Digital wireless communications have revolutionized our world. The advantages to digital signal transmission are substantial, ranging from being able to secure an information signal, much better spectral efficiency, lower cost equipment, increased immunity to noise and interference, the ability to easily store information, and error correction and detection. Digital satellites in the microwave bands provide millions of people broadcast television signals every day with extremely low error rates. Global Positioning Satellites (GPS) provide a digital signal enabling location service that has become almost ubiquitous. Mobile phones are digital devices with tremendous capability. Computing in virtually all forms is digital.

AMSAT does not operate a digital satellite nor does it have a dedicated digital payload team.

AMSAT does have a successful digital design team working on broadband microwave radios to support digital payloads that use DVB-S2 and DVB-S2X. This team is Phase 4 Ground. It's open source and the landing page can be found at https://phase4ground.github.io/

It's time to match that effort with an open source team dedicated to broadband digital microwave satellite engineering and development. The AMSAT mission is to keep amateur radio in space. We are also expected to advance the radio art and promote international goodwill.

We are not advancing the radio art by remaining on the sidelines of the digital revolution in wireless communications.

The solution to this problem is to recruit and support a team dedicated to open source digital broadband microwave-band amateur radio satellites.

An open source project properly managed, using public domain materials, falls under an important ITAR exception. By using and creating work in the public domain, AMSAT provides powerful technical leadership and takes full advantage of the enormous benefits of open source while avoiding the vast majority of the onerous and collaboration-killing requirements of ITAR.

While documents having to do specifically with the launch would have to be

controlled, the engineering design can and should be done entirely as an open source project.

The proposed goals of Phase 4 Space are outlined below.

1. Perform a Careful COTS[1] (re)design of an Ettus Research 300 series USRP.

Blog post about the series.
https://www.ettus.com/blog/2014/01/ettus-research-releases-revolutionary-software-defined-radio-with-kintex-7

Schematic for the x300.
https://files.ettus.com/schematics/x300/

The USRP is a world-class SDR that is completely compatible with GNU Radio. Implementing a version of this USRP for space perfectly complements the work done to support DVB-S2/X for amateur radio payloads that is ongoing in Phase 4 Ground.

2. Three-axis stabilization must be implemented to support directional microwave antennas at 5GHz, 10GHz, and beyond.

3. Develop a payload that supports the Rincon AstroSDR[2] donated from Mike Parker of Rincon. This device is hosted by Virginia Tech and uses the same FPGA as the Ettus series 7 USRPs.

The support framework for this project includes the following parts.

1. Volunteers! The most important ingredient.
2. An open-access repository for engineering. A GitHub organization has

been established to achieve this goal. https://github.com/phase4space An organization can hold numerous repositories, each devoted to some particular aspect of the project.

3. An ITAR-compliant repository for anything inescapably ITAR. This is not for engineering. This is intended for launch and operations control documents. An AWS GovCloud account that fully complies with ITAR has been established to achieve this goal.

4. Team communications resources such as mailing lists.

5. Intellectual property team familiar with public domain and open source in the context of ITAR. Is this you?

6. A hardware design lead and advisors experienced with space hardware requirements. Is this you?

7. Funding to cover build and test.

8. Licenses to allow FPGA development. Xilinx Vivado licenses have been obtained.

While there are many milestones along the way, substantially complete progress and a final report describing that progress is scheduled for January 2020.

Volunteers can apply either to AMSAT or the address listed on the main page at the GitHub phase4space repository.

AMSAT volunteer inquiry needs to be updated to include the non-ITAR project nature of both Phase 4 Ground and Phase 4 Space. Currently, the engineering volunteer form and webpage both communicate that all AMSAT engineering is ITAR controlled. This is not the case. The language has delayed and in some cases discouraged volunteers from successfully applying through the AMSAT website.

ITAR projects obviously remain a part of the AMSAT engineering landscape. Supporting projects that take advantage of the public domain and open source ITAR exceptions improves AMSAT's position and potential productivity.

Open source and ITAR-compliant repositories have been established. Both are funded through January 2020.

Technical goals have been defined and are achievable.

A schedule has been proposed.

Open source and public domain resources exist.

Volunteers and leads with specific qualifications are needed.

Most pressing are a public domain compliance lead, a hardware design lead with spacecraft experience, and volunteers that either have or are willing to learn components engineering skills.

Board design and radiation testing will be unavoidable expenses.

If you want to volunteer for the roster, either fill out the engineering volunteer form at AMSAT or contact repository support staff at phase4space@optimizedtomfoolery.com. The roster will include your name and area of interest.

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[1] https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2934&context=smallsat

[2] http://www.rincon.com/wp-content/uploads/2016/11/ASTROSDR_Brief_v1-3-1.pdf