

CQ de WA2LQO

The official voice of the Grumman Amateur Radio Club
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COMMUNICATIONS SYSTEMS (Continued from April 2012)

By Bob Wexelbaum, W2ILP

When SS codes are properly chosen for low cross correlation, minimum interference occurs between users, and the receivers set to receive different codes are reached only by transmitters sending the correct code. Thus more than one signal can be unambiguously transmitted at the same frequency and at the same time; selective addressing and code division multiplexing are implemented in the same time format; while selective addressing and code-division multiplexing are implemented by the coded modulation format. A wideband signal spectrum generated by code modulation, according to Dixon's calculations, allows the signal power to be low in any narrow region, as compared to a conventional non-SS signal. Dixon explains that this also permits the entire spectral power density to be lower than that of a conventional signal.

Resolution in ranging is afforded in accordance with the SS code rate used, and the sequence length determines the maximum unambiguous range. RADAR is thus the best known use for SS, but communication may also be commonly used simultaneously with ranging for avionics systems such as ATC, DME, missile guidance, etc.

Hams are not interested in hiding their signals in the way that missile or torpedo designers might be, but they are interested in what is called *jamming margin* because it would also be a measure of immunity to undesired interference from any source. The most commonly calculated measure of an SS signal is known as *process gain*. Process gain and jamming margin go hand in hand when the benefits of SS are analyzed. So let us look at the basic algebra that is used to determine both of these parameters. No calculus is required.

$$\text{Process Gain} = G_p = [BW_{rf}] / R_{info}$$

This is a "rule of thumb" which depends on the difference in output and input signal-to-noise ratio in any signal processor. For example if a given signal processor has an input S/N ratio of 10 dB and an output S/N ratio of 16 dB it would have a process gain of 6 dB. The equation says that the RF Bandwidth (BW_{rf}) of a transmitted SS signal and that the information rate (R_{info}) is the data rate in the information baseband signal and that the former divided by the latter determines the Process Gain. That does not mean, however, that the processor can perform well when faced with an interfering signal having a power level higher than the desired signal of available Process Gain. We take this into consideration by determining the SS Jamming Margin, which takes into account the need for a practical SS system signal-to-noise ratio and allows for internal losses that are expressed in dB.

$$\text{Jamming Margin} = G_p - [L_{sys} + (S/N)_{out}] = M_j,$$

where L_{sys} = system implementation losses, and $(S/N)_{out}$ = signal-to-noise ratio at the information output.

For example, an SS system with 30-dB Process Gain, minimum $(S/N)_{out}$ of 10-dB, and L_{sys} of 2-dB would have an 18-dB Jamming Margin (M_j) and could not operate with interference that is more than 18-dB above the desired signal. Knowing the *Jamming Threshold* of a particular SS system is useful in determining how well the system may operate in the presence of interference. Let us consider a processor model with signal and noise inputs where the noise input may include interference:

signal and/or noise in } $(S/N)_{in} \gg G_p > (S/N)_{out} = (S/N)_{in} \times G_p$, for the region $S \ll N$,
converting to decibels that means: $(S/N)_{out} \text{ (dB)} = (S/N)_{in} \text{ (dB)} + G_p \text{ (dB)}$, but $(S/N)_{out} \text{ (dB)} = -J/S \text{ (dB)}$,
therefore: $(S/N)_{out} \text{ (dB)} = G_p \text{ (dB)} - J/S \text{ (dB)}$ and for the region above the jamming threshold, examples may be

given for particular systems that can be stated in dB. Determining actual thresholds relies on tracking loss, non-linearity as well as thresholding of a post-correlation detector. If one part of a system operates better than another the overall system is no better than the worst part. It is desirable that all parts of a system tend to degrade at the same threshold point but this may not be easy to accomplish with a very wide band system. In the real world sometimes antenna directivity can be used to reject jamming noise or man-made interference but that sort of rejection is not always available due to the limits of fixed geometry. Now let us make some comparisons of process gains available for various techniques, including signal rejection and cancellation.

