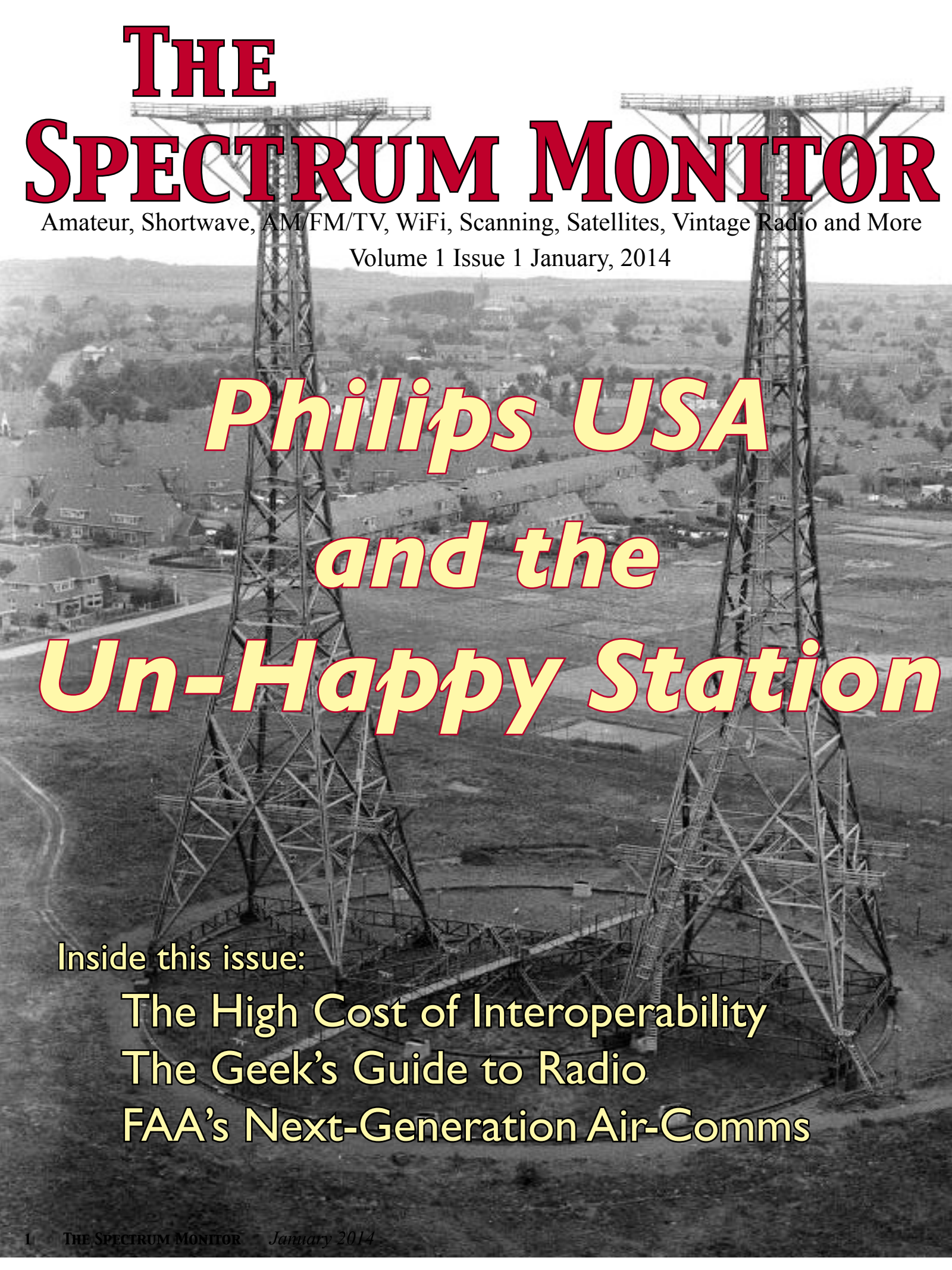
The Spectrum Monitor

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

Volume 1 Issue 1 January, 2014



Philips USA and the Un-Happy Station

Inside this issue:

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C O N T E N T S

The Spectrum Monitor Columns:

Writers for *The Spectrum Monitor* welcome your comments. To contact any of the writers whose material you find in this issue, use the email address found with each column or feature article. Most writers also write regularly for their own blogs, the locations of which are found in the above "About Us" section of the magazine.

Cover Story: *Image is from a 1940 photo by Jacq Stevens of the PCJ beam antenna. (Courtesy of the Streekarchief Gooi en Vecht historical archive)*

The Spectrum Monitor is published monthly by Ken Reitz KS4ZR at 1403 Holland Creek Road, Louisa, Virginia 23093.

Regular subscriptions to *The Spectrum Monitor* are $24 for one year (12 issues) and are available from **www.thespectrummonitor.com**. If you are not satisfied with your purchase you may receive a refund for the remaining issues on your subscription by contacting the publisher: ks4zr1@gmail.com. Your refund will be made in the manner in which the purchase was made. If you would like to write for *The Spectrum Monitor* please send an email to editor@thespectrummonitor.com and ask for our writer's guidelines. *The Spectrum Monitor* makes every effort to ensure that the information it publishes is accurate. It cannot be held liable for the contents. The reader assumes all risk in performing modifications or construction projects published in *The Spectrum Monitor*. Opinions and conclusions expressed in *The Spectrum Monitor* are not necessarily those of the publisher.

Dear TSM:

Send your comments to editor@thespectrummonitor.com
The Spectrum Monitor reserves the right to edit comments from readers for clarity and space availability.
Anonymous comments will not be published.

Comments, Advice, Kudos and Questions from Readers

Many former *MT* readers wrote to express their thanks for *TSM* picking up where *MT* left off, none more appreciated than from Fr. Lawrence Thompson KE4RPX, Dothan, Alabama who wrote:

"I can say that I am most thankful, pleased and delighted to learn you've decided to continue the idea and essence of *MT,* albeit in an electronic format. Ever since I first read *MT* was closing down, I, like many others, was lamenting its demise. After seeing whom you've contracted with to continue writing for you, I am really anxious to see your first, and subsequent issues. I've no doubt it will be a keeper.

"I've been buying my copies of *MT* at Barnes and Noble Booksellers. Two of their staff knew I was anxiously awaiting this last issue. So, last evening, when I went to B&N, both had pulled copies off the cart and had held them for me. Now, it'll be neat to just type a few keys and, Voila! I'll have *The Spectrum Monitor.* No doubt this will be a busy month for you, but may God bless each and all of you in the days, months and years to come."

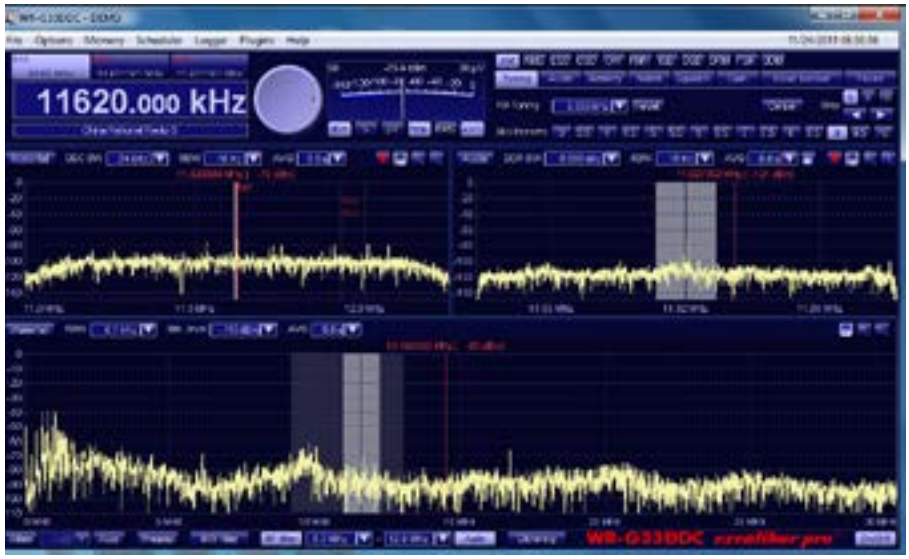
Thanks, Fr. Lawrence, for your support and your blessings. We need both! -- Ken KS4ZR

One Last "Ask Bob?"

With the transition from *Monitoring Times*' last issue in December and *TSM's* first issue in January, there was bound to be some carry-over. *MT*'s founder and publisher, Bob Grove, passed this interesting question along for the benefit of *TSM* readers.

Frank Howell K4FMH Asst. Dir., Delta Division, ARRL, Ridgeland, Mississippi, writes:

"Could you elaborate briefly on your comment in the Ham Radio Now interview [from this past August] regarding your habit of scanning the bands using a spectrum analyzer? I've used a Perseus SDR for a number of years now, but your comment has me intrigued."



Spectrum display from WiNRADiO WR-G33DDC Excalibur Pro, an excellent example of digital radio technology . Note that the bottom screen shows the entire HF spectrum from 0 to 30 MHz. To learn more about the merging of computers and radio technology read The Geeks Guide to Radio, on page 14. (Screen image courtesy of WiNRADiO)

Bob Grove W8JHD responds.

"I am visually perceptive, therefore: 1. Watching TV (along with its accompanying audio) is more informative than listening to the radio.

"2. Seeing a graph of data points is more cognitively meaningful than seeing a column of figures.

"With these precepts, adding a spectrum display to a receiver tells you far more about band occupancy than listening to a single signal. Whether you are looking for band openings, hunting for unknowns, or watching for new loggings, especially rapid on/off keying, the span of a spectrum display provides instant insight over a wide bandwidth compared to manually or even automatically slewing across a band one frequency at a time. Even when analyzing the contents of a single signal, the modulation bandwidth is revealed instantly."

A Lot too Small for LW?

Longtime *MT* reader, charter *TSM* subscriber and longwave enthusiast, Ron Smith wrote to share his appreciation for Kevin Carey's column on longwave listening, now known as The Longwave Zone. Relating his enthusiasm for the action on longwave, as he found it in mid to late November, he writes:

"Using a Kaito KA-1103, Palomar converter and improved Hula Hoop Longwave Loop, France Inter (162 kHz) was running English-lyric music with a French announcer. 198 and 207 were quiet as were the rest of the longwave broadcast channels (odd). There were beacons aplenty though including one with a two letter ID. My Sony 7600G was, and is, a good rig, but the sensitivity of the KA-1103 won the day.

"I full well know that most people in the longwave field can and do better (much better) than this. But, for the guys who, like me, have a high noise level and a small lot, this is very gratifying indeed. Frankly, I never thought it would even be this good!"

Great catch, Ron! Ron later wrote that he was also able to hear Iceland on 189 kHz.

We want to know what you've heard lately,. Send your listening triumphs, how you did it and what you did it with to editor@thespectrummonitor.com

TSM

Publisher's Message

Digital Era Heralds Big Changes for Radio and Publishing Industries

Welcome to *The Spectrum Monitor*! We live in a period of great transition, from time-tested analog technology to an ethereal, digital world. Anyone reading this publication understands this. The whole premise of this magazine is that the future of publishing and radio technology lies in this digital realm. Yet, there remains a coexistence between the analog and digital in both industries, a condition which is likely to last for some time. So, welcome to the future of both.

The vast majority of our subscribers have come to us through *Monitoring Times* magazine, a monthly print and electronic magazine that ceased publication after 33 years with the December, 2013 issue. *TSM* is not connected in any way to *MT* or its publisher, Bob Grove, founder and president of Grove Enterprises, a radio retail mail-order company as old as *MT* and which also closed its doors last month. Yet, I and the *TSM* writing staff owe a debt of gratitude to Bob for allowing me to launch *The Spectrum Monitor* on the pages of the last three issues of *MT*. Without his generosity, this process would have taken considerably longer. You'll note that Bob appears twice in this issue, a further extension of his generosity, once in the adjacent "Dear TSM" column and once in the "TSM Bookshelf."

Those who have come to *TSM* from other promotional efforts launched over the last three months will not be as familiar with the format of this magazine, so I'll make some introductions. The objective of *The Spectrum Monitor* is to report in-depth on the latest activities throughout the radio frequency spectrum. Included in our reporting are amateur radio, shortwave, longwave, VHF/UHF scanning, Free-to-Air satellite, WiFi radio, vintage radio and anything else related to the subject of radio. To do so, we have re-assembled nearly all of the writers from *Monitoring Times* who cover each of the above topics.

As you will notice, some writers' work will appear once every three months. This is according to their own wishes, based on work schedules and amount of new activity happening in their area of expertise.

These quarterly columns are "Maritime Monitoring," which appears in this issue, "Amateur Radio Satellites" and "Amateur Radio Astronomy." Some monitoring areas, including aeronautical, military, railroad and shortwave pirate radio activity will be covered regularly by experts whose work will appear as feature articles in the front of the magazine.

The Spectrum Monitor Writers Group has an amazing amount of expertise and we welcome your questions about any aspect of monitoring that you may have. No question is too simple nor too complicated. Send your questions directly to me, **editor@thespectrummonitor.com.** I'll pass the question to the appropriate expert and we'll publish the answer in the next available issue of the magazine.

There will do doubt be technical issues for all of us to overcome as we move along in this all-digital publishing world. If you know of some hints for Apple, Android, or PC-based platforms that can help other readers have success in downloading and saving issues of *TSM*, please let us know and we'll pass them on.

The Spectrum Monitor is an experimental publication and we'll be trying different ways of telling the radio story. In this issue, for instance, there are several relevant places where you may be able to hear audio that supports the text. That's something we could never do in print. When it's appropriate, we'll offer more and your suggestions are welcome.

If you have a question about your subscription, just send me an email and I'll take care of it. If you have a suggestion for a feature article, just send me an email and I'll consider it. Some of the best story ideas at *MT,* while I was features editor and managing editor, came from our readers.

As we start this first year, I appreciate your patience and your support. For several months we've all looked forward to 2014 and to bringing you the best information available on the RF spectrum.

– Ken Reitz KS4ZR, Publisher and Managing Editor, *The Spectrum Monitor*

RF Current

News from the World of Communications

RF Current is compiled and edited from news 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

WRMI Acquires WYFR Assets

Radio Miami International (WRMI) announced in early November, 2013, that it has agreed to purchase the shortwave broadcast facilities of Family Radio WYFR which ceased operations at the end of June, 2013. Under the agreement, the facilities, which includes a number of high-power HF transmitters and an extensive HF antenna farm, will air the programs of WRMI and Family Radio as well as Pan American Broadcasting's Radio Africa network.

In a press release, Jeff White, WRMI General Manager, said, "We are very grateful to Family Radio for entrusting us with this magnificent station." He noted WYFR's shortwave heritage, from when it first went on the air from its Okeechobee transmission site in 1977.

The agreement makes WYFR/WRMI the largest shortwave station in the United States in number of transmitters and antennas. The facilities include 13 transmitters (12 100-kW and 1 50-kW) as well as 23 antennas beamed to the

Radio Slovakia's Return to SW?

According to an item on Thomas Witherspoon's SWLing Post, Radio Slovakia International is considering a return to HF broadcasting from its own transmitters. The post, dated November 14, 2013, quoted remarks made at the High Frequencies Coordinating Conference (HFCC), held earlier in Slovakia in August and reported in the National Association of Shortwave Broadcasters (NASB) newsletter published this past September.

According to the newsletter, Maria Mikasova, Chief of Radio Slovakia International, told the HFCC:

"For us, this conference is a first-hand, live encounter with the shortwave network and its significance for broadcasting. But at the same time it unveils what strategies of radio broadcasting and shortwave transmission are out there in the modern world. After all, the outlook and future strategy of Radio and Television of Slovakia is to bring RSI back to shortwave broadcasting. Although this issue has not been resolved yet, it shows just how important the HFCC Conference in Bratislava is, and why we, RSI, are so very interested in it."

Published along with her comments was an extensive program schedule for RSI transmissions from within Slovakia. The station currently relays its programming on WRMI and is also available on Free-to-Air (FTA) satellite via World Radio Network (see TSM's Satellite Guide).

In an unrelated announcement, the Voice of Russia closes its shortwave service January 1, combining its service with other state-run media to become Rossia Segodnya (Russia Today).

High School Launches Cubesat

Students at Thomas Jefferson High School for Science and Technology in Alexandria, Virginia, made history when a cubesat they had a hand in building, known as TJ³Sat, launched November 19 aboard an Air Force Minotaur rocket from the Mid-Atlantic Regional Spaceport on Wallops Island, Virginia. The launch signaled the first time a high school cubesat had been launched.

The primary mission of the launch was the Air Force's STPSat3, a "bus" designed to support four independent payloads. According to a press release from the USAF Space Command, "STPSat-3 will demonstrate the flexibility of the…design by accommodating five payloads plus a de-orbit module." Flying with STPSat3 were 28 cubesats on an Integrated Payload Stack.

TJ³Sat is a joint project between the school and industry partners intended to "increase interest in aerospace technology as part of NASA's Educational Launch of Nano-Satellites (ELaNA) program," according to the school's website. The aim of the project is to provide "educational resources to other K-12 education institutions to foster interest in aerospace," through the successful design and flight of TJ³Sat.

Joining with the school in this project are Orbital Science Corporation, one of the leading developers of satellite technology and launch services (which provided funding for the purchase of satellite hardware and engineering consultation), and Stensat Group, LLC., which provided contributions to the design and construction of TJ³Sat's radio and power handling hardware.

TJ³Sat is an amateur radio spacecraft with a downlink on 437.320 MHz in the 70 cm band. During a pass in beacon mode, you will be able to hear a short "beep" every 13.5 seconds. In addition, the satellite will send its call sign, KK4PHU, every 10 minutes in CW.

The satellite will use an on-board "Text Speak" module designed to convert text messages from students and other users around the world. According to the website, "Approved text strings will be transmitted to the satellite and the resulting voice interpretation will be relayed back to Earth over an amateur radio frequency using the on-board Stensat radio." But, catch it while you can; mission life is expected to be only six months.

Hams and satellite monitors are

encouraged to report hearing the satellite by going to the school's website (**http://www.tjhsst.edu/students/activities/tj3sat/**) and click on the button "Report Contact with the Satellite." To track the satellite, just click on the website's "Track TJ3SAT" button. The satellite is the culmination of seven years of work from more than 50 students.

Prometheus Helps Thousands File for LPFM Licenses in LPFM Window

According to a press release, the Prometheus Radio Project helped thousands of civic groups across the U.S. file for Low Power FM (LPFM) radio station licenses this past November. Prometheus was directly responsible for the creation of the Local Community Radio Act (LCRA) of 2010, which led to the opening of a two week filing window, the first of its kind in 10 years. The longtime community radio advocacy group noted, "The original filing window was slated to be October 15-29, 2013, but was postponed and then extended due to the government shutdown in October. The new deadline was moved to November 14, 2013 6:00 pm EST, but as that deadline approached, technical difficulties on the FCC's website prohibited applicants from filing their forms. To allow for access to the site and database, the FCC extended the deadline to November 15, 2013 3:00 pm EST."

The importance of this particular filing period is that, for the first time, LPFM licenses would be granted in most of America's top 150 radio markets, seen as a threat by full-power FM broadcasters, despite the fact that the LCRA specifically protects the commercial broadcast giants against interference from the LPFM crowd.

While the filing window is closed, the FCC will likely not award construction permits (CPs) until all issues of competing interests in the few frequencies available in each market have been ironed out. Prometheus expects that to happen in the first quarter of this year. Once CPs are issued, stations will have up to 18 months to build their facilities and put the station on the air. Then, all they have to do is keep tripping over the many regulatory hurdles that seem to confound even longtime broadcast stations. The difference here is that LPFM stations, operating on a shoestring, could be sunk by even a small fine for a simple rules infraction.

New FCC Chair: Career Industry Lobbyist

If it seems that the FCC is too concerned about cable and wireless communications issues, it could be because the commission has for years been guided by leaders in that field. Previous commissioners have come to the commission from positions inside the two industries the FCC is intended to regulate. And, following their service on the commission, members often fall softly into waiting jobs in those same industries.

After a *pro-forma* confirmation by the U.S. Senate, Tom Wheeler, was installed as Chairman of the FCC. He was one of the biggest fund raisers for the Democratic party and a former CEO of the National Cable Television Association (NCTA), the nation's biggest cable-TV lobbying group, and former CEO of the Cellular Telecommunications and Internet Association (CTIA), the nation's biggest wireless lobbying group.

FCC Enforcement

Last year Laura Smith, Special Counsel for amateur radio matters did some serious cleanup work on the ham bands.

Among many offenders cited were Extra Class hams who had to be banned by 2-meter repeater trustees, or who were caught deliberately interfering with other stations on-air. There were Advanced Class and Technician Class hams who were caught rag chewing on amateur bands with their non-licensed CB buddies and a host of CBers running linear amplifiers who were also shut down. One Advanced Class ham was caught trying to work Kwajelin Atoll during a recent contest, in the Extra Class portion of the band.

And, finally, the Enforcement Bureau recently fined an individual $25,000 for interfering with police frequencies in a town in New Mexico. The commission was unmoved by the man's apparent inability to pay the fine.

LightSquared

Fight for LightSquared's Remains

Here's a modern fairy tale. Once upon a time there was a start-up, high-tech company with the odd name of LightSquared. They had a plan to provide Americans with satellite delivered, high-speed Internet. The company was even given the blessings of the FCC, which at the time, was claiming high-speed Internet connectivity as a priority for the nation.

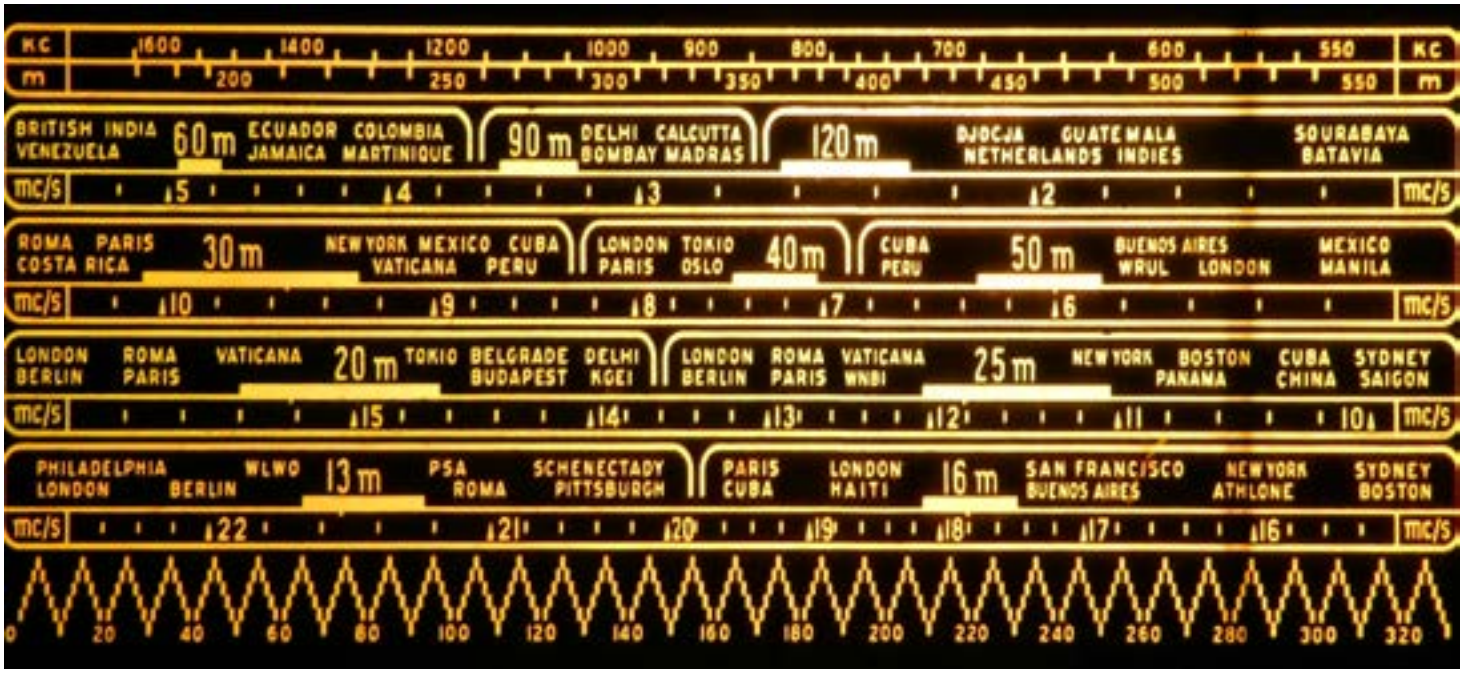
But, there was a problem. LightSquared's service was licensed to frequencies that were close to those used by the umpteen million cheap GPS receivers that had flooded the market in the time that it took for LightSquared to get its business model, including FCC approval, squared away, so to speak.

Just as LightSquared was set to roll out its wares and rake in billions, the powerful GPS industry lobby complained, citing inevitable interference with its devices that would render then useless. Caught between its hastily cobbled together high-speed Internet plan and the thought of a hundred million American commuters no longer able to find their way to work each morning, the FCC caved and revoked LightSquared's license.

Seeking Chapter 11 protection in 2012, LightSquared thought it could at least sell its greatest asset, frequency assignments awarded by the FCC, and valued at some $4 billion. Suddenly, a dark shadow appeared over LightSquared's landscape. It turned out to be Charlie Ergen, bazillionaire brains behind DISH Network, whose business has not fared well lately.

The future, Charlie believed, was in a vast terrestrial network of low power (1-2 kW) transmitters that would provide TV signals to mobile broadband devices in what was left of the OTA-TV band and guess who has a license for the frequencies Charlie needed? Then came the lawyers, as often happens in modern fairy tales, as Charlie tries to wrestle the precious frequencies, which he says are worth only $2 billion, out of the nearly dead, cold hands of LightSquared. Stay tuned

TSM



Philips 436-AN dial scale closeup showing cities and stations (Photo by Rich Post KB8TAD)

Philips USA and the Un-Happy Station

By Rich Post KB8TAD

I spotted the Philips radio at a swap meet. I was familiar with Philips as a manufacturer, with headquarters in the Netherlands, but was surprised when I saw the label on the back of the radio. Model 436AN was "Made in USA." It sported octal tubes, some of which were also labeled "Philips - Made in USA." It was missing its back but, like the typical American transformer-powered set, it had no exposed high voltage on top of the chasis.

Tube radios of European manufacture, including Philips, often have accessible high voltage points on the top side of the chassis, therefore requiring a full cover for the back. I had not known that Philips-branded radios had ever been made in the US. In fact, when Philips had tried to sell its branded products in the USA, Philco, as an established US electronics brand, had objected legally because of its name similarity to Philips, citing possible public confusion of the two names. Out of curiosity, I purchased the radio, wondering why it was made in the USA, and when and where it had been made.

The Tuning Scale and History

The dial tuning scale was labeled in both frequency and wavelength, typical for European sets. Its broadcast and four shortwave bands provided full coverage from 550 kHz to 22.5 MHz. The dial scale listed some typical shortwave stations of the late 1930s to the early 1940s era. The use of octal tubes and oversized IF transformers suggested a similar manufacturing time frame.

Looking further at the dial scale, the countries and cities listed, I noticed Panama, China, Cuba and cities such as London, Sydney, San Francisco, Boston, Berlin, Rome, Oslo, Bombay and so forth. It also had Djocja, Sourabaya, and Batavia which were located in the Netherlands East Indies, now known as Indonesia. Call letters of several US stations were listed including Crosley's WLWO in Mason, Ohio, NBC International's WNBI in Bound Brook, New Jersey, WRUL in Boston (Scituate) Massachusetts, and KGEI at Treasure Island, San Francisco. That narrowed the probable manufacturing date since the FCC granted those calls in September 1939 as a change from their earlier experimental call signs of W8XAL, W3XL, W1XAL and W6XBE respectively. The late 1939 FCC date suggested that the radio could not be older than the 1940 model year.
However, while the Dutch East Indies cities were listed, cities in the country of the Netherlands itself or in the provinces of North and South Holland were absent which seemed rather curious for Philips, a company based in the Netherlands. My 1939 Silvertone dial scale includes Hilversum. It and Huizen are Dutch cities for the studio and transmitter sites for station PCJ.

PCJ was developed by Philips in 1927 and had been on the international shortwave bands regularly since 1929. Its transmitter and large, water-cooled, final tubes were a source of pride for Philips engineering. Radio station PCJ was dubbed "The Happy Station," largely because of its well-known shortwave radio personality

Eddie Startz at the microphone. (Courtesy of the Instituut voor Beeld en Geluid, The Institute for Image and Sound in the Netherlands)

Eddie Startz. Eddie had hosted "The Happy Station Program" since 1929 and had christened PCJ as standing for "Peace, Cheer and Joy." His cheerful programs in Dutch, English and Spanish were a mainstay for shortwave listeners, not only in the Dutch East Indies but to English and Spanish language shortwave listeners throughout the world.

The transmitter site at Huizen had a unique 65 meter tall antenna system topped with beam antennas. Developed by Philips in 1937, the two antenna towers were made of wood to minimize RF absorption. The entire assembly could be rotated on circular rails for an effective radiated power (ERP) of 24 times isotropic to any point in the world. According to a Radio Netherlands report, the ERP was 2,000 kilowatts.

So what had happened to cause the station to disappear? And, could that possibly explain why the Philips radio had been made in the USA?

It was time to look at history and world events. For the US, World War II started on December 7, 1941 with the attack on Pearl harbor. However, for Europe the war had started earlier. For the Netherlands, it started on May 10, 1940 when the Nazi blitzkrieg attacked and overwhelmed the country without warning, bombing civilians in Rotterdam after wiping out the small and outdated Dutch air force. Germany used the country as a shortcut to Belgium and France on the way to much of the rest of continental Europe. The Dutch had tried valiantly to slow the German advance by blowing up dikes and bridges and flooding parts of the country. It was to be of no avail. The Dutch army blew up and burned the unique PCJ shortwave antenna and damaged the transmitter to try to keep it from being used for Nazi propaganda.

"Someone must have Pushed the Wrong Button"

Eddie Startz himself provided a first-hand account as written in the March 1947 Radio News.

"Here is the story in a nutshell. It began on the night of May 10th, 1940. The starlit sky over Holland was filled with the roar of planes. At 4 o'clock in the morning, PCJ's chief engineer broke the bad news... we were at war with Germany. The worst had happened! I slipped on my clothes and five minutes later I sat behind the wheel driving full throttle to the station. We went on the air and told a stunned world what was happening. Like thieves in the night, the German Wehrmacht, armed to the teeth, flooded over our borders and the peaceful soil of Holland resounded with the rattle of tanks... They dropped out of the air, machine-gunned our roads, bombed our towns, while Goebbels' poisonous propaganda bombarded us with lies and threats; 'We come as friends... or we shall smash you!' For four days and nights PCJ reported the coming of the hordes and the stubborn resistance of a small army that fought bravely to stem the onslaught of a vastly superior enemy.

Then came the blow that shook the earth for miles... PCJ was blown up in the air by ourselves – rather than let it fall into the hands of the enemy! And, what was not destroyed by the explosion was consumed by the flames of a roaring fire. Our pride, the big rotating beam antenna – the only one in the world – a masterpiece of skill and engineering, lay pole-axed along the ground. After 12 years of shortwave pioneering and goodwill programs to the world, PCJ, the 'Happy Station' was no more...

"'Vat happened here,' asked two Nazi officers who came to see the destruction. 'Oh, someone must have pushed the wrong button,' I suggested, wild with rage inside.

"'The 'rong button?...what do you mean?,' giving me a dirty look. He pointed to the sky where a squadron of German bombers flew in a westerly direction. 'See that,' said the German. 'They are heading towards England and in a few weeks we'll be standing on the ashes of London.'

"'Sez you!,' I thought, while trying to find a German equivalent, which I did not. Instead, I simply said, 'I doubt very much you will ever get there!'

"The war went on and the Gestapo moved in. PCJ had to be rebuilt by forced labor, to pump the German propaganda overseas. That's when yours truly beat it, retiring from radio for the entire period of the war. A broadcaster became a listener, outside listening in.

"Shortly before the (D-day) invasion came in 1944, a storm swept through the high antenna masts of PCJ's rotating beam, putting the directional mechanism on the circular rails out of order. Through clever sabotage of the engineers, the mechanism proved irreparable with the result that for the remainder of the war, all Nazi broadcasts were directed at the North and South poles, where polar bears enjoyed excellent reception!"

Startz goes on to say that with

the Allies closing in, the retreating enemy in 1944-45 demolished PCJ again. After the war ended, the engineers rebuilt the station in record time and once again the Happy Station could bring the world "the well-known spirit of Peace, Cheer and Joy (PCJ) – thanks to the great Allied Victory".

Philips During the War Years

So, that answered my question as to why any reference to PCJ or Hilversum or Huizen was missing on the tuning scale of the USA-made Philips radio. It turns out that the Philips company had considered the possibility of a Nazi invasion. Its chairman, Anton Philips, had, in the late 1930s, placed 89% of Philips' shares in a holding company and had moved the company's legal home to the Netherlands Antilles island of Curaçao off the coast of South America. Another six percent, though some sources say nine, was under the control of the General Electric company in the US. Philips also had prewar agreements with RCA. Philips created a US trust at the Hartford Bank and Trust Co., to hold majority interest in its North American division which manufactured products for the western hemisphere and Portugal.(1) A separate British trust handled its British division.

At the start of war, Anton Philips, along with his son-in-law and some board members, fled with company capital to England and then to the United States. His son Frits stayed in the Netherlands and managed Philips during the occupation and the forced labor requirements of the enemy. Frits was arrested and placed in the SS-run concentration Camp Vught in the Netherlands from May to September of 1943 because of a strike at the Philips plant, broken only by the threat of execution of Frits and fellow managers. He was honored by Israel's Yad Vashem Institute as one of the "Righteous Among the Nations" for risking his own life and liberty to save the lives of 382 Jewish employees by convincing the Nazis that they were of critical importance to production. (2,3)

With the approaching Allied armies in late 1944, Frits went underground to keep from being forced to go to Germany. His wife was imprisoned in the Vught camp to draw him out of hiding, but her faith sustained her. She was released and both made it through the ordeal. After five long years of occupation, and the lives of 300,000 Dutchmen, Allied victory in Europe came in May, 1945.

PCJ verification card (QSL) from 1929. (Courtesy of the Committee to Preserve Radio Verifications, Library of American Broadcasting, University of Maryland, College Park)

My Philips radio was likely produced in 1941, probably for the 1942 model year. Like automobiles, production for the 1942 model year would have started in mid to late 1941. The Japanese bombing of Pearl Harbor marked the entrance of the US into World War II and the end of civilian radio manufacturing, including that of Philips in the USA.

A Radio for Tropical Export

From its design and construction, the Philips-USA radio was clearly intended for export to tropical climates. It can be operated on a variety of socket voltages, from 110 to 245 volts. It has an insulated and sealed audio output transformer which is mounted on a phenolic base and has a DC bias on its core, by way of a high value resistor to B+. That would be of benefit in high-humidity climates. It also has a tuned RF stage for sensitivity. Like the typical European-designed radio, it has banana jacks for headphones or external speaker, antenna, and for phono input.

The radio was likely intended for the Dutch East Indies which, prior to the Pearl Harbor attack, had not yet been invaded by the Japanese. The radio was also intended for the islands of the Dutch Antilles and the neutral countries of South America and Portugal. I contacted some Dutch sources for information, but they did not know where in the US it was manufactured, or by what cooperating companies. It was suggested that it may have been General Electric, possibly on Long Island, New York. That is plausible given the stake that GE had in Philips. The board members had moved to New York City after coming to the US. Philips also had, since 1934, owned a factory in Mt. Vernon, New York, as the Philips Metalux Corporation. A later Philips portable radio is a near-identical copy of one marketed by Andrea Radio of Long Island New York, another possible connection.

Radio Repairs

The radio I had needed considerable work for restoration but I did not have a schematic or other documentation. Besides needing capacitors, the set had several power resistors that had drifted considerably and were replaced. The volume control was frozen on its shaft. The control has a fixed tap and would have been difficult to replace. I removed the control, clamped its shaft in a vise and, with some "Liquid Wrench" penetrant, finally freed its corrosion-welded shaft.

The tuning capacitor had a couple of points where the blades shorted. I managed to find those points and separate the blades to eliminate the problem. The dial cord was missing. I determined its likely path and replaced it. The spring-loaded band indicator was difficult to set accurately. It is activated by a separate dial cord but the length of the cord has to be exact to properly indicate the bands. After

several trial and error attempts, I finally managed to get it right.

Dial Scales and More History

It turns out that Philips-USA made a number of radio models during 1941 as listed on the **RadioMuseum.org** site. Several models on that site are listed as having been made in 1941 and 1946 or 1947, but with a couple of question marks behind the years. My set, the 436-AN, is listed as "1941?" Model 594-AN has a similar design, but is listed as "1947??" The pictures at the RadioMuseum site show the dial scale for that model. The scale includes "Berlin" as one of the stations, making the 1947 date improbable.

On April 25, 1945, the Russian army on the way to Berlin blew up the antennas at the Nauen transmitter site and dismantled the transmitters. Nauen is located about 40 kilometers to the west of Berlin and would soon become part of Soviet-controlled East Germany. Shortwave facilities at Zeesen were also dismantled in 1945. The DDR (East Germany) in 1956 resumed shortwave broadcasts and, in 1959, the Nauen site was increased in power for international shortwave service as Radio Berlin International. In the Federal Republic of Germany (West Germany), regular shortwave programming started again in 1953 as Deutsche Welle with headquarters in Cologne.(4) But, there was no international shortwave broadcaster in Berlin in 1947.

The Happy Station Today

Radio Netherlands Worldwide continued the Happy Station program after World War II. After repairing and aligning the Philips radio, I tuned into shortwave with the set working well. There is still plenty to listen to but alas, Radio Netherlands ceased its English and Dutch shortwave broadcasting in 2012. According to its editor-in-chief's message on New Year's Day 2013, "The era of short-wave radio is behind us." The website and its video clips have shifted focus to the news and social politics of the third world. The Happy Station of the golden age of shortwave is no more, although a non-affiliated podcast program by Keith Perron and friends is still available weekly. (5)

I personally prefer a happy message of peace, cheer, and joy and have good memories of listening to the Happy Station program of years past with Freddie Startz, a

Philips 436-AN Radio (Courtesy: Rich Post)

TSM's Radio Time Machine

The following vintage audio clips from radio station PCJ are made available courtesy of Keith Perron's PCJ Media. Click on the speaker of the radio icon for audio. To cancel audio, right click and choose "disable content."

Philips Radio PCJ 1929 – Part of a live broadcast concert of the Royal Concertgebouw Orchestra.

Philips Radio PCJ 1929 –
Start of the broadcast in Dutch.

Philips Radio PCJ 1930 – Part of a concert broadcast live of the Royal Concertgebouw Orchestra.

Philips Radio PCJ 1932 – Live recording of a music group on the streets of Amsterdam.

Philips Radio PCJ 1935 – Original 78 RPM of Happy Station Show sigature tune.

Philips Radio PCJ 1936 announcer - Mr Wyburn - doing a call out to listeners.

Philips Radio PCJ 1937 – Nice Cup Of Tea.

Philips Radio PCJ 1937 announcer Mr Wyburn – speaking to a listener who was visiting Holland. She is broadcaster Iris Greenham from Melbourne, Australia radio station 3KZ.

Philips Radio PCJ 1938 – Eddy Startz – Three different intros for Happy Station Show in English, Spanish and French.

Philips 6SQ7 "Made in USA," one of three Philips metal tubes in the set. Tubes are coded N2E. (Photo by Rich Post KB8TAB)

shortwave legend who retired in 1969, and Tom Meijer, who continued the program until 1993. Some Happy Station anniversary programs are on the net in MP3 format. (6) I think I will feed my Part 15 broadcaster with those MP3 programs and refresh some of those memories.

