitimate system radios or a "black list" of known stolen or missing radios.

A radio's unique identifying number can also be used by the system to support a conversation between that radio and the dispatcher or another radio. Rather than a number of radios participating in a group conversation, these one-to-one conversations take place between individuals, leading to the phrase "Individual Call" ("I-Call" for short) to describe them.

*Dear Dan,*

*Regarding, "Choosing Your First or Next Scanner", one of the specifications never mentioned is whether or not the scanner can pick up Motorola and EDACS I-Call transmissions. To me this is very important. I had been looking at the Uniden Home Patrol as a next scanner, but I rejected it because it cannot decode I-Call, as far as I know.*

*The bus system here in Albuquerque uses EDACS I-Call extensively. All of the bus driver-to-dispatcher conversations take place as I-Calls. When a bus driver wants to talk with the dispatcher, on talk group 02-041 the bus driver momentarily clicks his mike button without talking. This causes his bus number to appear on the dispatcher's screen. The dispatcher responds by initiating an I-Call to the calling bus, and the conversation proceeds on I-Call. If several buses click in a short time, the dispatcher answers each in turn. Talk group 02-041 is also used for the dispatcher to make announcements to all buses about accidents and detours.*

*I find the bus service so interesting to listen to that I would never get a new scanner without I-Call.*

## William in New Mexico

I-Call, sometimes called "Private Calls," since only the system users who will hear the conversation are the two participants, are available primarily on Motorola, EDACS (Enhanced Digital Access Communication System) and Project 25 networks.

A typical EDACS network can support just over 16,000 individual radios, where each radio is programmed with a unique Logical ID (LID). The dispatcher or another radio uses this LID to address the desired radio, which will emit a ringing alert sound to inform the user of an incoming call. The LID of the calling radio will appear on the display and, if the user presses the push-to-talk button, the system will connect that radio directly with the caller on one of the system voice channels.

## Scanning I-Calls

In general, the newer the scanner the more likely it is that it will monitor I-Calls. Specific models that are known to support I-Call scanning include:

| Make | Model |
|---|---|
| GRE | 500 |
| GRE | 600 |
| Uniden | 246 |
| Uniden | BC250D |
| Uniden | 780 |
| Uniden | BC785D |
| Uniden | BCD396XT |
| Uniden | BCD996XT |

Specific to William's letter, the Uniden HomePatrol-1 requires the "Extreme Upgrade" to follow I-Call activity. The Extreme Upgrade adds a number of features and capabilities to the HomePatrol-1, including trunked system analyzers and discovery tools to find new conventional and trunked channels. Activation of these features requires a Registration Key from Uniden and the installation of the latest firmware updates.

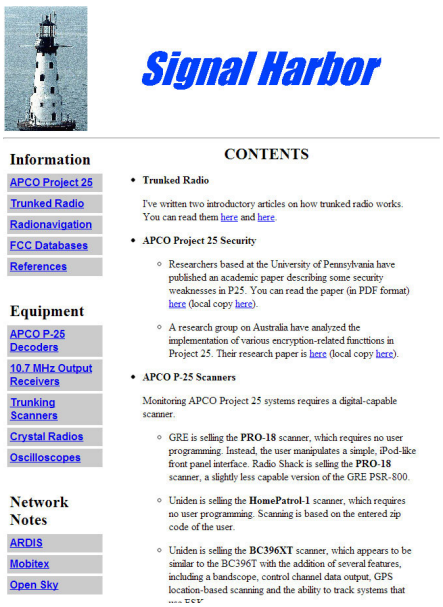
Models that cannot track I-Calls include:

| Make | Model |
|---|---|
| GRE | 300 |
| GRE | 400 |
| Radio Shack | PRO-163 |
| Radio Shack | PRO-164 |

Some recent scanners are also capable of displaying the identification number of the radio that is transmitting, whether in a talkgroup conversation or an I-Call. For instance, the Uniden BCD396XT has a specific setting called "Disp. Unit ID" that can be turned on to see the ID of the transmitting radio.

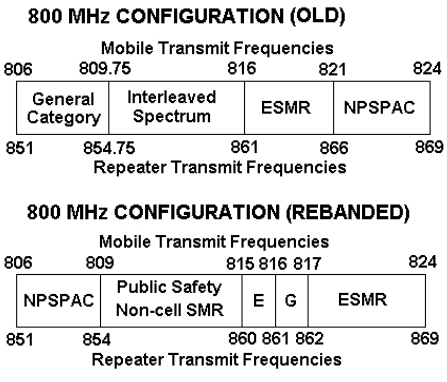

In many Uniden models, programming "i0" or "i0000" for EDACS and "700000" or ".0" for Motorola systems will result in hearing all I-Call activity. If there are particular radios you do not wish to hear, programming the lockout function with the radio ID will prevent them from interrupting your listening.

I will be publishing lists of models that do and do not support I-Call on my website at **www.signalharbor.com**. Please email me with additional models if you have verified that they do, in fact, follow I-Call activity.




## iDEN Service Shutdown

The end of June also marked the end of a once-popular wireless service known as iDEN. The Integrated Digital Enhanced Network (iDEN) is a wireless communications technology developed by Motorola that provided a combination of cellular telephone and trunked radio service. One of the largest users of iDEN technology was Nextel, which started out in



# NEXTEL

1987 as a company called FleetCall and became Nextel Communications in 1993. For the last eight years, Sprint Corporation owned and operated Nextels' iDEN network. At midnight on June 30, Sprint began the process of shutting down the service.

While other cellular companies purchased radio spectrum via Federal Communications Commission (FCC) auctions, Nextel bought frequencies in the Specialized Mobile Radio (SMR) band and built a cellular-like network on top of a dispatch-style radio system. They were the first company to offer both push-to-talk connectivity and cellular telephone service, giving them an marketplace advantage against companies like AT&T and Verizon.

On the downside, the success of Nextel and their extensive network of repeater sites resulted in ongoing interference with public safety radio systems in the 800 MHz band. At the time, Nextel and other Enhanced SMR (ESMR) operators had exclusive use of frequencies between 861 and 866 MHz, while public safety (through the National Public Safety Planning Advisory Committee) had exclusive use of 866 to 869 MHz. However, public safety and Nextel both operated on interleaved frequencies between 851 and 861 MHz. Nextel transmitters, being far more numerous and often more powerful than public safety repeaters, created significant problems for public safety users in the interleaved band.

In 2004, Nextel and the FCC agreed on a plan to reorganize the 800 MHz band, separating Nextel operations from public safety in a process called *rebanding*. The plan required public safety to give up operations between 866 to 869 MHz and move to equivalent channels between 851 and 854 MHz. Nextel gave up all of their frequencies below 862 MHz. Public safety ended up with exclusive use of frequencies between 851 and 854 MHz and shares the spectrum between 854 and 862 MHz with business and industrial users as well as low power SMR operators. Nextel, which was required to pay much of the cost of moving public safety systems to their new frequencies, has exclusive use of 862 to 869 MHz as well as being given spectrum in the 1.9 GHz band. In additional, there is an Expansion band between 860 and 861 MHz and a Guard band between 861 and 862 MHz, providing additional separation between Nextel and other operators.

This reconfiguration eliminated much of the interference to public safety and gave Nextel significant slices of continuous spectrum in the 800 MHz and 1.9 GHz bands – prime real estate in the cellular telephone market. The spectrum looked so good that Sprint agreed to merge with Nextel before rebanding began.

The reconfiguration caused problems for scanner users, especially those that were scanning Motorola systems in the old NPSPAC band. Because of the method Motorola systems used to communicate trunking channel information to radios in the field, the way that scanners tracked activity no longer worked correctly with rebanded agencies. While conventional,

EDACS, LTR (Logic Trunked Radio) and Project 25 (P25) scanning just needed the new frequencies programmed, tracking rebanded Motorola systems required either new scanner firmware or tricky programming. Newer model scanners made this a relatively painless process, but older scanners that could not be upgraded or reprogrammed were no longer useful on Motorola systems.

## ❖ Time Division Multiple Access

From a technical perspective, iDEN uses a technique called Time Division Multiple Access (TDMA) to fit more users in a given amount of radio spectrum than traditional trunked radio systems.

Time division is a way of sharing a single radio channel between multiple radios by having the radios take turns accessing the channel. A segment of time, usually called a "frame," is divided into smaller slices of time called "slots." The frame period is repeated over and over, with the result that each slot appears at regular intervals. For example, say a frame is exactly one second long and is evenly divided into four slots. That means that each slot is a quarter of a second long and occurs once each second.

In a two-way, time division system, both the transmit (radio to system) channel and the receive channel (system to radio) are divided into slots. Each radio is assigned a slot on each channel, during which it transmits or receives, respectively. By assigning different time slots to different radios, the system can serve multiple radios on a single pair of frequencies. In our example, this means that each of four radios would be allowed to transmit once per second, but each time for only a quarter of second. The system would hear a quarter-second from Radio 1, then a quarter-second from Radio 2, and so on. After Radio 4 takes its turn, Radio 1 would again transmit for a quarter-second and the whole process repeats.

Transmit ("Tx") and receive ("Rx") slots for a particular radio are typically offset in time from each other so that the hardware does not have to transmit and receive at the same instant, allowing it to be less complex and therefore less costly to manufacture. In our example, from a radio's point of view, it transmits for a quarter of a second, then quickly tunes to the receive channel and then at the appropriate time listens to its assigned receive slot. After that time slot is complete, the radio tunes back to the transmit channel and waits for its time slot to transmit again. This transmit-tune-receive-tune cycle continues for as long as the radio is engaged in a conversation.

In case you're wondering, most TDMA systems have a master clock signal included somewhere in the frame transmitted by the system. All of the radios synchronize to this clock so that they know exactly when to transmit and when to receive. Some more complex TDMA systems, like General System for Mobiles (GSM) cellular telephone networks, even adjust individual radio time slots to account for the distance between the radio and the system receiver.

Since signals coming from a radio, that is far from a receiving base station, will take longer to arrive than from a radio that is close by, the GSM controller can instruct a radio to transmit a little bit earlier or a little bit later to make sure that all the transmissions from all the radios arrive within their assigned time slot.

In order for a TDMA scheme to be more efficient, each radio must somehow fit an entire frame's worth of speech into a single slot. This requires that the sound coming into the microphone of the radio must be compressed, which these days means that it will be converted from analog to digital form, prior to transmission. Modern voice encoders are able to sample the sound from the microphone, convert it to a stream of binary digits ("bits"), then compress the stream into shorter chunks of information. For iDEN, the Vector Sum Excited Linear Predicting (VSELP) encoder can convert and compress 90 milliseconds of speech into 15 milliseconds worth of digital data. This level of compression allows iDEN to fit as many as six users in a single channel. iDEN transmissions occupy 20 kHz of bandwidth, allowing them to fit in normal 25 kHz channels.

Earlier this year, Nextel still had more than a million iDEN subscribers, meaning there are now a whole bunch of customers looking somewhere else for push-to-talk and cellular services. The shutdown of the iDEN network, considered a second-generation (2G) cellular service, allows Sprint to migrate those customers to their 3G CMDA (Code Division Multiple Access) network called "Direct Connect." The eventual goal is to consolidate their customers onto a single technology called Long Term Evolution (LTE), a Fourth Generation (4G) of cellular telephone technology. The shutdown also allows Sprint to repurpose the iDEN frequencies for 3G and 4G services.

Remarkably, the shutdown will generate more than 100 million pounds of obsolete and excess equipment and materials. All of the 30,000 or so iDEN repeater sites will be taken off the air, resulting in massive numbers of radios, antenna hardware, support infrastructure and even concrete shelters to be recycled or discarded. This deconstruction work is expected to be complete sometime early next year.

The "Nextel" brand name itself is already history. Softbank Corporation, a Japanese conglomerate, acquired 78% of Sprint-Nextel for $21.6 billion. The company is now called Sprint Corporation. Softbank had already invested $5 billion in the company and has promised to invest another $16 billion over the next two years as well as open a research and development center in California's Silicon Valley.

## ❖ White Space

The FCC licenses television channels in the United States. There are a limited number of these channels, and that number has shrunk over the years as portions of the UHF (Ultra High Frequency) television band have been reassigned for other uses due to the ever-present need for more spectrum.

Unfortunately, the remaining TV channels are not allocated in a spectrum-efficient way. To avoid potential interference, television channel licenses are separated geographically, meaning that a TV channel will only be licensed to a broadcaster if it is far enough away from every other broadcaster using that channel. In addition, in areas of the country where there are relatively few people, many television channels go completely unused. The FCC calls this unused spectrum between television channels "white space" (TVWS) and is interested in seeing it used to help satisfy the growing demand for wireless services. To that effect, it issued rules in 2010 to allow unlicensed transmitters to operate in white space. As you might imagine, television broadcasters aren't particularly happy with this idea, since they fear that regardless of whatever rules the FCC might put in place, they will still suffer interference from these unlicensed transmitters.

The FCC defined two types of unlicensed white space devices. The first are called "Fixed" because they are expected to stay in one place, typically providing service at relatively high power from large, permanent antennas. The second are "Portable" because, as you might expect, they move around. These would likely be the users of the services provided by Fixed devices, such as laptops and handheld telephones. They would operate at lower power levels with more limited antennas and therefore would be less likely to cause interference.

Regardless of the type of device, to avoid interfering with existing television stations and other television band users, the FCC requires these unlicensed devices to determine exactly where they are located within the country and then figure out which television channels are vacant in their immediate area. This process, called dynamic spectrum sharing, requires looking up locations in a database to find out who is licensed and how far away they happen to be. Rather than managing such a database themselves, the FCC has set up a process to select qualified third parties to build and maintain independent databases and has already chosen a dozen companies to demonstrate their capabilities. Among these companies are Microsoft, Telcordia, Spectrum Bridge, and most recently, Google.

Google views dynamic spectrum sharing this way:

"Spectrum is a globally finite resource, which makes it crucial that it be allocated and shared as effectively as possible. The demand for spectrum is growing, and more people and more devices need spectrum in the same place. Having a place where people can see what spectrum is available allows people to share, which enables more technology and devices to connect using an increasingly busy medium. This helps avoid conflict between devices using the same band."

In June, the FCC officially certified Google as a TV white space database administrator, clearing the way for wireless devices to access Google's digital records. There is also a public web page where anyone can see the spectrum available in any part of the country. You can view Google's Spectrum Database at **www.google.org/spectrum/whitespace/index.html**

# ASK BOB
## GENERAL QUESTIONS RELATED TO RADIO

*Bob Grove, W8JHD*
*bobgrove@monitoringtimes.com*

***Q.*** *I have a Grove Scanner Beam and I want to take it down to replace the balun transformer. How do I unlock the elements so that they can be folded back against the boom as it was originally shipped? (David, email)*

***A.*** To avoid creasing the element, you need to pull up on the flat spring tab on the main boom right at the rivet holding the element. With that tab released, grasp the element close to the rivet, not out toward the end of the element.

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***Q.*** *What coax would you recommend for use in 2.4 GHz work? (Jerry Demas, email)*

***A.*** Additional information is needed such as whether it's for transmitting; how much power and at what impedance; the length of the line; types of connectors required and, if cost is an object. But, in general:

Stay away from most thin, highly-flexible cables like RG-174 and RG-58.

For short runs (a few feet), RG-214, RG-8, RG-59, and RG-6 are all good choices.

For longer runs, LMR-400 is recommended and widely available. Increasing LMR numbers (500, 600, etc.) indicate even better performance, but at higher prices.

An excellent calculator for comparing a wide variety of coaxial cables is found at **www.timesmicrowave.com/cgi-bin/calculate.pl**.

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***Q.*** *I have a WiNRADiO G39. With such wide frequency coverage, should I get an antenna combiner like the WR-ACD-1800? (Jim Finn KJ6NJJ, Santa Monica, CA)*

***A.*** Yes, the WR-ACD-1800 is ideally suited for wide-frequency coverage receivers such as the G39. Under more restricted requirements, such as AM broadcast up to 900 MHz, I'd say simply use a standard TV antenna splitter; however, since the G39 has much wider range, and you'll be inquisitive as to what's up there, go for it!

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***Q.*** *Exactly where is the North Pole located (please don't say 90 degrees north). (Mark Burns, Terre Haute, IN)*

***A.*** The north *geographical* pole is in the middle of the Arctic Ocean and covered with sea ice. It is the point around which the Earth spins as illustrated on any world globe by the pivot point at the top.

The north *magnetic* pole is the point at which a compass needle points directly downward. It's located at 85.9 degrees north, 147.0 degrees west, and is slowly drifting toward Russia.

Since it's off-center of the geographical north, a compass needle doesn't point directly toward the North Pole unless you're located on a line that goes through both poles.

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***Q.*** *I've attached some sound files I've made on shortwave frequencies. What are all these strange noises? (James, email)*

***A.*** The shortwave bands are peppered with strange noises. Since most of yours seem to be on maritime frequencies, I suspect it's mostly ship-to-shore traffic, such as FAX (facsimile, photos and weather maps) and text in high-speed Morse (passenger manifests and day-to-day shipping reports). Some transmissions are digitized and some encrypted for privacy and security, especially military and government.

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***Q.*** *I have a random wire antenna in my attic connected to two receivers simply wired in parallel at their antenna inputs. Is this the proper way to connect two receivers to one antenna? It seems I'm losing signal strength in one of the receivers. (Tom Carroll, email)*

***A.*** If you have two receivers with identical 50 ohm antenna receptacles, you would theoretically lose only 3 dB (half an S-unit) in each since the available signal is now split in half for each radio. Losing an appreciable amount of signal level in just one radio is wrong.

Rather than hardwire the two receiver antenna lines together, it's best to use a splitter. Most standard TV antenna splitters work fine at shortwave frequencies (**see www.grove-ent.com/splitter.html**). Even better would be the Stridsberg multicoupler built for this purpose (**www.grove-ent.com/MC102.html**). If your original signal levels are low on the antenna, you could add an in-line preamp such as the one from Ramsey (**www.grove-ent.com/PRE2.html**).

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***Q.*** *I've often heard that antenna tuners are needed on a portable shortwave radio, but you say that it's necessary for sending and NOT necessary for receiving. Why the difference of opinions? (Ted, Cambodia)*

***A.*** Much of the difference in opinion comes from listeners' different expectations and experiences with different radios. If you are in a metropolitan area and your shortwave reception is compromised by strong-signal overload from VHF pagers, NOAA weather, and local AM and FM broadcasters, then a tunable pre-selector, not a tuner, would solve the problem since it isolates a narrow swath of spectrum, deeply suppressing frequencies above and below that. Portable, multiband radios are far more vulnerable to overload problems than desktop communications receivers and amateur radio transceivers.

An antenna tuner, more correctly called a transmatch, is an impedance matching device intended to make the antenna system's impedance approach that of the transmitter. This assures better transfer of RF power and less hazard to the transmitter by high RF voltages from reflections on the feedline caused by the mismatch. For receiving, on some frequencies there may be a marginal increase in signal strength, along with background noise, when the transmatch is properly adjusted. Tuners are far more broad than pre-selectors in their frequency selectivity, so they have little effect on slicing a narrow portion of spectrum out of the mire and suppressing the rest.

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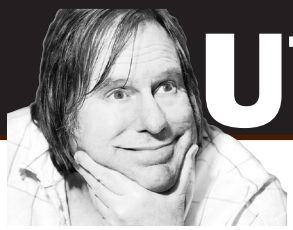
***Q.*** *I'd like to operate two or more scanners in my car. Can I do it with just one antenna and a splitter, or do I need a separate antenna for each scanner to avoid signal loss and mutual interference between the scanners? (Jerry Dehoney KA0QIZ, email)*

***A.*** Two separate antennas for two scanners will result in the highest signal strengths and best isolation between the two scanners. It will help prevent picking up oscillator radiation which can act like a bogus signal, locking up the scanning sequence in the affected scanners.

If signal strengths are reasonably strong, a standard TV antenna splitter, bringing one antenna into two scanners, will work just fine. You only lose about 3 dB of signal because you divide the signal voltage in half. With more scanners there's more loss, and more chances of the interference. I'd try the splitter method first before you turn your car into a porcupine.

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.)



# UTILITY WORLD
HF COMMUNICATIONS

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# Globe Wireless Abandons HF

The latest major closure to affect shortwave (HF, High Frequency) radio is on the utility side. It's the end of the Globe Wireless Maritime Digital Radio Network.

Not very long ago, this world-spanning net was an integral part of Globe's turnkey communication system for large cargo vessels. It was billed as a cheaper alternative to satellites for e-mail. Shore stations would repeatedly page ships with outstanding traffic, and the vessels would eventually answer to pick up their mail. Now, though, the network is essentially gone.

Here, only two stations are still audible. These are KPH, San Francisco Radio, CA, on 8606.0 and 13017.0 kilohertz (kHz), and WNU, Slidell Radio, LA, on 18224. These frequencies are the shore side of international duplex channels. Ships transmit on 8343, 12427, and 18203.5 kHz.

On July first, the two KPH pairs were much busier than before. The marker, in 100-baud FSK (Frequency-Shift Keying), was switching frequently to faster digital modes used to actually move traffic with ships. It would seem highly apparent that at least a few of Globe's oft-cited 4000 HF customers have been slow to give it up.

It's obvious that change is afoot at Globe Wireless. Articles in the investment press describe recent management changes, and an effort to build a leaner company, better suited to the shifting winds of the shipping industry.


***Ten-Tec RX-321 receiver, custom made for Globe Wireless (courtesy N5NA).***

While June 30 was given as something of a cutoff date, some HF signals vanished well before that. Some, like KPH, persisted after it. There was no abrupt, dramatic sign-off like the one on that dark day when Globe dropped Morse code services. It ended with a whimper, not a bang.

Even so, the decision must have come relatively quickly. The Globe web site continues at press time to stress the value of this "24-station network." It's still being pitched as a cheap and reliable satellite backup or alternative. The only problem is that it no longer exists.

## ❖ The End of History?

People who have been around for a while remember when Globe's call signs actually referred to real stations with proud histories of highly trained operators saving lives at sea. Some of the original station sites still exist, while others don't. In many cases, Globe bought the licenses from companies giving up on stations, and used the calls at other transmitters.

The good part of all this was that the network kept some pretty historic calls in use - sort of. They survived in the license documents. One could still refer to a particular Globe station by its old, iconic letters. Their very sound conjured up a more heroic time, when real humans made the strange beeping noises that connected ships at sea with the rest of the world.

Recently, these old calls lived on in another form. A free Java program called Rivet made it possible for ordinary listeners to find identifying bit sequences in the arcane, proprietary protocol used for Globe markers. These were decoded into hexadecimal bytes which could be used to look up the station calls. OK, it wasn't the same as the window-rattling, almost danceable, Morse code rhythm from KFS, but at least it was something.

Rivet, which does a lot of other good things too, remains a remarkable feat of programming. One has to feel good for amateur radio and utility listening when smart people like creator Ian Wraith can produce seemingly magical code for the rest of us. This is especially true when said code costs nothing, or at least a tiny fraction of the thousands of dollars required for the high-end commercial decoders.

Rivet led to quite a flurry of Globe loggings. The latest versions were also able to extract a vessel's Maritime Mobile Service Identity (MMSI) from FSK packets on either side of the duplex pair. Listening on the ship side, when it was audible, would sometimes give the vessel's position. This was fun, not to mention a good way to rack up ships.

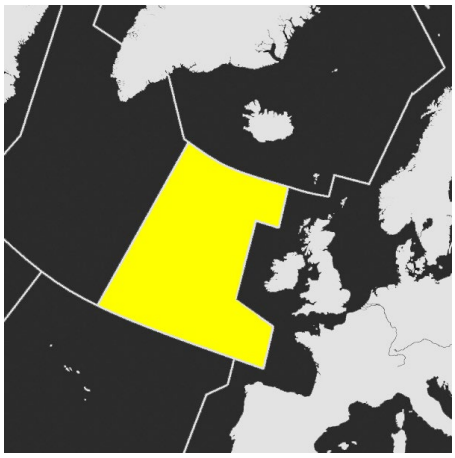
All of this will be missed, along with these echoes of the old call signs. Some will simply vanish forever, while others will still be used for other services. Right now, it's impossible to say which ones are which.

## ❖ More Shanwick Frequencies

This month's column is finally able to list all the "additional" frequencies being used for North Atlantic oceanic air traffic control by the center at Shanwick (Shannon/Prestwick). These were mentioned last month, but details were scarce.

The Shanwick aero mobile frequencies listed in all the publications and web sites are Major World Air Route Area (MWARA) allocations. These still exist, but in 2011 a number of others were authorized for Shanwick's use on the same North Atlantic routes. They came from the center's lesser-known allocations for Regional and Domestic Air Route Areas (RDARA).

As with the MWARA, these additional frequencies are organized into "families." The



***Shanwick Oceanic Control Area (map by author).***

publications all mention the North Atlantic families NAT-A through F. Now one can add H, I, and J. (It's unknown why there is no "G.")

Family H is 2965, 3491, 5583, 6556, 6667, 10021, 10036, and 11363 kHz. All of these are upper sideband voice (USB). 5583 and 6667 have recently been active with voice traffic.

Family I is 2860, 2881, 2890, 3458, 3473, 3488, 5484, 5568, 6550, 6595, and 10066 kHz USB.

Family J is 2869, 2944, 2992, 3446, 3473, 4651, 4666, 4684, 5460, 5481, 5559, 5577, 6547, 8843, 8954, and 11276 kHz USB. 6547 has recently been very active, with selective calling (selcal) and voice traffic.

In addition, some other changes were made in the use of families B and C on April 22, 2013. These relate to the assignment of frequencies based on the position of the aircraft. According to the Notice To Airmen (NOTAM), families B and C will now be used for aircraft between 47 and 64 degrees north latitude.

April's changes might relate to the increased use of automated systems for oceanic air traffic control. Then again, they might not. At this time, the voice channels still sound pretty busy.

## ❖ Tallinn Airport

Tallinn Airport (designators TLL and EETN) is the largest one in Estonia. It's short for Lennart Meri Tallinn Airport. Tallinn is the Estonian capital, and Lennart Meri was a leader in the movement for independence from the Soviet Union. He became the country's second president.

This airport is different because of the way it does its broadcasts of recorded information for arriving pilots. All airports of any consequence do these. They're a simple, time-saving way to brief pilots on the weather, approach conditions, and any special circumstances affecting safety of flight.

This information is broadcast on a voice loop, over assigned frequencies in the Very High Frequency (VHF) aircraft band. It is often referred to as ATIS, for Automatic Terminal Information Service.

Tallinn, however, also sends out their ATIS on 4645 kHz USB, in English. The loop starts out with the identifier, "This is Tallinn Airport met report," and a sequential phonetic letter.

The letter is a standard procedure used everywhere. It increments whenever the ATIS is updated, usually hourly to let pilots know when there's a new one, and its read-back lets controllers know that the pilot has the latest info.


***Tallinn Airport logo (courtesy Tallinn Airport).***

Tallinn's voice, however, sounds very digital. The ATIS vocabulary is a small one, and they might have just digitized a human reading all of the possible words and figures. Software would splice these together as necessary, the same way Cuba makes its voice "numbers" recordings.

Information items follow the international standard. After the identifier, the report starts with the Zulu (UTC) time, the runway being used for arrivals, sky condition, dew point (related to humidity), altimeter setting ("QNH"), and then "airport information [phonetic letter], out." It's only "out" for a small fraction of a second before looping again.

Several videos of radios receiving the information are on YouTube, for that large portion of the Earth's population which has trouble hearing Estonia in the 4-megahertz band. Or, of course, one can do as this editor did, find it on the University of Twente remote web receiver.

Some YouTube posts refer to 4645 as Tallinn Volmet, but this is wrong. Volmet ("flying weather") is a whole different service than ATIS. With discoveries like this one out there, it's no wonder that the radio thing never gets old.

## ABBREVIATIONS USED IN THIS COLUMN

AFB.....Air Force Base
ALE.....Automatic Link Establishment
ARQ .....Automatic Repeat reQuest teleprinting
AM .....Amplitude Modulation
BOM.....Australian Bureau of Meteorology
Camslant.....Communications Area Master Station, Atlantic
CW.....On-off keyed "Continuous Wave" Morse telegraphy
DGPS.....Differential Global Positioning System
DHFCS .....Defence High Frequency Communications Service
DSC .....Digital Selective Calling
E11a......"Stritch" family numbers in English
EAM .....Emergency Action Message
FAX.....Radiofacsimile
FEMA.....U.S. Federal Emergency Management Agency
G06.....Russian numbers in German, like other languages
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
M03......"Stritch" family numbers in Morse code
M21.....Russian CW time-stamped tracking datagrams
M89.....Chinese military 4-character calls
MARS .....U.S. Military Auxiliary Radio System
MFA.....Ministry of Foreign Affairs
MFSK.....Multiple Frequency-Shift Keying
MRCC .....Maritime Rescue Co-ordination Center
MSK.....Minimum-Shift Keying
MX.....Generic for Russian single-letter beacons/markers
NAT .....North Atlantic oceanic air control, families A-F
NOAA .....U.S. National Oceanic and Atmospheric Administration
Pactor .....Packet Teleprinting Over Radio, modes I-IV
RTTY.....Radio Teletype
Selcal .....Selective Calling
Sitor.....Simplex Telex Over Radio, modes A & B
TACAMO .....Take Charge And Move Out
UK .....United Kingdom
Unid.....Unidentified
U.S. .....United States
USAF .....U.S. Air Force
USCG .....U.S. Coast Guard
Volmet.....Scheduled, formatted, aviation weather broadcasts
XPA.....Russian Polytone, multi-frequency digital messages

*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 ().*

18.1 RDL-Russian military strategic broadcast, CW ID and message in six 5-figure groups, at 1840 (MPJ-UK).

294.0 428-DGPS, Vlieland, Holland, 200-baud MSK corrections, at 1247 (Ary Boender-Netherlands).

303.5 493-DGPS, Zeven, Germany, 100-baud MSK corrections at 1240 (Boender-Netherlands).

304.0 783-DGPS, Lista, Norway, 100-baud MSK corrections at 1258 (Boender-Netherlands).

1888.0 IPD-Civitavecchia Radio, Italy, information bulletins in Italian, at 2059 (MPJ-UK).

1982.0 4JSQ-Fishing beacon, unknown location, CW ID at 0229 (Mario Filippi-NJ).

2142.5 ZLST-German Customs Control Post, Cuxhaven, calling ZRUE, Water Police Boat *Rügen*, also on 2673, ALE at 2322 (MPJ-UK).

2187.5 219592000-Danish roll on/ roll off auto ferry *Crown Seaways* (OXRA6), DSC safety test to Bremen MRCC, Germany, at 2031. 002734446-Possibly Taman Radio, Russia, acknowledging request for voice contact on 2182 with Novorossiysk MRCC, DSC at 2040 (MPJ-UK).

