

“Space News”, March 11th 2013, Viewpoint Op-ed

Leaving the Cradle

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It was Konstantin Tsiolkovsky, back in 1912, who said that “The Earth is the cradle of reason, but man cannot remain in the cradle forever.” He also pointed out why. No need to dwell on the potential threats here — we all know that in the very long term Earth will become uninhabitable for a number of reasons, including the sun’s lifecycle, asteroid or comet bombardment, magnetic pole reversals, gamma-ray bursts — quite apart from impacts due to humans themselves.

The threats are real, but their associated timescales are way beyond that of the budget cycle, a single presidential term, or even beyond that of a human generation. We have made a good start in the first half-century of the space program, but are now somewhat uncertain about how to proceed.

In order to make sure that, through the space program, there is an “insurance policy” for our descendants, we do not need precipitate action, just so long as the actions we do perform are headed in the right direction. What is the right direction? Any one of a number of current proposals would be in this category, but they may not all be affordable in the short term. So what can we realistically undertake within a reasonable budget and timescale (say, today’s current constrained NASA budget and 20 years or so) that would be technically achievable, affordable, fit the very long term goal, and offer opportunities for new commercial business development and revenue generation?

I suggest that we need to make it possible to routinely leave Earth’s gravity well. We need a new gateway — call it Spaceport Earth — situated near the rim, the gateway at the edge of the universe. Going beyond to any future chosen interplanetary destination would then require very little extra energy to travel across the vast geopotential plateau between the planets.

To make it financially viable, I suggest making it a three-part complex. Two parts would be commercial and one part would be governmental. First let’s consider the role of the government.

Imagine what NASA and other space agencies could do with a facility located at the edge of Earth’s gravity well. It would provide a number of options not available today. First, it could be the departure and arrival port for subsequent interplanetary vehicles. These spacecraft would not, therefore, need to be designed to survive Earth’s atmospheric re-entry. A different class of vehicles (much lighter and cheaper and requiring much less propulsive energy) would thus be enabled to travel onward from the new gateway to almost anywhere in the solar system. It would therefore need to be an assembly base for these new interplanetary vehicles. It would also need to be a destination space station in its own right for tugs making the journey from low Earth orbit (LEO) — say, from the international space station. These tugs would cycle back and forth from the gateway station to the space station, and therefore would need to be reusable and refuelable — and of course there would also need to be a fuel depot in LEO.

Where exactly should this gateway be? From a purely governmental perspective, there are a number of possible places near or just outside the rim of Earth’s gravity well that would serve. All the various Lagrangian points and even the lunar surface might be considered. But when we introduce the notion of the potential commercial uses, we shall find that another location offers significant advantages.

I said this could be a three-part complex, with two parts being commercial in utilization and funding. The first of the commercial parts in this proposal would be a space tourism hotel. It could be a Bigelow-type inflatable habitat co-located with the gateway station (and its associated taxi tug arrival/departure ports).

To satisfy this commercial need, we would have to narrow the location options to either the Moon/Earth L1 Lagrange point, or to geostationary orbit (GEO), which is located almost all of the way out of Earth’s gravity well.

There are pros and cons for both locations. From either, space tourists would be able to see the entire hemisphere of Earth all of the time. From L1 they would also get a good view of the Moon, but Earth might appear too distant from there, even using telescopes. From GEO, telescopes would provide a marvelous view of the Earth (I checked with someone who had been in the neighborhood!) but not a much better view of the Moon than we get from Earth. Plus, there would need to be coordination efforts with the International Telecommunication Union regarding possible locations and other issues.

Neither location is therefore ideal, but both would work, provided the market research would indicate a sufficient revenue source at the likely prices. This market research has not yet been done, although there are indications of a strong interest in tourists going further into space than LEO. Of course, we must be patient, because it is still early for space tourism, and the operators need to experience success at the suborbital and LEO business before introducing new destinations. But in principle there would be a joint interest in NASA and space tourism operators in providing such a destination and the means of getting to and from it. NASA astronauts could, for example, take taxi rides to the gateway from LEO via commercial tugs, precisely as is being proposed from the Earth to the international space station in LEO via the Commercial Orbital Transportation Services program.

What of the third proposed part of the complex? Well, for this second commercial part to work, and therefore a third source of funding to emerge, we would have to narrow the possible location of the gateway down to GEO. This could then also serve as a base for a new geostationary satellite servicing and maintenance business. There would need to be tugs that could move around GEO to do this work, and these tugs could also be used by the space tourists who wanted

to drift around the orbit to see the other side of the Earth. Very little fuel is required for such maneuvers; it is only necessary to move slightly above or below GEO and the spacecraft will drift to its required area of operation.

Of course, we cannot instantaneously set about servicing GEO satellites, even if we had a company ready to do this, because the satellites would need to be designed from the outset with on-orbit servicing and refueling in mind, which must happen in parallel with the development of the overall gateway proposal. So we can imagine it would take at least a decade before that part of this proposal could operate, and maybe another decade beyond that before some of these new satellites would need servicing. And in any case, we would also need in parallel to develop the LEO-GEO reusable tugs and their orbiting gas depots as essential infrastructure, which would also require a decade or two. It would take time to get the new entrepreneurial geosat servicing companies established, and for the requisite changes in the satellite designs to be introduced. Of course, the good news is that at least transfers from LEO to GEO are now a matter of routine due to the experience of the commercial geosat operators.

So, the proposal that emerges is for the next big thing to be a Spaceport Earth gateway placed in geostationary orbit, as a cousin of the international space station, which would continue to serve as the LEO port of call for astronauts, and for the development of the refueling taxi tugs to make the return journey between LEO and GEO possible. The Commercial Orbital Transportation Services providers will get us into LEO in the first case.

The whole point of this particular proposal is that it will a priori require the national space agencies to work alongside the commercial operators to make it happen, and to make the funding possible and sustainable. But it will take time. The space tourism operators and the potential satellite servicing operators will eventually be capable of at least partially supporting the funding of the venture, and even designing, building and operating the tugs, thus freeing the national space agencies to concentrate on assembling interplanetary vehicles at the gateway. But this will require an entirely new kind of integration and long-term trust between the national space agencies and the future commercial concerns.

I am not sure it will be possible, but I do believe the benefits would make the effort worth the risks. America, at its core, is about accepting risks in order to progress.

This is quite a different proposal than has been considered thus far in trying to come up with a way ahead for the space program. Do we have the management abilities to bring off something that requires this combination of commercial and governmental objectives? The Commercial Orbital Transportation Services program has at least shown that it may be possible. And it is clear that what is required in the current fiscal environment is something very different from what has been tried for the last 40 years.

Providing we are realistic in our planning, the timing of this whole venture could be arranged so that no increase in annual governmental budgets is required, and we should then have a clear mission. The mission would be for NASA, in conjunction with other national space agencies and commercial operators, to provide us routine access to the edge of Earth's gravity well — to provide us with the gateway at the edge of the universe.

Those pioneer astronauts who are still alive today, and who risked their lives in the early years of the space program, would be able to see this as a fitting ongoing objective for their successors to strive for, and something that would help our descendants in the decades to come. We could leave the eventual approach to settlement and resource development missions to future generations, while at least recognizing that we have done our best during our lifetimes to create the highway to make it ultimately possible. I would like to feel we had done that instead of just kicking the can down the road for another couple of generations.

Furthermore, because the proposal depends upon a parallel governmental and commercial operation, new businesses and employment would emerge, and the funding for the proposal should be sustainable, provided the space tourism business develops successfully, starting with its current suborbital and orbital phases and then adding a new destination: the gateway at Spaceport Earth.

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