The Only Way Is Up

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space-ist.com

1 – A Warning

INMARSAT CEO ISSUES WARNING OVER RISKS TO SUSTAINABILITY AND INNOVATION POSED BY 'UNMANAGED EXPANSION' IN SPACE INDUSTRY

26 Apr 2022

CORPORATE | PRESS RELEASE | SUSTAINABILITY

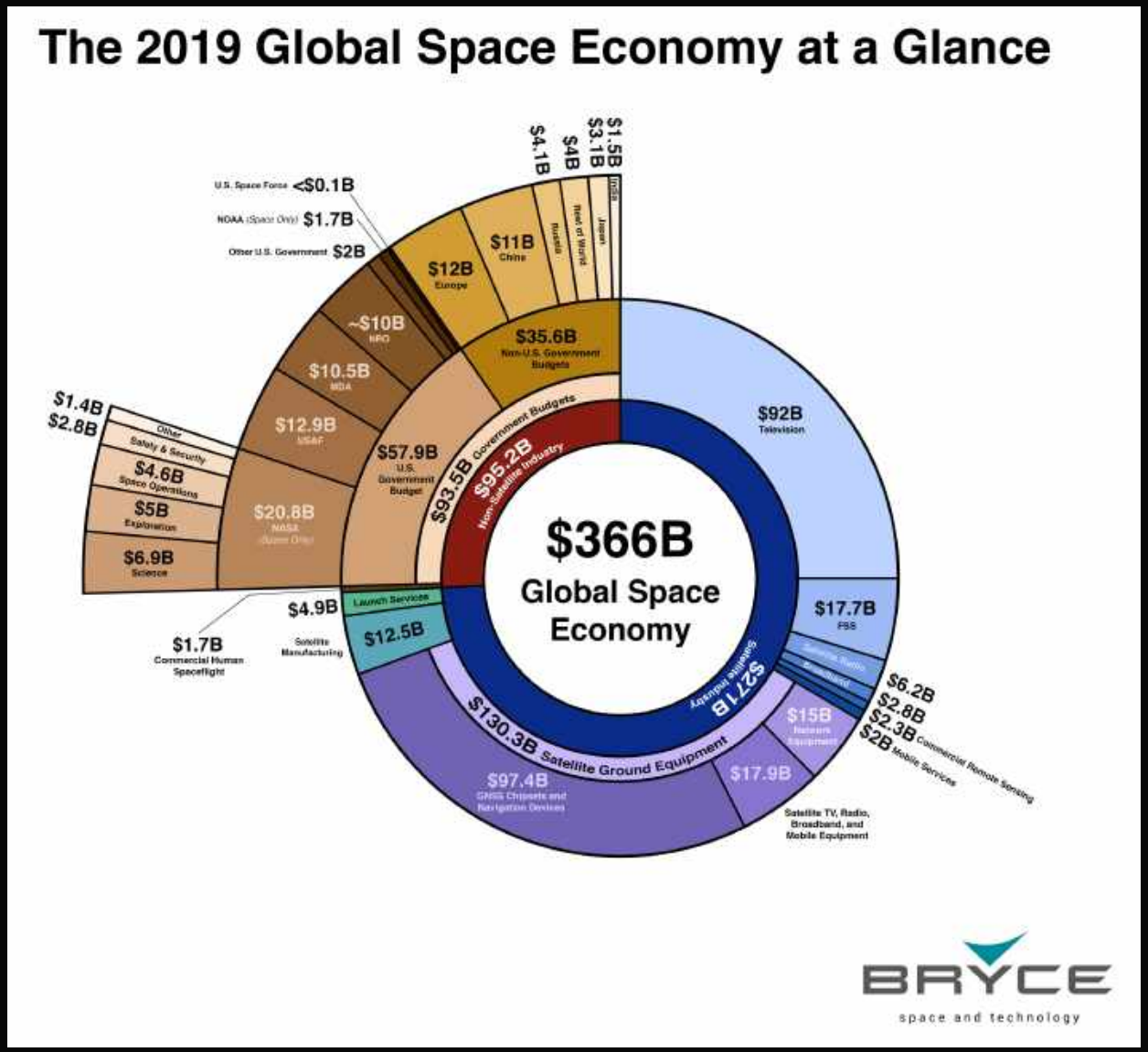
"For space to support sustainability on Earth, there needs to be sustainability in space. And, to be blunt, we are moving in the wrong direction here": Rajeev Suri, CEO Inmarsat

Rajeev Suri, Chief Executive Officer of Inmarsat, the world leader in global, mobile satellite communications, issued a stark warning today that unmanaged space sector expansion could exacerbate environmental damage, stifle innovation and undermine the long-term capability of satellites to help combat climate change.

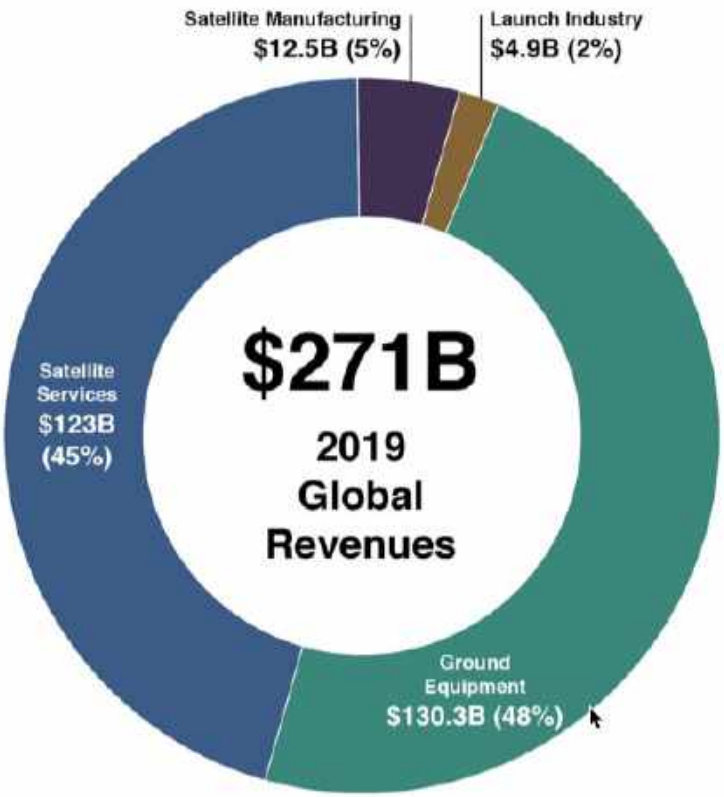
Addressing the Royal Aeronautical Society's conference 'Towards a Space Enabled Net Zero Earth', Mr Suri focused attention on major factors threatening long-term environmental and economic sustainability.

