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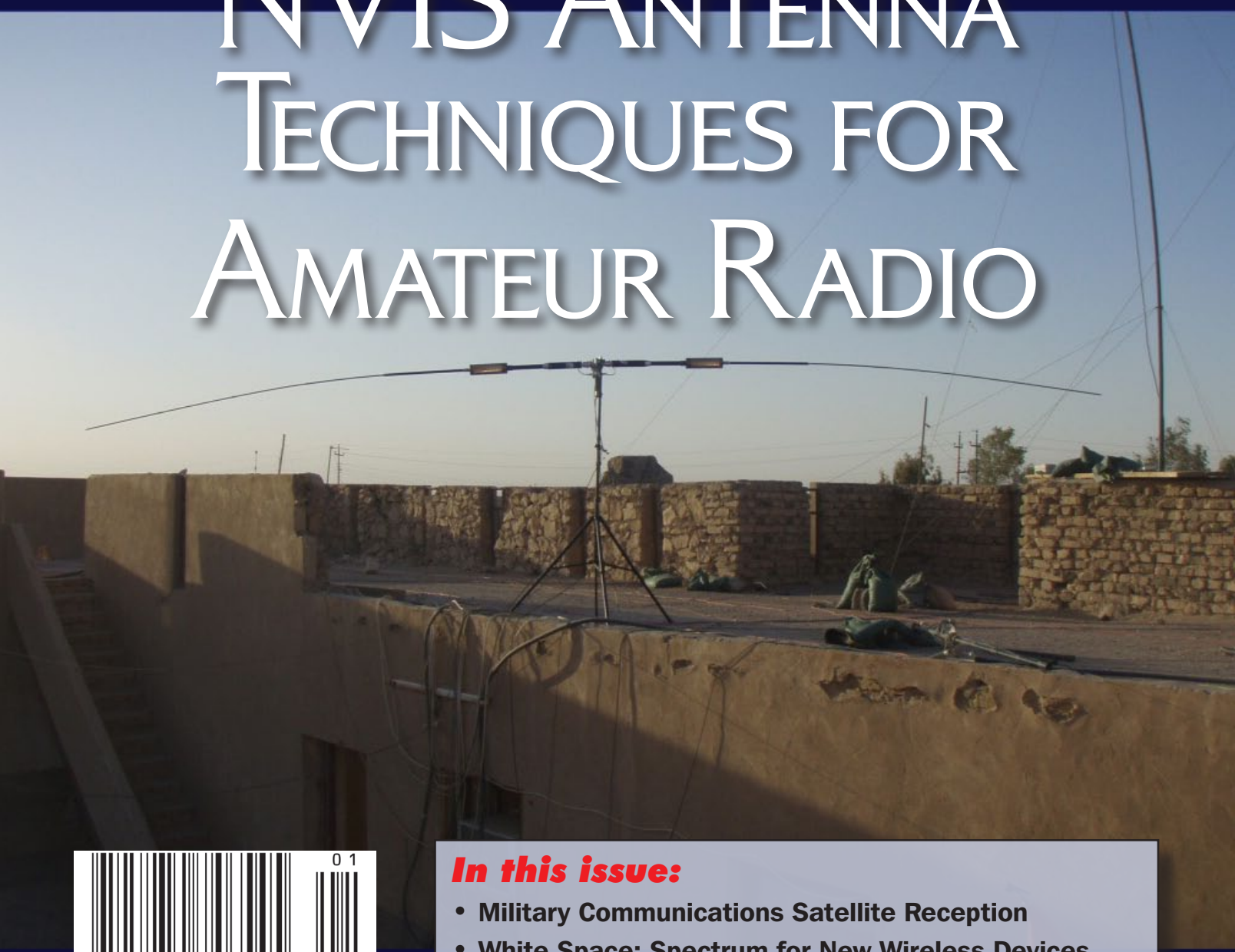
NVIS Antenna Techniques for Amateur Radio



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- Military Communications Satellite Reception
- White Space: Spectrum for New Wireless Devices
- Who's Killing AM Radio? (And, why isn't it dead yet?)

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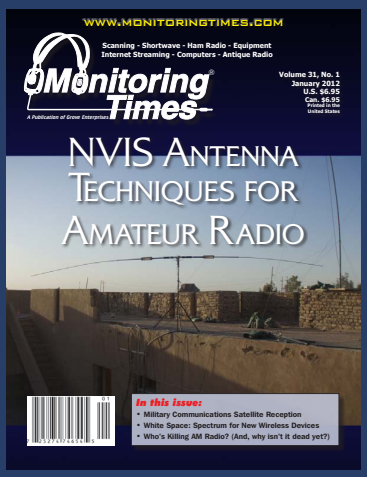

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Near Vertical Incident Skywave (NVIS): A useful technique for amateur radio

By Bob Patterson K5DZE

Every location presents a different problem that hams have to overcome in order to put a signal out on HF, especially on lower frequency bands, trying to reach other stations within a 200 or 300 mile radius. One proven method is called Near Vertical Incident Skywave (NVIS), a technique used quite effectively by the military from both sides during World War II.

Bob Patterson K5DZE explains how NVIS works and, more importantly, how amateur radio operators can use these same techniques on the ham bands. Here's a hint: You may already have everything you need to operate NVIS!

On Our Cover

Hi-Q Military HF NVIS antenna as deployed in Iraq. (Courtesy: Hi-Q Military Antennas www.hi-q-military-antennas.com)

C O N T E N T S

Reception of Military Communications Satellites: A DIY Extravaganza 11

By Bob DeVarney W1ICW

Courtesy: Air Force Space Command

There's nothing Bob DeVarney W1ICW likes better than a radio-related challenge. Having purchased a used dream receiver that had some pretty flashy features; Bob challenged himself to build a monitoring station for the reception of military communications satellites. It worked! Now, he shows readers the results of his project and just how he did it.

Who is Killing AM Radio? *(And, why isn't it dead yet?)* 13

By Ken Reitz KS4ZR

(Courtesy: Crosley Radio)

For the first 40 years of its existence AM radio was king; it had no competition. In the car, at home, in public places, everybody listened. AM radio stars commanded Hollywood-style paychecks while dozens of fan magazines followed their every move each week.

Since the 1950s the influence of AM on America has slowly seeped away. Now, an entire broadcast industry sits on real estate that even mobile broadband doesn't want to poach. Just who is killing AM radio and why isn't it dead yet?

White Space: New Wireless Devices come to your Neighborhood..... 17

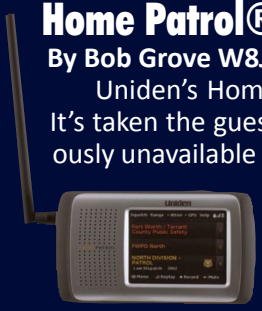
By Kevin Parrish

Spectrum maneuvering from the Digital TV switch in 2009 has brought a whole new crop of participants to what was once sole TV territory. Among these new occupants are wireless microphones used in everything from tent revivals to on-field Super Bowl referees. But, the FCC is paying close attention to who uses this spectrum. It's no longer possible to just set up for a show and turn on the wireless mics. As Kevin explains, everything has to be coordinated for the protection of the main spectrum users.

R E V I E W S

Home Patrol® "Extreme" Firmware Upgrade..... 70

By Bob Grove W8JHD



(Courtesy: Uniden)

Uniden's Home Patrol scanner has been a huge consumer success. It's taken the guesswork out of programming and offers features previously unavailable on any other scanner. How could the product possibly be made better? Bob Grove explains how as he takes a look at the newly released Home Patrol "Extreme" firmware update that includes a band scope, RF power plot, trunked system analysis, and much more.

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Address:	7540 Highway 64 West, Brasstown, NC 28902-0098
Telephone:	(828) 837-9200
Fax:	(828) 837-2216 (24 hours)
Internet Address:	***www.grove-ent.com*** or ***www.monitoringtimes.com***
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Subscription Questions?
belinda@grove-ent.com

Owners
Bob and Judy Grove
judy@grove-ent.com

Publisher
Bob Grove, W8JHD
bobgrove@monitoringtimes.com

Managing Editor
Rachel Baughn, KE4OPD
editor@monitoringtimes.com

Assistant and Reviews Editor
Larry Van Horn, N5FPW
larryvanhorn@monitoringtimes.com

Features Editor
Ken Reitz
kenreitz@monitoringtimes.com

Art Director
Bill Grove

Advertising Services
Judy Grove
(828) 837-9200
judy@grove-ent.com

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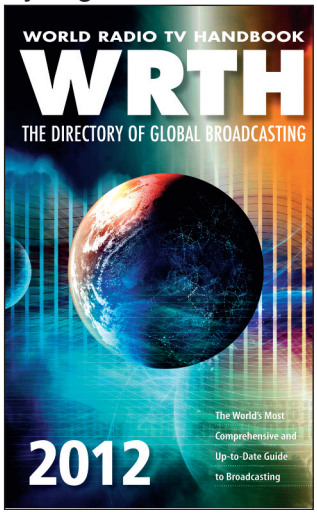
You may contact any MT staff writer by email by combining their ***first and last name @ monitoringtimes.com.*** By postal mail, you may write them in care of MT Headquarters in Brasstown. Please enclose a self-adressed, stamped envelope if you wish the columnist to reply.

We are very pleased to announce the publication of the 2012 edition of *World Radio TV Handbook*, the bestselling directory of global broadcasting on LW, MW, SW & FM

The Features section has a history of radio on Tristan da Cunha, reviews of the latest equipment, an explanation of receiver testing terms and techniques, a visit to Radio Bulgaria, and other articles and items, including our regular *Digital Update*.

The remaining pages are, as usual, full of information on:

- National and International broadcasts and broadcasters by country with frequencies, powers, languages, contacts, and more, including Clandestine and other target broadcasters
- MW frequency listings by region. International and domestic SW frequency listings, as well as DRM listings
- International SW broadcasts in English, French, German, Portuguese & Spanish.
- Reference section with Transmitter locations, DX clubs, Internet Resources, and much more



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SOME COMMENTS ON WRTH 2011

With 50 years of WRTH under my belt I still look forward to the next year's volume appearing, thank you for your ongoing effort in producing this invaluable reference work – *Roger Bunney, UK*

The World Radio TV Handbook has consistently set the gold standard in broadcast reference information and it remains the very best, most authoritative, and comprehensive reference book in the broadcast world – *Gayle van Horn, Monitoring Times*

I still am convinced that your publication is awesome! – *Gérard Koopal, The Netherlands*

The handbook seems nearly perfect – *Wolfgang Bueschel, Germany*

As always, we highly recommend WRTH as excellent value for money, and a must-have for both the hobby listener and the broadcast professional – *Andy Sennitt, Radio Netherlands Worldwide*

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Thanks for another excellent edition of our "bible" – *Günter Lorenz, Germany*

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A "must have" reference for any SWL – *Randall Morrison, USA*

COMMUNICATIONS

by Ken Reitz

AMATEUR RADIO/SHORTWAVE

BPL: It is Alive!

Just when you thought that Broadband over Power Lines (BPL) was dead and buried, the FCC lurches out of the crypt with a Second Report and Order (SR&O) released October 24 regarding final rules governing BPL, the transmission scheme by which Internet data may be sent to subscribers along power lines. The original rules were adopted by the FCC in 2004 but have been essentially on hold thanks to wrangling between the Commission and the American Radio Relay League (ARRL), which represents the interests of America's licensed amateur radio operators. The bulk of the 76 page SR&O is a re-hash of the arguments both brought during litigation.

The League went to federal court questioning the Commission's initial methodology which had been redacted in the first report. The case made it to a federal appeals court in 2008 where the court ordered the Commission to come clean. The result was a further period of study and comment which has resulted in this second report. The original problem was that the nature of BPL technology causes interference in the HF portion of the ham bands that renders those frequencies useless to operators unfortunate enough to be near a BPL transmitter.

In the second report the FCC notes that it has made what it called "several refinements to our Access BPL rules" including, "modifying the rules to increase the required notch filtering capability for systems operating below 30 MHz from 20 dB to 25 dB…Establishing a new alternative procedure for determining site-specific extrapolation factors [and] adopting a definition for the 'slant-range distance' used in the BPL measurement guidelines to further clarify its application." In other words, they're hoping to better protect ham frequencies from harmful interference.

What the SR&O doesn't explain is that time has passed BPL technology by. What may have looked promising seven years ago as a way to bring low-cost broadband to the nation's hinterlands has proven instead to be otherwise. Some municipalities that bought into the scheme have ended up handing the debacle to taxpayers to pick up the tab. The most famous case was in Manassas, Virginia which was launched by a private company, with the help of state and local taxpayer subsidies, to great fanfare, only to have the city take over after the company bailed out.

After several years of operation, the service enticed a little over 500 subscribers and cost the city $170,000 annually, according to an article in the *Washington Post*. The article noted that BPL provided speeds up to 10 times faster than dial-up, which may have been considered fast in 2004 but would be considered too slow for most of today's online applications.

With fiber optic cable service and 3G mobile broadband available in most areas of the country (not available seven years ago), 4G wireless broadband rapidly building out, newer and faster satellite and wireless terrestrial repeaters operating outside the ham bands becoming available this year, BPL, even with FCC approval and promotion, is DOA in the marketplace.

ARRL: 700,000 U.S. Hams

A surge of interest in amateur radio has led to an all-time high in amateur radio licenses as reported by the ARRL. According to figures released by the League, and based on FCC licensing data, there are now more than 700,000 licensed amateur radio operators in the U.S. At roughly 340,000, nearly half are Technician Class operators, nearly 160,000 are General Class and just over 125,000 hold Extra Class licenses. There are just over 58,000 Advanced and nearly 15,000 Novice legacy licenses (classes of license no longer issued by the FCC).

While the total is the highest ever, the numbers released by the League show licenses over the past 12 years have actually held fairly steady, with an overall increase of just 23,000 licenses since 1999. The actual number of active, individual, U.S. hams is a much more elusive number. Based on a recent League survey, 80% of respondents said they are active on-air, which means that at least 140,000 licensed hams are inactive.

In addition, thousands of licenses are actually secondary licenses of visiting foreign hams registered over the last 10 years; thousands more are club, repeaters or organization licenses. Many thousands more are the call signs of deceased hams whose licenses could possibly remain in the database for up to 12 more years (a 10 year license period plus a two year grace period before being deleted) and who obviously can't respond to a survey regarding on-air activity.

Cost of QSLing Rises (Again)

The U.S. Postal Service announced another hike in postage fees. While domestic First Class postage increased 1 cent to 45 cents, post card stamps have gone up 3 cents to 32 cents. Mail to Canada and Mexico went up 5 cents and now costs 85 cents per letter. International First Class mail went up 7 cents and is now $1.05.

Sending international QSLs through the mail? Better bring your credit card! (Courtesy: USPS)

But, the biggest jump is in International Reply Coupons (IRCs) which went up 10 cents to $2.20, so the joy of receiving an international QSL will now cost $3.25 each. For hams, the best way to beat the high cost of QSLing is to use the QSL Bureau. Details on how to do this are found here: **www.arrl.org/qsl-service**. ARRL membership is required to send QSL cards through the bureau, but not for receiving QSLs. SWLers can take advantage of online QSL reporting, which has been made available by many international shortwave broadcasters.

TV BROADCASTING

FCC Threatens TV Broadcasters

The FCC has mounted another assault on the spectrum currently licensed to the nation's

TV broadcasters which the Commission would like to auction off to the mobile broadband industry. In a press release from October 19 the Commission warned, "Failure to free up more spectrum for mobile broadband will stifle innovation and result in higher prices for consumers and growing network congestion." The Commission described the deal as, "an incentive-based approach, grounded in strong, free-market principles," and confusingly claimed that surrendering spectrum would somehow preserve, "a strong and healthy TV business."

But broadcasters are fighting back. The National Association of Broadcasters has mounted an ad campaign running on many stations nationwide asking viewers to urge their Congress members not to support the FCC's efforts. In addition, the Coalition for Free TV and Broadband, a group of dozens of broadcast stations, companies and other stakeholders in the broadcast spectrum issue, released their own plan for an "Alternative to Incentive Auctions" the day after the FCC's press release.

Part of their plan calls for wireless broadband companies to use existing Over-the-Air (OTA) TV infrastructure to send and receive data. The Coalition argues that this plan would take care of the presumed bandwidth crunch, allow OTA TV to continue to serve cities and communities with free television, and deliver as much as $60 billion to the U.S. Treasury in the first fifteen years – far more than the $6 billion the FCC estimates it would make from auctioning OTA TV frequencies. The Coalition explains that the Treasury windfall would come from fees OTA TV stations would have to pay the FCC to allow them to transmit signals other than TV programming.

OLD SPY VS. NEW SPY

Russian Spies Used Shortwave Radio

In an echo of the 2010 arrests of Russian spies in New York, German police commandos broke into the apartment of a German couple in the middle of what appeared to be reception of a coded shortwave message at 6:30 in the morning local time, October 18. According to an article in the online international version of *Der Spiegel*, one of the suspects was "sitting in her study in front of a wireless transmitter that was receiving encoded messages on a shortwave frequency and was hooked up by cable to a computer."

The couple were suspected of having been Russian spies for the past 20 years and seemingly part of the same program as the New York spies. The two, aged 45 and 51, claimed to be from South America, but the report told of their Russian-accented German. The article speculated that the two may have been among those referred to in messages captured along with the New York spies that indicated messages were being sent to Germany. The article reported that the arrests were the first such made in Germany since the end of the Cold War.

Chinese Military Hacking U.S. Satellites?

Then there's this story from *Bloomberg Businessweek* October 27 that makes the above report about Russian Cold War-era spying seem quaint. It concerns a U.S.-China Economic and Security Review Commission annual report that reveals that computer hackers, possibly Chinese military, have used a ground station in Norway to somehow access the controls of two U.S. environmental observation satellites. The article noted that the unauthorized access happened several times from two to 12 minutes during each episode in 2007 and 2008. The satellites, Terra AM-1 and Landsat-7, both use the Svalbard Satellite Station in Spitzbergen, Norway. According to the article, China denies any involvement.

Terra AM-1 environmental observation satellite. (Courtesy: NASA)

FCC ENFORCEMENT

Pirate Cat's Monkey $10k Fine Affirmed

The brains behind San Francisco's Pirate Cat Radio (PCR), Daniel K. Roberts (AKA Monkey or Monkey Man), had been issued numerous warnings and Notices of Unauthorized Operation (NOUOs) for transmitting on 87.9 MHz dating back to 2008. After several visits to the Pirate Cat Café, a Notice of Apparent Liability for Forfeiture (NAL) was issued August 31, 2009 for $10,000.

By the end of October 2009, according to FCC documents, Roberts responded by saying that he was not associated with the transmissions of Pirate Cat Radio and anyhow, he was financially unable to pay the fine. The Commission swept aside his non-affiliation claims, quoting from PCR's own web site, articles in *SF Weekly* as well as *Radio Survivor* in which he was quoted saying the opposite. The Commission also noted that he gave no evidence of his inability to pay, hence the Forfeiture Order.

More Pirates Walking the FCC Plank

An FM pirate operating out of the Miami area since 2007 who had also been issued numerous NOUOs wasn't as lucky as Monkey. The Commission upped his fine an additional $5,000 for a total of $15,000.

One FM pirate, operating out of Ft. Lauderdale, Florida and styling himself as a gangsta DJ, was busted by FCC field agents with the aid of the Ft. Lauderdale police department. A photo of the pirate on his station's website matched the photo on his driver's license when presented during the bust.

Another Miami area pirate was using his unlicensed station to promote his "social club" on-air. The FCC, with the help of the Miami police department, raided the station's headquarters (a locked room in a residence), the address of which was listed on the station's website. He was issued an NAL for $10,000.

One pirate operator from St. Petersburg, Florida has had his $10,000 fine reduced to $250 after the FCC reviewed documented evidence of his inability to pay.

And, finally, an FM pirate from Chicago had told FCC agents so many conflicted stories about his operation that even he couldn't keep them straight. The case dates back to March 2006, when field agents first monitored an unlicensed FM station on 92.9 MHz. The man initially claimed that the signals were coming from another nearby property, adding that all that electronic gear he had was for weather monitoring.

The FCC didn't bite on that bait so he claimed that a character came to him wanting to install online radio equipment in his apartment in order to stream religious programming. He was shocked, shocked, that the "online" equipment turned out to be an FM transmitter! The name the man gave the FCC turned out to be fictitious and the address turned out to be property owned by other members of the man's family.

In their Memorandum Opinion and Order, the FCC dismissed appeal of the fine, noting that the signatures of the pirate operator and the fictitious character were remarkably similar. The $10,000 fine was affirmed.

Communications is compiled by Ken Reitz KS4ZR (kenreitz@monitoringtimes.com) from clippings and links supplied by our readers. Many thanks to this month's fine reporters: Anonymous, Rachel Baughn, Bob Grove, Norm Hill, Steve Karnes and Larry Van Horn.

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NVIS for Hams

Near Vertical Incident Skywave

A Useful Technique for Amateur Radio

Bob Patterson K5DZE

Amateur radio operators who have been in the radio hobby for a while have probably heard of Near Vertical Incident Skywave (NVIS) operation, but they may not be very familiar with just what it is or what use it might have in amateur radio. This article will attempt to present just enough of "how it works" with some "how to" ideas to help you better meet some of your own operational needs for area net, EMCOMM, MARS, or casual operation. As with most such discussions in amateur radio, the key is to take the ideas and experiment.

NVIS Background

The first thing to understand about NVIS in amateur use is that we are talking about a technique rather than some special equipment design. By this, we mean choosing the right frequency for the time of day, positioning the antenna in a slightly different configuration than normal, and perhaps getting some other operators to do the same thing to test these changes.

It is true that some antenna designs apply specifically for NVIS use, but for the most part, the antennas you currently know and use will probably work just fine for NVIS operation. In fact, some operators may find they are already using an NVIS configured antenna system without even knowing it! In most cases, to employ NVIS in your operations you can simply change how you use the antennas that you already have rather than employing new equipment or new antennas.

The NVIS concept is certainly not new and its use dates back to at least WWII when the Axis and the Allies used NVIS techniques very effectively for their communications.

The SdKfz.251 half track vehicle shown in Figure 1 was used by the German Army in WWII and came in several configurations. The photo shown is a /3 variant used as a command and communications vehicle. What appears to be a top rack for some type of frame for a tarp or cover over the halftrack is actually its horizontal frame antenna used for NVIS communications. Depending on the variant, frequencies normally ranged from 200 kHz to 7 MHz with this antenna. The Allies also used NVIS techniques when they planned their HF communications to reach from England to France in support of the D-Day landings.

NVIS is not a new idea. This WWII German half-track is equipped with such an antenna. (Courtesy: SdKfz.251/3 Halftrack Photograph Courtesy of Bundesarchiv, Bild 1011-769-0229-02A.Photo: Eric Borchert 1940 May-Jun)

Bundesarchiv, Bild 1011-769-0229-02A
Foto: Borchert, Erich (Eric) | 1940 Mai - Juni

NVIS techniques were again used in the Vietnam conflict to help overcome heavy jungle and forest foliage in the southern and lower central areas and the mountains of the upper central and northern regions. For HF backpack radios, wire antennas were strung out horizontally within a few feet of the ground or the long whip antenna was pulled over to a horizontal position rather than being erected vertically.

Today, such techniques are still employed in current military operations along with specially configured, low-mounted NVIS antennas. When used properly, this proven technique can have a useful place in amateur radio communications.

NVIS Applications in Amateur Radio

On the lower HF frequencies, such as 75 meters, most of us have likely experienced how frustrating it can be when we can talk to most of the outlying areas of the state but we cannot talk to the area surrounding us. Ground wave, which propagates a few miles out along the ground away from the transmitter, can provide some very local area coverage, but even this coverage can be negated by mountains, heavy forests, or built up metropolitan areas.

For local area to statewide communications, amateurs often must turn to distant HF stations to relay traffic back to nearby stations, or stations must turn to VHF and UHF repeaters placed on mountain tops, towers or buildings to reach local area stations.

In some more recent emergencies, even circling aircraft with repeaters or relay equipment have been used to fill in communications gaps. This airborne relay has been a common practice in the military for a number of years, and was most recently employed by non-military personnel during New Madrid Earthquake drills. While such options certainly help, these are not always efficient answers for reliable area-wide communications. NVIS operations can often eliminate the need for additional equipment and relays by providing area-wide direct HF contact.

Among the most practical applications of NVIS techniques for amateur radio would be use in statewide traffic nets, area ENCOMM nets, state MARS nets, and even daily or evening

casual HF operations on the lower bands. When NVIS techniques are used for such operations, signals can be noticeably stronger, noise is noticeably lower, and communication is better contained within a 300 mile area.

In this latter regard, the propagation reduction of state net or area net signals is a plus, since it reduces possible interference with or from other distant state nets or non-net communications that might occur at the same time. Particularly for Homeland Security support operations, this reduction of interference from distant communications and the reduction of state Homeland Security communications information that can be monitored by outsiders are obvious advantages.

My own personal experience using NVIS for Army MARS net operations showed a marked increase in effective communications when switching to a NVIS configured horizontal Loop antenna to replace a full sized G5RV antenna. The effect was noticeable enough that two net stations asked what I had done to so markedly increase my on-air signal. The only change was a switch to an "NVIS antenna."

Area signals were up, overall noise was down, and I could easily communicate with area stations that I had often had a difficult time in working. One station with a similar NVIS configuration was as exceptionally strong to me as I was to him.

Hi-Q Military portable HF NVIS antenna (Courtesy: www.hi-qmilitaryantennas.com)

How Does NVIS Work?

Simply stated, NVIS is a technique of making the antenna radiate at a high vertical angle. For most Amateurs, this is just the opposite of what we have always tried to do, which is design an antenna that gives a very low angle of radiation to reflect off the ionosphere as far away from the transmitter as possible in order to yield maximum distance.

By changing this low angle to a high angle of radiation, our signal is transmitted almost vertically so it will reflect off the overhead ionosphere and it comes back down all around the transmitter. This has been compared to setting a water hose to the shower setting and pointing it straight up so that it showers back all around the nozzle. While such a design is not good for DX, it works extremely well for distances from the local area out to 300 or 400 miles. It greatly eliminates local and area dead spots due to skip, terrain, or vegetation.

In addition to the antenna design and its installation, the frequency used is absolutely critical. For NVIS to work, you must operate well below the Maximum Usable Frequency (MUF). The MUF is the highest frequency that can be used to communicate between two given points considering power, antennas, emission type, time, etc. In actuality, the MUF does not guarantee communication up to that frequency; it's simply a maximum frequency with which one might expect to have effective communications.

Normally, a figure of no more than 80% of the MUF for communications is used for planning communications, though it should be noted that some users are more conservative and figure no more than 50% MUF for communications. Using these figures, this would mean that if the MUF is 18 MHz for some given period, then a frequency of 14 MHz (80%) might be usable for NVIS communications, or better yet a frequency of 9 MHz (50%) would be more practical for communications planning.

For Amateur planning purposes, the two bands that we should consider the most practical and reliable for HF NVIS communication would be 40m for daytime use and 75m for late evening and night use. The 60 meter (5 MHz) frequencies might also figure into NVIS use depending upon the time of day and the MUF.

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Amateur frequencies above 40 meters in the daytime generally don't work well for NVIS, since vertically radiated signals will tend to pass into and distort in the reflective layer. While high power has shown to make a difference in some cases, most amateurs don't run high power nor is this practical for most amateur emergency situations.

At a frequency point above the MUF, signals pass through the D layer and into space. This frequency is called the Critical Frequency. Amateur signals below 40 meters during daylight (75 meters) will be absorbed rather than reflect. Note, too, that 40 meter NVIS for the daytime and 75 meter NVIS for the night are the reasonable choices for amateur use not because they are necessarily always the optimum frequencies for NVIS, but rather because these frequencies are the best ones within amateur radio frequency allocations.

The other consideration for effective NVIS operation is to communicate with stations in the NVIS range (up to 300 miles) that are using similarly optimized NVIS antenna systems. Experience has shown that two stations using NVIS techniques can make even more difference in the quality and strength of the signals between the stations.

NVIS Techniques

As mentioned, NVIS techniques should start with the antenna. Tests have shown that a good antenna at a height of 15 feet or less can give you good NVIS results out to about 300 miles, but DX capability will suffer as it is certainly not optimized at this low height. Some NVIS operators have used antennas installed only 2 to 3 feet off the ground, but the physical impracticality of such a low antenna seems to make this a poor choice except in special situations. People and animals can easily trip, fall, and get hurt over such low antennas, not to mention that this also makes it very easy to break the antenna.

Placing an antenna on top of a wooden fence using standoff insulators has been successful, as have installation heights of less than 10 feet. Users should use caution at such low heights and use insulated wire to avoid accidental RF burns to people and animals in case the antenna is touched while transmitting. (If you doubt there is much RF coming from the antenna, take a long fluorescent bulb outside and hold it near the antenna. It will light up as you come near to the antenna at various points.)

Back at the rig, you will note that noise levels will be reduced and distant station interference will also be reduced, since such low-mounted antennas usually don't work very well receiving distant signals and noise.

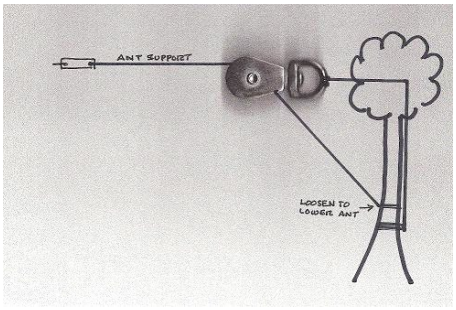
Any number of antenna designs can be used for NVIS operations. The standard coax fed single wire dipole strung placed 10 to 20 feet over the ground can be an effective NVIS antenna. A 1/4 wave coax line brought away from the antenna at a 90 degree angle will help reduce RF feedline pickup.

Another antenna that can perform well is the long wire antenna…generally, the longer the better. Use an antenna tuner to match the antenna to your desired frequency. Placed on top of a wooden fence with insulators, a long wire antenna becomes very unobtrusive, yet it is effective for area communications. Again, insulated wire is recommended if human or animal encounters are possible.

A tip to help you check any antenna mounted low to the ground is to always check the SWR when you prepare to operate. If the reflected power is unusually high when you check it, this could mean the low mounted antenna is broken or something is touching it. Stop transmitting immediately and make a quick visual check of the antenna to identify the problem; it might help you keep from hurting someone who could be touching the antenna. If the antenna is broken or shorted to ground, this simple check can also protect your transmitter from a high SWR situation.

My favorite wire antenna (for NVIS or otherwise) is the All Band Horizontal Loop antenna. It works very well as an NVIS antenna. My first effort with an NVIS horizontal loop was when I used one on a state Army MARS net. The loop was only about 17 feet high but yielded excellent results when I used it to replaced a 30-foot high G5RV used as an inverted V.

Since the feed point and corner support points of the loop were on pulleys, I dropped the loop to 10 feet for a few tests. This proved to show little or no difference in its use on the net, and while performance did not improve, more importantly it did not deteriorate. I used the antenna at 10 feet for a short time, but for my particular installation it looked rather strange at 10 feet, so back up it went to 17 feet after testing. Using a coax fed, balun match design for the loop, it was easy to make and install this effective NVIS configuration.



Homemade antenna support lets you lower the antenna for NVIS operation.

When raised to 30-40 feet, big loop antennas work very well for DX. If your installation will permit you to do so, you might consider installing pulleys on the feedline point and on each antenna support point (Fig 2), so you can easily raise the antenna to its highest point to work DX, and then lower it to a good NVIS point for improved area coverage on the lower HF frequencies.

Another step to improve area coverage on lower HF frequencies is to perhaps encourage some amateur friends or net members that you regularly work to set up a similar NVIS installation. While your NVIS efforts will make an improvement in your area communications, you should find that the signal improvement of two stations both using NVIS techniques to be even more noticeable.

Do You Need NVIS Options?

While you can see that achieving a well performing NVIS station is not really hard to do, you must ask yourself if having and using an NVIS capability is something you need to employ. If your interest is only working DX on the lower frequencies and you have little interest in operating there for any other purpose, then NVIS may not have much interest for you other than just understanding how it is done.

On the other hand, if you are an active area or state net control station or member of a net, you and your net might profit from your station being NVIS capable. If you are an active member of MARS, you too can profit from such a system for your state and area nets. ENCOMM in particular is a primary candidate to use an NVIS system, since this capability improves local area emergency HF communications where they are needed most.

Surely, having antennas for HF NVIS for emergency preparedness and an antenna configured for DX gives one the best of both worlds. It also helps the Amateur know he/she is prepared to help in the local area if called upon to do so.

Why not read up on NVIS and get a few amateur friends to join you in configuring your stations for NVIS operations? Setting up such tests and experiments are much of the fun of amateur radio. Use a low power (QRP) rig with an NVIS antenna set-up to see what such communications might be like in a real emergency. Conduct some tests and experiments using the techniques discussed here perhaps with other operators at various times. Keep notes and make the results available to your fellow ENCOMM, MARS, and traffic net operators. It might be that you will discover improvements you can employ immediately, or you will at least have it to put in the ole experience bag to be used if and when needed. MT

MORE INFORMATION

For more on NVIS and related topics, see:

NVIS – Near Vertical Incident Skywave - **www.qsl.net/wb5ude/nvis/**

Near Vertical Incident Skywave Communication, Antony Wedgwood, G0TJD **www.vmarsmanuals.co.uk/newsletter_articles/nvis.pdf**

Near Vertical Incident Skywave - **www.armymars.net/ArmyMARS/Gen-Mil-Info/Resources/Dave-Fiedler/Antenna_Performance_for_NVIS_Comms.pdf**

NVIS, Norm Fusaro W3IZ - **www.coares.org/publications/NVIS.pdf**

"An Easy-to-Build All-Band Loop Antenna," K5DZE - *Monitoring Times*, OCT 2010

"Loop Your Way to HF DX Success," KS4ZR - *Monitoring Times*, JUN 2011

Reception of Military Communications Satellites

A D-I-Y Extravaganza

By Bob DeVarney W1ICW

The U.S. military and NATO have a world-wide network of geostationary communications satellites, many of which operate in the UHF frequency range. This allows operation by a very small and, consequently, very portable ground terminal. Communications by military users have primarily shifted to encrypted communications, but in the past several years there has been increasing use of the satellites by South American "pirate operators."

Fleet Satellite Communications, as they are known (usually abbreviated FltSatCom), are geostationary military communications satellites originally built in the 1970s by TRW for the U.S. Navy, the last of which was launched in 1989. FltSatCom satellites were followed by the UFO (UHF Follow-On) satellite system, each of which has circularly polarized transponders of 6 kHz and 34 kHz bandwidths, which require a helical or spiral receiving antenna.

Since these are geostationary satellites, the task of tracking them is greatly simplified. However, due to the height of the geostationary orbit (approximately 22,000 miles) the task of reception is not quite so simple. High-gain antennas and low-noise preamplifiers are essential for clear reception.

Author's home-brew FltSatCom antenna showing the gamma match. (Courtesy Bob DeVarney W1ICW)

A Technical Challenge

Why, I'm often asked, do I get interested in some of the truly arcane things I do? The simple answer is that I am curious, and I like a technical challenge. Once I have built something, or accomplished something, I usually get bored with it and move on to something else. But, it was the acquisition of a truly amazing wideband receiver from a well-known Internet auction site that was probably the thing that led me down this path.

For this project I had two objectives: To do it as inexpensively (read cheaply) as possible and to do as much of it as possible from scratch (see objective 1) without going overboard. Some items I chose to purchase, as opposed to build, because the actual cost was very nearly the same.

To receive military satellites in the UHF frequency range, you will need three things:

1. A receiver capable of 240 MHz to 270 MHz in AM and FM modes.
2. A preamplifier with at least 18 dB of gain and a noise figure below 1.5 dB.
3. A resonant antenna with 8 dB of gain or more and a good feed line.

First I will address the receiver. There are a number of off-the-shelf receivers which do a fantastic job of reception in the UHF range. Several scanners will also tune this range including Icom PCR100/PCR1000, R-7000/R-7100, R-1500/R-2500, R-10 Yaesu VR-500, VR-5000, and nearly all AOR receivers.

In addition, many of the recent crop of amateur rigs now include wideband receive capabilities and will work admirably for our purposes. In my case, I had two choices, an Icom PCR-1000 computer controlled receiver and a Watkins-Johnson WJ-8615D wideband surveillance receiver. The WJ was the crème de la crème in the mid-1980s for government and military listening posts. They originally cost in the neighborhood of $20,000 in 1980 dollars, depending on options.

My particular model has continuous coverage in all modes (AM, FM, WFM, CW, LSB, USB, and PULSE) from 2 MHz to 1100 MHz with no gaps. Simply put, it is the most incredible receiver I've had the good fortune to operate, but that is perhaps another article. For those curious about this amazing receiver, Terry O'Laughlin has a superb website dedicated to the Watkins-Johnson products here: **http://watkins-johnson.terryo.org/**

The receiver has an IF out at 21.4 MHz, which is 4 MHz wide, and can be used with a panadapter. In my case, I am using both a Watkins-Johnson SM-9203 Signal Monitor and an RF Space SDR-IQ receiver. The SDR-IQ gives me a great graphical representation of the passband within 190 kHz of the center frequency, while the WJ Signal Monitor allows me to tune the band very rapidly and spot signals which I might otherwise miss with the SDR-IQ.

The RFSpace SDR-IQ is a computer-controlled software-defined radio, and has become perhaps the gold standard for amateur use as a panadapter. The combination of the two receivers is tough to beat for the ability to spot signals that may not otherwise be heard.

Next, the preamplifier. There are many designs for homebrew preamps on the Internet. Doing a Google search for "220 MHz preamp" will net you many hits if you choose to go this way. Such designs will have to be modified somewhat to move them up in frequency. There are also several very good preamps commercially available such as the L222NACK kit from Downeast Microwave. Another good preamp is the P240-270VDG from Advanced Receiver Research. Both have excellent specs. I chose the Downeast Microwave kit, first because it was a kit, and secondly because the cost ($45.00 as of summer 2011) was very nearly what it would cost me to purchase the parts necessary to duplicate it.

The construction was straightforward, and the preamp was tuned on a Hewlett-Packard 8921service monitor. I do not have actual gain figures at 255 MHz, because the preamp was actually built and tuned for 217 MHz for reception of the NAVSPASUR radar. Gain was 18 dB at 217 MHz as specified.

Lastly, the antenna was built from scratch.

An antenna for the amateur 222 MHz band would probably work here if you don't want to build one. I chose to go the build route, as I had originally planned to use this setup for reception of echoes from the NAVSPASUR radar. An excellent webpage on this subject can be found here: **www.itrdatanet.com/~pe1itr/navspasur.html**. I had planned to build the antenna for 217 MHz, and then modify it for use at 255 MHz. As luck would have it, when I was adjusting the match, it really liked 255 MHz, so I decided to leave well enough alone.

The antenna was built using 1 inch 6061-T6 aluminum tubing for the boom and 6061-T6 3/16 rod for the elements. I chose an insulated, through-the-boom design. The insulators are the same as used by M2 for their commercially available antennas and were purchased as repair parts. I used K7MEM's online Yagi design page to calculate the element lengths and spacing for a 10 foot boom, and ended up with a 10 element Yagi with a calculated gain of 11.8 dBd and a 3 dB beamwidth of roughly 37 degrees in both the horizontal and vertical plane.

The hardest part of Yagi construction for me has always been how to mark the boom in a straight line so the elements all line up. A recent article in *QST* shows a very simple solution: clamp the boom to a table and scribe the line with a pen or pencil on a block of wood!

A gamma match was chosen for the design, due to its simplicity. Scaling the match down from a 144 MHz design in the *ARRL Antenna Book*, I found I needed a capacitance of roughly 16 pF. I used a fixed ceramic cap and made the tuning element out of aluminum rod. I wouldn't transmit into it, but for receive it works just fine. A suitable mounting plate was built from aluminum plate, and the antenna was mounted to my tower at around the ten foot level. I wanted to be able to get to it easily, and the top of the tower was full already.

For the feed line, I used Radio Shack quad shielded RG-6 and also ran 16 gauge speaker wire to supply power for the preamp.

Where, When, and How?

To determine what satellites you can receive at your location, you either need a satellite tracking program or use several of the online tracking websites. I use Nova for Windows by Northern Lights Software Associates, which lets me track a multitude of satellites. I determined that from my location here in northwestern Vermont, that the following satellites should be able to be received:

1. Fltsatcom 8 has an azimuth of 137.8 degrees, elevation of 28.0
2. UFO F7 has an azimuth of 238.7 degrees, elevation of 14.5
3. UFO F10 has an altitude of 204.4 degrees, elevation of 34.9

I chose to originally point towards UFO F10 as I was hearing several transponders from it. Putting it all together, I got the following results: The top spectrograph to the right shows a single satellite transponder from the satellite SDS-3F3 on 267.550 MHz. This satellite has a classified mission, although it is believed to collect and relay data from NRO's many photo-reconnaissance satellites.

The middle spectrograph shows that FM voice modulation is clearly visible on the signal. This signal was easily copied and turned out to be Spanish language, presumably pirates. At the bottom of the screen, the noise floor of the transponder is clearly visible when there is no signal present.

Lastly, to the bottom right is a screen shot of multiple transponders, some with traffic and some without.

Conclusion

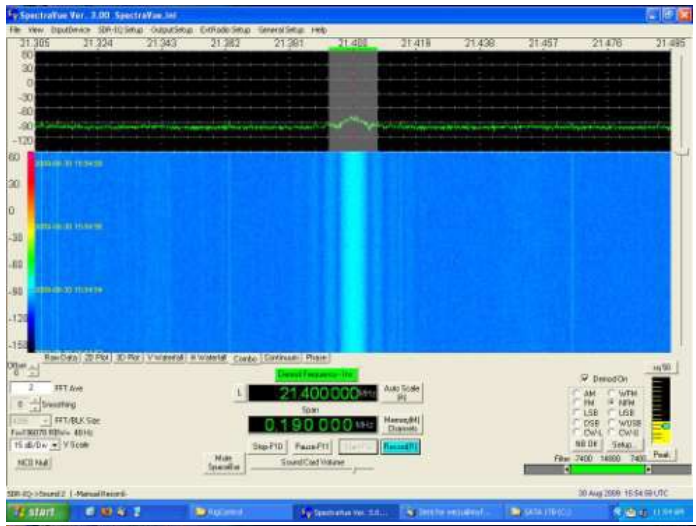
The results so far have been beyond my anticipation. I had originally planned to try reception of NAVSPASUR and then shift to the UHF Military satellites, but given the results I will probably do it the other way around. I have copied many hours of voice, and plan to "sweep the sky" with the antenna to try to copy other satellites.

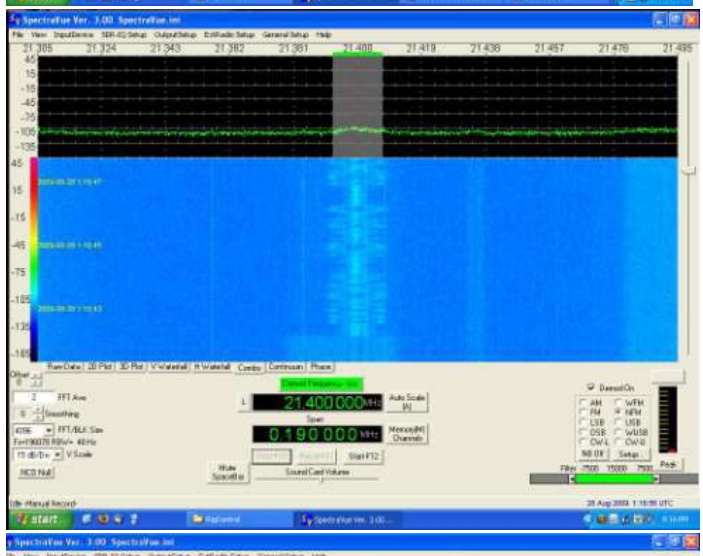
For a spur of the moment project on a shoestring budget, this was a lot of fun and provided me with a considerable amount of knowledge about satellites in general. I encourage anybody with a wideband receiver or a scanner capable of tuning the 255 MHz band to try doing something similar. Until recently, INMARSAT was still in analog mode and was easily copyable with a receiver capable of tuning in the 1550 MHz range. There is shareware and freeware available to copy the digitally modulated signals from INMARSAT using your computer's soundcard.

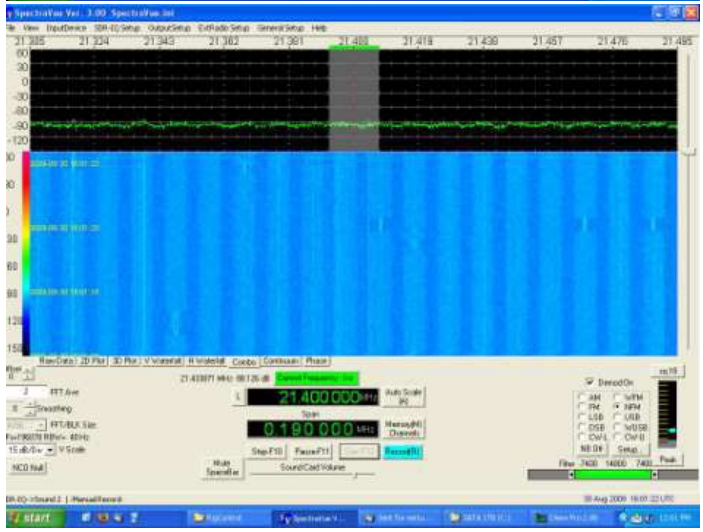
The high point of such reception for me was to copy a Coast Guard notice to mariners regarding a private sailboat that was becalmed and had run out of fuel for their generator. A friend had relayed ham radio traffic for them just the weekend before!

About the Author:

Bob DeVarney W1ICW has been amateur radio operator since 1980. He holds an Extra class license and a GROL. He has tried nearly every aspect of the hobby from QRP to contesting, satellites to moonbounce, but somehow still comes back around to his first love, SWL. He is an ARRL and W5YI Volunteer Examiner, and for the past 20 years he has been a cell site technician for Verizon Wireless. A former engineering technician for Joslyn Defense, he lives in Milton, Vermont on his family homestead with his wife Cherié, dog Dusty, cat Jello, and 14 chickens.







Who is Killing AM Radio? (And, why isn't it dead yet?)

By Ken Reitz KS4ZR

It's hard to overemphasize the impact that AM broadcasting has had on America. From its experimental inception 100 years ago to the Golden Age of Radio – that era just before television became the go-to medium for entertainment and news – AM thrived.

The technology of AM broadcasting has changed so little that experimenters from the 1920s to the present have a lot in common. Over a span of nearly 100 years it's been possible for anyone to build an AM radio from a handful of still easily obtained parts that can tune in modern broadcast band radio stations.

That's part of AM's problem: While other media have leapfrogged each other in a dizzying race of technology, AM has been more or less content to slowly sink into history.

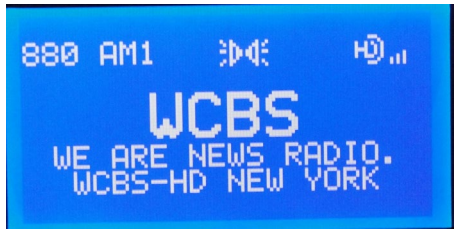
Stonewall at the FCC

The band has had plenty of help going under, but the FCC gets credit for crushing it at nearly every turn. As early as 1958, when FM was little more than a curiosity in most homes, the FCC was petitioned separately by Philco, RCA and Kahn Research Laboratories, Inc. to establish an AM stereo standard. Early adoption of AM stereo might have spurred manufacturers and engineers to take AM high-fidelity seriously, particularly at a time when programming on the AM band was still mostly music where such high fidelity would have mattered. But, in 1961 the FCC denied the petition and, four months later, denied the appeal.

While FM radio came of age in the 1960s and boomed throughout the 1970s, the FCC would not revisit the subject of AM stereo broadcasting again until 1979-80, when it sought to establish a standard from five competing AM stereo broadcast systems.

After more foot dragging, by March 1982 the FCC was finally persuaded to allow a "marketplace approach" to decide the winning system. The Report and Order from that date called it a "bold, new step for the Commission to take." And, certainly not the last time the marketplace would rule. The marketplace, however, was turned into a courtroom free-for-all by attorneys for the competing systems and, as the FCC admits, "Competing systems faded out… effective implementation of AM stereo in the U.S. was delayed." Yes, by another full decade.

While FM had cemented itself as the premier band for audio quality, it literally took an act of Congress (the Telecommunications Act of 1992) to blast the Commission into action. By 1993 it officially made Motorola's C-Quam AM stereo system the standard, noting that by that time 24 million radios equipped to receive C-Quam AM stereo broadcasts had already been sold. The marketplace had spoken and listeners couldn't have cared less. Meanwhile, manufacturers seem to have been unimpressed as well; good luck trying to find a new receiver that can tune C-Quam AM stereo.



Nighttime AM-HD DX? Maybe. Using a Sangean HDT-1X receiver with a Radio Shack tunable AM loop, WCBS-AM 880 comes through with a locked-in HD-Radio signal from 300 miles away. It sounded like a local FM station, for a little while. (Courtesy: Author)

Policy Changes Suffocate AM

Avid AM DXers and even casual listeners in the 1960s and '70s remember listening to their favorite rock groups on 50 kW clear channel AM stations around the U.S. that, thanks to their nighttime antenna arrays, came through like locals. Teens listening in the southeast U.S. tuned in Little Rock, Arkansas' KAAY "The Mighty 1090," or Indianapolis' 1190 WOWO (rhymed with go-go), Chicago's WLS and New York City's "77 WABC."

Daytime AM HD? In town, yes, beyond the suburbs, no. Of three AM HD stations within 30 to 40 miles, only WRVA's HD icon and call sign could be received, the signal remained analog. (Courtesy: Author)

FCC rules that made such reception possible forced all other stations on clear channel frequencies to go off the air at sundown local time. The powerhouse stations rolled through for 1,500 miles or more unimpeded.

But, in 1980 the FCC decided to limit the frequency protection clear channel stations had originally enjoyed to a radius of 750 miles. Then the FCC authorized the addition of 125 more stations on those frequencies. Even though those stations were limited to 1 kW, the result was that AM DXing got a lot harder and the influence the big guns once enjoyed, regarding the direction of popular culture over great parts of the country, disappeared. Now, virtually all of the old great Top 40 rockers are syndicated talkers and Top 40 has been dispersed into a dozen niche formats, all on FM.

Even though FCC rules require daytime-only radio stations to reduce their power or leave the air at sundown, as required by their licenses, many stations blatantly ignore the rule and continue broadcasting at their full daytime power. The odds, as seen by the very infrequent fines for such operation, favor the stations. There are simply too few FCC field agents to check that the 1,500 such stations are obeying the rules. The result is more interference across the band.

Following new regulations from the 1979 World Administrative Radio Conference (WARC), the Commission expanded the AM band to 1705 kHz, allowing new broadcast licenses, limited to 10 kW output, in the upper end of the band. The idea was to issue licenses to existing stations to migrate to the new band if they would surrender their current frequency assignments and thereby reduce AM congestion.

It was a tough sell, and following the usual legal hurdles and bureaucratic foot dragging (the hallmark of the FCC), band expansion was finally implemented in 1992. But, again it was too little too late. Who cared? Not the tens of millions who had stopped listening to AM radio and were now listening to high fidelity music in stereo, on static-free, fade-free, FM.

Ignored by Design

Other forces of the progress of technology helped insure AM would be unlikely to regain lost ground. From the design of car antennas to home stereos, AM reception has become an afterthought. It wasn't until the early 1980s that U.S. car makers started including FM reception

Kenwood after-market in-dash AM/FM/HD-Radio ($160) gets good reviews, but to enjoy it you need to live in an area where HD-Radio has made inroads. (Courtesy: Crutchfield.com)

as standard equipment. Up until that time, car antennas were optimized for AM reception. But as FM became more popular, antennas were optimized for that band. The exceedingly long telescoping antennas that work best for AM were unnecessary for FM.

Automobile designers seemed to be at war with the car antenna, seeking to minimize it for aesthetic reasons as well. First, antennas became short, ultrathin and painted black. Then someone had the bright idea to make the antenna a thin wire folded-dipole, embedded in the windshield. The antenna disappeared entirely! And, it performed best for FM (though not as well as the outside vertical it was designed to replace).

Kenwood Excelon KDC-X995 AM/FM/HD/Pandora (connected through your iPhone) for $329. (Courtesy: Crutchfield.com)

After 2001, as satellite radio was added to new model in-dash radios, the addition of a satellite antenna along with FM reception became the design priority. Then in-dash GPS receivers were added which required additional GPS antennas. This has resulted in the small, sculpted bumps on the rear roof of many cars, all optimized for GPS, satellite radio and FM. Sorry, AM.

One result of such engineering has been the nearly universal dissatisfaction car owners have with their radios' AM reception. As a test, I Googled, "Why is AM reception in my car so bad?" I found complaints on forums devoted to Chevy, Ford, Volvo, Honda, Hyundai, VW, Toyota – you name it. I read page after page of consumer complaints online that AM reception was poor while FM was great.

One of the blessings of FM reception, unlike AM reception, has always been that it is less susceptible to noise: atmospheric noise from seasonal static, power line radiation noise, ignition noise, alternator whine and sparkplug-radiated noise. In addition, FM was not subject to skywave fading at night. In the 1980s, drivers noticed the difference immediately and appreciated that car radios from that period typically had more buttons for FM station presets than for AM. Even today there are often two FM band presets labeled FM1 and FM2 and only one set for AM band presets.

For the first forty years AM radio was the king of the dashboard. But designers constantly sought competition for the radio. The FM option was first, followed by 8-track cartridge players, then cassette players, then compact disc players, then multi-disc changers, then satellite radio and finally USB ports for iPods and other MP3 players. Today, competition for the AM band in the car has never been greater.

The Hopeful Digital Future

In October 2002, in an effort to let broadcast radio compete with the growing popularity of satellite radio, the FCC gave its blessings to a broadcast industry consortium known as iBiquity to find a way to improve the audio for both AM and FM as well as allowing extra channels to be broadcast on the same frequency by the licensee. The result was an engineering scheme known to engineers as In-band On-channel (IBOC), but promoted to consumers by iBiquity as HD-Radio®.

HD FM has several advantages over HD AM, including multicasting and slightly better audio fidelity, approaching that of compact discs. The FCC does not allow AM HD to multicast, and those stations buying into the scheme will settle for audio fidelity approaching that of analog FM. But, one of the drawbacks of hybrid-mode transmitting is that the IBOC side of the transmission is heard on analog receivers as a loud hiss that makes listening to distant adjacent stations very difficult. The upshot is that IBOC transmissions help kill AM DX.

But, becoming an AM HD-Radio station is not cheap. In order to buy HD-Radio transmission equipment, stations must first buy a license from iBiquity to do so, the basic fee of which is $25,000. Equipment that stations need to purchase to actually get their licensed HD-AM signal on the air – including exciter/signal generators, data generators, HD-broadcast monitors, transmitters, studio transmitter links, antennas, filters and audio processors – run to tens of thousands of dollars more. These costs arrive at a time when AM station revenues have nose-dived, energy costs are rising, and listeners have scattered to a dozen other competitors. It's little wonder that, after nearly ten years, only 298 AM stations have bought into the scheme.

Jensen HD-5313IR AM/FM/HD-Radio in-dash receiver could be the cheapest after-market HD car radio available at $70. It also has a front-mounted AUX input. (Courtesy: Crutchfield.com)

Still, there are two movements afoot that could help AM stations, though not necessarily the AM band. The FCC is beginning to allow daytime AM stations to broadcast after hours on FM translators (low wattage FM transmitters originally designed to help FM stations fill in coverage to their primary service area). And more importantly, the FCC is allowing HD FM stations to re-broadcast AM stations in and out of their broadcast market on up to three multi-cast sub-channels. The best example of this is WJFK-FM Manassas, Virginia which re-broadcasts the signals of WJZ-AM (Baltimore), WIP-AM (Philadelphia), and WFAN-AM (New York). All four stations are CBS affiliates and all four are flagship stations for pro and college sports networks.

According to HD-Radio.com, other markets offer similar trans-band multicasting. In Los Angeles, KCBS-FM carries the separate programming of KCBS-AM; KTWV-FM carries KNX-AM programming; KLOS-FM carries KABC-AM, and KSCA-FM carries KTNQ-AM (Spanish programming). Similarly, in New York City most of the big AM stations are also available on the multicast channels on the station's sister FM outlet.

Another multicast approach is found at WUSN-FM, Chicago, which carries contemporary country music on its main channel, classic country music on its second channel and "At the Track: All Motorsports" on the third channel. This is bringing the FM side of HD-Radio extremely close to the Sirius/XM model. It's possible to imagine major markets offering, for instance, CNN News, Fox News, ESPN Radio, or other satellite radio/cable-TV programming on their multicast channels. WJCT-FM, Jacksonville, Florida carries the local NOAA Weather Radio station on a secondary HD channel as does WKIS-FM, Miami.

