

4 on 4

Phase 4 Update for Palomar Amateur Radio Club
November 4, 2015

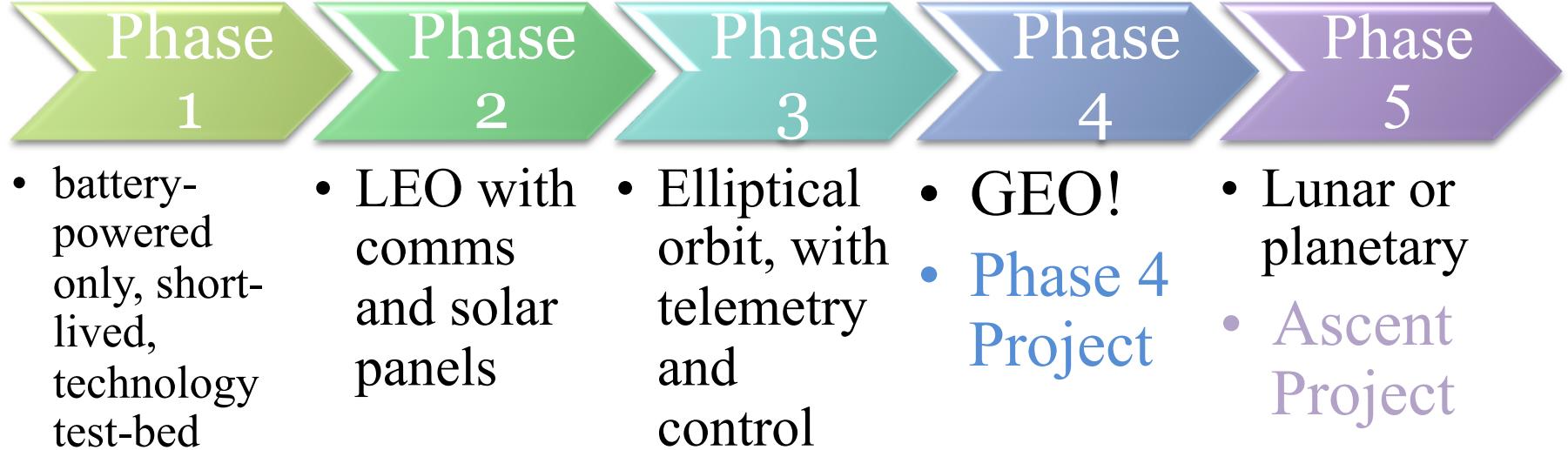


Phase 4

- A digital microwave geosynchronous amateur radio satellite service system made possible by a partnership between Virginia Tech, AMSAT, and Millennium Space Systems.



The AMSAT Phase System Explained



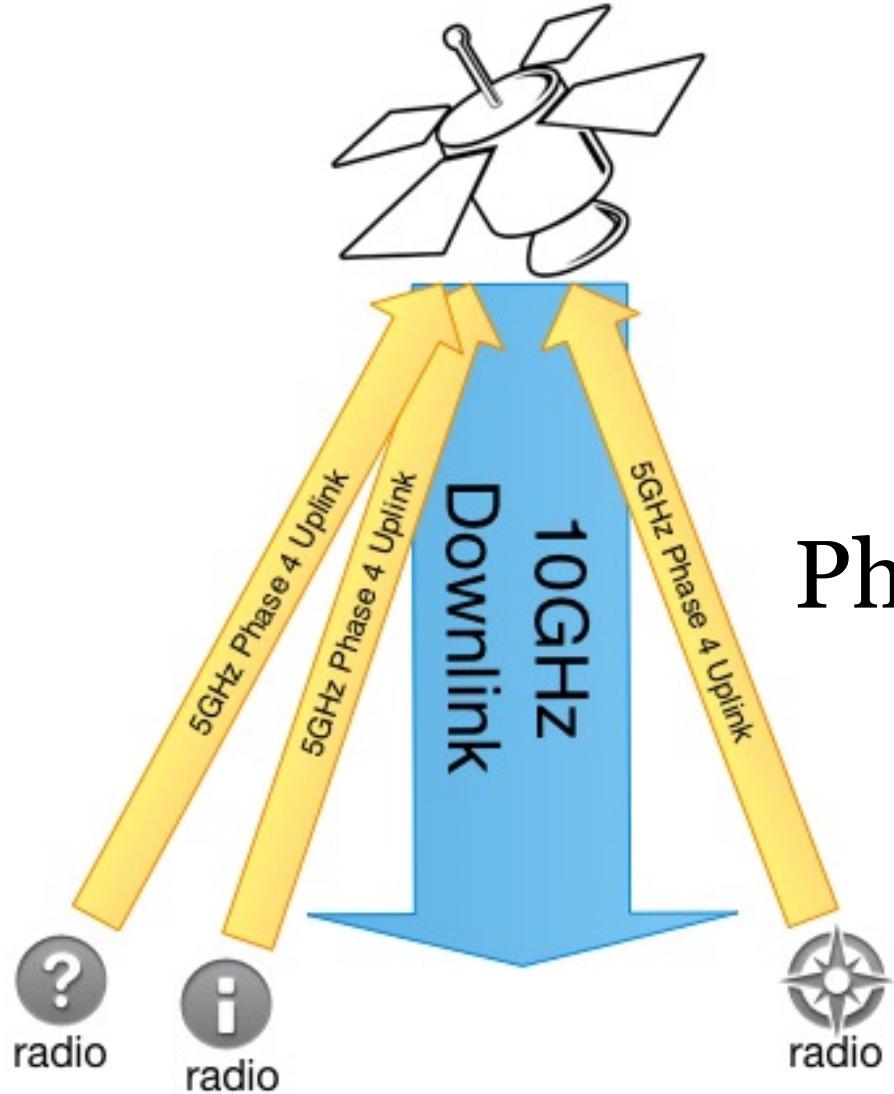
Phase 4 – Not Just a Satellite Project

Satellite Service

This mission (Phase 4b) is expected to last at least a year, but possibly four, before the satellite is placed in a parking orbit. This means that satellite service will be for a limited time on this mission. We are hoping to leverage this successful mission into having our own geosynchronous satellite(s) with longer missions. Phase 4a is a AMSAT-DN project.

