The Spectrum Monitor®

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

Volume 4 **Number 5** **May 2017**

QRP Labs WSPR Transmitter Kit

Plus:

Longwave Legacy in Europe

DX Engineering Portable Antenna

DRM: A Spectrum in a Spectrum

Report: Repacking the TV Band

The Spectrum Monitor®

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

May 2017 **Table of Contents** **Volume 4 Number 5**

Dear TSM **4**

RF Current **6**

***TSM* Reviews: QRP Labs Ultimate 3S Transmitter Kit** **9**
By Mark Haverstock K8MSH

It's the old radio conundrum: Is the band dead or is it that no one is listening? This month Mark looks at a beacon transmitter kit that lets you see just how active the band really is. The QRP Labs Ultimate 3S transmitter uses Weak Signal Propagation Reporter (WSPR) Frequency Shift-Keying (FSK) transmissions in beacon mode that can be heard by receivers around the world set up to send back reports to a central reporting site on the Web. Mark puts this kit through its paces.

Tuning Out? History and Legacy of Longwave Broadcasting in Europe **13**
By Georg Wiessala

Longwave broadcasting seems to be a relic from radio's infancy. While its future is uncertain, during an era of Internet streaming and satellite beaming, it continues to hang on. Georg examines the history of longwave and explains why countries "disinvesting in AM broadcast radio make a shortsighted decision—losing an important channel for media diplomacy and international communications abroad."

***TSM* Reviews: DX Engineering HF Portable TW Antennas** **16**
By Joe Lynch N6CL

TSM VHF and Above columnist, Joe Lynch N6CL, lives in a very restrictive neighborhood but, as an active ham, that's not deterred him from enjoying the radio hobby to its fullest. Joe wanted to see how well DX Engineering's DXE-TW-2010-P 20 through 10 meters portable antenna would work—given his QTH. Find out why he says these antennas are, "worth the cost, considering the practicality they provide."

DRM—Digital Radio Mondiale Spectrum within a Spectrum **19**
By John Piliounis SV1OCS

Digital Radio Mondiale (DRM) has been around since 1998 and has slowly found acceptance on HF as well as the FM band. But, the lack of affordable, capable receivers has hampered its success. John takes a look at the technical side of this open-sourced, international digital radio format that can coexist with analog signals broadcast from the same tower.

Results of FCC Incentive Auction and Repacking of US TV Spectrum **22**
By Mike Kohl

The results are in from the FCC's massive TV band incentive auction and now the 39-month process begins in which some stations will go off the air; others will go off the air but join another station in the market to show up on a sub-channel, while others will move from UHF to the VHF TV band. Mike explains it all.

Scanning America **27**
By Dan Veeneman
Charlotte County (FL) and Dallas County (IA)

Federal Wavelengths **31**
By Chris Parris
Shifts in Federal Trunked Radio Systems

Utility Planet **35**
By Hugh Stegman
New Insights into North Korean "Numbers"

Shortwave Utility Logs **38**
By Hugh Stegman and Mike Chace-Ortiz

Digitally Speaking **40**
By Cory GB Sickles WA3UVV
Feeling Like a Kid Again

VHF and Above **44**
By Joe Lynch N6CL
Kenwood's New TH-D74

Amateur Radio Insights **45**
By Kirk Kleinschmidt NT0Z
The Truth about Lightning: Most of us are Unprepared!

Radio 101 **50**
By Ken Reitz KS4ZR
Cord-Cutting Update: Options for your FTA Satellite and OTA-TV Systems

Radio Propagation **54**
By Tomas Hood NW7US
Setting It Straight...

World of Shortwave Listening **58**
By Jeff White
The Shortwave Scene in the Middle East

The Shortwave Listener **63**
By Fred Waterer
Korea (North and South) on SW; New BBC Programming

Amateur Radio Astronomy **66**
By Stan Nelson KB5VL
1420 MHz Band Interference

The Longwave Zone **69**
By Kevin O'Hern Carey WB2QMY
Introducing a New Band: 630 Meters!

Adventures in Radio Restoration **73**
By Rich Post KB8TAD
Philco 48-360: Last of the "Woody" Portables

Antenna Connections **77**
By Dan Farber AC0LW
Balanced Feedline: Ace in the Hole

Radio Horizons **80**
Icom 4100A VHF/UHF D-STAR Transceiver

About Us **83**

Cover Story:
QRP Labs Ultimate 3S WSPR transmitter kit along with the results of transmissions on 20 meters in background. (Graphics by Mark Haverstock K8MSH)

The Spectrum Monitor ® is published monthly by Ken Reitz KS4ZR at 1403 Holland Creek Road, Louisa, Virginia 23093.
 All subscriptions to *The Spectrum Monitor* begin with the January issue and end with the December issue (12 issues) and are $24 for one year, 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

Chicago and New York fans have one thing in common: Cubs and Yankees are both broadcast on CBS owned statiions. (Courtesy: CBS Radio)

Baseball on the Radio

Re: 'Baseball on the Radio 1921-2017' Radio 101 April 2017 *TSM*: **"**After the WORLD CHAMPION CHICAGO CUBS (yes, I like saying that!) left WGN (720 kHz, of course) after I-don't-know-how-many years, they went to WBBM (780 kHz) for only a single season. After 2015, they moved to WSCR (670 kHz). Thanks to consolidation, this is all really the same company. WSCR used to be WMAQ and, apparently, WMAQ was the first to broadcast a Cubs game on the radio in 1925. No matter. Pat Hughes, voice of the Chicago Cubs, was the very first radio announcer to cover a Cubs World Series win, what with there not being any radio the last time they won ...Keep up the great work with *TSM*! – Peter Laws N5UWY

Yes, just like New York City today. For many years WCBS-AM was the flagship station for the New York Yankees and now WFAN-AM is the Yankees flagship station—both are owned by the same company: CBS Radio (as is Chicago's WSCR). – Editor

The Record on Gary Kildall's NDA

"I enjoyed Cory Sickles' 'Computers and Ham Radio: Part 010' in the April 2107 issue, but was dismayed to find him repeating the tired old legend of how Gary Kildall supposedly shrugged off the appointment with IBM. Mr. Sickles creates a new twist by stating that Gary Kildall decided to play golf instead of meeting with IBM. Usually the legend has Kildall deciding to fly his private aircraft instead.

As related in 'They Made America: From the Steam Engine to the Search Engine: Two Centuries of Innovation,' by Harold Evans, Gary Kildall did meet with IBM at the scheduled time and did sign the Non-Disclosure Agreement (NDA). – Silas Cole, Cheyenne, Wyoming

Cory Sickles Replies:

"At the heart of the matter is: Why IBM didn't make a deal with Digital Research (DR)? If the meeting did take place and DR had a suitable operating system at the ready, why wasn't a deal struck? Did DR want too much money? Was there an element of arrogance evident in the negotiations? Who knows for sure?

"Because of when I heard the first account, and my perception of certain key players in this whole affair, plus some other aspects to it all; I hold to what I accepted as gospel at the time. My understanding may be flawed but, at this point, I don't know of any recordings that have come forth from those moments that offer conclusive evidence in absolute contradiction.

"What I think is more important is that we remember Gary Kildall not as the guy who underestimated the importance of a visit from IBM, but instead as a brilliant computer software engineer and designer, who created a cross-platform operating system that further revolutionized the fledgling microcomputer industry while earning millions. His further extensions of CP/M into the multi-user MP/M allowed many businesses (including those I was involved in) to make use of substantially lesser-priced hardware as suitable alternatives to the many minicomputers of the day and numerous time-share services.

"Eventually, DR did offer an operating system alternative to Microsoft's MS-DOS and it was marketed as an option for the IBM PC. Further down the road, DR-DOS was introduced and many of us adopted it as our default OS, even with having to pay more for the privilege. It was a serious improvement and made networking so much simpler.
We all make mistakes and may misjudge situations or fail to see the opportunities that lie before us. What's important is to not allow ourselves to be limited by those errors, but instead learn from them and further strive to succeed. I believe Gary Kildall did those things and more. His successes are significantly important to the revolution and evolution of microcomputers and how quickly we achieved the technology and benefits to our lives that we enjoy today."

FCC Report and Order: A Closer Look

"The FCC issued its 22 page (63 pages with the Footnotes and Appendices) Order on March 29, 2017 (FCC 17-33). In addition to expanding amateur radio into the longwave bands, it contains extensive frequency reallocations, expansions of radio spectrum, restrictions, and exclu-

sions. Appendix B includes a revised Table of Frequency Allocations. Much of the Order contains legal technicalities and minutiae, and would not necessarily hold your readers' attention. However, the more substantive provisions relating to frequency and mode allocations would be important information for hams, monitors of HF utility, LF beacons, and satellite communication, experimenters in the super-high frequency ranges, etc. The Order will become effective after appropriate publication in the Federal Register. I do recommend the Order as an important subject of analysis or summary by one or more of your regular contributors in an upcoming issue of *The Spectrum Monitor*. Continued success with *TSM*." – Leslie Polt, Esq K3JTP Baltimore, MD

The R&O regards the FCC's implementation of the final acts of the World Radiocommunication Conference (Geneva 2012) known as WRC-12. To read the full text of this Report and Order go here: **https://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0329/FCC-17-33A1.pdf**

Whistler's Non-Support of Legacy Radio Shack Scanners

"A minor point about Chris Parris' comments on Page 4 of the April 2017 issue of *The Spectrum Monitor* about Radio Shack. The Whistler WS-1080 is the scanner that had the DMR update, not the PSR-800. The WS-1080 is the Whistler replacement for the PSR-800. The PSR-800 is not supported by Whistler. The workaround can be applied to the earlier PSR-800 as well as the Pro-18, and PSR-668." – Eric Cottrell

Thanks for the clarification, Eric. The major point here remains that Whistler does not appear interested in updating legacy Radio Shack scanners. – Editor

Bad Audio out of Anguilla

"I wonder if others have noticed the incredibly bad audio on Anguilla on 6090 kHz. There is not much about it on the Internet. I wonder if the sponsors and advertisers know their message is inaudible. It's been that way for months. Thanks for a GREAT magazine!" – Rich Swenton

World of Shortwave Listening Columnist, Rob Wagner VK3BVW, Replies:

"I haven't heard it here recently on 6090 though it will be stronger in the coming winter months. However, I noted someone also commenting on the 25-meter band outlet of 11775 yesterday—bad modulation. There appears to have been ongoing trouble with the transmitters over the past couple of years—often off-air and modulation issues."

Shortwave monitoring expert, Gayle Van Horn W4GVH, agrees, "I have heard that, and there were several days the station wasn't audible at all; possibly transmitter issues."

May Mystery Movie Radio frame #1 (top) and #2 (bottom). (Screen views courtesy of Eric Behiem)

April Mystery Movie Radio

The April Mystery Movie Radio was…a stumper. Even *TSM* vintage radio master, Rich Post had, "Absolutely no idea. I thought it might indeed be a remote dispatch panel, but that is just a guess. I'm impressed by the number of screws on the speaker and all around. Looks like it was intended for desktop use. It's much too wide for direct rack mount and too few controls for a typical communications radio. The mystery continues.

"The left radio on top is obviously a Hallicrafters S-38. The three slide switches on its left side distinguish it from the later S-38A,B,C which only have two. The other unit on top is a Hallicrafters HT-17 transmitter. I assume everyone easily caught my April Fool's identification for last month's radio (model LL-4-1-17 leaving out a couple of hyphens!). Superman's arch-villain and girlfriends have LL for initials."

Yes, Rich, the LexCorp company name should have clued us in to your April Fool's prank. – Editor

May Mystery Movie Radio

For the May issue, old-radios-starring-in-old-movies buff, Eric Beheim, writes: "Here are two mystery radios that appear in the 1941 Columbia serial 'Holt of the Secret Service.' In Chapter 3, 'Illicit Wealth,' the leader of a gang of counterfeiters (played by John Ward) confers by radio with one of his key lieutenants (played by veteran screen villain Tristram Coffin). Good views of both radios are provided as the action shifts back and forth between the gang leader's swank apartment (as seen in frame #1) and the gang's rustic hideout (frame #2). TSM

RF Current

News from the World of Communications

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

Massive antenna array at Shepparton, Victoria, Australia, source of Radio Australia's formerly big shortwave signal to the world. (Courtesy: Radio Australia)

One of a few lower power commercial shortwave outlets coming out of Australia today, 4KZ near Innisfail, Far North Queensland, Australia. (Courtesy: 4KZ)

Radio Australia Update

TSM World of Shortwave Listening contributing editor, Rob Wagner VK3BVW, reports on movement in the Australian Senate to restore some Radio Australia shortwave transmissions.

"Right now it's in the 'information gathering' stage. The Senate committee has called for submissions, which close in mid-May. My guess is that, after that, there'll be more meetings and a new level of inquiry based on those submissions. I wouldn't expect to see any definitive results one way or the other before the second half of the year. There is also a Federal Budget being delivered in May, but I don't expect any increase in ABC funding in that one."

Regarding a new commercial shortwave service from Australia, he notes:

"An AM/FM commercial broadcaster in Far North Queensland (FNQ) has succeeded in an application for a SW license, on 5055 kHz. The purpose is to relay this broadcaster's network north to regions that have great difficulty delivering reliable AM/FM services due to great distances and rugged terrain that impedes signals as well as the cost and maintenance of relays /translators.

"Looking up the particulars on this license from the Australian Communications and Media Authority's (ACMA) website (Australia's FCC), I've found the license registration, which was only approved on March 21, so this is a very recent development. The registration has been approved for:
1) A "tuned longwire" antenna, (the station has indicated an inverted-V antenna)
2) Non-Directional with 2.2 dB gain.
3) Licensed for 1 kW with an EIRP of around 1600 watts.
4) Intended for 'local' coverage.
5) Antenna height is registered as 10-meters.

"The registration is listing a site as 3 km east of the city of Innisfail, so that is the mediumwave station 4KZ transmitter site (531 kHz). Lat: -17.529872 Lon: 146.053299.

"The site is only about seven meters ASL (Above Sea Level), so it's right on the coast. The station's General Manager, Al Kirton, anticipates the new outlet will begin sometime in May. The schedule is to broadcast between 4 pm and about 9 am local time (between 0600 and 2300 UTC) seven days a week.

"4KZ has FM and MW translators up and down the coast at Mission Beach, Cardwell, Hinchinbrook, Murray Falls, etc. This whole area was hit badly by Cyclone Debbie three weeks ago, resulting in much destruction and flooding. But it's a beautiful part of the world. My wife and I toured through there last July/August and saw lots of banana and sugar plantations.....oh, and lots of snakes and the occasional croc! When we drove north past the city of Cairns and up to Cape Tribulation, I had to switch off the AM/FM car radio and listen to my wife instead! So there is certainly a need for better radio services beyond Cape Tribulation and right up to Cape York.

"5045, 5055 and 3210 kHz have all been licensed to a few tiny backyard operators over the recent years, but nothing much has ever come of it. The idea of having a proper larger commercial broadcaster using the 6-meter band to extend coverage further north makes good sense."

Canadian artist, Amanda Dawn Christie's audio art installation, "Requiem for Radio: Full Quiet Flutter," to be installed this month in Moncton. (Photo by of Amanda Dawn Christie courtesy: CBC))

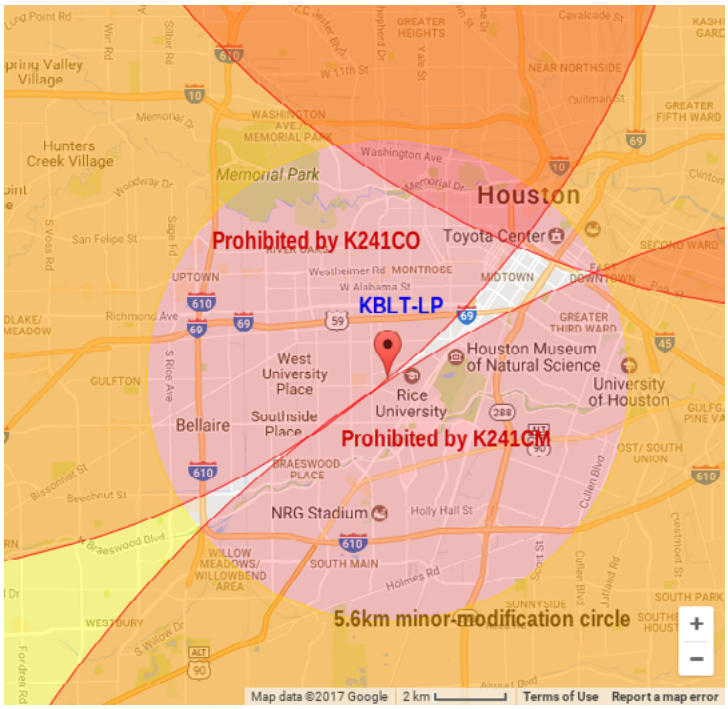
Canadian Art Installation Evokes RCI Heyday

In an odd bit of irony, CBC-TV reported April 23 about an art installation May 26 and 27 at the Aberdeen Cultural Center in Moncton, about the broadcasting towers of Radio Canada International, titled, "Requiem for Radio: Full Quiet Flutter." In the news story, the artist, Amanda Dawn Christie, said of the piece, "It's kind of like conjuring ghosts on radio towers." The news report said, "The experimental sound art project…involves a scale model of the original towers, but a large model—about 16-metres wide, six-meters deep and five-meters tall. Christie said the towers have red lights resembling the originals. They are made from pipes with four copper pads on each tower. She added that when someone touches one of the copper pads, a wireless signal is sent to a computer, which then sends a sound file back to that tower of the actual, recorded sound the original tower made when it was operational. The sound is transmitted through a speaker on the model tower."

The report notes that the artist had previously produced a documentary, called "Specters of Shortwave," about the Sackville, New Brunswick, towers that had stood for 67 years before they were brought down by budget cuts in March 2014.

Prometheus Radio Project Petitions for AM Translator Slowdown

Low Power FM (LPFM) advocacy group, Prometheus Radio Project, filed a petition April 17 with the FCC seeking reconsideration of new rules released in January that allow the largest commercial AM stations to place more FM translators near LPFM stations. The Philadelphia-based group, which spearheaded the Local Community Radio Act (LCRA) that became law January 2011, says the intent of the LCRA is threatened by new rules enacted January of this year as part of the AM Revitalization plan. The group says the new rules would allow, "the largest commercial AM stations to place FM translators far away from their core service area.



LPFM radio station KBLT-LP above is shown with the push pin, and the two red-shaded areas are where it is now prohibited from moving because of the two recent translators for AM stations named in the figure. The clear circle is where KBLT-LP could normally relocate.(Graphic courtesy of Prometheus Radio Project)

At least 1,644 large AM stations stand to benefit from removal of the limit, subjecting most of the land area of the US to extra demand for translators, which compete with LPFMs for space on the FM dial and can box them in." The group noted, "Section 5(3) of the Local Community Radio Act (LCRA) says that LPFM stations and FM translators are to 'remain equal in status' and the Commission enacted rules to protect this equality prior to the 2013 LPFM application period. The 'boxing-in' problem is one of several LCRA equality issues that the FCC must address especially with increasing demand for, and possible increased supply of FM translators."

The FCC reported that the number of translators this year jumped 13 percent compared to 2016, with 7,453 translators licensed as of the end of March.

FCC Incentive Auction Results: A Windfall for Some

The FCC's Incentive Auction results were released to the public April 13. Chairman Ajit Pai was expectedly enthusiastic and claimed, "Consumers are the real beneficiaries, as broadcasters invest new resources in programming and service, and additional wireless spectrum opens the way to greater competition and innovation in the mobile broadband marketplace."

The FCC, in a press release noted, "Today, there are more connected mobile devices than there are people living in the U.S., and about 70 percent of Americans use data-hungry smartphones. This increasing demand for wireless airwaves poses a major challenge to ensuring that America's

networks have the capacity to support the critical economic, public safety, health care and other activities that rely on them."

In order to support the growing population of wireless devices, the incentive auction was set up to transfer bandwidth on the UHF-TV band, thought to be the easiest frequencies to be able to reach such devices in urban locations, from the broadcasters who had occupied that spectrum to wireless broadband companies ready to provide those new services.

In its press release, the FCC noted that more than $10 billion in revenue would be paid to "winning" stations; that 84 MHz of TV band had been cleared by the reverse auction process; that there were 175 "winning" stations; the largest individual station payout was $304 million; the largest non-commercial station payout was $194 million; 30 stations will move from UHF to low or high VHF; 36 "winning" stations received more than $100 million each; 11 non-commercial stations "won" more than $100 million.

Among the non-commercial "winners" was New Jersey Public Broadcasting Authority (NJTV), which will receive $332 million from its participation in the auction. However, the state of New Jersey owns the licenses that were cashed in so NJTV, in a press release April 13, stated, "NJTV is asking the State to dedicate at least some of those funds to New Jersey's public television network…"

Richmond, Virginia, public broadcaster Commonwealth Public Broadcasting Corporation, which cashed out two licenses it held in the Washington, DC, area for $182 million, will take those stations off the air. The two channels had been broadcasting up to 10 channels of international programming under the MHz Networks brand, aimed at various ethnic communities in the DC area. They will continue to have an online presence as MHz Networks.

Wireless broadband industry news sources indicate that the real transfer of bandwidth will take place later through mergers and acquisitions as the big wireless players snap up smaller companies that bid actively for a piece of the wireless future. It's widely thought that the current administration's Depart of Justice, which has to approve such mergers, will look much more favorably on these business transactions than the previous one.

Details on the results of the auction can be found elsewhere in this magazine. *TSM* contributing editor, Mike Kohl, explains what happened in the three top US media markets, New York, Los Angeles and Chicago, in the first part of an examination of these results.

EmmComm Behind Rising Ham Numbers

An article in the April issue of *Emergency Management* magazine credits the rise in amateur radio operator license numbers to emergency communications. The magazine noted, "The public's growing interest in amateur radio for emergency communications is a legacy of 9/11, when Americans saw their cellular telephone networks become overwhelmed

(Courtesy: Amateur Radio aboard International Space Station)

by excess traffic and system outages. When regular phone service fails, amateur radio operators fill the communications gap with their independent transceivers and battery power backups." According to Joe Speroni AH0A, who maintains an up to date running total on licensing data at **http://www.ah0a.org/FCC/Licenses.html**, in October 2001 there were a total of 682,627 licensed hams in the US. The most recent FCC data shows there are now 743,806 as of the end of March, an increase of more than 61,000 licensees since October 2001.

ISS: VHF Packet Resumes

According to news from Amateur Radio on the International Space Station (ARISS), "The packet digipeater system is again operating on VHF on 145.825 MHz. The failure of an Ericsson handheld VHF transceiver on board the ISS last fall had caused ARISS to shift packet operation to 70 centimeters. A cargo resupply mission in February delivered a new Ericsson 2-meter handheld, to replace the one that had failed, which had been used in the Columbus module for school group contacts and for amateur radio packet.

"While the VHF transceiver was off-line, ARISS shifted school contacts from NA1SS to the Kenwood TM-D710 transceiver in the Russian Service Module. NASA ISS Ham Project Coordinator Kenneth Ransom N5VHO said the VHF capability now back in Columbus can be used in conjunction with passes involving the HamTV digital amateur television (DATV) system, which operates on 2.4 GHz.

"ARISS International Chair Frank Bauer KA3HDO, said recently that ARISS continues to make progress on the development of the new interoperable radio system on the ISS 'that we hope to use to replace our aging radio infrastructure in the Columbus module and the Service module.'"

TSM

Front panel view of the Ultimate 3S transmitter inside optional case. I elected to leave out the second toggle switch and replaced it with a plastic plug. (Photo: Mark Haverstock)

TSM Reviews

QRP Labs Ultimate 3S Transmitter Kit

By Mark Haverstock K8MSH

(Except where noted, photos courtesy of the author)

When I want to check for general information on propagation conditions, I often look at the N0NBH solar-terrestrial data banner that appears on QRZ.com and other websites. But if you want to analyze propagation in real time, a better way is to monitor beacons. If you can receive the beacon, there's currently an open path between you and the beacon's location.

But wouldn't it be cool to transmit a beacon from your QTH and actually see reports from dozens of receivers around the world that are receiving your signals? Or maybe you have more than one antenna available to you and you want to know which one is really the best one to get your signal to the desired location? The Ultimate 3S could be the solution to both.

Just a WSPR

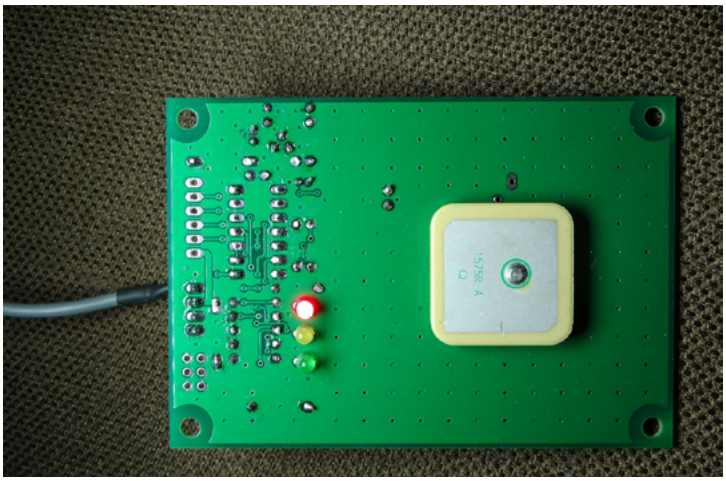
Traditional beacons usually used CW because they were easy to build and didn't require much power to be effective. But with current interest in digital communications, there's an increased use of more advanced digital systems like WSPR. Pronounced "whisper," this stands for Weak Signal Propagation Reporter. It is a computer program used for weak signal radio communications between ham radio operators. The original program was written by Joe Taylor K1JT, but is now open source and continues to be improved and refined.

The program is designed primarily for sending and receiving low-power transmissions to test propagation paths on the MF and HF bands. Transmissions carry a station's call sign, Maidenhead grid locator, and transmitter power in dBm. The signal is frequency shift-keying (FSK) with a very small shift and a very slow rate. The bandwidth occupied is only about 6 Hz, so many stations can operate within the 200 Hz WSPR window without interference.

Each transmission lasts for less than two minutes and starts at the beginning of each even-numbered minute. It is very important that transmitters and receivers are in sync, so successful WSPR operation depends on an accurately set clock. Receiving stations with Internet access can automatically upload their reception reports to a central reporting site called WSPRnet, which includes mapping functions and a recent activity log by band.

There's one caveat regarding WSPR beacon operations. According to 97.203 of the FCC regulations, any beacons–including WSPR–can be operated 24/7 unattended on 10-meters and above. However, if you are operating on the other HF frequencies, a control operator should be present to comply with part 97 rules.

Members of PCARS (Portage County Amateur Radio Service, Ravenna, Ohio) collaborate in an Ultimate 3S WSPR transmitter build. (Photo: Tom Parkinson KB8UUZ)



The GPS unit makes sure the transmitter's clock is accurate. Antenna is the white square on the middle right side of the board. (Photo: Mark Haverstock)

Kit Assembly

The basic Ultimate 3S kit contains the main U3 PCB with LCD module, a Si5351A synthesizer module kit, and a low-pass filter module kit for one band—you can choose any band from 2200-meter to 6-meters. This package will get you on the air for $33 plus shipping. They're available online at **http://shop.qrp-labs.com**

I purchased the deluxe six-band kit which included the Base U3S kit that has the LCD module, Si5351A synthesizer module kit, low-pass filter kits for 10, 15, 20, 30, 40 and 80-meters, relay-switched 6-band low-pass filter extension kit, GPS receiver kit, two extra BS170 transistors, and the aluminum enclosure kit. Total cost for this package was $134 plus shipping. It seemed like a good idea to get everything I anticipated I'd want both now and for later, and ordered from QRP Labs, which is located in the UK. As it turns out, the kits are actually shipped from China. Delivery time was about 10 days, but can vary.

The Ultimate3S QRSS/WSPR Transmitter Kit transmits in several slow-signal modes on any LF, MF, HF or VHF band from 2200-meters to 2-meters. Modes include QRSS, Hell, Opera, PI4 as well as WSPR. Standard output is up to 200 mw, depending on the band, and extra BS179 transistors can be added to the circuit to increase power levels. An optional 5-watt amplifier add-on is also available from QRP Labs.

This is not a beginner kit. Surface mount components are already on the boards—an extremely helpful feature. However, the boards are small and the through-the-hole components are tiny and tightly packed. I strongly recommend that you read through all the assembly instructions, downloadable from the QRP Labs site, before you begin the project. You'll avoid mistakes, some of which may be challenging to correct. I assembled mine as part of a club build, and having the collective input and suggestions of the group certainly helped us avoid mistakes as well.

As you navigate through the assembly instructions, please follow the order carefully. There is a reason for this–with the tight space, it makes sense to get the smaller components in place first so the larger ones don't block access. Also, be aware that you'll need to consider which options you may wish to add, such as the ability to enable firmware updates, the relay board or display adjustments–all of which are done with jumpers–or the absence of a jumper.

Another suggestion is to have good lighting available and use a magnifying device while building. The 1/8-watt resistors, for example, are tough to identify without a magnifying glass or digital multimeter. Use a soldering iron with a fine tip, fine gauge solder, and don't overheat the connections or apply too much solder. Some of the pads are very close together and could be accidentally bridged if you're not careful.

Assembly and Setup

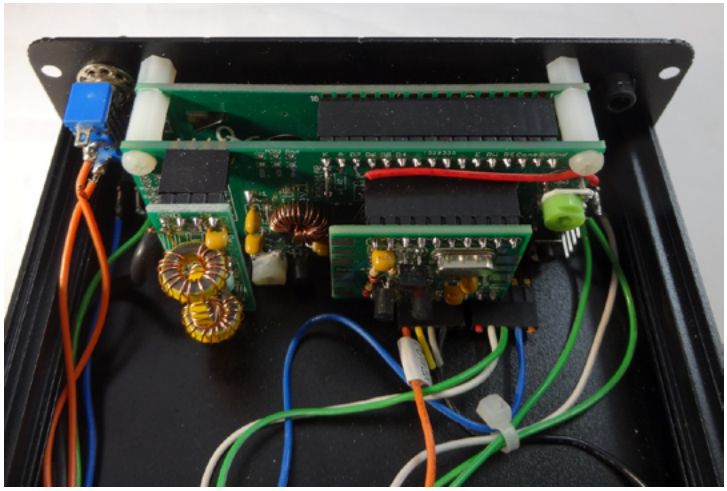
Construction went smoothly for the most part and we took our time completing the steps. The manual contains several photos and board diagrams to help you place and locate parts on the board. Again, please follow directions carefully—even the best of us make errors. I mistakenly installed one of the headers upside-down, and the extraction was rather time consuming.

Don't be intimidated by the toroid winding—if you can count, you can wind. There are four toroids needed for basic operation, one on the main board and three on the low-pass filter. Just be sure to scrap the enamel off the ends of the wire and tin them before installing.

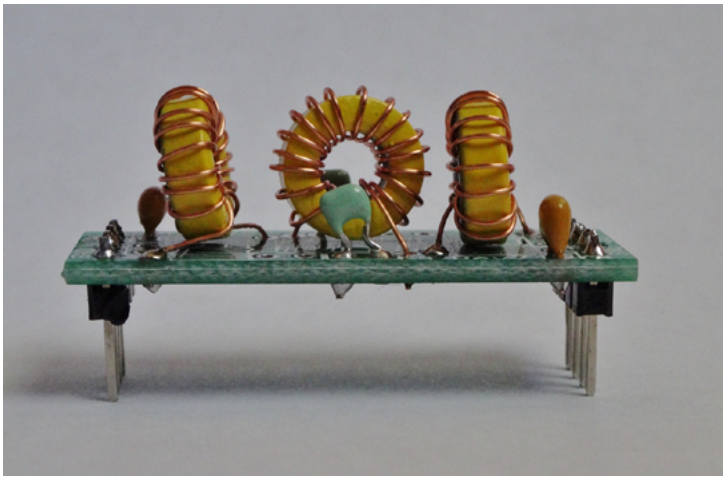
Final assembly involves piggybacking the main board and LCD module. These are held in place with nylon spacers and screws. Finally the synthesizer module and low-pass filter are inserted on the main board. On power up, you'll need to adjust the contrast potentiometer for the LCD screen and set the bias on the PA.

Timing is Everything

When using WSPR, frequency and time stability is



Rear view of boards mounted in optional Ultimate 3S case. (Photo: Mark Haverstock)



This 20-meter low-pass filter uses three toroids and several capacitors. It's based on a design by Ed Whetherhold W3NQN. (Photo: Mark Haverstock)

paramount. Though you can manually set the internal clock using a frequency standard such as WWV with the basic kit, I found it to be a real pain. For the beacon to work properly in WSPR, the time must be accurate within one second and the frequency can't vary more than a few Hz.

The easiest solution is to add the OLG1 GPS receiver kit to the Ultimate 3S. It's only $23 and well worth the cost—I highly recommend you order this as well. This GPS receiver kit is easily assembled and very sensitive–mine sits on a desk almost eight feet from the nearest window.

You'll Need More Stuff

QRP Labs has done a very good job of providing a functional and reliable kit, but you will have to add some items to finish the project. The assumption is that you have a well-stocked junk box or are willing to find a few easily obtainable parts. A 5-volt supply is needed for operation. You can use a wall-wart, but they vary widely in quality and stability. I chose to construct a simple 5-volt regulator circuit in a small project box that easily connects to my station's switching power supply. It works well.

Hans Summers, who developed the 3S, also included a number of headers into the board design for external connections such as remote switches, power supply, and the GPS. That means you'll need some female header sockets as well. The antenna connection needs a short run of thin coax, such as RG-316 and your choice of connector for the antenna.

There's an aluminum box available–not absolutely necessary, but nice to have. It's a pre-drilled, printed anodized extruded aluminum case custom-made for the U3S. It includes an accessories kit: two buttons, two toggle switches, 9-pin D connector, power socket and matching plug, BNC connector, four self-adhesive feet, and mounting hardware.

On the Air

Some of our group met at the club station about three weeks after the initial build for testing. After perusing the operating manual, we began configuring the 3S. Mine was the only one with the optional case and external push-button switches. Menu/edit functions were much easier for me to manipulate on the front panel as compared to the tiny switches on the main board. Needless to say, some of the others decided they were going to add the external buttons to their transmitters as well.

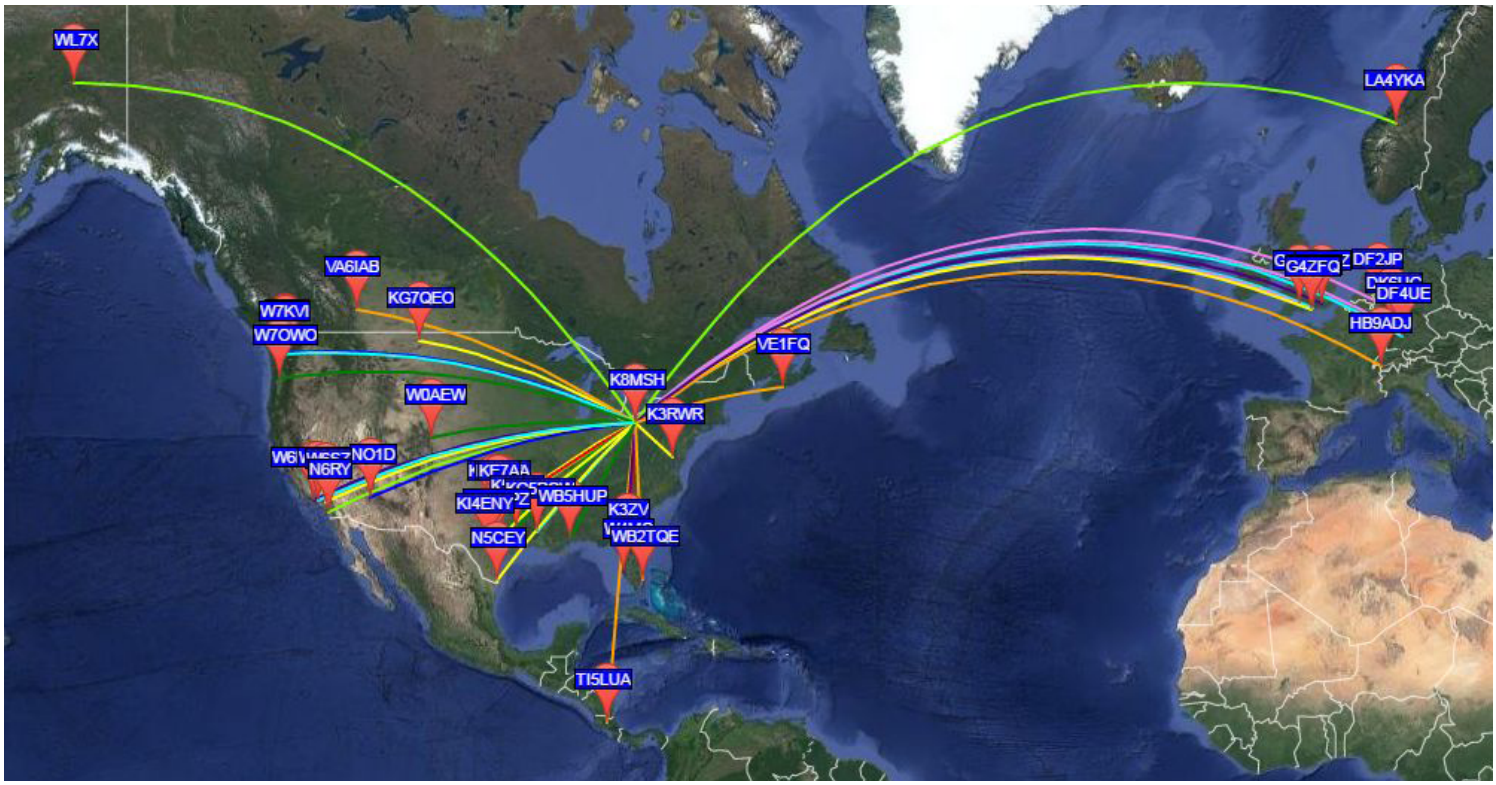
Programming includes setting up WSPR parameters by scrolling through alphanumeric characters in the edit mode. Detailed instructions are available as a download at the QRP Labs site. Mode, transmission frequency, frame length, GPS and other settings are entered in preparation for operation. A WSPR transmission is extremely short and contains your call sign, Maidenhead grid location, and output in dBm. Output power on the standard unit is about 23 dBm, which equals about 200 mW.

I plugged in the GPS and fired up the transmitter. After about a minute or so, the green LED on the GPS began to flash, indicating it had locked in. The 3S display then showed longitude, latitude, elevation, and a flashing heart symbol–signaling the unit was "alive." Message frame length was set as suggested in the manual, with transmissions 10 minutes apart—but you can easily change the timing.

The results of some experimental transmissions from my QTH in Ohio are shown in the illustrations captured from the **www.wsprnet.org** site. There are two map formats available, as well as a chart of signal reports. The antenna used was a Mosley tri-bander pointed west, and the output power from the 3S was typically around 180 mW on 20 meters. If you look at the map, you'll notice there were signals received off the back of the beam as well.

Got Problems?

Our group got together for a second session once the project was completed. But if you don't have any nearby hams experimenting with WSPR, you've also got the option of joining an active group online at: **https://groups.io/g/QRPLabs**. Here you can find help, advice, and see what others



This map shows my location (K8MSH in Ohio) and callsigns of the receivers worldwide that have detected my beacon on 20m as displayed on wsprnet.org (Screen capture from wsprnet.org)

are doing with their kits. Hans frequently checks in, answering questions and giving advice.

Overall Impressions

The Ultimate 3S is currently in its third generation, which means the improvements just keep coming. Firmware can be upgraded, either by ordering a new chip (about $6) or by updating the original one. It's good that the product continues to evolve and that upgrades are always possible. Add to this an active group of Ultimate 3S users online who continue to experiment with the unit.

Though I concentrated on the WSPR mode in this article, other digital modes are available on this transmitter, including the granddaddy of them all, CW. A QRP Labs receiver kit, with standard WSPR in mind, can be matched with transmitters having firmware v3.11 or higher.

Price point is a plus. For $56 and shipping, you can get the board, display, synthesizer and the GPS board–everything you need for a relatively hassle-free WSPR station. Adding extra bands is only $4.60 each, and if you want 6-band switching capabilities, the $16 relay kit will sequence through multiple bands for transmissions. I chose to delay installation of the relay board because of some known issues with spurious emissions related to the relay board. I'll be using single band plug-in operation for now and watch the message board for updates until I'm confidant the issue is solved.

Again, I want to emphasize this is not a beginner's kit and some kit building experience is essential. If you're primarily an "appliance operator," this is not plug and play right out of the assembly process. You'll need some extra items to make connections and run the unit, as well as spend some time doing the necessary setup.

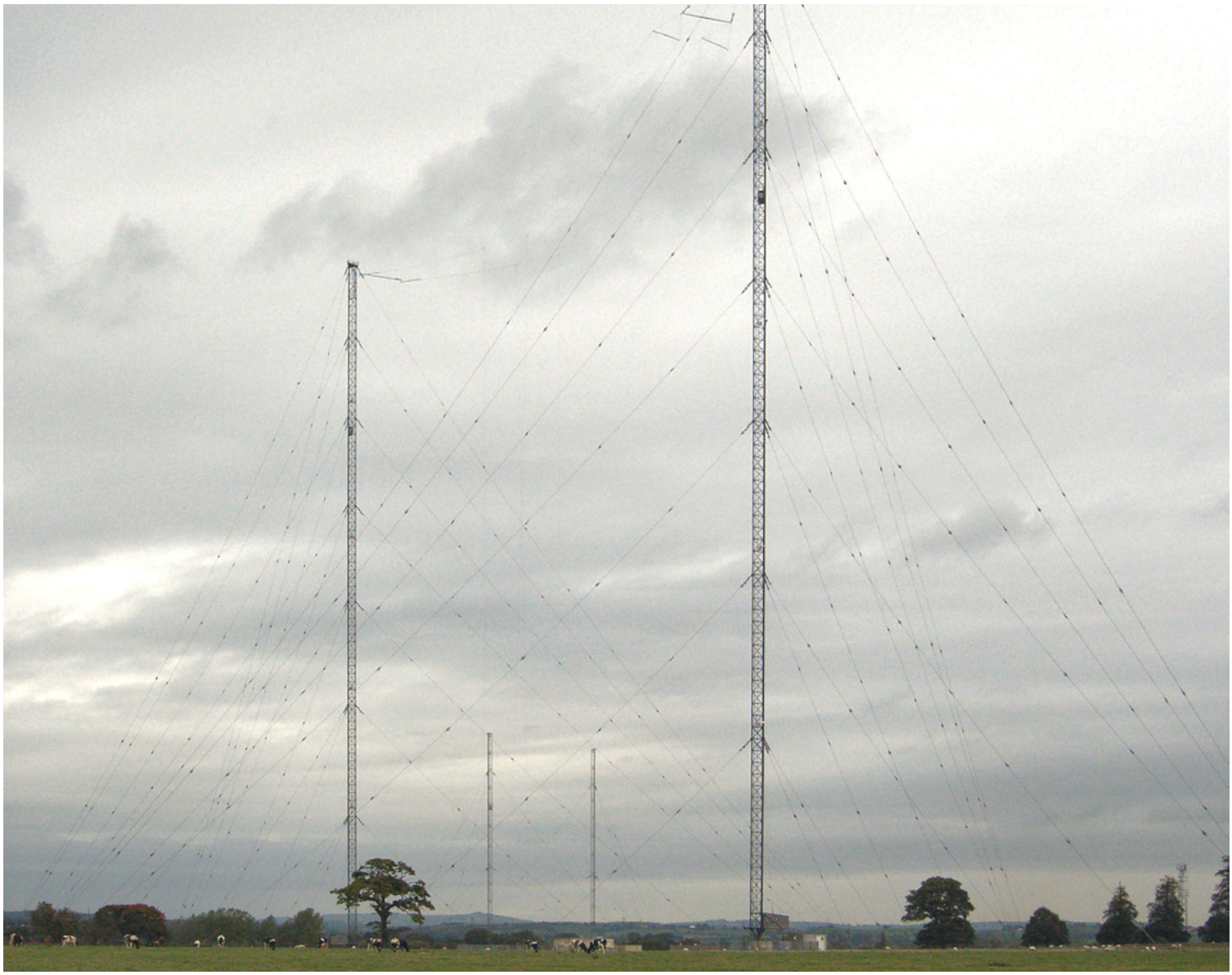
However, if you're an experienced kit builder and experimenter who wants to have some fun learning about digital modes and propagation on a budget, this is the kit for you.