<u>SYSTEM</u>	<u>PROCESS GAIN</u>
Direct sequence	$(BW_{rf}) / (R_{info}) = TW$
Frequency hopping	$(BW_{rf}) / (R_{info}) = TW = \text{number of frequency choices}$
Time hopping	1 / transmit duty cycle
Chirp	Compression ratio = $\pi dF = TW$
Antenna rejection	Antenna forward gain
Electronic cancellation	Dependent on accuracy of replica; sometimes 40 dB
Selective rejection	High but useful only against narrow band interference

Selective rejecters, such as notch filters, are useful for removing interfering signals but are limited to narrowband signals such as CW or relatively narrow bandwidth digital modes that radio amateurs use. Rejection of a wide band signal with a filter could also reject much of the desired signal, which would degrade system operation and net no gain in performance, even though the interference was rejected.

Next month I will analyze some of the digital modes that hams now legally use on HF and see how they relate to the communications theory that has been discussed so far.

(To be continued)

PRESIDENT’S NOTE by Ed Gellender, WB2EAV

The biggest event on the amateur radio calendar is almost here – Field Day is the weekend of June 23 and 24 – and it is now time for us to start planning and getting things into place. We will be repeating what we did last year, when Northrop Grumman made using their generator such a nightmare that we decided to instead operate off commercial power mains. That isn’t quite the way it is supposed to be, but it is the only viable path open to us. The crew has also been losing interest in pulling those all-nighters, so no one was really upset when we learned our current arrangement requires us to leave at about 9 or 10 PM. What a civilized idea – sleeping in our own beds on Field Day weekend.

We will be operating two stations, and will string both 20 and 40 meter dipoles through the trees. We plan to operate both phone and CW, depending on individual operator preference.

We will be at the Town of Oyster Bay Haypath Road Park. Best way to get there is off NY135 (Seaford Oyster Bay Expwy) at exit 9 – Broadway, Bethpage. From the southbound exit, turn left, go under the highway and turn left again; From the northbound exit, simply go straight. On Plainview Rd, go past the NY 135 entrance, and continue a quarter mile to the traffic light at Haypath Rd. Turn right and go ¾ mile to the park on the right. You will see the traffic light on Old Bethpage Rd. about 1/8 mile ahead. It is easy to miss so take it slow.

Unlike prior years, we will not be doing any preliminary setup on Friday. We will meet at the park at about 10 AM Saturday to set up for the official start time of 2 PM.

The June newsletter will have any final updates. See you at Field Day!

Ed, WB2EAV

**GRUMMAN AMATEUR RADIO CLUB
MINUTES OF GENERAL MEETING
4/18/2012**

By Karen, W2ABK, Secretary

The meeting was called to order by Gordon at 5:45 PM

TREASURER'S REPORT – Ed, WB2EAV

Finances continue to be in good shape.

REPEATER REPORT – Gordon, KB2UB

145.745 is noisy.

NET REPORT – Karen, W2ABK

Thursday night net at 8:15 PM on 146.745 MHz had 2 check-ins and was noisy..

Thursday night net at 8:30 PM on 145.330 MHz had 5 check-ins.

Sunday morning net at 7:10 AM on 7.289 MHz had 2 check-ins, but Gene was unable to hear me.

Sunday morning net at 7:20 AM on 14.289 MHz had 2 check-ins; it was noisy but readable.

Sunday morning net at 7:30 AM on 7.289 MHz had 2 check-ins.

VE REPORT – Bob, W2ILP

There one applicants; who passed Technician and General Exams.

4 VEs were Karen, W2ABK, Ed WB2EAV, George WB2IKT, and Bob, W2ILP.

OLD BUSINESS

Ed renewed our equipment insurance.

We need programs for our meetings.

NEW BUSINESS

Town of Oyster Bay Haypath Road Park has been reserved for FD.

PROGRAM

Gordon, KB2UB brought in his Marklin Z track micro trains. He explained how he built them and how they run on catenary and track power.

The meeting was adjourned at 6:45 PM.

GARC WAG NETS: HF: 7.289 MHz at 7:30 AM EST Sundays (Early bird 7:00 AM EST)

Net Controller: Eugene, W4JMX

As per Gene's recent message, operation on 14.289 MHz or 21.289 MHz may be attempted if 40 Meters is not usable. Comments or suggestions may be e-mailed to Gene. His e-mail address is:-

w4jmx@earthlink.net

2 Meters (repeaters): Net Controller, Karen, W2ABK **Thursdays: 146.745 MHz at 8:15 PM
145.330 MHz at 8:30 PM**

Both repeaters (-600 kHz) and 136.5 Hz tone.

