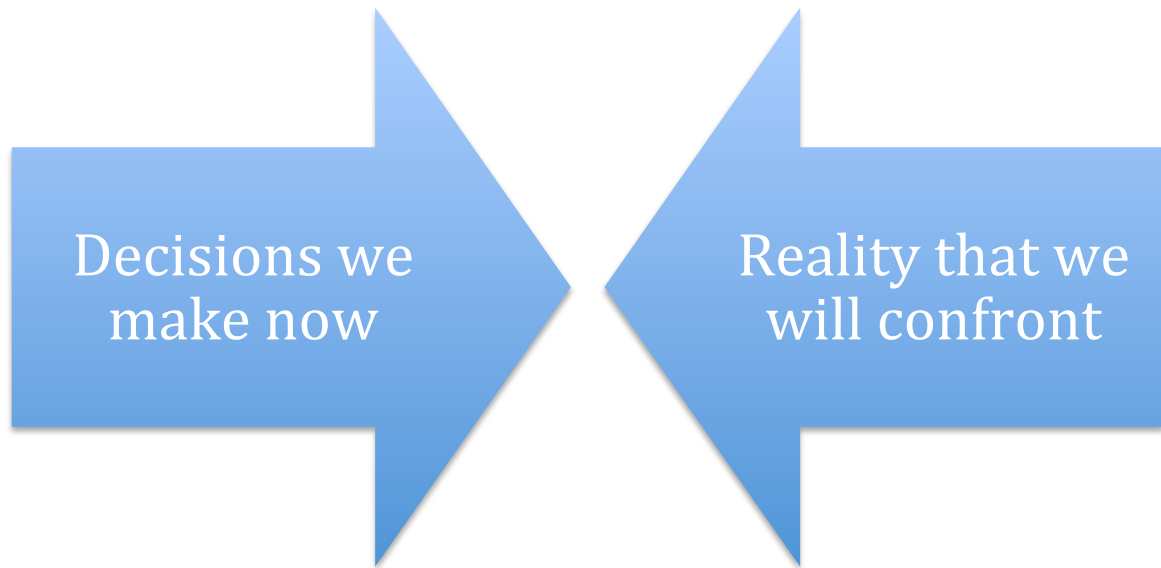# Phase 4 Use Cases

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 begin with 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 Normal Communications

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.

The ARAP use cases are as follows.

Single-channel ARAP

Attach some 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.