Other Applications

Besides propagation, the Ultimate 3S can be used for tracking balloons and other mobile devices. One example is the ZL1SIX floater, an ocean going marine buoy containing a GPS and QRP-Labs Ultimate3S based transmitter. This buoy was built to drift in the Pacific Ocean at the mercy of the tides, currents and wind directions while sending its position, battery voltage and temperature information via HF radio telemetry in WSPR and JT9 modes.

The unit transmits once per hour on the 30 meter Amateur Radio band. The receiver dial frequency required to decode the digital signals is 10.138700 MHz USB (the 30-meter band WSPR frequency). The WSPR trail is near the top of the WSPR waterfall segment, and the JT9 signal is found about 150 Hz higher on the waterfall. More information can be found at: **http://www.qsl.net/zl1rs/oceanfloater**.html Information on balloon flights and picospace flight experiments using WSPR and JT-9 can be found at the same site, **http://www.qsl.net/zl1rs/index.html**

TSM



Masts for Droitwich longwave transmitting station in Worcestershire, England, on 198 kHz at 500 kW. (Photo by Bob Nienhuis, courtesy of Wiki commons)

Tuning Out? History and Legacy of Longwave Broadcasting in Europe

By Georg Wiessala

I remember it well. When I was but a youngster, too many years ago now than I care to remember, my father used to love to take us on our annual summer holidays. He loved to drive, so we would travel by car from Germany, across the Alps, to such far-flung places as Yugoslavia or Spain. A great adventure for a teenager like me. One of the things I distinctly recall from these long-haul trips is that the car radio was always on.

At that time, car radios had magic buttons for all bands, including shortwave (SW), medium wave (MW) and longwave (LW). More often than not, we listened to LW during the journey, taking Germany with us, as it were, when going abroad. I had absolutely no appreciation at that time as to how this might work, and I did not wonder why the signals did not disappear as we travelled further.

I just took this for granted, in the same way in which my students today take the ubiquity of the Internet for granted. Neither was I aware that Europe (including North Africa, the Middle East and Russia) was one of the few regions in the world in which LW radio broadcasting was happening—Australia being another example.

Propagation and Rationale

Later on, it remained possible to traverse Europe and stay close to my LW favorites such as Radio Luxembourg,

Europe 1, Deutschlandfunk, Atlantic 252 (RTÉ), France Inter, Radio Monte Carlo or the BBC on a 9 kHz channel spacing. The key reason for this was the unique, 'ground-hugging' propagation behavior of LW signals. The signals travel mostly by ground (surface) wave, so topography and the di-electric constant of the ground (in siemens per meter) do have a big influence. Water is better than soil, and mountains are not good news.

In general, stability, low attenuation and absorption, diffraction over obstacles, limited ground conductivity of lower frequencies and high transmitter power made for easy Europe-wide reception. No, it was definitely not Hi-Fi quality, but I never cared about noise, I still do not. It was enough that low frequency waves could reach for more than 2000 km and follow me.

Why did broadcasters put resources into transmitting on LW? I can think of at least three key reasons here—economic, political and cultural. In terms of economics, remember this was the pre-Internet age. All longwave broadcasters needed to make money from foreign-language commercials. Therefore, signals needed to go far, and longwave was a good medium for that. Same considerations as apply to shortwave really.

Moreover, consider the politics of longwave. A great number of longwave transmitters in East and West have a significant military history dating back to the two World Wars of the 20th Century. Some became full-fledged military installations, used for jamming and propaganda towards Eastern Europe (and in Asia). Not unlike Radio Free Europe/ Radio Liberty, these became part of the 'electronic iron curtain,' the 'cold war in the ether.'

However, perhaps most importantly, LW radio was 'national' radio—an instrument of nationalist promotion. The information (and, at times, misinformation) spread here functioned as a 'shop-window' for countries such as France and Germany in much the same way as shortwave radio did, and arguably still does for China. Radio, propaganda and diplomacy are always interrelated. I learned a lot about Britain, France, Scandinavia and Africa by tuning to LW.

Last, but by no means least, as far as my own country of origin is concerned, LW became part of external broadcasting services (foreign radio), presenting an image of Germany to the rest of Europe. Thus, LW, in Germany, the UK, Sweden, Switzerland and beyond, was always part of foreign policy and diplomacy. It reached out to expatriate and tourist communities alike, in a way no other medium could.

Programming reflected this as indeed it did on SW. Until very recently, it was the LW (and MW) stations where you could access a more demanding cultural content of greater variety (Brand, 2002; Hendy, 2008), in order to escape the mind-deadening shallowness of so many stations on FM.

Funkstille: The Silence of the Transmitters

There is more to longwave (and VLF) than foreign broadcast radio. Examples include low frequency navigational systems such as LORAN/C, ALPHA (Russia) and OMEGA (USA), time signal stations, 'electronic lighthouses' (navigational beacons), weather, ionospheric and geological instrumentation and more). LW radio bursts can be indicators of impending geomagnetic storms. However, in key areas, AM radio has been replaced by GPS, satellite and Internet technology, especially in time measurement and navigation. ALPHA: **http://www.vlf.it/alphatrond/alpha.htm** OMEGA: **http://www.jproc.ca/hyperbolic/omega.html**

Consequently, most LW broadcasting stations in Europe and European Russia have gone, some of them recently. France Inter, Deutschlandfunk and Deutschlandradio are lost, and the BBC transmitter on 198 kHz is on its last glass valves—when they are broken, the station will go. The *Guardian* and *Telegraph* newspapers have termed this "The Long Wave Good Bye."

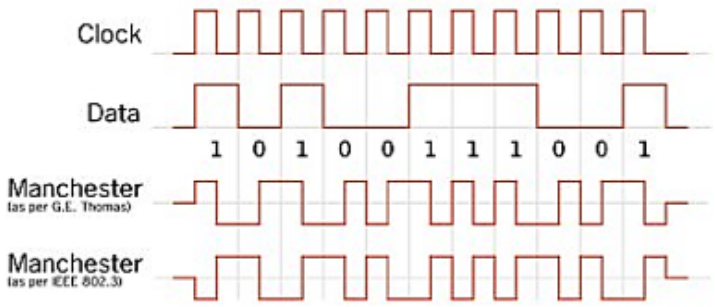
The demise of longwave broadcast radio is deliberate and mirrored on medium wave. It results from three key developments: the rise of digital media and the Internet, shrinking budgets of radio stations, and changing expectations of consumers of all ages. However, there are some downsides of these and related developments, as seen in the current switch-off of analogue radio in Norway and elsewhere (*Radio Times*, 4-10 February 2017: 125). For instance, many regions in Europe are under-served by DAB/ Internet Radio.

More importantly, newer forms of radio rely on Wi-Fi connections. However, these are subject to disruptions and deliberate interference. Censorship and content control are easier on the new media, as opposed to, say, unlicensed and 'pirate' radio, and news is much harder to 'fake' on terrestrial radio. Study after study has found that listeners trust traditional radio. Finally, yet importantly, in disasters and emergencies, what use are media when the Internet is often the first infrastructure to break down? The recent earthquakes in Italy and elsewhere have shown this.

Do not get me wrong: I am not a Luddite. I enjoy new technologies. However, I think that if a country is 'disinvesting' in AM broadcast radio, it makes a very shortsighted decision towards significant sections of its listening community inland, as well as losing an important channel for media diplomacy and international communication abroad.

Droitwich Calling: Longwave Legacies

Is LW an anachronism? Well, the fact that there are still LW broadcast radio stations commands significant levels of respect and enthusiasm among radio listeners and DXers. Transmitters like Junglinster (Luxembourg), Allouis (France), Droitwich (UK), Kalundborg (Denmark) and Aholming, Donebach, Burg and Zehlendorf (Germany) have grown a large and dedicated following among enthusiasts. Consequently, national radio magazines such as *TSM*, the UK's *Radio Use*r and the German *Radio Kurier* report about them. They have become national treasures, attracting visitors and maintaining dedicated websites for their preser-



An Economy-7 Radio Teleswitch (left) and the 'Manchester-Coding' transmission format (right) (Courtesy of Wikimedia)

vation or commemoration:
https://en.wikipedia.org/wiki/Atlantic_252
http://www.rtl208.de
http://www.saar-nostalgie.de/EuropeNo1.htm

This is important, because it is often through the history of a country's transmitters that one learns of that country's history, culture and geography. Moreover, there are some significant stations left. I am using the BBC Radio 4 longwave 198 kHz service as an example, because is, in my view, it is still indispensable for mariners, weather watchers and many other users. The Shipping Forecast is not just a 'British Institution,' it helps to save real lives at sea.

At 12:01 and 17:54 each day, the forecast is being transmitted on LW 198 kHz only; at 00:48 it can be heard on both LW and FM (93.00 MHz) and DAB. There are concerns here in the UK how service levels to mariners can be upheld when BBC transmission on LW finally do cease—and cease they must, since the BBC has bought up all the remaining stock of the right glass valves, and no more can be made anywhere. A stormy future, indeed.

Longwave Multi-tasking

In addition to voice broadcasts on weather, sport and current affairs, which are only available via LW 198 kHz BBC, the transmitter in Droitwich is an example of 'longwave multi-tasking.' Like other LW (and VLF) transmitters (e.g. DCF77, MSF and Allouis, 162 kHz), the LW signal is vital for meteorology—accurate time signal transmission. The 198 kHz frequency distributes radio data, encoded using phase modulation (PSK), giving a time-of-day signal with a carrier power of 400 kW. The Droitwich station uses rubidium frequency standards. This service is part of the wider UK AM Data System (UKAMDS) developed in 1984, through a document on BBC Phase-modulated Transmissions on Long Wave. **http://www.sigidwiki.com/images/2/29/1984-19.pdf**
http://www.sigidwiki.com/wiki/UK_AM_Data_System_(UK-AMDS)

Other than for voice broadcasts and time signals, 198 kHz is used for a perhaps lesser-known purpose. It forms part of the UK Radio Tele Switch Services (RTS). Since the early 1980s, the UK Energy Networks Association have used Manchester Coding (Phase Coding, PE) on the 198 kHz frequency. In this way, energy companies communicate with meters in peoples' homes, in order to facilitate energy management, adjust load curves and change tariffs.

The UK Environment Agency too are said to be using this form of transmission, among other channels, for flood warnings. In continental Europe, a similar system, Radio Ripple Control, is in operation, for instance through the German DCF49 transmitter on VLF (129.1 kHz).

Transmitting DRM (Digital Radio Mondiale) signals on recently vacated LW frequencies has been another attempt to modernize this frequency band, and there are some test transmissions. However, DRM receivers have never made it to the mass market in Europe, and few people have invested in decoding software.

Resources:

Carey, K. (2007) Listening to Long Wave (Reynoldsburg, Ohio: Universal Radio Research)

Cawte, M. (1996) 'Making Radio into a Tool of War': http://www.bmartin.cc/pubs/peace/96Cawte.pdf

Risso, L. (2013) 'Radio Wars – Broadcasting in the Cold War' in: Cold War History, Vol. 13. No. 2: 145-152

About the Author

Dr. Georg Wiessala is currently working as Editorial Assistant for RadioUser, the leading UK radio hobby magazine in the United Kingdom. He got hooked on shortwave when his father gave him his first radio at the age of ten. He was a radio operator during his time in the army. His general background is in teaching, and often uses radio to teach his students about his main subject—International Relations. He is very interested in matters of radio wave propagation, VLF, space weather as well as radio history, and has written a number of articles in hobby magazines about all of these subjects.

TSM

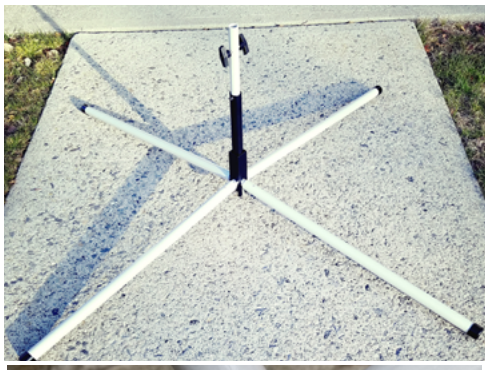


Photo 1 (top left) shows the storage/travel bag for the DX Engineering TransWorld antenna. Photo 2 (bottom left) shows the four fiberglass legs and short mast that comprise the Quadrastand Portable Base. Photo 3 (bottom right) shows the small ring that is held in place by a wing nut and screw. Photo 4 (top right) shows the fully assembled Quadrastand. (Photos courtesy of the author)

TSM Reviews:

The DX Engineering HF Portable TW Antennas

By Joe Lynch N6CL

About a year ago DX Engineering announced that it had acquired TransWorld Antenna. Previously owned by Dennis Barrett N4ECW, and his wife, Marilyn K1ECW, the HF antenna line had limited success. Problems with parts sometimes caused long delays in shipping the final product. Nevertheless, those who acquired them often wrote great reviews on eham.net.

Along came DX Engineering (DXE), which purchased the antenna product line from the Barretts early last year. DXE brought all the inventory and stock into its huge warehouse and began retooling the antenna lines. Late last year the company began to promote it in the catalog, which piqued my interest.

I live in a very restricted neighborhood. My antennas consist of a 40/80-meter dipole, a loop for 30 meters and a 100-foot long wire. Having a portable antenna that could be easily transportable appealed to me.

I purchased the 20-10 meter five band remotely switchable antenna (DXE-TW-2010-P), along with the 40-meter (DXE-TW-4040-P) versions and installed them in my postage-sized backyard. True to their reputation, the antennas are simple to set up (and tear down). In less than 5 minutes I had the antennas up and ready to go. It took longer to string out the 75 feet of RG-8X that is recommended.

I chose to operate during the ARRL CW DX contest in February and the ARRL Phone DX contest in March. The latter operation was from my brother-in-law's home in Tulsa, Oklahoma. Finally, I tested the 40-meter center section during the FOC (First Class CW Operator's Club) BW QSO Party.

First, the assembly. Photo 1 (see above) shows the storage/travel bag. With all the parts inside, along with 75 feet of coax, the bag weighs in at just under 22 pounds.

Photo 2 (also above) shows the four parts of the antenna, the four fiberglass legs and the short mast that comprise the Quadrastand Portable Base, the bottom and top sections and the center section. In this photo, you see the 20-10-meter version that contains the socket for the remote unit's cable.

Assembling the Quadrastand was a bit tricky. You can see from Photo 3 (above) that there is a small ring that is held in place by a wing nut and screw. It is very important that the wing nut be as tight as possible to prevent the ring from coming loose. Photo 4 (also above) shows the fully assembled Quadrastand. Photo 5 (next page) shows the fully assembled antenna using the 20-10-meter center section. Photo 6 (also on the next page) shows the remote switch. Operating the antenna in both places worked quite well. I worked several DX stations quite effortlessly.

A point about the remote switch: It requires a 12-volt source. This was not a problem for me because I used my

Photo 5 (above) shows the fully assembled antenna using the 20-10-meter center section. (Photo courtesy of the author)

Powerwerx power supply for my ICOM 7300 (see last month's VHF and Above column) and got power from the banana plugs in the back of the power supply.

The 40-meter antenna had its unique challenge. Photo 7 (next page) shows the antenna in my back yard. Out of the box it had a very high SWR. Using my MFJ-269C (see photo 8 also on the next page), I determined that the resonant frequency was approximately 7.420 MHz, well outside the 40-meter band. I pulled the cover off the center section (see photo 9 on the next page) and saw that there were five coils. The top two on the left are associated with the top section of the antenna. The bottom two are associated with the bottom section of the antenna. The sole coil on the right links the coils to the coax connector.

By carefully squeezing each of the four coils closer together, I could lower the resonant frequency to inside the band. Again, using the MFJ-269C, I determined the 3:1 maximum SWR range of the center section. It turned out to be about 120 kHz. I chose the 3:1 maximum SWR ratio because my ICOM 7300 antenna tuner tunes best within that range. It will not tune at all much outside that range.

Because I wanted to operate in the 40-meter CW band, I alternatively squeezed and separated the coils until I got

Photo 6 shows the remote switch. Operating the antenna in both places worked quite well. I worked several DX stations quite effortlessly. (Photo courtesy of the author)

LDG IC-100 tuner takes care of matching problems across the band. (Photo courtesy of the author)

the resonant frequency to about 7065 kHz. Checking the ICOM 7300's antenna tuner, I found that it would tune from 7001 kHz and to about 7120 kHz. I put the cover back on the center section and proceeded to test the antenna.

Using an A-B antenna switch, I compared the TW antenna with my in-the-trees 40-80-meter dipole. I found that, as expected, most of the time the dipole performed better. However, occasionally, the TW antenna worked better. Entering the contest, I chose to exclusively use the TW antenna. Only occasionally I was not able to work the station I called—and that always was a DX station. No problem working any stateside station I called.

A point about the narrowness of the antenna: Because it is a high-Q antenna, it has a narrow frequency range. This can be problematic for the person who wishes to operate in both the phone and CW portions of the band. There are two practical solutions: First, buy two center sections and set each one for the portion of the band you want to use. Using this solution requires changing the center section, which is not a problem.

I chose to purchase a broader antenna tuner: an LDG IC-100, which took care of matching problems across the band. It is a handy little tuner that works in conjunction with the IC 7300. Just plug and play (see above).

Overall, I was quite pleased with the operation of the TW antenna. The ease of assembly and disassembly was quite remarkable—even in the dark. For example, after the FOC BW contest ended, I went outside in the dark and took apart the antenna without the aid of a flashlight.

I also purchased the 30- and 80-meter center sections and will report on them in a future article.

These antennas are promoted as being useful for a variety of settings. I used them two ways: in my very small

Photo 7 (Left): The antenna in the author's backyard. Photo 8 (Center) Using my MFJ-269C, I determined that the resonant frequency was approximately 7.420 MHz, well outside the 40-meter band. Photo 9 (Right) shows the cover off the antenna's center section with five coils that were adjusted by hand to help tune the antenna. (Photos courtesy of the author)

back yard and portable at a distant location. Assembling the antennas and unfurling the coax was simple in these two residential settings. The antennas will handle up to 800 W CW, 500 W RTTY/Digital, 375 W AM 100 percent modulation.

Next month is Field Day and these antennas are ideal for Field Day. They can be used as the primary antennas or as initial antennas. You can set them up and get on the air very quickly while your teammates put together the big antennas.

Using the 40-meter TW Antenna instead of a wire antenna is so much more practical. No climbing trees, raising masts, launching wires over branches.

For SOTA operations, you must keep in mind what is your footprint of operating space. Obviously, if you are going to operate from Mt. Mitchell in North Carolina or Bear Mountain in New York, these antennas work quite well.

By contrast, if you must hike into your location, the storage/travel bag is not very practical to carry on your back. It worked well in the trunk of my car. However, I would suggest a different method of storage/travel that is more conducive to backpacking.

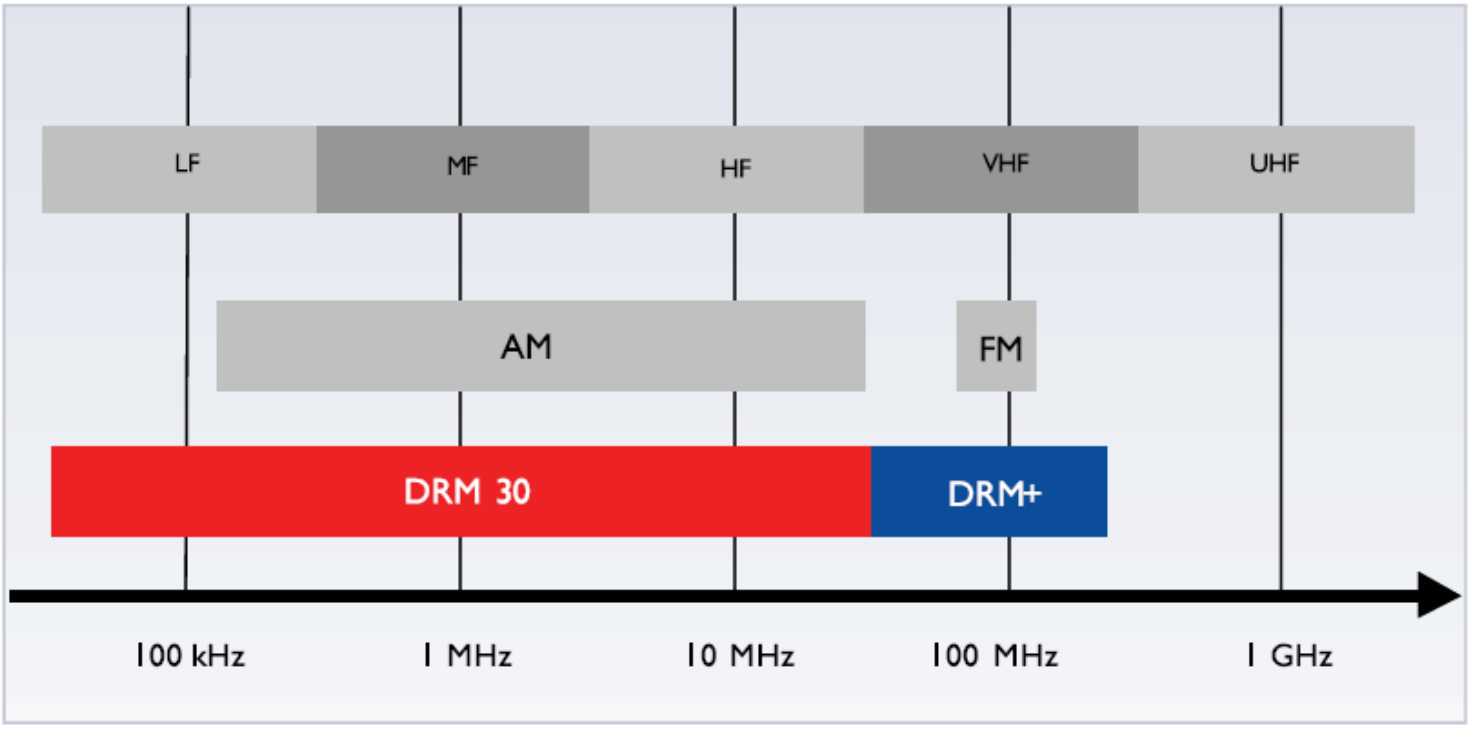
Finally, for those of us who are scaling down or have scaled down our operations and are moving or have moved into an antenna restricted QTH, these antennas work quite well and, as illustrated, in my own backyard. Using the permanent mounting pole (DXE-TW-PMP) to put the antenna in with the tulips will provide some permanency for it.

Leaving it up permanently, however, is not recommended. If you need to leave it up, it is recommended to place a plastic bag around the center section to protect it from the rain and snow that could become problematic.

In summary, I see these antennas as filling the antenna needs for several operating situations and locations. They are a bit pricey ($400), but I think well worth the cost, considering the practicality they provide. They are available from DX Engineering at: **https://www.dxengineering.com/parts/dxe-tw2010**

A word about ordering: Because these antennas are starting to generate a demand, they are sometimes out of stock. For example, when I checked availability of the 20-10-meter antenna at the end of last month, I noticed that they are shipping late next month. It is best to go ahead and order the antenna because doing so will get you in queue for it—that worked for me: When the antenna is back in stock, they'll shipped it, sometimes a few weeks before it was scheduled to be delivered.

TSM



DRM frequency band overview. (Courtesy of the DRM.org)

DRM – Digital Radio Mondiale: Spectrum within a Spectrum

John Piliounis SV1OCS

It is rather puzzling when one thinks why a reliable method for digital transmission at low frequencies has not yet been of wide use. Actually, such a method has existed for some years now. It was formed under the name of DRM, (Digital Radio Mondiale), mondiale means world-wide, at Guangzhou, China, back in 1998. It was started as a non-profit international organization whose aim was digitize what had been until then only analog broadcasting. It sought to bring several digital schemes to all areas of the spectrum from the LF up to VHF-III bands.

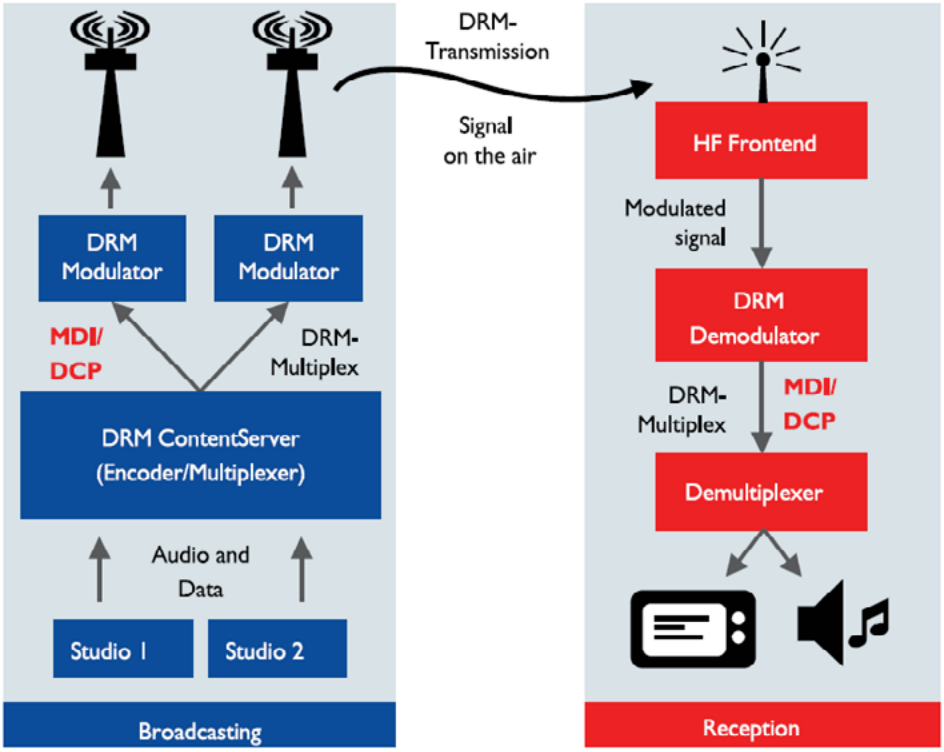
The first system for DRM broadcasting below 30MHZ was named DRM30. The evolution of it is called DRM+ and expands spectrum usage from 30MHz up to VHF Band-III, centered on the well-known FM band. The DRM spectrum's coverage layout may be seen in the picture above.

DRM is an active international committee under the International Telecommunications Union (ITU) and over the years, the technology has gained momentum as more countries and worldwide broadcasters join this very promising broadcasting technology.

By design, DRM coexists peacefully on the air with analog transmissions in the AM, HF, and FM spectrum and highlights the pathway to a full digitization of all bands. Broadcasters, through various international agreements, have had plenty of time to settle on the worldwide specifications for the full utilization of this technology. While most of the DRM's core functionality has already been settled and is being enjoyed by listeners around the world, DRM receivers are still not so widely available in the Western world, but India and many other countries in the Far East have already adopted DRM as the broadcasting and radio listening method of choice.

DRM utilization of the spectrum is open in the sense that both DRM broadcasters and manufacturers of DRM receivers can freely implement automation and information services along with any well designed multimedia and/or text service. And all these services become available to any listener who tunes in the delivering frequency using a DRM enabled radio receiver.

DRM's spectrum usage starts at 150 kHz and, as frequency goes up, channels may host up to four distinct digital services for voice, music and/or data content. The fundamental advantages of DRM are its ability to deliver sound of exceptional quality, never heard before on AM, HF, FM and VHF bands, along with data content that compliments the audio experience. It offers a mix of other information services, such as emergency weather notifications, through any portable or car radios with DRM enabled receivers. A special service, known as Journaline, a trademarked data application for DAB and DRM digital radio systems. The following pic-



Modulating the DRM signal. (Courtesy of DRM.org)

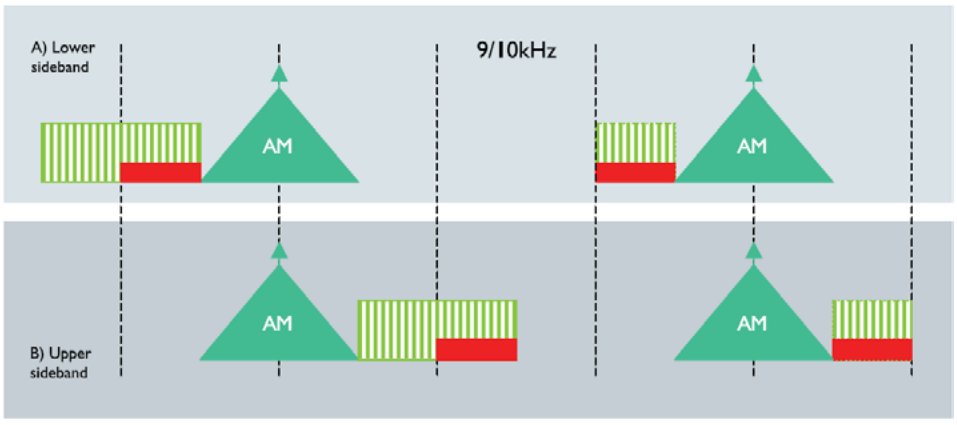
ture (above) displays the implementation of the DRM broadcasting system.

The prime mechanism by which all this content comes together and goes into the spectrum's air is based on an intelligently designed content multiplexer-server, called the DRM Content Server. A Configuration Interface Unit, part of this server, according to programmable or predefined broadcasting templates and schemata, multiplexes audio, data and other useful content such as GPS info and streams it as frames through an OFDM modulator to the air.

During this transition period, as we move from purely analog transmissions to the DRM spectrum space, broadcasters may simultaneously broadcast analogue and DRM content using the same transmitter and antenna systems. This is made possible by a method called Simulcast. For DRM30 and, in one of the various implementations of simulcast, the same program at the 9/10 kHz channel is broadcast as a 4.5/5 kHz USB DRM digital signal and as a 4.5/5 LSB analog signal that can be demodulated by conventional AM receivers and DRM enabled receivers. Adjacent channels in Simulcast are depicted as the graphic found below.

DRM bandwidths at the different spectrum bands are 4.5 kHz, 5 kHz, 9 kHz, 10 kHz, 18 kHz and 20 kHz for DRM30 and 100 kHz for DRM+. The

Simulcasting analog and DRM programming. (Courtesy of the DRM.org)



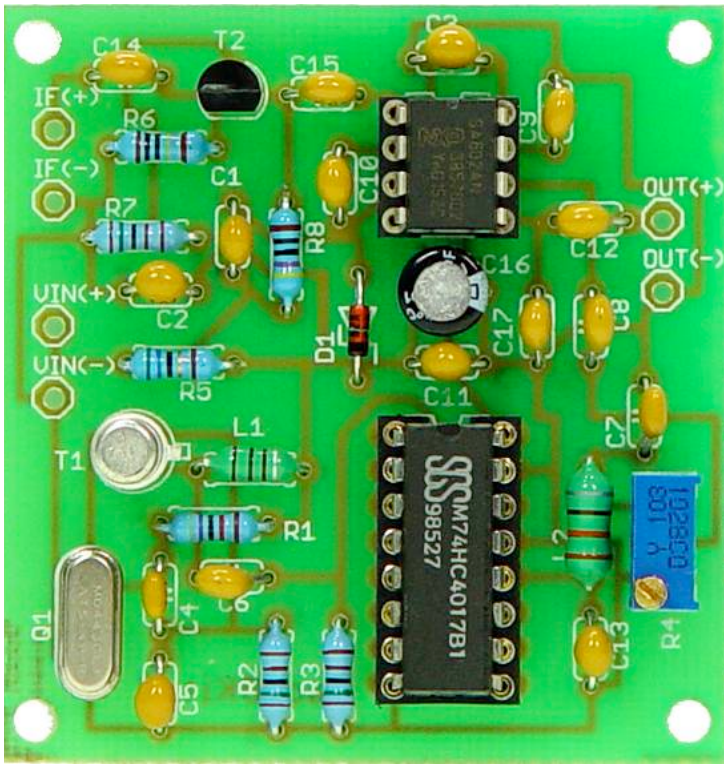
modulation method for DRM broadcasting is COFDM and each separate carrier, with a maximum of four, is QAM modulated. Lots more technical details can be found at **http://www.drm.org**.

Some manufacturers of analog radio receivers already deliver units that are either 100% DRM based or are enabled for both analog and DRM reception. Switching between the two occurs via a selection interface. Some other manufacturers, such as ETON or TECSUN, offer quality analogue radio receivers with a secondary AM IF output at 455 kHz.

On my desk I have a TECSUN S-2000 radio (£253.58 or $313.76), which performs exceptionally well on all receiving bands and also gives me that second IF output that I use to drive the following depicted IF demodulator unit named Radi0Kit-2. This unit's output is fed on the input of my PC's sound card using an absolutely free SDR DRM software application named DREAM, which can be downloaded from **https://sourceforge.net/projects/drm**. I enjoy exceptional DRM audio quality from European DRM broadcast stations and also from others worldwide. Radi0Kit-2 IF demodulator can be purchased for £26.75 ($33.10) plus £7.15 ($8.85) shipping at eBay UK at the following address, where detailed construction info can also be found, **http://www.ebay.co.uk/sch/sis.html?_nkw=RADI0KIT+2+DRM+SSB+RADIO+BROADCASTS+DECODER+KIT+IF+CONVERTER&_trksid=p2047675.m4100**

The operation of this kit is that it simply converts the 455 kHz IF into the 12 kHz mixed audio content signal. Seems that a crystal operating at 443 kHz or 467 kHz, is needed so that the output can be mixed with the 455 kHz IF frequency of the receiver's output, to obtain the 12 kHz signal. But such a crystal does not exist.

Instead, the thing to do is use a common 4.433619 MHz crystal and via a 74HC4017 Johnson decade counter you'll get a division-by-ten output at 443.3(4) kHz frequency which is very close to the desired frequency. Since the crystal's circuitry output is a square pulse, it cannot be mixed directly with the IF. To overcome that, we use two capacitors and a ceramic coil, C13, C17, L1 in a low-pass Bessel



Radi0kit2 (Courtesy: http://www.ebay.co.uk/sch/sis.html?_nkw=RADI0KIT+2+DRM+SSB+RADIO+BROADCASTS+DECODER+KIT+IF+CONVERTER&_trksid=p2047675.m4100)

filter configuration, the output of which is amplitude configurable via R4. This is the final LO frequency. The IF signal is passed through an N-JFET, BF245, so that it is buffered from the rest of the circuit via a 1 MOhm path, for the purpose of the protection of the stability of the reception's input. Both signals eventually are driven to the very "magic" and cute mixer IC, SA602AN, which delivers our 12 kHz mixed signal.

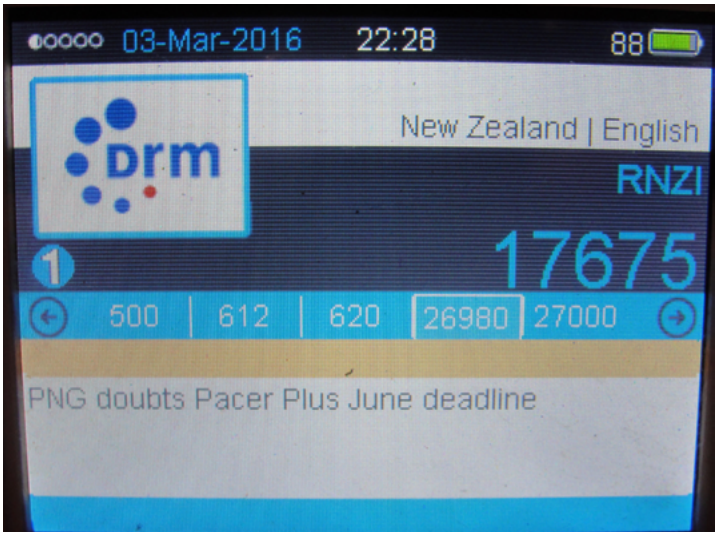
Any DC voltage source from 9 to 12 volts may be used. Special attention must be given to the quality and soldering of the coax between the IF output of the radio receiver and the IF input of our converter kit, because that path, if not well handled, may act as an input antenna to our converter kit.

With the aid of the SDR, Software Defined Radio DREAM software we can then demodulate and listen to any AM, DRM or SSB signal. We can even create and define our own DSP bandpass filters on DREAM for reception improvements. The SDR DREAM software gives numerous valuable options for us to configure both DSP and bandwidth adjustments as well as profiles testing. If other DRM30 or DRM+ spectrum bands demodulations are desired, where different IFs come into play, the above kit may be easily modified to meet the appropriate frequency ranges.

Many stations worldwide broadcast DRM content daily. Detailed and updated lists of all AM, HF, FM DRM stations and their frequencies as well as programs and times of broadcasting may be found at drm.org. There you will also find detailed literature for all the aspects of this technology and its current worldwide status as well.

TECSUN S-2000 radio (£253.58 or $313.76), which performs exceptionally well on all receiving bands and also gives me that second IF output that I use to drive the following depicted IF demodulator unit named Radi0Kit-2. This unit's output is fed on the input of my PC's sound card using an absolutely free SDR DRM software application named DREAM. (Courtesy: Amazon.co.uk.)

Avion AV-DR-1401 analog/DRM shortwave receiver, one of very few off-the-shelf DRM-capable radios. Made in India it is so far available only through Amazon.in. (Courtesy Avion)



Reception of Radio New Zealand International DRM broadcast on 17.675 MHz in US using an Avion AV-DR-1401 portable radio. Screen shows news text reception. (KS4ZR photo)

TSM

WNVC and WNVT UHF-TV stations in northern Virginia, owned by Richmond-based public broadcaster, Commonwealth Broadcasting, hosted MHz Networks, a combined 10 digital channels bringing international programming to the DC market. The two stations sold for $182 million in the FCC's Incentive Auction. Both stations will leave the air. (Courtesy: MHz Networks)

Results of FCC Auction and Repacking of US TV Spectrum

By Mike Kohl

This past fall and winter have been very challenging times for the FCC, as they tried to get broadcasters to sell off their frequencies so that spectrum could then be sold to the wireless industry that had previously showed signs of wanting to spend huge amounts of money to take over previous TV spectrum. It was a complicated process known as the Incentive Auction. As winter progressed to spring, reality settled in, and it was found that the wireless folks did not dig as deeply into their pockets as expected. They simply did not want to part with huge sums of money in order to be able to hoard everything that was offered, and that reality has given the broadcast industry as well as the general public a bit of a breather. There was talk of losing UHF TV frequencies all the way down to channel 28, but the end result is that we will be able to continue watching television on frequencies all the way up to channel 36. While it is still very confusing at first glance, the end game may be quite manageable.

Because of the comparatively huge numbers of TV stations in the larger markets, most activity centers on major rearrangements of channels within those big cities, in addition to removing any channel currently operating on a frequency above channel 36. TV broadcasters in affected channels above 36 were given several options while moving out of that spectrum. They could completely give up their current broadcast channel and go off the air, often in exchange for a generous payout from proceeds of the FCC auction. They could move to a UHF frequency between channels 14 and 36, and have their expenses more than covered. The FCC also provided generous incentives to leave the UHF band completely, and accept a new channel on low band VHF (2 to 6) or high band VHF channels between 7 and 13.

A considerable number of public TV channels across the country accepted large reimbursement to go completely off the air. Some of them owned other facilities, and will have an easy time doubling up on use of their other frequency to carry both channels. Expect to see some of these broadcasters investing their windfall in new production equipment, buildings and real estate. Others will put part of their FCC checks into place to rent space from another broadcaster with available spectrum. And a few will completely go off the air, in some cases using the cash to retire debt. You might even see some doing Internet-only distribution in the future.

Unless a local station is one of the rare few to completely go off the air, consumers will not be losing that local station. If it is going to a shared frequency from another broadcaster, it will remain a part of your local cable or satellite provider's offering. Or available for free over the air, although in some cases you may have to purchase and/or re-point an antenna to receive signals from their new facility. This will be an issue with some stations that will be moving completely off the UHF band onto a VHF channel frequency. Especially to low band channels 2-6. VHF signals are often difficult or impossible to receive with an indoor antenna, because the lower frequencies require matching lengths of antenna array and outdoor placement to receive an acceptable signal. At the very least viewers will have to do a "rescan" of their TV to find the channel changes once they have occurred.

Some folks in engineering circles question the wisdom of going back to VHF, when the average consumer can use an amplified indoor antenna costing less than $20 in most inner city locations and get great reception. Low band VHF usually needs an outdoor mounted antenna with elements

several feet long, even in many locations as close as a few miles from the transmitter. Digital signals do not always work inside houses with thick walls, especially many homes in desert locations such as Phoenix and Las Vegas, which have a great number of stucco walled houses that start with metal mesh or chicken wire type construction, surrounded by the stucco or other material. The metal can create a perfect Faraday shield and block many VHF signals from getting through—outdoor mounting of antennas is almost always suggested in such environments.

When do we need to worry about getting ready for our local broadcasters to change facilities? There will be a constant stream of updates from the FCC in coming months, starting in the next several weeks, as broadcasters that will be sharing facilities with other stations are required to disclose who their partners are. The next 39 months will feature a transition to new frequency assignments for affected stations. Starting with channels now operating on channels 38 through 51, as soon as stations receive the proceeds from the FCC auction, there will be a timeline for them to do engineering, make arrangements for installation and testing, plus make public announcements in advance of turning on the new facilities as well as turn-off of transmissions on channels 38 to 51. The FCC will coordinate things in an orderly fashion, as groups of channels in the larger cities are systematically converted to new channel numbers, and at the same time coordinated with channel changes in nearby markets, so there is little or no interference in the process. It is their intention in all markets to limit the need to re-scan TV tuners a maximum of twice during the entire process. While there will be ten total process windows across the country, coordination will be done to make it as efficient as possible with a minimum amount of disruption for any station or its viewers. More details on this and other issues with the Repack can be found at **www.fcc.gov**

I have prepared charts for the New York, Los Angeles and Chicago television markets. Existing channel numbers in column one, with the new TV channel in the second column. Changes to other channel numbers are in red. Question marks are left on Low Power TV stations, as their permanent status is currently unknown. The recent FCC auction and repack was designed for the benefit of full power TV stations, and a few LPTV channels in certain markets were also given allocations. Whenever possible, all existing stations, even those now classified as LPTV and not yet given a future assignment, will be given a chance at applying for a new displacement TV channel. Four columns are listed to the right, giving space to list primary TV channels and digital sub-channels. There is also a NOTES column on the right, indicating "no changes," the channel number being moved to, or a note indicating LPTV-status unknown—or that this channel frequency is permanently going off the air.

