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SHORTWAVE LISTENING SPECIAL



In this issue:

- Clandestine Shortwave Operations
- Shortwave History through QSL Cards
- Those Really Big Shortwave Antennas

AR2300 "Black Box" Professional Grade Communications Receiver

Introducing a new generation of software controlled "black box" receivers!



Available in professional and consumer versions, the AR2300 covers 40 KHz to 3.15 GHz*

With the new AR2300 "black box" receiver from AOR, up to three channels can be monitored simultaneously. Fast Fourier Transform algorithms provide a very fast and high level of signal processing, allowing the receiver to scan through large frequency segments quickly and accurately. All functions can be controlled through a PC running Windows XP or higher. The AR2300 features advanced signal detection capabilities which can detect hidden transmitters. An optional external IP control unit enables the AR2300 to be fully controlled from a remote location and send received signals to the control point via the internet. It can also be used for unattended long-term monitoring by an internal SD audio recorder or spectrum recording with optional AR-IQ software for laboratory signal analysis. The AR2300 appeals to federal, state and local law enforcement agencies, the military, emergency managers, diplomatic service, news-gathering operations, and home monitoring enthusiasts.

Discover exceptional performance, state of the art specifications and a receiver with a menu of optional extras that can be configured to your own needs and specifications.

- Receives AM, wide and narrow FM, upper and lower sideband, CW modes, and optional APCO-25
- Up to 2000 memory channels (50 channels X 40 banks) can be stored in the receiver
- Alphanumeric channel labels
- Fast Fourier Transform algorithms
- Operated by a Windows XP or higher computer through a USB interface using a provided software package that controls all receiver functions
- An I/Q output port that allows the user to capture up to 1 MHz of bandwidth onto a computer hard drive or external storage device
- An SD memory card port that can be used to store recorded audio
- Analog composite video output connector
- CTCSS and DCS squelch operation
- Two selectable Type N antenna input ports
- Adjustable analog 45 MHz IF output with 15 MHz bandwidth
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- An optional GPS board can be used for an accurate time base and for time stamping digital I/Q data.
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- Powered by 12 volts DC (AC Adapter included), it may be operated as a base or mobile unit.
- Software-driven operating selections include IF bandwidth, frequency, mode, filters, a screen-displayed graphical "S-meter," memory inputs, volume and squelch settings and more
- Professional (government) version is equipped with a standard voice-inversion monitoring feature



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The WinRADIO *EXCALIBUR Pro*TM receiver has a *Pause* button to pause the audio while you are away. Neat?



WINRADIO WR-G33DDC 'EXCALIBUR Pro' Receiver - Windows Internet Explorer

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WR-G33DDC 'EXCALIBUR Pro'

Overview

The WinRADIO WR-G33DDC 'EXCALIBUR Pro' is a high-performance, low-cost, direct-sampling, software-defined, shortwave receiver with a frequency range from 9 kHz to 49.995 MHz. It includes a *real-time* 50 MHz-wide spectrum analyzer and 4 MHz-wide instantaneous bandwidth available for recording, demodulation and further digital processing.

This product is an advanced version of the award-winning [WR-G31DDC](#) receiver, offering many additional features and improvements, such as for example:

- 4 MHz instantaneous processing bandwidth
- Low-noise preamplifier
- Configurable preselection filters
- Filter bandwidth adjustable down to 1 Hz
- 0.5 ppm frequency stability
- Test and measurement functions
- Pause function



The receiver's superior performance results from its innovative, direct-sampling, digital down-conversion architecture along with the use of leading-edge components and design concepts.

Features

- 9 kHz to 49.995 MHz continuous frequency range
- Direct sampling
- Digital down-conversion
- 16-bit 100 MSPS A/D converter
- 50 MHz-wide, real-time spectrum analyzer
- 4 MHz recording and processing bandwidth
- Continuously adjustable filter bandwidth down to 1 Hz
- Three parallel demodulator channels
- Pause function
- Waterfall display functions
- Audio spectrum analyzer
- Audio and IF recording and playback
- Recording with pre-buffering
- EIBI, HFCC and user frequency databases support
- Very high IP3 (+31 dBm)
- Excellent sensitivity (0.20 μ V SSB, 0.10 μ V CW)
- Excellent dynamic range (107 dB)
- Excellent frequency stability (0.5 ppm)
- Selectable medium wave filter
- User-configurable preselector
- Selectable low-noise preamplifier
- Test and measurement functions
- USB 2.0 interface

The receiver's robust front-end is equipped with an ultra-linearity amplifier which results in exceptional strong-signal performance. This already robust front-end is further enhanced with a user-selectable preselector that can operate either automatic or user-configurable mode. As many as 119 different filter combinations can be constructed by the user (91 bandpass and 14 high-pass). The front-end employs 3-subminiature electromechanical relays (rather than often distortion-prone semiconductor switches) to ensure high range.

Internet | Protected Mode: Off 100%

Shouldn't you pause and have another look?
www.winradio.com/epro



Vol. 30 No. 10

October 2011



Cover Story 8
Clandestine Broadcasting
on Shortwave Today
By Hans Johnson

This month MT celebrates the start of another season of shortwave listening with a look at some of the more interesting sides of the hobby. In the cover story, Hans Johnson takes a look at the intriguing world of clandestine shortwave broadcasts. Unauthorized transmissions inside and outside of the countries these stations target, “clandestines” carry on a rich broadcast tradition that goes back to the beginnings of the HF bands.

Murky funding sources, shaky transmissions and elusive schedules have been the hallmark of these stations. But, as Hans points out, times have changed. Groups from a variety of political persuasions can get their anti-government messages broadcast simply by paying for transmitter space on certain stations by the hour.

Learn which stations are on the air now, who’s backing them, the origins of their broadcasts and how you can receive their QSL card. Accompanying this article are clandestine QSL cards collected by veteran shortwave monitor and author Jerry Berg, whose articles about the history of radio through QSLs is also part of this month’s SWL special.

On Our Cover
 Thomson HP-RCA HF rotatable antenna system dwarfs the surrounding countryside. Massive antennas like this make beaming 100 kW to various parts of the planet possible. (Courtesy: Thomson)

Looking at QSLs and Seeing Radio History 12

By Jerry Berg

Whether they are full-data confirmations, thank-you notes, or something in between, QSL cards are usually thought of as mementoes of an individual’s listening experience. Sometimes they also have broader historical meaning, reminding us, directly or indirectly, of important events of the past. In this article Jerry examines QSLs as reflective of political history.

The Committee to Preserve Radio Verifications..... 14

By Jerry Berg

Years ago Jerry was one of a handful of people who understood the value of QSL cards. They represent a graphic look at the history of broadcasting and, once their collectors have gone, the cards would soon follow. In an effort to save radio history and the QSLs that tell each station’s story, Jerry helped found the Committee to Preserve Radio Verifications (CPRV). Years later CPRV has collected and preserved many thousands of QSL cards from some of the premier collections in the world. He shares some of the most interesting ones this month in MT.

Those Really Big Antennas..... 16

By Bob Grove W8JHD

How do international shortwave broadcasters put out those whopping 20 and 40 over S9 signals? Plenty of power and really big antennas. MT founder and antenna guru Bob Grove explains the concepts behind curtain, Sterba and Bruce arrays, lazy “H,” collinear, rhombic, and controlled current distribution antennas. Want to build one yourself? Better have lots of room and plenty of money!

First Person Radio: A Love of Listening..... 18

By Thomas Witherspoon W4SWL

What started out as a fond childhood memory has turned into a lifetime of interested listening and a passion for giving the gift of listening to others around the world. Thomas Witherspoon understands the liberating value of shortwave radio for those in the underdeveloped world. He launched his own non-governmental organization, Ears to Our World, in an effort to place shortwave radios where they’re needed most.

R E V I E W S

**The Poor Man Investigates...
 The World’s Worst World Receiver?**

By Eric Bryan

Is the Bell + Howell 9 Band World Receiver really the world’s worst? Eric Bryan sets out to prove there’s something worth \$10 in this discontinued radio and a lot to recommend it for fifty cents at a garage sale! For all it has against it, it’s truly better than nothing and performance on the FM band was among the best he’s ever tried!



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COMMUNICATIONS

by Ken Reitz

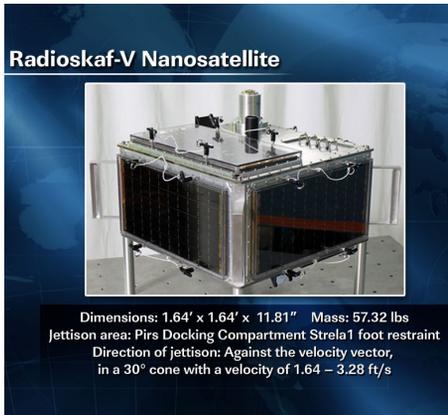


AMATEUR/SHORTWAVE

ARISSat1: Intro to Amateur Satellite

The successful deployment of ARISSat1 (also known by its Russian call sign as RS01S), the nano-satellite launched August 3 by Russian cosmonauts aboard the International Space Station, has given many thousands of hams and monitors around the world an introductory course in amateur radio satellites. The small satellite, hand-launched during a spacewalk, sends a combination of voice greetings in 15 languages and transmits Slow Scan TV (SSTV) images as it travels around the Earth every 93 minutes.

The diminutive craft also has a 435-145



Radioskaf-V Nanosatellite

Dimensions: 1.64' x 1.64' x 11.81" Mass: 57.32 lbs
Jettison area: Pirs Docking Compartment Strela1 foot restraint
Direction of jettison: Against the velocity vector, in a 30° cone with a velocity of 1.64 - 3.28 ft/s

ARISSat1 before launch (Courtesy: NASA)

MHz linear transponder for licensed hams to use to communicate with other hams as the spacecraft zips over their locations. Details on how to receive data, SSTV imagery, operate the transponder or receive a reception report certificate may be found at www.amsat.org.

ARISSat1 is expected to continue to orbit the Earth until it is gradually pulled into the Earth's atmosphere in late October or early November. Judging from the number of SSTV images received by Earth-bound monitors, found at www.amsat.org.



2011-AUG-08 1318

ARISSat1 SSTV image. (Courtesy: AMSAT)

amsat.org/amsat/ariss/SSTV, ARISSat1 has been a huge success.

BBG Still Making Waves

The Broadcasting Board of Governors' noted in early August that Chief Information Officer André Mendes, author of the 174 page 2010-12 BBG Technology Strategic Plan (see *Communications* August 2011), that called for the "sun-setting" of VoA's shortwave service, is up for an IT award.

Meanwhile, the *Washington Times* reported July 31 that the planned switch from radio broadcasting to social media and Internet broadcasting was sowing seeds of "chaos and confusion," as an unnamed agency official put it. The article noted that current and former BBG officials reported that, "cutting costs and the shift to online broadcasting are devastating the organization at a time when promotion of key U.S. values is urgently needed in places such as China and the Middle East."

RTI's New English Website

Radio Taiwan International launched its new English language website August 1 in an effort to promote its English language programming. The site, <http://english.rti.org.tw>, has a quick link to its daily shortwave program schedule as well as an online reception report.

AM/FM/TV BROADCASTING

NY State Outlaws Radio Piracy

New York State Governor Andrew Cuomo signed into law early August a bill that makes AM or FM broadcasting without a license a Class A misdemeanor, calling for confiscation and destruction of related equipment and a possible prison sentence of up to one year. The law had been supported by the New York State Broadcasters Association (NYSBA), which somehow thought enactment would curb burgeoning FM piracy throughout the state and most notably in New York City.

The problem for NYSBA is that such legislation is preempted by FCC rules which already make such broadcasts illegal; that the law doesn't provide for additional funding, training or specialized equipment needed for radio direction-finding, crucial in determining just where the broadcasts are coming from, and that the law can't force overworked FCC field offices to make New York state or City radio piracy a national priority.

Over the last few years, the FCC has shut down many New York pirate broadcasters without the benefit of the new law. And, FCC rules already give the agency authority to confiscate equipment, while having the additional and more

appropriate authority to fine such broadcasters \$10,000 to \$25,000 individually as they have done in the past.

Further, Florida has had such a law on its books for years and remains one of the most active states for FM pirate radio operation. Incidentally, under the New York law, HF radio pirates operating in New York get a pass.

Translator Shenanigans

An article in *Radio World Online* from August 4 reports on the increasing use of FM translators that allow, for one thing, AM daytime only broadcasters to originate programming on their FM translator at night. More troubling to FM DXers, is that there is apparently no limit on the number of FM translators a station may have as long as they don't serve the same market.

A number of questionable practices, such as receiving a translator license for one location and then moving the translator, through a series of license changes, to another location, have led to additional abuse of translator rules.

The FCC finally cracked down when one operator, licensed to Key West, put his translator on a trailer with a push-up antenna and, parking in road-side pull offs, gradually moved to Miami. Some stations are rebroadcasting other stations on HD-2 or HD-3 translators and effectively introducing new stations to existing markets without the bother of new FM licenses.

FCC Strikes down HOA Rules (Again)

A Virginia Beach couple received a Declaratory Ruling from the FCC in late July which struck down restrictive antenna rules of the Home Owner's Association (HOA) to which the two belonged. According to FCC documents, the HOA rules made it nearly impossible to put a satellite dish in a place that would afford a watchable signal and were declared "invalid and unenforceable." The ruling noted that satellite TV provider DirecTV filed comments in support of the couple while the HOA did not respond to the petition.



1 meter Ku-band FTA dish is legal to mount even under HOA rules. (Courtesy: Sadoun.com)

If you live under restrictive HOA antenna rules find out what your rights are at: <http://transition.fcc.gov/mb/facts/otard.html>. You'll find information on HOA Covenants, Conditions and Restrictions (CC&Rs) regarding amateur radio antennas here: www.arri.org/ccrs-covenants-conditions-restrictions. Even if you live outside of

HOA rules, your town or city may have illegal ordinances on the books restricting your right to antennas. That information may be found here: www.arrl.org/prb-1.

Satellite TV viewers, DirecTV, DISH Network or Free-to-Air (FTA) satellite TV hobbyists also have the right to place their dishes (there's no limit to the number of dishes allowed) where a signal may be received as long as it's within an area under their direct control. Satellite Broadcasting and Communications Association (SBCA), has similar advice on protecting your viewing rights here: www.sbc.com/dish-satellite/otard-receiver.htm.

Canadian DTV Déjà Vu

September 1 was the deadline for TV signals in major Canadian TV markets to make the switch from analog to digital TV (DTV), similar to the event that happened in the U.S. two years ago. An article in the *Toronto Star* predicted that over two million viewers, mostly low income and/or elderly, across the country who receive TV signals over-the-air (OTA) would see only blank screens on that day. That's because, unlike in the U.S., minimal effort has been spent by the federal government to notify viewers of the change or help those least able to afford the necessary converter boxes.

As in the U.S., the Canadian government is hoping for a \$4 billion windfall in vacated spectrum auctions as it repurposes parts of the TV bands for broadband use. And, as in the U.S., the government claims that only 8 percent of CBC viewers use OTA for CBC broadcasts. The article in the *Star* disputed those claims, citing a 2010-11 survey that found 10-20 percent of Canadian households rely on OTA for CBC broadcasts.

TECHNOLOGY

CD Disappears from Ford Dash

The march of technology is rapidly changing the way our new car dashboards look. According to an article in the July 25 edition of *Digital Music News*, Ford will begin to drop the CD player from its new car dashboards. The article quotes a Ford spokesperson saying, "The in-car CD player – much like pay telephones – is destined to fade away in the face of exciting new technology."

While the 2012 Ford Focus will be first model *sans* CD, the rest of the line-up will see the CD slot disappear over time. In its place Ford moves toward its SYNC technology that lets users interface their MP3 players and smartphones through touch-screen technology. Interestingly, Ford continues to support HD-Radio in its in-dash radios.

Navy vs Garage Doors

An article in the southern California *Press-Enterprise* last May detailed the mystery of area garage door openers refusing commands of homeowners trying to get into their garages. It turned out that powerful transmitters operating in the same spectrum had just been turned on at a nearby naval base. According to the article, military services across the U.S. are using reserved frequencies also used by millions of garage door openers.

The problem for the homeowners is that,

in this case, the Navy has primary use of the frequencies for their own communications needs and the garage door companies are there on a secondary basis and so must accept any interference from the primary spectrum users. There's no recourse for homeowners locked out of their own garages except to retro fit their doors with openers not operating in the same spectrum, and at their own expense.

5 GHz Devices Causing Radar Headaches

Operation of IT transceivers in the 5 GHz range have been causing interference to FAA radar and TV weather radar installations, according to a report in *Radio World Online* from August 5. The FCC issued a Notice of Apparent Liability (NAL) and Forfeiture in the amount of \$25,000 to Rapidwave, a Utah-based company, when it found the transceiver at issue, Ubiquiti Xtreme Range 5, to be interfering with an FAA Terminal Doppler Weather Radar in Salt Lake City, Utah.

The device is a low power unlicensed transceiver that normally would not interfere with such radar except that, according to FCC documents, Rapidwave had outfitted the device with a high-gain antenna that allowed it to operate at power levels not permitted such license-free devices. The device, which was supposed to be putting out 250 milliwatts was, according to FCC engineers, putting out an EIRP equal to 159 watts.



Terminal Doppler Weather Radar logo

FCC ENFORCEMENT

The Crystal Ship Sinks

The HF pirate station known as The Crystal Ship (TCS) was shut down by FCC field agents in May. Official word of the bust came at the end of July when the FCC issued a Notice of Unauthorized Operation (NOUO) on July 21 for operating on 6,815 and 6,960.6 kHz, according to FCC documents. The shutdown was preceded in February with the closure of WEAK Radio. Curiously, in the case of WEAK Radio, no NOUO has been issued.

Since early spring of this year, battling blogs, on-air frequency poaching and general feuding has disrupted the normally clubby atmosphere among shortwave pirate operators and has surprised many regular listeners. Online and e-mail charges of snitching to the FCC have further churned the murky waters. Despite FCC actions, the frequencies between 6,800 and 7,000 kHz remain quite active with broadcasts from an assortment of pirate band regulars appearing almost nightly.

Couple Blames Friend for FM Pirate Station

The FCC slapped a \$10,000 Forfeiture Order on a couple in Brooklyn, New York for allowing a pirate FM station to be broadcast from their apartment. The case dates back to July 23 and 24, 2008 when FCC field agents, operating on a

complaint from a licensed FM station, located the source of a signal on 96.5 MHz as coming from their apartment. Agents found an antenna on the roof and a coax feed coming from the couple's apartment. The two, who refused the agent's request for entry, were notified of the illegal nature of the broadcasts. When the agents returned to their vehicle they noticed the transmitter had been turned off, thereby demonstrating to the agents that the two had control of the station. An NOUO was issued but no reply was ever received by the FCC.

In December 2008, the FCC issued a Notice of Apparent Liability for Forfeiture (NAL) in the amount of \$10,000, which must have finally attracted the couples' attention. In response they argued that they had actually allowed a friend to operate the station in their apartment and further claimed they believed the station complied with FCC rules. They noted that they shut down the station immediately after the FCC visit and they further claimed they didn't have the money for the fine. But, the FCC wasn't buying. In dismissing all of their points the FCC noted, "Ignorance of the law is not a mitigating factor." And, the couple neglected to supply any financial evidence to support their claim of inability to pay.

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



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Clandestine Broadcasting on Shortwave Today

By Hans Johnson

(QSLs courtesy the Committee to Preserve Radio Verifications)

Radio entertains, informs, and influences; most stations do so openly. “This is Radio Japan from Tokyo,” identifies the broadcaster and its location. A listener surmises that Radio Japan has Japanese government approval if not outright backing. But, some stations are clandestine rather than open. A clandestine station or program seeks political changes and/or media freedom in the country it is broadcasting to without the approval of the target country’s government. They usually cannot operate openly or safely from inside the country to which they are broadcasting.

All shortwave broadcasters need programming and access to a transmitter, and it’s no different for a shortwave clandestine station. Traditionally the backer controls the transmitter. The backer might operate the transmitter, as in the case of Radio España Independiente. This station, the voice of the Spanish Communist Party during the Cold War, used transmitters controlled by its communist backers in the Eastern Bloc. Since the station was not located in Spain or close to the country, it needed large transmitters. These required trained personnel to operate and maintain the transmitter. The transmitter demanded steady electricity and plenty of it.

Another method was to operate a transmitter purchased by the backer. In this case, the transmitter operated secretly inside the country. You might think it is glamorous to operate such a station in the jungle or on a mountain but it was hardly so. The transmitter and antenna could be smaller, but it still required skilled personnel to operate them. There was a real danger that hostile forces would destroy the station and kill its personnel if they found them.

In either case, not only did you have to know how to produce a program, you also had to know how to run a radio station from a technical and engineering point. You were at the mercy of your backers. If they didn’t want you on, you were suddenly off.

Few stations sold time as a straight commercial transaction. WRUL in Scituate, Massachusetts, sold time to a number of groups. But WRUL was very much the exception. That started to change in the 1980s, when the FCC lifted a twenty year freeze on issuing commercial shortwave station licenses after some strong lobbying got WRNO in New Orleans on the air in 1982. The flood gates then opened and a number of stations went on the air.

But, these stations had a problem, the

same one that has plagued all commercial shortwave stations in the United States. They could not make money selling advertisements on shortwave. It’s a lesson stations have discovered again and again, including WRNO, which tried a commercial rock-n-roll format when it first came on the air. They needed a new model if they were to stay in business, and that model was to operate as brokered stations; they would sell blocks of time.

By the late 1980s there were a number of brokered stations in the United States. “We put the Cuban American National Foundation on Radio Clarin and then WHRI. We also put Alpha 66 and a few other Cuban groups on WHRI. Then, when a lot of Cuban groups wanted to do the same thing, we bought a bunch of block time on WWCN and started running it on air as Radio Miami International [RMI], with various Cuban groups within this block. Eventually, we moved the whole block



Radio 15 de Septiembre from Nicaragua

to WRNO,” recalls Jeff White, President of RMI.

During the Cold War, both East and West used multiple shortwave frequencies for transmissions. The West did this to overcome Eastern jamming and the East wanted to make sure its message was heard. With the end of the Cold War in 1989, there was suddenly a surplus of transmitting capacity. It was offered for sale and there were many takers, including clandestine groups.

The significance of the wide availability of commercial airtime on clandestine programmers is hard to overstate. No longer did you need to own a whole station. You did not need an engineer, a frequency manager, or a vulnerable station. You simply needed to produce a program and raise the money to purchase airtime. If you wanted to be on just a few hours a week to keep it affordable, that was fine.

It is easier to get on the air, but staying on the air is still hard. The most sophisticated

clandestine stations on the air today are able to secure funding from non-governmental organizations (NGO’s) such as the National Endowment for Democracy (NED). Grants provide funds for transmissions and offer a bit of security. Fundraisers are another way to raise money.

No matter what the funding mechanism is, there is always the danger of donor fatigue. This is especially true of the smaller stations and is the main reason stations come and go: they simply run out of donations. Those receiving grants also run into the same problem. Funding is tight all over the Western world and new crises are constantly popping up that compete for available funding.

Shortwave monitoring expert Mathias Kropf’s annual measurement of Clandestine Radio Activity put the weekly number of hours at 1,092 in 2010. So let’s see who is on the air now. All frequencies are in kilohertz and all times are in UTC.

CLANDESTINE STATIONS

Africa

Djibouti is a tiny nation of less than one million people in the Horn of Africa. Both French and American troops are based there. **La Voix De Djibouti** has close ties to the opposition party Movement for Democratic Renewal and Development (MRD). The leader of the MRD and many of his supporters live in exile in Belgium. The government banned the MRD in 2008 after allegedly urging Eritrea to invade Djibouti. La Voix De Djibouti is heard Thursdays only in Somali and French on 21525 kHz from 1200-1300 via Russia. A few e-QSLs have been received.

Eritrea is also in the Horn of Africa. All media are state controlled in this one-party state. A number of political groups are broadcasting to this country. Some are sponsored by exile groups. Others are sponsored by neighboring Ethiopia, with which Eritrea is waging a radio war. None of the stations broadcasting to Eritrea have QSLed yet.

Voice of Asena is on Mondays, Wednesdays, and Fridays from 1700-1800 on 15350 or 15360 kHz in Tigrinya and might be using the same site in Russia as La Voix de Djibouti. The following three stations use Radio Ethiopia’s facilities:

Voice of Peace and Democracy in Eritrea is more of a traditional clandestine. Programs are on 7235 kHz variable from 0400-0500 and 1800-1830 on Mondays, Wednesdays, and Fridays.



Radio Free Russia

15750 kHz 1200-1230. They do QSL direct.

Minghui Radio 1300-1400 on 6030 is a sister station to Sound of Hope. No reports of QSLs.

Voice of China is the station of Foundation for China in the 21st Century. The Foundation is headed by Yang Jianli, a Chinese dissident living in exile in the US. He participated in the 1989 Tiananmen democracy movement and was later jailed in China for five years. They can be heard from 1400-1500 and 2300-0000 in Chinese on 7270 kHz via Taiwan. They do reply to correct reception reports.

Voice of Tibet - Communist China took over Tibet in 1959. The Dalai Lama and many Tibetans went into exile. Programs are in Mandarin and Tibetan from 1230-1430 on a frequency around 15560 kHz from Central Asia, 1330-1400 on 15275 kHz via the UAE, and from 1400-1430 on 17560 kHz via Madagascar. They do respond to reception reports.

India and its rival Pakistan continue to dispute their border, particularly in the Kashmir region. Each country directs a radio station to the other.

Voice of Jammu and Kashmir Freedom Movement is from Pakistani facilities, probably in Islamabad. Their schedule is 0300-0400 and 1300-1445 on 3995 kHz in a variety of languages. They do QSL direct and welcome \$1 USD return postage.

Malaysia is recognized for holding free elections, but some are still concerned about media freedom in the country and are using shortwave to get their message in.

The target audience of **Radio Free Sarawak** is the longhouse people living in the Borneo jungle of Sarawak. Programs are produced in London and there is a focus on environmental issues. Radio Free Sarawak is also covering an upcoming April election in Sarawak and might be thought of as a temporary station. Their schedule is 1000-1200 daily on 15420 in Iban via Palau. No direct verifications reported.

The communist government in North Korea suppresses human rights and does not allow other political parties or organizations. The country fought a war with South Korea in the 1950s and tensions have remained high since. The

two nations are still in a radio war with each other sponsoring programs directed to the other.

All cluster of stations run by North Korean defectors have come on in the last several years. They have each received grants from the NED for as much as \$200,000 in 2008 and \$150,000 in 2009, according to NED annual reports. A recent piece in *The Atlantic* notes these stations have become an important source of reporting on North Korea for Western media. These outlets have also broken a number of stories, such as the recent sabotage of a train headed for North Korea from China. Several Central Asia transmitter sites are used for these services.

Radio Free Chosun has been on the air since 2005 is heard from 1200-1300 on 15720 kHz, 1500-1600 on 11560 kHz and 2000-2100 on 7505 kHz. They do e-verify.

Free North Korea Radio got on the air one year earlier than Radio Free Chosun and is heard from 1200-1400 on 15645 kHz. They also e-verify.

North Korea Reform Radio, started by a defector who used his life's savings to get the station going, is heard from 1500-1600 on 7590 kHz. No QSL's reported.

Open Radio For North Korea - Programs include soap operas and the station welcomes citizen participation. Their current schedule is 1400-1500 on 11570 kHz and 2100-2200 on 7480 kHz. They do verify reception reports.

The South Korean government operates two stations directed to North Korea, both transmit via South Korea. **Echo of Hope** has been on for decades and it is heard on 3985, 6003, and 6348 kHz at 0854-1900 daily and starting at 0254 on the weekends. Transmissions last until 2303 every day except Fridays and Saturdays. Reception reports sent to the Korean Broadcasting Systems have been verified.

Voice of the People is heard on 3480, 3912, 4450, 6518, and 6600 kHz from 0500-2305. No verifications reported.

Tensions are high in the Korean peninsula. North Korea sponsors a station directed to South Korea that openly supports the North Korean government and advocates for reunification of the Korean peninsula under the leadership of North Korea.

Pyeongyang Branch of the Anti-Imperialist National Democratic Front transmits from 0755-1405 and 2155-0400 on variable 3480, 4450, and 4557 kHz in Korean. The transmissions are jammed. They will QSL direct.

Myanmar (Burma) has been ruled by the army for much of its existence. The opposition leader, and Nobel Laureate, Aung San Suu Kyi, won the country's election in 1990. The army nullified the result and continued to rule. Suu Kyi lived in house arrest off and on for two decades until her release last November.

Democratic Voice of Burma (DVB) grew out of frustrations with the 1990 election results. DVB was started by Burmese expatriates living in Oslo, Norway. You would never guess that a radio station is based here by walking around the neighborhood. Only a small plaque tells you that you are at the right address. DVB has been very successful in fund raising and has received significant sums from various NGO's. DVB recently had their budget cut by 15% and reduced their radio schedule as a result. They are still on from 1430-1530 on 11515 kHz (Armenia) and 17790 kHz (Madagascar) in Burmese and other local languages. The station does QSL, but appreciates \$1 USD for return postage. There is a chance that their

morning 2330-0030 broadcasts may return.

Radio Sedayee Kashmir is transmitted from All India Radio's Delhi facility on 4870 and 6100 kHz at 0230-0330, 0730-0830, and 1430-1530. They do not QSL. Pakistan has fought a number of wars with India since independence from the British and partition of the sub-continent in 1947. They continue to dispute the Kashmir region.

When South Vietnam fell to Communist North Vietnam in 1975 an exodus of refugees fled the country with many coming to the United States. Over the years a number of exile groups have broadcast to Vietnam on shortwave expressing their concerns about the human rights and political situation in the country.

Radio Hoi Mai is a Houston-based organization promoting the Vietnam Populist Party in its transmissions. It broadcasts from Palau on 13745 kHz on Tuesdays and Thursdays from 1300-1330. They have not QSLed yet.



Radio Americas

Americas

Many Cubans fled to the United States in the wake of Fidel Castro's communist takeover of the island in 1959. They object to the human rights situation on the island and the lack of media and political freedom. Jeff White's WRMI located in Miami transmits a number of programs for the island.

Forum Revolucionario Democratico Cubano is heard Sundays from 2030-2130 in Spanish on 9955 kHz.

La Voz de la Coordinadora de Ex-Presos Politicos Cubanos is heard Saturdays from 2330-2345 and Sundays from 2200-2215 in Spanish on 9955 kHz.

Radio Libertad broadcasts everyday from 1200-1300, Monday to Friday from 2300-0000, and Tuesday to Saturday from 0400-0500 all on 9955 kHz.

Voz del CDHD Brigada 2506 is on Saturdays from 2200-2230 and in English on Sundays from 1500-1515 both on 9955 kHz. WRMI will QSL reception reports of any of these services.

Venezuela is led by strongman Hugo Chavez who has suppressed the media. A number of Venezuelans have fled, many to south Florida.

Acontecer Venezolano is an anti-Chavez program hosted by Jose Torrellas who provides news and views about what is happening in Venezuela. "It's on several times per week, including Saturdays 2030, Mondays 1300 and 2200 and Thursdays at 0000. It's 15 minutes long," says Jeff White of WRMI which transmits the program on 9955 kHz. WRMI will also QSL reception reports of this program.

Good luck in hearing these stations. Those expressing an interest in a station's goals, objectives, and history will have the best response to their reception reports. Return postage helps, too.



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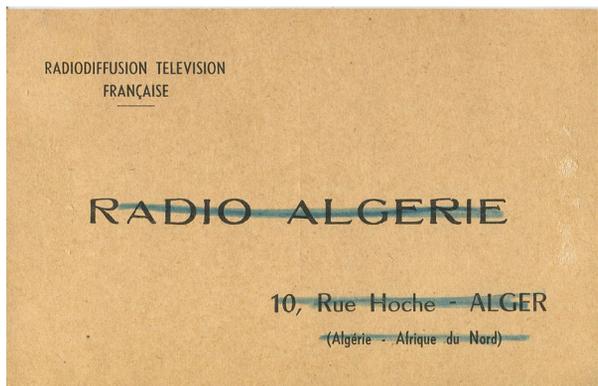
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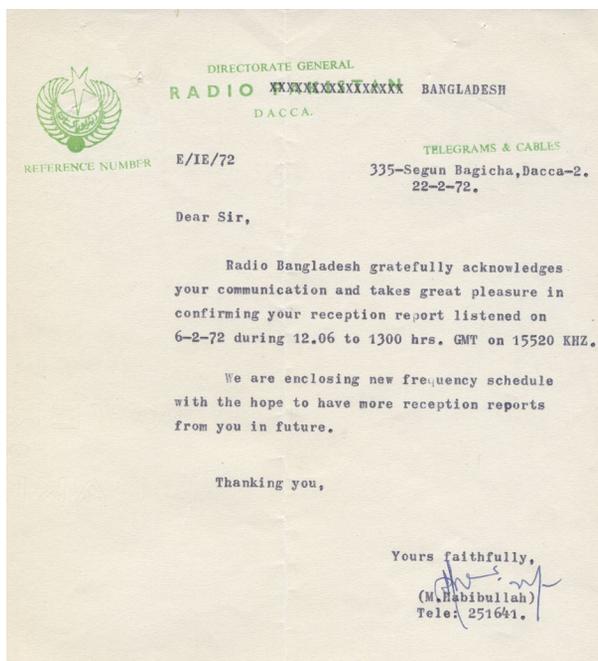
Looking at QSLs and Seeing History

By Jerry Berg

(Except where otherwise stated, photos and graphics from the author's collection or the collection of the Committee to Preserve Radio Verifications)



Algeria gained independence from France in 1962 after a bloody eight year revolt. During the years of fighting, Radio Algerie, the shortwave station of Radiodiffusion Television Française in Algiers, was a good verifier. However, on many QSLs the name and address of the station was crossed out. Was it a political statement of a disgruntled employee? The reason has never been established. This card is from 1958. (Courtesy: Don Jensen.)



When it was established in 1947, Pakistan was divided into two parts, West Pakistan and East Pakistan, with India in the middle. East Pakistan became the independent nation of Bangladesh in 1971. The capital was Dacca. For a time, QSLs from Dacca were sent on old Radio Pakistan stationery with "Pakistan" crossed out and "Bangladesh" inserted. This one is for reception in February 1972.

Whether they are full-data confirmations (date, time and frequency), thank you notes, or something in between, QSLs are usually thought of as mementoes of an individual's listening experience. Sometimes they also have broader historical meaning, reminding us, directly or indirectly, of important events of the past. This article looks at QSLs as reflective of political history.

The historical aspect of QSLs is most obvious where the station's country of origin has changed status in some way. There are many examples that are familiar to QSLers and among the most recent are those in Europe. Czechoslovakia was one country until January 1, 1993 when it was divided into the Czech Republic and Slovakia, yielding a new station, Slovak Radio in Bratislava. Yugoslavia was likewise considered one country until the fighting there produced multiple new states: Bosnia & Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia, and Slovenia.

No nation has yielded more new countries than the Soviet Union. Although its constituent republics were usually counted separately for radio country counting purposes, the democratization of the former Soviet Union has resulted in a reconstructed Russia and true independence for Armenia, Azerbaijan, Kazakhstan, Latvia, Lithuania, and the other Soviet Socialist Republics. As recently as the late 1980s, such an event could have hardly been conceived.

Occasionally countries disappear as separate political entities entirely. The most dramatic examples are East Germany, which, along with Radio Berlin International, was absorbed by West Germany in 1990; and South Vietnam, which was taken over by the north in 1976. Numerous other lesser examples are familiar to DXers. Goa was a Portuguese colony until it was seized by India in 1960. Okinawa was returned to Japanese control in 1972. The Panama Canal Zone became part of Panama proper in 1979. Aden became part of Yemen in 1990. DXers know the special value of QSLs from places whose fundamental identity has been changed by history.

Between new countries and countries that have disappeared are the many that have changed names and political administrations in fairly dramatic ways. Often these changes coincided with the end of the colonial era. That most mysterious of places, the Belgian Congo, became the Democratic Republic of the Congo, then Zaire, then the Democratic Republic of the Congo again. Tanganyika became Tanzania, Bechuanaland became Botswana, Northern Rhodesia and Southern Rhodesia became Zambia and Zimbabwe respectively. In Asia, Burma has become Myanmar. In the Middle East, Egypt and Syria joined for a time as the United Arab Republic. QSLs bearing the old names remind us of history's march.

Shortwave listening was growing during the colonial period of the 1950s and 1960s, and many SWLs learned their international politics and geography while seeking out signals from these stations. Africa was the leading DX target. The many low power stations (4 kW) in what was then called French West Africa and French Equatorial Africa were regular visitors in East Coast afternoons and late evenings. Reception reports brought the good looking SORAFOM QSL-card, showing all the stations. It was prepared for local station use by the Société de Radiodiffusion de la France d'Outre-Mer, a French office established to further the development of broadcasting in French areas.

Also among the most sought-after African targets were the many stations in Portuguese Angola, such as Radio Diamang and Radio Clube do Lobito, as well as Radio Clube de Mozambique, broadcasting from Portugal's East African colony. Perhaps the best known of all the colonial stations was Radio Brazzaville, set up in the French Congo in 1940. It served as the voice of the Free French during the war, and broadcast internationally for many years thereafter.

Over the years, the hobby has taught SWLs much about the role of the United Nations in international affairs. Although U.N. headquarters no longer transmits on shortwave, some of the U.N. missions have had their own radio stations. In recent years these have included Radio UNMEE, operated by the U.N. Mission in Eritrea and Ethiopia; Radio MINURCA, station of the U.N. Mission in the Central African Republic; and Radio UNAMSIL, voice of the U.N. Assistance Mission in Sierra

Leone.

Breakaway efforts in particular countries have illustrated the typically-complicated ethnic and geographic elements of the conflicts. Secessionist Katanga Province declared its sovereignty soon after the Belgian Congo gained independence in 1960. Radio Katanga, broadcasting from Elisabethville (later renamed Lubumbashi), was heard for years and sent out many QSLs. And Radio Biafra brought the Biafran civil war, which lasted from 1967 to 1970, home to SWLs.

More recent examples of breakaway radio are found in the dissolution of the Soviet Union. Pridnestrovie declared itself independent of Moldova in 1991 and is still broadcasting as Radio DMR. The next year Abkhazia, previously part of Soviet Georgia, declared its independence. While Abkhazia is recognized by only a few countries, the radio station in the capital of Sukhumi, Radio Abkhazia, still operates on shortwave.

The connection between shortwave broadcasting and all-out war or other military activities is a natural one, as each side seeks to maximize its impact on the enemy, on its own people, and on the world at large. World War II was the first major international conflict where shortwave played an important role.

There was not a great deal of QSLing, however. Paper and funds were in short supply, as were DXers themselves, most of whom were either in the military or working overtime on the home front. Contact with enemy stations was problematic. Most clubs had shut down or were operating at a nominal level, and many QSLs in Europe were lost or destroyed during the war. The Axis stations – Deutscher Kurzwellensender (“Zeesen”), EIAR-Italy, and Radio Tokyo – all had been good verifiers in the pre-war years.

Many QSLs have been illustrative of military ventures old and new, including verifications from EA9AH, a lead Franco station during the Spanish Civil War; Far East Network, Japan; Radio SEAC, the wartime South East Asia Command station of the British Forces Broadcasting Service in Sri Lanka; Radio Vietnam, Saigon; post-liberation Radio Kuwait (whose QSL included the reminder, “Don’t Forget Our POW’s”); and the BFBS broadcasts during the Gulf War.

The Cold War was played out extensively on shortwave, where high power and high dudgeon were both in great supply and QSLs were plentiful. In hindsight, it was probably the Cold War that gave shortwave broadcasting its *raison d’être*.

From the DXer’s standpoint, the more interesting history of those years was the rise of clandestine broadcasting, which is defined generally as opposition broadcasting that is unwelcome in the target area. Real clandestine broadcasting, where the source of the signal is not known, was used extensively in Europe during World War II, but produced few if any QSLs. The first clandestines that would eventually QSL (albeit many years later) were probably Radio España Independiente and Radio Euzkadi, whose first broadcasts date back to the 1940s.

The Cold War years saw an explosion in clandestine broadcasting not directly related to the Cold War. Most clandestine broadcasting in the 1950s was from, and to, the Middle East. Thereafter, Cuba, Vietnam and other Southeast Asian countries, Iran, Iraq and the rest of the Middle East, and East Africa, have all been favorite targets. Best remembered by American listeners were the years of intense anti-Castro clandestine broadcasting (1960-70 and 1975-85), the extensive clandestine broadcasting in Central America (1978-92), and the Southeast Asian years (1969-75).

As clandestine broadcasting has given way to leased time “target” broadcasting, there is now very little that is “clandestine” about opposition political broadcasting on shortwave. Nonetheless, the political conflicts that are at the heart of opposition broadcasting today have made for interesting DXing and QSL collecting. Many of these stations QSL with ease, often by e-mail.

Among the interesting “clandestines” that were decent verifiers over the years are the Democratic Voice of Burma, Voz de Resistencia de Galo Negro (Angola), La Voz del CID (Cuba), Radio Venceremos (El Salvador), Radio Vatan (Iran), Radio Sandino (Nicaragua), Radio Liberation (Vietnam), and countless others. The latest group of target broadcasters are those beaming to North Korea, e.g. Shiokaze. It is thanks to their interest in these stations that many DXers are well informed on political doings in trouble spots big and small.

Alas, with the ebb of shortwave broadcasting, when history repeats itself in the future it is unlikely to be memorialized in many QSLs. But verifications will always be a window into history.

About the Author:

Jerry Berg has been DXing and collecting QSLs for over 50 years. He has written several books about shortwave broadcasting history and many articles about DXing. Jerry is a member of the Executive Council of the North American Shortwave Association, chair of the Committee to Preserve Radio Verifications and co-producer of the website www.ontheshortwaves.com. He is an attorney and before his retirement served for many years as court administrator of the Massachusetts district court system. He can be reached at jsberg@rcn.com.



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Ref. No. _____

23rd January, 1970

Thank you very much for your recent letter.

Regular broadcast on Radio Biafra ceased on the 12th/13th January and make shift broadcasts continued until the 13th/14th January.

On the 12th January General Effiong of Biafra made an appeal for disengagement of troops and for surrender terms to be worked out. The people of Biafra faced by decimation from starvation and military operations decided to opt to stop fighting in order to save the remaining millions.

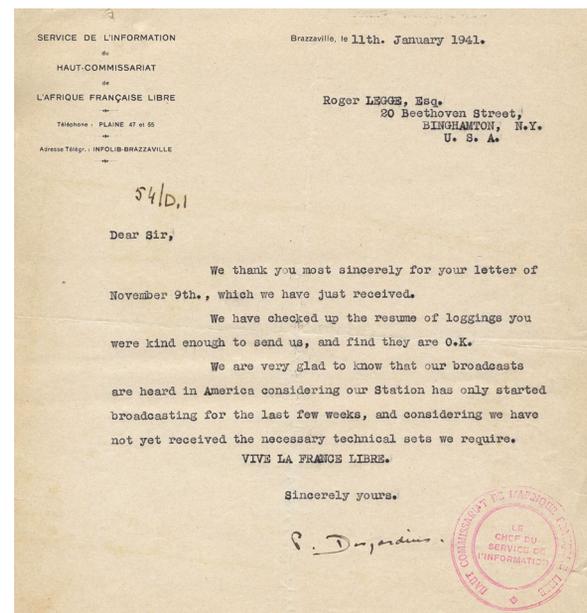
From the 12th onwards therefore the administration at home fell apart as people started fleeing into the bush. I assume only technical personnel continued to man Radio Biafra. In similar circumstances in the past, in the absence of programme staff, music would be played continuously, as actually happened.

However the transmission monitored here was on the 41 meter band 7.301 KHZ (we had lost contact with the 49 meters transmission on the 12th).

From 14th January 1970 Radio Biafra closed down as Biafra Radio after a clear run of 30 months under the most difficult conditions in technical logistics and personnel terms. The Spirit of Biafra lives on.

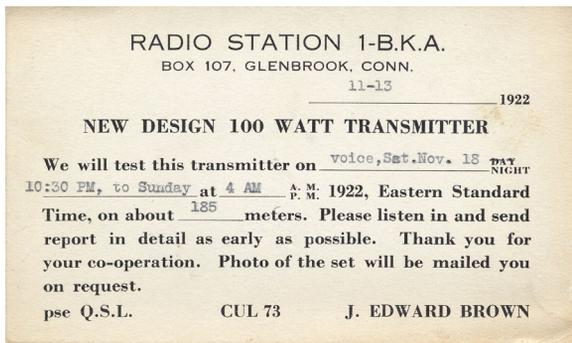


On May 30, 1967, the breakaway region of Biafra declared its independence from Nigeria. Soon the Eastern Nigerian Broadcasting Service on 4855 kHz became Radio Biafra, later it was heard on 7301 kHz. An international service known as Voice of Biafra transmitted on 6145. The stations were on the air until Biafra's surrender to Nigerian government forces in January 1970. They usually replied to reception reports via the Biafran office in Abidjan, Ivory Coast.



Radio Brazzaville, French Equatorial Africa, was set up in 1940. It was founded by two Frenchmen, Capt. François Desjardins and his brother, Lt. Pierre Desjardins, and had been on the air for only a few weeks when this QSL, signed by Pierre, was sent. As the closing, “Vive La France Libre,” suggests, Radio Brazzaville would be the international voice of the Free French during World War II. It had an extensive foreign service, which continued even after the French Congo's independence in 1960.





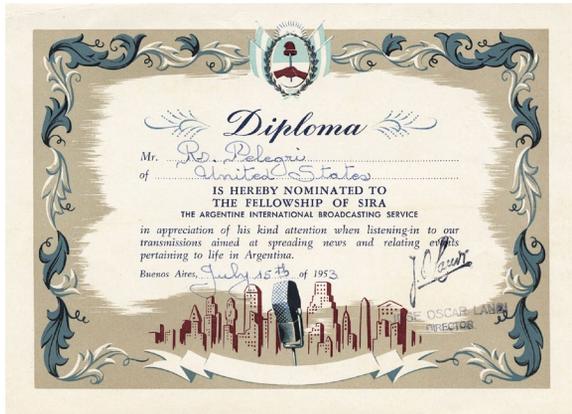
IBKA - Not every card in the CPRV collection is a QSL. Here is a card that a Connecticut ham sent to prospective monitors in 1922, inviting them to listen for his new 100 watt transmitter.



2ZA - Many QSLs are colorful and well designed. This 1939 broadcast band QSL is from 250-watt station 2ZA on New Zealand's north island.



3UZ - 3UZ, a 500-watt station in Melbourne, Australia, advised listeners that the station's parent, the engineering firm Oliver J. Nilsen & Co. Pty. Ltd., would be happy to provide advice on radio and electrical problems.



Argentina - International shortwave broadcasting in Argentina was reorganized in 1950. The new government broadcaster was Servicio Internacional Radiofonica Argentina (SIRA), and it operated the most powerful shortwave broadcast transmitter in South America (LRA, 100 kw). It was a lucky DXer who found this "Diploma" in his mailbox.

The Committee to Preserve Radio Verifications

By Jerry Berg

It seemed like a long shot: Find and gather the QSLs of DXers who are no longer active or who had passed away, and preserve them for the future. How many QSL collectors, even if inactive, would be willing to part with their collections? What were the odds that the collections of deceased hobbyists had survived and could be located?

Such were the questions facing the Committee to Preserve Radio Verifications, a six-member group born in 1986 as a special project of the *Número Uno* DX newsletter and established soon thereafter as a committee of the Association of North American Radio Clubs (ANARC). The strategy would be simple enough: start contacting people and see what happens.

Old bulletins were examined, memories were searched, old friendships were tapped, and a list of known QSL collectors of yore was compiled. Then came extensive letter writing and telephoning – remember, this was before e-mail. Many people had moved; others had passed away during years of DX inactivity. New contact information was constantly being sought.

Happily, there were more than enough successes to make the CPRV viable. Soon we would learn some lessons that would serve us well in the future. One was that, when people give up DXing, and especially as they reach their senior years, the strong possessory interest in their QSLs gives way to an interest in having them preserved for the future. This is especially true in the typical case where no other family member is interested in radio. It also became clear that families often kept QSLs because they knew what they had meant to a deceased family member, but they did not know what to do with them.

These dynamics led to positive responses from many quarters, and soon collections large and small began arriving. They covered all modes of reception: shortwave broadcast, mediumwave (both domestic and foreign), utilities, even FM and TV. QSLs were sorted, indexed and organized for easy retrieval. Early on it became clear that the volume of amateur QSLs was beyond the committee's capabilities to handle, and so, except for ham QSLs of special importance, the focus would be on the broadcast and utility categories.

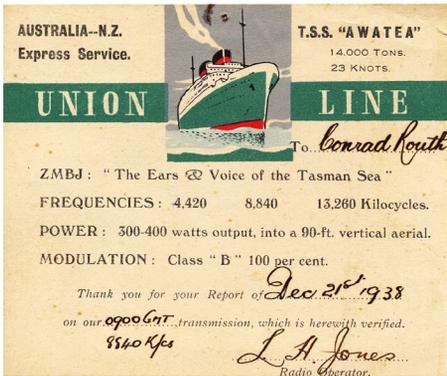
In the early years the committee's collection was kept at the facilities of the *Christian Science Monitor* in Boston. The *Monitor* had ambitious shortwave plans when it opened its first station in 1987, and providing a home for the CPRV collection was a way to strengthen contacts with listeners. As the collection grew, however, and as the *Monitor's* shortwave plans changed, it became clear that a new home would be needed.

So, in 1999 the collection was relocated to the Library of American Broadcasting (www.lib.umd.edu/LAB/) located in the Hornbake Library on the campus of the University of Maryland, College Park, near Washington, D.C. The LAB was founded in 1972 as the Broadcast Pioneers Library and is the sister library of the National Public Broadcasting Archives. The setting in which the QSLs now reside serves as a fitting memorial to their original owners and provides a professional, accessible research environment for those with a serious interest in the history of radio.

Over the years, the committee has remained active in seeking out collections of DXers who have passed away. Today the initiative is often taken by a DXer or his or her family who has learned of the committee through the internet (www.ontheshortwaves.com). The CPRV collection now includes QSLs from over 200 listeners. Among them are the verifications of such DX greats of the past as August Balbi, John Tweedie, Carroll Weyrich, Roger Legge, Paul Kary, and Al Niblack, as well as many well-known departed of more contemporary times, such as Andy Rugg, Al Sizer, John Sgrulletta, and John Bryant.

The strength of the collection is in the amalgamation of QSLs from many different people who listened during many different time frames. Often a station's QSLing can be traced over decades. Especially with regard to broadcast band stations, a QSL is sometimes the only remaining trace of a station no longer on the air.

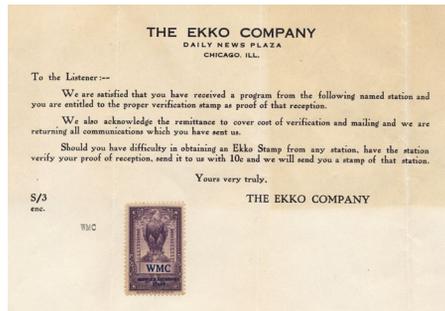
Since ANARC closed in 2005, the Committee has continued its operation as an independent project. Today the members of the CPRV are: Jerry Berg, chair; Gerry L. Dexter, Tom Gavaras, Dan Henderson, John C. Herkimer, and Don Jensen. The committee welcomes the opportunity to provide a new home for QSLs. Inquiries should be sent to jsberg@rcn.com.



Awatea - The New Zealand T.S.S. [Turbine Steam Ship] Awatea sailed between Australia and New Zealand and up the North American west coast in 1938. Though ZMBJ was mainly a communications station, it did some broadcasting as well.



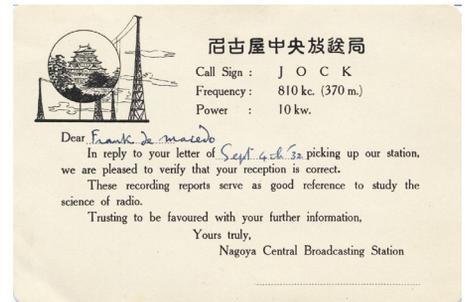
Beira - The small shortwave stations in the Portuguese colony of Mozambique were among the rarest of stations to hear. This one ran 300 watts. The QSL is from 1959.



EKKO - In the 1920s and 1930s, for 10 cents most stations would include an EKKO stamp with their QSL, and many listeners made a hobby of collecting the stamps. As this 1930 communication from the EKKO Company shows, for stations that did not use EKKO stamps you could send your QSL to the EKKO Company and they would send you the stamp.



Ethiopia - Could there be a more exotic-sounding place than Addis Ababa, Ethiopia? Radio Addis Ababa was the government telecommunications station. This QSL is from 1970.



JOCK - West Coast reception of mediumwave stations in Japan was fairly common among 1930s DXers, even with the relatively low power of the day. This 1932 QSL from JOCK in Nagoya confirms reception in Victoria, British Columbia.



JOFK - This 1932 mediumwave QSL from Hiroshima leaves no doubt as to the correctness of the listener's report: "We are very much pleased to hear that you have received our waves on the 4th Sept. and beg to verify with much interest that your receptions are all entirely correct."

MT

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Those Really Big Antennas

By Bob Grove W8JHD

In its simplest terms, a radio antenna is any device which is designed to emit or capture electromagnetic energy. So why isn't a screwdriver just as effective as a Yagi beam? And isn't bigger always better?

There are many considerations to be made in designing an antenna. At the higher frequencies above, say, 50 or 100 MHz, tricks can be played with various combinations of elements that would be impractical at the lower frequencies. It's all a matter of the wavelength, and the lower the frequency, the longer the wavelength; thus, the longer and wider spaced the elements.

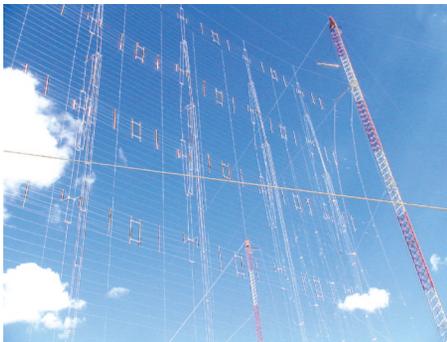
Skin effect is another consideration. The higher the frequency, the closer to the surface of the conductor the RF current flows. Besides the strength provided by large tubing, the extra surface area means less resistance to the RF current.

For receiving purposes on AM broadcast and shortwave frequencies (530-30,000 kHz), most DXers are satisfied with using a wire 30-60 feet in length. Mounted high and in the clear, and away from power lines, this simple antenna provides excellent, worldwide reception.

Some listeners prefer erecting two independent horizontal wire antennas, then switching between them to favor reception from different directions. Others may use a rotatable loop for the same directional choices, as well as nulling out interference.

If these simple antennas are so satisfactory, why do world broadcasters use such large arrays other than just to handle the RF power? The answer is directivity. In order to concentrate the signal in a particular direction, elements must be phased (spaced with regard to wavelength) to enhance radiation upward (takeoff angle) to take advantage of skip propagation, and outward horizontally for extended ground-wave coverage.

An excellent technical source on several of these antennas is found at www.w8ji.com/



Close-up of TCI Dipole Array at World Christian Broadcasting Madagascar World Voice station (Courtesy: World Christian Broadcasting)

[curtain%20sterba%20USIA%20array.htm](http://www.arrl.org/curtain%20sterba%20USIA%20array.htm).

One of the best sources of information on all types of antennas is the popular *ARRL Antenna Book*, available from the ARRL (225 Main Street, Newington, CT 06111-1494). Visit their website at www.arrl.org.

The Array

When elements are all electrically interconnected, they are called "driven." If they are isolated and reflective, as on common beam antennas, they are said to be "parasitic." As an example, VHF and UHF beam antennas like the Yagi in figure 1 have isolated, reflective elements. Only one pair is connected to the feedline. A slightly-longer reflector is behind the driven element, and several parasitic directors are in front.

The log-periodic, however, like the popular Create, has a zigzag pair of conductors commonly connecting all elements, making this a driven array as illustrated in Figure 2.

Depending upon where they are fed by the feedline, driven arrays may be either end-fire (main lobes radiate from the far end of the antenna) or broadside (main lobes radiate from the sides of the antenna).

Since the elements of driven arrays are directly fed by the transmission line, their patterns can be controlled by phasing the lines. By feeding one set of elements with a particular length of transmission line and the other set by a different length, one can change the phases between the elements to intentionally narrow and thus provide gain over that of a single, broad lobe.

