The Spectrum Monitor®

Amateur, Shortwave, AM/FM/TV, WiFi, Scanning, Satellites, Vintage Radio and More

Volume 4 Number 9 September 2017

Icom IC-R8600

All-Band All-Mode Receiver

Plus:

Marconi and Alexanderson

Milcom Monitoring Today

Inside a Top US Ham Club

The Spectrum Monitor®

Amateur, Shortwave, AM/FM/TV, WiFi, Scanning, Satellites, Vintage Radio and More

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Cover Story:
Icom ICR-8600 all-mode, all-band software defined receiver. (Courtesy: Icom America)

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Anonymous comments will not be published.

Comments, Advice, Kudos and Questions from Readers

A QSL Perspective from a Shortwave Programmer/Producer

"Thanks to Fred Waterer for his kind mention of From the Isle of Music and Uncle Bill's Melting Pot in 'The Shortwave Listener' column in the August 2017 issue. The support that Fred and *TSM* provide to shortwave programs by independent programmers is invaluable. I also enjoyed Rob Wagner's World of Shortwave Listening on 'The Use and Abuse of SINPO' in the same issue (it was an excellent technical explanation) and I have some comments from a programmer's perspective:

"1. It's true enough that both stations and programmers care more about whether people are actually listening to the programs than we do about the number of reception reports sent by people who are clearly jumping stations every five minutes. Rob made some excellent points here. But those quickie reports aren't completely useless—they do tell us whether it is worthwhile paying more attention to certain geographic areas as well as if we are failing to hit the target areas we are aiming at.

"And, as a listener since the 1960s, I absolutely understand the thrill that someone gets with a difficult shortwave DX 'catch,' so a savvy programmer or station tries to accommodate these reports even when we wish they were longer and more content oriented.

"What we ask though, is that the listener be genuine. Like others, I do occasionally get correspondence where it's very doubtful that the program was actually heard, and the only motive appears to be to see if there are 'goodies' available.

"2. It's OK to write us just to tell us what you think even if you don't want to go to the trouble of doing a reception report. You may not get a QSL back that way, but those of us who can will usually at least respond. (At the risk of blasphemy, if you are streaming a program or listening via a Web SDR, it is still OK to write! The important thing is that you are listening somehow.) Every genuine listener is valuable. This is especially important within the US where getting a QSL from, say, far-off Maine or Miami may seem less glamorous but some of the programming is worth listening to anyway.

"3. Cyberspace is often full of repeated complaints about certain privately funded programs that some listeners don't like. But people should remember that without the revenue from those programs, some stations would either go off the air or become unaffordable for programmers like yours truly. Blessed are those programs, for they indirectly subsidize the rest of us. The Internet and shortwave could both be better served by spreading the good word about programs that people do like. (If you don't have any, you aren't looking hard enough. I can think of a dozen off the top of my head on various channels around the planet.)" – William "Bill" Tilford, Producer/Host, From the Isle of Music & Uncle Bill's Melting Pot, Tilford Productions, LLC. Chicago, Illinois

Digital Voice Fans on "Digitally Speaking"

Several subscribers commented on Digitally Speaking columnist, Cory Sickles WA3UUV's, announcement that he is accepting the position of General Manager for Yaesu North America's Amateur, Aviation and Marine Division. Here are two that sum up the feeling:

"I'd like to congratulate Cory Sickles WA3UVV on his new position at Yaesu! Very exciting! I can only imagine all the cool gear he'll get the inside scoop on.

"I'm an avid *TSM* subscriber since day one and back in the day I always loved picking up copies of *Monitoring Times*. *TSM* is an excellent resource, and I especially enjoyed Cory's wide breadth of covering all aspects of digital radio.

"I liked the wide range of information in the digital (ham radio) world, and as a new D-Star user, I enjoyed all of the information, regardless of whether D-Star, Fusion, DMR, or anything else being covered. Cory is an excellent writer and columnist.

"I'm probably neutral to on the general idea of vendor-specific columns in *TSM*. I do own a Yaesu radio, and although most of the gear I own is Kenwood, I don't really consider myself loyal to one brand—I consider myself a 'radio omnivore.'

"Cory's new position at Yaesu should provide some interesting insight to what's going on in the world of Yaesu and System Fusion, maybe opening up another channel of communication between Yaesu and users, for example; perhaps Cory could shed some light as to why the FT-1XD was discontinued." – Tony N0RUA

"Because of my interest in Digital Voice, Cory's column, 'Digitally Speaking' has become my favorite topic in *TSM*. Having someone on the inside writing about System Fusion would be a plus but I would still like to see any and all DV modes covered in the magazine as well.

"I personally own four D-Star radios and one C4FM radio and have interest in all DV modes of operation. In my local area, southern Oregon Rogue Valley, we have five

August Mystery Movie Radio was correctly identified as a Breting model 40. ***(Screen capture by Eric Beheim)***

D-Star repeaters (one 2-meter, three 70-cm and one 1.2GHz) as well as two C4FM repeaters (one for 2-meters and one 70-cm). I have no DMR radio and there are no repeaters for DMR in the area.

"My main concern as a subscriber is to get the most up-to-date information on any and all DV modes whenever available. That is something that *TSM* has over all the other radio related magazines in my opinion, not to mention a much broader radio content as well. I am very interested in being updated on System Fusion because it is the newest DV mode for amateur radio." – Bob Earl KD6UIH

TSM will definitely continue to cover Digital Voice. It's certainly the future of amateur radio and, now that Cory has whetted the subscribership's appetite, we'll do what we can to continue providing the most coverage that we can on the subject. – Editor

August Mystery Movie Radio

"This receiver appears to be a Breting model 40 or 49. The pictures of the two models look almost identical in Raymond Moore's 'Communications Receivers' book.'" – Charlie Hinkle W8CFO

Vintage Radio Guru, Rich Post KB8TAD Replies:

"And a very good first guess! It's definitely a Breting with matching speaker and it sure looks like a Breting 40." – Rich Post KB8TAD

September Mystery Movie Radio

Vintage movie and radio enthusiast and regular *TSM* contributor, Eric Beheim, checks in with our September Mystery Movie Radio.

"September's mystery radio from the movies is from the 1939 Universal serial 'Scouts to the Rescue.' While

In the late 1930s move series, "Scouts to the Rescue" above in frame #1, can you ID the microphone used? In frame #2 is this an actual radio or a prop department mash-up? (Screen captures courtesy of Eric Beheim)

camping out in the Sierra Nevada mountains near Sonora, California, Jackie Cooper and his fellow Boy Scouts use their portable shortwave radio to keep in touch with their base station, which is being manned by another Scout who couldn't make the trip because of a broken leg. During the course of the serial's 12 chapters, the Scouts use their radio to help a U.S. Treasury agent round up a gang of counterfeiters who are operating out of a Western 'ghost town.'

"Although the Scouts' portable set is not shown in frame enlargement #1, someone might be able to identify the distinctive microphone that Jackie Cooper is holding. The base station set shown in frame enlargement #2 looks like it was put together by the Universal prop department using vintage equipment."

RF Current

News from the World of Communications

RF Current is compiled and edited by Ken Reitz KS4ZR from various news sources and links supplied by TSM readers. If you find an interesting story pertaining to amateur, shortwave, scanning, broadcasting or satellites, send a link to editor@thespectrummonitor.com

Radio Havana Cuba celebrates 56 years of international shortwave broadcasting. (Courtesy: Radio Havana Cuba)

Arnie Coro CO2KK Reports on Radio Havana Cuba

Prof. Arnaldo Coro Antich CO2KK, known to shortwave listeners worldwide as "Arnie" is a Senior Advisor/Consultant at the Cuban Broadcast Institute and presenter of the DXers Unlimited program on Radio Habana Cuba (RHC). He sends this report on RHC activities:

"DXers Unlimited, after more than something like 30 years on the air, still receives a lot of correspondence from listeners around the world. It is one of the few technically minded radio hobby programs still on the air, and also streaming on the Internet. We are now in the process of improving the quality of the live audio feed from several Cuban broadcast stations to the Internet.

"Among Radio Havana Cuba's future plans, based on the forecasts of Solar Cycle 24's tail end, are operating a 50 kw SNIEG air-cooled shortwave transmitter, built half a century ago, and kept in pristine condition by maintenance personnel that have upgraded the old rig to be more energy efficient. For example, we changed the thyratron mercury-vapor high voltage rectifiers with up to date silicon fast-recovery diodes and the installation of a vacuum fast-acting high voltage switch to cut the power to the final amplifier RF stage and the modulator, to prevent arc-overs.

"The idea is to operate on the 90-meter band with a simple dipole antenna, using the already existing 83 meter high towers, so as to achieve a compromise vertical radiation angle that would provide national NVIS coverage all over the Cuban archipelago, Florida, Jamaica, Haiti and the Dominican Republic. The secondary lobe at less vertical elevation will provide enjoyment to listeners farther away.

"In essence, this project was derived from my research about Tropical Band propagation especially on the 4.7 to 5.1 megahertz 60-meter band that led to us registering with the ITU in Geneva for the use of 5040 kHz, something that has given excellent results, especially during periods of very low nighttime maximum usable frequencies."

Arnie also reports that, "The station managers at RHC wanted yours truly to keep the 'En Contacto' show on the air. I said yes, but emphasizing that I will add many new features including covering worldwide amateur radio activities. So far, the new concept of covering all 93 different ways to enjoy our hobby have brought a lot of good feedback from old listeners and a myriad of new listeners to RHC."

Australian Senate Rejects Bill to Restore ABC Shortwave

TSM World of Shortwave Listening columnist, Rob Wagner VK3BVW, has been following the developments of the Australian Senate committee charged with Radio Australia's abandonment of international shortwave broadcasting. He writes:

"The final report from the Senate Committee looking into the ABC shortwave enquiry was released August 9 and is at: **http://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Shortwaveradio/Report**

"The real meat is in 'Chapter 2' of the report. The committee has recommended that the Senate not pass the bill to have shortwave reinstated. Although this is only a recommendation, it is highly unlikely that the Senate would go against the findings of the committee and try to pass the bill—they don't have the numbers to do that. Eventually, the bill will fail in the Senate and be dismissed.

"It is clear, however, that the committee's decision was not a unanimous one. See dissenting comments from Sen. McKenzie and Sen. Xenophon in the above report."

From the report's final summary, in the section titled "Committee View," Rob dug into the report and found these paragraphs of interest to *TSM* readers:

"'2.50 The committee is of the view that the measures proposed in this bill are not an appropriate way to address the concerns raised by some submitters about the cessation of the ABC's shortwave services.

"'2.51 In relation to the cessation of domestic shortwave services, the committee considers that the recommendations made in its report on the Australian Broadcasting Corporation Amendment (Rural and Regional Advocacy) Bill 2015 will address many of the concerns raised by those

Former Radio Australia shortwave transmitting antenna at Shepparton, Australia (Courtesy: Radio Australia)

living in rural and regional communities. The committee also notes the ABC's commitment to the delivery of improved services through the allocation of funding for up to 80 new content roles in regional Australia.[74]

"'2.52 Regarding concerns about the cessation of the international shortwave service, the committee notes that the ABC is working to ensure its continued presence in international broadcasting by developing a new international strategy across all its content divisions. The ABC is also expanding the provision of broadcasts through an array of technologies and investing in more FM transmitters in Papua New Guinea. The new strategy will enable the ABC to align its services to the way in which audiences access news, current affairs and other programs. The committee supports the ABC's approach to ensuring that it remains a recognisable source of independent, high quality broadcasting in Papua New Guinea and the Pacific.

"'2.53 The committee acknowledges the concerns expressed by some submitters that emergency broadcasts will no longer be received by certain domestic and overseas audiences. However, it is not the sole responsibility of the ABC to ensure that communities, especially communities outside Australia, are briefed on weather warnings. Rather, this responsibility lies with government authorities with ABC broadcasts serving as an alternative source of emergency information.

"'2.54 The committee is also concerned that the measures in the bill would, if enacted, impinge on the independence of the ABC and could lead to increased costs. While the committee notes that the proposed amendments do not affect the ABC's editorial independence, the committee is not convinced that dictating the broadcaster's choice of technology is in line with the established tradition and understanding of independence that has been fostered over many decades. The ABC has made the decision to terminate its shortwave broadcasts, and is seeking a modern and efficient

Two Australians want to save vintage AM radios from the landfill by converting them into Bluetooth speakers. (Courtesy: BOE)

way forward for the dissemination of content, which are legitimate activities for the broadcaster to undertake.

"'2.55 The committee therefore does not support the bill. However, the committee emphasises that it will continue to monitor developments in this area. In particular, the committee's Senate estimates hearings will facilitate ongoing scrutiny of the ABC's commitment to the delivery of improved services to regional Australia and the effectiveness of the ABC's new international strategy.

"'Recommendation 1

"'2.56 The committee recommends that the Senate not pass the bill.'

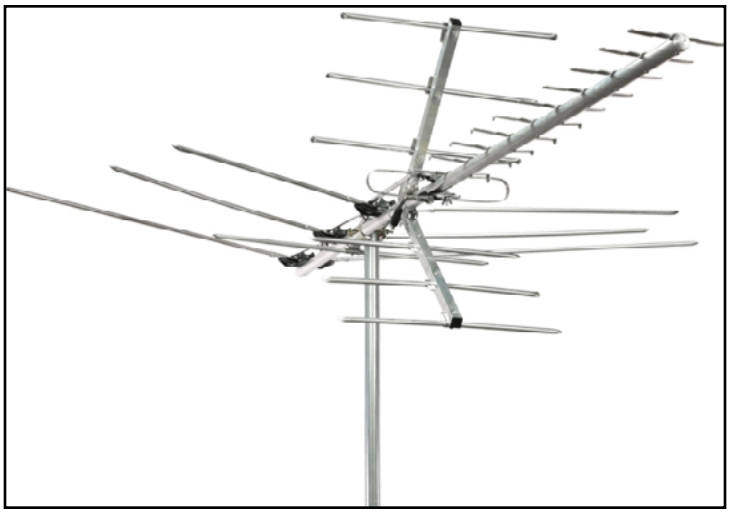
"The upshot of all this," notes Rob, "is that it looks like no return of RA to SW nor the NT SW Services."

Kickstarter Project to Turn Old Radios into Bluetooth Speakers

Two Australians, who build custom electric bicycles, have started a Kickstarter campaign that take their talents into the realm of recycling vintage radios otherwise destined for the landfill. "Bluetooth speakers with a history—a new life for old radios." Their campaign notes, "We're dusting off the vintage radio and giving it a chance to sing again. Introducing the BOE [Built on Enthusiasm], Vintage Radio Bluetooth Speaker." Their short video presentation notes, "Turn the tide on disposability!"

"These beautiful musical relics deserve a chance to shine again. We're bringing them back to life by replacing their aged electronics with a brand new 8W Bluetooth 4.0 amplifier. This transforms obsolete radios into beautiful universal Bluetooth speakers, ready to play any music your heart desires. Mixing old and new not only produces completely unique Bluetooth speakers, it is also environmentally friendly. As the only new components are the circuit-boards and power supply, every BOE Vintage Radio Bluetooth Speaker produced is one less vintage radio in the landfill and one less new speaker produced."

The project will only be funded if it reaches its goal by Wednesday, September 20, 2017 at 4:32 PM EDT. You can learn more here: **https://www.kickstarter.com/proj-**



New device discovered by millennials to hack into free TV. (Courtesy: Channel Master)

ects/1992848929/bluetooth-speakers-with-history-a-new-life-for-old

Shortwave Report on Tunein

Dan Roberts' weekly "Shortwave Report" is available now from Tunein as an RSS feed.

According to the posting on Tunein, Shortwave Report is, " a 30-minute review of news stories recorded from a shortwave radio. Times and frequencies for English-language programs are included to encourage you to listen on your own." To make Shortwave Report a "favorite" go to: **https://tunein.com/radio/Shortwave-Report-p1697** To learn more about Shortwave Report go to: **http://www.outfarpress.com/shortwave.shtml**

Daring Millennials Hack into Free TV: Shhhh!

An August 2 article in the *Wall Street Journal* headlined, "Millennials Unearth an Amazing Hack to Get Free TV: the Antenna," might have come directly from the satirical newspaper, *The Onion*, but it was real news in the *WSJ*.

What's even crazier, the article quotes a conversation between an attorney for the National Association of Broadcasters (NAB), the largest US Over-the-Air TV lobbying group, and apparently members of Congress during a hearing. The NAB attorney was trying to make it clear that, during the Time-Warner/CBS carriage "blackout," a dispute about how much the cable-TV company would pay the network to carry their local stations, viewers could still watch CBS for free over the air using a simple external antenna. Incredibly, according to the article, some thought that the blackout would include over-the-air broadcasts, not just cable or satellite-TV.

T-Mobile First to Rollout 600 MHz Spectrum Service

The ink on T-Mobile's $8 billion check for its portion of the 600 MHz band gobbled up in the FCC's spectrum auction, had barely dried before it announced, August 17, that it had already commenced 5G service in Cheyenne, Wyoming.

T-Mobile launches 600 MHz 5G service, first in Cheyenne, Wyoming, just two months after buying spectrum in the FCC's TV band auction. The company plans to rollout similar service in rural non-competing TV markets. (Courtesy: T-Mobile)

Just two months after acquiring its spectrum, the company explained its plan, "Starting in rural America and other markets where the spectrum is clear of broadcasting today, T-Mobile plans to deploy the new super-spectrum at record-shattering pace—compressing what would normally be a two-year process from auction to consumer availability into a short six months."

According to the press release, "This year alone, additional 600 MHz sites are slated for locations including Wyoming, Northwest Oregon, West Texas, Southwest Kansas, the Oklahoma panhandle, Western North Dakota, Maine, Coastal North Carolina, Central Pennsylvania, Central Virginia and Eastern Washington."

While the spectrum auction was taking place, the company had been working with infrastructure providers, chipset makers and device makers such as Nokia, Qualcomm, Samsung and LG to take advantage of what would be an early lead in the market.

The press release added, "T-Mobile is also working closely with the FCC and broadcasters like PBS to clear the spectrum in record time, investing where necessary to preserve programming consumers care about while paving the way for new wireless coverage and competition for consumers."

Dubbing itself the "Un-carrier," it couldn't help but crow that, "The Un-carrier owns a whopping average of 31 MHz of 600 MHz spectrum licenses that can cover every single American across the nation with low-band spectrum that reaches twice as far and is four times better in buildings than mid-band."

There is no mention of how much the wonder of 5G service will cost consumers or how much 5G bandwidth each customer will be allowed before being throttled back to 4G.

FCC Clamps Down on 121.500 MHz

August 8, the FCC issued the following Enforcement Advisory:

"The Enforcement Bureau of the Federal Communications Commission (FCC), in coordination with the Federal Aviation Administration (FAA), has been investigating instances of misuse of, and harmful interference to, frequency 121.500 MHz, which the FCC has set aside for emergency and distress communications. The FCC regulates aviation communications in cooperation with the FAA, which, among other things, continuously monitors distress frequencies to protect life and property. The FAA has reported to the FCC that the FAA's ability to monitor aviation channel 121.500 MHz for actual emergencies is being impaired by an increase in the use of 121.500 MHz for non-emergency communications. The Enforcement Bureau will aggressively enforce the rules related to aviation radio operations. Ensuring the integrity of safety and distress frequencies is vital to safeguarding lives and property."

FCC's FM Over-Crowding Initiative Gains More Applicants

Dressed-up as his "AM Revitalization Initiative," FCC Chairman, Ajit Pai, closed his latest effort at giving preferred access to the already over-crowded FM band to AM radio stations. On August 3 he announced that over one thousand AM stations took advantage of this latest window (open only to AM broadcasters). Said the Chairman, "The success of this window follows on the great success of the two cross-service FM translator modification windows that were opened in 2016."

Outernet Update

The ambitious, crowd-funded project to bring satellite delivered content to the entire globe for free forever, called Outernet, continues to struggle with a number of issues. The device used for reception of the satellite delivered data is called Lantern and is a self-contained L-band satellite receiver/antenna, which has gone through a number of versions since its inception in the fall of 2014. Details can be found in previous issues of *TSM*: "Outernet: Free, Global, One-way Internet to the World," September 2015 and "Outernet Update: Free, One-way Internet Now Via L-Band Satellite," April 2017, both by Kenneth Barbi.

Outernet spokesperson, Syed Karim, posted an update to all crowd-funders August 17, noting that the boards used in the self-contained system are about ready for mass production but that a contract with their L-band service is the latest holdup, "We are still negotiating this agreement with the [satellite] operator…Although things are moving forward, we're dealing with a large public company with very specific processes related to executing contracts.

"As soon as the contract has been finalized, we can get back to the producing Lanterns. All of the technical risk has already been resolved; thousands of people with DIY kits have been successfully receiving the broadcast for over a year. Once the new contract is signed, we can spin up production once again. Our manufacturer has stock of all of the hard-to-find components, which we purchased long ago. They've quoted a 4-week lead-time to produce 5,000 boards and it takes a weekend to press that many enclosures. Once we are ramped up, we'll be assembling, testing, and packaging a thousand units per week."

Latest version of Outernet's Lantern L-band data receiver, a self-contained receiver, antenna, amplifier and data processor. (Courtesy: Outernet)

You can find out more on the Outernet website: **https://store.outernet.is.**

OZY Radio Returns

Shortwave blogger and *TSM* columnist, Rob Wagner VK3BVW, sends this late-breaking report on Ozy Radio:

"The flea-powered Ozy Radio has begun testing on 5045 kHz in the 60-meter band. First noted here in Australia on August 28, the station has been missing for several years from its former 3210 kHz allocation. The transmitter location has been reported as Razorback, New South Wales, but I have not been able to confirm this yet. The transmitter power and the type of antenna are also unknown at this time. Observations by myself and other Australian listeners have noted the station operating between 0600 and past 1300 UTC.

"The signal into Mount Evelyn, Victoria (at a guess, about 800 km from the reported transmitter site) is very strong – about 10 dB over S9! This is a much better signal than was ever heard on the old 3210 outlet. Whatever has been done at the station appears to be working very well! I believe there is a very good chance that Ozy Radio will be heard internationally!

"The current programming consists of test transmission announcements, relays of the Australian Independent News service, and continuous antique pop music from the 50s and 60s. Cheekily, the station is also using the Radio Australia interval signal, while the RA kookaburra also fires off every now and again throughout the broadcasts. I'm not sure how the ABC feels about that!"

TSM

Icom's new benchmark all-band, all-mode receiver: IC-R8600. (Courteys: Icom America)

TSM Reviews:

Icom IC-R8600 All-Band All-Mode Software Defined Receiver

By Bob Grove W8JHD

"Unquestionably, the new Icom IC-R8600 is a remarkable technical achievement. It is a receiving laboratory that takes software-defined receivers to a new level."

With the release of this Software Defined Receiver, analog receiver design is relegated to history. Never before have so many features and options been offered in one general-coverage receiver. No wonder it comes with a 93 page, 8 x 10 inch instruction manual!

The IC-R8600 is heavy for its size (nearly ten pounds), and seems smaller than expected from its photos. It measures 8.7 inches wide x 4 inches high x 9.1 inches deep. Although its main tuning knob is only about 1 ¾-inch in diameter, its adjustable-tension detent-rotation selects precise 1 Hz increments of fine-tuning with frequency stability rated at 0.5 ppm (0.5 Hz per MHz).

The compact desktop receiver offers a 4.3-inch diagonally measured color LCD touch-screen surrounded by 26 front-panel keys, knobs, and jacks (stereo earphones, USB connector, and SD card slot). And, here's a tip: keep the manual handy because the front panel is a busy place—as is the 17-connector rear panel, which we shall examine shortly.

Although small, a top-mounted, two-inch diameter speaker does an excellent job with room-filling sound. Bass and treble may be separately adjusted and, for the audiophiles, there is a rear-mounted external speaker jack. There is also a front mounted ¼-inch headphone jack for private listening.

While a fused DC power cord nearly 10 feet long is included, the IC-8600 must be connected to a 12-volt, 2A power supply, which is not included. However, most radio hobbyists and professionals probably already have ready access to such a power supply, which can be used. Alternatively, a matching AD-55NS power supply is an available option from ICOM dealers for $75, but is available for $60 from Universal Radio.

Primary Features

The receiver's frequency coverage from 10 kHz-3000 MHz (less 822-851, 867-896 MHz on U.S. non-government models) invites reception of virtually any signal of normal

With a combination of actual buttons and knobs, there are plenty of virtual buttons too on the touch screen display, which can display an array of information, including decoded RTTY. (Photos courtesy of the author)

interest. Tuning the first 30 MHz is done by direct sampling conversion, 30-1100 MHz is provided through double superheterodyne and 1100-3000 MHz is triple superheterodyne tuning.

Demodulation modes are considerable. Traditional reception of AM, WFM, NFM, CW, SSB, and FSK signals are complemented by the addition of popular digital modes (P25, NXDN, dPMR, DCR [Digital Communication Radio], and D-STAR).

A 12 kHz IF output port is available for external accessory decoding of other modes such as Digital Radio Mondiale (DRM). It is unknown whether missing modes like MotoTRBO will be downloadable in the future, assuming they aren't prohibited by law or patent.

Specs at a Glance

Filter selectivity:

Bandwidth	-60 dB Suppression
500 Hz	<700 Hz
2.4 kHz	<3.6 kHz
6 kHz	<15 kHz
15 kHz	<25 kHz

Typical sensitivity (preamp on, 2.4 kHz BW, 10 dB S/N)

0.1-30 MHz	-14 dBµ
30-2000 MHz	-10 dBµ
2000-3000 MHz	-8 dBµ

Spurious/image rejection: 0.1-30 MHz >70 dB
30-1100 MHz >50 dB
1100-3000 MHz >40 dB

The alphanumeric screen is editable for identification of settings. A simple key press converts the screen into a standard keyboard. Other commands and readouts are similarly editable on the touch screen.

The spectrum analyzer function is a major draw for those of us who search bands for new or unknown signals and enjoy the confirmation of discovery. We will discuss that option shortly.

After you've spent hours and hours choosing all the desirable settings for your listening requirements, you want to save those choices in case you suddenly screw up the commands. A front panel slot accepts an SD card to store those parameters. You can also record received audio, decoded FSK, and more on your card.

To perform a complete reset to factory settings, there is a key for that, too. Since that also clears all memory channels, a second key option offers only a partial reset that restores factory sets, but preserves your memory channel entries.

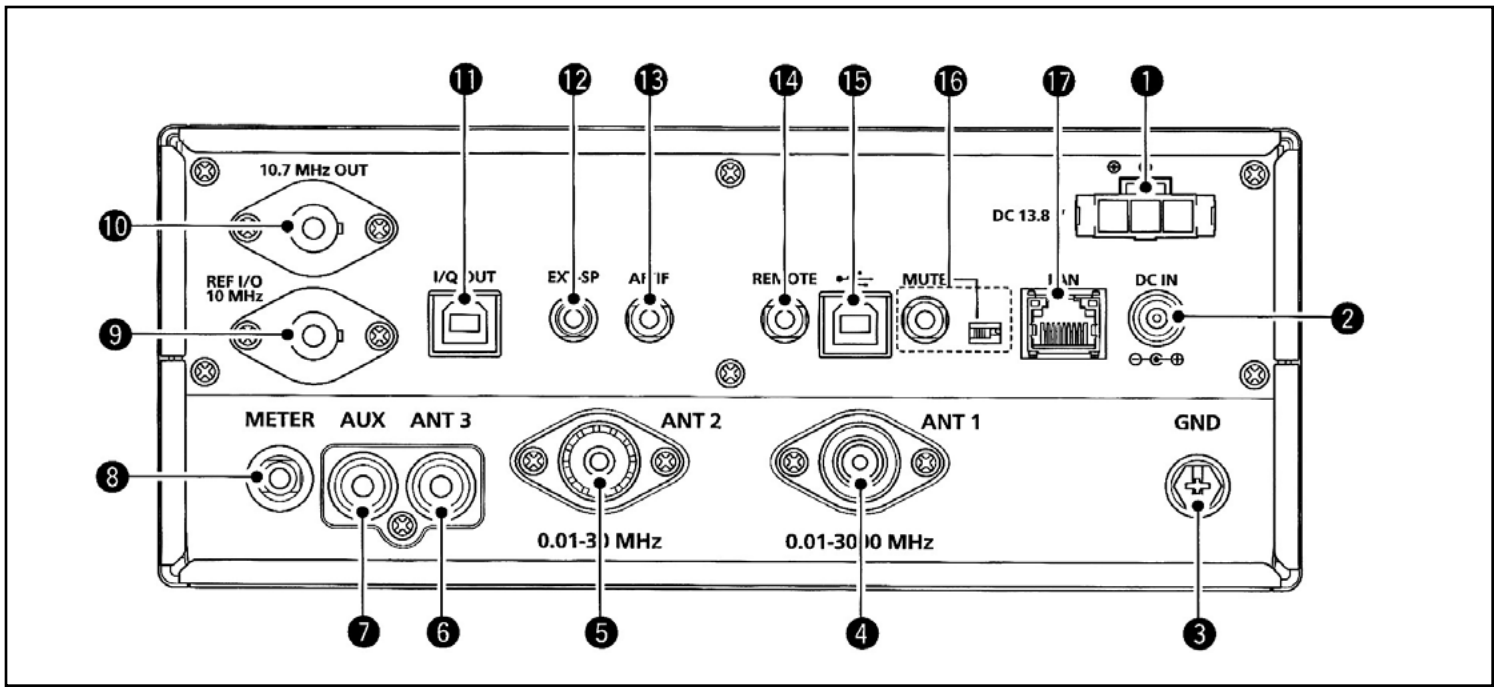
Most of us hobbyists also have a scanner (or two, or three…), so you will undoubtedly wish to commit your favorite channels to memory for scanning. The IC-R8600 accepts up to 2000 channels in 100 twenty-channel banks ("groups"). Additionally, there are 50 pairs of scan edges, 200 auto-memory write channels, and 100 scan skip channels.

Scan speed is adjustable up to 30 channels per second. This isn't super fast, but usually adequate, especially since this is a mini-laboratory, not just a scanner.

That Loaded Front Panel

Don't be frightened by the front panel. Yes, it has more than two dozen keys and knobs, but you don't have to use them all, all the time. Moving counter clockwise from the upper left corner of the photo, we have:

1: Power on/off
2: Local key (turns off remote)
3: Panel lock (locks all controls and turns off display)
4: Timer on/off
5: Headphone jack
6: USB mini B (PC/CIV output; FSK/D-STAR data; outputs demodulated audio and 12 kHz IF; mates with future CS-R8600 and RS-R8600 accessories
7: Dial B multifunction (volume, squelch, RF gain, bass and treble)
8: SD card slot (stores settings)
9: Menu (offers settings and memory channels)



The rear panel provides a panoply of interconnections to peripherals. (Courtesy of Icom)

10: Function (configures various settings)
11: Mini Scope (actuates spectrum display)
12: Quick (Displays quick menu)
13: Exit (returns to previous screen)
14: Speech/Lock (audibly announces frequency/mode; locks functions)
15: Tension (adjusts main dial turning friction)
16: Main (frequency tuning)
17: Receive (lights green when signal received)
18: Lock (lights white to show 14 is activated)
19: Memory (allows main dial to slew through memory channels)
20: Memory (assigns current frequency and settings to memory channel)
21: VFO/Memory (toggles between VFO and memory channels)
22: Memory group (selects banks)
23: Dial C (displays multi dial menu, changes channel number)
24: Priority scan (start/cancel priority memory channel)
25: Dial A (shows scan settings, sets scan speed, priority interval)
26: Scan (initiates memory channel scan)

Now let's check all those rear panel jacks, clockwise from the upper right of the diagram:

1&2: DC input jacks (choice of connector type)
3: Ground screw
4: Antenna (N); 10 kHz-3000 MHz
5: Antenna (SO-239); 10 kHz-30 MHz
6: Antenna (RCA); 10 kHz-30 MHz
7: Auxiliary (RCA); unconnected
8: Meter (BNC); for user's signal strength or squelch lever meter
9: 10 MHz in/out (BNC); reference standard
10: 10.7 MHz IF output (BNC); external processing
11: I/Q port (USB/B); data output
12: External speaker output (1/8"/3.5 mm); 4-8 ohms
13: AF/IF output (1/8"/3.5 mm); 4700 ohms, fixed level
14: PC/CIV remote control (1/8"/3.5 mm)
15: PC/CIV output (1/8"/3.5 mm); FSK/D-STAR data; outputs demodulated audio and 12 kHz IF; mates with future CS-R8600 and RS-R8600 accessories
16: Mute/bit error rate (switchable) (1/8"/3.5 mm)
17: LAN network (LAN port); time synch, AF/12 kHz out, RS-R8600 remote control (future product)

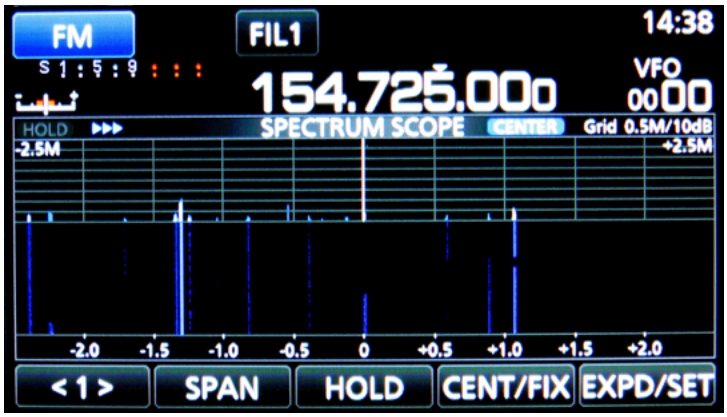
The 'Scope

As a great fan of spectrum analyzers, I was eager to test that function. Could I actually make valid measurements on such a small screen with all the busy text? After discovering that I could clear the screen of verbiage and enlarge the spectrum display, the answer was yes.

The compressed mode for the display is crammed with many informative parameters, but clearing the screen to enlarge the spectrum display alone really means business (see photo on next page).

The span (spectrum display width) is incrementally selectable from 5 kHz to 5 MHz. Signal presence is indicated by a rising "spike" above the horizontal midline of the spectral graph. The spike shakes with the modulation, revealing the bandwidth as well as the relative signal strength. The user may choose a variety of colors for contrasting various elements of the display.

To its additional credit, the spectrum display has a waterfall mode, whereby the bottom of a signal spike



IC-R8600 spectrum display showing waterfall. (Courtesy of the author)

Icom AD55NS power supply ($60) is an option that provides filtered, regulated 15 VDC at 2 amps. (Courtesy: Universal Radio)

gradually grows longer and longer over time until the signal disappears. It's an advantage to be able to identify signal frequencies after the signals have gone off the air – the residual spikes continue to fall for a time before they gradually disappear into the bottom of the display.

Final Thoughts

Unquestionably, the new Icom IC-R8600 is a remarkable technical achievement. It is a receiving laboratory that takes software-defined receivers to a new level. It's a little overwhelming for a newcomer to the radio hobby, although it will work fine in the factory set mode, but the optional array of functions and configurations would bewilder the novice.

I would, however, recommend it to the experienced radio hobbyist or professional who feels comfortable with the myriad parameters of radio signals, and who wants a compact, personally configurable, wide frequency coverage, spectrum analyzing receiver. It does its job, and it does it well.

The Icom IC- R8600 lists at $3000, but is available at a discount from Universal Radio ($2699), which also provides free shipping to the lower 48 US states, extra for Alaska and Hawaii. **http://www.universal-radio.com/catalog/widerx-vr/0086.html**

There are a number of Icom options available for this receiver. Here are some that area are available from Universal Radio:

AH-8000 Omnidirectional discone antenna ($270) for 100-3335 MHz with 49 feet of lead-in (this antenna may also be used to transmit on 144, 430, 1200, and 2400 MHz bands with under 200 watts)

SP-23 external speaker with dual inputs, audio filtration, speaker switch and headphone jack ($240)

SP-39AD matching external speaker with integrated power supply ($250)

MB-123 mounting hardware for a carrying handle ($29)

RS-R8600 software for remote control (price to be announced)

ICOM IC-R8600 Specifications
(as provided by the Manufacturer)

General Frequency Coverage
0.010000–821.999999* MHz
851.000000–866.999999 MHz
896.000000–3000.000000 MHz
*Guaranteed range: 0.100000–821.999999 MHz

Antenna connectors:
ANT 1 (0.01–3000 MHz): Type-N (50 Ω)
ANT 2 (0.01–30 MHz): PL-259 (50 Ω)
ANT 3 (0.01–30 MHz): RCA (500 Ω)

Frequency stability:
Less than ±0.5 ppm (at 25˚C after warm up)

Mode:
USB, LSB, CW, FSK, AM, FM, WFM, Digital
(D-STAR, P25 Phase 1, NXDN, dPMR, DCR)
Number of channels: 2000 regular with 100 groups, 200 auto memory write, 100 skip and 100 scan edge channels

Scan Types:
Programmed, memory, selected memory, selected mode, auto memory write, priority scan and Δf scan

Power supply requirement: 13.8 V DC ±15%
DC current drain: Stand-by: 1.8 A, Maximum audio: 2.0 A
Operating temperature range–10 ˚C to +60 ˚C; 14 ˚F to 140 ˚F
Frequency resolution: 1 Hz

Dimensions (W × H × D)(projections not included)
220 × 90 × 230 mm; 8.7 × 3.5 × 9.1 in
Weight: (approximately) 4.3 kg; 9.5 lb

Antenna at Grimeton, Sweden, radio station SAQ (Courtesy: The Alexander Association http://alexander.n.se/?lang=en)

Electrical Pioneers:

The Life and Times of Guglielmo Marconi (1874-1937) and Ernst Alexanderson (1878-1975)

By Georg Wiessala

Steampunk, Shock and Awe

I have just re-read "The First Men in the Moon," the famous novel by H.G. Wells. It is a great piece of scientific romance, steam-punk, which harks back to Jules Verne and other early sci-fi authors. What I did not appreciate during earlier readings, is just how much Wells was fascinated by the radio discoveries of the day. 'Radiant energy,' Wells has one of his heroes speculate, 'was anything like light or heat or those Röntgen rays there was so much talk about a year or so ago, or the electric waves of Marconi, or gravitation.' Tesla gets a look in too, when Wells mentions possible communications from the Moon (Wells, 2017: 12 [quote] and 165 [Tesla])

It is hard to imagine in our own age just how groundbreaking, confusing and inspirational the work of the early radio pioneers was in theirs, at a time when even the Eiffel Tower became a radio mast. However, our era of borderless communication and technological advance carries with it echoes of the 'globalization' of earlier times, as the 19th Century turned into the 20th. In the history of radio, there are at least three key themes a time-traveller looking at our 21st Century from the vantage point of, say, 1890, would easily recognize.

First, if you give people limitless communication, this changes everything, from economic to international relations, from crime to politics. As Dr. Hawley Harvey Crippen was apprehended in the first manhunt that made use of Marconi technology, so, in our time, social media are both the bane of terrorists and the lifeblood of their vicious propaganda. The Crippen story, by the way, is subject of Erik Larson's brilliant 2006 novel, Thunderstruck.

Second, the use of electromagnetic waves and every subsequent technology based in it inspires awe and greed, philanthropy and superstition in equal measure. Worried as we are about the rise of the machines, unaccountable algorithms and artificial intelligence today, an observer of the age of Alexanderson, Marconi, Tesla and Edison would have been similarly concerned, focusing, instead of that mysterious force from the ether, electricity, invisible 'waves' and new-fangled machines doing the jobs of humans.

Third, in the same way we speak of 'circuits' in electri-

cal engineering, there are many circuitous – and few straight, linear – developments in this early age of wireless. Professor Jim Al-Khalili's recent Open University/ BBC FOUR collaborations on Shock and Awe – The Story of Electricity was a great reminder of this, showing how the time of the electrical pioneers connects to ours though time. **www.bbc.co.uk/programmes/p00kjq6d www.open.edu/openlearn/tv-radio-events/tv/shock-awe/shock-and-awe-the-story-electricity**

On the Shoulders of Giants

Then as now, new technologies and discoveries were made by those who stood on the shoulders of giants. Table 1 shows a rough time-line of just some of the key minds in this area, sorted by date of birth and with apologies for any glaring omissions and simplifications:

Table 1: Some Electrical Pioneers

Benjamin Franklin (1706-1790) Positive and Negative Electric Charge
Alessandro Volta (1745-1827) Electric Battery (Voltaic Pile)
Hans Christian Ørsted (1777-1851) Electromagnetism
Michael Faraday (1791-1867) Mutual Induction, Electric Motor, Magnetic Field
Heinrich Rühmkorff (1803-1877) Induction Coils
Heinrich Geissler (1814-1879) Gas Discharge Tube
Mahlon Loomis (1826-1886) Aerial Telegraph (Radio Transmission)
James Clerk Maxwell (1831-1879) Theory of Radio Waves
Édouart Branly (1844-1940) Radio Conductor/ Coherer
Oliver Lodge (1851-1940) Electromagnetic Waves
Joseph John Thomson (1856-1940) Electron
Nikola Tesla (1856-1943) AC Motor, Tesla Coil, Radio Transmission
Heinrich Hertz (1857-1894) Radio Transmission
Jagadish Chandra Bose (1858-1937) Microwave Radiation, Semiconductors, Crystal Detector
Alexander Popov (1859-1906) Radio Transmission
Reginald Fessenden (1866-1932) Radio, voice transmission, sonar
Guglielmo Marconi (1874-1937) Radio Transmission
Ernst Alexanderson (1878-1975) Alexanderson Alternator/ VLF Transmitter

The discovery of the electromagnetic field, crystals, the cable telegraph, wireless telegraphy, valves, 'cathode rays,' semiconductors, transistors, electrons, the Earth's very own electrical phenomena, and much more besides, was, it would seem, attributable not to individuals but to innovative chains of discoverers and scientists. Some, such as Hertz, Bose, Lodge and Tesla, may not have been commercial geniuses; others, such as Marconi and Westinghouse were much more finely-attuned to patenting their technologies and putting them to practical use. Ernst Alexanderson, in this respect, seems to have been more like Tesla than Marconi.

Therefore, many different individuals contributed the

The Alexanderson transmitter set consists of three parts: the driving motor, a gear drive and the high frequency generator, commonly called the alternator. They are assembled on a solid base of steel. The weight of the complete transmitter set is about 50 tons. (Screen shot from a YouTube video of the transmitter courtesy: The Alexander Association. http://alexander.n.se/the-radio-station-saq-grimeton/the-alexanderson-transmitter/?lang=en)

innovations needed to create broadcast radio and TV. Mahon (2004: 180) summarises that, "in the popular account, Marconi gets the credit for inventing radio, and Hertz for discovering the waves. Maxwell, whose inspired prediction started the whole thing off, is rarely mentioned." Last but by no means least, note the temporal frame within which they all lived – a space of a mere 250 years for an entire electrical revolution. Was there something in the ether from the 1700s onwards? In this article, I would like to dwell on the two last names on the list, Marconi and Anderson, one very well-known, one, perhaps, as lesser-known radio personality, unless you are seriously into VLF monitoring. This article continues what I began with Nikola Tesla and Kristian Birkeland a few months ago.

