# MOUNTAIN SPARK GAPS

**NPARC—The Radio Club for the Watchung Mountain Area**

**Website: http://www.nparc.org**
**Club Calls: N2XJ, W2FMI**
**Facebook: New Providence Amateur Radio Club ((NPARC)**

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# UPCOMING EVENTS

## Regular Meetings

10/10 &10/24
Monday 7:30
NP Community Center

## Meeting Schedule

**Regular Meeting:** 7:30—9:00 PM
**2nd Monday of each month** at the
NP Senior & Adult Center
15 East Forth Street
New Providence

**Informal Project Meeting:** 7:30—9:00 PM
**4th Monday of each month**
**Same location**
**Everyone is Welcome**
If a normal meeting night is a holiday, we usually meet the following night.
Call one of the contacts below or check the web site

## Club Officers for 2016

President: KC2WUF David Bean
973-747-6116
Vice President:K2UI Jim Stekas
973-377-4180
Secretary: KD2EKN Tim Farrell
973-921-1175
Treasurer: K2YG Dave Barr
908-277-4283
Activities: W2PTP Paul Wolfmeyer
201-404-6914

## On the Air Activities

Club Operating Frequency
145.750 MHz FM Simplex

Sunday Night Phone Net
Murray Hill Repeater (W2LI) at 9:00 PM
Transmit on 147.855 MHz
With PL tone of 141.3 Hz
Receive on 147.255 MHz
Net Control K2AL

Digital Net
First & Third Mondays 9 PM
Details as announced.

## Club Internet Address

Website:http://www.nparc.org
Webmaster K2MUN David Berkley
Reflector: nparc@mailman.qth.net
Contact K2UI, Jim


## MOUNTAIN SPARK GAPS

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WB2QOQ Rick Anderson
WB2EDO Jim Brown
K2UI Jim Stekas


Climatological Data for New Providence for August 2016

The following information is provided by Rick, WB2QOQ, who has been recording daily weather events at his station for the past 35 years.

**TEMPERATURE -**
Maximum temperature this August, 94 deg. F (August 11,13)
Last August(2015) maximum was 95 deg. F.
Average Maximum temperature this August, 87.0 deg. F
Minimum temperature this August, 55 deg. F (August 23)
Last August(2015) minimum was 56 deg. F.
Average Minimum temperature this August, 67.7 deg. F
Minimum diurnal temperature range, 10 deg. (79-69 deg.) 8/1
Maximum diurnal temperature range, 26 deg. (86-60 deg.) 8/4

Average temperature this August, 77.4 deg. F
Average temperature last August, 75.1 deg. F

**PRECIPITATION -**
Total precipitation this August - 1.64" rain.
Total precipitation last August - 5.40" rain.

Maximum one day precip. event this August - August 11, 0.55" rain
Measurable rain fell on 6 days this August, 5 days last August.

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Rick Anderson
9/3/16
243 Mountain Ave.
New Providence, NJ
(908)464-8912
rick243@comcast.net

**Lat = 40 degrees, 41.7 minutes North**
**Long = 74 degrees, 23.4 minutes West**
Elevation: 380 ft.
CoCoRaHS Network Station #NJ-UN-10

# Take it to the (Shannon) Limit

Jim Stekas - K2UI

Back in 1988 I upgraded my original IBM PC (dual floppy, w/ 256kB) to a ZEOS AT class machine with 1MB of memory and a whopping 30MB hard disk. I couldn't imagine ever running out of disk space (just as I couldn't imagine ever turning 40 years old) but after acquiring a few bloated Microsoft apps I was up against the stops. As a temporary solution I installed a software package that created a compressed file system on the disk and doubled the effective capacity of my drive. I expected the compression and decompression would slow the disk I/O rate, but I was stunned to find I/O was faster than before! The CPU was decompressing/compressing sectors faster the disk could read/write them.

Today, computers have 10,000 times the capacity of my vintage AT, but compression utilities are ubiquitous. So … how much can a file be compressed? Claude Shannon's Information Theory, invented some 60 years ago provides the answer. His theory gives a precise definition of the quantity of information in a message, and the minimum number of bits required to encode it. He also derived an formula giving the maximum bit rate that can be sent over a communication channel – the Shannon Limit.

For Shannon, a message is composed of a set of symbols occurring with different frequencies. Given a message, Shannon's formula defines the information content of the message, which in turn defines the minimum number of bits to encode it. Shannon doesn't provide a prescription for generating the optimum encoding, but there are some simple principles that can be used for creating a very efficient encoding. As it happens, radio amateurs have been applying Shannon's principles since before he was born (1916).

Shannon's definition of the quantity of information in a message is very closely related to the definition of entropy in physics (statistical mechanics). In fact, information theorists frequently refer to the “entropy” of a data file as a measure of how difficult it is to compress. File compression essentially involves turning a large “low entropy” file into a much smaller “high entropy” one.

To see how "entropy" works, suppose we had a fair coin where any flip had an equal likelihood of coming up heads or tails. If we flipped the coin 10 times, there are 210 = 1024 possible outcomes corresponding to the 10-bit binary numbers from 0000000000 to 1111111111. Since all outcomes are equally probable we need all 10 bits to express the result so no compression is possible – hence this is a case of "high entropy". The information content of each toss of a fair coin is 1 bit.

Now let's suppose the coin isn't fair, but comes up heads 99% of the time. So learning that a toss came up heads really doesn't convey much information since we pretty much knew the answer already. In ten flips, we would get the ten heads 90% of the time, one tail 9% and more than one tail < 1% of the time.