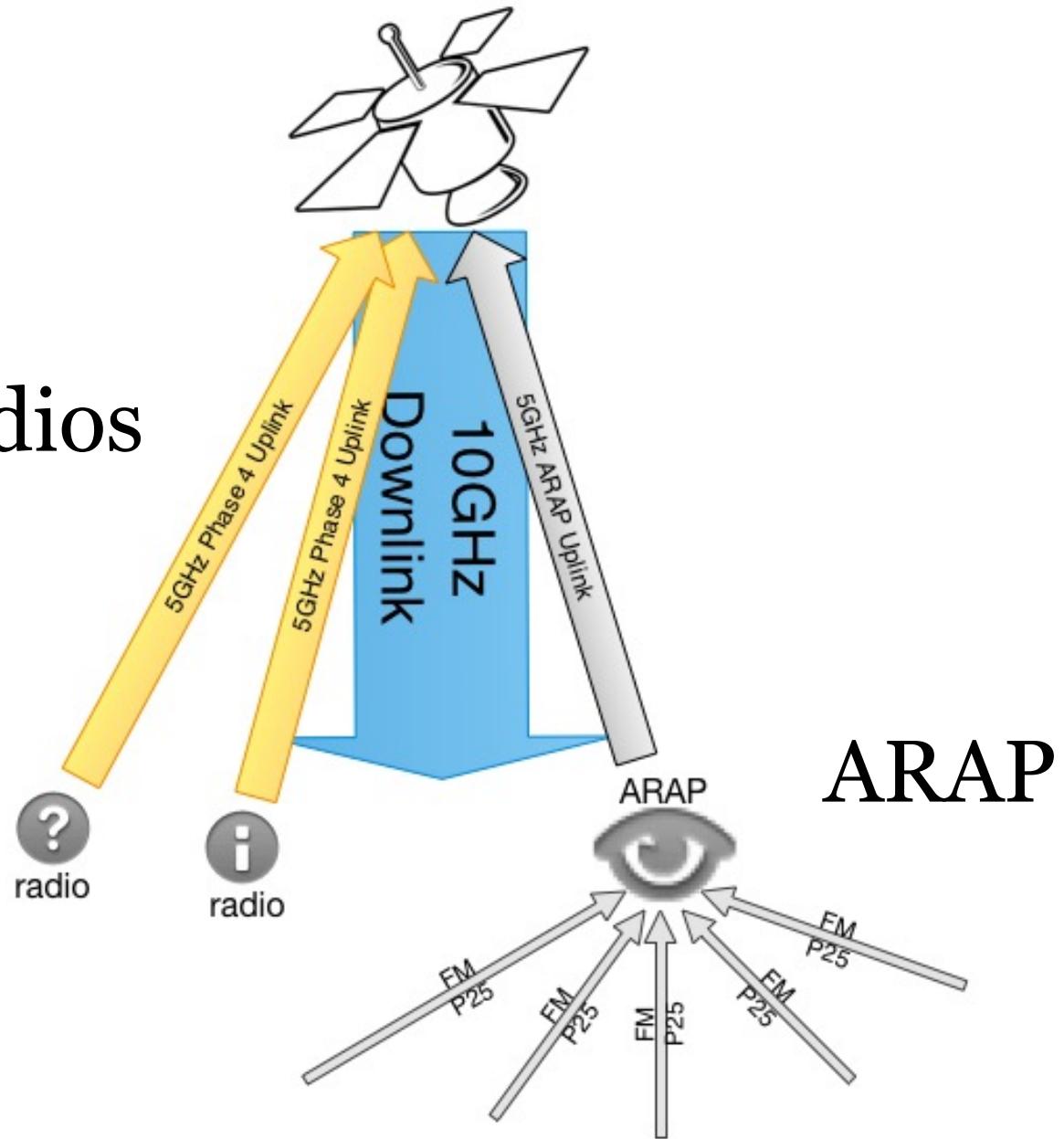
Terrestrial Service

Using the launch as a motivator, we will create ground stations and equipment that will live on past the satellite mission. Terrestrial service is built-in from the beginning. The system will be fun, useful, reconfigurable, powerful, and will make getting on the microwave bands much easier and much more accessible than they have been in the recent past. Use them or lose them!

