INTRODUCTION TO HAM RADIO





George Sullivan

- Life Senior Member IEEE
- **Amateur Radio Operator WB2IKT**
- VP Long Island Mobile Amateur Radio Club (LIMARC)
- Trustee WA2LQO Grumman Amateur Radio Club (GARC)
- **April 2025**

AGENDA

- What is Amateur Radio
- My Amateur Radio Story
- IEEE and Amateur Radio
- Activities in Amateur Radio
 - Practical applications of communication technologies
 - > Advancements in analog and digital communications
 - Local amateur radio opportunities
- What Can YOU Accomplish in Ham Radio



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WHAT IS AMATEUR RADIO – ACCORDING TO THE FCC

> 97.1 Basis and purpose.

- The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:
- a) Recognition and enhancement of the value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications.
- b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
- c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
- d) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
- e) Continuation and extension of the amateur's unique ability to enhance international goodwill.

- Amateur service. A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.
- Amateur station. A station in an amateur radio service consisting of the apparatus necessary for carrying on radiocommunications.



GEORGE SULLIVAN WB2IKT



George earned his Technician class license while attending (1965-1969) Chaminade High School in Mineola, NY.



WLIR's chief engineer, George Sullivan, cues up a disc for recording on one of the Revox A77's used for origination of most music programs at the Long Island FM station.

He started his career at WLIR-FM and worked his way up to Chief Engineer.

He subsequently went to Fairchild Space & Defense Systems where he worked in a RF Lab on radio direction finding systems, high performance receivers, and tactical jammers.



He left Telecare for a career at Grumman, eventually becoming the lead network architect for Northrop Grumman Corp (NGC). He was selected as a NGC Technical Fellow in 2002 and retired in 2015.

GEORGE SULLIVAN (CONT.)

- In between Fairchild and Grumman, he became the Chief Engineer of Telecare, an educational TV station; simultaneously he worked as prime time master control engineer for WLIW-TV21.
- George earned his bachelor's degree from Hofstra University, and his master's degree from Polytechnic University. He was (1993-2016) an adjunct professor at NYU's Tandon School of Engineering (formerly Polytechnic University).
- He is a Life Senior IEEE member and an occasional lecturer at IEEE LI Section meetings. He is Secretary of the Long Island Consultants Network (LICN), an IEEE affiliated organization.

Personal

 George is married to Carolyn; they have 3 children and 4 grandchildren, and live in Hicksville, NY. His other interests include audio engineering, classical and choral music, pipe organs, electronics, scouting, computing, travel, and bicycling.





Amateur Radio Highlights

- George upgraded to Extra Class in 2008, his station consists of an ICOM 7300, MFJ993B, AnyTone 578, and a BTech 5x3 triband HT. The antennas are a 10 foot high fan dipole and a 25 foot high VHF/UHF vertical collinear.
- He serves as a LIMARC (Long Island Mobile Amateur Radio Club) vice-president, is a certified ARRL and W5YI volunteer examiner, and an ARRL registered amateur radio licensing instructor.
- He serves as a judge for Long Island Science and Engineering Fair (LISEF).
- He is a registered Merit Badge Counselor in electricity, electronics, and radio for the Theodore Roosevelt Council Scouting America (formerly BSA).
- He is the trustee for the Grumman Amateur Radio Club (GARC) station WA2LQO.

IEEE AND AMATEUR RADIO

- IEEE's core purpose is to foster technological innovation & excellence for the benefit of humanity.
- IEEE actively engages with the ham radio community through initiatives that promote education, emergency preparedness, and technical advancement. These activities highlight IEEE's commitment to ham radio but also demonstrate the reciprocal involvement of ham radio enthusiasts in IEEE endeavors.
- IEEE Rising Stars Conference: This annual event offers workshops tailored for students and young professionals, including sessions on operating ham radios. Participants have the opportunity to prepare for and take the Federal Communications Commission (FCC) Amateur Radio License exam, facilitating their entry into the amateur radio community.
- https://ieee-risingstars.org/2025/workshops/