2656.0 IPA-Ancona Radio, Italy, weather and information bulletins in Italian, at 2052 (MPJ-UK).

2680.0 IDC-Cagliari Radio, Italy, information bulletins in Italian and English, at 2050 (MPJ-UK).

2749.0 Halifax-Canadian Coast Guard, NS, Notices to Shipping with live male and female announcers, at 0246 (Filippi-NJ).

3246.5 Unid-Russian Air Defense, CW null-data tracking strings (M21), parallel on 5221.5, at 1938 (MPJ-UK).

3531.0 REA4-Russian strategic air broadcast, CW message in 5-figure groups, then signed with call sign, at 2040 (MPJ-UK).

3642.0 3A7D-Chinese military CW calling marker (M89), calling 3A7D, at 2054 (MPJ-Russia remote).

3816.0 XL4E-Russian military, CW net control callup to 1XWM, GGKK, 5C7D, and many other 4-character call signs, at 2200 (MPJ-UK).

4553.5 ZEMD- German Water Police Boat *Emden* (DLVH), ALE and data with ZLST, Cuxhaven, at 2348 (MPJ-UK).

4755.0 AFA4HQ-USAF MARS, net with AFD4NC, at 2301 (Jack Metcalfe-KY).

4775.0 AFA4QY-USAF MARS net, at 0100 (Metcalfe-KY).

5322.5 NF53FQ-USCG Auxiliary, net with station of possible call NO13NG, at 0102 (Metcalfe-KY).

5410.0 SP1OZ2-Sonatrach oil net, Algeria, pumping Station 1 on OZ2 pipeline, ALE sounding at 2150 (MPJ-UK).

5596.0 MCLM-Russian military, CW duplex signal checks with 7CFF, ELTO, and GNYZE, at 1928 (MPJ-UK).

5680.0 Kinloss-UK Royal Air Force, Scotland, position from Navy 177, a Royal Navy Sea King helo, at 1149. Kinloss Rescue-UK Aeronautical Rescue Coordination Centre, working Rescue 137, a Sea King, at 1548 (MDMonitor-Netherlands Remote).

5696.0 Camslant-USCG Camslant Chesapeake, VA, working Coast Guard 2006, an HC-130J, at 0118. Camslant, working Coast Guard 1716, an HC-130H, at 0139 (Allan Stern-FL).

5738.0 D22-Dutch military, working D17, ALE at 1533 (Boender-Netherlands).

5943.0 218-Russian intelligence "German Lady" (G06), callup 545/15, then message in 5-figure groups ending "00000," at 1930 (MPJ-UK).

6313.0 NMF-USCG, Boston, MA, Sitor-B weather for Atlantic and Caribbean, at 0119 (Filippi-NJ).

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

6352.5 WHL-GlobaLink, FL, CW ID every three minutes in Pactor-I idler, at 0400 (PPA-Netherlands).

6399.0 ZSC-Globe Wireless at Capetown Radio, South Africa, hex ID in GlobeFSK marker, at 0356 (PPA-Netherlands).

6524.0 795-Unknown agency with CW numbers (M03), callup 795/31 and message in 5-figure groups, at 1535 (MPJ-UK).

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

6661.0 "04"-HFDL ground station, Riverhead, NY, uplink to Avianca 855, at 0338 (PPA-Netherlands).

6668.0 768-Georgian military, ALE link check with 762, at 1755 (Boender-Netherlands).

6823.0 AAM6RE-U.S. Army MARS, net with AAM6RA AAM6RO, at 0003 (Metcalfe-KY).

6974.0 WE5-Polish military, ALE and voice with AR6, at 2114 (Boender-Netherlands).

7037.2 "D"-New parallel frequency of Russian MX beacon, Odessa, Ukraine, with malfunctioning CW ID sending different letters other than D, also on 7038.7 (old cluster frequency), at 2151 (Hugh Stegman-Netherlands remote).

7039.4 OK0EPB-Amateur time station, Czech Republic, one-minute CW cycle with ID, propagation info, and time beep, at 2140 (Stegman-Netherlands).

7461.4 Tin Can 30-USAF C-17A, working Hazard 06, a C-130H, at 0145 (Metcalfe-KY).

7540.0 AFA7ZJ-USAF MARS, net in Olivia (an MFSK protocol), at 0130 (Metcalfe-KY).

7697.1 CONTROL222-Possible U.S. NS/EP (National Security/ Emergency Preparedness), ALE and voice with XNDR261, at 1621 (Metcalfe-KY).

7845.0 DQ30-Algerian military, ALE link check with BZ33, at 2126 (Boender-Netherlands).

8002.3 NM85CO-USCG Auxiliary, testing with NM85AO and NM85AR, then went to 5253.5, at 0100 (Metcalfe-KY).

8132.0 BPLEZS-German Federal Police, working BP25, Police Boat *Bayreuth* (DBGY), at 1630 (MPJ-UK).

8317.5 2487380009-Maltese flag vessel *AM Larafale*, duplex with LFI (Rogaland Radio, Norway) in GlobeFSK, at 2231 (Stegman-Netherlands).

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

8484.0 HLG-Seoul Radio, Korea, CW marker at 1847 (PPA-Netherlands).

8489.0 SAB-Globe Wireless, Göteborg, Sweden, GlobeFSK traffic for 636011004, Liberian flag reefer *Cape Belle* (ELWE4), at 1248 (MPJ-UK).

8617.0 XSV-Globe Wireless at Tianjin Radio, China, hex ID in GlobeFSK marker, at 1935 (PPA-Netherlands).

8677.0 CBV-Valparaiso/ Playa Ancha Radio, Chile, grainy FAX satellite image, at 2348 (Filippi-NJ).

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

8806.0 WLO-ShipCom, AL, machine "female" voice with Pacific weather and request for help locating missing vessel, at 0005 (Filippi-NJ). XSG-Shanghai Radio, China, live female reading traffic list, at 2005 (PPA-Netherlands).

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

8875.0 C3-Moroccan Army, ALE link check with R3, at 0410 (Boender-Netherlands).

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

8886.0 5A-OND-Afriqiyah Airways A319, flight 8U1706, HFDL position for Krasnoyarsk, at 2135 (MPJ-UK).

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

9065.0 186CDR-Probable U.S. military, ALE and data with 186ACMD, at 0218 (Metcalfe-KY).

10075.0 VQ-BFW-Ural Airlines A320 Flight U60151, HFDL position for Al Muharraq, Bahrain, at 1959 (MPJ-UK).

10087.0 SU-GCE-Egyptair 956, an A330, HFDL position for Krasnoyarsk, at 1841 (PPA-Netherlands).

10344.0 XSS-UK DHFCS, Forest Moor, ALE link check with XED; also on 14485.5, 18403, and 20423.5; at 1810 (Boender-Netherlands).

10487.0 951-Unknown agency, numbers in female voice (E11a), callup 951/30 and message in 5-figure groups, at 1710 (MPJ-UK).

11030.0 VMC-Australian BOM, Charleville, FAX wind analysis at 0637 (PPA-Netherlands).

11090.0 KVM70-NOAA, HI, FAX infrared satellite image at 0650 (PPA-Netherlands). KVM70, FAX satellite image at 1238 (Filippi-NJ).

11175.0 Offutt-USAF HFGCS, Offutt AFB, NE, operator in major exercise telling unheard station that the base was destroyed, and therefore he could only take real world requests, at 0230 (Jeff Haverlah-TX). Abduction-US military, two exercise EAMs at 0440 (Boender-Netherlands). Aphis 06-U.S. Navy E-6 TACAMO aircraft, passing a 4-character message, at 2242 (Metcalfe-KY).

11184.0 G-ZBAF-Monarch Airlines A321, flight MON742, HFDL position for Reykjavik, at 1620 (MPJ-UK).

11285.0 Kuala Lumpur-Regional air traffic control, Malaysia, working Malaysian 20, a Malaysia Airlines A380 reg 9M-MNB, at 1720 (PPA-Netherlands).

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).

11354.0 Priboj-Russian Naval Air Transports Central Sector, Moscow, position from 52651, a Russian Navy AN-26 transport, at 1121 (MDMonitor-Netherlands).

11360.0 Korsar-Russian Air Force transport, Pskov, working 76738, an IL-76MD, at 1107. Korsar, comm checks with Polis (Orenburg), Proselok (Bryansk), Davlenie (Taganrog), and Klarnetist (Tver); at 1200 (MDMonitor-Netherlands).

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

11478.0 155-Chinese military, ALE text, Chinese voice, and 39-tone modem with 493, similar on 11490, at 1801 (PPA-Netherlands).

11900.0 Leon 1-Unknown station, calling Zebra, at 0157 (Metcalfe-KY).

12168.0 Unid-Russian 20-tone Polytone (XPA), MFSK callup 813 and message in 5-figure groups, at 0620 (PPA-Netherlands).

12209.0 3031-Turkish Civil Defense, ALE link check with 3161, at 0815 (Boender-Netherlands).

12356.0 XVG-Hai Phong Radio, Viet Nam, weather and marine information in Vietnamese, at 1727 (PPA-Netherlands).

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

12388.5 636091157-Liberian flag tanker *E.R. Denmark* (A8JX9), position for SAB, Göteborg, in GlobeFSK, at 2042 (MPJ-UK).

12397.5 235011860-UK flag cargo vessel *Eileen C* (MPJC3), position in GlobeFSK for SAB, at 1305 (MPJ-UK).

12577.0 005030001-Charleville/Wiluna Radio, Australia, DSC with 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).

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

12641.0 SAB, GlobeFSK traffic for 235080632, UK flag cargo vessel *Karla C* (2DNZ4), at 1200 (MPJ-UK).

12709.0 A9M-Globe Wireless, Bahrain, GlobeFSK traffic for 235080633, UK flag cargo vessel *Kikki C* (2DNZ5), at 1857 (MPJ-UK).

12712.0 HLF-Globe Wireless, Korea, hex ID in GlobeFSK marker, at 1843 (MPJ-UK).

12743.0 Unid-Unknown station with CW message in 5-figure groups, at 0340 (Filippi-NJ).

12749.0 Unid-Probably CWA, Cerrito Radio, Uruguay, CW weather at 0014 (Filippi-NJ).

12756.5 A9M, GlobeFSK traffic for 235075588, UK flag cargo vessel *Kristin C* (2CTI5), at 2036 (MPJ-UK).

12786.0 NMC-USCG, Point Reyes, CA, clear FAX satellite image of East Pacific, then a Sea State Analysis chart, at 0205, at 0155 (Filippi-NJ).

12851.0 SAB, GlobeFSK traffic for 235075591, UK flag cargo vessel *Kathy C* (2CTI7), at 1757 (MPJ-UK).

13182.0 XSQ-Guangzhou Radio, China, female working unknown vessel on 12335, in Chinese, at 1755 (PPA-Netherlands).

13200.0 Offutt-USAF, Offutt AFB, NE, possible exercise message "Four Tribal XQBA7B," at 1834 (PPA-Netherlands).

13270.0 GIA650-Garuda Indonesia flight, HFDL position for Hat Yai, Thailand, at 1813 (PPA-Netherlands).

13282.0 Hong Kong Volmet, China, voice synthesized aviation weather for West Pacific, at 1846 (PPA-Netherlands).

13377.0 CNC-Algerian Air Force, working CM3, 3rd Region Headquarters, ALE at 1902 (MPJ-UK).

13396.0 BYGR-Russian military net, working E1E6 and others, at 1055 (MPJ-UK).

13433.0 HKI2-Finnish MFA, Helsinki, working RIA, Riyadh embassy, Saudi Arabia, ALE at 1808 (MPJ-UK).

13435.0 Unid-Cuban intelligence "hybrid" (HM01), AM Spanish machine voice followed by digital transmission of file named 34584437.txt, at 0700 (PPA-Netherlands).

13927.0 AFA6BU-USAF MARS, AR, radio check (no patch) with King 79, a New York Air National Guard HC-130P, at 1345. AFA6BU, radio check with King 76, different C-130, at 1408 (Stern-FL).

14375.0 HM01, alternating 5-figure groups from Spanish machine voice and data modem transmissions, at 0640 (PPA-Netherlands).

14484.0 WGY 950-FEMA Region 10, WA, working Green Acres (unknown recurring exercise call sign), went to 14752 with no joy, so back to primary 14484, at 1621 (Metcalfe-KY).

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

14776.0 WGY 912-FEMA Mt. Weather Emergency Assistance Center, VA, working WGY 950 (different operator and console), at 1621 (Metcalfe-KY).

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

16035.0 Unid-Kyodo News relay, Singapore or Penang, FAX newspaper in Japanese, at 0852 (PPA-Netherlands).

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

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

16388.0 956-E11a, callup 956/40, then message in 5-figure groups, at 1110 (MPJ-UK).

16888.5 Unid-North Korean MFA, no decode on 600/600 ARQ, also on 19418.4, at 0909 (PPA-Netherlands).

16907.5 JFC-Misaki Fishery Radio, Japan, short text FAX saying QRU (no message today), at 1700 (PPA-Netherlands).

16947.7 9MG-Penang Radio, Malaysia, hex ID in GlobeFSK marker, also on 17045.6 and 17430, at 1707 (PPA-Netherlands).

16971.0 JSC-Kyodo News, Kagoshima, Japan, English ID in header of Japanese newspaper, at 1639 (PPA-Netherlands).

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

16989.4 XSF27-GlobaLink, Weihai, China, Pactor-I idler, at 1752 (PPA-Netherlands).

16995.0 Unid-Station with "quick brown fox" test loop in Sitor-B, at 1720 (PPA-Netherlands).

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

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

17207.6 HEB-GlobaLink, Berne, Switzerland, CW ID and Pactor idler, at 1909 (MPJ-UK).

17234.5 VCS-Globe Wireless, Halifax, NS, hex ID in GlobeFSK traffic for 367141680 (U.S. flag container ship *National Glory*, WDD4207), at 2058. VCS, GlobeFSK traffic for 218506000 (German flag container ship *Wehr Flottbek*, DPEX), also at 2058 (Patrice Privat-France).

17418.0 HKI2-Finnish MFA, Helsinki, working RIA, Saudi Arabia embassy in Riyadh, who also identified with RI1, ALE at 1705 (MPJ-UK).

17912.0 "14"-HFDL ground station, Krasnoyarsk, Russia, uplink at 1617 (PPA-Netherlands).

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

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

18234.5 B01MEAFRC-Maine National Guard Armed Forces Reserve Center, ALE sounding at 1549 (Metcalfe-KY).

21997.0 "13"-HFDL ground station, Santa Cruz, Bolivia, working Copa Airlines flight CM137, at 1819 (PPA-Netherlands).

28203.0 PY2WFG/BCN-Amateur propagation beacon, Brazil, CW ID giving Maidenhead grid square as GG77ff *[Between Rio de Janeiro and São Paulo. -Hugh]*, at 1211 (Filippi-NJ).

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# U.S. Embassies on HF

Ask many utility station listeners the question of whether you can hear U.S. embassies around the world on HF radio today, most will probably answer no. However, since at least 2003, the U.S. State Department has been active on shortwave using voice and MIL-188-141A ALE (Automatic Link Establishment) transmissions.

The network, called "State-NET," forms an important part of the regional emergency and evacuation systems for U.S. consulates and embassies the world over and provides long-range communications support for various classified missions. At the time of writing, the network comprises more than 280 stations, many of which can be heard almost daily. There have also been logs of embassies interacting with U.S. Air Force bases and U.S. SHARES (Shared Resources) stations over ALE in the past.

Each diplomatic post is required to perform a weekly communications test with its neighboring stations, most often occurring on a Wednesday during business hours. Stations will link using the usual ALE mechanism, followed by voice contact using a challenge-response authentication system from codebooks. Occasionally, AMD text messages have also been passed between stations, perhaps as an alternative to the voice challenges. You can hear an audio clip of the operator at station KLU52 making a weekly test by checking the example in the "Resources" section below.

At present, State-NET stations can be heard on the following frequencies:

4553.6, 5748.6, 6902.6, 8058.6, 10733.6, 11168.6, 11217.6, 11472.6, 13503.6, 16283.6, 16358.6, 16836.6, 18248.6, 18944.6, 20810.6 and 24883.6 kHz USB

Regular ITU-conforming call signs in the K and W-series are used by stations, though you won't find them in the FCC public call sign database! Sometimes, the suffix "OS" or "OS1" is added to a call sign, indicating an offsite or alternative location and "MBL" for a mobile station, though these are rare. Here are the known call signs logged so far:

KAG29
KAL71
KBF70, 95, 96
KBR29
KBX26
KCY63OS
KDC39
KEA32
KEH34TOC, 35, 36, 38, 39
KEM99
KEN20, 21, 22, 23, 23OS1
KFB90, 90OS
KFW28
KJA86
KLU52
KMN93, 93A, 93B, 93C, 93M3, 94
KRC81, 82, 83, 84
KRH48, 50, 54, 57, 58, 60, 61, 62, 71, 73
KRZ61, 64
KSI84
KSN21
KSK20
KTR67, 69, 71, 93, 94
KVW25, 71
KVX45, 50, 51, 53, 54, 56, 56OS, 99
KWA22, 37, 37OS1, 43, 54, 64, 80
KWB48, 48F, 57
KWE41, 41OS, 92
KWF22, 28, 79, 91
KWG41
KWH49
KWI26, 56
KWJ34, 58, 66
KWK20, 53, 90, 91, 92, 93, 95, 96, 97, 98, 99
KWL27, 63, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99
KWM24
KWN91, 93, 95, 96, 97, 98
KWP72, 92, 95, 95OS1, 96, 97, 98
KWQ36
KWR86, 91, 92, 93, 95, 96, 97, 98
KWS78, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99
KWT49, 50, 51, 90, 91, 92, 93, 94, 95, 97, 98
KWU47
KWV71
KWW25
KWX43, 45, 51, 53, 57, 58, 59, 62, 72, 78, 90, 91, 92, 93, 94, 95, 96, 99
KWY20, 21, 22, 23, 28, 28OS, 48, 49, 52, 53, 54, 58, 59, 59A, 92, 93, 95
KWZ99, 99MBL1
KXV44, 44MO1, 45, 49

WNG739, 739A, 739B, 740, 746, 747, 748, 751, 752, 764, 767, 777, 779, 780, 782, 790, 803, 808, 811, 828, 830, 831, 838

As one might expect of such an important and secretive network, the allocation of the majority of these call signs to the corresponding embassy or consulate remains unknown. The infamous WikiLeaks cables (see Resources) provided confirmation of just four call signs and a few more have apparently been pieced together by patient listeners picking up on sloppy operating procedure during weekly tests or other clues. Here are the few call signs that have been pinned to a given embassy:

KBF70 = Ashgabat, Turkmenistan
KBF95 = Baku, Azerbaijan (Net Control Station for European Net 10)
KBR29 = Tbilisi, Georgia
KCA30 = Yerevan, Armenia
KEH34 = Basrah, Iraq
KWE41 = Addis Ababa, Ethiopia
KWK95 = Cairo, Egypt
KWL90 = Manila, Philippines
KWL92 = Tokyo, Japan
KWL93 = Taipei, Taiwan
KWL94 = Jakarta, Indonesia
KWL95 = Beijing, China
KWR96 = Nicosia, Cyprus
KWS78 = Athens, Greece
KWV71 = Ankara, Turkey
KWW25 = Oslo, Norway
WNG767 = Pristina, Bosnia & Herzegovina

In a long overdue attempt to get a better sense of this large network, I spent a wet and dreary weekend plowing through hundreds of logs of these stations reported by monitors over the years. In a simple spreadsheet, I listed each of the calls above on a line of its own and then listed next to each, the call sign of any station that it either linked to, or to which it sent an LQA (Link Quality Assessment) request. Here's an extract of that spreadsheet:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| KVX45 | KEH35 | KWA54 | | | | | | |
| KVX50 | KVX53 | KWB57 | KWN98 | KWQ36 | WNG747 | | | |
| KVX51 | | | | | | | | |
| KVX53 | KVX50 | KVX51 | KVX54 | KVX55 | KVX56 | KWQ36 | KWU47 | KWW25 |
| KVX530S1 | KVX54 | KVX55 | | | | | | |
| KVX54 | KVX51 | | | | | | | |
| KVX55 | KWB48F | | | | | | | |
| KVX56 | KVX53 | | | | | | | |
| KVX560S | KVX53 | | | | | | | |

You can easily see that most stations communicate with just one other station but a few stations communicate with many other stations. A similar pattern is repeated across the rest of the network and clearly indicates a "hub and spoke" network arrangement, reflecting the regional organization of the State Department's diplomatic outposts. In the example above, KVX53 is a large regional NCS (Network Control Station), probably in Northern Europe because it calls Oslo (KWW25). KVX50 is a smaller hub which also communicates with KVX53, and so is probably geographically close.

In total, I found 40 embassies that appear to operate as the NCS for at least three other outposts. I also loaded the data from my spreadsheet into a very useful free software package called Gephi (see Resources), which takes lists like those above and builds the network connection diagram (network graph) for you automatically, making it much easier to see the hub-spoke and hub-hub interconnections.

## ❖ Globe Wireless Network Goes Dark

Hugh's column will no doubt provide a full account of its closure, but it would be remiss of me not to mention the passing of Globe Wireless' HF operations on June 30. It's with a keen sense of irony that I think of the timing of Ian Wraith and Alan W's work to finally unravel the secrets of this network and make them public in the Rivet decoder with just enough time for everyone to enjoy their work before the network's demise. Now HF is a little quieter without the Globe stations and ships active. Stay tuned though. Rivet's development will continue and promises some interesting capabilities in the future I hope.

### Resources

Wikileaks Cable Example - **wikileaks.org/cable/2006/10/06EFTOBAKU1453.html**
Embassy KLU52 Audio - **www.dropbox.com/s/yp01v1egiutqvjm/KLU52.wav**
Gephi Software - **gephi.org**
Sorcerer Decoder - **dl.dropboxusercontent.com/u/301213/sorcerer-v1.0.1.exe**

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# The Highs and Lows of Amateur Satellites

At the local Field Day site this summer, a group of beginning hams tried valiantly to make a *single* FM amateur satellite QSO to qualify the group for the 100-point bonus. Despite trying a variety of solutions and persevering valiantly, they failed. Although it's true that they weren't experienced satellite users, they had plenty of experience with weak-signal VHF/UHF, FM, repeaters, antennas and feed lines.

I was initially surprised, having heard about how easy it's been to work through one or more of the tiny "flying FM repeaters" in Low Earth Orbit (LEO). However, according to AMSAT (the Radio Amateur Satellite Corporation), SaudiSat OSCAR-50 (145.850 MHz uplink with 67.0 Hz CTCSS tone and 436.795 MHz downlink) would be the only operational FM-transponder satellite during this year's get-together. Stations considering only FM voice for Field Day satellite contacts, an ARRL bulletin cautioned, would find the single uplink/downlink channel "extremely challenging." This year, as in recent years, frenzied congestion on the FM satellites in low orbit caused the ARRL to limit Field Day groups to one QSO per FM bird.

## OSCAR Basics

For readers who aren't familiar with amateur radio satellite operations, let's expand on the Field Day scenario to add detail and highlight the difficulty. Saudi-OSCAR 50 is a shiny 10-inch cube that orbits the earth every 98 minutes at an average orbital altitude of about 450 miles. Its orbit is inclined 64.5 degrees as referenced to the equator, which means that as the earth is rotating west to east "underneath" it, OSCAR 50 is orbiting mostly north-south at a breezy 17,000 miles an hour!

The satellite's *footprint*, the area underneath the satellite which contains the hams who can "see" the satellite at any one time, is moving fast. To work through any repeater, terrestrial or orbiting, hams who hope to have a QSO have to be able to simultaneously see the repeater. And, with low-orbit repeaters, they had better be quick, because the typical pass lasts from three to 15 minutes. Most passes in which the satellite is less than 10 degrees above the horizon are essentially useless because of buildings, trees and hills obscuring line-of-sight paths to the horizon.

Working through terrestrial repeaters is like target practice on a staid British rifle range, while working through low-orbit satellite repeaters is like skeet shooting from a Six Flag's roller coaster! Clearly, knowing exactly where and when the satellite will be in view, and having the means to "aim" your signal at the fast-moving target, is paramount. Satellite tracking software (PC or online) takes care of the former, and azimuth-elevation rotators (or your left arm) takes care of the latter.

So, now that we know where and when the satellite will be in range, at an elevation angle that's high enough above the horizon to be practical and with a pass duration of at least several minutes, we need to let the bird know that we want to use the repeater. OSCAR 50 doesn't seem to have an onboard beacon, but many hamsats do. If you can hear the beacon, you can reasonably expect that the satellite can hear you.

OSCAR 50 receives (uplinks) on 145.850 MHz and transmits (downlinks) on 436.795 MHz. To save precious power, however, the repeater isn't fully powered up *all the time* (remember, there are usually no hams around to use the repeater when it's zipping over the poles or across vast stretches of ocean or remote land masses!).

So, to activate the repeater, your initial transmission requires a two-second carrier with a 74.4 Hz CTCSS tone that, when received, turns on the transmitter circuitry for 10 minutes. Assuming that nobody else is using the repeater, all further transmissions require a 67.0 Hz CTCSS tone, or the repeater will ignore your signal. Sending another 74.4 Hz tone before the 10-minute window is over, resets the countdown timer.

At this point, if everything's gone well, you will be able to hear your own transmissions on 436.795 MHz, as will everyone else in the satellite's footprint. On a "normal" day, things probably won't be very crazy, but on Field Day, actually *working* another station takes all of the technical maneuvering described so far, plus a whole lotta cooperation from fellow hams.

Why? Because OSCAR 50 uses FM, which brings the "capture effect" into play, meaning that FM receivers will lock onto only one (strong) signal at a time, "ignoring" the rest. So, if you manage to get the repeater's attention on your initial call, several stations may respond, but only one will get through (capture effect). On the next go-around, which is necessary to exchange signal reports (or any actual information), the station you just called *must* "capture" the satellite's receiver, as must you when it's your turn again, which requires a steady, strong signal into the fast-moving bird and disciplined cooperation from anyone else who might be frantically standing by during the same brief satellite pass.

If the two stations trying to work through the repeater can't maintain "capture" through enough successive go-rounds (other strong stations may be calling, antennas may lose track or the fast-moving satellite may slip below the horizon), madness ensues and QSOs remain incomplete!

For simplicity's sake I have completely ignored any Doppler shift issues, which are somewhat minimized by the use of FM instead of SSB or CW. In a nutshell, because LEO satellites are moving so fast (toward you and then away from you), your uplink signal may need to be adjusted (perhaps continuously) to keep your signal "on frequency." This is more important with SSB and CW via "linear transponder" satellites, but Doppler effects can impact LEO FM-sats as well. If your radio has the capability, station-control and satellite-tracking software can team up to automate Doppler-shift corrections, freeing you from the need to "man the rudder" with one hand and juggle with the other.

***MT columnist Keith Baker, KB1SF, shown here working AO-51 from the shores of Lake Huron. Keith's dual-band H-T is paired with a lightweight Arrow II sat antenna (3 elements on 2 meters, seven elements on 70 cm). Satellite tracking is via "whole body Armstrong rotation." (KB1OGF photo)***

## Linear LEOs

So, if the FM satellites are too crazy for the sheer volume of potential Field Day users, what's a ham to do? Well, as the ARRL bulletin suggests, switching to other birds equipped with linear transponders (such as VO-52, FO-29 and the venerable AO-7, launched in 1974 and still partially functional!), which support multiple, simultaneous SSB/CW contacts, is the most logical thing to do (*never* use FM on a linear transponder!).

Instead of supporting a single repeater pair, satellites with linear

transponders retransmit a range of input frequencies on a similar range of output frequencies ("mapped" band segments are typically 10 to 50 kHz wide). All linear-sats use cross-band transponders, that is, up on one band and down on another. Some invert the frequency relationship between uplinks and downlinks (inverting transponders) and some don't (non-inverting transponders). Increasing your transmit frequency could *increase* or *decrease* your downlink frequency depending on the transponder's inversion scheme. Beyond knowing that, it's not a big deal.

According to AMSAT, the available linear birds come alive during Field Day "like 20 meters on a contest weekend." As long as users carefully monitor their own signal strengths through the satellites, many simultaneous users can access them. The idea is for everyone to keep their uplink signal strengths in the same reasonable range. If one or two users slam the bird with overly powerful signals it reduces the satellite's ability to properly allocate transmit power among the various downlink signals, and it can severely "desensitize" the uplink receiver, which affects everyone's signals.

Adhering to the FCC's amateur service rule about "using the minimum necessary power to communicate" is a good idea under any circumstances, but critically important when working through satellites!

The handful of satellites with linear transponders noticeably increases satellite access during Field Day. The speedy little critters still suffer from relatively small footprints and always-too-short pass durations, but the increased complexity of making SSB and CW contacts is offset by the benefits of multiple users and onboard beacons. What amateur radio lacks are the glorious high-altitude satellites of yesteryear.

## ❖ Wherefore Art Thou, Molniya?

In the 1980s and 90s, which may one day be recognized as the "one-time-only" heyday of the amateur satellite service, we had a couple of large, high-power ham-sats in highly elliptical, Molniya-like orbits (meaning "lightning" in Russian, many Russian communication satellites have these highly eccentric orbits).

Unlike the LEO-sats (or space stations and deep space telescopes) that zip around the earth in more circular orbits 300 to 500 miles up, OSCARs 10 and 13, AMSAT's groundbreaking Phase 3 birds, had elliptical orbits that flung them some 25,000 miles away from Earth at apogee (farther out than the geosynchronous orbits of most TV satellites), and about 2,000 miles out at perigee, with orbital periods of about 12 hours. With most of each orbit spent far from earth, antenna tracking hassles were minimized and footprints and pass durations were maximized. At 20,000+ miles from earth, footprints covered as much as 40% of the globe, making DX QSOs commonplace.

Phase 3 satellites have a truly volatile history. In 1980, the first ham-sat of its kind was destroyed because of launch vehicle failure. In 1983, the second sat of the series, Phase 3B, made it to high orbit despite some mechanical high jinks and became Oscar 10. The first high-altitude ham-sat set a high bar for amateur radio achievement. It functioned for years and is still in orbit (although no longer functional). Phase 3C, which became Oscar 13, launched in 1988. Although not perfect, it was the Gold Standard for high-orbit ham-sats until it reentered the earth's atmosphere, burning up in 1996.

Oscar 13, which traces its design lineage back to 1979, gave us eight years of daily domestic and global satellite DX and was arguably the crowning ham-sat achievement. Phase 3D, launched in 2000 and destined to become Oscar 40, probably would have eclipsed even the great Oscar 13 if it had survived long enough to reach high orbit and full functionality. Instead, it exploded and is now dead in orbit. Phase 3E, interestingly an Oscar 10/13 clone, was expected to launch some eight years ago, but no suitable launch opportunities could be found.

