2025-07-15 Hamlet Net - Satellite Communications

Announcements:

- Test Session Info
    - Next VE session is Saturday, July 26th in the Clover Building at the Boulder County Fairgrounds, and starts at 9 am. It is a PVET session, so there is no fee to test. For more info, and to pre-register, see the Licensing/Testing page on the club web site, https://w0eno.org/, under the Education menu.

- Tomorrow is the July General Club meeting. The topic this month is 3D printing. There are endless opportunities to make use of 3D printing in our hobby, and encompasses not only printing objects, but also designing your own to solve issues you come across. I've done this myself to construct parts used for demos in licensing classes.

  As always, the meeting will take place in the Clover Building at the Boulder County fairgrounds, and starts with socializing at 6:30pm. The meeting itself will begin at 7pm. While we strongly encourage attending in person to foster camaraderie within the club, the meeting will also be available via Zoom and later via a recording on Youtube. For Zoom info, see the club's event calendar on the club web page.

- For August's general meeting, Fred (AF4BY) has volunteered to host a BBQ and will be putting together the club's SpiderBeam antenna. For September's meeting, we are trying to get the Edge of Space Sciences to present.

- We are looking for presenters or presentations for November. We'd love to have club members present something they're interested in or working on, and there's plenty of time to get your presentation ready!

  We're also interested in hearing any ideas for presentations that we could find someone to do.

- Chuck is currently running a Slow-Scan TV activity. The International Space Station is transmitting a series of 12 images featuring the Apollo Soyuz mission and STS 51F which pioneered SSTV operation on the space shuttles.

  The transmissions will take place from July 15th at 16:05 UTC to July 20th at 18:00 UTC.and will occur on 145.800 MHz, probably using the PD120 mode.

  See the latest July 2025 newsletter email for information on how to receive and decode these signals, as well as information on tracking the ISS.

  For the LARC activity, collect as many pictures as you can and send them to Chuck. There will be prizes for the most photos collected, the clearest picture received, and the

type of radio used.

Note that you do not necessarily need any special equipment to participate. Depending on the pass location, you can receive the signal with a Baofeng and rubber duck antenna, and decode it with an app on your cell phone.

Event Flyer:
https://w0eno.org/wp-admin/admin-ajax.php?action=tnptr&nltr=OTQ7NDg4O2h0dHBzOi8vd3d3LmFyaXNzLm9yZy91cGNvbWluZy1zc3R2LWV2ZW50cy5odG1sOztlZTM1NGUzMzRmZmY3NGJkOWMwY2UxODhiYTQyNjZmYQ%3D%3D

How to get pictures from the ISS:
https://w0eno.org/wp-admin/admin-ajax.php?action=tnptr&nltr=OTQ7NDg4O2h0dHBzOi8vaXNzZmFuY2x1Yi5ldS8yMDI1LzA3LzEwL2hvdy10by1nZXQtcGljdHVyZXMtZnJvbS10aGUtaW50ZXJuYXRpb25hbC1zcGFjZS1zdGF0aW9uLXZpYS1hbWF0ZXVyLXJhZGlvLzs7YTBjYzcxYzU2NDFjMTU4NzNhNzg5ODQzMjY1MjBiMjE%3D

ISS Prediction Page:
https://w0eno.org/wp-admin/admin-ajax.php?action=tnptr&nltr=OTQ7NDg4O2h0dHBzOi8vd3d3Lm4yeW8uY29tL3Bhc3Nlcy8%2Fcz0yNTU0NDs7ZDFjMjlkN2U0YThjOTAwNmYwMjY4ODJmYjIxNWJjMzg%3D

- If you are interested in find out more about the Amateur Radio Emergency Services (or ARES) in the local area, check out the Boulder County ARES web site at https://bouldercountyares.org/

  They have a VHF net on Monday nights at 8:00pm, as well as a DMR net on the 2nd, 3rd, and 4th Mondays at 8:30pm.

- Upcoming Club Volunteer Opportunities:
  - HAMCON Colorado 2025 for Rocky Mountain Division is October 23-26, 2025 in Grand Junction. For more information and to register, see their web site at: hamconcolorado.com They are also looking for presenters.

- Breakfast Saturday at 7:30 - 8:00 am at the Hidden Cafe.

- Mark - RMHAM is taking over the summer swapfest this year from the Denver Radio Club, Sunday August 24th at the Adams County Fairgrounds from 9am to 1pm. Admission is just $6, so plan on dropping by! Tables are also available for $13 in advance, and $20 at the door.

