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A Publication of Grove Enterprises

Volume 31, No. 11
November 2012
U.S. $6.95
Can. $6.95
Printed in the United States

MT's 2013 Radio Buyer's Guide

In this issue:

- Breakout Year for SDRs
- Scanners in Digital Transition
- The All-in-One Antenna

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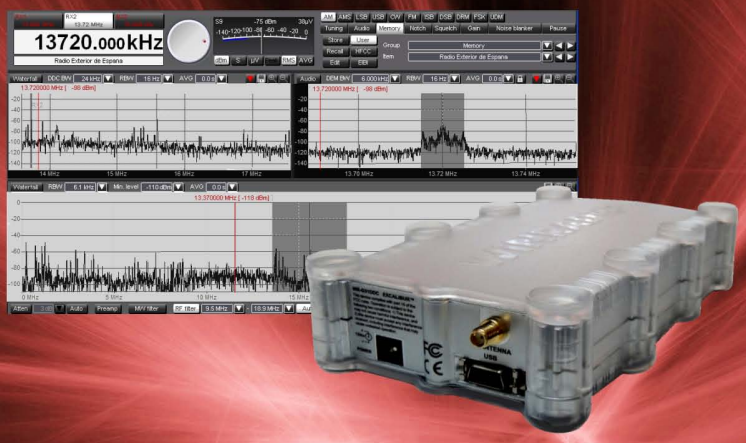


WinRadio Excalibur Pro

WRTH AWARDS 2012
WinRadio Excalibur Pro
BEST SDR

towards settled measurement protocols but it is abundantly clear that the Excalibur Pro is better than anything we have hitherto encountered. To be able to connect a full-size 6/7MHz dipole to a receiver on an autumn evening and be able to observe the sideband sets of individual broadcasters down to virtually the receiver's noise floor is – to put it mildly – an unusual position for a reviewer to find himself in! Certainly the Excalibur Pro was not remotely troubled at any time by anything our various antennas could throw at it.

CONCLUSION

The Excalibur Pro is the best SDR we have used – in some ways it is the best receiver we have used regardless of the underlying architecture –

www.wrth.com

Overall rating ★★★★★

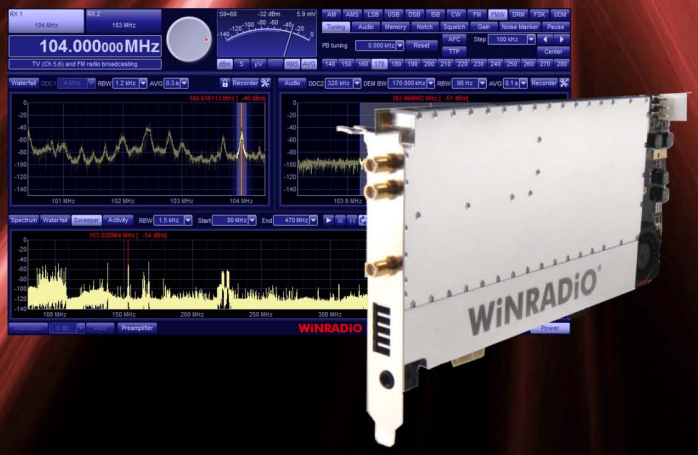
review

Mike Richards takes a look at the WiNRADiO G39DDC Excelsior, a receiver that some might consider the best software defined radio currently available.

If there's one thing that is likely to be at the top of a radio enthusiast's wish list, it's a system that can find signals quickly. The WiNRADiO G39DDC Excelsior certainly has the ability to do this and it must be something close to a dream receiver.

summary

v, the WiNRADiO G39DDC Excelsior is a stunning receiver and a dream for ew, I have only really covered the most interesting aspects of its performan



FIRST LOOK

MT Takes a Look at the Latest Tech

By Bob Grove, W8JHD

This is the most amazing receiver I've ever encountered. It employs the latest proven SDR architecture, operates well beyond the spectral range that most of us would ever think of trying to hear, and demodulates all conventional modes.

I ordinarily find something to complain about in my reviews, but trying to find something I don't like about the G39DDCe has left me at a loss, and that's a gain for this winner.

We have lots of good gear. Take a look:

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Monitoring Times

Vol. 31 No. 11 November 2012

MT's 2013 Radio Buyer's Guide

This month's issue of *Monitoring Times* is devoted to a look at the latest radio-related products available. Our up-front features include a complete overview of Software Defined Radios (SDRs) for amateur radio; how to get the best buy in shortwave radios for your hard-earned money; how to cope with the digital transition in the world of VHF/UHF scanners, and an antenna tutorial from MT founder and antenna guru, Bob Grove W8JHD.

But, that's not all. Columnist Kirk Kleinschmidt takes a look at the contemporary world of radio kit-building; Ken Reitz compares the value of today's best table radios with those from 60 years ago; Mike Chase highlights the latest digital decoding software available; Kevin Carey tells how to get below 500 kHz on the cheap; Kent Britain shows how to use inexpensive TV accessories with your scanner or SWL radio, and Dan Farber shows how antennas for 10 and 6 meters offer some of the best gain per dollar in HF.

On Our Cover

A few of the digital transceivers and receivers now on the market: WiNRADiO's G3 and AOR's 2300 screen graphics in background; Elecraft KX3; AOR 2300; SDR Cube and rear panel of SRL QS1R. (Courtesy: WiNRADiO, AOR U.S.A., Elecraft, Midnight Design Solutions and Software Radio Laboratory)

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- An SD memory card port can be used to store recorded audio
- Analog composite video output connector
- CTCSS and DCS squelch operation
- Two selectable Type N antenna input ports
- Adjustable analog 45 MHz IF output with 15 MHz bandwidth
- Triple-conversion receiver exhibits excellent sensitivity
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- Professional (government) version is equipped with a standard voice-inversion monitoring feature

Add to the capabilities of the AR5001D with options:

- Optional APCO-25 decoder
- Optional LAN interface unit enables control via the internet
- Optional I/Q output port allows capture of up to 1 MHz onto a computer hard drive or external storage device
- Optional AR-I/Q Windows software facilitates the easy storage and playback of transmissions captured within the selected spectrum in conventional modes, or, signals can be subjected to further analysis
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MONITORING TIMES (ISSN: 0889-5341; Publishers Mail Agreement #1253492) is published monthly by Grove Enterprises, Inc., Brasstown, North Carolina, USA.

Address: 7540 Highway 64 West, Brasstown, NC 28902-0098
Telephone: (828) 837-9200
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Subscriptions: ***order@grove-ent.com***

Subscription Rates: $19.95 MTXpress; $32.95 in US; $42.95 Canada; and $58.95 foreign elsewhere, US funds. Label indicates number of issues left. Renewal notice is cover sheet 3 months before expiration. Subscribe at **www.monitoringtimes.com**.

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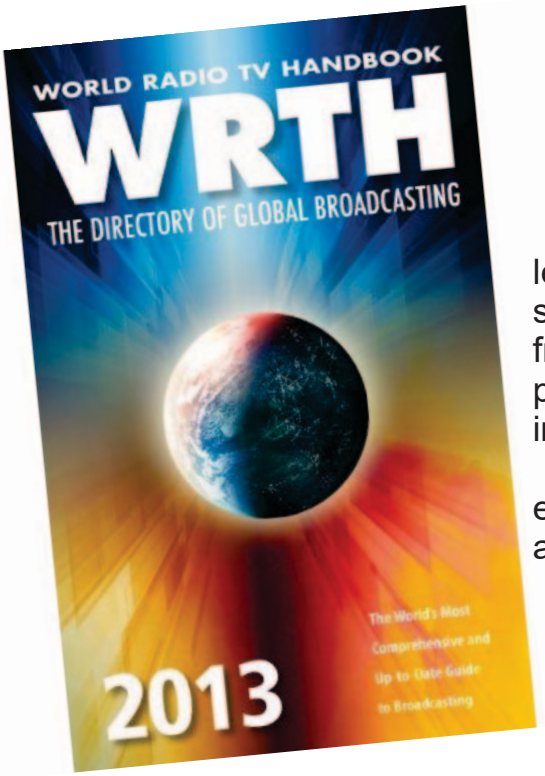

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The World Radio TV Handbook continues as the leading annual reference for shortwave broadcasting stations. Not only does it include comprehensive frequency and schedule listings, but it provides in-depth profiles of the stations and staffs along with contact information.

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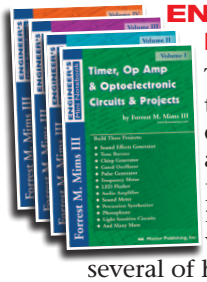

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to the editors

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

Happy monitoring!

Ken Reitz, Editor

The Kids are Alright

Larry Wheeler W9QR writes:

The cover story about W9GRS [*MT* September, 2012] reminds me that many, if not most, amateur radio operators do not understand the FCC rules regarding the licensing of control operators. The story leads one to believe that unlicensed operators are controlling the emissions of the club station. I suspect that that is the case in this instance. The rule requires a licensed operator at the controls at all times. An unlicensed person cannot control a transmitter in any manner [and] that includes using a push-to-talk switch or a keyboard. That also applies to licensees who hold a license that does not carry privileges for the frequencies that they wish to use.

Bob Grove W8JHD, *MT* Publisher responds:

Larry's concern is that FCC rules may be violated if an unlicensed operator presses a mike button to activate a transmitter even if the licensed control operator is present and gives the command to press the button.

According to FCC Rules, "A control operator must ensure the immediate proper operation of the station..." (97.105(a)). "A station may only be operated in the manner and to the extent permitted by the privileges authorized for the class of operator license held by the control operator" (97.105(b)).

In other words, anyone is permitted to operate the equipment provided a licensed control operator is supervising.

Troy Simpson W9KVR, trustee of the Glenn Raymond School station, and author of "W9GRS: From Room 104 to the World!" responds:

There is always a licensed control operator, whether it is a licensed student, staff member, or volunteer from the local amateur radio club, while the radio station is on-air, overseeing the operations. Currently, all of our control operators hold at least a General Class license. In many ways, without the FCC's Third Party Communications policies, many amateur radio activities such as Field Day, School Club Round-Up, Scouts on Air, Kids Day, etc. would not be possible.

Buddy Sohl KC4WQ, author of "A Decade of Amateur Radio in the Classroom," and trustee for W4KBR, St. Aloysius School, responds:

Whenever you introduce amateur radio to a non-ham, third party rules are likely to be encountered. All of the students and staff at the St. Aloysius Radio Club were well aware of third party regulations and the station was locked when class was not in session. A control operator was always at the station control point (usually coaching the students what to say) when an unlicensed person was on the air.

A funny aside; while working the School Club Roundup a few years ago, as one of the girls was calling CQ, a Portuguese station answered her call. I explained to her that I'd take this call. We worked the station and afterward she asked what she had done wrong. I explained where the station was and that we did not have a third party agreement with that country. She was still excited beyond comprehension and that contact was the talk of the station for a couple of weeks.

While I'm certain that there are times that third party rules are not followed to the letter, the majority of hams do understand the requirements for third party communications and respect the rule of law. After all, they earned their license and as such have a vested interest in keeping amateur radio well policed.

MT on an iPad

Chip Kofler writes:

I remember sometime in the last year there was an article about how I can read your magazine on my iPad. As I recall, it was a bit complicated... sure wish you would make it available through the newsstand, Zinio or a special app. Thank you for your attention!

Chip, you are referring to the August, 2011 issue of MT, page 17, "Reading MT on the iPad" by Gordon Bousman NW7D. There's nothing complicated about it and no special apps are required. Anyone else interested may read that article by going to ***www.monitoringtimes.com*** *and clicking on "Reading MT on the iPad."*

Newsstand sales have been made more difficult over the last few years as bookstores go out of business and returns policies end up costing smaller publishers more than they can make on such sales.

MT readers who also want to experience the digital version of MT can do so by going to the above website and clicking on the MTXpress button to download a sample directly to your tablet e-reader, laptop or desktop computer. – Editor

The Noise of "Digital Progress"

Irv Sanders K3IUY, writes:

I've been following your articles in *Monitoring Times* concerning the dying of the AM broadcast band, and the comments sent in by some of your avid readers. I find the situation scary. Let me begin by giving some background.

Three and a half years ago I was forced to move into a retirement community and found the HF atmosphere relatively quiet. I was granted permission to install a "stealth" antenna which made signals a bit better but could never match what I was used to, having had a large lot out in the country with unlimited antennas.

Then, last year, came "D-day," "Digital Day," or in this case, "Disaster Day." The Comcast Company descended on the retirement facility with trucks full of electronics. Their mission was to install high-def TV, high-speed Internet, and anything else they could that would create RF noise.

No one has been able to play an AM radio anywhere in the building or within 40 feet of the building since this equipment was installed. The noise sounds like the arcing contacts on a 5,000,000 watt buzzer; all the way from 40 kHz to 300 MHz; S-9 + 40db and more.

I attempted to talk to the installers while they were in the building, "We don't have time right now," they said. I attempted to call a Comcast supervisor earning me the answer, "He's not here right now," and no one seemed to know if or when someone would be available. A dead end!

Next I tried the F.C.C. What a joke. That netted me the opportunity to spend hours walking through the maze of phone options. Another dead end!

One of my ham friends suggested I call A.R.R.L. Wow, why didn't I think of that? I phoned them and was told, "That's a tough one." Tell me! I received what amounted to several promises of, "I'll have to do some more investigation and get back to you." It's been over a year; another dead end.

Meanwhile no one can enjoy AM radio in this building. I'm wondering how many other digital cable installations are driving nails into the coffins of AM radio. I'm at my wits end.

It's hard to imagine anything worse for a longtime radio hobbyist and ham than to have such wideband inference. Unfortunately, you are not alone; digital hash on AM through HF is a common complaint among those who live with, or even near, digital cable-TV installations.

As to the FCC, you were probably not at the right place. Here's where you need to be: ***www.fcc.gov/complaints*** *. Click on "Broadcast (TV and Radio), Cable, and Satellite Issues," Then click the "Next" button, then click on "Cable modem issues, cable signal leakage, cable customer premises equipment issues (such as tuning adapters and set-top boxes)."*

This takes you to an online PDF form called a "2000E Media (General) Complaint." This form does not work with Firefox. You'll have to open Internet Explorer to do this task. The form lets you name the issue and the company and gives you plenty of room to detail the efforts you've already made in finding a remedy for the interference. You also have the option to attach files, for instance, if you've received email or letters from a company or their representatives. If enough people in your area file similar complaints, it could get their attention more quickly.

You may also try to contact the FCC's Consumer & Mediation Specialists who are available Monday through Friday, 8 a.m. to 5:30 p.m. ET to answer your questions and assist you in filing a complaint. Call toll-free at 1-888-CALL-FCC (1-888-225-5322) voice or 1-888-TELL- FCC (1-888-835-5322) TTY. – Editor

MT Slightly Smaller

In order to keep subscriptions at the current low price, in the face of increasing costs, we have downsized slightly without sacrificing the wide spectrum coverage that has made MT the leading publication in its field for more 32 years. – Editor

COMMUNICATIONS

by Ken Reitz KS4ZR

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

Domestic BBG Ban Reconsidered

Since 1948, with the passage of the Smith-Mundt Act, U.S. government sponsored radio services such as Voice of America, Radio Free Europe, Radio Martí and other stations controlled by the Broadcasting Board of Governors (BBG) have been prohibited from beaming their broadcasts directly to listeners in the United States. Of course, broadcast physics being what they are, U.S. citizens have always been able to listen to these broadcasts if they tried. The initial ban was in response to the legacy of government sponsored propaganda that flourished throughout the world during and after World War II. There was a fear that an unscrupulous American administration could use such a broadcast arm to dupe an unsuspecting citizenry.

But, times have changed and surely U.S. citizens no longer need to be protected against government sponsored demagoguery. Widespread use of unfiltered Internet content and reception via satellite of BBG programming by U.S. citizens would seem to make Smith-Mundt irrelevant. That's why members of Congress have introduced legislation that would "modernize" Smith-Mundt, making it possible for the government to enter the domestic broadcast market in a big way. The bill is supported by BBG in its recently released five year strategic plan.

There is opposition to the bill from the Committee for U.S. International Broadcasting, a non-partisan group of advocates for human rights, which is often critical of BBG policies. Writing on their website **www.cusib.org**, co-founder Ted Lipien noted the BBG has a "track record in seeking easy higher audience ratings abroad by downplaying hard news and human rights reporting." Lipien wrote, "BBG officials have been eliminating or trying to eliminate Voice of America (VOA) broadcasting services to countries like Russia and China and are focusing instead on providing lifestyle and educational content. The new legislation will make it easier for these officials to divert money and other resources from serving foreign audiences with comprehensive analysis of current events to producing easy to place programs, not just for foreign but also for domestic broadcasters."

Ted Lipien wrote that CUSIB seeks language in the bill that would, "make it absolutely clear that the BBG is not allowed to own or operate any domestic stations, to favor one station over another or to sign rebroadcasting agreements with domestic broadcasters."

Meanwhile, the Chinese government continues to buy all available air-time on a number of destitute AM stations across America; the China Radio International signal is the biggest on all shortwave bands and TV stations all around the U.S. air documentary and news programming direct from China Central TV. At the same time, the Chinese government is busy blocking BBG websites and jamming BBG shortwave programming aimed at their citizens.

FCC Readies OTA Auction Date

If you watch Over-the-Air TV, using an actual TV antenna, it's easy to imagine that, given the great quantity of advertising that takes up much of each broadcast hour, your local TV station is doing great. And, tuning in dozens of digital channels where just a few years ago there were only a handful of analog channels, you may further imagine that we're at some sort of pinnacle of terrestrial TV broadcasting. But, that's not the way the FCC sees it.

In a relentless effort to turn what's left of the broadcast TV spectrum over to commercial broadband interests to solve the perceived shortage of spectrum being sucked up by bandwidth-hungry 4G devices, the FCC has set a timetable that will allow "repacking" of the TV band by as early as 2014. September 28 the FCC voted on a framework of rules that will lead to a final vote on rules for a TV spectrum auction by the middle of next year with the actual auction to take place the following year.

The process involves a convoluted scheme by which local TV stations will first be encouraged to cash in their licenses and join with their competitors on new consolidated TV channels. The consolidating stations would divide some of the profits from the sale of their former spectrum real estate. Broadband mega-corporations such as Verizon, which will presumably win such an auction, would then make local TV programming, cable and Internet-TV fare available to consumers via mobile devices on a monthly billed basis. What hasn't been discussed is what to do with recalcitrant TV stations unwilling to surrender their licenses.

One of the downsides to the scheme is that OTA-TV viewers will likely be reduced to watching lower resolution transmissions because repacking won't allow full 1080i for all channels crammed into one. Of course, that doesn't matter to cable and satellite-TV viewers, most of whom have never seen network TV in full 1080i anyway.

West Palm Beach OpenSky® Fiasco

An article in the *West Palm Beach Post* from early September detailed the multi-million dollar fiasco of that city's so far unused OpenSky public service radio system. The system, from Harris Corporation, had already cost the city $5 million, but could cost a million more to upgrade to working status. The story goes back to May 2011 when the *Post* first reported that city officials hid documents related to problems with the system that were encountered as early as 2009. According to the article, the city's technical staff issued a report that was highly critical of the system but was silenced by the city's Chief of Police who later resigned as a result of continued *Post* coverage of the issue.

The OpenSky system has split Palm Beach County commissioners, some of whom favor ditching the whole mess and switching to Motorola's P25 system (a more expensive proposition) and some of whom favor plowing more taxpayer funding into the so far nonfunctional OpenSky system. The best advice came from West Palm Beach's new Chief of Police who was quoted in the article as saying that West Palm Beach, "should be cautious about believing face value, whatever salesmen are trying to sell." Meanwhile, West Palm Beach and Palm Beach County, according to the article, continue to use the old analog system that dates back to the 1990s and apparently still works.

Good Karma, Bad Karma

Cleveland, Ohio radio station WKNR is licensed to a company called Good Karma Broadcasting which ran afoul of FCC rules regarding on-air contests. According to FCC documents, in a case that dates back to 2007, it seems Good Karma ran a contest from 10:00 a.m. to noon called, "Who Said That?" in which listeners would try to identify a voice from the sports world by calling or sending their answers via email. Winners would be awarded prizes. But, it seems that after a 20 month period during which no one could identify any of the voices, the rules of the contest sort of morphed into no more prizes. Unfortunately, the FCC is a stickler for contest rules (who knew?) so, a Notice of Apparent Liability (NAL) was sent to the station in the amount of $4,000 for the offense.

Good Karma bristled at the fine, claiming such rules constitute, "government regulation of program content." To support their claim Good Karma noted two recent cases involving indecent speech in which the FCC was overruled by the courts. Not the same, the FCC responded, "These cases provide no relevant guidance about the contest case at issue, which has nothing to do with regulating indecency and the sensitive First Amendment implications that such regulation entails. Indeed, the Commission has stated that the contest rule, unlike matters involving indecency, is content neutral and 'does not implicate the First Amendment.'" The fine stands.

Breakout Year for SDR Transceivers

By Kirk A. Kleinschmidt NT0Z

Radio amateurs are known for their nearly constant contributions to the communication arts, but groundbreaking technological changes are still rare. Spark gave way to CW; AM was all but replaced by SSB; crystal detectors were rendered obsolete by regenerative receivers which, in turn, fell to the onslaught of the superhet, and so on.

We still use all of these "replaced" technologies in one way or another, but when it comes to receiver (and transceiver) design, the software-defined radio (SDR), with us for some 30 years now, has become the architecture of choice for all high-performance models (from ham rigs to cell phones to satellites).

The switch to SDR represents a "fork in the road," and you'll soon be hard-pressed to find a new transceiver that isn't based on SDR technology. SDR is nothing short of a redefinition of the radio art, and if you look at the performance charts, you'll see that all of the top-performing models use SDR technology (even if it's not obvious). In any practical sense, you just can't make a conventional superhet that outperforms an SDR when it comes to dynamic range and selectivity. It's a shock to see $10,000 superhets bested by $500 SDRs, but that's already old news!

There are tradeoffs, pro and con, when the features and operating necessities of SDRs are compared to those of more conventional designs, but in terms of raw performance, the test results speak volumes. See **www.sherweng.com/table.html** for the details and note that the performance chart shown there is sorted on "dynamic range at 2-kHz signal spacing" (the ability of the radio to receive weak desired signals that are only 2 kHz away from strong unwanted signals). At signal spacings of 20, 50 or 100 kHz the top performers jockey around a bit, with superhet/SDR hybrids benefitting the most.

SDR Genealogy

To better understand the basics of SDRs, let's selectively trace their development, starting with the superhet. Conceived in the early days of radio, the superhet gained prominence in the 1930s and continues to be used in almost every commercially made amateur radio to date. In a superhet, incoming radio signals are mixed with a locally generated signal (VFO) and converted to an *intermediate frequency* (IF), at which filtering, amplification and other functions take place, before the IF signal is itself mixed with another local signal (BFO) and converted to audio, which we can hear.

To ensure peak performance, the dynamic range, impedance matching and linearity of the analog mixer, crystal filters and RF amplifiers in the IF must be top-notch (read: difficult and expensive). Typical IFs are 9 MHz and 455 kHz, with some radios using both. "Double-conversion" designs offer extra features and increased performance but are more complex and cost more. Analog superhets can still perform well at signal spacings of 20 to 100 kHz, but when undesired signals are nearby, performance can fall dramatically.

Direct-conversion receivers (DC), a simpler alternative to the superhet in which incoming radio signals are mixed with a locally generated signal (VFO) and converted directly to audio, are often associated with inexpensive, home-brew QRP radios. Simple DC receivers have idiosyncrasies of their own, but can be made to perform well and are simple to build. Interestingly, most SDRs are still essentially high-tech, direct-conversion radios. Surprise!

What's Old is New Again

The most basic SDRs, which we'll call "Generation 1," use DC receiver circuits that output a pair of baseband signals (from dc up to 200 kHz or so, including the audible range) that have a specific phase relationship to one another. These audio signals, called I and Q, are fed into a high performance PC sound card where they're converted into digital signals by the sound card's analog-to-digital converters (ADCs). Once in the digital domain, the sound card's digital signal processor (DSP) can perform all of the functions normally performed by the various and complex superhet analog circuits (amplification, detection, AGC, demodulation, filtering, limiting, etc), plus handy functions such as noise reduction, noise blanking, binaural audio, digital-mode demodulation, and more. Sophisticated PC software runs the show, so a PC is always required, even for basic radio operation.

With this approach, the dynamic range of the sound card's ADCs and DSPs have a significant impact on the dynamic range of the receiver itself! So, even though the "receiver" may have only a handful of parts, it can provide performance commensurate with that of the sound card. A high-performance sound card (or other ADC/DSP hardware) equals a high-performance receiver! The pioneering FlexRadio SDR-1000 uses this approach, as do many home-brew and kit Gen 1 radios. For best performance, "studio-quality" audiophile sound cards work best, but almost any PC sound card will work to some extent.

Gen 1 SDR technology is often called QSD/QSE, short for Quadrature Sampling Detector (receivers) and Quadrature Sampling Exciter (transmitters).

To simplify things, most "Generation 2" SDRs still use a "single conversion to baseband" approach (QSD/QSE), but build the "sound card ADC/DSP" into the radio itself and connect it to the PC (and the SDR control software) via Firewire or USB. This greatly simplifies connections and setup, and makes tiny SDRs the norm, but keeping critical software/hardware timing synchronized on each end of the connecting cable can be difficult, especially with USB. FlexRadio 1500-, 3000- and 5000-series transceivers use Gen 2 technology.

Cutting-edge "Generation 3" designs put the DSP/SDR hardware *and the computer itself* inside the radio—not a general-purpose PC as we know it, but a dedicated computing platform designed *only* to run the SDR/DSP hardware (and often a complete operating system) in a single, integrated package. Putting the computer, the software and the DSP in the same (tiny) box eliminates any potential issues that might arise from keeping them separate (Gens 1 and 2) and allows for SDRs that can have physical knobs and switches, don't necessarily need external PCs to function and, most importantly, achieve the highest possible performance and flexibility.

These dedicated, embedded "SDR computers" are usually built around Field Programmable Gate Arrays (FPGAs), which are essentially "blank" CPUs that contain memory and logic that can be programmed by an individual designer for a very specific purpose (not just standard Intel or AMD general-purpose designs). Because FPGAs don't have to run *Windows*, connect to YouTube or tally spreadsheets, all of their custom-designed computing power can be focused on one thing, in this case, high-speed DSP number crunching. In the same way that a modern PC video card can perform its specific task much faster than any general-purpose CPU, FPGA-based DSP systems can be *many times* more powerful than those run on standard PC CPUs.

Thanks in part to FPGAs and the latest high-performance ADC/DSP chips to trickle down from military and laboratory-grade applications, Gen 3 radios use ADC/DSP hardware that can "directly sample" the RF signals being received without first converting them to baseband. This requires fast, dedicated FPGAs and ADCs that can perform well at high RF frequencies (and not just at baseband from dc to 200 kHz).

Gen 3 SDR technology is often called DDC/DUT, short for Direct Down Conversion (receivers) and Direct Up Conversion (transmitters). DDC/DUT is the likely future for all commercially made radios, amateur and otherwise.

In 2013, Gen 3 digital performance isn't inexpensive; today's direct-sampling receivers range from $500 to $1200 and beyond. Direct-sampling amateur radio transceivers are really just becoming available. Many home-brew, kit and semi-kit designs are offered (or hinted at) on the Internet, but actually getting one in your shack isn't even possible (just yet).

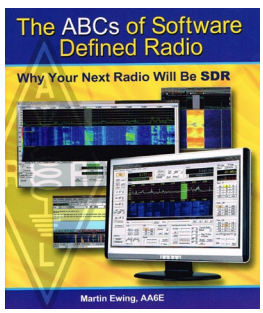
The Quicksilver QS1R/QS1E Gen 3 combo costs about $1200 but puts out only 2 mW, so additional amplification will be required for most ops! Various direct-sampling transceivers based on the OpenHPSDR Hermes, a 500-mW, single-board, HF+6, multimode transceiver, show great promise, but aren't quite shipping as this is being written. Hermes (and other OpenHPSDR) variants cost between $900 and $2500 (if and when you can purchase them) and put out 500 mW to 10 W (with some 100-watters in the works). If you want a "big name" direct-sampling transceiver, FlexRadio 6000-series models should be shipping by press time, but will sell for $4,300 and $7,500, plus accessories.

Gen 3 technology adds a few "science fiction" features as well, including models that can continuously receive and record the *entire* HF spectrum (or smaller, more manageable swaths), compact units that house eight full-performance, independent receivers that can simultaneously receive on single or multiple bands (controlled by multiple human operators logged on from separate networked PCs), etc. Gen 3 adds the crazy stuff!

To get some of the benefits of an SDR without requiring PCs, monitors, etc, many manufacturers use an "embedded SDR" for the IF section of their superhet radios. These "hybrid SDRs" may not have the ultimate flexibility of a "pure SDR," but they don't require external PCs and monitors, either. Instead of "SDR," most manufacturers call this technology "Advanced IF DSP," or something similar.

A growing trend among manufacturers and home-brewers alike is to route the IF signals of a conventional superhet transceiver to an external spectrum display that's powered by an SDR. In addition to providing a graphical band scope display for conventional radios, connecting an SDR to an existing radio's IF can provide true "digital IF" features such as "brick wall" CW and SSB filters, digital detection, noise reduction, etc. Some new radios have IF output ports (or even I/Q audio ports) on their back panels, while others can accommodate aftermarket IF adapters.

This brief introduction barely scratches the surface of what's happening with ham radio SDR technology. A much more comprehensive introduction can be found in *The ABCs of Software Defined Radio*, by Martin Ewing AA6E, available from your favorite amateur radio bookseller or from **www.arrl.org**.



Courtesy: ARRL

Practical Aspects of SDRs

In day-to-day operation, SDRs have many pros and cons, some technical, some personal. Unless you can find a way to try one out, however, it's not easy to predict whether you'll rate certain aspects as positive or negative. Opinions and experiences vary! So, before we examine specific models, let's examine some common SDR characteristics.

PC Requirements

Only two SDRs in this Guide don't require PCs to function. In general, fast, modern PCs are better than older, slower models, but specific radios often have specific requirements, so it's *very important* to check these out ahead of time. Some SDR software runs in Linux and OSX, but many packages require Windows (or older versions of Windows such as Windows XP).

Gen 1 SDRs prefer (or require) high-performance sound cards or SDR-oriented codec cards (internal or external), making this a top priority. Typical Gen 2 radios require Firewire or USB ports that meet certain performance requirements, but don't even need sound cards because the equivalent hardware is built into the radios themselves. Many Gen 3 models use proprietary software, but typically need less powerful PCs because the heavy lifting is done by the radio's internal FPGA. FlexRadio 6000-series models and those based on the OpenHPSDR Hermes, which connect to the outside world via Ethernet, are expected to require minimal external computing power, which may allow a wide variety of computers, tablets and even smart phones to operate the radios.

Advantages

SDRs offer many features that can't be offered by traditional superhets (or can't be offered in any practical sense). The most important include spectrum displays with "point and click" tuning. Being able to visually see the signals on any particular band is a tremendous leap forward over pre-SDR radios. And when you see an interesting signal, you can simply move your pointer over it and click the mouse to tune it in. Once you've done that it's hard to go back to the old days!

SDRs typically have "crunch proof" receivers that are a joy to use on crowded bands stuffed with big signals. They also offer a near-infinite array of "brick wall" filters, unlike superhets, which offer only a few (or one). SDR filters, implemented in the digital domain, do not ring or sound mushy, even at 100-Hz bandwidths. You can tune in a weak CQ right next to a powerhouse ragchew, click in a super-narrow filter and you'd never even know the "offending" signal was there. There's no AGC thumping, no front-end desensitizing, no nothin', except the signal you're zoomed in on.

SDR digital gymnastics also include high-performance noise-reduction, notch filters, binaural reception, RX and TX audio equalization, and much more, but the raw RF performance and spectrum display tuning are universally well-received among converts.

Disadvantages

There are rough spots with any maturing technology, and SDRs have them aplenty. PC-based SDRs need PCs, of course, which limits their flexibility and portability. SDR transceivers can be very challenging to connect, configure and set up though receivers are less so. While Gen 2 models don't require the often-complicated sound card interconnects that Gen 1 models do, the SDR software itself has hundreds of settings that can, or likely need, to be tweaked. PC-based SDRs are not yet "plug and play," but they do offer unparalleled flexibility. It's a double-edged sword!

Despite their captivating displays and generally awesome performance, the ergonomics of actually using an SDR on the air aren't for everyone. If you've grown accustomed to knobs and switches, PC-based SDR operation can be quite frustrating. To some ops the missing "radio feel" is just too much.

Because SDR software runs on your PC, getting PC-based SDRs to "play nice" with other ham software such as logbooks, contesting software, digital-mode controllers, CW and voice keyers, etc, can be difficult. Success can require extreme multitasking, the use of multiple monitors, and complex configuration schemes for mapping virtual COM ports and internal audio redirects. Gen 3 radios may offer some improvements here.

Unless you're using a dedicated hardware tuning knob or control box for your SDR (an external accessory for some models), it can be difficult or impossible to tune or control your SDR in any way when the mouse pointer is "focused" on another open program (such as your logbook or PSK-31 software). Clicking back and forth between SDR and contest software windows, for example, perhaps with each displayed on a different monitor, can require lots of mouse-hand gymnastics and back-and-forth clicking *for every QSO that gets logged*.

The Catch 22 of SDRs is that you can't really get a feel for them without using one on the air. You'll discover things you like (or make you crazy) months into the experience. However, what's insurmountable to one ham is trivial to another, so sooner or later it's going to happen. It's just a question of when!

Software

PC-based SDRs require software to function, and although some models (mostly Gen 1) support a wide variety of open-source SDR software, many models require specific software versions or even proprietary software to function at all. If your favorite PC/operating system can't support the required SDR package, your shiny new SDR is nothing more than an expensive doorstop!

SDR software is being constantly improved to provide ever-better performance and ever-new features, but you must make sure your radio and your PC/operating system are compatible. As always, check the requirements ahead of time to minimize frustration!

SDR BUYER'S GUIDE

Globally, there are dozens of SDR transceivers available as kits, semi kits and fully assembled radios, and those are only the rigs that identify themselves as SDRs! Our apologies go in advance to those whose makes and models we missed or excluded. Superhet/SDR hybrids aside, because of space limitations, to be considered here a radio has to be *marketed* as an SDR, be reasonably available to U.S. buyers, have enough market presence to be discovered by average ham buyers, and use PC-based SDR software (two notable exceptions are included in this guide).

Many SDRs are available as kits or semi-kits that require a wide range of skills to successfully assemble (some easy, some extreme). Make sure you're up to the task or have sufficient help lined up before going that route. As with any purchase of emerging technology, do your homework before you buy.

Generation 1 SDRs

Gen 1 SDRs require high-performance sound cards (or other ADC/DSP hardware) and PCs running specialized SDR software (there are many available, most are free). A stereo sound card is required for RX, and a second stereo card is required for TX (or a single high-end card with both built-in). The pioneering FlexRadio SDR-1000 used this approach although most Gen 1 units today are kits.

Gen 1 SDRs are great for exploring and experimenting. When paired with high-end sound cards even simple Gen 1 SDRs can offer outstanding performance, but assembly, setup and interconnections can be challenging. Not recommended for non-technical types!

Softrock RXTX Ensemble: KIT, $, GOOD, MT-PICK

This 1-W, multimode SDR transceiver can be built for full coverage of one of the following five band groups: 160; 80-40; 40-30-20; 30-20-17; 15-12-10. Components are included for all five options. The circuit board, which measures 5 x 2.5 inches, has mostly surface-mount parts, so SMT soldering experience is a must. Tony Parks, KB9YIG, the rig's designer and the "father of affordable SDR experimentation," says nearly 17,000 Softrock kits have been sold to date (more RX than TX). All Softrock models enjoy a strong online support community and an active user base. The RXTX Ensemble is probably the least expensive way to explore SDR. The kit costs $90 and is available factory-direct at http://fivedash.com.

Courtesy: http://fivedash.com

GenesisRadio G11: KIT, $$, BETTER

This 10-W, multimode SDR transceiver can be built for full coverage of two to five ham bands from 160-6 meters. See the order page for details. All 600+ surface-mount components are factory installed and the remaining 60 through-hole components take about eight hours to assemble. The G11 requires GenesisRadio's proprietary software, "GSDR," to operate. The factory-direct G11 kit costs $300; $350 with custom enclosure. According to Genesis distributor Bruce Greenleaf KF1Z, an add-on kit that enables all-band coverage (160-6) is expected in early 2013 with a target price of $150. See www.genesisradio.com.au and www.greenmountainradio.com/G11/order.html for more info.

Courtesy: www.genesisradio.com.au/G11

Generation 2 SDRs

Most Gen 2 SDRs require reasonably fast PCs outfitted with Firewire and/or USB ports that meet certain performance specs and proprietary SDR software (unlike Gen 1, you usually can't pick and choose your SDR software). Gen 2 SDRs generally outperform Gen 1 radios and, although still complex, are usually much easier to get up and running.

FlexRadio FLEX-1500: ASSEMBLED, $$, GOOD, MT-PICK

This 5-W, HF+6 multimode transceiver (RX 0.01-54 MHz) can put out as little as 1 mW and is designed to also work as an IF deck for external VHF/UHF/microwave transverters. Features: 48-kHz-wide panoramic band scope display with point-and-click tuning, sophisticated DSP filters, noise-reduction, advanced AGC, and very high RF performance for its price. It outperforms previous-generation superhets costing many times more. A full feature matrix can be found at www.flex-radio.com.

Courtesy: FlexRadio

The tiny and versatile FLEX-1500 is the most affordable way to get your feet wet with a Gen 2 SDR that's powered by FlexRadio's proprietary PowerSDR software. The '1500 requires a Windows PC with high-performance, low-latency USB ports (often easier to find on older PCs than on new!). Some users experience T/R and keying issues related to USB implementation. Available factory-direct for $650.

FlexRadio FLEX-3000: ASSEMBLED, $$$, BETTER

This 100-W, HF+6 multimode transceiver (RX 0.01-65 MHz) isn't set up to handle transverters like its little brother, but the "middle child" of FlexRadio's Gen 2 series boasts better specs in every critical subsystem, including a 96-kHz-wide spectrum display and a Firewire PC interface that eliminates any potential USB connectivity problems. A full-feature matrix can be found at the Flex website. Running FlexRadio's PowerSDR software, the FLEX-3000 is a high-performance "single receiver" Gen 2 radio. Available factory-direct for $1700.

FlexRadio FLEX-5000: ASSEMBLED, $$$$, BEST

This 100-W, HF+6 multimode transceiver (RX 0.01-65 MHz) is FlexRadio's Gen 2 flagship. With specs that are even better than those of the already strong '3000 (and still running PowerSDR), the FLEX-5000 adds a 192-kHz-wide spectrum display, optional VHF transverters, an optional internal second receiver, cross-band, cross-mode operation, etc. This high performer may be eclipsed by FlexRadio's upcoming Gen 3 models. Available factory-direct for $2,800 (base radio); $3,400 (with built-in second RX); $3,600 (with RX2 and built-in autotuner).

Generation 3 SDRs

Most Gen 3 "direct-sampling" models use proprietary software that can run well on less-powerful PCs (or perhaps tablets and smart phones) because the SDR number crunching is done by the radio's internal FPGA. Gen 3 transceivers promise unheard-of performance and never-before-seen capabilities, but they're just starting to become available to "average ham" buyers and don't have an established track record. This technology is experiencing accelerated evolution, so don't stop your research here—keep checking! A year from now we'll know much more.

Software Radio Laboratory QS1R/QS1E: ASSEMBLED, $$$, GOOD.

The QS1R (RX), when paired with the QS1E (add-on internal TX board) and any necessary T/R switching circuitry (not supplied), makes a 2-mW, HF+6, multimode direct-sampling transceiver (RX 10 kHz-62.5 MHz) that can simultaneously receive on multiple bands (or band segments) totaling up to 2 MHz in aggregate. The QS1R/QS1E runs SDRMAX software (USB2 interface), which is cross-platform compatible with Windows, Linux and OSX (other software can also be used). All firmware, software, and FPGA microcode is freely available for modification by owners (and supported by an active user community). If necessary, external RX/TX band-pass filters and amplifiers must be supplied by users. QS1E add-on recommended for tech types only. Available factory-direct from www.srl-llc.com for $900 (QS1R Rev D RX); $300 (QS1E TX add-on).

from www.srl-llc.com

FlexRadio FLEX-6500: ASSEMBLED, $$$$, BEST (expected rating, not shipping at press time).

This 100-W, HF+6 multimode transceiver (RX 0.03-77 MHz) aims to provide a quantum leap forward for amateur radio transceivers. Designed for unparalleled ease of operation and powered by FlexRadio's SmartSDR software, the '6500's internal FPGAs and embedded digital hardware can perform an almost ridiculous 78 GFLOPS (billion floating-point instructions per second). Typical SDR FPGAs can do 1-4 GFLOPS, while a $1,000, 8-core Intel CPU can do about 100 GFLOPS at 100% load on all cores!

This much computing power, combined with top-shelf components throughout, provides essentially every existing SDR function plus: four independent, full-performance receivers (anywhere in the 0.03-77 MHz range), each with 384-kHz-wide spectrum displays; receiver dynamic performance so high "it no longer matters" (FlexRadio brochure) and may not even be measurable by most existing labs; multiple antenna and XVTR ports; super-fast digital QSK; GPS Disciplined Oscillators (GPSDO, add-on) for lab-grade accuracy; Gigabit Ethernet interface with future WAN/Internet connectivity (simultaneous remote operation by multiple users); and enough built-in smarts to intelligently control, monitor and interface with external amplifiers, tuners, rotators, antennas, etc. For a comprehensive feature list or to order factory-direct, see the FlexRadio website. Price: $4,300 (radio), $700 (GPSDO add-on).

FlexRadioFLEX-6700: ASSEMBLED, $$$$$, BEST (expected rating, not shipping at press time)

If FlexRadio has its way, this 100-W, HF+6, multimode transceiver (RX 0.03-77 and 135-165 MHz) will be the only rig in town that can outperform its own FLEX-6500. The two boxes are quite similar,

continued on page 15

MT's Guide to Buying a Shortwave Radio

By Ken Reitz KS4ZR

A never-ending recession has continuing consequences and among those are that radio manufacturers are less interested in building new product lines or even improving older lines. Meanwhile, consumers are spending more time analyzing their future purchases and trying to get the most out each dollar spent.

If you're a newcomer to shortwave listening now is a perfect time to get into the hobby. There are excellent products on the market, plenty of sources for good, free advice and reputable as well as knowledgeable places to make purchases.

If you're a veteran shortwave listener you already know that moderately priced, top-grade receivers are available to you that outperform virtually anything off the shelf from the "good old days" of shortwave listening.

Radios with a Purpose

Most inexpensive portable shortwave radios can tune well down below 500 kHz, but that doesn't mean that you'll hear much there. Those radios are sold worldwide and in Europe, for example, where longwave transmissions are widely used, they may work well. But, usually that's not the case on this side of the Atlantic. So, you have to know your expectations before you can decide on a set to buy. If longwave DX is your interest, you're better off buying a more serious radio.

The very best of today's shortwave receivers are Software Defined Radios (SDRs), such as the WiNRADiO or AOR full-coverage receivers seen advertised in this magazine. They typically feature extremely wide coverage from 40 kHz to over 3 GHz, have selectivity and sensitivity suitable for international intrigue, more filters than can be imagined and memory channels numbering in the thousands. But, they're not cheap and they're not portable. In other words, such sets are not the place for beginners to get their feet wet (unless, of course, you have extraordinarily well-heeled feet!).

Even so, beginners who are serious about shortwave will need more than they can get from the typically inexpensive shortwave portable. They're looking for better sensitivity, selectivity and advanced features such as multiple filters, external antenna options and computer interfacing that will let them experiment with digital communications such as Digital Radio Mondiale (DRM). In this category there are several options that are not that much more than you might pay for a top-rated portable.