In short, there are no functional high-orbit ham-sats today, and although AMSAT has a tested, proven design in AO 10/13, no launch opportunities are expected and the amateur satellite community has essentially moved on to a variety of interesting low-orbit projects (that are actually doable in the modern era). My beginning ham buddies at Field Day had no idea that Oscars 10 and 13 had ever existed (which prompted me to write this column)!

In this ever-more-technological era it's rare for us to *lose* capabilities as we move forward, but one exception seems to be space-exploration. We have stealth bombers and unmanned aerial vehicles, but we no longer have Space Shuttles or Saturn V rockets (to launch really big payloads or return to the moon). Whether that's catastrophic in the long run remains to be seen, but it's this changing nature of space exploration that has temporarily (or permanently) killed high-orbit ham-sats.

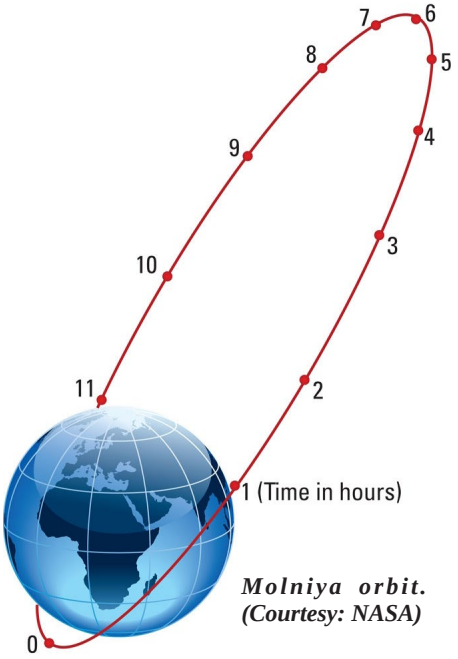
In hindsight, the 1980s provided the perfect mix of "free" or "essentially free" launch opportunities for "large" secondary payloads, and several space agencies were amenable to serendipitous partnerships. Oscar 40, a once-in-a-lifetime exception to the rule, was actually a primary payload and not riding "piggyback." The European Space Agency needed a non-commercial payload to test its new Ariane 5 rocket, and Phase 3D was it. Commercial and military satellite builders don't like to "go first" on new launch platforms!

Today, with no Space Shuttle fleet and every space agency the world over keeping a keen eye on their bottom lines, nobody (ESA, Russia, NASA, the U.S. Air Force, or China) seems interested in freebie launches. And, because the vast majority of launches these days are in support of the International Space Station and other "very low orbit" destinations, reaching geosynchronous transfer orbit (GTO) is a pay-as-you-go proposition. High-orbit sats are initially launched into GTO orbits that are quite a bit higher than that of the Space Station. Once the spacecraft completes diagnostics at GTO it's boosted to a higher, usually final, orbit. Unfortunately, you can't boost to high orbit from the Space Station's orbital altitude.

The price tag for a modern GTO launch is about $10 million and, frankly, we can't afford it. AMSAT raised about $4 million over five years, probably the most money ever raised for an amateur radio project, to pay for Oscar 40 (and much of that came from the ARRL). It would have been *much more* if the design, assembly and testing hadn't been done by volunteer experts.

## ❖ Future Orbits

Short of Warren Buffet becoming a ham or finding "angel investors," it will probably take an emerging economy (China, India, Korea or South Africa) or significantly expanded launch capabilities from the private space sector (companies such as SpaceX, which planned its first geosynchronous launch for 2013) to reach high orbit.




***Molniya orbit. (Courtesy: NASA)***

In the meantime, LEOs are where it's at, and AMSAT, with its international counterparts, has several new birds on the horizon, including some with linear transponders. There's a lot going on in the amateur satellite arena, and AMSAT has been actively partnering with universities and other entities on cooperative missions. With decades of experience building successful satellite platforms, universities can focus on their experimental payloads and let the experts at AMSAT provide satellites as well as command and control systems. This process has been working well and will likely be expanded. Lucky for us, some of those collaborative satellites include amateur radio payloads!

AMSAT's public web site was recently hacked, and the new and improved replacement site isn't fully operational at press time. Regardless, check out **www.amsat.org** for more information, including the status of all active amateur radio satellites and online satellite tracking. Check out **www.n2yo.com** for real-time satellite tracking (amateur and otherwise), **http://oscar.dcarr.org** for real-time satellite status reports, and **www.ac6v.com/satellites.htm** for general links.



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# WiFi Radio, Tiny OTA-TV Antennas Update and Field Day Notes

*MT* reader Carl Lewandowski KB3YUV had an interesting question about the different capabilities of WiFi radio. He writes:

"I was reading your article, 'Innovative WiFi Radio (Almost) has it All,' in the April issue of *Monitoring Times*. In the article you talk about the Cambridge SoundWorks Ambiance Touch, stating that, 'There are a minimum of 60,000 stations available...' But, in a review of the Sangean WFR-28, another Internet radio, on page 57 of the same issue, author Larry Van Horn states that, 'With it, users can listen to over 13,000 radio stations...'

"That's 60,000 stations available on one Internet radio, but only 13,000 available on another. I am curious, shouldn't all Internet radios be able to receive all Internet stations? Why can some Internet radios receive more stations than others? Does it have to do with the type of codec used to encode the audio stream? Perhaps some Internet radios are compatible with more coding streams than others? Or is there another reason?"

Carl, you've pretty much nailed it. With WiFi radio, it's all about what kind of software decoding each device is capable, as well as what licensing agreements have been signed by the manufacturer for each product. It also has to do with the number of apps available for a particular model. And, the more capable the receiver, the more features, and the more licenses signed, the higher the price.

But, I believe there's something else going on here. I asked WiFi manufacturers to explain the discrepancy in "available Internet stations" and got a definitive shrug. One maker assumed that the difference was between a radio that could only receive U.S. stations and one that could receive stations from all over the world, which is totally wrong. I believe that Internet radio makers don't know and are just guessing, kind of like the miles claimed that you can talk on your FRS and GMRS two-way radios; no relation to reality.

I'm not sure that it's possible or even important to count the number of Web-based streams any WiFi radio is capable of receiving. So, instead of comparing bogus station counts let's look at useful features and price tags. For example, let's compare the Cambridge SoundWorks Ambiance Touch with the Sangean


***Cambridge SoundWorks Ambiance Touch. (Courtesy: Cambridge SoundWorks)***


***Sangean DDR-68 WiFi radio. (Courtesy: Sangean)***

DDR-63. At first glance they look similar: stereo speakers, iPod docking station, remote control, etc.

But, the Ambiance Touch offers a full-color display, touch-screen navigation and on-screen QWERTY-style keyboard with full-fidelity speakers at $263 direct from CSW (**http://store.cambridgesoundworks.com/Cambridge-SoundWorks-Ambiance-Touch-System/dp/B00CFULOZ8**). The DDR-63 at $320 from **www.jr.com/sangean/pe/SGN_DDR63** does have a CD slot but also has monochrome text display and the audio quality doesn't compare to the Ambiance Touch.

Having used a good number of WiFi radios over the last year, I've noticed a number of other factors which could figure into your purchase. Some WiFi radios offer Sirius/XM apps which let you stream 130 Sirius/XM channels via your WiFi radio for $15 per month. Logitech's UE Smart Radio also offers apps, under "Radio Networks," for numerous radio services which may be state supported (BBC, CBC, etc.) public supported (soma fm), advertising supported (Radioio), commercial-free pay services or a combination of both (Pandora, Rhapsody, etc.). Here's how the app list offered by many WiFi radios breaks down:

**iHeart Radio**: Free service that lets you roam radio stations seeking particular music you want to hear.
**Last.fm**: Let's you keep up with what's trending in various music genres for $3 per month.
**MOG**: Another pay service, this one charges $5 per month.
**Pandora**: Free service has commercials and limited hours per month. Pandora One is a $36 per year service that gives you commercial-free, unlimited listening at a slightly higher bit rate.
**Rhapsody**: Similar to Pandora, but lets you download music as well as stream; $10 per month.
**Slacker**: Has two subscription levels: $4 per month for Slacker Radio Plus and $9 per month for Slacker Premium.
**Spotify**: Similar to Pandora, has ad-supported free service plus $5 and $10 per month commercial-free service.
**TuneIn**: Ad-supported aggregator of radio stations by genre (including scanners).
**Absolute Radio UK**: Ad-supported, independent UK-based radio station.
**AccuRadio**: Multi-channel, low bit-rate (32 kb/s) music service in 40 formats.
**BBC**: Lets you stream BBC Radio 1, BBC Radio 1 Xtra, Radio 2, Radio 3, Radio 4, Radio 4 Xtra, Radio 4 LW, Radio 5 live, Radio live sports extra, Radio 6 music, BBC Asian Network and BBC World Service.
**CBC**: Lets you stream the Canadian time zone feeds from CBC Radio 1 and 2 as well as CBC Radio 3. CBC's 14 music genres are not available in the U.S.
**CBS Radio**: Lets you stream any of the 126 U.S. radio stations belonging to CBS.
**DI.fm**: Digital dance music in 55 channels both ad-supported (64 kb/s) and pay (128 kb/s and $5 per month).
**Live Music Archive**: Huge database of archived live music performances.
**Live365**: Similar to other services, it offers free, ad-supported channels and ad-free VIP premium service with 7,000 stations in 260 genres with three pay plans, the cheapest of which is $6 per month for 12 months.
**Radio feeds UK & Ireland**: Aggregator of UK and Irish stations. U.S. listeners may be barred from listening.
**Radioio**: Offers low bit-rate ad-supported channels or 21 formats of 192 kb/s for "audiophiles only" at $5 per month, includes talk/news channels.
**SHOUTcast**: Claims 49,897 free Internet radio stations including music and news/talk.
**Radionomy**: Ad-supported aggregator of online radio stations from around the world.
**Sky.FM**: More than 60 ad-supported music formats.
**soma fm**: Unique, public-supported, commercial-free, 25-channel service from San Francisco with titles such as Def Con Radio, Mission Control and SF 10-33 which mixes ambient music with San Francisco public safety radio traffic. When I tuned in, 20 others were listening.

If you're looking at WiFi radios, look for features that are most important to you. For instance, I like the portability of the Logitech UE Smart Radio (with built-in rechargeable battery pack, lacking in the Ambiance Touch) and am willing to sacrifice audio for that particular feature. I also like the full-color graphic display which has it all over the Sangean WFR-28's monochromatic text screen. It's fun to see album cover art, even on Logitech's 2.5 inch screen and especially nice on the Ambiance Touch's 3.5 inch screen.

## ❖ Those Tiny OTA-TV Antennas

Another longtime *MT* reader, Ron Shire N8APZ, writes:

" I've enjoyed reading your articles on these Over-the-Air (OTA) antennas. Have you tried the new Jolt antenna amplifier from Mohu? I was thinking of using it in conjunction with some OTA-TV antennas I have built. It appears to be the same unit used with the Sky & Leaf antennas. A question I have relates to your articles that says to 'check out the reception capabilities' of TVs and converters.' I haven't seen any specs from manufacturers of TVs or converters. Do you know of any sources that rate the sensitivity of these devices or if that data is available from manufacturers? I'd bet their ratings are like antenna gain and vary between manufacturers."

***Mohu Jolt antenna amplifier. (Courtesy: Mohu)***

With regards to the Mohu Jolt antenna amplifier ($70 at **www.gomohu.com** or $59 at **www.amazon.com**), while I haven't used the Jolt, I'm sure you could use it with any passive OTA-TV antenna, especially one you've made yourself, provided it wasn't for outdoor reception. The short, thin, coax on the Jolt is really meant for indoor, short-distance use. Online user reviews are mostly from urban TV viewers who report good results indoors.

Any mast-mounted antenna preamplifier, such as the Winegard AP-8275 ($70) found at Radio Shack, will also work well, but you'll need additional RG/6 coax to get from your homebrew antenna to your TV. An advantage of the Jolt is that it can be powered directly through a USB port on your TV (if your TV has such a port).

Regarding converter and TV specs, I think you're right, manufacturer's ratings aren't reliable. Information found on the Web on DTV converter boxes is old and aging rapidly. Many products included in the ratings are no longer made. CDNet lists a number of converters still available but the specs listed are straight out of the minimal owner's manuals and not very helpful. The Zenith DDT901 ($116 on Amazon.com) got mostly favorable reviews (4.4 out of 5 stars with 192 reviews). One reviewer from June of this year claimed this converter was more sensitive than the one built into his Samsung HDTV set. The RCA DTA800B1($50 at Amazon.com) rated 3.6 out of 5 stars with 85 reviews, the most recent of which was from the first week of July (as this is written).

As to TVs, a good overview of TV types and brands from *Consumer Reports*, published March 2013 is found here: **www.consumerreports.org/cro/tvs/buying-guide.htm.** The article traces the origins of many different brands back to a handful of manufacturers. Actual ratings on TV sets, from 27 inches to 65 inches and up, are found in the *CR Buying Guide 2013*, which is available from your local bookseller or at your local library.

However, you're not likely to be satisfied with their ratings. Typical of *CR*, they assume that your TV is hooked up to either a cable or satellite-TV system, in which case any TV will do because tuner sensitivity does not come into play. They're interested mostly in "HD Picture Quality," "3D Performance," "Viewing Angle," etc., categories that have nothing to do with reception capability.

If you're interested in how an actual receiver performs when hooked up to an actual OTA-TV antenna, it's harder than ever to know. That's because TV demo rooms use cable or satellite-TV feeds or special TV demo DVDs designed to show how great the pictures are on each set. You can only know a set's reception ability by using a set at your home with your antenna setup. I really wouldn't worry about reception capability since, as *Consumer Reports* notes, many sets have components originating from the same manufacturer.

## ❖ Abbreviated Field Day Yields Mixed Results

Field Day (FD) was an abbreviated affair at my house this year owing to several previously committed, time-consuming things that always seem to pop up just as FD looms. With my late start I was left contemplating what to use as an antenna. I was trying for expediency, so I decided to set up in the garage. With the door open and rain predicted it seemed a safe place to set up. For an antenna, I hooked the rig up to a downspout that was 20 feet high, just to the side of the garage door, and drove a six-foot copper tube into the wet soil nearby as a ground. Signals were good in a north/south direction (the house faces south) and I worked a station in New Hampshire and one in Venezuela (which was involved in the the concurrently run King of Spain contest). But, RF hash from nearby electronics made reception very difficult.

Next, I decided to pull a couple hundred feet of aluminum fence wire from deep in the woods, that I had strung up years earlier, and press that into FD service. That was a huge time-consumer. It took more than two hours to successfully extricate the wire from trees which had fallen in the interim along the way. Braving chigger and tick-infested woods, my legs scratched by the thorn-covered vines protecting the wire, I finally pulled the wire free. The FD clock continued to tick and I still had only two contacts to show!

Then came the task of stringing the antenna as a horizontal loop attached to four trees in woods that surround the open field west of the house. In the process, the thin-gauge wire broke and I was forced to do a mechanical splice on the loop that was about 200 feet long, but not more than 10 feet off the ground. My expectations were diminishing as the sun started going down. I finally got the rig, the lawn-tractor battery, tuner, etc. located on a table under one side of the loop. At least I was set up in the shade!

As ominous looking clouds rolled by, I fired up the rig to see what could be salvaged from this year's FD. Running just 10 watts into the loop for just over an hour I worked a Maryland/DC station on 80 meters and stations from Florida and Vermont on 20 meters. But the antenna seemed to be particularly well suited for 15 meters where I worked stations from Maine, Illinois, California, and the Canadian Maritimes. A brief foray onto 10 meters netted Wisconsin, but that band appeared to be in very poor condition. By then, it was getting dark so I packed it in.

It wasn't my most successful FD but it did prove the point that, using found material, a battery-powered transmitter running just 10 watts on bands choked with competition, I could work as far away as California for a good information exchange. And, that's what emergency operations are intended to do.



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# Quality Programs From Russia and China

Many things have changed on the international broadcasting scene in recent years. Some radio stations have left the bands altogether, while others have radically reduced their hours of operation or their target areas. Does that mean that there is nothing to hear on the shortwave bands? A resounding no! Two radio stations in particular have really increased the quality of their programming in recent years. The **Voice of Russia** and **China Radio International** both present "must hear" programming just about every day of the week.

On local Saturday nights (Sundays UTC), **Voice of Russia** presents some very enjoyable programming. At 0130 UTC one can hear the venerable *Folk Box* program, a popular program featuring folk music from the many regions and sub-cultures of Russia. This is one of the few programs on **Voice of Russia** which date back to the Soviet era, and has been on the schedule for as long as I have been a shortwave listener (I started in the hobby in the late seventies).

One is struck by the sheer diversity of folk music and styles on offer in Russia. Each week the program may present the musical styles of one of the myriad Russian sub-cultures, such as the Buryats of Siberia, or it may focus on a particular musical instrument from Russia, like the Gudok, 900 year-old ancestor of the modern violin. While one is sure to hear lots of great music, one is also exposed to the entire cultural diversity of Russia. You will hear folk tales, discussions about folk costumes, arts and crafts, decorations and household items of old. It is an interesting look at the vast array of Russia's cultural groups and well worth hearing each week.

Following *Folk Box* at 0200 UTC one can hear *Religion and Society*, a weekly magazine which examines faith issues from a Russian perspective. While *Folk Box* dates from Soviet times, this program clearly does not, and is evidence that many things have changed since the collapse of the Soviet system. While discussing many issues of faith from around the world, the focus is more often on the Russian Orthodox Church and the activities of Patriarch Kiril.

The program usually tackles one issue each week, on such diverse topics as the portrayal of Christian values on television, the future of the Orthodox Church in China, and the adoption of Russian children by same-sex couples abroad. This is not your typical program about faith and religion. Agree or disagree, it is an interesting insight into Russian thinking on matters of faith.

Continuing with a cultural theme, **VOR** *Treasure-Store* is up next, featuring the literary diversity of Russia, examining the literary output of some of Russia's greatest writers and thinkers. This is a subject near and dear to my heart as I studied Russian lit in an earlier life during my university days. Russian literature is an important facet of the Russian psyche. Giants like Pushkin, Gogol and Tolstoy are featured, as well as less-well-known but important figures and works of the Russian literary world. Always a good listen, this program is one of my favorites.

Next up on the schedule at 0300 UTC is our old friend Vasily Strelnikov and his co-host Natalia Stefanova with *From Moscow With Love*, discussed in the July edition of this column. This is one fun program highlighting events in Russia with a keen wit and a sense of humor.

The final half hour of the North American broadcast features two more wonderful 15-minute programs. At 0330 *This is Russia* can be heard, and it's a real gem. It looks at Russian history, culture and civilization. Topics might include the various historic districts of St. Petersburg, the four hundred year history of the Romanov Dynasty (imagine that program airing prior to 1989!) or in-depth discussions of Russian art. It is another program examining the rich history and culture of this great nation.

To wrap up, at 0345 is the delightful travel program *Travel Russia*. Dan Moody hosts the program. Each week. he highlights a particular city or region, taking the listener on an all-too-brief tour of the place in question. Moody is an enthusiastic host presenting each program in a fast-paced and entertaining manner. This should really be a half hour program!


***Dan Moody, host of "Travel Russia" (Courtesy: vor.ruvr.ru)***

Each Saturday night, **Voice of Russia** presents these programs examining the great historical and cultural diversity of Russia. If you want to understand Russia, this is a good place to start. Tune in each UTC Sunday on 9665 kHz to hear this delightful programming. Sadly, not on the shortwave service to North America are two more programs well worth hearing: *Eco Plus* and *Hits in Russia*. One can hear both online via the **Voice of Russia** website in the 0400 hour on UTC Sundays. *Eco Plus* looks at issues dealing with the environment, examining climate change, pollution and other "Eco-issues." This is followed at 0430 by *Russian Hits*, a terrific program, as the name suggests highlighting the latest hit music from Russia. Give it a listen at **english.ruvr.ru** (Click the "Radio: World Service" link at the very top of the page).

**China Radio International** is fast becoming a must-hear radio station, as China becomes an important player in world affairs, from both a political and economic perspective. This isn't the old Radio Peking of Mao's day any more.

I find myself tuning in more often than not during the 0300 UTC hour each day on either 9690 or 9790 kHz. Monday through Friday one can hear the *Beijing Hour* at this time, a program discussed here several times in recent years. It is a fast paced news hour looking at the latest world and Chinese news. It has been interesting listening to the coverage of the Eric Snowden case from a Chinese perspective. Even the impending birth of a new heir to the British Crown was covered! If you want to know what is important in China this is the place to start.

On the weekends, a different program airs. On UTC Sundays and Mondays at 0300 one can hear *News and Reports.* As the name implies, *News and Reports* features world, Asian and Chinese news, as well as various reports about the issues of the day. The presentation is very good. In thirty minutes one can hear a comprehensive review of the news, foreign and domestic, and reports as varied as natural disasters (flooding in Sichuan), accidents (the Asiana air crash in San Francisco), trade and economics (Sino-British trade and global stock markets) and lighter stories about tourism and Internet gaming. *News and Reports* winds up with *Media Digest*, a quick review of the world press, and concludes with a look at some lighter stories. A recent program included a story about a toddler who inadvertently bought a car on eBay while playing with Dad's "smart phone." This weekend half-hour is a lighter, but just as informative as the *Beijing Hour*.

*News and Reports* is followed by an odd program called the *World According to Words.* Each week, program host Liu Yan discusses "the most important and popular new words that have come to define the world we live in." If you have an interest in language and words, it is a treat to hear this program. Typical words discussed on the show include: Selfie, a self-portrait photograph taken with a digital camera, Kidult, an adult who participates in youth culture and activities traditionally intended for children, and significantly, Whistleblower... which was discussed about the same time Edward Snowden leaked his documents. I had never heard many of the "hip" new words discussed on the show. Maybe I need a hip replacement. Nevertheless, its a fun and informative program to keep up with trends in language in both the English and Chinese-speaking worlds.

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# Celebrating Two Anniversaries

On the heels of Radio Free Asia's (RFA) popular International Broadcasting Bureau (IBB) Saipan QSL card, RFA announces the release of their 17th anniversary card. RFA's first broadcast was on September 29, 1996. Today, RFA continues their commitment to bring news, commentary and cultural programming to Asian countries, where accurate and timely news reports are unavailable.

RFA reception reports may be submitted online by following the QSL Reports link at **http://techweb.rfa.org** or via email to: *qsl@rfa.org*. Send your postal reports to Reception Reports, Radio Free Asia, 2025 M. Street NW, Suite 300, Washington, D.C. 20036 U.S.A. This card will be used to confirm all valid reception reports from September 1 through December 31, 2013.

Australian Radio DX Club (ARDXC) announced that they are offering a new Radio Symban World Radio e-QSL. The 24 hour Greek radio broadcaster from Sydney, Australia, boasts listeners throughout the world via shortwave on 2368 kHz and streaming audio. Detail requirements include a brief MP3 recording of the date/time, and should include a station ID, as well as easily identifiable program content such as commercials, music or announcements. Written program details should include date, time, frequency, SINPO, location of receiver and antenna. The e-QSL is not being offered from the station, nor does it extend to the Voice of Le Manamea Somoa program on Radio Symban World Radio. Submit your details to John Wright at *dxer1234@gmail.com*

The September 2013 edition of QSL Report is the 25th anniversary of this column. Twenty five years ago, Burkina Faso, Central African Republic, Kenya, New Caledonia, and Qatar were wowing collectors. Three hundred columns later, it remains you the reader, to whom I say thank you for your readership, comments and contributions.

## AMATEUR RADIO

Japan-JR8UKI, 21 MHz/JT65. Full data blue/gray *Japan Awards Hunters Group* card, signed by Hajime Tanaka. Received via ARRL bureau packet (Larry Van Horn, NC)

Japan-JG1XUZ, 14 MHz/JT65. Full data color photo of Tokyo skyline/logo card, unsigned via Hideo Karasawa. Received via ARRL bureau packet (Van Horn)

Saudi Arabia-HZ1HN, 21 MHz SSB. Full data color photo card of Riyadh at night, unsigned. Received in three months for $3.00US and nested Euro envelope. QSL address: Hani Ahmad Alzahrani HZ1HN, P.O. Box 9099, ABHA 61413, Kingdom of Saudi Arabia (Van Horn)

## CLANDESTINE

Radio Free Sarawak 11600 kHz (T8WH, Palau) 17840 kHz (Trincomalee, Sri Lanka), 15430 kHz (Dhabbaya, UAE), and 15460 kHz via Taiwan. Four partial data black/white cards, without site notation. Scenic postcard and brief personal note enclosed. Received for four reports to: Bruno Manser Fonds, Socinstrasse 37, 4051 Basel, Switzerland. (Wendel Craighead, Prairie Village, KS)

## ETHIOPIA

Radio Oromiya, Addis Ababa 6030 kHz. No data e-mail response from Habtamu Dargie Gudeta, Engineering Department Head. Received in one hour for program details and attached MP3 audio to *habtamu_dargie@yahoo.com*. Friendly response and reference to new Oromo broadcast schedule commencing at 0300 UTC. Station address: P.O. Box 2919, Adama, Ethiopia. (Ron Howard, CA/DX Window) Website: **www.orto.gov.et**

## ISRAEL

Galei Tzahal (Israel Defence Forces Radio) 6885/15850 kHz USB. Full data notation for each frequency on microphone/logo card, unsigned. Received in 36 days for an English report to *glz@galatz.co.il* Station address: Military Post Office Box 01005, 23 Yehuda Hayamit, Jaffa, Israel. (David W. Pettingham, PA) Streaming audio **www.glz.co.il**

## LONGWAVE

Poland-Polskie Radio, Solec Kujawski 225 kHz. Full data station e-QSL. Received in three weeks for posting program details at **www.polskieradio.pl** Station address: Polskie Radio S.A., al. Niepodleglosci 77/85, 00-977 Warszawa, Poland. (Artur Fernandez Llorella, Catalonia, Spain/HCDX).

## MADAGASCAR

Vatican Radio relay via Talata Volondry, 13765 kHz. Full date e-QSL for e-report to *gestfreq@vatican.va* (Llorella).

## MEDIUM WAVE

Armenia-Trans World Radio, Gavar 1377 kHz AM. Full data e-QSL from Kalman Dobos. Received in four weeks for an AM report to *kdobos@twr.org* U.S. contact address: P.O. Box 8700, Cary, NC 27512 USA (Llorella)

Canada-CFZM, 740 kHz AM. Date only e-mail response. Received in 624 days for an English airmail report and $2.00 US. Three additional follow ups required with mint stamps for return postage. E-mail response from John Van Driel, VP Programming *jvd@mzmedia.com*. Station address: CFZM, 550 Queen Street E., Suite 205, Toronto, Ontario M5A 1VA Canada (Al Muick, Whitehall, PA/HCDX)

Hungary-Dankó Rádió, 1251 kHz AM. Full data verification letter, signed by Miklós Kenderessy, Director Technical Department. Received in four weeks for an AM report. Station address: Kunigunda útja 64, H-1037 Budapest, Hungary (Llorell)

Mozambique-Radio Moçambique, Maputo 738 kHz AM. No data Portuguese thank you letter and frequency list, signed by Eng. Nazario Muchango, Technical & IT Dept. Admin. Received in 810 days for initial Portuguese airmail report and two IRC's, followed by a Portuguese follow up. Additional letter to station director and $5.00US for return postage. Reply received 72 days from last letter to *nazario.muchango@live.co.za* Logged from Kandahar Airfield, Afghanistan. Station address: Radio Moçambique, EP de Maputo, Mozambique (Munick).

## SOUTH AFRICA

Vatican Radio relay via Meyerton, 15570 kHz/585 kHz AM Vatican City. Full data Vatican QSL cards for each frequency. Received in eight days for two reports. Station address: Vatican Radio, Piazza Pia 3, 1-00120 Vatican City, Vatican City State (Francesco, Italy/playdx) Streaming/on-demand audio **www.radiovaticana.va**

## UTILITY

France-Non Directional Beacon VE Valence-Chabeuil, 320 kHz. Full data prepared QSL card stamped and signed by Pascal Brandy, ATC Manager. Received in eight days for a utility report. QSL address: Service de la Navigation Aérienne Centre-Est, Organiseme de contrôle de Valence-Chabeuil, Aérodrome de Valence-Chabeuli, 26120 Chabeuil, France. (Patrick Robic, Austria/UDXF)

International Waters-OXMF2 Torm Estrid and OYNS Torm Charente (Tankships) 12577 kHz. Full data prepared QSL cards stamped. Received in six days for utility reports. QSL address: Torm A/S, Tuborg Havnevej 18, 2900 Hellerup, Denmark. (Robic)

OWNT2-Thor Guardian (Safety/Rescue Vessel) 8414.5 kHz. Full data prepared QSL card stamped and signed. Received in 12 days for a utility report. QSL address: Thor Ltd., Bryggan 5, 420 Hósvik, Faroe Islands (Robic).

Mauritius-Coastal Radio 3BM, 8414.5 kHz. No data e-mail response. Received in one day for utility details to *3bm.mrs@mauritiustelecom.com* (Robic).

Montenegro-Coastal Radio 4OB, 2187.5 kHz. Full data e-QSL. Received in one day for utility details to *barradio@pomorstvo.me* (Robic).