The Inmarsat CEO told the conference: "Space is increasingly important for the creation of a sustainable world. While the role of new players – with new investment and innovations - is to be welcomed, space is too important an asset to be driven by short-term thinking. To protect our shared future, there must be a common approach and common rules that protect the space environment too.

2 – Space and Money



2019 Top-Level Global Satellite Industry Findings



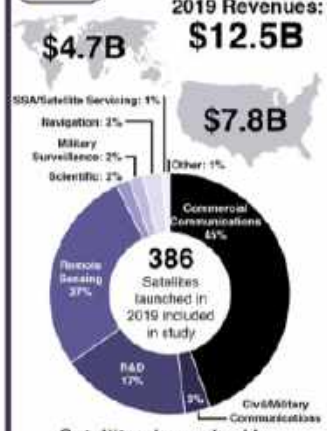
Satellite Services

2019 Revenues:
$123B

Television	$92B
Radio	$6.2B
Broadband	$2.8B
Fixed	$17.7B
Mobile	$2B
Remote Sensing	$2.3B

Satellite Manufacturing

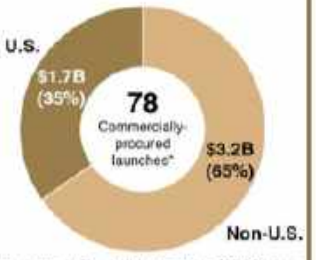
2019 Revenues:
$12.5B



Satellites Launched by Mission Type

Launch Industry

2019 Revenues	$4.9B



* There were 102 total orbital launches in 2019. Of these, 78 were commercially procured, 9 were not commercially procured, and 15 launched space vehicles.

Commercial Launch Revenues by Region

Ground Equipment

2019 Revenues	$130.3B

$17.9B
Consumer Equipment
(Satellite TV dishes, etc.)

$97.4B
GNSS Equipment
(GNSS devices/chipsets)

$15B
Network Equipment
(VSATs, gateways, etc.)

For more information on the satellite industry, or for previous SSIR reports, contact SIA:

SIA

Satellite Industry Association
info@sia.org
202-503-1560
www.sia.org

BRYCE
space and technology

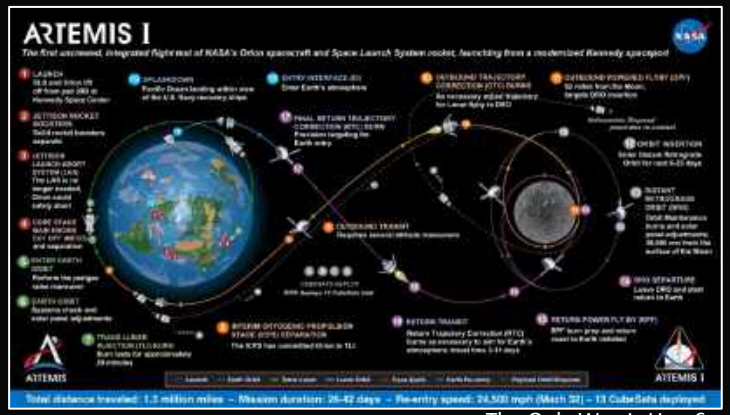
Prepared by:
Bryce Space and Technology
brycetech.com

3 – New Space

- **NewSpace**
  - A catch-all term for an approach to space that is notably different from that of the traditional industry.
  - Tends to be
    - Private
    - Entrepreneurial
    - Focused on low-cost approaches

