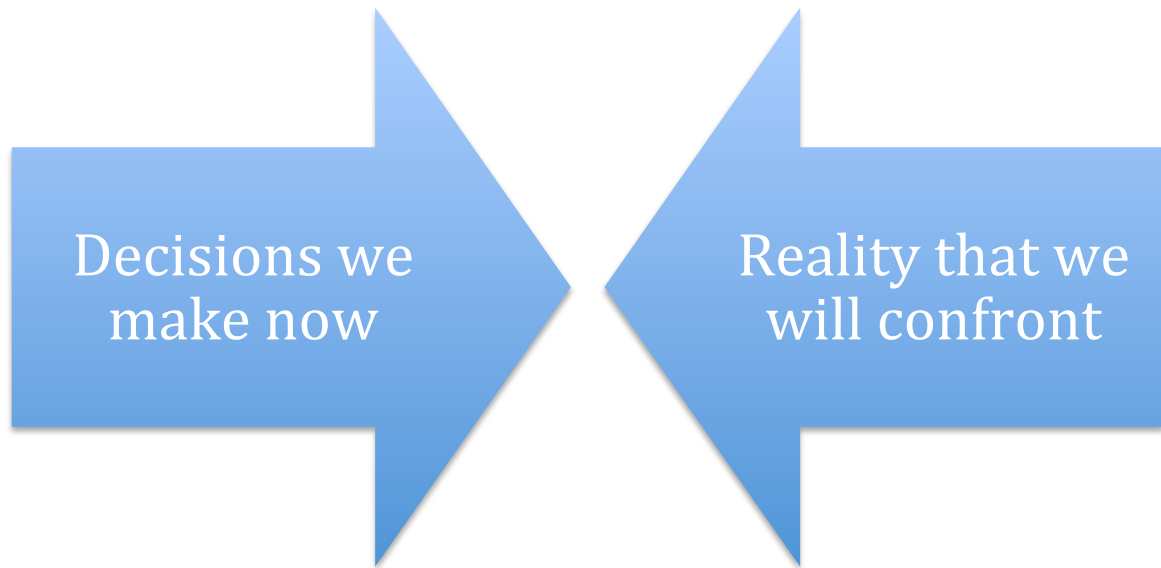


Phase 4 Use Cases

Use cases guide development. Development decisions affect use cases.



The use cases listed here are best effort predictions of how Phase 4 radios will be used. The list will not be perfect or exhaustive, but will guide decisions that must be made in order to produce real hardware.

We are assuming operational radios for these use cases. We assume that the radios comply with our current understanding of the electromagnetic as well as the policy environment.

Emergency Communications

We emphasize emergency communications for two reasons. First, emergency operations must not differ from normal amateur operations unless absolutely necessary. Therefore, anything necessary to emergency communications has immediate relevance to any other use case. Second, providing emergency communications demonstrations and support is a primary justification of the project. Emergency communications is therefore the fundamental use case.

Phase 4 radios must “just work”. This is understood to be that Phase 4 radios must work with a minimum of configuration and setup in general, and either minimal or completely eliminated differences between normal and emergency operation.

Phase 4 radios in an emergency must be able to respond to authorization. This is understood to mean that satellite access may be controlled in an emergency, and Phase 4 radios must comply with this uplink access control.

Phase 4 radios fall into a category of non-voice-centric (NVC) telecommunications devices. This expands the use case from voice-centric telecommunications devices that many amateur radio operators are familiar with or have trained to provide service with. The addition of images, text, and data enhances emergency communications, but also places additional demands and complexities on operations. It is the operator that must properly use the radio given the challenges of any particular deployment. It is our job to make that operator’s decisions as easy as possible.

Phase 4 radios intended for emergency communications must be durable and rugged enough in order to serve in difficult environments. Efforts must be made to design them to run on emergency or limited power. We acknowledge that ensuring high levels of durability may be very difficult or expensive goals to meet. We commit to best possible efforts in terms of ensuring durability.

Using Phase 4 radios in emergency communications services require training. We believe that regularly scheduled drills on Groundsat or Satellite will enable operators to be better prepared for emergency communications. We strongly encourage a requirement for emergency communications drills on the deployed satellite and for it to be included in the operational requirements.