- IEEE MOVE Radio Club (IMRC): Established to support IEEE's Mobile Outreach VEhicle (MOVE) deployments, the IMRC focuses on developing radio skills pertinent to emergency communications. The club is open to IEEE members who are amateur radio operators interested in emergency communications (EmComm). MOVE.IEEE.ORG
- Youth in Amateur Radio: The IMRC organized a session titled "Youth in Amateur Radio" by Anthony Luscre (K8ZT) to encourage young individuals to explore amateur radio, emphasizing its educational and community benefits. EVENTS.VTOOLS.IEEE.ORG
- Amateur radio operators, including IEEE members, participate in annual Field Day events. These events serve as emergency preparedness exercises and public demonstrations of amateur radio, aligning with IEEE's goals of promoting technological proficiency and community service. SPECTRUM.IEEE.ORG

IEEE is essential to the global technical community and to technical professionals everywhere, and is universally recognized for the contributions of technology and of technical professionals in improving global conditions.

IEEE AND AMATEUR RADIO

- Make Operating Radio Easier (MORE) Project: Led by the IEEE Central Jersey Section's Broadcast Technology Chapter, this initiative aims to address gender and age imbalances in ham radio. Through education and hands-on activities, the project seeks to expand amateur radio's outreach and inclusivity. ARDC.NET
- IEEE AP-S/URSI Symposium: The IEEE Antennas and Propagation Society encourages amateur radio activities during its annual symposium, fostering engagement between radio amateurs and symposium participants.
 2020APSURSI.ORG

These examples illustrate the symbiotic relationship between IEEE and the amateur radio community, where both entities collaborate to advance technical knowledge, support emergency response efforts, and promote educational initiatives.



HAM RADIO LICENSING IN THE USA

Technician

The Technician class license is the entry-level license of choice for most new ham radio operators. To earn the Technician license requires passing one examination totaling 35 questions on radio theory, regulations and operating practices. The license gives access to all Amateur Radio frequencies above 30 megahertz, allowing these licensees the ability to communicate locally and most often within North America. It also allows for some limited privileges on the HF (also called "short wave") bands used for international communications.

General

The General class license grants some operating privileges on all Amateur Radio bands and all operating modes. This license opens the door to world-wide communications. Earning the General class license requires passing a 35 question examination. General class licensees must also have passed the Technician written examination.

Extra

The Amateur Extra class license conveys all available U.S. Amateur Radio operating privileges on all bands and all modes. Earning the license is more difficult; it requires passing a thorough 50 question examination. Extra class licensees must also have passed all previous license class written examinations.

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Any person is eligible to hold a FCC amateur license except a representative of a foreign government. To operate on the air legally, one needs to possess a valid FCC license. US amateur radio licenses are good for 10 years before renewal.

EQUIPMENT FOR A HAM RADIO STATION

This list represents equipment found in a typical ham radio station:

- Power Supply
- Antenna
- ► Feedline
- Transmitter
- ► Receiver
- Control System
- Test Equipment







HAM RADIO TECHNIQUES IN ENGINEERING LABS

Basic Electronic Troubleshooting & Debugging Skills

- Ham radio helps engineering students develop basic troubleshooting skills for labs and projects. After all, Murphy is a frequent (unwanted) visitor and usually wreaks havoc on our expectations of successful projects. Some heuristics to cope with the vagaries of Murphy and his relatives:
- Be safe! Recognize hazards including lethal high voltage. Learn where and avoid contact.
- 2. Learn to recognize what components look like including color, date, and type codes
- 3. Practice your soldering skills. Be able to discover and fix "cold joints" and "solder bridges".
- 4. Memorize the basic formulas used in our equipment: Ohms Law, Watts Law, Thevenin's and Kirchhoff theorems, Capacitive and Inductive Reactance, Time Constants, and Filters
- 5. Learn how Active Components (transistors, op amps, diodes, ICs) work and understand thoroughly how they affect the signal flow
- 6. Study equipment schematics. Divide and conquer, draw arrows and notes on the schematic that show what the signal is doing. (in terms of voltages and timing). Learn how power is distributed across the components.

