

Everything you need to know about satellites, orbits, and such

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Tech Curiosity

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Satellite Defined

- A **satellite** is an object that has been intentionally placed into orbit – so what's an orbit then?
- An **orbit** is the gravitationally curved trajectory of an object, such as the trajectory of a planet around a star or a satellite around a planet. An orbit normally refers to a regularly repeating trajectory.
- A **trajectory** or flight path is the path that an object with mass in motion follows through space as a function of time.

And why do we care?

What do satellites do for us? ([source](#))

- **Television** - Satellites send television signals directly to homes, but they also are the backbone of cable and network TV
- **Telephones** - Satellites provide in-flight phone communications on airplanes, and are often the main conduit of voice communication for rural areas
- **Navigation** - Satellite-based navigation systems like the Navstar Global Positioning Systems (known colloquially as GPS) enable anyone with a handheld receiver to determine their location
- **Business & finance** – supports instant credit card authorization and automated teller banking services, pay-at-the-pump gas at freeway gas stations, video conferencing for international corporations, etc.
- **Weather** - Satellites provide meteorologists with the ability to see weather on a global scale
- **Climate & environmental monitoring** - Satellites are some of the best sources of data for climate change research
- **Safety** - Earth observation satellites can monitor ocean and wind currents as well as the extent of forest fires, oil spills, and airborne pollution, and help organize emergency responders and environmental cleanup
- **Land stewardship** - Satellites can detect underground water and mineral sources; monitor the transfer of nutrients and contaminants from land into waterways, etc.
- **Development** - Earth observation satellites allow developing countries to practice informed resource management and relief agencies to follow refugee population migrations.
- **Space science** - Satellite telescopes have been critical to understanding phenomena like pulsars and black holes as well as measuring the age of the universe.

And now, high-speed internet access!

'Orbits' Ad Nauseum

- [Geostationary orbit](#) is a circular orbit with a period of about 24 hours and inclination of 0° . Geostationary orbits are particularly useful for communication satellites because a spacecraft in this orbit appears motionless to an Earth-based observer, such as a fixed ground station for a cable TV company.
- [Geosynchronous orbits](#) are inclined* orbits with a period of about 24 hours.
- A [semi-synchronous orbit](#) has a period of 12 hours.
- [Sun-synchronous orbits](#) are retrograde, low-Earth orbits (LEO*) typically inclined 95° to 105° and often used for remote-sensing missions because they pass over nearly every point on Earth's surface.
- A [Molniya orbit](#) is a semi-synchronous, eccentric orbit used for some specific communication missions.

For more info: [Describing Orbits](#)

'Orbits' Ad Nauseum

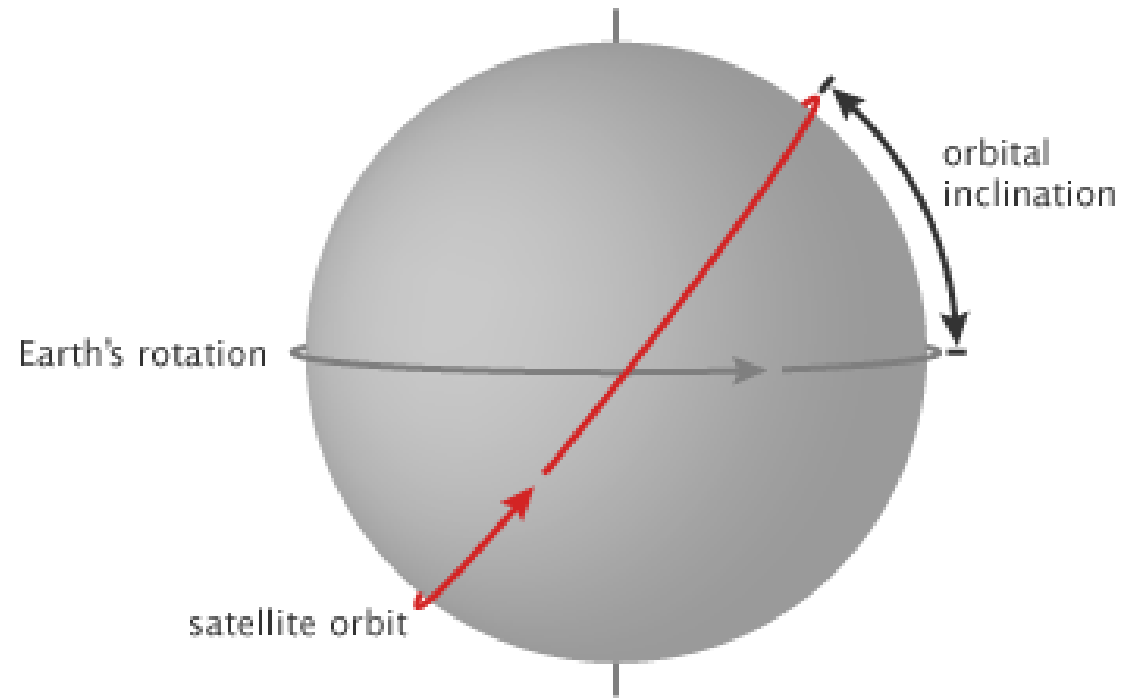
Table 4.1.4-4. Orbital Elements for Various Missions.

