

Provided by Interstellar Communication Holdings Inc.

Beyond the Skies: A Guide for Investors in the Satellite Industry

Jan 2024

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Why are Satellites Important?

- Satellites and our access to space offer **tangible benefits** to people worldwide.
- A day without satellites would be **exceptionally challenging**.
- Satellites constitute the **backbone of the commercial space industry**, contributing significantly to economic growth, generating revenue, and creating job opportunities



How Satellite Impact Your World

Five Ways You Might Know...



**Weather
Forecasting**



Television



Cell Phones



**Military
Communications**



Navigation

And Some You Might Not...



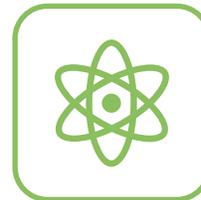
Banking



Agriculture



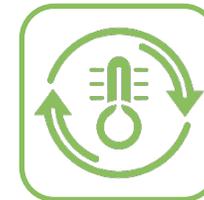
Search & Rescue



**Scientific
Discovery**



Aviation



**Climate
Monitoring**

What Is a Satellite?

- Derived from the Latin word '**satellus**,' meaning a servant or attendant, a satellite is one that serves a powerful master or Lord.
- First named for the moons of the planets (named for ancient gods) that seemed to run quickly around their masters
- In essence, **a satellite can be a moon, a planet, or a machine that orbits a planet or star**. For instance, Earth is a satellite as it orbits the sun, and the moon is a satellite as it orbits Earth. Typically, when we refer to satellites, we mean artificial machines launched into space, revolving around Earth or another celestial body.



What are the Parts of a Satellite?

Bus

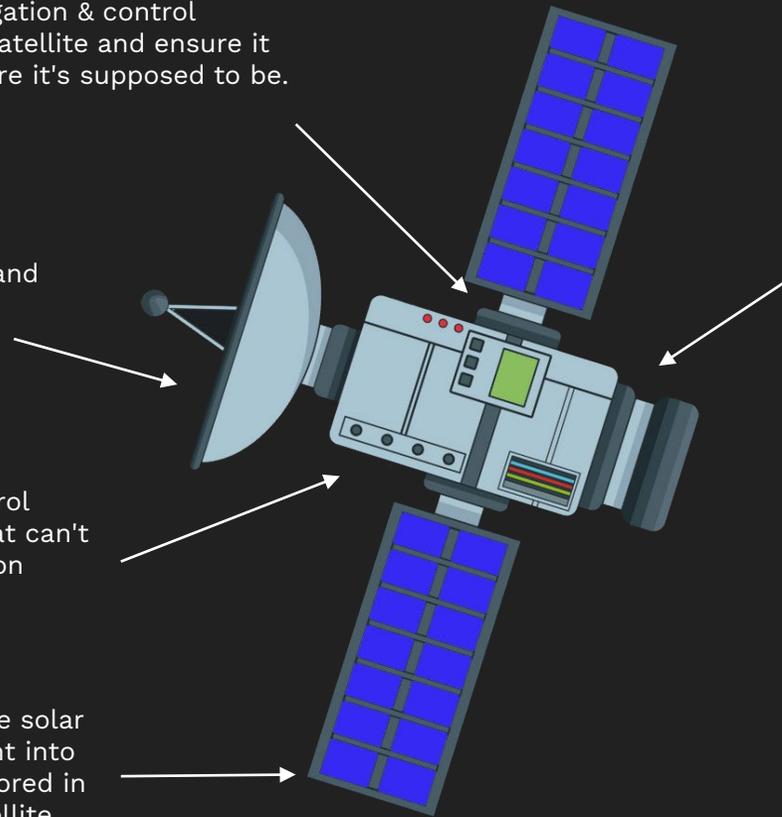
The main structure of the spacecraft, the bus houses the power and communications systems, guidance, navigation and control, antennas and avionics.

GNC: Guidance, navigation & control systems 'steer' the satellite and ensure it remains in orbit where it's supposed to be.

Antenna: Satellite antenna system transmit signals to and from terminals on Earth.

Avionics: These components control every aspect of the spacecraft that can't be commanded via a ground station

Power: Most satellite use solar arrays to convert sunlight into energy. Energy is also stored in batteries within the satellite.



Payload

The payload is made up of the components specific to the satellite's mission.

Payload module: Contains the components and electronics for mission systems. Examples:

Communication satellite: Transponders to send and receive signals; amplifiers, receivers, transmitters

Earth observation satellite: Cameras, sensors, spectrometers

GPS satellite: Atomic clocks, signal generators

Scientific satellite: Telescopes, particle detectors, spectrometers, magnetometers, or other scientific instruments.

How Big is a Satellite?



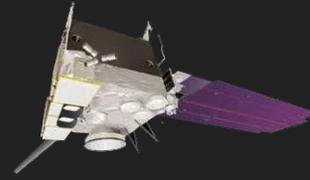
GOES-R

6,173lbs/ 2,800kg



PICKUP TRUCK

7,000lbs/ 2,175kg



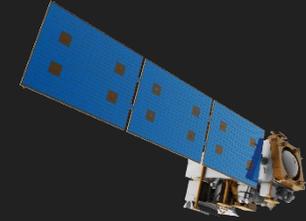
GOES-15

3,395lbs/ 1,540kg



HIPPOPOTAMUS

3,250lbs/1,474kg



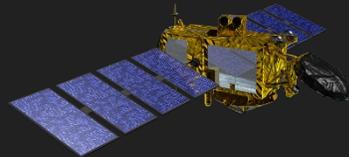
SUOMI NPP

3,086lbs/ 1,400kg



1965 VW BUG

1,900lbs/ 862kg



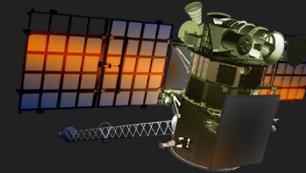
JASON-3

1,157lbs/ 525kg



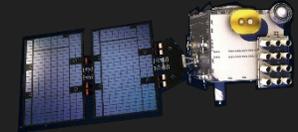
GRAND PIANO

1,000lbs/ 454kg



DSCOVR

677lbs/ 307kg



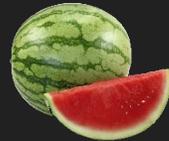
ONE COSMIC-2

617lbs/ 280kg



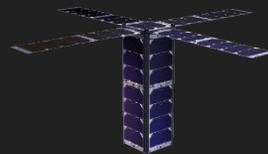
42in RIDING LAWN MOWER

400lbs/ 181kg



WATERMELON

20lbs/ 9kg



EARTH OBSERVATION CUBESAT

9.3lbs/ 4.2kg



PocketQube SAT

0.55lbs/ 0.25kg



iPhone 15 Pro Max

0.49lbs/ 0.22kg

Classes of Satellites

Largesat > 2500 kg

- Large complex design, redundant, multiple missions
- ISS, Hubble, TDRS, JWST
- Launch scenario: EELV H or M, Falcon 9, Ariane V, Proton

