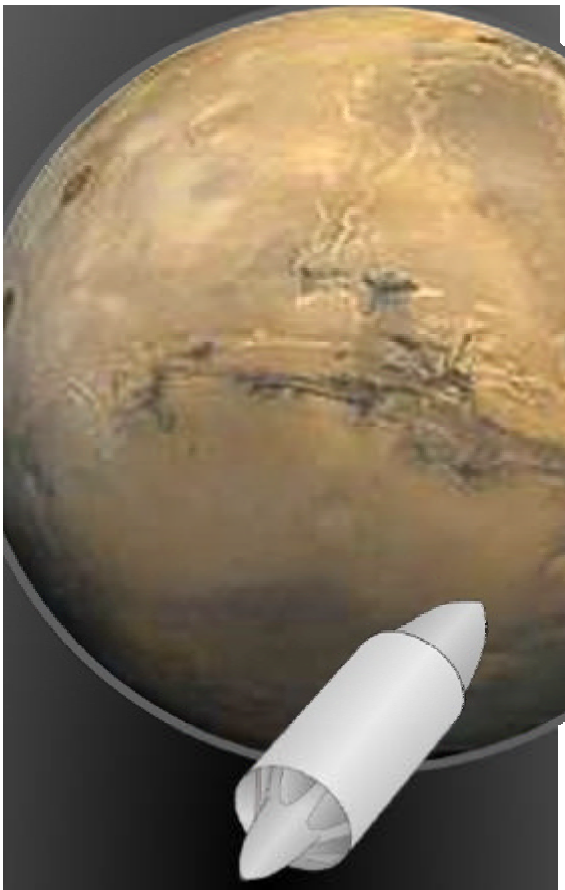

# Telepossession Transforms Asteroids Into Resources

**Gary 'ROD' Rodriguez**

abstract: *A deep-space probe with integral RADAR transponders should be a sufficient improvement to a space rock to qualify a resource mining claim. Such a legal device would allow Aldrin (Earth-Mars) Cycler Orbiters to develop the asteroids, widely viewed as a menace to Earth, into valued resources.* In-Situ Resource Utilization *(ISRU) Technologies enable exploration, development and evolution of the law.*

Investment in space has the usual risks associated with any leading-edge technology, and space adds a few surprises to the mix. Potential economic gains can only be achieved if the legal system allows and *encourages* entrepreneurial success.

Fundamental to most legal systems is a method for controlling real estate, and providing for the unique use of a defined space by a developing user without conflict or collision with other parties. There emerges an interest in methods for declaring title to extra-terrestrial real estate in the form of asteroids, moons, LaGrangian points, minerals, eclipses, gravity wells, orbits of advantage, *etc*. Treaty and convention have and will establish acceptable norms for laying claim to various forms of real estate, mineral rights, easements and *rights-of-way*.

Title to real estate often underpins risk capital and allows many a risky "scheme" to emerge into main-stream industry and commerce. The backers of an investment can always take claim to the real estate should a venture fail. The land grants which accompanied the railroad rights of way to Union Pacific have been a major asset on their balance sheets from the start. This real estate backed the construction of the first transcontinental railway in North America.

Mineral claims have been historically cast by marking boundaries and filing with a local government office. Sometimes a claim would be substantiated with some improvement, such as a cabin or a well, particularly when real estate was a component of the claim.

Telepossession has been positted as a legal device[1] which could provide foundations for the formation of investment capital for space development, allowing venture capital to flow into a firm which holds title to a telepossessed property. The concept suggests that a robotic proxy embeds itself on the surface of an asteroid or other celestial body and by its presence establishes pretext for a claim. This concept seeks to bypass the huge inconvenience of actually travelling out to a rock in a remote, severely elliptical orbit, and planting flags or stakes. The premise is that "tagging" an asteroid is sufficient to establish a claim, and that human presence is unnecessary.

Such a tag would certainly demonstrate that the claimant can reach the asteroid. Yet simply

'tagging' the rock does not improve the claim. We suggest that the claimant need only to add the functionality of upgrading the property with an active RADAR transponder to add value to the franchise.

