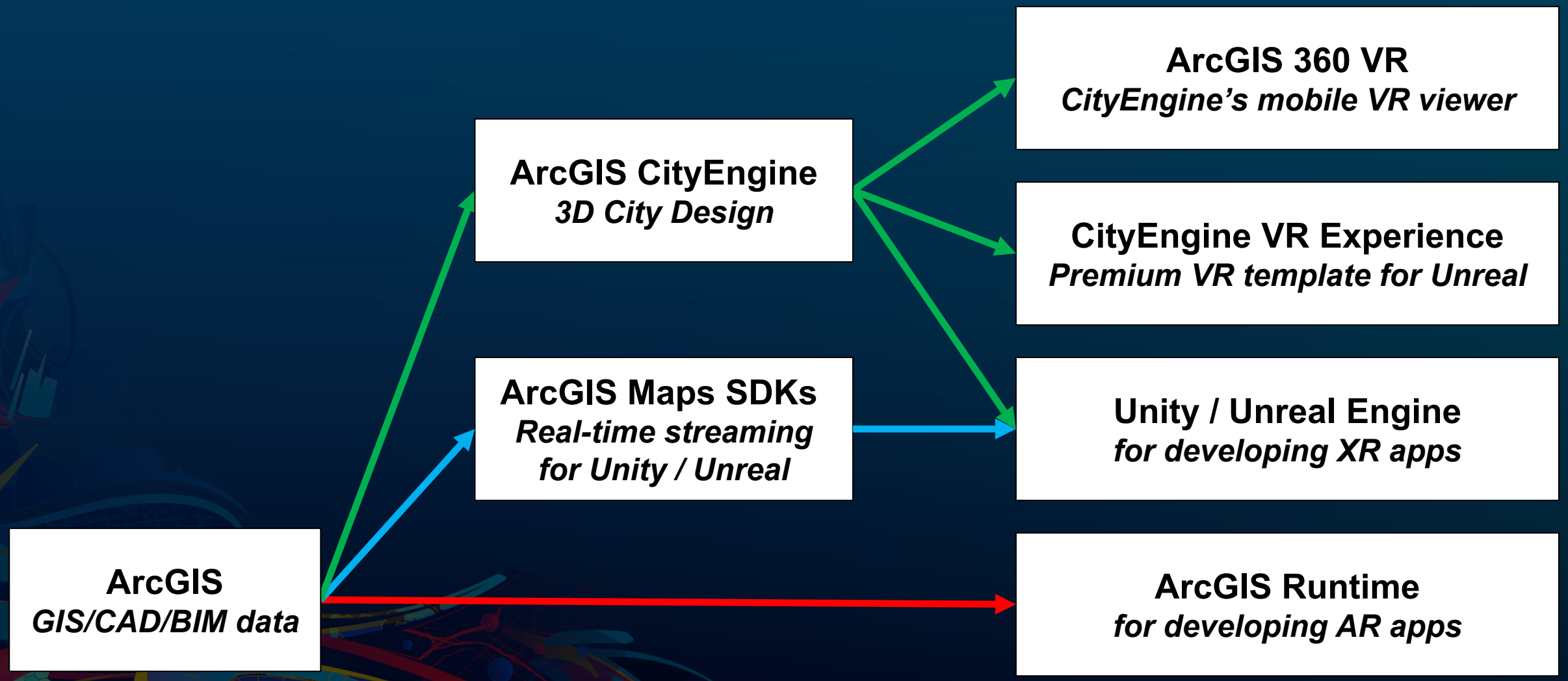
Extended Reality (XR) with ArcGIS

Taisha Fabricius, Stefan Arisona, Rex Hansen

2021 ESRI
DEVELOPER SUMMIT

Overview


ArcGIS
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VR - Virtual Reality

Being there

Oculus Rift

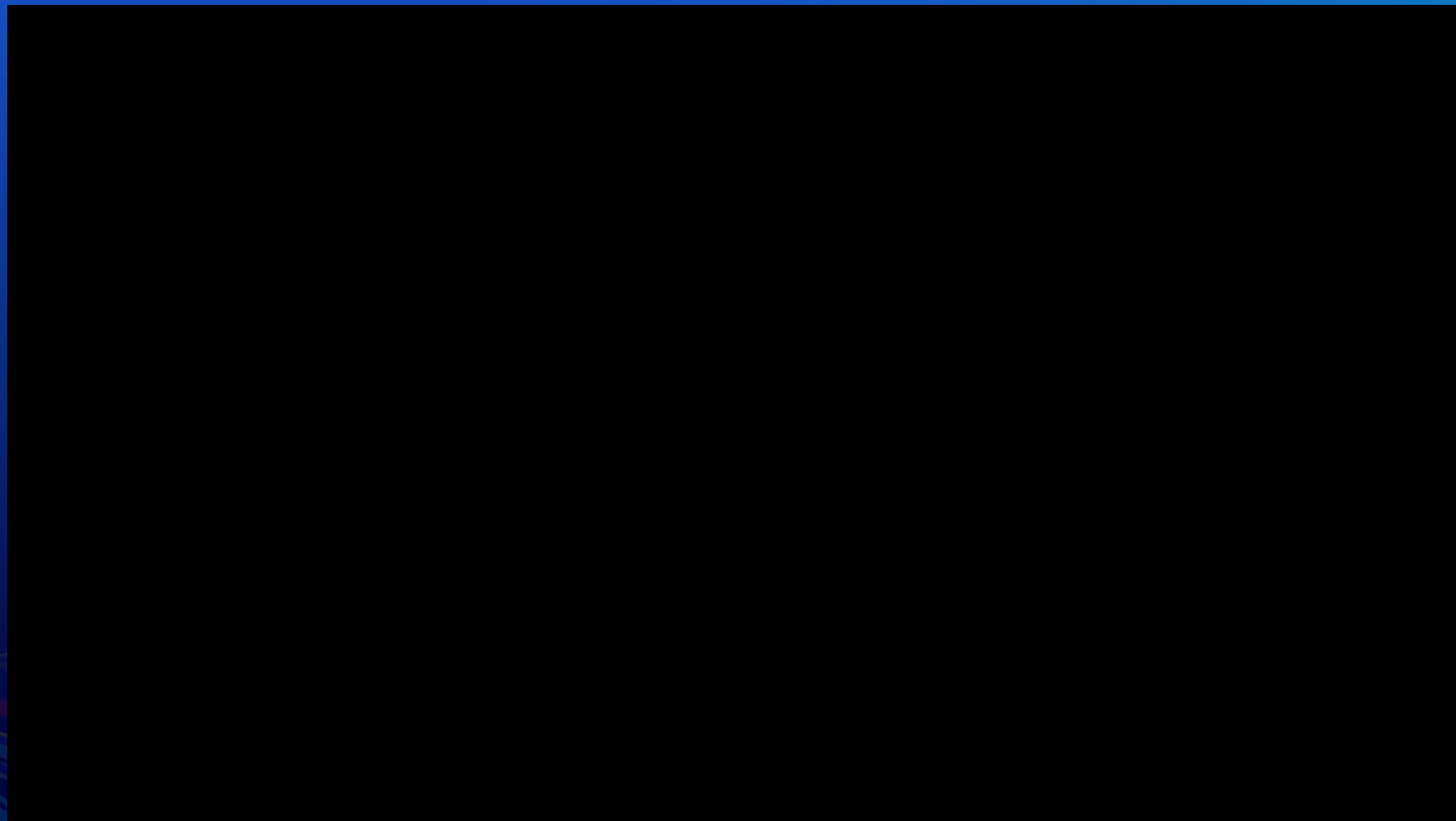
Oculus Quest

HTC Vive