Medsat < 2500 kg

- Complex design, redundant, multiple missions
- GPS, Direct Broadcast, GlobalStar
- Launch scenario: Antares, Delta, Ariane IV, H-II, Long March

Smallsat < 500 kg

- Reduced redundancy, single-missions focus
- Orbcomm, STEP, Lewis and Clark, EarlyBird, Iridium
- Launch scenario: Taurus, Pegasus, Minotaur I/IV

Microsat < 180 kg

- Simple design, minimal redundancy, often experimental
- MightySat, CFESat, STPSat
- Launch scenario: ESPA, Minotaur IV multiple

Nanosat < 10 kg

- Modular mass-producible design, little/no redundancy
- SNAP, NanoCore, Multi U CubeSat
- Launch scenario: Secondary payload, multiple satellite dispenser

Picosat < 1 kg

- Integrated circuit, utilization of MEMS, multichip modules
- Single U CubeSats
- Launch scenario: Secondary/tertiary payload, multiple-satellite dispenser

PocketQube < 250g

- Miniaturized satellites, measuring just 5x5x5 centimeters and weighing less than 250 grams

Chipsats - grams

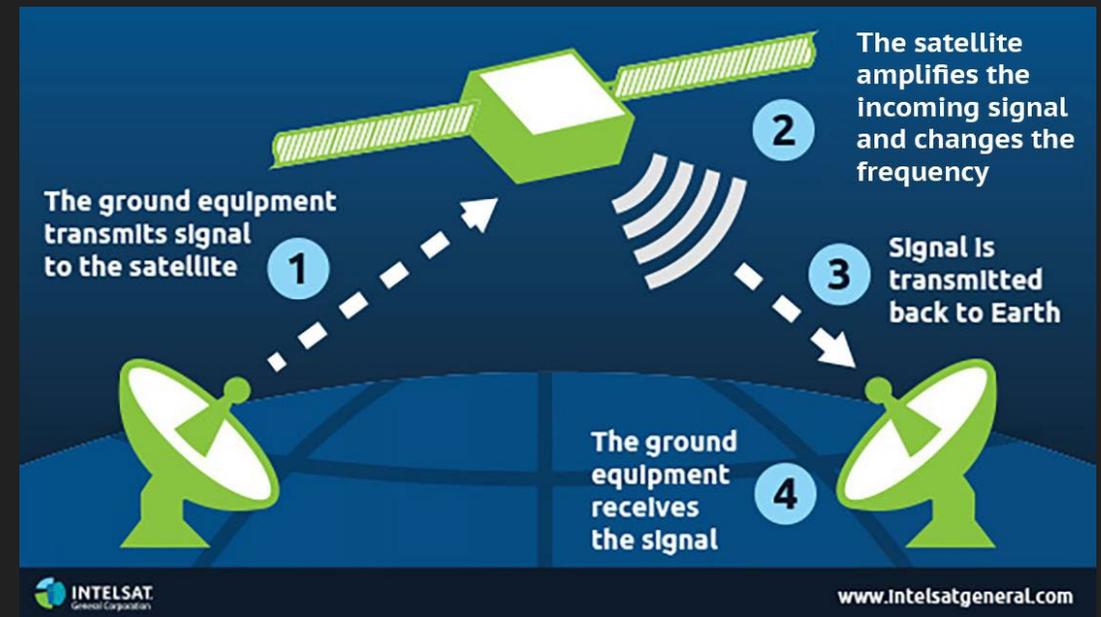
Key Satellite Network Elements

Space Segment

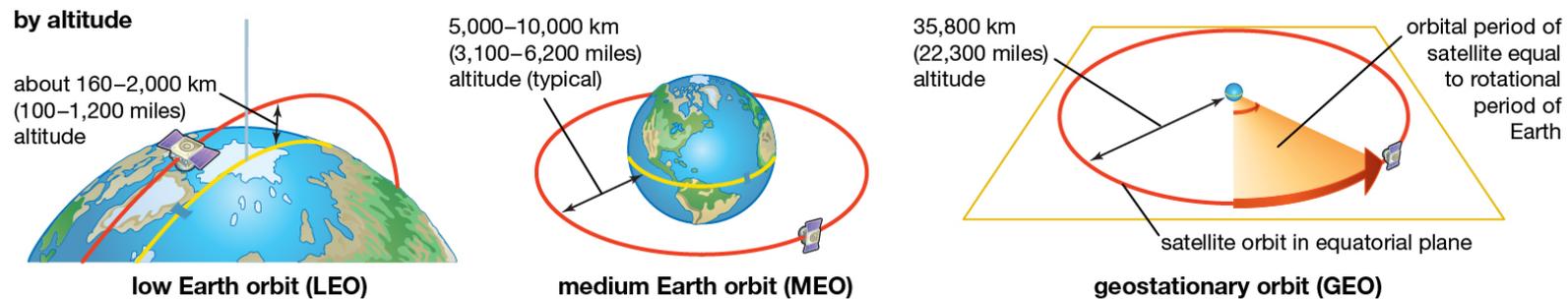
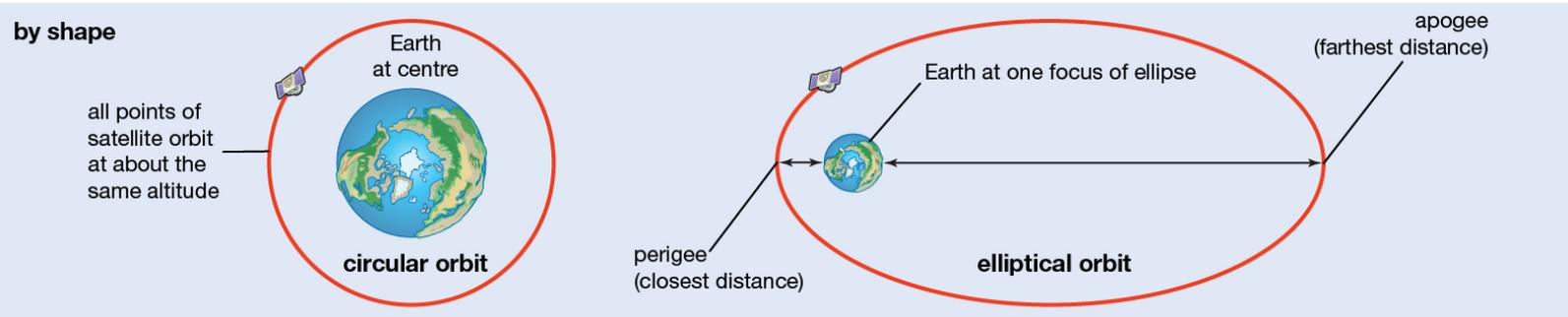
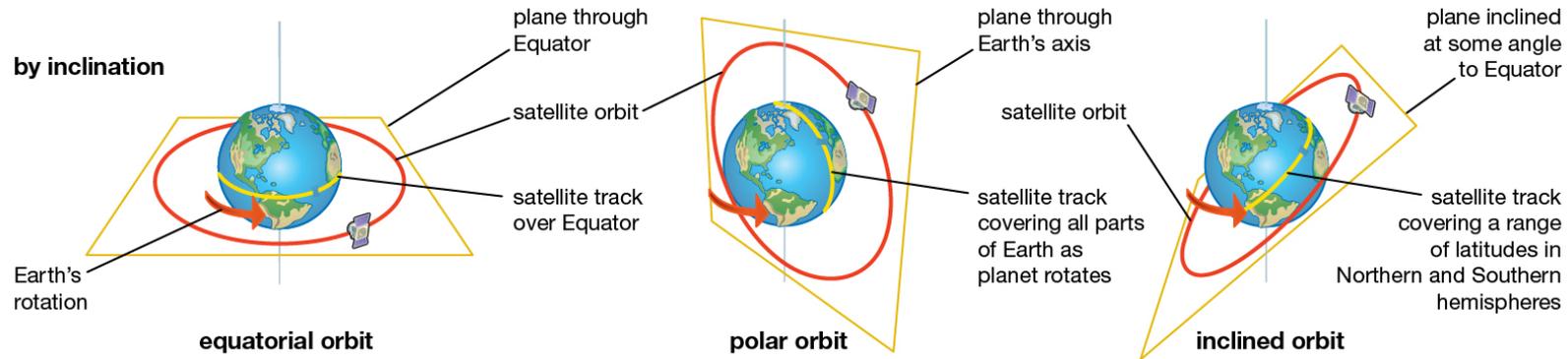
- Satellites in geostationary orbit or non-geostationary orbit (medium earth orbit, or low earth orbit)