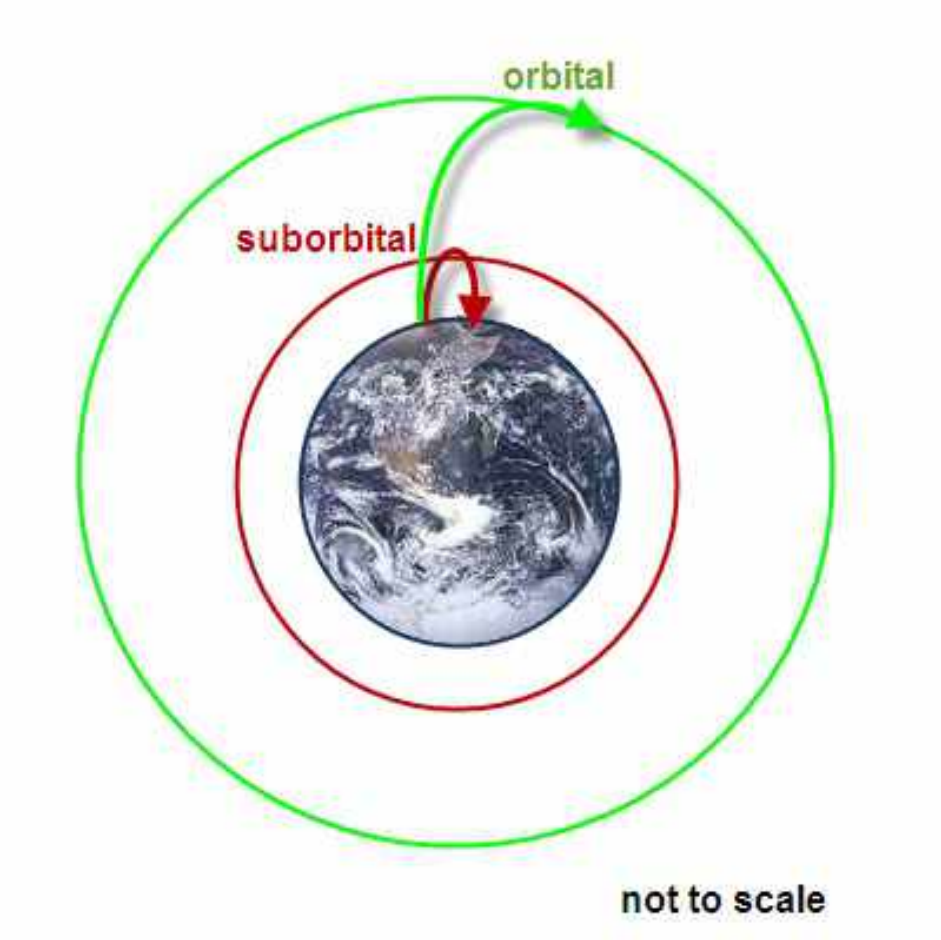
4 – Space Domains

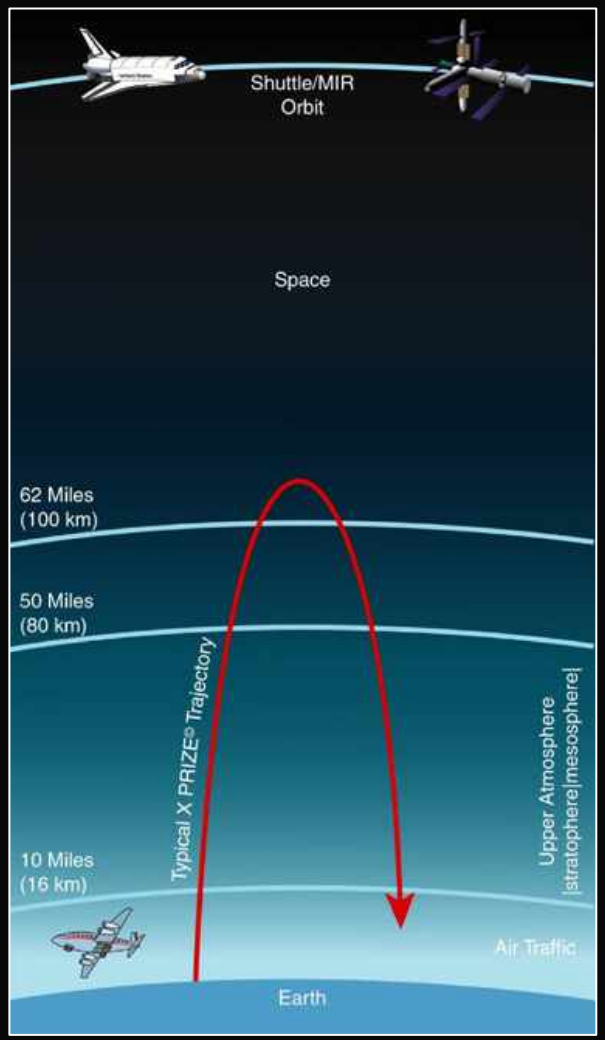
- We can look at space activities by the domain in which they are active:
  - Sub-orbital
  - Orbital
  - Deep Space



4.1 - Suborbital

Orbital v Suborbital





Commercial suborbital opportunities

- **Tourism**
  - The ‘suborbital experience’
- **Research**
  - Microgravity science
  - Upper atmosphere science
  - Tech demos
- **Travel**
  - Point-to-point for terrestrial packages/people.
  - Difficult!

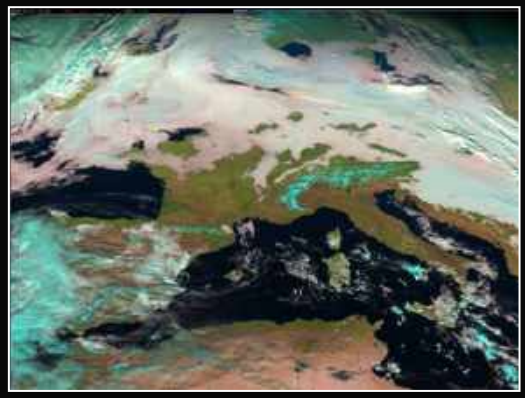
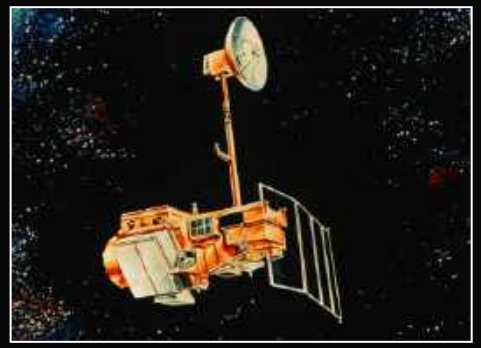
BLUE ORIGIN

Virgin GALACTIC

4.2 - Orbital (LEO to GEO)

- Looking back at the Earth from orbit has given us insight into nature and workings of our planet.



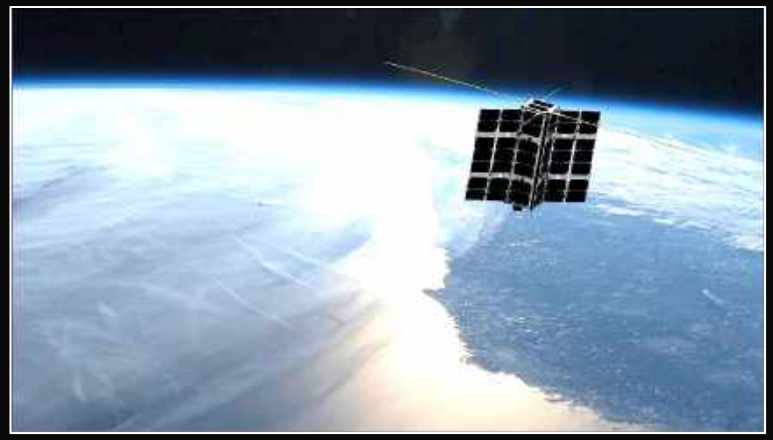




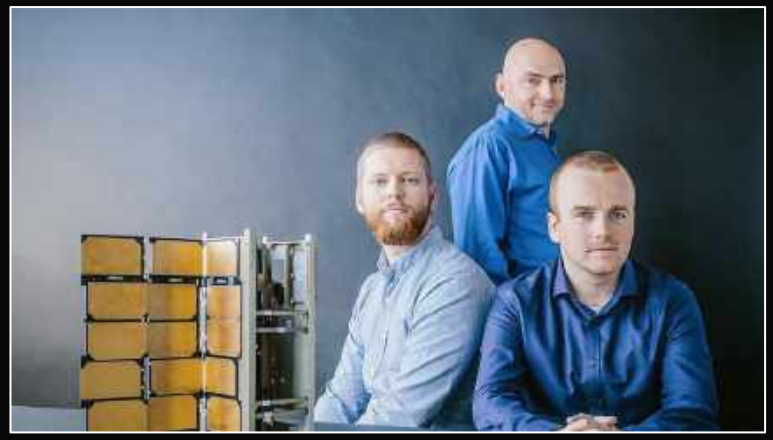

Commercial orbital opportunities

- Earth applications
  - Communications
  - Remote sensing
  - Navigation and Positioning
- Research
  - Experiments on space stations and satellites/ platforms
- Tourism
  - Trips to space stations/space hotels
- In-orbit satellite launch/servicing
  - Launch smallsats from space stations.
  - Service satellites, refuel, upgrade, etc.
- Debris removal
  - Capture and deorbit debris

