Today's Space Elevator

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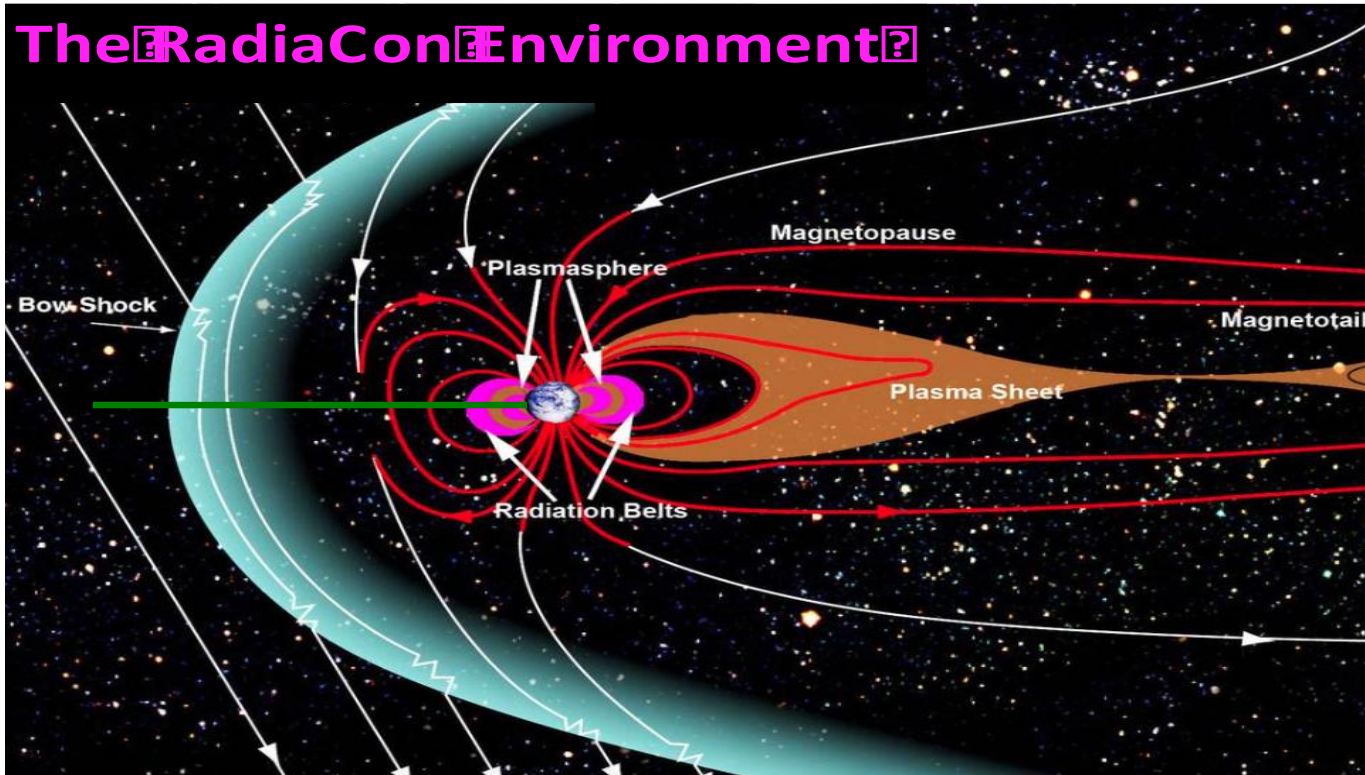


Earth Radius
6,378 Km

Space Elevator
100,000 km
In green

Breakout Year - 2019

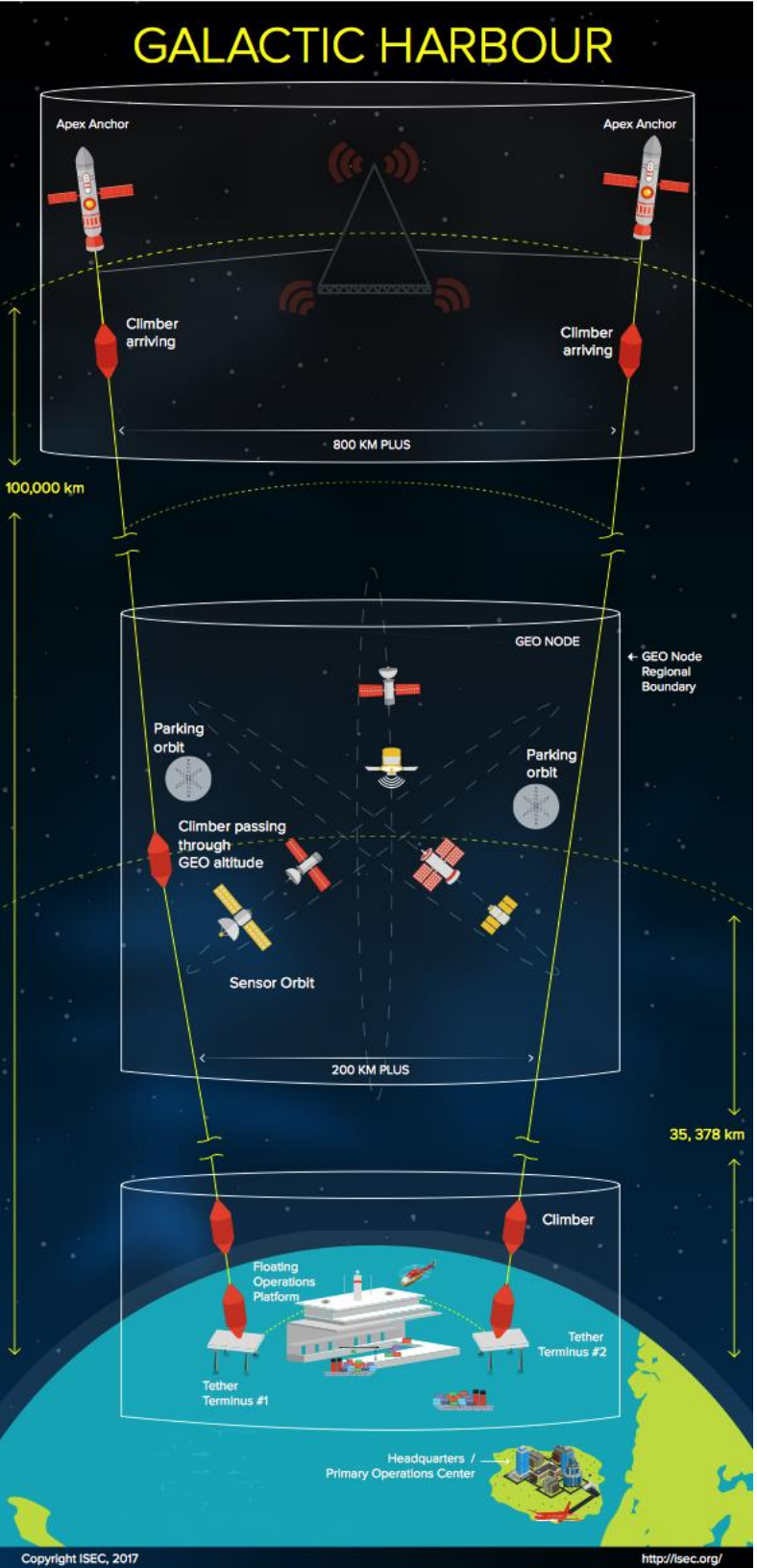
- From Space Elevator to Galactic Harbour
- From wishing for a material for the tether to having one successfully tested
- From an immature plan to a preliminarily positive assessment of each system segment technology
  From silent discussions in small groups to advocacy across the world.

The story here is still being written. The Apex is where the Galactic Harbour meets the Shoreline of Outer Space;
Where the "Transportation Story of the 21st Century" meets the "Final Frontier."

Breakout Year 2020

- NASA Contracts and Expectations
  - Invitations to International partners for Lunar activities
  - Vision includes International Moon (2028) & Mars (36)
- Commercial Successes
  - Blue Origin and Virgin Galactic to space with humans (summer 2020)
  - SpaceX & Boeing to ISS soonest
  - Commercial contracts delivery to Moon (Masten) and Lunar Gateway (SpaceX)

Humanity is moving off-planet in a big way.



Today's Agenda

Introduction

Where is the Galactic Harbour Today?

Tether Material

Engineering Development

Interplanetary Mission Support

Conclusions

Galactic Harbours will Unify Transportation and Enterprise Throughout the Regions.

Exciting Future with Immense Needs

Traditional Geosynchronous Orbit Missions: Traditional Satellites as weather, communications, and governmental missions will be enhanced as access becomes easier and cheaper. There are over 400 active GEO satellites as of October 2018. When the cost and simplicity of operations goes way down, this number will escalate.

Revolutionary Geosynchronous Orbit Missions: New Missions will be supported such as refueling and repair of ailing satellites, construction of new systems, and new enterprises not even thought of during the first three decades of this century. This will be a huge growth area when people realize the opportunities.

Lunar and Interplanetary Missions: Two reference missions (Moon Village and Mars Colony under design); robotic missions to anywhere in our solar system; human exploration missions to Moon and Mars and beyond; human missions to L-5 type colonies; and robotic missions beyond solar system - on to the stars will be discussed.

IAA Study Result, 2014

Demand in Metric Tons	2031	2035	2040	2045
Space Solar Power	40,000	70,000	100,000	130,000
Nuclear Materials Disposal	12,000	18,000	24,000	30,000
Asteroid Mining	1,000	2,000	3,000	5,000
Interplanetary Flights	100	200	300	350
Innovative Missions to GEO	347	365	389	400
Colonization of Solar System	50	200	1,000	5,000
Marketing & Advertising	15	30	50	100
Sun Shades at L-1	5,000	10,000	5,000	3,000
Current GEO satellites + LEOs	347	365	389	400
Total Metric Tons per Year	58,859	101,160	134,128	174,250

Table 13-V. Projected Demand [MT/yr]

Old Numbers – 2013 without Artemis & SpaceX

Three Chosen Missions

- Space Solar Power – 5,000,000 MT – "Space solar power can solve our energy and greenhouse gas emissions problems. Not just help, not just take a step in the right direction, but *solve*."*
- SpaceX Colony – 1,000,000 MT** – Mr. Musk has stated that he needs that amount of mission support on Mars.
- Moon Village – 500,000 MT - European "togetherness" towards a Moon Village suggests a massive support effort required.

***The Case for Space Solar Power by John C. Mankins**

**** July 21, 2019 Quotation on Sunday Morning TV.**

New Results Enabling Interplanetary Missions

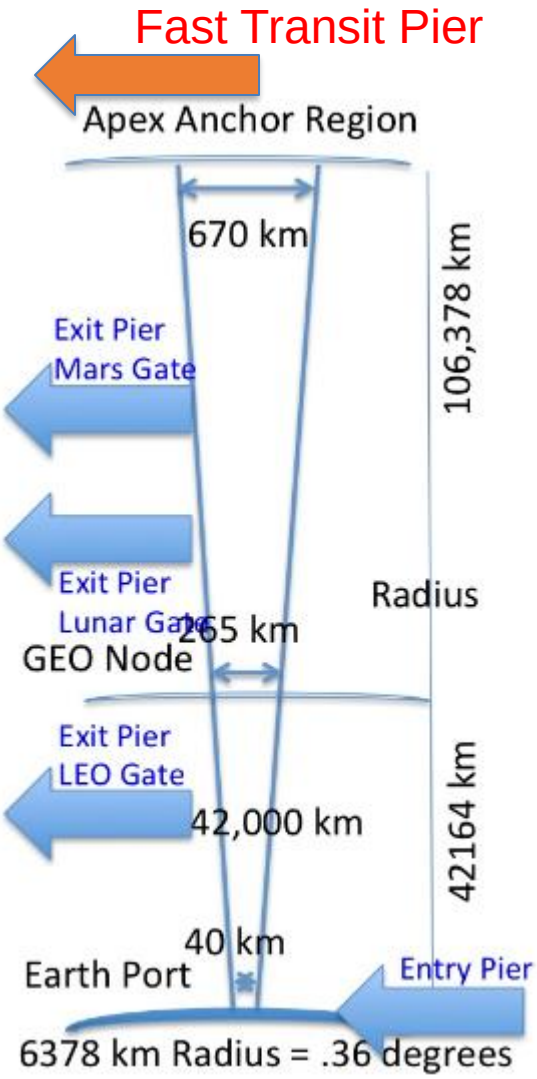
Galactic Harbours can significantly enable Interplanetary Mission Suport when incorporated into Humanity's movement off planet. This infrastructure activity leverages three strengths not previously discussed;

- Fast Transit to destination (Mars as short as 61 days). Arizona State University (ASU) research into release from an Apex Anchor (with the concept of a Lambert Problem solution) shows remarkable transit times periodically during the 26 month orbital relationship between Earth and Mars.
- Massive liftoff capability (14 metric tons of payload per day to start). Space Elevators start out with huge throughput capacity with daily liftoffs (5,110 MT per year per SE). In addition, there will be remarkable growth as the tether material and infrastructures mature. The Initial Operational Capability starts at 14 MT of payload per day with the Full Operational Capability reaching 79 MTs.
- Daily departures available (no waiting for 26 month Mars Launch Windows). The ability to launch every day towards Mars is a revolutionary concept vs. the traditional wait period of 26 months. Transit times for cargo can vary over the repeating planetary dance; but, they can be started towards Mars each day -- simplifying the mission support concept.