Ground Segment

- Telemetry, Tracking, and Control (TT&C): used to “fly” the satellite
- Gateway/Hub: used to manage communications
- User Terminals: devices used to connect the customer to the satellite network



Types of Orbits



Features and Applications of Satellite Orbits

There are many factors that decide which orbit would be best for a satellite to use, depending on what the satellite is designed to achieve.

Geostationary Orbit (GEO):

- Ideal for satellites requiring a fixed position above a specific point on Earth.
- Applications: **Telecommunication, weather monitoring.**

Low Earth Orbit (LEO):

- Positioned close to Earth with numerous available routes.
- Applications: **Imaging, Internet of Things (IoT).**

Medium Earth Orbit (MEO):

- Offers flexibility in orbital paths.
- Applications: **Navigation systems.**

Polar Orbit and Sun-Synchronous Orbit (SSO):

- Ensures constant observation of a point on Earth, simulating a consistent time of day.
- Applications: **Climate and environmental monitoring.**

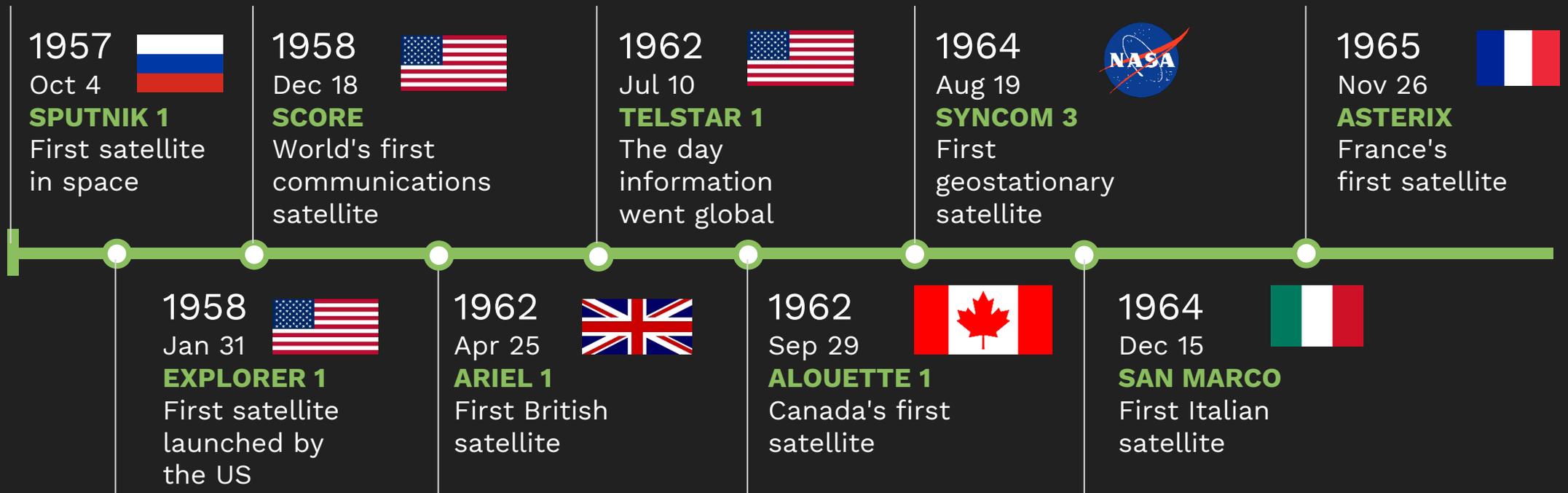
Transfer Orbits and Geostationary Transfer Orbit (GTO):

- Enables efficient movement from one orbit to another using minimal energy.
- Essential for satellite or spacecraft **trajectory adjustments.**

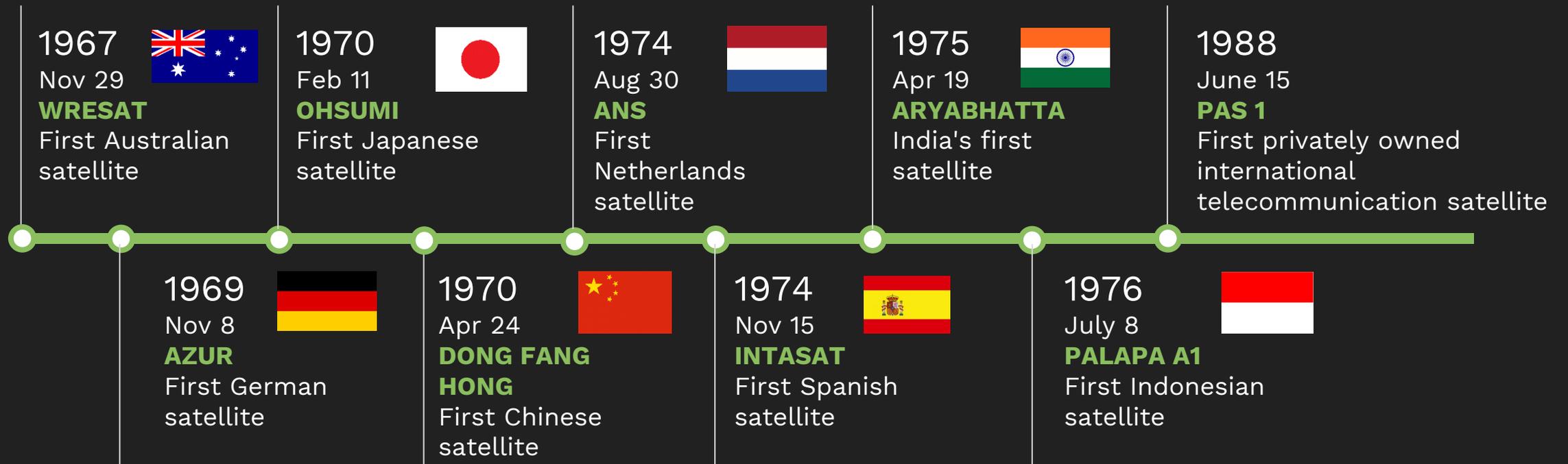
Lagrange Points (L-points):

- Strategic points in space where gravitational fields of Earth and the Sun create stable orbits.
- Spacecraft can remain anchored relative to Earth.

