SAMPLE

Cosmic Explorers: Satellites

Our Eyes in the Sky

Aira Astralis

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Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

A satellite or an artificial satellite is an object, typically a spacecraft, placed into orbit around a celestial body. They have a variety of uses, including communication relay, weather forecasting, navigation (GPS), broadcasting, scientific research, and Earth observation. Additional military uses are reconnaissance, early warning, signals intelligence and, potentially, weapon delivery. Other satellites include the final rocket stages that place satellites in orbit and formerly useful satellites that later become defunct.

Except for passive satellites, most satellites have an electricity generation system for equipment on board, such as solar panels or radioisotope thermoelectric generators (RTGs). Most satellites also have a method of communication to ground stations, called transponders. Many satellites use a standardized bus to save cost and work, the most popular of which are small CubeSats. Similar satellites can work together as groups, forming constellations.

Because of the high launch cost to space, most satellites are designed to be as lightweight and robust as possible.

Most communication satellites are radio relay stations in orbit and carry dozens of transponders, each with a bandwidth of tens of megahertz. Spaceships become satellites by accelerating or decelerating to reach orbital velocities, occupying an orbit high enough to avoid orbital decay due to drag in the presence of an atmosphere and above their Roche limit. Satellites are spacecraft launched from the surface into space by launch systems.

Satellites can then change or maintain their orbit by propulsion, usually by chemical or ion thrusters.

As of 2018, about 90% of the satellites orbiting the Earth are in low Earth orbit or geostationary orbit; geostationary means the satellites stay still in the sky (relative to a fixed point on the ground). Some imaging satellites choose a Sun-synchronous orbit because they can scan the entire globe with similar lighting. As the number of satellites and amount of space debris around Earth increases, the threat of collision has become more severe.

Begin with the subject's invisibility, a quality worth feeling before any hardware enters the story. The satellite is the most consequential technology the reader never sees: the reader's morning news, weather, maps, money, and messages ride on machines the reader has never looked at, crossing a sky the reader rarely checks, and the species' orbital population, thousands of active spacecraft, is the largest infrastructure ever built and the least noticed; this

volume opens the case of the invisible utility, and the book's standing project is to make the reader see the man-made sky, the moving points that the reader can, with patience, watch crossing the evening, the whole modern world passing overhead at the speed of a bicycle's balance, too high to hear, too low to ignore.

A second thing to carry through the pages is the subject's double inheritance, and it sets the arc this book will follow. The satellite descends from two parents: the rocket, the missile's descendant, the Cold War's transport, and the radio, the communications century's instrument, and the subject's history is accordingly a treaty between the two, the launcher's capacity and the transponder's reach negotiating every generation; it is worth watching how the treaty's chapters unfold, the early payloads riding military rockets, the commercial era's dishes, the modern constellations' mass-produced buses, and the reader's own era being the treaty's newest renegotiation, the launch price's collapse letting the radio side of the inheritance flood the sky, the subject's present being, at last, the communications engineers' turn to drive.

Third comes the working method itself, declared here once so the reader holds it as a standing rule from the first orbit to the last. The chapters describe the machines generically, the anatomy and the orbits, and name the specific missions where the history is made, the book's numbers, the altitudes and the periods, being printed at the standard values the field quotes; treat the book as a field guide to a moving population, and the convention's promise is that the reader who finishes can decode any satellite news item, the launch announcements, the constellation filings, the debris warnings, the subject's daily headlines being, after this book, legible, which is the book's practical purpose and the series' standing offer.

Chapter 01: The Discovery of Satellites

Space telescopes take advantage of outer space's near perfect vacuum to observe objects with the entire electromagnetic spectrum. Because satellites can see a large portion of the Earth at once, communications satellites can relay information to remote places. The signal delay from satellites and their orbit's predictability are used in satellite navigation systems, such as GPS. Crewed spacecraft which are in orbit or remain in orbit, like Space stations, are artificial satellites as well.

The first artificial satellite launched into the Earth's orbit was the Soviet Union's Sputnik 1, on October 4, 1957. As of June 28, 2025, there are 12,952 satellites in the Earth's orbit, of which 8,530 belong to the United States, 1,559 to Russia, and 908 to China.

The first published mathematical study of the possibility of an artificial satellite was Newton's cannonball, a thought experiment by Isaac Newton to explain the motion of natural satellites, in his Philosophiae Naturalis Principia Mathematica (1687).

The first fictional depiction of a satellite being launched into orbit was a short story by Edward Everett Hale, "The Brick Moon" (1869). The idea surfaced again in Jules Verne's The Begum's Fortune (1879). In 1903, Konstantin Tsiolkovsky (1857-1935) published Exploring Space Using Jet Propulsion Devices, which was the first academic treatise on the use of rocketry to launch spacecraft.

He calculated the orbital speed required for a minimal orbit, and inferred that a multi-stage rocket fueled by liquid propellants could achieve this.

Herman Potocnik explored the idea of using orbiting spacecraft for detailed peaceful and military observation of the ground in his 1928 book, The Problem of Space Travel. He described how the special conditions of space could be useful for scientific experiments.