Supporting Results from Arizona State University Research 2019-20

Vision of the Galactic Harbour Piers

- *Space Elevator Transportation System serves as the 'main channel' in the Galactic Harbour.*
- *Businesses access the main channel from the Earth Port, the GEO Node, and the APEX Region.*
- *Businesses flourish as part of the Space Elevator Enterprise System*

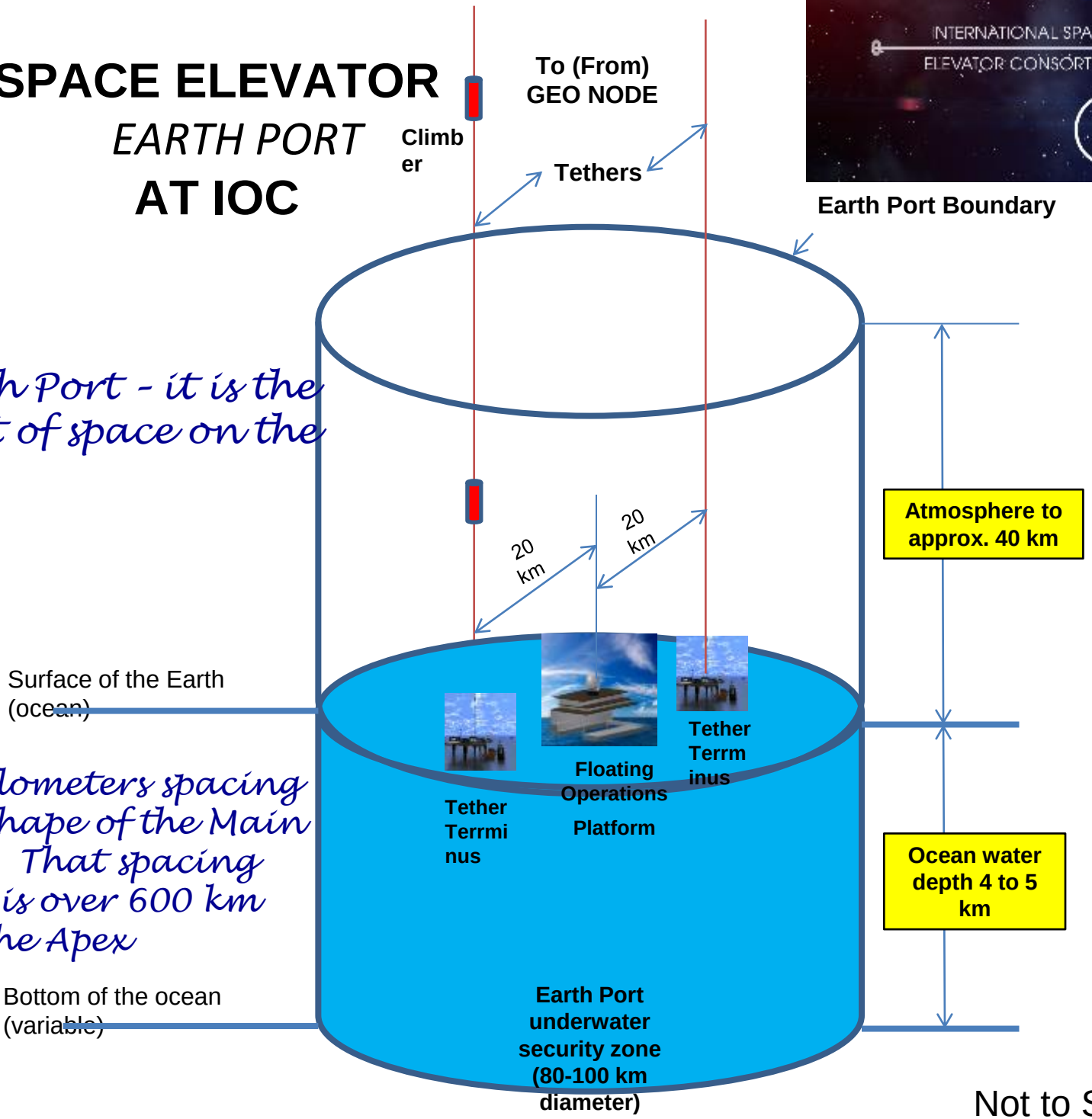


Galactic Harbour The Unifying Vision

SPACE ELEVATOR
EARTH PORT
AT IOC

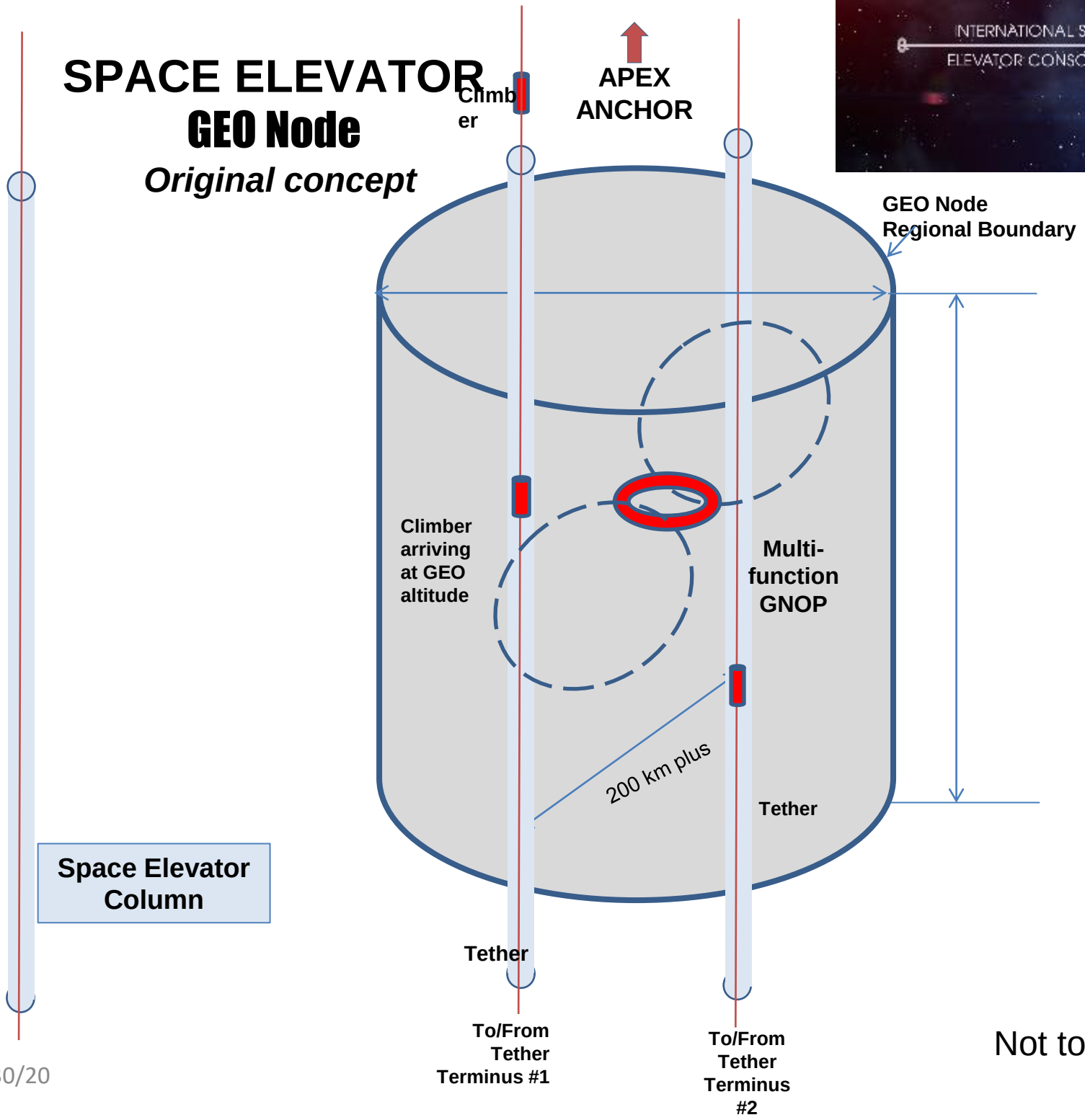
The Earth Port – it is the footprint of space on the Earth

The 40 kilometers spacing sets the shape of the Main Channel. That spacing becomes is over 600 km wide at the Apex



Not to Scale

SPACE ELEVATOR
GEO Node
Original concept

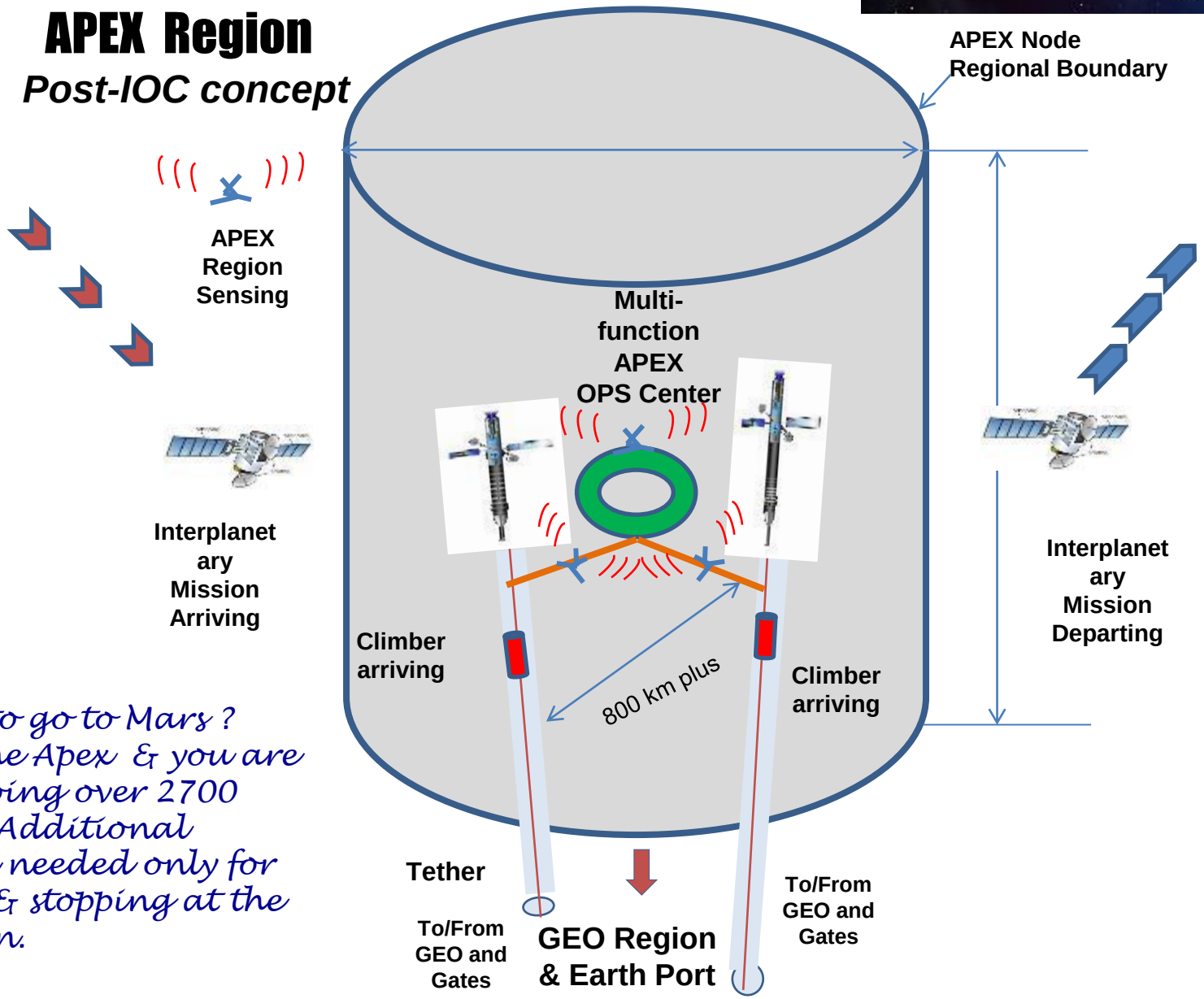


Not to Scale

SPACE ELEVATOR

APEX Region

Post-IOC concept



You want to go to Mars ? Jump off the Apex & you are already going over 2700 km/hour. Additional propulsion needed only for guidance & stopping at the destination.

Galactic Harbour Basics

1. Space Elevator Transportation System is the 'main channel' in the Galactic Harbour.

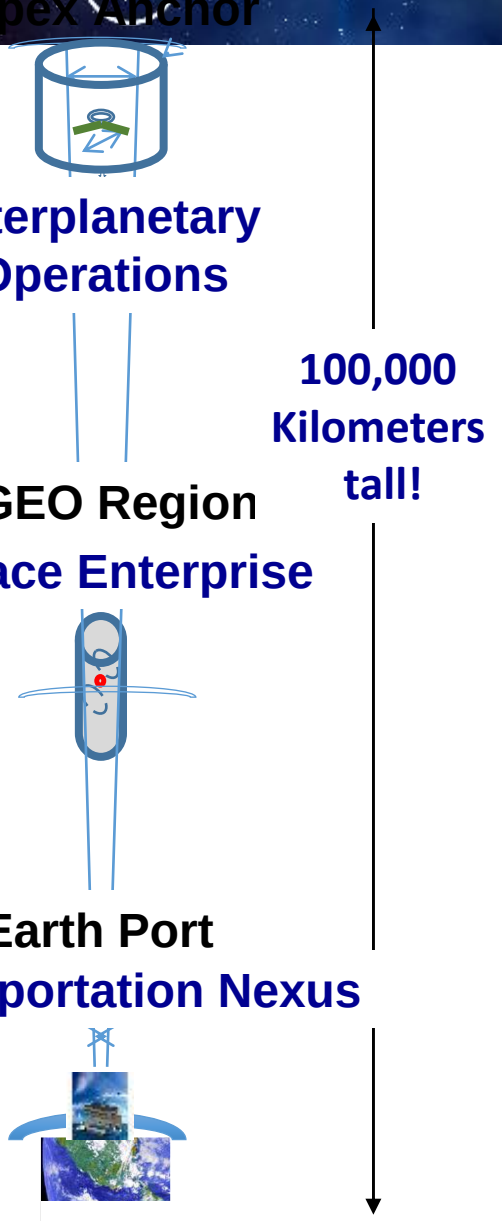
- *Apex Region*
- *GEO Region*
- *Earth Port*
- *HQ/POC*
- *14 Climbers*
- *2 Tethers*

2. Businesses flourish within the Harbour as the Space Elevator Enterprise System

- *Business support to Operational Satellites*
- *Interplanetary Efforts within reach*
- *Power and Products delivered to Earth*
- *Research*

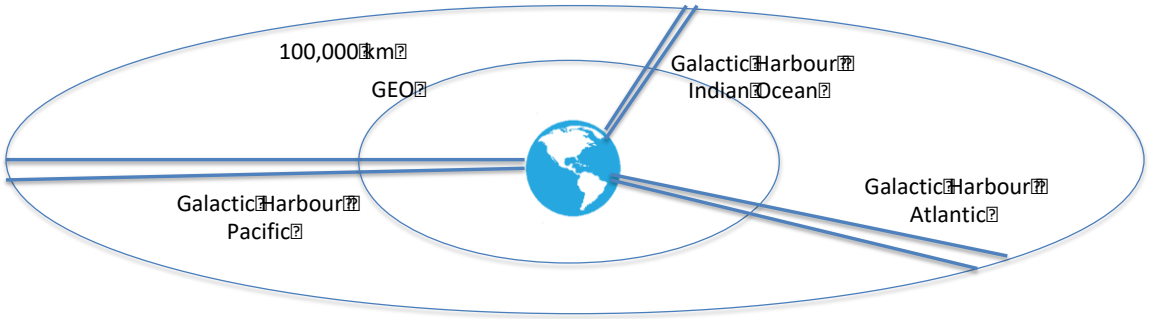
Galactic Harbour Architecture

This is the transportation story of the 21st century. Reliable, safe, & efficient access to space; close at hand.



