

Cesium: Foundations

The Cesium: Foundations course will help you understand the basic concepts and terminology needed to progress through the Cesium learning paths.

Learning objectives:

- Describe the Cesium platform
 - Understand how to use 3D Tiles
 - Understand how to use Cesium ion fits into the platform
 - Understand how to create Cesium Stories
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Lesson 1: The Cesium Platform

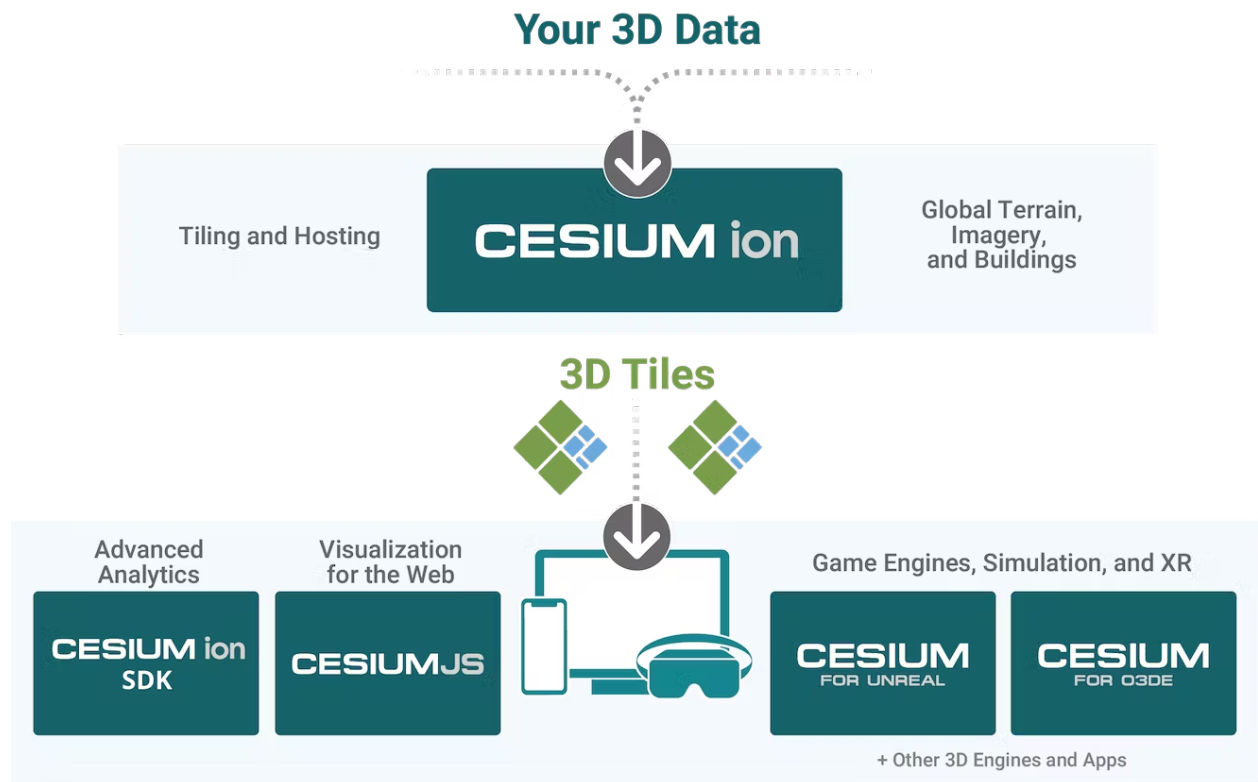
Introduction:

In this lesson, we will cover the Cesium platform and provide an overview of each component that makes Cesium the best 3D geospatial platform.

What is Cesium?

CesiumJS was created in 2011 by an Analytical Graphics Inc. (AGI) team to deal with global-scale aerospace visualizations. When Cesium spun out of AGI in 2019, it became its own company. It began offering CesiumJS as a free open source software alongside Cesium ion as a commercial option to extend into a complete 3D geospatial platform.