One of the simplest forms of this combination of wire elements is known descriptively as a "Lazy H" – referring to its appearance as the letter H lying on its side – or even more imaginatively as a "butterfly dipole." See figure 3.

More accurately known as a four-element broadside array, approximately 6 dB gain can be achieved with spacing of 3/8 to 3/4 wavelength of the parallel elements.

As with all of these arrays, feed point impedance is high (hundreds of ohms), and they are balanced systems. Direct coax feed is not an option.

When two or more elements are in an axial line with each other, it's called a *collinear* array as diagrammed in figure 3. The resulting radiation pattern is broadside (at right angles) to the elements. The number of collinear elements that can be used is theoretically endless, and some real giants have emerged for shortwave broadcasting.



OK, so it's not my antenna but it's a beauty! It's Thomson's HP-RCA HF rotatable dipole array optimized for analog AM and DRM transmissions. Note the car and the figure behind it on the lower right. And they are closer to the camera than the antenna! (Courtesy: Thomson)

The Bruce Array

By angularly folding a single, multiple-wavelength wire into quarter-wavelength sections as shown in figure 5, gain of up to 5-6 dB can be acquired. The Bruce array is vertically polarized and works best over a good ground plane.

In this instance, since the array is a length of wire, the ground plane or counterpoise can be a simple, ground-mounted, quarter-wavelength of wire.

As a dipole, the Bruce exhibits a bipolar pattern. It has a typical feed-point impedance of 130-450 ohms, depending upon where you feed it and how close the bottom element is to the ground or counterpoise.

Receiving vs. Transmitting Antennas

For receive-only purposes, antennas large enough to bring received signals up and over background noise (static) are usually adequate, but for transmitting, elements need to be thicker, and directivity must be taken into consideration as well. On the shortwave bands, this means a lot of metal spread over a lot of space, and the more power and sharper the directivity, the more metal and the more space.

Because of mechanical and electrical sym-

metry of these arrays, the impedance is the same at either end; therefore you can connect quite a series of them to get desired radiation pattern of the colossus.

Complications come not from the basic principles of the elements, but from their relative placement in order to form the desired directivity and gain. Similarly, size is not due to the basic design of the antenna, but because of the multiple identical units working in concert to achieve directional gain over a simple dipole or vertical.

Legends abound around these high-powered broadcasting behemoths. One of which was that homeowners near Voice of America (VOA) facilities couldn't sleep at night because their fluorescent lights continued to glow!

Enter the Sterba Curtain

Collinear arrays may be daisy-chained into a large complex of antenna units as shown in figure 6. Simply stated, the antenna consists of virtually any number of collinear pairs of parallel half-wave elements spaced a half-wavelength. The end horizontal elements are a quarter-wavelength, joined by a half-wavelength element. It is a broadside array.

The Sterba has a rather narrow bandwidth and is usable only on one band of frequencies.

Variant curtains like the distributed or branch feed systems, similar to the Sterba, are popular among international broadcasters. The Sterba has a very practical application in cold climates. Because it is a closed loop of wire, an AC current can be simultaneously applied to the entire system, warming the wire to prevent it from icing up! RF chokes are used to isolate the AC current from the RF current.

The Rhombic Antenna

As a wire antenna becomes longer and longer in terms of wavelength, the major lobes migrate toward the ends of the wire, resulting in considerable gain and very narrow patterns. Phasing two or more elements together can magnify these characteristics.

The rhombic antenna, as shown in figure 3, gets its name from its rhombus (diamond) shape, an arrangement of end fed, multiple half-wavelength wires parallel to the surface of the Earth. It may be terminated at the far end by a resistor or it may be left open. That far end is also the direction of the major radiated lobe, so this array is an end-fire.

Since the rhombic is a balanced antenna, it should be fed by twin-lead, preferably open-wire feeders or ladder line for high power. It has high feed-point impedance, so a tuner (transmatch) is required.

If the far end of the rhombic antenna is left open, high forward gains over a simple half-wave dipole are achievable. The maximum recommended size is six wavelengths per leg, providing up to 20 dB gain – more than three S-units.

A terminating resistor is often used with a shorter rhombic (two wavelengths per leg, for example) to reduce the back lobe, thus improving front-to-back ratio. The resistance is the same as the nominal impedance of the antenna, typically 800 ohms.

The terminating resistor must be non-inductive; otherwise the coiled turns of the resistance wire would add reactance which would complicate the impedance of the system.

Gains of only 3.5 dB less than that of an unterminated rhombic of the same size can be realized with the resistively-terminated antenna. That loss is from the 1/3 of the RF power that is wasted heating the resistor!

The longer the rhombus, in terms of wavelengths, the more gain it has and the sharper the lobe. Since this large an array can't be rotated, an overly-sharp beam width is impractical. A maximum of six wavelengths per leg is recommended.

A rhombic for the 14-29.7 MHz range should be mounted at about 70 feet elevation and tilted upward to take advantage of propagation.

The bad news is revealed by the math. We are talking about a large antenna – typically six wavelengths per leg – to achieve that sort of gain. On ten meters, that approaches 400 feet from tip to tip, and just under 200 feet wide! Do you have a nearby football field that's not being used?

That's just for a "small" rhombic! A six-wavelength rhombic antenna on 160 meters would be well over a mile long and a half-mile wide! Where would the average ham put that monster and all its supports?



Thomson rigid dipole antenna, a "smaller" version of the large antenna on the cover.

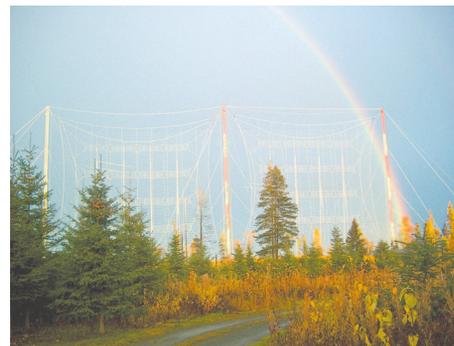
The Controlled Current Distribution (CCD) Antenna

We normally think of a dipole antenna as a half-wave length of wire fed at the center. But what if we break the length into a number of small segments and reconnect them all with capacitors? This makes a mutated type of collinear array as shown in figure 4.

Each wire, plus its attached capacitor, is a resonant circuit in its own right, redistributing its RF current into multiple resonant lobes depending upon the number of capacitor/wire segments. This antenna has a number of interesting properties. Ground effects are of little consequence, and some users report excellent results with the antenna actually lying on the ground!

Because of the shortened wire segments, the CCD is, in fact, a full-wave antenna on the band of choice and provides some 3 dB gain over a half-wave dipole. And the pattern is more concentrated toward the horizon for better DX.

The CCD is not in common use in the



The Sterba curtain array is a chain of identical collinear elements as in the TCI Dipole Array at KNLS, Anchor Point, Alaska. The initial elements are shown here as a center-fed antenna, although it can be fed at other points as well. (Courtesy: World Christian Broadcasting)

broadcast industry, and an external transmatch is mandatory for impedance-matching any band other than its resonant center. Twin-lead is highly recommended for this balanced antenna which has a typical impedance of about 250 ohms, no matter where you feed it along its length. For more information on the CCD, see <http://ad7md.com/AD7MD/DualBandCCD>.

Some Final Thoughts

Building scaled-down versions of some of these monsters for use in ham radio, and especially in shortwave listening without concern for transmitting, calls for some logic.

First of all, these antennas are all quite frequency dependent, some with quite narrow bandwidths before impedances and patterns change dramatically. Because we are talking about the shortwave band, multiple-wavelengths are considerable, resulting in substantial sizes.

In the majority of cases, gain over a simple dipole is just a few decibels. This may sound like a huge improvement, but doesn't necessarily equate to improved ability to receive. To hear the difference, simply tune in an international broadcaster and note the signal level. Now tune in another station about 6 dB stronger or weaker. Do you hear much difference? Probably not.

But if there's no immense improvement in received signal, why do the international broadcasters resort to such mammoth installations?

Huge, government-sponsored and religious broadcasting stations can afford the custom hardware required to construct these large arrays, but their primary goal is to propagate their messages to specific locations, and that's where the necessary directivity comes in. They concentrate their radiated power for best performance in a given direction.

And, for receiving purposes, the listener may wish to choose a scaled-down array in order to limit reception to a particular direction and attenuate co-channel interference. But a good receiver has far more single-signal-selection capability than any antenna can provide.

Many listeners use loop antennas to null interference or enhance the received signal, and such devices do work well. But for transmitting stations, large arrays still have their advantage of directivity and gain to put their RF power where it really counts.



A Love of Listening

By Thomas Witherspoon W4SWL
(Photos courtesy the author)



I've never been a fan of television. That's ironic considering that I grew up in the seventies and eighties when most kids were glued to the tube, addicted to Nickelodeon. Perhaps one of the reasons is that I find the visual often distracts from what I want to hear. Maybe it says something about my reluctance (some might say inability) to multitask, but I'm much better at simply listening, than listening while also being asked to watch. I prefer to close my eyes, to just listen – and allow my mind to construct images from sound.

An Early Start to Listening

My father still has in his living room the vintage RCA 6K3 wooden console radio which emitted, like an aging, crackly-voiced Siren with her own kind of coarse charm, the various scintillating sounds that first caught my ear and captured my young imagination.

One of my earliest memories is of my father, tuning in WWV in Fort Collins, Colorado, on the RCA to set his watch to the atomic pulse coming through the aether, a practice he

followed each Sunday morning. Sometimes he would allow me to tune around afterwards and on these occasions, I would catch broadcasts out of Europe, Australia, South America, as well as places I could not readily identify.

Not long after that, my great aunt unearthed in her basement a classic Zenith Transoceanic which she offered me. I took the dusty unit into my room and promptly set up a listening post. Little did I know at the time that I was joining a fraternity of radio listeners around the world who also logged into and listened to stations, as I began to do, far into the night. I often fell fast asleep listening to my Zenith and no doubt some of those mysterious DX stations I heard over shortwave and medium-wave infiltrated my dreams with languages and cultures altogether unlike my own.

Then, when I was in my teens, again, in an ironic twist, a TV repair man who came to work on my parents' set mentioned that he was a ham, and I was suddenly introduced to the intriguing world of ham radio. Though it took several years before I pursued my ticket, as I was busy with school, music, and other typical teen pursuits, my interest in the medium deepened.

While in college, I spent a year living and studying in France. At the time, the world wide web was still in its infancy, and my portable shortwave radio, which had helped teach me French back home, now became my English-speaking companion, bringing news from home courtesy of Voice of America. Unlike satellite television, cable TV, or an internet connection, radio was also inexpensive, vital for a poor student like me struggling to pay my own way in Europe. Through just listening, a virtual flight home was free and nearly instant, arriving at the speed of sound.

After graduation, once more stateside, I encountered two hams who were to become lasting friends and Elmers: Mike Hansgen K8RAT and Eric McFadden WD8RIF. These two talented hams nourished my keen interest in the hobby, and in their company, I soon found myself in the field experiencing the scrappy fun of hands-on radio contests.

I loved how my resourceful guides worked so many stations with the lowest-powered QRP equipment and only the simplest, cheapest wire

antennas, and moreover, that they often derived their station power from the sun. I appreciated the remarkable skill with which they milked such modest equipment, initiating contacts all over the globe. With their steady encouragement, I finally got my ticket.

I've been a ham for 14 years now and there's no doubt that radio has influenced my decisions to travel, to live and work abroad, and to pursue a graduate degree in Social Anthropology at the London School of Economics. Whatever I did, I did while listening to radio. I even changed my call sign not long ago to reflect my passion as a shortwave radio listener; my new call is K4SWL.



Here's a photo of the RCA 6K3 that my father used to listen to WWV when I was a child; I cut my teeth on this beauty!

Recently I found myself charmed and inspired by a BBC audio piece on Gerry Wells, the British radio repairman who in his eighties continues to do what he has always done, and is still sought for his skill. The story's subject is

truly enjoyable, if a bit of an anachronism: most remarkable is its relevance in the new millennium due to the simple fact that old mid-century (and earlier) radios continue to function today, and are still relied upon by listeners.

As I listened to this report, I couldn't help but wonder, as I have so often before: *why does radio have such powerful nostalgic appeal?* I reckon that, at least in part, it's because radio has always been the voice of reassurance, of comfort, during darker times, reminding us that we are human, yet reminding us of our ability to survive. Radio is a friend – or, perhaps, a “great-uncle, in cords and a cardigan,” as Jeremy Paxman characterizes the BBC in his recent defense of this valuable institution in *The Guardian* – whose warm, familiar voice is there even when other media sources, or the internet, are down. Shortwave, meanwhile, is much like the world's pulse – we check in, we listen, and we confirm: all's well, we're still okay.

Listening as Mission

One could say that listening to radio has shaped my life. I suppose that's why radio has recently become a mission for me. Today, I'm the founder and director of Ears To Our World (ETOW), a charitable organization with a simple objective: distributing self-powered world band radios and other appropriate technologies to



Children attending Unity Presbyterian Primary School in Belize City, Belize holding an ETOW shortwave radio.

schools and communities in the developing world, so that kids like I once was, not to mention those who teach them, can learn about their world, too, through the simple act of listening. I want others, children and young people, especially, who lack reliable access to information, to have the world of radio within their reach.

Specifically, Ears to Our World works in rural, impoverished, and sometimes war-torn or disaster-ravaged parts of the world, places that lack reliable access to electricity (let alone the internet) and where radio is often the only link to the world outside. The heart of our mission is to allow radio to be used as a tool for education, so we give radios to teachers, who, in turn, use the radios in the classroom and at home to provide real-life, up-to-date feedback about the world around them.

Through the encouragement of our good friends at Universal Radio and the extraordinary magnanimity of Eton Corporation, who donate our wind-up world band radios, ETOW's first two years has been noteworthy. On a budget of less than \$3,500 ETOW distributed radios to schools and communities in nine countries on three continents – in Africa, Eastern Europe, Central and South America, and the Caribbean – as well as to both Haiti and Chile, where the dissemination of information through radio was life-saving when earthquakes struck.

We've done all this through partnerships with other reputable and established non-profit agencies that already help struggling schools throughout the world, and who believe, as we do, in freedom of and access to information. Creating these partnerships is an important move, and, due to the very nature of the remote regions we serve, extending our assistance demands persistence, financial resources, and logistical support, times ten. To persistence, add a great deal of patience.

Just shipping radios to other countries usually involves detailed arrangements with national and regional governmental authorities (for example, to waive duties or taxes); once the radios arrive, safely distributing them to these remote areas can also be very costly and complex. We listen attentively to our existing partner organizations, who have often laid the groundwork in these regions and have established reliable connections with communities in them. Their need is for resources like radios.

By listening closely to and working cooperatively with other established organizations, we find we're able to distribute radios much more cost-effectively, too. In other words, we can operate on a shoestring budget so that donations to ETOW are used wisely and to their fullest extent. For example, because of our strong partnerships, money otherwise spent on travel can be put into shipping costs instead, thus getting more radios to more of the world with less donated funds.

So far, our scope has been limited only by our financial resources. Meanwhile, we are looking to place radios in other countries farther off the beaten path; Mongolia recently received our radios. Yet we're not simply focusing on expansion: ETOW is establishing strong, lasting bonds with our schools and teachers so as to better serve their needs long term. We endeavor

to replace their equipment and batteries as needed. We would also like to develop on-air teacher training programs; a new partnership with Oklahoma State University seeks to develop and disseminate content on important subjects, among them literacy and health education, so there is new and valuable content to listen to.

MT readers will have already guessed why we prefer radio to, say, computers, for information access. It is because much of the world does not have the communications infrastructure to support access to the world wide web and other dynamic media sources such as digital television, wireless networks, or even electric power or phone. Political instability, meanwhile, can undermine even the written word.

Radio, however, is simplicity itself; all one needs is a modest yet capable receiver, and one has instant – speed of light – access to local and world media. So far, every teacher we've worked with already knows something about radio; indeed, many of them have an intricate knowledge of broadcast schedules. But in these places it can take up to an entire week's wages to pay for a set of batteries. Thus ETOW's wind-up radios become vital; we effectively eliminate this cost, giving them steady access to information.

The reports we're hearing from the field have been overwhelmingly encouraging: Teachers in rural Mongolia, Tanzania, and Kenya are able to teach current events. Visually impaired children in rural Belize can listen to the outside world and hear music and languages they've never heard. Children in Haiti and families in Chile learned where to go to get food and medical care and information about loved ones affected by the quakes. A remote community in southern Sudan was able to listen to reports of their burgeoning country's first democratic election. Being able to listen is making a difference.

Listening and Learning Work Together

Radio captured my imagination as TV never could, it travelled with me and taught me early on that everyone has a story. Listening to radio taught me, too, that each voice is different in the consideration of what's meaningful or newsworthy. I learned to understand, or at least appreciate, the diverse perspectives I heard in my vicarious radio journeys, and from these sprang my own opinions, hopes, beliefs. Radio became my teacher, one who gave me, in my formative years, a global perspective.

Just as radio taught me, and opened my young mind, I'm convinced that it can teach and open the minds of others. In some parts of our world, futures are still written on the airwaves.

But it's never just a one-way street. Willingness to listen to those with whom we work helps



Here I'm explaining shortwave propagation to Project Education Sudan's (PES) Sudan Program Director, Daniel Majok Gai (left) and PES Executive Director, Carol Rinehart. ETOW radios have been used extensively in PES' schools in the new country of South Sudan.

us better serve them, but also to make the leaps of mind required to cross cultures, to become aware of those outside our Western sphere, to understand and grow and learn, ourselves. "Listen and learn," that's ETOW's tag line, but to some young people, and to me, it still means the world.

Want to help us give the gift of radio? Visit ETOW online at www.earstoourworld.org or write us at PO Box 3230, Cullowhee, NC 28723, USA. Your personal interest, or that of your local radio club or business, could put radios in a school or village in the most remote corner of the world.



Post-earthquake, ETOW radios continue to be a vital link for those in need in Haiti. Here, Erlande, who suffered a stroke in her early 30s and can barely walk, listens to one of our self-powered Etón radios, given to her through the Haitian Health Foundation.





Security Problems with Project 25

No fielded technology is perfect. System designers and engineers make tradeoffs to achieve performance goals within limitations driven by finances, time, and available technology. This month we will take a detailed look at some weaknesses in one popular digital radio technology.

Public safety agencies are moving in increasing numbers from old analog systems to new digital systems. The most common digital systems being deployed follow the Association of Public-safety Communications Officials (APCO) Project 25 standards, which specify the technological details of how mobile and portable radios communicate with each other and with repeater sites.

One of the primary goals of Project 25 (P25) is to provide a well-defined basis for interoperability. Because the P25 standards are public rather than kept hidden by a single manufacturer, customers have the ability to choose among several competitive equipment providers who are thus motivated to improve performance, enhance features and lower prices. Adherence to standards ensures that equipment from different providers will work together as a seamless whole.

In order to reach this level of interoperability, the P25 standards are very detailed and fairly complex. A significant number of engineering tradeoffs were made to meet the desired performance goals within the constraints imposed by existing technology and the environment in which a P25 system operates. Some of these tradeoffs, while appearing reasonable to the designers, can have unintended consequences when finally put into operation in the real world.

❖ Project 25 Encryption

One of the advertised features of P25 is the ability to encrypt voice transmissions. Often this is presented as an unquestionably secure capability that always and completely prevents any unauthorized monitors from hearing any part of a conversation.

Reality is a little bit different.

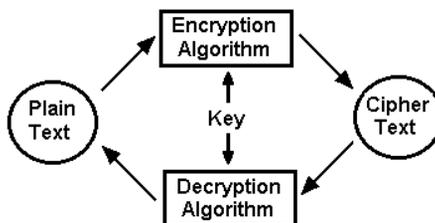
As anyone who monitors law enforcement activity with a scanner knows, it is not uncommon to hear sensitive information passed over the radio, even on supposedly encrypted P25 talkgroups. How is this possible?

At a security conference in August of this year, a group of researchers based at the University of Pennsylvania presented a paper that described several weaknesses in P25 sys-

tems. Failures related to voice encryption were included in that paper.



Encryption is the process of converting information from its original, understandable form, called *plain text*, into an unrecognizable form called *cipher text*. Decryption is the reverse process, converting cipher text back into plain text. When a radio is transmitting plain text it is operating "in the clear."



In a P25 system with properly functioning encryption, the radio takes the digitized voice information and encrypts it, then transmits the cipher text over the air. The receiving radio takes the cipher text and decrypts it, converting it back into understandable sound. In this way, anyone intercepting the transmission will have only the cipher text and presumably have no way to decrypt it.

There are many different methods to encrypt and decrypt information. These methods are called algorithms, which are sets of specific steps that are performed to convert plain text to cipher text and back again.

Encryption and decryption algorithms use a piece of secret information called a *key*. For the algorithms that are implemented in P25, these keys must be loaded into every radio that will participate in an encrypted conversation. Within each radio, keys are stored in an electronic table, where each entry has a numeric identifier for the key, another numeric identifier for the algorithm, and the actual cryptographic key.

Because encryption is an optional feature,

Key ID	Algorithm ID	Crypto Key
1	84	A7332D5E2C...
2	84	0322BD71D3...
3	84	909AF47281...

Example Cryptographic Key Table

P25 radios are capable of decrypting transmissions for which they have the proper key and, of course, are able to operate in the clear. All radios in a group must have the same key stored in memory in order to communicate using encryption. If one or more radios do not have the proper key, the entire group must revert to operating in the clear.

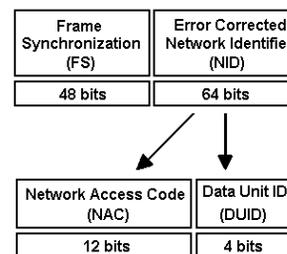
Cryptographic keys used in a P25 system are generated and issued by a central authority, usually the system operator. This central authority must make sure that all radios are loaded with the correct keys for the groups in which they participate. Automatic key updates, although normally recommended to "improve security," can cause problems if some radios get updated keys and others don't. Such key mismatches can result in the necessity for all members of a group to revert to operation in the clear.

❖ P25 Protocol

At its core, Project 25 is a set of standards defining the exchange of radio-related digital data. The fundamental unit of information in a digital system is the *bit* (short for binary digit) which can have only one of two possible values: a zero or a one.

P25 transmissions are made up of sequences of bits called frames. Within each frame, bits are organized into a series of shorter sequences that represent various types of information. For instance, a P25 frame starts with a 48-bit frame synchronization sequence. The sequence is the same for all frames and allows the receiver to reliably find the beginning of the frame. Following the synchronization sequence is a 64-bit Network Identifier ("NID") field with two sub-fields, a 12-bit (NAC) Network Access Code that identifies the network and a 4-bit Data Unit ID (DUID) that specifies the remaining contents of the frame. A 47-bit error correction code and a single parity bit protect these two sub-fields.

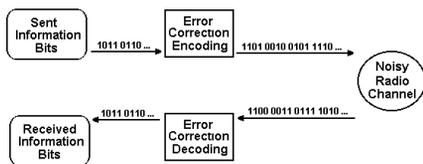
The radio channel itself creates problems



Frame Synchronization and Network Identifier

for the receiver because it contains noise and interference that can degrade the quality of the transmission. In a digital system, this degradation results in bit errors – the receiver cannot correctly determine whether the transmitter actually sent a zero or a one.

In P25 systems, this degradation is countered by a mathematical technique called *forward error correction*. In the transmitter, the information bits to be protected are run through an error correction method that encodes them into a larger block of data bits, which are then transmitted. When the receiver gets this block of bits, perhaps with some of them in error, it runs them through the error correction method. The method identifies the bits that are wrong and corrects them, producing the original information bits, usually without error.



Forward Error Correction

This method works very well, but it means that the transmitter must send many more bits than just the original information bits. It also has a limit: if there are too many bits in error, the receiver cannot fix them all and will be unable to produce the correct original bits.

Assuming the error correction method in the receiver can produce the correct bits, the next step is to check that the Network Access Code (NAC) in the frame matches the NAC that was programmed into the radio. If they're not the same, the radio remains silent because the radio assumes it is hearing a transmission from a different system. However, if there are so many bit errors in the NID that the error correction mechanism cannot correct them all, the radio will remain silent because it cannot determine if the NAC is correct. As we will see, an attacker can exploit this weakness to eliminate the use of encryption.

The four bits of the Data Unit ID (DUID) field identifies the type of frame, indicating whether it is a voice header, a voice superframe, a voice trailer, a data packet, a trunked frame, and so on. As with the NAC, if the NID has too many bit errors, the DUID will not be usable and the radio will remain silent.

❖ P25 Voice



P25 voice begins as sound from the radio's microphone. The sound is sent to a voice encoder-decoder (called a *vocoder*) that digitizes it, 20 milliseconds at a time, into a set of 88 bits. 56 bits of error correction are added, bringing an audio subframe size to 144 bits. Nine audio subframes make up a Link Data Unit (LDU), which is the equivalent of 180 milliseconds of sound. Signaling and control information is added to the audio data to form a complete LDU frame of 1728 bits.

As it turns out, the 88 bits produced by the vocoder (called Improved Multi-Band Excitation or IMBE) are not all of equal importance. Some of the bits are critical to reproducing the sound at the receiver, but other bits don't make all that much difference whether they're received correctly or not. So, in order to save on the number of bits that must be transmitted, P25 designers chose to protect the critical bits with error correction but left the less important bits of the audio subframe unprotected. This design choice has security implications, as we will see.

Technically speaking, there are two types of LDUs, imaginatively named LDU1 and LDU2. The differences have to do with the non-voice information that is carried in each frame. A LDU1 immediately followed by a LDU2 is called a *superframe*.

In addition to the audio data, a LDU1 frame contains what might be called addressing information, including a 24-bit source identifier (the identity of the radio that is transmitting) and either a 24-bit destination identifier or a 16-bit talkgroup identifier.

Message Indicator (MI)	Manufacturer's Identifier (MFID)	Algorithm Identifier (ALGID)	Key Identifier (KID)	Talkgroup Identifier (TGID)
72 bits	8 bits	8 bits	16 bits	16 bits

Header Data Unit Fields

A LDU2 frame also contains audio data, but in addition may contain information related to encryption, including a Message Identifier, Algorithm Identifier and Key Identifier. This information is needed by the receiver to properly decrypt the audio data. A Message Indicator (MI) is what cryptographers call an *initialization vector*. It sets the selected cryptographic algorithm to a known starting state. MI is 72 bits long. The 8-bit Algorithm Identifier (ALGID) identifies the encryption algorithm that the radio is using to encrypt the transmission. Because a radio may store more than one key, the Key Identifier (KID) field, 16 bits long, uniquely specifies the key used to encrypt the transmission. When the radio is transmitting in the clear, MI is 0, KID is 0, and ALGID has a special value.

Header Data Unit	Logical Data Unit 1	Logical Data Unit 2	Terminator Data Unit
792 bits	1728 bits	1728 bits	144 bits

APCO Project 25 Digital Voice Transmission

A complete voice transmission is made up of a header frame, indicating the start of the audio, followed by one or more LDU superframes, followed by a terminator frame that marks the end of the transmission. The number of superframes a radio transmits depends on how long the user holds down the push-to-talk button.

Because the necessary cryptographic information is carried as part of LDU2 in every superframe, a radio that is a late arrival, that is, a radio that tunes to the channel while a voice transmission is already underway, can quickly begin decoding. It also means that it is theoretically possible for cryptographic keys and even algorithms to change from transmis-

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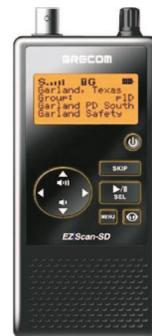
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sion to transmission or even from superframe to superframe.

To give you a sense of the amount of data moving during a voice transmission, one second of audio is 4,400 bits. P25 adds 2,800 bits worth of error correction and another 2,400 bits of signaling and control information. This is a total of 9,600 bits transmitted each second.

❖ Encryption Methods

The encryption algorithms supported by P25 are called *block ciphers*, usually commercial algorithms like Data Encryption Standard (DES) and Advanced Encryption Standard (AES). For encrypted communication among a group, the same key must be loaded in all radios prior to using encryption. If a radio does not have the proper key it cannot encrypt or decrypt voice transmissions in the group.

A mathematical limitation of a block cipher is that it requires an entire cipher text block be received without any bit errors before it can be correctly decoded. For P25 frames that allow bit errors, like voice frames, a block cipher cannot be used to protect the entire frame.

To protect voice transmissions, P25 uses the block cipher to generate what cryptographers call a *mask*. The mask is mathematically combined with the plain text audio subframe to produce cipher text, which is then transmitted. The receiver uses the same block cipher algorithm and the same key to produce the same mask, which it then mathematically combines with the received cipher text to produce the original plain text audio subframe.

Because the mask doesn't change the order of the bits, if there is a bit error in the received cipher text there will be a bit error at the same location in the plain text, but the error won't affect any other bits. In this way the use of a mask allows P25 audio subframes to tolerate bit errors.

❖ Eavesdropping

Even when encryption is active and working correctly, there are still significant amounts of data that are transmitted in the clear. This includes information identifying the system, the sender, the receiver and talkgroup, and the type of message. This is why digital scanners can still track and report activity on a P25 system regardless of whether voice activity is encrypted. Such monitoring is specifically allowed under U.S. federal law.

The University of Pennsylvania researchers identified this in-the-clear information as a weakness of P25 and a potential risk for users. While it is true that in a strict cryptographic sense information is "leaking" from an encrypted P25 system, in the real world those leaks are necessary for interoperability with mutual aid organizations not normally part of the system as well as existing radio equipment. The potential risks related to revealing this information are outweighed by the lower administrative burden and higher availability of service than would be found in a more secure system. This cost-benefit tradeoff between security and ease of use is very common in the security world.

One positive outcome of the report is to make it clear to the municipalities that are considering the use of encryption that such a purchase will not guarantee a completely stealthy operation. Persons monitoring an encrypted P25 system are still able to know which radios and talkgroups are active and can derive limited operational details even if they do not have access to voice transmissions.

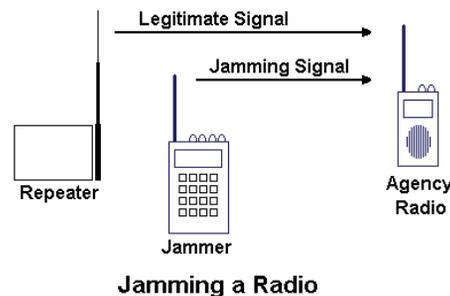
Although it is not a normal feature of consumer-level scanners, it is also possible to track activity to and from specific, individual radios and build an understanding of who talks to whom and when. This kind of tracking is called *traffic analysis* and can be done passively, meaning that it does not require the tracker to transmit or otherwise reveal his or her existence.

❖ Jamming

P25 radios will receive transmissions in the clear even when they're in encrypted mode. It's not immediately obvious to a user, who is typically focused on other things than his or her radio, which transmissions are encrypted and which are in the clear. Due to non-standard and often confusing user interfaces on the radio, it is easy to transmit information in the clear and it is difficult to tell whether an incoming message is encrypted, or if it is encrypted with the proper key.

For someone who has access to a P25 transmitter, it may be possible to encourage legitimate users to deliberately switch off encryption through the use of *selective jamming*.

Simple jamming is the process of preventing a receiver from successfully receiving a signal by injecting enough noise into the communications to cause the receiver to capture the jamming signal rather than the legitimate signal. For digital signals, the jammer only needs to inject enough noise to create a sufficient number of bit errors in the receiver. As we've seen, if the receiver experiences so many bit errors that it cannot correct them all, it will discard the frame, which is the goal of the jammer – to prevent correct reception of the digital message.



Jamming a Radio

Jamming can be much more effective and use less power if it is done at the proper time. Instead of trying to jam the entire transmission, a jammer can transmit a very short burst, just enough to corrupt a few critical bits. For instance, if the 12 bits of the Network Access Code (NAC) are corrupted, the receiving radio will not be able to correctly determine whether the transmission was sent from the correct

system and will have to discard the frame. If this type of selective jamming is done only on encrypted packets, it will keep the targeted radio silent and lead the user to believe that the encryption mechanism is not working, forcing him or her to switch the radio to operate in the clear.

Recall that a voice frame is 1728 bits and the Network Identifier is 64 bits. At a data rate of 9,600 bits per second, jamming 64 bits requires a transmission of less than ten milliseconds. Such a short burst would be very difficult to detect, but could be quite effective if performed correctly.

❖ Locating

With relatively simple direction-finding equipment, the location of any transmitting P25 radio can be determined. Many amateur radio operators even practice locating hidden transmitters through an activity called *fox hunting*. The challenge in locating a P25 radio is to get it to transmit on command. There are several ways this can be done if a tracker is willing to transmit a P25 signal.

P25 supports a "Radio Check" message that is used to determine if a specific radio is active on the system (in P25 lingo this is called *presence*). There is also a "Radio Unit Monitor" command that instructs a specific radio to begin transmitting without the user pressing the push-to-talk key. This capability is intended to allow the dispatcher to hear what is going on near the radio without the user having to take any action, but it could be triggered by a tracker as well.

It is possible to trigger a radio to transmit without using these kinds of system messages. In addition to voice, P25 standards also specify a means of moving data between radios in what are called *packets*. A P25 data packet can be sent in one of two ways: it can be unconfirmed, meaning the destination radio does not need to do anything if and when the packet arrives, or it can be sent confirmed. When a packet is sent confirmed, the destination radio responds with either an acknowledgment if the packet was received without error or a request to resend if the packet was received with errors.

Someone with a P25 transmitter can send a data packet addressed to the target radio. Regardless of what is in the data packet, as long as the header information is correct, the target radio will receive and process the packet. If the contents of the packet are corrupted or otherwise don't make sense, the radio will assume there were too many bit errors and immediately transmit a message back to the sending radio requesting it re-send the packet. This request transmission can be used to direction-find the target radio.

That's all for this month. More information is available on my web site at www.signal-harbor.com, including security information, links and scanner comparison charts. Please continue to send your questions, comments and frequency lists to me at danveeneman@monitoringtimes.com. Until next month, Happy Halloween and happy scanning!



Land Mobile Band

Referring to an item in our August column, reader Frank, K3FS, points out that frequencies above the common 450-470 MHz range, formerly assigned exclusively to UHF-TV broadcasters, are in growing use among public safety agencies in his area and others as well. The full range of frequencies in that land mobile band is 450-512 MHz.

FCC Rules and Regulations (Part 90.303) authorize the following UHF-TV frequency blocks to be assigned to public safety agencies in these metropolitan areas:

Boston, MA	470-476, 482-488 MHz
Chicago, IL	470-476, 476-482 MHz
Cleveland, OH	470-476, 476-482 MHz
Dallas/Fort Worth, TX	482-488 MHz
Detroit, MI	476-482, 482-488 MHz
Houston, TX	488-494 MHz
Los Angeles, CA	470-476, 482-488, 506-512 MHz
Miami, FL	470-476 MHz
New York, NY/NE NJ	470-476, 476-482, 482-488 MHz
Philadelphia, PA	500-506, 506-512 MHz
Pittsburgh, PA	470-476, 494-500 MHz
San Francisco/Oakland, CA	482-488, 488-494 MHz
Washington, DC/MD/VA	488-494, 494-500 MHz

If your older-style scanner stops at 470 MHz, you may be missing out on some exciting radio traffic!

Q. *In a recent issue of MT you suggested using a Diamond RH77CA (BNC) antenna with two adapters for a replacement antenna on a Uniden Home Patrol. I tried this and it does improve reception. But I prefer fewer adapters, so I switched to a Diamond RH77CA (SMA) with just one adapter which seems to be more secure. (Jim Jerzycke, KQ6EA)*

A. Jim's solution is a good one. What I've done in the past, if I've used two adapters and am afraid the whip will swivel down, is to mount the assembly in place, then remove the assembly and put a tiny drop of instant-setting glue on the slipping joint. That still allows plenty of contact surface for good electrical/RF integrity while solidly securing the antenna.

Q. *How does carbon-14 dating work and how accurate is it? (Mark Burns, Terre Haute, IN)*

A. Constant bombardment of our atmosphere by cosmic rays converts a small amount of the nitrogen into carbon 14, an unstable radioactive form of carbon that gradually "decays" over time back to a nitrogen atom.

Plants and animals absorb the C14 during normal respiration, and when they die, the C14 starts diminishing. The rate of decay is known as the half life, the period over which half of the carbon 14 changes back to nitrogen.

When that time period repeats, half of the remaining C14 decays, then half again, and so on. The half life of C14 has been established at 5730 +/- 40 years, and remains stable until about 60,000 years when the small numbers of remaining radioactivity approach randomness.

There are many ways of validating C14 half-life dating. One is by verifying the calculated age through original archaeological documents which describe those actual artifacts at the time of their use.

Q. *I had a customer ask me about a Q-meter. What is it and what would one be used for? (S.T., Hayesville, NC)*

A. "Q" stands for "quality factor." It refers to the ability of a component like a coil or capacitor to store the energy induced by a signal without introducing resistive losses. It is a ratio, so it has no unit. A high-Q component would process a signal predictably as its lossless design would expect, while a low-Q component like a small coil of fine, poorly insulated wire dobbed with moisture-laden potting compound would introduce consequential resistive losses, especially at higher frequencies.

Q. *With a good mobile antenna and quality coax, will a preamp like the Grove/Ramsey PR2 still help weak signal reception? Can a switch be installed to turn the unit off to avoid battery drain when not in use? (Sam Brittell)*

A. If you have good coax (as close to 100% shielding you can get), then your motor noise isn't likely to affect your reception. Depending on the type of antenna you're using, and what frequency ranges are most important, and how far away (thus, how weak) the signals are, the preamp should do some good.

Keep in mind, however, that if the majority of your driving is in areas of strong repeaters, you are likely to increase overload interference on the scanner when you are using the preamp.

Yes, you can merely put a small toggle switch in series with the positive (+) power lead to the unit to turn it on and off, but when it's off, it won't pass any signal at all unless it's immensely strong and is merely conducted by the stray wiring in the preamp.

Q. *I have a 400' wire loop mounted about 5 feet above the ground with part of it passing by my neighbor's electric fence. There is a constant pop from the fence that can be heard on all my radio equipment. Is there any way to alleviate this problem?*

A. Without moving your antenna, there is no way you can keep that noise out of your receiver. If the antenna must stay in place, you may need to replace the receiver with one that has a noise blanker.

Q. *Can I use my old NiCd charger to recharge newer NiMH batteries? (Eric Ferguson KA6USJ)*

A. An automatic timed NiCd charger will under-charge a NiMH because the latter has higher capacity, and the timer will likely turn off before fully charging the newer chemistry.

If it's one of those low-current "overnight" chargers, then it will take much longer to charge the NiMH, perhaps a couple of days.

If it's a rapid charger, then better check occasionally to make sure it's not overheating the battery. Warm is fine; hot is not!

Q. *My desirable FM radio stations are getting blasted by locals here in Breinigsville, PA. What can I use for a directional indoor antenna?*

A. A set of TV rabbit ears set to about 48" tip to tip should do the trick. If your FM receiver has a pair of screws for twin lead, you're all set; if it has a coax connector, you'll need a standard TV balun transformer to match the balanced 300 ohm antenna to 50 or 75 ohm coax.

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



It's Halloween: October "Numbers" Survey

Halloween is always a good time to check up on the "spooks," namely all the presumably intelligence-related "numbers" stations still inhabiting shortwave (high-frequency or HF). They are as strange and mysterious as ever.

This column continues to support and use the ENIGMA Control List. ENIGMA, or ENIGMA 2000 as it's now known, is the European Numbers Information Gathering and Monitoring Association. The name also refers to the notorious German code machine of World War II, the decryption of which was a major activity at Britain's historic Bletchley Park.

This list really did bring order from chaos in the numbers sub-hobby, and it's considered authoritative. It classifies numbers stations and other radio oddities by language or mode, and then adds a sequential number as stations are discovered. "M" is Morse code, "X" is for oddities, "G" is German, "S" is Slavic languages like Russian, "E" is English, and "V" is everything else.

The current Control List is version 25 (February, 2011), and older versions should be discarded. The latest one is always available at www.brogers.dsl.pipex.com/enigma2000/. ENIGMA's bi-monthly electronic newsletters are huge collections of current information and frequencies. Also useful is Ary Boender's "Numbers and Oddities," also known as "The Spooks Newsletter." It, too, is packed with timely information. These are at www.numbersoddities.nl/.

❖ 2011 Changes

The big change is the complete disappearance of Israel's huge operation last spring. This was ENIGMA's E10 and its variants, and it always competed with Cuba for the title of world's busiest numbers agency. On March 1, 2011, at the height of the "Arab Spring" unrest across the Middle East, it simply vanished without a trace. Nothing has been heard since.

In July, that weird Vietnamese numbers broadcast on 10225 kilohertz (kHz), upper sideband (USB) was assigned the ENIGMA designator of V30. Also in July, however, it disappeared from the air. Right now, its status is unknown. Hopefully, improved fall conditions will bring some hard information on this one.

A mystifying new player is VC01, also known as The Chinese Robot. "VC" stands for "Voice Chip." It's ENIGMA's new policy to give these descriptive acronyms to "new mode" digital stations. This one is a female Chinese voice, obviously from a digital chip, which delivers

hours of rapid-fire numbers almost too fast to copy. It's currently being heard on 7744 kHz USB around 0500 or 0600 Coordinated Universal Time (UTC). Other hours and frequencies were reported earlier in the year. These include 4530 and 7864, at approximately 1000 or 1100 UTC.

Cuba's round-the-clock numbers schedule continues to entertain North American listeners, both for its sheer strangeness and its frequent flubs. The two primary formats are still V02a, with the Spanish "Atención!" callup and three messages, and M08a, a "cut number" station sending Morse code letters corresponding to numbers.

If anything, Cuba has increased its weird digital transmissions, which are known as SK01. The name derives from early use of a ham radio direct-printing mode called PSK31 (binary phase-shift keying, 31 baud). Fairly soon after, however, they switched to an even more esoteric ham radio mode called Redundant Digital File Transfer (RDFT). As the name implies, it was originally developed to transfer graphic files ("digital slow-scan television").

SK01's files have the text (.txt) extension, but they are definitely not plain text. The ultimate output looks more like Asian characters or just gibberish, depending on data format and which software is used. There are many times and frequencies, but currently a good bet is 6768 kHz USB at 1600 UTC.

❖ Still Stalking ONEMI

Summer band conditions have given California some nice long-distance eastward propagation right after sunset. It's finally been possible to hear the Chilean emergency management office ("ONEMI") on frequencies lower than 17 megahertz (MHz).

While others have heard voice, everything heard here has used the Automatic Link Establishment protocol (ALE). Like nearly all ALE stations, these test propagation conditions approximately every hour or two.

This is done by "sounding." A sound is any test transmission, usually automated, that is used to collect data regarding band conditions. In the case of ALE, it's a long string of data bursts that are mostly repetitions of the station's call sign (an "address" in ALE jargon). Generally, each net player occupies a different time slot, to avoid interference.

These soundings typically move up HF from low to high in quick sequence. There are a few nets that go from high to low, and one or

two which are just strange.

Soundings are evaluated by all stations in the net, and each radio's ALE controller updates its internal list accordingly. The radio operator is then able to initiate a link by simply telling the controller which station to call. Software will pick a frequency with a maximum chance for success, make the call, and (hopefully) establish the link.

Extended monitoring of a net will reveal its sounding schedule, making it much easier to lurk on a given frequency until a station comes along. Often, gaps indicate that more frequencies need to be discovered. A straight run through a range usually means the list is complete.

It would appear, therefore, that the 10 MHz portion has been nailed. For those who missed last month's column, it goes as follows: 10128, 10135, 10160, 10176.5, 10187, 10193, 10218, 10222, 10234, and 10244 kHz USB.

The first two frequencies are in the 30 meter amateur band, which is shared with fixed-service utilities in many countries. All manner of unidentified signals, including Cuban M08a numbers and European psychological warfare aimed at Libya, have turned up there.

US listeners will likely encounter severe interference on 10128 kHz from a powerful radio teletype (RTTY) transmitter. The speed (75 baud), shift (850 Hertz), and encryption scheme all strongly suggest an unknown military station. Google searches turn up guesses for locations all over the planet. The ALE has actually been successfully copied through this signal on occasion.

❖ Meet PACTOR-IV

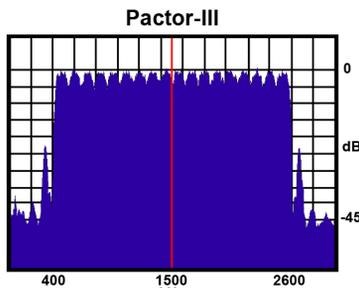
PACTOR stands for Packet Teleprinting Over Radio – at least it used to. It was developed by hams around 1991. The resulting German company is known as Special Communications Systems (SCS). According to SCS, "Pactor" also means "the mediator" in Latin.

The original design was intended to combine the strong error checking of HF packet modes with the better degraded-channel throughput of automatic repeat request (ARQ) systems. Other ARQ modes still in use are SITOR-A (Simplex Telex Over Radio, mode A) and AMTOR (Amateur Teleprinting Over Radio).

SCS has always kept a tight leash on all but the most basic (and slowest) PACTOR-I mode, which is used today mostly for calling. Anything more advanced is restricted to products made by SCS or its licensees. These tend to be solid, high-end designs, which cost accordingly. Even so,

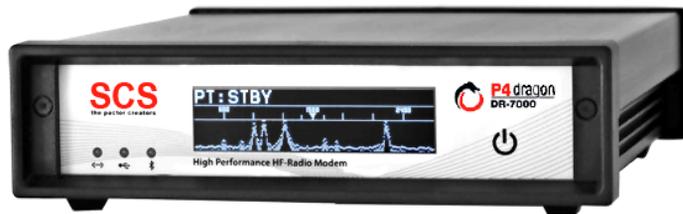
the more recent PACTOR-II and its firmware upgrade called PACTOR-III are widely used for HF e-mail, even on amateur bands.

PACTOR-I sounds like slowed-down SITOR-A. The sound of PACTOR-III is hard to describe, because it switches waveforms very quickly in response to channel conditions. As faster modes kick in, it becomes buzzy and then hissy. Often, one encounters 14 tones, spaced out over approximately 2.4 kHz. This is wide by ham standards, and some resistance to its use has developed. In commercial or military work, it's pretty much a standard voice channel.



PACTOR-III waveform (18 tones)

The latest SCS product is PACTOR-IV. It's a completely new modem. It features faster adaptation, and there are now 10 waveforms. The fastest of these uses quadrature amplitude modulation (QAM). It is said to achieve net bit rates from



The new \$2000 PACTOR-IV modem

approximately 5 to 10 thousand per second, depending on compression used and type of material.

Keeping this much information within a 2.4-kHz voice channel approaches the theoretical limit predicted by Shannon's Law. Other companies are currently testing QAM modes with far wider channel widths. These can achieve throughput competing favorably with satellite links, at an attractive cost.

All of this is likely to add yet more funny noises to the auditory zoo on HF. Keep your ears on until next month.

ABBREVIATIONS USED IN THIS COLUMN

AFB..... Air Force Base	MFA..... Ministry of Foreign Affairs
ALE..... Automatic Link Establishment	NATO..... North Atlantic Treaty Organization
AM..... Amplitude Modulation	PACTOR..... Packet Teleprinting Over Radio, modes I-IV
ARQ..... Automatic Repeat reQuest	PSK..... Phase-Shift Keying
AWACS..... Airborne Warning And Control System	R3E..... Single-sideband reduced-carrier AM
CAMSLANT..... USCG Communications Area Master Station, Atlantic	RTTY..... Radio Teletype
CAP..... US Civil Air Patrol	S06..... Numbers in Russian, male computer voice
COTHEN..... US Customs Over-The-Horizon Enforcement Network	S30..... "Pip" marker for occasional Russian voice and data
CW..... On-off keyed "Continuous Wave" Morse telegraphy	S32..... "Squeaky Wheel" marker for Russian voice and data
DHFCS..... UK Defence High-Frequency Communications Service	Secal..... Selective Calling
DSC..... Digital Selective Calling	SHARES..... SHARed RESources, US Federal interagency freq pool
E11..... "Stritch" (/) family English version, unknown origin	SITOR..... Simplex Telex Over Radio, modes A & B
FAX..... Radiofacsimile	STANAG 4285..... NATO 8-ary PSK teleprinting
FSK..... Frequency-Shift Keying	UK..... United Kingdom
G06..... Russian numbers in German, female voice	Unid..... Unidentified
HFDL..... High-Frequency Data Link	US..... United States
LDOC..... Long-Distance Operational Control	USAF..... US Air Force
LSB..... Lower Sideband	USCG..... US Coast Guard
M89..... Chinese military automated CW, looks like calling	VC01..... Chinese voice chip robotic numbers
MFA..... Ministry of Foreign Affairs	V02a..... Cuban "female," 3x150-group message format
MX..... Generic for Russian single-letter beacons/markers	V13..... Taiwan "New Star," music and live female voice
MARS..... US Military Auxiliary Radio System	Volmet..... Formatted aviation weather broadcasts
MCW..... Modulated CW, direct or in AM	

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

2142.5	ZLST-German Customs Control Post, Cuxhaven, working ZRUE (Customs Boat Rügen, DLVC), ALE at 2252 (MPJ-UK).	5448.0	The Pip-S30 day frequency, MCW marker at 0552 (Boender-Netherlands).
3297.0	Q7NW-Chinese military CW tactical code (M89), calling GKVZ; similar on 3642, 4225, and 5500; at 2118 (Ary Boender-Netherlands).	5474.0	Squeaky Wheel (S32), Russian marker at 0554 (Boender-Netherlands).
3587.0	TWLA2-Spanish Guardia Civil, Leon, calling TXX1, Madrid, ALE at 2241 (MPJ-UK).	5696.0	CAMSLANT Chesapeake-USCG, VA, working Coast Guard 2001 (not heard), at 2246 (MDMonitor-MD).
3756.0	The Pip-Russian military, night frequency for descriptively named marker (S30), MCW at 2135 (Boender-Netherlands).	5800.0	Unid-Cuban "Atención" station (V02a), AM Spanish callup 41532 06001 81622, then messages in 5-figure groups, at 0301 (ALF-Germany).
3818.0	Unid-German Red Cross, calling DEK24 (Regional Command Westfalen-Lippe, Münster), also on 4013, PACTOR-I at 1442 (ALF-Germany).	6330.5	OSY-SailMail, Bruges, Belgium, PACTOR-III traffic with WDB3306, vessel Cielita, at 1842 (PPA-Netherlands).
3829.0	The Squeaky Wheel-Russian military, another descriptively named marker (S32), at 2135 (Boender-Netherlands).	6450.0	PWZ33-Brazil Navy, Rio de Janeiro, signing off a broadcast in continuous PACTOR-I, at 0439 (ALF-Germany).
3831.0	ZSHO-German Customs Boat Schleswig-Holstein (DLVB), ALE and data modem traffic with ZLST, Cuxhaven, at 2302 (MPJ-UK).	6661.0	G-VFIZ-Virgin Atlantic A340 "Bubbles," flight VS0651, HFDL position for Riverhead, NY, at 2356 (MPJ-UK).
4150.0	"V"-Russian Navy Baltic Fleet CW marker (MX), at 2044 (Boender-Netherlands).	6668.0	344-Possible Chinese diplomatic net control, ALE link checks and some voice with many stations using 3-figure calls; also on 6725, 8056, 8275, 9243, 9050, and 12509; at 2140 (ALF-Germany).
4582.0	"Net Control"-CA CAP, roll call and standby for "any Region 5 station," then discussing exercise schedules post-net with Yosemite 68, at 0300 (Hugh Stegman-CA).	6715.0	AME 3195-Unknown Spanish Air Force flight, calling JOTA (Zaragoza), at 0318 (ALF-Germany).
4700.0	PL1-Polish unit in Kosovo UN mission, ALE link check with TOC, probable tactical ops center at Camp Bondsteel, also 5550, at 0100 (ALF-Germany).	6751.0	DJ34-Algerian military, working UN30, ALE at 1903 (PPA-Netherlands).
4745.0	MOBE3F-French Air Force ground station, Avord, working 203E3F, an E-3F AWACS with registration F-ZBCC and voice call Cyrano 203; also on 5684, 10965, and 14591.5; ALE at 2151 (MPJ-UK).	6770.0	Unid-Russian intelligence "Russian Man" (S06), null-message callup 471 00000 in R3E, at 1800 (PPA-Netherlands).
4958.0	Unid-Russian intelligence "German Lady" (G06), null-message callup 439 00000 R3E, at 1803 (PPA-Netherlands).	6801.5	Unid-SHARES Bulletin Board System, PACTOR-I calls to NCS311, NCS009, NNN0ANH, and NNN0JKI, at 0000 (ALF-Germany).
4988.0	TWL-Spanish Guardia Civil, working TXX1, Madrid, also used 5319, ALE at 2058 (MPJ-UK).	6815.9	"HA"-Possible US underground CW beacon, identifying at 0239 (ALF-Germany).
5206.0	Control-UK Royal Navy in weekly "Thursday War" exercise, calling Kilo Alpha, also on 8304, at 0640 (Michel Lacroix-France).	6957.0	Unid-German Red Cross, calling mobile unit DEK3210 in PACTOR-I, at 1137 (ALF-Germany).
5210.0	RCV-Russian Navy Black Sea Fleet, Sevastopol, Ukraine, voice in Russian at 2018 (Lacroix-France).	6963.0	T5L1-Venezuelan Navy, Carabobo, calling 5JL1 (Frigate Mariscal Sucre, F-21), ALE at 0125 (ALF-Germany).
5371.5	9A5EX-Croatian Amateur Radio Club 60-meter experimental station, Samobor, ALE sounding at 0155 (ALF-Germany).	6967.5	IGST-Italian Coast Guard Patrol Vessel Luigi Dattilo (CP 903), calling ICI (headquarters in Rome), at 0305 (ALF-Germany).
		6998.0	HWK7-Fake call used by "The Crazy Italian Pirate," CW marker at 0955 (ALF-Germany).
		7038.2	"L"-Russian CW channel marker (MX), possibly reactivated St. Petersburg site, with many frequency changes partially including 7041.8, 8494.2, and 8497.8; at 2119 (Boender-Netherlands).