- If you are an ARRL member, remember that you have digital access to four magazines - QST, On the Air, QEX, and National Contest Journal.

- We have a new net on the LARC repeaters. It's run by Timothy Moss, KFØLAR, on the 22nd of every month at 6pm. The 22nd was chosen to highlight the average of 22 vets who commit suicide each day. While the purpose of the net is to connect veterans, non-vets are welcome to participate as most all of us have friends or family who are or have served.

- The ARRL Colorado Section Net occurs on the second Monday of the month from 7 to 8pm. The net is run by Amanda Alden, K1DDN, our Colorado ARRL section manager, and is open to hams and non-hams alike. This net is a place where Colorado hams can ask questions of ARRL leadership and request help, guidance, club support, and technical support. This net meets on the second Monday of each month at 7:00 pm Mountain time. The net is on the Colorado Connection, Rocky Mountain Ham Radio DMR Talk Group 700, The Fun Machine, WE0FUN, and the NCARC Buckhorn Repeater 447.700 – with 100 Hz tone.

- We have some volunteer opportunities available where you can help out LARC:

    - Photographer / videographer - record team activities and upload to web site / YouTube

    - Newsletter Editor - put together the monthly Splatter newsletter

    - Event Coordinator

- Time's up for this year, but you can earn your 2026 membership or future renewal by acting as NCS for at least 5 nets next year. You can run either this Tuesday night net or the Thursday night net (or both). We have scripts available for both, so all you need is a good connection into the repeater, and somewhere to keep track of names and call signs as people check in. If you're going to be on the net anyway, why not save some dough at the same time!

- Chuck has set a goal for the Club of running at least one activity a month. This can be a hands-on construction activity, an operating activity like Field Day, a fox hunt, or a special event station. The goal is to get people together to have fun with amateur radio! We have multiple locations at our disposal, as well as lots of Club equipment, so if you have an idea for something you think others hams would like to do, please let us know, and if you're willing to run it, even better!

- The Club is also looking for presentation topics for 2025. If you have any ideas, or better yet, would like to present, please let Chuck know and we'll get you on the schedule! We would like to get some presentations from club members on stuff they've been doing, projects they're working on, or just things that interest them.

- All club activities are open to anyone - members and non-members. If you have questions, ask them on a net or **send email to elmer@w0eno.org**

Presenter: Bryan, AF0W

Topic: Satellite Communications

- I discussed slow-scan TV (or SSTV) back in October, but this month's activity adds another wrinkle - satellites
- There are numerous amateur radio satellites in orbit - some support repeater functionality, while many transmit telemetry information that can be received and decoded
- Most of the satellites function in the 2m and 70cm bands, so they are usable by hams with Technician licenses and above, but anyone with a radio can listen and decode satellite transmissions.

History

- You've likely heard about the first artificial Earth satellite - Sputnik I which was launched by the Soviet Union on October 4, 1957
    a. It broadcast a 1 watt signal on 20 and 40 MHz, which allowed every ham radio operator in the world to hear its distinctive "beep beep" signal for three weeks until its batteries were depleted
    b. These signals also contained simple telemetry information - temperature and pressure were encoded in the durations of the beeps
    c. This event was unexpected by the United States, and was a major trigger for the space race
- The first satellite targeted toward Amateur Radio was OSCAR-1
    a. OSCAR stands for Orbiting Satellite Carrying Amateur Radio
    b. OSCAR-1 was launched on December 12, 1961
    c. It had a 140 mW beacon operating in the 2 meter band transmitting "HI" in Morse code (the frequency of transmissions corresponded to the satellite's internal temperature)
- OSCAR-3 was launched in 1965, and contained a transponder which functioned as an "orbiting repeater"
    a. By the 9th orbit, the first two-way QSO was made between a ham in Switzerland and Germany

- There have been over 100 OSCAR satellites launched over the years, some of which are still operational