A spacefaring nation with asteroid intercept capabilities stands to be liable worldwide for those asteroids which impact the planet. Declan J. O'Donnell, a prominent pioneer in space law, succinctly characterizes the dilemma of eliminating threatening asteroids and comets as follows:

*'A capable nation is liable for an asteroid impact:*

- ✧ *If they act and any damage is inflicted;*
- ✧ *If they don't act and any damage is inflicted;*
- ✧ *If they could have acted . . . and didn't, irrespective of the outcome.'*

*Ergo*, a capability is required which solves the problem through the expedient of displacing the site of the asteroid capture and rendering from the vicinity of Earth.

**The Method**

A RADAR Transponder is an indispensible component of a contemporary flightdeck, whether a commercial, military or private aircraft. When a transponder is interrogated by an encoded RADAR sweep, the transponder transmits a string of bits with unique identifiers imbedded. An encoding altimeter reports the aircraft's altitude and flight number through the RADAR transponder in response to interrogation by air traffic control.

Similarly a RADAR Transponder may augment the usual optical methods of locating celestial bodies. The value added to the claim is that considerably less time will be necessary to develop a positive location for a "tagged" asteroid. The transponder is also helpful for the docking of development payloads under automatic control.

Transponder packages can be a relatively low-cost mechanism for "tagging" a target asteroid or comet, incorporating the registration and property ownership. *Ergo*, transponders would constitute an improvement on the claim made by an *absentee landlord* or *telepossessor*. The package constitutes an inexpensive claim improvement mechanism, but a claim nonetheless. After all, entire terrestrial continents have been claimed based upon a mere piece of cloth affixed to a stick.

Asteroids are known to be tumbling continuously in their orbits, which in conjunction with irregular asteroid shapes, creates complex rendezvous and attachment hazards for approaching probes. An asteroid can also block communications to Earth by obscuring the antenna. It may be sufficient that a transponder fly in close proximity (formation) with the target asteroid.

The transponder may be launched by any number of *off-the-shelf* commercial launch vehicles to intercept a particular asteroid or comet. These missions should also provide substantial space science, high-value data at small incremental cost to the overall mission.

**Consequences of the Method**

The demand for exploitable properties will give rise to a launch service which threads its way to various comets and asteroids, "tagging" them with transponders which are then sold under contract or perhaps at a global auction – *ebay*?

Another possible service of interest is related to real estate title services. Optical confirmation of the transponder's actual location coinciding with the RADAR return could be of large value to the owners, developers and lessors of space property.

A telepossessor might be required to maintain continuous transponder operation for ninety days before his registration would be approved. A telepossessor would further have to be allowed perhaps as much as three or more years to replace a failed transponder to allow for backlogs and mission transit times for replacement packages. It is possible that "dirty tricks" by those seeking to encroach on a registered patent or patent application might include electromagnetic pulse (EMP) to silence one or more transponders. So recourses must be in place from the start, to support the honest claimants.

At some point the owner of an asteroid or comet will want to take physical possession of the asset and park it in a useful orbit or reduce it to component fragments. The latter is probable because asteroids and comets often contain water ice and organic matter which is known to be rare on the Moon and elsewhere.

A capture mission generally requires a more complex implementation vehicle. Where the Transponder is a very modest package, hardware required for corraling and acquiring an asteroid starts to grow significantly.

In order to process an asteroid it will probably be necessary to alter the long period and highly elliptical orbit of the asteroid. Conducting such operations from the Earth successfully seems improbable, especially when Earth could easily become the 'bullseye.' An opportunistic strategy would be to maintain a vehicle for tagging prospective asteroid properties with transponders.

Such a vehicle could also launch recovery vehicles which, in addition to a transponder, would be equipped to translate asteroid mass into reaction thrust for altering the shape and inclination of the orbit. Ideally the altered orbits would allow for later intercept by a factory ship which would 'render' the asteroid and convert it to value-added products. The big benefit is that the asteroid capture and rendering remains in a distant orbit and the mass of the digested asteroid returns to Earth as a Cycler Orbiter plus value-added products.