HP Reverb

AR - Augmented Reality

Interacting with outside world



Smartphones

Tablets

AR glasses

MR - Mixed Reality

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Mixed presence

Microsoft HoloLens
Magic Leap

XR – Extended Reality

Physical Reality

The real world around us

Augmented Reality AR

Overlay of information onto the real world

Mixed Reality MR

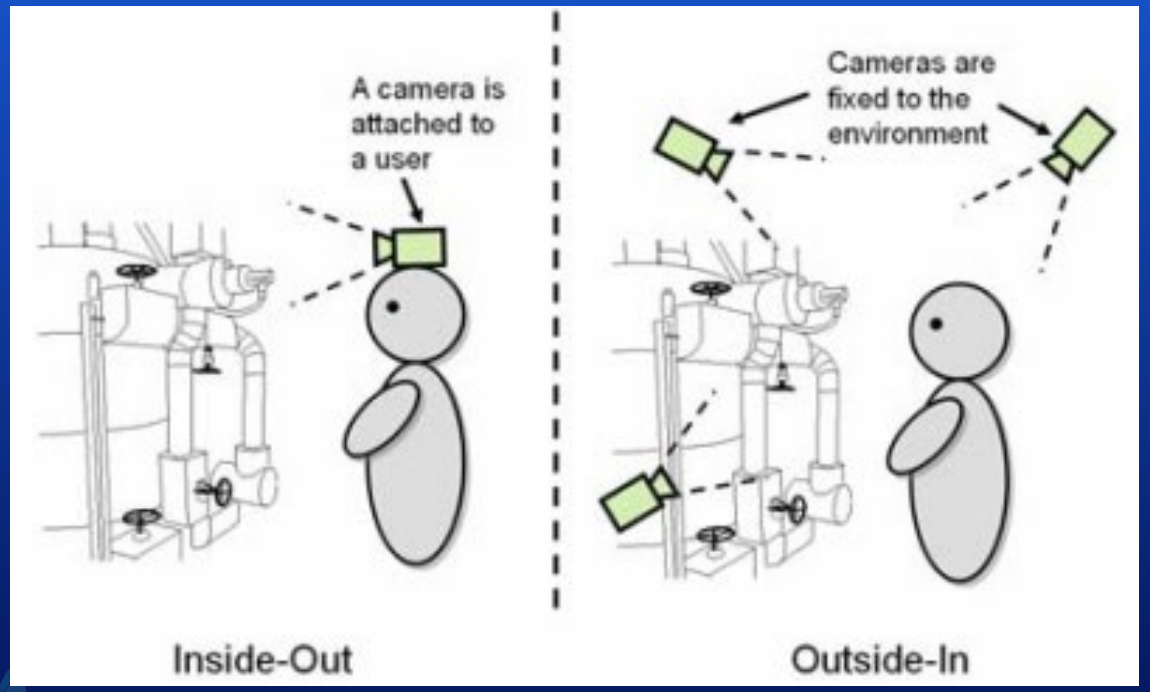
Merging of information and real world

Virtual Reality VR

Immersing in a digital world

Positional Tracking for XR

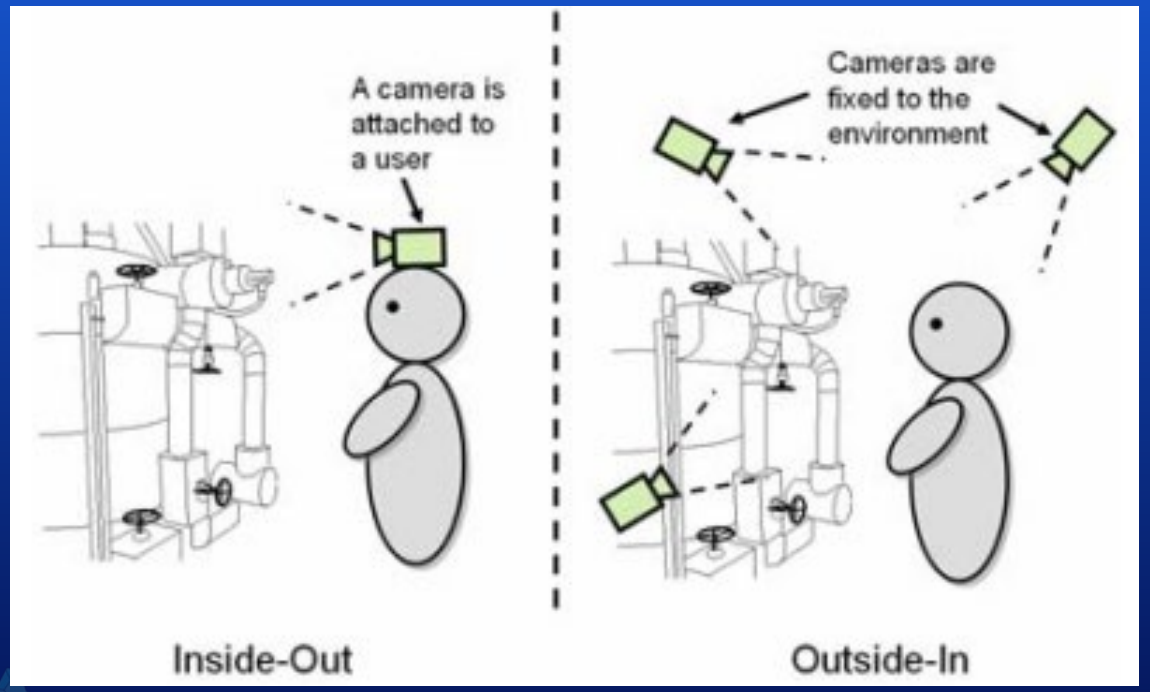
Inside-out vs Outside-in Tracking



Inside-out: Cameras on HMD, <u>marker-less</u> tracking