The book described geostationary satellites (first put forward by Konstantin Tsiolkovsky) and discussed the communication between them and the ground using radio, but fell short with the idea of using satellites for mass broadcasting and as telecommunications relays.

In a 1945 Wireless World article, English science fiction writer Arthur C. Clarke described in detail the possible use of communications satellites for mass communications. He suggested that three geostationary satellites would provide coverage over the entire planet.

In May 1946, the United States Air Force's Project RAND released the Preliminary Design of an Experimental World-Circling Spaceship, which stated "A satellite vehicle with appropriate instrumentation can be expected to be one of the most potent scientific tools of the Twentieth Century." The United States had been considering launching orbital satellites since 1945 under the Bureau of Aeronautics of the United States Navy.

Project RAND eventually released the report, but considered the satellite to be a tool for science, politics, and propaganda, rather than a potential military weapon. In 1946, American theoretical astrophysicist Lyman Spitzer proposed an orbiting space telescope. In February 1954, Project RAND released "Scientific Uses for a Satellite Vehicle", by R. R. Carhart.

This expanded on potential scientific uses for satellite vehicles and was followed in June 1955 with "The Scientific Use of an Artificial Satellite", by H. K. Kallmann and W. W. Kellogg.

The first artificial satellite was Sputnik 1, launched by the Soviet Union on 4 October 1957 under the Sputnik program, with Sergei Korolev as chief designer. Sputnik 1 helped to identify the density of high atmospheric layers through measurement of its orbital change and provided data on radio-signal distribution in the ionosphere.

The unanticipated announcement of Sputnik 1's success precipitated the Sputnik crisis in the United States and ignited the so-called Space Race within the Cold War.

In the context of activities planned for the International Geophysical Year (1957-1958), the White House announced on 29 July 1955 that the U.S. This became known as Project Vanguard. On 31 July, the Soviet Union announced its intention to launch a satellite by the fall of 1957. Sputnik 2 was launched on 3 November 1957 and carried the first living passenger into orbit, a dog named Laika. The dog was sent without possibility of return.

In early 1955, after being pressured by the American Rocket Society, the National Science Foundation, and the International Geophysical Year, the Army and Navy worked on Project Orbiter with two competing programs. The army used the Jupiter C rocket, while the civilian-Navy program used the Vanguard rocket to launch a satellite. Explorer 1 became the United States' first artificial satellite, on 31 January 1958.

The information sent back from its radiation detector led to the discovery of the Earth's Van Allen radiation belts.

The TIROS-1 spacecraft, launched on April 1, 1960, as part of NASA's Television

Infrared Observation Satellite (TIROS) program, sent back the first television footage of weather patterns to be taken from space. In June 1961, three and a half years after the launch of Sputnik 1, the United States Space Surveillance Network cataloged 115 Earth-orbiting satellites.

While Canada was the third country to build a satellite which was launched into space, it was launched aboard an American rocket from an American spaceport.

The same goes for Australia, whose launch of the first satellite involved a donated U.S. Redstone rocket and American support staff as well as a joint launch facility with the United Kingdom. The first Italian satellite San Marco 1 was launched on 15 December 1964 on a U.S. Scout rocket from Wallops Island (Virginia, United States) with an Italian launch team trained by NASA.

In similar occasions, almost all further first national satellites were launched by foreign rockets.

The idea then waited for a war to supply the rockets. The intercontinental missiles of the 1950s were built as weapons, but their designers knew from the first drawings that the same booster could put an object into orbit, and when the International Geophysical Year of 1957 invited nations to study the Earth and sky, two of them announced satellite projects. The American effort was announced openly and pursued in the open; the Soviet effort was announced ambiguously and pursued in secret, which is why the beep of Sputnik over the October sky fell on the West like a thunderclap. Within a year the American answer followed, and the space age had its two founding objects, one a polished sphere with a radio, the other a small science probe that discovered the belts of trapped radiation that now bear its physicist's name.

Let the discovery chapter end on the beeping sphere's message, the era's pure signal. The first satellite carried no camera and no science beyond the temperature inside, and its entire contribution was the beep, heard by anyone with a receiver, and the beep's meaning was the launcher's, the demonstration that the missile's arithmetic could deliver a payload anywhere; the message's double character deserves a moment's attention, the innocent radio's tone carrying the Cold War's loudest fact, and the subject's whole early history being the message's elaboration, the beeps becoming the relays, the cameras, the navigation, the treaty's terms, the first satellite's beeping having been, in the most literal sense, the modern world's opening note.

A second discovery note belongs with the first relays' telephone diplomacy, the commercial era's founding. The early communications tests, the bouncing of signals off passive balloons and then the first active repeaters, were priced

and argued before they flew, the telephone companies and the governments negotiating the orbit's economics in advance; the pattern here is one the chapters will repeat, that the satellite's every generation was a business plan before it was a machine, the subject's history being unusually financial for a space book, and the reader who notices the pattern early will read the modern era's constellations correctly, the fleets being less a technology than a subscription.

End of free sample. The full book is available at putrabooks.github.io

ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.