Many Internet true-believers see the salvation of broadcasting in a brave new, transmitterless, online world. But the statistics so far won't grant the wish. On-line broadcasting is unlikely to lift AM's downtrodden spirits anytime soon. According to a report from BIA/Kelsey, a telecommunications consultancy, radio industry over-the-air revenues as a whole, which began declining in 2008 and bottomed out in 2009 after staying relatively flat for the previous three years, are not expected to reach 2005 levels until past 2015. Online revenue makes up less than 5% of the industry's total income, according to the report. The online future of AM is just not relevant yet.

AM Listening in the Real World

Modern life has done no favors for AM reception. Ubiquitous inventions such as dimmer switches, compact florescent lights, computers, home routers, poorly filtered wall transformers, fiber optic digital cable-TV installations, microwaves, plasma screen TV sets and some appliances such as refrigerators and washer/dryers, emit all manner of electrical noise that is easily picked up by the average AM radio. Ever bigger, more numerous, and seemingly more leaky power line transformers set up to handle the increased power load modern homes, apartment complexes, condominiums and other densely packed human habitats demand, have piled their share of noise onto the band.

In the course of writing this article I did a lot of listening, both daytime and nighttime, to the AM band. In the car, reception was not great. Audio was poor (compared to FM reception) despite the excellent tuner and Bose speaker system. The AM tuner struggled with

Denon AM/FM/HD-Radio stereo receiver with surround-sound home theater audio; at $900 it's one of the lower priced, high-end, HD-capable receivers. (Courtesy: Crutchfield.com)

the windshield embedded antenna; noise from power line transformers came and went. Sitting at traffic lights, the noise often overwhelmed the audio entirely until I could turn the corner and move away from the electrical conflagration. If there had been no other options I might have stayed longer on the band. But, with an excellent FM tuner, in-dash CD player and iPod hooked into the in-dash audio through a cassette adapter, I was relieved not to have to listen to AM.

At home it was slightly better. With antennas optimized for the AM band, a relatively noise-free environment, and excellent AM tuner, I enjoyed listening to the Major League Baseball playoffs at night. The audio, even from a station 300 miles away was great; there was little band noise and I could hear the crowd noise in the background. With the help of a Radio Shack tunable AM loop antenna, positioned to achieve the best signal, there was little fading.

Sherwood RD7405HDR AM/FM/HD receiver ($230 at Sears) is one of the least expensive HD-capable receivers with surround-sound. (Courtesy: Sherwood)

But, since there's so little music on the band, it wasn't long after the game before I had flipped the band switch and tuned-in to truly great music reproduction from a local analog FM station that prides itself in audio fidelity.

During the daytime, I tuned the AM band using two different antennas, searching for HD-Radio signals on the Sangean HDT-1X. From the AM HD list, I found that there are five AM hybrid stations in Virginia with only three located in Richmond, close enough for possible reception. Of the three stations (WRNL 910, WRVA 1140 and WDZY 1290) only one station locked onto the IBOC signal enough to show the HD icon and display the station's call letters. A full HD signal couldn't be received from 40 miles away. On an analog radio all three came through with big signals.

I got luckier with nighttime listening, but barely. Tuning up and down the band many times with the Radio Shack loop on the Sangean, only WCBS-AM (300 miles away) locked the Sangean long enough to display the icon, call letters, radio slogan and slip into HD mode. The audio changed to nearly FM quality and it was great while it lasted. But, it didn't last. The signal faded enough to lose the HD audio but still displayed the icon, call letters and slogan. It was the only station I could get a lock on.

Your experience, especially if you live near a large metropolitan area, will be much better. Major markets, as seen above, offer a wide range of HD broadcasts on both bands. And, with the addition of in-dash HD receivers now being offered in most new vehicles and not uncommon in newer used vehicles, the urban HD experience will be extraordinary.

In today's economy, as satellite radio fees continue to rise (they're already at $15 per month for the cheapest plan in 2012, $17 per month if you have them send a paper invoice), "free" AM and FM HD reception looks really attractive in metro markets.

Is it the End for AM?

No. AM broadcasting is still at its best doing two things: Sports/Talk radio and local community radio. Despite the inroads of FM in the broadcast of major sports franchises, analog AM with its solid in-city signal and expanded nighttime listening market, is still the platform of choice. Across the U.S., tens of millions of avid sports fans tune in their favorite teams via AM radio. A quick check of the station affiliate lists for the biggest teams in sports shows that AM is still king.

And, all over small-town America, local voices presenting local news and talking about local issues dominate the AM band. These stations, with their blend of news and regionally popular music, keep the locals listening and the local merchants advertising. In so many ways AM still provides local communities with what will likely never be available on satellite radio or via some convenient or cheap app via smartphones or laptops, since the same signal is available on any cheap portable AM radio.

In 1968, according to FCC statistics, there were 4,236 AM radio stations in the U.S. As of March 31, 2011, there are 4,778. More than 4,300 of those stations are broadcasting in brilliant, old-school monaural audio. The dead snail pace of HD-Radio, glacial movement at the FCC and moribund economy insures that AM will continue to stay exactly where it is today for some time to come.

Is there a chance that another, possibly better, digital format such as Digital Radio Mondiale will take AM where HD-Radio can't? Not in your lifetime. If it took the FCC 30 years to come to a decision on AM stereo, there is zero chance it will change its mind on HD-Radio.

What if the FCC allows a power increase as they did for FM? Still no chance: The 4,300 other stations who haven't bought into the iBiquity scheme would flood the FCC with objections, fearing increased interference.

One thing that AM radio has going for it that broadcast TV does not, is location. Nobody wants the real estate where AM resides. It's safe from the clutches of mobile broadband, which is ironic because if there were suddenly some sort of technological breakthrough that turned the wireless broadband industry's interest to the AM band, I imagine there would be thousands of AM radio station sales in the space of a week.

Until then, we can enjoy this winter's AM DX season, build crystal sets and lay out Beverage antennas, because AM isn't dead, it's just moving really slow.

MT

CHASING AM HD-RADIO

As of this writing, there are 298 AM stations in the U.S. authorized to broadcast a hybrid HD-Radio signal. But, just because a station is authorized to do so, doesn't necessarily mean that it does. Broadcast consortium iBiquity, through their HD-Radio web site, provides a list of the AM and FM radio stations in each state licensed to broadcast IBOC hybrid signals. You'll find it here: www.hdradio.com/stations.

Click on your state then click on "View all Stations" to list them all. Then, check out the AM stations in the list (they're at the bottom of each state's list). Note that many FM stations listed, especially in major metro markets, carry AM stations on their multicast channels. You get AM with the FM sound! It should be noted that the list may not be entirely accurate. I found several discrepancies within the list and, while it's not clear how up to date it is, it is the best available.

The FCC maintains an official list of AM and FM IBOC hybrid stations which can be found here: www.fcc.gov/encyclopedia/iboc-digital-radio-broadcasting-am-and-fm-radio-broadcast-stations. Click on "AM list" to find a complete list of U.S. stations.

If you want to find out more information, for example, how much power a station is running, who owns it, day/night direction pattern, etc., do a search on the AM Query page: http://transition.fcc.gov/mb/audio/amq.html.

The FCC does not maintain a list of AM stereo radio stations of which there are fewer than 100, according to the only list I could find at http://meduci.com/stations.html.

Kaito tunable AM antenna ($30) is a good replacement for Radio Shack's discontinued model. A similar loop is also available from Grove Enterprises and Universal Radio at about the same price. (Courtesy: Kaito USA)

White Space
New Wireless Devices coming to your Neighborhood

By Kevin Parrish

Kevin Parrish goes to work (Courtesy: Author)

Radio enthusiasts know a lot of terms and jargon used within the hobby, but have you ever heard of "White Spaces?" Many low-power wireless communication devices operate on a wide range of frequencies from DC to daylight. These include common wireless gadgets that we often take for granted, such as garage door openers, headset intercoms used at your favorite fast food restaurant, baby monitors, as well as medical and security devices.

When you watch your favorite NFL game, have you ever wondered how the referee's voice commands such power down on the field as the man wearing the black and white stripes announces a 20-yard penalty? He's using a wireless microphone to make that call and guess where his wireless microphone lives? If you guessed white spaces, you've scored a touchdown!

Where are the White Spaces?

The term white spaces refers primarily to unused portions of the UHF television broadcast spectrum where no incumbent television transmissions exist within a given television market. White space spectrum as a whole encompasses TV channels 2 through 51. However, in most cases the primary use of this spectrum by low-power devices occurs at frequencies above 470 MHz.

Monitoring enthusiasts located in the 14 largest metropolitan areas of the country, such as New York City, Los Angeles, San Francisco, Chicago and Boston, are quite familiar with various Land Mobile Radio Services (LMRS) operating at 470-512 MHz frequencies within the UHF "T-Band" on TV channels 14-20.

As an example, New York City has no on-air incumbent television transmissions on UHF TV channel 14, which then makes frequencies from 470-476 MHz available for LMRS and other uses. Television channels used in the United States are 6 MHz wide.

(Courtesy: Shure Corp.)

Low-Power wireless equipment has been operating for many years within the UHF television broadcast spectrum on TV channels 14 through 69 (470 through 806 MHz) even prior to the introduction of LMRS within the UHF T-Band more than 30-years ago.

This valuable wireless spectrum serves as home turf to myriad devices, such as wireless microphones, in-ear monitors, wireless assist video equipment and related devices. These are routinely used in the production of television news broadcasts, musical productions, concerts, Broadway theatricals, motion picture and video production, along with sports events, just to name a few.

RF spectrum continues to play a vital role in our everyday lives, and agencies such as the Federal Communications Commission (FCC) have initiated various commitments to address the growing demand for wireless broadband Services in the United States. The FCC's National Broadband Plan, issued in March 2010, recommends making 500 MHz of spectrum between 225 MHz and 3.7 GHz available to facilitate unlicensed wireless broadband services.

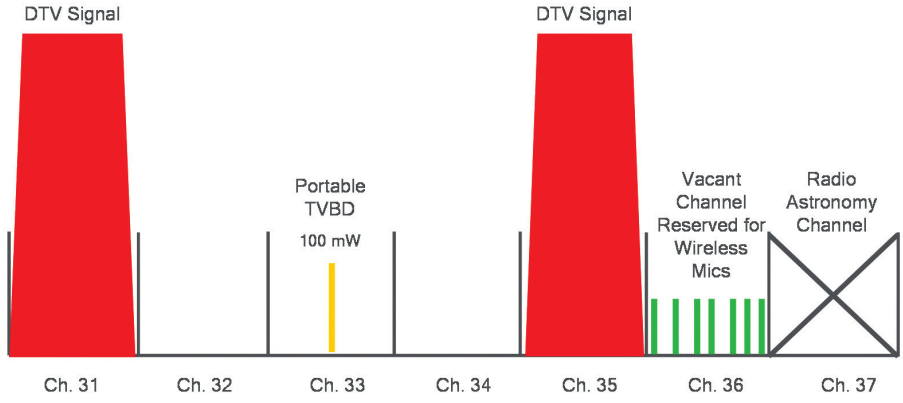
FCC spectrum initiatives that took effect on June 12, 2010 have re-allocated the entire 698 - 806 MHz range, generically called the "700 MHz Band," which became available to support 700 MHz Public Safety Communications, along with various spectrum segments assigned to Advanced Wireless Broadband Services (AWS).

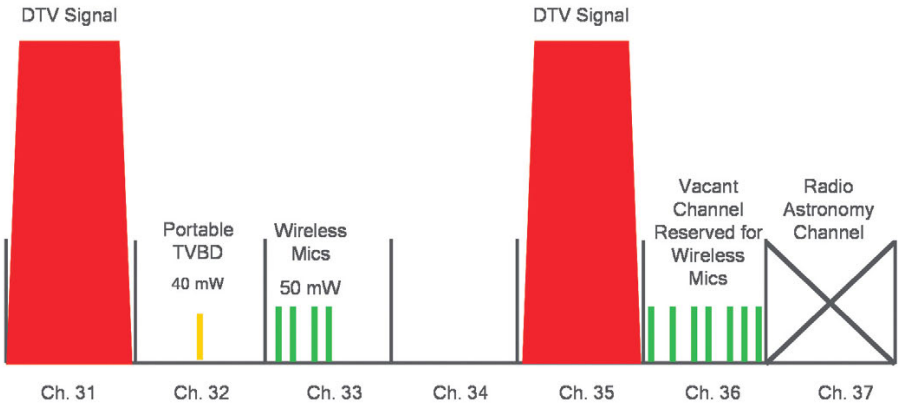
This range of spectrum was reallocated as follows:

698 – 758 MHz "AWS" Advanced Wireless Services
758 – 763 MHz "D-Block" Reserved for future spectrum auction
764 – 776 MHz "Public Safety & Emergency Communications"
776 – 788 MHz "AWS" Advanced Wireless Services
788 – 793 MHz "D-Block" Reserved for future spectrum auction

Spectrum reallocations for frequencies within 698 – 806 MHz of the UHF T-Band were achieved after FCC rules mandated the transition from analog to digital television (DTV) broadcasting. FCC rule changes and DTV conversion permanently eliminated TV channels 52 through 69 (698 – 806 MHz) within the United States.

On September 23, 2010 the FCC issued a ruling allowing wireless broadband devices to utilize white spaces within the UHF television broadcast spectrum. This rulemaking permits a new class of wireless broadband devices, which are known as Television Band Devices (TVBDs) to operate on un-used UHF TV channels.





Courtesy, Sennheiser Electronic Corporation

TVBDs are being developed to support both "fixed" and "personal/portable" applications, delivering wireless broadband services in what many people are calling "Super WiFi" or "WiFi on Steroids." This type of equipment may be used to support rural and metropolitan broadband Internet, multimedia services, home network systems, Local Area Networks (LANs), along with future consumer electronics products.

Fixed and portable TVBDs are permitted to operate on unoccupied television channels, but they may not cause harmful interference to licensed users such as TV stations and production wireless equipment.

Fixed TVBDs are allowed to operate with an effective radiated power up to 4 watts on TV channels 2 through 51. FCC rules specify that fixed TVBDs may not operate on TV channels 3, 4, and 37. Additionally, the rules specifically state they cannot operate on any channel, which is "adjacent" to an active (on-air) TV channel.

Courtesy, Sennheiser Electronic Corporation

The "personal/portable" class of TVBDs are low power devices which are limited to a maximum output of 100mW or 40mW if operating in a channel adjacent to an active (on air) television station. Additional restrictions for personal/portable TVBDs permit operations on TV channels 21 through 51 (512 – 698 MHz) only. They cannot operate on TV channel 37 (608 – 614 MHz), which is used to support radio astronomy.

As one might imagine, the introduction of additional unlicensed wireless equipment sharing the same RF spectrum with television stations, UHF T-Band Land Mobile Radio Services, wireless microphones, and other types of low-power wireless equipment currently operating from 470 through 698 MHz, has a significant potential to cause interference to existing users.

The problem immediately becomes how to manage wireless devices sharing the same spectrum and, most importantly, having them operate effectively without causing interference to existing wireless services.

So, How does all this Work?

Under initial FCC rules, the TVBDs were designed to use geo-location and database access to determine which TV channel they may operate on. Additionally, requirements for this type of equipment stipulated that TVBDs could use geo-location and database access or "spectrum sensing" to detect the presence of incumbent users like TV stations, wireless microphones and so forth.

Initial testing of prototype TVBDs proved that spectrum sensing, although a highly desirable feature designed to protect and avoid causing interference to existing users, was unreliable and troublesome for equipment designers. Spectrum sensing technology incorporated within the test devices failed on several occasions during laboratory and multiple field tests. The sensing thresholds were reduced from –114 dBm to –107 dBm, but problems within the initial prototype TVBDs remained an issue.

On January 26, 2011 a revised FCC Order (ET Docket No. 04-186) states that in order to prevent interference to authorized users of the TV bands, TVBDs must include a geo-location capability and the capability to access a database that identifies incumbent users entitled to protection, including, for example, full power and low power TV stations, broadcast auxiliary point-to-point facilities, two-way LMRS operating on TV channels 14-20 (470 – 512 MHz), and the Offshore Radio Telephone Service.

Fixed and personal/portable unlicensed TVBDs are required to query a database, which identifies the available channels at their geographic location of operation. The FCC order conditionally designated nine entities as TVBDs database administrators, recently adding Microsoft to the list.

As this new generation of wireless equipment continues to evolve and eventually makes its way into consumer markets in the very near future, users of professional production wireless equipment are voicing many concerns. Technical operating procedures and safeguards are now being established within this industry in order to prevent interference from TVBDs equipment.

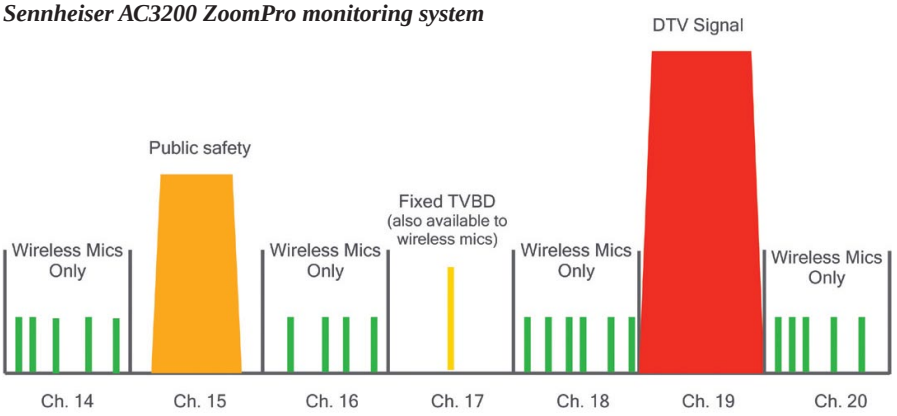
The IEEE (Institute of Electrical and Electronics Engineers) has recently established a new technical standard known as 802.22 Wireless Regional Area Network (WRAN) for this class of devices which utilize white spaces spectrum. For those who currently operate existing low-power wireless equipment within the 470 – 698 MHz spectrum, the greatest concern is the protection of interference emanating from TVBDs, which are now permitted to share this spectrum with incumbent users.

In March 2011, during the Cellular Telecommunications Industry Association (CTIA) Trade Show in Tampa, Florida, an unlicensed, non-FCC type-accepted TVBD being demonstrated at the show caused destructive interference to television broadcasters' wireless microphones. Fortunately, in this instance, the RF engineers involved with the remote-broadcast utilized mobile direction-finding techniques and quickly located the offending TVBD transmitter.

This is the first reported case of harmful interference to a licensed low-power broadcast auxiliary user caused by TVBDs. After a prompt visit from the FCC, this particular TVBDs transmitter immediately became a "silent station" and caused no further interference!

How do we ensure that emerging wireless technologies such as TVBDs operate efficiently without causing harmful interference to others? Low-power wireless equipment, such as wireless microphones, have become ubiquitous within our society and are routinely used by many people supporting various production activities. Some wireless microphones and related production wireless equipment are licensed,

Sennheiser AC3200 ZoomPro monitoring system



UR4S+ Front and Rear Panel

UR4D+ Front and Rear Panel

Shure UR4 Diversity receiver UHF wireless mic system. (Courtesy Shure Corp.)

but the majority of those currently operating (estimated in excess of 500,000 transmitters) within the United States are unlicensed at the present time.

Television broadcasters and many users of professional wireless audio equipment such as motion picture production entities can obtain a license from the FCC for the operation of this type of equipment which operates within the Broadcast Auxiliary "Low-Power" Radio Service (FCC Part-74, Subpart-H, Sec-74.801).

Under FCC rules, licensed users are afforded interference protection from TVBDs. The process of initiating this protection to eligible licensees involves the newly added step of registering their frequencies, at least 24-hours in advance of intended operation with a TV bands database administrator.

Here's a basic example of how the registration process is designed to work: As a licensed professional wireless audio equipment user – let's say the Statesmen Quartet in this example – will be going on tour and the first stop is the rural community of Brasstown, North Carolina.

They don't want any problems during their performances in Brasstown (the Statesmen Quartet have some big fans there), so the group's technical staff determines in advance just what types of wireless gear is needed to support the production and, most importantly, which wireless equipment is frequency compatible for use in this area of North Carolina.

Where is Brasstown, anyway? Well, let's have a look at Google Earth and see what we can find out. You need to know where you're going before you can tell the TV bands database administrators and submit your white spaces frequency registrations.

Google Earth reveals that Brasstown, North Carolina is located at 35-02-22 N / 083-57-24 W and it's somewhere up in the hills at 1,611 feet AMSL. Various online tools will tell us what UHF television stations may be operating within the vicinity of our venue. Remember

Sennheiser AC3200 professional monitoring system. (Courtesy: Sennheiser Corp.)

Shure ULX Wireless mic system(Courtesy: Shure Corp.)

that all of our professional wireless equipment operates from 470 through 698 MHz. A quick check indicates that we have mostly UHF television translators to worry about, rather than full power or low power television stations in the immediate area.

A determination is made by the technical engineering staff to utilize frequencies within TV channel 45 (656 - 662 MHz) to support the use of the Statesmen Quartet's wireless microphones, in-ear-monitors and wireless intercom equipment. This television channel was specifically selected because there's no existing TV-45 on-air within many miles of Brasstown, North Carolina.

Now that we have our list of frequencies that we want the Statesmen Quartet to use up in the rolling hills of Brasstown, we need to submit a white spaces TV bands registration to one of the TV bands database administrators. In order to submit an online registration to the database administrators, FCC rules require basic information be sent electronically to all 10 of the TV bands database administrators. Now it stands as an "electronic signpost" or marker to TVBDs that TV channel 45 is being used within a geographically defined radius of Brasstown, North Carolina.

The devices then use their built-in geolocation function to identify their current operating position (Lat/Long) and then receive the database downloads from the TV bands database administrator which identifies all available channels the TVBDs' may utilize. If all goes well at the concert in Brasstown, they won't have to worry about any interference from other TVBDs which may be operating within the same vicinity.

The concept of TVBDs utilizing white spaces spectrum for operations in rural communities where broadband services may not be easily available is valid, and it makes good use of otherwise unoccupied spectrum where it's possible to do so. However, this concept becomes increasingly problematic when we move from rural locations to large metropolitan areas such as New York City.

The problem is further compounded by the anticipated widespread use of personal/portable TVBDs which makes spectrum management that much more difficult. As the personal/portable devices move from location to location, "dynamic spectrum management" takes on a completely new complexity.

Currently in rural Northern California, tests of TVBDs using white spaces spectrum is underway at the Yurok Indian Reservation. The reservation, which is located near Klamath, California, encompasses a very large geographical area and is spread across many miles of

mountains, valleys and coastal terrain.

The availability of reliable high-speed broadband services supporting the residents of this Native American community is reported to be limited, and therefore the use of TVBDs' using white spaces spectrum is a very good example of where this new wireless technology is able to serve many people without causing interference to other incumbent services.

Due to its rural location on California's' Northern Pacific Coast, there isn't much activity from incumbent television stations within the area. The closest full-power TV stations, for example KVIQ (TV-17) and KAEF (TV-28), are licensed at transmitter sites over 50 miles from Klamath, CA. Several UHF Television Translators are licensed in this area, but even with existing users, several channels become available to support TVBDs. The available spectrum for TVBDs is manageable in rural locations and more widely available to serve multiple uses than it is within large metropolitan areas where demand for wireless spectrum consistently exceeds availability.

As new wireless broadband equipment and advanced wireless technologies continue to make their way into our daily lives, the problem remains: what spectrum they will call home? The present cultural desire to move about freely on a worldwide basis without boundaries as a "universal wireless mobile society" will ultimately dictate the next chapter for the development of emerging wireless technologies. Hopefully the trend will promote unbiased and effective spectrum management which serves the needs of us all.

About the Author:

Kevin Parrish has been working within the television broadcast industry since 1973. His area of specialty is RF engineering & wireless system design related to television remote-broadcasting, wireless pro-audio, special event production and breaking news events. Mr. Parrish has been actively involved in spectrum management and frequency coordination for many years within the broadcasting and remote-production industries. In his spare time he enjoys volunteer public service activities, amateur radio (N6LUI), disaster planning and emergency management along with being an active professional monitor radio enthusiast.

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Terrestrial Trunked Radio (TETRA)

New technology is changing the way scanner listeners monitor radio signals. We have a number of effective consumer-level scanners available from retail locations and via the Internet. These radios provide ordinary listeners with the ability to monitor complex digital signals with relatively little effort. This month we take a look at a growing digital radio technology that may become more common in the United States.

❖ TETRA

Here in the U.S. we are used to hearing about APCO Project 25 as the leading digital public safety radio system. In other parts of the world, however, there are other technologies already in widespread use.

TETRA, which originally stood for *Trans-European Trunked Radio*, is a set of standards that define different parts of an all-digital trunked radio system. TETRA standards were first approved in 1995 by the European Telecommunications Standards Institute (ETSI) and are currently in use in more than 100 countries. TETRA now stands for *Terrestrial Trunked Radio*.

Hundreds of networks across Europe have been put into service since the first one came on the air in 1997. TETRA has been formally accepted in China and South Korea and new systems are in operation in Africa, Asia, the Middle East and South America. Public safety is the largest segment for TETRA, followed closely by transportation operations like mass transit and major airports.

TETRA supports a number of services, including group calls (what we would call talk groups), individual calls (from one radio to another radio), and two main types of data transfer mechanisms. All of these services may be transmitted either encrypted or unencrypted ("in the clear").

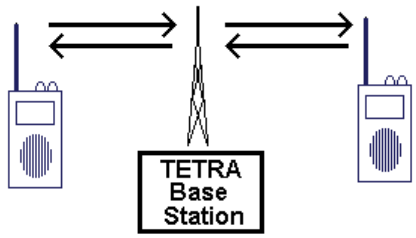
❖ Jargon

Like most standards, TETRA has its own jargon and abbreviations.

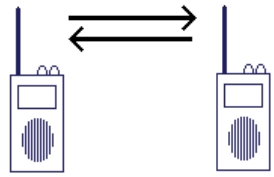
The user's radio is referred to as a Mobile Station (MS) and the repeater site is called a Base Station (BS).

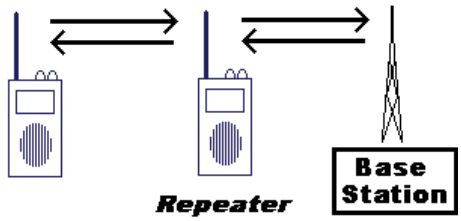
TETRA has two types of air interface standards, which are the specifications that define how radios communicate over the air with base stations and with other radios. The first air interface is the radio link between a mobile station and a base station and is called Trunked-Mode Operation (TMO). It uses the Switching and Management Infrastructure (SwMI) of base stations, which is the wired part of the TETRA network.

In areas where there are no base stations, or if a base station fails for some reason, TETRA supports a second air interface called Direct-Mode Operation (DMO), which allows radios to form a local network among themselves without needing any fixed network infrastructure.



Trunked Mode Operation


Direct Mode Operation



Gateway Mode Operation

A combination of the two air interfaces comes into play when a mobile station acts as a relay for out-of-range mobiles. This is known as Gateway Mode Operation (GMO).

TETRA has the ability to form talkgroups "on the fly" with a capability called Dynamic Group Number Assignment (DGNA). Participants from different departments and agencies can all be quickly placed into a common talk group, allowing them to communicate directly with each other.

TETRA has 16 levels of priority, allowing critical users to access the network even during times of heavy load, while lower priority, routine traffic may be denied. This is an important feature during emergencies when a large number of users are active, ensuring that critical transmissions get through. Contrast that with many cellular telephone systems that quickly become overloaded during unusual events.

An interesting feature of TETRA systems is the ability of a dispatcher to place a radio into "Ambiance Listening" mode, allowing him or her to hear sounds within range of the target radio's microphone. This is sold as a safety feature, giving supervisors the ability to hear background conversations and noises without the user having to manipulate the radio. On the other hand, some officers find this capability to be an invasion of privacy and are careful to place their radio where the microphone cannot pick up "off the record" conversations.

❖ Data Services

In addition to voice, TETRA offers the ability to transfer data. At the low end, the Short Data Service (SDS) can move up to 256 bytes of data, allowing users to send and receive small text messages, location information, and other brief updates. If more information needs to be passed, the Packet Data Service (PDS) can support a bit rate of up to 4,800 bytes per second. There is also a "bandwidth on demand" capability to deliver at rates as high as 19,200 bits per second by having the radio transmit during all four time slots.

TETRA radios can be attached to Global Positioning System (GPS) receivers and Automatic Vehicle Location (AVL) units to automatically deliver the radio's geographic location to the dispatcher and other users.

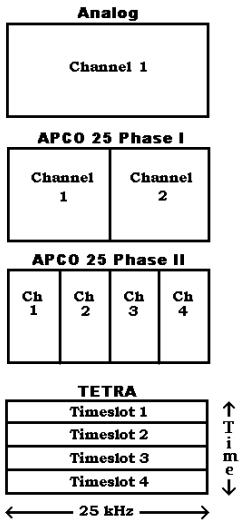
❖ Air Interface

In analog radio systems and current APCO Project 25 networks, a single radio uses a radio channel continuously for the duration of a transmission. No one else can use that channel while the user has the push-to-talk button depressed. This method of using a radio resource is called Frequency Division Multiple Access (FDMA) and requires an entire frequency be dedicated to that one transmission.

In contrast, TETRA uses a technique called Time Division Multiple Access (TDMA), where a single radio frequency is shared between

multiple radios. By dividing up the frequency into short duration segments called slots, the participating radios can take turns transmitting.

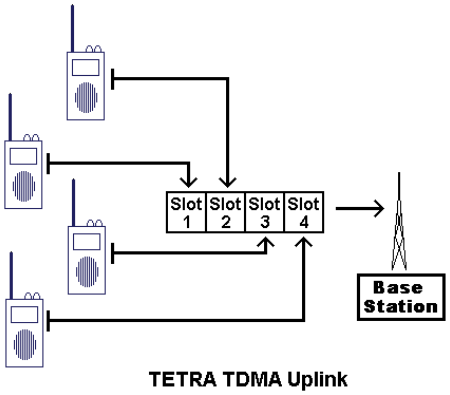
To get an idea of how this works, imagine four people in an auditorium sharing a single microphone. A big clock on the wall has a second hand that every one can see and the speakers agree to divide up each minute into four equal periods of 15 seconds each. So, from the top of the minute to 15 seconds after, speaker number one uses the microphone. This is the first time slot. When the clock shows 15 seconds, the first speaker stops talking and steps away from the microphone. The second speaker steps up to the microphone and begins talking from then until the clock shows 30 seconds. This is the second time slot. At 30 seconds, the second speaker steps away and the third speaker steps up, talking during time slot three until the clock shows 45 seconds. At that point the third speaker stops talking and the fourth speaker begins talking as time slot four begins. At the end of time slot four, which is the top of the minute, speaker four stops and speaker one returns to the microphone, picking up where he left off. This is time slot one again and the "round robin" sharing continues until each speaker finishes delivering his or her respective speech.



In a TETRA network there are four slots carried in a single 25 kHz radio channel, where each slot is 14.167 milliseconds long. All radios are synchronized to the same time base, so they all know exactly when each time slot begins and ends. Each participating radio is assigned the use one of the four slots. Like the speakers in our example, each radio starts at a specific time, transmits during the time slot, then stops. So, Radio 1 transmits during the 14 milliseconds of time slot 1, then stops. Radio 2 then transmits for 14 milliseconds within slot 2, followed by Radios 3 and 4, each taking their turn within their corresponding slot.

From an efficiency standpoint, current P25 systems can fit two simultaneous users in a single 25 kHz channel by allocating 12.5 kHz of bandwidth to one user and the remaining 12.5 kHz to the other user. Each P25 user gets exclusive use of the frequency for as long as they hold down the push-to-talk button. In comparison, TETRA is able to fit four users into a 25 kHz channel by having each of them take turns using the entire bandwidth. This is the equivalent of one user per 6.25 kHz, which meets the upcoming Federal Communications Commission (FCC) requirement for "narrowband" operation.

In the same way each radio is assigned a time slot in which to transmit, it is also assigned a different time slot during which it will receive. A TDMA radio will tune to a transmit frequency just prior to its assigned time slot, transmit during that slot, then tune to a corresponding receive frequency and actually receive data during the proper receive time slot. This alternating transmit-then-receive process is known as *half-duplex* operation and allows manufacturers to build simpler and therefore less expensive equipment, since a radio does not have to transmit and receive simultaneously (which is known as *full-duplex* operation).



TETRA TDMA Uplink

Digital Voice

TETRA is a fully digital system, so voice activity is carried in digital form as well. Sound from the radio's microphone is sampled 8,000 times per second and digitally encoded via a method called Adaptive Code Excited Linear Prediction (ACELP), creating a data stream of 4,567 bits per second. This method is not compatible with the proprietary method called IMBE (Improved Multi-Band Excitation) used in P25 systems.

ACELP is described by TETRA proponents as "very good" and usually provides better clarity than IMBE. Error correction is added to the data stream to protect it from bit errors encountered during transmission, bringing the data rate up to 7,200 bits per second. The bit stream is broken up into smaller segments so that it will fit into a time slot.

Four TETRA slots in sequence are called a *frame* and there are 17.65 frames every second. A total of 18 frames make up a *multiframe*, which just over one second long. For transmissions from the base station to the mobile station (called the *downlink*), 17 of those frames carry traffic, while the 18th frame carries signaling and other system related information as well as SDS traffic.

Encryption

Transmissions in TETRA systems may be encrypted via one of four TETRA Encryption Algorithms (called a *TEA*) that are specified in the standard. Which algorithm is used depends on the system and where it is operating. TEA1 and TEA4 provide basic security, while the more powerful TEA2 is reserved for European public safety systems. TEA3 is implemented in systems where TEA2 would normally be used but is not legally or administratively available, including areas outside Europe.

TETRA supports both air interface encryp-

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tion and end-to-end encryption, meaning that transmissions can be encrypted just between a radio and a base station or they can be encrypted at the originating radio and only decrypted at the destination radio.

Cryptographic keys may be changed directly through a physical connection to the radio or via over-the-air rekeying (OTAR), where new keys are transmitted to the radio via a normal radio channel.

TETRA supports an additional level of protection related to encryption called *authentication*, which is the process assuring that only properly authorized users can access the network. TETRA supports mutual authentication, meaning that a radio can authenticate a TETRA network and the network can authenticate a radio. This prevents unauthorized users from using the network and prevents a radio from being spoofed or tricked by an illegitimate base station.

Mobile Country Code	Mobile Network Code	Short Subscriber Identity
10 bits	14 bits	24 bits

TETRA Subscriber Identity

❖ Identification

Every TETRA subscriber is identified by a unique number called the Individual TETRA Subscriber Identity (ITSI). It is somewhat like a telephone number and consists of a mobile country code (MCC), a mobile network code (MNC), and a short subscriber identity (SSI). In a similar manner, a talk group is identified by a Group TETRA Subscriber Identity (GTSI).

A mobile station sends group membership information to the SwMI when it connects to the TETRA network. This is part of the *registration* process that lets the network know that the radio is now active and can be reached via a specific base station.

When a mobile station wants to start a conversation, it sends the GTSI (which represents the talk group that the user selected) to the SwMI. In turn, the SwMI allocates a traffic channel on every base station within the area and broadcasts a message to other listening mobile stations, letting them know that a talk group is active and on which traffic channel it can be found. Because the network knows where each participating radio is located, it may choose to reserve traffic channels only on base stations that are serving those radios.

❖ TETRA in North America

In 2009, the TETRA Association filed a request for a waiver of Federal Communications Commission (FCC) rules. In April 2011, the FCC approved part of that request and now allows TETRA equipment to be used in the United States for business, transportation and industrial uses in the 450 to 470 MHz bands as well as the Enhanced Specialized Mobile Radio (ESMR) portions of the 817 to 824 MHz and 862 to 869 MHz bands. The approval specifically did not include the use of TETRA equipment by public safety agencies, although the FCC asked for comments and plans to address the issue in a rule-making procedure.

Industry Canada followed suit in July 2011 when it revised the Radio Standard Specification (RSS) to allow TETRA equipment to operate in Canada under similar restrictions.

❖ Canada

BC Hydro, a large Canadian electric power utility, has awarded contracts to install what they claim will be the first fully operational TETRA network in North America. The network will have 25 base stations operating in the 400 to 450 MHz range, serving about 800 handheld and mobile radios, as well as 20 fixed units in the Vancouver area of British Columbia. The network will be installed in two phases and is expected to be fully operational by October 2012.

BC Hydro had conducted an evaluation of TETRA in 2009 with a three-site installation serving 20 radios and came away pleased with the performance of the technology. Their Request For Proposal (RFP) asked for a digital mobile radio network to cover the lower mainland area of British Columbia and welcomed proposals from competing technologies, including APCO Project 25 (P25), Digital Mobile Radio (DMR) and iDEN. As it turned out, the TETRA proposal had the highest score from the BC Hydro bid evaluation team.

❖ New Jersey

In November 2010, the first TETRA pilot network in the United States went live in New Jersey. Two repeater sites were set up for New Jersey Transit, the third largest transit system in the country, as they tested various technologies to replace their aging analog VHF radio system. The pilot was completed in October 2011 and successfully demonstrated TETRA voice capability in the equivalent of 6.25 kHz channels as well as higher speed data connectivity.

❖ Wisconsin

Just a year ago, a TETRA demonstration project also went live in northeast Wisconsin near the City of Green Bay. Several equipment and service providers set up three base stations along Route 41 in the towns of Appleton, DePere, and Oshkosh, and operated more than 30 radios during the demonstration period. The goal was to show the features and functionality of TETRA technology to potential U.S.-based customers.

The project transmitted on two UHF radio frequencies from DePere, giving it the equivalent of eight user channels, and one UHF radio frequency each from Appleton and Oshkosh, providing each site with four user channels.

A significant challenge to widespread adoption of TETRA in the United States is finding a sufficient number of unused radio frequencies that are 25 kHz wide, the necessary size for TETRA's TDMA operation. For years now the FCC has been trying to make more frequencies available by splitting up the available spectrum into 12.5 kHz channels and is planning for a transition to even smaller, 6.25 kHz channels, so finding enough contiguous space to operate may be difficult.

❖ TETRA Decoding

The question that really matters to scanner listeners is, if TETRA really comes to the United States, will we be able to monitor it?

The TETRA standards are defined by ETSI and are open and available for anyone to study, so implementation of a receiver is certainly possible. In fact, a German programmer named Harald Welte has already written a software-based decoder that can receive, demodulate, and decode signals from a TETRA base station and provide low-level, raw information. His Osmocom TETRA project (found at **tetra.osmocom.org**) is a research-oriented effort to understand the air interface and provide an open source software tool to take in radio signals and output a bit stream. Please note that it is not a complete monitoring package and is intended for software engineers rather than casual listeners, but it does prove the point that capturing and decoding TETRA signals is feasible.

It is also important to point out that the Osmocom decoder, or any other TETRA monitoring tool, does not decrypt the contents of encrypted transmissions. This probably rules out the practical likelihood of monitoring public safety agencies that use TETRA, should that eventually be allowed in the United States. It has proven to be a significant hindrance in Europe, where public safety agencies use encryption on nearly all of their traffic. Interestingly enough, Mr. Welte has determined that although government agencies routinely encrypt their TETRA transmissions, private users typically do not.

That's all for this month. As always, I welcome your questions, comments and reception reports via e-mail at *danveeneman@monitoringtimes.com.* You can also find more radio-related information on my web site at **www.signalharbor.com**, including digital scanner comparisons, security reports, and software defined radio links. Until next month, keep scanning! Happy New Year!

ASK BOB

GENERAL QUESTIONS RELATED TO RADIO

Bob Grove, W8JHD
bobgrove@monitoringtimes.com

Q. *Do properly installed lightning rods protect the house from lightning strikes? Or does the lightning branch off to the internal wiring, plumbing and other metal within the house? (John Bishop, Hawthorne, FL)*

A. Lightning paths are hard to predict, but it does look for the lowest resistance path to ground. The main problem you may face in spite of such protective measures is that Florida's sand is a poor conductor. Unless you prepare a good ground field with large-gauge conducting cabling, the lightning may not show a preference for the rods. Still, since it's a toss-up, you'd be better off with the ground rods than without.

Q. *Will adding two adapters to a connector on the end of 18 feet of RG58 cable to a mobile scanner adversely affect the reception? (Robert Young, email)*

A. RG-58/U is useful at HF (under 30 MHz) in lengths of up to 100 feet or so. At higher frequencies, its losses (signal voltage absorption by its insulation and poor shielding) go up dramatically. But at such short lengths as you have (18 feet), you wouldn't hear the difference on your scanner between RG-58U and the most expensive cable you can buy.

As for the adapters, it all depends on their quality. We have measured the loss of our RG-6/U fitted with F connectors, then connected with our adapters, giving a loss of maybe 1 dB at 1000 MHz. Not discernible under normal listening conditions.

Q. *VHF/UHF radio transceivers used in the Part 90 (land mobile services) become obsolete in 2013 when the new bandwidth specifications are mandated. Couldn't these radios still be used in Part 95 (GMRS) which doesn't require the narrower bandwidth? (J.J. Owens, NC)*

A. They could if that was the way they were certified, but since they weren't, the radio won't be good for anything but Part 97 (amateur radio) services. The FCC is very specific about this. Regardless of whether or not a radio meets the specifications of another service, it must be registered for the service(s) for which it is intended to be marketed and duly marked with that certification.

Q. *I am replacing the power supply that came with my ICOM R75 receiver with another unit that has an on/off switch. Is there any reason I can't simply switch off that power supply, thus automatically shutting off the receiver, so that the power supply doesn't continue running as it did when I turned off the receiver separately with the original power supply? (Larry, email)*

A. The only reason that there are no on/off switches on AC/DC power supplies like those that come with the R75 and similar accessories is that those accessories already have an on/off switch, so it saves manufacturing costs. The bottom line is that you can go ahead and turn the power supply off. Everything will stay cooler and you won't waste electricity energizing the unused power supply.

Q. *How will the new narrowbanding rules set for 2013 affect scanner listening? (Mark White, email)*

A. Basically, the narrow-banding rule does two things. It dictates the bandwidth of the signal to be only half as wide (+/-7.5 kHz instead of +/-15 kHz), and it adds interstitial channels between the old allotments. For example, instead of three successive VHF channels being 15 kHz apart (155.145, 155.160, and 155.175 kHz), add two more in between, making them 7.5 kHz apart: 155.1525 and 155.1675 MHz.

If your old scanner can only program larger spacings like 15 kHz, you are likely to lose reception of those new, narrower channels. If it allows narrower spacing like 5 kHz, then even if it's not right smack dab on the center of the channel, it will still pick up the signal due to the wide shape factor of scanner filters.

However, the new, narrower modulation (deviation) means that old scanners will suffer a quieter audio recovery than when listening to older, wider deviation signals. The fix? Just turn up the volume a bit!

Q. *Older model marine radios had their microphones connected via connectors on the front panel; now they are hard wired. Why? (J.J.O.)*

A. I can think of two reasons: to avoid the prospect of corrosion from saltwater intrusion, and they are cheaper.

Q. *We have a wireless microphone for our minister's church service; it's on 72.9 MHz. There is some sort of strong interference that interrupts his sermon. Any suggestions on how to find the offending device during this era of widely-distributed electronics? (Keith H., Hayesville, NC)*

A. I can think of several:

1. Set up a spectrum analyzer on 72.9 MHz before you turn on the wireless mike. If you see a signal spike on there, you can carry the spectrum analyzer around, plugging it into other outlets and watch the spike get weaker/stronger until you find the source.

Alternatively, you can hook a long length of coax to the input jack of the spectrum analyzer, connect a short whip to the far end and carry that around while you look back at the signal spike.

2. Acquire a hand-held scanner that includes 72.9 MHz reception and walk around listening for the signal to get stronger.
3. If you don't find a signal before the congregation arrives, you can be pretty sure it's one of them. Set up the spectrum analyzer at the entrance and watch for the signal to appear when the guilty party walks in.
3. Do a strip search of the incoming parishioners and confiscate anything that looks electronic. (I'd opt for 1, 2, or 3.)

Q. *I'm having lousy reception in my apartment with my cell phone. Are there passive or even active personal repeaters for cell phones? (Jim Rubin, KC2LMH, Forest Hills, NY)*

A. There are no passive repeaters which, by their very design, would actually reduce signal power rather than boost it. Active (amplified) cell phone repeaters do exist, but they are under considerable scrutiny at the moment because of possible interference with other users on those frequencies.

Cell phone boosters -- bi-directional amplifiers (BDAs) -- come under Part 15 of the FCC Rules and Regulations and are currently lawful to use. The Cellular Telecommunications Industry Association (CTIA) is pressuring the FCC to outlaw BDA systems.

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

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Hugh Stegman, NV6H
mtutilityworld@gmail.com
www.ominous-valve.com/uteworld.html
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Russian Spy Caught Decoding "Numbers?"

This column is being written on Halloween. It's a perfect day to start with the latest "spook" story involving shortwave "numbers" broadcasts!

This lurid tale begins in Balingen, Germany, at 6:30 in the morning, local time. This is when agents of the GSG-9 special operations division of the German Federal Police busted in the door of "Heidrun A.," an alleged spy for Russia. She is accused of being hard at work with a "wireless transmitter that was receiving encoded messages on a shortwave frequency and was hooked up by cable to a computer."

The accusation goes on to state that she then "fell off her chair and pulled out the connecting cable between the receiver and the computer, thereby interrupting the recording of conspiratorial messages coming from the radio, accompanied by a special identification tune." It is not known what this "tune" was, or whether in fact it even existed outside the imaginations of news writers who've heard too many radio shows about the "numbers" scene.

Back in the real world, "numbers" fans have been trying to determine which particular station could have been transmitting a copyable signal into Germany at this particular time of day. Possibilities were quickly narrowed down to two known transmissions from Russian intelligence. These are the ones called M12 and XPA by the European Numbers Information Gathering and Monitoring Association (ENIGMA 2000).

M12 is a Morse code broadcast from the same Russian intelligence sections responsible for the various, rather creepy, machine-voice transmissions with names like the English Man (E07), German Lady (G07), and several others. XPA is the Polytone, a weird-sounding broadcast using sequential audio frequencies. There are 20 of these tones: ten correspond to the numeric figures, and the rest are for various formatting and control functions.

The speculation is that M12 and XPA are both for the type of machine decoding described in the news accounts, and that XPA might even have been the "tune" mentioned therein. Unfortunately, both broadcasts made in that time frame were null messages. The question remains open.

This bust has already been linked to the more widely covered Chapman arrest in the United States. "Heidrun A." and her husband are alleged to be semi-retired "sleeper" spies, who served various mailbox functions for more important operations in other countries.

Hopefully, more hard facts will be forthcoming.

❖ The Last Frontier: VHF Lo

30 megahertz (MHz) seems to be some kind of a magic number. It's where the high-frequency (HF) band ends and the Very High Frequency (VHF) band begins. It's where "communications receivers" usually stop. It's where utility listeners are supposed to stop listening, except when they don't.

Use of the number 30 comes from the formula for frequency in Hertz versus wavelength in meters, as related by the speed of light. Multiples of 30 in frequency correspond to powers of ten in wavelength.

Otherwise, it's only a division of convenience. HF radio is defined more by its dominant propagation mode, namely F-region ionospheric skip. In quiet-sun years, this rarely goes much above 20 MHz. Right now, though, it is routinely over 30 MHz in daylight hours. If this solar peak runs true to form, we may ultimately see brief F_2 openings all the way to 50 MHz or higher.

For this reason, there is currently a great interest in checking what's up there in the land above HF. But even though the propagation mode is the same, crossing this line can be a real adventure. For various reasons, it's definitely a new world up there.

❖ Exploration Guide

When you're "over 30," the next 20 MHz constitute the lower VHF band, often just called "low band." They are used mostly for various older versions of land-mobile radio, nearly always in voice. The dominant signal mode is frequency modulation (FM).

Scanners with decent outdoor antennas should be able to pick up skip. Wideband receivers, with some tweaking, are even better.

A good place to start searching is the United States public safety band between 33.4 and 34 MHz, in 20 kilohertz (kHz) channels. This is mostly used by fire departments in rural areas, and there are still a lot of them.

Presumably, the dedicated members of these small (often volunteer) agencies know how to use their radios. But at a distance, and out of context, their disconnected chatter may sound more like chaos.

A listener can go mad trying to dig a clear call sign out of all this. Many agencies rarely, if ever, identify themselves. Even before selective fading and FM heterodynes do their worst, dispatchers find personal and unique ways to mispronounce the English language.

On rare occasion, searching the FCC license database with clues from traffic heard actually returns useful information. Usually, though, one finds hundreds of old licenses that may or may not be used any more. Technology has kind of passed this band by, and a lot of agencies have moved to higher frequencies. This leaves a lot of ghosts in this part of the FCC records.

Web sites can often be more up to date. One site popular with scanner fans is **www.radioreference.com** For example, your editor was wondering if "Westmoreland 911" (Westmoreland County Fire Department, PA) was still on 33.7 MHz. In the bad old days, the 2000-mile skip from this 90-watt transmitter sometimes captured out the Los Angeles City FD's high-powered bases only a few miles from here. A quick search of this site indicated that Westmoreland is still there, with a call sign of KGH 706. Even though the best Radioreference features are for the paying customers, this site is a nice resource.

❖ Skip Tips

Up here, the listener is most definitely alone in the wilderness. A few survival tips are in order:

1. Many U.S. agencies have daily monitor tests, usually at local noon, in which they identify themselves and bring up receivers in the volunteers' locations. As a bonus, sometimes the daily town siren test might be audible in the background.
2. Regional dialects still exist in rural America. One can narrow down the region by hearing accents, or such pronunciations of the word *fire* as "far" or "fiy-uh."
3. Place names in dispatches can be searched on Internet maps. In the bad old days, listeners were known to use phone books at the library for this. Duplicates are a problem, though. It's just amazing how many Jacksons, Jeffersons, Lincolns, and Franklins there are in the United States.
3. F_2 skip follows the sun, so listen eastward in the morning and westward in the afternoon.
4. It can be helpful to find radio people in the areas where the skip appears to be originating.
5. If skip is booming in on 33 MHz from many

areas, it's time to check out higher frequencies. These can briefly light up with anything from anywhere in propagation range, producing some of the strangest things you'll ever hear on the radio.

6. If you're listening to HF in the day time, and a shortwave fadeout from a solar flare makes everything go away, move higher. These events can really kick up the 10-meter and/or VHF skip.
7. Sometimes, crossing the equator can enhance signal propagation between roughly equal geomagnetic latitudes. In much of the US, this often creates a pipeline into Buenos Aires, Argentina, and surrounding areas including Uruguay.

This column includes a table of other US allocations to aid in the hunt. Good luck!

US Low-VHF Allocations	
Frequency (MHz)	User
30.00-30.55	Military
30.58-30.82	Industrial/ Petroleum/ Transit
30.86-32.00	Alternates police and industrial

32.00-33.00	Military
33.00-33.10	Emergency
33.10-33.40	Business
33.40-34.00	Fire departments
34.00-35.00	Military
35.00-35.20	Business
35.20-35.70	Obsolete mobile phones, industrial
35.70-36.00	Business, industrial
36.00-37.00	Military/ government
37.00-37.42	Police
37.44-37.88	Water utilities
37.90-38.00	Highway patrols
38.00-39.00	Military/ government
39.00-40.00	Police
40.00-42.00	Military/ government
42.00-42.94	State highway patrols & police

ABBREVIATIONS USED IN THIS COLUMN

AFRTS ..... US Armed Forces Radio/TV Service
ALE ..... Automatic Link Establishment
AM..... Amplitude Modulation
ARQ..... Automatic Repeat reQuest
CAMSLANT ..... Communications Area Master Station, Atlantic
CAP ..... US Civil Air Patrol
CIS ..... Commonwealth of Independent States
COTHEN..... US Customs Over-The-Horizon Enforcement Network
CW..... On-off keyed "Continuous Wave" Morse telegraphy
DSC..... Digital Selective Calling
EAM..... Emergency Action Message
FAX..... Radiofacsimile
FEMA..... US Federal Emergency Management Agency
FM..... Frequency Modulation
FSK..... Frequency-Shift Keying
G06..... Russian machine "female," numbers in German
HFDL ..... High-Frequency Data Link
HF-GCS ..... High Frequency Global Communications System
LSB ..... Lower Sideband
M45..... Russian? MCW numbers, starts hour +02
MARS..... US Military Auxiliary Radio System
MCW ..... Modulated CW, tone or in AM
Meteo ..... Meteorological (weather office), also "Metro"
MFA..... Ministry of Foreign Affairs
NAT ..... North Atlantic air route control, families A-F
NATO..... North Atlantic Treaty Organization
NCS..... US National Communications System
PACTOR ..... Packet Teleprinting Over Radio, modes I-IV
RTTY ..... Radio Teletype
S06..... Russian "male" or "female," ends 00000
S06s ..... "Slow zero" S06 variant
Selcal ..... Selective Calling
SHARES..... SHAred RESources, US Government frequency pool
SITOR..... Simplex Telex Over Radio, modes A & B
UK..... United Kingdom
Unid ..... Unidentified
US ..... United States
USAF..... US Air Force
USCG ..... US Coast Guard
V13..... Taiwan "New Star," music and live female voice
VC01 ..... Chinese Robot, "female" machine numbers for hours
Volmet..... Formatted aviation weather broadcasts

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

502.3 ES5AM-Estonian 600-meter experimental station, Kuremaa, very slow CW all-stations call at 2020. OR7T-Belgian 600-meter station, Baal, calling ES5AM, very slow CW at 2025 (ALF-Germany).

502.8 S52AB-Slovenian 600-meter experimental station, Novo Mesto, very slow CW beacon identifier, at 2035 (ALF-Germany).

2142.5 ZLST-German Customs Control Post, Cuxhaven, ALE and modem traffic with ZEMD, Water Police Boat Emden (DLVH), at 2235 (MPJ-UK).

2187.5 8PQS-Barbados flag bulk carrier Wilson Rouen, DSC safety test with Milford Haven, Wales, at 2329. J8B4240-St. Vincent registry cargo ship Baltic Strait, DSC to Lyngby Radio, Denmark, for a duplex patch on 2102 and 1758, at 2335. PBKO-Netherlands flag container ship Endurance, DSC safety check with Falmouth, Cornwall, UK, at 2340. IBEQ-Italian flag tanker Clipper Legacy, DSC to Malaga Radio, Spain, for patch on 2081 and 1656, at 2343. 2EEM7-UK flag container ship Maersk Eubank, DSC safety test with Goteborg, Sweden, at 2350 (MPJ-UK).

3216.0 SP8N-CIS military; comm checks with 1VF1, G3VH, 1XPK, and others; CW at 1907 (MPJ-UK).

3228.5 Unid-Russian Air Defense, CW null-message strings with time stamps 3 minutes fast; also on 4628, 5201, 5752, 6822, and 6911.5; at 2026 (MPJ-UK).

3371.6 MIBDOI-US Department of Interior Main Interior Building, DC, ALE sounding at 2219 (Jack Metcalfe-KY).

3413.0 Shannon Volmet-Shannon Aeradio, Ireland, formatted aviation weather for European cities, simulcast on 5505 and 8957, at 0651 (Allan Stern-FL).

3831.0 ZHID-German Customs Boat Hiddensee (DLVK), working ZLST, ALE at 2242 (MPJ-UK).

4046.0 FAV22-French military CW Morse code training, Vernon, also on 5426, 6818, and 6825; at 1953 (MPJ-UK).

4209.5 TAH-Istanbul Radio Turkey, SITOR-B maritime information bulletins, at 2226 (MPJ-UK).

4212.0 XSQ-Guangzhou Radio, China, CW ID in SITOR-A burst marker, at 2235 (MPJ-UK).

4215.7 IDR2-Italian Navy, Roma, RTTY channel availability marker, at 0456 (ALF-Germany).

4380.0 Unid-Possible CIS Navy, numeric data in Russian, at 0715, 0753, 0820, 1217, and 1557 (Michel Lacroix-France).

4457.0 The German Lady-Russian Intelligence "female" (G06), AM null-message callup "439 439 439 00000," at 1700. G06, AM test message "123456789," at 1704 (Ary Boender-Netherlands).

4550.0 UN40-Algerian military, working CB60, ALE at 2248 (MPJ-UK).

4553.5 ZSHO-German Customs boat Schleswig-Holstein, working ZLST, ALE at 1916 (PPA-Netherlands).

4618.0 BP23-German Federal Police Boat Bad Düben (DBIG), working BPLEZS, Cuxhaven control, at 2303 (MPJ-UK).

4780.0 Golden Pirate-IN National Guard, control in Joint Forces Net roll call of around 32 stations; answered by Angola, Danville, Greencastle, and Lafayette; LSB at 1300. WPPQA0-Unknown IN National Guard, calling GARYLAASF, Gary Limited Army Aviation Support Facility, LSB ALE at 1307 (Metcalfe-KY).