All of this information is a work in progress, and will likely be subject to at least weekly changes that should be accessible at either the rabbitears.info website **http://rabbitears.info** or at **fcc.gov**

Chicago's television spectrum will undergo great changes as a result of the latest FCC auction program. Channels above UHF 36 will no longer be used, meaning that existing channels 38 through 51 will be turned off. Existing broadcasters currently using channels 21, 45, 49, 50 and 51 will cease broadcasting on those channels, getting generous amounts of money from the proceeds of the FCC auction to go off the air. The remaining users within channels 38 through 51 have been given permission to shift to other UHF frequencies.

Most broadcasters in the UHF band have agreed to shift to other UHF frequencies. Lower powered analog channel 6, currently airing a test card and playing pop music on the 87.75 audio carrier of channel 6 will have to eventually go off the air, ending the ability to telecast on an FM radio frequency while still licensed as a TV station. Unknown at this time is the fate of WRJK-channel 24, W25DW-D on channel 25 and Daystar channel WDCI on channel 30. They all have low powered status, but this auction only awarded new frequencies to full powered and some Class A low powered stations. Other LPTV licensees and TV translators have little or no protection from eventually getting forced off the air by another broadcaster with a higher-grade license. This is a risk in crowded big city markets like New York, Chicago and Los Angeles, where there are literally too many users to promise a home for them all while eliminating the use of channels 38 through 51. There will be winners and losers, but all affected low power broadcasters will be given at least one opportunity to file a displacement application with the goal of getting a new permanent channel assignment. One interesting side note is the intention of some Diginet providers, most notably Weigel Broadcasting, to amend contracts with local broadcasters across the country to forbid over-the-air free broadcast of channels such as Me TV, Antenna TV, Heroes & Icons, Decades, and require subscription reception via the Internet, cable or satellite. It remains to be seen how this monetizing trend will be accepted across America, because people have gotten used to free TV. Perhaps they will back off in certain markets, if these actions have a negative response when first being attempted in larger big city markets. I do not think it is the end of free TV, because there are other Diginet services that may fill the place of any exiting popular channels if they go subscription only.

On April 13, the FCC released a lot of information that clears the air about what frequency each station will be using after the Repacking process has completed. Since we really do not know where many sub-channels will be going on a long term basis, and who some of the broadcasters that are giving up their frequencies will partner with to stay on the air, we will list the "after" channel assignments for Chicago in numerical order, with the main channel name. Please refer to the separate full chart for more details.

Ch 04 WOCK-IND. Ch 12 WBBM-CBS. Ch 17 WYIN-PBS. Ch 18 WMEU-Me TV. Ch 19 WGN-IND. Ch

CHICAGO TV SPECTRUM				MAY 2017			
							NOTES:
RF Ch Today	RF Ch New	Call	Channels		HD Channels in Yellow		
VHF-04	VHF-04	WOCK	13.1-WOCK CD	13.2-KBS World	13.3-Z Living		LPTV-status unknown
			13.4-Scene TV	13.5-Arirang TV	13.6-Infomercials		
VHF-06	Off	WRME	Ch 6-WRME-LP				Analog Ch going off the air
VHF-12	VHF-12	WBBM	2.1-WBBM CBS	2.2-Decades			No changes
UHF-17	UHF-17	WYIN	56.1-WYIN PBS	56.2-NHK World			No changes
UHF-18	?	WHNW	18.1-WHNW WHTV				LPTV-status unknown
UHF-19	UHF-19	WGN	9.1-WGN Ind	9.2-Antenna TV	9.3-This TV		No changes
UHF-20	UHF-26	WPVN	24.1-Movie 4U	24.3-Tuff TV	24.4-Polvision		Moving to UHF channel 26
			24.5-WINmedia	24.6-MC TV	24.7-KBS World		
UHF-21	Off	WYCC	21.1-WYCC PBS	21.2-FNX	21.3-MHz Worldview		Frequency going off the air
UHF-24	?	WRJK	22.1-Corner Store	22.2-CRTV	22.3-Diya TV		LPTV-status unknown
			22.4-Aiya Music	22.5-DRTV	22.6-Rev'n		
UHF-25	?	W25DW	25.1-HSN	25.2-HSN 2	25.3-Shop LC		LPTV-status unknown
			25.4-QVC Plus	25.5-LATV	25.6-Almavision		
UHF-27	UHF-23	WCIU	26.1-WCIU Ind	26.2-U Too	26.3-WWME Me TV		Moving to UHF channel 23
			26.4-H & I	26.5-Bounce TV			
UHF-29	UHF-33	WMAQ	5.1-WMAQ NBC	5.2-Cozi TV			Moving to UHF channel 33
UHF-30	?	WDCI	57.1-Daystar				LPTV-status unknown
UHF-31	UHF-24	WFLD	32.1-WFLD Fox				Moving to UHF channel 24
UHF-32	UHF-18	WMEU	48.1-WMEU Me Too	48.2-U & Me	48.3-WBBM CBS	48.4-Decades	Moving to UHF channel 18
UHF-33	UHF-33	WCHU	61.1-Azteca America	61.2-CCTV News	61.3-CCTV Doc	61.4-Jewelry TV	No changes
UHF-34	UHF-28	WEDE	34.1-WEDE MCTV				Moving to UHF channel 28
UHF-35	UHF-32	WLPD	30.1-You Too Am				Moving to UHF channel 32
UHF-36	UHF-36	WJYS	62.1-WJYS Ind	62.2-WEDE MCTV	62.3-WJYS (-2 hr)	62.4-SonLife	No changes
UHF-38	UHF-35	WGBO	66.1-WGBO Univisn	66.2-Get TV	66.3-Grit		Moving to UHF channel 35
UHF-39	UHF-20	WWME	23.1-WWME Me TV	23.2-H & I	23.3-Me TV		Moving to UHF channel 20
UHF-40	?	WESV	40.1-WESV Estrella				LPTV-status unknown
UHF-40	UHF-27	W40CN	40.1-Educational				Moving to UHF channel 27
UHF-43	UHF-34	WCPX	38.1-WCPX Ion	38.2-Qubo	38.3-Ion Life		Moving to UHF channel 34
			38.4-I Shop	38.5-QVC	38.6-HSN		
UHF-44	UHF-22	WLS	7.1-WLS ABC	7.2-Live Well	7.3-Laff		Moving to UHF channel 22
UHF-45	Off	WSNS	44.1-WSNS Telemdc	44.2-Telexitos TV			Frequency going off the air
UHF-47	UHF-25	WTTW	11.1-WTTW PBS	11.2-PBS Encore	11.3-Create/World	11.4-PBS Kids 24/	Moving to UHF channel 25
UHF-49	Off	WOCH	41.1-Charge!	41.2-Comet TV			Frequency going off the air
UHF-50	Off	WXFT	60.1-WXFT Unimas	60.2-WGBO Univsn	60.3-Escape		Frequency going off the air
UHF-51	Off	WPWR	50.1-WPWR MyN/C\	50.2-Movies!	50.3-Light TV	50.4-Buzzr	Frequency going off the air

20 WMEU-Me Too. Ch 22 WLS-ABC. Ch 23 WCIU-IND. Ch 24 WFLD-FOX. Ch 25 WTTW-PBS.

Ch 26 WPVN-Polvision. Ch 27 W40CN-Educational. Ch 28 WEDE-MCTV. Ch 32-WLPD-You Too America. Ch 33 WCHU-Azteca America. Ch 34 WCPX-Ion. Ch 35 WGBO-Univision. Ch 36-WJYS IND.

There will be a constant flux of changes as this three-year or more process goes through, so it will be difficult to track unless you use resources found on the Internet. The Federal Communications Commission will have many updates to provide this information to both broadcasters as well as the general public, at **www.fcc.gov**.

One of their employees, known online as Trip Ericson, has been running a broadcasting information website at **www.rabbitears.info** for over nine years, and has just created a number of tools to follow the process, whether it be on a national search basis or just to look at your local TV market for upcoming changes. Go to his blog and access the latest information.

Some interesting trends from the center of the country: South Dakota had the need to reassign only one UHF channel (47) to a lower frequency, so there was little or no reason for any stations to move anywhere. There is an abundance of channels that have always been and will continue to remain on VHF channel numbers, with acceptable reception easily attained in open prairie environments with few hills in the way. Milwaukee will have no less than four UHF channels go completely off the air, due to its proximity to Chicago, and the fact that affected broadcasters have at least one other channel available to move the disappearing frequency's ser-

NEW YORK TV SPECTRUM				MAY 2017			
							NOTES:
RF Ch Today	RF Ch New	Call	Channels		HD Channels in Yellow		
VHF-02	?	WKOB	42.1-Iqra TV	42.2-Daystar	42.3-Peace TV	42.4-Guide US TV	LPTV-status unknown
			42.5-SonLife	42.6-MiCasa	42.7-Retro TV	42.8-Infomercials	
VHF-03	VHF-03	WJLP	3.1-WJLP Me TV	3.2-Laff	3.3-Escape	3.4-Grit	No changes
			33.10-Weather	33.11-106.3 WKMK	33.12-98.5 WBBO	33.13-99.7 WBHX	
			33.14-1410 WHTG				
VHF-07	VHF-07	WABC	7.1-WABC ABC	7.2-Live Well	7.3-Laff		No changes
VHF-08	VHF-08	WNJB	58.1-WNJB PBS	58.3 NJ Audiovision			No changes
VHF-09	?	W09CZ	17.1-W09CZ				LPTV-status unknown
VHF-11	VHF-11	WPIX	11.1-WPIX CW	11.2-Antenna TV	11.3-This TV		No changes
VHF-12	?	WPXU	12.1-WPXU Daystar				LPTV-status unknown
VHF-13	VHF-12	WNET	13.1-WNET PBS	13.2-PBS Kids 24/7			Moving to VHF channel 12
UHF-17	UHF-17	WNMF	17.1-Infomercials	17.2-Jewelry TV			LPTV-status unknown
UHF-18	UHF-18	WMBC	63.1-WMBC Ethnic	63.2-CGN	63.5-NTD	63.7-Aliento Visio	No changes
				63.8-WDJN fm	63.9-KCBN Radio		
UHF-20	?	W20CC	20.1 Hope Channe	20.2-Esperanza			LPTV-status unknown
UHF-20	?	W20EF	27.1-Infomercials	27.2-Jewelry TV			LPTV-status unknown
UHF-21	UHF-32	WLIW	21.1-WLIW PBS	21.2-Create	21.3-PBS World		Moving to UHF channel 32
UHF-22	?	WCBS	2.1-WCBS CBS	2.2-Decades			LPTV-status unknown
UHF-22	UHF-28	WEPT	15.1-WEPT AMG				Moving to UHF channel 28
UHF-23	UHF-22	WDVB	23.1-Country Netwk	23.2-Soul of-South	23.3-TBA	23.4-SonLife	Moving to UHF channel 22
UHF-23	UHF-23	WFTY	67.1-WFTY UniMa	67.2-WXTV Univisior	67.3 Get TV	67.4-Escape	No changes
UHF-24	UHF-24	WNYE	25.1-WNYE NYC Lif	25.2-NYC Gov	25.3-CUNY TV		No changes
UHF-25	?	WASA	24.1-WASA Estrella	24.3-Sinovision Eng	24.4-Sinovision	24.5-WASA Estrella	LPTV-status unknown
UHF-26	?	WYXN	26.1-CCTV News				LPTV-status unknown
UHF-27	Off	WTBY	54.1-WTBY TBN	54.2-Hillsong Ch	54.3-JUCE/SOAC	54.4-Enlace USA	Frequency going off the air
				54.5-TBA Salsa			
UHF-28	Off	WNBC	4.1-WNBC NBC	4.2-Cozi TV			Frequency going off the air
UHF-29	Off	WNYJ	66.1-CNC World	66.2-MHz Worldview	66.6-WFME fm		Frequency going off the air
UHF-30	UHF-26	WFUT	68.1-WFUT UniMa	68.2-WXTV Univisior	68.3-Get TV	68.4-Escape	Moving to UHF channel 26
UHF-31	UHF-34	WPXN	31.1-WPXN Ion	31.2-Qubo	31.3-Ion Life	31.4-Shop TV	Moving to UHF channel 34
				31.5-QVC	31.6-HSN		
UHF-32	?	WXNY	32.1-CCTV News	32.2-CCTV 4	32.3-CCTV Spanis	32.4-Rev'n	LPTV-status unknown
		H		32.5-Retro TV			
UHF-32	?	WNYW	5.1-WNYW FOX	5.2-Movies!	5.4-Light TV	9.2-WWOR MyN	LPTV-status unknown
UHF-33	UHF-36	WCBS	2.1-WCBS CBS	2.2-Decades			Moving to UHF channel 36
UHF-34	?	WWOR	5.3-WNYW FOX	9.1-WWOR MyN	9.3-Buzzr	9.4-H & I	LPTV-status unknown
UHF-34	?	WPXO	34.1-America TeVe				LPTV-status unknown

vices to. Only one channel in Milwaukee will stay on their existing assignment. Madison, Wisconsin has a CBS affiliate that used to be on VHF channel 3 in analog days. They were the only station in the market on VHF, until they were shifted to UHF channel 50 with the first digital conversion. WISC-TV was given nearly $49 million to move back to VHF, and they chose high band channel 11 this time. What has been an all UHF market for most of this decade will now require addition of a high band VHF antenna, or a dedicated UHF-VHF system to keep CBS service.

Very little change in North Dakota. Fargo-Grand Forks channels transmitting from what used to be the world's tallest towers (2060 and 2063 feet respectively) will leave the upper UHF band. KRDK-38 shifts to channel 24, and KVLY-44 will convert to channel 18. Other North Dakota changes include Minot's PBS channel KSRE, from 40 to 15. Minnesota changes: Alexandria's CBS satellite channel 7-KCCO gets over $9 million to go off the air, and seeks a partner, likely KSAX-42, which is moving to 24. Fox affiliate KQDS in Duluth: 17 to 18. Twin Cities changes are independent KSTC-45, moving to 30 and neighboring St. Cloud channel 40 to 16. KXLT-Fox Rochester moves from 46 to 26. Omaha, Nebraska has three UHF moves: KXVO-38 to 29, KPTM-43 to 26, and KMTV-45 to 31. Iowa changes include Quad Cities KGCW-41 to 21, KWQC 36 to 17, and KLJB from 49 to 30. Across the river, but in Illinois we find WQAD migrating from 38 to 31. Cedar Rapids KPXR from 47 to 22. No changes in Des Moines, although neighboring

LOS ANGELES TV SPECTRUM				MAY 2017			
							NOTES:
RF Ch Today	RF Ch New	Call	Channels		HD Channels in Yellow		
VHF-02	?	KHIZ	39.1-Escape	39.2-Laff	39.3-Grit	39.4-Am Sports	LPTV-status unknown
				39.5-Shop LC	39.6-QVC Plus	39.7-Altavision	
VHF-03	?	KVTU	3.1-KVTU				LPTV-status unknown
VHF-05	?	KRVD	6.1-CEN TV	6.2-Corner Store T	6.3-Khmer TV	6.4-Jewelry TV	LPTV-status unknown
				6.5-AMGA			
VHF-06	?	KZNO	6.1-KZNO				LPTV-status unknown
VHF-07	VHF-07	KABC	7.1-KABC ABC	7.2-Live Well	7.3-Laff		No changes
VHF-08	?	KFLA/	8.1-Tuff TV	8.2-Country Network	8.3-Retro TV	8.4-Biz TV	LPTV-status unknown
		KILA		8.5-Ebru TV	8.6-Rev'n		
VHF-09	VHF-09	KCAL	9.1-KCAL IND				No changes
VHF-10	?	KIIO	10.1-US Armenia	10.2-Film On TV	10.3-Best TV	10.4-AABC	LPTV-status unknown
				10.5-Horizon Arm	10.6-RAZ TV	10.7-ARM Music	
VHF-10	?	KZSW	10.1-3ABN	10.2-3ABN Proclaim	10.3-Dare To Dream	10.4-3ABN Latino	LPTV-status unknown
				10.5-3ABN Radio	10.6-3ABN R Latino	10.7-Radio 74	
VHF-11	VHF-11	KTTV	11.1-KTTV FOX				No changes
VHF-12	?	KTBV	12.1-Cornerstone	12.2-Dare To Dream	12.3-GCN	12.4-3ABN	LPTV-status unknown
				12.5-Al Karma TV	12.6-CNL New Life		
VHF-13	VHF-13	KCOP	13.1-KCOP MyN	13.2-Buzzr	13.3-Movies!	13.4-H & I	No changes
			11.1-KTTV FOX	11.3-Light TV			
UHF-18	UHF-18	KSCI	18.1-KSCI IND	18.2-SBS	18.3-MBC D	18.4-CGN	No changes
			18.5-US Armenia	18.6-MBCA	18.7-ARTN	18.8-LA 18.8	
				18.9-YTV	18.10-CHTV	18.11-Channel A	
UHF-22	Off	KSFV	6.1-CEN TV	6.2-Corner Store T	6.3-Khmer TV	6.4-Jewelry TV	Frequency going off the air
				6.5-AMGA		10.4-3ABN Latino	
UHF-22	?	KMRZ	69.1-KMRZ HSN	69.2-MBN	69.3-Diya TV	69.4-New Day	LPTV-status unknown
				69.6-LA 18.8	69.8-Grace TV		
UHF-23	UHF-23	KVMD/	31.1-KVMD Ethnic	31.2-UDG	31.3-Fil Am TV	31.4-GDTV	No changes
		KSGA/		31.5-Creation TV	31.6-CRTV	31.7-CRTV	
		KIMG/		31.8-WCETV	31.9-CCTV News	31.10-CRTV	
		KSMV					
UHF-24	Off	KBEH	63.1-KBEH IND	63.2-Guadalupe RTV	63.3-Pan Armenian	63.4-TVA	Frequency going off the air
			63.5-Latin TV	63.6-Rede iTV	63.7-Pan Armenian	63.8-Teledunamis	
UHF-25	Off	KNET	18.12-Diya TV	25.1-HSN	25.2-CitiCable 3	25.3-FETV	Frequency going off the air
				22.5-DRTV	22.6-Rev'n		
UHF-26	VHF-05	KVCR	24.1-KVCR PBS	24.2-FNX	24.3-PBS Encore	24.4-Create	Moving to VHF channel 05
UHF-27	UHF-22	KHTV	27.1-CEN TV	27.2-Mana	27.3-HSN 2	27.4-Jewelry TV	Moving to UHF channel 22
				27.5-Al Karma TV			

Newton has Pax affiliate KFPX moving from 39 to 36. Mason City CBS affiliate KIMT from 42 to 24. Sioux City sees three changes that include KTIV 41 to 14, KMEG 39 to 32, and KPTH going from channel 49 to channel 30.

Lots of changes in Wisconsin: WMOW in Crandon from VHF 12 to 13. Eau Claire area WEUX from 49 to 14. Also WQOW from 15 to 25 and WEAU-38 to 17. Neighboring LaCrosse sees sister station WXOW-48 drop to channel 28. PBS affiliate WHLA 30 moves to 15. WLAX-FOX 17 to 33. Green Bay area WACY-27 to 36,

WFRV-39 to 22, WCWF-21 on 15, WGBA from 41 to 14, WPNE-42 to 25, WLUK Fox from 11 to 12, protecting a Madison move of WISC-50 to channel 11. Other Madison changes include independent WIFS-32 going to 21, and Fox WMSN-47 to 18. Religious channel WWRS in Mayville from 43 to 34. Only PBS station WMVS stays on channel, continuing to transmit on VHF channel 8 to the Milwaukee market. The four UHF channels that are signing off include channel 48-WMLW, channel 25-WCGV, channel 35-WMVT, and WVCY-22. Other Milwaukee area shifts are 28 to 32 for WTMJ, 33 to 31 for WITI, WMKE from 21 to 36, WVTV-18 going to 27, WBME-24 to 17, and WDJT-46 to 29. Finally, Wausau's WTPX moves from channel 46 to 19.

TSM

Scanning America

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

Charlotte County (FL) and Dallas County (IA)

Upgrades to public safety radio networks proceed in various parts of the country, although security for one radio-related system was tested in April and found wanting.

Charlotte County, Florida

In April, Charlotte County, Florida awarded a contract for a new Project 25 (P25) Phase 1 and Phase 2 public safety radio system.

Charlotte County is located in south-central Florida, along the coast of the Gulf of Mexico. It covers an area of about 850 square miles, a fifth of which is water. The county is home to about 175,000 people, with nearly 17,000 living in the county seat of Punta Gorda.

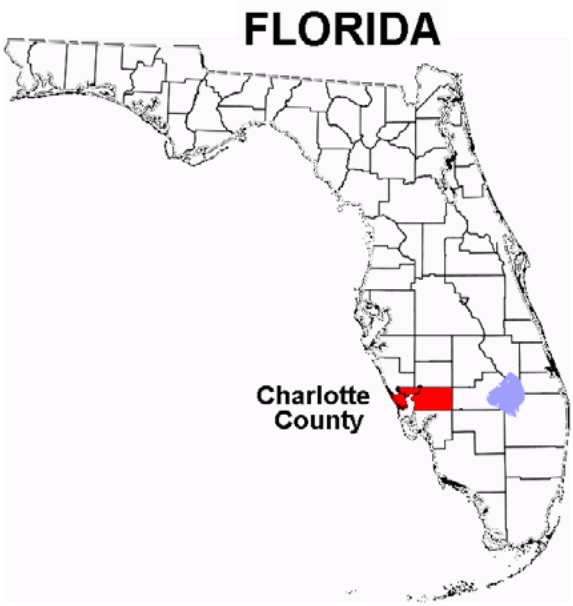
Charlotte County suffered extensive damage when Hurricane Charley came ashore in August of 2004.

The new radio system will operate in the 700 MHz band from seven repeater sites using equipment from Melborne, Florida-based Harris Corporation. The use of P25 standards will allow improved interoperability with surrounding counties. The dispatch center will also be upgraded with new Harris consoles.

The contract was awarded to Communications International, which will procure and install the system as well as provide service and ongoing maintenance.

Charlotte County currently operates a Motorola Type II SmartNet system carrying analog voice traffic on the following frequencies: 851.1250, 851.1750, 851.2125, 851.2625, 851.3125, 851.5625, 851.8125, 852.0375, 852.0625, 852.3125, 853.4000, 853.6500, 853.8500 and 853.9000 MHz.

The system operates in a simulcast (simultaneous broadcast) mode, meaning the same information is transmitted from each repeater site at the same time. This allows mobile units to roam across the entire county, moving from the coverage area of one repeater site to another, without having to transmit a registration message or otherwise update the system with their location. Simulcasting also makes monitoring easier for scanner listeners, since activity occurring in one part of the county will be transmitted from all repeater sites, allowing the listener to follow the action regardless of where he or she is located.



Charlotte County, Florida (in red).

Decimal	Hex	Description
176	00B	County Emergency Operations Center (EOC)
208	00D	County Red Cross
240	00F	County Red Cross (Tactical 1)
272	011	County Red Cross (Tactical 2)
752	02F	Aeromed Air Ambulance
848	035	Charlotte and Sarasota County Mutual Aid
880	037	Charlotte and Sarasota County Mutual Aid (Tactical 1)
912	039	Charlotte and Sarasota County Mutual Aid (Tactical 2)
1008	03F	County Radio Service
1136	047	County Law Enforcement (Group Call)
1168	049	County Law Enforcement (Tactical 1)
1200	04B	County Law Enforcement (Tactical 2)
1232	04D	County Law Enforcement (Tactical 3)
1264	04F	County Law Enforcement (Tactical 4)
1616	065	Sheriff (Dispatch for Districts 1 and 2)
1648	067	Sheriff (Records)
1680	069	Sheriff (Dispatch for Districts 3 and 4)
1712	06B	Sheriff (Special Operations)
1744	06D	Sheriff (Records 1)
1776	06F	Sheriff (Records 2)

1808 071 Sheriff (Tactical 1)
1840 073 Sheriff (Tactical 2)
1872 075 Sheriff (Tactical 3)
1904 077 Sheriff (Tactical 4)
1936 079 Sheriff (Tactical 5)
1968 07B Sheriff (Tactical 6)
2032 07F Sheriff (Special Activities)
2128 085 Sheriff (Vice 1)
2160 087 Sheriff (Vice 2)
2192 089 Sheriff (Special Operations)
2832 0B1 County Jail 1
2864 0B3 County Jail 2
2896 0B5 County Jail 3 (Maintenance)
2928 0B7 Courthouse Security
3216 0C9 County Fire (Dispatch)
3248 0CB County Fire (Unit-to-Unit)
3280 0CD County Fire (Tactical 1)
3312 0CF County Fire (Tactical 2)
3344 0D1 County Fire (Tactical 3)
3376 0D3 County Fire (Tactical 4)
3408 0D5 County Fire (Tactical 5)
3424 0D6 County Fire (Tactical 6)
3440 0D7 Universal Fire (Tactical)
3536 0DD Emergency Medical Services (Charlotte Regional Medical Center)
3568 0DF Emergency Medical Services (Englewood Community Hospital)
3600 0E1 Emergency Medical Services (Fawcett Hospital)
3632 0E3 Emergency Medical Services (Peace River Regional Medical Center)
3664 0E5 Universal Fire Mutual Aid (Punta Gorda to Charlotte County Fire)
3696 0E7 County Fire (Hazardous Materials Operations)
4816 12D County Water and Sewer Utilities
7216 1C3 County Ambulatory Transportation
7280 1C7 County Dial-A-Ride
7696 1E1 County Animal Control
7728 1E3 County Animal Control
13936 367 Airport Operations
13968 369 Airport Operations
16048 3EB Punta Gorda Police (Dispatch)
16080 3ED Punta Gorda Police (Dispatch 2)
16112 3EF Punta Gorda Police (Tactical 1)
16144 3F1 Punta Gorda Police (Tactical 2)
16880 41F Punta Gorda Fire (Tactical 1)
16816 41B Punta Gorda Fire
17616 44D Punta Gorda Water Plant
19216 4B1 County Public Schools (Buses A)
19248 4B3 County Public Schools (Buses B)
19280 4B5 County Public Schools (Buses C)
19408 4BD County Public Schools (Maintenance)

There are also a handful of conventional (non-trunked) analog frequencies active in the county:

Dallas County, Iowa (in red).

Frequency	Description
152.2700	Charlotte Technical Center
152.3225	Meadow Park Elementary
152.3900	Murdock Middle School
155.8800	Punta Gorda Public Works
453.6750	Telemetry (Data)
463.0500	County Medical Coordination
463.1125	Ambulance to Peace River Regional Medical Center
463.1375	Ambulance to Charlotte Regional Medical Center
463.1625	Ambulance to Fawcett Memorial Hospital
857.2625	Sheriff Dispatch (Alternate)

Dallas County, Iowa

By the time you read this, Dallas County, Iowa, should be operational on the Iowa Statewide Interoperable Communication System (ISICS). County first responders will receive training on new equipment and dispatchers will begin using new consoles in the emergency communications center.

Shifting onto ISICS effectively replaces the county's existing VHF (Very High Frequency) radios, which could not easily interoperate with adjacent counties and were limited due to Federal Communications Commission (FCC) requirements for narrowband operation.

Dallas County covers about 600 square miles in central Iowa and has about 66,000 residents.

ISICS has been operational since July 2016 and was built by Motorola Solutions using ASTRO-25 technology, the Motorola flavor of APCO Project 25 standards. Westcom Emergency Communications, a combined dispatch center for the five cities of Clive, Norwalk, Urbandale, Waukee and West Des Moines, connected their existing P25 system to

ISICS soon afterward.

The Westcom P25 Phase 1 system operates on the following frequencies: 852.9625, 854.1375, 854.9625, 856.5875, 859.4875 and 859.9625 MHz. A handful of Norwalk talkgroups have been reported, although these (and others) are active on ISICS:

Decimal	Hex	Description
601	259	Norwalk Police (Dispatch)
603	25B	Norwalk Police
605	25D	Norwalk Police
607	25F	Norwalk Police (Tactical)
611	263	Norwalk Fire
613	265	Norwalk Fire (Fireground)
631	277	Norwalk Public Works

In addition to Dallas County, Woodbury County will join ISICS later this year and Mills County has announced they will join and become operational next year.

As of March, ISICS was operational in three counties (Dallas, Polk and Warren), under construction in 33 counties and yet to be scheduled in the remaining 63. The full buildout of the statewide system is expected early next year, operating in the 700 MHz band from more than 85 repeater sites. Each repeater site includes backup equipment as well as batteries and a generator to provide power if commercial electrical service is interrupted.

The initial system design for ISICS includes mobile coverage across 95% of the state. ISICS supports both Phase 1 and Phase 2 of the P25 standards. One significant advantage of Phase 2 is the dual-rate vocoder (voice encoder/decoder) that offers improved performance in environments with significant background noise. Radio manufacturers have also added background noise reduction on top of the vocoder improvements. This combination makes it much easier to understand voice communications with users working in noisy locations, such as a large fire or police pursuit.

The ISICS system currently operates from three sites. The first site is the Westcom system listed above. The other two are Des Moines on 770.69375, 773.34375, 773.81875 and 774.06875 MHz; and Dallas County on 770.06875, 770.53125, 771.00625 and 771.28125 MHz.

Talkgroups active on the system so far are:

Decimal	Hex	Description
41	029	West Des Moines Fire (Paging)
91	05B	West Des Moines Emergency Medical Services (Alliance)
161	0A1	Polk County Tactical 5
163	0A3	Polk County Tactical 6
165	0A5	Polk County Tactical 7
167	0A7	Polk County Tactical 8
169	0A9	Polk County Tactical 9
171	0AB	Polk County Tactical 10
175	0AF	Polk County Fire (Dispatch)
177	0B1	Polk County Fire 2
179	0B3	Polk County Fire 3
381	17D	Clive Fire
407	197	Clive Public Works
459	1CB	Urbandale Operations 1
461	1CD	Urbandale Operations 2
463	1CF	Urbandale Operations 3
465	1D1	Urbandale Operations 4
475	1DB	Urbandale Fire 1
477	1DD	Urbandale Fire 2
505	1F9	Urbandale Public Works
551	227	Clive Law Enforcement
707	2C3	Waukee Police
711	2C7	Waukee Fire (Dispatch)
713	2C9	Waukee Fire
731	2DB	Waukee Public Works
1052	41C	Patch to Metropolitan Incident Command Radio Network (MICRN)
1101	44D	Polk County Law Enforcement (Dispatch)
1102	44E	Polk County Law Enforcement 2
1103	44F	Polk County Law Enforcement 3
4021	FB5	State Capital (Des Moines) Security

There are also a number of conventional analog frequencies in Dallas County, although many may go silent after the county completes the transition to ISICS.

Frequency	Description
150.9950	County Road Department
151.1900	Dallas Center Police, Fire and Public Works
153.7400	County Fire and Emergency Medical Services 3
153.7850	County Fire and Emergency Medical Services 1
154.4450	County Fire (Dispatch)
154.9650	Sheriff (Dispatch)
155.1300	Waukee Police
155.6250	Waukee Police
155.7300	Perry Police (Information)
155.7675	Adel Public Works
155.8200	DeSoto Public Works
155.8500	County Fire and Emergency Medical Services 4
155.9250	Redfield Public Works
158.7600	Adel Police
158.8500	Sheriff (Information)
159.0900	Perry Police (Dispatch)
159.3150	Sheriff (Dispatch for Adel, Dallas Center, DeSoto and Granger)
159.4200	County Fire and Emergency Medical Services 2

Hamvention

The month of May traditionally means Hamvention. The world's largest annual gathering of radio enthusiasts will take place this year from May 19 through 21 at the Greene County Fairgrounds and Expo Center in Xenia, Ohio.

No longer in Dayton, this year marks the transition from the old Hara Arena, which has hosted the Hamvention since 1964, to the new Greene County Fairgrounds location.

Late last summer Hara Arena, which was built in the 1950s, announced it would be closing, forcing convention officials to find a new host. The fairgrounds are off Route 35 about 16 miles east of Dayton.

The Hamvention regularly draws more than 25,000 attendees from 60 countries over the three-day event.

This year there are more than two dozen scheduled forums, covering such topics as antenna design, emergency communications, fox hunting (radio direction finding), robotics and software defined radio (SDR).

Many companies choose to announce new products at Hamvention as well as running promotions and discounts on current equipment. This year more than 200 indoor vendors will be spread across six buildings and include such companies as Alinco, Comet Antenna, DX Engineering, Diamond Antenna, FlexRadio, Great Scott Gadgets, Ham Radio Outlet, ICOM America, JVC Kenwood, MCM Electronics, MFJ Enterprises, Nuts & Volts Magazine, Mini-Circuits, Quicksilver Radio, Tuscon Amateur Packet Radio, Universal Radio, the Whistler Group and Yaesu.

Equally interesting, if not more so for vintage equipment hunters, is the outdoor flea market. This year the new location for the flea market will be the areas around the horse racing track. More than 1,500 booths will offer a wide variety of radio and computer related items and parts, both modern and vintage. This is the preferred place to hunt for that elusive device as well as meet up with friends and acquaintances.

With a new location and an expanding set of vendors, attending Hamvention this year promises to be a worthwhile trip.

The official address of the Greene County Fairgrounds is 120 Fairground Road, Xenia, Ohio 45385. If you are so inclined, GPS coordinates are 39.7021 degrees North, 83.9420 degrees West.

Dallas, Texas Warning Sirens

At 11:42 p.m. on Friday, April 7, Dallas area residents were startled to hear tornado sirens on a clear and calm night. Someone managed to activate all 156 outdoor warning sirens in and around the city. City officials turned off the sirens, only to have them re-activate soon afterward. This went on for 95 minutes until technicians finally unplugged equipment, manually deactivating the siren system.

The Dallas Outdoor Warning System (OWS) was installed over a three-year period beginning in 2007, at a cost of about $3.3 million.

Initially the city called it a malfunction, but later referred to the event as a "hack," although it turned out to have nothing to do with computers. Although city officials were tight-lipped regarding details of the compromise, informed speculation concluded that someone transmitted the proper activation tones.

The siren system, built by Federal Signal Corporation and maintained by Michigan-based West Shore Services,

Siren from Federal Signal Corporation (Courtesy: Federal Signal Corporation)

includes a radio receiver programmed to listen for a specific sequence of tones. When the proper tones are received, usually on a UHF frequency in the 450 MHz range, the sirens begin to sound. Normally these tones originate from a transmitter at a dispatch center. However, because Dallas was not using any type of encryption or authentication, someone else was apparently able to transmit the proper activation tones.

The city tests the outdoor warning system at noon on the first Wednesday of every month. It is certainly possible for someone to record the activation tones during one of these scheduled tests and transmit them later. In security parlance this is called a "replay attack" since the attacker is simply replicating a previously-transmitted message.

It is also possible that the activation was performed via the Internet. A 2012 briefing about the Dallas OWS indicates three primary activation points and the capability to activate the system remotely. This seems to conflict with statements made by city officials.

While Dallas Police, the Federal Bureau of Investigation (FBI), and the FCC investigate the incident, the city claims to have added encryption to the siren system in an effort to prevent future unauthorized activations. The Dallas City Council also voted to spend up to $100,000 to upgrade security on the siren system.

The incident also caused the city to start looking at other critical systems to determine what vulnerabilities may exist and what can be done to secure them. These systems include the water utility, the public safety radio network, 9-1-1 and 3-1-1 telephone services, police and fire dispatch centers and flood warning sensors.

TSM

Federal Wavelengths

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

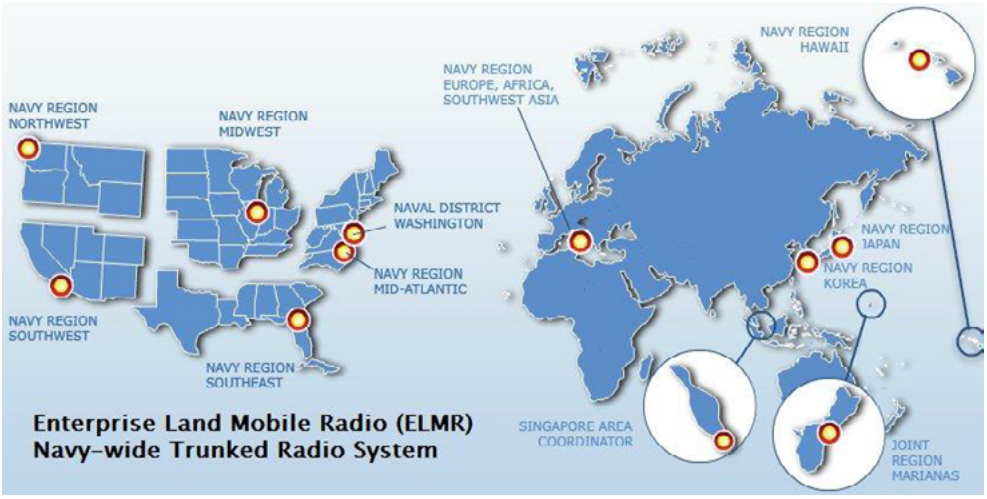
Shifts In Federal Trunked Radio Systems

Over the last 10 years or so there had been a definite shifting of frequencies and bands for some federal trunked systems, particularly those utilized by the various branches of the military. A recent move by a military base in Arizona got me thinking about these moves and why they might be happening. First, let us take a quick trip back in time and see how the federal government and military bases got interested in trunked radio systems.

Trunked radio systems, as we know them today, first started appearing in some major metropolitan areas as early as the late 1970s and early 1980s. The essential concept behind trunking is to allow more users on a given set of radio frequencies. The concept of following trunked radio systems has been frustrating to scanner listeners, as there were no scanners available to monitor trunking until the late 1990s. And it adds a certain level of complexity to scanners and radio monitoring in general. Today we have access to many different trunked radio system technology with scanners and software defined radio receivers.

As trunking technology began showing up in public safety trunked systems, multiple cities had Motorola trunked radio systems that appeared suddenly in the federal UHF band, between 406 and 420 MHz. There were some listeners who mistakenly believed these were going to be wide area coverage trunked systems for all federal agencies to use in a major population center. The assumption was the FBI, DEA, Secret Service, U.S. Marshals and other agencies would all participate in the trunked system for their day-to-day radio operations.

In fact, most all of these early trunked systems were used by a specific federal agency or facility in the area. Many early trunked systems turned out to be used by the Bureau of Prisons (BoP), part of the U.S. Department of Justice at various federal prisons facilities around the country. The BoP continues to be a large player in the UHF federal bands with trunked systems, both Motorola and P-25 types in use.



Map of the Navy ELMR System showing the world wide coverage. (Courtesy of US Navy)

Most federal trunked radio system for both the federal agencies and the military initially appeared in the UHF bands. However, some military facilities utilized trunking in the VHF federal band of 162 to 174 MHz, or in some cases, the 138 to 143 MHz bands. Even trunked systems aboard U.S. Navy vessels began appearing. These systems were known by the acronym of HYDRA, or Hierarchical Yet Dynamically Reprogrammable Architecture. HYDRA is a wireless interior communications system that provides communications throughout the naval vessel. The first HYDRA systems found by radio hobbyists were using analog voice and used the General Electric Enhanced Digital Access Communications System or EDACS trunking format. Quite a few shipboard systems are still using the same type of trunking today. Most of the original systems were found in the 400-420 MHz band. However, newer HYDRA trunked systems are being specified as being in the 380-399.9 MHz band. However, it should be noted that many of these HYDRA systems are not using the same band plan that the land-based 380 MHz systems are. Many HYDRA systems have been noted using repeater outputs up in the 398-399 MHz area with inputs below that range. Land based systems are required to use 380-390 MHz for repeater outputs.

Back in 2005, the first wide-scale deployment of P-25 digital trunking in the 380-400 MHz band managed by the Department of Defense, was found on the air on the Pacific Northwest, specifically the Puget Sound area. The first 15 sites of this new system were showing to be networked together and utilizing a single system controller, making it one big trunked system. This networked system became known as ELMR, standing for the Enterprise Land Mobile Radio system. The system is managed by the Department of the Navy and now serves Navy and Marine Corps sites all over the globe. You can see more about the ELMR system here:

http://www.radioreference.com/apps/db/?sid=3856

In addition to the Navy and Marine facilities, some U.S. Army bases, specifically Joint Base Lewis-McChord near Tacoma, Washington and the Yakima Training Facility in Central Washington State are using what appear to be sites that are utilizing the same system controller and system identification as the ELMR sites. However, no evidence of interaction between the Navy and Army facilities has been monitored so far. And both bases originally had their own 400 MHz trunked systems before moving to the 380 MHz band.

Another interesting example of a wide-area trunked radio system being shared by different government sectors is the Front Range Federal system in the Denver, Colorado area. This three-site Motorola Type II system is managed by the Federal Protective Service to provide coverage for the FPS and other agencies along the eastern edge of the Rocky Mountains:

System ID 8D34
001 – Aurora, Colorado
406.5000
406.9750
408.0750
409.4000
410.8000

002 – Denver, Colorado
406.7750
407.1250
407.8125
408.4250
408.7750

003 – Lakewood, Colorado
406.9875
408.2750
409.0250
410.1750
410.6750

One of this system's subscriber agencies (meaning that they pay for airtime and use of the system) is Buckley Air Force Base in Aurora, Colorado, just east of Denver. Buckley has base operations talk groups on the federal system for day-to-day activities. However, another trunked system in the area, belonging to the US Air Force, shows an active trunked site at Buckley, but currently no active talk groups for Buckley. This USAF trunked system operates in the 380 to 400 MHz band and is networked to quite a few other USAF facilities and bases: **http://www.radioreference.com/apps/db/?sid=3593**

So why are these military trunked systems being moved to different bands? The 406 MHz to 420 MHz federal spectrum has a fixed number of channels available in any given region. And even with narrow-banding, assignments are limited. It would seem that the National Telecommunications and Information Administration (NTIA), wants to move the Department of Defense systems out of the 406-420 MHz frequency range and into the radio spectrum under control of the Department of Defense, specifically the 380-400 MHz band. I'm sure the spectrum management department of the various military service branches like having their own slice of radio frequencies to use, free from a lot of interference issues from other users. And, in many cases, when a military base or group replaces older radio equipment, the frequency management groups use that opportunity to make changes in the frequencies as well as the hardware.

But what are the NTIA plans for the 406-420 UHF band? New federal agency trunked systems are likely to continue to appear in the federal UHF band for the foreseeable future. There is no sign of any of the Bureau of Prisons UHF trunked systems vanishing from the band, but they do appear to be in the process of updating the older Motorola systems to P-25 trunking. And some agencies, such as the Drug Enforcement Administration (DEA) that used to be very active in the federal UHF band, have started moving away from UHF toward VHF channels. So keep an ear on the federal UHF bands and see what comes up in your area!

Luke AFB

As I noted at the top of this column, it was the notation seen in an on-line scanner forum that caught my attention about another military trunked system changing frequencies. It was Luke Air Force Base in Glendale, Arizona. Luke is the training base for the new F-35 "Lightning" combat aircraft.

Over the years, Luke AFB has made changes to their base communications systems several times. They originally started out with a Motorola Type II trunking system in the 406-420 MHz band for base operations. This system served the base for many years, but in 2008, the system moved frequencies around. This was likely due to re-channeling in the 406-420 MHz spectrum and assigning a standard 9 MHz offset for the repeater inputs.