The venerable Icom R-75 ($720) and the newer Alinco DXR8T ($450) are examples of traditional table-top wideband shortwave receivers. The Ten-Tec RX-320D ($385) and RFspace SDR-IQ ($500) are examples of very capable SDRs that exceed anything anyone's portable can do and challenge the features found in the more expensive traditional table-top sets.

But, before you get too excited about using an SDR, remember that you do need a fairly robust computer to actually hear anything. Both of the aforementioned sets require a computer running Windows 2000 XP or Vista. DRM reception requires extra, though free, downloadable software. You also have to remember that, regardless of how capable your new radio is, you will not get the most out of it without some sort of external antenna.

Everyone's a Critic

Buying a shortwave radio in a retail setting used to be so easy. Even in Radio Shack stores of days long ago salespeople understood the basics of shortwave radios. Not so today. You'll be lucky if your local Shack associate can find the right battery you need for your flash light, let alone give advice on anything other than cell phone plans.

The best possible advice is only a toll-free phone call or just a click away. Virtually all specialty radio retailers including Grove Enterprises (800-438-8155), Universal Radio (800-431-3939) and most amateur radio retailers have sales people who know their products well and can make recommendations based on your needs and finances. Be sure to check the web sites of all retailers selling the radio in which you're most interested; prices vary widely among them and some may have special, limited time offers that could really help you make up your mind.

But, what should you buy and how can you find out what current owners of the one radio that's really caught your eye feel about their purchase? There's no better place than eham.net. On the left-hand side of their homepage click on "Product Reviews," then click on "Receivers General Coverage." That brings up a list of 392 products spanning the universe and history of shortwave listening. Golden oldie brands such as National, Lafayette, Zenith Transoceanic, JRC, Hallicrafters, Hammarlund, and Drake are found along with today's best sellers from Kaito, Grundig, Tecsun and Sangean.

As with any online reviews you may read, some reviewers are more knowledgeable than others. Some have little experience with radios in general and you have to try to weigh their inarticulate grumblings along with the studied opinions of old hands.

Reviews on eham.net are ranked on a scale of 1 to 5. The average rating of any particular product will be at the top of the product page. A glance down the main list may tell you all you need to know. But, pay attention to the number of reviews posted. If there are only a handful of reviews with a 2.5 or 3 average, the jury may still be out. But, if there are 20 or more reviews on a particular product, you could have some good crowd wisdom working for you. Another thing to look for on these reviews is how recently the product has been reviewed. If the last review was a year or more ago, it's not likely to be a popular model or perhaps it's been discontinued.

Here's what they're saying about some popular sets at eham.net: The Sony ICFSW7600G had 24 reviews averaging a 4.2 out of a possible 5; a pretty good score. The Kaito 1103 had 51 reviews and earned a 4.5 average; a better score. The ICFSW7600G has been replaced by the ICFSW7600GR ($160 at Universal Radio) and should be a comparable radio. The Kaito 1103 ($90 at Grove Enterprises) seems a better buy based on reviews and price. You can save $70 buying the Kaito.

What are the best current radios, according to eham.net? Predictably, the Icom-R75 got 73 reviews and earned an impressive 4.7 out of 5. The Grundig Satellit 750 ($300) received 40 reviews and earned a 4.1 out of 5. Late reviews from this year were solid 5.0 but there was a time in 2009 when reviewers complained about quality control issues and gave it 2s. This could be an indication that the QC issues were addressed and the product actually improved. You can see the value of mining these reviews for insights into the product that interests you. This information may also help to steer you clear of three year-old Satellit 750s that you may find used at bargain prices.

The Used Market

Some of the best bargains in shortwave radios can be found in the used market. But, as you might expect, there are some caveats. Buying from a reputable dealer with whom you've done business lets you buy used equipment with confidence. Buying from auction sites may work just as well, but the potential for difficulty is greatly elevated. Before you catch auction fever you can check out the prices currently paid for the model in which you're interested. Unless there is a particular reason, cherished childhood memories for example, you shouldn't pay more.

There is one other aspect to consider regarding vintage radios. Unless you are equipped to repair and service this sort of radio you should know that it's become difficult to find shops that can do repairs on vintage solid state radios. My trusty old Uniden CR-2021, which was a terrific all-band portable that was in daily service for more than 30 years, finally stopped functioning several months ago. After a rigorous search, I located a service tech who specialized in vintage portable shortwave sets. He said, "Unless this is a radio of great significance or some treasured personal item, it's not going to be worth what I will charge to troubleshoot this radio. Even if I do find the problem, it's likely that the parts required to fix it have long been out of production." Such shops will typically charge a flat bench fee, parts plus labor and shipping both ways. Once you figure up the expenses, it could become obvious that a new radio, with a warranty, is well worth the price.

Scanners in Transition

By Larry Van Horn N5FPW, *MT* Assistant/Technical Editor

In the last 20 years we have seen some major changes in the world of VHF/UHF communications. Fortunately for those of us in the radio hobby, scanner manufacturers have kept up with those changes allowing us to continue monitoring land mobile radio communications.

The area in which we have seen this the most is the slow but progressive change from conventional to trunked radio systems and the scanners that can monitor these communications. Another significant part of this technology revolution has also involved a changeover from analog to analog/digital capable scanners.

Despite all that has been written in this magazine, as well as in online scanner groups and forums, an age-old question is still being asked by many radio hobbyists: "What scanner do you recommend I buy?"

In short, the best answer I have is that this is a very difficult question to answer straight up without some additional information from the potential buyer. What do you want to monitor? Where do you live? How much do you have to spend? Do you want a handheld (HH) or base/mobile scanner (B/M)? Should you buy new or used?

The answers to those questions will help you determine whether you should purchase a conventional versus trunking and analog versus digital scanner.

The Basics

A scanner is a frequency agile radio that will allow you to program various radio frequencies which it will then scan as it looks for activity on those frequencies that you can then monitor. The traditional scanners from Uniden/GRE are optimized for frequencies between 25 and 1300 MHz, basically the police, air (civilian/military), fire, EMS, marine and federal government/military or what are called the "action bands." This optimization includes presets (modes, steps and functions) that are automatically set based on the frequency range being monitored.

If you want extended frequency coverage (i.e., shortwave and AM/Longwave coverage below 25 MHz, and UHF to microwave frequencies above 1300 MHz), a wide-band communications style receiver/handheld should be considered in your buying equation. But you will have to deal with a more limited set of traditional scanning functions, including the ability to decode digital communications or follow a trunked radio system with these receivers.

As with most consumer items, there is no one "best" scanner radio for everyone. For example, if you want to simply listen to your local police and fire departments, a basic, low cost scanner will do fine as long as they aren't trunked or using digital modes. As you move up in price, you add capability such as analog trunking. Increase that price more and you add the ability to decode conventional and some digital trunking modes.

Beginner conventional scanners can start at less than $100. A good analog-only trunk tracking scanner can be purchased for less than $200 (street price); however, if you need to monitor an APCO P25 digital trunk radio system, that price quickly jumps above $400.

The used market does provide an attractive, low cost alternative for the new radio hobbyist. The caution here is to ensure that the product you are buying will meet your scanning needs and, of course, the watchword whenever dealing in used products is: *Caveat Emptor* "Let the buyer beware."

So if you have an idea what you want to monitor, the next step is to determine what frequencies are active in your area that you are interested in monitoring. A good source of information available online is the *RadioReference.com* website database at **www.radioreference.com/**. This database will go a long way toward helping you decide what scanner you need to buy and should be consulted before any scanner is purchased.

When you are researching your local area, check to see if you need to have trunking and/or digital capability. If a trunking system is used in your area, and you want to monitor it, be sure to note the system type and system voice lines on the *Radio Reference* page that has the data on your system. That information will help drive your decision of analog or digital.

A common mistake made by the new scanner purchaser is to have an interest in military air communications, for example, only to discover after the purchase that their new scanner does not cover that band. Our guide in this article will help you in that decision process.

Conventional versus Trunking Scanners

A conventional scanner is designed to follow a series of discrete frequencies programmed into the scanner, each one carrying separate types of conversations. Conventional scanners cannot properly follow conversations on a trunked radio system. If you want to monitor a trunk radio system, you need a trunk tracking scanner.

A trunk-tracking scanner is designed to allow the user to program a set of trunk system frequencies that are used among several channels or agencies on a shared basis. A trunk tracking scanner can also perform the same scanning functions as a conventional scanner.

We have covered trunk basics here in the pages of *MT* in our *Scanning Report* written by Dan Veeneman. You can review many of Dan's *MT* columns on his website at **www.signalharbor.com/**.

The most common trunking system types that can be monitored on trunk tracking scanners in today's marketplace include: Motorola, EDACS, LTR, and Project 25. Scanners are available to work with all of these types of systems, but not all scanners currently being sold can receive all of these types.

The analog mode is still the most common type of transmission currently in use by land mobile services; however, it is giving way slowly to digital modulation modes. All scanners sold in the marketplace today are capable of monitoring analog transmissions. When applied to public safety monitoring, this typically means FM transmissions while aircraft monitoring uses AM mode transmissions. A few scanners and many wideband receivers can also receive the wideband FM signals used by FM broadcast stations.

When digital modes are introduced into the scanning equation, this is where things become a little more involved. Over the years, various methods of digitally encoding voice have been developed. Public safety agencies today use two main ones that you will need to be concerned with: P25 CAI and ProVoice.

When purchasing a digital scanner, the important thing to remember is that there are "no" scanners capable of decoding ProVoice or any of its variants. There are other digital modes that you may run across including Motorola VSELP and OpenSky, both of which cannot be monitored.

Into today's marketplace the only digital mode used that can be monitored by scanners are the APCO-25 (P25 CAI) digital transmissions. Do not confuse the P25 Common Air Interface, which is just the audio encoding method, with a Project 25 system which is the entire trunking system that uses a 9600-bps control channel. The important thing to remember is that the ability to decode any P25 digital modulation comes with a premium price.

Scanners by the Numbers

To better understand what scanners are available relative to cost, I have prepared the following scanner market guide. Prices listed below are retail, street prices will be considerably less at Grove Enterprises and various dealers who advertise here in *MT*. An * indicates full frequency coverage of all major public safety bands (less cellular), including civilian and military air.

Level 1: Crystal-Controlled Scanners.

Avoid these scanners for anything other than antique-radio collections.

Level 2: Budget Scanners.

These were the very early pioneers of the programmable scanner industry. Models such as the old Bearcat scanners (i.e., 210/220/250),

the Regency scanners and others were common place. Scanners in this category receive the major "action bands" mentioned previously. They have a limited number of memory channels, may not have a search mode for finding new stations, and usually do not receive any aircraft communications. These scanners are adequate for people in many rural areas interested in listening to only one or two public safety agencies, such as their local police or fire department and are only found in the used marketplace.

Level 3: Conventional Scanners without 800 MHz.

These radios have more features than the level 2 budget scanners. They receive all major "action bands" except 800 MHz. Some even include the civilian aircraft band. They typically have more memory channels, so you can listen to more agencies and they usually do have a search mode. These scanners are recommended for users who do not need 800 MHz coverage or trunking, such as users in a rural area or those only interested in hearing aircraft communications.

No rating yet	GRE PSR-110 (HH) this is a specialized racing scanner with only 450-467 MHz frequency coverage. Price to be announced, not yet FCC type accepted.
Good	GRE PSR-100 (HH) No milair but does have civilian air coverage: $100
Good	GRE PSR-200U (Base only) No milair but does have civilian air/FM broadcast coverage: $100
Good	Uniden BC340CRS (Base only) No milair but does have civilian air AM/FM coverage: $140
Better	Uniden BC-125AT (HH) it does have civilian and milair coverage: $180

Level 4: Conventional Scanners with 800 MHz

These scanners can hear all major "action bands" plus civilian aircraft. One below also has military air frequencies. Frequency coverage normally includes: 30-54, 108-174, 406-512, and 806-956 MHz. They can monitor 800 MHz conventional radio systems and can monitor audio on analog trunked systems, but cannot follow the conversations as they hop across frequencies.

Good	GRE PSR-120 (HH) No milair but does have civilian air coverage: $120
Good	Uniden BC355C (B/M) No milair but does have civilian air coverage: $150
Good	Uniden BC95XLT (HH) No milair but does have civilian air coverage: $150
Better	Uniden BC370CRS (Base only) Does have both civilian and milair coverage: $200

Level 5: Analog Trunk Tracker Scanners

These radios can follow conversations on analog (non-digital) trunked radio systems and conventional radio frequencies. These scanners contain all major "action bands," both civilian/military aero bands (except for two models), they can trunk track Motorola Type I, II, and I/II hybrid systems, and analog EDACS/LTR trunking systems.

Good	Uniden BC346XT (HH) No milair, but does have 700 MHz / civilian air coverage: $220
Good	Uniden BCT-8 (B/M) No milair / 700 MHz but does have civilian air coverage: $320
Better	GRE PSR-310 (HH)*: $200
Better	GRE PSR-410 (B/M)*: $200
Better	Uniden BCT15X (B/M)*: $300

Level 6: Digital Trunking Scanners

These scanners can follow analog (Motorola/EDACS/LTR) / digital trunked and conventional radio frequencies. All radios at this level have a built-in or add-on device for decoding the Motorola APCO-25 digital protocol. Due to their high price, they are recommended only if the agencies you would like to monitor are APCO-25 digital. Such scanners will not decode encrypted voice or voice transmitted in other, incompatible digital formats.

Best	GRE PSR-500 (HH)*: $450
Best	GRE PSR-600 (B/M)*: $450
Best	Uniden BCD396XT (HH)*: $600
Best	Uniden BCD996XT (B/M)*: $600

Level 7: Memory Card Scanners

There are currently three scanners in this category, and one in development. Two of the three are considered the top of the line; the Uniden HomePatrol-1 and the GRE-800. This type of scanner is easy to use, easy to program, can be used as a handheld or a mobile/base and they also carry the highest price tag. They all use memory cards and are updated via the Internet, so a PC and Net connection is a must.

No rating yet	GRE PSR-900 (B/M) Digital trunking* Price to be announced, not yet FCC type accepted.
Better	GRE PSR-700 (HH) Analog trunking*: $230
Best	GRE PSR-800 HH Digital trunking*: $500

Uniden Home Patrol (HH/B/M) Digital trunking*: $600

(Author's Note: We continue to rank this scanner the best of the best for the beginner and advanced user alike. Features, portability, capability and ease of use are just a few of the reasons we rank this scanner so high. The HP-1 still has no equal in the marketplace as of press time).

In the Future

We believe that we will still continue to see scanners developed in all the major categories, analog and digital, with more units in the future utilizing memory card technology.

Even though we continue to see major state, metropolitan, military and government land mobile radio systems going digital, we are confident that there will continue to be analog radio systems in use.

Company personnel from MyRadioCompany.com / Strutman Electronics in Cuba, Missouri, a major land mobile radio equipment retailer, put it this way, "There is a common perception that most of the radios produced from now on will use the best of digital technology. But the importance of analog radios can never be done away with. Owing to its compatibility and low costs on radio designs, analog radios are unlikely to get wiped off completely from the market."

So now it is time for you to apply the information gathered in this article to make your decision on which scanner you want to buy. You can get additional help and details on current available scanners on the Grove Enterprises website/online catalog at **www.grove-ent.com/**.

Bottom line: Whether it is analog or digital or conventional versus trunking, only you can provide the final answer what scanner is best for you.

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Can One Antenna do it All?

By Bob Grove W8JHD

Very few of us have enough real estate to put up an antenna farm, and very few upscale neighborhoods would approve of a property that looks more like an outdoor hardware store. While VHF/UHF antennas are small and more of them can be accommodated than shortwave dipoles, we often have to make a final compromise in antenna selection.

But are there some antenna designs that can produce the operator's required specifications over a wide frequency range? There are many variables to be considered like frequency span, directivity, and transmit capability. Let's take a brief look at some of these challenges.

Proposition 1: I want to listen to shortwave broadcasters from around the world. I also listen to local AM broadcasters and occasionally to low frequency signals as well. What's the least expensive way to do it?

That's easy. Run a wire (any copper wire, insulated or bare, solid or stranded) at least 20-30 feet in length from the outside of your house to a tree as high as practical. Any longer than about 50 feet is unnecessary. Solder the center conductor of a length of any standard coaxial cable (RG-58/U, RG-59/U, RG-6/U, RG-8/U, X or M) to the close end of the wire. Be sure the shield of the coax is connected to the appropriate receiver connector.

Proposition 2. I live in an underground apartment with metal siding and roof. I'm not allowed to put up an outside or attic antenna. What can I do to get good reception?

Move.

Proposition 3. Can I use a random antenna like the one above for transmitting as well?

Absolutely, but you'll need a "tuner" (transmatch) to adjust the nominal 50 ohm impedance of the transmitter/transceiver to the variable impedance of the antenna system. The transmatch won't change anything in the transmitter, antenna cable, or antenna wire; it merely adds inductance and/or capacitance for conjugate matching. That means that the transmitter does "see" 50 ohms due to the additional components now in line.

To maximize the system efficiency and effectiveness, it's best to use thick wire, low-loss coax, and a length of antenna element that is easily matched by a transmatch.

Proposition 4. I have a wide-frequency-coverage scanning receiver which allows me to hear local AM broadcasters, international shortwave, and VHF/UHF public safety communications. Since it has only one antenna port is there one antenna that can receive all ranges effectively?

That's the big question. There are antennas that work well over a wide frequency range, and there are simple ways to combine antennas for the wide divergence of frequencies. The simplest is to use a conventional two-way TV splitter commonly used to connect two TV sets to one antenna. Only you would use it in reverse, connecting two antennas to one output.

Keep in mind that the higher the frequency, the lossier your coax becomes. It's wise to select low-loss cable like RG-6/U, RG-8/U or X or M, or LMR400 for runs exceeding 20 feet at UHF.

Proposition 5. I know that shortwave antennas are pretty easy to design with only a 2-30 MHz frequency range, but what about VHF/UHF scanners with a 30-1000 MHz typical span?

There are four ways commonly used to widen VHF/UHF coverage on a single antenna: discone design, log periodic beams, trap antennas with in-line coils to electrically separate resonant lengths, and multiple element lengths joined together at the base. All these techniques are useful for transmitting as well as receiving.

Proposition 6: I can put up an outside shortwave antenna if it's not obvious. Is this possible?

Absolutely if you select an active antenna. This design utilizes a small element with a high-gain amplifier. Their advantage is compact mounting convenience; outdoors is recommended to avoid household electrical interference.

So what's available on the commercial market?

It's very hard to pick the "best" antennas since so many variables come into play. What's best for one application isn't always best for another. We'll take a look at some the most popular wideband models using 30 MHz to separate long/shortwave versus VHF/UHF frequency ranges. The absence of makers and models from our listings does not imply poor performance or quality, only the limitation of page space.

MFJ 1020C ($90): Covering 300 kHz to 30 MHz, this frequency-selectable active antenna can be mounted right in the radio room for convenient adjustment. The downside of any indoor antenna is that it is vulnerable to electrical interference from appliances, fluorescent lighting, switched-capacitance power supplies, and many other household, radio frequency interference (RFI) generators. Available from MFJ, Universal Radio, Amateur Electronic Supply, Ham Radio Outlet, Grove Enterprises.

AOR LA390 ($420): This indoor, active loop antenna can be switched through four bands for 10 kHz-500 MHz reception on shortwave and scanning receivers. Since it's intended for indoor use, it's vulnerable to the usual environmental electrical interference sources. But properly positioned, it does a good job. Grove Enterprises, Universal Radio.

AOR SA7000 ($270): Consisting of two parallel whip antennas covering 30 kHz-2000 MHz, the SA7000 is designed to meet the trend of wide frequency coverage receivers. With a maximum height of only 72 inches, the lightweight package can withstand winds in excess of 100 miles per hour. A good choice for portable tactical applications. Available from Universal Radio, Grove Enterprises.

G5RV ($45): Named after the call sign of the inventor, this popular HF dipole is useful for transmitting and receiving over the entire 2-30 MHz spectrum; a transmatch is required for transmitting. Although a conventional HF dipole can do the same thing, this one is listed here because of its reputation for easy tuning with a transmatch. Available from MFJ Enterprises, Universal Radio.

LF Engineering H-900 Gain Probe ($149): This small active antenna provides reception from 10 kHz through 30 MHz. Includes 50' coax for outdoor mounting, may be powered by internal batteries or AC adaptor (supplied). Available from Grove Enterprises, Universal Radio.

PAR End Fedz ($75): Excellent receiving antenna for the 1-55 MHz range. Has a reputation for low noise pickup. Rugged Flex Weave construction covered with polyethylene jacket. Matching transformer, SO-239 connector. Available from Grove Enterprises, Universal Radio.

Gap Challenger DX ($370): For compact HF/VHF coverage, this vertical cluster antenna can transmit on

eight ham bands: 80, 40, 20, 15, 12, 10, 6 and 2 meters. Measuring 31.5 feet in height and weighing 18 pounds, it doesn't require any guy wires, but it does require three 25 foot wires for a transmitting counterpoise. Available from Universal Radio, Amateur Electronic Supply.

HF FlexTenna ($15): By far the least expensive and providing 10 kHz-50 MHz continuous reception, the Grove FlexTenna consists of two parallel wire elements ("zip" cord) of 24' and 19' lengths. It can be suspended horizontally, or hung vertically from a tree branch. Female F connector allows attachment to standard TV coax (RG-6/U or RG-59/U). Available from Grove Enterprises.

Grove Hidden Flex-Tenna ($20): This modification of the HF antenna described above has an additional wire element for VHF/UHF reception. It is intended to be strung lengthwise through an attic space with the VHF/UHF element hanging down vertically to favor local communications. Frequency range for reception is 10 kHz-2500 MHz. Available from Grove Enterprises.

Create CLP5130-1 ($450): This vertically polarized log-periodic beam has an operational bandwidth with gain and directivity from 50-1300 MHz. It is a popular choice for DX (distance) VHF/UHF monitoring and transmitting. You'll need a rotator for it unless you want to concentrate on a particular compass direction. A 108-1300 MHz model, the CLP5130-2, is $320. Both models are available from Ham Radio Outlet, Universal Radio, Grove Enterprises, Amateur Electronic Supply.

Scanner Beam ($70): Modeled after traditional TV antennas, the Grove Scanner beam stands alone for a low cost, directional, wideband, VHF/UHF antenna. Intended for reception of the 30-1000 MHz spectrum, the Scanner Beam can also transmit at low power (a few watts) limited by the use of a conventional TV balun transformer. Available from Grove Enterprises.

Super-M Ultra Mobile and Base ($125): This VHF/UHF cluster antenna on a mobile base from MP Enterprises has the widest frequency coverage we've seen so far. The manufacturer claims continuous 25-6000 MHz reception capability and 120-6000 MHz for transmitting, making it ideal for wide frequency coverage mobile applications. A full-size mast-mount version is also offered ($190). Available from Universal Radio, Grove Enterprises.

Hy-Gain AV-18HT HyTower ($950): Claimed by the manufacturer as "The world's best performing vertical," it's also expensive. Covers 80/40/20/15/12/10 meters with 17 and 160 meters optional. Receives 1-30 MHz continuous coverage. The HyTower is 53 feet tall with its hinged tower. No external tuning required, and it's self-supported on a user-supplied concrete-base pedestal. $1180 with 17/160 meter options. Available from MFJ, Ham Radio Outlet, Amateur Electronic Supply, Universal Radio.

Diamond D3000N ($210): Currently the widest frequency coverage discone on the market, this omnidirectional antenna is rated for reception from 25-3000 MHz, and transmitting from 50-1200 MHz. Available from Universal Radio, Grove Enterprises.

Diamond D-130J ($100): Probably the best known discone, this low cost antenna works well for reception from 25-1300 MHz and transmitting from 50-1200 MHz. Available from Grove Enterprises, Universal Radio, Ham Radio Outlet.

WEBSITES FOR LISTED DEALERS

Amateur Electronic Supply (Multiple U.S. stores): **www.aesham.com**
Grove Enterprises: **www.grove-ent.com**
Ham Radio Outlet (Multiple U.S. stores): **www.hamradio.com**
Universal Radio: **www.universalradio.com**

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SDR Feature continued from page 10

with the most significant additions being a total of eight independent receivers, coverage of 135-165 MHz (RX on any antenna port, TX via XVTR ports) and embedded computing hardware that can hit 121 GFLOPS! For a comprehensive feature list or to order factory-direct, see the FlexRadio website. Prices: $7,500 (radio), $700 (GPSDO add-on).

PCs Not Required

Software-defined radios don't necessarily require PCs to function, and most of today's top-performing models incorporate SDRs internally, but are not identified as such. Two radios in this Guide do not require external PCs despite being marketed as SDRs. As SDRs evolve and lose their connotation with complex, experimental Gen 1 designs, this welcome trend will likely continue.

Midnight Design Solutions SDR Cube: KIT or ASSEMBLED, $$, GOOD.

This 1-W, single-band (80, 40, 30, 20 or 17 meters), multimode HF transceiver is a flexible, self-contained QSD/QSE radio that doesn't require a PC. At only 4 inches square, the SDR Cube pairs a Softrock SDR transceiver board (built-in or external) with a dedicated DSP controller and a full-featured "front panel," complete with knobs, switches an LCD frequency readout, and an 8-kHz-wide spectrum display. Add plenty of I/O connectors, experimenter-friendly firmware and an active support community and you've got a platform for SDR fun and innovation, no PC required. See the complete list of goodies and order factory-direct at www.sdr-cube.com. Prices: $725 (assembled and tested); $520 (assembled and tested, you supply your own Softrock SDR board); $424 (full kit); $293 (you supply your own Softrock SDR board); $40 (PCBs only).

Elecraft KX3: ASSEMBLED or KIT, $$$, BEST, MT-PICK

This 10-W, multimode, HF+6 transceiver (RX 0.5-30 MHz) is a standout achievement. About the size of a house brick and weighing 1.5 pounds (trail friendly), the KX3 is a competition-grade "do everything, have every feature" hybrid SDR for home or field use. At press time the KX3 is ranked first on the Sherwood Engineering Receiver Performance Chart when compared to every radio ever tested, regardless of price or size (104 dB dynamic range at 2-kHz signal spacing).

That some of the competing rigs are 20 times the size and cost 10 times as much is a testament to SDR's amazing future. This tiny powerhouse has a full complement of knobs, switches, displays and I/O connectors—it's a standalone radio, no PC required—but includes I/Q quadrature audio outputs for easy PC/tablet spectrum display connections (and is fully PC-controllable via the usual CAT commands).

To many ops this provides the best of both worlds: a conventional radio with knobs and switches with the hi-res spectrum display of an SDR. The 10-W base radio in "modular, no soldering required kit" form sells for $900, and a large assortment of add-ons allows you to customize your rig (some are available now, some are in the works). You can add modules over time and only pay for the parts you want or can afford. It's a tiny radio that's not a "pure SDR," but there's no better way to put this much performance in your shack at such a low price. It's a Ferrari for the price of a Ford! The KX3 is available factory-direct from http://elecraft.com. Price: $900 (modular kit); $1000 (assembled); $130 (roofing filter); $170 (internal wide-range ATU); $130 (detachable keyer paddle); $60 (internal battery charger).

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SCANNING REPORT

THE WORLD ABOVE 30MHZ

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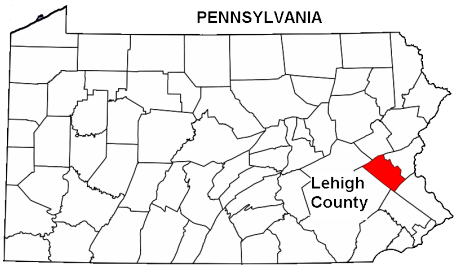
The Encryption of Lehigh County

Encryption of public safety radio systems is a controversial subject. Law enforcement representatives claim that preventing criminals from overhearing their transmissions will increase officer safety and make it harder for the bad guys to get away. Journalists, scanner listeners and those interested in government accountability believe that closing off a source of immediate and unfiltered information harms the public trust in many ways. It reduces widespread awareness of local events and potential dangers, hampers the ability of citizens to aid the police with timely tips and observations, and enables agencies to hide unpopular decisions and unacceptable behavior of their employees.

This month I'll take a look at one particular municipality that has begun encrypting all of their police transmissions and review how encryption actually takes place.

❖ Allentown, Pennsylvania

Allentown is a city in the eastern part of Pennsylvania and is the county seat of Lehigh County. It is the third largest city in the state, with more than 118,000 residents, and covers 18 square miles. The city operates an Enhanced Digital Access Communications System (EDACS) trunked radio system from two repeater sites, one in Allentown and the other in Salisbury.



In August the Allentown Police Department began using encryption on the system, claiming that it will improve officer safety and enhance what military planners call operational security (OPSEC) by preventing criminals from overhearing transmissions. They had previously been encrypting only sensitive activities, such as narcotics investigations, but now are doing so for all transmissions, even routine traffic stops and trouble calls. Allentown police Chief Roger MacLean said, "With this new system the criminal element will not know where our officers are located. It will also make it more difficult for them to try to judge how many officers are on duty at any given time." He added,

pennsylvania EMERGENCY MANAGEMENT AGENCY

"We understand there are people who listen to the police scanner and they may be upset over losing that ability but with today's technology it became very easy for some of the criminal element to also use that technology."

Other Allentown agencies, including the Fire Department and Emergency Medical Services, remain unencrypted (referred to as "in the clear").

Allentown spent $1.1 million to replace their 12-year-old radios and associated hardware. That figure includes upgrades to the 911 Emergency Communications Center consoles and the purchase of 244 handheld radios and 60 vehicle-mounted radios, 25 of which were assigned to Allentown Emergency Medical Service personnel.

One significant problem with encryption is that anyone you want to talk to also must have the same type of encryption. Because the Allentown Police often work with Salisbury and South Whitehall Townships, both of those municipalities also purchased radios just to be able to interoperate.

It is interesting to note that Allentown's purchase comes as EDACS is reaching what manufacturers call "end of life." Harris Corporation, the Florida-based manufacturer of EDACS equipment, has announced that it will stop building EDACS-specific products and instead work to move their customers to systems built on more modern standards like APCO Project 25. Harris intends to cease support for all EDACS systems by 2017 (see the April 2012 *Scanning Report* column for more details). Hopefully, the new Allentown radios can be easily upgraded to an open standard by loading new software rather than having to purchase new hardware. The software upgrade won't be free, of course, but should be significantly cheaper than being forced to buy new equipment in five years.

Allentown
City without limits.

The Allentown upgrade required radios that are able perform two additional functions that the old radios did not. The first step is to digitize the voice information from the user. The second step is to encrypt the digitized voice. Obviously, the radios must also be able to reverse each of these steps; that is, they must be able to decrypt the digitized voice as well as convert digitized voice back into the normal analog form that humans can understand.

❖ EDACS Digital Voice

EDACS has the capability of carrying voice information in three distinct forms. The first and simplest is what Harris Corporation calls "clear," which is just voice in analog form. As long as your scanner has EDACS capability you will be able to monitor and track this type of system without difficulty.

The second form is called "digital," where the voice information is converted from analog into a digital format where it is represented by a sequence of binary digits (bits). A bit is the smallest possible unit of information, taking the value of either '0' or '1'.

Historically speaking, the first digital EDACS format was introduced in the 1980s and was called "Voice Guard." The second digital EDACS format was called "AEGIS" and was a big improvement for users since the perceived voice quality was much better.

The newest EDACS digital format is called "ProVoice" and uses a well-regarded voice encoder/decoder (codec) called Improved Multi-Band Excitation (IMBE) to convert analog sound from the microphone into a sequence of bits. Alert readers might be aware that APCO Project 25 (P25), a competitor to EDACS, also uses IMBE for digital voice. Despite this commonality, the two systems are not interoperable; EDACS transmissions will not be processed correctly by P25 systems and vice versa.

Harris calls the third form of voice information "Private," which is digital voice run through an algorithm that encrypts it prior to transmission.

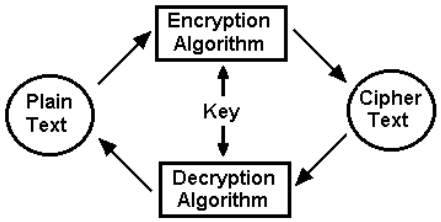
❖ ProVoice Encryption

Once voice information is in digital form, manufacturers can use established methods to encrypt it. These methods take in sequences of bits called *plaintext* and output scrambled, mixed up sequences called *ciphertext*. A corresponding method takes in the scrambled ciphertext and produces the original plaintext. The specific steps used for turning plaintext into ciphertext (encryption) and turning ciphertext back into plaintext (decryption) are defined by a set of operations called an algorithm.

Encryption algorithms use of secret piece of information called a *key* to control exactly

how the scrambling takes place. A key is just a sequence of bits that is shared between the sender and the receiver. Generally speaking, the larger the key (that is, the longer the bit sequence) that an algorithm uses, the better job it does of mixing up the plaintext and the harder it is for someone who doesn't know the key to try and undo that mixing.

EDACS has offered encrypted digital voice as far back as the Voice Guard product. The "Guarded" option encrypted the digital voice using a proprietary method called Voice Guard Encryption (VGE). It used a 64-bit key but the actual algorithm was never published, meaning it was never reviewed for weaknesses by an independent third party. This act of hiding the details of an encryption algorithm is called "security by obscurity" and generally ends badly when it inevitably leaks out and problems are found. This is exactly what happened with the original authentication algorithm used by GSM (Global System for Mobiles) cellular telephones, which was reverse engineered and used to create duplicate SIM cards.

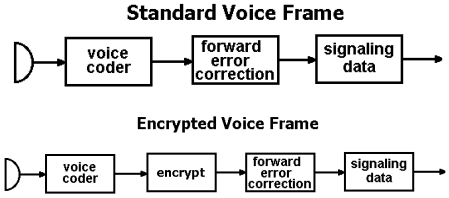


One option Harris offers for encrypting EDACS ProVoice is to use the Data Encryption Standard (DES), an algorithm first developed by IBM in the 1970s and published by the National Bureau of Standards (now the National Institute of Standards and Technology, NIST). DES uses a key that is 64 bits in length, although internally the algorithm only uses 56 of those bits to perform the actual encryption and decryption. The remaining eight bits were intended to be used only as parity indicators to be sure the key was loaded correctly. At the time of publication in 1977, the DES key length of 56 bits was judged to provide sufficient strength for government and commercial use. However, due largely to significant advances in computer processing power, DES is now considered to be vulnerable enough that NIST withdrew it as a standard and in 2002 replaced it with a newer, stronger algorithm called the Advanced Encryption Standard (AES). AES can support three different key lengths, specifically 128, 192 and 256 bits. Equipment manufacturers have apparently assumed that the 256-bit key option is the most secure and have developed products focused on that key length.

Whichever algorithm is used by the radio, it scrambles the IMBE digital voice bit sequence prior to transmission and unscrambles incoming sequences that it has received. In this way, the encryption process is kept separate from the codec and other mechanisms inside the radio, allowing it to be independently upgraded (and sold) by the manufacturer according to customer needs.

❖ Framing

Because the frequencies used by the communications system might be noisy, a radio cannot just transmit the IMBE digital voice bit sequence (encrypted or not) and expect it to be received without error. Noise and interference have the potential to confuse the receiver and cause it to mistake a '0' for a '1' and vice versa. To help the receiver deal with this possibility, the transmitter combines the IMBE bit sequence with another sequence of bits called *forward error correction* (FEC). Using advanced mathematical concepts from a field of study called information theory, the receiver can use the FEC sequence to fix bits that might have been received incorrectly.



In order to allow the receiver to sort out which radio is transmitting and what data are being sent, the transmitter adds yet another sequence of bits that provide identification, format and status information. This signaling data, plus the FEC and the IMBE sequence, are placed into a structure called a *frame*. Each frame typically has a fixed size and is transmitted as one continuous set of bits. Radios and repeater sites communicate with each other by sending sets of frames that represent a conversation.

❖ Technical Weaknesses

Even in a system that carries encrypted talkgroups, the only part of a frame that is actually encrypted is the voice information. The signaling information is in the clear, allowing radios to receive and process a frame. The FEC is in the clear, of course, since the bits in the IMBE digital voice sequence must be correct before they can be decrypted. Trying to decrypt ciphertext that contains the wrong bits will, as you might expect, produce garbage rather than the correct plaintext. What all this means is that even if the particular key needed for decryption is unknown, there is still enough information in the clear that collecting and analyzing frames is worthwhile.

By looking at radio and talkgroup identifiers from a large set of collected frames, a pretty good picture can be derived of who talks to whom and how often. This kind of deduction is called *traffic analysis* and can provide valuable insights into how an agency operates and clues to when something big is happening. For instance, if radios and talkgroups known to be part of the Allentown Emergency Response Team (ERT) suddenly become very active, it might be correct to surmise that a significant law enforcement action is taking place.

❖ Outsourcing

Given the ease with which information crosses international borders, it might be possible to avoid the Federal Communications Commission (FCC) restriction on monitoring encrypted transmissions. Such a scenario might go something like the following.

1. A local monitor is set up to capture transmissions from an encrypted system.
2. The captured transmissions are sent to a computer located in a foreign country.
3. The foreign computer collects and stores the captured transmissions and applies various cryptanalysis techniques to try and recover the encrypted content.
4. If and when the foreign computer is successful in cracking a transmission, it either sends the plaintext back to the local monitor or makes it available via the Internet.

In this way the actual decryption is occurring outside of the country, thus technically avoiding a violation of FCC regulations. Such outsourcing of computer processing is already done for many types of work; cracking encrypted transmissions would simply be one more type of work.

❖ Cracking

The hard part, of course, is the cracking task itself. It is here that the choices and actions of the radio system operator make all the difference. As discussed earlier, DES is relatively weak. It is now possible, given the right hardware, to try all of the possible 56-bit keys in a reasonable amount of time and see if one of them works. This "brute force" attack has been successful in a few well-publicized incidents and only gets easier as computers continue to get faster. If a radio system is relying on DES to protect their transmissions, their faith might be misplaced.

A successful crack of a DES-encrypted transmission will produce the corresponding plaintext as well as the actual key used for encryption. The next obvious step would be to use that key to decrypt other captured transmissions. Hard drives are relatively inexpensive, so captured messages could be stored for a significant period of time. If the radio system operator does not change the encryption key often, a single successful crack could allow the decryption of transmissions over a significant amount of time. If the crack produces the key that is currently in use, the foreign computer would then be able to decrypt transmissions in real time, completely defeating the radio system's encryption.

In order to adequately protect the content of transmissions, a radio system operator would need to be using a more secure algorithm, like AES rather than DES, and change keys on a frequent and regular basis. This is standard operating procedure for encrypted systems, but like most things, basic human nature often prevents these actions from being taken.

❖ Allentown EDACS

The following ten frequences are used by the Allentown system. Because it is an EDACS system, each frequency is assigned a Logical Channel Number (LCN). In order to track the activity correctly, the frequencies must be programmed into your scanner in LCN order. The manual for your scanner should describe the proper way to do this.

LCN	Frequency
01	855.2125
02	856.4375
03	856.9375
04	857.4375
05	857.9375
06	858.4375
07	858.9375
08	859.4375
09	859.9375
10	860.9375

❖ Agency-Fleet-Subfleet

Talkgroups on the Allentown system include the ones listed below. EDACS talkgroup numbers are most commonly represented as either a decimal value or as a pair of numbers separated by a hyphen. The pair is referred to as AFS, short for Agency-Fleet-Subfleet.

Since a trunked radio system can serve many different municipal workers from multiple departments, the EDACS talkgroup scheme anticipated customers having a hierarchical organizational structure that supported several "agencies," each with their own "fleet." Each of these "fleets," in turn, would have "sub-fleets." A typical EDACS system can support 16 agencies, 16 fleets per agency, and 8 sub-fleets per fleet.

Actual AFS numbers are displayed as AA-FFS, where AA identifies the agency, FF identifies the fleet within the agency, and S is the sub-fleet. You can see in the list of Allentown talkgroups below where, for instance, the fire department is agency 04, emergency medical services is agency 06, and so on.

The all-zero values for agencies and fleets have a special meaning. An AFS of 00-000 is a "System All-Call" meaning that every radio in the system will hear the transmission. When the fleet and sub-fleet values are all zero it is considered an "Agency All-Call" and every radio that is part of the agency will hear the message. The first Allentown Fire Department talkgroup, 04-000, is just such an all-call AFS. Transmissions made in this talkgroup will be heard by all radios programmed to be part of the Fire Department.

Dec	AFS	Description
512	04-000	Fire (All Call)
529	04-021	Fire Operations 1
530	04-022	Fire Operations 2
531	04-023	Fire Patch
532	04-024	Fireground 1
533	04-025	Fireground 2
534	04-026	Fire Marshal
544	04-040	Fire Events 1
545	04-041	Fire Events 2
546	04-042	Fire Events 3
576	04-080	Fire Training 1
578	04-082	Fire Training 2
785	06-021	Emergency Medical Services (Dispatch)
786	06-022	Emergency Medical Services (Administration)
787	06-023	Emergency Medical Services (Supervisors)
801	06-041	Emergency Medical Services Events 1
802	06-042	Emergency Medical Services Events 2
849	06-101	Ambulance to Lehigh Valley Hospital (Cedar Crest)
850	06-102	Ambulance to Lehigh Valley Hospital (17th Street)
851	06-103	Ambulance to Sacred Heart Hospital
852	06-104	Ambulance to Saint Luke's (Bethlehem)
853	06-105	Ambulance to Saint Luke's (Allentown)
854	06-106	Ambulance to Lehigh Valley Hospital (Muhlenberg)
868	06-124	Allentown Emergency Medical Services (Patch)
1041	08-021	Streets Department (Dispatch)
1042	08-022	Water Resources (Dispatch)
1043	08-023	Building Standards and Safety
1044	08-024	Traffic Engineering
1045	08-025	Public Works Engineering
1046	08-026	Communications Center
1047	08-027	Public Works 1
1048	08-030	Public Works 2
1049	08-031	Wastewater Treatment
1050	08-032	Recycling
1051	08-033	Animal Control
1060	08-044	Parks and Recreation Department
1061	08-045	Recreation Office
1062	08-046	Municipal Golf Course
1063	08-047	Traffic Signal Maintenance
1064	08-050	Building Maintenance
1066	08-052	Vultee Street Parking Garage
1297	10-021	Citywide Events 1
1298	10-022	Citywide Events 2
1300	10-024	Public Safety 1
1313	10-041	Citywide Events 3
1349	10-085	County Emergency Management Agency
1345	10-081	Parking Authority 1
1346	10-082	Parking Authority 2
1350	10-086	County Emergency Management Agency
1352	10-090	Muhlenburg College Public Safety
1353	10-091	Parking Authority 3
1354	10-092	Cedar Crest College Public Safety
1361	10-101	Citywide Common
2039	15-147	Allentown Fire (Alternate Dispatch)
2044	15-154	Emergency Medical Services ("Med 10" Patch)
2045	15-155	Emergency Medical Services ("Med 1" Patch)
2046	15-156	Emergency Medical Services ("Med 2" Patch)
2047	15-157	Allentown Fire (Patch)

❖ Allentown Police

The Allentown Police Department uses AFS agency identifier 02. Several new talkgroups were created to carry the full-time encrypted traffic. The original talkgroups remain in the system but are reportedly unused.

256	02-000	Police (Citywide)
273	02-021	Police (Dispatch)
274	02-022	Police (Records)
275	02-023	Police (Warrants)
276	02-024	Police (Criminal Investigations)
289	02-041	Police (Special Events)
305	02-061	Police (Emergency Response Team)
307	02-063	Police (Vice)
308	02-064	Police (Vice) [Encrypted]
309	02-065	Police (Vice) [Encrypted]
321	02-081	Police (Training)
337	02-101	Police Dispatch [Encrypted]
338	02-102	Police Records [Encrypted]
339	02-103	Police Desk [Encrypted]

There are still a significant number of analog frequencies in use in Lehigh County. Activity on these frequencies can still provide some insight into conditions and events in the community.