7039.3	"K"-Russian CW cluster beacon (MX), Petropavlovsk, also on 8495.3 and 10872.3, at 1240 (Eddy Waters-Australia).	11226.0	580062-USAF KC-135Q tanker (voice Reach 269), ALE sounding at 1733 (PPA-Netherlands).
7039.4	"M"-MX, Magadan, also on 8495.4, CW at 1240 (Waters-Australia).	11232.0	Trenton Military-Canadian Forces, ONT, working Rescue 325, a CC-130E, at 2319. Trenton, working aircraft Canforce 4152 at 2334 (MDMonitor-MD).
7527.0	IW-USCG Buoy Tender Willow (WLB 202/NIIW), ALE link check on COTHEN with 01Z, then working LNT (CAMSLANT), at 0215 (ALF-Germany). CAMSLANT, working Juliet 39 (USCG HH-60J #6039), at 2132 (MDMonitor-MD).	11387.0	N204UW-US Airways B757, HFDL log-on with Riverhead, NY, at 2321 (MPJ-UK).
7744.0	The Chinese Robot-Rapid-fire Chinese numbers (VC01), LSB at 0529 (Boender-Netherlands).	11400.5	OEY62-Austrian military, working OEY80, also on 14609.5 and 17451.5, ALE at 0605 (PPA-Netherlands).
7785.0	OGFG-Probable US military signal-intelligence training in RTTY, also heard 06HG, 0FF0, and 0X06, all with simulated combat comms, at 1437 (Jack Metcalfe-KY).	11494.0	CAMSLANT-USCG, working Coast Guard 1711 at 2307 (MDMonitor-MD).
8058.6	KWX90-US Department of State, Europe, making ALE and voice calls to WY23, KWX92 (unknown European embassy), KWT49, and KWT51; at 1412 (PPA-Netherlands).	12205.5	Unid-North Korean MFA, no decode of 600/600 ARQ, also on 14442.5, at 1141 (PPA-Netherlands).
8088.0	Unid-"Stritch" family numbers (E11), callup 415/31 74819, at 1730 (PPA-Netherlands).	12356.0	Unid-Probable Hai Phong Radio, Viet Nam, running simplex phone patches in Vietnamese, at 1553 (PPA-Netherlands).
8127.0	RGN-Saudi Arabian aero net, calling JDN in LSB ALE, also on 9160 and 10468, at 1945 (PPA-Netherlands).	12577.0	003160023-Canadian Coast Guard, Iqaluit, DSC test with self, at 1206. 533174000-Malaysian flag tanker Selendang Mutiara, calling 004122600 (Fuzhou Radio, China), DSC at 1720 (PPA-Netherlands).
8136.0	RDL-Russian Navy, CW flash traffic of "XXX" priority grade, at 1912 (PPA-Netherlands).	12580.5	WDD4696-Sailing vessel Emmanuel, PACTOR-III e-mail to OSY (SailMail Bruges), at 1149 (PPA-Netherlands).
8190.0	PALERMO-Italian Financial Police, Palermo, Sicily, working TARANTO, ALE at 1300 (ALF-Germany).	12581.5	XSV-Tianjin Radio, China, CW identifier in SITOR-A marker, at 1831 (PPA-Netherlands).
8345.0	RMZW-Russian Navy vessel, calling RIT, CW at 1824 (PPA-Netherlands).	12603.5	SVO-Olympia Radio, Greece, long SITOR-B text broadcast in Greek, at 0603 (Waters-Australia).
8478.5	FUF-French Navy, Fort de France, Martinique, STANAG 4285 test loop at 0150 (Terry Netzley-OH).	12612.9	XSQ-Guangzhou Radio, China, CW in SITOR-A marker, at 1728 (PPA-Netherlands).
8549.6	CTP-Portuguese Navy/ NATO, Oeiras, RTTY Notice to Allied War Ships loop at 0130 (Netzley-OH).	12783.5	9MR-Malaysian Navy, Johor Bahru, RTTY marker at 1637 (PPA-Netherlands).
8626.8	FUM-French Navy, Tahiti, STANAG 4285 test loop at 0240 (Netzley-OH).	12858.8	6WW-French Navy, Dakar, Senegal, STANAG 4285 test loop at 0215 (Netzley-OH).
8894.2	Unid-Station calling LP2000 in PACTOR-I, then formatted text log in, some binary traffic, and finally a marker in FSK, at 1706 (ALF-Germany).	13011.0	AQP6-Pakistani Navy, Karachi, CW marker, simulkeyed with AQP2 on 2458.5, and AQP4 on 6391, at 1832 (PPA-Netherlands).
8912.0	B52159-US Army 159th Aviation, ALE sounding on COTHEN, at 0147. R00136-US Army Aviation helo #89-00136, ALE sounding on COTHEN, at 0200 (ALF-Germany).	13023.8	HEC-Bern Radio, Switzerland, PACTOR-II identifier and traffic list, at 0100 (Netzley-OH).
8930.0	Cargoitalia 662-Cargitalia MD-11 freighter, registration EI-UPI, answered selcal FK-DM from Stockholm LDOC, at 2155 (ALF-Germany).	13257.0	Trenton Military-Canadian Forces, rescue op with Rescue 327, at 1122 (PPA-Netherlands).
8948.0	F-HPIA-Air France A380, flight AF0995, HFDL position for Canarias, at 0009 (MPJ-UK).	13270.0	"06"-HFDL ground station, Hat Yai, Thailand, HFDL uplink to VQ-BEG (Aeroflot SU297), at 1752 (PPA-Netherlands).
8957.0	CO0115-United/Continental Airlines B757, HFDL position for Santa Cruz, Bolivia, at 2337 (MPJ-UK).	13282.0	VRK22-Hong Kong Volmet, voice-synthesized aviation weather at 1746 (PPA-Netherlands).
8971.0	Fiddle-US Navy, FL, working Cardfile 717 (US Navy P-3), and Red Talon (Navy P-3C, missed suffix), at 2135 (MDMonitor-MD).	13303.0	CN-ROB-Royal Air Maroc B-737, flight AT0687, HFDL position for Canarias, at 1843 (MPJ-UK).
8983.0	CAMSLANT-USCG, VA, working Coast Guard 2001 (USCG HC-130J), at 2245 (MDMonitor-MD).	13406.4	OLO32-Czech intelligence, encrypted SITOR-B text at 0547 (Waters-Australia).
8989.0	Unid-Central American religious net, possible missionary group, with daily Spanish sermons and operator chatter around 2300 or 0000 (ALF-Germany).	13528.0	"C"-MX, Moscow, also on 16332.0, CW at 1240 (Waters-Australia).
9031.0	Tascomm-UK DHFCS, Forest Moor, working UP548 and Magic 82 (back end of Royal Air Force E-3D AWACS), at 1100 (ALF-Germany).	13927.0	Rican 75-US Air National Guard C-130, patch via USAF MARS to Lightning Ops (MacDill AFB, FL), at 1455 (Allan Stern-FL).
9047.0	RIC-CAP National Technology Center, Richmond, VA, ALE sounding at 0453 (PPA-Netherlands).	13945.0	STAT154-Tunisian Ministry of Information, ALE and PACTOR-I with TU2/STAT2, at 0755 (PPA-Netherlands).
9056.6	OPMHQ2-Possible US Office of Personnel Management, ALE sounding at 0141 (ALF-Germany).	13979.2	RFUUAJ-NATO routing indicator for French Air Force, Villacoublay, ARQ idler at 0549 (Waters-Australia).
9087.0	ECO06-Chilean Oficina Nacional de Emergencia - Ministerio Del Interior (ONEMI), Region 6, ALE sounding, also on 9091, at 2310 (ALF-Germany).	13988.5	JMH4-Japanese Meteorological Agency, FAX wave analysis chart at 1725 (PPA-Netherlands).
9183.0	68-Republic of Singapore Navy Frigate Formidable (68), ALE link check with shore station DL6, at 2359 (ALF-Germany).	14396.5	AAV4AR-US Army MARS and SHARES Alternate Net Control, GA, taking check-ins from AFA3HY (USAF MARS and Alternate Net Control, KS), NCS 202 (SHARES Southeast Region), and KGD 34 (SHARES Master Control, VA), at 1530 (MDMonitor-MD).
9253.0	NPABOC-Brazil Navy Patrol Vessel Bocaina (P62), working Manaus in Portuguese, ALE at 2210 (ALF-Germany).	14582.0	CAMSLANT-USGC, working J36 (USCG MH-60J #6036), at 2345 (MDMonitor-MD).
9725.0	New Star Radio Station-Chinese music and numbers (V13), in progress at 0526 (Boender-Netherlands).	14664.0	RDL-Russian military, FSK Morse "XXX" priority callup, then messages in a data mode, at 0906 (MPJ-UK).
10081.0	CPA090-Cathay Pacific B747 reg B-LID, HFDL position for San Francisco, at 0419 (PPA-Netherlands).	14696.7	IGIELIT37-Polish Army, ALE calling SUDANIT42, then voice as IG7 working SU2, at 1558 (PPA-Netherlands).
10125.0	Unid-Continuing NATO psychological operations broadcasts to Libyan personnel, in Arabic and English, at 1335 (PPA-Netherlands). [Still very common at 1200 and/or 1300 on various frequencies, as of August. -Hugh]	14890.0	01-Moroccan Army, ALE sounding at 0640 (Waters-Australia).
10242.0	CAMSLANT, giving primary of COTHEN and secondary of "5 megahertz" to Coast Guard 2001, at 2250. Clearwater Air-USCG Clearwater Air Operations, FL, working Coast Guard 1711 (HC-130H), at 2355 (MDMonitor-MD).	16061.7	Unid-Egyptian MFA, Cairo, SITOR-A selcalling and working embassies KKXZ (Pretoria, South Africa), and KKXT (Nairobi, Kenya), at 0934. MFA Cairo, SITOR-A hexadecimal message to Washington, at 1437 (PPA-Netherlands).
10492.0	RMBB-Unknown Russian Navy vessel, two long CW messages to RCV in Cyrillic Morse letter groups, at 1558 (MPJ-UK).	16285.0	STAT 25-Unknown Tunisia, ALE sounding at 0709 (Waters-Australia).
10518.0	4602WACAP-WA CAP, ALE raising 163CACAP, CA, who then answered in voice as "163" with no traffic, at 0318 (Stegman-CA).	16986.0	CTP-Portuguese Navy, RTTY marker at 0622 (Waters-Australia).
10555.0	VMW-Australian Bureau of Meteorology, Wiluna, FAX wind analysis chart at 1829 (PPA-Netherlands).	17412.0	AVS-CAP Avenging Spirit, special call at National Headquarters, Maxwell AFB, AL, calling 0004AZCAP, AZ CAP, at 0251 (Stegman-CA).
11000.0	RIW-Russian Navy headquarters, Moscow, calling RAL48 in CW, at 1528 (PPA-Netherlands).	17457.2	G3N8-Russian military, tactical CW duplex net with AU11, at 0550 (PPA-Netherlands).
11010.0	GWPWB33-Brazil Navy, Belem, calling GWPWSP, vessel Nae Sao Paulo, at 2022 (PPA-Netherlands).	17901.0	N77014-United/Continental Airlines B777, HFDL engineering data for Panama ground station, at 2347 (MPJ-UK).
11034.7	Unid-Egyptian MFA, Cairo, calling OOVF, Pyongyang, North Korea, SITOR-A at 1728 (PPA-Netherlands).	18205.0	202SERCAP-CAP Southeast Region, ALE sounding at 2010 (Stegman-CA).
11090.0	KVM70-US Government, HI, FAX surface forecast chart at 0727 (PPA-Netherlands).	18238.0	ZSJ-South African Navy, Silvermine, weather map of Southern Africa at 0647 (Waters-Australia).
11128.0	XGP-UK DHFCS, working XSS (control, Forest Moor), ALE at 1228 (MPJ-UK).	18594.0	Panther-US Drug Enforcement Administration Operations, Bahamas and Tortugas (OPBAT), Nassau, taking encrypted position from an unknown helicopter, at 2201 (MDMonitor-MD).
11155.0	RIT-Russian Navy, Severomorsk, calling RAL48, CW at 1523 (PPA-Netherlands).	18615.0	"12928"-Unknown Australian station selcalling "128," no joy at 0705 (Waters-Australia).
		19101.7	Unid-Egyptian MFA, Arabic SITOR-A messages to unknown embassy, at 0712 Arabic to unidentified embassy (Waters-Australia).
		19814.0	9999HICAP-HI CAP, ALE sounding at 2251 (Stegman-CA).
		19889.7	Unid-Idler in ARQ no traffic, at 0635 (Waters-Australia).
		20890.0	CAMSLANT-USGC, position from Foxtrot 35 (USCG HU-25C #2135), at 1900 (MDMonitor-MD).
		23197.0	Unid-Unknown station in Humpty Doo Northern Territory, Australia, with modem idler and traffic, at 0525 (Waters-Australia).



Automatic Link Establishment

This month we take a look at few things that can complicate listening to ALE signals, some more revelations in monitoring the mysterious US 3-Letter Stations, and news of a new high-speed data mode.

❖ Why Won't My ALE Decode?

Back in the December 2008 issue of this column we took an extensive look at getting going with standard MIL-STD-188-141A ALE (Automatic Link Establishment) monitoring.

For those of you who are new to the column, you'll need to know that ALE is a very popular signal on the HF utility bands and is used by many types of organizations to select the best operating frequency from a pool of available channels, to open and close links and send text messages, all without human intervention. Armies, Navies, diplomatic services, MOIs (Ministries of the Interior) operations and commercial companies all make use of ALE to keep their HF communications working regardless of the prevailing conditions.

There are now many free options for decoding ALE using your computer's soundcard, including PC-ALE and Multi-PSK on Windows and Multimode on Mac OS X. With thousands of known identifiers and networks, in addition to hundreds yet to be cracked, and operations that are 24/7 the world over, these programs enable any listener with a computer and radio to "see" these ALE networks from around the world both quickly and inexpensively.

Despite the simplicity of the ALE decoder programs and the prevalence of this mode on the air, many users soon come across some signals that "just won't decode" or "produce gibberish." There are a few ways that this can happen and it's important to know why.

The first and most common way of getting problematic reception is that settings on the decoder software aren't allowing for a full and complete decode. This could be for a variety of reasons, but the usual culprits are too high an audio signal level (which causes distortion and clipping) or too low an audio signal level (which renders the signal inaudible to the decoder). Most decoder programs provide a way to change the audio level using the software and a visual indication of level, or you can usually use the mixer or audio controls within your computer's operating system to fix the problem.

The second most common problem is that the signal you are listening to has encryption enabled or, in ALE-parlance, what is called LP (Link Protection). The ALE specification provides for one unencrypted (called AL0) and two encrypted

(AL1 and AL2) levels of operation. It's fairly rare to find AL1 or AL2 signals, but the most common and most active is the Swiss Diplomatic network (see *Digital Digest* April 2009 issue for more details).

Most decoder programs will print the link protection level in addition to sometimes attempting a decode even with AL1 and AL2, so you can tell whether that exotic-looking identifier is real or not. So, unless you know the encryption key (unlikely), any AL1 or AL2 ALE signals "decoded" by your equipment will not produce valid output, even if it looks legitimate!

The third most common reason for no decode or a gibberish decode is that you are not in fact listening to a MIL-STD-188-141 ALE signal but something that sounds like it. The most typical culprit in this case originates from the French-made Thales Skymaster ALE modem that is built into their Systeme 3000, HF 3000 and SkyF@st radios.

While the waveforms used are exactly the same, namely 125bd, 8 tones spaced 250 Hz with center at +1625 Hz above the carrier point, the usual way to tell the difference between regular and Skymaster ALE is that there are often frequent and brief high-speed modem bursts in between the ALE. However, this is not always a definitive sign, as you may have caught a Skymaster-series radio sending a long text message, just as you can with regular MIL-STD-188-141 ALE. Here are a few channels with regular Skymaster ALE traffic heard recently:

4618, 4956, 5424, 5826, 5930, 6798, 6972, 7795, 8719, 10497, 10550, 10630, 12410, 14425, 14428, 15956, 16000, 16260, 16558, 18214, 20556, 20558, 20780, 20812 kHz USB

❖ More "3 Letter Net" Developments

Back in the December 2010 issue of this column, we covered the antics of a long-established US military or government network that appears on the third week of each month and communicates using ALE and STANAG4197 (aka ANDVT Advanced Digital Voice) traffic. Hours of operation are 0900 to 1600 EDT. As of the last period of activity, the list of stations participating was:

ALN, AMK
BFG, BGD, BLL, BRX, BVO
CNU, CTB
EDK
FSM
GHM, GWO
HPT, HYR
IRK
JES
LPP, LXV
MBY, MCK, MHE

RRL
TTD
VSF
ZFA

While monitoring 15037 kHz USB on 23rd June of this year, I happened to catch two stations exchanging messages using the DBM (Data Block Message) mode. This is something not previously noted among the numerous members of this network. Here is the beginning of the message between stations MHE and EDK:

```
[DBM]
11:43:35 6/23/2011 fuMIHNG
SXORc>&D-4Qf aEHa0ur7RX-^ ^
```

```
6x
~\
v
; | X
/ @ } HBq > E5fSZ >
BFuB; Fsd < MT8 @ < vc
= # = } B z - K r 3 d f K r . f A \ > -
2e8fWOP4 ^ rFEXNCYkhS6/q
```

As you can see, there are few clues in this message except the beginning sequence "MIHNG". Could this perhaps be a message header indicating Michigan National Guard as the source? Only time (and a few more weeks of concentrated monitoring time!) will tell. Perhaps you can help?

❖ PactOR-IV Is Here!

Announced with little fanfare, SCS brought the fourth generation of their popular PACTOR data mode to the market, along with a smart new modem, the P4dragon DR7800 (see photo on page 25), that implements this new system. This new modem offers a doubling of throughput (up to 10500 bits per second) compared to PactOR-III, and remains backward compatible with all previous PactOR modes while still fitting in a standard 2400 Hz voice channel.

PactOR-IV uses 10 different speed levels, from a simple 2 tone chirp to 32 level QAM (Quadrature Amplitude Modulation), automatically choosing each mode according to the prevailing channel conditions to maximize data transfer speed.

I've yet to hear this new modem on the air, but doubtless it will soon be appearing on the HF airwaves.

RESOURCES

MIL-STD-188-141 ALE signals.taunus.de/WAV/MIL-STD-188-141A_SOUND.WAV
Thales Skymaster ALE signals.taunus.de/WAV/SYS3000-ALE.WAV
SCS PactOR-IV Site www.p4dragon.com



The Old-School Performance of Open-Wire Line

As children of the industrial and information ages, we tend to assume that modern radios and electronic goodies are universally better than those that came before them. In many ways, that's probably true. In recent columns, even I have been touting the performance of software-defined radios, marveling at the capabilities and prices of palm-size vector network analyzers, and detailing the advantages of portable inverter generators over their old-style counterparts.

Continuous-wave code absolutely outperforms spark, just as SSB voice does when compared to full-carrier AM (aesthetic considerations aside, with an apology to "broadcast quality" enthusiasts). Digital PSK31 grinds analog RTTY under its digital heel when it comes to signal-to-noise performance, and is itself bested by the latest in a never-ending stream of digital modes. And don't even get me started on computers in general!

Technology and performance march inexorably forward, hand in hand, but there are some old-school technologies that, when used correctly, can still *dramatically outperform* their present-day equivalents. Although they can trace their ancestry back more than 100 years, open-wire line, ladder line, and even TV twin-lead – all variations on the same theme – are just such technologies.

So how is it that a 100-year-old feed line can still outperform the latest-and-greatest in coaxial goodness? Well, it mostly comes down to the fact that modern hams – and modern people in general – are victims of their own need for convenience. If it's new, sleek, shiny, easy to use, and easy on the pocketbook, it's gotta be good, right? Well, not always!

From the earliest days of radio through the end of World War II, hams used balanced (two parallel wires) or single-wire feed lines. If you crack open any radio or antenna handbook from that era you'll find dozens of illustrations depicting the early feed lines in all of their antediluvian glory.

Things changed after WWII, thanks to a flood of Uncle Sam's surplus electronics, including receivers, transmitters and miles of newfangled 50-ohm coaxial cable. With its unparalleled ease of installation (pun intended) and its shiny black jacket, coax quickly became the amateur radio standard. It was flexible, inexpensive and convenient when compared to the open-wire lines it shouldered aside. But in many ways – especially when it comes to SWR losses – coaxial cable was a major step backward.

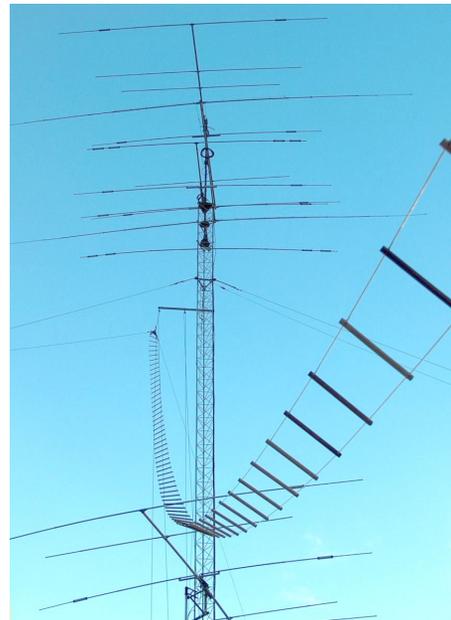
Despite performance increases and the

economy of scale, "coaxial liabilities," which we'll examine this month, still exist today. In certain circumstances – many of which are quite common in average backyard antenna installations – coaxial cable is downright horrible!

❖ How Coaxial Cable Can Kill Your Signals!

Having grown up in the "coaxial era," I remember being completely surprised to learn that coax wasn't a great choice for many antenna applications, and that open-wire line, 450-ohm "ladder line," and even antiquated TV twin-lead can work *a lot better* in certain common applications.

As typical hams, we have only a fuzzy understanding of how coax works and when to use it. And technical jargon relating to imped-



You won't find this jumbo ladder line in any shop! George Portell Jr., W8QBG, of Mesa, Arizona, built this run of 8-inch ladder line from urethane-coated dowels and 10-gauge stranded wire. W8QBG assembled 250 feet of the 800-ohm line to feed various antennas on one of his backyard towers. Licensed since 1951, George sits at the top of the DXCC Honor Roll, having worked every available DXCC entity. If ladder line is good enough for him, you might want to give it some serious consideration! You can see this and other projects and antique hardware restorations by W8QBG at www.arizona-am.net/PHOENIX/W8QBG/index.html.

ance, velocity factors and phase relationships only make that understanding fuzzier. Coaxial cable is ubiquitous and readily available, and it *usually* gets our radio signals from rig to antenna, but it's often used improperly.

Feeding a single wire antenna on multiple bands – whether dipole, vee or loop – with coaxial cable is probably the worst way to use the handy black stuff. As I have harped about in recent columns, coax works best for *matched* antennas at low frequencies with relatively short cable runs. For multiband wire antennas – especially those "tuned" by "antenna tuners" – coaxial cable performance can really kill your signals.

The multiband dipole, a "staple antenna" used by beginning and experienced hams alike, is traditionally fed with a random length of 50-ohm coax through a shack-mounted antenna tuner. The thought is to put up a single antenna and let the tuner worry about matching it on various bands. Even on bands where the system's SWR losses are quite high, at least some RF energy will be radiated. True, but the losses on some bands may turn your antenna into a real dummy load!

For example, a standard 40-meter dipole (about 66 feet overall) fed with 50 feet of decent-quality coaxial cable will tune up on all bands, 40 through 10 meters. Tuning on some bands might be a bit critical, but you can make contacts and even work some DX. So far, so good.

According to the manufacturer, our beefy coaxial cable (RG-8 type) has 1.5 dB of loss per 100 feet at 100 MHz (loss increases with cable length and frequency), so our losses with a mere 50 feet should be minimal, right?

Not necessarily. Published loss figures are for *matched, resonant antennas*. With high feed line SWR conditions, a lot of power (or *most* of your power) can be lost between your antenna tuner and your antenna.

How can that be? The low SWR produced by the antenna tuner really only exists on the cable that runs between your rig and your antenna tuner. The cable that runs between your tuner and your antenna probably has a much higher SWR, and much higher resulting losses. In coaxial cables, no matter how good the quality, losses increase with frequency *and* SWR, with a 3-dB loss representing a whopping 50% reduction in transmitted signal strength.

As we "tune" our standard dipole on various frequencies via the antenna tuner, on 40 meters, our 66-foot dipole is a great match, and the antenna system wastes only about 0.2 dB. Not bad! On 15 meters, an odd harmonic of 40

meters, the match is also pretty good, sporting an acceptable 0.8-dB loss. On 80 meters, however, because of the high SWR on the coax between the tuner and the antenna, feed line losses approach 14 dB. And on 160 meters, losses total a staggering 27 dB! If we start with 100-W output, we'll radiate about 3 W on 80 meters and less than a half a watt on 160!

Even as a long-time QRPer, milliwattling on 160 meters is more of a challenge than I care to take on, especially when my rig is dutifully putting out 100 W...

When used in this "traditional way," coaxial cable really can kill your signals!

❖ Open-Wire Line to the Rescue!

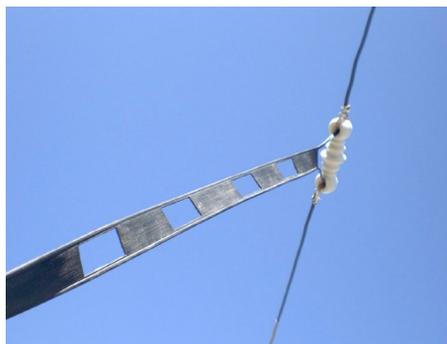
One way to reduce the feed line losses experienced while using multiband, non-resonant antennas is to place the antenna tuner at the antenna feed point (as detailed in the Feb column). Another option is to replace our coaxial cable with open-wire line, ladder line or TV twin-lead (the latter is recommended only for low-power and/or portable operation).

For our purposes, the terms we use to describe balanced feed lines – parallel conductors separated by a plastic, ladder-like insulating material – are interchangeable. The size of the wires, the distance that separates them and the specific insulating material determine the characteristic impedance of the feed line (and can impact its resistive and SWR losses to some extent).

Open-wire line, ladder line or window line has a typical conductor spacing of two to four inches and is rated at 450 to 600 ohms. TV twin-lead, with conductors spaced at one-half to three-quarters of an inch, is typically rated at 300 ohms. Two-conductor "lamp cord" or "zip cord," used to wire table lamps or make low-wattage extension cords, is often assumed to have an impedance of 75 ohms or so. Because it has close-spaced conductors and continuous insulation (no air gaps like the other balanced lines), its losses are much higher and it's not really in the same league as its more legitimate cousins. Of course, hams sometimes use zip cord as balanced feed lines, but unless you just washed up on a deserted island with no other feed lines in sight, just forget about it!

And as long as we're talking about impedances, when used with an antenna tuner to feed a multiband wire antenna, the exact impedance of a balanced feed line is really irrelevant. What benefits us in this situation is the line's low SWR losses, and as long as we're using a wide-range impedance transformer (antenna tuner), the exact impedance of the balanced line doesn't matter much.

Ladder line may not be as convenient as coaxial cable, but when used with an antenna tuner designed to handle it (most are, although some a much better than others), feed line losses for the 66-foot dipole described above stay blissfully below 0.3 dB on all bands, 40 through 10 meters! On 80 and 160 meters – essentially unusable when fed with coax – losses total 1.5 and 8.5 dB, respectively. That's a *spectacular* improvement!



An old ceramic "dog-bone" insulator with smooth, well-rounded corners is probably the simplest way to connect 450-ohm window line to your antenna's feed point. The feed wires on WB0JNR's dipole go up and through the holes at each end of the center insulator to help relieve flexing stress, which can break soldered connections that aren't secured. (photo courtesy of Roger Wendell, WB0JNR, www.rogerwendell.com/mystation.html, of Golden Colorado)

In the simplest terms, to reap the most rewards from your backyard multiband wire antenna, simply install the longest center-fed dipole (or horizontal loop) that's practical (make each dipole leg the same length) and feed it with enough ladder line to comfortably reach your station. With a decent antenna tuner (the beefier the better), you'll put out a nice signal on a variety of bands – something you can't always do with a coax-fed antenna in a similar situation.

Of course, simply using a balanced feed line doesn't *guarantee* increased performance or trouble-free installation. If that were the case, nobody would ever use coax. Ladder line has its own quirks and gotchas, but for many users the trade-offs are worth the performance boost.

Snow, ice and rain can affect (unbalance) open-wire feed lines. Keep your feed lines free of the frozen wet stuff for best results, and be ready to tweak your antenna tuner settings a bit if your feed line has snow or ice build-up.

Convenience and installation flexibility is one area where coaxial cable has a decided advantage over open-wire feeds. When attaching balanced lines to masts, towers, houses and structures, you need to keep balanced feed lines at least several inches away from metal (or metal-containing) objects. If the lines get too close to other conducting surfaces, losses can increase and the line's electrical balance can be degraded.

You can make or purchase stand-off insulators to keep the feed line spaced appropriately away from undesirable nearby objects. Brass and plastic stand-offs were once readily available in sizes suitable for TV twin-lead back in the pre-cable days of analog TV reception. Nowadays, I usually make my own stand-offs out of plexiglass or lengths of PVC tubing. These installation issues can make bringing the line into the house a bit tricky, but where there's a will, there's a way.

When using open-wire line, make sure your antenna tuner has a sufficient voltage rating. Wrangling high feed line SWRs can

create *very high* RF voltages inside your tuner. Resulting arcs and sparks can damage expensive equipment.

Antenna tuners designed specifically for ladder-line usually work better than their coax-oriented counterparts. The problem is usually the balun transformer that's required for conventional unbalanced tuners (coaxial cable is unbalanced) to handle balanced feed lines. Typical antenna tuners have a voltage or current balun at the tuner output. These are often wound on toroidal cores and are prone to saturating and arcing over, even at relatively low power levels. Plus, tuner output baluns usually don't work well over a wide frequency range. They may work well on a band or two, but not in the "dc to daylight" service desired by most hams.

Because of their specialized designs, most balanced tuners put the balun transformer on the tuner input, where it performs better in every meaningful way. You can build a balanced tuner (you can see mine in the February column), or you can purchase off-the-shelf models from several vendors. MFJ makes several balanced antenna tuners. Check out the Model 974B or, if you want to run higher power, the Model 976, which is rated for 1500 W. The Palstar BT1500A, also rated for maximum legal power, is a bit pricey, but it's built like a battleship.

Making connections at the antenna feed point is straightforward and rather "coax-like." The only special treatment required is to make sure that the ladder line isn't left swaying in the breeze where it's soldered to the antenna elements at the center insulator or the connection will probably fatigue and break rather quickly. You can reinforce the junction with electrical tape, make a center insulator that minimizes "flex fatigue" or use a center insulator designed for ladder line. Ten-Tec's Model 3003 Acro-Bat is inexpensive and sized for 450-ohm window line.

These days, open-wire line, ladder line and TV twin-lead can be difficult to find locally. Several national vendors stock these feeders, so check online and in magazines for wire and cable suppliers. Perhaps the best commercially made balanced line is the 600-ohm variety available from www.trueladderline.com. Their web site is straight out of 1994, but their open-wire line (the same run) has been feeding my loops for more than a decade. Other varieties, including 450-ohm "window" line and 300-ohm twin-lead, are available from www.universal-radio.com and elsewhere.

Open-wire feed lines are definitely old-school, but for multiband wire antennas, they can still outperform "the latest and greatest." If this month's introduction to balanced feed lines has sparked your interest, you can find more detailed information in Paul Danzer's "Open-Wire Feed Line – A Second Look," in April 2004 *QST* and in "The Lure of the Ladder Line," by Steve Ford, WB8IMY, in December 1993 *QST*. A quick Google search usually turns up downloadable PDFs of both articles. I plan to cover balanced feed lines in more detail in a future column.



Radio Listening in a non-FiOS Home

There is a sense among city-dwellers, well attached to their digital cable-TV systems and the accompanying high-speed Internet access, that most Americans enjoy the same. Not true.

According to the National Cable and Telecommunications Association, of the 129 million homes to whom cable is available, only 45 million (a little more than a third of those homes) subscribe to high-speed Internet access. Interestingly, that number actually peaked in 2008, another victim of the great and never-ending recession.

Even the phrase “high-speed Internet access” can mean anything over 1 Megabit per second (Mbit/s), too slow for high-definition TV viewing at 1080p resolution. In addition, your speed may vary. Actual download speeds are on average 20 percent lower than advertised, according to an FCC nationwide survey of Internet Service Providers (ISPs).

❖ Slim Choices

The further away from the city a person gets, the less possible high-speed Internet access becomes, and the less possible services such as Internet TV streaming become. For rural residents or those to whom high-speed Internet service is not available, there are few choices. There is wireless broadband, mobile wireless broadband, and satellite. Wireless broadband uses a main tower to exchange data at distances within and up to a 30 mile radius and can have a download speed up to 100 Mbits/s, but systems typically offer far less.



NexAira NexConnect II 3G/4G wireless router (\$90) from B&H Photo. (Courtesy: bhphoto-video.com)

Verizon’s Fiber Optic Service (FiOS) offers speeds in tiers from 15 Mbits/s to an astounding 150 Mbits/s; AT&T U-verse offers 1.5 to 24 Mbits/s tiers, and cable-TV giant Comcast of-

fers downloads up to 15 Mbits/s. But, you’ll get only a fraction of that with either mobile wireless broadband or Internet satellite.

The 3G mobile wireless broadband service I use – which involves using a small wireless modem operating in the 800 MHz spectrum in the same fashion as 3G smartphones – typically achieves 1 Mbit/s download. HughesNet satellite claims up to 2 Mbits/s, but delivers considerably less in reality. Competitor WildBlue offers plans from 500 kbits/s to as high as 1.5 Mbits/s, but also delivers considerably less.

As with cable-TV, DirecTV and DISH Network, satellite-delivered Internet access is often bundled with TV service in complicated plans that involve disastrous financial consequences for early cancellation.

While many customers are happy with HughesNet and WildBlue, many others are not. I urge readers to read reviews of each service before signing up. *Consumer Reports* ranked both services at the bottom of all broadband Internet Service Providers nationwide.

The big problem with 3G wireless is that you have to be within about a five mile radius, depending on terrain, of an available 3G network cell tower to make it work. Earlier this year in select cities there began a national build-out of 4G-wireless that promises to deliver high enough download speeds to enable wireless modem subscribers to enjoy HDTV streaming of content currently not available to them.

Naturally, when and if it gets built-out to the hinterlands, we can expect a significant hike in monthly fees for such service. T-mobile’s 4G “laptop sticks” reportedly can achieve 42 Mbits/s, costs \$80 for the modem, and subscribers can expect to pay \$40 to \$80 per month for the service. Each monthly plan reduces download speeds after a subscriber has reached as little as 2 GB – an easy thing to do when streaming HD movies. The \$80 per month plan lets you download up to 10 GB before your download speed will be reduced. Verizon’s 4G service promises 5-12 Mbits/s and offers similar monthly plans, but requires subscribers to pay \$10 per GB for overages in monthly allowed downloads. This could end up being a substantial bill for subscribers who stream daily HD programming.

To watch HD movies via broadband, your connection should be capable of maintaining 3.5 GBits/s minimum. With our “slow-speed” wireless broadband connection, we can stream Netflix movies, but only in standard definition. (You should also know that the definition of “High Definition” itself is as elusive as the definition of “broadband.” For example, Amazon TV streams

its “HD” movies at 720p resolution; considerably under the 1080p resolution your TV is probably capable of producing.)

❖ The 3G Radio Streaming World

That brings me to the subject of this month’s column: Streaming radio via wireless broadband. Luckily, Internet radio streaming requires very little in the way of download rates to reproduce satisfactory audio and still leaves enough bandwidth to do most Internet-related work at the same time or allow several other devices to access the data stream even on a mobile wireless broadband modem.

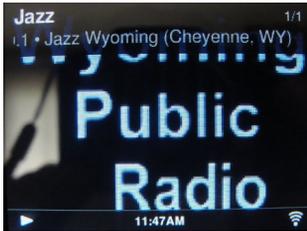
I’ve been following Loyd Van Horn’s *Globalnet* column and find the topic of Internet radio very interesting. I’ve streamed many different radio stations on my PC for more than 10 years, but it wasn’t until I had two crucial pieces of equipment that I was able to enjoy Internet radio the way people with real high-speed Internet can.

First was the aforementioned mobile wireless broadband modem, and the second was the addition of a 3G wireless router. The router makes it possible to connect any modern WiFi-equipped device, such as an iPad, an Internet TV box such as a Roku or BlueRay, or an Internet radio, to the modem without wires and without the main computer being turned on. Recently I bought a Logitech Squeezebox Internet radio from Crutchfield (\$180), based on a review Loyd had done in his column.

Setup, which included establishing a Logitech account (free) and updating the software (done quickly through the router attached to the wireless modem in another part of the house), I was ready to start tuning in the world. An hour later I had vowed to drop my XM Satellite radio subscription which I’ve had for almost 10 years. Suddenly, an amazing world of radio from short-



Logitech Squeezebox Internet Radio. (Courtesy: Logitech)



Jazz Wyoming, CBC Jazz and Jazz from WBGO-FM Newark, New Jersey just a few of the great full-time jazz channels on the Squeezebox. (Courtesy: Author)

wave to scanning, from web-based Old Time Radio to NASA mission audio, was available in a nearly endless list that sounded as good as FM and better than the super-compressed XM satellite audio.

I have a Pandora premium account which features unlimited listening time, no commercials and enhanced audio bandwidth. The Squeezebox had me up and running with it, including all the custom "radio stations" I had developed in my account. I had been streaming Pandora on the BlueRay and enjoying it, but found it annoying to have to have the TV on to see what song and artist was playing at the moment. The Squeezebox has a nice little 1.5 x 2 inch full-color display that tells me everything I want to know.

❖ Squeezebox Attributes

The Logitech Squeezebox has built-in WiFi, but also an Ethernet connection on the back that lets you plug directly into the router. It also has a 1/8 inch Auxiliary input (for your MP3 player, for instance) and a headphone jack. I use the headphone jack to drive a Part 15 FM transmitter that lets any radio in the house tune in.

The front panel features six station presets for your all-time favorite stations and an endless list of favorites that is quickly accessed through the well designed "home" screen. An alarm button lets you choose which stream you would like to wake you up in the morning with a slowly rising volume that can be adjusted to be as loud or soft as you like.

Navigation through the amazing list of menus is done with a large central knob and the "back" button. Turning on the radio and pressing the home button brings up a list of options, including Internet Radio which gives you seven additional options in categories. If you want to find a particular radio station, there's a good chance it's already listed in the enormous built-in radio list. But, if you insist, you may enter the name of the station in "Search" and it will find it for you, displaying the options that come closest to your request.

One of the most impressive options is listening to scanner traffic. From the home button press Internet Radio then Talk, then News, then Explore News, and finally Scanner. You'll be presented with 15 "scanner stations," a choice of 15 localities. You may also choose Explore Scanner which then brings up four additional categories: Air, Fire, Police, and Rail. Pressing Rail, for example, you'll get an additional 34 rail scanning options from states, provinces and cities all over Canada and the U.S.

Pressing the Air option gives you 10 Air

Traffic Control towers, including New York, Chicago, Dallas-Ft. Worth, and (oddly enough) Moscow. Pressing Police, I counted 276 county, city and state police services from all over the U.S. and Canada. Pressing Fire brought up categories for Australia, North America and South America. North America brought up choices for Canada and the U.S., and nearly 300 city and county fire departments across the U.S. alone.

Similarly, the list of public radio stations was truly amazing. In Explore Public/NPR I found 87 public radio networks; American Public Radio, Nebraska Public Radio, Alabama Public radio, etc. Among these are reading services for the sight impaired. I counted 432 public radio stations, many of which were HD2 or HD3 services.

For international broadcasters, go to Internet Radio and press World, then National Networks, which brings up a list of 36 shortwave broadcasters. Pressing Voice of America, for example, brings up a selection of 25 languages in which VoA broadcasts, including English. Pressing RTE Ireland brings up 10 stations from all over Ireland. BBC offers 14 U.K. based stations as well as World Service, and CBC includes 45 CBC stations from all over Canada. In all, I counted 34 countries from which to choose. I found 8 stations from Israel, 23 stations from Iran, 20 feeds from China Radio International; you can spend hours exploring these services. If you find one you like, press the "More" button and you can add it to your growing list of favorites for easy retrieval.

❖ Last Word

If you're a sports fan, you may want to hang on to your Sirius/XM subscription. Even though you can tune in any flagship station of any major league sports franchise, if there's a game being played, the online stream will be blocked while the game is underway. Nor is it a substitute for having a great shortwave radio. You won't have access to shortwave utility stations, the pirate band, amateur radio, or many of the other reasons for which you have a shortwave radio.

And, yes, all of the thousands of stations you have access to via the Squeezebox can be found on the Web with any PC or laptop. The point of a stand-alone Internet radio is that it's all organized for you in a most convenient way that doesn't require your computer to be turned on. This radio is also portable. With a built-in rechargeable battery pack, you can take it outside anywhere it can still pick up the router's signal.

The only thing I don't like about the Squeezebox is that it didn't come with a remote control or battery pack. Both are available, but for \$50 extra.

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Don't Look Over Your Shoulder ...

A few years ago we shone the *Programming Spotlight* on programs dealing with history. Recently I have become something of a fan of a program I had never heard before, and I've been working my way through an extensive archive of past programs.

I refer to *The History Show*, a program produced by **RTE Radio 1** in Ireland. It is an interesting program from a country teeming with history. Programs in the series do not always focus on Irish history exclusively, but it is always lurking nearby.

Programs have included such diverse topics as the history of public executions back to the Roman Empire, conscientious objectors in World War One (Interesting from a personal point of view because my grandfather was one. He refused to carry a gun, spending the war in the gruesome task of stretcher-bearer), Songs against World War One, and 400 years of food writing. Other programs look at the Irish in America, and Frederick Douglass's trip to Ireland.

Myles Dungan, who has worked at **RTE** since 1977 and has written extensively on the Irish and their history, presents the program. In 2006 he received a Fulbright Scholarship to study in the United States. He brings both an academic and journalistic background to the program making it well researched and well presented.



The program seems to be on hiatus at the moment, but there is an extensive archive of podcasts which one can listen to online or download as mp3 files. Check it out at: www.rte.ie/radio1/podcast/podcast_thehistoryshow.xml

Normally the program airs on Sunday nights from 6:05 pm – 7 pm local time (1705-18 UTC) via **RTE Radio 1** transmitters in Ireland or via the live stream at www.rte.ie/radio/

❖ Hallowe'en Programming

In 1938, Orson Welles scared the pants off many in America during his re-creation of H.G. Well's (no relation) *War of the Worlds* broadcast, one of the most famous, if not infamous, radio plays of all time. About 30 years later in Buffalo, NY, **WKBW**, then one of the top music stations in the northeastern United States, created their own version. I was a child at the time, and while I didn't hear the broadcast I remember the buzz about it. In the **WKBW** version the Martians land on Grand Island (home of the Fantasy



Island theme park...coincidence?) and cause all sorts of mayhem. Reportedly the Canadian border at Fort Erie was closed briefly after reports were made to authorities about "the invasion."

WKBW did it again a few years later. While the audio of that first broadcast appears to have been lost over the years, there are various copies of the 1971 version available. A Google search turned up a number of sources where one can listen to this program, including one of my favorite sources for old time radio shows, www.archive.org. The 1971 version features Jackson Armstrong, a legend in Southern Ontario and Western New York, who worked in both Toronto and Buffalo radio and who sadly passed away not long ago.

Interestingly, despite the notoriety of the 1938 broadcast, the 1968 version still managed to fool a few people, enough that it made headlines. Proof once again of the power of radio and Theatre of the Mind.

Many stations, especially those that play old time radio shows on a regular basis, will probably air the 1938 broadcast. **AM 740** in Toronto and **CHML 900 AM** in Hamilton, Ontario have been known to broadcast classic radio shows with a Hallowe'en theme on the 31st.

On Sunday, October 30, "Count Michael" Godin presents his 15th annual *Hallowe'en Spooktacular* on his *Treasure Island Oldies* net cast. It can be heard from 9pm-1am Eastern, 6-10pm Pacific. *Treasure Island Oldies* is one of the longest running internet programs, debuting in 1997. There are an amazing number of novelty tunes with a Hallowe'en theme, or songs that are just "spooky."

Each year, Michael presents four hours of these gems, which get played far too rarely. It is a really fun evening, especially if you love rock and roll music with a twist. The program will also be available on demand for a few weeks after Hallowe'en. Listen live or listen to the archive at www.treasureislandoldies.com

The *Coast-to-Coast AM* program, heard on hundreds of radio stations overnight, usually airs an edition of "Ghost-to-Ghost" on or about Hallowe'en night. Callers from across North America call in with their ghostly tales. Some are quite imaginative. Best heard with the doors locked, the lights off and the covers pulled over your head!



❖ The Anachronistic and Unusual

There are a number of radio programs which harken back to an earlier pre-Internet era, when they provided a vital information service, but now seem almost quaint, either because society has moved on, or the information service is more efficiently delivered via satellite and the Internet.

Time marches on and inevitably these programs will probably disappear as broadcasters move farther into the 21st Century. As a self-proclaimed history geek, with a particular interest in radio history, I rather enjoy tuning in to hear these programs, which provided an important service in times past.

BBC Radio 4 – Bells on Sunday: As a child I can remember hearing the bells of a local Roman Catholic Church every Sunday morning as I climbed into bed with my parents. It recently occurred to me that it has been years since I have heard church bells of any kind live. **BBC Radio 4** provides *Bells on Sunday*, every Sunday morning and evening, for shut-ins who aren't able to get to church, and for those like me who enjoy the history behind the bells, and the pleasing sounds of days gone by. Each week, *Bells on Sunday* brings listeners a few minutes of the bells of some church in the United Kingdom (and at least once in Russia), and a brief discussion of the age and number of the bells and the parish where they are located. It brings back many childhood memories of time spent with my parents and of those simpler days when church was a major focus of most of the community.



After about a minute to ninety seconds of the bells, more often than not, they fill the time until the next program with a lovely piece of music called "Sailing By" which is a tradition on its own.

Sailing By was created in the 1960s..."(it is played every night on BBC Radio 4 at around 0045hrs before the late *Shipping Forecast*. Its tune is repetitive, assisting in its role of serving as a signal for sailors tuning in to be able to easily identify the radio station. It also functions as a buffer – depending on when the final program before close-down finishes, *Sailing By* (or part of it) is played as a 'filler' as the shipping forecast starts at 0048 hrs precisely."

(youtube) "Besides its intended function, *Sailing By* is thought of affectionately by many British

radio listeners, as it is considered a soothing accompaniment to bedtime.”

The *Shipping Forecast* is another of these programs, which once provided a vital service. Nowadays with GPS and other resources, mariners have much of this information at the click of a mouse. The program nevertheless remains popular with non-nautical listeners, as well as seafarers. “The waters around the British Isles are divided into sea areas, also known as weather areas and many listeners find the well-known repetition of the names of the sea areas almost hypnotic, particularly during the bedtime (for Britain) broadcast at 0048 UK time (GMT or BST depending on the time of year). It is regarded with affection by many listeners, and in the UK often arises in general knowledge quizzes and is the butt of many affectionate jokes.” (Wikipedia)

Concluding our look at unusual programming, there are two obituary programs available. *Last Word* is heard on **BBC Radio 4**. This weekly program looks at the lives of notable persons who have died in the past week. It often provides interesting insight into the famous and near-famous. The times I have listened to it, they have covered such notables as Betty Ford, actress Anna Massey and Otto von Habsburg, pretender to the Austro-Hungarian throne. **Matthew Bannister** hosts *Last Word*, although **Jane Little** occasionally sits in for him. Heard weekly on Sundays at 2030 UK time, the program can be heard for 7 days afterward on the BBC iPlayer. In fact up to 120 past episodes can be listened to via the **BBC** website at www.bbc.co.uk/programmes/b012x12t

Those featured in the program have often had a profound influence on politics, entertainment, sport or society in general. It's good to look back on lives, for the most part, well lived.

CBC Radio One also has an obituary program, but it takes a slightly different viewpoint. “An unconventional take on the art of the obit. *The Late Show* is a moving, sometimes humorous, and always compelling national radio documentary series that explores the extraordinary life stories of deceptively ordinary Canadians.” Hosted by renowned Canadian actor **Gordon Pinsent**, *The Late Show* looks at those who may have slipped under most people's radars, but who deserve to be recognized for their contributions to Canadian society, quite often in relative obscurity. Among those who have been featured over the past few years were homeless advocates, a soldier killed in Afghanistan, and a man who spent his life studying whales. All of the stories are quite interesting, indeed compelling and really needed to be told. **CBC Radio** is to be commended for providing this show.

Pinsent is brilliant as host of the program. After a 50-year career as an actor in stage, radio, television and film, he is the perfect host to introduce these programs in a reverential tone without being maudlin or overly dramatic.

The program has aired as a summer program during the 2008, 2010 and 2011 seasons, but all three seasons are available to listen to via the website, and one can also subscribe to the podcasts at www.cbc.ca/thelateshow/ The series will be over by the time you read this, but like other summer shows it may someday find its

way into the regular **CBC** schedule *a la Black Coat, White Art* and *The Vinyl Cafe*.

❖ Spotlight on the Economy

Now for something truly scary: In early August stock markets dropped and rebounded at a dizzying rate. Many of us were left wondering what was going on and what was behind it. We live in an interconnected world and it seems when one country sneezes, a half dozen more catch a cold.



In trying to follow the “big picture,” several radio programs from around the world are useful to the listener trying to decipher what the economy is doing and what is happening in other parts of the world to cause the markets to behave the way they do. Let's shine the *Programming Spotlight* on the economy and take a quick spin around the globe in the process.

Starting in Asia there are a number of business and financial programs. **Radio Australia** is first up with *Asia-Pacific Business*. The program is hosted by **Karen Snowden** and provides a “weekly wrap of finance and corporate news from the Asia Pacific region.” Topics have included India's remarkable economic growth, Australian unemployment, stock market volatility and free trade negotiations. Listen to recent editions at www.radioaustralia.net.au/asiapac/business/

Biz China – **China Radio International's** business program. With China becoming the world's dominant economic power, not unsurprisingly the mood here is more upbeat. There is also a business segment during the daily *Beijing Hour*. Listen to *Biz China* online at <http://english.cri.cn/08webcast/biz.htm> The programs are posted online on Wednesdays. **CRI** can be heard on multiple frequencies in the 49 and 31 meter bands each evening.

Business Watch is heard in the last 15 minutes of UTC Monday broadcasts from **KBS World** in Seoul, Korea. As with other broadcasters, **KBS World** also devotes a web page to business and technology issues. http://world.kbs.co.kr/english/program/program_economymain.htm Listen on 9560 kHz via Sackville, Canada from 11-12 UTC or at 02 UTC on 9580 kHz.

Moving to Europe, **Radio Prague** in the Czech Republic is home to the weekly *Business News*. The program airs on Fridays. Go to the Radio Prague website and click on *Business News* for the latest edition. www.radio.cz/en

Germany is the biggest economy in Europe and as such, has the Cadillac of business programs. As Germany goes, so goes Europe. **Deutsche Welle's** “*European Business Week* looks at the major happenings in the world of

money and provides insights into the business climate in Europe. We explore the major issues in the economic world, with a personal touch.” It has been a dramatic summer in Europe with economic woes in Greece, Spain and other countries, many of which have been bailed out by countries like Germany. Week by week, *European Business Week* has chronicled the ups and downs of the economy in Europe and what is being done to stabilize the situation. On shortwave, try 11795 or 11865 kHz at 2030 UTC. Or listen online at www.dw-world.de/dw/0,,12582,00.html?id=12582

Polish Radio External Service, while not having a dedicated business program, groups all its financial stories on one page at www.thenews.pl/1,The-News/12,Business

Radio Romania International has its own business program called *Business Club*. The program is heard during UTC Tuesday broadcasts. While not a terribly comprehensive program, it is an opportunity to hear about the economy in southeast Europe. Try **RRI** broadcasts at 0000 UTC on 7385 and 9580 kHz, at 0300 on 7335 and 9645 kHz

Like China, Russia, which once condemned capitalism, now embraces it. This new attitude is reflected in *Russia Business Report* from the **Voice of Russia**. Listen online or try UTC Mondays at 0000 on 9665 kHz http://english.ruvr.ru/radio_broadcast/34718245/

And, of course the **BBC World Service** has *World Business Report*. It's a daily 18-minute program that can be heard at www.bbc.co.uk/programmes/p00fvhj7 along with a number of past episodes from the recent past.

NASB

National Association of Shortwave Broadcasters

Representing the privately-owned shortwave stations in the USA

- Find links to all of our members at www.shortwave.org
- Take the NASB Shortwave Listener Survey and get a free subscription to the NASB Newsletter. www.surveymonkey.com/s/6LRV1J7
- Listen to “The Voice of the NASB” on HCJB's DX Party Line on WRMi's 9955 kHz. Visit www.wrmi.net for schedule
- NASB is a member of the HFCC (High Frequency Coordination Conference) and the DRM (Digital Radio Mondiale) Consortium

THE QSL REPORT

VERIFICATIONS RECEIVED BY OUR READERS

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Chainsaws, Ouija board and Morak

In quiet circles, pirate radio fans still talk about last year's premier Halloween broadcast from Chainsaw Radio. Despite their brief broadcast airing over several days on 6925 USB, Chainsaw Radio presented a bizarre program of death metal music from Rob Zombie of Hellbilly Deluxe fame and revving chainsaw sound effects.

Pumpkin Patch Radio toned down their former, scary approach of *Highway to Hell*, to a gentler easy-listening *Dust in the Wind* tune on 6925 USB. Fans say they prefer their former ghoulish image.

Satan Radio's mission is to "corrupt the salvation of DXers everywhere!" With just one appearance in 2010, Lucifer broadcast with a mixture of creepy death metal music and spooky sound effects. Listeners throughout the South observed an excellent signal, and at sign-off a SSTV image of the station name on a Ouija board were transmitted.

Who isn't expecting a reprise performance from Voice of Doom this year? Look for possible promos prior to the Halloween show. Listeners are anticipating the returning saga of Morak ("the thing behind the wall") presented by Rig-O-Mortis.

Look for more Halloween fare from Automated Halloween Radio (WAHR), a computerized version of voices reading Poe's *Raven* between haunting sound effects, or perhaps a fright fest from Wolverine Radio on 6925 or 6950 USB.

My October 2009's *Tis the Season...of the Witch* column took a nostalgic look at Witch City Radio's 1993 broadcast. In 2010, the Halloween-theme station returned to the airwaves on October 30 and 31 on 6937.5 kHz. This year, DXers hope Station Manager Tommy Pickles returns again with news of the weird and audio clips from *The Mummy* or *The Thing Without Eyes*.

As in years past, Halloween produces more pirate radio broadcast than any other holiday. Check for weekend broadcasts this year on October 29 and 30 with a final blowout on Monday the 31st. Frequencies to scan include 6925 (AM or USB) plus or minus 30 to 40 kHz. The majority of U.S. pirates operate between 2000-0500 UTC; however, some may broadcast their programming earlier or later during holidays.

If the station QSLs, most operators will announce their email address or postal maildrop address during the broadcast. Some may announce "QSL via FRN," a reference to logs posted at the *Free Radio Weekly* website at www.frn.net/vines. Include "please QSL," if you post your logs online, as some operators scan the logs to verify their station.

Don't forget to read my review this month of Andrew Yoder's *2011 Pirate Radio Annual*, for additional pirate radio information to aid your monitoring.

If the bizarre or shocking intrigues you, plan to spend some time at your listening post on Halloween weekend 2011. You may hear revving chainsaws and *that thing behind the wall*.

NORTH AMERICAN PIRATE MAIL DROPS

Corresponding via postal mail requires three first-class postage stamps with the report.

P.O. Box 1, Belfast, NY 14711
P.O. Box 109, Blue Ridge Summit, PA 17214
P.O. Box 293, Merlin ON NOP 1WO Canada
P.O. Box 80146, Stoneham, MA 02180

EMAIL CONTACT LISTS

USA

The following addresses represent stations using email contacts this year. A portion of addresses are courtesy of the 2011 *Pirate Radio Annual*. Special thanks to *Sealord* for his Satan Radio QSL card for this year's Halloween column.

Ann Hoffer via www.frn.net/vines
Baby Time Radio babytimeradio@gmail.com
Bad Andy badandyradio@gmail.com
Barnyard Radio barnyardradio@gmail.com
Blue Ridge Radio blueridgeaudio@gmail.com
Bust a Nut Radio banradio@gmail.com
CHIP Radio chipradio@gmail.com
CYOT Radio cyotradio@gmail.com
Calling Marco Radio callingmarcoradio@gmail.com
Captain Morgan captainmorganshortwave@gmail.com
Channel Z channelzradio@gmail.com
Crystal Ship tcshortwave@gmail.com
Derby Radio derbyshortwave@yahoo.com
Eccentric Shortwave eccentricsw@yahoo.com
Edmund Fitzgerald Radio edmundfitzgeraldradio@gmail.com
Family Friendly Radio via www.frn.net/vines
Fire Drake Pirate Shortwave firedrakepsw@gmail.com
Fright Night Radio frightnightr@gmail.com
Germany Calling germanycalling@gmail.com
Germ Radio germradio@gmail.com
Hard Tack Radio hardtackradio@gmail.com
Hot Legs Radio hotlegsradio@gmail.com
Hunk of Junk hunkajunkradio@gmail.com
Iron Man Radio ironmanradi90@hotmail.com
KARR Mobile Radio radiokarr@hotmail.com
KBOX Radio kboxradio@gmail.com
KPR Radio kpr88.1@hotmail.com
Liquid Radio wrrbfm@gmail.com
MAC Shortwave macshortwaveradio@gmail.com
Mac in the Box Radio macintheboxradio@gmail.com
Mack Truck Radio mactruckradio@gmail.com
Metro Radio International metrointernational@gmail.com
Northwoods Radio northwoodsradio@gmail.com
Outhouse Radio outhouseradio@gmail.com
Partial India Radio haroldkrishnapir@gmail.com
Pirate Radio Boston pirateradioboston@gmail.com
Pirate Radio St. Helena piratesinthehelena@gmail.com
Pumpkin Patch Radio pumpkinpatchradio@gmail.com
Punxsutawney Pothead Radio puxradio@gmail.com
Radio Anarchy radioanarchy@yahoo.com
Radio Casablanca radiocasablanca@gmail.com
Radio Cinco de Mayo radiocincoemayo@gmail.com
Radio Fidel radiofidel@gmail.com
Radio Free Euphoria radiofreeeuphoria@yahoo.com

Radio Free Whatever radiofreewhatever@yahoo.com
Radio Ga-Ga radiogaga6925@gmail.com
Radio Magnetar magnetarradio@gmail.com
Radio Mariene radiomariene@gmail.com
Radio Mushroom radiomushroom@gmail.com
Radio Paisano radiopaisano@gmail.com
Radio Pigmeat pigmeat_voab@yahoo.com
Radio Rainbow International rainbowradio@hotmail.com
Radio Ramona radiatoramona@hotmail.com
Renegade Radio renegadeshortwave@gmail.com
Satan Radio satanradio@gmail.com
Somebody's Gotta Say It Radio somebodyradio@gmail.com
Sycko Radio syckradio@gmail.com
Thinking Man Radio thinkinmanradio@gmail.com
Toynbee Radio toynbeeradio@gmail.com
Trip Wave Radio tripwaveradio@gmail.com
Turkey Breast Radio turkeybreastradio@gmail.com
Undercover Radio undercoverradio@gmail.com
VUDU Voodoo Radio vuudu11@hotmail.com
Vanishing Hot Dog Radio vanishinghotdogradio@gmail.com
Voice of Captain Ron SW captainronswr@yahoo.com
Voice of Honor thevoiceofhonor@gmail.com
Voice of KAOS voiceofkaos@gmail.com
Voice of Next Thursday voiceofnextthursday@gmail.com
Voice of the Robots voiceoftherobots@gmail.com
Voice of Spike voiceofspike@gmail.com
WBNU Radio wbnuradiobunny@hotmail.com
WFUQ dj_jack_hammer@rockermail.com
WHYP Radio whypradio@gmail.com
WKND petsmartdoggie1@yahoo.com
WNKR wnrk@rock@rock.com
WTCR marbis@nyms.net
Witch City Radio witchradio@gmail.com

EUROPE

Though not a complete list of all European pirates, addresses represent a sample of stations verifying. European activity in North America is best heard from 2100-0200 and 1300-1900 UTC using 3900-4025 and 5800-7490 kHz upper or lower sideband.

