Michael A. Fitzgerald
Final

Architecture Note
#13
Published November 2017

Communications within the Space Elevator Architecture

Michael A. Fitzgerald

October 2017

Personal Prolog

This is an Architecture Note. It is the opinion of ISEC's Chief Architect. It represents an effort to document ISEC's ongoing science and engineering discussions, and is one of many to be published over time. Most importantly, it is a sincere effort to be the diary, or the chronicle, of the multitude of our technical considerations as we progress; along the pathway developing the Space Elevator.

Michael A. Fitzgerald

Communications with in the Space Elevator Architecture.

Introduction

The change year – 2017 – is coming to an end and most of us in the International Space Elevator Consortium are excited. Our vision of a Space Elevator Architecture was presented in Seattle at the 2017 ISEC Conference. What we see is magnificent; large regions in Space dedicated to operating the revolutionary space access transportation system. Businesses will flourish, satellites will be repaired and refueled, power generation systems will be assembled, and interplanetary journeys will be launched. All is wonderful. Then we are awakened; – like that guy in the car commercial who is saved from an accident by the car's new automatic braking system. Jolted back to reality, we now wonder; how can we manage all these flying space objects – safely and efficiently – spread over a few zillion cubic kilometers of the great unknown.

In fact, the answer is straight forward; we communicate with all the objects in our inventory, and keep all of them under positive control. We know where each object is, what it is doing, which way it is heading, how fast, who is nearby, what they are doing, …Wow, maybe this isn't so straight forward!!

The Galactic Harbour has three operating Regions

The three operating Regions (Earth Port, GEO Node, and the Apex Anchor) will each be doing their thing; both as part of the transportation system and as part of an Enterprise. Robust communications capabilities will be needed within each Region to execute transportation functions and to support the enterprise activities. Each Region's communications flow will be a transparent symptom and will be used as a situational awareness monitoring element. This, in the same way a doctor & nurse monitor a patient, will be an open & free flow report of the Region's life; its safety and its efficiency.

During the Architecture development process, the HQ/POC will delegate operational structuring to each region. That structuring will levy activity reporting requirements & identify and codify the content of those reports. In the same way FedEx and UPS track packages within their distribution systems; the Galactic Harbour's 3 regional communication systems will track all items within their respective regional boundaries. Further, all legitimate customers can access the display layer of the communications systems and locate specific items. The Galactic Harbour will take the Internet of Things (IOTs) to a new level. I know where my en route Amazon purchases are, as does Amazon, and as does UPS.

Transportation System Communications

Balancing act. The Space Elevator Transportation System is a balancing act; almost a juggling act. The connective nature of the system between the Tether Termini at the Earth Port and the counterweight at the Apex Anchor 100,000 kilometers up - is a unique operation. By notion, the amount of mass above center of mass must ALWAYS equal the mass below the center. We envision "reel in – reel out" (RIRO) capabilities at the Earth Port and at the APEX Anchor. Like an outer space version of a tug-of-war, the upper & lower RIRO stations will operate in a symbiotic choreography not yet defined; keeping the overall center of mass properly positioned. The persistent information exchange needed to enable that choreography has also not been defined. Further, this RIRO dance must also accommodate the up and down travel of 14 Climbers with varying payloads and the side to side movement of the Tethers to avoid collision.

Pre-Operations System Communications

From last month's Architecture Note #12, we see that the three operating regions have their own operational personality & scope. The Earth Port is an open water region more than 50 kilometers across. The GEO Node is now seen as hundreds of kilometers across, and the APEX region is even larger. Perhaps the most telling pre-operations communications consideration is that extensive amounts of test activity will be required; and conducted on orbit. Test support communications must adapt many tests and retests in several locations; perhaps at the same time.

GEO Node role was also clarified. Its role in testing and deployment is extensive and will be ongoing for years. We envision a series of parking lot orbits; with test and surveillance craft departing to, and returning from, test activities. The GEO Node region will be a busy place! The GEO Node offers services, parking, repairs, safety, and keeps an eye on all things.

The personality of the Apex Anchor is important to understand – It must work right away! From the beginning moments, the Apex Anchor deployment satellite must service the balancing of tether mass above versus below geosynchronous. Swing and miss is not permitted.

Even during activities prior to operations everything goes through the GEO Node, and then it manages all for the good of all.

In closing

Communications in the Space Elevator is quite an undertaking. It has me talking to myself.

Fitzer