The Framingham Circuit

Newsletter of the Framingham Amateur Radio Association, November 7, 2026 Vol. 93, No. 4

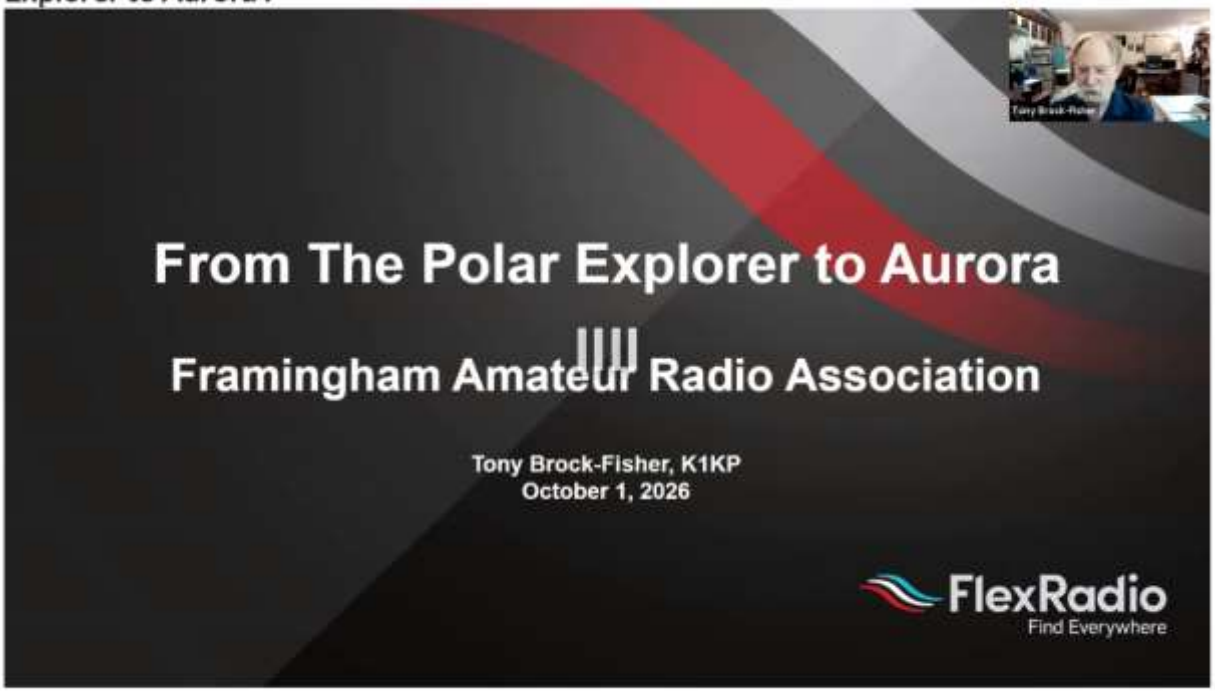
President's Message: We had three excellent presentations as noted below, and we will end 2026 with a luncheon at Longhorn Steakhouse on Saturday December 12, 2026. A good time was had by all last year. As the leaves fall, it will soon be an opportunity to adjust/move your wire antennas, as you will have better visualization of the branches. Please submit to me your new call signs, radios, articles, photos, presentation requests, video suggestions and other random odds and ends for the Circuit. Please see the very practical article by Sumner, W1VIV, on logging FT8 using N1MM and WSJT-X and other programs. Also please see the theoretical article by Bruce, W1HNZ, on antennas available to hams in 1933, the year of our club originated. As we enter the holiday season, stay safe and be careful and get on the air.

CLUB ACTIVITIES SINCE LAST CIRCUIT:
Meeting videos available online at https://w1fy.org/past-meetings

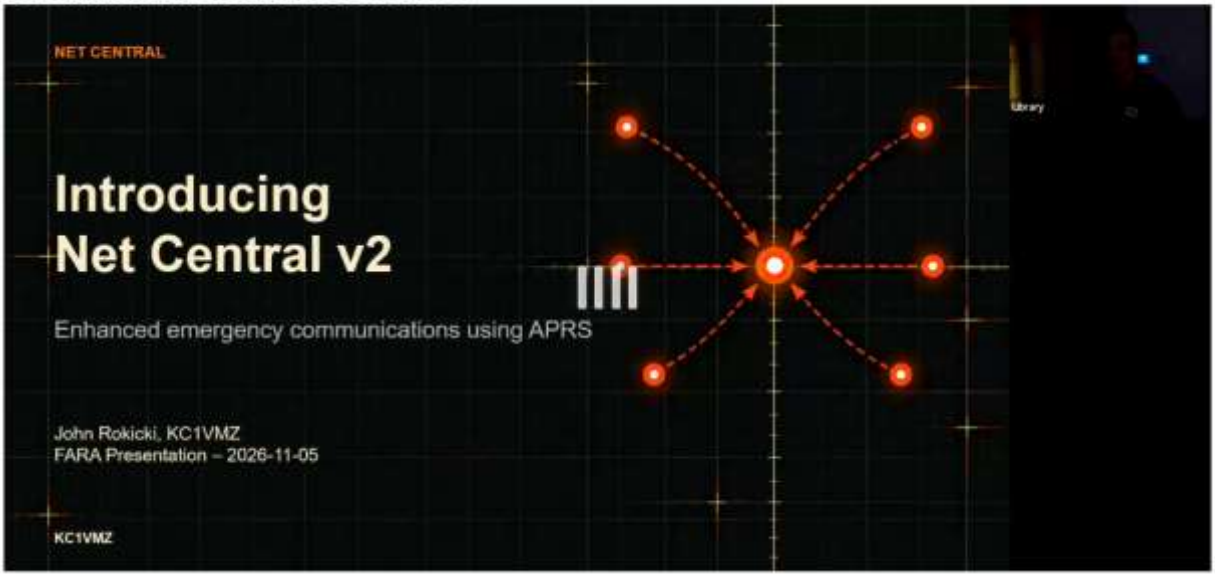
Thursday September 10, 2026, Steve Hewlett, W1NIV, presented "A Primer On VHF Contesting."



