

# CQ de WA2LQO

The official voice of the Grumman Amateur Radio Club  
March 2012 Volume 85 Number 3

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## COMMUNICATIONS SYSTEMS (Continued from February 2012) By Bob Wexelbaum, W2ILP

Last month I said that a Morse signal theoretically has zero bandwidth, but that was not exactly correct. It is a coherent RF carrier that theoretically has zero bandwidth when it is not being keyed. A line with no width would be invisible on a perfect spectrum analyzer but any signal is visible on real spectrum analyzers due to their own receiving responses. Morse keyed bandwidths generally increase as a function of the keying speed, but that too has changed in the computer age. When actual transmitter circuits were keyed directly by telegraph keys the average time for transients, and what were called key clicks, was about five milliseconds. This is no longer true. Keying circuits using optoisolators became cleaner than direct brass pounding but this is only part of the story. Next best is keying that is enabled only in the presence of a clocking pulse derived from a high speed clock that may be as fast as the same GHz computer bus that enables microprocessor commands. Even better are the method by which the key controls a tone oscillator, which then operates in a SSB transmitting mode to produce Morse pulses that can be programmed by software to exactly control their shape with nanosecond resolution.

Now back to Dixon's definition of Spread Spectrum (SS). Dixon says that these general types will be accepted in his analysis of spread spectrum as examples of spread spectrum signal methods, although he does not strictly limit the definition to these types.

1. Modulation of a carrier by a digital code sequence whose chip rate is much higher than the information signal bandwidth. Such systems are called *direct sequence* modulated systems.
2. Carrier frequency shifting in discrete increments in a pattern dictated by a code sequence. These are called *frequency hoppers*. The transmitter jumps from frequency to frequency with some predetermined set; the order of frequency usage is determined by a code sequence.
3. Pulsed-FM or *chirp* modulation in which a carrier is swept over a wide band during a given pulse interval.
4. Closely akin to the frequency hoppers are *time hopping* and *time-frequency hopping* systems whose direct chief distinguishing feature is that their time of transmission (usually of low duty cycle and short duration) is governed by a code sequence. In time-frequency hoppers it follows that the code sequence determines both the transmitted frequency and the time of transmission..

Dixon begins by explaining that his examples of SS are of systems that are often tens to hundreds of megahertz wide, to handle signals that are normally confined to bandwidths that 10 – 100 kHz. This is not the type of SS that hams may use on HF ham frequencies but it does not eliminate the HF ham applications of SS either, as I will eventually explain.

To further analyze the bases for SS technology we go to C. E. Shannon's definition of channel capacity.

$$C = W \log_2 (1 + S/N),$$

where  $C$  = channel capacity,  $W$  = bandwidth in Hz,  $S$  = signal power,  $N$  = noise power.

The equation shows the relationship between the ability of a channel to transfer error-free information, compared with the signal-to-noise ratio existing in a channel, and the bandwidth used to transmit the information. Letting  $C$  be the desired system information rate and changing bases, we find:

$$C / W = 1.44 \log_e (1 + S/N),$$

and for small S/N, say less than or equal to 0.1 (as one would wish it to be in an anti-jam system).

$C / W = 1.44 S/N$ , since

$\text{Log}_e(1 + S/N) = S/N - \frac{1}{2} (S/N)^2 + \frac{1}{3} (S/N)^3 - \frac{1}{4} (S/N)^4 \dots$  ( $-1 < S/N < 1$ ) by the logarithmic expansion. From this equation Dixon finds :  $N/S = (1.44 W) / C =$  approximately  $W/C$  and therefore  $W = NC / S$

Thus we see that for any given signal-to-noise ratio we can have a low information-error rate by increasing the bandwidth used to transfer the information; for example, if we want a system to operate in a link in which the interfering noise is 100 times greater than the signal and our information rate is 3 kilobits per second (kbps) then our 3-kbps information must be transmitted in a bandwidth of:

$$W = (1 \times 3 \times 10^3) / 1.44 = 2.08 \times 10^5 \text{ Hz}$$

The information may be embedded in the SS signal by several methods. The most common is that of adding the information to the SS code before its use for spreading modulation. This technique is applicable for any SS system that uses a code sequence to determine its RF bandwidth (either direct sequence or frequency hopping systems are good candidates). Of course, the information to be sent must be in some digital form because addition to a code sequence involves modulo-2 addition to binary code. Alternately, information may be used to modulate a carrier before spreading it. This is usually done in some form of angle modulation, for the need in SS systems is often to output a constant-power RF envelope.

Summing up; a SS system, then must meet two criteria

- (1) The transmitted bandwidth is much greater than the bandwidth or rate of information being sent, and
- (2) Some function other than the information being sent is employed to determine the resulting RF bandwidth.

