Introduction to Azure Space

16 min ∙ Module ∙ 8 units

Space is one of the fastest growing industries today. There are more satellites orbiting the earth than ever before. These satellites can be categorized into two broad categories: (1) satellites that enable space-based communication and (2) satellites that collect valuable data that can be used on earth.

As the future of cloud computing extends beyond our planet, Azure capabilities will play a major role in helping businesses unlock powerful connectivity, analytics, and development possibilities. In this module, you’ll learn more about the rapidly evolving space ecosystem and see how the Azure Space portfolio drives space-based innovation, creating new opportunities for space and non-space industries alike.

Key terms: space, satellites, connectivity, downlink data, ground station, data analytics

Prerequisites: Familiarity with cloud computing concepts

# Introduction

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Azure Space combines the possibilities of space with the power of the cloud. It extends Azure capabilities and enables organizations to connect to the cloud from anywhere, analyze and disseminate space data, and build and test in the cloud from space.

By completing this module, you will be able to:

* Understand the current state of the space industry and the key players
* Articulate the business opportunities that space enables
* Know the most important capabilities of the Azure Space portfolio

Let’s explore some of the ins and outs of the space industry and how it’s quickly changing.

# Describe key trends of the space industry

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The space industry is rapidly expanding, with the size of the global space economy reaching $469 billion in 2021. By 2030, that figure is expected to be $600 billion. This growth is fueled by several key trends.

## The barrier to entry is lowering

Space has never been more accessible. For example, the cost to deliver payload to space has decreased significantly over the past few decades. When the Space Shuttle was launched in 1981, it cost $65,400 per kilogram, around $1.8 billion per launch. When SpaceX launched Falcon Heavy in 2018, it cost $1,500 per kilogram, about $95 million per launch.

As launch costs decrease, the size of satellites is also decreasing—satellites have gone from roughly the size of a school bus to the size of a loaf of bread. The Hubble Telescope, launched in 1990, weighed 11,000 kilograms, but by 2014, Planet Labs’ Dove satellites weighed as little as 5 kilograms.

Together, these factors are resulting in an explosion in the number of satellites orbiting the earth. There were 1,713 Satellites launched in 2021, a 40% increase over 2020, taking the number of total satellites circling the earth to 4,852 by the end of 2021.

## Technology is enabling more compelling use cases

What are the implications of all these satellites orbiting the earth? Many are equipped with sensors that observe the earth, and in turn, these sensors are generating enormous amounts of data.

As the capabilities of sensors advance, the data from space is becoming more granular and useful. The sheer amount of data collected now is staggering. A single National Aeronautics and Space Administration (NASA) Earth Science mission can now generate seven times more data than has been collected over the program’s lifetime.

The usefulness of this data opens new possibilities across industries, including ecological monitoring and supply chain health awareness. At the same time, the increase in the amount of data will also require more processing power to handle.

## The playing field is leveling

Space used to be reserved for government applications, whether that was exploratory missions or satellite monitoring. But that balance has shifted, with space becoming a place ripe with commercial opportunities.

There are more than 183,000 people employed in the space industry, running the gamut from massive corporations to smaller startups. In 2020 alone, around $8 billion was spent on space startup investments.

Next, let’s take a closer look at some of those key players in the industry.

# Describe the key players of the space ecosystem

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The needs and goals of companies in the space industry can vary widely. The key players include:

## Space manufacturers

Space manufacturers build large commercial and government satellite platforms. Space manufacturers build the satellite bus and the structural component of the satellite that contains instruments such as sensors. They play a crucial role in providing infrastructure for geosynchronous satellite operation.

## Launch service providers

Launch service providers provide the carrier rocket, assembly, payload integration, and launch. While some government organizations are equipped to conduct launches themselves, most will go through a launch service provider to put a satellite into orbit.

## Satellite operators

Satellite operators is a broad category that includes government, commercial, and private entities that own the ~4,800 satellites in orbit, both for satellite communication and observation. Operators focused on communication are generally referred to as SATCOM operators, with communications satellites used to relay signals across the globe. Operators focused on observation are generally referred to as Earth Observation (EO) operators, with low earth orbit (LEO) satellites that collect data from earth.