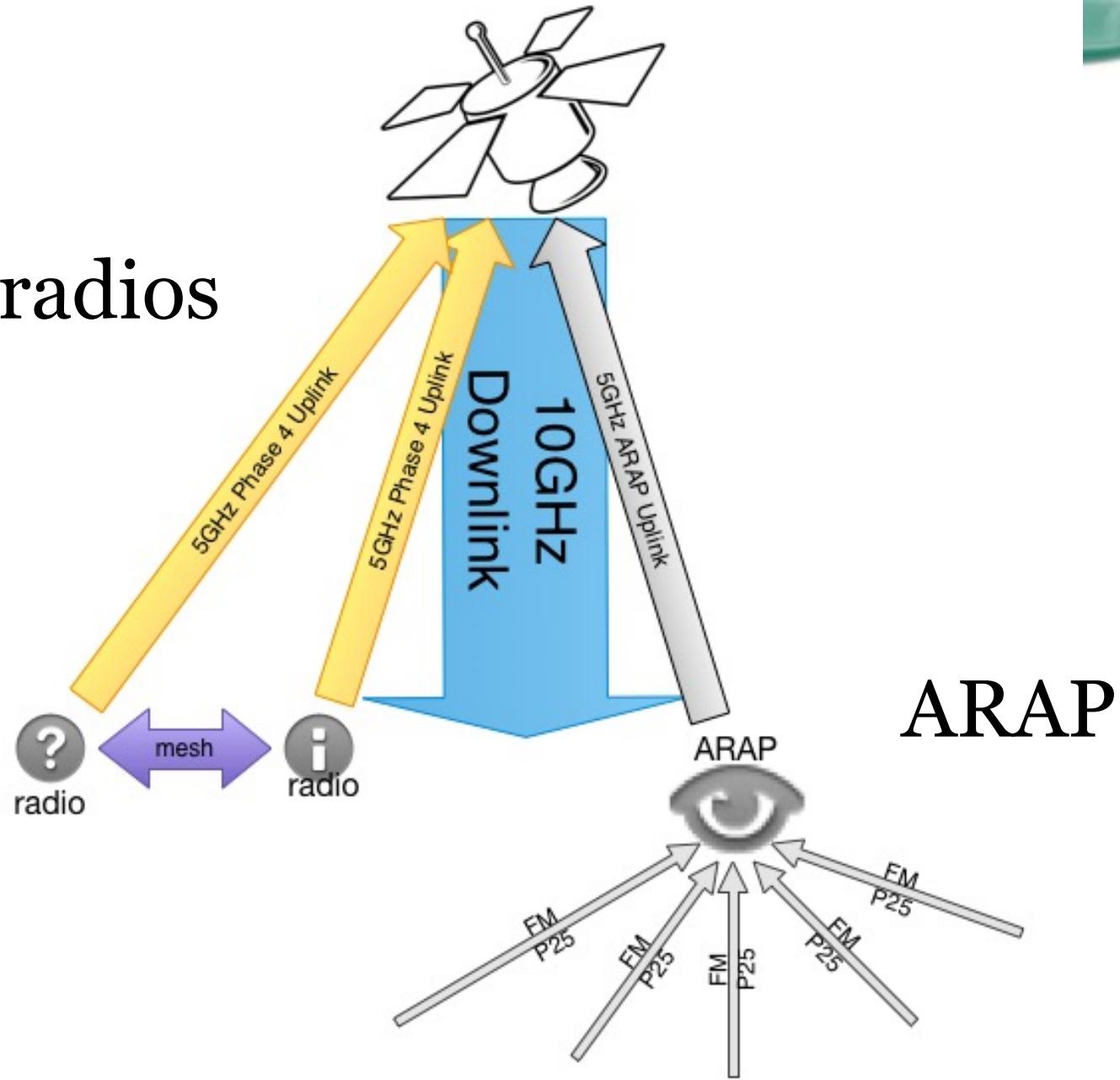


Phase 4 radios

Phase 4 radios

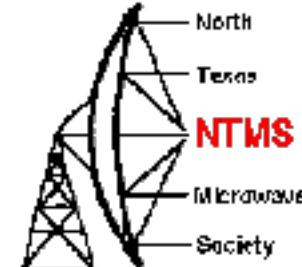


Phase 4 radios meshed



Who else is directly supporting this project?

- Palomar Amateur Radio Club, Escondido Amateur Radio Society, Dixon Lake Recreation Area, North Texas Microwave Society, Federal Emergency Management Agency, Amateur Radio Relay League...



And lots of volunteers!



Current Status

- We have a growing team of 40 volunteers/employees
- A \$100,000+ rideshare payload study at MSS is underway
- We are expecting a late 2016 or early 2017 launch
- We will have 100 watts of power from the spacecraft
- We will enjoy access to the coldplate
- We can use several external areas on the spacecraft for antennas
- We do not have to control the spacecraft
- Ground station development is completely open source
- Space segment development is ITAR controlled

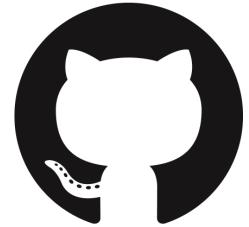
Issues and Resolutions

- International Traffic in Arms Regulations directly affects this project
- What and how did it impact the project?
 - Time wasted, stress increased, harsh and unnecessary limits on human resources
- Splitting up the project into **Ground** and **Space** allowed for open source development of the ground station while enabling the space segment development to continue to comply with ITAR.
- Teams are now separate and communicate through the Air Interface Document, which defines the radio link between satellite and stations on the ground.