Galactic Harbour - The Unifying Vision - is the combination of the Space Elevator Transportation System & the Space Elevator Enterprise System

Vision of Galactic Harbours



Three Galactic Harbours with two SEs each

– 7 Climbers per week per SE

– 14 Metric Tons each – 30,660 MT/yr

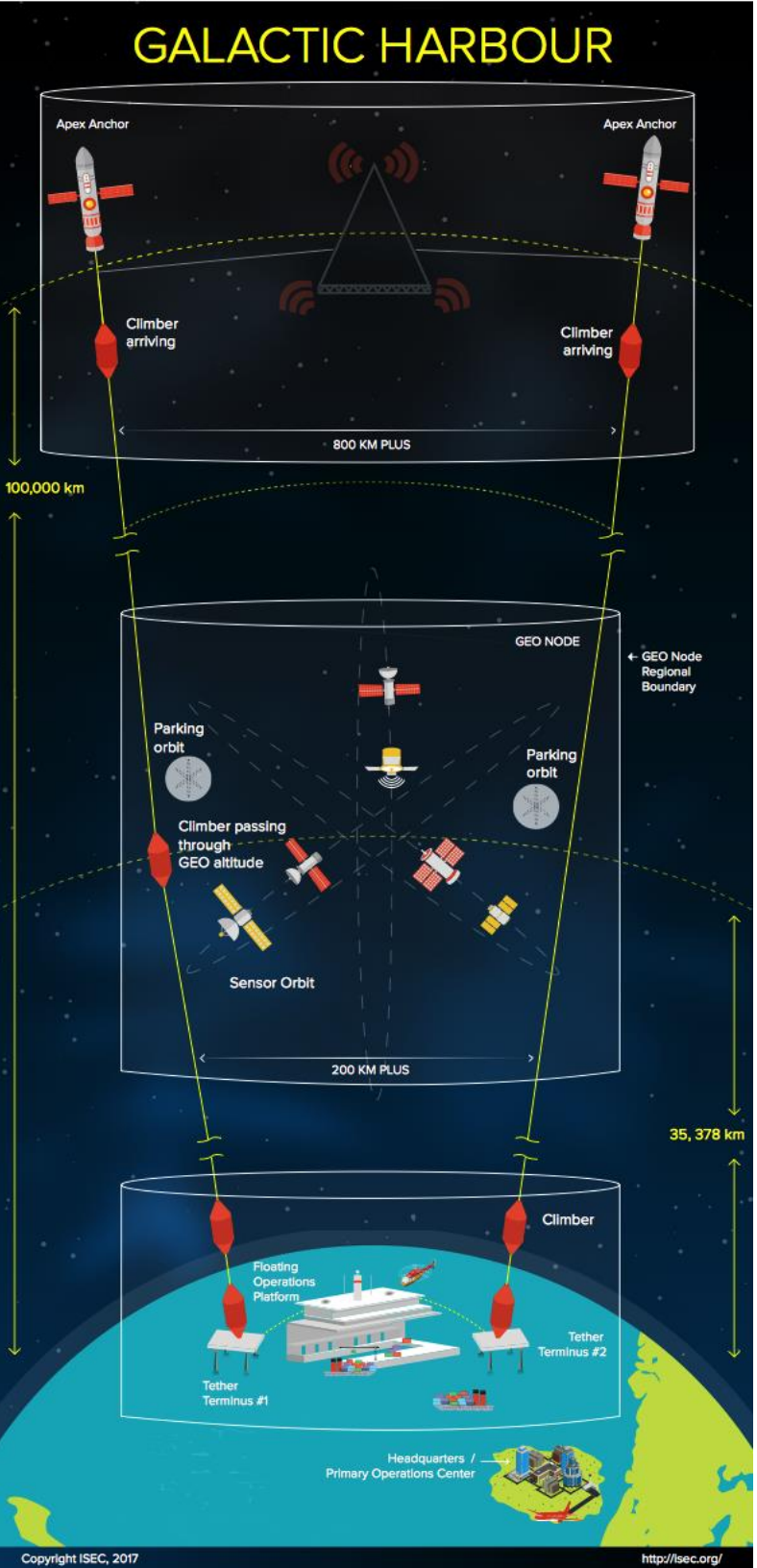
- growing to 79 MT each SE – 173,010 MT/yr

Strengths 1 – Enables Liftoffs

- Routine [daily launches]
- Permanent infrastructure (no throw-a-ways)
  - Multiple paths when infrastructure matures
  - 24/7/365/50 yrs. [bridge similarities]
  - Massive loads multi-times per week [7 tether climbers per elevator]
  - Cargo segments of 14 metric tons each
  - Little impact upon the global environment
  - Does not leave space debris in orbit
  - Safe [no chemical explosions from propulsion]
- Revolutionarily inexpensive to GEO
  - Commercial development similar to bridge building
  - Financial numbers that are infrastructure enabling
  - No consumption of fuel [solar cells will drive the motors for lift]
- Design flexibility for Cargo
  - Opening up design options for space systems
  - No shake-rattle-roll during launch
  - Fewer volumetric restrictions for launch
  - Minimum stressors with slow accelerations
- Environmentally Friendly
  - No burning exhaust with residual hazardous materials into atmosphere
  - No disruption of the ozone layer in the upper atmosphere
  - Improves Earth's environment by accomplishing missions not seen before such as dispersing nuclear waste, sun shades, and moving hazardous operations off-Earth

Strengths 2 – Enables New Missions

- Massive movements to GEO
  - Construction of Large Satellites
  - Recovery and repair of satellites
  - Co-orbiting [floating] at GEO for easy delivery and assembly.
  - Easy delivery to GEO location within a week
- Revolutionary Approach to Interplanetary Destinations - both robotic and human colonization (which require massive support)
  - Massive movement of cargo towards the Moon, Mars and other Solar System Destinations (asteroids, comets, L-5 location, other Moons, planets, etc.)
  - Rapid movement to these locations (low as 61 days to Mars – release Apex Anchor)
  - Daily release towards interplanetary missions from Apex Anchor
- New Mission Enabling - Space Elevators can do these in a timely manner!
  - Space Solar Power needs massive (5,000,000 metric tons) to GEO
  - Interplanetary Mission Support (1,000,000 metric tons) to SpaceX's Colony
  - Moon Village requires massive support with timely delivery required
  - Release of Nuclear waste to disposal orbits towards the sun - routinely/safe/inexpensive releases from Apex Anchor



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Case for Space Elevators

Point One: Space Elevator Transportation Infrastructure - if you ship 100 tons of mission support equipment from the Earth Port; 100 tons show up in proper orbit. No rocket equation eating up launch pad mass.

Point Two: Interplanetary Mission Support - Departs daily from Apex to Mars (no 26-months wait between launch windows) with rapid transit (61 days best time) plus other solar-system destinations.

Point Three: Inexpensive, routine, and environmentally friendly daily departures from the Galactic Harbour's Earth Port.

Point Four: Single Crystal Graphene shows remarkable potential as tether material, half meter single molecule already made in the lab in 2D form.

The Space Elevator will be the transportation story of the 21st Century!

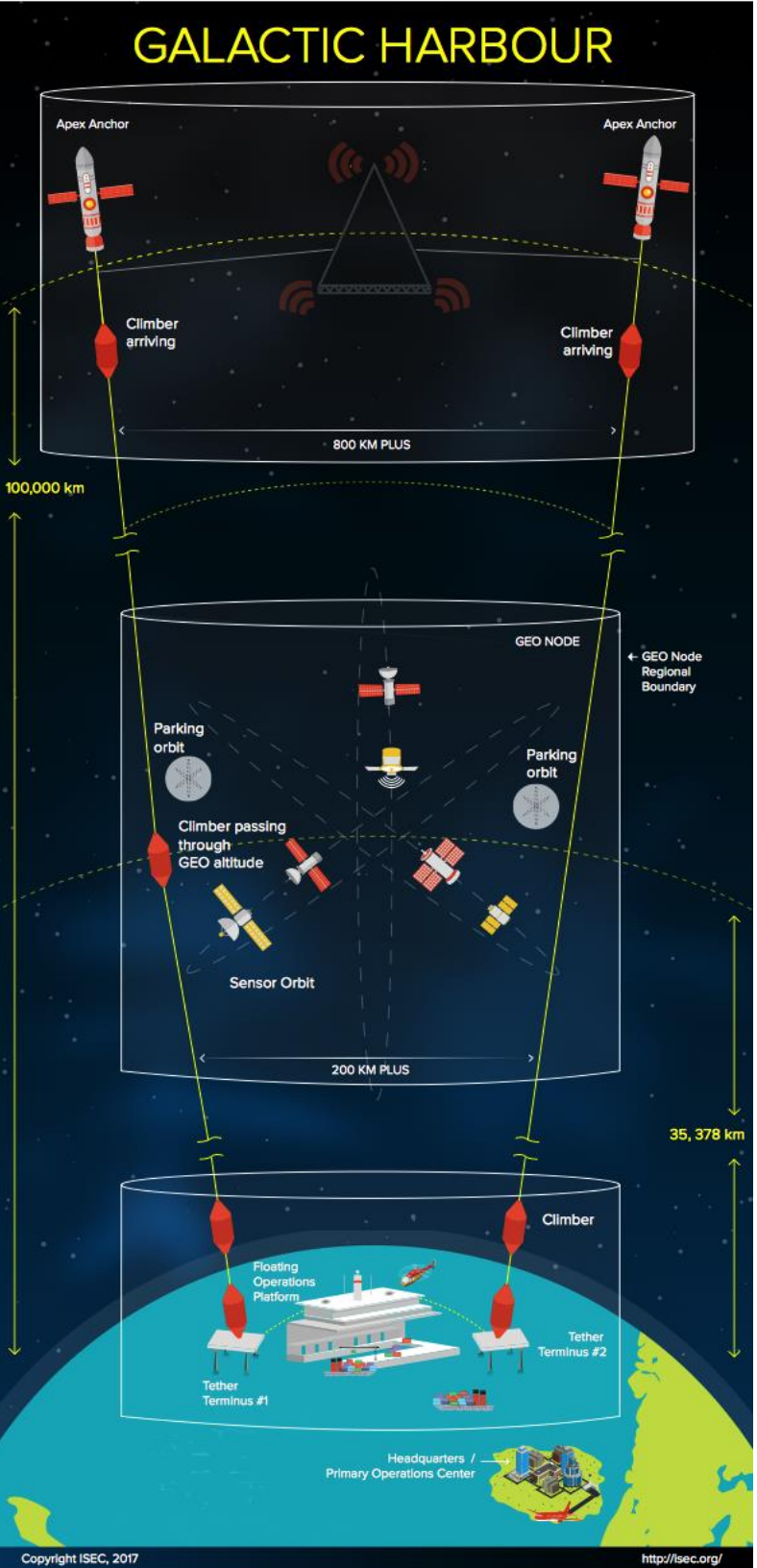
Major ISEC Studies

Year	*Title*
in work	Beneficial Environmental Impacts of the Space Elevator
in work	Galactic Harbour Interplanetary Mission Support
2020	Today's Space Elevator Assured Survivability Approach Space Debris
2019	Today's Space Elevator, Status as of Fall 2019
2018	Design Considerations for a Multi-Stage Space Elevator
2017	Design Considerations for a Software Space Elevator Simulator
2016	Design Considerations for Space Elevator Apex Anchor and GEO Node
2015	Design Considerations for Space Elevator Earth Port
2014	Space Elevator Architectures and Roadmaps
2013	Design Considerations for Space Elevator Tether Climbers
2012	Space Elevator Concept of Operations
2010	Space Elevator Survivability, Space Debris Mitigation

Free pdf download at www.isec.org or purchase at www.lulu.com

Parallel Studies

Year	*Title*
2019	The Road to the Space Elevator Era
2014	Space Elevators: An Assessment of the Technological Feasibility and the Way Forward
IAA	International Academy of Astronautics - sponsor of study www.iaaweb.org - Virginia Edition Publishing Company, Heinlein Prize Trust https://www.heinleinbooks.com/book-store
2013	The Obayashi Corporation conducted a major study on space elevator design with published results. Dr. Ishikawa,



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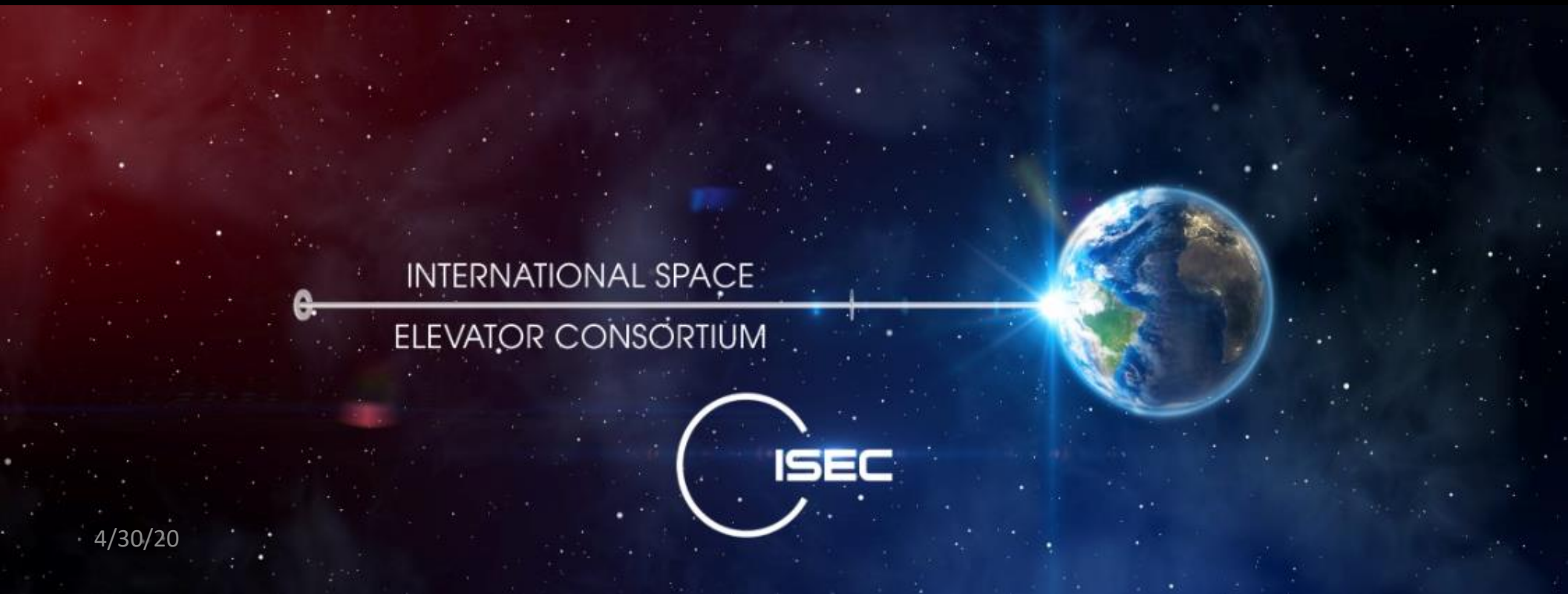
The last piece of the puzzle?