A Rare Catch: SAQ Grimeton

SAQ Grimeton on 17.2 kHz is unique. It is said to be the last transmitter left in the world generating RF power without any electronic parts. No tubes, no semiconductors, transistors, no nothing; only an engine driving an AC generator. The vintage alternator is running at high speeds, emitting up to 200 kW and the entire apparatus can generate frequencies from around 14 to 40 kHz, with 14.5 to 17.4 kHz the most interesting ones. Automated, dependable, machine transmitters like this were used from the beginning of the 20th Century to establish an early global www of communications and to communicate across oceans.

Between roughly 1860 and 1930 many unemployed Swedes emigrated to the US and the radio station, built in 1924, became a lifeline to the home country. Subsequently, the transmitter was put into service to communicate with submarines on VLF. It was eventually decommissioned in 1995. However, the alternator is open to the public via the local tourist office (at Varberg). SAQ Grimeton became a

World Heritage Site in 2004 and is attracting its own dedicated community of followers, much like the Marconi sites at Poldhu and Porthcurno in Cornwall and at the Villa Griffone, near Bologna in Italy. **http://whc.unesco.org/en/list/1134**

At Grimeton, six 400 feet high towers, with 150-foot cross-arms supports, carry a multi-wire antenna for SAQ. The actual A-1 mode Morse code signal radiates from vertical wires, one from each of the towers. The station can easily be heard in Europe and the US. SAQ traditionally transmits at Christmas and on Alexanderson Day (1 July) and on some other occasions such as World Radio Day (13 February).

Many individuals and amateur radio associations around the globe get in on the action, with monitoring, special call signs and events. The Grimeton site's amateur radio station is SK6SAQ. Receiving it is easy, using a VLF receiver/converter/SDR and software. **www.nsarc.ca/hf/saq.pdf www.vlf.it/parmigiani/saq_eng.htm**

Ernst Alexanderson: Alternators and Continuous Waves

The behemoth in Sweden is a remarkable feat of engineering. It was developed by the Swedish engineer and radio pioneer, Ernst F. W. Alexanderson, who worked for General Electric New York and was later chief engineer at the Radio Corporation of America (RCA). Alexanderson was directly influenced by Charles P Steinmetz (1865-1923) and Reginald Fessenden (1866-1932). This multi-lingual Swede is, perhaps, not as well-known as Marconi or Edison, probably because he worked for others, General Electric (from 1901) and its subsidiary, the Radio Corporation of America (from 1952). Consequently, many of his 344 patents were owned by his employers.

Notwithstanding this, Alexanderson's work was ground-breaking. The high-frequency alternators he designed for use in radio succeeded the earlier spark and arc transmitters, which had used Morse code dots and dashes for telegraphy. An alternator is a device that converts direct into alternating current. The one installed in Brunswick, New Jersey, in 1917 facilitated transatlantic radio communication during the First World War, most famously President Woodrow Wilson's messages to forces near the end of the war. Other alternators, like the Swedish machine, helped the home country to stay in touch with the Swedish diaspora across the Pond.

In 1921, Einstein toured the New Brunswick facility and was impressed, expressing "great surprise and interest at the high perfection" of American radio development. Professor Einstein was asked to send a message to Nauen, Germany. A newspaper later wrote, "He did and in exactly six minutes received the following reply: 'Many thanks and reciprocations. Most hearty greetings to the great German scientist. Officer in charge POZ.'" **tinyurl.com/y7kwck5v**

Alexanderson's high-frequency alternators were so revolutionary because they enabled operators to transmit radio as a continuous wave ('undamped'). This made the broadcasting of voice, pictures and music possible for the first time, undoubtedly giving the USA a significant early start in radio communications innovation. Arguably, Alexanderson is best known for his work on television. However, he also experimented with shortwave radio propagation and invented electrodynamic amplifiers and radar altimeters (before the development of radar).

Alexanderson sent the world's first radio facsimile messages from 1924-26 and demonstrated home television reception at 48 lines and 16 frames in Schenectady, New York, as early as 1927/28. It appears that he (not unlike Tesla) also predicted wireless transmission of electricity through the air. Not surprising then, that he was (posthumously) admitted to the National Inventors Hall of Fame in Arlington, Virginia, in 1983.

Guglielmo Marconi: Magic Boxes and Public Engagement

It seems that Marconi understood very well the significance of the audio quality produced by Alexanderson's alternator; so much so that he tried a few times to purchase the exclusive rights of use to the technology from GE. As Wenaas (2007: 23) points out, GE was about to grant Marconi sole rights to Alexanderson's machine, which, remember was the key transoceanic communications technology at the time. However, the US Navy convinced GE to create a wireless communications company as an alternative market for the alternator.

This story is one of many that make up the anecdotal evidence about Marconi's life. There are others. For example, the incongruously-named German Professor Adolphus Slaby witnessed Marconi's success in transmitting across the Bristol Channel and hurried back to Germany to tell Kaiser Wilhelm II about this. Weightman notes (2004: 29), "and so it was that Marconi's first benefactor, William Preece, had unwittingly enabled the nation which was for many years be a bitter rival of Britain in the development of wireless telegraphy to indulge in a blatant piece of industrial espionage."

Moreover, in 1902, the American Institute of Electrical Engineers (founded in 1884) held a dinner in Marconi's honour at the Waldorf Astoria – the very hotel in which Nikola Tesla resided at the time. In one of the most famous 'near-misses' in history, Tesla did not turn up, sending a token message. In 1903, a public demonstration by Guglielmo Marconi of his Morse code radio system was hijacked by rogue protest transmissions by the moustachioed British music-hall-magician Nevil Maskelyne, embarrassing Marconi by proving that his system was less than secure (Marks, 2011). Meanwhile Arthur Conan Doyle, the leading 'spiritualist' of the day and creator of Sherlock Holmes, wrote to Marconi to let him know that the new medium of wireless telegraphy would be well-suited to the investigation of psychic phenomena (Raboy, 2016: 476). Conan Doyle famously set his Sherlock Holmes short story The Adventure of the Devil's Foot near the Cornwall Marconi sites, in a small cottage, near Poldhu Bay (Weightman, 2003; 72). In 1910,

Marconi's wireless system was used to penetrate the disguise of Dr Hawley Harvey Crippen and his companion Miss Ethel Le Neve aboard the transatlantic liner in which they were escaping to America after the murder of Mrs Crippen in London. Four years later, Marconi narrowly missed travelling on the Titanic during her maiden voyage, having joined an earlier ship to America. Those who were saved on the Titanic survived because of wireless, which was used to raise the alert. Stories like this abound in Marconi lore.

But where exactly can we find the real Marconi? First, consider his strategies. Helped by an English relative and becoming a protégé of Sir William Henry Preece (1834-1913), the then chief engineer of the British Post Office, Marconi gave away little, took out patents, conducted research and founded a range of companies such as Marconi Cable and Wireless. Second, Marconi was visible. Aware of the power of hands-on public engagement, the Italian relentlessly demonstrated his wireless equipment. From his earliest appearances in Toynbee Hall (London, 1896) and Madison Square Garden (1898) to the AIEE dinner in 1902 (above), via his coverage of the America's Cup race in New York in 1899, he rarely wasted an opportunity to promote his work to financiers and backers. Apart from commercial success, his efforts earned him the Nobel Prize in 1909, jointly with Ferdinand Braun (the German co-inventor of the cathode ray tube and of semiconductors).

Third, Marconi was also public. He bridged the Bristol Channel, sending a signal between Lavernock Point and Flat Holm island in 1897. He publicly transmitted to Queen Victoria on the Isle of Wight and sent signals across the English Channel in 1899. In 1901, he famously transmitted the letter 'S' across the Atlantic from Poldhu (Cornwall) to Newfoundland. Cheney points out (2001: 201) that, for this, Marconi utilised Tesla's radio patent (No. 645,576), filed in 1897 and issued in March 1900. At Madison Square Gardens in 1898, Marconi used a Tesla oscillator (without any acknowledgement) to show how mines could be blown up by firing a 'Cuban dynamite gun' via telegraphy (Cheney, 2001: 163). Tesla labelled this the 'Borgia-Medici' method of science. And the argument over who really invented radio continues, of course, unabated (good overview: Andersen, 1980).

Fourth, there were always the courts. The litigation between Tesla and Marconi from 1915 onwards has echoes of the War of the Currents involving Thomas Alva Edison and George Westinghouse in the late 1880s (Hughes, 1983: 106/7, 120-135; Carlson, 2015: 377). These battles have become part of radio history, as has the US Supreme Court's finding in Marconi Wireless Telegraph Company of America versus United States, of 21 June 1943. The verdict, by the way, vindicated Tesla and his fundamental radio patent.

Further Reading

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Electrical engineer/inventor Guglielmo Marconi with the spark-gap transmitter (right) and coherer receiver (left) he used in some of his first long distance radiotelegraphy transmissions during the 1890s. (By Published on LIFE [Public domain or Public domain], via Wikimedia Commons)

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TSM

RMHAM 2017 Field Day set up in South Park, Colorado. (Courtesy of the author)

Rocky Mountain Ham Radio Inc.

The Dayton Hamvention 2016 Club of the Year

By Wayne Heinen N0POH

Rocky Mountain Ham Radio Inc. (RM Ham) started as a small contest group—a group of hams that used old mountain top commercial radio sites to participate in the ARRL June VHF contest. After serious thought they decided to build a modest contest "trailer" that could house their radios and computers and let them operate from various locations.

The first trailer was shown off at a local hamfest and members of the local ARRL Amateur Radio Emergency Services ARES talked to RM Ham about using the trailer for various exercises and public service events. To this end, VHF and UHF FM radios were installed and the trailer was used to support events. The first documented event was the Denver Marathon in 2006. Over time, more amateurs became interested in RM Ham and wished to be involved and become members. When that happened, those who founded the initial group needed to develop an organizational structure.

RM Ham – What Makes it Different?

RM Ham is a different kind of amateur radio group; it's not a club where you fill out an application, pay your dues and join. You can only become a member by participating with the group and over time, if you pitch in on a regular basis, you get an invitation to have your name added to the roster. The membership model is based on the reverse of the "Volunteer Principle" that many members of clubs, societies and guilds have heard time and time again. "Ten Percent of the members do 90% of the work." All of our members contribute and their membership is maintained through their willingness to continue to contribute. RM Ham is a small but dedicated group that has undertaken a variety of ongoing projects to benefit the amateur radio community and the communities in which we live. Once it became apparent that we were going to be spreading out into new and more innovative projects we knew we needed to incorporate. We

RM Ham University DMR Class. (Photo by Jeff Ryan K0RM)

QRV3 Operating position. (Photo by Jeff Carrier K0JSC)

incorporated as a nonprofit and applied for and received our IRS 501(c)(3) status shortly thereafter.

RM Ham is also an ARRL affiliated organization. Many of our members serve in positions within the ARRL field organization and through this involvement we spread the organizational model from Colorado to New Mexico. With the permission of RM Ham, Rocky Mountain Ham Radio – New Mexico Inc. (RM Ham-NM) was formed. Headquartered in the Albuquerque area they have the same values as RM Ham and both groups have cooperated in the design and implementation the microwave backbone that links a DMR repeater system between the states that was featured in last month's issue of *TSM*.[3]

RM Ham University – Sharing our Knowledge 4

Many of the hams involved with RM Ham are experts in their chosen fields and in many aspects of amateur radio as well. RM Ham has for the last four years offered classes on a variety of subjects of interest to amateurs. Topics have included DMR operation and code plug programming; projects for Raspberry Pi; repeater controllers and repeater linking. Classes are scheduled between October and April of each year and traditionally have been the third Saturday of the month. There is a $10 fee that has helped keep "no show" registrants to a minimum and covers the cost of a pizza lunch served at the end of the class. A few RM Ham members are employed in a local school district and have made arrangements for the classes to be held at a school facility. Speaking of the school; many RM Ham members are Volunteer Examiners and, in conjunction with the Cherry Creek Young Amateur Radio Club, sponsors W5YI VE Test sessions nine months out of the year utilizing the same school resources.

In a similar vein to our university, RM Ham-NM members sponsor an annual TechFest in Albuquerque. The TechFest is in February and is a full day event held in an event hall. Presenters are drawn from the ranks of both RM Ham groups and other amateurs who wish to share their expertise. In addition to presentations, there are demonstrations and poster boards on a variety of topics. There is a $10 registration fee that goes to cover coffee and snacks. An optional catered lunch is made available so that those who stay through the lunch hour can participate in conversations and observe demonstrations. RM Ham-NM goes all out and obtains donated items from amateur radio vendors and offers them in prize drawings for the participants.

When a new technology is introduced, it is sometimes a little difficult to obtain accurate information about it. RM Ham decided early on to make our research available and whenever possible share what we have developed or discovered via research so that others don't have to "reinvent the wheel"[4] For Example: we have reviewed many DMR radios and found some that are not truly compatible with two time slot DMR TDMA[5] and can wreak havoc on these systems when used. RM Ham's research is readily available to everyone at the website[4]. Our Code Plug Team has developed and maintains a large selection of sample code plugs for most of the popular DMR radios. Although these are configured for the Rocky Mountain Region, they provide a starting point for beginners to see how code plugs are developed. Couple this with the course material from RM Ham University's classes about code plug programming and new DMR users are well on their way to success. There are also operating tips and a DMR is FAQ available. RM Ham conducts a DMR Net the first Saturday of each month on the Rocky Mountain Wide talkgroup3 where all DMR users can keep abreast of the latest information on this technology and the status of the RM Ham backbone and DMR repeater system.

RM Ham – Mobile Communications – CommTrailer 20112

Over time it became apparent that the first communications trailer that was used for the Denver Marathon in 2006 was not designed for the roles that were currently being discussed for future RM Ham endeavors—especially public service. For example, the four operating positions shared one commercial grade VHF radio and one commercial grade

Bikes 'n' Brews Net controls in CommTrailer 2011. (Photo by Jeff Ryan K0RM)

QRV2 On Display at Loveland Hamfest (Photo Jeff Ryan K0RM)

UHF radio1. After deploying this trailer for four years, a new trailer was designed and built with public service, as well as contesting, in mind. CommTrailer 2011 was born and is still in use today. A full report on the new trailer was published in the May 2014 issue of *TSM*.

RM Ham – Mobile Communications – The QRV2 and QRV3

RM Ham has two retired mobile news vans, which were christened QRV2 and QRV3. The Quick Response Vehicle's monikers fit aptly with the amateur "Q code" QRV, which means "Are you ready?/I am ready." The first QRV was a donated former remote van that developed some mechanical issues that were beyond what we could handle but RM Ham-NM came to the rescue and towed it to Albuquerque where it is being refurbished.

QRV2 is a 1996 Ford E350 Econoline 4x4 Quigley Conversion Van equipped with a 47-foot Will Burt air mast with a rotor plate and a custom built nycoil[6] with two runs of coax for RF, two runs of CAT5 for controls and power cable. Power is supplied by an Onan 6500-watt, on-board generator with a custom built power system for DC with batteries and Samlex charger. A Motorola XPR4550 analog/DMR UHF mobile transceiver is mounted up front for the driver. There is a large array of equipment mounted in the back of the van that allows the QRV2 to provide complete "on scene" communications (Table 1). In addition to the mounted equipment, any radio/antenna combination can be pulled from the RM Ham inventory and quickly installed in the either QRV van.

Table 1 QRV 2 Equipment

Unit	Purpose
Motorola XPR4550 to roof from the rack	Analog/DMR VHF mobile patched
Motorola XPR4550 to roof from the rack	Analog/DMR UHF mobile patched
Icom ID5100 rack	Analog/DStar Dual band mobile in
Icom IC-746 side bulkhead	All Mode HF/2m patchable to out-
Kenwood TKR750 with duplexer	Analog VHF Allstar link repeater
Kenwood TKR850 with duplexer	Analog UHF Allstar link repeater
Mikrotik RB2011UiAS	Router for connection to any medi-
um allowing for direct VPN tunnel back to our network	
Ubiquiti Picostation 2HP	outside access point for hotspot use
Cradlepoint MBR1400	LTE to Ethernet router

The QRV3 is a 1997 Ford Econoline 350 4 x 4 Quigley Conversion Van. RM Ham designed QRV3 as a dual-purpose van for quick response and as a VHF Contest rover vehicle. Up front there is an Icom ID-880 Analog/D-Star transceiver and a permanently mounted Panasonic Toughbook CF-31 for driver communication, navigation and information. In the rear there is a permanently rack-mounted monitor and keyboard connected to a DC-powered computer. A patch panel allows the selection of antennas for the radios. Up top there is a 1.5-meter Ku-band uplink dish for both terrestrial or satellite communications and Yagi and halo antennas for 6-meters and 2-meters as well as 432 and 222 MHz. There are also eight additional antennas on the roof for patching to all of the radios. Power is provided by a built-in 3500-watt gasoline Onan generator. The additional radios and communications equipment, which is located in the back of the van is shown in Table 2.

Table 2 QRV 3 Equipment

Unit	Purpose
Yaesu FT-736	All Mode transceiver 6m 2m 432

RMHAM logo (Courtesy: RMHAM)

and 220

ICOM IC746PRO	All Mode HF through 2 meter all mode transceiver
SGC-230	HF Tuner With removable HF whip antennas on the roof
2 Kenwood TK-7180	Analog VHF commercial radios
2 Kenwood TK-8180	Analog UHF commercial radios
Motorola CDM-1550	Analog VHF remote base with channel steering and AllStar link module
Motorola CDM-1550	Analog UHF remote base with channel steering and AllStar link module
Motorola XPR4550	Analog/DMR VHF mobile
Motorola XPR4550	Analog/DMR UHF mobile
Motorola XPR8300	Analog/DMR UHF linked repeater
Motorola R1225	Analog Allstar Linked UHF repeater
2 Larsen NMO150/450	Dual band antennas with EMWAVE diplexers
Mikrotik RB2011UiAS	Router for connection to any medium allowing for direct VPN tunnel back to our network
Ubiquiti Picostation 2HP	outside access point for hotspot use
Cradlepoint MBR1400	LTE to Ethernet router
Pelco Esprit	Digital Camera mounted on the side of the 1.5 meter dish

RM Ham – Lending a Hand

RM Ham has partnered with other clubs and groups in the extension of our backbone and in providing our services to other amateurs that enhance the capabilities and performance of their systems3. RM Ham's largest public service event is the Triple C Bike Ride. We partner with the Broomfield Crossing Rotary to plan and staff the event every May. We also support charity events like the Dirty Thirty Trail Run in Golden Gate Canyon, Bike MS Denver to Fort Collins, Bikes 'n Brews Bike Event in Cañon City and many more. The CommTrailer 2011 is used as command center and wide coverage repeaters for the use of the organizations that are manning the events.

L-R: Chris KD0ZYF, RMHam-CO, Brian N5ZGT, RMHam-NM, Doug K2AD, RMHam-CO, accepting the Award from Hamvention chairman, Jim Tiderman N8IDS. (Courtesy: Hamvention)

RM Ham also works with other national groups. RM Ham hosted the 2015 Central States VHF Society Conference at the Denver Marriott Westminster in July of that year. The 2017 Central States VHF Society Conference was hosted by RM Ham-NM July 27-30 at the Sheraton Albuquerque Airport Hotel.

RM Ham supplies staffing and equipment support for disaster exercises in conjunction with ARES and many governmental agencies. We have supported National Disaster Medical System (NDMS) annual exercise for many years. The QRV3 was deployed at the Chemical Stockpile Emergency Preparedness Program (C-SEPP) exercise where a live video feed was streamed to the State EOC from Pueblo using the RM Ham backbone. Not all of our support efforts have been for exercises. In July 2012 RM Ham deployed CommTrailer 2011 as a mobile communications center to the Waldo Canyon fire in Colorado Springs. The CommTrailer 2011 was used to coordinate communications for the Red Cross in the many evacuation shelters that were set up for the disaster.

RM Ham – Having Fun

The last weekend in June finds amateurs all over taking to the outdoors for the ARRL Field Day, this year RM Ham was no exception. One of our members has a three-acre parcel of land in Park County, Colorado and it became the encampment for two-dozen RM Ham members, their families and pets. We took CommTrailer 2011, QRV2, QRV3, along with personal campers and tents. We had so many people in attendance we had to rent a Port-a-Potty!

RM Ham operated as a Class 3A Club portable station with all power "off the grid" using our Whisperwatt Diesel generator2 to power the entire encampment. We had two operating positions for 20 meters set up in CommTrailer 2011; one was phone and the other CW. The QRV3 was used for

QRV3 Internet Camera. (Photo by Joan Heinen KB0YRX)

Wildfire 392 (Photo by Joan Heinen KB0YRX)

40-meter phone. Our GOTA station was set up at the picnic table that served as the focal point for socializing and meals.

We had a 3-element tri-bander and 6-element 6-meter beam mounted on our tower trailer. A second 3-element tri-bander and a 40-meter dipole were mounted on the air-mast on the QRV2. Our GOTA station used a multiband vertical. We were using N3FJP's Amateur Radio Logging Software at all of the operating positions and it was networked to a central server using fiber between QRV3 and CommTrailer 2011. This software showed all of the sections worked and the total QSO's for each station and band. We used the portion of the rules that let us set up the day before and then operated from 1800Z Saturday until 1800Z Sunday. We made 113 CW, 26 Digital, and 820 Phone contacts for a total of 959 QSO's. We had 1098 points times a power multiplier of 2 and are claiming 509 bonus points. Claimed score 2705.

During our Field Day operation, we spotted smoke coming from north of our site. We contacted the County Sheriff and they were aware of the fire and the South Park Volunteer FD was on the scene. Since many of us had open receive VHF radios we began monitoring the fire crews on VFire21 154.28000 MHz. There were other Field Day operations in the vicinity and we knew some other hams that were six miles north of us. Making contact on two meters we determined that they were about a mile farther north of the fire placing it about five miles from us. Later in the day our friends were evacuated from their site and joined us. We contacted Colorado State Emergency Operations Center and offered to stream a live feed of the fire from the QRV3's Internet camera. They thought that would be helpful and displayed it on their monitors. The fire was named the 392 fire and consumed about 90 acres of trees and grassland. It was believed to be human caused and was still not 100% contained when we left.

Sunday morning one of the ladies who was with us posted a picture and this to Facebook: "I took my dog for a quick walk. And lo and behold what did I see 100 feet in front of me? A bear! I froze! My dog was totally clueless and could've been an easy snack! The bear backed up and took off into the trees thank goodness." Sunday Noon came and went and it was time to tear down and go home.

RM Ham – The Bottom Line

There is more about RM Ham that I haven't mentioned: our annual hamfest, fund raising, and the things that most clubs do. The Board of Directors and the members of RM Ham want to thank Ken and *The Spectrum Monitor* for this opportunity to pass our successes on to you; we'll reserve our failures for a future article. We also wish to encourage everyone to look at their organizations and if something that you read here takes your fancy, try it! If your group starts innovating and doing things differently and you find that they work, by all means please pass it on to the rest of us. Amateur radio is a fantastic hobby and there is much that can be done to make it grow and have it serve the world, our nation and our communities.

Footnotes:

1 More on the first trailer "A Trailer for All Seasons" December 2008 *Monitoring Times*

2 More on Comm Trailer 2011"Rocky Mountain Ham Radio Communications Trailer" May 2014 *The Spectrum Monitor*

3 "Rocky Mountain Ham Radio Microwave Backbone and DMR Repeater Network" *TSM* August 2017

4 **http://www.rmham.org** to see complete schedules, download past class presentations and sample DMR code plugs and other shared resources from RM Ham.

5 See *TSM* January 2017 Scanning America page 32 for more on this technology

6 See "Rebuilding a NyCoil for an Air Mast" in *Proceedings of the 2015 Central States VHF Society Conference*

TSM

Televes DATBOSS LR VHF/UHF antenna ($104) has a built-in amplifier. (Courtesy: Jet.com)

Impact of the FCC's TV Band Repack

By Mike Kohl

There are lots of unexpected expenses that now make it utterly certain that we will have to go back to the well for more money.

Only $1.75 billion has been supplied by Congress to pay back those that participated in the repack. As discussed in last month's *TSM* (page 8), there appear to be many developing situations where whatever can go wrong financially, it will go wrong, and deeper into red ink. Television stations shifted to certain frequencies by the FCC Repack may find that the cards that they have been dealt are really bad. WETA-TV in Washington, DC, is finding that the UHF-14 frequency they have been told to move to is precariously close to the low end of the Land Mobile Radio band, with thousands of users within a 50-mile radius, rendering it nearly unusable due to potential interference both ways. Separate from the fact that there may not be a good solution for WETA, even by applying for and getting another channel assignment, this is all going to cost more money than was proposed and agreed to during the Repack process.

As an urban station in one of the most congested spectrum markets in the USA, it was known in advance that the process would not be easy, and WETA may be the tip of a huge iceberg of not-yet-known complications as other stations begin the process. Whatever is decided, that station has until August 2019 to complete the process in its entirety.

Speaking of deadlines, the FCC has started setting some for stations that won cash payments in return for surrendering their spectrum. A group of stations has been told that January 23, 2018 is the final day that existing transmitters will be allowed on the air, in exchange for payments from the federal treasury that are now starting to be issued. Part of the process allows these stations to request up to two 90-day extensions to the above date. A peculiar twist to the payments to stations limits each transaction to under $100 million, so larger market stations that are entitled to hundreds of millions of dollars will be paid in several periodic installments. The market of Milwaukee, Wisconsin, had an unusual number of stations having to change frequencies during the repack process, with only one channel remaining on its original allocated frequency. An unusually large number of UHF stations (four in this market) requested and won permission to go off the air in exchange for payments from the auction. Analysis of this market can result in interesting interpretations about where the money goes, possible political influence, etc. These four stations agreed to over $315 million in compensation to give up their spectrum.

Religious channel WVCY has made arrangements to be carried on another local station, likely costing them only a small fraction of the auction proceeds, and the rest of the money available for various other investments and projects that include national religious radio networks. While not accountable to the public due to tax exemptions from its non-profit religious status, it can generally be assumed that most of any profits are reinvested to continue their religious mission.

PBS channel WMVT can easily double up their signal on sister PBS station WMVS, so all of that money will likely go to infrastructure directly or indirectly related to long term operation of PBS in the Milwaukee area. Given past attempts at reducing PBS funding at the national level, any windfall

such as this can plug the inevitable financial holes common when running a public television operation.

Weigel Broadcasting ceded WMLW's frequency, and should easily relocate as a tenant somewhere else in the Milwaukee spectrum as an independent television station; most likely on the airwaves of sister station WDJT-CBS.

Sinclair Broadcasting, which is one of those larger national organizations that already had two frequency allocations, had the ability to move their station WCGV to an existing frequency that they still owned (WVTV television). In a strange turn of events, they chose to turn in the WCGV license, go off the air, and take the money. Result was voluntary forfeiture of the ability to continue using the WCGV station at all, possibly wishing to gain favor with the FCC as parent company Sinclair Broadcasting attempts to get approval for the purchase of Tribune Broadcasting. That purchase in itself will require the divestiture of one or more stations in major markets to stay within the limit of two of the top four stations in a market, and it appears that Milwaukee was the self-chosen market to make this "sacrifice," while acquiring still another larger station in the Milwaukee market through the Tribune purchase of WITI-FOX, while parting with WCGV.

A quick study of the auction winners that were awarded over $100 million shows that while the majority are listed as going off the air, all but a very small number have already made sharing agreements with other stations and will continue on the air somewhere—even if that somewhere is also on the Internet. This was a once-in-a-lifetime opportunity for some broadcasters to cash in, and get paid to give up their licenses, even though they would truly not be leaving the broadcasting business.

Spectrum Auction Big Winners

Here is a listing of the top national recipients from the FCC auction: $304,050,240 WWTO-TBN Chicago. Going off the air.

- $214,023,017 WNBC-NBC New York. Going off the air.
- $211,680,472 WRNN-Independent New York. Going off the air.
- $198,965,211 WXTV-Univision New York. Going off the air.
- $193,892,273 WNJN-PBS Newark. Going off the air. $191,813,165 WZME-Me TV New York. Going off the air.
- $162,402,181 WTBY-TBN New York. Going off the air.
- $162,108,481 WLVI-ABC Boston. Going off the air.
- $161,723,929 WGBH-PBS Boston. Moving to Low Band VHF.
- $160,748,259 WPWR-MyN Chicago. Going off the air.
- $157,113,171 KVCR-PBS San Bernardino. Moving to Low Band VHF.
- $141,658,837 WSNS-Telemundo Chicago. Going off the air.
- $140,482,163 WFMZ-Independent Philadelphia. Going off the air.
- $138,059,363 WNJT-PBS Philadelphia. Going off the air.
- $138,003,711 KOCE-PBS Los Angeles. Going off the air.
- $135,542,845 KJLA-Independent Los Angeles. Going off the air.
- $134,987,151 WYDN-Daystar Boston. Going off the air.
- $131,578,104 WYBE-Educational Philadelphia. Going off the air.
- $130,510,880 KLCS-PBS Los Angeles. Going off the air.
- $126,107,725 WXFT-UniMas Chicago. Going off the air.
- $125,932,367 WLWC-CW Providence. Going off the air.
- $125,903,049 WWSI-Telemundo Philadelphia. Going off the air.
- $125,568,545 WUVN-Univision Hartford. Going off the air.
- $124,801,961 WNVC-Independent Washington. Going off the air.
- $123,474,177 KWHY-Spanish Independent Los Angeles. Going off the air.
- $122,912,964 WJTB-Baltimore. Going off the air.
- $121,752,169 WLVT-PBS Philadelphia. Going off the air.
- $121,992,349 WDCW-CW Washington. Going off the air.
- $120,974,061 WNYJ-Religious New York. Going off the air.
- $118,834,183 WDCA-MyN Washington. Going off the air.
- $114,173,699 KTNC-Religious San Francisco. Going off the air.
- $109,592,126 WCTX-MyN Hartford. Going off the air.
- $108,475,345 WXBU-Independent Harrisburg. Going

Winegard's FlatWave ($100) TV antenna in a 16-inch square box claims to be VHF capable, but you should be near the station. (Courtesy: Winegard)

off the air.
- $105,731,122 WCWG-CW Greensboro. Going off the air.

Despite the reported $1.75 billion set aside by Congress to pay winners in the spectrum auction, there are many surprises awaiting the FCC that perhaps should have been expected in advance, which will now hit everyone in the backside in a bad way. In order for transmitter and antenna changes to be made at most facilities, other operations at that location must be shut off to allow personnel to safely climb the towers and do their work without the worry of RF radiation in their presence. Normally, such changes are done in the middle of the night on weekends, to minimize interruption of viewing for the general public.

The number of simultaneous changes required are going to make this very complicated to coordinate, and it appears that nobody thought about the many radio stations that occupy the same transmitting towers with their own RF transmissions. Not one red cent has been requested to compensate radio stations to go off the air temporarily, or make temporary arrangements to use auxiliary facilities at other locations. This is especially critical for any public radio stations caught in these events, as they may not have any dollars to spend, given a hostile President and Republican dominated Congress that would like them off the air. Public and commercial radio stations will need to stand in line to force Congress to fund their expenses. Potential expenses that could be argued include but may not be limited to engineering fees, permits, equipment and additional site rentals, loss of revenue, added personnel expenses to make these changes, and others.

Also forgotten in the confusion were the interests of amateur radio as well as low powered television translators. Amateur repeaters have been increasingly located at or near common city tower locations or "antenna farms," and will face the same total lack of funding that faces broadcast radio stations. They may have to go off the air completely for periods of time, while installation is being completed and testing done on new television facilities. Congress needs to consider the amateur radio community, who stand in the background as an unpaid emergency services communications network during times of disaster. All ham operators in the USA need to be aware that their local operations may be impacted, and take steps to minimize these threats to their operations such as communicating with other users of their tower facilities. If things need to go off the air for a few hours, discuss the impact with the local amateur radio club, and if it becomes necessary to move to auxiliary locations for any period of time, document anticipated costs, and report them to the appropriate authorities such as the Federal Communications Commission. Consult with your local congressman if there is a need for funding.

In the midst of all of this craziness is a shining light from an unexpected source—T-Mobile, an upstart effort that spent over $8 billion in the spectrum auction and won 45%

Channel Master's CM2020 VHF/UHF outdoor antenna is $100 without rotator, amplifier or mast. (Courtesy: Channel Master)

of that spectrum. They have volunteered to cover the costs for public broadcasting (PBS) translators to switch out to their new frequencies. This should cover new equipment and engineering costs, installation, legal and other fees for at least 284 of the 561 translators transmitting PBS programming. This is huge, because if nothing was done, PBS had calculated that up to 38 million viewers would be lost because of the latest digital transition. While full-powered stations were covered in the original FCC plan, low powered translators that relay PBS signals to rural areas were completely forgotten, Utah, the state with the most translators, stood to lose over half of them, and will now save all of their public rebroadcasts due to the generosity of T-Mobile. The situation is duplicated in neighboring western states such as California, Oregon, Washington, Idaho, Montana, Nevada, Colorado, Arizona, New Mexico and Texas. No such reprieve has been given to translators of commercial stations, but T-Mobile's plan has shown that with a bit of cooperative thinking, it can be a win-win situation for all involved. One needs to only think back to 2011, when Canada was faced with a similar situation with Public TV broadcaster CBC and over 600 low-powered relays. Nobody acted, and all analog stations were shut down permanently, thereby depriving most of rural Canada of over-the-air reception of their public broadcaster.

T-Mobile is not completely altruistic with this donation. Let's call it a polite way to grease the wheels of progress, and at the same time, benefit all parties involved. The frequencies that they purchased are in widely spread out areas of rural America, which T-Mobile would like to have available ASAP for build-out of its 600 MHz wireless network by the end of 2017. Once that is in place, these same rural areas being gifted PBS translator moving expenses will also have much improved cellphone and wireless service. Anything to speed the process means that T-Mobile will be in a profit mode sooner than later.

TSM

Scanning America

By Dan Veeneman **dan@signalharbor.com**

Dubuque County, Iowa, and RACOM

The financial and technical challenges of operating and maintaining a public safety radio system have led to alternative arrangements for municipalities that don't want to own their own network. These public-private partnerships generally have a private company owning a network and providing technical support and maintenance while the public agencies use the system and pay for service.

Dubuque County, Iowa

Dubuque County, Iowa, is upgrading their public safety radio system from an analog trunked system to digital Project 25 (P25) technology.

Dubuque County is located in eastern Iowa, across the Mississippi River from Illinois and Wisconsin. The county is home to more than 93,000 residents, more than half of whom live in the county seat of the city of Dubuque. The county covers 617 square miles, with generally rolling hills near the river and flatter toward the west. A total of 13 fire departments, operating out of 21 fire stations and staffed with a total of 550 first responders, handle an average of 7,600 calls for service each year.

As part of the upgrade, the county will also replace the existing analog voice paging for its volunteer firefighters to a digital alerting solution.

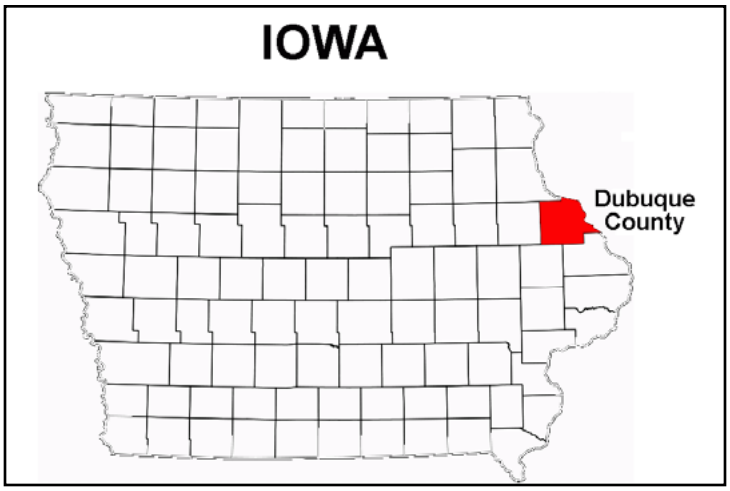
The upgraded system will eventually operate from a dozen repeater sites that will provide improved coverage across the county and better indoor coverage in towns. The system will also be used to activate all of the outdoor warning sirens.

RACOM Network

The current Dubuque County system is a public-private partnership with RACOM Critical Communications, headquartered in Marshalltown, Iowa.

The RACOM network operates in half a dozen states and serves more than 300 agencies, with a total user base of almost 10,000 radios. RACOM provides service for all Iowa State Patrol dispatch centers, hospitals, medical helicopters, county public health agencies and nearly all state emergency management agencies and emergency operations centers. Numerous local law enforcement and fire departments also use the network.

RACOM ("Radio Communications") was formed in 1972, selling two-way radios across the upper Midwest. In 1993 RACOM acquired enhanced specialized mobile radio (ESMR) licenses and began to build a network. Rather than try to sell the repeater sites, antennas and buildings to the end user, RACOM kept ownership of the infrastructure and simply sold radios and airtime, in a manner similar to cellular telephone networks. Under this business model, smaller government agencies and private companies could gain access to a network and technology that they might not otherwise be able to afford.



RACOM maintains a local office in Dubuque to support a business relationship with the county that dates back to 1997, when the county board made the determination that a public-private partnership was the most cost-effective way to provide two-way radio communications services. The existing Dubuque system, now about 20 years old, was originally provided by RACOM for $3 million plus $250,000 a year in maintenance and airtime costs. Other bids for an equivalent radio system that the county would have to own and maintain came in at about $9 million.

EDACS

The core radio technology in the RACOM network is Enhanced Digital Access Communications System (EDACS), originally developed by General Electric and later improved by Ericsson. The first system was installed in 1988, and by 2001 about 400 systems were in operation. A series of business purchases ultimately resulted in Harris Corporation owning the technology in 2009. In 2012, Harris

announced end-of-life for EDACS, with all support ceasing by December of 2017. Product manufacturing, improvements, and new development for EDACS soon ceased, and critical parts became more difficult to source.

At one point General Electric, later Ericsson GE, owned one-third of RACOM and established them as the exclusive distributor of EDACS technology in several Midwestern states. Although ownership subsequently changed, RACOM still provides EDACS service to a number of customers. The end-of-life announcement caused RACOM to begin planning for a transition to Project 25 technology, which they explained to their customers this way:

We at RACOM have decided that we will gradually migrate the RACOM Network from one based on EDACS to one based on a digital IP, APCO P25-compliant platform. That migration will begin in the third quarter of 2011 with the installation of the redundant, geographically split, master P25 controller switch; the first P25 tower sites; and the communications gateway that will link the EDACS-based technology to the P25-based technology. A RACOM Network based on P25 will provide several benefits to end users:

•Compliance with federal P25 recommendations

•Synchronicity with the ISICSB master plan for Iowa

•Common technology to provide interoperability with the statewide networks in Minnesota, Illinois and Nebraska

•Next-generation technology platform with a life of at least 1.5 to 2 decades

•Ability to use radios from multiple manufacturers of P25-compliant mobiles and portables

•Ability to purchase radios to use on the network from multiple vendors of P25 compliant radios

Dubuque County began planning for this transition early, by purchasing mobile and portable radios capable of operating over both EDACS and P25 networks, and by 2014 had nearly all county fire and law enforcement agencies ready to go. The current system serves approximately 122 mobile, 480 portable, and 38 control station radios.

The system uses a combination of 800 MHz frequencies licensed to RACOM and to Dubuque County.

EDACS supports both analog and digital voice traffic and uses a dedicated control channel to communicate talkgroup requests and assignments between radios and base stations. Frequencies are assigned a number between 1 and 25, called a Logical Channel Number (LCN), and only the LCN is carried on the control channel. For scanner listeners, this means that EDACS frequencies must be programmed into the proper memory locations in order for conversations to be properly tracked.

A number of repeater sites serve Dubuque County. Each site is linked back to a central switch in Marshalltown via T1 leased telephone lines and provides EDACS service on the following frequencies. Be sure to read your scanner manual for the correct way to program each frequency into the proper memory location for the assigned LCN.

(Courtesy: Dubuque Communications)

Repeater Site: Dyersville, IA

LCN	Frequency
06	861.6125
07	854.6125
12	859.1125
13	860.1125
14	861.1125
17	855.4875

Repeater Site: Dubuque, IA

LCN	Frequency
01	857.4625
02	858.4625
03	859.4625
04	854.7125
05	858.7125
06	859.7125
07	856.1625
08	856.7125

Repeater Site: Cascade, IA

LCN	Frequency
11	854.9625
12	855.9625
13	857.9375
14	859.9375

Repeater Site: Peosta, IA

LCN	Frequency
02	857.1375
04	859.1375
05	860.1375
06	861.1375

Repeater Site: Sherrill, IA

LCN	Frequency
09	856.5125
13	860.5125

Repeater Site: Dubuque-2, Iowa

LCN	Frequency
01	856.0875
02	857.0875
03	858.0875
04	859.0875
05	860.0875

EDACS talkgroups are organized into hierarchies. A system has a number of agencies. Each agency has a number of fleets, and each of these fleets has a number of subfleets. This Agency-Fleet-Subfleet scheme is abbreviated as AFS.