- Determine the direction of the signal and the biasing of active devices. Is it proportional, inversely proportional, or is it linear or non-linear. Take & record measurements.
- Develop your ability to make estimates, learn, & don't be afraid to use math calculations.
- Learn how to use circuit modelling software such as Spice: https://www.analog.com/en/resouced/designtools-and-calculators/itspice-simulator.html
- 10. Spend adequate time on your workbench learning how to use basic test equipment such as multi-meters, oscilloscopes, and signal generators to fix your equipment
- 11. Antennas have their own unique troubleshooting environment and specialized tools. Vector Network Analyzers, Standing Wave Ratio Meters, and Dip Meters are often used to measure antennas.
- 12. Practice, Practice, Practice! You may not get to Carnegie Hall, but you will learn how to sing!

ACTIVITIES IN AMATEUR RADIO

- Public Service
 - Marathons
 - Charitable Events
- Electronic Experimentation
 - ► SDR
 - Instrumentation
 - Simulation
- Antennas
- Radio Propagation Studies
 - HamSCI
 - Eclipse, Meteors, Lightning
 - Digital vs SSB analog
- STEM Education
 - Licensing Classes and Exams



Heather AH7RF

- Field Day
- Fox Hunts
- Memorial Operation Events
- Contests
- ARISS Contacting the International Space Station via Ham Radio
- Cube Satellites www.amsat.org
- Balloon Tracking
- Moonbounce
- xOTA Operations
 - Parks, Islands,
 - Jamboree,
 - ► Summits, ...
- Remote Control
- ► Telemetry



https://shop.heathkit.com /products/amsat?variant= 49895666090296

WHAT CAN YOU DO - OPPORTUNITIES

Get Licensed and Get on the Air

- Gamification of Ham Contesting
- Massive Multiplayer On-the-Air Gaming
- Use Ham Radio KPIs:
 - Callsigns, # of Contacts, Location Details, Distance, SNR as received
- Certificates for Prizes
- <u>https://www.youtube.com/watch?v=IWF_zNrjDno</u>
- https://frequencyfrenzy.live/
- How to experiment with a Baofeng/BTech
- You can't easily take it apart, and the circuitry is so tiny, you can't easily modify it
- What you CAN do is modify the things that connect to it and its location
 - Antennas (need SMA adapter)
 - Cables to the mic/spkr port on the side
 - Change your position (nice and high, in a clear area helps!)
 -- Courtesy AH7RF

- Available HF Bandwidth (2.8 KHz)
- Power Limitations
- No encryption
- Band Plans
- Non-pecuniary
- Open Source Code / non-proprietary
- Works with current/future radios
- Mode-Specific Games
 - RTTY, FT8, CW, Digital Audio
 - DMR, P25, Dstar, AllStar, WiresX, FreeDV
- Use of AI in Ham Radio (RADE)
 - Speech Recognition
 - Logging Speech to Text Translation
 - Language to Language Translation
 - Speech to Command & Control Systems
 - https://freedv.org/

HAM RADIO EDUCATIONAL ACTIVITIES IN THE US

▶ 02-14-2025

- A \$10,000 grant to the University of Scranton, from the Frankford Radio Club (FRC) in Pennsylvania, will support the development of a contest dashboard that will leverage the popularity of amateur radio operator con tests to benefit science, technology, students and Ham Radio Science Citizen Investigation (HamSCI) community members.
- Through the grant, a team of university students, faculty, and FRC members, along HamSCI community members, will collaborate to develop a real-time Contesting/DXing Dashboard for the HamSCI Personal Space Weather Station (PSWS). The PSWS is a modular, groundbased system that measures space weather impacts on the Earth's ionosphere.

- The grant will fund Scranton University student researcher, Owen Ruzanski, KD3ALD, a firstyear computer engineering major, for the summer and fall 2025 semesters to help develop the contest dashboard and is expected to conclude in the spring semester of 2026.
- University of Scranton physics professor Nathaniel Frissell, Ph.D., W2NAF, said through the project, he hopes the University's W3USR Amateur Radio Club members, present and future, will become active radio contesters.