Mission	Orbital Type	Semimajor Axis (Altitude)	Period	Inclination	Other
<ul style="list-style-type: none"> • Communication • Early warning • Nuclear detection 	Geostationary	42,158 km 26,195 miles (35,780 km)	~24 hr	~0°	e = 0
<ul style="list-style-type: none"> • Remote sensing 	Sun-synchronous	~6500 – 7300 km 4,300 miles (~150 – 900 km)	~90 min	~95°	e = 0
<ul style="list-style-type: none"> • Navigation – GPS 	Semi-synchronous	26,610 km 16,535 miles (20,232 km)	12 hr	55°	e = 0
<ul style="list-style-type: none"> • Space Shuttle 	Low-Earth orbit	~6700 km (~300 km) 4,163 miles	~90 min	28.5°, 39°, 51°, or 57°	e = 0
<ul style="list-style-type: none"> • Communication/ intelligence 	Molniya	26,571 km ($R_p = 7971$ km; $R_a = 45,170$ km) 16,510 miles	12 hr	63.4°	$\omega = 270^\circ$ e = 0.7

Starlink satellites are in 'Very-Low Earth Orbit' (VLEO) – most at 340 miles

What is Inclination?

- **Orbital Inclination** is the angle of the orbit in relation to Earth's equator. A satellite that orbits directly above the equator has zero inclination. If a satellite orbits from the north pole (geographic, not magnetic) to the south pole, its inclination is 90 degrees.



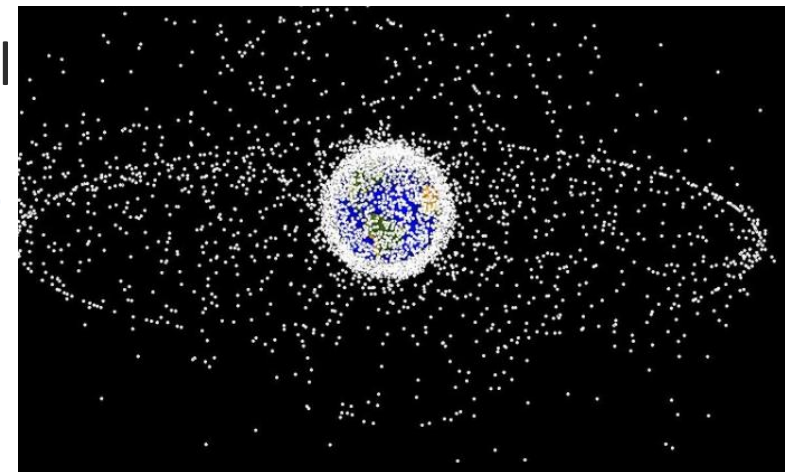
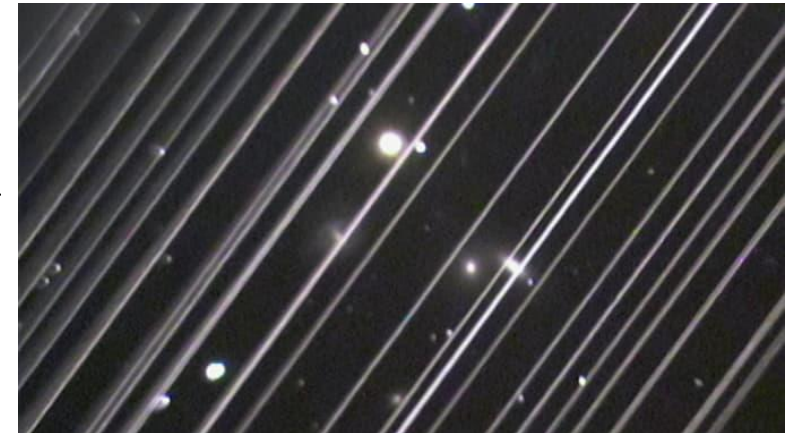
Source: [Catalog of Earth Satellite Orbits](#)