Then in 2014 the base updated the trunked system to an APCO P-25 digital trunked system. This new system used the same frequencies as previous Motorola system, but all transmissions were digital with a P-25 control channel. The system was now also networked with other Air Force bases that also utilized P-25 trunking.

And now in March of 2017, they have updated the Luke P-25 system to a new set of frequencies. Here are the system particulars for the system at Luke:

System ID 3D6
WACN BEE00
Site ID 1-014
385.0375
385.7625
385.9750
386.2500

386.5000
386.9750
387.4375
387.7875
387.9750
388.1500
388.3000
388.5750

The other systems that are networked together with the Luke system are all part of System 3D6, listed in the Radio Reference database as "United States Air Force." Being networked with other bases allows seamless communications for the wide-area military command infrastructure. In some cases, you can hear other bases checking in with the command center on their talk group of the trunked system.

Other military facilities that are part of this system include other USAF bases in states across the country, and almost all the military bases in the San Antonio, Texas area, including army facilities and bases. You can see the details here: **http://www.radioreference.com/apps/db/?sid=7769**

Curiously, Davis-Monthan Air Force Base in Tucson, Arizona is not part of this networked trunked system. Currently they are operating a stand-alone 400 MHz trunked P-25 system. Why they are not linked up with other bases as seems to be the trend is unknown. And watch for Davis-Monthan to move to the 380-400 MHz band sometime in the future.

NASA Wallops Island

Another trunked system being moved as it gets an upgrade is the radio system serving NASA's Wallops Island flight facility in Virginia. This system had been a 2-site VHF EDACS analog trunked system for many years. But they have recently deployed a new APCO P-25 trunked system in the federal UHF band. My guess is that the federal VHF band is getting pretty crowded and moving to UHF was to free up VHF channels in the region. Here are the system specifics so far:

System ID **Unknown**
WACN Unknown
Site ID 001
406.2375
406.4375
406.8375
407.0375
407.2375
407.4375

The Radio Reference data on this system shows only one site, and also seems to imply this will use P-25 Phase 2 TDMA when fully operational: **http://www.radioreference.com/apps/db/?sid=9325**

NASA Wallops Island Lauch Facility. (Courtesy: NASA)

Moving to DMR and Beyond

In addition to changing frequencies, some federal operated trunked systems may even be changing what digital mode they are transmitting in. During a recent trip to the Washington D.C. area, I have noted both trunked and conventional federal radio systems that are now using Digital Mobile Radio (DMR) or NEXEDGE (NXDN) digital voice.

In my home location of Portland, Oregon, both the Veterans Affairs Medical Center and the US Postal Office are using DMR conventional radios. While these are not very prevalent modes on most federal frequencies everywhere, they might be soon. And, fortunately, we now have access to these new digital modes in a variety of scanner models.

Federal law enforcement agencies adopted the APCO P-25 open-standard digital mode when the transition to digital radios occurred in the late 1990s and early 2000s. And it made a requirement of local, county or state public safety that used federal assistance funding for digital radio upgrades to also utilize the APCO digital mode to insure interoperability between federal agencies and civil public safety agencies. However, there are some federal offices, agencies and facilities that are not held to that requirement, as they have no need for interoperability.

Federal agencies, such as the US Postal Service (not the Postal Inspection Service), Department of the Interior, Department of Veterans Affairs and even the Environmental Protection Agency all seem to be buying whatever radios happen to fit their budgetary requirements these days, which means you might come across some unusual digital activity on their frequencies at any time. The radio manufacturers are all pushing digital radios heavily in their sales pitches to any agency buying radio equipment. And some of the lesser-known digital radio manufacturers offer a lower cost to upgrade from analog to digital than buy P-25 radios.

During my recent trip to the Washington, DC, area I came across several examples of federal radio systems using

digital modes other than the APCO P-25 standard. One such trunked system serves a number of tourist attractions in the National Capitol Region. It is a three-site system using the NXDN digital mode, and apparently they are using voice privacy on this system:

National Mall - U.S. National Parks Service
406.5875
408.4500
409.8500

National Zoo - Smithsonian Institution
407.6750
408.4500
409.4250
409.7500
409.8875

Udvar-Hazy Center, Fairfax, VA - Smithsonian Institution
406.5875
409.8500
410.9625

Another system that I ran across is operating at the U.S. Capitol complex. This system apparently serves Capitol operations other than the Capitol Police, who have their own VHF P-25 trunked radio system. This small, single-site system is using the Motorola TRBO digital standard, a proprietary version of the DMR mode. This system has three frequencies and is also using voice privacy:

Washington, D.C. - U.S. Capitol
406.3875
408.5125
409.8375

One other small system is used by the United States Holocaust Memorial Museum in Washington, DC. It also uses the Motorola TRBO digital mode and can be monitored with a DMR capable scanner:

Washington, D.C. – Holocaust Memorial Museum
407.0750
407.3750

So it now seems that to be really ready for federal monitoring, you not only need a digital scanner, but you are going to need the latest versions of the multi-mode digital scanners offered by Uniden and Whistler!

If you run across any unusual digital modes when you search through the VHF or UHF federal bands in your area, please pass them along to us here at The Spectrum Monitor!

Federal Wavelengths Frequency List Legend

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

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

TSM

Utility Planet

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

New Insight into North Korean "Numbers"

Once upon a time, there was a radio group named ENIGMA. This stood for European Numbers Information Gathering and Monitoring Association. Needless to say, it also referred to the famous German code machine used in World War II. ENIGMA brought order from chaos in the numbers sub-hobby, with its station designation list still in use today.

ENIGMA is still around, but the current version that most of us are familiar with is ENIGMA 2000, an online entity with a mailing list and web site. It's lively, and the members really know their stuff. Their newsletter is always good reading. On occasion, they come up with some very interesting material regarding the whole "numbers station" phenomenon.

This was the case in January, when a member contributed a better explanation of the North Korean numbers. This broadcast has been the news as of late, and its existence has inspired many doomsday predictions on the Internet. The ENIGMA designator for this broadcast is V15. For decades, it was sent out on the mighty broadcast waves of Radio Pyongyang, now called the Voice of Korea. Today's VOK, like the country originating it, is a time machine right back into the Cold War. It blasts half the planet with stirring revolutionary music and voice-of-doom announcers reading the officially approved version of reality.

Actually, V15 did stop for quite a while. Broadcasts abruptly ceased in 2001, during an unsuccessful attempt to re-unite Korea. In 2016, as the situation on the peninsula deteriorated, they started right up again. The media were all over this, and it rapidly became yet another doomsday discussion topic on the Internet.

V15 version 2.0 has a few minor changes from the original. The stirring revolutionary music uses different selections. Several of my sources have identified these as "We will go Together with a Song of Joy," and "Spring of my Hometown." At present, the selection between these depends on which specific spies are supposed to copy the subsequent message. A live female announcer addresses the callup targets (in Korean) as "exploration agents" studying information technology at a "Distance Learning University." The following coded message is sent as a series of assignments ("questions") listed by page and item numbers in an unknown textbook. The schedule seems to depend on what month it is.

I've noted several times in this column that V15's code might have been the old "book cipher," where a specific

This looks like an antenna, but it's actually North Korea's giant flagpole near the DMZ. (U.S. Military photo)

volume like a dictionary or Bible is used as sort of a lookup table to encrypt and decrypt messages. This was the common guess at the time, but now we know that it's probably wrong. The ENIGMA newsletter author makes a good case for a different system using numbered grids with Korean characters in the squares. He gives details on how this is done, and how it resembles an old commercial code once used by banks. He also supplies photographs of typical grids. It's worth a read, and the link appears at the end of this column.

The March edition of this same newsletter mentions a mysterious USB station heard in the UK, in which a Russian female voice sounding a bit like one of their numbers stations gives weather information. Well, this is actually Rostov Volmet, in European Russia. It gets out quite nicely. Its 5-minute transmissions, in Russian, are at 25 and 55 minutes after the hour. Its frequencies, all of which have been verified here, are 2941, 6617, 8939, and 11297 kHz. "Rostov" in this case refers to Rostov-na-Donu (Rostov-on-Don). The weather office is at an airport near the Sea of Azov, not far from the Ukrainian border.

Yet more on WEGI

My mention of the "WEGI" ("ВЕГИ") group call in Russian military transmissions continues to draw interesting comments. This one comes from Ary Boender. As we noted last month, he runs the Numbers and Oddities web site, not to mention the Utility DXers Forum (UDXF). If anyone

knows this stuff, he does. He writes, "We now see this call-sign mainly in flash messages. Originally -in the Soviet time- it was the used in messages to pass the coordinates of the presidential plane. The messages were on perforated tapes, fed into the KTSOS system and then transmitted to WEGI. KTSOS is a system for technical message processing, technical standard AUVYU.466514.001 TU."

Of course, the real name of this standard is in Russian. Ary passed along a copy of the standard, also in Russian. I've been translating parts of it the best I can, using online translators, and some of it is pretty interesting. It's too long for this column, but maybe it'll appear on the blog at some point

Western Pacific Weather Fax

I've been doing a lot of listening on various SDRs in Japan and New Zealand. It's nice to have the Pacific back. At one time, I heard it all, before consumer electronics raised the noise floor. It's good to know that radio fax is still going strong over there, with regular schedules from Japan, New Zealand, Australia, Korea, and Taiwan. Internet latency makes these remotes a bit iffy for fax, and the images can jump. I've been receiving them anyway and fixing them later with Photoshop. This is not an easy process, but it works. All but the Kyodo News faxes are 120 lines per minute, with an Index of Cooperation of 576. Kyodo is 60/576. Schedules, of varying timeliness, are all over the Internet.

I was pleased to see Auckland Radio (ZKLF) still sending fax from New Zealand. They still use the same rather odd schedule. Twice a day, at 0900 and 2100, a chart is sent by a single transmitter, which changes frequency every 15 minutes. It starts on the hour, using 5807 kHz (dial frequency is 5805.1). Then, at 15 minutes past the hour, it changes frequency to 9459 kHz (dial 9457.1), and does the same. 13550.5 (dial 13548.6) is at the half hour, and 16340.1 (dial 16338.2) is at 45. I got copy on all four at the 2100 UTC hour, though the higher frequencies got noisier due to propagation.

3622.5 kHz (dial 3520.6) is JMH, the Japan Meteorological Agency, also copied at 2100. 11030.0 (dial 11028.1), 13920 (13918.1), and 20469 (20467.1) all had VMC, the Australian weather office transmitter in Charleville, with some gorgeous big charts. Finally, HLL2, Seoul Radio in Korea, was found on 9165 (9163.1) and 13570 (13568.1).

Japanese Fishery

Japanese fishery radio also continues just as before. Most of the hits are in CW, using International Morse and Wabun code. That latter is a means of sending Japanese with dits and dahs, by encoding the phonetic Kana characters. I did find something in USB voice, on 2279.5 kHz at 2135. A machine-generated "female" was giving some kind of information in Japanese. The ID at the end was JHA, which comes back to Ibaraki Fishery.

Logo of Indonesia's National Resilience Institute. (Courtesy Lemhannas)

I have found a more recent list of fishery radio stations than the old one I've been using. There aren't many changes. Most are still operated by various prefectures in Japan, and some of them also send faxes. The list is too long for this column, but after some more checks I'll do something with it elsewhere. Here are a few that I've been able to verify as active on HF: JFC, Kanagawa/Misaki; JFM, Kochi/Muroto; JFW, Fukushima/Iwaki; and JFX, Kagoshima. There are others.

Indonesia National Resilience Institute

Every so often, something comes along that's so outside the box that even I have to get dizzy. Recently, I ran across one of these in CW, at 0000 UTC on 18980 kHz. This frequency was logged a long time back as the Indonesian Navy, call signs 7CB and 7CJ. These calls were being used again, as was "P5O." It was banging along in very loud, very nice, machine Morse at 22 words per minute. It printed better on the computer than most do, though I was also getting some by ear.

At first, it looked like encryption. Soon after, names and dates started showing up, revealing it as plain text in Indonesian, with "))" signifying a new paragraph. This is definitely a Navy transmitter, and other people have found parallel transmissions on 6365 and 12335. Along with the 0000 schedule, some people reported one at 1200 UTC. The messages themselves are originated by a government agency called the "National Resilience Institute of the Republic of Indonesia (Lemhannas RI)." Its entry in the Indonesian Wikipedia translates as follows: "A non-ministerial government institution in charge of implementing Indonesian government duties in the field of education, the national level leadership, strategic assessment of national security, and the consolidation of national values."

FCC Approves Two New Ham Bands

This item has some history. In 2007, an ITU World Radio Conference (WRC-7) internationally allocated a new

amateur radio band, at 135.7 to 137.8 kHz, in the low frequency (LF) range. This is known as the 2200-meter band. In the U.S., it's had some use by a few amateurs who were granted experimental licenses. Otherwise, no band.

Here's the catch. All of these international decisions still have to be implemented separately by each member country. Here, the FCC was getting objections from power companies. It seems they use 9-490 kHz for something called PLC (Power Line Carrier). This isn't the dreaded "BPL" that never caught on commercially. PLC is for the power company's transmission lines to substations, not the lines to customers. It has various uses for control and supervision of the system, sending RF over the lines on a noninterference basis.

In 2012, WRC-12 allocated a long-sought amateur band in the historic mediumwave spectrum, at 472 to 479 kHz. This is known as the 630-meter band. In the U.S., there was the same PLC problem. The bureaucratic machine churned for five more years, finally spitting out an FCC Report and Order in late March of this year. This finalized both bands in the U.S., along with some other interesting changes. And so, the usual 30 days after publication in the Federal Register, American hams will finally have their two new bands.

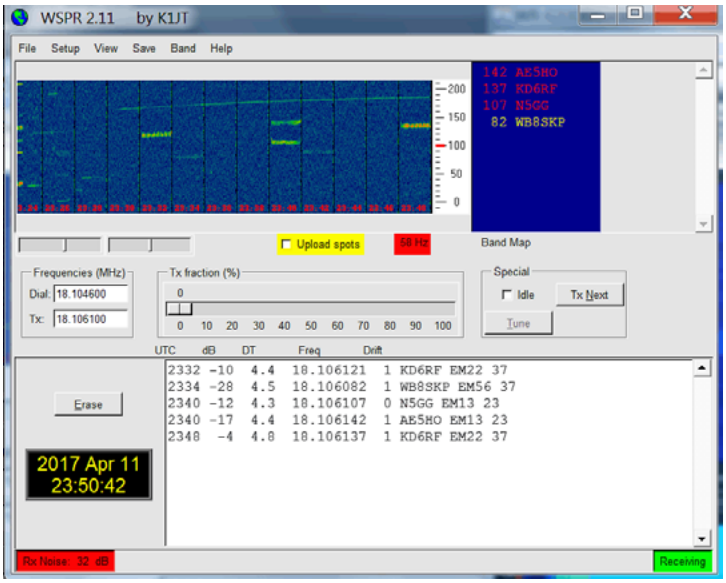
These bands have a lot of rules. Amateur operation is secondary. All operation has to be at fixed locations, at least one kilometer (0.6 miles) from any transmission line using PLC. Power on the low band is limited to one watt equivalent isotropically radiated power (EIRP). On the higher band, it's five watts EIRP, except for one watt in the part of Alaska nearest Russia. Given that most antennas feasible for hams are very inefficient at these frequencies, this rule is not as severe as it sounds.

This end of the radio spectrum is very interesting. Reception gets better at night, and in winter. It does well in solar minimums. If predictions of an extended minimum are correct, we could see some interesting things here. Right now, most operation (where legal) uses weak-signal modes. Examples are QRSS (ultra-slow Morse in CW or narrow FSK), and WSPR (Weak Signal Propagation Reporter). 474.2 kHz is a common WSPR frequency.

Allocations to the fixed and maritime mobile services have been accordingly adjusted. Interestingly, KFS, WNU, and WNE are specifically grandfathered in as primary on their existing frequencies. No new public coastal stations will be licensed here.

There were some other changes in this R&O. For years, radio buoys have operated in the 160-meter amateur band, legally or otherwise. They're used by fishing boats to locate gear. Now, these buoys have primary status from 1900 to 2000 kHz, limited to commercial fishing operations on the open sea and Great Lakes. Power is limited to eight watts, and antenna height to 4.6 meters (about 15 feet).

In addition, the FCC has finally moved U.S. sea surface radars such as CODAR to the ITU's existing international bands. This should help reduce some chaos here, putting all the dweep, dweep, dweep into specific frequency ranges.



Screenshot of WSPR receiving on 17 meters. (Author)

These ranges, in kHz, are 4438-4488, 5250-5275, 13450-13550, 16100-16200, 24450-24650, 26200-26420, 41015-41665, and 43350-44000. Note that the last two are well above HF. This allocation is on a noninterference basis to existing licensees in these ranges, and traditional mobile stations are now primary between 5250 and 5275 kHz. The radars will now use standard FCC licenses instead of experimental ones. They will have five years to move to these bands.

Finally, the FCC has allocated 495-505 kHz exclusively to the maritime mobile service, and removed the distress and calling restriction on historic 500 kHz. This conforms to an allocation made at WRC-12 for a new digital radio system called NAVDAT (NAVigational DATa). It's kind of a hot-rod version of the existing NAVTEX (NAVigational TeleX) system, using digital file transfers to increase speed and allow more different types of content.

Until next month, fair winds and following seas.

Resources:

ENIGMA 2000 January newsletter:
http://www.apul64.dsl.pipex.com/enigma2000/newsletters/En98.pdf

ENIGMA 2000 March newsletter:
http://www.apul64.dsl.pipex.com/enigma2000/newsletters/En99.pdf

FCC Report and Order for new bands:
http://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0329/FCC-17-33A1.pdf

New full table of ITU and FCC allocations:
https://transition.fcc.gov/oet/spectrum/table/fcctable.pdf

TSM

Shortwave Utility Logs

Recent Shortwave Utility Logs Compiled by Mike Chace-Ortiz

Frequency (kHz)	Callsign	Time (UTC)	User, Location	System Details
3394.00	4XZ	0138	Israeli Navy, Haifa	Hybrid PSK/FSK HF modem, tfc (on USB)
5056.00	???	2030	NATO MIL, ???	Link-11 CLEW, tfc (on USB)
5059.40	WI2XJP	0100	Warren Ziegler, Wayland MA	45.45bd/170 Baudot “ryry wi2xjp wayland,ma
5120.50	???	0013	NATO MIL, ???	75bd/850 STANAG4481 FSK, crypto tfc
6487.00	NSS	0100	US Navy, Davidsonville MD	75bd/850 STANAG4481 FSK, sync, cont, ACF=0
8145.00	???	2300	NATO MIL, ???	75bd/850 STANAG4481 FSK, crypto tfc
8316.00	???	0310	NATO MIL, ???	Link-11 CLEW, 2 channels tfc (on ISB)
8319.00	4XZ	2300	Israeli Navy, Haifa	CW, “nr382 gr 3” followed by 5LGs offline crypto message with “BT BT” separator
10153.00	NAU	2220	US Navy, Isabela PR	50bd/850 STANAG4481 FSK, crypto tfc
10186.10	FUG	2140	French Navy, La Regine	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
10195.20	OVK	0015	Danish Navy, Aarhus	600bps/L STANAG4285 HF Modem, crypto tfc (on USB)
10264.10	FUE	2330	French Navy, Brest	1200bps/L STANAG4285 HF modem, tfc (on USB)
10356.00	???	2250	Russian MIL, ???	AT3004D 12 tone HF modem, tfc with full carrier (on USB)
11096.00	MKD	0210	Royal Navy, Akrotiri	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
11145.00	???	2240	Australian MHFCS, North West Cape	50bd/350 FSK UNID System, sync, cont, ACF=0 with +1350Hz offset (on USB)
11145.00	???	2240	Australian MHFCS, North West Cape	600bd/600 STANAG4481 FSK, KG84 crypto with +1350Hz offset (on LSB)
11387.00	???	2245	ARINC, Riverhead NY	HF Datalink, tfc to aircraft US1209 (stn ID=004) (on USB)
11506.00	SNB813***	1140	Polish MIL, ???	125bd/1750 MIL-188-141A, ALE LQA with “SPT424” (on USB)
11508.00	NCS353	1140	US SHARES, ???	PacTOR-I FEC, station ID
12120.00	NAU	2120	US Navy, Isabela PR	75bd/850 STANAG4481 FSK, KG84 crypto
13042.50	FUV	2356	French Navy, Djibouti	600bps/L STANAG4285 HF modem, “voyez le brick” marker in 5N1 mode (on USB)
13206.00	???	2320	UK MIL DHFCS, ???	Link-11 CLEW, 2 channels tfc (on DSB)
13920.00	VMC	1205	Australian Met Office, Charleville	120lpm/576/900 FAX, weather pix
13985.00	???	1200	Russian MIL, ???	50bd/500 FSK UNID System, sync, cont, ACF=128 tfc
14411.00	RDL	1232	Russian Navy, Moscow	50bd/250 BEE, short messages (//11468kHz) with sync=[0x1eb41eb2952]
14411.70	???	1253	NATO MIL, ???	600bps/L STANAG4285 HF modem, crypto tfc (on USB)
14416.00	???	1250	Russian MFA, Moscow	MFSK with 250bd inserts, tfc (on USB)
14485.50	XSS***	1228	UK MIL TASCOM, Forest Moor	125bd/1750 MIL-188-141A, ALE sounding (on USB)
14508.00	???	1215	Russian Navy, Moscow	50bd/250 BEE, tfc
14631.00	CTA	1300	Portuguese Navy, Lisbon	600bps/L STANAG4285 HF modem, “cta04/cta06/...” CARB in ITA2 (on LSB)
14643.00	???	1255	Russian Intel, Moscow	200bd/1000 FSK UNID System, “11166 90073 52369 05001 00049 00000 x 10”
14664.00	RDL	2100	Russian Navy, Moscow	50bd/200 BEE, tfc on sync=[0x1414bebe952] (//18576kHz)
14722.20	FUG	2320	French Navy, La Regine (Saissac)	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
14844.00	???	1240	Russian Navy, ???	50bd/250 BEE, tfc
15016.00	MAINSAIL***	2355	US Air Force, HF Ground Control Station	USB, OM/EE reads EAM characters
15091.00	PLASPR***	2136	US Air Force, Lajes	125bd/1750 MIL-188-141A, ALE sounding (on USB)
16106.20	???	1130	UK MIL DHFCS, Akrotiri	1200bps/L STANAG4285 HF modem, crypto tfc (on USB)
16112.00	RDL	2040	Russian Navy, Moscow	50bd/250 BEE, tfc sync on [0x1414bebe952] & [0x1414bebe64c]
16168.00	???	1242	Russian Intelligence, Moscow	200bd/1000 FSK, ACF=288 tfc “11166 90073 52369 05001 00049 00000 x 10”
16223.70	???	1300	Egyptian Embassy, Havana	100bd/170/E SITOR-A, hex off-line crypto to MFA Cairo
16223.70	SSE	1300	Egyptian MFA, Cairo	100bd/170/E SITOR-A, hex off-line crypto, calling “XBVF” (Embassy Madrid)
16287.00	???	2200	UK MIL DHFCS, Ascension Island	1200bps/L STANAG4285 HF Modem, crypto tfc QRV @2100UTC (on USB)
16316.00	RMP	1551	Russian Navy, Kaliningrad	50bd/250 BEE, tfc on sync=[0x1eb41eb2952]
16433.20	OVK	1540	Danish Navy, Aarhus	600bps/L STANAG4285 HF modem, short KG84 crypto messages (on USB)
16473.60	DHM85	1414	German Navy, Marlow	600bps/L STANAG4285 HF modem, crypto tfc (on USB)
16595.60	???	1230	French Navy, ???	600bps/L STANAG4285 HF modem, short KG84 crypto messages (on USB)
16633.00	???	1414	???, ???	CW, hand sent
16809.00	WLO	1720	ShipCom, Mobile AL	100bd/170/E SITOR-A, phasing signal and “WLO” CWID
16984.00	PWZ33	2000	Brazilian Navy, Rio de Janeiro	200bd/200 PacTOR-I FEC, navigation warnings
17545.00	8GZAAR***	2000	US Army MARS, ???	125bd/1750 MIL-188-141A, ALE LQA with “7QEAAR” (on USB)
18012.00	???	1812	French Air Force, ???	USB, OM/FF in conversation
18737.00	???	1438	UK MIL, Ascension Island	2400bd QPSK HF modem, idle (on USB)
19098.00	VC1***	2106	Venezuelan Navy, ???	MIL-188-110A/B HF modem, crypto tfc to “VC6” (on LSB)
19098.00	VC1***	2106	Venezuelan Navy, ???	125bd/1750 MIL-188-141A, ALE LQA with “VC6” (on LSB)
19098.00	VC6***	2106	Venezuelan Navy, ???	125bd/1750 MIL-188-141A, ALE LQA with “VC1” (on LSB)
19743.00	CTA	2218	Portuguese Navy, Lisbon	600bps/L STANAG4285 HF Modem, crypto tfc on USB, ITA2 CARB on LSB (on ISB)
19810.00	CCC***	1918	Chilean Navy, ???	125bd/1750 MIL-188-141A, ALE LQA and encrypted DBM tfc with "G3W" (on USB)
19810.00	G3W***	1918	Chilean Navy, ???	125bd/1750 MIL-188-141A, ALE LQA and encrypted DBM tfc with "CCC" (on USB)
19810.00	HLA***	1851	Chilean Navy, ???	125bd/1750 MIL-188-141A, ALE sounding (on USB)

Shortwave Utility Logs

Recent Shortwave Utility Logs Compiled by Hugh Stegman

Frequency	Callsign	User, Location	Time	System Details
40.00	JJY	Japanese NICT, Fukushima	2045	CW ID in time signals, also on 60.0 (Kyushu)
226.00	KK	NDB, Kerikeri, New Zealand	2221	AM, repeating Morse ID with 1 kHz tone
309.00	686	DGPS, Ken Saki, Japan	2059	MSK (200), type 9 correction data on transmitter 643
518.00	"H"	JNR, Moji Radio, Japan	2115	Sitor-B (100/170), NAVTEX warning for military exercises
2474.00	PBB	Dutch Navy, Den Helder	2143	RTTY (75/850), repeating channel availability marker
2656.00	IPA	Ancona Radio, Italy	2146	USB, relay of IAR, Rome, machine "female" with weather in Italian
2872.00	Shanwick	Atlantic ATC, Ireland (NAT-C)	2152	USB, selcal FH-CR for FedEx 17 (MD-11 freighter reg N616FE)
3377.00	RIS9	Chinese Military (M89)	1956	CW calling marker for M8JF, parallel 4532
4395.00	AFA5NF	USAF MARS	2311	USB, taking net check-ins from AFA2PD, AFA3DJ, many others
4700.00	Halifax Military	Canadian Forces, NS	0128	USB, working Rescue 344, a CC-130H, not heard
4761.00	921	Russian Intelligence (HM02)	0420	FSK (19.8/129), then FSK Morse callup "921 46" and message
4784.00	691	Russian Intelligence (G06)	1659	USB, null-message callup "691 00000," in Russian
4934.10	GHM	U.S. Military	1512	ALE, working MBY, then voice as Athletic Coach with Clothing Store
5154.20	"F"	Russian Navy, Vladivostok	2058	CW cluster beacon, "A" (5154.1) and "M" (5154.4) also heard
5186.00	AFS5IN	USAF MARS	2316	Net using OLIVIA 16/1000 and encrypted MIL-STD-188-110A
5429.00	NNE5PY	Unknown SHARES	1654	USB, quick check and back to 6765 primary
5807.00	ZKLF	Auckland Radio, NZ	2110	FAX (120/576, dial fq 5805.1), then on 9459, 13550.5, and 16340.1
6324.50	KPH	MRHS, Pt. Reyes, CA	2025	RTTY (45/170), Bering Sea gale and volcano warnings
6529.00	17	ARINC, Canary Islands	0105	HFDL, working TB0602 (TUI Fly B787 reg OO-JDL)
6685.00	76650	Russian AF IL-76MD	1605	USB, working Davlenie (Taganrog) and Korsar (Pskov)
6694.00	Halifax Military	Canadian Forces, NS	1609	USB, clear and secure voice with warship HMCS Glace Bay
6733.00	Tascomm	UK DHFCS, Forest Moor	1623	USB, selcal check JK-ES with Ascot 6603 (RAF C-17A reg ZZ171)
6749.00	Korsar	Russian Air Force, Pskov	1632	USB, working 76763 and 76714, both IL-76MDs
6972.80	NF07CT	USCG Auxiliary	1546	USB, working NF07ZF and MSU-1
6982.50	KHA950	NASA Stennis Space Center, MS	1643	USB, calling unknown NASA station
7340.00	893	Russian Intelligence (S06s)	1010	USB, callup "893 245 6," and message in Russian
7904.00	5S7K	Russian Military	2040	CW, working Ch6ZN (not heard), changed frequency
8052.50	410CDR410CAVB	U.S. Army	1335	ALE, calling 3BDETOC3ABCTNE
8102.00	575	Polish Intelligence (E11)	1045	USB, null-message callup "575/00," in English
8471.50	WLO	ShipCom, AL	2100	Sitor-B (100/170), station info and Somalia piracy warning
8834.00	KQ0304	Kenya Airways B737 (5Y-CYB)	2110	HFDL, working Johannesburg (not heard)
8843.00	San Francisco	Pacific air control (CEP-1)	0007	USB, selcal CQ-ER for Alaska Airlines 870, a B737 reg N585AS
8846.00	New York	Caribbean air control (CAR)	2152	USB, selcal FK-GS for KLM 730 (A330 reg PH-AOM)
8847.00	Korsar	Russian Air Force, Pskov	1122	USB, working 78757 (IL-76MD) enroute to Chkalovsky
8906.00	Shannon	Atlantic air control (NAT-A)	2030	USB, selcal FG-PS for Air Berlin flight (A330 reg D-ALPE)
8992.00	Guide Post	U.S. Military	2020	USB, EAM "K66OJB" on USAF HFGCS
9443.00	462	Polish Intelligence (E11)	1205	USB, null-message callup "462/00," in English
11175.00	Reach 54	USAF Air Mobility Command	1327	USB, calling Mainsail (any ground station) for comm check
11360.00	Polis	Russian Air Force, Orenburg	1313	USB, working 78757 (IL-76MD) enroute to Kedr
12365.00	VMC	Australian B.O.M., Charleville	2039	USB, machine male voice with coastal weather, also on 16546
12579.00	L2C	Argentine Coast Guard, Buenos Air	0041	Sitor-B (100/170), marine warnings in Spanish and English
12856.00	XSG	Shanghai Radio, China	0224	CW/MCW, navigation warning, then ID and traffic list
13276.00	"04"	ARINC, Riverhead, NY	2046	HFDL, football score for LOT045 (LOT Polish Airlines B787 SP-LRB)
13366.00	GTMN	Russian Military	1002	CW, coded traffic for J4M6
13570.00	HLL2	Seoul Meteo, Korea	2136	FAX (120/576, dial 13568.1), noisy weather chart
13907.00	A60	U.S. CBP UH-60M	2322	ALE, 2 way link check with OPB, OPBAT Service Center, Bahamas
14402.00	AFA0GP	USAF MARS	1704	USB, taking check-ins on SHARES West net
14582.00	718	USCG HC-130H #1718	2122	ALE, link check with LNT, COMMCOM, VA
15034.00	Trenton Military	Canadian Forces, ON	1630	USB, volmet with aviation wx for Canadian airfields
16957.90	FUJ	French Navy, New Caledonia	2349	STANAG 4285 (600L/5N2), test loop with ID, also 22461
17069.60	Unid	Kyodo News, Japan	0145	FAX (60/576, dial 16067.7), newspaper in Japanese
17430.00	9VF	Kyodo News, Singapore	0203	FAX (60/576, dial 17428.1), Seamen's Union news in Japanese
17916.00	HA0457	Hawaiian Airlines A330 reg N383HA	0056	HFDL, ACARS message for station 05, Auckland, NZ
18524.00	548	Russian Intelligence (M12)	1400	CW, callup "548 1 9984 103" and msg in Russian, also 17424, 15824
18980.00	7CB/7CJ	Indonesian Navy	0022	CW, long message from National Resilience Institute
20459.00	VMC	Australian B.O.M., Charleville	2330	FAX (120/576), very clear polar weather charts
21928.00	KE0054	Korean Airlines B747 (HL7636)	2350	HFDL, working ground station 16, Agana, Guam
21937.00	NH0855	All Nippon Airways	0152	HFDL, B787 reg JA884A, working Molokai
22542.00	Unid	Kyodo News, Japan	2343	FAX (60/576, dial 22540.1), newspaper in Japanese
22611.50	HLF	Seoul Radio, Korea	0010	CW, marker "CQ DE HLF QSX 22 MHZ K"

Digitally Speaking

By Cory GB Sickles WA3UVV **wa3uvv@gmail.com**

Feeling Like a Kid Again

A news update on the much anticipated DR-2X System Fusion repeater is expected at the Hamvention. Expect to see one on display at the Yaesu booth. (Courtesy: Yaesu)

When we first get involved in amateur radio there is newness to the entire experience. We're learning things, we're exploring things, and we're achieving new goals. The overall "freshness" of new knowledge and the new friends we're making all combine to create a positive experience and a desire to do even more.

Eventually, the excitement diminishes a bit as our activities become more of an everyday experience. If we work a new DX entity or realize our CW speed has increased substantially, the thrill returns. That level of fun also gets kicked up a bit when we try some new aspect of ham radio.

As I've been giving some Digital Voice (DV) radio presentations at hamfests and conventions, I've also been getting some feedback. There are usually some follow up questions and nice comments that show up in my email inbox. Lately though, there's also been an increase in audience members letting me know they purchased a new DV radio and just how excited they are to have it or just to know one is on the way to them.

I think the best comments have been along the lines of "I haven't been this excited since I first became a ham." or "This radio is so much fun, I feel like a kid again." and "I thought the thrill of ham radio was gone. Boy, was I wrong. Thanks for turning me onto this digital stuff!"

Such enthusiastic accolades – and others – toward DV radio are amazing in their own right. Even more impressive is what DV enthusiasts have been doing to spread the word to get more hams involved and then move beyond "just radios" to build up a system of infrastructure that in turn entices more to join in on the fun.

Recently, I had the pleasure of speaking at an ARRL Section Leadership Conference in Delaware. About two years ago, I spoke at another Leadership Conference, about the emerging growth of Yaesu's System Fusion product line and the opportunity it represented in Delaware. While I was at this year's meeting, I was simply blown away by the presentation of two other projects and just how much experimentation and advancement was being made in "The Diamond State" in digital communications. But before I get into the details of those, allow me to give you some necessary background.

At the start of 2014, the state of Delaware was completely devoid of any documented and publicly known DV repeaters of any kind. No D-STAR, no P25, no NXDN, no DMR, and certainly no TETRA. Notice I didn't mention System Fusion. That's because at the beginning of 2014, no System Fusion repeaters existed outside of Yaesu's product development section, in Japan.

Soon, Yaesu would announce a Beta Testing Program for the DR-1 repeater. If a given radio club was willing to replace an existing analog FM repeater with a DR-1, the company was willing to provide a package, with the understanding that regular reports regarding performance, deployment issues, detailed error reports, etc., would be provided—plus the club members would acquire System Fusion radios to experience the advantages for themselves and invite still more to be part of the fun.

Certain areas of the country embraced System Fusion faster than others. In Southern New Jersey (SJN), System Fusion caught on like wildfire but in Northern New Jersey, not so much. Central Jersey, being in between, adopted it at a slower pace. Next to SNJ, Many Eastern Pennsylvania (EPA) clubs wanted to be Beta Testers, as well. Slightly south of this area, is the state of Delaware. While EPA and SNJ had at least one NXDN, P25, D-STAR, and DMR repeater – here again – Delaware had nothing supporting DV of any kind.

However, they soon had one. Then another one. Then a few more and within a year, I believe the total was up to six – which included the original DR-1 (which after the six month test ended, was available for purchase) and the

Delaware System Fusion Repeater Linking Project

Callsign	Node Location	Repeater Location
AD3M	Wilmington	Wilmington
K3RIC	Salisbury	Salisbury
K3KNT	Laurel	Seaford
KC3AM	Claymont	Wilmington
WB3JUV	Smyrna	Dover
AD3J	Middletown	Dover
KB3PRW	Smyrna	(Simplex)
KB3KYH	Milton	(Simplex)
K3JL	Georgetown	Roxanna
W0ADD	Belle Haven (VA)	(Simplex)
N4TIK	Pungoteague (VA)	Pungoteague

production model DR-1X. To go from zero to six - in a state with only three counties - is impressive. Today, that total is up to 10 permanent installations and a few portable ones. I understand even more are planned.

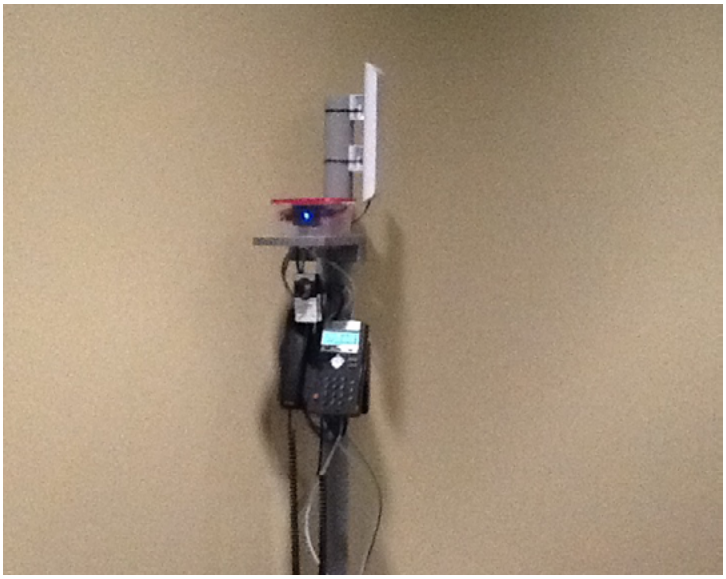
Of note, one homebrew D-STAR repeater is up and running, along with three DMR machines. All of this growth was made possible by a core set of radio amateurs that believed in DV radio—especially System Fusion.

Bringing us up to speed with today, seven of the System Fusion DR-1X repeaters are now networked via 11 WIRES-X nodes into a scheme that supports primary, secondary, and tertiary rooms as well as links to next door neighbor Virginia. An eye-opening update on this project was presented by Grady Ball WB3JUV and Diane Acker KB3SVU. While they are certainly leaders in this, I also know that the participation of many (see chart) continues to be essential to the project's success.

Currently, networking is handled the way most are—by using the Internet. As Delaware has seen its share of severe weather systems in recent years, there's always a concern about using conventional ways to connect repeaters under emergency conditions. That's why they've already moved onto the next phase in the project—identifying and installing suitable RF based networking. At the Leadership Conference, those specifics had not yet been determined. By the end of that day, however, they probably had a good set of possibilities that also addressed some other possibilities.

Mesh networking is a subject that evokes thoughts of modified Wi-Fi routers and relatively short distances between nodes. This has limited the more common use of mesh networking to supporting events such as multi-lap bicycle races and other "contained" events. Longer interstitial ranges are possible, but the per-node cost is higher, so this becomes a limiting factor, too.

Paul Milazzo K3PGM and Brenden McNeil W3VD have been working on a significant breakthrough that wowed the crowd with nodes that support Wi-Fi, Voice Over IP (VOIP), video, and high-speed data, with the ability to reach longer distances for a low price tag, using many off the shelf components. I think their longest distance so far is 13 miles, but I don't think that's the real limit.



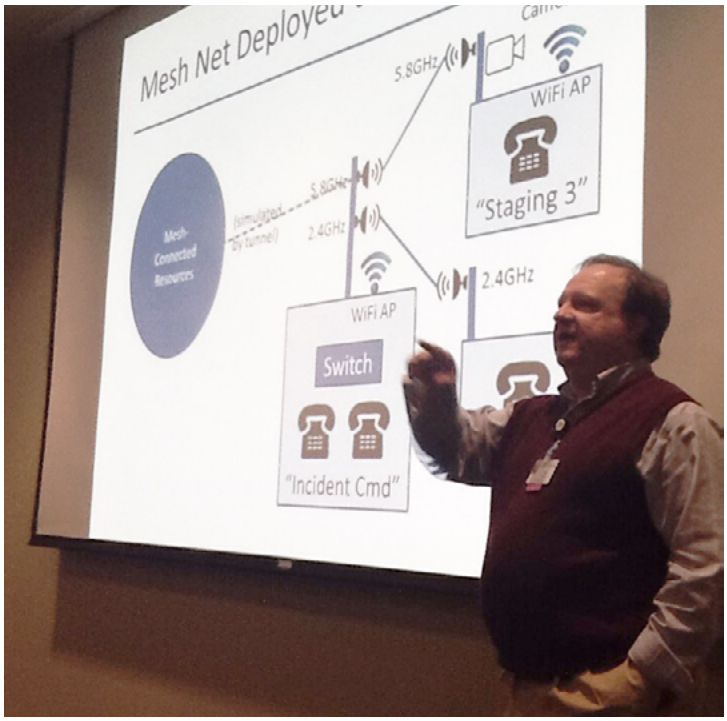
Some proof of concept Go Kits were on display at the Delaware Section Leadership Conference. Support for VOIP telephones, video camera, high-speed data transfers and more are in this affordable and flexible package. (Courtesy of the author)

Paul also showed off a set of conceptual Go Kits and repeaters, capable of readily being deployed on the ground or atop whatever high buildings can be found. In Delaware, there are no high hills, but where I live, there most certainly are. I sat there envisioning a way to extend an RF bridge from Morgantown, West Virginia, to Uniontown, Pennsylvania (a 40 minute drive, if you stay within the confines of the posted speed limits), with just five repeater/node stations placed at strategic locations. With slot antennas that have 45-degree beamwidths, each allows for a number of stations to access them, with a variety of locations.

With such a setup, we could easily link System Fusion repeaters in both states, without requiring Internet connections throughout. I think this major leap forward in mesh network configuration is also the key to linking all of those repeaters in Delaware. With such a set of stations, their network could link across the Delaware Bay, into South Jersey or well into southeastern Pennsylvania, not to mention northeastern Maryland.

As these points of presence can run for some time on deep-cycle marine batteries, when the mains are down, sources of backup power are readily obtainable for reasonable prices. As the antennas offer high gain with a broad spread, being buffeted by high winds would not affect signal reliability as much as some other directional antenna designs.

Fortunately or unfortunately, the Leadership Conference had a lot of ground to cover and we all ran long in our presentations. I did not learn everything I wanted to about



Paul Milazzo K3PGM, had the undivided attention of attendees, as he explained some of the concepts behind the inexpensive and innovative mesh network solutions that have been developed. (Courtesy of the author)

Not all of the DV action will be found under the big tents. If you are going to be at the Hamvention, be sure to keep an eye out for bargains in the flea market area. (Courtesy of the author)

their designs but fortunately, I have a second chance to find out.

I'm headed back to Delaware for the State Convention so at the top of my "must do" list is to learn more about what they are using and how it is all put together as they will have a table set up and will be conducting demonstrations. Look for more details in an upcoming column.

As discussed earlier, seeing their work inspired me to experiment with something new, which until I came to the meeting, I had no real desire to try. I'm sure that when I get my first pair of stations up and running, I too, will again feel the excitement of a new ham.