4864.0 G06, AM test message "123456789123456789 12345," at 1712. G06, same message as 4457, at 1800 (Boender-Netherlands).

4956.0 Unid-Russian hand-keyed MCW (M45), callup at 1802 (Mike-West Sussex, UK).

5036.5 B11-Netherlands military, ALE and modem traffic with B01, at 2140 (MPJ-UK).

5236.0 NNN0EBC-US Navy/ Marine Corps MARS, control of SHARES Northeastern Evening Net with KNY82 (NCS Auxiliary), checking in stations at 0102 (Metcalfe-KY).

5262.1 MTX-Georgian military; calling GLT, GRM, ALG, QSN, and ALZ; at 1827 (PPA-Netherlands).

5306.0 Unid-US Naval Radio Transmitting Facility, Awase, Okinawa, encrypted RTTY at 1853 (PPA-Netherlands).

5550.0 New York-Caribbean oceanic air control, sending unknown aircraft to 8906, at 0700 (Stern-FL).

5616.0 Gander-NAT-C, Newfoundland, working aircraft at 0652 (Stern-FL).

5649.0 Gander-NAT-C, selcal FS-CR and position check with Lufthansa Cargo 8160, an MD-11 freighter reg D-ALCP, at 0427 (PPA-Netherlands).

5680.0 Kinloss-UK Rescue Coordination Centre, Scotland, working Rescue 125 on a medical evacuation from a ship, at 1415 (Patrice Privat-France). EI-CXS-Irish Coast Guard S-61N helo, working Kinloss Rescue, at 1559 (MPJ-UK).

5696.0 CAMSLANT Chesapeake-USCG, VA, radio check with Coast Guard 2104, a HU-25C, at 2340. CAMSLANT, check with Coast Guard 2004, an HC-130J, at 2347 (Stern-FL).

5805.0 K3A-Swedish Army Cavalry "Hussars," Karlsborg, ALE link check with 99V1, at 1033 (ALF-Germany).

5881.5 AASF2-Possible OH National Guard aviation facility, voice and ALE with R021, at 1559 (Metcalfe-KY).

6535.0 TAP194-Air Portugal A340 reg CS-TOB, answered selcal FS-AL from Canarias, South Atlantic air route control in Canary Islands, at 0634 (Lacroix-France).

6556.0 Jakarta-Southeast Asia air route control, Indonesia, selcal KR-AD to Singapore 479, a B777 reg 9V-SVI, at 1932 (PPA-Netherlands).

6566.0 LD2-Angola Ministry of Interior/ Police net control, Luanda, ALE sounding at 2023. 1012-Mauritania National Police, ALE link check with 1001; and calling 1005, 1006, 1009, 1010, 1011; at 2000 (ALF-Germany).

6586.0 New York-Caribbean air route control, selcal check AD-KP with Caribbean Airlines 601, a B737 reg 9Y-JMA, at 0436 (PPA-Netherlands). New York-Caribbean oceanic air control, working Air Canada 091, who was deviating for weather, at 0645 (Stern-FL).

6604.0 New York Volmet, Terminal Aerodrome Forecasts for US cities, at 0705 (Stern-FL).

6622.0 Starway 017-XL Airways, position for Shanwick (NAT-F), at 0758 (Lacroix-France).

6697.0 "K-8-E"-Possible UK Royal Air Force, calling MKL, busy frequency for possible exercise, at 1615 (Lacroix-France).

6733.0 Troy 61-Unknown aircraft, possibly USAF, calling IDR, Italian Navy, at 0410 (ALF-Germany).

6739.0 McClellan-USAF HF-GCS, CA, EAM beginning YM5TP, at 0527 (PPA-Netherlands).

6745.5 UN40-Algerian military, working CB45, CB52, CB53, and CB58; ALE at 1926 (MPJ-UK).

6754.0 Trenton Military-Canadian Forces Volmet, ONT, aviation weather for Canadian airports at 0213 (PPA-Netherlands).

6761.0 Okie 03-USAF KC-135R tanker, aerial refueling coordination with B-1B bombers Rambo 91 and 92, at 0200 (Stern-FL).

6769.0 RLA88-Russian Navy vessel, calling RMP (Baltic Sea Fleet, Kaliningrad), CW at 1803 (ALF-Germany).

6783.0 Unid-Russian Intelligence numbers (S06), callup 632, ended 00000, at 1820 (Mike-UK).

6795.0 3651-Turkish Civil Defense, self-identified as Van City, ALE and earthquake-related voice traffic in Turkish with 3061, at 0007. 3061-Turkish Civil Defense net control, ALE link check with 3655 (also earthquake area), at 2000. 43402-Turkish Civil Defense, link check with 3651, at 2100 (ALF-Germany).

6830.0 Russian numbers variant (S06s), message "176 980 5 55463 58078 65470 85204 25743 980 5 00000," at 1610 (Boender-Netherlands).

6963.0 Aranzerdragon1-Polish Army exercise Dragon 2011; ALE link checks with Dragon1 (group call sign?), Podatnidragon1, Czar21dragon1, Trzon-32dragon1, and many others; at 2000 (ALF-Germany).

6982.0 4XZ-Israeli Navy, Haifa, CW marker at 1722 (PPA-Netherlands).

6986.0 JOC-Unknown US government or military, voice and ALE testing with D8N, at 1424. JOC, voice and ALE with J8C, P8T, and W8S; at 1617 (Metcalfe-KY).

6998.0 EK9-Greek Military, ALE link check with GEF, at 0413 (ALF-Germany).

7346.5 Fort Worth-US Navy Littoral Combat Ship USS Fort Worth (LCS-3), comm checks with EAGAN during trials on Lake Michigan, at 1510 (Metcalfe-KY).

7523.5 WAR3CAMPBFT-US Army, Fort Campbell, KY, calling WAR1CAMPBFT, ALE at 1446 (Metcalfe-KY).

7540.0 AFA4ZX-USAF MARS, drill message to AFA7ZJ in Olivia (amateur 32-tone teleprinting mode), at 1504 (Metcalfe-KY).

7578.5 AFA7DT-USAF MARS, PACTOR message headed "San Diego," via AAB5IL, at 1458 (Metcalfe-KY).

7633.5 Derby 81-KY Air National Guard C-130H, attempting patch with AFA9PF, USAF MARS, CA, no joy, at 1828 (Stern-FL).

7726.0 BRE-Chilean Navy, ALE link check and voice operator chatter with BG9, at 0252 (ALF-Germany).

7811.0 Unid-US Navy, Saddlebunch Key, FL, rebroadcasting downlink of AFRTS Interruptible Voice Channel, talk show at 0321 (PPA-Netherlands).

7890.0 Unid-Chinese Robot (VC01), fast voice-chip numbers at 0620 (Boender-Hong Kong remote).

7998.0 REA4-Russian Strategic Air Broadcast, 5-figure groups in FSK Morse, parallel on 7117, at 1340 (MPJ-UK).

8040.0 S06s, same message as on 6830, at 1600 (Boender-Netherlands).

8143.0 NRS-Pakistan Naval Radio Station, Islamabad, working ZULFIQAR1, frigate Zulfiqar (F-25), ALE at 0010. KHAIBAR-Pakistan Navy Frigate Khaibar (F-183), working KW ("Karachi Wireless"), ALE at 0034 (ALF-Germany).

8764.0 NMN-USCG CAMSLANT Chesapeake, VA, gale warnings for Gulf of Mexico, at 0527 (PPA-Netherlands).

8837.0 Magadan Radio-Russian regional/domestic air route control, sending flight Delta 181 to 11390, at 0445 (Privat-France).

8867.0 Brisbane Control-South Pacific air route control, Australia, working Qantas 44, a B738 reg ZK-ZQH, at 0530. Qantas 113-Jetconnect/Qantas B738 reg ZK-ZQF ("Abel Tasman"), working Brisbane at 0530 (Privat-France).

8879.0 Mumbai-Indian Ocean air route control, India, selcal BH-CS to Korean Air A330 reg HL7240, at 1848 (Lacroix-France).

8891.0 Gander-NAT-D, working aircraft at 0715 (Stern-FL).

8894.0 "11"-HFDL ground station, Panama, uplink to N647AV, Avianca 287, at 0638 (PPA-Netherlands).

8912.0 FTM-COTHEN remote transmitter, Sarasota, FL, ALE sounding at 0706 (PPA-Netherlands).

8942.0 AZA636-Alitalia A330 airliner, HFDL position for Shannon ground station, at 1149 (Lacroix-France). F-WWCA-Airbus Industries prototype A340-600, HFDL log-on with Shannon, at 1515 (MPJ-UK).

8957.0 "13"-HFDL ground station, Santa Cruz, Bolivia, position from Copa Airlines CM338, at 0723 (PPA-Netherlands).

9025.0 190011-USAF Air Mobility Command C-5A number 69-0015, ALE link check with ICZ, then voice as Reach 9011 asking Sigonella for patch to Hilda Metro, whose number the op couldn't find, at 2105 (ALF-Germany).

9047.0 RIC-CAP National Technology Center, Richmond, VA, ALE sounding at 0359 (PPA-Netherlands).

9073.0 REA4-Russian Strategic Air Broadcast, 5-figure groups in FSK Morse, at 1242 (MPJ-UK).

9080.0 TANGO99-Polish military, ALE link check with WHITEEAGLE99, at 1200. GEKON05, ALE link check with BLACKDEVIL99, at 1500 (ALF-Germany).

9110.0 NMF-USCG, Boston, FAX wind/wave chart at 0324 (PPA-Netherlands).

9220.0 S06, callup "371 904/5," then 5-figure-group message, at 1900 (Mike-UK).

9394.6 MIBDOI-US Department of Interior, also WV1DOI (West VA?), ALE at 0003 (Metcalfe-KY).

10816.5 V020IN-US Army National Guard, Virgin Islands, ALE sounding at 0241 (PPA-Netherlands).

11030.0 VMC-Charleville Meteo, Australia, FAX surface analysis chart at 0654 (PPA-Netherlands).

11232.0 Trenton Military-Canadian Forces, Trenton, ONT, position from Tiger 493, a CC-130E, at 1357 and 1427. Trenton, selcal and radio check with Reach 0463, US Air National Guard C-5A #70-0463, at 1530 (Stern-FL).

11312.0 B-6718-Sichuan Airlines flight 3U8922, an A321, HFDL position for "02," Molokai, HI, at 1724 (PPA-Netherlands).

11387.0 AXQ421-Australian Volmet, Queensland, aviation weather for Australian airports, at 0733 (PPA-Netherlands).

11390.0 Magadan-Russian regional/domestic air route control, working airliner Delta 189, at 0750 (Privat-France).

12163.5 STL-US Army or National Guard, calling NORMAND1BDE, at 1500 (Metcalfe-KY).

12362.0 VMW-Wiluna Meteo, Australia, Northern Australia warnings at 0702 (PPA-Netherlands).

12365.0 VMC-Charleville Meteo, Australia, gale warnings for New South Wales, at 0700 (PPA-Netherlands).

12431.0 ALBERTI-Italian Coast Guard Patrol Boat Alberti (G-92), working MAZZARELLA, Patrol Boat Mazarella (G-111), ALE at 1320 (MPJ-UK).

12577.0 005030001-Australia Rescue Coordination Centre, DSC test with 311008500, Bahamas registry bulk carrier CS Savannah (voice call C6V2061), at 0750 (Lacroix-France).

13200.0 New Star Radio Station-Chinese music and numbers (V13), old 7580 frequency dead, in progress at 0618 (Boender-Hong Kong remote).

13270.0 "06"-HFDL ground station, Hat Yai, Thailand, uplink to VH-OQI, Qantas flight QFA9, at 1750 (PPA-Netherlands).

13927.0 AFA5JC-USAF MARS, OH, morale patch from Death 46, USAF B-2A, at 0015. AFA5JC, morale patch from Death 44, another USAF B-2A, at 2357 (Stern-FL).

13988.5 JMH4-Japan Meteorological Agency, FAX prognostic chart at 1247 (PPA-Netherlands).

14396.5 KOG55-US Federal Bureau of Investigation, attempting SHARES check-in at 1610 (Metcalfe-KY).

14475.0 CM1-Algerian Air Force Net, Blida, working COF (Headquarters, Cheraga), ALE at 1244 (MPJ-UK).

14776.0 FR3FEM-FEMA Region 3, MD, ALE sounding, also on 24526, at 1218 (PPA-Netherlands).

16135.0 KVM70-US National Oceanic and Atmospheric Administration, HI, FAX weather forecast at 1902 (PPA-Netherlands).

16219.0 Unid-Russian station idling in Serdolik (40-baud Multiple Frequency Shift Keying), at 0833 (Eddy Waters-Australia).

16986.0 CTP-Portuguese Navy. Palhais/Oeiras, RTTY marker at 1109 (MPJ-UK).

17430.0 9VF20-Kyodo News, Singapore or Penang, FAX newspaper in Japanese at 1651 (PPA-Netherlands).

17468.0 RIW-Moscow Naval Radio, CW message for RFK99, at 1053 (MPJ-UK).

17952.0 New York-NAT-E, selcal check CR-BL to Air Portugal 121, an A330 reg CS-TOI, at 1401 (PPA-Netherlands).

18315.0 Unid-Egyptian MFA, Cairo, no decode of 16-tone modem, at 1100 (Waters-Australia).

23005.0 Unknown-Likely Swiss MFA, link protected ALE [Decodes as garbage -Hugh] followed by data messages, at 0643. PAE-Unknown station, ALE sound at 0811 (Waters-Australia).

24526.0 FC0FEM-FEMA Region 10, WA, ALE sounding at 0006. FR7FRM-FEMA Region 7, KS, ALE sounding at 0006. FC6FEM, Region 6, TX, sounding at 0010. FC1FEM, Region 1, MA, sounding at 1656. FC8FEM, Region 8, CO, sounding at 1708. FR5FEM, Region 5, IL, sounding at 1738. FR4FEM, Region 4, GA, sounding at 1831 (Hugh Stegman-CA).

25120.0 C3-Moroccan military, also on 25210, ALE sounding at 1037 (MPJ-UK).

25350.0 703-USCG HC-130H number 1703, COTHEN ALE sounding at 1942. BUFNY-NY Army National Guard, Buffalo, ALE sounding at 2007. SLKNY-NY National Guard, Serenak Lake, ALE sounding at 2304 (Stegman-CA).

25441.6 HPT-Unknown US government, calling LVK in ALE, at 1739 (Metcalfe-KY).

25910.0 WQGY434-Program audio dump for AM news/talk station WBAP, TX, narrow FM at 1850 (ALF-Germany). [Talkers use these to cue reporters in the field, since the main signal is delayed. -Hugh]

25990.0 WQGY434-Program audio for KSCS-FM, TX, narrow FM country music, at 1842 (ALF-Germany).

26119.0 A9M-Globe Wireless, Bahrain, identifier string in Globedata marker at 1501 (MPJ-UK).

26617.0 6700ARCAP-CAP, AR, ALE sounding at 1941 (Stegman-CA).

33500.0 Unid-North African military, using NATO phonetics in Arabic, calling Mike Sierra and others, also on 34200, FM at 1605 (ALF-Germany).

33900.0 KGC755-Lancaster County, PA, 2-tone selcals and fire department dispatch in FM, at 1500 (ALF-Germany).

DIGITAL DIGEST

DIGITAL MODES ON HF

Mike Chace
mikechace@monitoringtimes.com
www.chace-ortiz.org/umc

Saudi Navy RTTY

Here's an interesting puzzle that proves that identifying stations might take many years of listening together with a lucky catch. This station has been logged since at least 1999 on a variety of frequencies and has, as yet, defied positive identification. I've often bumped into this enigma but hadn't spent much time chasing information that might reveal the organization behind the transmissions.

I knew that it uses standard 75bd Baudot RTTY with approximately 900Hz tone shift. I also knew that it employs bit masking – a simple but sneaky way of disguising its content from regular decoders – but in all the times I had tuned in, there was nothing much to add to the story. I had also heard from some listeners that NATO-style plaintext messages had been received, but I'd never been able to confirm that finding.

Today, the station lives on the primary frequencies of 12333.1 kHz and 8815.1 kHz as center of data. These transmissions usually correspond to a USB frequency 2 kHz lower. The channels are simulcast – what utility listeners frequently refer to as "parallel" transmissions. These are what we'll call the base station frequencies. The other parties – what we'll refer to as the "mobiles" – currently respond on 8328.1 kHz. Several other frequencies have been used in the past and may still be used (in particular the 4MHz channels), but poor conditions over the past years have prevented them from reaching these shores:

2440, 2443.9, 4146.1, 4146.7, 4428.8, 6210, 6878.9, 8324, 8327.9, 12127, 12330.3, 12333.4 and 17258.1 kHz

Note that these channels tend to lie in maritime allocations, and over the years, the station has been variously logged as Algerian Military, Iranian Navy and Unidentified NATO Navy. A naval origin is a good bet, given the typical style of operation with a main "base" station and responses on another independent frequency close-by. The ITU monitoring station in Baldock, England reported good bearings of 120 degrees to the station on 12333.1 kHz, and another UDXF listener reported a beam heading of 115 degrees from his location near Basel. Both of these bearings would certainly rule out Algeria as a possible origin, probably Iran, too, and suggest a location more in-line with Egypt or Saudi Arabia.

What will you hear? To begin with, expect occasional short messages with little by way of a fixed schedule. If you are using a standard Baudot RTTY decoder, this is what you will hear and see: The stations "idles" on continuous letter shift characters which won't print on your terminal. Most frequently, once a message starts, you'll see the encryption lead-in of "bpxlbpxl…" repeated many times, then comes a marker, encryption key or synchronization string of "myapjirahuc", which is followed by a block of five letters each sent four times. The encrypted message will follow.

If your decoder supports bit masking, things are a little more revealing (if not, send an email to the software developer asking them to add this useful feature!). The lead-in to most traffic is actually sent with a bit mask of 31. There are 32 (or 2 to the power of 5) possible masks in a 5 bit code like Baudot. The lead-in text is actually "fidfidfid…"; the encryption key is "uuuuarmdhbymjoz &=80¥?¥&"; and the rest of the message structure is the same. Here's a real off-air example:

```
fidfidfidfidfidfidfidfidfidfidfidfidfidfid
u u u u a r m d h b y m j o z
  &=80¥?¥&ccccxxxxzzzznnnneeee {en-
  crypted message}
```

Sometimes, you'll see an empty "plain text" message, which seems to be sent like the following example:

```
fidfidfidfidfidfidnidfidfidfidfidfidfid
ryryryryryryryryryryryryryryryryryryryry
ppppp
```

This traffic, along with the occasional string of "quick brown fox" test tapes, is pretty much all I had seen from this station over the years. So, imagine my surprise one day when I copied the following message a number of times one Sunday evening:

```
p 222oooz sep 11
fm comtskforcf 77
to comtskunt 77.o.7
info comrsnf riyadh
comlrgrp
bt
confidential
msgid/genadmin/comtskforce 77//
subj//permission//
ampn/permission granted to enter karachi
  port.
be inform that permison to enter karach port
  after staplish contact
with port control to coordinat the timing for
  entring the port//
rmks/-//
decl/orig:rsnf/-/inst:oadr//
bt
nnnn
```

Since bearings probably rule out Algeria as a possible location and the Iranian Navy is unlikely to be forwarding a message on behalf of the Saudi Navy, we can be reasonably confident that the organization behind this station is indeed the Royal Saudi Naval Force (RSNF). The origin is probably the Western Fleet base at Jeddah. There are close ties between the RSNF and the Pakistani Navy, especially in terms of training, so one of their ships visiting Karachi wouldn't be unusual.

❖ Irish Navy Codan

With better propagation, we were once able to hear the SITOR-A transmissions from the Irish Navy HQ at Haulbowline. Nowadays, their network uses Codan equipment including the 80bd chirp for link management and the 9001/3012 16 tone HF modem for data.

IRC #wunclub channel regular "faux" sent along a number of audio files from transmissions on 3450 and 5254 kHz USB. From these files, I was able to determine that the master station uses the Codan identifier "1986" and the outstations (the coastal patrol vessels) use identifiers like "36004", "36006", "36007," etc.

As we've often discussed, old habits die hard on many HF networks when equipment is modernized. The identifiers used are the direct translation of the old SITOR-A selcals used by the stations: 1986 is equivalent to XSFC and the 36xxx-series identifiers correspond to the old CVVx-series selcals.

Most of the data traffic is sent using the secure compressed method, but the header information shows an address of "nhq&commcennhq@com.net" used by the HQ. One text file was received as follows:

```
7R120001.TXT ROUTINE 120001 A SEP 11
  FROM OCNOC TO ALL SHIPS ON S/O
  BT UNCLAS 1. FISHREP NIL. BT N N N N
```

❖ Better Conditions, Finally!

With a couple of years of premature announcements of "Cycle 24," followed by "up again, down again" solar conditions during the first half of 2011, we finally seem to be enjoying a protracted period of improved conditions. The 10m amateur band is now open to Europe most days, 15m opens very quickly after sunrise and 12m is also busy.

Like any other service reliant on HF radio, digital utilities are no different in making use of higher frequencies available to them. Here are a few tell-tale signs of improved propagation that you can look for, too:

- Egyptian Diplomatic communications using SITOR-A and Codan 16 tone modem regularly taking place between 20000 and 20100 kHz, instead of 16000-300 most days.
- MFA Bern using ALE-controlled channels to reach embassies on frequencies as high as 25240 and 25244 kHz USB with their MIL-188-110A modems.
- Globe Wireless coastal station nodes are back to using the 22 and 26 MHz maritime bands.
- PBC, the Dutch Naval Base at Goeree Island on 22864 kHz with 75bd/850 Hz Baudot RTTY channel availability messages
- The Over the Horizon RADAR at RAF Akrotiri on Cyprus regularly using frequencies in the 24 and 25 MHz range, sometimes even above 30 MHz.

Have fun with your digital DX and please keep the letters and emails with your suggestions coming.

ON THE HAM BANDS

THE FUNDAMENTALS OF AMATEUR RADIO

Kirk A. Kleinschmidt, NT0Z
kirk@monitoringtimes.com

Of Mics and Men: Transmit Audio, Part 1

Thanks to the prevalence of transmit-mode DSP in modern radios, a generally increased awareness of microphone issues in communication applications, and plenty of discussion about transmission bandwidths, enhanced SSB, extended SSB, the spectrum efficiency of various modes, and the like, amateur radio audio quality is on the rise (or at least the discussion of audio quality is on the rise)!

At the most basic level, I think almost all ham operators want to "sound good" on the air. But producing quality SSB (or AM) signals is as complicated as we want to make it. Just like any pursuit of excellence, solid fundamentals will take us most of the way there, but achieving top-shelf performance – eking out the last nubbin of audio and RF perfection – takes work and experimentation. Surprisingly, it doesn't necessarily take a lot of money.

I remember several interesting milestones over the years that got me thinking about audio optimization and what it takes to produce good on-air sound. The first came as a gift – literally. When I was a teenage ham, some Old-Timers from the local Civil Air Patrol gave me a TCS-6 AM/CW transmitter-receiver pair from the 1940s. These ruggedized rigs were often used on navy ships, covered 1.5 to 12 MHz, and put out 10-20 Watts or so. Along with their hulking dynamotor power supplies, came an antique-looking carbon microphone.

(I had the whole shebang: TX, RX, mic, dynamotor supplies, manuals, and even the external antenna matching coil. The radios were in tip-top shape, having never been deployed in the field. And, yes, as a youngster, I cannibalized them for parts before I realized they would be collectibles some day. It was one tragedy among many in this regard....)

I made a bunch of CW QSOs with those antediluvian monsters on the 80-meter Novice sub-band and (true confession) talked to a co-conspirator teenage ham a few blocks away on 1.5 MHz AM a time or two. The fact that 1.5 MHz happens to be in the AM broadcast band is not the takeaway here: The surprisingly good-quality sound produced by the then-30-year-old carbon mic and transmitter is! (When you're 16, have an AM transmitter and an interest in broadcasting, you *will* broadcast. It's just a fact.)

I remembered that old mic when a friend demonstrated his Drake C-line transmitter paired with an Astatic D-104 crystal mic a few years later. It, too, sounded great on the old Drake, but not very good at all on newer, solid-state transmitters. At the time I didn't know exactly why....

Moving forward on the Milestone Highway, the first thing I did upon arriving at college (after spending my student loan money on a motorcycle) was to volunteer at the local FM radio station. As a beginning ham I had focused most of my "SSB attention" on properly tuning up my Tempo One transceiver (made by Yaesu and a lot like the FT-101), not overdriving the speech amp and balanced modulator, and loading the fragile TV sweep tube finals to survivable levels. Initially, this somewhat complicated process didn't leave a lot of room for niceties such as microphone impedance matching, equalization and compression – all things that *can* improve SSB quality, but not necessarily.

What did get me thinking about those things was an encounter with the FM station's chief engineer, who positively beamed as he showed me his prized Orban Optimod. Known as the "father of broadcast audio processors," the Optimod is a split-band EQ, compressor, stereo generator, and more, designed to make transmitted FM/AM/TV audio *sound fabulous*. And it did! Engineers could tweak the response for sweet-sounding classical music, with its searing dynamic range, rich and authoritative talk radio, or mind-numbing, overly-compressed pop/rock.

After that demonstration, I became acutely aware of how FM broadcast stations "sounded," and I could soon distinguish between local stations simply by the sound of the transmitted signals. One particularly "flat-sounding" station would have me as its news director some eight years later. I wasn't surprised that the transmitter still sounded "all wrong" when I started working there. The station owner was making money, subpar sound and all, and broadcast-quality audio processors weren't exactly casual purchases. End of story!

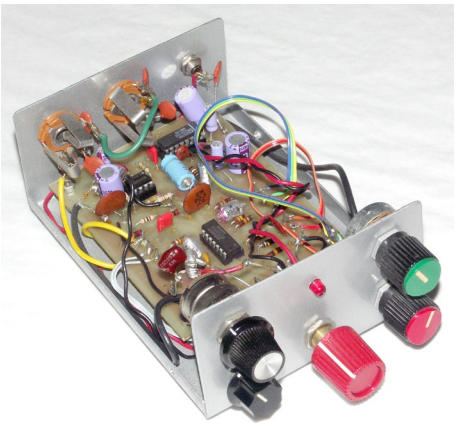
This Orban Optimod 8100 FM processor with Model XT 6-band limiter pioneered a new era of audio/modulation processing for the broadcast industry in the late 1970s and early 80s. Most modern processors are all digital, but these "antique" analog Optimods are still in service worldwide and are still sought after, serviced and supported. You don't need an Optimod for 10-mter SSB, but a little "ham appropriate" audio processing can really perk up your on-air sound. (Photo courtesy of Bohn Broadcast Services of Chelsea, Alabama)

My memory of the exact time line gets a little fuzzy here, but I remember experimenting with various equalizers, compressors and speech processors – home-brew and low-cost commercial units for stereos – in an attempt to make my Shure 444 dynamic mic sound its best and pack a bit more punch (until recently my rigs generally lacked built-in speech processors). I didn't have much luck until I discovered a circuit published in one of the ham radio magazines (not sure which); I believe a semi-kit version was also available called the AGC-EQ. Frustratingly, I can't find a published reference to it, but the version I built 20-some years ago still works fine.

The circuit uses a Signetics NE570 compandor chip configured as a compressor/AGC, and a pair of low-noise op-amps as low- and high-frequency EQs (and preamps). It's not nearly as sophisticated, but it *is* a poor man's Optimod! Actually, it's more of a poor man's version of W2IHY's 8-band TX audio equalizer, which I'll mention again later.

By carefully adjusting the mic (input) gain, the compression levels, and the high and low EQ settings, the SSB audio quality of my mic (the old Shure in my case) and transceiver is noticeably improved. Even the ops on the other end of the QSO will agree! And that is the whole point of the exercise.

Most modern radios have more sophisticated



If you can overlook my scruffy, uninspiring 1980s construction, my home-brew, split-band EQ, compressor and mic preamp makes for a surprisingly effective Poor Man's Optimod. This design uses a pair of low-noise op-amps and a Signetics NE570 compander chip (see text). To this day it makes my old Shure 444 mic sound its best. If your rig doesn't have DSP-based equalization and processing, a circuit like this will do the same for yours. (NT0Z photo)

audio processing and TX equalization controls built in – especially in SDRs or radios with high-end DSP subsystems. Thanks to the magic of software-defined radios, a radio such as my teeny FLEX-1500 can feature a built-in TX compander, 10-band EQ and continuously variable TX filter bandwidths for an almost ridiculous degree of customization. All compression and ALC processing occurs before the final transmit filter, which dramatically reduces splatter and other unwanted modulation products that are the hallmark of "over-processed" TX audio.

My TX audio quality journey has evolved over 30+ years and, although your experience may be somewhat different, I'm assuming that we all want to have great-sounding TX audio that's tailored to our voices, our equipment and our on-air interests. The technology and equipment required to produce hi-fi ragchew-quality audio is essentially the same as that required to produce clean, punchy, DX Pileup-busting audio. The equipment settings may be different and the microphone elements themselves may be different, but the concepts are pretty much universal.

So, starting with this month's column and finishing in a future column or two, we'll take a look at the hardware, software, and concepts required to maximize our TX audio.

❖ Microphones 101

Many hams view microphones like they view TV dinners: If you've seen one, you've seen 'em all, or so the theory goes. In a certain sense, that's true, but as with TV dinners – which span 89-cent "franken food" entrees to $3.99 "luxury supermarket offerings," to $29 "all organic, vegan and made by German-speaking mystics" varieties – not all mics are created equal.

For many of us, the microphone that came with our radio is the only mic we'll ever use with that radio. And while most "bundled" mics work pretty well, what if you want a better-sounding signal or a mic for DXing, contesting, or mobile operation in a noisy environment? Maybe you have a hand-held mic right now, but want a desk mic or a boom mic with a footswitch. Maybe you'd like a headset for contesting or better environmental noise performance. The options are many, so how do you choose?

Regardless of a mic's physical form – desk, hand-held, boom, headset, etc. – to be usable it must at least *reasonably* match the input impedance of our radio's speech amplifier and have a connector that's compatible with our radio (or be adaptable). However, hundreds of mics meet these criteria!

Modern radios are designed for low- to medium-impedance dynamic or condenser microphones, and some can even handle the higher-impedance (crystal) mics favored by some older tube-type transceivers. The mic connectors on most modern radios also provide a low dc voltage to power electret condenser mics (although some condenser mics are battery powered to get around this limitation). Many radios also have rear-panel audio inputs that typically connect to external audio processors or audio interface units for digi-mode operation (and don't usually support microphones directly).

Most amateur radio mics have PTT switches and unbalanced outputs/connectors, which practically limits cable lengths and often necessitates RFI/EMI protection measures to reduce RFI susceptibility. Broadcasting and vocal/stage mics often lack built-in PTT switches but feature balanced "XLR-style" outputs/connectors that usually afford much greater RFI immunity and the ability to match impedances and voltages with inline transformers. Just imagine how much RFI and other electrical crud a vocalist's mic might pick up if it had a 120-foot run of unbalanced cable!

Most transceivers don't have XLR-style connectors, although most studio mixing gear does, as do some high-end ham radio audio processors such as W2IHY's line of EQs and compressors. Balanced mics can easily be adapted to work in unbalanced systems, but some method of PTT switching must usually be provided. If you're accustomed to VOX operation, PTT isn't an issue.

The quality of your transmitted signal depends on many factors that go beyond the basics of microphone style, type, impedance and connectors. In Part II we'll consider variations in the human voice (male or female, young or old, etc.), the ideal audio response for human voice communication under varying conditions, mic placement and "usage techniques," how the audio and RF response of the transmitter circuitry affects "our sound," and equalization and audio/RF processing issues.

Even if you have a stellar-quality mic that's perfectly matched to your rig, these remaining factors are still important. If, for example, you connect a broadcast quality (hi-fi) microphone to a transmitter with a narrow RF TX bandwidth, no amount of processing and equalization will provide "ragchew-quality" sound. The opposite is also true. If you connect a microphone optimized for contesting to a hi-fi transmitter, your transmitted signal will still sound "contesty" and not hi-fi.

Although modern rigs feature enhanced DSP-based transmit equalization and audio/RF processing, setting everything up just right still usually involves work beyond finding a properly matched microphone. Be prepared for experimentation. In the end, the results will be worth the effort.

Before Part II, you may want to do a little homework. The 2012 *Buyer's Guide* in our November 2011 issue has more information and some suggested mics to consider in a variety of styles and price ranges.

W2IHY's demo page at **www.w2ihy.com/audiodemos.asp** features recorded, before-and-after, on-air comparisons of "typical" and "perfectly equalized" SSB signals. The contrast is *dramatic*, and W2IHY's site features a lot of high-end information on audio processing for communication applications. It's a great all-around reference, as is the amateur radio audio excellence site maintained by Larry Wassman, W3OZ, at **http://w3oz.com**.

Reader Comments about Open-Wire Feed Line

The October column focused on open-wire feed lines, and several readers commented via e-mail. The first is a question from **Angel Santana, WP3GW**, who writes:

"A few years ago I spoke with Arnie Coro, CO2KK, on 20 meters, and he asked me if we still used telephone cables – the ones on utility poles. I said that we did, and he informed me that, as underground cable runs become more and more popular, the older aerial telephone cables are being pulled down. These, he said, make excellent antennas and feed lines. The two-conductor cables look like lamp (zip) cords and have an impedance of about 200 ohms when used as open-wire feed lines.

"A friend's father made a dipole and feed line out of the stuff and, because he reported excellent results, in February I put up a 40-meter inverted vee that uses salvaged telephone cable as antenna elements and as a close-spaced, open-wire feed line. I connected the feed line to the balanced output of my antenna tuner, which easily matched the load.

"Have you ever heard of this type of construction? I wonder if you could confirm the impedance of this type of cable. It works for me, and I'm curious. " – Angel Santana, WP3GW

Insulated, parallel, two-conductor cables such as lamp cord and the telephone service drop wires you mention have been pressed into service as antennas and feed lines pretty much since Day One. Service drops are very sturdy and make excellent antenna wires and functional (but not really desirable) open-wire feed lines (unless you peel the wires apart and use wider-spaced insulators to separate them).

There's really no "open space" between the parallel wires, and the continuous run of insulation that uniformly spaces the wires also contributes to the lackluster RF performance, especially at frequencies above 80 or 40 meters. The spacing between parallel feed wires affects the impedance of the line and greatly contributes to the line's low-loss characteristics.

Within the limits required to maintain a practical impedance, the larger the wires and the space between them, the lower the loss. Because service drops and lamp cord are close-spaced and are coated with RF-absorbing insulation, these feed line/antenna combos are mostly used for emergency operations or last-minute, seat-of-the-pants installations.

Impedance-wise, I have heard that telephone service drops are rated at 200 ohms, but my guess is that the value is closer to the 75-ohm impedance attributed to zip cord when used in this manner.

The bottom line is, if at all possible, space those wires farther apart or use TV twinlead or 450-ohm ladder line for greatly improved performance.

Next up is a note from **C L Hallmark, W5ZWM**, who writes:

"I especially enjoyed your recent column on open-wire feed lines. It brought back many good memories (and some not so good!) from my early days in ham radio. When I was in high school and junior college in the mid-'50s, my Dad had five acres on which I "grew" antennas. I learned about rhombic antennas from my Elmer, W5LX, and with his encouragement I decided to build one. The feed line, of course, would be homemade open-wire line, as buying gear was somewhat frowned upon back then.

"For spreaders, I went to a local drug store and bought some plastic ladies' hair curlers. I had plenty of salvaged 26-gauge wire on hand and, once properly provisioned, I set out to make my antenna and feed line. I twisted several runs of the lightweight wire to make sturdier stranded wires for the antenna and each half of the feed line. The resulting unterminated rhombic was 205 feet on a side and mounted on four 30-foot surplus telephone poles. I tuned it with a home-brew antenna tuner made with variable capacitors and rotary inductors from a WW II-vintage BC-375 tuning unit.

"The rhombic was a great performer, and I spent many fun hours on 10- and 20-meter CW using that antenna. My other antennas – a 135-foot dipole (also fed with open-wire line), a 135-foot end-fed wire and a 40-foot vertical – eventually came down, as the rhombic outperformed all of them.

"Keep the good articles coming. 73"–C L, W5ZWM

Thanks for your kind words, C L. It's pretty tough to beat even a low rhombic, and the low-loss, open-wire feed line makes it that much tougher. Ah, to be young ham with access to surplus telephone poles!

GETTING STARTED

THE BEGINNER'S CORNER

Ken Reitz, KS4ZR
kenreitz@monitoringtimes.com

Best FTA Satellite Receiver Ever!

I've been reviewing digital Free-to-Air (FTA) satellite receivers in *MT* since April 1999 when I reviewed the Prosat P3500. Over the last 13 years I've had a dozen or more FTA receivers for evaluation, each slightly better than the last, but all lacking several critical features. The latest entry into the market is the Manhattan RS-1933 HDTV FTA satellite receiver, which sets a new standard for the rest of the industry.

❖ A Long Time Coming

Since the late 1990s, the world's satellite broadcasters have migrated from transponder space-wasting analog transmissions to a digital standard called Digital Video Broadcast (DVB). First used in Europe, it quickly became the worldwide standard using the internationally established MPEGII format for video and audio. Satellite users who require their digital broadcasts to be encrypted can apply several different but compatible encryption systems. Those who don't need encryption broadcast their signals in Free-to-Air mode, available to anyone with an inexpensive FTA MPEGII receiver. The big advantage to digital transmission is that, depending on compression methods, you can cram dozens of individual digital channels onto one standard 36 MHz wide satellite transponder.

In the last 10 years, the number of FTA channels across the viewable sky over North America has risen dramatically just as the numbers of big-dish satellite TV systems have diminished across the country. There's now actually more to see and hear than ever before on the viewable North American Arc. Since the 2009 terrestrial digital TV switch, there's been a growing market for niche programming as individual stations scramble to find additional programming to add to their second or third channels. The result is that between Over-the-Air channel expansion and the explosion of available FTA satellite channels, there's more reason than ever to cut the satellite-TV or cable-TV cord.

❖ Manhattan Wins the Technology Race

FTA satellite receiver manufacturers have had to race to keep up with broadcast technology. It's no longer good enough just to be able to receive MPEGII video and audio; new receivers have to be able to tune in MPEG4 video and Dolby® AC-3 audio. Demand for HDTV programming in homes has caused many satellite broadcasters to switch to the MPEG4 HDTV format.

Manhattan RS-1933 HD Free-to-Air receiver with remote control: small package, big performance. (Courtesy: Author)

RS-1933 back panel connections: LNB loop-through, HD/SD video and audio output with digital recording output to your DVR. (Courtesy: Author)

Unfortunately, MPEGII FTA receivers couldn't do anything when presented with an MPEG4 signal, until now. The Manhattan RS-1933 receiver does it all: MPEGI, MPEGII, MPEG4 video and all currently used audio formats. The Manhattan RS-1933 is not the first receiver to tackle the job of being able to receive MPEG4 HDTV transmissions, it's the first to do it right.

The first thing that amazed me when I took the receiver out of the box was the size. At 11 inches wide, 6.75 inches deep and only 1.5 inches high, it's the smallest FTA receiver I've seen. As with most FTA receivers, it tunes any C or Ku-band transponder and can be used with a fixed-position dish or a movable dish through a DiSEqC (Digital Satellite Equipment Control) switch.

To drive a big dish (typical 10 foot C/Ku-band dish), you'll need a separate receiver or dedicated dish drive. I use a Motorola 4DTV receiver to do that job. So, between the capabilities of the 4DTV to receive analog and DigiCipherII (Motorola's proprietary digital scheme that won the cable-TV digital race) satellite TV signals and the Manhattan's ability to receive all the FTA digital modes, the combination of the two makes for the complete satellite TV monitoring station.

❖ What You'll See *and* Hear

Most FTA hobbyists use their receivers with a fixed Ku-band dish for which no motor is required, but you severely limit your reception capabilities. Adding several other fixed dishes to the receiver through a DiSEqC switch increases your channel count by linking up to four separate dishes.

Having a motorized Ku-band dish does even more, but until you add a motorized dish with a C/Ku-band feed horn, you won't be able to see half of the available channels. Most U.S. and Canadian network HD feeds (ABC, CBC, CBS, CW, FOX, Ion, NBC and PBS) are found on C-band along with many old-time TV and movie Standard Definition (SD) channels such as THIS, Retro-TV, Me-TV and others.

Many foreign SD TV nets such as Deutsche Welle-TV (and radio); Antenna 1 (Greece); Canal Vasco (Spain) with Radio Nacional España-1, 3, 5 and RNE Classica; France 24, Russian Today, Al Jazeera English, TVN-24 and ITVN(Poland), dozens of Mexican and Central American channels, and Columbia, are also found on C-band satellites. You'll see dozens of religious and shopping channels (some in HD!), Horse Racing TV, Bloomberg-TV, Jewelry TV, The Liquidation Channel, the Pentagon Channel and too many more to mention.

There are many other HD channels as well, including Weather Nation HD, NASA-HD, Reelz Channel-HD, NHK World-HD, Fashion TV-HD, Husker Vision-HD, Galavision-HD, Azteca-7 HD, Once-TV-HD, Telemundo-HD, Live Well-HD, BYU-HD-TV, and more. Then there's the Ku-band side which has at least five PBS-HD feeds, NBC-TV feeds, Pentagon-HD and dozens of SD religious, shopping, news-feeds, sports feeds, foreign language, ethnic religious and Mid-Eastern sports channels.

Radio channels include RAI International from Italy; Voice of Tibet; Radio International from Brazil; ten stations from Lima, Peru; four from Honduras; Bolivia; Barbados; BBC World Service; Radio Netherlands Worldwide, six stations from Guatemala; four from Quito Ecuador, and RDP International (Portugal).

One of the aspects of this receiver is that it comes with many current transponder parameters pre-loaded. But, it also has a very fast "blind search" feature that lets it scan the satellite at which it's aimed for available FTA channels. This means that it captures all kinds of things you'd miss if you just relied on the pre-loaded data, because new channels are being leased daily. Unannounced news and sports feeds abound and it's just a matter of letting the receiver find them for you. It's a good idea to keep notes for future reference when you do find something of interest.

❖ The Manhattan RS-1933 Advantage

Among the problems previous attempts at an SD/HD-FTA receiver encountered were overheating and system crashing. I've had the

receiver on 24/7 for at least a week and it isn't even warm. And, it flows seamlessly between SD and HD formats. It handles audio from mono to left-right stereo to AC-3 digital stereo through RCA jacks, digital coax or HDMI output equally without flaw. It helps if you have a stereo receiver capable of AC-3 audio to appreciate the full value of the audio of which this receiver is capable.

You can pause any live picture using the remote control or record SD or HDTV programming through the use of a USB plug-in device such as the 320 GB DVR from Magnavox model MDR-5 ($200 at Walmart). The USB port is on the back panel. Using the remote control, the screen display will let you store and sort the contents of the recording.

❖ What I'd Add

There's very little that absolutely needs to be added to this receiver. But, a couple of things would make things a little easier. The timers are very useful but it would be nice if the timer clock were AM and PM instead of 24 hours; there can be some confusion when setting timers in getting the time right for the receiver to come on. In addition, there are only six timers that can be set (the 4DTV has 25 and there have been times when I have set nearly all of them!). There should be more options for the timer. As it is, you can only select daily or weekly events. We should be able to pick multiple days other than one or all.

The receiver has the traditional LNB loop-through that lets you pass the LNB signal to another receiver (the 4DTV dish driver for instance), but only *either* the C-band or the Ku-band LNB. I'd like there to be a C *and* Ku-band LNB loop-through. As it is, you'll have to switch your LNB cables in order to feed either to the receiver. Having both would let you switch seamlessly between C and Ku-band satellites.

I talked with one of the people involved in development of the receiver and there was mention that they might build-in a terrestrial HDTV receiver into future models. Being able to switch between Over-the-Air and C or Ku-band satellite TV would be a real plus. But, if it's going to add significantly to the price, leave it out. Most TVs today have excellent off-air tuners built-in and the $200 price tag for the Manhattan RS-1933 is just right as it is.

❖ Last Word on FTA

Over the last ten years there has been a lot of negative publicity about DirecTV and DISH Network satellite TV piracy using hacked FTA receivers. There is also a very large and legitimate FTA market, with millions of these receivers being sold to hobbyists and others simply for the viewing of FTA channels and having nothing to do with the illegal practice of watching pay TV without paying. Happily, the two companies have worked hard to put the signal thieves out of business and many are now behind bars.

The Manhattan RS-1933 is sold, among others, by Skyvision (**www.skyvision.com/store/advancedhobbyist.html** or call 800-500-9275), a longtime satellite TV equipment dealer that has stood by the satellite TV hobbyist since the beginning and represents the best in products, sales and service. There's still a lot of life left in the satellite TV hobby and now that the RS-1933 has come along, I'm really glad I've kept my old 10 foot dish. It's a new HDTV world now!

SATELLITE NAME CONVERSION

Motorola froze the naming of satellites on its 4DTV satellite receiver at least ten years ago. But, satellites change, companies change, and so do the names of satellites. This causes confusion because, in order for the 4DTV receiver to move the dish to the satellite you want it to, it has to have a name that it recognizes. Here's a list of the current names of most of the satellites viewable to most of North America and their corresponding 4DTV name, courtesy of Global Communications, which provides the most authoritative FTA satellite list available.

Complete and current lists of all domestic, Pacific Rim, and Atlantic region satellites carrying FTA signals, both C and Ku-band, are found here: **www.global-cm.net/mpeg2central.html**. A typical 25 inch actuator drive will let you see satellites from AMC-10 (C4) at 135°W to Intelsat 805 (P1) at 55.5°W. To receive lower on the horizon in either direction, you'll need a 36-inch actuator motor.

Satellite	*Location (°W)*	*4DTV*
AMC-8	139	W8
AMC-7	137	W7
AMC-10	135	C4
Galaxy 12	133	G1
AMC-11	131	C3
Galaxy 13	127	G9
Galaxy 14	125	G5*
Galaxy 18	123	G0*
Galaxy 23	121	T7
Anik F3	118.7	F3*
SatMex 5	116.8	M5*
SatMex 6	113	M6*
Anik F2	111.1	F2*
Anik F1R	107.3	F1*
AMC-18	105	25*
SES-3	103	W1*
SES-1	101	W4*
Galaxy 16	99	G4*
Galaxy 19	97	T5*
Galaxy 3-C	95	G3*
Galaxy 25	93	T6*
Galaxy 17	91	GB*
Galaxy 28	89	T4*
AMC 3	87	W3*
AMC 9	83	W9*
AMC 6	72	W6*
Intelsat 9	58	P9
Intelsat 805	55.5	P1

*Denotes Ku-band as well as C-band

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Deutsche Welle – Back to the Future?

This month, we are shining the *Programming Spotlight* on big changes at Deutsche Welle, and some programs from the BBC, Poland and Russia.

❖ Back to the Future?

In the 1970s **Deutsche Welle** English language broadcasts were brief, usually about 15 minutes of news, and perhaps an amusing comment from **Larry Wayne**. As the years passed, (West) German shortwave radio broadcasts in English expanded to an hour and many fascinating features were added. It was truly a full service radio station. Until 1989, one could also tune in to the other half of divided Germany. **Radio Berlin International** was a typical East European Cold War broadcaster until after 1990 when it was folded into Deutsche Welle.

At the end of October 2011, Deutsche Welle became a victim of shrinking budgets and changing times. Many longstanding programs in English were unceremoniously axed. These cancelled programs included: ***Newslink, Newslink Plus, European Business Week, Arts on the Air, Inspired Minds, Living In Germany, In-Box, Sports Report*** and ***Correspondent's Report***. Some of these programs had been around in excess of two decades.

After this gutting of the broadcast output, has DW reverted to that earlier 1970s minimal output? Well no. What can one hear now? It is jarring to open the Audio on Demand page of Deutsche Welle's English Service and see just how few programs are now offered for listening or download. However, there is still quality programming to be heard from the heart of Europe.

News – DW News has been cut drastically to a handful of 5-minute newscasts daily.

WorldLink – is the show "which looks at the people behind the headlines." One of the first episodes looked at people involved in the "occupy movement," a young Portuguese woman, a clergyman from St. Paul's in London, a banker's view of the whole thing…and how to get a shower during the protests in NY. Later the program looked at efforts to break the Gaza blockade and the granting of Palestinian membership in UNESCO. Nice program, but a weekly news program would be nice. (Saturdays)

AfricaLink – the first episode of the program in November was hosted by DW stalwart **Mark Caldwell**. As one might expect from the name, the program focuses on African news and stories. Items discussed included Kenyan intervention in Somalia, concerns about Somali immigrants in the Minneapolis area going "underground" and ending up radicalized in terrorist training camps in Africa, and accusations that Chinese mining companies in Zambia are forcing workers to work in unsafe conditions and threatening workers with dismissal if they refuse.

After these reports, a serialized dramatization as part of the DW ***Learning by Ear*** program was aired, about fighting malaria. In this program, a female student asks her teacher about methods of avoiding malaria, using mosquito nets treated with insecticide that are offered free by the government. Her family then acquires a mosquito net to protect her day-old baby brother. It's an interesting approach to learning, reminiscent of DW's German courses. The participants were all clearly African actors. It made me want to get a mosquito net for myself!

While the DW cutbacks are disappointing, this program is well worth investing a half hour of one's time. In 30 minutes I learned many things that just aren't reported in North America. (Mondays)

Inside Europe – hosted by **Chuck Penthold** takes an in-depth look at European affairs. The European debt crisis dominates headlines all over Europe and ***Inside Europe*** is no exception. It's a shame that ***European Business Week*** is no more; it was a valuable source of information about the economic situation in Europe. It sounds (to me) that some of the expertise from that program has migrated to this one.

Other stories covered include anti-Kurdish animosity in Turkey hampering efforts to alleviate the problems caused by the recent earthquake in Turkey. After the earthquake, a Turkish journalist created a storm of controversy when she suggested that the Kurds were not deserving of state efforts to help the victims, the earthquake coming just after a Kurdish bombing that killed 24 people and the deaths in recent months of 50 Turkish soldiers fighting Kurdish separatists. Other reports looked at Chinese buying up London real estate, and development in a small Swiss town.

In the second half hour, a lengthy report on moves towards Scottish independence from the UK led things off, followed by an interview with an author who (rather bizarrely) claims that Hitler escaped at the end of the war and ended his life in Argentina in the early 1960s. Finally, the program ended with an item on German beer exports. Chuck Penthold reminds one very much of Rick MacInnes-Rae, host of Dispatches on CBC Radio One. (Fridays and Sundays)

Spectrum – This is Deutsche Welle's science and technology program. Items discussed included Facebook privacy issues. This was followed by a segment called ***Digital Europe***, which discussed efforts to preserve "digital art." In the middle of the show is a fast paced "news" segment which looked at news of the computer world and efforts to sequence the DNA of all residents of the Faroe Islands. This was followed by ***Future Now*** which looks at the work of German scientists. The program is a good listen if you enjoy hearing about the latest developments in science and online activities. (Mondays)

World in Progress – "World in Progress explores globalization, education, economic development, poverty alleviation, human rights and more." A recent episode in November looked at Egyptian democracy post-Mubarak and the teaching of history in Cambodia. This was followed by a bulletin of "development news." The program concluded with a story about gay rights in Uganda. (Wednesdays)

Living Planet – is the environmental program of DW. A program in November looked at the issue of e-Waste and better ways to recycle electronic waste, Berlin's animal sound archive (one of the world's largest archives of animal sounds), habitat protection in the world's oceans, and the threats faced by Brandenburg's forests due to climate change. (Thursdays)

Pulse – This is DW's youth oriented magazine. A typical episode might look at youth employment prospects, rising ballet stars, new ways of introducing young people to classical music. Each program concludes with a ***Generation Change*** segment. There is a Generation Change blog associated with the program webpage. (Tuesdays)

Listen to all of these programs on demand at **www.dw-world.de/dw/0,,4703,00.html** If you wish to hear the programs via shortwave, give 9655 kHz via Kigali, Rwanda a listen between 2000 and 2200 UTC. It provides a fairly reliable signal into central North America. Good luck!

❖ This Sceptred Isle

For fans of British history, **BBC Radio 4 Extra** has begun another run of their lengthy series tracing the history of the British Isles and its people, ***This Sceptred Isle***. In over 200 15-minute episodes, it surveys the long history of Britain, its dynasties, its conflicts and the peoples.

Part of the allure of this series is its writing and narration. The

principal narrator is the late **Anna Massey**, a star of radio and the stage. She lends a sense of gravitas to the script. Another frequent participant in the program is the late **Paul Eddington**, who may be remembered as the frequently flustered Jim Hacker in both *Yes, Minister* and *Yes, Prime Minister*. With a considerable number of national networks and local stations available, the BBC is one of the few organizations that could devote the time to broadcasting a program on this scale. With a 212 total episodes at roughly four episodes per week, this series will be meandering through 2000 years of British history for the next few months. This is about the fourth go-round for the series since I started listening to **BBC Radio 7/4 Extra** in 2002.

A similar series aired on **BBC Radio Ulster** and subsequently on the then **BBC Radio 7**. It was called ***A Short History of Ireland***…in 240 parts! Sure the episodes were only 5 minutes each, but still, only the BBC could devote this kind of time to a series.

❖ Dad's Army

The BBC has a long tradition of comedy both in radio and television. Starting in the 1940s with ***ITMA*** (***It's That Man Again***, "That Man" being Hitler) and the 1950s with shows like ***Hancock's Half Hour***, starring Tony Hancock, Sid James, Hattie Jaques and a young Kenneth Williams. In the 1960s ***Round the Horne*** and ***Beyond Our Ken*** with Kenneth Horne and Kenneth Williams preceded gems from the late sixties and early seventies like the classic sketch comedy ***I'm Sorry I'll Read That Again***, starring among others John Cleese and Tim Brooke-Taylor. The 1970s also gave us treasures such as ***I'm Sorry I Haven't A Clue*** (the antidote to panel games) and ***Just A Minute***, both of which are alive and well and which continue to this day.

In North America, many early radio programs eventually migrated to television. In Britain in the 1970s, a number of programs went in the opposite direction. Successful television programs like ***To the Manor Born, Yes, Minister*** and ***Dad's Army*** were re-recorded as radio programs, in most cases featuring the original casts.

Dad's Army is a particularly endearing program. The stories revolve around a group of mostly elderly misfits who comprise a Home Guard unit in the early days of World War II. Many of the actors were elderly themselves when the program was made in the early seventies. Ironically, two of the surviving cast members are the actors who played the youngest and oldest members of the platoon. **Ian Lavender** played Private Pike, a teenaged mama's boy and **Clive Dunn** played Lance-Corporal Jones, born in 1870, who had been a drummer boy in Lord Kitchener's Sudan campaign (1896-98). He was responsible for the catch phrase "Don't Panic! Don't Panic!" which he always did anyway. Dunn was much younger than his character was supposed to be and (at last check) is still with us!

You can view a number of episodes of ***Dad's Army*** on youtube…it combines a brilliant cast, with great writing. The radio version can often be heard on **BBC Radio 4 Extra**, along with all of the classic comedy mentioned above.

Worried you might miss an episode? Don't Panic! Don't Panic! Sign up for the **Radio 4 Extra newsletter** so you will never miss your favorite comedy (or other programs you like). All programs are available in streaming audio or on demand for 7 days after the broadcast. **www.bbc.co.uk/4extra** There is a link on the 4 Extra home page for the weekly e-newsletter.

❖ Polish External Service

"RIP **Polish Radio External Service**, at least for most of us. According to their website (**www.thenews.pl**) the only shortwave transmission for B11 is on 3955 kHz from 1800-1900 via Sitkunai, Lithuania. This is sad, as I was a semi-regular listener to their programs having grown to like them when the CBC's Overnight Service used to carry them at 4:30 a.m. (local)." (Mark Coady, ODXA)

I agree that Polish Radio External Service is well worth listening to. I've been listening to them for years either through the CBC Overnight Service or the World Radio Network online and more recently via the PRES website.

There was a semi-regular feature in my ODXA column over the years called *Languages of Shortwave*. I was reminded of this when Mark pointed out that while Polish Radio is a difficult catch in English, it is still audible in Polish. Polish is an interesting language, similar in many ways to Russian. There is also a large first, second and third generation Polish community here in North America. My hometown even has a "Little Poland," where one is more likely to hear Polish than any other language in its Polish community halls, shops and churches. Polish Americans number over 11 million, and according to census data almost a million people in Canada and the United States speak Polish in the home.

Mark also reports: There is a one hour Polish broadcast at 2200 on 7330 via Skelton and 15260 via Sackville. (via Cumbre DX Facebook group)

❖ So you want to be a Foreign Correspondent...