This is the essence of SS communication as defined by Dixon. It is the art of expanding the bandwidth of a signal, transmitting that expanded signal, and remapping the received signal into the original information bandwidth. Furthermore, in the process of carrying out this series of bandwidth trades the purpose is to deliver error-free information in a noisy signal environment. Next month I will discuss other advantages of SS technology that are used to answer those who might ask, "Why bother with SS?"

(to be continued)

### **PRESIDENT'S NOTE by ED GELLENDER, WB2EAV**

Recently there was an article in Newsday about four local high schools that have FM broadcasting stations and one that has an AM broadcasting station. Some club members have wondered if this might be a lead-in to ham licensing, as historically such operations involved commercial FCC licenses and many of the participants started by getting ham licenses as well.

These stations transmit low power, usually with a range of about 10 or 15 miles. They always have adult supervision and are fully FCC licensed; we are not talking about little kids that talk into your FM radio in the next room. I have some personal experience in this manner, as my son was one of the DJs and recording engineers for WKWZ 88.5 FM at Syosset High School on Friday evenings for his entire high school career. I gotta tell ya – it is really something to drive along and hear your own kid's voice coming out of the car radio.

When my son got to the University of Maryland I asked if he tried out for their radio station and he answered that the staff were no match for his high school experiences, and he quietly left.

I don't see this as a way to break into serious broadcasting as much as a way to experience something new for a couple of years. I feel if anyone brought up licensing with the kids, they would immediately abandon radio and try out for bowling. What do you think?

73, Ed, WB2EAV

**GRUMMAN AMATEUR RADIO CLUB**  
**MINUTES OF GENERAL MEETING 2/15/2012**  
By Karen, W2ABK, Secretary

The meeting was called to order by Jack at 5:40 PM

**TREASURER'S REPORT – Ed, WB2EAV**

Finances continue to be in good shape.

**REPEATER REPORT – Gordon, KB2UB**

Repeaters are working. 146.745 is noisy.

**NET REPORT – Karen, W2ABK**

Thursday night net at 8:15 PM on 146.745 MHz had one check in.

Thursday night net at 8:30 PM on 145.330 MHz had a nice turn out.

Sunday morning net at 7:10 AM on 7.289 MHz was noisy.

Sunday morning net at 8:20 AM on 14.289 MHz – Had one check in.

**VE REPORT – Bob, W2ILP**

There were no applicants. Therefore the February VE session was cancelled.

**OLD BUSINESS**

We need programs for our meetings.

**NEW BUSINESS**

Jack has Haypath Road Park reserved for our Field Day, June 23 & 24.

**PROGRAM**

Dave and Karen brought in a DVD of their pictures of their ARRL Headquarters trip.

The meeting was adjourned at 6:40 PM.

**GARC NETS: HF: 7.289 MHz at 7:30 AM EST Sundays** 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](mailto:w4jmx@earthlink.net)

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

**2012 MEMBERSHIP DUES ARE DUE**

Dues are the same as last year: \$20 each, or \$25 for two members who reside at the same address. Retirees living out of town need pay only \$10. We are now offering an introductory \$10 rate to new members, which should be included with a membership application form. Checks should be mailed to: Grumman Amateur Radio Club, P.O. Box 0644, Bethpage, NY 11714-0644.

## INTERNET LINK OF THE MONTH FOR INTERNERDS

The link for this month is:-

<http://hackaday.com/2012/02/27/visualizing-a-nanosecond/>

This is a visual demonstration of a nanosecond. Most of us learn physics from visual demonstrations, like the link that I had found which showed us mechanical waves and gave us a view of what SWR is really like.

In this month's demonstration Rear Admiral Grace Hopper shows us the distance that electricity can travel in a wire in one nanosecond. A nanosecond is one billionth of a second. People made fun of Carl Sagan when he wrote about billions of stars. Billions seemed funny to them. That is because most of us cannot really conceive of very large numbers. Our national debt is now in the trillions. That isn't funny. Enough said about that.

It is good to see that Rear Admiral Grace Hopper has a sense of humor. When we discover her technical savvy, we don't ask how long it must have taken for her to rise to Rear Admiral. I could be wrong but I think that it might have taken her billions of seconds. She is obviously a good teacher. She reminds me of my Aunt Tilly. My Aunt Tilly taught me how to color pictures in picture books with large fat crayons, without going over the lines. This skill gave me a valuable insight about the theory of limits...better than any calculus teacher could. You have to start early to master such skills. You have to see stuff to believe it yourself. Trying to do things yourself is even better. Anyone who has built a Heathkit HW-101 knows about twisting waxy ferrite slugs in tiny RF coils that had to be tuned to resonance without cracking them or the tuning tool or running them out of the coil forms, knows what I mean. Those who buy manufactured transceivers will never know. It takes talent that may go unappreciated by those who never precision aligned a Heathkit. I can't hold a coffee cup steady anymore, but I can still tune the coils. I can't explain how I can do that...but I can.