Moving on to western Pennsylvania, the Uniontown Amateur Radio Club (ARC), my hometown club, effectively doubled the number of DMR repeaters in our section, which is about half the width of the Commonwealth. Digital radio guru Tony Alviar KA3VOR, finished the necessary tasks to upgrade our 147.045 MHz repeater that's high on a hill known as "The Summit," with a Vertex VXD-R70 operating in mixed-mode, so that we didn't "kick out" all of our legacy FM users.

As there is only one other DMR repeater on the air, doubling the population was relatively easy. A third one—again under the auspices of the Uniontown ARC—will be going up to fill in a few coverage holes, once we get an MMDVM board set configured and married to an existing DR-1X, already on 147.355 MHz, that currently supports the addition of D-STAR, through a UDRC board set. The UDRC is destined to be moved to our UHF DR-1X on The Summit.

While the 147.045 MHz repeater is not going to be networked anytime soon, the 147.255 MHz repeater will be. As it turns out, having a non-networked DMR repeater is allowing more members and area hams to get used to the differences and challenges of adapting LMR (Land Mobile Radio) technology to amateur radio without having to worry about accidentally bringing up dozens of repeaters while incurring the wrath of the "Radio Police," from hundreds or thousands of miles away.

Those who were around when FM first began to become popular may remember "Old Timers" calling CQ, when they put their first radios on the air. Typically, one of two things would happen. Either someone would contact them on the repeater and let them know we said things like "WA3UVV listening" or "WA3UVV monitoring" or something similar, but that calling CQ (especially long ones) was unnecessary and not desired procedure. This helpful folks did this in a positive way.

The alternative response was from a somewhat cranky "expert" would strongly admonish the newcomer, express some disdain at their lack of knowledge and the errors of their ways, essentially making them wish they had never purchased the radio or thought of joining the FM crowd.

Naturally, the former method is the best. We all have found ourselves in new situations and environments trying to learn new terms and new ways of doing things. A helpful guide and a positive attitude is encouraging and makes you want to know more. Eventually, those that have gained knowledge will pass that information and positive attitude on to "newbies" as they come along.

Those who are conditioned by the more negatively oriented arbiters of right and wrong may well join the ranks of such bullies and make life unpleasant for others. I may

Left: Kenwood's TH-D74A tri-band D-STAR and APRS portable. (Courtesy: Universal Radio)

Above: Icom ID-4100a dual-band 2-meter/440 MHz mobile. (Courtesy: Universal Radio)

have rolled my eyes while listening to someone new making a rookie mistake, but I always offer positive comments and guidance. If nothing else, I feel I owe it to those who were positive and helpful to me, when I was starting out.

For some reason, I have heard (and heard about) more instances of the Radio Police cracking down on newbie mistakes with DMR. I don't know why exactly, but I have my suspicions and it has something to do with what brand of radio you are perceived to have or not have. To be sure, ham radio is not a place to promote class distinctions.

It reminds me of the grumbling about "No Code Techs" or Extras that only had to pass a 5 WPM code test or even those who were grandfathered into a higher class license. This attitude of, "If I had to do something, then everyone should have to do it," is such a poor attitude and is hurtful and disruptive. If you witness things like this, please step up, set a better example, and help our newest members of the DV community to experience all there is to enjoy in a positive and encouraging way. That will further set a good example for anyone else listening in, too.

Finally, the Dayton Hamvention is just around the corner. No, it's not in Dayton now, but it never was—it was in Trotwood. Now that it has been moved from Montgomery County to Greene County, the venue and the experience is going to be new to all, just like it was the first time you made the annual pilgrimage to the Hara Arena.

I'll be attending, but it will all be new to me, as well. My suggestion is to embrace the "Undiscovered County" and have the best time you can. No doubt there will be a good selection of new product announcements; some real and some not so real. I expect to see some updated demos of things promised last year that still haven't become "real" products, but I also expect to be able to lay hands on Icom's new ID-4100 D-STAR dual band mobile, Yaesu's new FT-70DR System Fusion dual-band portable, and perhaps the much-rumored mobile from Kenwood, that will match up nicely with the TH-D74A tri-band D-STAR and APRS portable. Will Alinco have an NXDN portable that covers the 440 MHz ham band? If so, I think that will go a long way toward growth of that particular DV methodology.

Will there (finally) be a dual-band DMR portable that's actually shipping? Many have been promised and much artwork has been created with Adobe Illustrator and Photoshop, but what about something that is "really real"? It would be nice if at least one of the companies, that have been promising such a product, actually delivers. Whoever does it first should easily be recognized by a multi-layered crowd surrounding their booth, vigorously waving their credit cards and pictures of dead presidents.

I'll also be looking for some of my favorite things—innovative products and solutions from small companies and groups you may never have heard of before. These are the innovators that make infrastructure like Brandmeister and P25NX possible. New tools you didn't know you needed, advances in battery technology and insightful conversations with groups from other countries are also things I hope to experience.

I'll be taking pictures, gathering all sorts of brochures and SWAG, plus learning what's on the horizon. All of that and perhaps some unexpected surprises will be the subject of June's column.

VHF and Above

By Joe Lynch N6CL VHFandabove@gmail.com

Kenwood's New TH-D74; 6-Meter Antenna Project

Some of you may already using Kenwood's latest handheld, the TH-D74. For a while there was a backorder problem but now there are plenty in stock.

There are several reviews available via YouTube and my point in mentioning it here is to take a serious look at it if you are going to Hamvention.

Along with being a tri-band radio, it includes APRS and D-STAR, along with GPS. For interface, both USB and Bluetooth are available, as well as a microSD/SDHC. Using Bluetooth, you can link your cellphone to the TH-D74.

In receive mode, you can access frequencies from 100 kHz to 523 MHz, all modes. With the whip antenna, your reception is limited. However, connected a resonant antenna for 40 meters will allow you to listen in on QSOs on that band. Transmit, however, is limited to 144 MHz, 222 MHz and 430 MHz, and only FM and D-Star.

For satellite work, it can be used as another receiver. However, it will not work cross-band.

In short, there is a lot you can do with this new radio. However, there are a couple of things that might be of interest to you that you cannot do. Nevertheless, there is so much versatility with the things you can do and it is well worth taking a serious look at it.

TW Antennas and 6 Meters

Elsewhere in this issue of *TSM* you can read my review of DX Engineering's TW Antennas. While traveling from West Point to Tulsa in March, I had the opportunity to stop by the DX Engineering store in Tallmadge, Ohio. While there, I talked with Cory Gibson W3CDG, about the TW Antennas. Ever the VHF and Above guy, I suggested they come up with a 6-meter version. Cory told me that they would work on one.

Well, as you saw last month, I couldn't wait on them. What you saw last month was a mess—a work in progress. What you see this month is my 6-meter dipole using the Quadrastand Portable Base. I selected three 2-foot sections of 1-inch schedule 40 PVC, coupled them together with threaded coupling. I added a length of 3/4-inch schedule 40 PVC and topped it off with a short piece of 1/2-inch schedule 40 PVC.

At the tee, I coupled sections of 1/2-inch CPVC to the tee by way of 1/2-inch threaded couplers. Inside the CPVC is #14 THHN house wiring that is connected to a short length of coax that has banana jacks on one end and a BNC connector on the other.

The author's 6-meter antenna work in progress. (N6CL photo)

SWR is flat on 50.125 MHz. I was able to receive three beacons (each about 60 miles' distance) via groundwave at my QTH. I have yet to make any contacts because spring sporadic-E propagation had not gotten underway by the deadline of this column. I will report on it later.

All components of the antenna come apart and will fit inside the TW Antenna bag.

Current Contests

The European Worldwide EME Contest 2017: Sponsored by DUBUS and REF. The EU WW EME contest is intended to encourage worldwide activity on moonbounce. Information for this contest is available at the following website: **http://www.marsport.org.uk/dubus/EMEContest2017.pdf**.

The June VHF QSO Party will be held during June 10-12, 2017. The ARRL Field Day will be held June 24-25, 2017. For more information on these contests, see the ARRL website: **http:www.arrl.org**.

Meteor Showers

May showers and approximate peaks: η-Aquariids, May 6; η-Lyrids, May 9; ε-Arietids, May 9; May Arietids, May 16; and o-Cetids, May 20. For more information on the above meteor shower predictions please see the American Meteor Society website: **http://www.amsmeteors.org/meteor-showers/2017-meteor-shower-list**

TSM

Amateur Radio Insights

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

The Truth About Lightning: Most of us are Unprepared!

Within such a large, disparate group of rugged individuals—hams, of course!—there are plenty of controversies, wives tales, rules of thumb, evidence-based practices, differing opinions, completely crazy practices, and some occasional bits of common ground.

Protection from lightning for our equipment and ourselves definitely falls into disputed territory, with a select few hams taking all possible (and possibly expensive) precautions, the majority taking at least some precautions, with the final group essentially taking no precautions at all.

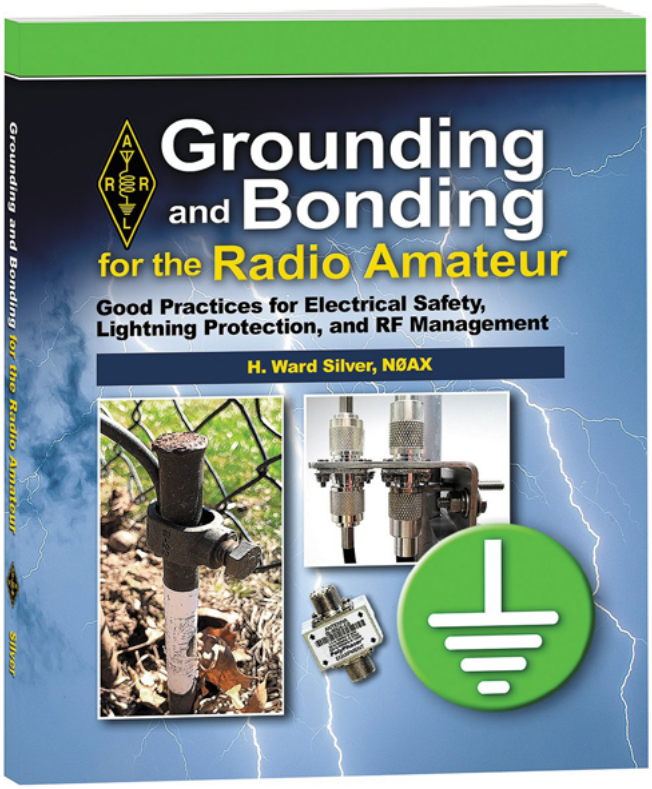
During our formative years, when we were learning about amateur radio and studying diligently, we learned how to make all kinds of antennas, for example, but only a few standard lightning safety and "grounding" platitudes—many of which are wrong or incomplete.

Most of us also learned to confuse chassis grounds, AC electrical safety grounds, and RF grounds. Sometimes, any particular "ground" may actually serve all three purposes, but it's more useful (and much safer) to remember that, in general, these three "grounds" are not the same and do not perform the same functions. I have covered these differences, particularly as they relate to good-performing RF grounds, in previous columns.

As with many amateur radio topics, there's quite an education gap between those who are really in the know about electrical safety grounds and RF grounds and those who know only the vague and often wrong generalities that are passed down through word of mouth.

In general, hams with large antennas and tall towers tend to know a lot about these topics, with many gaining expert knowledge the hard way! Big antennas and tall towers = big risk. Hams with low backyard antennas have statistically less overall risk, but they suffer just as much when tragedy strikes.

I am not yet an expert in all aspects of electrical safety grounding, but I'm studying with a purpose, as I have decided that, after skating by for the past few decades, I must implement all reasonable measures at my new QTH. And, as always, I will do my best to refer you to updated safety material and bona fide experts!



Grounding and Bonding for the Radio Amateur, the new book by Ward Silver, N0AX, translates the complex theory and practices surrounding grounding and lightning protection and translates them into plain English, with action plans for "average hams." The printed edition lists for $22.95 from the ARRL or your favorite bookseller, while the Amazon Kindle edition costs only $9.99. (Courtesy: ARRL)

Anatomy of a Lightning Bolt

As the earth rotates "underneath" its atmosphere, and because of the movement of clouds, air and water in relation to the surface of the earth, static electric charges build up between parts of the atmosphere and parts of the earth, especially during thunder storms.

When the charges are large enough to overcome the electrical insulation characteristics of the atmosphere between the charged cloud and the opposite ground, a lightning bolt(s) creates a conductive path(s) between the two charged areas and electrical current flows, equalizing the charges.

This happens, on average, 50 times each second worldwide.

Lightning isn't an evenly distributed phenomenon.

Some parts of the world get almost none, while others, such as Texas and parts of Central Africa and South America, get five to 10 times the global average.

Although, according to NOAA, there haven't been any lightning deaths in the US so far this year, lightning kills an average of 30-40 people each year in the US, mostly men.

Interestingly, positive and negative charges can build up in the clouds or the ground. The charge profile isn't fixed, as I once assumed. And yes, lightning sometimes does shoot up from the ground toward the clouds, where a descending bolt rushes downward to meet it. Weird!

Depending on various storm types and geographic locations, many lightning bolts equalize charges between the clouds themselves and do not strike the earth. This cloud-to-cloud lightning is visually spectacular but isn't generally dangerous to hams (unless you're in one of the clouds, perhaps wing-walking on a biplane while holding your 2-meter HT?).

Local objects that "stick up" from the surface of the earth—trees, skyscrapers, towers (ham and broadcast), golfers with raised clubs, swimmers in the water or on the beach, etc—conduct local static electricity charges from the earth—through themselves—which creates an ever-so-slightly shorter path between the charges in the clouds and the charges in the ground. And when the charges equalize through a lightning strike, the charge conductors that are sticking up higher than their neighbors are much more likely to take a hit.

Over the years, various ARRL technical publications asserted that properly grounded towers and antenna systems tended to bleed static charges from the ground into the air, and that this "charge draining" process, instead of encouraging lightning strikes, actually provided a "cone of protection" against such strikes. Some experts contend that this is completely false, but others do not, further highlighting the fact that lightning and lightning protection still isn't settled science. To counter the unknowns it's usually best to fall back on proven, working safety techniques that have been pioneered by those unfortunate test subjects that have gone before us!

The physics of what gets hit and when, and even the physics-level properties of the various types of lightning, aren't completely understood. But, just as we don't have to know the physics of electricity at the sub-atomic level to turn on a light switch and use electricity to read a book in the dark, there are several common sense things we can do to minimize the chances that lightning will ruin our ham radio day. Before we cover those, however, let's look at some additional lightning tidbits and a lightning strike story or two.

A typical lightning bolt (cloud to ground) is charged to a few million volts and transfers energy at 30,000 amps. Yes, 30 kA! A typical strike transfers about 1 billion joules of total energy, but in a very short period of time—microseconds to milliseconds! The most powerful bolts, however, although somewhat rare, are much more powerful: 400 kA driven by a billion volts. Yikes!

In 2007, the most powerful megabolt ever recorded

This custom junction/entrance panel from KF7P Metalwerks provides a waterproof, externally mounted box with a high quality, built-in ground plane for securely mounting and grounding all of your lightning-protection goodies (outside your house). If you don't want to roll your own, this is exactly what you need. The company provides one-stop-shopping for all of the goodies that mount inside, too, along with ham-to-ham customer service. See www.kf7p.com. (Courtesy: KF7P Metalwerks)

spanned a whopping 200 miles from end to end (cloud-to-cloud lightning) over the skies of Oklahoma. To get some measure of perspective, the breakdown voltage of dry air (which the air isn't during a storm) is about 30 kV per centimeter (30 MV per meter). Despite confounding factors such as moisture in the air and specific differences in air pressure, a 200-mile-long lightning bolt still requires an unthinkably high voltage potential to cause it to fire!

When megabolts travel from cloud tops to ground, a bolt from the blue can strike the trees or antennas in your back yard from 20 miles away! You're in complete sunshine, but that thunderstorm anvil cloud in the next county can still ruin your day!

Technically, the actual electricity in a lightning bolt doesn't really have a temperature per se, but when it rips through air and water vapor it can heat its immediate surroundings to as much as 50,000 °F—which is five times hotter than the sun! No wonder many things—humans included—start on fire and/or explode when struck!

Lightning's ultimate goal is to equalize charge potentials with the ground, but when lightning strikes the ground or is conducted into the ground, it can travel through the ground for 100 feet or more. If you're standing in the blast radius you can contact the current stream, and it doesn't take much electricity to overwhelm the human electrical system. In 1998, a lightning bolt that struck the playing field killed an entire African soccer team. There have been other, similar incidents.

Lightning isn't a pure direct current (DC). It's a complex and ever-changing mishmash of DC, AC and RF, and it's actually quite difficult to standardize or even describe in

definitive terms. Of notable concern to hams is how lightning current flow seeks ground. Conductive objects—and let's face it, at millions to billions of volts, everything is a conductor!—can't be viewed as simple resistors.

As lightning energy flows through trees, the ground, people, cows, telephone and AC overhead wires, ham towers, ham antennas, ground rods, coaxial cables, etc, this complex mix or pulsed DC, AC and RF acts funny and treats conductors differently depending on impedances (what's impeding DC, what's impeding AC and what's impeding RF). And each strike is different.

Lightning bolts are not at all simple! Scary? Yes. Simple and easy to characterize? No.

Lightning Story

In addition to doing things right at my new QTH (which requires me to seek expert knowledge), a friend's recent lightning story reinforced my thinking, and his questions and situations are probably useful to us all.

He had recently put up a large horizontal loop antenna and, as I'm a known horizontal loop advocate and user, we had been e-mailing back and forth about various configuration and remote tuner details, etc.

Essentially, he had two antennas (one loop and one vertical), each with its own Icom AH-4 autocoupler at its feed point. The loop and the vertical were reasonably close to his wood-frame house, using support lines from the house, a fiberglass pole, and some trees to keep everything shipshape.

A bundle of coax and several control wires ran from each AH-4 back to separate ham transceivers in the op's basement shack. Like many of us, the only electrical safety grounding—including lightning—was provided by a nearby AC receptacle through its connection to the house's AC ground (which was a copper rod, bonded to the AC service box, but probably driven into the earth 60 years ago when the house was built. Connections to that ground rod, having been exposed to the outdoor elements for decades, are often degraded.

Because the shack was in a basement that had been converted to living space in the 1970s, the cable runs were "buried" behind wall coverings and above glued-in-place ceiling tiles, etc, and were essentially inaccessible. These cables were 1970s-era foam dielectric RG-8 types that were sourced from a Radio Shack-type store and were not high-end cables that might have been available from Belden, Times Microwave, etc.

Needless to say, the stage is set for disaster. I'm not singling my friend out—many of us, myself included for years at a time—have similar setups.

On the fateful night, storm approaching, the op dutifully disconnected the coaxial antenna lead-in cables from his radios. But despite the worthwhile precaution, when lightning struck nearby (or struck the loop), lots of bad things happened.

Both AH-4s were turned into smoldering lumps of coal. One segment of the square horizontal loop, made from 14-gauge copper-coated steel wire, melted into bits of slag and fell straight to the ground (while the other three segments remained intact). A huge current pulse traveled down the coax and the control wires into the shack (after running through the basement, behind the walls and ceiling, etc).

The coaxial cables were dutifully disconnected at the radios, but the current easily jumped between the coax and the still-somewhat-grounded transceivers, both of which also became DOA, along with other goodies in the shack.

Even if the coaxial cables had been disconnected and outside the house, curled up on the ground, the energy that traveled through the AH-4 control lines would almost certainly have accomplished the same thing.

A large flat-panel TV near the point where the coaxial cables exited the house also became a victim of flash-over energy during the strike. I suspect that other electronic devices in the house may have also taken a bit of a hit and, because of that, may be prone to early failure in the coming days and weeks (especially computers).

Without factoring other devices that may now fail early, the insurance estimate is already north of $5,000. My friend hadn't yet heard from his agent about whether his ham gear would even be covered.

We talked at length about various aspects of the event. I'm paraphrasing them here because they may help us head off our own, similar events.

Wire Loop

Why did only one segment (out of four) of the horizontal loop, which was about 30 feet above the ground, melt and not the whole thing? My best guess is that the particular segment was closest to the lightning energy when the strike occurred, and because that segment ran between two support insulators that each forced a 90-degree bend in the wire, the energy jumped to an easier path to ground at the sharp corners.

Lightning—a complex mishmash of DC, AC and RF—wants to get to ground in the worst way, but does not like to flow gracefully around sharp bends or sharp points.

Some lightning-protection devices that are found on cell towers in desert climates look like sea urchins! They're "spike balls" that are electrically connected to their well-grounded towers. At night they sometimes glow with a blue light as tiny arcs of plasma flow from each spike into space, creating an eerie glow.

Accumulated charges won't jump into space from rounded tower parts, but they readily jump from pointy things, including the sharp tips of Yagi antenna elements in extreme cases! So, I suspect that the strike energy jumped to a more conductive path to ground when it hit the two sharp corners!

I also suspect that, because the melted segment was somewhat isolated from the rest of the loop by those sharp corners, it saw maximal current flow. We would expect any

16-gauge wire to behave like a fuse when subjected to a few million volts at a few thousand amps, but because this wire had a steel core beneath a thin layer of copper, it simply evaporated.

Steel is rather resistive when compared to copper, and when subjected to massive current, it will get massively hot. Hot enough to evaporate! It's exactly like arc welding, where you're applying a controlled plasma arc (lightning bolt) to two pieces of steel. Some of the steel at the joint simply evaporates into slag, liquid and gas—antennas, too.

Insulated Wire?

My friend wanted to know whether insulated wire would have prevented or minimized the damage from the strike. My take? Nope. Insulated wire, say 14-gauge house wire, is a fantastic insulator at 12 V, and is rated for 600 V, where it's also pretty darn good. But voltages of 1,000 to 2,000 volts can cause the wire to flash over.

That's why antenna baluns built from the stuff are fine at 100 W, probably fine at 500 W, but aren't always fine at 1,500 W, especially when feed point SWRs are high. Under these conditions the balun flashes over and becomes a fireball—and not in a good way! Need a monster balun? Use beefy, Teflon-coated wire.

When subjected to lightning-grade voltage, the insulation on insulated wires becomes invisible. The lightning simple sees a juicy path to ground (the wire inside) and takes it until it can find a better path. When it encountered the loop's sharp corners—perhaps a microsecond before the steel wire vaporized—it jumped to a better path. Lightning is crazy opportunistic.

Insulated wire can be quite protective when it comes to reducing or eliminating the electrical noise caused by the wire rubbing on leaves or tree branches. Ditto for rain noise and wind noise. Large wire antennas accumulate static electricity charges when the wind rushes by the wire (like you petting your cat, but to a much smaller degree) or when raindrops hit the wire (transferring some of their charge).

Insulated wire can be quite helpful for these conditions, but it's not a given. Some common static electricity charges, such as those you might encounter on a dry day when touching a grounded doorknob or electrical chassis, have tiny currents but pack upwards of 25 kV! That's why they can kill your CMOS integrated circuits in the kit radio you're building or potentially penetrate the insulation on an antenna wire. Remember: When exposed to millions of volts, almost everything is a conductor!

Disconnected Cables

Disconnecting the coaxial cables from the radios certainly didn't hurt anything, but when driven by such high voltages, lightning energy will simply jump from the disconnected cable ends to anything that looks like ground. In this case, the transceivers were plugged into the AC wall socket, which was ground. Dark burn tracks between the radios and the cable ends on the surface of the operating desk punctuated that tendency!

Fiberglass Pole

A 33-foot, heavy-duty fiberglass pole supported one corner of the loop, and my friend was wondering whether it succeeded as an insulator during the strike. Probably, yes and no. Thirty-three feet of fiberglass is a much better insulator than a few hundred feet of grounded antenna wire positioned only a few feet away. But when exposed to several million volts, 33 feet of wet fiberglass (with traces of dirt and other contaminants on the surface) still looks like a conductor to lightning.

Control Wires

As we have seen, we can disconnect coaxial cables all day long, but if we have other conductors that enter our otherwise protected spaces, it's game over. Even if the strike hadn't arced from the disconnected cable ends, the 10 AH-4 control lines (five per tuner) would almost certainly have conducted enough energy to destroy the shack goodies.

Replace the Coax?

In short, yes! Most foam dielectric coax from the '70s was, well, pretty crappy even when it was new. And even if it hadn't been subjected to a killer lightning strike, the foamy stuff usually deteriorates with time, becoming lossy and causing the center conductor to migrate toward the outer shield, potentially messing up the cable's impedance and reducing the insulation's breakdown strength.

The fact that the cable is inaccessible means that it's a real pain to replace, but considering that it's also impossible to see whether the cable has partially melted or has been poked full of lightning holes along its length, is grounds for definite replacement.

Take Action

This is an unfortunate situation all around, and none of us likely feels anything but sympathy for the folks who wind up on the wrong end of an electrical storm. But I hope this tragedy prompts us—me included—to step our game. Many of us have been lucky for too long, but there's no guarantee that our luck will hold out forever.

Essentially, whatever detailed steps we take to accommodate our respective, distinctive, antenna installations, our main tasks include properly grounding and bonding every wire that comes into our protected interior space (AC, cable TV, phone and DSL, ham coax and control cables—everything) and taking every opportunity to keep the lightning energy outside the house and never inside. Once it's inside the house, stuff is going to fry.

From a broad perspective, every conductor that penetrates the house perimeter needs to be properly bonded and grounded, and we should be able to disconnect them (all of our ham cables, at least) outside the house.

Remember: we want to keep the lightning outside the house, because once it's inside it's game over. A lightning bolt that can jump three miles from a cloud to your house can easily jump all though the inside of your house once it breaches the perimeter!

The details of exactly how to accomplish these tasks are varied, complex and often expensive. Towers need to be properly grounded. And no, a single ground rod from your local home store, even properly pounded into the ground at the tower base, won't cut it. It will help, but it's no panacea.

Coaxial cables should be bonded to the tower at the top of the tower, the bottom of the tower, and at a properly bonded and grounded lightning protection/disconnect box outside your house, just where your cables transition from outside to inside.

In addition to proper bonding and grounding, each cable and control line should have a lightning arrestor and the ability to be disconnected from the lines that run into the house.

If you're thinking that adds up to a lot of potentially expensive hardware and lots of engineering and installation effort, you're probably right!

Commercial and amateur radio stations with proper, robust grounding, bonding and lightning-protection systems can handle multiple strikes each year with no death and destruction.

The trick for the average ham is to find the happy medium that provides excellent real world protection without the extreme costs of setting up a system that can take lightning shots all day long with ease. Most of us aren't in a location where that's necessary, but if you are, it's necessary!

Resources

Commercial engineering firms and the military have lots of material on how to protect sensitive radio and electronic systems from the ever-present hazards of lightning, but most of it is confusing and even contradictory for typical hams.

As mentioned, this isn't settled science, nor is it completely settled practice, but the techniques available are certainly better than doing nothing, and almost certainly better than what we've learned through the grapevine.

One brand new ham accessible source of expert, actionable information is Ward Silver's new book, "Grounding and Bonding for the Radio Amateur," (see photo at front of the column). N0AX, himself a respected author, consulted with Jim Brown K9YC, an expert's expert on grounding, bonding, noise and lightning protection, when writing the book.

K9YC has written extensively on these subjects, and much of his work is freely available at **http://audiosystemsgroup.com/publish.htm**. For starters, try **http://audiosystemsgroup.com/GroundingAndAudio.pdf**.

Doubleheaders happen all the time in baseball, but I don't remember ever receiving two ham magazines in the mailbox on the same day! In addition to their usual goodness, the publications provided the perfect excuse to not rake the leaves that didn't get raked before last year's snow. I call that a tripleheader! (NT0Z photo)

Polyphaser, a noted manufacturer of mil-spec grounding, bonding and lightning-protection technology, makes its book, "Lightning Protection & Grounding Solutions for Communications Sites," available widely on the Internet.

In my experience, most homeowner's insurance policies go to every possible length to exclude coverage for typical amateur radio losses unless you pay for some seriously expensive add-ons. And even then, staggering deductibles usually apply. For its members, the ARRL has a reasonably well-received insurance coverage for hams. It currently has a reasonable $50 deductible, and coverage for radios, towers, computers, test equipment, etc, costs about 1.4% per year. That is, $5,000 in coverage costs $70 per year, $10,000 in coverage costs $140 a year, and so on.

The smallest deductible I can get today for my own homeowner's insurance is $1,000! And I wouldn't be surprised if my radios, test equipment and towers are specifically excluded. Yes, I still need to shop around! For details about the ARRL-sponsored plan, see https://arrlinsurance.com.

If these materials don't prompt you to take action, probably nothing will!

I plan to cover more details on these topics in future columns. But until then, safe journeys—and keep the lightning out of the house!

TSM

Radio 101

By Ken Reitz KS4ZR ks4zr1@gmail.com

Cord-Cutting Update: Options for Your FTA Satellite and OTA-TV System

Those who have been following this column and Mike Kohl's features on cord-cutting (getting off cable and subscription satellite-TV) for the last few years, know that no one component can give you everything you need to replace some of the things you've become used to (can't do without?) on either cable or satellite-TV. First, here's a quick run down of the reasons for cord-cutting:

- Constantly increasing prices for cable and satellite-TV programming packages that contain dozens of channels you never watch.
- Having to play games with satellite-TV companies to take advantage of "teaser" rates. How many times have you switched between Dish Network and DirecTV?
- Not having access to channels you might like to watch or listen to, that aren't offered on cable or satellite-TV at any price tier.

The cheapest Dish Network price is $40/month ($480 per year) so that, by the end of the second year of your contract, you will have paid Dish nearly $1,000. Dish Network packages go as high as $80/month ($960/year, almost $2,000 for the duration of your contract).

DirecTV monthly fees start at $55/month ($660/year or $1,320 for the duration of the required two-year contract) and go as high as $125/month ($1,500/year or a whopping $3,000 for the two-year contract). You can buy a lot of antennas, FTA satellite systems, streaming devices and monthly streaming fees for that much money.

Both services require a two-year contract with substantial early-termination fee and required eAutoPay, which can take some time to turn off . Both services try to sweeten the deal with various promotions including free premium channels for the first three months, extra receivers and digital recording devices. So far, only DirecTV offers limited 4K video programming. Cable-TV packages are comparable.

The only advantage to a cable subscription is the option to sign up only for their high-speed Internet service—a real plus that allows you to have access to many more services offering 4K programming, provided that you have an unlimited data plan. There is no similar offering with either satellite-TV service provider.

Winegard's FlatWave Air ($100 shipped free from Winegard) VHF/UHF amplified OTA-TV antenna, which comes with it's own mount that can be placed on the side of a house, deck or gable end. (KS4ZR photo)

OTA-TV Antenna Options

A good Over-the-Air (OTA) antenna is the first step to getting off cable or satellite-TV. The best options reviewed earlier in this column include Winegard's FlatWave VHF/UHD amplified TV antenna (reviewed in this column May 2016) and the Televes DAT-790 amplified VHF/UHF TV antenna (reviewed in this column October 2016). The FlatWave Air, as it's now called, currently sells for $100 and ships free direct from Winegard (**http://www.winegard.com/flatwave?q=offair**). The Televes antenna has been found at solidsignal.com for $56 plus shipping **http://www.solidsignal.com/pview.asp?p=149481&utm_source=-google&utm_medium=cse&utm_term=149481&g-clid=CJ6V-KDurtMCFY-FswodOcIAJg**.

While both are amplified VHF/UHF antennas, the Winegard Air, due to its much smaller size, is not as adept at receiving VHF signals as the Televes. This is now important because the FCC's repacking of OTA-TV stations moves many UHF stations to VHF, where it will be harder to receive them on smaller antennas.

If you live in an area that will have more stations mov-

Televes DAT790 ($56 plus shipping) VHF/UHF amplified OTA-TV antenna. While no amplifier is needed, you will need a mast to mount it on and possibly a rotator, if you want to turn the antenna to different directions. (Courtesy: SolidSignal.com)

Channel Master's Advantage 60 ($100 shipped free from Channel Master) is a traditional VHF/UHF OTA-TV antenna that will require a mast-mounted pre-amp for best reception as well as a mast and rotator, if you intended to receive signals from different directions. (Courtesy: Channel Master)

ing to VHF, a more traditional VHF/UHF antenna, such as the Channel Master Advantage 60 ($100) may be required, but you'll need a mast-mounted pre-amp to get the most out of such an antenna (add another $65 plus shipping), a mast to mount it on and possibly a rotator, if you plan to receive OTA-TV signals from different directions. Those items could add an extra $100 to your OTA-TV setup.

The big advantage of the FlatWave Air is that it blends perfectly with urban and suburban environments, especially in antenna-restrictive housing governed by Home Owners Association (HOA) rules—it virtually disappears. It can also be used indoors, simply placed on a shelf. Rural locations will want to mount the FlatWave outside on the mount that comes with the antenna. It's also bi-directional, so reception from two different directions is possible, without having to turn the antenna, as I found out after I installed mine. The Televes is more of a rural antenna and needs plenty space to maneuver (it's about seven feet long). It's not bi-directional but receives VHF band signals better than the FlatWave Air. It will also require a mast to get it above your roofline and a rotator to turn it, if necessary.

Free-to-Air Satellite TV Options

As discussed in numerous columns and feature articles since the beginning of this magazine, complete Free-to-Air (FTA) satellite TV systems can be had for under $250, including shipping. This is a pretty good deal since it's the same cost as only a few months subscription to either pay satellite-TV service and yet will give many years of service. Set up and pointed at any one of the many Ku-band satellites or used with a small motor so that you can move from satellite to satellite (see last month's feature "Motorized Ku-band Satellite Reception" by Mike Kohl), an FTA system, combined with your OTA antenna greatly expands your viewing options with a minimum of initial expense and no subscription fees.

One thing I've noticed of late is that there is a scarcity of quality FTA satellite-TV receivers available from a shrinking number of retailers. While there are a number of off-brand, mini-sized FTA satellite receivers found online through Amazon, for example, pay attention to the customer reviews—one such receiver got over 30 percent one-star reviews with caustic comments about poor customer service. Another box had 22 percent one-star reviews with phrases such as, "…gets extremely hot and shuts down." Give these a pass.

Of the better receivers available, though probably in short supply at most dealers, look for Manhattan 1997, Linkbox9000i and GeoSatPro HDVR3500 receivers, which typically sell from $100-200. We will review several new FTA receivers in upcoming issues. So far, no FTA satellite receivers are capable of 4K reception, even though there are some experimental FTA satellite 4K transmissions operating now.

Other options that have been available in previous sets, including Internet connectivity and digital video recording, may or may not be operational in current or future sets. To locate FTA dealers check out those listed at **http://manhattan-digital.net** or on FTA forums such as **http://www.satelliteguys.us**.

The Streaming Box Option

Finally, assuming you have some sort of connection to the Internet, the final piece of the puzzle is a way to stream online content. But, some such TVs have a limited number of streaming options, look for ones, such as Sony, that use Android based apps obtainable through Google Play Store. Many Sony models are 4K with higher end models offering

Roku Premiere+ ($100) is a featured laden streaming box but you can start streaming for as low as $40 with a Roku stick. (Courtesy: Roku)

You don't have to spend a lot of money to stream video and audio services through any TV with an HDMI input. This is the Amazon TV Fire Stick ($40) (KS4ZR photo)

OLED resolution with a price tag to match.

Even on smart TV sets with limited built-in apps, you can broaden your reach with a stand-alone Internet device such as Roku **https://www.roku.com/index**. These devices are a bridge between the wireless router connected to your Internet service (cable-TV modem, wireless broadband modem, satellite modem) and your TV. It lets you choose among a vast array of streaming services including standard ones you're familiar with such as Hulu, Netflix, Amazon, YouTube, etc., and many you're not. It also connects you to streaming packages, such as Sling TV (a Dish Network product) that gives you a minimum number of popular cable channels at a minimum price: $20/month. This is how you can get back the ESPN channels you wound up missing when you cut the cable or satellite-TV cord. Unlike cable-TV, Dish or DirecTV, with Sling TV there is no contract—you subscribe for as long as you like, and cancel the service whenever you want. Sling-TV is available on Apple-TV, iOS, Roku, AmazonFireTV, Chromecast, XBox One, AndroidTV and others. Sling offers three tiers: $20, $25, and $40/month. You can watch Sling TV for free for seven days to try it, without obligation. **https://www.sling.com**

Roku devices have some interesting features, including earplugs that plug into the remote that let you watch and listen privately without having the TV audio on. For as little as $40 you can turn an older TV into a smart TV by letting you connect via composite cables, if your TV doesn't have HDMI connectors. The Roku Premiere+ ($100) offers 4K with an enhanced remote. You can also control the Roku device through your iOS or Android mobile phone. The Roku Ultra ($129) offers these features in addition to voice search that uses a microphone built-in to the remote to search across 100 streaming channels.

Some channels you'll find on Roku require a cable subscription in order to watch (you'll be told how to verify your subscription). Others require a fee to join (Hulu, for example is $13/month) while others, such as Amazon Prime are "free" in that they are included with your Amazon Prime membership.

On Roku there are some 275 sports channels, 307 music related channels, 329 news channels, and 1,214 religious channels. You can find everything from channels for dog and cat relaxation to "cannabis lifestyle" channels.

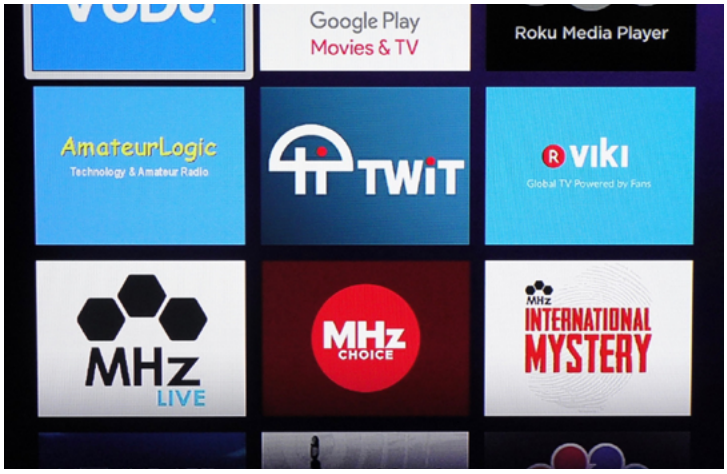
I've only mentioned the Roku streaming option here because it's fairly inexpensive, widely available (your local Walmart carries several models) and easy to set up and operate. I've used a Roku 3 (no longer available) for a year and a half without a single issue. There are dozens of streaming box options available. You only have to Google "streaming media boxes" to find countless devices from all over the globe. But, pay attention to the reviews, if you're buying through Amazon. Some streaming boxes get dismal reviews. There are streaming media boxes that promise access to free cable-TV programming and first run movies for free, but streaming pay TV content without actually paying is no more legal than using a hacked satellite-TV receiver.

How's Your Streaming Speed?

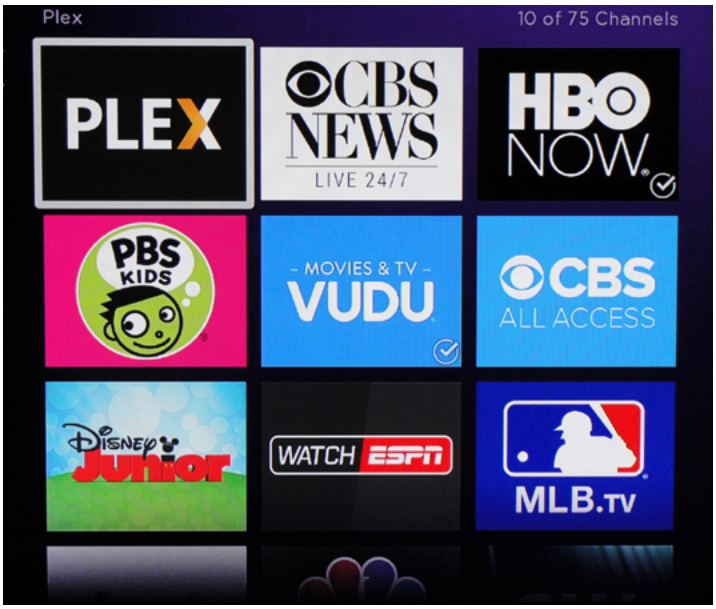
You have to have a moderately fast Internet connection to stream movies and it's getting so that you have to have a faster and faster connection with few data restrictions. One reason for this is that steaming services, in order to "give you the greatest possible quality video," offer higher resolution, which translates into greater bandwidth, which, if you have bandwidth limitations on streaming, can limit your viewing pleasure to just a handful of movies or TV series each month. A slower than optimum connection can also result in endless buffering.

Some streaming services, Netflix and Hulu, for example, let you set the resolution to accommodate available bandwidth. This is usually done in the "settings" page on

Missing the Weather Channel when you cut the cord? Many OTA-TV stations offer Weather Nation as a second channel, which shows local radar and forecasts for surrounding counties as well as regional and national weather from the Weather Nation studios in Colorado. (KS4ZR photo)



Among the lesser known TV channels are channels popular with hams, including Amateur Logic and This Week in Technology (TWiT). These are just a few of the free special interest channels with content that's are updated frequently. (KS4ZR photo)



Missing ESPN or other sports channels when you cut the cord? You might find them on your Roku through a package such as Sling TV, which you can try for free for seven days. Some cable-TV fare may require that you already have a cable or satellite-TV subscription, which defeats the purpose of cord-cutting. Others, such as MLB.TV can be subscribed to across multiple platforms. (KS4ZR photo)

It's not all video on streaming boxes. You can stream Pandora too. (KS4ZR photo)

whatever device you are using. Others, Amazon, for example, expect that you are on a high-speed cable service with unlimited data and feed the highest resolution possible.

This "bandwidth divide" will get more critical as more and more 4K content becomes available and streaming services imagine that you, of course, are on a cable service with an unlimited data plan.

Those on such services have no idea what I'm talking about, but if you live in a relatively rural area you are painfully aware. Many rural areas, outside of the county seat, which might enjoy high-speed cable Internet, are left to search for whatever is available, including (believe it or not) dial-up modems.

The FCC, in its 2010 Broadband Initiative, sought to identify those areas of the US underserved by high-speed Internet and bring them up to speed, so to speak. It was imagined that the marketplace would take care of the problem by offering competitive services through fiber optic cable, or advanced satellite delivery. But, fiber optic cable, as electricity was done in the 1930s, is advanced only to population densities where the most addresses can be signed up per foot of cable laid. And, broadband over satellite remains relatively expensive, hampered by latency, rain-fade and multi-year contracts.

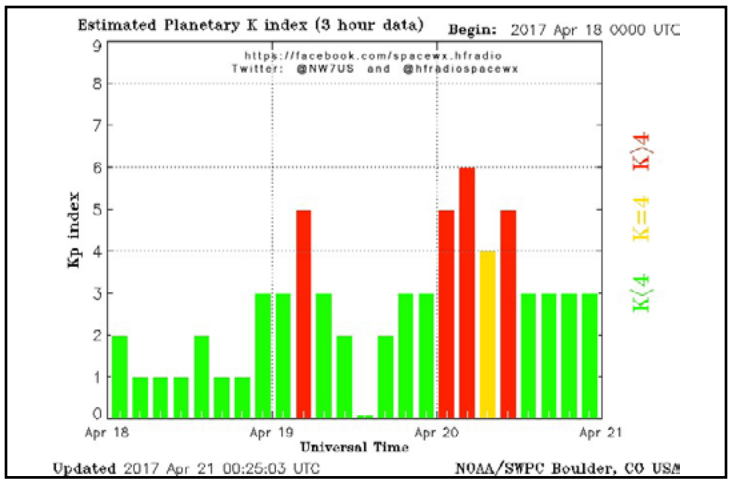
Unfortunately, the FCC seems to have been distracted by other pressing matters—AM Revitalization, for example. Seven years after the announced initiative, many rural areas are no closer to getting even moderately high-speed Internet.