Thursday October 1. 2026, Tony Brock-Fisher, K1KP, spoke about "The Journey from Polar Explorer to Aurora".



Thursday November 5, 2026, John Rokicki, KC1VMZ, spoke about "APRS, Emergency Communications and Net Central".



UPCOMING FARA MEETINGS / ACTIVITIES:

- November 12, 2026, **Zoom meeting to discuss future presentations for 2027.** Zoom link has been sent. Please come with your requests and suggestions.
- December 12, 2026: **Noon luncheon at Longhorn Steakhouse** in Marlborough.
- January 7, 2027: **DxPedition video(s**).

ODDS AND ENDS:

- For years, **CW has no longer been required for any military use.** Recently the U.S. Navy has seen a need for knowing CW for emergency situations. Some advantages include narrow bandwidth, effectiveness at low power levels (QRP), and simple equipment requirements. https://morsecoder.us/blog/morse-code-navy-2026/?utm_source=ARRL&utm_campaign=379e4a1326EMAIL_CAMPAIGN_2026_10_02_07_07&utm_medium=email&utm_term=0_-379e4a1326-443806883 from Sumner Weisman, W1VIV

- **Zippitty-Do-Dog Hot Dog Shack is being sold again**

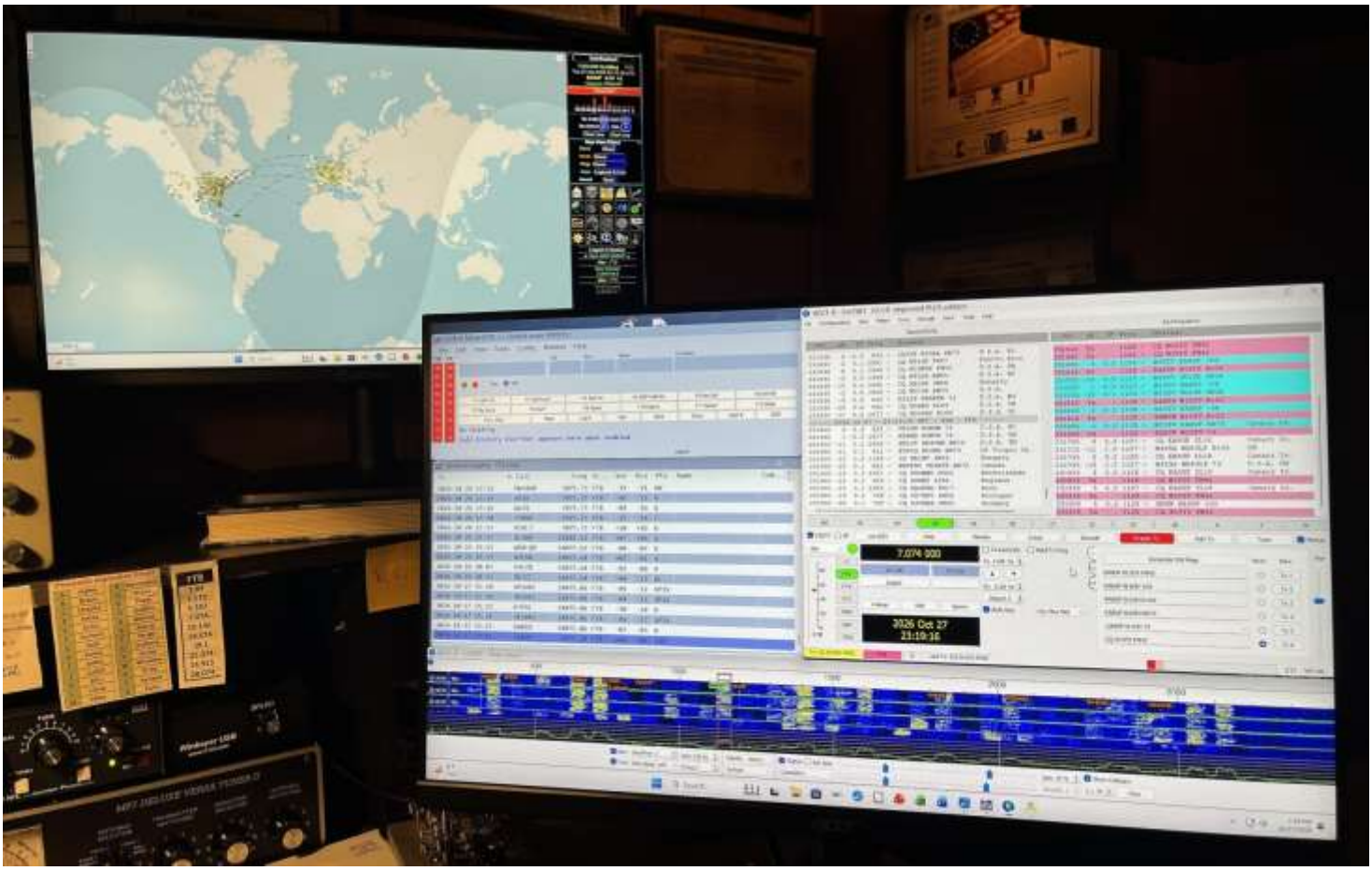
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ARTICLE ONE:

Automatically Log and Display Your FT-8 Contacts

Sumner Weisman, W1VIV

As a long-time occasional contester, I use N1MM+ contest logging software. Each completed contact is immediately added to the log shown on my computer monitor as soon as I hit the enter key. I enjoy watching the list grow. But that has not worked for the digital modes. Now that I am using WSJT-X for the newer digital modes like FT-8 and FT-4, as soon as I manually log each station worked, it disappears. Unlike contesting, I cannot conveniently see a list of my worked stations. I know that I can use WSJT's ADIF file to see the stations I have worked, but that's not in real time. I can also see the number of my new FT-8 contacts on GridTracker2, but that is not a contact list. To me, this weakness makes using the digital modes less interesting. My solution was to add both N1MM+ and GridTracker2 to WSJT-X, running simultaneously, for a far more enjoyable radio experience. See Figure 1 below>>



N1MM+ Contest Logging Software

It is possible to have N1MM+ control and log stations during your digital operating. If you set it up properly, you can simply open N1MM+ and it will bring up the WSJT-X operating window and the waterfall display. To do that, I type FT8 into the N1MM+ display window and hit Enter, and that automatically opens the WSJT-X window and the waterfall display. All three windows can be shown on your monitor simultaneously. You then can use WSJT-X as you always do. As soon as you complete an FT-8 contact, it will be logged and shown on the adjacent N1MM+ screen. You have a choice of auto-logging, which I use, or manually logging the contact by hitting Enter, just as you do when logging a contest entry. The system is a pleasure to use, and it has made my digital operating far more interesting.