Atlantic Radio atlanticradio1251@gmail.com
Atlantic 2000 Int'l atlantic2000international@gmail.com
Baltic Sea Radio balticseapirate@gmail.com
Blue Star Radio bluestarradio@live.nl
Borderhunter Radio borderhunterradio@hotmail.com
Cactus Jack Radio cactusjackradio@hotmail.com
Cupid Radio cupidradio@hotmail.com
Free Radio Victoria freeradiovictoria@hotmail.com
Geronimo Shortwave geronimoshortwave@hotmail.com
Mustang Radio mustangradio@live.nl
Mystery Radio mysteryradio@googlemail.com
Orion Radio info@orionradio.nl
Overijssel Radio verzoek@overijsselradio.nl
Pink Panther Radio pinkpantherram@hotmail.com
Radio Alice radioalice@hotmail.com
Radio Amica radioamica@gmail.com
Radio Atlantic studio atlanticradio.ie
Radio Batavia radiobatavia@hotmail.com
Radio Black Arrow radioblackarrow@hotmail.com
Radio Bluestar bluestarradio@live.nl
Radio Dutchwing radiodutchwing@live.nl
Radio Marabu info@radiomarabu.de
Radio Merlin Int'l radiomerlin@blueyonder.co.uk
Radio Marconi radiomarconi@msn.com
Radio New Wave shortwave@live.nl
Radio Northpole northpole@planet.nl
Radio Paardenkracht paardenkracht@draait.nl
Radio Ramona radiatoramona@hotmail.com
Radio Saxonia radiosaxonia@web.de
Radio Shadow sw radioshadow@gmail.com
Radio Spaceman 3927am@rock.com
Radio Spaceshuttle spaceshuttleteradio@yahoo.com
Radio Star Int'l rsi@live.co.uk
Radio Supersound superstudiolo@gmx.de
Radio Tarzan radiotarzan@hotmail.com
Radio Tonair radioonair@hotmail.com
Radio Waves Int'l rwaves@free.fr
Radio Zodiac radiozodiac@hotmail.com
Spider Radio spider.sw@hotmail.com
Trans Europe Radio radiotranseurope@gmail.com
Volle Melk Radio doctortim@online.de



HOW TO USE THE SHORTWAVE GUIDE

0000-0100 twhfa USA, Voice of America 5995am 6130ca 7405am 9455af
 ① ② ⑤ ③ ④ ⑥ ⑦

CONVERT YOUR TIME TO UTC

Broadcast time on ① and time off ② are expressed in Coordinated Universal Time (UTC) – the time at the 0 meridian near Greenwich, England. To translate your local time into UTC, first convert your local time to 24-hour format, then add (during Daylight Time) 4, 5, 6 or 7 hours for Eastern, Central, Mountain or Pacific Times, respectively. Eastern, Central, and Pacific Times are already converted to UTC for you at the top of each hour.

Note that all dates, as well as times, are in UTC; for example, a show which might air at 0030 UTC Sunday will be heard on Saturday evening in America (in other words, 8:30 pm Eastern, 7:30 pm Central, etc.).

FIND THE STATION YOU WANT TO HEAR

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

If a broadcast is not daily, the days of broadcast ⑤ will appear in the column following the time of broadcast, using the following codes:

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

CHOOSE PROMISING FREQUENCIES

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

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

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

print deadline.

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

Target Areas

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

Mode used by all stations in this guide is AM unless otherwise indicated.

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Thank You to ...

BCL News, Cumbre DX; Hard-Core DX; DSWCI/DX Window; DBS 2011; DX Mix News WWDXC/Top News.

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SHORTWAVE BROADCAST BANDS

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

Notes

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

"MISSING" LANGUAGES?

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

0000 UTC - 8PM EDT / 7PM CDT / 5PM PDT

0000 0030	Egypt, Radio Cairo	6270na	
0000 0030	USA, BBG/Voice of America	7555as	
0000 0045	India, All India Radio/External Svc	6055as	
	7305as	11645as	13605as
0000 0057	Romania, Radio Romania International	7385na	
	9580na		
0000 0058	Germany, Deutsche Welle	9885as	13780as
0000 0100	Anguilla, University Network	6090na	
0000 0100	Australia, ABC NT Alice Springs	4835do	
0000 0100	Australia, ABC NT Katherine	5025do	
0000 0100	Australia, ABC NT Tennant Creek	4910do	
0000 0100	Australia, Radio Australia	9660pa	12080pa
	13690pa	15240pa	17715pa
			17795pa
0000 0100	Bahrain, Radio Bahrain	6010me	
0000 0100	Canada, CFRX Toronto ON	6070na	
0000 0100	Canada, CFVP Calgary AB	6030na	
0000 0100	Canada, CKZN St Johns NF	6160na	
0000 0100	Canada, CKZU Vancouver BC	6160na	
0000 0100	Canada, Radio Canada International	11700as	
0000 0100	China, China Radio International	6020eu	
	6075as	6180as	7350eu
	9570na	11790as	11885as
			13750as
			15125as
0000 0100	Malaysia, RTM Kajang/Traxx FM	7295do	
0000 0100	Micronesia, The Cross Radio/Pohnpei	4755 as	
0000 0100	New Zealand, Radio NZ International	15720pa	
0000 0100	New Zealand, Radio NZ International	17675pa	
0000 0100	Palau, T8WH/ WHRI	15700as	
0000 0100	Russia, Voice of Russia	9665va	9800va
0000 0100	Spain, Radio Exterior de Espana	6055na	
0000 0100	Thailand, Radio Thailand World Svc	15275na	
0000 0100	UK, BBC World Service	5970as	6195as
	9740as	12095as	15335as
			15360as
			17685as
0000 0100	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	
0000 0100	USA, EWTN/WEWN Irondale, AL	11520af	
0000 0100	USA, FBN/WTJC Newport NC	9370na	
0000 0100	USA, WBCQ Monticello ME	5110usb	7415usb
	9330usb		
0000 0100	USA, WHRI Cypress Creek SC	5920na	
	7315na	9860na	
0000 0100	USA, WINB Red Lion PA	13570ca	
0000 0100	USA, WRMI Miami FL	9955ca	
0000 0100	USA, WTWV Lebanon TN	5755va	12100va
0000 0100	USA, WWCR Nashville TN	3215eu	4840na
	5935af	7465eu	
0000 0100	USA, WWRB Manchester TN	2390na	3185na
	3215na	5050na	
0000 0100	USA, WYFR/Family Radio Worldwide	7360sa	
	7520sa	15440ca	
0000 0100	Zambia, CVC Radio Christian Voice	4965af	
0030 0045	Albania, Radio Tirana	9860na	
0030 0100	Australia, Radio Australia	15415as	17750as
0030 0100	Canada, Bible Voice Broadcasting	7405as	
0030 0100	Serbia, International Radio Serbia	9685na	
0030 0100	Thailand, Radio Thailand World Svc	15275na	
0030 0100	USA, BBG/Voice of America/Special English		
	7430va	9715va	9780va
	12005va	15205va	15290va
			17820va
			9955ca
0030 0100	USA, WRMI/Radio Slovakia Intl		
0035 0045	India, All India Radio/Aizawl	5050do	
0035 0045	India, All India Radio/Chennai	4920do	
0035 0045	India, All India Radio/Guwahati	4940do	
0035 0045	India, All India Radio/Hyderabad	4800do	
0035 0045	India, All India Radio/Imphal	4775do	
0035 0045	India, All India Radio/Port Blair	4760do	
0035 0045	India, All India Radio/Shillong	4970do	
0035 0045	India, All India Radio/Shimla	4965do	
0035 0045	India, All India Radio/Thiruvananthapuram	5010do	

0100 UTC - 9PM EDT / 8PM CDT / 6PM PDT

0100 0130	Vietnam, Voice of Vietnam/Overseas Svc	6175na	
0100 0157	North Korea, Voice of Korea	7220as	9345as
	9730as	11735ca	15180sa
0100 0200	Anguilla, University Network	6090na	
0100 0200	Australia, ABC NT Alice Springs	4835do	
0100 0200	Australia, ABC NT Katherine	5025do	
0100 0200	Australia, ABC NT Tennant Creek	4910do	

0100 0200	Australia, Radio Australia	9660pa	12080pa
	13690pa	15240pa	15415as
	17750as	17795pa	17715pa
0100 0200	Bahrain, Radio Bahrain	6010me	
0100 0200	Canada, CFRX Toronto ON	6070na	
0100 0200	Canada, CFVP Calgary AB	6030na	
0100 0200	Canada, CKZN St Johns NF	6160na	
0100 0200	Canada, CKZU Vancouver BC	6160na	
0100 0200	China, China Radio International	6020eu	
	6175eu	6180as	9410eu
	9535as	9570na	9580na
	9790na	11870as	15215as
			15785as
0100 0200	Cuba, Radio Havana Cuba	6000na	6050na
0100 0200	Malaysia, RTM Kajang/Traxx FM	7295do	
0100 0200	Micronesia, The Cross Radio/Pohnpei	4755 as	
0100 0200	Mongolia, Mongolian Radio 2/Ulaanbaatar	7260do	
0100 0200	New Zealand, Radio NZ International	15720pa	
0100 0200	New Zealand, Radio NZ International	17675pa	
0100 0200	Palau, T8WH/ WHRI	15700as	
0100 0200	Russia, Voice of Russia	9665va	9800va
0100 0200	Taiwan, Radio Taiwan International	11875as	
0100 0200	UK, BBC World Service	7395as	9410as
	9740as	11750as	11955as
	15310as	15335as	15360as
			17685as
0100 0200	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
0100 0200	USA, BBG/Voice of America	7430va	9780va
	11705va		
0100 0200	USA, EWTN/WEWN Irondale, AL	11520af	
0100 0200	USA, FBN/WTJC Newport NC	9370na	
0100 0200	USA, KJES Vado NM	7555na	
0100 0200	USA, WBCQ Monticello ME	5110usb	7415usb
	9330usb		
0100 0200	USA, WHRI Cypress Creek SC	5920na	
	7315na		
0100 0200	USA, WHRI Cypress Creek SC	5920na	
0100 0200	USA, WHRI Cypress Creek SC	7315na	
0100 0200	USA, WINB Red Lion PA	13570ca	
0100 0200	USA, WRMI Miami FL	9955ca	
0100 0200	USA, WTWV Lebanon TN	5755va	12100va
0100 0200	USA, WWRB Manchester TN	2390na	3185na
	5050na		
0100 0200	USA, WYFR/Family Radio Worldwide	15440ca	
0100 0200	Zambia, CVC Radio Christian Voice	4965af	
0120 0200	Sri Lanka, SLBC	6005as	9770as
0130 0200	USA, BBG/Voice of America/Special English	7465va	9820va
0145 0200	Albania, Radio Tirana	7425na	

0200 UTC - 10PM EDT / 9PM CDT / 7PM PDT

0200 0215	Croatia, Croatian Radio	3985eu	9925am
0200 0230	Thailand, Radio Thailand World Svc	15275na	
0200 0230	USA, KJES Vado NM	7555na	
0200 0245	USA, WYFR/Family Radio Worldwide	5985ca	
0200 0257	North Korea, Voice of Korea	13650as	15100as
0200 0300	Anguilla, University Network	6090na	
0200 0300	Argentina, RAE	11710am	
0200 0300	Australia, ABC NT Alice Springs	4835do	
0200 0300	Australia, ABC NT Katherine	5025do	
0200 0300	Australia, ABC NT Tennant Creek	4910do	
0200 0300	Australia, Radio Australia	9660pa	12080pa
	13690pa	15240as	15415as
	17750as	21725pa	15515pa
0200 0300	Bahrain, Radio Bahrain	6010me	
0200 0300	Bulgaria, Radio Bulgaria	9700na	11700na
0200 0300	Canada, CFRX Toronto ON	6070na	
0200 0300	Canada, CFVP Calgary AB	6030na	
0200 0300	Canada, CKZN St Johns NF	6160na	
0200 0300	Canada, CKZU Vancouver BC	6160na	
0200 0300	China, China Radio International	11770as	
	13640as		
0200 0300	Cuba, Radio Havana Cuba	6000na	6050na
0200 0300	Egypt, Radio Cairo	9315na	
0200 0300	Indonesia, Voice of Indonesia	9526va	
0200 0300	Malaysia, RTM Kajang/Traxx FM	7295do	
0200 0300	Micronesia, The Cross Radio/Pohnpei	4755 as	
0200 0300	New Zealand, Radio NZ International	15720pa	
0200 0300	New Zealand, Radio NZ International	17675pa	
0200 0300	Palau, T8WH/ WHRI	17800as	
0200 0300	Philippines, PBS/ Radyo Pilipinas	11880me	
	15285me	17700me	
0200 0300	Russia, Voice of Russia	7440na	9665sa
	15425na		

0200 0300	South Korea, KBS World Radio	9580sa	
0200 0300	Sri Lanka, SLBC 6005as	9770as	15745as
0200 0300	Taiwan, Radio Taiwan International	5950na	9680ca
0200 0300	UK, BBC World Service	6005af	6195as
	12095as	15310as	17790as
0200 0300	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	
0200 0300	USA, EWTN/WEWN Irondale, AL	11520af	
0200 0300	USA, FBN/WTJC Newport NC	9370na	
0200 0300	USA, WBCQ Monticello ME	5110usb	7415usb
	9330usb		
0200 0300	USA, WHRI Cypress Creek SC	5920na	
	9840na	9860na	
0200 0300	USA, WINB Red Lion PA	13570ca	
0200 0300	USA, WRMI Miami FL	9955ca	
0200 0300	USA, WRNO New Orleans LA	7505am	
0200 0300	USA, WTWW Lebanon TN	5755va	12100va
0200 0300	USA, WWCN Nashville TN	3215eu	4840na
	5890af	5935af	
0200 0300	USA, WWRB Manchester TN	2390va	3185na
	5050na		
0200 0300	USA, WYFR/Family Radio Worldwide	9385ca	
0200 0300	Zambia, CVC Radio Christian Voice	4965af	
0215 0300	Nepal, Radio Nepal	5005as	
0230 0300	Albania, Radio Tirana	7425na	
0230 0300	Myanmar, Myanma Radio/National Svc	5915do	5920af
	5920af		
0230 0300	Vietnam, Voice of Vietnam/Overseas Svc	6175na	
0245 0300	Australia, HCJB Global Australia	15400as	
0245 0300	India, All India Radio/Bhopal	7430do	
0245 0300	India, All India Radio/Delhi	4860do	6030do
	7235do	11830do	15135do
0245 0300	India, All India Radio/Gorakhpur	3945do	
	6030do	7235do	11830do
			15135do
0245 0300	India, All India Radio/Guwahati	4940do	
0245 0300	India, All India Radio/Hyderabad	7420do	
0245 0300	India, All India Radio/Imphal	7335do	
0245 0300	India, All India Radio/Itanagar	4990do	
0245 0300	India, All India Radio/Jaipur	4910do	
0245 0300	India, All India Radio/Kolkata	7210do	
0245 0300	India, All India Radio/Kurseong	4895do	
0245 0300	India, All India Radio/Lucknow	4880do	
0245 0300	India, All India Radio/Radio Kashmir	4760do	
0245 0300	India, All India Radio/Shillong	4970do	
0245 0300	India, All India Radio/Shimla	6020do	
0245 0300	India, All India Radio/Thiruvananthapuram	7290do	
0245 0300	Zambia, ZNBC/Radio Two	6165do	
0250 0300	Vatican City State, Vatican Radio	6040am	
	7305am	9610am	
0255 0300	Sat Swaziland, TWR Africa	3200af	

0300 0400	Canada, CKZN St Johns NF	6160na	
0300 0400	Canada, CKZU Vancouver BC	6160na	
0300 0400	China, China Radio International	9690am	
	9790na	11770as	13750as
	15120as	15785as	15110as
0300 0400	Cuba, Radio Havana Cuba	6000na	6050na
0300 0400	Germany, Deutsche Welle	15595as	
0300 0400	Malaysia, RTM Kajang/Traxx FM	7295do	
0300 0400	Micronesia, The Cross Radio/Pohnpei	4755 as	
0300 0400	New Zealand, Radio NZ International	15720pa	
0300 0400	New Zealand, Radio NZ International	17675pa	
0300 0400	Oman, Radio Sultanate of Oman	15355af	
0300 0400	Palau, T8WH/ WHRI	17800as	
0300 0400	Russia, Voice of Russia	9665sa	15425na
	15585as		
0300 0400	mtwhf South Africa, Channel Africa	3345af	
0300 0400	Sat Sri Lanka, SLBC 6005as	9770as	15745as
0300 0400	Taiwan, Radio Taiwan International	5950na	
	15320as		
0300 0400	UK, BBC World Service	3255af	5875af
	6005af	6145af	6190af
	7255eu	9410af	9750af
	12095as	15310as	15365as
			17790as
0300 0400	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	
0300 0400	USA, BBG/Voice of America/African Svc	4930af	
	6080af	9885af	15580af
0300 0400	USA, EWTN/WEWN Irondale, AL	11520af	
0300 0400	USA, FBN/WTJC Newport NC	9370na	
0300 0400	USA, WBCQ Monticello ME	7415usb	9330usb
0300 0400	USA, WHRI Cypress Creek SC	5920na	
	7385na	9840na	
0300 0400	USA, WINB Red Lion PA	13570ca	
0300 0400	USA, WRMI Miami FL	9955ca	
0300 0400	USA, WTWW Lebanon TN	5755va	12100va
0300 0400	USA, WWCN Nashville TN	3215eu	4840na
	5890af	5935af	
0300 0400	USA, WWRB Manchester TN	2390na	3185na
	5050na		
0300 0400	USA, WYFR/Family Radio Worldwide	11740ca	
0300 0400	Zambia, CVC Radio Christian Voice	4965af	
0300 0400	Zambia, ZNBC/Radio Two	6165do	
0315 0400	Australia, Radio Australia	15240pa	
0330 0400	Albania, Radio Tirana	7425na	
0330 0400	Iran, IRIB/ VOIRI 9605na	11920na	
0330 0400	Vietnam, Voice of Vietnam/Overseas Svc	6175na	
0335 0345	India, All India Radio/Aizawl	5050do	
0335 0345	India, All India Radio/Delhi	7235do	11830do
	15135do		
0335 0345	India, All India Radio/Kolkata	7210do	

0300 UTC - 11PM EDT / 10PM CDT / 8PM PDT

0300 0315	India, All India Radio/Imphal	7335do	
0300 0315	India, All India Radio/Itanagar	4990do	
0300 0315	India, All India Radio/Shillong	4970do	
0300 0325	Sun Swaziland, TWR Africa	3200af	
0300 0327	Iran, IRIB/ VOIRI 11920na		
0300 0330	Egypt, Radio Cairo	9315na	
0300 0330	Myanmar, Myanma Radio/National Svc	9731do	
0300 0330	Philippines, PBS/ Radyo Pilipinas	11880me	
	15285me	17700me	
0300 0330	Vatican City State, Vatican Radio	7305af	
	7360af	9660af	
0300 0355	mtwhf South Africa, Channel Africa	5980af	
0300 0355	Turkey, Voice of Turkey	6165as	9515va
0300 0357	North Korea, Voice of Korea	7220as	9345as
	9730as		
0300 0357	Romania, Radio Romania International	7335na	
	9645na	11895as	15340as
0300 0358	Germany, Deutsche Welle	12005as	
0300 0400	Anguilla, University Network	6090na	
0300 0400	Australia, ABC NT Alice Springs	4835do	
0300 0400	Australia, ABC NT Katherine	5025do	
0300 0400	Australia, ABC NT Tennant Creek	4910do	
0300 0400	Australia, Radio Australia	9660pa	12080pa
	13690pa	15240as	15415as
	17750as	21725pa	15515pa
0300 0400	Bahrain, Radio Bahrain	6010me	
0300 0400	twhfas Canada, CBC Northern Quebec Svc	9625na	
0300 0400	Canada, CFRX Toronto ON	6070na	
0300 0400	Canada, CFVP Calgary AB	6030na	

0400 UTC - 12AM EDT / 11PM CDT / 9PM PDT

0400 0427	Iran, IRIB/ VOIRI 9605na	11920na	
0400 0430	USA, BBG/Voice of America/African Svc	4930af	
	4960af	6080af	9855af
	15580af	11670af	
0400 0457	Germany, Deutsche Welle	7240af	
0400 0458	New Zealand, Radio NZ International	15720pa	
0400 0458	DRM New Zealand, Radio NZ International	17675pa	
0400 0459	Germany, Deutsche Welle	13840af	
0400 0500	Anguilla, University Network	6090na	
0400 0500	Australia, ABC NT Alice Springs	4835do	
0400 0500	Australia, ABC NT Katherine	5025do	
0400 0500	Australia, ABC NT Tennant Creek	4910do	
0400 0500	Australia, Radio Australia	9660pa	12080pa
	13690pa	15240as	15515pa
	17725pa		17750pa
0400 0500	Bahrain, Radio Bahrain	6010me	
0400 0500	twhfas Canada, CBC Northern Quebec Svc	9625na	
0400 0500	Canada, CFRX Toronto ON	6070na	
0400 0500	Canada, CKZN St Johns NF	6160na	
0400 0500	Canada, CKZU Vancouver BC	6160na	
0400 0500	China, China Radio International	6020na	
	6080na	13750as	15120as
	17730va	17855va	15785as
0400 0500	mtwhf France, Radio France Internationale	9805af	
	11995af		
0400 0500	Germany, Deutsche Welle	6180af	
0400 0500	Malaysia, RTM Kajang/Traxx FM	7295do	
0400 0500	Micronesia, The Cross Radio/Pohnpei	4755 as	
0400 0500	Palau, T8WH/ WHRI	17800as	
0400 0500	DRM Russia, Voice of Russia	15735as	
0400 0500	Russia, Voice of Russia	13775na	15585as

0400	0500	mtwhf	South Africa, Channel Africa	3345af	
0400	0500	Sat	Sri Lanka, SLBC	6005as	9770as
0400	0500		UK, BBC World Service	3255af	3955eu
			5875af	6005af	6190af
			7310af	11945af	12035as
			13840as	15310as	15365as
0400	0500		USA, American Forces Network/AFRTS	4319usb	
			5446usb	5765usb	7812usb
			12759usb	13362usb	
0400	0500		USA, EWTN/WEWN Irondale, AL	11520af	
0400	0500		USA, FBN/WTJC Newport NC	9370na	
0400	0500		USA, WHRI Cypress Creek SC	5920na	
			7385na	9825na	
0400	0500		USA, WINB Red Lion PA	13570ca	
0400	0500		USA, WRMI Miami FL	9955ca	
0400	0500		USA, WTWW Lebanon TN	5755va	12100va
0400	0500		USA, WWCR Nashville TN	3215eu	4840na
			5890af	5935af	
0400	0500		USA, WWRB Manchester TN	3185na	
0400	0500		Zambia, CVC Radio Christian Voice	4965af	
0400	0500		Zambia, ZNBC/Radio Two	6165do	
0430	0500	mtwhf	Swaziland, TWR Africa	3200af	4775af
0430	0500		USA, BBG/Voice of America/African Svc	4930af	
			4960af	6080af	11670af
0435	0445		India, All India Radio/Delhi	4860do	
0455	0500		Nigeria, Voice of Nigeria	15120af	
0459	0500		New Zealand, Radio NZ International	11725pa	
0459	0500	DRM	New Zealand, Radio NZ International	11675pa	

0500 UTC - 1AM EDT / 12AM CDT / 10PM PDT

0500	0507	twhf	Canada, CBC Northern Quebec Svc	9625na	
0500	0530		Germany, Deutsche Welle	7430af	9480af
			11875af		
0500	0530		Japan, Radio Japan NHK World	5975va	
			6110na	11970va	
0500	0530		UK, BBC World Service	5975eu	
0500	0530		Vatican City State, Vatican Radio	5965va	
			7250eu	9660af	11625af
0500	0557		China, China Radio International	6020na	
			6190na	11710af	11895as
			15465va	17505va	17540as
			17855va		
0500	0600		Anguilla, University Network	6090na	
0500	0600		Australia, ABC NT Alice Springs	4835do	
0500	0600		Australia, ABC NT Katherine	5025do	
0500	0600		Australia, ABC NT Tennant Creek	4910do	
0500	0600		Australia, Radio Australia	9660pa	12080pa
			13630pa	13690pa	15160pa
			17750as		15240pa
0500	0600		Bahrain, Radio Bahrain	6010me	
0500	0600		Bhutan, Bhutan Broadcasting Svc	6035do	
0500	0600		Canada, CFRX Toronto ON	6070na	
0500	0600		Canada, CKZN St Johns NF	6160na	
0500	0600		Canada, CKZU Vancouver BC	6160na	
0500	0600		Cuba, Radio Havana Cuba	6000na	6010na
			6050na	6060na	6150sa
0500	0600	mtwhf	Equatorial Guinea, Radio Africa 2	15190af	
0500	0600	Sat/Sun	Equatorial Guinea, Radio East Africa	15190af	
0500	0600	mtwhf	France, Radio France Internationale	11995af	
			13680af		
0500	0600		Malaysia, RTM Kajang/Traxx FM	7295do	
0500	0600		Micronesia, The Cross Radio/Pohnpei	4755 as	
0500	0600		New Zealand, Radio NZ International	11725pa	
0500	0600	DRM	New Zealand, Radio NZ International	11675pa	
0500	0600		Nigeria, Voice of Nigeria	15120af	
0500	0600		Palau, T8WH/ WHRI	17800as	
0500	0600		Russia, Voice of Russia	13775na	
0500	0600	mtwhf	South Africa, Channel Africa	7230af	
0500	0600	mtwhf	Swaziland, TWR Africa	3200af	4775af
0500	0600		Swaziland, TWR Africa	9500af	
0500	0600	Sat/Sun	Swaziland, TWR Africa	4775af	
0500	0600		Taiwan, Radio Taiwan International	6875na	
0500	0600		UK, BBC World Service	3255af	3955eu
			6005af	6190af	7255af
			11945af	12095as	15310as
			15420af	17640as	17790as
0500	0600		USA, American Forces Network/AFRTS	4319usb	
			5446usb	5765usb	7812usb
			12759usb	13362usb	
0500	0600		USA, BBG/Voice of America/African Svc	4930af	
			6080af	11670af	155870af
0500	0600		USA, EWTN/WEWN Irondale, AL	11520af	
0500	0600		USA, FBN/WTJC Newport NC	9370na	
0500	0600		USA, WHRI Cypress Creek SC	7385va	
			9825va	11565va	

0500	0600		USA, WINB Red Lion PA	13570ca	
0500	0600		USA, WRMI Miami FL	9955ca	
0500	0600		USA, WTWW Lebanon TN	5755va	12100va
0500	0600		USA, WWCR Nashville TN	3215eu	4840na
			5890af	5935af	
0500	0600		USA, WWRB Manchester TN	3185na	
0500	0600		Zambia, CVC Radio Christian Voice	4965af	
0500	0600		Zambia, ZNBC/Radio Two	6165do	
0515	0530	Sat	Greece, Voice of Greece	11645eu	
0530	0550	Sun	Greece, Voice of Greece	11645eu	
0530	0557	DRM	Romania, Radio Romania International	7305eu	
0530	0557		Romania, Radio Romania International	9655eu	
			17760eu	21500eu	
0530	0600	Sat/Sun	Clandestine, Sudan Radio Service/SRS	13720af	
0530	0600		Thailand, Radio Thailand World Svc	17655va	

0600 UTC - 2AM EDT / 1AM CDT / 11PM PDT

0600	0603		Croatia, Croatian Radio	7410eu	
0600	0615	Sat/Sun	South Africa, TWR Africa	11640af	
0600	0629		USA, WINB Red Lion PA	13570ca	
0600	0630		Germany, Deutsche Welle	9545af	15275af
0600	0645	smtwhf	South Africa, TWR Africa	11640af	
0600	0655	mtwhf	South Africa, Channel Africa	15255af	
0600	0657		China, China Radio International	11710af	
			11870me	11895as	13660as
			15350as	15465as	17505va
			17710as		17540as
0600	0658		New Zealand, Radio NZ International	11725pa	
0600	0658	DRM	New Zealand, Radio NZ International	11675pa	
0600	0700		Anguilla, University Network	6090na	
0600	0700		Australia, ABC NT Alice Springs	4835do	
0600	0700		Australia, ABC NT Katherine	5025do	
0600	0700		Australia, ABC NT Tennant Creek	4910do	
0600	0700		Australia, Radio Australia	9660pa	12080pa
			13630pa	13690pa	15160pa
			15415as	17750as	15240pa
0600	0700		Bahrain, Radio Bahrain	6010me	
0600	0700		Canada, CFRX Toronto ON	6070na	
0600	0700		Canada, CFVP Calgary AB	6030na	
0600	0700		Canada, CKZN St Johns NF	6160na	
0600	0700		Canada, CKZU Vancouver BC	6160na	
0600	0700		Cuba, Radio Havana Cuba	6000na	6010na
			6050na	6060na	6150sa
0600	0700	mtwhf	Equatorial Guinea, Radio Africa 2	15190af	
0600	0700	Sat/Sun	Equatorial Guinea, Radio East Africa	15190af	
0600	0700	mtwhf	France, Radio France Internationale	11615va	
			15160af	17800af	
0600	0700		Malaysia, RTM Kajang/Traxx FM	7295do	
0600	0700		Malaysia, RTM/Voice of Malaysia	6175as	
			9750as	15295as	
0600	0700		Micronesia, The Cross Radio/Pohnpei	4755 as	
0600	0700		Nigeria, Voice of Nigeria	15120af	
0600	0700		Palau, T8WH/ WHRI	17800as	
0600	0700		Papua New Guinea, Radio Fly	5960do	
0600	0700		Russia, Voice of Russia	15405pa	
0600	0700	mtwhf	South Africa, Channel Africa	7230af	
0600	0700		South Africa, CVC 1 Africa Radio	13590af	
0600	0700		Swaziland, TWR Africa	9500af	
0600	0700		UK, BBC World Service	5875eu	6005af
			6190af	7430eu	9410af
			12015af	12095as	15105af
			15420af	17640af	17790as
0600	0700		USA, American Forces Network/AFRTS	4319usb	
			5446usb	5765usb	7812usb
			12759usb	13362usb	
0600	0700		USA, BBG/Voice of America/African Svc	6080af	
			11670af	15580af	
0600	0700		USA, EWTN/WEWN Irondale, AL	11520af	
0600	0700		USA, FBN/WTJC Newport NC	9370na	
0600	0700		USA, WHRI Cypress Creek SC	7385va	
			9825va	11565va	
0600	0700		USA, WRMI Miami FL	9955ca	
0600	0700		USA, WTWW Lebanon TN	5755va	12100va
0600	0700		USA, WWCR Nashville TN	3215eu	4840na
			5890af	5935af	
0600	0700		USA, WWRB Manchester TN	3185na	
0600	0700		USA, WYFR/Family Radio Worldwide	9680na	
0600	0700		Zambia, CVC Radio Christian Voice	13590af	
0600	0700		Zambia, ZNBC/Radio Two	6165do	
0602	0700		Swaziland, TWR Africa	6120af	
0630	0645		India, All India Radio/Guwahati	7280do	
0630	0645		India, All India Radio/Hyderabad	7420do	
0630	0645		India, All India Radio/Kurseong	7230do	
0630	0645		India, All India Radio/Mumbai	7240do	

0630	0645		India, All India Radio/Thiruvananthapuram 7290do	
0630	0700		Bulgaria, Radio Bulgaria	9600na 11600na
0630	0700		USA, WINB Red Lion PA	9265ca
0630	0700		Vatican City State, Vatican Radio 13765af 15570af	11625af
0645	0700	Sun	Germany, TWR Europe	6105eu
0645	0700	Sun	Monaco, TWR Europe	9800eu
0659	0700		New Zealand, Radio NZ International	6170pa
0659	0700	DRM	New Zealand, Radio NZ International	7440pa

0700 UTC - 3AM EDT / 2AM CDT / 12AM PDT

0700	0730	Sun	Canada, Bible Voice Broadcasting	5945eu
0700	0745	Sat	Canada, Bible Voice Broadcasting	5945eu
0700	0745		USA, WYFR/Family Radio Worldwide	7570eu
0700	0750	mtwhf	Germany, TWR Europe	6105eu
0700	0750	smtwhf	Monaco, TWR Europe	9800eu
0700	0758		New Zealand, Radio NZ International	6170pa
0700	0758	DRM	New Zealand, Radio NZ International	7440pa
0700	0759		USA, WINB Red Lion PA	9265ca
0700	0800		Anguilla, University Network	6090na
0700	0800		Australia, ABC NT Alice Springs	4835do
0700	0800		Australia, ABC NT Katherine	5025do
0700	0800		Australia, ABC NT Tennant Creek	4910do
0700	0800		Australia, Radio Australia	9475as 9660pa 9710pa 11945as 12080pa 15160pa
0700	0800		Bahrain, Radio Bahrain	6010me
0700	0800	m/DRM	Belgium, TDP Radio	6015eu
0700	0800		Canada, CFRX Toronto ON	6070na
0700	0800		Canada, CFVP Calgary AB	6030na
0700	0800		Canada, CKZN St Johns NF	6160na
0700	0800		Canada, CKZU Vancouver BC	6160na
0700	0800		China, China Radio International	11895as 13660as 15125va 13710eu 15350as 15465as 17490eu 17540as
0700	0800	mtwhf	Equatorial Guinea, Radio Africa 2	15190af
0700	0800	Sat/Sun	Equatorial Guinea, Radio East Africa	15190af
0700	0800	mtwhf	France, Radio France Internationale	15615af 17605af
0700	0800		Malaysia, RTM Kajang/Traxx FM	7295do
0700	0800		Malaysia, RTM/Voice of Malaysia	6175as 9750as 15295as
0700	0800		Micronesia, The Cross Radio/Pohnpei	4755 as
0700	0800		Palau, T8WH/ WHRI	17800as
0700	0800		Papua New Guinea, Radio Fly	5960do
0700	0800		Russia, Voice of Russia	15405pa
0700	0800	mtwhf	South Africa, Channel Africa	7230af
0700	0800		South Africa, CVC 1 Africa Radio	13590af
0700	0800		Swaziland, TWR Africa	6120af 9500af
0700	0800		UK, BBC World Service	5875eu 6190af 11760me 11765af 11830af 12095af 15310as 15400af 15575as 17640af 17790as 17830af
0700	0800		USA, American Forces Network/AFRTS	4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
0700	0800		USA, EWTN/WEWN Irondale, AL	11520af
0700	0800		USA, FBN/WTJC Newport NC	9370na
0700	0800		USA, WHRI Cypress Creek SC	7385va 9825va 11565va
0700	0800		USA, WRMI Miami FL	9955ca
0700	0800		USA, WTWW Lebanon TN	5755va 12100va
0700	0800		USA, WWCR Nashville TN	3215eu 4840na 5890af 5935af
0700	0800		USA, WWRB Manchester TN	3185na
0700	0800		USA, WYFR/Family Radio Worldwide	5950ca
0700	0800		Zambia, CVC Radio Christian Voice	13590af
0700	0800		Zambia, ZNBC/Radio Two	6165do
0715	0750	Sun	Germany, TWR Europe	6105eu
0715	0750	Sat	Monaco, TWR Europe	9800eu
0730	0745		India, All India Radio/Aizawl	5050do
0730	0745		India, All India Radio/Delhi	6190do 11710do 15185do 15260do
0730	0745		India, All India Radio/Guwahati	7280do
0730	0745		India, All India Radio/Imphal	7335do
0730	0745		India, All India Radio/Jaipur	7325do
0730	0745		India, All India Radio/Kolkata	7210do
0730	0745		India, All India Radio/Kurseong	7230do
0730	0745		India, All India Radio/Shimla	6020do
0730	0800		Australia, HCJB Global Australia	11750pa
0730	0800		India, All India Radio/Chennai	4920do
0759	0800		New Zealand, Radio NZ International	6170pa
0759	0800	DRM	New Zealand, Radio NZ International	7440pa

0800 UTC - 4AM EDT / 3AM CDT / 1AM PDT

0800	0830		Australia, ABC NT Alice Springs	4835do
0800	0830		Australia, ABC NT Katherine	5025do
0800	0830		Australia, ABC NT Tennant Creek	4910do
0800	0830		Australia, HCJB Global Australia	11750pa
0800	0845		USA, WYFR/Family Radio Worldwide	5950ca
0800	0900		Anguilla, University Network	6090na
0800	0900		Australia, Radio Australia	5995pa 9475as 9590pa 9710pa 9580pa 11945as 12080pa 13630pa
0800	0900		Bahrain, Radio Bahrain	6010me
0800	0900	t/DRM	Belgium, TDP Radio	6015eu
0800	0900		Bhutan, Bhutan Broadcasting Svc	6035do
0800	0900		Canada, CFRX Toronto ON	6070na
0800	0900		Canada, CFVP Calgary AB	6030na
0800	0900		Canada, CKZN St Johns NF	6160na
0800	0900		Canada, CKZU Vancouver BC	6160na
0800	0900		China, China Radio International	11620as 11895as 13710eu 15350as 15465as 15625va 17490eu 17540as
0800	0900	mtwhf	Equatorial Guinea, Radio Africa 2	15190af
0800	0900	Sat/Sun	Equatorial Guinea, Radio East Africa	15190af
0800	0900	Sat	Italy, IRRS-Shortwave	9510va
0800	0900		Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
0800	0900		Malaysia, RTM Kajang/Traxx FM	7295do
0800	0900		Malaysia, RTM/Voice of Malaysia	6175as 9750as 15295as
0800	0900		Micronesia, The Cross Radio/Pohnpei	4755 as
0800	0900		New Zealand, Radio NZ International	6170pa
0800	0900	DRM	New Zealand, Radio NZ International	7440pa
0800	0900		Palau, T8WH/ WHRI	17800as
0800	0900		Papua New Guinea, Radio Fly	5960do
0800	0900		Russia, Voice of Russia	15405pa
0800	0900	mtwhf	South Africa, Channel Africa	9625af
0800	0900		South Africa, CVC 1 Africa Radio	13590af
0800	0900	Sun	South Africa, SA Radio League	7205af 17570af
0800	0900		South Korea, KBS World Radio	9570as
0800	0900		UK, BBC World Service	6190af 11760me 12095af 15310as 15400af 15575as 17640af 17790as 17830af 21470af
0800	0900		USA, American Forces Network/AFRTS	4319usb 5446usb 5765usb 7812usb 12133usb 12759usb 13362usb
0800	0900		USA, EWTN/WEWN Irondale, AL	11520af
0800	0900		USA, FBN/WTJC Newport NC	9370na
0800	0900		USA, WHRI Cypress Creek SC	7385va 11565va
0800	0900		USA, WINB Red Lion PA	13570ca
0800	0900		USA, WRMI Miami FL	9955ca
0800	0900		USA, WTWW Lebanon TN	5755va 12100va
0800	0900		USA, WWCR Nashville TN	3215eu 4840na 5890af 5935af
0800	0900		USA, WWRB Manchester TN	3185na
0800	0900		Zambia, CVC Radio Christian Voice	13590af
0815	0900		Zambia, ZNBC/Radio Two	6165do
0820	0900	mtwhfa	Nepal, Radio Nepal	5005as
0820	0900		Guam, TWR Asia/KTWR	15170as
0830	0845		India, All India Radio/Aizawl	5050do
0830	0845		India, All India Radio/Chennai	4920do
0830	0845		India, All India Radio/Delhi	6190do 11710do 15185do 15260do
0830	0845		India, All India Radio/Hyderabad	7420do
0830	0845		India, All India Radio/Imphal	7335do
0830	0845		India, All India Radio/Itanagar	4990do
0830	0845		India, All India Radio/Kolkata	7210do
0830	0845		India, All India Radio/Shillong	7315do
0830	0845		India, All India Radio/Thiruvananthapuram	7290do
0830	0900		Australia, ABC NT Alice Springs	2310do
0830	0900		Australia, ABC NT Katherine	2485do
0830	0900		Australia, ABC NT Tennant Creek	2325do
0830	0900		Guam, TWR Asia/KTWR	11840as

0900 UTC - 5AM EDT / 4AM CDT / 2AM PDT

0900	0910		Guam, TWR Asia/KTWR	11840as
0900	0930	Sat/Sun/DRM	Bulgaria, BNR Horizont/Home Svc 1	11900eu
0900	0959		Germany, Deutsche Welle	15640as
0900	1000		Anguilla, University Network	6090na
0900	1000		Australia, ABC NT Alice Springs	2310do
0900	1000		Australia, ABC NT Katherine	2485do

0900 1000		Australia, ABC NT Tennant Creek	2325do
0900 1000		Australia, Radio Australia	9475as 9580pa
		9590pa 11945as	
0900 1000		Bahrain, Radio Bahrain	6010me
0900 1000	w/DRM	Belgium, TDP Radio	6015eu
0900 1000		Canada, CFRX Toronto ON	6070na
0900 1000		Canada, CFVP Calgary AB	6030na
0900 1000		Canada, CKZN St Johns NF	6160na
0900 1000		Canada, CKZU Vancouver BC	6160na
0900 1000		China, China Radio International	11620as
		13790pa 15210as 15270eu	15350as
		17490eu 17570eu	
0900 1000		Germany, Deutsche Welle	17820as
0900 1000	Sun	Greece, Voice of Greece	9420va 15630va
0900 1000		Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
0900 1000		Malaysia, RTM Kajang/Traxx FM	7295do
0900 1000		Malaysia, RTM/Voice of Malaysia	6175as
		9750as 15295as	
0900 1000		Micronesia, The Cross Radio/Pohnpei	4755 as
0900 1000	DRM	New Zealand, Radio NZ International	7440pa
0900 1000		New Zealand, Radio NZ International	6170pa
0900 1000		Nigeria, Voice of Nigeria	9690af
0900 1000		Papua New Guinea, Radio Fly	5960do
0900 1000		Russia, Voice of Russia	15170as
0900 1000	mtwhf	South Africa, Channel Africa	9625af
0900 1000		South Africa, CVC 1 Africa Radio	13590af
0900 1000		UK, BBC World Service	6190af 6195as
		9740as 11760me 12095af	15310as
		15400af 15575as 17640af	17760as
		17790as 17830af 21470af	21630as
0900 1000		USA, American Forces Network/AFRTS	4319usb
		5446usb 5765usb 7812usb	12133usb
		12759usb 13362usb	
0900 1000		USA, EWTN/WEWN Irontdale, AL	11520af
0900 1000		USA, FBN/WTJC Newport NC	9370na
0900 1000		USA, WHRI Cypress Creek SC	7385va
		9825va 11565va	
0900 1000		USA, WINB Red Lion PA	13570ca
0900 1000		USA, WRMI Miami FL	9955ca
0900 1000		USA, WTWW Lebanon TN	5755va 12100va
0900 1000		USA, WWCN Nashville TN	4840na 5890af
		5935af 9985eu	
0900 1000		USA, WWRB Manchester TN	3185na
0900 1000		USA, WYFR/Family Radio Worldwide	9465as
		9755ca	
0900 1000		Zambia, CVC Radio Christian Voice	13590af
0900 1000		Zambia, ZNBC/Radio Two	6165do
0930 1000	Sun	Italy, IRRS-Shortwave	9510va
0930 1000		Saudi Arabia, BSKSA/External Svc	15250af
0959 1000		Netherlands, R Netherlands Worldwide	12065as
		15110as	

1000 UTC - 6AM EDT / 5AM CDT / 3AM PDT

1000 1030		Japan, Radio Japan NHK World	9605as
		9625pa 9840pa	
1000 1030		Vietnam, Voice of Vietnam/Overseas Svc	9840as 12020as
1000 1057		Netherlands, R Netherlands Worldwide	12065as
		15110as	
1000 1057		North Korea, Voice of Korea	11710ca 11735as
		13650as 15180sa	
1000 1058	DRM	New Zealand, Radio NZ International	7440pa
1000 1058		New Zealand, Radio NZ International	6170pa
1000 1100		Anguilla, University Network	11775na
1000 1100		Australia, ABC NT Alice Springs	2310do
1000 1100		Australia, ABC NT Katherine	2485do
1000 1100		Australia, ABC NT Tennant Creek	2325do
1000 1100		Australia, Radio Australia	9475as 9580pa
		9590pa 11945as	
1000 1100		Bahrain, Radio Bahrain	6010me
1000 1100	h/DRM	Belgium, TDP Radio	6015eu
1000 1100		Canada, CFRX Toronto ON	6070na
1000 1100		Canada, CFVP Calgary AB	6030na
1000 1100		Canada, CKZN St Johns NF	6160na
1000 1100		Canada, CKZU Vancouver BC	6160na
1000 1100		China, China Radio International	6040na
		11610as 11635as 13590as	13620as
		13790na 15190as 15210as	15350as
		17490as	
1000 1100		India, All India Radio/External Svc	7270as
		13695pa 15260as 15410as	17510pa
		17800as 17895pa	
1000 1100		Indonesia, Voice of Indonesia	9526va
1000 1100	Sun	Italy, IRRS-Shortwave	9510va

1000 1100		Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
1000 1100		Malaysia, RTM Kajang/Traxx FM	7295do
1000 1100		Micronesia, The Cross Radio/Pohnpei	4755as
1000 1100		Nigeria, Voice of Nigeria	9690af
1000 1100		Russia, Voice of Russia	15170as
1000 1100		Saudi Arabia, BSKSA/External Svc	15250af
1000 1100	mtwhf	South Africa, Channel Africa	9625af
1000 1100		South Africa, CVC 1 Africa Radio	13590af
1000 1100		UK, BBC World Service	6190af 6195as
		9740as 11760me 12095af	15310as
		15400af 15575as 17640af	17760as
		17790as 21470af 21660as	
1000 1100	Sat/Sun	UK, BBC World Service	17830af
1000 1100		USA, American Forces Network/AFRTS	4319usb
		5446usb 5765usb 7812usb	12133usb
		12759usb 13362usb	
1000 1100		USA, EWTN/WEWN Irontdale, AL	9390as
1000 1100		USA, FBN/WTJC Newport NC	9370na
1000 1100		USA, KNLS Anchor Point AK	11870as
1000 1100		USA, WHRI Cypress Creek SC	7385va
		11565va	
1000 1100		USA, WINB Red Lion PA	13570ca
1000 1100		USA, WRMI Miami FL	9955ca
1000 1100		USA, WTWW Lebanon TN	5755va 12100va
1000 1100		USA, WWCN Nashville TN	4840na 5890af
		5935af 9985eu	
1000 1100		USA, WWRB Manchester TN	3185na
1000 1100		USA, WYFR/Family Radio Worldwide	9465na
1000 1100		Zambia, CVC Radio Christian Voice	13590af
1000 1100		Zambia, ZNBC/Radio Two	6165do
1030 1100		Iran, IRIB/ VOIRI	17710as 21630as
1030 1100		Mongolia, Voice of Mongolia	12085as
1059 1100		New Zealand, Radio NZ International	9655pa
1059 1100	DRM	New Zealand, Radio NZ International	7440pa

1100 UTC - 7AM EDT / 6AM CDT / 4AM PDT

1100 1105		Pakistan, PBC/Radio Pakistan	15725eu 17720eu
1100 1120	f/DRM	Japan, Radio Japan NHK World	9760eu
1100 1127		Iran, IRIB/ VOIRI	17710as 21630as
1100 1130	Sat/DRM	South Korea, KBS World Radio	9760eu
1100 1130	fa	UK, BBC World Service	9760eu
1100 1130		Vietnam, Voice of Vietnam/Overseas Svc	7285as
1100 1145		USA, WYFR/Family Radio Worldwide	9755ca
1100 1157		Romania, Radio Romania International	15210eu
		15430eu 17510af 17670af	
1100 1158	DRM	New Zealand, Radio NZ International	7440pa
1100 1200		Anguilla, University Network	11775na
1100 1200		Australia, ABC NT Alice Springs	2310do
1100 1200		Australia, ABC NT Katherine	2485do
1100 1200		Australia, ABC NT Tennant Creek	2325do
1100 1200		Australia, Radio Australia	9595pa 6020pa
		9475as 9560pa 9580pa	9590pa
		11945as 12080pa	
1100 1200		Bahrain, Radio Bahrain	6010me
1100 1200	f/DRM	Belgium, TDP Radio	6015eu
1100 1200	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1100 1200		Canada, CFRX Toronto ON	6070na
1100 1200		Canada, CFVP Calgary AB	6030na
1100 1200		Canada, CKZN St Johns NF	6160na
1100 1200		Canada, CKZU Vancouver BC	6160na
1100 1200		China, China Radio International	5955as
		6040as 11650as 11660as	11750na
		11795as 13590as 13645as	13650eu
		13720as 17490eu	
1100 1200	Sun	Italy, IRRS-Shortwave	9510va
1100 1200		Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
1100 1200		Malaysia, RTM Kajang/Traxx FM	7295do
1100 1200		New Zealand, Radio NZ International	9655pa
1100 1200		Nigeria, Voice of Nigeria	9690af
1100 1200		Russia, Voice of Russia	12065as
1100 1200		Saudi Arabia, BSKSA/External Svc	15250af
1100 1200	mtwhf	South Africa, Channel Africa	9625af
1100 1200		South Africa, CVC 1 Africa Radio	13590af
1100 1200		Taiwan, Radio Taiwan International	7445as
		11715as	
1100 1200		UK, BBC World Service	6140as 6195as
		9740as 11760me 12095af	15285as
		15310as 15400af 15575as	17640as
		17760as 17790as 17830af	21470af
1100 1200		USA, American Forces Network/AFRTS	4319usb
		5446usb 5765usb 7812usb	12133usb
		12759usb 13362usb	

1100	1200	USA, EWTN/WEWN Irondale, AL	9390as
1100	1200	USA, FBN/WTJC Newport NC	9370na
1100	1200	USA, WHRI Cypress Creek SC	7385va
		9410va 11565va	
1100	1200	USA, WINB Red Lion PA	13570ca
1100	1200	USA, WRMI Miami FL	9955ca
1100	1200	USA, WWCN Nashville TN	4840na 5890af
		5935af 15825eu	
1100	1200	USA, WWRB Manchester TN	3185na
1100	1200	USA, WYFR/Family Radio Worldwide	5950na
		15560sa	
1100	1200	Zambia, CVC Radio Christian Voice	13590af
1100	1200	Zambia, ZNBC/Radio Two	6165do
1130	1140 f	Vatican City State, Vatican Radio	15595as
		17765as	
1130	1200	Vietnam, Voice of Vietnam/Overseas Svc	
		9840as 12020as	
1135	1145	India, All India Radio/Aizawl	5050do
1135	1145	India, All India Radio/Delhi	9595do 11710do
		15185do	
1135	1145	India, All India Radio/Shillong	4970do

1200 UTC - 8AM EDT / 7AM CDT / 5AM PDT

1200	1215	Vatican City State, Vatican Radio	13730am
1200	1230	Germany, AWR Europe	17535as
1200	1230	Saudi Arabia, BSKSA/External Svc	15250af
1200	1245	USA, WYFR/Family Radio Worldwide	5950na
1200	1258	New Zealand, Radio NZ International	9655pa
1200	1259	Poland, Polskie Radio Warsaw	11675eu
		11980eu	
1200	1300	Anguilla, University Network	11775na
1200	1300	Australia, ABC NT Alice Springs	2310do
1200	1300	Australia, ABC NT Katherine	2485do
1200	1300	Australia, ABC NT Tennant Creek	2325do
1200	1300	Australia, Radio Australia	5995pa 6020pa
		9475as 9560pa 9580pa	9590pa
		11945as	
1200	1300	Bahrain, Radio Bahrain	6010me
1200	1300 Sat/DRM	Belgium, TDP Radio	6015eu
1200	1300 Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1200	1300	Canada, CFRX Toronto ON	6070na
1200	1300	Canada, CFVP Calgary AB	6030na
1200	1300	Canada, CKZN St Johns NF	6160na
1200	1300	Canada, CKZU Vancouver BC	6160na
1200	1300	China, China Radio International	5955as
		9460as 9600as 9645as 9730as	
		9760pa 11650as 11660as 11690va	
		11760pa 11980as 13645as 13650as	
		13790eu 17490eu	
1200	1300	Ethiopia, Radio Ethiopia/National Program	
		5990do 7110do 9705do	
1200	1300	Italy, IRRS-Shortwave/Euro Gospel Radio	
		7290va	
1200	1300	Japan, Radio Japan NHK World	6120na
		9695as	
1200	1300	Malaysia, RTM Kajang/Traxx FM	7295do
1200	1300	Nigeria, Voice of Nigeria	9690af
1200	1300 DRM	Russia, Voice of Russia	9445as
1200	1300	Russia, Voice of Russia	11500as
1200	1300	South Africa, CVC 1 Africa Radio	13590af
1200	1300	South Korea, KBS World Radio	9650na
1200	1300	UK, BBC World Service	5875as 6140as
		6190af 6195as 9740as 11750as	
		11760me 12095af 15310as 15575as	
		17640af 17790af 17830af 21470af	
1200	1300	USA, American Forces Network/AFRTS	4319usb
		5446usb 5765usb 7812usb 12133usb	
		12759usb 13362usb	
1200	1300	USA, BBG/Voice of America	7575va 9510va
		12075va 12150va	
1200	1300	USA, EWTN/WEWN Irondale, AL	13580va
1200	1300	USA, FBN/WTJC Newport NC	9370na
1200	1300	USA, KNLS Anchor Point AK	11870as
1200	1300	USA, WHRI Cypress Creek SC	7385va
		9410va 11565va	
1200	1300	USA, WINB Red Lion PA	13570ca
1200	1300	USA, WRMI Miami FL	9955ca
1200	1300	USA, WWCN Nashville TN	7490af 9980af
		13845eu 15825eu	
1200	1300	USA, WWRB Manchester TN	3185va
1200	1300	Zambia, CVC Radio Christian Voice	13590af
1200	1300	Zambia, ZNBC/Radio Two	6165do
1215	1300	Egypt, Radio Cairo	17870as
1230	1245	India, All India Radio/Aizawl	5050do
1230	1245	India, All India Radio/Chennai	4920do
1230	1245	India, All India Radio/Delhi	4860do 6085do

1230	1245	India, All India Radio/Hyderabad	4800do
1230	1245	India, All India Radio/Jepore	5040do
1230	1245	India, All India Radio/Kurseong	4895do
1230	1245	India, All India Radio/Port Blair	4760do
1230	1245	India, All India Radio/Radio Kashmir	4950do
1230	1245	India, All India Radio/Shillong	4970do
1230	1245	India, All India Radio/Thiruvananthapuram	
		5010do	
1230	1300	Australia, HCJB Global Australia	15400as
1230	1300	Thailand, Radio Thailand World Svc	9890va
1230	1300	Turkey, Voice of Turkey	15450va
1230	1300	Vietnam, Voice of Vietnam/Overseas Svc	
		9840as 12020as	
1259	1300	New Zealand, Radio NZ International	6170pa