Modes

- There are many different modes of communication used on modern amateur satellites
- The simplest of which are beacons - these can be as simple as a repetitive transmission, or as complex as telemetry transmissions
    a. When monitoring your signal into the satellite, the retransmitted signal should be no stronger than the satellite's beacon - otherwise you will waste battery power and could prevent other users from accessing the satellite
- For more excitement, look for satellites with some sort of transponder or "repeater"
    a. The simplest form is a single-channel crossband repeater
        - An example of which is the International Space Station, or ISS - it has a Kenwood D710GA operating as a crossband voice repeater which has an uplink frequency of 145.990 MHz (with a CTCSS tone of 67 Hz) and a downlink frequency of 437.800 MHz
        - Most satellite transponders are cross band to eliminate the bulky filtering equipment typically used for terrestrial single-band repeaters, and generally operate using FM
        - The ISS also contains another Kenwood that operates as a packet node on 145.825 MHz and is also used for SSTV transmission on 145.800 MHz down.
    b. A more complicated (but more versatile) transponder is sometimes referred to as a "linear transponder."
        - Instead of operating at a single frequency, this type of transponder repeats a range of frequencies, which allows multiple QSOs to take place simultaneously
        - The transponders will either be inverting or non-inverting - inverting transponders reverse the order of frequencies between uplink and downlink
        - With an inverting satellite, you transmit lower sideband on the uplink, and it will appear as upper sideband on the downlink - this is done to reduce Doppler shift issues

- Depending on the satellite, various other modes may be supported, such as packet, APRS, SSTV, and other data modes

Equipment

- To receive FM satellite downlinks (including many beacons), you don't necessarily need any special equipment - an HT with a rubber duck antenna may be sufficient
- **Radio**
    a. For linear transponder satellites, you will need a multi-mode radio capable of CW and/or SSB operation
    b. Ideally, you will want to be able to monitor the satellite's downlink to verify you are getting into the satellite - this requires either a separate radio or a multi-VFO radio which is capable of simultaneous transmission and reception
        - Not all dual-band radios support this type of operation
        - For example, the Kenwood D710 in the club's GoBox and the Kenwood D72 in the club's satellite GoBox both support this operation, but a Baofeng will not
        - You can use multiple HTs when working satellites - one to transmit and one to receive
- **Antenna**
    a. As satellites are constantly in motion and utilize relatively weak signals (as compared to terrestrial communications), having some sort of directional antenna can be beneficial
    b. A common example is a Yagi antenna - either something like an Arrow dual-band Yagi or even a homemade tape measure Yagi will work great for handheld operation
    c. If you get really serious, you can put together a system that uses one or more directional antennas plus one or more rotators to automatically track the satellite
    d. This is not to say that an upgraded omni directional antenna will not improve performance over a rubber duck antenna
        - One thing to keep in mind is that many antennas are designed with radiation patterns that are mainly horizontal
        - For example, if you are using a rubber duck antenna on your HT, instead of pointing it straight up in the air as you would for terrestrial use, or

pointing it directly at the satellite, it would be better to point it perpendicular to the satellite

- **Recorder**

    a. Satellite QSOs are much more abbreviated and speedy than those on your local repeater

    b. Moving satellites are only usable for short periods of time, so exchanges are optimized to allow as many hams to make contact as possible

    c. Many satellite operators will use some sort of audio recorder during their QSOs so they can focus on making the contact, and the listen to it later for logging purposes

    d. Some modern radios support the ability to record audio - this can be very handy for voice QSOs

    e. You can also use a recorder on a phone or tablet, or a dedicated voice recorder such as you might use to record a lecture or presentation

    f. Recording the downlink will allow you to listen to both sides of the conversation

Tracking

- In addition to uplink and downlink frequency and access tone information, you need to know the location of satellites to be able to use them
- With satellite communications is that the "repeater" is constantly in motion - it will likely not even be usable for the majority of its orbit
    - Passes may range from a few seconds to 10-15 minutes
    - The satellite will also not always be in the same part of the sky during different orbits
- There are many applications, apps, and web sites dedicated to tracking satellites - I've included a number of them in the notes for this presentation
- I've also seen projects using Raspberry Pis to provide satellite tracking information, and even to control rotators
- Objects in Earth orbit are affected by many things such as gravity, other objects, solar activity, friction with the atmosphere, to name a few
    - These things can cause the satellite's orbital path to change over time

    - Tracking systems account for this by importing information called Keplerian Elements or Keps, primarily provided by AMSAT and NASA
    - Make sure you have updated Keps when using the apps, and that you have set your location and desired time system (either UTC or local time zone) or you may miss the pass

- Tracking programs typically provide a table of information describing upcoming satellite passes - some may even provide a view of the sky with the satellite's path indicated
- These tables usually include:
    - Date as well as numbers for start of the pass (or AOS - Acquisition of Signal), max. altitude, and end of pass (or LOS - Loss of Signal)
        - For each of the three conditions, a time, azimuth, and elevation will be provided
- Some apps will provide this information on a constant basis
- They may also indicate whether the satellite is visible or not - this means to the naked eye, and is not relevant for radio communications
- When evaluating passes, look for those with higher maximum elevations - these will typically be longer passes, providing better opportunities for making contacts

