

# Space

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“...the final frontier”

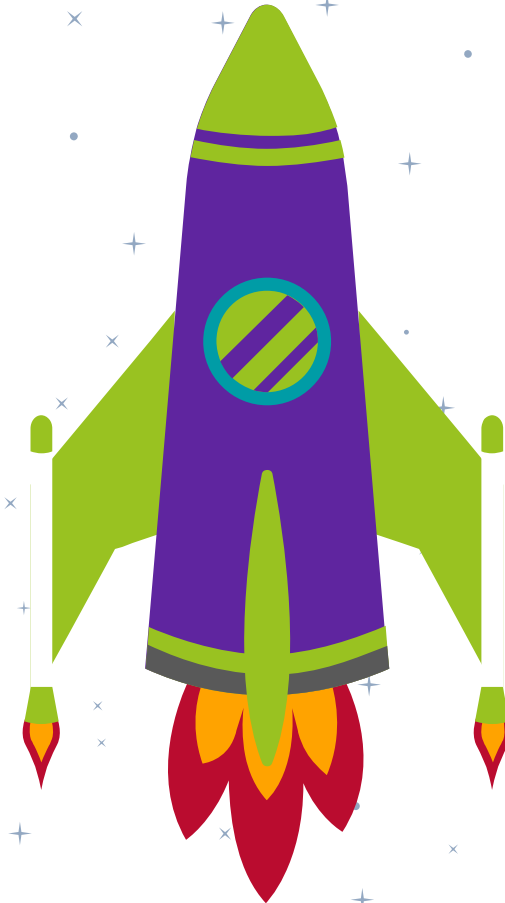
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# 5 Satellite Facts

- 1 Satellites travel at 18,000 miles per hour!
- 2 They can travel around Earth about 14 times per day
- 3 Over 10,500 satellites in orbit around earth but only 8,100 operational
- 4 They are programmed to avoid meteorites
- 5 24 satellites make up the Global Positioning System (GPS)

# What is a Satellite?

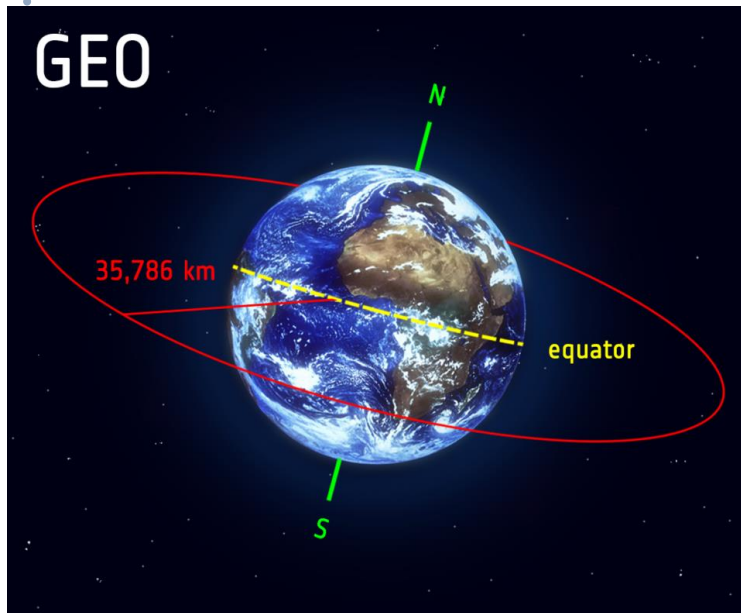


- A satellite is simply any body that moves around another (usually much larger) one in a mathematically predictable path called an orbit
- Satellites have a variety of uses including
  - Communication Relay
  - Weather Forecasting
  - Navigation (GPS)
  - Broadcasting
  - Scientific Research
  - Earth observation
- Additional military uses ie reconnaissance, early warning, signals intelligence and, potentially, weapon delivery.

# Orbit - GEO vs LEO

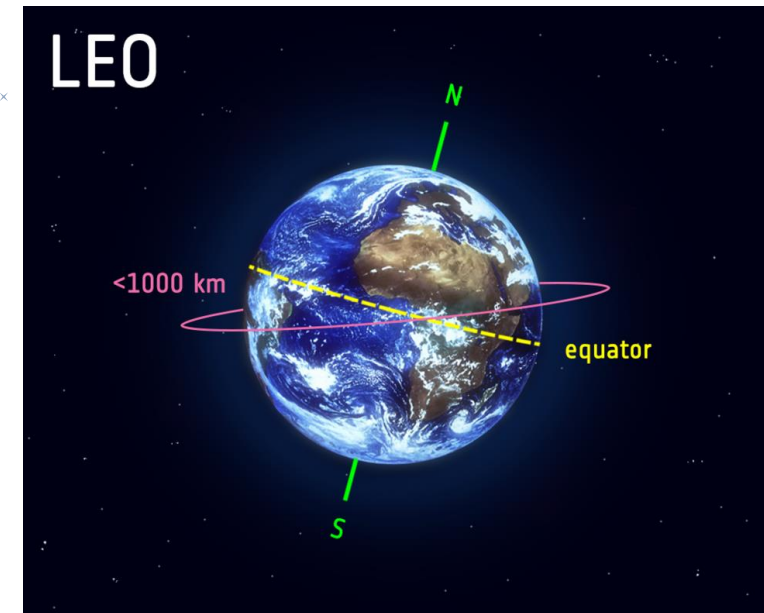
## GEO – Geostationary Orbit

- Satellites travel at 3km per second
- At an altitude of 35,786km, always above the equator
- This calculates to the exact same rate of the worlds spin
- Meaning they can stay over a particular location at all times
- Satellites in GEO tend to be telecommunication satellites