Decimal	AFS	Description
545	04-041	Heartland Emergency Medical Services
1609	12-091	County Fire (Dispatch, patched to 154.1750 MHz)
1610	12-092	Dubuque City Fire (Dispatch)
1611	12-093	County Fireground 2
1612	12-094	County Fireground 3
1613	12-095	County Fireground 4
1614	12-096	County Fireground 5
1615	12-097	County Fireground 6
1616	12-100	County Conservation
1617	12-101	County Sheriff 1 (Dispatch)
1618	12-102	Dubuque City Police (Dispatch)
1619	12-103	Dubuque City Police Tactical 9
1620	12-104	Dubuque City Police Tactical 10
1621	12-105	Dubuque City Police Tactical 11
1622	12-106	Dubuque City Police Tactical 12
1623	12-107	Dubuque City Police (Car-to-Car)
1625	12-111	Dubuque City Police 1
1626	12-112	Dubuque City Police 2
1627	12-113	County Sheriff 2
1628	12-114	Holy Cross Law Enforcement Assistance (Patched to 155.7000)
1629	12-115	County Mutual Aid (Patched to 155.4750)
1630	12-116	County Emergency Management Agency 1
1631	12-117	County Emergency Management Agency 2
1634	12-122	Ambulance to Finley Hospital
1635	12-123	Ambulance to Mercy Hospital
1640	12-130	Local Community Channel 1
1641	12-131	Asbury (Local Agencies)
1642	12-132	Local Community Channel 2
1643	12-133	Local Community Channel 3
1644	12-134	Epworth (Local Agencies)
1645	12-135	Farley (Local Agencies)
1646	12-136	Local Community Channel 4
1647	12-137	Cascade (Local Agencies)
1648	12-140	Bernard (Local Agencies)
1649	12-141	Local Community Channel 5
1650	12-142	Key West (Local Agencies)
1651	12-143	New Vienna (Local Agencies)
1652	12-144	Sherrill (Local Agencies)
1653	12-145	Worthington (Local Agencies)
1654	12-146	Local Community Channel 6
1655	12-147	Local Community Channel 7
1656	12-150	Dubuque City Public Works
1658	12-152	Dyersville Police (Dispatch)
1659	12-153	Dyersville Police

Several conventional (non-trunked) analog frequencies are also in operation:

Frequency	Description
151.0250	Dubuque Highway Department
154.1750	Dubuque County Fire (Dispatch)
154.2800	State Fire
155.4750	Law Enforcement Mutual Aid
163.2500	Mercy Health Center (Maintenance)
854.7875	Mercy Health Center (Security)

Transit Agency Switches to Cellular

The Siouxland Regional Transit System (SRTS) operates in seven counties around northwest Iowa, northeastern Nebraska and southeastern South Dakota, serving about 200,000 residents as well as providing specialized services for the disabled. Last year SRTS traveled more than one million miles and provided about 180,000 rides. The service area is mostly rural, with only a few larger communities, including school systems and Sioux City agencies.

Until recently SRTS was paying about $35,000 a year for radio installation and maintenance, including a monthly $2,500 service fee for renting space on the local RACOM trunked 800 MHz system. They were also operating dispatch services out of Sioux City and Anthon, both in Woodbury County, Iowa, using 463.6250 MHz.

Six dispatcher positions and 50 bus radios were reaching end-of-life and SRTS was facing a potentially expensive upgrade process, with new radios priced between $800 and $1,200 each. In addition, bus operators were forced to handle unwieldy radios while driving, and there were coverage gaps along many of the routes.

Rather than continue to use traditional Land Mobile Radio (LMR) equipment, SRTS chose to use the Verizon commercial cellular network for coverage. Each bus driver was equipped with a cellular-enabled Samsung tablet while each dispatcher was issued a Samsung Galaxy smartphone. Dispatch software provides schedules, updates, and special instructions to the drivers via the cellular network.

SRTS employees also use an application that provides push-to-talk over cellular (PoC) audio connectivity over the same commercial network. Bus drivers are organized into geographic groups, allowing dispatchers to talk to drivers one service area at a time rather than everyone hearing everything. The application also maintains a history of all conversations, which can be replayed at a later time. Each driver was also issued a Bluetooth-based headset, allowing him or her to use the push-to-talk feature without having to touch the tablet and while assisting riders outside the bus.

The entire solution, including driver tablets, dispatcher smartphones, software applications and data-enabled cellular service, costs SRTS about 70 per cent per year less than the previous LMS setup. According to SRTS, wireless coverage is as good as or better than the 800 MHz system, even in the most rural areas.

The next step for SRTS is to implement live video streaming from the video camera system installed in every bus. This will require additional cellular bandwidth and the use of an in-vehicle Internet Protocol (IP) router. Tests have shown that dispatchers can see and hear live activity on the bus, as well as download and review content from the digital video recorder in case of emergency or after an incident. The use of such a router may also enable free Wi-Fi service for passengers.

SRTS is considered a non-mission-critical service, so ultimate reliability is offset by cost sensitivity.

Dispatch and voice services are completely reliant on Verizon. If there is a problem with the Verizon network, buses will be out of contact with dispatchers, since there is no backup option. With the LMR system, cellular was the backup option.

Consumer-level products like the Samsung tablets are certainly less rugged than traditional LMR radios, but the substantial cost savings makes it possible to have spare tablets and smartphones on hand and simply replace them when they fail.

Crowded Skies

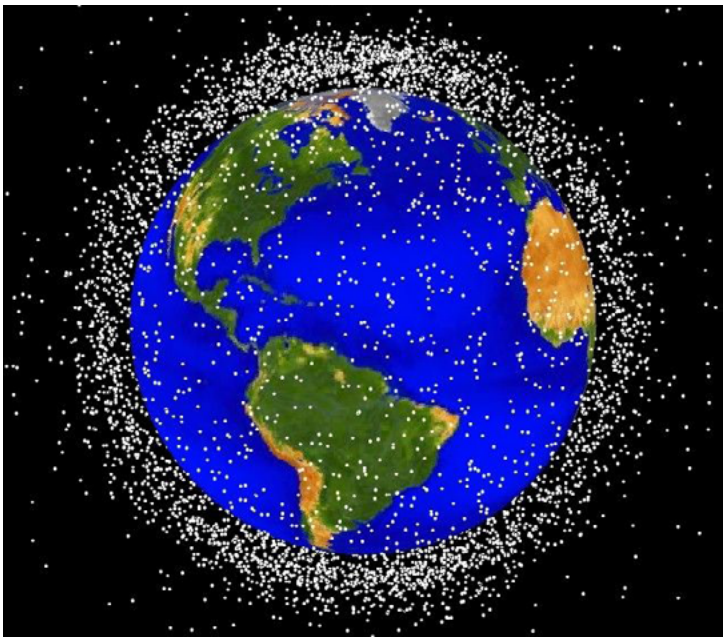
At the end of August, the Federal Communications Commission accepted several applications for commercial satellites. If these and previous applications are approved and the satellite operators actually launch even a fraction of the planned satellites, the space above our planet is going to become very crowded.

Many of these proposals intend to use a part of the spectrum called V-Band, with frequencies between 37.5 and 42.0 GHz used for communication from the satellite (called Space-to-Earth) and between 47.2 and 50.2 GHz for communications up to the satellite (Earth-to-Space). V-band is also being considered for fifth-generation (5G) personal communications services.

Boeing joined the push for satellite-based V-band service last year when it applied to launch as many as 2,956 low earth orbit (LEO) satellites, to orbit at 1,200 kilometers (750 miles) above the Earth in what is known as Low Earth Orbit (LEO). Operation at V-band from so many satellites would allow broadband Internet service directly to individuals, businesses, and government customers.

A company called OneWeb has proposed a constellation of 648 satellites operating at 1,200 kilometers altitude. A March filing with the FCC included a request for 720 satellites at 1,200 kilometers and 1,280 satellites in medium Earth orbit (MEO), all operating in V-band.

Space Exploration Holdings, LLC, better known as



(Courtesy: NASA)

SpaceX, seeks to add V-band spectrum to previously requested 4,425 satellites, which will orbit at altitudes ranging from 1,110 km to 1,325 km. These satellites will communicate with users at both Ku-band and V-band. SpaceX has also applied for a "very low earth orbit" constellation of 7,518 satellites orbiting between 335 km and 346 km. For comparison, the International Space Station (ISS) orbits between 330 and 435 kilometers above the Earth.

Telesat Canada intends to fly 117 satellites, some in polar orbits at 1,000 km and some in inclined orbits at 1,248 km, all operating in V-band.

O3b Limited has requested access to U.S. frequencies for 24 satellites in the O3bN constellation that will operate in circular equatorial orbit at frequencies of 17.8 to 18.6 GHz and 18.8 to 19.3 GHz (Space-to-Earth) and from 27.6 to 28.4 GHz and 28.6 to 29.1 GHz (Earth-to-space).

Other companies have applied for authority to operate under the Earth Exploration Satellite Service (EESS), which uses passive and active sensors onboard satellites to monitor and measure the Earth's environment, including temperature, humidity, cloud cover, atmospheric gas concentrations, ocean waves and sea states, as well as ice and snow.

Astro Digital U.S. Inc. seeks to fly 30 satellites between 475 and 625 km, deploying as many as 100 satellites over 15 years. These will operate at frequencies of 25.5 to 27.0 GHz (space-to-Earth) and 29.9 to 30.0 GHz (earth-to-space).

Planet Labs, Inc. wants to operate 600 satellites at 500 km altitude, with 120 of those rising as high as 550 km. They will transmit at 8025 to 8110 MHz (Space-to-Earth) and receive from 2025 to 2100 MHz (Earth-to-Space).

There are already more than 18,000 man-made objects currently in orbit around the Earth and tracked by the U.S. Space Surveillance Network. Each dot in the image represents a satellite, whether functional or not, or a piece of debris. In a few years this image may have many, many more dots.

TSM

Federal Wavelengths

By Chris Parris **cparris@thefedfiles.com**

Portable WHCA Trunked Systems

For many years, there have been stories, rumors and even some physical evidence of a transportable trunked radio system used when the President of the United States (POTUS) travels around the world. These trunked systems are not for Secret Service protective detail radio communications, but rather for the White House Communications Agency (WHCA) and the White House Military Office personnel that provide communications and operational support for the White House staff and others who travel with POTUS.

The first stories of a portable trunked system came to light when trunking in the federal government bands was still a relatively new thing. In early 2004 information surfaced that there existed a mobile trunked radio system was carried on board the VC-25 aircraft used to transport POTUS and was deployed, as needed, at locations where the Presidential protective detail and White House staff required wide area communications. Another version of this was that the trunked system was actually build in to the VC-25 aircraft and used while it was parked and on the ground.

Until recently, it was assumed that the trunked system used the UHF federal bands between 400-420 MHz. To review, here are the known allocations for the White House Communications Agency and what they are most likely used for:

406.2000	Washington DC area
406.3000	Washington DC area
406.4500	Transportable Trunking System
407.1250	Transportable Trunking System
407.4750	
407.5250	Washington DC area
407.6750	Wideband UHF reported
407.8000	Transportable Trunking System
407.8500	ECHO Nationwide (no longer in use)
408.5250	Transportable Trunked System
408.8500	Transportable Trunking System
408.8750	Transportable Trunking System
408.9250	Transportable Trunking System
408.9375	Washington DC area
409.2500	Washington DC area
410.3875	Transportable Trunked System
410.5875	Transportable Trunked System
410.8875	Transportable Trunked System
410.9875	Transportable Trunked System
415.6750	Wideband UHF reported

One of the VC-25 aircraft commonly referred to as "Air Force One." (Courtesy: whitehouse.gov)

415.7000	FOXTROT Nationwide (no longer in use)
415.8000	
418.2750	Transportable Trunking System
418.3750	Transportable Trunking System
418.4000	Transportable Trunking System
418.5000	Transportable Trunking system
418.5250	Transportable Trunking System

The latest version of this story is that some listeners in the New York/New Jersey areas were hearing possible P-25 trunked transmissions in the 380 to 400 MHz Department of Defense band that were related to a POTUS visit to the New York City area. One listener in New Jersey, who posted his findings in a popular scanner forum, said that he heard clear communications regarding the motorcade and status of the ground equipment with Air Force One over these UHF frequencies:

382.7500	
385.3125	N293
386.2250	N582
386.8000	N582

Some have suggested these might be from Fort Hamilton in the Bronx, but the frequencies don't match up. The Fort Hamilton site is part of the Joint National Capitol

Region (JNCR) trunked system in the Washington, DC area. Here are the specifics:

Fort Hamilton, NY
System ID 00B
Site 1-001
380.0750
380.2750
380.4250
380.5750
380.7250

There has been a suggestion that this is a mobile trunked site that is related to the JNCR trunked site at Joint Base Andrews in Maryland. Here are the specifics of that site:

Joint Base Andrews
System ID 00B
Site 1B-101
385.2125
385.3125
385.9000
385.9125
386.2000
386.3375
386.5000
386.6375
386.8000
386. 0375

Indeed, two of the frequencies match those at Andrews. However, the use of the "default" Network Access Code, or NAC of N293 doesn't match up with what would normally appear on the Andrews trunked site.

Others have noted that two of the frequencies are utilized at one of the trunked sites in update New York at West Point Military Academy. Here are the specifics of that site:

West Point, NY
System ID 58A
Site 302
385.9000
386.0500
386.2250
386.8000
387.2125

We can see that not only are two of the frequencies used at West Point, but the P-25 NAC matches what would likely be used on this system (Often P-25 trunked systems use a NAC that is derived from the System ID).

With this small amount of information, what can we conclude? My first impression is that the original poster who heard this activity probably did catch some traffic from the West Point trunked system and assumed it to be related to the POTUS visit. The frequencies and P-25 NAC obviously

A KC-135 aerial refueling tanker based at Fairchild AFB. (Courtesy of the author)

match up with the West Point system. And I have heard the West Point system from the NYC area in the past. But the two frequencies that don't match up with the West Point system do provide some interesting possibilities. The original posted was pretty positive about the voice traffic he heard was definitely related to POTUS motorcade movements. It certainly would not be outside the realm of possibility that the WHCA would use these 380 MHz frequencies conventionally, and also not so far-fetched that they could carry a portable trunked system on these frequencies. But I can't say with any certainty that this is what is happening.

In any case, more information is needed! Next time there is a visit nearby by the President (POTUS), or Vice President (VPOTUS), please take the time to search the 380 to 400 MHz band and see what you hear.

Fairchild Air Force Base, Washington

Fairchild Air Force Base, located near Spokane, in eastern Washington, started out life as the Spokane Army Air Depot back in 1940. Local business owners and citizens raised the money in order to bring the base to Spokane. The base was renamed in 1951 in honor of General Muir S. Fairchild.

Fairchild was at one time home to the 92nd Bomb Group, flying the B-29 Superfortress. The base also supported the B-36 Peacemaker for a time in the early 1950's. The base became home to B-25 bombers in 1956 and KC-135 tankers in 1958. During the Cold War, a ring of nine Atlas intercontinental ballistic missiles silos surrounded Spokane and Fairchild Air Force Base. These were operational from 1961 through 1965, as part of the Air Force's 567th Missile Squadron. The bombers moved away in 1993, making aerial refueling the base's primary operational function.

In addition to the tankers, Fairchild is home to the Air Force Survival School. The 336th Training Group teaches

SERE tactics, Survival - Evasion - Resistance - Escape. Some of the real-world training takes place in the nearby Coleville National Forest.

The base itself is served by a VHF P-25 digital trunked radio system. This system was a Motorola system years ago (the last time I was at the base), but has since been upgraded to a true, P-25 system. Base personnel that I spotted with radios seemed to be using mostly Motorola APX radios. The system appears to be a single site with no networking to anywhere else, but with the recent trend of military base radio systems being networked with other bases, I would not be surprised if that happened in the future here at Fairchild. Here are the specifics of the base trunked system:

Fairchild Air Force Base
System ID 5E1
WACN BEE00
Site 001
138.0250
138.0375
138.0625
138.1375
138.1625
138.3375
138.3625
138.4125
138.4375
138.5125

The only clear traffic I was able to catch were from the Fire Dispatch (talk group 31801) and the Security Police (talk group 31300), but only "All Call" informational broadcasts were in the clear. All other activity was encrypted.

One question several people have asked is why the system is using frequencies in the 138 to 144 MHz band, rather than the 162 to 174 MHz, or 406 to 420 MHz bands. I have no direct knowledge, but I suspect that Fairchild falls within a critical distance of the U.S – Canada border, radio frequency allocations, even for the military, can result in some unusual channels being used.

In addition to the trunked system, there are a number of VHF and UHF conventional frequencies allocated to the base. While on base for the 2017 Skyfest air show (more on that later), I spotted a variety of antennas on hangers, buildings and small towers located all over the base. I have confirmed a few of the UHF air band frequencies, and have information that some of the VHF channels are being used for the USAF Survival School training. Here is a compilation of my database of conventional frequencies for Fairchild Air Force Base, as well as some Washington National Guard frequencies from nearby Spokane International Airport (KGEG):

118.3000	AM	Spokane (GEG) Tower
120.3500	AM	Fairchild (SKA) Tower
121.8500		

The Federal Protective Service mobile command post on display at the Fairchild AFB Skywest near Spokane, WA. (Courtesy of the author)

121.9000	AM	Spokane (GEG) Ground
122.9500	AM	Spokane (GEG) Unicom
123.6000	AM	Fairchild (SKA) Ground
123.7500	AM	Spokane (GEG) Approach/Departure
124.3000	AM	Spokane (GEG) Approach/Departure
124.3250	AM	Spokane (GEG) ATIS
124.7000	AM	Spokane (GEG) Approach/Departure
126.2000	AM	Fairchild (SKA) Tower (alternate)
133.3500	AM	Spokane (GEG) Approach/Departure
134.1000	AM	Fairchild (SKA) Radar Approach
139.3000	AM	Pilot-To-Dispatch
139.3500	AM	Survival School helicopter
139.6250	FM	Survival School
139.8250	FM	Survival School
139.8750		
141.7500		
141.9000		
142.2250	FM	Survival School Operations
143.8250		
148.2250		
149.1500		
149.1750	FM	Survival School Operations
149.3000		
150.0750		
150.1250		
150.1500		
150.1750		
150.2000	FM	Survival Operations Repeater
150.2250		
150.2500		

150.2750		
150.3000		
150.3250		
150.3500		
150.3750		
150.4000		
150.4750		
150.5250		
150.6500		
150.6750		
163.2750		
163.4625		
163.4875		
163.5125		
163.5875		
164.5000		
165.1625		
173.4375		
173.5125		
173.5375		
173.5625		
173.5875		
233.7000	AM	Fairchild (SKA) Tower
234.8000	AM	PMSV Weather
236.0000	AM	Survival Training
238.3000	AM	Maintenance
239.0250	AM	Washington Army Guard helicopters
240.1500	AM	SOF - Supervisor of Flying
240.5000	AM	
251.9000	AM	Survival Rescue Training
253.4000	AM	Maintenance
254.3750	AM	Spokane (GEG) ATIS
254.7000	AM	Survival Training
256.4000		
257.6250	AM	Fairchild (SKA) ATIS
263.0000	AM	Spokane (GEG) Approach/Departure
269.2500	AM	Fairchild (SKA) ATC
275.8000	AM	Fairchild (SKA) Ground
278.3000	AM	Spokane (GEG) Tower
282.2500	AM	Spokane (GEG) Approach/Departure
289.6000	AM	Fairchild (SKA) Tower (alternate)
293.7000	AM	Maintenance Operations
301.6000	AM	Survival School Training
314.3000	AM	Training
311.0000	AM	Command Post STRIKEHAWK
321.0000	AM	Command Post STRIKEHAWK
339.3000	AM	Fairchild (SKA) Radar Approach
348.6000	AM	Spokane (GEG) Ground
359.0000	AM	Training
363.8000	AM	Fairchild (SKA) Radar Approach
372.2000	AM	Pilot-To-Dispatch
372.5000	AM	
375.2000	AM	USAF METRO
381.3000	AM	Command Post
384.9000	AM	Fairchild (SKA) Radar Approach
385.0000	FM	Army Guard
387.4875	FM	Army Guard
388.8500	AM	Maintenance
389.8000	AM	Fairchild (SKA) Radar Approach
389.9125	FM	Army Guard
396.9000	AM	ANG Command Post 141ARW
407.4500	FM	
413.0000	FM	
413.4500	FM	

The Thunderbirds mobile communications trailer, referred to as the Comm Cart. (Courtesy of the author)

Fairchild 2017 Skyfest Airshow

As I mentioned earlier, the main reason for the visit to Fairchild and the Spokane area was not only to monitor the base and its air activity, but also to attend the 2017 Skyfest Airshow and Open House. These types of air shows used to be an annual event at Fairchild, but many military bases have cut back or even eliminated their annual air shows.

This year's show featured a number of military demonstration teams, including the F-18 Super Hornet "Rhino" team, a pair of A-10 Warthogs from Whiteman Air Force Base in Missouri, and a live demo of a helicopter rescue featuring members of the Air Force Survival School. Civilian demo teams included several groups of WWII vintage aircraft, wing walking and stunt flying. The show program occasionally featured an inbound or outbound military aircraft that departed or arrived between acts. Several KC-125R tanker aircraft were allowed to make low passes along the show line before the landed. And at least on C-17 aircraft departed just prior to show start, adding a slow pass around the base to say goodbye to the crowds.

Unfortunately, this year's air show had special security requirements and prohibited scanners along the secured

flight line. I attended the first day of the air show without any radios with me, but the second day of the show, I sat in my vehicle in the parking area and used the scanners outside of the secured area. I had several security personnel stop by and ask what I was listening to, but none were concerned, just curious. Here are some of the active frequencies used for the air show performances:

120.3500	AM	Air Boss (Fairchild control tower)
134.1000	AM	Discrete
141.5750	127.3 PL	Civil Air Patrol Explorers
251.9000	AM	USAF Survival School demonstration helicopter
139.8000	AM	Diamond
141.1750	AM	Diamond
149.6500	AM	Diamond
235.2500	AM	Solos
322.9500	AM	Solos
413.2750	FM	Travel radios
413.3250	FM	Travel radios
530.5000	FM	Comm Cart
534.6250	FM	Comm Cart
535.2500	FM	Comm Cart

The highlight of the show was obviously the USAF Thunderbirds. On the particular day I attended, Thunderbird #6 had a problem at the departure end of the runway before the performance and had to switch aircraft. This delayed the show about 30 minutes. But once up in the air, things went smoothly.

Thunderbirds radio frequencies are well known, and scanner listeners across the country have confirmed what channels are used at every performance. In this case, it appears that 141.1750 and 235.2500 were used for the practice flights and at the Skyfest show. The Thunderbirds ground communications "Comm Cart" has previously been heard using 900 MHz channels for their wireless mic and headset links to the announcers of the air show, but recently they have begun using 500 MHz commercial RF gear for their operations. Thunderbird ground team members have been see carrying UHF radios and have been noted on 413 MHz frequencies in the past.

A part of the Thunderbirds demonstration that many in the air show crowd don't get to see is the precision performance of the pilots and ground crew as they prepare for taxi and takeoff, as well as the return and shutdown of the aircraft after the planes are finished. Every movement of the ground crew and equipment is coordinated and timed with amazing precision.

Federal Wavelengths Frequency List Legend

Unless otherwise noted, frequencies listed are FM and frequencies are shown in Megahertz (MHz). Frequencies listed will show additional information as follows:

PL	CTCSS Tone Squelch
D	DCS Digital Coded Squelch
RID	APCO P25 Radio Identification Number
CSQ	Carrier Squelch, no squelch tone
N	APCO P25 digital Network Access Code (NAC)
DMR	Digital Mobile Radio, marketed by Motorola as TRBO
NXDN	Nexedge Digital, marketed by Kenwood
WACN	Wide Area Communications Network, an APCO P25 trunked network Identifier

TSM

Milcom

By Larry Van Horn N5FPW MilcomMP@gmail.com

21st Century Military Monitoring – This Isn't Your Daddy's Milcom Anymore

U.S. Navy FA-18 Super Hornet takes off from the USS Stennis (Photo courtesy US Navy)

Having been a member of the radio hobby now for more than 50 years has allowed me to gain a pretty good prospective about where we have been and where we are now as a hobby. From my historic point of view, our hobby has come a long way in our ability to monitor not only shortwave radio frequencies, but VHF/UHF (Very High Frequency/Ultra High Frequency) communications also thanks to major advances in electronic technology.

Looking back, though, it hasn't always been this way. Growing up in a military town (San Antonio, Texas), I have always had an interest in military and civilian aviation communications. We didn't live that far from the local international airport and, depending on which way the wind was blowing, civilian aircraft would fly over my house on their way to landing at the airport.

When I first started in the radio hobby, most of my activity was focused on monitoring HF (High Frequency) radio signals. There wasn't any VHF/UHF equipment in the marketplace that covered any of the radio spectrum utilized by the military.

In those days you could buy a tunable multi-band radio that let you listen to civilian aircraft communications one VHF frequency at a time. With two major air force bases in the area, the one thing that I couldn't, but wanted to hear, was military aircraft communications. Nothing was readily available at that time except for some huge military surplus radios that were outside my meager monitoring budget.

When the first programmable handheld scanner hit the marketplace in the late 1970s (Bearcat BC-100), I loaded its 16 channels with all sorts of public safety frequencies, but unfortunately it didn't cover any of the aircraft bands that I wanted to hear.

When the Bearcat BC-220, a 20-channel programmable base scanner, was released in 1979, I finally could proclaim a partial victory of sorts because this was the first programmable scanner that could monitor civilian aircraft communi-

cations.

On the heels of that scanner's release, Bob Grove and Grove Enterprises released a converter, (the Grove CVR-1) that let you monitor the 225-400 MHz using band-stacking technology on a scanner that covered the 118-136 MHz civilian aircraft band. While we could finally monitor signals in the 225-400 MHz band, the frequency stacking didn't tell us which frequencies we were monitoring.

Regardless of its limitations, it is my belief that the old Grove CVR-1 sent a message to the various scanner manufactures in that era that the scanner community was interested in monitoring military aircraft in the 225-400 MHz range. Fortunately for all of us, it wasn't long before we had a plethora of programmable scanners that could monitor not only 118-136 MHz, but 225-400 MHz frequency range as well.

From that day forward, military aircraft monitoring has only increased in popularity among radio hobbyists.

Tools for Monitoring the Military Today

Not only has the equipment changed since many early days in the hobby, but the frequency spectrum and even the modes used by the military have changed as well. If you are still using your Grove CVR-1 for UHF monitoring, an old Universal M-7000 decoder for HF digital modes, or a non-trunk capable scanner for VHF/UHF military land mobile radio listening, you probably aren't hearing very much at all. If you want to become an effective Milcom (military communications) monitor it requires a bit of an investment in equipment, the ability to research military frequencies and call signs, and dedication to monitoring the airwaves themselves.

Milcom Monitoring Hardware

It all starts with your radio equipment. To succeed as a milcom monitor you need to have a well-equipped, wide-frequency coverage radio shack. Pick the wrong equipment and you will probably not have a good experience monitoring the military airwaves. I have found that you should not concentrate on just shortwave or VHF/UHF, but you should be equipped to monitor both. The military uses both and in most scenarios rely on both to get their job done. I will cover the shortwave in next month's Milcom column, but for now let's look at monitoring the military VHF/UHF frequencies. Chances are, if you have been in the scanner portion of the radio hobby for any length of time, you probably already have some if not all the equipment you need to get started.

Milcom Frequency Coverage

To pick out the equipment we want to monitor VHF/UHF communications we need to know where in the radio spectrum military communications and what modes are being used.

Grove CVR-1 ScanVerter (Courtesy Grove Enterprises/Monitoring Times)

Frequency Range	**Frequency channel/steps** (Mode)
30.000-30.560 MHz	10/15/25.0 kHz (FM/AM)
32.000-33.000 MHz	10/15/25.0 kHz (FM/AM)
34.000-35.000 MHz	10/15/25.0 kHz (FM/AM)
36.000-37.000 MHz	10/15/25.0 kHz (FM/AM)
40.000-42.000 MHz	10/15/25.0 kHz (FM/AM)
46.600-47.000 MHz	10/15/25.0 kHz (FM/AM)
49.600-50.000 MHz	10/15/25.0 kHz (FM/AM)
30.000-87.975 MHz	25.0 kHz SINCGARS (Single Channel Ground and Airborne Radio System) (FM/Encryption/ Single channel/frequency hopping modes)
118.000-137.000 MHz	25.0 kHz (8.33 kHz in Europe) (AM)
138.000-144.000 MHz	12.5 kHz (AM/Narrowband FM/ Project 16/Project 25 Phases I/II)
148.000-150.800 MHz	12.5 kHz (AM/NBFM/ Project 16/ Project 25 Phases I/II)
162.000-174.000 MHz	12.5 kHz (NBFM)
225.000-380.000 MHz	25.0 kHz (AM/NBFM/Digital Modes/Encryption)
380.000-400.000 MHz	12.5 kHz (AM/NBFM/Project 25 Phases I/II)
406.100-420.000 MHz	12.5 kHz (NBFM/Project 16/Project 25 Phases I/II)

It All Starts at the Antenna

When monitoring the VHF/UHF spectrum it all starts at the antenna. When we monitor aircraft keep in mind that they could be transmitting from any direction around your location. For this reason, I always recommend an omni-directional style of antenna for monitoring aircraft comms. Since we are listening to line of sight frequencies, we need to get that antenna as high as possible. Finally, we need to get as much of the signal that the antenna captures into the

Diamond D3000N discone antenna ($135) is 67 inches high and receives from 25 to 3000 MHz and can also be used for transmit on 50, 144, 430, 900 and 1200 MHz ham bands (under 100 watts on 144 up, and 20 watts on 6 meters). (Courtesy: Universal Radio)

shack, so do not scrimp on the coax between the antenna and your radio. Buy the best, lowest loss, and highest quality coax you can afford.

You may also want to use a preamplifier between the antenna and your radio to boost your received signals. But there is a caveat to using preamps. If you live in a high-level (urban) radio frequency (RF) environment you run the risk of overloading your radio's front end with too much signal. A preamp might do more harm to reception than good. About the only time I recommend a preamp is if you are on the fringe of a land mobile radio system at a military base you are trying to hear. If this is the case, I recommend you consider a directional antenna first that you can point towards the base before investing in the preamp. I would much rather get my gain using more metal than the additional decibels that a preamp would provide if you are in a high RF environment.

What VHF/UHF Scanner Should You Use for Milcom Monitoring?

I am frequently asked which scanner I recommend for military monitoring. Before I answer that question with some specific recommendations, let's look at what we should be

Whistler TRX1 handheld ($500). (Photo courtesy: Whistler)

looking for in a VHF/UHF milcom scanner. I am going to divide this into two parts – aircraft comms and land mobile radio (LMR) frequencies.

Most of the scanners with 118-150.8 and 225-400 MHz coverage sold in the marketplace today are suitable for basic military monitoring. On the other hand, some of the older scanners on the used market are not suitable for some specific frequency areas of military "air comm" monitoring.

If you are going to monitor aircraft communications (AM mode) in the 138-150 MHz military land mobile band then you will need a scanner that is mode independent. You must have the ability to select any mode the scanner can receive regardless of the frequency being monitored. Some older scanners fail this test as their modes are locked in for specific frequency ranges.

Once I find some active frequencies for my area, I like putting those into scanners that do not have as many memory channels. This insures that I have a better chance of catching aircraft transiting my area. By their nature milair communications tend to be brief and less verbose than their civilian air counterparts.

Land Mobile Radio Scanning

Another area of monitoring that has become increasingly popular, if you are within line of sight range, is monitoring the land mobile radio systems at the military bases. The military has undergone a real transformation in their land mobile systems over the last few years. Many radio enthusiasts have noted that old reliable simplex and repeater frequencies have gone quiet leaving them to wonder where have they moved their communications to?

Most of the smaller bases, including some National

Guard bases, still use either simplex frequencies or repeater systems for their internal communications. In most cases these are analog narrowband FM mode communications; however, due to existing U.S. Government/Department of Defense (DoD) regulations Project 25 comms (simplex, repeater, and trunked) are more commonplace in today's base LMR environments.

Many of the bases have moved over to the Project 25 digital mode in association with new trunk radio systems, so if you want to monitor them you will have to have a scanner capable of decoding the Project 25 digital stream and be able to track trunk radio systems.

Because of these technology and regulatory developments, many of the major military bases have moved most of their land mobile communications to trunk radio systems thus the disappearance of many conventional radio systems.

The major bands for these trunk radio systems are 138.0 to 150.8 MHz (excluding the two-meter ham band 144-148 MHz), 406-420 MHz, and the DoD 380-400 MHz LMR subband. We have found a few holdovers in the 162-174 and 406 -420 MHz range, but it will only be a matter of time and funding before these systems are moved into DoDs primary trunk radio system bands.

Another recent development within DoD is the switching their trunk radio systems from Project 25 Phase I digital trunk systems to the new and more efficient P25 Phase II systems.

If you want to monitor just military air comms in the 138-144/148-150.8/225-400 MHz frequency ranges, just about any modern scanner will meet your needs. I am particularly partial to the Uniden 396/996 series of scanners since these scanners use dynamic allocated channel memory and I can program thousands of frequencies and use them to find new frequencies that are only occasionally heard in my local area.

I also press my older conventional scanners into monitoring milair frequencies even though they do not have as many memory channels. As I mentioned previously, these radios are programmed with milair frequencies that I have confirmed from my various searches and scans of the bands. Using these less capable scanners gives me have a better chance of not missing any activity that may be operating in my area since I am not scanning as many frequencies. As crazy as this may sound, I am still using my trusty old Radio Shack Pro-2004/2005/2006 scanners to monitor milair frequencies for local and confirmed milair frequencies.

For monitoring milcom land mobile radio frequencies, your choices narrow down given the current move within DoD to Project 25 Phase II trunk radio systems.

The following scanners can decode P25 Phase II and Motorola X2-TDMA trunk radio systems:

- GRE PSR-800 with a paid upgrade from Whistler
- Radio Shack Pro-668, Pro-18 with a paid upgrade from Whistler

Wide coverage SDRs such as the Airspy R2 and Spyverter (above $218) includes the accessories of each item for coverager from 1 kHz to 1800 MHz. (Courtesy: AirspyUS)

- Uniden BCD325P2, BCD436HP, BCD536HP, BCD996P2, HomePatrol-2
- Whistler WS1080, WS1088, WS1095, WS1098, TRX-1, TRX-2

If you are considering purchasing one of the radios above, you will find some of the scanners mentioned above available from our friends at Universal Radio in Ohio (**http://www.universal-radio.com**). When you place your order with Universal, be sure to tell them that *TSM* and the Milcom column sent you.

You can also use the new Software Defined Radio (SDR) technology using free software based decoders for your Milcom monitoring. This method of monitoring uses computer based technology and relatively inexpensive SDR dongles such as the RTL-SDR or the AirSpy series of SDRs for milcom listening. You can find more SDR information on the Radio Reference website at **http://wiki.radioreference.com/index.php/Software_Defined_Radios**.

So, grab that scanner and start looking around the various frequency ranges I have include in this column for some military communications.

If you are looking for some additional milcom resources be sure to check out my blog – the Milcom MP at **http://mt-milcom.blogspot.com**. You can also follow me live during certain monitor periods on our twitter feed @MilcomMP. Until next time, 73 and good hunting.

About the Author

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TSM

Utility Planet

By Hugh Stegman NV6H **mtutilityworld@gmail.com**

Tracking the Buzzer: The World's Most Popular Radio Station?

Yes, weirdness fans, it's 4625 kHz "Buzzer" time again. This strange little military alerting network in European Russia just won't go away. In fact, judging from the amount of attention it gets from news media and Internet speculation, it might well be the world's most popular radio station. "UVB-76," its popular misnomer, has 2.4 million Google hits. It has been used as the name of a techno-pop group, and also for a record label. All this fuss is over a little signal which spends nearly all of its time sending noise. For many, though, that may be its biggest appeal of all.

I wasn't going to write about this intermittent-buzz oddity any more this year. Those plans changed abruptly in early August, when the BBC web site ran a feature story on UVB-76 and international intrigue in general, titled, "The ghostly radio station that no one claims to run." It's the usual mass-media hype that turns a strange mystery into a sinister one. Needless to say, the Internet and media buzz started immediately. A few paragraphs were even on Shortwave Radiogram. One thing led to another, and clearly it was time for the ultimate Buzzer column. And so, lovers of the dark side, here we go.

Most likely UVB-76 transmitter locations. (Map by author)

Mass Media and UVB-76

The BBC story is actually more accurate than it looked on first reading. It was written for popular consumption, so of course the author had to make everything look like deep dark international spookiness. That's fine, and it really is fun to read, but a few picky little details still stand out.

The pickiest one of all starts with the catchy photo at the start of the article. It's looking out the window at an absolutely gorgeous radio tower. The architectural style is definitely Russian Constructivism. It would fit right into a Cold War spy flick. The only problem is that it's clearly not for HF. In fact, it's the Shukhov Tower, a 1920s broadcasting landmark in the middle of Moscow. It's 500 feet tall, and built with a helix instead of a truss. Photos of it are everywhere. Even the broadcast antennas shown in the BBC photo have been removed. It narrowly escaped the scrap yard in 2014, when the city of Moscow made it a protected historical monument. Its future, though, remains uncertain.

They could probably also have left out the pithy quote from the SIGINT expert. It's good for spy intrigue, but it's oversimplified. He says that the buzz, which lasts just over a second and is repeated every two seconds or so, has no useful information whatsoever. Even the story's author sort of disputes this point farther down, noting that it's a channel marker. We all know what those say to people who need to know. The frequency is busy, the transmitter still works, and the audio feed is still up. Oh, and it hasn't been nuked.

The nuke thing comes from the irresistible urge that all writers have to associate the Buzzer with Russia's highly speculative "Dead Hand" system. The theory, which some experts do support, is that Russia has or had a fail-deadly doomsday machine, designed to launch everything on evidence of a catastrophic first strike. The Internet took it from there. The story became that, if the buzz ever stopped, we were toast. We are not toast, and the buzz has stopped many times. It's safe to conclude that the fate of the human race has not been entrusted to a few cranky old Russian transmitters. Thank goodness for that.

There's a point to all this. All together now, let us chant the mantra of utility radio: "The people who know aren't telling." There will always be a severe shortage of hard

facts, as opposed to wild speculation or clickbait. Therefore, readers are strongly advised to stick to trusted sources. There's always Ary Boender, of Numbers & Oddities fame. He has been at this forever, and there's a good rational essay about UVB-76 on his web site. ENIGMA 2000, a smart and knowledgeable bunch, also has a site. Pryom.org is newer, but it has earned considerable respect. Finally, there's the Temporary Internet Repeater, with a live stream and blog that became permanent. Before online SDRs, it's how we heard the Buzzer in real time. Links to all these are at the end of this column.

Reality and UVB-76

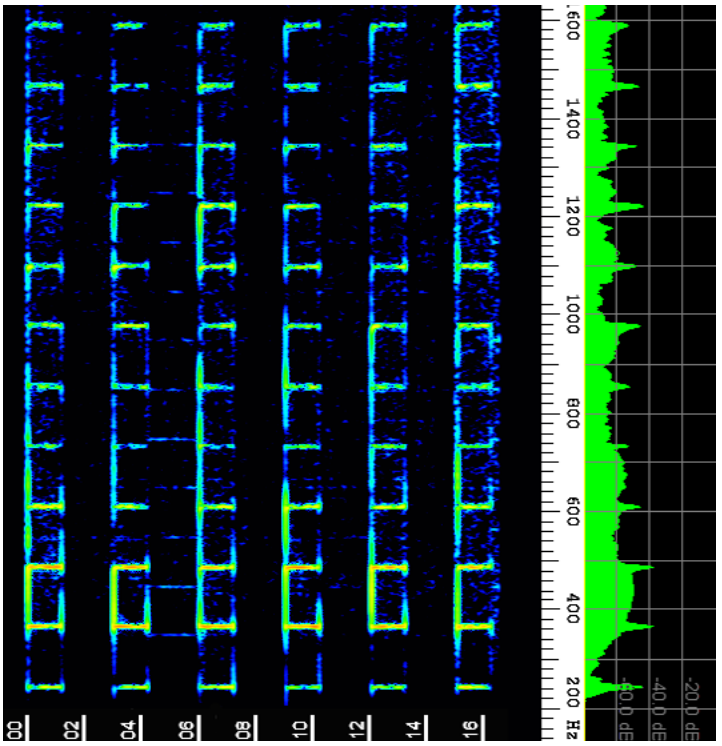
Those of us who have come to know and love the whole UVB-76 phenomenon are especially amused by the fact that even that obsolete call sign is wrong. It came from a mishearing of UZB-76, or УЗБ-76 in Russian. Even that is not a transmitter ID. It's a collective call sign for the target group to which the message is directed. In 2010, it was replaced with MDZhB (МДЖБ). In 2016, this switched to the current ZhUOZ (ЖУОЗ). Even so, I'm afraid that we're stuck with UVB-76 for all time. It's the name that the most people understand.

For a long time, the definitive Enigma Control List, now the Active Stations List, had this frequency as XB, for buzzer oddity. After the voice messages became more frequent, they switched it to S28, for the 28th numbers station using a Slavic language. This has issues too, since it isn't a true numbers station. Those broadcast coded messages to spies operating in deep cover overseas. UVB-76 broadcasts "Monolith" command control (C2) messages for the Western Military District. A couple of other formats are also heard on occasion.

Recently, we have seen quite a bit of evidence that the "station" is really a network. It has at least two transmitter sites, probably fed by from somewhere else. One good guess for the audio's point of origin is the 60th Communication Hub ("Vulcan"), on a well-antenna'd building near St. Petersburg's famous Palace Square. Another is the 69th Communication Hub, at a base near Naro-Fominsk, southwest of Moscow.

We don't know exactly when all this started. You'll see 1982 for the year of discovery, but unconfirmed accounts put it back as far as 1976. The first marker was a simple beep. Someone logged a voice message in 1997, but no recording exists. After that, a few different buzzes were used. At one time, the top of every hour had a double buzz with alternating tones, but this went away during the big changes in 2010. Reports of voice messages increased as well, but that might have been due to increased monitoring after the Dead Hand tempest in a teapot.

These messages are not the highest priority traffic. That goes by more advanced modes, or plain old Morse code, depending on the frequency. The modulation type and voice



The buzz is very rich in harmonics. (Spectrum display by author)

communication suggests an effort to support older Soviet receivers that lack a BFO for CW and sideband. These would likely be operated by personnel without advanced radio training.

Transmitter Locations

Historically, one transmit site was pretty well nailed down as Povarovo, a now largely abandoned rhombic farm just north of Moscow. Its Google Earth coordinates are 56.082635° north by 37.089717° east. Remnants of the huge antenna array show dimly as cleared lines in the woods. After this activity ceased in 2010, "urban explorers" made a good video of this site. It showed the distinctive footprints of large HF transmitters, and clear evidence of their very hasty removal. The only sign of activity they found was a repeater tower for VHF/UHF, guarded by a mean-looking dog.

2010 was a big year for the Buzzer. Its target area was expanded from the Moscow Military District to the western one. This is a much larger area of responsibility, requiring wider coverage. Ultimately, they moved the transmitter.

Around the middle of the year, the buzzing abruptly ceased. Needless to say, discussion of its absence practically melted the Internet. All was well, however. Following a weeks-long outage that did not cause a nuclear holocaust, it started up again. Some engineering chatter gave evidence of testing and tweaking-in a new setup.

Hobbyists tried to locate the new source. Triangulations weren't really all that conclusive. They kind of suggested the Pskov area, where there's a large air base about 20 miles southeast of the Estonian border. I did manage to locate one small transmitter on the west side of this base, with Google Earth coordinates of 57.782158° N, 28.372832° E. Now,

though, there's quite a bit of doubt as to whether it was actually used.