Frequency	Description
150.7825	County Fire Fireground 4
151.0175	County Emergency Management Agency
151.0400	South Whitehall Township Utilities
151.1300	South Whitehall Township Public Works
151.3550	Cetronia Ambulance Service
154.1750	County Fire and EMS Dispatch/ Paging
154.2725	County Fire Fireground 3
154.5700	Allentown City - Fire Police Operations
154.7250	County Fire Fireground 1
155.0400	Allentown Emergency Medical Services (Patch)
155.2650	County Emergency Medical Services (Hospital)
155.2950	Cetronia Ambulance Service
155.3250	County Fire Fireground 2
155.3400	County Emergency Medical Services (Regional Network)
155.7750	County Fire-Police (South)
155.8050	Sheriff's Office
155.8350	County Emergency Medical Services (Response)
156.0900	Sheriff's Office
156.1500	Sheriff's Office
158.2500	County Fire North
158.7450	County Fire-Police (North)
158.7750	County Police (Records)
158.7900	Allentown Police (Interoperability 1)
158.8350	County Police (Dispatch South)
158.8500	County Police (Dispatch North)
159.0600	County Fire South
159.0900	Allentown Police (Interoperability 2)
159.1200	Salisbury Township Police
453.2625	County Courthouse (Maintenance)
453.4750	Fire (Special Operations)
453.5250	Pennsylvania Emergency Management Agency Radio System
453.5750	County Corrections 4
453.7625	County Juvenile Detention Center
453.8250	Fire (Special Operations)
453.9750	County Corrections 1
458.2000	County Fire (Hazardous Materials)
458.4750	Technical Rescue
458.5000	County Fire (Hazardous Materials)
458.5250	Pennsylvania Emergency Management Agency Radio System (Simplex)
458.5750	County Emergency Management Agency
458.8250	Technical Rescue
460.0750	County Courthouse (Security)
461.5000	Allentown School District (Security)
462.0375	Allentown School District (Operations)
462.9500	County Emergency Medical Services ("Med 9")
462.9750	County Emergency Medical Services ("Med 10")
464.3375	Allentown School District (William Allen High School)
464.3875	Allentown School District (Francis Raub Middle School)
469.3875	Allentown School District (Louis Dieruff High School)
502.9125	Allentown School District (Buses)

That's all for this month. More information is available on my web site at **www.signalharbor.com,** including security information. Please send your questions, comments, frequency lists and reception reports to me at danveeneman@monitoringtimes.com. Until next time, Happy Thanksgiving and happy scanning!

ASK BOB

GENERAL QUESTIONS RELATED TO RADIO

Bob Grove, W8JHD
bobgrove@monitoringtimes.com

Q. *Since I can't get broadband phone service out here in the woods, I need to reach a 2.4 GHz WiFi tower some 15 miles away. Can I simply attach a mag-mount whip to my external antenna jack? (Mark K., Oakland, MD)*

A. 15 miles is a consequential distance for reliable intercommunications with a fractional-watt device. A whip antenna is omnidirectional, not directional, so the advertised gain may not be enough. Even so, the antenna would have to be mounted on a metal ground plane (horizontal metal surface) no less than 8" in diameter; that's why it is designed to be mounted on a metal car roof.

A beam antenna would offer more gain in the preferred direction. You can predict the gain you need by seeing how far you have to drive toward the nearest cell tower to get service, realizing that half the distance is equivalent to about a 6 decibel (dB) signal improvement, plus the absorption losses from surrounding tree leaves.

Another problem is the coax cable, quite lossy at these frequencies; 1 dB per meter of length for common RG-58/U. So, if you are thinking about putting the antenna on the roof of the cottage, that's a few more dBs of loss. Is cable available there? There's always HughesNet or Excede (formerly WildBlue) satellite Internet service, although both are known to bog down with increased usage. A high-gain 2.4 GHz beam may be your only option, besides moving!

Q. *I just helped salvage a damaged tower which I assumed was aluminum, but when we cut the pieces there were sparks, and a magnet was attracted to the metal. Is aluminum ever mixed with steel? (Mark Burns, Terre Haute, IN)*

A. No, they won't alloy together or even weld together. What you had was galvanized (zinc plated) steel.

Q. *I have read in the past that some folks have gotten good shortwave reception with a random wire simply lying on the ground. I tried this but my reception was noisy and signals were weak. What's the real story? (Van Wilshire, email)*

A. Similar experiments I've done in the past showed that reception was good below about 3 MHz, but above that, it was increasingly poor due to ground absorption losses and high upward directivity. Dry, sandy soil would work better than moist, mineral-rich soil.

Q. *If you hold a CFL by its base in one hand and slap the glass smartly with the other it will flicker. Why is this? (MB, email)*

A. You don't need to slap it which could cause it to break, just hold the metal screw base and rub the glass on a wool sweater! CFLs need very little current to ionize their gas and energize the fluorescent coating on the inside of the glass. It's simply static electricity charging the gas.

Some folks report the light flashing occasionally in a lamp which is turned off! This is commonly reported with type X10 controller switches which allow a little trickle charge to build up in the line.

Q. *A friend told me that any cell phone that is capable of being powered up, regardless of whether or not it is currently subscribed, can reach 911. Is that true?*

A. Yes; it's for emergency calls only. We donate our old cell phones to our local abused women's shelter. They often escape from their abusers with nothing more than their children and the clothes on their backs.

Q. *In my youth I had an odd job at an AM broadcasting station. During one of my discussions with the Chief Engineer, he said that if I stood on the ground and touched the antenna, I could burn my hands on the DC feed. He said I could jump from the ground up to the antenna if necessary. Did he really mean DC, or was it a slip of the tongue and he meant AC or RF? (Van Wilshire, email)*

A. The only voltage on a transmitting tower is at radio frequency (RF).

Q. *I currently have my HF dipole mounted in the attic under the roof peak running power up to 100 watts. I'm planning to install a large solar array on my roof 2-4 feet above the entire length of the antenna. Wiring to the panels is encased in metal conduit. Is the RF signal likely to cause damage to the solar array or its associated electronics, and will it act like a Faraday shield on my antenna, preventing it from radiating its signal? (Mike Bornstein K6UMO)*

A. I doubt that 100 watts ERP of RF being radiated several feet away from the array is likely to induce damaging voltages. The way these cells are all mounted on a metal framework, and the wiring being metal encased, I don't see the likelihood of damaging voltages or currents being imposed.

The solar array won't act like a Faraday shield because it doesn't enclose your antenna, but there will be consequential downward reflective effects that will unfavorably impact your preferred horizontal radiation pattern.

Another thing to be concerned about as a ham or shortwave listener is that pulse width modulated charge-controllers, used to charge back-up batteries in photovoltaic solar panel systems, can generate a great amount of broadband RF interference during the charging process. The degree of interference will vary with the battery state of your system. Obviously, the greatest amount of interference will occur during daylight hours. You can alleviate the effects of some of the interference by placing the charge-controller as far away from your antenna and/or rig as possible, using best grounding practices and DC filtering. Make sure your installer is aware of your concerns and can plan the system accordingly.

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

UTILITY WORLD

HF COMMUNICATIONS

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FANS-1/A: Will the Future Doom HF Aero Mobile?

FANS stands for Future Air Navigation System. It has been in the works for many years, all around the world, but now it is actually happening. These changes will definitely cause a drastic decline in the volume of voice traffic heard on many high-frequency (HF) aeronautical frequencies. As always, satellite communication (satcom) will be the primary replacement.

This transition is based on a need for closer aircraft spacing on routes defined by the Major World Air Route Areas (MWARA). These are used by all commercial and some military flights over the oceans when out of radar range. Aircraft contact the appropriate operator, who checks the selective calling (selcal) and sets up a flight watch with regular position checks.

During this period, requests to or from air traffic control centers go through these operators. Aircraft frequently request changes, such as different altitudes, and the delay can be several minutes before hearing back on whether these are available. The various uncertainties in the process require that aircraft separation be up to 100 nautical miles laterally, and 10 minutes in trail of the preceding aircraft.

The new target for separation is called "30/30," for 30 nautical miles both laterally and in trail. This is already available on many air routes, but its use requires a new generation of avionics; the FANS.

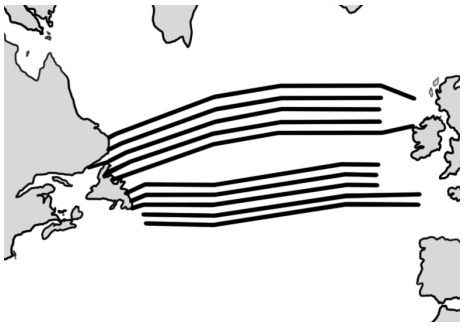
The hardware solution made available for Boeing aircraft was called FANS-1. Airbus called theirs FANS-A. Therefore, we have FANS-1/A. These have been in development for quite some time. Most materials on the subject are in that aviation-speak where everything's named in long acronyms. There's a huge amount of alphabet soup here.

The heart of both systems is a set of air-ground links called ADS-C and CPDLC. Both are automatic digital modes requiring minimal interaction with the pilots.

ADS-C is Automatic Dependent Surveillance - Contract. This means that air traffic control, through satcom, will electronically establish a "contract" with the plane's avionics for position reporting and other services. For example, it allows different centers to specify their own reporting intervals.

CPDLC is Controller-Pilot Data Link Communications. Think of it as an expanded form of text messaging. Those familiar with present digital systems used by aircraft already know about the text links in use today.

On HF, the best known of these is High-Frequency Data Link (HFDL), where ground stations communicate with aircraft on many frequencies, using a data mode proprietary to Aeronautical Radio Incorporated (ARINC). It's especially popular with cargo airlines, since (as they say), freight never wants to make phone calls.



Typical North Atlantic Tracks (Courtesy: Author)

The current version of FANS-1/A sends both links over an aero service offered by INMARSAT. This satellite bandwidth contractor is the private successor to the original system established by the International Maritime Organization. That one was used in a similar transition made by large cargo and passenger ships in the mid to late 1980s.

Airlines have shown some resistance to contracting with INMARSAT due to expense. This led to exploration of other data link paths, both ground (HFDL) and space based.

The "winner," at least at present, uses Iridium, a competing provider with a constellation of 66 low-earth-orbiting satellites. Iridium is far from broke. It claims 360,000 users, and its revenue from the United States government alone is substantial.

FANS-Over-Iridium, as it is called, got a huge boost when it was approved by the U.S. Federal Aviation Agency following a trial period. Today, at least one manufacturer offers a drop-in unit which is advertised as costing less to operate than HF, let alone INMARSAT.

So, is civil aeronautical HF dead? No. The current standard still requires one HF radio for backup, and it must be tested, including a selcal check. There might be some continuing use of the present High-Frequency Data Link (HFDL) system, especially in polar latitudes. However, the oceanic air control frequencies that we know today are going to gradually become a whole lot quieter.

❖ Dates of Transition

Don't expect any sudden, dramatic cutoff such as the various ones in the maritime service. It's a phase-in. The next key date is February 7, 2013, when the two center North Atlantic tracks become 30/30 and FANS-only. At the same time, the North Atlantic net will adopt a policy of "best equipped, best served." Then, in 2015, all tracks become FANS only.

Other parts of the world, notably in the Pacific, have similar schedules. For better or for worse, the future is coming.

❖ Another UVB-76 Surprise

It's a little thing, but then the changes in this widely-monitored, 4625 kilohertz (kHz) signal from the northwest of Russia generally are. The latest one came on the last day of August, at a time determined by European numbers ace Ary Boender to be 0705 Coordinated Universal Time (UTC). At this time, following a short break, the harmonically-rich buzz came back considerably higher in pitch. The reason, as always, is unknown.

Spectrum analysis shows this new buzz to be essentially a sawtooth wave. The fundamental is around 300 hertz. Right now, "The Buzzer" sounds more like a beeper.

Other characteristics, such as the slight audio frequency waver, remain the same. The signal still has only a carrier and an upper sideband. The lower sideband is largely (not completely) suppressed.

Long-time readers already know that this buzz is a channel marker for brief, coded, voice messages in Russian. These are designated S28 by the European Numbers Information Gathering and Monitoring Association (ENIGMA 2000).

The messages are thought to be high-priority, military, command-control traffic. They contain what is either a call sign or group identifier in a variant Russian phonetic alphabet. One common example is MDZhB - "Mikhail, Dimitriy, Zhenya, Boris." Note that the "Zh" is a distinct letter in the Cyrillic alphabet.

Needless to say, it will be interesting to see if the sound ever changes back, and if so, when. Stay tuned.

❖ Utility Hardware

Time was when any modest receiver with a beat frequency oscillator (BFO) was fine for utility listening. Voice and continuous-wave (CW) Morse code were king. Sometimes the voice was even still in old-fashioned amplitude modulation (AM).

The most exotic digital modes were radio teletype (RTTY) and Simplex Telex Over Radio

(SITOR). These were used by huge, powerful stations that carried news and message traffic to customers and ships all over the world.

Obviously, things are different now. Especially in North America, these old flame throwers are history, except for proprietary data services. Today's accessible stations tend to be more modest. As often as not, they use funny-sounding digital modes with even funnier names, as described in jargon more closely resembling computer programming.

All this places much greater demands on equipment. Unfortunately, parts shortages and the erroneous impression that "shortwave is dead" have led to the discontinuing of several excellent radios.

What's left shakes out into tabletop receivers and software-defined radios (SDRs). The SDR must be attached to a computer. The old-school tabletop receiver stands on its own, but a computer is usually attached for sound-card decoding and control.

One popular tabletop receiver is the Icom R-75 ($650-700). It's an old design, but a good one. Its intermediate-frequency (IF) strip comes with factory-installed digital signal processing (DSP) at no increased cost.

The popular Icom IC-R75
(Courtesy: Author)

Those who want to spend more money can invest in new or used surveillance-grade designs such as the Ten-Tec RX-340 ($4500). With decent antennas, these boxes hear everything.

On the SDR side, things aren't as simple. It's a new technology, and often aimed more at the advanced experimenter or tinkerer. Those looking for plug-and-play systems encounter such units as the Perseus ($1200), and several by WiNRADiO ($1200-1600).

As noted last month, the Perseus is an established product, somewhat revolutionary at its introduction, with a worldwide base of advanced users and software developers. The WiNRADiOs attract fewer experimenters, though they too have a development potential.

The Perseus and the newest WiNRADiOs require fairly powerful computers, and they have a much steeper learning curve for absolute newcomers than traditional receivers. However, once the user gets the knack of their many exposed parameters, they bring some interesting new possibilities to the utility scene.

Finally, there's the most important equipment of all; the antenna. It used to be a matter of getting as much wire into the sky as one's budget, space, neighbors, and Homeowner's Association (HOA) would allow. Fortunately, today's radios have tremendous gain, and a lot of people have done just fine with more modest installations.

This editor used to make his own antennas. They were cheap and effective, but they never lasted very long. Currently, the PAR EF-SWL ($75) is in use here. It's an end-fed wire around 45 feet long; with a matching transformer that lets the user experiment for the lowest noise. It has lasted an absolutely amazing amount of time.

The opposite of the old-school wire in the sky are the active antennas, some of which work very well, and they certainly save space.

One active loop that is very popular, and highly regarded in Europe, is the Wellbrook ALA-1530L. It's a bit pricey at £200 ($317 at today's exchange rate), but its sophisticated design receives mostly the magnetic field of a radio wave, cutting down on noise from the electric field. It is typically mounted fairly low to the ground, away from the dwelling, where results have been very nice indeed. The major advice is, don't give up. Technology changes by the minute, but shortwave utility radio is far from dead.

ABBREVIATIONS USED IN THIS COLUMN

AFB..... Air Force Base
ALE..... Automatic Link Establishment
AM..... Amplitude Modulation
ARQ..... Automatic Repeat reQuest
Camslant..... Communications Area Master Station, Atlantic
CW..... On-off keyed "Continuous Wave" Morse telegraphy
DHFCS..... UK Defence High-Frequency Communications System
DSC..... Digital Selective Calling
E11..... "Strich" family English numbers
E11a..... E11 variant, ends with "out"
FAX..... Radiofacsimile
FEMA..... US Federal Emergency Management Agency
FSK..... Frequency Shift Keying
HFDL..... High-Frequency Data Link
HFGCS..... High-Frequency Global Communications System
ID..... Station identification
LDOC..... Long-Distance Operational Control
LSB..... Lower Sideband
M23..... Unknown agency, usually CW 5-figure groups
M89..... Chinese military CW coded/group call signs
MARS..... US Military Auxiliary Radio System
Meteo..... Meteorological; weather office
MFSK..... Multiple Frequency Shift Keying
MX..... Generic for Russian single-letter beacons/markers
NDB..... Non-Directional Beacon (Aero).
NOAA..... US National Oceanic and Atmospheric Administration
RTTY..... Radio Teletype
S06s..... Russian numbers, slow ending variant
S11a..... "Strich" family numbers in Russian
S28..... Russian strategic "buzzer" and short voice messages
Selcal..... Selective Calling
SHARES..... Shared Resources, US federal 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
V02a..... Cuban "Atencion," Spanish 3x150 format
V13..... Taiwan "New Star," music and numbers in Chinese
Volmet..... Scheduled, formatted, aviation weather broadcasts

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

507.0 WE2XGR/2-Amateur 600-meter experimental group, CT, CW ID at 0049 (Mario Filippi-NJ).
516.0 YWA-NDB, Petawawa, Ontario, Canada, ID in slow CW, at 0048 (Filippi-NJ).
520.0 F9-NDB, Miramichi Airport, New Brunswick, Canada, CW identifier at 0211 (Filippi-NJ).
523.0 JJH-NDB, Fulton County Airport, Johnstown, NY, identifying in slow CW, at 0047 (Filippi-NJ).
1700.0 WPSH468-Manville, NJ Department of Emergency Management, AM Travelers' Information Station with female voice ID and announcement, then local NOAA weather, at 1423 (Filippi-NJ).
4441.0 LDBO-Russian military tactical call, CW traffic with unheard station; similar on 5214.5, 8104, 8116, 8138, 8193, and 14682; at 1942 (MPJ-UK).
4625.0 MDZhB-The Buzzer/ "UVB-76," Russian military voice message "MDZhB 64 915 UGOVORNYJ 09 15 70" in Russian (S28), at 1136. MDZhB-S28, Russian voice message "MDZhB 27 624 UGLOVOJ 61 41 79 74," at 1143 (Ary Boender-Estonian remote).
4739.0 Trident 71 Charlie-US Navy, calling unknown station along with Wafer 71 Bravo, followed by secure voice, at 0141 (Jack Metcalfe-KY).
4927.5 Q9K-US National Guard, AR, ALE with BCT; also on 8058.5, 9065, 9145, 10151.5, and 10703; at 0219 (Metcalfe-KY).
4956.0 FAV22-French Morse code training, Favières, CW drill messages in 5-letter groups; also on 6825, 6851, and 10313; at 2044 (MPJ-UK).
5077.5 WNU-Slidell Radio, LA, Globe Wireless data ID 0xD8, at 0228 (PPA-Netherlands).
5135.0 SEMOHQ-New York State Emergency Management, NY, also on 7477, ALE sounding at 0241 (PPA-Netherlands).
5195.5 DRA5-German Amateur Radio Club propagation beacon, CW forecast at 2056 (MPJ-UK).
5221.5 Unid-Russian Air Defense, time-stamped CW tracking strings with null data replaced by "?," at 1958 (MPJ-UK).
5251.0 DIAMANTI-Albanian police, calling DRINI, also on 5285, ALE at 0356 (PPA-Netherlands).
5505.0 Shannon Volmet, Ireland, weather observations for European airports, at 0245 (Filippi-NJ).
5680.0 Kinloss Rescue-UK air/sea rescue center, working unknown flight at 1509 (Michel Lacroix-France).
5838.0 RIT-Severomorsk Naval Radio, Russia, passing traffic to RLO at 2105 (MPJ-UK).
6317.0 WLO-ShipCom, AL CW ID in Sitor-A marker, at 0529 (Robbie Spain-WY).
6318.0 KLB-ShipCom, WA, CW ID in Sitor-A marker, at 0529 (Spain-WY).
6501.0 NMN-USCG Camslant Chesapeake, VA, Mid-Atlantic weather by "Iron Mike" voice, at 0341 (Filippi-NJ).
6585.0 Air France 3539 selcal check with New York, USB, at 0238 (Filippi-NJ).
6586.0 New York-Caribbean area air control, selcal check with Northwest flight 329, at 0255 (Filippi-NJ).
6596.0 VS651Y-Virgin Atlantic A340 "Miss Behavin'," reg G-VWKD, HFDL position for Krasnoyarsk, at 2215 (MPJ-UK).
6604.0 New York Volmet, aviation weather for St. Louis and Atlantic City, at 0539 (Spain-WY).
6608.0 4XZ-Israeli Navy, CW "VVV" marker, at 0242 (Filippi-NJ).
6876.5 Alpha-US National Guard, calling 595 Bravo, and then "any station this net," at 1600 (Metcalfe-KY).
6961.0 Unid-Strange numbers station (M23 variant), repeating marker "111 111 111," parallel on 9886, at 1922 (Boender-Netherlands).

7710.0 VFF-Canadian Coast Guard, Iqaluit, FAX ice maps for Hudson Bay, at 0300 (Filippi-NJ).
8106.9 SVJ4-Athens Meteo, Greece, FAX surface analysis chart at 0846 (PPA-Netherlands).
8107.0 XSS-UK DHFCS, Forest Moor, also on 8167 and 15040, at 1843 (PPA-Netherlands).
8127.0 RGP-Saudi Arabian military, calling JDP in ALE; similar on 8133, 8160, 8190, and 10677; at 0321 (PPA-Netherlands).
8129.0 L03-Unknown Chinese net, raised A96, then voice and digital exchanges; also on 10617, 10696.2, and 14594; at 1815 (PPA-Netherlands).
8132.0 BPLEZS-German Federal Police, Cuxhaven, calling BP24, ALE at 1841 (PPA-Netherlands).
8140.0 BMF-Taipei Meteo, Taiwan, FAX typhoon warnings at 1904 (PPA-Netherlands).
8166.0 S1B-Lithuanian military, ALE link check with P1G, also on 9315, at 2241 (PPA-Netherlands).
8182.0 XRW-UK DHFCS, calling XSS, Forest Moor, ALE at 1847 (PPA-Netherlands).
8190.0 ROMA-Italian Financial Police, Rome, answered ALE from VIBOVALENTIA, followed by modem traffic, at 1828 (PPA-Netherlands).
8431.0 TAH-Istanbul Radio, Turkey, CW ID in Sitor-A marker, at 0254 (Filippi-NJ).
8472.0 WLO-ShipCom, AL, RTTY news stories at 0000 (Filippi-NJ).
8530.0 "Vnimanie"-"Cherta" variant numbers in Russian (S11a), callup "486/32," then message in 5-figure groups, repeated, finally ended "Konec," at 0915 (Boender-Netherlands).
8764.0 Camslant Chesapeake-USCG, VA, marine weather in live (non-synthesized) voice, at 0517. NMO-USCG, HI, Pacific high seas weather with "Iron Mike" voice, at 0600 (Spain-WY).
8818.0 Unid-Possible Mexican Army, male with generator noise in background, using procedures to pass traffic (mostly lists of numbers) to another male, in Spanish, at 0253 (Hugh Stegman-CA).
8885.0 BAW345-British Airways World Cargo B747 freighter reg G-GSSD, HFDL position for Al-Muharraq, Bahrain, at 1957 (MPJ-UK).
8942.0 CCA964-Air China A330 reg B-6533, HFDL downlink for Shannon, at 2001 (Patrice Privat-France).
8971.0 Pelican 71D-US Navy P-3C, working Fiddle (USN, FL), at 1430. Pelican 71D, air-air with Pelican 71E (a P-3C), at 1416 (Allan Stern-FL).
8983.0 Coast Guard 2003-USCG HC-130J, ops-normal and position for Camslant Chesapeake, VA, at 1715 (Stern-FL). Coast Guard 2004-USCG HC-130J, discussing patient status with Camslant, at 1130 (Tony Agnelli-FL).
9019.0 JES-US "3-Letter Net," calling GHM for monthly exercise, ALE at 1620 (MDMonitor-MD).
9069.0 LCR154-Polish Military, probably Janki, calling SPI324, ALE at 1841 (MPJ-UK).
9240.0 Unid-Cuban intelligence, AM Spanish numbers message in 5-figure groups (V02a), in progress at 1016 (Eddy Waters-Australia).
9276.0 New Star Radio Station-Live female with music and numbers messages (V13), program 3, at 0800 (Boender-Hong Kong remote).
9655.0 Unid-Russian intelligence, numbers in Russian with 5-figure groups (S11a), callup "516 893 7," ended "00000," repeat of earlier on 10290, at 0940 (Boender-Netherlands).
9981.0 KVM70-NOAA, Honolulu, HI, FAX schedule at 1318 (Filippi-NJ).
10066.0 CHH491-Hainan Airlines A330 reg B-6133, HFDL position for Hat Yai, Thailand, at 2027 (MPJ-UK) SU2579-Aeroflot A321 reg VP-BQX, HFDL position for Hat Yai, at 1523 (Lacroix-France).
10075.0 KQ0321-Kenya Airways B737 reg 5Y-KYB, HFDL position for Al-Muharraq, at 2141. R29547-Orenburg Airlines B737 reg VP-BPY, HFDL position (over Turkey) for Al-Muharraq, at 2215 (MPJ-UK).
10087.0 J20079-Azerbaijan Airlines B727 reg 4K-AZ8, position for Krasnoyarsk, at 1838 (Privat-France). PR0536-Philippine Airlines A320, reg RP-C8604, HFDL log-on with Krasnoyarsk, at 2049 (MPJ-UK).
10100.8 DDK7-Hamburg/ Pinneberg Meteo, Germany, ID in RTTY loop between weather broadcasts, also on 11039 as DDH9, at 0220 (Stegman-CA).
10150.0 Head Master-MARS monthly exercise with various military and government stations, passing message from Top Hand to Payroll, came from 14658, at 2301 (Metcalfe-KY).
10190.7 DHJ59 German Navy, Wilhelmshaven, working unknown vessel in German, at 1223 (Lacroix-France).
10262.0 Mobile SESEF-USN Shipboard Electronic Systems Evaluation Facility mobile van, all-mode test with vessel *Arlington*, at 2330 (Metcalfe-KY).
10290.0 S11a, callup "516 893 7," ended "00000," repeated later on 9655, at 0930 (Boender-Netherlands).
10543.0 RCV-Russian Navy, Sevastopol, CW message in 5-figure groups for RCJG, at 1851 (MPJ-UK).
10638.0 EK9-Greek military, calling GEF, ALE at 2006 (PPA-Netherlands).
10658.0 2013-Turkish emergency net, ALE and voice in Turkish with 4016, at 1945. 1020-Turkish emergency net, ALE and voice with 4016, at 2024 (PPA-Netherlands).
10754.0 Unid-Mexican Army, two simultaneous traffic exchanges, one in USB and one LSB, using traditional Mexican "radiograma" procedures in Spanish, at 0231 (Stegman-CA).
10871.7 "D"-Russian military cluster beacon (MX), Odessa, CW ID at 0049 (Filippi-NJ).
10871.8 "P"-MX, Kaliningrad, CW ID at 0049 (Filippi-NJ).
10872.0 "C"-MX, Moscow, CW ID at 0049 (Filippi-NJ).
10872.1 "A"-MX, Astrakhan, CW ID at 1826 (MPJ-UK).
11100.0 NNN0FHA-US Navy/ Marine Corps MARS, relay of station report text in Thor-11 (18-tone, 10.8 baud MFSK), at 0259 (Stegman-CA).
11175.0 Offutt-USAF HFGCS, Offutt AFB, NE, working Spinback and Nightwatch (likely E-4B National Airborne Operations Center mission), went to 13200, at 2212 (Mark Morgan-OH).
11318.0 O66015-Oceanair Linhas Aereas (Brazil), A319 reg PR-AVB, HFDL log-on with Santa Cruz, Bolivia, at 2236. AV9383-Avianca A320 reg HK-4659, HFDL log-on with Santa Cruz, at 2245 (MPJ-UK).
11336.0 Gander-Gander Radio, Newfoundland, Canada, selcal check GS-JP with Roma 61, a USAF KC-10 tanker #85-0028, at 1204 (Stern-FL).
11348.0 SU0510-Aeroflot A321 reg VP-BUM, HFDL downlink for Canarias, Canary Islands, at 1937 (Privat-France). AC0031-Air Canada B777 reg CF-IVM, HFDL position for Canarias, at 2257 (MPJ-UK).
11384.0 MC0060-USAF Air Mobility Command C-5B #84-0060, HFDL position for Shannon (not heard), at 0158 (Stegman-CA).
11387.0 Brisbane Volmet, female voice with aviation weather, Australia, at 1602 (Lacroix-France).
11430.0 V13, Program 4 with music, voice intro, and messages, at 1200 and 1300 (Boender-Australian remote).
11468.0 RDL-Russian military strategic broadcast, FSK reversals followed by FSK Morse "RDL RDL RHR 84869 3636 MI," then long message in 5-figure groups, beginning "84969", at 0303 (Stegman-CA).
11581.0 S11a, callup "426/00" and message, at 1020 (Boender-Netherlands).
12155.0 Unid-Russian intelligence "Russian Man," slow ending variant (S06s), callup "425 973 6" and message "91826 56473 90806 24358 55618 69110 973 6 00000," at 1200 (Boender-Netherlands).
12577.0 OJKU-Finnish flag cargo vessel *Josefine*, DSC to Lyngby, at 0937 (Privat-France).
12832.0 RDL-Russian strategic broadcast, routine FSK Morse message in 5-figure groups, at 1858 (MPJ-UK).
12843.0 HLO-Seoul Radio, Korea, CW marker at 1900 (MPJ-UK).
12916.5 HLF-Seoul Radio, Korea, CW marker at 1904 (MPJ-UK).
12923.0 HLW2-Seoul Radio, Korea, CW marker at 1903 (MPJ-UK).
12993.0 KSM-Maritime Radio Historical Society, CA, CW marker at 2014 (Spain-WY).
13245.0 Magnavox-US military, attempting traffic with Corn Hill, at 1832. High Tide, traffic for Corn Hill, at 1843 (Metcalfe-KY).
13330.0 Nairobi-Kenya Airways company LDOC, selcal check CM-BS with flight 117, a B777 reg 5Y-KYZ, at 1818 (PPA-Netherlands).
13342.0 Stockholm-Stockholm LDOC, Sweden, working Transavia flight TVF502, at 1513 (Lacroix-France).
13927.0 Hawk 81-USAF B-1B, patch to Dyess AFB ops via USAF MARS AFA5RS, IN, reporting #2 engine shut down, at 2025 (Stern-FL).
14396.5 NCS 312-US National Communications System, control of weekly SHARES net, at 1455 (MDMonitor-MD).
14484.0 Poker Face-Unknown monthly exercise player, calling Payroll, then working Head Master, also on 18387 and 20242, at 1641 (Metcalfe-KY).
14512.5 Desert Eagle-Likely control station of MARS monthly exercise, calling an unknown station at 1641 (Metcalfe-KY).
14658.0 WGY 911-FEMA, MA, working unknown station at 1423. Head Master, taking message from Top Hand, went to 10150 "secondary" to pass it to Payroll, at 2303 (Metcalfe-KY).
14661.0 HKI2-Finnish Ministry of Foreign Affairs, Helsinki, calling RIA (Riyadh, Saudi Arabia) and ANK (Ankara, Turkey), ALE at 1842 (PPA-Netherlands).
14664.0 RDL-Russian military, idling and then FSK Morse flash traffic, at 1351 (PPA-Netherlands).
14670.0 CHU-Canadian National Research Council, Ottawa, time pips and announcements in English and French, in single sideband with carrier mode (H3E), at 1742 (PPA-Netherlands).
14753.0 Unid-English numbers callup "633 Oblique 00" (E11), weak at 0710 (Boender-Netherlands).
15000.0 WWVH-US National Institute of Standards and Technology, HI, AM standard time signals, at 1326 (Filippi-NJ).
15034.0 Trenton Military-Canadian Forces, Ontario, Volmet for western Canadian air fields, at 2250 (Spain-WY).
15037.0 RRL-US "3-Letter Net," calling GHM, ALE at 1728 (MDMonitor-MD).
15635.0 TUD-Tunisian military/ government net control, ALE call to TU1, at 1304 (MPJ-UK).
16223.0 RGT77-Unknown Russian station, short CW message at 0340 (Waters-Australia).
16243.0 Head Master-MARS monthly exercise, no joy calling Poker Face, also tried 14484 and 14658, at 2021 (Metcalfe-KY).
16285.0 TUD-Tunisian net, calling STAT14 ("Station 14"), ALE at1241 (MPJ-UK).
16388.0 Unid-English numbers callup "958 Oblique 35" and message in 5-figure groups, ended "Out" (E11a), weak at 1110 (Boender-Netherlands).
16402.0 ABA-Maltese Maritime Squadron headquarters, Floriana, passing ALE text message to AB2 (Patrol Boat P-22); also on 18204; at 1232, 1246, and 1324 (MPJ-UK).
16607.0 GWPWBL-Brazilian Navy training ship *Brasil*, working GWPWN33, Natal Naval Radio, ALE at 1326 (MPJ-UK).
16806.5 NMF-USCG, Boston, MA, Sitor-B navigation bulletins at 1659 (PPA-Netherlands).
16948.4 Unid-North Korean diplomatic, usual 600/600 ARQ teleprinting, no decode, at 1709 (PPA-Netherlands).
17403.0 AB1-Maltese Navy, calling A1A, ALE at 1736 (PPA-Netherlands).
17430.0 9VF/209-Kyodo News, Singapore, relay of FAX Japanese newspaper at 60 lines per minute, at 1740 (PPA-Netherlands).
17912.0 "14"-Krasnoyarsk HFDL, Russia, uplink to A6-EDG (Emirates A380), and B-6848 (Air China A320), at 1223 (PPA-Netherlands).
17928.0 SVA373-Saudi Arabian Airlines A330 reg HZ-AQB, HFDL position for Canarias, at 1530 (Privat-France).
17931.0 Holloway-Ethiopian Airlines company LDOC, Addis Ababa, selcal check HK-AB with Ethiopian 602, a B737 reg ET-AOA, at 1253 (PPA-Netherlands).
18052.0 Top Hand-MARS monthly exercise, working stations at 2118 (Metcalfe-KY).
18600.0 RDL-Russian military, FSK Morse message in 5-figure groups following "XXX RDL" marker, at 1312 (PPA-Netherlands).
18673.0 470009-Queensland Department of Community Safety, Australia, ALE sounding at 0416 (Waters-Australia).
18980.0 P5O-Indonesian Navy, Belewan, CW messages in 5-letter groups, at 1327 (PPA-Netherlands).
22609.0 HLF-Seoul Radio, Korea, CW marker at 1304 (Filippi-NJ).
22927.0 Unid-Station repeating "BZL26" in RTTY, at 0600 (Waters-Australia).

DIGITAL DIGEST

DIGITAL MODES ON HF

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Digital Decoder Updates

In keeping with November's traditional theme of equipment updates and the Buyer's Guide, let's take a look at what's new in the world of digital decoder software and hardware.

Hoka Decoders

Hoka's flagship Code300-32 software-based decoder has recently been updated version 3.09 and includes several new and useful modes in its Standard and Extended versions. Available soon as an option in the Extended version will be the Chinese "4+4" modem. This venerable system has been in use for many years by Chinese embassies the world over and can still be heard fairly regularly, though not as often as once was the case. This modem uses 8 tones (4 pairs of parallel tones) of 75bd QPSK to send data and has a very distinctive raspy, chugging on-air sound (see Resources). Check the section below for some recent channels carrying this signal. Other decoders also included in the new Extended version are:

PacTOR-II FEC: a rarely heard modem used by Angolan Forces, Pakistani Navy and others
PacTOR-III: a very commonly heard modem in use by many agencies worldwide
NATO Link-11: a commonly-heard NATO air defense radar tracking system
Codan Chirp: an 80bd PSK chirp used by Codan radios to perform ALE and other functions
Codan 9001/3012: a commonly heard high-speed modem in use by many agencies worldwide
Codan Convertor: to recover content embedded in 9001/3012 data such as faxes, pictures, etc

Hoka's Standard decoder version has also expanded its offerings to include PacTOR-II FEC, Codan Chirp and Link-11. Also available from Hoka is a "P" version of the Code300-32 which integrates most of the "radio control" parts of the Perseus SDR (Software Defined Receiver) software into the decoder itself. This allows the decoder, SDR and a utility frequency database to all work together in one integrated package rather than switching between different programs and using virtual audio drivers and such to allow the SDR to "talk" to the decoder. At the time of writing, the Standard version retails for EUR4,500 (about $5,500) and the Extended, EUR7,500 (about $9,250).

WaveCom Decoders

High-end decoder specialists WaveCom have also been busy this year releasing both new decoder software and hardware.

The W-Code software is now at Version 8.1 and provides all the usual decoding, analysis and classification functions that one would expect of any high-end package, supporting more than 140 HF, VHF, UHF and SHF modes. However, as I have often pointed out (and in the case of Hoka too) many of these modes are now either defunct or very rarely heard. Some notable inclusions in the W-Code software are:

Link-11: NATO system described above
Globe Wireless OFDM: the high-speed mode most often heard on GW ship and shore channels
RPR: Robust Packet Radio: a seldom-heard cross between AX.25 packet with better reliability
Clover-2000: a seldom heard mode used by Russian trawlers, Colombian Navy and others

W-Code is also able to decode advanced VHF/UHF modes such as APCO P25 (widely used by Police and other Federal agencies in the US), Mobitex and TETRA.

The W-PCIe is a PCI-standard hardware card that demodulates both IF and AF-level inputs from any receiver and feeds the resulting data to the W-Code software. It is also available as a LAN version to be plugged into an Ethernet network and is therefore available to multiple machines. The W-PCI and W-PCI LAN are the smaller siblings of these products and perform much the same functions but with lesser specs. Check with MT's parent Grove (see Resources) for details on latest pricing.

Rivet

The free multi-operating system, Java-based software decoder from Ian Wraith is now at version 32 and implements the "bare bones" of a decoder for the commonly heard Russian 200bd synchronous FSK system that uses a 1kHz tone shift and a 288bit frame. It may be possible that plain text can be extracted from the system, but we'll have to wait and see! See below for channels where you can hear this interesting system.

Also in the works for Rivet are decoders for the 100bd Globe Wireless "channel free" markers that are widely heard across the HF bands, in addition to the less common 200bd FSK mode that is used to transmit ship GPS locations to shore stations. Stay tuned!

MultiPSK

Patrick's (F6CTE) popular free decoder software for Windows is now at 4.21.1, and in addition to a huge variety of amateur radio modes, also includes the following valuable HF digital utility modes:

MIL-188-110A: 2400bd high-speed modem used by many agencies worldwide
STANAG4285: 2400bd high-speed modem used by many NATO navies
MIL-188-141A: 125bd 8FSK ALE protocol used by many agencies worldwide
HFDL: ARINC's HF "ACARS" used to communicate between aircraft and many groundstations
Coquelet: Veteran French-made 8FSK modem favored by a number of Algerian agencies

Chinese 4+4 Modem

As mentioned earlier, Hoka is now supporting this modem. Transmissions typically take place on the lower sideband (LSB) with the center of the 8 tones at 1700Hz above the carrier point. Here are some recent places where the Chinese MFA and its embassies have been heard:

10113, 10230, 10467, 10521, 10683, 10737, 10845, 10917, 13848, 14578, 16516, 17412, 18201 & 18521kHz LSB

Russian Intelligence & Diplomatic Services

As featured in the August 2011 issue of this column, among a multitude of different modes, a commonly heard one used by the Russians sends data at 200bd with 1000Hz shift and shows an ACF (auto correlation function) of 288 indicating the use of 288bit frames for carrying the underlying data. While there is undoubtedly a schedule behind these transmissions, I've yet to hear enough of them to piece together all but the smallest part of the overall plan.

Here are some recent channels in use. Note that transmitters are often on-frequency for many minutes before the actual sked time, resting on one tone and in common with many other Russian transmissions using other modes, the same message is repeated 10 minutes later on a channel approximately 2MHz lower. Signal strength is always very good here on the eastern seaboard of the US:

5460, 6791, 6841, 8100, 9067, 9129, 11112, 11428, 11476, 12208, 14464, 14809, 15831,
16213, 17448, 18394, 18516, 19156, 19314 & 20873kHz (center of data)

You can keep in touch with all the latest updates to existing decoders or find new ones by checking Utility Monitoring Central's hardware and software decoder pages, kindly maintained by Mike Agner, KA3JJZ. Until next month, enjoy the digital DX!

RESOURCES

Chinese 4+4 Modem Audio Clip: **youtu.be/6r74PzU89BY**
Hoka: **www.hoka.com**
WaveCom: **www.wavecom.ch**
MultiPSK: **f6cte.free.fr/index_anglais.htm**
Grove WaveCome Page: **www.grove-ent.com/wavecom.html**
UMC Decoder Hardware Page: **http://www.chace-ortiz.org/umc/hardware.html**
UMC Decoder Software Page: **www.chace-ortiz.org/umc/software.html**

ON THE HAM BANDS

THE FUNDAMENTALS OF AMATEUR RADIO

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Kit Building: Bigger (and Smaller) Than Ever!

As a veteran PC tech and computer enthusiast, I like to build each of my computers from scratch because I can pick and choose each part to get just the right machine. Most "store-bought" PCs, unless they're hideously expensive, cut a lot of corners. Some have decent motherboards but low-rent power supplies. Some have purposefully "crippled" parts that sport famous brand names, so buyers *think* they're getting something really nifty, even if they're not. And some are just low-rent, period. As a service tech, these are my favorites, as they're good for business!

Originally, ham radio was almost all DIY, and it wasn't too many years ago that DIY or kit-built radio gear was the norm and was much more affordable than store-bought hardware. That's certainly not as true today when high-performance radios are more affordable than ever before (especially in inflation-adjusted dollars).

For a small percentage of hams, perhaps, economic necessity drives our urge to build our own gear. But for most of us, it's the rush and satisfaction of creating a customized, one-of-a-kind item in an era when everything around us is store-bought (or made overseas) that gets our creative juices flowing. The drive to "learn by doing" is still the ultimate way to really know a skill or master almost any subject. Building radios, high performance or otherwise, is more about education and achievement than saving money. And, if you factor your time into the equation, there's no cost savings at all (and probably a lot of "opportunity cost"). So it's definitely not about saving money!

On the left is a Kenwood TS-120S VFO I packaged (somewhat crudely) in 1993. On the right is a life-size mock up of a Midnight Design Solutions SDR Cube monoband transceiver, complete with DDS, software-defined innards, built-in DSP controller, band scope and digital display! (NT0Z photo)

The Internet is abuzz with how-to videos that support "hardware hackers" of every stripe, from woodworking, to digital stuff, to ham radio stuff, and hams are building, tweaking, modifying and customizing everything from A to Z.

If you're at all inclined, I think building radio stuff, whether simple station accessories or a complete station, pays dividends in many ways. But, beginners shouldn't try to build a high-performance transceiver from scratch as a first project, though in a certain sense, building *anything* beyond a simple antenna from scratch may not be the best approach, either. Unless you're already an experienced builder (a Catch 22), to create a positive, satisfying outcome consider building a kit radio or radio accessory.

The Golden Age of Kit-Building

If you're relatively new to the scene, you probably don't remember the demise of the first great ham radio and electronics "kit companies," Johnson, Knight and Heathkit, among others. Thankfully, the ham radio kit industry has recovered nicely, is thoroughly modern, and is doing well. The passing of these bedrock companies, however, marked the end of an era.