ARES/RACES NETS: Mondays.

MEETINGS: General Meetings of the GARC are held on the third Wednesday of each month, starting at 5:30 PM, at the Ellsworth Allen Park in Farmingdale. Driving directions and map can be obtained from <http://www.mapquest.com>. It is suggested that the GARC web site be checked to be certain of the meeting location, which may change after this newsletter is distributed. Board meetings are held a week before the General Meeting at the Bethpage Skating Rink Center.

WEBSITE: The GARC web site can be found at <http://www.qsl.net/wa2lqo>. Webmaster is Pat Masterson, KE2LJ. Pictures of GARC activities, archives of newsletters, roster of members, and other information about the GARC may be found there.

INTERNET LINK OF THE MONTH FOR INTERNERDS

The link for this month is:- http://www.netcom.army.mil/MARS/docs/AMC_test_2012.pdf

This will give you the PDF operating schedule for:

THE ANNUAL ARMED FORCES DAY CROSSBAND MILITARY/AMATEUR RADIO COMMUNICATION TEST (12 May 2012)

If you have HF equipment and can spend time on the air on May 12th and/or May 13th, you might want to participate in this event. The Army, Navy, Marine Corps and Coast Guard will sponsor tests in celebration of ARMED FORCES DAY. Armed Forces Day is actually May 19th but this event will be conducted on May 12th so as not to conflict with the Dayton Hamvention., which is scheduled for May 18-20.

There will be crossband military to amateur SSB and CW for hams. SWLs may also take part by receiving and reporting military signals. QSL cards will be sent in reply to reports of QSOs or receptions. For those who are able to receive and print digital signals there will also be acknowledgements for receiving scheduled messages from the Secretary of Defense using RTTY, PACTOR FEC, MT63, PSK-31, or MFSK.

IMPORTANT: Do not transmit on the frequencies that the military stations will be using. They are not inside the ham bands. You must split frequencies and only transmit within the normal ham bands. The military stations will tell you the frequencies they will be listening at. This is why it is a *crossband test*. Unlike ham stations, the military stations have call signs that contain no numerals. Just like ham calls they begin with W, K, A or N. Complete information is available for downloading using the link above.

PUZZLE

Last month I presented this question, taken from the Amateur Extra Class Exam.

How is antenna efficiency calculated?

- A. (radiation resistance / transmission resistance) x 100 %.
- B. (radiation resistance / total resistance) x 100 %
- C. (total resistance / radiation resistance) x 100 %
- D. (effective radiated power / transmitter output) x 100 %

The Correct Answer is B.

This month I will again ask a question that is taken from the Amateur Extra Exam.

What is the definition of the term telemetry?

- A. One-way transmission of measurements at a distance from the measuring instrument.
- B. A two-way interactive transmission.
- C. A two-way single channel transmission of data.
- D. One-way transmission that initiates, modifies, or terminates the functions of a device at a distance.

GARC Officers

President: Ed Gellender, WB2EAV M/S:X08-14 516-575-0013 edward.gellender@ngc.com

or wb2eav@yahoo.com

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Secretary: Karen Cafalo, W2ABK 631-754-0974

Treasurer: Ed Gellender, WB2EAV (see above)

WA2LQO Trustee: Ray Schubnel, W2DKM Retiree

1 Yr. Board Member: Jack Cottrell, WA2PYK Retiree 516-249-0979

2 Yr. Board Member: Dave Ledo, AB2EF

2 Yr. Board Member: Jack Hayne, WB2BED

2 Yr. Board Member: George Sullivan, WB2IKT

Newsletter

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Editor: Bob Wexelbaum W2ILP 631-499-2214 w2ilp.radio@gmail.com

Contributing writers: All GARC members (we hope). To submit articles or ham equipment advertisements contact the editor. Articles will only be edited when permission is granted by the author.