Figure 2 below>>

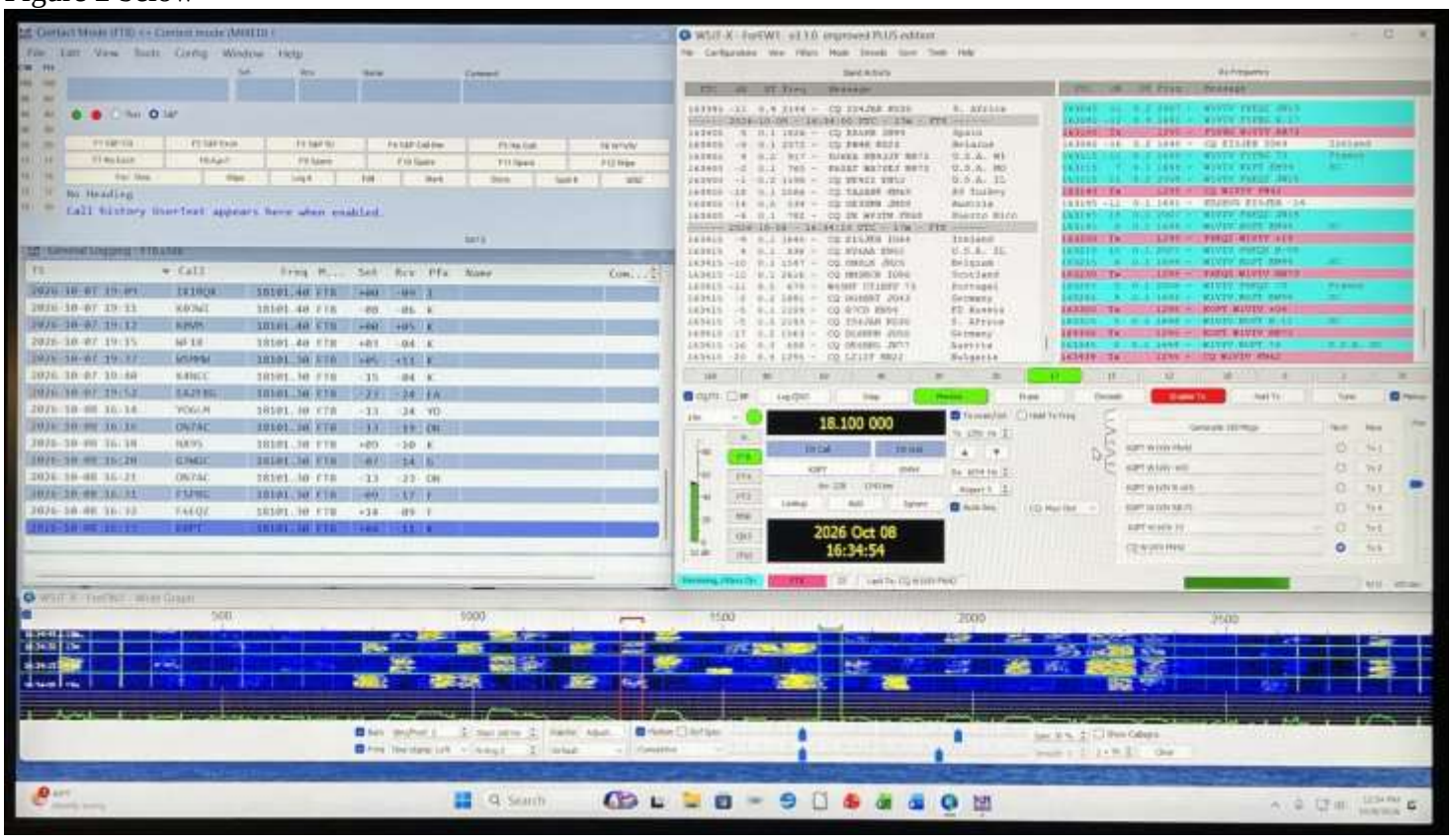


Figure 2 above shows my computer display. You can see the waterfall display at the bottom, and the WSJT-X operating panel on the right. The N1MM+ logging software is at the left, showing all my newly logged contacts. When you first bring it up, you will see a little pop-up window at the top left to remind you that you must shut off WSJT-X before shutting off N1MM+, because the system is controlled by N1MM+. If the bar at the top of that window is red, then you do not have everything set up correctly. If it is green, then everything is correct. Of course, you can put each window wherever you want it. I chose to cover that window with the N1MM+ logging window, as shown in the photo.

I strongly recommend that you first get WSJT-X operating correctly as a stand-alone application. Once you are working hams on FT-8 successfully that way, then you should be able to combine it with N1MM+ using the instruction links listed below. This was not a simple project. It took me some time to work it all out, and many things can go wrong. For example, I had set up N1MM+ as an administrator, but I did not do that when installing WSJT-X. This system will not run correctly unless both programs are set up the same, either as an administrator or not.

If you are a contester and use N1MM+ for logging, you know that to change bands, you click on the list of bands on the display, and you are now logging on that band if you use CAT control. Or, you can type the frequency into the entry window and hit Enter, and you are on that band. I do not use CAT control, and only change bands manually with my radio. If you are not using CAT control, after changing your radio to the new frequency, you

must change bands with the WSJT-X display, not with N1MM+. Simply select the band with WSJT-X as you always do when operating FT-8, and you are all set.

Adding GridTracker2 FT-8 Accessory Program

GridTracker2 gives me lots of information at the same time. For example: Which bands are most active, what are the last stations I've worked, where the grayline and the daytime/nighttime line is, current activity of many FT-8 stations, and most interestingly, a red line from my station to the station I am working, anywhere in the world. This feature is especially enjoyable when working DX stations.

In order to have all three applications talking to each other, I had to set up Multicasting, which is a group communication technique where data is sent to multiple destinations simultaneously. I also had to change the IP Address, which stands for Internet Protocol Address, and is a unique identifying number assigned to every device that uses the Internet.

A. Modifying WSJT-X:

Go to WSJT>File>Settings>Reporting>UDP Server
Type in IP Address 239.255.0.0.
Make sure that the UDP Server Port Number is 2237. If it is not, then change it.

Optionally, you can also click on Log Automatically, which I recommend.

B. Modifying N1MM+:

Go to N1MM+>Config>Configure Ports>WSJT-X and JTDX.
UDP Settings: Click on Enable
Type in IP Address 239.255.0.0.
Make sure that the UDP Server Port Number is 2237. If it is not, then change it.

C. Modifying GridTracker2:

Click on Settings (showing the gears, at the right)
Click on Multicast.
Type in IP Address 239.255.0.0.
Make sure that the UDP Server Port Number is 2237. If it is not, then change it.

Proper Sequence

Here is the proper sequence for startup and shutdown of your FT-8 operation:
Startup: Bring up N1MM+ first, and if configured correctly, it will then bring up WSJT-X when you type in FT8 and press the Enter key. Then, you can open GridTracker2 by clicking on the icon.
Shutdown: When finished, shut down Gridtracker2 first, then WSJT-X, and finally N1MM+.

Conclusion

After being a ham for many years, I thought I had seen it all. Ham radio was becoming less enjoyable. Trying these new digital techniques has forced me to learn some new skills, and I am now "hooked" on FT-8. Radio is fun again. Although the setup was somewhat difficult and took more time than I expected, the result was absolutely worth the effort.

