Welcome to our project! We are called Phase 4 Ground. We were founded to produce an ensemble of open source digital solutions for “Five and Dime”, the 5GHz uplink and 10GHz downlink strategy for upcoming digital payloads from AMSAT.

Phase 4 Ground is working to produce both a manufactured solution and a set of documents that fully enable motivated operators to build their own gear or assemble a station from commonly available parts and SDR products. These radios will be modern, capable, flexible, and fun! No crappy codecs, no confusing user interfaces.

Why microwave? Relatively small antennas and big bandwidths, and if we don’t get more people on the microwave bands, we risk losing them. Why digital? Too many advantages to list!

But wait, there’s more! Phase 4 Ground radios aren’t just for satellites and space. These radios will also work terrestrially. Instead of a satellite, you would use a Groundsat on a mountaintop or tower. You would get all of the really interesting and fun services that the powerful payload provides, but on the ground instead of in space. Point-to-point communications on 10GHz looks entirely possible and is being actively discussed. This means you don’t have to be geographically close to a mountaintop Groundsat to work someone terrestrially.

So what have we done so far?

We split this team off from the space payload teams to avoid ITAR. It is open to all.

We demonstrated frequency division multiple access uplink to time division multiplex downlink using GNU Radio and USRPs. We have just scratched the surface of what GNU Radio can do for us.

We will support legacy analog radios through an optional radio peripheral called an Amateur Radio Access Point. Similar to Wires-X, analog radio traffic is digitized and then intelligently tagged to become part of the distributed digital downlink stream. People with NBFM HTs can play with us!

We have identified and adopted a framework. Phase 4 Ground uses standards from https://www.dvb.org. We’re using DVB-S2X for space, DVB-T2 for terrestrial, GSE for low-overhead encapsulation of digital data, and we are going to implement adaptive coding and modulation. Your radio will use the best code and modulation scheme it can, in order to maximize throughput!

The DVB standards provide very well thought out solutions to the most common problems of digital transmission. However, the decision to adopt them does not mean we’re finished. On the contrary! Implementing the standard in a ham-centric way requires figuring out what options are unnecessary, what needs to be modified, and what additional mechanisms need to be designed.

However, that’s just the tip of the iceberg. The RF chain has challenges too. Remember the choice of frequencies? That 5GHz uplink has a second harmonic that just happens to be within the range of the sorts of LNBs that we’d really like to use on 10GHz. A dual band feed from Paul Wade W1GHZ has been designed and simulated. We look forward to building and testing it!

Another challenge that digital communication brings is the possibility of access control. Digital systems provide a means for identifying, authenticating, and authorizing access to a communications resource. We have adopted a Logbook of the World approach to authentication, and support several approaches to authorization. Next? Implement and test!

Phase 4 Ground team currently consists of nearly 100 volunteers that have signed up to work on the project. “Work” ranges from building equipment, calculating things that need calculating, finding the best existing solution to adapt to our project, reviewing documents for dumb mistakes, making communications happen, blank paper engineering, cheerleading, designing beautiful graphical user interfaces, evangelizing, fundraising, documenting, providing adult supervision, programming, meeting people that might provide us services we need, updating the documentation, more programming, coming up with algorithms, and many other roles and responsibilities. We have a lot of fun and we want to share the fun with you.

We’ve accomplished a lot but have a long way to go! We need you!

All our documents and software are and will be at our github account at <https://github.com/phase4ground>

Our Slack is  
<http://phase4ground.slack.com>  
  
And, we have a mailing list.  
  
Want to join Phase 4 Ground engineering?

Contact Michelle at [mountain.michelle@gmail.com](mailto:mountain.michelle@gmail.com) and we’ll get you started!