Since then, Cesium has released Cesium for Unreal and Cesium for O3DE to support both runtime engines.



Cesium has also been central to creating an open ecosystem for 3D geospatial applications. Cesium was the original creator of 3D Tiles in 2015 and shepherded its acceptance into the OGC Community Standard in 2019, where developers have widely adopted it. Cesium believes that openness and interoperability are the essential elements that will propel the entire 3D geospatial ecosystem forward.

Assignment:

- Read [The Cesium Business Model](#) to understand how Cesium balances open source and commercial software.
- Explore Cesium's contributions to an [open 3D geospatial ecosystem](#).

Additional Resources:

This section contains helpful links related to the lesson's content that might be interesting or helpful.

- Browse the "[Building the Open Metaverse](#)" podcast co-hosted by Cesium's CEO, Patrick Cozzi, and Epic Games' Marc Petit. Many episodes explore the relationship between 3D geospatial applications and an open ecosystem for developers.

Knowledge Check:

This section contains questions to check your understanding of this lesson. If you're having a problem answering a question, click the link and review the content again.

- How did Cesium start?
 - Which open standard did Cesium help create?
 - Which runtime engines does Cesium support?
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Lesson 2: 3D Tiles

Introduction:

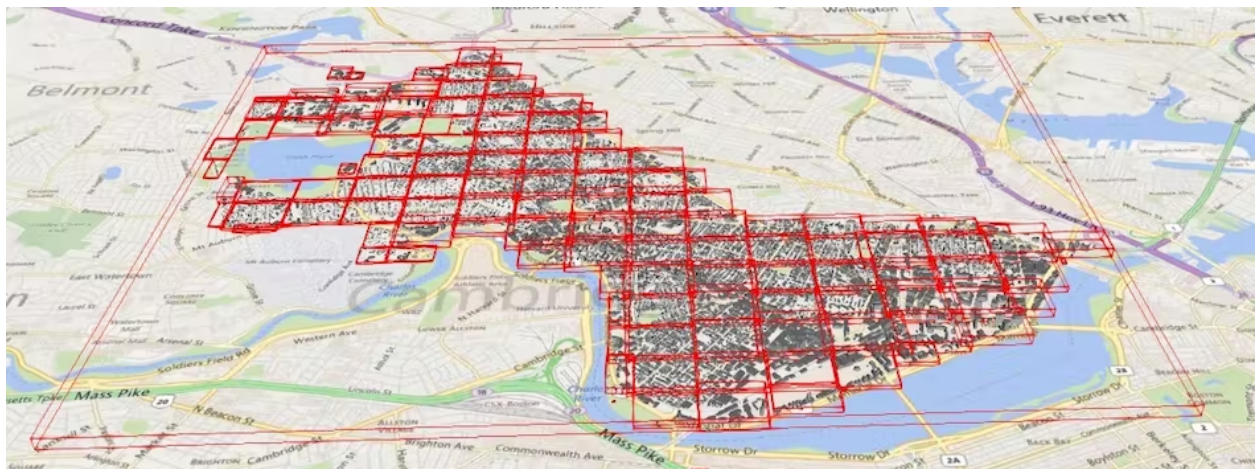
In this lesson, we will cover some of the core concepts in the 3D Tiles specification and discuss why 3D Tiles are essential within the Cesium platform.

What are 3D Tiles?

First, let's cover a little history of 3D Tiles.

Soon after its inception in 2011, Cesium faced the problem of streaming large collections of 3D models from different sources, i.e., point clouds, photogrammetry, 3D buildings, vector data, etc. Unfortunately, the existing available approaches made streaming these datasets impractical, so Cesium set out to create a better alternative.

By 2015, Cesium had created the 3D Tiles specification for streaming massive heterogeneous 3D geospatial datasets. By 2019, the Open Geospatial Consortium (OGC) adopted the 3D Tiles specification as a community standard.