Notes:

1. N1MM+ has some very helpful material online that will help, shown in the link below.

   https://n1mmwp.hamdocs.com/manual-windows/wsjt-x-decode-list-window/

2. In addition, WSJT-X has a good online operating manual. Especially see Part 4, Settings

   https://wsjt.sourceforge.io/wsjtx-doc/wsjtx-main-2.7.0.html#CONFIG

3. Also, N1MM+ has an outstanding Google User Group. I have posed questions to them several times, and have always gotten helpful replies. I subscribe to the Digest, so I get emails several times per week. I look at each one, and occasionally find a gem that increases my knowledge of N1MM+ operation.

   N1MMLoggerPlus+subscribe@groups.io

4. N1MM+, WSJT-X, and GridTracker2 are maintained by very dedicated hams and are provided at no cost to the user.

5. Frequently when you open N1MM+, a screen will state that there is a new version available and will ask if you would like to download it. I strongly recommend a Yes answer. It only takes a few seconds.

6. If you are downloading N1MM+ for the first time, you should select the Full Install and follow the instructions.

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ARTICLE TWO:

1933 FARA Antenna Types and Technologies

As our website notes—and our members know—the Framingham Amateur Radio Association (FARA, call sign W1FY) was founded in 1933 and is one of the oldest active amateur radio clubs in the United States. What technologies and antenna configurations did our predecessors use that year, and what antenna topics might they have discussed at monthly meetings? The purpose of this article is to explore the empirically based antenna engineering core principles and antenna types potentially used by our former fellow Framingham Amateur Radio Association members in 1933.

Historical Context: Amateur Radio in the 1930s

By 1933, amateur radio had evolved substantially from its spark-gap origins in the early 1900s. The International Telecommunication Union's 1927 Washington Radio Conference had allocated specific shortwave frequency bands to amateurs, creating a defined spectrum framework within which systematic antenna experimentation could be conducted. American amateurs, in particular, had played a pioneering role in demonstrating that shortwave frequencies once dismissed by commercial operators as useless could support reliable intercontinental communication via ionospheric skip propagation.

The state of antenna engineering in 1933 was characterized by a productive tension between academic electromagnetic theory, which had been fully codified in Maxwell's 1865 formulations known to engineers in principle, and practical implementation, which depended almost entirely on empirical measurement. Professional antenna engineers at broadcasting stations had access to field-strength measurement equipment and could characterize antenna performance experimentally. Amateur radio operators, by contrast, relied on published design rules, receiver signal reports from distant stations, and qualitative assessments of antenna performance.

The ARRL Handbook served as the primary technical reference for American amateurs throughout the 1930s. Its 10th edition, published in 1933, contained antenna chapters that distilled the best available practical knowledge of the period, drawing on contributions from both academic sources (including early work on dipole radiation resistance by Abraham, Hertz, and Marconi) and the accumulated experimental data of the amateur community.

Theoretical Foundations of High-Frequency Antenna Engineering in 1933

Electromagnetic Radiation Mechanics and Energy Detachment

In 1933 radio engineering, the antenna was fundamentally understood as an open oscillatory circuit designed to transfer radio-frequency alternating current into free-space electromagnetic waves. In

closed tuned circuits operating at power frequencies (such as 60-cycle AC), current flow through a conductor establishes alternating magnetic and electrostatic fields that collapse during each half-cycle, returning nearly all stored electrical energy back to the circuit.

However, when the frequency of excitation exceeds approximately 15,000 cycles per second (15 kHz), a dramatic physical transition occurs: the magnetic and electrostatic fields expand at the velocity of light, and a substantial portion of the field energy fails to return to the conductor before the field reverses polarity. This escaped energy detaches from the conductor in the form of self-propagating electromagnetic radiation. While any conductor carrying high-frequency current radiates to some degree, maximum energy detachment occurs when the physical linear conductor is rendered strictly resonant to the driving frequency.

Under resonant conditions, the power dissipated as radiated electromagnetic waves behave identically to power dissipated across a pure ohmic resistance. This equivalent virtual resistance is formally defined as Radiation Resistance (R_{rad}). For an ungrounded half-wave conductor (Hertz antenna) suspended in free space and operating at its fundamental frequency, the radiation resistance measured at the central current loop (antinode) is approximately 70 Ω. Conversely, for a quarter-wave grounded conductor (Marconi antenna) operating at its fundamental, the image conductor established within the earth halves the effective radiation space, resulting in a fundamental radiation resistance of approximately 35 Ω.

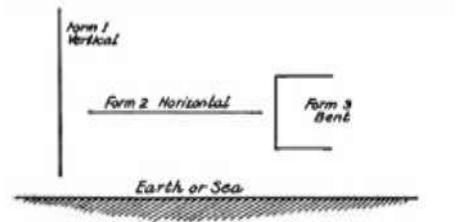
Distributed Circuit Constants vs. Lumped Tank Parameters

The fundamental distinction between transmitter tank circuits and antenna systems lies in the spatial distribution of inductance, capacitance, and resistance. Conventional transmitter circuits utilize lumped constants—discrete inductors (coils) and variable capacitors—where magnetic energy is concentrated almost entirely within the coil turns and electrostatic energy within the capacitor dielectric.