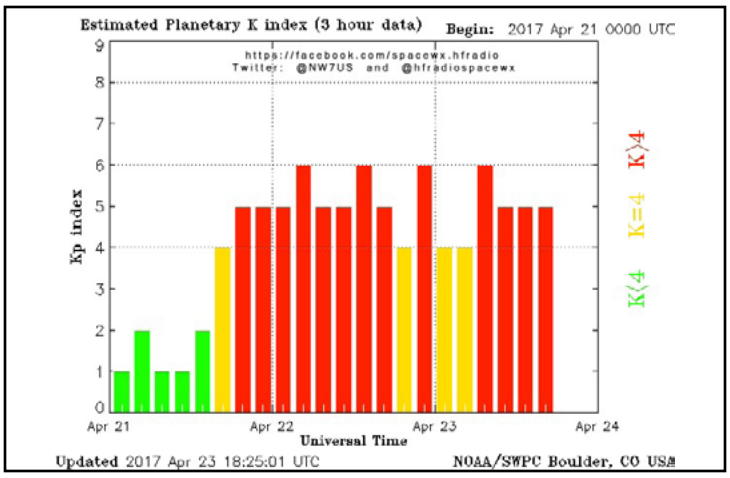
TSM

Radio Propagation

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

Setting It Straight...





The coronal hole that rotated into geo-effective position during April, 2017, along with a blast of plasma from coronal mass ejection related to a minor solar flare, caused a few days during which the propagation of radiowaves in the HF spectrum was greatly affected. The MUF over most paths was lowered by as much as 28% of typical MUFs for the week. The graph insert shows the K-index in red for the few three-hour periods when the solar wind was high, and the geomagnetic field was experiencing storm-level activity. This Sun-Earth connection exists even when there are no sunspots, because coronal holes occur during any part of a solar cycle. We expect some degradation of propagation by the second day of Field Day 2017. (Credit: NASA/SDO/SWPC)

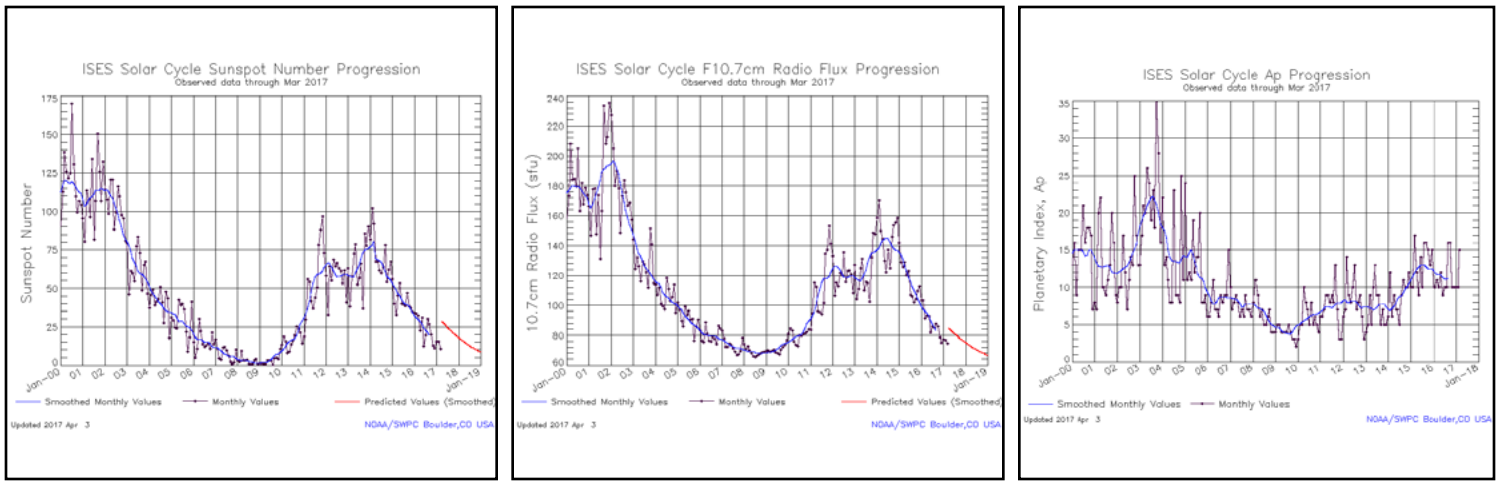
Have you heard a fellow amateur radio operator make this statement: "Aa solar flare is heading our way, so conditions will be terrible!"? Even the news media makes statements like this, as did popular blogs, "A spectacular coronal mass ejection…sent a solar flare heading our way at a speed of 1,400 kilometers per second. The flare, said to be of medium size, is likely to result in spectacular aurora and other space weather effects with the potential to cause some communications, navigation, and power-grid problems." (Do a search on your favorite 'net search engine for "solar flares heading our way" and look at how popular this phrase has become!) The problem with these statements is that they are inaccurate.

Solar flares do not head our way, in the way that these statements imply. Faithful readers of this column know that solar flares often trigger a complex series of events that may lead to the release of solar plasma clouds that do head our way, but also know that the flare itself is a nearly instant release of energy much like the flashing of a flash on a camera.

Solar flares are good examples of some of the most energetic natural explosive events known to man. Complex magnetic looping structures concentrated in an active sunspot region suddenly snap apart. Radiation is emitted across virtually the entire electromagnetic spectrum, from longwave radio frequencies, through the optical spectrum (the bright flash of a solar flare that is seen by the naked eye), to x-rays and gamma rays at the shortest wavelength end. The amount of energy released is the equivalent of millions of 100-megaton hydrogen bombs exploding at the same time!

This release of energy is nearly instantaneous—and because this radiation of light and radio energy travels at the speed of light, it takes only about eight minutes for the energy to reach Earth. When an X-ray flare occurs on the Earth-facing side of the Sun, it takes only eight minutes for full impact of the flare's energy to reach our planet! That's why it is misleading for someone to say, "a solar flare is heading our way and the HF bands are going to be terrible tonight," as if sometime in the coming hours, the results of the flare are going to make it here.

The x-rays from these events penetrate into the lower ionosphere (but get absorbed) and cause the D-region, which acts as a sponge that soaks up radio signals, to become more energized. The more ionized the D-region, the higher the frequencies that are absorbed, and the stronger the absorption of the lower frequencies. Thus, radio signals from distant locations that travel through a flare-enhanced ionosphere are absorbed and become inaudible. These fadeouts, what used to be called radio blackouts but is now known as "Sudden



Sunspot Cycle 24 progression charts showing the steady but sure decline in solar activity. We will continue to see variable monthly numbers, but overall, it is clear that this sunspot is ending soon. As can be seen by the geomagnetic progression chart, conditions are moderately high, degrading HF propagation. Source: Space Weather Prediction Center (SWPC) / The National Oceanic and Atmospheric Administration (NOAA)

Ionospheric Disturbances" (SID), last only minutes for minor flares, to maybe an hour or so for the largest of flares. Once the flare is exhausted, the x-ray radiation fades and the ionosphere recovers to its normal level of ionization.

It might be that there is confusion about what may be actually heading toward the Earth, when people talk about a "solar flare is heading our way." As all this magnetic energy is being released during the explosive moment of a solar X-ray flare, the sun heats and accelerates the sun's plasma caught up by the complex tangle of magnetic fields, and sometimes releases these plasma particles as huge clouds out into interplanetary space. These billion-ton clouds are known as coronal mass ejections (CMEs), and they ride the solar wind out away from the Sun.

A CME travels very fast, but not as fast as the speed of light. Depending on how intensely the plasma was ejected during the explosive solar flare, the coronal mass ejection could take anywhere between one to four days to arrive at the Earth, if the CME was directed toward the Earth—not all CMEs are ejected toward the Earth.

If a CME is directed toward the Earth, it can cause a lot of havoc. When they hit our magnetosphere, we could see the geomagnetic activity turn stormy, which will cause longer-term degradation of HF propagation, as well as trigger auroral conditions. Geomagnetic activity has the effect of lowering the ionization of the various ionospheric layers, which brings down the maximum usable frequency (MUF) over a given signal path. This lowering is much like what happens at night, when the ultraviolet radiation of the sun is blocked, and the ionosphere settles down. The stronger and longer the geomagnetic storm, the more depressed the ionospheric propagation becomes.

Some people think of the coronal mass ejection and the resulting geomagnetic storms collectively as a "solar storm." This may lead some to think of this as the "solar flare that is heading our way leading to bad radio conditions." But now we know that a solar flare is a nearly instant event that affects radio propagation on the sunlit side of the Earth, with a possible longer-term event known as the coronal mass ejection. But wait! There is one more related event.

Faithful readers of this column know that the Sun is always generating a solar wind. The solar wind is made up of protons and other particles that stream out away from the Sun with varying speeds. When CMEs plow through interplanetary space, they plow through this gaseous material, first in the sun's atmosphere and then out in the solar wind. Shock waves in front of the CME can accelerate these protons in our direction, causing what we know as "the proton storm."

When these accelerated protons are aimed toward the Earth, they penetrate our Magnetosphere and are funneled down toward the Polar Regions, forced along the Earth's magnetic field lines. These highly energized protons cause the D-region of the ionosphere to become highly ionized, effectively absorbing first the lowest wavelengths of the high frequency spectrum, to the highest of the shortwave spectrum if the proton storm is extremely intense. This is known as a "polar cap absorption" event (PCA), and this can occur as quickly as within hours of an X-ray flare, or perhaps days after the flare. When a PCA occurs, and radio signals over the Polar Regions are absorbed, it shuts down radio paths between DX locations depending on the polar paths, between central Europe and the United States, for example.

HF Propagation

It is Spring, and as we move closer to summer, DX signals on the higher bands become weaker and openings sparse, especially now that Solar Cycle 24 is nearing its end. Long-distance F-layer propagation via 10 meters through 15 meters will not be commonplace due to the low solar activity, as well as the "summer doldrums" caused by the chemical changes in the upper atmosphere. The lower Maximum Usable Frequencies (MUFs) average lower during the summer in the Northern Hemisphere, but also suffer from a barely active Sun. Optimum frequencies for DX propagation are

lower during most of the daylight hours, and higher during the late afternoon, early evening and nighttime hours than were observed during the winter months.

Not all is lost on the higher bands, though. During May, occasional Sporadic-E propagation pops up on the highest HF bands and even on 6 meters. While seasonal static is increasing during May on lower frequencies, Sporadic-E brings some excitement to the on-air chase for signals.

The following is an overall picture of high frequency amateur band openings expected during May 2017. For day-to-day propagation conditions expected during the month, see the Last-Minute Forecast which appears on **http://SunSpotWatch.com**.

Ten, 12 Meters

Except for an occasional daytime opening to some southern or tropical areas, not many DX openings are forecast for these bands during May. The afternoon hours are the best time to check for DX openings. Frequent short-skip openings between distances of approximately 750 and 1400 miles, however, should be possible.

Fifteen Meters

A seasonal decrease in DX openings is normal for May. Some fairly good openings still are possible towards the south during the late afternoon and evening. Numerous short-skip openings, between about 600 and 2300 miles should be possible almost daily.

Seventeen, 20 Meters

These should be the best bands for DX during May. Opening shortly after sunrise, good DX conditions are expected to one area or another, through the evening hours. These bands may also remain open to southern and tropical areas through much of the nighttime hours as well; DX conditions should peak during the late afternoon and early evening, with openings possible to almost all areas of the world. Very frequent short-skip openings are also forecast for distances between about 350 and 2300 miles. Quite often, especially during the late afternoon, optimum conditions may exist for both the short and long skip, and stations a few hundred miles away will be heard at the same time as DX stations from several thousand miles away, causing considerable QRM.

Thirty Meters

This band will often play a major role in DX propagation, with somewhat better daytime propagation than 40, and solid nighttime propagation into some areas of the world. Exotic DX can be found here on CW and other digital modes. Check this band often throughout the day.

Forty Meters

Fewer DX openings are expected because of the shorter hours of darkness and the higher level of static. Good openings should still be possible, however, to several areas of the world from shortly before sunset, through the hours of darkness, until shortly after sunrise. Good daytime short-skip openings can be expected over distances of between approximately 150 and 750 miles, with nighttime openings extending up to the one-hop limit of 2300 miles.

Sixty, 75, 80 Meters

Fewer hours of darkness and higher static levels are also expected to reduce DX openings on these bands, but a few fairly-good openings should be possible. Check during the hours of darkness. Excellent short-skip openings are forecast for the daylight hours over distances ranging between 50 and 250 miles. During the hours of darkness, the short-skip range should increase up to approximately 2300 miles.

The 160-Meter Band

Propagation conditions on this band have passed their seasonal peak, and should decline until the early autumn. Openings up to a thousand miles, or so, should be possible this month during the hours of darkness. An occasional opening well beyond this range may also be possible when static levels are exceptionally low.

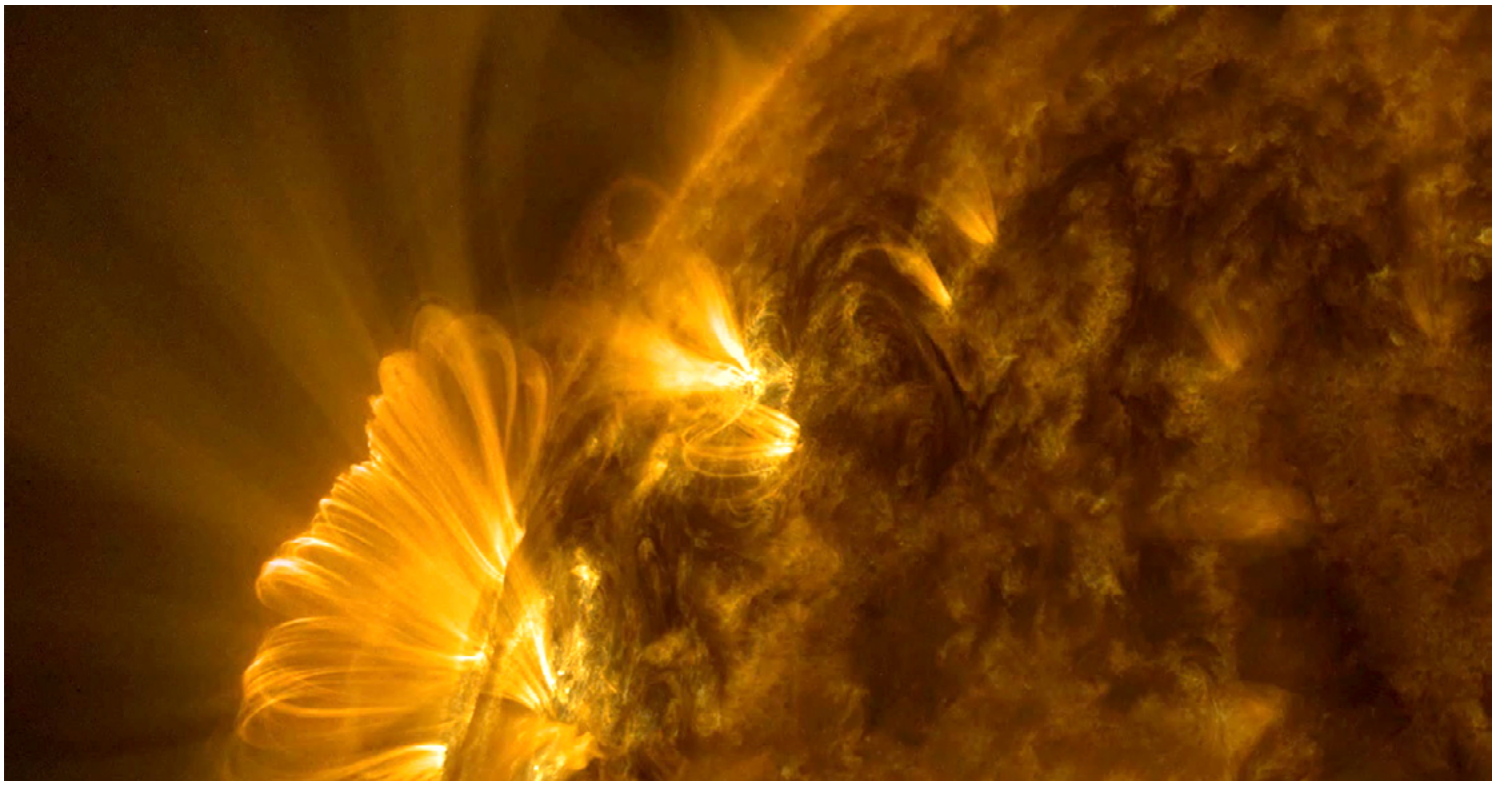
VHF Conditions

May should see an increase in Sporadic-E, especially at the end of the month. At the same time, solar activity is not expected to be high enough to support long-range DX on the 6-Meter Band.

With Sporadic-E ionization expected to increase, look for short-skip openings, likely to occur over distances of approximately 1000 to 1400 miles. Although Sporadic-E openings can take place at just about any time, the best time to check is between 10 AM and 2 PM and again between 6 and 10 PM local daylight time.

During periods of intense and widespread Sporadic-E ionization, two-hop openings considerably beyond 1400 miles should be possible on 6 Meters. Short-skip openings between about 1200 and 1400 miles may also be possible on 2 Meters.

Auroral activity is generally lower than March and April, due to the change in the orientation and position of the earth and magnetosphere in relation to the solar wind. This year, very little aurora can be expected during May. Even so, watch for Kp values above 6, which occur on days of Below Normal and Disturbed HF conditions (refer to the Last-Minute Forecast mentioned, above, for those days in May that are expected to be in these categories). Point your antenna toward the North when this condition exists. You will find



Cascading Post-coronal Loops -- An active region that had just rotated into view blasted out a coronal mass ejection, which was immediately followed by a bright series of post-coronal loops seeking to reorganize that region's magnetic field (April 19, 2017). We have observed this phenomenon numerous times, but this one was one of the longest and clearest sequences we have seen in years. The bright loops are actually charged particles spinning along the magnetic field lines. The action was captured in a combination of two wavelengths of extreme ultraviolet light over a period of about 20 hours. Credit: Solar Dynamics Observatory (SDO), NASA.

that CW is the modulation and mode of choice, as the signals you will hear on Aurora will be raspy and very distorted.

Solar Cycle 24 Today

The Royal Observatory of Belgium, the world's official keeper of sunspot records, reports a monthly mean sunspot number of 10.6 for March 2017, five points below 15.7 for February. The mean value for March results in a 12-month running smoothed sunspot number of 19.9 centered on September 2016. Following the curve of the 13-month running smoothed values, a smoothed sunspot level of 22 is expected for May 2017, plus or minus 14 points.

Canada's Dominion Radio Astrophysical Observatory at Penticton, British Columbia reports a 10.7-cm observed monthly mean solar flux of 74.6 for March 2017. The twelve-month smoothed 10.7-cm flux centered on September 2016 is 83.7. A smoothed 10.7-cm solar flux of about 82 is predicted for May 2017.

The geomagnetic activity as measured by the Planetary-A index (Ap) for March 2017 is 15, showing a significant uptick in geomagnetic activity since February. The twelve-month smoothed Ap index centered on September 2016 is 11.3. Geomagnetic activity this month should pick up a bit over the level seen in April 2017. Refer to the Last-Minute Forecast for the outlook on what days we might witness degraded propagation (remember that you can get an up-to-the-day Last-Minute Forecast at **http://SunSpotWatch**.com on the main page).

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. If you are interested in space weather and radio propagation forecast self-study course, visit **http://SunSpotWatch.com/swc** for details.

Your columnist has a website dedicated to space weather, at http://SunSpotWatch.com and also provides a Facebook page at https://www.facebook.com/spacewx.hfradio which features daily updates with solar images, space weather graphs, data, and educational tidbits, all day long, so please take a look. There are quite a few space weather and radio videos on this columnist's YouTube channel at **https://YouTube.com/NW7US**. Be sure to check out the Tumblr blog, **http://blog.nw7us.us**, in which daily space weather posts are available.

On Twitter, radio propagation and space weather Tweets are provided in regular updates by @hfradiospacewx (**https://Twitter.com/hfradiospacewx**). Your columnist is on Twitter, as @NW7US (**https://Twitter.com/NW7US**).

TSM

The World of Shortwave Listening

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

The Shortwave Scene in the Middle East

I can remember a decade or two ago when stations such as Radio Kuwait, Kol Israel, the Voice of the UAE and Radio Jordan used to have external services on shortwave in English. Some of them consisted mostly of Western pop music as they were simulcasts of local radio services for expatriates from the UK, the US and other English-speakers in those countries. But often they had some newscasts with local news, some features about Islam, etc., to give them a little local flavor.

Nowadays, the pickings are slim in English from the Arab world. Radio Cairo has a bona fide external service in various languages, but it is often hard to hear and the audio quality leaves a lot to be desired. Stations, including the Broadcasting Service of the Kingdom of Saudi Arabia and Radio Sultanate of Oman, still broadcast on shortwave in Arabic, but these are programs for their citizens (often students) living abroad, and they don't have foreign-language programs for overseas audiences. Algeria also has programs in Arabic, which are broadcast via TDF in France, while they say they are revamping their own shortwave transmission facilities that should be on the air in the future.

Tunisia recently ceased its shortwave broadcasts after being unable to sell airtime on its somewhat older facilities to outside clients. Iran is not an Arab country, but it is part of the Middle East, and the Islamic Republic of Iran Broadcasting (IRIB) is still going great guns on shortwave in multiple languages. They have four shortwave transmitter sites in Iran, two of which are currently operating with transmitters up to 500 kilowatts.

Kol Israel went off of shortwave many years ago, except for a program in Farsi to Iran. And even that was dropped a few years ago. I was able to hear an English newscast from Kol Israel on FM from my location on the Jordanian side of the Dead Sea. The Sea is only about seven miles across, so lots of AM and FM stations from Israel could be heard. I also heard an English newscast on FM from Palestine, which may have been from Radio Ramallah. I'm not sure, because they gave no ID in English, but the content was almost all very anti-Israeli.

The latest good radio news from Israel was the inauguration of the Voice of Hope-Middle East in March of this year. This Christian station—the first ever to be licensed in Israel—on 1287 kHz mediumwave, was established by the same folks who run KVOH shortwave in Simi Valley, California and Voice of Hope-Africa in Zambia. John Tayloe is the President of Strategic Communications Group, which operates the Voice of Hope stations. He is very excited about the new Israeli station, especially since it was his father-in-law, George Otis, who founded the original Voice of Hope station just across the border in Lebanon back in the 1980s.

Looking across the Dead Sea from the A17 Conference hotel. At night you could see very faintly the lights of Jerusalem in the distance. (Photo courtesy of the author)

It was also an AM station, but it had a shortwave frequency, 6280 kHz, as well. Rev. Tayloe says the 1287 AM frequency is already being heard in several Middle Eastern countries, but he hopes to be able to add a shortwave channel as well before the end of this year. The station's programming is primarily in Arabic, with some Farsi programming for Iran.

There were recent reports that the Syrian government intended to resume an external shortwave service, but we haven't seen any signs of this. There are no more local services on shortwave from the UAE or Kuwait, but shortwave relay stations operated by Babcock International are transmitting from the UAE and Oman, and the U.S. International Broadcasting Bureau transmits from Kuwait. Republic of Yemen Radio is believed to be broadcasting (in Arabic) from

This was the opening plenary session at the A17 Global Coordination Conference in Jordan. (Courtesy of the author)

transmitters in Saudi Arabia. The BBC relay station in Cyprus was recently closed, and Radio Bayrak from the Turkish Republic of Northern Cyprus is reportedly inactive now after previously operating in Turkish 24 hours a day on 6150 kHz in the 49-meter band. FG Radio, a weekly 15-minute program in English sponsored by the Famagusta Gazette in the Republic of Cyprus, is heard several times per week on WRMI from Florida. Radio Lebanon and the Qatar Broadcasting Service haven't been heard on shortwave for many years.

But the Voice of Turkey is another prolific shortwave broadcaster that's well heard in many languages in many parts of the world. Radio Bahrain seems to no longer have English programming on shortwave, but it may still be on in Arabic. Radio Sawa, the U.S. International Broadcasting Bureau's Arabic-language service to the Middle East, is now on AM and FM frequencies throughout the region.

A Lively Meeting on the Dead Sea

So international radio is a mixed bag in the Middle East. And this was the venue for the A17 Global Coordination Conference for shortwave broadcasters, hosted by the Arab States Broadcasting Union (ASBU) and with the participation of the High Frequency Coordination Conference (HFCC) and the Asia-Pacific Broadcasting Union (ABU) during the first week of February. The site for the A17 Conference—where frequencies were chosen for the period from March 26-October 29, 2017—was the Dead Sea resort area near Amman, Jordan.

While Jordan discontinued its shortwave broadcasts back in 2007, Dr. George Hawatmeh, Chairman of the government-owned Jordan Radio and Television, told me at the Dead Sea conference that he would very much like to resume an international service in Arabic and English, if the funds can be found to finance the operation. He suggested that maybe a group of Arab broadcasters could get together and establish such a service. So there's hope for the future.

Yours truly addressed this subject in my opening remarks at the Global Coordination Conference at the Dead Sea. This is what I told around 70 delegates from over 40 shortwave organizations, including a lot of Arab broadcasters:

"We have come together this week at the Dead Sea in Jordan to do our usual semi-annual frequency coordination work—making sure that our signals propagate well, are free of interference and are audible by our listeners in all target areas of the world.

"But this week in Jordan we come together at a particularly important time

Abdelrahim Suleiman, Director-General of the Arab States Broadcasting Union (ASBU), is interviewed by Jordan Television (photo by Mousa al-Zoubi). (Photo courtesy of the author)

for the world. Certain forces are attempting to provoke distrust and unrest among nations of the world, and we as international broadcasters know that shortwave radio is one of the best methods of creating trust, harmony, goodwill and mutual understanding among the peoples of the world.

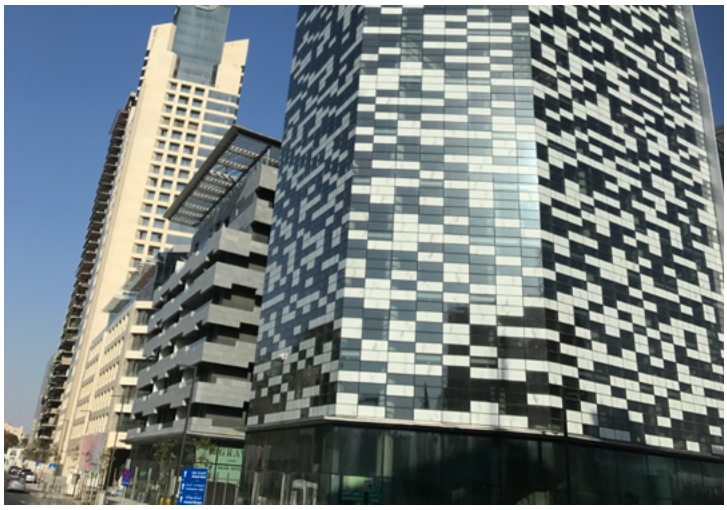
"There are those who say that shortwave is an old technology and is outdated. But those who really understand the technological challenges in the world today can see the continued importance of shortwave—and I would say even the increased importance of shortwave in today's world.

"Yes, satellite and Internet are very helpful and important technologies, and local FM rebroadcasts are also very nice. But all of these media can be turned off in an instant if a particular country doesn't like the message that it's hearing. Shortwave radio remains the only medium of international broadcasting that can transmit directly from the people of one country to the people of another, with no intermediary.

"Sitting here in this modern conference room on the Dead Sea of Jordan, we are privileged to have a super-fast 45-megabit Wi-Fi Internet service. But a short distance from here, in the desert, there are people who have no Internet service whatsoever, or very limited service, or very expensive service, which doesn't permit live audio streaming. And this is the case throughout the Middle East and many other parts of the world. In these areas, radio is essential to reach the population, and shortwave radio can reach corners of the world where there is no local radio service.

"As international broadcasters, we also know the extreme importance of shortwave radio in times of crisis—natural disasters, political and other types of crises. Often shortwave is the only practical means of communication. And at this critical time in world history, the possibilities of crisis are higher than ever. We have to be prepared. And shortwave should be one of those means of preparation.

"But even in normal times, shortwave radio can be of vital importance. We live in a time when there are many misunderstandings about people in this part of the world—the Middle East—by people in my part of the world—the Americas—and other parts of the world as well. Shortwave radio can play an important part in dispelling these misunderstandings. I would like to make a personal plea to the management of national broadcasting entities all over the Middle East, and I think most of my HFCC colleagues would agree. I know that many national broadcasters



Amman, the capital of Jordan, is a modern Arab city. (Photo courtesy of the author)

Urban housing in central Amman. (Photo courtesy of the author)

in the Middle East use shortwave to transmit programs in Arabic to their expatriates abroad. And this is a very important service.

"But I would also like to suggest that national broadcasters in this part of the world strongly consider establishing or re-establishing external services on shortwave beamed overseas to other parts of the world in English, and perhaps other languages as well—but at least in English—in an attempt to reach people and to explain your points of view on international developments, to explain your country and culture, to play your music and to make people aware of the tremendous possibilities for investment and tourism in your countries—tourism to places like the Dead Sea and [the ancient ruins of] Petra here in Jordan. The broadcasts can be made through existing shortwave transmission facilities in your own country or via many relay facilities in other parts of the world, which make airtime available at a very low cost.

"A few days ago I read in the Jordan Times newspaper about King Abdullah's visit to Washington last week. But I know that many Americans were probably not even aware that the King was in the United States. That's why it's important for every country to have at least one shortwave service that can broadcast news and other programs about its country to listeners abroad.

"Those of us who understand the unique technical qualities of shortwave radio have an obligation to explain to the decision-makers the great potential this medium has to reach foreign and overseas audiences. And maybe some of those decision-makers will listen, and maybe there will soon be more voices on the international airwaves from this part of the world. Let's hope so. That would mean more frequency coordination work for us, but I'm sure that's a challenge we would all like to have."

Well, that's what I suggested to the Middle Eastern broadcasters present at the Dead Sea coordination conference. There was a lot of positive reaction, but bureaucracies move very slowly, so we'll see what happens.

Other News from the HFCC-ASBU Conference

Abdelrahim Suleiman, Director General of the Arab States Broadcasting Union, welcomed all the members of the coordination groups to the 13th Global Coordination Conference at the Dead Sea. He stressed that shortwave radio is still an important medium in that part of the world, and he noted that his organization has been cooperating fully with the HFCC and the ABU for the past 20 years. Suleiman said digital radio is also important, and that the Arab world is very interested in DAB and DAB+. However, he said the availability of low cost receivers is still a problem for the development of DRM in the shortwave and mediumwave bands.

Horst Scholz, Vice Chairman of the HFCC, reported good progress on the IRDR (International Radio for Disaster Relief) project. This project, which was the brainchild of former HFCC Chairman Oldrich Cip, is designed to allocate certain HF frequencies for use by any stations carrying humanitarian programming during natural disasters. A new emergency channel was announced for both A and B seasons: 5910 kHz at 0000-0100 UTC. The HFCC requested that the IRDR frequencies (and adjacent channels) be kept clear of any potential interference. Here is a complete list of the frequencies that the HFCC has reserved for IRDR use:

Band *(MHz)*	**IRDR Freq.** *(kHz)*	**Times Currently Coordinated** *(UTC)*
6	5910	0000 -- 0100
7	7400	00:00 – 12:00, 23:00 – 24:00
9	9430	01:00 – 10:00, 19:00 – 24:00
11	11840	00:00 – 01:00, 09:00 – 24:00
13	13620	00:00 – 24:00
15	15650	00:00 – 24:00
17	17500	00:00 – 24:00
19	TBD	TBD
21	21840	00:00 – 24:00
26	26010	00:00 – 24:00

Salt deposits on the shore of the Dead Sea. It's so salty that you can only float in it; you cannot sink. There is no plant or animal life, except some microscopic bacteria and fungi. This is the lowest point on earth, at about 420 meters below sea level. (Photo courtesy of the author)

George Ross of Trans World Radio gave an update on the Titus II DRM receiver, which was first presented at the HFCC B16 Conference in Miami last August. The manufacturer, PantronX, says various improvements have been made since then, including improved RF shielding, and these have delayed production of the receiver. However, the first batch of confirmed orders was expected to be dispatched before mid-2017. Ross also explained that applications to enable the Titus II to receive DRM+ and DAB transmissions will be available soon.

The HFCC announced a new addition to its Steering Board. Dr. Jerry Plummer, frequency coordinator for the Caribbean Beacon in Anguilla and WWCR in Tennessee, was named an assistant to the Board. Plummer will be mainly working with the Systems Development Coordinator, but will also be involved with various other projects.

Travel Notes

When I heard that the A17 Conference was going to be in Jordan, I began to look for the best way for me to get from Miami to Amman. There are no direct flights, but there are various possibilities for connections, all of them involving two long flights and a layover somewhere. To my surprise, I found that my best option was via Chicago on Royal Jordanian airlines. Even though I used to live in the Chicago area, I was unaware that there is a large population of Jordanians in Chicago, and the Jordanian state airline flies that route multiple times per week—a journey of about 14 hours. The stopover in Chicago was rather interesting, as this was right after President Trump announced his first travel ban from eight Muslim countries, and the O'Hare Airport international arrivals area was full of attorneys and legal aides who were offering free legal services to passengers arriving from those countries.

Conference delegates paid a visit to the spot in the Jordan River where Jesus was baptized -- a popular tourist attraction for people of various religions. (Photo courtesy of the author)

As many of us were travelling to Jordan for the first time and we had come from so far away, the ASBU and Jordan Radio and TV provided a few local experiences for us, including a dinner at a famous fish restaurant in Amman and at a Lebanese restaurant at the conference hotel overlooking the Dead Sea. They also gave us a sightseeing trip around the Dead Sea/Amman area to see the place in the Jordan River where Jesus was baptized by John the Baptist, Mt. Nebo where Moses was able to see Jerusalem after wandering through the desert for 40 years (we were able to see the lights of Jerusalem from our hotel rooms at night), a mosaic factory where beautiful handicrafts are made, and some very impressive Roman ruins in the center of Amman.

On some evenings after our coordination sessions, I had time to listen to the radio. I didn't listen to much shortwave, except to check out my own frequencies from WRMI in Okeechobee (11580 and 15770 kHz did very well into Jordan), but I listened a lot to local radio. The AM band was quite active, but the FM band was even more full of stations.

Based on the languages (Hebrew and Arabic) it seemed that about half of them were from Israel and the other half from Jordan. There was a lot of Western pop/rock music, Arabic music and talk, Israeli music, a few classical music stations, recitations of the Quran, and even opera music. I heard Kol Israel on 100.5 MHz with an English newscast at 12:30-12:45 pm local time.

Looking Ahead

Finally, it was announced in Jordan that the B17 HFCC frequency coordination conference will take place August 21-25 in South Africa, hosted by Sentech, which operates the large shortwave station in Meyerton; and the A18 Conference will be January 22-26, 2018 in Malaysia, hosted by the Asia-Pacific Broadcasting Union.

TSM

The Shortwave Listener

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

Korea (North and South) on SW; New BBC Programming

Welcome to the May edition of The Shortwave Listener. This month we'll take a look at programming from the Korean Peninsula, which is in the news a lot these days, some radio drama from Germany for Africa, and a look at lots of new spring programming from the BBC World Service. Finally we'll look at one of the better programs on CBC Radio.

Korea is very much in the news these days. Listening to programming from the Korean Peninsula has always been interesting on a number of levels. The North broadcasts stultifying propaganda, the South, news and cultural programming. The North gives us martial music, the South K-Pop and Psy. These two countries could not be any more different and these differences are reflected in their radio broadcasts.

I always found the North to be a more difficult catch, mainly because one had to rely on transmitters in the North. For many years, Radio Canada International transmitters in Sackville, New Brunswick, relayed KBS in Seoul, which made for much easier reception. Since the demise of the RCI transmitter site a few years ago, this option has evaporated, but with a little effort one can still hear broadcasts from both sides of the 38th Parallel.

From the North, Radio Pyongyang as it was then known, was first heard by the author in 1984. The programming has not changed that much in all these years. It consists largely of martial music, news and reports chronicling the achievements of the Party and of course the Leader, with a Capital "L," Kim Jong-Un. The worship of Kim is done to great excess. It follows the pattern of the Leadership Cult of his father, Kim Jong-Il and his grandfather, the "Great Leader" Kim Il-Sung. If you want to witness a Stalinist Cult of Personality, just tune to the Voice of Korea. You can hear it on a number of times and frequencies including 0430-0530 7220, 9445,11735, 13760,15180; 0630-0730 7220,9445,9730; 1030-1130 6170, 9435; 1330-1430 9435, 11710; 1930-2030 9875,11635. (Frequencies courtesy of Harold Sellers, ODXA Target Listening April 2017)

And now for something completely different: KBS World Radio, in Seoul, South Korea. Broadcasts from Seoul reflect a modern, sophisticated nation. The martial music of the North, is replaced by the enchanting music native to the South, known as K-Pop or Korean Pop music. The genre is very big in Korea and has a following around the world. Korean pop artists are very good and the music makes for very enjoyable listening. I quite like listening to pop music from Korea, and neighboring nations, Japan and Taiwan. Give it

***North Korea** (Map courtesy: CIA.gov)*

a try for yourself and see if you don't agree! You can hear KBS World Radio at 1300-1400 UTC on 15575; 1600-1700 on 9640; and at 2200-2300 UTC on 11810 kHz.

Crime Fighters: Radio Crime Stories for Africa's Youth

If you enjoy radio drama, Deutsche Welle in Germany has a treat for you. Crime Fighters is a very entertaining, 10-minute weekly drama. "Join our detectives in their fight for truth and justice while gaining valuable perspectives on critical issues. Cyber crime, domestic violence, environmental pollution, human trafficking, terrorist recruitment, poaching, land grabbing and counterfeit drugs – this is a series that gets to the heart of what challenges young Africans." These programs are part of Deutsche Welle's "Learning by Ear" initiative using educational radio dramas to provide knowledge and information in an entertaining way. If I am up late I often hear these features via the CBC Radio One "Overnight" block of programming. On shortwave they can be heard on UTC Wednesdays and Sundays at 1650 UTC. Try 9670, 15290, 15315, 17800 and 21780 kHz. The last frequency is via Ascension. Learn more at: **dw.com/en/top-stories/crime-fighters/s-32392**

At the end of March, the BBC World Service rolled out its new spring schedule, reflecting its increased funding and a fresh approach to arts programming. Several new programs are being launched as a result.

The new culture series "In the Studio" will give unique

(Courtesy: KBS, VOK, BBC)

access to the world's leading creative people in the process of making their art and work a reality. BBC OS will bring together "Outside Source" and "World Have Your Say" into a new extended two-hour program, and "The Newsroom" will increase its coverage of key stories, with up to six broadcasts a day.

Launching in April is "Life Stories," a new season exploring fascinating stories about who we are and how we live. BBC World Service is also rolling out a new product launch with "BBC Minute On…" additional 60-second programs, which will explore a single subject in greater detail and be available to partner stations around the world.

Mary Hockaday, Controller of BBC World Service English, says: "Making the most of the funding boost we received last year, the new schedule will bring our global audience a richer mix of programs and digital content to keep them up to speed with the key stories of the day and satisfy their interest in a broad array of topics."

"'In the Studio' takes listeners into the working lives of leading and emerging artists from across the globe. Each week the series will follow painters, designers, musicians, dancers, directors and creative people of all types as they make their work. The series launches with Chinese artist, activist and architect Ai Weiwei, who will take Tim Marlow (Artistic Director of the Royal Academy) on a tour of his Berlin studio, revealing Ai Weiwei's creative process and the details that continue to inspire and drive his work. Subsequent episodes will go on set with rock-star cinematographer Christopher Doyle as he directs a movie in Hong Kong; and meet Brazilian visual artist Vik Muniz, who creates images photographed from helicopters and microscopes. The series will continue throughout the year, spending time with actors, game designers, artistic directors and many more.

"'BC OS' will bring together the best of 'Outside Source' and 'World Have Your Say,' building on both programs' strengths and including new elements that give a vibrant account of the day's events with explanation and reaction from those involved. Showcasing the best of the BBC's global resources, the two hour program will be broadcast every weekday at the new time of 1500-1700 GMT, opening it up to peak audiences in Europe, Africa and America. Nuala McGovern, who has presented 'Outside Source' since 2015, will anchor the program across the two hours from the middle of the BBC newsroom in London.

"'The Newsroom' from 1 May, 'The Newsroom,' where the BBC's worldwide network of correspondents report on the stories of the day, will enhance its coverage with up to six editions across the day, seven days a week. 'The Newsroom' will be able to adapt rapidly to breaking stories and events whenever they happen.

"'Life Stories' - April will see the launch of Life Stories – a new season of content across BBC World Service, BBC World News and digital platforms exploring a diverse range of stories - from celebrating the birthday of one of the oldest women in Africa to uncovering differing attitudes to death, companionship and rites of passage around the world.

"'Celebrating Life at 117' (TV and radio) follows a trainee journalist as she travels to Kenya to celebrate the 117th birthday of her great grandmother who is thought to be the oldest woman in Africa. #GrannyWisdom will see some of the world's top social media stars find out what their grandmothers think about their online lives and the issues they deal with in the digital world; this content will be shared online and on BBC World Service radio.

"'Living With The Dead' (TV and radio) will look at an Indonesian community who live with the bodies of their loved ones, while Dying To Talk (radio) will visit the Death Cafes popping up worldwide encouraging people to talk about grief and fear of death.

"'A Stranger's Ear' (radio) will head to Japan where a man has set up a network of temporary friends – people who lend a sympathetic ear to a stranger in need. 'Four Days' (TV and radio) will look at the impact of the practice in Nepal of confining women away from the family during their period. Last year a 15 year-old girl died, suffocated by a fire she lit in the hut where she was staying during menstruation. The

season will also see BBC World Service and Wellcome Collection join forces to host a series of events and broadcasts exploring humankind's relationship with animals in 'The Evidence: Humans And Animals' (radio). Over five programmes, presenters Claudia Hammond and Tim Cockerill will be joined by a panel of experts in front of a live audience to discuss topics including human and animal interaction, intelligence and consciousness.

"'BBC Minute On...'- BBC World Service is also launching new BBC Minute products with 'BBC Minute On…' - new 60-second features that will focus on a single subject. From 3 April, in addition to the existing BBC Minute which provides a dynamic roundup of the latest news updated every half hour, there will now also be two additional BBC Minute products each day which elaborate on the key talking point of the day or explore a topic - from tech and money to fitness and science - in more detail." (Courtesy of **bbc.co.uk/mediacentre/latestnews/2017/bbc-world-service-spring-schedule**)

How very twenty-first century to describe new programs as "products." These new programs sound quite exciting, especially the BBC OS. I look forward to this two hour programming block. It is also encouraging that it is timed to get listeners in North America. It sounds like some great new programing is on the horizon from London.