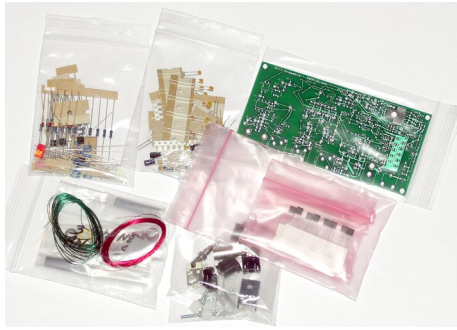
The most successful company of the original kit-building powerhouses was Heathkit. It pretty much owned the kit-building scene from the 1950s through the 1970s, survived and tried to innovate in the 1980s. It managed to hold on in one shape or another until its passing in the early 1990s. Heathkit was surprisingly resurrected in 2011, and just when things were looking good for a return of Heathkit ham radio kits, financing fell through and Heathkit died yet again.

Even from the 1960s through the 1980s, which saw Japanese equipment makers rise to market dominance, Heathkit was still synonymous with ham radio and just about everyone who couldn't afford a Collins or Drake setup was using Heathkit gear lovingly built from a kit of parts using Heathkit's fabulous step-by-step instruction manuals.

There were plenty of kit makers in those days, but nobody but Heathkit produced major kits (and kit lines) that featured complete stations, receivers, transmitters, transceivers, etc. Until the modern kit-building era, DIYers had to make do with accessory kits and smaller projects (or buy used Heathkit gear, much of which is still bought and traded to this day).

Present-Day Kit Building

Unlike "Heathkit Hams," modern DIYers have easy access to low-cost, high-performance radios (and the Internet and toll-free numbers with which to research and order them). And, except for towers, rotators and antennas, everything is a tremendous bargain.



One of the kits I'm working up the nerve to build this fall is a three-band Softrock RXTX Ensemble SDR transceiver. (NT0Z photo)

For modern DIYers, despite the compelling performance and reasonable price of modern radios, the satisfaction that comes from using radio gear they've built themselves is a powerful motivator. If you've ever made a QSO while using a transceiver you've assembled from raw parts, you know what I'm talking about!

And unlike many DIY radios from years past, modern kit radios aren't "dumbed-down" models that offer fewer features and reduced performance when compared to the finest store-bought gear. Top-quality radio kits ranging from simple station accessories to powerful multiband transceivers are now the norm. This is an amazing time to build radio gear!

Dozens and dozens of companies (many in Europe and elsewhere) offer an amazing assortment of high-quality products, many of which are aimed at low-power ops (QRPers). Kit-building and QRP are truly inseparable, but you don't have to be a QRPer to enjoy building kit radios and accessories.

California-based Elecraft, for example, in some ways Heathkit's spiritual successor, sets the bar *very high*. The company's KX3, a 10-W, HF+6, all mode, trail-friendly software-defined transceiver, available as a "no solder" kit or fully assembled, presently sits at the top of the transceiver performance charts at Sherwood Engineering. No kit radios in the past, Heathkit included, could outperform the best commercial radios costing thousands more. The company's other kit radios also offer top-shelf performance in a package you can "build yourself." See **www.elecraft.com** for all the details.

Building top-performing ham gear has never been easier, so it's a fantastic time to get started. Check out **http://fofio.blogspot.com/2012/04/amateur-radio-kit-roundup.**

html; **www.dxzone.com/catalog/Manufacturers/QRP_Kits/; www.w1wc.com/kits**; and **http://ac6v.com/kits.htm** for links to dozens of ham radio kit sites on the web (kit companies come and go, so some of the listed links are dead). If you need inspiration, YouTube hosts hundreds of "ham radio kits in action" videos.

Some of my favorite kit companies include Hendrick's QRP Kits (**www.qrpkits.com**); Five Dash, the new home of KB9YIG's Softrock SDR kits (**http://fivedash.com**); Kanga US (**www.kangaus.com**); Almost All Digital Electronics (**http://aade.com**); Kits and Parts (**http://kitsandparts.com**); JUMA Kits (**www.nikkemedia.fi/juma**); and Ten-Tec, USA's last "old school" ham radio maker and kit provider (**www.tentec.com/categories/Kits**).

❖ New Tool of the Trade: a Microscope?

Many kits, especially "traditional" kits or the latest offerings that are specifically designed to use mostly "through-hole parts," can be built using a soldering iron, wire cutter/stripper, pliers, a screwdriver or two and some solder, so don't be shy; building kits isn't as difficult as it might seem.

But as I discovered when I woke from my latest kit-building slumber (about 10 years), SMT kits have become the norm. Once used only by electronics manufacturers, SMT components have caught up with ham radio home-brewing in a "big" way and for a variety of reasons.

Because of reduced lead lengths and stray inductance and capacitance, SMT circuits often perform better at RF. They're physically small, so SMT radios and accessories can be amazingly (ridiculously?) small, as well. Parts availability is also a big factor, and many (soon to be most and then, perhaps, all) parts are manufactured only in SMT packages! In the long run there's no getting around it, so we may as well get used to it!

SMT parts come in sizes ranging from super small, to bizarrely small, to impossibly small and that's the biggest challenge in working with them as hobbyists. Unless you have perfect eyesight and the steady hand of a brain surgeon, seeing, identifying, testing, grasping and soldering the little buggers requires a bit of practice and a few new tools.

A complete tutorial on SMT construction is beyond the scope of this column, but there are many helpful videos and instructions on the Internet. Let's look at a few SMT hobbyist necessities to get your thought processes started.

Tweezers: Many SMT parts are so small you really need a precision tweezers just to pick them up! Don't try to make do with drugstore tweezers, get a pair that's designed for electronic parts. I bought a nice set from **www.meritline.com** for about $3.

Test Lead Tweezers: If an SMT part is small enough that it's difficult to pick up with your bare hands, imagine how hard it would be to measure with a pair of test leads from your DMM? Some DMMs, scopes and L/C meters have SMT accessory tweezers that have tiny contacts on the tips of the tweezers that electrically contact the parts as you pick them up. Nifty!

Microscopes: In manufacturing plants and SMT service shops the techs use stereo microscopes (2X-45X) to see what they're doing. The consensus is that stereo scopes (as opposed to monocular scopes and other magnifying devices) work best and produce less eyestrain and fatigue. Big-name stereo scopes start at $2,000, but used scopes (especially parts-missing scopes) and many imported stereo scopes available on eBay and from amazon.com (AmScope is one well-reviewed brand) work just fine. The 'scopes cost between $40 and $100 and come with conventional mounts and focusing racks. It's the adjustable boom mounts that drive up costs. I plan to build a boom of my own, as many SMT experimenters do.

Weighing a mere 1.5 pounds, Elecraft's tiny all-mode, 10-W, KX3 ($900) transceiver covers 160 through 6 meters with all of the usual bells and whistles. (Photo courtesy of Elecraft)

Magnifiers: If a stereo microscope is out of the question or unavailable, inexpensive head-mounted magnifying glasses can work for occasional use. The "working distance" for glasses is much less than that of a scope, however, so you'll have to get very close to the work at hand, which makes soldering difficult and potentially more dangerous. A decent set of head-mounted magnifying glasses can be purchased at Harbor Freight Tools for about $10.

Vise: Back in the day you could simply place a big ol' PCB on your workbench and solder away. Today you'll want to have some kind of vise that allows the PCB to be supported and positioned appropriately for soldering, microscope inspection, etc. PanaVise makes delicious high-end models, but I have done just fine with my $10 suction-mounted mini vise (with rubber-lined jaws) from Harbor Freight Tools.

S*oldering iron and tips*: Soldering sub-millimeter leads and PCB pads with a standard soldering iron tip is like trying to eat with chopsticks the size of a baseball bat, essentially impossible! All mainstream soldering iron manufacturers (Weller, Hakko, etc) make ESD-protected, adjustable temperature models with interchangeable tips, including tiny tips for SMT work. Many SMT pros like SMT tips that have the very end of the tip angled at 45 degrees because it makes it easier to see the work under high magnification.

Heat guns: In addition to soldering irons, in some situations, heat guns can also be used to solder or desolder certain SMT parts. Naturally, expensive SMT-oriented models are available, but many builders have had good luck with inexpensive models available from outlets such as Harbor Freight Tools. The trick with these is to make sure you use the low-power (or low fan speed) settings so you don't blow the parts off the PCB while you're trying to solder them!

Solder paste: Solder paste is the secret sauce that ensures hobbyist SMT success. Whether used for conventional or reflow soldering, solder paste is a sticky liquid mixture of powdered solder and flux that's used to temporarily "tack" SMT parts to their PCB pads. Once the parts are "stuck" in place they can be soldered conventionally (with a tiny soldering iron tip) or "reflowed" in an oven or with a heat gun.

Toaster ovens and electric frying pans: Nope, I'm not kidding! Perhaps the best way to assemble SMT kits today is to use solder paste to "stick" all of the parts to their PCB pads (all at once) and use a toaster oven or an electric frying pan to supply the heat required to "reflow" the solder paste (all SMT parts get soldered in one setting). At a certain temperature, which varies from paste to paste, the heat causes the sticky solder paste to become liquid (melted) solder. In the process the solder forms up on the component leads and the PCB pads as if by magic, and when the temperature cools below the "reflow temperature," the parts are all nicely soldered to their respective pads. There are dozens of YouTube videos that show reflow soldering in action, and every time I see one it still freaks me out!

For consistent results you'll have to "characterize" your toaster oven or frying pan so you know how long it takes to reach the appropriate temperature. The idea is to keep the PCB just above the solder paste's reflow point (but much higher) for a certain length of time (often about 30 seconds) after "ramping up" the temperature at a rate that doesn't thermally shock the electronic parts in the heating process. Surprisingly, most discount store toaster ovens and frying pans do just fine.

If SMT is just too difficult or impossible (because of vision limitations, etc), most SMT kit producers can refer you to individuals or companies that will mount all of the SMT parts in a particular kit for a nominal fee. Assembling the rest of the kit and soldering any conventional parts and connectors is up to you, the builder.

Before trying out your new SMT skills on a complex kit, I strongly urge you to build at least one "SMT practice kit." Many vendors sell these for only a few bucks. You'll probably end up with a final product that is somewhat less than useless (blinking LEDs, etc), but you'll have an opportunity to get those "first SMT" jitters out of the way and perfect your technique before you move on to more important projects.

Whether through-hole or SMT, using a radio or accessory that you built from a kit is a thrill you will never forget. Our radio ancestors did it, and you can, too. And don't be intimidated by newfangled SMT doohickeys. What gives me hope is that many experimenters who've tried working with SMT find reflow soldering and the whole SMT process to be easier than traditional methods. I will let you know how it goes in future columns, as I'm gearing up to build a Softrock transceiver and a pair of Norcal FCC-2 Mk II DSS VFOs. Wish me luck!

GETTING STARTED

THE BEGINNER'S CORNER

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The $467.56 Radio Buying Challenge

MT reader Lynn Kelly sent an article from the November 1940 issue of *Consumers Union Report,* as *Consumer Reports* was known in those days, titled, "1941 Radios under $30." Featured among the sets reviewed were some names dear to the hearts of many *MT* readers including Silvertone, Crosley, Lafayette, Knight, Philco, Echophone and Ward's Airline, just to name a few. It was a three page article that detailed the qualities (or lack thereof) on no fewer than 35 different models almost all of which were priced under $30. The article listed their 10 "best buys," based on a combination of both quality and price. The number one radio under $30 was judged to be the Crosley 24AU at just a nickel under $30. Second place went to the Sears Silvertone No. 1561 at five cents under $18.

Consumers Union judged the top-rated Crosley seven-tube AC set, which covered 540 kHz to 18 MHz (with a 1 MHz break from 5 to 6 MHz) this way, "Tone, volume, sensitivity and selectivity excellent. Appearance poor. Dial movement excellent and suitable for short-wave tuning. Slight shock hazard at chassis, ground and antenna connections." Well, what do you expect for $30? Quite a lot actually, because in today's dollars that set would cost $467.56, according to the Bureau of Labor Statistics' Inflation Calculator. Can you imagine a radio with a poor appearance, "slight shock hazard at chassis, ground and antenna connections," and costing $467, attracting many buyers today? I can't either, but many tens of thousands of these sets were sold during what's now referred to as the Golden Age of Radio.

In case you're curious, the Ward's Airline catalog number 420 ($5.75) came in 35th and was damned by faint praise: "Despite its small size, the radio is somewhat more than a novelty, and represents a remarkable value for the money. It is selective enough to provide satisfactory reception on an adequate number of stations." *Satisfactory* reception on an *adequate* number of stations? That would make amazing ad copy today! Incidentally, in today's money, that set would cost almost $90. Compare that with the Kaito 1103 ($90 at Grove Enterprises) and you'll see what a real bargain the 1103, which receives 150 kHz through 30 MHz *and* FM, really is.

The Crosley was not the most expensive radio of the lot in the 1940 *Consumers Union Reports* article; the Philco model 230-T took home those honors at $32.50, a whopping $506.52 in today's money, and ranked number nine on the 1941 list in order of "tone quality."

❖ Bargain Shortwave Radios under $467

Times have changed. Now, not only do you get a radio that won't present a shock hazard, you'll get AM *and* FM, amazing audio performance, great reception, digital tuning, dozens of presets, audio input and output, an iPod docking station and often a remote control! Oh, did I mention that you'll also get instant-on, solid state, low power consumption and probably more than ten years of maintenance-free listening?

The best part is that great table radios today cost considerably under $400, in most cases a third that cost. I know, you're saying, "But, Ken, the Crosley 24AU was AM *and* shortwave up to 18 MHz. You're radios are only AM and FM!" OK, it's true, so I'll offer instead the Alinco DX-R8T: 150 kHz through 30 MHz, all-band, all-mode, solid-state, keypad frequency entry, digital readout, 500 Hz CW filter, 600 channel memory, RIT, IF shift, noise blanker, squelch, two VFOs and no shock hazard; all for $450! OK, if you don't already have one, you'll need an outboard 12-13 volt power supply ($35 new); still close to our $467 budget limit.

Even better, you can step up to the world of Software Defined Radios (SDRs) with the Ten-Tec RX-320D ($383), which covers the whole HF spectrum with your choice of 34 different filters, can tune DRM shortwave broadcasts and has earned a 4.7 out of 5 rating from the crusty reviewers on eham.net. Since it has its own power supply you'll have to figure out what extra to buy with the $67 you'll have left from our $467 radio challenge.

❖ Table Radios with Awesome Audio

But, back to table radios: What's available? I recently bought a Boston Acoustics (BA) Solo II radio that I had had my eye on for the last six years, ever since I did reviews of HD-Radio table sets for *MT* in 2006. The Solo II looks like it's based on BA's Receptor HD (which sold at that time for $280), but wasn't the best HD receiver, though the Receptor's audio fidelity was excellent and the construction was superb. I had despaired when the company discontinued the product. The set sold at fire sale prices at Radio Shack stores at the end 2006 which, at the time, stocked HD-Radios. Some lucky shoppers walked out with real bargains.

Then BA brought out their Solo II. It was an updated version of the Receptor; without the HD

Boston Acoustics Solo II ($150) outstanding audio fidelity, excellent AM and FM reception. (Courtesy: Boston Acoustics)

and no extra speaker, but with a larger cabinet, bigger speaker, and awesome audio now priced at just $150. I found an "open box" Solo II at a nearby, big name, audio mail-order company and picked it up for just under $100. A very radio-savvy visitor to the house heard the radio and was amazed at the depth of the audio fidelity and couldn't believe there weren't other speakers providing extra sound. What's more, it's an excellent AM DX radio. It has antenna connectors in the rear for both AM and FM antenna inputs; an auxiliary input for your MP3 player and a front mounted stereo headphone jack. Even if you have to pay full price for the Solo II, you'll still pocket $317 in our $467 radio challenge with which you can buy a Sangean ATS-909X ($260) portable shortwave radio and still have $50 in change!

Perhaps the best deal in today's table radios, particularly if you're an audiophile with brand consciousness, is the Bose Wave® Radio III for $350. Yes, you can buy the vaunted sound of the Bose Wave Radio with its iconic cabinet styling and still have $117 left over from our $467 challenge, more than enough to order the Kaito 1103 for your shortwave hankerings!

Bose Wave® Radio III ($350), the legendary table radio known for its timeless cabinet design and full stereo audio capability. (Courtesy: Bose Corp.)

Tivoli Model One ($150), based on Henry Kloss' Model One from the late 1950s, offers analog tuning and excellent monaural audio. (Courtesy: Tivoli Audio)

Another great table radio with excellent audio comes from Tivoli Audio. Their series, based on the original Henry Kloss Model One from the late 1950s (which was a small, tube-fired, high fidelity, monaural table-top set), includes the current version of the Model One ($150) and the Tivoli Model Ten ($200) which brings you the same amazing audio but with digital tuning in a very small package.

Tivoli Model Ten ($200) brings amazing audio to a very small footprint with convenient, digital controls. (Courtesy: Tivoli Audio)

Tivoli makes an upscale version, the Music System, for $500. Think of the Tivoli Music System as the stretch limo version of their Model One. It is a slick-looking retro-styled, high fidelity stereo table radio with a built-in CD player, adjustable downward-firing subwoofer and remote control. OK, it comes in $33 over our budget but it makes the Model One, Model Ten and Boston Acoustics Solo II, seem like a real bargains.

Tivoli Music System ($500), retro-style, excellent audio, great controls with remote and built-in CD player. (Courtesy: Tivoli Audio)

CambridgeSoundworks makes one of the best sounding, full-featured table radios available. Their model i755 tunes AM and FM, has a built-in iPod docking station as well as antenna inputs for both bands. The audio is on par with the Bose Wave Radio III (I actually prefer its sound to the Bose) and this radio comes in at just $290, $60 less than the Bose and a full $177 below our budget challenge.

❖ Going WiFi

The very definition of "radio" is now up for reconsideration. Today's WiFi radios stretch the common usage of the term, but ought to be considered. They are after all, wireless, and while most don't receive over-the-air AM and FM signals, they pick up web-based signals through

Cambridge SoundWorks i755 ($290) AM/FM stereo with iPod docking brings the versatility of a superb-sounding table radio that utilizes the music you've packed into your iPod. (Courtesy: Cambridge SoundWorks)

their wireless WiFi capability. What they feature is unimaginable reception of everything from international shortwave broadcasters, thousands of AM and FM radio stations from around the world, hundreds of city fire and police departments, air traffic control towers and build-your-own radio stations from commercial music interests such as Pandora®. Almost all WiFi sets though, lack the audio fidelity that the above mentioned table radios have.

The great drawback to these radios is that the purchase price, anywhere from $100 to $500, is just the start to the expenses. If you don't already have them, you'll need a wireless router ($100 plus or minus) and access to some sort of high-speed Internet connection (another $40 to $80 per month thereafter, depending on the service you can get where you live).

Compared to any of the above actual radios (with or without CD player or iPod docking station), a WiFi radio by itself represents a significant yearly cost; a minimum of about $500 per year. You can still buy a lot of CDs or songs at the iTunes store for that amount of money each year. Of course, if you already have the router and high-speed connection you're only out the cost of the WiFi radio. Even so, in a service outage or if your router breaks down, your WiFi radio is just another expensive door stop.

❖ What's Missing?

You may have noticed that there's something missing from the lineup of table-top radios that was a big deal just a few years ago: HD-Radio. It was intended as the inexpensive answer to satellite radio, bringing better audio and multiple program channels per FM station as well as near-FM quality audio on AM. But, where have all the HD-Radios gone? If you hadn't bought an HD-capable table top set a few years ago when they were the "coming thing" you should know that they are now the "gone thing."

Many table radio manufacturers rushed HD-capable sets to market six years ago (though Bose steadfastly refused to do so), none have stuck around. The HD-Radio website (**www.hdradio.com**) is not reliable as several models listed are no longer available. I did

Insignia Narrator Advanced HD-Radio ($100) attempts to revive the HD-table top set, includes Radio Reader Service capability. (Courtesy: Insignia)

find one new AM/FM HD-Radio model, the Insignia Narrator Advanced HD-Radio with Radio Reader Service, available from Best Buy for $100. But, online reviews are mixed; earning three out of five stars from buyers.

The HD-Radio concept proved to be too expensive for the highly competitive table radio market and has migrated to high-end stereo receivers. You can find several models in the Denon, Onyko, Marantz, and Yamaha brands, though prices range from $1,500 to several times that. They did list one inexpensive model; the Sherwood RD-7405HDR ($300), which I found discounted to below $200, but that product was in short supply. If you Google that model you'll find which retailers still stock that particular product.

Here's the irony: HD-Radio has finally taken off, especially in major metro areas. Stations in these locations offer all manner of additional programming and people who live in these areas report dozens of interesting subchannels which are easily heard on the few HD-Radio sets still on the market.

PROGRAMMING SPOTLIGHT

WHAT'S ON WHEN AND WHERE?

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Spanish, a Language without Bounds

That is the title of the Spanish language course heard for many years on **Radio Exterior de Espana** or Spanish Foreign Radio. For some reason, I always misheard this title. Perhaps it was because of static, or the way it was pronounced, but over the years I heard it as "Spanish, a Language without Sounds" (which would be rather impractical) and other times I heard it as "Spanish, a Language without Vowels." Eventually I got it. As a Canadian, French courses in school became mandatory during my lifetime, since Canada is an officially bilingual country. French is a Romance language and as such, an understanding of it can make the understanding of other Romance languages such as Spanish and Italian much easier.

Recently I have been listening to a lot of Spanish-language programming, with varying degrees of success. Between words borrowed from English, and other words similar to French, I can usually figure out what is going on. And even if I can't it is still interesting to try.

Mornings from 1100-1500 UTC, one can hear **Radio Habana Cuba** quite well. Perhaps it is just as well that I don't understand every word in this case, as the propaganda is pretty much lost on me. But it is fun to listen to the station anyway. I consulted the Internet and translated the schedule for RHC's morning broadcast. From 1100-1400 *Revista Informativa Despertar con Cuba* which Google translates as "Wake Newsmagazine Cuba" is on the air. At 1400 UTC a news bulletin is followed by *Voices of the Revolution*. At 1423 another news bulletin is heard, followed by *Formally Casual* and *Cuba Sound.* The transmission ends with a morning news summary. I like to listen to this as I start my busy day.

Perhaps those who speak the language can correct me on this, but the morning program "sounds" to me like it's a lot more laid back than the evening broadcast, especially after 1400. Like any other time of the day, the opportunity to hear Cuban music should always be embraced when it is available. You may catch a tune from time to time.

Weekday mornings one can try 17730 and 17580 kHz. These frequencies may be changed by November, so consult the frequency listings elsewhere in this issue.

My other recent daily fix of Spanish-language programming comes from Spain. Or in this case from Spain via Costa Rica. **Radio Exterior de Espana** has been heard at 1800 UTC on 17850 kHz in recent months. Again the programming is enjoyable, even if one doesn't speak the language. It is also interesting to note the distinctive accent of Spain, most notably the letter "c" is pronounced as "th" in Spain, and "s" in Latin America.

❖ China Radio International

China Radio International (CRI) didn't get the memo about abandoning shortwave radio. If anything it is easier to hear now than in the "golden age" of shortwave broadcasting, before the Internet. Most weekday evenings, I like to tune in to *The Beijing Hour*, heard at 0100 UTC. As I am writing this before the clocks change, try an hour later after DST ends. 6020 kHz has been a pretty reliable frequency for a long time.

CRI is definitely not the **Radio Peking** of Chairman Mao's day. During a broadcast in September, there was even a discussion of transsexuals in China. *The Beijing Hour* is a fast paced news magazine about China and the world, and is well worth a listen for anyone interested in what is going on in this burgeoning nation.

Following *The Beijing Hour* is two hours of Chinese-language programming. For the same reasons mentioned above in regard to the Spanish language, it is nice to listen to the Chinese dialogue. While it is not possible for me to understand what they are saying, I do enjoy just listening to the sing-song nature of the language.

❖ Presidential Election

November 2012 will see the election of a President of the United States and a new Congress. Many shortwave radio programs will cover the election campaign itself. During past elections (2000 in particular) I have listened to **WWCR** on election night. In 2000 it was fascinating listening to the coverage. This was the Bush-Gore election, which took many days to decide amidst much acrimony, and the infamous "hanging chads" of West Palm Beach. Whether this year's election is a nail-biter or a landslide, give WWCR or the **Voice of America** a shot.

The **VoA** will certainly be covering the election. I recall listening to their coverage of the conventions and election night in the 1980s. Somewhere I still have a tape of Ronald Reagan's speech to the Republican convention in 1984 as heard on the **Voice of America**. I also recall listening on election night in 1988, and using the handy "scorecard" the then VoA's *Voice* magazine provided for tallying the electoral college results. In the end it wasn't even close, but it was a fun exercise regardless. Watch the results on TV, or follow them on the Internet, but also give shortwave a try.

❖ Folk Box from VoR

Folk Box is one of the last hold-overs from the Soviet era **Radio Moscow**. Today it is hosted by Svetlana Yekemenko, nowadays one of the more familiar voices heard on the **Voice of Russia**. The station is well known for the quality of its music programs, drawing on a thousand years of Russian musical heritage. *Folk Box* can be heard at 0130 UTC Sundays. 9665 and 9800 kHz have been good frequencies during the summer, but probably by November they will have slipped down to the 49 or 41 meter bands.

The program is both historically and musically interesting. One can learn not only about the diverse ethnic culture of Russia, but their music as well. Sometimes one is introduced to some unique musical instruments and styles. Other programs talk about cultural events, like the traditional Russian wedding. If the music and culture of the Tatars, the Kalmyks and the Chukchi people are your cup of tea, this is the program for you. I was entranced by the program about the Khomus, one of the most ancient musical instruments on earth. Originating in Siberia hundreds of years ago, their popularity has spread around the world. In the West they are known as "Jew's Harps." My Dad even played one of those. They have a very pleasing sound. *Folk Box* is a treat your ears will thank you for.

There is some time tested advice that one hears often. "Don't try this at home." Well, I am defying this advice. I started hosting an Internet radio show in August. Called *The Radio Time Capsule*, it consists of two hours of Old Time Radio Shows from the Golden Age of radio, and related music. It is certainly a learning experience. After having been a radio listener for over 40 years, and writing about radio for 26 years, it feels strange to be behind the mic. Join me on Tuesdays between 8 and 10 PM Eastern (0100-0300 UTC) for drama, adventure, history and comedy on Radio Scooter International **www.radioscooterinternational.net.**

THE QSL REPORT

VERIFICATIONS RECEIVED BY OUR READERS

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QSL Bytes

Larry Zamora sends a reminder about Radio Romania International's (RRI) Listener Club. Listeners who submit a reception report each month, are eligible to receive diplomas at the end of one, three, five and ten years of reporting. RRI offers a new QSL card each month that represents Romanian landmarks, artistry and more. Send your program details to *engl@rri.ro* or at the QSL Link at **www.rri.ro/** Postal address: Radio Romania International, 60-62 General Berthelot Street, P.O. Box 111, Bucharest, Romania.

As stations reduce or eliminate their presence on shortwave, DXers are finding new stations to log and add to their QSL count. Radio Logos, a new religious station aided by HCJB, is broadcasting on 4810 kHz from Chazuta in Peru's San Martin province. At press time, reception reports may be sent to Ray Rising, Director of Ethnic Radio at *ray rising@sil.org* or Glenn Smith, Ethnic Radio International (WBT), 5011 B Addison Road, Waxhaw, North Carolina 28173. Website: **www.ethnicradio.org/**

Colombia has a new station, Salem Stereo from Rioblanco in the Tolima Department. Currently active on 14950.6 kHz and streaming audio at **www.salemstereo.com** Send your Spanish details to Luis Emilio Torres Garzón, Director at *salemstereo@hotmail.com*

Winter DX season brings an enhanced listening opportunity for All India Radio (AIR) domestic and general overseas service stations. AIR has updated their website to reflect the continuing growth of broadcasting from the subcontinent at **www.allindiaradio.gov.in**. Reception details may be submitted online by downloading the form at the Reception Report link or direct to *spectrum-manager@air.org.in* or Director of Spectrum Management, All India Radio, Room No. 204, Akashvani Bhavan, New Delhi 110001 India.

Sri Lanka Broadcasting Corporation is offering new QSL cards. DXer, Victor Goonetilleke is lending assistant for reports addressed to the Director General, SLBC. Send your program details to Victor at *victor.goonetilleke@gmail*.com or *dg@slbc.lk* Postal address: Independence Square, Colombo 7, Sri Lanka or P.O. Box 574, Colombo 7, Sri Lanka. Those interested in QSLing the IBB stations from Sri Lanka, can send their report to Station Manager, IBB Relay Station, c/o U.S. Embassy, Galle Road, Colombo 2, Sri Lanka.

Current broadcast schedules for Romania, Peru, Colombia, India and Sri Lanka are listed in the SW Guide and MTXpress. Don't forget to refer to my blog, **Shortwave Central** for daily updates in the shortwave world and follow me on Twitter at the addresses in the above column banner.

FRENCH GUIANA

DX-Antwerp via Montsinery, 17880 kHz. Full data 30th Anniversary card, signed by Ludo Maes. Received in 22 days for an English report and two IRCs. Station address: DX-A, c/o TDP Radio, P.O. Box 1, B-2310 Rijkevorsel, Belgium. (Bill Wilkins, Springfield, Missouri)

MEDIUM WAVE

Russia-Kaliningrad 1215 kHz AM. Full data QSL card with illegible signature. Transmitter site listed as Bolshokovo. Received in five months for reception of Voice of Russia programming. Station address: Kaliningrad Regional Centre 184, Sovetsky prt, Kaliningrad 236023, Russia. (Patrick Martin, Seaside, Oregon)

U.S.-KMNS, 620 kHz AM Fox Sports. Full data confirmation on Clear Channel letterhead, signed by Shirley Dicus, Market Controller. Received in 56 days for an AM report, $1.00U.S. (returned) and an address label (used). Station address: P.O. Box 3009, Sioux City, Iowa 51102-3009 (Wilkins). Streaming audio via iHeart Radio **www.620kmns.com**

WEEU, 830 kHz AM. The Voice of Berks County. No data confirmation letter, signed by John Engle, Chief Engineer. Received in 12 days after follow up letter via certified mail and $1.00U.S. (total 317 days). Station address: 34 North Fourth Street, Reading, Pennsylvania 19601 (Al Muick, Williamsport, Pennsylvania/HCDX) Email *weeu@weeu.com* Website **www.weeu.com/**

ROMANIA

Radio Romania International, 9700 kHz. Full data color QSL card of 19th Century Orchard Homestead, unsigned. Received in four weeks for an English report. Station address (see above). (Larry Zamora, Garland, Texas)

UNITED STATES

Radio Taiwan International via Okeechobee, Florida relay, 9680 kHz. Full data "Bamboo Forest in Summer" card, unsigned. Program schedule, report forms and post card enclosed. Received in 35 days for an English report and two IRCs. QSL address: P.O. Box 123-199, Taipei, Taiwan (Wilkins) Streaming/on demand audio **www.rti.org.tw**

UTILITY

Belgium-OSU, Oostende Radio, 518 NAVTEX. No data map card QSL and letter, signed by Walter Philipsen. Received in 255 days for a utility report and one IRC. Station address: commc Zeebrugge, Graaf Jansdijk 1, 8380 Zeebrugge, Belgium (Muick)

Bosnia-Non Directional Beacon, MA Mostar, 355 kHz. Prepared QSL card signed by Arpad Salai, Head of ATC Mostar. Received in 32 days for a utility report. Station address: Centar kontrole zracnog prometa Mostar, Zracna luka-Aerodrom Mostar, Ortijes bb, 88000 Mostar, Bosnia-Hercegovina (Patrick Robic, Austria/UDXF)

Canada-Gander Volmet, Gander, Newfoundland 10.051 MHz. Full data color Nav Canada E-QSL from John Michael Fleming, Operations Specialist, Nav Canada. Received in 36 hours for a utility report to *service@navcanada.ca* (Rafael Rodriguez, Bogotá, Colombia/playdx). Postal address: 77 Metcalf Street, Ottawa, Ontario, Canada K1P 5L677.

Canary Islands-TZCT1, Guardia Civil Santa Cruz de Tenerife, 8025 kHz. Prepared QSL card signed and stamped. Received in 118 days for a utility report. Station address: Dirección General de la Guardia Civil, Subrecciónes, XVI Zona de Canarias, Comandancia de Santa Cruz de Tenerife, G.A. Teconolgia de la Información, c/ Conde de Pallsar n°3, Santa Cruz de Tenerife, Spain (Robic).

Chile-ONEMI, Oficia Nacional de Emergencia del Ministerio del Interior, 17426 kHz. No data E-QSL from Vladimir Maturana, via Regions 5 Headquarters in Valparaiso, Chile. *onemi@gorevalparaiso.cl* (Robic) ONEMI, a Chilean government agency, dedicated to prevention and coordination relative to natural disasters.

Ireland-Shannon Aeradio, 8957 kHz. Full data station folder card signed as Watch Manager. Received in 150 days for a utility report to *info@iaa.ie* Postal address: Irish Aviation Authority, Shannon Volmet, Operations Manager, Ballygireen, Newmarket-on-Fergus, County Clare, Republic of Ireland. (T. Banks, Dallas, Texas) Website: **www.iaa.ie**

Italy-Associazione Amici di Italcabe, 10000 kHz. Partial data QSL card, unsigned. Received in 30 days. QSL address: Via del Borgo 6, 55049 Viareggio (LU) Italy (Robic)

WAR, 14438.5 MHz USB. Annual Armed Forces Day Crossband Radio Communications Test. No data Pentagon ARC K4AF card, unsigned. Received in 39 days for shortwave report, $1.00U.S. and a SASE (used for reply). QSL address: AFDCBT, P.O. Box 2322, Arlington, Virginia 22202 (Wilkins).

How to Use the Shortwave Guide

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

① ② ⑤ ③ ④ ⑥ ⑦

CONVERT YOUR TIME TO UTC

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

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

FIND THE STATION YOU WANT TO HEAR

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

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

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

CHOOSE PROMISING FREQUENCIES

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

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

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

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

Target Areas

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

MT MONITORING TEAM

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Additional Contributors to This Month's Shortwave Guide:

Thank You to …

BCL News; BDX Club; Cumbre DX; DSWCI/DX Window; Hard-Core DX; DX Re Mix News 743-747; BCDX/WWDX/Top News.

Adrian Petersen/DBS 2012; Alokesh Gupta, New Delhi, India; Ashik Rajshahi, Bangladesh; Brenda Constantino/Florida; Eike Bierwirth, Germany; Georgi Bancov, Bulgaria; Ivo Ivanov, Bulgaria; Nigel Holmes/R Australia; Ron Howard, CA; Sean Gilbert UK/WRTH 2012; Wolfgang Bueschel, Stuttgart, Germany.

SHORTWAVE BROADCAST BANDS

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

Notes

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

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

0000 0030	Egypt, R Cairo	9965na
0000 0030	USA, BBG/VOA	7555as
0000 0045	India, AIR/External Svc	6055as 9705as 9950as 11670as 13605as
0000 0045 DRM	India, AIR/External Svc	9950eu
0000 0045	USA, WYFR/Family R Worldwide	11650as
0000 0056	Romania, R Romania Intl	9700na 11965na
0000 0100	Anguilla, University 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, ABC/R Australia	9660pa 12080pa 15240pa 15415pa 17795pa 19000pa 21740pa
0000 0100	Bahrain, R Bahrain	6010me
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 R International	6075eu 6180as 7350eu 7415as 9570na 11790as 11885as 15125as
0000 0100	Malaysia, RTM Kajang/Traxx FM	7295do
0000 0100	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0000 0100	New Zealand, R New Zealand Intl	15720pa
0000 0100 DRM	New Zealand, R New Zealand Intl	17675pa
0000 0100	Russia, VO Russia	9665va 9800va
0000 0100	Spain, R Exterior de Espana	6055na
0000 0100	Thailand, R Thailand World Svc	15275na
0000 0100	UK, BBC World Service	5970as 6195as 7395as 9410as 9740as 12095as 15335as 15755as 17685as
0000 0100	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
0000 0100	USA, FBN/WTJC Newport NC	9370na
0000 0100 Sat/Sun	USA, WBCQ Monticello ME	5110am
0000 0100	USA, WBCQ Monticello ME	7490am 9330am
0000 0100	USA, WEWN/EWTN Irondale AL	11520af
0000 0100	USA, WHRI Cypress Creek SC	5920va 7315ca 9860na
0000 0100	USA, WINB Red Lion PA	9265am
0000 0100	USA, WTWW Lebanon TN	5755va
0000 0100	USA, WWCR Nashville TN	4840eu 5935af 6875af
0000 0100	USA, WWRB Manchester TN	3185na 3215na 9385na
0000 0100	USA, WYFR/Family R Worldwide	6145na 17580as
0000 0100	Zambia, Christian Voice	4965af
0030 0100	Australia, ABC/R Australia	17750as
0030 0100 mtwhf	USA, WRMI/R Slovakia Intl relay	9955am
0035 0045	India, AIR/Aizawl	5050do 7295do
0035 0045	India, AIR/Chennai	4920do
0035 0045	India, AIR/Guwahati	4940do
0035 0045	India, AIR/Hyderbad	4800do
0035 0045	India, AIR/Imphal	4775do
0035 0045	India, AIR/Port Blair/Andaman & Nicobar	4760do
0035 0045	India, AIR/Shimla	4965do 6020do
0035 0045	India, AIR/Thiruvananthapuram	5010do

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

0100 0115 Sat	Canada, Bible Voice Broadcasting	9490as
0100 0130	Vietnam, VO Vietnam/Overseas Svc	6175na
0100 0200	Anguilla, University 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, ABC/R Australia	9660pa 12080pa 15160pa 15240pa 15415as 17750pa 17795pa 19000pa
0100 0200	Bahrain, R 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 R International	6175eu 9410eu 9410eu 9470eu 9535as 9570na 9580na 9675eu 11870as 15125as 15785as
0100 0200	Cuba, R Havana Cuba	6000na 6050na
0100 0200	Malaysia, RTM Kajang/Traxx FM	7295do
0100 0200	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0100 0200	New Zealand, R New Zealand Intl	15720pa
0100 0200 DRM	New Zealand, R New Zealand Intl	17675pa
0100 0200	Russia, VO Russia	9665va 9800va
0100 0200	Taiwan, R Taiwan Intl	11875as
0100 0200	UK, BBC World Service	7395as 9410as 9740as 11750as 12095as 15310as 15335as 15755as 17685as
0100 0200	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
0100 0200	USA, BBG/VOA	7430va 9780va 11705va
0100 0200	USA, FBN/WTJC Newport NC	9370na
0100 0200	USA, KJES Vado NM	7555na
0100 0200 Sat/Sun	USA, WBCQ Monticello ME	5110am
0100 0200	USA, WBCQ Monticello ME	7490am 9330am
0100 0200	USA, WEWN/EWTN Irondale AL	11520af
0100 0200 m	USA, WHRI Cypress Creek SC	9605na
0100 0200	USA, WHRI Cypress Creek SC	9840na 9860na
0100 0200	USA, WINB Red Lion PA	9265am
0100 0200 irreg	USA, WRNO New Orleans LA	7505am
0100 0200	USA, WTWW Lebanon TN	5755va
0100 0200	USA, WWCR Nashville TN	4840eu 5890na 5935af 6875af
0100 0200	USA, WWRB Manchester TN	3185na 5050na
0100 0200	USA, WYFR/Family R Worldwide	6145na
0100 0200	Zambia, Christian Voice	4965af
0120 0200 mtwhfa	Sri Lanka, SLBC	6005as 9770as 15745as
0130 0200 twhfas	Albania, R Tirana	7425na
0130 0200	Myanmar, Thazin BC Sta	6030do
0140 0200	Vatican City State, Vatican R	9580as 11730as

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

0200 0230	Thailand, R Thailand World Svc	15275na
0200 0230	USA, KJES Vado NM	7555na
0200 0230 Sat	USA, WBCQ Monticello ME	5110am
0200 0300	Anguilla, University 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, ABC/R Australia	9660pa 12080pa 15160pa 15240pa 15415as 17750pa 17795pa 19000pa
0200 0300	Bahrain, R 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 R International	11770as 13640as
0200 0300	Cuba, R Havana Cuba	6000na 6050na
0200 0300	Egypt, R Cairo	9720na
0200 0300	Malaysia, RTM Kajang/Traxx FM	7295do
0200 0300	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0200 0300	New Zealand, R New Zealand Intl	15720pa
0200 0300 DRM	New Zealand, R New Zealand Intl	17675pa
0200 0300	Palau, T8WH/World Harvest R	17800as
0200 0300	Philippines, R Pilipinas Overseas	11880me 15285me 17700me
0200 0300	Russia, VO Russia	9665va 15425na
0200 0300	South Korea, KBS World R	9580sa
0200 0300 mtwhfa	Sri Lanka, SLBC	6005as 9770as 15745as
0200 0300	Taiwan, R Taiwan Intl	5950na 9680na
0200 0300	UK, BBC World Service	6005af 6195me 12095as 15310as 17790as
0200 0300	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
0200 0300	USA, FBN/WTJC Newport NC	9370na

0200 0300 Sat/Sun	USA, WBCQ Monticello ME	5110am
0200 0300	USA, WBCQ Monticello ME	7490am 9330am
0200 0300	USA, WEWN/EWTN Irondale AL	11520af
0200 0300	USA, WHRI Cypress Creek SC	5920va
0200 0300	USA, WINB Red Lion PA	9265am
0200 0300 irreg	USA, WRNO New Orleans LA	7505am
0200 0300	USA, WTWW Lebanon TN	5755va
0200 0300	USA, WWCR Nashville TN	3215eu 4840na 5890af 5935af
0200 0300	USA, WWRB Manchester TN	3185na 5050na
0200 0300	USA, WYFR/Family R Worldwide	5985ca 6145na
0200 0300	Zambia, Christian Voice	4965as
0215 0227	Nepal, R Nepal	5005do
0230 0300	Myanmar, Myanma R/Yangon	9731do
0230 0300	Vietnam, VO Vietnam/Overseas Svc	6175na
0245 0300	Australia, HCJB Global Australia	15400as
0245 0300	India, AIR/Bhopal	4810do
0245 0300	India, AIR/Guwahati	4940do
0245 0300	India, AIR/Hyderbad	7420do
0245 0300	India, AIR/Imphal	4775do 7335do
0245 0300	India, AIR/Itanagar	4990do
0245 0300	India, AIR/Jaipur	4910do 7325do
0245 0300	India, AIR/Jeypore	5040do
0245 0300	India, AIR/Kolkata	4820do 7210do
0245 0300	India, AIR/Kuresong	4895do
0245 0300	India, AIR/Lucknow	4880do 7440do
0245 0300	India, AIR/Shillong	4970do
0245 0300	India, AIR/Shimla	4965do 6020do
0245 0300	India, AIR/Thiruvananthapuram	5010do
0250 0300	Vatican City State, Vatican R	7305am
0255 0300 Sun	Swaziland, TWR Africa	3200af