In contrast, a straight wire conductor suspended in space possesses distributed inductance and distributed capacitance along its entire physical length. Every increment of length contributes a minute inductance (L per unit length) and every incremental surface area forms a distributed capacitance (C per unit length) with respect to surrounding objects and ground. Consequently, a single straight conductor acts as an infinite series-parallel matrix of LC elements, forming an open linear oscillatory circuit capable of natural resonance without requiring discrete physical inductors or capacitors.

Antenna Type Classification: The Hertz vs. Marconi Paradigm

1933 antenna engineering strictly divided all radiating structures into two fundamental architectural categories based upon ground dependency: Marconi Antennas and Hertz Antennas.



HERTZ ANTENNAS

G. 122 — THREE FORMS OF HERTZ ANTENNAS

1. **Marconi (Grounded) Antennas**: A Marconi antenna relies fundamentally upon a direct connection (or high-capacity counterpoise) to ground. The earth acts as an electrical mirror, establishing a virtual image conductor below the surface. Consequently, a grounded wire operating at its fundamental frequency is physically one-quarter wavelength ($\lambda/4$) long, establishing a current maximum at the grounded base and a voltage maximum at the open top. Marconi systems radiate standing waves consisting of an odd number of quarter-wavelengths ($1/4\lambda$, $3/4\lambda$, $5/4\lambda$). Because of severe ground absorption losses at high frequencies, Marconi antennas in 1933 were largely restricted to lower frequency allocations (1750 kHz band) or specialized mobile installations where physical height was constrained.

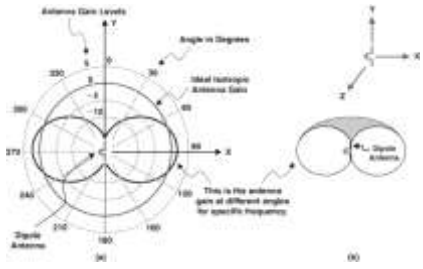
2. **Hertz (Ungrounded) Antennas**: A Hertz antenna operates entirely isolated from direct ground connections. In its purest form, it consists of a symmetrical open conductor suspended high above the earth. The fundamental Hertz antenna is physically a half-wavelength ($\lambda/2$) long,

maintaining an even number of quarter-waves (2/4λ, 4/4λ, 8/4λ). Because both extremities terminate in open air, voltage maxima and current minima always exist at both ends of a Hertz wire regardless of operating harmonic. Free from direct ground current dissipation, Hertz antennas exhibited vastly superior efficiency on high frequencies (3500 kHz to 56 MHz) and formed the backbone of 1933 short-wave communication.

Key Antenna Types in 1933

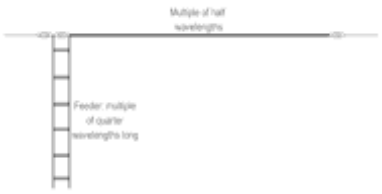
The 1933 Handbook described four principal antenna types that formed the foundation of HF antenna practice:

- **Hertz Antenna (Center-Fed Half-Wave Dipole)**: Named for Heinrich Hertz, this antenna consists of a conductor of length approximately $\lambda/2$ (one half-wavelength), fed at its center. The 1933 Handbook described it as a "self-contained" antenna requiring no ground connection, suitable for installation as a horizontal wire. The feed-point impedance at resonance was understood to be approximately 70–75 ohms.



- **Marconi Antenna (Quarter-Wave Vertical with Ground Return)**: Named for Guglielmo Marconi, this antenna consists of a vertical conductor of length $\lambda/4$, with the earth or a system of buried radials serving as the return path, effectively forming the "mirror image" lower half of a half-wave dipole. A requirement for this antenna is a good earth connection, though an elevated counterpoise or buried radial system could substitute for earth ground.

- **Zepp (Zeppelin) Antenna**: Originally developed for use on zeppelin airships, where a trailing wire was fed from one end via a parallel-wire resonant feedline (an "open-wire stub"), the Zepp antenna became extremely popular among amateur operators due to its versatility on multiple bands. The Zepp antenna is described as an end-fed half-wave wire matched via an adjustable open-wire stub, which could be tuned to present a suitable impedance to the transmitter output tank circuit. Today, the Zepp antenna would be recognized as an end-fed half-wave.