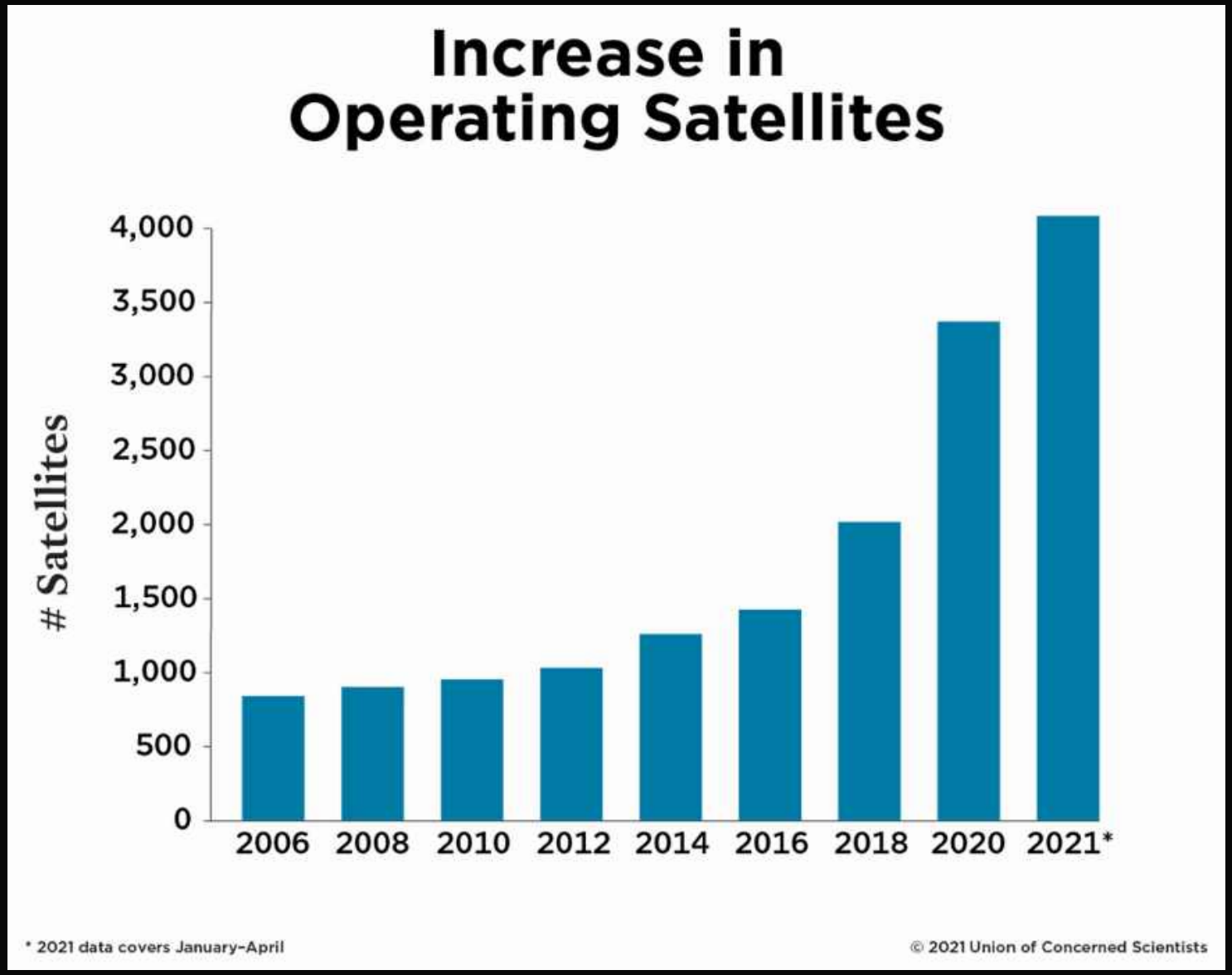
- Founded in 2010 by Will Marshall, Robbie Schingler, Chris Boshuizen
- Planet's goal is to image/monitor the entire Earth daily.
- Operates more than 200 active satellites

spire





- Operates 100+ CubeSats in LEO.
- Plans to replace them every 2-3 years.
- Satellites are used for tracking ships, and weather payloads measure temperature, pressure and precipitation


Increase in
Operating Satellites
Satellites
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2006
2008
2010
2012
2014
2016
2018
2020
2021*
* 2021 data covers January–April
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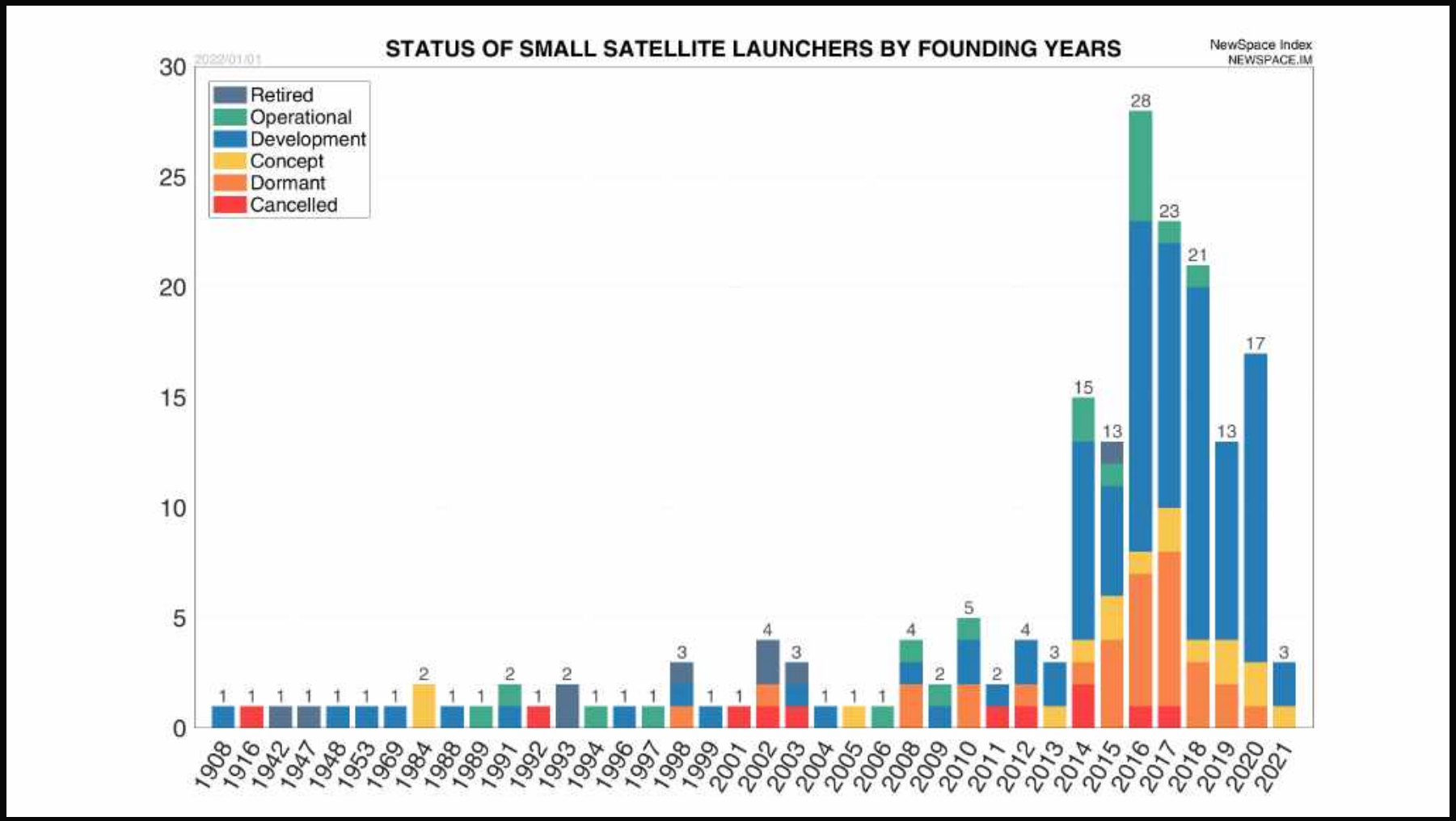
SPACEX