1300 UTC - 9AM EDT / 8AM CDT / 6AM PDT

1300	1325	Turkey, Voice of Turkey	15450va
1300	1330	Egypt, Radio Cairo	17870as
1300	1330	Japan, Radio Japan NHK World	15735as
		15660al	
1300	1357	North Korea, Voice of Korea	9335na 11710na
		13760eu 15245eu	
1300	1400	Anguilla, University Network	11775na
1300	1400	Australia, ABC NT Alice Springs	2310do
1300	1400	Australia, ABC NT Katherine	2485do
1300	1400	Australia, Radio Australia	5995pa 6020pa
		9560pa 9580pa 9590pa	
1300	1400	Bahrain, Radio Bahrain	6010me
1300	1400 Sun/DRM	Belgium, TDP Radio	6015na
1300	1400 Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1300	1400	Canada, CFRX Toronto ON	6070na
1300	1400	Canada, CFVP Calgary AB	6030na
1300	1400	Canada, CKZN St Johns NF	6160na
1300	1400	Canada, CKZU Vancouver BC	6160na
1300	1400	China, China Radio International	5995as
		9570na 9650na 9730as 9760pa	
		9765va 9870as 11660as 11760pa	
		11980as 13610eu 13755as 13760eu	
		13790eu 15260na	
1300	1400 Sat	Greece, Voice of Greece	15630va
1300	1400 Sun	Greece, Voice of Greece	9420va
1300	1400	Indonesia, Voice of Indonesia	9526as
1300	1400	Italy, IRRS-Shortwave	15610va
1300	1400	Italy, IRRS-Shortwave/Euro Gospel Radio	
		7290va	
1300	1400	Malaysia, RTM Kajang/Traxx FM	7295do
1300	1400	New Zealand, Radio NZ International	6170pa
1300	1400	Nigeria, Voice of Nigeria	9690af
1300	1400	Russia, Voice of Russia	12065as
1300	1400	South Africa, CVC 1 Africa Radio	13590af
1300	1400	South Korea, KBS World Radio	9570as
1300	1400	Tajikistan, Voice of Tajik	7245va
1300	1400	UK, BBC World Service	5875as 6190af
		6195as 9740as 11760me 12095af	
		15310as 15420af 15575as 17790as	
		17830af 21470af	
1300	1400	USA, American Forces Network/AFRTS	4319usb
		5446usb 5765usb 7812usb 12133usb	
		12759usb 13362usb	
1300	1400 Sat/Sun	USA, BBG/Voice of America	7575va 9510va
		12150va	
1300	1400	USA, EWTN/WEWN Irondale, AL	13580va
1300	1400	USA, FBN/WTJC Newport NC	9370na
1300	1400	USA, KJES Vado NM	7555na
1300	1400	USA, WBCQ Monticello ME	9330usb
1300	1400	USA, WHRI Cypress Creek SC	7385va
		11565va	
1300	1400 Sat/Sun	USA, WHRI Cypress Creek SC	9840af
1300	1400	USA, WINB Red Lion PA	13570ca
1300	1400	USA, WRMI Miami FL	9955ca
1300	1400	USA, WWCN Nashville TN	7490af 9980af
		13845eu 15825eu	
1300	1400	USA, WWRB Manchester TN	9385na
1300	1400	USA, WYFR/Family Radio Worldwide	11560as
		11560ca 12160ca	
1300	1400	Zambia, CVC Radio Christian Voice	13590af
1300	1400	Zambia, ZNBC/Radio Two	6165do
1330	1345	India, All India Radio/Delhi	6085do
1330	1400 w	Guam, AWR/KSDA	11880as
1330	1400	India, All India Radio/External Svc	9690as
		11620as 13710as	
1330	1400	Vietnam, Voice of Vietnam/Overseas Svc	
		9840as 12020as	
1345	1400 Sun	Canada, Bible Voice Broadcasting	17945as
1359	1400	Netherlands, R Netherlands Worldwide	11835as

1400 UTC - 10AM EDT / 9AM CDT / 7AM PDT

1400	1415	Sun	Germany, Pan American Broadcasting	15205as
1400	1430		Japan, Radio Japan NHK World	11705as
			15735as 21560va 15660al	
1400	1430		Thailand, Radio Thailand World Svc	9575va
1400	1430	Sun	UK, FEBA Radio	12025as
1400	1457		Netherlands, R Netherlands Worldwide	9800as
			11835as	
1400	1500		Anguilla, University Network	11775na
1400	1500		Australia, ABC NT Alice Springs	2310do
1400	1500		Australia, ABC NT Katherine	2485do
1400	1500		Australia, ABC NT Tennant Creek	2325do
1400	1500		Australia, Radio Australia	5995pa 6080as
			7240pa 9590pa 11660as	
1400	1500		Bahrain, Radio Bahrain	6010me
1400	1500	DRM	Belgium, TDP Radio/Disco Palace	6015eu
1400	1500	Sat	Canada, Bible Voice Broadcasting	17945as
1400	1500	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1400	1500		Canada, CFRX Toronto ON	6070na
1400	1500		Canada, CFPV Calgary AB	6030na
1400	1500		Canada, CKZN St Johns NF	6160na
1400	1500		Canada, CKZU Vancouver BC	6160na
1400	1500		China, China Radio International	5955as
			9765va 9870as 11665me 11765as	
			13710eu 13760eu 11740na 13790eu	
			17630af	
1400	1500	Sat/Sun	Equatorial Guinea, Radio East Africa/Malabo	
			15190af	
1400	1500		India, All India Radio/External Svc	9690as
			11620as 13710as	
1400	1500		Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
1400	1500		Libya, LJBC Voice of Africa	17725af
1400	1500		Malaysia, RTM Kajang/Traxx FM	7295do
1400	1500		New Zealand, Radio NZ International	6170pa
1400	1500		Nigeria, Voice of Nigeria	9690af
1400	1500		Oman, Radio Sultanate of Oman	15140va
1400	1500	DRM	Russia, Voice of Russia	7225eu 9750eu
1400	1500		Russia, Voice of Russia	4975va 11500as
1400	1500		South Africa, CVC 1 Africa Radio	13590af
1400	1500		UK, BBC World Service	5845as 5875as
			6190af 6195as 7435af 9740as	
			12095as 13820as 15310as 17640af	
			17830af 21470af	
1400	1500		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb 12133usb	
			12759usb 13362usb	
1400	1500	mtwhf	USA, BBG Voice of America	9405va
1400	1500		USA, BBG/Voice of America/African Svc	4930af
			6080af 12080af 15580af 17545af	
1400	1500		USA, EWTN/WEWN Irondale, AL	15610va
1400	1500		USA, FBN/WTJC Newport NC	9370na
1400	1500		USA, Overcomer Ministries	9655eu 13810va
1400	1500		USA, WBCQ Monticello ME	9330usb
1400	1500		USA, WHRI Cypress Creek SC	7385va
			9840va	
1400	1500	Sat/Sun	USA, WHRI Cypress Creek SC	9840af
			17510af	
1400	1500		USA, WINR Red Lion PA	13570ca
1400	1500		USA, WJHR International Milton FL	15550na
1400	1500		USA, WRMI Miami FL	9955ca
1400	1500		USA, WWCN Nashville TN	7490af 9980af
			13845eu 15825eu	
1400	1500		USA, WWRB Manchester TN	9385na
1400	1500		USA, WYFR/Family Radio Worldwide	9615as
			11560as	
1400	1500		Zambia, CVC Radio Christian Voice	13590af
1400	1500		Zambia, ZNBC/Radio Two	6165do
1405	1435	Sat/Sun	Canada, Bible Voice Broadcasting	9345as
1415	1430		Germany, Pan American Broadcasting	15205as
1415	1500	Sun	Canada, Bible Voice Broadcasting	17945af
1415	1500		Nepal, Radio Nepal	5005as
1420	1440		India, All India Radio/Itanagar	4990do
1425	1455		Swaziland, TWR Africa	4760af
1430	1445	Sun	Germany, Pan American Broadcasting	15205as
1430	1445		India, All India Radio/Aizawl	5050do
1430	1445		India, All India Radio/Delhi	6085do
			9835do	
1430	1445		India, All India Radio/Jeyppore	5040do
1430	1445		India, All India Radio/Mumbai	4840do
1430	1500	mtwhfa	Albania, Radio Tirana	13625na
1430	1500		China, CNR-11/Xi'an	4905do 4920do
			6010do 6130do	
1430	1500		Guam, AWR/KSDA	9560as
1430	1500	Sat	India, All India Radio/Gangtok	4835do

1445	1500	smtwhf	Australia, HCJB Global Australia	15340as
1450	1500		India, All India Radio/Itanagar	4990do
1450	1500		India, All India Radio/Kurseong	4895do

1500 UTC - 11AM EDT / 10AM CDT / 8AM PDT

1500	1515	Sun	Canada, Bible Voice Broadcasting	12035as
1500	1525	tf	Guam, TWR Asia/KTWR	12140as
1500	1530	Sun	Canada, Bible Voice Broadcasting	17945as
1500	1530		Guam, AWR/KSDA	11720as
1500	1530		India, All India Radio/Jeyppore	5040do
1500	1530		Vietnam, Voice of Vietnam/Overseas Svc	
			7285as 9840as 12020as	
1500	1535	mwhfa	Guam, TWR Asia/KTWR	12140as
1500	1550		New Zealand, Radio NZ International	6170pa
1500	1557		North Korea, Voice of Korea	9335na 11710na
			13760eu 15245eu	
1500	1558		Libya, LJBC Voice of Africa	17725af
1500	1600		Anguilla, University Network	11775na
1500	1600		Australia, ABC NT Alice Springs	2310do
1500	1600		Australia, ABC NT Katherine	2485do
1500	1600		Australia, Radio Australia	5995pa 6080as
			7240pa 9475as 9590pa 11660as	
1500	1600		Bahrain, Radio Bahrain	6010me
1500	1600		Bhutan, Bhutan Broadcasting Svc	6035do
1500	1600	Sat/Sun	Canada, CBC Northern Quebec Svc	9625na
1500	1600		Canada, CFRX Toronto ON	6070na
1500	1600		Canada, CFPV Calgary AB	6030na
1500	1600		Canada, CKZN St Johns NF	6160na
1500	1600		Canada, CKZU Vancouver BC	6160na
1500	1600		Canada, Radio Canada International	11675as
			15125as	
1500	1600		China, China Radio International	5955as
			6095me 7325as 7395as 9720me	
			9765va 9800as 9870as 11965eu	
			13640eu 13730na 13760eu 17630af	
1500	1600	Sat/Sun	Equatorial Guinea, Radio East Africa/Malabo	
			15190af	
1500	1600		Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
1500	1600		Malaysia, RTM Kajang/Traxx FM	7295do
1500	1600		Nigeria, Voice of Nigeria	15120af
1500	1600	DRM	Russia, Voice of Russia	7225eu
1500	1600		Russia, Voice of Russia	4975va 9660as
			11985va 12040eu	
1500	1600	mtwhf	South Africa, Channel Africa	9625af
1500	1600		South Africa, CVC 1 Africa Radio	13590af
1500	1600		Uganda, Dunamis Shortwave	4750af
1500	1600		UK, BBC World Service	5845as 5875as
			6190af 6195as 7435af 9540as	
			9740as 12095as 13820as 15310as	
			15400af 15420af 17640af 17830af	
			21470af	
1500	1600		USA, American Forces Network/AFRTS	4319usb
			5446usb 5765usb 7812usb 12133usb	
			12759usb 13362usb	
1500	1600		USA, BBG/Voice of America	13570va 15530va
1500	1600	Sat/Sun	USA, BBG/Voice of America	9405va
1500	1600		USA, BBG/Voice of America/African Svc	4930af
			6080af 12080af 15580af 17895af	
1500	1600		USA, BBG/Voice of America/Special English	
			6140af 7465va 9485va 9760va	
1500	1600		USA, EWTN/WEWN Irondale, AL	15610va
1500	1600		USA, FBN/WTJC Newport NC	9370na
1500	1600		USA, KNLS Anchor Point AK	9920as
1500	1600		USA, Overcomer Ministries	9655eu 13810va
			17485af	
1500	1600		USA, WBCQ Monticello ME	9330usb
1500	1600		USA, WHRI Cypress Creek SC	7385af
1500	1600	Sat/Sun	USA, WHRI Cypress Creek SC	9840af
1500	1600	Sat	USA, WHRI Cypress Creek SC	17510af
1500	1600	Sun	USA, WHRI Cypress Creek SC	15195va
1500	1600		USA, WINR Red Lion PA	13570ca
1500	1600		USA, WJHR International Milton FL	15550na
1500	1600		USA, WRMI Miami FL	9955na
1500	1600		USA, WWCN Nashville TN	9980af 12160af
			13845eu 15825eu	
1500	1600		USA, WWRB Manchester TN	9385na
1500	1600		USA, WYFR/Family Radio Worldwide	11605as
			17580af	
1500	1600		Zambia, CVC Radio Christian Voice	13590af
1500	1600		Zambia, ZNBC/Radio Two	6165do
1515	1530		Australia, HCJB Global Australia	15340as
1515	1545	Sat	Canada, Bible Voice Broadcasting	13670as
1525	1555	Sat/Sun	Swaziland, TWR Africa	4760af
1530	1540	Sat	Vatican City State, Vatican Radio	11850as
			13765as 15235as	
1530	1545		India, All India Radio/Aizawl	5050do

1530	1545	India, All India Radio/Bengaluru	9425do
1530	1545	India, All India Radio/Bhopal 4810do	
1530	1545	India, All India Radio/Chennai	4920do
1530	1545	India, All India Radio/Delhi 5015do	
1530	1545	India, All India Radio/External Svc	9910as
1530	1545	India, All India Radio/Guwahati	4940do
1530	1545	India, All India Radio/Hyderabad	4800do
1530	1545	India, All India Radio/Itanagar	4990do
1530	1545	India, All India Radio/Jaipur 4910do	
1530	1545	India, All India Radio/Kolkata	4820do
1530	1545	India, All India Radio/Kurseong	4895do
1530	1545	India, All India Radio/Lucknow	4880do
1530	1545	India, All India Radio/Panaji, Goa	9820do
1530	1545	India, All India Radio/Port Blair	4760do
1530	1545	India, All India Radio/Radio Kashmir	4950do
1530	1545	India, All India Radio/Shillong	4970do
1530	1545	India, All India Radio/Shimla 4965do	
1530	1545	India, All India Radio/Thiruvananthapuram 5010do	
1530	1600	Afghanistan, Radio Afghanistan	6100as
1530	1600	DRM Belgium, TDP Radio/Disco Palace	15775as
1530	1600	Sun Canada, Bible Voice Broadcasting	13590me
1530	1600	h Canada, Bible Voice Broadcasting	13670as
1530	1600	Germany, AWR Europe	15255as
1530	1600	Iran, IRIB/ VOIRI 9600as	11945as
1530	1600	Mongolia, Voice of Mongolia 12015as	
1530	1600	Myanmar, Myanma Radio/National Svc	5985do
1545	1600	mtwhfa Canada, Bible Voice Broadcasting	13590me
1551	1600	New Zealand, Radio NZ International	7440pa
1551	1600	DRM New Zealand, Radio NZ International	6170pa

1600 UTC - 12PM EDT / 11AM CDT / 9AM PDT

1600	1605	Sun Croatia, Croatian Radio	6165eu
1600	1615	ff Canada, Bible Voice Broadcasting	13590me
1600	1615	mtwhfa Croatia, Croatian Radio	6165eu
1600	1627	Iran, IRIB/ VOIRI 9600as	11945as
1600	1630	Australia, Radio Australia	9965pa
1600	1630	DRM Belgium, TDP Radio/Disco Palace	15775as
1600	1630	Guam, AWR/KSDA	11805as
1600	1630	Myanmar, Myanma Radio/National Svc	5985do
1600	1630	Vietnam, Voice of Vietnam/Overseas Svc 7220me	7280eu
1600	1645	h Canada, Bible Voice Broadcasting	13590me
1600	1645	USA, WYFR/Family Radio Worldwide	11865na
1600	1657	Germany, Deutsche Welle	6170as
1600	1657	North Korea, Voice of Korea 9990va	11545va
1600	1659	Germany, Deutsche Welle	15410as
1600	1659	USA, WINB Red Lion PA	13570ca
1600	1700	Anguilla, University Network	11775na
1600	1700	Australia, ABC NT Alice Springs	2310do
1600	1700	Australia, ABC NT Katherine	2485do
1600	1700	Australia, Radio Australia	5995pa
1600	1700	7240pa	9475as
1600	1700	9710pa	11660as
1600	1700	Bahrain, Radio Bahrain	6010me
1600	1700	Bhutan, Bhutan Broadcasting Svc	6035do
1600	1700	Sat/Sun Canada, Bible Voice Broadcasting	13590me
1600	1700	Sat Canada, CBC Northern Quebec Svc	9625na
1600	1700	Canada, CFRX Toronto ON	6070na
1600	1700	Canada, CFVP Calgary AB	6030na
1600	1700	Canada, CKZN St Johns NF	6160na
1600	1700	Canada, CKZU Vancouver BC	6160na
1600	1700	China, China Radio International	6060as
1600	1700	7420af	7235as
1600	1700	9570af	11900af
1600	1700	11940eu	11965eu
1600	1700	13760eu	15345af
1600	1700	Sat/Sun Egypt, Radio Cairo	15345af
1600	1700	Equatorial Guinea, Radio East Africa/Malabo 15190af	
1600	1700	Ethiopia, Radio Ethiopia	7235va
1600	1700	Italy, IRRS-Shortwave/Euro Gospel Radio 7290va	9560va
1600	1700	Malaysia, RTM Kajang/Traxx FM	7295do
1600	1700	DRM New Zealand, Radio NZ International	6170pa
1600	1700	New Zealand, Radio NZ International	7440pa
1600	1700	Russia, Voice of Russia	4975va
1600	1700	12040eu	11985va
1600	1700	South Africa, CVC 1 Africa Radio	13590af
1600	1700	South Korea, KBS World Radio	9515eu
1600	1700	9640as	
1600	1700	Taiwan, Radio Taiwan International	9435as
1600	1700	15485as	
1600	1700	Uganda, Dunamis Shortwave	4750af
1600	1700	UK, BBC World Service	3255af
		5975as	6190af
		9495as	12095as
		13820as	15400af
		15420af	17640af
		17795af	17830af
		21470af	

1600	1700	USA, American Forces Network/AFRTS	4319usb
		5446usb	5765usb
		7812usb	12133usb
		12759usb	13362usb
1600	1700	USA, BBG/Voice of America/African Svc	4930af
		6080af	15580af
1600	1700	mtwhf USA, BBG/Voice of America/Special English	
		11890va	12080va
		13750va	
1600	1700	Sat/Sun USA, BBG/Voice of America/Special English	
		11890va	13570va
1600	1700	USA, EWTN/WEWN Irondale, AL	15610va
1600	1700	USA, FBN/WTJC Newport NC	9370na
1600	1700	USA, WBCQ Monticello ME	9330usb
1600	1700	USA, WHRI Cypress Creek SC	7385af
		9840af	17520af
1600	1700	USA, WJHR International Milton FL	15550na
1600	1700	USA, WRMI Miami FL	9955na
1600	1700	USA, WWCR Nashville TN	9980af
		12160af	
		13845eu	15825eu
1600	1700	USA, WWRB Manchester TN	9385na
1600	1700	USA, WYFR/Family Radio Worldwide	11850as
		17545af	21525af
1600	1700	Zambia, CVC Radio Christian Voice	13590af
1600	1700	Zambia, ZNBC/Radio Two	6165do
1630	1700	Guam, AWR/KSDA	11740as
1630	1700	Palau, T8WH/ WHRI	9930as
1630	1700	m South Africa, SA Radio League	3230af
1630	1700	Turkey, Voice of Turkey	15520as
1630	1700	mtwhf USA, BBG/Voice of America	13830af
1630	1700	mtwhf USA, BBG/Voice of America/Sudan in Focus	
		9675af	12015af
		13830af	

1700 UTC - 1PM EDT / 12PM CDT / 10AM PDT

1700	1720	† Canada, Bible Voice Broadcasting	13590me
1700	1725	Turkey, Voice of Turkey	15520as
1700	1729	DRM Romania, Radio Romania International	7350eu
1700	1730	m South Africa, SA Radio League	3230af
1700	1730	Vietnam, Voice of Vietnam/Overseas Svc 9625eu	
1700	1755	mtwhf South Africa, Channel Africa	9675af
1700	1757	DRM Romania, Radio Romania International	9535eu
1700	1757	Romania, Radio Romania International	11735eu
1700	1759	DRM Poland, Polskie Radio Warsaw	7265eu
1700	1759	Poland, Polskie Radio Warsaw	7265eu
		9770eu	
1700	1800	Anguilla, University Network	11775na
1700	1800	Australia, ABC NT Alice Springs	2310do
1700	1800	Australia, ABC NT Katherine	2485do
1700	1800	Australia, Radio Australia	5995pa
1700	1800	9475as	9580pa
1700	1800	9710pa	11880pa
1700	1800	Bahrain, Radio Bahrain	6010me
1700	1800	Sat/Sun Canada, Bible Voice Broadcasting	11960me
1700	1800	Sat Canada, CBC Northern Quebec Svc	9625na
1700	1800	Canada, CFRX Toronto ON	6070na
1700	1800	Canada, CFVP Calgary AB	6030na
1700	1800	Canada, CKZN St Johns NF	6160na
1700	1800	Canada, CKZU Vancouver BC	6160na
1700	1800	China, China Radio International	6090as
1700	1800	6140as	6145eu
1700	1800	6165me	7235as
1700	1800	7265as	7410as
1700	1800	7420as	11900af
		13760af	
1700	1800	Egypt, Radio Cairo	15345af
1700	1800	Sat/Sun Equatorial Guinea, Radio Africa	7190af
1700	1800	Italy, IRRS-Shortwave/Euro Gospel Radio 7290va	
1700	1800	Malaysia, RTM Kajang/Traxx FM	7295do
1700	1800	New Zealand, Radio NZ International	7440pa
1700	1800	DRM New Zealand, Radio NZ International	6170pa
1700	1800	Palau, T8WH/ WHRI	9930as
1700	1800	Russia, Voice of Russia	4975as
		12040eu	11985af
1700	1800	South Africa, CVC 1 Africa Radio	4965af
		13590af	
1700	1800	Swaziland, TWR Africa	3200af
1700	1800	Sat Swaziland, TWR Africa	3200af
1700	1800	Taiwan, Radio Taiwan International	15690af
1700	1800	UK, BBC World Service	3255af
		5845as	5975as
		6190af	7405af
		7405af	7565as
		9410af	9495as
		12095af	15400af
		17795af	17830af
1700	1800	USA, American Forces Network/AFRTS	4319usb
		5446usb	5765usb
		7812usb	12133usb
		12759usb	13362usb
1700	1800	USA, BBG/Voice of America/African Svc	6080af
		12015af	15580af
1700	1800	USA, EWTN/WEWN Irondale, AL	15610va

1700	1800	USA, FBN/WTJC Newport NC	9370na
1700	1800	USA, WBCQ Monticello ME 9330usb	15420usb
1700	1800	USA, WHRI Cypress Creek SC	7385af
		9840af 17520af	
1700	1800	USA, WINB Red Lion PA	9265ca
1700	1800	USA, WJHR International Milton FL	15550na
1700	1800	USA, WRMI Miami FL	9955ca
1700	1800	USA, WWCR Nashville TN	9980af 12160af
		13845eu 15825eu	
1700	1800	USA, WWRB Manchester TN	9385na
1700	1800	USA, WYFR/Family Radio Worldwide	7395af
1700	1800	Zambia, CVC Radio Christian Voice	4965af
		13590af	
1700	1800	Zambia, ZNBC/Radio Two	6165do
1720	1740	Sat/Sun USA, BBG/Voice of America/Studio 7	4930af
		7210af 12130af	
1720	2740	fas USA, BBG/Voice of America	7210af
1730	1745	India, All India Radio/Bhopal	4810do
1730	1745	India, All India Radio/Delhi	5015do 7370do
		9575do 9835do	
1730	1745	India, All India Radio/Guwahati	4940do
1730	1745	India, All India Radio/Hyderabad	4800do
1730	1745	India, All India Radio/Jaipur	4910do
1730	1745	India, All India Radio/Kolkata	4820do
1730	1745	India, All India Radio/Kurseong	4895do
1730	1745	India, All India Radio/Lucknow	4880do
1730	1745	India, All India Radio/Radio Kashmir	4950do
1730	1745	India, All India Radio/Shimla	4965do
1730	1745	India, All India Radio/Thiruvananthapuram	5010do
1730	1800	Bulgaria, Radio Bulgaria	5900eu 7400eu
1730	1800	DRM Bulgaria, Radio Bulgaria	9700eu
1730	1800	mtwhf Clandestine, Sudan Radio Service/SRS	9590af
1730	1800	mtwhf USA, BBG/Voice of America	7210af
1730	1800	mtwhf USA, BBG/Voice of America/Studio 7	4930af
		7210af 12130af	
1730	1800	Vatican City State, Vatican Radio	11625af
		13765af 15570af	
1740	1745	India, All India Radio/Chennai	4920do
1745	1800	DRM India, All India Radio/External Svc	9950eu
		11580af	
1745	1800	India, All India Radio/External Svc	7400af
		7410af 7550eu 9415af 9445af	
		11670eu 11935af	
1759	1800	Netherlands, R Netherlands Worldwide	6020af 15495af

1800 UTC - 2PM EDT / 1PM CDT / 11AM PDT

1800	1815	Sun Canada, Bible Voice Broadcasting	13590me
1800	1815	Sat Canada, Bible Voice Broadcasting	11855as
1800	1820	f USA, BBG/Voice of America	7210af
1800	1830	South Africa, AWR Africa	3215af 3345af
1800	1830	w South Africa, AWR Africa	9755af
1800	1830	mtwhf USA, BBG/Voice of America/African Svc	6080af
		9850af 12015af 15580af	
1800	1830	Sat/Sun USA, BBG/Voice of America/African Svc	4930af
		6080af 9850af 12015af 15580af	
1800	1835	New Zealand, Radio NZ International	7440pa
1800	1835	DRM New Zealand, Radio NZ International	6170pa
1800	1845	Sun Canada, Bible Voice Broadcasting	9430me
1800	1857	Netherlands, R Netherlands Worldwide	6020af 15495af
1800	1857	North Korea, Voice of Korea	13760eu 15425eu
1800	1900	Anguilla, University Network	11775na
1800	1900	mtwhf Argentina, RAE	15345eu
1800	1900	Australia, ABC NT Alice Springs	2310do
1800	1900	Australia, ABC NT Katherine	2485do
1800	1900	Australia, Radio Australia	6080pa 7240pa
		9475as 9580pa 9710pa 11880pa	
1800	1900	Bahrain, Radio Bahrain	6010me
1800	1900	Sat Canada, Bible Voice Broadcasting	9430me
1800	1900	Sun Canada, Bible Voice Broadcasting	6030eu
1800	1900	Canada, CFRX Toronto ON	6070na
1800	1900	Canada, CFVP Calgary AB	6030na
1800	1900	Canada, CKZN St Johns NF	6160na
1800	1900	Canada, CKZU Vancouver BC	6160na
1800	1900	Canada, Radio Canada International	9530af
		11765af 17810af	
1800	1900	China, China Radio International	6175eu
		9600eu 13760eu	
1800	1900	Sat/Sun Equatorial Guinea, Radio Africa	7190af
1800	1900	DRM India, All India Radio/External Svc	9950eu
		11580af	
1800	1900	India, All India Radio/External Svc	7400af
		7410af 7550eu 9415af 9445af	
		11670eu 11935af	

1800	1900	Italy, IRRS-Shortwave/Euro Gospel Radio	7290va
1800	1900	Kuwait, Radio Kuwait	15540eu
1800	1900	Malaysia, RTM Kajang/Traxx FM	7295do
1800	1900	Nigeria, Voice of Nigeria	15120af
1800	1900	Palau, T8WH/ WHRI	9930as 9955as
1800	1900	Russia, Voice of Russia	4975me 12040va
1800	1900	South Africa, CVC 1 Africa Radio	4965af
		13590af	
1800	1900	South Korea, KBS World Radio	7275eu
1800	1900	Swaziland, TWR Africa	9500af
1800	1900	Taiwan, Radio Taiwan International	6155eu
1800	1900	UK, BBC World Service	3255af 7405af
		11765va 11810af 12095af	15400af
1800	1900	USA, American Forces Network/AFRTS	4319usb
		5446usb 5765usb 7812usb	12133usb
		12759usb 13362usb	
1800	1900	USA, EWTN/WEWN Irondale, AL	15610va
1800	1900	USA, FBN/WTJC Newport NC	9370na
1800	1900	USA, KJES Vado NM	15385na
1800	1900	USA, WBCQ Monticello ME	9330usb 15420usb
1800	1900	USA, WHRI Cypress Creek SC	7385af
		9840af 17520af	
1800	1900	USA, WINB Red Lion PA	9265ca
1800	1900	USA, WJHR International Milton FL	15550na
1800	1900	USA, WRMI Miami FL	9955ca
1800	1900	USA, WWCR Nashville TN	9980af 12160af
		13845eu 15825eu	
1800	1900	USA, WWRB Manchester TN	9385na
1800	1900	USA, WYFR/Family Radio Worldwide	5905af
		7395af 9770af 9925af	13750af
1800	1900	Zambia, CVC Radio Christian Voice	4965af
		13590af	
1800	1900	Zambia, ZNBC/Radio Two	6165do
1805	1810	Sat Croatia, Croatian Radio	6165eu
1805	1815	mtwhf Croatia, Croatian Radio	6165eu
1810	1820	f USA, BBG/Voice of America/Studio 7	4930af
		7210af 12130af	
1815	1845	Sat Canada, Bible Voice Broadcasting	6030eu
1830	1845	Croatia, Croatian Radio	15540na
1830	1845	India, All India Radio/Delhi	5015do
1830	1900	Moldova, (Transnistria) Radio PMR	6240eu
1830	1900	South Africa, AWR Africa	9610af
1830	1900	Turkey, Voice of Turkey	9785eu
1830	1900	UK, BBC World Service	9850as 5875as
		5905af 5950as 5950as	5975as
		6190af	
1830	1900	UK, BBC World Service	9410af
1830	1900	mtwhf USA, BBG/Voice of America	7210af
1830	1900	USA, BBG/Voice of America/African Svc	4930af
		6080af 9850af 12015af	15580af
1830	1900	mtwhf USA, BBG/Voice of America/Studio 7	7210af
		12130af	
1836	1850	New Zealand, Radio NZ International	9615pa
1836	1850	DRM New Zealand, Radio NZ International	9890pa
1845	1900	mtwhfa Albania, Radio Tirana	7520na 13735na
1851	1900	New Zealand, Radio NZ International	9615pa
1851	1900	DRM New Zealand, Radio NZ International	15720pa
1859	1900	Netherlands, R Netherlands Worldwide	7425af 11610af

1900 UTC - 3PM EDT / 2PM CDT / 12PM PDT

1900	1925	Turkey, Voice of Turkey	9785eu
1900	1930	Germany, Deutsche Welle	6150af 9735af
		11795af 17610af	
1900	1930	USA, BBG/Voice of America/African Svc	4930af
		4940af 6080af 9850af	15580af
		17895af	
1900	1930	Vietnam, Voice of Vietnam/Overseas Svc	7280eu 9730eu
1900	1945	DRM India, All India Radio/External Svc	9950eu
		11580af	
1900	1945	India, All India Radio/External Svc	7400af
		7410af 7550eu 9415af 9445af	
		11670eu 11935af	
1900	1950	New Zealand, Radio NZ International	9615pa
1900	1957	Netherlands, R Netherlands Worldwide	7425af
		11615af 15195af	
1900	1957	North Korea, Voice of Korea	7210af 9975va
		11535va 11910af	
1900	2000	Anguilla, University Network	11775na
1900	2000	Australia, ABC NT Alice Springs	2310do
1900	2000	Australia, ABC NT Katherine	2485do
1900	2000	Australia, Radio Australia	6080pa 7240pa
		9500as 9580pa 9710pa	11880pa

1900 2000	Bahrain, Radio Bahrain	6010me	
1900 2000	Canada, CFRX Toronto ON	6070na	
1900 2000	Canada, CFVP Calgary AB	6030na	
1900 2000	Canada, CKZN St Johns NF	6160na	
1900 2000	Canada, CKZU Vancouver BC	6160na	
1900 2000	China, China Radio International	7295va	
	9435af	9440af	
1900 2000	Cuba, Radio Havana Cuba	11760sa	
1900 2000	Egypt, Radio Cairo	11510af	
1900 2000 Sat/Sun	Equatorial Guinea, Radio Africa	7190af	
1900 2000	Indonesia, Voice of Indonesia	9526eu	
1900 2000	Italy, IRRS-Shortwave/Euro Gospel Radio	7290va	
1900 2000	Kuwait, Radio Kuwait	15540eu	
1900 2000	Malaysia, RTM Kajang/Traxx FM	7295do	
1900 2000	Micronesia, The Cross Radio/Pohnpei	4755as	
1900 2000 DRM	New Zealand, Radio NZ International	15720pa	
1900 2000	Palau, T8WH/ WHRI	9930as	
1900 2000	Russia, Voice of Russia	12040va	
1900 2000	South Africa, CVC 1 Africa Radio	4965af	
	13590af		
1900 2000 mtwhf	Spain, Radio Exterior de Espana	9665eu	
	11610af		
1900 2000	Swaziland, TWR Africa	3200af	
1900 2000 Sat	Swaziland, TWR Africa	3200af	
1900 2000	Thailand, Radio Thailand World Svc	7205eu	
1900 2000	UK, BBC World Service	3255af 5875as	
	5950as	6005af 6190af	9410af
	11810af	12095af	15400af
1900 2000	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb 7812usb	12133usb
	12759usb	13362usb	
1900 2000	USA, BBG/Voice of America/Special English		
	7485va	9630va	
1900 2000	USA, EWTN/WEWN Irondale, AL	15610va	
1900 2000	USA, FBN/WTJC Newport NC	9370na	
1900 2000	USA, WBCQ Monticello ME	7415usb	9330usb
	15420usb		
1900 2000	USA, WHRI Cypress Creek SC	7385af	
	9840af	17520na	
1900 2000	USA, WINB Red Lion PA	9265ca	
1900 2000	USA, WJHR International Milton FL	15550na	
1900 2000	USA, WRMI Miami FL	9955ca	
1900 2000	USA, WWCN Nashville TN	9980af	12160af
	13845eu	15825eu	
1900 2000	USA, WWRB Manchester TN	9385na	
1900 2000	USA, WYFR/Family Radio Worldwide	3230af	
	6020af	7270af 7395af	9610af
	9775af	18980eu	
1900 2000	Zambia, CVC Radio Christian Voice	4965af	
	13590af		
1900 2000	Zambia, ZNBC/Radio Two	6165do	
1905 1920 Sat	Mali, ORTM/Radio Mali	9635do	
1930 2000 Sat/Sun	Germany, Pan American Broadcasting	9515af	
1930 2000	Iran, IRIB/ VOIRI	5940eu 6205eu	9780eu
	9800af		
1930 2000	South Africa, RTE Radio Worldwide	5840af	
1930 2000	USA, BBG/Voice of America/African Svc	4930af	
	4940af	6080af 15580af	
1945 2000 DRM	Vatican City State, Vatican Radio	9800am	
1950 2000	Vatican City State, Vatican Radio	4005va	
	5885va	7250va 9645va	
1951 2000	New Zealand, Radio NZ International	11725pa	

2000 UTC - 4PM EDT / 3PM CDT / 1PM PDT

2000 2015 Sat	Germany, Pan American Broadcasting	9515af	
2000 2027	Iran, IRIB/ VOIRI	5940eu 6205eu	9780eu
	9800af		
2000 2030 mtwhfa	Albania, Radio Tirana	7465eu	13735na
2000 2030	Egypt, Radio Cairo	11510af	
2000 2030	South Africa, RTE Radio Worldwide	5840af	
2000 2030 Sat	Swaziland, TWR Africa	3200af	
2000 2030	USA, BBG/Voice of America/African Svc	4930af	
	4940af	6080af 15580af	
2000 2030	Vatican City State, Vatican Radio	7365af	
	9755af	11625af	
2000 2050	New Zealand, Radio NZ International	11725pa	
2000 2050 DRM	New Zealand, Radio NZ International	15720pa	
2000 2057	Germany, Deutsche Welle	6150af 11865af	
2000 2057	Netherlands, R Netherlands Worldwide	7425af	
	11615af		
2000 2059	Germany, Deutsche Welle	11795af	
2000 2100	Anguilla, University Network	11775na	
2000 2100	Australia, ABC NT Alice Springs	2310do	
2000 2100	Australia, ABC NT Katherine	2485do	

2000 2100	Australia, ABC NT Tennant Creek	2325do	
2000 2100	Australia, Radio Australia	6080pa 7240pa	11880pa
	9500as	11650pa	11660pa
2000 2100	Bahrain, Radio Bahrain	6010me	
2000 2100	Belarus, Radio Station Belarus	7255eu	
	7360eu	7390eu	
2000 2100 DRM	Belgium, TDP Radio/Disco Palace	17755am	
2000 2100	Canada, CFRX Toronto ON	6070na	
2000 2100	Canada, CFVP Calgary AB	6030na	
2000 2100	Canada, CKZN St Johns NF	6160na	
2000 2100	Canada, CKZU Vancouver BC	6160na	
2000 2100	Canada, Radio Canada International	15235af	
	15330af	17735af	
2000 2100	China, China Radio International	5960eu	
	5985af	7285eu 7415eu	9440af
	9600eu		
2000 2100 Sat/Sun	Equatorial Guinea, Radio Africa	7190af	
2000 2100	Kuwait, Radio Kuwait	15540eu	
2000 2100	Malaysia, RTM Kajang/Traxx FM	7295do	
2000 2100	Micronesia, The Cross Radio/Pohnpei	4755as	
2000 2100	Palau, T8WH/ WHRI	9930as	
2000 2100	Russia, Voice of Russia	12040va	
2000 2100	South Africa, CVC 1 Africa Radio	4965af	
	9505af		
2000 2100	UK, BBC World Service	3255af 6005af	6005af
	6190af	9410af 11810af	12095af
	13710af		
2000 2100	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb 7812usb	12133usb
	12759usb	13362usb	
2000 2100 mtwhf	USA, BBG/Voice of America	5930va	9480va
2000 2100	USA, EWTN/WEWN Irondale, AL	15610af	
2000 2100	USA, FBN/WTJC Newport NC	9370na	
2000 2100	USA, WBCQ Monticello ME	7415usb	9330usb
	15420usb		
2000 2100	USA, WHRI Cypress Creek SC	7385na	
	15665na		
2000 2100	USA, WINB Red Lion PA	9265ca	
2000 2100	USA, WJHR International Milton FL	15550na	
2000 2100	USA, WRMI Miami FL	9955ca	
2000 2100	USA, WWCN Nashville TN	9980af	12160af
	13845eu	15825eu	
2000 2100	USA, WWRB Manchester TN	9385na	
2000 2100	USA, WYFR/Family Radio Worldwide	12060af	
	15195af	17725ca	
2000 2100	Zambia, CVC Radio Christian Voice	4965af	
	9505af		
2000 2100	Zambia, ZNBC/Radio Two	6165do	
2030 2045	Thailand, Radio Thailand World Svc	9680eu	
2030 2057 DRM	Romania, Radio Romania International	9765eu	
2030 2057	Romania, Radio Romania International	11880na	
	11940na	13800na	
2030 2100	Moldova, (Transnistria) Radio PMR	6240eu	
2030 2100	Turkey, Voice of Turkey	7205va	
2030 2100	USA, BBG/Voice of America	7555as	
2030 2100	USA, BBG/Voice of America/African Svc	4930af	
	6080af	15580af	
2030 2100 Sat/Sun	USA, BBG/Voice of America/African Svc	4930af	
	4940af	6080af 15580af	
2030 2100	Vietnam, Voice of Vietnam/Overseas Svc		
	7220me	7280eu 9550me	9730eu
2045 2100	India, All India Radio/External Svc	7550eu	
	9445eu	9910pa 11620pa	11670eu
	11715pa		
2045 2100 DRM	India, All India Radio/External Svc	9950eu	
2051 2100 DRM	New Zealand, Radio NZ International	11675pa	
2051 2100	New Zealand, Radio NZ International	11725pa	

2100 UTC - 5PM EDT / 4PM CDT / 2PM PDT

2100 2125	Turkey, Voice of Turkey	7205va	
2100 2130	Australia, ABC NT Alice Springs	2310do	
2100 2130	Australia, ABC NT Katherine	2485do	
2100 2130	Australia, ABC NT Tennant Creek	2325do	
2100 2130	Austria, AWR Europe	11955af	
2100 2130 Sat	Canada, CBC Northern Quebec Svc	9625na	
2100 2130	South Korea, KBS World Radio	3955eu	
2100 2150 DRM	New Zealand, Radio NZ International	11675pa	
2100 2150	New Zealand, Radio NZ International	11725pa	
2100 2157	Germany, Deutsche Welle	9735af	
2100 2157	North Korea, Voice of Korea	13760eu	15245eu
2100 2200	Angola, Angolan National Radio	7217af	
2100 2200	Anguilla, University Network	11775na	
2100 2200	Australia, Radio Australia	9500as 9660pa	13630pa
	11660pa	11650pa 11695as	
	15515pa		

2100 2200	Bahrain, Radio Bahrain	6010me	
2100 2200	Belarus, Radio Station Belarus	7255eu	
	7360eu	7390eu	
2100 2200 DRM	Belgium, TDP Radio	17555eu	
2100 2200	Bulgaria, Radio Bulgaria	5900eu	7400eu
2100 2200	Canada, CFRX Toronto ON	6070na	
2100 2200	Canada, CFVP Calgary AB	6030na	
2100 2200	Canada, CKZN St Johns NF	6160na	
2100 2200	Canada, CKZU Vancouver BC	6160na	
2100 2200	China, China Radio International	5960eu	
	7205af	7285eu	7325af
	9500eu		7415eu
2100 2200 Sat/Sun	Equatorial Guinea, Radio Africa	7190af	
2100 2200	Germany, Deutsche Welle	11865af	15275af
	15640af		
2100 2200	India, All India Radio/External Svc	7550eu	
	9445eu	9910pa	11620pa
			11715pa
2100 2200 DRM	India, All India Radio/External Svc	9950eu	
2100 2200	Malaysia, RTM Kajang/Traxx FM	7295do	
2100 2200	Micronesia, The Cross Radio/Pohnpei	4755 as	
2100 2200	Palau, T8WH/ WHRI	9930as	
2100 2200	South Africa, CVC 1 Africa Radio	4965af	
	9505af		
2100 2200 Sat/Sun	Spain, Radio Exterior de Espana	9650eu	
2100 2200	Syria, Radio Damascus	9330va	12085va
2100 2200	UK, BBC World Service	3255af	3915as
	5875as	5905as	6005af
	6195as	9410af	9915af
			12095af
2100 2200	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
2100 2200	USA, BBG/Voice of America	7555as	
2100 2200	USA, BBG/Voice of America/African Svc	6080af	
	15580af		
2100 2200	USA, EWTN/WEWN Irondale, AL	15610af	
2100 2200	USA, FBN/WTJC Newport NC	9370na	
2100 2200	USA, WBCQ Monticello ME	7415usb	9330usb
2100 2200	USA, WHRI Cypress Creek SC	7385na	
	13660na		
2100 2200	USA, WINB Red Lion PA	9265ca	
2100 2200	USA, WJHR International Milton FL	15550na	
2100 2200	USA, WRMI Miami FL	9955ca	
2100 2200	USA, WWCN Nashville TN	7465eu	9350af
	9980af	15825na	
2100 2200	USA, WWRB Manchester TN	3215na	
2100 2200	USA, WYFR/Family Radio Worldwide	7425af	
	12060af		
2100 2200	Zambia, CVC Radio Christian Voice	4965af	
	9505af		
2100 2200	Zambia, ZNBC/Radio Two	6165do	
2115 2200	Egypt, Radio Cairo	6270eu	
2130 2200	Australia, ABC NT Alice Springs	4835do	
2130 2200	Australia, ABC NT Katherine	5025do	
2130 2200 mtwhfa	Canada, CBC Northern Quebec Svc	9625na	
2151 2200 DRM	New Zealand, Radio NZ International	17675pa	
2151 2200	New Zealand, Radio NZ International	15720pa	

2200 UTC - 6PM EDT / 5PM CDT / 3PM PDT

2200 2205	Zambia, ZNBC/Radio Two	6165do	
2200 2229	USA, WINB Red Lion PA	9265ca	
2200 2230	India, All India Radio/External Svc	7550eu	
	9445eu	9445eu	9910pa
	11670eu	11715pa	11620pa
2200 2230 DRM	India, All India Radio/External Svc	9950eu	
2200 2230 smtwh	USA, BBG/Voice of America	5895va	7480va
	7575va	11955va	
2200 2245	Egypt, Radio Cairo	6270eu	
2200 2255	Turkey, Voice of Turkey	9830va	
2200 2257	Romania, Radio Romania International	5960eu	
	7435eu	9790eu	11940eu
2200 2300	Anguilla, University Network	6090na	
2200 2300	Australia, ABC NT Alice Springs	4835do	
2200 2300	Australia, ABC NT Katherine	5025do	
2200 2300	Australia, Radio Australia	9660pa	9855as
	13630pa	15230pa	15515pa
			15560pa
2200 2300	Bahrain, Radio Bahrain	6010me	
2200 2300 smtwhf	Canada, CBC Northern Quebec Svc	9625na	
2200 2300	Canada, CFRX Toronto ON	6070na	
2200 2300	Canada, CFVP Calgary AB	6030na	
2200 2300	Canada, CKZN St Johns NF	6160na	
2200 2300	Canada, CKZU Vancouver BC	6160na	
2200 2300	China, China Radio International	9590as	
2200 2300 Sat/Sun	Equatorial Guinea, Radio Africa	7190af	
2200 2300	Malaysia, RTM Kajang/Traxx FM	7295do	
2200 2300	Micronesia, The Cross Radio/Pohnpei	4755 as	
2200 2300 DRM	New Zealand, Radio NZ International	17675pa	

2200 2300	New Zealand, Radio NZ International	15720pa	
2200 2300	Palau, T8WH/ WHRI	9930as	
2200 2300	Russia, Voice of Russia	9800va	
2200 2300	UK, BBC World Service	3915as	5875as
	5905as	5935af	6195as
	9580as	9915af	12095af
2200 2300	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
2200 2300	USA, BBG/Voice of America	7555as	
2200 2300	USA, EWTN/WEWN Irondale, AL	15610me	
2200 2300	USA, FBN/WTJC Newport NC	9370na	
2200 2300	USA, WBCQ Monticello ME	7415usb	9330usb
2200 2300	USA, WHRI Cypress Creek SC	9850na	
	9860na	13620na	
2200 2300	USA, WRMI Miami FL	9955ca	
2200 2300	USA, WWCN Nashville TN	7465eu	9350af
	9980af	15825na	
2200 2300	USA, WWRB Manchester TN	3215na	5050na
2200 2300	USA, WYFR/Family Radio Worldwide	15255sa	
	15440ca		
2200 2300	Zambia, CVC Radio Christian Voice	4965af	
2215 2230	Croatia, Croatian Radio	3985eu	9925ca
2230 2300	China, Xizang PBS/Lhasa	4905do	
2230 2300	Moldova, (Transnistria) Radio PMR	6240eu	
2230 2300	South Africa, AWR Africa	15320as	
2230 2300	USA, BBG/Voice of America/Special English		
	7460af	9570va	11840va
			15340va
2230 2300	USA, WINB Red Lion PA	13570ca	
2245 2300	India, All India Radio/External Svc	6055as	
	7305as	11645as	13605as

2300 UTC - 7PM EDT / 6PM CDT / 4PM PDT

2300 0000	Anguilla, University Network	6090na	
2300 0000	Australia, ABC NT Alice Springs	4835do	
2300 0000	Australia, ABC NT Katherine	5025do	
2300 0000	Australia, Radio Australia	9660pa	9855va
	13690pa	15230pa	15415pa
			17795pa
2300 0000	Bahrain, Radio Bahrain	6010me	
2300 0000	Bulgaria, Radio Bulgaria	9700na	11700na
2300 0000 smtwhf	Canada, CBC Northern Quebec Svc	9625na	
2300 0000	Canada, CFRX Toronto ON	6070na	
2300 0000	Canada, CFVP Calgary AB	6030na	
2300 0000	Canada, CKZN St Johns NF	6160na	
2300 0000	Canada, CKZU Vancouver BC	6160na	
2300 0000	China, China Radio International	5915as	
	5990ca	6145na	7350eu
	9610as	11690as	11790as
			11840na
2300 0000	Cuba, Radio Havana Cuba	5040ca	
2300 0000	Egypt, Radio Cairo	6270na	
2300 0000	India, All India Radio/External Svc	6055as	
	7305as	11645as	13605as
2300 0000	Malaysia, RTM Kajang/Traxx FM	7295do	
2300 0000	Micronesia, The Cross Radio/Pohnpei	4755 as	
2300 0000	New Zealand, Radio NZ International	15720pa	
2300 0000 DRM	New Zealand, Radio NZ International	17675pa	
2300 0000	Palau, T8WH/ WHRI	9930as	
2300 0000	Russia, Voice of Russia	9665va	9800va
2300 0000	UK, BBC World Service	7490as	9580as
	9740as	9890as	11850as
			12010as
2300 0000	USA, American Forces Network/AFRTS	4319usb	
	5446usb	5765usb	7812usb
	12759usb	13362usb	12133usb
2300 0000	USA, BBG/Voice of America	5895va	5915va
	7555va	7575va	11955va
2300 0000	USA, BBG/Voice of America/Special English		
	7460af	9570va	11840va
			15340va
2300 0000	USA, EWTN/WEWN Irondale, AL	15610me	
2300 0000	USA, FBN/WTJC Newport NC	9370na	
2300 0000	USA, WBCQ Monticello ME	7415usb	9330usb
2300 0000 mtwhfa	USA, WHRI Cypress Creek SC	9850na	
2300 0000 Sun	USA, WHRI Cypress Creek SC	7315na	
	17820va		
2300 0000	USA, WINB Red Lion PA	13570ca	
2300 0000	USA, WRMI Miami FL	9955ca	
2300 0000	USA, WTWW Lebanon TN	5755va	12100va
2300 0000	USA, WWCN Nashville TN	7465eu	9350af
	9980af	13845na	
2300 0000	USA, WWRB Manchester TN	3215na	5050na
2300 0000	USA, WYFR/Family Radio Worldwide	11580sa	
	15440ca		
2300 0000	Zambia, CVC Radio Christian Voice	4965af	
2300 2330 DRM	Vatican City State, Vatican Radio	9755am	
2330 0000	Australia, Radio Australia	17750as	
2330 0000	Vietnam, Voice of Vietnam/Overseas Svc		
	9840as	12020as	
2330 2345	India, All India Radio/Aligarh	9470do	



MTXTRA

Shortwave Broadcast Guide

PORTUGUESE

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

1300 UTC - 9AM EDT / 8AM CDT / 6AM PDT

1300	1330	Brazil, Radio Difusora do Amazonas	4805do	
1300	1355	Portugal, RDP Internacional	12020eu	15180af
1300	1400	Brazil, Educadora/Braganca	4825do	
1300	1400	Brazil, Radio 9 de Julho	9820do	
1300	1400	Brazil, Radio A Nossa Voz	4974do	
1300	1400	Brazil, Radio Alvorada/Londrina	4865do	
1300	1400	Brazil, Radio Aparecida	5035do	6135do
		9630do	11855do	
1300	1400	Brazil, Radio Bandeirantes	6090do	9645do
		11925do		
1300	1400	Brazil, Radio Boa Vontade	6160do	9550do
		11895do		
1300	1400	Brazil, Radio Brasil 5000	4785do	
1300	1400	Brazil, Radio Brasil Central	4985do	11815do
1300	1400	Brazil, Radio Cancao Nova	4825do	6105do
		9675do		
1300	1400	Brazil, Radio Capixaba	4935do	
1300	1400	Brazil, Radio Clube do Para	4885do	
1300	1400	Brazil, Radio Congonhas	4775do	
1300	1400	Brazil, Radio Cultura do Para	5045do	
1300	1400	Brazil, Radio Cultura Ondas Tropicais	4845do	
1300	1400	Brazil, Radio Cultura/Sao Paulo	6170do	
		9615do		
1300	1400	Brazil, Radio Daqui	4915do	11830do
1300	1400	Brazil, Radio Difusora Acerana	4885do	
1300	1400	Brazil, Radio Difusora Caceres	5055do	
1300	1400	Brazil, Radio Difusora de Macapa	4915do	
1300	1400	Brazil, Radio Difusora Roraima	4875do	
1300	1400	Brazil, Radio Difusora/Londrina	4815do	
1300	1400	Brazil, Radio Educacao Rural/Coari	5035do	
1300	1400	Brazil, Radio Educadora 6 de Agosto	3355do	
1300	1400	Brazil, Radio Educadora/Guajara Mirim	3375do	
1300	1400	Brazil, Radio Educadora/Limeira	2380do	
1300	1400	Brazil, Radio Gaucha/Porto Alegre	6020do	
1300	1400	Brazil, Radio Gaucha/Rio de Janeiro	11915do	
1300	1400	Brazil, Radio Gazeta	9684do	15325do
1300	1400	Brazil, Radio Gazeta Universitaria	5955do	
1300	1400	Brazil, Radio Globo	11805do	
1300	1400	Brazil, Radio Guaiba	6000do	11784do
1300	1400	Brazil, Radio Guarujá Paulista	5045do	
1300	1400	Brazil, Radio Imaculada Conceicao	4754do	
1300	1400	Brazil, Radio Inconfidencia	6010do	15190do
1300	1400	Brazil, Radio Itatiaia	5970do	
1300	1400	Brazil, Radio Jornal A Critica	5055do	
1300	1400	Brazil, Radio Maria	4885do	
1300	1400	Brazil, Radio Marumby	11724do	
1300	1400	Brazil, Radio Meteorologia Paulista	4845do	
1300	1400	Brazil, Radio Missoes da Amazonia	4865do	
1300	1400	Brazil, Radio Mundial	3325do	
1300	1400	Brazil, Radio Nacional da Amazonia	6180do	
		11780do		
1300	1400	Brazil, Radio Novas de Paz	6080do	9515do
1300	1400	Brazil, Radio Novo Tempo	4895do	
1300	1400	Brazil, Radio Record	6150do	9505do
1300	1400	Brazil, Radio Rio Mar	6160do	9694do
1300	1400	Brazil, Radio Rural	4765do	
1300	1400	Brazil, Radio Senado	5990do	
1300	1400	Brazil, Radio Transmundial	5965do	11735do
1300	1400	Brazil, Radio Voz Misionaria/Camboriu	9665do	
1300	1400	Brazil, Radio Voz Misionaria/Florianopolis	11749do	
1300	1400	Brazil, Super Radio Deus e Amour/Curitiba	6060do	11765do
1300	1400	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do	9585do
1300	1400	Portugal, RDP Internacional	17575sa	21655va
1300	1400	USA, WYFR/Family Radio Worldwide	17555sa	
1315	1330	Vatican City State, Vatican Radio	9645eu	
		11740eu		
1355	1400	Swaziland, TWR Africa	7315af	