# How to Use the Shortwave Guide


## 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 787-790; WWDX Club/Top News.

George Baxter/R Australia; Zacharias Liangas, 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 | 0035 | | Vanuatu, R Vanuatu | 3945do | 7260do | |
| 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 | | India, AIR/Imphal | 4775do | | |
| 0000 | 0100 | | India, AIR/Kohima | 4850do | | |
| 0000 | 0100 | | India, AIR/Mumbai | 4840do | | |
| 0000 | 0100 | | India, AIR/Port Blair | | 4760do | |
| 0000 | 0100 | | Malaysia, RTM/Kajang | | 5965do | 6050do |
| 0000 | 0100 | | Malaysia, RTM/Traxx FM | | 7295do | |
| 0000 | 0100 | | Mexico, R Educacion | | 6185do | |
| 0000 | 0100 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755 as |
| 0000 | 0100 | | New Zealand, R New Zealand Intl | | | 15720pa |
| 0000 | 0100 | DRM | New Zealand, R New Zealand Intl | | | 17675pa |
| 0000 | 0100 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | |
| 0015 | 0100 | | India, AIR/Chennai | 4920do | | |
| 0020 | 0100 | | India, AIR/Hyderabad | | 4800do | |
| 0020 | 0100 | | India, AIR/Thiruvananthapuram | | 5010do | |
| 0025 | 0100 | | India, AIR/Aizawl | 5050do | | |
| 0025 | 0100 | | India, AIR/Bhopal | 4810do | | |
| 0025 | 0100 | | India, AIR/Jaipur | 4910do | | |
| 0025 | 0100 | | India, AIR/Jeypore | 5040do | | |
| 0030 | 0100 | | Australia, ABC/R Australia | | 17750va | |
| 0030 | 0100 | | India, AIR/Srinagar | 4950do | | |
| 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 | | India, AIR/Aizawl | 5050do | | |
| 0100 | 0200 | | India, AIR/Bhopal | 4810do | | |
| 0100 | 0200 | | India, AIR/Chennai | 4920do | | |
| 0100 | 0200 | | India, AIR/Gangkok | | 4835do | |
| 0100 | 0200 | | India, AIR/Hyderabad | | 4800do | |
| 0100 | 0200 | | India, AIR/Imphal | 4775do | | |
| 0100 | 0200 | | India, AIR/Jaipur | 4910do | | |
| 0100 | 0200 | | India, AIR/Jeypore | 5040do | | |
| 0100 | 0200 | | India, AIR/Kohima | 4850do | | |
| 0100 | 0200 | | India, AIR/Mumbai | 4840do | | |
| 0100 | 0200 | | India, AIR/Port Blair | | 4760do | |
| 0100 | 0200 | | India, AIR/Srinagar | 4950do | | |
| 0100 | 0200 | | India, AIR/Thiruvananthapuram | | 5010do | |
| 0100 | 0200 | | Malaysia, RTM/Kajang | | 5965do | 6050do |
| 0100 | 0200 | | Malaysia, RTM/Traxx FM | | 7295do | |
| 0100 | 0200 | | Mexico, R Educacion | | 6185do | |
| 0100 | 0200 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755 as |
| 0100 | 0200 | | New Zealand, R New Zealand Intl | | | 15720pa |
| 0100 | 0200 | DRM | New Zealand, R New Zealand Intl | | | 17675pa |
| 0100 | 0200 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | |
| 0100 | 0200 | | Vanuatu, R Vanuatu | 7260do | | |
| 0128 | 0200 | | India, AIR/Leh | 4660do | | |
| 0130 | 0200 | twhfas | Albania, R Tirana | 9850va | | |
| 0130 | 0200 | | India, AIR/Chennai/FM Gold | | 7270do | |
| 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 | 0215 | | India, AIR/Bhopal | 4810do | | |
| 0200 | 0215 | | India, AIR/Hyderabad | | 4800do | |
| 0200 | 0215 | | India, AIR/Imphal | 4775do | | |
| 0200 | 0215 | | India, AIR/Srinagar | 4950do | | |
| 0200 | 0215 | | India, AIR/Thiruvananthapuram | | 5010do | |
| 0200 | 0230 | | Thailand, R Thailand World Svc | | 15275na | |
| 0200 | 0230 | | USA, WRMI/R Prague relay | | 9955am | |
| 0200 | 0245 | | India, AIR/Chennai | 4920do | | |
| 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 | | India, AIR/Aizawl 5050do | | |
| 0200 | 0300 | | India, AIR/Chennai/FM Gold | 7270do | |
| 0200 | 0300 | | India, AIR/Gangkok | 4835do | |
| 0200 | 0300 | | India, AIR/Jaipur 4910do | | |
| 0200 | 0300 | | India, AIR/Jeypore 5040do | | |
| 0200 | 0300 | | India, AIR/Kohima 4850do | | |
| 0200 | 0300 | | India, AIR/Leh 4660do | | |
| 0200 | 0300 | | India, AIR/Mumbai 4840do | | |
| 0200 | 0300 | | India, AIR/Port Blair | 4760do | |
| 0200 | 0300 | | Malaysia, RTM/Kajang | 5965do | 6050do |
| 0200 | 0300 | | Malaysia, RTM/Traxx FM | 7295do | |
| 0200 | 0300 | | Mexico, R Educacion | 6185do | |
| 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 | | Papua New Guinea, Wantok R Light | | 7235do |
| 0200 | 0300 | | Philippines, R Pilipinas Overseas Svc 15285me 17820me | | 11880me |
| 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 13362usb | 5765usb | 12759usb |
| 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 9860na | 5920va | 7315ca |
| 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 5890ca 5935af | 3215eu | 4840na |
| 0200 | 0300 | irreg | USA, WWRB Manchester TN | 3185na | 3195na |
| 0200 | 0300 | Sun/irreg | USA, WWRB Manchester TN | 5050na | |
| 0200 | 0300 | | Vanuatu, R Vanuatu 7260do | | |
| 0215 | 0230 | | Nepal, R Nepal 5005do | | |
| 0215 | 0300 | | Myanmar, Myanma R | 9731do | |
| 0225 | 0300 | | India, AIR/Bhopal 7430do | | |
| 0225 | 0300 | | India, AIR/Hyderabad | 7420do | |
| 0225 | 0300 | | India, AIR/Imphal 7335do | | |
| 0225 | 0300 | | India, AIR/Srinagar 6110do | | |
| 0230 | 0300 | | India, AIR/Delhi 6030do | | |
| 0230 | 0300 | | India, AIR/Delhi 4870do | | |
| 0230 | 0300 | | India, AIR/Thiruvananthapuram | 7290do | |
| 0230 | 0300 | | Myanmar, Myanma R | 5985do | |
| 0230 | 0300 | | Vietnam, VO Vietnam/Overseas Svc | | 12005na |
| 0245 | 0300 | | Zambia, Zambia Natl BC | 5915do | 6165do |
| 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 15285me 17820me | | 11880me |
| 0300 | 0330 | | Vatican City State, Vatican R | 7360af | 9660af |
| 0300 | 0355 | mtwhf | South Africa, Channel Africa | 3345af | 5980af |
| 0300 | 0356 | | Romania, R Romania Intl 17800as | 7350na | 9645na |
| 0300 | 0356 | DRM | Romania, R Romania Intl | 15340as | |
| 0300 | 0400 | | Anguilla, Caribbean Beacon/Univ Net | | 6090ca |
| 0300 | 0400 | | Australia, ABC/R Australia 15415va 17750va | 9660va | 15160pa 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 11770as 13750as 15785as | 9690am 15110as | 9790na 15120as |
| 0300 | 0400 | | China, Xizang PBS 4905do 7385do | 4920do | 6130do |
| 0300 | 0400 | | Clandestine, R Miraya | 11560af | |
| 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 | | India, AIR/Aizawl 5050do | | |
| 0300 | 0400 | | India, AIR/Bhopal 7430do | | |
| 0300 | 0400 | | India, AIR/Chennai 7380do | | |
| 0300 | 0400 | | India, AIR/Chennai/FM Gold | 7270do | |
| 0300 | 0400 | | India, AIR/Gangkok | 4835do | |
| 0300 | 0400 | | India, AIR/Hyderabad | 7420do | |
| 0300 | 0400 | | India, AIR/Imphal 7335do | | |
| 0300 | 0400 | | India, AIR/Jaipur 4910do | | |
| 0300 | 0400 | | India, AIR/Kohima 4850do | | |
| 0300 | 0400 | | India, AIR/Leh 4660do | | |
| 0300 | 0400 | | India, AIR/Mumbai 4840do | | |
| 0300 | 0400 | | India, AIR/Srinagar 6110do | | |
| 0300 | 0400 | | India, AIR/Thiruvananthapuram | 7290do | |
| 0300 | 0400 | | Malaysia, RTM/Kajang | 5965do | 6050do |
| 0300 | 0400 | | Malaysia, RTM/Traxx FM | 7295do | |
| 0300 | 0400 | | Mexico, R Educacion | 6185do | |
| 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 | | Oman, R Sultanate of Oman | 13600af | |
| 0300 | 0400 | | Papua New Guinea, Wantok R Light | | 7235do |
| 0300 | 0400 | | Russia, VO Russia 9665ca | | |
| 0300 | 0400 | | Solomon Islands, SIBC | 9545do | |
| 0300 | 0400 | | Taiwan, R Taiwan Intl | 15320as | |
| 0300 | 0400 | | Turkey, VO Turkey 6165as | 9515va | |
| 0300 | 0400 | | UK, BBC World Service | 12095as | 15365as |
| 0300 | 0400 | | USA, AFN/AFRTS 4319usb 13362usb | 5765usb | 12759usb |
| 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 5890ca 5935af | 3215eu | 4840na |
| 0300 | 0400 | irreg | USA, WWRB Manchester TN | 3185na | 3195na |
| 0300 | 0400 | Sun/irreg | USA, WWRB Manchester TN | 5050na | |
| 0300 | 0400 | | Vanuatu, R Vanuatu 7260do | | |
| 0300 | 0400 | | Zambia, Zambia Natl BC | 5915do | 6165do |
| 0315 | 0400 | | India, AIR/Port Blair | 4760do | |
| 0315 | 0400 | mtwhfa | India, AIR/Port Blair | 7390do | |
| 0315 | 0400 | Sun | India, AIR/Port Blair | 4760do | |
| 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 | 0401 | | India, AIR/Gangkok | 4835do | |
| 0400 | 0415 | | India, AIR/Kohima 4850do | | |
| 0400 | 0415 | Sat | India, AIR/Port Blair | 4760do | |
| 0400 | 0427 | | Iran, VOIRI/VO Justice | 13650eu | 15470eu |
| 0400 | 0430 | mtwhfa | India, AIR/Chennai 7380do | | |
| 0400 | 0430 | | India, AIR/Chennai/FM Gold | 7270do | |
| 0400 | 0430 | | India, AIR/Jaipur 4910do | | |
| 0400 | 0430 | Sun | India, AIR/Leh 4660do | | |
| 0400 | 0430 | | India, AIR/Thiruvananthapuram | 7290do | |
| 0400 | 0430 | | USA, WHRI Cypress Crk SC | 7385na | |
| 0400 | 0435 | mtwhfa | India, AIR/Jeypore 5040do | | |
| 0400 | 0445 | Sun | India, AIR/Jeypore 5040do | | |
| 0400 | 0447 | mtwhfa | India, AIR/Bhopal 7430do | | |
| 0400 | 0455 | mtwhf | South Africa, Channel Africa | 3345af | |
| 0400 | 0457 | | Germany, Deutsche Welle | 9470af | 12045af |
| 0400 | 0457 | | North Korea, VO Korea 9730as 11735ca | 7220as | 9445as 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 15160pa 15240va | 9660va | 12080pa 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 15785as 17730va | 13750as | 15120as 17855va |
| 0400 | 0500 | | China, Xizang PBS 4905do 7385do | 4920do | 6130do |
| 0400 | 0500 | | Clandestine, R Miraya | 11560af | |
| 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 | Sun | India, AIR/Chennai | 7380do | | |
| 0400 | 0500 | Sun | India, AIR/Hyderabad | 7420do | | |
| 0400 | 0500 | Sun | India, AIR/Imphal | 7335do | | |
| 0400 | 0500 | Sun | India, AIR/Port Blair | 7390do | | |
| 0400 | 0500 | | India, AIR/Srinagar | 6110do | | |
| 0400 | 0500 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 0400 | 0500 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 0400 | 0500 | | Mexico, R Educacion | 6185do | | |
| 0400 | 0500 | | Micronesia, V6MP/Cross R/Pohnpei | | 4755 as | |
| 0400 | 0500 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 0400 | 0500 | | Solomon Islands, SIBC | 9545do | | |
| 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 | | Vanuatu, R Vanuatu | 7260do | | |
| 0400 | 0500 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 0400 | 0500 | irreg | Zimbabwe, VO Zimbabwe | 4828af | | |
| 0430 | 0500 | | India, AIR/Kohima | 6065do | | |
| 0430 | 0500 | Sat/Sun | India, AIR/Thiruvananthapuram | 7290do | | |
| 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 | 0501 | | India, AIR/Srinagar | 6110do | | |
| 0500 | 0505 | Sat | India, AIR/Hyderabad | 7420do | | |
| 0500 | 0510 | | India, AIR/Kohima | 6065do | | |
| 0500 | 0527 | | Germany, Deutsche Welle | 5905af | 9470af | |
| 0500 | 0530 | Sun | India, AIR/Bhopal | 7430do | | |
| 0500 | 0530 | Sun | India, AIR/Jaipur | 4910do | | |
| 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 | | Clandestine, R Miraya | 11560af | | |
| 0500 | 0600 | | Cuba, R Havana Cuba | 6010na | 6060na | |
| | | | 6125am | 6165na | | |
| 0500 | 0600 | 1st Sat | Finland, Scandinavian Weekend R | | 5980eu | |
| 0500 | 0600 | | Germany, Deutsche Welle | 9800af | 15275af | |
| 0500 | 0600 | | Germany, R 6150 | 6070eu | | |
| 0500 | 0600 | | Guatemala, R Verdad | 4055do | | |
| 0500 | 0600 | | Guyana, Voice of Guyana | 3290do | | |
| 0500 | 0600 | Sat/Sun | India, AIR/Thiruvananthapuram | 7290do | | |
| 0500 | 0600 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 0500 | 0600 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 0500 | 0600 | | Mexico, R Educacion | 6185do | | |
| 0500 | 0600 | | Micronesia, V6MP/Cross R/Pohnpei | | 4755 as | |
| 0500 | 0600 | DRM | New Zealand, R New Zealand Intl | | 11675pa | |
| 0500 | 0600 | irreg | Nigeria, VO Nigeria | 15120af | | |
| 0500 | 0600 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 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 | | Vanuatu, R Vanuatu | 7260do | | |
| 0500 | 0600 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 0500 | 0600 | irreg | Zimbabwe, VO Zimbabwe | 4828af | | |
| 0515 | 0530 | | Rwanda, R Rep Rwandaise | 6055do | | |
| 0525 | 0600 | | Vanuatu, R Vanuatu | 3945do | | |
| 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 | Sun | India, AIR/Hyderabad | 7420do | | |
| 0530 | 0600 | | India, AIR/Mumbai | 7240do | | |
| 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 | |
| 0555 | 0600 | | Mali, ORTM/R Mali | 5995do | | |

## 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 | 0630 | Sat/Sun | India, AIR/Thiruvananthapuram | 7290do | | |
| 0600 | 0655 | mtwhf | South Africa, Channel Africa | 7230af | 15255af | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | 4750as | |
| 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 | | India, AIR/Chennai | 7380do | | |
| 0600 | 0700 | | India, AIR/Hyderabad | 7420do | | |
| 0600 | 0700 | | India, AIR/Imphal | 7335do | | |
| 0600 | 0700 | | India, AIR/Mumbai | 7240do | | |
| 0600 | 0700 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 0600 | 0700 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 0600 | 0700 | | Mali, ORTM/R Mali | 5995do | | |
| 0600 | 0700 | | Micronesia, V6MP/Cross R/Pohnpei | | 4755 as | |
| 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 | | Papua New Guinea, R Central | 3290do | | |
| 0600 | 0700 | | Papua New Guinea, R East New Britain | | 3385do | |
| 0600 | 0700 | | Papua New Guinea, R Vanimo | 3205do | | |
| 0600 | 0700 | | Papua New Guinea, R Western | 3305do | | |
| 0600 | 0700 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 0600 | 0700 | | Russia, VO Russia | 21800pa | 21820pa | |
| 0600 | 0700 | DRM | Russia, VO Russia | 11830eu | | |
| 0600 | 0700 | | Solomon Islands, SIBC | 9545do | | |
| 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 |

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|---|---|---|---|---|---|
| 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 | | Vanuatu, R Vanuatu | 3945do | 7260do |
| 0600 | 0700 | | Zambia, Zambia Natl BC | 5915do | 6165do |
| 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 | | India, AIR/Bhopal | 7430do | |
| 0630 | 0700 | mtwhfa | India, AIR/Imphal | 7335do | |
| 0630 | 0700 | | India, AIR/Jaipur | 7325do | |
| 0630 | 0700 | Sun | India, AIR/Leh | 6000do | |
| 0630 | 0700 | | India, AIR/Srinagar | 6110do | |
| 0630 | 0700 | | India, AIR/Thiruvananthapuram | 7290do | |
| 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 | 0735 | | Vanuatu, R Vanuatu | 7260do | | |
| 0700 | 0745 | Sat/Sun | Canada, Bible VO Broadcasting | | | 7345eu |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 0700 | 0800 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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 | | India, AIR/Aizawl | 7295do | | |
| 0700 | 0800 | | India, AIR/Bhopal | 7430do | | |
| 0700 | 0800 | | India, AIR/Chennai | 7380do | | |
| 0700 | 0800 | | India, AIR/Hyderabad | 7420do | | |
| 0700 | 0800 | | India, AIR/Imphal | 7335do | | |
| 0700 | 0800 | | India, AIR/Jaipur | 7325do | | |
| 0700 | 0800 | | India, AIR/Jeypore | 6040do | | |
| 0700 | 0800 | | India, AIR/Kohima | 6065do | | |
| 0700 | 0800 | | India, AIR/Leh | 6000do | | |
| 0700 | 0800 | | India, AIR/Mumbai | 7240do | | |
| 0700 | 0800 | | India, AIR/Port Blair | 7390do | | |
| 0700 | 0800 | | India, AIR/Srinagar | 6110do | | |
| 0700 | 0800 | | India, AIR/Thiruvananthapuram | 7290do | | |
| 0700 | 0800 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 0700 | 0800 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 0700 | 0800 | | Mali, ORTM/R Mali | 5995do | | |
| 0700 | 0800 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755 as |
| 0700 | 0800 | | Nigeria, FRCN Abuja | 7275do | | |
| 0700 | 0800 | | Papua New Guinea, R Central | 3290do | | |
| 0700 | 0800 | | Papua New Guinea, R East New Britain | | | 3385do |
| 0700 | 0800 | | Papua New Guinea, R Northern | 3345do | | |
| 0700 | 0800 | | Papua New Guinea, R Vanimo | 3205do | | |
| 0700 | 0800 | | Papua New Guinea, R Western | 3305do | | |
| 0700 | 0800 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | | |
| 0700 | 0800 | | Vanuatu, R Vanuatu | 3945do | | |
| 0700 | 0800 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 0730 | 0800 | | Australia, HCJB Global Australia | | | 15490as |
| 0730 | 0800 | | Sudan, VO Africa/Sudan R | 9505af | | |
| 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 | 0830 | | Sudan, VO Africa/Sudan R | 9505af | | |
| 0800 | 0900 | | Anguilla, Caribbean Beacon/Univ Net | | | 6090ca |
| 0800 | 0900 | | Australia, ABC/R Australia | 5995as | 7410va | |
| | | | 9475as | 9580pa | 9710va | 11945va |
| | | | 12080pa | 15240va | | |
| 0800 | 0900 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 0800 | 0900 | | Bhutan, Bhutan BC Svc | 6035do | | |
| 0800 | 0900 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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 | | India, AIR/Aizawl | 7295do | | |
| 0800 | 0900 | | India, AIR/Bhopal | 7430do | | |
| 0800 | 0900 | | India, AIR/Chennai | 7380do | | |
| 0800 | 0900 | | India, AIR/Imphal | 7335do | | |
| 0800 | 0900 | | India, AIR/Jaipur | 7325do | | |
| 0800 | 0900 | | India, AIR/Jeypore | 6040do | | |
| 0800 | 0900 | | India, AIR/Kohima | 6065do | | |
| 0800 | 0900 | | India, AIR/Leh | 6000do | | |
| 0800 | 0900 | | India, AIR/Mumbai | 7240do | | |
| 0800 | 0900 | | India, AIR/Port Blair | 7390do | | |
| 0800 | 0900 | | India, AIR/Srinagar | 6110do | | |
| 0800 | 0900 | | India, AIR/Thiruvananthapuram | 7290do | | |
| 0800 | 0900 | Sat | Italy, IRRS Shortwave | 9510va | | |
| 0800 | 0900 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 0800 | 0900 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 0800 | 0900 | | Mali, ORTM/R Mali | 9635do | | |
| 0800 | 0900 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755 as |
| 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 | | Papua New Guinea, R Central | 3290do | | |
| 0800 | 0900 | | Papua New Guinea, R East New Britain | | | 3385do |
| 0800 | 0900 | | Papua New Guinea, R Northern | 3345do | | |
| 0800 | 0900 | | Papua New Guinea, R Vanimo | 3205do | | |
| 0800 | 0900 | | Papua New Guinea, R Western | 3305do | | |
| 0800 | 0900 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | mtwhf | South Africa, Channel Africa | 9625af | | |
| 0800 | 0900 | Sun | South Africa, SA Radio League | 7205af | 17660af | |
| 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 | | |
| 0800 | 0900 | | Vanuatu, R Vanuatu | 3945do | | |
| 0800 | 0900 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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 | 0920 | | India, AIR/Chennai | 7380do | | |
| 0900 | 0930 | | India, AIR/Leh | 6000do | | |
| 0900 | 0930 | | Mongolia, VO Mongolia | | 12085as | |
| 0900 | 0930 | smtwhf | Singapore, TWR Asia | | 15200as | |
| 0900 | 0931 | | India, AIR/Bhopal | 7430do | | |
| 0900 | 0931 | | India, AIR/Jaipur | 7325do | | |
| 0900 | 0931 | | India, AIR/Port Blair | | 7390do | |
| 0900 | 0945 | | India, AIR/Jeypore | 6040do | | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 0900 | 1000 | irreg | Cameroon, CRTV/R Buea | | 6005do | |
| 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/Aizawl | 7295do | | |
| 0900 | 1000 | | India, AIR/External Svc | | 7250as | 7340as |
| | | | 9595as | 11620as | | |
| 0900 | 1000 | | India, AIR/Imphal | 7335do | | |
| 0900 | 1000 | | India, AIR/Mumbai | 7240do | | |
| 0900 | 1000 | | India, AIR/Port Blair | | 7390do | |
| 0900 | 1000 | | India, AIR/Srinagar | 6110do | | |
| 0900 | 1000 | | India, AIR/Thiruvananthapuram | | 7290do | |
| 0900 | 1000 | | Malaysia, RTM/Kajang | | 5965do | 6050do |
| 0900 | 1000 | | Malaysia, RTM/Traxx FM | | 7295do | |
| 0900 | 1000 | | Mali, ORTM/R Mali | | 9635do | |
| 0900 | 1000 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755 as |
| 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 | | Papua New Guinea, R Central | | 3290do | |
| 0900 | 1000 | | Papua New Guinea, R East New Britain | | | 3385do |
| 0900 | 1000 | | Papua New Guinea, R Northern | | 3345do | |
| 0900 | 1000 | | Papua New Guinea, R Vanimo | | 3205do | |
| 0900 | 1000 | | Papua New Guinea, R Western | | 3305do | |
| 0900 | 1000 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | |
| 0900 | 1000 | | Vanuatu, R Vanuatu | 3945do | | |
| 0900 | 1000 | | Zambia, Zambia Natl BC | | 5915do | 6165do |
| 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 | Sun | India, AIR/Thiruvananthapuram | | 7290do | |
| 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 | 1031 | Sun | India, AIR/Bhopal | 7430do | | |
| 1000 | 1035 | | India, AIR/Mumbai | 7240do | | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 1000 | 1100 | irreg | Cameroon, CRTV/R Buea | | 6005do | |
| 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 | | India, AIR/Kohima | 4850do | | |
| 1000 | 1100 | | India, AIR/Srinagar | 6110do | | |
| 1000 | 1100 | irreg | Indonesia, VO Indonesia | | 9526pa | |
| 1000 | 1100 | Sun | Italy, IRRS Shortwave | | 9510va | |
| 1000 | 1100 | | Malaysia, RTM/Kajang | | 5965do | 6050do |
| 1000 | 1100 | | Malaysia, RTM/Traxx FM | | 7295do | |
| 1000 | 1100 | | Mali, ORTM/R Mali | | 9635do | |
| 1000 | 1100 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755as |
| 1000 | 1100 | | Nigeria, FRCN Abuja | | 7275do | |
| 1000 | 1100 | irreg | Nigeria, VO Nigeria | | 9690af | |
| 1000 | 1100 | | Papua New Guinea, R Central | | 3290do | |
| 1000 | 1100 | | Papua New Guinea, R East New Britain | | | 3385do |
| 1000 | 1100 | | Papua New Guinea, R Northern | | 3345do | |
| 1000 | 1100 | | Papua New Guinea, R Vanimo | | 3205do | |
| 1000 | 1100 | | Papua New Guinea, R Western | | 3305do | |
| 1000 | 1100 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | |
| 1000 | 1100 | | Vanuatu, R Vanuatu | 3945do | | |
| 1000 | 1100 | | Zambia, Zambia Natl BC | | 5915do | 6165do |
| 1030 | 1100 | | India, AIR/Gangkok | | 4835do | |
| 1030 | 1100 | | India, AIR/Imphal | 4775do | | |
| 1030 | 1100 | | India, AIR/Port Blair | | 4760do | |
| 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 | 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 |