Let's talk about Google Earth, or the "satellite" view in Google Maps, which is pretty much the same thing. Antennas show up notoriously poorly. Fortunately, their shadows show just fine. A tree has a shadow shaped like a tree. An antenna has a straight line, indicating the skinny masts that Russia likes to use for HF wires. Also, while two or three different coordinate systems are found in this column, they all work.

HF direction finding is never easy, but the problem might have been compounded by multiple transmitters at different locations. Yes, all the evidence now points to at least two sites in use, and possibly more. They're probably not all on at the same time.

Recently, a brave hobbyist took a portable receiver in his car, and followed it until the signal was loud even with the antenna shorted. This put him on the main highway, A121, due north of St. Petersburg near Kerro Massiv. Right next to the road was a major HF site with at least 20 antennas. Those distinctive Russian wires with the metal loops stretched out in all directions.

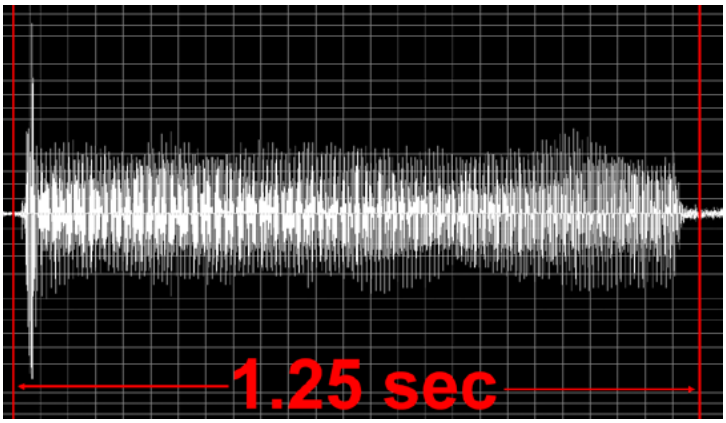
This highway has good, clear images made by the Google Street View camera. The site is at 60° 18' 40.1" N, 30° 16' 40.5" E. This puts you right in front of the main building, though the overhead view shows several other transmitter sites not visible from the street. The place just reeks of high-frequency RF. It's well guarded, and undoubtedly active.

A smaller comm site is located in Aglatovo Massiv, also north of St. Petersburg. This one is near the A129 highway, but not close enough to get good street views. Its coordinates are 60.231100° N, 60.231100° E. It's been suggested too, though the evidence isn't as strong. A third set of coordinates on the Internet are obviously a typo, with the only difference being a figure 4 where a zero should be. These take you to a swamp, or permafrost, or whatever, in the middle of nowhere. When you're nowhere in that part of Russia, you are really nowhere.

OK, so we've nailed down the northern site. We're pretty sure that another transmitter exists in the Moscow area. The best candidate for a site is southwest of the city, just north of Naro-Fominsk. This is a large facility at 55° 25' 35" N, 36° 42' 33" E. South of Naro-Fominsk, there's another possibility, with a much smaller site at 55.370363° N, 36.728416° E.

No one is sure which transmitters operate at which times. Some people suggest that Naro-Fominsk is on the most often. We have some weird recordings that sound like two were on at once. Someone else suggested that perhaps one broadcasts the carrier and another one the modulation, in USB. That seems far-fetched, but it brings us to the signal mode in use. It has an upper sideband with a full carrier, H3E emission. At times, listeners have heard a reduced carrier, which would make it R3E.

4625 kHz is always on. It fades in and out with the skip.



Note large transient at start of buzz. (Plot by author)

Spurious emissions often briefly appear on other frequencies. On occasion, a temporary parallel transmission comes up. Recently, one of these was on 6998 kHz, slopping over the lower edge of the 40 meter band. The hams were not amused. They are undoubtedly pleased that it stopped a couple of months ago.

The buzz sounds electronically generated, but some recordings suggest that it might be a mechanical device. On one of these, the audio frequency slows down and finally stops. The other parameters of the signal stayed the same, as if they were determined by a switch that was still functioning. It really sounded like a motor failure, but not from a tape loop.

On other occasions, multiple transmitters have been heard buzzing at different pitches, or interfering in other ways. One or two recordings have telephone conversations, in Russian of course, being transmitted simultaneously with the buzz. A good one from 2011 has clear evidence of gain pumping between sentences, as we'd hear on typical highly compressed circuits. It makes sense that the voice messages would come from offsite. Others, though, have heard what they think is evidence of local control, with open mikes and background chatter. Perhaps they have both, like the U.S. Air Force can do with its flexible High-Frequency Global Communications System. It's all very strange. Don't get too dizzy, and see you next month.

Resources:

BBC story:
http://www.bbc.com/future/story/20170801-the-ghostly-radio-station-that-no-one-claims-to-run

Ary Boender's Buzzer Primer:
http://www.numbersoddities.nl/the_buzzer_primer.pdf

ENIGMA 2000:
http://www.brogers.dsl.pipex.com/enigma2000

Priyom's S28 page:
http://priyom.org/military-stations/russia/the-buzzer

UVB-76 Temporary Internet Repeater:
http://uvb-76.net

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Shortwave Utility Logs

Recent Shortwave Utility Logs Compiled by Mike Chace-Ortiz

Frequency	Callsign	Time	User, Location	System Details
4005.00	NAU	0930	US Navy, Isabela PR	50bd/850 STANAG4481 FSK, sync, cont, ACF=0
5340.00	NAU	0930	US Navy, Isabela PR	75bd/850 STANAG4481 FSK, KG84 crypto (//12120khz)
5758.60	FUO	0031	French Navy, Toulon	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
8137.00	WCY	1153	Marine Weather, Lakeland FL	USB, op Chris with yachts checking-in regarding Caribbean and SE US Coast
8660.20	CFH	0030	Canadian Forces, Halifax	300bps/L STANAG4285 HF Modem, crypto tfc (on USB)
8672.20	???	2000	UK MIL DHFCS, Inskip	600bps/L STANAG4285 HF Modem, crypto tfc (on USB)
9072.00	???	2030	Russian MIL, ???	75bd/250 FSK UNID System, sync, cont, ACF=0
9095.00	6WW	0920	French Navy, Dakar	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
9110.00	NMF	0900	US Coast Guard, Boston	120lpm/576/800 FAX, North American surface analysis chart from NWS
9112.00	NPM	0900	US Navy, Lualualei HI	50bd/850 FSK UNID System, sync, cont, ACF=0
9317.60	???	0900	US Navy, Barford St John	75bd/850 STANAG4481 FSK, crypto tfc
9910.60	FUJ	0900	French Navy, Noumea	600bps/L STANAG4285 HF Modem, crypto tfc (on USB)
10380.00	???	0848	Russian MIL, Vladivostok	100bd/500 FSK UNID System, sync, cont, ACF=0
10405.70	AQP	0130	Pakistani Navy, Karachi	PacTOR-II FEC HF modem, sending 5LGs after "ZCZC"
10407.00	???	0900	Australian MHFCS, NW Cape	50bd/350 STANAG4481 FSK, crypto tfc (+1350Hz on USB)
10407.00	???	0900	Australian MHFCS, NW Cape	600bd/600 STANAG4481 FSK, KG84 crypto tfc (+1350Hz on LSB)
10430.00	NPG	2040	US Navy, Dixon CA	75bd/850 FSK UNID System, KG84 crypto
10438.20	???	0100	UK MIL DHFCS, Crimond	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
10505.00	ANTOFAGASTA***	0200	Chilean Gendarmes, Antofagasta	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	ARICA***	0300	Chilean Gendarmes, Arica	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	CALAMA***	0200	Chilean Gendarmes, Calama	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	OVALLE***	0200	Chilean Gendarmes, Ovalle	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	PUERTOAYSEN***	0300	Chilean Gendarmes, Puerto Aysen	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	RANCAGUA***	0200	Chilean Gendarmes, Rancag	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	SANANTONIO***	0200	Chilean Gendarmes, San Antonio	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10505.00	TOCOPILLA***	0230	Chilean Gendarmes, Tocopilla	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10545.00	046SERCAP***	0139	US Civil Air Patrol, SE Region	125bd/1750 MIL-188-141A, ALE sounding (on USB)
10726.00	???	0930	Russian MIL, ???	AT3004D 12 tone HF modem, tfc (on USB)
10800.00	???	0020	???, ???	2400bps/L MIL-188-110A HF modem, crypto tfc (on USB)
11005.70	JXU	0930	Norwegian Navy, Bodo	600bps/L STANAG4285 HF modem, tfc (on USB)
11015.00	???	0930	UK MIL DHFCS, Crimond	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
11116.00	???	0900	Russian Navy, ???	50bd/200 BEE, tfc
11117.60	???	0900	US Navy, ???	75bd/850 STANAG4481 FSK, crypto tfc
11260.00	920037***	2230	???, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
11260.00	920002***	2230	???, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
11260.00	920014***	2230	???, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
11260.00	920007***	2230	???, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
11260.00	920001***	2230	???, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
11360.00	7772***	0937	???, ???	125bd/1750 MIL-188-141A, ALE LQA with “7777" (on USB)
11500.00	???	0922	Russian MIL, Moscow	100bd/500 FSK UNID System, sync, cont, ACF=0
12323.20	???	2000	UK MIL DHFCS, ???	600bps/L STANAG4285 HF Modem, crypto tfc (on USB)
12390.20	MKD	2230	UK MIL DHFCS, Akrotiri	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
12568.20	PBC	1210	Dutch Navy, Goeree Island	600bps/L STANAG4285 HF modem, crypto tfc (on USB)
13419.80	FUE	1343	French Navy, Brest	50bd/850 FSK UNID System, sync, cont, ACF=21
13423.50	XSS***	1635	UK DHFCS, Forest Moor	125bd/1750 MIL-188-141A, ALE sounding (on USB)
14420.00	???	2348	UK MIL DHFCS, Ascension Island	600bps/L STANAG4285 HF modem, crypto (on USB)
14436.00	RCV	2336	Russian Navy, Sevastopol	50bd/200 BEE, tfc on sync=[0x1eb41eb2952]
14548.20	???	1630	UK MIL DHFCS, ???	600bps/L STANAG4285 HF Modem, crypto tfc (on USB)
14647.00	???	1920	Russian Intelligence, Moscow	USB, OM/EE reads “164 164 164 1” for 2 mins then “678 83 678 83”
14787.00	???	1238	Russian Navy, ???	50bd/200 BEE, tfc
16011.70	SSE	2045	Egyptian MFA, Cairo	100bd/170/E SITOR-A, Calling selcal "TVXS" (Manama), "KKVU" (Accra)
16020.00	???	1606	North Korean Embassy, Conakry	600bd/600 FSK UNID ARQ System, tfc QSX 14444LSB (on LSB)
16025.00	???	1619	North Korean Embassy, Conakry	600bd/600 FSK UNID ARQ System, tfc (on LSB)
16112.00	1402***	1945	Mauritanian Gendarmerie, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
16134.90	KVM70	2016	Honolulu Meteo, Hawaii	120/576/800 FAX, Weather pix
16196.20	???	1216	UK DHFCS, Akrotiri	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
16283.60	KWT94	2004	US Embassy/Consulate, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)
16559.00	???	1400	Shanghai Radio, Shanghai	120lpm/576/800 Fax, SE Asia chart
16700.00	7771***	1943	???, ???	125bd/1750 MIL-188-141A, ALE LQA & AMD “IFBUIFSHSBIBN” (on USB)
16700.00	7771***	1943	???, ???	100bd/170 CCIR493-4 selcall, calling “7777” (on USB)
16700.00	7772***	1930	???, ???	USB, OMs chatting in Arabic after ALE & CCIR493-4 selcall

Shortwave Utility Logs

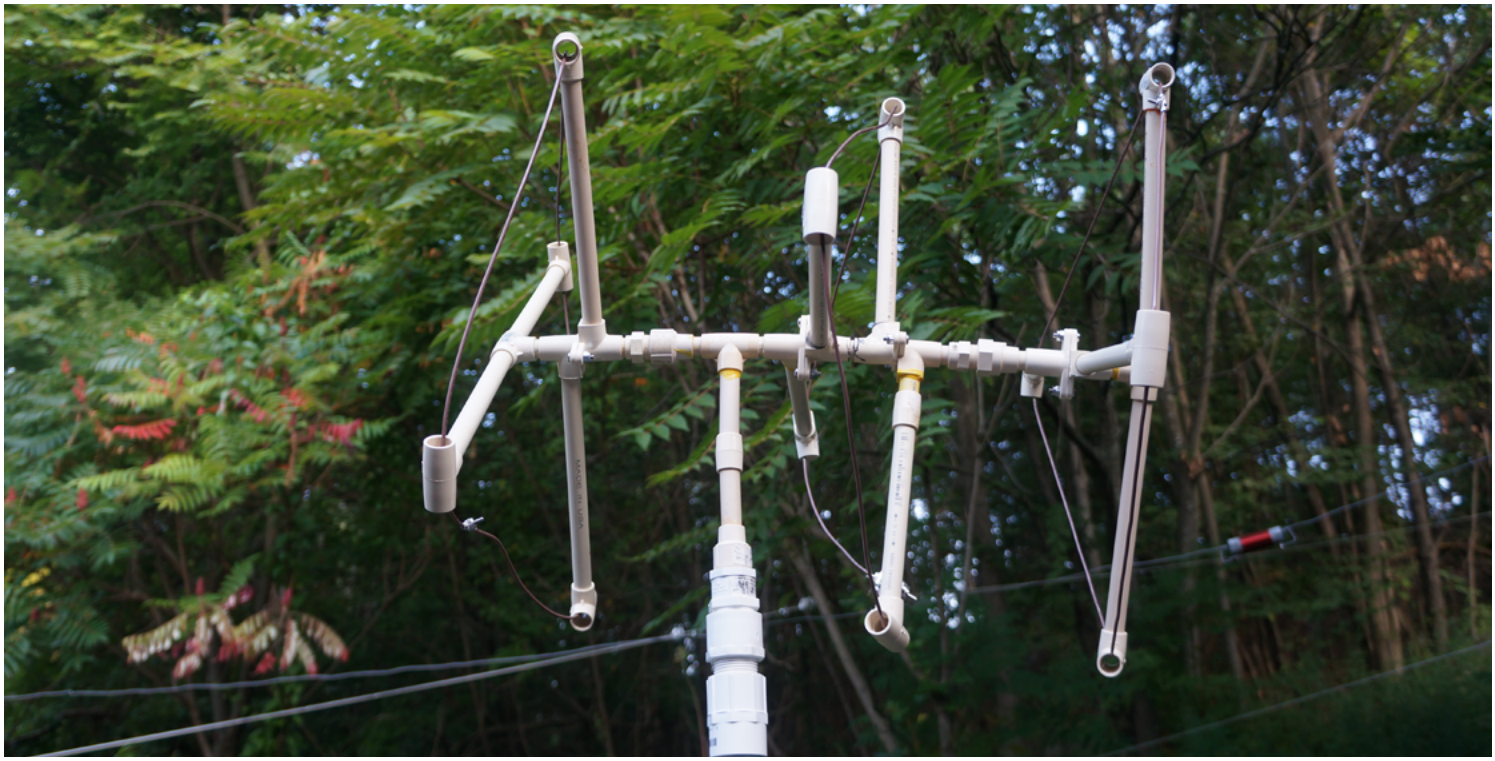
Recent Shortwave Utility Logs Compiled by Hugh Stegman

Frequency	Callsign	User, Location	Time	System Details
60.00	MSF	UK NPL, Anthorn	0027	CW, full decode of standard time/frequency signal
77.50	DCF77	German PTB, Mainflingen	0019	AM/PM, partial decode of standard time/frequency signal
129.10	DCF49	EFR Teleswitch, Germany	0038	FSK, power ripple control, idling sequence in ASCII (200/340)
518.00	"O"	USCG NMO, Honolulu, HI	1825	Sitor-B, Navarea 12 Navtex messages for Hawaii
2656.00	IPA	Ancona Radio, Italy	2209	USB, weather in Italian, remote controlled from Rome
2733.00	SDJ	Stockholm Radio, Sweden	2202	USB, navigation warnings in English and Swedish
2965.00	Bangkok	Bangkok Volmet, Thailand	2214	USB, SE Asian aviation weather, then ID
3413.00	Shannon Volmet	Shannon, Ireland	2220	USB, ID, then European aviation weather
3818.00	Unid	German Red Cross	1536	Pactor-1 (100/200), calling 1DEK28, Wiesbaden
4438.50	R01	U.S. Army MARS, AZ	0023	ALE, global "Allcall," causing PC-ALE to link & clear
4996.00	RWM	Russian time station, Moscow	1823	CW, ID and time pulses
5125.00	Unid	Arecibo Observatory, PR	0650	Ionospheric research, with tones in several modes
5153.70	"D"	Russian Navy, Sevastopol	2229	CW, single-letter cluster beacon, repeating ID
5153.90	"S"	Russian Navy, Severomorsk	2229	CW, single-letter cluster beacon, repeating ID
5154.00	"C"	Russian Navy, Moscow	2229	CW, single-letter cluster beacon, repeating ID
5154.10	"A"	Russian Navy, Astrakhan	2229	CW, single-letter cluster beacon, repeating ID
5156.80	"L"	Russian Military, St. Petersburg	2229	CW, single-letter solitary marker, also on 8497.8
5195.00	DRA5	DARC, Shegerott, Germany	1827	CW propagation beacon, with forecasts
5267.00	Unid	U.S. Military	1801	RTTY (45/170), many training messages, also 5772.2, 5269, 13952.8
5290.00	Unid	S. Korean Government (V24)	1430	AM, pop music and "numbers" message in Korean
5450.00	Military One	UK Royal Air Force	2244	USB, ID and Volmet for time slot 3, parallel on 11253
5775.00	Thunder	USN, off West Coast	0342	USB, USS *Theodore Roosevelt* carrier group, helping India activate link
5385.50	AFA7PQ	USAF MARS	1305	USB, control of Joint Army and Air Force Region 7 Net
6304.00	277	Polish Intelligence (E11)	0930	USB, callup 277/39 and 5-figure-group message in English
7325.00	BRX	U.S. Military/Government	1436	ALE, linking with GHM, possible ABNCP aircraft
7560.00	754	Russian Intelligence (S06s)	1110	AM, callup 754 291 6 and 5-figure-group message in Russian
7880.00	DDK3	German DWD, Pinneburg	2240	FAX, very clear North Atlantic wind/wave chart
8050.00	SESEF Norfolk	USN, VA	1458	USB, testing with USS *Ralph Johnson*, came from 10711
8416.50	UAT	Moscow Radio, Russia	1945	Sitor-B, Siberian navigation warnings in English
8473.00	WLO	ShipCom, Mobile, AL	0043	Sitor-B, Atlantic weather, switched to RTTY (45/170) for same
8843.00	San Francisco	Pacific air route control (CEP-1)	2342	USB, selcal and working unknown flight
9530.00	484	Polish Intelligence (S11a)	0915	USB, callup 484/34 and 5-figure-group message
10186.00	Unid	Russian Intelligence (F06/M42d)	0810	FSK (200/1000), brief 5-figure-group message
10588.00	FC9FEM	U.S. FEMA, WA	1640	ALE and voice as WGY910, working FR9FEM, WGY909, CA
10821.00	MEJT01	U.S. Natl. Guard, ME	1442	ALE, calling LKBAF, possible airport in MA
11175.00	Andrews	USAF HFGCS, VA	1423	USB, authenticating Race Car (possible TACAMO/ABNCP)
11188.50	Habitat	USN, possibly WA	1950	USB, working P-8s Dragon Claw 802 and 803
11205.00	Golf Whiskey	USN, off West Coast	2037	USB, USS *Theodore Roosevelt* carrier group, air defense net
11220.00	Wave Rider 69	USN, probable P-3C	2330	USB, with unsuccessful phone patch
11232.00	Trenton Military	Canadian Forces, ON	1818	USB, working Rescue 338 (CC-130 #130338, secal FM-EL)
11282.00	San Francisco	Pacific air route control (CEP-2)	1723	USB, working Coast Guard 101 (USCG Commandant's plane)
11306.00	Boeing Seattle	Boeing Aircraft, WA	2032	USB, selcal check GR-AB for test flight Boeing 001
11360.00	Korsar	Russian Air Force, Pskov	1308	USB, working 78811, an IL-76MD, in Russian
11494.00	Z32	USCG Sector Honolulu, HI	1920	ALE, link check with 790, USCG HC-130H #1790
12168.00	LKBBAF	Unknown U.S. Military	1628	ALE, calling TSC and PKFMH (likely CGAS Falmouth, MA)
12397.00	305	Polish Intelligence (E11)	1000	USB, callup 305/34 and 5-figure-group message in English
13204.00	Reaper 11	Possible USAF B-2A	1913	USB, with Reaper 12, working Tiger 71
13270.00	06	HFDL, Hat Yai, Thailand	2304	Ground station working AIC330 (Air India B787 reg VT-ANC)
13282.00	Auckland	Auckland Volmet, NZ	2320	USB, male robot voice with aviation weather
13312.00	Z14	USCG Sector St. Petersburg, FL	2327	ALE, calling J30, USCG MH-65D #6530
13315.00	13	HFDL, Santa Cruz, Bolivia	2316	Ground station working O66187 (Avianca Brasil A320 reg PR-OCN)
13324.00	02	HFDL, Molokai, HI	2320	Ground station working several unheard aircraft
13881.00	818	Russian Intelligence (E07)	1700	AM, callup 818 765 60 and 5-figure-group message in English
14415.00	N85	Chinese Military	0140	ALE, calling A99
14438.00	832	Russian Intelligence (E06)	1200	USB, should have been F06, null-message callup 832 951 64
14664.00	RDL	Russian Military, Smolensk	1922	FSK Morse, 5-number-group strategic broadcast in progress
16314.00	Unid	Russian Polytone (XPA2)	1900	MFSK-16/20, long tone coded 5-figure-group message
17426.00	OMEGACERO2	Chilean ONEMI, Santiago	2010	ALE, link check on CAT net with ECO06, also 17430 and 17440
17460.00	RDL	Russian Military, Smolensk	2014	FSK, short idler (??/200) and Morse strategic msg in 5-figure grps
18041.00	952	Russian Intelligence (M14)	0500	CW, callup 952 636 636 50 50 and message

VHF and Above

By Joe Lynch N6CL **VHFandabove@gmail.com**

Honey, I Repurposed the Loop!



My new 3-element 222 MHz quad antenna. (Courtesy of the author)

Last month I wrote about how I repurposed one of my 144 MHz loop antennas to make it a 222 MHz loop for use during the ARRL 222 MHz and Up Distance Contest. While the loop worked, I made no contacts. It seems that 20 watts and a loop antenna was not sufficient to attract attention from here.

To attract attention in the upcoming ARRL September VHF QSO Party, I decided to build two antennas for 222 MHz: a 3-element quad and a 6-element quad. I also decided to build a quad antenna for 144 MHz.

The calculator I used for designing the quad antennas is from the website: Cubical Quad Antenna Calculator (see: **http://www.qsl.net/yt1vp/CUBICAL%20QUAD%20ANTENNA%20CALCULATOR.htm**).

The calculator uses the formulas for the various sections of the quad, as follows: Length of loop in feet = X/Frequency in MHz. The value for X is as follows: Reflector: 1030; Driven Element: 1005; Director 1: 975; Director 2: 946; Director 3: 917; Director 4: 890; and Director 5: 863.

The website uses a standard separation between elements that is calculated as follows: Between the Reflector and Driven Element: Spacing in inches = ((1005/Frequency in MHz) x 0.182) x 12. Between the Driven Element and the first Director and between each subsequent directors: Spacing in inches = ((1005/Frequency in MHz) x 0.149) x 12.

Again, I used 1/2-inch CPVC pipe for the construction of the spreaders and wire holders for the quads. Also, I used #14 THHN stranded house wire for the elements for all the antennas described below. The 3-element quad is constructed entirely using CPVC pipe and fittings. Because it is rare to find a CPVC pipe cross fitting, I screw together two screw-mounted L-fittings 90 degrees out of phase from each other for two of the spreaders. For the center element of the 3-element quad, I connect two of these joined L-fittings together with a very short piece of pipe, offsetting them by 90 degrees. For the Reflector and Director, I connect a T-fitting to the joined L-fittings, again offsetting them by 90 degrees.

For the boom-to-mast connection, I inserted a CPVC Tee fitting close to the Reflector assembly. Then, I connected a female threaded pipe to CPVC pipe fitting to the T by using a short piece of CPVC pipe.

To keep metal out of the quad's field of radiation, as much as possible, I used my PVC pipe and Quadrastand collection as a mast. I screwed the female fitting onto a male PVC threaded fitting on the top PVC pipe. As usual, for this portable operation, rotating the antenna is accomplished by the Armstrong method.

Looking closely, you may notice that the balun is still in

My new 6-element 222 MHz quad antenna. (Courtesy of the Author)

place in one of the Driven Element spreaders. Because it is built into the spreader, I decided to leave it in place, should I decide to use the driven element as a standalone loop antenna.

Finally, to make it possible to easily disassemble the quad, I used PVC to pipe threaded fittings between the Driven element and the Director, as well as between the Driven Element and the Reflector.

For the 6-element quad, I did something different for each element: Because I wanted to make the quad more rigid, I used PVC cross fittings and short sections of PVC pipe to connect them together. Please note that all fittings are 1/2-inch, both in CPVC and PVC pipe.

To keep the quad as light possible despite the heavier weight of the PVC fittings, I used CPVC pipe for the spreaders and CPVC T-fittings for the wire holders. Because CPVC and PVC pipe do not naturally connect to each other, I created a method to connect CPVC pipe to the PVC cross fittings by using CPVC sleeve fittings. I cut a short piece of CPVC pipe that was long enough to connect to the sleeves that I inserted into the opposite holes of the cross fitting.

Next, I put some glue inside one of the sleeve-fittings and pushed it onto the CPVC pipe inside the PVC cross fitting. I performed the same operation to the opposite hole of the PVC pipe-fitting. Then, I glued the sleeves to the short piece of CPVC pipe now inside the PVC cross fitting. Finally, I inserted and glued each spreader into this hybrid holder.

To create the offset for the spreaders for the driven element and the interior directors, I glued two of these hybrid fittings together with a very short piece of PVC pipe. As I did with the 3-element quad, I used a T-fitting offset by 90-degrees for the Reflector and the last Director. These T-fittings were prepared in the same manner as the cross-fittings as hybrid fittings for CPVC pipe.

For the boom-to-mast connection, I used a cross fitting instead of a T-fitting at the end of the first Director. At the cross fitting hole opposite the spreader, I connected a female threaded pipe to PVC pipe fitting to the cross fitting by using a short piece of PVC pipe. Then, as with the 3-element quad, I screwed the 6-element quad onto the male pipe fitting atop the PVC pipe and Quadrastand mast.

Finally, as with the 3-element quad, to make it possible to easily disassemble the 6-element quad, I used PVC to pipe threaded fitting between the Driven element and the Director, and between the interior Directors, as well as between the Driven Element and the Reflector.

Building the 144 MHz quad proved to be quite a task. Using the formulas, I constructed a 3-element quad. The problem with the antenna was that I could not get it to dip on 144 MHz. It dipped quite lower, around 140 MHz. I fussed with shortening the elements and changing them back again. I removed the Director and reinstalled it. I removed the Reflector and reinstalled it. I installed a balun and removed it. Nothing seemed to work.

Ironically, during one of my times of removing the director, I accidentally moved it away from the antenna while keeping it in the plane of the antenna's radiation. When I did so, out of the corner of my eye, I noticed that the SWR meter was going to 1:1. I moved the Director back and forth, all the while keeping it in the plane. At one point, I achieved 1:1 SWR at a frequency close to where I wanted the antenna to resonate.

This experimentation led me to see what would happen if I temporarily put the quad together at an approximate length between the two elements. I reinstalled wire lengths according to the formula for the Driven Element for 144.2 MHz. The Director length I chose was the Third Director because I reasoned that it was closer to the spacing from the Driven Element according to the formula, which was 42 inches from the Driven Element.

I arbitrarily chose 42 inches of separation, which is close to a half-wavelength for 2 meters, because it was the

My experimental 2-element 144 MHz quad antenna. (Courtesy of the author)

length of PVC pipe I had prepared for another project. After I connected the elements to the mast, I moved them closer together and further apart. I noticed that the further apart I moved the Director from the Driven Element, the lower in frequency and SWR the antenna performed.

I continued to add pieces of pipe until I reached approximately 63 inches. At that point, the antenna resonated cleanly at 144.2 MHz and the SWR was 1.2:1. Unfortunately for my experimenting, I had to stop doing so and go to work, which is where I leave the project for this month's column. Photo 3 shows where I left off for this month. Hopefully, I will have solved my dilemma in time for the ARRL September VHF QSO Party.

Current Contests

There are several VHF and above contests this month. They are as follows:

The ARRL 2.3 GHz and Above EME Contest is September 9-10. The ARRL September VHF QSO Party is September 9-11. The second weekend of the ARRL 10 GHz and Above Cumulative Contest is September 16-17. The 144 MHz Fall Sprint is September 18.

For ARRL contest rules, see its URL: **http://www.arrl.org**. For Fall Sprint contest rules, see the Southeast VHF Society URL: **http://www.svhfs.org**.

Current Conferences and Conventions

The TAPR/ARRL Digital Communications Conference will be held September 15-17, in St. Louis, Missouri, at the Holiday Inn Airport West. Reservations: 1-314-291-6800. For more information, see their URL: **https://www.tapr.org**

Calls for Papers

Calls for papers are issued in advance of forthcoming conferences either for presenters to be speakers, or for papers to be published in the conferences' Proceedings, or both. For more information, questions about format, media, hardcopy, email, etc., please contact the person listed with the announcement. The following organization or conference organizer has announced a call for papers for its forthcoming conference:

Microwave Update:

A call for papers has been issue for the Microwave Update conference, to be held in Santa Clara, California. The deadline for proceedings paper submissions for is September 5. The Word file format (text) is preferred for these papers.

The deadline for the presentation version of selected papers is September 12, 2017; PowerPoint (slides) file format is preferred for presentations. If you are interested in submitting a paper for publication in their Proceedings, then, please e-mail your papers, as well as questions or comments regarding the technical program, to mud2017.papers@gmail.com. For more information, see: **http://www.microwaveupdate.org/call_papers.php**.

AMSAT-NA 2017 Space Symposium:

Technical papers are solicited for the 2017 AMSAT Annual Meeting and Space Symposium to be held on the weekend of October 27, 28, 29, 2017 at the Silver Legacy Resort, Reno, Nevada. Proposals for papers, symposium presentations and poster presentations are invited on any topic of interest to the amateur satellite community. They request a tentative title of your presentation as soon as possible, with final copy to be submitted by October 6 for inclusion in the printed proceedings. Abstracts and papers should be sent to Dan Schultz N8FGV at n8fgv@amsat.org.

TSM

Amateur Radio Insights

By Kirk Kleinschmidt NT0Z **nt0z@stealthamateur.com**

Are Hams Well-Meaning Scofflaws?

Scofflaw. Not often used in Midwestern conversation, I first encountered the word in my New England days, where I actually heard it used in conversation. Beautiful!According to a PBS documentary on the 1920s, the word was coined just after the start of Prohibition. Reportedly, the Boston Herald offered a $200 prize—not an insignificant amount—to the reader who came up with the best new word to describe someone who flagrantly drank then-illegal liquor. Twenty-five thousand readers weighed in, while the two readers who came up with "scofflaw" split the prize!

More recently, the word has come to define someone who flouts the law by failing to comply with laws that are effectively difficult to enforce. As with many modern statutes, rules, and regulations, amateur radio has plenty of difficult-to-enforce—never enforced?—rules, most of which are described in Title 47 of the Code of Federal Regulations (47 CFR).

Many rules detailed in 47 CFR are unambiguously clear, but some are as clear as mud—most are generally adhered to by hams, but many are routinely ignored by actual (and accidental) scofflaws. Despite our hobby's lauded and lofty ideals, behaviorally, ham radio still has a relatively thin veneer of civilization. It's not alone.

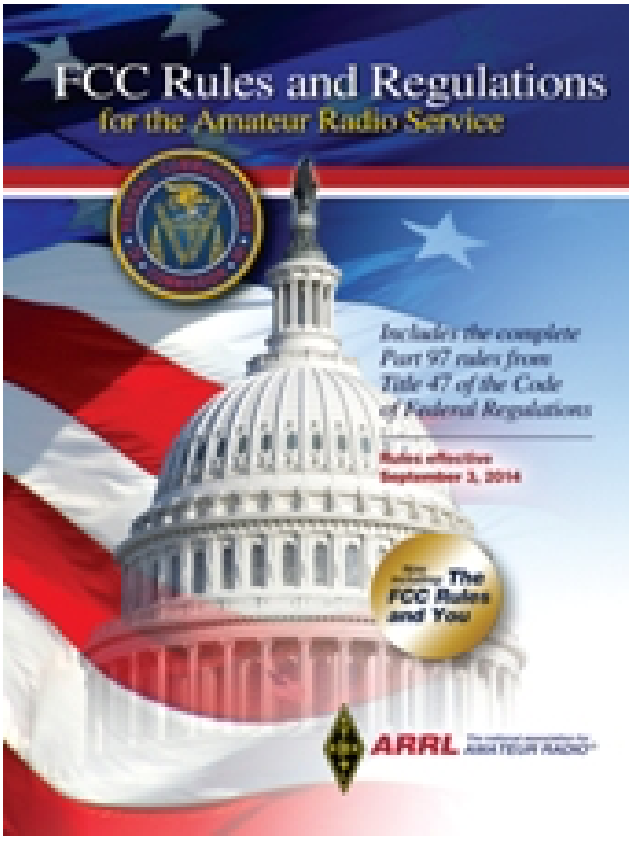
For example, everyone "knows," US citizens are obligated by law to pay federal income taxes every year, and the vast majority do just that. But if you think the matter —100 years after adoption of the sixteenth amendment, which created the personal income tax—is settled, you'd be wrong.

Since Day One, various tax protest organizations have been passionately opposing the federal government's authority to tax citizens in the manner to which it's become accustomed. We occasionally hear about various "fringe elements" and "fringe arguments" against federal taxing powers, but compelling arguments against the present system and its legality are also supported by former IRS investigators, including former Criminal Investigation Division Special Agents and a variety of Ivy League law professors and legislators.

Just think back to when you filed your last tax return. If you think Title 47 is confusing—and it is—it's nothing compared to Title 26, the 20-volume, 14,000-page Code of Federal Tax Regulations! Whether purposeful or accidental, it's almost impossible to not be a scofflaw to some extent, even when trying mightily to comply.

In a different, yet similar, arena, several states are wrestling with recent laws that legalized the recreational use of marijuana. In at least one state, legal use requires its purchase from licensed vendors, which means that "unlicensed" marijuana is still technically illegal. Law enforcement personnel are caught in the middle, however, and as the state finalizes its plans and procedures establishing licensed vendors, police are generally not prosecuting recreational users despite the fact that licensed marijuana is not yet officially available.

Another state has "decriminalized" recreational marijuana, although it's technically still "illegal" and, by tacit agreement, users aren't likely to be charged if they're in pos-



If you're confused about one FCC rule or another—and who isn't?—The ARRL's FCC Rules and Regulations for the Amateur Radio Service, is a great place to start. Along with the complete Part 97 rules from Title 47 of the Code of Federal Regulations, Rules and Regulations also interprets those rules in plain language in The FCC Rules and You, which is included. It's a great way to spend $8 if you're a ham. Be sure to get the latest edition, which includes the September 2014 rules changes and says so on the cover. The book is available from your favorite amateur radio bookseller or from www.arrl.org.

session of small amounts. But they could be charged if police or prosecutors choose to prosecute, for whatever reason. The federal government considers any recreational marijuana use in these states to be illegal. In these jurisdictions, recreational use of marijuana is legal, decriminalized and illegal, all at the same time, depending on who you ask, the mood they happen to be in at the time, who's arresting you, or who's prosecuting you!

The schizophrenia that plagues tax and criminal law also has amateur radio counterparts. Yes, Title 47 isn't nearly as impossible as Title 26, but whenever you're dealing with entrenched bureaucracies that are driven by politics, money and special interests, there is bound to be plenty of confusion.

In addition, the amateur community itself is home to dozens of special interests (generally a good thing) and has a long history of self-policing and "gentlemen's agreements" about how, where and when to operate. To add spice to the mix, some of our conventions don't necessarily align with FCC rules and intentions and, like marijuana laws, are often selectively enforced if enforced at all.

So, let's take a look at some interesting and contentious topics, knowing full well that reasonable hams come down on all sides of any particular argument. In presenting these few issues I'm not officially taking sides. Similarly, I'm also not exhaustively researching every last legal, procedural, historic and practical nubbin. So please, no hate mail (although if you have well-reasoned comments or corrections, feel free to contact me)!

I am calling you a scofflaw, intentional or otherwise, because it's practically impossible to not "break" an FCC Rule or six in daily on-air practice. Oh—and I'm not officially stating that I don't break a Rule or two, either. I'm just not stating!

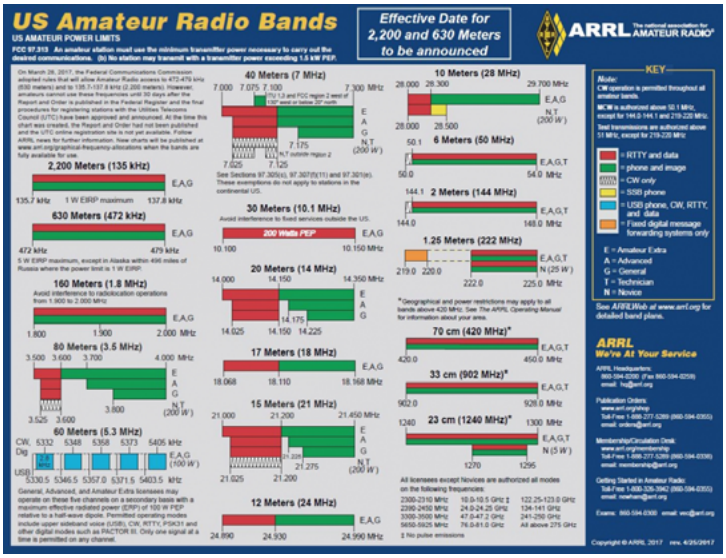
No Unidentified Signals

Think you're squeaky clean with your on-air hygiene? Ever send a few dits while tuning up, or say a few "hello tests" on SSB without adding your call sign, at least at the end of the "tuning session?" Congrats, you may have violated 97.119, which states that, unless you're a "space station or telecommand station," you have to transmit your assigned call sign at least every 10 minutes and you may not "transmit unidentified communications or signals." Scofflaw!

Actually, this might be a gray area, as "brief transmissions necessary to make adjustments to the station" are allowed in 97.111, but there doesn't seem to be any indication as to whether a "brief transmission" of this type is an "unidentified communication." Confused yet? Scofflaw?

What Band Edge?

In large contests it's easy to hear stations transmitting below the bottom of the band edges (below 7.0 or 14.0 MHz, for example). There are often unofficial contests between Big



When a chart of US amateur band frequency allocations sorted by license class needs to be 11 x 17 inches so you can take it all in without using a magnifying glass, you know there's plenty of complexity! You can buy this full-color beauty from www.arrl.org for $3, or you can download it as a PDF for free (smaller sizes, too).

Guns in Europe and North America to see who can transmit closest to the lower band edges without transmitting outside the lines. Unfortunately, many ops do transmit outside the band edge, even without meaning to. Some don't realize which sideband their CW signals occupy, while others have overly enthusiastic concepts about the "cleanliness" of their transmitted signals, perhaps because they're running the latest and greatest transceivers that are "guaranteed" to have "superior" spectral purity specs?

Well, Part 97.307 specifies various emission limits for spurious signals, such as harmonics, but I have my doubts about whether simply transmitting outside of the band constitutes a spurious emission, so these limits may not apply. It may very well be that purposefully transmitting outside the band is simply not allowed, regardless of power level. Scofflaw!

What Sub-band?

When I was a teenage ham (not a confession), the sub-bands in which I could transmit as a Novice, and then an Advanced-class licensee, we pretty simple. A friend of mine—also a "teenage Advanced-class ham"—and I would sometimes purposefully chat on the "no General-class hams allowed" portion of 75 meters so another buddy, who couldn't breathe our rarified air, had to listen only or purposefully violate FCC Rules. He usually violated the Rules, which we pointed out frequently on air, to no perceived effect. Scofflaw for sure!

Nowadays, even though I hold an Extra-class ticket, I still have to consult a chart, a reference book, of a communications attorney to figure out which licensees can transmit where. It's not easy! (If I'm in North Dakota, am I DX? No? Darn!)

What Channel?

According to the Rules, channels on 60 meters are intended to support only one QSO at a time, so if you can hear another signal in the passband, no matter how weak, and no matter if it's a warbly PSK31 signal and you want to call CQ on CW, you can't transmit. It doesn't matter if each channel can support 20 PSK31 QSOs at the same time. Sixty meters has Weird Rules!

What sometimes gets me wondering is the concept of frequency re-use. Let's say that skip is short on 60 meters, and two QSOs are going on at the same time, one on the East Coast and one on the West Coast. Each respective QSO can't hear the other, but what about an op in Kansas, who can hear both QSOs? Can he talk to one coast without violating the one-QSO Rule (assuming that both coasts can hear his signal)? Scofflaw?

And what about global frequency re-use? Dozens of global QSOs could be ongoing, with no QSO able to hear other QSOs, but there is obviously more than one QSO ongoing. Most of those QSOs fall outside the jurisdiction of the FCC, so how does that affect the situation? Probably not at all.

Regardless, I haven't heard of a single FCC enforcement action taken against a US ham for violating the one QSO Rule, nor have I heard of even a single incident of a government primary user station encountering unwanted interference from any US amateur operations there. I suspect that the NTIA (the "FCC" for government and military users) has just been digging in its heels about 60 meters since Day One, and that no federal comms of any importance ever take place there.

Off the record, the NTIA has said that it couldn't care less what kind of emissions hams use on 60 meters, or how many concurrent signals crowd onto each and every channel—as long as the assigned channel bandwidth isn't exceeded. That's unofficial, of course, but probably accurate.

I also suspect that there are wide swaths of the shortwave spectrum that are strictly protected by the FCCs and NTIAs of the world despite the fact that almost nothing of significance takes place there nowadays.

What Dummy Load?

Do you dutifully identify your transmissions into your dummy load when testing your linear amplifier? Well, why not? You might consider a dummy load to be non-radiating, but some RF energy does make it into the ether! Many an op has made a QSO when inadvertently transmitting into his "dummy antenna" instead of his "real antenna." Perhaps the FCC considers dummy loads as antennas with "significant negative gain?" After all, an antenna is an antenna and a transmission is a transmission! I don't see anything in the Rules that addresses power output levels vs. identification and unidentified signals. Scofflaw?