Notes

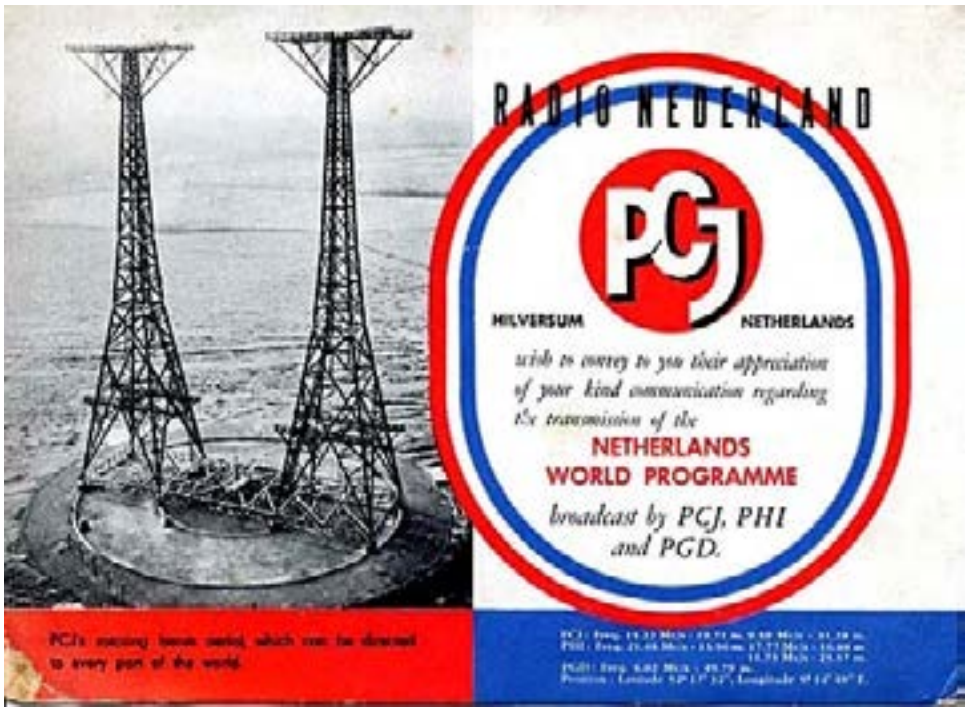
(1)*For more on Philips' investments in the USA, see The History of Foreign Investments in the United States - 1914 to 1945, by Mira Wilkins, Harvard University Press 2004*

(2)*Frits Philips' obituary has a good review of his life -* <**http://www.renewalarts.net/node/25190**>

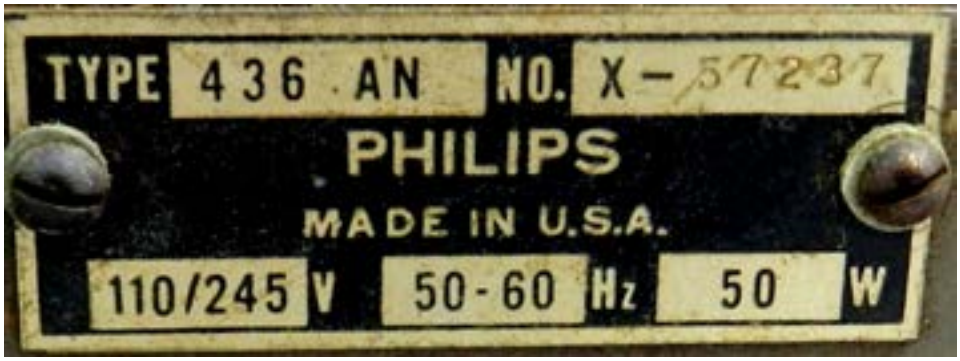
(3)A *Dutch-language website of the "Philips Kommando" factory inside the SS concentration camp Vught is at* <**http://www.philips-kommando.nl/grijs_kort.html**> *detailing the work and special status of prisoners. Drop the url into Google translate for an English version of the page.*

(4) *For more on postwar shortwave broadcasting from Germany ,see History of International Broadcasting - Volume 2, by James Wood, The Institution of Electrical Engineers, London 2000*

(5) *For current Happy Station podcasts, see* **http://pcjmedia.com**



QSL from PCJ showing the rotatable beam antenna at Huizen, Netherlands. Courtesy of the Committee to Preserve Radio Verifications, Library of American Broadcasting, University of Maryland, College Park.



The author's Philips-USA radio model 436-AN with a closeup of the radio's "Made in USA" label showing serial number and voltage options.

About the Author:

Richard Post's interest in electronics and radio started at age six when a friend showed him how to light a bicycle bulb using a worn lantern battery. As a teenager he 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**

Rich's previous work in Monitoring Times included feature articles "Sixty Years of Lafayette Radio "(December, 2012), "The Lafayette Radio Surprise" (April 2013) and "The Heathkit Legacy" (July, 2013) among others. Look for more in-depth articles about radio and history from Rich in future issues of The Spectrum Monitor. **TSM**

Geek's Guide to Radio

Meet the Original Makers, Hackers and Fixers

By Kirk Kleinschmidt NT0Z

Funcube Dongle Pro Plus, turns your computer into a receiver capable of tuning 64-1,700 MHz. (Courtesy: Howard Long G6LVB)

Creating "impossible" new devices with futuristic, homemade tools; cleverly re-purposing perfectly good hardware; relentlessly repairing cherished devices in the fight against planned obsolescence; getting together to share the tech and the joy of unchained creativity: Surprise! Radio amateurs – the original makers, hackers and fixers – have been doing these things for more than 100 years. It's time to meet and mingle!

Not too many years ago, being a computer nerd, a hacker – in the proper, non-criminal sense – or an electronics tinkerer who built stuff from scratch and fixed stuff other people had discarded, wasn't cool. A geek might have been president of the Audio Visual Club in high school, with complete dominion over film projectors, PA systems and even the wireless microphones used on stage by the much cooler kids in the dramatic arts department. But, nerdy AV guys didn't get the girls, and the nerdy AV girls, well, they hadn't even been invented en masse!

As the personal computer revolution took hold in the late 70s and early 80s, nerdy types started to gain social standing, but just barely. With the help of high-grossing films such as War Games and Back to the Future (analog, shot on primitive polyester film, no less!), geek-cred started gaining ground and making inroads into an emerging social fabric that was embracing technology in new and promising ways.

In the 1990s and the early part of this century, computers, tablets, cell phones, iPods and the like put geeky types on a new pedestal. High-tech stuff became ubiquitous in daily life, business, education and entertainment, high-tech "skillz" were prized and "1337-speakers" (short for "leet" or "elite" for the hopeless squares in the room) everywhere were now soaking up praise, making the big bucks and getting the girls (or guys, whatever).

Just look at Steve Jobs, co-founder of Apple. He dropped acid in the post-Jimi Hendrix era, didn't have any trouble with the ladies (even as an uber-geek, if you believe his autobiography), came to essentially define our modern high-tech era and built (with a little help) the highest-valued company the world had ever known (2012). Even Microsoft founder Bill Gates – who has never been cool – got the girl (he's married), and Steve Wozniak, the demigod who designed the first two Apple computers and is practically worshiped the world over for his awesome nerdiness, recently dated comedian Kathy Griffin and competed on Dancing with the Stars (he's also married). Definitely cool.

No Doubt about it – Nerds Rule!

Today, with 30+ years of personal computer technology under our belts, the nuts and bolts of the digital technology that makes everything happen are now available to everyone from kindergarten on up and are no longer the exclusive domain of big companies and degreed engineers.

Kids of all ages, with a design or engineering bent, who used to be limited to playing with Lincoln Logs, Erector Sets, chemistry sets and Legos (all still available) can now play with digital, computer-inspired toys (tools) such as 3D printers, tabletop CNC mills, tablets, ultra-tiny PCs (Raspberry Pi, BeagleBone) and bare-metal digital development platforms (Arduino, Funduino, Chipkit and many others).

Using these newly accessible technologies and plenty of "interconnects" (wireless, USB, infrared, HDMI, serial, parallel, NFC, RFID), modern hackers, like you, me and the kids down the street, invent, create and re-purpose electronic stuff to suit our needs, interests and moods. Open-source software and hardware, while not exclusive, point the way forward.

Modern hobbyist hackers delight in figuring out how to do whatever they need, helping others do the same, and they band together for support, education and camaraderie. Furthering their efforts are websites, TV shows, podcasts, magazines, entrepreneurial companies, evangelists and visionaries, all loosely championed by the Maker Movement and abiding by the unwritten tenets of Maker Culture (the

technology-based evolution of time-tested DIY culture).

Makers have collaborative workshops called "hackerspaces" (**hackerspaces.org**), and regular get-togethers and expos called Maker Faires (**makerfaire.com,** the largest of which drew 120,000 attendees in 2012). MAKE magazine (**makezine.com**) leads the charge, but dozens of publications and websites provide a tremendous amount of information and resources. Just like amateur radio! Say what?

Hams and Makers: Brothers from another Mother!

For more than 100 years, radio amateurs have been making, hacking, fixing and meeting in all of the same ways, for all of the same reasons. By virtue of a century's head start, the amateur radio "movement" predates the modern Maker Movement by about five generations.

The superhighways that makers speed down today were hacked out of raw jungle by their radio amateur ancestors. As a proud ham I mention this in the spirit of friendly competition and one-upmanship (makers and hackers embrace these as core values, as do hams), but mostly to encourage the two groups to meet and mingle!

Modern makers and radio amateurs are practically indistinguishable, yet amazingly, both groups at large don't know all that much about each other. We share the same interests, ethos, tools and technologies, though, so let's get together and see what happens. If you're a modern maker, fixer or hacker, ham radio is highly compatible, and offers a ton of unique benefits and resources (and vice-versa). We have more in common than you might think!

Parallel Evolution

In a certain sense, even the evolution of radio and computers has taken parallel paths (that have now completely merged). Not much more than a century ago, radio made the leap from the laboratory to the living room, and in doing so, it revolutionized entertainment, the way we acquire news and information, politics, religion, law enforcement, the way we fight wars, you name it.

By modern standards, early radio gear was primitive and barely adequate, as was our understanding of circuits, antennas, propagation and even the planetary physics that made radio possible. Much like early computers, radios that were more complex than crystal sets needed power-hungry vacuum tubes and large components.

Using modern material and superb craftsmanship, Dave Schmarder N2DS shows how he keeps "old school" radio construction alive. This is his #66 crystal set. Full details on this high-performance set, including schematics and more photographs are found at http://makearadio.com/crystal/66.php. Dave retains the original "breadboard" design on which the components are mounted. This radio is powered by the energy of the radio signal it is receiving. (Courtesy: Makearadio.com)

Although we're used to compact, powerful PCs, cell phones and tablets, let's not forget that the first computers were similarly large, required an immense amount of electrical power, had laughable capabilities and only a handful of scientists and engineers could make them work. ENIAC, for example, the first general-purpose, programmable computer, was built in the mid-1940s and contained more than 17,000 vacuum tubes, weighed 27 tons, and consumed 150 kW of power! Ignoring tube failures and other maintenance costs, just powering ENIAC today would cost about $20 an hour!

On a relative performance scale, ENIAC managed 0.05 MIPS (million instructions per second). The first PC I ever ripped apart, a 1983 Commodore 64, raced ahead to about 0.2 MIPS. A 1985 Cray supercomputer topped 850 MIPS. A modern quad-core, Intel CPU-based PC reaches 6,000 to 30,000 MIPS, depending on a program's ability to efficiently use multiple compute threads/CPU cores.

The numbers for modern PCs don't correlate exactly when directly compared against ancient systems, but the numbers are revealing, despite being relative and "fudgy." The 1985 Cray supercomputer, by the way, cost a cool $10M. Your kid's $350 iPad 2 has about the same performance (as long as you don't need the sustained memory bandwidth that only supercomputer architectures can offer)!

The original IBM PC's CPU ran at 4.77 MHz, while modern high-performance CPUs can run at 4.77 GHz – a thousand times faster (ignoring further performance boosts from efficiency, multiple CPU cores per chip, microcode, etc).

Interestingly, our society's use of radio itself has seen a similar evolution. Early radio, like early computers, was hampered by technological limitations, and even with the best equipment available, radio signals were "in the basement" at VLF (500 kHz and down). Much like ENIAC, generating a usable radio signal "down there" required large, high-power equipment, massive antennas and a swarm of scientists and technicians.

From the 1920s through the 1960s, frequencies below 500 kHz were mostly used for maritime radio circuits (mostly Morse code), and later for aircraft, nautical navigation and submarine coms. When broadcasting took off in the 20s, spectrum space between 500 kHz and 1,500 kHz (0.5 to 1.5 MHz) was set aside to create the AM broadcast band. Because

This may not be what you had envisioned when you thought about modern radio design, but nothing is more modern. This is the hardware side of the WiNRADiO WR-G31DDC Excalibur Software Defined Radio (SDR). (Courtesy: WiNRADiO)

Here's the display side of the WiNRADiO G31DDC Excalibur Software Defined Radio. With a frequency range of 9 kHz to 49.995 MHz with 1 GHz/s search speed, 50 MHz wide real-time spectrum display and built-in audio recorder with a USB 2.0 interface, this is state-of-the-art radio today. (Courtesy: WiNRADiO)

early experimenters were largely unable to generate and detect usable signals on higher frequencies, the "shortwaves" were relegated to amateur radio and military experimentation.

The wavelength of a radio signal, the physical "length" of one complete "cycle," is inversely proportional to its frequency, so VLF signals are called "longwave," the AM broadcast band is called "medium wave," and the frequencies from 3 to 30 MHz are called "shortwave."

The higher the frequency, the smaller its wavelength. Ironically, governments and corporations in that early era gave the "garbage frequencies" (the short waves) to hams because they couldn't imagine they'd ever be usable or commercially viable!

Early ham makers and hackers discovered most of the "radio" that we now take for granted: ionospheric and atmospheric signal propagation characteristics of the various shortwave frequency bands; how to build stable, high-frequency oscillators and detectors; the physics of antennas and directive arrays; how to add useful information to the radio signal itself (modulation and demodulation) and more.

Early radio started out in the low kilohertz, but modern radio systems (like the 802.11x radios in your network's wireless router), operate in the 5-GHz microwave band. Cell phones, satellites and sensors (from medical to military) operate from 1 to 40 GHz, and we're still only beginning to understand the characteristics and the technology required to exploit "terahertz" radio/optical systems (the mysterious part of the electromagnetic spectrum where radio transitions to light). Near-future, non-invasive, Star Trek-style medical scanners will use terahertz radiation for real-time scans that won't give you cancer, so stay tuned.

It took radio over one hundred years to go from 100 kHz to 100 GHz. Where will computers be in another fifty years? We can only imagine!

Not your Grandfather's Heathkit

The image of a 1960s radio amateur using a Heathkit transceiver he'd just built from a kit to talk with fellow hams in New Jersey or Nicaragua, is cherished by most hams (denotes maker and hacker ethos, reminds us of a kinder, gentler era), but isn't necessarily representative of modern amateur radio. You can still chat with fellow hams in every state and most every country, but modern radios are now computers, just as modern computers are now radios! Let me explain.

A critical part of every computer is its clock oscillator, which provides synchronized timing pulses that coordinate ("clock") the functions of the microprocessor, the memory, and just about every other circuit and subsystem. No clock, no computer. The device that generates the clock signal – from the earliest PCs running at 4.77 MHz to modern enthusiast PCs "overclocked" to 4.77 GHz – is a crystal-controlled oscillator. Whatever its exact frequency, the clock signal is multiplied and divided as necessary to provide all required timing signals.

The clock oscillator outputs a square wave signal at radio frequencies (the fundamental and multiplied/divided harmonics and sub-harmonics), and the circuits on the motherboard and any attached cards or peripherals function as antennas, transmitting "RF hash" into the environment. In addition to their main functions, computers are powerful, unintentional radio transmitters!

The unwanted radio signals transmitted from computers and digital circuits (PCs, cell phones, tablets, TVs, washing machines, etc.), combined with the wanted radio signals emanating from such devices (wireless Internet, wireless USB, wireless chargers, Bluetooth, NFC), can create real spectrum pollution, especially in metropolitan areas. Computers are definitely radios, and that's not necessarily a good thing!

Software-Defined Radios: No Going Back

Radios, once purely analog like the Heathkit transceiver mentioned above, now use "conventional superheterodyne" circuits that are controlled by embedded microprocessors (computers); or they actually are computers with attached antennas! The software-defined radio (SDR) technology that has already revolutionized cell phone, military and PC/wireless "radio" is now sweeping through amateur radio and shortwave listener spaces. From now on, no non-SDR amateur radios will likely be designed or commercially manufactured. If you want a "classic radio" you'll have to buy a used one or build one yourself (as many hams do).

The SDR breakthrough, which

started in the laboratory in the 1970s and became mainstream in the middle of the cell phone revolution, involves using fast CPUs (and other specialty chips) to perform all of the functions required to transmit and receive radio signals (signal generation, modulation, filtering, demodulation, AGC, etc) in the digital domain with software. This makes for tiny, affordable, high-performance, feature-packed radios that older designs can't match.

The ability to operate CPUs and the special integrated circuits required for SDR at radio frequencies didn't exist in the earliest days of the computer revolution and, until recently, was so expensive it was used only by the military and three-letter agencies. The cell phone and wireless networking revolution changed that, and now that technology is reshaping amateur radio hardware.

By ham standards, though, cell phones have substandard receivers that are easily bested by 40 year-old conventional radios at shortwave frequencies. To make SDR accessible and affordable so far, intermediate designs using quadrature-sampling technology (QSD/QSE), where radio signals are converted to baseband before being processed by SDR circuits, have achieved wide acceptance by consumers and experimenters alike. High-performance QSD radios can be built for less than $50 (plus a PC, which you probably have on hand).

The final nail in the analog radio coffin, however, is the availability of affordable direct-sampling SDR hardware that operates directly at radio frequencies from 1 to 60 MHz, making baseband conversion unnecessary and keeping almost every "radio" function in the digital/software domain.

Using this approach, dubbed DDC/DUC (direct down-conversion, direct up-conversion), digital radios still need analog band-pass filters between the radio and the antenna, and still need RF and audio amplification, but the design of every internal function and process – modulation, detection, demodulation, AGC, equalization, filtering, display, user interface – can be defined by the builder. That's you, by the way! And, that's why hackers and makers the world over are jumping on the SDR bandwagon.

The affordable tools, designs and building blocks that hams are using to explore shortwave SDR are the same as those used by PC hackers and makers to explore Bluetooth, ultra-wideband, wireless networking protocols, and a whole slew of non-amateur digital radio. We're in the same sandbox, so let's play together!

Don't Wait!

I can't count the number of engineers, programmers and technical types I've met over the years who were introduced to amateur radio later in life (or who knew about it, but didn't get involved right away) and expressed regret about "missing out on all those years" that could have included time to explore the diverse aspects of amateur radio.

If you think amateur radio is still limited to the stereotyped guy on the cover of the 1968 Heathkit catalog (a stereotype that has never actually existed), you're in for a pleasant surprise! Now that radio and computer technology have completely merged, modern makers and hackers can access a century's worth of experience, hard-won information, time-tested circuits and construction practices – you name it – about the stuff they're already interested in but may not have known about!

And, don't forget to say hello to a million new friends in just about every corner of the planet! The ham community is your community, you simply may not have realized it until now.

Nifty Ham Radio Stuff

Because we're all makers, hackers and fixers, regardless of whether we're radio amateurs, I won't dwell on the stuff we already have in common. Becoming a licensed amateur, however, definitely provides easier access to a wide swath of experimental goodness, some of which is only available to licensed amateurs (legally, anyway).

And, don't let the "licensed" part scare you away. Although the "Heathkit catalog guy" had to take his license test at an FCC field office (often a hundred miles from home) and under the terrifying scrutiny of an FCC examiner, modern hams usually take their tests from fellow hams in their home towns. Multiple choice. All "question pools" freely downloadable. No Morse code requirement.

Getting your amateur radio license is so easy these days that many hams think it's too easy! Just get it and go. The rest is gravy. There are hundreds of books and millions of magazine pages devoted to ham radio stuff, including how to find fellow hams and local clubs, how to pass your licensing tests, build radios, make killer antennas, and much more. Do a web search, see the Resource Box or make your first stop **www.arrl.org**.

Microwaves, Digital Radio and the Ionosphere

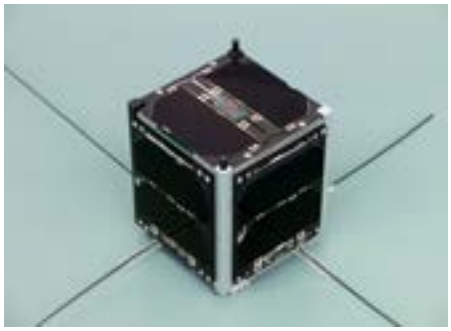
Like other specialized maker and hacker groups, hams do their "usual things" on a daily basis. Gamers slay digital dragons. Info junkies express cryptic tidbits via text or Twitter. Photographers create images, and so on. Hams, as the stereotype suggests, talk or "communicate" with other hams, across town or on the other side of the planet, using voice, Morse code, hybrid radio/Internet networks, television, or more modern digital (keyboard-to-keyboard) modes. On the surface, it's not too different from chatting, phoning or texting.

What is different is the way hams make use of the atmosphere, the ionosphere, the earth, the moon – even their own home-built satellites – in sending and receiving the radio signals that carry the desired information (voice, pictures, video, etc.)

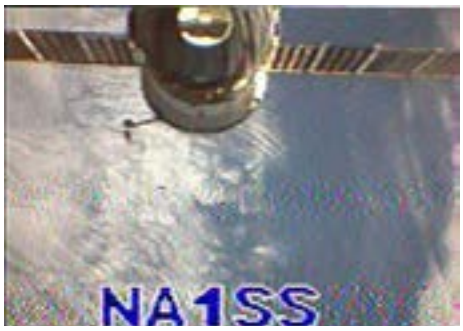
Remember the "garbage" frequencies given to radio experimenters in radio's earliest days (the frequencies from 500 kHz on up)? Signals at these frequencies, it turns out, can propagate from one location to another, often over great distances, in many unique ways. And, unlike the microwave signals from your cell phone or wireless network, which are typically limited to short-range, line-of-sight paths, shortwave signals can reflect off of the ionosphere, the earth itself, traveling hundreds or thousands of miles – or completely around the planet! They can also use certain types of weather fronts (called tropospheric ducting) to travel virtually unscathed for hundreds of miles, or be bounced off the surface of the moon by hams who use our closest celestial neighbor as a gigantic, faraway radio reflector. Some even reflect their signals off the dying trails of meteors!

Ham operators explore these phenomenon every day, and the complex interplay between the sun (which powers the earth's ionosphere, magnetosphere and weather) and the planet makes every day on the radio a little (or a lot) different than the day before.

It's always nifty to hack around



Ham toys: this amateur-built satellite is called FUNCube-1, currently in orbit, and it's an example of the technology hams are pursuing every day, just for the fun of learning.(Courtesy: Keith Baker KB1SF/VA3KSF Amateur Radio Satellite Corp.)



Hams in space: NA1SS is the call sign for US astronauts aboard the International Space Station. This slow scan TV (SSTV) image was grabbed by monitoring 145.80 MHz FM as the ISS zipped across North America at over 17,000 mph. (Courtesy: Ken Reitz KS4ZR)

with wireless networks, Bluetooth radios and the like, but in radio terms, hams hack the planet! Even after 100 years of study, there's plenty of fun – and plenty of science – to be done. And, if the moon is too far away, a swarm of tiny earth-orbiting satellites, designed and built by hams and universities (even one high school!), and orbited by governments and space agencies, is available for your enjoyment and experimentation!

Signal to Noise

Regardless of how a radio signal is generated and detected, the name of the game is the signal-to-noise ratio (SNR) of the radio link. If the signal can't be detected and demodulated, no information can be transmitted.

The first radio amateurs used CW (continuous wave) transmissions modulated with Morse code (still used today). In this system, the radio signal is simply turned on and off in an agreed-upon pattern. As it turns out, this system is very efficient and effective when it comes to SNR. Voice modes, which came later, first full-carrier AM and then suppressed-carrier single sideband (SSB), because they require much greater bandwidths, are much less efficient. The first digital data mode, radioteletype (RTTY), is more efficient than SSB, but not quite as efficient as CW.

For decades, every ham soon discovered that voice modes, more "natural" and convenient means of communication, required 10 to 100 times as much transmitter power compared to CW and RTTY, to achieve the same link quality. In the past 20 years or so, as computers and radio finalized their "merge," previously impossible digital modulation modes zoomed past CW and now provide "science fiction-level" performance when it comes to SNR. These keyboard-to-keyboard modes can transmit text and other digital data back and forth even when the noise is almost a thousand times stronger than the signal!

You might tune your receiver to a particular frequency and hear only static, but your computer, listening over your shoulder, might copy other station(s) plain as day. It's eerie, and it's just one of the most important areas in which "digital amateurs" and "radio amateurs" have combined their efforts to advance the state of the art. Better yet, these technologies are freely available to all hams, even beginners, are inexpensive, and they're used on the air every day, worldwide.

Applying these new digital modulation technologies to voice communication is the next big frontier. Chances are good that the breakthrough will come from the Hackerspace, perhaps even you!

Even though digital radio is the way forward, the ability to experiment with analog radio, audio and power circuits, in all of their "squishy," unpredictable, non-digital glory, is another great reason to get involved with amateur radio. Receivers and receiver designs from the 1920s and 1930s (even using primitive vacuum tubes, no less!), still work just fine, thank you very much, and are still used on the air every day. The same goes for triode-powered audiophile amplifiers, power supplies. It's all there for the taking (and experimenting).

Welcome Aboard

I've mentioned only a tiny fraction of the many aspects of modern amateur radio and the ways in which today's hams and today's makers and hackers are actually, and practically, one and the same. In addition to experimenting with electronics and communicating with other hams near and far, radio amateurs provide important public safety and emergency communications, compete against each other in organized and casual on-air competitions (similar to intramural and professional sports leagues), work toward awards and achievements of all kinds, and much more. Whether you're interested in retro circuits from a bygone era or in turning science fiction into reality, there's room for you in amateur radio. The people, clubs and organizations, whether local, national or international, are your kind of people.

Makers and hackers, meet your long-established ham neighbors. Hams, meet the new breed of makers and hackers. Surprise – you're one and the same!

HAM LINKS

ARRL/W1AW

www.arrl.org: The American Radio Relay League (ARRL) is the national organization for amateur radio in the United States, and a global champion of amateur radio worldwide. With headquarters in Newington, Connecticut, the ARRL is the world's largest publisher of ham radio books and magazines (of all skill and interest levels) and, thanks to its large organization of volunteers in every state, is pretty much "one stop shopping" when it comes to getting started in amateur radio, finding local hams and clubs.

The ARRL HQ station is W1AW and will operate this year using a special call sign granted by the FCC; W100AW.

The call sign reflects the ARRL's centennial birthday in 2014. The ARRL will be extra visible this year.

www.rsgb.org: Home of the Radio Society of Great Britain. The UK's national radio organization is one year older than its sister society, the ARRL. The UK is known worldwide for its ham radio makers and hackers.

www.ac6v.com: The web's largest aggregation of amateur radio links (exhaustive and still amazing, but some links are outdated). TSM

FAA's Next-Generation Air Communications

By Cory Koral K2WV

Beechcraft King Air 200 (Courtesy: Beechcraft)

When I was learning to fly back in the 1960's, radar was considered an advanced technology. Major airports had it, some enroute ATC centers had it, but there were many areas in the US with no radar coverage at all. In many cases, the enroute controller sat at a desk without a radar scope, and took reports over a VHF radio from aircraft passing through his sector. These aircraft would report in with their altitude, location the time they expected to be over a specific fix, and the time they expected to be over the next fix on their flight plan. The controller then jotted these times down on a paper strip which represented that particular aircraft and compared that time to other times reported over that same fix by other aircraft. If two aircraft reported the same ETA over the same fix, this indicated a conflict, and the controller would have to radio an alert to the affected aircraft, to avoid a collision.

Without radar the controller could not actually see these aircraft, so he was dependent on the pilots to provide him with accurate information. It's not hard to see why everyone wanted more radar coverage.

In those days, satellites, pocket calculators, and transistor radios were in their infancy, and there was no such thing as a personal computer. A computer was something that sat in a building at MIT, used thousands of vacuum tubes and wasn't even as powerful as one of our modern smart phones.

At that time, the thought of creating a satellite-based navigation system, combining it with the abilities of advanced computers and high speed data communications to enable a safer and more efficient flow of air traffic was pure science fiction.

The new NextGen air traffic control system promises to turn science fiction into reality, but can it really live up to its claims?

To understand NextGen, we first have to understand the system it's replacing. While we now have radar coverage virtually everywhere in the US, moving air traffic through the NAS (National Airspace System) requires a lot more than just radar monitoring. There is a complex system of airways, or established flight paths between radio navigation fixes, which must be monitored and maintained. Each aircraft flying on an instrument flight plan must be safely spaced away from other aircraft by altitude and timing along these routes. This aerial choreography requires considerable coordination with ATC facilities along the way, and the longer and more complex the route the longer it takes to issue a flight clearance through the system.

Using computers to assist in air traffic control operations is not new, however, the old computer system was not centralized. Back in the 1960s the longer the flight and the more legs involved the harder it was for a general aviation pilot to get a timely instrument flight clearance. I heard many stories of pilots filing an instrument flight plan, sometimes more than an hour before departure, only to have to postpone their departure because the clearance wasn't ready.

In some cases, pilots are told that the computer "lost their flight plan" (!) when they were ready to start engines and taxi out. This is inconvenient and stressful for both the pilot and controller. Also, aircraft which are delayed from their appointed take-off times will end up at the bottom of the list and have to start over.

Airline pilots didn't have this problem because they have established schedules and they have a team of people who make sure all of the details of the flight are taken care of weeks in advance.

An experienced airline pilot once told me that the quickest way for a general aviation pilot to get an instrument clearance was to plot a route that involved flying from one terminal radar approach control (TRACON) to another without having to get cleared through the enroute system. The departure controller would simply hand the flight off to the approach controller at the next airport, simplifying the process considerably. It worked, as long as each airport was close enough to have overlapping radar coverage. Another technique is to file only for one leg at a time, only requesting clearance to the next leg after landing at the end of the first leg. Obviously, there are huge limitations to these techniques

The other aspect of the old system are the instrument approaches themselves, which are divided into two categories: Precision and Non-Precision Approaches. A precision approach provides the pilot with horizontal and vertical guidance to the runway, and ILS (Instrument Landing System) has been the traditional method of doing this. ILS was developed during WWII and spread across the country in the 1950s. ILS provides horizontal guidance with a VHF localizer signal and vertical guidance, or glideslope, with a UHF signal, which is displayed in the cockpit as a vertical needle and a horizontal needle. As long as both needles are centered, the aircraft is on course to the runway.

A system of marker beacons, NDB's (non-directional beacons; aka outer compass locators), and later VOR and DME (Distance Measuring Equipment) fixes told the pilot how far he was from the runway.

If you are close enough to an airport with an ILS, you can hear localizer signals on 108.1 to 111.95Mhz. They are distinct, because each localizer is identified with an "I" transmitted before the 3 letter airport identifier in Morse code. For example, in the ILS approach chart shown for Rochester, NY (ROC), the localizer frequency is shown in the upper left box, identified as "I-ROC." The glideslope portion of the ILS transmits between 329.15 to 335.0Mhz and is unidentified.

If you want to have some fun, go to **http://flightaware.com** and punch in your local airport name or identifier under "Airport Tracker/Info" on the lower left side. Then click on "View Info." Near the top of the page, click on "IFR Plates." This will bring up all the published instrument procedures for your airport, and in some cases, instrument approaches for nearby airports. Approach charts or "plates" are a great way to tune in all the navaids in your area and they can be downloaded free of charge!

A non-precision approach, on the other hand, uses existing navaids, such as NDB's and VOR's to provide horizontal guidance, however, vertical guidance has to be calculated. For example, if there was a VOR station on the airport, the pilot would fly over the airport VOR station and then fly outbound for two minutes. He would then reverse course, and set his timer to two minutes inbound, while he descends to his MDA (Minimum Descent Altitude). At the end of two minutes if the runway was not in sight he would execute a MAP (Missed Approach Procedure).

As you can imagine, a non-precision approach is not nearly as accurate as a precision approach. Because of this higher cloud ceilings are required to fly the approach: typically 700 to 800 feet AGL (Above Ground Level) for a non-precision approach and vs 200 to 400 feet AGL for an ILS approach. If the glideslope portion of an ILS was out of service it would be considered a non-precision approach. Since the localizer signal is more accurate than most other forms of horizontal guidance, a lower ceiling would be allowed but not as low as a full ILS approach

Despite the higher minimum weather requirements the majority of CFIT (Controlled Flight Into Terrain) accidents occur on non-precision approaches. A friend of mine was flying for a commuter airline some years ago. When doing a non-precision approach into a town in Pennsylvania at night using the reported wind speed and direction from the nearest weather reporting station, he correctly calculated how many seconds to time his approach before his MAP. When he thought he had sixteen seconds to go, the aircraft impacted higher terrain near the airport. Miraculously, no one was killed, but my friend was seriously injured. What he didn't know was that the nearest weather station reported a headwind; where he was the wind was a *tailwind*. There are so many things like that on non-precision approaches that can go wrong, that I call them "Russian Roulette" approaches and look forward to the day when they will be completely phased out.

Air Monitoring Glossary

NDB - Non-Directional Beacon.

One of the very first radio navigation aides for aircraft, it was a major leap over following road maps during the day and bonfires at night during the early air mail days. It consists of a simple ground based radio transmitter operating between 190 and 1750Khz, and an aircraft based Direction Finding (DF) receiver.

Because of the Low Frequency of this system, beacons could be homed in from great distances. The early models consisted of a loop antenna mounted on top of the aircraft, which the pilot would swivel manually to determine the bearing to the NDB. Later models were called ADF receivers because they automatically displayed the bearing by an arrow on an instrument face. NDB couldn't tell the pilot where he was in relation to the station, only his bearing from the aircraft to it and whether he was flying to or from the station. There was no distance information. The only time the pilot knew where he was when he passed over the station and the needle reversed. Most NDBs are incorporated into ILS approaches and act as outer compass locators giving the pilot another indicator that he has passed the outer marker portion of the approach.

VOR - Very high frequency Omnidirectional Radio Range, or "omni".

This ground station transmits from 108.0 to 117.95MHz and puts out a different phased signal, or radial, to the aircraft depending on where the aircraft is in relation to it. With a VOR receiver, the pilot can actually turn a knob and see what direction he is from the station, not just his bearing to the station, a major improvement over NDB. He can navigate to the station without having to calculate wind compensation, in fact, he can even determine the wind speed and direction based on the corrections needed to stay on a VOR radial, or course. Each station identifies itself with a 3 letter Morse code identifier. On the ILS chart for the Rochester VOR is on 110.0Mhz, identified as "ROC."

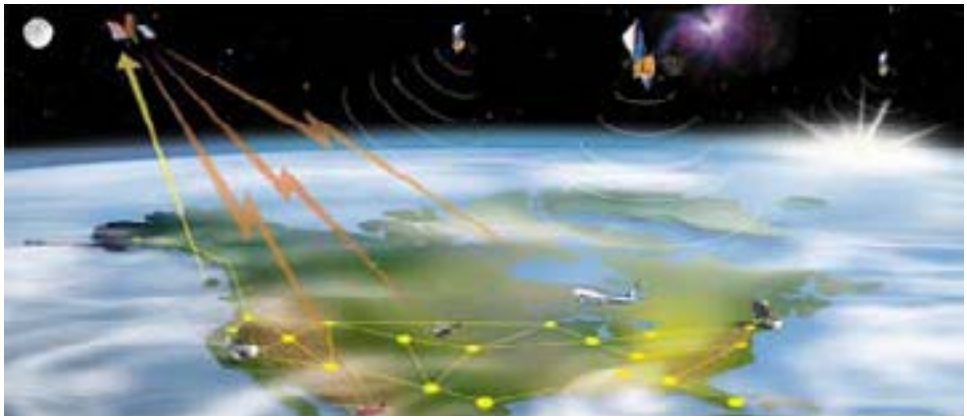


Diagram of Wide Area Augmentation System (WAAS) and 38 designated US ground stations. (Courtesy: FAA)

So why hasn't ILS taken the place of non-precision approaches long ago? Because an ILS approach requires a long, straight-in approach which is not always possible at some airports. Also, each runway requires it's own ILS equipment, and installing and maintaining the ILS equipment is very expensive, something few small airports can afford.

GPS approaches have the potential to solve this problem, however, it's been a long time coming and we have years yet to go before non-precision approaches can be eliminated entirely. Why? Because initially, the GPS signal was degraded for fear it could be used by incoming Russian ICBM's. But even after the fall of the Soviet Union, with the degraded signal restored, the accuracy was only 49 feet, not enough for an instrument approach.

If a GPS satellite develops a problem it has no way of alerting the user that the integrity of the system has been compromised; not something a pilot would want to encounter on an instrument approach. Surveyors have been successfully dealing with the accuracy issue for years by leaving a GPS receiver in an exact location for a period of time and letting it fine tune its position. However, a moving aircraft does not have this option.

WAAS Happening?

To address these issues, WAAS (Wide Area Augmentation System) was developed. It consists of 38 precisely surveyed ground stations in the continental US each of which receives the GPS signal and compares it to their exact location. Any inaccuracies are transmitted to master stations which then uplink the corrected information to geostationary WAAS satellites every 5 seconds. The WAAS satellites then broadcast the correction messages back to aircraft with WAAS-enabled GPS receivers. Nearly all aircraft GPS receivers are now WAAS-enabled and the accuracy is 25 feet or better.

Also, if the integrity of a GPS satellite is compromised it can relay a warning to the pilot within 6.2 seconds. Since the most common error is caused by "ionospheric billowing," which is random, constant corrections are needed.

Other countries have their own versions of WAAS. In Europe, it's called EGNOS (European Geostationary Navigation Overlay Service), in India, GAGAN (GPS Aided Geo Augmented Navigation), and in Japan, MSAS (Multi-functional Satellite Augmentation System). Commercial systems include StarFire and Omni STAR.

LAAS

It took eight years from the initial contract to develop WAAS to the first commercial flight to use it in an approach in March, 2003. In the meantime, an even more accurate means of correcting GPS signals has been developed, called LAAS, or Local Area Augmentation System. LAAS uses receivers placed around the airport to transmit correction signals to a central receiver, and uplinks the corrected GPS signal directly to the pilot via VHF data link. Unlike WAAS which covers most of North America, LAAS covers only the area within 23 miles of the airport, but is so accurate it can be used by properly equipped aircraft to land in zero visibility.

Integrating accurate GPS into the navigation system through data transmissions greatly enhances the flow of air traffic, allowing more traffic to be handled safely in the same amount of time without the inaccuracies and terrain-blocking limitations of radar. This integrated system, called ADS-B (Automatic Dependent Surveillance Broadcast), sends GPS position reports from aircraft which display on the controller's screen much more accurately than radar. Precision approaches can be made to small airports without the cost of installing and maintaining an ILS, and curved approaches can also be used saving time and fuel. Step down approaches, where an aircraft follows a pattern of incremental descents based on its position over various fixes or waypoints, can be simplified with one smooth "trajectory based" approach. Since the rate of descent is constant, there is no need to level off and burn fuel to maintain altitude. United Airlines studied the approaches to Denver and calculates they can save 200 pounds of fuel per approach using continuous descent approaches. And, because of the precision of ADS-B, aircraft can follow more independent routing to and from the airport, rather than overfly an established fix.

COST

At $100,000 to $400,000, ADS-B ground stations are simple and economical compared to $1-4 million for radar installations, and there is much lower maintenance, less power required and less

TACAN - Tactical Air Navigation is the military's version of VOR. Basically, the only difference is that the signal is transmitted on UHF (960 to 1215Mhz) rather than VHF. When a TACAN is co-located with a VOR it's called a VORTAC.

VOR / DME - A VOR with Distance Measuring Equipment installed giving the pilot distance information from the station, provided the pilot has a separate DME receiver in the aircraft. DME transmits between 962 and 1213Mhz.

FIX - or Position Fix. A location, usually on an established airway, determined by a cross bearing from two different stations. Some good examples are: MONCK, SUUSA, and BILAW are all position fixes on the approach from the Geneseo VOR. MONCK is on the 343 degree radial, SUUSA is on the 034 degree radial, and BILAW is on the 051 degree radial from GEE VOR.

building and site space required.

Centralized computer systems with ADS-B can issue clearances much more efficiently. If there is a weather problem along a route, alternate routes can be suggested to the pilot before he takes off. Frequency congestion can be greatly reduced by uploading clearances and weather information directly to a display in the cockpit.

As more aircraft upgrade to the system, separate clearance delivery and ATIS frequencies could become a thing of the past. Movement of aircraft on the ground can be more closely monitored resulting in fewer delays going to and from the runway and reducing the possibilities of runway incursions.

NexRad (Next-Generation Radar) is the latest high resolution S Band Doppler weather radar developed by the National Weather Service and consists of 159 sites across the country. It provides much higher sensitivity, resolution and range than the previous weather radar, and it is expected to be upgraded to an even more sophisticated phased array system by 2020. NexRad radar is one of the resources which will be integrated into CSS-Wx (Common Support Services -Weather), part of NextGen. Data can be uplinked to the cockpit to be shown on the pilot's moving map display. Previously, pilots would have to subscribe to a weather radar service to uplink while airborne, but with NextGen it is provided free of charge.

Virtual Control Tower

NextGen has the potential to provide all of these things, completely rejuvenating the way air traffic is handled. One of the more interesting applications of NextGen is called Virtual Control Tower. Instead of building a control tower and staffing it, cameras and other sensors located on the airport send their information to a controller in a remote location who handles the air traffic as if he were there.

This system also allows controllers to move virtually around the country to help out other ATC sectors when there is a peak demand without physically leaving their home base. A controller in New York City, for example, could control air traffic in Miami simply by sitting in front of a screen displaying Miami air traffic.