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

0300 0315	India, AIR/Aizawl	5050do 7295do
0300 0315	India, AIR/Imphal	4775do 7335do
0300 0315	India, AIR/Itanagar	4990do
0300 0315	India, AIR/Shillong	4970do
0300 0320	Vatican City State, Vatican R	7305am
0300 0325 Sun	Swaziland, TWR Africa	3200af
0300 0330	Egypt, R Cairo	9720na
0300 0330	Myanmar, Myanma R/Yangon	9731do
0300 0330	Philippines, R Pilipinas Overseas	11880me 15285me 17700me
0300 0330	Vatican City State, Vatican R	7360af 15460as
0300 0355	South Africa, Channel Africa	5980af
0300 0355	Turkey, VO Turkey	6165as 9515va
0300 0356	Romania, R Romania Intl	9645na 11795na 11895as 15340as
0300 0400	Anguilla, University 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, ABC/R Australia	9660pa 12080pa 15160pa 15240as 15415pa 15515pa 17750pa 21725pa
0300 0400	Bahrain, R Bahrain	6010me
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 R International	9690am 9790na 11770as 13750as 15110as 15120as 15785as
0300 0400	Cuba, R Havana Cuba	6000na 6050na
0300 0400	Malaysia, RTM Kajang/Traxx FM	7295do
0300 0400	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0300 0400	New Zealand, R New Zealand Intl	15720pa
0300 0400 DRM	New Zealand, R New Zealand Intl	17675pa
0300 0400	Oman, R Sultanate of Oman	15355af
0300 0400	Palau, T8WH/World Harvest R	17800as
0300 0400	Russia, VO Russia	9665va 15425na
0300 0400	South Africa, Channel Africa	3345af
0300 0400 Sun	Sri Lanka, SLBC	6005as 9770as 15745as
0300 0400	Taiwan, R Taiwan Intl	5950na 15320as
0300 0400	UK, BBC World Service	3255af 5875af 6005af 6145af 6190af 6195me 9410me 9750af 12035af 12095as 15310as 15365as 17790as
0300 0400	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
0300 0400	USA, BBG/VOA	4930af 6080af 9855af 15580af
0300 0400	USA, FBN/WTJC Newport NC	9370na
0300 0400	USA, WBCQ Monticello ME	7490am 9330am
0300 0400	USA, WEWN/EWTN Irondale AL	11520af
0300 0400	USA, WHRI Cypress Creek SC	5920va 7385na 9825va
0300 0400 irreg	USA, WRNO New Orleans LA	7505am
0300 0400	USA, WTWW Lebanon TN	5755va
0300 0400	USA, WWCR Nashville TN	3215eu 4840na 5890af 5935af
0300 0400	USA, WWRB Manchester TN	3185na 5050na
0300 0400	USA, WYFR/Family R Worldwide	11740ca
0300 0400	Zambia, Christian Voice	4965as
0330 0400	Iran, VO Islamic Rep of Iran	11920eu 13650eu
0330 0400	Vietnam, VO Vietnam/Overseas Svc	6175na
0335 0345	India, AIR/Kolkata	4820do 7210do

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

0400 0430	Iran, VO Islamic Rep of Iran	11920eu 13650eu
0400 0430	USA, BBG/VOA	4930af 4960af 6080af 9855af 12025af 15580af
0400 0457	Germany, Deutsche Welle	6180af 7240af 9470af 12045af
0400 0457	North Korea, VO Korea	3560as 7220as 9345as 9730as 11735as 13760as 15180as
0400 0458	New Zealand, R New Zealand Intl	15720pa
0400 0458 DRM	New Zealand, R New Zealand Intl	17675pa
0400 0500	Anguilla, University Network	6090na
0400 0500	Australia, ABC NT Alice Springs	4835do
0400 0500	Australia, ABC NT Katherine	5025do
0400 0500	Australia, ABC NT Tennant Creek	4910do
0400 0500	Australia, ABC/R Australia	9660pa 12080pa 15160pa 15240pa 15415as 15515pa 21725pa
0400 0500	Bahrain, R Bahrain	6010me
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 R International	6080na 17730va 17855va
0400 0500	Cuba, R Havana Cuba	6000na 6050na
0400 0500	Malaysia, RTM Kajang/Traxx FM	7295do
0400 0500	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0400 0500	Russia, VO Russia	13775na 15760me
0400 0500	South Africa, Channel Africa	3345af
0400 0500 Sun	Sri Lanka, SLBC	6005as 9770as 15745as
0400 0500 DRM	UK, BBC World Service	3955eu
0400 0500	UK, BBC World Service	3255af 5875af 6005af 6190af 7310af 11945af 12035af 12095me 15310as 15365as 17790as
0400 0500	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
0400 0500	USA, FBN/WTJC Newport NC	9370na
0400 0500	USA, Overcomer Ministry	15750af
0400 0500	USA, WBCQ Monticello ME	9330am
0400 0500	USA, WEWN/EWTN Irondale AL	11520af
0400 0500	USA, WHRI Cypress Creek SC	5920va 7385na 9825va
0400 0500	USA, WTWW Lebanon TN	5755va
0400 0500	USA, WWCR Nashville TN	3215eu 4840na 5890af 5935af
0400 0500	USA, WWRB Manchester TN	3185na 5050na
0400 0500	Zambia, Christian Voice	4965as
0430 0500	Myanmar, Thazin BC Sta	6030do
0430 0500 mtwhf	Swaziland, TWR Africa	3200af
0430 0500	USA, BBG/VOA	4930af 4960af 6080af 12025af 15580af

0455 0500	Nigeria, VO Nigeria	15120af
0459 0500	New Zealand, R New Zealand Intl	11725pa
0459 0500 DRM	New Zealand, R New Zealand Intl	11675pa

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

0500 0527	Germany, Deutsche Welle	5925af
0500 0530	Japan, R Japan NHK World	5975eu
	6110na 11970va	
0500 0530	Vatican City State, Vatican R	11625af 13765af
0500 0557	North Korea, VO Korea	13650as 15100as
0500 0600	Anguilla, University 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, ABC/R Australia	9660pa 12080pa
	13630pa 15240pa	15415as 15515pa
	21725pa	
0500 0600	Bahrain, R Bahrain	6010me
0500 0600	Bhutan, Bhutan BC Svc	5030do 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 R International	11710af
	11895as 15350as	15465as 17505va
	17730va 17855va	
0500 0600	Cuba, R Havana Cuba	6010na 6050na
	6060ca 6125am	
0500 0600	Eqt Guinea, Pan American BC/R Africa	
	15190af	
0500 0600	Germany, Deutsche Welle	9470af 9800af
	9850af 11800af	
0500 0600	Malaysia, RTM Kajang/Traxx FM	7295do
0500 0600	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0500 0600	Myanmar, Thazin BC Sta	6030do
0500 0600	New Zealand, R New Zealand Intl	11725pa
0500 0600 DRM	New Zealand, R New Zealand Intl	11675pa
0500 0600	Nigeria, VO Nigeria	15120af
0500 0600	Russia, VO Russia	13755na
0500 0600	South Africa, Channel Africa	7230af
0500 0600 Sat/Sun	Swaziland, TWR Africa	3200af
0500 0600	Swaziland, TWR Africa	9500af
0500 0600	Taiwan, R Taiwan Intl	5950na
0500 0600	UK, BBC World Service	3255af 5875af
	6005af 6190af	9410af 11945af
	12095me 15310as	15365as 15420af
	17640as 17790as	
0500 0600 DRM	UK, BBC World Service	3955eu
0500 0600	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb	13362usb
0500 0600	USA, BBG/VOA 4930af	6080af 12025af
	15580af	
0500 0600	USA, FBN/WTJC Newport NC	9370na
0500 0600	USA, Overcomer Ministry	15750af
0500 0600	USA, WBCQ Monticello ME	9330am
0500 0600	USA, WEWN/EWTN Irondale AL	11520af
0500 0600	USA, WHRI Cypress Creek SC	5920am
	7385na 9825va	
0500 0600	USA, WTWW Lebanon TN	5755va
0500 0600	USA, WWCR Nashville TN	3215eu 4840na
	5890af 5935af	
0500 0600	USA, WWRB Manchester TN	3185na
0500 0600	Zambia, Christian Voice	6065af
0530 0556 DRM	Romania, R Romania Intl	11875eu
0530 0556	Romania, R Romania Intl	9700eu 17760eu
	21500eu	
0530 0600	Australia, ABC/R Australia	17750as
0530 0600	Thailand, R Thailand World Svc	17770eu

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

0600 0627	Germany, Deutsche Welle	15275af
0600 0630	China, Xizang PBS	6025do 6130do
	9580do	
0600 0630	Germany, Deutsche Welle	13780af 17820af
0600 0630	Myanmar, Thazin BC Sta	6030do
0600 0630 Sat/Sun	USA, WRMI/R Prague relay	9955ca
0600 0645 mtwhfa	Vatican City State, Vatican R	15595me
0600 0650 DRM	New Zealand, R New Zealand Intl	11675pa
0600 0655	South Africa, Channel Africa	15255af
0600 0657	North Korea, VO Korea	7220as 9345as
	9730as	
0600 0700	Anguilla, University 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, ABC/R Australia	9660pa 11945pa
	12080pa 13630pa	15240pa 15415as
	17750pa 21725pa	
0600 0700	Bahrain, R 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 R International	11710af
	11870me 11895as	13660as 15140me
	15350as 15465as	17505va 17710as
0600 0700	Cuba, R Havana Cuba	6010na 6050na
	6060ca 6125am	
0600 0700	Eqt Guinea, Pan American BC/R Africa	
	15190af	
0600 0700	Malaysia, RTM Kajang/Traxx FM	7295do
0600 0700	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0600 0700	New Zealand, R New Zealand Intl	11725pa
0600 0700	Nigeria, VO Nigeria	15120af
0600 0700	Papua New Guinea, R Fly	3915do
0600 0700	Russia, VO Russia	21800pa 21810va
0600 0700 DRM	Russia, VO Russia	11830eu
0600 0700	South Africa, Channel Africa	7230af
0600 0700	Swaziland, TWR Africa	6120af 9500af
0600 0700 Sat/Sun	Swaziland, TWR Africa	3200af
0600 0700	UK, BBC World Service	6005af 6190af
	9410af 12095va	15105af 15310as
	17640af 17790as	
0600 0700 DRM	UK, BBC World Service	5875eu 7355eu
0600 0700 mtwhf	UK, BBC World Service	15420af

0600 0700	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb 13362usb	
0600 0700	USA, BBG/VOA 6080af 12025af	15580af
0600 0700	USA, FBN/WTJC Newport NC	9370na
0600 0700	USA, Overcomer Ministry 15750af	
0600 0700	USA, WBCQ Monticello ME 9330am	
0600 0700	USA, WEWN/EWTN Irondale AL	11520af
0600 0700	USA, WHRI Cypress Creek SC	5920am
	7385na 11910va	
0600 0700	USA, WTWW Lebanon TN 5755va	
0600 0700	USA, WWCR Nashville TN 3215eu	4840na
	5890af 5935af	
0600 0700	USA, WWRB Manchester TN	3185na
0600 0700	Zambia, Christian Voice 6065af	
0600 0700	Zambia, CVC Intl/1 Africa 13590af	
0617 0630 Sun	Nepal, R Nepal 5005do	
0630 0645	India, AIR/Guwahati 4940do	7280do
0630 0645	India, AIR/Hyderbad 7420do	
0630 0645	India, AIR/Mumbai 4840do	7240do
0630 0645	India, AIR/Thiruvananthapuram	5010do
0630 0700	Germany, Deutsche Welle 13780af	17820af
0630 0700	Vatican City State, Vatican R 11625af	13765af
	15570af	
0645 0700 mtwhf	Israel, Kol Israel 9955na	
0651 0700 DRM	New Zealand, R New Zealand Intl	9890pa

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

0700 0730	Myanmar, Myanma R/Yangon	9731do
0700 0750	Austria, TWR Europe 6105eu	
0700 0750	Germany, TWR Europe 6105eu	
0700 0758	New Zealand, R New Zealand Intl	11725pa
0700 0758 DRM	New Zealand, R New Zealand Intl	9890pa
0700 0800	Anguilla, University 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, ABC/R Australia 7410pa	9475pa
	9660pa 9710pa 11945pa	12080pa
	13630pa 15240pa	
0700 0800	Bahrain, R 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 R International	11895as
	13660as 13710eu 15125va	15350as
	15465as 17490eu 17540as	17710as
0700 0800 mtwhfa	Ecuador, HCJB/LV de los Andes	3995eu
0700 0800	Eqt Guinea, Pan American BC/R Africa	
	15190af	
0700 0800	Malaysia, RTM Kajang/Traxx FM	7295do
0700 0800	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0700 0800	Papua New Guinea, R Fly 3915do	
0700 0800	Russia, VO Russia 21800pa	21810va
0700 0800 DRM	Russia, VO Russia 11830eu	
0700 0800	South Africa, Channel Africa	9625af
0700 0800	Swaziland, TWR Africa 6120af	9500af
0700 0800 Sat/Sun	Swaziland, TWR Africa 3200af	
0700 0800	UK, BBC World Service 6190af	11760me
	11770af 12095af 15310af	15400af
	15575me 17640af 17790as	17830af
0700 0800 DRM	UK, BBC World Service 5875eu	7355eu
0700 0800	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb 13362usb	
0700 0800	USA, FBN/WTJC Newport NC	9370na
0700 0800	USA, WBCQ Monticello ME 9330am	
0700 0800	USA, WEWN/EWTN Irondale AL	11520af
0700 0800	USA, WHRI Cypress Creek SC	5920am
	7385na	
0700 0800	USA, WTWW Lebanon TN 5755va	
0700 0800	USA, WWCR Nashville TN 3215eu	4840na
	5890af 5935af	
0700 0800	USA, WWRB Manchester TN	3185na
0700 0800	Zambia, Christian Voice 6065af	
0700 0800	Zambia, CVC Intl/1 Africa 13590af	
0730 0745	India, AIR/Aizawl 5050do	7295do
0730 0745	India, AIR/Chennai 4920do	7380do
0730 0745	India, AIR/Guwahati 4940do	7280do
0730 0745	India, AIR/Imphal 4775do	7335do
0730 0745	India, AIR/Jaipur 4910do	7325do
0730 0745	India, AIR/Kolkata 4820do	7210do
0730 0745	India, AIR/Shimla 4965do	6020do
0730 0800	Australia, HCJB Global Australia	11750as
0759 0800	New Zealand, R New Zealand Intl	6170pa
0759 0800 DRM	New Zealand, R New Zealand Intl	7440pa

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	11750as
0800 0830 Sun	Canada, Bible Voice Broadcasting	5945eu
0800 0830	France, R France International	9955na
0800 0845 Sat	Canada, Bible Voice Broadcasting	5945eu
0800 0900	Anguilla, University Network	6090na
0800 0900	Australia, ABC/R Australia 5995pa	7410pa
	9475pa 9580pa 9660pa	9710pa
	11945pa 12080pa 15240pa	
0800 0900	Bahrain, R Bahrain 6010me	
0800 0900 t/DRM	Belgium, TDP Radio 6015eu	
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 R International	11620as
	11895as 13710eu 15350as	15465as
	15625va 17490eu 17540as	
0800 0900	Eqt Guinea, Pan American BC/R Africa	
	15190af	
0800 0900 Sat	Italy, IRRS SW 9510va	
0800 0900	Malaysia, RTM Kajang/Traxx FM	7295do
0800 0900	Micronesia, V6MP/Cross R/Pohnpei	4755 as
0800 0900	New Zealand, R New Zealand Intl	6170pa
0800 0900 DRM	New Zealand, R New Zealand Intl	7440pa
0800 0900	Nigeria, VO Nigeria 15120af	
0800 0900 mtwhfs	Palau, T8WH/World Harvest R	9930as
0800 0900	Palau, T8WH/World Harvest R	17650as
0800 0900	Papua New Guinea, R Fly 3915do	
0800 0900	Russia, VO Russia 21800pa	21810va
0800 0900 DRM	Russia, VO Russia 9850eu	11830eu
0800 0900	South Africa, Channel Africa	9625af
0800 0900 Sun	South Africa, R Mirror Intl 7205af	17570af
0800 0900	South Korea, KBS World R 9570as	
0800 0900	UK, BBC World Service 6190af	11760me
	12095af 15310as 15400af	15575me
	17640af 17790as 17830af	21470af
0800 0900	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb 13362usb	
0800 0900	USA, FBN/WTJC Newport NC	9370na
0800 0900	USA, WBCQ Monticello ME 9330am	
0800 0900	USA, WEWN/EWTN Irondale AL	11520af
0800 0900	USA, WHRI Cypress Creek SC	5920am
	7385na	
0800 0900	USA, WTWW Lebanon TN 5755va	
0800 0900	USA, WWCR Nashville TN 3215eu	4840na
	5890af 5935af	
0800 0900	USA, WWRB Manchester TN	3185na
0800 0900	Zambia, Christian Voice 6065af	
0800 0900	Zambia, CVC Intl/1 Africa 13590af	
0815 0827	Nepal, R Nepal 5005do	
0820 0900 mtwhfa	Guam, KTWR/TWR Asia 15170as	
0830 0845	India, AIR/Aizawl 5050do	7295do
0830 0845	India, AIR/Chennai 4920do	7380do
0830 0845	India, AIR/Hyderbad 7420do	
0830 0845	India, AIR/Imphal 4775do	7335do
0830 0845	India, AIR/Kolkata 4820do	7210do
0830 0845	India, AIR/Shillong 4970do	7315do
0830 0845	India, AIR/Thiruvananthapuram	5010do
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, KTWR/TWR Asia 11840pa	
0830 0900	India, AIR/Itanagar 4990do	

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

0900 0910	mtwhfa	Guam, KTWR/TWR Asia	11840as		
0900 0930	mtwhfa	USA, WRMI/R Prague relay	9955ca		
0900 1000		Anguilla, University 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, ABC/R Australia	6080pa		9580pa
		11945pa			
0900 1000		Bahrain, R 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 R International			11620as
		13790pa	15210as	15270eu	15350as
		17490eu	17570eu	17750as	
0900 1000	Sat/Sun	Germany, Mighty KBC Radio			6095eu
0900 1000		Malaysia, RTM Kajang/Traxx FM			7295do
0900 1000		Micronesia, V6MP/Cross R/Pohnpei			4755 as
0900 1000	3rd Sun	Netherlands, XVRB Radio	6045eu		
0900 1000	DRM	New Zealand, R New Zealand Intl			7440pa
0900 1000		New Zealand, R New Zealand Intl			6170pa
0900 1000		Nigeria, VO Nigeria	9690af		
0900 1000		Palau, T8WH/World Harvest R			9930as
0900 1000		Papua New Guinea, R Fly	3915do		
0900 1000		Russia, VO Russia	9560as		15170as
		21800pa	21810va		
0900 1000	DRM	Russia, VO Russia	9850eu		11830eu
0900 1000		South Africa, Channel Africa			9625af
0900 1000		UK, BBC World Service	6190af		6195as
		9740as	11760me	12095af	15285as
		15310as	15575me	17640af	17760as
		17790as	17830af	21470af	21660as
0900 1000		USA, Amer Forces Network/AFRTS			4319usb
		5765usb	12759usb	13362usb	
0900 1000		USA, FBN/WTJC Newport NC			9370na
0900 1000		USA, WBCQ Monticello ME	9330am		
0900 1000		USA, WEWN/EWTN Irondale AL			11520as
0900 1000		USA, WHRI Cypress Creek SC			11565pa
0900 1000		USA, WHRI Cypress Creek SC			7315am
		7385na			
0900 1000		USA, WTWW Lebanon TN	5755va		
0900 1000		USA, WWCR Nashville TN	4840eu		5890af
		5935af	6875af		
0900 1000		USA, WWRB Manchester TN			3185na
0900 1000		USA, WYFR/Family R Worldwide			9465as
0900 1000		Zambia, Christian Voice	6065af		
0900 1000		Zambia, CVC Intl/1 Africa	13590af		
0905 0910		Pakistan, PBC/R Pakistan	15725as		17720as
0930 1000	fs	China, VO the Strait	6115do		
0930 1000	Sun	Italy, IRRS SW	9510va		

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

1000 1030		Japan, R Japan NHK World			9605as
		9625pa	9695as		
1000 1030		Vietnam, VO Vietnam/Overseas Svc			9840as
		12020as			
1000 1057		North Korea, VO Korea	3560ca		11710sa
		15180as	11735as	13650as	
1000 1058		New Zealand, R New Zealand Intl			6170pa
1000 1100		Anguilla, University 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, ABC/R Australia	6080pa		9580pa
1000 1100		Bahrain, R 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 R International			6040na
		11610as	11635as	13620as	13690as
		13720as	13790pa	15190as	15210as
		15350as	17490eu		
1000 1100	Sat/Sun	Germany, Mighty KBC Radio			6095eu
1000 1100		India, AIR/External Svc	7270as		13695pa
		15020as	15410as	17510pa	17800as
		17895pa			
1000 1100		Indonesia, VO Indonesia	9526va		
1000 1100		Malaysia, RTM Kajang/Traxx FM			7295do
1000 1100		Micronesia, V6MP/Cross R/Pohnpei			4755as
1000 1100	DRM	New Zealand, R New Zealand Intl			7440pa
1000 1100		Nigeria, VO Nigeria	9690af		
1000 1100		Palau, T8WH/World Harvest R			17650as
1000 1100		Russia, VO Russia	9560as		11500as
		15170as			
1000 1100		Saudi Arabia, BSKSA/External Svc			15250as
1000 1100		South Africa, Channel Africa			9625af
1000 1100		UK, BBC World Service	6190af		6195as
		9740as	11760me	12095af	15285as
		15310as	15575me	17640af	17760as
		17790as	21470af	21660as	
1000 1100	Sat/Sun	UK, BBC World Service	15400af		17830af
1000 1100		USA, Amer Forces Network/AFRTS			4319usb
		5765usb	12759usb	13362usb	
1000 1100		USA, FBN/WTJC Newport NC			9370na
1000 1100		USA, KNLS Anchor Point AK			9655as
1000 1100		USA, WBCQ Monticello ME	9330am		
1000 1100		USA, WEWN/EWTN Irondale AL			11520as
1000 1100		USA, WHRI Cypress Creek SC			7315am
		7385na			
1000 1100		USA, WTWW Lebanon TN	5755va		
1000 1100		USA, WWCR Nashville TN	4840na		5890af
		5935af	6875af		
1000 1100		USA, WWRB Manchester TN			3185na
1000 1100		USA, WYFR/Family R Worldwide			9465as
1000 1100		Zambia, Christian Voice	6065af		
1000 1100		Zambia, CVC Intl/1 Africa	13590af		
1030 1100		Iran, VO Islamic Rep of Iran	21590va		21640va
1030 1100		Mongolia, Voice of Mongolia			12085as
1030 1100		USA, WINB Red Lion PA	9265am		
1059 1100		New Zealand, R New Zealand Intl			9655pa

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

1100 1104		Pakistan, PBC/R Pakistan	15725as		17720as
1100 1127		Iran, VO Islamic Rep of Iran	21590va		21640va
1100 1130	Sat/DRM	South Korea, KBS World R	9760eu		
1100 1130		UK, BBC World Service	15400af		
1100 1130		Vietnam, VO Vietnam/Overseas Svc			7285as
1100 1156		Romania, R Romania Intl	15210eu		15430eu
		17510af	17670af		
1100 1158	DRM	New Zealand, R New Zealand Intl			7440pa
1100 1200		Anguilla, University 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, ABC/R Australia	5995pa		6020pa
		6080as	6140as	9475as	9580as
		11945pa	12080pa		
1100 1200		Bahrain, R Bahrain	6010me		
1100 1200	f/DRM	Belgium, TDP Radio	6015eu		
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 R International			5955as
		11650as	11660as	11750na	11795as
		13590as	13645as	13650eu	13720as
		16490eu			
1100 1200	Sat/Sun	Germany, Mighty KBC Radio			6095eu
1100 1200		Malaysia, RTM Kajang/Traxx FM			7295do
1100 1200		New Zealand, R New Zealand Intl			9655pa
1100 1200		Nigeria, VO Nigeria	9690af		
1100 1200	DRM	Russia, VO Russia	12030as		
1100 1200		Russia, VO Russia	9560as		11500as
		12065as			
1100 1200		Saudi Arabia, BSKSA/External Svc			15250as

1100 1200	South Africa, Channel Africa		9625af
1100 1200	Taiwan, R Taiwan Intl	7445as	9465as
1100 1200	UK, BBC World Service	6190af	6195as
	9740as	11760me	12095af 15285as
	15310as	15575me	17640af 17790as
	17830af	21470af	
1100 1200	USA, Amer Forces Network/AFRTS		4319usb
	5765usb	12759usb	13362usb
1100 1200	USA, FBN/WTJC Newport NC		9370na
1100 1200	USA, WBCQ Monticello ME		9330am
1100 1200	USA, WEWN/EWTN Irondale AL		11520as
1100 1200	USA, WHRI Cypress Creek SC		7315am
	9795am		
1100 1200	USA, WINB Red Lion PA	9265am	
1100 1200	USA, WTWW Lebanon TN	5755va	
1100 1200	USA, WWCR Nashville TN	4840na	5890af
	5935af	15825eu	
1100 1200	USA, WWRB Manchester TN		3185na
1100 1200	Zambia, Christian Voice	6065af	
1100 1200	Zambia, CVC Intl/1 Africa	13590af	
1130 1145 f	Palau, T8WH/World Harvest R		15525as
1130 1200 f	Vatican City State, Vatican R	15595me	17590me
1130 1200	Vietnam, VO Vietnam/Overseas Svc		9840as
	12020as		
1135 1145	India, AIR/Aizawl	5050do	7295do
1135 1145	India, AIR/Shillong	4970do	

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

1200 1225	Saudi Arabia, BSKSA/External Svc		15250as
1200 1230	Germany, AWR Europe	17535as	
1200 1230	Indonesia, AWR Asia/Pacific		17535as
1200 1230	Japan, R Japan NHK World		6120na
	9695as		
1200 1259	New Zealand, R New Zealand Intl		9655pa
1200 1300	Anguilla, University 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, ABC/R Australia	5995pa	6080as
	6140as	9475as	9580as 11945pa
1200 1300	Bahrain, R Bahrain	6010me	
1200 1300 Sat/DRM	Belgium, TDP Radio	6015eu	
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 R International		5955as
	9460as	9645as	9660as 9730as
	9760pa	11650as	11660as 11690va
	11760pa	11980as	13645as 13650eu
	13790eu	17490eu	
1200 1300	Ethiopia, R Ethiopia/Natl Pgm		9705do
1200 1300 Sat/Sun	Germany, Mighty KBC Radio		6095eu
1200 1300	Malaysia, RTM Kajang/Traxx FM		7295do
1200 1300	Nigeria, VO Nigeria	9690af	
1200 1300	Palau, T8WH/World Harvest R		9930as
1200 1300 DRM	Russia, VO Russia	9445eu	9850as
	12030as		
1200 1300	Russia, VO Russia	9560as	11500as
1200 1300	South Korea, KBS World R	9650na	
1200 1300	UK, BBC World Service	5875as	6190af
	6195as	9740as	11750as 11760me
	15310as	15575me	17790as 17830af
	21470af		
1200 1300	USA, Amer Forces Network/AFRTS		4319usb
	5765usb	12759usb	13362usb
1200 1300	USA, BBG/VOA 7575va	9510va	12075va
	12150va		
1200 1300	USA, FBN/WTJC Newport NC		9370na
1200 1300	USA, KNLS Anchor Point AK		7355as
1200 1300	USA, WBCQ Monticello ME		9330am
1200 1300	USA, WEWN/EWTN Irondale AL		11520as
1200 1300	USA, WHRI Cypress Creek SC		9795am
	9840na		
1200 1300	USA, WINB Red Lion PA	9265am	
1200 1300	USA, WTWW Lebanon TN	5755va	
1200 1300	USA, WWCR Nashville TN	7490na	9980af
	13845af	15825eu	
1200 1300	USA, WWRB Manchester TN		3185na
	9385na		
1200 1300	Zambia, Christian Voice	6065af	
1200 1300	Zambia, CVC Intl/1 Africa	13590af	
1215 1300	Egypt, R Cairo	17870as	
1225 1245	India, AIR/Imphal	4775do	
1230 1245	India, AIR/Aizawl	5050do	7295do
1230 1245	India, AIR/Chennai	4920do	
1230 1245	India, AIR/Hyderbad	4800do	
1230 1245	India, AIR/Imphal	4800do	
1230 1245	India, AIR/Jeypore	5040do	
1230 1245	India, AIR/Kuresong	4895do	
1230 1245	India, AIR/Port Blair/Andaman & Nicobar		
	4760do		
1230 1245	India, AIR/R Kashmir	4950do	
1230 1245	India, AIR/Shillong	4970do	
1230 1245	India, AIR/Thiruvananthapuram		5010do
1230 1300	Australia, HCJB Global Australia		15400as
1230 1300	Thailand, R Thailand World Svc		9890va
1230 1300	Turkey, VO Turkey	15450va	
1230 1300	Vietnam, VO Vietnam/Overseas Svc		9840as
	12020as		

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

1300 1325	Turkey, VO Turkey	15450va	
1300 1330	Egypt, R Cairo	17870as	
1300 1330	Japan, R Japan NHK World		15735as
1300 1330	Serbia, International R Serbia		9635eu
1300 1357	North Korea, VO Korea	9335na	11710na
	13760eu	15245eu	
1300 1400	Anguilla, University Network		11775na
1300 1400	Australia, ABC NT Alice Springs		2310do
1300 1400	Australia, ABC NT Katherine		2485do
1300 1400	Australia, ABC/R Australia	5940as	5995pa
	6020pa	9580pa	11945pa
1300 1400	Bahrain, R Bahrain	6010me	
1300 1400 Sun/DRM	Belgium, TDP Radio	6015na	
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 R International		5995as
	9570na	9730as	9760pa 9765va
	9870as	11660as	11760pa 13610eu
	13755as	13790eu	
1300 1400 Sat/Sun	Germany, Mighty KBC Radio		6095eu
1300 1400	Indonesia, VO Indonesia	9526va	
1300 1400	Italy, IRRS SW	15190va	
1300 1400	Malaysia, RTM Kajang/Traxx FM		7295do
1300 1400	New Zealand, R New Zealand Intl		6170pa
1300 1400	Nigeria, VO Nigeria	9690af	
1300 1400	Palau, T8WH/World Harvest R		9930as
1300 1400 DRM	Russia, VO Russia	9560as	12065as
1300 1400	Russia, VO Russia	12065as	
1300 1400	South Korea, KBS World R	9570as	
1300 1400	Tajikistan, VO Tajik	7245va	
1300 1400	UK, BBC World Service	5875as	6190af
	6195as	9740as	11760me 15310as
	15420af	15575me	17640af 17790as
	17830af		
1300 1400	USA, Amer Forces Network/AFRTS		4319usb
	5765usb	12759usb	13362usb
1300 1400 Sat/Sun	USA, BBG/VOA 7575va	9510va	9610va
	9760va	12150va	
1300 1400	USA, FBN/WTJC Newport NC		9370na
1300 1400	USA, KJES Vado NM		11715na
1300 1400	USA, WBCQ Monticello ME		9330am
1300 1400	USA, WEWN/EWTN Irondale AL		15615as
1300 1400 Sat/Sun	USA, WHRI Cypress Creek SC		9795na
	9840am		
1300 1400	USA, WINB Red Lion PA	13570am	
1300 1400	USA, WTWW Lebanon TN	9479va	
1300 1400	USA, WWCR Nashville TN	7490af	9980af
	13845eu	15825eu	

1300 1400		USA, WWRB Manchester TN	9385na
		9385na	
1300 1400		USA, WYFR/Family R Worldwide	11540as
1300 1400		Zambia, Christian Voice	6065af
1300 1400		Zambia, CVC Intl/1 Africa	13590af
1330 1400		India, AIR/External Svc	9690as 11620as
		13710as	
1330 1400		Vietnam, VO Vietnam/Overseas Svc	9840as
		12020as	

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

1400 1430		Japan, R Japan NHK World	11705as
		15735as	
1400 1430		Thailand, R Thailand World Svc	9395va
1400 1430	Sun	USA, Pan Amer Broadcasting	15205as
1400 1500		Anguilla, University 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, ABC/R Australia	5940as 5995pa
		9580pa 11945pa	
1400 1500		Bahrain, R Bahrain	6010me
1400 1500	Sun	Canada, Bible Voice Broadcasting	17495as
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 R International	5955as
		9765va 9870as 11665me	11675as
		11765as 13710eu 13740na	13790eu
		17630af	
1400 1500		Eqt Guinea, Pan American BC/R Africa	
		15190af	
1400 1500	Sat/Sun	Germany, Mighty KBC Radio	6095eu
1400 1500		India, AIR/External Svc	9690as 11620as
		13710as	
1400 1500		Italy, IRRS SW	15190va
1400 1500		Malaysia, RTM Kajang/Traxx FM	7295do
1400 1500		New Zealand, R New Zealand Intl	6170pa
1400 1500		Nigeria, VO Nigeria	9690af
1400 1500		Oman, R Sultanate of Oman	15140va
1400 1500	DRM	Russia, VO Russia	12095eu
1400 1500		Russia, VO Russia	4975va 9560as
		11500as 11840as	
1400 1500		South Korea, KBS World R	9570as
1400 1500		UK, BBC World Service	5845as 5875as
		6190af 6195as 9740as	11890as
		12095af 13820me 15310as	17640af
		17830af 21470af	
1400 1500		USA, Amer Forces Network/AFRTS	4319usb
		5765usb 12759usb	13362usb
1400 1500		USA, BBG/VOA 4930af 6080af	15265af
		15580af 17530af	
1400 1500	mtwhf	USA, BBG/VOA 7540va 7575va	12150va
1400 1500		USA, FBN/WTJC Newport NC	9370na
1400 1500		USA, Overcomer Ministry	9655eu
1400 1500		USA, WBCQ Monticello ME	9330am
1400 1500	Sat/Sun	USA, WBCQ Monticello ME	15420am
1400 1500		USA, WEWN/EWTN Irondale AL	15615as
1400 1500	Sat/Sun	USA, WHRI Cypress Creek SC	9795am
		9840am 21670va	
1400 1500		USA, WJHR Intl Milton FL	15550usb
1400 1500		USA, WTWW Lebanon TN	9479va
1400 1500		USA, WWCR Nashville TN	7490af 9980af
		13845eu 15825eu	
1400 1500		USA, WWRB Manchester TN	9385na
1400 1500		USA, WYFR/Family R Worldwide	11540as
1400 1500		Zambia, Christian Voice	6065af
1400 1500		Zambia, CVC Intl/1 Africa	13590af
1405 1435	Sat/Sun	Canada, Bible Voice Broadcasting	15270as
1415 1427		Nepal, R Nepal	5005do
1415 1430	mtwhfa	USA, Pan Amer Broadcasting	15205as
1420 1440		India, AIR/Itanagar	4990do
1420 1455		Swaziland, TWR Africa	4760af
1430 1445		India, AIR/Aizawl	5050do 7295do
1430 1445		India, AIR/Gangkok	4835do
1430 1445		India, AIR/Jeypore	5040do
1430 1445		India, AIR/Mumbai	4840do 7240do
1430 1445	Sun	USA, Pan Amer Broadcasting	15205as
1430 1500		Australia, ABC/R Australia	9475as 11660as
1430 1500	Sat	Canada, Bible Voice Broadcasting	17495as
1430 1500		China, China Business R	6190do 7220do
1430 1500		China, China Natl R/CNR11	4905do
		4920do 6130do	
1430 1500		USA, WRMI/R Prague relay	9955ca
1445 1500		Australia, HCJB Global Australia	15340as
1450 1500		India, AIR/Itanagar	4990do
1450 1500		India, AIR/Kuresong	4895do

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

1500 1515	Sun	Canada, Bible Voice Broadcasting	13740as
1500 1525	mhf	Guam, KTWR/TWR Asia	15200as
1500 1530		Australia, ABC/R Australia	11945pa
1500 1530		Australia, HCJB Global Australia	15340as
1500 1530		Vietnam, VO Vietnam/Overseas Svc	7285as
		9840as 12020as	
1500 1535	twas	Guam, KTWR/TWR Asia	15200as
1500 1550		New Zealand, R New Zealand Intl	6170pa
1500 1557		North Korea, VO Korea	9335na 11710na
		13760eu 15245eu	
1500 1600		Anguilla, University Network	11775na
1500 1600		Australia, ABC NT Alice Springs	2310do
1500 1600		Australia, ABC NT Katherine	2485do
1500 1600		Australia, ABC/R Australia	5940as 5995pa
		7240pa 9475as 11660as	
1500 1600		Bahrain, R Bahrain	6010me
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 R International	5955as
		6095me 7325as 7395as	9720me
		9800as 9870as 11965eu	13640eu
		13740na 17630af	
1500 1600	Sat	Clandestine, Sudan R Service	17745af
1500 1600		Eqt Guinea, Pan American BC/R Africa	
		15190af	
1500 1600	Sat/Sun	Germany, Mighty KBC Radio	6095eu
1500 1600	Sat	Italy, IRRS SW	15700va
1500 1600		Malaysia, RTM Kajang/Traxx FM	7295do
1500 1600		Nigeria, VO Nigeria	15120af
1500 1600		Russia, VO Russia	4975va 9560as
		11840as 15640me	
1500 1600		South Africa, Channel Africa	9625af
1500 1600		Uganda, Dunamis Shortwave	4750do
1500 1600		UK, BBC World Service	5845as 5875as
		6190af 6195as 7435af	9410as
		9740as 11890as 12095af	13820me
		15310as 15400af 17640af	17830af
		21470af	
1500 1600		USA, Amer Forces Network/AFRTS	4319usb
		5765usb 12759usb	13362usb
1500 1600		USA, BBG/VOA 4930af 6080af	7540va
		7575va 12150va 13570va	15265as
		15530va 15580as 17895as	
1500 1600	mtwhf	USA, BBG/VOA 7450va 7575va	12150va
1500 1600		USA, FBN/WTJC Newport NC	9370na
1500 1600		USA, KNLS Anchor Point AK	9655as
1500 1600		USA, Overcomer Ministry	13810me
1500 1600		USA, WBCQ Monticello ME	9330am
1500 1600	Sat/Sun	USA, WBCQ Monticello ME	15420am
1500 1600		USA, WEWN/EWTN Irondale AL	15610eu
1500 1600	Sat/Sun	USA, WHRI Cypress Creek SC	9795am
		9840am	
1500 1600	Sun	USA, WHRI Cypress Creek SC	21630af
1500 1600		USA, WINB Red Lion PA	13570am
1500 1600		USA, WJHR Intl Milton FL	15550usb
1500 1600		USA, WTWW Lebanon TN	9479va
1500 1600		USA, WWCR Nashville TN	9980af 12160af
		13845eu 15825eu	
1500 1600		USA, WWRB Manchester TN	9385na
1500 1600		USA, WYFR/Family R Worldwide	6280as
		13690as 15520as	
1500 1600		Zambia, Christian Voice	6065af

1500	1600		Zambia, CVC Intl/1 Africa	13590af	
1515	1530	Sat	Australia, HCJB Global Australia		15340as
1515	1530	f	Canada, Bible Voice Broadcasting		15275as
1525	1555	Sat/Sun	Swaziland, TWR Africa	4760af	
1530	1545		India, AIR/Aizawl	5050do	7295do
1530	1545		India, AIR/Bhopal	4810do	7430do
1530	1545		India, AIR/Chennai	4920do	
1530	1545		India, AIR/Guwahati	4940do	
1530	1545		India, AIR/Hyderbad	4800do	
1530	1545		India, AIR/Imphal	4775do	
1530	1545		India, AIR/Itanagar	4990do	
1530	1545		India, AIR/Jaipur	4910do	7325do
1530	1545		India, AIR/Jeypore	5040do	
1530	1545		India, AIR/Kuresong	4895do	
1530	1545		India, AIR/Lucknow	4880do	7440do
1530	1545		India, AIR/Port Blair/Andaman & Nicobar	4760do	
1530	1545		India, AIR/R Kashmir	4950do	
1530	1545		India, AIR/Shillong	4970do	
1530	1545		India, AIR/Shimla	4965do	6020do
1530	1545		India, AIR/Thiruvananthapuram		5010do
1530	1550	smtwhf	Vatican City State, Vatican R	17510as	
1530	1600		Afghanistan, RTV Afghanistan		7200as
1530	1600		Australia, ABC/R Australia	11880pa	
1530	1600	DRM	Belgium, The Disco Palace	15775as	
1530	1600	h	Canada, Bible Voice Broadcasting		15275as
1530	1600	Sun	Clandestine, Sudan R Service		17745af
1530	1600	smtwa	Germany, AWR Europe	15255as	
1530	1600	mtwas	Indonesia, AWR Asia/Pacific		15255as
1530	1600		Iran, VO Islamic Rep of Iran	11945va	13780va 13720al
1530	1600		Mongolia, Voice of Mongolia		12015as
1530	1600		Vatican City State, Vatican R	11850as	13765as
1530	1600	DRM	Vatican City State, Vatican R	17815as	
1550	1600	Sat	Vatican City State, Vatican R	17510as	
1551	1600		New Zealand, R New Zealand Intl		7440pa
1551	1600	DRM	New Zealand, R New Zealand Intl		6170pa

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

1600	1627		Iran, VO Islamic Rep of Iran	11945va	13780va 13720al
1600	1630		Australia, ABC/R Australia	9540as	
1600	1630	DRM	Belgium, The Disco Palace	15775as	
1600	1630		Vietnam, VO Vietnam/Overseas Svc	7220me	7280eu 9550me 9730eu
1600	1657		North Korea, VO Korea	3560eu	9990va 11545va
1600	1700		Anguilla, University Network		11775na
1600	1700		Australia, ABC NT Alice Springs		2310do
1600	1700		Australia, ABC NT Katherine		2485do
1600	1700		Australia, ABC/R Australia	5940as	5995pa 7240pa 11660as 11880pa 19475as
1600	1700		Bahrain, R Bahrain	6010me	
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 R International		6060as 7235as 7420af 9570af 11900af 11940eu 11965eu 13760eu
1600	1700		Egypt, R Cairo	15345af	
1600	1700		Eqt Guinea, Pan American BC/R Africa	15190af	
1600	1700		Ethiopia, R Ethiopia	7235va	9560va
1600	1700	Sat/Sun	Germany, Mighty KBC Radio		6095eu
1600	1700		Malaysia, RTM Kajang/Traxx FM		7295do
1600	1700	DRM	New Zealand, R New Zealand Intl		6170pa
1600	1700		New Zealand, R New Zealand Intl		7440pa
1600	1700		Palau, T8WH/World Harvest R		15530as
1600	1700	DRM	Russia, VO Russia	6070as	7370eu
1600	1700		Russia, VO Russia	4975as	7285me 11985me
1600	1700		South Korea, KBS World R	9515eu	9640as
1600	1700		Taiwan, R Taiwan Intl	9435as	15485as
1600	1700		Uganda, Dunamis Shortwave		4750do
1600	1700		UK, BBC World Service	3255af	5845as 5975as 6190af 9410as 11890as 12095af 13820me 15400af 17795af 17830af 21470af
1600	1700		USA, Amer Forces Network/AFRTS		4319usb 5765usb 12759usb 13362usb
1600	1700		USA, BBG/VOA	4930af	6080af 6080as 15580as
1600	1700		USA, FBN/WTJC Newport NC		9370na
1600	1700		USA, Overcomer Ministry	15425as	
1600	1700		USA, WBCQ Monticello ME	9330am	
1600	1700	Sat/Sun	USA, WBCQ Monticello ME	15420am	
1600	1700		USA, WEWN/EWTN Irondale AL		15610eu
1600	1700	Sat/Sun	USA, WHRI Cypress Creek SC		9795am
1600	1700		USA, WHRI Cypress Creek SC		9840na 11630af
1600	1700		USA, WINB Red Lion PA	13570am	
1600	1700		USA, WJHR Intl Milton FL	15550usb	
1600	1700		USA, WTWW Lebanon TN	9479va	
1600	1700		USA, WWCR Nashville TN	9980af	12160af 13845eu 15825eu
1600	1700		USA, WWRB Manchester TN		9385na
1600	1700		USA, WYFR/Family R Worldwide		11850as
1600	1700		Zambia, Christian Voice	6065af	
1600	1700		Zambia, CVC Intl/1 Africa	13590af	
1615	1630		Vatican City State, Vatican R	15595va	
1630	1700		Clandestine, Sudan R Service		17745af
1630	1700		Indonesia, AWR Asia/Pacific		11740as
1630	1700		Turkey, VO Turkey	15520as	
1630	1700		USA, BBG/VOA/Sudan in Focus		9490af 11655af 13800af
1645	1700		Canada, Bible Voice Broadcasting		15215me