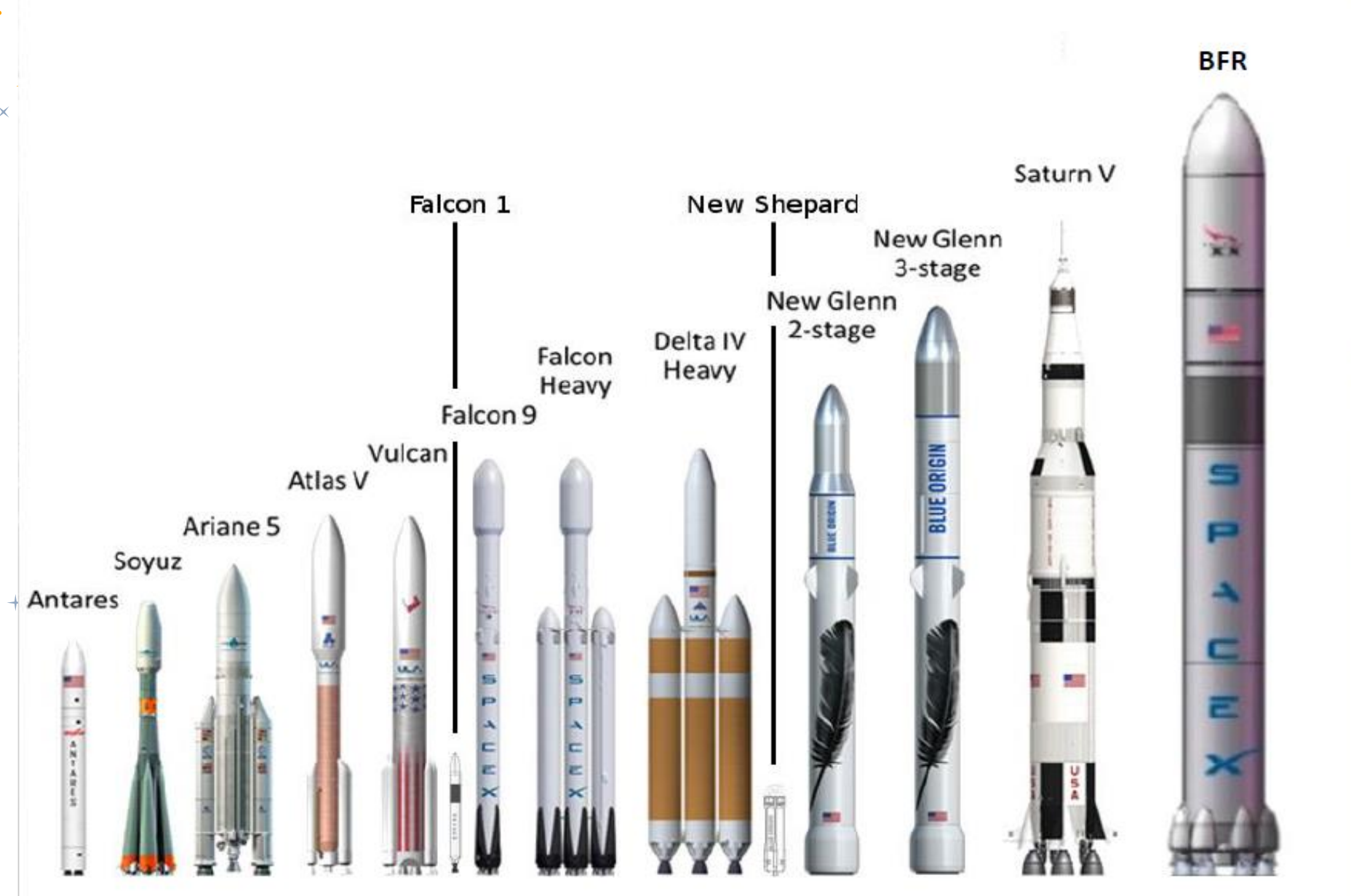


## LEO – Low Earth Orbit

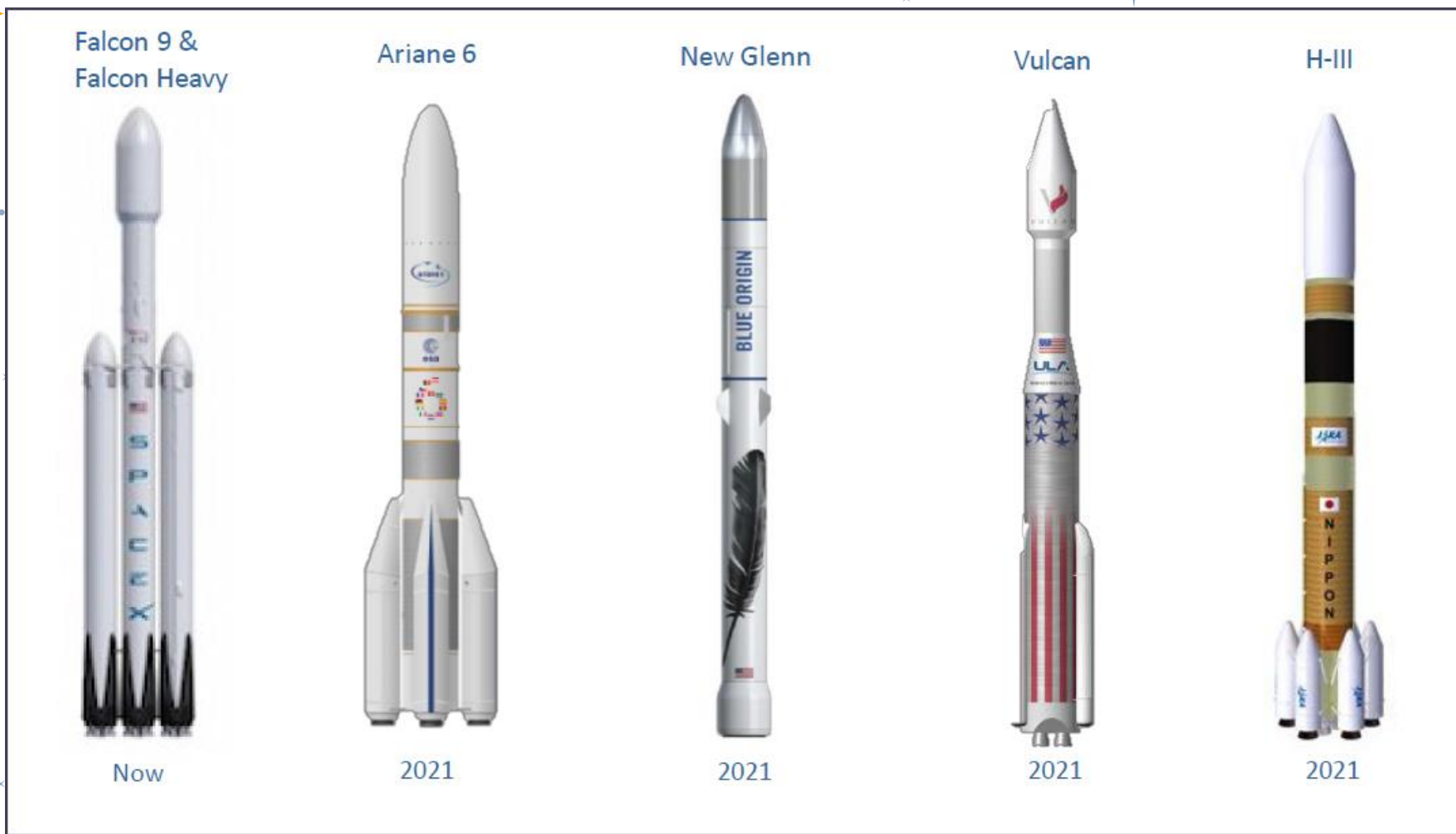
- Satellites travel at 7.8km per second, meaning they can circle the globe in 90m
- Altitude is less than 1000km
- Very commonly used altitude as satellites do not have to be over the equator
- Satellites used for imagery as closer to the surface
- Also the orbit of the International Space Station