All communications and data would be uplinked and downlinked in real time. Saab's r-TWR video is a good example of how one such system works: http://www.saabgroup.com/en/Civil-security/Air-Transportation-and-Airport-Security/Air-Traffic-Management-Solutions/Remote-Tower/. This system is currently undergoing development trials in Sweden and Norway.

How ADS-B Works: The aircraft determines its position through GPS; that position is downlinked to a ground station to be added to other data and rebroadcast to all ADS-B equipped aircraft. (Copyright Air Services Australia, used by permission)

There are no Virtual Control Towers operating in the US, however some smaller US airports are applying to be the first to do developmental testing.

With all this promise, could there be a downside to NextGen? Yes.

For one thing, aircraft are not required by the FAA to have ADS-B-Out, the most rudimentary form of ADS-B, until 2020, and there is no mandate requiring ADS-B-In equipment, a more sophisticated version. In the meantime, aircraft with any ADS-B version will not always be able to receive traffic information from non-ADS-B equipped aircraft.

Many of the other aspects of NextGen, such as the central computer system known as SWIM (System Wide Information Management) are under development and will take years to fully implement, even when fully funded.

According to Transportation Department Inspector General Calvin L. Scovel III, an FAA internal study concluded that the NextGen program could be ten years late and cost two to three times the $40 billion price estimate. Meanwhile, air traffic control facilities are getting the budget axe.

STARS, the Standard Terminal Automation Replacement Systems update of air traffic control equipment, which was started in 1999 was to be finished by 2017 and cost $438 million, but the update is now uncertain because of costs and scheduling.

The En Route Modernization System, replacing and enhancing air traffic control software, was to be done in 2010 for $2.1 billion, but has been pushed back to 2014 with $330 million in added costs.

NextGen was to be in place by 2025, but Scovel said, "2025 is off the table."

According to an Associated Press article, "Delays, Problems Plague Transition to Satellite-Based Air Traffic Control System," published in the *Washington Post* Oct. 31, 2013, the predicted increase in passengers, has not materialized. "The one billion passengers a year the FAA predicted by 2014 has now been shoved back to 2027. Air traffic operations...are down 26 percent from their peak in 2000..."

According to Christopher Oswald, Vice President for Safety and Regulatory Affairs at Airports Council International-North America, "In the early stages, the message seemed to be that NextGen implementation was going to be pretty easy: You're going to flip a switch, you're going to get NextGen, we're going to get capacity gains. It wasn't realistically presented."

Air Line Pilots Association First Vice-President Sean Cassidy, who helped draft the recommendations, said, "You

can't have an infrastructure project that is the equivalent of what the (interstate) highway program was back in the 50s and the 60s and take this *ad hoc*, hodgepodge approach to moving this thing forward,"

I posed the following questions about NextGen to Tom Kramer, Manager of Airspace and Modernization for the Airplane Owners and Pilots Association (AOPA), the largest general aviation organization in the US:

Is AOPA satisfied with the progress being made to implement NextGen?

Kramer: "NextGen is a complex initiative that is fundamentally changing the way aircraft navigate and the way controllers manage aircraft movements. As such, NextGen has experienced significant delays and cost overruns on several NextGen systems. Much of the issue is prioritization of NextGen components.

"With limited resources, the FAA should prioritize those initiatives that provide the greatest benefit in the shortest amount of time to all airspace users. This will help encourage acceptance and equipage by aircraft operators to comply with NextGen requirements and realize the benefits."

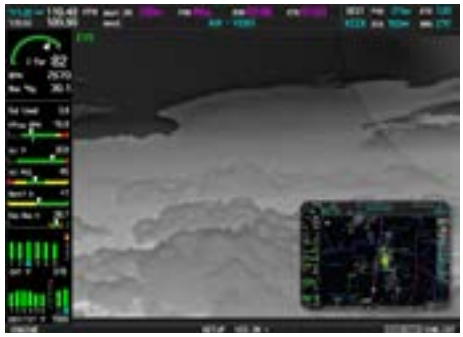
Do you think it will result in the safer movement of more aircraft?

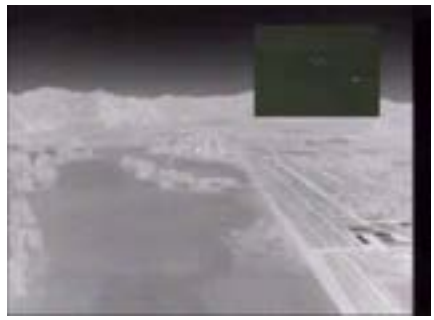
Kramer:"Potentially. NextGen should offer more precise and timely exchange of information between the ground and the cockpit. The devil is in the details and AOPA is working to ensure that NextGen offers an operational benefit for general aviation; in terms of safety, access, and efficiency."

Do you think there are other systems or methods that would accomplish the same thing with less cost?

Kramer: "NextGen is a system of systems. Within the collection, AOPA believes that some systems offer greater benefit than others. Some systems do not appear to provide significant value to any operator, or will not realize any benefits for decades. The FAA could better prioritize NextGen systems to maximize the agency's resources and provide the greatest benefit to all users."

Are you concerned about the safety of Virtual Tower? Is moving controllers from one area of the country to another, virtually, going to give the controllers enough time to familiarize themselves with their new area?





Imagery (above) using Enhanced Vision System is the civilian version of FlIR (Forward Looking Infrared Radar) which has been used by the military for many decades. These systems consist of a near-infrared camera mounted typically in the nose of the aircraft, allowing the pilot to see through clouds, dust and precipitation. (Courtesy: Astronics Corporation Max-Viz)

Kramer:"Virtual, or remote towers, is a very new concept with limited safety and operational data. AOPA would expect an equivalent level of safety, access, and efficiency with a remote tower as compared to a staffed tower.

"Advances in technology may eventually make remote towers a feasible solution for some small airports that would not otherwise qualify or necessitate a staffed tower. The relocation of Air Traffic Controllers is something that happens routinely in the current national airspace system. Air Traffic Controllers receive extensive training and certification in specific geographic areas with ample opportunity and evaluation for their respective geographic area of responsibility."

Most people don't realize that an air traffic controller does more than just talk directly to aircraft over the radio. A tower controller, for example, needs to be able to talk to his approach and departure controllers in the radar room below, and they need to be able to talk to the enroute controllers in order to coordinate instrument arrivals and departures through the system.

Typically, a tower controller will ask his approach controller via intercom to space out or put arrivals in a holding pattern so he can expedite departures. Likewise, a departure controller may be getting congested and need to have tower hold his departures. During the early stages of the "Miracle on the Hudson" accident, when Capt. Sullenberger told his departure controller he had lost both engines, that controller called tower via intercom and told him "Stop all departures - emergency return!"

Enroute controllers stay in touch with other enroute controllers via dedicated landlines. For example, an enroute controller will receive a request from a flight for a change in altitude before passing into the next sector. The exchange goes something like this:

Airliner to enroute controller via radio:
"American 453 requesting flight level three eight zero."

Enroute controller in sector A to enroute controller in sector B via landline:
"American 453 wants flight level three eight zero."

Response: "Tell him I can get him higher in twenty miles."

Enroute controller to airliner via radio:
"American 453, contact center on 134.3. Expect flight level three eight zero in twenty miles."

There is considerable and complex communicating going on besides what you hear when monitoring the aircraft band.

What will happen to voice communications when NextGen takes over? North American Enroute Aviation Guide author, and former *Monitoring Times* military communications columnist, Larry Van Horn had this to say:

"I do not see any major changes to ARTCC (Air Route Traffic Control Center) comms in the near term. The voice side of Next-gen is known as NAS Voice System (NVS). The NVS is currently in a planning phase but is scheduled to be operational by the year 2016. (I'm not holding my breath).

"The system is more apparent on the ground side of things. It is a system designed to share the load between ATC facilities. If, say, there is an outage in ARTCC A, ARTCC B can step in to help by taking over or sharing the traffic load. This is suppose to be done through ground based switching networks. As I understand the system right now, the aircraft or monitor really won't see much difference. It still isn't clear whether this will be a digital or analog, I can't nail that down. I believe it will be analog as I have not heard any calls for pilots to have to change to digital radios in aircraft."

Other countries have their version of NextGen and are not having nearly the difficulties the US has. Europe's SESAR (Single European Sky ATM Research) has already passed the development stage and will be fully deployed by 2020. SESAR will be fully compatible with NextGen.

Australia has mandated all aircraft operating above 29,000 feet be equipped with ADS-B by Dec. 12, 2013, and their oneSky Australia project, their version of NextGen, which will also combine civilian and military operations into a single air traffic management solution, is on track to be fully operational by 2020. Ironically, Lockheed Martin is providing this system to Australia. Australia is also now testing Saab's r-Tower (remote tower) system.

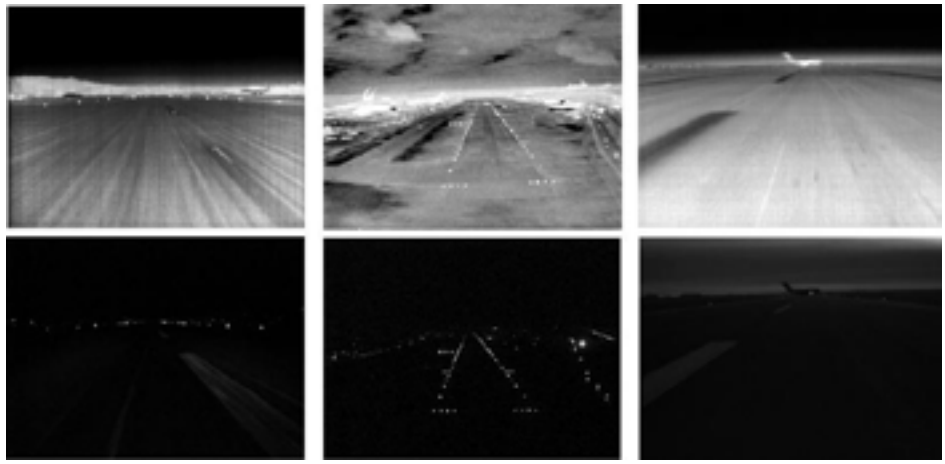
Could there be a conflict of interest in the implementation of NextGen? Marion Blakey, who was the head of the FAA when the program was authorized by Congress in 2003 now leads a trade association that includes NextGen contractors.

Flawed Technology?

What about concerns of becoming too reliant on computers? Computers cannot make judgments and are prone to failure. With Virtual Tower, is it realistic to expect to transfer a controller to another sector to "fill in" during peak demand? Doesn't it take time for a controller to learn a new area?

Regarding Virtual Tower, a retired air traffic controller told me:

"The higher ups have always been trying to eliminate the controller from the equation with automation and procedures, doing things exactly the same each and every time. Not only is this unbelievably wasteful and at times dangerous, it discounts the mind of a well trained controller.



How much better is a pilot's vision with EVS? On top shows what a pilot sees with EVS and on bottom without. (Courtesy: Astronics Corporation Max Viz

"For a controller to properly and safely learn an area of control takes quite a while. Of course, the more seasoned a controller is, the faster he or she can adapt to a new area of control, but still, it will take some time. The key to efficient and accurate ATC is a well trained controller who doesn't have to think about frequencies or agreements between facilities.

"To try and relegate this to automation or procedures is to create an inefficient and at times (such as weather or limited visibilities) unsafe situation.

"And, relying on high data rate connections to stream control information from hundreds of miles away is asking for trouble in the long haul. Data infrastructure will fail eventually, even with redundancies, and in that event many aircraft may end up being on their own. Remote control air to ground frequencies have been used for decades, but these were phone line (hard wired) and even at that were occasioned to fail."

Saab's r-TWR even allows one controller to handle several airports at once. If an emergency were to occur at an airport while he's busy with another airport, how will he even know about the emergency, much less handle it? I posed this question in an email to the Saab representative and have not heard a response yet.

What about other ways of facilitating air traffic flow and reducing costs?

EVS

Enhanced Vision System is the civilian version of FlIR (Forward Looking Infrared Radar) which has been used by the military for many decades. These systems consist of a near-infrared camera mounted typically in the nose of the aircraft, allowing the pilot to see through clouds, dust and precipitation.

LWIR (Long Wave Infrared) cameras, sometimes called "far infrared," operate at 8 to 12 micro meters and see a few miles away, plenty of range for a pilot to complete an instrument approach visually. Beyond that, the infrared light is absorbed, scattered and refracted by air and by water vapor.

MWIR (Medium-wave infrared) cameras operate in the 3-to-5 micro meter range and are less affected by water vapor absorptions, but generally require a more expensive sensor array, along with cryogenic cooling.

If a pilot can see the runway in any kind of weather, what does he need an ILS or even GPS instrument approach for? The pilot will basically be flying visually, greatly enhancing safety without any ground equipment or satellites. The temptation to go below minimum descent altitudes (aka "busting minimums") which leads to so many accidents, will be eliminated. The autoland system now in use in the UK, which requires very sophisticated and expensive equipment on the ground and in the aircraft to allow automatic landings in zero visibility, will be unnecessary.

The FAA currently restricts the use of EVS to aircraft on an approved instrument approach, and descent below 100 feet above the ground is prohibited with these devices without acquiring the runway using "natural vision" first (see **http://www.nbaa.org/ops/airspace/20110408-enhanced-flight-visual-systems.php**).

The first civil certification of an

EVS was offered as an option on Gulfstream V aircraft; since 2003 it is now standard equipment on the Gulfstream G450, 550 and 650 aircraft, with over 500 EVS models delivered since 2009.

Boeing is now offering EVS on it's line of Boeing Business Jets and may be an option on the B787 and B737 MAX. Surprisingly, after all the development and deployment experience with these devices in the military, they are not in widespread use in the civilian sector, despite the fact that the cost and complexity of the technology has been reduced even for general aviation aircraft.

Decentralization

The trend over the last 50 years has been to funnel more and more flights into larger and larger hub areas, like Chicago O'Hare, LAX and DCA. This creates more congestion and more delays. If I want to go to Rochester, New York, for example, the closest airport to me, that handles airliners is 70 miles away (Dulles), an hour and a half drive, sometimes longer depending on traffic. I also have to park and walk a considerable distance to the terminal and have to check in, go through security, ride the underground subway to the other terminal, and be at my gate at least an hour before push back time. Even after push back, it takes awhile to actually get to the runway because the taxi distance is often a mile or more! I could have been half way to Rochester by car already.

While United claims it can save 200 pounds of fuel during approaches to Denver, how much fuel is it wasting on these long taxis back and forth to the terminal? Dulles airport was recently renovated with a new tower, a subway system and a new north-south runway, parallel to the first two and even farther away from the terminal. It's no mystery then, when I'm monitoring Dulles Tower, that I keep hearing pilots requesting the closer runway, leaving the new runway little used.

A runway is not at all like an automotive highway. It is steel reinforced concrete several feet thick to handle the weight of large, landing aircraft, so it's very expensive to build. To invest that kind of money on something and not use it is also incredibly wasteful.

I have taken that actual flight from Dulles to Rochester, on a number of occasions, leaving Dulles in a 737 on one occasion and a smaller commuter prop plane on another, and discovered it was exactly the same flight time. Why? Because the jet has to climb to a much higher altitude to conserve fuel. Does this make sense? Using a jet for a 500 mile or less flight like that is not only extremely wasteful of fuel, but considering the higher maintenance and insurance costs over a prop plane, is ridiculous, whether the plane is being directed by NextGen or not.

Wouldn't it make more sense to catch a small commuter plane at a small, outlying airport? Baggage, security, parking, and most importantly, air traffic control would be greatly simplified and expedited. Every city has these satellite fields which are struggling to remain economically viable, under the threat of being bulldozed for suburban sprawl. It doesn't take a rocket scientist to see an easier, less expensive, faster and safer way of moving air traffic.

In fact, I'd be willing to bet if more air traffic could be decentralized, the savings would more than pay for NextGen, especially with all the money saved by not having to continually renovate these huge hub airports. Also, who couldn't find something better to do with their time than wait around at an airport?

So, how much of NextGen is actually beneficial and how much is just hype? Only time will tell, but in the meantime, how can the monitoring enthusiast tap into all of this new digital air traffic information?

Right now, there are numerous ADS-B receivers and software applications that allow you to display aircraft on a virtual radar scope on your computer monitor, however, they display little or no additional digital information. AirNav's Radar Box (**http://www.airnavsystems.com/RadarBox/whybuyradarbox.html**) provides some weather reports. With NextGen, all the digital data like PIREPS (Pilot Reports), NOTAMs (Notices to Airmen), TFR (Temporary Flight Restrictions), AWOS (Airport Weather Observation System) and NexRad weather radar, is uplinked to the cockpit either via 1090ES (1090 MHz extended squitter transponder) or a 978 MHz UAT (Universal Access Transceiver). 1090ES has a limited bandwidth and therefore has to transmit or "squit" its message by breaking it into five segments. UAT, because of it's broader bandwidth, provides the same information in a single, short duration transmission. The FAA wants high performance aircraft and all aircraft operating above 18,000 feet to use 1090 MHz, all others to use 978 MHz to further reduce frequency congestion.

Obviously, it's not practical to buy a 1090ES transponder and adapt it to home use. If you have a 978 MHz receiver, you can receive the data bursts, but you would still need the appropriate software to decode and display all the information.

FAA certified UAT units for aircraft are available, such as NavWorx ADS 600-B, (see **http://www.navworx.com/navworx_store/cart.php?m=product_detail&p=32**) but the cost is over $2,000 and they are designed to plug into an aircraft display system, not your home computer.

Still, there are lower cost units designed for portable aircraft use, which could be rigged for home use. For example, Skyradar offers both a single band UAT ($600) and a dual band 1090/UAT model ($850) designed to plug into an aircraft cigarette lighter socket and display the information on an Apple I-Pad (**http://www.skyradar.net/purchase/buy-receiver.html**). Both units will accept remote antennas. Sporty's Pilot Shop offers a similar dual band model (**http://www.sportys.com/PilotShop/product/17165**) for $700.

This might be a good time for monitoring enthusiasts to start contacting companies like AirNav and Kinetic, who are the leaders in ADS-B receivers, and ask when they will come out with either a separate UAT receiver or incorporate it into their existing ADS-B receivers.

TSM

The High Cost of Interoperability

By Ken Reitz KS4ZR

(Courtesy: Motorola Solutions)

This past September a shooter went on the rampage at the U.S. Navy shipyard in Washington, D.C., killing a dozen people. Within minutes first responders were on the scene. This might have been the kind of test the Department of Homeland Security (DHS) would simulate as part of the National Emergency Communications Plan (NECP), but it wasn't.

The NECP was a federal response plan, part of the Homeland Security Act of 2002, which in turn was in response to the terror attacks of 9/11. One of the problems facing first responders on that fateful day was their inability to communicate with each other over emergency frequencies.

During the ensuing twelve years, billions in taxpayer funds have been used to build-out federal, state, county and city emergency radio systems with an eye toward developing a lasting remedy to the inability of first responders to communicate in real emergencies. The term used is interoperability.

Washington, D.C. has such a system in place, but when the attack came, things didn't go well. According to a report on WUSA-TV Channel 9 there were suggestions that lives might have been spared had first responders been better able to communicate. In the on-air report one first-responder was quoted as saying, "Immediately upon their arrival they were experiencing radio problems. They were not receiving and not able to transmit messages to other emergency responders."

A Familiar Story

The problem at the D.C. shipyard was not an isolated occurrence. Over the last several years, across the US, jurisdictions of every size have experienced serious problems with first responder radio systems. These aren't antiquated systems, not up to today's working environment. These are brand new, extremely expensive, technically complicated systems designed specifically to work in today's electronically interconnected, high-speed public safety environment.

The radios are part of trunked, digital, public safety systems manufactured to standards set up by the Association of Public-Safety Communications Officials' Project 25 (known by the acronym APCO P25). Jurisdictions using these systems have been plagued by problems. Here are just a few incidents that were reported in various newspapers in the last six months:

At the end of August, the Detroit police radio system crashed, for the second time in two months. The first incident, when the system was down for 15 hours over the Fourth of July holiday, was blamed on a hardware glitch of the Motorola Solutions system. The late August crash was due to "corrupt data" somehow entering the system, according to a Motorola spokesperson quoted in the *Detroit Free Press*.

In Colorado, during September's disastrous wildfire that destroyed nearly 500 homes in that state, a fire chief found himself on the fire's front-line juggling two different radios with which he needed to talk to various groups trying to contain the blaze. When a military helicopter arrived, he was given a third radio to try to make contact, but, according to a report in the *Denver Post*, the batteries were too weak to allow the contact.

An article in the Pittsburgh *Tribune-Review* from mid-October noted, "Law enforcement and emergency services agencies paid millions to switch to a federally mandated new radio system this week that may not work as well as their old system."

In mid-November of this year, according to an article in the Omaha *World-Herald,* Nebraska state police were dealing with several incidents recently where officers' lives were at stake when that state's $17.3 million system failed during criminal incidents and wildfires. The system, not two years old, has been recommended for an upgrade by a state-hired consultant.

In an article in the December 3, New Jersey *Star-Ledger,* flaws in the Piscataway, New Jersey, radio system, also less than two years old, caused officers to label it a safety hazard.

The Funding Trail

In July, 2007 the Department of Homeland Security (DHS) announced that $1 billion would be made available, in the form of Public Safety Interoperable Communications Grants, to help state and local first responders improve public safety communications during natural or man-made disasters. The funding, part of the Digital Television Transition and Public Safety Act of 2005, was tapped out by 2010.

And, while many states, cities and county-wide public safety systems received new digital radio systems to replace aging analog systems, there were add-on costs that might not have been made clear in the original presentations. The new systems require regular hardware and software updates and, because of this, these systems can cost hundreds of thousands or even millions of dollars per year

to maintain, depending on the size of the system.

In Riverside County, California, according to a news report in the Riverside County *Press-Enterprise,* that county's Motorola Solutions $172 million system will require $14.2 million in annual maintenance costs (up from the originally projected $6.7 million). The system was originally supposed to cost $148 million but was three years late in delivery and $24 million over budget.

With poorly performing local economies, some cities and counties are hard pressed to afford the upgrades required to maintain these new systems. There is even less patience in those localities where the system itself has not performed well. A little over one year ago the city of Las Vegas dumped their $42 million Harris Corporation OpenSky P25 system, dubbed DesertSky. An article in the Las Vegas *Review-Journal* noted, "It was a multimillion-dollar mistake. And the timing couldn't be worse. After two years of battling dropped calls and dead zones in the department's new radio system, Clark County Sheriff Doug Gillespie has opted to drop Desert Sky." One year later the city tested its new Alcatel-Lucent 4G LTE system. That's the new direction of public safety radio systems.

In February, 2012, Congress enacted the Middle Class Tax Relief and Job Creation Act which contained funding for a new nationwide interoperable broadband network intended to help police, firefighters, emergency medical service professionals and other public safety officials.

The group in charge of this new effort was designated as "First Responder Network Authority," and is known as FirstNet, an independent authority within the National Telecommunications and Information Administration (NTIA), part of the US Department of Commerce. The Act provides $7 billion toward deployment of this new network as well as $135 million for a new state and local implementation grant program to support state, regional, tribal and local jurisdictions.

According to NTIA, FirstNet will provide emergency responders with the first nationwide, high-speed network dedicated to public safety, a broadband data network that finally fulfills, after more than ten years, a recommendation of the 9/11 Commission report.

FirstNet, using a nationwide spectrum license in the 700 MHz band, will build this high-speed network using

Ford Interceptor (Courtesy: Motorola Solutions

Long-Term Evolution (LTE) wireless technology. In addition, police, firefighters and emergency medical personnel will continue to use Land Mobile Radio (LMR) networks for voice while FirstNet provides the high-speed data. Eventually, according to NTIA, FirstNet's LTE system will provide mission-critical voice as well as data. FirstNet will support the integration of LMR networks, even after LTE voice is provided.

Inventory Issues

It turns out that the Act only fronts $2 billion of FirstNet's $7 billion budget and experts disagree on the amount such a nationwide system will actually cost. From previous experience with some P25 systems, that number could be low by half. The original funding plan would be the result of a spectrum auction in which the FCC would sell what's left of the TV bands to wireless telecommunications companies once those bands are re-packed.

With billions of dollars worth of radio hardware floating around its system, there's room for waste. Luckily, DHS has a vigorous Inspector General's office. The DHS OIG released a report in August, 2013, titled, "DHS Needs to Manage its Radio Communication Program Better."

The 27 page report makes interesting reading and gives an idea of the scope of equipment and sites managed by DHS. In its executive summary the OIG notes that DHS "operates and maintains 20 land mobile radio networks serving more than 120,000 frontline agents and officers. These users rely on radio systems for primary communications, officer safety, and mission success. DHS manages about 197,000 radio equipment items and 3,500 infrastructure sites, with a reported value of more than $1 billion.

"Many of these systems have exceeded their service-life and urgently need to be modernized to meet Federal and DHS mandates. DHS has estimated that full modernization of its existing end-of-life radio systems would require a $3.2 billion investment. The audit objective was to determine whether DHS is managing its radio program and related inventory in a cost-effective manner to prevent waste of taxpayer dollars."

As an example of management issues, the DHS OIG noted that two DHS components their office visited, "stored more than 8,000 radio equipment items valued at $28 million for a year or longer at their maintenance and warehouse facilities, while some programs faced critical equipment shortages."

Among other problems the OIG uncovered were a lack of inventory data (one DHS component listed 1,740 items, valued at $6.6 million as "in service" when they were actually storing the items at a maintenance facility, some for as long at 17 months). New radio equipment, such as 93 repeaters used for Customs and Border Patrol (CBP) and the US Secret Service (USSS) agencies were unrecorded. These sorts of failures make it difficult for DHS to know what they have, what they can deploy and what they need to buy.

The DHS OIG noted that excess stockpiles of radios were in warehouse facilities, not on an inventory list, while other agencies which used the same radios were experiencing shortages in the field. Many of the "portable radios" and "digital interface units" cost taxpayers $4,600 each. These inventory issues are mostly a result of a lack of "best practices" in management.

Unrealistic budget funding, mistakes in state and local system purchases, poorly performing systems, inadequate end-user training, inventory irregularities and unexplored security issues means that, nationwide, we will continue to experience a higher cost for our much needed, and still missing, interoperability.

TSM

Scanning America

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

Scanning, Satellites, Trunked Systems and More!

Welcome to the first Scanning America column in our new digital publication, *The Spectrum Monitor*. We are continuing in the tradition of *Monitoring Times* magazine to bring you interesting, detailed and useful radio information.

In this column we cover activity that can be monitored by commercially available scanners, whether portable handheld units or larger base/mobile models. This includes the "action bands" used by public safety agencies, where law enforcement, firefighters, paramedics and other first responders communicate. Scanners can also bring you conversations from business users, utility workers, taxicabs, power plants, and industrial operations, giving you a better understanding of activity in your local area.

Another popular monitoring subject for listeners is aviation, both civilian and military aircraft operations. Civil aircraft frequencies range from 118 to 136 MHz, while military activity is most commonly found in the 225 to 400 MHz band. Both of these ranges, as well as others, are available on most modern scanners.

Railroad observers and enthusiasts, often called "railfans," use scanners to monitor train and switchyard movements, including Amtrak passenger routes and commercial cargo transport. Local commuter lines and light rail operations are also of interest. Many railroads use assigned frequencies between 160 and 162 MHz.

NOAA's Advanced Television Infrared Observation Satellite (Courtesy: NOAA)

Scanners can also be used as the first stage of a data reception setup, tuning in to mobile data terminals, environmental telemetry sensors, and orbiting satellite. For instance, a wideband scanner with an appropriate antenna connected to the sound card of a personal computer, along with a couple of free software packages, can be used to track, receive and produce weather imagery from orbiting satellites.

The National Oceanic and Atmospheric Administration (NOAA) operates a number of environmental monitoring satellites, including several Polar Orbiting Environmental Satellites (POES) that send Automatic Picture Transmission (APT) images on a regular schedule. A software package called WXtoImg (available for free from **www.wxtoimg.com**) takes scanner output via a computer sound card and turns it into color images, complete with map overlays and animation. A separate software program called WXtrack (available for free from **www.satsignal.eu/software/wxtrack.htm**) will allow you to see when and where these satellites will appear to schedule optimal reception.

Frequency	Satellite
137.1000	NOAA 19
137.6200	NOAA 15
137.9125	NOAA 18

Which Scanner?

The most common question I receive is, "What scanner should I get to hear the police and fire departments in my area?"

Depending on where you're located and what you want to hear, scanning can be simple or complex. Many simple scanning environments can be found in rural areas, where the low population density allows basic radio communication to serve public safety needs. The simplest environment is one that uses conventional analog transmissions, where each licensed radio frequency is dedicated to a specific agency

or department for a specific purpose.

Fort Scott, Kansas

I have to go to Fort Scott, Kansas. Are there any interesting frequencies in this city?

Thanks!

Johannes via the Internet

Fort Scott is the county seat of Bourbon County, located in eastern Kansas just 90 miles south of Kansas City on the Missouri border. It is home to about 8,000 residents, down from nearly 12,000 at the turn of the 20th century when it was a significant railroad transportation center.

Despite the name, Bourbon County was "dry" until 1992, when the prohibition against the sale of alcohol was finally lifted. The entire county, covering about 640 square miles of rural agricultural land, has a population of just over 15,000.

The following table provides a list of frequencies in use by county and local police and fire departments. Notice that Bourbon County Sheriff and Fort Scott Police share a dispatch frequency of 155.565 MHz.

Frequency	Description
150.790	Bourbon County Fire
153.920	Bronson Fire (Fireground)
154.235	Fort Scott Fire Dispatch (Tone-Out)
155.235	Bourbon County EM
155.565	Bourbon County Sheriff and Fort Scott Police (Dispatch)
155.895	Bourbon County Highway Main-

tenance
158.760 Bourbon County Fire
159.120 Bourbon County EM
159.210 Fort Scott Fire
463.100 Bourbon County EMS (Dispatch)

Voices are carried on these frequencies in analog format, meaning that the radio signal contains a straightforward representation of the sound from each participant that every scanner is capable of monitoring. Nearly any scanner manufactured in the past 40 years is capable of tuning in to activity on these frequencies.

More complex radio systems may carry voices in digital formats of various types that require a more advanced scanner to monitor. Many complex systems also share licensed frequencies between users in a process called trunking.

Trunked Radio

Hi Dan,

I saw your name and address on a Trunking page and thought I'd send you this note as I'm beginning to experience Trunk Tracker scanning in my area. I bought a Radio Shack PRO-2096, which seems to work quite well, although it's a model that has been out for quite awhile. In reading your trunking explanation, I still don't understand something. For example, in my area in eastern Ontario, Canada, is a system called Bell FleetNet - Ontario Provincial Government Zone 2.

There are a number of towers but the Harrowsmith tower is one that is near my home, so I have it programmed into my 2096. Here is the Harrowsmith-related data from **www.radioreference.com**:

Harrowsmith (HARROW)
Frontenac

141.54000, 141.72000, 141.93000, 142.09500, 142.26000c, 142.39500, 142.59000a, 142.99500

Custom Frequency Tables

Base	Spacing	Offset
141.01500	15.0	380
151.73000	15.0	579
154.32000	15.0	632

My question is, when people in the same talk-group are listening to a transmission, I assume that they are listening to one of the Voice Channels associated with this tower, those being one of 141.540, 141.720, 141.930, 142.095, 142.395 and 142.995 MHz. But the person who is transmitting the message, are they actually transmitting on one of the Base Frequencies as listed in the Custom Frequency Table, those being 141.015, or 151.730 or 154.320? Is the input to the repeater, one of these latter three frequencies, or are these three frequencies used for something totally different? Thanks for your help and time.

Brad, Kingston, Ontario

Because most hand-held and mobile radios transmit with relatively low power, their transmitted signal cannot reach all intended recipients directly. To address this problem, most systems place a device called a repeater on a tower or tall hilltop that has a good view of the desired area of coverage.

A repeater in its simplest form is basically a receiver connected directly to a transmitter. The repeater's receiver is tuned to an input frequency, which is the frequency on which a user's radio transmits. The repeater takes the audio content from that receiver and transfers it to a transmitter,

which puts it out over an output frequency at much higher power. User radios tuned to the repeater's output frequency are thus able to hear their transmitting colleague.

When a repeater is not used for communication, the user who is talking transmits on the same frequency to which receiving radios are tuned. This is called direct communication (the transmitting radio sending directly to receiving radios), also known as talk-around since users talk around (that is, without using) the repeater.

One input frequency and one output frequency paired together are called a channel. Scanner listeners, like user radios, typically tune to the repeater output frequency because it is transmitted with a great deal more power than the input frequency. So, for the system Brad is monitoring, the repeater output frequencies are 141.540, 141.720, 141.930, 142.095, 142.395 and 142.995 MHz. Each of those frequencies happens to be paired with a corresponding input frequency that is not listed.

The next question becomes, how does the scanner know which frequency to tune to when a conversation is underway? In order to answer that question and deal with the custom frequency table, we need some background on trunking.

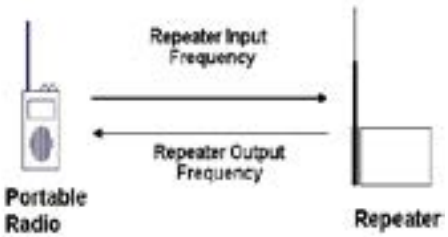
Trunked Radio

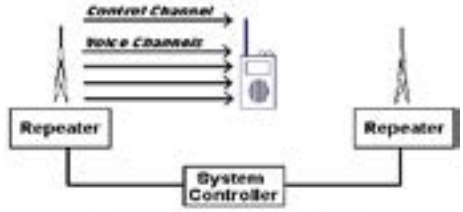
Rather than dedicating a radio frequency to one specific purpose as conventional systems do, a trunked radio system shares that frequency among multiple users. A typical trunked system may have anywhere from five up to nearly thirty channels available to be shared.

A trunked system has two basic types of transmissions on these radio channels. One type carries the voice traffic between users and is called, naturally enough, a voice channel. A trunked system will have several voice channels that are dynamically assigned to different users when needed. The second type is called a control channel and carries digital requests and instructions between a user's radio and the system. There is typically just one control channel at each repeater site and user radios tune to this channel when not involved in a conversation. Modern scanners are also capable of monitoring the control channel to determine all of the voice activity occurring on the system.

When a user on a trunked system wants to communicate, he or she presses the push-to-talk button on the radio. This action causes the radio to transmit a request on the repeater input frequency used by the control channel. The repeater receives this transmission and forwards it to a system controller, which interprets the request and quickly checks the pool of shared channels to see if one is currently idle. If so, the controller assigns the channel and creates a response message that is transmitted back to the user's radio on the repeater output frequency. The system controller also begins sending an information message on the repeater output frequency, letting all users know that a particular channel is now assigned and active.

Different trunking systems have different techniques to communicate information on the control channel. The system Brad is attempting to monitor is a Type II SmartNet made by Motorola, which has an associated set of specific message formats carried on the control channel. Instead of transmitting the actual frequency assigned to a conversation, this type of Motorola system sends a channel number. This makes more efficient use of the limited





Trunked Radio System

capacity of the control channel, since the channel number can be represented in a fewer number of information bits than the actual frequency. The radio uses a mathematical formula to convert that channel number into the corresponding radio frequency.

The problem for scanner users is that the mathematical formula has changed over time due to legislative and regulatory changes. There are also some frequency bands where the original formula does not apply. This means that when the scanner receives a control channel message containing a channel number, it cannot use a single, simple formula to determine the corresponding frequency. A custom frequency table provides the scanner with the additional information it needs to make the proper computation. The three frequencies listed in the table in Brad's letter are used by the scanner to convert channel numbers to the correct frequencies; they do not necessarily represent an actual frequency used by the system.

Software Defined Radio

We will also cover some of the more "cutting edge" work being done with software-defined radios (SDR) and inexpensive re-purposed digital television tuners. Although modern scanners are powerful and extremely capable devices, there are signals and digital modes that they cannot monitor. For instance, there is a digital format called ProVoice that is used on some EDACS (Enhanced Digital Access Communication System) radio systems. No scanner on the market today can monitor ProVoice, but using a software package called Digital Speech Decoder (DSD) many hobbyists are having good success listening to such systems.

Where scanners are limited to monitoring a single channel at a time, the combination of powerful yet inexpensive radio frequency (RF) hardware and open source software (OSS) is enabling hobbyists to monitor and record voice activity on every active frequency of a system simultaneously. Such a setup allows listeners to go back and hear complete conversations, without gaps, even if they overlapped each other.

Inexpensive RF hardware can also be used to monitor Automatic Dependent Surveillance - Broadcast (ADS-B) transmissions from commercial aircraft, providing the hobbyist with the equivalent of an air traffic control screen to track the movement of flights. The Federal Aviation Administration (FAA) intends to require most aircraft operating within the National Airspace System (NAS) to have ADS-B by 2020. Transmissions from aircraft occur at 1090 MHz or alternately at 978 MHz.

That same piece of hardware can also be used to monitor Automatic Identification System (AIS) transmissions from maritime vessels. These transmissions contain position, course, speed, destination and other information about large ships that are intended to reduce the possibility of collisions.

Expect to hear more about SDR in the future.

Ventura County, California

In my final Scanning Report column in *Monitoring Times* magazine, I reported on Ventura County in southern California. In response I received the following update.

Hi Dan,

I contacted you a few years ago with questions regarding the 800 MHz re-banding which you answered in your column. Now perhaps I can help you.

I have lived in Ventura since 1966 and have been a serious scanner of the county Public Services frequencies for many years. As I mentioned previously, I was a column writer for AOSC. I was thus very interested in your Ventura County listings. Thought you might be interested in comments. Last week I submitted some updates to RadioReference on the Sheriff's Office and Fire which have been incorporated.

151.070 Search & Rescue repeater (156.105 in). Rarely used. NOT Traffic Operations.
153.830 East Tactical (Use change from original plan. 153.830/153.950 switched. Incorporated in RR.)
153.845 Animal Control. (That seems to be all that's left.)
153.950 Brush Tactical.
154.010 (Dormant,not heard since 151.050 became dispatch. Not in county plan.)
154.115 Thousand Oaks LG
154.325 County Fire (Brush Command) (Use change from original plan. 154.325/155.985 switched. Incorporated in RR.)
154.725 (This the input to 155.985.)
155.100 (Dormant, no longer in County Fire plan.)
155.145 Main Jail (PL 100.0) (Low power repeater. I live a 3 miles away & usually can't hear.)
155.145 Channel Islands Harbor Patrol/ Lifeguards (PL 136.5) (Hasn't been SO C/C for years.)
155.415 (Nothing here)
155.830 (Not assignable) (West Tactical is 154.025)
155.835 (Input to 154.325)
155.985 County Fire (East Command) (Use change from original plan. Incorporated in RR.)
158.730 Sheriff (Car-to-Car)(Delete "West")
158.805 (Input to 153.875)
158.850 (Dormant, nothing ever heard.)
453.550 County Building Security (PL 123.0)
453.550 County Med Ctr Security/Ops (PL 141.3)
453.700 Simi Valley Transit Bus (Why include only Transit while all SV agencies are under the same license, WQCL798, including PD?)

Hope this helps you. If you would like more detailed info on Ventura County, let me know.

Larry Smith
Former Scanning Across America column editor, AOSC.

As you can see from the contents of this column, I welcome questions, comments and reception reports from readers. You can reach me via email at dan@signalharbor.com or via links on my website at **www.signalharbor.com**. The website also contains information on scanners, trunking, and a number of other radio-related subjects.

TSM

Federal Wavelengths

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

Monitoring Federal Frequencies

Welcome to the first edition of "Federal Wavelengths." My name is Chris Parris and I have been listening to federal and military communications since the mid-1970s, when I acquired my first programmable scanners, a Bearcat 101 and a Bearcat 210. Most of you may know that I wrote the "Fed Files" column for Monitoring Times magazine from 2004 through 2103.

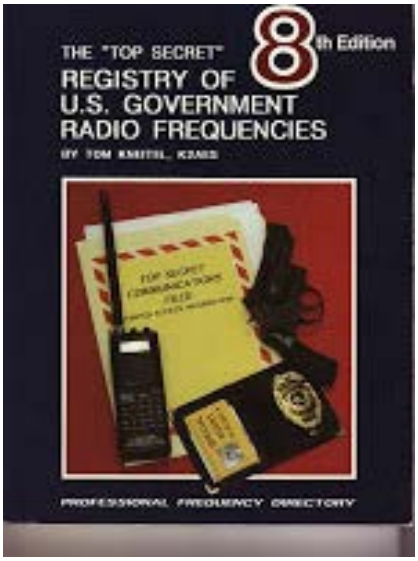
This column focuses on federal government communications systems, how they work and what you might be able to hear from federal agencies across the country. But, why does federal monitoring require it's own column? Because there are a lot of things about scanning federal operations that require a little more patience and a larger knowledge base than needed for listening to your local police and fire channels. Some federal agencies or facilities, such as the U.S. Postal Service or many military installations, can provide continuous chatter, while other agencies may be busy during certain times of the day, then silent for long periods.