## Data analytics Independent Software Vendors (ISVs)

Data analytics independent software vendors aggregate and analyze insights based on satellite data. These companies use proprietary data analysis and Artificial Intelligence (AI) offerings to help customers unlock insights from the data collected by earth observation satellites.

## Ground station providers

Ground station providers provide antennas to contact satellites in orbit, enabling the downlinking of data collected by the satellites. It’s important for antennas on the ground to continually monitor the status of satellites, and by providing a large network of stations across the globe, ground station providers help ensure that access.

## Enterprises

In this context, enterprises refers to non-satellite-operating businesses that need to harness the data and communication capabilities of satellites. These enterprises can be found across industries and represent an important end customer for space solutions. Examples of non-satellite-operating businesses include agricultural companies looking to perform more precise monitoring of crop health, government and financial firms who need to automate risk analysis, and logistics companies looking to identify supply chain issues more quickly.

While Azure Space products will be relevant to all key players within the industry, the portfolio is focused primarily on providing value for two: Satellite Operators and Enterprises. Let’s examine the value propositions for them.

# Understand the value proposition

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With Azure Space, Microsoft is building a platform for space and non-space industry leaders to use to unlock new use cases and innovation. Our strategy is:

* **Non-competitive:** We are building a powerful partner community that will enable innovation and collaboration across industry leaders using the Azure Space platform.
* **Multi**-**orbit:** By using a multi-orbit strategy, we can provide the best information and connectivity from both orbits. Our platform operates with NGSO (non-geostationary orbit) satellites for global coverage and low latency and GEO (geostationary orbit) satellites for use cases in high-density places.
* **Multi**-**vendor:** We work with multiple vendors to provide a wide range of capabilities and the best-possible offerings for specialized use cases.

Broadly speaking, the business opportunities for Azure Space serve two categories of users:

1. Satellite Operators: Operators fall into two main categories: (1) Satellite communications (SATCOM) operators that provide communications capabilities over space and (2) Earth Observation satellite operators that produce data.
2. Enterprises: Non-satellite-operating businesses that need to harness data and communication from satellites.

Microsoft’s Azure Space platform can be used by satellite operators and end customers in both government and enterprise. While the intended user for each product in the Azure Space portfolio varies, Microsoft’s approach is to provide value for all users through these core principles:

* Our global network and infrastructure
* Support for classified environments
* Differentiated AI and machine learning offerings
* An approach rooted in partnership, not competition
* Advanced go-to-market channels that enable digital transformation
* A comprehensive space product portfolio that meets the needs of operators and enterprises

# Describe the Azure Space portfolio

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The Azure Space portfolio consists of products that fall under the Azure Orbital umbrella. There are three principles that are foundational to the Azure Orbital offerings:

* Connect: Connect to the cloud anywhere and at any security level
* Analyze: Turn space data into knowledge and insights
* Develop: Enable rapid development

## Connect

Products that fall under this category help meet needs around space-based connectivity. Some of the key Azure capabilities are:

* Access to connect through space to the Microsoft cloud, with access to Azure through satellite communications
* Multi-vendor, multi-orbit satellite connectivity
* A fully cloud-based ground segment to communicate with satellites
* Co-location services, networking services and a platform for virtualization

## Analyze

Products that fall under this category help end users create insights from space data. Some of the key Azure capabilities are:

* Connect spacecraft to Azure with the ability to command satellites and downlink to the cloud
* A fully managed satellite ground network to provide global coverage for earth observation and remote sensing satellites
* A single control plane to manage antennas from one powerful application
* Rapid data processing to derive insights and create clarity
* Use Azure to create analytics pipelines

## Develop

Products that fall under this category enable developers to do more with space data. Some of the key Azure capabilities are:

* The ability to build applications in the cloud and then deploy on spacecraft
* A software architecture for hosting on-orbit applications, with common services that can be extended by satellite operators

Finally, let’s turn to some real-world examples of what Azure Orbital can look like in action.

# Understand the real-world implications

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So how do these technologies affect the world around us? There are numerous scenarios unlocked by the possibilities of space and the power of the cloud. Here are several examples:

## Enterprise scenarios

**Example scenario:** I run a multinational agricultural company, and I need more accurate reporting of yields and shortages.

**Example outcome:** Earth observation sensors enable object detection and classification, allowing for monitoring of changes over time and precision reports on crop health.