1400 UTC - 10AM EDT / 9AM CDT / 7AM PDT

1400	1425	Sun	Swaziland, TWR Africa	7315af
1400	1500		Brazil, Educadora/Braganca	4825do
1400	1500		Brazil, Radio 9 de Julho	9820do
1400	1500		Brazil, Radio A Nossa Voz	4974do
1400	1500		Brazil, Radio Alvorada/Londrina	4865do
1400	1500		Brazil, Radio Aparecida	5035do
			9630do	11855do
1400	1500		Brazil, Radio Bandeirantes	6090do
			11925do	9645do
1400	1500		Brazil, Radio Boa Vontade	6160do
			11895do	9550do
1400	1500		Brazil, Radio Brasil 5000	4785do
1400	1500		Brazil, Radio Brasil Central	4985do
1400	1500		Brazil, Radio Cancao Nova	4825do
			9675do	6105do
1400	1500		Brazil, Radio Capixaba	4935do
1400	1500		Brazil, Radio Clube do Para	4885do
1400	1500		Brazil, Radio Congonhas	4775do
1400	1500		Brazil, Radio Cultura do Para	5045do
1400	1500		Brazil, Radio Cultura Ondas Tropicais	4845do
1400	1500		Brazil, Radio Cultura/Sao Paulo	6170do
			9615do	
1400	1500		Brazil, Radio Daqui	4915do
1400	1500		Brazil, Radio Difusora Acerana	4885do
1400	1500		Brazil, Radio Difusora Caceres	5055do
1400	1500		Brazil, Radio Difusora de Macapa	4915do
1400	1500		Brazil, Radio Difusora Roraima	4875do
1400	1500		Brazil, Radio Difusora/Londrina	4815do
1400	1500		Brazil, Radio Educacao Rural/Coari	5035do
1400	1500		Brazil, Radio Educadora 6 de Agosto	3355do
1400	1500		Brazil, Radio Educadora/Guajara Mirim	3375do
1400	1500		Brazil, Radio Educadora/Limeira	2380do
1400	1500		Brazil, Radio Gaucha/Porto Alegre	6020do
1400	1500		Brazil, Radio Gaucha/Rio de Janeiro	11915do
1400	1500		Brazil, Radio Gazeta	9684do
1400	1500		Brazil, Radio Gazeta Universitaria	5955do
1400	1500		Brazil, Radio Globo	11805do
1400	1500		Brazil, Radio Guaiba	6000do
1400	1500		Brazil, Radio Guarujá Paulista	5045do
1400	1500		Brazil, Radio Imaculada Conceicao	4754do
1400	1500		Brazil, Radio Inconfidencia	6010do
1400	1500		Brazil, Radio Itatiaia	5970do
1400	1500		Brazil, Radio Jornal A Critica	5055do
1400	1500		Brazil, Radio Maria	4885do
1400	1500		Brazil, Radio Marumby	11724do
1400	1500		Brazil, Radio Meteorologia Paulista	4845do
1400	1500		Brazil, Radio Missoes da Amazonia	4865do
1400	1500		Brazil, Radio Mundial	3325do
1400	1500		Brazil, Radio Nacional da Amazonia	6180do
			11780do	
1400	1500		Brazil, Radio Novas de Paz	6080do
1400	1500		Brazil, Radio Novo Tempo	4895do
1400	1500		Brazil, Radio Rio Mar	6160do
1400	1500		Brazil, Radio Rural	4765do
1400	1500		Brazil, Radio Senado	5990do
1400	1500		Brazil, Radio Transmundial	5965do
1400	1500		Brazil, Radio Voz Misionaria/Camboriu	9665do
1400	1500		Brazil, Radio Voz Misionaria/Florianopolis	11749do
1400	1500		Brazil, Super Radio Deus e Amour/Curitiba	6060do
			11765do	
1400	1500		Brazil, Super Radio Deus e Amour/Sao Paulo	6120do
			9585do	
1400	1500	mtwhf	Portugal, RDP Internacional	17575sa
1400	1500	Sat/Sun	Portugal, RDP Internacional	11905eu
1400	1500	mtwhf	South Africa, Channel Africa	9625af
1400	1500		USA, WYFR/Family Radio Worldwide	15770sa
1425	1455		Swaziland, TWR Africa	7315af

1500 UTC - 11AM EDT / 10AM CDT / 8AM PDT

1500 1545	USA, WYFR/Family Radio Worldwide	18980sa
1500 1555 mtwhf	Portugal, RDP Internacional	17575sa 21655va
1500 1555 Sat/Sun	Portugal, RDP Internacional	11905eu 15520na
1500 1600	Brazil, Educadora/Braganca	4825do
1500 1600	Brazil, Radio 9 de Julho	9820do
1500 1600	Brazil, Radio A Nossa Voz	4974do
1500 1600	Brazil, Radio Alvorada/Londrina	4865do
1500 1600	Brazil, Radio Aparecida	5035do 6135do
	9630do 11855do	
1500 1600	Brazil, Radio Bandeirantes	6090do 9645do
	11925do	
1500 1600	Brazil, Radio Boa Vontade	6160do 9550do
	11895do	
1500 1600	Brazil, Radio Brasil 5000	4785do
1500 1600	Brazil, Radio Brasil Central	4985do 11815do
1500 1600	Brazil, Radio Cancao Nova	4825do 6105do
	9675do	
1500 1600	Brazil, Radio Capixaba	4935do
1500 1600	Brazil, Radio Clube do Para	4885do
1500 1600	Brazil, Radio Congonhas	4775do
1500 1600	Brazil, Radio Cultura do Para	5045do
1500 1600	Brazil, Radio Cultura Ondas Tropicais	4845do
1500 1600	Brazil, Radio Cultura/Sao Paulo	6170do
	9615do	
1500 1600	Brazil, Radio Daqui	4915do 11830do
1500 1600	Brazil, Radio Difusora Acerana	4885do
1500 1600	Brazil, Radio Difusora Caceres	5055do
1500 1600	Brazil, Radio Difusora de Macapa	4915do
1500 1600	Brazil, Radio Difusora do Amazonas	4805do
1500 1600	Brazil, Radio Difusora Roraima	4875do
1500 1600	Brazil, Radio Difusora/Londrina	4815do
1500 1600	Brazil, Radio Educacao Rural/Coari	5035do
1500 1600	Brazil, Radio Educadora 6 de Agosto	3355do
1500 1600	Brazil, Radio Educadora/Guajara Mirim	3375do
1500 1600	Brazil, Radio Educadora/Limeira	2380do
1500 1600	Brazil, Radio Gaucha/Porto Alegre	6020do
1500 1600	Brazil, Radio Gaucha/Rio de Janeiro	11915do
1500 1600	Brazil, Radio Gazeta	9684do 15325do
1500 1600	Brazil, Radio Gazeta Universitaria	5955do
1500 1600	Brazil, Radio Globo	11805do
1500 1600	Brazil, Radio Guaiba	6000do 11784do
1500 1600	Brazil, Radio Guarujá Paulista	5045do
1500 1600	Brazil, Radio Imaculada Conceicao	4754do
1500 1600	Brazil, Radio Inconfidencia	6010do 15190do
1500 1600	Brazil, Radio Itatiaia	5970do
1500 1600	Brazil, Radio Jornal A Critica	5055do
1500 1600	Brazil, Radio Maria	4885do
1500 1600	Brazil, Radio Marumby	11724do
1500 1600	Brazil, Radio Meteorologia Paulista	4845do
1500 1600	Brazil, Radio Missoes da Amazonia	4865do
1500 1600	Brazil, Radio Mundial	3325do
1500 1600	Brazil, Radio Nacional da Amazonia	6180do
	11780do	
1500 1600	Brazil, Radio Novas de Paz	6080do 9515do
1500 1600	Brazil, Radio Novo Tempo	4895do
1500 1600	Brazil, Radio Record	6150do 9505do
1500 1600	Brazil, Radio Rio Mar	6160do 9694do
1500 1600	Brazil, Radio Rural	4765do
1500 1600	Brazil, Radio Senado	5990do
1500 1600	Brazil, Radio Transmundial	11735do
1500 1600	Brazil, Radio Voz Misionaria/Camboriu	9665do
1500 1600	Brazil, Radio Voz Misionaria/Florianopolis	9665do
	11749do	
1500 1600	Brazil, Super Radio Deus e Amour/Curitiba	6060do 11765do
1500 1600	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do 9585do

1600 UTC - 12PM EDT / 11AM CDT / 9AM PDT

1600 1630	France, Radio France Internationale	12015sa
	17660sa	
1600 1700	Brazil, Educadora/Braganca	4825do
1600 1700	Brazil, Radio 9 de Julho	9820do
1600 1700	Brazil, Radio A Nossa Voz	4974do
1600 1700	Brazil, Radio Alvorada/Londrina	4865do
1600 1700	Brazil, Radio Aparecida	5035do 6135do
	9630do 11855do	
1600 1700	Brazil, Radio Bandeirantes	6090do 9645do
	11925do	
1600 1700	Brazil, Radio Boa Vontade	6160do 9550do
	11895do	
1600 1700	Brazil, Radio Brasil 5000	4785do

1600 1700	Brazil, Radio Brasil Central	4985do 11815do
1600 1700	Brazil, Radio Cancao Nova	4825do 6105do
	9675do	
1600 1700	Brazil, Radio Capixaba	4935do
1600 1700	Brazil, Radio Clube do Para	4885do
1600 1700	Brazil, Radio Congonhas	4775do
1600 1700	Brazil, Radio Cultura do Para	5045do
1600 1700	Brazil, Radio Cultura Ondas Tropicais	4845do
1600 1700	Brazil, Radio Cultura/Sao Paulo	6170do
	9615do	
1600 1700	Brazil, Radio Daqui	4915do 11830do
1600 1700	Brazil, Radio Difusora Acerana	4885do
1600 1700	Brazil, Radio Difusora Caceres	5055do
1600 1700	Brazil, Radio Difusora de Macapa	4915do
1600 1700	Brazil, Radio Difusora do Amazonas	4805do
1600 1700	Brazil, Radio Difusora Roraima	4875do
1600 1700	Brazil, Radio Difusora/Londrina	4815do
1600 1700	Brazil, Radio Educacao Rural/Coari	5035do
1600 1700	Brazil, Radio Educadora 6 de Agosto	3355do
1600 1700	Brazil, Radio Educadora/Limeira	2380do
1600 1700	Brazil, Radio Gaucha/Porto Alegre	6020do
1600 1700	Brazil, Radio Gaucha/Rio de Janeiro	11915do
1600 1700	Brazil, Radio Gazeta	9684do 15325do
1600 1700	Brazil, Radio Gazeta Universitaria	5955do
1600 1700	Brazil, Radio Globo	11805do
1600 1700	Brazil, Radio Guaiba	6000do 11784do
1600 1700	Brazil, Radio Guarujá Paulista	5045do
1600 1700	Brazil, Radio Imaculada Conceicao	4754do
1600 1700	Brazil, Radio Inconfidencia	6010do 15190do
1600 1700	Brazil, Radio Itatiaia	5970do
1600 1700	Brazil, Radio Jornal A Critica	5055do
1600 1700	Brazil, Radio Maria	4885do
1600 1700	Brazil, Radio Marumby	11724do
1600 1700	Brazil, Radio Meteorologia Paulista	4845do
1600 1700	Brazil, Radio Missoes da Amazonia	4865do
1600 1700	Brazil, Radio Mundial	3325do
1600 1700	Brazil, Radio Nacional da Amazonia	6180do
	11780do	
1600 1700	Brazil, Radio Novas de Paz	6080do 9515do
1600 1700	Brazil, Radio Novo Tempo	4895do
1600 1700	Brazil, Radio Record	6150do 9505do
1600 1700	Brazil, Radio Rio Mar	6160do 9694do
1600 1700	Brazil, Radio Rural	4765do
1600 1700	Brazil, Radio Senado	5990do
1600 1700	Brazil, Radio Transmundial	11735do
1600 1700	Brazil, Radio Voz Misionaria/Camboriu	9665do
1600 1700	Brazil, Radio Voz Misionaria/Florianopolis	9665do
	11749do	
1600 1700	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do 9585do
1600 1700	Portugal, RDP Internacional	11905eu
1600 1700 mtwhf	Portugal, RDP Internacional	21655va
1600 1700 Sat/Sun	Portugal, RDP Internacional	15560na
1630 1645 mh	Swaziland, TWR Africa	3200af

1700 UTC - 1PM EDT / 12PM CDT / 10AM PDT

1700 1730	France, Radio France Internationale	9870af
	17660sa	
1700 1800	Brazil, Educadora/Braganca	4825do
1700 1800	Brazil, Radio 9 de Julho	9820do
1700 1800	Brazil, Radio A Nossa Voz	4974do
1700 1800	Brazil, Radio Alvorada/Londrina	4865do
1700 1800	Brazil, Radio Aparecida	5035do 6135do
	9630do 11855do	
1700 1800	Brazil, Radio Boa Vontade	6160do 9550do
	11895do	
1700 1800	Brazil, Radio Brasil 5000	4785do
1700 1800	Brazil, Radio Brasil Central	4985do 11815do
1700 1800	Brazil, Radio Cancao Nova	4825do 6105do
	9675do	
1700 1800	Brazil, Radio Capixaba	4935do
1700 1800	Brazil, Radio Clube do Para	4885do
1700 1800	Brazil, Radio Congonhas	4775do
1700 1800	Brazil, Radio Cultura do Para	5045do
1700 1800	Brazil, Radio Cultura Ondas Tropicais	4845do
1700 1800	Brazil, Radio Cultura/Sao Paulo	6170do
	9615do	
1700 1800	Brazil, Radio Daqui	4915do 11830do
1700 1800	Brazil, Radio Difusora Acerana	4885do
1700 1800	Brazil, Radio Difusora Caceres	5055do
1700 1800	Brazil, Radio Difusora de Macapa	4915do
1700 1800	Brazil, Radio Difusora do Amazonas	4805do
1700 1800	Brazil, Radio Difusora Roraima	4875do
1700 1800	Brazil, Radio Difusora/Londrina	4815do
1700 1800	Brazil, Radio Educacao Rural/Coari	5035do

1700	1800	Brazil, Radio Educadora 6 de Agosto	3355do	
1700	1800	Brazil, Radio Educadora/Limeira	2380do	
1700	1800	Brazil, Radio Gaucha/Porto Alegre	6020do	
1700	1800	Brazil, Radio Gaucha/Rio de Janeiro	11915do	
1700	1800	Brazil, Radio Gazeta	9684do	15325do
1700	1800	Brazil, Radio Gazeta Universitaria	5955do	
1700	1800	Brazil, Radio Globo	11805do	
1700	1800	Brazil, Radio Guaiba	6000do	11784do
1700	1800	Brazil, Radio Guarujá Paulista	5045do	
1700	1800	Brazil, Radio Imaculada Conceicao	4754do	
1700	1800	Brazil, Radio Inconfidencia	6010do	15190do
1700	1800	Brazil, Radio Itatiaia	5970do	
1700	1800	Brazil, Radio Jornal A Critica	5055do	
1700	1800	Brazil, Radio Maria	4885do	
1700	1800	Brazil, Radio Marumby	11724do	
1700	1800	Brazil, Radio Meteorologia Paulista	4845do	
1700	1800	Brazil, Radio Missoes da Amazonia	4865do	
1700	1800	Brazil, Radio Mundial	3325do	
1700	1800	Brazil, Radio Nacional da Amazonia	6180do	11780do
1700	1800	Brazil, Radio Novas de Paz	6080do	9515do
1700	1800	Brazil, Radio Novo Tempo	4895do	
1700	1800	Brazil, Radio Record	6150do	9505do
1700	1800	Brazil, Radio Rio Mar	6160do	9694do
1700	1800	Brazil, Radio Rural	4765do	
1700	1800	Brazil, Radio Senado	5990do	
1700	1800	Brazil, Radio Transmundial	11735do	
1700	1800	Brazil, Radio Voz Misionaria/Camboriu	9665do	
1700	1800	Brazil, Radio Voz Misionaria/Florianopolis	11749do	
1700	1800	Brazil, Super Radio Deus e Amour/Curitiba	6060do	11765do
1700	1800	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do	9585do
1700	1800	France, Radio France Internationale	15530af	17600af
1700	1800	Portugal, RDP Internacional	11905eu	
1700	1800	Portugal, RDP Internacional	21655va	
1700	1800	Portugal, RDP Internacional	15560na	
1700	1800	USA, BBG/Voice of America	9800sa	13630sa
1700	1800	USA, BBG/Voice of America	17820sa	
1700	1800	USA, WYFR/Family Radio Worldwide	17725sa	21525saf
1730	1800	Spain, Radio Exterior de Espana	7275eu	17715af

1800 UTC - 2PM EDT / 1PM CDT / 11AM PDT

1800	1830	France, Radio France Internationale	9905af	
1800	1830	USA, BBG/Voice of America	9800sa	13630sa
1800	1830	Vatican City State, Vatican Radio	11625af	13765af
1800	1855	Portugal, RDP Internacional	11905eu	21655va
1800	1900	Brazil, Educadora/Braganca	4825do	
1800	1900	Brazil, Radio 9 de Julho	9820do	
1800	1900	Brazil, Radio A Nossa Voz	4974do	
1800	1900	Brazil, Radio Alvorada/Londrina	4865do	
1800	1900	Brazil, Radio Aparecida	5035do	6135do
1800	1900	Brazil, Radio Bandeirantes	6090do	9645do
1800	1900	Brazil, Radio Boa Vontade	6160do	9550do
1800	1900	Brazil, Radio Brasil 5000	4785do	
1800	1900	Brazil, Radio Brasil Central	4985do	11815do
1800	1900	Brazil, Radio Cancao Nova	4825do	6105do
1800	1900	Brazil, Radio Capixaba	4935do	
1800	1900	Brazil, Radio Clube do Para	4885do	
1800	1900	Brazil, Radio Congonhas	4775do	
1800	1900	Brazil, Radio Cultura do Para	5045do	
1800	1900	Brazil, Radio Cultura Ondas Tropicais	4845do	
1800	1900	Brazil, Radio Cultura/Sao Paulo	6170do	9615do
1800	1900	Brazil, Radio Daqui	4915do	11830do
1800	1900	Brazil, Radio Difusora Acerana	4885do	
1800	1900	Brazil, Radio Difusora Caceres	5055do	
1800	1900	Brazil, Radio Difusora de Macapa	4915do	
1800	1900	Brazil, Radio Difusora Roraima	4875do	
1800	1900	Brazil, Radio Difusora/Londrina	4815do	
1800	1900	Brazil, Radio Educacao Rural/Coari	5035do	
1800	1900	Brazil, Radio Educadora 6 de Agosto	3355do	
1800	1900	Brazil, Radio Educadora/Limeira	2380do	
1800	1900	Brazil, Radio Gaucha/Porto Alegre	6020do	

1800	1900	Brazil, Radio Gaucha/Rio de Janeiro	11915do	
1800	1900	Brazil, Radio Gazeta	9684do	15325do
1800	1900	Brazil, Radio Gazeta Universitaria	5955do	
1800	1900	Brazil, Radio Gazeta Universitaria	5955do	
1800	1900	Brazil, Radio Globo	11805do	
1800	1900	Brazil, Radio Guaiba	6000do	11784do
1800	1900	Brazil, Radio Guarujá Paulista	5045do	
1800	1900	Brazil, Radio Imaculada Conceicao	4754do	
1800	1900	Brazil, Radio Inconfidencia	6010do	15190do
1800	1900	Brazil, Radio Itatiaia	5970do	
1800	1900	Brazil, Radio Jornal A Critica	5055do	
1800	1900	Brazil, Radio Maria	4885do	
1800	1900	Brazil, Radio Marumby	11724do	
1800	1900	Brazil, Radio Meteorologia Paulista	4845do	
1800	1900	Brazil, Radio Missoes da Amazonia	4865do	
1800	1900	Brazil, Radio Mundial	3325do	
1800	1900	Brazil, Radio Nacional da Amazonia	6180do	11780do
1800	1900	Brazil, Radio Novas de Paz	6080do	9515do
1800	1900	Brazil, Radio Novo Tempo	4895do	
1800	1900	Brazil, Radio Record	6150do	9505do
1800	1900	Brazil, Radio Rio Mar	6160do	9694do
1800	1900	Brazil, Radio Rural	4765do	
1800	1900	Brazil, Radio Senado	5990do	
1800	1900	Brazil, Radio Voz Misionaria/Camboriu	9665do	
1800	1900	Brazil, Radio Voz Misionaria/Florianopolis	11749do	
1800	1900	Brazil, Super Radio Deus e Amour/Curitiba	6060do	11765do
1800	1900	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do	9585do
1800	1900	Portugal, RDP Internacional	11905eu	15560na
1800	1900	USA, WYFR/Family Radio Worldwide	17725sa	
1850	1900	Sat Swaziland, TWR Africa	6130af	

1900 UTC - 3PM EDT / 2PM CDT / 12PM PDT

1900	1905	Sat Swaziland, TWR Africa	6130af	
1900	1930	France, Radio France Internationale	5950af	13675af
1900	2000	Brazil, Educadora/Braganca	4825do	
1900	2000	Brazil, Radio 9 de Julho	9820do	
1900	2000	Brazil, Radio A Nossa Voz	4974do	
1900	2000	Brazil, Radio Alvorada/Londrina	4865do	
1900	2000	Brazil, Radio Aparecida	5035do	6135do
1900	2000	Brazil, Radio Bandeirantes	6090do	9645do
1900	2000	Brazil, Radio Boa Vontade	6160do	9550do
1900	2000	Brazil, Radio Brasil 5000	4785do	
1900	2000	Brazil, Radio Brasil Central	4985do	11815do
1900	2000	Brazil, Radio Cancao Nova	4825do	6105do
1900	2000	Brazil, Radio Capixaba	4935do	
1900	2000	Brazil, Radio Clube do Para	4885do	
1900	2000	Brazil, Radio Congonhas	4775do	
1900	2000	Brazil, Radio Cultura do Para	5045do	
1900	2000	Brazil, Radio Cultura Ondas Tropicais	4845do	
1900	2000	Brazil, Radio Cultura/Sao Paulo	6170do	9615do
1900	2000	Brazil, Radio Daqui	4915do	11830do
1900	2000	Brazil, Radio Difusora Acerana	4885do	
1900	2000	Brazil, Radio Difusora Caceres	5055do	
1900	2000	Brazil, Radio Difusora de Macapa	4915do	
1900	2000	Brazil, Radio Difusora Roraima	4875do	
1900	2000	Brazil, Radio Difusora/Londrina	4815do	
1900	2000	Brazil, Radio Educacao Rural/Coari	5035do	
1900	2000	Brazil, Radio Educadora 6 de Agosto	3355do	
1900	2000	Brazil, Radio Educadora/Limeira	2380do	
1900	2000	Brazil, Radio Gaucha/Porto Alegre	6020do	
1900	2000	Brazil, Radio Gaucha/Rio de Janeiro	11915do	
1900	2000	Brazil, Radio Gazeta	9684do	15325do
1900	2000	Brazil, Radio Gazeta Universitaria	5955do	
1900	2000	Brazil, Radio Globo	11805do	
1900	2000	Brazil, Radio Guaiba	6000do	11784do
1900	2000	Brazil, Radio Guarujá Paulista	5045do	
1900	2000	Brazil, Radio Imaculada Conceicao	4754do	
1900	2000	Brazil, Radio Inconfidencia	6010do	15190do
1900	2000	Brazil, Radio Itatiaia	5970do	
1900	2000	Brazil, Radio Jornal A Critica	5055do	
1900	2000	Brazil, Radio Maria	4885do	
1900	2000	Brazil, Radio Marumby	11724do	
1900	2000	Brazil, Radio Meteorologia Paulista	4845do	
1900	2000	Brazil, Radio Missoes da Amazonia	4865do	
1900	2000	Brazil, Radio Mundial	3325do	

1900 2000	Brazil, Radio Nacional da Amazonia	6180do	
	11780do		
1900 2000	Brazil, Radio Novas de Paz	6080do	9515do
1900 2000	Brazil, Radio Novo Tempo	4895do	
1900 2000	Brazil, Radio Record	6150do	9505do
1900 2000	Brazil, Radio Rio Mar	6160do	9694do
1900 2000	Brazil, Radio Rural	4765do	
1900 2000	Brazil, Radio Senado	5990do	
1900 2000	Brazil, Radio Transmundial	9530do	
1900 2000	Brazil, Radio Voz Misionaria/Camboriu	9665do	
1900 2000	Brazil, Radio Voz Misionaria/Florianopolis	11749do	
1900 2000	Brazil, Super Radio Deus e Amour/Curitiba	6060do	11765do
1900 2000	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do	9585do
1900 2000	China, China Radio International	5985af	
	7335eu	7405af	9535af
1900 2000 mtwhf	Portugal, RDP Internacional	21655va	
1900 2000	Portugal, RDP Internacional	9820eu	11945af
	15560na		
1900 2000	USA, WYFR/Family Radio Worldwide	3955af	
	6100af	17725sa	
1905 1920 mt	Swaziland, TWR Africa	6130af	
1920 1950	Swaziland, TWR Africa	6130af	
1930 1957	Germany, Deutsche Welle	17610af	
1930 2000	Germany, Deutsche Welle	6150af	15640af

2000 UTC - 4PM EDT / 3PM CDT / 1PM PDT

2000 2030	Cuba, Radio Havana Cuba	11770eu	
2000 2030	France, Radio France Internationale	15530sa	
2000 2100	Brazil, Educadora/Braganca	4825do	
2000 2100	Brazil, Radio 9 de Julho	9820do	
2000 2100	Brazil, Radio A Nossa Voz	4974do	
2000 2100	Brazil, Radio Alvorada/Londrina	4865do	
2000 2100	Brazil, Radio Aparecida	5035do	6135do
	9630do	11855do	
2000 2100	Brazil, Radio Bandeirantes	6090do	9645do
	11925do		
2000 2100	Brazil, Radio Boa Vontade	6160do	9550do
	11895do		
2000 2100	Brazil, Radio Brasil 5000	4785do	
2000 2100	Brazil, Radio Brasil Central	4985do	11815do
2000 2100	Brazil, Radio Cancao Nova	4825do	6105do
	9675do		
2000 2100	Brazil, Radio Capixaba	4935do	
2000 2100	Brazil, Radio Clube do Para	4885do	
2000 2100	Brazil, Radio Congonhas	4775do	
2000 2100	Brazil, Radio Cultura do Para	5045do	
2000 2100	Brazil, Radio Cultura Ondas Tropicais	4845do	
2000 2100	Brazil, Radio Cultura/Sao Paulo	6170do	
	9615do		
2000 2100	Brazil, Radio Daqui	4915do	
2000 2100	Brazil, Radio Difusora Acerana	4885do	
2000 2100	Brazil, Radio Difusora Caceres	5055do	
2000 2100	Brazil, Radio Difusora de Macapa	4915do	
2000 2100	Brazil, Radio Difusora do Amazonas	4805do	
2000 2100	Brazil, Radio Difusora Roraima	4875do	
2000 2100	Brazil, Radio Difusora/Londrina	4815do	
2000 2100	Brazil, Radio Educacao Rural/Coari	5035do	
2000 2100	Brazil, Radio Educadora 6 de Agosto	3355do	
2000 2100	Brazil, Radio Educadora/Guajara Mirim	3375do	
2000 2100	Brazil, Radio Educadora/Limeira	2380do	
2000 2100	Brazil, Radio Gaucha/Porto Alegre	6020do	
2000 2100	Brazil, Radio Gaucha/Rio de Janeiro	11915do	
2000 2100	Brazil, Radio Gazeta	9684do	15325do
2000 2100	Brazil, Radio Gazeta Universitaria	5955do	
2000 2100	Brazil, Radio Globo	11805do	
2000 2100	Brazil, Radio Guaiba	6000do	11784do
2000 2100	Brazil, Radio Guarujá Paulista	5045do	
2000 2100	Brazil, Radio Imaculada Conceicao	4754do	
2000 2100	Brazil, Radio Inconfidencia	6010do	15190do
2000 2100	Brazil, Radio Itatiaia	5970do	
2000 2100	Brazil, Radio Jornal A Critica	5055do	
2000 2100	Brazil, Radio Maria	4885do	
2000 2100	Brazil, Radio Meteorologia Paulista	4845do	
2000 2100	Brazil, Radio Missoes da Amazonia	4865do	
2000 2100	Brazil, Radio Mundial	3325do	
2000 2100	Brazil, Radio Nacional da Amazonia	6180do	
	11780do		
2000 2100	Brazil, Radio Novas de Paz	6080do	9515do
2000 2100	Brazil, Radio Novo Tempo	4895do	
2000 2100	Brazil, Radio Record	6150do	9505do
2000 2100	Brazil, Radio Rio Mar	6160do	9694do
2000 2100	Brazil, Radio Rural	4765do	

2000 2100	Brazil, Radio Senado	5990do	
2000 2100	Brazil, Radio Transmundial	9530do	
2000 2100	Brazil, Radio Voz Misionaria/Camboriu	9665do	
2000 2100	Brazil, Radio Voz Misionaria/Florianopolis	11749do	
2000 2100	Brazil, Super Radio Deus e Amour/Curitiba	6060do	11765do
2000 2100	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do	9585do
2000 2100 mtwhf	Portugal, RDP Internacional	15295va	
2000 2100	Portugal, RDP Internacional	9820eu	11945af
	13755na		
2005 2020 Sun	Swaziland, TWR Africa	6130af	

2100 UTC - 5PM EDT / 4PM CDT / 2PM PDT

2100 2145	USA, WYFR/Family Radio Worldwide	15695eu	
2100 2200	Brazil, Educadora/Braganca	4825do	
2100 2200	Brazil, Radio 9 de Julho	9820do	
2100 2200	Brazil, Radio A Nossa Voz	4974do	
2100 2200	Brazil, Radio Alvorada/Londrina	4865do	
2100 2200	Brazil, Radio Aparecida	5035do	6135do
	9630do	11855do	
2100 2200	Brazil, Radio Bandeirantes	6090do	9645do
	11925do		
2100 2200	Brazil, Radio Boa Vontade	6160do	9550do
	11895do		
2100 2200	Brazil, Radio Brasil 5000	4785do	
2100 2200	Brazil, Radio Brasil Central	4985do	11815do
2100 2200	Brazil, Radio Capixaba	4935do	
2100 2200	Brazil, Radio Clube do Para	4885do	
2100 2200	Brazil, Radio Congonhas	4775do	
2100 2200	Brazil, Radio Cultura do Para	5045do	
2100 2200	Brazil, Radio Cultura Ondas Tropicais	4845do	
2100 2200	Brazil, Radio Cultura/Sao Paulo	6170do	
	9615do		
2100 2200	Brazil, Radio Daqui	4915do	
2100 2200	Brazil, Radio Difusora Acerana	4885do	
2100 2200	Brazil, Radio Difusora Caceres	5055do	
2100 2200	Brazil, Radio Difusora de Macapa	4915do	
2100 2200	Brazil, Radio Difusora do Amazonas	4805do	
2100 2200	Brazil, Radio Difusora Roraima	4875do	
2100 2200	Brazil, Radio Difusora/Londrina	4815do	
2100 2200	Brazil, Radio Educacao Rural/Coari	5035do	
2100 2200	Brazil, Radio Educadora/Guajara Mirim	3375do	
2100 2200	Brazil, Radio Educadora/Limeira	2380do	
2100 2200	Brazil, Radio Gaucha/Porto Alegre	6020do	
2100 2200	Brazil, Radio Gaucha/Rio de Janeiro	11915do	
2100 2200	Brazil, Radio Gazeta	9684do	15325do
2100 2200	Brazil, Radio Gazeta Universitaria	5955do	
2100 2200	Brazil, Radio Globo	11805do	
2100 2200	Brazil, Radio Guaiba	6000do	11784do
2100 2200	Brazil, Radio Guarujá Paulista	5045do	
2100 2200	Brazil, Radio Imaculada Conceicao	4754do	
2100 2200	Brazil, Radio Inconfidencia	6010do	15190do
2100 2200	Brazil, Radio Itatiaia	5970do	
2100 2200	Brazil, Radio Jornal A Critica	5055do	
2100 2200	Brazil, Radio Maria	4885do	
2100 2200	Brazil, Radio Meteorologia Paulista	4845do	
2100 2200	Brazil, Radio Missoes da Amazonia	4865do	
2100 2200	Brazil, Radio Mundial	3325do	
2100 2200	Brazil, Radio Municipal	3375do	
2100 2200	Brazil, Radio Nacional da Amazonia	6180do	
	11780do		
2100 2200	Brazil, Radio Novas de Paz	6080do	9515do
2100 2200	Brazil, Radio Novo Tempo	4895do	
2100 2200	Brazil, Radio Record	6150do	9505do
2100 2200	Brazil, Radio Rio Mar	6160do	9694do
2100 2200	Brazil, Radio Rural	4765do	
2100 2200	Brazil, Radio Senado	5990do	
2100 2200	Brazil, Radio Transmundial	9530do	
2100 2200	Brazil, Radio Verdes Florestas	4865do	
2100 2200	Brazil, Radio Voz Misionaria/Camboriu	9665do	
2100 2200	Brazil, Radio Voz Misionaria/Florianopolis	11749do	
2100 2200	Brazil, Super Radio Deus e Amour/Curitiba	6060do	11765do
2100 2200	Brazil, Super Radio Deus e Amour/Sao Paulo	6120do	9585do
2100 2200 fas	Canada, Radio Canada International	15455sa	
	17860sa		
2100 2200 mtwhf	Portugal, RDP Internacional	15295va	
2100 2200	Portugal, RDP Internacional	9820eu	11945af
	13755na		
2100 2200	Russia, Voice of Russia	5920eu	
2100 2200 mtwhf	Spain, Radio Exterior de Espana	17595sa	

2100 2200 USA, WYFR/Family Radio Worldwide 15770af
 2130 2200 Japan, Radio Japan NHK World 11880sa

2200 2300 Brazil, Radio Boa Vontade 6160do 9550do
 11895do
 2200 2300 Brazil, Radio Brasil 5000 4785do
 2200 2300 Brazil, Radio Brasil Central 4985do 11815do
 2200 2300 Brazil, Radio Cancao Nova 4825do 6105do
 9675do
 2200 2300 Brazil, Radio Capixaba 4935do
 2200 2300 Brazil, Radio Clube do Para 4885do
 2200 2300 Brazil, Radio Congonhas 4775do
 2200 2300 Brazil, Radio Cultura do Para 5045do
 2200 2300 Brazil, Radio Cultura Ondas Tropicais 4845do
 2200 2300 Brazil, Radio Cultura/Araquara 3365do
 2200 2300 Brazil, Radio Cultura/Sao Paulo 6170do
 9615do
 2200 2300 Brazil, Radio Daqui 4915do

2200 UTC - 6PM EDT / 5PM CDT / 3PM PDT

2200 2300 Brazil, Educadora/Braganca 4825do
 2200 2300 Brazil, Radio 9 de Julho 9820do
 2200 2300 Brazil, Radio A Nossa Voz 4974do
 2200 2300 Brazil, Radio Alvorada/Londrina 4865do
 2200 2300 Brazil, Radio Alvorada/Parintins 4965do
 2200 2300 Brazil, Radio Aparecida 5035do 6135do
 9630do 11855do
 2200 2300 Brazil, Radio Bandeirantes 6090do 9645do
 11925do

MT SHORTWAVE STATION RESOURCE GUIDE

Albania, Radio Tirana <http://rtsh.sil.at/>
 Angola, Angolan National Radio www.rna.ao/
 Anguilla, University Network www.worldwideuniversitynet-work.com/
 Argentina, RAE www.radionacional.gov.ar
 Australia, ABC NT Alice Springs www.abc.net.au/radio/
 Australia, ABC NT Katherine www.abc.net.au/radio/
 Australia, ABC NT Tennant Creek www.abc.net.au/radio/
 Australia, HCJB Global Australia www.hcjb.org/
 Australia, Radio Australia www.abc.net.au/ra/
 Austria, AWR Europe www.awr2.org/
 Bahrain, Radio Bahrain www.radiobahrain.fm/
 Belarus, Radio Station Belarus www.radiobelarus.tvr.by/eng/
 Belgium, TDP Radio www.airtime.be/schedule.html
 Belgium, TDP Radio/Disco Palace www.airtime.be/schedule.html
 Bhutan, Bhutan Broadcasting Svc www.bbs.com.bt
 Bulgaria, Radio Bulgaria www.bnr.bg/
 Canada, Bible Voice Broadcasting www.biblevoice.org/
 Canada, CBC Northern Quebec Svc www.cbc.ca/north/
 Canada, CFRX Toronto ON www.cfrb.com
 Canada, CFVP Calgary AB www.classiccountriam1060.com
 Canada, CKZN St Johns NF www.cbc.ca/listen/index.html
 Canada, CKZU Vancouver BC www.cbc.ca/bc
 Canada, Radio Canada International www.rcinet.ca/
 China, China Radio International www.cri.cn/
 Clandestine, Sudan Radio Service/SRS www.sudanradio.org
 Cuba, Radio Havana Cuba www.radiohc.cu/
 Egypt, Radio Cairo www.ertu.org
 Equatorial Guinea, Radio Africa www.radiopanam.com/
 Equatorial Guinea, Radio Africa 2 www.radiopanam.com/
 Equatorial Guinea, Radio East Africa www.radiopanam.com/
 Equatorial Guinea, Radio East Africa/Malabo www.radiopanam.com/
 Ethiopia, Radio Ethiopia www.ertagov.com
 Ethiopia, Radio Ethiopia/National Program www.ertagov.com
 France, Radio France Internationale <http://rfi.english.com>
 Germany, AWR Europe www.awr2.org/
 Germany, Deutsche Welle www.dw-world.de/
 Germany, Pan American Broadcasting www.radiopanam.com/
 Germany, TWR Europe www.twr.org
 Greece, Voice of Greece www.voiceofgreece.gr/
 Guam, AWR/KSDA www.awr2.org/
 Guam, TWR Asia/KTWR <http://ne.aktwr.net/>
 India, All India Radio/Aizawl www.allindiaradio.org/
 India, All India Radio/Aligarh www.allindiaradio.org/
 India, All India Radio/Bengaluru www.allindiaradio.org/
 India, All India Radio/Bhopal www.allindiaradio.org/
 India, All India Radio/Chennai www.allindiaradio.org/
 India, All India Radio/Delhi www.allindiaradio.org/
 India, All India Radio/External Svc www.allindiaradio.org/
 India, All India Radio/Gangtok www.allindiaradio.org/
 India, All India Radio/Gorakhpur www.allindiaradio.org/
 India, All India Radio/Guwahati www.allindiaradio.org/
 India, All India Radio/Hyderabad www.allindiaradio.org/
 India, All India Radio/Imphal www.allindiaradio.org/
 India, All India Radio/Itanagar www.allindiaradio.org/
 India, All India Radio/Jaipur www.allindiaradio.org/
 India, All India Radio/Jeyapore www.allindiaradio.org/
 India, All India Radio/Kolkata www.allindiaradio.org/
 India, All India Radio/Kurseong www.allindiaradio.org/
 India, All India Radio/Lucknow www.allindiaradio.org/
 India, All India Radio/Mumbai www.allindiaradio.org/
 India, All India Radio/Panaji, Goa www.allindiaradio.org/
 India, All India Radio/Port Blair www.allindiaradio.org/
 India, All India Radio/Radio Kashmir www.allindiaradio.org/
 India, All India Radio/Shillong www.allindiaradio.org/

India, All India Radio/Shimla www.allindiaradio.org/
 India, All India Radio/Thiruvananthapuram www.allindiaradio.org/
 Indonesia, Voice of Indonesia www.voi.co.id
 Iran, IRIB/ VOIRI www.irib.ir/English/
 Italy, IRRS-Shortwave www.nexus.org
 Italy, IRRS-Shortwave/Euro Gospel Radio www.egradio.org/
 Japan, Radio Japan NHK World www.nhk.or.jp/english/
 Kuwait, Radio Kuwait www.media.gov.kw/
 Malaysia, RTM Kajang/Traxx FM www.traxxfm.net/index.php
 Malaysia, RTM/Voice of Malaysia www.rtm.gov.my
 Mali, ORTM/Radio Mali www.ortm.ml
 Micronesia, The Cross Radio/Pohnpei www.pmapacific.org/
 Monaco, TWR Europe www.twr.org/
 Nepal, Radio Nepal www.radionepal.org/
 Netherlands, R Netherlands Worldwide www.radioneetherlands.nl/
 New Zealand, Radio NZ International www.rnzi.com
 Nigeria, Voice of Nigeria www.voiceofnigeria.org
 Oman, Radio Sultanate of Oman www.oman-tv.gov.om
 Pakistan, PBC/Radio Pakistan www.radio.gov.pk
 Palau, T8WH/ WHRI www.whr.org/
 Philippines, PBS/ Radyo Pilipinas www.pbs.gov.ph/
 Poland, Polskie Radio Warsaw www.polskieradio.pl
 Romania, Radio Romania International www.rri.ro/
 Russia, Voice of Russia <http://english.ruvr.ru/>
 Saudi Arabia, BSKSA/External Svc www.saudiradio.net/
 Serbia, International Radio Serbia www.glassrbije.org
 South Africa, AWR Africa www.awr2.org/
 South Africa, Channel Africa www.channelafrica.org
 South Africa, CVC 1 Africa Radio www.1africa.tv
 South Africa, RTE Radio Worldwide www.rte.ie/radio1/
 South Africa, SA Radio League www.sarl.org.za
 South Africa, TWR Africa www.twr.org/
 South Korea, KBS World Radio www.worldkbs.co.kr
 Spain, Radio Exterior de Espana www.ree.rne.es/
 Sri Lanka, SLBC www.slbc.lk
 Swaziland, TWR Africa www.twrafrica.org
 Syria, Radio Damascus www.rtv.gov.sy/
 Taiwan, Radio Taiwan International <http://english.rti.org.tw/>
 Thailand, Radio Thailand World Svc www.hsk9.org/
 Turkey, Voice of Turkey www.trt-world.com
 Uganda, Dunamis Shortwave www.biblevoice.org/stations/east-africa
 UK, BBC World Service www.bbc.co.uk/worldservice/
 UK, FEBA Radio www.febaradio.net
 USA, American Forces Network/AFRTS <http://myafn.dodmedia.osd.mil/>
 USA, BBG Voice of America www.voanews.com/
 USA, BBG/Voice of America/African Svc www.voanews.com/
 USA, BBG/Voice of America/Special English www.voanews.com/
 USA, BBG/Voice of America/Studio 7 www.voanews.com/
 USA, BBG/Voice of America/Sudan in Focus www.voanews.com/
 USA, EWTN/WEWN Irondale, AL www.ewtn.com/
 USA, FBN/WTJC Newport NC www.fbnradio.com/
 USA, KNLS Anchor Point AK www.knls.org/
 USA, Overcomer Ministries www.overcomerministry.org/
 USA, WBCQ Monticello ME www.wbcq.com/
 USA, WHRI Cypress Creek SC www.whr.org/
 USA, WRMI Miami FL www.wrmi.net/
 USA, WRMI/Radio Slovakia Intl www.wrmi.net/
 USA, WRNO New Orleans LA www.wrnradio.com
 USA, WTWW Lebanon TN www.wtww.us/
 USA, WWCN Nashville TN www.wwcn.com
 USA, WWRB Manchester TN www.wwrb.org/
 USA, WYFR/Family Radio Worldwide www.familyradio.com/
 Vatican City State, Vatican Radio www.vaticanradio.org/
 Vietnam, Voice of Vietnam/Overseas Svc www.vov.org.vn
 Zambia, CVC Radio Christian Voice www.voiceafrica.net
 Zambia, ZNBC/Radio Two www.znbc.co.zm



Base Profile: Columbus AFB, Mississippi

Many countries in the New World and elsewhere celebrate the anniversary of Christopher Columbus's arrival in the Americas, which occurred on October 12, 1492, as an official holiday. So, to honor old Columbus and his accomplishments in this month's *Milcom*, we will feature one of the major U.S. Air Force training bases here in the southeast U.S. that carries his namesake – Columbus AFB, Mississippi.

Columbus Air Force Base is home of the 14th Flying Training Wing of Air Education and Training Command's 19th Air Force. The 14th FTW mission statement is simple: "Produce Pilots, Advance Airmen, Feed the Fight."

The wing's mission is specialized undergraduate pilot training in the T-6 Texan II, T-38C Talon and T-1A Jayhawk aircraft. Each day the wing flies an average of 350 sorties on its three parallel runways. In addition to the flying training mission, Columbus AFB maintains more than 300 highly trained individuals capable of deploying at a moment's notice to support worldwide taskings and contingencies.

❖ Specialized Undergraduate Pilot Training

In the primary phase of training, students fly the T-6. The emphasis throughout this phase is on basic aircraft control, including takeoff and landing techniques and aerobatics. Students also learn to use aircraft instruments to fly and to navigate in all types of weather to several different locations.

Following the T-6 phase of training, student pilots enter specialized, track specific training – depending on the type aircraft they've been selected to fly – T-38 for those bound for fighter and bomber aircraft or the T-1A for tanker and airlift pilots. Student pilots selected to fly helicopters conduct training at Fort Rucker, Alabama, while the U.S. Army and C-130 bound students conduct training at NAS Corpus Christi, Texas, with the Navy.

To earn their Air Force wings, each student flies nearly 200 hours during a 52-week period. Paralleling flying training, students complete 300 hours of flight-related classroom instruction. Columbus averages 475 officers a year entering pilot training.

Columbus AFB is located five miles north of the city of Columbus in Lowndes County, Northeast Mississippi, ten miles west of the Alabama state border. Thanks to this central

southern location, 14th FTW aircraft fly all over the southeast U.S. in various military operating areas (MOAs) and on various military training routes.

❖ Flying Squadrons at Columbus

Ask any active monitor in the southeast United States who they hear quite frequently during monitoring sessions, and aircraft from the 14th Fighter Training Wing (14th FTW) will probably be near the top of their list.

Under the 14FTW command umbrella, there are six flying units at Columbus:

37th Flying Training Squadron: The 37th FTS conducts primary flight training in the T-6 Texan II. Seated with an instructor, each student receives about 81 hours of training in this aircraft. Students learn basic aircraft characteristics and control, takeoff and landing techniques, aerobatics, and night, instrument and formation flying.

41st Flying Training Squadron: The 41st FTS mission is to train future Air Force military aviators in specialized undergraduate pilot training phase 2 in the T-6. Additionally, the 41st FTS trains several foreign military pilots each year in the T-6, through both the foreign military sales program and the international aviation leadership program. To accomplish its mission, the 41st FTS annually flies over 17,200 sorties and 22,000 flight hours. The squadron also qualifies and sustains 84 mission-ready T-6 instructor pilots.

43rd Flying Training Squadron: The 43rd FTS administers and executes the AETC/AFRC associate instructor pilot (IP) program and provides active guard reserve (AGR) and traditional reserve (TR) IPs to augment the cadre of active duty pilots conducting pilot training. During wartime, or in the event of hostilities, the unit is mobilized to offset anticipated losses of experienced instructor pilots returning to active duty.

48th Flying Training Squadron: The tanker and airlift track of specialized undergraduate pilot training is conducted by the 48th FTS. Students receive a minimum of 159 hours of flight instruction in the Beech T-1A Jayhawk. They also learn air refueling procedures, tactical navigation, airdrop and advanced navigation, with an emphasis on crew resource management. Upon completion of this phase of training, these students earn the aeronautical rating of pilot and receive their Air Force wings.

49th Fighter Training Squadron: The 49th FTS conducts introduction to fighter fundamentals flying training for over 75 U.S. Air Force and international pilots and weapon system officers

annually. The unit executes an annual flying hour program of 2,430 sorties and 2,250 hours valued at more than \$4.9 million. It develops the ability, proficiency, confidence, discipline, judgment, situational awareness and airmanship of future fighter wingmen. In addition, unit members deploy to support training students in close air support and air combat against dissimilar types of aircraft. Currently, the 49th FTS has 29 officer and enlisted members.

50th Flying Training Squadron: The advanced phase of undergraduate pilot training is conducted by the 50th FTS. This phase consists of 110 hours of flight instruction in the Northrop T-38C. Training includes advanced aircraft handling, tactical navigation, fluid maneuvering and an increased emphasis in two- and four-ship formation. At the completion of this training, the graduate is awarded the aeronautical rating of pilot and receives their Air Force wings.

❖ Monitoring the 14th FTW

There are quite a few frequencies that you can program in your scanner to monitor the flying units of the 14th FTW. If you are in the local flying area, we have listed base land mobile radio and local ATC frequencies. If you are outside the local listening area, we have included all the known air-to-air and MOA frequencies used by the wing. In the tables that follow we present our exclusive list of these frequencies and callsigns that have been monitored.

COLUMBUS FACILITY FREQUENCIES ICAO ID – KCBM

LAND MOBILE FREQUENCIES

The main land mobile radio (LMR) system at Columbus AFB is a P16 (Analogy/APCO-25 Common Air Interface) Motorola trunk radio system.

System ID: a90d

Base Frequency: 406.000 MHz, Spacing: 12.5 kHz, Offset: 380

Frequencies: 406.3625/415.3625 406.5625/415.5625
406.7625/415.7625 406.9625/415.9625
407.9625/416.9625 408.7625/417.7625
410.3625/419.3625

Other LMR Conventional frequencies

Repeaters 407.1625 409.9625
Paging 413.2750

Ground Call Signs

Sunfish Rwy 13R/31L RSU
Gunshy Rwy 13/31 RSU (Aux Field)
Gin Fizz Rwy 13C/31C RSU
Live Oak Rwy 13L/31R RSU

Texan Ops	T-6 Sup
Snake Ops	T-38C Sup
Knight Ops	T-38C (IFF) Top 3
Searay	R-4404 (IFF)
Jayhawk Ops	T-1 Sup
Columbus SOF	SOF

Columbus Air Force Base provides both RAPCON (Radar Approach Control) and ATC (Air Traffic Control) tower services to aircraft. During normal T-37/T-6 student training the inside runway is controlled by a Runway Supervisory Unit (RSU), call sign "Sunfish." During normal T-38C student training, the outside runway is controlled by an RSU, call sign "Live Oak." RSU operation is not required for 49th FTS student training.

AERONAUTICAL FREQUENCIES

ATC Tower Frequencies/Channels:

Operating Position	UHF Freq	VHF Freq	T-6 Ch	T-38/T-1 Ch
ATIS 273.500	115.200	N/A	18	
Clearance Delivery (CD)	269.550	126.250/119.750	N/A	19
Ground Control (GC)	275.800	121.900	1	1
Tower/Local Control (LC)	379.925	128.650	3	3

RAPCON Frequencies/Channels:

Operating Position	UHF Freq	VHF Freq	T-6 Ch	T-38/T-1 Ch
Airway Control (AWY)	291.650	132.025	7	4
Arrival (AR)	307.800	133.250	16	16
North App Control (NAC)	239.250/282.200	126.075	N/A	7/8
South App Control (SAC)	263.150/351.950	134.550	18/19	N/A
West Approach (WAC)	317.500/349.000	121.075	8/9	N/A
West Arrival (WAAR)	323.275/350.300	135.600	14	14
Other Approach Control Freqs	285.425 290.200 363.150 (ex-387.000)		307.175	

Miscellaneous Frequencies/Channels:

Operating Position	UHF Freq	VHF Freq	T-6 Ch	T-38/T-1 Ch
Sunfish (T-6) RSU	374.100	N/A	2	2
Live Oak (T-38C) RSU	317.900	N/A	N/A	13
PMSV (Metro)	354.600	N/A	N/A	N/A
Pilot to Dispatcher (PTD)	376.000	142.300	N/A	N/A
Supervisor of Flying (SOF)	252.100	140.975	12	12
Emergency	307.175	N/A	15	15
T-6 Squadron Ops	369.000	N/A	20	N/A
T-38 Squadron Ops	272.000	143.600	N/A	20
T-1 Squadron Ops	293.400	141.700	N/A	20
49th Squadron Ops	341.750	149.400	N/A	N/A
Unknown Squadron Common	270.900			
Flight Following (Range Advisories)	275.900 276.000			
14 th FTW VHF Training Frequencies	138.350 139.000 141.700 143.000			

14th FTW VHF Air-to-Air Frequencies:

14 th FTW Interplane - 150.250
T-1A Training (Columbus 1/2/3 and Meridian East/Meridian 1 West MOAs) - 138.150 138.175 138.600 139.900 140.950 141.875 141.950 142.375 142.600 143.150 148.575 148.925 149.625
T-1A Aircraft Refueling - 138.175 140.950 141.875 142.375 148.575 148.925 149.625
T-6A Aircraft (Columbus 1/2/3 MOAs and Columbus AFB Aux Field) - 138.550 138.625 139.600 140.500 142.700
T-6 A/A Training - 138.250 140.300 141.150 141.250 141.400 141.600 143.250
T-38 Training (Columbus 1/2/3 and Meridian East/Meridian 1 West MOAs, also R4404A/B/C) - 141.725
T-38 A/A Training - 138.450 140.375 141.900 142.625 143.325 143.375 148.800 148.875 149.100 150.150

14th FTW UHF Air-to-Air Frequencies:

14 th FTW Interplane - 264.950 279.725 324.050 324.100
T-1A Training - 228.950 229.475 276.825 295.000 378.250
T-1A Aircraft Refueling - 233.400 240.225
T-6A Aircraft (Columbus 1/2/3 MOAs and Columbus AFB Aux Field) - 260.225 266.025 299.725 363.650
T-38A Aircraft (Columbus 1/2/3 and Meridian East/West MOA) - 275.825
Multiple Formation T-1/T-6/T-38 aircraft - 367.300 (replaced 399.875)

14th FTW Aeronautical Call Signs

14FTW	Cappo Columbus Flat
37FTS	Boma Valor
41FTS	Boma Cutlas Stine Valor
48FTS	Alley Blaze Boma Haze Jaws Moon Mulet Patrol Possum Scream Troll Wolf
49FTS	Austin Beard Guts Jimbo Killer Knight Torch Wheels
50FTS	Badger Banzai Baron Black Bone Burner Cowboy Cutty Eagle Fang Fast Gonzo Gundog Harley Hoax Hummer Jackal Jaws Killer Knight Musket Ninja Phantom Pistol Poison Push Scar Sluggo Snake Speed Spike Spooky Zamma

Memphis (ZME) ARTCC Frequencies:

127.100/269.400	Low Altitude (SFC-FL230)	Sector 13/HAB-L
134.775/294.700	High Altitude (FL240-FL340)	Sector 30/Columbus (CBM-H)
275.400	Special Military Use	No VHF pair
320.400	Special Military Use	Sector Echo No VHF pair

Civil Air Patrol Repeaters

We recently obtained the following list of USAF CAP repeaters for the states of California and Texas from public domain Internet Web sites. That is it for this month. Until next time, 73 and good hunting.

CALIFORNIA CAP REPEATERS

Location	County	Repeater Output/Input Freq
Blue Ridge Summit	San Bernardino	148.150/143.700
Breckenridge	Kern	148.150/143.700
Mt. Bullion	Fresno	148.150/143.700
Cahto Peak	Mendocino	148.150/143.700*
Cuesta Peak	San Luis Obispo	148.125/143.550
Mt. Diablo	Contra Costa	148.150/143.550
Mt. Diablo	Contra Costa	148.150/143.700
Edwards AFB	Kern	148.125/143.550
Horse Mountain	Humboldt	148.150/143.700
Inskip Peak	Tehama	148.125/143.550
Joaquin Peak	Fresno	148.125/143.550
Kelso Peak	Kern	148.125/143.550
Mt. Laguna	San Diego	148.125/143.550
Mt. Laguna	San Diego	148.150/143.700
Mazourka Peak	Inyo	148.125/143.550
Meadow Lakes	Fresno	148.125/143.550
Oat Mountain	Los Angeles	148.150/143.700
Onyz Peak	San Bernardino	148.125/143.550
Onyz Peak	San Bernardino	148.150/143.700
Mount Otay	San Diego	148.150/143.700*
Palomar	San Diego	148.125/143.550
Palomar	San Diego	148.150/143.700
Mt. San Jacinto	San Bernardino	148.125/143.550
San Hedrin	Mendocino	148.125/143.550
St. Helena	Napa	148.150/143.700
Santa Ynez	Santa Barbara	148.125/143.550
Saddle Peak	Los Angeles (Malibu)	148.150/143.700
Palo Escrito Peak	Monterey	148.150/143.700
Mount Sanel	Mendocino	148.150/143.700
Santiago Peak	Orange	148.125/143.550
Santiago Peak	Orange	148.150/143.700
Silver Peak	Inyo	148.150/143.700
Sutter Buttes	Sutter	148.150/143.700
Mt. Tamalpais	Marin	148.150/143.700
Tenhi Mountain	Kern	148.150/143.700
Mt. Thom	Los Angeles (Glendale)	148.125/143.550
Mt. Umunhum	Santa Clara	148.150/143.700
Mt. Vaca	Solano	148.125/143.550
Vandenberg AFB	Santa Barbara	148.125/143.550*
Ward Peak	Placer	148.150/143.700

* Not on the air yet.