Finding the frequencies used by government agencies can be a challenge in itself. Although we generally know what frequency bands various agencies use for their communications systems, we often don't know specifics about what frequencies are used and how they use them. This requires some detective work and the use of your scanner's "search" feature. Searching and finding active federal channels in your listening area can be like finding a rare coin or stamp. The reward is hearing some interesting radio communications and often having some previews of headline-making activities taking place around you.

Personally, I find federal communications monitoring to be particularly fascinating. It is different than listening to the highway patrol or the local ambulance service (which I do as well). I think it may have started when I first developed an interest in scanners and radios in general, and discovered that a nearby TV station tower was also the location of the FBI radio repeater for the area. It was a plain, grey cabinet with no markings and a huge high-security padlock on the door. It was the goal of figuring this out that really interested me. I tried all sorts of investigative paths to figure out the frequency, but these were the days before the Internet and even before I had discovered the printed frequency books by Bob Grove, Gene Hughes, Robert Kelty and Tom Kneitel.

In the early days, I gained a lot of insight into federal frequencies by meeting and exchanging information with other scanner listeners. I often crossed paths with other scanner hobbyists at the local Radio Shack or ham radio stores and we were able to compare notes and see what we all knew about what it was possible to hear. Our lists often consisted of scraps of paper covered in hand-written frequencies and copies of typed "official" frequency lists that may have been handed down from an unofficial source. I really got interested in federal agencies when I moved down to the Rio Grande Valley in South Texas. The Border Patrol and U.S. Customs were highly visible federal agencies and very easy to scan at the time. It was then that I really started understanding the layout of the federal radio spectrum and who was where.

Although federal frequency information is not officially available to the general public, quite a few sources exist on the Internet for federal monitoring information. Radio Reference is probably the largest on-line source of scanning information as well as active forums, including a federal monitoring forum and a federal agency wiki. There are also numerous regional radio hobby sites and forums as well as several Yahoo Groups that specialize in federal monitoring. In this column I will help provide many more frequencies and additional federal monitoring information.



Changes For CBP

One of the goals of this column will be to keep you updated on the latest changes that are occurring in federal communications systems – and change they do. Although many frequency assignments have been set for decades, things can vary over time. And, just when you think you have things figured out – something new pops up. Federal communications have been on a nearly constant wave of change over the last 20 years, moving from analog to digital, conventional systems to trunking systems, and so on.

Some federal agencies have disappeared from existence, some have been combined with other agencies and renamed, while new agencies have appeared and stated using what appear to be new frequencies. When the Department of Homeland Security (DHS) was officially formed in 2002, it took a number of existing federal agencies from the Department of Justice, Treasury, Department of Agriculture and the General Services Administration (GSA), combined some operations, eliminated others, and ended up with seven distinct agencies under nine different divisions.

One agency that has started making some potentially major changes in their radio systems is Customs and Border Protection (CBP). In 2002, under the DHS umbrella, U.S. Customs became CBP Field Operations. Prior to the formation of DHS, U.S. Customs (then part of the Department of the Treasury) deployed a nationwide VHF radio system to support their checkpoint and border interdiction efforts.

This VHF radio network consists of numerous repeater sites scattered across the country, all controlled from their national dispatching center, the National Law Enforcement Communications Center (NLECC), located in Orlando, Florida. On the air, this dispatch center can be heard using the call sign of CHARLIE-100. Besides CBP, there are a number of other federal agencies that are subscribers to the CBP radio system, such as the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA) and others that do not maintain national radio networks of their own.

Now, let's take a look at the legacy VHF CBP network channels. All of these NET channels are repeaters and these are still in use in most areas of the country. As with all the channel lists I provide, all frequencies are in Megahertz (MHz) and presumed narrow-band FM (NBFM). PL indicates a Continuous Tone Controlled Sub-audible Squelch (CTCSS) tone, DCS stands for Digital Coded Squelch and N indicates a P-25 Network Access Code or NAC. CSQ stands for Carrier Squelch and indicates no squelch tones are used:

NET 01 - 165.2375, 100.0 PL
NET 02 - 169.4500, 100.0 PL
NET 03 - 165.2375, 100.0 PL
NET 04 - 165.6875, 100.0 PL
NET 05 - 164.6000, 100.0 PL
NET 06 - 165.2375, 100.0 PL
NET 07 - 165.4625, 100.0 PL
NET 08 - 165.4875, 100.0 PL
NET 09 - 165.6875, 100.0 PL
NET 10 - 163.1250, 100.0 PL
NET 11 - 165.7625, 100.0 PL
NET 12 - 166.5875, 100.0 PL
NET 13 - 165.4125, 100.0 PL
NET 14 - 165.4375, 100.0 PL
NET 15 - 162.0500, 100.0 PL
NET 16 - 164.7750, 100.0 PL
NET 17 - 165.2375, 100.0 PL
NET 18 - 163.6250, 100.0 PL
NET 19 - 163.6750, 100.0 PL
NET 20 - 163.6250, 100.0 PL
NET 21 - 163.6250, CSQ
NET 22 - 163.6750, CSQ
NET 23 - 163.6750, CSQ
NET 24 - 165.6875, 094.8 PL
NET 25 - 165.4875, 100.0 PL
NET 26 - 166.3000, 100.0 PL
NET 27 - 166.2000, 100.0 PL
NET 28 - 163.1750, 100.0 PL
NET 29 - 169.5500, 100.0 PL
NET 30 - 163.2250, 100.0 PL
NET 31 - 170.1000, 100.0 PL
NET 32 - 165.4125, 100.0 PL
NET 33 - 169.5500, 100.0 PL
NET 34 - 162.3000, 100.0 PL
NET 35 - 163.1250, 131.8 PL
NET 36 - 170.7250, 100.0 PL
NET 37 - 165.6875, 100.0 PL
NET 38 - 166.1250, 100.0 PL
NET 39 - 165.2375, 100.0 PL
NET 40 - 165.2375, 100.0 PL
NET 41 - 165.6875, 100.0 PL
NET 42 - 165.5125, 100.0 PL
NET 43 - 165.2375, 094.8 PL
NET 44 - 162.6625, 100.0 PL
NET 45 - 165.4375, 156.7 PL
NET 46 - 164.1000, 100.0 PL
NET 47 - 165.2375, 100.0 PL
NET 48 - 169.4125, 100.0 PL
NET 49 - 165.6875, 100.0 PL
NET 50 - 162.2500, 100.0 PL
NET 51 - 163.3000, 100.0 PL
NET 52 - 165.2375, 100.0 PL

Over the last 10 years or so, CBP has been in the process of upgrading repeater sites and the system infrastructure to allow for APCO P-25 digital operation. The first area of the country to experience some of these changes was Southern California. The border counties of California experienced substantial changes with what was first named the Encrypted Voice Radio Project (EVRP), which later became part of the larger Integrated Wireless Network (IWN). These areas changed over to a large number of VHF repeaters that seemed to be linked or tied together in some areas, but all using the APCO P-25 Common Air Interface digital format. Later on, these

same frequency changes occurred in southern Arizona and New Mexico, and beginning in 2012, these changes have started taking place along the southern Texas border areas as well.

When the digital sites became operational, some changes were noted in both frequencies and the names of the channels. Often you will now hear these channels referred to as "D-NET" channels, most likely meaning Digital NETworks. Note that I have not yet confirmed the NACs for DNET 54, 55 and 56:

Name	Repeater Out	Repeater In
DNET 1	165.2375, N301	166.4375, N325
DNET 2	169.4500, N301	171.0750, N325
DNET 7	165.4625, N301	166.5875, N325
DNET 9	165.6875, N301	166.4375, N325
DNET 33	169.5500, N301	170.1000, N325
DNET 36	170.7250, N301	173.5000, N325
DNET 47	165.2375, N301	172.3500, N325
DNET 52	165.2375, N301	166.8750, N325
DNET 53	168.0000, N001	170.0750, N001
DNET 54	164.6250	170.0250, N001
DNET 55	165.2375	166.4375, N324
DNET 56	163.4500	166.4375, N325
DNET 57	165.2375, N001	166.4375, N001
DNET 58	165.2375, N002	166.4375, N002
DNET 59	165.2375, N003	166.4375, N003
DNET 60	165.2375, N004	166.4375, N004
DNET 61	165.2375, N005	166.4375, N005
DNET 62	165.2375, N006	166.4375, N006
DNET 63	165.2375, N001	166.4375, N007
DNET 64	165.2375, N001	166.4375, N009
DNET 65	165.2375, N001	166.4375, N008
DNET 66	166.2000, N301	173.5000, N325
DNET171	173.8625, N003	166.4375, N003

Recent indications are that even more changes are taking place in this channel lineup. In areas along the southern US border, some new frequencies and channel lineups are appearing, with multiple DHS agencies utilizing these wide-area repeater systems. Why these new frequencies? In some cases, new frequency pairs will help a long time problem of interference from sources in Mexico and Canada.

But there is also a mandate by the National Telecommunications Information Administration (NTIA) to "re-farm," or reorganize the VHF federal band into similar pairings that are found in other communications bands. In the UHF federal band, the standard is to have the repeater outputs in the lower frequencies and the repeater inputs in the upper frequencies, 9 MHz apart. So a repeater on 408 MHz would have an input of 418 MHz. The proposed plan in the federal VHF spectrum is to have a 7 MHz offset between repeater input and outputs, so a repeater on 170 MHz would have an input of 163 MHz. Simplex only channels will be available in the 167 to 169 MHz range. These changes are also evident in many of the newly discovered FBI repeater channels, which are being seen in the 169 MHz to 174 MHz end of the band.

Here are just a few of the new CBP D-NET channels that have been identified as in use in Texas, although expect these channels to show up eventually in other areas of the country:

170.1000 MHz, N301 D-NET 200 - Heard in Galveston TX
170.1250 MHz, N304 D-NET 203 - Heard in Houston TX
170.4625 MHz, N301 D-NET 201 - Heard in Stafford TX
171.6625 MHz, N301 D-NET 2xx - Houston Seaport and IAH Airport
172.0625 MHz, N301 D-NET 202 - heard in Houston and San Antonio TX
172.8625 MHz, N301 D-NET 2xx - heard in San Antonio TX

In addition to these new D-NET repeater channels, one listener has reported a possible CBP D-TAC simplex operation on 167.8875 MHz, N301. So, be on the lookout for new P-25 digital channels using these NACs in your area. Let me know if you hear anything! You can always contact me at my email address, chrisparris@thefedfiles.com, check for updates on my blog page, **http://mt-fedfiles.blogspot.com**, and you can follow me on Twitter, @TheFedFiles.

TSM

Utility Planet

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

Utility Shortwave Explained

This column takes up right where Utility World and *Monitoring Times* left off. The only significant change is the demise of Utility Logs. This had to be done, for a variety of reasons. Worry not, however, because this column will still include plenty of frequencies and reports on what people are hearing.

Please continue to send logs to the same e-mail address as always. The plan is to run them on this column's blog, which stays the same except for a name change. It's way less work, and it's also way more timely than waiting months for publication.

It is good that Mike Chace-Ortiz, the former *Monitoring Times* digital columnist, has come along as well. His column describes the many new modes, who uses them, and how to hear them, in more detail than is usually possible here. Also, he's well located, and equipped to hear everything. Check it out.

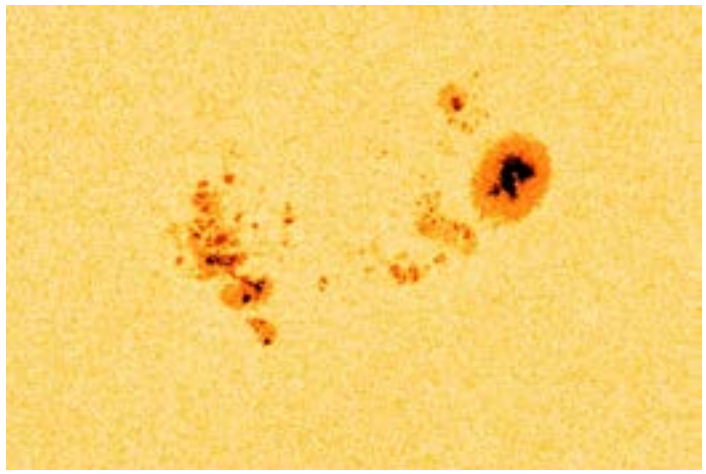
First columns are always good for reviewing fundamentals. Unfortunately, the definition of utility radio is rather vague. Often, utility radio is defined by what it is not. Many groups involved in chasing shortwave DX (distant or interesting stations) define it as everything that isn't broadcasting, ham or Citizens Band (CB), for example.

Let's do better than that. There are too many special cases for it to work. A broadcast transmitter used for "numbers" is a utility. The hams currently doing Philippine typhoon relief on frequencies such as 7095 kHz, as this is written, can be thought of as honorary utilities.

A better definition is needed. "Utility" comes from Latin, and refers to something that is useful for practical purposes. The utility man on a sports team can play several positions, so he's useful. Utility companies supply things like power, water, and phone service, so they're useful.

The same goes for utility radio stations. They are nearly always used for something. They exist because some government, military, or other organization needs to communicate over long distances. This content is not intended for the public. It's for the users, and responsible listeners respect this.

"Shortwave" is also pretty nebulous. It refers to a specific frequency range, but a lot of the better utility DX catches are not in this range. Some are on very long waves indeed, from the navigation warnings (Navtex) just below AM broadcasting, to strategic messages and Alexanderson alternator special events below 20 kilohertz (kHz). That's audio frequency, but when turned into radio waves it can span the globe.



Sunspot region #1890 (NASA/SDO/HMI)

Technically, most distant stations arrive by various kinds of skip propagation. Often, though, the term refers to the sudden appearance of DX on bands more commonly associated with line of sight reception.

On these bands, skip tends to be associated with the solar cycle. Generally, the first signs appear on the world's various CB channels, legal and otherwise, which go from around 26 megahertz (MHz) clear into the 28-MHz amateur band.

As conditions improve, taxi dispatchers and fire departments thousands of miles away start to fade in and out on 30 to 34 MHz. Up here, the mode of choice is narrow-band frequency modulation (FM).

There's a bit of a catch. For technical reasons, it is convenient to use 30 MHz as the line between HF (high frequency) and VHF (very high frequency). Most shortwave receivers stop at 30 MHz. Until fairly recently, most FM scanners had this for a lower limit.

This division is completely human-made. The ionosphere follows laws of physics, not those made by regulatory bodies in Geneva. There is no single magic frequency where suddenly radio physics change.

At the time this column is being written, there are strange and distant stations appearing all the way to 35 MHz at times. Better cycles than this one have seen band openings well above 50 MHz. This editor's all time record high is around 70 MHz, during an extreme situation caused by a solar flare.

The point, though, is that if it's skip it's DX, and it belongs in this column. Local stuff, however, is definitely for the scanner people.

Fake Numbers Broadcasts

Not everything on utility bands is serious. For example, spoof "numbers" stations appear on occasion. Some make an effort to sound real, while others just sound strange. The 6900-7000 kHz pirate radio band is especially prone to these.

One frequency, which is always good for pirates and general strangeness, was even mentioned in an American TV show. It's 6955 kHz, which was the title of an episode of "Fringe."

This episode first aired in November of 2010. The story concerns a bizarre network of doomsday machines from a parallel universe. This network's numbers station, on 6955 of course,

causes amnesia in anyone who hears it. An investigation begins, and things get steadily weirder from there.

This episode recently aired again, on November 9, 2013. Apparently as a response, an unidentified AM station appeared on 6955 a few hours later. It sent a string of numbers, and then vanished. According to one listener, these numbers did match the ones shown on TV.

It gets better. Following a report from another listener, the longtime numbers/pirate writer Chris Smolinski, crypto fans on several utility mailing lists went to work. The encryption scheme turned out to be a simple letter-substitution cipher, with some character sequences shifted around to make it a little harder.

The middle part was quickly decrypted to "CMDR BUNNY FOR PRESIDENT." Bingo. People who know their pirate radio history will instantly remember the 2007 "U.S. presidential campaign" by a certain on-air character called "Commander Bunny."

This year's fake numbers broadcast, then, is already pretty funny. Now, if its numbers were really the same ones used on TV, it's amazing. Some writer planted one of the all-time TV in-jokes.

HF pirate radio remains a viable scene, especially in Europe and the eastern U.S. While stations can appear anywhere between 6800 and 7000 kHz, there is currently a certain tendency to congregate around 6925 kHz. Their broadcasts tend to be short and low-powered, for reasons that should be obvious, given the complete illegality of these broadcasts. The best times to listen are on European and U.S. weekend nights and holidays.

One of the strangest "real" numbers stations is called the Chinese Robot, for reasons that will soon be evident. There have been persistent rumors of its demise, but these are not true.

Right now, Nick Carrigan and "Token," both on the U.S. West Coast, are hearing this station around 1400 Coordinated Universal Time (UTC). A recent hit was on 8715 kHz USB, but it moves around a lot.

The official keepers of the numbers list, a very dedicated group of very knowledgeable people called ENIGMA 2000, have not given this one an official designator yet. They're waiting for more info on what it is, which may take a while.

For now, its informal designator around the hobby is Ary Boender's VC01. The "VC" stands for "Voice Chip," since that's obviously what it is. Data goes in one end, and this headache-inducing stream comes out the other, straight to the air.

Token notes that he also hears a slow variant, going maybe 90 per cent the rate of the normal 3 numbers per second. Do we need a VC01a designation?

To Western ears, Chinese numbers sound strange enough already, but the robotic pace of this one can be downright unsettling. Sometimes it lasts for hours, or even days. It sounds like some bad guy on an old Doctor Who episode. Several examples are on YouTube. Just search for "Chinese Robot."

VC01's purpose is not completely known. One theory is that it is outputting aircraft tracking data for some sort of military use.

Except in summer, morning in the U.S. Pacific time zone is generally a good time to hear Asia and the Pacific in general. Signals can be very strong. Even F stations can make enough level for a recognizable decode. It's truly amazing what's on from there.

Following a long summer slumber, solar activity picked up markedly in October and November. One active region, number 1890 as they count these things, was huge and very complex in magnetic structure.

People waiting for some real sunspot activity from this anemic cycle were delighted to see this group. It didn't disappoint either, putting out strong and impulsive flares on its entire trip across the visible solar disk.

The delight comes from Cycle 24's odd behavior. It began very late, rose quickly to an impressive enough peak, but then dropped just as quickly to a level not that much above quiet sun conditions. Plenty of sunspots appeared, but they decayed almost immediately to inactive configurations.

A lot was hanging on whether or not this cycle would show a second peak. Now, once the smoothed numbers come out in a few months, we'll very likely see this.

Along with the increase in the strength and frequency of flares, we've seen a similar growth in coronal mass ejection (CME). CME can come from a number of phenomena, all of which seem to be increasing at the moment.

Flares cause the radio "blackouts" that people read about. Everyone should be lucky enough to hear one of these, even though it means unlucky radio propagation. Everything just stops. There's a quick fade, and then nothing. Even the static crackles go away. It's very easy to think one's radio is broken, but actually the ionosphere is broken.

What happens is that extreme ultra-violet and sometimes even X-rays from the sun instantly change the whole ionosphere on the daytime (sunlit) side of the Earth. It becomes thicker, raising minimum usable frequencies right out of HF at times.

Moving higher in frequency can often restore communication, if the blackout isn't too strong. Complete recovery is usually quick after 45 minutes to an hour.

While solar photons moving at light speed get to our planet in minutes, the massive CME particles take more like 36-48 hours. It's sort of like dropping the other shoe.

When and if the CME gets here, it causes a "magnetic storm." This sounds scarier than it is. It starts with a sudden shock that puts this planet's entire magnetic field into motion. Then particles start flowing toward the poles, causing the aurora.

And so, CME's radio effect is just the reverse of flares. Instead of thickening the ionosphere, the resulting magnetic storm tends to thin it. Auroral flutter can appear on signals. Maximum usable frequencies go down, sometimes for days.

This is why one goes lower during a magnetic storm. Sometimes, though, the ionosphere just gets too tired. Then one goes fishing.

Cycle 24 strongly appears to be the beginning of a long, relatively quiet period. These are nothing new, and in fact the data turn up three of them in the millennium just ended.

In fact, Cycle 24's late arrival and general weakness look a lot like the start of the Dalton Minimum. This was three weak peaks between 1790 and 1830. In these, activity became about 60 per cent lower than before, and the peaks got farther apart – just like now.

One interesting theory concerns the sun's magnetic field, which flips polarity at the peak of every cycle. The idea is that the two poles flip separately, and slightly out of phase. When their cyclic periods coincide, there's a high and sharp peak like in 1958. When they slip out again, we get a lower double peak like this year, and finally the low cycles for a while.

TSM

Digital HF: Intercept and Analyze

By Mike Chase-Ortiz AB1TZ/G6DHU mchaceortiz@gmail.com

The Intrigue of Digital Noise

Many of us came into this wonderful hobby of shortwave listening through amateur radio or broadcasting, but a quick look at any chart of the high frequency (HF) radio spectrum shows that there's big world outside of those spaces on the dial. Many venturing into the "utility" sections of HF radio for the first time are greeted with a bewildering variety of strange and unfamiliar digital sounds. With some patience, learning and modest investment in new software and equipment however, these warbles, gurgles, noise bursts, "buzz buzz buzzes" and "zip zip zips," can soon reveal the daily workings of the world's military, diplomatic, maritime, aeronautical, humanitarian aid, peacekeeping, police and intelligence agencies.

The mission of this column is to keep you at the forefront of these organizations and their activities, detailing the frequencies where you can find them, providing you with the tips, tools and techniques to understand their workings and explain the digital technologies they use. Equipped with this knowledge, you'll be able to navigate these exciting new places on the dial, and, I hope, contribute your own findings to some very active Internet communities that cover digital utilities. Above all, let's shed some light in HF's less well known places! If you are interested in tuning in to US embassies, Algerian oil pipelines, Mauritanian Police, Russian Intelligence, Turkish Civil Defense and the Egyptian Ministry of Foreign Affairs, you'll be in good company here.

CW Buzz Buzz Buzz Buzz: What is That?

A case in point, listener Todd in Colorado emailed recently, having just made his first foray into the space above the 11 MHz broadcast band. Here's what he said: "On 12580.00 kHz I am hearing a signal that puts out a buzz buzz buzz buzz then CW and then starts over again. What is this? Always 4 buzzes then CW over and over again."

Intrigued, I switched on my Icom IC7600 radio and tuned to the channel Todd had indicated. Sure enough, there was the signal that he described, a short clip of which you can also download and listen to (see Resources). Next, I started up my decoding software of choice, the Hoka Code 300-32, and selected the module that shows the audio spectrum of the signal in "waterfall" format.

What the Waterfall Saw

This is one of the digital listener's most important tools to help us accurately describe and begin to break down what we are hearing since they allow us to measure both the frequency and time parameters of a signal. Figure 1 (next page) shows what I saw when tuned to Todd's signal after I added measurement markers for time (the two horizontal lines) and frequency (the two vertical lines):

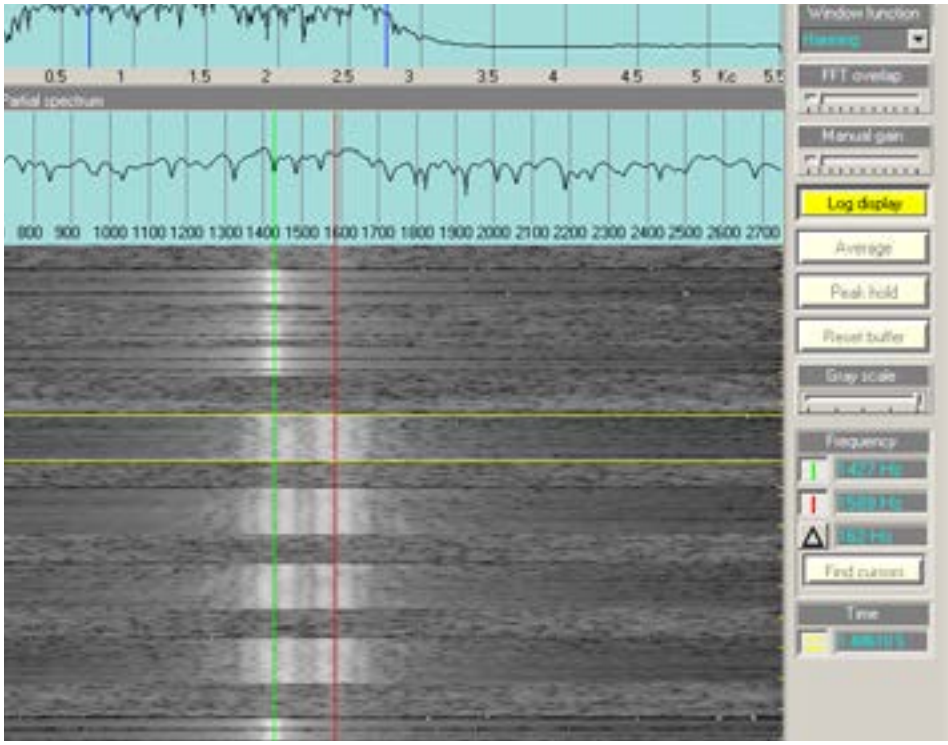
From the waterfall and its four measurement markers, you can easily see that Todd's description fits very well. You can see three letters of Morse code (CW), that are keyed at 1427 Hz above my "dial frequency" of 12580 kHz. This is followed by four bursts (what Todd described as "buzzes") of a two tone digital data signal that has two "legs" spaced approximately 160 Hz apart. You can also see that each of the bursts of digital signal lasts approximately 1.5 seconds. Finally, you can also determine that the center of the digital signal is at 1500 Hz above my dial frequency, making the "center of data" frequency 12581.5 kHz. So, with the aid of this simple tool, we've already discovered an awful lot about the nature of Todd's mystery signal.

The concept of "center of data" frequency is very important, since for most simple digital signals, such as this example, it is the frequency quoted in guidebooks and mailing lists, and it's the correct frequency for you to quote if you want other listeners to be able to tune in accurately and help you identify an unknown intercept. With Todd's example, my dial frequency was 12580 kHz (USB) and the center of data is 1500 Hz above that, at 12581.5 kHz. In this column, I will always take care to note whether I'm quoting dial or center of data frequencies.

Now, I can decipher only the simplest and slowest of Morse code by ear, but if you study the Morse code in the waterfall carefully, you can make out the different lengths of the "dits" and "dahs" that make up each character and the gaps between them that tell us that there are three characters in all.

In the case of the waterfall (next page), time advances down the screen, so the first character is the lowest on the screen. Reading up the screen, our three characters are then "dit dah dah", "dit dah dit dit", "dah dah dah" or WLO. A search on the web will quickly tell you that this call sign belongs to a company called ShipCom and originates from Coden in Mobile County, Alabama. A trip to the FCC database (see Resources), will confirm our frequency of 12581.5 kHz (center of data) and list a staggering 203 additional channels on which WLO is authorized to operate. WLO's license is granted as part of the Coastal Service, so we now know that we are listening to a maritime coast station.

Tuning around 12580 kHz and other maritime HF allocations, you can find many more examples of the exact same signal, coming from all over the world. These "channel markers" or "idle signals" tell ships at sea that the shore station is alive and well, and can be a great way for you to determine the prevailing state of HF propagation. Here are some commonly heard channel markers and where you can find them (center of data):



[Figure 1] From the waterfall and its four measurement markers, you can easily see that Todd's description fits very well. You can see three letters of Morse code (CW), that are keyed at 1427 Hz above my "dial frequency" of 12580 kHz. This is followed by four bursts (what Todd described as "buzzes") of a two tone digital data signal that has two "legs" spaced approximately 160 Hz apart. You can also see that each of the bursts of digital signal lasts approximately 1.5 sec-onds. Finally, you can also determine that the center of the digital signal is at 1500 Hz above my dial frequency, making the "center of data" frequency 12581.5 kHz. So, with the aid of this simple tool, we've already discovered an awful lot about the nature of Todd's mystery signal.

HLF Seoul Radio, South Korea 12916.5 & 22615.5 kHz
HLW Seoul Radio, South Korea 8636.0 & 17130.0 kHz
KLB ShipCom, Seattle WA 8318.0 & 12590.5 kHz
SVO Olympia Radio, Greece 8423.5, 8424.0, 12603.5, 16830.5 & 22387.5 kHz
TAH Istanbul Radio, Turkey 4219.5, 8431.0, 8434.0, 12629.0, 12654.0 & 16886.0 kHz
WLO ShipCom, Mobile AL 6317.0, 8419.0, 8421.0, 12581.5, 12584.5, 16809.0 & 16814.0 kHz
XSG Shanghai Radio, China 12637.5, 12649.5, 16892.0, 16898.5 & 17103.2 kHz
XSQ Guangzhou Radio, China 12613.0, 12648.5, 16880.0 & 22057.0 kHz

Audio spectrum measurement software (see Resources) with a waterfall and measuring tools like the Hoka are available for free with purpose-designed audio analysis applications like Audacity (Mac OS X, Windows and Linux) and Gram and Spectrum Lab (Windows only) and as tuning aids in amateur radio-focused software like Fldigi (Mac OS X, Windows and Linux) and Digipan (Windows only). Try downloading a few and practice tuning into various digital signals to see which works best for you.

Going Deeper

Those four "buzzes" of digital data that Todd mentioned are still largely unidentified. Figuring out parameters such as the speed of the signal (baud rate) and other characteristics requires some more sophisticated tools and techniques. We'll take a look at how to do this in next month's column. In the meantime, feel free to email me with your unidentified signals and any suggestions for topics you would like to see covered in future issues.

Resources

Todd's Mystery Signal
dl.dropboxusercontent.com/u/301213/12580kHzUSB.wav

FCC Search Tools

Audacity
audacity.sourceforge.net

Gram
www.bro.lsu.edu/radio/Spectogram/sgram.html

Spectrum Lab
www.qsl.net/dl4yhf/spectra1.html

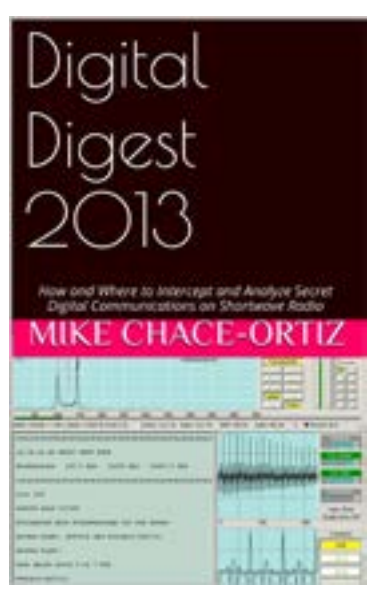
Fldigi
www.w1hkj.com/Fldigi.html

MultiMode
www.blackcatsystems.com/software/multimode.html

Digipan
www.digipan.net

TSM

Mike Chase's Column, "Digital Digest," appeared monthly in Monitoring Times. You can read his previous columns in annual collections now available as Kindle e-books.



Amateur Radio Insights

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

Antenna Tuners: The Devil's in the Details!

When it comes to properly understanding and using amateur radio antenna tuners and feed lines, as you peel away the layers of the onion, you'll discover the little things that can lead to greater and greater understanding of an otherwise esoteric topic—and similarly greater success in using what you know to improve your on-air signal. The Devil, as they say, is truly in the details.

The "business end" of my SGC-231 autocoupler. I wish it still looked so bright and shiny! The large bolt at the upper left is "output ground," while the bolt just above the "Danger High Voltage" label is RF out. It tunes just about any antenna from 1 to 60 MHz in the blink of an eye and handles 100 W PEP (but takes only 3 W to tune). It also requires 12 V dc and, like any tuner, it can't match every possible antenna at every possible frequency. It also has internal losses, so it's no free lunch. It is, however, a crazed band hopper's delight that essentially eliminates feed line SWR losses at all frequencies. After 15 years, it finally needs servicing. See the current version at www.sgcworld.com. (NT0Z photo)

Take auto mechanics, for example. When it comes to maintaining or repairing a vehicle, the average beginning driver, upon encountering a problem, might check to see whether the car is in park before turning the ignition key (or make sure the brake pedal is depressed), but if the car doesn't start, a quick call to a friend, spouse or AAA comes next. Every beginner starts here. There's no shame in it.

A shade tree mechanic might pop the hood to see whether there's a gassy smell, whether there's spark at the plugs, etc. A mechanic at a service station would probably whip out a handy OBD engine trouble code scanner and connect it to the car's service port to see what the onboard computer thinks about the problem. This is a significant step forward in sophistication.

A dealership mechanic, however, another step up the knowledge tree, might know, right off the top, that when a specific make and model exhibits a particular symptom (not starting for no apparent reason), that the ignition switch, which is frequently faulty, often causes the problem and the fastest, least expensive option is to simply replace the switch.

That's high-level knowledge, but if you could talk to the manufacturing engineer who designed the switch mechanism, you might discover that simply reattaching a single wire that's prone to disconnecting from its connector on the back of the switch would fix the problem all by itself (and that replacing the switch mechanism requires reattaching the same wire to the now-new ignition switch).

Further, if you could talk to the vice president of ignition switch procurement and development, you might learn that the switch/connector mechanism was known to be faulty from Day One, but that the company decided to use it—and kept using it—because it almost always failed outside the car's warranty period, generating little consequence to the company's short term bottom line (probably providing a nice bonus for the VP because the faulty switch was inexpensive).

Yes, I'm paraphrasing from experience here (the manufacturer starts with "F" and it's not Fiat or Ferrari) to illustrate that there are secrets—and secret knowledge—behind every beginner and intermediate "rule of thumb" in amateur radio (and just about everything else), and the more layers you peel away, the more profound your understanding and success.

When it comes to antenna tuners, beginner and intermediate wisdom is to feed backyard multiband wire antennas (dipoles and vees intended to be used on multiple bands) with 50-ohm coax and use a manual or automatic antenna tuner in the shack to make everything work just right.

This can work well (hence the practice's reputation), but it can also be a signal killing disaster for a variety of reasons, many of which merit future columns of their own. Figuring out when to use, how to use, and which type of antenna tuner to use in any situation is often confusing. A lot of "accepted wisdom" is just plain wrong.

Standard Deviation

Secret Wisdom: Whether manual or automatic, shack-mounted antenna tuners feeding coax-fed antennas should ideally be used to make minor adjustments to antennas that are already "mostly resonant" (the antenna presents a feed point impedance that's not too far above or below 50 ohms).

Tweaking a dipole cut for 80-meter CW to work SSB on the high part of the band is a good example. If a dipole is resonant at 3.6 MHz, the impedance transformation required to get a match on 3.9 MHz isn't too extreme, and the SWR losses on the coax itself aren't significant. Using a shack-mounted tuner to enable operation on 15 meters with a 40-meter dipole often works well, too, because a 40-meter dipole is reasonably resonant on 15 meters (21 MHz is close to being an

odd harmonic of 7 MHz).

If you can't use better configurations (discussed below), a reasonable rule of thumb is to limit this classic beginner setup (tuner in shack, coaxial feed line, single antenna in back yard) to the antenna's fundamental frequency (the lowest band at which the antenna is reasonably resonant) and up. Use a 40-meter dipole or Vee from 40 through 10 meters, use a 20-meter dipole from 20 through 10 meters, etc.

This "fundamental and up" approach works OK with dipoles and Vees, which have higher-order, odd harmonic resonances. But it works even better with closed, full-wavelength loops (preferably horizontal), which have higher-order, even and odd harmonic resonances, which makes the "fundamental and up" approach work even better when it comes to minimizing SWR losses on the feed line. Impedances and efficiencies vary, but it's safe to assume that SWR-related feed line losses with most "fundamental and up" setups will range from 2 to 8 dB. Those losses are tolerable, but not ideal.

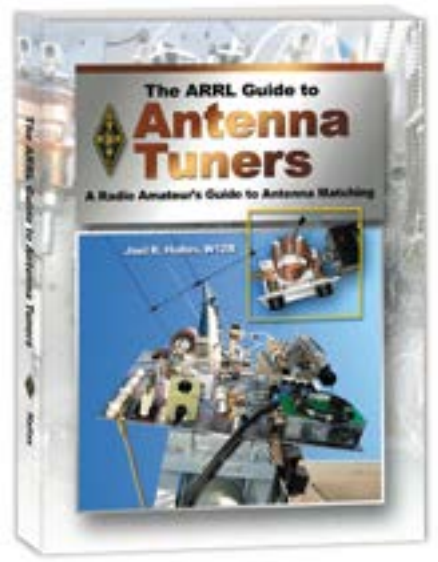
So, what happens if you try to "go the other way" and use this setup to load a 40-meter dipole on 80 meters, or an 80-meter dipole on 160? Plenty. And it's all bad!

When used on 80 meters, a coax-fed 40-meter dipole represents an extreme impedance, and even if your antenna tuner—essentially an adjustable impedance transformer—can match it, the SWR on the feed line that runs from your tuner to your antenna will be very high. Ignoring losses in the antenna tuner itself (often considerable), under high SWR conditions your coaxial feed line might waste 20-25 dB of your precious transmitter power! If your radio puts out 100 W, only about 1 watt will make it to your antenna!

Higher Wisdom: Feed line losses specified for each type of coaxial cable assume a 1:1 SWR (a perfect match)! The more your match deviates, the more losses you will incur. Your rig and your SWR meter will be perfectly happy even if your feed line losses are staggering. Remember, dummy loads, which are designed to absorb all RF power presented to them by converting RF to heat, present a perfect match to your rig and tuner! If your feed line is behaving like a dummy load, your radio and your SWR meter will be happy as a clam, but your on-air success will be dismal and you may not know why.

Solutions

So, if you need to keep your antenna tuner in your shack—especially if you want to use an antenna below its design frequency—consider replacing your coax with 450-ohm ladder line or true open-wire line. In this scenario, when compared to coax, 450-ohm line is essentially lossless! In settings where coax SWR losses might reach 3 to 30 dB



For an in-depth treatment of many of the topics covered this month, pick up a copy of The ARRL Guide to Antenna Tuners: A Radio Amateur's Guide to Antenna Matching by QST Technical Editor Joel Hallas W1ZR. Topics include: internal vs. external tuners; coaxial vs. open-wire feed lines; balanced and unbalanced tuners; baluns, ununs and chokes; antennas that work well with tuners; and how to build your own tuner. The 160-page ARRL Guide to Antenna Tuners is available from your favorite amateur radio bookseller or from www.arrl.org. (ARRL photo)

(using an 80-meter dipole on 160 meters, for example), ladder-line losses might be 0.3 to 6 dB. That's a staggering benefit from ancient technology. Open-wire line isn't always easy to manage and install, however, which is one of the reasons why coaxial cable became so popular in the first place.

Most conventional antenna tuners are designed primarily for coax-fed antennas and usually don't work to their full potential when feeding open-wire lines. The problem is with the balun transformer required to accommodate balanced lines and keep them electrically "balanced," which is critical to overall performance, minimizing RFI, etc. If you're making the move to ladder line, consider building or buying a tuner designed expressly for balanced lines. MFJ and other manufacturers still produce these, and you can even find some dandy vintage balanced tuners at flea markets (set your sights on a Johnson Matchbox, the granddaddy of balanced-line tuners).

Because of SWR losses, you may be wondering about the relative wisdom of putting your antenna tuner in your shack instead of putting it at (or near) the feed point of your antenna. That's good thinking, indeed! Often called autocouplers, automatic tuners designed to be mounted at the antenna feed point are wide-range units built inside weather-resistant enclosures. When you transmit, an internal circuit measures the SWR and automatically configures capacitors and inductors inside the coupler to maximize the power transferred to the antenna (exactly like internal or in-shack autotuners, but without the potentially horrible SWR losses on the feed line).

Mounting the autocoupler might be a bit of a chore, but that's offset by the fact that, once installed, you don't have to do anything but transmit! You can switch bands at lightning speed because autocouplers typically take one to five seconds to do their magic, and most remember multiple tuning solutions, which greatly reduces tuning times in the future.

Autocouplers aren't magical devices, but they often seem that way. They require DC power, for one thing, and can get balky because they're outside in scorching summers and freezing winters. But, they do make SWR losses on the feed line that runs from your shack to your antenna a thing of the past. As a crazed band hopper, autocouplers are my favorite way to use a single antenna on multiple bands. Look for units manufactured by LDG, SGC, MFJ, CG Antenna, and others.

Efficiency

Although designed to minimize antenna system SWR losses, antenna tuners suffer from internal losses, which can sometimes be quite high. Even if a particular tuner can find a match on a certain frequency with a certain antenna, the losses inside the tuner can be huge. Every transformer has a certain amount of loss, and an antenna tuner, regardless of its specific design or network topology, is essentially an adjustable transformer.

The ratio between tuner input power and tuner output power defines its efficiency (internal losses). Top-quality tuners usually have losses in the 5% to 15% range, depending on load impedances, but losses can soar to 50 percent and even 60 percent with certain designs under certain conditions. More than 10 years ago, the ARRL Lab started measuring the internal losses for tuners that made it into *QST*'s Product Review pages. Some of the results were surprising. Not every expensive tuner has low internal losses under all conditions, and some "really affordable" models perform admirably.