Unlike my real antennas, which are still somewhat modest, I happen to have a 24-element, home-brew dummy antenna! That ought to raise hell on the bands, eh? I will definitely identify my transmissions while using that monster!

The "Minimum Power" Rule

With no explicit listed exceptions, Part 97.313(a), FCC Rules clearly state that amateur stations must use "the minimum power necessary to carry out desired the communications."

Whoa! Who actually does that? Even as a lifelong QRP operator, I've rarely stepped my power down during a QSO to determine the minimum power necessary to facilitate the QSO. And, when I did, it was while in contact with other QRPers who were similarly curious.

Like many QRP ops, I assume that my up-front use of 5-10 W output in a 100-1500 W environment presupposes compliance. A careful reading of the rule at face value, however, seems to indicate that power-reduction should be a part of every QSO. At a minimum, stations that use high-powered amplifiers for every QSO would seem to be violating FCC rules during every QSO!

As with many rules, however, this one seems destined to fail because it doesn't define "desired communications." Ostensibly, desired communications means the lowest signal levels required to exchange any and all necessary information. But if I were cited for violating this rule (which probably hasn't happened to anyone) I would simply state that I desired "40-dB-over-S9 communications" with the other station, justifying my use of any output power up to the maximum allowed.

There's a "reasonably assumed" meaning of "desired communications" and there's an operator's self-described meaning of "desired communications," and the FCC rule doesn't differentiate and isn't clear. Welcome to bureaucracy! These rule distinctions, however clear to you or me, are small consolation if the bureaucracy in question fines you, confiscates your stuff, imprisons you or guns you down in the street! I'm just saying! Definite scofflaw!

Up, Up and Away!

Everybody loves balloons, right? Who among us hasn't thought of including some kind of ham radio payload to play around with during the course of a balloon (drone, model airplane or even an amateur rocket) flight? For those of us unfortunate enough not to have worked for NASA or the National Weather Service, super-fun amateur radio balloons might be the next best thing. Or not! There are a few potential problems with this scenario—one that is carried out by individuals and clubs on a regular basis.

First, the FCC frowns on unattended transmitters that can't be turned off, especially those at towering heights. Actually, the Rules don't necessarily say that you have to be able to turn off the transmitter, but they do say that you have

to be able to "control" the communications from it, which is essentially the same thing. If you can't "turn off" the signal it's uncontrolled.

It's one thing to fire up an unattended, low-power beacon on the ground, where signals are significantly attenuated by objects, terrain and local weather conditions (fox-hunter style). It's quite another to power up a beacon at 30,000 or 70,000 feet, where the signal footprint may easily cover hundreds or even thousands of square miles! The interference potential, though ultimately low, is much greater, whether yours is a beacon, an APRS reporter, a video cam or a "flying repeater."

Depending on frequencies, devices, power levels and geography, the FCC almost always insists that you have the ability to "turn the transmitter off" at any point after launch—an afterthought on many backyard radio balloon launches. Telecommand is the name of the game!

Another afterthought on many casual balloon launches is coordination with the Federal Aviation Administration (FAA). Depending on the size and composition of your balloon and its proximity to airports or other government installations, the FAA generally insists that you coordinate, "get permission" and comply with any necessary rules prior to launch.

The chances that your ham radio balloon might get sucked into an engine and cause the crash of a jetliner are remote, but not zero. It's much more likely that your balloon might present a mysterious and unresponsive radar signature to air traffic controllers, potentially disrupting flight operations and needlessly annoying and endangering people on airplanes.

The composition of your balloon might raise hackles, too, even if it's not technically prohibited. If you happened to use a large Mylar-coated balloon, for example, and it happens to encounter a high-voltage power line during ascent or descent, a resulting flash-over might take down the power grid for miles around. It's not likely, but it has happened, and you don't want to be a part of the next incident.

If you balloon is really successful, other unforeseen situations might develop. For example, if you launch in one country and your balloon winds up flying over another, your payload, which may not have appropriate provisions for remote shut-down, may continue transmitting on frequencies that are unauthorized in your new "host country." Or, the country that owns the airspace in question might not have a reciprocal operating agreement with your country, or may not allow amateur radio at all. Oops. International incident! Amateur radio balloon launches are seemingly innocent and lots of fun, but even if they're brightly colored, balloons always seem to come in various shades of gray!

Is That Drone Registered?

Whether delivering packages for Amazon.com or launching Hellfire missiles at "undesirables," the age of the drone has arrived. Hams use drones for sexy tower-top photography, and there has been plenty of talk about using drones to loft antenna support lines over treetops—and even to loft wire verticals for the low bands (subject to available battery power and the ability to successfully operate in high RF environments!). These have probably already happened. Whatever your pleasure, many jurisdictions prohibit and restrict drone usage, while some require licensure and pilot training.

Some drone manufacturers (DJI? among them), reportedly require real-time GPS flight-tracking and user registration or the drone's firmware will "brick" itself, turning an expensive drone into an expensive piñata. Buyers and scofflaws beware.

Remote Station Operation

The Internet, now pervasive and mature, enables operators from around the country and around the world remotely operate ham radio stations. This is a great way to enjoy ham radio from condos, apartments and locations from which it's impossible or prohibitive to put up a typical station or antenna. But this ability, nifty though it may be, sometimes violates existing FCC Rules.

If you hold a U.S. Extra-class ticket, let's say, and you set up a remote station at a friend's house (same state, same country), it's almost impossible to mess things up short of non-hams at the remote location "using" your equipment.

But if done properly, you can safely transmit on all bands using any and all modes. With a remote station in the boonies, your ham operations don't bother anyone, and nobody from your townhouse association is the wiser. So far, so good.

But what if a friend who holds a lesser-class license wants to log onto your remote station to work DX? Are you present at your station to act as a proper control operator? Probably not. Is your friend signing his call sign or yours? It might make a big difference! And what if a ham friend from Germany wants to use your remote station to hear what the bands actually sound like from the States?

If he's just listening, you're probably okay. But if he transmits, maybe not. Are you present as control operator? That might be a factor. And if your friend is from a country without any type of reciprocal agreement, or one that doesn't allow amateur radio at all, you might potentially be in big trouble. Or none at all, because some of these issues have yet to be "tested" in The Court of the FCC.

I Can't Hear You if You WSPR!

Weak Signal Propagation Reporter (WSPR) operations have skyrocketed over the past several years, and it's a safe bet that many WSPR operations violate FCC Rules. The problem is, unattended operation of digital stations on most HF frequencies are prohibited or rest on a very slippery slope. If you're in the next room watching TV or playing video games, your WSPR station isn't operating "attended."

The same goes for sleeping, mowing the lawn at the home QTH, etc. Yet "attending" your WSPR station can be the very definition of boring. Nothing much happens in real time, and when it does it's often painfully slow. The temptation to "not attend" is powerful, scofflaws!

On the other hand, because WSPR operations almost always operate at puny power levels, they rarely cause problems (save for the droning warble on 7.040 MHz if you're an old-school QRP CW operator). Plus, to the best of my knowledge, no ham has been "NALed" by the FCC for unattended WSPR operation...yet. Still, I suspect that a great many WSPR ops are "flagrant" violators!

Gray Goes With Everything

Other "unsettled ham radio case law" includes the use of proprietary, commercial modulation schemes on the amateur bands (I'm talking about you, D-STAR and CLOVER), certain maritime data-mode practices (HF-linked, unattended Internet mailbox access schemes, often also using CLOVER), and the expression of "acceptable profanity" (have you listened to broadcast TV lately?), among others.

Our Elected Officials

Despite all of these gray areas, it's difficult to almost impossible to actually be cited for most/any of these aforementioned activities. In the post-Riley Hollingsworth era the FCC has earned a certain reputation for being "softer on radio enforcement"—at least in the gray zone—although FCC Special Counsel Laura Smith says recent FCC cutbacks won't affect amateur radio enforcement (2016 Pacificon convention).

Speaking of cutbacks, the FCC has shrunk its field offices and field engineering/enforcement staffers to historic lows. Perhaps this is why the ARRL is working with the FCC and other agencies to revamp its Official Observer (OO) program.

And speaking of engineering staffers, back in the day, the FCC was staffed and led by "engineering types" who were close to the issues and the technologies, whereas today, "lawyer types" exclusively helm the agency that defines our destiny as hobbyists (and Internet users).

It's kinda scary, actually!

Two well-placed sources I interviewed before writing this month's column expressed additional concerns about the dearth of FCC engineers and the rise of "politically appointed lawyers" at the Commission: Amateur radio is becoming less relevant and less important to government, military, and law enforcement as time goes by.

Ubiquitous global communication technologies have captured the imagination and the mindshare when it comes to "services" that traditionally relied on amateur radio and non-aligned enthusiasts of every stripe. This pendulum swings back and forth in relatively slow arcs.

When hams provide disaster communications we're praised, of course, but our relevance is still waning. Unless something Really Big happens, perhaps, like a home-grown or state-sponsored EMP attack or a high-altitude nuclear detonation—things that would likely destroy most or all of the terrestrial and satellite-based communications systems over a sufficiently wide area.

Sometimes out of necessity, sometimes just for fun, for many years every iteration of my "personal maker space" has had some kind of sliding rack or sliding/rolling shelf. Last time around, in the condo, a 4 x 7-foot piece of pegboard slid back and forth on a length of garage door track in front of two large, steel shelves. The added storage was useful and necessary. This time, in the roomier basement of the "new" QTH, this white shelf rolls back and forth in front of an existing pegboard wall. Although it's useful, it's not entirely necessary! A 2 x 2 "rail" suspended from the floor joists "guides" the shelf, which rolls on four, fixed-direction casters. Don't dare me to motorize it, as I have a couple of new Arduino chips on hand and I need to learn how to use them! (NT0Z photo)

Then, it's hams to the rescue, as usual, but perhaps in a new, post-apocalyptic setting. But that's material for another story that will hopefully never be written!

So, even if typical scofflaw behavior probably won't draw the ire of the FCC, what will put you in direct contention with the agency and, if necessary, the federal justice system, are clear and willful violations such as transmitting on amateur bands without a license, pirate broadcasting, selling non-type-accepted radios and amplifiers, and the biggie: intentionally interfering with government public safety (or military) communications.

Those violations, perhaps along with the flagrant use of ridiculously high-powered CB radios, have historically been vigorously enforced, and continue to be enforced today, subject to available FCC resources.

Things that should get the agency's enforcement attention but don't? Crappy, RF-noisy light bulbs and other "garbage" electrical and electronic devices sold online and at every big-box retailer.... TSM

Radio 101

By Ken Reitz KS4ZR ks4zr1@gmail.com

The Ups and Downs of Antenna Installations

It looks like I'm launching the antennas pole-vaulting style. The block and tackle does the heavy lifting, the safety rope did its job and the guide rope keeps the entire array from swinging wildly into other parts of the house or nearby shrubs and trees. (KS4ZR photo)

Last year I put up a 16-element quad-stacked Yagi array for the FM band (you can read the details in this column in the June and July 2016 issues). It worked great but antenna experimenters can't be stopped from making changes, so last month I took the whole thing down. It was actually easier than putting it up. I just sat on the peak of the roof and removed one antenna after the other until they were off the mast.

I lowered the mast to the ground by means of a rope that passed through two pulleys attached to the side and gable end of the house. A guide rope secured the mast from one side—preventing the whole thing from crashing into several nearby trees and shrubs.

I set about to put up a whole new antenna system, complete with the antenna rotator that I took off the mast last year to put up the 16-element FM array. Everybody needs a hobby.

Hacksaw, Rope, Block and Tackle

With the mast secured to the gable end of the house, I wanted the top of the mast to clear the roof peak by a couple of feet so that, with the rotator attached, I could add a 10-foot section of mast on which to mount the various antennas. I put a small Radio Shack ground-plane (to cover the VHF/UHF scanner frequencies) on top since it was omnidirectional. Below that, I would mount the Televes VHF/UHF antenna (see this column in the February 2017 issue for more on this antenna). Below that I would mount two of the original 4-element FM Yagis I had just taken down from the quad-stacked array—making it a 4-over-4 stack at less than half the gain but still, I hoped, a decent FM antenna.

To minimize interference between the antennas (including the two stacked FM Yagis), they would all be separated by one-half wavelength at their respective frequencies. The top-most antenna would be about 35 feet off

Left: Block and tackle from Tractor Supply ($50) turns an antenna-raising project into a one-man ordeal. (Courtesy: Tractor Supply) Right: 40-watt soldering iron with modified tip for splicing synthetic rope. The type of rope used with the block and tackle was braided and the spliced rope was twisted, but they both appeared to be Polyester. I overlapped the two by about two inches, melted and smoothed the connecting edges so that they would pass through the block and tackle pulley sets. (KS4ZR photo)

the ground.

I bolted the rotator onto the lower portion of mast and in turn bolted the 10-foot steel mast section to the rotator. I laid the rotator and mast across a sawhorse to support the weight while I loaded the mast.

I had two concerns: I knew there would be plenty of flex in the steel mast as it was hoisted in place because that's what happened when I put up the FM array. But, would the 10-foot mast and four antennas be too much weight? Would it bend too much before the point where the weight of the entire assembly was transferred to the ground? I was also concerned that the Channel Master rotator, designed for a TV antenna by itself, might not be up to turning such a load. I would just have to find the answers to those questions the hard way.

The scanner antenna was attached first, then the Televes VHF/UHF-TV antenna and finally the two FM Yagis. I measured the separation distance of each while they were loosely attached to the mast. After securing each antenna to the rotating portion of the mast (all lined up in the same direction), I then attached the separate coax cables that would feed each antenna and secured them to the rotating mast with zip-ties. I left plenty of coax at the base of the rotator to wrap around as the rotator did its job—it has a 360-degree rotation, which then must be brought back around. There was no concern that the cable would get wrapped around the mast. I also made sure to leave plenty of coax as a drip-loop to deter rain from coming into the attic space via the coax.

One-Person Antenna Raising

With the base of the lower mast secured against the foundation of the house and a cement block, I was ready to try raising the whole assembly. The plan was to place the base of the mast directly under where all of the outside wall brackets line up on the gable end of the house. All I needed to do was pull the mast up via the two pulleys I used to lower the other antenna assembly. Once it was upright I could scramble up the ladder and secure the lower mast to each of the four wall brackets.

I knew it was going to be a tough job and one I would have to be able to do myself. There was no place for anyone to be below the mast to help raise it up. It was more than a hardhat area. If anything went wrong, the whole thing would come unceremoniously crashing down, crushing anyone below. I would be directly under the pulleys, safe from disaster.

Mechanical Advantage

I tried pulling on the rope through the pulleys but the mechanics made it too hard. I could lift the entire assembly only a few inches. It was time to bring out the block and tackle, which I had used when pulling up the 16-element FM array in the same fashion the year before.

To make this work, I attached a very hefty swivel hook to the peak of the gable and hooked one end of the block and tackle to that hook. I drilled a hole into the mast at a little over the halfway point on the lower portion of the mast and placed a threaded screw eye in the hole. I attached the bottom hook of the block and tackle to this screw eye. The original rope on the pulley was then secured to the antenna rotator as a safety rope and the guide rope was secured to the mast in between the rotator and the screw eye.

I still had one big problem: the rope end of the block and tackle was about thirty feet short. I would have to add more rope to the block and tackle but it would have to pass through the set of pulleys up at the roof peak while lifting the entire load.

I made a mistake when I eyeballed the amount of rope I thought I would need. I came up two feet short. The old carpenter's adage rang in my ears, "Measure twice—cut once." Well, I would just have to tack on another two feet of

Looking down the flexing mast, just before the splice broke, but the safety rope kept the entire project from crashing to the ground. (KS4ZR photo)

rope and hope that both splices would successfully make it through the first set of pulleys.

Splicing Polyester rope is easy. It can be done with a 40-watt soldering iron, the tip of which has been removed and fashioned with a hammer to make a blade that can cut and weld such rope together. The problem is that you can only weld Polyester with Polyester. Some Nylon and Polyester ropes are blends with natural fibers and don't weld quite as easily and you can't weld synthetic rope to straight natural fiber rope at all. I had no idea what the rope on the Tractor Supply block and tackle was made from, though it was braided rope, whereas the additional rope was twisted, I would just have to try welding the rope and hope it worked.

With everything in place, it was time to start raising the mast. The plan was to pull on the block and tackle until the entire system was up a few feet. I would secure the block and tackle rope to two cleats (16-penny nails pounded into the siding where I knew there would be studs) then run over to the safety rope, pull out the slack and secure that rope to two other cleats, also nailed through the siding into studs.

I did this successfully as the system steadily rose. I got the first rope splice past the pulleys without any trouble, but the weight of the entire antenna proved too much for the second splice, which I hadn't done as well. There was a loud snap and the entire system fell about ten feet bouncing on the strength of the safety rope. But no damage was done. Everything was fine. I brought out the soldering iron on a very long extension cord and did a proper job this time with the

Actually not a black and white photo. Looking up into a dreary overcast day, all four antennas on the mast with rotator in place. (KS4ZR photo)

rope weld. I was confident it would hold.

I noticed that in the fall, the lead rope from the block and tackle had run out the pulleys so that now, instead of having two sets of two pulleys, one set at each end of the block and tackle, I had use of only one pulley at each end. Luckily, the weight of the entire array was now shifted mostly to the ground and that proved more than enough to pull the whole system up and into place.

So, How Does it All Work?

After going through all this, you can imagine my anticipation. I came inside the house and hooked the FM lead to the Sangean HDT-1X AM/FM/HD tuner and the TV lead to the terrestrial antenna jack on the LinkBox 9000i Local OTA-FTA-TV receiver. After turning on the Sangean tuner, I was a little disappointed that, with the rotator turned northeast to Washington, DC, I could just hear WETA-FM (90.9 MHz) in the FM hiss. Not too promising. Next I turned on the TV and did a terrestrial signal search, which netted some eight or so channels. Very disappointing.

I rotated the antennas in every direction many times, but couldn't get any better results. Unfortunately, it was by then the end of the day so I packed it in, resolving to troubleshoot the situation the next day.

Top left: WETA-FM, Washington, DC, lights the RDS display and often locks the HD icon on the Sangean display from 80 air miles away. Bottom left: Even more impressive is WHUR-FM in Washington, with just 16,500 watts, enough to get the RDS display working. Right: Channel 12 from Richmond, a lower wattage VHF station comes through nicely on the Televes antenna from 46 miles away. At the same time, channel 29, Charlottesville, comes through from the backside of the antenna. (KS4ZR photos)

The following morning, after stewing over the lack of signals, I mentioned it to my wife, well versed in trouble-shooting, who said, "Maybe you got your wires crossed." I was reluctant to think the problem could be anything so mundane. But, since it was raining outside, there was no going to the antennas to see if anything had come undone (like, maybe, when the whole system plunged 10 feet and got jerked back up like a yo-yo).

So, I pulled the FM lead off the Sangean and the TV lead off the LinkBox and switched them. Voilà! Everything came in perfectly.

A second scan using the LinkBox with the Televes antenna pointed to Richmond, brought in 29 channels (21 of those channels were from Richmond, including a lower power VHF station that doesn't come in on any other antenna I have, and 8 channels from Charlottesville, incredibly from the opposite direction at the same time). This is more confirmation of the value of this antenna.

It was just as gratifying to tune the FM band with just the two Stellar 4-element FM Yagis. Suddenly, WETA was coming in with a strong enough signal for the RDS to be displayed and a good bit of the time to lock the HD logo on the Sangean display—impressive reception, considering that the HD portion of this 75 kW station is transmitting only 7500 watts at a distance of 80 air miles.

Did the 2-stack FM array perform anywhere nearly as well as the quad-stacked array did? No, but considering the size, cost and trouble with putting up the big array, it did very nicely.

Notes and Resources:

The Televes DAT Boss LR VHF/UHF amplified antenna is getting harder to find. That figures—it really works. I found it still offered at Jet.com for $104 with free shipping. If it's one of your first three orders from Jet.com, you can deduct 15%, so your price would be more like $88 with free shipping, an excellent price for this antenna, especially considering that it is amplified and that the amplifier can be configured to drive an additional TV. Go to **Jet.com** and type in: Televes DATBOSS LR Mix UHF VHF long-range antenna with LTE Filter.

The Stellar Labs 4-element FM Yagi is $29 at MCM Electronics. It's often on sale for much less. I paid $13 each when I bought four of them together and the shipping was only $5 on another promotion. Of course, you'll need two in order to stack them. **http://www.mcmelectronics.com/product/STELLAR-LABS-30-2460-/30-2460**

FM array phasing harness: The value of stacking antennas is that you don't need an antenna preamplifier and you will see just under 3 dB gain over a single antenna. All you need are two RG/6 coax cables 5-feet long and an antenna splitter/combiner. The coax must be within one-half inch of being the same length each in order for the signals from both antennas to be combined in-phase and sent to your receiver. You can get the coax and the splitter/combiner at your local big box store for between $15 and $20. An excellent analysis of the Stellar FM antenna, including modifications, can be found here: **http://ham-radio.com/k6sti/stellar.htm**

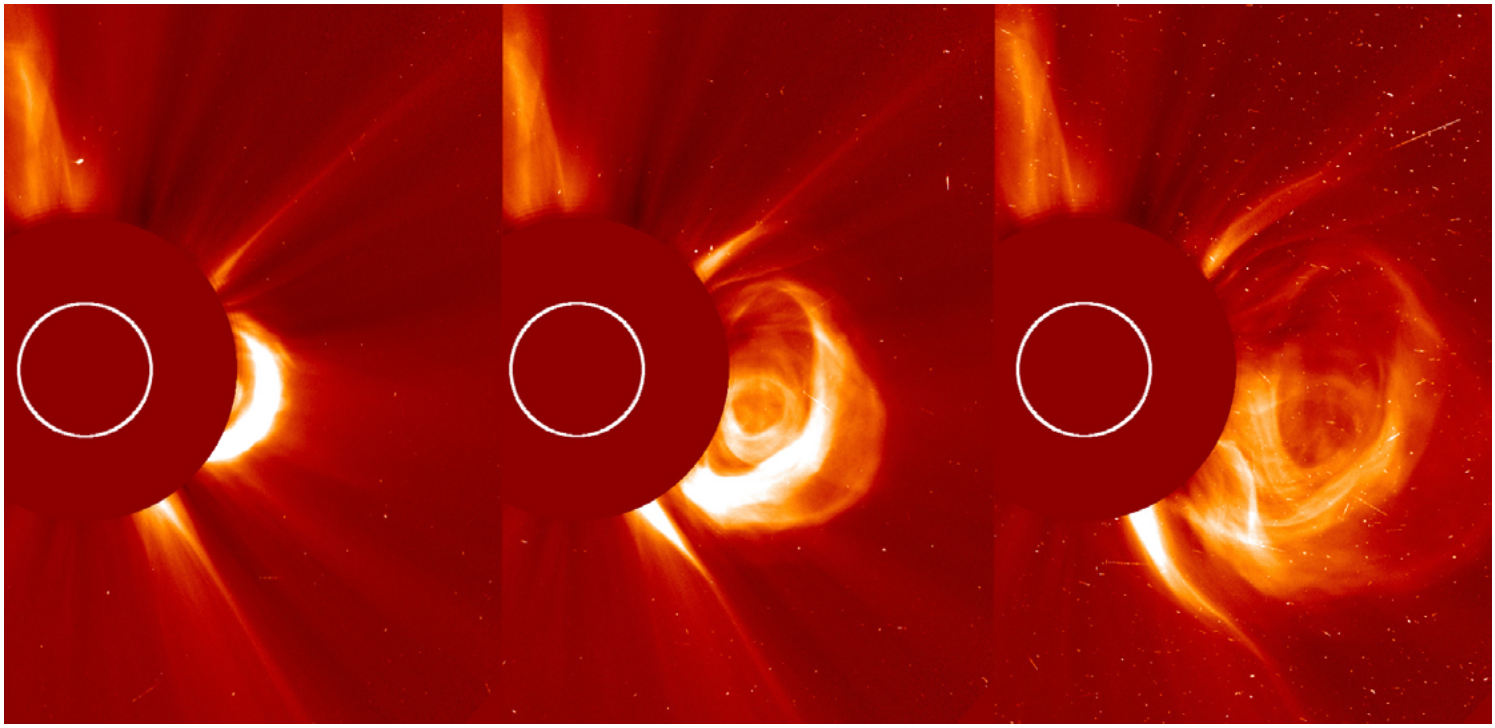
Of course, if you can find a better FM antenna (i.e. one that has more elements), the better for your reception. Radio Shack used to carry the Antennas Direct 6-element FM6 model, and though they're still listed on the Antennas Direct website, I've had trouble finding a dealer for these. Channel Master offers a 3-element FM Yagi for $49 and Winegard has apparently discontinued their stand-alone FM antenna. Years ago, there were many FM antenna manufacturers in the market, with as many as 13 elements. They are long gone. As hard as it is to believe, a stand-alone FM antenna with more than 3 elements is hard to find.

As for the rotator, a Channel Master 9521A ($125 at Amazon, which includes the rotator, remote control, power supply and 50 feet of control wire with free shipping), it seems to be holding up nicely, but time will tell. TSM

Radio Propagation

By Tomas Hood NW7US **nw7us@nw7us.us**

Historic Event in Cycle 24: the GLE



NOAA Active Region 1476, first appearing on May 5, 2012, rotated to the right side (Western side) of the Sun's disk by May 17. Quiet for a few days prior, it erupted with an M-class flare that peaked at 9:47 PM EDT on May 16, 2012. A coronal mass ejection or CME was also associated with the flare. It burst from the sun at 9:48 PM EDT and traveled at over 930 miles per second. NASA labels CMEs at this fairly fast, but not extreme, speed as Type O, for "occasional", since CMEs with speeds in this range happen a few times per year. This eruption, however, caused a proton even unlike any at that date in Solar Cycle 24 (see text).

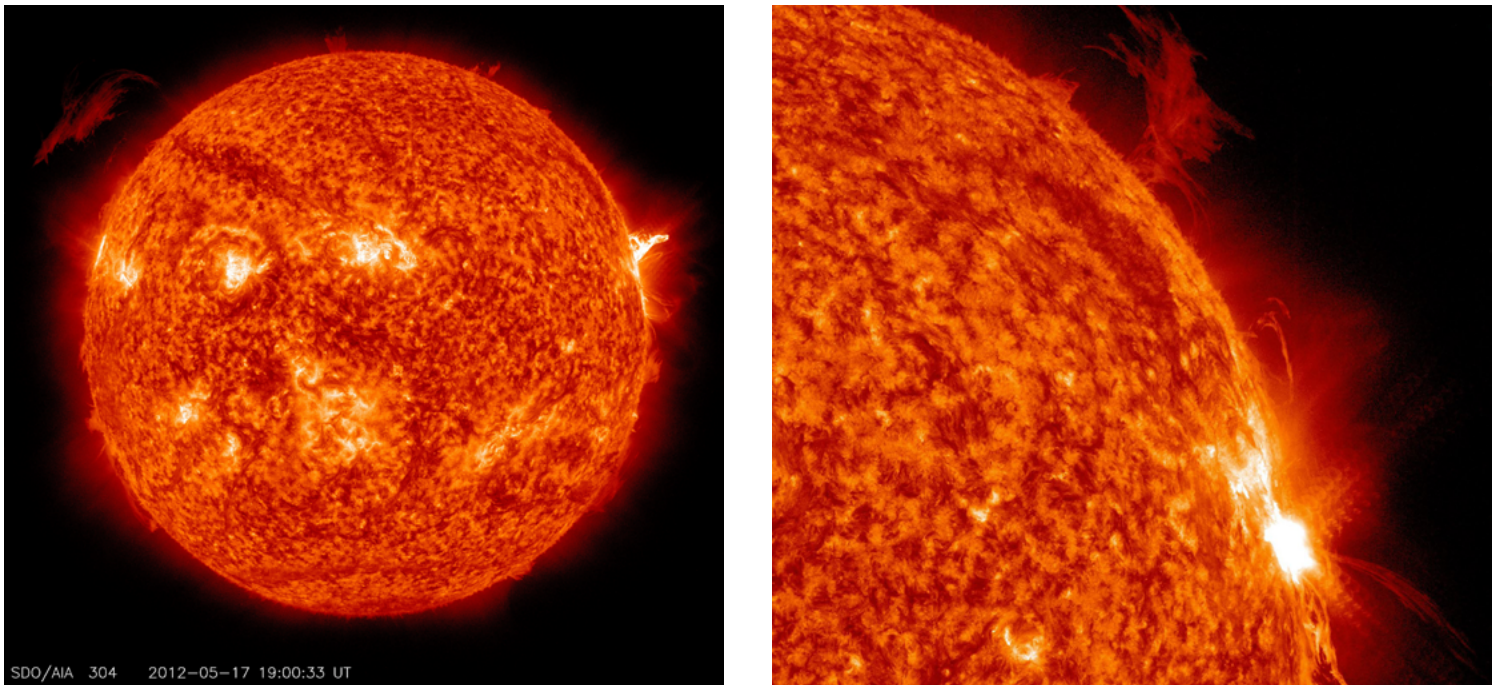
A flare's light reaches Earth in eight minutes and can cause radio blackouts. According to NOAA's space weather scales, this M-class flare produced a moderate radio blackout, meaning that both high and low frequency radio communication may have been blocked for tens of minutes.

A flare's arrival is sometimes followed by a front of solar energetic particles about 20-30 minutes later. In this case, a solar energetic particle event was detected at 10:10 PM EDT, causing a moderate solar radiation storm that has since subsided. Solar radiation storms can disturb the regions through which high frequency radio communications travel. (Credit: NASA/SOHO)

In 2012, on the seventeenth day of May, a magnitude M5.1 X-ray flare erupted from the Sun's western limb (when we view the Sun, the Sun's western limb is on our right side). The flare originated in NOAA Active Region 11476 (or, just 1476, as we typically drop the leading number). It peaked at 0147 UTC, just as it rotated over the edge of the visible solar disc. An M-class flare is considered a "moderate" flare, at least ten times less powerful than X-class flares. This flare produced Type II radio bursts, and triggered an ongoing proton event. An associated coronal mass ejection (CME) was also detected, but the CME was not directed toward Earth, since the flare occurred on the Western edge of the Sun.

This particular flare is not like any of the previous flares from this current sunspot cycle, Solar Cycle 24 (and few since). What makes this flare unique is that the associated proton blast was so fast—this eruption shot out a burst of solar particles traveling at roughly 900 to 1000 miles per second, which reached Earth about 20 minutes after the light from the flare. It was so energetic that when the protons collided with atoms in Earth's atmosphere, they caused a shower of particles to cascade down toward Earth's surface. The shower created what's called a Ground Level Enhancement (GLE).

GLEs are quite rare; fewer than 100 such events have been observed in the last 77 years since instruments were first able to detect them. There were 16 GLE events during solar cycle 23 (1996 to 2008) all associated with the



The M-class x-ray flare of May 17, 2012, as seen by the Solar Dynamics Observatory (SDO). While the flare erupted from the very edge of the visible solar disc, it created a somewhat rare event: a ground level enhancement (GLE). The last one prior to this 2012 flare was during Solar Cycle 23, in December of 2006. Fewer than 100 GLE events have been observed in the last 77 years (see text). Credit: SDO/AIA

very-high-energy CMEs. However, there have been only two GLE events (GLE71 on 17 May 2012 and GLE72 on 6 January 2014) during the first 5 years of cycle 24. GLE71 was associated with the May 2012 M5.1 flare and a very fast (approximately 2,000 km/s) CME. GLE72 was from a source region behind the west limb, so we do not have flare information. However, the CME was very fast (approximately 1,700 km/s). Thus, the first two GLE events of Cycle 24 are consistent with shock acceleration. However, there were other Cycle-24 energetic eruptions (larger flares and faster CMEs) from the same longitude range as GLE71 that did not result in GLEs.

The May 2012 flare is unique in this sunspot cycle—Cycle 24. This flare produced the first GLE of the cycle, and this was captured in an historic way.

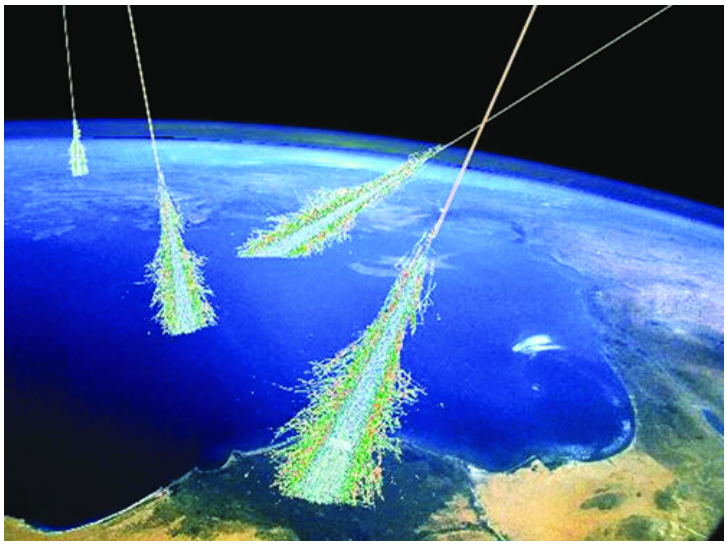
Scientists took quite an interest in this event. The joint Russian/Italian mission PAMELA, short for Payload for Antimatter Matter Exploration and Light-nuclei Astrophysics (see http://g.nw7us.us/2x4xfdO), measured the particles from the Sun that caused the GLE. Measuring solar particles is not new, but PAMELA is highly sensitive to the very high-energy particles that reach ground level at Earth. The data obtained by PAMELA helps scientists understand the details of space weather phenomenon, helping them model solar flares as they work out the details of why a moderate flare like the one on May 17, 2012 can produce the high-speed particles needed to cause a GLE.

"Usually we would expect this kind of ground level enhancement from a giant coronal mass ejection or a big X-class flare," says Georgia de Nolfo, a space scientist who studies high speed solar particles at NASA's Goddard Space Flight Center in Greenbelt, Maryland. "So not only are we really excited that we were able to observe these particularly high energy particles from space, but we also have a scientific puzzle to solve."

The stage was set for this observation when, on May 5, 2012, a large sunspot rotated into view on the eastern (left) side of the Sun. The sunspot was as big as about fifteen Earths. This was a sizable active region, but not nearly as big as some of the largest sunspots that have been observed on the Sun during this current cycle. NOAA numbered this sunspot region as Active Region (AR) 11476. The sunspots had already shown activity on the back side of the Sun—as seen by a NASA mission called the Solar Terrestrial Relations Observatory (STEREO)—we've touched on STEREO in past editions of this column—so scientists were on alert for more.

Scientists who study high-energy particles from the Sun are always watching for solar activity that would result in GLEs. The last GLE they'd observed occurred during December of 2006. They are always hoping for the chance to observe proton storms with PAMELA, because the PAMELA mission, which focuses on cosmic rays from outside our galaxy, could also be used to observe solar particles. Such solar cosmic rays are the most energetic particles that can be accelerated at or near the Sun.

There was a hitch as scientists watched AR 1476 during early May. The satellite carrying the PAMELA instruments were not currently usable since they were in calibration mode. Scientists including de Nolfo and another Goddard researcher, Eric Christian, let the PAMELA collaboration group know that this might be the chance they had been waiting for and they convinced the Russian team in charge of the mission to turn the instruments back on to science mode.



An artist's concept of the shower of particles produced when Earth's atmosphere is struck by ultra-high-energy cosmic rays. Credit: Simon Swordy/University of Chicago, NASA

"And then the active region pretty much did nothing for two weeks," says Christian. "But just before it disappeared over the right side of the sun, it finally erupted with an M-class flare."

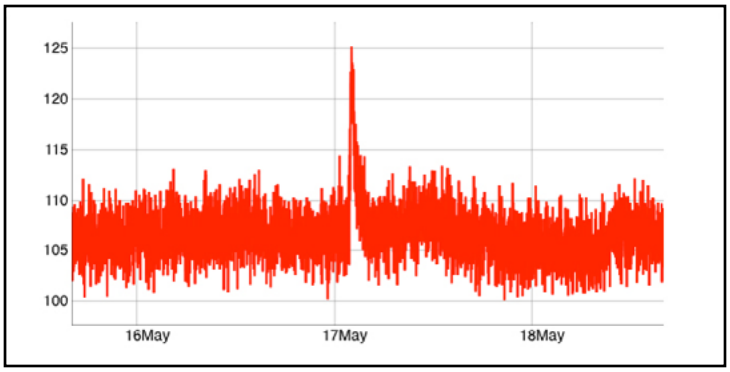
This was it! This was the moment these scientists hoped for. Neutron monitors all over the world (see **http://g.nw7us.us/KOzOTt**) detected the shower of neutrons that represent a GLE. Most of the time these particle showers do not contain the solar energetic particles themselves, but rather contain the resultant debris of super-fast particles slamming into atoms in Earth's atmosphere. This time around, these particles were the real deal. The elevated levels of neutrons lasted for an hour.

Simultaneously, PAMELA recorded the incoming solar particles up in space, providing one of the first in-situ measurements of the stream of particles that initiated a GLE. Scientists have been working on this and events since, hoping to learn more about why this 2012 event triggered a GLE when earlier bursts of solar protons in January and March did not (for example, see the paper, "Major solar eruptions and high-energy particle events during solar cycle 24," by Gopalswamy, Xie, Akiyama, Makela, and Yashiro published 1 September 2014, at **http://g.nw7us.us/2x4Nes4**).

PAMELA is a space-borne experiment of the WIZARD collaboration (see http://g.nw7us.us/2vEsOmc), which is an international collaboration between Italian, Russian, German and Swedish institutes. The mission was realized with the main support of the Italian (ASI) and Russian (Roscosmos) Space Agencies. (Read more at **http://g.nw7us.us/2vEPkLG**).

HF Propagation for September

Some days, propagation on shortwave will be much like conditions during the summer. Other days (and more often), conditions will be more like those experienced during the winter season. With the low 10.7cm-Radio-Flux



This graph shows the neutrons detected by a neutron detector at the University of Oulu in Finland from May 16 through May 18, 2012. The peak on May 17 represents an increase in the number of neutrons detected, a phenomenon dubbed a ground level enhancement or GLE. This was the first GLE since December of 2006. Credit: University of Oulu/NASA's Integrated Space Weather Analysis System

levels during September, worldwide propagation openings on frequencies higher than 10 MHz will be spotty. When paths open (especially on higher frequencies) conditions will change fast, and vary greatly.

On the highest of the bands (10 meters through 17 meters), paths from Europe and the South Pacific as well as from Asia, into the North American region, will occur on days when the flux is higher than 80 (which may occur). On lower frequencies, openings are more stable and last longer, providing better opportunity for worldwide communications.

Sixteen meters, used by a larger group of broadcasters, will be the most reliable higher broadcast band, especially when the solar flux levels are higher during the month. This band may supply day-path propagation even over the polar paths. A considerable improvement is expected, with the band opening shortly after sunrise and remaining open until after sundown. However, 16 meters will not stay open late into the night like it typically does during the spring season.

Openings should be possible from all areas of the world, with conditions best from Europe and the northeast before noon, and from the rest of the world during the afternoon hours. Openings from the South Pacific, Australia, New Zealand, and the Far East should be possible well into the early evening, particularly when we have low geomagnetic activity combined with higher flux readings. Amateur radio operators will experience much the same between 17 and 15 meters.

Conditions may be marginal during the month, but these higher bands are certainly capable of surprises. There will be less polar propagation as we move toward winter, though, making some parts of the world difficult to hear over these paths. To catch the openings over high latitudes, get on these bands shortly after sunrise, or watch for polar signals as they close for the evening.

The bands from 19 meters through 22 meters compete with the higher bands for the best daytime DX bands this month. Look for these to open for DX at sunrise and remain open from all directions for a few hours. It should be possi-

ble to hear many areas of the world throughout the daylight hours, with a peak in the afternoon. Nighttime conditions will favor openings from the south and tropical areas, but some openings will also be possible from other areas, especially during days when the sunspot count is higher. Look for polar gray-line propagation from Asia. Long-path is common on 19 meters and on 20 meters from southern Asia, the Middle East, and northeastern Africa as well as the Indian Ocean region via the North Polar path.

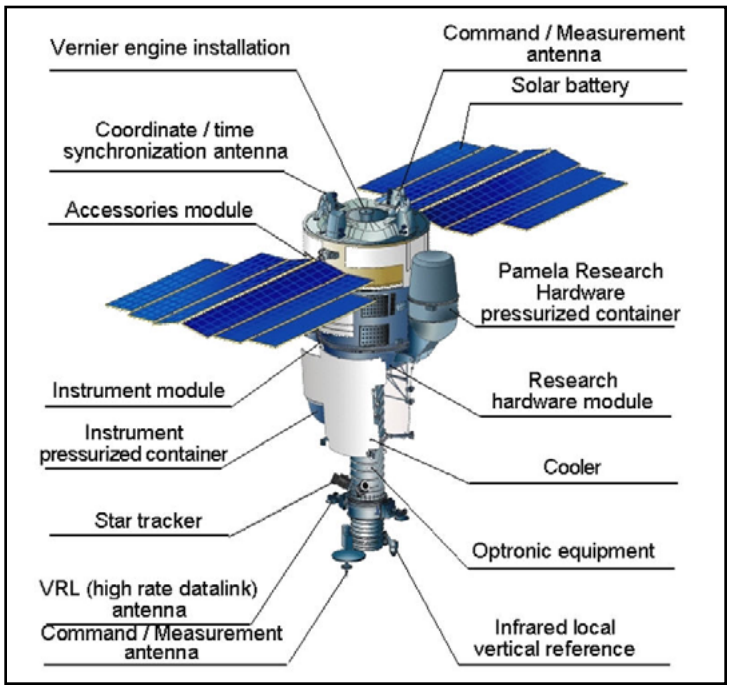
The bands from 25 meters through 31 meters are all-season bands. Expect an incredible amount of activity on these two hot bands. Many broadcasters choose the international broadcast bands in this slice of spectrum, targeting their audiences during prime times (morning and early evenings). Similarly, amateur radio operators prefer the 30-Meter (non-voice) band for the stability and availability it provides this month. The conditions prevalent on 19 through 22 meters are more pronounced, and last much longer, on these lower-frequency bands. Look for exotic stations a few hours before sunrise through early morning, then again in the early evening before sunset, until around midnight.

Expect an improvement in nighttime DX conditions on the bands from 120 meters through 40 meters during September and October. This is due to the ever-increasing hours of darkness combined with the seasonal decrease in the static level. For hams, 40 meters, and for shortwave broadcasting, 41 meters should be best for worldwide DX from sunset to sunrise. A lot of the larger, stronger broadcasting stations use 49 and 60 meters, so you can always depend on hearing signals from early evening (from before sunset) to a few hours after sunrise. For exotic regional signals, check 75 through 120 meters during the hours of darkness, especially for an hour or so before local sunrise.