A Little Bit of Rocket Science

- [How do Satellites work?](#) (use this)
 - (start :29 – 4:00)
- [All Rocket Science in 15 minutes](#)
 - (start 1:12 – 4:04 and 7:00 – 10:40)

So what's the problem with Elan's plan

- [Starlink satellites](#) have appeared as bright streaks across images taken by telescopes, ever since SpaceX launched the first mission almost a year ago. Solution: “VisorSat, a deployable visor, to block sunlight from hitting the brightest parts of the spacecraft.”
- And then there's the space junk problem. Once thousands of these satellites rise to their 340 mile orbit, it's reasonable to assume that a number of them will malfunction. At that point, the descent will take five years, and until they come down, they will be [a threat to other satellites and space installations](#)
 - [Kessler syndrome](#) - a theoretical scenario in which the density of objects in [low Earth orbit](#) (LEO) due to [space pollution](#) is high enough that collisions between objects could cause a cascade in which each collision generates [space debris](#) that increases the likelihood of further collisions. *OMG we're all doomed!*

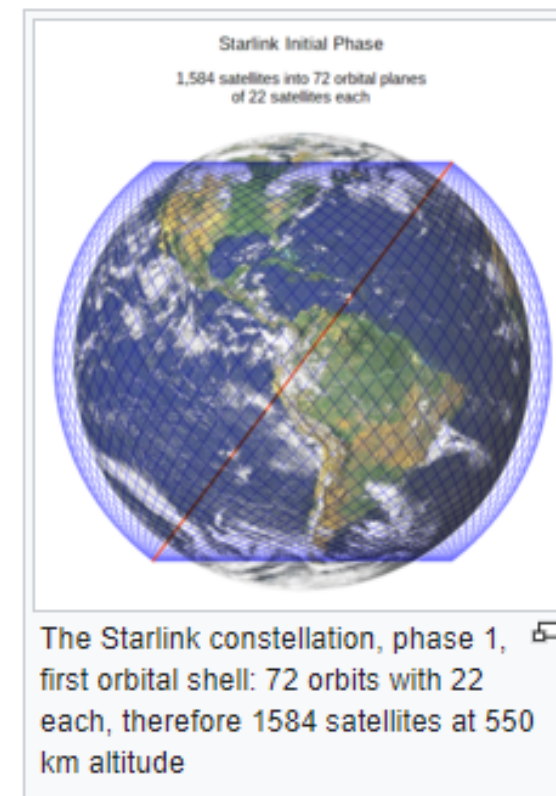


Musk Madness (continued)

Constellation design and status [\[edit \]](#)