of position changes in relation to environment

Outside-in: Cameras placed in stationary locations & <u>markers</u> on devices (HMD & controllers)

Inside-out vs Outside-in Tracking

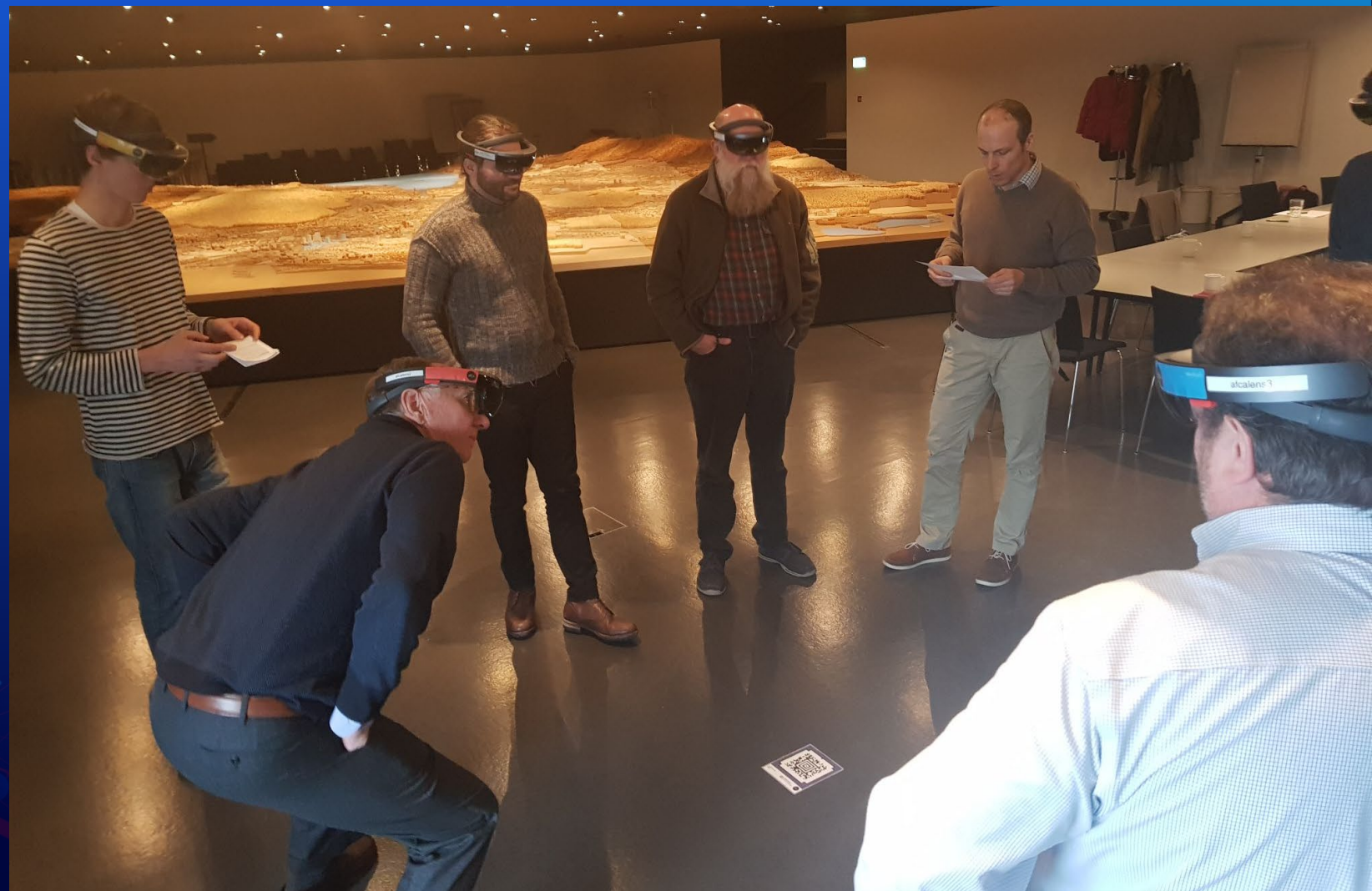


Inside-out: Cameras on HMD, <u>marker-less</u> tracking of position changes in relation to environment