# Launch



# Launch – Heavy Lift





# Falcon 9



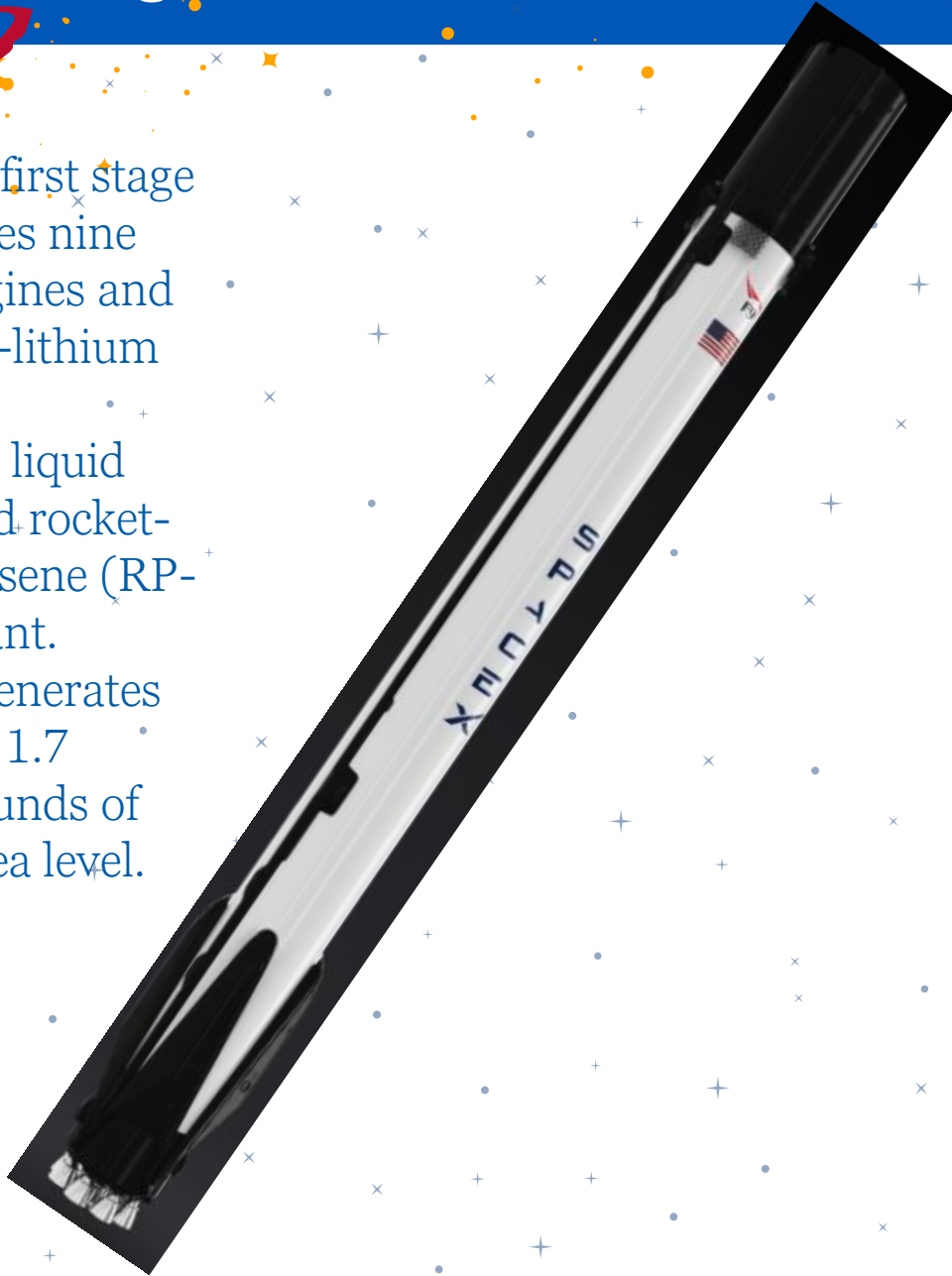
HEIGHT	70 m
DIAMETER	3.7 m
MASS	549,054 kg
PAYLOAD TO LEO	22,800 kg
PAYLOAD TO GTO	8,300 kg
PAYLOAD TO MARS	4,020 kg



# First Stage

Falcon 9's first stage incorporates nine Merlin engines and aluminum-lithium alloy tanks containing liquid oxygen and rocket-grade kerosene (RP-1) propellant.

Falcon 9 generates more than 1.7 million pounds of thrust at sea level.



The Falcon 9 first stage is equipped with four landing legs made of state-of-the-art carbon fiber with aluminum honeycomb.

Placed symmetrically around the base of the rocket, they are stowed at the base of the vehicle and deploy just prior to landing.



# Interstage / Second Stage



## INTERSTAGE

The interstage is a composite structure that connects the first and second stages, and houses the pneumatic pushers that allow the first and second stage to separate during flight.

## GRID FINS

Falcon 9 is equipped with four hypersonic grid fins positioned at the base of the interstage. They orient the rocket during reentry by moving the center of pressure.



## SECOND STAGE

The second stage, powered by a single Merlin Vacuum Engine, delivers Falcon 9's payload to the desired orbit. The second stage engine ignites a few seconds after stage separation, and can be restarted multiple times to place multiple payloads into different orbits.

NUMBER OF ENGINES	1 vacuum
BURN TIME	397 sec
THRUST	981 kN / 220,500 lbf



# Payload



## FAIRING

Made of a carbon composite material, the fairing protects satellites on their way to orbit. The fairing is jettisoned approximately 3 minutes into flight, and SpaceX continues to recover fairings for reuse on future missions.