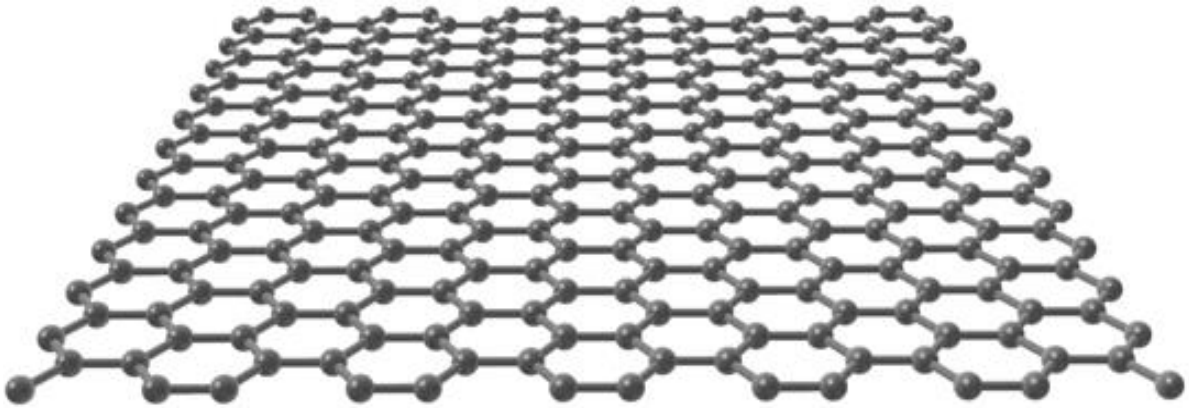
Graphene

Adrian Nixon

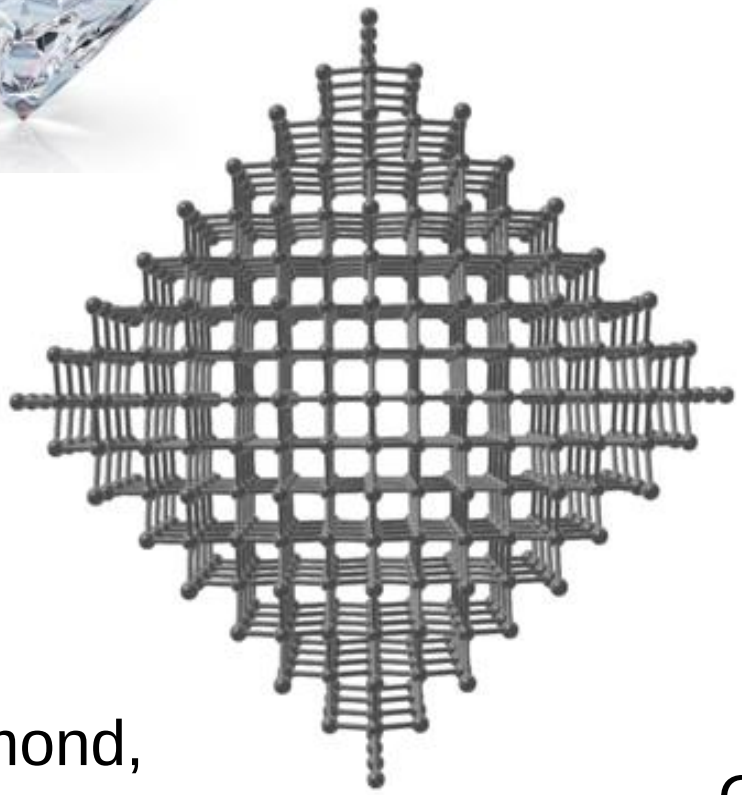
15th June 2019



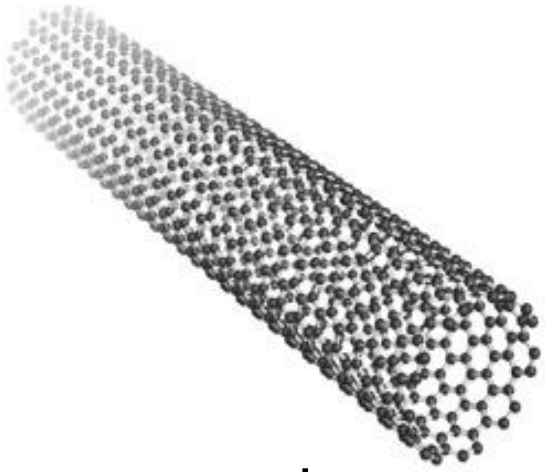
The carbon family



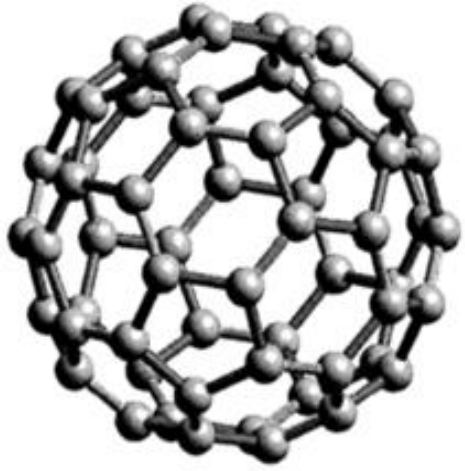
Graphene:
2D material



Diamond,
Amorphous Carbon:
3D material



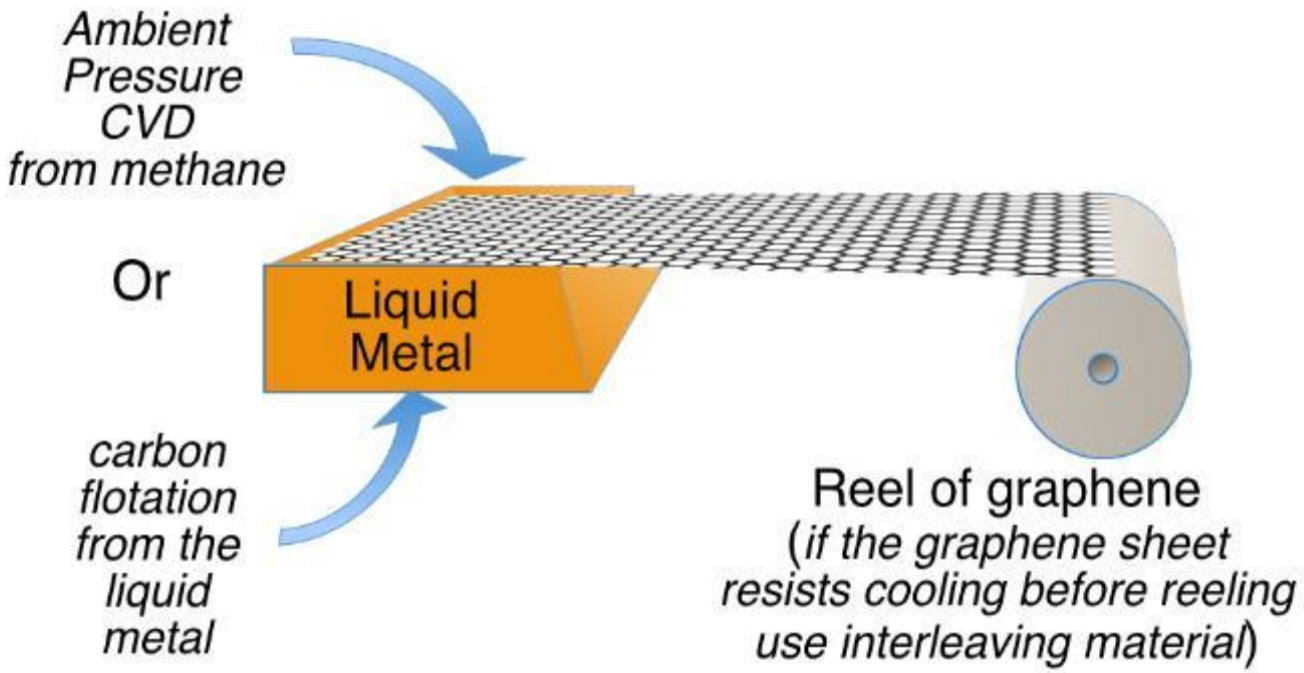
Carbon nanotubes:
1D material



Fullerenes:
0D material

Graphene: A new continuous process

Principles for making continuous single crystal sheet graphene



I published the hypothesis to test it amongst the world's top graphene scientists. (While retaining key intellectual property)

This hypothesis has not been invalidated to date.

https://investorintel.com/market-analysis/making-graphene-2d-materials-liquid-

Tether candidate materials

YES: Graphene is strong enough to be a candidate tether material

Ashby Plot - Tensile Strength vs Density

Aramid (4 GPa) Plausible (20 GPa) Best Case (50 GPa)

Tensile Strength (GPa)

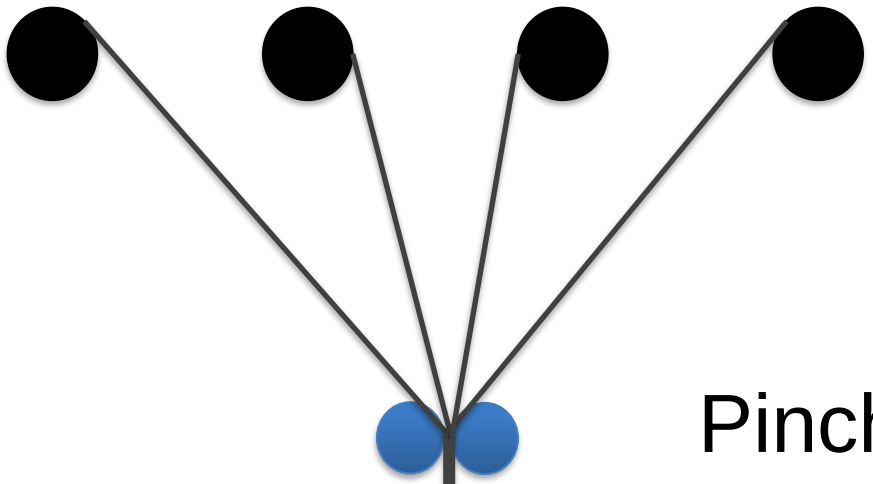
1000
100
10
1
0.1

GRAPHENE
CNT Thread
Composites
Glass
Ceramic
Metal & Alloy
Polymer
Porous Ceramic
Rubber
Wood and Wood Products

0.1 1 10

Density (g/cm³)

Combine the tether layers in orbit…



Single crystal graphene roll cassettes

Pinch rolls forming Multilayer graphene (Graphitic) tether ‘Nixene’

Is a tether feasible made from single crystal graphene?

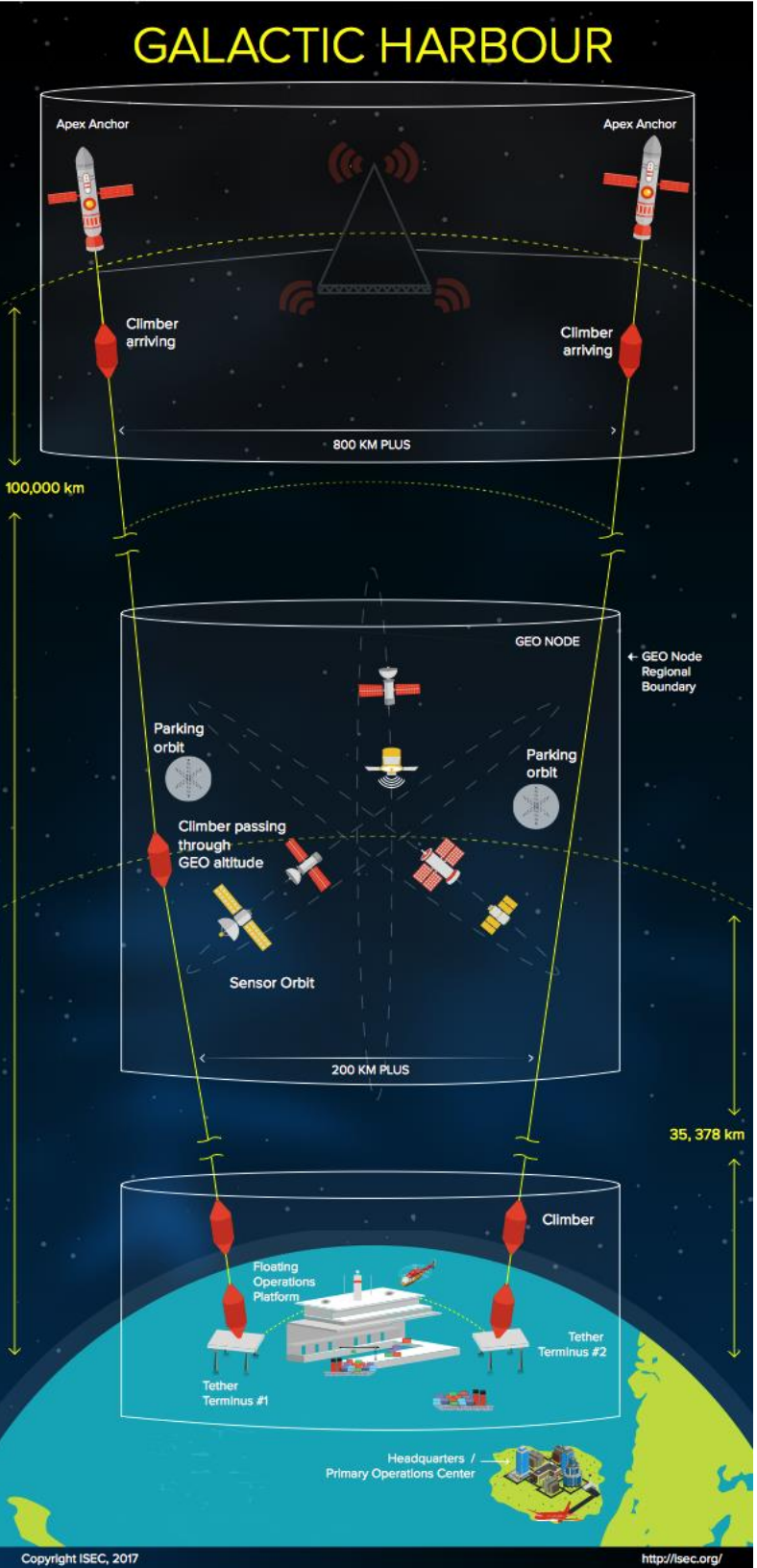
Current commercial nanoplate graphene cannot be used to make a tether.