TEXAS CAP REPEATERS

Desig	Location	Repeater output/input freqs	NAC
R42P	Abilene	148.150/143.700	302
R35P	Amarillo	148.125/143.550	3CE
R16P	Auston	148.150/143.700	555
R02P	Bay City	148.150/143.700	656
R29P	Beaumont	148.125/143.550	6CA
R49P	Belton	148.125/143.550	526
R09P	Brownville	148.125/143.550	61F
R47P	Colorado County	148.125/143.550	68F
R46P	Corpus Christi	148.150/143.700	5EA
R11P	Dallas North	148.125/143.550	4CE
R58P	Dallas South	148.150/143.700	4A4
R44P	Decatur	148.150/143.700	47C
R13P	El Paso	148.125/143.550	393
R01P	Granbury	148.125/143.550	455
R09P	Houston Downtown	148.125/143.550	61F
R14P	Houston North	148.150/143.700	68F
R50P	Kerrville	148.150/143.700	40B
R52P	King Mountain	148.150/143.700	31D
R21P	Lubbock	148.125/143.550	585
R36P	Midland	148.150/143.700	356
R40P	San Angelo	148.150/143.700	339
R26P	San Antonio North	148.150/143.700	5B6
R57P	San Antonio South	148.125/143.550	4A4
R56P	Sherman	148.150/143.700	430
R60P	Sulphur Springs	148.150/143.700	3B4
R07P	Tyler	148.125/143.550	356
R27P	Victoria	148.125/143.550	5B6
R41P	Wichita Falls (Future)	148.125/143.550	40B
R24P	Waco (Future)	148.150/143.700	4F9



BROADCAST BANDSCAN

THE WORLD OF DOMESTIC BROADCASTING

Doug Smith, W9WI

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<http://americanbandscan.blogspot.com>

Talk Radio, not just AM Any More

I think it's probably been apparent to pretty much everyone that the days of mainstream *music* on AM are over. A small number of AM stations broadcast music for the purpose of being rebroadcast by FM translators, and an occasional AM carries some kind of unusual musical programming, but for the most part, AM programming is spoken word.

And, on the flip side, it's been "conventional wisdom" that spoken-word programming *doesn't* happen on FM. However, that tradition has been falling by the wayside with increasing speed.

In early 1991, shortly after I arrived in Nashville, something unusual happened on FM. WMSR-FM, located in Manchester, about 50 miles southeast of town, went off the air – and returned as FM news/talk station WWTN. WWTN wasn't the only FM talk station (there were FM talk stations in Akron and Philadelphia), but it didn't have much company in the land above 88 MHz. In 2003, classic-rock station WGFX here changed to all-sports – another programming niche previously not heard on FM.

Over the subsequent 20 years, WWTN and WGFX have found more spoken-word companions on the FM dial. Boston, Greensboro, Minneapolis, Madison, Portland, Seattle, and Phoenix are among dozens of cities with at least one commercial FM station that plays almost no music.

The move towards spoken-word programming on FM has also been noticeable in the non-commercial band below 92 MHz. Public radio stations across the country have been curtailing classical music and jazz programming, and adding hours of talk. Public stations in Boston, Columbus, and Houston have purchased second stations and moved the classical music completely to the new frequency.

America's three largest cities have so far



This doesn't look like an FM radio, but it is... AE7AX's Singer NM-37/57 Field Intensity Meter.



And this one doesn't look like an AM radio. This is James' HP-3586 Selective Level Meter.

been immune to this trend, at least among commercial stations. At the beginning of August, this changed dramatically in New York and Chicago. New broadcasting company Merlin Media purchased rock stations in New York (WRXP 101.9) and Chicago (WKQX 101.1). Both stations have switched to all-news formats, with the calls WEMP and WWWN respectively.

All-news stations (as opposed to news/talk stations) are fairly rare. They're expensive to operate, and most cities don't generate nearly enough local news to fill the airtime. All-news stations on FM are, of course, even rarer. However, Chicago now has *two* such stations. In an attempt to fend off competition from Merlin's new WWWW, the Windy City's existing AM all-news station WBBM 780 has added an FM simulcast. WBBM Newsradio 780's FM signal is on 105.9.

(Here's the confusing part: the call letters of Newsradio 780's FM station remain WCFS-FM. They can't use WBBM-FM, as there already *is* a WBBM-FM – a successful popular music station on 96.3 – and they have no intention of messing with the successful 96.3 operation.)

There are rumors of pending changes elsewhere. Remember the well-publicized predictions that the world would end on May 21st? These predictions were broadcast over Family Radio's network. Family owns dozens of radio stations, including stations in Philadelphia (WKDN 106.9) and Annapolis. (WFSI 107.9) The latter two stations, operating above 92 MHz, can be converted from non-commercial operation to commercial outlets. In early July, they did so. This has led to widespread speculation the two stations will be sold to commercial broadcasters – possibly the same ones who launched WWWW and WEMP – and will adopt spoken-word formats.

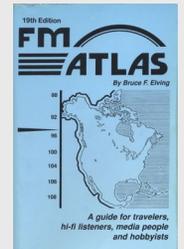
❖ Montreal 690/940

Last time, we reported two 50,000-watt clear-channel Canadian stations would be

DR. BRUCE ELVING PASSES

Dr. Bruce Elving, tireless promoter of FM radio and FM stereo, and publisher of the *FM Atlas*, died on July 24th. Dr. Elving may have been the only person pushing FM in the mode's dark days in the 1960s and early 1970s. He was constantly pushing the FM band's considerable advantages over AM.

Bruce was also an avid DXer and active member of the Worldwide TV-FM DX Association. He'd taken up a bit of digital TV DXing in his final days in California. He will be deeply missed by DX hobbyists everywhere.



I'm afraid the 21st edition of the FM Atlas will likely be the last.

returning to the air, carrying traffic information to Montreal motorists. These frequencies, 690 and 940, have been silent for a few years. They're going to remain silent a bit longer than expected.

In late July, the applications to reactivate these frequencies were removed from the agenda for an August hearing. This does *not*, however, mean they're dead. It seems other broadcasters complained, arguing that they should have a shot at the abandoned channels. The Canadian government has agreed to accept competing applications for these frequencies.

There is a remote possibility the government will decide to leave these frequencies silent. It is possible they will decide the Montreal broadcasting market cannot support the competition from another set of stations. However, this is *very* unlikely. It's almost certain permits will be issued, late this year or early next year, for the use of these frequencies. It is, however, quite possible they will *not* be used for traffic information broadcasts.

Here's hoping you're all carefully checking 690 and 940 for DX. When these frequencies return to the air in Montreal, many DX opportunities will disappear for Eastern listeners...

Speaking of new stations in Montreal, four applications have been filed for stations on other frequencies:

On 600 kHz, a South Asian ethnic station is proposed with 250 watts daytime, 50 watts at night.

On 1400, another South Asian ethnic station would operate with 1,000 watts day and night; this station would move to 1610 when CJWI completes its move from 1610 to 1410. A Spanish-language station proposes to operate with 1,000 watts on 1610 after CJWI moves; this would, of course, be mutually-exclusive with the previous application. Finally, there's a proposal for a contemporary Christian station on 1530 with 1,000 watts daytime only.

❖ The End of the "Franken FMs"

In 1999, a low-power TV station, K06LY, was operating on channel 6 in Anchorage, Alaska. As a channel 6 station, K06LY's sound was broadcast at 87.7 MHz – just outside the FM radio band and receivable on most FM radios. K06LY decided to take advantage of that characteristic. They decided to operate their TV station as a radio station, changing the call letters to KZND-LP and carrying modern rock.

Over the years, many other channel 6 low-power TV stations have followed suit, operating as radio stations at 87.7 FM. Wikipedia lists twelve such stations; I suspect there are more. Due to loopholes in the FCC regulations, such stations can use FM radio modulation standards (including stereo) and can run significant power. For example, the coverage radius of channel 6/87.7 FM station WLFM-LP Chicago is 87% of that of Chicago's major "regular" FM stations. DXers have coined the term "FrankenFM" (as in Frankenstein's monster) to refer to these operations.

Full-power channel 6 analog TV stations could also be heard on 87.7 FM. Two years ago, these stations were required to convert to digital operation, rendering reception on FM radios impossible. But the mandatory conversion did not apply to low-power stations; KZND, (now KNIK) WLFM, and the others continue to operate as FM radio stations.

While low-power stations were not required to convert to digital in 2009, they have been on notice since 2004 that a conversion would be eventually required, and the mechanism for these stations to convert has been in place since then. The FCC has now set the deadline for that conversion. Low-power TV stations have until September 1, 2015 to convert to digital. When that date hits, these "Franken FM" stations on 87.7 will no longer be able to operate as radio stations.

❖ The "Great Translator Invasion of 2003"

There is also a low-power FM service. This service, created in 2000, broadcasts in the regular 88-108 FM band. Applicants had one opportunity, in 2001, to apply for these stations. Two years later, the FCC accepted applications for new FM translator stations. Much to everyone's surprise, over 13,000 translator applications were filed!

The regulations requiring low-power FM stations (LPFM) to protect full-power stations from interference are considerably more strict

than those requiring protection by translators. As a result, the Commission (and other observers) felt that processing the 13,000 translator applications would make further LPFM service impossible. In 2005, the FCC stopped processing translator applications pending changes in the rules.

At the beginning of this year, the Local Community Radio Act *required* the FCC to adopt rules allowing the licensing of both LPFM and translator stations.

A proposal has now been put forth to implement the requirements of the Act. The Commission has proposed to set an "LPFM floor." If fewer than five channels would be available for LPFM stations after all pending translator applications are processed, the translator applications will be dismissed. (This five channel "floor" applies for the smallest markets. Six, seven, or eight available LPFM channels will be required in larger markets.)

❖ Respect or Disrespect for the FCC?

A recording has surfaced on the Internet that is almost too bizarre to believe. The best I can tell, it's true; in 1939, at the beginning of a program on the NBC Radio Network, Cary Grant *sang* the FCC regulation that required radio stations to identify themselves. Actually, "chanted" might be a better term. See below for a link to this recording..

❖ Mailbag

I'm continuing to hear from readers who listen to radio using something other than a radio. In the morning, Jim from Phoenix listens to local KFYI-550 – but uses his smartphone and the IHeartRadio website. In the afternoon, he switches to WILM-1450 (Wilmington, Delaware) or WPGB-104.7. (Pittsburgh) Both stations carry the Michael Savage show live; his Phoenix affiliate airs the show on delay.

BROADCAST STATION REPORT

NEW:

Permits granted for new stations:

Prescott Valley, Arizona	1330	800/250 DA-2
Olivehurst, California	890	350/250 DA-2
Coral Springs, Florida	1120	9,500/1,100 DA-3
Terre Haute, Indiana	1230	1,000/1,000 ND
Beaver, Utah	1230	1,000/1,000 ND

Applications for new stations dismissed:

Chico, California	890
Medford, Oregon	830

Applications for new stations:

Reno, Nevada	1180	7,500/950 DA-N
Mississauga, Ontario	960	2,000/280
Montreal, Quebec		see text

New stations on the air:

Helendale, California	1450	KQTE	250/250 ND, near Barstow
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CHANGES:

Frequency & location changes on the air:

Isleta, New Mexico	1510	KMYN	5,000 daytime/25 night; from 1500 Alamo Community
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Stations deleted:

Bald Knob, Arkansas	710	KAPZ
Lillooet, British Columbia	860	CBUL (going to FM)
Haines City, Florida	930	WLVF
Valparaiso, Florida	1340	WFSH
Blakely, Georgia	1260	WBBK
South Bend, Indiana	1490	WPNT
Waterloo, Iowa	850	KXGM
Wiggins, Mississippi	1420	WIGG
DeWitt, New York	720	WVOA
Saluda, South Carolina	1200	WJES
Tulia, Texas	1260	KTUE
Clarksburg, West Virginia	1400	WOBG

Station "undeleted"

Winona, Mississippi	1570	WONA
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ND: non-directional

DA-N: directional at night only

DA-D: directional during daytime only

DA-2: directional all hours, two different patterns

DA-3: directional day, night and critical hours, three different patterns

James Kretzschmar AE7AX listens to "regular" AM/FM signals, but the devices he uses sure aren't radios! James has a HP Selective Level Meter and a Singer Field Intensity Meter. He was able to buy the HP at an auction of surplus government property; it tunes from 50 Hz to 32 MHz. The Singer was \$30 at a hamfest; it doesn't tune the AM band but its 30-1000 MHz coverage does tune FM broadcasts, as well as the 118-136 MHz aircraft band.

❖ 'Til Next Month

Do you get your news from FM radio? Write me at 7540 Highway 64 West, Brasstown NC 28902-0098, or by email to dougsmith@monitoringtimes.com. Good DX!

URLS IN THIS MONTH'S COLUMN

<http://americanbandscan.blogspot.com> - My DX blog.

www.iheartradio.com/main.html - IHeartRadio.com, with links to radio stations' online streams.

www.dinosaurgardens.com/archives/175 - Cary Grant sings the FCC legal ID rule.

www.fmnewschicago.com/ - WWWW-101.1 Chicago, one of the Windy City's new all-news FM stations.

http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-105A1.pdf - FCC proposal to process LPFM and FM translator applications.

http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-110A1.pdf - FCC sets drop-dead date for "Franken FM" stations on 87.7.



Easy Tools for Smarter Listening

I am sure every radio enthusiast has his/her favorite websites for picking up the propagation forecasts. Not only does time standard station WWV broadcast geophysical alerts and solar flux information on 2.5, 5, 10, 15 and 20 MHz, but since 2.5 and 20 MHz are lower power, they are a good indicator of propagation conditions in those bands. When the forecasts are good, you know it's time to check out the bands for some DX stations.

However, it's helpful to know what is actually being heard on the amateur bands, so I use a site set up by VE7CC. You have to be a licensed amateur to access www.ve7cc.net, which you must verify when you first log in. I have found the DX cluster at this site invaluable for predicting what frequencies might yield some good DX, since it shows what is being reported on all bands. This information is also useful for those of us who listen outside the amateur bands as well.

This site is also useful for the special event stations we may want to work or hear. I helped activate Amherst Island for the local ARES group as an exercise. Ontario Island ON 021 was desirable DX, so we put the station on the DX cluster site. We were only on the air for a few hours but logged 50 contacts. The Islands on the Air and Lighthouse weekend are great for logging stations with marine interest.

I woke up early on the morning of July 1. I wanted to give out some calls for the Canada Day Contest. At 1039 UTC, I worked ZL2AGY, Tony Marr, in Hawera, New Zealand, on 40 meter CW. I looked him up on qrz.com and noticed he used simple antennas.

This got me thinking, and I went up to the 8 MHz marine frequencies in the hope of finding some Pacific DX. Sure enough, from 1041



Stephen B. Roman eastbound in the Welland Canal heading for Picton to load cement.

to 1043 I heard VMC Charleville, Australia on 8.176 MHz. I listened again at 1100 UTC and heard the weather forecast where New South Wales was mentioned. I went down to 8.113 MHz and heard VMW as well. The signals were not strong but they were readable.

It shows how using the results of one service and band can help catch some other DX. It also shows where the MUF (Maximum Usable Frequency) actually is. Even if you do not have a computer available, listening to the amateur bands will give you an idea what frequencies are open and to what areas. If a low power signal is being heard, then the commercial marine stations on nearby frequencies should be available.

Don't forget the reports in various columns of magazines. Hugh Stegman's monthly utility column in this magazine is a great source of information. I have monitored the CW identifier of SVO, a Greek station on 8.423 MHz at 0222 UTC. At 0223 UTC I monitored the CW identifier, then a digital pulse from TAH, Istanbul Turkey

	UTC	MHz
Chiponia	0733, 1233, 1903	1.656
Tarifa	0733, 1233, 1903	1.704
Palma	0750, 1303, 1950	1.755

France broadcasts 1.696 and 2.677 MHz at 0650, 1433 and 1850 local time. Monaco Radio is listed as broadcasting weather at 0800, 0930, 1030, 1403 and 1930 local time on 4.363, 8.728, 13.146, and 17.260 MHz. In the Adriatic, BAR radio has 0850, 1420 and 2050 UTC listed as times for broadcasts on 1.720 MHz.

For the more adventurous listener, I have seen listings for 8 stations using 8.176 MHz in Australia. Each station broadcasts twice a day and all broadcasts are at 57 minutes past the hour. Listen for Adelaide, Cairns, Darwin, Gladstone, Melbourne, Perth, Port Hedland and Sydney on this frequency. All the stations monitor 4.125, 6.125 and 8.291 MHz for distress.

At 0903 local time, Hobart broadcasts a safety message on 2.524, 4.146 and 6.227 MHz. Coastal Radio Adelaide is the only one which monitors 2.182 MHz on a regular basis. The others do not guarantee to monitor this frequency.

On the Internet, I found a listing for Turkey's marine broadcasts. They list USB broadcasts from TAH Samsun at 1000 and 1800 UTC on 4.405, 8.812 and 13.128 MHz. Stations TAH I Istanbul and TAL in Antalya are also listed. The Internet listing was up to date as of August 11, 2011 and showed a cw broadcast from YBM 20 Bandirma radio at 0700, 0950, 1900 and 2150 UTC on 478 kHz. I would appreciate confirmation of this information.

❖ North American Frequencies

WLO and KLB broadcast synthesized traffic lists and weather broadcasts on the hour. Forecasts for the Gulf of Mexico, Caribbean and

❖ Winter Monitoring Targets

I have gathered some frequencies that will be among my monitoring targets for the coming winter DX season. Checking the 160 meter amateur band should give me a good chance to receive some weather broadcasts from Spain. According to information printed, they are broadcast in English and Spanish. Times are UTC and USB is used.



Lake vessels Halifax and Saunierre in Montreal 2010. Now they are just a pile of scrap metal in Aliaga Turkey.

SW North Atlantic are broadcast at 0500, 1100, 1700 and 2300 UTC. East Pacific forecasts are broadcast at 0800, 1500 and 2000 UTC. The Alaska Offshore forecasts are broadcast at 0800 and 1500 UTC. WLO lists 4.369, 4.396, 6.519, 8.788, 8.806, 13.110, 13.152, 17.260, 17.362 and 22.804 MHz as being used. KLB lists 4.405, 8.371, 13.101, and 17.311 as their frequencies.

4.125 MHz seems to be a common frequency for the Alaskan fishing vessels. I have seen this in several places.

❖ Search and Rescue

SAR (Search and Rescue) for the US Coast Guard can be found on 5.696 and 8.923 MHz. Reports show that 3.023 and 11.201 MHz are also used. You may hear other SAR radios here such as Canadian Centers and Bermuda.

Canadian SAR mainly uses 5.717 MHz; however, since they are military, they may go to other frequencies. Joint Rescue Co-ordination Centres are operated in St. John's, Halifax, Trenton and Victoria. It appears that St. Johns Newfoundland JRCC is going to close, so now is the time to log it.

Canadian Maritime Command uses the following frequencies, 3.047, 4.560, 4.700, 4.739, 5.1985, 5.684, 5.694, 5.717, 5.850, 6.694, 6.715, 6.736, and 6.751 MHz. Halifax uses all these frequencies. St. John's shows listings for 4.560, 4.739, 5.684 and 57.17 MHz. Victoria is listed at 5.717, 5.850, 6.694, 6.715 and 6.751 MHz. I also saw a listing for 5.702 MHz used from Vancouver. Trenton showed use of 6.715 MHz. Trenton, Ontario is the center for the Laurentien Region of Canada. Thus they do a lot of air and marine SAR work.

I have seen plans for the use of 149.080 to become the Canadian National Interagency SAR frequency (SAR-IF). A CTCSS tone of 156.7 Hz would also be used. I will check into this for future columns.

❖ Amateur Marine Radio

Here are some listings for amateur radio marine nets (times are UTC and frequency in MHz):

- 1) Weather and Cocktail Net (Caribbean) at 0730 and 1630 on 7.086
- 2) UK Maritime Mobile net at 0800 and 1800 on 14.313
- 3) European Maritime Mobile Net at 1900 on 14.297.5

Don't forget the Maritime Mobile service Net from 1200 until 2200 Eastern Time on 14.300, followed by the Pacific Seafarer's Net. Of course, this is October, but the Hurricane Watch Net on 14.325 MHz may still be activated during any tropical storm.

❖ Local Activity

I have been personally involved in amateur radio activations of Howe Island and Amherst Island. Our local group has also activated Nine Mile Point Lighthouse and Point Petre Lighthouse. This has been quite an experience, and we have a very portable setup. At times three or even four transmitters have been used. I am building some portable antennas and battery power sources.

George Kennedy, VE3G-HK, has been actively rebuilding and manufacturing light weight, multiband wire antennas for VE3LYC. Cezar Trifu is well known world-wide for activating many remote islands. He was part of the expedition to Walliston and Diego Ramirez Islands at the southern tips of South America in January of this year. A new expedition is planned for the coming year. He has received awards from the Islands on the Air group.

Another local amateur David Sellick VE-3DZE is equipping his newly acquired houseboat, *Iron Lady*, with HF and VHF equipment. David uses four 80 watt solar panels and batteries to provide power to the boat and will be installing a separate solar panel for the amateur rigs. He may be on the air this year, but definitely will be active next year from the water. Details and photos of the finished installation will be in future columns. Also, a long time friend, Bob Tester is now VE3PND. Hopefully people will have heard him as VE3PND, as he pilots his sailboat *Pendragon* across the Atlantic.

Plans are also taking place for an activation of the historic site of VBH Kingston Marine Radio during the 100th anniversary of its founding. This is three years in the future, but we must begin planning now to get permission for special call signs and use of the original site.

❖ VHF

As you are reading this column, we will be starting the famous gales of November here on the Great Lakes. We always get some bad storms and even have hurricane velocity winds particularly on Lake Superior. However, winds of 50 knots plus and seas over 20 feet are not uncommon on Lake Ontario. The VHF frequencies will be very active and usually we have a few incidents for the local Coast Guard cutter, *CCGC Cape Hearne*, to handle.

I would remind people to scan the whole marine VHF spectrum with a scanner. You may have some simplex channels that go unnoticed. Here, channel 83A, 157.175 MHz is used by the Seaway when they have an emergency. The USCG uses 81A, 157.075 MHz. If you are using a marine radio, always select the United States or Canadian setting when you check the channels.

Channel 17 is heard but is only used at low power in this area by the crews at some Seaway locks. It is also good to check outside the marine frequencies, as many port authorities, shipping lines, etc. have their own internal frequencies. You never know what you might hear.

I have been monitoring some old Canadian Navy submarines being towed up the Seaway. Hopefully, I will have some photos by the time this column is in print!

❖ Marine Radio Historical Society

This dedicated group plans the Night of Nights broadcasts on July 12 every year. This commemorates the last commercial Morse



Canadian Navigator 2010, upbound for the Seaway. Now she is the Algoma Navigator as the Upper Lakes Shipping Line has been bought out.

message. Stations from all over contact the restored KSM, KPH and KFS marine stations. This year they asked for messages from people who wanted them sent over the air. I was pleased to submit one and have Hugh Stegman report reception of this message to the editor. They also operate amateur station K6KPH at the site.

MRHS is on the air every Saturday and the schedule, photos, history, etc. is available at www.radiomarine.org. This is a great way to improve your cw and also learn to tune RTTY. KSM has a new RTTY frequency of 6.328 MHz. All the operators are retired professionals and the cw is great to copy.

❖ Email

I appreciate all email and will be happy to reply. Herb WA3HGT emailed me and complimented my July column. I am pleased that the information was useful. I was able to direct Herb to some sites for accurate Canadian arctic station frequencies.

Kriss Larson, KR6ISS, wrote about his recent trip to Ireland. He visited the Volmet site there and saw the antenna farm. Like Kriss, I have listened to those broadcasts for many years. He also visited the marine Navtex sites at Valentia and Malin Head. Both of these locations are also Irish Coast Guard radio stations. Malin Head uses 2.182 and broadcasts on 1.677 MHz. I have also seen 1.644 MHz listed. Kriss got a tour of Valentia Navtex station. They also monitor 2.182 and broadcast on 1.755MHz. Either of these stations would be quite a catch. Apparently, Valentia was to close but has been kept open. Both of these stations have web sites which you can access by a Google search.

I hope there is more email after this column with lots of new information to share. Let me know what you are listening to. I have a trip to the Caribbean from New York in December, so will report on what I heard next spring.

❖ Plasma Nightmare

I also have a request for readers: We are having a national problem with interference to amateur and short wave radio from plasma television sets. The level of emission below 30 MHz is way above acceptable industry standards. We were told that the problem was they only tested for emissions above 30 MHz. If anyone has any information that might help solve this, I would appreciate it by email. The Radio Amateurs of Canada (RAC) is trying to get something done about this. I am personally having problems with a neighbor's set and just have to close my HF radios down when it is on. Hopefully there will be some simple cure to prevent this.

73's and good dx!



The Great Shortwave Migration Shortwave still surfing, online

Possibly even more than traditional FM and AM broadcasters, shortwave broadcasters have seen their audiences cut by the great tidal shift to the Internet. This has led scores of broadcasters to cease shortwave broadcasts all together, migrating to Internet and satellite to reach their audiences.

This shift has led many shortwave hobbyists to despise the Internet as the scourge that will be the final death knell of a beloved medium for listening to the world.

As I have written many times, I have extremely fond memories of tuning in far away broadcasts through the pulsating propagation of shortwave radio. Somewhere, packed away, are my QSL cards from across the globe. They serve as reminders of a time when you could fire up a shortwave radio, and without much skill at all, pull in broadcasts from nearly every continent.

As a hobbyist, I can see how many would look upon the Internet with disdain as a cold and faceless replacement for the venerable and reliable radio. However, as a realist (and one who fancies hearing programming content more than fighting atmospheric conditions), I know that Internet radio will not completely kill shortwave radio. I also know that it has opened the door for hobbyists to hear things they had never dreamed possible!

Now 20 years on, the World Wide Web has made the distances between us seem even smaller than shortwave radio ever could!

❖ Really, it's all still there!

Name a major broadcaster that you have enjoyed listening to over the years, there is a better-than-average chance you will find them streaming their broadcasts online.

Strolling through my own personal list of stations I enjoyed listening to as a child, every single one of them are available online. And this, without a hint of reception problems or the hassle of fighting interference issues in my apartment.

My first QSL was from the BBC. My fascination with the English culture is one of the constants of my life, and back then, it was in full force. Can you find the BBC online? But of course! Not only will you find the BBC's World Service available online, but you can also find streams for the BBC's local radio stations as well. Finally, I am able to sit at my home in South Carolina and listen to local radio in Manchester or Liverpool, something I only dreamed about as a child. Brilliant!

In fact, the BBC makes it easier than almost

any other broadcaster to listen to its stations. From the interface of the BBC iPlayer, you can access all of the local BBC stations as well as the World Service. No more memorizing links or setting up tons of bookmarks. You can set up your favorites in the iPlayer interface, so you always have one-click access to any BBC station you fancy!

❖ But the Brits aren't the only ones

During the devastating earthquake and tsunami disaster that struck Japan, NHK's World Service broadcasts online were a popular and constant source of news and information from the island. In addition to the streaming service, you can find podcasts, news items and even Japanese lessons on the NHK



Web site. These are all added features that a radio broadcast alone could not provide on-demand.

I remember being fascinated by tuning in broadcasts from Australia and New Zealand, knowing they were on the opposite side of the globe from me and already broadcasting from tomorrow! Both ABC Radio Australia and Radio New Zealand International are online. Radio New Zealand, like many of the broadcasters that are still broadcasting through traditional methods, also provides program schedules and shortwave frequencies on its Web site.

Another common thread to be found on the Web sites of most major broadcasters is the wealth of additional information. As world service broadcasts are often seen as a window for the world to experience each country and a welcome mat for thousands to get immersed in a country's culture, world service broadcast Web sites often include information on culture, music, art, history and language as well.

Just as NHK has Japanese language lessons on their Web site and Deutsche Welle teaches German through their Web site, so too can non-English speakers learn the English language from the BBC through their Web site, and so on.

This harkens back to a tradition in which many broadcasters would include language lessons as part of their normal programming schedule. Now, you don't have to wait for the program to come on the air; you can experience this type of content on-demand, anytime online!

❖ No longer on air? Try online!

Even though many international broadcasters have stopped broadcasting their English service to North America – or have even stopped broadcasting altogether – you can still find them online!

One example of this is another one of the first stations I tuned in as a child, Radio Nederland. It no longer broadcasts its English service to North America, but it is still possible to tune in the programming of this ever-popular station through the online audio stream.

The same can be said of Radio Sweden. No longer broadcasting in English to North America, Radio Sweden can still be heard online, along with a plethora of podcasts and other interactive media for interested listeners.



❖ Where to find your favorite?

So, whether your favorite station is no longer receivable where you are, or they are off-air completely, or you just want a reliable reception platform for tuning them in even during poor atmospheric conditions, where can you find international broadcasters online?

Is there a one-stop link list ready to plug into your internet radio? Well, not really. There are several Web sites with lists of links to international broadcasters, but the reliability of the links and thoroughness or the lists is spotty at best.

Beyond the links provided in the table at the conclusion of this column, how can you find out if your favorite shortwave broadcaster is now available online for streaming?

First, you can try one of the streaming service providers like TuneIn or Reciva. From these, you can search by location, genre and station name. You can do the same if you are using a mobile device or WiFi radio that uses these services, like the C.Crane WiFi Radio or the Logitech Squeezebox.

After searching these databases of streams, you can also try finding the actual station Web site, by doing a simple Google or other search engine lookup. This will enable you to find not only the stream, but the additional interactive content like news updates



through RSS feeds, podcasts and more that may be offered. If the station still broadcasts on air, a list of English language station web sites appears in *MT* at the end of the *Shortwave Guide* section. Foreign language web sites are included in the *MTXtra Shortwave Guide* of comprehensive broadcast schedules, available to *MT Express* subscribers.

If the web site is in a language foreign to you, a tip is to eye the top of the page for language links. These may be in a pull-down menu or be stand-alone links that will translate the page into your language. Most, but not all, of the major international broadcasters will at least be in their own native language and have an English option available.

For those that do not, you may also try some of the services such as Google translate or other Web site translation services. This can help you navigate these sites with ease to find streams, podcasts, etc.

All-in-all, it's not yet the end of the world as we know it for shortwave radio. There are still broadcasters sending their signals for a return trip through the atmosphere; there are still stations responding to QSL requests: Radio will never completely die.

Look at the Internet as a companion to your shortwave radio. It is there to be an aid for the hobby, as well as a source for programming content that you cannot find anywhere else!

That is, until the next technological advancement that threatens to make the Internet obsolete. DXing by brainwaves? Who knows?!

❖ Survey says....

I try to keep all of my readers up-to-date on the latest and greatest technologies in the Internet radio industry. One we have spent a lot of time looking at is the advancement of portable and in-vehicle Internet radio. After last month's column, I was interested to see the findings of an ABI research study that examined what consumers really value for connectivity in their cars.

The study showed that consumers value having in-car navigation over all other features, including Internet radio. The study found only "average levels of interest" among consumers at having access to Pandora and other Internet radio services available to them in car.

So does that mean the industry is going to abandon their efforts for in-car streaming in favor of GPS? Thankfully, no. The study also found that those who already use Internet radio in their cars tune in frequently. This means, once consumers are familiar with a technology, they embrace it fully and actively seek to use it.

The thinking from this study, then, is that the technology of in-car navigation is something that consumers are more familiar with, and therefore, they are more keen to have access to it. Once the Internet radio and other infotainment options in vehicles become more mainstream and comfortable, it is believed that we will all

be wanting Pandora apps in our SUVs.

What a glorious day it will be indeed, when you can turn on your car stereo and be able to tune in a radio station in Chile as easily as your own local stations. Until then, it is up to those of us on the cutting edge to set the precedent and work out all of the kinks!

Be proud, faithful readers. Like those early adopters of the Internet in the early '90s, one day you will be able to say "Yeah, I was listening to Internet radio *way* before everybody else was!"

❖ Sirius 2.0 – What it means for Internet radio

Sirius/XM recently announced that over the next 12 months they are going to be gradually releasing Sirius 2.0 hardware in vehicles. This new technology will support WiFi, Bluetooth, Internet and on-demand technology for Sirius subscribers.

Details are still forthcoming, as of press time, but the move by the satellite radio company is supposed to be their answer for increasing audience-loss to Pandora and other Internet radio options. The addition of WiFi and Internet technology through the radio is intriguing.

Does this mean we will be able to access the Internet through a WiFi hotspot in our car as a Sirius subscriber? The possibility of satellite-based Internet in vehicle is more than a little exciting. As wireless providers are increasingly putting restrictions on the amount of data we consume through cell phone networks, satellite could be a fantastic solution to the bandwidth problem!

I have been a late-comer to satellite radio. As a former broadcaster, I had an issue with paying a subscription fee for what I was already getting for free. It wasn't until I purchased a new vehicle that provided 3-months of free Sirius service, that I started to realize the value of satellite radio.

If you throw in an in-car WiFi and Internet solution, that would make satellite radio positively necessary in our increasingly connected world.

Stay tuned to *GlobalNet* for more details on what this service will provide as we learn them! Until next month, 73!

GLOBALNET LINKS

- BBC World Service - www.bbc.co.uk/worldservice/programmes/index.shtml
- NHK Japan - www3.nhk.or.jp/nhkworld/
- ABC Radio Australia - www.abc.net.au/ra/
- Radio New Zealand International - www.rnzi.com/index.php
- Deutsche Welle - www.dw-world.de/dw/0,,266,00.html
- Icelandic National Broadcasting Service - www.ruv.is/english
- Radio Nederland - www.rnw.nl/english
- Radio Sweden - <http://sverigesradio.se/sida/default.aspx?programid=2054>
- FMQB: Navigation most desired feature in-car - www.fmqb.com/article.asp?id=2245082
- Sirius 2.0 coming in 2013 model cars - http://reviews.cnet.com/8301-13746_7-20087074-48/sirius-xm-satellite-2.0-coming-to-cars-in-2013/

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Taking the Mystery out of DGPS

We don't normally cover UHF frequencies in this column, especially ones extending as high as 1500 MHz! However, this month we'll discuss a longwave link to a well-known UHF system – the satellite-based Global Positioning System (GPS).

Today, recreational GPS units are available for under \$100 in stores and online, but it wasn't long ago that getting equipped for GPS meant laying out 4-5 times that much at a specialty supplier. Today's lower prices make it possible for just about anyone – boaters, hikers, or motorists – to justify getting a GPS unit for their activities. Units are even built into some of today's cars.

As remarkable as GPS is, it is not perfect. The accuracy of standard GPS is subject to several variables, including ionospheric delays of satellite signals, multipath fading, and receiver clock variables. In addition, the military may, at any time introduce intentional error rates to prevent the system from being used by hostile forces against the United States or its allies. This intentional "dithering" is known as Selective Availability (SA), and although it was disabled in May of 2000, it can be reactivated with little or no advance notice.

Standard GPS units are capable of accuracies within 10 to 20 meters (30 to 65 feet) under ideal conditions. Nevertheless, some users require a level of precision beyond this to do their work. These users include surveyors, cartographers, and mariners operating in tightly restricted harbors. When precision counts, a supplemental system known as Differential GPS (DGPS) comes into play.

❖ DGPS – How it Works

DGPS greatly improves the accuracy of standard GPS. It works on the principle that the latitude and longitude coordinates for fixed transmitting stations, such as longwave beacons, can be determined with extreme accuracy using existing U.S. Geological Survey information. This data is then compared to the claimed position reported by a 1500 MHz GPS receiver located at the beacon site, and an error factor is generated, based on the difference between the two readings.

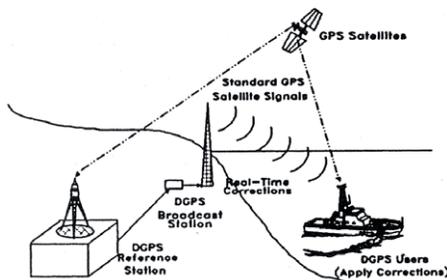
The error factor is broadcast by the beacon in the form of a data stream, which is received by DGPS-equipped users in the vicinity of the station. The corrections are automatically applied to GPS receivers, and they allow users to achieve highly accurate positioning. Accuracies of 1 to 3 meters are the norm with DGPS, and in some cases sub-meter accuracy is possible. The

drawing below shows the basic principles of the US Coast Guard DGPS system.

The Coast Guard maintains a vast network of DGPS-enabled beacons in the 285 to 325 kHz band. These frequencies used to be the domain of marine beacons (remember those?), some of which operated in a sequenced fashion – especially those around the Great Lakes in cooperation with Canada. Rather than tear these stations down when they became obsolete, the Coast Guard re-tooled some of them for DGPS service, saving taxpayer dollars in the process.

You can tell a DGPS station when you hear it by listening for the warbling note on its carrier (CW or SSB receiving mode required). There are scores of these stations operating in North America today.

BASIC DIFFERENTIAL GPS CONCEPT



❖ Decoding DGPS

Interested in viewing some DGPS signals on your computer? This can be an interesting diversion to "conventional" beacon chasing with Morse Code. With DGPS, a wealth of information is provided in text form, including transmission frequency (kHz), position coordinates, ID number, service range, equipment health and more.

To view the signals, you'll need a software program that works in conjunction with your computer's soundcard. One popular tool for DGPS reception is *RadioRaft*, now at version 3.21. It decodes a number of other digital modes as well as DGPS. For more information on this software, visit <http://radioraft.pagesperso-orange.fr/>. A simple hardware interface is also required with the program, but one is clearly described on the website.

Another package that can be used for DGPS (and NAVTEX too) is *DSC Decoder*. Full information and a free download for this

software may be obtained at www.coaa.co.uk/dscdecoder.htm.

An essential website for DGPS enthusiasts is the Coast Guard's "navcen" section at www.navcen.uscg.gov/?pageName=dgpsMain. Here, you'll find a wealth of information on these stations, including a list of active sites and their identification numbers. Click the submenu titled "By Site DGPS Status & Operating Specifications" for site-specific data. Happy surfing, and if you have some DGPS intercepts you'd like to share, please forward them to me for use in a future column.

❖ DGPS/NAVTEX Loggings

My thanks to *MT* reader John Collins, KN1H (NH) for his loggings shown in Table 1. In a rarity for *Below 500 kHz*, all loggings are of DGPS or NAVTEX stations, which were decoded with a PC and specialized software. John used *DSC Decoder* for DGPS and *YaND* version 5 for NAVTEX decoding. All of the NAVTEX signals were logged on 518 kHz, the primary NAVTEX channel. He used an Icom IC-R75 receiver with a 380-foot wire antenna for these loggings.

Table 1. DGPS & NAVTEX Logs from NH

FREQ.	ID	ST/PR/ITU	CITY
286	#804	NJ	Sandy Hook
288	#942	NL	Cape Ray
290	#799	ME	Penobscot
291	#788	PA	Hawk Run
292	#778	SC	Kensington
293	#803	NY	Moriches
294	#771	NC	New Bern
295	#843	WV	St. Marys
295	#939	NB	Partridge Isl.
296	#929	QC	St. Jean Richelieu
298	#831	MI	Upper Keweenaw
300	#926	QC	Riviere du Loup
301	#847	MD	Annapolis
303	#824	NC	Greensboro
304	#777	WI	Mequon
305	#782	TN	Dandridge
306	#772	MA	Acushnet
307	#834	MD	Hagerstown
309	#927	QC	Lauzon
310	#944	NL	Cape Norman
311	#863	IL	Rock Island
312	#935	NS	Western Head
313	#821	VA	Portsmouth
313	#925	QC	Moise
314	#808	FL	Card Sound
315	#940	NL	Cape Race
316	#800	ME	Brunswick
319	#936	NB	Point Escuminac
319	#838	MI	Detroit
322	#839	NY	Youngstown

324	#834	NY	Hudson Falls
518	\$04O	NL	St. Johns
518	\$04Q	NS	Sydney
518	\$04G	LA	New Orleans
518	\$04U	NB	St. John
518	\$04X	NL	Labrador
518	\$15K	CHL	Puerto Montt
518	\$04A	FL	Miami
518	\$12D	BC	Prince Rupert
518	\$04F	MA	Boston
518	\$04H	ON	Prescott
518	\$04N	MD	Chesapeake
518	\$04P	ON	Thunder Bay
518	\$04C	QC	Sept-Iles
518	\$04B	BDA	Bermuda

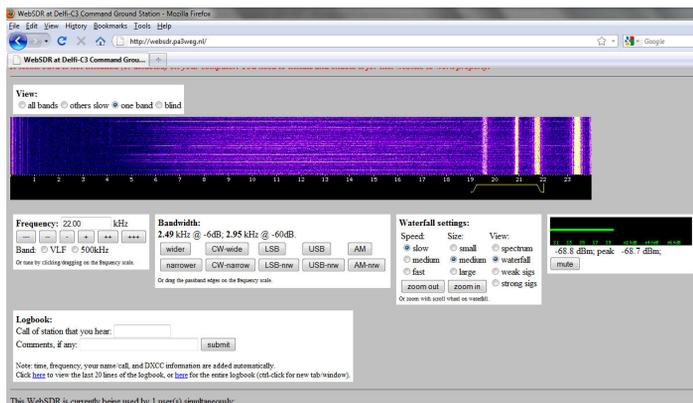
For a complete list of ITU Codes, see www.wordiq.com/definition/ITU_letter_codes

❖ I Heard SAQ – Finally!

It all started with an e-mail message from Lars Kalland, SM6NM, that there would be a special transmission from the Alexanderson Alternator in Grimeton, Sweden on Friday, August 5th at 0900 UTC, with tune-up beginning at 0830. I have always wanted to hear this transmitter, but to date, have had no luck hearing it on my own receiving equipment. People do hear it from time to time on the East Coast of the US, but these occasions are rare, and signals are usually very weak.



I decided on a different approach this time. I opted to use the online **WebSDR receiver** operated by Wouter Weggelaar PA3WEG. This receiver may be accessed at <http://websdr.pa3weg.nl/>. In essence, this is a fully functional receiver operating in real-time fashion, which you can hear over your PC's speakers. The receiver must be operating in a low-noise environment and with a good antenna system, because I was able to hear several VLF signals with it, including the short beeps from the Russian Alpha navigation system down at 14 kHz.



Anyway, to hear SAQ, I set the frequency to 18.2 kHz to provide a comfortable listening tone. At the appointed time, I was able to copy the following Morse Code transmission from SAQ quite clearly. (Note that this is my exact written copy – by ear – and it may contain minor errors

or omissions:

VVV DE SAQ SAQ SAQ – This is Grimeton Radio SAQ in a special transmission using the Alexanderson 200 kW Alternator on 17.2 kHz. Osten Maekitalo, known as the father of mobile telephony communication in Sweden, passed away on June 16, 2011. At his funeral today he is honoured by the Swedish National Committee or URSI, the International Union of Radio Science. He has done excellent work for the benefit of radio technology and for his country, may he rest in peace. –Signed, the Alexander at Grimeton Veteranadis Veener Association and World Heritage Group – No QSL required and no QSLs given. DE SAQ SAQ SK.

This was followed by another series of V's and the SAQ identifier again. After a few minutes of quiet on the frequency, I heard a somewhat lower frequency carrier tone, then a data transmission in RTTY. As an interesting side note, there were 21 simultaneous users of the WebSDR receiver during the SAQ transmission.

❖ VLF Antenna Option – Active Antennas

For those tuning VLF the old fashioned way (with your own receiver), the antenna used can be critical to success. Many newcomers to VLF try to use the same “random length” wire antenna they use for shortwave, and while it may work in low-noise locations, it often results in little more than static being heard or perhaps a few close-in stations.

There are several commercial active antennas available, including the popular L-400B from LF Engineering Co. (see *MT* review at <http://tinyurl.com/y9zb2td>). I know that not everyone has the budget for a commercial antenna, especially if longwave is only a “sideline” activity. So, how about building one? A simple design, complete with a printed circuit board (PCB) design, can be found at <http://tiny.cc/KEBjh>. The author, Adrian Knott of the UK, states that the frequency coverage is approximately 10 kHz to 200 kHz, but changes in the filter components should allow reception well above this range. Time to experiment!

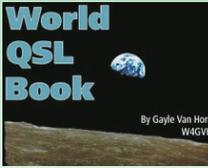
That's it for this month. 73, and best LW DX!

NOW AVAILABLE

Radio hobbyists interested in receiving and identifying radio stations in the HF/VHF/UHF radio spectrums now have a new whopping 1414 page CD-ROM publication to aid them.

International Callsign Handbook is a concise world directory of various types of radio station identifications covering the military, government, maritime, aeronautical, and fixed radio stations on CD-ROM. Thousands of callsigns and other types of identifiers have been collected from our own personal log book, official sources and dedicated hobbyists who contributed their material.

World QSL Book - Radio hobbyists interested in receiving verifications from radio station now have a new CD-ROM publication to aid them in the art of QSLing. This 528-page eBook covers every aspect of collecting QSL cards and other acknowledgments from stations heard in the HF spectrum.

"I'm impressed. This is a comprehensive collection of worldwide radio identifiers likely (and even some less likely) to be heard on the air. Over the years the Van Horns have earned the well-deserved respect of the monitoring community. Accurately assembling a collection like this is a mammoth undertaking. Congratulations on a job well done."

Bob Grove - December 2008 *What's New Column*, *Monitoring Times* magazine

Both books may be ordered directly from Teak Publishing via email at teakpub@brmemc.net or via our two main dealers, Grove Enterprises, www.grove-ent.com, and Universal Radio, www.universal-radio.com.



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RADIO RESTORATIONS

BRINGING OLD RADIOS BACK TO LIFE

Marc Ellis, N9EWJ

marcellis@monitoringtimes.com

Introducing a New Project

Before we get started on the next restoration project. I'm turning over the beginning of this column to guest author Brian Rogers with his lively story about how he made a silk purse out of what seemed to be a sow's ear.

❖ Resurrecting a Garage Sale Find

It's been said that one person's trash is another's treasure. The axiom is ever so true about me and radios. I'm no technical restoration genius; but frequently, over the years, I've picked up a radio someone else thought was toast and had it working with simple fixes after only a few minutes' work. And my wife has gotten very good at cleaning and polishing cabinets, cases and dial faces.

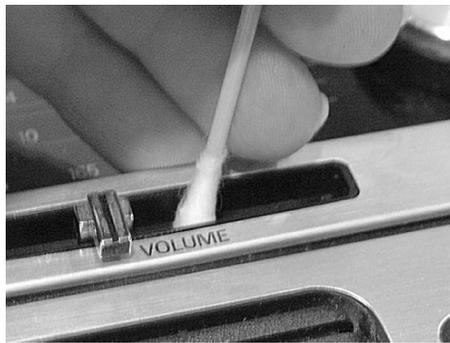
Once she brought home, from a church rummage sale, a Zenith tube-type, table-model set from the late 1950s; the seller said it didn't play. I plugged it in, turned it on (which the experts say you shouldn't do with a radio that hasn't been played in a while) and, about a half a minute later, was rewarded with beautiful sound from its speaker. The person who sold it simply was not familiar with tube radios needing time to warm up.

At a recent nearby estate sale, I saw a clean-looking multi-band, solid-state portable marked \$6 on a strip of masking tape stuck to its top. I guessed the radio dated from the late 1970s. The sale had only a couple of hours to go; and, as we entered, the man at the door told us everything was now half price.

I didn't recognize the brand name, Westminster; but what did I expect for less than what I'd



Brian Rogers' Westminster ready to go on display in his family room.



All it took to get the three-dollar radio back in operating condition was some careful attention with Q-tips and contact cleaner.

pay for a pizza, a Zenith Transoceanic? It wouldn't even be a large pizza! I picked it up and gave it my "sniff test," trying to determine if it had been used in a smoky environment. If it had, I would have put it back down and walked away. It would have been harder to clean both inside and out. And, since I quit smoking 30 years ago, the odor of tobacco smoke bothers me.

Three bucks for a radio! I figured if I couldn't get it working I could probably have it fixed and still be money ahead.

After I got it home, I plugged it in and was pleasantly surprised that there was no brilliant purple flash followed by all our lights going out. I turned it on, and was greeted with no sound save for loud scratching every time I turned a knob or moved a control.

There are folks who would trash a radio that did that; but frequently it's only a symptom of dirty contacts inside. So I unplugged the set, removed its back and went looking for cotton swabs, small rags and contact cleaning liquid.

The radio had sliding lever controls for volume, tone and squelch and the on-off switch was separate from the volume control. I first squirted contact cleaner on a cotton swab, stuck the swab into the areas occupied by each control, let the liquid penetrate for a moment, then vigorously worked the lever back and forth to the limits of its travel.

After about twenty minutes of squirting, wiping and swabbing, I plugged the radio back in and switched on the power. Tuning on the medium wave band, I heard, sounding perfectly clear on 950 kHz, WWJ, 20 or so miles away in Detroit. Several other Detroit and Canadian stations also came in well. Switching to FM, I heard Detroit classical music station WRCJ on 90.9 MHz and the city's NPR outlet, WDET, on 101.9 MHz.

I was pleased to have saved a nice old radio

from a one-way ride in a trash can. It will now live honorably in our basement instead of, perhaps, ending up unwanted, unused and unloved in a landfill.

Brian Rogers, brogers3909@sbcglobal.net

I'm a dedicated scrounger myself, and I can't resist tacking on a story about one of my finds, even if it doesn't involve a radio. Browsing some years ago in a thrift store, I saw a beautiful, mint condition, reproduction of a "Regulator" pendulum wall clock. It was displayed on the floor – of all places. Besides telling time, the clock struck the hour and the half-hour and had an extra hand pointing to the date.

The price sticker said it was just \$49.50. And, as I was kneeling to study the clock, the attendant advised that it was on sale for half price because it didn't work. As I put the cash into his hand, I said "You know, a clock like this has to hang on the wall in order to work." I wish I had a picture of the expression on his face as realization dawned! The beautiful "Regulator" has been keeping perfect time in our family room ever since! -- M.E.

❖ Unfinished Business

Before getting into our new restoration project, I have a postscript about our previous one: the BC-1206-C low frequency aircraft receiver. I had been stymied by a buzz saw-like noise that appeared throughout the frequency range of the radio. After conducting several tests, I concluded that the noise was almost certainly not originating in the receiver or power supply, but rather coming from the outside.

After last month's article, I dug out a BC-344 low-frequency receiver that I had overhauled in this column some months back. This is a much more serious receiver than the BC-1206-c, weighing some 60 pounds to the 1206-c's not quite four. Tuning it throughout the 1206-c's frequency range, I heard the same buzz saw noise, though not as loud. I attribute that to the BC-344's much better shielding.

And before I leave the topic, I want to thank Kevin Carey of the *Below 500 kHz* column for his many constructive suggestions and supportive comments concerning this project.

❖ Meissner Kits

Our new project, which is apparently a Meissner Broadcast "7," is one of the well known Meissner kits. But, considering the commanding presence this company once had in the electronic kit market of the 30s 40s and 50s, I'm not able to unearth much in the way of company history

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You'll have a world of fun assembling a MEISSNER Radio Kit, and what's more you'll have a REAL radio at an amazing low cost.

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Model T8CK

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MEISSNER MFG. DIVISION
Maguire Ind., Inc.
Mt. Carmel, Illinois

Write Today for Free Kit Catalog

Upbeat Meissner ad from a 1950s Popular Mechanics was aimed at younger hobbyists.

right now.

What I do know is that Meissner was (and still is) located in the little town of Mt. Carmel, Illinois. A major manufacturer of coils and transformers, the firm eventually expanded into the electronic kit market, where it became a major player. Equipment built from Meissner kits, often with chassis and cabinets in the company's "Crackline" (black crackle) finish, turns up frequently at radio meets and on e-Bay.

Eventually the company merged with Thor-darson, with Maguire industries as the parent company, and gave up the manufacture of kits in favor of transformers and other electronic components. If anyone can expand on this admittedly sketchy history, please contact me and I will share the information in a future column.

Locating information on a Meissner kit is usually not much of a problem because of an unusual marketing tactic practiced by the company. Meissner regularly published "How to Build" instruction manuals, containing useful electronic reference material as well as assembly instructions and technical information for every kit in the line. I have a 1949 version as well as a reprint by Lindsay Publications of a 1943 edition.

Neither one is marked with an original price, and I have no idea how they were distributed. I'm imagining that a free one was supplied with each kit — thus providing the buyer with the instructions he needed as well as stimulating him to purchase additional projects in the future. These books turn up frequently at radio meets, and I've also seen them on e-Bay and amazon.com. They are fun to study even if you don't have one of the kits.

❖ The Broadcast "7"

The Broadcast "7" is also called the 7-Tube AC "Utility" Broadcast Superheterodyne Receiver in Meissner literature. (The quotes are Meissner's; they seemed to love to use quotes in their product and publication names.) I believe my set is a Broadcast "7." However, its slide-

rule dial has a 6-18 MHz scale in addition to one for the broadcast band. So, naturally at first I assumed that I was dealing with a broadcast and shortwave radio — specifically the Meissner 7-tube Broadcast and Shortwave Receiver.

In comparing the chassis layout drawings, I noticed that the layout of the r.f. transformers and tubes in the front end of my radio seems to match the two-band set more closely than the broadcast only set. However, my set has no bandswitch — which is an obvious and necessary feature of the two-band radio.

So, it appears that we have a mystery on our hands. For now I'm operating on the premise that the two-band dial was a supplier's mistake that the original kit builder didn't bother to correct and that the front end layout anomaly is a production variation. Perhaps the mystery will unravel once I remove the cabinet and am able to study the chassis wiring.



The Meissner Broadcast "7" as found, except that the feet have been taken off in preparation for removing cabinet.

In the meantime, if any reader has an earlier-than-1942 edition of the Meissner "How to Build" book, I'd like to compare notes. Perhaps my variation of the Broadcast "7" will be found there.

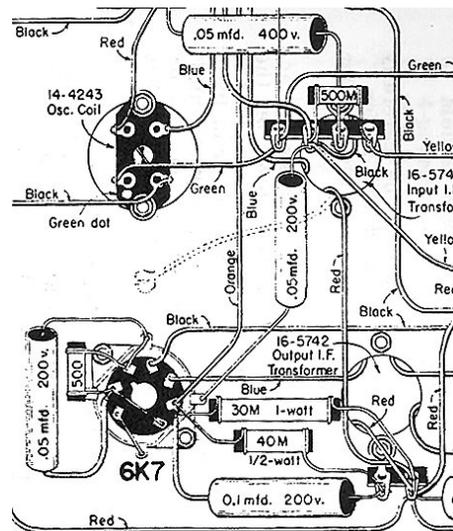
The tube complement includes a 6K7 r.f. amplifier, 6A8 oscillator-mixer, 6K7 i.f. amplifier, 6Q7 detector/first audio and 6V6 final audio. The remaining tubes are the 5Y4 rectifier and 6G5 tuning indicator. The receiver has conventional AVC. Meissner claimed that the two high gain (iron core) i.f. transformers would provide excellent sensitivity and selectivity.

My radio came in a heavy-gauge black crackle steel cabinet that looks like factory issue (the Meissner radios could also be purchased without a cabinet for those who would like to install their set as a built-in or make other arrangements). The parts that are visible are of very high quality and the wiring that is visible seems to have been done neatly and professionally.

The spartan front panel, also black crackle of course, definitely lives up to the radio's "Utility" designation. The controls and dial are arranged simply and symmetrically. Centered above those, a magic eye tuning indicator adds some interest and convenience. There are no labels on the controls.

There is no provision for a speaker in the cabinet, and Meissner did not supply one with the kit. The user must set up an outboard speaker in its own cabinet. Specified is a dynamic speaker with a 1500-2000 ohm field, though a modern PM speaker could be used with a 1500-2000 ohm resistor substituting for the field. An output transformer for matching the 6V6 output tube to the speaker voice coil is also required.

All in all, this looks like a receiver that



Meissner's very clear pictorial diagrams helped even relatively inexperienced constructors achieve success.

means business and that would bring in quite a haul of distant stations when connected to a good antenna for a night of serious DXing!

❖ Next Time

In the next work session, we'll remove the chassis from the cabinet — which will require dismantling the tuning eye assembly from the front panel and removing each of the four cabinet feet. (The threaded mounting screws for the feet pass through the bottom of the cabinet and a flange at the bottom of the chassis. The nuts securing the screws lock chassis and cabinet tightly together.)

Then, since we are dealing with a kit, the wiring will be carefully checked against the pictorial diagram supplied in the "How to Build" book. Careful attention will be paid to the receiver front end wiring to try to reconcile the differences between the parts layout shown in the book and the actual layout in my radio. See you then!

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Active Antennas for Stealthy SWLing

Scanning over recent columns, I see that I've strayed somewhat from one of the main goals I had in mind when I first started writing for *Monitoring Times* – to supply good ideas and methods for stealth operation. Sure, stealth isn't our only goal in radio by any means, but it becomes increasingly important as more and more neighborhood associations and other restrictive organizations take steps to ban our outdoor antennas.

