The Case for CW

For nearly two decades now, a vocal group of radio amateurs have pushed for the elimination of telegraphy exams as a prerequisite to Amateur Radio Licensing. Many of these individuals have formed opinions about radiotelegraphy based on little or no knowledge of its history or applications.

With the elimination of the FCC Element One telegraphy exam for all classes of Amateur Radio License, it is hoped that individuals will now take a more dispassionate, logical look at radiotelegraphy, without concerns regarding possible hidden agendas or other politics related to the regulatory process.

It is the purpose of this article to provide an opportunity for new radio amateurs, and others, to gain some insight into the advantages of radiotelegraphy. Ideally, the reader will walk away with a few myths dispelled and perhaps some valuable insights into the motivations of those individuals who continue to strongly support and promote radiotelegraphy despite the development of many new automated digital techniques. Most importantly, it is hoped this article will encourage new radio amateurs to learn and use "CW."

The beginning….Morse Telegraphy

The fountainhead of all modern communications is the electromagnetic telegraph. The telegraph was a true revolution in telecommunications. It standardized time, made safe rail transportation possible, and revolutionized industry, war, and commerce. It transformed local stock and commodities exchanges into worldwide engines of capitalism and economic progress. The telegraph supported the development of other modern infrastructure, from pipeline storage and distribution systems to modern urban fire departments.

In comparison to the telegraph, its modern successor, the Internet, is simply a refinement. It accomplishes the same tasks more efficiently, but fundamentally, it still performs the same tasks as the telegraph. The real revolution occurred nearly 150 years earlier.

It is interesting to note that the electromagnetic telegraph saw commercial use well into the mid 1980s, at which time it remained in use in railroad, brokerage, and similar business applications. Sadly, modern historians tend to overlook the history of the telegraph, resulting in the general perception that it disappeared with the development of the telephone. Ironically, even the Bell System utilized telegraphy to coordinate the repair and maintenance of long-distance telephone toll circuits, radio and television programming distribution networks, and the like. Telegraph systems were typically less expensive to utilize, easier to maintain, and telegraph carriers could be composited to operate simultaneously on voice circuits.

There must be a reason this very basic technology survived well into the late 20th Century, and it had everything to do with efficiency!

Radiotelegraphy

The development of wireless communications in the late 19th and early 20th century brought the application of telegraphy to radio communications. For the first two decades of the 20th Century, voice communications was difficult to accomplish. The reasons for this are somewhat technical, however, a brief explanation is in order.

Early radio transmitters produced a damped oscillation caused by discharging a high voltage spark across a parallel resonant circuit, which was then coupled to an antenna system. The process was somewhat like ringing a bell. Each high voltage discharge across the gap would excite the L-C circuit, which would then "ring" at its resonant frequency with a decreasing amplitude (decrement) over time until again excited by the succeeding high voltage spark discharge. The "damping" effect associated with early spark transmitters made it impractical to modulate these early RF carriers.

In an attempt to overcome the deficiencies of early spark technology, continuous wave transmitters were developed, which produced undamped oscillations. The earliest versions produced high-power, long wave signals utilizing alternator and arc technology. While this improved efficiency through better energy transfer and narrower bandwidth, such systems were also difficult to modulate due to the high power levels employed.

Only with the development of reliable, stable vacuum tube transmitters in the late 'teens and early twenties did it become possible to efficiently transmit voice communications. Low-level circuits could be modulated at manageable levels, and the modulated signal could then be amplified to achieve the needed power output and coverage area required of the radio transmitter. This gave birth to a wide range of technological applications such as commercial radio broadcasting, police radio dispatching, long-distance radiotelephony, and so forth.

It is interesting to note that utilizing "CW" as a description for radiotelegraphy is somewhat of a misnomer dating from this early period. The term actually arose to differentiate a continuous wave radiotelegraph transmitter from its predecessor spark technology. In a sense, all modern radio and wireless devices utilize continuous wave, from 1920s radio transmitter to the latest cellular telephone or Wireless Internet device!

Why CW?

So why did radiotelegraphy, or "CW" remain in widespread use for so many years after the development of voice communications? Why is it still utilized today for some applications? Why do so many radio amateurs place so much emphasis on what often seems to the uninitiated "just another mode of communications." The answers are many!

Efficiency:

A competent radiotelegraph operator can transfer information at a speed of perhaps 40 to 60 words per minute. The average person on the street talks at speeds ranging from 200 to 300 words minute. Yet, the radiotelegraph operator will often clear message traffic at speeds ranging from two to four times faster than a voice operator handling identical traffic. It seems paradoxical doesn't it? The reasons for this are surprisingly straightforward.

First, voice methods encourage unnecessary language. The convenience of voice methods, and their similarity to daily, casual discussion, guarantees that a radio operator will trend toward adding unnecessary phrases, comments, and clarifications. The *perception* that plenty of time is available on the radio circuit due to the immediacy and convenience of voice communications encourages operators to "think aloud," and engage in spontaneous, informal communications and problem solving.