History of Satellites I

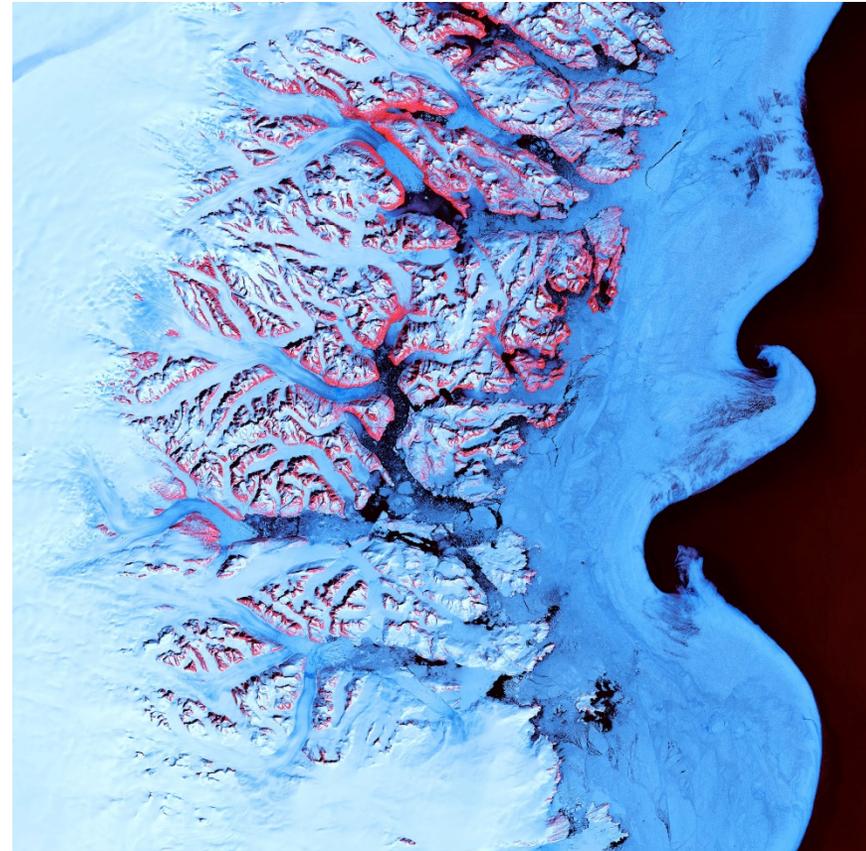


History of Satellites II



Satellite Services & Applications - Remote Sensing & Imaging

Remote sensing satellites detect both **visible light** for photographs as well as **electromagnetic radiation** used for microwave, ultraviolet, infrared, radio, and other types of sensing. This information is used by **weather forecasters, farmers, natural resources companies, geologists** and other scientists, government users, and a host of other customers.



Satellite Services & Applications - Mobile Communications

Mobile communications satellites provide ubiquitous **voice and data** services to users virtually anywhere, far beyond the coverage provided by cellular or terrestrial networks.



Satellite Services & Applications - Broadband Connectivity

Many communications satellites provide **high speed broadband** services. Many more constellations (networks of satellites) are being launched and developed which will also help bridge the “Digital Divide” and provide connectivity for users on land, sea and in the air.



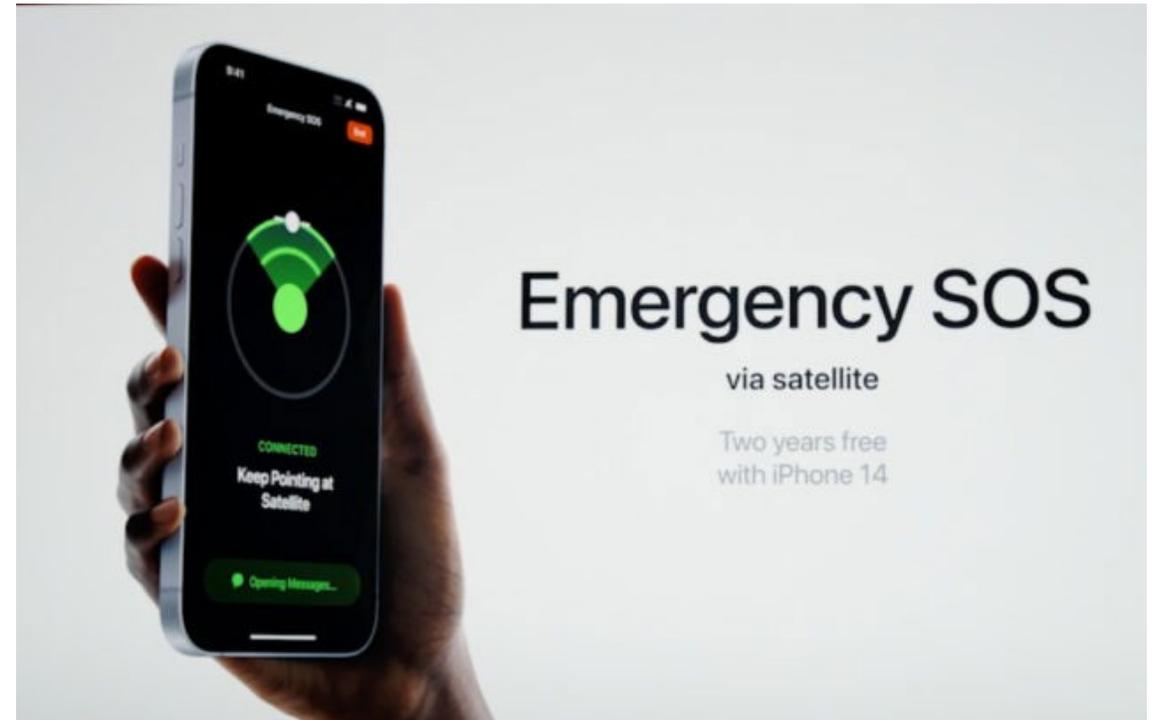
Satellite Services & Applications - GPS & Navigation

GPS satellites provide location-based services for navigation devices, including the average smartphone. They also serve billions of customers with timing information which is critical for the operation of everyday services such as **cellular mobile and financial networks, power grids, FAA weather radar** and more – all of it free of charge.



Satellite Services & Applications - Emergency Response

Because satellites fly far above the Earth's surface, this makes space-based voice, data and broadband services ideal for use by **emergency responders** who often require service where terrestrial networks have been damaged or destroyed by hurricanes, earthquakes, or other disasters. Satellites also provide connectivity for average citizens in the months it may take to rebuild cell towers.



