Phase 4 Space GEO x4

Orbital Concepts and

the CAD Models Needed

11/13/19

This paper is about the potential orbital concepts for GEO x4 and the CAD models for the studies and proposals. Questions and comments welcome and encouraged. Send them to Wally Ritchie and/or Michelle Thompson.

Orbital Concepts

We are considering two approaches for achieving GEO orbit. The first is to spiral up from LEO. The second is to work hard to get a launch that takes us mostly to GEO. We propose a 6U 100W platform for digital microwave broadband amateur radio communications.

LEO-spiral-to-GEO

The first strategy under consideration is a LEO-spiral-to-GEO.

What do we need?

A concept document for Spiral from LEO and a talk with Busek. Busek is our baseline thruster choice, but spiral from LEO orbit involves a long-duration transit through Van Allen belts. If the Busek can't last, then this will kill this approach from the start. That talk should happen sooner rather than later.

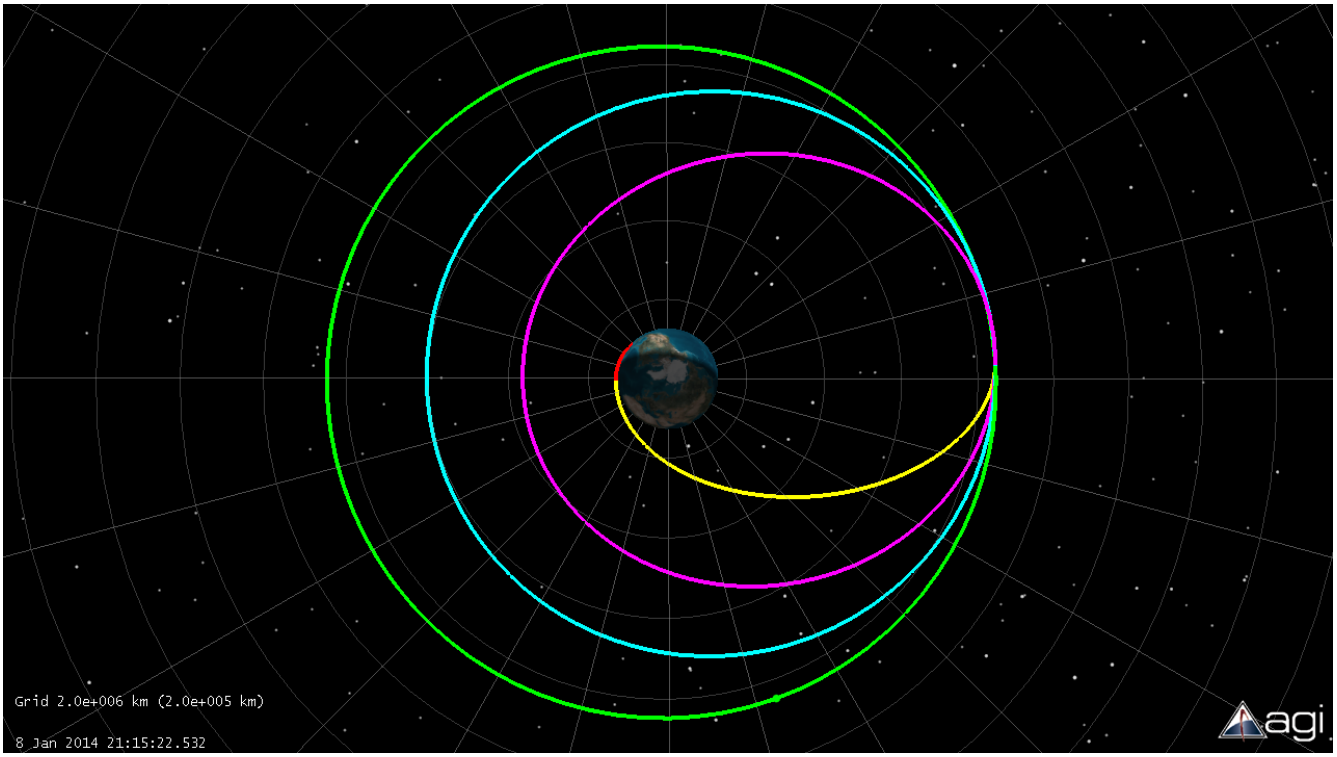
Near GEO

The second strategy to get a configuration of multiple 6U (we have proposed 4) is to include them along with another GEO deployment. The idea is that they could be taken all the way to near-GEO and released sometime before the primary starts maneuvers. The 4 payloads would separately maneuver to their orbits. In this case only a single Busek or other thruster would be required. Two would be superior for redundancy. There are limited launch opportunities for this but ~40kG is not excessive.

GEO deployments like this may involve several circulation burns. The final burn puts the satellite near its final position. Before that, the orbit is high and circular enough so that we can maneuver from that point to GEO on our own.

After deploying the primary payload, the apogee kick motor is disposed to a graveyard orbit. The concept here is that the apogee kick motor has an adapter that can deploy some number of 6U (or other size) payloads prior to the final circularization burn. The payloads independently maneuver to their GEO orbits. This still takes a lot of time with low thrust ion engines but not nearly as long as trying to spiral from LEO.

Example of 3 circularization burns:
https://planetary.s3.amazonaws.com/assets/images/charts-diagrams/2014/20140116_image009.png



Green is GEO. Teal is feasible for final transit using Busek thruster. This is above the most intense part of the outer Van Allen belts.

A dual Busek configuration could likely be used for either spiral from LEO or final circularization. Final circularization provides much more fuel for in-orbit operation and disposal.

What do we need?

A concept document for Near GEO, a lot of engineering, and intense effort to secure a launch.

CAD Drawings

What we're after is a library of 3d cad models of the various components that might be used in our 6U project as well as on each of boards in the transponder. This will be an ongoing activity - assembling

and organizing what's out there and of potential use and building of 3d cad models.

Generally, they should be .stp files which could then be used in many different ways. We can use the open source FreeCAD or OpenSCAD for the modeling. The .stp files can be built in any tool as long as it can export to .stp.

There are a lot of models available from manufacturers. Models can range in fidelity and we do want both simple and more complex models. Some models from manufacturers may be covered by NDAs.

Anybody interested in 3d cad and mechanical engineering can contribute. We need to maintain a list of component models needed (or desired) and those willing can pick what's within capabilities and interests. There should a mechanical lead/mentor who keep things on track overall. Some verification steps should also be required down the road.

What do we need?

We need an .stp model of the Busek thruster. A simplified version showing mounting locations is more than good enough to start.

We need .stp models of 6U frames.

We need (rough) CAD models for the boards.

We need a lead for this effort. This is a good mechanical engineering position.