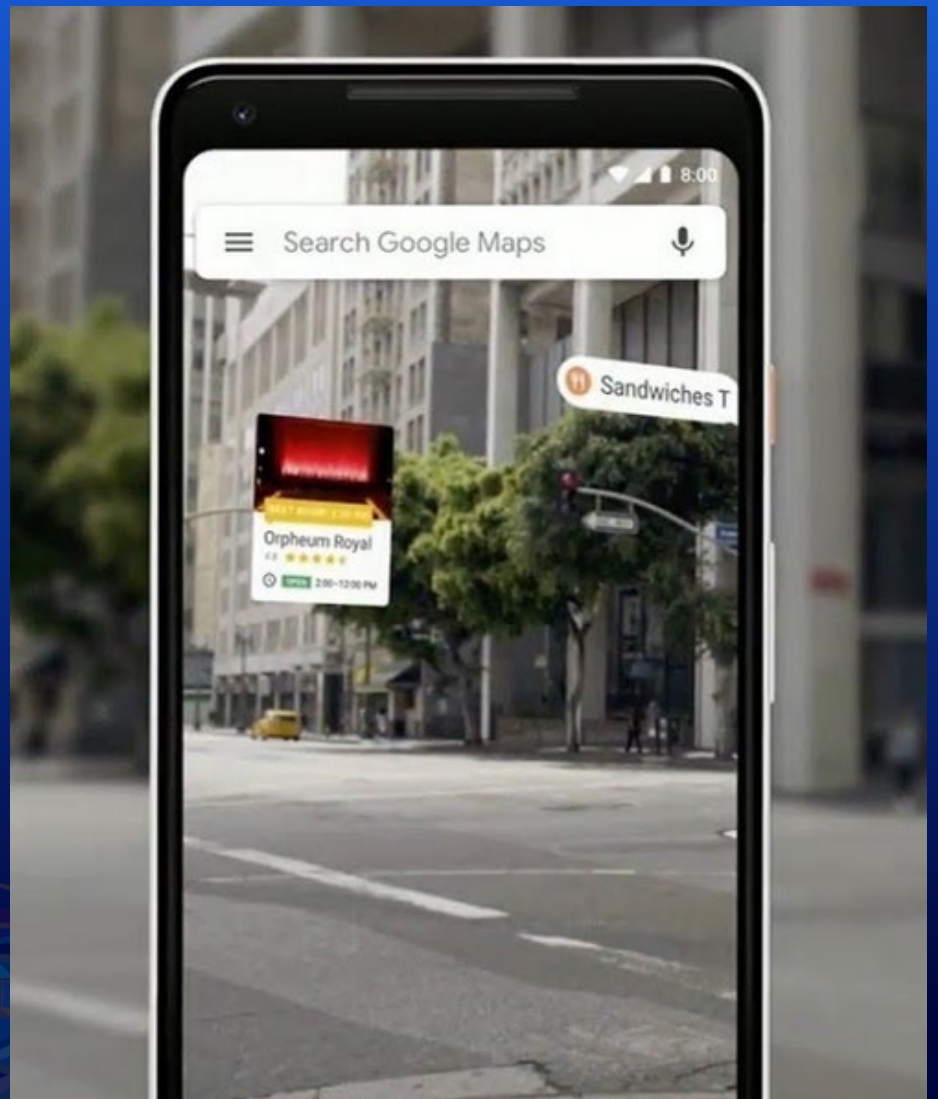
~~**Outside-in**: Cameras placed in stationary locations & <u>markers</u> on devices (HMD & controllers)~~

Positional Tracking for MR

Inside-out motion tracking, but needs initial position



Global Positional Tracking for AR



Accuracy:

- **GPS: ~10m**
- **Wi-Fi: ~1m**
- **RFID / Beacon: ~1m**
- **UWB: ~0.1m**

XR Devices

... and many more devices, each with different features

Premium VR

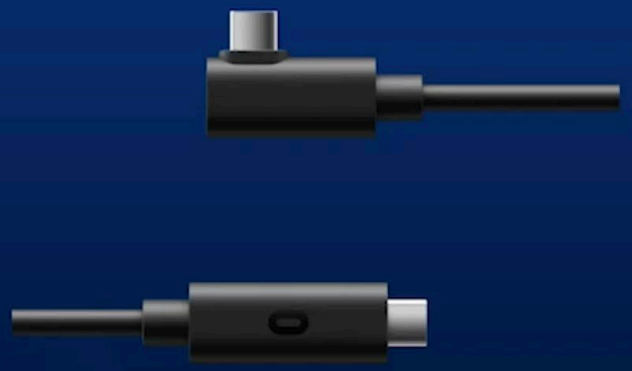
- Inside-out or outside-in
- 6 DoF
- High cost, requires PC
- Great graphics, but cables

Mobile VR

- Gyro or inside-out
- 3 DoF or 6 DoF
- Low cost, standalone
- Limited graphics, no cables

Special Mention for VR: Oculus Quest

- Standalone mobile VR device that optionally can be connected to a PC with a USB cable (Oculus Link)
  → Mobile and Premium VR in one
- Provides both controllers or hand tracking



Special Mention for MR: Hololens 2

- Standalone MR device with large FOV
- Windows MR platform provides many features e.g. spatial anchors, allowing for apps where VR & MR user can collaborate
- Contents (pixels/video) can be streamed from Unreal Engine without cable, allowing also for PC graphics

XR User Interface Concepts

Table-scale a.k.a. the “Tabletop” UX

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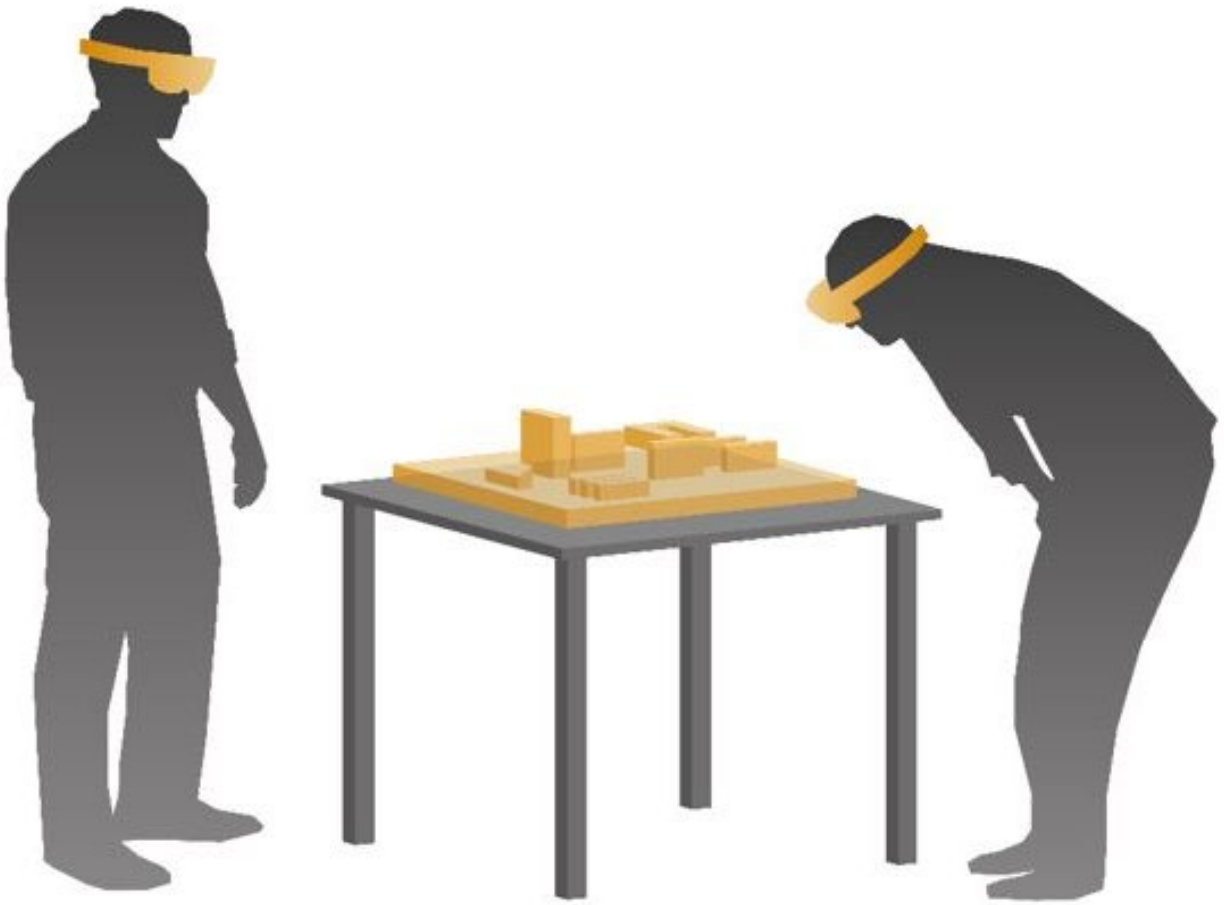
- Common UX pattern in AR, MR & VR
- Collaborative
- Intuitive, people can relate to table
- No motion sickness