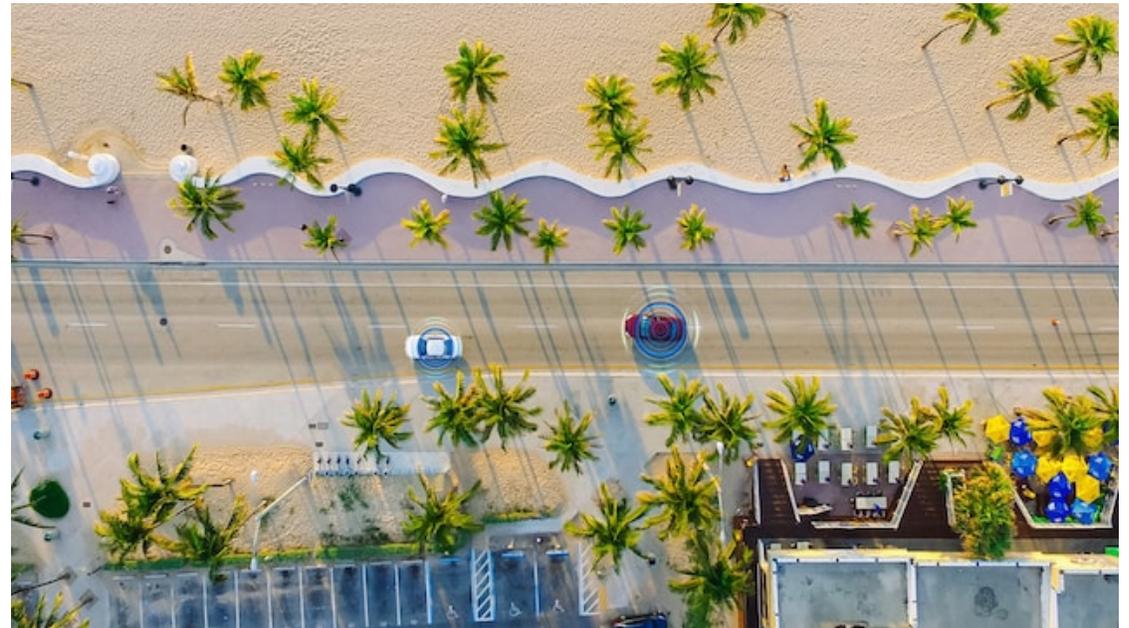
Satellite Services & Applications - Satellite TV & Radio

Broadcast satellites transmit **video of live news and sporting events** so that viewers around the world can watch these events take place live and as they happen. Satellite television and radio signals provide news, weather, sports and entertainment to millions of consumers in the U.S. and around the globe.



Satellite Services & Applications - IoT and M2M

The Internet of Things (IoT) describes devices that are networked or connected to the internet. This include **laptops, tablets and cell phones** but it also includes a myriad of devices such as **vending machines, tracking tags, oil and gas wells, connected automobiles,** and literally billions of other devices. Satellite data can connect many of these devices even when they are operating far beyond the coverage of terrestrial networks.



Satellite Services & Applications - Satellite Telehealth

Telehealth services are used to remotely **connect patients to health care professionals via the internet**, allowing them to remotely monitor the progress and condition of a patient without being onsite. Satellite data services are particularly suited to connect patients who are located in **rural regions**, across America and the entire world, who do not have access to terrestrial broadband coverage.



Types of Satellite Data

Land



Optical sensors

Condition of the Earth's surface



SAR sensors¹

Changes in the Earth's surface



Thermal infrared sensors

Temperature of the Earth's surface

Air



ADS-B²

Position of aircrafts



Microwave scanning radiometer, Precipitation radar

Precipitate



Lidar

Particles, wind velocity

Sea



AIS³

SAR sensors

Position of vessels



Microwave scanning radiometer precipitation radar

Sea temperature



Microwave scatterometers

Sea surface winds



Microwave altimeters

Sea surface height



Microwave scanning radiometer SAR sensors

Sea ice

Source: sorabatake

1. synthetic aperture radar 2. Automatic Dependent Surveillance-Broadcast 3. automatic identification system

How Many Satellites

<https://orbit.ing-now.com/>



2024 DAY 17

Welcome - thousands of Satellites and countless other objects (including the Moon) are orbiting our Planet right now, use this web site to browse active Satellite information derived from TLE orbit data and other public domain resources.



 9229 Objects

- ▶ Low Earth Orbit (LEO) : 8348
- ▶ Medium Earth Orbit (MEO) : 205
- ▶ HEO / Graveyard : 26
- ▶ Geostationary Orbit : 551
- ▶ : 87
- ▶ Orbital Decay : 6
- ▶ Reentry : 6

Where are the Satellites

Check GNSS¹ Satellites

<https://www.gnssplanning.com/#/settings>

The screenshot shows the Trimble GNSS Planning Online interface. The top navigation bar includes 'Settings', 'Satellite Library', 'Charts', 'Sky Plot', and 'World View'. The main content area is divided into sections for 'Satellite Selection' and 'My Settings'. The 'Satellite Selection' section shows a table of satellite systems with their status and counts. The 'My Settings' section shows the 'Time of almanac' as 2023-11-15. The right side of the interface displays a grid of satellite health status for various systems, including GPS, GLONASS, Galileo, and BeiDou. Each satellite is represented by a small icon with its ID and health status (Healthy or Unhealthy).