I never wanted to play the trumpet...but if I did I probably would never know how to play it like Louis Armstrong did. I wouldn't even have the chutzpah to ask Louis how to learn to play like he did. He would say, "If you need to ask, you will never know." Right on Sachmo wherever you are!

### PUZZLE

*This month I will not give you another cryptogram to solve. Instead I will give you a question that is on the current Amateur Extra Exam. Many of you are Extra Class hams but when you took the exam you had to pass a 20 wpm Morse test. At that time the written part of the test was much different than the present 50 question Extra Class exam. Anyway here is a question from a present exam. The answer will be provided next month.*

What is one of the potential hazards of using microwaves in the amateur radio bands?

- A. Microwaves are ionizing radiation.
- B. The high gain antenna commonly used can result in high exposure levels.
- C. Microwaves often travel long distances by ionospheric refraction.
- D. The extremely high frequency energy can damage the joints of antenna structures.

*The solution for the February 2012 cryptogram is: I USED TO BE A HEAVY GAMBLER, BUT NOW I JUST MAKE MENTAL BETS. THAT'S HOW I LOST MY MIND. --STEVE ALLEN--*

**GARC Officers**

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2 Yr. Board Member: Jack Hayne, WB2BED

2 Yr. Board Member: George Sullivan, WB2IKT

**Newsletter**

CQ de WA2LQO is published monthly by the Grumman Amateur Radio Club for its members and friends.

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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.

**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. Adminstrating fees vary. For information or to register contact W2ILP.

**Editorial**

As of this date we have three confirmed registrants for the March VE session, so the session will definitely be held. Getting our sessions listed on the ARRL website has been the best advertisement for our sessions.

I am in the process of setting up an HF station in another room. I have my little IC-706 in a room with my PC tower but there is no space for any more ham equipment on my computer furniture. I will still be using the IC-706 for VHF/UHF but my HF station will now be in the original room where it was before I got seriously into the digital modes. In preparing for my HF station I tried to fix my 40-Meter dipole, which got its wire twisted onto tree branches that have grown around it. In doing so I only succeeded in breaking the dipole and I cannot fix that until I hire a professional tree climber. My 10-15-20 Meter attic antenna is still OK but I will not be able to try to sign into the Sunday morning WAG net until I can get the 40 Meter dipole repaired.

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

FIRST CLASS MAIL

*Do Not Delay*

### **RECRUITING YOUNGER HAMS**

It was I who suggested that the GARC contact high school people who are operating radio broadcasting stations on commercial frequencies. I can admit that there aren't many young people getting interested in ham radio in our area but this is not true in other states. There are some schools that don't even operate over the air but use carrier current communication methods, similar to what hams used during WWII when they were banned from transmitting over the air. Operators of school stations in areas other than ours are often hams or wannabe hams, although studio operators of broadcasting stations are no longer required to hold FCC licenses. Only the installers of broadcasting equipment require FCC licenses because modern broadcasting equipment uses automatically adjusted frequency control and automatic over-modulation prevention and compression. Old timers still ask applicants for the broadcasting jobs if they hold operator licenses...because it's a tradition. Naval and Coast Guard Academies still train students for Commercial Operator Licenses that are required in maritime services. Air lines require HF radio maintenance people to hold a GROL.

When Ronald Reagan started his career as a sports announcer at a small broadcasting station, his boss wanted him to get a First Class Radio Telephone Operator License. In those days, particularly at the smaller stations, the announcers were often licensed radio engineers. The story is that Reagan was unable to pass the First Class exam, but could only pass the Second Class exam. I don't know if this is true, but I've heard that is why the First Class License was eliminated when Reagan became President, and the Second Class License was replaced by the General Radiotelephone Operator License (GROL) that still exists today. Kids in our area may have expectations of becoming highly paid professionals or personalities, while radio engineers are may now be considered to be no more than low paid technicians. This is not true in areas like Ohio or West Virginia where folks may not have such grand expectations. Most of the folks there want licenses. For example, the only surviving miner in a mine collapse a few years ago was a young man who held a ham ticket. The average age of hams in our area used to be over 50. I haven't checked lately but I think it is now over 65. Boy Scouts may be too young to get mentored into ham radio, but I believe that there may still be people who are enthusiastic enough to learn about FCC rules and regulations and the technology that applies to both commercial and amateur radio. If we expect the GARC to survive we must work to contact young people. When we operate FD we do find that many colleges and organizations are sponsoring large ham clubs with avid young operators. In my humble opinion there is no excuse for not seeking young members. If we don't care or won't try we will expire before the other local clubs. -w2ilp-