However, 500mm of single crystal graphene has been made 13 years after graphene first isolated.

Layered single crystal graphene is yet to be made but we know how to do this and the material is already being called Nixene

YES

Graphene tether material really is possible within our lifetimes.



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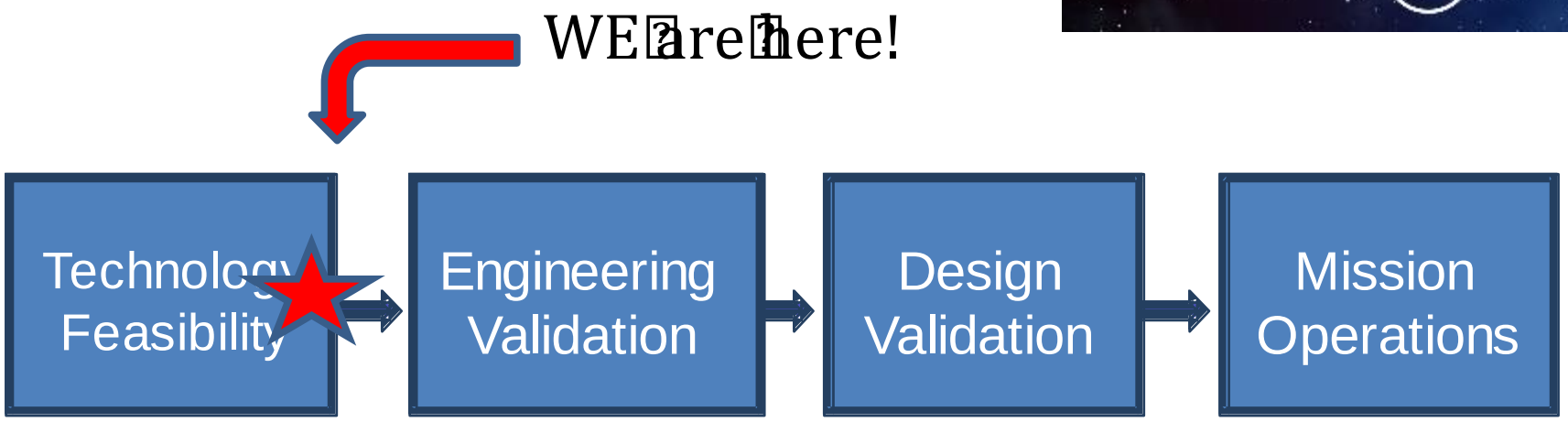
Engineering Development



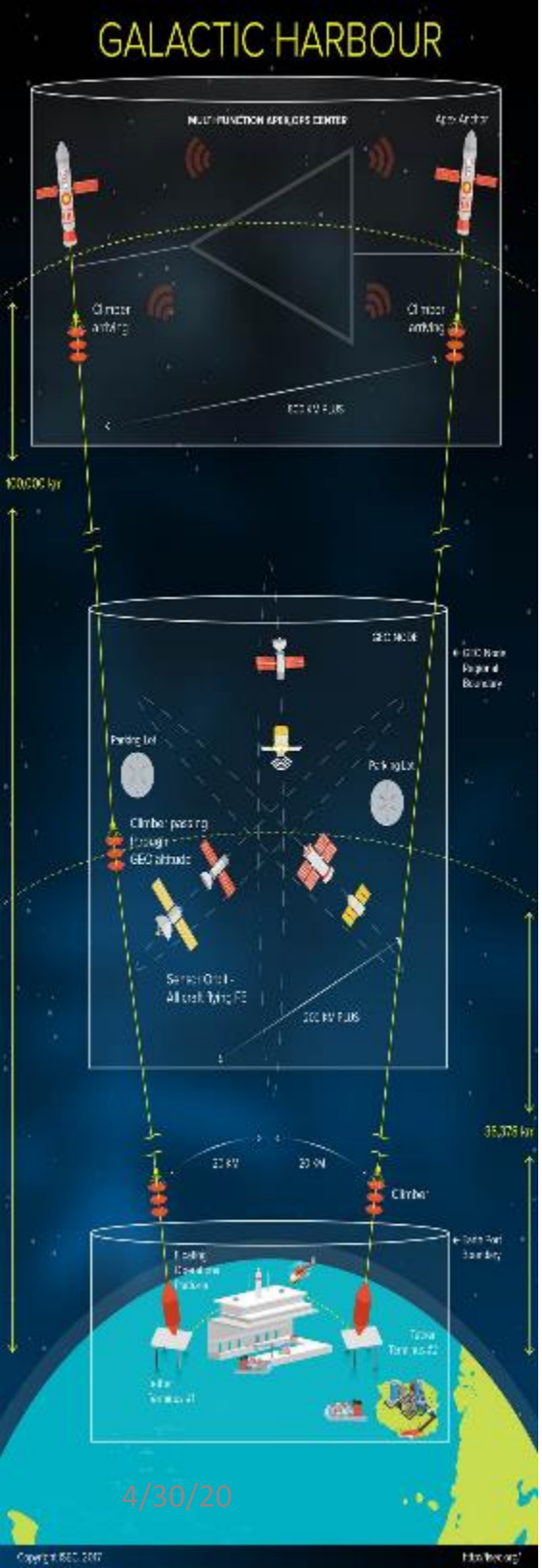
- The technology development approach is to build around a set of well-defined demonstrations, inspections, tests and simulations to move the concept forward.
- The engineering teams around the Space Elevator development believe that we are very close to exiting the technology feasibility phase. This will require quite a bit of testing at the sub-system and system level for each of the major segments of the Space Elevator.
- This complexity is normal for all mega-project developments and is well understood.
- The rationale for exiting the first phase boils down to the readiness assessments as described for the phase one exit criteria, different for each mega-project.

IAA Study Summary
(as of Fall 2019)

- The Galactic Harbour Earth Port ➔ ready for an engineering validation program
- Space Elevator Headquarters / Primary Operations Center ➔ ready to start an engineering validation program
- Tether Climber ➔ Engineering model assemblies needed -- then start an engineering validation program
- GEO Node ➔Engineering discussions and demonstrations with key members of industry are needed along with collaboration / outreach with certain government offices.
- Apex Anchor ➔ Engineering discussions and various simulations are needed. Near term collaboration with engineering organizations and academia should begin follow-on outreach to key members of industry and government. Engineering validation follows.
- Tether material ➔ Prime material candidate is identified; and, production demonstrations are needed.
- Assured Survivability➔ Architectural engineering definition is being finalized. Candidate concepts are identified. On orbit performance demonstrations are needed.

Next Steps

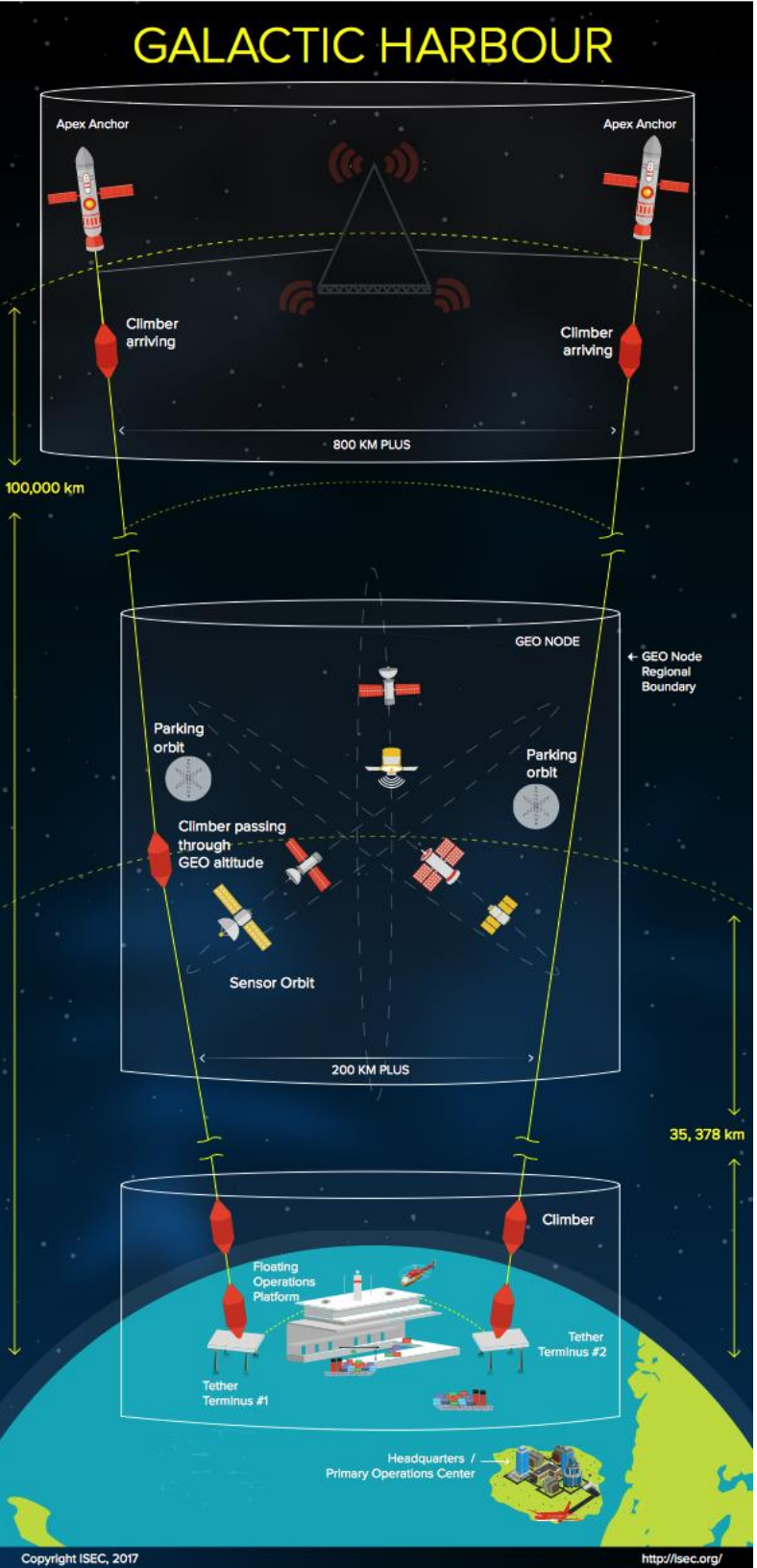
- The Space Elevator Community needs to be included in the discussions around access to space.
- The creation of a Space Elevator Institute will help the community address, and orchestrate responses to, critical questions, issues, and topics. This Institute would research major questions and ensure they are investigated leading to discussions within the larger space community, not just the Space Elevator community. There are two major thrusts that can be leveraged to start an institute:
  - Transportation Baseline Studies
  - Investigations into Chosen Topics



Status as of Spring 2020

- The Materials are Ready for development
- We are ready to move into the second engineering development phase
- We are ready to join the discussions
- We need a Space Elevator Institute

Reliable, daily, routine, safe and environmentally friendly movement off-planet towards the Moon Mars and asteroids.



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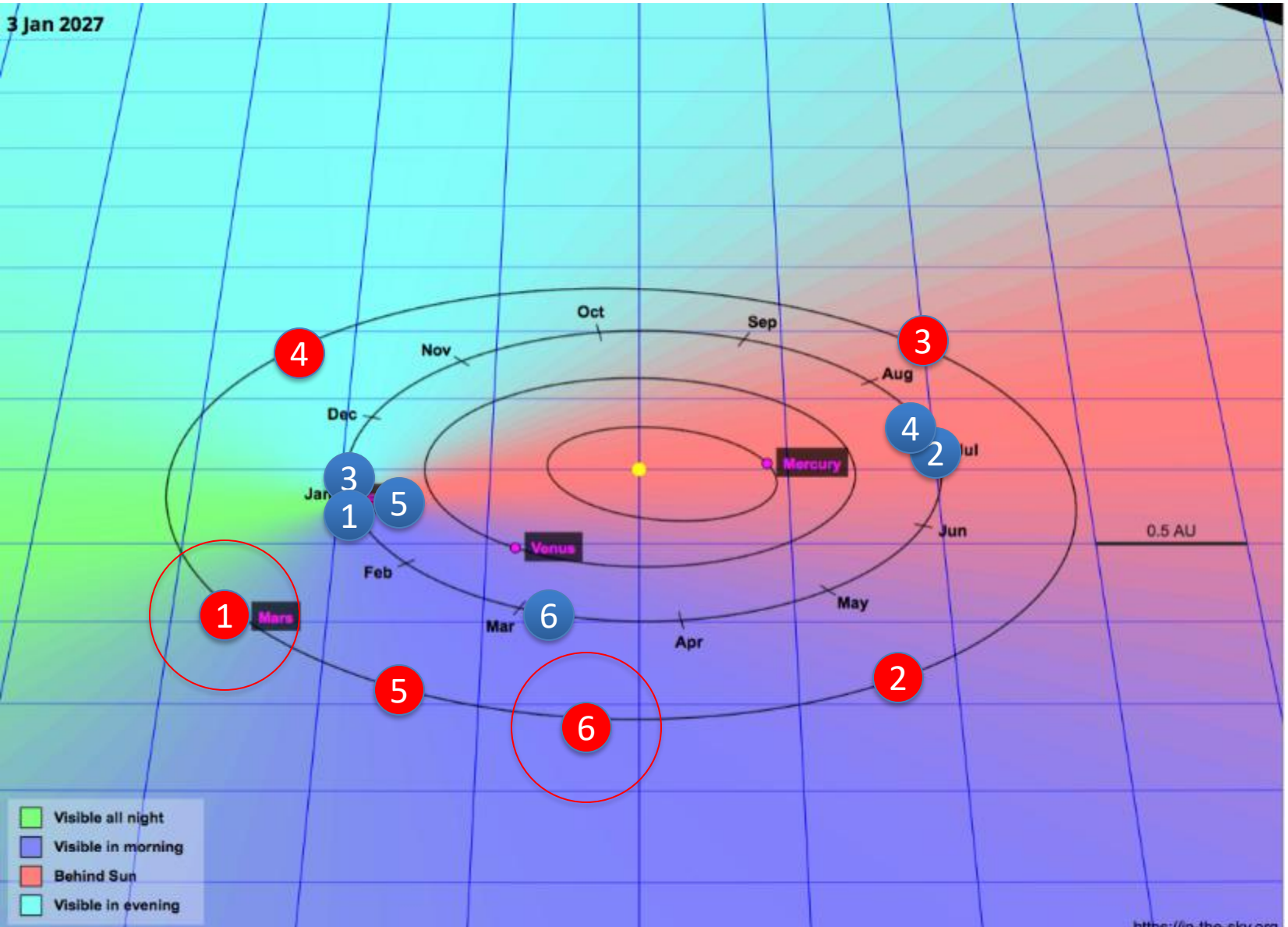
Results from Arizona State University support conclusions from the Interplanetary Mission Support team