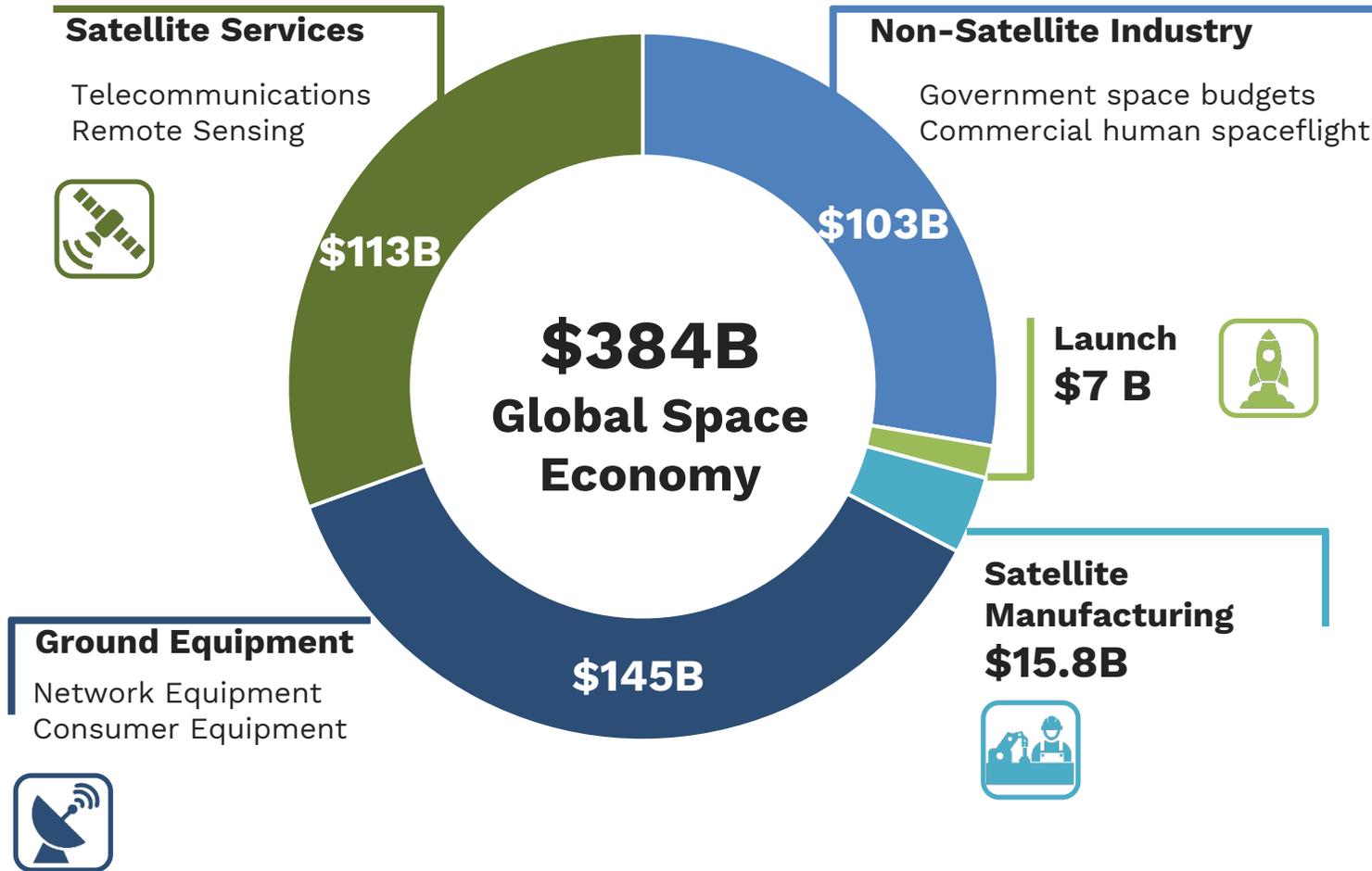
System	Selected	Healthy
GPS	31	31
GLONASS	24	24
Galileo	25	25
BeiDou	46	46
QZSS	5	5

The screenshot shows the Satellite Explorer website. The main visual is a 3D rendering of Earth with numerous white lines representing satellite orbits. The website has a dark theme with white text. The top navigation bar includes 'Satellite Explorer', 'SEARCH', and 'ABOUT'. The bottom of the page features four columns of text: 'PURPOSE: Why do we need satellites?', 'ORBITS: Where are satellite orbits?', 'OWNERS: Who owns all the satellites?', and 'DEBRIS: What is space debris?'.

Search and Check Owners of Satellites

<https://geoxc-apps.bd.esri.com/space/satellite-explorer/>

2022 Global Satellite Industry Revenues

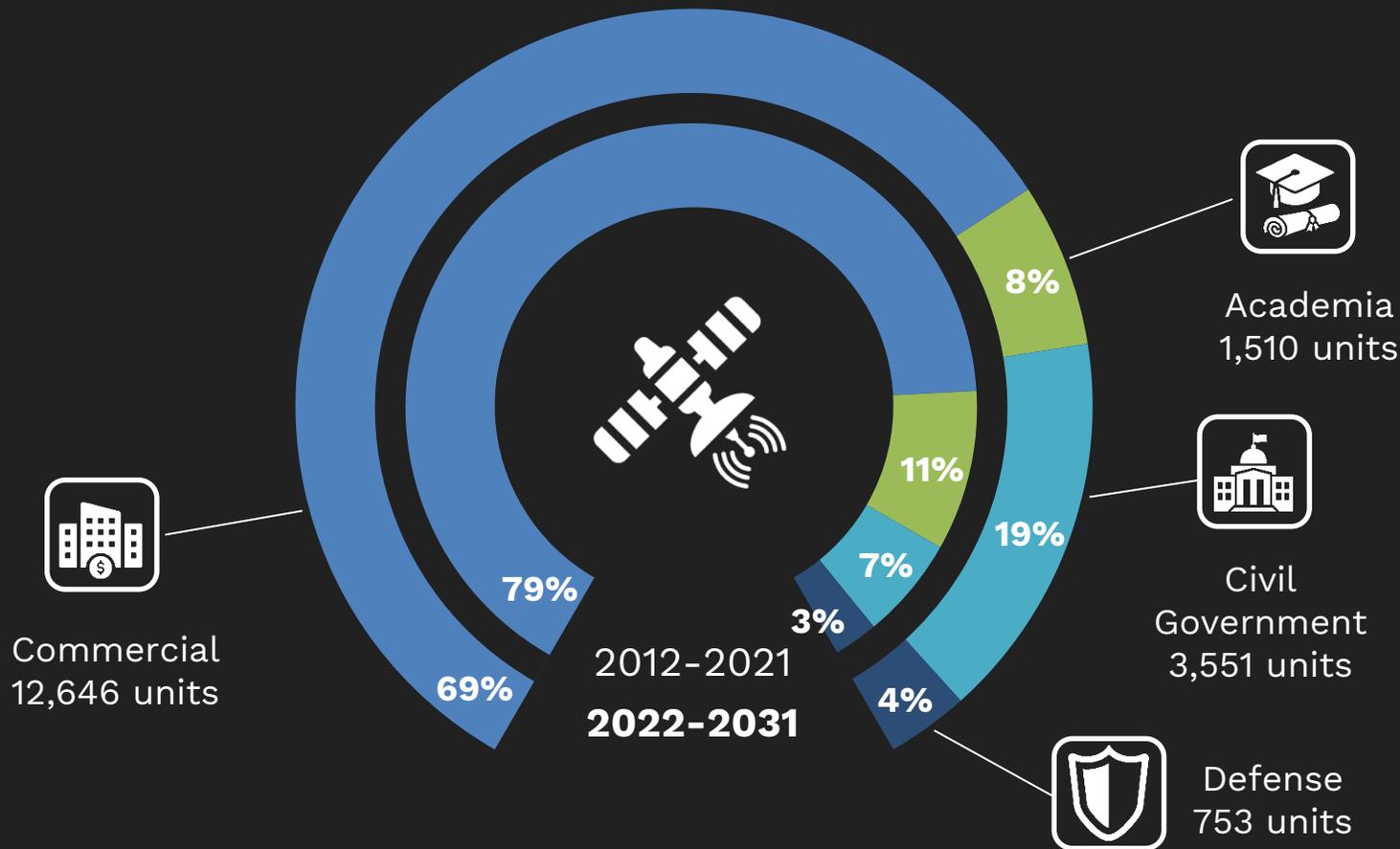


The commercial satellite industry continued to be dominant, increasing to **\$281 billion** and accounting for more than **73 percent** of the world's space business.

