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Motivating Amateur Radio Clubs to Open New Initiatives (MARCONI)

Program 4: SATELLITE COMMUNICATIONS (Sat Comm)

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Operational Guidelines

Statement of Program Purpose: Portable & Mobile Satellite Operations is a radiosport program that encourages communications between Radio Amateurs using hand-portable equipment and FM Satellites in non-geosynchronous orbit. Considered a regional-local activity, portable Sat Comm recently has grown in popularity. Importantly, it also has been attracting a younger audience.

The Meriden Amateur Radio Club (MARC) utilizes its MARCONI Sat Comm Program to facilitate the teaching of station set-up, equipment management, radio operations and etiquette, as well as technical lessons based on club member interest and experience.

Scope of a Portable Sat Comm Operation: Initially, a basic knowledge of repeater operation and cross-banding is helpful but not required. Using portable equipment, operators can take to the field with FM dual-receive or HT transceivers, portable Yagi-Uda antennas, knowledge of specific FM Satellite transponder frequencies, PL Tones, and satellite trajectories (rise azimuth & elevation to set az/el), to make contacts or short QSO's during a satellite pass. The entire pass may only last from eight (8) to fifteen (15) minutes.

Satellite QSO's are typically fast-paced, technical in nature. They require dexterity, properly programmed radios, a knowledge of "The Doppler Effect" and how to compensate for the associated physics. A smart phone is usually the preferred method of determining a satellite's trajectory via use of various App's. However, a computer with internet access and handwritten notes will suffice. Most QSOs are recorded digitally for logbook reporting.

Typical Sat Comm Scenario: First, the operator needs to determine which satellite will pass overhead (literally), and when. He/she then needs to determine a best local location to allow for the longest exposure to the satellite's trajectory. Parking lots with views to the horizon work great. The operator then calculates: 1) AOS (**A**cquisition **O**f **S**ignal or satellite rise in degrees of compass, degrees of angle above horizon and time), 2) **Z**enith (highest elevation of the pass in degrees above horizon, direction angle and time) and 3) LOS (**L**oss **O**f **S**ignal or satellite set in degrees of compass, degrees of angle above horizon and time) for that location. When the satellite rises above the horizon, signals from this 'flying repeater in orbit' will start to be heard. The Operator transmits his/her own callsign on the uplink frequency while listening on the downlink frequency. Once the Operator can hear his/her own callsign on the downlink signal, QSO's with other Radio Amateurs can be initiated.

Calls are of necessity, very short. Typical conversations involve the operator's call sign and grid square and sometimes State. Replies from the other amateur are similar. The operator calling CQ, then states '73' and in search of other QSO's, repeats this process for the duration of the pass. Conversations are fast-paced and short since there usually are many operators attempting QSO's. Sometimes signal polarity must be compensated-for by twisting the yagi along its long axis. Doppler correction must be observed by changing the channelized 70cm frequencies. Approaching (or rising) satellites require a lower doppler shift, passing (or at zenith/maximum elevation) satellites normalize the doppler effect, while departing (or setting) satellites require a higher doppler shift. Most experienced operators simply record the pass digitally for later logbook entry. After the pass – operators may use any logging program or upload manually via TSQL to report the QSO and convert to a QSL via LoTW for validation and VUCC recognition. Other methods can be

used, or none at all. Every satellite pass has different challenges: terrain, space constraints, weather, accessibility, etc. It is an opportunity to perfect your portable radio kit, always evolving and modifying it to suit your operating style and needs.

Getting Started: Radio Amateurs must learn about which FM Satellites are active, when they are active, how to program their radio, why and how to compensate for doppler shift, how to track satellites, how to channelize for Doppler shift, which frequencies to use and which PL tones are necessary for each satellite. AMSAT-US is an excellent website to start. There are others. The simplest gear works very well which lends itself to economy. The social media community of Facebook, Twitter (X), Slack, YouTube, and Discord also provides a massive amount of up-to-date information on Sat Comm activities.

Equipment for Setting Up Sat Comm: Radio Amateurs are diverse; so too, is their equipment. One HT with a dual band Yagi will work. Two HT's and a dual band Yagi may work better. A dual receive mobile unit may work the best but all of this is for each Radio Amateur to decide according to budget, availability and ease of operation or convenience. Smart Phone App's. are very convenient for satellite tracking but using a PC and writing hand notes, as mentioned, also will work. A team of hams would be an alternate method where one ham would work the antenna and radio while the other tracks where to point the antenna (tracking) and supports QSO logging. If not using a smart phone app, a simple compass and watch will work to determine AOS/Z/LOS. Elevation can be approximated: horizons will be zero elevation, and directly above the observer is 90 degrees elevation. The antenna is the most important part of the station. Some sort of dual band directional antenna is required. If using one HT, a duplexer is required. If using a mobile rig, a portable power source is required. Some Radio Amateurs use a chest harness or other device to carry the equipment on his/her person. Doing so will leave the hands free to manipulate the antenna and work the microphone or HT and view the satellite tracker or their own written notes.