- Space Exploration Technologies Corporation (SpaceX) was founded by PayPal co-founder Elon Musk.
- Developing partially reusable launch vehicles, the Falcon 1, 9 and Heavy and the Dragon space capsules and the Starship.

- Rocket Lab is a US rocket company which currently operates its Electron smallsat launcher from New Zealand with a new launch site being constructed in Wallops Island, USA.

- Electron is a two-stage vehicle which uses RLs own 3D-printed. battery-powered liquid engines in both stages.

- Yesterday RL caught – briefly - the returning rocket stage.


STATUS OF SMALL SATELLITE LAUNCHERS BY FOUNDING YEARS
NewSpace Index
NEWSPACE.IM
2022/01/01
Retired
Operational
Development
Concept
Dormant
Cancelled
30
25
20
15
10
5
0
1908 1916 1942 1947 1948 1953 1969 1984 1988 1989 1991 1992 1993 1994 1996 1997 1998 1999 2001 2002 2003 2004 2005 2006 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
1 1 1 1 1 1 1 2 1 1 2 1 2 1 1 1 3 1 1 4 3 1 1 1 4 2 5 2 4 3 15 13 28 23 21 13 17 3

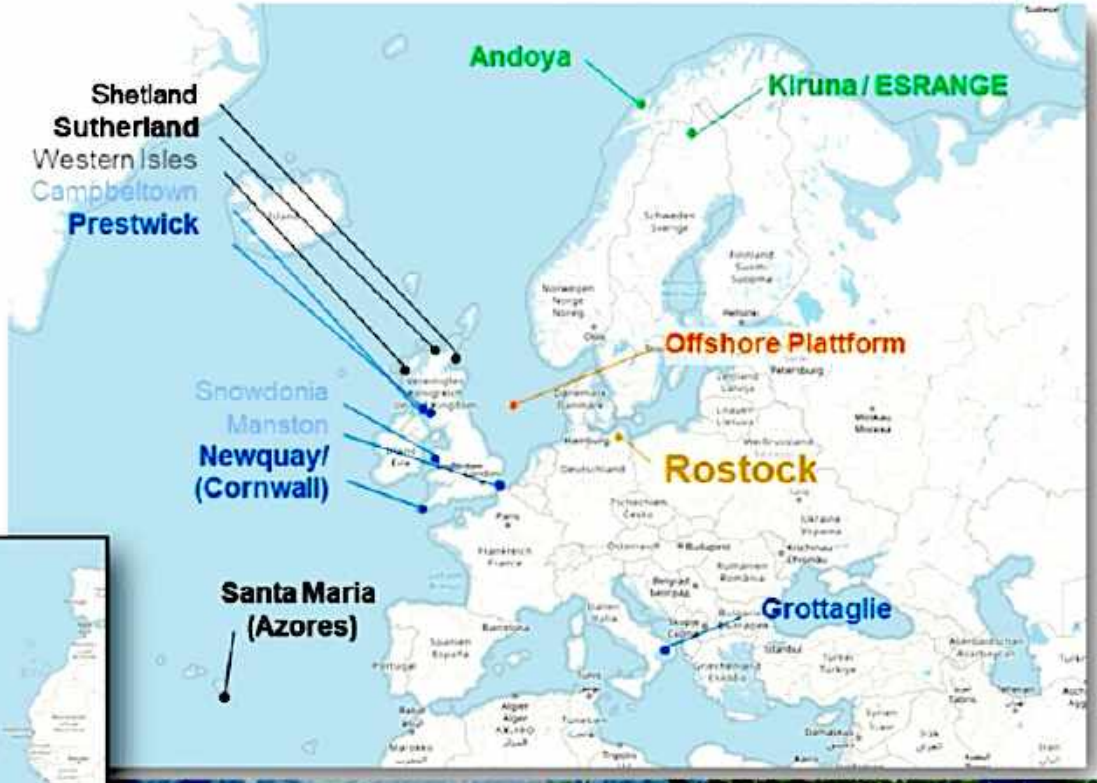
Spaceports in international competition: Europe

Quelle: DLR
Basiskarte und Daten von OpenStreetMap und OpenStreetMap Foundation

Rostock-Laage:

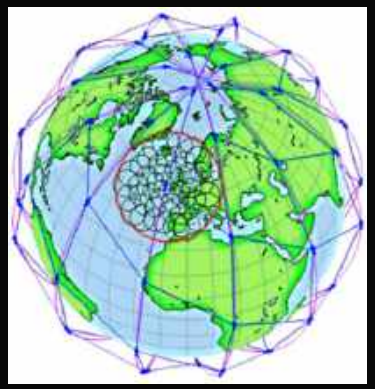
- **good geographical location**
- **base for airlaunch operations to relevant orbits**

- ***Operating***
- ***Planned for vertical launch***
- ***Planned for air launch / suborbital***
- ***Planned Spaceport Rostock***
- ***Planned Offshore launch pad***