In general, though, bigger is better. That is, physically large components usually offer reduced losses, and you can never be too rich, too thin or have an antenna tuner that's too beefy. Matching certain loads can produce extreme RF voltages, so don't be afraid to use a 100-W tuner for QRP work or a kilowatt tuner for "barefoot" operation.

Internal losses are often at their worst when matching antennas on 160 meters, or when matching extreme load impedances, such as the strangely popular 43-foot vertical craze that's sweeping the scene. It presents horrible, hard-to-tune impedances on almost every band! Don't use a shack-mounted tuner unless you want a 43-foot dummy load! In this case, the matching network or autocoupler must be mounted at the base of the antenna.

In the early 1990s, when testing a particular "300-W" antenna tuner on 160 meters with a lab-induced "high SWR," a plastic insulator on the tuner's main roller inductor would burst into flame as I keyed the 100-W transmitter! On all other bands, where the efficiency was much better, the tuner worked fine and had reasonable losses.

SWR Loss Comparison for Belden 8214 Coaxial Cable and 450-ohm Ladder Line

The antenna is a 66-foot dipole (resonant at 40 meters) fed with 50 feet of each respective cable.

Frequency (MHz)	Loss (in dB) 8214	Ladder Line
1.9	26.9	8.62
3.8	13.7	1.37
7.15	0.19	0.07
10.14	2.85	0.07
14.27	5.3	0.15
18.14	6.96	0.31
21.4	0.78	0.12
24.9	3.94	0.13
28.5	5.69	0.18

Notes: These numbers show why it's a bad idea to use a coax-fed dipole on frequencies below resonance, and why open-wire line should be used if an autocoupler can't be placed at the antenna feed point. Note that, at resonance (7 MHz), coax and ladder line each have negligible SWR losses, and that this condition essentially repeats itself at 21 MHz, where the antenna impedance is reasonably close to 50 ohms. On other frequencies, however, even those that are above resonance, ladder line SWR losses are significantly lower. On 80 and 160 meters, a coaxial feed line essentially becomes a dummy load, while the ladder line is perfectly usable (especially on 80 meters). If an autocoupler were placed at the antenna feed point, SWR losses on all bands would range from 0.1 to 1.0 dB.

Closing Thoughts

For the most part, antenna tuners are practical only at HF and down. Unless you're using an antenna-mounted autocoupler on 6 meters—which works great, as I use a 40-meter loop antenna on the Magic Band—forget about using antenna tuners at VHF/UHF. Feed line losses increase rapidly at these frequencies and antenna tuners are rarely useful. The only real solutions above 6 meters is to use high-quality, low-loss feed lines and well-matched antennas. If your rig has a built-in autotuner, it probably isn't designed to match wide-ranging loads (lots of hams find this out the hard way). That doesn't really matter, because unless your rig is at or near your antenna's feed point, using it with a single wire, multi-band antenna probably isn't a good idea anyway. Do use your built-in tuner to enable an existing antenna to operate across an entire band, etc.

Back in the days when tube transmitters ruled the airwaves, most rigs had pi-network outputs that could tune and load just fine into a much wider range of feed line impedances (the difference would make a modern solid-state transmitter blush). But even today, if the SWR at your operating frequency is 2:1 or less (maybe even 3:1), chances are good that you don't even need an antenna tuner. Most modern rigs will tolerate an SWR of 2:1 or less with no difficulty and still put out full power. Remember, all antenna tuners have internal losses, so don't add a tuner to your system if it's not required.

Mastering when and how to use antenna tuners (and with which feed lines) can dramatically enhance your enjoyment and success with amateur radio, so there's no time like the present to get "tuned" in!

TSM

Radio 101

By Ken Reitz KS4ZR **ks4zr1@gmail.com**

Antenna Solutions for Hams and SWLers

This column, Radio 101, is *TSM*'s version of the Beginner's Corner, which I wrote for the last 13 years in *Monitoring Times*. While it's intended as an introduction to all shades of radio, from shortwave listening to amateur radio to Free-To-Air satellite TV, many veteran monitors can gain some useful information here too.

As longtime MT readers know, I started as a SWLer in 1965, when I built a Knight-Kit Star Roamer shortwave radio. I've been listening ever since. As an amateur radio operator since 1988 and Extra Class licensee since 1999, I've always been interested in amateur communications including CW (Morse code), digital modes (PSK31, RTTY and Slow Scan TV), single sideband (SSB) and amateur radio satellites. I find it all endlessly interesting and whenever there's something new to monitor, I have to give it a shot. That's what this column is designed to do; expand your radio horizons.

The Antenna is Everything

For this first issue, I'm going to look at something fundamental to us all. When it comes to longwave, shortwave and broadcast band DX, the receiver is one thing, but the antenna is everything. Most people believe that they don't have room for a decent sized antenna for longwave through 30 MHz, or that such antennas are too expensive.

One thing I've learned from the past few years of doing Field Day with "found" antennas is that, if it's aluminum, it will radiate RF and, if you can attach a feed line to it, you can put out a signal.

I've used everything from a small roll of magnet wire tossed across a tree limb; a 21 foot aluminum extension ladder leaned up against the house and various lengths and heights of rain gutter and downspout to work other amateurs hundreds, even thousands, of miles away on just five or 10 watts.

Most of my antenna supplies I get at the local Tractor Supply Company (TSC). You can buy a lifetime supply of aluminum antenna wire (they call it "electric fence" wire) for $42. You get one-quarter mile of 14 gauge antenna wire, I mean fence wire, which TSC even describes as if it were to be used to work DX, "1/4 mile aluminum wire for electric fences comes on a spool for ease of use. It has a breaking load of 215 lb. and tensile strength of 38,000 PSI and conducts 4 times better than steel wire. This wire won't rust, either!" What more do you want in antenna wire?

If you're balking at spending $42 for a quarter-mile of antenna wire, go in with a couple of friends from the local ham club and split the difference. There are 1,320 feet in a quarter mile. With four "investors," each ham or SWLer gets 330 feet of antenna wire to play with for a little over $10 each. With two investors, each gets 660 feet.

And, don't bother going to Radio Shack for plastic insulated feedline supports. TSC has them 25 to the bag for just $10. And, they come complete with nails already to pound into fence posts, house siding, trees, you name it!

Want to build a nice-sized, stealth antenna? Try this. Measure the outside of your house. Let's say it comes in at 75 feet by 30 feet. That's a typical 2,250 square foot house. Run to Tractor Supply Company and get your antenna supplies: a quarter-mile spool of wire and a bag of nail-on insulators. Go to a hobby shop and buy a can of spray paint that closely matches the color of your house (unless, of course, your house is bright yellow!).

Outdoors, and away from anything you don't want painted, set the insulators on a tarp. Spray paint the the insulators on one side. Wait until dry, and do the other side.

Now, get a stepladder and hammer in the insulators six inches to a foot from the top of the wall near the facia and soffit (the two trim pieces that make up the overhang of your roof). Start at the

Screw-in ceramic insulators ($2.50 each) and heavy-duty plastic corner insulators ($4.50 each) such as these from Tractor Supply make going to TSC your one-stop antenna shop. (Courtesy: Tractor Supply Company)

One-quarter mile of aluminum fence wire from Tractor Supply Company ($42) will give you a lifetime of antenna material to play with. (Courtesy: Tractor Supply Co.)

Plastic off-set insulators designed for electric fence use are perfect for stringing long lines of wire antennas. These come 25 to a bag and cost $10, nails included! (Courtesy: Tractor Supply Co.)

The versatile MFJ 4603 antenna feed through ($90) is a radio operator's dream: eight antennas can be fed through this panel including random wire, "F" connector, "N" connector, one balanced line and four four UHF connectors for scanner antennas, 2-meter beams and more. It even has a ground connection! (Courtesy: MFJ Enterprises)

window just above where your shack is located. Roll out the wire and insert it into the stand-off insulators around the house until you come back to where you started. The wire should be tight enough so that it doesn't sag and draw attention to itself.

Use RG/6 coax cable and wire nut the center conductor to one pigtail of the center connector ($20 from MFJ Enterprises). Now, wire nut the copper shield of the coax to the other end of the loop. Run the coax into the house through a discreet hole in the wall or use an MFJ 4603 eight-antenna feed through ($90). You might find something less expensive but you won't find anything as versatile. This feed-through lets you connect up to four standard PL-259 antenna plugs, one "F" connector, one "N" connector, a two-wire balanced line (ladder line, for example), a random wire, a ground wire, DC terminals and a single cable feed-through. It's the last cable feed-through you'll ever need.

Having finished your installation, you will have made a 210 foot horizontal loop antenna that will bring in DX from every direction. And, depending on how far off the ground the top of your wall is, it could be up to 15 feet high (ground floor) or up to 30 feet high (second floor), depending on how far up the wall is from the grade of the land, etc. Either way, your antenna will be out of the reach of innocent bystanders and visitors.

Don't be fooled by this antenna's lack of height. It will be a far better performer than a dipole or random wire antenna because the more wire you can put in the air, the more signals you can capture. Plus, this antenna will be omni-directional; it will be a great performer on the shortwave bands, the ham bands, AM broadcast, you name it. As I really like having just one antenna to worry about. The horizontal loop lets me listen to all HF frequencies and transmit on the ham bands without the need to tune up when chaning bands

All Antennas Have Shortcomings

Of course, you have to remember that all antennas are a compromise. This antenna will have some shortcomings. On the AM broadcast band, because you've got a loop, and it is omnidirectional, you will not be able to null out competing signals on the same frequency coming from different directions. But, strong stations will come in so well, you'll think they're locals.

My loop is not around the house, but around an open field. It's 480 feet in circumference and the omnidirectional capabilities work to my advantage as a ham working DX. While dipole users bemoan the fact that the rare DX station may be off the end of their antenna and barely readable, on the loop, the DX will come in no matter the compass location.

Here's a recent example. As this is written, in mid-November, several DXpeditions are underway. XRØZR, Juan Fernandez Island, Chile, is 5,000 miles away due South from my location. This afternoon I worked them on 10, 12 and 15 meters within one hour.

The other day the K9W DXpedition to Wake Island in the Pacific was also active. Located almost 7,000 miles due West of my location, I worked them on 20 meters. My loop is not in optimum shape. Thanks to high winds that we had experienced in the last few months, I relieved the tension that kept the loop at 30 feet and let the whole antenna drop to the point where it is no more than 15 feet off the ground in some areas. Remember, too, that I'm using a standard issue, 100 watt, Kenwood TS-140s transceiver that's over 25 years old; no amps, no tower, no expensive beam antenna on a rotator, not even Digital Signal Processing (DSP); just an old ham rig and aluminum electric fence wire from TSC.

More Stealthy Options

A really great opportunity for a stealth antenna might be found in the ubiquitous privacy fence found all across America's suburban yards. If you're worried about the look of a wire antenna on the front of your house, try keeping it in the backyard. Using the fence and the back of your house, you might end up with a decent sized HF loop.

Another advantage this antenna will have, particularly compared to an attic-mounted loop, is that it is outside and away from a lot of household-generated noise. Plus, it's going to be very hard for nosey neighbors from the neighborhood antenna-police to see.

OK, even though it may be protected from electrical hash generated by your home, it might be susceptible to extensive noise from nearby, RF-leaky power poles, digital cable-TV installation boxes and weird electrical devices your neighbors might have, that you don't know about. You won't know until you do the installation. But, in the event that you do encounter HF noise of an unknown origin, you might be able to take most of it out with your built-in DSP, something my older rig simply doesn't have.

With an antenna up against the house and out to the fence (above head height!) you should limit the power output. There's no need to transmit more than 50-100 watts; there's never a need for an linear amplifier, because making your own signal louder won't help one bit to make weak signals come in stronger. Nobody wants to be an alligator (all mouth, no ears). If you're using the digital modes you should never operate more than 10 or 15 watts anyway to keep your very narrowband signal clean.

While good fences do indeed make good neighbors, you can help things along by asking your neighbors to help

Modern shortwave radios and amateur transceivers have built-in Digital Signal Processing. But, many shortwave listeners and hams have older rigs not so well equipped. MFJ's 784B Tunable DSP filter can be just the thing to help block out adjacent channel interference and dull the effects of QRN and local QRM. At $250 from Universal Radio, it's not cheap, but then, neither is buying a new rig! (Courtesy: MFJ Enterprises)

One of the simplest and cheapest solutions to shortwave reception is adding an antenna tuner (or preselctor) such as the MFJ-956 ($65). It covers 150 kHz to 30 MHz. (Courtesy: MFJ Enterprises)

with your extensive antenna projects. Normally, if there's no expense on their part, no liability to assume and nothing illegal involved, friendly neighbors will do what they can to accommodate each other.

A reader once wrote to me that he was able to convince his friendly neighbors, who occupied several lots in one direction, to let him string an antenna along the backside of their property. The result was that he had a nice mini-Beverage antenna that ran for several hundred feet. His longwave and AM reception had never been so good! Consider doing this at your location.

Extensive listening antennas, such as I've been describing, are easier to use than transmitting antennas. First, with no transmit power applied, there's little danger of humans coming into contact with your active, low-hanging wire. Antenna matching is not an issue with SWL because there is no Standing Wave Radio (SWR), reflected power, to be concerned about. Even so, you can improve HF signals by passing the antenna feed first into an antenna pre-selector such as the MFJ-956 ($65 from Universal Radio), which covers longwave through 30 MHz and acts to boost the signal your receiver is tune to and limits the strong intermodulation and images created by nearby transmitters or devices referred to by the FCC as "unintentional radiators."

For transmitting antennas, it is a different story. You have to be concerned about pets, animals, neighbor kids and random visitors coming into contact with your antenna while you are on the air, that's why you need to keep your antenna up and out of reach.

Loop VS Beam

For years I had a CushCraft A3S three element tri-band beam for 20, 15 and 10 meters. It worked extremely well and I worked a lot of great DX with it. At times it almost seemed unfair. With just 100 watts and the ability to aim at specific areas of the globe, the DXCC count quickly rose, especially working the digital modes.

But, beams have drawbacks. The A3S is about the smallest three element tri-bander on the market and even it requires a substantial support. You've got to have a place big enough to swing its 28 foot reflector element, not an easy thing to do if you have trees near your house. It needs to be at least 30 feet in the air to really take advantage of the Yagi's properties.

I was able to mount the A3S on three lengths 10-foot TV antenna against the gable end of the house. But, without an expensive heavy-duty antenna rotator, to turn the antenna required going outside and manually turn the antenna (this is referred to as the Armstrong Method). During inclement weather, this was not so much fun.

Other issues with a beam included heavy wind loading during ice storms, a frequent occurrence all winter long in Virginia, which could potentially damage the elements and having to mount the antenna on the top of the mast to begin with. That was a tricky Wallenda-style escapade that had me walking along the peak of the second-story roof carrying a thirty pound antenna with a 14 foot boom and 28 foot reflector, in a decent wind. I won't be trying that again.

The more I recollect that antenna installation the more satisfied I am with the horizontal loop, drawbacks and all!

TSM

Radio Propagation

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

In The Beginning...

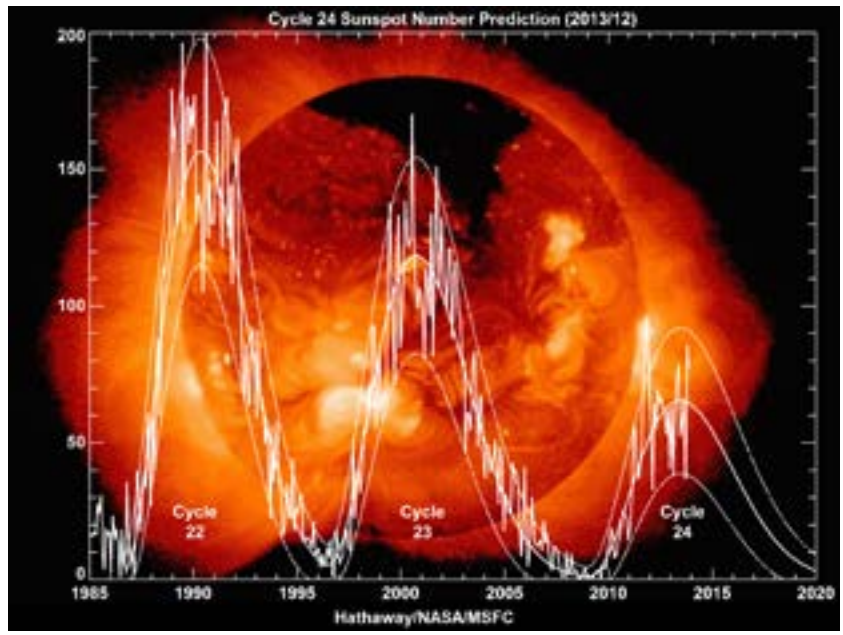
For thousands of years – perhaps since the dawn of human perception of the sky above – the sun has held our interest, sparking curiosity if not devout worship. In the days of antiquity, Chinese observers noted spots on the Sun, and many cultures had stories about the powerful influence of the sun over all of life.

When the enterprising Italian physicist, mathematician, astronomer, and philosopher, Galileo Galilei, improved the telescope and began exploring the visible solar disc with his scientific discipline, he launched a journey of discovery about the sun that has become a critical part of modern science and technology.

Today, a number of universities offer degrees and courses in solar physics, space weather, radio propagation, and related topics. There are scientific journals and magazines devoted to nothing else. Many governments have organizations funded and tasked to study space weather, and provide forecasting and live reporting of the sun-earth connection. Even in the private sector, commercial enterprises have been launched to leverage the science of space weather.

Yet, with all of the monumental discoveries about our life-giving star, myth and legend permeate our culture and conscience, with a seemingly increased infatuation with fantastic rumors and explanations of current terrestrial storms, the human condition, and the fragility of our modern infrastructure. Movies, such as "Frequency," and the Canadian made-for-TV sci-fi thriller, "Exploding Sun," perpetuate pop-science but do little to educate the masses with solid, well-grounded understanding of our solar system's dynamic star.

This column has a mission: to educate about, inspire with, and report on the sun, the sun-earth connection (often referred to as "space weather"), and the geophysical aspects of the Earth's Magnetosphere, geomagnetic field, and the Ionosphere.



Three cycle display from 1985 through 2020 shows propagation going down with each succeeding cycle. . (Courtesdy: Hathaway/NASA/MSFC)

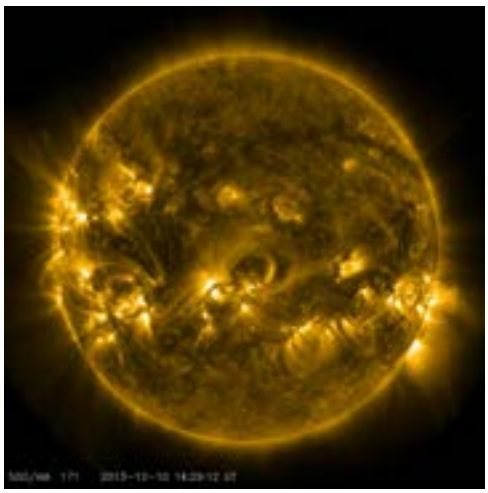
Radio signal propagation, with an emphasis on ionospheric propagation, is more than a passing topic for the radio communicator, as this science is the foundation of the hobby. Space weather directly affects how our radio signals get from transmitter to receiver, even above the shortwave radio spectrum. Space weather affects satellite communications, VHF weak-signal communications, and more.

I first became aware of space weather in the early 1970s, when a chance tuning of the shortwave radio dial landed on the United States National Institute of Standards and Technology's radio station, WWV, in Fort Collins, Colorado. At eighteen minutes after the top of each hour, a solar and geophysical report is broadcast that provides the latest sunspot count, the 10.7-cm radio flux, and the condition of the Earth's geomagnetic field. A forecast is also provided. This began a life-long study and interest in space weather, as well as how space weather affects radio communications.

While this might seem to be a topic requiring the brain power necessary to understand rocket science, this column dispels such notions with an approachable discussion that brings the complexity of physics and theory into an every-day application of facts and figures. Each month, space weather concepts and the science of radio wave propagation is explored, and a report of recent conditions and events are provided, so that you gain a working knowledge that translates to better radio communications as well as an appreciation of the science behind our hobby.

Additionally, you will be able to hold your own during heated discussions around the water coolers and hamfest tables when the topic of X-ray flares, coronal mass ejections, and solar storms capture the imagination of the community. With the edge you gain through the monthly study of this column, your experience with

Solar Dynamics Observatory (SDO) Investigating the causes of solar variability and how space weather results from that variability. Already into its third year, the satellite could last another seven years. (Courtesy: NASA/SDO)



What the satellite sees: Latest image of the sun from the SDO just days before this issue is published. (Courtesy: NASA/SDO)

daily on-air radio communications will be enhanced in new and exciting ways.

Space Weather and History

A Chinese astronomer, Gan De, made notations about sunspots in a star catalogue in 364 BC ["Early Astronomy and the Beginnings of a Mathematical Science". NRICH (University of Cambridge). 2007]. By 28 BC, Chinese astronomers included sunspot observations in the official government records ["The Observation of Sunspots". UNESCO Courier. 1988]. In Western records, the earliest observation mentioned was around 300 BC, as detailed by the Greek scholar Theophrastus (a student of Plato and Aristotle) in his book on predicting terrestrial weather. He wrote in "De Signis Tempestatum" about black marks on the sun, as signs of rain. In A.D. 807, Adelmus reported on a black spot on the sun that remained visible for eight days.

In the "Chronicles of John of Worcester," the first known Western drawing illustrated "two black circles" appearing on the sun on December 8, 1128. Thomas Harriot, Johannes and David Fabricius, and Galileo Galilei were among the first Europeans to make telescopic observations of sunspots in 1610.

The study of the sun that ensued in 1610 shook the scientific world because it revealed our nearest star was rotating. This implied that our solar system might be more dynamic than ever imagined, contrary to the long-held theory of Aristotle that all celestial bodies were perfect, unchanging spheres.

Heinrich Schwabe discovered a cyclic variation in the number of sunspots between 1826 and 1843, inspiring Rudolf Wolf to begin systematic observations of the solar disc and sunspots in 1848.

The "Wolf number" became a measure of individual spots and spot groupings. Solar observations have been made nearly every day, since. The cyclic nature of the appearance of sunspots were confirmed, and we now have many cycles in record, all of which reveal that the Sun has a sunspot cycle that lasts approximately eleven years from a period of no sunspots, through a peak period with many daily sunspots, back to a period of no sunspot activity. This is known as a "Sunspot Cycle" or "Solar Cycle." Currently, we are in Sunspot Cycle 24 (the 24th observed cycle since regular observations began).

Radio Wave Propagation and History

At the dawn of the modern industrial revolution, the idea of wireless communications held the fascination of inventors and scientists. Experiments involving inductive and capacitive induction in different mediums such as the ground, water, even railroad tracks were tried. James Clerk Maxwell theorized through mathematics that electromagnetic waves could move (propagate) through the air. It is possible that the first experimental transmission of an electromagnetic wave (a radio wave) was in 1880, by David Edward Hughes, though at the time, this was considered induction rather than free-space transmission.

In 1888, the infamous Heinrich Rudolf Hertz conclusively proved that Maxwell's theory of electromagnetism was true, by transmitting electromagnetic waves through the air. We now measure the cycles per second of an alternating current of electricity, and also of radio waves, in a unit known as the "Hertz," in honor of his contribution. (One Hertz is one complete cycle; the shortwave radio spectrum contains all of the radio frequencies between 3 and 30 million Hertz; Mega-Hertz, abbreviated, MHz).

It is commonly held that the first amateur radio hobbyists (who were amateur scientists and inventors) discovered long-distance communication with radio waves, when they were able to communicate far beyond the reach of ground-wave and line-of-sight distances. Such communications caused many to speculate on how these radio waves propagated over such long paths.

Oliver Heaviside and Arthur Edwin Kennelly, in 1902, described a model for a layer above the Earth by which a radio wave could be "reflected" back to Earth, allowing for the propagation of that radio wave far beyond the reach of ground-wave and line-of-sight transmissions. This layer was known as the "Kennelly-Heavyside Layer."

Others postulated about the existence of an "ether" by which this kind of propagation was possible. Edward Appleton was awarded a Nobel Prize in 1947 for confirming the existence of the ionosphere in 1927. Scottish physicist Robert Watson-Watt introduced the term, "ionosphere" in a letter published only in 1969, in the publication "Nature." Lloyd Berkner first measured the height and density of the ionosphere.

Many scientists joined the quest

for an understanding of the ionosphere, and to this day, research continues. Even amateur radio hobbyists lend their efforts to reveal new aspects of radio wave propagation by ionospheric propagation.

The Modern Scientific Landscape

Since the 1950s, models have been created and refined that provide an understanding as well as analysis and prediction of ionospheric characteristics and variations. Software that relies on various models has found a place in the toolset of many amateur radio communicators.

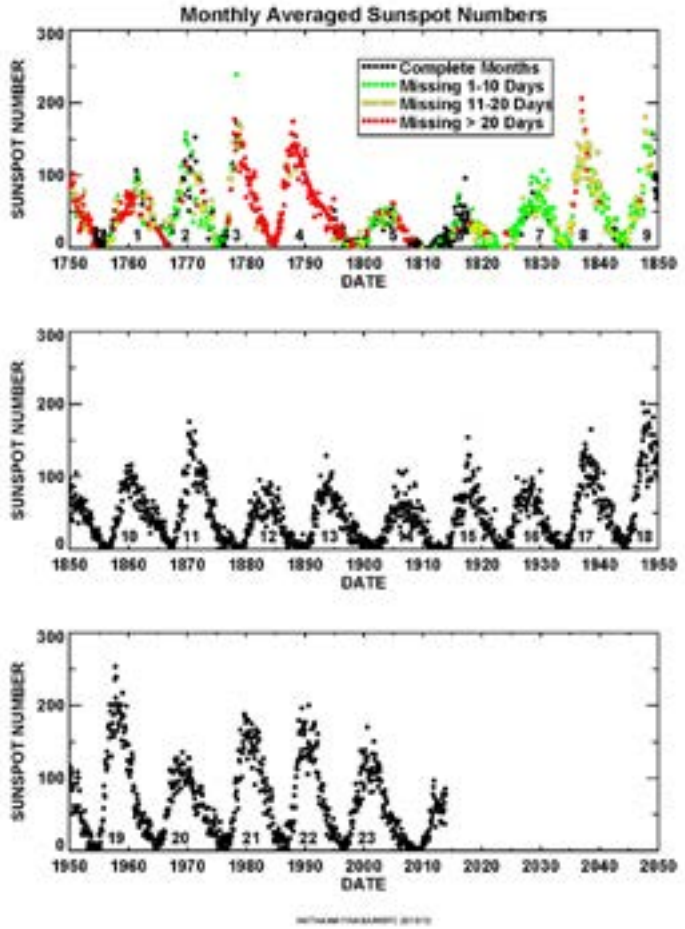
Institutions such as NASA provide live and historical data on the Sun-Earth connection, from solar wind conditions to the X-ray flare and coronal mass ejection data collected by dedicated spacecraft. This information is available to anyone interested, easily accessible through various Internet resources. Digital radio modes such as WSPR, PropNET, JT65A, and JT9, and networks of stations using these modes have been created to help the amateur scientist explore daily propagation conditions.

This column is your gateway into this world of scientific research, reporting, and leverage of the wealth of knowledge and data. Each month, a topic will be explored to help you gain a better understanding of this information. Current sunspot cycle activity is reported and put into perspective. Your feedback is also considered; your questions will be answered, and your observations shared. Join in, each month, as the journey in this exciting world moves ahead.

Solar Cycle 24 Today

There is a lot of speculation in the amateur radio community regarding the current sunspot cycle. Debates on the near future demise of sunspot activity, a possible period when there will be no sunspot activity for an extended "minimum" that could last for several eleven-year cycles, rages on with even the postulation that the Earth will see a mini-Ice Age. The sunspot minimum between the last cycle and this cycle was longer than many in recent history, and much was learned during this time about radio wave propagation and the ionosphere. The facts do reveal that this cycle is the weakest in at least one hundred years. Are we seeing a second peak, though? We'll know, soon.

The Dominion Radio Astrophysical Observatory at Penticton, British Columbia, Canada, reports a 10.7-cm observed monthly mean solar flux of 132.3 for October 2013, the highest since July 2012 when it was 135.6. The twelve-month smoothed 10.7-cm flux centered on April 2013 is 116.6. The predicted smoothed 10.7-cm solar flux for January 2014 is about 131, give or take about 17 points.



Sunspot numbers through the centuries 1760-2013. Courtesy: Hathaway/NASA/MSFC)

The official keepers of sunspot records, the Royal Observatory of Belgium, reports that the monthly mean observed sunspot number for October 2013 is 85.6, the highest since November 2011 when it was 96.7. The twelve-month running smoothed sunspot number centered on April 2013 is 57.9. A smoothed sunspot count of 78 is expected for January, 2014, give or take about 12 points.

The observed monthly mean planetary A-Index (Ap) for October 2013 is 7. The twelve-month smoothed Ap index centered on April 2013 is 7.2. Expect the overall geomagnetic activity to be quiet to active during most days in January.

Feedback Requested

Do you have propagation-related questions, or a topic related to the sun, the Ionosphere, or the sun-Earth connection, that you'd like answered? Please send in your questions and comments, for possible inclusion in this column. This is your chance to unlock the mystery of this exciting area of science and communications. I have a website dedicated to space weather, at **http://SunSpotWatch.com** and a Facebook page at **https://Facebook.com/spacewx.hfradio**, so please take a look. On Twitter, radio propagation and space weather Tweets are provided in regular updates by @hfradiospacewx and may follow me @NW7US. Until next month, may your radio journey be exciting and rewarding.

TSM

We are very pleased to announce the publication of the 2014 edition of *World Radio TV Handbook*, the best-selling directory of global broadcasting on LW, MW, SW & FM

The Features section has a History of SW Broadcasting, a look back at Broadcasting in Sri Lanka, reviews of the latest equipment, an article on Voice of Vietnam, along with other articles and items, including a glimpse of the *Digital Future*.

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

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

Available December 2013

SOME COMMENTS ON WRTH 2013

World Radio TV Handbook 2013 is a publication that has arguably achieved cult status. It rates as a classic among many short wave listeners and those interested, both professionally and through their hobby, in national and international broadcasting – *Radiouser*

The *World Radio TV Handbook 2013*, is the ultimate directory of global broadcasting for a worldwide radio audience. *WRTH* continues their tradition of producing the very best, most comprehensive and most authorative radio reference book. It is an exceptional annual guide – *Gayle Van Horn, Monitoring Times*

Multiple Information for radio professionals and interested DXers found nowhere else. Highly recommended – *Dieter K. Reibold, Germany*

I have bought the *WRTH* every year since 1976 and find it a valuable aid to my listening hobby – *John Fisher, USA*

I've been reading *WRTH* since 1965. It has been a "bible" – *Alexander Dutkewych*

I have been using your new 2013 edition of the *WRTH*. It is an amazing book, all you need for a shortwave listening guide – *David Clark, USA*

Astonishing content, a radio listener's "bible". All found easy, no complaints – *Olof Rautavaara, Finland*

I just bought the *WRTH* book for the first time a couple of weeks ago. What an awesome publication! – *Gary Gallerani*

WRTH has been great for years! I always enjoy having it around, even just to browse through – *Max Heidel, USA*

Like its logical layout. Nice job – *Andrew Hervey, USA*

The World of Shortwave Listening

By Thomas Witherspoon K4SWL thomas@earstoourworld.org

TSM Tests: Best SW Portables under $40

(All Photos Courtesy of the Author)

While I've been regularly blogging about shortwave radio for several years now, I simply can't tell you how many times I've received an email asking doubtfully, "This seems like a fun hobby, but isn't shortwave radio dead?" My response? No way! Here's why.

I once had the truly good fortune to be interviewed by Gareth Mitchell, host of the BBC World Service technology program "Click." For once, I made a point of listening to this interview that featured me, always a bit embarrassing, but after all, this was the BBC World Service!

But Gareth's lead-in to our segment about my shortwave radio-based charity, Ears To Our World (ETOW), truly surprised me: our non-profit, he said, "distributes portable battery powered devices that can stream audio in real time, all via an intuitive touch interface."

Wow...how true. And, since that interview, this is exactly how I see shortwave radio, too; not as a forgotten relic of the past century, but as a medium at home in the future with a unique, highly accessible, and yet global reach. Shortwave radio, after all, requires no apps, no subscriptions, and no mobile phone or Internet connection to deliver information worldwide at the speed of light. All you need, in short, is a radio.

Shortwave Lives!

This column exists to prove to the doubtful that shortwave radio, indeed, radio in general, is not only alive and well, but loud and clear in urban as well as rural settings the world over. Here, you'll find in-depth articles that reflect the changing state of shortwave radio: the technologies, the techniques, and the vast array of content currently available across the shortwave radio spectrum. Best yet, because SWLing (shortwave listening) is what you make of it, you can be part of it: share your input, so that I can cover (and uncover) shortwave topics you wish to discuss. Just drop me a note: thomas@earstoourworld.org.

So, I begin this first column with a little comparison, a shootout, between five newly-popular analog DSP (Digital Signal Processing) radios. We'll find out who's left standing, and you'll even get a chance to hear these radios in action, but first let's look at:

The Contenders

We'll be pitting five models against each other here: the Degen DE321, the Degen DE32, the Tecsun R-2010D, the Kchibo KK9803 and the ShouYu SY-X5. With the exception of the ShouYu SY-X5, all of these manufacturers have in the past produced at least one portable with truly notable performance (the Degen DE1102, 1103, Kchibo D96L and an array of Tecsuns, including the PL 310, 380, 390, 600 and 660).

Moreover, so that you can hear the difference for yourself, I've included linked audio clips for each model. They were all tuned to the same frequency, same broadcast and recorded within seconds of one another. But first, what is a DSP radio? And why do we need them?

Mechanically-Tuned DSP

Radio is no longer just your granddad's medium. Several years ago, the digital signal processing chip manufacturer, Silicon Labs (SiLabs), altered the

You can test drive the radios below. To hear what each sounds like picking up a local AM radio station, click the speaker area of each. To hear what each sounds like picking up a weak shortwave radio station, click on the dial of each. In this case the station was Korean Broadcasting Service on 9805 kHz. The DE32 is on the next page. Each audio clip runs about thirty seconds. Right click "disable content" to stop audio. (Audio clips courtesy of the author)

Degen DE321

Tecsun R-2010D

ShouYu SY-X5

Degen DE32

entire radio landscape with one little chip. Indeed, most new digital shortwave/AM/FM radios on the market use a SiLabs DSP chip as the centerpiece of their receiver architecture.

Using a DSP chip in a fully digital radio makes sense: after all, you have a digital display, digital buttons, and digital encoder. But, using a digital chip with a traditional analog display, a mechanically-tuned DSP radio, does that make sense?

SiLabs, and a growing number of radio manufacturers and retailers, believe the answer is a resounding "yes." In truth, there are concrete benefits to making this addition:

decreasing production cost of radios by as much as 80%; decreasing research and development costs of new radios, digital signal processing with the simplicity of analog radio design

reduces power consumption when compared with digital display radios. And, an avenue to make radios more affordable, especially to listeners living in poverty, such as those in developing world settings, who make up a large subgroup of listeners.

When I first learned about the implementation of a DSP chip with a mechanically-tuned radio in 2010, I felt like it might be the way to make quality receiver performance available and accessible to many. Now, four years later, several manufacturers have produced mechanically-tuned DSP shortwave radios. As if to add icing to this cake, all are available from sellers at a price of under $40!

Common Review Points for Mechanically-Tuned DSP Radios

I've now reviewed enough mechanically-tuned DSP-based radios that I'm beginning to note performance commonalities that can only be attributed to the design of the DSP chipset itself, regardless of how these are implemented in each model. So, before the shooting starts, let's take a quick look at some common review points of the contenders.

Tuning: Not Quite an Analog Radio

I've got to begin with the most obvious common review point: namely, tuning. For those of us accustomed to analog tuning, the DSP/analog combination is, well, completely different and a little quirky. Here's how. Tuning a traditional analog radio is a fluid process which allows for a certain amount of play; you need not be precisely on a frequency to hear a station, and often you hear a station fade as another pops into the band pass.

But, when tuning analog DSP, you hear stations and static pass by in comparatively coarse 5 kHz chunks. This is especially so in radios with tiny analog frequency dials, it makes tuning feel somewhat "sticky" or finicky, and ironically, rather imprecise. You feel like you're skipping over stations while band-scanning. And, for those accustomed to digital tuning, instead of using buttons to tune in these 5 kHz increments, you're using a tuning wheel, with no customary "step" response. That's not what you would expect from either digital or analog radio.

But of course, you can locate your station with this method. It takes a little practice, and a measure of patience, but you'll soon adjust to this different method of tuning. Note that much of this awkwardness may disappear if SiLabs produces a chip with more precise tuning increments, such as 1 kHz steps with decreased muting.

Automatic Gain Control

In all of the models I've tested so far, the Auto Gain Control (AGC) is a little too overactive when listening to weak AM/SW stations. This results in a "pumping" sound and serious listening fatigue when set on weaker stations. However, on strong stations, all models perform quite well.

Conformity

Since all of these radios are based on the same chip family from SiLabs, you can expect two FM bands, one AM (medium wave) band, and eight shortwave bands. The frequency ranges in all bands are identical.

The Degen DE321 with DSP in a side-by-side comparison with the ShouYu SY-X5, with digital display. (Photo: Courtesy Author)

FM

FM performance on each of these radios is above average, and the coverage is quite wide, from 64 MHz to 108 MHZ, in two FM bands. If you like listening to FM radio, you'll be pleased with any of these inexpensive models.

And now for some Action!

Let's pit these five radios against each other in an listener's challenge that will leave the losers in the dust...and the winners clear.

The Degen DE321 ($21)

The DE321 was the first analog DSP shortwave radio on the market. The DE321 is small, slim, über-simple, and fits nicely in the hand. The analog tuning dial takes up more than half of the front face of the radio – a good thing, as the larger the dial, the easier the tuning. As for performance, the DE321 holds its own in this crowd; it's quite reasonable in both sensitivity and selectivity. The DE321 is the most bare-bones radio among the five described here.

The Degen DE32 ($27)

The DE32 is the smallest radio of the five. Unlike the DE321, the DE32 is not "just" a radio; it also sports a simple MP3 audio player and a small white LED flashlight. The DE32 has a small, built-in speaker which delivers tinny and rather cheap audio. It's OK for a single listener, and fine for spoken-word broadcasts. Audio fidelity is greatly improved with headphones. The DE321 is slightly better than the DE32 on shortwave.

The Tecsun R-2010D ($39)

When I first held the R-2010D, I initially thought I had found the holy grail among analog/DSP radios: while the R-2010D is the largest of the five radios, nearly equivalent in size to my Sony ICF-SW7600GR (not a pocket-sized portable like the others), it nonetheless has a beautiful large analog display (a major plus!), an amply-sized speaker for great portable audio, and a fluid tuning mechanism. To top it off, the R-2010D has a small digital frequency display so that you can verify your frequency. The R-2010D's AGC circuit handles strong stations well, but clips on weak stations. But, the promising R-2010D has one major flaw: terrible selectivity. Indeed, the selectivity is so sloppy, that you will not be able to delineate two strong signals spaced 10 kHz apart from each other.

The ShouYu SY-X5 - Current Retail: $27.00

The SY-X5 surprised me. What makes this model stand out is the fact that it can be powered by either a rechargeable slim battery pack (found in the DE32) or three standard AA batteries. It also has a built-in MP3 player that, like the Degen DE32, uses a standard micro-SD card for media storage. Unlike the DE32, the SY-X5 has a bright red LED display that helps in navigating MP3 files. The SY-X5 also has surprisingly good audio from its built-in speaker, rivaling the much larger Tecsun R-2010D. The negative here? Though the SY-X5 has a fluid tuning mechanism, it is

The Degen DE32 ($27, top left) has a built-in MP3 audio player, the Degen DE321 ($21, upper right) earned "Best Value" title and the Tecsun R-2010D ($39, below) earned "Best Sensitivity" title. (Photo: Courtesy Author)

ShouYu SY-X5: Rated "Best Overall" offering the most value and vesatility for the performance.

Compare Reception and Audio with a Tecsun PL660

A Tecsun PL660 ($110) was used as an audio benchmark for comparison. Click speaker for audio. KBS International was also used here. (Photo courtesy of Universal Radio)

prone to drifting when trying to adjust the analog tuning needle to frequency.

The Kchibo KK9803 - Current Retail: $16.00

When I first wrote this review, I didn't even include the KK9803. Why? Because, frankly, it's one of the worst performing radios I've ever owned, and I would strongly discourage you from even considering it. My primary criticism of this radio is that the tuning is barely functional: the shortwave band segments are far too close to one another on the dial, hence the digital tuning steps are too narrowly-spaced to offer any sort of tuning accuracy whatsoever. Barely moving the tuning wheel, one may pass over even a strong station...undetectably. The only hint of the station's existence may be an occasional quick blip or audio buzz. I must confess that the experience of band-scanning (tuning) this radio offers is the worst I've ever known in any radio. Don't buy it. In our shootout, it's bitten the dust before it even aims because, let's face it, this radio just can't.