Conducting Portable Sat Comm Sessions: Every activation has different challenges: terrain, space constraints, weather, and accessibility. Operating near your vehicle in an open parking lot, from a rooftop,

from a clear summit or an open field will supply different experiences, opportunities, and obstacles. Be prepared to explain what you are doing to any passers-by, police, and property managers. A typical pass is 10-12 minutes long, so you won't be there for long. Set up your station where you are comfortable and safe in your surroundings. Be mindful to be a good steward of the land, represent Amateur Radio while in a public setting – and protect the investment on your equipment. Weather, trees, and buildings can all affect the outcome of your endeavor, so plan accordingly.

Portable Sat Comm Challenges: Every pass location you may choose has different challenges as does each pass: angle of the pass, direction of the pass, local obstructions, terrain, space constraints, weather, accessibility. Each location and pass is an opportunity to evolve your Sat Comm experience and perfect your operating style.

Portable Sat Comm Costs: Portable Sat Comm activations require a radio station setup. An inexpensive HT can be used as well as mobile rigs with a harness or possibly a mobile station using whichever rig the Radio Amateur likes. A single channel HT can be used but throughput will be impossible to gauge since you will not be able to 'hear yourself through the satellite'. A dual receive HT or two single channel HT's can be made to operate this way. HT's can run from $28 (Baofeng) to around $500 for more capable units (dual receive). The Icom ID-5100 is a dual receive mobile rig which is easy to set up and can access the FM Birds. The Icom IC-9700 is capable of similar satellite QSO's but can additionally access linear satellites (think SSB or CW). There are other rigs available which have dual receive capability. The Icom ID-5100 runs under $500 as of the date of this publication. The Icom IC-9700 averages $1800 likewise. Antennas are a unique challenge. For portable work, a hand-held, dual band Uda-Yagi is in order. There are several available in the Amateur Market or an enterprising, handy ham may be able to fabricate one using basic components, but I would advise a new ham to have prior experience building antennas beforehand. If using moderate power (above 10W) I would advise against using a hand-held antenna. The Arrow series of handheld antennas can be ordered with a duplexer built into the handle (this splits the VHF from the UHF components for a dual receive rig) but can only handle up to 10 watts. If using more than 10W, the Radio

Amateur must use a duplexer with higher power capability for this same antenna. For mobile Sat Comm, a Yagi with Azimuth/Elevation control mounted on a tripod can be purchased. M2 makes a specific antenna nicknamed, The Eggbeater". It comprises a UHF/VHF circularly polarized (overhead) omni-directional antenna mounted on a cross-boom. This can be a mobile style setup or base station setup. This setup is a bit too large and bulky for most portable situations but if you're determined, it can be pressed into portable service. Additionally, it does not have to be articulated or pointed at the passing satellite since it is omni-directional.

The cost of some of these pieces of gear can pose a budgetary challenge. The portable HT coupled with a hand-held Arrow antenna is the least expensive but requires the most articulation. One idea to consider is how many things can you juggle at once? The fewer things you have to do during a pass makes each activation a little easier.

Sat Comm Rewards: When you're making Satellite QSOs, you are working grids; it's a part of the exchange. Some Radio Amateurs make VUCC their goal. The League recognizes hams that make confirmed contacts in all fifty states using VHF/UHF. Sat Comm make this possible. This is a technology that has been around for years but recently seems to have re-surfaced in popularity. QSOs are fast paced, technically challenging and lend themselves to hams that like to summit peaks, work from islands, beachheads or simply like to get out and hike. POTA Sat Comm are gaining popularity as well with some POTA Activations using satellites as one more band/mode. It is this ham's opinion that making contacts via satellite fosters a sense of accomplishment due to its technical nature. The fact that the equipment can be as simple or complex as one wishes can create an atmosphere of personal growth. Likewise non-amateurs in the places we find ourselves are naturally curious about "what are you doing?". This creates an opportunity to reach out and become an Ambassador for our hobby: "To advance the art, science and enjoyment of Amateur Radio".

It's also a wonderful way to reach out to the youth in our communities. Schools, STEM programs, Scouting programs and other programs are venues to consider. Young hams or ham wanna-be's may be drawn to the local ham club to learn more about satellite communication. The Club could view this as an opportunity to provide the spark that re-excites both their older club members and encourages ham wanna-be's to become licensed and a new Club member, as well. All this activity and interest helps promote both amateur radio, and their Club. Most kids find a natural curiosity for something that allows them to 'talk' through a satellite moving at 17,000 mph that they can neither see, feel, hear, smell, nor touch. Sat Comm can indeed provide just the thing for a Club that wants to grow its membership! For further information, the reader is referred to the myriad of available podcasts, videos, web sites and books on Sat Comm operations.

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MARCONI PROGRAM

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