

GALACTIC HARBOURS

A galactic harbour is a permanent transportation infrastructure including two space elevators that will enable a space economy

By Michael Fitzgerald | Images courtesy Lux Virtual & Galactic Harbour Inc.

A galactic harbour is a permanent transportation infrastructure that has two space elevators which consist of several major segments. A space elevator transportation system (SETS) is the core of a galactic harbour. Essentially, it is the starting point around which a new space economy is established. Through developing the infrastructure, new enterprises and missions emerge expanding the vitality of these space-based hubs and strengthening new space architectures. Those strengths include economic investment and growth matching the planet's future needs. Strategic investment in the space economy will flourish because SETS-based infrastructures are safe and reliable, and even possibly essential for humankind. Development of SETS has begun and is in the engineering validation phase. Elevator segments begin with the Earth port, somewhere along the planet's equator. The others are the elevator's tether, the tether climbers that carry the payload, the geostationary orbit (GEO) node, where payloads are loaded and unloaded and the Apex Anchor, which is the end of an elevator. To send payloads across interplanetary space there are also gates such as the "Mars Gate".

An elevator's journey begins with payloads arriving by ship from an "access city" but they will need further preparation for the ride to GEO. An Earth port has a floating operations platform (FOP) with more than a dozen clean rooms for final trip preparation. On the FOP's two upper decks, the SETS command and control centre manages the movement of cargo. For safety and security reasons, the cargo is under positive control from the time it leaves the manufacturer, as it moves through the intermodal

OPPOSITE FROM TOP

A cargo ship docks at the floating operations platform where the payloads will be processed before ascending.

A tether terminus platform is part of an Earth port and it is where the payloads, processed at the floating operations sister platform, are loaded from cargo ships into a geostationary orbit climber for the ascent.

This artist's impression shows a geostationary orbit climber climbing the elevator's tether with the tether terminus platform beneath it.

A space tug removes payloads from a climber once it has reached geostationary orbit. A tug can transfer the cargo to nearby orbital space station laboratories and factories.

transportation system (trucks and trains), to the FOP and then to climbers for the week-long trip to GEO.

From the FOP, the cargo containers are delivered to a tether terminus platform (TTP) and inserted into elevator climbers. Each day, a climber departs the TTP for the trip to GEO. The FOP could likely support more than two TTPs. At GEO, the cargo containers are removed from the climber for final delivery elsewhere in the GEO region by space tugs. That region is much larger than envisioned just a few years ago, likely reaching several hundred kilometres above and below the GEO belt. A region of that size will be home to all manner of enterprises and services drawn by space elevator access to and from Earth and most of the solar system.

The economics of space elevators as infrastructure is not new but assessments have been updated in recent years to match the vision set out above. Using relevant historical examples, such as transcontinental railroads, Panama Canal, and recent standardisation of shipping containers, SETS' economic value is remarkable just as its developmental impact will be immense. Infrastructure, at its core, provides value through the reduction of transaction costs. Trying to close a business case for infrastructure by charging high transaction costs is a chancy venture.

The business case can be closed if the view is expanded to include impacts on the economy from increased access to value and more efficient markets through lower transaction costs. With this approach SETS becomes a very lucrative, stable, and reliable investment for decades to come. SETS has the inherent economic strengths of strategic investment, ubiquitous access, and uninterrupted exchange of resources between the Earth's surface through the

GEO region toward cislunar space and Mars. Space elevators, as the transportation core, attract and logistically support future enterprises.

Space logistics transshipment activities will operate as an extension of the worldwide intermodal transportation system. The logistics transshipment chain is the customer's cargo delivery service for galactic harbours. It starts with the cargo's identification and tracking at the beginning of its journey from the customer's production facility. The chain tracks the cargo through its journey, can store the cargo until the enterprise customer requires it and will deliver it upon the customer's request. From Earth ports' access cities to the operations centre on Earth ports' floating operations platforms, the process can be seamless.

Logistics transshipment missions maintain positive control of all cargo to be delivered by climbers. This is as essential as any Amazon Fulfilment Centre is to Amazon – and to its customers. There will also be collaboration and coordination with various enterprises in the GEO region and apex anchor to deliver raw materials or finished products and to return products to Earth. The story of SETS does not stop at GEO. In some ways the story gets more remarkable the higher one goes. An apex anchor has the most unique properties provided by SETS.

APEX ANCHOR

The apex anchor flight operations centre can propel a mass at 7.76 km per second out into cislunar space, past Mars and even to the asteroid belt. Hence the name galactic harbour. The relevance of space infrastructure has been gaining interest to ensure the 'big picture' is pursued versus all its parts. Space, in general, is now fully recognised as an essential venue for economic, environmental, and diplomatic activity in the 21st century. Inside this big picture is the realisation that humanity can initiate the development of SETS today to enable continuous operations with routine space access for tomorrow.

Two International Academy of Astronautics study reports (each a four-year study), along with twelve International Space Elevator Consortium 18-month studies have lowered the risk for each SETS segment. These systems, within galactic harbours, will be able to support the lift of 170,000 t to GEO every year once fully operational. This capability will fully support the goals of a growing space economy and substantially satisfy the world's economic needs by 2050 through the envisioned logistics transshipment missions and enabling programmes such as space-based solar power constellations. The concept of mining operations on other planets and along the asteroid belt is also more reasonably achievable with galactic harbours. Many SETS can be built on asteroids and on the Moon and Mars, a network of them spanning Earth, cislunar space, Mars and its moons as well as the asteroid belt. Work can start now to build these SETS and this network of galactic harbours on Earth will enable much more activity and will foster the life-giving economy for the coming centuries. ⁵¹