Long-time **CBC** Principal Foreign Correspondent **David Halton** told a chilling story from his long radio and television career, on CBC Radio's ***The Current***. In 1977, Halton scored an interview with Anwar Sadat, just before the latter had announced his plans to seek peace with Israel. Halton, who was in Jerusalem, had to get to Cairo as soon as possible. He crossed the frontier into Jordan in order to get a flight to Egypt (there were obviously no direct flights).

When he arrived in Cairo he was picked up by two people from the "Foreign Ministry." Halton asked how they knew he was coming to Egypt. "Aren't you David Holden (UK Telegraph Foreign Correspondent)?" they asked. He said "No, I am David Halton from the CBC." They seemed surprised. One week later, Holden himself arrived in Cairo on a similar assignment and was assassinated between the airport and his hotel, a crime still unsolved.

Newsgathering remains a very dangerous occupation. According to the website of the Committee to Protect Journalists, in 2011 alone (as of Nov 1), 36 journalists were killed in which a motive has been confirmed, 32 more have been killed, motive unconfirmed. Spare a thought for all these brave souls putting their lives on the line to keep the public informed about what's going on in the world. This sobering reading can be found at **www.cpj.org/killed/2011/**

❖ Back to Russia...

While looking through the **Radio Rossii** website mentioned last month, I clicked on "Radio Show" under the heading Radioteatr on the left-hand menu. I thought perhaps "Radio Show" might be a program about Russian media, but instead I discovered a series of radio plays which are audible on demand. Some interesting radio plays are available here, including "Bermuda Square" written by a Ukrainian playwright, Anna Yablonskaya (who was killed Jan 24, 2011 in a suicide bombing at Moscow's main airport), and a Russian-language version of *Gulliver's Travels*. My Russian was not good enough to follow the whole thing, but it was interesting to listen to.

Russia is not only a land of history and politics, but also one of culture and the arts. The number of hours of programming devoted to the arts and culture by **Radio Rossii** and **Voice of Russia** is commendable, and well worth checking out. **www.radiorus.ru/**

It's wonderful to discover programming like this quite by accident. Be sure and let us know what YOU discover while tuning your radio or surfing the net!

NASB

National Association of Shortwave Broadcasters

Representing the privately-owned shortwave stations in the USA

- **Find links to all of our members at www.shortwave.org**
- **Take the NASB Shortwave Listener Survey and get a free subscription to the NASB Newsletter. www.surveymonkey.com/s/6LRVLJ7**
- **Listen to "The Voice of the NASB" on HCJB's DX Party Line on WRMI's 9955 kHz. Visit www.wrmi.net for schedule**
- **NASB is a member of the HFCC (High Frequency Coordination Conference) and the DRM (Digital Radio Mondiale) Consortium**

THE QSL REPORT

VERIFICATIONS RECEIVED BY OUR READERS

Gayle Van Horn, W4GVH
gaylevanhorn@monitoringtimes.com
http://mt-shortwave.blogspot.com
Twitter @QSLRptMT

Bringing Blues to the World

Blues Radio International will inaugurate the world's only weekly worldwide radio broadcast dedicated exclusively to Blues Music on January 1, 2012 (January 2 UTC). Blues Radio International brings Blues Music to a potential audience of tens of millions through Radio Miami International, a privately owned international broadcast station in Miami, Florida.

"We are excited to bring Blues Music to a worldwide audience, which includes both Blues enthusiasts and tens of millions of potential new Blues music fans" said Jesse Finklestein, who hosts and produces Blues Radio International.

Tune in to Blues Radio International every Monday at 0200 UTC, or Sunday at 9 pm EST throughout the Americas, on 9955 kHz in the 31 meter shortwave band. Programming will also stream simultaneously for listeners at **www.wrmi.net**

The thirty minute program features the best in classical Blues music, as well as important new music from today's most promising Blues artists.

Send your program details to: Jesse A. Finkelstein, Blues Radio International, 103 Hillsboro Mile, Suite 303, Hillsboro Beach, Florida 33062 USA or email to *bluesradiointernational@gmail.com*

ALBANIA

China Radio International relay, 6020 kHz. Full data Ozbek ethnic minority group card with "Albania" notation, unsigned. Also received program and frequency schedule, contact sheet and a copy of *The Messenger* newsletter. Received in 35 days for an English report and two IRCs. QSL address: English Service, CR-2, POB 4216, Beijing, PR of China 100040 (Bill Wilkins, Springfield, MO).

AMATEUR RADIO

Cameroon-TJ9PF, 20 meters/RTTY. DXpedition via F50GL. Full data color sunset scenery card. Received in two weeks for $2.00 US and nested Euro SASE. QSL address: Didier Senmartin, P.O. Box 7, F-53320 Loiron, France (Larry Van Horn, NC).

USA-WX4NHC, 14325 kHz USB. National Hurricane Center. Full data NHC staff and Eye of Hurricane card, signed by John K4AG. Received in 89 days for a utility report and SASE (used for reply). Report for their equipment Test Day. Station address: WX4NHC, c/o Mr. Julio Ripoll, 11691 SW 17th St., Miami, FL 33165 USA (Wilkins).

BRAZIL

Radio Clube do Para, 4885 kHz. Full data logo card and English letter with illegible signature. Received in 62 days for a Portuguese/English letter, return mint postage and SASE with address label (both used). Station address: Av. Almirante Barroso 2190 3° andar, Marco, 66095-000 Belém, Brasil (Tom Banks, Dallas, TX). Streaming audio **www.radioclubedopara.com.br/**

Radio Senado, 5990 kHz. Full data QSL card, unsigned. Received in 30 days after e-report follow up in Portuguese to *ondascurtas@senado.gov.br* (Sam Wright, Biloxi, MS). On-demand audio **www.senado.gov.br**

GERMANY

WYFR/Family Radio relay via Nauen, Germany 13660 kHz. Full data 50th Anniversary card with site notation. Received in seven months, three weeks after follow up report to *inti@familyradio.com* (Edward Kusalik, Alberta, Canada).

INDIA

Andaman and Nicobar Islands-All India Radio Port Blair. Full data verification letter as email attachment via V.G. Suresh Babu, Assistant Engineer, All India Radio. Verification for special transmission of the Mahalaya program. Received in 11 days for program details to: *idairport@rediffmail.com* (Alokesh Gupta, New Delhi, India).

MEDIUM WAVE

WBT, 1110 kHz AM. *Charlotte's News Talk*. Full data color station logo card, signed as Chief Engineer. Received in eight days for an AM report with return mint postage. Station address: 1 Julian Price Place, Charlotte, NC 28208-5211 USA (James Robertson, Jacksonville, FL). Streaming audio **www.wbt.com/**

WHO, 1040 kHz AM. *Newsradio 1040*. Full data WHO logo/owl card, unsigned. Received in 10 days for an AM report, SASE (not used) and return mint postage. Station address: 2141 Grand Avenue, Des Moines, IA 50312 USA (Frank Hillton, Charleston, SC). Streaming audio **www.whoradio.com/**

WMAL, 630 kHz AM. Full data 1960 vintage QSL card, signed by David A. Sproul, Chief Engineer. Received in eight days for an AM report and return mint postage. Station address: 4400 Jenifer Street NW, Washington DC 20015 USA (Al Muick, Whitehall, PA/HCDX). Streaming audio **www.wmal.com/**

WHKW, 1220 AM kHz AM. *The Word*. Friendly full data letter, signed by Brett Patram, Director of Engineering. Veri-signer noted he enjoys DX reports from the US and Europe, and included sheet of photos of the antenna field. Photos and information available at **http://hawkins.pair.com/wknr.html.** Received in four days for an AM report and return mint postage (Muick). Station address: 4 Summit Drive, Suite 150, Cleveland, OH 44131 USA Streaming audio **www.whkwradio.com**

UTILITY

Australia-VMC Charleville, Queensland. Australian Bureau of Meteorology. 12365 kHz. Full data color E-QSL of bureau crest/ map card via Navin Chandran. Received in 12 days for a utility report to *N.Chandran@bom.gov.au* Postal address: Navin Chandran, Telecommunications Systems, Bureau of Meteorology, 700 Collins St., Docklands - 3008, Australia (Gupta). Additional station information including schedules and frequencies at **www.bom.gov.au/marine/marine_weather_radio.shtml**

Croatia-CRE Cres/LOS Losinj. Two color map/antenna photos cards, signed by Darko Lenz, Head of Technical Department. Received for a utility report to Zagreb address. Reply came from: Hrvatska. Kontrola Zracne Plovidbe d.o.o., Podruznica Pula, Valtursko Polje 210a, pp 238, 52000 Pula, Croatia (Patrick Robic, Austria/UDXF).

Japan-JNA Tokyo Sea Patrol Radio, 8414.5 kHz. No data letter, signed by C. Terada, plus sticker and info sheet. Received in 26 days for a utility report. QSL address: Japan Coast Guard, 2-1-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8918, Japan (Robic).

Spain-TXX2 Guardia Civil Madrid/Valdemoro, 7527 kHz. Full data prepared QSL card signed and stamped. Received in 18 days for a utility report. Station address: Dirección General de la Policía y de la Guardia Civil, Servicio de Telecommunicaciones, Guzmán el Bueno 110, 28003 Madrid, Spain (Robic).

Taiwan-XSX Keelung (Chilung) Radio, 12577 kHz. Full data DIN A4 certificate, signed by Janet Kuo. Received in 23 days. Station address: 9, Yi 3rd Road, Keelung, Taiwan, PR of China (Robic).

United Kingdom-XSS-DHFCS Forest Moor, 14555 kHz. Full data prepared QSL card signed and stamped. Received in nine days for a utility report. Station address: DHFCS NCS Forest Moor, Menwith Hill Road, Harrogate, Yorkshire HG3 2RE United Kingdom (Robic).

United States-KVM70-Honolulu Meteo, 11090 kHz. No-data station letter from Mike Cantin, Warning Coordination Meteorologist, plus station sticker. Received in 41 days for a utility report. Station address: National Weather Service, 2525 Correa Rd., Suite 1250, Honolulu, HI 96822 USA (Robic).

How to Use the Shortwave Guide

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

① ② ⑤ ③ ④ ⑥ ⑦

CONVERT YOUR TIME TO UTC

Broadcast time on ① and time off ② are expressed in Coordinated Universal Time (UTC) – the time at the 0 meridian near Greenwich, England. To translate your local time into UTC, first convert your local time to 24-hour format, then add (during Standard Time) 5, 6, 7 or 8 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.).

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

Gayle Van Horn
Frequency Manager
gaylevanhorn@monitoringtimes.com

Larry Van Horn, MT Asst. Editor
larryvanhorn@monitoringtimes.com

Additional Contributors to This Month's Shortwave Guide:

Thank You to …

ADXC; BCL News; Cumbre DX; DSWCI-DBS 2011; DSWCI-DX Window; DX Asia; DX India; HFCC; Hard-Core DX; JPNpremium; DX Mix News 699-703; BC-DX WWDXC Top News.

A.J. Janitschek/Radio Free Asia, Washington, DC; Aleksandr Diadischev, Ukraine; Alexey Zinevich, Bulgaria; Alokesh Gupta, New Delhi, India; Andreas Volt, Munich, Germany; Andrew Flynn & Michael Bloch/CVC, UK; Andrew Sainsbury, R NZ Intl; Alan Roe, Teddington, UK; Carmen, Jung/PABC; Caudius Dedio/AWR; Claire Bircham/Babcock, UK; Derek Kickbush/HCJB Global Australia; Drita Cico/R Tirana; Elena Osipova/Voice of Russia; George Ross/KTWR Guam; Gerald Theoret/R Canada Int'l; Leo van de Woude/R Netherlands; Mark Coady, ODXA/Canada; Paula Chao/R Taiwan Intl; Glen Tapley, Frequency Manager/WEWN; Ivo Ivanov, Bulgaria; Jaisakthivel, Tirunelveli, India; Jeff White/WRMI; Rachel Baughn/MT; Sarah/BVB; Sean Gilbert UK/WRTH; Victor A. Goonetilleke, Sri Lanka; William Hague, UK; Wolfgang Bueschel, Stuttgart, Germany; YingLian/China R Intl.

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

"MISSING" LANGUAGES?

A **FREE** download to MTXpress subscribers, the online MTXtra Shortwave Guide is 115+ pages of combined language schedules, sorted by time. Print subscribers: add the MTXtra SW Guide to your subscription for only $11.95. Call **1-800-438-8155** or visit ***www.monitoringtimes.com*** to learn how.

0000 UTC - 7PM EST / 6PM CST / 4PM PST

0000 0030 Egypt, Radio Cairo 6270na
0000 0030 USA, BBG/Voice of America 7560as
0000 0045 India, All India Radio/External Svc 6055as 7305as 11645as 13605as
0000 0057 Canada, Radio Canada International 9880as
0000 0100 Anguilla/Caribbean Beacon/Univ Network 6090na
0000 0100 Australia, ABC NT Alice Springs 4835do
0000 0100 Australia, ABC NT Katherine 5025do
0000 0100 Australia, ABC NT Tennant Creek 4910do
0000 0100 Australia, Radio Australia 9660pa 12080pa 13690va 15240va 17715va 17750va 17795va
0000 0100 Bahrain, Radio Bahrain 6010me
0000 0100 Bulgaria, Radio Bulgaria 5900na 7400na
0000 0100 Canada, CFRX Toronto ON 6070na
0000 0100 Canada, CFVP Calgary AB 6030na
0000 0100 Canada, CKZN St Johns NF 6160na
0000 0100 Canada, CKZU Vancouver BC 6160na
0000 0100 China, China Radio International 6005as 6020na 6180as 7350eu 7425as 9425as 9570as 11650as 11790as 11885as
0000 0100 Malaysia, RTM Kajang/Traxx FM 7295do
0000 0100 Micronesia, The Cross Radio/Pohnpei 4755 as
0000 0100 New Zealand, Radio NZ International 15720pa
0000 0100 DRM New Zealand, Radio NZ International 17675pa
0000 0100 Palau, T8WH/ WHRI 15700as
0000 0100 Russia, Voice of Russia 7250va
0000 0100 Spain, Radio Exterior de Espana 6055na
0000 0100 Thailand, Radio Thailand World Svc 13745na
0000 0100 UK, BBC World Service 6195as 9410as 9740as 12095as 13725as 15755as
0000 0100 USA, American Forces Network/AFRTS 4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
0000 0100 USA, EWTN/WEWN Irondale, AL 11520me
0000 0100 USA, FBN/WTJC Newport NC 9370na
0000 0100 USA, WBCQ Monticello ME 5110usb 7415usb 9330usb
0000 0100 USA, WHRI Cypress Creek SC 5920na 7315na 9860na
0000 0100 USA, WINB Red Lion PA 9265ca
0000 0100 USA, WTWW Lebanon TN 5755va 12105va
0000 0100 USA, WWCR Nashville TN 3195eu 5070 9980af 13845eu
0000 0100 USA, WWRB Manchester TN 2390na 3185na 3215na 5050na
0000 0100 USA, WYFR/Family Radio Worldwide 5930ca 7360sa 7520sa 15440ca
0000 0100 Zambia, CVC Radio Christian Voice 4965af
0030 0100 Australia, Radio Australia 15415va
0030 0100 fsa Canada, Bible Voice Broadcasting 7395as
0030 0100 UK, BBC World Service 9510as
0030 0100 USA, BBG/Voice of America 6170va 9325va 9490va 9715va 11695va 11730va 15185va 15205va 15290va
0030 0100 USA, BBG/Voice of America/Special English 6170va 9325va 9490va 9715va 11695va 11730va 12005va 15185va 15205va 15290va
0035 0045 India, All India Radio/Aizawl 5050do
0035 0045 India, All India Radio/Chennai 4920do
0035 0045 India, All India Radio/Guwahati 4940do
0035 0045 India, All India Radio/Hyderbad 4800do
0035 0045 India, All India Radio/Imphal 4775do
0035 0045 India, All India Radio/Port Blair 4760do
0035 0045 India, All India Radio/Shillong 4970do
0035 0045 India, All India Radio/Shimla 4965do
0035 0045 India, All India Radio/Thiruvananthapuram 5010do

0100 UTC - 8PM EST/ 7PM CST / 5PM PST

0100 0115 Sat Canada, Bible Voice Broadcasting 7395as
0100 0128 Vietnam, Voice of Vietnam/Overseas Svc 6175na
0100 0156 Romania, Radio Romania International 6145na 7355na
0100 0157 North Korea, Voice of Korea 7220as 9345as 9730as 11735ca 15180sa
0100 0200 Anguilla/Caribbean Beacon/Univ Network 6090na
0100 0200 Australia, ABC NT Alice Springs 4835do
0100 0200 Australia, ABC NT Katherine 5025do
0100 0200 Australia, ABC NT Tennant Creek 4910do
0100 0200 Australia, Radio Australia 9660pa 12080va 13690va 15240va 15415va 17715va 17750va 17795va
0100 0200 Bahrain, Radio Bahrain 6010me
0100 0200 Canada, CFRX Toronto ON 6070na
0100 0200 Canada, CFVP Calgary AB 6030na
0100 0200 Canada, CKZN St Johns NF 6160na
0100 0200 Canada, CKZU Vancouver BC 6160na
0100 0200 China, China Radio International 6005na 6020na 6075as 6175as 7350eu 9410eu 9420as 9570na 9580na 11650as 11885as
0100 0200 Cuba, Radio Havana Cuba 6000na 6050na
0100 0200 Malaysia, RTM Kajang/Traxx FM 7295do
0100 0200 Micronesia, The Cross Radio/Pohnpei 4755 as
0100 0200 Mongolia, Mongolian Radio 2/Ulaanbaatar 7260do
0100 0200 New Zealand, Radio NZ International 15720pa
0100 0200 DRM New Zealand, Radio NZ International 17675pa
0100 0200 Palau, T8WH/ WHRI 15700as
0100 0200 Russia, Voice of Russia 7250va
0100 0200 Taiwan, Radio Taiwan International 11875as
0100 0200 UK, BBC World Service 5940as 5970as 9740as 11750as 12095as 15310as 15335as 15755as 17685as
0100 0200 USA, American Forces Network/AFRTS 4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
0100 0200 USA, BBG/Voice of America 9435as 11705pa
0100 0200 USA, EWTN/WEWN Irondale, AL 11520me
0100 0200 USA, FBN/WTJC Newport NC 9370na
0100 0200 USA, KJES Vado NM 7555na
0100 0200 USA, WBCQ Monticello ME 5110usb 7415usb 9330usb
0100 0200 USA, WHRI Cypress Creek SC 9840na 9860na
0100 0200 mtwhf USA, WHRI Cypress Creek SC 5920na
0100 0200 Sat/Sun USA, WHRI Cypress Creek SC 7315na
0100 0200 USA, WINB Red Lion PA 9265ca
0100 0200 USA, WTWW Lebanon TN 5755va 12105va
0100 0200 USA, WWCR Nashville TN 3195eu 4840na 5935af 9980af
0100 0200 USA, WWRB Manchester TN 2390va 3185na 5050na
0100 0200 USA, WYFR/Family Radio Worldwide 15440ca
0100 0200 Zambia, CVC Radio Christian Voice 4965af
0120 0200 Sri Lanka, SLBC 6005as 9770as 15745as
0130 0200 Iran, IRIB/ VOIRI 7230eu 7365eu
0130 0200 twhfa Serbia, International Radio Serbia 6190va
0130 0200 twhfa USA, BBG/Voice of America/Special English 5960va 7465va
0130 0200 twhfa USA, WRMI/Radio Slovakia Intl relay 9955am

0200 UTC - 9PM EST / 8PM CST / 6PM PST

0200 0227 Iran, IRIB/ VOIRI 7230eu 7365eu
0200 0230 Thailand, Radio Thailand World Svc 15275na
0200 0230 USA, KJES Vado NM 7555na
0200 0230 USA, WINB Red Lion PA 9265ca
0200 0245 USA, WYFR/Family Radio Worldwide 5985ca
0200 0257 North Korea, Voice of Korea 13650as 15100as
0200 0300 Anguilla/Caribbean Beacon/Univ Network 6090na
0200 0300 twhfa Argentina, RAE 11710am
0200 0300 Australia, ABC NT Alice Springs 4835do
0200 0300 Australia, ABC NT Katherine 5025do
0200 0300 Australia, ABC NT Tennant Creek 4910do
0200 0300 Australia, Radio Australia 9660pa 12080va 13690va 15240va 15415va 15515pa 17750va 21725as
0200 0300 Bahrain, Radio Bahrain 6010me
0200 0300 Canada, CFRX Toronto ON 6070na
0200 0300 Canada, CFVP Calgary AB 6030na
0200 0300 Canada, CKZN St Johns NF 6160na
0200 0300 Canada, CKZU Vancouver BC 6160na
0200 0300 China, China Radio International 11785as 13640as
0200 0300 Cuba, Radio Havana Cuba 6000na 6050na
0200 0300 Egypt, Radio Cairo 9315na
0200 0300 Indonesia, Voice of Indonesia 9526va

0200	0300		Malaysia, RTM Kajang/Traxx FM	7295do
0200	0300		Micronesia, The Cross Radio/Pohnpei	4755 as
0200	0300		New Zealand, Radio NZ International	15720pa
0200	0300	DRM	New Zealand, Radio NZ International	17675pa
0200	0300		Palau, T8WH/ WHRI 17800as	
0200	0300		Philippines, PBS/ Radyo Pilipinas	11880me
			15285me 17700me	
0200	0300		Russia, Voice of Russia 7250sa	
0200	0300		South Korea, KBS World Radio	9580sa
0200	0300		Sri Lanka, SLBC 6005as 9770as	15745as
0200	0300		Taiwan, Radio Taiwan International	5950na
			9680na	
0200	0300		UK, BBC World Service 5875me	5940as
			7385af 12095as	15310as
0200	0300		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
0200	0300		USA, EWTN/WEWN Irondale, AL	11520me
0200	0300		USA, FBN/WTJC Newport NC	9370na
0200	0300		USA, WBCQ Monticello ME 5110usb	7415usb
			9330usb	
0200	0300		USA, WHRI Cypress Creek SC	5920na
			9840na 9860na	
0200	0300		USA, WRNO New Orleans LA	7505am
0200	0300		USA, WTWW Lebanon TN 5755va	12105va
0200	0300		USA, WWCR Nashville TN 3215eu	4840na
			5890af 5935af	
0200	0300		USA, WWRB Manchester TN 2390va	3185na
			5050na	
0200	0300		USA, WYFR/Family Radio Worldwide	9385ca
0200	0300		Zambia, CVC Radio Christian Voice	4965af
0215	0300		Nepal, Radio Nepal 5005as	
0230	0258		Vietnam, Voice of Vietnam/Overseas Svc	6175ca
0230	0300	twhfas	Albania, Radio Tirana 7420na	
0230	0300		China, China Radio International	15435as
0230	0300		Myanmar, Myanma Radio/National Svc	5915do
			5920al	
0245	0300		Australia, HCJB Global Australia	15400as
0245	0300		India, All India Radio/Bhopal 7430do	
0245	0300		India, All India Radio/Delhi 4860do	6030do
			7235do 11830do 15135do	
0245	0300		India, All India Radio/Gorakhpur	3945do
			6030do 7235do 11830do	15135do
0245	0300		India, All India Radio/Guwahati	4940do
0245	0300		India, All India Radio/Hyderbad	7420do
0245	0300		India, All India Radio/Imphal 7335do	
0245	0300		India, All India Radio/Itanagar	4990do
0245	0300		India, All India Radio/Jaipur 4910do	
0245	0300		India, All India Radio/Kolkata 7210do	
0245	0300		India, All India Radio/Kurseong	4895do
0245	0300		India, All India Radio/Lucknow	4880do
0245	0300		India, All India Radio/Radio Kashmir	4760do
0245	0300		India, All India Radio/Shillong	4970do
0245	0300		India, All India Radio/Shimla 6020do	
0245	0300		India, All India Radio/Thiruvananthapuram	
			7290do	
0245	0300		Zambia, ZNBC/Radio Two 6165do	
0250	0300		Vatican City State, Vatican Radio	6040am
			7305am	
0255	0300	Sat	Swaziland, TWR Africa 3200af	

0300 UTC - 10PM EST / 9PM CST / 7PM PST

0300	0315		Croatia, Voice of Croatia 3985am	7375am
0300	0315		India, All India Radio/Imphal 7335do	
0300	0315		India, All India Radio/Itanagar	4990do
0300	0315		India, All India Radio/Shillong	4970do
0300	0325	Sun	Swaziland, TWR Africa 3200af	
0300	0330		Egypt, Radio Cairo 9315na	
0300	0330		Myanmar, Myanma Radio/National Svc	9731do
0300	0330		Philippines, PBS/ Radyo Pilipinas	11880me
			15285me 17700me	
0300	0330		Vatican City State, Vatican Radio	9660af
			11625af	
0300	0355		South Africa, Channel Africa 6120af	
0300	0357		North Korea, Voice of Korea 7220as	9345as
			9730as	
0300	0359		South Africa, Channel Africa 3345af	
0300	0400		Anguilla/Caribbean Beacon/Univ Network	
			6090na	
0300	0400		Australia, ABC NT Alice Springs	4835do
0300	0400		Australia, ABC NT Katherine 5025do	
0300	0400		Australia, ABC NT Tennant Creek	4910do
0300	0400		Australia, Radio Australia 9660pa	12080va
			13690va 15240va 15415va	15515pa
			17750va 21725as	
0300	0400		Bahrain, Radio Bahrain 6010me	
0300	0400		Bulgaria, Radio Bulgaria 5900na	7400na
0300	0400	twhfas	Canada, CBC Northern Quebec Svc	9625na
0300	0400		Canada, CFRX Toronto ON 6070na	
0300	0400		Canada, CFVP Calgary AB 6030na	
0300	0400		Canada, CKZN St Johns NF 6160na	
0300	0400		Canada, CKZU Vancouver BC	6160na
0300	0400		China, China Radio International	6190na
			9460as 9690na 9790na	13620as
			15120as	
0300	0400		Cuba, Radio Havana Cuba 6000na	6050na
0300	0400		Malaysia, RTM Kajang/Traxx FM	7295do
0300	0400		Micronesia, The Cross Radio/Pohnpei	4755 as
0300	0400		New Zealand, Radio NZ International	15720pa
0300	0400	DRM	New Zealand, Radio NZ International	17675pa
0300	0400		Oman, Radio Sultanate of Oman	15355af
0300	0400		Palau, T8WH/ WHRI 17800as	
0300	0400		Russia, Voice of Russia 7250sa	12040as
0300	0400	Sat	Sri Lanka, SLBC 6005as 9770as	15745as
0300	0400		Taiwan, Radio Taiwan International	6875na
			15320as	
0300	0400		UK, BBC World Service 3255af	5940me
			6145af 6190af 7255af	9410as
			9460af 11860af 12095as	15310as
			17790as	
0300	0400		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
0300	0400		USA, BBG/Voice of America 4930af	6080af
			9885af 15580af	
0300	0400		USA, EWTN/WEWN Irondale, AL	11520me
0300	0400		USA, FBN/WTJC Newport NC	9370na
0300	0400		USA, WBCQ Monticello ME 5110usb	7415usb
			9330usb	
0300	0400		USA, WHRI Cypress Creek SC	5920na
			7385na 9840na	
0300	0400		USA, WTWW Lebanon TN 5755va	12105va
0300	0400		USA, WWCR Nashville TN 3215eu	4840na
			5890af 5935af	
0300	0400		USA, WWRB Manchester TN 2390na	3185na
			5050na	
0300	0400		USA, WYFR/Family Radio Worldwide	11740ca
0300	0400		Zambia, CVC Radio Christian Voice	4965af
0300	0400		Zambia, ZNBC/Radio Two 6165do	
0330	0358		Vietnam, Voice of Vietnam/Overseas Svc	6175ca
0330	0400		Iran, IRIB/ VOIRI 7200eu	7365eu
0335	0345		India, All India Radio/Aizawl 5050do	
0335	0345		India, All India Radio/Delhi 7235do	11830do
			15135do	
0335	0345		India, All India Radio/Kolkata 7210do	

0400 UTC - 11PM EST / 10PM CST / 8PM PST

0400	0427		Iran, IRIB/ VOIRI 7200eu	7365eu
0400	0430		USA, BBG/Voice of America 4930af	4960af
			6080af 9885af 15580af	
0400	0456		Romania, Radio Romania International	6130na
			7305na 11895as 15220as	
0400	0457		Germany, Deutsche Welle 6180af	7350af
			9855af	
0400	0458		New Zealand, Radio NZ International	15720pa
0400	0458	DRM	New Zealand, Radio NZ International	17675pa
0400	0500		Anguilla/Caribbean Beacon/Univ Network	
			6090na	
0400	0500		Australia, ABC NT Alice Springs	4835do
0400	0500		Australia, ABC NT Katherine 5025do	
0400	0500		Australia, ABC NT Tennant Creek	4910do
0400	0500		Australia, Radio Australia 9660pa	12080va
			13690va 15240va 15515pa	17750va
			21725as	
0400	0500		Bahrain, Radio Bahrain 6010me	
0400	0500	twhfas	Canada, CBC Northern Quebec Svc	9625na
0400	0500		Canada, CFRX Toronto ON 6070na	
0400	0500		Canada, CKZN St Johns NF 6160na	
0400	0500		Canada, CKZU Vancouver BC	6160na
0400	0500		China, China Radio International	6190na
			9460as 13620as 15120as	17725as
			17855as	
0400	0500		Cuba, Radio Havana Cuba 6000na	6050na
0400	0500	mtwhf	France, Radio France Internationale	9805af
			11995af	

SHORTWAVE GUIDE

0400	0500		Malaysia, RTM Kajang/Traxx FM			7295do
0400	0500		Micronesia, The Cross Radio/Pohnpei			4755 as
0400	0500		Palau, T8WH/ WHRI	17800as		
0400	0500		Russia, Voice of Russia	12040as		
0400	0500		South Africa, Channel Africa	7230af		
0400	0500	Sat	Sri Lanka, SLBC	6005as	9770as	15745as
0400	0500		Turkey, Voice of Turkey	7240as	9655va	
0400	0500		UK, BBC World Service	3255af	6005af	
			6190af	7255af	9410me	11860af
			12035af	12095af	15310as	15360as
			17790as			
0400	0500		USA, American Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
0400	0500		USA, EWTN/WEWN Irondale, AL			11520me
0400	0500		USA, FBN/WTJC Newport NC			9370na
0400	0500		USA, WHRI Cypress Creek SC			5920na
			7385na	9825na		
0400	0500		USA, WTWW Lebanon TN	5755va	12105va	
0400	0500		USA, WWCR Nashville TN	3215eu	4840na	
			5890af	5935af		
0400	0500		USA, WWRB Manchester TN	3185na		
0400	0500		Zambia, CVC Radio Christian Voice			4965af
0400	0500		Zambia, ZNBC/Radio Two	6165do		
0430	0500		Australia, Radio Australia	15415va		
0430	0500	mtwhf	Swaziland, TWR Africa	3200af	4775af	
0430	0500		USA, BBG/Voice of America	4930af	4960af	
			9885af	15580af		
0435	0445		India, All India Radio/Delhi	4860do		
0455	0500		Nigeria, Voice of Nigeria	15120af		
0459	0500		New Zealand, Radio NZ International			11725pa
0459	0500	DRM	New Zealand, Radio NZ International			13730pa

0500 UTC - 12AM EST / 11PM CST / 9PM PST

0500	0507	twhfas	Canada, CBC Northern Quebec Svc			9625na
0500	0530		Germany, Deutsche Welle	6155af	9800af	
			12045af			
0500	0530		Japan, Radio Japan NHK World			5975va
			6110na	9770va		
0500	0600		Anguilla/Caribbean Beacon/Univ Network			
			6090na			
0500	0600		Australia, ABC NT Alice Springs			4835do
0500	0600		Australia, ABC NT Katherine	5025do		
0500	0600		Australia, ABC NT Tennant Creek			4910do
0500	0600		Australia, Radio Australia	9660pa	12080va	
			13630va	13690va	15160va	15240va
			17750va	21725va		
0500	0600		Bahrain, Radio Bahrain	6010me		
0500	0600		Bhutan, Bhutan Broadcasting Svc			6035do
0500	0600		Canada, CFRX Toronto ON	6070na		
0500	0600		Canada, CKZN St Johns NF	6160na		
0500	0600		Canada, CKZU Vancouver BC			6160na
0500	0600		China, China Radio International			5960na
			6190na	7220af	7295af	9440af
			11880as	15350as	17505va	17540as
			17725as	17855as		
0500	0600		Cuba, Radio Havana Cuba	6010na	6050na	
			6060na	6150na		
0500	0600	mtwhf	Equatorial Guinea, Radio Africa 2			15190af
0500	0600	Sat/Sun	Equatorial Guinea, Radio East Africa			15190af
0500	0600	mtwhf	France, Radio France Internationale			11995af
			13680af			
0500	0600		Malaysia, RTM Kajang/Traxx FM			7295do
0500	0600		Micronesia, The Cross Radio/Pohnpei			4755 as
0500	0600		New Zealand, Radio NZ International			11725pa
0500	0600	DRM	New Zealand, Radio NZ International			13730pa
0500	0600		Nigeria, Voice of Nigeria	15120af		
0500	0600		Palau, T8WH/ WHRI	17800as		
0500	0600		South Africa, Channel Africa	7230af		
0500	0600	mtwhf	Swaziland, TWR Africa	3200af	4775af	
0500	0600		Swaziland, TWR Africa	9500af		
0500	0600	Sat/Sun	Swaziland, TWR Africa	4775af		
0500	0600		Taiwan, Radio Taiwan International			6875na
0500	0600		UK, BBC World Service	3255af	3955eu	
			6005af	6190af	7255af	9410me
			12095af	15310as	15360as	15400af
			15420af	17640af	17790as	
0500	0600	Sat/Sun	UK, BBC World Service	15420af		
0500	0600		USA, American Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
0500	0600		USA, BBG/Voice of America	4930af	6080af	
			9885af	15580af		
0500	0600		USA, EWTN/WEWN Irondale, AL			11520me
0500	0600		USA, FBN/WTJC Newport NC			9370na
0500	0600		USA, WHRI Cypress Creek SC			7385va
			9825va	11565va		
0500	0600		USA, WTWW Lebanon TN	5755va	12105va	
0500	0600		USA, WWCR Nashville TN	3215eu	4840na	
			5890af	5935af		
0500	0600		USA, WWRB Manchester TN	3185na		
0500	0600		Zambia, CVC Radio Christian Voice			6065af
0500	0600		Zambia, ZNBC/Radio Two	6165do		
0530	0600		Australia, Radio Australia	15415va		
0530	0600	Sat/Sun	Clandestine, Sudan Radio Service/SRS			13720af
0530	0600		Thailand, Radio Thailand World Svc			12015eu

0600 UTC - 1AM EST / 12AM CST / 10PM PST

0600	0615	Sat/Sun	South Africa, TWR Africa	11640af		
0600	0630		Australia, Radio Australia	15290as		
0600	0630		Germany, Deutsche Welle	12045af	15440af	
			17800af			
0600	0630		Vatican City State, Vatican Radio			3975eu
			6075eu	7250eu		
0600	0645	smtwhf	South Africa, TWR Africa	11640af		
0600	0650	DRM	New Zealand, Radio NZ International			13730pa
0600	0655		South Africa, Channel Africa	15255af		
0600	0659		South Africa, Channel Africa	7230af		
0600	0700		Anguilla/Caribbean Beacon/Univ Network			
			6090na			
0600	0700		Australia, ABC NT Alice Springs			4835do
0600	0700		Australia, ABC NT Katherine	5025do		
0600	0700		Australia, ABC NT Tennant Creek			4910do
0600	0700		Australia, Radio Australia	9660pa	12080va	
			13630va	13690va	15160va	15240va
			15415va	17750va	21725va	
0600	0700		Bahrain, Radio Bahrain	6010me		
0600	0700		Canada, CFRX Toronto ON	6070na		
0600	0700		Canada, CFVP Calgary AB	6030na		
0600	0700		Canada, CKZN St Johns NF	6160na		
0600	0700		Canada, CKZU Vancouver BC			6160na
0600	0700		China, China Radio International			6115na
			11750af	11770as	11880as	13645as
			15145as	15350as	15465as	17505va
			17540as	17710as		
0600	0700		Cuba, Radio Havana Cuba	6010na	6050na	
			6060na	6150na		
0600	0700	mtwhf	Equatorial Guinea, Radio Africa 2			15190af
0600	0700	Sat/Sun	Equatorial Guinea, Radio East Africa			15190af
0600	0700	mtwhf	France, Radio France Internationale			11615va
			15160af	17800af		
0600	0700		Malaysia, RTM Kajang/Traxx FM			7295do
0600	0700		Malaysia, RTM/Voice of Malaysia			6175as
			9750as	15295as		
0600	0700		Micronesia, The Cross Radio/Pohnpei			4755 as
0600	0700		New Zealand, Radio NZ International			11725pa
0600	0700		Nigeria, Voice of Nigeria	15120af		
0600	0700		Palau, T8WH/ WHRI	17800as		
0600	0700		Papua New Guinea, Radio Fly			5960do
0600	0700		Russia, Voice of Russia	17805pa	21805pa	
0600	0700	DRM	Russia, Voice of Russia	11635eu		
0600	0700		South Africa, CVC 1 Africa Radio			13590af
0600	0700		Swaziland, TWR Africa	9500af		
0600	0700		UK, BBC World Service	3955eu	6005af	
			6190af	9410af	11760me	12015af
			12095af	15310as	15400af	15420af
			17640af	17790as		
0600	0700		USA, American Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
0600	0700		USA, BBG/Voice of America	6080af	9885af	
			15580af			
0600	0700		USA, EWTN/WEWN Irondale, AL			11520af
0600	0700		USA, FBN/WTJC Newport NC			9370na
0600	0700		USA, WHRI Cypress Creek SC			7385va
			9825va	11565va		
0600	0700		USA, WTWW Lebanon TN	5755va	12105va	
0600	0700		USA, WWCR Nashville TN	3215eu	4840na	
			5890af	5935af		
0600	0700		USA, WWRB Manchester TN	3185na		
0600	0700		USA, WYFR/Family Radio Worldwide			9680na
0600	0700		Zambia, CVC Radio Christian Voice			6065af
			17695af			
0600	0700		Zambia, ZNBC/Radio Two	6165do		
0602	0700		Swaziland, TWR Africa	6120af		
0630	0645		India, All India Radio/Guwahati			7280do

0630	0645		India, All India Radio/Hyderbad	7420do
0630	0645		India, All India Radio/Kurseong	7230do
0630	0645		India, All India Radio/Mumbai	7240do
0630	0645		India, All India Radio/Thiruvananthapuram 7290do	
0630	0656	DRM	Romania, Radio Romania International	9600eu
0630	0656		Romania, Radio Romania International 17780eu 21600eu	7310eu
0630	0700		Vatican City State, Vatican Radio 9660af 11625af	7360af
0651	0700	DRM	New Zealand, Radio NZ International	13730pa

0700 UTC - 2AM EST / 1AM CST / 11PM PST

0700	0745		USA, WYFR/Family Radio Worldwide	7570eu
0700	0758		New Zealand, Radio NZ International	11725pa
0700	0758	DRM	New Zealand, Radio NZ International	13730pa
0700	0800		Anguilla/Caribbean Beacon/Univ Network 6090na	
0700	0800		Australia, ABC NT Alice Springs	4835do
0700	0800		Australia, ABC NT Katherine 5025do	
0700	0800		Australia, ABC NT Tennant Creek	4910do
0700	0800		Australia, Radio Australia 9475as 9660pa 9710as 11945as 12080va 13630va 15160va 15240va 21725va	
0700	0800		Bahrain, Radio Bahrain 6010me	
0700	0800	m/DRM	Belgium, TDP Radio 6015eu	
0700	0800		Canada, CFRX Toronto ON 6070na	
0700	0800		Canada, CFVP Calgary AB 6030na	
0700	0800		Canada, CKZN St Johns NF 6160na	
0700	0800		Canada, CKZU Vancouver BC	6160na
0700	0800		China, China Radio International 11785eu 11880as 13645as 15125va 15350as 15465as 17540as 17490eu 17710as	
0700	0800	mtwhf	Equatorial Guinea, Radio Africa 2	15190af
0700	0800	Sat/Sun	Equatorial Guinea, Radio East Africa	15190af
0700	0800	mtwhf	France, Radio France Internationale 17605af	15615af
0700	0800		Malaysia, RTM Kajang/Traxx FM	7295do
0700	0800		Malaysia, RTM/Voice of Malaysia 9750as 15295as	6175as
0700	0800		Micronesia, The Cross Radio/Pohnpei	4755 as
0700	0800		Palau, T8WH/ WHRI 17800as	
0700	0800		Papua New Guinea, Radio Fly	5960do
0700	0800		Russia, Voice of Russia 17805va	21805va
0700	0800	DRM	Russia, Voice of Russia 11635eu	
0700	0800		South Africa, CVC 1 Africa Radio	13590af
0700	0800		Swaziland, TWR Africa 6120af	9500af
0700	0800		UK, BBC World Service 3955eu 5875eu 6190af 11760me 11770af 12095af 13820af 15310as 15400af 15575me 17640af 17790as 17830af	
0700	0800		USA, American Forces Network/AFRTS 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb	4319usb
0700	0800		USA, EWTN/WEWN Irondale, AL	11520af
0700	0800		USA, FBN/WTJC Newport NC	9370na
0700	0800		USA, WHRI Cypress Creek SC 9825va 11565va	7385va
0700	0800		USA, WTWW Lebanon TN 5755va	12105va
0700	0800		USA, WWCR Nashville TN 3215eu 5890af 5935af	4840na
0700	0800		USA, WWRB Manchester TN 3185na	
0700	0800		USA, WYFR/Family Radio Worldwide	5950ca
0700	0800		Zambia, CVC Radio Christian Voice 17695af	6065af
0700	0800		Zambia, ZNBC/Radio Two 6165do	
0730	0745		India, All India Radio/Aizawl 5050do	
0730	0745		India, All India Radio/Delhi 6190do 15185do 15260do	11710do
0730	0745		India, All India Radio/Guwahati	7280do
0730	0745		India, All India Radio/Imphal 7335do	
0730	0745		India, All India Radio/Jaipur 7325do	
0730	0745		India, All India Radio/Kolkata 7210do	
0730	0745		India, All India Radio/Kurseong	7230do
0730	0745		India, All India Radio/Shimla 6020do	
0730	0800		Australia, HCJB Global Australia	11750pa
0730	0800		Bulgaria, Radio Bulgaria 7400eu	9400eu
0730	0800		India, All India Radio/Chennai	4920do
0745	0800		Saudi Arabia, BSKSA/External Svc	17785af
0759	0800		New Zealand, Radio NZ International	9765pa
0759	0800	DRM	New Zealand, Radio NZ International	9870pa

0800 UTC - 3AM EST / 2AM CST / 12AM PST

0800	0830		Australia, ABC NT Alice Springs	4835do
0800	0830		Australia, ABC NT Katherine 5025do	
0800	0830		Australia, ABC NT Tennant Creek	4910do
0800	0830		Australia, HCJB Global Australia	11750pa
0800	0830	Sun	Canada, Bible Voice Broadcasting	7250eu
0800	0845	Sat	Canada, Bible Voice Broadcasting	7220eu
0800	0845		USA, WYFR/Family Radio Worldwide	5950ca
0800	0850		Austria, TWR Europe 7310eu	
0800	0850		Germany, TWR Europe 6105eu	
0800	0900		Anguilla/Caribbean Beacon/Univ Network 6090na	
0800	0900		Australia, Radio Australia 5995va 9475as 9580pa 9590pa 9710as 11945as 12080va 13630va	
0800	0900		Bahrain, Radio Bahrain 6010me	
0800	0900	t/DRM	Belgium, TDP Radio 6015eu	
0800	0900		Bhutan, Bhutan Broadcasting Svc	6035do
0800	0900		Canada, CFRX Toronto ON 6070na	
0800	0900		Canada, CFVP Calgary AB 6030na	
0800	0900		Canada, CKZN St Johns NF 6160na	
0800	0900		Canada, CKZU Vancouver BC	6160na
0800	0900		China, China Radio International 11785eu 11880eu 13350as 15465as 15625va 17490eu 17540as	9415as
0800	0900	mtwhf	Equatorial Guinea, Radio Africa 2	15190af
0800	0900	Sat/Sun	Equatorial Guinea, Radio East Africa	15190af
0800	0900		Malaysia, RTM Kajang/Traxx FM	7295do
0800	0900		Malaysia, RTM/Voice of Malaysia 9750as 15295as	6175as
0800	0900		Micronesia, The Cross Radio/Pohnpei	4755 as
0800	0900		New Zealand, Radio NZ International	9765pa
0800	0900	DRM	New Zealand, Radio NZ International	9870pa
0800	0900		Palau, T8WH/ WHRI 17800as	
0800	0900		Papua New Guinea, Radio Fly	5960do
0800	0900		Russia, Voice of Russia 17805va	21805va
0800	0900	DRM	Russia, Voice of Russia 7325eu	11635eu
0800	0900		Saudi Arabia, BSKSA/External Svc	17785af
0800	0900		South Africa, Channel Africa 9625af	
0800	0900		South Africa, CVC 1 Africa Radio	13590af
0800	0900	Sun	South Africa, South African Radio League 7205af 17760af	
0800	0900		South Korea, KBS World Radio	9570as
0800	0900		UK, BBC World Service 5760eu 5875eu 6190af 11760me 12095af 15310as 15400af 15575me 17640af 17790as 17830af 21470af	
0800	0900		USA, American Forces Network/AFRTS 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb	4319usb
0800	0900		USA, EWTN/WEWN Irondale, AL	11520af
0800	0900		USA, FBN/WTJC Newport NC	9370na
0800	0900		USA, WHRI Cypress Creek SC 11565va	7385va
0800	0900		USA, WTWW Lebanon TN 5755va	12105va
0800	0900		USA, WWCR Nashville TN 3215eu 5890af 5935af	4840na
0800	0900		USA, WWRB Manchester TN 3185na	
0800	0900		Zambia, CVC Radio Christian Voice 17695af	6065af
0800	0900		Zambia, ZNBC/Radio Two 6165do	
0815	0900		Nepal, Radio Nepal	5005as
0820	0900	smtwhf	Guam, TWR Asia/KTWR	15170as
0830	0845		India, All India Radio/Aizawl 5050do	
0830	0845		India, All India Radio/Chennai	4920do
0830	0845		India, All India Radio/Delhi 6190do 15185do 15260do	11710do
0830	0845		India, All India Radio/Hyderbad	7420do
0830	0845		India, All India Radio/Imphal 7335do	
0830	0845		India, All India Radio/Itanagar	4990do
0830	0845		India, All India Radio/Kolkata 7210do	
0830	0845		India, All India Radio/Shillong	7315do
0830	0845		India, All India Radio/Thiruvananthapuram 7290do	
0830	0900		Australia, ABC NT Alice Springs	2310do
0830	0900		Australia, ABC NT Katherine 2485do	
0830	0900		Australia, ABC NT Tennant Creek	2325do
0830	0900	mtwhfa	Guam, TWR Asia/KTWR 11840pa	

0900 UTC - 4AM EST / 3AM CST / 1AM PST

0900	0910	mtwhfa	Guam, TWR Asia/KTWR	11840as

0900	0930	Sat/Sun/DRM	Bulgaria, BNR Horizont/Home Svc 1 11900eu			
0900	1000		Anguilla/Caribbean Beacon/Univ Network 6090na			
0900	1000		Australia, ABC NT Alice Springs			2310do
0900	1000		Australia, ABC NT Katherine	2485do		
0900	1000		Australia, ABC NT Tennant Creek			2325do
0900	1000		Australia, Radio Australia	9475as		9580pa
			9590pa	11945as	12080va	
0900	1000		Bahrain, Radio Bahrain	6010me		
0900	1000	w/DRM	Belgium, TDP Radio	6015eu		
0900	1000		Canada, CFRX Toronto ON	6070na		
0900	1000		Canada, CFVP Calgary AB	6030na		
0900	1000		Canada, CKZN St Johns NF	6160na		
0900	1000		Canada, CKZU Vancouver BC			6160na
0900	1000		China, China Radio International			9415as
			15210pa	15270eu	15350as	17490eu
			17570eu	17690pa	17750as	
0900	1000	3rd Sun	Germany, XVRB Radio	6045va		
0900	1000	Sat	Italy, IRRS-Shortwave	9510va		
0900	1000		Malaysia, RTM Kajang/Traxx FM			7295do
0900	1000		Malaysia, RTM/Voice of Malaysia			6175as
			9750as	15295as		
0900	1000		Micronesia, The Cross Radio/Pohnpei			4755 as
0900	1000	DRM	New Zealand, Radio NZ International			9870pa
0900	1000		New Zealand, Radio NZ International			9765pa
0900	1000		Nigeria, Voice of Nigeria	9690af		
0900	1000		Papua New Guinea, Radio Fly			5960do
0900	1000		Russia, Voice of Russia	7205as		17805va
			21805va			
0900	1000	DRM	Russia, Voice of Russia	7325eu		11635eu
0900	1000		South Africa, Channel Africa	9625af		
0900	1000		South Africa, CVC 1 Africa Radio			13590af
0900	1000		UK, BBC World Service	6190af		6195as
			9740as	11760me	11895as	12095af
			15285as	15310as	15400af	15575me
			17760as	17790as	17830af	21470af
0900	1000		USA, American Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
0900	1000		USA, EWTN/WEWN Irondale, AL			9390as
0900	1000		USA, FBN/WTJC Newport NC			9370na
0900	1000		USA, WHRI Cypress Creek SC			7385va
			9825va	11565va		
0900	1000		USA, WTWW Lebanon TN	5755va		12105va
0900	1000		USA, WWCR Nashville TN	3215eu		4890na
			5890af	5935af		
0900	1000		USA, WWRB Manchester TN	3185na		
0900	1000		USA, WYFR/Family Radio Worldwide			9465as
			9755ca			
0900	1000		Zambia, CVC Radio Christian Voice			6065af
			17695af			
0900	1000		Zambia, ZNBC/Radio Two	6165do		
0905	0910		Pakistan, PBC/Radio Pakistan	15725eu		17700eu

1000 UTC - 5AM EST / 4AM CST / 2AM PST

1000	1030		Japan, Radio Japan NHK World			9605as
			9625pa	9840pa		
1000	1030		Vietnam, Voice of Vietnam/Overseas Svc			9840as
			12020as			
1000	1057		Netherlands, R Netherlands Worldwide			12065as
1000	1057		North Korea, Voice of Korea	11710ca		11735as
			13650as	15180sa		
1000	1058		New Zealand, Radio NZ International			9765pa
1000	1100		Anguilla/Caribbean Beacon/Univ Network 11775na			
1000	1100		Australia, ABC NT Alice Springs			2310do
1000	1100		Australia, ABC NT Katherine	2485do		
1000	1100		Australia, ABC NT Tennant Creek			2325do
1000	1100		Australia, Radio Australia	9580pa		9590pa
			11945as	12080va		
1000	1100		Bahrain, Radio Bahrain	6010me		
1000	1100	h/DRM	Belgium, TDP Radio	6015eu		
1000	1100		Canada, CFRX Toronto ON	6070na		
1000	1100		Canada, CFVP Calgary AB	6030na		
1000	1100		Canada, CKZN St Johns NF	6160na		
1000	1100		Canada, CKZU Vancouver BC			6160na
1000	1100		China, China Radio International			5955as
			7215as	11640as	13590as	13720as
			15190as	15210pa	15350as	17490eu
			17690as			
1000	1100		India, All India Radio/External Svc			7270as
			13695pa	15260as	15410as	17510pa
			17800as	17895pa		
1000	1100		Indonesia, Voice of Indonesia	9526va		
1000	1100		Malaysia, RTM Kajang/Traxx FM			7295do
1000	1100		Micronesia, The Cross Radio/Pohnpei			4755as
1000	1100	DRM	New Zealand, Radio NZ International			9870pa
1000	1100		Nigeria, Voice of Nigeria	9690af		
1000	1100		Russia, Voice of Russia	7205as		
1000	1100		Saudi Arabia, BSKSA/External Svc			15250af
1000	1100		South Africa, Channel Africa	9625af		
1000	1100		South Africa, CVC 1 Africa Radio			13590af
1000	1100		UK, BBC World Service	6190af		6195as
			9740as	11760me	11895as	12095af
			15285as	15310as	15575me	17640af
			17760as	17790as	21470af	
1000	1100	Sat/Sun	UK, BBC World Service	15400af		17830af
1000	1100		USA, American Forces Network/AFRTS			4319usb
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
1000	1100		USA, EWTN/WEWN Irondale, AL			9390as
1000	1100		USA, FBN/WTJC Newport NC			9370na
1000	1100		USA, KNLS Anchor Point AK	11870as		
1000	1100		USA, WHRI Cypress Creek SC			7385va
			11565va			
1000	1100		USA, WTWW Lebanon TN	5755va		12105va
1000	1100		USA, WWCR Nashville TN	4840na		5890af
			5935af	7465eu		
1000	1100		USA, WWRB Manchester TN	3185na		
1000	1100		USA, WYFR/Family Radio Worldwide			9465na
1000	1100		Zambia, CVC Radio Christian Voice			6065af
			17695af			
1000	1100		Zambia, ZNBC/Radio Two	6165do		
1030	1030	mtwhfa	USA, WRMI/Radio Prague relay			9955am
1030	1100		Iran, IRIB/ VOIRI	21575va	21695va	
1030	1100	Sun	Italy, IRRS-Shortwave	9510va		
1030	1100	Sun	Italy, IRRS-Shortwave/Euro Gospel Radio			9510eu
1030	1100		Mongolia, Voice of Mongolia	12085as		
1059	1100		New Zealand, Radio NZ International			15720pa

1100 UTC - 6AM EST / 5AM CST / 3AM PST

1100	1104		Pakistan, PBC/Radio Pakistan	15725eu		17700eu
1100	1127		Iran, IRIB/ VOIRI	21575va	21695va	
1100	1130	f/ DRM	Japan, Radio Japan NHK World			9760eu
1100	1130	Sat/DRM	South Korea, KBS World Radio			9760eu
1100	1130		UK, BBC World Service	15400af		
1100	1130		Vietnam, Voice of Vietnam/Overseas Svc			7285as
1100	1145		USA, WYFR/Family Radio Worldwide			9755ca
1100	1158	DRM	New Zealand, Radio NZ International			9870pa
1100	1200		Anguilla/Caribbean Beacon/Univ Network 11775na			
1100	1200		Australia, ABC NT Alice Springs			2310do
1100	1200		Australia, ABC NT Katherine	2485do		
1100	1200		Australia, ABC NT Tennant Creek			2325do
1100	1200		Australia, Radio Australia	5995va		6020va
			6140as	9475as	9560as	9580pa
			9590pa	11945as		
1100	1200	DRM	Australia, Radio Australia	12080pa		
1100	1200		Bahrain, Radio Bahrain	6010me		
1100	1200	f/DRM	Belgium, TDP Radio	6015eu		
1100	1200	Sat/Sun	Canada, CBC Northern Quebec Svc			9625na
1100	1200		Canada, CFRX Toronto ON	6070na		
1100	1200		Canada, CFVP Calgary AB	6030na		
1100	1200		Canada, CKZN St Johns NF	6160na		
1100	1200		Canada, CKZU Vancouver BC			6160na
1100	1200		China, China Radio International			5955as
			5960na	9570as	11650as	11795as
			13645as	13665eu	13590as	13720as
			15110as	17490eu		
1100	1200	Sun	Italy, IRRS-Shortwave	9510va		
1100	1200	Sun	Italy, IRRS-Shortwave/Euro Gospel Radio			9510eu
1100	1200		Malaysia, RTM Kajang/Traxx FM			7295do
1100	1200		New Zealand, Radio NZ International			15720pa
1100	1200		Nigeria, Voice of Nigeria	9690af		
1100	1200	DRM	Russia, Voice of Russia	12000as		
1100	1200		Russia, Voice of Russia	7205as		7260as
			7350as	9560as	9670as	
1100	1200		Saudi Arabia, BSKSA/External Svc			15250af
1100	1200		South Africa, Channel Africa	9625af		
1100	1200		South Africa, CVC 1 Africa Radio			13590af
1100	1200		Taiwan, Radio Taiwan International			7445as
			11715as			
1100	1200		UK, BBC World Service	6190af		6195as
			9740as	11760me	11895as	12095af
			15285as	15575me	17640af	17790as
			17830as	21470af		