SHORTWAVE GUIDE

| | | | | | | |
|---|---|---|---|---|---|---|
| 1100 | 1200 | | Australia, NT VL8K Katherine | 2485do | | |
| 1100 | 1200 | | Australia, NT VL8T Tennant Creek | | | 2325do |
| 1100 | 1200 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 1100 | 1200 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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 | | India, AIR/Gangkok | 4835do | | |
| 1100 | 1200 | | India, AIR/Imphal | 4775do | | |
| 1100 | 1200 | | India, AIR/Jeypore | 5040do | | |
| 1100 | 1200 | | India, AIR/Kohima | 4850do | | |
| 1100 | 1200 | | India, AIR/Port Blair | 4760do | | |
| 1100 | 1200 | | India, AIR/Srinagar | 6110do | | |
| 1100 | 1200 | | India, AIR/Thiruvananthapuram | 5010do | | |
| 1100 | 1200 | Sun | Italy, IRRS Shortwave | 9510va | | |
| 1100 | 1200 | | Malaysia, RTM/Kajang | 5965do | | 6050do |
| 1100 | 1200 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1100 | 1200 | | Mali, ORTM/R Mali | 9635do | | |
| 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 | | Papua New Guinea, R Central | 3290do | | |
| 1100 | 1200 | | Papua New Guinea, R East New Britain | | | 3385do |
| 1100 | 1200 | | Papua New Guinea, R Northern | 3345do | | |
| 1100 | 1200 | | Papua New Guinea, R Vanimo | 3205do | | |
| 1100 | 1200 | | Papua New Guinea, R Western | 3305do | | |
| 1100 | 1200 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | | |
| 1100 | 1200 | | Vanuatu, R Vanuatu | 3945do | | |
| 1100 | 1200 | | Zambia, Zambia Natl BC | 5915do | | 6165do |
| 1115 | 1145 | f | Canada, Bible VO Broadcasting | | | 21480as |
| 1120 | 1200 | | India, AIR/Srinagar | 4950do | | |
| 1130 | 1145 | smtha | Australia, HCJB Global Australia | | | 15490as |
| 1130 | 1145 | f | USA, Eternal Good News | 15525as | | |
| 1130 | 1200 | | Guatemala, R Verdad | 4055do | | |
| 1130 | 1200 | | India, AIR/Aizawl | 5050do | | |
| 1130 | 1200 | | India, AIR/Bhopal | 4810do | | |
| 1130 | 1200 | | India, AIR/Jaipur | 4910do | | |
| 1130 | 1200 | | India, AIR/Leh | 4660do | | |
| 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 | 1215 | | India, AIR/Srinagar | 6110do | | |
| 1200 | 1225 | | Saudi Arabia, BSKSA/External Svc | | | 15250af |
| 1200 | 1230 | | Japan, R Japan/NHK World | 9695af | | 11740as |
| 1200 | 1230 | | Vanuatu, R Vanuatu | 3945do | | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 1200 | 1300 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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 | | India, AIR/Aizawl | 7295do | | |
| 1200 | 1300 | | India, AIR/Bhopal | 4810do | | |
| 1200 | 1300 | | India, AIR/Chennai | 4920do | | |
| 1200 | 1300 | | India, AIR/Gangkok | 4835do | | |
| 1200 | 1300 | | India, AIR/Imphal | 4775do | | |
| 1200 | 1300 | | India, AIR/Jaipur | 4910do | | |
| 1200 | 1300 | | India, AIR/Jeypore | 5040do | | |
| 1200 | 1300 | | India, AIR/Kohima | 4850do | | |
| 1200 | 1300 | | India, AIR/Leh | 4660do | | |
| 1200 | 1300 | | India, AIR/Port Blair | 4760do | | |
| 1200 | 1300 | | India, AIR/Srinagar | 4950do | | |
| 1200 | 1300 | | India, AIR/Thiruvananthapuram | 5010do | | |
| 1200 | 1300 | | Malaysia, RTM/Kajang | 5965do | | 6050do |
| 1200 | 1300 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1200 | 1300 | | Mali, ORTM/R Mali | 9635do | | |
| 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 Central | 3290do | | |
| 1200 | 1300 | | Papua New Guinea, R East New Britain | | | 3385do |
| 1200 | 1300 | | Papua New Guinea, R Fly | 3915do | | 5960do |
| 1200 | 1300 | | Papua New Guinea, R Northern | 3345do | | |
| 1200 | 1300 | | Papua New Guinea, R Vanimo | 3205do | | |
| 1200 | 1300 | | Papua New Guinea, R Western | 3305do | | |
| 1200 | 1300 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | | |
| 1200 | 1300 | | Zambia, Zambia Natl BC | 5915do | | 6165do |
| 1215 | 1300 | | Egypt, R Cairo | 17870as | | |
| 1230 | 1245 | smtwhf | Australia, HCJB Global Australia | | | 15340pa |
| 1230 | 1300 | | Bangladesh, Bangla Betar | 15105as | | |
| 1230 | 1300 | | India, AIR/Mumbai | 4840do | | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | | 4750as |
| 1300 | 1400 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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 | | India, AIR/Aizawl | 7295do | | |
| 1300 | 1400 | | India, AIR/Bhopal | 4810do | | |
| 1300 | 1400 | | India, AIR/Chennai | 4920do | | |
| 1300 | 1400 | | India, AIR/Gangkok | 4835do | | |
| 1300 | 1400 | | India, AIR/Imphal | 4775do | | |
| 1300 | 1400 | | India, AIR/Jaipur | 4910do | | |
| 1300 | 1400 | | India, AIR/Jeypore | 5040do | | |
| 1300 | 1400 | | India, AIR/Kohima | 4850do | | |
| 1300 | 1400 | | India, AIR/Leh | 4660do | | |
| 1300 | 1400 | | India, AIR/Mumbai | 4840do | | |
| 1300 | 1400 | | India, AIR/Port Blair | 4760do | | |
| 1300 | 1400 | | India, AIR/Srinagar | 4950do | | |
| 1300 | 1400 | | India, AIR/Thiruvananthapuram | 5010do | | |
| 1300 | 1400 | irreg | Indonesia, VO Indonesia | 9526as | | |
| 1300 | 1400 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 1300 | 1400 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1300 | 1400 | | Mali, ORTM/R Mali | 9635do | | |
| 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 Central | 3290do | | |
| 1300 | 1400 | | Papua New Guinea, R East New Britain | | 3385do | |
| 1300 | 1400 | | Papua New Guinea, R Fly | 3915do | 5960do | |
| 1300 | 1400 | | Papua New Guinea, R Northern | 3345do | | |
| 1300 | 1400 | | Papua New Guinea, R Vanimo | 3205do | | |
| 1300 | 1400 | | Papua New Guinea, R Western | 3305do | | |
| 1300 | 1400 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 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 | | |
| 1300 | 1400 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | 4750as | |
| 1400 | 1500 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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/Aizawl | 7295do | | |
| 1400 | 1500 | | India, AIR/Bhopal | 4810do | | |
| 1400 | 1500 | | India, AIR/Chennai | 4920do | | |
| 1400 | 1500 | | India, AIR/External Svc | 9690as | 11620as | |
| | | | 13710as | | | |
| 1400 | 1500 | | India, AIR/Gangkok | 4835do | | |
| 1400 | 1500 | | India, AIR/Imphal | 4775do | | |
| 1400 | 1500 | | India, AIR/Jaipur | 4910do | | |
| 1400 | 1500 | | India, AIR/Jeypore | 5040do | | |
| 1400 | 1500 | | India, AIR/Kohima | 4850do | | |
| 1400 | 1500 | | India, AIR/Leh | 4660do | | |
| 1400 | 1500 | | India, AIR/Mumbai | 4840do | | |
| 1400 | 1500 | | India, AIR/Natl Channel | 9425do | 9470do | |
| 1400 | 1500 | | India, AIR/Port Blair | 4760do | | |
| 1400 | 1500 | | India, AIR/Srinagar | 4950do | | |
| 1400 | 1500 | | India, AIR/Thiruvananthapuram | 5010do | | |
| 1400 | 1500 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 1400 | 1500 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1400 | 1500 | | Mali, ORTM/R Mali | 9635do | | |
| 1400 | 1500 | | Mexico, R Educacion | 6185do | | |
| 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 | | Papua New Guinea, R Central | 3290do | | |
| 1400 | 1500 | | Papua New Guinea, R East New Britain | | 3385do | |
| 1400 | 1500 | | Papua New Guinea, R Northern | 3345do | | |
| 1400 | 1500 | | Papua New Guinea, R Vanimo | 3205do | | |
| 1400 | 1500 | | Papua New Guinea, R Western | 3305do | | |
| 1400 | 1500 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 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 | 12150as | 15490as |
| 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 | | |
| 1400 | 1500 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | 4750as |
| 1500 | 1600 | | Bhutan, Bhutan BC Svc | 6035do | |
| 1500 | 1600 | irreg | Cameroon, CRTV/R Buea | 6005do | |
| 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/Aizawl | 7295do | | |
| 1500 | 1600 | | India, AIR/Bhopal | 4810do | | |
| 1500 | 1600 | | India, AIR/Chennai | 4920do | | |
| 1500 | 1600 | | India, AIR/Gangkok | 4835do | | |
| 1500 | 1600 | | India, AIR/Imphal | 4775do | | |
| 1500 | 1600 | | India, AIR/Jaipur | 4910do | | |
| 1500 | 1600 | | India, AIR/Jeypore | 5040do | | |
| 1500 | 1600 | | India, AIR/Kohima | 4850do | | |
| 1500 | 1600 | | India, AIR/Leh | 4660do | | |
| 1500 | 1600 | | India, AIR/Mumbai | 4840do | | |
| 1500 | 1600 | | India, AIR/Natl Channel | 9425do | 9470do | |
| 1500 | 1600 | | India, AIR/Port Blair | 4760do | | |
| 1500 | 1600 | | India, AIR/Srinagar | 4950do | | |
| 1500 | 1600 | | India, AIR/Thiruvananthapuram | 5010do | | |
| 1500 | 1600 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1500 | 1600 | | Mali, ORTM/R Mali | 9635do | | |
| 1500 | 1600 | | Mexico, R Educacion | 6185do | | |
| 1500 | 1600 | | Nigeria, FRCN Abuja | 7275do | | |
| 1500 | 1600 | irreg | Nigeria, VO Nigeria | 15120af | | |
| 1500 | 1600 | | Papua New Guinea, R Northern | 3345do | | |
| 1500 | 1600 | | Papua New Guinea, R Vanimo | 3205do | | |
| 1500 | 1600 | | Papua New Guinea, R Western | 3305do | | |
| 1500 | 1600 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 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 | 12150va | 15490as | 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 | | |
| 1500 | 1600 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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 | | India, AIR/Aizawl | 7295do | | |
| 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 | | Bangladesh, Bangla Betar/Home Svc | | 4750as | |
| 1600 | 1700 | | Bhutan, Bhutan BC Svc | 6035do | | |
| 1600 | 1700 | irreg | Cameroon, CRTV/R Buea | 6005do | | |
| 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/Bhopal | 4810do | | |
| 1600 | 1700 | | India, AIR/Chennai | 4920do | | |
| 1600 | 1700 | | India, AIR/Imphal | 4775do | | |
| 1600 | 1700 | | India, AIR/Jaipur | 4910do | | |
| 1600 | 1700 | | India, AIR/Jeypore | 5040do | | |
| 1600 | 1700 | | India, AIR/Kohima | 4850do | | |
| 1600 | 1700 | | India, AIR/Leh | 4660do | | |
| 1600 | 1700 | | India, AIR/Mumbai | 4840do | | |
| 1600 | 1700 | | India, AIR/Natl Channel | 9425do | 9470do | |
| 1600 | 1700 | | India, AIR/Port Blair | 4760do | | |
| 1600 | 1700 | | India, AIR/Srinagar | 4950do | | |
| 1600 | 1700 | | India, AIR/Thiruvananthapuram | 5010do | | |
| 1600 | 1700 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 1600 | 1700 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1600 | 1700 | | Mali, ORTM/R Mali | 9635do | | |
| 1600 | 1700 | | Nigeria, FRCN Abuja | 7275do | | |
| 1600 | 1700 | | Papua New Guinea, Wantok R Light | | 7235do | |
| 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 | 6180as | 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 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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, SA Radio League | 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 | | Bangladesh, Bangla Betar/Home Svc | | 4750as | |
| 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 | | India, AIR/Mumbai | 4840do | | |
| 1700 | 1730 | m | South Africa, SA Radio League | 3230af | | |
| 1700 | 1730 | | Turkey, VO Turkey | 15520as | | |
| 1700 | 1730 | | Vietnam, VO Vietnam/Overseas Svc | | 9625eu | |
| 1700 | 1739 | | India, AIR/Chennai | 4920do | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1700 | 1739 | | India, AIR/Srinagar | 4950do | | |
| 1700 | 1740 | | India, AIR/Jeypore | 5040do | | |
| 1700 | 1741 | | India, AIR/Jaipur | 4910do | | |
| 1700 | 1742 | | India, AIR/Bhopal | 4810do | | |
| 1700 | 1745 | DRM | New Zealand, R New Zealand Intl | | | 6135pa |
| 1700 | 1745 | | New Zealand, R New Zealand Intl | | | 7330pa |
| 1700 | 1755 | mtwhf | South Africa, Channel Africa | 15235af | | |
| 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/Kajang | 5965do | 6050do | |
| 1700 | 1800 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1700 | 1800 | | Mali, ORTM/R Mali | 9635do | | |
| 1700 | 1800 | | Mexico, R Educacion | 6185do | | |
| 1700 | 1800 | | Nigeria, FRCN Abuja | 7275do | | |
| 1700 | 1800 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | 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 | |
| | | | 13590af | | | |
| 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 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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 | | Sudan, VO Africa/Sudan R | 9505af | | |
| 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 | | Sudan, VO Africa/Sudan R | 9505af | | |
| 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/Kajang | 5965do | 6050do | |
| 1800 | 1900 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1800 | 1900 | | Mali, ORTM/R Mali | 5995do | | |
| 1800 | 1900 | | Mexico, R Educacion | 6185do | | |
| 1800 | 1900 | | Nigeria, FRCN Abuja | 7275do | | |
| 1800 | 1900 | irreg | Nigeria, VO Nigeria | 7255af | | |
| 1800 | 1900 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 1800 | 1900 | irreg | Zimbabwe, VO Zimbabwe | 4828af | | |
| 1815 | 1845 | Sun | Canada, Bible VO Broadcasting | | | 9430me |
| 1825 | 1900 | | Vanuatu, R Vanuatu | 3945do | | |
| 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 |

SHORTWAVE GUIDE

| | | | | | | |
|---|---|---|---|---|---|---|
| 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 | 15540eu | | |
| 1900 | 2000 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 1900 | 2000 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 1900 | 2000 | | Mali, ORTM/R Mali | 5995do | | |
| 1900 | 2000 | | Micronesia, V6MP/Cross R/Pohnpei | | | 4755as |
| 1900 | 2000 | | Nigeria, FRCN Abuja | 7275do | | |
| 1900 | 2000 | irreg | Nigeria, VO Nigeria | 7255af | | |
| 1900 | 2000 | | Papua New Guinea, R Central | 3290do | | |
| 1900 | 2000 | | Papua New Guinea, R East New Britain | | | 3385do |
| 1900 | 2000 | | Papua New Guinea, R Northern | 3345do | | |
| 1900 | 2000 | | Papua New Guinea, R Vanimo | 3205do | | |
| 1900 | 2000 | | Papua New Guinea, R Western | 3305do | | |
| 1900 | 2000 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 1900 | 2000 | | Solomon Islands, SIBC | 5020do | 9545do | |
| 1900 | 2000 | mtwhf | Spain, R Exterior de Espana | 9665eu | 11615af | |
| 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 | | Vanuatu, R Vanuatu | 3945do | | |
| 1900 | 2000 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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 | 15540eu | | |
| 2000 | 2100 | | Malaysia, RTM/Kajang | 5965do | 6050do | |
| 2000 | 2100 | | Malaysia, RTM/Traxx FM | 7295do | | |
| 2000 | 2100 | | Mali, ORTM/R Mali | 5995do | | |
| 2000 | 2100 | | Mexico, R Educacion | 6185do | | |
| 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 | | Papua New Guinea, R Central | 3290do | | |
| 2000 | 2100 | | Papua New Guinea, R East New Britain | | | 3385do |
| 2000 | 2100 | | Papua New Guinea, R Northern | 3345do | | |
| 2000 | 2100 | | Papua New Guinea, R Vanimo | 3205do | | |
| 2000 | 2100 | | Papua New Guinea, R Western | 3305do | | |
| 2000 | 2100 | | Papua New Guinea, Wantok R Light | | | 7235do |
| 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 | 11775af | | |
| 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 | | Vanuatu, R Vanuatu | 3945do | 7260do | |
| 2000 | 2100 | | Zambia, Zambia Natl BC | 5915do | 6165do | |
| 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/Kajang | 5965do | 6050do |
| 2100 | 2200 | | Malaysia, RTM/Traxx FM | 7295do | |
| 2100 | 2200 | | Mali, ORTM/R Mali | 5995do | |
| 2100 | 2200 | | Mexico, R Educacion | 6185do | |
| 2100 | 2200 | | Micronesia, V6MP/Cross R/Pohnpei | | 4755 as |
| 2100 | 2200 | | Nigeria, FRCN Abuja | 7275do | |
| 2100 | 2200 | | Papua New Guinea, R Central | 3290do | |
| 2100 | 2200 | | Papua New Guinea, R East New Britain | | 3385do |
| 2100 | 2200 | | Papua New Guinea, R Northern | 3345do | |
| 2100 | 2200 | | Papua New Guinea, R Vanimo | 3205do | |
| 2100 | 2200 | | Papua New Guinea, R Western | 3305do | |
| 2100 | 2200 | | Papua New Guinea, Wantok R Light | | 7235do |
| 2100 | 2200 | | Solomon Islands, SIBC | 5020do | 9545do |
| 2100 | 2200 | Sat/Sun | Spain, R Exterior de Espana | 9570af | 9660eu |
| 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 | | Vanuatu, R Vanuatu | 3945do | |
| 2100 | 2200 | | Zambia, Zambia Natl BC | 5915do | 6165do |
| 2100 | 2200 | irreg | Zimbabwe, VO Zimbabwe | 4828af | |
| 2125 | 2200 | | Vanuatu, R Vanuatu | 3945do | 7260do |
| 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 | | Zambia, Zambia Natl BC | 5915do | 6165do |
| 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 | | Egypt, R Cairo 9965eu | | |
| 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/Kajang | 5965do | 6050do |
| 2200 | 2300 | | Malaysia, RTM/Traxx FM | 7295do | |
| 2200 | 2300 | | Mali, ORTM/R Mali | 5995do | |
| 2200 | 2300 | | Mexico, R Educacion | 6185do | |
| 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 | | Papua New Guinea, R Central | 3290do | |
| 2200 | 2300 | | Papua New Guinea, R East New Britain | | 3385do |
| 2200 | 2300 | | Papua New Guinea, R Northern | 3345do | |
| 2200 | 2300 | | Papua New Guinea, R Vanimo | 3205do | |
| 2200 | 2300 | | Papua New Guinea, R Western | 3305do | |
| 2200 | 2300 | | Papua New Guinea, Wantok R Light | | 7235do |
| 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 |
| 2200 | 2300 | | Vanuatu, R Vanuatu | 3945do | 7260do |
| 2220 | 2300 | | India, AIR/Srinagar | 4950do | |
| 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 | | Malaysia, RTM/Kajang | 5965do | 6050do |
| 2300 | 0000 | c | Malaysia, RTM/Traxx FM | 7295do | |
| 2300 | 0000 | | Mali, ORTM/R Mali | 5995do | |
| 2300 | 0000 | | Mexico, R Educacion | 6185do | |
| 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 | | Papua New Guinea, R Central | 3290do | |
| 2300 | 0000 | | Papua New Guinea, R East New Britain | | 3385do |
| 2300 | 0000 | | Papua New Guinea, R Northern | 3345do | |
| 2300 | 0000 | | Papua New Guinea, R Vanimo | 3205do | |
| 2300 | 0000 | | Papua New Guinea, R Western | 3305do | |
| 2300 | 0000 | | Papua New Guinea, Wantok R Light | | 7235do |
| 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 | 0000 | | Vanuatu, R Vanuatu | 3945do | 7260do |
| 2300 | 2305 | | Nigeria, FRCN Abuja | 7275do | |
| 2300 | 2315 | | India, AIR/Srinagar | 4950do | |
| 2300 | 2315 | smtwh | Moldova, R PMR/Transistria | 9665eu | |
| 2300 | 2355 | | India, AIR/Port Blair | 4760do | |
| 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 | | |
| 2355 | 0000 | | India, AIR/Mumbai | 4840do | |

# MILCOM
MONITORING MILITARY COMMUNICATIONS

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# Military Land Mobile Radio Systems Primer

Monitoring military aeronautical communications in the 118-137 and 225-400 MHz frequency ranges is only one part of the military communications (Milcom) listening hobby. In addition to HF (2-30 MHz) military communications, another service that radio hobbyists can monitor are the Land Mobile Radio or LMR systems used by the Department of Defense (DoD).

LMR systems are used by military units and bases for critical day-to-day operations such as logistics, maintenance activities, range operations, base infrastructure support, law enforcement, fire fighting and many other support services.

When looking at this aspect of the radio hobby, monitoring military land mobile systems today is nothing like we had 25 years ago. Most of the military conventional frequency assignments we cataloged in those days have largely been replaced by multi-frequency trunk radio systems.

In order to monitor military base communications today, we need to learn more about these trunk radio systems and equip ourselves with the scanners to monitor them. Gone are the days of just punching in a frequency into our old conventional scanners and monitoring the local military cop shop. The radio hobby is more complicated today than it was in years past.

## What is Trunked Radio Technology?

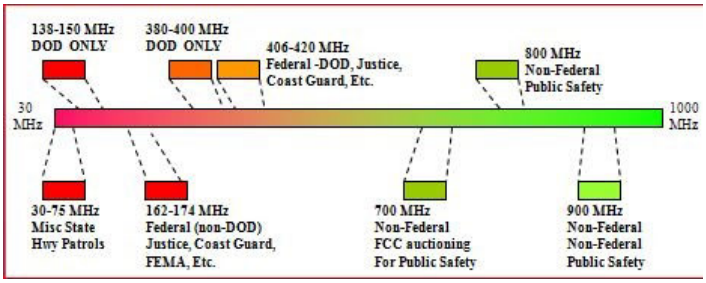
Trunked radio technology takes advantage of the probability that, with any given number of user units, not everyone will need channel access at the same time. Therefore, fewer discrete radio channels are required. From another perspective, with a given number of radio channels, a much greater number of user groups can be accommodated.

For instance, a military law enforcement agency using the additional capacity that a trunked system affords them could assign individual talk groups to specialized units such as investigators, traffic control, wildlife agents or special-events groups which might otherwise not have the benefit of individual private communications. They would no longer have to provide a single dedicated frequency or repeater frequency pair for each of the units mentioned above.

To the end user, a trunking radio looks just like an "ordinary" radio: there is a "channel switch" for the user to select the "channel" that they want to use. In reality though, the "channel switch" is not switching frequencies as in a conventional radio. When changed, it refers to an internal software program which causes a talk group affiliation to be transmitted on the trunk system control channel. This identifies the specific radio to the system controller as a member of a specific talk group, and that radio will then be included in any conversations involving that talk group.

A given radio can choose which of the talk groups it listens to at any given time. Similarly, a given speaker can choose which talk groups are the recipient of his call. These talk groups can be rapidly modified under a number of options. In a time of emergency, for example, a combination of agencies providing emergency services could be linked together in a single new talk group. Radio users not belonging to a given talk group would be unaware of any activity on that talk group, except for the possible consequence of general crowding on the system.

This talk group arrangement also allows great flexibility in radio usage – the same radio model can be used for many different types of system users (e.g., police, public works, animal control, etc.) simply by changing the software programming in the radio itself.




*Current Federal LMR Spectrum*

*Fort Huachuca TRS Site*

Trunked radio systems also provide a small level of extra privacy since the talk groups are constantly transmitting on different frequencies. This makes it difficult for a scanner listener without a programmed trunk tracking scanner to keep up with the conversation.

Fortunately that technology is available to monitors. It is hard to believe that it has been a little more than 20 years since the introduction of the first trunk tracking scanner in the radio hobby by Uniden (BC-235XLT). Anyone who has been associated with the scanning radio hobby for a long time knows that the BC-235XLT fundamentally changed the way we listen to all public safety communications.

A complete tutorial on trunking is outside the scope of this column. So if you want to learn more about trunking basics, *MT* Scanner columnist Dan Veeneman has an excellent basic tutorial online that explains trunk radio systems at **signalharbor.com/ttt/00jan/index.html**.

## How Narrowbanding Changed Everything!

Several years ago I wrote a series of military radio frequency guides for Grove Enterprises that included not only aeronautical frequencies, but also land mobile radio systems as well. Back in those days, the single-channel 15 kHz analog FM voice, simplex or repeater frequency was king throughout most of the military VHF/UHF spectrum.

Since those early guides were written, the federal government, and in particular the military, have completely overhauled their land mobile radio frequencies. A little thing called, "Congressionally mandated narrowbanding" changed everything!

In 1995, the U.S. Congress passed a law that mandated all federal agencies to transition to narrowband transmission bandwidths by January 1, 2008. Instead of 25 kHz spacing between frequencies, the military could now space their signals at 12.5 kHz intervals. That would double the amount of radio signals in any given band. In addition, DoD mandated that all their new equipment would also have to be P25 digitally compliant.

Until this time the military used frequencies in all the major federal land mobile bands (30-50, 138-150.8, 162-174, 406.1-420 MHz). In all those bands except one (138-150 MHz) they had to compete with the rest of the federal bureaucracy for radio frequency assignments.

Based on the limited information we have been able to find in public records, DoD evidently decided that was also a good time to overhaul most of their LMR band plans.

For instance, under the old DoD 138-150 MHz frequency band plan, each frequency was assigned to one of the military services and they in turn would determine how those frequencies would be used. Using a new 2004 DoD band plan, each frequency is now identified by a specific usage and any service department wanting to utilize a frequency could do so as long as they conformed to the usage of that frequency assignment.

As part of this LMR overhaul, DoD incorporated narrowband trunk radio systems into the mix. In the early days for federal trunking, like many other federal agencies, DoD used the 406-420 MHz range for their trunked radio systems. But this meant they had to compete with all those

other agencies for those coveted trunk frequency assignments which involved a lot of time and money.

Sometime in late 2003, DoD decided to make a major change, creating a whole new land mobile radio sub-band from another frequency band that they had exclusive assignment control over – the 225-400 MHz military air band. This new LMR sub-band is a mix of aeronautical (AM) and digital single frequency/trunk radio assignments. This is where we find the majority of the DoD trunk systems in operation today. We were the first to document this new band in the June 2004 issue of *MT*.

## ❖ What can you Monitor Now?

The first thing that has become apparent is the impact that trunked radio systems have had on LMR frequency usage. Ask anyone who has regularly monitored military base communications frequencies over the last few years and they will tell you about the decline in the use of conventional frequencies in all portions of the military LMR spectrum. This is a direct result of the increase in trunk radio systems usage.

There still are conventional frequency assignments in the DoD LMR bands. Not all of the existing conventional frequency assignments are trunk radio system capable. In many cases these frequencies will have digital radio signals (e.g., security and fire alarms and range target control) that you will not be able to decode.

The most important thing to remember about monitoring the military or any federal communications is that you won't find a comprehensive online database of military frequencies (they are NOT in the online FCC database). Any frequency that you see published for the feds or the military have been uncovered by radio hobbyists such as yourself and reported to the rest of the hobby community in various venues. The most important tool you have when monitoring your local area is you and your scanner's search button.

So, if you want to get in on the monitoring action, we have provided you in this edition of the *Milcom* column our latest breakout of where to listen for military LMR communications in the VHF/UHF spectrum.

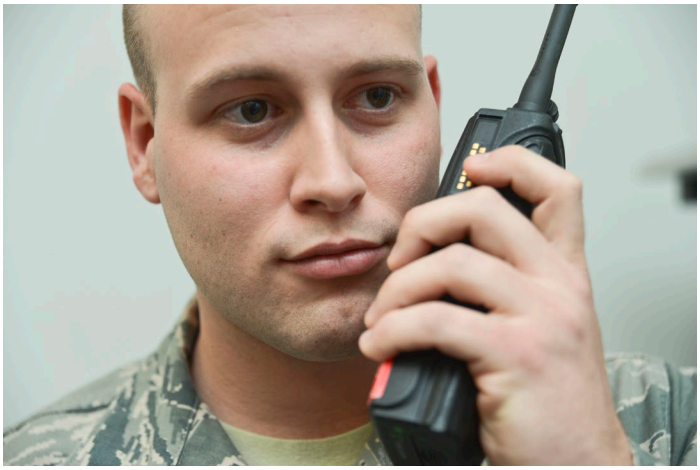
### VHF Low Band

Frequencies: 30.00-30.56, 32.00-33.00, 34.00-35.00, 36.00-37.00, 38.25-39.00, 40.00-42.00, 46.60-47.00 and 49.60-50.00 MHz.

Modes: AM, narrowband and wideband FM and digital SINCGARS. Spacing is primarily 25 kHz steps with some 20 kHz spaced assignments. I recommend searching the band using 5 kHz search steps. Frequency usage here consists of conventional simplex and repeater frequency assignments.
Military agencies operate LMR systems in this band for networks providing command and control for combat, combat support, and combat service support for tactical and training operations. They also operate tactical air-to-ground and air-to-air communication systems for close air support missions.

### VHF High Band - Military

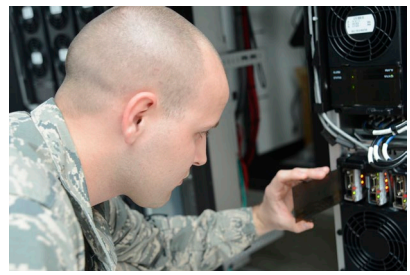
Frequencies: 138.0-144.0 and 148.0-150.8 MHz.



***Senior Airman Jared Arledge, 6th Communications Squadron radio frequency transmissions journeyman, performs a radio check on a portable land mobile radio at MacDill Air Force Base Fla. Computer software is used to sync the LMR. (U.S. Air Force photo by Airman 1st Class Vernon Fowler)***

Modes: AM, narrowband FM and P25 digital communications. Spacing is 12.5 kHz between assignments. Frequency usage is a mix of conventional simplex/repeater operations and trunk radio system assignments.

138-144 MHz: Military agencies operate fixed, mobile, and aeronautical mobile systems in this band to support tactical/training operations and military infrastructure support. DoD, the National Aeronautics and Space Administration (NASA), and the Coast Guard operate LMR systems for infrastructure functions (e.g., fire cache, security, ambulance, fuels, disaster preparedness, and transportation). The Civil Air Patrol and the Coast Guard Auxiliary operate radio systems in this band for search and rescue operations. The three Military Auxiliary Radio System (MARS) organizations also operate in this band. NASA uses this band for the International Space Station (ISS) VHF voice communications link, used when docking with space stations. There are also some Department of Homeland Security/Federal Emergency Management Agency assignments in this frequency range.



***Senior Airman Jared Arledge opens a back compartment of the tower on the trunking system at MacDill Air Force Base Fla. The Trunked Radio System is a computer-controlled two-way radio system that allows sharing of radio frequency channels among a large group of users. (U.S. Air Force photo by Airman 1st Class Vernon Fowler)***

148-149.9 MHz: In addition to the description listed in the 138-144 MHz section above, NASA, the Department of Energy, and the National Science Foundation perform satellite uplink operations in this band.

150.05-150.8 MHz: The military departments, NASA, and the Coast Guard operate LMR systems in this band for infrastructure functions (e.g., fire cache, security, ambulance, fuel, disaster preparedness, and transportation, among others). The federal agencies also use this band for natural resource management communications. Federal law-enforcement agencies use this band for interoperability between law enforcement and the military agencies.

### VHF High Band - Federal

Frequencies: 162.0125-174.000 MHz.

Modes: P25 digital and narrowband FM. Spacing is 12.5 kHz between assignments. Frequencies in this band are a mix of conventional simplex/repeater operations and trunk radio system assignments.

162.0125-173.2 MHz: Federal agencies operate large numbers of conventional and trunked systems in this band including fixed /mobile operations essential to public safety and to maintain Federal government infrastructure-related functions. These operations encompass law enforcement, transportation, natural resources, emergency, disaster, medical and administrative duties. There are specific frequencies in this band that are used by all federal agencies to interoperate with state and local public safety agencies for joint law enforcement and incident response operations. Military agencies make extensive use of this band for non-tactical LMR infrastructure and interoperability.

173.2-173.4 MHz: FFederal agencies use this band for LMR shared systems and mutual aid response with public safety agencies in local communities (fire fighting, public safety, etc.).

173.4-174.0 MHz: See the listings in the 162.0125-173.2 MHz range.

### UHF DoD LMR Sub-band

Mode: P25 and AM. Spacing is 12.5 kHz between assignments. Frequencies in this band are a mix of conventional simplex/repeater operations and trunk radio system assignments.

380-399.9 MHz: Military agencies use selected portions of the 225-399.9 MHz band for simplex, repeater and trunked LMR communications networks, primarily for non-tactical applications such as military base security, fire fighting and other base operations.

### UHF Government Band

Mode: P25, narrowband FM and digital hydrologic. Spacing is 12.5 kHz between assignments. Frequencies in this band are a mix of conventional simplex/repeater operations and trunked radio system assignments.

406.1-420 MHz: Federal agencies use this band extensively for conventional and trunked LMR systems for law enforcement, security, transportation, natural resources, emergency, disaster, medical and administrative duties. There are specific frequencies in this band that are used by federal agencies to interoperate with state and local public safety agencies for joint law enforcement and incident response operations.

If you hear anything interesting in the LMR bands, we would like to hear from you. You can reach us at the e-mail address in the masthead. 73 and good hunting.

*Chris Parris*
*chrisparris@monitoringtimes.com*
*www.mt-fedfiles.blogspot.com*

# More Than a Few Words about Encryption

We can't discuss the topic of federal radio communications today without touching on the subject of encryption. Federal agencies have been using various forms of voice encryption on their communications system as far back as governmental or military communications were in existence, even before radio ("One if by land, two if by sea…"). The reasons should be quite obvious – to keep unwanted parties from listening to your communications. While some scanner listeners may think the federal agencies are just out to annoy them, the government is probably more concerned with the suspects or foreign terrorists they are trying to catch from hearing what is going on.

Early forms of radio encryption were adequate enough to prevent casual eavesdropping, but ultimately were not secure enough for what the users considered "sensitive" information being transmitted over their radio channels. In some early installations, various forms of voice inversion or masking were tried. Some methods had an annoying tone injected into the voice signal that was filtered out on the authorized receiver. The FBI utilized Datotek analog time-domain encryption units for a time during the 1970s. All these seemed to be useful for a while, but ultimately were dropped.

In the early 1980s, the first forms of digital voice encryption started showing up on various federal radios. The FBI was one of the first federal agencies to adopt digital encryption on their radio channels, deploying DES (Digital Encryption Standard) beginning in 1983. Other agencies, such as the Secret Service and U.S. Customs were close behind in using the various forms of digital encryption that could be compatible with their existing analog-voice radio infrastructure.

An interesting side note with the FBI transition to DES was that in some cases the VHF radio channels were upgraded to carry the DES encryption, but some installations used UHF radio or telephone lines to link their repeater sites or remote receive sites to the dispatch center. These links were sometimes not capable of passing enough bandwidth to carry the DES encryption reliably, so they decrypted the voice traffic at the repeater sites, and passed it in the clear over these various links. Scanner listeners who knew of these UHF radio links were able to monitor the FBI traffic on those clear frequencies, while the VHF channels were carrying encrypted traffic. Clearly this was not an ideal situation for secure radio traffic.

Starting in the early-to-mid 1990s, these same agencies began trying the newer all-digital voice radio systems, such as the Motorola ASTRO radio series, an early proprietary version of what we now know as APCO P25. All of the first generation digital encryption systems left something to be desired by the users, who complained of poor voice quality or readability of the received signals, and somewhat reduced radio range when using encryption. Fortunately for scanner listeners, many agencies continued to operate in the clear, analog mode and used their encryption only when they really needed to.

For the past 15 years or so, most federal agencies have moved to, or are planning to move towards the APCO CAI (Common Air Interface) digital voice standard for their radio communications. The federal government decided upon this open-standard, digital radio format for all federal and interoperable radio systems so that various federal agencies can talk to each other, even when encrypted. These systems are digital from end-to-end, so in theory, switching between clear voice and encrypted voice should be the same to the radio users. The APCO CAI is the type of digital signal that can be received by current digital scanners, as long as the users are not encrypted.

When the first forms of voice encryption started appearing on federal government radio channels, hobbyists were at the forefront of trying to figure out ways around them. Audio frequency inverters were able to defeat some early inversion scrambling systems, and various filtering techniques were used to eliminate the tone-injection systems. When the first digitally based encryption systems appeared, scanner listeners were locked out. Some tried various workarounds, but most were just trying to eliminate the annoying "white-noise" that these digital systems produced when listening on an analog scanner.