NASA Window to Mars Every 26 Months



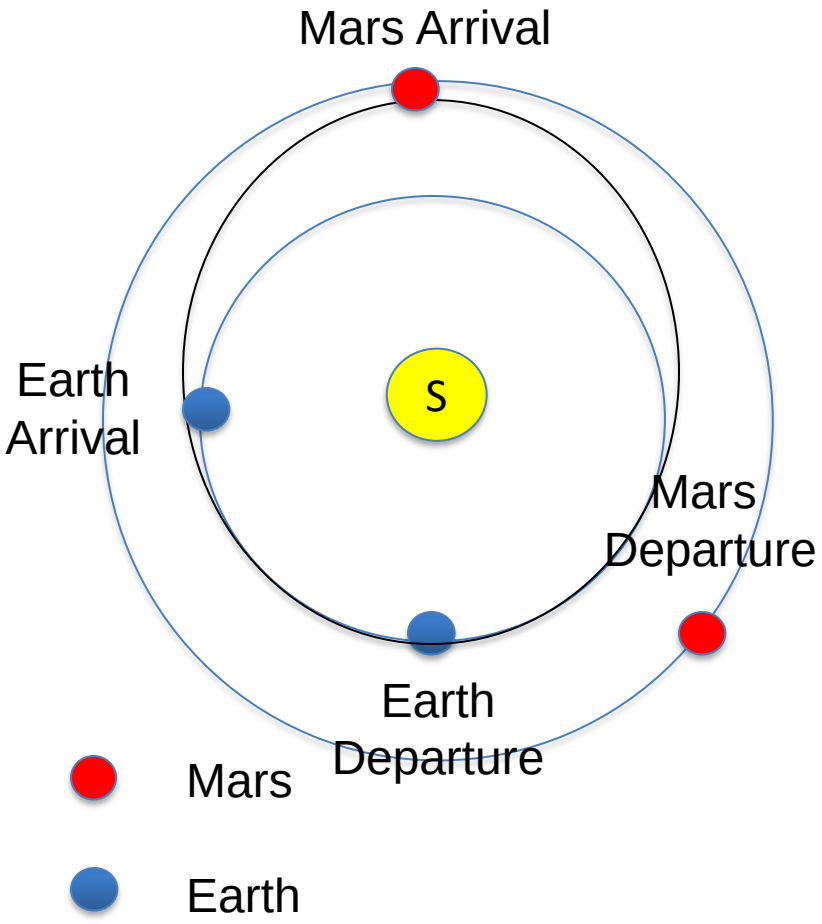
Mars

Earth

1--3 Jan 2027
2--3 July 2027
3--3 Jan 2028
4--3 July 2028
5 --3 Jan 2029
6 --3 Mar 2029

Motion counter clockwise

Traditional Hohmann Transfer



Numbers for Calculations			
Sun to Earth	De	149,597,870	km
Sun to Mars	Dm	227,940,000	km
Radius of Earth	Re	6,378	km
Radius of Mars	Rm	3,397	km
Earth velocity around Sun	Ve	29.785	km/sec
Mars velocity around Sun	Vm	24.13	km/sec
Hohmann Transfer vel at Earth's Sphere of Influence	Vht	2.945	km/sec
Apex Anchor vel at Earth's Sphere of Influence	Vaa	7.76	km/sec

*values from Space Mission Engineering," SMAD 4 pg282 table

Traditional Approach to Mars: Minimum energy Hohmann Transfer from ellipse perigee (Earth's orbit) to apogee (Mars orbit). Characteristics: time consuming (7 to 9 months), restriction of launch window only every 26 months, and historically, small payloads. The departure velocity is historically 2.5 km/sec added to Earth's velocity around the sun. Can go faster with shorter transit, but requires great fuel consumption.

Basic Needs for Interplanetary Flights

- Massive Movement of Support Equipment, Food, and Fuel for robotic and human expansion.
- Rapid Transits – Minimum of 61 days to Mars
- Every Day lift-offs (no 26 month wait)

One Million Tons to Mars to Support my Colony!

Elon Musk, 21 July 2019, CBS Sunday Morning Interview

Reference Missions

- To Compare future loads with today's loads, three Reference Missions are identified:
  - GEO: Space Solar Power
  - Lunar: Moon Village
  - Mars: SpaceX's Colony
- Reference Missions must have support far exceeding current capabilities.
- Concept: Cooperative Infrastructures working together: Future Rocket Portals and Glactic Harbour Infrastructures

Three Chosen Missions

- *Space Solar Power – 5,000,000 MT* – "Space solar power can solve our energy and greenhouse gas emissions problems. Not just help, not just take a step in the right direction, but *solve*."*
- Moon Village – 500,000 MT - European "togetherness" towards a Moon Village suggests a massive support effort required.
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***The Case for Space Solar Power by John C. Mankins**

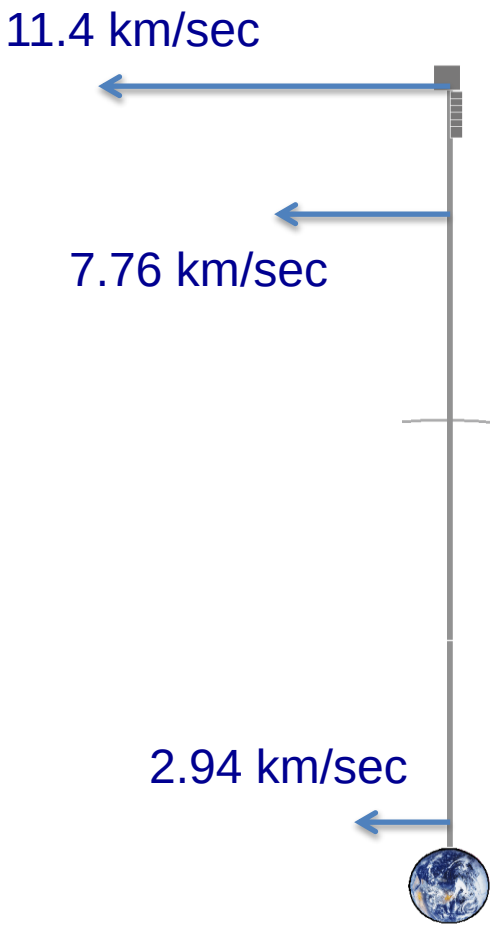
**** July 21, 2019 Quotation on Sunday Morning TV.**

New Concept

New Paradigm for Supporting Interplanetary Flights and Destinations

- Fast Transit -- as low as 61 days to Mars
- Everyday "releases" – No 26 month wait
- Massive support -- support colonies and missions with 84 MT per day (14 x 6) for 365 days or 30,576 MT per year with growth to over 170,000 MT per year (full operational capability)

Velocity at Sphere of Influence



Three Release Locations

Traditional Hohmann Transfer (LEO)
Traditional Apex Anchor (100,000 km)
Optional Apex Anchor (150,000 km)

	Alititude (Km)	*Radius (Km)*	*Velocity (km/sec)*
Earth's surface	0	6378	0.465594
Geosynchronous	35,786	42,164	3.077972
Mars Gate	57,000	63,378	4.626594
Apex Anchor	100000	106,378	7.765594
Option Apex Anchor	150000	156378	11.415594

Every Day an Opportunity for Release

Rapid Transfer From Apex Anchor

31.90 km/sec

30.78 km/s

E

Velocity entering ellipse

Vector Addition = 31.90 km/sec

150000km release

Ve 29.785 km/s

Vsoi 7.755 km/sec

Ve 29.785 km/s

30.78 km/s

100,000 km release

Vaa 150

11.41 km/sec

Vaa

7.75 km/sec

E

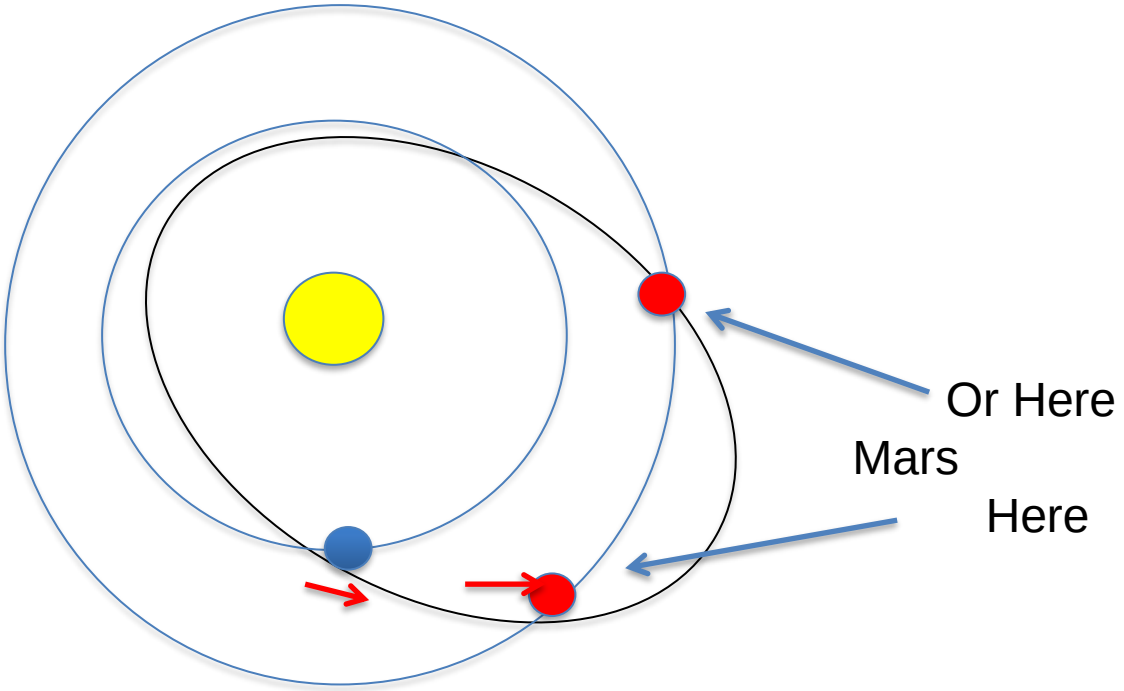
Ve 29.785 km/s

100K

150 k

Sun

Case One: Fastest Approach
Earth to Mars: 61 days

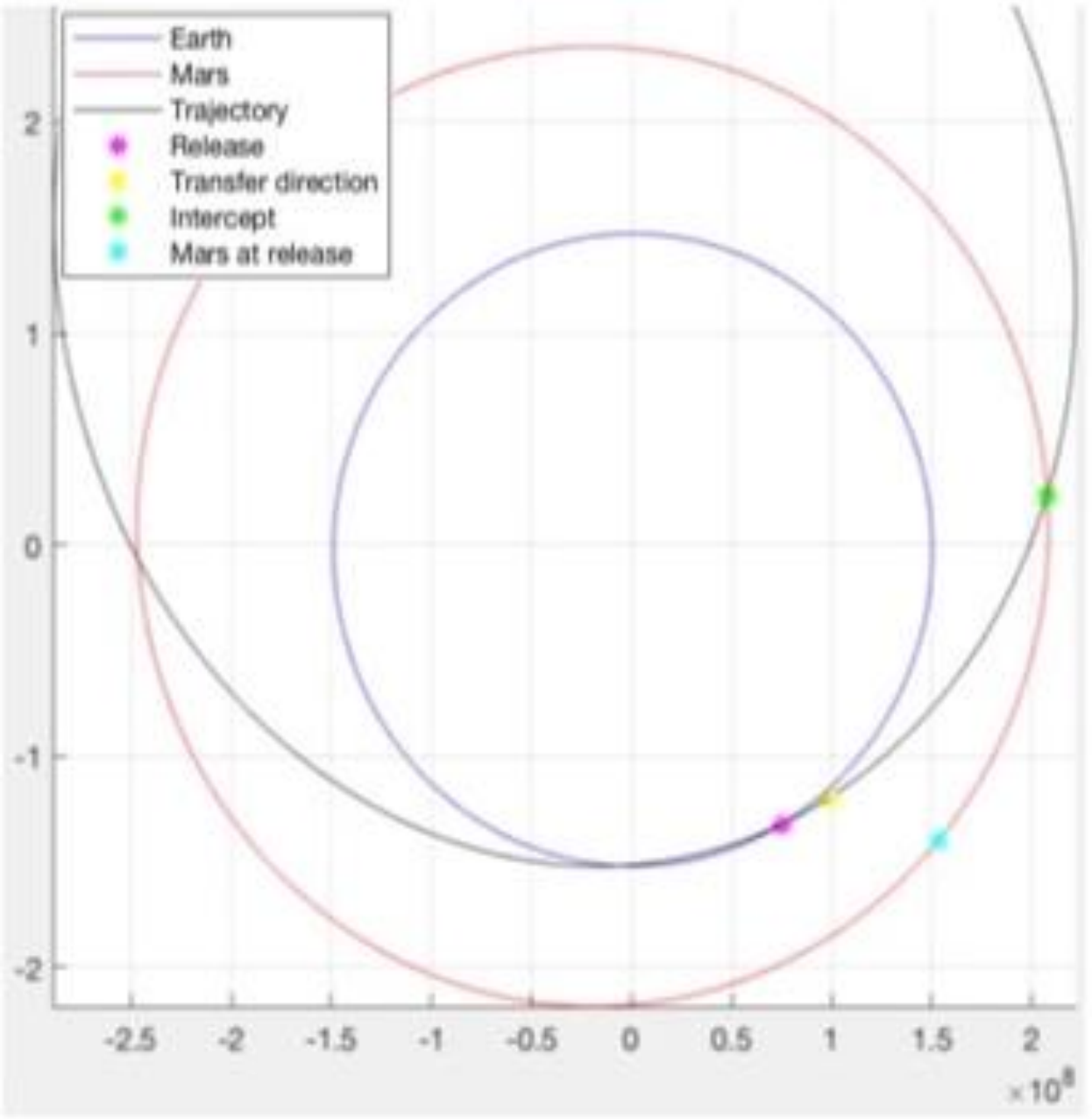


Concept: Our spacecraft enter the ellipse “not at perigee”
Ellipse is created by a velocity vector with one foci at the Sun
A later portion of the ellipse coincides with Mars with a rendezvous vector

Hypothesis: With a departure velocity of 7.76 or 11,41 km/sec, added to the Earth's velocity in vector addition [not orthogonal vectors as is Hohmann Transfer], time of flight decreases and a plethora of launch windows appear.