Phase 4 Top-level Team Structure

Phase 4
Space Team

<https://github.com/phase4ground>



Common
Air
Interface



Phase 4 Ground Team

Phase 4 Ground Team Structure



It's All About The Team

RF Hardware

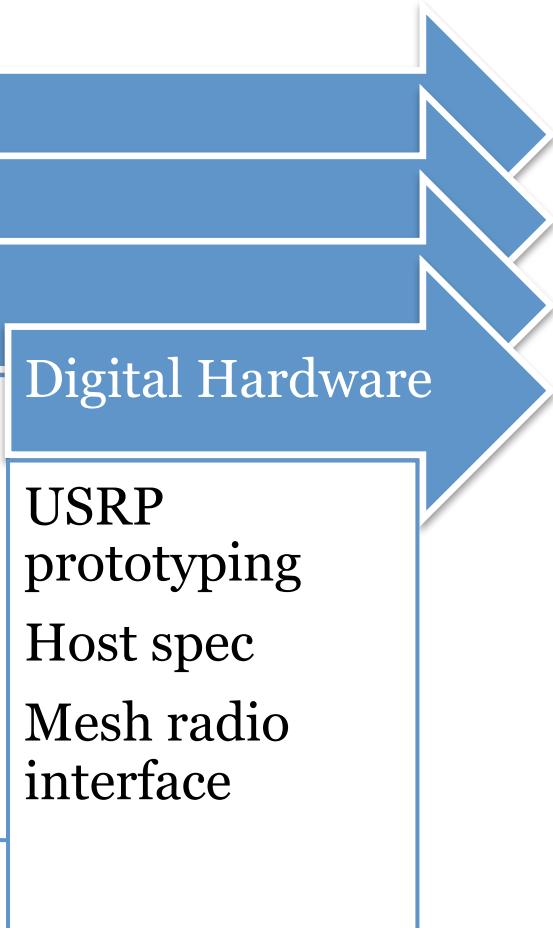
5GHz link
10GHz link
Antennas

Applications

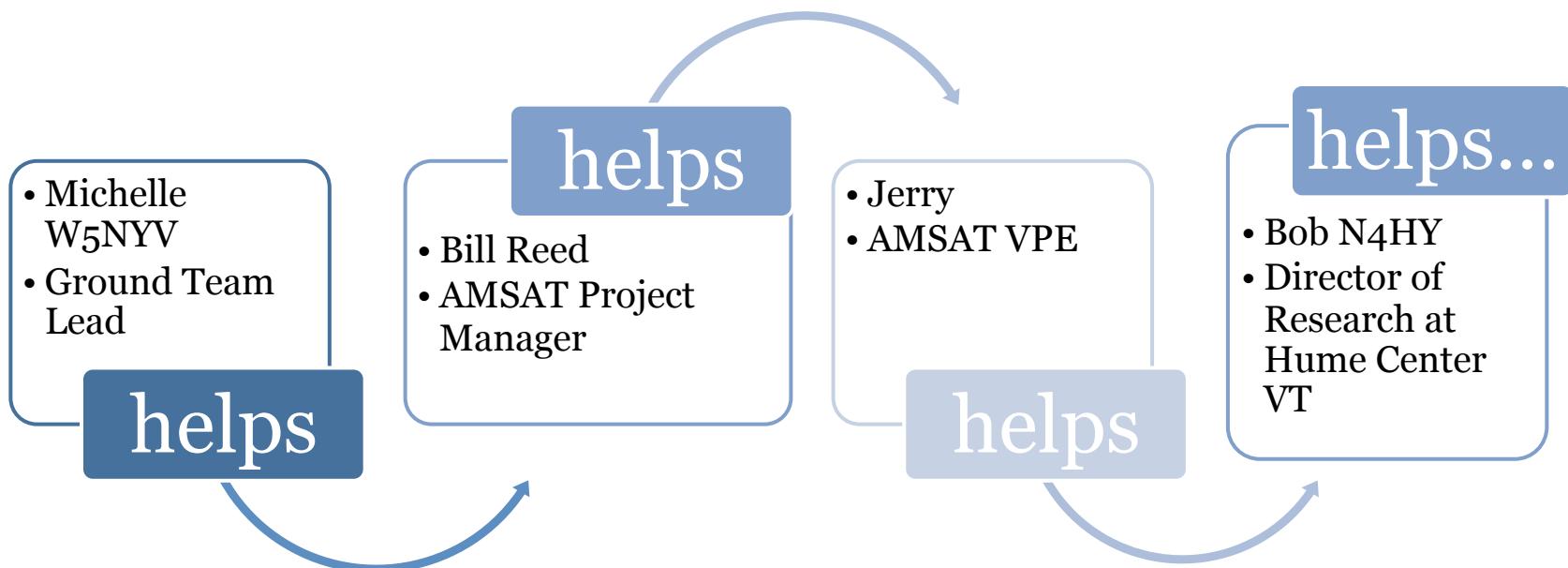
QSO party
SatChat 1k
EmComm
Stereo Field
FractalQSL