RADE (RADIO AUTOENCODER)

- AREG Amateur Radio Experimenters Group Australian Based
- Design Methodology
- Goal is a digital HF voice mode competitive with SSB at varying S/N ratios
 - Applying machine learning (ML) to send speech over HF radio Sol Combines traditional DSP and modern ML to encode and decode Re speech Bu
 - Connect a PC running RADE to your SSB radio
 - 8 kHz audio bandwidth, high quality speech
 - Works at low and high SNRs, handles multipath fading

https://freedv.org/rade-ham-club-presentation/

- Comparison of traditional analog vs machine learning digital
- Machine learning matches its desired output against the incoming signal by adjusting the neural network

F radio
 Sometimes we don't know the best way to design something
 and decode
 Real world problems are complex, perfect designs don't exist
 But we do have a good idea of what success looks (sounds) like
 So we just treat the system as a black box
 Show it examples of what we would like to see - and train
 ML has provided step changes in performance for many applications
 Including speech synthesis and compression

HAM RADIO BALLOON TRACKING

> 01-06-2025

- WB6RER Pico Balloon (a 10 meter WSPR transmitter) current position over Antarctica this morning and still at 44,300ft. Looks like it will fly right over or very close to the Neumayer Station III DP0GVN within the next day or two. The Neumayer Station is apparently the only 10 meter WSPR spotting station in Antarctica as we have only seen spots from their station. We very much appreciate their help keeping track of this world traveling balloon. It flew north of the Arctic Circle during its early orbits so it has flown over almost every part of our world.
- Distance Traveled Miles: 143,083 +
- Spots: 888
- > Flight duration: 597 days, 22 hours, 40 mins



BALLOON TRACKING



Weather Balloon Science project launched in Wisconsin lands in Michigan

https://www.youtube.co m/watch?v=PfkwT2bZxBk

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HTTPS://IEEER1.ORG/R1_EVENTS/LIST/PAGE/2/

- March 29 @ 1:30 pm 2:25 pm EDT
- Al Katz's K2UYH Professional Life Story: Have Fun Every Day with Your Hobby while Building a Thriving Company. Connecting an approximate 60-year Amateur Radio hobby to becoming a microwave successful expert
- Abstract: This presentation is to be more than a list of all Al's significant accomplishments as an educator, microwave expert, electronics business owner, amateur radio and EME hobbyist ,but more of what I learned from AI as his friend who shared interest in many of his hobbies. It became clear to me over the 25+ years we were friends and colleagues, that Al's motivation was to have fun with EME (Earth-Moon-Earth) by counting microwave EME contacts made across the globe. EME contests drove both his theoretical and practical knowledge. This presentation attempts to explain AI's fascination with EME by presenting the technical opportunities and challenges of EME, and how this knowledge is connected with his Electromagnetics engineering classes and successful business ventures.
- Bio: The speaker, Joe Jesson, W2JEJ, co-founded & was CTO of a General Electric business, Asset Intelligence, a GE business which designed and sold remote IoT smart sensors for the logistics and energy sectors. Joe is currently CEO of RF Sigint Group and has over 25+ years of engineering and management experience. Masters degree from DePaul University & working on a PhD.
- I was introduced to AI Katz in the 1960's through reading his microwave articles in CQ and QST, two amateur radio publications, while I was employed at Allen & Hurley, a commercial radio communications shop located in Trenton, NJ.. I moved to Chicago in 1970 and when Al cocreated TCF in 1976, I would often fly back to NJ to attend TCF and visit AI, As soon as I received and accepted a job offer and move package from General Electric in Connecticut, I immediately was "drafted" by AI to be on his TCF steering committee, ioin his microwave-centered clubs - the SETI League and PACKRATS. Also, Al asked me to teach classes at TCNJ and provide research assistance for his microwave company, LTI while remaining my best friend.