1100	1200		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
1100	1200		USA, EWTN/WEWN Irondale, AL	9390as
1100	1200		USA, FBN/WTJC Newport NC	9370na
1100	1200		USA, WHRI Cypress Creek SC	7385va
			9410va 11565va	
1100	1200		USA, WWCR Nashville TN 4840na	5890af
			5935af 7465eu	
1100	1200		USA, WWRB Manchester TN 3185na	
1100	1200		USA, WYFR/Family Radio Worldwide	5950na
			15560sa	
1100	1200		Zambia, CVC Radio Christian Voice	6065af
			17695af	
1100	1200		Zambia, ZNBC/Radio Two 6165do	
1130	1200	f	Vatican City State, Vatican Radio	15595as
			17590as	
1130	1200		Vietnam, Voice of Vietnam/Overseas Svc	9840as
			12020as	
1135	1145		India, All India Radio/Aizawl 5050do	
1135	1145		India, All India Radio/Delhi 9595do	11710do
			15185do	
1135	1145		India, All India Radio/Shillong	4970do

1200 UTC - 7AM EST / 6AM CST / 4AM PST

1200	1230		Germany, AWR Europe 17510as	
1200	1230		Japan, Radio Japan NHK World	6120na
			9695as	
1200	1230		Saudi Arabia, BSKSA/External Svc	15250af
1200	1245		USA, WYFR/Family Radio Worldwide	5950na
1200	1256		Romania, Radio Romania International	15430eu
			15460eu 17530af 17765af	
1200	1258		New Zealand, Radio NZ International	15720pa
1200	1300		Anguilla/Caribbean Beacon/Univ Network	
			11775na	
1200	1300		Australia, ABC NT Alice Springs	2310do
1200	1300		Australia, ABC NT Katherine 2485do	
1200	1300		Australia, ABC NT Tennant Creek	2325do
1200	1300		Australia, Radio Australia 6020va	6140as
			9475as 9560as 9580pa	9590pa
1200	1300	DRM	Australia, Radio Australia 5995va	
1200	1300		Bahrain, Radio Bahrain 6010me	
1200	1300	Sat/ DRM	Belgium, TDP Radio 6015eu	
1200	1300	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1200	1300		Canada, CFRX Toronto ON 6070na	
1200	1300		Canada, CFVP Calgary AB 6030na	
1200	1300		Canada, CKZN St Johns NF 6160na	
1200	1300		Canada, CKZU Vancouver BC	6160na
1200	1300		China, China Radio International	5955as
			7250as 9460as 9660as	9645as
			9730as 9760 oa	11650as
			11690as 11760pa 12015as	13665eu
			13790eu 13980as 17490eu	
1200	1300		Ethiopia, Radio Ethiopia/National Program	
			5990do 7110do 9705do	
1200	1300	Sun	Italy, IRRS-Shortwave/Euro Gospel Radio	9510eu
1200	1300		Malaysia, RTM Kajang/Traxx FM	7295do
1200	1300		Nigeria, Voice of Nigeria 9690af	
1200	1300	DRM	Russia, Voice of Russia 7325eu	7340as
			12000as	
1200	1300		Russia, Voice of Russia 7350as	9560as
			11660as	
1200	1300		South Africa, CVC 1 Africa Radio	13590af
1200	1300		South Korea, KBS World Radio	9650na
1200	1300		UK, BBC World Service 5875as	6190af
			6195as 9740as 11760me	11895as
			15310as 15575me 17640af	17830as
			21470af	
1200	1300		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
1200	1300		USA, BBG/Voice of America 7575as	9640as
			11700pa 11750pa 12150va	
1200	1300		USA, EWTN/WEWN Irondale, AL	14610eu
1200	1300		USA, FBN/WTJC Newport NC	9370na
1200	1300		USA, KNLS Anchor Point AK 11870as	
1200	1300		USA, WHRI Cypress Creek SC	7385va
			9410va 11565va	
1200	1300		USA, WWCR Nashville TN 4890na	5935af
			9980af 15825eu	
1200	1300		USA, WWRB Manchester TN 3185va	
1200	1300		USA, WYFR/Family Radio Worldwide	15560as
			17520as 17880as	
1200	1300		Zambia, CVC Radio Christian Voice	6065af
			17695af	
1200	1300		Zambia, ZNBC/Radio Two 6165do	
1215	1300		Egypt, Radio Cairo 17870as	
1230	1245		India, All India Radio/Aizawl 5050do	
1230	1245		India, All India Radio/Chennai	4920do
1230	1245		India, All India Radio/Delhi 4860do	6085do
1230	1245		India, All India Radio/Hyderbad	4800do
1230	1245		India, All India Radio/Jeypore 5040do	
1230	1245		India, All India Radio/Kurseong	4895do
1230	1245		India, All India Radio/Port Blair	4760do
1230	1245		India, All India Radio/Radio Kashmir	4950do
1230	1245		India, All India Radio/Shillong	4970do
1230	1245		India, All India Radio/Thiruvananthapuram	
			5010do	
1230	1300		Thailand, Radio Thailand World Svc	9720va
1230	1300		Vietnam, Voice of Vietnam/Overseas Svc	9840as
			12020as	

1300 UTC - 8AM EST / 7AM CST / 5AM PST

1300	1330		Egypt, Radio Cairo 17870as	
1300	1330		Japan, Radio Japan NHK World	11730as
1300	1357		North Korea, Voice of Korea 9335na	11710na
			13760eu 15245eu	
1300	1400		Anguilla/Caribbean Beacon/Univ Network	
			11775na	
1300	1400		Australia, ABC NT Alice Springs	2310do
1300	1400		Australia, ABC NT Katherine 2485do	
1300	1400	DRM	Australia, Radio Australia 5995va	
1300	1400		Bahrain, Radio Bahrain 6010me	
1300	1400	Sun/DRM	Belgium, TDP Radio 6015na	
1300	1400	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1300	1400		Canada, CFRX Toronto ON 6070na	
1300	1400		Canada, CFVP Calgary AB 6030na	
1300	1400		Canada, CKZN St Johns NF 6160na	
1300	1400		Canada, CKZU Vancouver BC	6160na
1300	1400		China, China Radio International	5995as
			7300as 9570na 9655as	9730as
			9765as 9870as 11760pa	11885na
			11900pa 11980as 13670eu	13790eu
			15230na	
1300	1400		Indonesia, Voice of Indonesia 9526as	
1300	1400		Italy, IRRS-Shortwave 15190va	
1300	1400		Italy, IRRS-Shortwave/Overcomer Ministry	
			15190pa	
1300	1400		Malaysia, RTM Kajang/Traxx FM	7295do
1300	1400		New Zealand, Radio NZ International	5950pa
1300	1400		Nigeria, Voice of Nigeria 9690af	
1300	1400	DRM	Russia, Voice of Russia 7325eu	7340as
			9675eu	
1300	1400		Russia, Voice of Russia 7205as	7260as
			9560as	
1300	1400		South Africa, CVC 1 Africa Radio	13590af
1300	1400		South Korea, KBS World Radio	9570as
1300	1400		Tajikistan, Voice of Tajik 7245va	
1300	1400		UK, BBC World Service 5875as	6190af
			6195as 9410as 9740as	11760me
			11890as 12095af 15310as	15420af
			15575me 17640af 17830as	21470af
1300	1400		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
1300	1400	Sat/Sun	USA, BBG/Voice of America 7575as	9640as
			11700va 12150va	
1300	1400		USA, EWTN/WEWN Irondale, AL	15610eu
1300	1400		USA, FBN/WTJC Newport NC	9370na
1300	1400		USA, KJES Vado NM 7555na	
1300	1400		USA, WBCQ Monticello ME 9330usb	
1300	1400		USA, WHRI Cypress Creek SC	7385va
			11565va	
1300	1400	Sat/Sun	USA, WHRI Cypress Creek SC	9840af
1300	1400		USA, WWCR Nashville TN 7490af	9980af
			13845eu 15825eu	
1300	1400		USA, WWRB Manchester TN 9385na	
1300	1400		USA, WYFR/Family Radio Worldwide	11560as
			12160ca	
1300	1400		Zambia, CVC Radio Christian Voice	6065af
			17695af	
1300	1400		Zambia, ZNBC/Radio Two 6165do	
1330	1345		India, All India Radio/Delhi 6085do	
1330	1400		India, All India Radio/External Svc	9690as
			11620as 13710as	
1330	1400		Turkey, Voice of Turkey 12035va	

SHORTWAVE GUIDE

1330	1400		Vietnam, Voice of Vietnam/Overseas Svc	9840as 12020as

1400 UTC - 9AM EST / 8AM CST / 6AM PST

1400	1415	Sun	Germany, Pan American Broadcasting	15205as
1400	1430		Japan, Radio Japan NHK World	5955as 11695as 21560af
1400	1430		Serbia, International Radio Serbia	9635eu
1400	1430		Thailand, Radio Thailand World Svc	9725va
1400	1430		Turkey, Voice of Turkey	12035va
1400	1457		Netherlands, R Netherlands Worldwide	12080as
1400	1500		Anguilla/Caribbean Beacon/Univ Network	11775na
1400	1500		Australia, ABC NT Alice Springs	2310do
1400	1500		Australia, ABC NT Katherine	2485do
1400	1500		Australia, ABC NT Tennant Creek	2325do
1400	1500		Australia, Radio Australia	5995va 6080as 7240pa 9590pa 11660as
1400	1500		Bahrain, Radio Bahrain	6010me
1400	1500	Sun	Canada, Bible Voice Broadcasting	15470as
1400	1500	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1400	1500		Canada, CFRX Toronto ON	6070na
1400	1500		Canada, CFVP Calgary AB	6030na
1400	1500		Canada, CKZN St Johns NF	6160na
1400	1500		Canada, CKZU Vancouver BC	6160na
1400	1500		China, China Radio International	5955as 7300as 9460as 9700eu 9765eu 9870as 11665as 13675na 13740na 15230na 17630af
1400	1500	Sat/Sun	Equatorial Guinea, Radio East Africa/Malabo	15190af
1400	1500		India, All India Radio/External Svc	9690as 11620as 13710as
1400	1500		Italy, IRRS-Shortwave/Overcomer Ministry	15190va
1400	1500		Libya, LJBC Voice of Africa	17725af
1400	1500		Malaysia, RTM Kajang/Traxx FM	7295do
1400	1500		New Zealand, Radio NZ International	5950pa
1400	1500		Nigeria, Voice of Nigeria	9690af
1400	1500		Oman, Radio Sultanate of Oman	15140va
1400	1500	DRM	Russia, Voice of Russia	7340as 9675eu
1400	1500		Russia, Voice of Russia	4975va 7260as 7310as 11660as
1400	1500		South Africa, CVC 1 Africa Radio	13590af
1400	1500		UK, BBC World Service	5845as 5875as 5975as 6190af 6195as 9410as 9740as 11760me 11890as 12095af 15420af 17640af 17830as
1400	1500		USA, American Forces Network/AFRTS	4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
1400	1500		USA, BBG/Voice of America	6080af 15580af 17650af 17715af
1400	1500	mtwhf	USA, BBG/Voice of America	7575as 9760as 12150va
1400	1500		USA, EWTN/WEWN Irondale, AL	15610eu
1400	1500		USA, FBN/WTJC Newport NC	9370na
1400	1500		USA, WBCQ Monticello ME	9330usb
1400	1500		USA, WHRI Cypress Creek SC	7385va 9840va
1400	1500	Sat/Sun	USA, WHRI Cypress Creek SC	9840af 17510af
1400	1500		USA, WJHR International Milton FL	15550na
1400	1500		USA, WWCR Nashville TN	7490af 9980af 13845eu 15825eu
1400	1500		USA, WWRB Manchester TN	9385na
1400	1500		USA, WYFR/Family Radio Worldwide	9615as 11560as
1400	1500		Zambia, CVC Radio Christian Voice	6065af 17695af
1400	1500		Zambia, ZNBC/Radio Two	6165do
1405	1435	Sun	Canada, Bible Voice Broadcasting	9390as
1415	1430		Germany, Pan American Broadcasting	15205as
1415	1500		Nepal, Radio Nepal	5005as
1420	1440		India, All India Radio/Itanagar	4990do
1430	1445	Sun	Germany, Pan American Broadcasting	15205as
1430	1445		India, All India Radio/Aizawl	5050do
1430	1445		India, All India Radio/Delhi	6085do 9575do 9835do
1430	1445		India, All India Radio/Jeypore	5040do
1430	1445		India, All India Radio/Mumbai	4840do
1430	1500		Australia, Radio Australia	9475as
1430	1500	Sat	Canada, Bible Voice Broadcasting	15470af
1430	1500		China, CNR-11/Xi'an	4905do 4920do 6010do 6130do
1430	1500	Sat	India, All India Radio/Gangtok	4835do
1445	1500		Australia, HCJB Global Australia	15340as
1450	1500		India, All India Radio/Itanagar	4990do
1450	1500		India, All India Radio/Kurseong	4895do

1500 UTC - 10AM EST / 9AM CST / 7AM PST

1500	1515	Sun	Canada, Bible Voice Broadcasting	13740as
1500	1525	mh	Guam, TWR Asia/KTWR	15200as
1500	1529		Canada, Radio Canada International	9635as 11975as
1500	1530		Australia, HCJB Global Australia	15340as
1500	1530		Clandestine, Sudan Radio Service/SRS	17745af
1500	1530		India, All India Radio/Jeypore	5040do
1500	1530		USA, WRMI/Radio Prague relay	9955am
1500	1530		Vietnam, Voice of Vietnam/Overseas Svc	7285as 9840as 12020as
1500	1535	twas	Guam, TWR Asia/KTWR	15200as
1500	1550		New Zealand, Radio NZ International	5950pa
1500	1557		North Korea, Voice of Korea	9335na 11710na 13760eu 15245eu
1500	1558		Libya, LJBC Voice of Africa	17725af
1500	1559		South Africa, Channel Africa	9625af
1500	1600		Anguilla/Caribbean Beacon/Univ Network	11775na
1500	1600		Australia, ABC NT Alice Springs	2310do
1500	1600		Australia, ABC NT Katherine	2485do
1500	1600		Australia, Radio Australia	5995va 6080as 7240pa 9475as 9590pa 11660as
1500	1600		Bahrain, Radio Bahrain	6010me
1500	1600		Bhutan, Bhutan Broadcasting Svc	6035do
1500	1600	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1500	1600		Canada, CFRX Toronto ON	6070na
1500	1600		Canada, CFVP Calgary AB	6030na
1500	1600		Canada, CKZN St Johns NF	6160na
1500	1600		Canada, CKZU Vancouver BC	6160na
1500	1600		China, China Radio International	5955as 6095va 7325as 7405as 9435eu 9525eu 9720va 9785as 9870as 13740na 17630af
1500	1600	Sat/Sun	Equatorial Guinea, Radio East Africa/Malabo	15190af
1500	1600		Malaysia, RTM Kajang/Traxx FM	7295do
1500	1600		Nigeria, Voice of Nigeria	15120af
1500	1600	DRM	Russia, Voice of Russia	7340as
1500	1600		Russia, Voice of Russia	4975va 9470va 9660as 9880as
1500	1600		South Africa, CVC 1 Africa Radio	13590af
1500	1600		Uganda, Dunamis Shortwave	4750do
1500	1600		UK, BBC World Service	5875as 6190af 6195as 9410as 9490af 9505as 11830me 12095af 15400af 15420af 17640af 17830as
1500	1600		USA, American Forces Network/AFRTS	4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
1500	1600		USA, BBG/Voice of America	4930af 6080af 7575as 9930pa 11840va 12150va 13570va 15580af 17715af 17895af
1500	1600		USA, BBG/Voice of America/Special English	6140va 7465va 7520va 9760va 9945va
1500	1600		USA, EWTN/WEWN Irondale, AL	15610eu
1500	1600		USA, FBN/WTJC Newport NC	9370na
1500	1600		USA, KNLS Anchor Point AK	9920as
1500	1600		USA, WBCQ Monticello ME	9330usb
1500	1600		USA, WHRI Cypress Creek SC	7385af
1500	1600	Sat/Sun	USA, WHRI Cypress Creek SC	9840af
1500	1600	Sat	USA, WHRI Cypress Creek SC	17510af
1500	1600	Sun	USA, WHRI Cypress Creek SC	15195va
1500	1600		USA, WJHR International Milton FL	15550na
1500	1600		USA, WWCR Nashville TN	7490af 9980af 13845eu 15825eu
1500	1600		USA, WWRB Manchester TN	9385na
1500	1600		USA, WYFR/Family Radio Worldwide	11605as 17580af
1500	1600		Zambia, CVC Radio Christian Voice	6065af 17695af
1500	1600		Zambia, ZNBC/Radio Two	6165do
1515	1530	Sat	Canada, Bible Voice Broadcasting	13670as
1525	1555	Sat/Sun	Swaziland, TWR Africa	4760af
1530	1545		India, All India Radio/Aizawl	5050do

1530	1545		India, All India Radio/Bengaluru	9425do
1530	1545		India, All India Radio/Bhopal	4810do
1530	1545		India, All India Radio/Chennai	4920do
1530	1545		India, All India Radio/Delhi	5015do
1530	1545		India, All India Radio/External Svc	9910as
1530	1545		India, All India Radio/Guwahati	4940do
1530	1545		India, All India Radio/Hyderbad	4800do
1530	1545		India, All India Radio/Itanagar	4990do
1530	1545		India, All India Radio/Jaipur	4910do
1530	1545		India, All India Radio/Kolkata	4820do
1530	1545		India, All India Radio/Kurseong	4895do
1530	1545		India, All India Radio/Lucknow	4880do
1530	1545		India, All India Radio/Panaji, Goa	9820do
1530	1545		India, All India Radio/Port Blair	4760do
1530	1545		India, All India Radio/Radio Kashmir	4950do
1530	1545		India, All India Radio/Shillong	4970do
1530	1545		India, All India Radio/Shimla	4965do
1530	1545		India, All India Radio/Thiruvananthapuram	5010do
1530	1550	DRM	Vatican City State, Vatican Radio	15180as
1530	1600		Afghanistan, Radio Afghanistan	6102as
1530	1600	DRM	Belgium, TDP Radio/Disco Palace	12115as
1530	1600	h	Canada, Bible Voice Broadcasting	13670as
1530	1600	smtwa	Germany, AWR Europe	15255as
1530	1600		Iran, IRIB/ VOIRI	13785as 15525as
1530	1600		Mongolia, Voice of Mongolia	12015as
1530	1600		Myanmar, Myanma Radio/National Svc	5985do
1530	1600	Sat/DRM	Vatican City State, Vatican Radio	15180as
1530	1600	Sat	Vatican City State, Vatican Radio	7585as
			11850as	13765as
1551	1600		New Zealand, Radio NZ International	7440pa
1551	1600	DRM	New Zealand, Radio NZ International	5950pa

1600 UTC - 11AM EST / 10AM CST / 8AM PST

1600	1627		Iran, IRIB/ VOIRI	13785as 15525as
1600	1630		Afghanistan, Radio Afghanistan	6102as
1600	1630		Australia, Radio Australia	9580as
1600	1630	DRM	Belgium, TDP Radio/Disco Palace	12115as
1600	1630		Guam, AWR/KSDA	11690as 11935as
			15215as	
1600	1630		Myanmar, Myanma Radio/National Svc	5985do
1600	1630		Vietnam, Voice of Vietnam/Overseas Svc	7220va
			7280va	9550va 9730va
1600	1645		USA, WYFR/Family Radio Worldwide	11865na
1600	1650	DRM	New Zealand, Radio NZ International	5950pa
1600	1650		New Zealand, Radio NZ International	7440pa
1600	1657		North Korea, Voice of Korea	9990va 11545va
1600	1700		Anguilla/Caribbean Beacon/Univ Network	11775na
1600	1700		Australia, ABC NT Alice Springs	2310do
1600	1700		Australia, ABC NT Katherine	2485do
1600	1700		Australia, Radio Australia	5995va 6080as
			7240pa	9475as 9710as 11660as
1600	1700		Bahrain, Radio Bahrain	6010me
1600	1700		Bhutan, Bhutan Broadcasting Svc	6035do
1600	1700	Sat	Canada, CBC Northern Quebec Svc	9625na
1600	1700		Canada, CFRX Toronto ON	6070na
1600	1700		Canada, CFVP Calgary AB	6030na
1600	1700		Canada, CKZN St Johns NF	6160na
1600	1700		Canada, CKZU Vancouver BC	6160na
1600	1700		China, China Radio International	6060as
			7235as	7255eu 7420af 7435af
			9435eu	9570af 9875eu
1600	1700		Egypt, Radio Cairo	15345af
1600	1700	Sat/Sun	Equatorial Guinea, Radio East Africa/Malabo	15190af
1600	1700		Ethiopia, Radio Ethiopia	7235va 9560va
1600	1700		Malaysia, RTM Kajang/Traxx FM	7295do
1600	1700	DRM	Russia, Voice of Russia	6180as
1600	1700		Russia, Voice of Russia	4975va 9470me
1600	1700		South Africa, CVC 1 Africa Radio	13590af
1600	1700		South Korea, KBS World Radio	9515eu
			9640as	
1600	1700		Taiwan, Radio Taiwan International	9435as
			12055as	
1600	1700		Uganda, Dunamis Shortwave	4750do
1600	1700		UK, BBC World Service	3255af 5875as
			5975as	6190af 9410as 9505as
			11830me	12095af 13790af 15400af
			15420af	17640af 17830as
1600	1700		USA, American Forces Network/AFRTS	4319usb
			5446usb	5765usb 7812usb 12133usb
			12759usb	13362usb
1600	1700		USA, BBG/Voice of America	4930af 6080af
			15580af	17895af
1600	1700		USA, BBG/Voice of America/Special English	
			13600va	15470va
1600	1700		USA, EWTN/WEWN Irondale, AL	15610eu
1600	1700		USA, FBN/WTJC Newport NC	9370na
1600	1700		USA, WBCQ Monticello ME	9330usb
1600	1700		USA, WHRI Cypress Creek SC	7385af
			9840af	17520af
1600	1700		USA, WJHR International Milton FL	15550na
1600	1700		USA, WWCR Nashville TN	9980af 12160af
			13845eu	15825eu
1600	1700		USA, WWRB Manchester TN	9385na
1600	1700		USA, WYFR/Family Radio Worldwide	11850as
			17545af	21525af
1600	1700		Zambia, CVC Radio Christian Voice	6065af
			17695af	
1600	1700		Zambia, ZNBC/Radio Two	6165do
1630	1700	Sun	Canada, Bible Voice Broadcasting	9460me
1630	1700		Palau, T8WH/ WHRI	9930as
1630	1700	m	South Africa, South African Radio League	4895af
1630	1700	mtwhf	USA, BBG/Voice of America	9790af 13635af
1645	1700	mtwhfa	Canada, Bible Voice Broadcasting	9460me
1651	1700	DRM	New Zealand, Radio NZ International	9890pa
1651	1700	smtwhf	New Zealand, Radio NZ International	9765pa
1658	1700	Sat	New Zealand, Radio NZ International	9765pa

1700 UTC - 12PM EST / 11AM CST / 9AM PST

1700	1715	f	Canada, Bible Voice Broadcasting	9460me
1700	1720	th	Canada, Bible Voice Broadcasting	9460me
1700	1730	m	South Africa, South African Radio League	3230af
1700	1750	DRM	New Zealand, Radio NZ International	9890pa
1700	1750	smtwhf	New Zealand, Radio NZ International	9765pa
1700	1755		South Africa, Channel Africa	15235af
1700	1800		Anguilla/Caribbean Beacon/Univ Network	11775na
1700	1800		Australia, ABC NT Alice Springs	2310do
1700	1800		Australia, ABC NT Katherine	2485do
1700	1800		Australia, Radio Australia	5995va 6080as
			9475as	9580pa 9710as 11880pa
1700	1800		Bahrain, Radio Bahrain	6010me
1700	1800	Sat/Sun	Canada, Bible Voice Broadcasting	9460me
1700	1800	Sat	Canada, CBC Northern Quebec Svc	9625na
1700	1800		Canada, CFRX Toronto ON	6070na
1700	1800		Canada, CFVP Calgary AB	6030na
1700	1800		Canada, CKZN St Johns NF	6160na
1700	1800		Canada, CKZU Vancouver BC	6160na
1700	1800		China, China Radio International	6090as
			6100eu	6140as 7205eu 7255eu
			7410as	7420as 7425as 9570af
			9600as	13685af
1700	1800		Egypt, Radio Cairo	15345af
1700	1800	Sat/Sun	Equatorial Guinea, Radio Africa	7190af
1700	1800		Malaysia, RTM Kajang/Traxx FM	7295do
1700	1800		Palau, T8WH/ WHRI	9930as
1700	1800	DRM	Russia, Voice of Russia	7300eu
1700	1800		Russia, Voice of Russia	4975va 7240as
			7270va	7330eu 9880as
1700	1800		South Africa, CVC 1 Africa Radio	4965af
			13590af	
1700	1800		Swaziland, TWR Africa	3200af
1700	1800	Sat	Swaziland, TWR Africa	3200af
1700	1800		Taiwan, Radio Taiwan International	15690af
1700	1800		UK, BBC World Service	5875as 5975as
			6190af	7600as 9505as 12095af
			13790af	15400af 15420af 17640af
			17830af	
1700	1800		USA, American Forces Network/AFRTS	4319usb
			5446usb	5765usb 7812usb 12133usb
			12759usb	13362usb
1700	1800		USA, BBG/Voice of America	15580af 17895af
1700	1800		USA, EWTN/WEWN Irondale, AL	15610eu
1700	1800		USA, FBN/WTJC Newport NC	9370na
1700	1800		USA, WBCQ Monticello ME	9330usb 15420usb
1700	1800		USA, WHRI Cypress Creek SC	7385af
			9840af	17520af
1700	1800		USA, WJHR International Milton FL	15550na
1700	1800		USA, WWCR Nashville TN	9980af 12160af
			13845eu	15825eu
1700	1800		USA, WWRB Manchester TN	9385na
1700	1800		USA, WYFR/Family Radio Worldwide	7395af

1700	1800		Zambia, CVC Radio Christian Voice	4965af
1700	1800		Zambia, ZNBC/Radio Two	6165do
1730	1745	h	Canada, Bible Voice Broadcasting	9460me
1730	1745		India, All India Radio/Bhopal	4810do
1730	1745		India, All India Radio/Delhi	5015do 7370do 9575do 9835do
1730	1745		India, All India Radio/Guwahati	4940do
1730	1745		India, All India Radio/Hyderbad	4800do
1730	1745		India, All India Radio/Jaipur	4910do
1730	1745		India, All India Radio/Kolkata	4820do
1730	1745		India, All India Radio/Kurseong	4895do
1730	1745		India, All India Radio/Lucknow	4880do
1730	1745		India, All India Radio/Radio Kashmir	4950do
1730	1745		India, All India Radio/Shimla	4965do
1730	1745		India, All India Radio/Thiruvananthapuram	5010do
1730	1800	mtwhf	Clandestine, Sudan Radio Service/SRS	9590af
1730	1800		Turkey, Voice of Turkey	11735as
1730	1800		Vatican City State, Vatican Radio	9755af 11625af 13765af
1740	1745		India, All India Radio/Chennai	4920do
1745	1800	Sat	Canada, Bible Voice Broadcasting	13810af
1745	1800	DRM	India, All India Radio/External Svc	9950eu 11580af
1745	1800		India, All India Radio/External Svc	7400af 7410af 7550eu 9415af 9445af 11670eu 11935af
1751	1800	DRM	New Zealand, Radio NZ International	11675pa
1751	1800		New Zealand, Radio NZ International	11725pa
1758	1800	DRM	New Zealand, Radio NZ International	11675pa
1758	1800	Sat	New Zealand, Radio NZ International	11725pa

1800 UTC - 1PM EST / 12PM CST / 10AM PST

1800	1815	Sat	Canada, Bible Voice Broadcasting	7365as
1800	1830	w	Austria, AWR Europe	11690af
1800	1830	t	Canada, Bible Voice Broadcasting	9460me
1800	1830	DRM	Romania, Radio Romania International	5875eu
1800	1830		South Africa, AWR Africa	3215af 3345af
1800	1830		Turkey, Voice of Turkey	11735as
1800	1830		UK, BBC World Service	5975as 7600as 9505as
1800	1830		USA, BBG/Voice of America	4930af 6080af 13635af 15580af
1800	1830		Vietnam, Voice of Vietnam/Overseas Svc	5955va
1800	1850	DRM	New Zealand, Radio NZ International	11675pa
1800	1856	DRM	Romania, Radio Romania International	9745eu
1800	1856		Romania, Radio Romania International	11955eu
1800	1857		North Korea, Voice of Korea	13760eu 15425eu
1800	1859		Canada, Radio Canada International	9740va 9770af 11845af 15365af 17790af
1800	1900		Anguilla/Caribbean Beacon/Univ Network	11775na
1800	1900	mtwhf	Argentina, RAE	15345eu
1800	1900		Australia, ABC NT Alice Springs	2310do
1800	1900		Australia, ABC NT Katherine	2485do
1800	1900		Australia, Radio Australia	6080as 7240pa 9475as 9580pa 9710as 11880pa
1800	1900		Bahrain, Radio Bahrain	6010me
1800	1900	Sun	Canada, Bible Voice Broadcasting	6110me 9460me
1800	1900	Sat	Canada, Bible Voice Broadcasting	6110me
1800	1900		Canada, CFRX Toronto ON	6070na
1800	1900		Canada, CFVP Calgary AB	6030na
1800	1900		Canada, CKZN St Johns NF	6160na
1800	1900		Canada, CKZU Vancouver BC	6160na
1800	1900		China, China Radio International	6100eu 6165as 7405eu 13685af
1800	1900	Sat/Sun	Equatorial Guinea, Radio Africa	7190af
1800	1900	DRM	India, All India Radio/External Svc	9950eu 11580af
1800	1900		India, All India Radio/External Svc	7400af 7410af 7550eu 9415af 9445af 11670eu 11935af
1800	1900		Kuwait, Radio Kuwait	15540eu
1800	1900		Malaysia, RTM Kajang/Traxx FM	7295do
1800	1900		Netherlands, R Netherlands Worldwide	11655af
1800	1900		New Zealand, Radio NZ International	11725pa
1800	1900		Nigeria, Voice of Nigeria	15120af
1800	1900		Palau, T8WH/ WHRI	9930as 9955as
1800	1900		Poland, Polskie Radio Warsaw	3955eu
1800	1900	DRM	Russia, Voice of Russia	6145eu 7300eu
1800	1900		Russia, Voice of Russia	7270va 7330eu 11985va 12060eu
1800	1900		South Africa, CVC 1 Africa Radio	4965af 13590af
1800	1900		South Korea, KBS World Radio	7275eu
1800	1900		Swaziland, TWR Africa	9500af
1800	1900		Taiwan, Radio Taiwan International	3965eu
1800	1900		UK, BBC World Service	3255af 5945as 6190af 9430af 11810af 15400af
1800	1900		USA, American Forces Network/AFRTS	4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
1800	1900		USA, EWTN/WEWN Irondale, AL	15610af
1800	1900		USA, FBN/WTJC Newport NC	9370na
1800	1900		USA, KJES Vado NM	15385na
1800	1900		USA, WBCQ Monticello ME	9330usb 15420usb
1800	1900		USA, WHRI Cypress Creek SC	7385af 9840af 17520af
1800	1900		USA, WJHR International Milton FL	15550na
1800	1900		USA, WWCR Nashville TN	9980af 12160af 13845eu 15825eu
1800	1900		USA, WWRB Manchester TN	9385na
1800	1900		USA, WYFR/Family Radio Worldwide	5905af 7395af 9770af 9925af 13750af
1800	1900		Zambia, CVC Radio Christian Voice	4965af 17695af
1800	1900		Zambia, ZNBC/Radio Two	6165do
1815	1900		USA, WINB Red Lion PA	13570ca
1830	1845		India, All India Radio/Delhi	5015do
1830	1900		Bulgaria, Radio Bulgaria	7400eu 9700eu
1830	1900	DRM	Clandestine, Dmetse Tewahedo	15370na
1830	1900	Sun	Italy, IRRS-Shortwave/Euro Gospel Radio	7290eu
1830	1900		South Africa, AWR Africa	11830af
1830	1900		UK, BBC World Service	9410af
1830	1900		USA, BBG/Voice of America	4930af 6080af 13635af 15580af
1851	1900	DRM	New Zealand, Radio NZ International	15720pa
1858	1900	Sat/DRM	New Zealand, Radio NZ International	15720pa

1900 UTC - 2PM EST / 1PM CST / 11AM PST

1900	1915	Sun	Canada, Bible Voice Broadcasting	9460me
1900	1928		Germany, Deutsche Welle	12045af
1900	1930	DRM	Clandestine, Dmetse Tewahedo	15370na
1900	1930		Germany, Deutsche Welle	9735af 12070af
1900	1930		Vietnam, Voice of Vietnam/Overseas Svc	7280va 9730va
1900	1945	DRM	India, All India Radio/External Svc	9950eu 11580af
1900	1945		India, All India Radio/External Svc	7400af 7410af 7550eu 9415af 9445af 11670eu 11935af
1900	1950	DRM	New Zealand, Radio NZ International	15720pa
1900	1957		Netherlands, R Netherlands Worldwide	11655af
1900	1957		North Korea, Voice of Korea	7210af 9975va 11535va 11910af
1900	1959		Netherlands, R Netherlands Worldwide	11615af
1900	2000		Anguilla/Caribbean Beacon/Univ Network	11775na
1900	2000		Australia, ABC NT Alice Springs	2310do
1900	2000		Australia, ABC NT Katherine	2485do
1900	2000		Australia, Radio Australia	6080as 7240pa 9500as 9580pa 9710as 11880pa
1900	2000		Bahrain, Radio Bahrain	6010me
1900	2000	Sat	Canada, Bible Voice Broadcasting	9470me
1900	2000	Sun	Canada, Bible Voice Broadcasting	6030eu
1900	2000		Canada, CFRX Toronto ON	6070na
1900	2000		Canada, CFVP Calgary AB	6030na
1900	2000		Canada, CKZN St Johns NF	6160na
1900	2000		Canada, CKZU Vancouver BC	6160na
1900	2000		China, China Radio International	7295as 7435 `af 9440as
1900	2000		Cuba, Radio Havana Cuba	11760sa
1900	2000		Egypt, Radio Cairo	11510af
1900	2000	Sat/Sun	Equatorial Guinea, Radio Africa	7190af
1900	2000		Indonesia, Voice of Indonesia	9526eu
1900	2000		Italy, IRRS-Shortwave	7290va
1900	2000	fas	Italy, IRRS-Shortwave/Overcomer Ministry	7290eu
1900	2000		Kuwait, Radio Kuwait	15540eu
1900	2000		Malaysia, RTM Kajang/Traxx FM	7295do
1900	2000		Micronesia, The Cross Radio/Pohnpei	4755as
1900	2000		Netherlands, R Netherlands Worldwide	7425af

1900	2000		New Zealand, Radio NZ International	11725pa
1900	2000		Palau, T8WH/ WHRI	9930as
1900	2000	DRM	Russia, Voice of Russia	6040eu
1900	2000		Russia, Voice of Russia	7330eu
1900	2000		South Africa, CVC 1 Africa Radio	4965af
			13590af	
1900	2000	mtwhf	Spain, Radio Exterior de Espana	9605af
			9665eu	
1900	2000		Swaziland, TWR Africa	3200af
1900	2000	Sat	Swaziland, TWR Africa	3200af
1900	2000		Thailand, Radio Thailand World Svc	9680eu
1900	2000		UK, BBC World Service	3255af 5945as
			6005af 9410af 9430af	11810af
			15400af	
1900	2000		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
1900	2000		USA, BBG/Voice of America	4930af 4940af
			6080af 7480va 9590va	15580af
1900	2000		USA, BBG/Voice of America/Special English	
			7480va 9590va	
1900	2000		USA, EWTN/WEWN Irondale, AL	15610af
1900	2000		USA, FBN/WTJC Newport NC	9370na
1900	2000		USA, WBCQ Monticello ME	7415usb 9330usb
			15420usb	
1900	2000		USA, WHRI Cypress Creek SC	7385af
			9840af 17520na	
1900	2000		USA, WINB Red Lion PA	13570ca
1900	2000		USA, WJHR International Milton FL	15550na
1900	2000		USA, WWCR Nashville TN	9980af 12160af
			13845eu 15825eu	
1900	2000		USA, WWRB Manchester TN	9385na
1900	2000		USA, WYFR/Family Radio Worldwide	3230af
			6020af 7270af 7395af	9610af
			9775af 18980eu	
1900	2000		Zambia, CVC Radio Christian Voice	4965af
			13590af	
1900	2000		Zambia, ZNBC/Radio Two	6165do
1905	1920	Sat	Mali, ORTM/Radio Mali	9635do
1915	1945	Sat	Canada, Bible Voice Broadcasting	6030eu
1915	1945	Sun	Canada, Bible Voice Broadcasting	9470me
1930	2000	Sat/Sun	Germany, Pan American Broadcasting	9515af
1930	2000		Iran, IRIB/ VOIRI 6010eu 6115eu	7320eu
			13670af 15450af	
1930	2000		Serbia, International Radio Serbia	6100eu
1930	2000		South Africa, RTE Radio Worldwide	5840af
1930	2000		Turkey, Voice of Turkey	6050va
1951	2000	DRM	New Zealand, Radio NZ International	17675pa
1958	2000	Sat/DRM	New Zealand, Radio NZ International	17675pa

2000 UTC - 3PM EST / 2PM CST / 12PM PST

2000	2015	Sat	Germany, Pan American Broadcasting	9515af
2000	2027		Iran, IRIB/ VOIRI 6010eu 6115eu	7320eu
			13670af 15450af	
2000	2030		Egypt, Radio Cairo	11510af
2000	2030		South Africa, RTE Radio Worldwide	5840af
2000	2030	Sat	Swaziland, TWR Africa	3200af
2000	2030		Turkey, Voice of Turkey	6050va
2000	2030		Vatican City State, Vatican Radio	7365af
			9755af 11625af	
2000	2050	DRM	New Zealand, Radio NZ International	17675pa
2000	2057		Netherlands, R Netherlands Worldwide	7425af
			11615af	
2000	2059		USA, WINB Red Lion PA	13570ca
2000	2100		Anguilla/Caribbean Beacon/Univ Network	
			11775na	
2000	2100		Australia, ABC NT Alice Springs	2310do
2000	2100		Australia, ABC NT Katherine	2485do
2000	2100		Australia, ABC NT Tennant Creek	2325do
2000	2100		Australia, Radio Australia	9500as 11650as
			11660pa 11880pa	
2000	2100	mtwhf	Australia, Radio Australia	7240pa
2000	2100	Sat/Sun	Australia, Radio Australia	6080as 7240pa
			12080va	
2000	2100		Bahrain, Radio Bahrain	6010me
2000	2100		Belarus, Radio Station Belarus	7255eu
			7360eu 7390eu	
2000	2100	DRM	Belgium, TDP Radio/Disco Palace	17755na
2000	2100		Canada, CFRX Toronto ON	6070na
2000	2100		Canada, CFVP Calgary AB	6030na
2000	2100		Canada, CKZN St Johns NF	6160na
2000	2100		Canada, CKZU Vancouver BC	6160na
2000	2100		China, China Radio International	5960eu
			5985af 7285eu 7295as	7415eu
			9440as 9600eu 11640af	13630af
2000	2100	Sat/Sun	Equatorial Guinea, Radio Africa	7190af
2000	2100		Germany, Deutsche Welle	9655af 9735af
			12070af	
2000	2100		Kuwait, Radio Kuwait	15540eu
2000	2100		Malaysia, RTM Kajang/Traxx FM	7295do
2000	2100		Micronesia, The Cross Radio/Pohnpei	4755as
2000	2100		New Zealand, Radio NZ International	11725pa
2000	2100		Palau, T8WH/ WHRI	9930as
2000	2100	DRM	Russia, Voice of Russia	6040eu
2000	2100		Russia, Voice of Russia	7330eu
2000	2100		South Africa, CVC 1 Africa Radio	4965af
			9505af	
2000	2100		UK, BBC World Service	3255af 6005af
			6190af 9410af 9430af	11810af
			15400af	
2000	2100		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb	12133usb
			12759usb 13362usb	
2000	2100	mtwhf	USA, BBG/Voice of America	7470va 9480va
			9490va	
2000	2100		USA, EWTN/WEWN Irondale, AL	15610af
2000	2100		USA, FBN/WTJC Newport NC	9370na
2000	2100		USA, WBCQ Monticello ME	7415usb 9330usb
			15420usb	
2000	2100		USA, WHRI Cypress Creek SC	7385na
			15665na	
2000	2100		USA, WJHR International Milton FL	15550na
2000	2100		USA, WWCR Nashville TN	9980af 12160af
			13845eu 15825eu	
2000	2100		USA, WWRB Manchester TN	9385na
2000	2100		USA, WYFR/Family Radio Worldwide	12060af
			15195af 17725ca	
2000	2100		Zambia, CVC Radio Christian Voice	4965af
			13590af	
2000	2100		Zambia, ZNBC/Radio Two	6165do
2030	2045		Thailand, Radio Thailand World Svc	9535eu
2030	2100		USA, BBG/Voice of America	4930af 6080af
			7560as 15580af	
2030	2100	Sat/Sun	USA, BBG/Voice of America	4940af
2030	2100		Vietnam, Voice of Vietnam/Overseas Svc	7220va
			7280va 9550va 9730va	
2045	2100		India, All India Radio/External Svc	7550eu
			9445eu 9910pa 11620pa	11670eu
			11715pa	
2045	2100	DRM	India, All India Radio/External Svc	9950eu
2045	2100	DRM	Vatican City State, Vatican Radio	9800am
2050	2100		Vatican City State, Vatican Radio	3975eu
			6075eu 7250eu	
2051	2100	DRM	New Zealand, Radio NZ International	15720pa

2100 UTC - 4PM EST / 3PM CST / 1PM PST

2100	2130	mtwhfa	Albania, Radio Tirana	7530na
2100	2130		Australia, ABC NT Alice Springs	2310do
2100	2130		Australia, ABC NT Katherine	2485do
2100	2130		Australia, ABC NT Tennant Creek	2325do
2100	2130		Austria, AWR Europe	9830af
2100	2130	Sat	Canada, CBC Northern Quebec Svc	9625na
2100	2130		China, China Radio International	11640af
			13630af	
2100	2150		New Zealand, Radio NZ International	11725pa
2100	2150	DRM	New Zealand, Radio NZ International	15720pa
2100	2157		North Korea, Voice of Korea	13760eu 15245eu
2100	2200		Angola, Angolan National Radio	7217af
2100	2200		Anguilla/Caribbean Beacon/Univ Network	
			11775na	
2100	2200		Australia, Radio Australia	9500as 9660pa
			11650as 11660pa 11695va	12080va
			13630va 15515va	
2100	2200		Bahrain, Radio Bahrain	6010me
2100	2200		Belarus, Radio Station Belarus	7255eu
			7360eu 7390eu	
2100	2200		Canada, CFRX Toronto ON	6070na
2100	2200		Canada, CFVP Calgary AB	6030na
2100	2200		Canada, CKZN St Johns NF	6160na
2100	2200		Canada, CKZU Vancouver BC	6160na
2100	2200		China, China Radio International	5960eu
			5690eu 7205af 7285eu	7405af
			7415eu 9600eu	
2100	2200	Sat/Sun	Equatorial Guinea, Radio Africa	7190af

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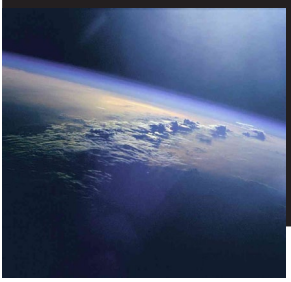
2100	2200		Germany, Deutsche Welle	12070af		
2100	2200		India, All India Radio/External Svc	7550eu		
			9445eu	9910pa	11620pa	11715pa
2100	2200	DRM	India, All India Radio/External Svc	9950eu		
2100	2200		Malaysia, RTM Kajang/Traxx FM	7295do		
2100	2200		Micronesia, The Cross Radio/Pohnpei	4755 as		
2100	2200		Palau, T8WH/ WHRI	9930as		
2100	2200		Russia, Voice of Russia	7300eu		
2100	2200		South Africa, CVC 1 Africa Radio	4965af		
			9505af			
2100	2200		Syria, Radio Damascus	9330va		
2100	2200		UK, BBC World Service	3255af	3915as	
			5875as	5905af	5910af	5965as
			6190af	6195as	9410af	9915af
			12095af			
2100	2200		USA, American Forces Network/AFRTS	4319usb		
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
2100	2200		USA, BBG/Voice of America	6080af	15580af	
2100	2200		USA, EWTN/WEWN Irondale, AL	15610af		
2100	2200		USA, FBN/WTJC Newport NC	9370na		
2100	2200		USA, WBCQ Monticello ME	7415usb	9330usb	
2100	2200		USA, WHRI Cypress Creek SC	7385na		
			13660na			
2100	2200		USA, WINB Red Lion PA	9265ca		
2100	2200		USA, WJHR International Milton FL	15550na		
2100	2200		USA, WWCR Nashville TN	7465eu	9350af	
			9980af	13845eu		
2100	2200		USA, WWRB Manchester TN	3215na		
2100	2200		USA, WYFR/Family Radio Worldwide	7425af		
			12060af			
2100	2200		Zambia, CVC Radio Christian Voice	4965af		
			13590af			
2100	2200		Zambia, ZNBC/Radio Two	6165do		
2115	2200		Egypt, Radio Cairo	6270eu		
2130	2156		Romania, Radio Romania International	6030na		
			7310na	7380na	9435na	
2130	2200		Australia, ABC NT Alice Springs	4835do		
2130	2200		Australia, ABC NT Katherine	5025do		
2130	2200	mtwhfa	Canada, CBC Northern Quebec Svc	9625na		
2130	2200		Turkey, Voice of Turkey	9610va		
2151	2200		New Zealand, Radio NZ International	15720pa		
2151	2200	DRM	New Zealand, Radio NZ International	17675pa		
2158	2200	Sat	New Zealand, Radio NZ International	15720pa		
2158	2200	Sat/DRM	New Zealand, Radio NZ International	17675pa		

2200 UTC - 5PM EST / 4PM CST / 2PM PST

2200	2205		Zambia, ZNBC/Radio Two	6165do		
2200	2230		India, All India Radio/External Svc	7550eu		
			9445eu	9445eu	9910pa	11620pa
			11670eu	11715pa		
2200	2230	DRM	India, All India Radio/External Svc	9950eu		
2200	2230		Serbia, International Radio Serbia	6100eu		
2200	2230		South Korea, KBS World Radio	3955eu		
2200	2230		Turkey, Voice of Turkey	9610va		
2200	2245		Egypt, Radio Cairo	6270eu		
2200	2300		Anguilla/Caribbean Beacon/Univ Network			
			6090na			
2200	2300		Australia, ABC NT Alice Springs	4835do		
2200	2300		Australia, ABC NT Katherine	5025do		
2200	2300		Australia, Radio Australia	9855as	11550as	
			12080va	13630va	15230va	15240va
			15515va			
2200	2300	fa	Australia, Radio Australia	9660pa		
2200	2300		Bahrain, Radio Bahrain	6010me		
2200	2300		Bulgaria, Radio Bulgaria	5900eu	7400eu	
2200	2300	smtwhf	Canada, CBC Northern Quebec Svc	9625na		
2200	2300		Canada, CFRX Toronto ON	6070na		
2200	2300		Canada, CFVP Calgary AB	6030na		
2200	2300		Canada, CKZN St Johns NF	6160na		
2200	2300		Canada, CKZU Vancouver BC	6160na		
2200	2300		China, China Radio International	5915as		
2200	2300	Sat/Sun	Equatorial Guinea, Radio Africa	7190af		
2200	2300		Malaysia, RTM Kajang/Traxx FM	7295do		
2200	2300		Micronesia, The Cross Radio/Pohnpei	4755 as		
2200	2300		New Zealand, Radio NZ International	15720pa		
2200	2300	DRM	New Zealand, Radio NZ International	17675pa		
2200	2300		Palau, T8WH/ WHRI	9930as		
2200	2300		Russia, Voice of Russia	7250va	11830na	
2200	2300	Sat/Sun	Spain, Radio Exterior de Espana	6125eu		
2200	2300		UK, BBC World Service	3915as	5875as	
			5890as	5965as	6190af	6195as
			7490as	9915af	12095af	
2200	2300		USA, American Forces Network/AFRTS	4319usb		
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
2200	2300	smtwh	USA, BBG/Voice of America	5840as	7365as	
			7425pa	7570va	11860va	
2200	2300		USA, EWTN/WEWN Irondale, AL	15610af		
2200	2300		USA, FBN/WTJC Newport NC	9370na		
2200	2300		USA, WBCQ Monticello ME	7415usb	9330usb	
2200	2300		USA, WHRI Cypress Creek SC	9850na		
			9860na	13620na		
2200	2300		USA, WINB Red Lion PA	9265ca		
2200	2300		USA, WWCR Nashville TN	7465eu	9350af	
			9980af	13845eu		
2200	2300		USA, WWRB Manchester TN	3215na	5050na	
2200	2300		USA, WYFR/Family Radio Worldwide	15255sa		
			15440ca			
2230	2300		China, Xizang PBS/Lhasa	4905do		
2230	2300		Guam, AWR/KSDA	15320as		
2230	2300		USA, BBG/Voice of America	7545as	9570pa	
2230	2300		USA, BBG/Voice of America/Special English			
			5810va	7545va	9570va	
2245	2300		India, All India Radio/External Svc	6055as		
			7305as	11645as	13605as	

2300 UTC - 6PM EST / 5PM CST / 3PM PST

2300	0000		Anguilla/Caribbean Beacon/Univ Network			
			6090na			
2300	0000		Australia, ABC NT Alice Springs	4835do		
2300	0000		Australia, ABC NT Katherine	5025do		
2300	0000		Australia, Radio Australia	9855as	9660pa	
			12080va	13690va	15230va	15515pa
			17795pa			
2300	0000		Bahrain, Radio Bahrain	6010me		
2300	0000	smtwhf	Canada, CBC Northern Quebec Svc	9625na		
2300	0000		Canada, CFRX Toronto ON	6070na		
2300	0000		Canada, CFVP Calgary AB	6030na		
2300	0000		Canada, CKZN St Johns NF	6160na		
2300	0000		Canada, CKZU Vancouver BC	6160na		
2300	0000		China, China Radio International	5915as		
			5990me	6040na	6145as	7350eu
			7415as	9535as	11790as	11970va
2300	0000		Cuba, Radio Havana Cuba	5040ca		
2300	0000		Egypt, Radio Cairo	6270na		
2300	0000		India, All India Radio/External Svc	6055as		
			7305as	11645as	13605as	
2300	0000		Malaysia, RTM Kajang/Traxx FM	7295do		
2300	0000		Micronesia, The Cross Radio/Pohnpei	4755 as		
2300	0000		New Zealand, Radio NZ International	15720pa		
2300	0000	DRM	New Zealand, Radio NZ International	17675pa		
2300	0000		Palau, T8WH/ WHRI	9930as		
2300	0000		Russia, Voice of Russia	7250va	7290va	
2300	0000		Turkey, Voice of Turkey	5960va		
2300	0000		UK, BBC World Service	3915as	5875as	
			5980as	6195as	7490as	9740as
			11955as			
2300	0000		USA, American Forces Network/AFRTS	4319usb		
			5446usb	5765usb	7812usb	12133usb
			12759usb	13362usb		
2300	0000		USA, BBG/Voice of America	5840as	5895as	
			7365as	7460as	7480pa	7570pa
			9490va	11840va	11860va	
2300	0000		USA, EWTN/WEWN Irondale, AL	15610af		
2300	0000		USA, FBN/WTJC Newport NC	9370na		
2300	0000		USA, WBCQ Monticello ME	7415usb	9330usb	
2300	0000	mtwhfa	USA, WHRI Cypress Creek SC	9850na		
2300	0000	Sun	USA, WHRI Cypress Creek SC	7315na		
			17820va			
2300	0000		USA, WINB Red Lion PA	9265ca		
2300	0000		USA, WTWW Lebanon TN	5755va	12105va	
2300	0000		USA, WWCR Nashville TN	3195eu	5070af	
			9980af	13845eu		
2300	0000		USA, WWRB Manchester TN	3215na	5050na	
2300	0000		USA, WYFR/Family Radio Worldwide	11580sa		
			15440ca			
2300	2330		Australia, Radio Australia	15240as		
2300	2330	DRM	Vatican City State, Vatican Radio	7370am		
2300	2356		Romania, Radio Romania International	6015eu		
			7220eu	7300eu	9530eu	
2315	2330		Croatia, Voice of Croatia	3985ca	7375eu	
2330	0000		Australia, Radio Australia	15415va	17750va	
2330	0000		Vietnam, Voice of Vietnam/Overseas Svc	9840as		
			12020as			
2330	2345		India, All India Radio/Aligarh	9470do		



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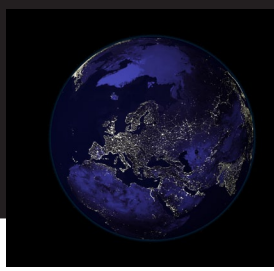


CHINESE

The following language schedule is extracted from our new MTXtra Shortwave Broadcast Guide pdf which is a free download to all MTXpress subscribers. This new online Shortwave Broadcast Guide has more than 9,100 station entries that include all languages being broadcasts via shortwave radio worldwide, sorted by time and updated monthly.