Teleporting

- Still the most used locomotion technique in VR
- No motion sickness
- May result in loss of orientation

Controllers

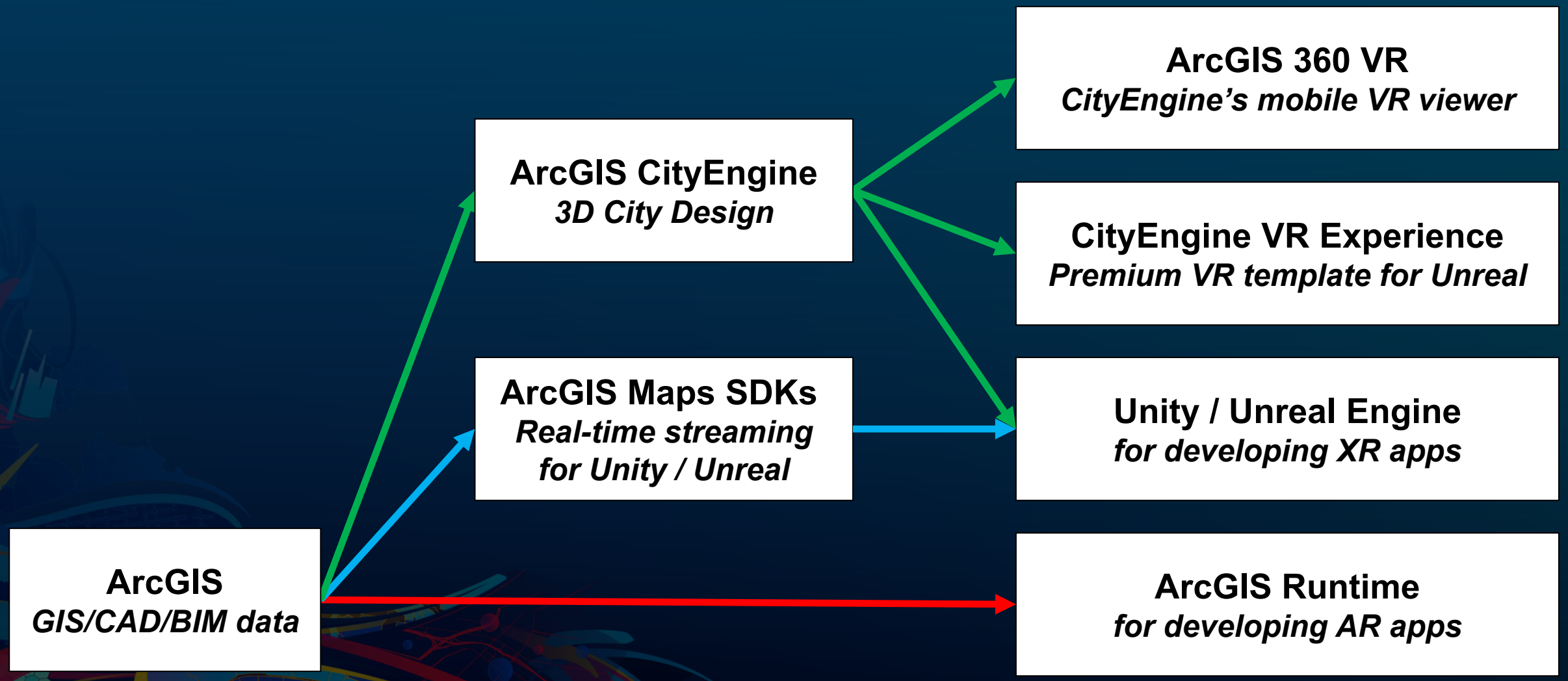
- Fast and reliable
- Complicated to use (like game pads)
- Established UI concepts
- Comfortable