BBC Program Highlights for May

May 1 11:30 AM-Noon
"The Conversation: Animal Keepers"

"Shanet Rutgers is Head of Penguins at the Two Oceans Aquarium in Cape Town, South Africa. She and her team are responsible for around 30 birds and also introduce visitors to the resident penguins. Shanet talks about the importance of educating the public about these 'funny' animals and says that while she understands the criticisms leveled at zoos and aquariums she strongly believes they are beneficial too. The program suggests that well-managed zoos play an important role in awareness-raising and conservation work."

May 2 9-9:50 AM
"The Forum: How The Meter Changed The World"

"This week, The Forum explores why we switched from measuring length in units derived from the human body, such as the foot or the distance across outstretched arms better known as the fathom, to the meter, which is much harder to visualize. We explain why 18th century French scientists decided to use one ten-millionth of one quarter of the Paris meridian as the standard length and why we had to abandon this definition of the meter in the 20th century.

"Quentin Cooper is joined by Stonybrook University science historian and philosopher Professor Robert Crease; Professor Marc Himbert, the scientific director of the Metrology Laboratory at CNAM University in Paris; and historian of contemporary and 20th century science from King's College in London, Dr. Jahnavi Phalkey.

Terry O'Reilly presents "Under the Influence" (Courtesy CBC)

May 2 1:30-2 PM
"The Documentary: The Cathedral Of The Fallen"

"Giles Tremlett takes us into the fierce battles being fought over The Valle de los Caidos, an enormous memorial to Spain's civil war dead constructed by the dictator Francisco Franco. For some a great monument, for others a war crime, it has become a flashpoint for spiritual and political conflict.

"The Valley of the Fallen is a giant cemetery, made visible by a basilica larger than St. Peters in Rome, carved into a mountain. Most striking of all is the freestanding granite cross which at 150 meters is the tallest in the world. The visual association of Franco and Catholicism at the valley is stark, not least because of the giant cross, but it reflects the long-held and close association between the two. The church supported Franco openly during the civil war, which lasted from 1936 until 1939.

"In the aftermath of Franco's death in 1975 Spain transitioned from dictatorship to democracy, but one aspect of the transition was silence over the issues of Francoist persecution and brutality. Today, the battle over how Franco and the Civil War should be remembered is one of the most significant religious and political conflicts in Spain. At the valley of the fallen, and the working church buried deep within it, they collide." (Programming courtesy of the BBC Media Center)

To conclude The Shortwave Listener this month, we'll take a look at a fascinating program on the CBC Radio One Network in Canada. While not on shortwave, it can be heard on CBC Radio One and online as a podcast. I refer to "Under the Influence," hosted by Terry O'Reilly (not to be confused with the NHL star by the same name).

"'Under the Influence' looks at all facets of advertising. It explores and explains the many ways that people and companies persuade us to buy things. Each week Terry digs deeply into the whole concept of marketing in a very entertaining and fascinating way. The program airs on local Thursdays at 1130 AM. Download the podcast at **cbc.ca/podcasts**." (Courtesy of CBC Radio)

TSM

Amateur Radio Astronomy

By Stan Nelson KB5VL **stan.nelson@RoswellMeteor.com**

1420 MHz Band Interference

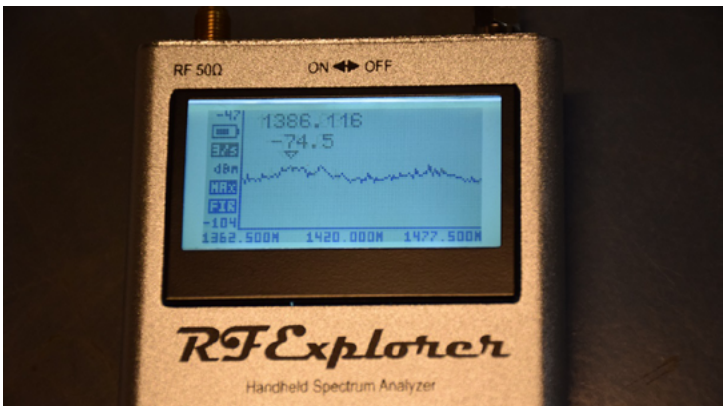
The 1420 MHz 'Water Hole' is often used by amateur radio astronomers due to hardware and antennas that work reasonably well at modest costs. The so-called 'Water Hole' reflects the fact that the band has less absorption of the signal as it passes through the earth's atmosphere. The Milky Way is a source of 1420 MHz radiation.

I have mentioned in previous columns the dish and setup that I use to monitor the Milky Way on that frequency. Through the winter I neglected the setup and recently reconnected the receiver, a Funcube Pro Plus dongle, tuned to 1420 MHz with Spectravue's software running in the continuum mode. I had noticed some 3 to 5 dB narrow (short duration) spikes appearing in what at first seemed to be random. I set the sleuthing aside for a week and when I tried it again the pulses were still occurring.

I turned the dish from its southern direction towards north. There was a large decrease in pulses signal strength. But the pulses were still there. I dragged out a portable spectrum analyzer and hooked it up to the output of the bias-t and the signal was showing a peak at 1386 MHz. But hardly anything at 1420 MHz. I had been using a 1420 MHz band filter that I had removed. I reinserted it suspecting the out-of-band signal was the offender. The 1386 MHz signal was now gone.

Just where was the 1386 signal coming from? I did a Google check and found that that part of the spectrum just below the astronomy band is used for a variety of activities. Here's some of the FCC information:

"Domestically, the 1390-1395 MHz band is a Federal Government exclusive band that is allocated to the radiolocation service on a primary basis and to the fixed and mobile services on a secondary basis.113 Federal agencies use this band for long-range air defense radars, military test range telemetry links, tactical radio relays, and radio astronomy."

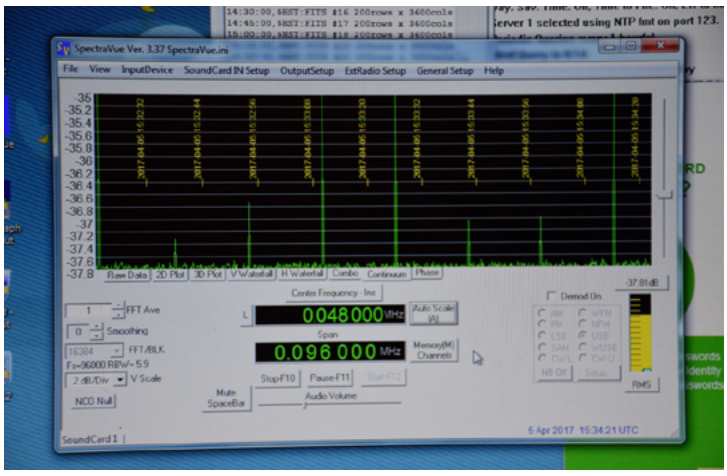


This picture shows the handheld RF Explorer displaying the peak interfering signal with a peak at 1386 MHz. Though not a significant spike, the display is currently set to show the MAX signal levels. (Courtesy of the author)

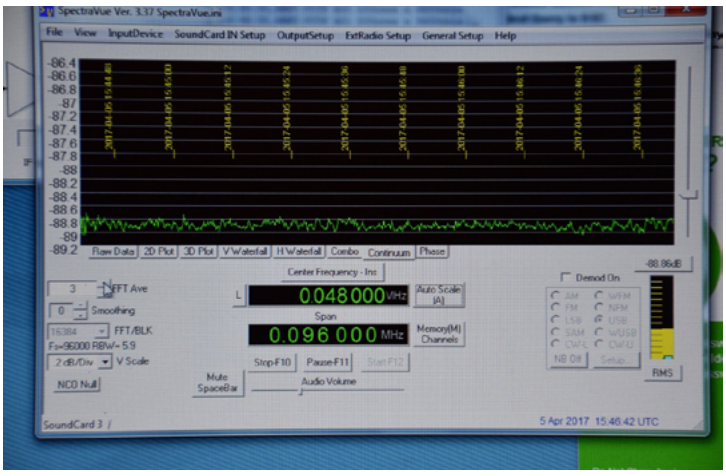
There's a lot more information in the FAA's document regarding the use of the band but the moral of the story is one has 'neighbors' in the radio astronomy world and may require filters. This picture shows the handheld RF Explorer displaying the peak interfering signal with a peak at 1386 MHz. Though not a significant spike, the display is currently set to show the MAX signal levels.

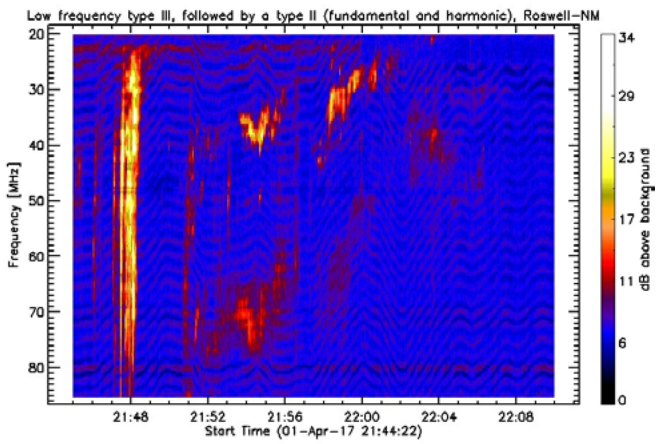
The Spectravue charts show the reduction in interference. The chart (left) shows the spikes that appear in the 1420 MHz centered Spectravue running in the continuum mode. The chart (right) shows the spikes are gone when the filter is reinstalled.

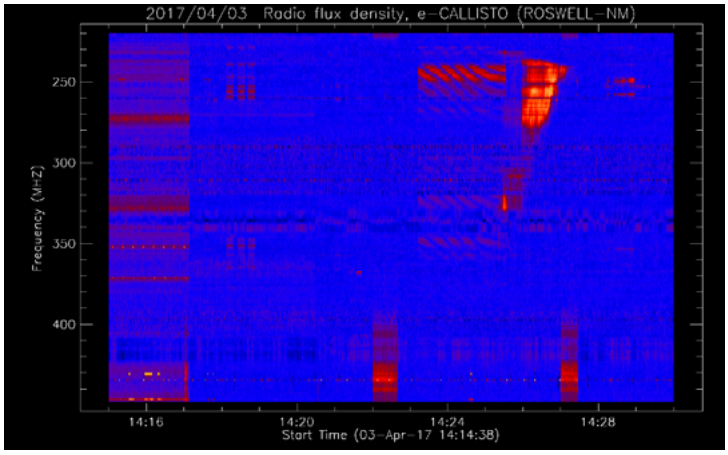
Spectravue chart without filter. (Courtesy of the author)



Spectravue chart with filter reinstalled. (Courtesy of the Author)







(Left and right) Major solar outburst caught on the author's Callisto receiver April 1 to April 4. (Courtesy of the Christian Monstein)

Solar Activity Increases in April

Solar activity had been relatively quiet for a long spell until April 1, 2017. NOAA issued warnings of a major outburst. And it happened. My Callisto receiver NA027 caught the following bursts beginning April 1 to April 4 (above left and right and below left).

The three Callisto images are from E-Callisto.org, created from the data from my Callisto receiver, by Christian Monstein. For more information on this solar monitoring program check out **http:www.e-callisto.org**. You can also find an interesting document on the Australian Government's Space Weather Services website that describes the various types of radio spectral solar events at **http://www.sws.bom.gov.au/Solar/2/2**. Type III Events are noted to be the most common.

If you noted the slight 'ripples in the charts that appears to be due to some power supply issues from the switching power type of 'wall-warts.' A highly regulated power supply is on the way.

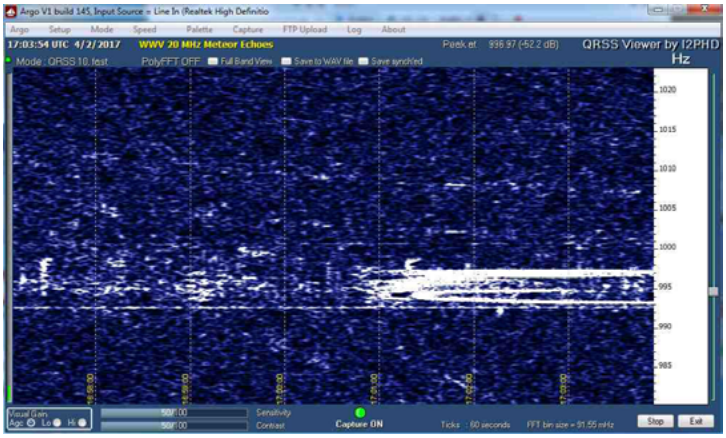
If you're interested in getting involved in the E-Callisto program check out http://www.reeve.com for details on purchasing the Callisto receiver.

I also monitor WWV signals on 20 and 25 MHz for meteor activity and the occasional SID (sudden ionospheric disturbance) which accompanies solar bursts. Here's an Argo chart of a Doppler shift on 25 MHz received here at Roswell on April 1st (below at bottom of column). Not a joke!

It is fairly easy to receive WWV on 5, 10, 15, 20, and 25 MHz and is a low cost way to monitor solar activity during major solar bursts. You can also monitor meteor activity. Here's a chart from April 2 during a significant fade that shows a very long duration meteor echo (below).

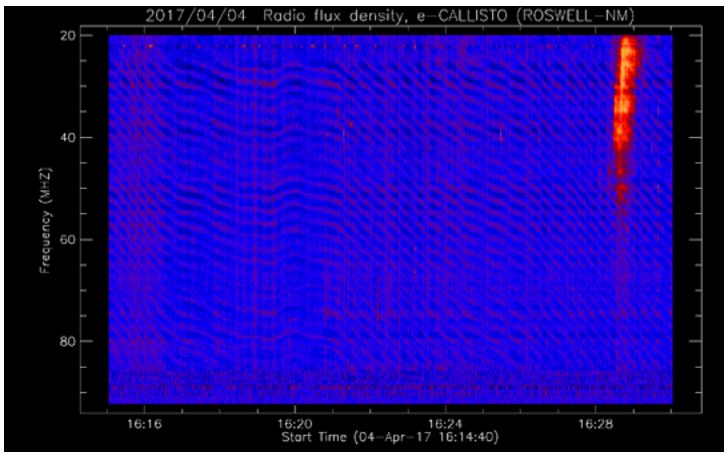
Reader's often have contacted me regarding their interest in meteor monitoring and ask how to find a frequency that works. The usable frequencies with high powered carriers and at reasonable distances from the receiver (500-1500

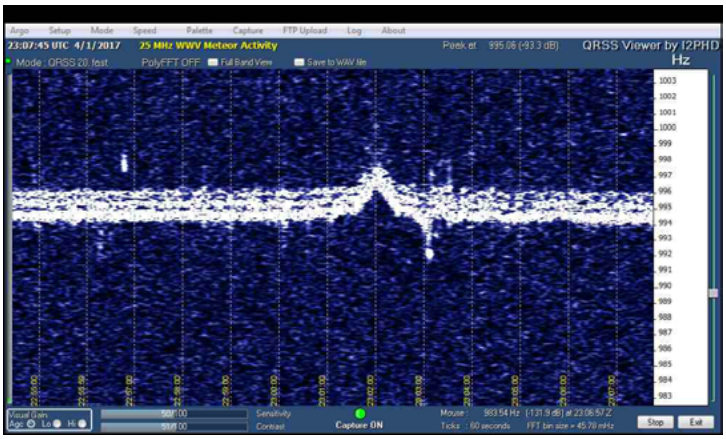
April 2 chart shows significant fade shows a very long duration meteor echo. (Courtesy of the author)



Doppler Shift on 25 MHz as recorded by the author on April 1.

(Callisto image courtesy of Christian Monstein)





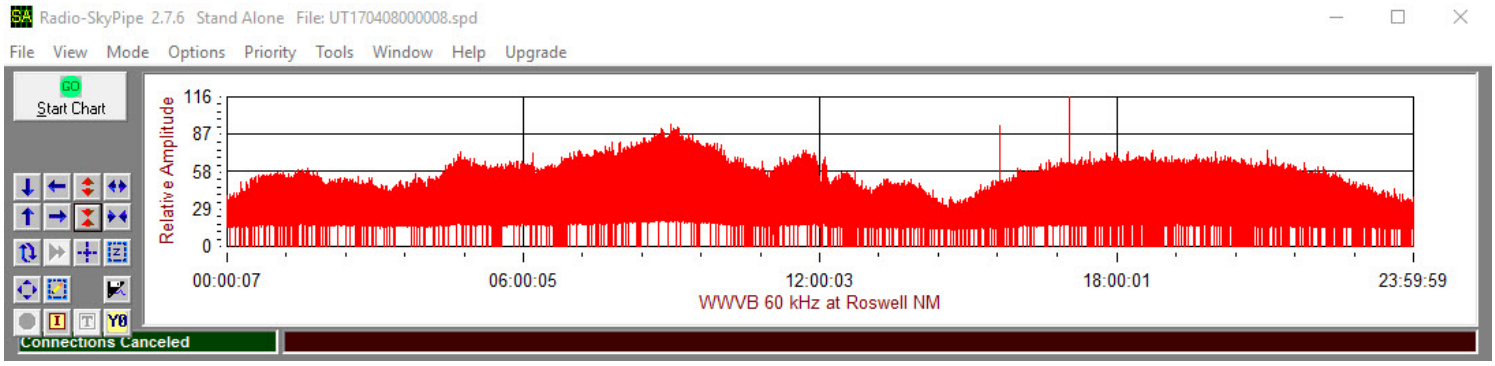


Chart for April 8 recorded with Skypipe II. The receiver is a RF-Space SDR-IQ using Spectravue software. It is running in the CW mode using its filter set for 75 Hz wide with no AGC (automatic gain control.) Sunrise here on April 8 was 12:36 UT and sunset was at 01:23 UT on April 9. (Courtesy of the author)

miles) have been slowly disappearing due to conversion to digital television. You can receive digital carriers but they are not as good as the old fashion RF video carriers.

FM stations have been used and can be useful but tend to be subject to interference from other same channel interference. And no steady carrier to obtain a Doppler shift. FM meteor monitoring essentially listens to a normally unheard station and waits for a sudden increase in the station's signal that lasts as long as the meteor's ionized trail persists, reflecting the signal to your receiver. WWV transmits using amplitude modulation for their time signal services. The 20 and 25 MHz carriers from Colorado have worked well for me. At night the 15 to 25 MHz signals fade, and only 5 or 10 MHz are available for normal listening. Fortunately a meteor echo can be detected even when there's no discernable carrier as apparent in the chart above for 20 MHz.

I don't listen to WWV's audio but detect the carrier with SSB (single side band) which feeds the audio to ARGO software to produce the chart. Modest antennas such as a simple dipole or vertical can work well. The receiver should be stable and capable of good selectivity. I suggest trying 25 MHz first. The nice thing about WWV is they don't have co-channel users in the US. Meteor activity is higher late night and in the early morning hours when the reception of the normal 25 MHz signal is weak or non-existent. That makes it easy to see meteor echoes in the charts.

A few weeks ago, my WWV receivers were down due to software updates. I got an e-mail last month from Matthew Deutch at NIST in Colorado who was wondering what happened to the WWV charts that I upload to **http://www.RoswellMeteor.com**. Nice to have viewers keep me posted. Thanks, Matthew. He is involved in keeping the WWV stations running.

WWVB's 60 kHz time signals is another NIST station that I monitor, looking for the 'possible' impact on the 60 kHz signal by SID events recorded here in Roswell, New Mexico. Here's a chart for April 8 recorded with Skypipe II. The receiver is a RF-Space SDR-IQ using Spectravue software. It is running in the CW mode using its filter set for 75 Hz wide with no AGC (automatic gain control.) Sunrise here on April 8 was 12:36 UT and sunset was at 01:23 UT on April 9.

Sunrise here on April 8 was 12:36 UT and sunset was at 01:23 UT on April 9.

I upload the hourly and daily charts to **http://www.roswellmeteor.com/skypipedata.htm**.

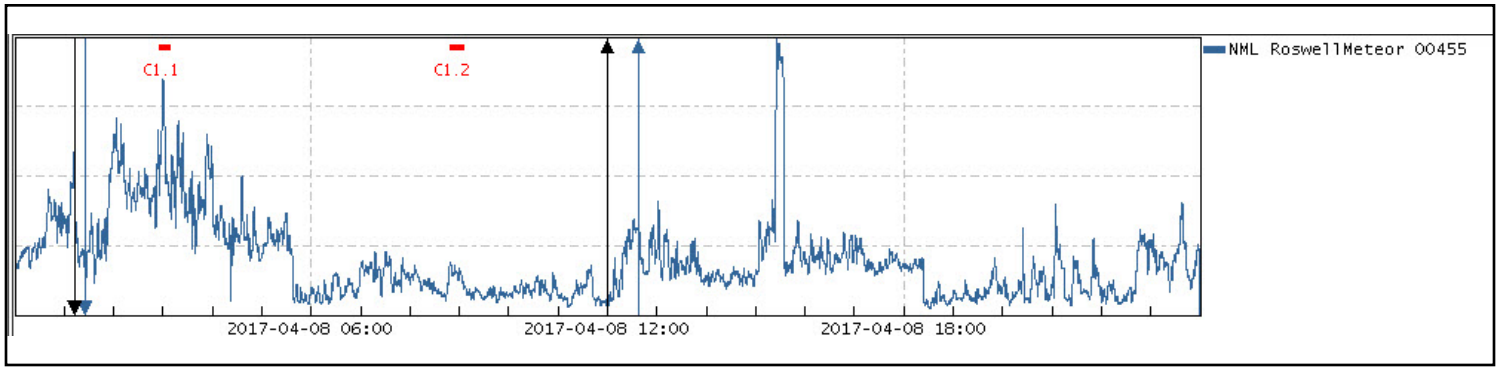
Here's a daily chart of the signal from the 25.2 KHz VLF station NML located in La Moure, North Dakota.

If you would like to see data from other stations from around the world, go to **http://www.standford.edu/database-browser**. The stations are grouped and lately mine are on top. Keep in mind that some of the VLF station's charts are out of range. I am closet to NML.

There are many ways to get involved in radio astronomy. I have often highlighted the more inexpensive approaches such as the SID receiver. It's a great way to learn about the fascinating hobby.

TSM

Daily chart of the signal from the 25.2 KHz VLF station NML located in La Moure, North Dakota. (Courtesy of the author)



The Longwave Zone

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

Introducing a New Band: 630 Meters!

At the tail end of last month's column, I mentioned what may be the biggest news of the year for LF/MF enthusiasts. Late-breaking news had been received that the FCC released a Report and Order (R&O) formalizing rules for U.S. amateur operation in the 630-meter band (472-479 kHz) and a "sliver band" at 2200 meters (136 kHz). Once the new rules are published in the *Federal Register*, we will know the effective date when operation can begin. U.S. hams must not begin transmitting until this occurs, but the R&O puts hams on track to finally join their counterparts in other countries (including Canada) in using these new bands. It has been a very long time in coming!

This month, we'll focus on the 630-meter band, although the R&O covers several other FCC actions. You can view the official notice from the FCC at **http://tinyurl.com/New-LF-MF-Bands**, but in a nutshell, here are the key provisions for 630-meter operation:

- Amateurs in the continental U.S. are permitted a maximum power output of 5 Watts EIRP.
- A 1-kilometer (0.62 mile) separation distance must be observed between radio amateurs transmitting in the new bands and electric transmission lines with PLC systems operating on those frequencies.
- Amateurs are required to notify the Utilities Telecoms Council (UTC) of station location prior to beginning operations. More details on notification procedures should be released soon by the FCC.
- Transmitting antenna height must not exceed 60 meters (approximately 197 feet) above ground level.
- Operation will be available to General class and higher amateurs, and the modes of operation allowed are CW, RTTY, data, phone, and image. Automatically controlled stations are also permitted.

The biggest question at this writing is just when the new rules will take effect. The *ARRL Letter* had this to say about the effective date:

"The fact that the new rules contain a new information-collection requirement — notification of operation to the UTC — makes it difficult to guess at an effective date. The FCC R&O says the Office of Management and Budget (under the Paperwork Reduction Act) must first approve the information-collection requirements (in §97.303[g][2]). Once that happens, the revised Part 97 rules sections will become effective after the FCC publishes a notice in *The Federal Register* announcing such approval and the relevant effective date."

Rudy Severn N6LF has posted his 2014 Sea-Pac presentation online, and it provides a useful introduction to the new 630-meter band. You can download it at http://www.antennasbyn6lf.com/2014/06/index.html (Courtesy: Rudy Severn N6LF)

What took so long for this to finally become reality? There are several factors, but one of the main roadblocks was the objection voiced by the UTC. Several of their members (power utilities) have long operated license-free Part 15 power line carrier (PLC) systems capable of operating in the 630-meter band. PLCs may operate anywhere in the 9-490 kHz spectrum. It was an interesting twist of events because it saw unlicensed stations effectively being given protected status against a licensed radio service. Ordinarily, Part 15 users are afforded no protection whatsoever from harmful interference received, and they must not cause any harmful interference to others.

Experimental tests over many years proved a minimal risk of interference to PLC systems from amateur-type operation in the 630-meter range. In one well-documented study, thousands of transmissions were logged over a multi-year

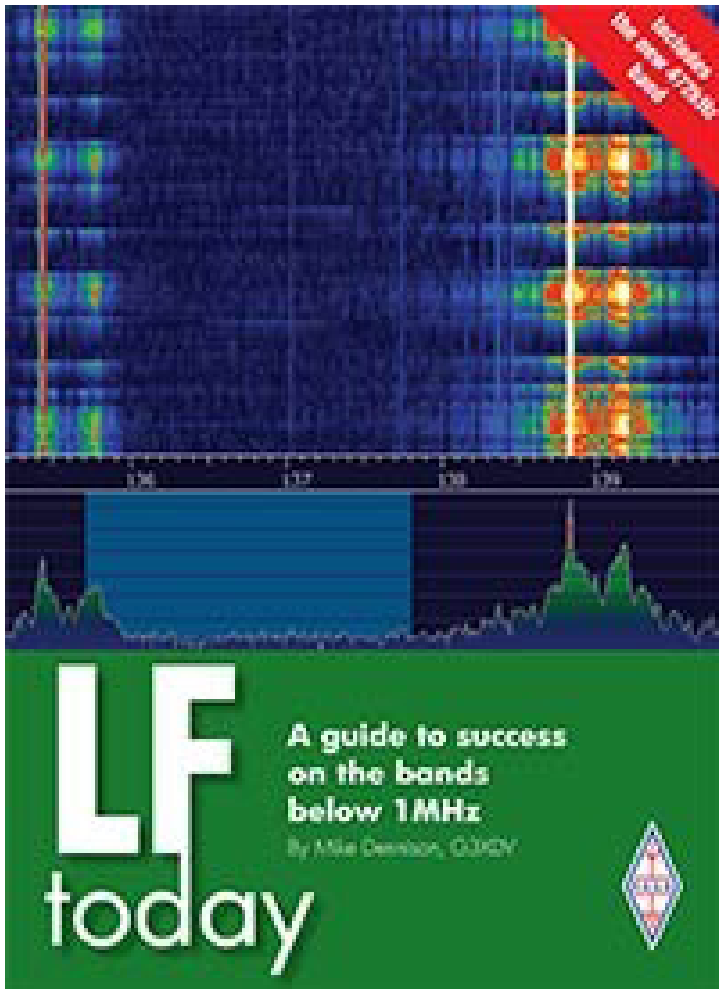
PLCC (Power Line Carrier Communication) transmitter (Wave Traps and Line Matching Units) as used in a power substation. (Courtesy: Zaneth Transformers and Switchgear, PVT. LTD.)

period without a single report of harmful interference. Still, the UTC pressed on with their objections. As an interesting side note, the UTC saw little conflict a few years ago in allowing broadband over power line (BPL) transmissions over unshielded power lines. BPL was a technology demonstrated to cause severe, harmful interference across wide swaths of the radio spectrum, and it eventually collapsed under its own inefficiencies, at least here in the U.S.

With all of the debate behind us, it's time to actually look at operating on this new band. How can you get started? What is needed for equipment? How about antennas? As with any new on-air activity, the best thing you can do at first is to listen. Chances are you already have the equipment needed to do that, and you will learn a great deal about the behavior of the band and operator protocol.

Commercial equipment options will likely be forthcoming for 630-meter, as well as construction articles for building your own transmitting gear. Many of the existing designs for Lowfer or 160-meter transmitters could be scaled to 630 meters fairly easily. The existing literature on low band operation (especially for 160 meters or the 1750 meter Lowfer band) will apply with very little adaption needed for 630 meters. Amateurs interested in operating here would do well to review these resources and learn from them.

A quick word on receiving antennas is in order. Even the best transmitting antenna for 630 meters may be a rather poor choice for receiving work. Large arrays will often deliver strong received signals, but will also collect a lot of noise, especially in the summer months when atmospheric noise tends to be at its peak. For receiving antennas, 630-meter operators will want to look at designs used by serious Broadcast Band DXers. These antennas will include loops, Beverage, and active antennas. As the old saying goes, you can't work 'em if you can't hear 'em!



"LF Today" is a useful guide for transmitting in the bands below 1 MHz. It is available from the publisher, Radio Society of Great Britain (RSGB) at http://tinyurl.com/LF-Today. (Courtesy: RSGB)

Commercially made amplified loop antennas, such as this AOR LA400 ($520), cover longwave frequencies down to 10 kHz. This is an indoor antenna that the manufacturer claims has 20 dB gain. (Courtesy: Universal Radio) http://universal-radio.com/catalog/sw_ant/5051.html

Selected NDB Loggings

Our contributors this month are Richard Palmer (MO), Tom Root (MI), and Russ Hill (MI). Each contributor is identified by their initials and state in the right-most column. My thanks to all for submitting your logs. Loggings are always welcome at the e-mail address in the masthead. Ask for our free template.

kHz	ID	Location	By
198	DIW	Dixon, NC	T.F. (WY)
200	UAB	Anahim Lake, BC	T.F. (WY)
200	YDL	Dease Lake, BC	R.P. (MO)
201	IP	Mobile Lufthansa, AZ	T.F. (WY)
206	AP	Alpena, MI	R.P. (MO)
212	CFV	Coffeyville, KS	T.F. (WY)
212	LIU	Littlefield, TX	R.P. (MO)
216	ME	Matane, QC	R.P. (MO)
218	PR	Prince Rupert, BC	R.P. (MO)
218	RL	Red lake, ON	T.R. (MI)
219	TO	Toledo, OH	R.P. (MO)
220	HUR	Roxboro, NC	R.P. (MO)
223	YKA	Kamloops, BC	R.P. (MO)
223	YYW	Armstrong, ON	T.R. (MI)
224	BK	Baker Lake, NU	R.P. (MO)
225	YIK	Ivujivik, QC	R.P. (MO)
230	NRN	Norton, KS	R.P. (MO)
230	VQ	Detroit, MI	R.P. (MO)
240	MJL	Mejillones, CHL	R.P. (MO)
241	HF	Hearst, ON	T.R. (MI)
242	XC	Cranbrook, BC	T.F. (WY)
245	FS	Sioux Falls, SD	T.F. (WY)
245	MG	Montgomery, AL	R.P. (MO)
248	WG	Winnipeg, MB	T.F. (WY)
250	FO	Flin Flon, MB	T.F. (WY)
254	EV	Inuvik, NT	R.P. (MO)
254	MB	Manistee, MI	R.P. (MO)
257	MB	Saginaw, MI	R.P. (MO)
257	YXR	Earlton, ON	T.R. (MI)
260	AP	Denver, CO	T.F. (WY)
260	SNE	Santa Elena, TX	R.P. (MO)
266	VR	Vancouver, BC	R.P. (MO)
272	XS	Prince George, BC	R.P. (MO)
275	R1	Thetford Mines, QC	R.P. (MO)
278	HFF	Camp Mackall, NC	R.P. (MO)
287	YSF	Stony Rapids, SK	R.P. (MO)
290	YYF	Penticton, BC	T.F. (WY)
302	HO	Huron, SD	R.P. (MO)
308	ZZD	Edmonton, AB	R.P. (MO)
312	UNT	Penticton, BC	R.P. (MO)
317	VC	La Ronge, SK	T.F. (WY)
320	9V2542	West Intrepid, Gulf	R.P. (MO)
323	GR	Fort Hood, TX	R.P. (MO)
326	FC	Fredericton, NB	R.P. (MO)
326	UOT	Union, SC	R.P. (MO)
329	CH	Charleston, SC	T.R. (MI)
329	YHN	Hornepayne, ON	T.F. (WY)
332	PH	Port Huron, MI	R.P. (MO)
332	QT	Thunder Bay, ON	T.R. (MI)
334	UU	Corinth, MS	R.P. (MO)
335	CVP	Helena, MT	T.F. (WY)
335	YLD	Chapleau, ON	T.R. (MI)
338	TU	Tulsa, OK	R.P. (MO)
339	6X	York Landing, MB	R.P. (MO)
340	JES	Jesup, GA	R.P. (MO)
340	YY	Mont-Joli, QC	R.H. (MI)
341	DXX	Madison, MN	R.P. (MO)
341	YYU	Kapuskasing, ON	R.H. (MI)
344	FCH	Fresno, CA	T.F. (WY)
346	JXT	Morristown, TN	R.P. (MO)
346	YXL	Sioux Lookout, ON	R.H. (MI)
350	D7	Kincardine, ON	R.P. (MO)
350	NY	Enderby, BC	T.F. (WY)
350	RG	Oklahoma City, OK	T.F. (WY)
353	IN	Int'l Falls, MN	T.F. (WY)
356	ZF	Yellowknife, NT	R.P. (MO)
358	CKC	Grand Marais, MN	R.P. (MO)
360	PN	Port Menier,QC	T.R. (MI)
362	RPX	Roundup, MT	T.F. (WY)
362	SB	Sudbury, ON	R.H. (MI)
362	YZS	Coral Harbour, NU	R.P. (MO)
365	AA	Fargo, MN	T.F. (WY)
365	PAL	Palma, EQA	R.P. (MO)
365	YGZ	Grise Fiord, NU	R.P. (MO)
366	YMW	Maniwaki, QC	T.R. (MI)
368	SX	Cranbrook, BC	T.F. (WY)
369	ZDX	St. Johns, ATG	R.P. (MO)
370	YBV	Berens River, MB	T.F. (WY)
371	ITU	Great Falls, MT	T.F. (WY)
371	UK	Ukiah, CA	T.F. (WY)
372	YCO	Kugluktuk, NU	R.P. (MO)
374	EX	Kelowna, BC	R.P. (MO)
375	CP	Casper, WY	R.P. (MO)
376	K2	Olds-Didsbury, AB	R.P. (MO)
378	RJ	Roberval, QC	T.R. (MI)
378	UX	Hall Beach, NU	R.P. (MO)
382	YPL	Pickle Lake, ON	R.H. (MI)
383	CN	Chappell, NE	T.F. (WY)
384	JB	Lumberton, NC	R.P. (MO)
388	MM	Fort McMurray, AB	R.P. (MO)
390	JT	Stephenville, NL	R.H. (MI)
392	ML	Charlevoix	T.R. (MI)
392	ML	LaMalbaie, QC	R.H. (MI)
396	UV	Martinsville, VA	R.P. (MO)
397	AIT	Aitkin, MN	R.P. (MO)
400	CI	Sault Ste. Marie, MI	R.H. (MI)
401	YPO	Peawanuck, ON	R.H. (MI)
404	MOG	Montague, CA	T.F. (WY)
407	HCD	Hutchison, MN	R.P. (MO)
407	ZHU	Montreal, QC	R.H. (MI)
408	MW	Moses Lake, WA	T.F. (WY)
410	EGQ	Emmetsburg, IA	T.R. (MI)

413	YHD	Dryden, ON	R.H. (MI)
414	FDW	Winnsboro, SC	R.P. (MO)
420	FQ	Fairmont, MN	T.F. (WY)
521	RPK	Middlesboro, KY	R.P. (MO)
523	JJH	Johnstown, NY	R.P. (MO)

Contributor's Information

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

Russ Hill (MI)
Receiver(s) Used: Kenwood R5000
Antenna(s) Used: Palomar Loop

Tom Root (MI)
Receiver(s): ICOM R-75
Antenna: Clifton Z1501F active antenna with a 10 foot (3.05m) whip; the antenna base is ~12'7" (3.84m) above earth ground.

Tom Filecco (WY)
Receiver(s) Used: Icom R-75
Antenna(s) Used: 150-foot (45.72 meter) longwire

I also received some additional logs from Robert Harvey K2PI. For these loggings, Robert is using an Afedri SDR-Net receiver (software defined) with BCB reject filter, a 500-foot (152.4m) Beverage antenna at 8 Ft. (2.43 meters) height, and a DX Engineering Preamplifier. He is running HDSDR software with his receiver.

kHz	ID	Location
219	YMG	Manitouwadge, ON
334	LH	Bloomington, IL
338	DE	Detroit, MI
346	THJ	Laurel, MS
349	GW	Greenwood, MS
350	NY	Enderby, BC
350	DF	Deer Lake, NL
353	IN	Ericsburg, MN
355	YWP	Webequie, ON
365	AA	Harwood, MN
370	YBV	Berens River Apt, MB
385	WL	Williams Lake, BC
390	JT	Stephenville, NL
413	YHD	Dryden Regional, ON
415	CBC	Cayman Brac, CYM
417	IY	Floyd, IA
420	V7BE3	Gulf Of Mexico, TX
266	YFH	Fort Hope, ON

TLZ Link of the Month

This Wikipedia link (below) provides a back-to-basics, comprehensive look at the longwave spectrum, even taking a look at what the definition of "longwave" really means (definitions do vary somewhat). It includes a tabular listing of longwave broadcast stations—both past and present—from around the world. Be sure to check the external links at the end of the article for some interesting side-trips. This Wikipedia link should be required reading for all longwave enthusiasts!

https://en.wikipedia.org/wiki/Longwave

272	RU	San Marcos, TX
341	CQN	Chattanooga, TN
369	ZDX	Saint Johns, Antigua
326	FC	Fredericton, NB
268	UBY	Bayamo, Cuba
366	3R	Postville, NL
227	CLD	Caldera, Chile
391	DDP	Vega Baja, PR
332	FIS	Fish Hook - Key West, FL
344	JA	Dinnsmore, FL
309	GPI	Guapi Apt, Col

Adventures in Radio Restoration

By Rich Post KB8TAD **kb8tad@gmail.com**

Philco 48-360: Last of the "Woodie" Portables

Last month we looked at a Philco 46-350, advertised as "By actual test, the most powerful, greatest performing portable radio ever built." That was the 1946 model. Two years later, it's time for the 1948 models. How do you top that ad and the product, especially since over 220,000 of that model were sold? Well, you don't. Instead you try to improve the radio in a few less conspicuous ways. The improved version was given model number 48-360. It retained that popular tambour cover, spring-loaded the stay-flat belt, and changed the trim on its sides to simulated alligator in place of simulated leather. It also changed the audio output tube to a loctal version, the tube style favored by Philco in other sets, changed the mechanical design of the rather unhandy battery changeover mechanism, and made the rear cover fully removable. It also eliminated that closed-circuit antenna connector, leaving just one hole on the right side as a pass-through for an external antenna in place of the three holes in the older model.

A newspaper ad in August 1947 mentioned it as "The Great New Philco Powerful Portable" along with other Philco offerings. Unfortunately, the price also had to be increased to $49.95. New thermoplastics were being popularized, making radios lighter and cheaper to manufacture.

To combat the increase in price, Philco introduced a second three-way portable, model 48-300 priced at $39.95. It was cheaper to make, eliminating both the tambour door and that extra tuned radio frequency stage that had made the radio a standout in sensitivity. The pre-Christmas ads in 1947 magazines such as *Life* only touted the cheaper model, likely expecting dealers to up-sell to the more sensitive and handsome tambour door model for only $10 more. However $10 in 1948 would be a bit over $100 in today's dollars.

So what happened to sales of the now more-expensive tambour-door portable? Instead of over 220,000 like its older sibling, only 13,500 were sold. By contrast the new cheaper model sold more than three times that many. And that was the beginning of a major shift in portables, going to plastic in place of wood. Cheaper and lighter were both advantages in portable sets. And that makes the 1948 version of the tambour-door Philco portable much more difficult to find for a collector but shows a unique turning point in the history of broadcast-only portables. It was the last of the obviously

Philco 48-360 "Woodie" ready for another weekend getaway! (KB8TAD photo)

real wood portables. It joined the real-wood speedboats and "woodie" station wagons into history, although alongside those items, it likely played music throughout that time, from Big Band to the Beach Boys.

My 48-360

I hadn't looked at it carefully before buying, assuming it was just a 46-350 in very nice cosmetic condition. The inside looked almost new. It wasn't until I looked at it more thoroughly that I saw the model number printed on the chassis. As mentioned last month, the Philco service bulletin for this set is an excellent repair guide with an easy-to-read two-page schematic.[1] Like the older model, it uses the same 1.4 volt tubes except for substituting a 3LF4 loctal audio output for the 3Q5 in the 46-350. Although not indicated in most service literature, Philco had already begun substituting the 3LF4 in some late production runs of the model 46-350, possibly the Canadian version.

I was eager to begin restoring the set. The first act was a thorough inspection for any previous repairs. I immediately noticed that one of the four nuts holding the chassis to the cabinet was missing. Those nuts are admittedly difficult to mount. For the 46-350, I used by small magnetic pickup

The cheaper competition, Philco December 1947 ad for model 48-300. (Author's collection)

tool to carry the nuts to the four captive bolts, starting the nuts for a turn or two with the magnetic tool before using a proper socket driver. The missing nut indicated that someone may have worked on the chassis before me. However, after removing the chassis, I did not find any evidence of component changes.

The Candohm resistor, which drops the voltage from B+ down to the 8.5 volts for filaments, was in good condition. The power cord was totally dry and cracking. I cut it off, tossed it, and then checked to see which of the power cord wires led to the B-. Unfortunately, this was a "code 122" version which added a separate switch section to cut off both sides of the power line in the event of battery operation, likely to satisfy Underwriters Laboratories. However, in the process Philco wired the volume control power switch to switch the B-. There was no easy way to make the chassis somewhat safer using a polarized cord and hardwiring the neutral to B- as I had done with model 46-350. Instead I opted to replace the cord with an ALCI (Appliance Leakage Current Interrupter) recycled from a hair appliance.

Another 15 Capacitors

Replacing the 15 dry capacitors in this tight chassis,

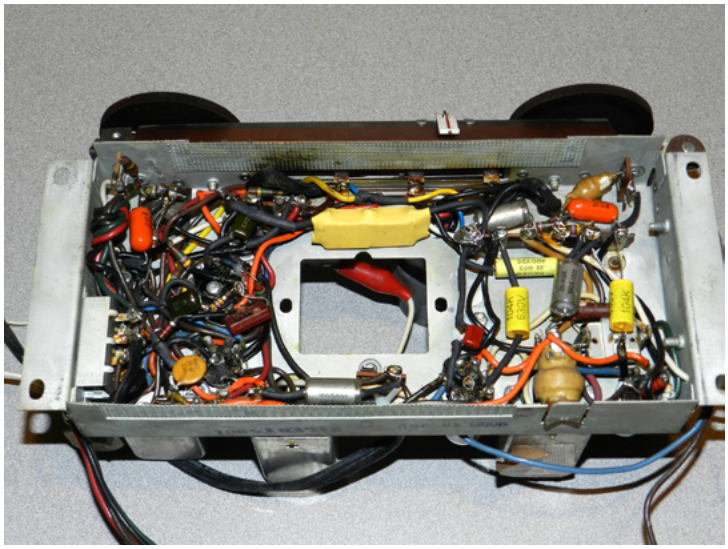
Clean interior as purchased but notice the cracked and taped power cord. (KB8TAD photo)

that requires leaving room for the speaker, was as much of a chore as with the 46-350. I had run out of 0.004 uF capacitors. However, I remembered that that value was common in CFL bulbs. Sure enough, I found a couple of tiny 4200 pF caps that were rated at 1200 volts. Just to be sure, I tested them for leakage at the maximum that my Sencore LC-75 would allow, 600 volts. As expected the caps easily passed the test—not surprising as I have yet to find a bad cap in any of the CFL bulbs I have dissected. I looked for the special single turn "gimmick" choke on a capacitor in the AVC line but this chassis did not have one. The parts list mentions C-403 ("condenser and choke assembly, IF bypass, .01 mf."), but that cap did not have the gimmick choke.