HEIGHT	13.1 m / 43 ft
DIAMETER	5.2 m / 17.1 ft



# Space Insurance

# Insurance Cover Available



## Pre-Launch

From manufacturer + transit to launch site; testing and integration with rocket launcher



## Third Party Liability

Covers liabilities to 3<sup>rd</sup> parties for bodily injury and property damage on ground, during launch and in-orbit



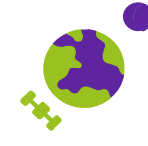
## Launch

Launch, in-orbit testing, commissioning into service (usually up to 1 year)



## Loss of Revenue

Cover to protect revenue generated by the satellite or additional expenses if satellite cannot be used following physical damage



## In-Orbit only


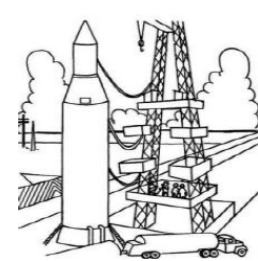
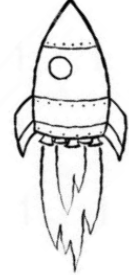



Attaches when launch policy expires. All risk cover



## Cyber Liability

Cover for data breaches and costs of notifying customers and legal fees etc

# Who buys what !

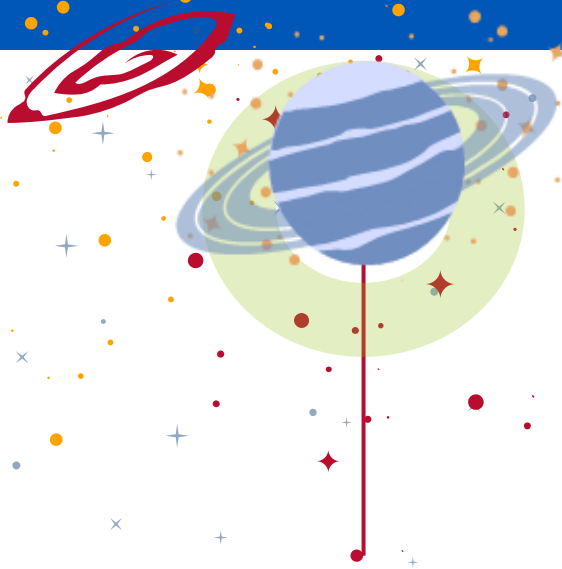
Legend:							
Asset	Liability						
Phase →	Pre-Launch			Launch and In-Orbit			
Insured ↓	Transit to Launch Site	Launch Site Processing	Launch Vehicle Flight	Initial Operations	In-Orbit Operations	Re-Entry	
Satellite Owner / Operator	Contingent Business Interruption			Launch + 1 year		In-Orbit	Re-Entry / Recovery
Satellite User	Contingent Business Interruption			Launch Vehicle Flight Only	Post-Separation	In-Orbit Liability	Re-Entry Liability
Satellite Manufacturer	Transit & Pre-Launch			Business Interruption			
Launch Service Provider	Transit & Pre-Launch			Performance Incentives / Warranty Payback			
Other Coverages:	Transit & Pre-Launch			Launch Risk Guarantee			
		Pre-Launch Liability	Launch Liability				Re-Entry Liability
	Seamless (Pre-Launch and Launch)						
Other Coverages:	Engine tests, on-orbit servicing, human spaceflight, etc.						



# Space Market



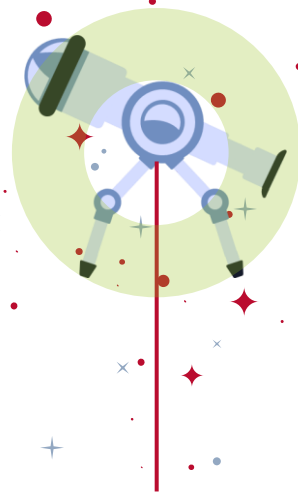
# Space Insurers



## Major multiline Insurers

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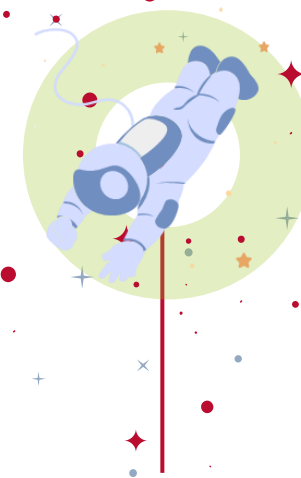
- Ability to deploy large capacity and long-term involvement in class



## Class Specific MGA's

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- Expertise and technical knowledge



## Follow Capacity

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- Opportunistic capacity who rely on other insurers to conduct risk analysis
- Tend to write “vanilla” risks that is tried and tested