Bounding volumes for tiles in a sparse grid layout. Each tile is one WebGL draw call.

What does the 3D Tiles specification achieve?

3D Tiles allow users to stream massive 3D datasets by limiting which portions of the dataset are loaded based on a Hierarchical Level of Detail (HLOD). Because Cesium created 3D Tiles with streaming performance as their primary goal, their design enables them to compress and render their contents efficiently in a web browser.

Take a few minutes to read Patrick Cozzi's blog post that describes the benefits of 3D Tiles and how they have enabled 3D geospatial applications worldwide.

- [Introducing 3D Tiles - Patrick Cozzi](#)

Assignment:

- If you skipped the [Introducing 3D Tiles](#) blog above, take a few minutes to read it now.
- Read about the next step for 3D Tiles by understanding how [3D Tiles Next](#) will expand on the existing specification.

Additional Resources:

This section contains helpful links related to the lesson's content that might be interesting or helpful.

- A recent [Venture Beat article](#) helps draw the line between 3D Tiles and the metaverse.
- Detailed reference cards for [3D Tiles](#) and [3D Tiles Next](#) that includes excellent visual references for anyone unfamiliar with the underlying 3D or geospatial concepts.
- The OGC's [3D Tiles specification](#) is an excellent resource if you are interested in learning about the technical details of 3D Tiles.

Knowledge Check:

This section contains questions to check your understanding of this lesson. If you're having a problem answering a question, click the link and review the content again.

- Why was the 3D Tiles specification first created?
 - What are the ten core features of 3D Tiles? (*Hint: you can find them [here](#).*)
 - Why is metadata such a critical feature in the 3D Tiles Next specification?
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Lesson 3: Cesium ion

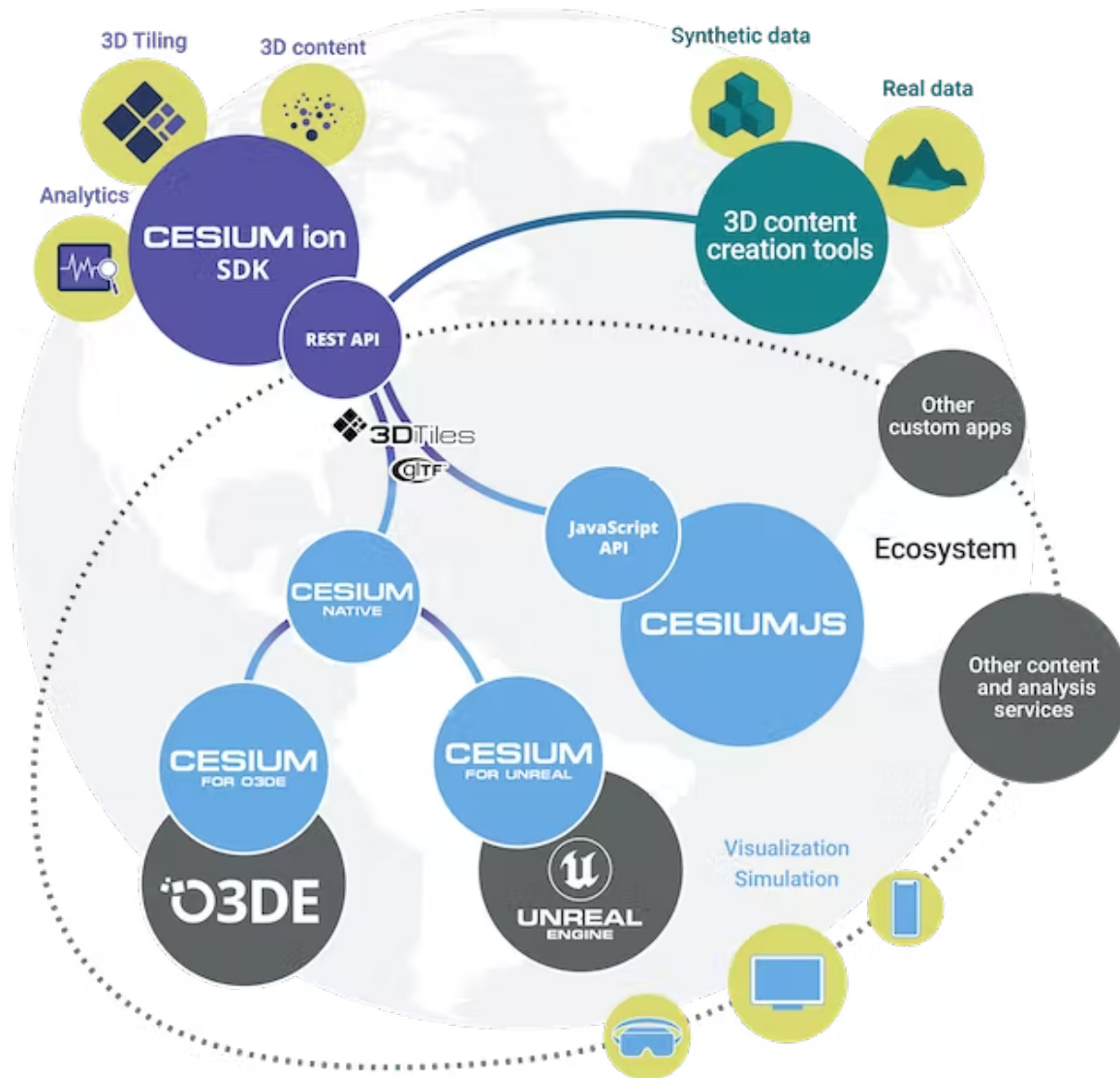
Introduction:

In this lesson, we will look at Cesium ion and understand how it can create streamable 3D content.

What is Cesium ion?

Cesium ion began as the commercial extension of the free open source software CesiumJS to create the most efficient pipeline for creating 3D Tiles.

Because we built ion as an end-to-end 3D platform, developers can upload their 3D content and host 3D Tiles in the cloud so that any visualization engine can stream the content. It is also free for non-commercial and non-government up to 5GB of stored data, and users can secure their data through token-based access controls.



Cesium ion also includes access to a curated set of 3D content that includes Cesium World Terrain (CWT), Cesium OSM Buildings, and Bing Maps imagery, all optimized for streaming. In addition, users can bring their data and combine it with the existing data sets that come with Cesium ion.

Cesium ion also provides tools for measuring and analyzing 3D content, so applications built with ion can make meaningful and accurate decisions about the data.

How can Cesium ion be used?

We built Cesium ion with openness and flexibility in mind. As a result of that approach, Cesium ion allows you to upload data from several utilities that create 3D content, including:

- FME
- RealityCapture
- Context Capture
- Correlator3D
- WebODM
- Agisoft Metashape
- SketchUp
- Blender
- 3DS Max

Cesium ion's REST API allows you to leverage ion's tiling and streaming capabilities from existing applications. In addition, these clients and engines have built-in support for streaming from Cesium ion:

- CesiumJS
- Cesium for Unreal
- Cesium for O3DE
- deck.gl
- iModel.js
- osgEarth
- STK

Which types of data can Cesium ion support?

Cesium ion is capable of supporting a wide variety of massive heterogeneous data types, including the following:

- Photogrammetry or LiDAR-derived mesh
- BIM, CAD, or other 3D models
- Point Clouds
- 3D Buildings
- Terrain
- Satellite or Drone Imagery

If you would like to take a deeper look at which file formats Cesium ion supports and how you can access them through ion, take a few minutes to read through the [Tiler Data Types and Formats](#) page. Each data type listed above also has a tutorial you can access on the same page.