The Winners

All of these radios share similar qualities. After all, they're brothers of a sort, built around the same family of DSP chips. If you've read the summaries above, then you won't be disappointed by any of these that follow, especially at this modest price point. Still, I reach for different radios based on their strengths, and to help you choose, here's a "best of" list:

Most Versatile: ShouYu SY-X5
Best Audio: Tecsun R-2010D and ShouYu SY-X5
Best Sensitivity: Tecsun R-2010D
Best Value: Degen DE321

Best Overall

If I had to choose just one of these radios, it might just be the ShouYu SY-X5. It offers the most value and versatility for the performance. I think its audio is brilliant for a pocket radio, and I love the fact it has an LED display to help me navigate through the MP3 files loaded on my micro-SD card. However, as with any of these low-cost contenders, don't expect to try any weak-signal DXing with the SY-X5.

By the way, if the Tecsun R-2010D simply had better selectivity, and weak signal gain control,it would win this contest, hands down. In fact, I actually sent feedback to Tecsun engineering regarding the R-2010D selectivity shortcoming in the hope that they'll fix this problem in future production runs. You might do the same.

In conclusion, mechanically-tuned DSP portables may not pack DX-grade performance, but they are priced so that everyone can afford to experiment. And for your buck, that's pretty good radio bang!

TSM

The Shortwave Listener

By Fred Waterer **programming_matters@ya-**

Shortwave Radio Listening in 2014

Welcome to the inaugural edition of "The Shortwave Listener." It is exciting to be part of a pioneering new Internet venture. As the name of this column implies, each month I will explore the world of shortwave radio programming, and the people who create and present these marvelous word pictures we hear on the international radio bands.

Since this is the first edition of the column, please let me begin by introducing myself. Since 1986, I have been a shortwave programming columnist in one way or another with both the Ontario DX Association (1986-2011) and Monitoring Times (2006-2013). I grew up in Southern Ontario, Canada in the mid-sized city of St. Catharines, just a few miles from Niagara Falls. In 1969 I had one of the first "eureka" moments of my life. I was given a transistor radio for Christmas. I turned it on and the first thing I heard emanating from this magical little box was the voice of Roy Orbison, singing "Pretty Woman." I was hooked! I never let that little radio out of my sight. And, it was always tuned to 1050 CHUM in Toronto. One of the benefits of living in St. Catharines is that it places me geographically equidistant from Toronto, Canada and Buffalo, New York. Together they form one of the largest radio markets in North America, after New York, Chicago, Los Angeles and Detroit/Windsor. So, I grew up being able to sample the best (and worst) of both Canadian and American radio.

Fast forward to 1978. On a summer day in that year, I turned on my father's old Nordmende radio, and had my second "eureka" moment. A push of a button and a slight spin of the dial, brought the programming of Radio Sofia, Bulgaria to my ears! I was so excited. I began spinning the dials and tuning radio stations from around the world. Moscow. Havana. London. Washington. Montreal, Quito. They all came booming into my bedroom. Thus began a life long fascination with shortwave radio programming.

Through the years I had a front row seat for many world events. The Soviet invasion of Afghanistan, the assassination of Anwar Sadat, the rise of Gorbachev and the collapse of Communism were just a few of the events I followed zealously. Shortwave broadcasters such as Joe Adamov (Radio Moscow), Alistair Cooke (BBC World Service), Jeff White (WRMI) and Jonathan Marks (Radio Netherlands Worldwide) became regular house guests. And, in many ways, shortwave radio was the Internet, before the Internet was invented. It was a pretty reliable way to get news, music and opinions from around the world.

Looking back, from our vantage point in the twenty-first century, it would be easy to think that the era of shortwave radio is over. Not so!

While many radio stations have abandoned the shortwave bands, there is still much to be heard on the kilohertz. For instance, China Radio International (CRI) does not seem to have received the memo that shortwave broadcasting is dead. CRI runs an extensive schedule of programming on shortwave. Lively Cuban music continues to emanate from Radio Havana. And, recently, some exciting news came out of Florida. Jeff White and WRMI intend to start using the transmitters and antenna systems of WYFR, which ceased operations in June of last year, in Okeechobee, Florida.

So yes, dear reader, shortwave is still alive and well. Maybe not as ubiquitous as it once was, but it's still there with many exciting and entertaining programs.

The Voice of Russia is a shadow of its former self, but continues to broadcast to North America on 9395 kHz from 2200-0000 UTC each and every day. Weekends are the best days to tune in. Why? Simply because, some of the more popular and (relatively) longstanding programs and personalities can be heard then.

For instance, on UTC Fridays, "Red Line" can be heard at 2200 UTC hour after the news. It is a fascinating news magazine, looking at two or three stories in depth, "beyond the headlines." In November, one episode looked at Syria's bumpy road to peace, a drone attack in Pakistan which took out a key Taliban leader, and Pakistani reaction, and the trials and tribulations of deposed President Mursi of Egypt. It is well worth a listen.

In the 2300 UTC hour "From Moscow With Love," hosted by Vasily Strelnikov and Natalia Stefanova continues to be heard. This popular program is one of the best on the shortwave bands. Vasily has been a popular host on the station, back to its old Soviet-era Radio Moscow World Service days, and Natalia is a delightful co-host, making this program worth hearing. Together they make a great team. I have said before that it brings to mind the old Happy Station broadcasts.

Something new on the Voice of Russia schedule, is Sochi Update. This 15-minute broadcast is heard at the end of

the 2300 UTC hour, on Fridays. With the winter Olympics approaching in just a few weeks time, this is a very interesting program. The coverage is pretty much equally distributed between stories about Russian athletes and those of the rest of the world.

The program also offers interesting insight into the host city and facilities. Sochi is known as the "Russian Riviera."

Another popular international radio station is Radio New Zealand International. New Zealand may be a tiny country in the South Pacific, but it packs a booming voice to the world. The quality of the broadcasts is truly awesome.

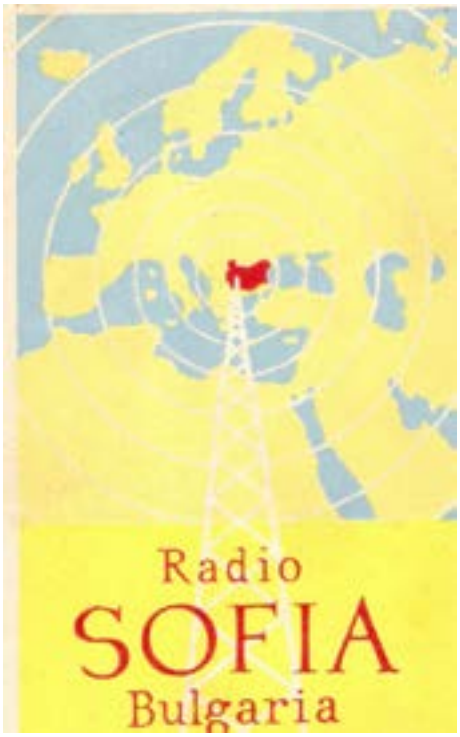
Many RNZI programs originate with the domestic Radio New Zealand National. Among the programs one can hear is the flagship news and current affairs program Dateline Pacific. It can be heard at 0700 UTC, on 11725 kHz. The program offers insight on a region which is rarely talked about in North America. Topics covered included tribal violence in Papua New Guinea, political and economic news from Fiji and a pacific Judo competition. RNZ National carries some fascinating programming. For instance at 9765 kHz on Saturdays at 1000 UTC some really great music documentaries have aired including one about the last two years of The Beatles. Be sure and check it out!

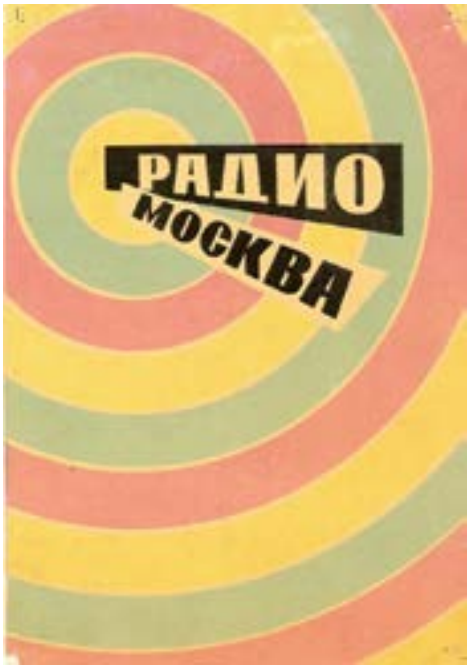
As this column is being written Toronto radio station CFRX 6070 kHz, is off the air due to transmitter issues, but it may be on air soon. CFRX relays Newstalk 1010, CFRB. Leaning right, much of the talk is about local, provincial and national politics. In October and November, the coverage has been dominated by the self-inflicted wounds of Toronto Mayor, Rob Ford, who has had a very public meltdown. Well publicized struggles with drugs and alcohol as well as several almost daily faux pas, has left the governance of Canada's largest city in virtual chaos, it's almost like watching a train wreck. One cannot bear to watch, yet one cannot avert one's eyes. Check out 6070 kHz or 1010 kHz if you live within range of the station.

In November, it was fascinating to listen to international broadcasters as they reported on the devastating typhoon which leveled many parts of the Philippines. BBC World Service expanded its hours of operations in order to report on the situation. Radio Australia, Voice of America, China Radio International and others had extensive coverage of the storm, and its resulting damage. Often these radio stations reported details that just weren't covered in depth here in North America. And, while the Internet is a wonderful thing, when there is a disaster of the scale of the recent typhoon, people in the affected areas are not going to have access to it. Radio, and particularly shortwave radio can provide an important and valuable source of current information, in times of trouble.

TSM

Two Cold War-era QSL cards from the 1960s peak of shortwave radio propaganda: East vs West. Radio Sofia, Bulgaria (top) and Radio Moscow (bottom). According to an announcement made December 9 by the Voice of Russia, Radio Moscow's successor, VOR will merge with RIA Novosti to become Rossia Segodny (Russia Today). (QSLs courtesy: KS4ZR)





TSM's Guide to Shortwave

By Ken Reitz KS4ZR

Each year the world's international shortwave broadcasters reduce the number of transmitters, antenna systems and hours of broadcast to the world. Many of these broadcasters had been on shortwave since the 1920s and 30s and, until just a few years ago, comprised the bulk of what was heard on those bands. As Internet connectivity has become more widespread globally, and the world's economies continue to slump, expensive shortwave broadcasting has been a natural target for governments wanting to cut expenses.

Many international broadcasters have retreated to online broadcasting only, with no presence on the shortwave bands. Others, such as the Voice of America, BBC World Service and Deutsche Welle have cut shortwave broadcasts to North America entirely to concentrate instead on Africa, Asia as well as the Mideast and Pacific regions. Many maintain Free-to-Air (FTA) digital satellite transmissions to North America (see section on FTA satellite).

Still others have switched to the all-digital format Digital Radio Mondiale (DRM), a European-based, open-sourced, digital HF broadcasting scheme designed to conquer the vagaries of shortwave to deliver near-FM quality audio. However, the lack of inexpensive receivers and the fact that these transmissions aren't nearly as robust as analog shortwave signals, has meant that such digital broadcasts are hard to receive in North America.

To add to the current shortwave condition, several U.S.-based private shortwave broadcasters have not fared well in this poorly performing economy, forcing some off the air permanently and others to struggle for financial support. One such example is WYFR, whose founder had famously (and, more than once) predicted the End Times, closed in June, 2013, due to lack of financial support. However, by November, 2013, that station's assets were acquired by Miami-based private broadcaster WRMI (Radio Miami International). The fact that WYFR's powerful transmitters and huge antenna arrays were in nearby Okeechobee, Florida, made that acquisition a very smart move for WRMI.

One exception to the overall dismal outlook for international shortwave broadcasting has been China Radio International (CRI). With apparently endless government support, CRI maintains a huge presence on HF, with a particularly impressive schedule of broadcasts to North America at a time when all other international broadcasters have cut their services to that continent. CRI is famous for plopping its blowtorch signal down just about anywhere it likes, even in the amateur radio bands, and for intentionally (though not admittedly) jamming signals it judges are opposed to its own foreign and domestic policies. The Voice of America and BBC World Service's Chinese language broadcasts to mainland China have been targets of such jamming. In the past, a Chinese folk song loop, known to SWLers as Firedrake, was used for jamming, but lately an unmodulated DRM carrier has turned up on the bands as a jamming device. According to one credible source, the DRM signal carries the CRI identifier in the digital transmission. Oops.

Trans World Radio Shortwave Curtain Antenna at Guam (Courtsy(Courtesy: TWR)

In addition to the shortwave broadcasters listed here, there are dozens of lesser known shortwave stations that will present extremely tough targets for listeners. Stations such as Radio Vanuatu and Bhutan Broadcasting Service, not only transmit limited schedules, but their transmissions, in native languages, are intended for local reception. Their lower powered transmitters and the use of low frequencies, that don't hop across oceans very easily, will make them tough, if not impossible, for listeners outside their immediate region to hear. Regional shortwave broadcasting is still very much alive in parts of Africa, Asia and South America with analog shortwave radios still prized possessions of their owners.

Guide to Program Guides

The two most comprehensive guides to shortwave listening are the 2014 World Radio/Television Handbook (see ad elsewhere in this magazine) and the 2014 Klingenfuss Shortwave Guide (see ad elsewhere in this magazine).

For decades, Gayle Van Horn maintained a list of English as well as foreign language analog and DRM international shortwave broadcasts which appeared monthly in *Monitoring Times* until that magazine ceased publishing in December, 2013. Gayle continues to publish the list as the International Shortwave Broadcasting Guide, a Kindle e-book which is available for $4.99 (See *TSM* Bookshelf). She plans to update the guide every six months when the shortwave season changes. Gayle and husband, Larry Van Horn, who for decades wrote the Milcom (military communications) column in *Monitoring Times*, formed Teak Publishing which publishes an assortment of the couples' books, including Gayle's previously released "QSLing the World" and Larry's best-selling "North American

Enroute Aviation Guide." Both of those titles sell for $2.99. The two also maintain their very popular blogs, **Milcom Monitoring Post** and **Shortwave Central**.

There are online guides as well, including **short-waveschedule.com**, a very easy to use website that lets you find the station and frequency you're looking for instantly. Another easy to use guide is **short-wave.info**.

A new development in shortwave programming guides has been the availability of apps for smartphones and tablets. Blackcat Systems' app for iPhone and iPad is $1.99 in Apple's iTunes store. A similar program is available in the Android store for $.99.

One difficulty with all guides is that, while a guide might show that certain stations are on the air and perhaps even transmitting to your area of the world, variations in propagation, levels of seasonal noise, nearby station interference or even interference on certain frequencies from electronic devices in your home could hamper reception. These resources are, after all, only guides and you may have to try several listed frequencies before you find one that comes in best for you.

The widespread use of smartphones and tablets has also brought about a string of other apps for shortwave listeners including HF Weather FAX, again for iOS and Android-based devices, also available through Blackcat Systems' in iTunes ($2.99) and Android ($2.99) stores. Additional apps for iPad, iPhone and iPod, that let you decode Morse code; amateur radio packet transmissions (such as those from amateur operators using the International Space Station as a sky-bound 2-mete repeater); NAVTEX (longwave marine weather-related data); PSK31 (a narrowband digital mode used by amateur operators in the HF bands); SSTV (Slow Scan TV, used by amateurs in the HF bands and by astronauts aboard the International Space Station in the 2-meter band), and ACARS ($1.99 in Android and $2.99 in iOS), lets you monitor text sent by commercial aircraft. There are a number of amateur radio license tutorials that are also available at $2.99 for each level of license.

QSLing Shortwave Broadcasters

Since shortwave broadcasting first began, avid shortwave listeners (SWLers) have sought confirmation of their "catch" through a QSL (confirmation of reception) card issued by the station. Stations seek reception reports because it gives them direct feedback on how reception is faring to various regions of the world, so all are eager to issue QSL cards. SWLers, like all collectors, enjoy racking up their country count and displaying their collection of cards for the benefit of other SWLers.

QSL collecting is not limited to international shortwave broadcasters. Avid all-band DXers (long distance listeners) seek QSLs for AM station reception, especially out of country catches (see Doug Smiths, "The Broadcast Tower," column), Directional Navigational Beacons (see Kevin Carey's, "The Longwave Zone," column for more about DNBs), and utility shortwave stations (see Hugh Stegman's column, "Utility Planet," for examples of such stations).

But, things have changed dramatically over the last ten years. Many years ago, in addition to the QSL card, some stations would lavish other bits of ephemera on listeners who sent in signal reports including glossy magazines, pennants, and even, in the case of HJCB (Peru), small bamboo Andean flutes. But, postage worldwide has increased to the point where many cost-cutting international broadcasters ask that QSL requests by mail include return

Blackcat Systems' app to display shortwave broadcast schedules is available for iPhone and iPad as well as Android-based devices. (Courtesy: Blackcat Systems)

postage. Many seek reception reports via email and respond by sending e-QSL cards to listener. The most authoritative resource on the subject of QSL cards for shortwave is the aforementioned QSLing the World by Gayle Van Horn (see above). Everything you could possibly want to know on this subject is thoroughly covered in her e-book. An excellent historical view of QSLing is found at the website of the Committee to Preserve Radio Verifications.

How to Know Which Bands are Open

Wouldn't it be great if there were weather vanes on the HF bands that would tell listeners and hams where the signals will be best? Well, there are. They are called beacons and they're found on virtually all the bands from longwave frequencies into the 10 meter band (28 MHz), i.e., the whole HF spectrum. Beacons are usually low powered, licensed transmitters that send out a message 24/7, usually in Morse code, identifying the transmitter location. By being able to identify the beacons, the savvy SWLer or ham knows where conditions are best.

Much has been written on the subject of beacons and there are many places to go on the Web for more information. For a complete list of worldwide beacons on the 10 meter amateur radio band go here: 10 meter beacons. This list is updated quite regularly and is used by thousands of 10 meter beacon hunters around the world. It's astounding to hear these tiny transmitters, some putting out less than one-watt, from hundreds, even thousands, of miles away. Print out this list every couple of months and keep it by your radio for a reference. Like train or plane spotting, radio beacon enthusiasts keep tabs on all of the beacons they've heard. One activity beacon hunters enjoy is collecting QSL cards from the beacons they log. And, beacon operators are very happy to send such QSLs as it lets them know how well their beacon is getting out.

Another beacon target to shoot for is the Northern California DX Foundation's (NCDXF) beacon project. These beacons are located all over the world and are coordinated in their transmissions so that the listener can determine conditions on the various bands to various parts of the world. It may help you determine the best times to make contact with hams in certain parts of the world or help you figure out which bands will

Radio Romania International, still a stalwart QSLer. This QSL was for reception of their DRM singal on 6030 kHz at 00:21 UTC in 2010. (Courtesy: KS4ZR)

provide the best listening conditions for SWLers.

Longwave beacons (see Kevin Carey's column, "The Longwave Zone," in this issue) are amazing. Considering the relative low power, the extremely low frequencies and the typically noisy band conditions, these beacons can be heard hundreds and sometimes thousands of miles. Check your logs against this list from **DXinfocentre.com** to find out just how far away those beacons are.

Experimental amateur radio beacons operating near the bottom of the spectrum present a real challenge to your listening post. Check out the list provided by the Long Wave Club of America which shows frequency, call sign and other station information of operators braving lowest reaches of radio waves. This list is update regularly.

International Shortwave Broadcasters

Below is an abbreviated list of international shortwave broadcasters, large and small, that occupy the vast regions of the HF frequency range. A brief description of each service and links to their program schedules and frequencies are provided with each service. In most cases this list represents only English language broadcasts. There are many more stations that broadcast only in their native language to a smaller, regional audience, not served by local AM and FM stations as North Americans are accustomed. These stations will be even harder to tune in, but comprise a significant part of the overall global shortwave broadcast world.

Adventist World Radio Global religious shortwave broadcaster. A full program schedule and frequency list is found here.

All India Radio AIR maintains a schedule of shortwave programming for both a national and international audiences in both analog and DRM formats.

Angolan National Radio RNA has one hour of English daily from 2100-2200 UTC on 7217 kHz.

ARN/AFRTS Armed Forces Network/Armed Forces Radio and Television Service was once a major shortwave presence with a full lineup of programs taken from major U.S.-based radio networks and rebroadcast on many shortwave frequencies. Today the service is limited to four frequencies from two locations; Guam (Pacific Ocean) 13,362 kHz (daytime), 5,765 kHz (nighttime) and Diego Garcia (Indian Ocean) 12,759 kHz (daytime), 4,319 kHz (nighttime) all in USB. What's left of their shortwave schedule is here.

Argentina RAE language and frequency schedule here.

BBC World Service, the legendary international broadcaster still maintains a full program schedule with powerful enough transmitters that still allow North American listeners to tune in.

Bible Voice Broadcasting This Canadian religious broadcaster has a full schedule of shortwave broadcasts to various regions of the globe.

Canada has a number of lower powered, regional shortwave stations that retransmit the programming from co-located sister AM stations. CFRX 6070 kHz, rebroadcasts Toronto's CFRB 1010 kHz ; CFVP 6030 kHz underwent a format change with it sister station, Calgary's CKMX 1060 kHz, to an all-comedy format; CKZN 6160 kHz, St. John's, Newfoundland, offers CBC-One network programming, and CKZU 6160 kHz, Vancouver, British Columbia rebroadcasts the programming of CBU 690 kHz, Vancouver. All are tough targets for stateside listeners and is all that remains from Canada's once-vaunted and greatly admired international shortwave presence.

Caribbean Beacon (University Net) The late Dr. Scott and Pastor Melissa Scott (his widow) beam their message from Anguilla, BWI on 11.755 MHz (daytime) and 6.090 MHz (nighttime).

Channel Africa Great programs from South Africa with a full schedule here.

China Radio International CRI is the biggest presence on HF with a seemingly endless list of frequencies and powerful transmitters. Their English service to the world is extensive.

Deutsche Welle Formerly one of the world's most listened to international broadcasters, Deutsche Welle confines global broadcasts to third world countries while it continues radio and TV broadcasts to North and South America via FTA satellite (see FTA listings). They have an extensive English broadcast schedule to Africa.

HF Pirate Radio Unlicensed shortwave broadcasters, operate mostly within a small set of frequencies above and below 6025 kHz. With irreverent programming that lampoons everything from current politics to licensed shortwave broadcasters, these stations randomly pop up on the band, typically late evenings, for short broadcasts, usually 15 minutes to an hour long. The greatest amount of HF pirate activity occurs around the weekend of major and minor holidays. Programming on these stations may not be everyone's cup of grog. Some will, in fact, find such programming offensive. Since it's illegal to operate on the shortwave bands without a license, these stations play a cat and mouse game with FCC field agents who try to track down the source of these transmissions.

HF Underground is a website for pirate radio enthusiasts. "Pirate Radio Annual" is an excellent resource on the subject. An annual publication, which sells for $16 at Universal Radio, this 186 page book details every known HF pirate broadcaster and includes a CD of sample broadcasts received by the author. Most HF pirate stations QSL reception reports through untraceable mail drops or fictitious email accounts.

KJES Vado, New Mexico is a unique religious broadcaster transmitting from a single rotatable log-periodic dipole array (LPDA) beam antenna

Blackcat Systems' app to display HF WEFAX charts (Courtesy: Blackcat Systems)

with 50 kW in the desert of southern New Mexico. It is operated by The Lord's Ranch and the Las Alas Catholic Prayer Community. Their schedule can be found in any of the guides. The highlight of this station's programming is scripture reading and chanting of the children of ranch. Programs are in English and Spanish. You'll find them on11.715 MHz.

KNLS Anchor Point, Alaska private religious shortwave broadcaster with a full broadcast schedule.

Korean Broadcasting Service World Radio, originally the Voice of Free Korea (1953) went through various name changes, settling on KBS World Radio in 2005 features this colorful and comprehensive shortwave broadcast schedule.

HF WEFAX via shortwave on an iPad (courtesy: KS4ZR)

Mighty KBC 6095 kHz, bills itself as "Trucker Radio" and broadcasts across Europe with an American 60s-style rock station sound, playing oldies interspersed with actual commercials. Their weekend broadcasts to North America are on 7375. For updated information go here.

NHK World Radio maintains a full schedule of programs in many languages that are relayed via various transmitters about the globe. A full schedule is found here.

Radio Australia Government funded international shortwave broadcaster with a large presence in Asia and the Pacific. Schedule to Asia, Central South Pacific and Western Pacific

Radio Cairo provides limited English service to North America on 15710 kHz from 1800-2100 UTC.

Radio Educacion Operated by the Mexican government on 6185 kHz shortwave and 1060 kHz AM (100,000 watts) in Spanish language, a full schedule is found here.

Radio Ethiopia National Service limited schedule to North America can be found on any of the online guides.

Radio Exterior de Espana, one of the big European shortwave broadcasters still maintains a strong presence on the bands with a full schedule to Africa and the Americas (mostly Central and South America).

Radio Havana A vestige of the Cold War with less strident voice, RHC also has one of the few remaining DX news programs in Arnie Corro's "DXers Unlimited." RHC maintains a limited schedule of English transmissions to North America: 6000 kHz (0100-0700 UTC), 6165 kHz (0100-0700 UTC), 6060 kHz (0500-0700 UTC).

Radio Kuwait often one of the biggest signals into North America from the mid-East, Radio Kuwait English transmission are found afternoons at 15540 UTC.

Radio New Zealand International provides a good listening target with transmissions mostly into the Pacific Ocean region. Their schedule is here.

Radio Pakistan has a full schedule of broadcasts in several languages, but not English. Try your luck with this shortwave schedule.

Radio Romania International An unlikely holdout in an age of shrinking international broadcasters, RRI maintains a short (two and one-half hours) broadcast schedule to North America in English.

Radio Serbia International (Voice of Serbia) offers a comprehensive list of broadcasts in major languages and is found here.

Radio Sultanate of Oman though the website dates the English schedule from ten years ago, the site has been updated.

Radio Taiwan International, RTI provides entertaining programs in English.

Radio Thailand World Service provides a considerable number of English programs and frequencies here.

Radio Verdad, Guatemala offers English on 4055 kHz from 0300 to 0600 UTC.

Solomon Islands Broadcasting Corporation another tough catch on 5020 kHz. Frequencies and details on

QSLing this station are here.

Radio Tirana with two half-hour English broadcasts on 7425 kHz (0230 UTC) and 7465 kHz (2100 UTC).

Vatican Radio, still one of the most active shortwave broadcasters with an extensive frequency list available on any of the online guides.

Voice of Africa Sudan Radio a tough catch in Arabic on 7205 kHz.

Voice of America VOA is one of the oldest international shortwave broadcasters and is known for its impartial news programming, attempting to make administration foreign policy a separate part of programming. Despite having its budget continuously slashed, it maintains a full schedule of programs to the world.

Voice of Guyana found on 3290 offers extensive English programming from 0000 – 0400 and 0800 – 2400 UTC.

Voice of Islamic Republic of Iran steady drumbeat of anti-Americanism with a surprisingly limited schedule beamed to North America.

Voice of Korea (North Korea) VOK broadcasts an extensive schedule in many languages that can be found on any online guide. To glimpse the day-to-day wonders of this worker's paradise go here.

Voice of Mongolia broadcasts two English language programs on 12085 kHz (0900-0930 UTC) and 12015 kHz (1530-1600 UTC).

Voice of Nigeria According to the World Radio/TV Handbook, VON maintains a daily schedule of English programming to Europe, mostly on 15120 kHz from 0455-0700 UTC.

Voice of Russia As of January 1, 2014, VOR, formerly Radio Moscow will be folded into a state-run media service known as Rossia Segodnya (Russia Today).

Voice of Tajikistan transmits on 7245 in English for one hour from 0100-0200 UTC.

All Aboard Radio QSL, just one of dozens of peculiar pirate HF broadcasters. (Courtesy: KS4ZR)

Voice of Turkey offers a complete program schedule in a spreadsheet. Go to the homepage and click at the bottom of the page where it indicates "Voice of Turkey info."

Voice of Vietnam, another of the last vestiges of Communism, VOV has an extensive list of English programs, often relayed by shortwave transmitters around the world, is easily heard in North America. Check any online guide for times and frequencies.

Voice of Zimbabwe, "The independent voice of Zimbabwe," operates on 4880 kHz with this schedule.

WBCQ "Free Speech Radio," a private shortwave station transmitting from Monticello, Maine. WBCQ founder, Alan Weiner, has a storied past among domestic shortwave broadcasters. WBCQ's eclectic mix of programs is unrivaled. Frequencies: 5110, 7490, 9330 and 15420 kHz WBCQ full schedule

WINB Red Lion, Pennsylvania, airs a full lineup of religious programming, click on "Schedule by Time."

WEWN Irondale, Alabama, longtime global Catholic shortwave broadcaster with extensive lineup of popular programs in English and Spanish. Full schedule available

Kaito KA-1103, one of the best portable shortwave radios is also one of the cheapest. (Courtesy: Katio U.SA.)

here.

WJHR Milton, Florida, private religious broadcaster operating between 1400-2200 UTC on 15500 kHz.

World Harvest Radio private Christian-based broadcaster with extensive shortwave and satellite transmissions to the world. WHR shortwave frequencies and schedule.

WRMI "Radio Miami International," a private shortwave broadcaster serving Latin America from Miami, Florida. Frequency: 9950 kHz. WRMI has recently acquired the substantial assets of religious broadcaster WYFR, which ceased transmission in June, 2013. WRMI full schedule.

WRN World Radio Network presents a 24 hour schedule of international broadcasts from around the world including Radio Prague, Channel Africa, Radio New Zealand International, Radio Sweden, Korean Broadcasting Service, Radio France International, NHK World Radio Japan and more. WRN was formerly on XM/Sirius satellite radio but was dropped in April, 2013. However, listeners in North America can still enjoy WRN's full channel line-up on Free-to-Air satellite Galaxy 19 at 97°W (see FTA listing for complete details). WRN's schedule of programming to North America is found here.

WRNO New Orleans, Louisiana, one of the original private shortwave broadcasters from the 1980s when it was known as "The Rock of New Orleans," it now transmits religious programming on 15590 and 7506 kHz.

WTWW Lebanon, Tennessee, a private shortwave broadcaster with this schedule.

WWCR Nashville, Tennessee, a private shortwave broadcaster. From the homepage, click on "program guide."

WWRB Manchester, Tennessee, a private broadcaster with five frequencies available and an extensive program schedule.

W1AW Current Bulletin Schedule (Winter 2014)

Keep abreast of amateur radio news via the American Radio Relay League's amateur radio station W1AW. The station sends out daily bulletins of news for radio amateurs, including DX and propagation bulletins via Morse code (CW) in slow speeds (5 to 15 words per minute) and fast speeds (up to 35 words per minute), voice (SSB) and digital modes (old fashioned BAUDOT at 45.45 baud, BPSK31 and MFSK16 in a revolving schedule).

Digital bulletins are sent daily at 2300 UTC on 3.5975, 7.095, 14.095, 18.1025, 21.095, and 28.095 MHz. Morse bulletins are sent daily at 18 words per minute at 2200 UTC on 1.8025, 3.5815, 7.0475, 14.0475, 18.0975, 21.0675 and 28.0675 MHz. And, voice bulletins are sent daily at 0245 UTC on 1.855, 3.990, 7.290, 14.290, 18.160, 21.390 and 28.590 MHz.

Shortwave listeners can monitor these digital bulletins using a number of available free software programs including HamScope which may be downloaded here: **http://www.qsl.net/hamscope**. Connecting a small audio patch cord from the speaker of your radio to the microphone input of your desktop or laptop will let you monitor these transmissions. Using a tablet or smartphone, simply hold the device's microphone close to the speaker while the software is running and the station is transmitting. A complete operating schedule for W1AW is found here:

http://www.arrl.org/w1aw-operating-schedule

Zambia National Broadcasting Company According to, ZShortwave Schedule.com Zambia's NBC broadcast in English from 0245 to 2205 UTC on 6165 kHz.

TSM

TSM's Guide to Satellites

By Ken Reitz KS4ZR

If you've ever wondered how TV stations and cable-TV affiliates get their programming, it's often done via communications satellites in the Continental U.S. (CONUS) part of the Clarke Belt, so named for author-visionary, Arthur C. Clarke. These satellites differ from DISH Network and DirecTV satellites in several crucial ways. They operate in different regions of the Ku-band and communications satellites are much less powerful, which is why FTA dishes tend to be twice the size of those of Direct-to-Home systems. You can think of these satellites as the worker satellites of the broadcast/cable-TV business.

While much of the programming on these satellites is unencrypted, or Free-to-Air (FTA), those programs intended for cable systems are encrypted and there is no way to subscribe other than to sign up with DISH, DirecTV or your local cable-TV service. But, such programming is not the focus of FTA hobbyists. Instead, they're looking for audio and video services of interest such as the former shortwave giants, BBC World Service and Deutsche Welle. While these may be hard to find on the shortwave bands, they're readily available on FTA satellite.

One FTA channel that ought to be of great interest to every reader is World Radio Network (WRN) which is found on Ku-band satellite Galaxy 19. In case you missed it, this is where all the former voices of the shortwave bands went including, Vatican Radio, Radio Prague, Israel Radio, Radio Sweden, Radio New Zealand International, Channel Africa, Polish Radio External Service, Radio Slovakia International, NHK World Radio Japan, Radio France International and Swiss Info. They're all on this one channel on G19 and, they're broadcasting in English. You can listen all day, everyday: no fading, no atmospheric noise, no adjacent channel interference, just full-quality audio.

Complete FTA satellite systems can cost less than $200 and are very easy to install. At the end of this guide you'll find a list of FTA equipment dealers. If you don't want to do the installation yourself, there are probably independent satellite-TV installers who can do the work for you.

One thing you should know is that the FCC has issued a ruling regarding your right to install an FTA satellite dish wherever you live, even if you are renting a small apartment. It's called the Over-the-Air Reception Devices Rule and you can read it **here.** FCC rules carry the weight of federal law, trumping state and local laws regarding erecting satellite dishes (you may have one as large as 1 meter in diameter, a little over 39 inches), OTA-TV antennas (but only to receive local stations) and wireless broadband antennas. Amateur radio is not covered by this rule.

More importantly, the FCC states, "Antennas covered by the rule may be mounted on 'masts' to reach the height needed to receive or transmit an acceptable quality signal (e.g. maintain line-of-sight contact with the transmitter or view the satellite)." It notes that, "Masts higher than 12 feet above the roof line may be subject to local permitting requirements for safety purposes. Further, masts that extend beyond an exclusive use area may not be covered by this rule." And, by "exclusive use area," the FCC means, "an area of the property that only you, and persons you permit, may enter and use to the exclusion of other residents.

For example, your condominium or apartment may include a balcony, terrace, deck or patio that only you can use, and the rule applies to these areas."

And, finally, the number of such devices may not be restricted, "The Commission's rule covers the antennas necessary to receive service. Therefore, a local rule may not, for example, allow only one antenna if more than one antenna is necessary to receive the desired service."

Most localities and Homeowner Associations (HOAs) are unaware that their local restrictions are against the law and it's up to you to make them aware. However, you still have to jump through their hoops in order to bring them around. Such local organizations rarely cave in when confronted with the simple facts of the law, but many individuals have fought the local rules and won. You can too.

If you want to subscribe to DISH Network or DirecTV and are having trouble with your landlord, HOA or local ordinances, the satellite companies may help. DISH Network provides this advice which is based on the above FCC OTARD **rule**. DirecTV provides a similar form and you may download it **here**.

In case you're wondering, it's not worth the effort to turn a disused DISH Network or DirecTV system into an FTA system. Most such installations use a dish that's too small to pick up the weaker FTA communications satellites. The feed horn/LNBF will have to be replaced with one

Just because the Cold War is over doesn't mean that there's no more propaganda. The US State Department battles it out for the ears and eyes, if not the hearts and minds, of the Cuban population daily. TV Marti vs Cubavisiion on NSS 806 satellite. Voice of America is also there, along with plenty of other video programs aimed at Latin America, Africa and the Mideast. (Video stills courtesy: Ken Reitz KS4ZR)

that tunes the FTA part of the Ku-band, and you'll still need an FTA receiver to tune the transponders on the communications satellites.

If you happen to have an older 10 foot C-band satellite dish, you can easily adapt it to FTA activity. Assuming it has an older analog C-band receiver with dish drive, and that it already has a C-band LNB/feed horn, simply hook it up to your new FTA receiver, position the dish on any of the C-band satellites listed below and enter the parameters. In addition, you can add a C/Ku-band LNB/LNBF and you'll have access to both C-band and Ku-band satellite FTA transponders. This is the best way to fully explore the world of FTA satellites.

While many FTA hobbyists are happy with a single Ku-band dish permanently parked on Galaxy 19, others have installed additional dishes pointed at other FTA satellites and linked with a DiSEqC (Digital Satellite Equipment Control) switch that lets you electronically switch among dishes from the remote control on your FTA receiver. In fact, when you program your receiver's "favorites" list to include channels on different dishes, the switch automatically changes dishes.

These switches cost between $5 and $15 dollars each, depending on how many dishes they can switch.

Another way to switch satellites is to mount more than one LNBF at the feedpoint of your dish, each LNBF aimed at another satellite. This technique is a lot trickier, requires a multi-feed mount and a lot of patience lining up the multiple feeds, but it can be done.

International Shortwave and TV Broadcasters on C and Ku-Band FTA Satellites

Reception parameters in the chart below are courtesy of Mike Kohl's web site **Global-CM.net**.

For a complete list of FTA C and Ku-band satellites and their transponders go to Mike's MPEG2/MPEG4 DVB Free-to-Air Central.

In this chart, the frequencies are given in MHz, polarization is either horizontal (H) or vertical (V) or, in the case of international satellites, circularly polarized: left-hand (LHCP) or right-hand (RHCP) and the Symbol Rate is SR. Virtually all receivers automatically input the FEC (Forward Error Correction) so it isn't included in the parameters below.

This list starts at the western end of the Clarke Belt, works its way to the east and includes those satellites parked over the Atlantic that serve as a bridge between Europe/Africa and North and South America. Depending on buildings and trees in your area, you may be able to see as far to the east as NNS 806 at 40.5°W, some FTA enthusiasts can reach even further. The only way to know the limits of your location is to experiment.

Readers on the West Coast may not be able to see much beyond the CONUS satellites because Pacific region satellites tend to be beamed to specific locations in the Pacific so that the signal is strongest where it is actually needed. Locations east of Hawaii will not see much in the way of Asian satellites.

This list is limited to just those FTA channels relating to international broadcasters. A full list of all FTA satellites, as seen in Mike Kohl's list, would run dozens of pages, but is interesting to look at nonetheless, so I urge you to check it out.

World TV is available from dozens of countries in as many languages on as many satellites. From Nicaraguan TV (left) to NHK Tokyo (middle) to Al Jazeera International (right), There's global news from a global perspective. (Video stills courtesy: Ken Reitz KS4ZR)

Galaxy 15 133°W

Eternal Word Television Network (EWTN) provides standard definition and high-definition TV feeds of EWTN programs in English and Spanish for the U.S., Canada, Pacific and Africa regions as well as numerous radio feeds, including their Sirius/XM satellite radio feed, Radio Pax 830 kHz AM, Miami, Florida and Radio Catolica Mundial.

Freq.	Polarity	SR
3790	H	11.935
3808	H	16.300

Galaxy 14 125°W

TBN Trinity Broadcasting Network (TBN) provides standard and high-definition TV feeds of TBN programming as well as TBN Enlace USA (Spanish), JCTV and The Church Channel.

Freq.	Polarity	SR
3720	H	26.667

Galaxy 23 121°W

Russia Today (RT) in Spanish, RT-Documentary and RT-America in English. RT intends to compete with the other major international TV broadcasters such as Al Jazeera, France 24 and Deutsche Well-TV.

Freq.	Polarity	SR
3910	H	14.400

Radio Nacional Exterior (Spain) provides radio programming from RNE-1, RNE Classica, RNE-3, REE and RNE-5 all in Spanish.

Freq.	Polarity	SR
4192	V	11.060

Anik F1-R 107.3°W

This Canadian satellite provides excellent signals throughout the U.S.

Freq.	Polarity	SR	
4080	H	30.000	Occasional CBC-TV feeds.
4020	V	30.000	CTV feeds in HD and SD formats.
4150	V	30.000	More CTV feeds in HD and SD.
4060	V	28.346	Radio France International in French.

AMC-18 105°W

NASA provides live television feeds in HD and SD from the International Space Station as well as other space-related science programming from NASA HQ in Houston, Jet Propulsion Laboratory, NASA Spaceflight Center and other interesting locations.

Freq.	Polarity	SR	
3760	V		28.070

SES-3 103°W

Deutsche Welle TV in German and English in SD format as well as DW Radio.

Freq.	Polarity	SR	
3740	V		29.270

PBS-X national feed in HD and SD of PBS-TV programming.

Freq.	Polarity	SR	
4090	V		14.028

Galaxy-16 99°W

World Harvest Radio and Television's network broadcast signals originates from this satellite.