Spectral displays, demodulator options, options for filtering and grouping communications types and stations, logging contacts, sending and receiving ICS forms, monitoring, responding to authorizations, and other normal and emergency

communications functions are all available in the emergency communications use case.

Ham Radio Operations

Access to radio functions for normal communications is through the application space. Applications include programs such as gqrx or something like gqrx. Spectral displays, demodulator options, options for filtering and grouping communications types and stations, logging contacts, browsing, and other normal communications functions are all available. Applications written by the community are available to be added to the application space in order to provide additional functions.

The current use case would have an operator install gqrx (or something like it) on a machine that can run it, connect a USRP to a USB port, connect the TX port to a 5 GHz amplifier, connect the RX port to the IF output from a 10 GHz LNB, connect the appropriate antenna or antennas, and point at the satellite.

As hardware is developed or alternative parts of the communications chain identified, a variety of recipes will emerge.

Ham Radio Experimenter

The experimenter use case envisions operators that want to interact directly with their Phase 4 radio. For example, an experimenter will be able to use GNUradio and GNU Radio Companion directly. This allows operators to build flowgraphs in order to change the way their radio operates.

This use case assumes greater technical knowledge on the part of the operator. This use case needs to be studied in order to ensure that there aren't any incompatibilities between Experimenter stations and Emergency stations. The best way to determine incompatibilities or problems is to have regular emergency drills on the Phase 4 systems.

Amateur Radio Access Point

The amateur radio access point (ARAP) use case is intended to allow access to the satellite from radios that would not normally be able to communicate through the

satellite. Radios that are not powerful enough or use a modulation scheme that the satellite doesn't support are the anticipated users. ARAPs can support emergency, normal, and experimenter operations.

Single-channel ARAP

Single-channel ARAPs can be constructed by adding hardware to a normal Phase 4 radio. The hardware consists of an antenna and transceiver designed to support the desired modes. The hardware connects to the Phase 4 radio with microphone in/line out. This would allow a single-channel Phase-4 radio to relay local traffic. Throughput is limited, but 2-way communications through the satellite would be possible with relatively lightweight and inexpensive gear.

Multiple-channel ARAP

The current demonstration software ("The 2015 Symposium Demonstration") supports four local channels. Four FM radios can transmit at the same time. The channels are digitized and then multiplexed. The reverse link would require the FM channels to be assigned internal tactical IDs in order to transmit back to the correct channel. Multi-channel ARAPs are expected to be more complex and more expensive than single-channel ARAPs.

Education

Phase 4 radios are useful in at least two educational roles. First, the process of building a Phase 4 radio provides the opportunity for many lessons in both design and integration. Second, radio modes and operations can be introduced by using Phase 4 radios as the teaching instrument.

Machine-to-Machine

Machine-to-machine operation is possible with Phase 4 radios. They can be set up for unattended monitoring. They can be scripted to wait for and then react to specific conditions or sets of conditions.

Use Cases

Name of Case	Licensed Operation
Description	Phase 4 is part of the licensed amateur radio service.
Actors	Alice and Bob
Pre-conditions	None
Basic Flow	Alice and Bob think Phase 4 sounds awesome. They learn they have to get radio licenses. They study, take, and pass the test.
Post-conditions	Alice and Bob successfully obtain their amateur radio licenses.
Alternate Flow	Alice and Bob fail their test and can't use Phase 4 radios.

Name of Case	Phase 4 Registration
Description	Phase 4 radios require registration.
Pre-conditions	Alice and Bob are licensed operators.
Basic Flow	Alice and Bob obtain Phase 4 radios. Registration is fraught with peril. Is registration required? The assumption that access to the satellite needs to be controlled seems to imply registration. Registration is related to authentication and authorization. Authentication is the process of verifying "you are who you say you are". Authorization is the process of verifying "you are permitted to do what you are trying to do". Authentication is required for authorization.
Post-conditions	Alice and Bob successfully register their Phase 4 radio.
Alternate Flow	Alice and Bob do not register. When they attempt to use their radios, the radios do not respond.