# 2012 to present day...

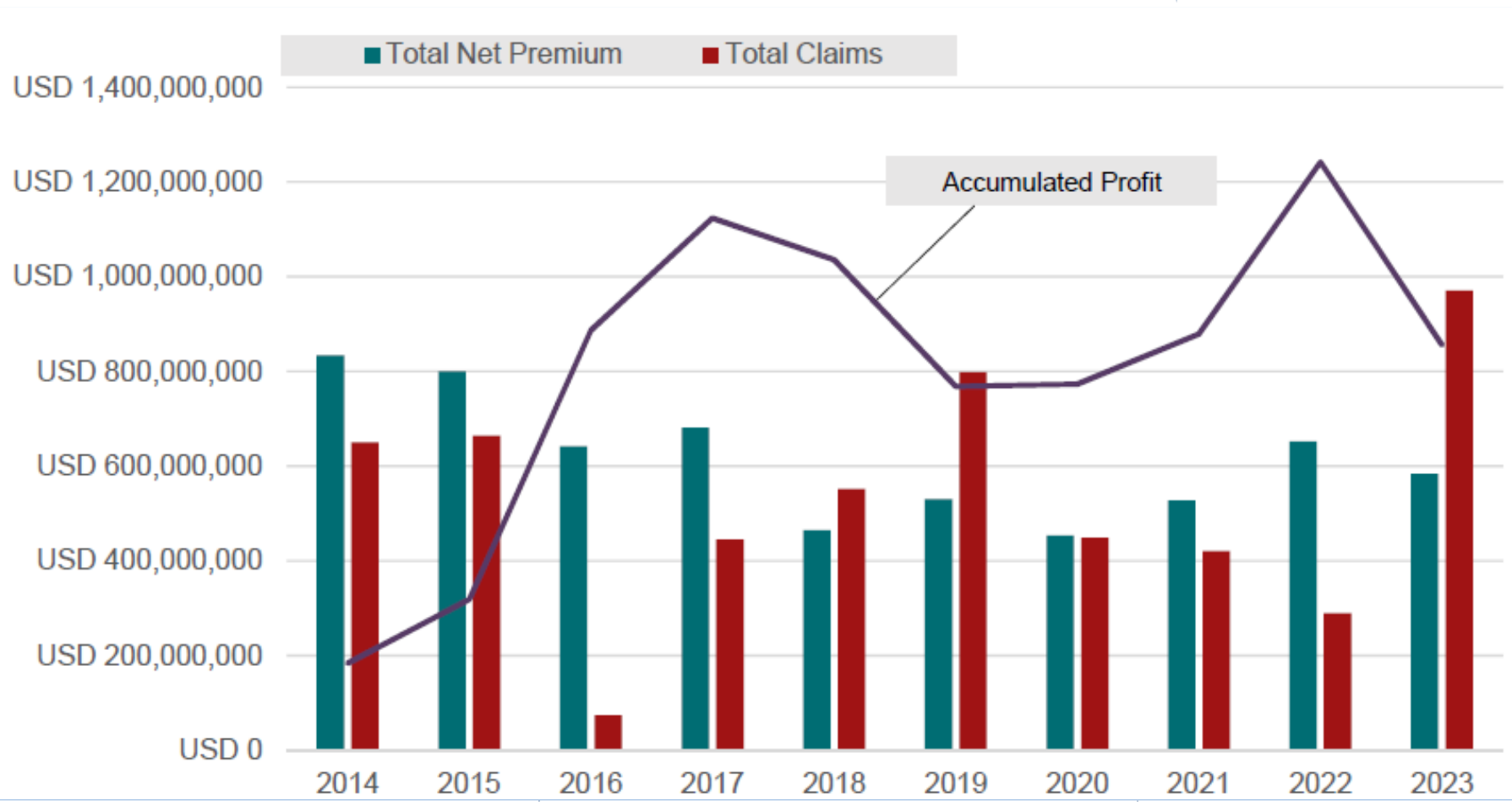
- Capacity high creating strong competition
- More reliable launches and hardware
- Reduction in insurance rates

But then....

- 2019 was a bad year for losses
- Harder market returns – markets withdraw, contraction of capacity, prices rise again
- In 2023, the space insurance market endured its most challenging year in two decades, culminating in nearly USD 1 billion in losses
- Smaller satellites- Starlink



# Space Market Results



L/R Market	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	78%	83%	12%	65%	119%	150%	99%	80%*	44%	166%



# 01.01.2024 – Market Review



- Pre Renewal discussions dominated by the 2 major losses in 2023:
  - Viasat 3F1 and Inmarsat 6F2.
  - Both new high valued satellites
  - This brought total Market losses in excess of \$900mn
  - There were more, smaller losses in the year too.
- Space market 10 year LR<sup>+</sup> = 95%

Risk	Date of Loss	Market Sum Insured
Satellites on Virgin LauncherOne Failure	January 2023	\$1.2M
ICEYE-X22 & X27	January & March 2023	\$8M
Satellites on H3 Failure	March 2023	\$12M
Azersky (Spot 7)	May 2023	\$40M
Chinasat 6C	April 2023	\$32M
Viasat 3 F1	June 2023	\$420M
Inmarsat 6 F2	August 2023	\$350M
Arcturus	August 2023	\$40M
Capella (Rocket Lab Electron Failure)	September 2023	\$4M
Ceres 1	September 2023	\$7M
<b>Total</b>		<b>\$914.2M</b>