Student Challenge: Show how Apex Anchor release improves Interplanetary flights and discuss impacts?

Optimum Case 77 Days



This is the transportation story of the 21st century. Reliable, safe, and efficient access to space is close at hand. The Space Elevator is the Galactic Harbour, and an essential part of the global and interplanetary transportation infrastructure.

Bus Schedule to Mars

When one can release from the Apex Anchor on any day of the 26 month cycle, one can have routine bus schedules developed

Bus Schedule for Interplantary Transportation when departing from Galactic Harbour Apex Anchor

Bus Schedule, from Apex Anchor 2035

Date	Departure	Destination	Flight Time	Arrival	Comments
7/1/2035	Indian #1	Mars	87 days	9/26/2035	
7/1/2035	Pacific #1	Mars	86 days	9/25/2035	
7/1/2035	Pacific #2	Mars	84 days	9/22/2035	Fast

Bus Schedule, from Apex Anchor 2035

Date	Departure	Destination	Flight Time	Arrival	Comments
7/8/2035	Indian #1	Mars	81 days	4/14/2035	
7/8/2035	Indian #2	Mars	81 days	4/14/2035	
7/8/2035	Indian #1	Mars	80 days	4/13/2035	Fast

Bus Schedule, from Apex Anchor 2035

Date	Departure	Destination	Flight Time	Arrival	Comments
7/15/2035	Indian #1	Mars	79 days	10/2/2035	
7/15/2035	Indian #1	Mars	79 days	10/2/2035	
7/15/2035	Indian #2	Mars	79 days	10/1/2035	
7/15/2035	Indian #2	Mars	79 days	10/1/2035	
7/15/2035	Pacific #1	Mars	78 days	9/30/2035	Fast
7/15/2035	Atlantic #1	Mars	190 days	1/21/2036	
7/15/2035	Atlantic #1	Mars	182 days	1/13/2036	
7/15/2035	Atlantic #2	Mars	173 days	1/4/2036	
7/15/2035	Atlantic #2	Mars	164 days	12/25/2035	
7/15/2035	Atlantic #1	Mars	154 days	12/15/2035	

Bus Schedule, from Apex Anchor 2035

Date	Departure	Destination	Flight Time	Arrival	Comments
7/22/2035	Pacific #2	Mars	77 days	10/7/2035	Fastest
7/22/2035	Pacific #2	Mars	77 days	10/7/2035	Fastest
7/22/2035	Pacific #1	Mars	223 days	3/1/2036	

Bus Schedule, from Apex Anchor 2035 to Moon

Date	Departure	Destination	Flight Time	Arrival	Comments
every day	Indian #1	Moon	14 hours	+14 hours	
every day	Indian #2	Moon	14 hours	+14 hours	
every day	Pacific #1	Moon	14 hours	+14 hours	Fast
every day	Pacific #2	Moon	14 hours	+14 hours	
every day	Atlantic #1	Moon	14 hours	+14 hours	
every day	Atlantic #2	Moon	14 hours	+14 hours	

Comparison to Rockets - data varies greatly, only representative

Table 1: Launch Vehicle Delivery Percentages to GEO

Launch Vehicle	Pad Mass	To LEO (with % of pad)	to GEO (est.) (with % of pad)	to Moon surface (with % of pad)
Atlas V	590,000	18,500 (3%)	7,000 (1.2%)	
Delta IV H	733,000	28,770 (3.9%)	10,000 (1.4%)	
Falcon H	1,420,000	63,000 (4.4%)	26,000 (1.8%)	
Saturn V	2,970,000	140,000 (4.7%)		16,000 - 0.5%
average		4% of Pad mass	1.5% of pad Mass	

Note: data from web varies greatly - these numbers are representative only

Rough Numbers for Rockets:

Mass on the Pad	3,000,000 kg
Mass to LEO	120,000 kg
Mass insertion to GEO	45,000 kg
Mass to Lunar Surface	15,000 kg

Rough Numbers for Space Elevators

Mass at Earth Port	20,000 kg	(14,000 kg of Payload)
Mass upon release at Apex Anchor	14,000 kg	
Mass approaching Moon or Mars	14,000 kg	

Number of Rocket Launches per year
= 91 average

Number of SE Liftoffs in a year
= 2190

Massive Movement

- Space Elevator (SE) - single tether of 100,000 km length
- Initial Operational Capability (IOC) - estimated to have 14 Metric Tons of carrying capability of cargo each day.
- Full Operational capability (FOC) - estimated to be a future capability for a mature Space Elevator with human passengers as well as 79 Metric Tons of cargo per day.
- Galactic Harbour (GH) - Transportation Infrastructure with robust enterprises along the 100,000 km dual Space Elevators.

Number Comparison

Destination Needs vs. Liftoff Capacity	Capacity	Projected Rate Historic Missions to 2040	Destination Needs - Mars Colony	Destination Needs - Moon Village	Destination Needs - Space Solar Power
		Metric Tons	Metric Tons	Metric Tons	Metric Tons
Needs by 2040 (Metric Tons)		5000	1000000*	500000**	5000000***
	MT/yr	Years to Satisfy	Years to Satisfy	Years to Satisfy	Years to Satisfy
2019 Rockets to Orbit	1,000	5	-	-	-
Rockets for 2040^	6500	0.8	154	77	770
Initial Space Elevator (3036)	5110	1	200	100	1000
3 GHs (6 IOC SE) (2040)	30660	0.016	32.6	17	150
3 GH (6 FOC SE) (2052)	173000	-	5.78	2.89	28.9

^ Rockets for 2040 estimated at 50 Starships (100 MT) + 150 old (10 MT) per yr

* Musk Estimate

** Team Esitmate

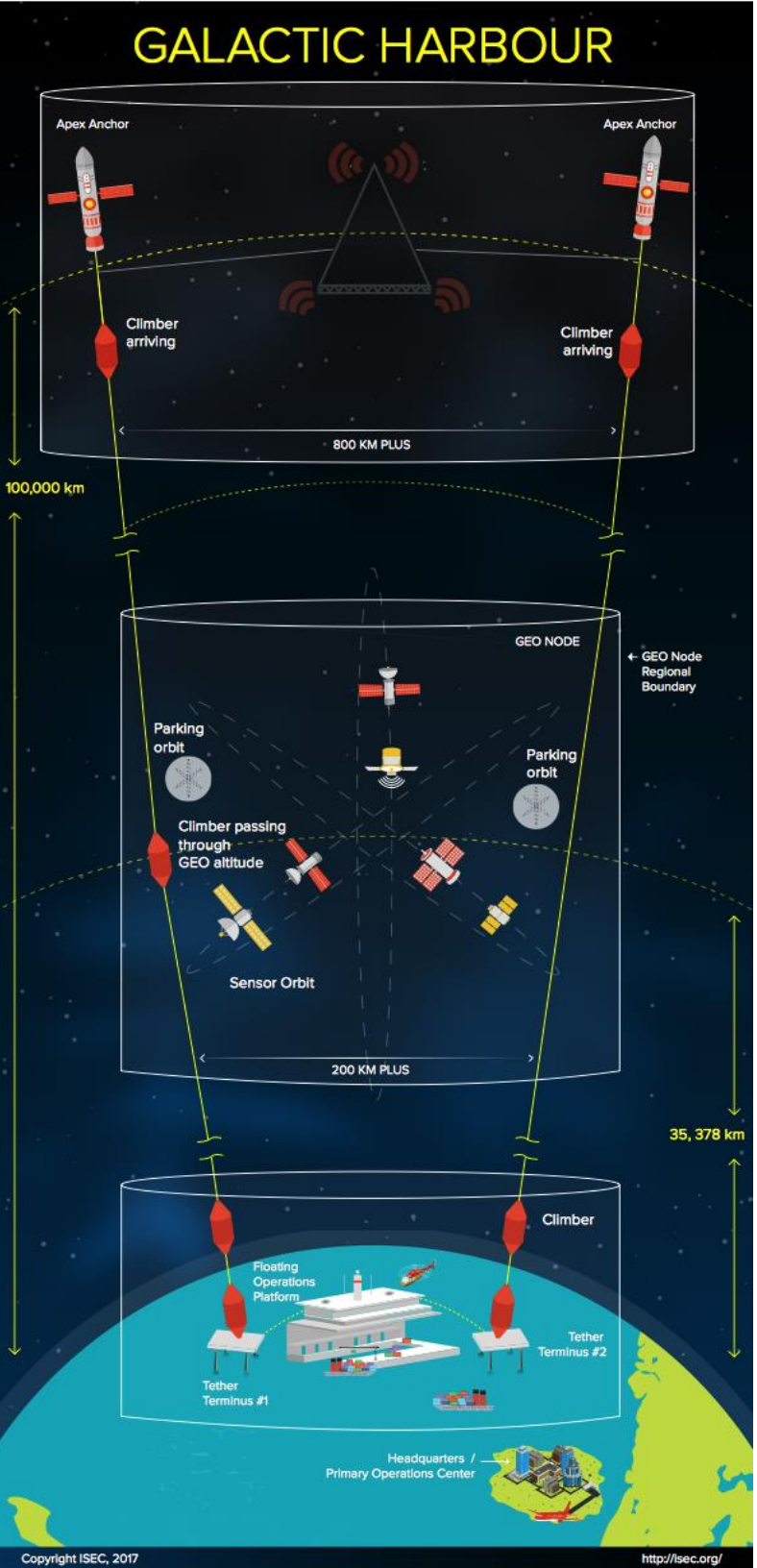
*** Dr. Mankins Estimate

Interplanetary Reference Missions

Reference Mission	*Metric Tons to Destination*	*Galactic Harbour IOC Fulfillment Time (yrs)*	*Galactic Harbour FOC Fulfillment Time (yrs)*
Space Solar Power	5,000,000	150	29
Mars Colony	1,000,000	33	6
Moon Village	500,000 estimated	17	3

This throughput chapter showed that the potential movement of mass off-planet by Galactic Harbours will enable the achievement of major missions hindered by the limited capabilities of the past. This transportation infrastructure will satisfy customer needs while being compatible and complementary to the growing rocket portals.

-- from draft of Interplanetary Mission Support, ISEC Study Report 2020



Today's Agenda

Introduction

Where is the Space Elevator Today?

Tether Material

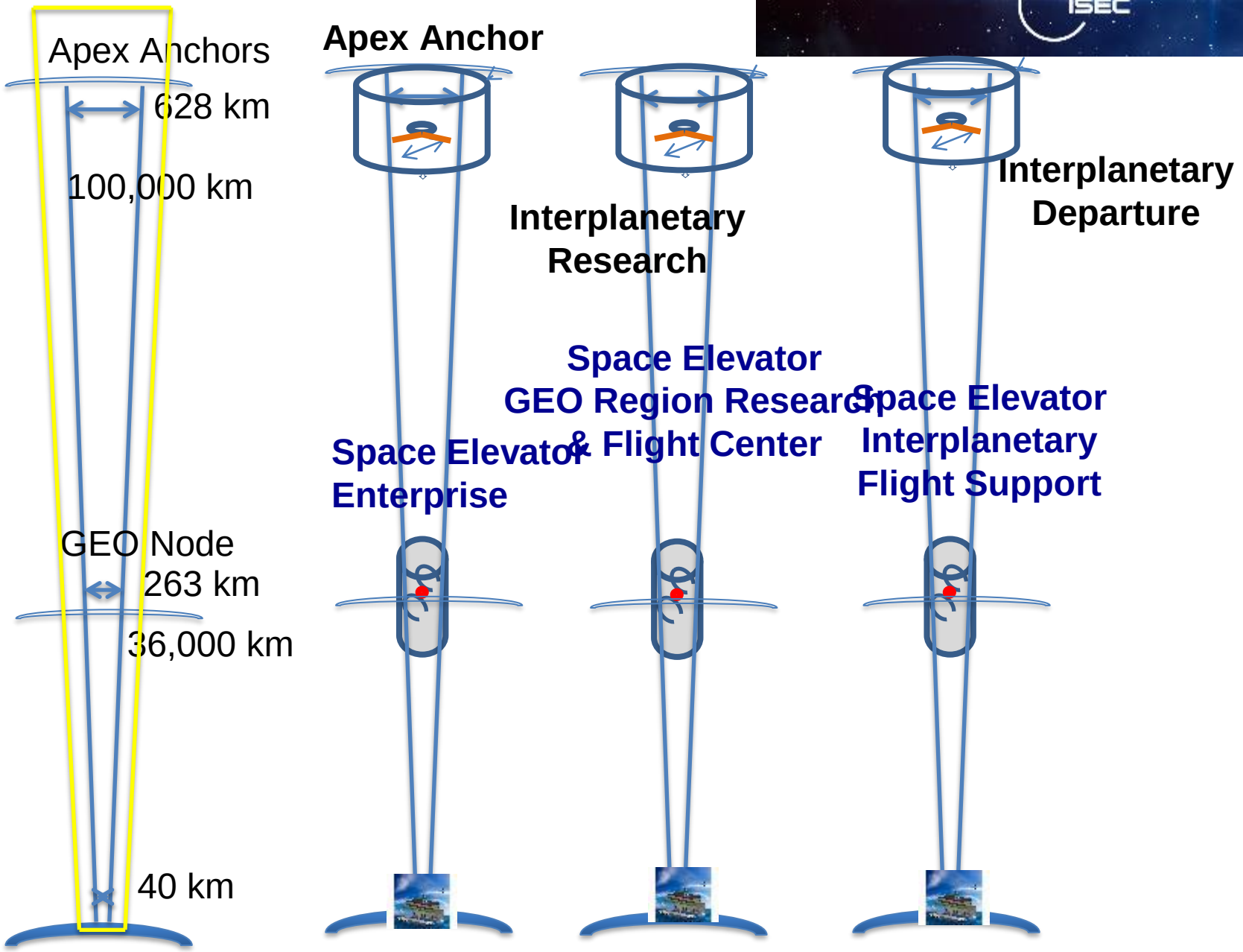
Engineering Development

Interplanetary Mission Support

Conclusions

Galactic Harbours will Unify Transportation and Enterprise Throughout the Regions.