0000 UTC - 7PM EST / 6PM CST / 4PM PST

0000	0027	Iran, IRIB/ VOIRI	5955as	6110as	7380as
0000	0030	China, China Business Radio/Beijing			6040do
		6065do	7375do	9515do	11670do
		11800do			
0000	0030	China, Voice of China		4460do	4750do
		4800do	7275do	11710do	15380do
		17605do			
0000	0057	North Korea, Voice of Korea		13650as	15100as
0000	0100	China, China Business Radio/Beijing			3985do
		7245do	9515do	9775do	9820do
		11670do	15270do		
0000	0100	China, China Business Radio/Quinghai			3985do
		6190do	7220do		
0000	0100	China, China Business Radio/Xi'an			3985do
		7255do	7315do	7335do	9775do
		11740do			
0000	0100	China, China Business Radio/Xianyang			3985do
		6065do	6155do	7265do	7335do
		9720do	9810do	11610do	11660do
		11685do	11915do	12080do	
0000	0100	China, China Business Radio/Xinjie			3985do
		7315do	9620do	9820do	11610do
		11660do	11670do	11845do	15270do
0000	0100	China, Gannan PBS		3990do	5970do
0000	0100	China, Guangxi Beibu Bay Radio			5050as
		9820as			
0000	0100	China, Hulun Buir PBS		3900do	
0000	0100	China, Hunan PBS		4990do	
0000	0100	China, Nei Menggu PBS		7420do	9520do
0000	0100	China, Qinghai PBS		4750do	6145do
0000	0100	China, Sichuan PBS-2		6060do	7225do
0000	0100	China, Voice of China		4460do	6030do
		6175do	7230do	7290do	9500do
		9630do	9645do	9675do	9710do
		11720do	11750do	11760do	11960do
		13610do	15380do	15550do	17550do
		17565do			
0000	0100	China, Voice of China		4460do	4800do
		5945do	6000do	6030do	15480do
0000	0100	China, Voice of Taiwan Strait/Ch 1			4940do
		9505do			
0000	0100	China, Xinjiang PBS		3950do	5060do
		5960do	7260do	7310do	
0000	0100	China, Xizang PBS/Lhasa		4820do	5935do
		6050do	6200do	7240do	11860do
		11950do			
0000	0100	China, Yunnan PBS		6035as	
0000	0100	China, Yunnan PBS/Minority Svc			7210do
0000	0100	Taiwan, Fu Hsing Brc. Corp/Network 3			9410do
		9774do	15375do		
0000	0100	USA, BBG/Voice of America		7495as	9545as
		11925as	15125as	15385as	17645as
0030	0100	China, China Business Radio/Beijing			3985do
		6040do	7375do	11800do	
0030	0100	China, China Business Radio/Xianyang			3985do
		7335do	11915do	15270do	15500do
0030	0100	China, Voice of China		4460do	7275do
		13610do	15380do		

0100 UTC - 8PM EST/ 7PM CST / 5PM PST

0100	0130	China, Yunnan PBS		6035as	
0100	0200	China, China Business Radio/Beijing			3985do
		6040do	7245do	7375do	9515do
		9620do	9755do	11670do	15270do
0100	0200	China, China Business Radio/Quinghai			3985do
		6190do	7220do		
0100	0200	China, China Business Radio/Xi'an			3985do
		11740do	15770do		
0100	0200	China, China Business Radio/Xianyang			3985do
		6155do	7265do	7335do	9720do
		9810do	11610do	11660do	11685do
		11740do	11915do	12080do	11915do
		12080do	15270do	15500do	
0100	0200	China, China Business Radio/Xinjie			3985do
		6000do	7425do	9810do	9820do
		11610do	11660do	11670do	11835do
		11845do	12080do	15270do	
0100	0200	China, Hulun Buir PBS		3900do	
0100	0200	China, Hunan PBS		4990do	
0100	0200	China, Nei Menggu PBS		7420do	9520do
0100	0200	China, Qinghai PBS		4750do	6145do
0100	0200	China, Sichuan PBS-2		6060do	7225do
0100	0200	China, Voice of China		4460do	4750do
		4800do	5945do	6030do	6175do
		7230do	7290do	9500do	9630do
		9645do	9675do	9710do	11720do
		11750do	11960do	13610do	15380do
		15480do	15550do	17550do	17565do
0100	0200	China, Voice of Taiwan Strait/Ch 1			4940do
		9505do			
0100	0200	China, Xinjiang PBS		3950do	5060do
		5960do	7260do	7310do	
0100	0200	China, Xizang PBS/Lhasa		4820do	6050do
		6200do	7240do	11950do	
0100	0200	China, Yunnan PBS/Minority Svc			7210do

0200 UTC - 9PM EST / 8PM CST / 6PM PST

0200	0257	North Korea, Voice of Korea		7220as	9345as
		9730as			
0200	0300	China, China Business Radio/Beijing			3985do
		6040do	7245do	7375do	9515do
		9620do	9755do	11670do	15270do
		15500do	17625do		
0200	0300	China, China Business Radio/Quinghai			3985do
		6190do	7220do		
0200	0300	China, China Business Radio/Xi'an			3985do
		11740do	15770do		
0200	0300	China, China Business Radio/Xianyang			3985do
		6155do	7265do	7335do	9720do
		9810do	11610do	11685do	11740do
		11915do	12080do	15270do	15500do
		17625do			
0200	0300	China, China Business Radio/Xinjie			3985do
		6000do	7425do	9810do	9820do
		11610do	11660do	11670do	11835do
		11845do	12080do	15270do	
0200	0300	China, Hulun Buir PBS		3900do	
0200	0300	China, Hunan PBS		4990do	
0200	0300	China, Nei Menggu PBS		7420do	9520do
0200	0300	China, Sichuan PBS-2		6060do	7225do
0200	0300	China, Voice of China		4460do	4750do
		4800do	6030do	6175do	7230do
		7290do	9500do	9630do	9645do
		9675do	9710do	11720do	11750do
		11960do	13610do	15380do	17550do
		17565do			
0200	0300	China, Voice of Taiwan Strait/Ch 1			9505do
0200	0300	China, Xinjiang PBS		3950do	5060do
		5960do	7260do	7310do	
0200	0300	China, Xizang PBS/Lhasa		4820do	5935do
		6050do	6200do	7450do	11860do
		11950do			
0200	0300	China, Yunnan PBS/Minority Svc			7210do

0230 0300 China, Qinghai PBS 4750do 6145do 9780do

0300 UTC - 10PM EST / 9PM CST / 7PM PST

0300 0357 North Korea, Voice of Korea 13650as 15100as
0300 0400 China, China Business Radio/Beijing 3985do 6040do 7245do 7375do 9515do 9620do 9755do 11670do 15270do 15500do 17625do
0300 0400 China, China Business Radio/Quinghai 3985do 6090do 6190do 7220do 9570do 9620do
0300 0400 China, China Business Radio/Xi'an 3985do 11740do 15770do
0300 0400 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0300 0400 China, China Business Radio/Xinjie 3985do 6000do 7425do 9810do 9820do 11610do 11660do 11670do 11835do 12080do 15270do
0300 0400 China, Hulun Buir PBS 3900do
0300 0400 China, Hunan PBS 4990do
0300 0400 China, Nei Menggu PBS 7420do 9520do
0300 0400 China, Qinghai PBS 4750do 6145do 9780do
0300 0400 China, Sichuan PBS-2 6060do 7225do
0300 0400 China, Voice of China 4460do 4750do 4800do 6030do 6175do 7230do 7290do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 11960do 12055do 13610do 13700do 15380do 15390do 17550do 17565do
0300 0400 China, Voice of Taiwan Strait/Ch 1 9505do
0300 0400 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11770do
0300 0400 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7450do 11860do 11950do

0400 UTC - 11PM EST / 10PM CST / 8PM PST

0400 0500 China, China Business Radio/Beijing 3985do 6040do 7245do 7375do 9515do 9620do 9755do 9775do 11670do 15270do 15500do 17625do
0400 0500 China, China Business Radio/Quinghai 3985do 6090do 6190do 7220do 9570do 9620do
0400 0500 China, China Business Radio/Xi'an 3985do 11740do 15770do
0400 0500 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0400 0500 China, China Business Radio/Xinjie 3985do 6000do 7425do 9810do 9820do 11610do 11660do 11670do 11835do 12080do 15270do
0400 0500 China, Hulun Buir PBS 3900do
0400 0500 China, Hunan PBS 4990do
0400 0500 China, Nei Menggu PBS 7420do 9520do
0400 0500 China, Qinghai PBS 4750do 6145do 9780do
0400 0500 China, Sichuan PBS-2 6060do 7225do
0400 0500 China, Voice of China 4460do 4750do 4800do 6030do 6175do 7230do 7290do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 11960do 12055do 13610do 13700do 15380do 15390do 17550do 17565do
0400 0500 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11700do
0400 0500 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7450do 11860do 11950do
0400 0500 Taiwan, Fu Hsing Brc. Corp/Network 3 9410do 9774do 15375do

0500 UTC - 12AM EST / 11PM CST / 9PM PST

0500 0526 DRM Romania, Radio Romania International 17870as
0500 0526 Romania, Radio Romania International 15160as
0500 0600 China, China Business Radio/Beijing 3985do 6040do 7245do 7375do 9515do 9620do 9755do 9775do 11670do 15270do 15500do 17625do
0500 0600 China, China Business Radio/Quinghai 3985do 6090do 6190do 7220do 9570do 9620do
0500 0600 China, China Business Radio/Xi'an 3985do 11740do 15770do
0500 0600 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0500 0600 China, China Business Radio/Xinjie 3985do 6000do 7425do 9810do 9820do 11610do 11660do 11670do 11835do 12080do 15270do
0500 0600 China, Hulun Buir PBS 3900do
0500 0600 China, Hunan PBS 4990do
0500 0600 China, Nei Menggu PBS 7420do 9520do
0500 0600 China, Qinghai PBS 4750do 6145do 9780do
0500 0600 China, Sichuan PBS-2 6060do 7225do
0500 0600 China, Voice of China 4460do 4750do 4800do 6030do 6175do 7230do 7290do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 11960do 13610do 15380do 15480do 17550do 17565do
0500 0600 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11700do
0500 0600 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7450do 11860do 11950do
0500 0600 Taiwan, Fu Hsing Brc. Corp/Network 3 9410do 9774do 15375do

0600 UTC - 1AM EST / 12AM CST / 10PM PST

0600 0700 China, China Business Radio/Beijing 3985do 6040do 7245do 7375do 9515do 9620do 9755do 9775do 11670do 15270do 15500do 17625do
0600 0700 China, China Business Radio/Xi'an 3985do 11740do 15770do
0600 0700 China, China Business Radio/Xianyang 3985do 6155do 7265do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0600 0700 China, China Business Radio/Xinjie 3985do 6000do 7425do 9810do 9820do 11660do 11670do 11835do 12080do 15270do
0600 0700 China, Hulun Buir PBS 3900do
0600 0700 China, Hunan PBS 4990do
0600 0700 China, Nei Menggu PBS 7420do 9520do
0600 0700 China, Qinghai PBS 4750do 6145do 9780do
0600 0700 China, Sichuan PBS-2 6060do 7225do
0600 0700 China, Voice of China 4460do 4750do 4800do 6030do 6175do 7230do 7290do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 11960do 13610do 15380do 15480do 17550do 17565do
0600 0700 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11770do
0600 0700 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7240do 7450do 11860do 11950do
0630 0700 China, Yunnan PBS/Minority Svc 7210do

0700 UTC - 2AM EST / 1AM CST / 11PM PST

0700 0800 China, China Business Radio/Beijing 3985do 6040do 7245do 7375do 9515do 9620do 9755do 9775do 11670do 15270do 15500do 17625do

0700 0800 China, China Business Radio/Quinghai 3985do 6090do 6190do 7220do 9570do 9620do
0700 0800 China, China Business Radio/Xi'an 3985do 11740do 15770do
0700 0800 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0700 0800 China, China Business Radio/Xinjie 3985do 6000do 7425do 9810do 9820do 11610do 11660do 11670do 11835do 12080do 15270do
0700 0800 China, Hunan PBS 4990do
0700 0800 China, Nei Menggu PBS 7420do 9520do
0700 0800 China, Qinghai PBS 4750do 6145do 9780do
0700 0800 China, Sichuan PBS-2 6060do 7225do
0700 0800 China, Voice of China 4460do 4750do 4800do 6030do 6175do 7230do 7290do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 11960do 13610do 15380do 15480do 17550do 17565do
0700 0800 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11770do
0700 0800 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7240do 7450do 11860do 11950do
0700 0800 China, Yunnan PBS/Minority Svc 7210do

0800 UTC - 3AM EST / 2AM CST / 12AM PST

0800 0830 China, Voice of China 6000do 9645do 9675do
0800 0830 China, Yunnan PBS/Minority Svc 7210do
0800 0857 North Korea, Voice of Korea 9345as
0800 0900 China, China Business Radio/Beijing 3985do 6040do 7245do 7375do 9515do 9620do 9755do 9775do 11670do 15270do 15500do 17625do
0800 0900 China, China Business Radio/Quinghai 3985do 6090do 6190do 7220do 9570do 9620do
0800 0900 China, China Business Radio/Xi'an 3985do 11740do 15770do
0800 0900 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0800 0900 China, China Business Radio/Xinjie 3985do 6000do 7425do 9810do 9820do 11610do 11660do 11670do 11835do 12080do 15270do
0800 0900 China, Hunan PBS 4990do
0800 0900 China, Nei Menggu PBS 7420do 9520do
0800 0900 China, Qinghai PBS 4750do 6145do 9780do
0800 0900 China, Sichuan PBS-2 6060do 7225do
0800 0900 China, Voice of China 4460do 4750do 4800do 6030do 6175do 7215do 7230do 7290do 7345do 7390do 9500do 9630do 9645do 9710do 11720do 11750do 11960do 13610do 15380do 15480do 17550do 17565do
0800 0900 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11770do
0800 0900 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7240do 7450do 11860do 11950do
0800 0900 Taiwan, Fu Hsing Brc. Corp/Network 3 9410do 9774do 15375do
0830 0900 China, Voice of China 6000do 9645do 7305do 15390do

0900 UTC - 4AM EST / 3AM CST / 1AM PST

0900 0930 Japan, Radio Japan NHK World 6090as
0900 1000 China, China Business Radio/Beijing 3985do 6040do 7245do 9515do 9775do 9820do 15270do
0900 1000 China, China Business Radio/Quinghai 3985do 6010do 6090do 6190do 7220do 9570do 9620do
0900 1000 China, China Business Radio/Xi'an 3985do 11740do 15770do
0900 1000 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 9720do 9810do 11610do 11660do 11685do 11740do 11915do 12080do 15270do 15500do 17625do
0900 1000 China, China Business Radio/Xinjie 3985do 6000do 7315do 7425do 9620do 9810do 9820do 11610do 11660do 11670do 11835do 15270do
0900 1000 China, Hulun Buir PBS 3900do
0900 1000 China, Nei Menggu PBS 7420do 9520do
0900 1000 China, Qinghai PBS 4750do 6145do
0900 1000 China, Sichuan PBS-2 6060do 7225do
0900 1000 China, Voice of China 4460do 4750do 4800do 5945do 6000do 6030do 6125do 6175do 7215do 7230do 7290do 7305do 7345do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 11960do 13610do 15390do 15480do 17550do 17565do
0900 1000 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11770do
0900 1000 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7240do 7450do 11860do 11950do
0900 1000 Sat/Sun Clandestine, Sound of Hope Radio International 9540as 11760as
0900 1000 Taiwan, Fu Hsing Brc. Corp/Network 3 9410do 9774do 15375do
0900 1000 USA, BBG/Voice of America 9845as 11720as 11855as 12120as 13650as 13765as 15670as 21590as
0900 1000 USA, WYFR/Family Radio Worldwide 9545as 9945as 11565as
0930 1000 France, Radio France Internationale 7325as 11875as 12025as
0950 1000 China, Gannan PBS 3990do 5970do

1000 UTC - 5AM EST / 4AM CST / 2AM PST

1000 1030 China, Yunnan PBS 6035as
1000 1030 France, Radio France Internationale 7325as 11875as 12025as
1000 1100 China, China Business Radio/Beijing 3985do 6040do 6155do 7245do 9515do 9775do 9820do 11670do 15500do
1000 1100 China, China Business Radio/Quinghai 3985do 6010do 6090do 6190do 7220do 9570do
1000 1100 China, China Business Radio/Xi'an 3985do 11740do 15770do
1000 1100 China, China Business Radio/Xianyang 3985do 6155do 7265do 7335do 11610do 11740do 11915do 15270do 15500do
1000 1100 China, China Business Radio/Xinjie 3985do 6000do 7315do 7425do 9620do 9820do 11660do 11835do 15270do
1000 1100 China, Gannan PBS 3990do 5970do
1000 1100 China, Hulun Buir PBS 3900do
1000 1100 China, Hunan PBS 4990do
1000 1100 China, Nei Menggu PBS 7420do 9520do
1000 1100 China, Qinghai PBS 4750do 6145do
1000 1100 China, Sichuan PBS-2 6060do 7225do
1000 1100 China, Voice of China 4460do 4750do 4800do 5945do 6000do 6030do 6125do 6175do 7215do 7230do 7290do 7345do 7390do 9500do 9630do 9645do 9675do 9710do 11720do 11750do 12055do 11960do 13610do 13700do 15390do 17550do 17565do
1000 1100 China, Voice of Taiwan Strait/Ch 1 9505do
1000 1100 China, Xinjiang PBS 3950do 5060do 5960do 7260do 9600do 11770do
1000 1100 China, Xizang PBS/Lhasa 4820do 5935do 6050do 6200do 7240do 7450do 11860do 11950do
1000 1100 Sat/Sun Clandestine, Sound of Hope Radio International 9540as 11760as

1000	1100	Malaysia, RTM/Voice of Malaysia	6175va
		9750as 15295as	
1000	1100	Russia, Voice of Russia	6075as
1000	1100	USA, BBG/Voice of America	9530as 9845as
		11720as 12120as 13650as 13765as	
		15670as 21590as	
1000	1100	USA, WYFR/Family Radio Worldwide	9545as
		9920as 9945as	
1030	1030	Mongolia, Voice of Mongolia	12085as
1030	1100	China, China Business Radio/Beijing	3985do
		6040do 7375do 11800do	
1055	1100	China, Yunnan PBS/Minority Svc	7210do

1100 UTC - 6AM EST / 5AM CST / 3AM PST

1100	1130	China, Yunnan PBS	6035as
1100	1130	Vietnam, Voice of Vietnam/Overseas Svc	7220as
		12000as	
1100	1157	North Korea, Voice of Korea	7220as 9345as
1100	1200	China, China Business Radio/Beijing	3985do
		6040do 6155do 7245do 7370do	
		7375do 9515do 9775do 9820do	
		11670do 15270do 15500do	
1100	1200	China, China Business Radio/Quinghai	3985do
		6010do 6090do 6190do 7220do	
		9670do	
1100	1200	China, China Business Radio/Xianyang	3985do
		6155do 7265do 7335do 11610do	
		11740do 11915do 15270do 15500do	
1100	1200	China, China Business Radio/Xinjie	3985do
		7315do 9620do 11660do 11670do	
		15270do	
1100	1200	China, Gannan PBS	3990do 5970do
1100	1200	China, Hulun Buir PBS	3900do
1100	1200	China, Hunan PBS	4990do
1100	1200	China, Nei Menggu PBS	7420do 9520do
1100	1200	China, Qinghai PBS	4750do 6145do
1100	1200	China, Sichuan PBS-2	6060do 7225do
1100	1200	China, Voice of China	4460do 4750do
		4800do 5945do 6000do 6030do	
		6125do 6175do 7215do 7230do	
		7275do 7290do 7305do 7345do	
		9500do 9630do 9675do 9710do	
		11720do 11960do 11960do 13610do	
		15390do 17550do 17565do	
1100	1200	China, Voice of Taiwan Strait/Ch 1	9505do
1100	1200	China, Xinjiang PBS	3950do 5060do
		5960do 7260do 9600do 11770do	
1100	1200	China, Xizang PBS/Lhasa	4820do 5935do
		6050do 6200do 7240do 7450do	
		11860do 11950do	
1100	1200	China, Yunnan PBS/Minority Svc	7210do
1100	1200	Clandestine, Sound of Hope Radio International	
		7280as	
1100	1200	Indonesia, Voice of Indonesia	9526va
1100	1200	Malaysia, RTM/Voice of Malaysia	6175va
		9750as 15295as	
1100	1200	Russia, Voice of Russia	6075as
1100	1200	Taiwan, Fu Hsing Brc. Corp/Network 3	9410do
		9774do 15375do	
1100	1200	USA, BBG/Voice of America	9530as 9825as
		11720as 12045as 13650as 15670as	
1100	1200	USA, WYFR/Family Radio Worldwide	6240as
		9280as 9865as 11725as	
1130	1200	Clandestine, Sound of Hope Radio International	
		12160as	
1130	1200	South Korea, KBS World Radio	9770as
1145	1200	India, All India Radio/External Svc	11840as
		15795as 17705as	

1200 UTC - 7AM EST / 6AM CST / 4AM PST

1200	1230	China, China Business Radio/Xianyang	3985do
		7265do 9810do 11610do 11660do	
1200	1230	Japan, Radio Japan NHK World	6090as
1200	1230	South Korea, KBS World Radio	9770as
1200	1230	Vietnam, Voice of Vietnam/Overseas Svc	7220as
		12000as	
1200	1257	Iran, IRIB/ VOIRI	13825as 15150as 15360as
		15525as	
1200	1300	China, China Business Radio/Beijing	3985do
		6155do 7245do 7370do 9515do	
		9775do 9820do 15270do 15500do	
1200	1300	China, China Business Radio/Quinghai	3985do
		6010do 6090do 6190do 7220do	
		9670do	
1200	1300	China, China Business Radio/Xianyang	3985do
		7265do 9810do 11610do 11660do	
1200	1300	China, China Business Radio/Xinjie	3985do
		6065do 7315do 9620do 11660do	
1200	1300	China, Gannan PBS	3990do 5970do
1200	1300	China, Hulun Buir PBS	3900do
1200	1300	China, Hunan PBS	4990do
1200	1300	China, Nei Menggu PBS	7420do 9520do
1200	1300	China, Qinghai PBS	4750do 6145do
1200	1300	China, Sichuan PBS-2	6060do 7225do
1200	1300	China, Voice of China	4460do 4750do
		4800do 5945do 6000do 6030do	
		6080do 6125do 6175do 6180do	
		7215do 7230do 7275do 7290do	
		7305do 7345do 7365do 9420do	
		9500do 9630do 9655do 9675do	
		9845do 9890do 11710do 11925do	
		11960do 13610do	
1200	1300	China, Voice of Taiwan Strait/Ch 1	4940do
1200	1300	China, Xinjiang PBS	3950do 5060do
		5960do 7260do 7310do 11770do	
1200	1300	China, Xizang PBS/Lhasa	4820do 5935do
		6050do 6200do 7240do 7450do	
		11860do 11950do	
1200	1300	China, Yunnan PBS/Minority Svc	7210do
1200	1300	Clandestine, Sound of Hope Radio International	
		7280as 11550as	
1200	1300	Pakistan, PBC/Radio Pakistan	11845as 15700as
1200	1300	Russia, Voice of Russia	6075as
1200	1300	Taiwan, Fu Hsing Brc. Corp/Network 3	9410do
		9774do 15375do	
1200	1300	Turkey, Voice of Turkey	11805as
1200	1300	USA, BBG/Voice of America	6045as 9530as
		9825as 11635as 12045as 15110as	
1200	1300	USA, WYFR/Family Radio Worldwide	6240as
		9280as 9865as 11535as 11725as	
1230	1240	Sat Vatican City State, Vatican Radio	6020as
		9790as 17590as	
1230	1300	China, China Business Radio/Xianyang	3985do
		6065do 6155do 7265do 9810do	
1230	1300	Clandestine, Sound of Hope Radio International	
		15750as	
1230	1300	mtwhfs Vatican City State, Vatican Radio	6020as
		9790as 17590as	

1300 UTC - 8AM EST / 7AM CST / 5AM PST

1300	1330	China, Yunnan PBS	6035as
1300	1330	Clandestine, Sound of Hope Radio International	
		12170as	
1300	1330	Japan, Radio Japan NHK World	6190as
		9895as	
1300	1357	North Korea, Voice of Korea	11735as 13650as
1300	1400	China, China Business Radio/Beijing	3985do
		6155do 7245do 7370do 7375do	
		9515do 9775do 9820do 15270do	
		15500do	
1300	1400	China, China Business Radio/Quinghai	3985do
		6010do 6090do 6190do 7220do	
		9670do	
1300	1400	China, China Business Radio/Xianyang	3985do
		6065do 6155do 7265do 7335do	
		9810do 11740do 11915do	
1300	1400	China, China Business Radio/Xinjie	3985do
		6000do 6065do 7315do 7425do	
		9620do 11660do 11835do	
1300	1400	China, Gannan PBS	3990do 5970do
1300	1400	China, Hulun Buir PBS	3900do
1300	1400	China, Hunan PBS	4990do
1300	1400	China, Nei Menggu PBS	7420do 9520do
1300	1400	China, Qinghai PBS	4750do 6145do
1300	1400	China, Sichuan PBS-2	6060do 7225do
1300	1400	China, Voice of China	4460do 4750do
		4800do 5945do 6000do 6030do	
		6080do 6125do 6175do 7215do	
		7230do 7275do 7290do 7290do	
		7305do 7345do 7365do 9500do	
		9675do 9810do 9845do 11960do	
1300	1400	China, Voice of Taiwan Strait/Ch 1	4940do
1300	1400	China, Xinjiang PBS	3950do 5060do
		5960do 7260do 7310do 11770do	

1300	1400	China, Xizang PBS/Lhasa	4820do	5935do	
		6050do	6200do	7240do	7450do
		11860do	11950do		
1300	1400	China, Yunnan PBS/Minority Svc		7210do	
1300	1400	Clandestine, Minghui Radio	6030as		
1300	1400	Clandestine, Sound of Hope Radio International			
		7310as			
1300	1400	Russia, Voice of Russia	13610as		
1300	1400	South Korea, KBS World Radio		7275as	
1300	1400	USA, BBG/Voice of America	6045as	7295as	
		9530as	9825as	11635as	12045as
1300	1400	USA, WYFR/Family Radio Worldwide		6240as	
		9280as	9865as	11725as	
1330	1400	Clandestine, Sound of Hope Radio International			
		11820as			

1400 UTC - 9AM EST / 8AM CST / 6AM PST

1400	1426	Romania, Radio Romania International		9660as	
		11825as			
1400	1430	China, Yunnan PBS	6035as		
1400	1440	China, Hulun Buir PBS	3900do		
1400	1500	China, China Business Radio/Beijing		3985do	
		6155do	7245do	7370do	7375do
		9515do	9775do	9820do	15270do
		15500do			
1400	1500	China, China Business Radio/Quinghai		3985do	
		6010do	6090do	6190do	7220do
		9670do			
1400	1500	China, China Business Radio/Xianyang		3985do	

MT SHORTWAVE STATION RESOURCE GUIDE

Afghanistan, Radio Afghanistan ..... **www.rta.org.af**
Albania, Radio Tirana ..... **http://rtsh.sil.at/**
Angola, Angolan National Radio ..... **www.rna.ao/**
Anguilla/Caribbean Beacon/Univ Network ..... **www.worldwideuniversitynetwork.com/**
Argentina, RAE ..... **www.radionacional.gov.ar**
Australia, ABC NT Alice Springs ..... **www.abc.net.au/radio/**
Australia, ABC NT Katherine ..... **www.abc.net.au/radio/**
Australia, ABC NT Tennant Creek ..... **www.abc.net.au/radio/**
Australia, HCJB Global Australia ..... **www.hcjb.org.au**
Australia, Radio Australia ..... **www.abc.net.au/ra/**
Austria, AWR Europe **www.awr2.org/**
Austria, TWR Europe ..... **www.twr.org**
Bahrain, Radio Bahrain ..... **www.radiobahrain.fm/**
Belarus, Radio Station Belarus ..... **www.radiobelarus.tvr.by/eng/**
Belgium, TDP Radio ..... **www.airtime.be/schedule.html**
Belgium, TDP Radio/Disco Palace ..... **www.airtime.be/schedule.html**
Bhutan, Bhutan Broadcasting Svc ..... **www.bbs.com.bt**
Bulgaria, Radio Bulgaria ..... **www.bnr.bg/**
Canada, Bible Voice Broadcasting ..... **www.biblevoice.org/**
Canada, CBC Northern Quebec Svc ..... **www.cbc.ca/north/**
Canada, CFRX Toronto ON ..... **www.cfrb.com**
Canada, CFVP Calgary AB **www.classiccountryam1060.com**
Canada, CKZN St Johns NF ..... **www.cbc.ca/listen/index.html**
Canada, CKZU Vancouver BC ..... **www.cbc.ca/bc**
Canada, Radio Canada International ..... **www.rcinet.ca/**
China, China Radio International ..... **www.cri.cn/**
Clandestine, Sudan Radio Service/SRS ..... **www.sudanradio.org**
Croatia, Voice of Croatia ..... **www.hrt.hr/**
Cuba, Radio Havana Cuba ..... **www.radiohc.cu/**
Egypt, Radio Cairo ..... **www.ertu.org**
Equatorial Guinea, Radio Africa ..... **www.radiopanam.com/**
Equatorial Guinea, Radio Africa 2 ..... **www.radiopanam.com/**
Equatorial Guinea, Radio East Africa ..... **www.radiopanam.com/**
Equatorial Guinea, Radio East Africa/Malabo ..... **www.radiopanam.com/**
Ethiopia, Radio Ethiopia ..... **www.ertagov.com**
Ethiopia, Radio Ethiopia/National Program ..... **www.ertagov.com**
France, Radio France Internationale ..... **http://rfienglish.com**
Germany, AWR Europe **www.awr2.org/**
Germany, Deutsche Welle ..... **www.dw-world.de/**
Germany, Pan American Broadcasting ..... **www.radiopanam.com/**
Germany, TWR Europe ..... **www.twr.org**
Guam, AWR/KSDA **www.awr2.org/**
Guam, TWR Asia/KTWR ..... **http://nea.ktwr.net/**
India, All India Radio/Aizawl ..... **www.allindiaradio.org/**
India, All India Radio/Aligarh ..... **www.allindiaradio.org/**
India, All India Radio/Bengaluru ..... **www.allindiaradio.org/**
India, All India Radio/Bhopal ..... **www.allindiaradio.org/**
India, All India Radio/Chennai ..... **www.allindiaradio.org/**
India, All India Radio/Delhi ..... **www.allindiaradio.org/**
India, All India Radio/External Svc ..... **www.allindiaradio.org/**
India, All India Radio/Gangtok ..... **www.allindiaradio.org/**
India, All India Radio/Gorakhpur ..... **www.allindiaradio.org/**
India, All India Radio/Guwahati ..... **www.allindiaradio.org/**
India, All India Radio/Hyderbad ..... **www.allindiaradio.org/**
India, All India Radio/Imphal ..... **www.allindiaradio.org/**
India, All India Radio/Itanagar ..... **www.allindiaradio.org/**
India, All India Radio/Jaipur ..... **www.allindiaradio.org/**
India, All India Radio/Jeypore ..... **www.allindiaradio.org/**
India, All India Radio/Kolkata ..... **www.allindiaradio.org/**
India, All India Radio/Kurseong ..... **www.allindiaradio.org/**
India, All India Radio/Lucknow ..... **www.allindiaradio.org/**
India, All India Radio/Mumbai ..... **www.allindiaradio.org/**
India, All India Radio/Panaji, Goa ..... **www.allindiaradio.org/**
India, All India Radio/Port Blair ..... **www.allindiaradio.org/**
India, All India Radio/Radio Kashmir ..... **www.allindiaradio.org/**
India, All India Radio/Shillong ..... **www.allindiaradio.org/**
India, All India Radio/Shimla ..... **www.allindiaradio.org/**
India, All India Radio/Thiruvananthapuram ..... **www.allindiaradio.org/**
Indonesia, Voice of Indonesia ..... **www.voi.co.id**
Iran, IRIB/ VOIRI ..... **www.irib.ir/English/**
Italy, IRRS-Shortwave ..... **www.nexus.org**
Italy, IRRS-Shortwave/Euro Gospel Radio ..... **www.nexus.org**
Italy, IRRS-Shortwave/Overcomer Ministry ..... **www.nexus.org**
Japan, Radio Japan NHK World ..... **www.nhk.or.jp/english/**
Kuwait, Radio Kuwait ..... **www.media.gov.kw/**
Malaysia, RTM Kajang/Traxx FM ..... **www.traxxfm.net/index.php**
Malaysia, RTM/Voice of Malaysia ..... **www.rtm.gov.my**
Mali, ORTM/Radio Mali ..... **www.ortm.ml**
Micronesia, The Cross Radio/Pohnpei ..... **www.pmapacific.org/**
Nepal, Radio Nepal ..... **www.radionepal.org/**
Netherlands, R Netherlands Worldwide ..... **www.radionetherlands.nl/**
New Zealand, Radio NZ International ..... **www.rnzi.com**
Nigeria, Voice of Nigeria ..... **www.voiceofnigeria.org**
Oman, Radio Sultanate of Oman ..... **www.oman-tv.gov.om**
Pakistan, PBC/Radio Pakistan ..... **www.radio.gov.pk**
Palau, T8WH/ WHRI ..... **www.whr.org/**
Philippines, PBS/ Radyo Pilipinas ..... **www.pbs.gov.ph/**
Poland, Polskie Radio Warsaw ..... **www.polskieradio.pl**
Romania, Radio Romania International ..... **www.rri.ro/**
Russia, Voice of Russia ..... **http://english.ruvr.ru/**
Saudi Arabia, BSKSA/External Svc ..... **www.saudiradio.net/**
Serbia, International Radio Serbia ..... **www.glassrbije.org**
South Africa, AWR Africa **www.awr2.org/**
South Africa, Channel Africa ..... **www.channelafrica.org**
South Africa, CVC 1 Africa Radio **www.1africa.tv**
South Africa, RTE Radio Worldwide **www.rte.ie/radio1/**
South Africa, South African Radio League ..... **www.sarl.org.za**
South Africa, TWR Africa ..... **www.twrafrica.org/**
South Korea, KBS World Radio ..... **www.worldkbs.co.kr**
Spain, Radio Exterior de Espana ..... **www.ree.rne.es/**
Sri Lanka, SLBC ..... **www.slbc.lk**
Swaziland, TWR Africa ..... **www.twrafrica.org**
Syria, Radio Damascus ..... **www.rtv.gov.sy/**
Taiwan, Radio Taiwan International ..... **http://english.rti.org.tw/**
Thailand, Radio Thailand World Svc **www.hsk9.org/**
Turkey, Voice of Turkey ..... **www.trt-world.com**
Uganda, Dunamis Shortwave ..... **www.biblevoice.org/stations/east-africa**
UK, BBC World Service ..... **www.bbc.co.uk/worldservice/**
USA, American Forces Network/AFRTS ..... **http://myafn.dodmedia.osd.mil/**
USA, BBG/Voice of America ..... **www.voanews.com**
USA, BBG/Voice of America/Special English ..... **www.voanews.com**
USA, EWTN/WEWN Irondale, AL ..... **www.ewtn.com/**
USA, FBN/WTJC Newport NC ..... **www.fbnradio.com/**
USA, KNLS Anchor Point AK ..... **/www.knls.org/**
USA, WBCQ Monticello ME ..... **www.wbcq.com/**
USA, WHRI Cypress Creek SC ..... **www.whr.org/**
USA, WINB Red Lion PA ..... **www.winb.com**
USA, WRMI/Radio Prague relay ..... **www.wrmi.net/**
USA, WRMI/Radio Slovakia Intl relay ..... **www.wrmi.net/**
USA, WRNO New Orleans LA ..... **www.wrnoradio.com**
USA, WTWW Lebanon TN ..... **www.wtww.us/**
USA, WWCR Nashville TN ..... **www.wwcr.com**
USA, WWRB Manchester TN ..... **www.wwrb.org/**
USA, WYFR/Family Radio Worldwide ..... **www.familyradio.com/**
Vatican City State, Vatican Radio ..... **www.vaticanradio.org/**
Vietnam, Voice of Vietnam/Overseas Svc ..... **www.vov.org.vn**
Zambia, CVC Radio Christian Voice ..... **www.voiceafrica.net**

MILCOM
MONITORING MILITARY COMMUNICATIONS

Larry Van Horn, N5FPW
larryvanhorn@monitoringtimes.com
Blog: http://mt-milcom.blogspot.com
Twitter: MilcomMP

Monitoring NORAD and Combat Air Patrols

As we move into the 2012 political season, business will start to really pick up for one United States military organization that is charged with watching the busy skies over the U.S. for possible bad guys – NORAD.

Practically invisible after the end of the Cold War, North American Aerospace Defense (NORAD) Command now has a daily presence over American cities due to the events of September 11, 2001. After the terrorist strikes against New York and Washington, D.C., NORAD was suddenly thrust back into the national spotlight.

As a result of the 9/11 terrorist attacks, the North American Aerospace Defense Command made improvements and enhancements to its mission and resources to face a new range of internal threats. Configured to meet outside threats such as a Soviet bomber or missile attack, NORAD had to change to meet a new threat that could appear without warning within the U.S. and Canadian borders. Now NORAD is at the heart of the all the combat air patrol (CAP) missions flown over U.S. cities.

The organization was established on May 12, 1958 (an effect of the Cold War) as a joint command between the governments of Canada and the United States, as the North American Air Defense Command. Its main technical facility has been the Cheyenne Mountain Directorate, formerly Cheyenne Mountain Operations Center, of the Cheyenne Mountain Air Force Station, Colorado; and for this reason NORAD is sometimes referred to as Cheyenne Mountain.

Similar to the Cheyenne Mountain Directorate, but on a smaller scale, the Canada East and Canada West Sector Air Operations Control Centers were located in an underground complex 600 feet below the surface at Canadian Forces Base (CFB) North Bay in Ontario, Canada.

On October 12, 2006, NORAD operations at CFB North Bay officially moved above ground into the Sergeant David L. Pitcher Building, and the underground complex has been "moth balled" but can be returned to operation if it should be needed again.

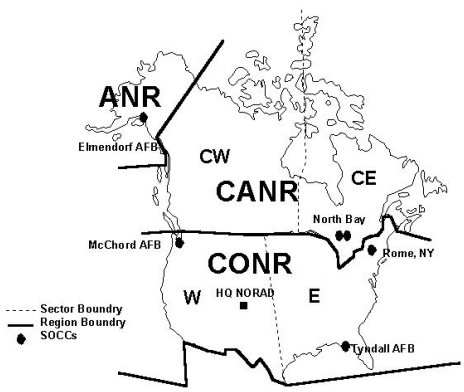
The Commander of NORAD and U.S. Northern Command (USNORTHCOM) maintains a headquarters and command center at Peterson Air Force Base in Colorado Springs, Colorado. The NORAD and USNORTHCOM Command Center serves as a central collection and coordination facility for a worldwide system of sensors designed to provide the commander and the leadership of Canada and the U.S. with an accurate picture of any aerospace or maritime threat.

NORAD has administratively divided the North American landmass into three regions, the Alaska NORAD (ANR) Region, under Eleventh Air Force; the Canadian NORAD (CANR) Region, under 1 Canadian Air Division, and the Continental U.S. (CONR) Region, under 1 AF/CONR-AFNORTH. Both the CONR and CANR regions are divided into eastern and western sectors.

❖ NORAD Combat Air Patrols Protect North America

The military definition of a combat air patrol (CAP) is an aircraft patrol that protects an objective area – over a military force, over a critical area of a combat zone, or over an air defense area – for the purpose of intercepting and destroying hostile aircraft before they reach their target. Combat air patrols apply to both overland and over water operations, protecting other aircraft, fixed and mobile sites on land, or ships at sea.

A CAP typically entails fighter aircraft flying a tactical pattern around or screening a defended target, while looking for incoming attackers. Effective combat air patrol patterns may include aircraft positioned at both high and low altitudes, in order to shorten response times when an attack is detected. Modern CAPs use either Ground Control Intercept (GCI) radar units or an AWACS aircraft to provide maximum early warning for defensive reaction.



The most common CAP mission flown over the U.S. today is done under the banner of Operation Noble Eagle (ONE). It is the name given to military operations related to homeland security and support to federal, state, and local agencies.

This operation marks the first combat mission for the U.S. Air Force F-22 Raptor. The United States Department of Defense also provides F-15 Eagles and F-16 Fighting Falcons to this operation, and the Canadian Forces provides CF-18s.

The F-15, F-16 and F-22 fighters assigned to NORAD have carried out intensive patrolling operations since the 9/11 attacks. E-3 Airborne Warning and Control System aircraft – from Air Force and NATO – have also been flying many missions and are used to direct action against any hostile aircraft in U.S. airspace. A large number of KC-10 and KC-135 aerial tankers have been engaged in this mission.

You can monitor combat air patrol operations if they are active in your area on a milcom capable scanner. Load the frequencies in our Table One below and you will have a front row seat to the action in your local area.

COMBAT AIR PATROL RELATED FREQUENCIES

All frequencies are in MHz and use the AM mode.

Air Defense:
139.700 228.900 234.600 235.900 238.400
252.000 254.200 260.900 265.400 270.200
271.000 274.400 274.600 277.600 278.000
281.600 282.600 288.400 293.600 316.300
320.600 324.000 327.900 328.000 355.200
364.200 386.000

AWACS:
231.825 232.500 237.150 241.200 254.475
288.200 303.100 304.000 313.300 317.950
320.600* 324.650 325.600 335.950 388.950

Have Quick 1:
288.875 288.900 298.275 298.300 343.075
343.100 375.725 375.825 375.925 376.025
376.125

Have Quick II:
225.150 235.050 239.950 252.925 257.250
262.450 267.850 271.950 279.950 279.750
284.150 289.050 293.550 298.650 303.275
308.750 314.450

**Shared with air defense*

❖ Another ARTCC Update

It has been quite a while since we last updated any of the Federal Aviation Administration (FAA) Air Route Traffic Control Center (ARTCC) frequency lists in this column. So, to kick off the New Year, we will present the another round of ARTCC frequency profiles. I want to remind regular readers of this column to please be patient and we will get around to the

ARTCC covering your area as soon as space and current events allow.

This month we will continue our center tour with Jacksonville ARTCC (Table Two), and Miami ARTCC (Table Three). Our exclusive Atlanta ARTCC frequency profile appeared in the January 2011 issue of *Monitoring Times*.

JACKSONVILLE ARTCC RCAG FREQUENCY LIST

Note: All frequencies are in MHz and mode is AM.

RCAG Freq	Sector/Altitude	Location (ICAO Identifier)
120.125/-------	High Altitude	Charleston SC (CHS) paired with 354.075 (BQK)
120.200/346.400	Low Altitude	Crestview FL (CEW)
120.850/322.500	Low Altitude	Savannah GA (SAV)
121.375/290.275	Low Altitude	Valdosta GA (VLD) Approach/Departure Services
121.500/243.000	Low/High Altitude	Hilliard FL (ZJX) Emergency
124.075/351.700	High Altitude	Charleston SC (CHS)
124.475/323.050	High Altitude	Crestview FL (CEW)
124.675/282.200	Low Altitude	Brunswick GA (BQK)
124.700/269.550	Low Altitude	Columbia SC (CAE)
125.050/360.800	High Altitude	Tallahassee FL (TLH)
125.175/360.700	High Altitude	Lowell FL (EC7)
125.375/254.325	Low Altitude	Lake City FL (QJY)
125.750/363.075	Low Altitude	Albany GA (ABY)
126.125/285.650	High Altitude	Savannah GA (SAV)
126.350/307.250	Low/High Altitude	St. Augustine FL (SGJ)
126.750/277.400	Low Altitude	Brunswick GA (BQK)
127.225/322.325	Low Altitude	Panama City FL (PAM)
127.475/346.250	High Altitude	St. Augustine FL (SGJ)
127.800/352.000	Low Altitude	Perry FL (QPE)
127.875/319.200	High Altitude	Columbia SC (CAE)
127.950/379.100	Low Altitude	Charleston SC (CHS)
128.050/335.550	Low Altitude	Lowell FL (EC7) Area/Workload Frequency
128.075/307.200	High Altitude	Tallahassee FL (TLH)
128.625/379.175	Low Altitude	Tallahassee FL (TLH) Approach/Departure Services
128.700/343.600	Low Altitude	Myrtle Beach SC (MYR)
132.300/269.025	Low Altitude	Alma GA (AMG)
132.425/290.350	High Altitude	Savannah GA (SAV)
132.500/363.200	Low Altitude	Millen GA (QMG)
132.825/269.600	High Altitude	St. Augustine FL (SGJ)
133.300/346.300	High Altitude	Alma GA (AMG)
133.325/269.250	Low Altitude	Lowell FL (EC7)
133.450/306.300	Low Altitude	Florence SC (FLO)
133.625/370.950	High Altitude	Charleston SC (CHS)
133.700/322.550	Low Altitude	Valdosta GA (VLD)
133.875/322.475	High Altitude	Lake City FL (QJY)
134.000/273.550	Low Altitude	Daytona Beach FL (DAB)
134.150/338.300	Low Altitude	Crestview FL (CEW)
134.175/-------	Jacksonville ARTCC Flight Watch	Gainesville AFSS: Gainesville FL (GNV)/ Charleston SC (CHS)/Panama City FL (PAM)/ Clinton NC (CTZ)
134.300/353.500	Low Altitude	Dothan AL (DHN)
134.400/317.425	Low Altitude	Gainesville FL (GNV) Approach/Departure Services
134.450/285.475	Low Altitude	Albany GA (ABY)
134.850/-------	Low/High Altitude	Daytona Beach FL (DAB)/Jacksonville (JAX) paired with 327.100 (JAX)
134.975/278.300	High Altitude	Columbia SC (CAE)
135.050/-------	High Altitude	Myrtle Beach (MYR)/Charleston SC (CHS) paired with 273.525 (MYR)
135.450/256.875	Ultra High Altitude	St. Augustine FL (SGJ)
135.625/317.525	High Altitude	Valdosta GA (VLD)
135.750/317.600	Low Altitude	Lowell FL (EC7)
135.925/363.175	High Altitude	Panama City FL (PAM)
135.975/282.300	High Altitude	Alma GA (AMG)
-------/243.000	Low/High Altitude	Charleston SC (CHS) Emergency
-------/254.275	Low Altitude	Valdosta GA (VLD) Live Oak MOA
-------/263.025	Low Altitude	Albany GA (ABY) Moody MOA
-------/269.000	Medium Altitude	Charleston SC (CHS) Gamecock D MOA
-------/269.125	Low Altitude	Crestview FL (CEW) Rose Hill/Pensacola North MOAs
-------/269.200	Low/High Altitude	Jacksonville FL (ZJX) Gator MOA
-------/269.350	Medium Altitude	Jacksonville FL (ZJX) Gator MOA
-------/273.525	High Altitide	Myrtle Beach (MYR) paired with 135.050 (CHS/MYR)
-------/281.400	Low Altitude	Valdosta GA (VLD) Moody MOA
-------/281.550	High Altitude	Florence SC (FLO)
-------/282.250	Medium Altitude	Charleston SC (CHS) Warning Area W-161
-------/288.300	Low/High Altitude	Dothan AL (DHN) Rose Hill MOA
-------/290.225	Jax Center Aerial Refueling Operations	Crestview FL (CEW)/Daytona Beach FL (DAB)/ Tallahassee FL (TLH)/Charleston SC (CHS)
-------/323.200	Low Altitude	Albany GA (ABY) Moody MOA 3
-------/327.100	Low/High Altitude	Jacksonville FL (JAX) paired with 134.850 (DAB/JAX)
-------/335.500	Medium Altitude	Columbia SC (CAE) Gamecock MOA
-------/354.075	Ultra High Altitude	Brunswick GA (BQK) paired with 120.125 (CHS)
-------/371.900	Low/High Altitude	Crestview FL (CEW) Pensacola North MOA
-------/375.825	Low Altitude	Valdosta GA (VLD) Moody MOA 1

MIAMI ARTCC RCAG FREQUENCY LIST

Note: All frequencies are in MHz and mode is AM.

RCAG Freq	Sector/Altitude	Location (ICAO Identifier)
119.575/239.025	Low/High Altitude	Georgetown BAH (FK7)
119.825/348.700	Low/High Altitude	Melbourne FL (MLB)
120.675/298.900	High Altitude	Andros Island BAH (MYAF)
121.075/263.100	Low Altitude	West Palm Beach FL (PBI)
121.500/243.000	Low/High Altitude	Miami FL (SMA) Emergency
122.600/-------	Miami ARTCC Flight Watch - Low Altitude	Miami AFSS
123.675/-------	High Altitude	Grand Bahama BAH (BHF)
123.775/256.800	Low/High Altitude	Grand Truk Island BAH (GDT)/Matthew Town (ZIN)
123.825/307.900	High Altitude	Andros Island (MYAF)
124.525/251.125	Low/High Altitude	Georgetown BAH (FK7)
124.750/291.725	Low/High Altitude	Key West FL (EYW)
124.775/227.125	High Altitude	West Palm Beach FL (PBI)
124.825/348.650	High Altitude	Fort Myers FL (FMY)
125.075/319.000	High Altitude	Vero Beach FL (VRB)
125.100/263.000	Low/High Altitude	Grand Turk TCA (GDT)
125.250/284.750	Low/High Altitude	Miami FL (MIA)
125.325/270.325	High Altitude	West Palm Beach FL (PBI)
125.425/363.050	Low Altitude	Grand Bahama BAH (BHF)
125.675/319.100	Low Altitude	Bimini BAH (ZBV)
126.275/251.125	High Altitude	Georgetown BAH (FK7)
126.325/257.725	High Altitude	Miami FL (MIA)
126.475/379.250	Low/High Altitude	Melbourne FL (MLB)
126.525/310.800	High Altitude	Avon Park FL (AVO)
126.950/293.225	Low Altitude	Vero Beach FL (VRB)
127.200/317.750	Low Altitude	Avon Park FL (AVO)
127.225/290.250	Low/High Altitude	Miami FL (MIA)
127.275/291.600	High Altitude	Pahokee FL (PHK)
128.225/285.450	High Altitude	Sarasota FL (SRQ)
128.375/284.750	Low Altitude	Key West FL (EYW)
128.650/343.700	Low/High Altitude	Melbourne FL (MLB) (Workload for Sectors 1/2/3/4/22)
132.025/342.250	Low/High Altitude	Key West FL (EYW)
132.250/370.900	Low Altitude	Vero Beach FL (VRB)
132.300/307.200	Low/High Altitude	Grand Turk Island TCA (GDT)/Matthew Town BAH (ZIN)
132.350/377.100	Low Altitude	Sarasota FL (SRQ)
132.400/281.500	Low Altitude	Miami FL (MIA)
132.450/307.100	Low Altitude	Pahokee FL (PHK)
132.725/-------	Miami ATCC Flight Watch - High Altitude	Miami AFSS: Avon Park (AVO)/Tamiami (TMB)
133.200/353.900	Low Altitude	Hilliard FL (ZMA)
133.275/335.500	Low/High Altitude	Fort Myers FL (FMY) Workload: Sectors 7/8/24/25/45/47/66/67
133.475/269.300	Low Altitude	Melbourne FL (MLB)
133.900/307.300	High Altitude	Sarasota FL (SRQ)
134.025/323.125	Low Altitude	West Palm Beach FL (PBI)
134.550/257.700	Low Altitude	Avon Park FL (AVO)
134.750/322.500	Low Altitude	Fort Myers FL (FMY)
135.175/239.250	Low Altitude	West Palm Beach FL (PBI)
135.200/270.300	Low/High Altitude	Grand Turk Island TCA (GDT)
135.600/269.050	Low Altitude	Bimini BAH (ZBV)
135.700/254.250	Low Altitude	Vero Beach FL (VRB)
135.775/251.050	High Altitude	Sarasota FL (SRQ) Gulf of Mexico Project Contingency Coverage
-------/256.700	Low Altitude	Avon Park FL (AVO) Avon Park MOA
-------/257.850	Low/High Altitude	Fort Myers FL (FMY) Warning Areas
-------/281.400	High Altitude	Key West FL (EYW) Warning Areas
-------/282.275	High Altitude	Key West FL (EYW) Warning Areas
-------/285.500	Low Altitude	La Belle FL (LBV)
-------/290.200	Low/High Altitude	Fort Myers FL (FMY) Warning Areas
-------/292.150	Low/High Altitude	Sarasota FL (SRQ) Military Operating Areas
-------/296.700	Low/High Altitude	Miami FL (MIA) Warning Areas
-------/306.900	Low Altitude	Key West FL (QMQ)
-------/322.450	Low Altitude	Avon Park FL (AVO) Military Operating Areas Workload
-------/323.000	Low Altitude	Miami FL (MIA)
-------/323.100	High Altitude	Key West FL (EYW/QMQ)
-------/363.100	Low/High Altitude	Sarasota FL (SRQ) Warning Area W-168
-------/385.550	Low/High Altitude	Fort Myers FL (FMY) Military Operating Areas

FED FILES

GOVERNMENT COMMUNICATIONS

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

A Fed Files Road Trip – New York City

Happy New Year and Welcome Back from the *Fed Files*. I hope to keep this year filled with interesting federal frequencies and related information. Thanks to all the readers who have written with comments and frequency information. I really appreciate the feedback and look forward to hearing from more of you.

As regular readers of this column may have noticed, I travel a lot for my work as a remote television-broadcasting engineer. The good side is I get to travel to quite few cities in the US and Canada while there I can scan the radio spectrum. The bad news is I travel a lot – I'm never home. My federal radio logs for my home area of Portland, Oregon are woefully lacking in updates. I do catch some active frequencies while waiting for flights at the airport, but more on that later.

I often receive emails asking about what kind of equipment I have with me while traveling and hints for searching the federal bands. So I thought I would share with the *Fed Files* readers my routine for traveling and scanning in all the different areas I cover for work. As an example, here is how things went on a recent trip to New York City for a televised event at Madison Square Garden in the heart of Manhattan.

The gear I travel with varies on the situation I am traveling to and how much time away from work I will have to actually listen to the radios. The very basic "go kit" for me rides in my carry-on backpack on every trip. The basic gear consists of three hand-held scanners, usually a Uniden 396T, a 396XT and a GRE PSR-500, along with assorted antennas, earpieces and spare batteries. And even though I fly well over 100,000 miles a year and go through multiple TSA security checks weekly, I've never been questioned or hassled about the radios in the carry-on bags.

With my basic setup I can search and scan with multiple radios and even have my laptop computer log the active frequencies. Often, one scanner will be scanning a known set of area federal frequencies while the others are searching.

On some longer trips I may add my PRO-96 or even my Yupiteru MVT-7100. Why still carry the nearly 15-year-old "Yupi" around? It's still one of the best hand-held receivers around, covers frequencies from the AM broadcast band up to 1300 MHz, and does an excellent job in the military UHF band. Although it cannot be programmed by computer software, it is very easy and quick to program by hand.

When I am headed somewhere for multiple days in a hotel (usually three or more nights), I will add some radios and computer gear. Usually my GRE PSR-600 or the Uniden 996T come along in a specially built travel case. (I built the case after bending or breaking off the front panel knobs on both radios at least once.) And on a big event, such as a political convention or large sporting event where there will be plenty of monitoring targets, I may also carry a "black box" receiver, such as the Optocom or Icom PSR radio and an additional "netbook" computer to run and log activity.

Antennas are also part of the travel equipment. And setting up antennas can be a challenge in some locations, so I usually bring along some specialized connectors, filters and cable for any situation. I've been developing a suction-cup mount for antennas that can be placed in the hotel room window for best reception.

So I set up the radios and antennas in the hotel room: now what? First thing I check is a general sweep of the VHF & UHF federal bands. I always make sure I don't have any frequencies locked out to start with, but in any urban RF environment you are going to run into frequencies that will have some sort of interference and will probably need to be skipped. At some locations, I've had to resort to filters or attenuators to limit overloading the radios.

Make sure to listen to the entire federal spectrum. Searching from 162 through 174 MHz and 400 through 420 MHz will give you most federal radio traffic in any given area. If you can, also check out 138 to 144 and 148 to 150.75 MHz, as some have reported surveillance operations in these bands, likely from Department of Defense agencies. And give a listen to the 380 to 400 MHz band to see if there are any military bases or trunked systems nearby. You may be surprised where these frequencies are active.

❖ New York City Federal Logs

During this visit I was based near mid-town Manhattan and caught quite a bit of federal traffic. Although my master list of logged frequencies for New York City runs over 500 entries, this is the raw data that was logged during my latest three-day stay. I have identified what I have been able to, but some of these entries remain unidentified:

163.3750, D065	
164.1000, N001	US Secret Service (unconfirmed)
164.3375, D251	Postal Service Brooklyn
164.4000, N001	US Secret Service PAPA
164.6500, N001	US Secret Service TANGO
165.2125	
165.2375, N301	DHS CBP NET 1
166.3750, D065	Postal Service Manhattan
166.5625, N301	DHS CBP
166.8875, 103.5	UN Security Base
167.1250, 114.8	Postal Service
167.4625, N207	DHS ICE Regional Network
167.5125	
167.7875, N653	NYC FIO Federal Interoperability repeater
167.8875, 127.3	Previously logged, unknown agency
168.3000, N167	FBI H3/H4
168.8250, N167	FBI H1/H2
168.8250, N730	
168.8875, N167	FBI (not previously logged)
168.9125, N935	
169.4500, 100.0	DHS, CBP Customs NET 2
169.6250, N167	FBI (not previously logged)
169.7000, N864	DoJ, US Marshals Service
169.7250, N864	DoJ, US Marshals Service
169.9750, N167	FBI Newark
169.9875, N4F9	
170.3750, N167	FBI G5/G6
170.4250, N167	FBI G3/G4
170.4250, N730	
170.5500, N167	FBI
170.5500, N730	
170.6250, N167	FBI C7/C8
170.6250, N730	
171.1750, N653	NYC Federal Interoperability FIO 2
171.4625, N24F	
171.5500, N167 -	FBI
171.5500, N673	
161.6875, N173	
171.6875, N9C5	DHS ICE Regional Network, New Jersey
171.7250, N159	
172.1875, N167	FBI
172.5250, N167	FBI B1/B2
172.6625, N615	
173.6625, N167	FBI A1
173.6625, N673	
173.6625, N730	
406.1125, 82.5	
406.1500, N293	VAMC Brooklyn
406.3375, N482	US Postal Inspectors RED Net
406.4250, 67.0	
406.5000, N020	
406.5000, N2E1	BoP Metropolitan Detention Center, Brooklyn
406.9250, N020	
406.9250, N2E1	BoP Metropolitan Detention Center, Brooklyn
407.1375, N482	US Postal Inspectors GREEN Net
407.2000, N293	State Department Bureau of Diplomatic Security
407.4125, N1A3	BoP Metropolitan Correctional Center, Manhattan
407.5000, 107.2	Previously logged, unknown agency
407.7250, N482	US Postal Inspectors WHITE Net
407.7750, N482	US Postal Inspectors BLUE Net
407.9500, N020	
407.9500, N2E1	BoP Metropolitan Detention Center, Brooklyn
408.1000, N0F0	State Department Bureau of Diplomatic Security
408.1250, N293	VAMC Manhattan
408.2000, N270	
408.2125, N020	

408.2125, N2E1	BoP Metropolitan Detention Center, Brooklyn
408.3000, 74.4	
408.4250, 67.0	
408.5750, N020	
408.5750, N2E1	BoP Metropolitan Detention Center, Brooklyn
408.8125, N1A3	BoP Metropolitan Correctional Center, Manhattan
409.0250, 110.9	Postal Service Flushing/Nassau
409.3250, 67.0	
409.6250, N293	State Department Bureau of Diplomatic Security
409.7500, N020	
409.9000, N1A3	BoP Metropolitan Correctional Center, Manhattan
409.9375, N482	US Postal Inspectors BLACK Net
410.4125, N1A3	BoP Metropolitan Correctional Center, Manhattan
411.7375, 67.0	
412.9750, N293	
413.4125, N293	VA Medical Center, New Jersey
413.8625, CSQ	VA Medical Center - Paging
413.8750, 67.0	
413.9750, D271	
414.6875, D503	
414.8750, 173.8	
414.9000, 156.7	DEA
415.9000, 74.4	
416.1375, N482	US Postal Inspectors, input to 407.1375 MHz
416.7250, N482	US Postal Inspectors, input to 407.7250 MHz
417.2000, N270	Federal Protective Service
417.6000, N293	State Department Bureau of Diplomatic Security
417.6500, 103.5	
417.9125, 192.8	
418.3500, 141.3	
418.6250, 156.7	DEA
418.6750, 156.7	DEA
418.7500, 156.7	DEA
418.7875, D125	
418.9250, D731	
418.9375, N482	US Postal Inspectors, input to 409.9375 MHz
418.9500, 156.7	DEA
419.7875, 67.0	

So, that's my basic game plan for scanning while on the road. The next step is to take these logs, identify what I can via Internet searches, check against data I already have, and then add the new information to my "master" database. Some folks are more dedicated to maintaining their data as current as possible. I still end up with lots of little pieces of paper with frequencies on them, waiting for a rainy day at home to put them all in the computer!