Name of Case	2-way Voice Communications
Description	Amateur radio operators have a 2-way voice communication.
Actors	Alice and Bob
Pre-conditions	Alice and Bob are licensed operators. They are registered on the Phase 4 system.
Basic Flow	Alice decides to call Bob. She turns on the Phase 4 radio. If the antenna is not pointed, then she uses whatever means are necessary to point the antenna at the satellite. If a beacon is implemented, basic information about the satellite is available, up to an including information that may allow for automated pointing as well as what mode the satellite is in. The beacon may or may not have a map of available channels. She picks up the microphone and presses PTT. The radio is randomly assigned a channel that is currently open. If the Phase 4 radio hears its own signal on the downlink, then all is well. Alice calls Bob. Bob hears Alice, and answers.
Post-conditions	Alice and Bob successfully have a QSO.
Alternate Flow	If the Phase 4 radio does not hear its own signal on the downlink, then at least two things may have happened. It has either not been heard at all, or it has been heard but has lost synchronization, and it will need to re-attempt synchronization.

Name of Case	Basic Radio Experimentation
Description	Ham radio operator wants to experiment with a new codec.
Actors	Alice and Bob
Pre-conditions	Alice and Bob are licensed operators. They are registered on the Phase 4 system. They are able to have successful 2-way voice communications.
Basic Flow	Bob decides to try a new codec. Bob researches codecs, picks a new one, and specifies the use of that codec at the application layer. He collaborates with Alice, who also installs the codec. Bob successfully calls Alice, and they discuss whether or not the new codec makes Bob's butt look big.
Post-conditions	Alice and Bob successfully have a QSO where part of the radio has been modified.
Alternate Flow	The QSO fails due to a failure of either the installation or performance of the codec.

Name of Case	Declared Emergency
Description	Hams provide emergency communications support. During a declared emergency, where the satellite is involved, uplink access to the satellite is restricted to equipment that is authorized to operate.
Actors	Alice and Bob
Pre-conditions	Alice and Bob are licensed operators. They are registered on the Phase 4 system. They are able to have successful 2-way voice communications. There is a declared communications emergency or declared emergency drill.
Basic Flow	<p>A communications emergency or communications emergency drill is declared. All or part of the communications resources of a Phase 4 satellite is set aside for emergency communications use. The satellite mode is changed to Emergency Mode by those responsible for its operational status. This enforces a filter on the uplink. The filter allows authorized radios to access the uplink. Authorized communications take place. Unauthorized radios would not be able to pass the filter. Unauthorized communications do not take place.</p> <p>Filtering can be accomplished with a challenge and response. This requires two-way communications. Filtering can be accomplished with a white list. This does not require two-way communications, but does require some sort of identification in the uplink header or elsewhere in the transmission. White list stations would be identified in advance. Ad hoc or day-of-emergency additions to the white list would require an additional procedure or mechanism.</p> <p>What happens to unauthorized communications? Are they demodulated, but not transmitted on the downlink? Are they not demodulated at all? Answering this question directly affects uplink header content. With the minimal header we are currently considering, without station or equipment identification included, signal authentication and authorization would be carried out later in the communications flow.</p>
Post-conditions	Alice and Bob support emergency communications by operating their Phase 4 radios in authorized emergency communications mode.
Alternate Flow	<ol style="list-style-type: none"> 1. Alice and Bob cannot access the satellite because they do not know how to configure their radio to respond in emergency communications mode. 2. Alice and Bob cannot hear the satellite (are uplink-only due to damage, position, or other impediments) and despite knowing how to respond to the challenge, cannot respond to

	<p>the challenge, and are therefore unable to access the satellite.</p> <p>3. An unattended Phase 4 radio is taken over by Jason, who becomes an unintentional or intentional jammer.</p> <p>4. An unattended Phase 4 radio successfully authorizes, yet continues to transmit large amounts of telemetry or other machine-to-machine data, which inadvertently uses up system bandwidth.</p> <p>5. Forgo authentication and authorization entirely and allow open access to the satellite at all times, including emergencies.</p>
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