**Enter the Cycler Orbiter**

The cycler orbiter is a deep space vehicle which travels in a Solar Orbit, making close approaches alternately to Earth and Mars. Each approach "slingshots" the orbiter on a new path designed to intercept the alternate planet weeks and months in the future. These orbits have been promoted by Apollo 11 astronaut and moonwalker, Edwin Eugene "Buzz" Aldrin, with orbital studies conducted at Purdue University and elsewhere.

The flights between Earth and Mars are seldom symmetric in duration and distance. So a traveler will want to plan his trip to use the short legs of the flight and sit out the long intervals on the ground at Mars, for instance. Given sufficient numbers of Cycler Orbiters, ~six and up, Missions to Mars can choose outbound and return legs of convenience.

The vehicle is essentially a roving space station: an hotel evolving into an archology. The orbiter is an accretion of goods and services which serve to maintain a significant manned presence in remote space. The orbiter features a hospital, library, genetic (seed) banks, industrial base, a court, a university, library, hotels, shopping mall with restaurants, nurseries, barracks, condominiums, fuel "dump", nuclear power plants, banks, and numerous docking facilities for private craft and mission packages. The docks make the orbiter look "fuzzy" from a distance because of the wide variety of "grunge" – miscellaneous hardware attached to the airlocks at hardpoints.

It is possible that the "permanent party" crew may be sequestered from the "transient" crew in order to avoid microbial cross-contamination of two planets, and various crews. Such quarantines may be sufficiently long that they may be standard on short legs, and relaxed on extended duration flights. It is also quite possible that advances in medical technology may render such quarantines unnecessary.

The proposed Prometheus nuclear powerplant and nuclear rocket system is expected to slash the transit times between Earth and Mars to weeks. An Orbiter so equipped can be accelerated to a near halfway point of the trip and then flipped end for end and decelerated to a planetary approach velocity. Incorporating this powerplant in the orbiters would mean that nearly constant thrust would provide a fractional-*g* gravity to the crews and the engineering and workspaces of the ship.

The Cycler Orbiter concept invokes the marketing dictum "*presence dictates presence.*" Developing deep space industry multiplies space development. Having manned capability nearby, within weeks rather than years, enhances the development non-linearly. The orbiter reflects a capability which begs for thousands of applications in extended duration manned flight. The most important of these missions is delivering personnel and materiel to Mars.

The second most important mission may be to scavenge space for earth-threatening asteroids and comets – and convert them into cycler orbiter expansion and value-added exports to Mars and Lunar encampments.

**Taking Possession**

The previous description of the class of spacecraft called Aldrin Cycler Orbiters is to set the stage for the exploitation of asteroids as a resource for a space economy. Figure 1 shows an Orbiter in transit from Earth to Mars. An inbound asteroid or comet (*at the 3 o'clock position of the diagram)* is located and tracked with the ship's high-power RADAR, confirmed by optical sightings.

When the asteroid's elliptical orbit is predicted by computer and the mission fuel budget forecast, a Transponder / Recovery probe is fuelled and launched. After the intercept is achieved the probe positions itself on the long axis of the rock body and digs itself in. The asteroid's highly elliptical solar orbit is steadily altered and circularized until a

Cycler Orbiter can match orbits or the asteroid can be "parked" in a useful holding orbit.

The usual portfolio of property management tools are available to these space resources including the exchange of properties among the orbiter fleet. One cycler, enroute from Earth to Mars, might tag a comet, only to have another, four orbits later, secure the prize – splitting the spoils between the two discrete economies.

**Summary**

Funding space enterprises will require that such projects are backed by real estate holdings. Telepossession technologies will enable the legal system to devise a system of claims, rights and title to real estate similar to those employed on Earth.

The telepossession model has many possible implementation paths. We have visited a few options which are based on the concept that a RADAR transponder is an improvement sufficient for a resource mining claim to be asserted.

The concept of an asteroid recovery vehicle is not new. Such a vehicle would attach to a comet or asteroid, alter the orbit and ultimately bring it to a favorable intercept point. In past proposals this was expected to be Earth orbit. This notion is fraught with bringing to Earth the very risk and liabilities which we seek to mitigate: loose asteroids colliding with the home planet.