Second, even when voice methods are managed through strict discipline and training, such as on military radio circuits, problems arise. The letter "B" sounds like "D," which in turn sounds like "E," and "C" and so on. Therefore, it becomes necessary to institute phonetic alphabets and similar procedural phrases to maintain accuracy. When such practices are bypassed in favor of speed, receiving operators tend to make assumptions about the meaning and nature of words, which may only have been partially perceived. For example, a public health message in reference to "pneumonic plague" is transcribed as "bubonic plague." "Ethyl" becomes "Methyl" within a complex chemical name, and so on.

Radiotelegraph operators, on the other hand, trend toward eliminating unnecessary language. The fact that the individual operator naturally "thinks" faster than he/she can send constantly encourages the elimination of any unnecessary word, phrase of procedure. Furthermore, phonetic alphabets are unnecessary due to the fact that every sound pattern for the various Morse characters is absolutely unique. For example, complex chemical name containing "Methyl" or "Ethyl" are more likely to be transcribed accurately.

It is not uncommon to hear one operator transmitting a quantity of messages to a receiving station, only to hear a single "dit" as acknowledgement of receipt between the messages. This is an example of the trend toward limited language inherent in CW methods. In this example, both operators intuitively understand that the "dit" indicates acknowledgement.

Both a language and a system:

Radiotelegraphy is unique in the world of radio communications because, in the hands of an experienced operator, it becomes a hybrid between a communications method and a natural language. As such, it combines the best benefits of a digital radio system with the intuitive nature of language. The skilled operator thinks in Morse, he processes the language of Morse “in his mind” in the same way he responds to voice communications, yet, when it comes time to transcribe information, he can do so with greater accuracy due to the “digital” nature of the mode. The operator can seamlessly move from a basic discussion or tactical problem solving mode to a record message traffic exchange with ease.

This is a difficult concept for the beginning radio operator or the uninitiated to understand, particularly when his experience with Morse is limited to 5 or 10 words per minute and before he has successfully made the transition to the point where he can process Morse in the same manner he does the spoken word. As in the case of learning a foreign language, it takes time and effort to develop the skills necessary to utilize Morse as a language. However, once one does, an entire new world of communications efficiency opens to him.

Technical benefits:

We have all heard the tired old explanation that a simple CW transmitter can be easily constructed from just a few parts. This is true, but few today are willing or qualified to do so. However, CW offers a variety of benefits, which make it ideal for basic emergency communications.

First, a ten to twenty watt CW transceiver offers the same level of efficiency as a 50 to 100 watt voice (SSB) transmitter. This has everything to do with bandwidth. Whereas a CW signal occupies perhaps 200 Hertz of spectrum, voice and some data transmissions occupy up to 4000 Hertz of spectrum. So why is this important?

In a disaster situation, one can operate a CW transmitter and communicate reliably in an net situation for days utilizing little more than a couple of lantern batteries or gel cells as a source of primary power due to the low RF power output required for reliable communications. In order to accomplish the same level of reliability, a voice transmitter requires a generator and fuel for extended operation. Those that suggest this is a minimal obstacle have never tried to locate fuel in a disaster area, nor have they tried to compete with police departments, fire departments, state and federal agencies, hospitals, and other critical services for any fuel that remains available.

Drop a CW operator into a disaster area with a simple man-pack radio, a couple hunks of wire, a solar panel and a few gel-cells, and one has a reliable communications system, which can operate indefinitely. Unlike those operators employing digital modes, he will not need to worry about powering a laptop computer, PDA, and similar peripheral devices, all of which consume additional power. Furthermore, many computers and electronic devices are easily damaged by environmental factors, such as rain, vibration, and so forth. A simple CW unit can be kept nice and dry, with only a simple key exposed to the elements.

Multiplexing:

Set up a radio network with multiple stations, and one quickly discovers that occupied bandwidth is an issue for other reasons. A CW net can efficiently dispatch multiple stations off-frequency to simultaneously exchange message traffic with minimal impact on overall spectrum use. Unfortunately, voice nets find that the same technique creates real problems. Send two voice operators to simultaneously exchange messages on adjacent frequencies, and one quickly discovers that a single net operation is now consuming a minimum 10.5 KHz! Toss in a couple speech processors or inappropriately adjusted transceivers, and that figure expands yet further.

The fact is, a single CW net can send several traffic exchanges off the main net frequency and still have less impact on adjacent users than a single voice net.

Q-Signals

Q-Signals, procedural signs (prosigns), and the like offer little advantage on voice, yet they do wonders on CW. A net control operator may say WB8SIW QNY K8SIW d 3 SEOC. Both stations respond with a simple “dit” and they are now 3 KHz lower exchanging a message for the State Emergency Operations Center.

Q-signals, Z-signals, and similar abbreviations and prosigns convey tremendous amounts of information with minimal time and effort. Unfortunately, they do not translate well to voice operation for the reasons mentioned above.

Language barriers:

Not only do Q-signals and prosigns translate universally via CW, a qualified CW operator can transmit and receive messages written in many foreign languages without knowledge of the language itself. The International Morse Code is quite universal and facilitates message exchange despite barriers that would be insurmountable using voice methods.