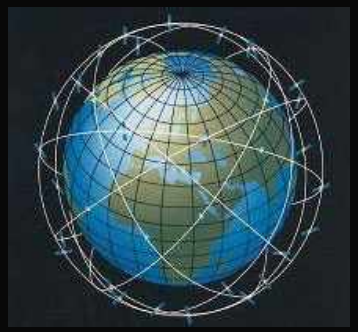
DLR

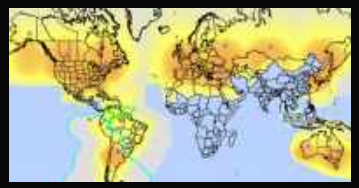
LEO Communications satellites



Iridium Satellite Constellation

- Iridium: 66 satellite constellation
  - Inter-satellite connection provides global coverage service
  - Altitude 781 km, Inclination 86.4^{o}
  - 6 orbital planes
  - Up to 10 kbps “direct internet” service

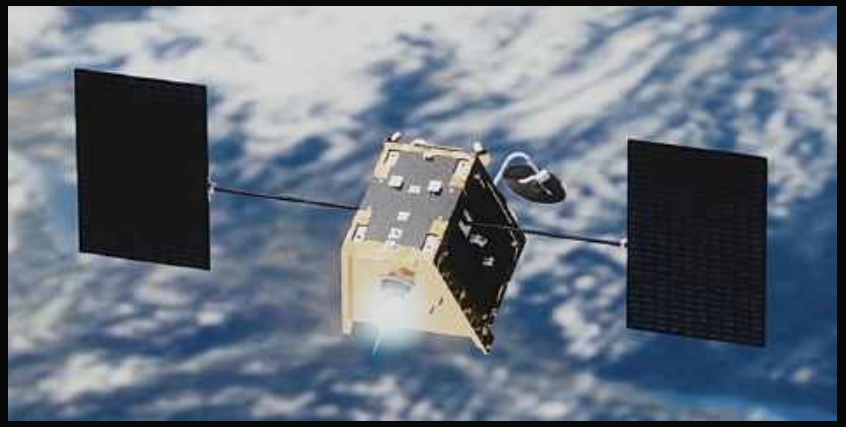


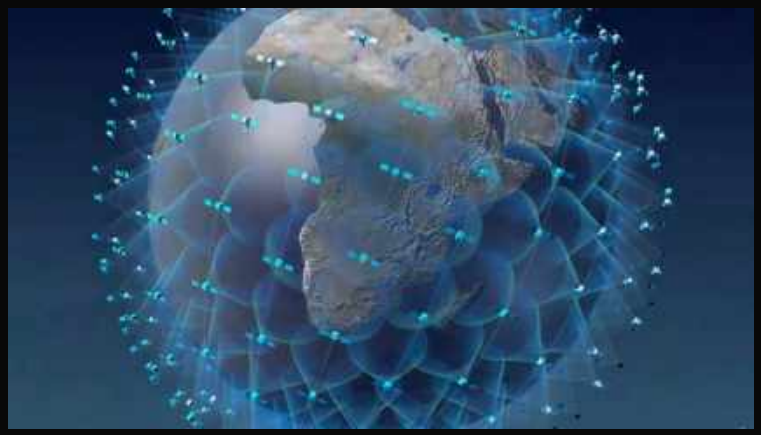


Globalstar Satellite Constellation & Voice coverage

- Globalstar: 48 satellite constellation
  - Limited global coverage service due to the connection through ground gateway stations
  - Altitude 1400 km, Inclination 52o
  - 8 orbital planes
  - 9.6 kbps packet-switched internet

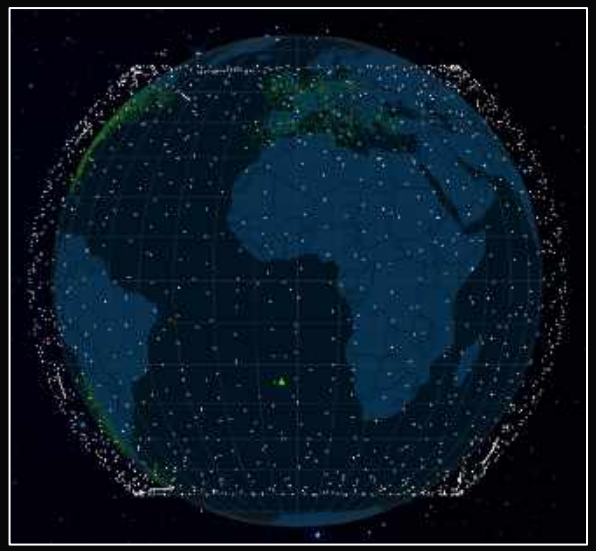
OneWeb





- OneWeb is deploying a constellation of 648+ LEO satellites to provide global high-speed internet access.
- The 150 kg satellites orbit at 1,200 km altitude in 18 polar planes using the Ku band.
- The user terminal antenna on the ground is a phased array antenna measuring approximately 36 by 16 centimeters and will provide Internet access at 50 Mbs.