Assignment:

- If you haven't already, read over [the types of data and formats](#) you can use with Cesium ion.
- Browse the [Cesium ion integrations page](#) and see if your preferred software is listed. If it isn't listed, look at the [Community Forum](#) to see if it is in an upcoming release.

Additional Resources:

This section contains helpful links related to the lesson's content that might be interesting or helpful.

- If you're interested in Cesium ion's launch, read the first [blog post about the platform](#).
- You can [read an overview](#) if you want to know how Cesium designed the original server architecture for ion.
- Cesium ion's [REST API tutorial](#) provides excellent instructions on how to set up and utilize the potential of ion with your existing applications and workflows.
- You can dive into the [reference documentation](#) to learn more about ion's REST API.

Knowledge Check:

This section contains questions to check your understanding of this lesson. If you're having a problem answering a question, click the link and review the content again.

- Which 3D content does Cesium include with Cesium ion?
 - What types of data does Cesium ion support?
 - How can you integrate existing applications or workflows with Cesium ion?
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Lesson 4: Cesium Stories

Introduction:

In this lesson, we will look at Cesium Stories and understand how you can use them to create 3D geospatial presentations.

What are Cesium Stories?

Cesium Stories is a cloud-based app available to anyone with a Cesium ion account to create presentations using their own 3D geospatial data, which they can share on the web without writing a single line of code.

Users can create Cesium Stories with 3D data, including imagery, models, terrain, and point clouds. These are processed into 3D Tiles, allowing anyone to easily share or stream their presentation through a mobile or desktop browser.

To help explain Cesium Stories, we have a Cesium Story to demonstrate how powerful the app can be.

- [Embed the [Cesium Stories demo](#) here]

How can I create my own Cesium Story?

Creating your own Cesium Story is very straightforward, and we have a tutorial already created that gives step-by-step instructions for how to learn the basics. Plan to spend 20 minutes working through the tutorial.

- Tutorial: [Create an Interactive 3D Presentation with Cesium Stories](#)

Once you have finished the tutorial, come back to continue with the lesson.

How can I visualize my time dynamic data?

Now that you know how to create a Cesium Story, the next step is to understand how to include time-series data in your 3D presentation using Cesium Stories. The tutorial below will walk you through uploading and organizing your 3D data into a presentation. Plan to spend 20 minutes working through the tutorial.

- Tutorial: [Visualizing Time Dynamic Data with Cesium Stories](#)

How can I style the content in my Cesium Story?

One of the benefits of using 3D Tiles is that we can leverage the metadata available when visualizing our 3D geospatial presentation. Using your 3D data, you can customize the styling if metadata is available at a per-feature level.

Take a few minutes to follow along with the tutorial below to understand how you can use the styling features within Cesium Stories to add more context for your audience. Plan to spend 20 minutes working through the tutorial.

- Tutorial: [Styling 3D Tiles in Cesium Stories](#)

Assignment:

- If you haven't done so, complete the three tutorials shared in this lesson.
 - Tutorial: [Create an Interactive 3D Presentation with Cesium Stories](#)
 - Tutorial: [Visualizing Time Dynamic Data with Cesium Stories](#)
 - Tutorial: [Styling 3D Tiles in Cesium Stories](#)
- Using the skills you learned in this lesson, create your unique Cesium Story using your 3D data or open data sets like the [City of Melbourne's](#).

Additional Resources:

This section contains helpful links related to the lesson's content that might be interesting or helpful.

- If you are looking for inspiration on how you can use Cesium Stories, consider how Professor Hidenori Watanave uses Cesium Stories to [capture the extent of damage in Ukraine](#).
- Cesium Stories are also great for educational aides, as [this blog post](#) shows.

Knowledge Check:

This section contains questions to check your understanding of this lesson. If you're having a problem answering a question, click the link and review the content again.

- Which programming language do you need to know to use Cesium Stories?
- How can you share your Cesium Story with others?
- How can you control the playback speed of time dynamic data?
- Which type of metadata is needed to use the styling tool in Cesium Stories?