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

1700	1710		Pakistan, Azad Kashmir R	3975do	4790do
1700	1710		Pakistan, PBC/R Pakistan	11575eu	
1700	1715	mf	Canada, Bible Voice Broadcasting		15215me
1700	1720	h	Canada, Bible Voice Broadcasting		15215me
1700	1725		Turkey, VO Turkey	15520as	
1700	1730		Australia, ABC/R Australia	11660as	
1700	1730		Vietnam, VO Vietnam/Overseas Svc		9625eu
1700	1745	DRM	New Zealand, R New Zealand Intl		6170pa
1700	1745		New Zealand, R New Zealand Intl		7440pa
1700	1755		South Africa, Channel Africa		15235af
1700	1756	DRM	Romania, R Romania Intl	9535eu	
1700	1756		Romania, R Romania Intl	11740eu	11740eu
1700	1800		Anguilla, University Network		11775na
1700	1800		Australia, ABC NT Alice Springs		2310do
1700	1800		Australia, ABC NT Katherine		2485do
1700	1800		Australia, ABC/R Australia	5995pa	9475as 9500pa 9580pa 9710pa 11880pa
1700	1800		Bahrain, R Bahrain	6010me	
1700	1800	asm	Canada, Bible Voice Broadcasting		15215me
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 R International		6090as 6140as 6145eu 6165me 7235as 7265af 7410as 7420as 9570af 9695eu 11900af 13760eu
1700	1800		Egypt, R Cairo	15345af	
1700	1800		Eqt Guinea, Pan American BC/R Africa	15190af	
1700	1800		Malaysia, RTM Kajang/Traxx FM		7295do
1700	1800		Poland, Polish R/External Svc		9955na
1700	1800	DRM	Russia, VO Russia	7370eu	
1700	1800		Russia, VO Russia	4975va	7285va 11985af 12040eu
1700	1800		Swaziland, TWR Africa	3200af	
1700	1800		Taiwan, R Taiwan Intl	15690af	
1700	1800		UK, BBC World Service	3255af	5845as 5975as 6190af 7565as 9410as 12095af 15400af 15420af 17640af 17795af 17830af
1700	1800		USA, Amer Forces Network/AFRTS		4319usb 5765usb 12759usb 13362usb

1700 1800	USA, BBG/VOA 6080af 11795af 15580af 17895af	
1700 1800	USA, FBN/WTJC Newport NC	9370na
1700 1800	USA, Overcomer Ministry 15425as	
1700 1800	USA, WBCQ Monticello ME 9330am	15420am
1700 1800	USA, WEWN/EWTN Irondale AL	15610eu
1700 1800	USA, WHRI Cypress Creek SC 21630af	9840na
1700 1800	USA, WINB Red Lion PA 13570am	
1700 1800	USA, WJHR Intl Milton FL 15550usb	
1700 1800	USA, WTWW Lebanon TN 9479va	
1700 1800	USA, WWCR Nashville TN 9980af 13845eu 15825eu	12160af
1700 1800	USA, WWRB Manchester TN	9385na
1700 1800	USA, WYFR/Family R Worldwide 17545af	7395af
1700 1800	Zambia, Christian Voice 4965as	
1700 1800	Zambia, CVC Intl/1 Africa 13590af	
1730 1745 h	Canada, Bible Voice Broadcasting	15215me
1730 1745	India, AIR/Bhopal 4810do	7430do
1730 1745	India, AIR/Chennai 4920do	
1730 1745	India, AIR/Guwahati 4940do	
1730 1745	India, AIR/Hyderbad 4800do	
1730 1745	India, AIR/Imphal 4775do	
1730 1745	India, AIR/Jaipur 4910do	7325do
1730 1745	India, AIR/Kuresong 4895do	
1730 1745	India, AIR/Lucknow 4880do	7440do
1730 1745	India, AIR/R Kashmir 4950do	
1730 1745	India, AIR/Shimla 4965do	6020do
1730 1745	India, AIR/Thiruvananthapuram	5010do
1730 1800	Australia, ABC/R Australia 6080pa	
1730 1800 Sun	Italy, IRRS SW 7290va	
1730 1800 m	South Africa, R Mirror Intl 3230af	
1730 1800	Vatican City State, Vatican R 11625af 15570af	13765af
1745 1800 Sat	Canada, Bible Voice Broadcasting	17515af
1745 1800 DRM	India, AIR/External Svc 9950eu	
1745 1800	India, AIR/External Svc 7400af 9415af 11580af 13695af	7550eu 11670as 11935af
1746 1800	New Zealand, R New Zealand Intl	9615pa
1746 1800 DRM	New Zealand, R New Zealand Intl	7440pa

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

1800 1830 w	Austria, AWR Europe 15325af	
1800 1830	Japan, R Japan NHK World	15720af
1800 1830	South Africa, AWR Africa 3215af	3345af
1800 1830 m	South Africa, R Mirror Intl 3230af	
1800 1830	Tanzania, Zanzibar BC/VO Tanzania	11735do
1800 1830	UK, BBC World Service 5850as	5975as
1800 1830 mtwhf	USA, BBG/VOA 6080af 9850af 15580af	12015af
1800 1830 Sat/Sun	USA, BBG/VOA 4930af 6080af 12015af 15580af	9850af
1800 1836 DRM	New Zealand, R New Zealand Intl	7440pa
1800 1850	New Zealand, R New Zealand Intl	9615pa
1800 1857	North Korea, VO Korea 13760eu	15245eu
1800 1900	Anguilla, University 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, ABC/R Australia 6080pa 9475as 9500pa 9580as 11880pa	7240as 9710pa
1800 1900	Bahrain, R Bahrain 6010me	
1800 1900 Sat	Canada, Bible Voice Broadcasting	9430me
1800 1900 Sun	Canada, Bible Voice Broadcasting 15215me	6130eu
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 R International 9600eu 13760eu	6175eu
1800 1900 mtwhfa	Ecuador, HCJB/LV de los Andes	3995eu
1800 1900	Eqt Guinea, Pan American BC/R Africa 15190af	
1800 1900 DRM	India, AIR/External Svc 9950eu	
1800 1900	India, AIR/External Svc 7400af 9415af 9445af 11580af 11935af 13695af	7550as 11670eu
1800 1900 fa	Italy, IRRS SW 7290va	
1800 1900	Kuwait, R Kuwait 15540eu	
1800 1900	Malaysia, RTM Kajang/Traxx FM	7295do
1800 1900 DRM	Russia, VO Russia 7370eu	9880eu
1800 1900	Russia, VO Russia 4975me 12040eu	9900va
1800 1900	South Korea, KBS World R 7275eu	
1800 1900	Swaziland, TWR Africa 3200af	9500af
1800 1900	Taiwan, R Taiwan Intl 6155eu	
1800 1900	UK, BBC World Service 3255af 5950as 6190af 15400af 15420af	5875me 11810af 12095af 17795af
1800 1900	USA, Amer Forces Network/AFRTS 5765usb 12759usb 13362usb	4319usb
1800 1900	USA, FBN/WTJC Newport NC	9370na
1800 1900	USA, KJES Vado NM 15385na	
1800 1900	USA, WBCQ Monticello ME 9330am	15420am
1800 1900	USA, WEWN/EWTN Irondale AL	15610af
1800 1900	USA, WHRI Cypress Creek SC 21630af	9840na
1800 1900	USA, WINB Red Lion PA 13570am	
1800 1900	USA, WJHR Intl Milton FL 15550usb	
1800 1900	USA, WTWW Lebanon TN 9479va	
1800 1900	USA, WWCR Nashville TN 9980af 13845eu 15825eu	12160af
1800 1900	USA, WWRB Manchester TN	9385na
1800 1900	USA, WYFR/Family R Worldwide 9610af 9925af 13750af	5905af
1800 1900	Zambia, Christian Voice 4965af	
1800 1900	Zambia, CVC Intl/1 Africa 13590af	
1815 1845 Sun	Canada, Bible Voice Broadcasting 9430me	6130eu
1830 1900 f	Canada, Bible Voice Broadcasting	17515af
1830 1900 Sun	Canada, Bible Voice Broadcasting	9635me
1830 1900 Sun	Italy, IRRS SW 7290va	
1830 1900 mtwhf	Moldova, R PMR/Pridnestrovye	9665eu
1830 1900 DRM/mtwhf	Nigeria, VO Nigeria 15120af	
1830 1900	Serbia, International R Serbia	6100eu
1830 1900	South Africa, AWR Africa 11840af	
1830 1900	Turkey, VO Turkey 9785va	
1830 1900	UK, BBC World Service 9410af	
1830 1900	USA, BBG/VOA 4930af 6080af 15580af	9850af
1837 1850 DRM	New Zealand, R New Zealand Intl	11675pa
1851 1900	New Zealand, R New Zealand Intl	11725pa
1851 1900 DRM	New Zealand, R New Zealand Intl	15720pa

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

1900 1915 Sun	Canada, Bible Voice Broadcasting	9635me
1900 1925	Turkey, VO Turkey 9785va	
1900 1927	Germany, Deutsche Welle 9735af	
1900 1930 f	Canada, Bible Voice Broadcasting	17515af
1900 1930	Germany, Deutsche Welle 7365af	11800af
1900 1930	USA, BBG/VOA 4930af 4940af 9850af 15580af 17895af	6080af
1900 1930	Vietnam, VO Vietnam/Overseas Svc 9730eu	7280eu
1900 1945 DRM	India, AIR/External Svc 9950eu	
1900 1945	India, AIR/External Svc 7400af 9415af 9445af 11580af 11935af 13695af	7550eu 11670eu
1900 1957	North Korea, VO Korea 3560eu 9975va 11535va 11910af	7210af
1900 2000	Anguilla, University Network	11775na
1900 2000	Australia, ABC NT Alice Springs	2310do
1900 2000	Australia, ABC NT Katherine	2485do
1900 2000	Australia, ABC/R Australia 6080pa 9500pa 9710pa 11660as	7240as 11880pa
1900 2000	Bahrain, R Bahrain 6010me	
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 R International	7295va 9435af 9440af
1900 2000	Cuba, R Havana Cuba	11760am
1900 2000	Egypt, R Cairo	15290af
1900 2000	Eqt Guinea, Pan American BC/R Africa	15190af
1900 2000	Indonesia, VO Indonesia	9526va
1900 2000	Kuwait, R Kuwait	15540eu
1900 2000	Malaysia, RTM Kajang/Traxx FM	7295do
1900 2000	Micronesia, V6MP/Cross R/Pohnpei	4755as
1900 2000 DRM	New Zealand, R New Zealand Intl	15720pa
1900 2000	New Zealand, R New Zealand Intl	11725pa
1900 2000 DRM/mtwhf	Nigeria, VO Nigeria	15120af
1900 2000 DRM	Russia, VO Russia	6155eu
1900 2000	Russia, VO Russia	12040eu
1900 2000 mtwhf	Spain, R Exterior de Espana	9665af 11620af
1900 2000	Swaziland, TWR Africa	3200af
1900 2000	Thailand, R Thailand World Svc	7205eu
1900 2000	UK, BBC World Service	3255af 5875me 5950as 6005af 6190af 9410af 11810af 12095af 15400af 17795as
1900 2000	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
1900 2000	USA, FBN/WTJC Newport NC	9370na
1900 2000	USA, Overcomer Ministry	9400eu
1900 2000	USA, WBCQ Monticello ME	9330am 15420am
1900 2000	USA, WEWN/EWTN Irondale AL	15610af
1900 2000	USA, WHRI Cypress Creek SC	9840na 21630af
1900 2000	USA, WINB Red Lion PA	13570am
1900 2000	USA, WJHR Intl Milton FL	15550usb
1900 2000	USA, WTWW Lebanon TN	9479va
1900 2000	USA, WWCR Nashville TN	9980af 12160af 13845eu 15825eu
1900 2000	USA, WWRB Manchester TN	9385na
1900 2000	USA, WYFR/Family R Worldwide	9775af 9925af
1900 2000	Zambia, Christian Voice	4965af
1900 2000	Zambia, CVC Intl/1 Africa	13590af
1905 1920 Sat	Mali, ORTM/R Mali	9635do
1930 1957	Germany, Deutsche Welle	7365af
1930 2000	Eqt Guinea, Pan American BC/R Africa	9515af
1930 2000	Germany, Deutsche Welle	11800af
1930 2000	Iran, VO Islamic Rep of Iran	9540eu 9800eu 11750af 11885af
1930 2000	USA, BBG/VOA	4930af 4940af 6080af 15580af
1930 2000 Sat	USA, Pan Amer Broadcasting	9515af

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

2000 2027	Iran, VO Islamic Rep of Iran	9540eu 9800eu 11750af 11885af
2000 2030 mtwhfa	Albania, R Tirana	7465eu
2000 2030	Australia, ABC/R Australia	6080pa 9500pa 11660pa
2000 2030	Egypt, R Cairo	15290af
2000 2030	Eqt Guinea, Pan American BC/R Africa	9515af
2000 2030 Sat	Swaziland, TWR Africa	3200af
2000 2030	USA, BBG/VOA	4930af 6080af 15580af
2000 2030	Vatican City State, Vatican R	9755af 11625af
2000 2057	Germany, Deutsche Welle	9490af
2000 2100	Anguilla, University 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, ABC/R Australia	9580pa 11650pa 11660pa 12080pa 15515pa
2000 2100	Bahrain, R Bahrain	6010me
2000 2100	Belarus, R Belarus	7255eu 11730eu
2000 2100 DRM	Belgium, The Disco Palace	17875na
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 R International	5960eu 5985af 7285eu 7295va 7415eu 9440af 9600eu
2000 2100	Eqt Guinea, Pan American BC/R Africa	15190af
2000 2100	Germany, Deutsche Welle	6150af 11800af
2000 2100	Kuwait, R Kuwait	15540eu
2000 2100	Malaysia, RTM Kajang/Traxx FM	7295do
2000 2100	Micronesia, V6MP/Cross R/Pohnpei	4755as
2000 2100 DRM	New Zealand, R New Zealand Intl	15720pa
2000 2100	New Zealand, R New Zealand Intl	11725pa
2000 2100 DRM	Russia, VO Russia	6155eu
2000 2100	Russia, VO Russia	12040eu
2000 2100	South Africa, CVC 1 Africa R	9505af 13590af
2000 2100	UK, BBC World Service	3255af 6005af 6190af 9410af 9855af 11810af 12095af 15400af
2000 2100	USA, Amer Forces Network/AFRTS	4319usb 5765usb 12759usb 13362usb
2000 2100 mtwhf	USA, BBG/VOA	7485af 9480va
2000 2100	USA, FBN/WTJC Newport NC	9370na
2000 2100	USA, Overcomer Ministry	9400eu
2000 2100	USA, WBCQ Monticello ME	7490am 9330am 15420am
2000 2100	USA, WEWN/EWTN Irondale AL	15610af
2000 2100 mtwhfa	USA, WHRI Cypress Creek SC	21630af
2000 2100	USA, WHRI Cypress Creek SC	17510va
2000 2100	USA, WINB Red Lion PA	13570am
2000 2100	USA, WJHR Intl Milton FL	15550usb
2000 2100	USA, WTWW Lebanon TN	9479va
2000 2100	USA, WWCR Nashville TN	9980af 12160af 13845eu 15825eu
2000 2100	USA, WWRB Manchester TN	9385na
2000 2100	USA, WYFR/Family R Worldwide	15195af
2000 2100	Zambia, Christian Voice	4965af
2000 2100	Zambia, CVC Intl/1 Africa	9505as
2030 2045	Thailand, R Thailand World Svc	9680eu
2030 2056 DRM	Romania, R Romania Intl	9700eu
2030 2056	Romania, R Romania Intl	11880na 13800na 15220na
2030 2100	Australia, ABC/R Australia	9500pa 11695as
2030 2100 mtwhf	Moldova, R PMR/Pridnestrovye	9665eu
2030 2100	Turkey, VO Turkey	7205va
2030 2100 mtwhf	USA, BBG/VOA	4930af 6080af 15580af
2030 2100 Sat/Sun	USA, BBG/VOA	4930af 4940af 6080af 15580af
2030 2100	USA, BBG/VOA	7555as
2030 2100	Vietnam, VO Vietnam/Overseas Svc	7220me 7280eu 9730me 9730eu
2045 2100	India, AIR/External Svc	7550eu 9445eu 9910pa 11620pa 11670eu 11715pa
2045 2100 DRM	India, AIR/External Svc	9950eu

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

2100 2125	Turkey, VO Turkey	7205va
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	11955af
2100 2130	Serbia, International R Serbia	6100eu
2100 2130	South Korea, KBS World R	3955eu
2100 2150	New Zealand, R New Zealand Intl	11725pa
2100 2150 DRM	New Zealand, R New Zealand Intl	15720pa
2100 2157	North Korea, VO Korea	13760eu 15245eu
2100 2200	Angola, Angolan National R	7217af
2100 2200	Anguilla, University Network	11775na
2100 2200	Australia, ABC/R Australia	9500pa 9660as 11650pa 11695pa 12080pa 13630pa 15515pa 21740pa
2100 2200	Bahrain, R Bahrain	6010me
2100 2200	Belarus, R Belarus	7255eu 11730eu
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 R International	5960eu
	7205af 7285eu 7325af	7415eu
	9600eu	
2100 2200	Eqt Guinea, Pan American BC/R Africa	
	15190af	
2100 2200	Germany, Deutsche Welle 11800af	11830af
	11865af	
2100 2200	India, AIR/External Svc 7550eu	9445eu
	9910pa 11620pa 11670eu	11715pa
2100 2200 DRM	India, AIR/External Svc 9950eu	
2100 2200	Malaysia, RTM Kajang/Traxx FM	7295do
2100 2200	Micronesia, V6MP/Cross R/Pohnpei	4755 as
2100 2200 DRM	Russia, VO Russia 6155eu	
2100 2200	South Africa, CVC 1 Africa R	9505af
	13590af	
2100 2200 Sat/Sun	Spain, R Exterior de Espana 9650eu	
2100 2200	Syria, R Damascus 9330va	
2100 2200	UK, BBC World Service 3255af	3915as
	5875as 5905af 6005af	6190af
	6195va 9410af 12095af	
2100 2200	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb 13362usb	
2100 2200	USA, BBG/VOA 6080af 7555as	15580af
2100 2200	USA, FBN/WTJC Newport NC	9370na
2100 2200	USA, Overcomer Ministry 9400eu	
2100 2200	USA, WBCQ Monticello ME7490am	9330am
2100 2200	USA, WEWN/EWTN Irondale AL	15610af
2100 2200	USA, WHRI Cypress Creek SC	17510va
2100 2200	USA, WINB Red Lion PA 9265am	
2100 2200	USA, WJHR Intl Milton FL 15550usb	
2100 2200	USA, WTWW Lebanon TN 9479va	
2100 2200	USA, WWCR Nashville TN 6875eu	9350af
	9980af 13845eu	
2100 2200	USA, WWRB Manchester TN	3185na
	3215na 9385na	
2100 2200	USA, WYFR/Family R Worldwide	12070af
2100 2200	Zambia, Christian Voice 4965af	
2100 2200	Zambia, CVC Intl/1 Africa 9505as	
2115 2200	Egypt, R Cairo 11890eu	
2130 2200	Australia, ABC NT Alice Springs	4835do
2130 2200	Australia, ABC NT Katherine	5025do
2145 2200	India, AIR/R Kashmir 4950do	
2151 2200	New Zealand, R New Zealand Intl	15720pa
2151 2200 DRM	New Zealand, R New Zealand Intl	17675pa

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

2200 2230	India, AIR/External Svc 7550eu	9445eu
	9910pa 11620pa 11670eu	11715pa
2200 2230 DRM	India, AIR/External Svc 9950as	
2200 2230 smtwh	USA, BBG/VOA 5895va 5915va	7480va
	7575va 12150va	
2200 2245	Egypt, R Cairo 11890eu	
2200 2255	Turkey, VO Turkey 9830va	
2200 2256	Romania, R Romania Intl 7435eu	9540eu
	9790eu 11940eu	
2200 2300	Anguilla, University Network	6090na
2200 2300	Australia, ABC NT Alice Springs	4835do
2200 2300	Australia, ABC NT Katherine	5025do
2200 2300	Australia, ABC/R Australia 9660as	9855as
	12080pa 13630pa 15230pa	15415pa
	15515pa 21740pa	
2200 2300	Bahrain, R Bahrain 6010me	
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 R International	9590as
2200 2300	Eqt Guinea, Pan American BC/R Africa	
	15190af	
2200 2300	Malaysia, RTM Kajang/Traxx FM	7295do
2200 2300	Micronesia, V6MP/Cross R/Pohnpei	4755 as
2200 2300	New Zealand, R New Zealand Intl	15720pa
2200 2300 DRM	New Zealand, R New Zealand Intl	17675pa
2200 2300 Sat	Palau, T8WH/World Harvest R	9930as
2200 2300	Russia, VO Russia 9800va	
2200 2300	UK, BBC World Service 3915as	5875as
	5905as 6195as 7490as	9580as
	9730af 9740as 12095af	
2200 2300	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb 13362usb	
2200 2300	USA, BBG/VOA 7555as	
2200 2300	USA, FBN/WTJC Newport NC	9370na
2200 2300	USA, Overcomre Ministry 9400as	
2200 2300	USA, WBCQ Monticello ME7490am	9330am
2200 2300	USA, WEWN/EWTN Irondale AL	15610me
2200 2300	USA, WHRI Cypress Creek SC	11775va
	13620na 17510va	
2200 2300 twhfas	USA, WINB Red Lion PA 9265am	
2200 2300	USA, WTWW Lebanon TN 9479va	
2200 2300	USA, WWCR Nashville TN 6875eu	9350af
	9980af 13845eu	
2200 2300	USA, WWRB Manchester TN	3185na
	3215na 9385na	
2200 2300	Zambia, Christian Voice 4965af	
2215 2300	USA, WYFR/Family R Worldwide	6145va
2230 2300	China, Xizang PBS 4905do	
2230 2300	Indonesia, AWR Asia/Pacific	9730as
2230 2300 mtwhf	Moldova, R PMR/Pridnestrovye	9665eu
2230 2300	USA, WYFR/Family R Worldwide	6145na
	11580af 15255af	
2245 2300	India, AIR/External Svc 6055as	9705as
	9950as 11670as 13605as	
2245 2300 DRM	India, AIR/External Svc 11645as	
2245 2300	India, AIR/R Kashmir 4950do	

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

2300 0000	Anguilla, University Network	6090na
2300 0000	Australia, ABC NT Alice Springs	4835do
2300 0000	Australia, ABC NT Katherine	5025do
2300 0000	Australia, ABC/R Australia 9660as	9855as
	12080pa 15230pa 15415pa	15230pa
	15415pa 17795pa 19000pa	21740pa
2300 0000	Bahrain, R Bahrain 6010me	
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 R International	5915as
	5990ca 6145na 7350eu	7410as
	9610as 11690as 11790as	
2300 0000	Cuba, R Havana Cuba 5040va	
2300 0000	Egypt, R Cairo 9965na	
2300 0000	India, AIR/External Svc 6055as	9705as
	9950as 11670as 13605as	
2300 0000 DRM	India, AIR/External Svc 11645as	
2300 0000	Malaysia, RTM Kajang/Traxx FM	7295do
2300 0000	Micronesia, V6MP/Cross R/Pohnpei	4755 as
2300 0000	New Zealand, R New Zealand Intl	15720pa
2300 0000 DRM	New Zealand, R New Zealand Intl	17675pa
2300 0000	Russia, VO Russia 9665va	9800va
2300 0000	Spain, R Exterior de Espana 6055na	
2300 0000	UK, BBC World Service 3915as	6195as
	7490as 9580as 9740as	9890as
	11850as 12010as	
2300 0000	USA, Amer Forces Network/AFRTS	4319usb
	5765usb 12759usb 13362usb	
2300 0000	USA, FBN/WTJC Newport NC	9370na
2300 0000	USA, WBCQ Monticello ME7490am	9330am
2300 0000 Sat/Sun	USA, WBCQ Monticello ME5110am	
2300 0000	USA, WEWN/EWTN Irondale AL	15610me
2300 0000	USA, WHRI Cypress Creek SC	13620na
	17510va	
2300 0000 Sun	USA, WHRI Cypress Creek SC	11775va
2300 0000 mtwhfs	USA, WHRI Cypress Creek SC	7315ca
2300 0000	USA, WINB Red Lion PA 9265am	
2300 0000	USA, WTWW Lebanon TN 9479va	
2300 0000	USA, WWCR Nashville TN 6875eu	9350af
	9980af 13845eu	
2300 0000	USA, WWRB Manchester TN	3185na
	3215na 9385na	
2300 0000	USA, WYFR/Family R Worldwide	6145na
	15255sa 11580sa	
2300 0000	Zambia, Christian Voice 4965af	
2330 0000	Australia, ABC/R Australia 17750pa	
2330 0000	Australia, ABC/R Australia 17750as	
2330 0000	Vietnam, VO Vietnam/Overseas Svc	9840as
	12020as	

MILCOM

MONITORING MILITARY COMMUNICATIONS

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Two New Air Force Thunderbird Frequencies Discovered

As the air show seasons starts to wind down and *MT* readers who have attended various air shows this season continue to file their field reports, two new frequencies have been discovered in use by the famed U.S. Air Force Thunderbird Flight Demonstration Team.

Our good friend in the Northeast and regular *MT* contributor Kevin Burke has uncovered and confirmed a new team VHF frequency of 141.175 MHz.

It is very possible that under the new band plan that has emerged in the 138-144/148-150.8 MHz Department of Defense (DoD) bands, there may be some additional frequencies that the Thunderbirds and other military units could be using. Here is some other VHF Air frequencies that you should have programmed in that scanner if you are a milair monitor.

An * indicates a Pilot-to-Dispatcher (PTD) frequency and ** indicates an air defense frequency.

138.4375 138.550 138.600 138.625
138.750 138.950 139.000 139.300*
139.600 139.700** 139.900 140.200
140.500 141.175 142.300* 142.600
142.700 142.800 142.900 143.000
143.600 143.725 143.750 MHz

We also have another report from Northeasterner Brian Topolski. Brian attended the Atlantic City air show, "Thunder over the Boardwalk." According to Brian, "the Thunderbirds were providing a live video feed from inside the jet cockpit to a huge video screen on the Atlantic City boardwalk. Their comm-cart was set up directly on the boardwalk and I was able to get a close look at it. I noticed a rack mounted receiver, and a screen readout of: (CH-3) 4845.0 MHz."

Brian confirmed with one of the team members that the frequency listed above on the comm-cart was providing the video feed.

So this will be an interesting frequency range to explore. I wonder whether the frequency is analog NTSC or the newer digital standard video used by U.S. television stations these days?

If you attended an air show during the 2012 season we want to hear from you. Even if the frequencies you monitored are in our *MT Air Show Guide*, your report is still valuable to us to confirm the current frequencies being used by the various air show performers. You can reach us in the address in the masthead.

U.S. Air Force Thunderbirds (USAF Photo)

❖ Scott AFB Profile

One of the more interesting military bases here in the continental United States belongs to the Air Force: Scott AFB, Illinois.

This base is operated by the 375th Air Mobility Wing (375AMW) and is also home to the Air Force Reserve Command's 932nd Airlift Wing (932AW) and the Illinois Air National Guard's 126th Air Refueling Wing (126ARW), the latter two units being operationally gained by the U.S. Air Force's Air Mobility Command (AMC). Its airfield is also used by civilian aircraft, with civilian operations at the base referring to the facility as MidAmerica St. Louis Airport.

MidAmerica has operated as a joint-use airport since beginning operations in November 1997, and has not been served by any commercial airlines since Allegiant Air pulled out of the airport on January 3, 2009.

Here is my latest frequency list for this base:

119.200/275.800	Ground Control
119.875/225.400	Clearance Delivery
122.950	Unicom
125.200/251.800	Approach Control
128.250/253.500	Tower
128.700/256.700	ATIS
130.650 375AW	Command Post
138.550	126ARW/108ARS Command Post
138.600	ANG Command Post
139.850/372.200	Pilot-to-Dispatcher (PTD)
234.600	AMC Command Post
239.800	Metro
251.075	Local Control (East Side Joint Use Runway)
263.025	Ground Control (East Side Joint Use Runway)
277.700	126ARW/108ARS Command Post/Maintenance
290.350	Approach Control
311.000	126ARW/108ARS Command Post
316.100	Approach Control
349.400	AMC Command Post
360.650	Approach Control
383.200	375AW Command Post

The base uses a VHF APCO-25 digital trunk radio system with the following frequencies: 138.1375 138.2625 138.3125 138.3375 138.3625 138.3875 138.4125 MHz.

❖ 8-9 MHz 'O-R' Aeronautical Sub-Band Scan

In this issue I will continue our exclusive profiles of the various aeronautical Off-Route, known as O-R, sub-bands. This month I will detail the 8965 to 9037 kHz frequency range in Table One. The information presented in our exclusive frequency list is based on many hours of monitoring and analyzing field monitor reports from around the world. See our background article in the October 2012 *MT Milcom* column for further details on these fascinating HF military radio frequencies.

❖ ARTCC Update

This month we will continue our FAA Air Route Traffic Control Center tour with a look at the Indianapolis ARTCC (Table Two). 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. Note: All frequencies listed in table one are in MHz and mode is AM.

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

TABLE ONE:

8-9 MHz 'O-R' Aeronautical Sub-Band Scan

*Note: All frequencies are in kHz and the mode is Upper Sideband (USB) unless otherwise indicated. An * indicates a frequency this is not part of the 'OR' band plan.*

8965.0 USAF Assignment: German Air Force air transport command network; Air Mobility Command (AMC) Department of Defense (DoD)/ Joint Chiefs of Staff (JCS) HF Global Communications System (HFGCS) Global Black - NIPRNet (Unclassified but Sensitive Internet Protocol

Router Network) (formerly called the Non-Classified Internet Protocol Router Network).

8968.0 USAF Assignment: Long Distance Operational Control (LDOC) JAT Airways, Serbia; AMC HFGCS Global Red - SIPRNet (Secure Internet Protocol Router Network).

8971.0 USN Assignment: Australian Defense Force MHFCS Fixed Node Net; U.S. Navy Atlantic/Pacific fleet ship/air operations, including HF CWC voice coordination nets.; NAS Jacksonville, Florida, Tactical Support Center (TSC) flight following – Atlantic (Fiddle call sign).

8974.0 USN Assignment: Royal New Zealand Air Force (RNZAF) Air Operations Communication Centre Auckland (AOCCAK) Network; Ukraine Air Force Net; U.S. Navy Atlantic/Pacific fleet ship/air operations, including HF CWC voice coordination nets.; U.S. Navy Stratcom Wing One command post – Tinker AFB, Oklahoma.

8977.0 USN Assignment: ARINC HFDL Reykjavik, Iceland, Slot 3; Italian Navy Air Reporting and Control Net (ARCN); U.S. Navy Atlantic/Pacific fleet ship/air operations; NAS Whidbey Island, Washington, TSC flight following - Pacific (Habitat call sign)

8980.0 USCG Assignment: French Navy Air Reporting and Control Net (ARCN); United Kingdom (UK) Defense HF Communication Service (DHFCS) Terrestrial Air Sea. Communications (TASCOMM) ALE network; UK Air Force Kinloss Rescue; DHN 66 - Geilenkirchen, Germany, NATO AWACS; U.S. Coast Guard air/ground communications for air stations and detachments with rotary wing aircraft.

8983.0 USCG Assignment: U.S. Coast Guard air/ground communications for air stations and detachments with fixed wing aircraft.

8986.0 USAF Assignment: MKL UK RAF - Northwood, England, Stanag 4481 NATO-75 (RTTY) 70/75 KG-84C Encryption - RAF MARTELO/AMCC Secure broadcast (RAF 2 Group MATELO Broadcast; AMC HFGCS global discrete; U.S. DHS Customs and Border Protection (CBP) Customs Over the Horizon Network (COTHEN) discrete (shared with Global).

8989.0 USAF/CANFORCE Assignment: LDOC Saudi Air Operations Jeddah, Saudi Arabia; Belgian Air Force; Canadian Forces (CanForce) Military Aeronautical Communications System (MACS) discrete; AMC HFGCS global discrete; CBP COTHEN discrete (shared with Global).

8990.0*Algerian Police La Direction Générale de la Sûreté Nationale (DGSN) ALE/LSB

8992.0 CANFORCE/USAF Assignment: CanForce MACS Search and Rescue discrete; French Air Force Circus Net Commandement De La Force Aérienne De Projection (CFAP) Vinaigrette 3; Russian Global Air Force Network frequency; DoD/JCS HF Global Communications System (HFGCS) primary.

8993.0*Israeli Air Force HF ALE Network

8995.0 USN Assignment: Lithuanian Navy HF ALE network; U.S. Navy Atlantic/Pacific fleet ship/air operations

8998.0 USN Assignment: U.S. Navy/U.S. Marine Corps Atlantic/Pacific fleet ship/air operations.

9001.0 USN Assignment: UK Air Force Kinloss Rescue; U.S. Navy Atlantic/Pacific fleet ship/air operations, including HF CWC voice coordination nets.

9004.0 USN Assignment: LDOC Gol Transportes Aéreos/Varig airlines, Brazil; LDOC Royal Jordanian Airlines; NASA Operations Eastern Test Range (infrequent operations); U.S. Navy Atlantic/Pacific fleet ship/air operations; NAS Whidbey Island, Washington, TSC flight following - Pacific (Habitat call sign)

9007.0 CANFORCE/USN Assignment: CanForce MACS Primary; French Navy Air Reporting and Control Net (ARCN); U.S. Navy/U.S. Marine Corps Atlantic/Pacific fleet ship/air operations.

9010.0 CANFORCE/USN Assignment: Brazilian Air Force HF ALE Net; CanForce MACS discrete; NAS Whidbey Island, Washington, TSC flight following - Pacific (Habitat call sign); U.S. Navy/U.S. Marine Corps Atlantic/Pacific fleet ship/air operations.

9013.0 USAF Assignment: LDOC Aerolineas Argentinas; Spanish Air Force HF Net; AMC HFGCS global discrete; CBP COTHEN discrete (shared with Global).

9016.0 USAF Assignment: UK DHFCS TASCOMM Net; AMC HFGCS global discrete.

9019.0 USAF Assignment: French Navy Air Reporting and Control Net (ARCN); UK DHFCS TASCOMM ALE Network; AMC HFGCS global discrete; U.S. Air Force Mystic Star network; U.S. Air Force JStars Discrete.

9022.0 CANFORCE/USAF Assignment: Czech Republic Air Force Net frequency; French Air Force Centre De Conduite Des Opérations Aériennes (CCOA); UK DHFCS TASCOMM ALE Network; NATO/DOD Link-11 (TADIL-A) data signal, Mil-Std-188-203-1A; Spanish Air Force HF Net; U.S. Air Force Eastern Test Range Operations (infrequent now since STS decommissioned); U.S. Air Force/NORAD Air Defense Network; AMC HFGCS global discrete.

9025.0 USAF Assignment: Brazilian Air Force HF ALE Net; U.S. Air Force AMC HFGCS Scope Command ALE HF network.

9028.0 CANFORCE/USN Assignment: CanForce MACS Search and Rescue discrete; U.S. Navy Atlantic/Pacific fleet ship/air operations, including HF CWC voice coordination nets.

9030.0*NAR - USN NRTF Saddlebunch Key, Florida Stanag 4481 NATO-75(RTTY) 850/75KG-84 Encryption.

9031.0 CANFORCE/USN Assignment: UK DHFCS TASCOMM Voice/ALE Network primary; U.S. Navy Atlantic/Pacific fleet ship/air operations, including HF CWC voice coordination nets.; U.S. Navy Stratcom Wing One command post – Tinker AFB, Oklahoma.

9034.0 USCG/USN Assignment: Japan Self Defense Force; U.S. Coast Guard air/ground communications for air stations and detachments with fixed and/or rotary wing aircraft; U.S. Navy Atlantic/Pacific fleet ship/air operations.

9037.0 CANFORCE/USCG/USN Assignment: MKL - UK Royal Air Force Northwood; U.S. Coast Guard air/ground communications for air stations and detachments with fixed and/or rotary wing aircraft; U.S. Navy Atlantic/Pacific fleet ship/air operations.

TABLE TWO: INDIANAPOLIS ARTCC RCAG FREQUENCY LIST

RCAG Freq V/U Pair MHz	RCAG Location (ICAO Identifier)	Sector Number/Name:	Notes
119.300	Indianapolis, Indiana (IND)	Approach Services	
119.525/379.175	Charleston, West Virginia (CRW)	Sector 85	High Altitude
119.550/350.225	Indianapolis, Indiana (IND)	Sector 34	Low Altitude
120.275/363.175	York, Kentucky (PMH)	Sector 95	Super High Altitude
120.275/363.175	Portsmouth, Ohio (PMH)	Sector 95	Super High Altitude
120.475/353.750	London Catawba, Ohio (CV8)	Sector 31	Low Altitude
120.575/317.625	Brookville, Ohio (BV8)	Sector 88	High Altitude
120.650	Muncie, Indiana (MIE)	Approach Services	
120.875/284.275	Merwin, Ohio (QW2)	Sector 70	Super High Altitude
121.175/353.650	New Hope, Kentucky (EWO)	Sector 19	Low Altitude
121.400/285.475	Terre Haute, Indiana (HUF)	Sector 90	Super High Altitude
123.775/263.050	Lexington, Kentucky (LEX)	Sector 93	Super High Altitude
123.925/256.700	Merwin, Ohio (QW2)	Sector 22	Low Altitude
124.225/360.725	Portsmouth, Kentucky (PMH)	Sector 26	Low Altitude (ex-127.775 / 327.050 / 269.325 MHz)
124.450/291.100	Zanesville, Ohio (ZZV)	Sector 30	Low Altitude
124.525/360.775	Indianapolis, Indiana (IND)	Sector 33	Low Altitude
124.575/290.550	Whitetop Mountain, Virginia (TRI)	Sector 86	High Altitude
124.625/371.925	New Hope, Kentucky (EWO)	Sector 21	Low Altitude
124.775/269.025	Henryville, Indiana (LOU)	Sector 18	Low Altitude
124.800/323.275	London Catawba, Ohio (CV8)	Sector 30	Low Altitude
125.075/353.525	Zanesville, Ohio (ZZV)	Sector 77	High Altitude
125.125/299.600	Indianapolis, Indiana (IND)	Sector 75	High Altitude
125.550/317.475	Parkersburg, Ohio (PKB)	Sector 24	High Altitude
126.375/343.650	Winchester, Kentucky (LEX)	Sector 20	Low Altitude
126.575/257.850	Lynch, Kentucky (QRI)	Sector 25	Low Altitude (ex-128.400 / 253.500 MHz)
126.575/257.850	Bluefield, West Virginia (BLF)	Sector 25	Low Altitude (ex-128.400 / 253.500 MHz)
126.925/319.150	Livingston, Tennessee (LVT)	Sector 94	Super High Altitude
127.025/322.425	Huntingbird, Indiana (HNB)	Sector 91	Super High Altitude
128.075/288.300	Rosewood, Ohio (ROD)	Sector 32	Low Altitude
128.225/317.750	Lexington, Kentucky (LEX)	Sector 83	High Altitude
128.275	Indianapolis International, Indiana (IND)		Clearance Delivery Services (ex-128.750 MHz)
128.300/291.625	Evansville, Indiana (EVV)	Sector 17	Low Altitude
128.375/317.525	Henryville, Indiana (LOU)	Sector 66	High Altitude
128.775/346.300	London Catawba, Ohio (CV8)	Sector 98	Super High Altitude
132.200/310.800	Terre Haute, Indiana (HUF)	Sector 35	Low Altitude
132.525/377.125	Evansville, Indiana (EVV)	Sector 81	High Altitude
132.775/370.925	Indianapolis, Indiana (IND)	Sector 99	Super High Altitude
132.825/360.675	Zanesville, Ohio (ZZV)	Sector 87	High Altitude (ex-343.600 MHz)
133.050/342.875	Henryville, Indiana (LOU)	Sector 82	High Altitude (ex-293.225 MHz)
133.425/273.475	Indianapolis, Indiana (IND)	Sector 89	High Alltitude
133.750	Winchester, Kentucky (LEX)	Sector 20	Low Altitude
133.775/379.975	Zanesville, Ohio (ZZV)	Sector 97	Super High Altitude (ex-363.025 MHz)
134.000/285.425	London Catawba, Ohio (CV8)	Sector 23	Low Altitude
134.175/317.425	Terre Haute, Indiana (HUF)	Sector 80	High Altitude
134.225/307.300	Charleston, West Virginia (CRW)	Sector 96	Super High Altitude
134.275/353.825	Henryville, Indiana (LOU)	Sector 92	Super High Altitude
134.675/348.625	Livingston, Tennessee (LVT)	Sector 84	High Altitude
134.700/307.225	Merwin, Ohio (QW2)	Sector 76	High Altitude
135.125/288.250	Marietta, Ohio (JPU)	Sector 77	High Altitude (ex-322.375 MHz Sector 79)
135.125/288.250	Parkersburg, West Virginia (JPU)	Sector 75	High Altitude (ex-322.375 MHz Sector 79)
135.575/290.500	Merwin, Ohio (QW2)	Sector 69	Low Altitude
135.800/282.375	Rosewood, Ohio (ROD)	Sector 78	High Altitude
257.950	Bible Grove, Illinois (BIB)	MOA	Low Altitude (Red Hills MOA, associated with Sector 35)
269.000	Rosewood, Ohio (ROD)	Sector 32	Low Altitude
282.300	Brookville, Ohio (DAY)	Sector 88	Workload
316.075	Indianapolis, Indiana (IND)	TSU	High Altitude
316.125	Columbus, Ohio (CMH)	MOA	Buckeye MOA
316.125	Hillsboro, Ohio (HOC)	MOA	Buckeye MOA

FED FILES

GOVERNMENT COMMUNICATIONS

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2012 Political Convention

At the time this column was being written, the political season was well underway with campaign trips and political party conventions in Tampa, Florida and Charlotte, North Carolina. Both cities appeared to have set up multiple, new communications systems for support of the convention and surrounding activities. Unfortunately I was not able to attend any of these events, but several federal monitors in both convention cities were kind enough to pass along some of what they were able to pick up. Federal frequencies were mostly encrypted, as expected, but some clear traffic was heard. As with the Super Bowl, the FBI seems to be taking a leading role in large event security and communications.

The first batch of frequencies came from several sources at the Republican National Convention in Tampa:

123.1000, AM - Intercepted civilian aircraft being warned out of restricted airspace
163.0500, N293 - USCG NET 112
163.0875, 131.8 PL
163.3125, N653 - Input to 171.6875 MHz
163.3625, 131.0 PL - VA Medical Center Police
164.3250, NE01
164.4000, N001 - USSS PAPA
164.4750, N167
164.6500, NAC 001 - USSS TANGO

164.8875, N001 - USSS OSCAR
165.2125
165.3750, N001 - USSS CHARLIE
165.5875
165.6375, N611
166.1875, N293 - USCG NET 124
166.4375, 100.0 - DHS CBP, input to 165.2375 MHz
166.4750, 94.8 PL - US Capitol Police
167.0375, N001 - USSS
167.0500, N1AF – Federal Communications Commission (FCC)
167.2500, N68F - Federal Interoperability LE-2/LE-6
167.4625, N167 – Tampa FBI
167.5375, N167 - FBI

167.5625, N167 - FBI
167.5875, N167 – Tampa FBI
167.6875, N167 – Tampa FBI
168.3500, 77.0 PL - US Capitol Police
168.4250, N001
168.5875, N001
168.8500, 151.4 PL - US Capitol Police
169.4500, 100.0 PL - DHS CBP NET 2
169.5125

170.3375, NF00
170.4375, NF00
170.5875, N131
170.8000, N293
170.8500, N864
170.8625
171.2000, N293
171.5750, 146.2 PL
171.6875, N653 - Federal Interoperability, TAM FIO
171.9500, NE01
172.9000, N001, TSA @ Tampa International Airport
173.0125, N650 - BATFE Tac 3
173.8750, 94.8 PL - US Capitol Police
406.1375, D371 - US Postal Service
406.5625, N4A0 - USCG Base
407.0000, N201
407.1375, N482 - USPS Postal Inspectors
409.0000, N293 - USCG
409.3375, N293
410.6500, 100.0 PL
410.8000, N201
411.8500

413.2125, 167.9 PL - Nationwide Interoperability, IR14
417.5500, N254
417.6125, D165
418.2000, N744 - Federal Protective Service

The next convention to be held was the Democratic National Convention in Charlotte. I received an anonymous list of frequencies heard there. Oddly, the source apparently did not hear much activity from the U.S. Secret Service channels while they were monitoring:

162.7625, N167
163.2000, N293
163.8125, N864
163.8625, N167
163.8750, N167
163.9000, N167
163.9250, N167
163.9500, N650
165.2875, N650 – BATFE NET 1
165.9250, N156
167.5375, N167
167.5625, N167
168.9875, N167
170.7500, N293 – Federal Courthouse Security
170.8125, N167
170.8375, N167
171.7750, N293
172.6000, N167

In addition to all the land base communications, some military air communications were heard relative to the Combat Air Patrol over the Charlotte area while President Obama was in the area. All these frequencies are in the AM mode:

228.9
247.05
251.1
260.9
269.55
360.525
369.9

One other note about the Tampa convention; I received reports from local listeners of some extensive testing on what appears to be a wide-area TSA repeater on 172.9000 MHz. This appeared prior to the convention, and although it may have been coincidence, it is more likely the TSA was planning to be on site at convention related gatherings and not just Tampa International Airport. I will delve into some new developments with the TSA in the next Fed Files column.