- **Harmonic Multi-Band Utilization**: A central engineering requirement in 1933 was operating a single physical wire antenna across multiple harmonically related frequency bands. Unlike lumped LC tank circuits that resonate at only one discrete frequency, open linear conductors resonate efficiently at integral harmonic multiples of their fundamental frequency. When excited at its fundamental frequency (1st harmonic), a Hertz antenna supports a single half-wave standing pattern with one current loop at the center. When driven at twice the frequency (2nd harmonic), two half-waves exist on the wire, establishing two current loops and an intermediate central voltage loop. At the 4th harmonic, four half-waves establish four current loops, and at the 8th harmonic, eight half-waves exist. For example, a Hertz antenna engineered with a fundamental frequency of 1790 kHz (132 feet long) resonates harmonically across four major amateur allocations: 1790 kHz (1st harmonic), 3580 kHz (2nd harmonic), 7160 kHz (4th harmonic), and 14,320 kHz (8th harmonic). A grounded Marconi antenna, however, can only operate on odd harmonic multiples (1st, 3rd, 5th, 7th) because a physical ground connection forces a current antinode at the base, which is incompatible with even harmonic voltage loops.

- **Broadside Arrays and Parasitic Reflectors**: As radio experimentation expanded onto 28 MHz and 56 MHz, engineers recognized that omnidirectional high-angle radiation was wasteful and ineffective for long-distance communication. To concentrate radiated RF power into a narrow

vertical beam at low angles toward the horizon, 1933 designers developed multi-element directive arrays. The primary directive design is the **28 Mc Four-in-Phase Broadside Array with Parasitic Reflectors**. This array comprises four vertical half-wave Hertz radiators arranged in a planar broadside configuration:

1. *Driven Phasing Elements*: Four vertical half-wave conductors are suspended parallel to each other. To ensure all four vertical elements radiate in phase, two-wire transposed transmission lines (utilizing ceramic isolative transposition blocks) interconnect the upper and lower antenna sections. Transposition reverses the phase of the feeding current by 180 degrees, exactly compensating for the half-wavelength spatial separation between element centers.

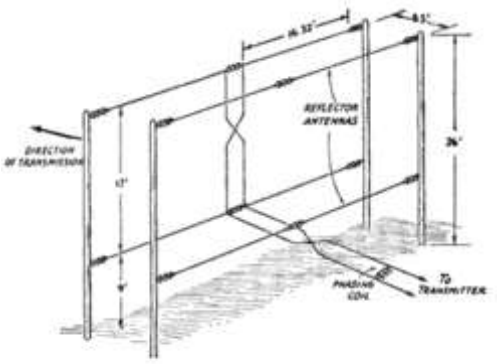


FIG. 1919 — A 28-MC. DIRECTIVE ANTENNA SYSTEM
Four-in-phase antennas backed up by four reflectors concentrate the radiation in the direction indicated by the arrow.

2. *Parasitic Reflectors*: Placed exactly one-quarter wavelength ($\lambda/4$) behind each driven vertical element is an un-fed, parasitic reflector wire cut slightly longer than a half-wavelength. The intense field radiated by the driven elements induces currents into the parasitic wires. The induced current reradiates an out-of-phase wave that cancels radiation in the rearward direction while reinforcing radiation in the forward direction. This converts a bilateral broadside radiation pattern into a highly concentrated unilateral beam, dramatically boosting effective radiated power toward the horizon.

Practical Antenna Design Rules of the Era

The 1933 Handbook codified several practical design rules that were derived from experimental observation rather than analytical derivation:

- **The** $468/f$ **formula**: For a horizontal half-wave dipole, the length in feet was calculated as 468 divided by the frequency in megahertz (f). This formula incorporates an empirical correction for the "end effect" or the capacitive loading at the wire tips that causes the electrical resonant length to be shorter than the free-space half-wavelength (492 feet $\times 1/f$).
- **Open-wire feeder line construction**: 14 AWG wire spaced 6 inches yielded approximately 500–600 ohms characteristic impedance. Spreaders were constructed from dry hardwood, Bakelite, or glass rod.
- **Standing wave indicators**: Simple neon-bulb or incandescent-lamp RF current indicators were placed along the feedline to qualitatively assess the presence of standing waves and to guide stub matching adjustments.
- **Transmitter coupling**: Output tank circuits were inductively or capacitively coupled to the feedline, with tuning adjusted for maximum antenna current or "brilliance" of the line indicator lamp—a precursor to modern SWR minimization.

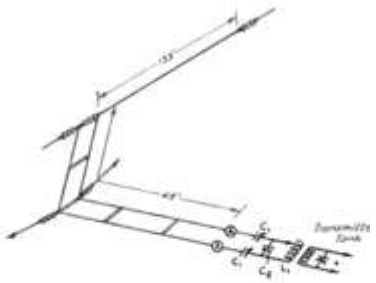
Feeder Systems

The antenna must be supplied with power from the transmitter. This process is termed feeding or exciting the antenna. The type of feed in itself does not make one antenna system more efficient than another; if the whole system is designed, erected, and tuned according to specifications, the antenna itself will radiate effectively with one feeder arrangement as with another.

Primarily there are two types of feed systems in general use by amateurs in 1933: tuned non-radiating links between the transmitter output circuit and the antenna, and untuned feed circuits whose characteristic impedance is matched at the antenna terminal end by a suitable coupling arrangement.

Current Feed Systems
A current feed system cannot be attached to the ends of a Hertz antenna because there is no current there. It must be connected at or near a point of maximum current, which occurs one or an odd number of quarter-wavelengths from the end. One or two variable capacitors can be connected in series with the antenna inside the station to permit precise tuning.