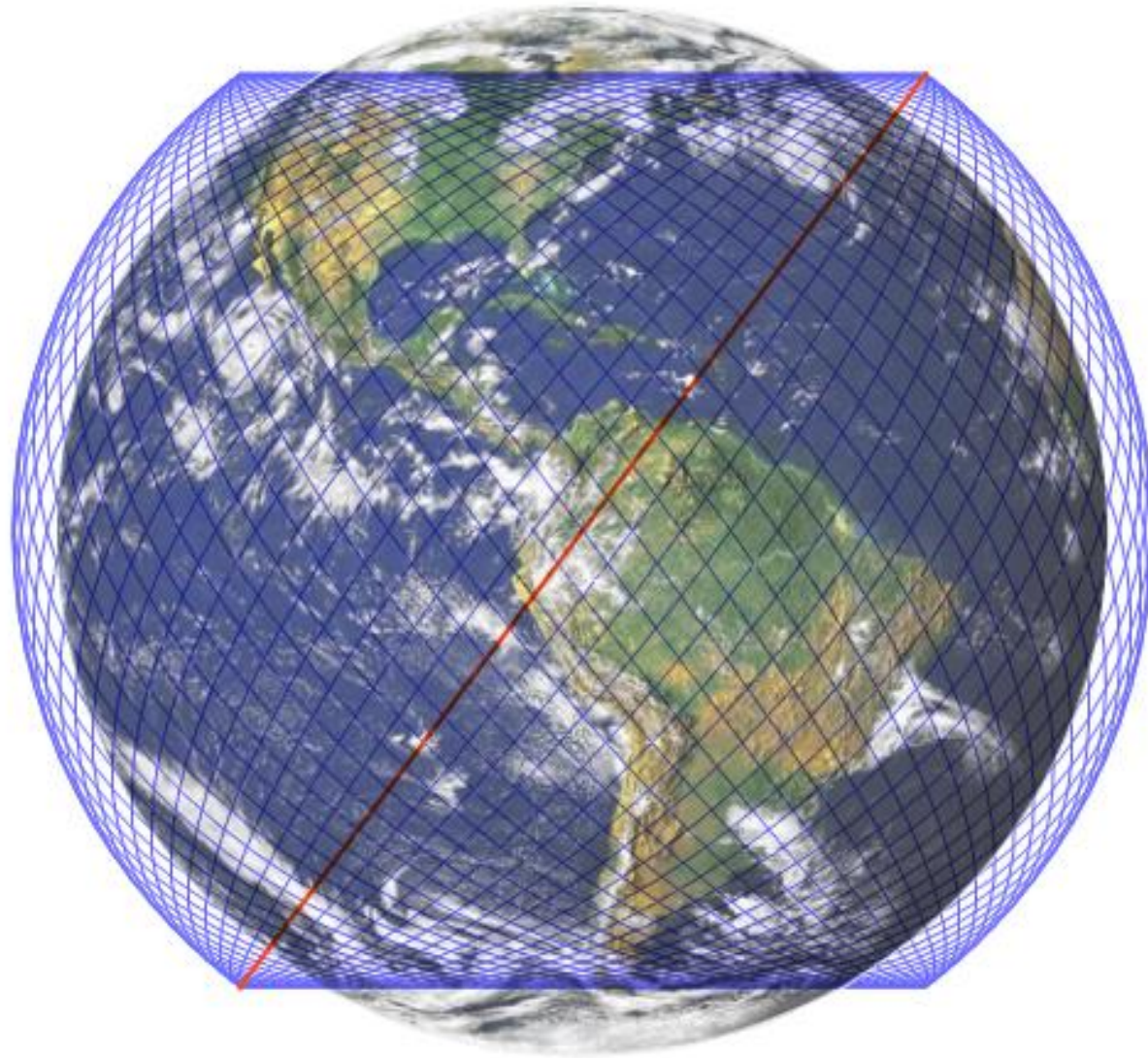
Contains all v0.9 and higher satellite generations. Tintin A and Tintin B as test satellites are not included.

Phase	Orbit shells (km)	Satellites	Inclination (degrees)	Required completion date		Operational satellites	
				Half	Full	On orbit, 7 April 2021	Deorbited, 19 January 2021
1	550	1584 ^[157]	53.0	March 2024	March 2027	1378	65
	1100	1600	53.8			0	
	1325	400	70.0			0	
	1130	374	74.0			0	
	1275	450	81.0			0	
2	335.9	2493	42.0	November 2024	November 2027	0	
	340.8	2478	48.0			0	
	345.6	2547	53.0			0	



Starlink Initial Phase

1,584 satellites into 72 orbital planes
of 22 satellites each



[SpaceX Starlink orbits
and coverage](#)

In the News

- [SpaceX Declined To Move A Starlink Satellite At Risk Of Collision With A European Satellite](#)
- [Space Junk Removal Is Not Going Smoothly](#)
- [SpaceX's Starlink internet satellites could make astronomy on Earth 'impossible' and create a space-junk nightmare, some scientists warn](#)
- [We're entombing the Earth in an impenetrable shell of dead satellites](#)
- [Starlink failures highlight space sustainability concerns](#)
 - “SpaceX said it lowered the satellites to reduce latency, but at that lower altitude the satellites will naturally deorbit within five years without propulsion.” (Why is this important?)

And a new discovery...

- [Venmo](#)
 - And my favorite part:

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[Learn more](#)

\$0

To sign up

\$0

To send money*

\$0

Monthly fees

*Venmo does not charge for sending money from a linked bank account, debit card, or your Venmo account. There is a 3% fee for sending money using a linked credit card.