❖ WHCA 166.5125 MHz Mysteries

If you have checked the Fed Files blog page recently, you may have seen my posting about the recent mysteries surrounding the use of 166.5125 MHz around the country. Some additional postings on some of the Radio Reference forums also offer some confusing and intriguing information.

White House Military Office logo

Although some scanner web sites have incorrectly attributed this frequency to the Secret Service, the frequency has long been associated with the White House Communications Agency (WHCA), a part of the White House Military Office (WHMO). There are many other groups that fall under the WHMO, including the White House Transportation Agency, the Presidential Airlift Group, White House Medical Unit, Camp David and Marine Helicopter Squadron One. The WHCA is staffed by active duty military personnel and is tasked with setting up and maintaining presidential communications systems, including land-mobile radio, mobile data and phone systems. At any event where the President or Vice President are appearing, you will almost always hear some activity on this frequency, along with known Secret Service channels.

The frequency of 166.5125 MHz is allocated to the WHCA and, so far, I have found nothing to indicate that any other agency has use of this frequency. Although there is no doubt that the Secret Service has this and perhaps other WHCA frequencies in their normal radio channel plan. For many years this channel showed up on lists of Secret Service frequencies, often bearing the label of channel "SIERRA." Over the last few years, I received some reports from sources

that indicated this channel might actually now be called "ALPHA" by the WHCA, the Secret Service, or both.

Experience has shown that this frequency is usually one that becomes active prior to and during a visit of someone from the Executive Branch (POTUS, VPOTUS, First Family, etc.). However, recent reports have shown that this frequency is being used for other events and locations where there is no obvious connection to White House activities.

I received listener reports of several days worth transmissions on this frequency in the Dallas/Ft. Worth metro area during the spring of 2011. The reports indicated most of the traffic was encrypted, but some radio transmissions were heard in the clear. The content and quality of the communications seemed to indicate the activity was some sort of law enforcement operation and the unit talking in the clear was airborne. These transmissions stopped after a few days, and there was no indication from the news media of any visit or potential visits from anyone from the White House.

I have also received reports from listeners in the northeast U.S. of numerous encrypted and clear transmissions on the frequency. Some reports seem to indicate a roll call or check-in of various base stations on the frequency. This might indicate that the frequency is being used for a wide area or regional radio network.

Other recent reports from listeners in Tennessee say they have also heard encrypted and clear transmissions on this same frequency. One Internet posting has this frequency being used by the E-4 Presidential Support aircraft. The reporter heard the call sign "Nightwatch" being used on this channel, during an exercise. (For those not familiar with the "Nightwatch" call sign, check out some of the reports over on the military communications web sites.)

What do all these anecdotes about the usage of 166.5125 MHz mean? It could be that the use of this frequency has spread to other units involved in Presidential travel support. It could also mean that the Secret Service has started using this channel as one of their own, in some situations. Time will tell, and hopefully more clues will be revealed as more activity is heard. Keep this frequency in your scanners and let me know what you hear!

❖ Department of Education OIG

In the January 2012 issue of *Monitoring Times*, I published information about the National Oceanic and Atmospheric Administration Office of Law Enforcement. The NOAA OLE is the federal law enforcement division of the National Marine Fisheries Service. I'm sure not that everyone realizes that almost every federal agency has some sort of law enforcement branch, even an agency as innocuous as the Department of Education.

The Department of Education is a relatively new federal agency, having its beginnings under the Carter administration. Its existence was signed into law in 1979 and began operating in 1980.

As I mentioned previously, every federal agency has its own law enforcement division, with each primarily dedicated to investigations involving the federal laws or regulations that the agency oversees, as well as internal investigations of the agency employees and the agency itself. The Department of Education OIG also conducts investigations and prosecutions of defaults and fraud involving student loans. And as with nearly every federal agency, there are federal radio frequencies allocated to their use. Here are some assigned frequencies used by the Department of Education, Office of Inspector General:

ED OIG 1	164.3000, N293
ED OIG 2	163.1000, N293
ED OIG 3	168.3500, N293
ED TAC 1	167.1000, N293
ED TAC 2	166.0000, N293
ED TAC 3	170.7000, N293

In addition to these frequencies, the Department of Education OIG appears to have access to the nationwide CBP VHF radio network (165.2375 MHz) as well as the new nationwide Federal Interoperability channels. These interoperability frequencies can be found here: **http://www.dhs.gov/national-interoperability-field-operations-guide**

❖ Tucson Scanning

I usually get to visit southern Arizona a few times each year. On my last visit to the Tucson area I searched the VHF federal band to see if anything new came up. Here are the logs from what I was able to monitor. I have identified the frequencies that I can, but I'm always looking for help from fellow listeners:

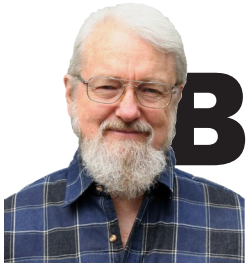
162.4375
162.5375, 67.0 PL
162.5375
163.0000
163.2625
163.2750
163.6250, N20C – DHS Border Patrol
163.6500, N207 – DHS Border Patrol
163.7000, N169 – DHS Border Patrol
164.0625, 206.5 PL - VA Medical Center Tucson, Tram operations
164.5500
164.5625
164.6250, N064
164.6750
164.6875
164.7750
164.8370, 103.5 PL
164.8370, 127.3 PL
164.8375, 146.2 PL
165.7375, 100.0 PL
165.9250, N293
166.0500, 103.5 PL
166.3500, N111 - Saguaro National Monument
166.3500, 110.9 PL
166.3625
166.5000
166.5125
166.7500
167.1500, N111 – Saguaro National Monument
167.1500
167.2875, N167 – FBI Tucson
167.6875, N167 – FBI Tucson
167.8625, CSQ – VA Medical Center Paging

167.9750, N293 – Western Area Power Administration (WAPA)
167.9750
168.0000
168.0125
168.0250
168.5250, 123.0 PL – National Science Foundation, Kitt Peak Observatory
169.0000, 156.7 PL – VA Medical Center Tucson, Maintenance
169.1625, N293 – DHS CBP Air
169.6000, 100.0 PL – Coronado National Forest
169.6000, 103.5 PL – Coronado National Forest
169.6000, 110.9 PL – Coronado National Forest, Mt. Bigelo
169.6875, 167.9 PL – US Department of Agriculture
169.7000
170.3500, N230 – DHS Wide Area Interoperability
170.3500, N8C0
170.5250, 107.2 PL – Coronado National Forest
170.5250, 110.9 PL – Coronado National Forest
170.5250, 114.8 PL – Coronado National Forest
170.5250, 118.8 PL – Coronado National Forest
170.5250, 123.0 PL – Coronado National Forest
170.8500, N864
171.0375, N201 – DHS Border Patrol
171.0375, N04E
171.1875, 110.0 PL
171.2625, NE11 – VA Medical Center Tucson, Police
171.3250, N830 – DHS Border Patrol
171.3250, N0C3 – DHS Border Patrol
171.3250, N20C – DHS Border Patrol
171.3500, N204 – DHS Border Patrol
171.6250, 167.9 PL
171.6625, N210 – DHS Border Patrol
171.8500
172.0620, N20A – DHS Border Patrol
172.2125, N167 – FBI Tucson
172.2750, 123.0 PL – Coronado National Forest
172.2750, 131.8 PL – Coronado National Forest
172.5125
172.7625, N210 – DHS Border Patrol
172.8250, N293 – FAA, Mt. Lemmon Repeater

173.1875, N230 – DHS Border Patrol, Mt. Lemmon
173.1875, N8C0 – DHS Border Patrol
173.5000, N20B – DHS Border Patrol
173.5000, N2CF
173.5000, N82C
173.5000, N82F
173.6125, N210 – DHS Border Patrol, Scan 3
173.6500, N206 – DHS Border Patrol
173.7375, N130
173.8250, 110.9 PL
173.9875, N230 – DHS Border Patrol

The Border Patrol, as well as CBP Field Operations and Immigrations and Customs Enforcement (ICE) are all utilizing a multi-site, conventional radio system that I have touched on before. I'm still seeking some additional details on how the system operates, and will have more information in a future Fed Files column.

That is all for this installment and this year for the *Fed Files*. I will be back in January with more frequencies and information!



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NTSB: The Nation's Air Safety Investigators

I maintain a large collection of Internet links to various Air Traffic Control (ATC), Federal Aviation Administration (FAA) as well as other government and private sector aircraft-related sites. About once a year, I check for dead links and ones that lead to outdated information and then seek replacements. It is a laborious task but, to me, a part of the hobby. Having these links, nicely arranged in folders, allows me quick access to desired information that I know exists.

It was late June when I undertook the link checking task and when I got to the National Traffic Safety Board (NTSB) links, they were all coming up dead and my searches to find replacements led nowhere. I first wondered if something had changed in the government hierarchy but found other government sites pointing to many of the same links I had saved and that were also no longer working. My next thought was that the whole NTSB site was down.

After a couple of days, I again tried some of my saved NTSB links. Things were back to working, well, sort of. This is what I got:

Where's My Cheese?

We recognize that our website used to present a challenge and that many people have memorized the path through the maze or bookmarked the information they need. Unfortunately, due to the new organization of our website content, those trails of breadcrumbs and bookmarks will no longer work. We apologize for "moving the cheese" at the end of the maze, but we think you'll have a much easier time finding the information you need. Our website content has been organized into a number of related categories listed below. Please Contact us if you need any further information.

It was very refreshing to see that some government employee was able to present information about the change in a non-bureaucratic and pleasant way. I learned quickly that the site structure was quite different and that I needed to set out on a cyber-expedition. My journey served as the inspiration for this column, one of accessing information from the NTSB that could be of interest to readers here. Let's take a look!

❖ Brief NTSB History/Mission

The NTSB began with the Air Commerce Act of 1926. At first, the Department of Commerce investigated aircraft accidents and later the Civil Aeronautics Board's Bureau of Aviation Safety. In the late 1960s it became part of the Department of Transportation (DOT) as the NTSB, but acted independently. In 1974, the NTSB became a completely separate government entity.

The NTSB has no authority to regulate the transportation industry but prepares recommendations to enhance transportation safety. Since the 1960s, the NTSB has investigated accidents in the aviation, highway, marine, pipeline, and railroad modes, as well as accidents related to the transportation of hazardous materials.

This column will focus on their aircraft investigations, recommendations, and related information and in that light, the Office of Aviation Safety's mission is to: *1) Investigate all civil domestic air carrier, commuter, and air taxi accidents; in-flight collisions; fatal and nonfatal general aviation accidents; and certain public-use aircraft accidents, 2) Participate in the investigation of major airline crashes in foreign countries that involve U.S. carriers or U.S.-manufactured or -designed equipment to fulfill U.S. obligations under International Civil Aviation Organization agreements, and 3) Conduct investigations of safety issues that extend beyond a single accident to examine specific aviation safety problems from a broader perspective….the office also works to formulate recommendations to prevent the recurrence of similar accidents and incidents, and to otherwise improve aviation safety.*

"To provide for the safest possible transportation system through application of lessons learned in the investigation of transportation accidents and incidents."
- NTSB mission statement

❖ NTSB and Related Topics

Following is an accumulation of a variety of topics, in no special order, that help explain the NTSB role and where to find subjects of interest on the NTSB Internet site.

❖ Accident/Incident

The definitions are rather specific and carefully worded, so I will offer quotes:

The NTSB defines an accident as an event associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.

And for incident: *An aviation incident is defined as an occurrence, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations.*

❖ NTSB Safety Recommendations

The NTSB issues safety recommendations that address specific issues which are based on accident investigations and safety studies. Here, **www.ntsb.gov/safety/safety_recs.html**, you will find the "Recommendation Letter Archive." Untitled safety recommendation letters, PDF files, are listed by year and can be worth exploring. Under the "2012" link, click on "A-12-008.pdf" as an example. It is about the P-51 Mustang crash on September 16, 2011 at the National Championship Air Races at Reno Stead Airport, Reno, Nevada. It is five pages and includes informative diagrams, conflicting specified distances between the primary spectator area and the show-line, fatality information, and more.

❖ NTSB and FAA Agreements

Necessary agreements exist between the NTSB and the FAA. The primary ones are briefly summarized here: Accident and incident investigations are under the control and direction of the NTSB Investigator-In-Charge (IIC). The FAA must have a designated principal representative until the investigation is complete. This FAA representative has the authority to procure and utilize needed FAA personnel, facilities, and records. In turn, the NTSB passes documents, reports, evidence, and tentative recommendations to the FAA representative.

For the determined reader, who wants the

fine details of this and lots more, go to FAA Order 8020.16A *Air Traffic Organization Aircraft Accident and Incident Notification, Investigation, and Reporting* (248 pages, 1.2 MB) at **www.faa.gov/documentLibrary/media/Order/JO8020.16A.pdf**. It has a good table of contents and the document can simply be browsed for subject areas of interest.

❖ Cockpit Voice Recorders (CVRs)

As part of crash investigations, the NTSB Vehicle Recorder Laboratory in Washington, D.C., extracts and analyses data from recovered Cockpit Voice Recorders (CVRs). The voice transcripts and flight data reports are combined with Air Traffic Control (ATC) radio communications and radar data archives, eye-witness accounts, the weather at the time, maintenance records, crash scene/debris field analysis, time-consuming and labor-intensive aircraft reconstructions, even microscopic examinations, and more, all in an attempt to determine the probable cause of a crash.

CVRs have an interesting and evolving history. They can play an important role in accident investigations. CVRs hold a limited amount of data via tape or electronic memory and the oldest data is overwritten by newer data as time passes. This can be a problem if some time lapses between the initiating cause of an accident/incident and when the recorder loses power or is manually turned off. From 2002 here is an example of just such an account: **www.ntsb.gov/doclib/recletters/2002/A02_24_25.pdf** is just such an account. It includes several real examples and is easy to read and understand.

If CVRs interest you, please also see *Cockpit Voice Recorder Handbook for Aviation Accident Investigations* at **www.ntsb.gov/doclib/manuals/cvr_handbook.pdf.** For a quickie reference on CVRs and Flight Data Recorders (FDRs), see: **www.airlinesafety.com/articles/CVR_FDR.htm**.

❖ CVR Transcripts

Written transcripts are prepared from recovered audio from CVRs. What is recorded? Several audio sources are inputs to the CVR. On airliners, there is an overhead microphone that captures voices and other sounds in the cockpit area. The microphones in crewmember headsets capture words spoken by the crewmembers, and additionally, area sounds even when no one is talking. The CVR captures public address announcements, both sides of any radio traffic, aircraft interphone voice, and audio from navigation or approach aids, anything that is introduced into the headset or speaker.

Reading some of the transcripts can suck you in like reading a good novel. It is also "hearing" the verbal exchanges between people who may soon perish. Reading them can be disturbing to some, so read them with caution. Go here www.tailstrike.com/database.htm and for a given transcript, click on the date at the left. You may also read some here: **http://aviation-safety.net/investigation/cvr/transcripts/.**

❖ Wrong Runway Departures

Yes, taking off on the wrong runway really does happen, in fact a publication by the same name may be found here: **www.asias.faa.gov/portal/page/portal/asias_pages/asias_home/studies.** Click on "Wrong Runway Report" (68 pages), but before you click, look at the other study titles in case they may interest you. I suggest looking at "NTSB Weather Related Accidents." In fairness to the reader, it doesn't show convective swirls or magnificent photos of thunderstorms but instead many colorful graphical representations of data: pie charts, graphs, and related. These studies are on the FAA Aviation Safety Information Analysis and Sharing (ASIAS) System site and not the NTSB site but some of the studies rely heavily on NTSB data.

From the Wrong Way Departures publication: *Tremendous strides have been made in reducing the threat of runway incursions at our nation's airports. Focusing on preventing collisions between airplanes has led to new technologies, new air traffic control (ATC) and flightcrew procedures, and changes in how airports are illuminated and marked. The wrong runway event reports had very similar circumstances to runway incursion reports in that the actions taken by the flightcrews did not match their intentions.*

The publication has several airport diagrams to supplement the text. The following is from a collision on the ground at St. Louis Lambert International Airport: *ATC personnel were not able to maintain visual contact with the Cessna after it taxied from the well-lighted ramp area into the runway/taxiway environment of the northeast portion of the airport. The NTSB stated that the pilot of the Cessna acted on an apparently preconceived idea that he would use his arrival runway, runway 30R, for departure. After receiving taxi clearance to back-taxi into position and hold on runway 31, the pilot taxied into a position at an intersection on runway 30R, which was the assigned departure runway for the MD-82. The flightcrew of the MD-82 was not able to see the Cessna until a moment before impact.*

❖ Aviation Accident Reports

The NTSB issues an accident report following the investigation. These reports are available online for reports issued since 1996, with older reports coming online soon. The listing of reports is sortable by the event date, report date, city, and state.

Go here: **www.ntsb.gov/investigations/reports_aviation.html.**

To sort a column, click on the column heading. To sort it in reverse order, click on it again. Click on "Summary" for, your guessed it, a summary. For a great deal more information click on the PDF version which also includes the Executive Summary. Some of these reports can really draw you in and it's hard to stop reading.

Not all things go as planned! This is Southwest Airlines Flight 1248 that slid off the snow covered runway at Chicago Midway International (MDW). The NTSB investigated, of course. (Photo by Gabriel Widyna, used with permission)

❖ Lessons Learned

This site is called "Lessons Learned from Transport Airplane Accidents Home." The home page is here: **http://accidents-ll.faa.gov.** When it comes up, you will see:

International commercial air travel has reached levels of safety and convenience which would have been unimaginable just a generation ago. Although almost always extremely tragic events, the lessons learned from accidents have played an important role in the process of continuing to improve safety.

This Lessons Learned From Aviation Accidents library represents some of the major accidents and their related lessons. The U. S. Federal Aviation Administration, with support from many others, plans to continue adding to this material annually. The objective is to populate the material with many more of the most historically significant, policy shaping accidents, in order that the lessons learned from their review may be available to all users of the library.

You will also find these tabs across the top: View All Accidents, Airplane Life Cycle, Accident Threat Categories, Accident Common Themes, Searching / Sorting, Site Map. Try them all but note that the "Accident Threat Categories" presents all the threat categories in one place.

The site can be explored in two ways; use the tabs across the top or click on the graphics below. Clicking on a graphic will bring more graphics as the subject is subdivided. When you reach what seems to be the end of a particular track, look to the right and you will see "View Related Accidents" (white on blue). Click on that to bring up links to accidents in that specific category.

❖ Closing Thought

Do take some time to read several of the accident reports. They can be quite interesting, riveting in fact. They contain many flying, aircraft-related, navigational, weather, airport, flight recorder, Air Traffic Control, and FAA terms and language that can contribute to understanding what you hear on your scanner. See you next time!

BELOW 500 kHz

DXING THE BASEMENT BAND

Kevin Carey, WB2QMY
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Getting on the Band, Cheap!

My high school friend and ham radio mentor, Doug Hoff WA2IUQ (now AB3OR), was the first person to tell me about longwave. He'd given me a copy of an early 1970s article from *Popular Electronics* titled, "A Transmitter for the Neglected Band." That's all it took. If the longwave band was neglected I wanted to know why and its underdog status only heightened my interest in exploration. My family always seemed to be chasing after underdogs; when some of our neighbors had sleek Ski-Doo snowmobiles, we had a rattling, snub-nosed AMF Ski-Daddler. When my friends had easy-starting Honda dirt bikes, we had an old Benelli that seemed to eat pistons on a monthly basis, though I sure wish I had that Benelli now! Looking back, I believe I was raised to appreciate the under-appreciated in many parts of life, and it taught me to be more resourceful.

Getting back to longwave, I was keen on hearing what the signals from this mysterious band sounded like. After a short time, my friend acquired a Palomar Engineers VLF Converter. This, along with a 250-foot wire antenna, provided the very first signals I heard on longwave. The Palomar unit was like a magic-box to me. You simply turned on the front panel power switch and your 80-meter receiver immediately came to life with intriguing signals from below the broadcast band. The converter was an excellent performer. There was just one problem, and it was really my own problem: *Cost*. To a 14-year old on a lawn mowing-income budget, the $80 price tag of this converter was out of the question.

A few years later, I found an article in *73 Magazine*, by Ken Cornell W2IMB (SK), who described a homebrew converter that seemed easy enough to build. I had most of the parts, and scrounged the rest, even grinding down a huge Bliley Electric crystal unit with extra-fine sandpaper to achieve the 3.5000 MHz local oscillator frequency. To my delight, the converter worked on the first try, and I spent an entire evening sifting through the longwave band. Life was good!

In later years, I also acquired an excellent converter made by LF Engineering Company, which I still use today. Finally, I was able to go all the way down to 5 kHz, which opened up more uncharted spectrum to explore. Anyone who has read this column for a while knows that I am a big fan of converters. They let you apply all of the features of your existing receiver, whether modern or vintage (filters, noise blanker, S-meter, digital readout, etc.) to longwave reception.

For some reason, most commercially available converters are still rather expensive today. I have often wondered why someone can't build a good unit for less than $45. Well, how does $14 sound? You'll need to assemble it yourself (it is a kit), but I believe the folks at Jackson Harbor Press have hit a home run with their LF Converter, which *MT* reader Ron Smith uses and has had good success with. Ron writes: "Hi Kevin: I am including a link to Chuck Olsen's 14-buck Jackson Harbor Press VLF converter. It works as advertised, too. I have been watching it for some time. The former unit had a lower tuning limit of 300 kHz, but that was fixed in May. It now does the entire band (and then some)."

Full information for the LF Converter can be found online at **http://www.wb9kzy.com/lfconv.htm**. For a quick enclosure, Ron recommends using a Radio Shack minibox, noting that they now carry just one size in their retail stores. Below are a few converter features, as reported on the Jackson Harbor Press website:

- Covers LF band (10 to 300 kHz), upconverted to HF
- Use with your HF ham radio or shortwave receiver
- All board-mounted parts are supplied with the kit
- Add your own metal case and connectors for a complete unit

Printed manuals are available for an additional charge, or you can save money by downloading the manual and schematic right from the Jackson Harbor website. This is also an excellent way to learn more about the kit before you buy. I would like to hear from other readers who have tried this converter and hear their impressions of it for LF DXing. As always, I want to caution anyone using a converter with a ham transceiver to take care not to transmit into it, which would cause damage. Just to be safe, I like to disconnect the microphone and key whenever using a converter.

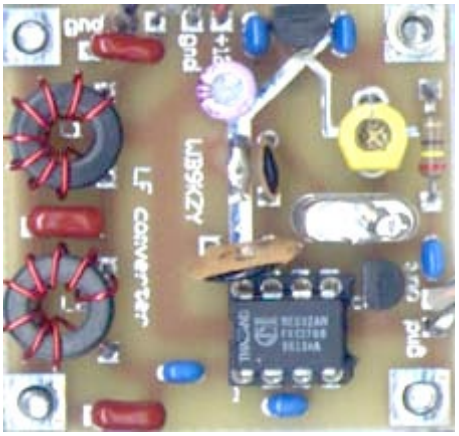

Figure 1. Jackson Harbor Press LF Converter (Source: http://www.wb9kzy.com/lfconv.htm)

Loggings & Mailbag

Mario Filippi N2HUN (NJ) sent the logs shown in Table 1. For this session, he used a Ten Tec RX-320D with a 43-foot vertical antenna made by S9 antennas. Most of these catches were made in the summer season, pointing out that much can still be done on the band before the onset of winter, although static levels are usually higher.

TABLE 1. LF LOGGINGS FROM NJ

kHz	ID	ST/PR/ITU	City
245	YZE	ON	Gore Bay
253	YTF	QC	Alma
254	5B	PE	Summerside
257	YXR	ON	Earlton
273	ZV	QC	Sept-Iles
276	YEL	ON	Elliot Lake
278	NM	QC	Matagami
326	FC	NB	Frederickton
332	QT	ON	Thunder Bay
332	YFM	ON	La Grande
335	YLD	ON	Chapleau
340	YY	QC	Mont Joli
344	YGV	ON	Havre-St. Pierre
360	PN	QC	Port Menier
362	SB	ON	Sudbury
366	YMW	QC	Maniwaki
370	GR	QC	Magdalen Islands
373	2Q	QC	Mont Laurier
378	RJ	ON	Roberval
382	YPL	ON	Pickle Lake
386	D8	QC	Dolbeau-Mistasini
390	JT	NL	Stephenville
391	3B	ON	Brockville
391	OO	ON	Oshawa
392	ML	LA	Monroe
400	PTD	NY	Potsdam
404	YSL	NB	St. Leonard
407	ZHU	QC	Montreal
410	YTA	ON	Petawawa
477	WD2XSH/31	VT	Rutland

We were pleased to hear from **Jim Stellema KA8ZXJ** (MI), who checked in with a note about radio direction finding (RDF) receivers that he has restored. He writes: "Hi Kevin, I read in *MT* that we could send in pictures of completed radio projects. I have several of these types of RDF units and I am sending photos of just two. The Raytheon DF-20 was restored, cleaned, and repainted. This radio was in sad shape and now works quite well. With the Benmar set, all I did was clean the controls and the exterior, and replace the telescopic sense antenna."

Figure 2. Raytheon and Benmar RDF Receivers Restored by Jim Stellema KA8ZXJ (MI) *(Ken, please combine the two RDF photos supplied into this one figure.)*

Jim later added that he has found a source for the snap latches that hold the battery doors closed on many of these types of sets. Alliance Express (www.alliance-express.com) carries these parts, and Jim was able to order them by the piece.

Larry Shaunce WDØAKX (MN) also wrote with a report on his DXing activities with a venerable Sony 2010 receiver: "Hello Kevin, The discussion of Sony 2010 radios a while back got me interested in seeing what beacons I might be able to hear on my radio if I took it outside of the house after sunset. I am sending a list of beacons (see Table 2) as copied from my location in Albert Lea, MN just after sunset on September 15th using only the built-in antenna. I wanted to see what I could hear with this portable radio without the use of an external or loop antenna. Perhaps someday I will consider a loop antenna for this band. Because I live near the MN-IA boarder, I was hearing a lot of Iowa stations as you can see. It was a very nice evening to give the band quick scan and log a few beacons!"

Figure 3. MT Reader Larry Shaunce WDØAKX (MN) DXing Outside with His Sony 2010

TABLE 2. LOGGINGS FROM MN WITH A SONY 2010

kHz	ID	Location
257	PEA	Pella, IA
260	JYG	St. James, MN
274	RG	Red Wing, MN
323	EBS	Webster City, IA
332	QT	Thunder Bay, Ontario Canada
348	MC	Mason City, IA
356	SKI	Sac City, IA
379	OW	Owatonna, MN
385	BA	St. Paul, MN
387	CAV	Clarion, IA
391	EFW	Jefferson, IA
403	AXA	Algona, IA
410	EGQ	Emmetsburg, IA
411	SDA	Shenandoah, IA
417	IY	Charles City, IA
428	POH	Pocahontas, IA
434	SLB	Storm Lake, IA

RADIO RESTORATIONS

BRINGING OLD RADIOS BACK TO LIFE

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Getting to the Howard's Dial System

Last month's work on the Howard 430 communications receiver began, as you might expect, by separating the chassis from the cabinet, or to be more accurate, by separating the cabinet from the chassis. Because of the unusual construction of this radio, the cabinet retaining screws had to be removed while the radio was still sitting on the bench. The cabinet could then be slid forward to clear the control shafts and switches (all knobs having been removed), and then lifted up off the chassis. Sounds simple, but it took a little while to figure that out!

Next came a power transformer check, which is something I do very early in any restoration project. If the transformer is bad, I'll generally put the project on ice until a replacement can be found, something that might take awhile! To do the check, the rectifier tube was first removed from its socket to keep from prematurely powering up the radio and the set was turned on. The dial lights came on and the heaters of the two glass envelope tubes could be seen glowing. That meant that the 6.3-volt heater winding of the transformer was OK. Checking at the pins of the rectifier tube socket, I measured 5 volts across the filament connections and 300 volts from each plate connection to ground, so it looked like the transformer was OK.

The work session concluded with a check of the tubes, both for proper function and to make sure each tube had been plugged into the correct socket. Everything looked good, except for an anomalous test result on the 41 audio output tube which proved to be a case of "operator error" when I rechecked my tester settings the next morning.

❖ Accessing the Dial Cords, the First Try

If removing the cabinet from the chassis was a bit of a puzzle, it was as nothing compared to the challenge of getting access to the dial cords of this radio. The indicator system seems almost to have been designed by someone with a clock making background. For example, in a more usual design, the bandswitch and bandspread control might be fitted with simple pointer knobs. But not the Howard! These two knobs are plain ones, but each is connected by a cord and pulley system with an indicator needle much like a clock hand. These indicators, mounted on either side of the slide rule dial, add charm to the radio's distinctive appearance but they do present a maintenance problem!

Before the dial plate could be taken off, both indicating needles would have to be removed.

As received, the cord for the bandswitch indicator was broken. And, while the cord for the main tuning dial was intact, it was so loose on its pulleys that the tuning knob spun freely without moving the tuning capacitor. These cords obviously had to be fixed before any other checking or repair of the set's operation could be carried out.

But there was clearly no way to access the dial drive systems without some dismantling. The pulleys and cords were in view, but there was hardly room for a finger or two, let alone space for the manipulation required to straighten out the cord situation. At the very least, the dial plate would have to be removed from the radio. Then, perhaps, I'd be able to get to the cords through the front of the set.

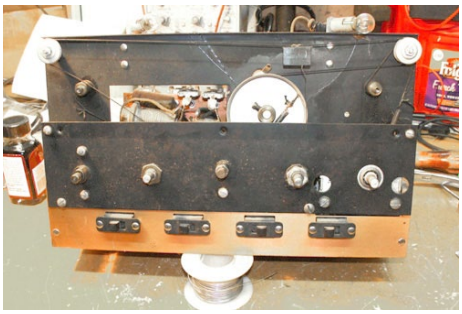
Looking carefully over the dial plate, I saw that there were some screws that needed to come out and others that had large clearance openings around them so that they could stay in place when the plate was removed. Also, the plate wouldn't be going anywhere unless the bandswitch and bandspread indicator needles were removed.

The needles seemed to be secured at their centers with what looked like round decorative nuts. Being round, I couldn't get a wrench on them, and I was really concerned about using pliers for fear that I might slip and scar the nuts or the dial. I almost called a local clock repairman to see if he might have a special wrench for clock hand nuts. However, I decided to try some long duckbill pliers with fine jaws. Placing them very carefully on a nut, I slowly applied grasping and turning pressure while holding the needle pulley from behind with conventional pliers. In a moment, I was gratified to feel the nut release. The other one was just as easy.

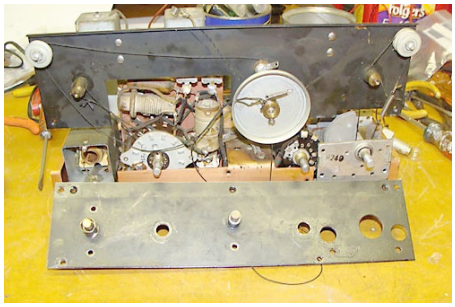
The good news was that the dial plate slipped easily out of the radio after I had released the necessary screws. The bad news was that I wasn't much closer to accessing the dial drive system. Though I had exposed the two steel plates on which the system was mounted, all of the drive hardware seemed to be mounted on the back side of those plates and was no more accessible than it was before the dial plate was removed. I would now have to look at removing the whole assembly.

❖ Stubborn Mounting Screws

At first, it looked as if the assembly could be removed in one piece, once three mounting screws were removed and it was (physically) disconnected from the BFO can, volume control and bandspread capacitor frame. The disconnections were easy, but removing the mounting screws was a different matter. These steel screws were installed in threaded openings tapped into the front apron of the chassis. The chassis of this set has a copper finish. I don't know if it is solid or plated. But apparently there was some sort of chemical reaction between the dissimilar metals of the screws and chassis, the



Even after the dial plate was removed, most of the dial cord system remained inaccessible.



With the lower mounting plate out of the way, I could now service the dial cords.

result being that the screw were frozen solid.

No amount of twisting would release them. Even worse, every once in awhile the screwdriver would slip out of the slot, enlarging it slightly and spoiling the fit of the screwdriver for future tries. I began searching the house for screwdrivers with larger and larger blades. I even tried heating the head of each screw with a heavy duty soldering iron. No dice.

Luckily, the point at which the end of each screw came through the chassis front apron was accessible. I stood the chassis up on that apron so that the ends of the screws were pointing up. Then I sprayed each screw liberally with WD-40 and went to bed.

The next morning, it didn't look as if the situation had changed much. The screws were still not budging and the screwdrivers were still slipping out of the slots. Finally, with an adrenalin rush born of desperation, I pushed my best-fitting screwdriver into a slot as hard as I could and applied the greatest twisting pressure I was capable of. At first nothing happened. Then there was a gratifying "crack" as the screw suddenly released! Moving on to the second screw, I had similar success.

I thought I was home free until I moved to the third screw. That one wouldn't budge, and after my many tries, the slot was mangled to the point where no screwdriver would stay in it. Using a mini hacksaw, I worked on deepening the slot, figuring that even if I didn't achieve a good screwdriver fit, I might separate the screw head into two halves that I could knock out of the hole. Then I might drill and tap a hole for a new screw. But after several cycles of cutting and trying to no avail, that last screw broke loose just as suddenly as the first two. It was quite gratifying!

❖ Success at Last!

With all three mounting screws backed out, I was sure I would be able to remove the entire dial drive assembly as a unit, but no such luck! The uppermost plate was attached to the main tuning capacitor in such a way that it could not be removed without dismounting the capacitor; quite a tall order. But then it dawned on me that if I removed the two screws and spacers that fastened the two plates together, I could probably remove the lower plate. And that proved to be the case.

Once it was removed, it was obvious that this was really all that had to be done in order to gain access to all of the dial drives. The entire system was mounted on the upper plate with good access for servicing. Hopefully, by the next issue, we will have all the dials replaced with all the parts reassembled and operating smoothly. Then we can proceed with recapping the set and checking resistor values. See you then!

❖ From the Mailbag

MT reader Leonard Thomas sent a very interesting e-mail recounting some of his own experiences in restoring a Howard 430. First of all, he found that he wasn't able to remove the cabinet from the chassis until he had screwed the BFO control shaft all the way in. The shaft is actually the slug of the BFO coil and changes the pitch of the oscillator as it is screwed in and out. And, speaking of the BFO, he wasn't able to get it to oscillate until he had replaced several resistors and capacitors that were out of spec. The output of the BFO is injected into the I.F. amplifier via a gimmick (twisted wire) capacitor that's hard to find.

Leonard had sent the radio's original speaker out for re-coning. When it came back with the voice coil jammed and useless, he substituted another speaker, which was quickly ruined by the heat buildup inside the cabinet. Now Leonard operates the radio using an external speaker. Perhaps the newer speaker had parts made of plastic or other heat-susceptible material not present in the older one. Incidentally, the speaker in our project radio is a nice-looking little Jensen unit that seems to test perfectly. Leonard also notes that anyone wishing to see a schematic for the 430 can find it at www.nostalgiaair.org.

❖ A.C.-D.C.s for Farm and City

From time to time I receive an information-packed letter from a very knowledgeable fellow who doesn't identify himself. Last time I printed something of his, I decided he needed a name, so I called him Sam. I guess he thought that was OK because I recently received a letter from him signed that way. This one deals with some subtle differences between A.C.-D.C. radios designed to run on 120-volt battery systems as used on farms prior to rural electrification and those designed to run from A.C. or D.C. mains. The differences involve the design of the filtering system and they are based on the fact that the voltage supplied by the mains is very stable around a nominal 120 volts while that from the battery banks would range from 120 to 140 volts depending on the state of charge.

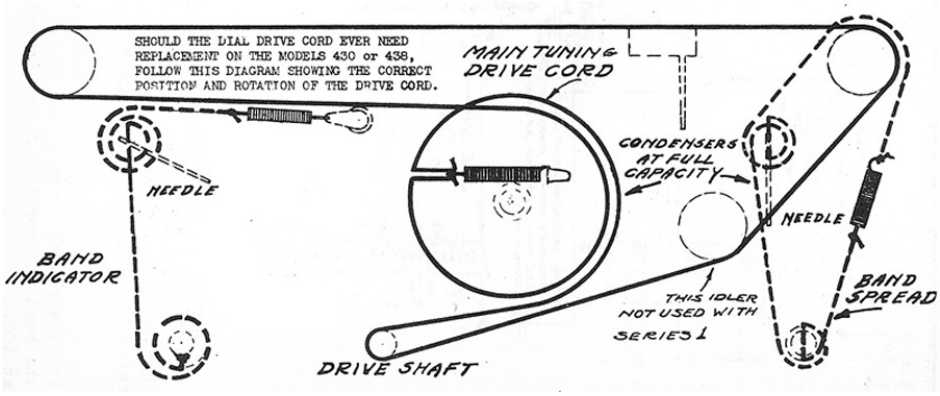
A farm family with a 120-volt battery system would not need an A.C. radio for their immediate needs, but they might want that capability for the future, when the rural electrification power line came through. So, they would typically shop for an A.C.-D.C. radio. The power supply filter in a radio sold for that purpose was typically an R/C design (using a resistor and a pair of capacitors) rather than an L/C design (using a choke and a pair of capacitors).

Though the R/C configuration was cheaper, that was not the reason for choosing it. The reason was that a significant voltage drop would appear across a resistor as D.C. current flowed through it (but not across a choke). This characteristic would prevent the voltage in the radio's circuits from becoming too high when the batteries were fully charged.

The motivation for buying an A.C.-D.C. radio in the city was different from that in the rural areas. While it was true that a few of the older downtown areas were served with D.C., most everyone had A.C. service. The main reason for buying an A.C.-D.C. set was economy. These sets were economical because they had no power transformers, a feature that had the side effect of making D.C. operation possible.

The inexpensive table model A.C.-D.C. sets sold in the cities at first used dynamic speakers (speakers in which the necessary magnetic field was generated by a field coil). Since the field coil doubled as a power supply filter choke, such radios, of necessity, had L/C filters. Even though these radios would run off a farm battery system, their use would be inappropriate because there would be no limiting action to protect against the higher voltage developed by fully charged batteries.

The later A.C.-D.C. sets sold for urban use had PM (permanent magnet) speakers. There was no need for an electrically-energized field coil. Hence the power supply filters in such sets tended to be the less expensive R/C type. These sets could be operated from battery bank systems, though that was not their intended purpose. From then on, the use of L/C filters would be limited to the more elaborate and costly A.C.-only sets.



Dial cord stringing diagram for the Howard 430.

ANTENNA TOPICS

BUYING, BUILDING AND UNDERSTANDING ANTENNAS

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TV Accessories you can use with your Scanner or SWL Receiver

This month I am going to hop between topics enough that I might get accused of having Attention Deficit Disorder, but there is a central theme: using television and satellite TV accessories with scanners and shortwave radios.

❖ Coax Cables

Have you ever seen the case where a little bit of knowledge was working against you? The impedance of coax cable is one of those places where a little bit of knowledge can take you down the wrong track. Here we have a table of many of the common types of coax and their loss in the 450-470 MHz Public Service Band.

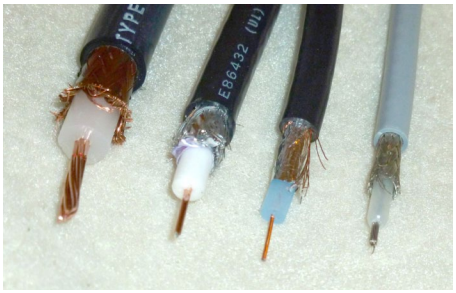


Figure 1: Loss with common coax types in the 450-470 MHz Public Service band.

Length (in Feet)	25	50	100	
RG58	3.2	6.3	12.5 dB	50 Ohm
RG59	1.9	3.8	7.5 dB	75 Ohm
RG6	1.5	2.8	5.5 dB	75 Ohm
RG8	1.2	2.3	4.5 dB	50 Ohm

In Figure 1 we show where a length of 75 Ohm coax cable has been placed between two 50 Ohm systems. For those of you who understand about odd quarter-wave sections, let's just say that the 75 Ohm line is long enough that its losses smooth out the quarter wave reflections and this is no longer an issue.

The two impedance changes have .2 dB of loss each. So, this section of 75 Ohm coax introduces an extra .4 dB of loss. Well, let's say you want mount a scanner antenna 25 feet way; there would be 3.2 dB of coax loss if you use RG58 but only 1.5 + .4 or 1.9 dB loss with RG6. For a 50 foot coax drop that would be 6.3 dB loss for RG58 but only 2.8 + .4 or 3.2 dB loss for RG6.

Now you have a use for that length of RG6 from an old cable-TV run, or the down lead from a satellite dish. It's great stuff! And, don't be afraid of the different impedance. For SWL systems, the coax impedance means almost nothing; it's another great place for that surplus TV or satellite-TV coax.

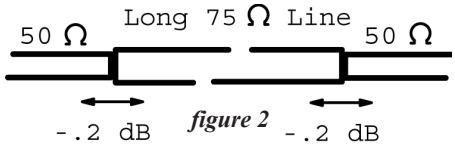


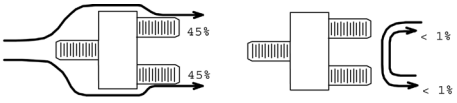
figure 2

❖ Splitters

Ever want to connect two scanners to one antenna, or maybe three or four scanners to one antenna? The simple splitters in the photo below work very well over the common bands covered by most scanners. These have several important advantages over a simple T-connection.

First, they maintain the impedance of the RF path. Two radios in parallel will not look like two resistors in parallel. Next, you have isolation between the two output connections. Most scanners have lots of RF oscillators with more than their share of spurs and images. These tend to show up as channels with a weak carrier, or "birdie," that never does anything. Put two scanners on the same antenna, and the number of birdies increase dramatically. The scanners are sharing oscillators. The output-to-output isolation of a splitter really helps to reduce these birdies giving you fewer stops on those band scans. Figure 2 shows that the two ports, or outputs, are isolated.

Now for the good news, these splitters are designed for use between 50 MHz and 800 MHz, but they work outside the TV band; you just lose the output-A-to-output-B isolation.



The other good news is that they really have no impedance. The circuit is a simple hybrid transformer. They work equally well in 50 or 75 Ohm systems. Don't like the F-connectors? Just pry the back off, unsolder the transformer and mount the transformer in the box of your choice. Try not to change the length of the wire leads off the transformer. The inductance of the longer leads is part of their impedance matching. The last bit of good news is that the splitters from the 'dollar' stores work just as well as the more expensive versions. It's the same transformer, just cheaper packaging.