Basic level of security.

While it is true that some computer programs can detect and decode CW, they often respond poorly to hand-keyed Morse. Additionally, Morse nets are difficult to locate unless one has some prior understanding of net times, frequencies, and procedures. A typical media outlet is not likely to comprehend “QNY D 3” or QMN QNA SEOC.” Rather, they will seek out the voice nets, which are easily understood and followed with a minimum of effort. For situations in which a degree of confidentiality is required, CW is an excellent choice.

CW offers an additional advantage. Whereas voice nets are often inundated with spontaneous, untrained volunteers in time of emergency, CW nets often continue to operate unaffected. While the unfortunate voice operators are contending with inexperienced individuals, poor procedures, and unnecessary language, the CW net keeps right on moving traffic, often at peak efficiency.

Analogs:

Many anti-CW operators point to the fact that the Department of Defense and maritime services no longer utilize CW. This is not entirely true. US Army Special Forces personnel are still trained in Morse, and many of the world's militaries still utilize it, albeit to a lesser extent than in years past. In fact, the military and maritime services have not so much abandoned CW as they have abandoned the High Frequency infrastructure, which once required its use. Global satellite platforms now support much of our military and maritime communications. As such systems are immune to selective fading, geomagnetic storms, and similar propagation anomalies, there is little need for CW.

Unfortunately, Amateur Radio does not have access to a stable, geosynchronous satellite system. Instead, Amateur Radio continues to rely on High Frequency spectrum for a much of its statewide, regional, and international communications. Such spectrum continues to prove problematic for high-speed digital modes and voice communications due to occasional solar flares and the like.

CW does offer tremendous advantages under poor propagation conditions. This fact, combined with the advantages noted above continues to render CW of value for both routine and emergency communications functions via Amateur Radio.

Digital Modes:

Today, radio amateurs have access to numerous digital modes, some of which occupy limited bandwidth and offer surprising reliability. However, problems arise here as well. Whereas SSB and CW are common denominators, readily available on nearly all High Frequency transceivers, digital modes are not. Visit a random sample of 100 digital equipped operators, and one quickly discovers that no common system is universally available. Unlike an army signal battalion, which has universal standards enforced to insure interoperability and uniformity, no such standards exist within Amateur Radio. One will encounter different terminal software, different TNC command structures, and a variety of different digital capabilities.

In reality, voice and CW are the only universally available common denominators within Amateur Radio. A qualified operator can walk up to any HF transceiver, plug in a microphone or key, and communicate instantly on a radio circuit, regardless of the age or type of HF radio transceiver.

It is interesting to note that many digital modes are also cumbersome in a net configuration. Whereas break-in CW offers instant access to a radio net for high-priority traffic, this feature is difficult to implement on a digital radio net. As stated earlier, the fact that CW combines both language skills and many features of digital communications allows a single net control station to quickly check individuals in and out of nets, provide rapid instructions, and yet clear traffic accurately. This is one reason why many emergency drills have revealed that CW nets are consistently more efficient than PSK-31, MFSK-63, and similar modes.

Is Amateur Radio needed?

Some will argue that modern cellular telephone, Internet, and satellite infrastructures are sufficiently developed to the point where High Frequency communications is no longer needed. The argument is somewhat inferential; if Amateur Radio HF resources aren't needed, then by extension CW is not needed. As such, any imperative to learn or develop CW proficiency is moot.

The devastation of Hurricane Katrina revealed the fragility of our nation's common carrier infrastructure. Ultimately, satellite telephones provided significant service for many government agencies. However, satellite telephones have some significant disadvantages, not the least of which is cost. The average call via satellite telephone can range from 1 to 3 dollars per minute, a steep price for many non-profit relief organizations. Satellite telephones are also problematic when utilized inside buildings.

Most modern telecommunications networks are extremely reliant on the electrical power grid. The distributed nature of networks means many nodes, control points, and RF access points are backed-up only by battery power. This is sufficient for 99 percent of power outages, which may last only hours or days. However, it is extremely insufficient for long-term outages. The fact is, any major disruption to the US electrical power grid due to natural disaster, technological disaster, or coordinated terrorist attack is likely to disrupt extensive segments of most modern networks. Yet, a HF equipped CW operator will be able to efficiently transfer basic text information indefinitely through the use of renewable energy and similar techniques.

Sadly, both the general public and the US government have been lulled into a level of complacency. Our infrastructure is the best in the world and it is so ubiquitous and reliable, most individuals are incapable of imagining a situation, which may render large portions of it inoperative. Yet, such hazards do exist and do occur from time-to-time.

Non-profit and decentralized:

There remains a place in society for a non-profit, decentralized radio service that is neither dependent on extensive infrastructure nor controlled by any particular government or business organization. Amateur Radio offers independence, survivability, and remains an unprecedented disaster communications resource.

CW in general, and CW nets in particular offer great reliability and tremendous efficiency for both casual use and emergency communications. The wise radio amateur will want to invest the time and effort necessary to become fluent in the language of radiotelegraphy. It is not only fun, but incredibly useful as well.

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