**Example scenario:** I manage a first-responder network that takes personnel to both remote rural areas and highly connected, dense cities, and I need consistent connectivity in both.

**Example outcome:** Space connectivity enables an ultra-reliable network across vastly different locales with less dependence on fiber pathways that can fail. First responders can access communications on any device in any environment, saving critical time.

## Operator scenarios

**Example scenario:** I am a SATCOM operator, and I would like to virtualize my ground segment, lower costs, and expand my business through cloud.

**Example outcome:** Operators can leverage co-location services, access networking services, and use a platform for virtualization.

**Example scenario:** I would like to have the capability to operate my satellite, downlink data, and process data without investing, building, and maintaining my own ground station antenna and data center.

**Example outcome:** Operators can operate satellites and downlink data, transfer data to Azure cloud using Azure networking, process data to produce imagery, and use Azure AI/ML and analytics services to gain further insight from earth observation data.

Next, we’ll review what we’ve learned in this module.

# Knowledge check

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Choose the best response for each of the questions below. Then select “Check your answers.”

### Which of the following is **not** a key factor in the rapid expansion of the space industry?

* ⬜ The cost to launch payload into space is decreasing.
  + Incorrect: The cost **is** a key factor in the rapid expansion of the space industry.
* ⬜ Space is becoming increasingly commercialized.
  + Incorrect: The commercialization of space **is** a key factor in the rapid expansion of the space industry.
* ⬜ Satellites can be much smaller than they used to be.
  + Incorrect: The decreasing size of satellites **is** key factor in the rapid expansion of the space industry.
* ❎ Increased government funding to build public private partnerships for space innovation.
  + Correct: While the government remains a major player in the space industry, it’s the advancements in satellite technology combined with the growing commercial applications that are resulting in the rapid expansion.

### What role do ground station providers play in the space ecosystem?

* ⬜ Aggregate and analyze insights based on satellite data.
  + Incorrect: This describes the role of data analytics ISVs.
* ❎ Provide antennas to contact satellites in orbit, enabling the downlinking of data collected by the satellites.
  + Correct: Ground station providers play an important role in the space ecosystem, ensuring that the data collected in space can be accessed on earth.
* ⬜ Provide the carrier rocket, assembly, payload integration, and launch.
  + Incorrect: This describes the role of launch service providers.
* ⬜ Build large, commercial and government satellite platforms.
  + Incorrect: This describes the role of space manufacturers.

### Which of the following best describes Microsoft’s approach to provide value for Azure Space users?

* ⬜ Focus exclusively on government customers that require support for highly classified environments.
  + Incorrect: While Azure’s support for classified environments is a key feature of Azure Space offerings, the user base goes beyond government customers.
* ⬜ Sell Azure Space products primarily to non-satellite-operating enterprise customers.
  + Incorrect: Azure Space products are geared toward both non-satellite-operating enterprise customers and operators of satellites.
* ⬜ Compete with ground station providers by offering a less expensive service.
  + Incorrect: Azure Space’s approach is rooted in partnership, not competition with other key players in the space industry.
* ❎ Create platform for satellite operators and end customers in both government and enterprise.
  + Correct: Microsoft’s approach is to provide value for all users through the core principles of the Azure Space portfolio.

### Which is **not** a foundational principle of the Azure Space portfolio?

* ⬜ Connect to the cloud anywhere and at any security level.
  + Incorrect: Connect is one of three foundational principles of the portfolio.
* ❎ Downlink data from any location.
  + Correct: While downlinking data is an important capability of the Azure Space portfolio, it falls under the foundational category of Connect.
* ⬜ Analyze space data to turn it into knowledge and insights.
  + Incorrect: Analyze is one of three foundational principles of the portfolio.
* ⬜ Enable developers to do more with space data.
  + Incorrect: Enable is one of three foundational principles of the portfolio.

# Summary

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Azure Space represents an exciting future, where possibilities of space are combined with the power of the cloud. By extending Azure capabilities beyond the confines of earth, we’re enabling organizations to connect to the cloud from anywhere, analyze and disseminate space data, and build and test in the cloud from space.

Now that you’ve completed this module and understand the current state of the space industry and some of the capabilities of the Azure Space portfolio, you can extend your knowledge with deeper dives into each of the products.