❖ DOJ "25 Cities" Project Marches On

I've mentioned the Department of Justice's "25 Cities Project" in several past *Fed Files* columns and in the *Fed Files* blog. The most recent list I put together for the project is available here:

http://mt-fedfiles.blogspot.com/2011/03/justice-department-25-cities-project.html

This project continues to grow, with even more cities being added to provide federal agency interoperability with local public safety agencies. Some additional cities have recently been added to the project, but not much is known about the frequencies that will be used.

The latest information shows the Hartford, CT area is hosting two VHF federal interoperability repeaters. However, no frequency information has been determined.

Hartford, CT
FEDCOM N = ?
FEDCOM S = ?

Originally, the Los Angeles area features two federal interoperability repeaters. Updated lists now indicate that there are three VHF federal interoperability repeaters in the Los Angeles area. I have confirmation the first two, but have no information on what is Federal Interoperability 3.

Los Angeles, CA
LA FIO 1 = 163.1000 MHz, N653
LA FIO 2 = 172.4125 MHz, N653
LA FIO 3 = ?

The New York City area is one of the earliest cites to host federal interoperability repeaters. Recently they have expanded this system to include additional repeaters besides the original two.

New York City, NY
NYC FIO = 167.7875 MHz, N653
NYC FIO2 = 171.1750 MHz, N653

These additional channels are listed but no specific frequencies have been confirmed

NYC FIO-N = ?
NYC FIO-E = ?
NYC FIO-S = ?

However, the frequency database on the Radio Reference website has all these frequencies listed as "Federal Interoperability" in the New York City area. I have not heard these in use yet. Can anyone confirm how these are used?

164.4750, N653
166.7500, N653
167.3500, N653
168.6625, N653
171.1125, N653
172.2875, N653

And finally, a new federal interoperability repeater has been confirmed on the air in the Central Florida area, located in Orlando.

Orlando, FL
ORL FIO = 172.3000 MHz, N653

❖ TSA Changes Continue

I have featured several mentions of the Transportation Security Administration (TSA) over the last year and they continue to provide some interesting mysteries as to what they are up to now.

Earlier I mentioned that I often find myself searching out federal radio activity during my waiting times at airports, particularly my home airport of Portland International (PDX).

I recently started to notice a lack of activity on the usual TSA frequencies that have been active at PDX for years. The 172.1500 MHz channel was usually hopping with activity as the TSA used that frequency, with multiple P-25 NAC's for each security checkpoint, as well as baggage screening operations.

However, in early 2011, all the baggage screening was moved from the main level to a level down below. Around that same time it seemed that something else had changed. The Justice Department's Integrated Wireless Network (IWN) trunked system had moved one of its sites. Site 115, previously located in on the north side of Vancouver, WA was moved to the Portland airport.

I decided to take a look at the active users of that trunked site to see if I could figure out who was using it. It turns out that the TSA is now an active user of the IWN trunked system. I have found four talk groups that are definitely associated with TSA activities at PDX. They are all using encryption full time, so figuring out what each talk group is used for may take some additional research.

I've also received reports that the TSA has been testing Motorola's TRBO digital radios in the South Florida region. Although I have run across other federal agencies, such as the Veterans Administration, using TRBO radios, I have not run into the TSA using TRBO in any of the areas I have been traveling, but am always on the lookout.

❖ IBWC Agency Close-Up

I would like to devote a little column space to an agency we haven't covered before, the International Boundary and Water Commission (IBWC). Created in 1889, and given the current name in 1944, the IWBC is actually an international commission that has members from both the United States and Mexico. The US section of the IBWC is part of the US Department of State and is headquartered in El Paso, Texas. More information is available at their web site: **www.ibwc.state.gov/home.html**

Day to day operations of the IBWC involve engineering, water supply survey and equipment maintenance as well as survey and boundary maintenance crews. These operations can require radio communications systems. Because the IBWC operates along an international border, their radio frequencies need to be coordinated with the bordering country (in this case, Mexico) to assure that the IBWC is not interfering with licensed users in the other country and that other users are not interfering with the IBWC.

Here are the IBWC frequencies that are protected from interference by agreement with Mexican government. If you find yourself along the southwestern US/Mexico border area, be sure to check these out and see what's active:

162.0250	162.1750	164.1750	164.4750
168.5750	169.4250	169.5250	171.8250
171.8500	171.9250	172.4000	172.4750
172.6000	172.6250	172.7750	173.1750
173.9625	411.6500	412.0500	412.1250
412.1750	417.2500	417.7250	417.7750
417.8750			

That's all for this month. More frequencies and federal monitoring information will return in March!

BOATS, PLANES, AND TRAINS

Ron Walsh VE3GO
ronwalsh@monitoringtimes.com

Cold Winds, Warm Hearth

I would like to dedicate this column to a friend and fellow radio enthusiast who passed away on my birthday, November 2nd. Bob Boyd, W2YLM, was not only a great friend, but we also shared a love of shipping and history. I learned much about electronics from him as he was a retired IBM employee with the nickname of the "Wizard." Bob would find the answers when no one else could. Both Bob and his wife Dorothy are gone, but certainly not forgotten. 73's Bob, SK.

Like most areas with seasons, the radio listening here changes in the fall and winter. Winter is formally here when the Seaway broadcasts the notice about the closing date for the year. Using the AIS information, VHF radio channels, and the Internet, I was able to track many vessels so I could get photographs for my collection. Channels 11, 12, 13 and 14 are used for traffic control from the middle of Lake Ontario to Montreal. For direct communications with the locks, channels 17 and 13 alternate as you proceed through the system.

The Seaway broadcast daily bulletins in December that gave water temperatures in Montreal, details of the ice situation in the system, as well as the number of ocean vessels above Montreal and the Welland canal. The Seaway Authority issued notice #18 that ships in the Montreal to Lake Ontario section had to monitor the sector control frequency as well as the frequency used by each lock. It just stresses the importance and usefulness of radio communication.

I know winter is truly here when the Seaway radio stations close down in sequence as the last ship leaves their section. Like all local ship enthusiasts, I await the ice breakers coming up the St. Lawrence and the return of VHF radio traffic in late March.

However, I remind listeners that not all radio traffic disappears. In this area, we still have ferries running. They use bubble systems to keep channels open and free of ice so island residents will not be isolated. VBR Prescott keeps its Kingston tower open and continues its 24 hour weather broadcasts. We also hear rescue aircraft on channel 82A as they leave Trenton on missions. I have heard some broadcasts on channel 16 of marine emergencies during our winter season.

There is winter traffic from Lake Erie to Lake Michigan, weather permitting, and icebreakers from the U.S. and Canadian Coast Guard can be heard as they try to keep channels navigable. I do not remove all marine frequencies from my scanner. Of course, this also forces me to look to HF for marine radio listening.

Cedarglen ***approaching Iroquois lock. This ship utilized the stern of an ocean vessel and a new Great Lakes forebody which was attached. This was one ship I particularly wanted to photograph as a similar ship went to scrap this year.***

❖ Southern Exodus and South Bound II

I am also reminded of the many yachts and sailors who leave this area for warmer climates over the winter. The exodus by vehicle to the south and by vessel on the Intracoastal Waterway will certainly have taken place.

Here I have to mention Herb Hilgenberg. He is VE3LML, but he is known worldwide for his marine HF coast station VAX498. This is one of the few private marine land stations in Canada. On the air, he is known as South Bound II.

Herb is famous for the extremely accurate weather forecasts he gives out. His knowledge of the intricate nature of weather patterns in the North Atlantic and Caribbean are legendary. Herb has even provided some information to the US Navy. Several local yachtsmen reminded me about giving out Herb's schedule, as they rely on him as they cruise the ocean. Herb operates on the frequency of 12359 kHz USB. He takes vessel check-ins from 1930 to 2000 UTC, asking for their current latitude and longitude. New check-ins are asked to give a short description of their location when they first check in. Stations then will standby until Herb calls them with specific weather information for their location.

Individual vessel forecasts are prepared ahead of time using up to five numerical forecast models, plus other available data and products to produce a revised surface chart for detailed analysis and forecast preparation. Vessels can get an extended four to five day route forecast if they wish.

His prime areas of coverage are the North Atlantic, the Eastern Seaboard, and Europe, including the Caribbean Sea, the Bahamas and the Gulf of Mexico. He does limited coverage of the South Atlantic and Eastern Pacific depending on propagation. These forecasts are value added information and not rebroadcasts of other available official forecasts.

He has announced that he was taking check-ins between 1930 and 2000 UTC but in my experience he forecasts anytime starting at 1940 UTC due to propagation problems. However, with the improvement in propagation near the end of 2011, he may be back to the original schedule when this column is read. He also has 8294 and 16528 kHz as back-up frequencies for the near shore traffic and the Caribbean area.

I am sure you will find South Bound II an interesting station to listen to. I know I planned to try and hear him when I sail on a Caribbean cruise in early December. I will let you know what I heard in the April column. That is as close as I will come to having my own yacht in warmer waters!

Another friend, Bob Testor, VE3PND, hopes to be doing an east to west crossing of the Atlantic in the equatorial latitudes during January. Look for his vessel, *Pendragon*, on the amateur and marine bands. He did a west to east crossing last July but had HF radio problems.

The Waterway Net on 7.268 kHz is active every day at 0745 EST (1245 UTC). This net is one of the longest continually operating nets on amateur radio. They give the Bahamas weather at the start of the net as well as the coastal weather. Check-ins with position reports begin at 1315 UTC. Net control,WA6CCA, Bill in Arlington Virginia was easily copied here. The net manager is Peter K3PRC and their web site is **www.waterway.net**. I am sure this will be used as the yachts go south for the winter.

❖ Historical Marine Radio

I am always pleased to have information about restored marine radio facilities. The Maritime Radio Historical Society's stations in Point Reyes, California are quite impressive. Stations KSM, KFS and KPH will verify correct reception reports. The amateur station at the site, K6KPH also will verify by QSL card. Professional operator Denise Stoops was doing the QSLs, but accepted a position aboard a ship, so Paul Shinn has stepped up to do the job, He has cleared the

back log of reports and QSLs. However, if a report was mislaid and you have not had a response, please contact him. The MMRS's address is P.O. Box 292, Point Reyes Station, CA 94956.

Their complete schedule of CW and RTTY transmissions is available at **www.radiomarine.org**. Also check this web site if you are in the area, as they have some great speakers and open houses. Wish I could attend!

The Frontenac County ARES has been considering a special event station here in Kingston. We have activated several area light houses and a few of the Thousand Islands for contacts. We are looking into obtaining a special amateur radio call sign such as CG3VBH to be used during 2013. We would like to celebrate the 100th anniversary of Canadian Marine radio stations on the Great Lakes.

The Marconi Wireless station VBH began operating in 1913. The service was the start of the Coast Guard Marine radio stations we have today. The station started with spark gap CW, then went to CW and AM phone around World War II. The CW ended after the war and FM VHF was introduced in the late 1950s. In the 1970s, SSB replaced the AM phone.

HF eventually disappeared from the Lakes. We all regret the last marine HF station, WLC Rogers City, closing down. Today, the local VHF marine tower is relayed by phone line to VBR Prescott Radio as one of their eight remote sites. The possibility of transmitting on one of VBH's old marine frequencies for historical purposes is also being investigated.

I still miss VBH Kingston on 2182 kHz! The weather forecasts which aired every six hours from VBH and the other Great Lakes station regularly boomed through my old S-38. My first radio use was on 2 MHz am to VBH from the tour boat *Lady Kingston* in 1968.

People with an interest in history will note the 1913 start-up date. The introduction of wireless to the Great Lakes was one result of the famous *Titanic* disaster, which has its 100th anniversary next April. This is just one of the radio regulations which sprang from that catastrophe. Mandatory listening watches during voyages, radio silence periods for 3 minutes on the hour and half hour, and a standard distress call are other examples.

❖ Receptions and Targets

Again I remind listeners to read Hugh Stegman's monthly *Utility World* column to get some of the marine stations being heard. This will give you some targets to try. I am interested in the Russian Navy CW reports that have been listed. Russian CW was reported on 6846, 8136, 8345, 11000, 11155 and 17425 kHz. 4150 was reported as a marker identification "V". Pakistan Navy CW was reported on 1458.5, 6391 and 13011 kHz. Several reports of VMW Australia on 10555 kHz also got my attention.

The following examples were logged during my most recent listening from my Great Lakes location:

WLO Mobile, 1013 UTC, announcement and ID on 6519 kHz
NMN Chesapeake, 1014 UTC, weather on 6501 kHz
Weak marine signals, 1028 UTC on 6510 kHz
Sydney Coast Guard, 0041 UTC 2182 and 2714 kHz, Gale Warning
Placentia Coast Guard Radio, 0050 UTC 2182 and 2598 kHz, weather

With the shorter days, I also visit the long wave frequencies, below 515 kHz. Although the beacons are not all marine related you may get some amazing DX. I hope to get KSM on their low frequency some day. I will keep trying!

Amateurs want to keep the 500 kHz frequency alive, and reports of their experimental broadcast near this frequency would be appreciated. Navtex on 518 kHz also becomes stronger at this time.

Coast Guard Icebreaker* CCGS Giffon *doing aids to navigation removal before the ice forms.

❖ Amateur Radio Activity

I have been impressed by the improved propagation over the end of 2011. I have seen the SFI index up to 150. Openings on all the bands, including 10 meters, led to some great DX. I must admit I have been working DX more than doing listening for a while. I guess working TX7M, in the Marquesas Islands during their expedition was my best catch. Within 10 minutes, I also worked 3XY1D, a DXpedition in Guinea. All of this was on 20 meter CW.

Like everyone else I was trying to get a local amateur, Cezar Trifu, VE3LYC, when he was on a DXpedition to Pupuya Island off the coast of Chile. He is using a unique portable antenna. It looks like a large discone having a vertical radiator and three sloping radials. The radials are also the supports for the pole which holds up the vertical wire. Jumpers placed along each wire allow for operating on different bands. George, VE3GHGKwas rebuilding these, and when I gave a bit of help we also tried this antenna. It worked quite well and was easy to erect. It is light and easily portable. I will give my results of the CE4A operation in the April column as well.

Our local ARES group has planned several island activations for next year. We are also planning to operate the ARRL Field Day from the retired Canadian Coast Guard icebreaker, *Alexander Henry*, which is moored at the Marine Museum of the Great Lakes, here in Kingston. We did this many years ago and many people wanted a QSL card from the ship. Once our arrangements are made I will pass them along. Not only is it fun to operate from these places, but we get a lot of experience setting up portable stations for emergencies.

The ferry* Quinte Loyalist *undergoing 5 year inspection and refit before winter operations. Vessel operates all winter utilizing a bubble system to keep the channel free of ice.

As well operating my station, VE3GO, I have been visiting the Communications and Electronics Museum at Canadian Forces Base Kingston and have been operating VE3RCS. They have a fantastic log periodic antenna which I enjoy. I will be trying to check into the maritime net on 14 300 kHz. Hope we can chat with other readers on the bands.

❖ Mail from Readers

Again, I want to thank everyone who sent me emails, etc. with comments about the column. **John, VE3CAK**, commented he enjoyed the column and he liked the way I wrote for the reader.

Jerry Klatt, a *Monitoring Times* subscriber for 25 years, wrote that he enjoys the column. He lives near Cleveland, Ohio and has set up an AIS monitoring station. He uses a Digital Yacht AISnet receiver and can often hear as far away as the Welland Canal. Like me, he enjoys the hobby but is not looking forward to the long cold winter and lack of radio traffic.

Werner Funkenhauser wrote me about my plasma TV interference mentioned in the October column. He gave me a link and suggested that an ANC4 unit might help with the interference. I have tried a similar MFJ unit, but will see if I can borrow one of these and try it out. Any other information concerning cures for plasma TV interference will be appreciated by many amateurs and HF radio listeners.

I also got a letter from **John Musgrave** at Oona River, BC. John reported listening to some distress traffic including a possible evacuation during hurricane force winds they had on the west coast. Look forward to hearing from John and getting information from the opposite side of the continent. He has a new sail boat to travel the coast and monitor radio from many locations.

Again, I appreciate any information about marine radio or what you hear on the bands. Please use the email address in the magazine.

I hope everyone had a great holiday season and you received some new radio gear. I will be enjoying the treasures I picked up at the local hamfest. Yes, I am also going south for February and March, 2012. I will be VE3GO/W4 in Myrtle Beach, SC.

Ron, VE3GO

GLOBALNET

Exploring the World of Internet Radio and Television

Loyd Van Horn, W4LVH
globalnetmt@gmail.com
Twitter: @GlobalnetMT

Do you *really* need a tablet?

Alright, it is 2012 now and even if the world does end in a few months, there is one thing that is absolutely certain: Our society has become gadget obsessed.

I know this is the pot calling the kettle black, because I can't help but fawn over each new gizmo release. But ultimately, it comes down to just how much of my hard-earned cash I am willing to part with in return for technological happiness.

At those times I find myself faced with the inevitable question, "OK, do I actually need this?"

My most recent foray into this inner battle came with such releases as the iPhone 4S and a handful of new tablets. So, I found myself wondering if you, my readers, might be finding yourselves in a similar predicament. While we are past the holiday gift-buying season, this is actually a perfect time to start examining big-ticket purchases for the coming year.

While I am not going to come to a definitive conclusion for each individual reader in the scope of this column, I will at least try to present some of the pros and cons for a tablet when compared to some of the alternatives. I will throw in my own observations on the chance that some might benefit from my approach. But, as I have always preached when trying to provide help with purchasing decisions, the onus lies on you to decide what is important to you!

❖ Tablet versus Smartphone

Probably the most common discussion among potential tablet buyers – and one I have even had myself – is what can a tablet do that a smartphone can't? In fact, when the iPad first was released, I looked at my recently upgraded iPhone and said "Wow, it is an iPhone, but bigger. No thanks."

For a long time that summarized the tablet versus smartphone debate for me. In fact, the most obvious difference comes down to size. Smarphone users will enjoy the portability that their device has over a tablet, while retaining almost every feature available on a tablet. A smartphone can easily fit in a pocket or purse and be taken just about anywhere.

However, tablet users will enjoy increased screen-size for things such as reading, web browsing and watching videos. Plus, productivity-minded people enjoy tablet's larger touch-screen keyboard – albeit still a poor replacement at this point for having a physical keyboard in front of you.

In terms of Internet radio usage, there really is no clear favorite, although smartphones may hold the edge for most people. It comes down to the nature of your own personal listening habits. I made the decision to hold off on a tablet purchase in favor of upgrading my smartphone, since I use my smartphone for Internet radio streaming while in my car and other on-the-go listening. My rationale, besides portability, was that I was already paying my monthly data charge for my phone: Why add a second data charge just to have Internet access on a tablet – especially when my iPhone would be tuning in the same streams? It just didn't make fiscal sense for me.

Plus, smartphones are much easier to use with portable docking stations, which makes them very versatile Internet radio devices. They even trump many of the specified WiFi radios on the market for terms of "most bang for your buck." So, for me at least, a tablet purchase would have to be based on much more than just Internet radio usage.

For those who enjoy streaming video, the larger screen-size of the tablet is a definite plus, and for many, size trumps everything else when it comes to streaming video.

It is worthy to note, however, that despite the larger size, tablets are still lagging way behind smartphones when it comes to screen resolution. In fact, the newest retina display on the iPhone 4S has nearly four times the resolution of the iPad 2. It is not like Apple hasn't tried; the technology to make the iPad's resolution match that of the iPhone is just having problems coming into place.

On top of resolution issues with devices such as Apple TV, Roku boxes and other streaming devices that enable interaction with smartphones and televisions, those who primarily are interested in streaming from home might be more inclined to use their smartphone, similar to a remote control interface. Sure, many of these same devices would support streaming from a tablet, but a smartphone is a much less expensive option for people interested in this type of setup – especially if you already own a smartphone!

So, maybe a tablet isn't that great for watching videos at home, but what about when you are on the go? This depends on two questions: first, are you planning to buy a tablet with a data connection to a cellular network (which comes at an extra monthly charge)? Secondly, if not, how often do you find yourself around a WiFi connection outside of your home?

If you do decide to spring for the extra monthly data charge for your tablet, then this could be a major win in the tablet column. Yes, smartphones also incur a monthly data charge as well. However, the ability to stream video, often in high-definition, from anywhere with a cell phone signal on a larger screen is promising. Just don't forget, many cellular providers either start charging extra, or cut-off or slow down your data connection once you pass a certain threshold of usage. What's the quickest way to gobble up data usage? Streaming high-definition video, of course.

If you find yourself around a WiFi hotspot on a regular basis during your daily activities (outside of your home), then the tablet actually is a very good option. Not only can you stream video, but you can access the Internet on a larger screen than you can your smartphone. For those who want a smartphone AND tablet, you might even be able to save money with a less-expensive data plan on your phone, and use the tablet for the majority of your Internet activity.

The tablet definitely wins over a smartphone when it comes to using it as a e-book or magazine reader, especially if screen-size is the primary concern, right? Possibly.

If having one central device for everything is what you are looking for, and e-reading is a big portion of what you are wanting to do with your device, then a tablet may be the way to

go. But for what some tablets retail for, users can often get a smartphone and an e-reader such as the Kindle or Nook for a much lower price than they would a tablet alone.

The bottom-line: Comparing these two devices is pretty much comparing an apple to a larger apple. It comes down to, how hungry are you?

Personally, I avoided seriously considering purchasing a tablet (ignoring my inner tech-geek screaming inside me) until the announcement of the Amazon Kindle Fire. With the Fire, the price-point had finally arrived where I felt comfortable pulling the trigger on a tablet. For me, the larger screen for e-reading and streaming video (something I find myself doing more and more each day) was very attractive. It also makes for a nice web browsing experience (much more comfortable than on my iPhone screen, comparatively).

When Amazon threw in the streaming video of Amazon Prime (for an annual fee, albeit cheaper than what I have been paying for streaming-only Netflix) with a commitment to expand the selection of titles, I was sold.

I will probably still rely on my iPhone for Internet radio, much like I used my Walkman as a child. However, I feel that a Kindle Fire could quickly become a focal point in my home for just about everything else.

❖ Tablet versus Laptop

While debating between a tablet and a smartphone can be a constant tug-of-war of features versus price, to me the tablet versus laptop debate is much easier.

You have two questions that you really need to answer: First, how much computing power do you really need? Secondly, how much do you really need that keyboard?

My lovely girlfriend is currently in the market for a laptop. She is looking for something basic to use around the house for web surfing, checking her email and updating her Facebook status. We price shopped everything from MacBooks to netbooks, but couldn't find anything that could beat the value of a tablet for her.

With a tablet, she can do everything she does currently on a laptop, but in a much more portable manner and in a much more user-friendly interface. As great as the latest Windows and Mac OS are, the operating systems on Android, iOS, and even the proprietary systems from developers like Amazon are much easier to use than their computer counterparts.

She basically represents the exact consumer that Steve Jobs had in mind when he envisioned his iPad. He wanted to create a computing device that would essentially replace a laptop or desktop computer for most homes.

Now, if I was in the market for a new laptop (which let's face it, I will always be until I finally purchase my dream MacBook Pro), a tablet wouldn't be as good a choice for me. For one, typing a 2,000 word column every month on a touch-screen keyboard would be downright nightmarish.

I know there are some tablets that have keyboard accessories available for them. Even the iPad supports the same Bluetooth keyboard I currently use on my iMac. So, theoretically, I could use that to type my columns each month. If the keyboard is your only stumbling block, see what accessory/accessibility options may exist for the tablet you are considering before making your purchase decision.

Another issue for someone like me is that I need something with a lot of horsepower under the hood. My music recordings require a lot of computing power. As such, I need a dedicated laptop or desktop computer (I love my iMac, for this very reason). Tablets just cannot keep up with a traditional computer in this area. The same holds true for those who are using their computers for gaming. Most gamers are playing games that require dedicated, high-end video cards which are usually the size of a small tablet, themselves.

So, we were the people Jobs had in mind when he said a tablet would replace a computer for *most* people. We were the other group that would still need a larger, productivity machine for our daily usage.

If you are in the midst of this buying decision, take some time to actually monitor your computer usage. How much time are you spending on the Internet, and what are you doing while there? Are you using your computer for hard-core, graphics-intensive gaming? Are you a student typing long papers?

These considerations don't even touch on the main concepts this column is interested in. If all you are interested in doing is streaming audio or video, the portability of a tablet makes it a heavy favorite. Anything you can stream on a computer, you can stream on a tablet, and some would say it is even easier with a tablet. Rather than memorizing or even having to bookmark Web sites, a tablet's app structure means you are a few finger touches away from your favorite streaming radio station or television show.

Plus, while laptops are portable, a tablet's streamlined frame is even more so. The fact that a person can watch the same Netflix stream on either one means that tablet gets the edge for better portability.

Bottom line: If portability, basic Web browsing, streaming and simple tasks are your primary concern, the tablet makes a good choice. If you need a little more computing power, a more streamlined laptop or even a larger desktop may be the best way to go. Again, it all comes down to, how are you going to use what you ultimately purchase?

Then again, some may want to take what I say with a grain of salt. After all, this column has been written by someone who owns a smartphone, a laptop, a desktop computer and is a soon-to-be owner of a tablet, too!

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New Year, New Horizons

Welcome to 2012! The dawn of a new year is a great time to reflect on our accomplishments and seek new challenges for the coming months.

Are you new to Longwave radio? If so, welcome to the band. You are starting at the perfect time. In the winter, natural static (QRN) is at its lowest, and the longer periods of darkness provide better propagation over longer signal paths. This month, we'll discuss what can be heard, discuss a small antenna option, and profile two popular LW monitoring activities: Lowfers and Natural Radio. Just as a programming note, we will conclude our mini-series on the AquaGuide RDF-304 receiver *next* month, as I am awaiting parts to complete this project.

A common question I hear from prospective listeners goes something like this: "Is there anything to hear on longwave besides static and a few beacons?" The question tells me right away that the person has either not listened to longwave with a proper antenna, or has been misinformed. The truth is that you will not hear a greater variety of signals in any other 500 kHz slice of the radio spectrum than you will on longwave. Here is a small sample of the signals you might hear:

- Natural radio
- Military transmissions
- Time stations
- Radiolocation services
- Experimenters
- Broadcasters
- Navigation Beacons
- Maritime bulletins
- Amateur Radio Stations

Why not make this the year that you learn more about longwave? I'll be the first to tell you that longwave should not be your *only* radio pursuit (it's certainly not my only RF interest), but I hope we've made the case here for checking out this part of the band, at least on an occasional basis.

If you're already well versed in longwave, how about taking on some new challenges, such as exceeding 300 loggings, setting a distance record for daytime reception, or building a new receiving antenna? The possibilities are endless. Keep us updated on what you are doing in the hobby, and keep those loggings and photos coming. I would especially like to see some shack photos, along with the operators in the picture! We'll run them here as space allows.

❖ Small Antenna, Big Results

I have long promoted using active antennas for longwave reception. Many newcomers to LF try to use the same "random length" wire antenna they use for shortwave, and while it may work in low-noise locations, it often results in little more than static being heard, or perhaps a few local stations.

There are several commercial active antennas available, including the popular L-400B from LF Engineering Co. (see *MT* review at **http://tinyurl.com/y9zb2td**).

I know that not everyone has the budget for a commercial antenna, especially if longwave is only a "sideline" activity. So, how about building one? A simple design, complete with a printed circuit board (PCB) design, can be found at **http://tiny.cc/KEBjh**. The author, Adrian Knott of the UK, states that the frequency coverage is approximately 10 kHz to 200 kHz, but changes in the filter components should allow reception well above this range. Time to experiment!

❖ Chasing Lowfers

Lowfers are experimental stations that operate license-free under Part 15 of the FCC rules and regulations. These rules allow a maximum power of 1 watt and an antenna length (including feedline) of no more than 15 meters (50 feet). Transmissions are limited to the frequencies between 160 and 190 kHz. Out-of-band emissions, such as harmonics or spurious signals, must be attenuated by at least 20 dB. Any transmission mode is allowed except for damped waves (spark gap).

Despite some seemingly severe handicaps, Lowfers routinely are heard at distances of up to 400 miles – sometimes much farther. The Longwave Club of America's website at **www.lwca.org** contains a wealth of information on Lowfer operation. For a listing of Lowfer beacons believed to be active at this time, visit **http://lwca.org/sitepage/part15/index-lf.htm**. The data comes from past issues of the *Lowdown*, the monthly journal of the LWCA. Their website is an excellent source of information about Lowfers, operating modes, and antenna systems.

For your best shot at hearing these stations, put on a good pair of headphones, switch in a narrow bandwidth filter and slowly sift through the band. You should try this at various times of the day. Surprisingly, some of my best Lowfer catches have been in full daylight during the mid-morning hours. A Lowfer QSL is one of the most prized verifications you can get, and I'm pleased to report that most Lowfers are excellent QSLers. If you hear one of these experimental stations and need a mailing address, please drop me a line. I can provide mailing information for many stations in North America.

SELECTED NDB LOGGINGS

kHz	ID	ST/PR/ITU*	CITY
207	CL	NB	Charlo
220	BX	QC	Blanc Sablon
220	IHM	MA	Mansfield
232	GP	QC	Gaspe
244	DG	QC	Chute Des Passes
254	5B	PE	Summerside
254	5B	PE	Summerside
261	2H	QC	Lebel-sur-Quevillon
284	AUV	OK	Ardmore
291	9Q	QC	Amos
332	BG	NY	Binghamton
332	DKA	NC	Kenansville
332	FIS	FL	Key West
336	BDB	VA	Melfa
338	5Y	NS	Trenton
338	DE	MI	Detroit
338	GFZ	IA	Greenfield
338	HIL	KS	Great Bend
338	HR	TX	Harlingen
341	CQN	TN	Chattanooga
341	EI	OK	Enid
344	CGQ	TX	Corsicana
348	BUP	ME	Pittsfield
349	APG	MD	Aberdeen Pvg. Gnd.
349	FV	IN	Indianapolis
350	D7	ON	Kincardine
353	IN	MN	International Falls
355	CGE	MD	Cambridge
356	AY	NL	St. Anthony
359	GUV	LA	Fort Polk
359	HHH	TX	Devine
361	HB	NC	Burlington
362	FM	MA	Falmouth
363	1F	NB	Bathurst
364	2B	NL	Springdale
365	FIT	MA	Fitchburg
367	FVX	VA	Farmdale
368	IMR	MA	Marshfield
370	GR	QC	Grindstone
373	2Q	QC	Mont-Laurier
373	AEA	VA	South Hill
375	7B	ON	Saint Thomas
379	BRA	NC	Asheville
379	IVV	VT	Hartland
381	3B	ON	Brockville
384	F8	ON	Victoriaville
386	GMA	NH	Whitefield
387	6E	NB	Grand Manan
388	H7	ON	Manitowaning
391	EFW	IA	Jefferson
395	GBR	MA	Great Barrington
400	AI	OK	Ardmore
400	FO	NY	West Hampton Bch
405	7L	QC	La Sarre
407	FR	NY	Farmingdale
410	CYE	PA	Wilkes-Barre
411	HDL	OK	Holdenville
414	3U	QC	Gatineau
417	HHG	IN	Huntington
432	IZN	NC	Lincolnton
495	WD2XSH/38	NH	Charlestown
510.1	HI	CT	Monroe

** A complete list of ITU codes is available at: www.wordiq.com/definition/ITU_letter_codes*

❖ Tuning into Natural Radio

Another popular activity for longwave enthusiasts is Natural Radio – monitoring signals from the Earth itself. Even the general public seems to be getting a taste of things lately. For example, not long ago, I heard a program on National Public Radio (NPR) dealing with Natural Radio, and it has also been covered in the science sections of major newspapers and magazines.

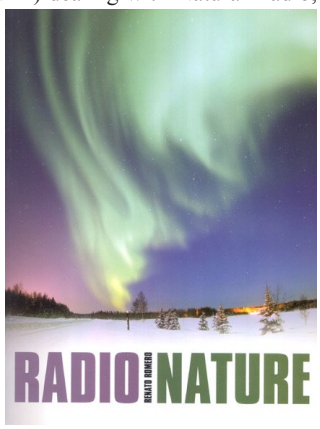

Figure 2. Radio Nature is a recent book by Renato Romero, IK1QFK. *(Courtesy Universal-Radio.com)*

Simply put, Natural Radio involves the reception of signals generated by an interaction between the Earth's magnetic field, bursts of solar energy ionizing the field, and lightning stroke energy within our atmosphere. Natural Radio signals have intriguing names like *Sferics*, *Tweeks*, *Whistlers*, and *Dawn Chorus*. While the basic mechanisms for these signals are understood in most cases, much remains to be learned about when they will occur, how they relate to our "space weather" conditions, and how best to hear them as an experimenter.

Natural Radio typically occurs on frequencies which, when detected, fall within the audible range of the human ear. These are true electromagnetic (radio) signals and *not* sound waves, but because they occur on such low RF frequencies (≈100 Hz to 30 kHz), they can be detected directly and amplified for human hearing with basic, yet specialized equipment.

Sound energy differs from radio in the sense that it consists of *vibrations of air molecules* and changes of air pressure that are detected by our ears. Confusion often results between ELF radio and sound waves, perhaps because the frequencies for both are rated in Hertz (Hz) or kilohertz (kHz). While sound and radio are entirely different types of energy, there is an overlap of the frequencies involved, making it easy to detect and reproduce Natural Radio signals for human hearing.

In coming issues, we'll discuss the huge number of resources that can be found on this fascinating subject, and cover equipment options for today's Natural Radio listener. We won't go into great deal about *how* these signals are created, as much has been written on this topic in the past – both here and elsewhere. A plethora of information is available online by simply entering the search terms "Natural Radio." There are also books covering various aspects of Natural Radio, one of which appears below.

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KSM
RADIOGRAM
AROUND THE WORLD
Maritime Radio Historical Society
TO SHIPS AT SEA

TOM HUMES
3050 WEST QUAIL TRAIL
CHINO VALLEY, AZ 86323

DH MSG NR1 KSM CKNC OCTOBER 23, 2011

THE MRHS CONFIRMS YOUR RECEPTION OF KSM ON JANUARY 1, 2011 TO BE CORRECT. WE ENJOYED RECEIVING AND READING YOUR REPORT.

A TIP OF THE GREEN EYE SHADE TO THOSE WHO LISTEN WITH VINTAGE GEAR, AND OUR THANKS FOR TAKING THE TIME TO SEND YOUR REPORT.

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426 KC. FREQ YOU COPIED USES A HENRY TRANSMITTER AT 5 KW INTO A MARCONI T ANTENNA.

73 ES ZUT FM THE KSM CREW DE PS

www.radiomarine.org
Marine Coast Station KSM
Maritime Radio Historical Society of America
Paul Shinn
Maintenance

QSL for Historical Station KSM *(Courtesy of Tom Humes, AZ)*

❖ Mailbag

Jacques d'Avignon, VE3VIA (ON) passed along word that the BBC's service at 198 kHz is now using its last pair of final amplifier tubes (valves) and will cease operation when these parts fail. Full details are available at the URL: **http://tinyurl.com/6eg9en5.**

Jay Laster, KE5ZYO (TX), writes: "I wanted to pass some info regarding the decommissioning of two NDBs here in the Dallas-Ft. Worth area. Lancaster Airport southeast of Dallas took their NDB (LNC 239 kHz) out of service this past May. I verified this information with airport operations via phone call this past June. Also, Dallas Executive Airport (Formerly Redbird) decommissioned their NDB (RDB 287 kHz) sometime this spring. Airport operations and the tower were unable to give me the exact date. I am in the process of verifying the status of other NDBs in the north Texas area and will forward my results to you when I have completed my survey. Hope this information is of help.

Tom Humes, KF7ANQ (AZ), reports success in his quest to hear and confirm historical maritime station KSM (CA) on 426 kHz. He received the QSL acknowledgment shown below. It indicates reception on October 23rd 2011 from the 5 kW Henry transmitter at KSM. Congratulations, Tom, and thanks for sharing your QSL!

❖ Loggings

The loggings on the previous page are courtesy of Bill Smith (MA), and Richard Palmer (MO).

Your notes, loggings, QSLs and station photos are always welcome at *Below 500 kHz*. You can reach me by email using the address in the masthead, or by regular mail at Monitoring Times, 7540 Hwy. 64 West, Brasstown, NC 28902.

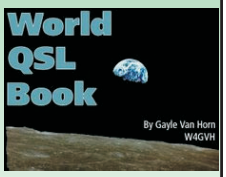
73, and best LW DX!

NOW AVAILABLE

Radio hobbyists interested in receiving and identifying radio stations in the HF/VHF/UHF radio spectrums now have a new whopping 1414 page CD-ROM publication to aid them.

International Callsign Handbook is a concise world directory of various types of radio station identifications covering the military, government, maritime, aeronautical, and fixed radio stations on CD-ROM. Thousands of callsigns and other types of identifiers have been collected from our own personal log book, official sources and dedicated hobbyists who contributed their material.

World QSL Book - Radio hobbyists interested in receiving verifications from radio station now have a new CD-ROM publication to aid them in the art of QSLing. This 528-page eBook covers every aspect of collecting QSL cards and other acknowledgments from stations heard in the HF spectrum.



"I'm impressed. This is a comprehensive collection of worldwide radio identifiers likely (and even some less likely) to be heard on the air. Over the years the Van Horns have earned the well-deserved respect of the monitoring community. Accurately assembling a collection like this is a mammoth undertaking. Congratulations on a job well done."
Bob Grove - December 2008 What's New Column, Monitoring Times magazine

Both books may be ordered directly from Teak Publishing via email at teakpub@brmemc.net or via our two main dealers, Grove Enterprises, www.grove-ent.com, and Universal Radio, www.universal-radio.com.

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RADIO RESTORATIONS

BRINGING OLD RADIOS BACK TO LIFE

Marc Ellis, N9EWJ
marcellis@monitoringtimes.com

Military Telephone Instruments

If you are old enough, as I am, to have been around when great hordes of World War II military surplus appeared on the retail market, you might have found yourself wondering about some of the exotic looking radio and telephone reproducers that were being offered. A lot of this material is still around, and I'm sure that even our younger readers might occasionally be scratching their heads over some of the equipment.

A few years ago, a copy of *The Bell Laboratories Record* for June 1945 came into my hands. In it was an article by J.R. Erickson titled "Military Telephone Instruments." The article explained most of these instruments in such a lucid manner and with such excellent graphics, that I put it aside to share someday with our readers. Right now it seems as if that time has come.

We not only have an unusually tight deadline for this issue, but I have to get ready for an out-of town trip. So rather than taking the time to continue working on our Meissner project – which I will pick up again with the February issue, I'm sitting down to summarize the material in this excellent article.

Headsets

Let's start with one World War II radio reproducer whose use is obvious: the headset many of us know as the HS-23 (Figure 1). But while its use is obvious, its electrical design is not. The graphs of Figure 2 provide an explanation. In all cases, the audio frequency being reproduced in cycles per second (or Hertz as we call it today) is plotted versus receiver output in decibels.

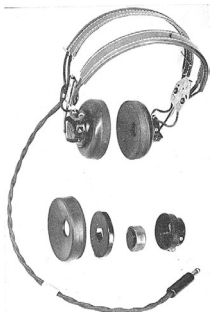

Fig. 1. The HS-23 headset had a flat response, permitting it to be operated well above the noise level without causing pain to the wearer.

Curve H-A-H' represents the threshold of hearing – or the lowest output which we can hear – at various frequencies. The curve S-S' represents the extremely high noise levels typical of World War II combat. Curve F-B-F' represents the level at which we experience pain at various frequencies.

Curve 1 represents the frequency response of the armed services headset in typical use at the beginning of the war. Note that this headset has a very sharp resonant peak at 1000 cycles. The smaller peak seen at the higher frequency is caused by the geometry of the receiver cap. Notice that even if the receiver output is increased up to the point that would cause pain, only a small band of frequencies would be audible above the noise level. Speech would be largely unintelligible.

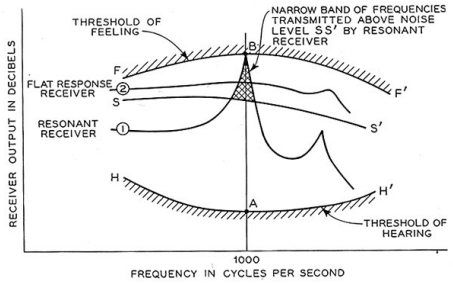

Fig. 2. Curve 1 shows frequency response of pre World War II headset. Note that the steep resonant peak allows only a narrow frequency band to be reproduced above the noise level (S-S') before the pain threshold (F-B-F') was reached. Curve 2 shows the flat frequency response of the HS-23, which solves this problem (see text).

The solution lay in a headset redesign resulting in the HS-23, which has a flat frequency response as shown by curve 2. Now headset output could be advanced well above the noise level while still reproducing a wide range of frequencies – preserving intelligible sound. The headset was also equipped with soft rubber earpads, which were very helpful in shutting out noise.

The HS-23 had an impedance of about 4000 ohms. Not covered in this Bell Labs article was the later introduction of a 600-ohm version, the HS33. That version looked very similar to the HS-23, but its earphone units were type ANB-H-1 instead of type R-14 as used in the earlier headset. As another distinguishing factor, the HS-23 headset had a black PL-54 plug while the HS-33 was equipped with a red PL-354 plug. A matching transformer was available to convert the HS-33 for higher impedance applications as necessary.

These headsets were used in all applications not requiring the wearing of protective helmets. However, the reproducing units alone, without the headband, were also installed in the helmets worn by aviators. An entirely different design was developed to be worn under the steel helmets worn by combat troops.

This headset (Figure 3) had soft rubber earplugs and a wire headband that could be bent to fit the user's head. It had a flat response similar to that of the HS-23. The reproducing units of this headset were, of necessity, low impedance, because only a limited amount of wire could be wound on their tiny pole pieces. Therefore, a matching transformer was built into the cord to convert the phones to higher impedance.

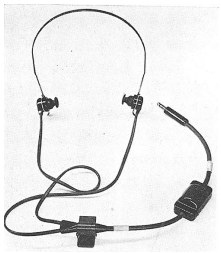

Fig. 3. Designed to be worn under a helmet, this headset had tiny reproducers and soft rubber earplugs. The wire headband could be bent to fit the wearer's head.

Microphones

Microphones had to be designed to deal with a slightly different problem – how to block or reduce ambient noise while accepting speech. One method of blocking the noise is shown in the mics of Figure 4. At left, the transmitter unit is installed in a shield that could be strapped around the user's nose and mouth. Similarly, as at right, the mic unit could be integrated in the design of an aviator's oxygen mask. These mics were supplied either as granular carbon or magnetic types.

The throat mic (Figure 5) blocked noise in a slightly different manner. Two carbon-type transmitter units were mounted on a strap that, worn high on the neck, pressed a transmitter against each side of the throat. This arrangement favored sound vibrations from the throat over noise vibrations in the air.

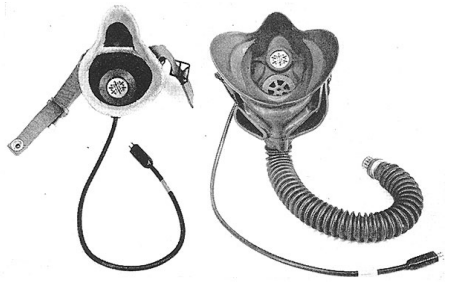

Fig. 4. At left, a carbon mic unit is installed in a noise reducing shield that was strapped over the user's nose and mouth. The same effect could be obtained (at right) by building the mic into an aviator's oxygen mask.

The result was a fair degree of noise sup-

Fig. 5. Here, reduction of external noise is accomplished by fastening two carbon mic units to a strap fastened tightly high on the user's neck. Reproduction of this throat mic was less than perfect, lacking high frequencies.

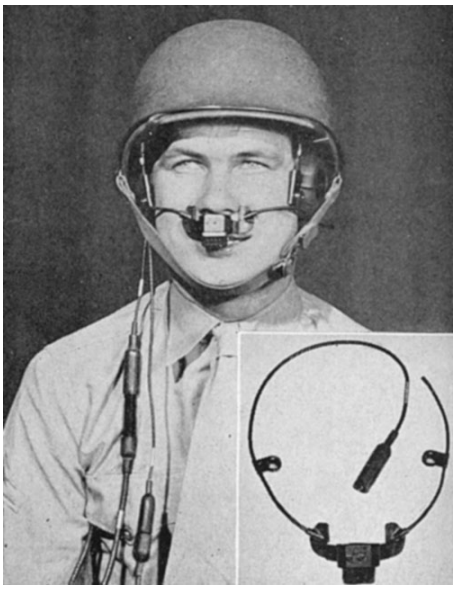

Fig. 6. The odd looking lip mic reproduced a wider frequency range than the throat mic, and used a simple, but ingenious design for minimizing noise pickup (see Fig. 7).

pression, but speech was muffled because the high frequency vibrations from the oral and nasal passages were not being picked up. This problem was avoided by the design of the ingeniously simple, but very odd looking, lip microphone (Figure 6). The electronic design of this mic was not discussed in "Military Telephone Instruments," but the acoustic design is shown in Figure 7.

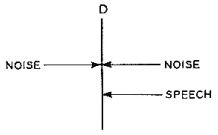

Fig. 7. In the lip mic, noise impinges equally on both sides of pickup diaphragm "D," thereby cancelling itself out. However, speech sounds fall mainly on one side of the diaphragm and are transmitted.

The microphone responds to the vibrations of a diaphragm that is open to the air on both sides. It is attached to a harness that holds the instrument very close to the wearer's lips. Ambient noise reaches the diaphragm from both sides at the same intensity and phase and thereby cancels itself out. But because the mic is positioned so close to the lips, the bulk of the speech vibrations impact the diaphragm from just one side, and are not cancelled out.

This instrument works only if maintained in a position very close to the lips. Otherwise, speech would be likely to impact on the diaphragm from both sides and would not be favored over the ambient noise.

❖ Sound Powered Phones

Sound powered phones (Figure 8) have had a number of interesting applications in the military. As the name implies, these phones require no external power. The voice signal alone generates the power necessary for transmission.

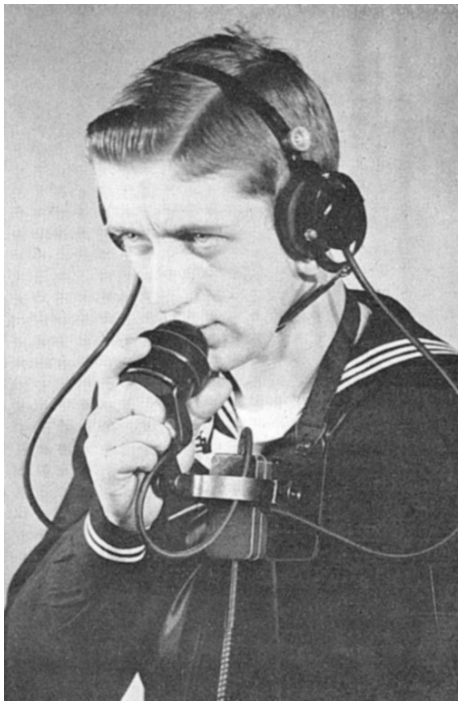

Fig. 8. In marine applications, sound powered phones replaced speaking tubes for emergency communications. In military applications, the phones replaced battery powered units in Arctic and tropical climates (see text).

Sounds in the microphone vibrate a winding positioned in a concentrated magnetic field – generating electrical currents in the winding proportional to the sound vibrations. The receiver is of very similar design, with the varying electric currents in its coil, also positioned in a strong magnetic field, causing vibrations that are transmitted to an attached diaphragm.

Generally, military field phones are powered by dry cells. But in extreme temperatures, such as in the Arctic or the tropics, dry cells have a very short life. Hence the advantages of sound powered phones come into play. Operating over field wire in good condition, such phones could communicate for eight to ten miles.

Aboard ship, sound powered circuits provided emergency communications formerly supplied by speaking tubes. The latter ran from one end of the ship to the other, compromising the integrity of the bulkheads they pierced and picking up interference as they passed through noisy locations such as engine rooms.

Sound powered phones were manufactured in various configurations such as the head and chest set shown in Figure 8, or the more familiar handset.

❖ Loudspeakers

Loudspeakers were used throughout ships for the purpose of issuing orders. Figure 9 shows units used in small compartments and in larger

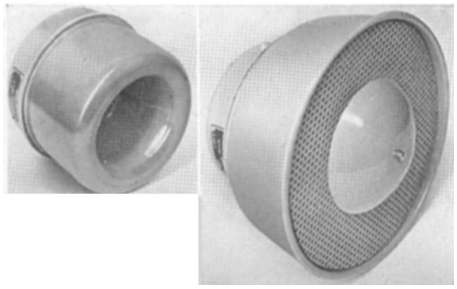

Fig. 9. At left, low range loudspeaker used in smaller ship compartments; at right, medium range unit used in larger compartments.

compartments or some deck locations. Another unit (not illustrated), called the "bull horn," was used on the flight decks of aircraft carriers. All speakers used the same basic reproducer unit (the "bull" horn used multiple units), and were designed to be operated above the noise level expected at each location.

❖ From the Readers

Joseph Erickson (Cadillac, MI), responding to my problem with buzz pickup during the recent BC-1206 project, tells how he reduced noise in his receivers. Switching to a 3-wire a.c. cord for his power supply, he bonded the ground lead to the receiver chassis. This drastically reduced the buzz, which he believes had been caused by the high impedance of the antenna input. Joseph has several BC-1206s, including an odd ac-powered variant, the Setchell Carlson 512.

The buzz saw noise that plagued me reminded **Victor, N4VIC**, (Georgia) of some interference generated from a printer power supply in his home. It was there even with the power turned off. He suggests that I get completely away from civilization to test it! An intriguing but, right now, impractical suggestion. However, I do plan to run more tests a little later on this year (It's near the end of October as I write), when winter conditions should reduce general noise levels.

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ANTENNA TOPICS

BUYING, BUILDING AND UNDERSTANDING ANTENNAS

Kent Britain, WA5VJB
kentbritain@monitoringtimes.com

Antennas out of Wood, Ink, and Plastic

This month we'll cover two topics. First is a new way of making antennas using the same technology that prints logos on T-shirts – silk screening. Next will be a family of 460 MHz antennas that are easy to make and can really boost the range of your 460 MHz scanner or FRS radio

❖ Silk-Screened Antennas

In Photo A we have part of a VHF/UHF TV antenna made by printing conduction ink on a large sheet of plastic. The gray area between the loops is a fine mesh crosshatch of lines too small for the camera to pick up. In Photo B you see two more of these new antennas made by printing a conductive ink on a plastic base. The top antenna is a UHF-only TV antenna; the bottom one has both UHF and VHF elements. At the base of the longer and folded back antenna elements, you can see they even have a loading coil for the TV VHF Hi channels 7 through 13 elements in the ink pattern.

One advantage to this printing technique is that very complex antenna patterns can be easily printed to produce multiband antennas, the same way they print your school mascot on a T-Shirt.

There are a few disadvantages: First, to get the ink conductive enough for an antenna, the ink has to be about 50-60% silver dust. Work has been done with copper and nickel powders, but all the manufacturers seem to end up using silver. Last week silver futures were going for $42/oz, so it's not an inexpensive process.

Figure 1 - Metal Particles in the Ink

The next problem is the resistivity of the 'wires' formed this way. In Figure A you see a representation of how the silver particles arrange themselves in the ink matrix as it hardens. The particles are just barely touching each other. So the size of the actual electrical contact area is quite small compared to a solid wire, and the electrical path is not straight. On average the printed conductors measured about 4 Ohms per foot. So a 9 foot long CB antenna would be a nearly 40 Ohm resistor. Darn close to a 50 Ohm dummy load!

I actually ran into a printed CB antenna recently. Oh they bragged about how flat its SWR was. Well, in Photo D I have an 'Antenna' with a similar broad SWR. I'm afraid their super duper CB antenna has more in common with that dummy load than it did a real antenna.

Another problem with resistors is that they get hot when you run some real power though them. The RF power of a modest ham rig was run into that printed CB antenna, and it melted! I sent a message to the antenna company, but never got feedback from their engineers. But, oh those marketing lads in the front office, they said that with the plastic base they used with the antenna, it would only melt, not actually catch fire. This was a safety feature! Let's just say you don't want to run more than a watt or so into one of these printed ink antennas.

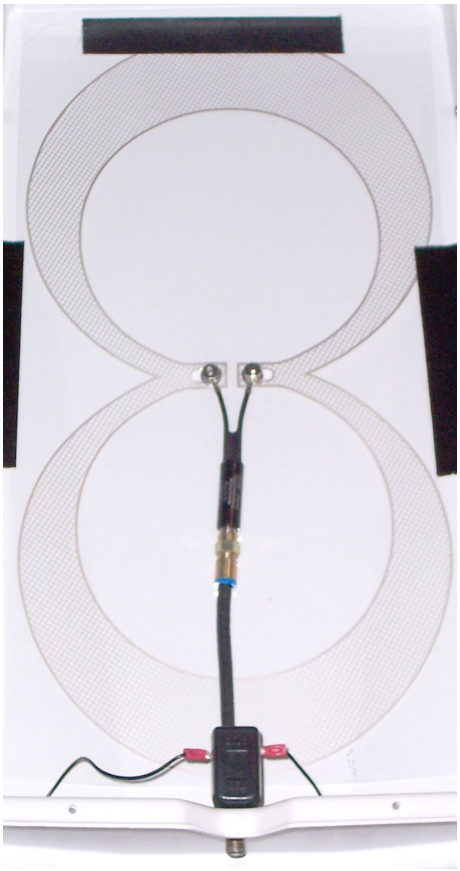

Photo A - Printed Ink TV Antenna

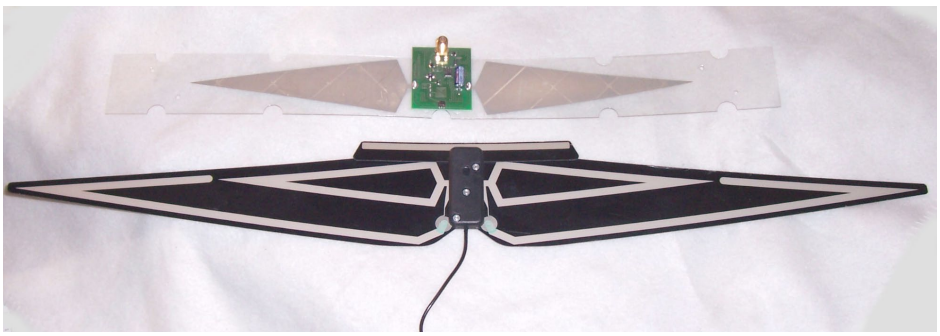

Photo B - Two smaller Printed Ink TV Antennas

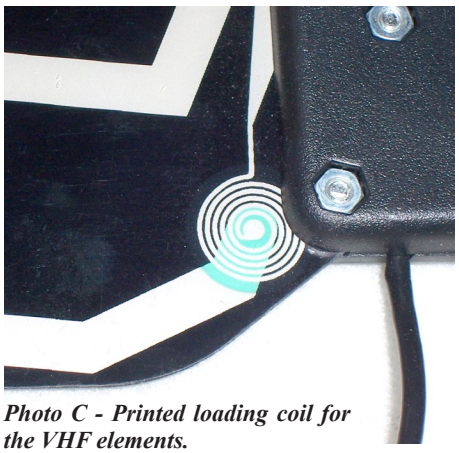

Photo C - Printed loading coil for the VHF elements.