Often, scanner hobbyists don't seem to grasp the level of sophistication that government encryption carries. I see postings on popular Internet scanner discussion forums asking how to "get around" encrypted radio systems. It is not as simple as clipping a diode from the receiver circuit board, or running the audio signal through a black box of some kind. The most secure version of the AES (Advanced Encryption Standard) encryption key is 256 bits long. And, despite the claims of some mathematical theorists and cipher experts of computerized attacks on AES encrypted data being possible, a radio hobbyist breaking an AES encryption key to listen to the FBI is just not going to happen.

I decided to tackle the subject of encryption because I have received some requests from readers of this column asking that when I post the various frequencies I have heard active, could I specify which frequencies are using encryption and which are in the clear. That is a very difficult request to fulfill for many reasons.

Any federal radio channels that are encrypted at any one time may not be the next. In most cases, the users of the radios may turn encryption on or off as they desire. The switch to turn the secure mode on or off gets bumped accidently and some radios end up transmitting clear voice, while others are not. Some federal agencies have made an attempt at keeping the radios as secure as possible and have programmed the radios they use so that the users in the field do not have a switch available to bypass the encrypted mode. Even then, occasional bits of clear traffic can be heard on these systems. Very few federal agencies are encrypted on 100% of their radios on 100% of their frequencies 100% of the time. Listing all the federal channels as possibly "encrypted" and "un-encrypted" at the same time serves no real purpose.

You might be wondering what is the point of listing or scanning channels that are encrypted if you can't hear what they are saying. One of my personal goals in federal monitoring is collecting frequencies and related data, such as P25 NAC, CTCSS tones, channel names, etc. Even if the voice traffic cannot be monitored due to encryption, I still want to know about activity on that frequency. It appears that many radio hobbyists apparently want to avoid these encrypted federal channels when programming frequencies into their scanners. I often see requests from people wanting confirmed, active and unencrypted federal frequencies. Although agencies try to make encryption use a standard policy, it usually isn't. If you simply avoid monitoring the channels that might be encrypted, you will miss any activity that may be in the clear.

In the early days of encryption, some listeners were able to mute the digital noise by utilizing their CTCSS (Continuous Tone Controlled Sub-audible Squelch), if their radios had it. Early encryption systems were not compatible with sub-audible tone squelch, and encrypted transmissions were broadcast without a PL (Private Line) tone.

Some current digital scanners have made the noise of an encrypted P25 channel less annoying. Most of the GRE/Radio Shack series do nothing but pass the encrypted voice traffic through to the listener (some have compared the resulting noises to drunken robots). The GRE PSR-800 scanner actually lets you choose what to do with encrypted traffic, and the Uniden digital scanners simply mute the encrypted radio traffic, usually with a small burst of the robot noises at the start of the transmission, to let you know what it's picking up.

Since we can't do anything about agencies using encryption on their radio channels, what is future of federal monitoring? In my case, I am always interested in the technical details of the radio system, such as frequencies, NAC's, and repeater locations. Some federal monitors have taken to logging the individual radio ID numbers that can be resolved on some scanners. This adds an additional piece of the puzzle as to the whole mystery of who is using what frequency and why.

## ❖ FBI Frequency Project

In the July *Fed Files* I wrote about the FBI involvement in the response to the Boston terrorist bombings, as well as speculation about some of the nationwide FBI radio channels. Some requests for frequencies from readers inspired me to start an on-line database of local FBI frequencies provided by readers of this column. It is located as part of the Fed Files Blog page and can be found here: **http://mt-fedfiles.blogspot.com**. If you look at the red colored bars at the top of the page, you will see one labeled "FBI Frequency Updates." Click there and you will find listings of all the local FBI channels as supplied by readers and myself. It will be updated as I acquire more frequency information, so check back often.

To kick off this collection of FBI frequencies, I thought I would offer some that I have not published before. I sometimes receive information from readers and fellow scanner listeners that includes channel lists that were actually taken from various federal agency radios. Sometimes these lists were paper labels taped to the radios; some were taken from the computer software used to program these radios. And, in some cases, actual surplus federal agency radios were sold at auction with the frequency information still in the radio, which is highly unusual. One such surplus radio appears to have come from the FBI Academy in Quantico, Virginia.

As with all the frequency lists published in this column, unless otherwise noted, all frequencies are narrowband FM, and "PL" indicates sub-audible tone squelch, "D" indicates digitally coded squelch and "N" indicates P-25 digital Network Access Code (NAC). Here are the frequencies that were found in this surplus radio:

163.1000, 167.9 PL – Department of Energy (DoE), Federal Agency Common
163.8625, 167.9 PL – Input to 167.5375 repeater
164.5500, 167.9 PL – Organized Crime Drug Enforcement (OCDE) 1 repeater
166.4625, 167.9 PL – OCDE 3
167.5375, 167.9 PL – Major Case repeater
167.5625, 167.9 PL – Bureau Common
167.8500, 167.9 PL – Academy Security repeater
168.8625, 167.9 PL – Input to 164.5500 repeater
169.5000, 167.9 PL – Fredericksburg repeater
169.9750, 167.9 PL – Simplex 1
170.2750, 167.9 PL – Quantico Repeater
170.6250, 167.9 PL – Special Surveillance Group (SSG) repeater
170.6750, 167.9 PL – Input to 169.5000 repeater
170.8250, 167.9 PL – Special Operation Response Team (SORT)
170.9000, 167.9 PL – Input to 170.2750 repeater
170.9250, 167.9 PL – Input to 171.6000 repeater
170.9500, CSQ – Wire 1
171.4500, 167.9 PL – Input to 172.2000 repeater
171.6000, 167.9 PL – Independent Hill repeater
171.6250, 167.9 PL – Simplex 2
172.2000, 167.9 PL – Main Academy Repeater
172.6250, 167.9 PL – Input to 170.6250 repeater
173.9125, 167.9 PL – Input to 167.8500 repeater

As you can see, the frequencies above are all analog channels, probably with DES encryption available. In addition to these analog channels, some were programmed in this radio as APCO P25 digital as well:

164.5500, N167 – DN01 OCDE repeater
164.5500, N167 – DN02 OCDE simplex
166.4625, N167 – DN03 OCDE simplex
167.5375, N167 – DN05 – Special Case simplex
167.5625, N167 – DN04 Bureau Common simplex
168.8625, N167 – Input to 164.5500 repeater

It is unknown if these same frequencies are in current use at the FBI Academy, but I would not be surprised if some, if not all, are still being used. Does anyone out there have anything current for the Quantico area? If so, please pass them along to the Fed Files!

## ❖ South Florida Road Trip

I had a chance to do a little Fed Files research on a trip to the Miami area in May of this year. The trip was mostly work, but I did have some radios with me and got to meet up with some long time monitoring friends from the area.

As was mentioned earlier in this column, there has been steady movement by all federal agencies towards APCO P25 digital radios, but in the Miami area it seems that Customs and Border Protection (CBP) continue to operate in analog. It's unknown why this section of the country continues to operate in this mode, but perhaps the time will come when they start replacing their older, analog infrastructure to accommodate the new, digital radios.

Although it has been known that many federal agencies have access to the Florida statewide trunked radio system, there continues to be quite a bit of federal agency activity in South Florida. Here is what I have logged on my trips to the area:

| | |
|---|---|
| 138.0750, N293 | Homestead Air Reserve Base Security |
| 162.0750 | Possible US Weather Service |
| 162.2375 | |
| 163.1250 | Possible input to 168.8500 repeater |
| 163.1750, 100.0 PL | DHS CBP NET 28 |
| 163.1875, N167 | FBI |
| 163.7000 | DHS Immigration & Customs Enforcement (ICE) |
| 164.4000, N001 | Secret Service PAPA |
| 164.5000 | Postal Service General Mail Facility |
| 164.5500, 156.7 PL | DEA Interoperability repeater |
| 164.5375, 203.5 PL | Unknown |
| 164.6500, N001 | Secret Service TANGO |
| 164.7750, 100.0 PL | DHS CBP NET 16 |
| 164.9625, 100.0 PL | DHS CBP Field Operations TAC 21 |
| 165.2125, N001 | Secret Service MIKE |
| 165.2375, 100.0 PL | DHS CBP Field Operations NET 1 |
| 165.2875, N650 | Bureau of Alcohol, Tobacco, Firearms & Explosives NET1 |
| 165.3125, N293 | Coast Guard NET 121 |
| 165.7875, N001 | Secret Service BAKER |
| 165.8500, 123.0 PL | Unknown |
| 166.2000, 100.0 PL | DHS CBP NET 27 |
| 166.2250 | USPS General Mail Facility |
| 166.2500 | USPS |
| 166.3000, 100.0 PL | DHS CBP NET 26 |
| 166.3500 | USPS |
| 166.4375, 100.0 PL | DHS CBP input to NET 1 (165.2375) |
| 166.4625, 100.0 PL | DHS Federal Government Common |
| 166.5875, 100.0 PL | CBP Field Operations |
| 166.8125, CSQ | Unknown, data of some type |
| 167.2625, N167 | FBI |
| 167.4375, N167 | FBI |
| 167.6125, N167 | FBI |
| 167.6625, N167 | FBI |
| 167.7375, N167 | FBI |
| 167.7625, N167 | FBI |
| 167.8625 | Veterans Affairs Medical Center Paging |
| 168.0000, 100.0 PL | DHS CBP heard with Over The Air Reykeying (OTAR) |
| 168.1625, 100.0 PL | Postal Service |
| 168.1625, 114.8 PL | Postal Service |
| 168.3250 | |
| 168.4250, N167 | FBI |
| 168.7500, N167 | FBI |
| 168.8500, 100.0 PL | DHS CBP Border Patrol @ Miami International Airport (MIA) |
| 169.2500 | |
| 169.2625, N293 | |
| 169.4375 | |
| 169.4500, 100.0 PL | DHS CBP NET 2, heard with OTAR data bursts |
| 169.5500 | Heard with OTAR data bursts |
| 169.5750, N167 | FBI |
| 169.6125 | |
| 170.1000, 103.5 PL | |
| 170.5000, 100.0 PL | |
| 170.6750, 123.0 PL | |
| 170.7250, 100.0 PL | DHS CBP @ Port of Miami |
| 170.7500, N293 | US Marshals Service, Federal Courthouse |
| 170.7750, 100.0 PL | |
| 171.4375, N653 | Federal Interoperability repeater, utilized by multiple agencies |
| 171.6250, N555 | Everglades National Park |
| 171.6875, N167 | FBI |
| 171.7750, N61F | Everglades National Park |
| 171.7750, CSQ | Everglades National Park |
| 171.8500 | |
| 171.9875, N167 | FBI |
| 172.2750, 162.2 PL | Arthur R. Marshall Loxahatchee National Wildlife Refuge |
| 172.4250, 103.5 PL | Big Cypress National Park |
| 172.5250, N555 | Everglades National Park |
| 172.6750, 123.0 PL | |
| 172.6750, N293 | |
| 172.7750, 156.7 PL | Everglades National Park |
| 172.9000, N023 | TSA @ Fort Lauderdale International Airport (FLL) |
| 172.9000, N001 | TSA @ MIA |
| 173.6000 | |
| 173.8000 | |
| 173.9125 | |
| 406.6625, 103.5 PL | Federal Reserve Security |
| 406.8125, N364 | Bureau of Prisons, Federal Correctional Institution trunked system |
| 406.9500, N364 | Bureau of Prisons, Federal Correctional Institution trunked system |
| 407.0125, N361 | Bureau of Prisons, Federal Detention Center trunked system |
| 407.1375, N482 | Postal Inspection Service |
| 407.4125, N361 | Bureau of Prisons, Federal Detention Center trunked system |
| 407.4750 | Possibly VA Medical Center using Moto TRBO digital mode |
| 407.7750, N482 | Postal Inspection Service |
| 408.1500, N364 | Bureau of Prisons, Federal Correctional Institution trunked system |
| 408.5500, N364 | Bureau of Prisons, Federal Correctional Institution trunked system |
| 409.6750, N361 | Bureau of Prisons, Federal Detention Center trunked system |
| 409.9500, N364 | Bureau of Prisons, Federal Correctional Institution trunked system |
| 410.0000, N361 | Bureau of Prisons, Federal Detention Center trunked system |
| 410.0375, D047 | Job Corps Center at Homestead ARB |
| 410.7750, 100.0 PL | |
| 410.8125, N361 | Bureau of Prisons, Federal Detention Center trunked system |
| 411.1000, 103.5 PL | |
| 412.5500, 156.7 PL | DEA |
| 413.0250, N293 | USCG NET 411 |
| 413.1000, N293 | Unknown agency |
| 413.6000 | FAA data |
| 413.9250, 103.5 PL | USPS |
| 414.0375 | |
| 415.2000, 192.8 PL | DHS Federal Protective Service |
| 415.2250 | |
| 419.3750, 156.7 PL | DEA |

# Rocket Radio Reminiscences

Mario Filippi N2HUN (All photos courtesy of the author)

One Saturday each month, my mother and I would take our mile-or-so walk to uptown New Rochelle, the epicenter of small mom-and-pop businesses that dotted Main Street of our small New York hometown. Of course, we'd always stop at the local five and dimes such as W.T. Grant and F.W. Woolworth to mill around and check out the latest bargains.

Then there were the smaller family-owned shops such as Mendelsohn's Luggage, Faina's Donut Shop, Shindel's Army and Navy, etc., which were always displaying the latest offerings in their large storefront picture windows. Faina's was known for their great donuts and coffee, served by cigarette-smoking, wise-cracking waitresses who called everyone "Hon'."

One particular day, a new shop opened up just off Main Street; a "dry goods store" featuring an odd assortment of clothing and household goods. The place wasn't very big in size, its proprietor was a friendly, middle-aged man with a European accent. The place was a hole-in-the wall with mostly imported goods, a sign of things to come.

While rummaging through the items for sale, mom and I noticed, atop a display case by the cash register, many small boxes with a cartoon drawing of a rocket on it. We inquired about them. "Well, it's a radio that needs no batteries, runs forever and never wears out," stated the proprietor in his unusual accent.

Being a good salesman, he opened up the box and inside was a small, red, plastic rocket with wires coming out of the bottom. One was a single, long wire with an alligator clip on the end, and the other was a twisted pair of light tan wires attached at the end with a large tan earphone. The tip of the rocket had a metal rod jutting from it with a plastic red ball on the end. Not much to it, and a pretty simple design.

Mom, being the good soul that she was, saw my interest in this gadget and purchased one for me. Being a youngster, the realization that this was a defining moment in my life did not occur to me. Fate had intervened and this simple, crystal controlled receiver became my first radio. It was a rudimentary, humble introduction to a lifelong hobby that has been a source of enjoyment for over five decades.

## The Era of Rocket Radio

It's funny that as you age, early childhood experiences, long tucked away in the brain's gray matter, suddenly resurface from memory in clear detail. Back in the late 1950s, the space race was in full swing. The United States and the Soviet Union were launching satellites just like a cold war sparring match. Next, came manned spacecraft, and each launch was covered by the media either live or on the nightly news for all to see.


***Crystal Rocket Radio, a reproduction once sold by Restoration Hardware, is no longer available.***

Most of us probably remember watching some history-making launch from Cape Canaveral, Florida, with a majestic looking rocket slowly and gracefully leaving Earth with a smoky, billowing fireball beneath it. Seemingly in slow motion, the television camera captured the lift-off as the rocket ascended its skyward path until it was a mere speck in the sky with a faint white contrail in its wake.

Our country was deeply immersed in this new frontier of Sputniks, Telstar, Lunas, Explorers, all of which required some type of rocket to propel the spacecraft to its ultimate goal. An integral part of the space program was radio communications. Whether it was with a satellite or manned spacecraft, terrestrial-to-space radio links were required to maintain communication and control spaceships. How many can remember the thrill of listening to astronauts reporting back to "Mission Control" while watching our black and white television sets! This magic elixir of space travel coupled with radio communications captured the interest and imagination of every American kid and was the venue that attracted us to the rocket crystal radio.

***Rotary phone finger-stop provided a good ground for fledgling listeners. You'll have to look for alternatives today since phones such as this are almost as forgotten as Rocket Radios.***

## Innards of the Rocket Radio

Crystal radios had been around for many decades prior to the advent of the Rocket Radio. Most were homebrewed or were available commercially in many shapes and sizes. Advertisements for crystal receivers appeared in magazines, back pages of comic books and catalogs, all extolling the virtues of their reception prowess. Rocket Radios were no different from their ancestral crystal sets, as far as circuitry was concerned. They usually consisted of a fixed value capacitor, a slug tuned coil, a diode rectifier (typically of germanium), a high impedance earphone, and a lead-in wire, terminated with an alligator clip.

***Water pipe - not as convenient but a good ground anyway, assuming you've got copper water pipes. This doesn't work with PVC.***

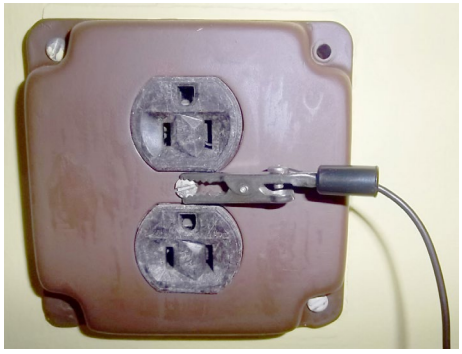
Unlike their sophisticated successor, the superhetrodyne receiver, which used variable capacitors, the Rocket Radio was tuned either by moving a cylindrically-shaped ferrite bar inside a wound coil, or moving a "wiper" contact across the coil, thus varying the inductance. Generally, this was accomplished by moving the red-tipped rod up and down into the nosecone of the rocket.

## Getting Ready for Takeoff

After Mom and I arrived home from our uptown sojourn, off I went to try out my new Rocket Radio. Living in a second floor apartment, the best bet to hear anything would be, as per the directions, to attach the alligator clip to a good ground such as the finger stop of a rotary telephone**.** Rotary dial phones were standard for that era but were slowly phased out in the 1970s. Other ways achieve a ground would be to attach the alligator clip to a water pipe**,** the screw of a wall outlet plate or even a table lamp.

Next, the rather large, high impedance earphone was pressed into the ear and slowly and methodically the nosecone rod of the rocket was moved ever so slowly up and down in an effort to seek out some broadcaster in the ether.

The audio output of these radios was pretty miniscule so I had to find a room with absolute



*Wall outlet screw had to be loosened a bit to get clip to "bite."*

quiet, not an easy task in my household back in those days. So, down to the cold, deserted basement I went, and hooked the radio's alligator clip to the brass water meter, which turned out to be an excellent ground.

## ❖ We Have Lift-Off

With the earphone securely pressed deeply in my ear, I moved the red-ball-tipped nosecone rod up and down, very slowly, sometimes even holding my breath while mentally concentrating on hearing something, anything. When the tuning rod was about half-way down in its travel, I heard a man's voice emanating from the earphone…yes! It was a pleasant, easy-going voice, velvety in nature. I kept listening until I heard some kind of station identification and later determined it was WCBS at 880 kHz, from New York City. It was the Jack Sterling Show, one of the staples of daily broadcast entertainment, way before WCBS became an all-news broadcaster.

*Typical crystal radio earphone continually slipped out of ear!*

Being fortunate enough to live about thirteen miles from New York City, there were plenty of AM radio stations broadcasting at that time, but snaring them with the pea-whistle receiver would hinge on experimenting with different grounds, and ultimately different antennas. Metal chain-link fences, wires strung across clotheslines, copper downspouts, TV antennas and even metal window screens were tried in an effort to achieve superior reception with the little Rocket Radio.

Ultimately, crystal radio nirvana was achieved when the alligator lead was attached to my next-door neighbor's metal wire that ran across his vegetable garden. But, to get to it required climbing up to the garage roof and carefully hanging over the side without falling off. That magical wire allowed me to hear my first rock n' roll song by Gary U.S. Bonds, over WINS at 1010 kHz, home to the famous DJ known as "Murray the K." Other New York City stations such as WABC (770 kHz) and WMGM (1050 kHz, later to become WHN) were all playing Top-40 rock hits through the earphone while I lay on my back atop the garage roof, staring up at the sky, those many years ago.

## ❖ Rocket Radio Resources

If your interest in these early receivers is piqued then there are websites to visit that will provide you with nostalgic information. First, try **www.crystalradio.net** which contains a plethora of information and links on crystal receivers in general. My favorite site for window shopping is Ebay, **www.ebay.com,** which always has a few Rocket Radios up for auction, and the pictures and descriptions in the ads are quite good.

Interestingly, some of the old Rocket Radios from the 50s command very handsome prices at auction. Perusing the Ebay ads is a walk down memory lane and several times a month I'll search the ads for interesting bits of history on these space-age receivers. You'll also find information on these radios by simply performing a Google or Yahoo search, as many of these radios are up for sale on antique/vintage vendor websites.

## ❖ In Memoriam

I'd like to dedicate this article to the memory of my late mother, Mrs. Nicolina "Nettie" Filippi who with love and kindness many years ago, on a winter's day, purchased a Rocket Radio for her son and with that simple act planted the seed of what would eventually become a wonderful lifelong hobby.

*Kevin O'Hern Carey, WB2QMY*
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# Online Tools for the Basement Band

Today, it's hard for me to imagine how we ever got along without the Internet. I can't recall the last time I wrote a column that didn't include some mention of a website or e-mail address. The same is probably true for any radio column you read. This month, I'll explore some of the websites that I use regularly for low frequency information. The web can be a goldmine of such data, helping you ID beacons, get technical data, and gain ideas for projects.

It can also help level the playing field with the transmitting side of our hobby (ham radio) by allowing listeners to "talk back" with others in near real-time fashion. Gone are the days of thinking the web would replace our radio hobby; it has only improved it!

Do you recall when you first got online? I remember hearing about the Internet in the 1980s when it was still run by the Department of Defense. Later, I heard that some companies and large universities had access to it, but it remained largely a mystery to me, and I certainly did not grasp the role it would later play later in the radio hobby. About 1994, I finally got an e-mail account at work, this was followed closely by web access and I haven't looked back since. I continue to be amazed at the information and resources I find online to enhance my radio experience.

## Not Online?

I want to say a quick word to our readers who are not online. Be assured that you will not be left hanging at *Below 500 kHz*! I understand that some folks have little or no interest in computers, or do not have the ability to get online for one reason or another. While we do make frequent use of web resources and e-mail, I will always welcome your traditional postal mail, and respect the fact that not everyone is online. Our main focus here remains on *radio*.

However, if you have the slightest interest in exploring the Internet, I would ask you to try one thing: Take this issue of *MT* to your local library, where you can get online for free, and try visiting a few of the websites listed here. If you're a complete novice with computers, don't worry. Library staff will be glad to assist you, and show you how to enter the website addresses.

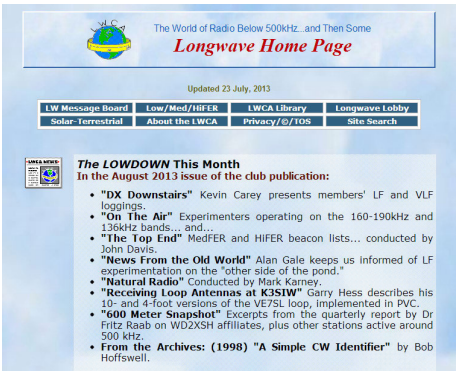
Who knows, you might discover a new horizon once you're there, and if you don't like it, at least you can say that you gave the Internet a try! It's really much easier than you think. My father-in-law is in his eighties, and you should have seen him light up when I brought up some websites related to WWII aircraft, one of his favorite interests. He ended up showing *me* some of the features on the planes he worked on as a P-47 mechanic in WWII.

## Longwave Websites

Listed below, in no particular order, are many of my favorite sites related to the longwave hobby. Although all of these addresses were tested in mid-July 2013, any list like this is subject to change. Should you find that a link returns an error message, try entering some key words from the description into your search engine. You may be able to find the site (or similar ones) in this way.

### www.lwca.org

The Longwave Club of America (LWCA) homepage. If I could only pick a handful of sites to have in my "favorites" list this would certainly be one of them. This site is maintained by John H. Davis, a fellow columnist in the LWCA's monthly journal, the *Lowdown*. Here, you will find links to reference data, a message board for posting questions and comments, and information on joining the LWCA.




### www.classaxe.com/dx/ndb/rna/index.php

The NDBRNA Database website is nothing short of amazing. Site creator Martin Francis of Ontario, Canada has done a thorough job of collecting and presenting beacon loggings from all across North America in a database format. Want to see if a particular beacon near you has been heard from afar? No problem, it will tell you who has heard it, when, and where they are located. Chasing a challenging DX target and want to know what else is on or near the frequency? Again, no problem, all of this data is shown. You can search for an unidentified beacon you have heard and even add your own loggings to the list to help others in their search.

### www.ve3gop.com

Alex Wiecek's website has an emphasis on Canadian longwave stations. Alex maintains several aviation beacons in Ontario as a career, and he brings a unique perspective to longwave monitoring. Be sure to check his online database of Canadian stations from 10 to 530 kHz, NDB photos, and his *WWSU* logging software, which you can download here. As of this writing the site hasn't been updated in a while (since 2010), but there is still much useful content to be found.

### www.angelfire.com/space/proto57/rdf.html

This is a site devoted to self-contained Radio Direction Finding (RDF) receivers that were once common on mid-sized boats prior to the advent of GPS. Nearly all of these operated on LF and MF frequencies, and they can still make great DXing receivers today. The site has a nuisance pop-up ad that appears upon launching, but once you close this window, you're good to go enjoying RDFs.

### www.radiosky.com

Resources for amateur radio astronomers, teachers and students. If natural radio is your thing, be sure to check out this site.


### www.auroralchorus.com

Famed site by Stephen P. McGreevy for learning about all aspects of natural radio reception and recording. The *VLF Story* here is a "must read" for anyone interested in the subject of whistlers, tweaks, dawn chorus, and the like.

### www.lfengineering.com

Website of the LF Engineering Company of East Haven, Connecticut, longtime manufacturers of Low Frequency Equipment for LF Communications, Natural Radio Research, AM Broadcast, Marine and Shortwave Radio.

### http://500kc.com

Home Page of the 500 KC Amateur Radio Experimental Group. This group operates under special FCC authority just above 500

kHz. Their work has been very successful, and may soon lead to a ham allocation in the vicinity of 500 kHz. The website gives details of the experiment, and provides a way for you to report stations you hear.

**www.stormwise.com**

Stormwise lightning detectors, ferrite rods, variable capacitors, and VLF radio equipment and more. Stormwise also has a line of LF antennas for listening, as well as plans for building radio projects, including a Whistler Receiver (see bottom of the webpage).

**http://alexander.n.se/in-english**

This website is for a museum in Grimeton, Sweden which exhibits and operates the last working Alexanderson Alternator in the world. This unique transmitter uses no tubes or semiconductors, but operates by spinning an alternator at low RF frequencies (17.2 kHz).

**http://worldaerodata.com**

Website of the World Aeronautical Database. Here, you can look up almost any beacon or Navaid in the world. Very complete and easy to use.

**www.airnav.com**

AirNav provides free, detailed aeronautical information on airports and navigation aids, and is completely searchable. Note: As with many online sites for beacons, this one does *not* include 2-letter "compass locator" beacons. AirNav was one of the earliest online sites for beacon lookups.


**www.w3eee.com**

W3EEE Longwave website by Stephen Dove, featuring his unique *Grabulator* online receiver, which you can monitor. The receiver is located in Mt. Gretna, Pennsylvania.

**www.w8ji.com/ndb beacon fish buoy net beacons.htm**

Good overview on beacon transmitters, fish net beacons and causes of NDB harmonics and keying problems. *(Note: The spaces in this web address are intentional.)*

**www.dxinfocentre.com/ndb.htm**

Bill Hepburn's very comprehensive list of LF/MF aeronautical & marine beacon stations.

**www.loran-history.info**

Most LORAN navigation stations (100 kHz) ceased operations years ago. Still, there is a fascinating history behind the development and operation of these stations. This ground-based system got the job done with an impressive accuracy, second only to today's GPS.

**http://members.shaw.ca/ve7sl/burhans.html**

In the mood for a new project? This site describes a shielded loop for LF work that could be just the ticket to high performance, low noise reception of beacons and other longwave signals. I built this antenna over several issues of *MT* a couple of years ago. It's a winner.

## ❖ Loggings

Mario Filippi N2HUN (NJ) sent a list of loggings made from his location in northwest New Jersey. For these intercepts, he used a Ten Tec RX-320D receiver and an S9 vertical (43 foot) with 53 radials. Mario writes: "This session was a banner evening as evidenced by the log. Receiving QI/206 from Nova Scotia was a thrill. This night the beacons were barely audible with some taking a few minutes for me to ID. Most of the beacons heard were new catches for me."

**SELECTED LOGGINGS FROM NJ**

| FREQ | ID | ST/PR/ITU | CITY |
|---|---|---|---|
| 243 | YVB | QC | Bonaventura |
| 218 | YUY | QC | Rouyn-Noranda |
| 206 | QI | NS | Yarmouth |
| 248 | IL | DE | Wilmington |
| 245 | YZE | ON | Gore Bay |
| 260 | YAT | ON | Attawapiskat |
| 276 | YHR | QC | Chevery |
| 248 | UL | QC | Montreal |
| 317 | ZMX | QC | Montreal-Mirabel |

From Lars Kallan SM6NM comes a preliminary report of the SAQ (17.2 kHz) transmission on Alexanderson Day June 30, 2013. This time, the station's Morse Code transmission was heard in several countries, including: Austria, Belgium, Canada, Czech Rep., Denmark, Finland, France, Germany (a large number of submittals), Great Britain, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Romania, Russia, Slovenia, South Africa (first time log), Spain, Sweden, Switzerland, Ukraine, and the United States.

The message sent from the station was as follows:

CQ CQ CQ DE SAQ SAQ SAQ =
THIS IS GRIMETON RADIO/SAQ IN A TRANSMISSION USING THE ALEXANDERSON 200 KW ALTERNATOR ON 17.2 KHZ.
*TODAY WE REMEMBER ONE HUNDRED YEARS AGO WHEN THE FIRST REGULAR TIME SIGNAL FOR SHIPPING ETC WAS TRANSMITTED VIA ARLINGTON RADIO/NAA (USA) AND VIA EIFFEL TOWER/FL (PARIS).*
SIGNED: THE ALEXANDER-GRIMETON VETERAN-RADIOS VAENNER ASSOCIATION AND WORLD HERITAGE GRIMETON
FOR QSL INFO PLEASE READ OUR WEBSITE: WWW.ALEXANDER.N.SE
DE SAQ SAQ SAQ

## ❖ Longwave CD & Book

Readers frequently ask if there is a way to obtain my longwave resources (CD and book) online. Indeed there is. Both the CD and the book *Listening to Longwave* are available at the Universal Radio's website (**www.universal-radio.com**). Specific links for these resources are as follows:

*VLF Radio*CD: **http://tinyurl.com/VLF-Radio**
*Listening to Longwave*Book: **http://tinyurl.com/Longwave-Book**

The original *VLF Radio!*recording was produced in the spring of 1997 with the aid of an old Radio Shack dubbing tape recorder, an inexpensive mic, and lots of patience! Later, with the help of Jacques d'Avignon VE3VIA, the tape was digitally re-mastered on CD, and that is now the primary format.