Starlink

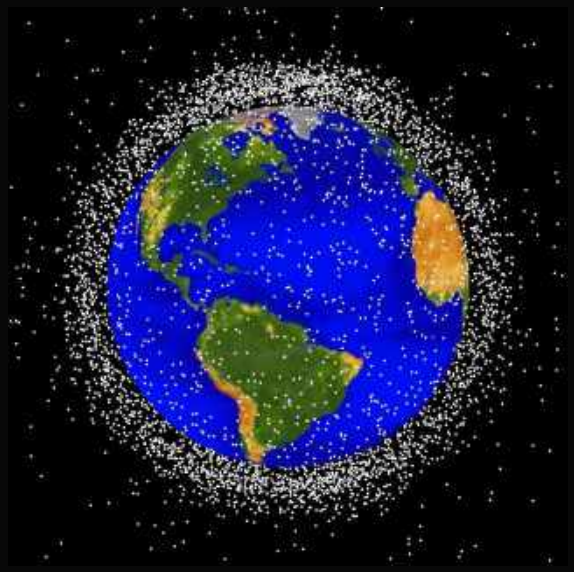


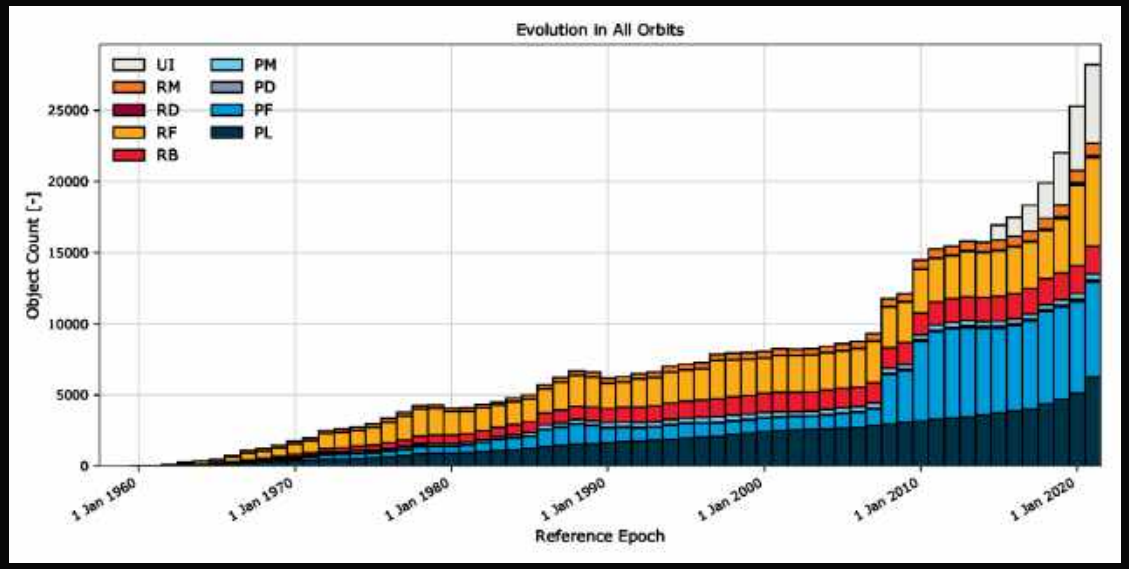
- For Starlink Phase 1, SpaceX plans to launch 4,100 satellites in five orbital shells
- In Phase 2, Starlink will launch another 7,500 satellites
- At the moment, SpaceX has launched around 2100 satellites.

Project Kuiper

- Amazon's Project Kuiper constellation plans to provide data coverage the region of the Earth between latitude 56° N and S.
- Currently, the plan is for 3,236 satellites: 784 at 590 km, 1,296 at 610 km and 1,156 at 630 km.

Space Debris





- As human space activities have increased, so has the amount of space debris.
- Consequently, measures are needed to prevent further increase.
  - Space traffic management
  - Debris removal

Space Tourism

- Since 2001, Space Adventures has launched seven clients on eight successful missions to the ISS.
  - 2001 – Denis Tito
  - 2002 – Mark Shuttleworth
  - 2005 – Greg Olsen
  - 2006 – Anousheh Ansari
  - 2006 – Charles Simonyi
  - 2008 – Richard Garriott
  - 2009 – Charles Simonyi
  - 2010 – Guy Laliberte

Inspiration-4

- Privately-funded 3-day ‘free-flyer’ mission using Space-X launch and capsule.

AXIOM SPACE

- In June 2019, NASA opened up the ISS to new commercial opportunitues and private astronauts.
- First private mission to ISS ended last week.
- Axiom will add its own module to ISS and eventually launch its own space station.

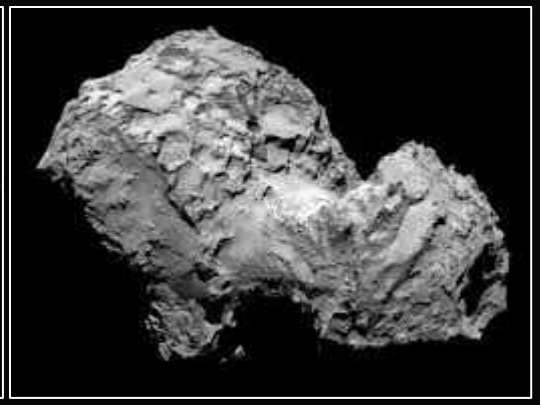
4.3 - Deep Space (Beyond GEO)

- We have also orbited/flown by Saturn, Jupiter/Io/Europa, Neptune, Uranus and Pluto as well as visiting other places such as Ceres, and Comet 67P.

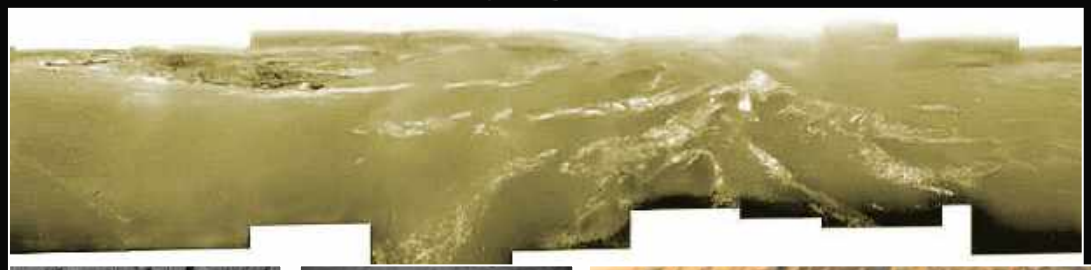


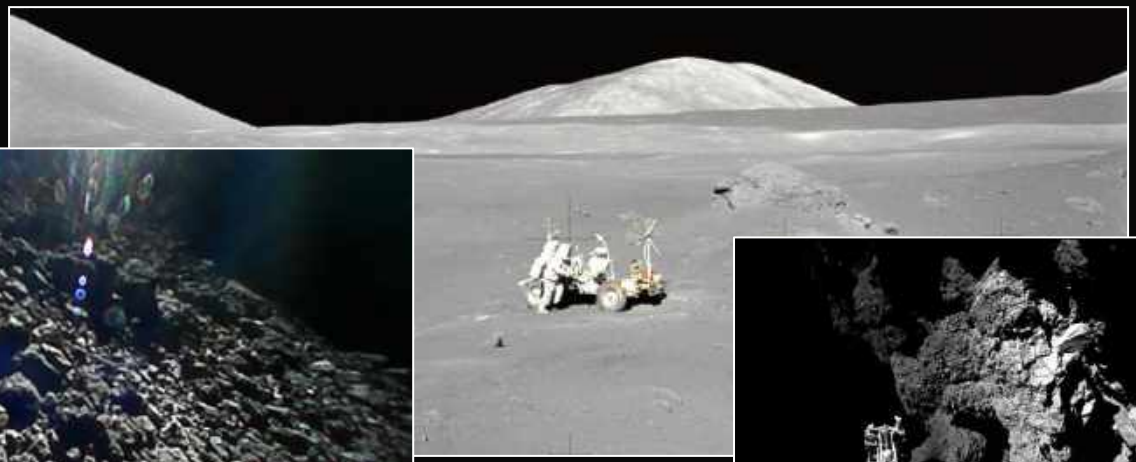






- We have landed on the Moon, Venus, Mars, Titan, Eros and Itokawa, Churyumov-Gerasimenko and Ryugu.