With the seasonal increase during the summer months in geomagnetic activity, MW (or, MF; Medium Frequency) DX over the northern latitudes is severely attenuated. This can be a blessing for those trying to DX tropical AM Broadcast stations and mid-latitude medium and low power stations, since the interference from strong over-the-pole stations is reduced. Signals below 120 meters will improve, with longer hours of darkness and the decline of noise-producing weather. Seasonal static, which makes it difficult to hear the weak DX signals, is decreasing little-by-little as we move away from the Autumnal Equinox. Stretch out those beverage antennas and start looking for signals along nighttime paths.

VHF Conditions

The Sporadic-E season is winding down, this time of year. There may be a few openings possible this month, but tropospheric ducting propagation is a real possibility. Look for signals on paths crossing through stalled high-pressure zones in the Midwest, or along cool, wet air masses. Tropospheric conditions are generally very good for many of the VHF bands during September with the appearance of



The various instruments and assemblies of the Resurs-DK1 Spacecraft.Credit: PAMELA GROUP)

different weather fronts. This will be the primary mode for working up to 300 miles.

Meteor shower activity will be slim. Toward the end of September Trans-equatorial (TE) propagation will begin to occur between southern North America and northern South America. Openings will generally occur in the late afternoon to early evening.

Solar Cycle 24 Today

The Royal Observatory of Belgium, the world's official keeper of sunspot records, reports a monthly mean sunspot number of 11.0 for July 2017. The mean value for June results in a 12-month running smoothed sunspot number of 16.7 centered on January 2017. Following the curve of the 13-month running smoothed values, a smoothed sunspot level of 18 is expected for September 2017, plus or minus 14 points.

Canada's Dominion Radio Astrophysical Observatory at Penticton, British Columbia reports a 10.7-cm observed monthly mean solar flux of 77.7 for July 2017. The twelve-month smoothed 10.7-cm flux centered on January 2017 is 79.4. A smoothed 10.7-cm solar flux of about 78 is predicted for September 2017.

The geomagnetic activity as measured by the Planetary-A index (Ap) for July 2017 is 9. The twelve-month smoothed Ap index centered on January 2017 is 11.3. Geomagnetic activity this month should stay level at about the same activity as seen in August 2017. Refer to the Last-Minute Forecast for the outlook on what days we might witness degraded propagation (remember that you can get an up-to-the-day Last-Minute Forecast at **http://SunSpotWatch.com** on the main page).

TSM

The World of Shortwave Listening

By Jeff White, General Manager WRMI **info@wrmi.net**

Shortwave Broadcasters Meet on the West Coast of North America for First Time

After landing at Los Angeles International Airport, renting a car, and during the one-hour drive north and west to the suburban area of Simi Valley, it seems that at least half of the radio stations we heard across the FM band on our car radio were playing Mexican music, catering to the very large Mexican-American community in southern California.

Our destination in Simi Valley was the local shopping mall where the low-powered FM station 99.1 The Ranch is located. A country music station, The Ranch is owned by Strategic Communications Group, the same organization that operates KVOH shortwave in Simi Valley, the shortwave Voice of Hope-Africa in Zambia, and Voice of Hope-Israel on AM in Israel. The Voice of Hope was the host of this year's annual meeting of the NASB—the National Association of Shortwave Broadcasters—in mid-May.

NASB group photo at KVOH transmitter site. (Photo by Thais White)

Global Impact of DRM

The NASB is an association for the privately owned shortwave stations in the United States, but shortwave listeners and anyone interested in shortwave radio is very welcome to attend the NASB annual meetings, which are generally held each May. The first topic on the agenda for the 2017 meeting was DRM (Digital Radio Mondiale). This relatively new form of digital shortwave broadcasting sounds really great, but you need a special DRM-capable radio to pick it up, and up to now there have been no DRM receivers available on a large-scale basis in the marketplace.

But DRM fans really support the medium. Christopher Rumbaugh of the DRM North America Yahoo Group and George Ross of Trans World Radio gave a presentation about DRM at the NASB meeting in Simi Valley. Christopher said one of the key areas DRM is focusing on now is India, where All India Radio has three or four large DRM shortwave transmitters. Neighboring Pakistan is also said to be interested in DRM. Indonesia wants to use DRM to cover all of its 18,000 islands, and it has recently done tests with just 5 kilowatts. South Africa is doing a lot of DRM experimentation, but mostly on local radio such as religious broadcaster Radio Pulpit, which has tested the DRM+ system on FM. Another 12 southern African countries are said to be interested in DRM broadcasting.

Elsewhere in Africa, the Voice of Nigeria has done some DRM shortwave tests that were heard by listeners in the United States. Radio Amazonia in Brazil has also tested DRM on shortwave. Russia was supposed to make a major transition to DRM, but this seems to be stalled at the moment. Saudi Arabia meanwhile has recently purchased and installed various DRM-capable transmitters. The Arab States Broadcasting Union may be interested in starting DRM broadcasts when the Titus II receiver comes out. Radio New Zealand International is using DRM to feed programs to radio stations throughout the Pacific for local rebroadcast.

On the receiver front, a year or so ago the Indian-made Avion DRM receiver seemed to have a lot of promise, but George Ross said it is not as user-friendly as the newer Titus II receiver made by the Panamanian company Pantronx, which has so far just produced a few prototypes of the Titus II. They had promised to be in general production some time ago, but this has been delayed several times by technical improvements that have been made in the receiver. George Ross from TWR was hoping to have a Titus II prototype at

Getting there is half the fun. This is the narrow road up Mount Chatsworth to the KVOH transmitter site. Note the potholes and no guard rails. (Photo by Jeff White)

the NASB meeting, but it wasn't ready yet. He said the receiver, which has been developed in cooperation with TWR, is designed to be audible in a room with 60 people. A show of hands indicated that fully half of the people at the NASB meeting had already placed pre-orders for the Titus II, which are being taken via the **hfcc.org** website.

Plans are for the Titus II to be manufactured in multiple countries, such as China, South Africa and maybe even Indonesia. Radio Republik Indonesia recently conducted DRM tests on FM in Batu, Indonesia, which were well heard in Singapore and Malaysia. The Titus II will have DRM+ for FM reception, and it will have a Wi-Fi hotspot. It is basically an Android tablet with a DRM app that cannot be used on any other type of receiver. The retail price is expected to be under $100. George Ross said that a "Baby Titus" is also in the development stages. It will be a smaller portable radio with fewer bells and whistles. It will not be an Android tablet, and should be about half the price of the Titus II. But this radio will not begin production until after the Titus II pre-orders get filled.

Another DRM receiver called the Gospell GR216 is also being developed. This radio has its roots in the old Newstar DRM receiver, which was made in China. The GR216 picks up DRM transmissions on AM and shortwave, and analog transmissions on FM. The radio has an internal active antenna. So far we know of only two units that exist in North America.

Someone at the meeting asked why big companies like Tecsun are not producing DRM radios. George Ross said he didn't know. Ray Robinson of KVOH pointed out that there isn't much to listen to in DRM mode for listeners in North America at this time. Jerry Plummer, frequency manager of WWCR, said this could be a brand new market, and he pointed out that using DRM would cut a shortwave station's electric bill by about half -- a major incentive.

Christopher Rumbaugh announced that an Italian philanthropist has plans to construct a DRM shortwave station using just 10 kilowatts from a site in New Jersey. The FCC normally requires US shortwave stations to use a minimum of 50 kilowatts, but for DRM the minimum power is 10 kilowatts, the theory being that 10 kilowatts in DRM mode will reach roughly the same coverage area as 50 kilowatts in analog modulation. The New Jersey station plans to use five 2-kilowatt transmitters stacked together, and its log periodic antenna will be directed towards Europe and the Middle East. The programming will consist of both audio and data broadcasts. Not much more is known about this project yet.

In Europe, DRM is being used for a new project in France called Smartcast

The new Smartcast DRM receiver. (Photo by Thais White)

which is in the testing stage. One of the project's partners is TDF, Telediffusion de France, which operates the large shortwave transmitting facility in Issoudun used by Radio France International and many other broadcasters. Jerome Hirigoyen is in charge of TDF's shortwave operations. He spoke at the NASB about the Smartcast project. Essentially it involves DRM transmissions on shortwave beamed to ships in the English Channel and the Mediterranean. These include weather reports and a variety of other programming intended especially for people on ships—all of it in French. A French partner of Smartcast has built a small DRM receiver, which picks up the signals onboard the ships and then rebroadcasts it in Wi-Fi for the passengers. Jerome said that Smartcast could eventually have other applications for maritime and land-based audiences.

At the NASB business meeting in Simi Valley, stations talked about their interest in DRM and the possibility of conducting some sort of joint NASB DRM transmissions in the near future. So stay tuned.

Internet or Shortwave?

An interesting map was displayed at the NASB meeting showing where significant Internet surveillance and censorship is going on around the world. Another map showed the percentage of Internet users in each country, which was pretty low in Africa, parts of Asia and Brazil, for instance. Essentially, only half of the world's people have Internet access, and some of the broadcasters at the meeting pointed out that shortwave can reach those people.

Bob Biermann, an engineer from WRMI in Florida, commented on an article from Radio World submitted by WRMI senior engineer Don Frish for discussion at the NASB. The article dealt with the problem of recruiting young broadcast engineers for shortwave and mediumwave stations these days. There just doesn't seem to be much interest in these media compared to the Internet and its various applications. This prompted an extensive discussion. Shortwave station representatives said it would be necessary to work with universities and trade schools to find future engineers. Dr. Dowell Chow, the recently-retired president of Adventist World Radio, said they have a program to take students to their shortwave station KSDA in Guam for periods of one or two years. Students pay their own airfare to Guam, but if they decide to stay with AWR after their training period their airfare will be reimbursed. While they are on the island, they have a stipend, a vehicle and housing. Jerry Plummer of WWCR offered to help develop a program for NASB stations to work with universities on producing HF engineering candidates.

Author and shortwave listener, John Figliozzi, speaks at NASB meeting. (Photo by Thais White)

Jerome Hirigoyen of TDF (left) with Jerry Plummer of WWCR. (Photo by Thair White)

A Listener's Perspective

A number of shortwave listeners always attend the NASB's annual meetings, and this one in California was no exception. In fact, it probably attracted more listeners than any other NASB meeting in memory. It was also the first-ever NASB meeting held on the West Coast of the United States in the organization's 27-year history.

John Figliozzi, originally from New York, now in Pennsylvania and visiting relatives in California, captivated the audience with a talk about his varied activities as a shortwave listener. He has been an SWL and DXer for over 50 years, since he was 12 years old.

One of the projects that John is most associated with is the Winter SWL Fest, an annual convention in the Philadelphia area—typically held in early March—which celebrated its 30th anniversary earlier this year. "The idea," said John, "is that it's a place for people to informally get together and talk radio. Radio was a solitary activity back 30 years ago without the Internet and with expensive phone calls."

Over the years, the Fest has had a lot of shortwave broadcasters attend in addition to the listeners, and the broadcasters have often been banquet speakers. They include such well-known names as Ian McFarland of Radio Canada International, Bob Zanotti of Swiss Radio International, Andy Sennitt of the World Radio TV Handbook and Radio Netherlands, Jonathan Marks of Radio Netherlands, Frans Vossen of Radio Vlaanderen Internationaal in Belgium, Jerry Plummer of WWCR and many others.

The Winter Fest features around 12 forums on radio-related subjects over a period of two to three days. It used to be a Friday and Saturday event. This year it was Thursday, Friday and Saturday, and next year it will be the same (March 1-3, 2018). There is always a banquet on Saturday night. But the organizers leave lots of free time for folks to just chat about radio. The forums or speakers have included, for example, a lady who has traveled the world with Canadian peacekeeping forces and shared her observations of radio stations she has listened to or visited. There have been talks about DRM. A regular staple is David Goren's Shortwave Shindig program late on Saturday night, with guests and many recordings of interesting radio transmissions. The Shindig is often broadcast live on a shortwave station (WRMI has aired it for the past few years). One Fest also screened a movie about pirate radio.

Over 130 shortwave listeners and DXers attended the Winter SWL Fest this year. Some years the number has been around 200.

The SWL Fest is organized by John Figliozzi and his fellow festmeister, Richard Cuff, on behalf of NASWA—the North American Shortwave Association. John is on the Executive Council of NASWA. This is the largest shortwave club in North America. Unlike some other DX clubs, it focuses exclusively on shortwave. NASWA still publishes a monthly paper magazine with member logs, QSL reports, etc. John said it might eventually go to an online-only magazine. They already publish a NASWA flashsheet, which is distributed by e-mail. And of course it has a webpage (**naswa.net**). NASWA was founded in the 1960s. In its heyday, the club had about 2000 members, mostly in North America. During the Gulf War, membership was around 500. Now there are about 250-300 dues-paying members.

John Figliozzi has been an SWL/DXer since 1966. He was very interested in listening to shortwave stations from the communist countries during the Cold War. He remembers listening to Radio Prague during the Warsaw Pact invasion of Czechoslovakia. In fact, he recently found written notes that he took of shortwave newscasts back then. John says he lost interest in shortwave somewhat during his college years, but later in life he regained interest in the hobby. He has written a lot of articles about international broadcasting for publications such as the World Radio TV Handbook and the now-defunct *Monitoring Times*. Years ago, John wrote a book called "The Shortwave Radio Guide" for Radio Shack. He has his own book called "The Worldwide Listening Guide," which is published every two years. John describes

himself as one-third DXer and two-thirds program listener. "I've always been more interested in the content of the broadcasts," he said.

The next edition of "The Worldwide Listening Guide" is due out in November of 2017. The spiral-bound book focuses on programming available internationally on various platforms—shortwave, Internet, satellite and podcasts. It's an hour-by-hour guide to what you can hear from international broadcasters. John points out that while many governments have cut back on shortwave broadcasting since the end of the Cold War, there's still a lot to hear on the bands, and he's still personally fascinated with the programming available. He says, "The TuneIn app, for example, has 30,000 radio stations from around the globe." The Worldwide Listening Guide is available from websites such as Amazon.com and Universal-Radio.com. A direct link is also found on the *TSM* Bookshelf in the back of this magazine.

Since the NASB meeting was taking place in California, John noted that international radio listening is different on the West Coast than on the East Coast. "Radio New Zealand International is available out here [in the West]," he said. "They just went from two shortwave transmitters to one transmitter—part-time analog, part-time DRM."

New Leadership at the Helm of Adventist World Radio

Dr. Dowell Chow was the President of NASB member Adventist World Radio from 2011-2017. He is also a member of the NASB Board of Directors. The new AWR President is Duane McKey, who asked Dr. Chow to stay on as AWR's representative to the NASB. Chow gave a presentation about AWR at the meeting in Simi Valley. He explained that Adventist World Radio has been on the air for 46 year. In the beginning, the station was particularly focused on reaching the East Bloc and Muslim countries. It began transmissions from a shared shortwave transmission facility in Sines, Portugal.

In 1987, AWR inaugurated its own shortwave station, KSDA, in Guam. AWR has purchased airtime from many shortwave stations over the years, including Radio Netherlands, the Sri Lanka Broadcasting Corporation, Telediffusion de France and Radio Taiwan International. "We're always looking for new stations to reach new markets," said Chow.

Dr. Chow said AWR has new platforms now besides shortwave, especially a big podcast operation. Most AWR programs including Wavescan are available as podcasts on the AWR.org website. Chow recommended that shortwave broadcasters might want to go to the NAB (National Association of Broadcasters) convention occasionally. He said it has had as many as 150,000 attendees, and "it's the best show for cutting-edge technology."

AWR's Asia-Pacific Region is now headquartered in Bangkok, Thailand. The African regional office is in the U.K. AWR's Americas division is at the station's world headquarters in Silver Spring, Maryland, co-located with the headquarters of the Seventh-Day Adventist Church. There

Dr. Dowell Chow of AWR on Mt Chatsworth. (Photo by Thais White)

is an AWR Media Center in Darmstadt, Germany, where Giuseppe Cirillo—better known as "Pino"—works. Pino is the frequency manager for AWR. There are four engineers at KSDA in Guam and a grounds-person. The total worldwide payroll of AWR is less than 30 persons, with one-third of them in Maryland.

"Shortwave is not dead and will never die," declared Dowell Chow. "Only 50 percent of the world has access to the Internet—at some speed. And there are lots of restrictions even where it's available." Chow lamented that it's difficult for AWR to get into the "-stan" countries (such as Kyrgystan, Kazakhstan and Tajikistan). "The Internet is blocked and controlled there, but you can get there via shortwave. We cannot give up shortwave with the current situation in the world." He cited Cuba as another example of the same situation.

"We have 80 languages on shortwave, 130 on podcasts," continued Chow. "Podcasts are very popular among the diaspora populations. We have lots of Somali listeners in North America. Altogether, we have 18 million downloads a day. Two-thirds of them are from China. We have a tremendous audience for our podcasts."

Local FM broadcasts are also a fast-growing market for AWR. "FM is growing fast in the Americas and Africa," Chow said. "We have been able to get licenses for FM stations in Guinea-Bissau, Gabon, Madagascar, Mauritius, India, Indian Ocean countries and many others. We have over 300 FM stations in Latin America from Belize to Argentina, including the Caribbean. We have 80 stations in Argentina alone."

Cho said that AWR tries to produce programs inside the target countries. They produce programs at studios inside Cuba, for example, that are sent to WRMI in Florida and then broadcast on shortwave back to the island. "Programs produced inside China," he said, "have a different flavor than those produced outside the country. Mandarin is the number one-spoken language in the world. Spanish is now number two, ahead of English. We have to diversi-

fy our languages." Apart from the Wavescan DX program, AWR has just two programs in English—one for India and another for Africa. "We're not too focused on English," said Chow. Another platform used by AWR is AudioNow, a service operated by a Washington-based organization whereby listeners can call a local telephone number in the United States and hear AWR programs in various languages. He suggested that other shortwave stations should look into this service.

Mediumwave Opportunities Worldwide

For many years, international broadcasting was synonymous with shortwave. But in certain geographical situations, AM or mediumwave can also be used for international broadcasting. Ben Dawson from Hatfield & Dawson Consulting Engineers in Seattle spoke to the NASB member stations to explain how mediumwave can be used, and how to save money while using it.

Dawson explained that every country has a broadcast regulator from which stations must receive a license. He said there are two international treaties that regulate mediumwave usage. AM frequencies don't change periodically like shortwave frequencies do. International Telecommunication Union regulations are the basis for AM rules. There are three ITU regions; Region 2 is the Americas. As with shortwave, the World Radio TV Handbook is an excellent reference of mediumwave stations worldwide.

Dawson said that it's possible to get substantial groundwave coverage from mediumwave transmitters in areas such as the Persian Gulf, for example. And of course skywave coverage is even larger. He said contrary to popular belief, mediumwave transmission facilities don't have to be large. AM transmitters are smaller today than they were in the past. And he said modern AM transmitters are more efficient, so they use less power.

Ben Dawson talked about ways to build an AM transmission facility for less expense, including antennas and ground systems. "With the right antennas," he said, "Radio Mitre in Argentina has been able to cover the same area with a 100-kilowatt transmitter than they did before with a 200-kilowatt transmitter." Sometimes, he explained, you can have a directional antenna using just one tower, dropping a line from a guy wire, which acts as a second tower.

Local regulatory agencies can often help with frequency selections, according to Dawson. Hatfield & Dawson has done a lot of consulting work for the U.S. International Broadcasting Bureau (IBB). "An experienced consulting engineer can often save you more money than what they charge you," he said. Local environmental regulations are an important factor. Hatfield & Dawson worked with the Voice of Hope on its new Israeli mediumwave installation. The license was for 100 kilowatts on 1287 kHz. But they determined that there was too much radiation, and they could achieve better coverage with just 50 kilowatts, thus saving Voice of Hope a lot of electricity. The station reaches Syria, Lebanon, Jordan and Cyprus with its 50-kilowatt AM signal.

L-R Jerome Hirigoyen of TDF, Ray Robinson of KVOH, Jeff White of WRMI recording interview outside the KVOH studios for AWR Wavescan program. (Photo by Thais White)

Speaking of Jordan, Glenn Tapley of WEWN and Jerry Plummer of WWCR gave a slide presentation of the February 2017 HFCC shortwave frequency planning conference at the Dead Sea in Jordan. They gave an explanation of the HFCC's work and history, the elimination of "collisions" on the shortwave bands (and no, they don't include jamming transmissions), and they talked about their experiences in and around the Dead Sea. Tapley and Plummer explained how shortwave station representatives resolve frequency collisions at these meetings, and they said the personal interaction creates good relations between frequency planners of many countries. They cited the good relationship between the American and the Iranian engineers, for example.

Besides shortwave business and radio-related presentations, there was also time for local sightseeing. On the final day of the meeting, the group visited the Ronald Reagan Presidential Library in Simi Valley. One night the NASB had a private showing of the movie "Good Morning Vietnam" at a theater in the shopping center where KVOH's studios are located. The broadcasters and listeners got together informally for meals at a local Italian restaurant and at other restaurants for wings and barbecue.

Next year's NASB annual meeting will be held at the headquarters of Son-Set Solutions (the former HCJB Global Technology Center) in Elkhart, Indiana. Shortwave listeners are welcome to attend. The dates will be May 17 and 18, 2018. More information will be available on the NASB webpage, **www.shortwave.org**.

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The Shortwave Listener

By Fred Waterer **programming_matters@yahoo.ca**

North vs. South Korea on Shortwave, CFRX, BBC Programming and More!

Welcome to the September edition of The Shortwave Listener. Is it possible that fall is in the air already? This month we look at shortwave from the Korean Peninsula, Ireland (maybe), Canada and, via the BBC, we will find out what it is like to travel the cosmos and, sticking to Earth, travel to the US as a refugee. Lots of great information this month, let's get to it.

Events in the Korean Peninsula have dominated the headlines for days, as this is being written. With both the Korean leader Kim Jong Un and US President Donald Trump sabre rattling, tensions in the region have risen. I thought it might be timely to look at the shortwave outlets in this region of the World.

The Voice of Korea, formerly known as Radio Pyongyang, is one of the strangest radio stations you will ever hear. Since the end of the Cold War, it is rare to come across the kind of programming and propaganda one hears emanating from the North. The Democratic Peoples Republic of Korea (DPRK—known often as North Korea) is a different world and this is reflected in it's radio programming. From the founding of the nation in 1945, a cult of veneration has been built up for the Kim Dynasty. Kim Il-Sung, the first leader is forever known as The Great Leader, and is in fact, constitutionally designated President for Eternity. His son and successor, Kim Jong-Il was The Dear Leader and had his own cult of veneration. The third generation of the Kim Dynasty, Kim Jong-Un is known as The Great General and even in a twist that outdoes Louis XIV, "The Sun."

So in listening to North Korean broadcasts, one will get a heavy dose of personality cult. The other overriding theme, is Juche, sometimes referred to as Kimilsungism, the official political ideology of North Korea, described by the regime as Kim Il-Sung's "original, brilliant and revolutionary contribution to national and international thought," Juche, or self-reliance could also be considered the official state religion of the DPRK. The third element of Pyongyang broadcasts is music. At best it can be described as patriotic music—at worst—unoriginal martial music.

Sometimes the propaganda is unintentionally funny, when it is way over the top. The other constants are the wonderfulness of all things Kim, the dastardliness of the United States and the invincibility of the North.

South Korean radio could not be more different. The

The border between North and South Korea is one of the most heavily armed spots on Earth. (Photo courtesy cia.gov)

music is lighter, the prose much less heavy. Whereas the North loves marching bands, the South gives us K-Pop and performers such as Psy (of the virally popular "Gangnam Style" K-rap). Southern news and commentary are much more believable and less self-serving. KBS World Radio presents the South, warts and all, in a realistic manner. Southern broadcasts are a treat to listen to at any time.

Weekday broadcasts from Seoul all begin with news followed by the 25 minute Seoul Calling. This in turn is followed by Drama Lines, a 5-minute feature that introduces Korean phrases as used in TV dramas from Korea. An interesting way to teach the language!

The final 15 minutes of the one hour broadcast are taken up with rotating features on the following schedule: UTC Mondays one can hear Business Inside, an interesting look at one of the World's bigger economies. UTC Tuesdays it is the turn of The Korea Travel Log, looking at interesting places in this vibrant country. On Wednesdays listen for Sounds of Korea an interesting little feature exploring the musical heritage of Korea. Thursdays Korea, Today and Tomorrow can be heard. This program looks at inter-Korean relations and issues involving the North. Timely given the state of relations on the Peninsula. Fridays, Current Affairs in Focus is on tap, another timely news and background program.

Weekend programming from Seoul is a real treat. Satur-

South Korean flag. (Courtesy: CIA.gov)

Vintage CFRB-AM/CKFM-FM/CFRX-SW QSL card from 1967 (KS4ZR collection)

day broadcasts open with News, followed by Touch Base in Seoul, a program about the people of Korea. Each week an interview with interesting Korean people is featured. Finally the Saturday broadcasts conclude with KBS Listeners Lounge, a mailbag program so to speak.

Sunday features include Hot Issue of the Week, and one of my personal favorite programs, K-Pop Interactive, featuring the fabulous pop music of South Korea.

Give KBS World Radio a listen on 15575 kHz at 1300 UTC.

Ireland on Shortwave?

Traditionally the All-Ireland Hurling final has been heard on shortwave each September. Hurling is the national sport of Ireland and is somewhat similar to field hockey, at least to my untrained eye. I have been unable to confirm that the Final will indeed be on the international bands again this year. If it is, it is scheduled to take place on September 3, 2017 between 1200 and 1600 UTC. In the past coverage has aired via shortwave transmitters in Africa, giving Irish citizens in Africa an opportunity to hear this annual event. In 2015, the Final was heard on 9470 kHz and 17540 kHz. Check the RTE website or other DX News sources closer to the event. It's a rare opportunity to hear Irish radio on shortwave.

Last of the Canadian SW Stations

Canada is also an increasingly rare catch on shortwave and it seems CKZN in Newfoundland has joined the ranks of silent stations. The transmitter was shut off earlier this summer, ostensibly to see if anyone was paying attention. CKZN was a unique voice from Canada's newest province, and technically represented a separate radio country, as Newfoundland was a semi-autonomous Dominion within the British Empire prior to joining Canada in 1949. Some older radio stations in Newfoundland continue to have call signs beginning with "V" rather than the normal practice in Canada of having call signs begin with "C".

One can still listen to Canada on shortwave but it is via 1 kW transmitters in Toronto (CFCX) and Calgary (CFVP). CFCX in Toronto relays the programming of Newstalk 1010 CFRB on 6070 kHz. Some of the more interesting programming on CFCX includes Beyond Reality Radio, a sort of poor man's Art Bell, which explores the paranormal and conspiracy theories. Beyond Reality Radio is heard weekdays at 0400 UTC. Real Talk with Evan Solomon is up at 0600 UTC. Solomon is the host of CTV Television's Question Period, the flagship current affairs program seen on Sunday mornings. He is an excellent journalist and asks all the hard questions. Weekdays at 2300 UTC one can hear The Night Side with Barb DiGuilio, a veteran of Toronto radio. "Barb keeps you company in the evening with a light and entertaining look at the world. Fun interviews with interesting people."

On weekends check out the TED Radio Hour, which offers the best of the famous "Ted Talks." This can be heard UTC Saturdays at 2200 UTC. On Sundays tune in at 2200 for Tech Talk, with information about all those gadgets we use and want, which is followed by TED Radio Hour. Seven days a week, one can hear a simulcast of the CTV National News with Lisa LaFlamme. This is heard at 11pm local, 0300 UTC—perhaps one of the most authoritative Canadian newscasts.

The other Canadian option is CFVP which relays CKMX on 1060 kHz in Calgary. That particular station identifies itself as "Funny 1060 AM" an all comedy station, 24 hours a day—perhaps the only shortwave station with a laugh track! It can be heard on 6030 kHz.

Isle of Music and Uncle Bill's Melting Pot

Now some news from William Tilford, host of From the Isle of Music and Uncle Bill's Melting Pot. "I'm adding a weekly contest to Uncle Bill's Melting Pot - one song

each week will be by an unnamed artist and without the title. Those who email the correct name and artist will be named on the air two weeks later." UBMP is quite an amusing, clever program—certainly off beat. In August he did an International Food Fight episode, chronicling the rivalry between two pierogi festivals. You can't make this stuff up. The warring festivals are hundreds of miles apart—it's not like they'll put each other out of business except maybe in court. Fun program!

More Programming Highlights

Some upcoming programming from the BBC World Service: In late August a new series called The Compass: Stargazing debuted. It continues in September on UTC Wednesdays at 1330 UTC

In this five part series, science writer and author Dava Sobel explores our fascination with the heavens, from the early revelations of Copernicus to the latest technologies around the world, as we peer ever further into the Cosmos. The series connects early science, with faith and the latest astronomical research around the world.

In program one, Dava Sobel uncovers the brilliance of her hero, the Polish astronomer Nicolaus Copernicus who some 500 years ago was secretly working on a theory that would reveal the true model of the universe, putting the Sun rather than the Earth at its hub. He observed with his naked eyes and using only rudimentary tools.

If you are at all interested in anything related to space this seems to be a "go to" series of programs. If you miss the first couple they should be available archived online as well.

Another potentially interesting program from the World Service is Assignment: Abidi in America

In 2015, the BBC's Leo Hornak followed Abdi Nor Iftin, a young Somali refugee living in Nairobi, as he battled to be admitted onto the US Green Card programme via a lottery. Since the making of Abdi And The Golden Ticket, Abdi has been creating a new life for himself in Maine, the whitest state in the United States.

Abdi In America documents the highs and lows of Abdi's struggle to make it in America, against the backdrop of growing public fear of Muslims and immigration, and the eventual rise of Donald Trump.

The program will document Abdi's gradual discovery of the unspoken rules of race and racism in the West, through his work as the only black employee at a blue-collar construction firm. It will also explore Abdi's changing relationship with the family he left behind in Nairobi. On the air August 31 at 1330 UTC it should be archived online, if not repeated in the following days.

The BBC is marking the fiftieth anniversary of the debut of BBC Radio 1 and Radio 2. Some fantastic programming is on tap for Radio 2 in August and September. Radio 2 programming can be heard online at bbc.co.uk/radio2.

"On Saturday 30 September, BBC Radio 2 celebrates its 50th birthday. To mark the occasion the station is broadcasting special season of programs including a Friday Night Is Music Night concert with songs and anecdotes from across the last five decades, The Listener's Stories where those at home share their memories, four episodes of Johnnie Walkers Long Players about the music of 1967, and documentaries on pirate radio and on The Light Program which both paved the way for BBC Radio 2."

BBC World Service news, along with many other programs, is available 24/7 via podcasts such as this News Room report on the BBCWS homepage. (Courtesy: BBC World Service)

Those last two really caught my eye. "Johnnie Walker Meets Pop Pioneers (19 September, 10-11pm) will see Johnnie reliving the early days of BBC radio 'pop' broadcasting with fellow pirates who left the high seas for the new stations' homes in Portland Place - Paul Burnett, Keith Skues, Emperor Rosko and Tony Blackburn, alongside former Radio 1 controller and opening morning producer Johnny Beerling and David Symonds. And he will pay tribute to the first voice on Radio 2, Paul Hollingdale, who sadly passed away recently (just before he was due to record an interview for this program). You'll also hear archive clips from the opening morning on both stations, shows from the period including Top Gear and Junior Choice, and songs that were making the charts in the summer of love."

Another program in this vein airs in August but it should be available on the BBC Radio 2 archive: "Johnnie Walker will be celebrating the excitement, energy and ground-breaking shows of the early pirate radio stations such as Radio London, Radio Caroline and Radio 270 in Johnnie Walker Meets The Pirates (14 August, 10-11pm). Joined by his friends and colleagues 'Admiral' Robbie Dale (who along with Johnnie remained on board after midnight on the 14 August when the Marine Offences Bill passed into law, broadcasting illegally to an estimated European audience of 22 million), Tom Edwards (who left Caroline on that same day), Pete Brady, Emperor Rosko and Tony Blackburn, who worked on both Caroline and London, he will play some of 1967's key tracks on the medium wave."

That's a wrap for this month. Be sure and let us know what you are listening to, what you like to listen to or even what you don't like. This is your forum to talk about programming. Feel free to join in!

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Amateur Radio Satellites

By Keith Baker KB1SF/VA3KSF **kb1sf@hotmail.com**

Spotlight on the Chinese Amateur Radio Satellites

In previous columns, I've been focusing on the many ways you can operate through the amateur radio satellites. But, without one or more satellites to operate through, even the very best ground station is little more than a money sink. So, in this installment, I'll shine the spotlight on a whole series of FM and linear satellites that our AMSAT friends in China have launched in the last few years that make up the vast majority of our current amateur satellite fleet. I'll also share some operating tips on how you can maximize your signals to and from these satellites.

Beginnings

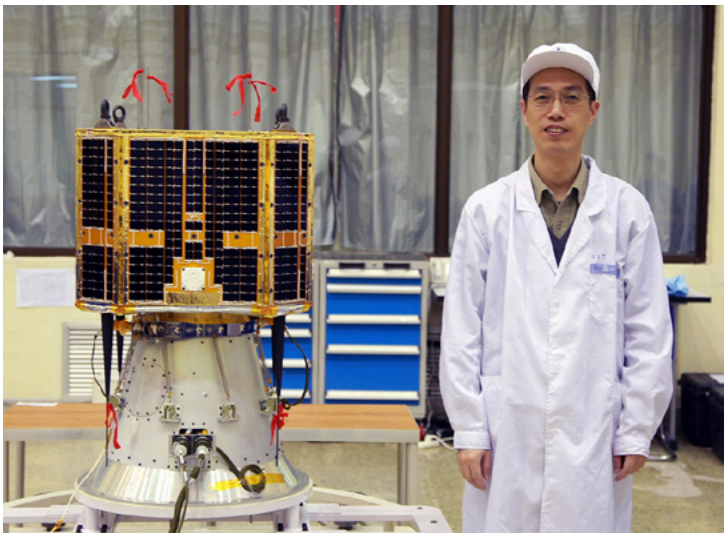
The Chinese AMSAT organization's (CAMSAT) group was largely responsible for the construction and launch of China's first-ever amateur radio satellite (CAS-1…the "CAS" most likely an acronym for "Chinese Amateur Satellite"). The satellite was also known as XW-1 (Xi Wang-1…Xiwang being the Chinese word for "hope") before launch, and, once activated on orbit, was also given the anglicized AMSAT designation "Hope OSCAR 68" (or just HO-68).

The 60 Kg satellite was launched into a 1200 Km by 1200 Km orbit on 15 December 2009 from the Taiyuan Satellite Launch Center of China on a CZ-4C (LM-4C) rocket. Soon after launch, its linear transponder proved very popular and provided hundreds of SSB and CW contacts for satellite-equipped hams worldwide over the Christmas-New Year 2009-2010 holiday period.

However, since that time, HO-69's linear transponder has gone largely silent with only it's 435.790 MHz (CW) beacon (sometimes!) being heard. While the cause of the transponder anomaly was not widely reported, it's believed an on-orbit software crash was the ultimate culprit.

CAMSAT at Hamvention 2011

I first became fully aware of the ongoing efforts of CAMSAT to add to the constellation of amateur radio satellites through a visit by some of their officers to the Dayton Hamvention in 2011. I ended up as their "satellite host," squiring them around the venue and introducing them to members of various North American ham radio and satellite-related organizations. CAMSAT President Alan Kung BA1DU (one of the people largely responsible for the design and construction of HO-68) was also present at the event and provided AMSAT forum attendees with an overview of the Chinese AMSAT efforts. After his talk, he then presented a "plaque of friendship" to AMSAT-NA President Barry Baines WD4ASW.



Alan Kung BA1DU poses with the fruits of his (and his team's) labor…the flight model of CAS-1 during final integration. The satellite was also known as XW-1 (Xi Wang-1…Xiwang being the Chinese word for "hope") before its successful launch. (Courtesy: CAMSAT)

CAS-2?

In the 2011 to 2013 time frame, CAMSAT and students at the Qian Youth Space Academy in China Academy began work on the next set of satellites in the series (CAS-2) as the successors of the first CAMSAT amateur radio satellite CAS-1 (XW-1, HO-68).

The launch of the first CAS-2 was initially planned for sometime in 2014 into a 1000 km orbit with an inclination of 12 degrees via a new Chinese missile from a new Chinese launch site into a sun-synchronous orbit to start. This orbit meant that the satellite's signals might not be receivable in those countries at high latitudes. It was also understood that most of the room in the CAS-2 satellite(s) was to be taken up by the primary (non-amateur) payload and it was only possible to fit a single channel FM amateur transponder into the satellite. A later announcement indicated that two separate CAS-2 satellite structures were being built…A1 and A2.

Members of the Chinese Amateur Satellite Group, CAMSAT, joined with us at our AMSAT-NA booth during the 2011 Dayton Hamvention. (Courtesy: Author)

Alan Kung BA1DU (left) and his CAMSAT team pose with QST Magazine Editor Steve Ford WB8IMY (second from left) at the 2011 Dayton Hamvention AMSAT booth. (Courtesy: Author)

Unfortunately, no further information about this particular CAS-2 imitative was ever published. Whether (or not) the satellites were ever launched (or even made it to orbit) is anyone's guess. As these satellites were all to be riding on Chinese government launch vehicles (and apparently new vehicles at that!) it's not unusual that the rest of the world would not ever hear about it if launch failures or other anomalies prevented such efforts from ever coming to fruition.

Enter CAS-3…and Success!

The CAMSAT orchestrated XW-2 (formerly known as CAS-3) amateur satellite system was successfully launched on Saturday, September 19, 2015 at 23:01:14 UT on China's new Chang Zheng 6 (CZ-6) rocket from the Taiyuan Satellite Launch Center (TSLC) in Shanxi, China.

The XW-2 constellation initially comprised six satellites of different mass, a 20 kg, three 10 kg and two 1 kg. All six satellites are equipped with substantially the same amateur radio payloads, a 435/145 MHz linear transponder for SSB/CW communications, a CW telemetry beacon and an AX.25 19.2k/9.6k baud GMSK telemetry downlink. Each set of amateur radio equipment has roughly the same technical characteristics, but operate on different frequencies in the 435 MHz uplink band and 145 MHz downlink band.

XW-2A, as it's the largest of the fleet, is also the most powerful of the bunch, with both beacon and transponder power in the 100 Mw category. XWs 2B, C, D, and F all sport 50 Mw beacons and transponder downlinks. Antennas are also all monopoles…one 1/4λ monopole VHF antenna with max.dBi gain is located on the top side of each satellite and one 1/4λ monopole UHF antenna with max.dBi gain is located at the opposite end of the top side, close to the edge of satellite body. All but one of the satellites (XW-2F) are three-axis stabilized on orbit with one of the satellite's surfaces continually facing the Earth.

A complete set of operating frequencies for these satellites (in .pdf format) can be found on the AMSAT-UK Web Site at: h**ttps://ukamsat.files.wordpress.com/2015/05/xw-2_cas-3_-satellites-frequency-allocation.pdf**. In addition, the series' CW telemetry encoding formats are also available (again from the AMSAT-UK Web site) at: **https://ukamsat.files.wordpress.com/2015/05/xw-2-cw-telemetry-encoding-format.pdf**.

In addition to the XW-2 satellites, three other satellites with amateur radio payloads (The LilacSats) were on the same launch. (CAS-3H) has an APRS digipeater, 144/437 MHz FM voice transponder and a SSB/CW linear transponder. DCBB (CAS-3G) and NUDT PhoneSat (CAS-3I) have telemetry downlinks. More information about the LilacSat series of satellites can be found at: **http://lilacsat.hit.edu.cn**. These Web sites are written in Chinese, so you'll have to translate them in your browser to read the information.

But Wait…There's More!

In mid-June, once again, the Chinese AMSAT organization (CAMSAT) proudly announced the launch of its CAS-4A and CAS-4B linear transponder payloads.

These payloads were riding "piggyback" on the Chinese OVS-1A and OVS-1B optical remote sensing satellites, which were launched along with the hard X-ray modulation telescope (HXMT) satellite aboard a CZ-4B rocket from Jiuquan (China) Satellite Launch Center at 03:00 UTC on June 15, 2017. Both satellites are in a 43-degree inclination orbit with an apogee of 524 Km.

CAMSAT worked closely with a Chinese Government aerospace contractor to build the two satellites with amateur radio linear transponder payloads. Both payloads carry a 435/145 (U/V) 20 dBm (100 Milliwatt) SSB/CW linear transponder, a 2m CW 17 dBm (50 mW) telemetry beacon and an AX.25 4.8 kbps GMSK 20 dBm (100 mW) telemetry downlink.

Each set of amateur radio equipment packages has the

Alan Kung BA1DU (second from right) poses with his team after presenting a friendship plaque to AMSAT-NA President Barry Baines WD4ASW (center) at the 2011 Dayton Hamvention AMSAT forum. (Courtesy: Author)

The Dayton Hamvention is a truly international event. Here members of the Chinese CAMSAT team pose with the then Radio Amateurs of Canada (RAC) President Geoff Bawden VE4BAW (back row, second from left) and some of his RAC booth helpers. (Courtesy: Author)

same technical characteristics, but they have different frequencies for the 70cm band uplinks and 2m band downlinks. The two micro-satellites also carry optical remote sensing missions. With identical 494 x 499 x 630 mm dimensions, a regular square shape and approximately 50 Kg mass, each satellite also contains a three-axis stabilization system.

A 43-degree inclination orbit, while not unique to amateur radio satellites, presents somewhat of a challenge to those of us located in the northern part of North America who may also wish to use them. That's because, the satellite(s) will appear to only be (briefly!) overhead in our part of the world, and no farther North than 43 Degrees North latitude, once or twice a day. And that Apogee point will also tend to shift steadily westward as the day progresses and the Earth turns underneath the orbit.

At deadline (mid-August 2017) neither of these satellite's amateur radio transponders had had been opened up to amateur radio use. But, my hunch is that, once the primary payload's experiments are completed, these two new satellites will become as popular as their Chinese brethren.

Operating Through The XW Series

As of the time of this writing in mid-August 2017, all but one of the XW-2 series of satellites were still on orbit and functioning well. Unfortunately, XW-2E was never heard from soon after launch, but the amateur radio transponders on XW-2A, B, C, D and F were all providing strong downlinks when last heard.

What's more, as these satellites were all deployed off the same rocket, and because they are of different sizes and therefore, slightly different orbital altitudes, they've since spread out and now tend to follow one another in their orbits. From an operational standpoint, this means that the satellites will appear to "line up" as they pass overhead. And, because their pass times are often separated by only a few minutes, it's quite possible to carry on a continuing conversation with the same ham via multiple XW satellites.