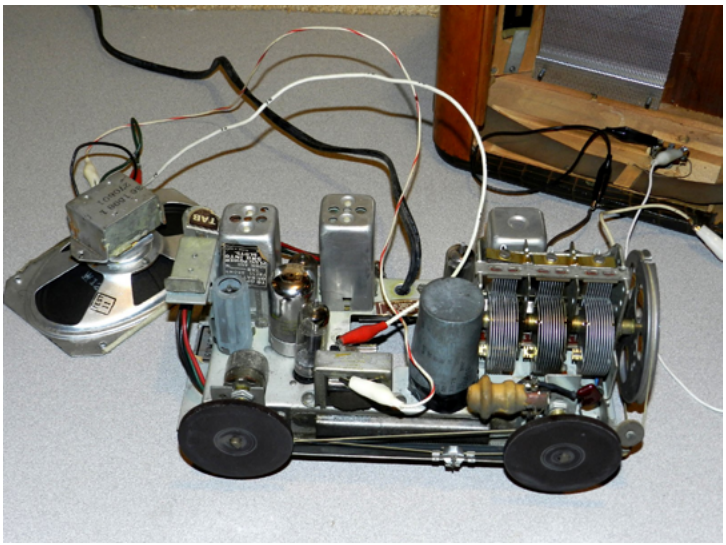
An Encapsulated Philco Electrolytic

The four-section electrolytic reminded me of the components from Philco's earlier days. It consisted of four electrolytics inside a metal shell that is not connected to B- but was completely encapsulated in pitch just like Philco's Bakelite capacitor blocks of the 1930s (see the *TSM* September 2016 column).

I tried some drilling to remove the pitch and contents but was afraid of destroying the very thin metal shell. I ended up making a simple wire harness looped around the two mounting bolts of the metal shell, pulling on the original cap wires and the wires of the harness in opposite directions. Heating the cap thoroughly with the heat gun finally allowed me to pull the contents out of the metal shell. The contents had been wrapped in a paper liner. I cut a similar cardboard inner lining for the shell and dry fitted three 33-uF electrolytics inside. I had run out of 10-uF electrolytics but remembered that smaller CFL bulbs used a 10-uF while most larger ones used a 22-uF electrolytic. I opened a small CFL bulb for its 10-uF at 200 volt cap and placed that inside the Philco shell. The four electrolytics were held into place to the cardboard liner using some hot-melt glue, and the assembly was again bolted to the chassis.



Chassis with new capacitors. (KB8TAD photo)



Testing the 48-360 on the bench. (KB8TAD photo)

First Power-Up

After wiring in the electrolytics and the X-rated capacitor, I inspected the work carefully and powered the chassis as I had the 46-350, checking to make sure that B+ was present but that the set was not drawing excess current. I then checked for the filament voltage. That voltage measured 8.5 with 118 volts AC input. That meant over-voltage at the more typical 122 at my house. I would have to address that. The radio played well at the 118 volts. A bit of alignment tweaking made a major difference however. This set was as sensitive as the 46-350.

***Rider* Describes the IF**

Was there anything special to enhance this set's sensitivity that was not obvious? My curiosity was piqued. The answer was found in *Rider's* Volume 18 "How it Works" in the section "Unusual I-F Amplifier Circuits."[2]

According to *Rider,* "In a battery-operated receiver, particularly a portable one, the power available to operate the tubes is much less than in a set operating from a 110 volt line. As a result, tubes used in portables are incapable of providing the sensitivity obtainable from the 6.3-volt heater-type tubes. In order to overcome this handicap to some extent, positive feedback is used in the IF amplifier of the Philco model 48-360 to increase the gain of this stage. ... In the model 48-360, the positive feedback is controlled and performs a useful and desirable function. The manner in which positive feedback is obtained in the model 48-360 is shown in Fig. 3. An extra winding, called a tertiary (third) winding, on the second i-f transformer, Z301, applies a signal to the screen grid of the i-f amplifier tube. The signal applied to the screen through the transformer is shifted 180 degrees in passing through the transformer, so that it is in phase with the signal at the control grid. In this way, the screen signal is of such a polarity that it increases the effect of the control grid on the tube. Thus, when the control-grid signal is positive, increasing the flow of electrons to the plate, the screen signal is also positive, further increasing the flow. In addition, the screen-grid signal amplitude is proportional to that on the control grid, so that the effect of the control-grid signal is increased without distorting it. Likewise, when the control-grid signal goes negative, the screen-grid signal goes proportionately negative, increasing the effect of the control-grid swing in this direction. By a proper choice of turns ratio and coupling between the primary and tertiary of Z301 the positive feedback is maintained at a level insufficient to produce oscillation. Thus, controlled positive feedback is used to attain the desired goal of increased gain."

So, apparently Philco did indeed have some bragging rights. I checked the older model 46-350 and found that it also had the tertiary winding connected to the screen grid. That circuit might also explain the gimmick choke originally designed into that model. It was part of the IF bypass circuit, probably there to prevent oscillation in the high-gain IF stage.

Zener Filament Protection

Before buttoning up this set, I decided to look into the problem of limiting the filament voltage without simply adding another resistor in the chain. In the *TSM* November 2015 column, "Powering and Testing the Zenith Trans-Oceanic G-500," I mentioned wiring a Zener diode across the filament string to limit the filament voltage to the Zener level adding an ordinary diode or two to extend the Zener voltage a bit. I decided that this set warranted such an improvement.

I found a Zener at 8.2 volts nominal that actually measured at 8.25 volts when wired between the filament source at the low end of the Candohm and B-. I could have extended that with a diode such as a 1N4007 to add about half a volt but the radio played very well and the voltage stayed constant when adjusting the input AC voltage from 118 to 126. The Zener would also limit the voltage in the series string if one of the filaments were to open.

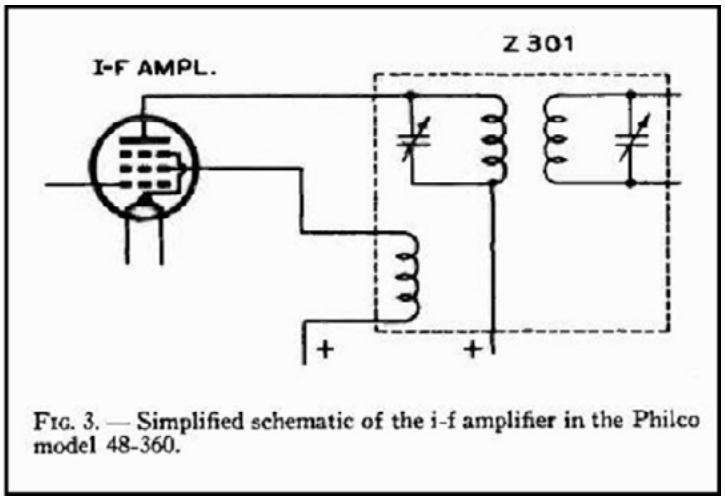
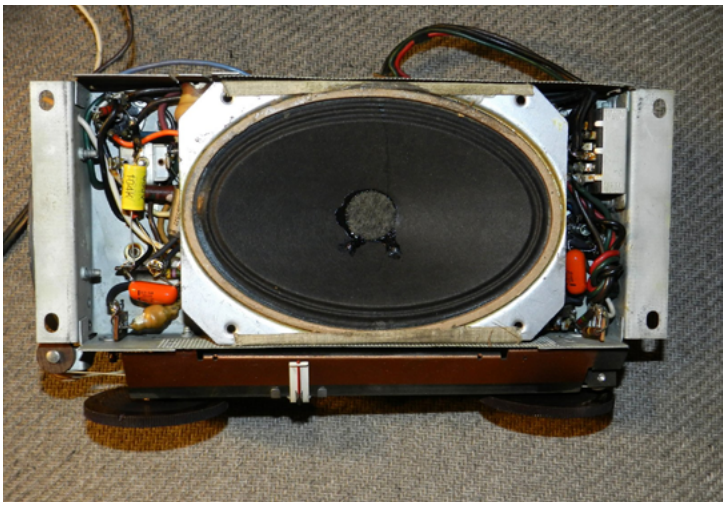


Fig. 3. — Simplified schematic of the i-f amplifier in the Philco model 48-360.

Rider "How it Works" simplified schematic of the IF in the Philco 48-360. (Author's collection)



Speaker back into place on the crowded 48-360 chassis. (KB-8TAD photo)

After further cleaning, I mounted the chassis back into the case, using a piece of rubber tubing on the end of a screwdriver as a simple nut starter to get to those hard-to-reach captive screws. I then tweaked the alignment according to the Philco instructions and enjoyed listening to a very sensitive broadcast portable.

External Antenna Connection

Both of the tambour door models have a wire that is connected to the chassis when using the internal loop antenna, but that wire is designed to be used with an external antenna. The 1948 model has a single hole in its side for that wire. Both models use a separate RF transformer for an external wire antenna. The low end for the input side of the RF transformer is grounded to the chassis through a 1500 pF capacitor. Given the AC-DC nature of the set, there is no provision for an external ground and one should not be attached but the ability to connect to an external antenna makes for a very versatile portable. When not connected to an external antenna, that extra wire should remain grounded to the chassis.

Battery Connector and Substitutions

I tried to locate a matching female socket for the battery plug but could not find one. However, the pin spacing matches that of an octal tube. Since the large off-center pin of the plug is just a locator key and not connected, an octal tube socket with the extra holes and most of the key-way blocked with some hot melt glue would match that plug very well. An A-B battery could easily be built up from ten 9-volt batteries in series for the "B" source and a set of six AA, C, or D cells in series for the "A" source. The original Philco battery provided 9 volts for the "A" side from carbon-zinc cells but alkaline cells might provide a bit more voltage than desirable under load. One simple solution for that extra voltage is to wire a diode in series with the output of the alkaline cells. When the cells weaken a bit, that diode can simply be shorted out. Modern "heavy duty" batteries can be used in place of alkaline since they are cheaper and would more closely match the original batteries. The Philco P-841A is the A-B battery specified for the two tambour models. The artwork for the Philco P-361 battery is nearly identical and is available as a free download on the web.[3] That artwork would be a nice enhancement to a custom battery box.

The tambour models are fun to use especially for broadcast DXing. Thanks to Rider's explanation, it appears Philco's boast in its ads may indeed have some validity. Let me know how you have used yours. Comments and questions to kb8tad@gmail.com

Notes:

(1) Philco 8 page service bulletin for Philco Model 48-360 in djvu format. **http://audiophool.com/Philco.html** page down to 48-360

NostalgiaAir has an on-line copy of *Rider's Perpetual Troubleshooter's Manual* pages for Model 48-360. The pages are the same Philco bulletin in lesser quality but in PDF format **http://www.nostalgiaair.org/Resources/633/M0013633.htm** Model 48-360 is also covered in detail in SAMS Photofact Folder 488-14

(2) *Rider's* Volume XVIII -"HOW IT WORKS" http://www.americanradiohistory.com/Archive-Rider/INDEX/Index-16-18.pdf

(3) Philco 361 battery scans by Hunter Compton and hosted by Steve Byan **http://www.byan-roper.org/steve/steve-at-play/antique-electronics-and-2/hunter-compton-battery.html** Philco P-841A battery is 9 ½-inches long x 4 ¼-inches wide x 2 5/8-inches thick.

TSM

Antenna Connections

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

Balanced Feedline: Ace in the Hole

Welcome back, my friends. This month, let's look again at the mighty flexibility of balanced feedlines, and examine their advantages over coaxial cable. You'll find, if you haven't already, that your antenna columnist is a great proponent of balanced feedlines. And, why not? The advantages over coaxial cable are numerous.

In This Corner: Coaxial Cable

First let's establish the nature of coaxial cable. All feedlines—except single-wire feed, which can be considered as part of the antenna, not a separate component—are two-wire conductors. With coax, these two conductors are thought of as "hot" and "ground," a center, insulated "hot" conductor, separated by a dielectric from, and surrounded by, a braided shield—the "ground." Thus coax is an "unbalanced" feedline—a hot and a ground.

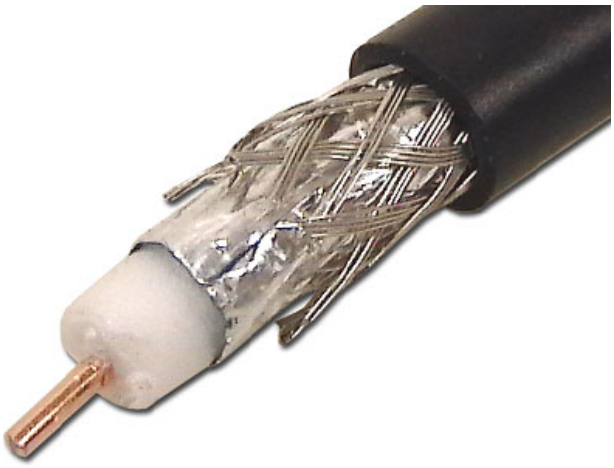
It's important to visualize that this outer shield contains the center conductor completely throughout the cable's length. The cable can be thought of as a long, slender, tubular capacitor, whose dimensions and dielectric define the cable's impedance.

Coaxial cable certainly has some advantages as a feedline. It has a neat, sleek appearance, can be run alongside of, or even taped to, guttering and any other metalwork. You can bend it easily and not affect its function.

Most of our radio journey is certainly built for 50-ohm coax. Radio antenna connections are routinely 50 ohms. The two commonest antennas, the fathers of all the others, namely the half-wave dipole and the quarter-wave vertical, normally show impedances at or near their resonant frequency ranging from 30 to 70 ohms. Coax can generally handle this situation quite well, where a 1 to 1 match is right in the middle of this range and even worst case is only 1.4 to 1.

For antennas outside this range, like the driven element of a Yagi, a family of matching networks exists to show the 50-ohm coax a similar situation, near the antenna's resonant frequency. It is common to speak of an "SWR bandwidth" for a given antenna, usually 2 to 1, meaning the frequency range over which the antenna shows 2 to 1 or less SWR. Obviously, the wider this SWR bandwidth is, the more of that band we can operate on.

Ah hah! It's time to talk about SWR—the Achilles heel



The business end of coax: center conductor, dielectric, braid, outer jacket. (Author's photo)

of coaxial cable. With a matched or nearly matched situation, the cable works fine. As mismatch grows, however, the cable begins to heat up; the long slender capacitor has become a liability; the "trapped" center conductor cannot escape its confinement inside its grounded "cage." The dielectric separating the center conductor and the braided jacket is very thin, so the reflected power quickly begins to build up heat between the conductors. Less and less power reaches the antenna; the cable is busy trying to self-destruct. At high enough power levels, and a large enough mismatch, the cable will punch through between the two conductors and that's all she wrote. Whew!

Regaining Our Balance

Now, consider "balanced" feedline. Instead of a hot conductor completely surrounded by a ground conductor, we now have two hots. Two identical conductors are run parallel throughout their length, at a specific spacing, which, along with the nature of the dielectric material, gives the line its characteristic impedance. Smaller spacing yields lower impedance, while greater spacing imparts higher impedance. Here are the general range of impedances for common feed lines: zip cord (two-wire AC cord) is around 100 ohms; twinlead, the thin, flat stuff about a half inch wide, is nominally 300 ohms; the very popular "windowed" line, which many of us call ladder line, is about 450 ohms; true ladder line, com-

Common "windowed" line, feeding a big dipole. (Author's photo)

Homemade ladder line, with bare #12 wires. (Photo by author)

monly a pair of #12 or #14 wires with spacers between every so often, usually in the neighborhood of 600 ohms.

The really crucial aspect, though, is that both conductors are "free," which is to say that neither is enclosed by the other. So when SWR does appear due to a mismatch, the reflected power isn't a factor; with the balanced line essentially lossless regardless of SWR, the forward power reaches the antenna, ah, unimpeded. (Sorry, bad pun.) This also means that the discussion of balanced line impedances a paragraph ago is largely meaningless; the nearly lossless line delivers the signal regardless. The real significance of conductor spacing in a balanced line is power-handling capability; six-inch wide homebrew ladder line can handle a lot more power than, say, half inch twin-lead, simply due to the far greater spacing, plus the fact that the dielectric of the homebrew ladder line is almost entirely air, while with the twin-lead it is entirely plastic. Also, the conductors of twin-lead are typically #18, or even smaller, while the robust ladder line is usually built with the much larger #12; which also increases power-handling capability. Recall that the larger conductor can carry the larger current.

The real "beware" with balanced line is that you must avoid running it near any metal surfaces; I have found that letting ladder line sit too close to the metal frame of my kitchen window interferes with its operation. (This window is directly above my basement operating position.) It needs to be run as straight as possible, without bends or loops, to work well. Also, true ladder line, made with bare wire conductors, must not be allowed to twist in the wind, as it can easily short itself out. If these minimal warnings are heeded, balanced line is your ticket to cheap, simple multiband operation.

The key to this scenario is a tuner right at the operating position, a tuner with an onboard balun. Generally the WIRE (or RANDOM) output of the tuner is jumpered to one of the BALANCED connections, and the balanced feedline is connected to the two BALANCED connections. It's important to realize that this tuner adjusts the SWR only on the short run of coax linking the radio and tuner. With balanced line, this is just what we want; we want the radio to see 50 ohms, or 1 to 1 SWR, so that maximum signal is delivered, while the SWR on the balanced line is meaningless.

This is why a tuner at the radio end is worse than useless with a coax-fed antenna; we may be able to easily adjust the tuner to show a 1 to 1 SWR on the short run of coax to the radio, but the mismatch on the coax to the antenna may be tremendous. It would be disheartening in the extreme to blow good coaxial cable in two when we thought we were running at 1 to 1, not to mention the ever-growing disillusionment of no one answering CQs or hearing our replies to theirs, while our poor mismatched coax slowly heats up the neighborhood.

A partial solution exists nowadays in the remote tuner. Located at the antenna feed point and connected to the rig by coax, the remote tuner can be thought of as a super turbo-matching network, always showing the coax to the radio an SWR at or near 1 to 1. There are "bewares" and limitations here, too; weatherproofing is definitely an issue to consider, as well as the laws of physics—one can mount, or even bury, such a tuner at the base of a vertical, but so far I haven't seen or heard a lot about dangling one in midair at the feed point of a big dipole, for example.

Sigh! Such fuss and bother! If you are an HF operator, or an SWL, simply put up the longest dipole you can, feed it with balanced line, equip yourself with a tuner at the shack end, and get set for one very effective and very inexpensive multiband system.

Generally, at all frequencies where the dipole is at least a quarter-wave long, the system will find a 1 to 1 match to the radio. In very rare cases, usually on a single band, a match is hard to find; simply adding a few feet of length to the balanced line (you can coil it on the floor) usually resolves this issue. Yep, you guessed it; at some frequency the feedline is exactly a half-wave long, and the tuner doesn't

MFJ-993BRT IntelliTuner™ ($270) covers 1.8 to 30 MHz. It handles 300 Watts SSB / 150 Watts CW and matches 6 to 1600 Ohm antennas. It features heavy duty 16 Amp / 1000 Volt relays and a highly efficient L-network. This tuner includes the MFJ-4117 BiasTee Power Injector to send DC/RF down your coax. (Text and graphic courtesy of Universal Radio)

My trusty MFJ 969 tuner, which has loaded up some really crazy loads 160 through 6 meters. (Photo by author)

like it at all. Another thing the tuner doesn't like is attempts to fudge the "at least a quarter-wave long" guideline for the dipole; trust me, if you try to load up a 100 foot dipole on 160 meters, running no more than 100 watts, the capacitors in the tuner arc and sizzle savagely; at a huge enough mismatch, the RF voltage can easily reach several thousands of volts, usually more than the capacitors are designed for. These large RF voltages also appear in the "feedline a half-wave long" scenario.

But these are minor inconveniences compared to the wonder of working every HF band with a single antenna. Even in a situation where you can only put up a dipole 33 feet long, this system still gives you every band 40 through 10 meters—and six meters, too, if your tuner can cover it. (My MFJ 969 tuner handles six meters nicely.) Contrast this with the coax-fed dipole, with adjusting the length to get resonance near a preferred frequency, and not always being able to cover all of this…one band. That's right, the 33 foot dipole that gave you 40, 30, 20, 17, 15, 12 and 10 meters with balanced line, will only give you 20 meters with coax. Seems like a simple choice…indeed, at higher frequencies where the dipole is long in terms of wavelength—for example, a 66 foot dipole is about four half-waves long at 10 meters—the dipole begins to show some real gain and directivity, with lobes more in line with the wire and less broadside to it, as they are with a half-wave dipole. This is a point for SWLs to consider too; this "poor man's beam" can put entities in your log your radio couldn't hear on the half-wave dipole, much more cheaply than a farm of dipoles or other coax-fed multiband SWL solutions.

Another point to realize about balanced line is that, besides being virtually unaffected by SWR, it is also usable at very high frequencies, like VHF and UHF. One more limitation of coax is how rapidly losses begin to mount as we go up in frequency, even with a matched situation. If we have an array of 432 MHz Yagis on a tower, and the run of coax to the radio is, say, 120 feet or so, we will lose significant power in the long run of coax even if the array is matched to 50 ohms. A common method of getting around this is to make the long run with ladder line instead, and use the appropriate balun at each end of the ladder line (for example, a 9 to 1 balun matches 450-ohm ladder line to a 50-ohm radio). Thus balanced line demonstrates its superiority again, even with no mismatch to consider.

Yet another aspect of ladder line, such as twin-lead or windowed line, is that you can make a sweet antenna out of it. Recall that a folded dipole is actually a loop folded down into a long and very narrow rectangle. With ladder line, you've already got the folded dipole built; short the wires together at the ends, cut into one conductor at the center of the folded dipole's length, and connect ladder line as a feedline. My tests of this setup reveal a more broadband antenna than the simple dipole fed with ladder line; in other words, you can move farther in frequency without retuning. It is also slightly quieter on receive, although the difference is not significant. Here again, SWLs, take note; this is a great "bang for the bucks" setup for the devoted listener.

Ta-Da!

Once again your antenna columnist has set out the advantages of balanced feedline. I realize that it cannot be used in all situations. Where it can, though, it is a proven and reliable performer. Get yourself a tuner, put up a random dipole fed with balanced line, and discover the joys of multiple bands on a single antenna!

That's all for now, boys and girls. Join me here in June as we delve ever deeper into the world of antennas. Stay safe out there, and happy operating!

TSM

Radio Horizons

Product Announcements of Interest to *TSM* Readers

Icom America's New D-STAR Transceiver Now Available

Icom 4100A mobile D-STAR VHF/UHF transceiver (above). Screen shots show GPS position and local repeaters. (Courtesy: Icom)

KIRKLAND, Wash. (May 2017) - Adventure awaits with the new Icom ID-4100A VHF/UHF Dual Band Transceiver. A compact and smart design, this is the perfect D-STAR companion with its intuitive interface and full dot-matrix display. Expand D-STAR communications today with Icom.

The ID-4100A offers a variety of operating modes. Access the D-STAR repeater network via the internet, regardless of location or conditions, with Terminal Mode or Access Point Mode. Easily search for repeaters with the DV/FM Function and communicate with ease with the DR and Reflector Functions.

Improve operation and communication, while using this smart device and Bluetooth®. The RS-MS1 applications for IOS™ and Android™ devices allow a wireless connection to the ID-4100A. DV modes allow for sending photos from a smart device or syncing with a map application. Plus the optional VS-3 Bluetooth® headset provides hands-free communication.

Other Features Include:

- Integrated GPS Receiver
- Wideband Receiver
- microSD Card Slot for Voice & Data Storage
- Selectable Backlight Color (White, Green, Amber & Blue)

Icom is the choice for D-STAR communications. For more information on the ID-4100A, contact an Authorized Icom Dealer or visit Icom's website

About Icom America
Icom America (part of Icom Incorporated) is a leading communications solutions provider. Icom began as engineering and manufacturing company, making advanced, compact solid-state radio equipment for use by amateur (ham) radio enthusiasts. Icom has since grown to become an industry leader with a product line that includes state-of-the-art communications equipment for land mobile, marine and avionics. Icom America was founded in 1979. With the exception of Cuba, Icom America is responsible for representing Icom products within the entire Western Hemisphere.

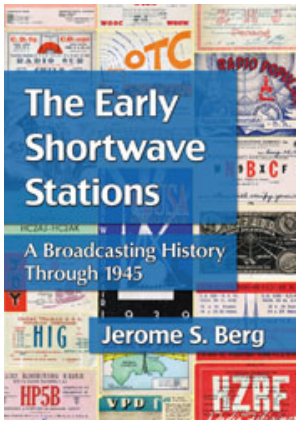
The Icom ID-4100A is available from Universal Radio for $460 plus shipping. **http://www.universal-radio.com/catalog/fm_txvrs/4100.html**

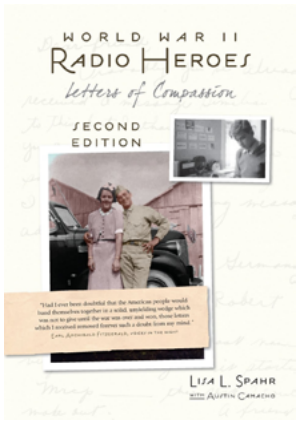
[Text and graphics courtesy of Icom]

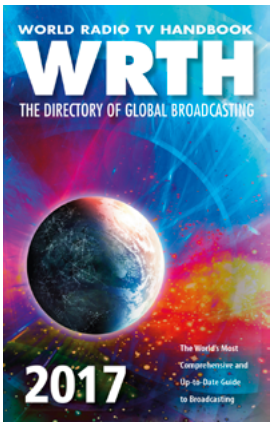
TSM

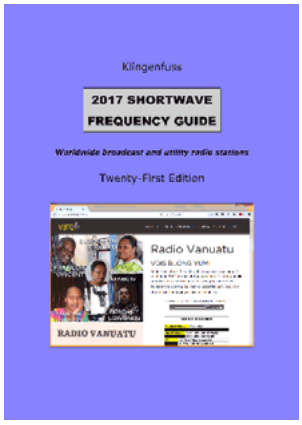
T S M Bookshelf

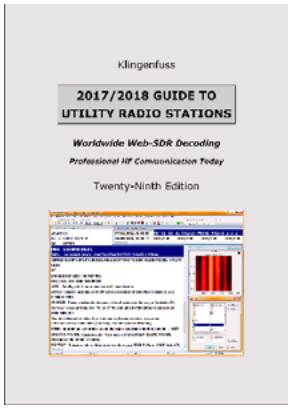
Books of Interest to *TSM* Readers to Enhance your Radio Listening

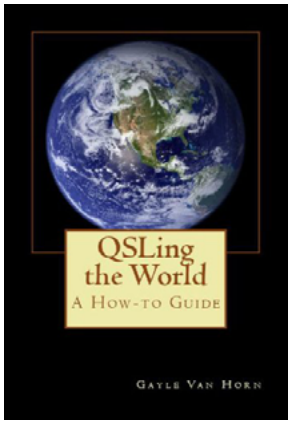


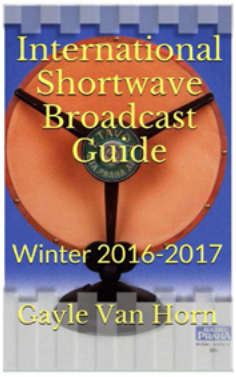


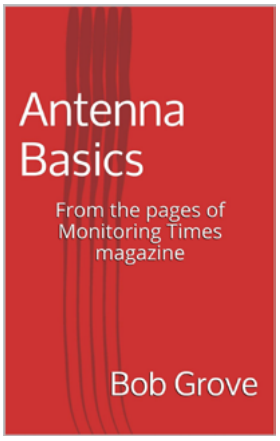


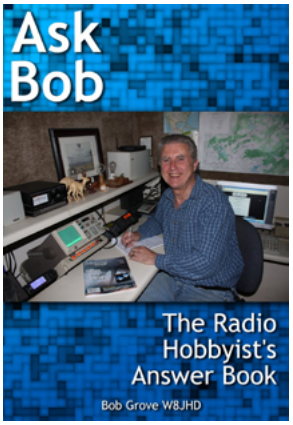


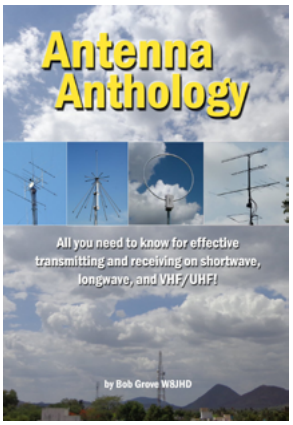


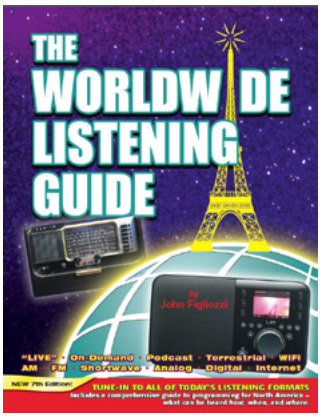


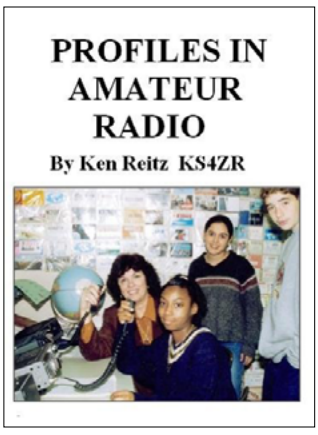


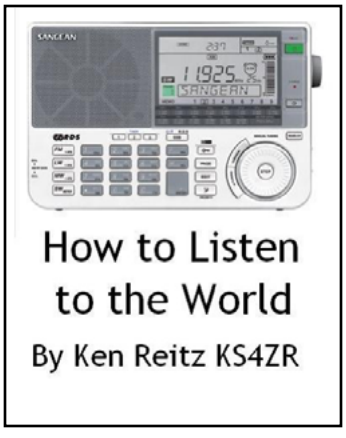


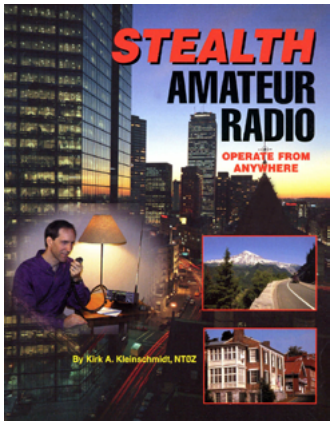






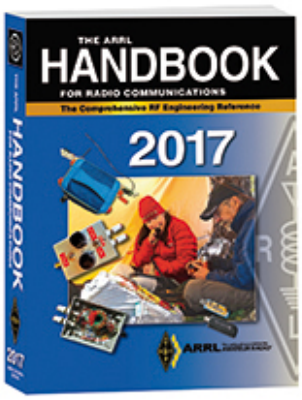


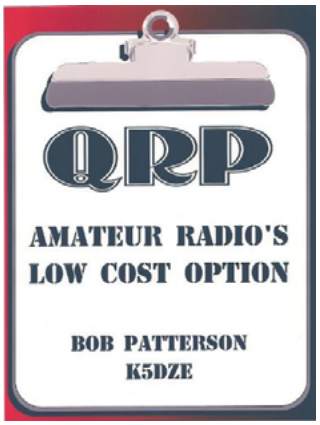


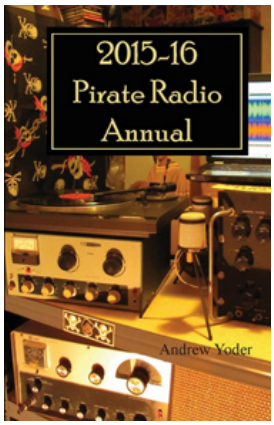


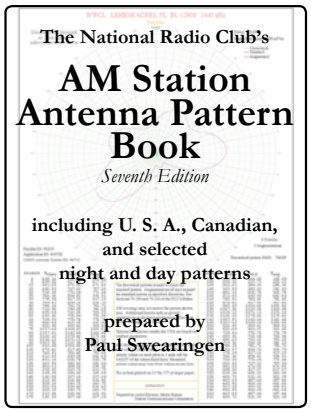
T S M Bookshelf

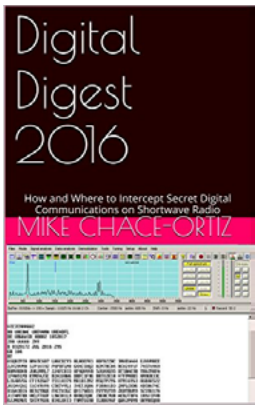
Books of Interest to *TSM* Readers to Enhance your Radio Listening

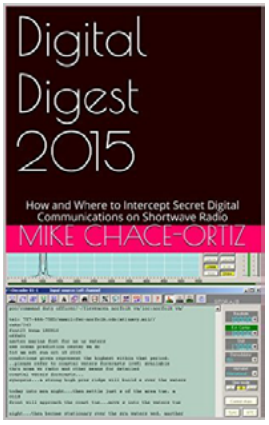


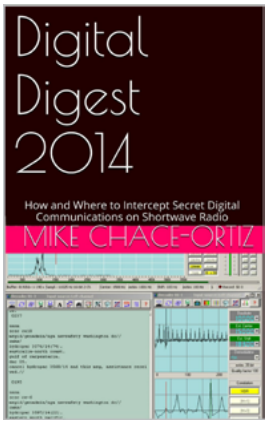


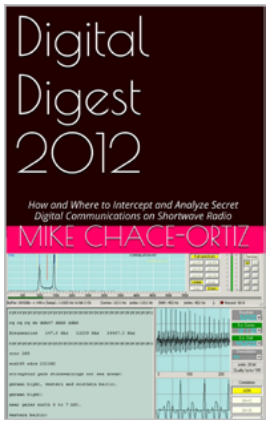


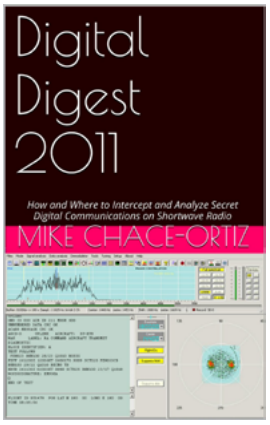


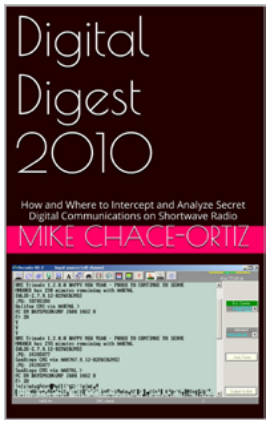


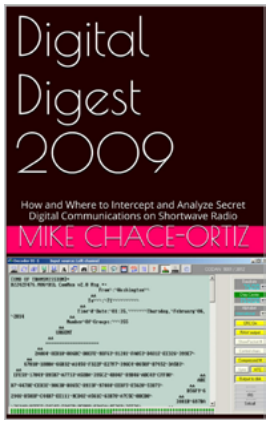


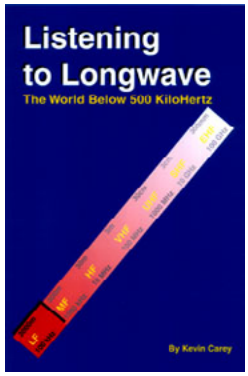












About Us

The Spectrum Monitor Writers' Group

The Spectrum Monitor is edited and published by Ken Reitz KS4ZR, former managing editor, features editor, columnist and feature writer for *Monitoring Times*. Former feature writer and columnist for *Satellite Times*, *Satellite Entertainment Guide*, *Satellite Orbit*, *Dish Entertainment Guide, Direct Guide;* contributing editor on personal electronics for *Consumers Digest*. Author of the Kindle e-books "How to Listen to the World" and "Profiles in Amateur Radio." E-mail: editor@thespectrummonitor.com

The Spectrum Monitor Writers' Group consists of former columnists, editors and writers for *Monitoring Times* and *Popular Communications* magazines. Below, in alphabetical order, are the columnists, their amateur radio call signs, the name of their column in *The Spectrum Monitor,* a brief bio and their websites and contact information.

Keith Baker KB1SF/VA3KSF, "Amateur Radio Satellites"

Past president and currently treasurer of the Radio Amateur Satellite Corporation (AMSAT). Freelance writer and photographer on amateur space telecommunications since 1993. Columnist and feature writer for *Monitoring Times*, *The Canadian Amateur* and the *AMSAT Journal*. kb1sf@hotmail.com **www.kb1sf.com**

Kevin O'Hern Carey WB2QMY, "The Longwave Zone"

Reporting on radio's lower extremes, where wavelengths can be measured in miles, and extending to the start of the AM broadcast band. Since 1991, editor of "Below 500 kHz" column for *Monitoring Times*. Author of "Listening to Longwave" (http://www.universal-radio.com/catalog/books/0024u.html). This link also includes information for ordering his CD, "VLF RADIO!," a narrated tour of the longwave band from 0 to 530 kHz, with actual recordings of longwave stations. E-mail: wb2qmy@arrl.net

Mike Chace-Ortiz AB1TZ/G6DHU "Digital HF: Intercept and Analyze"

Author of the *Monitoring Times* "Digital Digest" column since 1997, which follows the habits o f embassies, aid organizations, intelligence and military HF users, the digital data systems they use, and how to decode, breakdown and identify their traffic. **www.chace-ortiz.org/umc**

Dan Farber AC0LW, "Antenna Connections"

Monitoring Times antenna columnist 2009-2013. Building ham and SWL antennas for over 40 years. E-mail: ac0lw@att.net.

Richard Fisher KI6SN

A veteran journalist with a 35-year career in daily newspapers, and an amateur radio operator living in Riverside, California, Richard has been an editor and writer for *Popular Communications, WorldRadio Online*, and *CQ Amateur Radio* magazines. Among his previous responsibilities have been the monthly "Emergency Communications," "Trail-Friendly Radio" and "Easy Does It" columns for *CQ*, and has written for several QRP publications, including *QRP Quarterly* and *QRPp* magazine. An avid homebrewer, he is a co-founder of The Adventure Radio Society. Write to him at ki6sn@aol.com.

Tomas Hood NW7US, "Radio Propagation"

An Extra Class operator since 1990, Tomas enjoys CW and digital modes on all HF bands. He is a contributing editor to *CQ Amateur Radio*, the former *Popular Communications* and *CQ VHF* magazines, an ARRL publication on QRP communications, and *Monitoring Times*. He runs the Space Weather and RadioPropagation Center at **http://SunSpotWatch.com**. Web site: **http://nw7us.us** Twitter: **https://twitter.com/NW7US**.

Kirk Kleinschmidt NT0Z, "Amateur Radio Insight"

Amateur radio operator since 1977 at age 15. Author of "Stealth Amateur Radio." Former editor, "ARRL Handbook," former *QST* magazine assistant managing editor, columnist and feature writer for several radio-related magazines, technical editor for "Ham Radio for Dummies," wrote "On the Ham Bands" column and numerous feature articles for *Monitoring Times* since 2009. Web site: **www.stealthamateur.com**. E-mail: nt0z@stealthamateur.com

Joe Lynch N6CL, "VHF and Above"

Currently Director of Religious Education for the Army at West Point, New York. He holds a Doctor of Ministry, Master of Divinity, an MBA and is an adjunct instructor for four colleges and universities and a retired United Methodist minister. He served as the editor of *CQ VHF* magazine for 12 years and the VHF editor for *CQ* magazine for 22 years.

Stan Nelson KB5VL, "Amateur Radio Astronomy"

Amateur radio operator since 1960. Retired after 40-plus years involved in mobile communications/electronics/computers/automation. Active in radio astronomy for over twenty years, specializing in meteor monitoring. He wrote the "Amateur Radio Astronomy" column for *Monitoring Times* since 2010. A member of the Society of Amateur Radio Astronomers (SARA). **www.RoswellMeteor.com**. E-mail: Stan.Nelson@RoswellMeteor.com

Chris Parris, "Federal Wavelengths"

Broadcast television engineer, avid scanner and shortwave listener, freelance writer on federal radio communications since 2004, wrote the "Fed Files" column for *Monitoring Times*. h**ttp://thefedfiles.com http://mt-fedfiles.blogspot.com** Twitter: @TheFedFiles E-mail: cparris@thefedfiles.com

Rich Post KB8TAD, "Adventures in Radio Restorations"

As a teenager Rich Post repaired radios and TV sets. He passed the exam for a First Class FCC license when he was told he needed one to repair his CB. He later received his amateur radio license as KB8TAD. Rich now holds a University Emeritus title having retired from Ohio University as Assistant Dean and Director of the Instructional Media and Technology Services. One of his hobbies is collecting and restoring "boat anchors." He maintains the web site Boat Anchor Pix at **www.ohio.edu/people/postr/bapix**.

Tony Roper, "Military Air and Naval Reception"

A Civil Air Traffic Controller in the UK as well as previously being in ATC in the Royal Air Force, totaling 25 years experience. He has worked as a part-time aviation photographer/writer and has been published worldwide. He also provides photos and research for IHS Jane's, principally Jane's Fighting Ships. His photography website is **www.rogdabbit.co.u**k and his blog is **http://planesandstuff.wordpress.com**

Cory GB Sickles WA3UVV, "Digitally Speaking"

First licensed as a Novice over 40 years ago, he enjoys exploring various facets of amateur radio, from the latest state of the art technologies, to the elegant simplicity found with a one-tube transmitter and straight key. He has an extensive background with computers and likes to restore 8, 12 and 16-bit classics from the 1970s. He owns a television production company and creates series programming, as well as marketing and training videos. wa3uvv@gmail.com.

Hugh Stegman NV6H, "Utility Planet"

Longtime DXer and writer on non-broadcast shortwave utility radio. Former "Utility World" columnist for *Monitoring Times* magazine for more than ten years. Web site: **www.ominous-valve.com/uteworld.html** Blog: **http://mt-utility.blogspot.com** /email: mtutilityworld@gmail.com Twitter: @UtilityPlanet

Dan Veeneman, "Scanning America"

Software developer and satellite communications engineer writing about scanners and public service radio reception for *Monitoring Times* for 17 years. Web site: **www.signalharbor.com** E-mail: dan@signalharbor.com

Ron Walsh VE3GO, "Maritime Monitoring"

Retired career teacher, former president of the Canadian Amateur Radio Federation (now the Radio Amateurs of Canada), retired ship's officer, licensed captain, "Boats" columnist and maritime feature writer for *Monitoring Times* for eight years. Avid photographer of ships and race cars. E-mail: marinecolumn @gmail.com.

Fred Waterer, "The Shortwave Listener"

Former "Programming Spotlight" columnist for *Monitoring Times*. Radio addict since 1969, freelance columnist since 1986. Fascinated by radio programming and history. E-mail: programming_matters@yahoo.ca