❖ In-Line Amplifiers

Here is another TV product, in the photo below, that makes a great addition to your monitoring station. Again, designed to work from 50 to 800 MHz, most of the ones I have tested worked below 30 MHz, some down to 10 MHz. Except for one that was labeled to use below 450 MHz, they were all working at 900 MHz and some up to 1300 MHz.

Here is where you need to be careful with in-line amps. The amps are powered by sending DC voltage up the coax, that is, the voltage on the back of the amp shows up on the input of the amp. Note the 'DC Block' on the input of that first amp, this is a series capacitor that blocks the DC current, but lets the RF signals pass right though.

There are lots of advantages to putting the amplifier near the antenna. The gain of the amplifier overcomes much of the coax loss and improves reception on weak signals, especially in the 450 MHz and 800 MHz bands. The biggest disadvantage is that you will need to waterproof the connections if your antenna is mounted outside. For the record, most of my monitoring antennas are inside my attic. Yeah, they would work better outside, but they last a lot longer when they are inside!

Distribution amplifiers usually contain an amplifier that amplifies the signal about ten times. Then, using the hybrid transformers or splitters that we've just been talking about, the signals

are divided into two, four, or sometimes more outputs. It's another great way to connect your scanner antenna to several radios and they have their own 120 VAC power supply.

❖ A-B Switches

RF switches can be quite expensive, but again some pretty good ones are available at the 'dollar' stores. Now, you can switch two radios back and forth to the same antenna, or have several choices of which antenna to use with one radio.

This choice for antennas is especially handy for shortwave listening. With different wavelengths, propagation and noise sources, you can never be truly sure which antenna is going to have the best signal. At one point I had four antennas going to my Icom R71 and could switch around to the one that was hearing stations the best.

❖ FM TRAPS

Small notch filters like the ones in the photo below can be handier than you might think at first. Up until a few years ago, if you put a broadband antenna in the air, about half of the energy it picked up was coming from TV channels and about half were in the FM broadcast band. Many FM stations run just about as much power as an analog TV station, and in most areas there are about an equal number of FM and TV stations. With the switch to digital TV (DTV) most TV stations now run much less power. So that discone or log-periodic scanner antenna is now getting 80 to 90 percent of its RF energy from the FM broadcast band.

If your scanner or broadband radio is having overload problems, odds are that the intermodulation is from an FM station. It's amazing how many problems one of these filters can eliminate. Do you ever listen to a favorite FM station on your scanner? I know I often do. Even with the FM trap taking out 99.9% of the signal, the local FM stations still come through just fine, they are strong!

These FM traps are also very helpful with most DTV tuners, especially the $40 converters; they are wide open, that is, no filtering. During the analog-to-digital change-over each analog station was given a second channel, usually in the UHF band, and the stations ran two transmitters. Sometimes when they went all digital they moved the transmitter back to their original channel assignment, sometimes they didn't. The TVs are programmed to show the original channel number despite what channel is actually being used.

Technically, here is the problem: The second harmonic of FM Broadcast band, 88-108 MHz, falls right over the VHF-High TV Channels. TV Channels 7-13 use 172-216 MHz. Now the harmonics generated in those poor DTV RF tuners fall across the VHF-high stations and you have poor reception, if any. I have even seen this overload in extremely strong signal areas take out UHF DTV channels. If you watch DTV on an antenna, you might try an FM notch filter and a re-scan. It might be interesting to see how many new channels you pick up.

As always your questions make great fodder for future columns. A family of easy to build L-band antennas for listening to aircraft transponders is nearly finished and a column on explaining what those 'dBi' numbers on antennas advertisements really mean is in the works. I welcome most any electronics questions; just drop an email to *kentbritain@monitoringtimes.com* with your antenna or radio questions.

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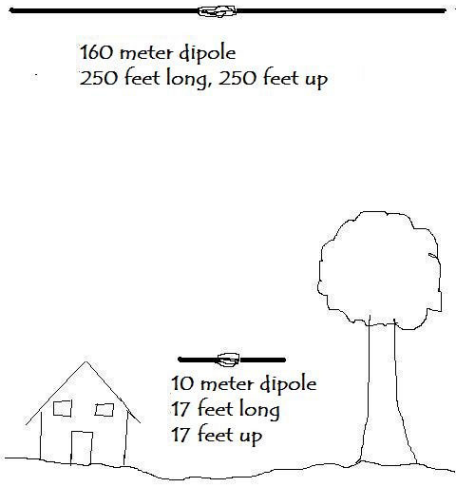
Size Matters: Antennas for 10 and 6 Meters

Welcome back, my friends. I've written many times about the challenges involved in constructing, erecting and operating antennas for the various HF bands. One obvious and consistent theme runs through all of this; the lower the frequency you want to operate at, the longer a half-wave becomes! This presents real obstacles to the person who would like to use, say, a full-sized dipole for 160 meters. Sounds great, but it would need to be over 250 feet long, and 250 feet above the ground, to garner the true function of a dipole.

A quarter-wave vertical for this band is a daunting engineering feat as well; one hundred and thirty feet of vertical radiator, as well as a great number of ground radials. Most of us, unless we are very lucky, do not have the real estate, the wherewithal, the luck with low-flying objects, or the spousal permission to put up truly full-sized antennas for top band. They're simply too huge.

On the other hand, a full-sized dipole for ten meters is only about 16 feet, 8 inches long, and need only be at least that high above ground, to produce the true effects of the dipole that all the textbooks tell us about. At six meters, it gets even more compact; about 9 feet, 4 inches will get you there, in dipole length and height above ground. And, if we consider an orthodox quarter-wave vertical for use on one of these two bands, the ten meter version is only about 8 foot, 4 inches and the six meter version only about 4 foot, 8 inches high! These are much more attainable dimensions for most of us, even given severe space limitations or the ever-insidious Antenna Gestapo. Since the sunspots have been steadily improving, sort of, it seems like a good time to think about the small and effective full-sized antennas we can use on these bands.



The drastic difference in altitude and real estate for 160 and 10 meter dipoles. (Drawing by author)

The Ubiquitous Dipole

As I alluded to, the length and height requirements for a full-sized dipole become ridiculously easy to attain on these two bands. This allows for a great deal of flexibility in design, construction and location. At less than 17 feet long, the 10 meter dipole will fit in just about any attic, or on just about any roof. A vertical dipole can easily be installed between the roof peak and ground at the rear end of even a one-story house. A rotatable version, made typically of one-half inch thin-wall conduit, is small enough to mount to, say, a chimney, and be turned with a small rotor.

At least one enterprising soul has made a fine 10 meter dipole by taping strips of aluminum foil to a large plate-glass window. Of course, all this applies even more to 6 meter dipoles, since they are only a bit over nine feet long. A big bonus is that we need to get these dipoles only 17 (or nine and a half) feet above ground to realize the full benefit of the dipole's directivity.

Contrast this with the average homeowner who, even if lucky enough to have the room to put up a full-sized dipole for one of the lower bands, faces real difficulty in installing it a half-wave above ground. These small dimensions for full-sized antennas and their height, makes 10 and 6 meters natural territory for stealth operation as well. And, as an added bonus, if you have a big dipole fed with ladder line like I do (mine is 100 feet long), tremendous gain and directivity are achieved on these two highest-frequency bands. Now, if I just had a way to rotate the big dipole...

It goes almost without saying that all of the dipole's descendants, such as folded dipoles, Yagis, quads and so forth, are also of much more workable size at 10 and 6 meters compared to those for lower frequencies. Thus they, too, are easier to construct, erect, and if necessary, conceal.

Fine Upstanding Verticals

Verticals for these two bands are similarly easier to build and install since they are much more compact. At 8 feet, 4 inches for the 10 meter vertical, and 4feet, 8 inches for 6 meters, plus radials of like length, one of these mighty midgets can be hidden in plain sight almost anywhere. These lengths are manageable enough that elements can be made from one-half inch thin-wall conduit without being overly heavy, if you're like me and consider aluminum tubing a luxury.

KK4BCV's elegant J-pole vertical for 6 meters is just 16 feet tall. (Photo courtesy hamuniverse.com)

Another quick route to success here is the well-known fact that Citizen's Band base station verticals are easily shortened to resonate on 10 meters. And, due to the compact nature of these higher-frequency verticals, lengths with real gain, say 5/8 wave or 3/4 wave, are much easier to deal with on these bands than they would be on the lower frequencies.

One of the popular broadband discone antennas, touted to cover 25-1300MHz. Ten and six, anyone? (Photo courtesy mfjenterprises.com)

Let's see, a 5/8 wave vertical for 160 meters would be 325 feet tall. Brutal! Yet, on 10 meters, a 5/8 wave is only a bit over 20 feet tall. Even the J-pole vertical, so popular on 144 and 432 MHz, is still doable at 6 and even 10 meters for the enterprising builder. I wouldn't recommend trying to build a J-pole vertical for 160 meters, though, since you will go broke buying enough length of strong enough copper tubing, and will still be faced with the engineering

nightmare of actually supporting the monster in a vertical position; not to mention the blinking red lights it'll need to ward off low-flying aircraft!

❖ Other Life Forms

Finally, the fact that antennas for these two bands are compact enough to work with enables us to build some things that would not be at all feasible for lower frequencies. For example, a full-wave loop is small enough at 28 or 50 MHz to build it as a rigid device made of copper or aluminum tubing, as well as being easy to build from wire in the conventional way. A big bonus of this small loop is that it is fairly simple to orient horizontally or vertically, allowing the operator to easily change to vertical polarization to work the local repeaters and fellow hams on FM, or back to horizontal polarization to do weak-signal work on CW, SSB, and digital modes.

The rectangular loop for ten meters even has some gain, around 2 dB, if mounted at least 30 feet (a full wavelength) above ground. Those who would like to try something really different should look to the discone antenna, so popular for its very broadband response (typically 25-1300 MHz). Here again, the compactness of the antenna at these higher frequencies makes it entirely feasible in a way that, for example, a 160 meter discone will never be.

❖ Onward!

In conclusion, these two highest "HF" bands (yes, I know, 6 meters is technically VHF) are much easier to build full-sized antennas for. It's worth thinking about for several reasons; the stealth operator finds these full-sized "shorties" actually concealable, and the DXer or casual operator will be thrilled by the amazing openings on these two bands. Some of the most fun I have had as a ham has been working great DX on 10 when the band was open, and trying to collect all 50 states on 6 meters when it was open. Next month, we'll look into actual construction details for an antenna that will get you into this exciting end of the HF spectrum.

DXtreme Reception Log

By Loyd Van Horn W4LVH (Graphics courtesy author)

Like so many of you, when I first began making my way into the world of DX, the most important part of my shack, next to the radio and antennas of course, was my trusty logbook. This station-by-station journal, chronicling each moment in time when a bit of DX was captured, has always reserved a special place on my DX station bookshelf.

Since I first put pen to paper with my first DX catch, everything has changed thanks to the Internet. We went from dial-up modems to high-speed wireless broadband in nearly the blink of an eye. There is more information at a DXers' disposal than ever before and no source has seen a bigger transformation than the logbook.

Now, computerized logbooks are nothing new as they have been around for years. From basic spreadsheets to fancy databases, DXers have been entering their catches with a keyboard for decades. However, thanks to the Internet, this generation of logbooks come with more features, customization and enhancements than my spiral-notebook logbook could ever even dream of. One such logbook is DXtreme Reception Log and it is a doozy.

❖ Out of the Box

You can order this program to be delivered to you in a CD, but I chose the download method. Once you purchase the software ($90 U.S. for new customers to download, a little bit more for CD by mail, less for upgrades from previous versions), they'll send you an email with the download link and instructions within a few hours. The download didn't take a long time with my Internet connection, but there is a chart that shows typical download times for the 54 MB file to download, so you can estimate the time for your connection.

Installation was pretty easy and standard. This is a Windows-based program for XP users or higher. No Macintosh version is available at this time.

The overall user interface is pretty simple. There is a menu of options at the top of the screen that allows you to either access information or setup the program to your preferences. Anyone with any experience using Windows-based programs, especially DX-related programs such as DX Atlas, should have no problem getting adjusted to the interface. The interface for logging catches is extremely intuitive.

How you interact with DXtreme Reception Log is really going to depend a lot on what you are logging. During my testing, I have been using it to log AM, FM, shortwave and amateur radio DX just to get a sense of what the program can offer for each of these. I found certain features are more useful for certain types of logging than others. The biggest factor in how much you get out of DXtreme is in what you put into customizing it.

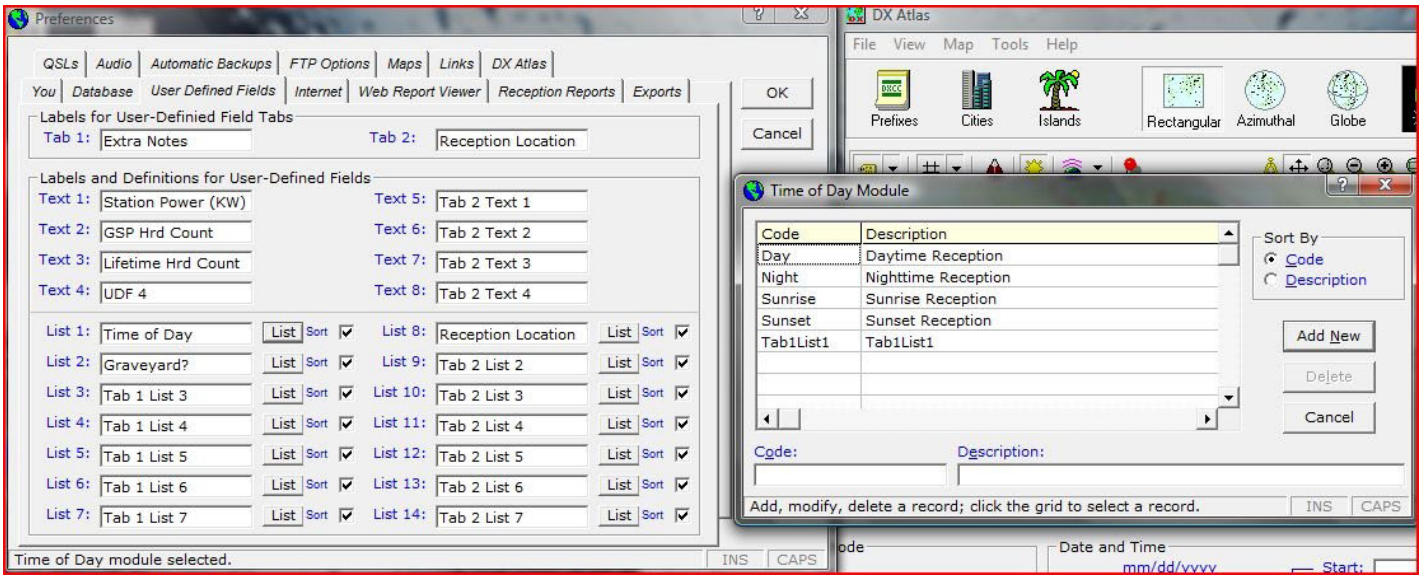
Before I begin the performance test, there is a matter of getting setup. To begin with, I went to Tools>Preferences (or you can hit the 'F6' hotkey) and did a basic setup. This included entering my name, address, email address, and basic contact information. From there, you can go through each of the tabs and customize how you will be interacting with DXtreme and how it will report information to you. One example is that for AM DX, I turned off tracking CQ zones. Obviously, when I am tracking my ham radio contacts, this feature will be turned back on.

My absolute favorite part of DXtreme is the user-defined fields. I like to get very granular with the statistics that I track in regards to my DX. I don't want to know just how many stations I have heard from one state or on one frequency, but how many daytime versus nighttime, how many during sunrise or sunset periods, where I was when I heard it (for separating my lifetime contacts), what the transmitter power was during reception, etc. These are all fields that I was able to do with the user-defined fields' setup.

So, for an example, under the user-defined fields 'tab 1' I have setup a pick-list for 'time of day.' From here, I have created options called daytime, nighttime, sunrise and sunset. Whenever I log a new station, I not only enter my time on the main logging page, but also the time of day the station was logged. This will come in very handy when we discuss reports later.

Before you begin using DXtreme, take a look at the information you are currently tracking with your current logbook and see if you have any user-defined fields you need to create. The process is very easy and well-documented and explained in the 'Information Center' accessible through the 'Help' menu.

In addition to the user-defined fields, the other very important setup step you will want to take can be found under the 'modules' menu. Here, you will set up things like what rig and antennas you are using, you can set up the various



classes of logs you will be creating (BCB, FM, TV, ham radio, pirate radio, Utes, etc...).

One note here, I found that when setting up most of these 'modules,' you are able to define one of the options in a given module to be the "default." As such, I have set a default rig, antenna, class and a few others. By setting a default, this doesn't mean you can't change the selection if need be, it just automatically populates that option in your logbook entry, if that is the option that will be used the most.

Not all modules can have a default option, though. One of the more surprising (and a bit irritating during my testing) was the country module. As an AM DXer, I am most likely going to be logging primarily stations in my own country, which in this case is the United States. Having to enter that the station is in the United States every time I log an AM station became a bit tedious after a lengthy DX session. There are other fields that would be nice to be able to select a 'default' entry for, and will bring those up in the testing phase below.

My main mode of operation for this test is going to be AM DX. This is because the same approach for entering and tracking information you use for AM DX can be applied to most other modes as well. For the purposes of this review, I'm testing the DXtreme Reception Log - Advanced Edition version 7.0, but there is also the DXtreme Station Log - Multimedia Edition that is more ham-radio centered.

❖ Performance Test

I turned on my ICOM R-72 and began my session. DXtreme Reception Log - Advanced Edition is able to do a moderate bit of rig control by integrating with Omni-Rig and Ham Radio Deluxe (version 5 or higher) if you have a rig interface. As such, fields like frequency and mode can automatically populate into your log entry from your receiver or transceiver. I am not currently running any interface between the ICOM and my computer, so I was unable to test this feature.

As I went through the AM broadcast band, logging new stations, I did a side-by-side comparison of entering the information into my old spiral logbook and typing it into DXtreme. I wanted to get a feel for how easy entering information was into the program. My guess was that my handwritten log would be considerably easier. I was actually pretty surprised.

For instance: one of the stations I logged was WWWC - 1240 kHz in Wilkesboro, North Carolina. Once I turned to the frequency and was waiting to hear station ID, I started entering information such as country (still would like to see this be a field that can have a 'default' setting), day, time, time of day, reception location and my comments (yes, there is a large comments field on a separate tab. Outstanding!) By the time I heard the station slogan and call letters, all I had to do was complete my notes and add the ending time.

Entering the information was no more cumbersome than my handwritten log. On the contrary, it was easier, I don't have to later decipher my nearly unintelligible handwriting, and I have much more room to enter comments than my handwritten log has.

There are fields when entering logs for signal quality, remarks (I have used this to great success for things like "fighting with co-channel splatter from....").

One of the cooler features, at least in potential, is the ability of the log to tell you the distance of the logged station from your location. As an AM DXer, though, I found this feature not nearly as user-friendly to take advantage of. The distance is calculated by what is entered in the 'transmitter site' field, which is where the 'city' would go for AM DXers. It only calculates the actual distance if the transmitter site you are entering is added to the available pick list in the 'modules' menu. So, my Wilkesboro catch doesn't have a distance without adding it manually, but Nashville, Tennessee, for example, comes with the program as a stock site, so a station logged there does show the distance.

This doesn't make it difficult to enter information; it just feels like a great feature that I would love to take advantage of, if I had more time to enter every city I log into the module as well.

Some of the other features I found interesting and even quite usable were the reception report builder and verification tab (to track verified stations), the QSL imager (get a QSL back? Scan it and keep an image of it in your logbook!), and the mapping interfaces (for tracking things like CQ Zones, grid squares and DXCC entities for ham radio logging. There is also a handy solar propagation interface, for space weather information including solar flux, A-index and K-index values, directly from the logbook. Here is a tip: to close the window that opens with this information, just hit your "ESC" key.

Overall, the work flow for entering and tracking information is quite easy and accessible to even the most computer-befuddled individual. If you just need the basics, DXtreme will pass that test with flying colors. If you are the type of DXer, though, that needs more enhancements, DXtreme has plenty here to keep you happy and your mouse and keyboard busy.

As I mentioned earlier, I am a report junkie. I used to sit for hours, counting manually every contact on a hand-drawn chart that showed every statistical category I wanted to track. DXtreme takes care of that for me!

There is a robust reporting package in DXtreme. In a matter of seconds, I can run exportable reports that will show me performance and data from any field that can be tracked in my log entries. I can tell you how many graveyard stations I have logged on 1230 kHz from the state of Georgia. I can tell you how many sunset DX stations I have logged on 1580 kHz during the month of October. If you have entered it into your log, the report package has a way to manipulate the data to show you just about anything you want.

For amateur radio operators, DXtreme has a wealth of features. In addition to your maps, you can track your various modes including all of your digital modes and detailed statistics for whatever band you want to track information in.

❖ The Final Word

There are a ton of features in this program, more than I have the space to discuss here. From an ease of operation standpoint, from the plethora of customization options and features available, not to mention the sheer amount of reporting and data crunching you can do once your DX session is complete, I highly recommend DXtreme to anyone who is ready to make that leap into the 21st Century. Maybe you are already using a computer logbook and you are just looking for a more reliable and robust option. Definitely give DXtreme a try.

There is still room for improvement, despite the overwhelming positives. The option to set more fields as a 'default' would be great, especially in the user-defined fields. An easier way to have the transmitter site/city distance accurately calculated would be really nice to see. Another thing I didn't mention earlier would be the ability to move fields within the log entry. As an example, it would be nice to be able to move the comments field to the main log entry, if that was preferable.

There is a tour of the advanced edition available on the DXtreme Web site. Do yourself a favor, check it out and see it for yourself. I am so glad I have added DXtreme Reception Log to my arsenal of tools in my DX shack, now if I could just find time to DX a little more!

MT RATING: 4 1/2 STARS

Quality – 5 out of 5 stars - This thing appears bullet-proof. No lock-ups or error messages during use so far.

Performance – 4 out of 5 stars – Lots of customization options, but the things you can't customize stick out. Entering logs is just as easy as a handwritten log, if not more so.

Features – 5 out of 5 stars – Reports, rig control, information on solar conditions, customization just about everywhere. Not much lacking in this department.

Design/Appearance – 4 out of 5 stars – It is a log book, not much you can do here to make it pretty. But it is well laid out and the various places you would need to access are easily found and easy to interact with.

Overall – 4.5 out of 5 stars – I will put it this way, I am finally ready to turn in my old trusty notebook log for a copy of DXtreme. After nearly 25 years of DXing, I can't believe I am actually saying that. That is how great this program really is.

Available: **www.dxtreme.com**

$89.95 for the download for new users, $93.95 for North American mail delivery of the new users CD, $97.95 for the new user CD delivered outside of North America.

GLOBALNET

Exploring the World of Internet Radio and Television

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All Hail the Internet, Savior of DX (Wait, What?!)

There truly has never been a better time to be a DXer than right now.

No, I am not talking about there being some elusive country or station that is suddenly available, or some formerly difficult station that is now easier to obtain a QSL for. I am talking about the Internet.

Now wait, isn't the Internet the thing that is supposed to kill DX?

Depending on your point of view and interests, DX actually is going through a bit of a renaissance thanks to the power of the Internet. In this column I am going to show you how the Internet has become a valuable DX tool, venue for instant sharing of information and of course, streaming is leading the charge.

❖ Is there an echo in here?

I recently found myself back behind the dials of my AM DX station for the first time in nearly four years. The Internet was around back then, but I didn't have a wireless network or broadband connection to have instant-on access to the 'net to use as a DX-aid.

I quickly realized the usefulness of the Internet in my DX while listening to a heavily propagating signal on 1580 kHz. I was only hearing snippets of programming, but a few items that came through quite clearly was that I was hearing a high school football broadcast and the two teams were the Greyhounds and the Cavaliers. I turned to my laptop and after a quick Google search, found that these were two teams located in Pascagoula, Mississippi that were indeed playing each other that night.

I then compared this information to my trusty copy of the *NRC Log* and confirmed there was still a station, WPMO, in Pascagoula-Moss Point, Mississippi. I went to that station's Web site and listened to their live stream. There, I heard the same announcers and content I had already heard live on the radio, as the stream was on a slight delay from the broadcast signal. Not long after that, the station faded into oblivion. However, thanks to some Google investigation tactics and cross-checking with a station's streaming broadcast, I was able to ID a station that 20 years ago would have never made it to my logbook.

Experienced DXers are likely cringing right now at the thought of logging a station without hearing the actual ID over the radio. There are things to be careful of, for example, network programming. Just because I hear a coast-to-coast AM station and check a station's stream, that doesn't mean that confirms this to be the station I am hearing. You want to make sure that you are cross-checking as much local content as you can.

On that point, stations are supposed to pull their local terrestrial broadcast commercial inventory from being heard on the stream, often using stream-specific ads or public service announcements. So if you try to cheat and use the stream to write your reception report, it is going to be obvious to the station and you probably aren't going to get a QSL back.

The best times to be comparing notes are around the top of the hour; bottom half of the hour and around the quarter-hour ad-break slots. Mornings and after-noon drive time usually have more local content such as live newscasts, weather and local ads. These are fantastic times to be using the stream to help ID a station.

Here's a further tip. I have found many stations that, believe it or not, don't have a stream online. Most of these are smaller stations in more rural areas. So you won't always be able to compare to the stream, and when you do the advertising content might be different. But with some practice and patience, stream-to-broadcast comparing is a huge DX tool to have in your arsenal.

A simple Google search of the station call letters you are checking out should suffice, but it might not be a bad idea to have some of your streaming resources bookmarked. I would recommend TuneIn, Reciva and iHeartRadio as definite requirements here.

I am not just talking to AM broadcast DXers either. These tips and sources will help you not only with American AM stations, but shortwave and international AM and FM stations too.

❖ Map that Pattern

Another highly useful tool that I have used for many of my loggings is the website Radio Locator. This site has pretty useful information on each station licensed by the FCC, from address and transmitter power (with breakdowns for daytime, nighttime, Pre-Sunrise Authority and Critical Hours included) to the extremely useful daytime and nighttime antenna pattern maps.

Trying to track down a specific state or station? A quick check of the pattern map will help identify nulls and lobes that will let you identify the times that you should be tuning in to try to hear them.

Non-AM DXers, don't feel left out. Radio Locator has a "Find World Radio" link as well, that while it might not have the level of detail as the American stations, should at least provide links to Web sites and general information.

❖ The Web-Connected Logbook

I don't care how advanced your spiral notebook log is or how detailed it allows you to be, it will never connect to your home network. Why does that matter? Earlier in this issue of *MT*, I reviewed the DXtreme Advanced Edition logbook software. It reminded me how fantastic net-connected logbooks can be. You can instantly access solar propagation conditions, station location information and ham radio operators can download instant data on the station they are contacting.

Ham radio operators will find instant uploads for eQSL and Logbook of the World as well. You could have that station you just worked verified pretty quickly, thanks to the power of the Internet! Sure beats sending out tons of postage in the hopes of maybe getting a card back in the mail.

When you add the reporting capabilities of most net-connected logbook programs, they help you not only during your DX session, but long after you turn the power off of your radio.

❖ All Together Now...

Finally, there are forums, user groups, email distribution lists and other online tools for DXers to share information. As a member of the National Radio Club, I have signed up for a DX alerts service. With this, AM DXers can send hot tips to each other such as normally dominant clear channel radio stations being off-air or not being heard from a certain location or DX tests. I will routinely post news to Twitter with the hashtag #MWDX, there are blogs, Facebook pages, you name it. The Internet has it out there for you if you just go try to find it.

Overall, the Internet is not a big, scary monster that is going to devour DX in its wake. It is a handy tool that you can use to log more DX and get more QSLs than ever before!

GLOBALNET LINK

TuneIn - **http://tunein.com/**
Reciva - **www.reciva.com/**
Radio Locator - **http://radio-locator.com/**
National Radio Club (DX Tips Email list) - **http://nrcdxas.org/**
iHeartRadio - **www.iheart.com/**

What's NEW

Tell them you saw it in Monitoring Times

Larry Van Horn, New Products Editor

Icom Showcases Two New Radios at the Tokyo Ham Fair

Icom Inc., parent company to Icom America Inc., announced the new ID-51A Dual Band D-STAR (Digital Smart Technologies for Amateur Radio) portable at the annual Tokyo Ham Fair. The ID-51A evolved from Icom's popular ID-31A D-STAR portable and comes with new features including: dual watch, 500 extra memory channels (for a total of 1,752 channels), automatic position reply, known as "DV-mode," repeater search functions and AM/FM receivers.

This new VHF/UHF dual band transceiver is based on Icom's celebrated ID-31A D-STAR handheld radio and retains key features such as DV-mode operation, built-in GPS, IPX7 standard (submersible in water up to one meter in depth for as long as 30 minutes), and Micro SD card accessibility. The ID-51A is slightly taller than the ID-31A to accommodate a larger, full dot matrix screen. Similar to the ID-31A, a simple directional keypad takes the user through various menu settings and functions, including one-touch access to radio features such as a preloaded D-STAR repeater directory.

The VHF/UHF ID-51A offers extended coverage and some very interesting features. The 144/430 MHz dual band transceiver can receive two bands simultaneously: VHF/VHF, UHF/UHF, or VHF/UHF. Additionally, the radio's independent AM/FM receiver can receive broadcast stations concurrently with the dual watch function.

The ID-51A handheld generates 5W of RF output power on both VHF and UHF bands, with five power level settings (5, 2.5, 1, 0.5, and 0.1 Watts). A voice synthesizer function announces frequency, mode, and call sign, ideal for blind or sight-impaired amateurs. Additional features include transmit voice memory (one channel, 60 seconds) for repeated calls, CSV formatted communication log, and a 10-step battery voltage indicator.

The company also showcased at the Ham Fair the new IC-7100, a multi-band, all mode, mobile transceiver with a user-focused interface.

"Icom changed the way the amateur radio enthusiasts thought about mobile communications with the introduction of the IC-706 nearly two decades ago," says Ray Novak, Icom America Division Manager for amateur and receiver products.

"Based on the requests from mobile HF operators and other amateur enthusiasts, we are proud to announce a new mobile radio with an enhanced user interface and 'big rig' features robust enough for home use," Novak said.

A state-of-the-art, touch screen interface combined with multi-band, full-mode operation makes the IC-7100 the complete amateur radio for mobile and digital enthusiasts alike.

The IC-7100's touch screen interface is an amateur radio first, providing intuitive access to various settings and functions. By simply tapping on certain parts of the large, dot matrix LCD, users can select operating mode, view multi-function meter information, and enter data through an on-screen, ten-key keyboard. The slant top controller display increases usability at various viewing angles, a feature ideal for mobile use. With a high efficiency oval speaker built directly into the controller, audio is heard loud and clear.

The thoroughly re-designed IC-7100 mobile radio powers HF/6m/VHF/UHF bands (The radio also supports the 70 MHz band for use in Europe, but is currently unavailable in the U.S.) A true full-mode transceiver, the IC-7100 mobile offers SSB, CW, AM, FM, and RTTY decode. No additional digital component is required for DV mode as D-STAR comes standard with every IC-7100 unit.

While pricing and a release date for both of these radios were not available at press time, you may check Icom America's website periodically for product updates on the IC-7100 at **www.icomamerica.com/amateur**.

DX Engineering's New Telescoping Fiberglass Tubing Kit

DX Engineering's new FTK50 telescoping fiberglass tubing kits are constructed from seven pieces of high-quality, smoothly telescoping fiberglass tubing that tapers from 2.0 to 0.5 inches OD. Each section of the extruded fiberglass tubing is 96 inches long and features a heavy-duty 1/8 inch thick wall. The lower six sections have slits for securing with compression clamps while the top section has no slits.

When fully assembled, the kit can reach up to 50 feet tall. Depending on your application, the length can be easily made shorter by telescoping the elements inward or removing element sections. The FTK50 can be used to make various vertical antennas or provide support for light-duty dipoles. It's the ideal starting point for home antenna projects, portable and emergency communications installations. The kits also include stainless steel band clamps to keep the telescoping poles properly secured in position. Priced at $138.00, you can get more information or order by visiting **www.dxengineering.com**.

New NRC AM Radio Log Released

The National Radio Club has announced the release of their 33rd annual edition of the *AM Radio Log*. The NRC's *AM Radio Log* is a source for information on AM radio stations in the United States and Canada. The new edition contains 274 pages of data, cross-references and 18 pages of instructions in a 8-1/2 inch by 11 inch size, three hole punched, loose leaf format that fits nicely in a three-ring one inch binder.

With over 6,000 updates since the previous edition was published September 2011, additional references include call letters of FM simulcasts with the AM station listings as well as listings of regional groups of stations in the groups section (this is a separate section of the log book), a cross-reference of those stations licensed to use IBOC (In Band On Channel, also known as HD-Radio) audio, and a comprehensive list of FM translators that are now simulcasting with AM broadcasters.

Pricing for this year's edition has increased due to the increasing costs of printing and postage. To order the *AM Radio Log* by credit card using PayPal visit **www.nrcdxas.org**. U.S. orders are shipped postpaid via USPS media rate. Overseas orders are shipped by USPS global priority mail. To order, and for more information, send correspondence to NRC Publications, P.O. Box 473251, Aurora, Colorado 80047-3251.

New Sangean Radios Released

Sangean WR-12

Elegant simplicity and state-of-the-art performance are the hallmarks of the new Sangean Model WR-12 AM/FM analog table top radio. This new Sangean model provides excellent reception with clear and static-free listening. The unit has only three dial knobs: volume, AM/FM band select and tuning knob. An LED tuning eye assures precise tuning for your selected station.

The WR-12 delivers its audio using a 2.1 channel system to a pair of stereo speakers and a subwoofer. This audio system is specially designed for better bass response characteristics. Bass and treble controls let you further adjust the sound to your liking.

Additional features include a stereo headphone jack, display dimmer and a provision for an external AM and FM antenna. An auxiliary input jack is also available for playing your favorite iPod/iPhone or MP3 tunes through the receiver. The radio is available in a light walnut colored, wood veneered cabinet with complementary metal speaker grill.

Sangean PR-D14

The PR-D14 is a true ultra-compact portable AM/FM-RDS (Radio Data System) digital radio. All controls are conveniently located and you can see the frequency and the clock on the display. It also features a tone control (talk and music) for more powerful overall sound. The PR-D14 has excellent sensitivity and selectivity which gives you the ability to pull in those distant stations.

Five presets are available on each band and the auto-seek will automatically look for active stations across the entire band rather than to the next frequency. The radio can be set to automatically turn off after 120, 90, 60, 45, 30, or 15 minutes, so you can fall asleep to the sound of music, talk, or news. A sleep alarm allows you to wake up to music, a buzzer with "humane wake-up system" or media by USB drive. You can power it with the included AC adapter, or four "D" size batteries (not included).

An easy-to-read LCD display shows you the station and the time. The segment-style LCD screen is backlit to be easy to see even across the room and for night viewing. The PR-D14 delivers sound to a three inch full-range stereo speaker and a headphone jack for private listening. You can connect external devices such as your iPod, iPhone, MP3 or CD player to the auxiliary input of this receiver and expanded connections include a USB port for playing MP3/WMA files from USB drives.

Sangean RCR-9

The Sangean RCR-9 AM/FM-RDS analog and digital tuning atomic clock radio is housed in a sleek design. It updates the time automatically from the U.S. Bureau of Standards in Boulder, Colorado, so you are assured of accurate and reliable time.

You can also listen to personal music from your MP3, iPod, iPhone or iPad through the auxiliary input jack. Additional features include

a sleep timer (15-120 minutes), snooze, dimmer, a dual time HWS (Humane Waking System) to gently ease you out of your slumber. It also features a headphone jack for private listening. The RCR-9 delivers sound to a 2.5 inch full range stereo speaker.

Sangean TB-100 Toughbox

Sangean's new compact-sized, utility worksite TB-100 Toughbox AM/FM digital PLL radio tuner includes some unique features, offers best-in class reception, is rain/dust/shock resistant, with superior sound quality of any radio in its class.

Some of the additional features in this radio include an auxiliary input jack to connect your external devices and rugged construction making this radio suitable for both in and outdoor work. This is a radio made for tradesmen who enjoy their music while at a job-site.

The Toughbox features a flexible pivoting antenna and digital AM/FM PLL tuner for better reception. Frequencies are displayed on a large backlit LCD display to ensure excellent visibility. The radio has durable ABS plastic construction.

In addition, the TB-100 can be powered with four rechargeable or alkaline "C" batteries. When the radio is plugged in via AC power, it will charge your rechargeable batteries.

The TB-100 also has five easy touch memory presets for each of your favorite AM / FM stations. The nine foot long rubber cable can quickly and easily rolled up on the back of the unit to avoid tripping over it while at a job-site.

WFR-28 Wi-Fi Internet / Portable Radio

Finally, Sangean has released a new, ultra-compact, portable Wi-Fi Internet radio,

the WFR-28. This new radio is a combination Internet radio and audio media streaming device that is fully portable. With it users can listen to 13,000+ radio stations from NPR, FOX news, CNN, BBC, CBS to KROQ, and over 35,000 podcast as well as to over-the-air FM Band with RDS (Radio Data System) capability.

Additional features include Frontier Silicon's IR 2.2 network audio software that provides the most complete and easy-to-use software available for the next generation Internet-connected audio systems. The WFR-28 delivers great sound and its bass and treble controls let you further adjust the sound to your liking. The radio has a built-in telescopic antenna for solid FM reception. You can connect external devices such as your iPod, iPhone, MP3 or CD player to the auxiliary input additional entertainment choices.

There is also an iSangean app that enables remote control of the WFR-28. iSangean is the remote control app for Sangean Internet radios and media streamers for your iPhone or iPod touch. The app allows selection of Internet radio stations, selection and control of media for UPnP/DLNA music streaming from a local computer, server or NAS device, as well as control of FM radio and other functions (where these functions are present on the radio). The "Now Playing" screen provides radio station or media information with direct control of the radio volume.

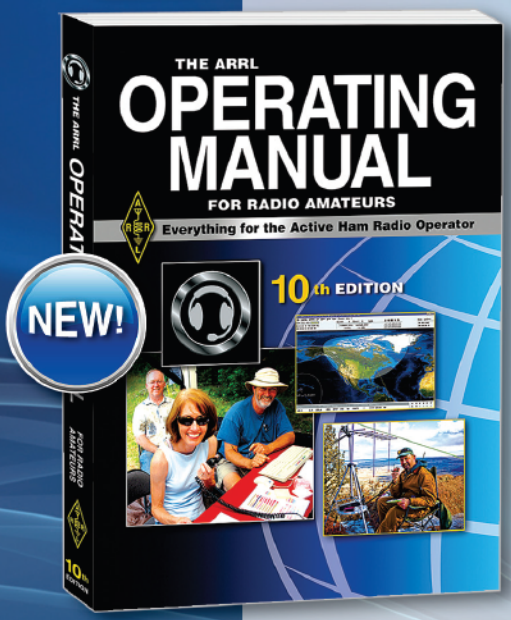
You can get more details on these new radios and other Sangean products on the Internet at the company website at **www.sangean.com**.

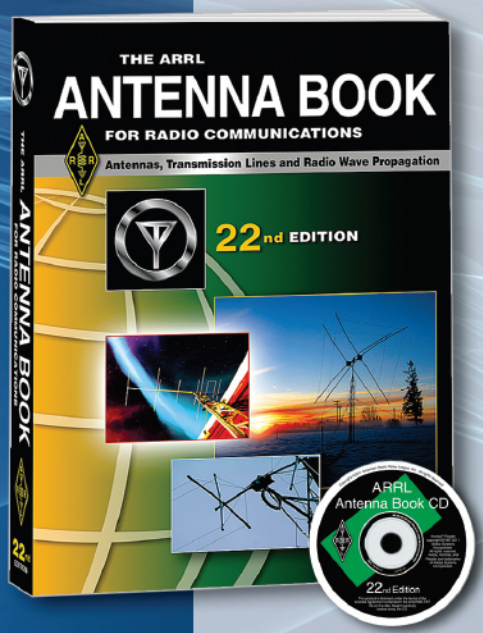
Finally . . .

We have heard as early as January of this year that GRE would be releasing a new base/mobile scanner known as the PSR-900. As of mid-September, when this is written, we still have not received confirmation or any details from GRE about this unit. Speculation over expected frequency range, features and price remain a mystery. Without FCC certification such a product cannot be offered for sale in the U.S. However, as soon as we receive some official word from GRE America, we will pass it along in this column.

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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*System Requirements: Windows® 7, Windows Vista®, or Windows® XP, as well as Macintosh® systems, using Adobe® Acrobat® Reader® software. The Acrobat Reader is a free download at www.adobe.com. PDF files are Linux readable. The ARRL Antenna Book utility programs are Windows® compatible, only. Some utilities have additional limitations and may not be compatible with 64-bit operating systems.

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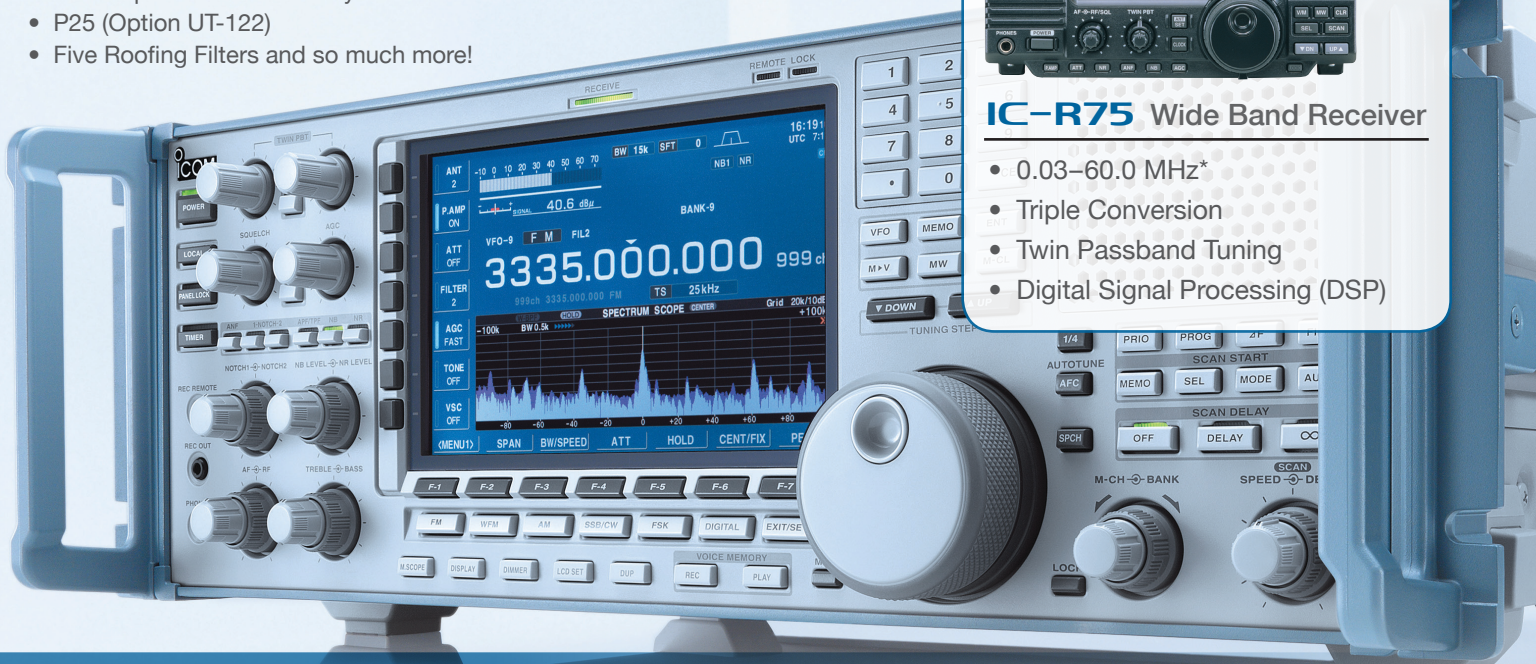

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