That is, as these satellites are all in polar orbits, as one satellite sets off to the North (or South) of your QTH, you often only have to swing your antennas 180 degrees in the opposite direction to pick up the next XW satellite coming your way. Using this technique, I've often carried on "rag-chew"-type conversations of upwards of an hour with a fellow ham while we were working through all five of the XW satellites…one by one…as they passed overhead. In many ways, this type of operation reminds me of the times back in the 1990s when we had one or more so-called "high altitude" ham radio satellites (such as AO-10 and AO-13) in very high elliptical (Molniya) orbits and could carry on the same conversation for hours with hams in other parts of the planet.

XW Antenna Technique

Unfortunately, as these satellites (and others like them…such as the CubeSats) are so small, they do not allow for circularly polarized antennas on their space frames. Most of the time, these satellites can only sport a single, linearly polarized uplink and/or downlink antenna. So, with the satellite providing only 50 or 100 Mw of downlink power to a .0 dBi single whip antenna, there will inevitably be times when your antenna(s) and the satellite's will be "cross polarized". The result is that either your uplink (or the satellite's downlink) will seem to fade out…sometimes to nothing.

Often, the natural (human) tendency when this happens is to "crank up the power." But, because your antennas and the satellite's are momentarily cross-polarized, this rarely… if ever…helps. Usually, the best thing to do in these situations is to either flip the orientation of your antenna around (if it's of the hand-held variety) or switch to right (or left) hand polarity if you are using a switchable circularly polarized Yagi array. In my case, my fixed antennas at my home are permanently set for right-hand circular polarization. So, when I'm operating from home, I simply wait for the satellite to move to a more favorable antenna orientation and then

Bob Bruninga WB4APR, the "father" of APRS (right), shares a moment with The Chinese CAMSAT delegation at the joint AMSAT/TAPR 2011 Dayton Hamvention banquet. (Courtesy: Author)

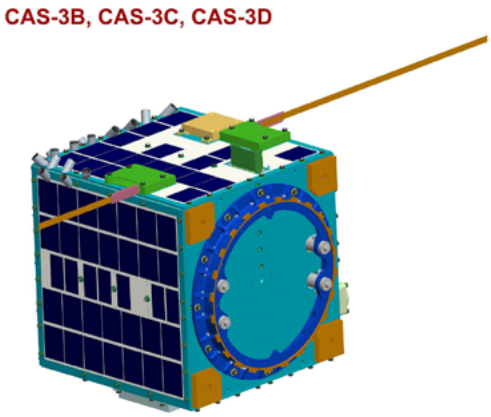
continue on with my conversation.

However, when operating portably (with a hand-held Arrow-style or Elk antenna) a flick of the wrist will sometimes bring your uplink (and the satellite's downlink) signals back into a strong (copyable) state.

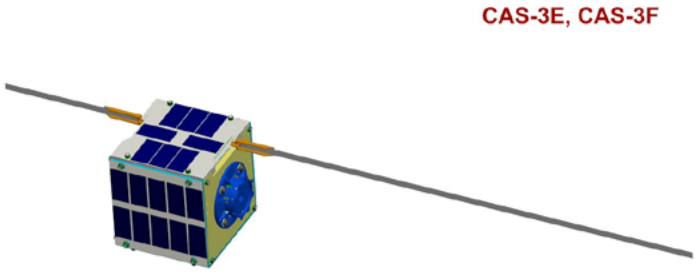
I recently took my portable satellite station 'on the road" to a city park near Sault Ste. Marie, Michigan, and had a ball working through each these satellites from a relatively "rare" Maidenhead Grid Square (EN-76). Needless to say, being somewhat of a DX station, I was a very popular camper on these wonderfully active satellites. TSM

Your author takes a break from operating portably on the XW satellites at Sherman Park, Sault Ste. Marie, Michigan (EN-76). Just a flick of the wrist usually brought each of the XW satellite's uplink and downlink antennas into roughly the same polarity as that of my handheld Arrow Antenna. (Courtesy: KB1OGF)

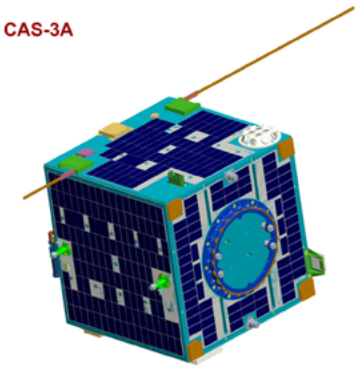
Comparing Three Chinese Amateur Radio Satellites



An artist's concept of the CAS-3B, CAS-3C and CAS-3D (XW-2B, 2C and 2D) satellites. For size comparison, the longer whip is the ¼ wave 2-meter downlink antenna. (Courtesy: CAMSAT)



An artist's concept of the CAS-3F (XW-2F) satellite. For size comparison, the longer whip is the ¼ wave 2-meter downlink antenna. (Courtesy: CAMSAT)



An artist's concept of the CAS-3A (XW-2A) satellite. For size comparison, the longer whip is the ¼ wave 2M downlink antenna. (Courtesy: CAMSAT)

The Longwave Zone

By Kevin O'Hern Carey WB2QMY **wb2qmy@arrl.net**

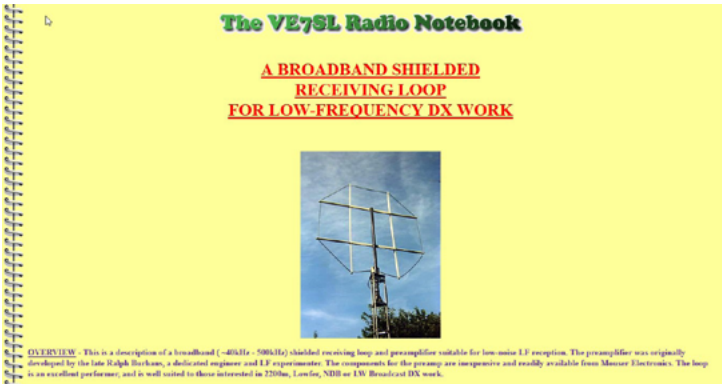
Gear Up for a New Season!

We are headed for a new season on longwave, where receiving conditions typically improve dramatically. Gone are the daily thunderstorms that wreak havoc on receiving conditions, and the long summer days that limit the amount of nighttime DX we can take advantage of. Without fail each year, when a chill is first noticed in the air, we will also notice an up-tick in longwave distance and quality of reception. Will you be ready, antenna-wise? Let's do a quick rundown of some popular antenna options for longwave receiving work.

First up is the random length wire antenna many of us have available for general SW reception. This antenna is sometimes called a "long-wire," but the term is usually a misnomer unless it is at least one wavelength long at the frequency of operation (quite a trick at longwave!). Random wire antennas are typically on the order of 50 to 150 feet long, and can work fairly well in quiet environments. I used one of these to hear my first "lowfer" experimental station many years ago from a quiet suburban location. While this antenna is easy to erect and provides a lot of convenience, it may tend to act as a "noise collector" in less than ideal environments with dense housing and man-made interference sources. If it's all you have, give it a try, but there are better options if you're looking for high performance reception on longwave.

Another popular antenna for serious DXers is the "active" antenna that has been designed specifically for use on longwave. What these antennas lack in size (they are often only 1 meter or so long) they make up with an amplifier at their base, boosting the signal delivered to the receiver. The best types of active antennas contain low-pass filtering to block strong signals in the AM broadcast band (or higher frequencies) from coming through to the receiver. Active antennas can be very effective, but you should spend some time finding the best (quietest) mounting location for them. Often, a move of just a few feet can make a big difference. Grounding the outside coaxial braid at the mounting point can also be effective at limiting noise pickup of an active antenna system. In addition to active whips, some DXers use compact ferrite bar antennas that are amplified—these can often be used indoors with surprisingly good results. They are another form of an active antenna.

Loop antennas, both active broadband and tuned wire types, are another specialized tool when hunting for weak signals. Their small size can help limit noise pickup as compared to a random length wire antenna, but more importantly, you can turn a "deaf ear" to interference and focus specifically on a signal of interest. This aiming ability can allow you to hear signals that would be otherwise buried beneath the noise floor, and it may net you two (or more) loggings on a single frequency. Various arrangements exist for remotely tuning a loop, or they can be used indoors with tuning right at the base of the loop. An indoor installation may suffer some loss in performance, but the ability to steer the reception pattern often wins out over signal strength. At longwave, signal-to-noise ratio is typically more important than the S-meter reading you are able to achieve on a particular station.



A broadband, shielded loop is one option for high performance longwave reception. Antennas of this type can be easily constructed with some common materials. One design is shown on VE7SL's Radio Notebook page at http://qsl.net/ve7sl/burhans.html.

Mailbag

Self-described "Beacon Tourist," Kriss Larson KR6SS (CA), has written with another interesting trip report from his worldwide travels, this time from Europe. Kriss writes:

"In July I went on a river cruise trip in Europe, starting in Amsterdam, up the Rhine River to the Main, on to the Main to Bamberg, into the Main Danube Canal over the continental divide to the Danube, and finally down the Danube to Vienna.

"Naturally, I had all of my longwave gear and radio beacon lists in hand. But I was only able to get one good longwave scan, because the ship itself was very electrically

noisy, the docks were very noisy, and all day, every day, we were on buses running around seeing stuff.

"The day we were going to do a tour of Frankfurt, the boat had actually docked 12 miles up the Main and we had to be driven back to town. I knew we would be getting close to Mainflingen where the German LF time standard station at 77.5 kHz is. I told the tour director about wanting to see the antenna field on the way to Frankfurt. You can imagine the reaction—you want to do WHAT?

"Well, as we flew past the antenna farm at 60 miles an hour, I did get some shots of the antennas out the window, which can be seen online. Mainflingen is similar to WWVB in Colorado, consisting of several towers with wires in between.

"My only real chance to get a good scan away from interference, with no car, was halfway through the cruise, where there was a rest day in Nuremburg, on the canal. They have bikes to borrow in the boat, so I grabbed one and pedaled about 10 km down the canal bike path, where I found a picnic table in a woodlot to set up with my 100' of wire and Palomar converter.

"My log included nothing too surprising, but there seems to be one additional power grid control station at around 127 kHz that I don't know about. There was also some kind of a pulsed carrier-type station down at 10 kHz, but that may have been an image.

"Besides the formal scan, I was constantly checking the radio beacon band as we moved along for stations that were supposed to be there. I would say, roughly 75% of the NDBs in the record within range were on air, so there has been no mass shutdown of beacons in Germany. What there HAS been a mass shutdown of is longwave and medium wave broadcasting in Germany—they're all gone. On the AM medium wave band, I could only hear stations from other countries at night. It's odd in Europe all the kinds of spoken-word AM stations we are used to here—all news, news-talk, sports-talk, Christian, and immigrant foreign language stations are largely non-existent in Europe. FM there is mostly pop music, same as here. So, in Europe, the whole AM band is becoming irrelevant. Perhaps UK-based listener Alan Gale has a comment on this phenomenon.

"The cruise allowed me to find out how radio communications are handled on the rivers. Everywhere, Marine channel 10 is the ship-to-ship channel. If you aren't sure what side a boat wants to pass you, call them on Channel 10. Besides that, every stretch of river or canal is assigned a channel, changes every 10 or 20 miles or so. There are signs on the riverbank to tell you when to switch. This is the channel you use to talk to authorities, like the people controlling the locks. They also put information broadcasts on them. We went through 64 locks from one end of the cruise to the other, so locking operations got pretty routine.

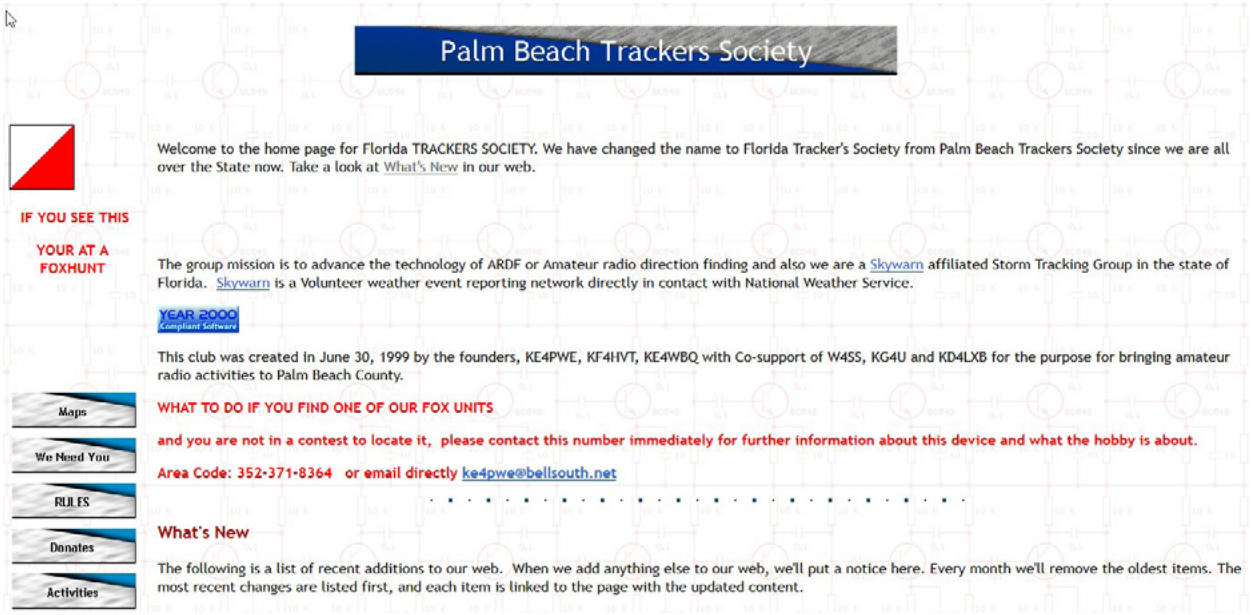
"So, in a week I'm driving up to Wyoming and back to see the solar eclipse. From my location in Southern CA, this will be a very long road trip. I plan to hit a few NDBs on the way, and on the way back try to get some pictures at the 60 kHz WWVB station in Fort Collins. We'll see how it turns out."

Many thanks for another interesting report, Kriss. I wonder if the signals you heard near 10 kHz could have been the Russian ALPHA system, similar to the old Omega network that used to exist. I hope you enjoyed your eclipse trip, and we look forward to a report on how it went.

Selected NDB Loggings

Our loggings this month are courtesy of Dick Palmer W7KAM (MO). Remember, loggings are always welcome from *TSM* readers. This column is not restricted to just aviation beacons, and never has been. Any longwave signals below 535 kHz are welcome!

kHz	ID	Location	By
198	DIW	Dixon, NC	R.P. (MO)
212	CFV	Coffeyville, KS	R.P. (MO)
212	UC	Union City, TN	R.P. (MO)
212	VP	Valparaiso, IN	R.P. (MO)
227	GW	Auburn, IN	R.P. (MO)
227	SQ	Connersville, IN	R.P. (MO)
227	TNZ	Walnut Ridge, AR	R.P. (MO)
236	BW	Bowling Green, KY	R.P. (MO)
245	FS	Sioux Falls, SD	R.P. (MO)
248	CG	Cape Girardeau, MO	R.P. (MO)
248	UL	Montreal, QC	R.P. (MO)
250	FO	Flin Flon, MB	R.P. (MO)
253	DD	Columbus, OH	R.P. (MO)
253	GB	Marshall, MN	R.P. (MO)
257	JYR	York, NE	R.P. (MO)
269	UDE	Delta Station, MB	R.P. (MO)
275	DE	Decatur, IL	R.P. (MO)
284	QD	The Pas, MB	R.P. (MO)
299	HW	Wilmington, OH	R.P. (MO)
300	YIV	Island Lake, MB	R.P. (MO)
311	GK	OK (Ft Smith, AR)	R.P. (MO)
326	FO	Topeka, KS	R.P. (MO)
329	PMV	Plattsmouth, NE	R.P. (MO)
332	FIS	Key West, FL	R.P. (MO)
335	YLD	Chapleau, ON	R.P. (MO)
347	AFK	Nebraska City, NE	R.P. (MO)
368	SOY	Sioux Center, IA	R.P. (MO)
371	AZ	Kalamazoo, MI	R.P. (MO)
371	ITU	Great Falls, MT	R.P. (MO)
371	RYV	Watertown, WI	R.P. (MO)
375	PSN	Palestine, TX	R.P. (MO)
375	SPH	Springhill, LA	R.P. (MO)
379	LRR	Oakdale, LA	R.P. (MO)
379	OW	Owatonna, MN	R.P. (MO)
379	UG	Waukegan, IL	R.P. (MO)
380	GC	Gillette, WY	R.P. (MO)
382	IRS	Sturgis, MI	R.P. (MO)
397	CIR	Cairo, IL	R.P. (MO)
407	HRU	Herington, KS	R.P. (MO)



Longwave Link of the month: **http://www.qsl.net/kg4dwj**

This is the website for the Florida Trackers Society, a group devoted to radio direction finding (RDF) in all its forms, as well as storm tracking. You may also wish to visit the qrz.com entry for this group by searching for the call sign K4RDF (neat call!).

410	BA	Columbus, KS	R.P. (MO)
421	VLY	McKinney, TX	R.P. (MO)
428	POH	Pocahontas, IA	R.P. (MO)

Contributor's Information

R.P. (MO) Richard D. Palmer (MO), Foristell, MO
Receiver: ICOM R-75
Antenna: Clifton Z1501 active, base up 25 feet (7.62m), 10-foot (3.05m) whip
Audio Processors: Timewave DSP-599zx and a Ratzlaff 9Hz in series

R.P. Comments: Logged 109 beacons this month, 167 less than last month. Conditions were very poor this month, static every night. No new ones for the year kept this year's total to 798.

Adventures in Radio Restoration

By Rich Post KB8TAD kb8tad@gmail.com

The "Moving Coil" Radio: National NC-100 (RCK Version)

The famous National HRO receiver, with its iconic epicyclic dial that looks like it should be at home on the door of a safe, was developed in 1934. It was designed with removable plug-in coil drawers for its various frequency ranges. It also utilized a separate power supply to minimize heat in the receiver. It became the standard for a quality receiver for a number of years and was heavily used in commercial applications as well as the military. The Bletchley Park setup during WWII as well as other sites for the British "Y" section used a number of these sets to monitor Axis communications during the war. The BBC would later call these sets the "Rolls-Royce" of radios.[1]

NC-100 RCK monitoring the bands again. (KB8TAD photo)

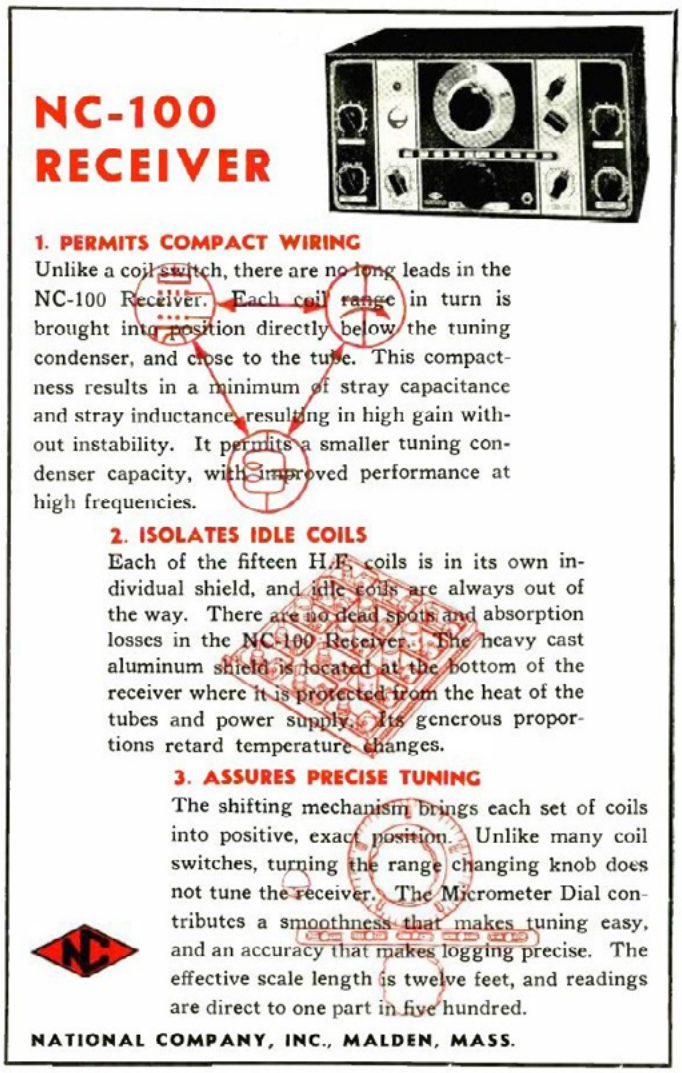
Why "Moving Coils"?

The NC-100 was developed two years after the HRO was introduced. The chief engineer for the radio was James Millen W1HRX of the National Radio Company whose informational ad pages in *QST* magazine and his work as the chief mechanical engineer for the development of the HRO made him legendary among radio hams and engineers. For the next generation of shortwave radios developed by National, Millen, who was by then General Manager at National, wanted to avoid using a band switch for the various frequency ranges. He wanted to emulate the removable coils of the HRO but build the radio as a single package.

The result was the NC-100 and its "moving coil" system. In that system, the entire set of high-frequency tuning coils are mounted on a single sliding cast-aluminum shielding frame, called a "coil catacomb" that literally moves from left to right and back under the chassis, engaging a set of prongs to connect the coils for each band in turn to the tuning capacitor. The radio included the distinctive "Micrometer" epicyclic dial and precision tuning gears as used on the HRO, thus requiring a chart to match the 1 to 500 numbers on the dial for frequency but allowing for a large number of turns for mechanical bandspread with excellent repeatable tuning accuracy. The bandspread effective length was advertised at 12 feet. Millen describes the radio and its moving coil tray in the December 1936 issue of *QST* in an article titled, "A Moving-Coil Tuning System for the High-Frequency Receiver." He critiques the band switch as acceptable for all-band receivers for the non-critical public but "[inactive coils] were not isolated, calibration was not permanent, and the design was not flexible." Removable coil banks such as those in the HRO could be easily swapped and could be designed to cover nearly any segment of the low and high frequency radio spectrum without the need to re-design the receiver each time.

He describes the problem of flexibility. "By this we mean that the arrangement (using a band switch) cannot be readily adapted for use in up-to-date receivers. A high performance receiver, such as the HRO for instance, may require four coils for each range, 'airtight' shielding, air-dielectric trimming condensers, and short HF leads to mention only a few of the more obvious necessities. These features could not be built into a switching system without running into a lot of trouble."

With the flexibility afforded by the moving coil concept, Millen could design receivers for commercial applications with customized repeatable band coverage using the same basic receiver since each coil set in the movable tray could be totally independent of any of the others. Millen's article goes on to say that challenges such as electrical noise from the moving metal was solved using insulated slide



The original NC-100 shown in an ad in "Radio World" magazine, December 1936. (KB8TAD collection)

bearings and also by cutting screen voltage whenever the band was changed.

Like the epicyclic dial and the very stable PW tuning cap gearing in the HRO, the moving coil set was a marvel of mechanical engineering, a tribute to Millen's skills. Like the HRO, the NC-100 had two IF stages, separate oscillator and mixer, and amplified AGC as well as RF pre-selection, although only a single stage in place of two for the HRO.

NC-100 Variations

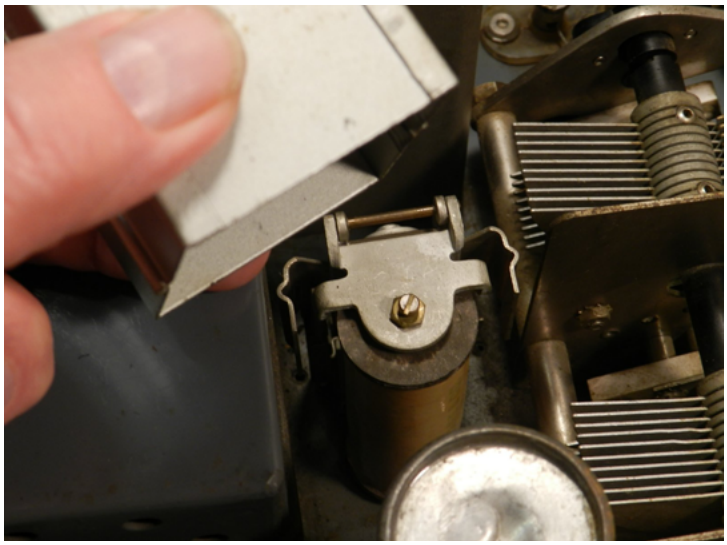
There were several variations of the NC-100 since, as Millen stated, the basic receiver could accommodate a variety of needs by simply customizing the coil sets. The first NC-100, with its art-deco front panel including use of red numbers on the HRO-style micrometer tuning knob, a red-painted section for the tuning coil locating windows, and a green tuning eye, seems almost garishly beautiful at least to my eyes. An NC-101X was introduced as a ham-bands-only version that looked a lot like the black-wrinkle-finished HRO with its micrometer dial, but still required a chart to determine frequencies. National followed up with the NC-100A with its direct-reading dial in place of the micrometer dial, thus not requiring a separate chart to determine the tuned frequencies. In 1940, National's 25th anniversary, that model morphed into the NC-200, the "Silver Anniversary" edition, one of my favorite receivers, which to my eyes is both simply beautiful and functional. Its single large tuning knob is pulled out to a position that enables moving the coil tray. Previous models had both a tuning knob and a coil-moving knob. My other moving-coil receiver is the NC-120—a variation of the direct reading NC-100A, which was made only for the military and labeled by Navy nomenclature as the RAO.

National NC-120 moving coil radio, made for the Navy as the RAO-2. (KB8TAD photo)

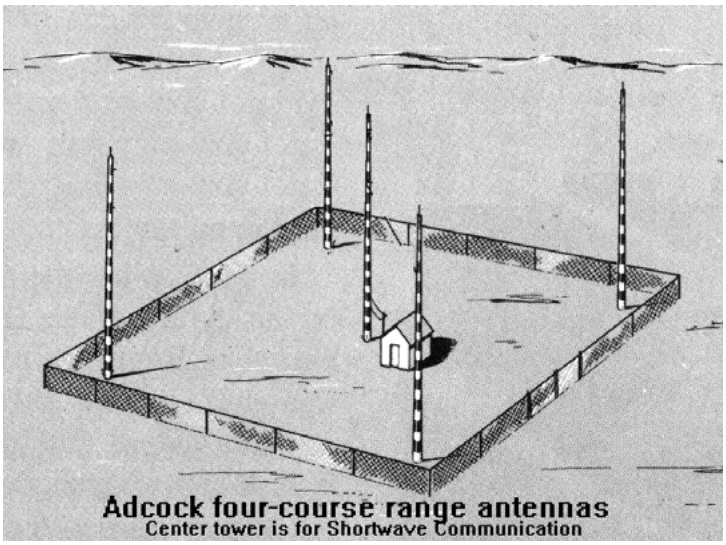
Identifying the Model

With an admiration for National radios and Millen's work, I spotted this rack-mount set at an auction. At the time, I did not know which variation it was or for which commercial application it had been intended, but the band coverage was clearly marked on the little windows that showed the position of the moving coil tray. Externally, it resembled the ham-bands-only NC-101X except for band coverage. Its bands were labeled 200-400 (kHz), 1.3-2.8(MHz), 2.7-6.4, 5.9-14.4, and 13.8-30. With those bands, it was determined that this example was used as an Airways Communication receiver, for which there were several versions all based on the NC-100. A partly detached shield cover showed serious rusting, but the receiver itself appeared to be in very good condition. After removing the partial shield cover, I noticed rubber-stamp markings on the right rear IF transformer indicating "RCK-171," confirming that this was the RCK variation.

According to Lawrence Ware, who compiled information on the various NC-100 variants, there were several contracts issued for the RCK with orders dating from 1937 to June 1939. All were built by National but installed by Western Electric, Westinghouse or Bendix depending upon the specific contract issued by the Department of Commerce.



CONS relay with cover removed. (KB8TAD photo)



Adcock antenna array for four-course radio range. Center tower is for shortwave communication. (Diagram is not to scale. The distance between opposite towers is nearly 5 times tower height.) (Wikipedia in public domain)

Commerce Department

The radio was designed for the Civil Aeronautics Administration (CAA), a division of the Department of Commerce charged with responsibility for US air traffic control, safety programs, and airway development at a time leading up to US involvement in World War II. I was able to locate the manual for the later RCP [(2)]. That manual stated that the RCP was in fact an RCL or RCK that had been modified by a third-party contractor, Schuttig and Company in 1945. That would indicate that the RCK was already in service during WWII, consistent with Lawrence Ware's information on the contracts for the set. The manual also mentions a tube complement of 12 tubes and an unboxed weight of 64 pounds, a true boat anchor.

According to the Manual:

"The RCP Receiver is designed for use at Civil Aeronautics Administration Airway Communication Stations. It is built for reception of aural radio range, radiotelephone and continuous wave signals. This receiver was originally a Type RCK or RCL receiver. The type designation was changed to RCP at the time the modifications were made to distinguish it from its original type. RCP modifications included optional crystal control, changing to delayed AVC to limit activation by static bursts, elimination of the sharp-broad control, changing tonal response to emphasize lower voice frequencies, and a CONS circuit change which mutes the receiver in the absence of a carrier as well as modifying the muting relay to activate a pilot light when the CONS circuit is operational."

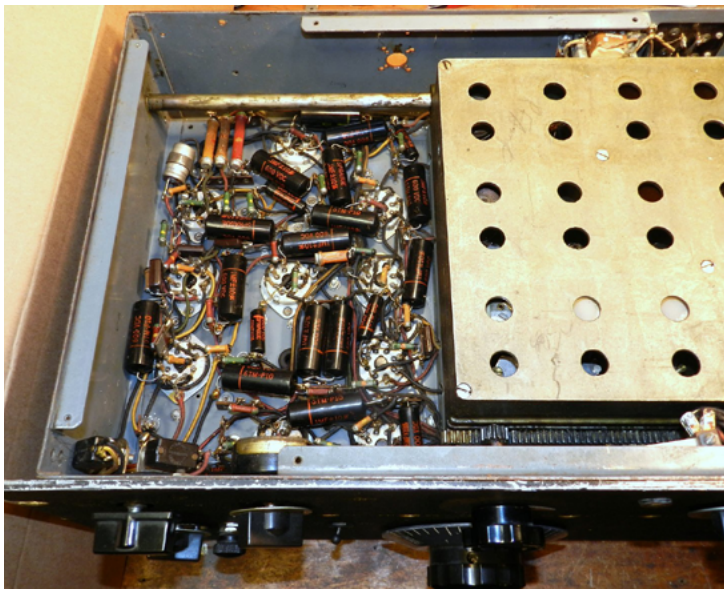
Since my RCK still had the front-panel sharp-broad control and no crystal-control, the changes to RCP had not been made. However, the manual had the needed operational instructions and schematics, and I was curious about that "CONS" circuit. What was it and what purpose did it serve? The manual explained that CONS stood for "Carrier-operated noise suppression" circuit. Aha—so it's a squelch circuit! It kept the receiver audio quiet unless at least a 5-microvolt or so signal was present. More importantly, it had a relay that was activated by that squelch circuit. That relay had a set of contacts that could also activate a larger light that could be remotely located.

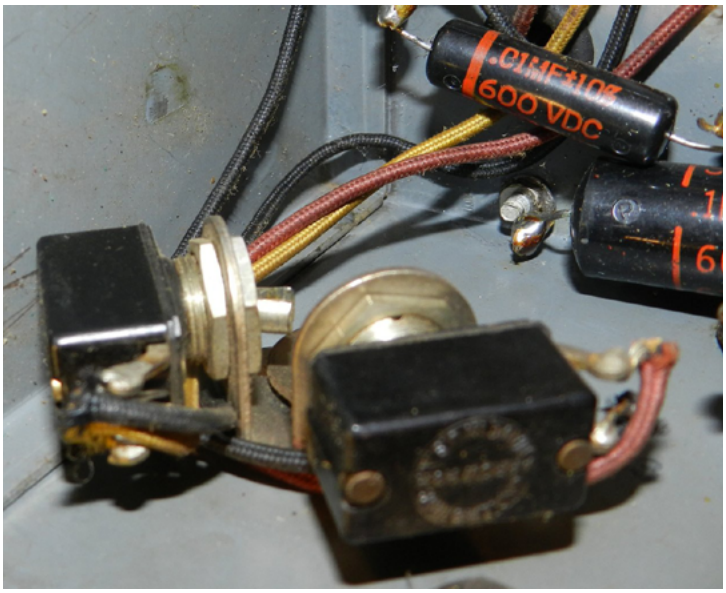
So, What's an "Airway"?

Starting in 1928 and throughout the 1930s and 40s into the 1950s, the federal government established a radio beacon system to allow aircraft to follow designated paths between airfields. Those supplemented the light beacons established earlier for airmail service. The light beacons were of course only useful when weather and visibility were good. With the aural range radio beacons, one could fly across the country in or above the clouds by following radio signals in the low frequency spectrum as a sort of invisible "highway in the sky," thus the need for ground-based airway receivers to have the 200 to 400 kHz band to monitor those frequencies.

The airway radio beacon system provided for "four-course navigation"[(3)(4)] with a Morse code letter "A" (dit-dah) transmitted to one side of the airway and a Morse code "N" (dah-dit) transmitted with equal strength on the other side of the airway by a radio beacon along with a twice per minute Morse code identifier, usually three letters, and intermittent weather information. By listening for equal strength A and N the two code letters would blend into a continuous tone and the pilot would know he was flying "on the beam." The "four courses" resulted from the A and N transmissions each being bi-directional in a figure 8 pattern 90 degrees apart. The transmitting antenna originally used two single-turn loop antennas but was later replaced by an Adcock antenna array[(5)].

The two overlapping bi-directional signals at 90 degrees separation resulted in a combined "X" radiation pattern of





Left: "Original caps must be kept close to the chassis so as not to interfere with the sliding coil tray" (Right) and "Toggle switches activated by a small arm attached to the front-panel knob shaft" (KB8TAD photos)

equal signal strength. The pilot would approach listening to the A and N on one leg of the X. At the center of the X, while crossing over the radio beacon, there would be a short "cone of silence" but then at the opposite end, he would hear the N and A in combination again as a single tone if he stayed "on the beam." Each open corner of that X in the sky would be one of the four quadrants or courses. By maneuvering through those quadrants, using his compass headings, and listening to the audio, the pilot could know in which quadrant or course he was flying relative to the radio beacon.

The airways receiver sets were used to monitor the beacon frequencies and also 3105, 6210 and 4495 kHz, the aircraft communication frequencies, all of which were on band 3 of the receivers. Those were also the crystal-controlled frequencies installed in the 1945 RCP modification according to the manual. The CONS served another function; monitoring the carrier for the airfield or beacon and could be used for activating a signal light if the transmitting carrier for the radio navigation system was functional. I'm told that the CONS relay was also used to activate a light at the beacon location that was visible to pilots but have not been able to confirm that use of the CONS. The CONS relay included a separate 6-volt winding so that it and the warning light could be manually activated. Manual activation would support the notion that it was used for visual warning.

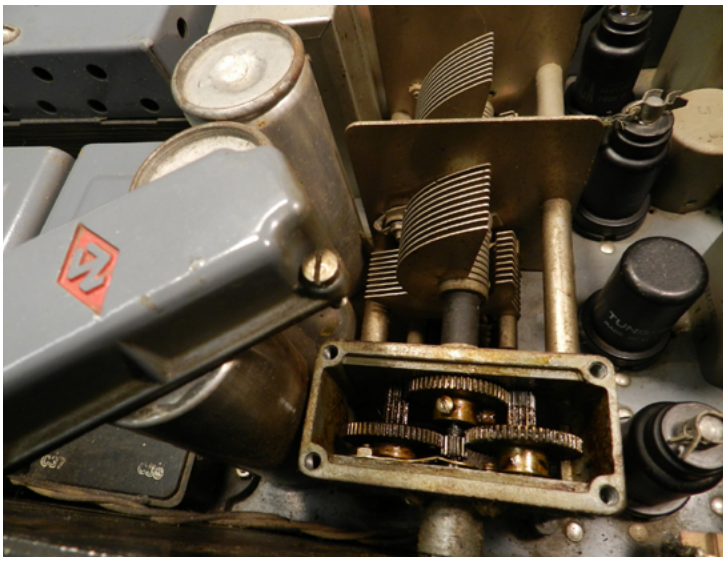
Because a system based on the low frequency band was also prone to natural and man-made static and variations in propagation if the antennas were close to a land and water boundary, a system based on VHF was designed. Beginning in 1951, the four-course low frequency system was slowly replaced with the new VHF Omni-Range (VOR) system described in an article in the February 1951 Radio-Electronics magazine [6]. According to that article, implementation of the new $1.5 billion system (that's 1951 dollars!) would take about 15 years, implying that the older system would remain in place until the new system was complete and probably beyond. However, high mountains such as in Alaska could block VHF. The last low frequency range in the United States was in use in Northway, Alaska until 1974; a long life for a technology that was state-of-the art in the 1920s.

First Looks

Once the partial rack-mount cover was removed, the RCK receiver appeared to be in remarkably clean condition. The 3/16 inch thick front panel in black wrinkle aluminum just shouts classic boat anchor. The lower knob, which actuates the sliding coil tray had been replaced. I replaced it with a larger knob but will look for a proper knob for that control. Turning the receiver upside down showed a modification. The original audio output transformer with dual output impedances of 20K-ohms and 600 ohms had been disconnected and a more typical 5K-ohm to voice coil transformer had been added to the inside back panel with just enough clearance for the coil tray to move past it. An ohmmeter check indicated that the original but disconnected output transformer was apparently still intact.

The set had three fuses including one for each side of the power line. One of the input power fuses was a proper 2 amp slow-blow type but the other line fuse was a 20 amp automobile fuse. That oversize fuse was quickly replaced with a more proper one since the power cord was not polarized. The set's third fuse was located at the transformer under the chassis. That fuse was in an open chassis-mount fuse holder with clips for two fuses, the one holder side was marked "Low" and connected to a line input tap on the power transformer. Another marked "High" was connected to another line-side tap. A fuse could be installed in either of those two fuse holders. A quick look at the schematic confirmed that the High/Low fuse in the power transformer primary was intended to select the proper line tap. The fuse was clipped into the Low side. I fed power to the set with my

Capacitor surprise, Sprague 6TM capacitors that were not leaky. The one capacitor on the lower left is not a 6TM and was the only leaky cap. (KB8TAD photo)



National tuning gearbox with cover removed. (KB8TAD photo)

Variac, verifying that the power transformer's high voltage secondary was intact. Checking voltage again with the fuse connected to the High side revealed that the high voltage was now almost 10% less. I measured the difference between the high and low taps with 120 volts in and found slightly over 10 volts between the two. Moving the fuse to the High tap connection would likely allow the radio to be used at today's higher line voltages without modification. The transformer in this set is tough as might be expected for a radio that was required to function on a 24/7 basis.

My first act at restoration was replacing the line cord with a 3-wire safety grounded version, re-wiring the neutral directly to the transformer and obviously not fusing that side. The radio then had two fuses both of which were in the line side. The line side (black wire) of the new power cord went to the back-panel fuse first, then to the power switch and then to the High/Low fuse assembly under the chassis.

The power switches in these sets are unusual, consisting of tandem toggle switches mounted behind the front panel that are actuated by a mechanical arm from a knob in front. I have seen those used on all the moving coil sets, probably at the direction of Millen. Care had to be taken when rewiring the power switch because the wires and all components have to be mounted so as to not interfere with the moving coil tray.

Capacitor Surprise

The same care has to be taken in replacing the dry tubular capacitors. Not only does the moving tray need proper clearance, but also all the mating pins on each coil section below the tray need clearance as the tray moves. The smaller size of modern replacement capacitors makes the job a lot easier than when the radio was new. I removed several of the large black 0.1 uF molded capacitors and tested them on my Sencore LC-75 capacitor tester. To my amazement, each one tested as if new with no leakage even at their full 600-volt rating.

My suspicion is that at some point after manufacture, the entire set of capacitors had been replaced with these large black caps which were manufactured by Sprague and labeled "6TM-P10" or "6TM-S10" as part numbers. After replacing the first few, I thought about leaving the remaining caps in place but then decided to replace only the ones that see high voltage, leaving the low-voltage cathode bypass caps as found. The manual made it easy to decide which caps to replace since the photos of the chassis bottom labeled all the caps with arrows and part numbers, and the parts list describes each cap and its function in the circuit, appropriate for a manual for a government contract. Checking all the capacitors removed from the circuit later on revealed that all black caps with red 6TM markings still showed no leakage even at their rated 600 volts, more than twice the maximum supplied by this radio. One 0.1 uF Sprague cap did show several microamps of leakage but a quick look confirmed it was marked in yellow printing, not red. The yellow-marked cap also had no part number listed on it, just the cap value and voltage. It was the only one of its type in the set.

In researching the part numbers on the Internet, the 6TM caps are apparently Mylar film and not likely to fail as opposed to the oil-filled "black beauty" types with color-coded stripes, which are almost guaranteed to have failed. Used 6TM capacitors are also in demand for full restoration of older guitar amplifiers. I learn something new every day in this hobby! I'll definitely be on the lookout for 6TM caps, but each one will visit my LC-75 cap tester.

Don't have an expensive Sencore LC-xx to check your 6TM cap? Clean the outside body of the cap to eliminate any dirt as a resistance path and place the cap in series with your 10 megohm-per-volt digital meter on its 1000-volt DC scale and the B+ supply of the radio. After the initial charging surge, the voltage should drop to the final voltage reading. That reading is one tenth of a microamp leakage for each volt indicated on the meter. A cap with no leakage should

read at zero volts. Don't forget to discharge the cap afterwards, especially if it is NOT leaky! You can connect the voltmeter across the cap to watch it discharge.

Electrolytics?