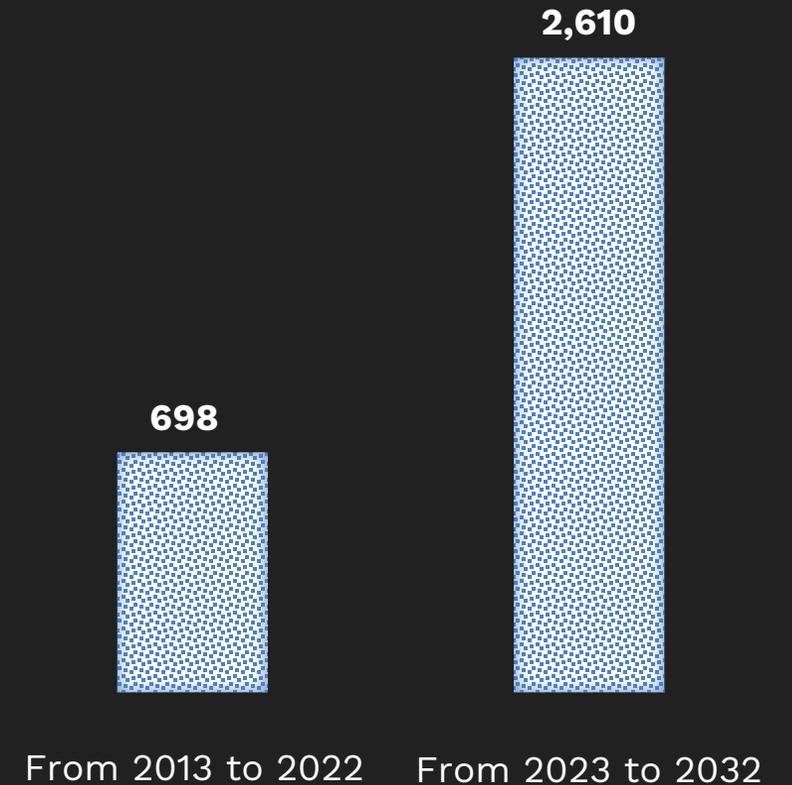
A total of **2,325** commercial satellites were deployed during 2022, an increase of over **35 percent** compared to the previous year, while the space industry once again conducted the most launches (161) in history.