Servers

Xmpp
YAWS
Authentication

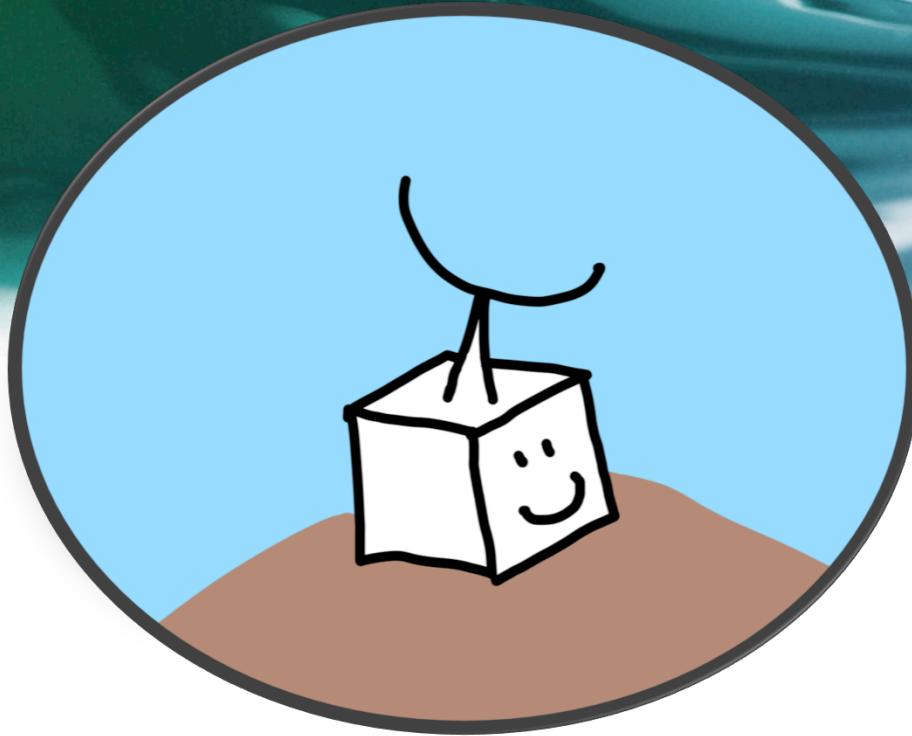


Phase 4 Ground Leadership Supports the Team



Development System

- **Groundsat** is a satellite simulator
- **ARAP** is an amateur radio access point
- **User Terminals** are individual Phase 4 radios



Groundsat

Satellite simulator on a mountaintop. Allows development with real stations and real traffic.

PARC has agreed to host a Groundsat for AMSAT Phase 4.

Groundsat sites are planned in four US locations with a variety of weather and geography.

Phase 4 Groundsats (proposed) ★

Groundsat Systems in the Phase 4 Network. Used for Phase 4 Development, these systems continue to operate terrestrially.
75 views

All changes saved in Drive

Add layer Share

San Diego System Individual styles PARC Groundsat Dixon ARAP

Maryland System Individual styles Maryland Groundsat

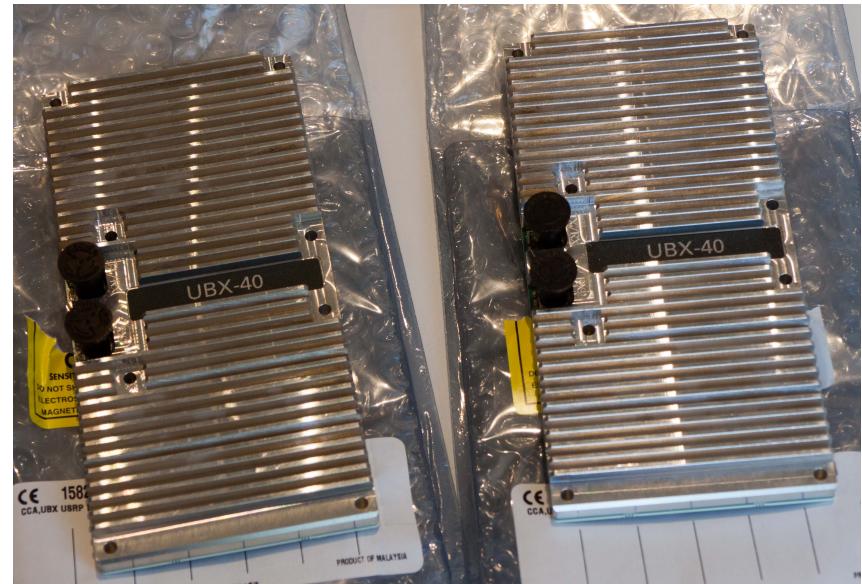
Virginia Tech System Individual styles Virginia Polytechnic Institut...

North Texas Microwave Society S... Individual styles North Texas Microwave Soci...

Base map

The map displays the following state abbreviations and names: ID, WY, SD, MN, WI, MI, NY, PA, NJ, DE, MD, VA, NC, SC, GA, FL, OK, KS, MO, IL, IN, OH, KY, TN, AL, MS, LA, TX, CO, UT, NV, AZ, NM, CHIHUAHUA, SONORA, COAHUILA, N.L., BAJA CALIFORNIA, BAJA CALIFORNIA SUR, SINALOA, DURANGO, TAMAULIPAS, MEXICO, and GULF OF CALIFORNIA.

USRP* X310 and 10MHz – 6GHz RF daughter cards.
This will simulate the FDMA demodulator and TDM modulator functions provided by the satellite.