The table below shows the probability of various heads/tails outcomes for 10 tosses and the number of ways it each can occur, N. From this we can calculate the average number of different results produced by 10 tosses of our unfair coin which turns out to be 2.02. Therefore the results of 10 tosses of the unfair coin can be encoded (almost) by a 1 bit. So the information content is about 0.1 bit per toss.

| Heads | Tails | Prob | N | N*Prob |
|---|---|---|---|---|
| 10 | 0 | 0.904 | 1 | 0.904 |
| 9 | 1 | 0.091 | 10 | 0.913 |
| 8 | 2 | 0.004 | 45 | 0.186 |
| 7 | 3 | 0.0001 | 120 | 0.013 |
| Etc. | | | | |
| | | | Sum | 2.02 |

Of course 0.1 bit per toss isn't really enough to handle 10 tosses because we would miss some low probability outcomes (like 10 tails). But as the number of tosses becomes very very large (i.e. approaching infinity), number of bits per toss required to encode the sequence approaches

$$0.0808... = - 0.99 * \log2( 0.99 ) - 0.01 * \log2( 0.01 )$$

This is Shannon's equations for the entropy of our unfair coin. In the general case, Shannon dealt with messages composed of a set of symbols occurring with different frequencies (probabilities). Shannon's formula defines the information content (in bits) of a message, but doesn't provide a prescription for generating the optimum encoding. But the equation gives a hint as to how to create a very efficient encoding: use the shortest bit sequences for the symbols occurring most frequently and longer sequences for the less frequently occurring symbols. (This approach is called Huffman coding.)

As it happens, radio amateurs have been applying Shannon's principles since before he was born (1916). Morse code represents each character of the alphabet with a sequence of dits (0) and dahs (1). Spaces are used to separate characters. For the sake of efficiency the most common characters are encoded with the shortest sequences of dits and dahs: E=0, T=1, I=00, A=01, N=10 and M=11. Similarly, the least frequently used characters have the longest sequences: Q=1101, J=0111, X=1001, Z=1100, etc. But we don't only send the characters efficiently, we also have defined some special sequences for words and phrases that occur frequently: R, TU, WX, 73, ES, HI, QRP, etc. (Note that RTTY is not as efficient as Morse since it uses 5 bits for every character irrespective of its frequency of occurrence.)

So, according to Shannon's Information Theory, the Morse code we use in ham radio is a pretty efficient way to encode messages. It's probably not significantly worse than the optimal coding in dits and dahs. But what does it take to get a message over-the-air from transmitter to receiver? Well, Shannon figured that out too, and it will be our subject next month.

# SCIENTIFIC TIDBITS

## Henry VIII's Head Injuries

England's notoriously mercurial King Henry VIII may have suffered traumatic brain injuries similar to the ones affecting an increasing number of NFL players. The 16th-century monarch, who engineered the English Reformation, but perhaps is best known for having two of his six wives beheaded, was by all accounts intelligent and even-tempered in his youth, as well as a dazzling physical specimen. By the time he died at 55, however, Henry had grown violently capricious and morbidly obese. After examining letters and other historical documents, researchers at Yale University say the Tudor king suffered several jousting mishaps that may have hastened his mental and physical decline. Two injuries sustained in his 30s left Henry dazed or unconscious, a third head trauma years later coincides with his increasing headaches, insomnia, memory loss, and impulsivity. All this evidence points to the fact that Henry may have suffered the lingering effects of concussions caused by head trauma. "It is intriguing," study author Arash Salardini says, "to think that modern European history may have changed forever because of a blow to the head."

## Marijuana Affects Memory

Many marijuana smokers enjoy the drug's short-term high, but a new study reveals that weed may also wreak long-term havoc on the brain. Specifically, researchers found that years of pot smoking could hinder people's ability to recall certain words. The team tracked the marijuana use of nearly 3,400 men and women over the course of 25 years. At the end of the study the subjects were tested on their verbal memory, mental processing speed, and executive function. For every five years of exposure to marijuana, the study found, one out of two smokers remembered one word fewer from a list of 15 – a small but statistically significant effect. Marijuana use didn't affect other areas of brain function, but the more pot people smoked, the worse they performed on memory test. The transit effect might have long-term consequences on the way the brain processes information, and could also have a direct toxic effect on neurons.

## Talk About Long-Term Storage

Imagine a disk that stores up to 360 terabytes of data, withstands temperatures up to 1800 degrees Fahrenheit, and will hold data for up to 13.8 billion years at room temperature without degrading. Researchers at the University of Southampton say they have created such a device. Using nanostructured glass, they developed a method to record and retrieve digital data using 5 dimensional recording technology based on femto-second laser writing. The scientists are looking for a company to help them market the storage device. If this device is as good as it looks peripherally, there should be venture capital available.

# Space Junk

Space junk presents problems for space travelers. A report by Wired.com on challenges of space travel lists space junk as 1 of 12 hazards. Some 17,000 softball-size or larger junk items orbit Earth. The report, citing NASA and Spacetrack.org data, says 3 countries account for 97% of the debris. Number 1 is China at 36%, number 2 is Russia with 34% and number 3 is the United States at 27%. It is looking like a good time for all these countries with active space programs to get out the brooms and start cleaning up this fast expanding litter; and you thought the United States was number one in space?

Jim WB2EDO