# Space Market Pricing

Post 9-11  
hardening

FalconEye & Chinasat  
losses = \$675mn

Viasat & Inmarsat  
Losses

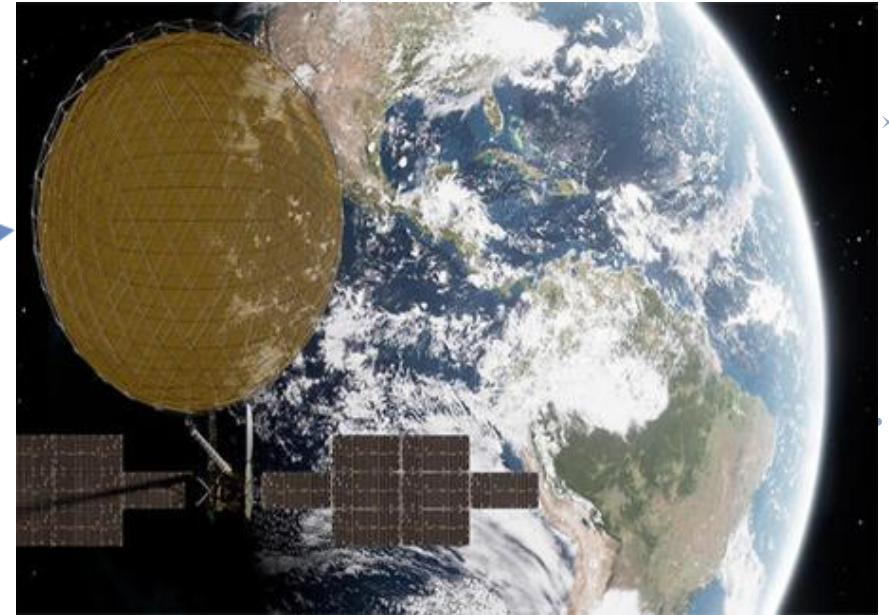
RATES	Launch	% Change	Index	Orbit	% Change	Index
2001	12.8%		1.00	1.9%		1.00
2002	15.2%	19%	1.19	2.5%	32%	1.32
2003	20.6%	36%	1.61	2.7%	8%	1.42
2004	20.5%	0%	1.60	2.7%	0%	1.42
2005	17.7%	-14%	1.38	2.5%	-7%	1.32
2006	15.3%	-14%	1.20	2.2%	-12%	1.16
2007	11.7%	-24%	0.91	1.7%	-23%	0.89
2008	13.5%	15%	1.05	1.7%	0%	0.89
2009	12.8%	-5%	1.00	1.6%	-6%	0.84
2010	10.4%	-19%	0.81	1.4%	-13%	0.74
2011	10.0%	-4%	0.78	1.3%	-7%	0.68
2012	9.3%	-7%	0.73	1.0%	-23%	0.53
2013	9.2%	-1%	0.72	0.8%	-20%	0.42
2014	8.8%	-4%	0.69	0.8%	0%	0.42
2015	7.3%	-17%	0.57	0.7%	-13%	0.37
2016	6.2%	-15%	0.48	0.7%	0%	0.37
2017	5.3%	-15%	0.41	0.6%	-14%	0.32
2018	5.2%	-2%	0.41	0.5%	-17%	0.26
2019	6.9%	33%	0.54	0.8%	60%	0.42
2020	8.7%	26%	0.68	1.1%	38%	0.58
2021	7.7%	-11%	0.60	1.1%	0%	0.58
2022	8.0%	4%	0.63	1.0%	-9%	0.53
2023	9.8%	23%	0.77	1.3%	26%	0.66
2024 Jan/Feb Low Activity	11.2%	14%	0.88	1.5%	21%	0.81
2024 Est @ Q42023	17.2%	75%	1.34	2.2%	75%	1.16