***Universal Software Radio Peripheral**

A R A P
イ M ヲク ヲ A キエイシニアエクク
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エ E イ O S ク
コ U S
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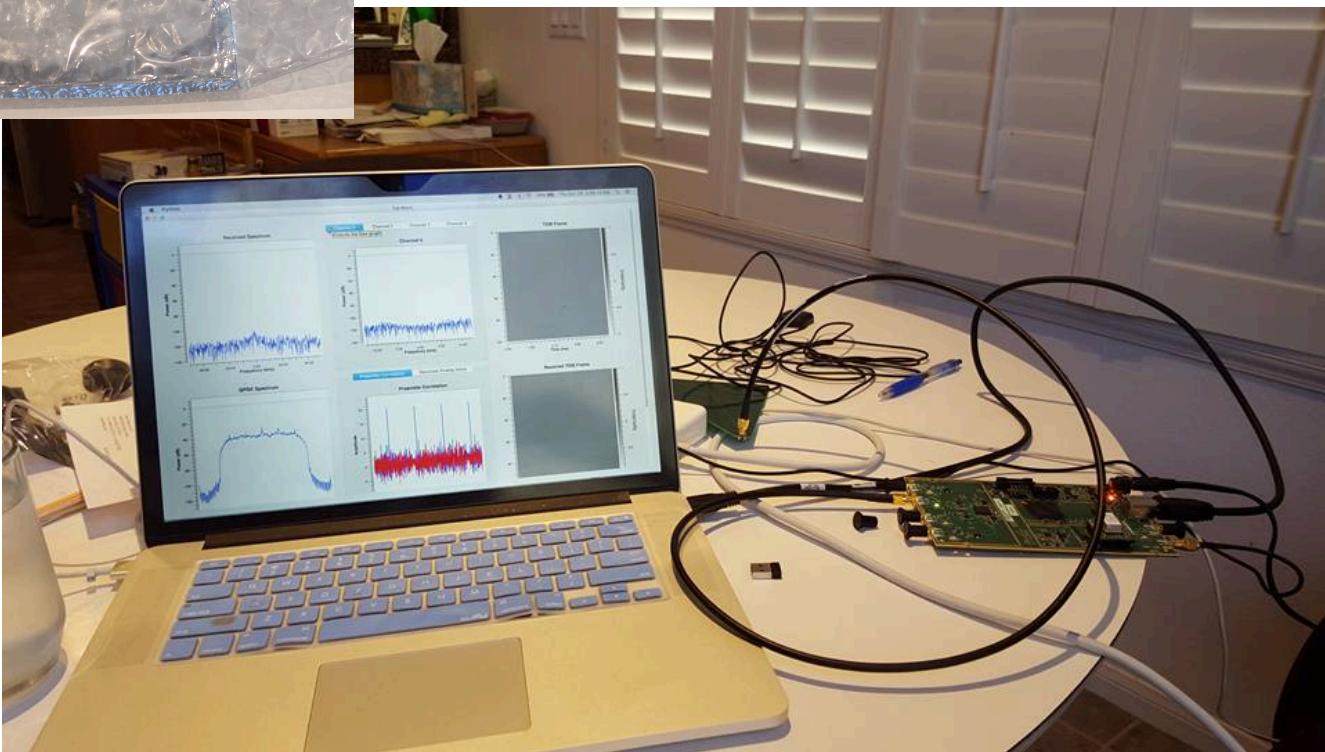
Amateur Radio Access Points

- Amateur Radio Access Points (ARAPs) **aggregate radio traffic and send it to the satellite.** They are powerful mobile stations that can provide emergency communications out of an affected area to either a satellite or Groundsat.
- The goal is for emergency or credentialed personnel to **use their own radio gear.**
- During a communications emergency, **shared secrets** allow for control of access to the satellite uplink.

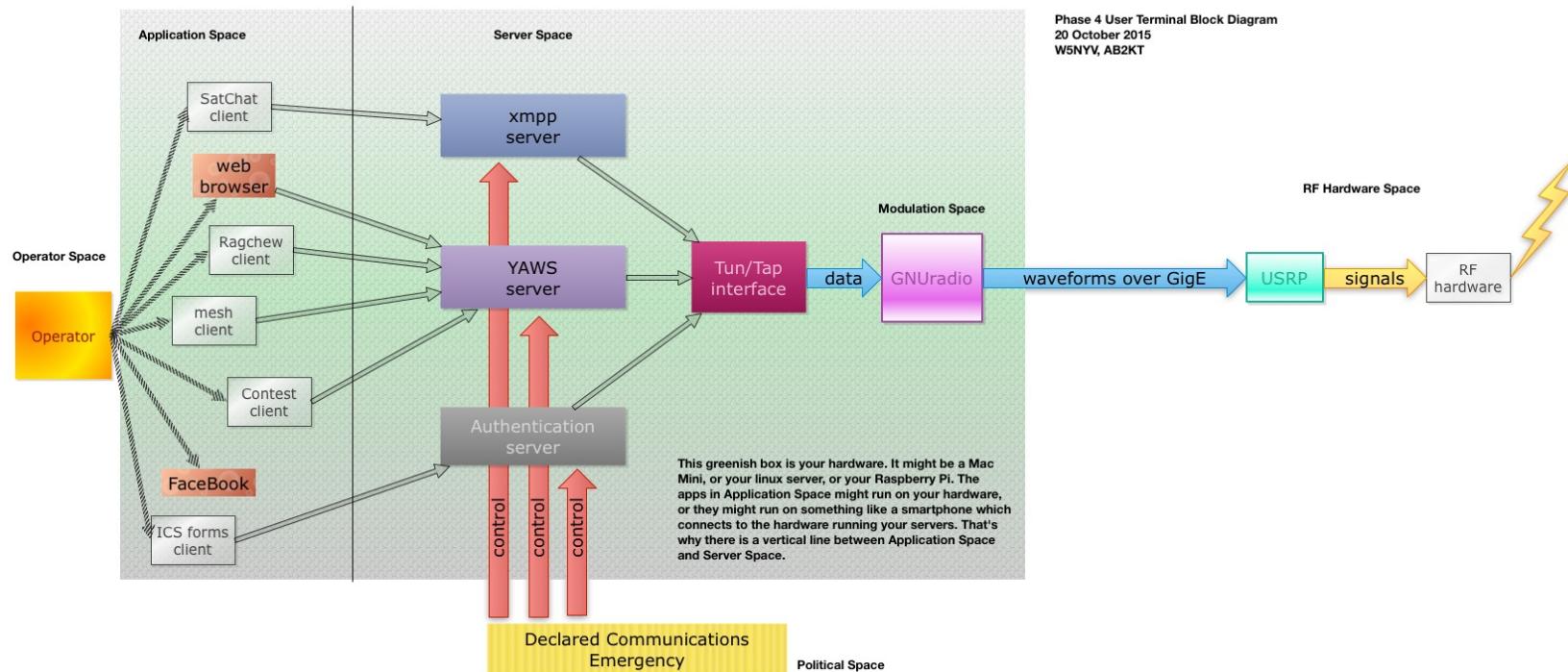


USRP B210 set up to demonstrate an ARAP collecting local FM traffic.

First demonstration was made at the AMSAT Symposium on 18 October 2015.