GARC Webmaster

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GARC VE Exams

We normally proctor exams for all classes of ham licenses on the second Tuesday of each month, starting at 5:00 PM. The exams are given at Briarcliffe College, 1055 Stewart Avenue, Bethpage, NY in room: Long Beach #5. Ham Exams are: Element 2 – Technician, Element 3 – General, Element 4 – Amateur Extra Class. All applicants must pre-register by contacting W2ILP. Time and location of exams are subject to change. If there are no applicants VE sessions will be cancelled. The fee for 2012 remains \$14 for all exams taken at one sitting. New first time applicants should be aware that their Social Security Number will be required on the application form unless they register with the FCC for an FRN. Applicants for an upgrade should bring their present license and a photocopy of it. All applicants should bring picture ID such as a driver's license. Study material may be bought from the ARRL-VEC or W5YI-VEC <http://www.arrl.org> or <http://www.w5yi.org>. All VECs use the same Q & A pools. The General Class Exam will be using a new set of Q & As, starting on July 1st, 2012. Study guides for the new General test were released on January 2012.

Commercial FCC Radio Operator Exams

We are certified by the National Radio Examiners to administer exams for all classes of FCC commercial radio operator and maintainer exams. All Commercial Operator License Examiner Managers (COLEMS) use the same commercial license pools. Administrating fees vary. For information or to register contact W2ILP.

Editorial

I am finally back on the air on HF. The tree limbs that were obstructing my 40-Meter dipole have been professionally sawed off. The coax lines from my HF antennas have been routed to my old radio room. My HF rig is now a Yaesu FT-920, which runs 100 Watts PEP in SSB mode. I can cover 10-15-20 Meters, using an antenna in my attic, which is the driven element of a Mosley tri-band beam. My antennas load with low SWR and I don't need to use an antenna coupler.

On Sunday, April 22nd I woke up early enough to contact W4JMX, who runs an Early Bird 7:00 AM WAG Net. There was some QSB, but I was able to copy Gene R5. The noise floor was lower that it had been for many months, when had I used my IC-706. Karen, W2ABK and Joe, W2IYS checked in and I of course had no trouble hearing them. Karen checked out, but Gene and Joe then went to 14.289 MHz and I was also able to work them there, although Gene's signal was weaker than it had been on 40-Meters.

Come on guys...If you have the HF equipment and can rise early on Sundays, check into the WAG net. Let us continue our old tradition. Old signals never die...They only fade away.

Grumman Amateur Radio Club
Sixty Eight Years 1944-2012
P.O. Box 0644
Bethpage, NY 11714-0644

FIRST CLASS MAIL

Do Not Delay

AMATEUR or COMMERCIAL?

In the early days of radio all radio experimenters were amateurs. The ship to shore radio operators soon realized that they should have some priority because their operation might be more a matter of life and death than the clatter of most of the amateur landlocked hobbyists. The spark coil days were initially unregulated and many had little or no knowledge about the radio frequencies that they were radiating. This all led to chaos until some states and then the US Navy and finally the Federal Communications Commission stepped in to regulate the use of the radio spectrum and assign frequencies. After the amateur radio experimenters started to use Amplitude Modulated voice, some fellow in Pennsylvania got the idea that he could sell seeds to farmers by advertising on the radio. Thus not only his vegetable seeds were sold and sown...but the concept of commercial profitable radio broadcasting was born! The commercial stations had different needs than the ham experimenters and they wanted protection from RFI chaos. Both hams and commercial operators wanted protection from each other's interference. The commercial stations also didn't want the hams to broadcast anything that would be as interesting and entertaining to normal radio listeners as the stuff that was on commercial radio. The hams were limited in that they were not supposed to address anyone but each other when they spoke. If Jimmy Durante was a ham operating a ham station, he could not say "Good night Mrs. Calabash...Wherever you are", unless Mrs. Calabash was also a licensed ham in contact with him or a regular operator in a common established ham net. Hams have never been permitted to transmit music, although some say that the tones of Morse code are music to their ears. In the early days of radio, accurate frequency control was expensive. The commercial stations were assigned specific frequencies because it was believed that they could afford to keep their transmitters on frequency, but it was different for the many amateurs, when most of them were unable to monitor the frequencies that they used with any kind of precision. The best they could do was to use quartz crystals for frequency control. These early crystals normally drifted as a function of temperature. That is why hams were never assigned specific frequencies or channels. They were instead assigned bands of frequencies, with the hope that they wouldn't buy crystals that were so close to the band edges that they could drift out.

(To be continued next month)

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Page 6