Freq.	Polarity	SR	
4000	H		26.400

SES-2 87°W

ZNS-1 and ZNS-2 as well as Joy-FM from the Bahamas is found here with a very low symbol rate on a relatively weak transponder. Numerous other radio networks are found on this satellite.

Freq.	Polarity	SR	
3842	H		06.150

Simon Bolivar 78°W

A large number of Venezuelan radio and TV feeds are found on this satellite in Spanish.

Freq.	Polarity	SR	
3888	V		23.000

Intelsat 9 and 21 58°W

Freq.	Polarity	SR	
3840	H	27.684	Deutsche Well-TV North America
			DW-Radio 2 (English)
			Radio France International (FR)
			China Radio International (ENG)
4040	H	26.590	NHK World-TV HD (English)
3840	V	27.684	Al Jazeera International (English)
			France 24 (French)
			Russia Today (Spanish)
4120	V	27.500	RAI Internatonal (Italian)
			Voice of Tibet (Tibetan)

Intelsat 805 55.5°W

This satellite has copious amounts of TV services from Latin America including RTU-TV Ecuador, La Tele Peru, TV-Jamaica and a few from Brazil. Radio services from Latin America including Honduras, Mexico, Ecuador, Costa Rica and Peru are also found here. This satellite also carries many

channels of BBC World Service in English, Spanish and Arabic in a very low symbol rate.

Freq.	Polarity	SR
3936	H	3256

NSS 806 40.5°W

This is by far the most important satellite in the Atlantic Ocean Region (AOR) but it requires extra attention in order to have any success with it. Like all satellites, some transponders aren't as powerful as others, so this will be a problem, you'll need the biggest dish you can get (a 10 foot dish will have the most success). In addition, the low angle on the horizon will make reception for those without a clear view to the south and east very difficult. On top of that, the transponders are circularly polarized so you'll need a feed horn that can handle circular polarity (CONUS satellites use linear vertical or horizontal polarity). If you don't have such a feed you can use a small Teflon™ block inserted into the feed horn to achieve the same thing.

With more than a dozen South American countries on this satellite, it's the best place to experience life in Latin America without having to leave your sofa. Besides general TV programming from those countries, there are a dozen or more local AM and FM radio stations from the region on the transponders too. Only two of the more important players on this satellite are listed.

CubaVisión International with Radio Taino, 93.3 FM, Havana. Mostly a channel for propaganda, this channel is where you want to be in January for the Caribbean Series, a month long series of baseball games with participants from various baseball-playing Latin American countries. It's an armchair baseball scouts dream!

Freq.	Polarity	SR
3803	RHCP	26.865

U.S. Information Agency's WorldNet South America and WorldNet Persian U.S. Also carries Voice of America's "News Now," "Music Mix" and VoA regular programming. This channel also has Radio/TV Martí and VoA Radio Farda (Farsi).

3980	RHCP	17.800

International Radio and TV Broadcasters on Ku-band satellites, note that the frequencies for these transponders are about three times higher than C-band.

Galaxy-16 99°W

Shalom-TV from Israel

Freq.	Polarity	SR
11800	H	30.000

Galaxy-19 97°W

This is the central satellite for international broadcasts. If you were to have only one non-movable Ku-band satellite dish set up at your home, this is where you would want it parked.

Radio Services:

Freq.	Polarity	SR	
11874	H	22.000	Vatican Radio (Italian)
12028	H	22.000	Kuwait Radio 1 and 2 (Arabic)
12060	H	22.000	Voice of Russia (English)
12152	H	20.000	Romanian Radio (Romanian)
12053	V	22.000	Radio France International (Fr)
12115	V	22.425	Adventist World Radio (English)
12177	V	23.000	World Radio Network-1 (English to North America) Extensive schedule of programs is found here.

TV Services

Freq.	Polarity	SR	
11874	H	22.000	Kazakh-TV, Kazakhistan (Kazakh, Russian)
			LTV World, Lithuania (Lithuanian)
			Telepace, Vatican City (Italian)
			U.S. Armenia (Armenian)
			Kurd Sat U.K. (Kurdish)
			Thai Global Network (Thai)
			MRTV-3 Myanmar (Burmese)
			TV Oromiyaa (Amharic)
			AZ-TV Azerbaijan (Azeri)
			VTV-4 Vietnam (Vietnamese)
			KTV-1 Kuwait (Arabic)
			KTV-2 Kuwait (English/Arabic)
12053	V	22.000	JN-1 Jewish News One Israel (English)
12152	H	20.000	Russia Today-America (English)

Galaxy 3-C 95°W

11780	H	20.760	CCTV-4 China (Chinese)
			CCTV-News (English)
			CCTV (French)
			CCTV (Spanish)
			CCTV-9 Documentary (Ch/En Subtitles)
			MAC-TV Taiwan (Chinese)

TSM

Complete FTA receiving systems can be under $200. The Patriot 85-E (30 x 36 inch elliptical) single-feed Ku-band dish (above left) combined with the Manhattan RS-1933 MPEG4 FTA receiver (center) is available from Global Communications (Global-CM.net) for $200. Photo on right shows same dish with double LNBF holder for 4.5 degree spacing that lets the you see two satellites on the same dish. (Courtesy: Mike Kohl Global Communications)

FTA Satellite Equipment Dealers

The following FTA equipment dealers are known to TSM staff as reputable dealers. Of course, this is not a complete list of every retailer that sells FTA equipment online. But, those of us who have followed the satellite-TV hobby for any length of time have had the opportunity to use the services of these companies without complaint. All of the equipment mentioned in this FTA guide may be purchased through these dealers. Prices are current as of publication date.

Global Communications (Global-CM.net), 608-546-2523, offers the Manhattan RS-1933 FTA receiver plus a Patriot 85-E dish (30 x 36 inch elliptical dish, which easily falls within FCC OTARD rules) with a single output Ku-band LNBF for $200 plus shipping. The Manhattan receiver is the best all-around FTA receiver. It not only does C and Ku-band reception but handles both MPEG2 (standard definition) and MPEG4 (high-definition) FTA signals. If you already have an FTA dish and LNBF installed and only need the receiver, the Manhattan by itself is $150 plus shipping from Global Communications.

HarmonyFTA.com (harmonytfta.com), 781-938-0013, is a Boston-area FTA satellite-TV installer/dealer with a good assortment of FTA receivers, dishes, LNBFs and accessories.

HyperMegaSat (**hypermegasat.com**), 810-744-1488, offers Linkbox 8000, an MPEG2/MPEG4 receiver that also has a built-in ATSC OTA terrestrial tuner ($190). They also sell other FTA receivers and dishes up to 6 feet diameter, LNBs, LNBFs, splitters and other FTA accessories.

Impakt Products and Distribution (**impaktproducts.com**), 614-252-3200, has a number of hard-to-find C/Ku-band dish accessories, including a stand-alone big dish positioner ($40), capable of storing 99 positions. They sell complete FTA systems with dish sizes from 30 inches to 40 inches, as well as various LNB, LNBF and feed horn accessories.

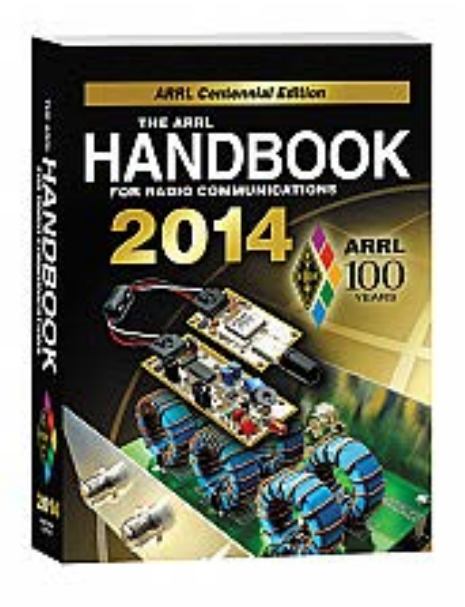
Sadoun Satellite Sales (**sadoun.com**) 888-527-9888, offers a wide range of FTA satellite products, including an assortment of dishes going up to six feet in diameter, lightweight dish actuators (to move small dishes), signal meters (to assist with installation), inexpensive MPEG2 FTA receivers, RG6 coax, connectors, splitters and much more.

Skyvision (**skyvision.com**), 800-500-9275, is one of the few remaining big dish suppliers, though in limited quantities. If you've ever wanted a new, 10 foot mesh C/Ku-band dish, this is the place to get one. But, at $1,250 (10 feet) or $1,100 (8.5 feet), they represent a major investment in the hobby. Skyvision also carries FTA systems, receivers and accessories.

TSM

TSM Bookshelf

New Releases of Books, Video, Audio, and Software to Enhance your Radio Listening



ARRL HANDBOOK 2014 CENTENNIAL EDITION

The America Radio Relay League (ARRL) has actively served as the headquarters for amateur radio in the United States for a full century. Their annually edited and enlarged handbook has been the technical bible for ham radio worldwide since its inception many decades ago. Editions now include a CD which allows the entire, searchable handbook to be loaded on a computer. It's available in either hard or soft cover.

The mammoth, 1300 page, compendium weighs in at a husky five pounds and is copiously illustrated with thousands of photos, diagrams and tables. The layout is sensibly topical, beginning with a pictorial introductory history of the first years of the handbook, followed by an overview of ham radio for the inductee.

The technical chapters begin with an examination of electric theory basics, concentrating on electrical components and their characteristics. The mathematics of radio are introduced here as well, covering resistance, capacitance, inductance and impedance. Analog and digital theory are examined as well.

Successive chapters begin with circuit layout and design including computer aided design (CAD) principles. The greatest girth of the encyclopedic volume details subsystems of communications equipment such as power supplies, receivers and transmitters. Oscillator, mixer, RF amplifier, IF stages, audio stages are examined in detail, with construction projects.

As I've often stated in my articles, antennas are as important as receivers and transmitters, and the Handbook covers those comprehensively along with transmission lines and signal propagation. Of course, accessories are an important consideration. Antenna system tuners (transmatches) and test equipment are addressed along with their applications.

The benefits of this latest edition would be incomplete without mentioning the supplementary construction files and software packaged aboard the accompanying CD-ROM. The disk is heavily loaded and takes a few minutes to install on Windows XP, Vista, and 7, even on fast computers, but the wait is worth it. You will be able to view and print the book's text and search by topic using Adobe Reader. If you don't already have this excellent software, it's available as a free download from adobe.com.

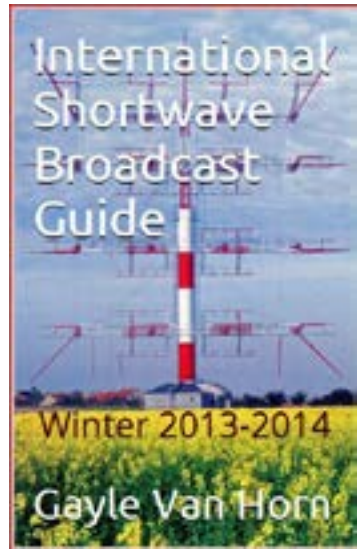
Supplemental files include projects and text on other subjects not contained in the print edition. After the download, a drop-down README.TXT box provides operating instructions.

Is the new edition expensive? Not when you consider the vast resource of pertinent topics in this colossal volume.

The ARRL Handbook, $49.95 soft cover edition (No. 0007), or $59.95 hard cover edition (No. 0000) from arrl.org/shop. – Review by Bob Grove W8JHD

Attention Publishers

If you have a radio-related book, periodical, audio, video or software product of interest to our readers, we would like to review it in *The Spectrum Monitor*. For more information, contact: editor@thespectrummonitor.com



International Shortwave Broadcast Guide 2013-14

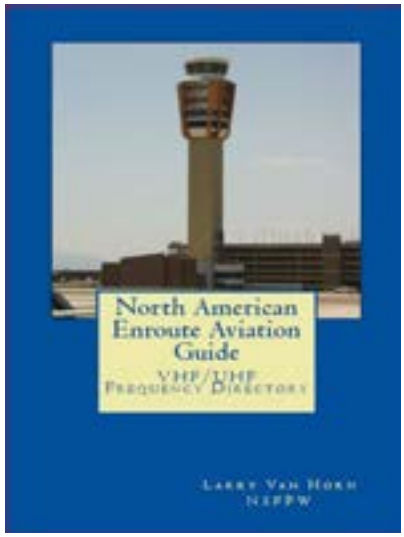
By Gayle Van Horn

For decades Gayle Van Horn edited the "QSL Report" and the "Shortwave Guide" in the center of *Monitoring Times*. With the close of that magazine, Gayle has decided to continue publishing the popular guide as a Kindle e-Book. The **International Broadcast Guide 2013-14** is the first edition of that effort, and it's massive; over 400 pages.

If you're familiar with Gayle's SW guide in *Monitoring Times*, you will know exactly what this guide is all about. If you're new to shortwave listening, you'll find this guide indispensable. It's also simple to use. Just check your time (local or UTC) and refer to that section of the Guide.

Programming, analog and digital (DRM), times and frequencies are listed in a very clear sans serif font, especially easy to read in the Kindle e-book format.

One of the best features of the guide is the target designator next to the frequency that gives you a clue as to whether or not you have a chance at listening to any particular station at any given time. The International Shortwave Broadcast Guide is $4.99 only in Amazon Kindle format.



North American Enroute Aviation Guide
VHF/UHF Frequency Directory
By Larry Van Horn N5FPW

With decades of military and aviation monitoring experience, Larry Van Horn is the authority on this subject. His popular "Milcom" column in *Monitoring Times* was a must-read for all air monitoring fans and was the basis for this book.

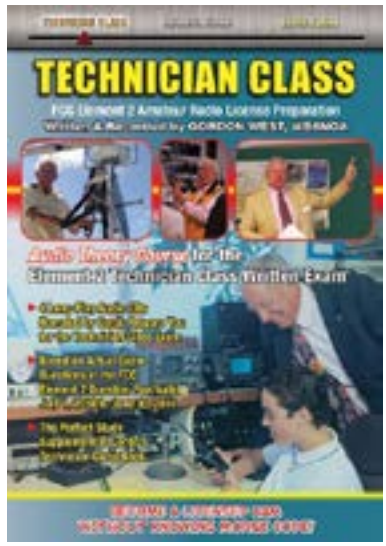
This book, which covers some 200 e-pages starts with a brief history of air traffic control in North America, and includes an explanation of the Air Route Traffic Control Centers of which there are 22 across the U.S.

An explanation of the National Airspace System (NAS) is given along with a step-by-step examination of how departing and arriving flights and their radio coordination works. Van Horn also looks at ways the NAS can improve as infrastructure ages, more flights are added to the system and newer planes come into the system.

You'll learn about the Automatic Dependent Surveillance (ADS) system works, what ADS-B means to pilots and monitors alike.

There's also a detailed history of air safety and the formation of the Federal Aviation Administration, how enroute traffic is handled over land and overseas, and the significance of Special Use Airspace, those areas of the U.S. that are severely restricted for air traffic including Controlled Firing Areas, National Security Areas, Military Operations Areas and more. He writes: "If you are within 200 to 300 miles of one of the sited listed in our e-book, plug in the RCAG VHF/UHF frequency pair for that site and get ready to monitor some of the most interesting civilian and military aircraft communications on your scanner - communications from the FAA ARTCCS."

This book is available only from Amazon.com Kindle e-books ($2.99) here: **http://www.amazon.com/North-American-Enroute-Aviation-Guide-ebook/dp/B00G0683GG**



Technician Class 2010-2014
By Gordon West WB6NOA

A ham for more than fifty years, and an Extra Class licensee, Gordon West WB6NOA, has literally written the book on amateur radio study. Named "Instructor of the Year" by the American Radio Relay League (ARRL) and recipient of the 2006 Amateur Radio Ham of the Year by the Dayton Amateur Radio Association at the annual Hamvention, Gordon West has helped tens of thousands of people from all walks of life get their amateur radio licenses.

The Technician Class 2010- 2014 guide is more than 220 pages long and includes everything you need to know to pass the Technician license exam.

One of the things this book does is to take the FCC Technician Class question pool and reorganize it into 20 logical topic groups. West has highlighted key words that help you remember the principles behind the Q&A.

The Technician Class 2010-2014 is published by the W5YI Group and is available in paperback for $19 from **www.W5YI.org**. Other license manuals for General and Extra Class exams are also available.

2014 Teak Publishing Air Show Guide
By Larry Van Horn

If you were a regular subscriber to *Monitoring Times* you know that one of the most anticipated issues of the year was the annual March "Air Show" issue. Well, you don't have to wait three months to read it, it's available now as an Amazon Kindle e-book from Teak Publishing.

For 14 years the *MT* annual Air Show Guide was a must-have for both air monitors and air-show enthusiasts. Taken to the show, it was the only way to monitor all of the action. Frequencies for the "Blues," "Birds," and all of the other regular air show participants are listed. But that's not all, you get the frequencies for the dozens of other air show performers from all over the world. And, you'll get little known frequencies that Larry alone gets from the dozens of air show fans who report what they've heard at the shows.

Check the air show schedule, know when and where the nearest air show is to where you live and don't forget to take along your Kindle, you'll be lost at the show without it.

The **2014 Teak Publishing Air Show Guide** by Larry Van Horn is 200 pages and a terrific bargain at $2.99.

TSM

Maritime Monitoring

By Ron Walsh VE3GO MaritimeMonitoring@gmail.com

Listening to the Action on Winter's Waves

(All Photos Courtesy of the Author)

As I look out at the snow, I am starting the 2014 loggings here in the radio shack. Several gale warnings marked the month of November as another season of sailing on the Great Lakes comes to an end. We had several gale warnings here in Kingston, which is not unusual during November. Winds gusting to 60 mph and waves of over 12 feet marked one of the gales. Fortunately, there was no snow, just some rain with this storm. Radio traffic was increased as many ships went to anchor to wait out the bad weather. With the December shut down of the Seaway locks, radio traffic goes to a bare minimum as there are only some ferries, operating to islands in the area, which continue to run. However, I monitor the major channels as there are usually some interesting transmissions during the winter.

US Seaway tug Robinson Bay which is used to remove and deactivate aids to navigation for the winter

Channel 82A is used by the Coast Guard, but also by the Search and Rescue (SAR) aircraft out of Trenton, Ontario. We still get weather information on channel 83B as well as alerts on channel 16. I heard SAR techs jump from a Hercules to an overturned aircraft on a lake north of here. The helicopter picked them up after the incident to return them to Trenton. The east coast aircraft were out of service so the guys here had to get ready quickly to cover that area as well for a while.

A steering problem caused a vessel to be stopped in the Seaway and thus a slow down of traffic for some time. Larger ships had to slow down to pass the stranded vessel. An interesting conversation was heard between a patrolling Canadian Pollution Patrol Aircraft and a freighter.

The annual race to leave the lakes resulted in interesting traffic as the water temperature cooled in Montreal. The canals are all closed by January 15 so winter navigation is contained in Lake Erie, Huron and Michigan. Icebreakers keep some ships moving depending on ice conditions. I am told that the Canadian breakers use frequencies in the 3 MHz range when they lose VHF contact. I would like people in that area to confirm this.

My last column spoke of the end of some eras in communication. I have found another end of an era or sign of the times. As of April 13, 2014, the federal government will no longer produce lithographed paper charts. They will continue to produce Print-on- Demand paper charts as well as digital and electronic formats. Budget realities and the increased use of electronic forms of charts are the reasons.

I recently visited the Iroquois lock of the Seaway as there had been an accident on the system. A vessel had hit the ship arrestor and torn out the supporting structure. Heavy winds and the need for a large crane delayed fixing the apparatus for about 36 hours which resulted in a backup of ships in the system. By monitoring the marine VHF channels, I was able to hear the ships getting ready to resume their transits. It did not take long for me to grab my camera, scanners, lunch and a warm coat. After driving the 60 miles, I was able to photograph nine vessels, including one which has a limited life left before going to scrap. Just another example of how radio monitoring can add another dimension to the hobby.

I also did my last trip on the Canadian Empress this fall. As I do not intend to renew my certification, another era came to an end. I did wheel a vessel through the Thousand Islands for the last time. I must admit that I enjoyed writing my column for Monitoring Times over the past eight years and thought that I had reached the end of another era. At the Iroquois lock, I was recognized by a column reader, Richard Edwards, who said he always read my column and was sorry that *MT* was going out of production. He was a long time subscriber. However, I must applaud Ken's efforts to get *The Spectrum Monitor* going. I am also pleased to have been invited to keep writing for the electronic magazine. Hopefully, many of the readers of my column will continue to subscribe.

Marine radio monitoring has been a hobby of mine since the early 1960s and I still enjoy hearing what is up on the Seaway. With the use of VHF and cell phones, the long range communications has gone, but it is still interesting to listen. My column will continue to give as many frequencies and times for monitoring as possible. I will add as much HF material as I can. Digital communications are the coming thing, so there must be added reports on these modes.

I cannot do a good job without having input from readers. I need frequencies and traffic details from your area. I would be happy to report on specific areas or ports. I would love to hear from practicing mariners about how they communicate. I would also welcome any information concerning marine communications equipment. Details of their equipment would add to the column. Any amateur radio operators who are doing some marine voyages are more than welcome to send details to me.

TSM's editor tells me that we have some new subscribers and many who continued on from *MT*. This column will give a general introduction of my background, some basic monitoring details, and a few common frequencies to monitor and some frequencies from research for people to try. I also refer readers to Hugh Stegman's utility column for some monthly loggings.

I have lived all my life along the shores of Lake Ontario and the St. Lawrence River. I grew up with canal-sized lake ships bringing coal and other commodities into Kingston, Ontario where I live.

I began to monitor shortwave radio in 1959 and soon began to listen to the ships on the 2 MHz marine frequencies. I have been fortunate to have made several trips as a guest on great lakes freighters. My interest in ships landed me a job with a local Thousand Island Cruise line to pay my university fees. I soon worked off a small-craft captain's certificate and eventually a Minor Waters Master's certificate. During my teaching career, I filled in on several tour boats. When I retired, I got to work on the Canadian Empress, a 64 passenger cruise ship which runs between Kingston and Quebec City.

I have been photographing ships for over 50 years and have studied the history of shipping on the lakes. I became an amateur radio operator in 1976, VE3IDW and got my present call, VE3GO, 12 years ago. My radio station progressed to improved receivers, transceivers, scanners and better antennas and I still like to monitor the shortwave bands.

I served as president of the Canadian Amateur Radio Federation and at present, I am an examiner for amateur radio and Marine Radio Restricted licenses. HF radio is my real interest and I can be found on all amateur bands at some time.

Let's look at some info for beginning marine radio listeners. There is still some activity on the 2 MHz marine bands in the rest of the world. A good catch is ZBR Bermuda Radio. They announce on 2182 kHz at 0035 UTC and then switch to 2582 kHz for their broadcast. They are heard again every four hours. The Canadian Coast Guard stations along the east, west and Arctic coasts still use 2182 kHz for emergency and calling.

Tanker Sarah Desgagnes entering Iroquois lock. She had a problem in the Seaway later in the season.

The East Coast stations use 2598 and 2749 kHz for information broadcasts while the West Coast uses 2054 kHz. Check the publication Radio Aids to Marine Navigation, online, for the other frequencies as well as times of broadcasts. There is no HF at Great Lakes stations. 5717 kHz is the primary frequency for HF SAR in Canada. The U.S. Coast Guard uses 5696 and 8983 for communicating with aircraft, among many frequencies. There are many web sites, such as Shortwavewatch, where you can find interesting marine frequencies to monitor.

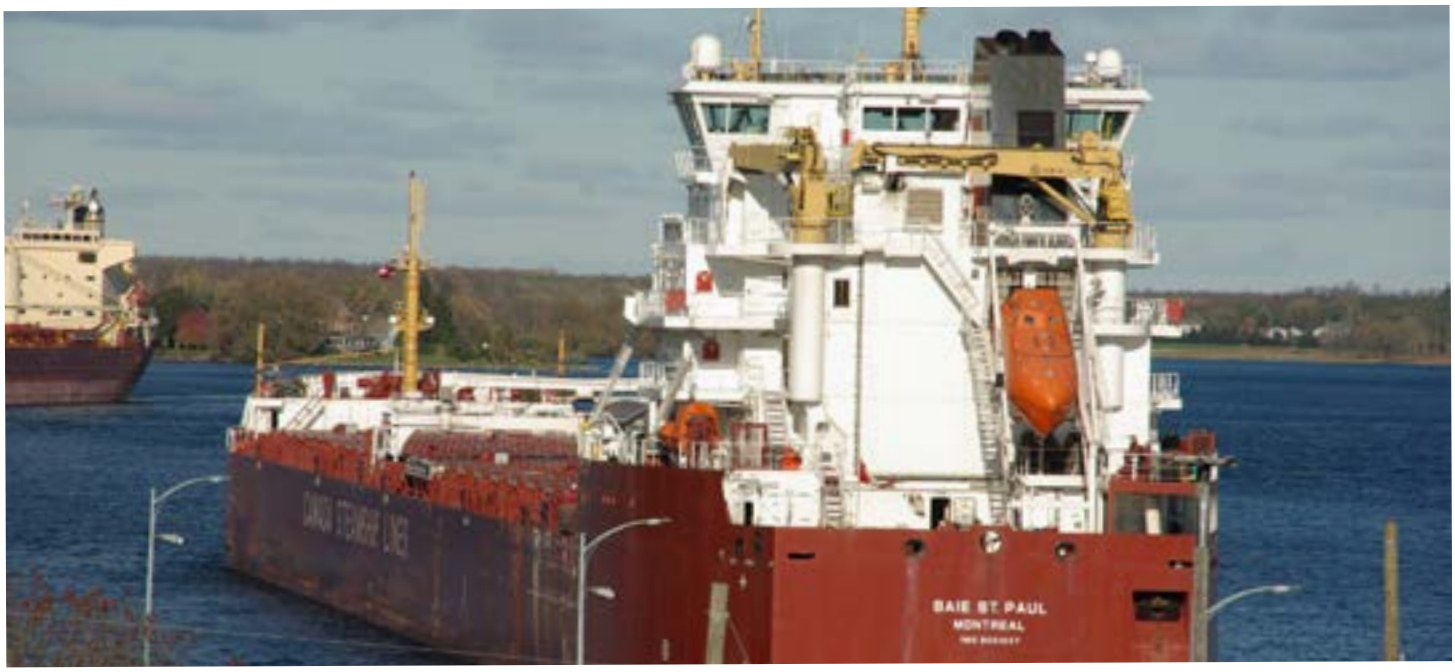
There are several free software programs, such as Multipsk, which will allow you to decode 518 kHz NAVTEX broadcasts. If you do not have cables to connect to the radio, put your computer microphone near the speaker to pick up the signals (however, the noise can get to you!). The same Canadian publication will give you times, mode and details of other digital broadcasts as well. With the longer nights coming on us, these frequencies will give better propagation.

The VHF channels are used worldwide. Channel 16 is the distress and calling channel. However, DSC (Digital Selective Calling) has been implemented, and vessels will soon monitor channel 70. You can decode these calls using the same free programs. However, they all go to channel 16 for the emergency traffic once the alert is given. At this time, channel 16 is still monitored for emergencies until the DSC becomes widely distributed. The USCG uses channel 22A for their information broadcasts. Channel 21B, and channel 83B are used for Canadian broadcasts. These channels operate continuously and are also seen as channels 8 and 9 on weather radios.

The main vessel traffic control channels are Channels 11, 12, 13 and 14. Channel 9 is used for pleasure craft communications in U.S. waters. Channel 10 is used in some areas. You can easily obtain a full channel list on the Internet and program a scanner. You will readily find what channels are used in your areas. Some channels are duplex, using two frequencies, so you'll want to put both frequencies in your scanner. Around locks, you may find that another channel is used to avoid interference. The locks on the Seaway alternate between channels 17 and 13 as you progress along.

Channel 13 is used for bridge-to-bridge communications between commercial vessels. It is also used on many of the internal canals in the United States. I know it is used along the Chesapeake canals, as well as the New York State canal system. The main ship-to-ship channels for commercial vessels are 6, 8 and 10. Channel 82A and 65A are used by the Canadian Coast Guard.

Amateur radio provides a good deal of marine radio interest. The maritime Mobile Service Net on 14300 USB is on from 1200 to 2100 EST. They get many marine mobiles checking in. I have copied stations as far away as Africa. There are several other nets there during the day. At 0730 on 7268 LSB the Waterway Net meets



Brand new, Trillium class vessel, Baie St. Paul leaving Iroquois lock, downbound, with her second cargo.

every day.

I have received a great deal of information from readers and will be happy to print your loggings and give you credit. Terry Moorby wrote and said he liked my October MT column. I hope to continue the same type of column here in The Spectrum Monitor. Jerry Klatt, who maintains an AIS receiving station, #907, in Ohio said he will miss the marine column in *MT* and I hope he continues as a subscriber to *TSM*. Jerry mentions that he has monitored ships as far a way as Lake Huron on his AIS.

James Allen N4DEE, suggested that I might like to visit the Naval Air Museum in Pensacola, Florida, or the battleship Alabama in Mobile. He read my feature on operating aboard the USS North Carolina battleship memorial. I plan to return there this year. I hope Jim and I can share a cup of coffee this spring when I visit Myrtle Beach, South Carolina. Jim Dapkus of Westfield, Wisconsin asked about icebreakers on the Great Lakes. Monitoring them on HF may be difficult. I know the USCG uses ALE on HF, but I must admit I need to learn more about that mode. As always, I enjoy the letters from John Musgrave on the West Coast of Canada, he always has some interesting stories to tell.

As for myself, I plan to be in Myrtle Beach, South Carolina, for February and March, 2014. I have been asked to help operate from the Battleship Memorial USS North Carolina for the North Carolina QSO party on February 23. Look for the call NI4BK! I hope to work some of the magazine readers.

I operate most amateur bands and usually show up in the contests. I do not really try to win, just give out as many contacts as possible and work a few new stations. I will be on for the RAC Canada Winter Contest, December 28, 2013. As usual, I try to work SSB and CW on several bands. I have been working the ECARS Net on 7255 LSB regularly.

Please let me know what I can do to improve my column and help T*he Spectrum Monitor* provide you with information. I am hoping the Gale force wind gusts do not take down my antennas. I do not want any more winter antenna work.

TSM

Canadian Empress arriving at Kingston for the final time this season.

The Longwave Zone

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

Is There a Future for the "Basement Band?"

Welcome to The Longwave Zone! I'm excited to continue my work reporting on a unique part of the radio spectrum. I know that many of you have joined us from *Monitoring Times*, where I wrote the Below 500 kHz column for 22 years. I'd like to welcome you to this brand new venue, and also welcome those who are new to my work. The goal of this column is to bring something of interest to longwave (LW) fans each month, and to include material that isn't readily available elsewhere. This will be a "monthly gathering" of longwave fans. We'll not only report on key topics, but also share input from readers, including photos, tips, and loggings. Feel free to write directly to me (wb2qmy@arrl.net) any time!

This longwave converter costs just $14 and provides respectable performance for DXing. (Photo courtesy of Ron Smith)

Shades of MT

The format of TLZ will follow the general theme of my former *MT* column, but I am also taking the opportunity to refine the direction of my work to reflect current trends. For better or worse, longwave has usually been associated with the "underbelly" of radio. Terms such as "basement band" and "submarine band" have often been used to describe this part of the spectrum. While I have always celebrated longwave's underdog status and its historical aspects, much has changed in recent years. I will explore these modern developments, while still occasionally visiting the traditional/historical side of the band.

Today, we are seeing cutting edge experimental work in weak signal modes and data transmission, and the band is used for high tech navigation enhancement in the form of Differential Global Positioning System (DGPS) signals. DGPS is a scheme in which ground-based transmitters (former beacons, in the case of longwave), are used to transmit local "correction" signals in the vicinity of the transmitter. GPS users can apply these signals to achieve greatly enhanced accuracy, which is important to some users. One example might be surveyors or navigators operating in small harbors.

These modes can be decoded by hobbyists with free (or inexpensive) software, and I'll show you how. The exploration of "natural radio" has also grown from the esoteric lash-ups of yesteryear, to sleek portable units that can be taken into the field with ease. Digital recording of natural radio is also commonplace today. I'll talk about how you can capture these signals and share them with others via the Internet.

ExcitingTime for LW

Almost all new receivers today include LW coverage, something that was not the case 20-30 years ago. This will be reflected in the column, and I look at how well these radios perform. Finally, I'll devote an increasing amount of coverage to amateur radio on longwave, as more countries grant allocations here. This is indeed an exciting time for the band! Here are a few of the topics planned for future columns: Part 95 experimental operations; New products; Ham band operations; DXing tips; New modes and reception techniques; Loggings; Reader news.

Who is Kevin Carey?

By way of introduction, I'd like to share some of my own history in the radio hobby and longwave in particular. I'm 51, and I live in the Rochester, New York area, where I have spent my entire life. I enjoy it here, including the winter months. I've been interested in longwave since shortly after getting my ham ticket in 1977. My high school friend and main Elmer (amateur radio shorthand for mentor), Doug Hoff KI8KN, gave me a copy of an old Popular Electronics article titled A Transmitter for the Neglected Band. This was the first time I had ever considered what went on below 530 kHz (the low end of the AM broadcast band), and I certainly did not know that anyone was experimenting with two-way communication there.

A few years later, I built my own longwave receiving converter based on a 73 Amateur Radio magazine article by Ken Cornell W2IMB (SK). Incidentally the term SK is amateur shorthand for deceased, it is an abbreviation for "silent key." Ken was a true pioneer in longwave experimenting, and this converter was just the thing to get me started on the band. It took a slice of the longwave spectrum and converted it up to the frequencies of the

80-meter ham band where I could tune it in with my Hallicrafters receiver, which was not designed to receive longwave transmissions.

This opened up a new world to me, and thanks to the simple instructions and pictorial wiring diagram, my converter worked the first time I turned it on. I had limited building experience, so this came as a pleasant surprise. I still have this converter in reserve status.

I have dabbled in Lowfer transmitting with the beacon identifier "KC" on 185 kHz (not currently operational), and built antennas, tuners, and other accessories to enhance longwave reception.

Chasing Beacons

I have chased beacons, and traveled on a series of DXpeditions to Canada's Miscou Island in New Brunswick, for serious trans-Atlantic reception. Some of you may be familiar with a book I wrote called "Listening to Longwave," or my Beaconfinder II directory. These are geared toward helping others get the most out of their time on longwave.

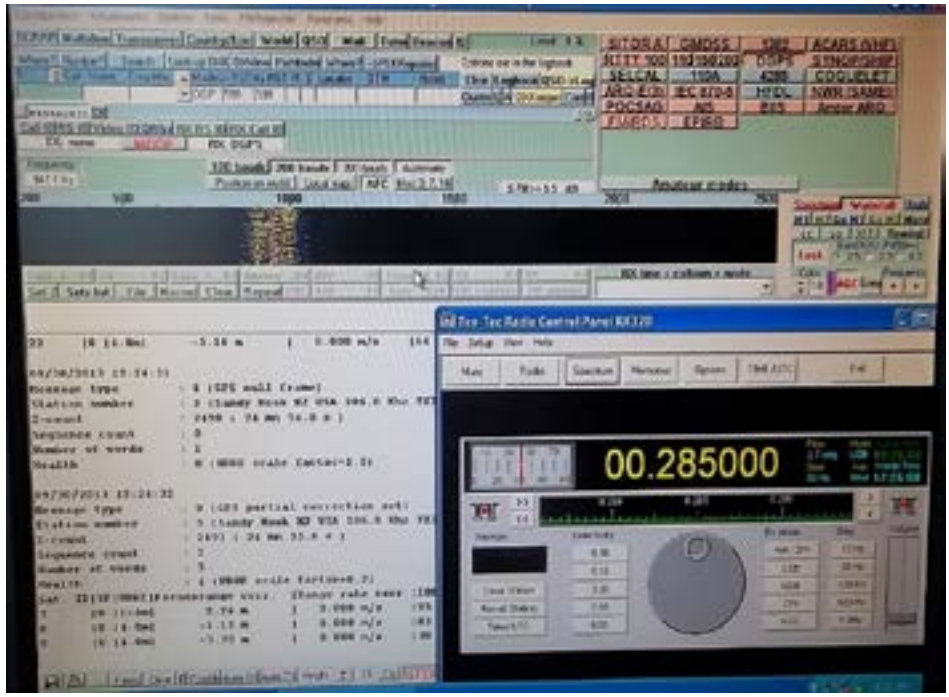
Finally, I have produced a CD-based audio tour of the band called VLF Radio. This is a survey from NAVTEX signals at the top of the band (518 kHz), all the way down to 'Sferics and whistlers at the low end.

I cite the above items not to brag, others have done far more impressive work on longwave, but rather to illustrate the point that I am a generalist, and not a specialist in any one aspect of the band. In fact, I consider myself to be primarily a reporter, so I'll be depending on you, our readers, to share your news and information on a regular basis. Please tell me what you'd like to read about, and stay in touch with TLZ!

Besides radio, I enjoy motorcycling on and off-road (observed trials), restoring vintage vehicles, outdoor activities (hiking, bird watching, canoeing, and fishing), family activities, studying Irish ancestry, and reading on a variety of topics, including local history and biographies. I find radio to be a perfect complement to the other areas of my life, and it allows me to learn more about the world around me. I find life exciting, and tend to be a positive person.

Reader Mail

I was pleased to hear recently from Ron Smith, who has an interest in



MultiPSK software can be used to decode many digital modes, and will be further explored in this column. This screenshot shows it being used in conjunction with a Ten -Tec receiver for DGPS reception. (Photo courtesy of Mario Filippi)

longwave converters that are currently available on the market. Ron has explored several such units, and in terms of cost effectiveness, it appears one real standout is the $14 unit from Jackson Harbor Press.

Detailed information on this converter can be found at **http://www.wb-9kzy.com/lfconv.htm**. From my perspective, one of the best things about this unit is that after you can decide on your own enclosure and connectors to use with it, giving your project a personal touch. This battery-powered unit includes an antenna bypass switch and an LED for a power indicator.

Remember the venerable Palomar Engineers converter that many of us got our start with in the 1990s? Well, Ron reports that an updated version of this classic is once again available, fully assembled and ready to use at a cost of $99. Full information for this "neo-classic" can be found online at: **http://k1el.tripod.com/VLF.html**. Design and assembly of the converter is by HamCrafters Radio Kits by permission of Palomar Engineers.

Ron has also been experimenting with a "Hula Hoop Longwave Loop" (that has a catchy sound, don't you think?), and his is a variant on the one described at this YouTube link: **www.youtube.com/watch**?v=UHKSYRnVYT8. You may be surprised by how much this antenna soups up an inexpensive portable receiver, not to mention its directional capabilities. Finally, Ron passed along a website with excellent tips on LW/MW loops: **www.mds975.co.uk/Content/aerials1.html**. This would be a great place to start if you are considering building such an antenna this winter.

Loggings

Our loggings this month are from Richard Palmer W7KAM (MO) and Russ Hill (MI). Each logging is identified by the contributor's initials in the list below. Richard uses an Icom R-75 receiver and a Clifton Z1501 active antenna, with the base up 25 feet and a 10 foot whip section. To further improve signals, he uses a Timewave DSP-599zx audio processor. Richard reports that he has logged 33 new beacons this month, and as of press-time, his yearly total stands at 860.

Russ Hill is using a Kenwood R5000 receiver and a Palomar loop from his Michigan location. I'd like to thank both contributors, and encourage other readers to tell us what they are hearing. I offer a free Longwave Loggings Template which you can request from me via e-mail. This makes logging entry simple and puts the them in a format we can use here. I also cross-post some logs to my DX Downstairs column in the Lowdown journal, the monthly publication of the Longwave Club of America (LWCA). Please let me know if

you'd rather not have your logs cross-posted.