Operating

- The first step in using a satellite is making sure it's still functioning. There's a great web page for that called the AMSAT Live OSCAR Satellite Status Page
    - Located at https://www.amsat.org/status/ , it shows status reports of active satellites are reported by hams like you
    - You can make sure that the ISS repeater is not turned off for a spacewalk, or that a new cubesat is still in orbit
- Before making a transmission via a satellite, make sure it is within range and usable - this can be done by listening for its beacon or listening for the downlink
- Once it is in range and a idle, make your transmission while monitoring the downlink to make sure you are getting into the satellite
    - If you don't hear yourself on the downlink, don't continue to transmit - you may be interfering with others who do have it within range

- Many satellite QSOs are similar to contest QSOs - very quick with minimal information exchanged
    - It is considered bad form to monopolize a satellite pass with a long-winded QSO if there are others waiting to use it
- A typical satellite exchange includes just your call sign and grid square
    - I would say something like "Alpha-Foxtrot-Zero-Whiskey Delta-November-70"
    - A response would be "Alpha-Foxtrot-Zero-Whiskey this is Whiskey-1-Alpha-Whiskey Delta-Mike-65"
    - I would end the contact with "Roger-Roger-W1AW, thanks for DM65, 73" to confirm to the other station that I received their transmission
- Doppler shift is part of operating satellites
    - This is similar to the change in tone you hear of the siren on an approaching emergency vehicle. It starts high then drops as the vehicle approaches and passes you
    - Due to frequency ranges, you can likely ignore the shift on the 2m frequency, but should adjust for it on 70cm
    - This can be done by programming multiple 70cm frequencies into your radio in advance, and then toggling through them during the pass
- Signal polarization is another factor
    - Satellites are usually spinning as they travel, so you would ideally try changing the orientation of your antenna during the pass for best reception

Summary

- This barely scratches the surface on using amateur radio satellites, but hopefully gives you a basic idea of what they are and what is involved when using them
- One of the "Holy Grails" of satellite operation is to speak live to an astronaut on the ISS.
- Satellite operation provides more challenges to operators, but also more satisfaction, so give it a try!

Questions:

- **The question for the week is:** Have you ever communicated with a satellite, and if not, does this sound interesting to you?

- **In my case,** I've sent an APRS packet up to the ISS and received multiple SSTV images from it over the years. I've not made a successful voice contact through any satellite.

More Info:

- Amateur radio satellites: https://en.wikipedia.org/wiki/Amateur_radio_satellite
- AMSAT OSCAR Satellite Status Page: https://www.amsat.org/status/
- For Beginners - An Amateur Radio Satellite Primer: https://www.amsat.org/wordpress/wp-content/uploads/2023/06/For_Beginners_Compilation.pdf
- How to Work Linear Satellites: https://amsat-uk.org/beginners/how-to-work-ssb-satellites/
- Amateur Radio on the ISS: https://www.amsat.org/amateur-radio-on-the-iss/
- Current Status of ISS Ham Radio Stations: https://www.ariss.org/current-status-of-iss-stations.html
- Amateur Satellite Information: https://noji.com/space/space.php#satellites
- Homemade Dual-Band Yagi Antenna: https://noji.com/hamradio/pdf-ppt/noji/Noji-Article-Dual-Band-Satellite-Yagi.pdf
- Arrow II Portable Dual-Band Yagi Antenna: https://www.arrowantennas.com/arrowii/146-437.html
- Elk Antennas Compact Log Periodic Antenna: https://elkantennas.com/product/dual-band-2m440l5-log-periodic-antenna/
- M2 Satellite Equipment: https://www.m2inc.com/categories/amateur/antennas/vhf-uhf-microwave-antennas/satellite-products.html
- Yaesu G5500 Azimuth-Elevation rotator: https://www.yaesu.com/product-detail.aspx?Model=G-5500DC&CatName=Rotators
- SATNOGs Rotator: https://satnogs.org/documentation/projects/
- N2YO tracking page: https://www.n2yo.com

Email to elmer@w0eno.org

- If you have ideas for net topics or general meeting topics / presenters, please let us know! Tell us on a net, or send email to k0itp@w0eno.org

Email to elmer@w0eno.org

1. KØDBL - Don - Mead
2. KØITP - Chuck - Firestone
3. WAØJJC - Bob - Boulder
4. KFØUSF - David - Longmont
5. AFØW - Bryan - Longmont
6. AFØXS - John - Thornton

End: 7:55pm