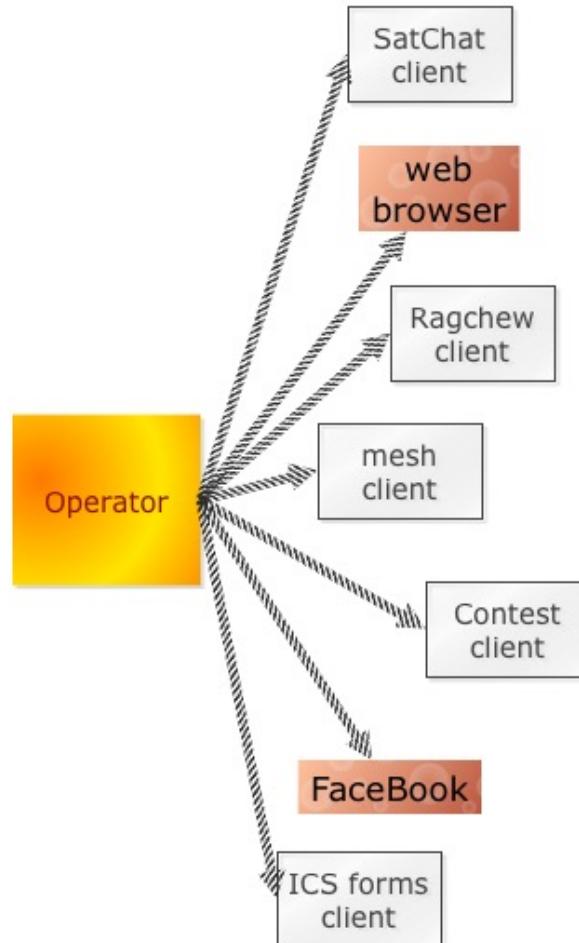


User Terminals... are still a block diagram

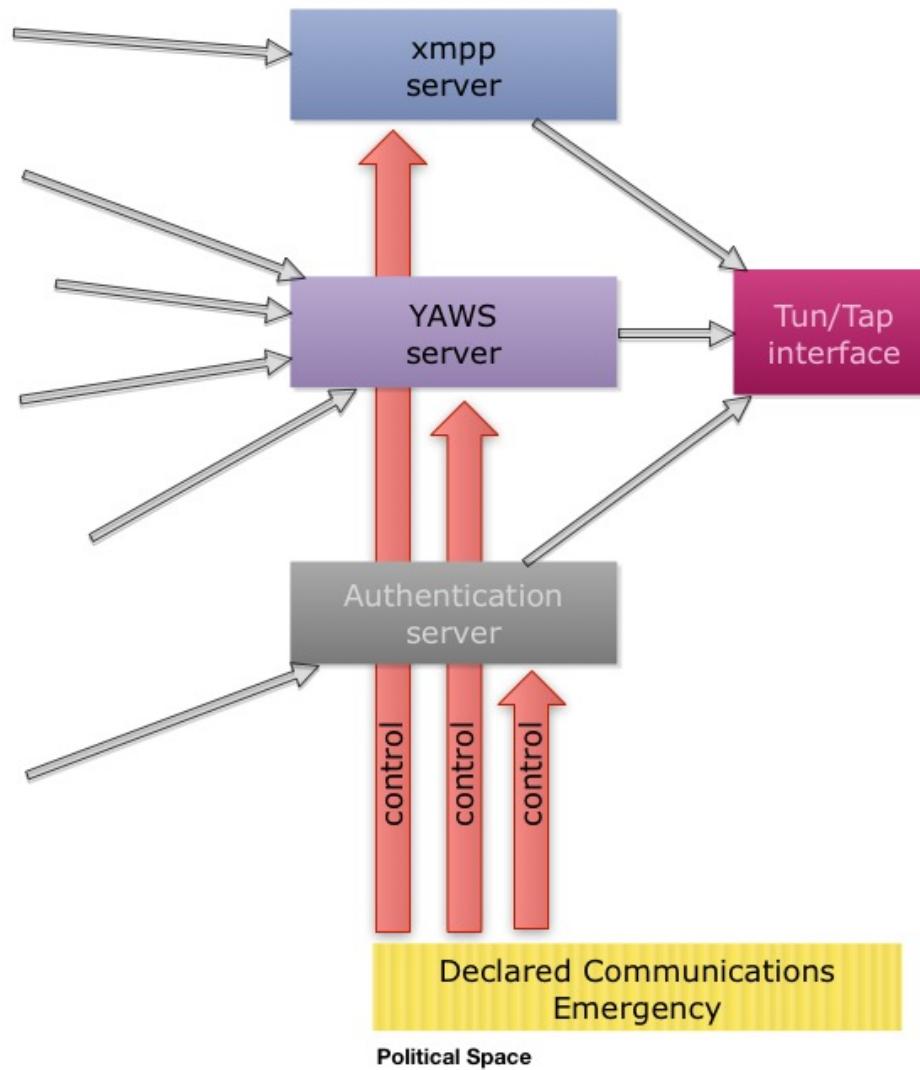


Application Space

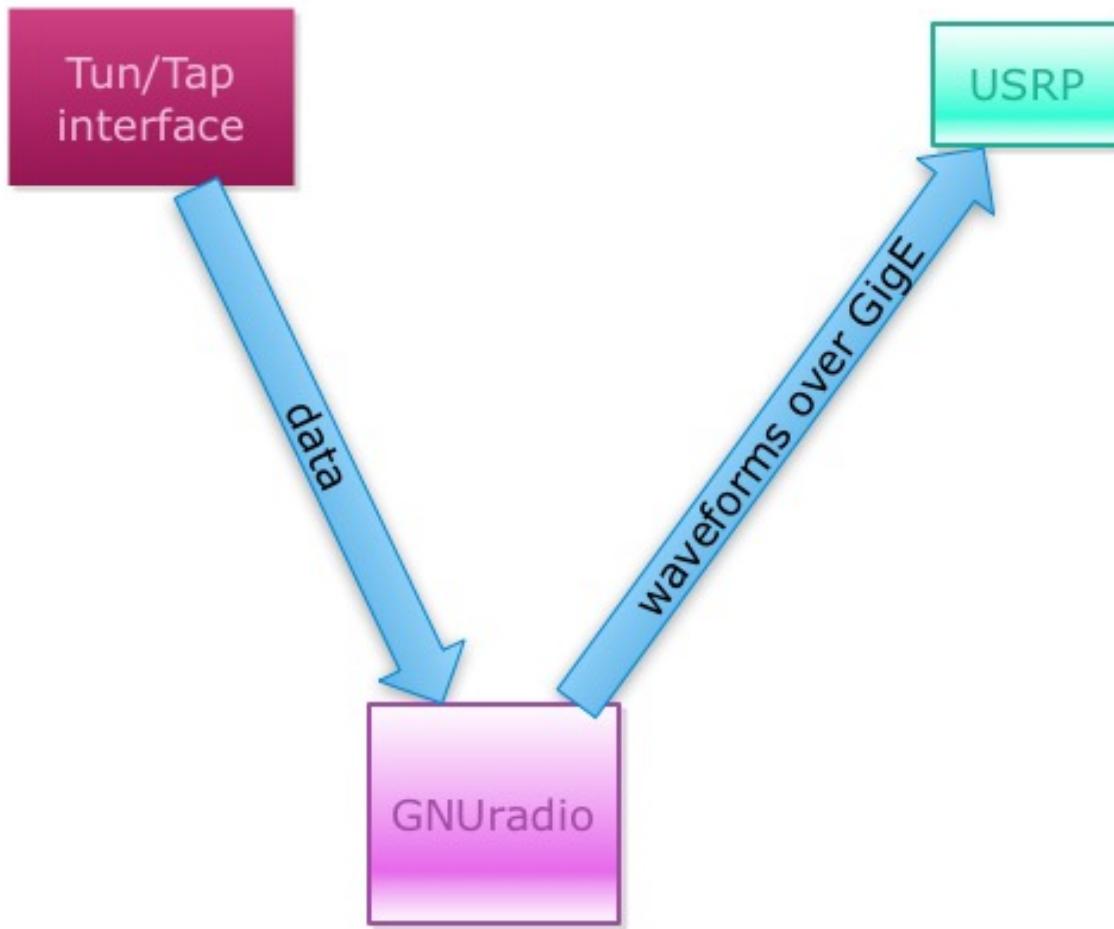
But, we have a great block diagram that has survived its first review.



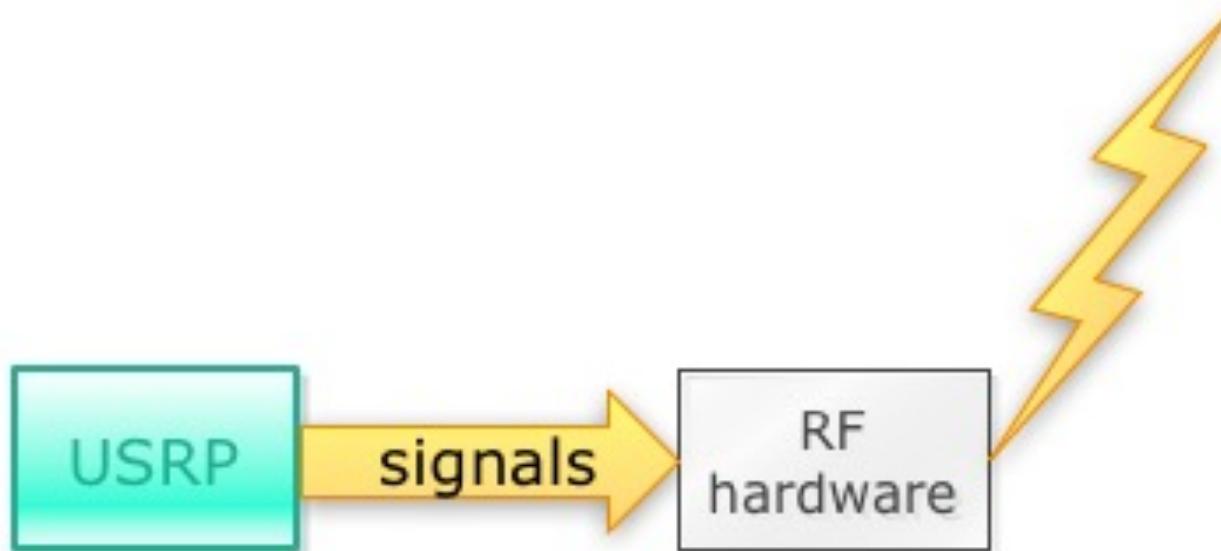
Server Space



Modulation Space



RF Hardware Space



Contact Phase 4 Ground

- <https://github.com/phase4ground> (team of 15 not visible)
- phase4@amsat.org (apply for membership to this address, open to both US and non-US citizens)
- Contact Michelle w5nyv@yahoo.com for more information.

Contact Phase 4 Space

- Due to ITAR, both the repository and the mailing list are closed, invite-only, and restricted to US citizens only.
- Contact Jerry Buxton vpe@amsat.org for more information.

NOTICE

**COMPLAINT
DEPARTMENT**



100 MILES