Having book-ended current recovery concepts with the Transponder and Cycler Orbiter, we see that we may push the collision hazard away from Earth's proximity, all the while providing an economic and infrastructural backbone for space exploration, development and habitation.

Early on, Transponder Probes will continuously mark the location and registration of the resource of interest. Later the Aldrin Cycler Orbiters will capture and convert threatening or merely convenient asteroids and comets into value-added products and Cycler Orbiter components, as they ply the space among Earth, Mars and their Moons.

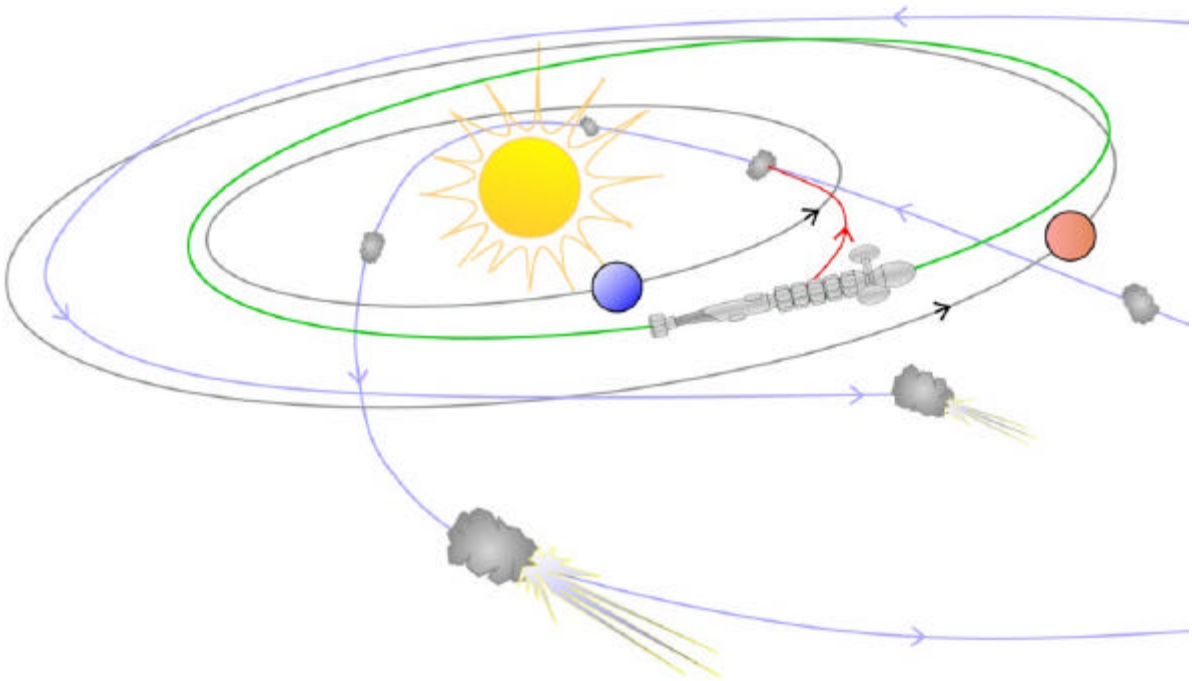

**Figure 1. Cycler Orbiters Intercept Asteroids**

*Curriculum Vitae*

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A bits and bolts technologist from 'way back, Rod designs and develops products with electronics or intelligence content for the industrial world. His oil patch, avionics, mining, systems and industrial automation customers have mass-produced his designs in oil well controllers installed on five continents, avionics flying in commercial and military fleets worldwide as well as the President's Helicopter Fleet, specialized test equipment and numerous other products. These devices are often, although not exclusively, embedded controllers operating in hazardous environments.

He holds a Bachelor's degree in Math and Computer Science, having grown up with computers since the sixties. He is a VietNam-era veteran and a sometimes-current private pilot.

[1] For further background on this topic visit Richard Westfall's SRR V paper at www.telepossession.com