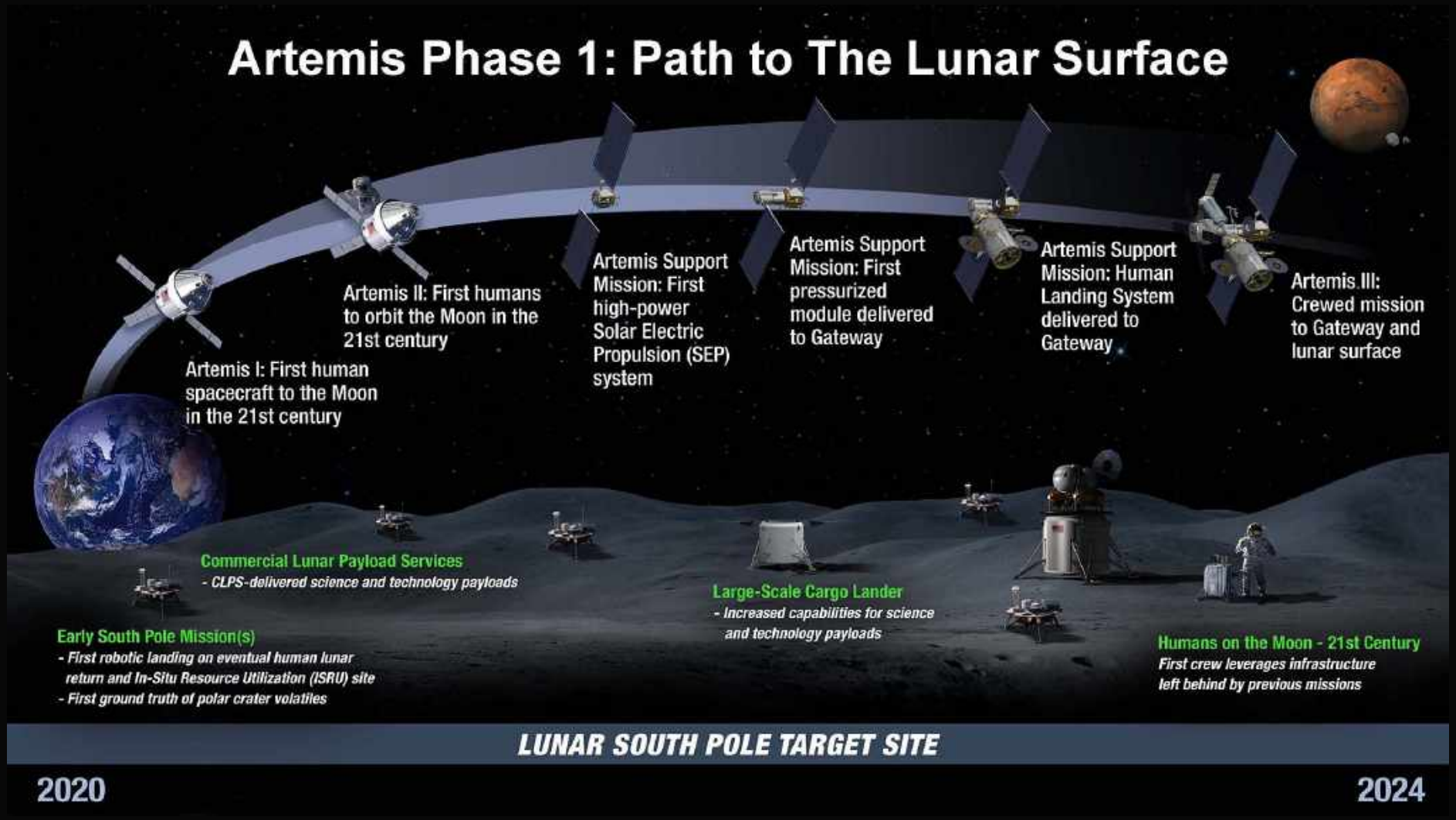


Commercial deep space opportunities

Research
- Wide variety of science/technology research
- Human performance in space research

- Extraterrestrial Resource Utilisation
  - Moon/asteroid mining for propellants and materials.
  - Energy generation
- Space-based infrastructure support
  - Space-based manufacturing
- Tourism
  - The ultimate trip!
- Settlement
  - Establishing humans in space and on other bodies.

Artemis


Artemis Phase 1: Path to The Lunar Surface
Artemis I: First human spacecraft to the Moon in the 21st century
Artemis II: First humans to orbit the Moon in the 21st century
Artemis Support Mission: First high-power Solar Electric Propulsion (SEP) system
Artemis Support Mission: First pressurized module delivered to Gateway
Artemis Support Mission: Human Landing System delivered to Gateway
Artemis III: Crewed mission to Gateway and lunar surface
Commercial Lunar Payload Services
- CLPS-delivered science and technology payloads
Early South Pole Mission(s)
- First robotic landing on eventual human lunar return and In-Situ Resource Utilization (ISRU) site
- First ground truth of polar crater volatiles
Large-Scale Cargo Lander
- Increased capabilities for science and technology payloads
Humans on the Moon - 21st Century
First crew leverages infrastructure left behind by previous missions
LUNAR SOUTH POLE TARGET SITE
2020
2024

Human lunar landers

+?

NASA Commercial Lunar Payload Services

- Through CLPS NASA has contracted for small lunar landers/rovers to support its human Artemis program.

- So far, three contracts have been awarded:
  - Astrobotic
  - Intuitive Machines
  - Masten Space Systems

- NASA has stated that it would buy lunar regolith and rocks from private companies.

LUXEMBOURG - LUXEXPO THE BOX/
HYBRID EVENT

SPACE RESOURCES WEEK

Supported by:

Luxembourg Space Agency,
European Space Agency,
Luxembourg Institute of Science & Technology.

03 - 05 MAY
2022

The Space Resources Week 2022, organized in Luxembourg, is a 3-day conference connecting thought leaders from the terrestrial resources sector, aerospace industry, financial institutions, research institutes and academia. It aims at understanding the technical and economic challenges facing in-situ resource utilization (ISRU) and elaborating recommendations for the future development of this high technology sector.

Organized by the European Space Resources Innovation Centre (ESRIC), in collaboration with the European Space Agency (ESA) and the Luxembourg Space Agency (LSA), the program of the event will include a series of captivating talks and facilitated discussion sessions on the technologies, business models and next steps that will enable space resources utilization in support of sustained and sustainable human presence on the Moon and beyond.


4TH SUMMIT FOR SPACE SUSTAINABILITY
LONDON, 22-23 JUNE 2022

Thank you for your attention