Rise of Small Satellites Industry

Small Satellites by Operator Status

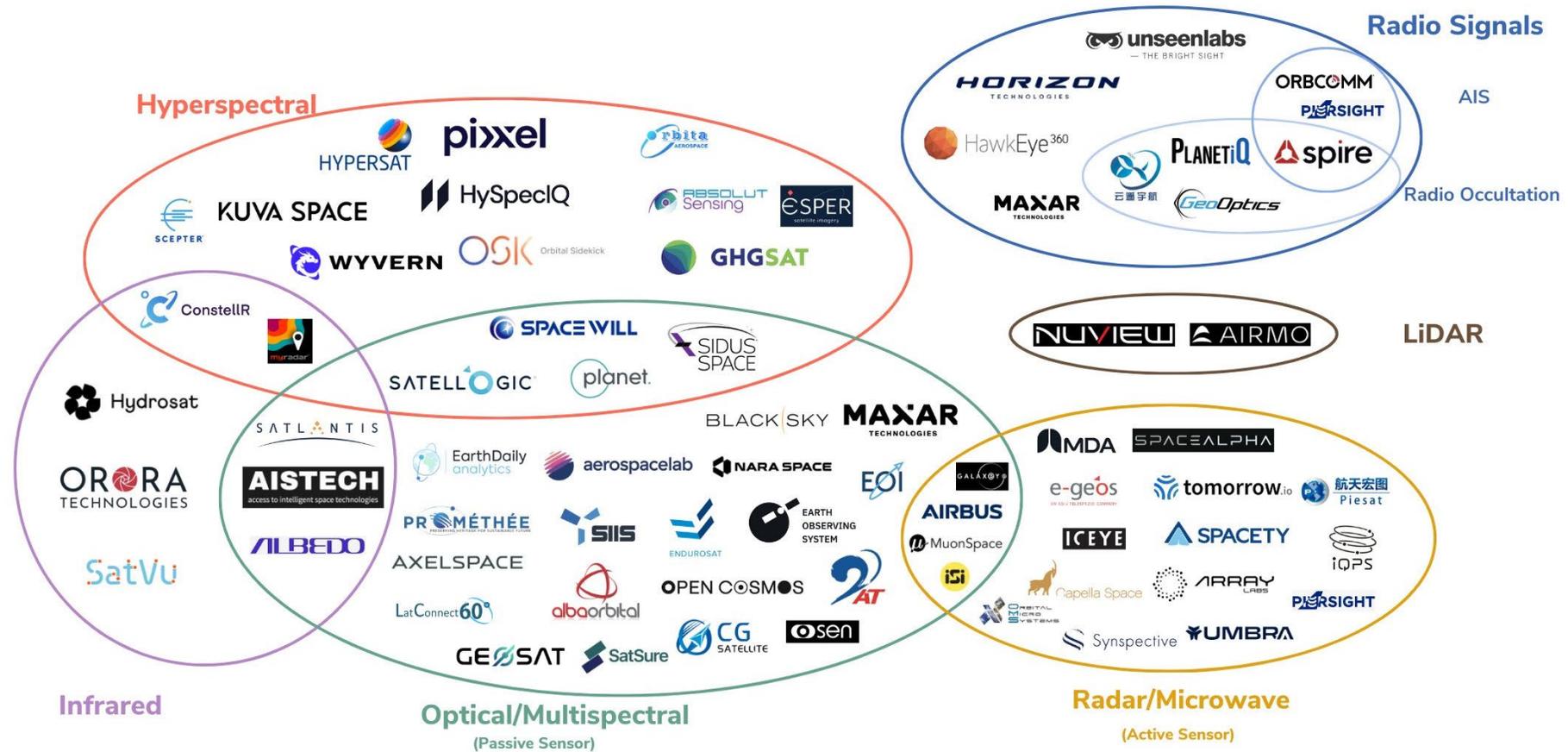


Average number of smallsats launched per year



Industry Landscape – Earth Observation

Earth Observation: Commercial Satellite Companies



Industry Landscape – Manufacturing and Data Service

Cubesats



Satellite Manufacturing



Satellite Accessories



Satellite Data Analytics



Space Data Infrastructure



Industry Landscape – Satellite Services

Network Provider



5G Access



IoT Networks



Public Company Players – Satellite Manufacturing

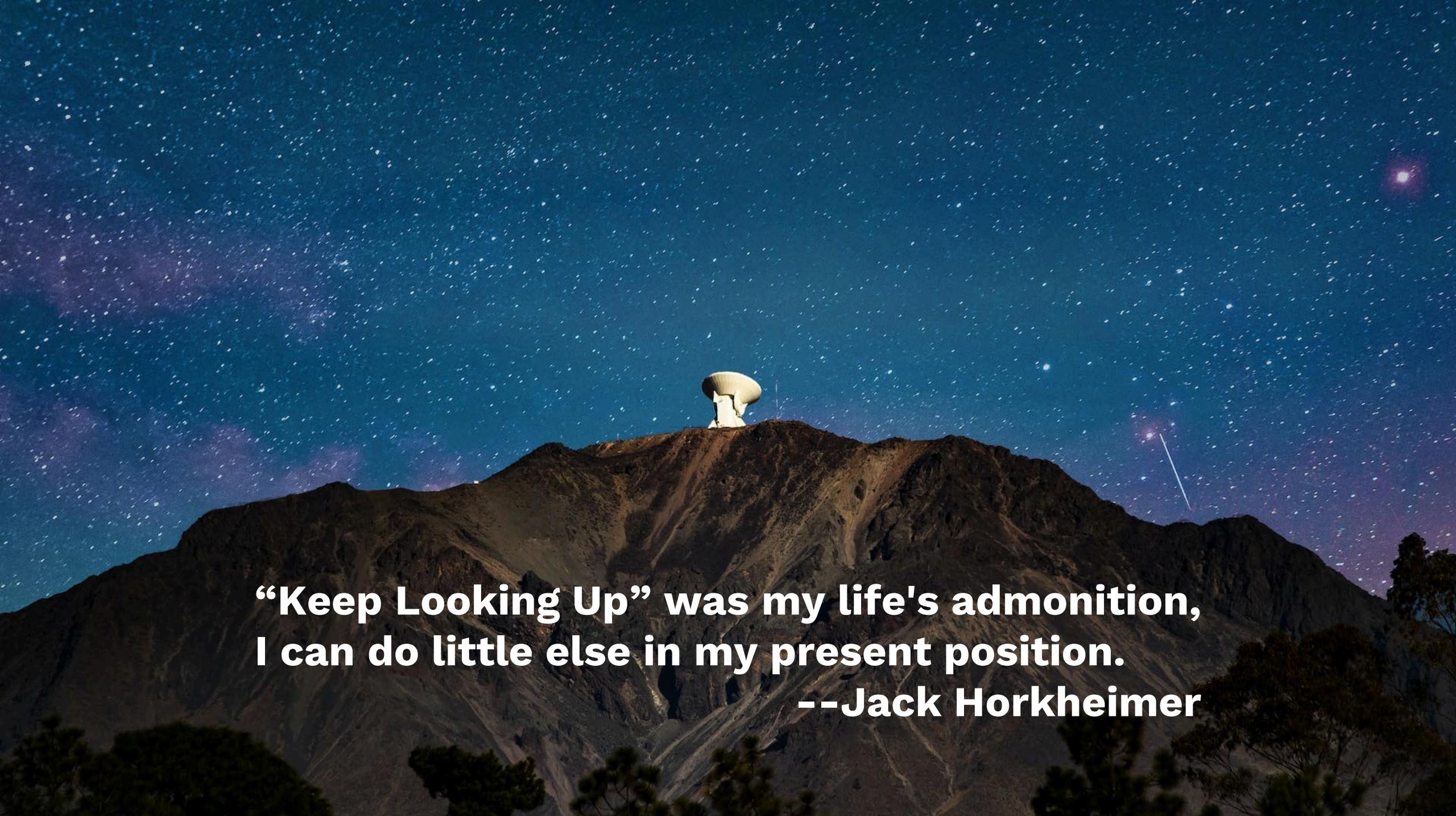
Company Name	Ticker	Business Focus	Website
Airbus	EADSY	Systems that range from electronic components to full telecommunications relay platforms, scientific satellites and crewed spacecraft, developing the technology to send spaceships to planets	https://www.airbus.com/en/products-services/space
Boeing	BA	Systems that range from electronic components to full telecommunications relay platforms, scientific satellites and crewed spacecraft, developing the technology to send spaceships to planets	https://www.boeing.com/space/
Lockheed Martin Corp.	LMT	A global security and aerospace company engaged in the research, design, development, manufacture, integration and sustainment of advanced technology systems, products and services.	https://www.lockheedmartin.com/en-us/capabilities/space.html
L3Harris Technologies, Inc.	LHX	Deliver end-to-end technology solutions connecting the space, air, land, sea and cyber domains	https://www.l3harris.com
Sidus Space, Inc.	SIDU	Space and Defense-as-a-Service company focused on mission-critical hardware manufacturing combined with commercial satellite design, manufacture, launch, and data collection.	https://www.sidusspace.com
Terran Orbital Corporation	LLAP	Manufactures and sells satellites for aerospace and defense industry in the United States	https://terranorbital.com

Public Company Players – Satellite Communication

Company Name	Ticker	Business Focus	Website
Amazon	AMZN	Amazon Web Services (AWS), Project Kuiper internet satellites.	https://ir.aboutamazon.com/overview/default.aspx
AST SpaceMobile, Inc.	ASTS	Space-based cellular broadband network to be accessible by standard smartphones	https://ast-science.com/
EchoStar Corporation	SATS	Premier global provider of satellite communication solutions	https://www.echostar.com
Iridium Communications Inc.	IRDM	Global satellite communications. Iridium designs and builds a number of products including satellite phones, Internet of Things (IoT) terminals, and mobile connectivity solutions.	https://investor.iridium.com/
Telesat Corporation	TSAT	Global satellite operator	https://www.telesat.com
Viasat, Inc.	VSAT	High-speed satellite internet	https://www.viasat.com/
SatixFy	SATX	Satellite communications systems, including satellite payloads, user terminals and modems	https://ir.satixfy.com/overview/default.aspx
Globalstar	GSAT	Satellite and terrestrial connectivity services as an international telecom infrastructure provider.	https://investors.globalstar.com/
Gilat Satellite Networks Ltd.	GILT	Satellite-based broadband communications	https://www.gilat.com/investor-relations/

Public Company Players – Satellite Data Service

Company Name	Ticker	Business Focus	Website
BlackSky Technology	BKSY	Real-Time Geospatial Intelligence	https://www.blacksky.com/
Planet Labs	PL	provides daily satellite data that helps businesses, governments, researchers, and journalists understand the physical world and take action	https://www.planet.com/
Satellogic	SATL	vertically integrated geospatial company. scalable, fully automated EO platform with the ability to remap the entire planet at both high-frequency and high-resolution, providing accessible and affordable solutions for customers.	https://investors.satellogic.com/
Spire Global	SPIR	offering access to unique datasets and powerful insights about Earth from the ultimate vantage point so that organizations can make decisions with confidence, accuracy, and speed.	https://spire.com/

A night sky filled with stars and the Milky Way galaxy. In the center, a white satellite dish sits atop a dark, rocky mountain peak. The sky is a deep blue, and the Milky Way is visible as a faint, glowing band of light. A bright star is visible in the upper right, and a comet or meteor streak is seen in the lower right. The foreground shows the dark silhouettes of trees.

**“Keep Looking Up” was my life's admonition,
I can do little else in my present position.
--Jack Horkheimer**

THANK YOU



Interstellar Communication Holdings Inc.

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Earth, Solar System, Milky Way, Laniakea

The Pale Blue Dot is a photograph of Earth taken Feb. 14, 1990, by NASA's Voyager 1 at a distance of 3.7 billion miles (6 billion kilometers) from the Sun.