***VLF Radio* CD and a companion book are available at Universal Radio, of Reynoldsburg, Ohio**

The book *Listening to Longwave* is a general treatise of the basement band. It had been a long time since a new book on longwave had been published, so the time was right for a new release. The book is actually an update of an earlier tome called *The World Below 500 kHz* by L. Peter Carron. It contains dozens of new pages, charts, pictures and diagrams, as well as information on new operating modes. Contact me at the address in the masthead should you need more information on either of these items.



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# Introducing the Echophone EC-1

In my February, March and April columns, I worked on a Hallicrafters S-38D, and in the process traced the descent of the popular S-38 series of "starter" shortwave sets from the S-41 Skyrider Junior. The subject of this latest restoration is the Hallicrafters-built ancestor of the S-41, designated the Echophone EC-1 Commercial. Where did the Echophone trade name come from and why did Hallicrafters use it on this product?

The interesting story goes back to the mid-1930s, when the fledgling Hallicrafters company began marketing shortwave receivers. Though these sets were Hallicrafters designed, they could not be Hallicrafters built. The reason: The Radio Corporation of America owned several key patents on radio designs, particularly the all-important superheterodyne circuit. At that time RCA was very reluctant to grant new licenses, much to the frustration of the young Bill Halligan, proprietor of Hallicrafters.

Halligan got around the problem by selling sets using a prototype sample and, when he had enough orders, having the sets built by a company with an RCA license. He got by for awhile in this clumsy manner, but finally obtained the coveted license in 1936 by buying a company that had one, the financially troubled Echophone firm.

At first, the Echophone brand was used not on radios but on various other electronic devices made by Hallicrafters. However, Halligan eventually decided to introduce a line of inexpensive shortwave receivers aimed at a user base more general than the hams and SWLs for which most of his sets were designed. He was most likely influenced by the growing interest in shortwave listening that was very evident in the late 1930s as war clouds gathered in Europe. Halligan did not want the Hallicrafters name associated with these simple sets and chose to market them using the Echophone trademark.

## ❖ Meet the EC-1

The first offering, released in 1940, was known as the Echophone EC-1 Commercial. There were a few immediately obvious differences between the little EC-1 and most of its Hallicrafters cousins. One was its very compact (11-inches x 7.5-inches x 7.5-inches) cabinet. Another is that the EC-1 was quite probably the first Hallicrafters-designed and manufactured receiver to shed the power transformer and utilize the AC/DC circuitry then so popular with small household radios. Also, as in those household sets, the EC1 lacked an RF stage and had only one stage of IF amplification. In contrast, the typical Hallicrafters set of the era had at least one RF stage and two stages of IF.

Other than the presence of a beat frequency oscillator tube, the tube complement of the EC-1 reflects its origin in household radio design: 2K8 converter (oscillator/mixer); 12SK7 IF amplifier; 12SQ7 detector/ AVC/first audio; 12J5 BFO; 35 L6 audio output; 35Z5 rectifier. However, though the EC-1's circuitry may be closely related to that of the inexpensive household radios of the time, there was no doubt that this radio was intended for serious shortwave and broadcast listening.

Dominating the front of the heavy steel cabinet, finished in no nonsense gray crackle, is the combination main tuning and bandspread dial. The tuning range is 0.55 – 30 MHz divided into three bands. In addition to the main tuning and bandspread tuning controls, the front panel holds a switch to select the speaker (built into the top of the radio) or phones (plugged into jacks on the rear apron); a volume control; BFO switch; bandswitch; and a standby switch to mute the radio without shutting it off. Screw terminals on the rear apron accommodate a ground and either a single wire or a doublet antenna.

Also available in the Echophone line were the Echophone Commercial EC-2 and the Echophone Commercial EC-3. The EC-2 has seven tubes compared to the EC-1's six, the extra tube being a stage of RF amplification. It also has a noise-limiter circuit. In addition to the noise-limiter and RF amplifier, the 9-tube EC-3 has an extra stage of IF amplification and a crystal filter. Both the EC-2 and the EC-3 have AC/DC power supplies.


***In the Echophone wartime ad series, the nerd got the girls as long as he had an EC-1. Vintage Hallicrafters Advertisement.***

Towards the end of Echophone production, about 1945, two variations of the EC-1 were released. The EC-1A added a noise limiter and used a 12SA7 rather than a 12K8 as the oscillator/mixer. Otherwise the tube complement was the same. There were also minor changes in the design of the main tuning and bandspread dials. The EC-1B was like the EC-1A except the "speaker-Phones" switch was moved to the rear apron and the noise limiter was eliminated.

Eventually, the various EC-1s were replaced by the Hallicrafters S-41 Skyrider Jr. which, except for a different paint scheme, was their virtual twin. Apparently, by this time, Hallicrafters was pleased enough with the performance of these little radios that they did not have to be hidden behind the Echophone name.

Just about a year later, the set was given a sleek modern look by industrial designer Raymond Loewy. Along with other sets in the Hallicrafters line, the S-41 became the classic S-38. With minor variations (A, B, C and D) the S-38 remained in production until 1957. The last S-38, the S-38-E (1957-1961), was a complete redesign using miniature tubes and with an enlarged slide rule dial.

## ❖ The EC-1 as a Morale Radio?

In a matter of months following the 1940 introduction of the EC-1, the United States was propelled into World War II by the Japanese attack on Pearl Harbor. Soon after that, all civilian radio production was terminated by government order so that the plants could be converted to military production. Hallicrafters, however, seems to have been allowed to continue building EC-1s.

I don't know what the logic behind this exception was. However, it might have been to allow GIs stationed far from home to listen in to their local radio stations or perhaps to Armed Forces Radio Network morale broadcasts. At any rate, the Hallicrafters EC-1 advertising soon had a military slant. A famous series of cartoon-style ads featured a nerdy looking enlisted man named Private Hogarth. He was "promoted" to Corporal later in the series and some say he eventually made Sergeant.

In the various ads, Hogarth and/or his EC-1 were usually pictured in some exotic location surrounded by scantily dressed babes. Often, macho looking guys looked on, chagrined because they were being ignored. A bold caption would give the EC-1 the credit. One example, written in cursive being "Dear Mom: Thank you for sending me an Echophone EC-1. It has certainly kept me from getting lonely!"

It's hard to imagine that a whole bevy of beautiful babes would be attracted to Private Hogarth and his EC-1 in preference to some


***My EC-1 as Removed From the Attic. Author's Photo.***

of the muscle they were ignoring. If those ads were not intentionally tongue in cheek, they were certainly naïve. But, they are still fun to look at!

A G.I. who did buy an EC-1 with the intention of taking it with him to some foreign clime might be able to get it into his duffle bag. But the 10 pound weight added to the weight of all his other possessions might begin seriously biting into his shoulder. And, there was no guarantee that he would find the necessary 115-volt power when he got to his destination.

A little later in the war, at the request of Army Special Services, Hallicrafters designed and built a radio specifically designed as a morale receiver. It was manufactured both as the Echophone EC-6 and the identical Hallicrafters RE-1 "Sky Courier." This one would run on 115 volts or from self-contained batteries. It received the broadcast band and two shortwave bands and weighed a whopping 30 pounds. But, at least it was built into a portable style case with a carrying handle!

## ❖ Looking Over our "Patient"

The EC-1 that is our latest project is unusual in that it doesn't arrive on my workbench directly from a flea market table. I've had this set for something like 20 years and, as I recall, I even had it running. For some reason, that I no longer remember, I was anxious to start it up and did so without the major recapping or alignment that I usually carry out. It hasn't been touched or turned on since that time.

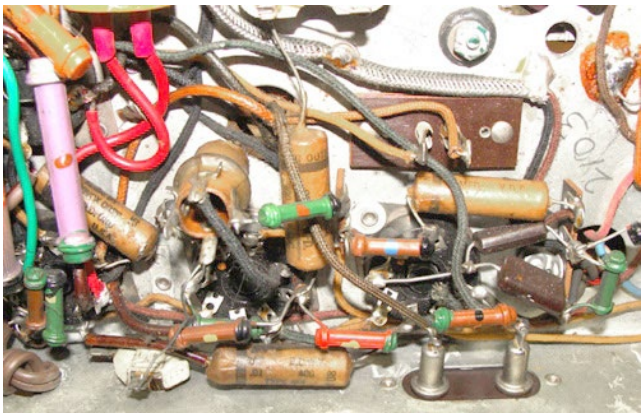
As far as the cosmetics are concerned, I give it an 8. While dingy from its long sojourn in our attic, the gray crackle paint looks intact and scratch free. The dial window is clear, with only a trace of yellow, and has no cracks or dents. The silkscreened lettering is intact everywhere and should brighten up nicely when I wash the cabinet with a detergent solution. Moreover, the dial cord for both the main tuning and bandspread is intact and both controls operate smoothly.

Under its coating of dust, the chassis looks absolutely clean, with no corrosion, seed hulls, or other signs that it had ever been a home for rodents. However, the composition board cabinet back originally came to me in four pieces, which I dutifully saved in an envelope for all these years, thinking I would eventually use them as a pattern to cut a new back. Well, "eventually" never came, but in the meantime, it became possible to order laser-cut backs for a wide variety of radios, including mine.

As my first official act on beginning this project, I e-mailed an order for a back to Retro-Tronics.com. Cost was $22.99 including shipping. I received immediate and friendly confirmation with a promise of shipment within five business days. I should receive the back in time to report on it in next month's column. In fact, as I am reading over these words the morning after writing them, I received another e-mail advising me that the back had already been shipped.

Having learned everything I could by scrutinizing the outside, it was time to dig deeper. The construction of the cabinet is unusual in that both the top and bottom are flat plates that can be removed after backing out a few screws. This provides all the access required for recapping and aligning. Having the front and sides of the cabinet remain in place during the restoration work is a very nice feature. It's handy to have all the knobs and switches remain in their normal positions during testing and alignment.

It's also advantageous not to have to remove the chassis from the cabinet, thus avoiding the need to disturb the system of insulating washers that electrically isolates the chassis from the cabinet. The isolation is necessary because, with this type of transformer-less circuit, the chassis can become "hot" to ground, and therefore a dangerous shock hazard, depending on which way the plug is inserted into the outlet. A further step in avoiding this danger would be to install a properly wired polarized plug, something we'll get into a little later.



***To be this compact, the EC-1's wiring had to have been installed in layers. Author's Photo.***

## ❖ First Look Inside

Removing the top plate was a bit tricky because, in addition to being fastened by some screws, the plate has a lip at its front edge that slides under some clips spot welded to the top of the front panel. The plate had to be lifted straight up to free the tightly held lip without bending the clips. First I tried to slide my hand under the plate to push it up from below, but I couldn't get enough leverage. Finally, I found slots big enough to insert a fine screwdriver under the two front corners, evidently put there to facilitate prying. I was then able to raise the plate enough to get a larger screwdriver under the corners and up it came.

Since the speaker is mounted on the top plate, I was grateful to Hallicrafters for equipping its cord with a plug. After prying it up with my small screwdriver, the top plate was freed so that I could set it aside.

The bottom plate presented no such difficulties. Removing it was a matter of backing out four sheet-metal screws and lifting it off. Under the chassis, the set looked very clean. There was also no sight or smell of overheating or burning due to electrical trauma. Most of the resistors were the old dog-bone style such as would be expected in early 1940s construction.

However, the paper capacitors were a mixed lot. Certainly most were of the wax-covered type appropriate for the era, yet some were plastic encased and had a later look, perhaps mid-1940s or later. I suppose it is to be expected that a large manufacturer like Hallicrafters would have stocks of parts from various eras, drawing on them as needed for various production runs.

Everywhere there was evidence of well-planned quality construction. All solder joints had that silvery gleam one associates with perfect work, and parts layout had been planned for minimum lead length. This compactness of construction had obviously required that the wiring be done in layers and I could see no sign that any of it had been disturbed or changed since it was put in.

Wholesale recapping, I felt, would be out of the question. the wiring was just too tightly packed and one might do more damage than good, burning parts or wires with a soldering iron while trying to reach a partially buried connection. This radio would require a gentle start-up with the original parts in place and fingers crossed, followed by diagnosis of any trouble that might turn up and replacement of the individual components involved. We'll start on that next time!

# ANTENNA TOPICS

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# Big Gun Antennas with a Vengeance

This month I'd like to take a look at a topic that has long fascinated me, the monstrous antenna systems used by medium and shortwave broadcasters. Very costly and very large, these systems allow a broadcaster to either blanket an area surrounding the station, or beam to specific overseas locations with a combination of overwhelming gain and massive transmitting power.

One of these at home, if it would fit in the backyard and not be a nuisance to low-flying aircraft, would enable any of us SWLs to quickly log every MW and SW transmitter in the world, or, if we hams could hook up our little 100-watt transceivers to it, to quickly attain 200 or 300 DXCC entities on the bands of our choice in, oh, say, three sleepless days.

## ❖ Our Old Friend, Mr. Vertical

Here in the U.S., we are accustomed to this medium-wave (MW) service we call "AM radio," and we've all seen the tall antennas they use. A quarter-wave vertical at MW is huge. For example, in the middle of the band at 1000 kHz, a quarter-wave is 234 feet. Down at 600 kHz, it's 390 feet! And these "towering" giants are accompanied by acres of ground radials to maximize their efficiency.

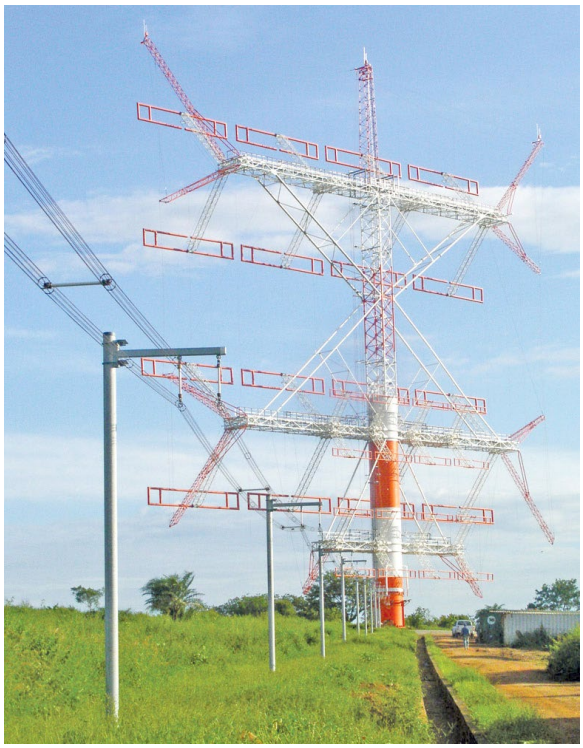
Quite an outlay in construction and maintenance costs is necessary to have one of these beasts. Fed at high power, anywhere from 10 kW to 500 kW, their omnidirectional pattern serves a circle on the map that is intended to include the town or city where they're located as well as "outlying areas."

Realize that AM radio far, far pre-dates FM radio, television and the Internet. For many years AM stations were the *only* electronic medium, supplanting the much-slower newspapers with up-to-the-minute news, weather, sports, as well as a bewildering variety of music programs. The choice of an omnidirectional antenna, the quarter-wave vertical, was almost a no-brainer from the point of view of maximizing coverage of an area.

We spoiled Americans don't realize that many parts of the world, notably sections of Africa and Asia, do not have, or have very limited, Internet access and cell phone capability. In these areas the "AM stations" model we are familiar with is often the default, or even the only means of disseminating information and entertainment.

Unlike the wealthy Americans, though, they can't afford the space and equipment to build MW transmitters and antennas. Shortwave frequencies are used instead, though long-distance propagation is not the goal; the smaller, cheaper equipment and antennas drive this choice. Here again, since omnidirectional coverage of an area centered on the station is the goal, the quarter-wave vertical is usually the default antenna choice.

By the way, we Americans often fall into a frame of mind that equates "AM" with that particular MW frequency range; but actually all the shortwave stations are "AM" stations too. Amplitude Modulation, though it is far from being the most *efficient* mode of transmission, is nevertheless the simplest to *receive;* it is the one mode that even a simple crystal radio can tune in. And, it's this factor that has kept AM alive on MW here in the U.S. and on SW elsewhere; the relative ease with which it can be picked up and listened to. Let FM convey the high quality sound, AM's primary mission is ease of reception for all.



*The Thomson HD-RCA Rotatable Antenna System delivers high power in a tight beam at HF. (Courtesy: Thomson)*

Shortwave broadcasters, though, have other agenda besides reaching those listeners in their immediate environs. As hams and SWLs know very well, this 3 to 30 MHz region is a magical place where, under the right conditions, signals can be bounced off the ionosphere and up to halfway around the globe.

If a station is in, say, China, and wants to saturate, say, the continent of Africa with propaganda, oops, I mean alternate viewpoints, then this "multihop" propagation is a made-to-order tool. All that is needed is accurate information about destination, distance, frequency and an antenna to concentrate the gain and angle of radiation. For this, a big station steps up from the simple vertical to some really awesome creations that produce gain figures that make this ham drool jealously. One of the most amazing, in my opinion, is the *curtain antenna.*

*VoA Greenville curtain array delivers high power HF to a fixed point. (Courtesy: BBG Strategies)*

## ❖ Ring Up the Curtain!

It's easy to see from the picture how the curtain gets its name. It is actually an enormous array of individual dipoles, carefully phased and spaced in rows and columns. Gain figures of 12 to 25 dB are typical for these monsters. Reality

check: 20 dB is a factor of 100, so 10 kW fed to such an array is equivalent to *one million watts* fed to a theoretical dipole or vertical. Hams could probably add the rest of the solar system as DXCC entities with this kind of clout (if we could figure out how to aim the darned thing at Saturn and Mars), assuming DXpeditions being there for us to work! In actual real-world practice, this means fairly consistent and reliable beaming by multi-hop to target people on other parts of the globe.

Just in case the basic curtain antenna isn't sufficiently impressive, some folks have upped the ante and built *rotatable curtains*, which can be aimed at different global targets for even greater coverage. These structures are quite expensive to build and maintain, still, it's nice to dream about fitting one into my backyard. As you can see from the picture, a reflector screen is sometimes placed behind the array to increase directivity in a single direction (dipoles, as we know, are basically bi-directional and the curtain is, after all, merely a large array of dipoles).

## In the Log, Periodically

Perhaps more familiar to many of us is the venerable *log-periodic dipole array* antenna. At first glance, it appears to be a conventional Yagi beam antenna. Closer inspection reveals the truth; the LPA is actually a series of actively fed dipoles arranged horizontally on a single boom. Broadband is the name of the game here; each dipole is near resonance at a given desired frequency, and nearly all power flows to that element; the other, non-resonant elements tend to act as directors or reflectors as in a conventional Yagi. Thus a single antenna can cover a wide frequency range, just the ticket for SW broadcasters who want to use multiple bands, but don't have the NASA-type budget to build a rotatable curtain array.

The typical LPA gain is not as impressive as the curtain antenna's 12 to 25 db, more like 5 to 13 dB, but the expense and complexity of the LPA is also far less than for the curtain array. The LPA also takes up far less room. And, let's not sneer at these "paltry" gain figures; 13 dB is a factor of 20, so a 10 kW transmitter feeding it is about equivalent to running 200 kW to a dipole! Hmm…might have to think about building an LPA for, oh, I don't know, 14 through 29 MHz. Never know when you might want to easily work the world on the higher bands!

***U.S. Antenna log-periodic dipole array delivers 7.0 dB from 13 to 30 MHz. (Courtesy: U.S. Antenna)***

## Into the Sunset

Commercial broadcasters, with much more economic clout than you or I, and with the acreage and the official permission to build and operate these monstrosities, use some really big arrays to reach their intended listeners, whether omnidirectionally or by a specific beam route. These huge antennas can handle awesome amounts of power, and the gain arrays produce some really impressive increases in db. Remember this, next time you grumble about trying to dig Radio Lower Slobbovia out of the noise, and be grateful they're running something more robust than 100 watts to a dipole. And, do check with the local zoning board before you embark on building your own curtain array in the back yard, won't you? Happy operating!



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# Doug Smith's AM Revitalization Plan

Last September, FCC Commissioner Ajit Pai created quite a stir by launching an AM Revitalization Initiative. In this column, you've read quite a bit about the Commissioner's ideas. You've read some of the responses, the ideas others have thrown into the ring. This month, I'll pass along my own AM revitalization plan.

One suggestion on the table is the forced conversion of analog AM to all-digital mode. Last time, you read that the all-digital test in Charlotte worked pretty well. All-digital doesn't improve coverage over analog, but it doesn't reduce coverage either. In areas where the signal is received, the quality of the digital signal is much improved over analog.

There a fairly obvious problem with converting AM to an all-digital band. Most listeners don't have HD radios and cannot receive digital stations.

While HD deployment is still slow, it is appearing in more cars. It's now standard in all BMW, Mercedes, Volvo, and Mini cars, and in certain models from eleven other manufacturers. It's available as an option in all Ford, Kia, and Lincoln vehicles. You might well argue that these represent a small fraction of cars currently on the road, but that fraction is only going to increase.

Note the brands in which HD is already standard. Obviously, these are vehicles which appeal to the well-to-do motorist. These are the same motorists who are best able to afford the products and services being advertised on radio. To put it a bit more bluntly, maybe stations don't really care about losing poorer listeners?

There is another significant problem with a forced conversion to all-digital mode. Many (most?) smaller stations simply cannot afford to convert to digital. The IBOC equipment represents an investment of tens of thousands of dollars. There are also fees to be paid to Ibiquity. Often, a smaller station will use an older transmitter which cannot be modified for HD. Transmitter replacement will be required. Stations which use directional antennas may require expensive modifications to the antenna system.

A mandatory conversion to digital will cost more than many stations can afford. One might presume these stations will simply turn in their licenses and go off the air. In my opinion, this would be a good thing for AM radio. As I've said before, the AM band contains far too many stations. Anything that removes some of these stations from the dial will make things better for the survivors.

So, the first step in my AM revitalization plan is to require AM stations to switch to all-digital HD.

Another frequent proposal is to relax restrictions on FM translators, allowing more AM stations to become FM stations as well. Many listeners never even try AM. With severe noise, highly-directional antennas, and low nighttime power levels on AM, often a small FM translator can cover more ground. AM stations wishing to acquire FM translators have been stopped by bureaucratic difficulty. Some AM operators also feel the need to provide for LPFM unduly limits their ability to add FM operation.

I'm wary of limiting LPFM to allow for more FM translators. Giving a small locally-programmed AM station an FM translator signal may allow that local programming to compete and succeed. Or, it may allow the local operator to switch to a satellite-fed music format and program exactly the same thing any number of larger stations are programming. We shouldn't prevent local organizations from launching LPFMs just to prop up an AM that may choose to air the same thing that's all over the rest of the dial.

However, in many places LPFM and translators are not mutually-exclusive.

My improvement plan would add two steps to make translators more available to stations that truly need them. First, I would reverse the restriction on "non-fill-in" translators. Under existing rules, if you wish to operate a translator that extends a station's coverage (instead of filling in gaps within that coverage), the translator must either receive the main station over-the-air, or it must be non-commercial and commonly owned with the station it rebroadcasts.

I propose to require it NOT be commonly owned with the station it rebroadcasts. If the people of Dodgeville, Wisconsin want to hear satellite-fed programming from Idaho, they can raise the money to build a translator. If they'd rather vote with their wallets for a local LPFM, the Idaho organization shouldn't be able to override that decision.

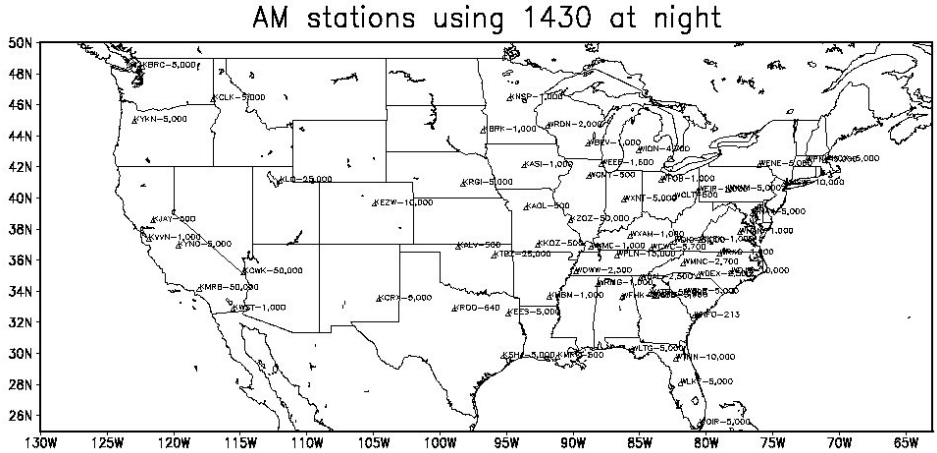
Last month, you read about an AM station in western Wisconsin which has asked the FCC to relax some restrictions so they can better cover their community. You also read that this station once had a full FM signal. A previous owner sold the FM signal and took the cash. While that's not the fault of WRDN's current owners, it's also not right to harm other AM operators in order to redress the previous owners' financial decision.

I propose that, in allowing AM stations to acquire FM translators, first priority should go to AM stations which have never had an FM signal.

While we're talking about FM translators for AM stations, let's look at another opportunity to clear out the AM dial. In many cases, when an AM station acquires a translator, the translator becomes the primary focus of the operation. The AM frequency is never mentioned. "AM 1260" becomes "101.5 The One". Management doesn't really expect anyone to listen to the AM frequency. It exists only to satisfy the FCC requirement that a translator have a primary station.

We should allow AM stations with translators to shut down the AM primary station under certain circumstances. We should limit this opportunity to operators who've made a good-faith effort to operate the AM station. Eligibility should be limited to AM stations which have observed the minimum operating schedule in the FCC regulations for at least the last two years. The AM license would remain "on the books", as its theoretical coverage area would establish the area in which the translators would be allowed to operate. However, the licensee would not be required to actually operate that AM signal.

These are several steps we could take to "thin out the herd," to reduce the ruinous levels of interference on the AM band. We've got a long way to go to bring crowding down to the level where most stations cover an economically sustainable market. In my opinion, the band holds roughly *five times* as many stations as it can reasonably sustain. That's my opinion; what's yours?




*U.S. AM stations on 1430 kHz. (Courtesy: Doug Smith, from FCC records)*

## More notes about KBRT-740

In July, Kriss Larson asked some questions about KBRT-740 Avalon, California and its move to the mainland. How does it expect to co-exist with KCBS on the same frequency up in San Francisco? Doesn't KCBS grind KBRT's low-power nighttime signal into oblivion? Why did the FCC permit a second station on 740 in California?

We've now heard from someone with firsthand knowledge on this subject. Cris Alexander is Director of Engineering for Crawford Broadcasting (see this month's Letters column). Crawford owns KBRT. Crawford's engineering is well-known in the business, both for doing excellent engineering work and for sharing information in a very interesting newsletter (see the web links).

Cris confirms that, when KBRT was transmitting from Catalina Island, they did not use their authorized 113 watts of night power. The 113-watt signal wouldn't have reached the mainland – indeed, it wouldn't have reached Avalon, the only town on the island. From the new site and antenna system on the mainland, the story is very different. Cris says KBRT now has a nighttime audience in much of eastern Orange County as well as several large communities in Riverside County and adjoining areas.

Cris also corrects me on the situation regarding KCBS's interference-protected area. Class B stations like KCBS are protected to the "25% exclusion root sum square of the interfering signals". To over-simplify a bit, KBRT is not allowed to interfere with KCBS in any location where KCBS wasn't already suffering interference from someone else. (AM engineering isn't simple!)

In any case, that interference-protected area does not come within 300 miles of Los Angeles. So, as far as the FCC is concerned, KCBS has no coverage in any area where KBRT's signal reaches.

## How many are there?

The FCC has released their quarterly Broadcast Station Totals. This report shows, in varying levels of detail, how many broadcast stations of each type existed since June of 1943.

AM radio continues its slow slide. Two more stations have been lost since March. Roughly 1% of AM stations have gone permanently silent in the last five years. We're down to 4,734 AM stations, after peaking at just under 5,000 stations in the early 1990s. Unfortunately, at this rate it will nearly 400 years to bring AM crowding down to a sustainable point. I don't think the AM band will last that long.

The real action is with non-commercial FM stations. The FCC continues to process applications filed in a June 2011 filing window. We're up to nearly 4,000 non-commercial stations, an increase of more than a third since 2008. Another class of non-commercial stations hasn't done quite so well; there are 6% fewer LPFMs than there were five years ago. This number will turn rapidly in the other direction next year!

We've spent a lot of ink in this column discussing FM translators recently. FM translators are down about 1% in the last five years. The FCC has had translator applications on hold for some time. These are now being processed again. Expect this number to grow considerably over the next year.

Now, there's television. Regular TV is up about 1% over the last five years, with nearly 1,800 stations. Low-power stations have not done so well. 13% of local low-power TV stations have left the air since 2008.

"Class A" TV stations are technically identical to "low-power" stations but receive additional interference protection in return for stricter regulation. More than 21% of these stations have disappeared in the last five years. This is in large part due to an FCC effort to reclassify Class A stations as "regular" low-power stations. Class A stations cannot be forced off the air by the upcoming reallocation of TV channels for wireless broadband. The Commission is trying to maximize the reassignable spectrum. Getting rid of Class A stations is certainly one way of accomplishing this. The Commission has found many Class A stations have not complied with some of the stricter, non-technical regulations that distinguish them from regular stations.

The oldest low-power TV service has seen small growth over the last five years. There are 1% more TV translators than there were five years ago. TV translators are stations which simply rebroadcast the signals of some other station. I strongly suspect this is "paper growth". Many translators hold two licenses; one for their original analog operation, and a separate license for their digital signal. These analog licenses will disappear in two years, if not sooner.