Selected Beacon Logs

kHz	ID	ST/PR/ITU	CITY	BY
206	AP	MI	Alpena	R.H. (MI)
206	YNE	MB	Norway House	R.H. (MI)
207	CL	NB	Charlo/Dundee	R.P. (MO)
208	YSK	NU	Sanikluaq	R.H. (MI)
221	RP	WI	Rice Lake	R.P. (MO)
243	YVB	QC	Bonaventure	R.H. (MI)
256	YXN	NU	Whale Cove	R.P. (MO)
260	GHJ	NC	Gastonia	R.P. (MO)
260	SNE	TX	Saint Elena	R.P. (MO)
261	D6	BC	Fairmont Hot Springs	R.P. (MO)
263	JDN	MT	Jordon	R.P. (MO)
264	SZT	ID	Sandpoint	R.P. (MO)
268	UBY	CUB	Bayamo	R.P. (MO)
269	TII	OH	Tiffin	R.P. (MO)
275	FPR	FL	Fort Pierce	R.P. (MO)
278	SRE	OK	Seminole	R.P. (MO)
283	SCO	MT	Scobey	R.P. (MO)
305	RO	NM	Roswell	R.P. (MO)
321	FT	CO	Denver	R.P. (MO)
329	YEK	NU	Arviat	R.P. (MO)
335	AWS	GA	Columbus	R.P. (MO)
344	JA	FL	Jacksonville	R.H. (MI)
345	PUF	IA	Estherville	R.P. (MO)
347	GC	KS	Garden City	R.P. (MO)
349	AAF	FL	Apalachicola	R.P. (MO)
350	DF	NL	Deer Lake	R.H. (MI)
351	YKQ	QC	Fort Rupert	R.H. (MI)
353	CY	WY	Cheyenne	R.P. (MO)
356	AQP	MN	Appleton	R.P. (MO)
356	AY	NL	St. Anthony	R.H. (MI)
356	GMZ	TX	Bowie	R.P. (MO)
356	HIX	KY	Hopkinsville	R.P. (MO)
356	PI	IL	Peoria	R.H. (MI)
356	PTT	KS	Pratt	R.P. (MO)
356	SKI	IA	Sac City	R.P. (MO)
359	GYG	MI	Grayling	R.P. (MO)
359	HHH	TX	Devine	R.P. (MO)
361	HB	NC	Burlington	R.P. (MO)
362	HPC	AR	Hope	R.P. (MO)
366	EZM	GA	Eastman	R.P. (MO)
367	FVX	VA	Farmville	R.P. (MO)
375	PSN	TX	Palestine	R.P. (MO)
376	ZIN	BAH	Great Inagua	R.H. (MI)
377	EHA	KS	Elkhart	R.P. (MO)
379	UG	IL	Waukegan	R.P. (MO)
382	APT	YN	Jasper	R.H. (MI)
382	XU	ON	London	R.P. (MO)
385	EMR	GA	Augusta	R.H. (MI)
385	UWL	IN	Greencastle	R.H. (MI)
388	CDX	KY	Somerset	R.H. (MI)
391	EFW	IA	Jefferson	R.P. (MO)
392	AGZ	SD	Wagner	R.P. (MO)
400	XW	KY	Flemingsburg	R.H. (MI)
521	INE	MT	Missouli	R.P. (MO)
523	JJH	NY	Johnstown	R.P. (MO)
524	HRD	TX	Kountze/Silsbee	R.P. (MO)

VLF Antenna Option—Active Antennas

Many newcomers to longwave try to use the same "random length" wire antenna they use for shortwave listening. While this may work in low-noise locations, it often results in little more than static being heard on longwave, or perhaps a few close-by stations. There are several commercial active antennas available, including the popular L-400B from LF Engineering Co.

I know that not everyone has the budget for a commercial antenna, especially if longwave is only a "sideline" activity. So, how about building your own? A simple design, complete with printed circuit board (PCB) artwork, can be found at **http://tiny.cc/KEBjh**. The author, Adrian Knott of the UK, states that the frequency coverage is approximately 10 kHz to 200 kHz, but changes in the filter components should allow reception well above this range. Time to experiment!

End Notes

Bryan Turner W8LN (AL) sent along note that a short clip on whistlers can be found on the Stardate Podcast for September 19th, 2013 at: **http://claycord.com/2013/09/19/stardate**-on-claycord-september-19-2013/. We plan to explore natural radio in this column from time to time, and this podcast offers a good overview of the phenomena. The home URL for Stardate is **http://stardate.org**/.

TSM

Adventures in Radio Restoration

By Marc Ellis N9EWJ **mfellis@alum.mit.edu**

Electrical Safety for Restorers

Since this is a new beginning for all of us, I thought it might be appropriate, for my first *TSM* article, to adapt an article that represented a new beginning for me some 20 years ago when I started a newsletter for radio collectors. It is from the pilot issue of that publication, which ran for about two years, and deals with electrical safety.

Various styles of ground fault interrupter (GFI) outlets. (Courtesy: Leviton)

Those of us who cut our teeth as electronic experimenters during the heyday of the vacuum tube learned how to work safely around high voltages and currents as we acquired our technical know-how. The dangers were made known to us by our advisors and teachers, the more responsible hobby writers of the time, and sometimes by sad personal experience.

Today, though, a new radio hobbyist is unlikely to have that background. In this day of low-voltage, low current, semiconductor circuits, even people with electronics expertise may be unaware of the hazards that lurk within a tube radio the moment its plug is inserted into a wall socket. Precautions that we older hobbyists take automatically, without even thinking about it, really need to be explained to the new collectors and restorers so that they can enjoy our hobby without jeopardizing their safety. And, that's just what I hope to accomplish here.

The shock hazards associated with a plug-in tube radio come from two sources: the AC power line and the high DC voltages developed within the set to operate the vacuum-tube circuitry.

Power Line Hazards

For many people, the familiar household wall outlet inspires little thought or concern. It's a convenient source of power for lamps, vacuum cleaners, tools, or whatever useful appliances we feel like plugging in. With few exceptions, the power is always there when we want it, always goes where it is needed and does the work we assign to it quietly and without incident.

Yet, improperly insulated and fused, the household power line can lash out with powerful and dangerous sparks or (perhaps even worse) quietly overheat the wiring within our walls until it reaches the point of ignition. So, here are the first and most obvious precepts of AC line safety:

(1) Make sure that all of the electric wiring in your home is correctly fused or breakered for its current carrying capacity.

(2) Make sure never to plug in devices with known short-circuit hazards such as radios having cracked or frayed line cords.

Besides being a fire hazard, the AC power-line can dish out uncomfortable and even fatal shocks. To avoid being on the receiving end of one of these, it's important that you know a little bit about how power is distributed to your home. The key facts to keep in mind are:

(1) one of the two wires in a ll5-volt electrical circuit, the "neutral," is connected to ground.

(2) that the ground, especially when damp, is an excellent conductor of electricity.

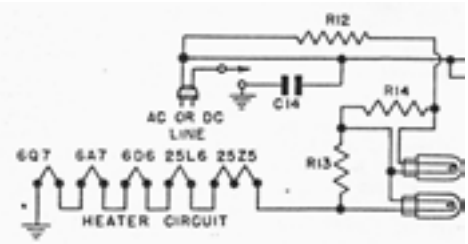
If even slightly damp, the concrete in your basement is also a good conductor of electricity. And, of course, the floor is in direct contact with ground. So if your workshop is in the basement, you have a special hazard to consider.

Placing a bare part of your anatomy in contact with the floor (or with a metal chair or workbench frame that stands on the floor) is almost the same as touching it to the grounded wire in a wall outlet. If you now come in contact with something connected to the ungrounded, or "hot," side of the line, while probing the innards of a radio, for example, your body will complete the circuit across the line and you will experience a nasty shock.

If the parts of your body completing the circuit are a foot and a hand, for instance, the shock will pass through your entire body, which can be extremely unhealthy, or worse.

So the morals for the restorer are these: if you have a basement workshop, try to place yourself and any metal benches or chairs on an insulating surface such as a rubber mat or wood platform. And, as a matter of principle, avoid poking around in a plugged-in radio with your bare hands, unless you're using an isolation transformer, which we'll discuss shortly.

Another good precaution for any workshop, basement or not, is to replace the electrical outlet on the bench with one equipped with ground fault interruption (GFI). Properly installed, such an outlet will automatically shut off the power as soon as any current begins to flow (through your body or otherwise) between the "hot"



Line cord wiring on a typical AC/DC set. Note that one of the wires from the cord goes to ground when the power switch is turned on.

side of the line and any ground external to the outlet. Connect an ordinary power strip (properly equipped with a grounding plug) to this outlet to obtain additional protected outlets. GFI outlets are available, at reasonable cost, at most hardware and home-center stores.

The AC/DC Set: A Safety Nightmare

And, speaking of power-line hazards, the common "AC/DC" set represents one of the worst. This type of radio is so named because, in addition to operating on alternating current (AC), it could run on the direct current (DC) power lines that were prevalent decades ago in the downtown areas of our older cities. The dual operating capability was a side effect resulting from the fact that the AC/DC, designed during the cash-tight days of the Great Depression, gets along without a power transformer.

But, the elimination of the transformer had another side effect, one creating a very serious safety hazard. It meant that the set's DC plate-supply circuitry was no longer isolated from the power line. In fact, one side of the line became the negative connection for the plate supply and, as such, was usually wired directly to the radio's metal chassis.

As a result, depending on which way the radio's line cord was inserted into the wall socket, the metal chassis was either at ground potential (no great problem) or connected to the "hot" side of the line. In the latter case, the unwary user who touched the chassis, or any metal part associated with it, while also touching a grounded object or surface would definitely receive a serious shock.

Back in the 1930s, when transformerless sets were first introduced, consumer safety was not nearly as much of a societal concern as it is today. It was considered adequate to provide the radio with a back cover protecting the user from contact with the chassis. However that cover was usually made of a fragile, fiber material, and it's the exception, rather than the rule, to find one still intact today.

The back of this flea market AC/DC set is missing, dangerously exposing the chassis and other metal parts, which could be hot to ground. See text for suggestions on replacing the deteriorated line cord.

Before you plug in any radio for the first time, particularly if it is a small table model, check to see if it's equipped with a power transformer. If not, be very careful once the plug goes into the wall. There will be a strong possibility that the chassis, not to mention the control-knob shafts and the chassis-mounting screws under the cabinet, are now hot to ground with the full line voltage. Actually, even transformer sets should be treated with respect; their chassis can sometimes become "hot" because of leaky bypass capacitors or other circuit faults.

The only way to work on an AC/DC radio safely is to use an isolation transformer. The primary of such a transformer is connected to the 115-volt AC line, and the secondary puts out 115 volts to the radio under test. However, the radio is now completely isolated from the AC line, no matter which way the plug is inserted into the wall, because there is no direct electrical connection between the primary and secondary of a transformer.

Isolation transformers are still available new from the larger electronics parts houses; they can also be found used at electronic flea markets and in surplus equipment catalogs. New ones are expensive, but whatever the cost, you'd be foolish not to invest in one if you expect to do much work on AC/DC radios.

At the risk of being repetitious, here are a few specific cautions that will keep you from causing some spectacular short circuits when working with AC/DC sets. Never attempt to improve reception by attaching a ground lead (unless there is a specific connection labeled for that purpose). Never connect a piece of test equipment to the radio unless the radio is powered through an isolation transformer.

If it's necessary, as is often the case, to replace a frayed or cracked line cord, don't use one that has a plug with a grounding pin. It can be helpful, though, to use a cord that has a polarized plug (one blade wider than the other). Such a plug can be inserted into an outlet in one direction only, and if the outlet has been installed correctly the wider blade will be connected to the ground side of the line.

Referring to the radio's schematic diagram, see if one of the line connections from the original power cord is connected to a circuit point that goes to ground either directly or through the "on-off" switch. If so, make sure that the wire from the wide blade in the replacement cord is connected to that same circuit point.

If your restored AC/DC radio is to be used regularly, don't leave any metal exposed. Make a replacement back, if needed, and don't operate the set with missing knobs. It might also be a good idea to put a small square of plastic electrical tape over each of the chassis mounting screw-heads. That's it for now. See you next month with more Adventures in Radio Restoration.

TSM

The Broadcast Tower

By Doug Smith W9WI **dougw9wi@gmail.com**

Use your PC for Off-Air Recording

Welcome to The Broadcast Tower! Those of you who read my work in *Monitoring Times* will find this column familiar. I hope all of you will find it informative and interesting.

The Broadcast Tower deals with the domestic AM, FM, and Over-The-Air (OTA) TV broadcast bands. I'll concentrate on information useful in locating and identifying distant stations, information that will help as you DX the domestic broadcast bands.

This column will be technology-heavy. I'll report on changes in broadcast technology, such as HD Radio and Modulation Dependent Carrier Level. I'll also report on technology available to you, the DXer, such as the information on automated DXing in this month's column.

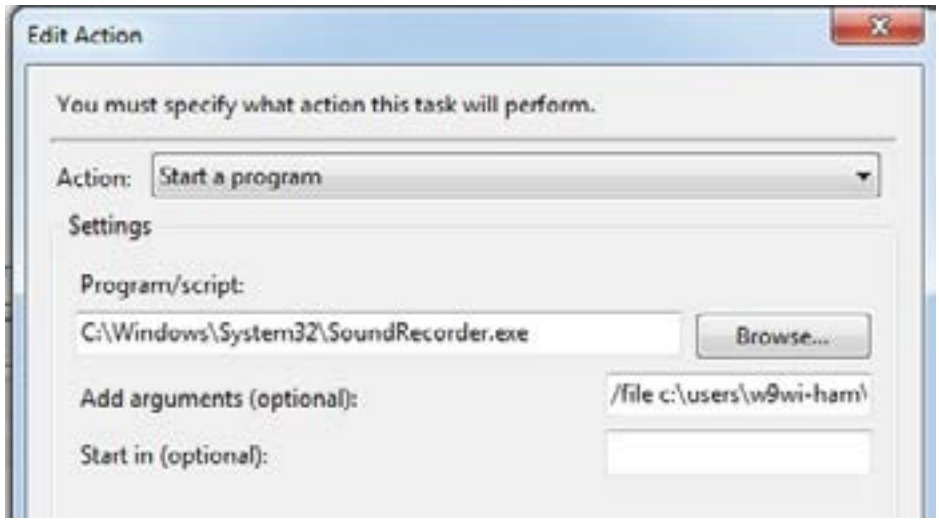
But while the column will be technology-heavy, it will not be technology-exclusive. Changes in programming and in non-technical regulations will affect the way you DX. You'll read about it here.

This column will depend upon your input. Please write if you have any questions, suggestions, or information. And, thanks for taking a look at T*he Spectrum Monitor*!

Asleep at the Dial

The largest challenge most hobbyists face is finding enough time to pursue their interest. That's certainly the largest challenge I face DXing. There's never enough spare time to spend behind the dials. When there is spare time, it seems to happen in the middle of the day, when there is no DX to be had. Wouldn't it be great if you could DX whenever you wanted? Wouldn't it be great if you could compress six hours' worth of DXing into six minutes' worth of listening? I am finding that you can.

Last month, in *Monitoring Times,* you read of the automatic TV DX scanners operating at 29 sites in the U.S. and Canada, including my site near Nashville. My autoscanner has caught digital TV stations from distances of up to 200 miles.



Setting up a Scheduled Task to record AM DX. (Doug Smith)

I figured it should be possible to automatically DX the AM radio dial as well. After some experimentation, I have it working. You can too, using software you probably already have on your computer. Here's how...

First, you're going to need to connect your computer to your radio. I should note, if you're an amateur radio operator (ham) and active on the digital modes (PSK31, RTTY, etc.), then you've already got the connection you're going to need.

The cable you'll need will depend on your radio. In most cases, a cable with 1/8" stereo plugs on both ends will work. Radio Shack (part #42-890 for $4) and Wal-Mart, among many other places, carry this cable.

Plug one end of the cable into your radio. If your radio has a "record" output, try it – otherwise, you'll need to use the headphone jack. The other end of the cable goes to the "Line In" jack on your computer. On most computers, this is the blue audio jack. Some laptop computers don't have a Line In. If you have one of these computers, you'll need to use the Microphone jack and an "attenuating patch cord." This is also a Radio Shack item, #42-2152 ($1).

Now, test it. Click the "Start" button, then All Programs, Accessories, Sound Recorder. There's a level indicator bar between the time (0:00:00) and the blue question mark. If you have a station tuned in on the radio, there should be a green level bar extending well towards the question mark. You may need to open up the Windows Mixer to adjust levels. Clicking on the speaker icon at the lower right, near the clock, will probably get you into the mixer.

Once you have a reasonable level showing on the indicator bar, click Start Recording and let it record from the radio for a few seconds.

When you click Stop Recording, Windows asks where to save the recording. By default, it goes in your Documents library. Open up that library, find your recording, and double-click on it. It should play back through your speakers. If it sounds like what's coming in on your radio, you're done with the hard part!

You now know how to manually record your radio DX on your computer. Of course, that's not what we're trying to accomplish here. We want to record it automatically. That's where Windows' Task Scheduler comes in.

Click Start, All Programs, Accessories again, but this time select Command Prompt. In the command prompt window,

A simple 1/8" audio cable will connect most radios to your computer. (Doug Smith)

type taskschd.msc and hit Enter. The Task Scheduler should come up. Click Action, Create Basic Task. The Task Scheduler will take you through the steps necessary to create a daily recording.

First, name your task! I'd put the time of the recording in the task name. 0100 DX Recording, something like that. You can add an optional description. Click Next.

Second, how often do you want your task to run? You want your 0100 DX Recording to happen every day. Select Daily, which is probably the default. Click Next.

Third, when do you want the recording to happen? The day doesn't really much matter, as long as it's either today or a day in the past. The time should be about 30 seconds before the top of the hour. The idea is to record the station identification announcement that's supposed to be broadcast every hour. For the 0100 DX Recording, you might have it start at 00:59:30. Tell Task Scheduler you want the task to Recur every 1 days. (I realize that's ungrammatical. You're going to have to complain to Microsoft about that.) Click Next.

Fourth, what action do you want the task to perform? The default, Start a program, is what you want. Click Next.

Fifth, what program do you want the task to start? In the Program/Script window, fill in C:\Windows\System32\SoundRecorder.exe. In the Add Arguments window, fill in /file C:\Users\{your login username}\0100.wma /duration 0000:01:00 . Replace {your login username} with whatever username appears on the screen where you type your password to start Windows. Click Next.

There is a sixth step, but all it involves is clicking Finish. You're done!

At 30 seconds before 1:00 in the morning, your computer should automatically begin recording off your radio. The recording should last one minute. Hopefully.. that one minute will include a station identification.

You will probably want to schedule additional recordings at the top of each other hour between maybe 5:00 pm and maybe 8:00 am. Be sure to change the name of the .wma file in the fifth step – otherwise, your 2:00 am recording will be recorded to 0100.wma, wiping your 1:00 am recording!

An FM station going away?

Each month there's been more bad news for the AM band. Stations keep vanishing from the dial, surrendering their licenses never to be heard again. And, as this happens, the FM band keeps growing. New, full-power stations appear. More FM translators are authorized. There's a LPFM filing window. This month, we have something unusual: a full-license FM station has gone permanently dark.

It's not entirely unheard of for small FM stations in small communities to temporarily suspend operations. Economic life can be precarious. This station is located in Denton County, Texas and covers many of Dallas' richest suburbs. It's not exactly the first place I'd expect to find a station disappearing.

Cumulus is one of the largest radio groups in the country. They wished to assume control of KESN 103.3 MHz in the Dallas market, but they already controlled too many Dallas radio stations to comply with FCC multiple-ownership regulations. So they arranged to sell another one of their stations, KTDK 104.1 MHz, to a

Windows Sound Recorder, showing a reasonable level on the green bar. (Doug Smith)

Whitley Media.

The Asset Purchase Agreement (APA) called for Whitley to pay Cumulus $100 for the station, plus all proceeds from any future sale of the station from Whitley to someone else (less any operating expenses and losses and a fixed $50,000). It also required Whitley to use, "commercially reasonable efforts to sell the Station Assets".

A commercial FM radio station covering rich suburbs north of Dallas is worth a whole lot more than $100! The FCC looked at the APA & realized Cumulus was not, in fact, selling KTDK. They recognized Whitley Media not as an owner of broadcast stations, but as a media broker (you could say they're a real estate agency that sells radio stations instead of homes).

The Commission expects a "sale" to convey both control of the station and the financial risk involved in its operation but, the KTDK deal didn't convey any of the financial risk.

So.. the FCC dismissed the KTDK license transfer as "not acceptable for filing." Which in turn left Cumulus to choose whether to keep KTDK and bail out of the agreement to control KESN, or keep KESN and get rid of KTDK. While KTDK covers a rich suburban area north of Dallas, KESN covers the same area, as well as most of Dallas itself and much of Fort Worth. It would seem Cumulus saw KESN as the preferred option.

Normally, in this kind of situation Cumulus would have found another buyer for KTDK. In this case, that didn't happen. I'm guessing that since approval of the APA had been pending since July, Cumulus (and KESN's owners) just couldn't wait any longer.

So, Cumulus returned the KTDK license to the FCC for cancelation. And, if you're listening to 104.1 MHz in the Dallas area, you're probably hearing nothing (or, you're hearing KMGL from Oklahoma City!).

What happens next? The 104.1 frequency is still assigned to this area (the FCC has it assigned to the town of Sanger, Texas). At some future date, the

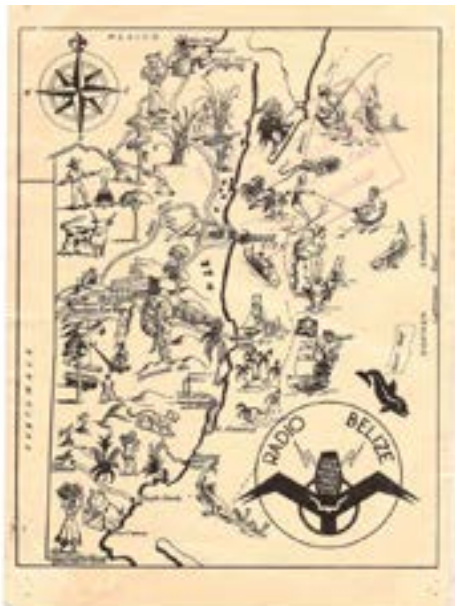
Commission will hold an auction, and the right to use 104.1 in Denton County will land with some other firm. My guess (and this is really just a guess) is that the auction will happen late this year. And we'll see 104.1 return to the airwaves sometime in the middle of 2015. Stay tuned...

Suspended Operation

As I wrote my last column for *Monitoring Times*, the U.S. Federal government, and the FCC, were still under shutdown. On October 16, the government, and the FCC, reopened. The Commission staff has been quite busy catching up.

A "filing window" for new Low-Power FM (LPFM) licenses was scheduled to open on October 15th. I had speculated the opening of this window would be delayed. It was, in fact, delayed, but only by one day. As soon as the FCC reopened, it opened the LPFM window. The Commission did delay the closing of this window, to November 14.

I had also speculated that Commissioner Clyburn's Notice of Proposed Rulemaking ("NPRM") for AM improvement would be released shortly after the government reopened. This NPRM has now been released. The formal release matches early publicity; there is nothing here that hasn't already been widely reported.



QSL card from May, 1966, for Radio Belize 834 kc with just 20 kw, a tough catch on that frequency with such low power. The image is a fanciful map showing the great attractions of what was then still called British Honduras. On the other side, the card announces: "Voice of the Emerging nation of Belize" Expand the image and explore it; that's something that couldn't be done with a print magazine. (Courtesy: Ken Reitz KS4ZR)

STATION REPORT:

NEW STATIONS

Application filed for new station:

Surrey, British Columbia	600	(new)	10,000/10,000
Vancouver, British Columbia	600	(new)	10,000/10,000

There are two applications at Vancouver. Surrey is a Vancouver suburb, so all three applications are mutually exclusive. The Surrey applicant would prefer 107.7 FM but will accept the AM frequency if someone else gets the FM channel.

STATIONS GOING AWAY

Jean d'Or, Alberta	1540	CBXH going to 102.5 FM
Alice Arm, British Columbia	1150	CBKL
Parson, British Columbia	740	CBKR
St. Stephen, New Brunswick	990	CBAO going to 88.1 FM
Sun Valley, Nevada	1590	KQLO
Albuquerque, New Mexico	1150	KDEF
Roswell, New Mexico	1430	KCRX
Cartwright, N.L.	570	CBNK going to FM
Fort Simpson, N.W.T.	690	CBDO going to FM
Elsa, Yukon	560	CBDD
Swift River, Yukon	970	CBDX

CALL CHANGES

Roanoke, Alabama	1360	WLWE from WELR
Oroville, California	1340	KNTF from KEWE
Honolulu, Hawaii	650	KPRP from KRTR
Boise, Idaho	730	KNFL from KINF
St. Louis, Missouri	630	KYFI from KJSL
Auburn, New York	1340	WMBO from WWLF
Enid, Oklahoma	1640	KZLS from KOAG
Darlington, South Carolina	1400	WJMX from WWRK
Florence, South Carolina	970	WWRK from WJMX
Lobelville, Tennessee	1570	WMAK from WNKX
Roanoke, Virginia	1410	WRTZ from WRIS
Vancouver, Washington	910	KMTT from KKSN

Web links for this month's column:

americanbandscan.blogspot.com My DX blog.

http://licensing.fcc.gov/cgi-bin/prod/cdbs/forms/prod/getimportletter_exh.cgi?import_letter_id=43711 KTDK's failed license transfer applications

http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-13-139A1.pdf FCC AM Improvement proposed rulemaking

http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-13-2029A1.pdf FCC extends LPFM filing window

TSM

QSL card from border blaster XEG Monterrey, N.L. Mexico, from 1966. Note output of 100 kw at 1050 kc. An easy catch across North America at the time. (Courtesy: Ken Reitz KS4ZR)

Antenna Connections

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

Antennas: Organic System, Targets of Oppression

Welcome, friends! Since this is our first issue, I would like to take a general overview of antenna systems, and the philosophies I see them through. Later on in life, we'll build, review, examine, and study. The concept called antenna is an extensive and multifarious beast, that will take us on many startling journeys of discovery, and that, properly harnessed, will enable us to get the most out of our radios, and our hobby.

And the Three Shall Become One

For me, the real breakthrough in understanding antennas came when I learned to see antenna, ground, and transmission line as a system, that is, the parts cannot be meaningfully separated. The more organically and integrally these three entities work together, the more efficient our antenna system will be. It is always a mistake to focus on one of the elements, typically, the antenna, and to treat ground and transmission line as afterthoughts, as second-class citizens.

An antenna has to be fed with the right line and an antenna must have a ground image to work against; a poor ground negates all the work done to build, for example, a vertical for the HF bands. The pieces can't be separated, but instead, are all three crucial to the system's success.

It might be helpful at this point to define what we are talking about when we say "antenna, transmission line and ground," because each of these entities can and do assume many different forms.

Antenna can be the stubby little "rubber duck" on top of a 432 MHz amateur radio handie-talkie, or a full-sized four element 40 meter beam with the acreage of a football field, or a rain gutter, or any of a million other arrangements. You can put a finger on the antenna terminal of a shortwave receiver and hear stations; your body has become an antenna. The dish that brings 300 channels of drivel to your TV is an antenna; your cell phone has an antenna, small and internal though it may be.

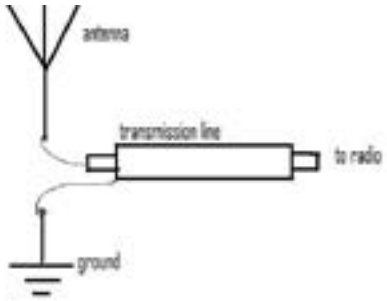
Transmission line, in my view, includes not only coaxial cable, ladder line, open-wire line, or even a single-wire feed, but also any tuner or pre-selector that you might happen to use. Why? Because what transmission line really means is "the connection between the antenna and the radio." A basic principle is that, the better the match between antenna impedance and the radio's antenna connection impedance, the more signal will be delivered, whether receiving or transmitting. Sometimes we accomplish this by building an antenna of 50 ohms impedance, connecting 50 ohm coaxial cable to it, and running the cable to a radio's 50 ohm antenna jack. Sometimes, like at my QTH, we build an antenna of wildly varying impedances over a wide range of frequencies, feed it with ladder line to minimize line losses, and connect a tuner between ladder line and radio so that the radio can always see as close to 50 ohms as possible. With small devices like cell phones and handie-talkies, the "transmission line" is very short indeed, at most a quick hop from a circuit board to the antenna base.

Bilal Isotron's amazing 40 meter antenna (Photo courtesy Isotronantennas.com

Ground is probably the murkiest issue to understand, since we mean several different things when we say "ground." There is the matter of safety ground, which dictates that all powered equipment is grounded relative to the power source to prevent electrical shock. In our homes, this is usually pretty straightforward; the breaker panel is grounded by law, normally to a cold-water pipe, sometimes to an external ground rod driven into the ground. Making sure our station equipment is solidly grounded to the same ground generally satisfies this requirement. Indeed, that's the purpose of 3-prong plugs and outlets to convey AC power to devices; the little "amazed mouth" under the "two eyes" on an outlet is, if your house is wired properly, connected firmly to ground at the breaker panel, where neutral is bonded to ground to make the system even safer.

A more nebulous issue, and one that we often stumble over understanding, is RF ground. What we really mean by "RF ground" is that the antenna has a ground image to work against. This can be accomplished in a variety of ways. Balanced antennas like dipoles, and their offspring, Yagis, quads, and so forth, often do very well without any additional RF ground provided, since the antenna's "balanced" nature allows the antenna to work well in a stand-alone configuration.

Antennas like verticals, on the other hand, are very "unbalanced" and need badly a robust ground image provided for them. Folks will labor long and hard to lay what seems like miles of radial ground wires for a conventional vertical; it can be thought of as the "missing half" of a dipole. There are variations on this theme, too; for example, the ground-plane vertical, which



Antenna, ground, and transmission line form a single entity whose pieces cannot be meaningfully separated. (Drawing by author)

My trusty MFJ 969 tuner, in my philosophy an integral part of the "transmission line." (Photo by author)

mounts quarter-wave radials at the base of the antenna, providing a ground image and allowing the mounting of the antenna high in the air, on a roof, for example. UHF handie-talkies, and their numerous cousins called cell phones, take advantage of the fact that wavelengths at these frequencies are very small and derive a ground image from the device's case.

Fight For Freedom

A major issue today, and for some years now, is the insidious, creeping, ever-growing persecution of antenna ownership. Fifty years ago, when every house seemed to have a multichannel Yagi for TV viewing on the roof, no one was worried about ham, shortwave, and CB antennas. The TV Yagis are all but gone, now, replaced by cable-TV or the ubiquitous satellite dishes that dot the landscape like some alien mushroom infestation. Apparently, the dishes are not at all aesthetically displeasing, but our hobbyist antennas are. Many communities have created stiff prohibitions of any of these "eyesores," claiming they are a safety hazard and a grave insurance issue as well as being visual clutter.

There are basically two ways you can fight this Antenna Nazism; you can campaign to change these laws in your area, or you can join the underground and learn to make stealth antennas. Stealth antennas have become very popular, allowing many people their only chance to operate. There are basically two kinds of stealth: hidden in plain sight, and invisible. In future columns, I will be demonstrating how to build and arrange some of these stealth antenna ideas. For now, let me say that the antennas manufactured by Isotron (isotronantennas.com) are a great example of "hidden in plain sight." It doesn't look like an antenna, it looks like some postmodern bird feeder, so the Antenna Nazis leave it alone. There are also many ways we can homebrew stealth antennas, and get on the air without worrying about the jackbooted thugs of the Antenna Gestapo. Eventually, they will die off, or find other things that are none of their business to hassle citizens about.

Nuts and Bolts of Antennas

Let's set some "ground" rules for terminology, and I'll try to stick to them as we go along. Many terms are multipurpose and flexible, and their application can be rather arbitrary. Learn to let context be your guide, rather than any textbook definition. For example:

Vertical is actually a very broad class of antennas, their up-and-down orientation being their one unifying characteristic. That half-mile tall bridgework you often drive by, that carries your local AM station at 50 kW, is a vertical. But so is the whip on the trunk lid of a CBer's car, and so is the little rubber duck on a hand-held UHF transceiver.

Dipole has long since come to mean, basically, "a horizontal antenna with a break, and two-wire feed, at some point, often the center." This is confusing enough, with OCF (off-center feed) and Carolina Windom-type dipoles joining the more orthodox center-fed variety. But our next class of antennas all started from a dipole, which got promoted and called "driven element."

"Beam" seems like it would be a catchall term for any antenna with extra elements to reflect and direct the signal. In common usage, though, most of us seem to use "beam" as a synonym for "Yagi." The other beam-type antennas, such as quads and log-periodic arrays, tend to be referred to as quads and log-periodics. They're all beams, though. It's important to keep that in mind. The presence of reflector and director elements focuses the signal into a tighter "beam," gaining decibels at the price of losing the signals the beam isn't pointed at or at least toward.

"Longwire" is a really vague term. As a small boy I encountered many texts that called any SWL antenna you could string out to the nearest tree a "longwire." Later, as a teenage ham, I learned more correctly that they meant "long in terms of wavelength," generally, more than one wavelength long. This too can be confusing if you're not careful; A 60 foot wire is a "longwire" on ten meters, where it's nearly two wavelengths long, but it is a mere stub at 160 meters, a bit short of an eighth-wavelength long. Often what someone means by "longwire" is actually just "a random length of wire." Don't be quick to dismiss this entity, either; I have worked killer DX with a tuner and "a random length of wire" more times than I can count.

"Tuner" generally describes a class of devices, either automatic or manually operated, placed between radio and antenna. It's important to grasp that the tuner doesn't actually tune anything; it merely transforms the 50 ohm radio impedance to whatever odd value might appear at the shack end of the feedline, fooling the radio into thinking it's actually looking into a 50 ohm load and maximizing power and signal flow. Viewed in this way , the preselector that many SWLs and other listeners use to maximize their antenna's effectiveness, is a tuner. As laid out in the main text, I've come to view the tuner as merely a subcomponent of the feedline.

"Ground," as the text implies, means several things, and can be confusing. Just remember that safety ground protects us from lightning and from electrical shock from powered devices, irrespective of radio being involved. RF ground is an antenna-specific issue. Don't get them confused.

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Radio Horizons

Product Announcements of Interest to *TSM* Readers

AOR's LA800 Amplified Loop Antenna Receives 10 kHz through 500 MHz

AOR USA has added a highly sensitive and directional "loop" antenna to its product line. The LA800 is designed for outdoor use by monitoring enthusiasts. It combines the proven and timeless characteristics of a loop design with modern low-noise amplification and tuning circuits, making it capable of capturing signals that may not be detectable when using more conventional antennas. It is a "receive only" antenna; it cannot be used for transmitting radio signals.

For those not familiar with loop antennas, they are highly directional, offering a means to provide isolation from noise and the ability to attenuate unwanted signals or electrical noise signals away from the desired direction. They are also very useful for locating the direction of an unknown incoming signal to offer monitoring enthusiasts enhanced capabilities when compared to conventional fixed-frequency or unamplified antenna systems.

The LA800 should provide a vast improvement over reception from a conventional indoor telescoping antenna, such as that provided as the basic antenna with most receivers.

Designed for outdoor placement, the LA800 is engineered to receive through a range of 10 kilohertz through 500 megahertz, using high-isolation relays and a low noise amplifier designed to boost signals 20dB. Signals between 150 kHz and 30 MHz are also electronically tunable. The shielded aluminum loop has a diameter of two feet and eight inches. Potential users will achieve the most benefit by placing the LA800 on a rotating mechanism. In addition to the antenna and its electronic controls, the package includes 33 feet of remote control and low-loss coaxial cables. MSRP for the LA800 is $819.00; dealer prices may vary.

The LA800 is suitable for use on any wide-range receiver with an external antenna connection port. Specifications on the new antenna, as well as others in the AOR product line, are available at www.AORUSA.com.

AOR's LA800 amplified loop antenna (left) works from 10 kHz through 500 MHz and measures two feet eight inches across. Control box (right) output is via a BNC jack. A 3.3 foot BNC to BNC patch cable and 33 feet of low loss coax cable is provided. This antenna operates from 12 VDC or via the supplied AC wall adapter.

AOR produces a wide array of high-quality receivers, antennas and radio accessories. AOR monitoring equipment is used extensively by government, law enforcement and military operators around the world. AOR products are distributed in North America by AOR USA, Inc., which is located in Torrance, California and can be reached at 310-787-8615 during regular business hours (Pacific Time Zone).

The LA800 in Action

A complete review of the LA800 loop antenna, written by Bob Grove W8JHD, appeared in the June, 2013 issue of *Monitoring Times*. The 14 year anthology of *MT* issues (1999-2013) is still available. Order direct from Bill Grove at **https://squareup.com/market/bill-grove-designs/monitoring**-times-express-complete-anthology.

Price for the 1999-2013 DVD-ROM anthology is $99 plus $5.95 shipping. The LA800 is available from Universal Radio among others fine retailers.

C. Crane's Amazing Part 15 Transmitter

Radio fans of every stripe and dimension will find countless uses for this truly amazing Part 15 transmitter from C. Crane. Unlike many inexpensive Part 15 transmitters, this one is versatile, great sounding and puts out the full legal limit 250 milliwatts, in stereo. I know it doesn't sound like much, but that's enough to cover your whole house and probably your yard and the neighbor's as well. It's the original Low Power FM transmitter and you don't have to wait unit the next FCC LPFM window to open to enjoy programming your own FM radio station. Hook your WiFi radio, satellite radio or any other audio source to this transmitter and enjoy the sounds all over the house on any FM radio. It's $60 at **www.ccrane.com**.

Two All-Band Antennas from CushCraft for Hams with Limited Real Estate and DX Dreams

At the Dayton Hamvention last year MFJ introduced the R9 and R8 vertical antennas by CushCraft, an MFJ company.

One of the most frustrating things for hams who use the trusted and ubiquitous horizontal dipole, is that it never seems to favor the direction of the latest DXpedition, there's always a certain amount of fumbling with tuning controls when jumping from one band to the other, and, while many dipoles excel on one, two or possibly three bands, working the bands in between, usually the WARC bands (30, 18 and 12 meters), leaves much to be desired when it comes to performance. For other hams with space restrictions or limited property, shortened, all-band dipoles offer only compromise when operating. Traditionally, a big drawback to using vertical antennas was the requirement to lay out yards of radial ground wires as a counterpoise, an impossible task for those with patio-sized backyards.

Most of those issues are resolved with the use of either one of CushCraft's all-band vertical antennas; the R9 ($640) which covers 80 through 6 meters and the R8 ($300) which covers 40 through 6 meters. One of the advantages with these vertical antennas over horizontal beams is band coverage. No single beam covers 80 through 6 meters.

And, because verticals radiate in all directions, there's no tower, rotator and associated hardware used to make them work. Once installed, verticals are "set and forget" antennas.

The R8 weighs 23 pounds and is 28.5 feet tall and the R9 weighs 25 pounds and is 31.5 feet tall.

With 365 degree radiation, and power-handling ability up to 1,500 watts PEP, these antennas offer an inexpensive, all-band, omni-directional chance to work the local 80 and 40 meter nets and chase all the DX you've been missing.

For more information about these and other CushCraft antenna products, visit **www.cushcraftamateur.com**.

Product photos and descriptions appearing in Radio Horizons are provided by the manufacturers as a service to TSM readers. Full reviews of these and other products may be found in many online sources and other radio-related magazines.

Degen 1127 Offers Shortwave Listening and MP3 Recording in one Stylish Package

Chinese radio manufacturer Degen makes this diminutive radio that covers AM (520-1710 kHz), shortwave (2.3-23 MHz) and FM with 248 memories (99 FM, 50 MW, 99 SW) memories, tuning via up-down buttons with an Auto Tuning function that tunes and stores stations in memory. The DE1127 has a built-in clock with sleep function. Other features include: headphone jack, backlit LCD, 9/10 kHz MW step, 31 level volume control, Signal strength indicator and battery level indicator.

One of the interesting features of this radio is its built-in 4GB MP3 player/recorder which lets you record directly from the radio or "live" via the builit microphone. The DE1127 has a mini-USB 2.0 jack and comes with a rechargeable lithium battery, cloth carry pouch, stereo ear buds, and USB cable. Size: 1.75 x 4.4 x 0.75" (42x110x19mm) and is available from Universal Radio for $70. Check it out at:

http://www.universal-radio.com/catalog/portable/1127.html

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About Us

The Spectrum Monitor Writers Group

The Spectrum Monitor is edited and published by Ken Reitz KS4ZR, managing editor for *Monitoring Times* since 2012, features editor since 2009, columnist and feature writer for the magazine since 1988. Former feature writer and columnist for *Satellite Times, Satellite Entertainment Guide, Satellite Orbit magazine, Dish Entertainment Guide* and *Direct Guide*. Contributing editor on personal electronics for *Consumers Digest* (since 2007). 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*, a monthly print and electronic magazine for thirty-three years, which ceases publication with the December, 2013 issue. 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.

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Reporting on radio's lower extremes, where wavelengths can be measured in miles, and extending up 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 of 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**

Marc Ellis N9EWJ, "Adventures in Radio Restoration"

Authored a regular monthly column about radio restoration and history since 1986. Originally writing for Gernsback Publications (*Hands-On Electronics, Popular Electronics, Electronics Now*), he moved his column to *Monitoring Times* in January 2000. Editor of two publications for the Antique Wireless Association (**www.antiquewireless.org**): The *AWA Journal* and the *AWA Gateway*. The latter is a free on-line magazine targeted at newcomers to the radio collecting and restoration hobbies. E-mail: mfellis@alum.mit.edu

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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 YouTube: **www.youtube.com/user/UtilityWorld**

Dan Veeneman, "Scanning America"

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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: MaritimeMonitoring@gmail.com.

Fred Waterer, "The Shortwave Listener"

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Founder and director of the charity Ears To Our World (**http://earstoourworld.org**), curator of the Shortwave Radio Archive **http://shortwavearchive.com** and actively blogs about short¬wave radio on the SWLing Post (**http://swling.com/blog**). Former feature writer for *Monitoring Times*. E-mail: Thomas@earstoourworld.org.

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