This month, I'd like to take a look at another choice that's not of much interest to ham operators, but that can benefit shortwave listeners. This is the active antenna – an idea that is certainly not new but that has grown ever more refined over time, and whose development and deployment has been accelerated by the increasing need for stealth. Some versions have the capability to enhance reception for medium or longwave listening as well. At least one model on the market even includes VHF and UHF frequencies within its range, and thus may be of interest to FM DXers, scanner users, and others.

❖ A Little Theory

The term "active antenna" might be a bit misleading at first glance. What we actually mean is that an amplifier is placed between the radio's antenna input and a physically small antenna that would probably not be very effective without the help of the amplifier. Often this small antenna takes the form of a whip, telescoping or otherwise, or a loop, either made of rigid metal, or a loop of wire.

At first this might seem like a really simple solution to receiving weak signals – just put a pre-amplifier between antenna and receiver, and everything gets louder. In fact, why not use an amplifier with a full-sized antenna for really spectacular results?

Unfortunately, as often happens in our hobby, things aren't quite that simple. Realize that the signals we want to hear are like boats floating in a vast sea we might call background noise. If we indiscriminately amplify everything coming from the antenna, the noise level will go up along with the strength of the signal we want to hear. Since the receiver's own signal-to-noise ratio remains the same through this process, you're really just back where you started.

So, the real issue becomes – how small of an antenna are we talking about? A three foot long whip, for example, probably can't pick up the noise that a 75 foot longwire can. So, the correct application for a pre-amplifier is an antenna that is severely restricted in size, like that

three foot whip, or a small rigid loop. The main thing to worry about then becomes keeping the small antenna away from powerful local noise sources, like computers, televisions, and other electronics, nearby power lines, and so forth.

Also (and here again, friends, in radio any technical notion is usually several layers deep), it's an oversimplification to think of this amplifier as merely a gain device, boosting the level of the received signal. That's certainly an important part of its job, but what often goes unrealized is that the amplifier is also serving as an impedance transformer, much like our old comrade the antenna tuner. (When an amplifier performs this function, it is sometimes called a buffer.)

The very short antenna, by the ineluctable laws of physics, has a very high impedance due to its large capacitive reactance, which left uncorrected would present quite a mismatch to our radio's nominal 50 ohm input impedance. But the circuits commonly used for an active antenna's amplifier have high impedance input – accommodating the small antenna – and low impedance output, effectively "matching" the small antenna to the radio's input impedance. All of this presupposes that the radio in question has a 50 ohm antenna connection; often, portable sets don't, but have the small whip antenna series-fed to the radio's input through a small capacitor to help accommodate the whip's high impedance.

Why not just use a tuner to match the antenna to the radio? There are a couple of factors to consider here. While it's true that the tuner might be able to match the impedances, or at least minimize the mismatch, it can't do anything about how small the antenna is. There's a limit to how much signal an antenna of a given size can gather. The tuner can only transform impedances; it can't do anything to increase the strength of a received signal.

In fact, even the very best tuner will cause a certain amount of insertion loss, however tiny, because the signal must travel through the capacitors and inductance of the tuner's circuit. Normally, we're working at high enough signal levels, due to a large enough antenna, that this isn't enough loss to worry about. Make the antenna small enough, though, and the amount of signal it can gather begins to be a factor.

That's the beauty of the active antenna. Not only does the amplifier's circuitry accomplish the impedance matching, it turns the tables on insertion loss and boosts the tiny received signal considerably. Plus, since the circuit is handling the matching, there's no fiddling with the controls of a tuner. Some of the active antenna circuits do include dial or switch settings for frequency to maximize results, but that's about it. I think most of us will readily accept the trade-off – some small additional control adjustments, in exchange for "full-size antenna"-type results from a small, portable, concealable device. Now the SWL can fully enjoy the hobby anytime, anywhere, without incurring the wrath of the Outdoor Antenna Gestapo.

❖ Three Active Alternatives

In the first photo we have the flagship of active antennas, the AOR LA-390. This beauty looks super cool just sitting there. But it's packed with features and capability. The loop is twelve inches in diameter, so the unit's not going to be hard to conceal or to carry around. It covers an astonishing range of 150 kHz through 500 MHz in five switch-selectable ranges. The first four ranges cover longwave, mediumwave, and low and high shortwave (up to 30 MHz). On these four ranges the unit provides 18 dB of gain, and the metal loop is rotatable to maximize reception from a given direction or to null out noise.



AOR's LA-390 active antenna. (Courtesy Universal Radio, Inc.)

On the fifth range, the unit becomes a non-directional, wide-band antenna system that provides 14 dB gain and covers the amazing range of 30 to 500 MHz. Quite a lot of performance packed into one device, and very useful to LW, MW, SW, FM, aircraft and scanner enthusiasts of every stripe.

Next up we have the WinRadio AX-17C, billed as an "active ferrite antenna," somewhat like the C Crane Company's unit we looked at in the August issue. The AX-17C covers 100 kHz through 30 MHz, though the manufacturer hastens to point out that it is optimized for shortwave (2-30 MHz) and thus is not a stellar performer on long- and mediumwave.

There are no controls to fiddle with; just



The WinRadio "active ferrite" antenna. (Courtesy WINRADIO Communications)

connect it to your radio and power it up. You are also encouraged to try the trick of taking the lead-in wire from an outside antenna, wrapping a few turns around the AX-17C, and grounding the end, which may improve the outdoor

antenna's performance considerably. Like the AOR device, the WinRadio unit will perform best when near a window, since radio waves are more certain to pass through window glass unimpeded than through the various wires, pipes and metals that live in the walls of your building.

The big selling point of this unit, aside from its simple operation, is the small size. You can park it unobtrusively on a windowsill. It, too, may need to be turned one way or another to maximize reception, or to null out a noise source, like power lines or a personal computer.

Lastly let's look at the MFJ 1020C Tuned Active Indoor Antenna. This one uses a telescoping whip antenna element instead of a loop or a loopstick. Covering a range of 300 kHz to 30 MHz, it features controls for band selection, tuning, gain, and on/off/bypass. Unlike the other two units, this one is listed as being powerable by a regular 9 volt battery, which would enable its use in a portable scenario. Of course, it too can be powered with a "wall wart" DC adapter.

MFJ touts its performance as "rivaling outdoor antennas hundreds of feet long," which sounds pretty impressive, and they also point

MFJ's active antenna/preselector unit. (Courtesy MFJ Enterprises, Inc.)



out that the 1020C can be used as a preselector between an outdoor antenna and your radio to improve selectivity, reduce intermodulation interference, and improve gain. If it resembles the performance of MFJ's antenna tuners, I'm definitely sold.

All three of these fine active antennas can be examined and purchased from the Grove Enterprises online catalog, at www.grove-ent.com. You'll find all your listening needs covered on this excellent website – from the catalog, to timely, pertinent information and suggestions from Bob Grove himself. If you haven't seen this website yet, check it out.

That's our look at active antennas. Join me here in the November issue for more fun with antennas. Until then, friends, happy operating!

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Shortwave Listening in Your Car

I've wondered for a long time why it's so hard to find shortwave radios built into cars. In the fifties and sixties, hams mounted HF transceivers in their cars, and that was not easy since rigs were physically large and they also required DC-DC converters to produce the high voltages needed for those tube rigs. But they did it anyway.

Then AM radio gave way to AM/FM and even AM stereo. Still, there were no manufacturers making AM/FM/SW car radios. I suppose they considered all of us SWLs too niche of a market, but it could have helped build our hobby into a bigger one if car stereos had had shortwave frequencies available.

Sony does now make one car radio with shortwave capability, the CDX-GT180 (\$220), available only through the Canadian online retailer www.shortwavestore.com. I went to a large U.S. electronics store – Fry's – and asked the car stereo clerk if anyone made car stereos that could pick up shortwave frequencies. He said, "You mean like CB?" I told him I wanted to listen to the frequencies between the AM and FM broadcast bands. He said, "Wow, we don't get too many questions like that. You would have to go to specialty audio store, and you would also need a special antenna."

So, I got to wondering just how you could get a reasonable antenna on your car and connect it to a shortwave receiver. But since this column is about PCs and radio, I thought it would be fun to see if I could use a Software Defined Radio receiver and a car PC to do it.

Turns out I had everything I needed to try an experiment. I reviewed the RFSpace SDR-IQ in this column several months ago, so I already had

an SDR. And I could easily connect it to a laptop for testing. I even found some USB-powered speakers to get a little more oomph out of the sound, without having to resort to figuring out how to tie the PC speaker output into the car's speakers. See Photo 1.

❖ A Mobile Antenna for SW

The only thing left was connecting an antenna. I knew I could attach a CB antenna to the car with a magmount, which might work OK for the upper HF bands. But, I wanted a cleaner solution with wider bandwidth. For this, I wanted to use the existing car antenna jack. A quick trip online netted information about how to remove the radio from the dash of my Toyota Tacoma so that I could get at the radio antenna cable.

Radio Shack had a Motorola female-to-BNC male adapter (P/N 278-117) which allowed the antenna to connect directly to the SDR-IQ. I actually used an extender cable to allow the SDR-IQ to be placed on the floor of the truck. It wasn't pretty, but this was an experiment, after all.

I installed and ran SpectraVue software that comes with the SDR-IQ, told it there were no radios connected to it so that it would act as a radio receiver and not a panadapter for a transceiver. I selected 5.000 MHz AM, hoping to hear what should have been a strong WWV signal. I could see the carrier, but could not hear anything but static.

Luckily, my Toyota Tacoma has a removable antenna. A trip to AutoZone yielded a replacement aluminum antenna (Pilot AB-128) and a set of adapters that allows its use in a variety of vehicles.

That antenna did not work much better unless I held onto it. "Needs wire!" I thought. So I stripped a few inches of insulation off the end of some 18AWG stranded wire and wrapped it around the top of the antenna. I draped my new "long wire" across the roof of the truck and tied it off on a hook in the bed of the pickup. Lo and behold! I could now hear WWV at 5, 10 and 15 MHz. See Photo 2.

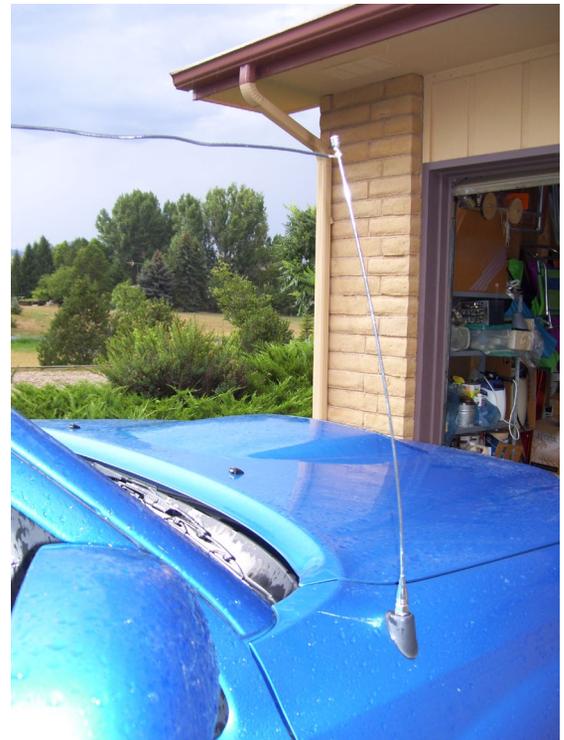


Photo 2. Replacement aluminum antenna mounted on truck with insulated wire running diagonally across the roof and into the bed of the pickup on the opposite side. The antenna bows slightly in order to make the wire as tight as possible.

I wanted to go for a test drive to see if I could pick up more stations in a quieter RF environment. First though, I needed to solder the wire together to keep it from unraveling in the wind. I didn't want to be trailing a wire behind my truck!

With my decidedly jury-rigged set-up, I started the engine and drove off. The first problem was ignition noise. Drat! Well, have to get back to that later, since it could be induced almost anywhere. Just finding a quiet place to listen to shortwave broadcasts would be fine. With a copy of *MT's* shortwave frequency guide in hand, I drove to a secluded spot away from power lines where I could try to listen to more stations. And they were there! I was able to find Radio Havana, Radio Australia and WWV without even trying.

Tuning consisted of clicking to the left or right of the center, and it was pretty easy to find strong carriers by just looking at the spectrum display, then selecting that frequency by clicking on the carrier. Photo 3 shows one such station.

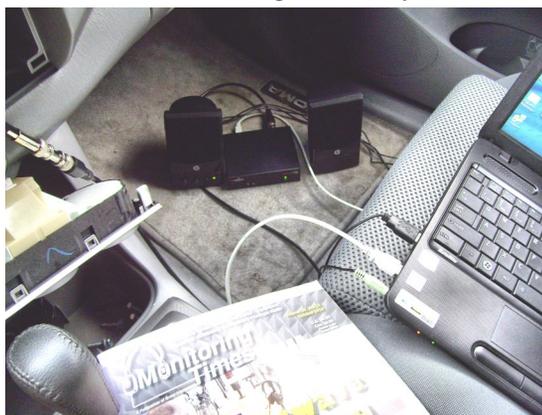


Photo 1. SDR-IQ and USB-powered speakers on the floor are connected to the laptop, with the center radio and environmental controls removed to gain access to the radio antenna.

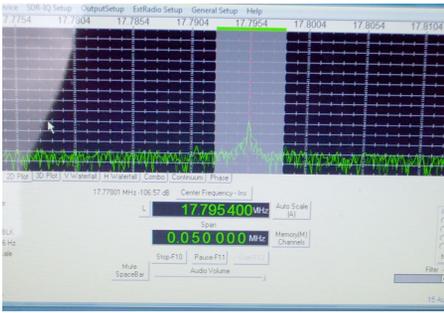


Photo 3. SpectraVue display showing an AM station being received at 17.7954 MHz. Audio from the SDR-IQ is sent back to the PC via the USB port, and played via the PC's sound card.

❖ Help from the Younger Generation

OK, so my idea worked. Now it was time to figure out how to integrate all this seamlessly into a vehicle.

Here, I had a little help from my son. Since the day he was born 29 years ago, he's been interested in cars. In his playpen, he only liked things that turned. As a toddler, he made Lego cars and played with Hot Wheels. That led to remote control cars and then radio control cars. In college, it was Formula cars that he and his SAE team at Colorado State University built and used in competition. Now he designs turbos for the company he works for. In short, he is into cars.

Along the way, he discovered that there were many ways to improve the performance of a car. He streamlined the whole airflow system in his Toyota Supra, eventually getting 800 Rear Wheel Horsepower out of it. One of the tricks



Photo 4a (above) shows the in-dash PC mounted in the space formerly occupied by the AM/FM/CD player. The pop-out monitor is directly below the PC. Photo 4b (below) shows the monitor in its extended position, with Microsoft Windows XP on the display.



he used was to replace the control system with software that allowed the whole system to be tuned. To do this, he installed an in-dash PC that he bought from www.mp3car.com, one of several places from which you can buy PCs made for cars, as well as in-dash monitors, AM/FM receivers (to replace the functionality lost when you install a PC and/or a monitor in your dash), and more.

The PC he used ran Windows and has VGA, USB, IEEE-1394 and soundcard interfaces. He installed a VGA made by Xenarc that occupies only one DIN unit in his dashboard. Push it in and it pops out and extends, covering the PC. See Photos 4a and 4b.

As with any PC, you simply install the desired software and you're ready to go. The small size of the monitor can be an issue, so be sure to select one with high resolution. The one shown here has a resolution of 1024 x 768.

❖ The Problem of Power

Car-mounted PCs have one other important issue – power. If the PC case does not have a built-in power supply (such as the M3-ATX, available from www.mini-box.com, shown in Photo 5), you need to get one. Windows software requires that the PC follow a shutdown procedure to avoid data corruption, and these supplies take care of that for you. Power must be stable during shutdown, so switched power is used only to tell the power supply whether to turn PC power on or off.

If you don't want to alter your dashboard to install a PC and/or monitor, you can mount the PC under a seat or even in the trunk, and you can now purchase pop-down video displays for some vehicles. The main difficulty will be getting enough wire in the air to get good reception.

If you choose to do what I did by replacing the existing car antenna but you don't want to eliminate your existing radio, you will need to remove the antenna cable from the radio and connect a splitter to it, then connect one lead

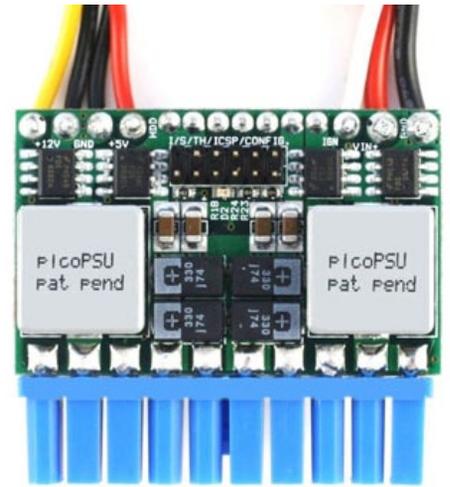


Photo 5. This is a switching power supply meant for use in a vehicle

to your existing radio and route the extra lead back to wherever you have placed the shortwave receiver.

There are some alternatives to a long wire antenna. One, made by Kaito, is the KA35 Active LW/MW/SW Antenna (www.shortwavestore.com/ka35-kaito-active-lw-mw-sw-antenna.html). I have not tried this product, but an amplified antenna should work pretty well in this application.

Tuning in a station requires you to use software, so you won't want to do this while driving. A passenger should be there to help, or you need to find some favorite stations and select them before you start driving. But don't let that deter you from enjoying shortwave listening in your car! And by using a car PC, you can do all the other things that a PC lets you do – surf the internet (yes, these PCs have available Wifi interfaces), play games, watch movies and so on. The touchscreen allows you to use a simulated keyboard when you need to enter information, but you can also hook up an external keyboard and mouse.

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The Future is Now for Mode-S Monitors

By Larry Van Horn, N5FPW
MT Assistant/Technical Editor

In my last few *MT On The Bench* columns, I have presented information about various aviation IFF (Identification Friend or Foe) modes and newer systems being implemented by aeronautical organizations/governments worldwide.

In this month's column, it is time to take a look at what the future will bring for Mode-S monitor enthusiasts – a future that you can start monitoring right now – ADS-B.

❖ What is ADS-B?

The most recent and most compelling use of Mode S has been in the area of Automatic Dependent Surveillance-Broadcast (ADS-B). This government acronym can best be explained when the individual components are broken down.

- Automatic – there is no interrogation needed to start the data or squitter coming from the transponder.
- Dependent – it relies on onboard navigation and broadcast equipment to provide information to other ADS-B users.
- Surveillance – it is a means of automatic surveillance and traffic coordination.

Under ADS-B, each aircraft periodically broadcasts its identification, position, and altitude. These broadcasts can be received by ground sensors and other aircraft for surveillance.

This system of broadcasting addresses the major deficiency of Traffic Alert and Collision Avoidance System (TCAS) – accuracy. In the TCAS system, aircraft positions are only accurate to a few degrees; thus, the accuracy of TCAS decreases with distance. Moreover, the reliance on transmission timing for range data in TCAS is error-prone. The method used by ADS-B avoids this problem.

As I mentioned in my last column, DF17 is the integral and working portion of the automatic dependent surveillance broadcast (ADS-B) system. This DF17 Mode S extended squitter (also known as the GPS squitter) is a component of ADS-B which was proposed, developed, and demonstrated by Lincoln Labs. A participating aircraft broadcasts (“squits”) positional information using a modified Mode S transponder. The positional information comes from a source of global navigation, such as a Global Positioning Satellite (GPS) receiver.

Our U.S. air traffic control system will reap some major benefits when ADS-B is fully implemented. Some of the benefits of ADS-B technology include:

- Provides air-to-air surveillance capability.
- Provides surveillance to remote or inhospitable areas that do not currently have coverage with radar.
- Provides real-time traffic and aeronautical information in the cockpit.
- Allows for reduced separation and greater predictability in departure and arrival times.
- Supports common separation standards, both horizontal and vertical, for all classes of airspace.
- Improves ability of airlines to manage traffic and aircraft fleets.
- Improves ability of air traffic controllers to plan arrivals and departures far in advance.
- Reduces the cost of the infrastructure needed to operate the National Airspace System.

ADS-B is a surveillance technology for tracking aircraft as part of the Next Generation Air Transportation System (NextGen) being developed by the FAA here in the United States. With ADS-B, Mode-S equipped monitors, air traffic controllers, and pilots will see the precise location of every equipped aircraft. Pilots will also have real-time access to weather, terrain maps, and flight information. The ADS-B infrastructure and services are planned to be complete National Air Space-wide by 2013. The United States will require the majority of aircraft operating within its airspace to be equipped with some form of ADS-B by January 1, 2020.

If you want to see where the full system has been implemented, check out this FAA website: www.faa.gov/nextgen/flashmap/. As this is being written, there are 280 operational ground stations in the national air traffic control network (see the map graphic).

Do not let a lack of ADS-B system development in your area of the country discourage you from putting up a Mode-S monitoring system. Any ADS-B equipped aircraft flying over U.S. airspace will transmit their Mode-S and (if equipped) ADS-B signals continuously, and if they are in range of your ground station you can receive it.

Right now many of the U.S. Department of Defense transport aircraft are commonly seen transmitting ADS-B signals, but no position reporting is enabled. One of the big reasons this class of aircraft are equipped right now with ADS-B hardware is due to their frequent deployment overseas, specifically Europe, where this technology is required to fly in that airspace.

In the near future, don't expect a flurry of ADS-B signals from Southwest airlines or other regional air carriers, but if a particular aircraft is used in service overseas, chances are it will have ADS-B and most will have positioning implemented.

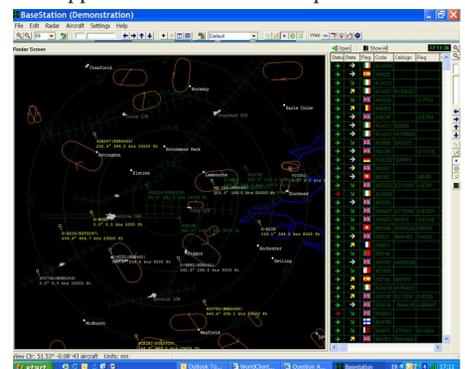
❖ Mode-S/ADS-B Monitoring Equipment

So what do you need to monitor Mode-S/ADS-B signals? The answer is a Mode-S virtual radar set or receiver, a receiving antenna (an outdoor antenna is the best option), and a computer/monitor combo to decode and display the results from the data stream.

A virtual radar set is a 1090 MHz receiver used to receive the Mode-S/ADS-B signals from commercial and military aircraft and, increasingly, from “general aviation” aircraft. Most of the receivers in the marketplace will have supplied software that will allow the decoded information to be displayed on both tabular and graphic form, like a radar screen display.

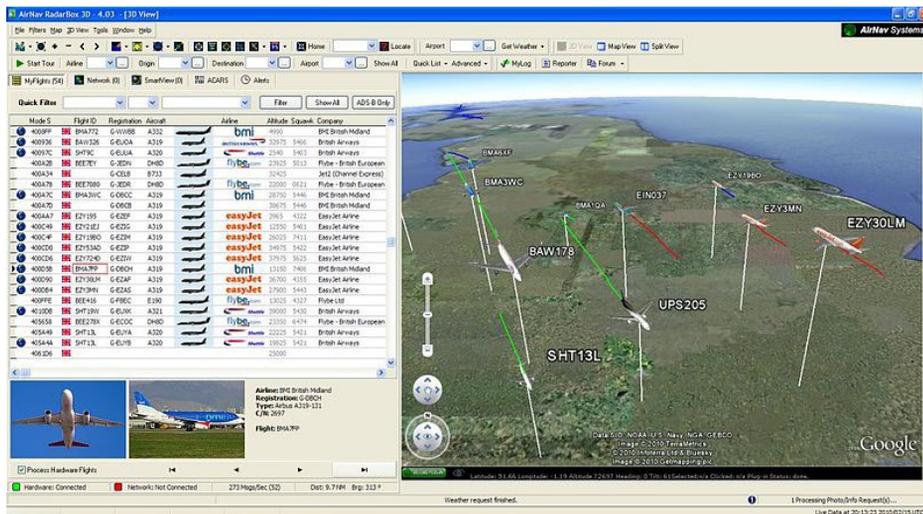
Known as radar spotting, this portion of our radio hobby has had a strong foothold in the European radio community for several years now. This is due to the requirement that aircraft there must be equipped with Mode-S/ADS-B equipment. As a consequence, most of the major manufacturers of Mode-S hobby equipment are based in Europe, particularly in the United Kingdom where the plane spotting hobby is the strongest.

There are two major European-based players in the Mode-S receiver marketplace: Kinetic Avionics Products Limited (www.kinetic-avionics.co.uk) and AirNav Systems (www.airnavsystems.com). Both companies make excellent products and have good reputations for support and service of their products.



❖ The AirNav RadarBox

The RadarBox is the flagship product for AirNav Systems. The unit is a Windows PC software and hardware package which allows appropriately equipped aircraft to be seen on a simulated radar screen. A small receiver connects to the PC via USB, and aircraft are detected



using the small supplied antenna.

By decoding the ADS-B (Automatic Dependent Surveillance Broadcast) transmissions, those aircraft transmitting position info are displayed on a computer in a display similar to that used by Air Traffic Control. Flight number, aircraft type, altitude, heading, speed are visible and updated every second.



The RadarBox system can be used at any location, either as a stand-alone system or connected to the Internet, which allows additional functions. An internal map database provides 3D multi-window maps with worldwide coverage and geographic points which include airports, runways, VOR/VORTAC, NDB, navigation fixes, cities, roads, airways and elevation data.

When the PC running the RadarBox software is connected to the Internet, the RadarBox Network function is available. This allows viewing of data received by other RadarBox users all over the world. Network data is delayed by five minutes by default, but real-time network data is also available.

The screen consists of two major sections, the "radar" map and the tabbed information area. The map can be scrolled and zoomed using the mouse to view any area on the Earth's surface. Aircraft symbols and associated data blocks show flight information which includes aircraft type, registration and altitude. The information area allows viewing of aircraft lists for both live and network aircraft and gives access to other functions which include alerting and fleet watch displays.

❖ SBS-1 Mode-S Receivers

The SBS-1eR receiver is the flagship product of Kinetic Avionic Products Limited. The SBS-1eR is a portable, low-cost Mode-S/ADS-B receiving station with a built-in VHF/UHF/FM broadcast/

airband radio receiver. It is supplied with a portable magnetic mount antenna and their BaseStation Virtual Radar software. Like the AirNav RadarBox, the SBS-1eR allows you to track and listen to ADS-B aircraft on your own radar style screen and identifies/displays Mode-S equipped aircraft.

With the SBS-1eR you can connect the unit to your laptop/desktop to your Windows-based PC via USB or Ethernet. The built-in receiver can be used to monitor VHF or UHF aircraft frequencies and the FM radio includes a built-in RDS decoding capability.



The audio output is via a 3.55mm stereo jack or it can be streamed over USB/Ethernet, and onto the Internet. The BaseStation software can also handle receiving ACARS digital signals using an audio port, but does require a separate ACARS decoder that is available as Freeware.

With the SBS-1eR ethernet capability you can connect to this Mode-S receiver via your home network or over the internet. If you have fixed IP you can watch your SBS-1eR activity from any location in the world. It also means of course that you can view the SBS from any PC on your home or office network. The permutations of what you can do with wireless routers and fixed IP addresses are nearly endless.

❖ Final Note on Equipment

There is no way I can go in-depth in this month's column on all the equipment available for Mode-S monitoring. I suggest you consult the resources online that I have provided in Table 1.

One area that does need to be addressed before I close is antennas. 1090 MHz is a line-of-sight frequency. In order to get the best results, an outdoor antenna is highly recommended. While it is true that the higher the aircraft flies, the larger the range of its signal and therefore the more lengthy your reception, the arrangement of

the antenna in your home will also have a major impact. Any and all obstructions (tall buildings, hills, mountains or forests in your area) will block reception. This will cut down the quantity and quality of the Mode-S signals you receive. A good quality outdoor antenna and coax, such as those available from DPD Productions (see table 1) will make a big difference in what you will see on the computer screen.

I have been an aviation monitoring hobbyist for many years. Like many, I've monitored not only the voice communication, but the digital aviation related communications as well. I started with ACARS set-ups and software. I tried HFDL monitoring using my shortwave radios and the MultiPSK software package. I've tried them all and they have been a lot of fun. But, I have always been on the lookout for something new and different.

Without question, the coolest digital monitoring I have experienced is monitoring Mode-S/ADS-B. Before Mode-S systems arrived on the scene, the best a hobbyist could do was to tune a high-end scanner/receiver to 1090 MHz and just listen to the short buzz that aircraft transponders would emit, as they were "illuminated" by the air traffic control station. Now I'm a full participant in the airspace in and around my listening post.

But, before you make the leap and buy a Mode-S monitoring system, I do have one important caveat to pass along. Don't buy a system unless you are fully prepared to deal with the addictive nature of this radio monitoring. If you choose to take on the risk, join the fun!

Table 1 – Mode-S/ADS-B Reference Guide

- Active Display Lite www.gatwickaviationsociety.org.uk/ADL_home.asp (Software)
- ADS-B Decoder (Russian) <http://diseqc.org.ua/projects/hard/adsb/index.html> (Homebrew)
- Airframes.org www.airframes.org/
- AirNav Systems www.airnavsystems.com/Radar-Box/
- Aurora Mode www.auroraeurotech.com
- Bones Aviation Page www.homepages.mcb.net/bones/index.htm
- DPD Productions www.dpdproductions.com/ (High-end 1090 MHz antennas)
- Easy ADS-B decoder <http://xavier.fenard.free.fr/fxad.htm> (Homebrew)
- F5ANN Mode-S Projects (French) <http://f5ann.pagesperso-orange.fr/> (Homebrew)
- Gatwick Aviation Society (Mode-S lookups) www.gatwickaviationsociety.org.uk/modeslookup.asp
- Kinetic Aviation www.kinetic-avionics.co.uk/
- Kloth.Net www.kloth.net/radio/
- MiniADSB (German) <http://miniadsb.web99.de/> (Homebrew)
- Pinkfoot <http://my.pinkfoot.com/> (Aviation and Marine iPhone/Touch/Pad and Android Smartphone Apps)
- Plane Finder <http://planefinder.net/> (Sponsored by Pinkfoot)
- Plane Gadget Radar www.radargadgets.com/
- Plane Plotter www.coaa.co.uk/planeplotter.htm (Software)
- RxControl Mode-S Receiver <http://rxcontrol.free.fr/PicADSB/index.html> (Homebrew)
- SBS Support Pages by jetvision <http://jetvision.de/sbs.shtml>
- Ship Finder <http://shipfinder.co/> (Sponsored by Pinkfoot)
- Simple ADSB Receiver www.ill.lu/~edward/edward/adsb/Very%20Simple%20ADSB%20receiver.html (Homebrew)

The Poor Man Investigates ... the World's Worst World Receiver?

By Eric Bryan

The Bell + Howell 9 Band World Receiver is an analog-tuned pocket radio with MW, FM, and seven shortwave bands. It has the extended FM band and covers the 49, 41, 31, 25, 22/21, 19, and 16 meter bands. This radio first appeared several years ago, and can occasionally be found used or new for about \$10. I bought one at a garage sale for 50¢ (batteries included!).

When I first saw it, I remembered the horrendous reviews the radio has received over the years. Many were the most vitriolic, negative reports I'd ever seen of a pocket shortwave set. There seemed to be passionate hatred for this receiver amongst the radio hobby crowd.

It's been my experience that the writers of the most extremely negative reviews of low-cost, pocket shortwave radios dismiss them out of hand with knee-jerk reactions based on comparisons with high-end equipment. It also seems apparent to me that often the writers of these reviews simply didn't try very hard to get performance out of the cheap radio in question. They usually describe a cursory run through the bands leading to a quick consignment to the junk drawer.

I thought that seeing what a cheap pocket set can do required more patience than that. And now that I had one of these models virtually for free, I was curious to put it to the test and see for myself if these rancorous reviews were justified. Is this really the pocket shortwave radio from hell? Is it truly, a piece of junk which you should avoid? Or, if you haven't managed to avoid it, should you immediately throw yours away as some reviewers advised?

Bearing in mind that this radio usually went for about half the price of the Grundig Mini 100PE or the Kaito WRX911, I wanted to see what just what it could do. Here's what I found.

Features

The radio measures roughly 5"x 3"x 1" and runs on two AA batteries. The 21-inch telescopic antenna, which folds down onto the top of the cabinet, swivels side to side but doesn't rotate. On the left side there is a center-negative DC3V power jack, an earphone jack, and the volume/on/off switch.

A tuning knob and wrist strap are on the right side of the cabinet, and a small world time zone map is on the back (requires a magnifier for use). On the front of the radio are AM/SW and

FM selector buttons, and a vertically oriented analog dial face. Mediumwave and a dial scale are on the left, followed by the 49 to 16 meter shortwave bands, with the FM band on the far right of the scale.

At the base of the dial face is a red LED signal strength indicator, a green LED MW/SW indicator light, and a red LED FM/TV light.

On the top of the cabinet above the dial face is a slider switch to select mediumwave or any of the shortwave bands 1-7. Although, as will be seen, the information was of limited use, the frequency range of the shortwave bands as listed on the dial face are shown in Table 1.

TABLE 1: FREQUENCY COVERAGE

49 meters	5.90-6.90 MHz
41 meters	6.90- 8.10 MHz
31 meters	9.30-10.30 MHz
25 meters	11.60 -13.50 MHz
22/21 meters	13.00 -15.00 MHz
19 meters	14.80-16.50 MHz
16 meters	17.10-19.10 MHz

Performance

When first firing up this little receiver in the middle of the day local time, I was able to tune WWV on 10000 kHz without much trouble. I was happy to see the calibration here was correct, with the needle straight across 10.00 MHz. Unfortunately, the calibration further down 31 meters quickly became extremely inaccurate.

On my Degen DE1103 I could hear CBC Quebec on 9625 kHz, despite the adjacent REE via Costa Rica on 9630 kHz, I wanted to try



the same on the Bell + Howell. I wish I could have! The frustrating thing was that 31 meters bottomed out at 9630, despite the dial setting reading 9.30 MHz. REE sounded good, but I could not tune below that to see if this little unit could pull out CBC next to it.

From the reception capabilities I found on this radio, CBC 9625 should have been listenable had I been able to tune the radio to this frequency.

Tuning was a little stiff, and some rocking back and forth was necessary to settle correctly on the desired frequency. For the most part, signals were not crammed together or difficult to separate.

In the late afternoon I found Radio Australia on 17795 kHz with a decent signal using the whip. Clipping on the wire made the broadcast easily listenable and enjoyable. But here again frequency calibration was an issue: The dial read somewhere around 18.40 MHz – fairly atrocious, but endemic with some of these small analog sets made over the last decade or so.

Calibration on 19 meters was similarly poor, with WWV 15000 kHz just squeaking onto the band well below 14800 kHz, and the Voice of Russia on 15425 kHz appearing at 15800 kHz. That's horrendous, but hearing VOR in English with room-filling sound and quality is making me feel very good about that 50¢ expenditure. It really sounded quite nice and clear as I sat there listening to a program covering the Greek economy, with the red tuning LED glowing on and off with the good signal.

As I explored the bands and sampled these broadcasts, the radio exhibited a moderate frequency drift. When settled on a frequency, such as that of the Voice of Russia's English broadcast, I found I needed to retune frequently,



BELL + HOWELL 9 BAND WORLD RECEIVER

but not constantly.

In experimenting to find the best shortwave reception, I alternated between using the whip and clipping on a short indoor wire. In some cases reception quality was excellent with the wire detached, and sometimes the set would overload with the wire clipped on. A more efficient method for dealing with over-strong signals was to simply leave the wire antenna attached and flip the DX-Local switch to Local.

If a signal was suffering from interference, reception quality could often be improved by switching between the antenna and DX-Local selection. However, when switching the selector to Local, I found the set did need a substantial volume increase to compensate for loss of signal strength.

One oddity with this radio is that when tuning through 49 meters in particular, the band appeared more or less dead if I was holding the radio while tuning. When I set the radio on the table and kept just enough fingertip pressure to prevent it from falling over while I tuned, the band came to life. While writing this review, Arnie Coro's *DXers Unlimited* was coming in well over RHC on 6010 kHz with the radio sitting on the table. But, if I picked the receiver up the signal all but disappeared.

In local mornings, when looking for Voice of Korea in English on 25 meters, several extremely strong signals made separating some of the channels difficult. North Korea was easily heard on my DE1103, so the Bell + Howell's limited selectivity and dynamic range when confronted with a band crowded with strong broadcasts was made apparent in this case.

Images were certainly present, as you'd expect on a budget, single-conversion radio and typically appeared in the band below the actual band of broadcast. The Voice of Russia from 19 meters showed up at the top of 22 meters, and WHRI from 41 meters presented itself somewhere above 49 meters. Sometimes the image offered better reception, providing an "optional frequency" if the real channel suffered from interference.

❖ Mediumwave

Scanning the mediumwave band after sundown and working off the internal ferrite bar antenna, I found KGO San Francisco was easily heard with a strong signal. I also received stations from Vancouver, Nevada, and other neighboring states. Calibration was a bit off on this band, but usable.



❖ FM Broadcast Band

Reception of FM stations was very good on this little set. Using a quality pair of earphones, I found the audio to be in mono, but clear and rich on strong signals. Even the lower-powered college stations which carry NPR and local, commercial-free programming came in with listenable signals. The FM band was packed with stations and, other than a lack of a stereo option for earphones, I can find no fault with reception on this band. The dial calibration of the FM band was quite good.

❖ Verdict

Of all these inexpensive pocket analog shortwave sets I've tried, the one that was initially the most surprising and the most fun was the Grundig Mini World 100PE. To be able to hear Radio Bulgaria and many others off the whip out of such a tiny device seemed amazing.

On the Grundig 100PE, I logged most of the Central and Eastern European international broadcasters, Channel Africa, all of the usual heavy-hitters, and even hams in AM mode from Maine and elsewhere. The only real drawback of the 100PE was an IF issue on 49 meters, making the use of a clip-on wire antenna problematic on that band.

I had overall reception results with the Kaito WRX911 equivalent to those of the 100PE, though without quite as much fun. But this Kaito radio had more shortwave spectrum coverage than the Grundig, and it was free of the IF troubles on 49 meters. It was the combination of extreme compactness and surprising performance

which made the 100PE so much fun and enjoyable to use.

Though taking into account the somewhat poor reception conditions present while I tried out the Bell + Howell radio, I think it's a bit behind the Grundig and Kaito in performance on shortwave. Sensitivity is not bad. Keeping in mind it was selling for around \$10, there's not that much wrong with it for that price.

The three obvious disadvantages of this radio are:

- The band limitations, with 31 and 49 meters bottoming out way too high and so leaving large portions of the bands uncovered.

- The atrocious calibration in most areas of the shortwave bands. Both the Kaito and Grundig radios suffered from calibration inaccuracy in portions of the shortwave bands, but the Bell + Howell stretches this to extremes.
- The deadening of 49 meters when the radio is held in the hand. This is a major drawback for a pocket radio, which obviously would see much handheld use in normal operation.

The FM performance of this radio was among the best of all the pocket receivers I've tried. I found the FM reception results of the Bell + Howell comparable to that of the Kaito KA105, a digital PLL-tuned pocket MW/SW/FM radio.

I don't think, based on some of my monitoring of shortwave broadcast signals, that this radio is actually junk or should not qualify as a "radio" as some other reviewers have said. If it were all I had, I would feel fortunate to be able to listen regularly to the English programming from Russia and New Zealand and (I'm sure) Croatia and many other places. For the usual price it went for, it's not that bad.

As slight as a \$10 analog pocket shortwave set may seem to some, it is still a powerful tool to mentally step outside of your culture and get in touch with sounds, voices, ideas, and music from other lands. This modest 50¢ garage sale Bell + Howell still provides a means to escape the high-pressure babbling of commercial radio, and to experience virtual travel to far away points around the world. We shortwave enthusiasts know that is no small thing.

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What's NEW

Tell them you saw it in *Monitoring Times*

Larry Van Horn, *New Products Editor*

Is My Cell Phone Bugged?

By Kevin D. Murray

Kevin Murray, author of a new book *Is My Cell Phone Bugged?*, is a top surveillance countermeasures expert. His organization, Murray Associates, in Oldwick, NJ, is internationally recognized for its cutting edge technologies in revealing covert spying.

Murray recognizes that most of us think of electronic spying in terms of hidden transmitters, recorders, and microphones. Movies popularize bugging done by suspicious spouses, unscrupulous business competitors, crime investigators, or government entities.

The truth is that some models of cell phones sitting on your side table, or dangling from your belt, are just waiting for a silent signal to open them up for listening.

Murray's easy-reading style describes the many ways that nefarious intruders can commandeer your phone electronically, loading it with vulnerable software and downloading your private information.

Fortunately, there are many ways to prevent such an easy intrusion into your personal life, as well as to detect the attempt from someone accessing your cell phone and all its records.

Have you noticed a sudden decrease in battery life? Does the display occasionally light up on its own? Does the phone feel warm even though you haven't been using it? Has your phone been displaying unaccountable error messages?

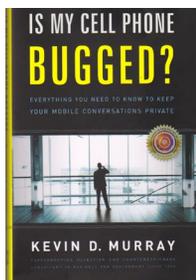
These are just a few of the 19 warning signs that your cell phone may be infected.

Murray's new book is packed with over 150 fact-filled pages describing how to choose the right cell phone, monitor its access by others, lists of spyware sources and anti-spyware techniques, legal issues, and the vulnerability of other wireless devices like cordless phones, baby monitors, and Bluetooth headsets.

Lists of resources are included as well, and if you order your copy directly from the author (www.IsMyCellPhoneBugged.com) for \$17.95 plus shipping, Murray will include at no additional charge his SpyWarn Mobile™ flasher module. This dandy little RF detector, set next to your cell phone or cordless phone, will brightly signal any activation of the phone with its six-LED ring chaser.

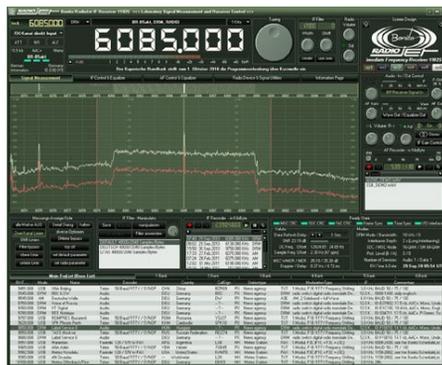
Is My Cell Phone Bugged? May be ordered from your favorite book seller: Amazon (<http://tinyurl.com/IsMyCellPhoneBugged>); Borders Books (<http://tinyurl.com/IsMyCellPhoneBugged-2>); or Barnes and Noble (<http://tinyurl.com/IsMyCellPhoneBugged-3>).

— Review by Bob Grove, W8JHD.



Bonito IF-Receiver RadioJet 1102S Debuts in Europe

Bonito has debuted a new receiver at the Hamradio Exhibition in Friedrichshafen, Germany earlier this year. The new Bonito shortwave receiver RadioJet 1102S combines innovative design with the advantages of modern computer technology. It has a frequency range of 40 kHz to 30 MHz.



According to Bonito, the 1102S has excellent sensitivity .03 mV at a noise level of -137 dBm with an extreme resolution of 144 dB at a bandwidth of 24 kHz. The noise floor is extremely low, because there are no active parts between the antenna and the analog-to-digital converter (ADC).

Strictly speaking, this radio is not a software defined radio (SDR), although it is exclusively controlled by computer. The Bonito RadioJet is a shortwave receiver with a built-in USB audio device and a 24-kHz multi-channel IM jack.

This new receiver sports a high level of electronic component integration density. To the average electronic enthusiast it may seem as if some elements are missing which have defined traditional receivers. For example, there is no AGC, instead there are three digital output channels with different signal levels. Each of these channels has -15dB ATT and can amplify or attenuate the input from -16 to +45 dB continuously.

The complete large signal is scaled in 144 dB and can be read at the same time on a scale of 48 dB via the high resolution DX-channel. This receiver can process an extremely weak signal without another signal being attenuated in its neighborhood. In this way, no strong transmitter can suppress a weaker one or can over-modulate the receiver to such a degree that the signal becomes unintelligible.

This is just a brief look at very interesting product that we hope to review in a future edition of *Monitoring Times*. You can get more details on the Bonito website at www.bonito.net/radiojet/infos/en_rj10_home.htm.

2011 Pirate Radio Annual

Andrew Yoder, pirate expert of the decades, admits his *Pirate Radio Annual* won't appear in Barnes and Noble, and despite his prediction of minimal success last year, Andrew has released a 2011 edition. Yoder credits magazine reviews and sales on eBay for capturing the interest of new listeners as well as pirate fans and operators.

This year's edition begins with Yoder's explanation of the basics about shortwave radio for newbies that also includes an explanation of the FCC's view on pirate broadcasting.

The chapter on "Tuning in Pirates" reminds the reader that one basic key to the pirate world is "listening," whether by radio or the Internet. Will you hear pirate stations on an aging boat-anchor or the latest communications receiver? This chapter also gives the reader an insight on receivers and antennas.

Keeping up to date on the pirate scene is another key component to the world of free radio. You'll find information about message boards, about the most popular ways to track pirate radio, and where to find email and web addresses. Additional updates include pirate web sites, how to QSL pirates, maildrops, QSL card reproductions and other tips. The chapter titled "What is Listening in the 21st Century?" is an informative look at how much receiving and transmitting have changed in the pirate hobby.

A chapter on "Classifying the Stations" is followed by "Tuning in Unlicensed Beacons" for pirate beacon fans. It may surprise the beginner to learn that pirate activity has been logged on the AM bands for years. Find out more about the new "pirate transmitting zone" in the "1710 Review" chapter. There is a chapter on stations that were active in 2010 that includes 118 pages of station descriptions.

In addition to this year's printed edition, an audio CD is included, which features 84 pirate stations taken from on-the-air recordings.

New listeners, the merely curious and seasoned pirate fans will find the *2011 Pirate Radio Annual* an asset to their radio reference library. This is an excellent guide to assist your chase of the bizarre and quirky side of radio.

The *2011 Pirate Radio Annual* is available for \$16.00 plus shipping (\$2.50 to US, \$4.00 to Canada and \$10.00 to the rest of the world, from Cabinet Communications, P.O. Box 109, Blue Ridge Summit, PA 17214 USA. — Review by Gayle Van Horn, W4GVH

Books and equipment for announcement or review should be sent to What's New, c/o Monitoring Times, 7540 Highway 64 West, Brassstown, NC 28902. Press releases may be faxed to 828-837-2216 or emailed to Larry Van Horn, larryvanhorn@monitoring-times.com.

When ordering or inquiring about the products mentioned in this column, be sure to tell them that you saw it in the pages of *Monitoring Times* magazine.



Uniden HomePatrol-1 Digital Radio Scanner

Simple Programming - Simply enter your zip code or city, and HomePatrol-1 selects the channels in use in your area.

TrunkTracker IV (Motorola APCO 25 Digital, Motorola, EDACS, LTR) - Lets you monitor all of the major types of communications systems used by public safety, local government, amateur radio operators, and more.

S.A.M.E. Emergency/Weather Alert - Allows you to specify the area that you need to hear any alerts that may be Weather, Civil, Biological, Nuclear, or National in nature.

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Instant Replay - Lets you replay the most recent reception with a single tap.

3.5" Daylight Viewable Display

Free Radio System Updates - Radio System database is updated weekly.

No Subscription Needed.

Touchscreen Operation - Makes it easy to control what you are hearing.

HomePatrol Sentinel PC Software Included - Lets you update the HomePatrol-1's database, update firmware, and more easily manage favorites lists and other settings in your HomePatrol-1.

HomePatrol-1 lets you quickly hear the communications systems used by Public Safety, Aircraft, Military, Weather Spotters and more. Simply enter your US Zip code or Canadian Postal Code and HomePatrol-1 does the rest. Whether it is across town or across the street, HomePatrol-1 keeps you informed.



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to the editors

editor@monitoringtimes.com

Pizza Pan Antennas?

Hi Kent: Saw your article [in June 2011 *Antenna Topics*] and wonder if it was an experiment or serious antenna design? I don't know much about SWR's so your tests didn't help, but since they're so simple, it's worth a try.

I've been experimenting with various antennas to improve the reception of signals in the 150-175 MHz region with my old RadioShack scanner (non-trunking). Some of the designs have worked ok more or less. Currently, I've got a temporary setup that looks like a discone/ground plane with 8 'droopers' at 45 degrees from horizontal, 8 horizontal elements and a vertical one. Trying different formulas for length as the elements are made of whip antennas that are adjustable.

Years ago I also made a really good Yagi but it's directional and not that suitable for scanning, where signals could come from any direction. So I was wondering whether your Pizza pan antennas are omnidirectional and how sensitive are they. Eventually, I'd like to put something up in the attic.

Joe Wdowiak

Hi Joe: Yes, it really is a serious antenna. Make sure your disks are at least 18" across and it will work fine at 150 MHz. Above 1500 MHz it does tend to have two beams going out from the edges of the pizza pans, but still, it's pretty omnidirectional.



Good luck with your scanning.

Kent Britain

More on Mobile Shortwave

Dear Mr. Reitz, I appreciate your article [July 2011 *Beginners Corner*] regarding the demise of mobile shortwave radio receivers.

About two years ago, I had a Sony XR-F5100 AM/FM/SW/Cassette unit stolen from one of my cars. When I contacted Durham Electronics in Durham (Toronto), Canada, from whom I had purchased the unit several years before, I was informed that the XR-F5100 had been discontinued, as had the equivalent CD version.

Additional inquiries with other outlets confirmed the above.

I also contacted the Sony Corp. – NOT an easy task – to see if they had either of the two units stashed in one of their warehouses. In a word...NO.

My other car still has an XR-F5100, which I enjoy.

Maybe someday Sony will resurrect these two units, but I am pessimistic.

Keith Emery

Hi Keith: Thanks for writing! What a shame about your in-dash shortwave radio, no doubt the miscreants didn't even know it was a shortwave receiver. Imagine my surprise this afternoon when I checked into The Shortwave Store (aka Durham radio) and found this for \$220 (plus shipping): www.shortwavestore.com/product.php?productid=768&cat=42&page=1

I talked to the proprietor who said the CDX-GT180 is a new product and that they have some in stock. Among the attractive features are a CD player (no more cassette!) and front panel aux input for your iPod. Tuning range is the same as my old Sony XR-CA660X 2940-7735 kHz and 9500-18135 (except 10140-11575). It's great news for MT readers and shortwave listeners everywhere.

The Shortwave Store has a toll-free number: 1-888-426-9617.

If you hadn't written there's no telling when I would have found this!

Ken KS4ZR

Hi we have corresponded before on this subject. Keith Emery forwarded your email on the CDX-GT180 from Durham to me.

I have had a Sony CDXGT470U in my car in my plastic-fiberglass Corvette. The Corvette has had terrible ignition noise problems (original shielding not used). I replaced a Philips DC777 – which was top of its line in the early 90s with a price over \$1000 in today's dollars. Before that I had an analog National Panasonic with shortwave and both the Philips and National Panasonic had terrible ignition noise problems in the Corvette.



The Sony CDXGT470U runs circles around the Philips as far as sensitivity and not picking up ignition and alternator noise. For example, 9.580 MHz – Australia, China, Romania – all come in quite good as does Cuba 6000 kHz, like small town AM stations 20-25 miles away. This radio is also much better than my Sony XR-CA640X (with optional CD changer) which I have in my metal-bodied (for the most part) Pontiac Grand Prix. I obtained the Sony CDXGT470U from an Australian seller on eBay for a little less than \$200 including the expensive shipping.

Assuming the Sony CDX-GT180 is a lower end version of the GT470U, I would assume it has the same basics and is probably good value for Durham's price. Both models only have 3 frequencies for sound adjustment, whereas my CA640X had 7 (I do not know why they would scrimp there, as that circuit they already had and it could not have saved them \$.02 to go from seven of their octaves to three.) Regardless, the

sound on CDs is very good.

Thomas J McKeon Indianapolis

Excellent information, Thomas! I'm sure other readers would like to know about your experiences, too. Thanks for writing! And while you're at it, be sure to check out this month's *Computers & Radio* column for another way to listen to shortwave in your car...

Ken KS4ZR and Rachel KEOPD

FAREWELL TO TWO FRIENDS



Nada Byers worked for Grove Enterprises in various capacities since our earliest days. As a friend and neighbor, and the mother of Belinda McDonald, our Office Manager, Nada could be counted on to assume many responsibilities without question, and always with professionalism.

Just over a month ago, a routine doctor's visit disclosed the rapid advance of cancer. Last night we all paid our final respects at her funeral service.

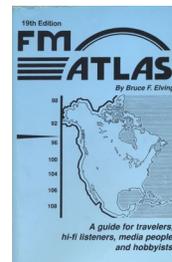
Thank you, Nada, for your honor, dependability, and friendship.

Bob, Judy, and the entire Grove and Monitoring Times team

Bob, Judy, and the entire Grove and Monitoring Times team

"Sad news to share about FM's friend, Dr. Bruce Elving," says Alan Freed. He passed away on July 24, 2011.

Bruce was best-known for his "FMAtlas" directories and until recent years, his "FMedia!" newsletters, along with his service of modifying FM radios to receive SCA broadcasts. He was among the founders of the University of Minnesota's KUMD 103.3 Duluth. He will be sadly missed within the hobby.



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

AR5001D Wide Coverage Professional Grade Communications Receiver

The Legend Lives On!



The AR5001D delivers amazing performance in terms of accuracy, sensitivity and speed.

Available in both professional and consumer versions, the AR5001D features wide frequency coverage from 40 KHz to 3.15 GHz*, with no interruptions.

Developed to meet the monitoring needs of security professionals and government agencies, the AR5001D can be controlled through a PC running Windows XP or higher. Up to three channels can be monitored simultaneously. Fast Fourier Transform algorithms provide a very fast and high level of signal processing, allowing the receiver to scan through large frequency segments quickly and accurately. AR5001D standard features include storage of up to 2000 frequencies, 45 MHz IF digital signal processing, direct digital sampling, a high performance analog RF front-end, a DDS local oscillator and advanced signal detection capabilities which can detect hidden transmitters. With its popular analog signal meter and large easy-to-read digital spectrum display, the AR5001D is destined to become the choice of federal, state and local law enforcement agencies, the military, emergency managers, diplomatic service, news-gathering operations, and home monitoring enthusiasts.

Discover the next generation in AOR's legendary line of professional grade desktop communications receivers.

- Multimode receives AM, wide and narrow FM, upper and lower sideband and CW
- Up to 2000 alphanumeric memories (50 channels X 40 banks) can be stored
- Analog S-meter
- Fast Fourier Transform algorithms
- Operated by a Windows XP or higher computer through a USB interface using a provided software package that controls all of the receiver's functions
- An SD memory card port can be used to store recorded audio
- Analog composite video output connector
- CTCSS and DCS squelch operation
- Two selectable Type N antenna input ports
- Adjustable analog 45 MHz IF output with 15 MHz bandwidth
- Triple-conversion receiver exhibits excellent sensitivity
- Powered by 12 volts DC (AC Adapter included), it can be operated as a base or mobile unit
- Professional (government) version is equipped with a standard voice-inversion monitoring feature

Add to the capabilities of the AR5001D with options:

- Optional APCO-25 decoder
- Optional LAN interface unit enables control via the internet
- Optional I/Q output port allows capture of up to 1 MHz onto a computer hard drive or external storage device
- Optional AR-I/Q Windows software facilitates the easy storage and playback of transmissions captured within the selected spectrum in conventional modes, or, signals can be subjected to further analysis
- Optional GPS board can be used for an accurate time base and for time stamping digital I/Q data



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*Cellular blocked for US consumer version. Unblocked version available to qualified purchasers with documentation. Specifications subject to change without notice or obligation

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Columnist Blogs and Web Sites

These blogs and web pages were created by some of our columnists to better serve their readers. While we highly recommend these resources, they are not official instruments of *Monitoring Times*.

AMERICAN BANDSCAN
<http://americanbandscan.blogspot.com/> - by Doug Smith

ANTENNA TOPICS
www.wa5vjb.com - by Kent Britain

BELOW 500KHZ
<http://below500khz.blogspot.com/> - by Kevin Carey

FED FILES
<http://mt-fedfiles.blogspot.com/> - by Chris Parris

LARRY'S MONITORING POST
<http://monitor-post.blogspot.com/> - by Larry Van Horn

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SHORTWAVE
<http://mt-shortwave.blogspot.com/> - by Gayle Van Horn

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<http://mt-utility.blogspot.com/> - by Hugh Stegman
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