## STATION REPORT:

### NEW STATIONS:

Applications filed for new stations:
Montreal, Quebec 1610 1,000/1,000; ethnic

Permits granted for new stations:
Anchorage, Alaska 1310 10,000/8,100 ND
Red Oak, North Carolina 1190 9,200/1,000 DA-N
Montreal, Quebec 850 50,000/22,000 DA-2; all-sports, in French

Applications for new stations dismissed:
Mililani Town, Hawaii 1230

### DELETIONS:

Stations deleted:
Williams Lake, B.C. 860 CBRL going to 92.1 FM
Belgrade, Montana 640 KGVW

### TECHNICAL CHANGES:

Applications filed for frequency changes:
Tampa, Florida 1100 WTIS
from 1110, 10,000/150 DA-2

Stations moved to new frequencies:
Belen, New Mexico 840 KARS
from 860, 1,800/30 ND

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://www.beaglebass.com/dx/dx_china.htm Chris Kadlec's page on FM DX from Korea
http://www.fcc.gov/encyclopedia/broadcast-radio-am-and-fm-application-status-lists Various FCC station lists, including the quarterly "census" of stations
http://www.crawfordbroadcasting.com/engineering.htm Crawford Broadcasting's engineering page, including links to the KBRT-740 project

# CC Radio-SW AM/FM/Shortwave Portable Radio

By Larry Van Horn N5FPW (Photos courtesy of the manufacturer)

If you are into radios, you probably have heard of the C.Crane Company, based in Fortuna, California. Founded in 1976 by Bob and Susan Crane, the company was initially a furniture design and manufacturing business and only switched to being an electronics distributor in 1983.

From those humble beginnings, with their first electronics product, the "Select-A-Tenna," the company eventually expanded into the portable AM/FM marketplace, selling popular radios such as the GE Superradio. Eventually, C. Crane began to produce its own radios in collaboration with Sangean and other companies.

Their latest portable continues a long tradition of excellent AM/FM portable radios and now includes a unit that covers the shortwave radio spectrum.

The CCRadio-SW AM/FM/Shortwave Radio is one of the better portable radios to come out of Fortuna in a long time. It is a U.S. consumer version of the Redsun RP2100 AM/FM/shortwave portable.

## What's in the Box?

The unit we received was well packaged and was received undamaged in shipment. Inside the box we found the following:

- CC Radio-SW
- AC Power Adapter
- Two PAL Antenna Connectors
- Printed Instruction Manual
- One Year Limited Warranty

Optional accessories for this radio include the CCRadio-SW carrying case ($30) and reel antenna ($20). C.Crane recently announced that the acrylic radio stand accessory is sold out and is no longer being included free with the purchase of this radio.

The manual is well written, clear and straightforward in the use of this radio. This radio is very easy to use so I have not needed to refer at all to the manual for normal operations.

And, that's one of the things that really strikes me about the CCRadio-SW; its sheer ease of use. The design is simple, ergonomic and effective. It's very well built and the hard plastic carrying handle gives the radio a solid feel.

The front panel contains the large tuning knob; to its left are the mode and band selector knobs with the volume control at the bottom. The smaller knobs at the lower left are RF gain, treble and bass. There's a one-eighth inch stereo mini-jack for headphones in the lower left front corner.

At the top right of the tuning knob are three buttons for Power/Sleep, Local/World Time and Lock, which disables all functions except the light switch. You can display world or local time momentarily while the radio is on.

Above the tuning knob are three push-buttons: Hold (a tuning lock) as well as slow and fast tuning. To the right, a group of eight push-buttons control down and up tuning and seek (both of those buttons double as minute/hour controls by a pressing and holding for the second function). There are also memory set, alarm, timers A and B and SW bandswitch buttons.

The back panel contains two PAL connectors: One is for an external FM/SW antenna input and the other is an AM IF output jack for connection to an outboard SSB or DRM decoder. There are also two spring-loaded connectors to aid in hooking up an external medium wave broadcast band (AM) antenna. Inside the battery compartment you can use two different sized batteries to power this radio; it has a 9/10 kHz MW step selection switch as well.

On the top panel of the radio there is a light switch (which can turn the lights on for eight seconds or lock it on) and a snooze bar (pressing it with the radio off defeats the key beep feature).

The left side of the radio contains two RCA stereo line out jacks, a AA or D battery selector switch, and DC/AC power input jacks.

The right side contains switches for button lights, DX/Local and internal/external antennas. The button light switch illuminates the push buttons on the front of the radio when the dial light is on.

The unit has a built-in Twin Coil Ferrite® AM Antenna that provides excellent AM reception in the same class as C.Crane's legendary CCRadio portables.

The CCRadio-SW comes with a large, easy-to-read LCD display that can be illuminated, but that illumination is not the best I have seen. More on this topic later.


## A Lot of Features for the Money

Here are some of the outstanding features found on the CCRadio-SW radio: a real RF gain control (not just a selectable attenuation switch), bandwidth control, bass and treble controls, fast and slow tuning buttons, 50 memory presets, lighted buttons, clock radio with snooze alarm, stereo line output and headphone jack, IF output for input to a computer. This radio runs on four D-batteries or four backup AA-batteries (simultaneously if you wish, but the unit will not run for long on the AA batteries). There is a built-in charging circuit that will recharge optional NiMh batteries inside the radio, saving you both time and money. Batteries are not included.

## Performance

If you're not as concerned about portability, the C.Crane CCRadio-SW is an excellent value for performance. Think of the CCRadio-SW as a medium size (11.25-inches wide x 7.25-inches high x 3.5-inches deep) portable or table radio. You won't be stashing this one in a carry on bag, but I do throw it in my regular luggage when I take a trip.

What makes this radio stand out from its peers? It has truly exceptional audio fidelity. The large five inch built-in speaker utilizes separate treble and bass controls. The sound is rich and warm and very 'listenable' for extended periods and this radio's audio will fill a large room.

No, it obviously does not have stereo speakers (you can listen to stereo through headphones or line-out), but it is one of the best sounding radios I have heard in this price category. On FM, it is easily comparable to the Bose Wave Radio that a friend of mine has at his home. The speaker and audio quality are really that good.

This unit has excellent AM reception that is almost equal to the legendary Panasonic RF-2200 and Sony 2010 portables, both of which I also own. This radio has nearly the best, if not the best AM reception (internal antenna) of any current production portable radio selling for less than $300 in the marketplace.

The FM band reception is nearly the best I've ever experienced in almost any portable I have tested. It is actually better than my Sony 2010 or an older Panasonic portable that I have been using for FM DXing off the telescoping whip antenna. With strong FM reception, it does not even need the telescopic whip fully extended to grab fringe area stations. You most likely will not even have to raise the whip for stations located within 50 miles of your location depending on the FM station power output.

Shortwave sensitivity is very good. In fact,

it is much better than some of the Sangean portables I have tested or owned and even somewhat better than my venerable Sony 2010 portable.

## ❖ Negatives?

You know I won't let any review here in the *MT First Look* columns get through without at least a few negatives. Surprisingly, given that this radio is a portable and sells for around $140, I didn't have many negatives.

The CCRadio-SW does not have direct keying to enter frequencies. However, the tuning/seek and SW band buttons helped speed things up when changing frequencies/bands.

This radio delivers stereo FM to the headphone and line out jacks, but be sure to keep the FM stereo/mono switch in mono at all times when using the radio with its built-in speaker. If you are listening to a stereo signal via the speaker, and the stereo position is selected, only one channel of audio will be heard. I never figured out which channel left or right, but one was definitely missing.

Quite frankly the LCD illumination on this radio is dim. This appears to be because only the left side of the unit we tested appeared to have light coming from it. It is good enough to let you operate the radio in the dark, but it's difficult to tell if the lights are on under typical room lighting. Other portables I have tested fared better in the regard. I do like the lighted buttons on this unit.

Speaking of buttons, the push buttons on the unit I tested require solid pushes. These are click style buttons, but the click does not necessarily indicate that the switch has been activated. You need to hold these buttons down briefly to get the function to activate. It's not a problem once you get used to it, but quick taps on the switches will be ignored.

This radio does not have single sideband built in. However, it does have impressive array of external connections, including an IF out connection, which (with an IF converter and some free software) will allow you to interpret SSB and an array of digital signals including DRM (Digital Radio Mondial).

One really strange quirk I found was with the battery level indication. The level indication appears to be rather conservative. It is a three-segment meter, but the third segment drops out rather quickly after new batteries are installed. Strangely, at times it will come back to three full bars when certain stations at certain signal levels are received. It is as though it is measuring battery current flow under load instead of battery power left in the tank, so to speak. Again, this is not a big problem nor a show stopper.

## ❖ Bottom Line

In conclusion, if you want a top-notch performing portable radio–and by top notch I mean powerful audio, great RF sensitivity on all bands, two well-chosen bandwidths for AM and SW, a convenient handle, many power options, a feel of solidity and quality and fairly simple operation–then this is it. If you are looking to purchase another portable and you already have a Grundig, or similar brand, you may want to

give the CC Radio-SW a try.

This phenomenal radio offers the best combination of sensitivity, selectivity and audio performance ever for any radio of this size and price range. Shortwave is excellent right off the whip antenna. The five-inch speaker is accurate, pleasant and reproduces deeper bass than any portable of similar size.

This radio offers absolutely superb overall performance at a $140 price tag. I highly recommend purchasing the CCRadio-SW directly from C.Crane or from Grove Enterprises instead of a third party in case there are any warranty return issues after purchase.

### CCRadio-SW AM/FM/Shortwave Radio Specifications

Frequency Coverage
AM broadcast band 520 - 1710 kHz (using 10-kHz steps) or 522 - 1620 kHz (using 9-kHz steps); FM broadcast band 87.0 - 108.0 MHz; and shortwave – SW1 1.711 to 10.010 MHz; SW2 9.990 - 20.010 MHz; SW3 19.990 - 29.999 MHz
Memory presets: 50 Total (10 per band)
Controls: RF Gain, bandwidth, bass and treble, fast/slow tuning
Rotary tuning knob resolution: AM 1 kHz, 9 kHz or 10 kHz; FM 10 kHz or 100 kHz; SW 1 kHz or 5 kHz
Tuning steps: AM 10 kHz or 9 kHz steps; FM 100 kHz steps and SW 5 kHz steps
AM Dual Conversion: 55.845 MHz 1st IF; 455 kHz 2nd IF
AM IF Output: For input into a computer for decoding DRM, SSTV, SSB, CW and more.
Sensitivity: AM 0.2 mV/m; FM > 5 uV and SW > 20 uV
Selectivity (Wide): Wide > 40 db (100x) and Narrow > 60 db (1000x)
AM Antenna: Internal ferrite bar 6.3-inches long with Twin Coil Ferrite® technology
FM/SW Antenna: Telescopic whip antenna
External antenna terminals: AM Spring loaded wire terminals and an FM/SW PAL connector
Line Out Jack: Dual RCA
FM Stereo/Mono Switch Yes
Earphone Jack: 1/8-inch (3.5mm) 32 ohm stereo jack
Audio Output: 2.5 Watts
Speaker: 5-inch, 8 ohms
Large, easy-to-read lighted digital LCD display
Clock12/24 hour modes
Alarm: Dual (Buzzer or Radio) with five minute snooze and a sleep timer with nine operational settings: 90, 60, 45, 30, 15, 10, 5, 1 (minutes) and "ON" (continuous).
Batteries: Four AA or D size and the unit has a bilt-in charging circuit that will recharge optional NiMh batteries. (No batteries are included)
Input power: AC adapter 9-VDC 500 mA tip negative
Weight: 4.2 lbs.
Dimensions: 11.25-inches wide by 7.25-inches high (9-inches high with handle) by 3.5-inches deep
Warranty: One year limited warranty
Note: Specifications are subject to change without notice



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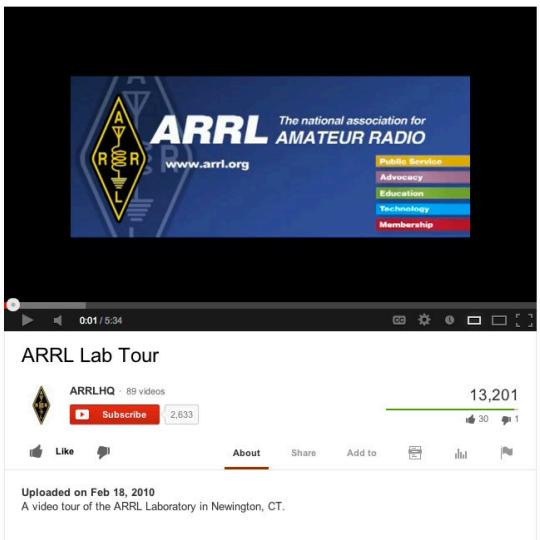
# Radio's Best TV Channel: YouTube!

One of the most interesting ways the Internet has changed the world as we know it is through the rapid expansion of a single Web site: YouTube. I remember when YouTube first showed up on the Internet, it was a clever way to find music videos or humorous clips of cats. In the past few years, it has really morphed into more of a resource than a novelty.

From the standpoint of the radio hobby, YouTube offers a treasure trove of information, from equipment reviews, how-to videos that show step-by-step instructions for making repairs or building antennas, air-checks of DX catches, interviews with other hobbyists and leaders of the hobby, and that is just a sampling.

YouTube has always been one of those sites you can get 'lost' in for hours by clicking from video to video. DXers will find they have similar temptations available to them as well.

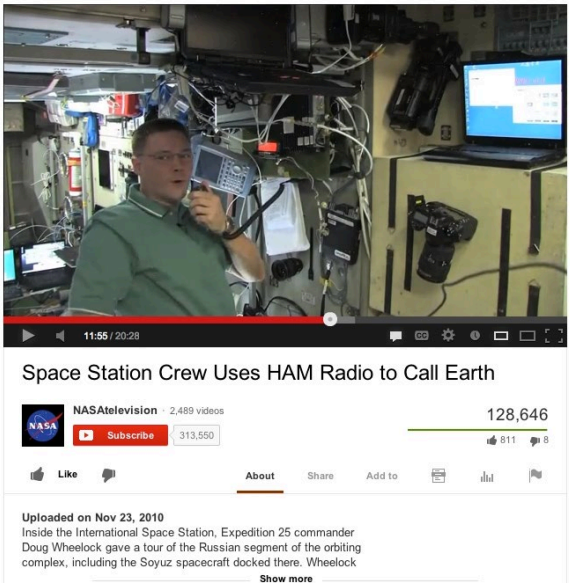
One late evening, while waiting on my fiancé to come home from work, I started my YouTube adventure by searching for videos to help me study for my Extra class amateur radio exam. Before I knew it, I was watching videos of people setting up DXpedition sites in the South Pacific. What seemed like a few minutes later (but was more like an hour or so) I was listening to trans-Atlantic mediumwave catches from people using their software defined radios and putting videos of the air-checks up on YouTube.




There is helpful information to be found here too. I was looking for information on the ICOM IC-746 prior to buying one and there were several YouTube videos to be found with people doing reviews and showing the various bells and whistles of what eventually became my new transceiver. A large part of my decision-making process was solved by the various videos I was able to catch on YouTube.

When trying to decide recently on an antenna solution for my 6-meter operations, I was able to find a plethora of designs on the Internet for a nice 4-element Yagi. At the same time, I was able to find some helpful YouTube videos that showed not only the fully constructed antenna in action and some actual operations with it, but also some construction how-to videos to help me decide if the project was something I wanted to try to tackle.

For my fellow amateur radio operators out there, have you ever worked a contest station and wondered what their setup looked like? Try searching the call sign of the station and more than likely you will find a YouTube video that shows their setup at most of the contests they work. A simple search for "ARRL Field Day 2013" yielded a number of club stations and videos of them in action during this past June's Field Day festivities.




Hams aren't the only ones with interesting videos to be found. When I was researching antenna options for my mediumwave DX, I found a number of videos on some of the options I was exploring that helped me decide which ones could work with the layout of land I have to work with.

And, for DXers, most of the stations that you have an interest in hearing will often have a dedicated YouTube channel, or at least uploaded videos of their studios and on-air personalities. You get to see behind the microphone in a way that was never really possible in the days before YouTube.

One of the aspects of searching for DX-related videos on YouTube that I wasn't expecting to find was some of the tips and tricks that other DXers shared in their videos. From shack layouts, homemade solutions to common shack problems (which reminds me, I need to upload my video of my curtain rod bracket holder for my wireless keyboard), to DX techniques, my knowledge base and skills have grown as a result of the DX community uploading their videos to YouTube.

So next time you are making a purchase decision, looking for some DIY tips or advice, or just want to see other DXers in action, make a trip over to YouTube. Just be prepared to end up like Gilligan and have your "3-hour tour" end up lasting much, much longer.

## ❖ Next-Gen Gaming Consoles: What's in it for Streaming?

Among the more popular devices used for streaming of video and Internet radio are gaming consoles such as PlayStation and Xbox. Both Sony and Microsoft are ready to launch their next generation of consoles with the PlayStation 4 and Xbox One. Is the cost of the upgrade worth it for streaming enthusiasts? It doesn't appear to be so, at least not in the immediate future. All of the streaming applications such as Pandora and Netflix are still going to be available to users of the "old" Xbox 360 and PlayStation 3 devices. If you are using a gaming console for streaming right now, that won't change just because the new units are on the market. You will still need an Xbox Live Gold membership to use apps such as Netflix and others on the Xbox, regardless of whether you are using the Xbox 360 or Xbox One.

There have been a number of privacy and security concerns for both consoles. PlayStation famously was the victim of a hacker attack a few years ago, in which sensitive information of users was compromised. Xbox users have been nervous over Microsoft's plans for their Xbox One console to be 'always connected' and exactly what information about gaming and app use will be shared with Microsoft and others. Microsoft has backed off a bit with their push for the 'always connected' console, but as of press time, it doesn't appear to have been scrapped completely.

As a user of an Xbox 360, I really don't see a need from a streaming standpoint to run out and buy one of the new consoles. Microsoft will probably do to the 360 what they did to the original Xbox and drop support for it, forcing users to upgrade to the new technology. However, in the immediate future, for both the PlayStation and Xbox consoles, there doesn't seem to be a need to run out and get the latest devices just to listen to Internet radio or watch a movie on Crackle.

# What's NEW

**Tell them you saw it in Monitoring Times**

*Larry Van Horn, New Products Editor*

## Alinco DX-SR9T SDR Transceiver

The DX-SR9T, a new desktop transceiver designed to be affordable without compromising performance, features three ceramic filters with narrow modes and optional mechanical filter insertion capabilities; excellent 1-ppm stability and an internal voice/data VOX circuit to make data-communication modes such as SSTV and PSK31 a snap.

The DX-SR9T is a hybrid, stand-alone analog and digital SDR transceiver, featuring simple operating commands, straightforward and logical key layout.

With front-panel separation, a large, bright LCD display, frontfacing speaker, auto-keyer and many other desirable features, the DX-SR9T will appeal to the beginner in the world of shortwave and to the most experienced amateur radio operators.

Here are just some of the features for this radio:

- General coverage receive from 150 kHz to 30 MHz in AM/SSB/CW/FM and SDR modes.
- Internal VOX, which eliminates optional interface box for your computer connection.
- Rugged, die-cast chassis and huge LCD display.
- Front speaker and plenty of audio output.
- Front and rear jacks for your computer interface.
- Narrow ceramic filters (AM 2.4-kHz/SSB 1-kHz), 0.5-kHz CW audio-filtering and space for optional mechanical filter insertion.
- Dual VFOs, three banks/600 memory channels, two sets of programmed search pairs and a variety of scanning modes.
- IF shift, RIT, noise-blanker, four level RF preamp /attenuator, auto-power-off, sleep timer, dial/key locks, indicator illumination and more.
- Computer utility software makes it easy to manage settings and edit memories.

The SDR system in the DX-SR9T consists of an I/Q signal output and a mixer circuit. It requires a high quality sound device (internal or USB-interface) and PC specs as follows (the higher the PC spec, the better the SDR performance): Windows Vista or 7 OS; Intel Core i5 2.4 GHz equivalent or faster CPU; 2-GByte or more memory; 1024x768pixel, 32 bit or more display resolution/color; 48-kHz 16 bit sampling sound device capable of stereo record/replay; center wheel and high-speed scroll feature mouse; and a pair of commonly available audio cables with 3.5 mm stereo-plug PC speaker, PC microphone or headset (with microphone).


Alinco recommends that, before you purchase the DX-SR9T, you should visit **www.alinco.com** to download the KG-TRX SDR software. Read the included instruction manual and start the program to understand how it works with your PC system.

The DX-SR9T has not been type-accepted by the FCC as of press time, so pricing information is currently not available.

## MFJ-266C Antenna Analyzer


The MFJ-266C digital antenna analyzer covers HF, VHF, plus UHF amateur and commercial frequencies with digital precision. It also displays SWR, complex impedance, and impedance magnitude simultaneously – all on the same LCD screen. Use it to measure capacitance, inductance, field strength, frequency and generate test signals. You can also fine tune stubs, analyze coax, test baluns and RF transformers, as well as perform many other important RF-related tasks around the shack or on the road. Not only is this analyzer easy-to-use, but it fits comfortably in one hand for on-the-fly measurements on the bench or in the field.

The MFJ-266C covers frequencies from 160 through 6 Meters, the FM broadcast band, air band, 2 Meters, 220 MHz, 70 cm, plus VHF/UHF commercial 2-way frequencies (Band A 1.5 to 2.7 MHz; Band B 2.5 to 4.8 MHz; Band C 4.6 to 9.6 MHz; Band D 8.5 to 18.7 MHz; Band E 17.3 to 39 MHz; Band F 38.7 to 65 MHz; Band V 85 to 185 MHz and Band U 300-490 MHz).

The velvet-smooth 10:1 vernier drive and solid state varicap makes fine tuning easy and a built-in dial lock prevents accidental detuning while making measurements. A switched, backlit LCD screen is easy-to-read in any light.

In SWR Mode, MFJ-266C reads SWR 1:1 to 9.9:1, impedance magnitude 10-500 Ohms and complex impedance (resistance and reactance). Best of all, it displays all three parameters simultaneously and operating frequency with one quick glance. No other low-cost handheld analyzer can do this. (Note: Z-mag and R+jX are not displayed on UHF).

The MFJ-266C is like owning several pieces of test equipment. You get a powerful wide-range signal source, inductance/capacitance meter, network analyzer, RF field-strength meter and a 500-MHz frequency counter all in one small package.

MFJ-266C uses eight internal AA alkaline batteries or optional 12 VDC/110 VAC adapter with MFJ-1312D ($16). It has a built-in Li-ion battery charger. You may also use the optional MFJ-18650 ($9) a powerful 3.7V, 3000 mAh Li-on battery. MFJ-266C is compact (3.75-inch wide, by 6.5-inches high, by 2.75-inches deep) and weighs just 1.32 pounds. It draws 30-mA in counter mode and 140-mA in analyzer mode and includes an N to SO-239 adaptor. The MFJ-266C sells for $360 and is available from various amateur radio suppliers.

## MFJ Ultrasonic Receiver Pinpoints Power Line Noise

HF and VHF operation can be greatly affected by band noise which makes it hard to hear the weaker stations and adds to ear fatigue. Many times the noise is coming just outside your doorway, from the power lines.

Power companies are usually very willing to help out with noise issues, but not all companies have the necessary equipment or trained personnel to properly locate nearby noise sources.

MFJ-5008 aids in locating the noise sources generated by corona discharge and arcing components on the power system using a receiver tuned to the ultrasonic range of 40 kHz.

MFJ uses an 18-inch diameter plastic dish giving a narrow beamwidth to pinpoint noise sources to less than 12 inches at 50 feet. The dish also has a short focal point making the overall front to back depth just seven inches. With the handle mounted close to the dish, the center of gravity is closer to the handle reducing fatigue on the hand from the weight of the dish pulling down in front.

An ultrasonic transducer mounted inside a sturdy metal support helps reduce dish bending and warping. Targeting holes built into the transducer mount and on the dish are aligned with the beam of the dish allowing you to pinpoint the noise sources on the pole.

Receiving electronics are mounted on the handle for convenient operation. MFJ-5008 operates on a standard 9-Volt battery (not included). The gain of the receiver is such that you can receive noise generated from power line sources from several hundred feet away. A 3.5 mm headphone jack lets you use any stereo or mono headphones.

Not only can you use the MFJ-5008 to find power line noise sources, you can also listen to a wide range of nature sounds. In the ultrasonic range bats, birds, and insects can easily be heard. MFJ-5008 can give you a whole new perspective on the wildlife around you. It can also help locate mechanical noise sources in the ultrasonic range. MFJ-5008 measures 20.5-inches wide by 19.5-inches high by 7-inches deep and weighs just 2.5 pounds.

The MFJ-5008 sells for $180 and you can get more details on the company website at **www.mfjenterprises.com**.

## AOR AR6000 Professional Receiver

The AR6000 delivers continuous tuning from 40-kHz to 6-GHz in a wide variety of modes for professional monitoring performance that's nothing short of amazing in terms of accuracy, sensitivity and speed. Standard modes include AM, FM, WFM, FM Stereo, USB, LSB and CW. An optional module can add the capability to receive APCO 25 digital communications plus an optional I/Q output can be added to capture up to one megahertz of bandwidth onto a storage device for later listening or signal analysis.

Designed for the monitoring or technical service professional, there are no interruptions in the AR6000's tuning range. With exceptional tuning accuracy and sensitivity throughout its tuning range, the AR6000 begins at the floor of the radio spectrum and continues up through microwave frequencies so it can be used for land-based or satellite communications. It works as a measuring receiver for those seeking a reliable frequency and signal strength standard. To support its broad spectrum, the AR6000 has two antenna ports, with the added capability of an optional remote antenna selector from the front panel of the receiver.

With its popular analog signal strength meter and large easy-to-read digital spectrum display, the AR6000 is destined to become the new choice of federal, state and local law enforcement agencies, the military, emergency managers, diplomatic service, lab technicians, news-gathering operations and security professionals.

The AR6000 professional grade receiver feature set includes:

- 40 kHz to 6 GHz frequency 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 to 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 and 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

Complete specifications can be found at **http://aorusa.com/receivers/ar6000.html**. The AOR AR6000 is available in the U.S. from Grove Enterprises only to qualified purchasers with documentation.

## New DSP Noise-Cancelling Base Station Speaker from bhi Ltd

The new bhi "DESKTOP" DSP noise-cancelling base station speaker has been designed to clean up noisy radio signals and will work with most radios and receivers, including SDR radios and other receivers with stereo line out, giving a new listening experience. The new rotary controls make it very easy to use and set up for your own operating conditions.

The "DESKTOP" noise-cancelling speaker has a 4-inch bass driver and a 1-inch tweeter with a built-in 10-Watt audio amplifier. The speaker functions are microprocessor controlled with features that include: Separate rotary volume and filter level controls, stereo line-in and speaker level audio input sockets, 3.5 mm headphone socket, LED and audio indication of filter function, audio level overload feature, sleep mode, noise reduction 9 to 35 dB, tone reduction 4 – 65 dB, 12 to 18V DC (2.5A peak). Size: 8-inches high by 6-inches wide by 6.25-inches deep.

For more info, visit **www.bhi-ltd.com**

## Shared Apex Loop Array™

Array Solutions, from Sunnyvale, Texas, has introduced a new compact wideband receiving antenna for MW and HF called the Shared Apex Loop Array™.

Now you have a new interference fighting weapon in your receiving arsenal. The Shared Apex Loop Array™ is a revolutionary receiving antenna that will change the way that you listen to the radio. The patented design provides performance over a range of frequencies that will please both the rag-chewer and DXer alike.

The antenna is a true time-delay array with four identical wire loops supported by a single non-conductive mast. Signals from each loop are transferred through a ferrite coupler to a short, balanced-line that connects to the switch/combiner/amp enclosure mounted at the base of the antenna. Within this enclosure, signals from each loop are routed either directly to a combiner or through a delay line and then to the combiner, where they are amplified by a dual stage balanced broadband amplifier and sent out to the feedline to the controller located in the shack. The controller connects directly to your receiver, and sends power and control signals over the feedline to the antenna.

This unique antenna features:

- Wide frequency range and compact size. This antenna is especially effective at reducing local interference.
- Provides eight instantly selectable directions in single or unidirectional mode.
- Provides four instantly selectable directions in bi-directional mode.
- Only one delay line
- Signals, power, and direction commands are carried by a single coax cable from the controller to the antenna.
- Pattern and sensitivity is adjustable by positioning loop couplers and selecting delay line length.
- No termination resistors or RF ground is required.
- Unique patented design (manufactured and marketed under U.S. patent number 8,350,776 and patent pending).

For more information contact Array Solutions, 2611 North Beltline Rd Suite 109, Sunnyvale, Texas 75182, Phone (214) 954-7140 or visit their website at **www.arraysolutions.com**.

Books and equipment for announcement or review should be sent to What's New, c/o Monitoring Times, 7540 Highway 64 West, Brasstown, NC 28902. Press releases may be faxed to 828-837-2216 or emailed to Larry Van Horn, *larryvanhorn@monitoringtimes.com*.

When ordering or inquiring about the products mentioned in this column, be sure to tell them that you saw it in the pages of *Monitoring Times* magazine.

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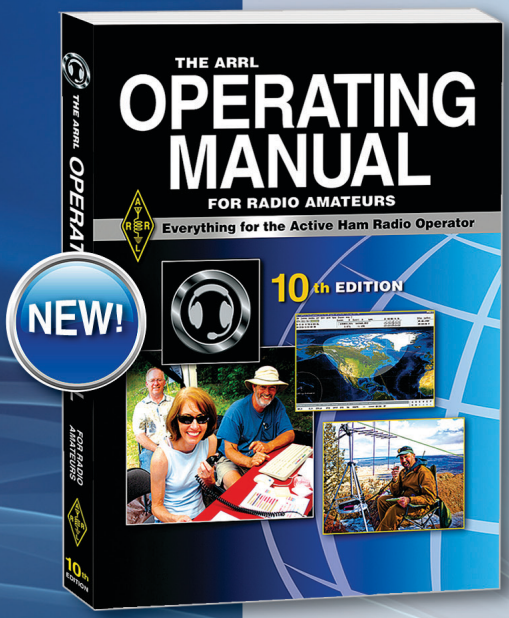


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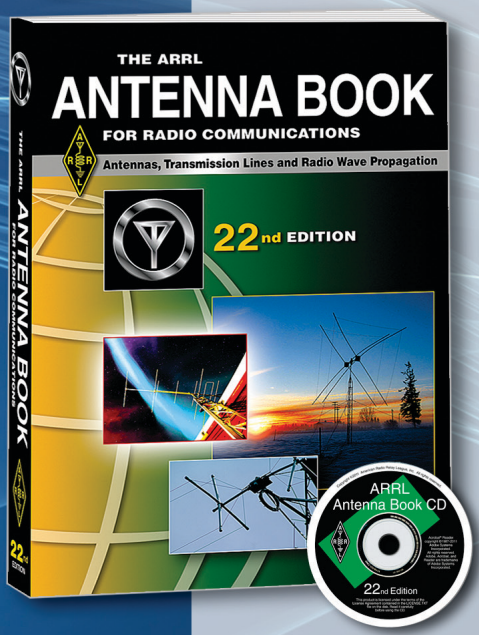


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*System Requirements: Windows® 7, Windows Vista®, or Windows® XP, as well as Macintosh® systems, using Adobe® Acrobat® Reader® software. The Acrobat Reader is a free download at www.adobe.com. PDF files are Linux readable. The ARRL Antenna Book utility programs are Windows® compatible, only. Some utilities have additional limitations and may not be compatible with 64-bit operating systems.

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