# Viasat 3F1 – what went wrong?

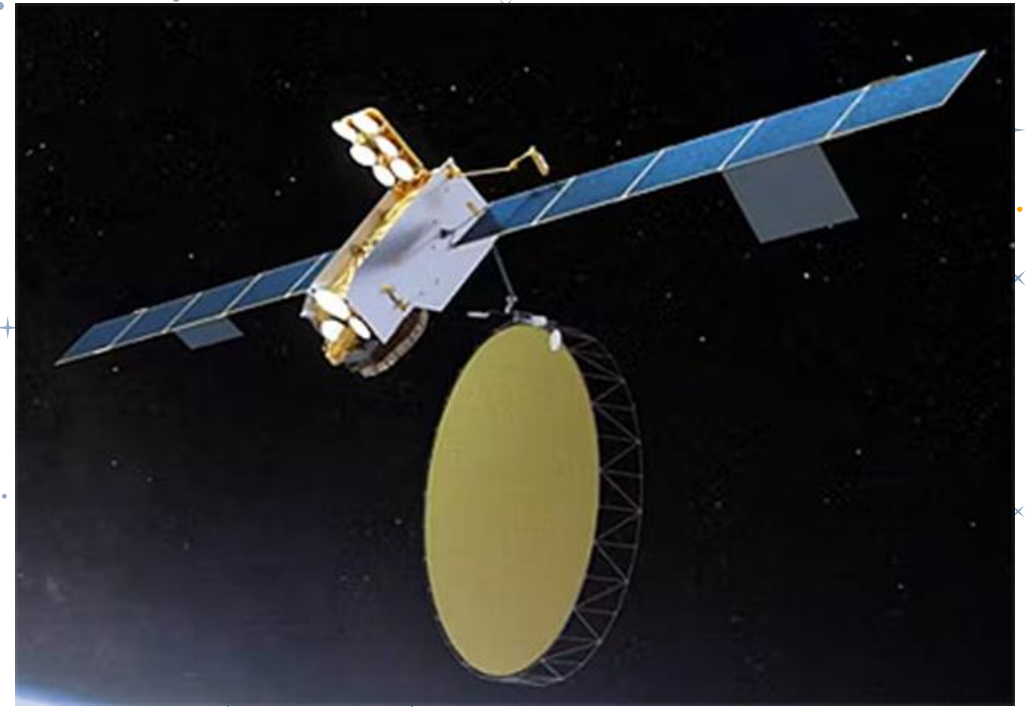


- Launched 1st May 2023 by a Falcon Heavy launch vehicle
- Successful launch and orbit
- Purpose of the satellite is to provide global J-band broadband
- June 14th notification of issue from Viasat regarding an 18 meter R3 antenna only being partially deployed
- Investigation via picture and videos showed unexpected tension in the deployment
- Despite further attempts to fully deploy the antenna it remained significantly unusable.
- If the R3 antenna can not be fully deployed the satellite will be a total loss



# Inmarsat 6 F2 – what went wrong?

- Launched on the 18th February 2023 by a Falcon 9 vehicle
- All initial deployments were successful and was expected to reach Geo-orbit by early October by using its electric propulsion systems
- An identical satellite to the F2 has successfully been in Geo since December 2021 (Inmarsat has a stellar history)
- August 14th the satellite detected an electrical power anomaly and went into safe mode
- Within 6 minutes, before safe mode activation could be completed, all communication was lost with the satellite
- The satellite is slowly rotating x2 per hour, suggestion of explosion or collision caused this



Mission – to augment both L-band and Ka-band broadband

# Market Reaction



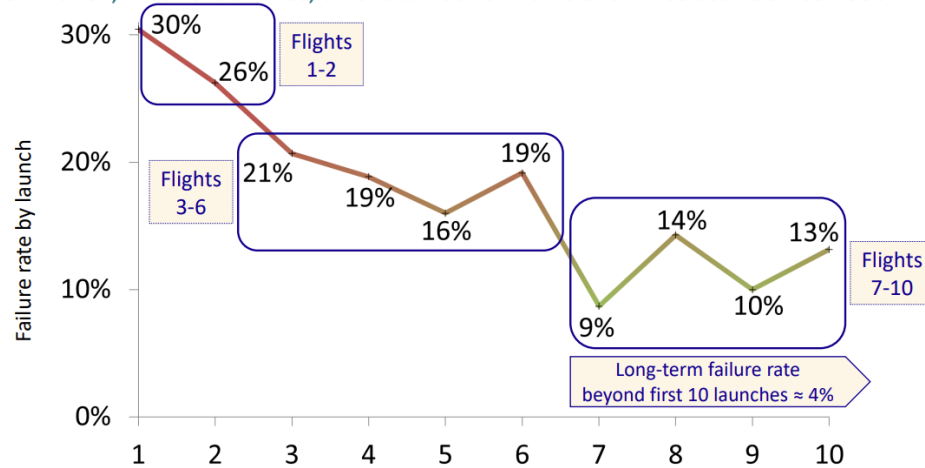
- Realization that there is not enough premium in the Space ecosystem to carry 2 major losses
- Assessment of underwriting tools and models
- How do you get this premium? +100% rate rises
- Tightening terms and conditions – a move to 2 year policies where possible instead of 3
- An attempt to take the power from the brokers and 1 time pricing earlier
- Increase rates in the in orbit sections as well as launch for Falcon 9
- Be pessimistic on new launch vehicles and price x2 – x3 of Falcon 9



# Additional Underwriting Concerns

## Launch Vehicle Stats

Each launch, first 10 launches, all orbital launch vehicle families active since 2000\*



## Satellite Reliability

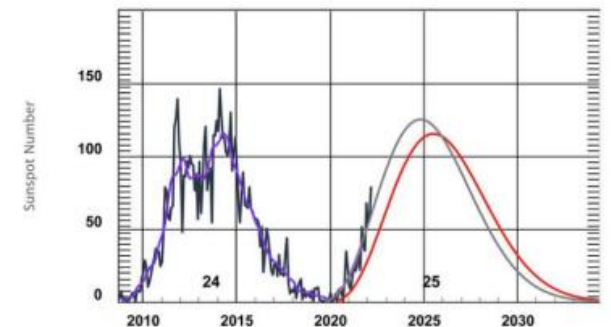
- Are satellites becoming more reliable as technology advances?

## Collision Risk

- More of concern in LEO than GEO
- Long term sustainability as more and more satellites are being launch into Orbit
- An 'event' space loss of 2 satellites colliding

## Space Weather

- Solar cycle 25
- More sunspots on the sun, more radiation
- Radiation disturbs electrical circuits on satellites and can cause loss of power



# The Future...

Continued technological development

Increased launches and deployment of Satellites

Space Tourism – Virgin Galactic, SpaceX

Revisiting the Moon and establishment of a Lunar Colony