Family Of Elevators



Recommendations

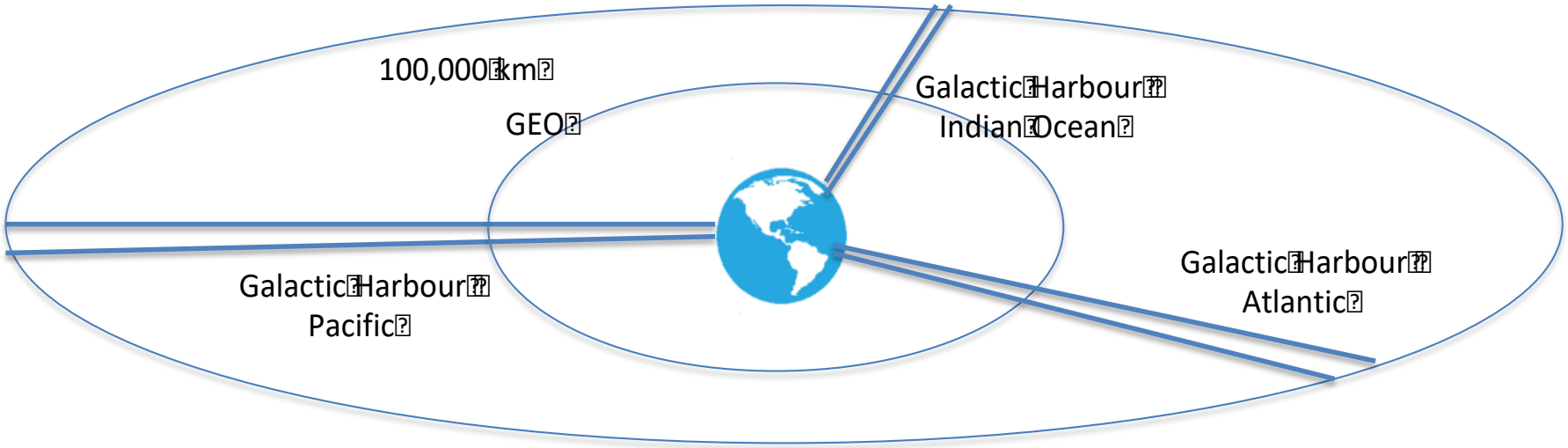
- *The vision of a Galactic Harbour should be enhanced as a unifying force for the space elevator community.*
- *Recognizing the strengths of space elevators leads one to realize that Movement off-planet will only happen when Galactic Harbours are supplying mission support within a cooperative arrangement with the future rocket infrastructure.*
- *Initiate a program soonest – while developing a Space Elevator Institute immediately.*

Final Thoughts

The Space Elevator is Closer than you Think!

Our "strategy" is to link the Space Elevator Transportation System to the Space Elevator Enterprise; within a Unifying Vision … the Galactic Harbour.

Our Vision of Space Elevators is Multiple Galactic Harbours



The story here is still being written. The Apex is where the Galactic Harbour meets the Shoreline of Outer Space;

Where the "Transportation Story of the 21st Century" meets the "Final Frontier."

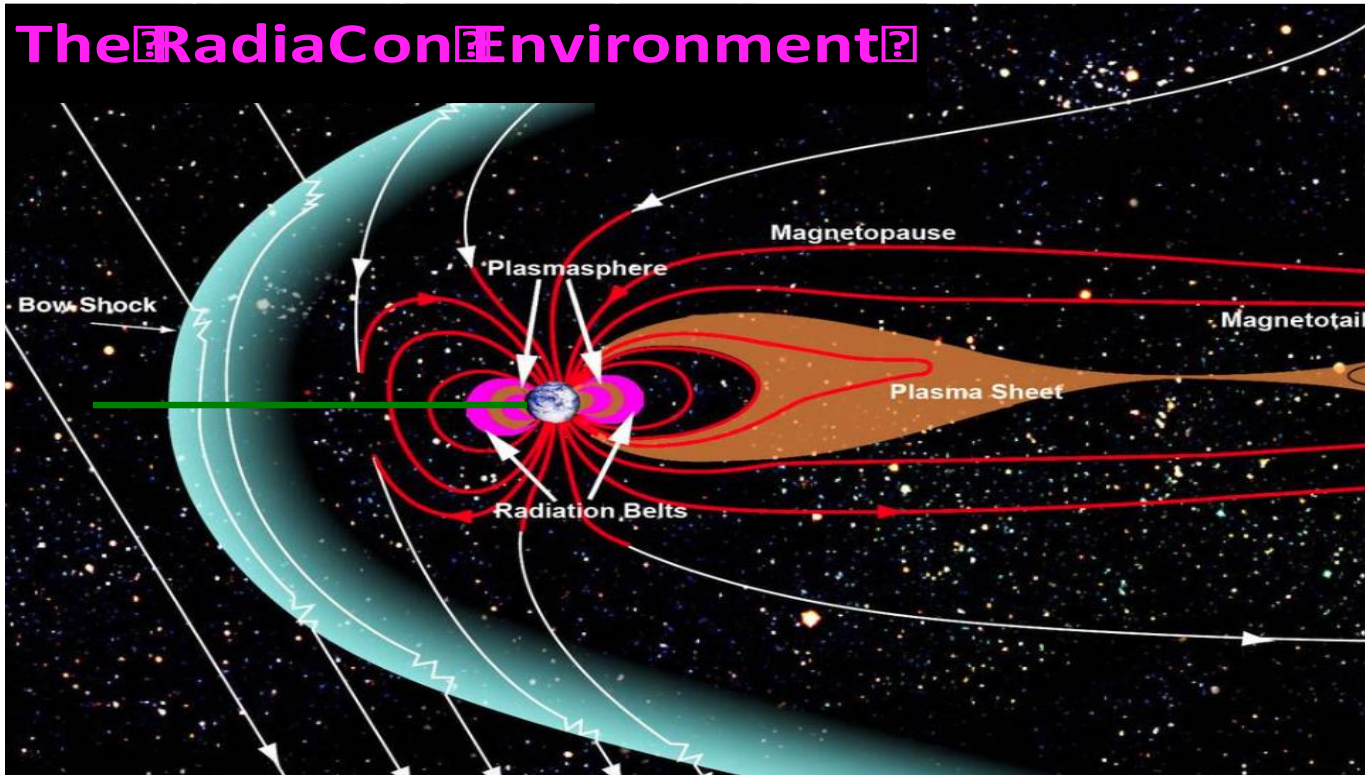
How the Space Elevator Grew into a Galactic Harbour?

Join us at www.isec.org and sign up for the enewsletter

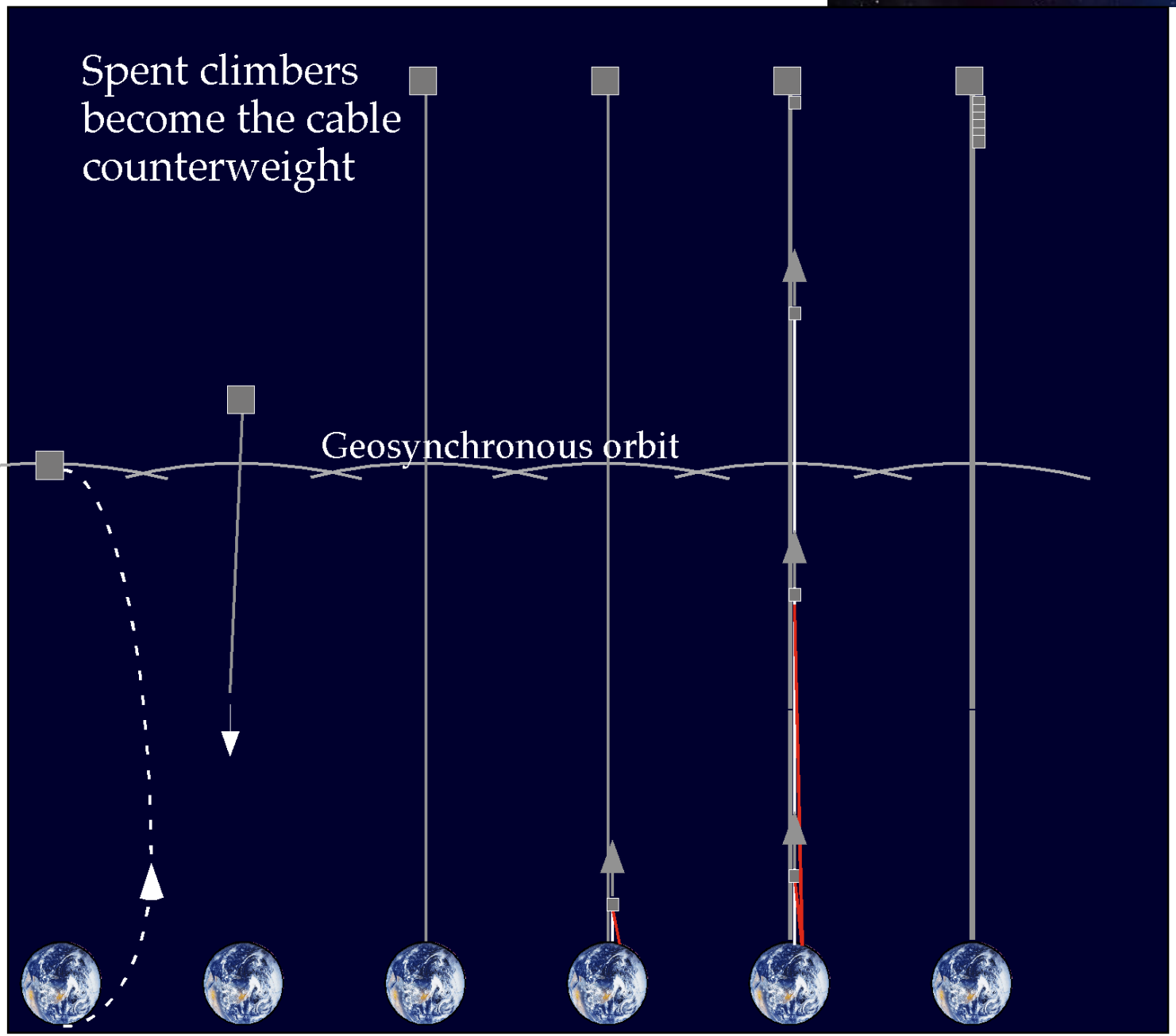
Backup Charts

Earth Radius
6,378 Km

Space
Elevator
100,000 km
In green



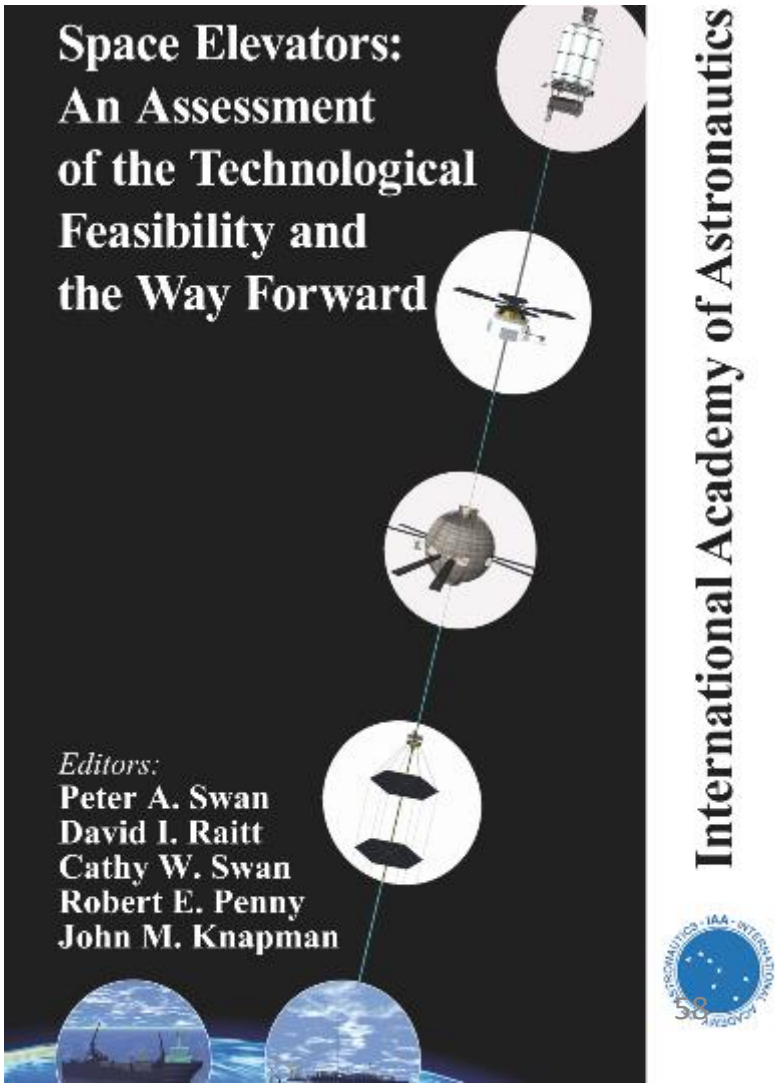
Deployment Overview



IAA Studies on Space Elevators

IAA Study One (2014) – Feasibility?
Conclusion: Space Elevators
Seem Feasible

IAA Study Two (2019) How To? Maturity?:
Road to the Space Elevator Era
Many global experts evaluating
critical technologies



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