Voltage Feed Systems
Voltage-feed systems feed energy to the antenna at one of its voltage loops, or current nodes, instead of at a current loop. One end of the antenna is brought into the station and attached to a tank circuit coupled to the transmitter output. The antenna length is determined by the same general formula, and the antenna can be operated at harmonics as well as at its fundamental frequency.


FIG. 1212 — A ZEPPELIN (VOLTAGE FEED) ANTENNA FOR SEVERAL BANDS

The two-wire voltage-feed system, popularly known as the Zeppelin or Zepp antenna, uses a tuned two-wire feeder attached to the Hertz antenna at one end. Since there is always a voltage loop at this feed point, the system operates as a true voltage-feed system at all harmonics as well as at its fundamental frequency.

Feeder Tuning
Tuning voltage- and current-feed systems are similar, and the recommended practices should be followed to obtain maximum output compatible with good frequency stability. With series tuning, the parallel tuning capacitor is set at minimum capacity and the series capacitors at maximum; the series capacitors are then tuned toward lower capacity until the meters show the proper maximum current conditions.



FIG. 1211 — SERIES FEEDER TUNING

Concluding Synthesis and Historical Engineering Legacy
The antenna technology detailed in the 10th Edition of *The Radio Amateur's Handbook* (1933) captures a pivotal historical transition in telecommunications engineering. During the early 1920s, radio communication relied upon massive, brute-force grounded Marconi antennas driven by high-power spark gap or long-wave arc transmitters. These early systems depended heavily upon surface ground waves, requiring immense physical structures and delivering low radiation efficiency.

By 1933, the rapid discovery and technical mastery of short-wave propagation permanently transformed radio architecture. Guided by the empirical research of the American Radio Relay League and pioneering vacuum-tube developments, radio engineers successfully migrated from low-frequency ground waves to high-frequency ionospheric sky waves. This architectural revolution elevated the resonant Hertz antenna, open-wire transmission lines, and matched-impedance feed systems to paramount importance.

Engineers mastered the mathematical physics of standing waves, velocity factors, end-effect corrections, and surge impedance matching. Non-resonant 600-ohm flat lines and single-wire Windom feeds demonstrated that RF power could be conveyed efficiently over vast distances without line radiation. Simultaneously, early exploration of the 56 MHz ultra-high frequency spectrum laid the technical foundations for modern VHF/UHF communications, directive beam arrays, mobile radio technology, and line-of-sight wave theory. The rigorous quantitative concepts standardized in the 1933 Handbook—radiation resistance, harmonic resonance, inductive link coupling, and low-loss ceramic dielectrics—remain fundamental cornerstones of modern radio-frequency electromagnetic engineering today.

Historical Primary Source References

- American Radio Relay League (10th Ed., 1933). *The Radio Amateur's Handbook: A Manual of Amateur High-Frequency Radio Communication*. Technical Headquarters Staff, Hartford, Connecticut.

- Lamb, James J. (1932). "The Single-Signal Superheterodyne Receiver Structure and High-Selectivity Crystal Filters." *QST Magazine / ARRL Handbook Technical Documentation*.
- Taylor, A. H. (1931–1933). "High-Frequency Skip Distance Curves and Ionospheric Propagation Data." *Naval Research Laboratory / ARRL Handbook Documentation*.
- Windom, Loren A. (1929–1933). "Notes and Design Specifications on the Single-Wire Matched-Impedance Antenna Feed System." *QST Magazine & ARRL Handbook Chapter 12*.

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Submissions: Please submit articles, selected DX or interesting contacts that you worked, new equipment reviews, ideas for group activities, YouTube videos that you liked, POTA activation dates ahead of time or results, etc., anything you think your fellow hams may be interested in.

FARA Meetings: FARA regular **c**lub meetings are held on Zoom on the 1st Thursday of each month at 7:00 PM, and some meetings will also be hybrid, usually at the McAuliffe branch of the Framingham Library. We take July and August off. Always check the webpage first. Members will get an email invitation before the meeting. **Members should be sure that they opted in for email notifications and that their email on record is accurate!** Nonmembers may request an invitation from president@w1fy.org.

Club Nets:
- **FARA Net: Sunday, 7:30PM**, output frequency 147.15 / input frequency 147.75, **NOTE: PL tone is 100.** Social/chat, emergency preparedness, amateur radio questions, Echolink enabled. W1FY-R
- **FARA Net: Wednesday 7:30 pm**, Informal Check-in Net: Echolink enabled, W1FY-R.
- Scanner listeners are invited to let us know you follow the nets by sending an email to contact@W1FY.org

Club Web Site: W1FY.org

Social Media:
- https://www.facebook.com/FARAW1FY/

Dues: Flat rate of $20 per year per person or family, and no separate repeater fee. Paid members will be posted on the web page. You can join/renew/pay online at http://w1fy.org/membershipform

Testing: Exams on hold. There are many testing options in the area, and we can help you find one.

Mail Address: Framingham Amateur Radio Association, P.O Box 5123, Framingham, MA 01701h