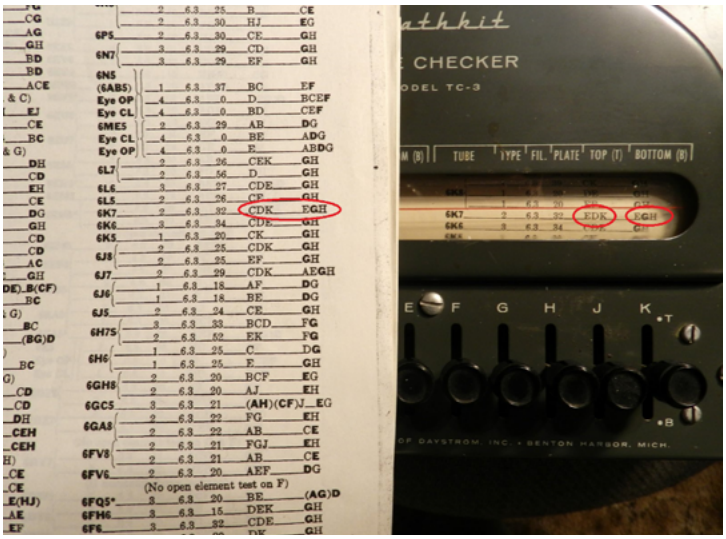
After tubular capacitor changes, I did the usual resistance checks, finding no surprises. The schematic shows just one electrolytic, for the B- to chassis ground bias voltage. The original cap for that circuit was a square sealed-metal 1 uF non-polarized cap, but the changes for the RCK and RCP show a 4 uF electrolytic added across that line. The RCP mentions replacing that 1 uF cap if leakage is less than 200K-ohm. I disconnected it although it tested fine. I had a nice modern 4 uF non-polarized film cap and used it for the B- line. Wait—aren't there supposed to be some electrolytic filter caps in the B+ line? The answer is no. As befits a quality commercial receiver, the original design had no electrolytics. The B+ filtering is by way of two chokes and three non-polarized 4 uF caps rated at 600 volts. Those 4 uF caps were more expensive than electrolytics but did not have the drying-out problems of electrolytics and unless physically leaky, have stood the test of time and were a better choice than electrolytics, especially for a receiver that had to be in service 24/7.

First Power-Up

After all this, it was time to try out the set. I connected a speaker and powered it up slowly with my isolated Variac, watching the current draw as well as the voltmeter connected to the B+ line. Voltage and current were as expected, but there was no noise from the speaker. I shut the power down and was about to get my signal injector to isolate the problem stage, thinking about the proper points for signal injection beginning at the volume control.

But, had I missed a step in my usual sequence? Yes—a quick ohmmeter check with the VOM revealed no continuity between pin 4 (screen grid) and pin 3 (plate) of the 6V6 audio output tube. On low ohms, I should have been able to hear scratchy noise from the speaker and on high ohms I should have continuity unless the output transformer added as a modification had an open primary. And that is exactly what I found.

I gave thought to connecting another temporary output transformer but, since the set still had its original that I had already checked for continuity, I replaced its missing wires, feeding its 600 ohm output tap to the external speaker terminals. To match that 600-ohm output to my 8-ohm speaker, I used a handy 12-volt transformer, which measured 14 volts at no load. That is a turns ratio of about 8.6 to 1 which, if squared, gives an impedance ratio of 74 to 1. Multiplying the nominal 8 ohms impedance of my speaker times 74 yields 592 ohms—just what I needed. On powering the set again, I touched my signal injector to the antenna post, which resulted in a healthy squeal from the speaker. Tuning the dial a bit



Tube-testing surprise. Note the roll-chart error (circled in red and corrected in later data as shown on the left) (KB8TAD photo)

modulated that squeal to a heterodyne. Sure enough, adding a clip lead to the antenna post brought it to life, picking up its first shortwave station in many years.

Tube-Tester Surprise

I checked all the tubes next. Since the radio had likely been in operation 24/7, until it was decommissioned, I expected that some of the tubes might be weak. I was wrong. Apparently, good maintenance had kept the radio supplied with good tubes. All tested well within the green on my Heathkit TC-3 emissions tester. While checking the 6K7, I discovered an error in the Heathkit tube chart! No, you cannot set an element at pin 5(E) at BOTH the up and down positions of a switch on the Heathkit tube checker. I used the 6J7 switch settings instead, the 6J7 being a sharp cutoff pentode versus the 6K7 being a remote cutoff pentode but both having the same pin-outs. They are interchangeable in some circumstances although the remote cutoff characteristics are necessary in a stage that is controlled by AVC/AGC. Each can be used as a temporary substitute for the other. A later copy of the Heathkit roll chart, which I had found on the Net, corrected the error.

Backlash from that Very Stable Tuning Cap Gearing?

While tuning the set through the shortwave bands, at certain positions of the knob there was what appeared to be a major backlash between turning that epicyclic dial in one direction versus the other. I removed the cover from the gearing only to discover that the gearing was fine, but that big knob was just a little bit loose! Simply tightening it solved the problem—another reminder to self to try the simple solutions first!

Alignment

The IF adjustments are fairly easy to make with those

large National IF transformers. As always, use caution on older IF transformers since the screw adjustments for the primary side are likely to have B+ voltage on them. A smaller metal screwdriver can be used if an insulated sleeve such as heat shrink is added to the screwdriver shaft. I found the output side of the second IF transformer to be off somewhat and also to be intermittent. Since that trimmer is just a standard small adjustable capacitor, I sprayed a bit of DeoxIt on it and cured the intermittent spots in its rotation. Adjusting it to resonance brought the signal level up noticeably.

Aligning the movable coils in the set is not as daunting as one might imagine. It is easy to tell which set of trimmers to adjust for each band since those trimmers in each case are moved directly above the tuning cap (with the chassis upside down). The coils are not adjustable, only the trimmers, although it is possible to adjust a couple of the coils on the highest frequency range by bending an exposed half turn of wire to aid or oppose the turns in the coil itself. If that half turn is in line with the direction of the other turns in the coil, it adds a slight bit of inductance. If opposed, it reduces inductance.

Some other older communications receivers also use that same scheme for tweaking coil alignment. The trimmer capacitors themselves are all rather large and stable compared to the simple compression trimmers found in many other radios. Adjustment requires more torque than the normal alignment tool can handle. The manual suggests that a regular screwdriver can be used as long as the shaft is insulated from the coil tray openings. That is again because some of the trimmers have B+ on them, the same as the IF primary side adjustments. Alignment of the two frequency ranges primarily used by the needs of the Airways (200 to 400 kHz and 2.7 to 6.4 MHz) was near perfect, but the sensitivity of the other bands benefited from alignment tweaking.

After some more cleaning, I spent an evening listening to SSB on the 160 and 80-meter ham bands and to a 300-watt (nighttime) oldies station on 1480 kHz [7], some 150 miles away using just a length of wire for an antenna. The radio was very stable. I wrote down the numbers on the epicyclic dial but also used my frequency counter to verify the frequency to which I was tuned. I hesitated to remove the radio from the bench, not because it was so heavy but because it was so much fun to use. This commercial version of the NC-100 definitely showed its heritage from the National HRO. Since the BBC had given the HRO the moniker "Rolls-Royce of radios," might this one be the Bentley? Comment and questions welcome; kb8tad@gmail.com

Notes and References:

(1) **http://www.bbc.co.uk/history/ww2peopleswar/stories/11/a8533811.shtml**

(2) RCP receiver manual
http://www.mediafire.com/file/attq6jnq2eabdyb/RCP+manual.pdf

Naional NC-200, the 1940 'Silver Anniversary' model (KB8TAD photo)

(3) "Flying '"The Beam,'" a history article from the Smithsonian on the four course "A and N beam" air navigation system on LF.
https://timeandnavigation.si.edu/multimedia-asset/flying-the-beam

For more information, see
http://home.iwichita.com/rh1/hold/av/stories/avionics/radiorange.htm

Adcock range system
http://www.aerofiles.com/adcock-range.html

Development of the visual type airway radio-beacon system -(covers 1926 to 1929 research)
nvlpubs.nist.gov/nistpubs/jres/4/jresv4n3p425_A2b.pdf

(4) For a great introduction to 1940s four-course navigation, and actually listening for the A and N Morse code through each quadrant (although at a code speed that is a bit faster than what was actually used), see this Youtube clip
https://www.youtube.com/watch?v=p-VqtNY8vpw

(5) Adcock antenna array
https://en.wikipedia.org/wiki/Adcock_anten

(6) Radio-Electronics magazine February 1951 p.26 Flying the Omnirange
http://www.americanradiohistory.com/Radio_Electronics%20_Master_Page.htm

(7)WDJO radio Cincinnati Rock 'n' Roll. WDJO is twice the frequency of "Zoomer 740" in Toronto, another of my nighttime favorites. **http://oldies1480.net**

National NC-100 variations list
http://www.redwaveradio.com/4_933700a8756388d5_1.htm

TSM

Antenna Connections

By Dan Farber AC0LW **ac0lw@att.net**

Antenna 101: A Nuts and Bolts Review

Welcome back, my friends. A summer of odd propagation continues, spotty, but with delightful surprises here and there. Man, do I miss the days of dependable sunspots…

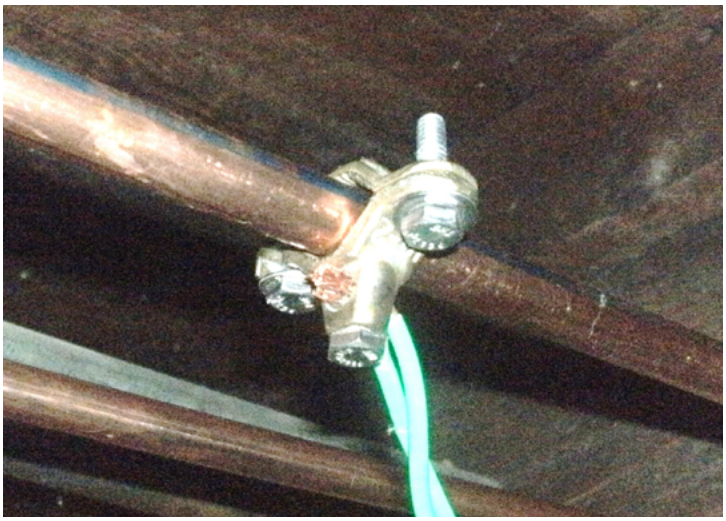
This time around, I'd like to stop and look back over what we've learned together so far about antennas and tuners and ground, oh my! (Sorry, the grandkids were watching "Wizard of Oz.")

Ground Means Different Things

In my opinion the terminology decision long ago to use "ground" as the opposite of "hot" has some unfortunate consequences for those trying to grasp RF principles. It's easy to see how it got started. A lightning rod is obviously an early method of safety ground, since its job is to route the "hot" (the lightning strike) to the surface of our planet, which is all that ever seems to stop a lightning bolt! Since the surface of our planet is the "ground," it followed very easily to call any return path in a circuit the "ground." The unfortunate result, though, is that many get the two confused when dealing with RF transmission to an antenna.

Here it is in a nutshell: Safety ground is a connection to the Earth's surface, like a ground rod or a metal cold water pipe. RF ground is a low-impedance return path for RF energy. It is NOT produced by connection to the Earth, although that is likely to be involved, since our rig is also connected to safety ground. It is produced by providing a low-impedance path—and the math tells us that, at RF, you can't beat a quarter-wavelength conductor for a low impedance path.

My often-repeated admonition to build a bundle of insulated wires, each a quarter-wave long at or near a desired operating frequency, connected together at one end and to the tuner's ground, the far ends taped, the bundle taped together at intervals and simply thrown across the floor, is an unbeatable visualization—and method—of accomplishing this. The thing to wrap your head around is that the far ends are connected to nothing! The math says that this quarter-wave long conductor is the best RF conductor around, and that there is zero or nearly zero RF voltage at the end connected to the tuner, and a fairly high potential at the far end, which is why we taped them. This RF ground produced by being a quarter-wave conductor is sometimes called a counterpoise ground. You can use a single counterpoise wire, and tune it for maximum RF current (lowest impedance)



Safety ground near the author's operating position. NOT a good RF ground. (Author's photo)

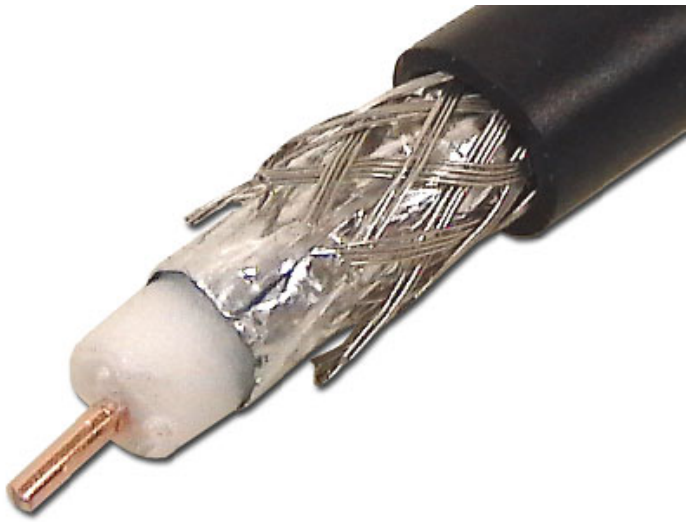
with a neat little device called an "artificial ground," such as MFJ's Model 931. Obviously, you'll have to re-tune every time you change bands, or move very far within a band.

More Quarters

This same principle—that a quarter-wave conductor is low impedance—is also the building block of most of our antennas. The simplest and most obvious example is, well, the quarter-wave vertical. This old warhorse has served many a ham and SWL quite well over the years. It tends to be low (30 to 50 ohms) impedance at or near resonance—IF it is supported by a good "ground image" (read "low-impedance ground path"). The sea of radial wires under such an antenna are NOT connections to the Earth—they are, ironically, an attempt to compensate for the lossy planetary surface which tries to soak up all the RF, since the radiating element is ground-mounted and thus very close to the lossy Earth. One method of stepping around this is the ground-plane vertical, which has rigid quarter-wave counterpoises at its base and thus can be raised up in the air, farther from the lossy Earth.

The next most obvious example is the dipole, which in its simplest form is a half-wave conductor split at the center and fed with one or another two-wire feed method. Thus the dipole is two quarter-wave conductors. This simple antenna typically shows 50 to 70 ohms impedance—IF we raise it at least a quarter-wavelength above ground.

MFJ's Model 931 Artificial Ground, which turns a random length of wire into a good RF ground. (Courtesy MFJ Enterprises)



Coaxial cable: Good stuff, if you have a matched load. (Author's photo)

A moment's thought shows that the dipole leads directly to other antennas like the Yagi, whose driven element is basically a dipole (or sometimes a folded dipole). The quad is a Yagi made of folded dipole-type elements, opened up into triangular, diamond, or other-shaped loops.

The quarter-wavelength conductor, then, is a crucial building block of both ground and antenna—and the quarter-wavelength is our guideline to understanding a great deal about both ground and antenna.

Feedlines: Black Formal-wear, Or No Jacket Required?

In many ways, feedlines may be the most difficult part of antenna technology to understand. I think this has to do with the fact that we basically use one of two feedline systems: the "default" system of 50 ohm coaxial cable, and the older technology of balanced line or single line and a tuner, and the two are almost schizophrenically different things to understand.

Few now remain to recall it (no, not even I am that old), but for the amateur radio community, coaxial cable was an unknown creature until World War Two ended. Up until then, hams had devised, and deployed, a number of single-wire and two-wire feed systems. Then WW2 ended with the Allies victorious, and many, many miles of surplus military coaxial cable lying about. Hams snapped up this treasure trove of "new and improved" feedline, usually for a song and two dances, and began eagerly to experiment with it. Quickly it was found that such cable typically has an impedance of 50 to 70 ohms—hey, right in dipole country! Now you know why the 50-ohm antenna connection on our radios long ago became the standard—when 50-ohm coaxial cable became the standard. It's important to realize that the era following World War Two is also the time in which television came to widespread prominence. Suddenly, the stray RF that often sprayed from the earlier, unshielded one- and two-wire feed lines was wiping out people's television sets—coaxial cable became almost a required aspect of the ham's station. Here we see one of those great ironies of technological history, where the advent of TV uncovered a problem with radio that had been hitherto irrelevant. Indeed, amateur radio struggled for a while in the 1950s to convince Average Television Viewer that the interference was not malicious and could be corrected or minimized. Tempers were flaring—no one liked seeing Uncle Milton Berle wiped out by "dah dit dah dit, dah dah di dah" scrambling the TV screen. And so coaxial cable attained a sort of exalted status since it was crucial in resolving this "Great TVI War."

There's much to recommend coaxial cable. It has a neat, finished appearance, can be easily routed almost anywhere, can be taped or cable-tied right to towers, gutters, or any other metal objects without ill effect. By dint of its construction, it is, if properly installed and maintained, much more weather-resistant than the typical two-wire system, with exposed wire and exposed connections. If placed between a 50-ohm radio connection and a resonant 50-ohm load, it does very well, at least until we get on up into VHF and UHF, where RF losses in the coaxial cable begin to become significant.

Subject coaxial cable to too much of an impedance mismatch, however—say, 2.5 to 1 or higher SWR—and losses in the coax begin to mount rapidly. At high enough power, and a large enough mismatch, the RF power from the rig will literally blow a hole in the coax jacket, as the cable self-destructs between the hot center conductor and the grounded outer braid. If you have an antenna for every band, this isn't a problem; just switch antennas every time you switch bands.

On the other hand—wait for it!—you can build an all-band system for HF using a single antenna—and two-wire, balanced feedline—within certain limits, of course. Here's the skinny: Simply put up the longest dipole you can—don't worry about its exact length—and feed it with balanced feedline, like ladder line or windowed line, and a balun-equipped tuner at the radio position, between the rig and the ladder line. At all frequencies where the dipole is at least a

One of the author's big dipoles, fed with ladder line. (Author's photo)

quarter-wave long (there's our buddy "Quartie" again), the system will load up. This means that a single dipole 130 feet long will give you every band 160 meters through 10, inclusive; even six meters, if your tuner will handle it (my trusty MFJ 969 does). Even a dipole only 65 feet long will give you every band from 40 meters up. As you might guess, the crucial link in this chain is the tuner.

Black Box Down

The tuner is my favorite bit of RF technology. This humble assembly of two variable capacitors and an adjustable coil accepts a wide range of antenna impedances (typically 6 ohms to 1200 ohms) and transforms them to 50 ohms on the "radio side." I say antenna impedances; actually, the load is a composite of antenna and feedline impedances at most frequencies. A moment's thought will reveal that at many frequencies there will be a high SWR on the feedline, since our random dipole will be nowhere near resonance. The beauty of this is, it doesn't matter! Unlike coaxial cable, with the hot conductor "trapped" throughout its length in a grounded braid jacket, balanced line has two conductors separated by anywhere from a half-inch (300-ohm "twin lead") to six inches (homemade 600-ohm ladder line). Thus the interaction of the two conductors is minimized.

It's important to understand that the tuner adjusts for the lowest possible SWR—on the short run of coax between the tuner and the radio. The SWR at the tuner input, from the incoming balanced line, may be very high. However, since high SWR doesn't affect the balanced feedline, and the tuner always shows the radio 50 ohms, the system works beautifully. The importance of this—that a single antenna can give the operator multiple bands—cannot be overstated. A single dipole that costs very little, and then provides eight or nine or ten bands once installed, is a tremendous advantage, especially for the person with limited space, or the unfortunate soul that must defy the Antenna Gestapo.

Front and back views of MFJ's excellent Model 969 tuner. (Courtesy MFJ Enterprises)

It's worth noting that the same thing can be accomplished with a ground-mounted vertical, a good set of ground radials, and a slick device called a remote automatic tuner. Waterproofed and buried right at the base of our prospective vertical, with a run of good quality 50-ohm coax connecting the buried tuner to the indoor rig, this is another way of multi-banding a single antenna. Coax purists will love it, since it uses only coax! Nowadays a popular height for such a vertical is the 43 foot vertical sold by a number of vendors. There's nothing mystical about the 43-foot length; 20 meters is by tradition the king of DX bands, and 43 feet is about five-eighths wavelength at 20 meters. Verticals longer than 5/8-wave have reduced low-angle radiation, so essential for DX work. (The fine print in the instructions for most of these 43 foot verticals tells you to telescope the length down shorter if you wand good DX results on 17, 15, 12, or 10 meters—not a real issue right now, with sunspots nearly nonexistent. Conversely, the 43-foot length is long enough to give the tuner something to work with at 80 and 160 meters—IF we have a good RF ground! Ah, we've come full circle at last…

Deep Thoughts

These are to me the essential building blocks of understanding antenna systems: A proper understanding of what "ground" is, an appreciation of the significance of a quarter-wavelength, and an understanding of the difference between coax and not-coax. The more we understand and hold to these concepts, the more efficient our station will be—and the more we'll enjoy operating!

That's all for this month, boys and girls. Join me here in October, when we'll delve farther into the Great Antenna Jungle. Be careful out there, and happy operating!

TSM

Radio Horizons

Product Announcements of Interest to *TSM* Readers

Antenna Basics: An Introduction to Antennas for the Radio Hobbyist

Monitoring Times founder and publisher, Bob Grove W8JHD, has written many books and published hundreds of articles on the subject of antennas. He is also an antenna designer and tireless antenna experimenter. Many of his designs were sold for decades through his mail order electronics company, Grove Enterprises, which also closed its doors in December 2013 when *Monitoring Times* ceased publication.

Since then, Bob has authored a number of best-selling Kindle publications on the subject of antennas. While those titles are no longer available as Kindle publications, don't worry, Bob has just published an actual paperback book you can hold in your hands and put on a real bookshelf.

Titled, "Antenna Basics: An Introduction to Antennas for the Radio Hobbyist," Bob demystifies the all-important subject of radio antennas in the same way he has for decades, allowing newcomers to quickly get up to speed on everything they need to know to get a foundation on the subject of antennas.

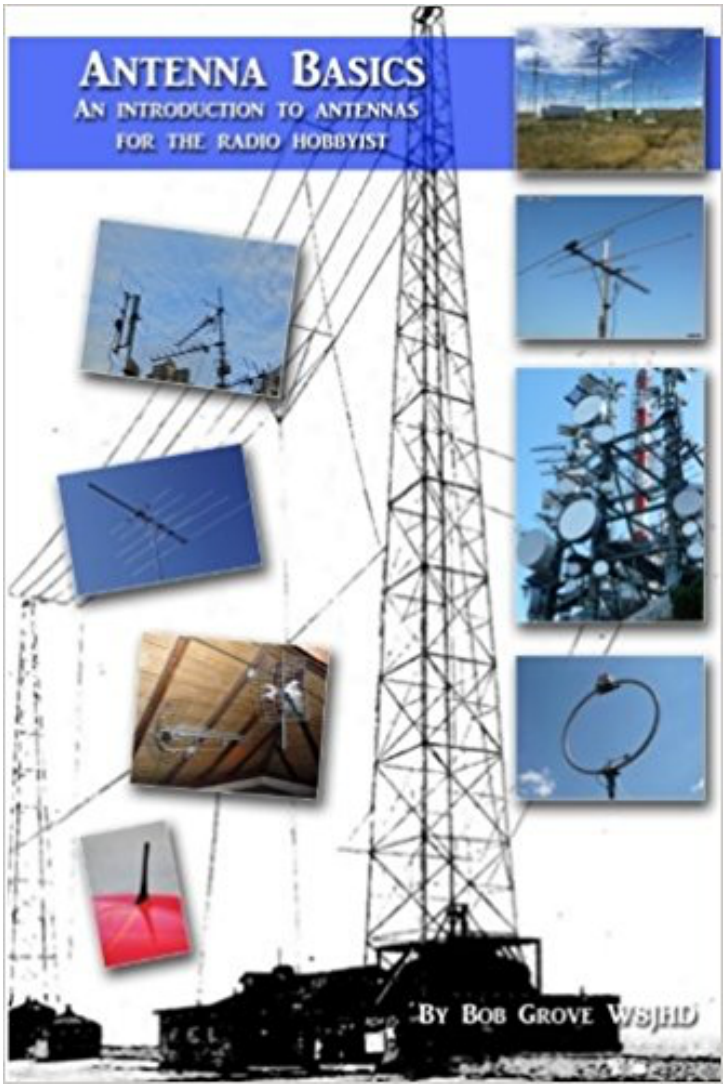
Don't know the difference between a log periodic dipole array and a discone antenna? Bob explains it. Which wire is best for a wire antenna? Bob's got it coverd. How high is high enough for an antenna? Bob lets you know.

While this is not a large book—it's only 75 pages in a 9 x 6-inch format—it's the best way to learn about antenna basics, without getting distracted by wave theory and mathematics formulas. For instance, in the five pages on antennas for shortwave, Bob explains, "A 150-foot wire is no better at receiving that a 50-foot wire…there's no net gain in clarity of reception which is expressed as signal above noise and interference."

High frequency radio waves, propagation, antenna designs and various gadgets as well as VHF/UHF antennas all get the cursory treatment you need to get started. There are many hefty books about antennas with prices to match, but for a ground-floor understanding, this small volume does the job.

Loop antennas, active antenna, low frequency antennas, beams, dipoles, wire and aluminum antennas, Bob gets into all topics deep enough to give you the basics with enough detail to start you on your way to a lifetime of antenna experimenting.

For decades Bob's popular *Monitoring Times* column, "Ask Bob," answered all the baiscs thrown at him by readers. In this book he reprints some of the most common questions.



If you're new to the antenna side of radio monitoring and need a quick, no-frills introduction to the subject from VLF to HF to VHF/UHF antennas, look no further.

The paper version of "Antenna Basics: An Introduction to Antennas for the Radio Hobbyist" is available through many sources, including Universal Radio: **http://www.universal-radio.com/catalog/books/3773.html**

[Review by Ken Reitz KS4ZR, book cover graphic courtesy of Bob Grove]

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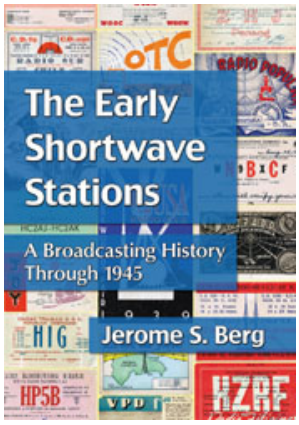
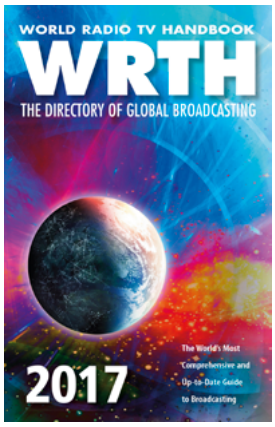
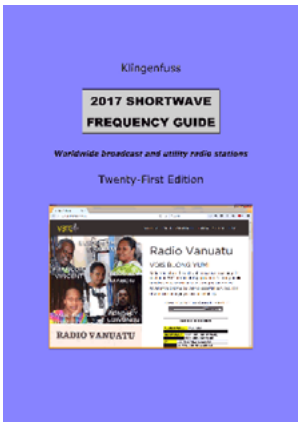
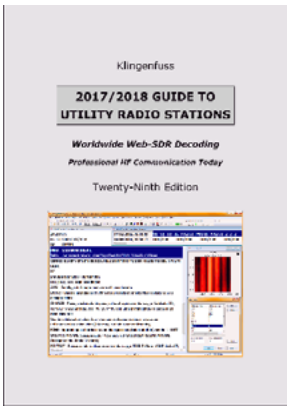
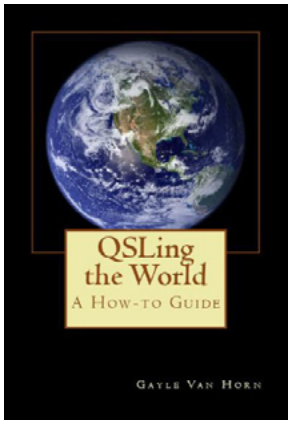
Books of Interest to *TSM* Readers to Enhance your Radio Listening

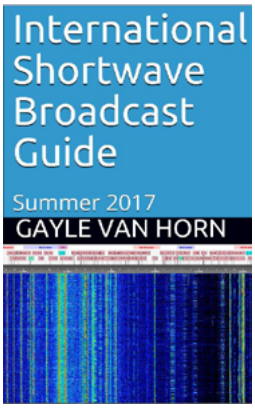


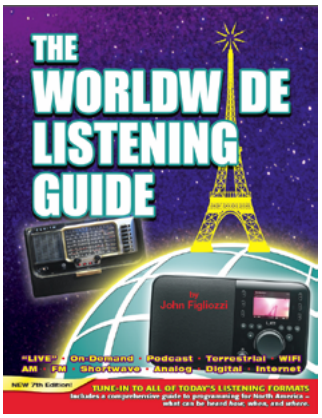


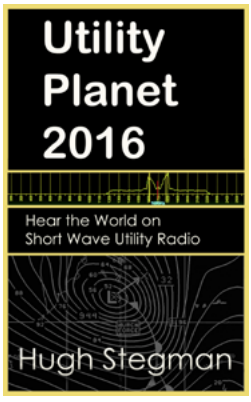


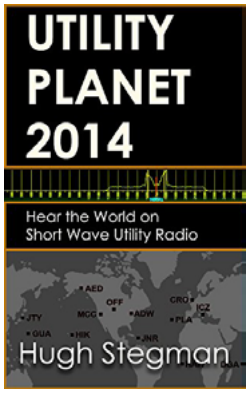


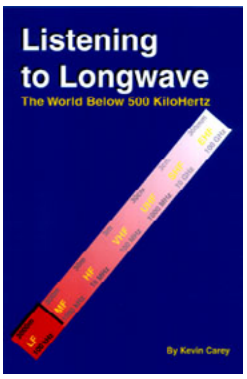


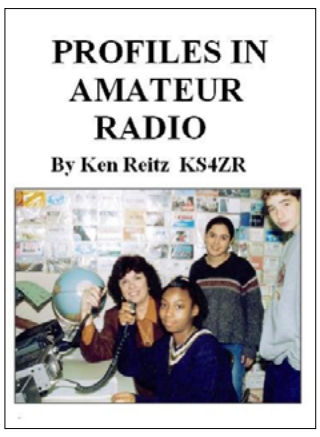


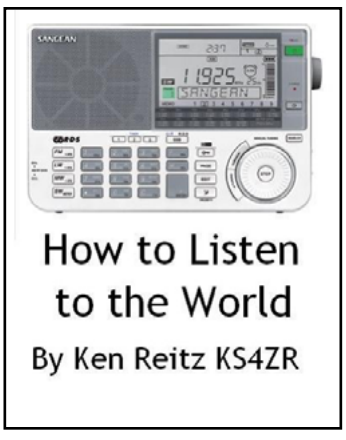


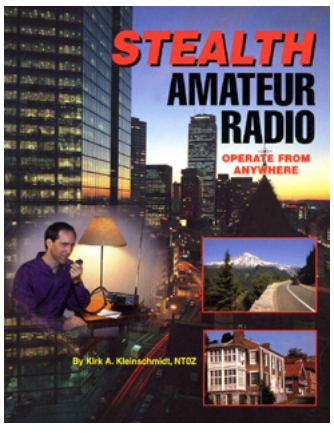












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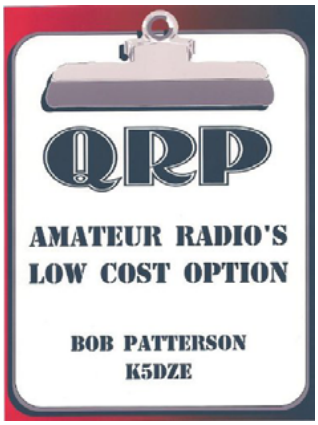

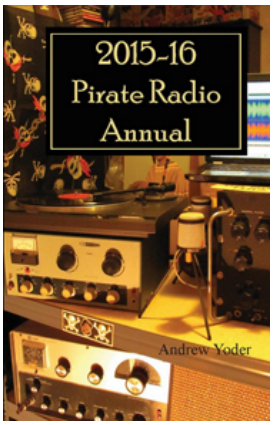

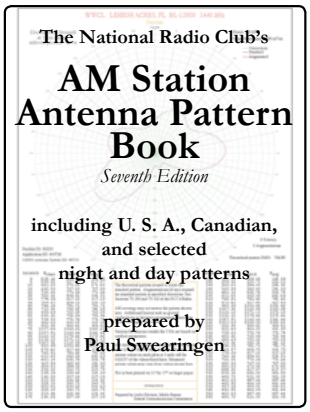

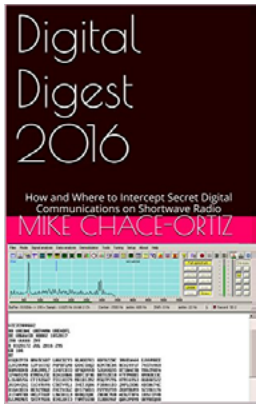

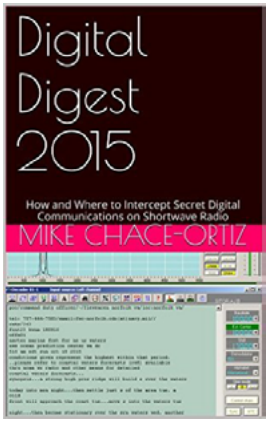

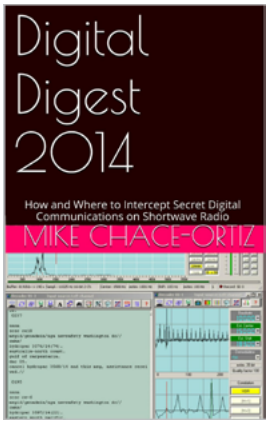

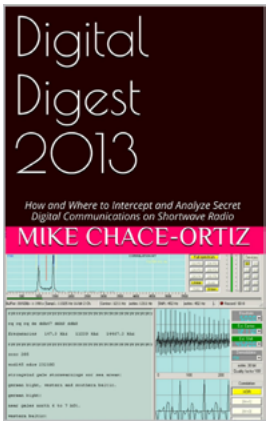

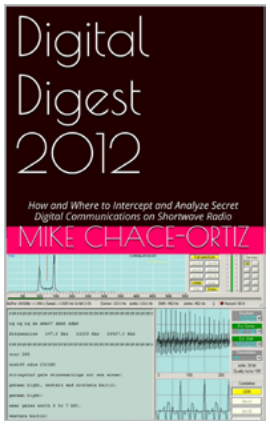

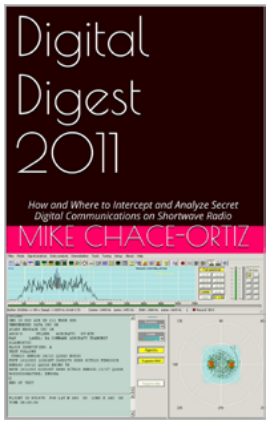

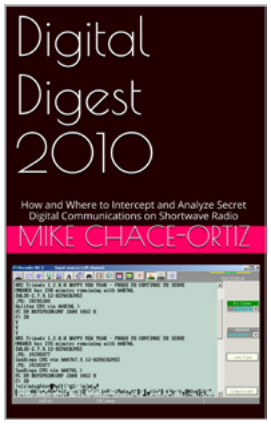

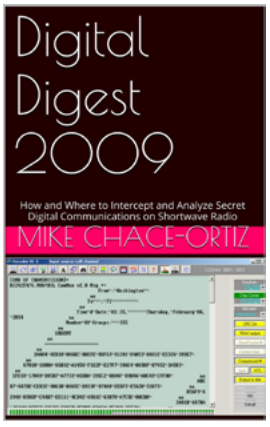

About Us

The Spectrum Monitor Writers' Group

The Spectrum Monitor is edited and published by Ken Reitz KS4ZR, former managing editor, features editor, columnist and feature writer for *Monitoring Times*. Former feature writer and columnist for *Satellite Times*, *Satellite Entertainment Guide*, *Satellite Orbit*, *Dish Entertainment Guide, Direct Guide;* contributing editor on personal electronics for *Consumers Digest*. Author of the Kindle e-books "How to Listen to the World" and "Profiles in Amateur Radio." E-mail: editor@thespectrummonitor.com

The Spectrum Monitor Writers' Group consists of former columnists, editors and writers for *Monitoring Times* and *Popular Communications* magazines. Below, in alphabetical order, are the columnists, their amateur radio call signs, the name of their column in *The Spectrum Monitor,* a brief bio and their websites and contact information.

Keith Baker KB1SF/VA3KSF, "Amateur Radio Satellites"

Past president and currently treasurer of the Radio Amateur Satellite Corporation (AMSAT). Freelance writer and photographer on amateur space telecommunications since 1993. Columnist and feature writer for *Monitoring Times*, *The Canadian Amateur* and the *AMSAT Journal*. kb1sf@hotmail.com **www.kb1sf.com**

Kevin O'Hern Carey WB2QMY, "The Longwave Zone"

Reporting on radio's lower extremes, where wavelengths can be measured in miles, and extending to the start of the AM broadcast band. Since 1991, editor of "Below 500 kHz" column for *Monitoring Times*. Author of "Listening to Longwave" (http://www.universal-radio.com/catalog/books/0024u.html). This link also includes information for ordering his CD, "VLF RADIO!," a narrated tour of the longwave band from 0 to 530 kHz, with actual recordings of longwave stations. E-mail: wb2qmy@arrl.net

Mike Chace-Ortiz AB1TZ/G6DHU "Digital HF: Intercept and Analyze"

Author of the *Monitoring Times* "Digital Digest" column since 1997, which follows the habits o f embassies, aid organizations, intelligence and military HF users, the digital data systems they use, and how to decode, breakdown and identify their traffic. **www.chace-ortiz.org/umc**

Dan Farber AC0LW, "Antenna Connections"

Monitoring Times antenna columnist 2009-2013. Building ham and SWL antennas for over 40 years. E-mail: ac0lw@att.net.

Richard Fisher KI6SN

A veteran journalist with a 35-year career in daily newspapers, and an amateur radio operator living in Riverside, California, Richard has been an editor and writer for *Popular Communications, WorldRadio Online*, and *CQ Amateur Radio* magazines. Among his previous responsibilities have been the monthly "Emergency Communications," "Trail-Friendly Radio" and "Easy Does It" columns for *CQ*, and has written for several QRP publications, including *QRP Quarterly* and *QRPp* magazine. An avid homebrewer, he is a co-founder of The Adventure Radio Society. Write to him at ki6sn@aol.com.

Tomas Hood NW7US, "Radio Propagation"

An Extra Class operator since 1990, Tomas enjoys CW and digital modes on all HF bands. He is a contributing editor to *CQ Amateur Radio*, the former *Popular Communications* and *CQ VHF* magazines, an ARRL publication on QRP communications, and *Monitoring Times*. He runs the Space Weather and RadioPropagation Center at **http://SunSpotWatch.com**. Web site: **http://nw7us.us** Twitter: **https://twitter.com/NW7US**.

Kirk Kleinschmidt NT0Z, "Amateur Radio Insight"

Amateur radio operator since 1977 at age 15. Author of "Stealth Amateur Radio." Former editor, "ARRL Handbook," former *QST* magazine assistant managing editor, columnist and feature writer for several radio-related magazines, technical editor for "Ham Radio for Dummies," wrote "On the Ham Bands" column and numerous feature articles for *Monitoring Times* since 2009. Web site: **www.stealthamateur.com**. E-mail: nt0z@stealthamateur.com

Joe Lynch N6CL, "VHF and Above"

Currently Director of Religious Education for the Army at West Point, New York. He holds a Doctor of Ministry, Master of Divinity, an MBA and is an adjunct instructor for four colleges and universities and a retired United Methodist minister. He served as the editor of *CQ VHF* magazine for 12 years and the VHF editor for *CQ* magazine for 22 years.

Stan Nelson KB5VL, "Amateur Radio Astronomy"

Amateur radio operator since 1960. Retired after 40-plus years involved in mobile communications/electronics/computers/automation. Active in radio astronomy for over twenty years, specializing in meteor monitoring. He wrote the "Amateur Radio Astronomy" column for *Monitoring Times* since 2010. A member of the Society of Amateur Radio Astronomers (SARA). **www.RoswellMeteor.com**. E-mail: Stan.Nelson@RoswellMeteor.com

Chris Parris, "Federal Wavelengths"

Broadcast television engineer, avid scanner and shortwave listener, freelance writer on federal radio communications since 2004, wrote the "Fed Files" column for *Monitoring Times*. h**ttp://thefedfiles.com http://mt-fedfiles.blogspot.com** Twitter: @TheFedFiles E-mail: cparris@thefedfiles.com

Rich Post KB8TAD, "Adventures in Radio Restorations"

As a teenager Rich Post repaired radios and TV sets. He passed the exam for a First Class FCC license when he was told he needed one to repair his CB. He later received his amateur radio license as KB8TAD. Rich now holds a University Emeritus title having retired from Ohio University as Assistant Dean and Director of the Instructional Media and Technology Services. One of his hobbies is collecting and restoring "boat anchors." He maintains the web site Boat Anchor Pix at **www.ohio.edu/people/postr/bapix**.

Tony Roper, "Military Air and Naval Reception"

A Civil Air Traffic Controller in the UK as well as previously being in ATC in the Royal Air Force, totaling 25 years experience. He has worked as a part-time aviation photographer/writer and has been published worldwide. He also provides photos and research for IHS Jane's, principally Jane's Fighting Ships. His photography website is **www.rogdabbit.co.u**k and his blog is **http://planesandstuff.wordpress.com**

Cory GB Sickles WA3UVV, "Digitally Speaking"

First licensed as a Novice over 40 years ago, he enjoys exploring various facets of amateur radio, from the latest state of the art technologies, to the elegant simplicity found with a one-tube transmitter and straight key. He has an extensive background with computers and likes to restore 8, 12 and 16-bit classics from the 1970s. He owns a television production company and creates series programming, as well as marketing and training videos. wa3uvv@gmail.com.

Hugh Stegman NV6H, "Utility Planet"

Longtime DXer and writer on non-broadcast shortwave utility radio. Former "Utility World" columnist for *Monitoring Times* magazine for more than ten years. Web site: **www.ominous-valve.com/uteworld.html** Blog: **http://mt-utility.blogspot.com** /email: mtutilityworld@gmail.com Twitter: @UtilityPlanet

Larry Van Horn N5FPW, "Milcom"

Retired US Navy Chief Petty Officer. 43-year licensed amateur Extra class ham. Former *Monitoring Times* Assistant Editor, Staff Journalist, Columnist. Former *Satellite Times* Managing Editor. Former Grove Enterprises Technical Support Technician. President Teak Publishing and author of dozens of print/e-Book radio hobby publications. EmaiL MilcomMP@gmail.com.

Dan Veeneman, "Scanning America"

Software developer and satellite communications engineer writing about scanners and public service radio reception for *Monitoring Times* for 17 years. Web site: **www.signalharbor.com** E-mail: dan@signalharbor.com

Ron Walsh VE3GO, "Maritime Monitoring"

Retired career teacher, former president of the Canadian Amateur Radio Federation (now the Radio Amateurs of Canada), retired ship's officer, licensed captain, "Boats" columnist and maritime feature writer for *Monitoring Times* for eight years. Avid photographer of ships and race cars. E-mail: marinecolumn @gmail.com.

Fred Waterer, "The Shortwave Listener"

Former "Programming Spotlight" columnist for *Monitoring Times*. Radio addict since 1969, freelance columnist since 1986. Fascinated by radio programming and history. E-mail: programming_matters@yahoo.ca