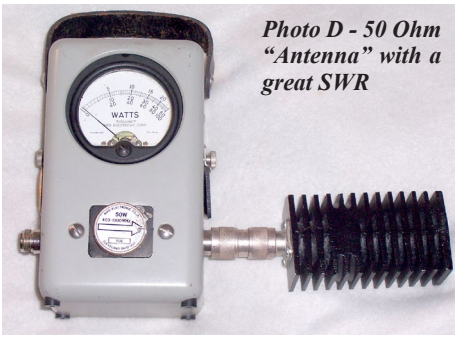

Photo D - 50 Ohm "Antenna" with a great SWR

❖ 460 MHz Yagi

In September 2011, we built a family of 300 MHz antennas. This time we'll construct a family of 460 MHz Yagis like the one in Photo E. There are a lot of variables in the UHF path

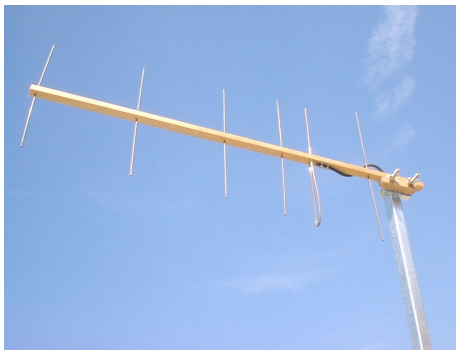

Photo E - 460 MHz Beam antenna

loss equation, but one of the beams will approximately double the distance your scanner will be able to pull in a 460 MHz service.

I am not a fan of using plastic water pipe as the boom for this antenna; it tends to melt when you solder the coax to the driven element. But if you solder the coax first, then attach the driven element to the boom, you can get away with it. I like to use wood for the boom.

Built of just wood and wire, how long can they last? When mounted outside, these antennas last 2 or 3 years. But a coat of house paint, wood preservative – or better yet, spar varnish – greatly extends their life. In all cases, painted or not, you need to take pains to seal the end of the coax to keep water out of the coax.

Many years ago a local ham group started retransmitting the area's Doppler radar on 427 MHz. This worked out quite well: you just told your TV set to look at Cable Channel 57, but connected to an antenna instead of cable. I mounted a 427 MHz version on this same antenna in the attic. Mounting the antenna in the attic keeps it out of the weather. It's a bit dusty, but after nearly 20 years it still works fine.

Back to our construction project. 1/2" x 3/4" or 3/4" square wood seems to work best for this project. The element can be any metal rod about 1/8th inch or about 3mm in diameter. Hobby tubing, #10 and #12 bare copper wire, ground rod wire, electric fence wire and welding rod have all been used.

TABLE - 50 OHM VERSIONS OF THE 460 MHZ BEAM

Element Lengths and Positions relative to the Reflector
All dimensions in Inches

Elements	Reflector	Driven Element	D1	D2	D3	D4	D5	D6
4 Element								
Length	12.5	Fig 2	11.2	10.0				
Position	0	4.7	7.5	9.5				
6 Element								
Length	12.5	Fig 2	11.5	11.0	11.0	10.0		
Position	0	2.5	5.3	10.5	16.5	22.74		
8 Element								
Length	12.5	Fig 2	11.5	11.0	11.0	11.0	11.0	10.0
Position	0	2.4	5.5	10.5	16.5	22.75	28.5	33.5

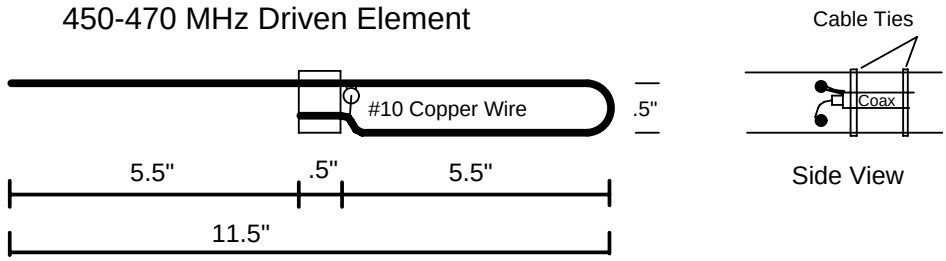

Figure 2 - Driven element for all versions

Once for grins and giggles I made one out of clear plastic tubes full of salt water and entered it in an antenna contest! Not recommended, but it did work .... A little bit.

For the driven element I suggest the bare copper wire or one of the bronze welding rods; they are much easier to work with when you are soldering the coax to the driven element. If you are going with welding rod, the other elements can be aluminum welding rod; it's a bit cheaper than the bronze welding rod, but they both work. Just form the driven element as in Figure 2. The same driven element is used with all versions of the 460 MHz Yagi.

A drop of your favorite glue will help hold the elements in place.

❖ Coax

You can use most any 50 Ohm coax: RG-58, RG-8X, RG-8 or even RG-213 or 214. Of course, the large coax is more difficult to work with but will have less loss. The coax is simply soldered directly to the driven element.

The coax shield goes to the long top section of the driven element, and the coax center conductor goes near the bottom tip of the J element as shown in Photo F.

Can't find any 50 Ohm coax, but you have a long length of 72 Ohm RG-6 left over from a satellite TV dish? Go ahead and use it. There is a little impedance mismatch, or SWR from using the 72 Ohm coax, but the lower loss of RG-6 easily makes up for this mismatch.

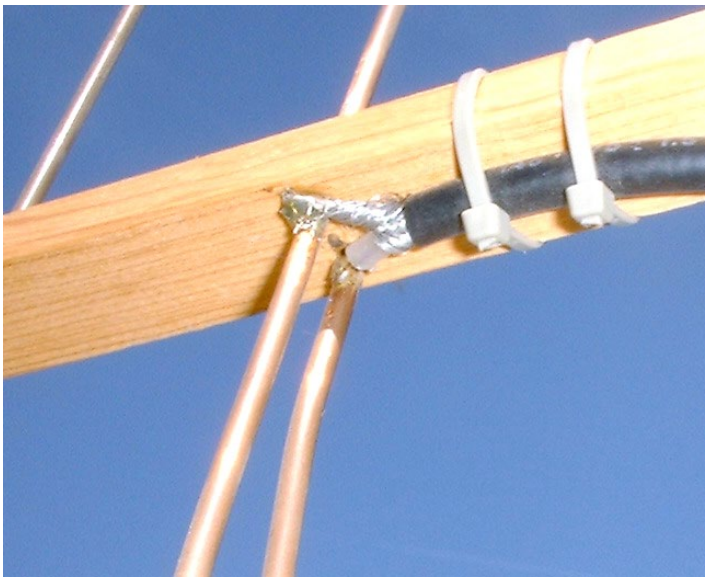

Photo F - Close up of the coax attachment

❖ Using a beam antenna with a scanner

The Yagi is not 100% directional. Let's say your old ground plane lets you hear stations 10 miles in any direction. Going to this Yagi would let you hear stations about 20 miles away when pointed in its preferred direction. Off the back and sides, you can still hear stations 5-8 miles away.

One park with a hiking trail uses one of these antennas pointed at the farthest part of the park. A scanner monitors the FRS radio channels. Hikers can be along most any part of their hiking trail and the people in the main office can hear a call for help on an FRS radio. So you can pull in that distant police or fire department, yet still hear the local UHF services.

❖ Portable operation

One backpacker has been using these types of antenna for years. He says he just wads them up and stuffs them in his backpack. When he gets to his remote location, he bends the elements back straight. After about 10 'waddings' he builds a new one.

I am working on a family of similar Yagi antennas for the 800 MHz services, and a family of WiFi antennas. Let me know which one you are more interested in for the next column.

For the amateur radio community, I have a collection of similar ham antennas available as downloads from my website, **www.wa5vjb.com** in the Reference section.

The quickest way to contact me is at *kentbritain@monitoringtimes.com* or snail mail to the QRZ.COM address for WA5VJB. Spring will soon be in the air: Time to start planning those new antennas you want to put up!

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How Do Computer Chips Make Radios Work?

Ever wondered just how a modern radio transceiver works? You know they have microprocessors, which are basically just simple computers. But what goes on inside that rig when you turn the tuning knob? …Adjust the audio level? …Push a button?

In the old days, radios did not include microprocessors. When you tuned the frequency, you were actually adjusting the capacitor or the inductor in one or more tuned circuits. That adjustment was also connected to a rather complicated arrangement of gears, pulleys and dial cords.

When rigs started showing up with digital displays, those displays were implemented by actually measuring a frequency with an internal frequency counter, not by generating a known frequency and simply displaying it. Switches were often forced to control multiple circuits at the same time, leading to very complicated (and ingenious!) wiring harnesses.

Old schematics are rife with drawings of ganged wafer switches, each wafer handling one section of the circuit and often having to withstand high voltages and currents. For example, when you selected the 20 meter band, the receiver circuitry had to be switched to one set of tuned circuits, and the transmitter's driver and final amplifier had to each be switched to still different tuned circuits.

Once the microprocessor came onto the scene – starting with the Intel 4004 in 1971, the 8008 in 1972, and the 8080 in 1974 – it became possible to do a lot of things in software that were formerly done in hardware, and it also became possible to simply feed low voltage switch states, tuning knob position, and other data into the processor for analysis. The processor could then decide what to do with it and generate programming information to other parts of the radio – the display, the oscillator frequency, lights and so on. Radios suddenly got much simpler and lighter in weight!

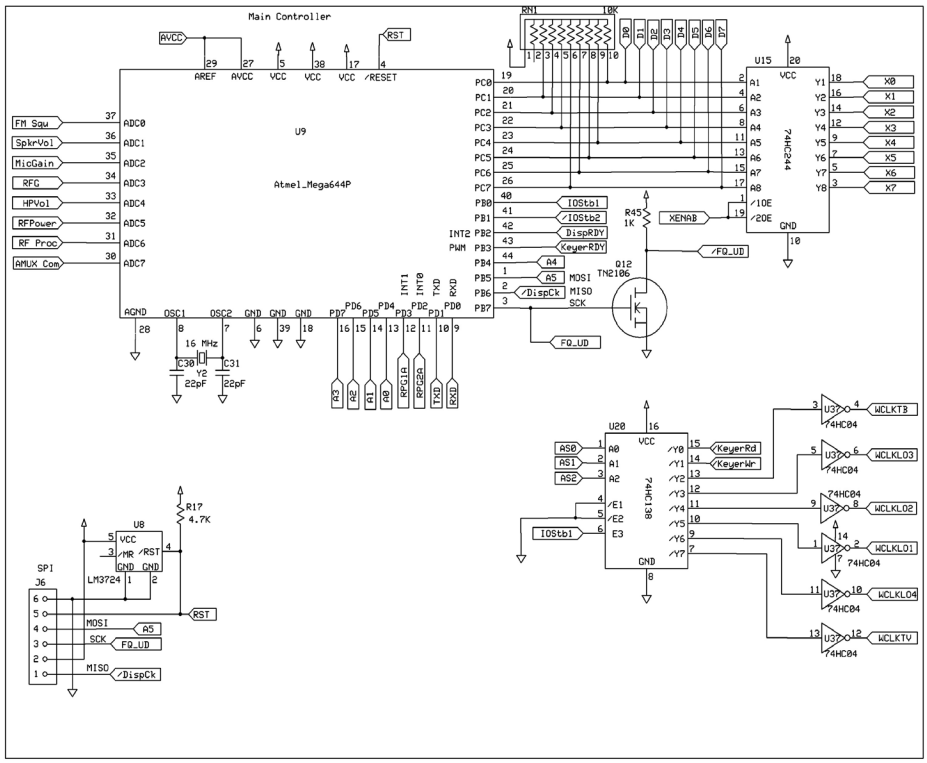

Figure 2. Main controller schematic diagram for the DZKit Sienna transceiver. Analog voltages are fed into an INPUT PORT (ADC0-ADC7) on the left side of the microcontroller. An 8-bit bi-directional data bus is used to send and receive data to the display, LEDs, switches and oscillators, and the "X Bus" on the far right sends data to the transmitter, amplifier, antenna tuner and receiver (and is only active when something changes, to avoid having high speed data causing RFI inside the radio). The circuit at the lower right generates read/write pulses to another microprocessor (used for the keyer and microphone audio sampling) that shares the main data bus, and also generates write pulses to send frequency information to the direct-digital-synthesis oscillators. The circuit on the lower left generates a reset pulse when power is first applied to make sure the microcontroller starts up correctly, and also connects to an "SPI" bus to allow the read-only memory inside the processor to be programmed.

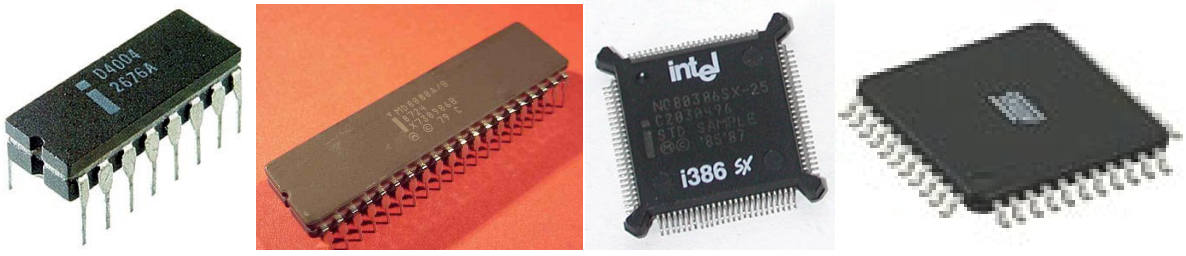

Figure 1. Evolution of the microprocessor. The Intel 4004 (left) was the first microprocessor. The Intel 8080 was the first to really gain popular acceptance, used in instruments and early computers alike. The Intel 386 was the one of a long line of microprocessors used in IBM PC style computers. It evolved into the 486, Pentium, Celeron, Core II Duo and others. A number of support chips are used with microprocessors to create a complete computer (including memory, I/O bus interfaces, etc.). On the right is a modern computer on a chip – the Atmel Mega644P, which has 64K bytes of program memory, 4K of random access memory and 2K of Electrically Eraseable Programmable Read Only Memory. It can hold about 35,000 instructions. It also contains four 8-bit I/O ports, several internal counter/timers, a multiplexed 8-channel 10-bit A/D converter, RS-232 port, PWM output, and more. Any pin can be used to generate interrupts. It's an excellent choice for instrument control applications.

Figure 1 shows the evolution of the microprocessor from the Intel 4004 to a modern Atmel Mega644P.

❖ A "Simple" Application

Let's look at a portion of the microcontroller design from the DZKit Sienna transceiver, shown in Figure 2. In this circuit, momentary switches are fed into an *input port* (via an 8-bit buffer IC) and then to a *bi-directional port* (D0-D7, used for input in this case). LEDs are connected to an *output port* (via an 8-bit flip-flop IC) that is also connected to the bi-directional port (used as an output). This same *data bus* is connected to a display that uses ASCII data, and to *direct digital synthesis* (DDS) chips, which are basically oscillators (two for the transmitter and four for the receiver).

Tuning devices, called *rotary pulse generators* (RPGs) are connected to an *interrupt port,* so that when the tuning knob is turned, the processor gets an interrupt, stops whatever it was doing, and goes somewhere else in the program to process data from the RPG.

Several voltages, such as the wipers of the various potentiometers on the front panel, are connected to an *Analog to Digital Converter* (A/D, or ADC) port. An A/D Converter is basically just a simple voltmeter.

The data bus is also buffered by means of another 8-bit buffer IC and used to send data to the transmitter, amplifier, antenna tuner and receiver (and is only active when something changes, to avoid having high speed data causing RFI inside the radio).

The microcontroller has a crystal connected to it to make it execute software commands at a particular rate. We are using a 16 MHz crystal, and the microcontroller thus has a "clock cycle" of 1/16,000,000 seconds, or 62.5 nanoseconds. Microcontrollers typically execute instructions in 1 to 3 clock cycles, so it doesn't take long to do things.

Microcontrollers have several *registers*, which are just dedicated storage locations used to move data around. For example, putting the value 96 into a memory location in the Atmel Mega644P microcontroller looks like this:

```
LDI R16,96 ; Put the value 96 into register 16 (uses 1 clock cycle, or 62.5 ns)
STS memory_location_1,R16 ; Store the value into memory (uses 2 clock cycles, or 125 ns)
```

(Semicolons show comments on the same line as the actual instruction.) Total execution time: 187.5 nanoseconds.

The processor could do over 5 million of these in one second. (Compare that to the 4004 microprocessor, which could execute about 50,000 of the above statements per second.) If you think about how slow Morse code is you can see that the processor has lots of time to generate dits and dahs. 60 words per minute, for example, has dot lengths of 20ms. The processor has time to do between 2.7 and 8 million instructions between edges of a dot! That gives it plenty of time to monitor switches, turn on LEDs, handle the tuning knob, and so on.

The simple instructions shown above are in a computer language called *Assembly Language*. All other computer languages that you may have heard of, such as Fortran, Pascal, C, C++ and BASIC, are converted to assembly language by a *compiler*.

Figure 3. Typical Programming Tasks for a Simple Radio

INITIALIZATION (HAPPENS AT POWER ON BEFORE ANYTHING ELSE)
Send starting state to receiver and transmitter
Set up internal counter to generate interrupts every 1 ms
Set up A/D converter (how fast, number of channels, etc.) to make voltage measurements
Output starting frequency and other data to display

1 MS INTERRUPT	A/D INTERRUPT	RPG INTERRUPT	MAIN (IDLE LOOP)
Read switches	Read A/D result	Determine direction	Program DDS
Turn LEDs on/off	Store A/D reading	Add or subtract to frequency	Send setup to Rx, Tx
Save switch states	Start another A/D	Return to main	Output freq. to display
Read key data	Return to main		Set audio volume
Output keying signal			Set mic gain
Return to main			Set keyer pitch/volume
			Turn Tx on or off

❖ Programming

No matter what language is used, there really are only a few basic concepts to computer programming:

1. Getting data in and out of memory
2. Writing to output ports or reading data from input ports
3. Comparing values with other values
4. Jumping to some other section of the program based on the results of a comparison
5. Performing simple math, such as addition, subtraction, multiplication and division
6. Doing logical operations (e.g., AND, OR, NOT)
7. Jumping to and then returning from sections of the program where a common thing needs to be done many times (say, converting a binary number into ASCII text)
8. Processing things that happen at regular or intermittent intervals (e.g., doing something every 1 millisecond, or reacting to someone turning the RPG)

A typical way to write a computer program that makes a radio work is as follows:

1. Make an "interrupt routine" that executes every 1 millisecond. This is slow enough to allow thousands of other instructions to be executed while still responding quickly to the user pushing a button and doing other things that require timing (such as waiting 10 milliseconds for a relay to open or close). An internal feature of the microcontroller is a "timer/counter" that can cause this to happen at any interval we want.
2. Make another interrupt routine that gets data from the microcontroller's internal A/D converter so that the measured voltages can be stored in memory and used by other sections of the program.
3. Make another interrupt routine that is executed when the tuning knob (the RPG) is turning.
4. Make a *main routine*, also called the *Idle Loop*, that tells the receiver and transmitter what state to be in, such as AM, FM, CW, USB, LSB, and what filters are selected, and that decides what should go into the display. These are not time-critical, so they can be done at our leisure.

Let's look at these sections of code that all execute at different times. See Figure 3.

Remember, each one of these sections of program executes independently from the others. When one section is running, the others are not. Pretty simple, eh? When you group the tasks that have to be done this way, the overall task becomes much more manageable. What seems like a lot of work suddenly isn't so daunting. Of course a real radio has to do a lot more than this, but the concept is not any more complicated.

❖ Getting Started

In the world of programming, it is common when one is just getting started to write a program to print the words "Hello World." When programmers begin writing a program like the one shown above to make a radio work, they generally do the equivalent: they make a light blink. A simple task like this tells the programmer several important things: the method of creating the program and downloading it into the microcontroller is working; the microcontroller can execute the program (the voltages are right, the clock oscillator is running); writing to an output port works; the timing mechanism is understood (the interrupts work, the timer works).

Once these startup tasks are done, the rest is just a "simple" matter of writing the rest of the code.

It seems like there's more and more functionality being added with every new rig. One wonders how we survived the '60s with rigs that had only a tenth of the capabilities of a modern radio! The microprocessor made all this possible, but it has added a complexity that translates into software bugs and more work on the part of the user, who must be able to become proficient at using all the features. I heard one ham say, "If I push the wrong button on a modern high-end radio, I may never figure out how to get back to where I was!"

You can see the dilemma faced by a radio designer today. How do you organize the various functions into a front panel that gives you the ability to control everything but that is also easy to use? This gets into a field called "ergonomics." The smaller the radio, the harder it is to achieve good ergonomics. Many functions that would have their own buttons or knobs on a larger radio end up being placed in menus. If the display and buttons are small enough, figuring out how to change settings can be a formidable task.

But, the price tag that comes with a big front panel is, well, BIG! Knobs, switches, RPGs, meters, displays, jacks and injection molded plastic panels are not cheap. This is one reason it's so hard to make a $300 HF transceiver! When we eliminate the things that make the radio easy to use, it is less expensive. But, I doubt anyone really wants to return to the days before microprocessors just to keep the cost down.

One way to keep the cost down is to use no front panel, such as is done in some Software Defined Radios, where a PC is used to emulate a front panel. This is fine for people who are comfortable using a PC, but many prefer a real front panel. Whether the panel is real or virtual, internally the radio does the same thing.

Editor's note: Brian Wood W0DZ is the designer and builder of DZ Kit's Sienna transceiver (www.dzkit.com)

Satlink Satellite Finder: FTA'ers Friend

By Mario Filippi, N2HUN

With the loss of so many of the great shortwave stations over the past decade or so, free-to-air (FTA) satellite reception has filled the void by allowing me to not only hear, but also see what is going on in the international scene around the globe.

To that purpose, a Satlink WS-6906 satellite finder – purchased via the Internet from Harmony FTA (**www.harmonyFTA.com**) – has recently been added to my armamentarium of FTA satellite equipment, priced at $235 plus shipping.

Satlink WS-6906, in the "On" position, with Power and 18V LEDs on. LCD display can be turned on and off using F1 key. Case and strap are useful when using outdoors to prevent scratching, and strap is used to hang unit around neck and prop against chest for easier viewing. Note that the carry case top flap can be folded over for easier viewing in bright light.

The Satlink WS-6906 is a portable, handheld device for aligning a satellite dish; it covers both C and Ku band satellites, contains an LCD, satellite receiver, and signal monitor all in one 6"x4"x2" package.

FTA hobbyists have many different choices of meters, satellite finders, etc., to align their dishes, but having an FTA receiver and viewing screen right at the point of alignment is the best approach. In the past, my method of properly aiming an FTA dish was to schlep a TV set, satellite receiver, satellite meter, an array of cables, connectors, and a power source out to the dish. It was cumbersome, to say the least, but with the purchase of this new Satlink WS-6906 meter, the task is a quantum leap improvement over the old method.

❖ Satlink Finder Features

The WS-6906, powered by rechargeable batteries (included), comes with a charger wall wart, audio/visual cable, automobile charging cable, carrying case, strap, double female F connector, and basic instruction sheet. After giving it a five hour charge, I put it through its paces

First off, the instructions are very basic and the operator is left on his own to figure out all the plentiful, detailed bells and whistles offered by this unit. The Menu options allow you to select what satellite you desire, and the unit is pre-programmed with most of the popular C and Ku band birds. Satellites and transponders can be deleted, edited, or added at will.

In a nutshell, the WS-6906 offers pretty much all the features of most full-size FTA receivers, and can itself be used as an FTA receiver, since the included A/V cable facilitates attachment to a TV set.

❖ Aiming at the Birds

Initially the unit was used to aim a 90 cm stationary Ku band satellite dish at Hispasat (30W). See Photo 2.

Fortec 90cm Ku dish, Invacom Quad Polar Legacy LNB mounted on tripod with leveling device on mast. Attached to the LNB are the WS-6906 and Channel Master Model CM-1007A Signal Level Meter. Just above the meters is a white picket that has a compass glued to it pointing to magnetic South. I could not remove neighbor's house from picture, hi hi.

In this photo you'll also notice a Channel Master satellite meter attached to the LNB, which is handy to get you into the Clarke Belt. The Satlink WS-6906 was then used, along with its internal signal and % quality meter to fine tune the satellite. A "Lock" LED on the Satlink lets you know when the satellite of choice has been found.

Next, using the meter's Add Channel search feature, it will scan the satellite's channels and save them in memory. Now, the user can view the actual broadcasts, both audio and video. This to me is the definitive proof of a good alignment.

❖ Op's Opinion

In closing, the WS-6906 is, in my experience, an invaluable tool for the FTA hobbyist. It allows one to expeditiously and accurately align a satellite dish with minimal equipment; it can be used as a back-up receiver back in the FTA shack; and it is especially handy for field/mobile/temporary setups. Even those folks who are prohibited from external antennas due to CCR's or space shortage can avail themselves of FTA by simply setting up a dish at some remote location, attaching the Satlink, and maneuvering the Clarke Belt.

Please note that the Fortec satellite dish and LNB were purchased from Sadoun Satellite Sales (**www.Sadoun.com**) via the 'Net, and as mentioned before, the Satlink was purchase from harmonyFTA (**www.harmonyFTA.com**). Both are outstanding firms to deal with, they ship fast, have competitive prices, and have great sales and customer service. As for the Channel Master satellite meter, I cannot recall to memory its purchase source.

Author and his FTA satellite farm with three Ku band dishes. Left to right are: FortecStar 90cm motorized dish for satellites from 72W to 101W, middle is FortecStar 90 cm stationary dish mounted on a pallet pointed toward Hispasat (30W), yours truly, and finally a WS International 100cm motorized dish, for satellites from 15W to 61 W. I was able to optimize all these dishes much faster and easier with the Satlink WS-6906. (Photo by Edith Filippi)

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Home Patrol "*Extreme*" Firmware Update

By Bob Grove, W8JHD

Released just this year, Uniden's HP-1 HomePatrol has established for itself a special place in the VHF/UHF scanner market. Its giant color touch screen is unique to this consumer application and is a giant step in easing programming of sophisticated technologies.

While the HP-1 already includes a U.S. nationwide and Canada-wide frequency database which will self-load for your location, a recently-released firmware update allows a number of useful additional functions to be unleashed.

Let's Take a Look

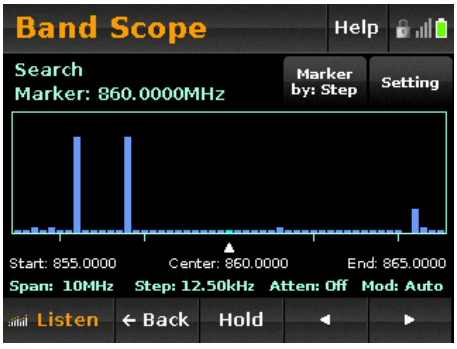
This composite of new updates may only be downloaded from the Uniden website, and they aren't free, but they are under $100 (actually $99.99!).

The download will work on all HomePatrol scanners. You need to provide your serial number so that the key for the download will unlock your particular scanner; the download to your scanner won't work on another.

So what are some of these new features enabled by the *Extreme* firmware?

Band Scope

Probably my favorite new function – since I'm addicted to spectrum analyzers which reveal all the signals at once on a chunk of spectrum – is the band scope. Simply enter a center frequency and the bandwidth on either side (up to 2 MHz wide) that you wish to visually examine for activity. As signals come on the air, the sweep of the screen will show spikes on their respective frequencies.



It's not in real time, but just so long as the span of spectrum isn't too wide, you have a good likelihood of seeing signals as they come and go. A press of a screen key allows you to hold and monitor the contents of any of those signals as they are discovered.

RF Power Plot

It is often useful to reveal the relative strengths of signals across the band. You can use this to determine the best antenna for your application, the best location for that antenna, even for direction finding, assuming you have a directional antenna.

Trunked System Analysis

Extreme provides enormous power for analyzing and filling in database gaps. A system status monitor indicates how well the HomePatrol is receiving and decoding the data on the control channel as well as overall system activity level. Details include channelgrams, radio on/off affiliations, and logging information.

A talk group converter allows you to easily switch formats for group IDs.

Since the Home Patrol allows up to three minutes of audio recording from its received signals, you can review the users audibly to determine which channels may be missing from the preloaded frequencies and fill them in from the chart generated by the analyzer.

The same feature can be used for conventional transmissions as well as trunking.

Activity

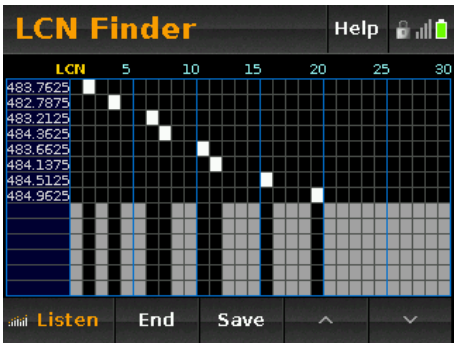
How busy is each of the system frequencies? *Extreme* generates a visual log to show on/off activity of any particular channel frequency. System commands that are sent over the control channel are recorded on the HomePatrol internal SD card.

EDACS/LTR LCN Finder/ Analyzer

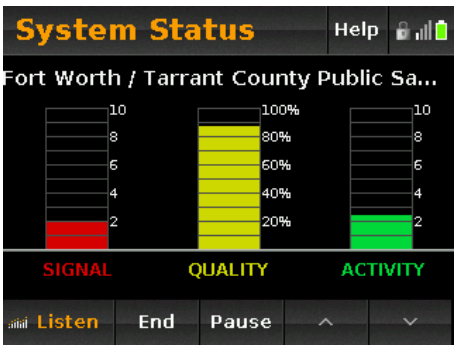
This feature enables you to determine a system frequency and its logical channel number that might not have been included in the database. A visual chart is generated to show trunking channel activity with on/off times.

And More Features

One of the chief complaints from initial HomePatrol users was the difficulty of, or even inability to customize the autoloaded files. Now you can create and edit your own files. With *Extreme*, you have the capability of full manual programming to create new systems, edit existing systems, and edit your favorites list.



New channel options have been added as well, like time-selectable per-channel delay, audio alert for specific channel activity, adding channels to existing trunked systems, and performing user-selectable geographical searches.



Extreme also allows you to export Google-map points of interest (KML files) and share them, as well as create multiple favorites lists to expand coverage areas.

You can also identify unknown signals between manually-entered frequencies by recording audio and DCS/CTCSS subtones.

The Bottom Line

Sales figures and customer comments show the remarkable success of the new HomePatrol, and now Uniden has provided a means of expanding even further the features of this fine scanner.

While not all of the features will be of interest to all users, certainly the ability to customize files and the ability to see tables and spectrum signal details should have wide appeal.

For your download of this latest software, log in or register at **my.uniden.com**.

MT LOOK BACK

PAR EndFedZ EF-SWL Antenna

By Larry Van Horn, N5FPW

This is a moment of true confession for me. I have to admit that I love using wire antennas for my HF monitoring. And among the many types of wire antennas I really like using the longwire style of antenna. Those who know me best know that I love low prices, simplicity and performance. The random length longwire antennas are very economical, easy to install and provide a lot of bang for the buck, meeting all these parameters.

But, the simple longwire does have one major drawback. Due to the higher impedance at the feed point (random length longwire antennas are end fed), coax is not normally used. Most often you will see longwire antennas fed with single conductor insulated wire to the high impedance input of HF receivers. This can be a problem in noisy RF environments. If we can get that feed point impedance of a longwire down to 50 or 75 ohms, then we can use low loss coax in our installation. By doing so we can reduce – and in some instances even eliminate –man-made noise that is picked up by the feedline. If only someone would develop an inexpensive longwire antenna that can deliver 50 or 75 ohms impedance to the receiver so I can use low loss coax!

Dale Parfitt, W4OP, developed an end fed longwire that can use a 50 or 75 ohm coax feed – the PAR Endfedz EF-SWL antenna.

The EF-SWL is optimally designed for 1-30 MHz reception. The heart of the EF-SWL is the UV resistant ABS matchbox that houses a wideband 9:1 transformer wound on a binocular core. This transformer has external stainless studs on the matchbox that allows the user to configure the primary and secondary grounds for best noise reduction at the receiving location. The antenna's output to the receiver is via a silver/Teflon SO-239 UHF connector that can accept a standard PL-259 coaxial connector. Lead-in coax cable is not provided by the manufacturer and will have to be purchased separately.

The basic configuration out of the box is a radiator that uses 45-feet of virtually-indestructible #14 black polyethylene coated Flex-Weave wire. The wire itself consists of 168 strands of #36 gauge woven copper. This material is very strong, yet can be easily coiled like a rope for portable work.

The radiator also attaches via stainless stud (#3) on the matchbox that allows it to be removed or replaced. You can attach any length of wire you want to the matchbox. This allows you the opportunity to experiment with different lengths for the radiator. If you need a shorter antenna for your particular installation or a longer run if you have the space, the EF-SWL matchbox can accommodate it.

The manual that comes with this unit shows typical radiation patterns for selected frequencies throughout the HF spectrum in the two primary mounting configurations: as a horizontal or sloper end fed longwire. This is a ***receive-only*** antenna.

❖ Antenna Construction-Installation

This antenna has a lot of the same characteristics as the monoband versions of the popular Cushcraft and HyGain half-wave or no-ground vertical antennas. The big difference between the no-ground verticals and this antenna is that the EF-SWL does not need any base radial wires.

My first impression after I opened the box was the quality of the antenna and its individual components – simply superb.

Since the radiator uses polyethylene coated Flex-Weave wire, environmental corrosion problems we normally associate with using uninsulated copper wire will not be an issue. A major failure location in most longwire installations is at the point where the user attaches the antenna's lead-in wire to the uninsulated radiator wire. If care is not taken to properly seal this connection, dissimilar metal corrosion will eventually cause a break where these two wires are connected. Fortunately, that will not be an issue with the EF-SWL, thanks to the polyethylene coated wire used as a radiator. To further protect our outdoor test installation of this antenna we used rubber tape to seal the PL-259 connector to the SO-259 matchbox connection.

Bottom line – once you get this antenna up, Mother Nature will be hard pressed to take it back down through corrosion.

The antenna comes assembled right out of the box, but you do have two decisions to make. The instructions that come with the antenna fully discuss the pros and cons to help you choose the option which will best work at your location.

First, you have several options on how to hang the antenna. Choices range from horizontal, sloper, inverted-L, inverted vee, or even as a vertical.

Next, you have to decide how you are going to configure the ground, and this will vary from installation to installation. We were able to use the factory default configuration – connectors #1 (SO-259 shield) and #2 (ground lead of the antenna side of the 9:1 transformer) shorted. Basically, this leaves the connection to the antenna ungrounded, and you should ground the receiver in the shack.

Even though we did not observe it during our test, this installation may pick up man-made noise. If this is the case, you can also take out the short between connections #1 and #2 and ground one or both of these connections (#2 direct to ground and #1 grounded back to the receiver). This installation works very well in noisy, man-made environments.

Installation of the EF-SWL is very easy to perform. My son Loyd assisted me in installing this antenna and it actually took us longer to get the ladder set up so we could climb on the roof than it did to put the antenna up. We ran our test EF-SWL antenna configured horizontally at 35 feet above ground level and we oriented the axis of the radiator north-south.

❖ How Well Does it Perform?

In a word: fantastic!

We put the EF-SWL head-to-head with some of the antennas on the N5FPW 2-acre antenna farm. We compared the PAR longwire with two102-foot G5RV antennas, two end-fed (insulated wire lead-ins) longwire antennas that were 150 and 250 feet long, a full size Grove Skywire sealed in the roof of my radio shack, and an MFJ amateur radio ten band vertical antenna.

While some of these antennas outperformed the EF-SWL over the entire tuning range we tested (1-30 MHz), there were some nice surprises.

In the AM broadcast band, the G5RV antennas with their 102-foot capture areas had a distinct advantage over both the EF-SWL and the Grove Skywire. We did notice that the PAR antenna seemed to come alive in the upper portions of the AM band when compared to the Skywire as we tuned higher in frequency.

On shortwave frequencies below 10 MHz, the PAR antenna was equal to or in some cases consistently better than our Grove Skywire on signals from selected shortwave stations we used for measurement. One notable exception was around 40 and 15-meters. Since the Skywire is cut for 40-meters, there was a noticeable difference between the two antennas in these two frequency ranges. Above 10 MHz, EF-SWL really shined. Signal levels were comparable on selected shortwave bands to our longer G5RV antennas.

Our final test was a head-to-head comparison of the EF-SWL to our 150 foot north-south end fed longwire. Since both antennas were oriented in the same direction, we felt this test would give us a realistic idea of how good the PAR EF-SWL really was. I must point out that the height above ground for our 150-foot longwire antenna was not optimized, whereas the EF-SWL was.

Consistently across the entire 1-30 MHz tuning range, the EF-SWL delivered a 5dB to 20dB signal over my 150-footer. But the real surprise was how quiet the EF-SWL was. In fact, at one point during the test, my wife Gayle, who helped me with this portion of the testing, questioned if the PAR end fed was even connected to the receiver. It was that quiet!

❖ In Conclusion

If you are looking for a good broadband, passive shortwave wire antenna for use in restricted space (i.e. attic, small city lot, etc), then the Par EF-SWL is your ticket. This antenna is especially ideal for portable operations, since it is compact, easy to install and does not take up a lot of space.

You can purchase the PAR EF-SWL from Grove Enterprises. It sells for $74.95 plus shipping and handling. This review of an "oldie but goodie" is still as valid as when it was originally published in September 2003.

What's NEW

Tell them you saw it in Monitoring Times

Larry Van Horn, New Products Editor

Grundig S450DLX Field Radio

Grundig has released a new portable: the Grundig AM/FM/Shortwave S450 Deluxe Field Radio. This latest Grundig receives all shortwave frequencies and covers all 13 international shortwave broadcast bands, plus domestic AM and FM stations.

Features include a digital display, backlit pushbutton keys, sleep timer, 3 tuning steps (fast/slow/lock), quick tune button, tone controls, five inch full range speaker, 50 memory settings, clock, dual alarms, battery level icon, telescopic antenna, multiple jacks, and a strap-type carrying handle.

Technical Details/Features List

- AM/MW (520-1710 kHz / 522-1620 kHz), FM (88-108 MHz) and SW (continuous frequency coverage from 1711-29999 kHz)
- Frequency tuning steps: Three methods to choose from (fast/slow/stop)
- High performance IC and MOSFET: provides high sensitivity, strong anti-interference, low background noise and lower distortion
- MW/SW IF wide/narrow bandwidth selection: allows adjustment of RF gain according to signal strength to achieve better receiver performance
- MCU Control (microcontroller unit) and large LCD backlight display with frequency, clock, battery level indicator, and signal strength indicator
- AM band features dual conversion PLL technology: provides anti-image rejection
- AM/FM/SW external antenna input socket and the ability to connect to cable FM
- Individual external/ground socket for external antenna
- Stereo line level audio input/output
- Size/Weight: 12 inches wide x 7 inches height x 3 inches diameter, 3 lbs. 4 oz.
- Power source: Six D-size batteries (not included) or 9-VDC adapter

This new Grundig portable is available from Grove Enterprises for $99.95 plus shipping and handling. You can get more information online at **www.grove-ent.com**.

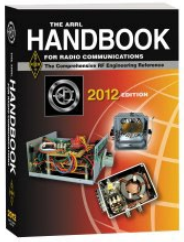
2011 Monitoring Times Anthology

Monitoring Times magazine is pleased to announce the release of our annual anthology on CD-ROM. The anthology includes all of the *Monitoring Times* articles and columns published during 2011 on one searchable CD-ROM. Frequency lists, shortwave program guides, equipment reviews, construction tips, antenna projects, scanner and shortwave topics, and even ads are included in high resolution and full color!

The *MT* anthology sells for $19.95 plus $3 USPS First Class mailing, or $14.95 plus free shipping for *MT* subscribers. You get can more information on this product or you can order online at **www.grove-ent.com** or call 1-800-438-8155 to order this or any product in the Grove Enterprises catalog. You can get an electronic version of the 2011-2012 *World of Radio* Grove catalog online at **www.monitoringtimes.com/grovecatalog.pdf**

The ARRL Handbook 2012 Edition

It is a book that most radio amateurs look forward to every year, and its many uses in the radio shack is legendary. For more than eight decades, *The ARRL Handbook for Radio Communications* has kept technologists – amateurs, professionals and students – immersed in the radio art for generations. As innovations in wireless communication march (or race) ahead, the *ARRL Handbook* has maintained its place at the forefront – a single resource covering electronic fundamentals, radio design, and loads of practical treatments and projects.



The new eighty-ninth edition of *The Handbook* includes something for every radio amateur and experimenter:

- New comprehensive treatment of noise in chapter 5.
- New test equipment and measurements chapter (chapter 25).
- New projects, including high-power RF samplers, RF current meter, and a two-tone audio oscillator from the ARRL Lab.
- Updated Elsie™ filter design software.
- Expanded content on CD-ROM, including an operating supplement for space communications, digital communications, and image communications.

A CD-ROM is included with the book. The CD-ROM includes all of the fully searchable text and illustrations in the printed book, as well as expanded supplemental content, software, PC board templates and other support files. System requirements to utilize the CD-ROM: Windows® 7, Windows Vista®, or Windows® XP, as well as Macintosh® systems, using Adobe® Acrobat® Reader® software.

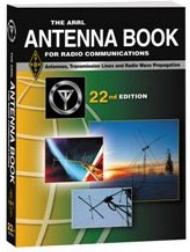
The Companion Software programs are known to have difficulty running on 64-bit versions of Windows operating systems. The programs were developed for and run on 32-bit versions of Windows operating systems. The Companion Software programs available with the *ARRL 2012 Handbook* have not been tested with 64-bit versions of Windows

This 89th edition is available in hard and soft cover, and its 1320 pages weigh in at 6 lbs!

The ARRL Handbook for Radio Communications is available from select *MT* advertisers or directly from the ARRL for $49.95 (softcover) and $59.95 (hardcover) plus shipping and handling.

The ARRL Antenna Book

Build one antenna and you'll quickly find yourself planning the next. *The ARRL Antenna Book for Radio Communications* is devoted entirely to that pioneering spirit. In this one book, you will find all of the information you need to design complete antenna systems, from planning to design and construction. *The Antenna Book* includes treatments for nearly any radio band and operating application: low-band, HF, VHF, UHF and microwave; fixed station, portable, mobile, maritime, satellite and more.



This twenty-second edition includes a complete reorganization, new content, and exciting new antenna projects:

- Every chapter updated or rewritten, including limited-space antennas, portable and mobile antennas, receiving antennas, building towers, and antenna system troubleshooting
- New designs, including a C-pole ground-independent HF antenna, a 40 meter Moxon beam, and improved half-element designs for Yagis
- Updated EZNEC-ARRL version 5.0 antenna modeling software
- Expanded content on CD-ROM, including and an extensive collection of antenna models

The CD-ROM included with this book includes all of the text and illustrations in the printed book, is fully searchable, and includes utility programs and supplemental content from expert contributors. Computer system requirements to run the CD-ROM are the same as those mentioned for the ARRL *Handbook* above.

This twenty-second edition has 936 pages and in an 8-1/2x11-inch format. The book is available from select *MT* advertisers or direct from the ARRL for $49.95 (softcover) and $59.95 (hardcover) plus shipping and handling.

You can order all the ARRL books mentioned in this column via snail mail to 225 Main Street, Newington, CT 06111-1494, via their website at **www.arrl.org,** or by calling their order line at 1-860-594-0259.

Streaming App for the iPad/iPhone

If you are looking for a broadcast and scanner streaming app for your iPad or iPhone, check out Wunder Radio ($3.99) available in the Apple iTunes store.

Wunder Radio's strength is its ability to support multiple formats including MMS, ASX, M3U, PLS, which means it can stream Sirius radio or pick up the BBC's signals. Users can search through 400 different radio genres, listen to MP3 and AAC streams in the background, and @ message favorite DJs using the app's Twitter directory.

WunderRadio provides sophisticated search capabilities to help you sort through the vast number of stations. The directory of stations is constantly updated and allows you to browse by over 400 different genre (sports, music, talk, etc.), as well as by location. Alternatively, you can use the search box to look for a specific station or use GPS to view local stations.

Created by the people who brought us Weather Underground, Wunder Radio includes easy access to local NOAA weather radio streams and emergency scanner streams. Listen to popular shows and podcasts on-demand. You can even listen to radio archive footage, including coverage of significant historical events, such as the attack on Pearl Harbor or Apollo 11's mission to the moon.

Emergency scanner streams are via ScanAmerica.us and local railroad information is from RailroadRadio.net Check **www.wunderradio.com/** to see which stations are available in the directory.

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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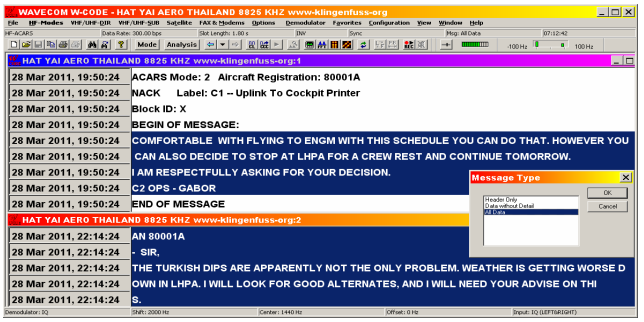

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7,300 shortwave broadcast frequencies. 8,500 frequencies of utility radio stations, plus 22,200 formerly active frequencies. 500 fascinating digital data decoder / SDR screenshots. 18th edition!

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You may custom-configure the shorting bar for grounding the antenna. A silver/Teflon SO-239 coax connector is ready to receive the PL-259 on your coax cable. Instructions include patterns for horizontal or slope mounting.

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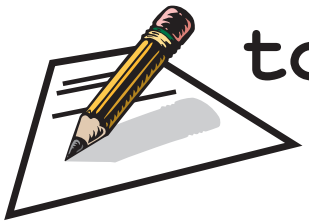


to the editors

editor@monitoringtimes.com

Thanks for Your Feedback

I have been an occasional shortwave listener in recent years and have gotten copies of *MT* at either Hastings or Borders. Borders is bankrupt now, and Hastings has stopped carrying *MT*!

I now am semi-retired with some more spare time for shortwave listening, so I am happy to order the 1 year subscription. I have dusted off my old Zenith TransOceanic and it works great, picking up many of your listed stations in the *Shortwave Guide*. I also have the Sony ICF 2010 which is still in great shape and getting most of the stations well, with an external wire antenna. I can of course listen via internet, but not as challenging as actual off-air reception via radio. Thanks for all the good info in *MT*.

Norm Delamater

Norm, I'm glad you discovered the best way to read *MT* and save money at the same time by subscribing. Fewer and fewer newsstands are carrying the magazine, so having it delivered to your door is the way to go. Even less expensive is the pdf version we call *MT Express*, and for a shortwave listener who is interested in other languages, it comes with the added benefit of *MTXtra* – a separate download of schedules for all non-English broadcasts via shortwave.

Irv Sanders mentioned the difficulty he has deciphering the internet addresses in the printed magazine. This is also remedied by a subscription to *MT Express*; as you are reading the magazine on your computer screen, a simple click of the mouse takes you to the linked website in your browser – no typing required!

Monitoring Times wishes to thank our readers for a record number of responses to our recent survey, which is now closed. Your feedback will be of enormous help in planning future articles and direction. Congratulations to reader Steve Williams for winning the $100 gift certificate from our publisher, Grove Enterprises.

Rachel Baughn, Managing Editor

Satellites and New Tech

Great magazine and great news column (*Communications*). I believe the problems with over-the-antenna television are the new technology (internet and smart-phones) and program quality – not that cable TV is much better. With the current multicasting technology, we could get by with fewer channels and better programming, say twenty-five to thirty channels. Oh, will this so-called MOBILE TV be any better than regular TV? or had we better put on internet and smart-phones?

Norman W. Hill

Someone, in a recent *MT* article, commented on the drawbacks of satellite internet service, such as Hughesnet and others, in your rural NC area. Can you supply a reference for this article? My daughter also lives in rural NC and could use the information.

Dave Crowley NØHMI

Yes, it was in my *Beginner's Corner* for October 2011 and it has gotten the most email of any column recently. I mentioned that:

"While many customers are happy with HughesNet and WildBlue, many others are not. I urge readers to read reviews of each service before signing up. *Consumer Reports* ranked both services at the bottom of all broadband Internet Service Providers nationwide."

I have a friend who signed up and couldn't get any better service than he had with dial-up. He ended up paying hundreds of dollars to get out of the contract. The service was poor, the installation poor, the customer service was poor. Just Google either service and you'll get mostly bad reviews. Compared to 24 kb/s it may be faster but barely. On a wireless broadband modem, which costs less than half of what satellite Internet charges and is available just about anywhere, I get 1 Mb/s.

Ken Reitz KS4ZR

I really liked the article on the Handy Video Tuning Tool: Your Wireless Camera (*On the Bench*, Nov 2011). What a great idea; which brings to mind all sorts of ways to use this idea. For hams they could use it to watch their antenna rotate without having to go outside or you could watch your TV antenna rotate, you can use it to watch your FTA dish movements. Many more… just use your imagination. Thank you for publishing this article.

Jim Stellema KA8ZXJ

Thanks, Jim. Hope you enjoy the same author's review of the Satlink Finder tool in this month's issue.

Rachel Baughn, editor

Views from an Old-Timer

I am indeed an old in the tooth hobbyist, a Brit who has lived on Salt Spring Island, British Columbia, Canada, 22-years. I earned my living in the UK as a national news reporter and also as a BBC news reporter and news reader. Since the age of 10 I always had a wire entanglement antennae somewhere in the house, often hidden under the bed.

Over the years I have met many amateur radio enthusiasts and yet somehow never became one myself. In the UK it is possible to listen to what is going on, but a punishable offence to use the content. I ran the gauntlet and produced many a first class story. My story concentrated mainly on ships and the sea; in fact I contributed to a BBC program of that name.

I suppose my mind retains graphic images of hearing Mayday calls by the score, one in particular from a Dutch ship named the *Divinia* which sank with all hands on board during a North Sea storm. The last words of the captain were … oh my God we are capsizing. They were never seen again.

Over the years I have made friends with and written about many an amateur. During WW2 in the R.N I learned Morse and still do remember it to some extent. While I in no way am setting out to condemn amateur radio enthusiasts, if I were a young person and introduced to the boring conversations of some (not all) of the older set, would I truthfully want to become involved?

You will point out to me no doubt your recent photo-story of the young people… But technology has advanced so quickly – men communicating to and from outer space, and all that – the old set, the pioneers of a golden age have been left behind. At 93 I am lucky to be alive and have full control of my mind and body, but in terms of satellites, what I can do to introduce them in my hobby? Don't forget us. You obviously have some very knowledgeable columnists, but they have the tendency to present facts that the layman sometimes finds hard to interpret and put into operation.

I bought a Diamond discone and got a tree climber to anchor it 80 feet above ground. It worked of a sort for four years until the strapping broke and it hung half way down the tree upside down, which improved my reception considerably. Higher the better, advised an amateur. Considering I live within sight of Vancouver Port I find the reception very poor. No hills, just sea. I can just about hear Seattle Coast Guard some 50-miles away as the crow flies. The air band reception is better for understandable reasons.

I have ordered another discone and can only rely on the honesty of the Vancouver amateur supplier that my Ic-R7000 needs specials plugs and coax. He will supply me with 50 feet of coax and stresses I should not go beyond 75 feet high because of coax loss.

I am aware that I have a fault on my Dell laptop, which is close to my Icom, but when it is on, it seems to cause a harmonic on the air band while I am monitoring Whidbey air base about 40-miles distant. Why? All very well to sell your electronics, that is business sales, but make technically clear what should be done to achieve the claims made.

I conclude by pointing out that *Monitoring Times* is published mainly for U.S consumption and your attempt to sell in Canada fails to a great extent simply because we because we can't read enough about where to listen in Canada.

Admittedly I don't have a subscription and buy *MT* off the shelf when I go to the local book shop, *but* only after looking through the pages. It is well produced undoubtedly, and it is obviously must be a struggle to produce a high

class magazine in these inflationary times, but I feel convinced *Monitoring Times* has a job to do in Canada and we will buy it providing we don't just read about the frequencies to be heard across the great and almighty USA. As the familiar words ring out God Bless America, that is sincerely my wish.

George G. Clogg

Thanks for sharing your memories and your opinions with us regarding your hobby and how *MT* does or does not contribute to it. I readily admit that a several years ago we made a more concentrated push to include Canadian content in the magazine. One column was even dedicated to Canadian topics. However, when finances forced us to cut pages in the magazine, and analysis showed that increasing Canadian coverage had not resulted in significant increase in Canadian subscriptions, that column was one of several we reluctantly eliminated.

Our maritime columnist, Ron Walsh, writes primarily about the Great Lakes area and is Canadian, but that's not of much help to you in BC. He would be delighted to get West Coast input for his column, however, so your area can be represented. He has had difficulty getting feedback from other coastal areas (including the US), and from his inland location he has difficulty hearing much HF. He would be quite jealous of your experiences!

We always strive to address technical topics in plain English, but I'll admit that this new digital world (including satellites) makes it hard to write without lots of new acronyms and newfangled jargon. Thanks for reminding us to keep it simple!

Rachel Baughn, Managing Editor

George, There are actually three technical questions that you have implied.

First, The fact that you are on flat land near the ocean is an advantage. You don't need considerable height for your antenna, just high enough to clear nearby obstructions between you and your target. If you use low-loss coaxial cable like RG-6/U, you shouldn't have a problem hearing the boats. You could enhance that reception even more by using a beam antenna like the popular Grove Scanner Beam. Or, if you're feeling flush, the Create 5130-2N is a huskier antenna for sea breezes.

Second, computers and their peripheral devices use oscillators, and their harmonics may fall anywhere in your listening spectrum. To be sure it's the computer and not the video display, turn that display off while you hear the interfering signal. If it's the display, sometimes putting a ferrite bead on the connecting cable will help attenuate the interference, or you may even consider another brand of display. If it's the computer, try relocating the antenna. If you're using a poor grade of coax to the antenna like RG-58/U, replace it with coax with better shielding like RG-6/U mentioned earlier.

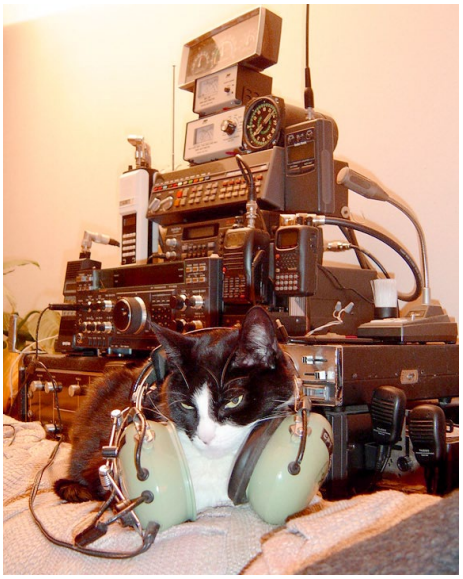
Third, it's very possible that the upside-down position of the discone making it work better reveals an interesting fact about discones. The higher the frequency, the higher the takeoff angle. That would explain why it initially heard aircraft just fine, but when it turned upside-down, it was directing its signal reception more downward. Were the boats coming in better then?

Bob Grove W8JHD, Publisher

Shack Cat

Every time I go to listen on my radios, my cat likes to participate as well. Thought I'd send in a picture of this phenomenon. She recently got her ham license KB9CAT...just kidding!

Brad KB900Q



Weather Radio Tip

RE: The NOAA article in Sept 2011 MT. A Texas supermarket chain – H-E-B – has been selling the Midland WR-100 for about $30 for several years. They do this because TX has "exciting weather" from the mouth of the Rio Grande to the top of the Panhandle, east to the Sabine River and west to El Paso and the Upper Rio Grande...

H-E-B – bless 'em – wants their customers to be as safe as possible. These babies usually come out in March and stay around until Turkey Day or Christmas and the end of hurricane season. Good for H-E-B!!!

We have a WR-100 in the kitchen and one in the office. Neat radios. I guess they are "dated" now, but they will "answer an alert".

Morgan Little

Bravo H-E-B! Thanks for the interesting info, Morgan. Readers should know that the WR-100 can still be found at many retailers though it has been replaced by the WR-120, essentially the same product but the MSRP is $50.

Ken KS4ZR

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!

Rachel Baughn, Editor

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*Just downloaded the August issue, saved it in iBooks, and have read about half. Looks *great* on the iPad. This is definitely the way to go....*

- Scott D.

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http://americanbandscan.blogspot.com/ - by Doug Smith

ANTENNA TOPICS
www.wa5vjb.com - by Kent Britain

BELOW 500KHZ
http://below500khz.blogspot.com/ - by Kevin Carey

FED FILES
http://mt-fedfiles.blogspot.com/ - by Chris Parris

LARRY'S MONITORING POST
http://monitor-post.blogspot.com/ - by Larry Van Horn

MILCOM
http://mt-milcom.blogspot.com/ - by Larry Van Horn

SCANNING REPORT
http://www.signalharbor.com/ - by Dan Veeneman

SHORTWAVE
http://mt-shortwave.blogspot.com/- by Gayle Van Horn

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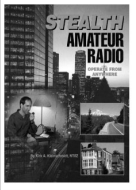

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