Hand tracking

- Still a tiny bit laggy
- Intuitive
- UI concepts are in its infancy
- Not comfortable (arms need to be up)

Microsoft

XR with ArcGIS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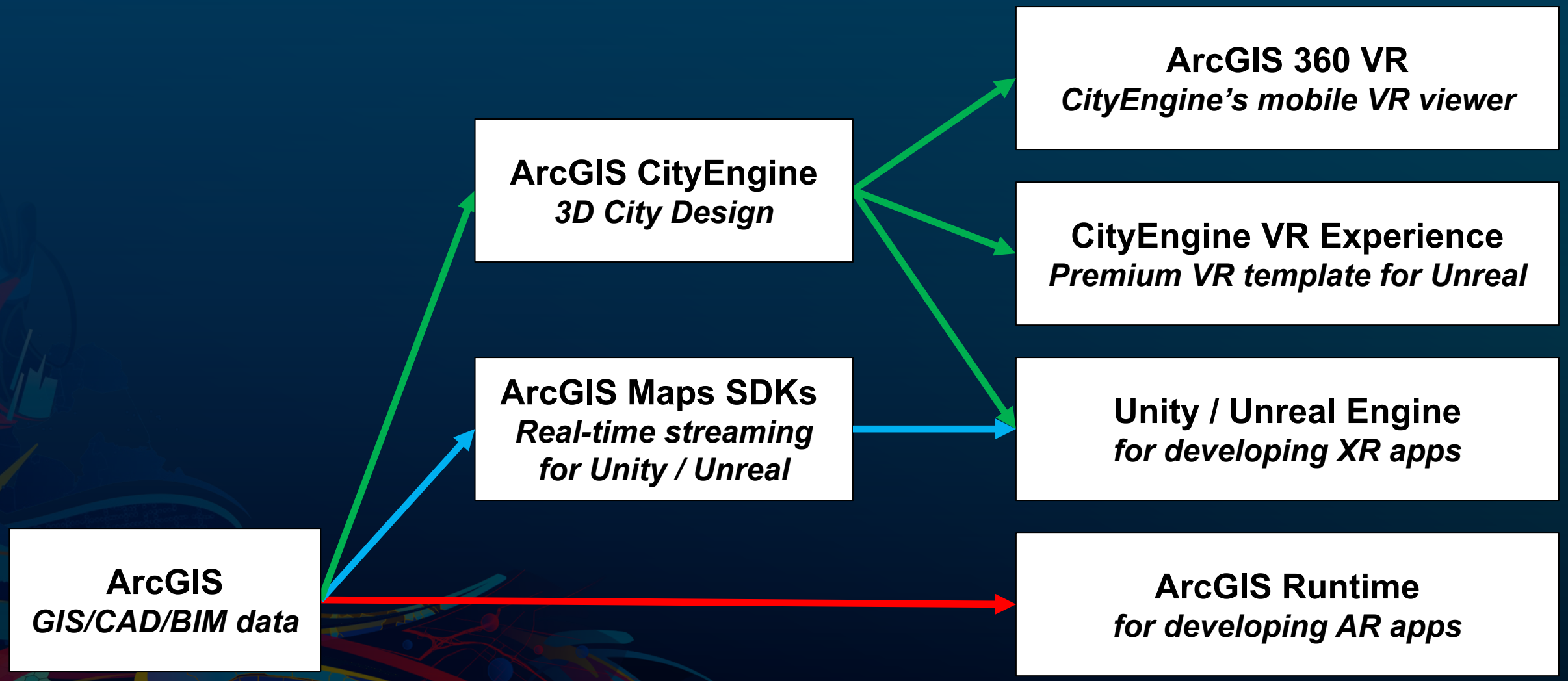
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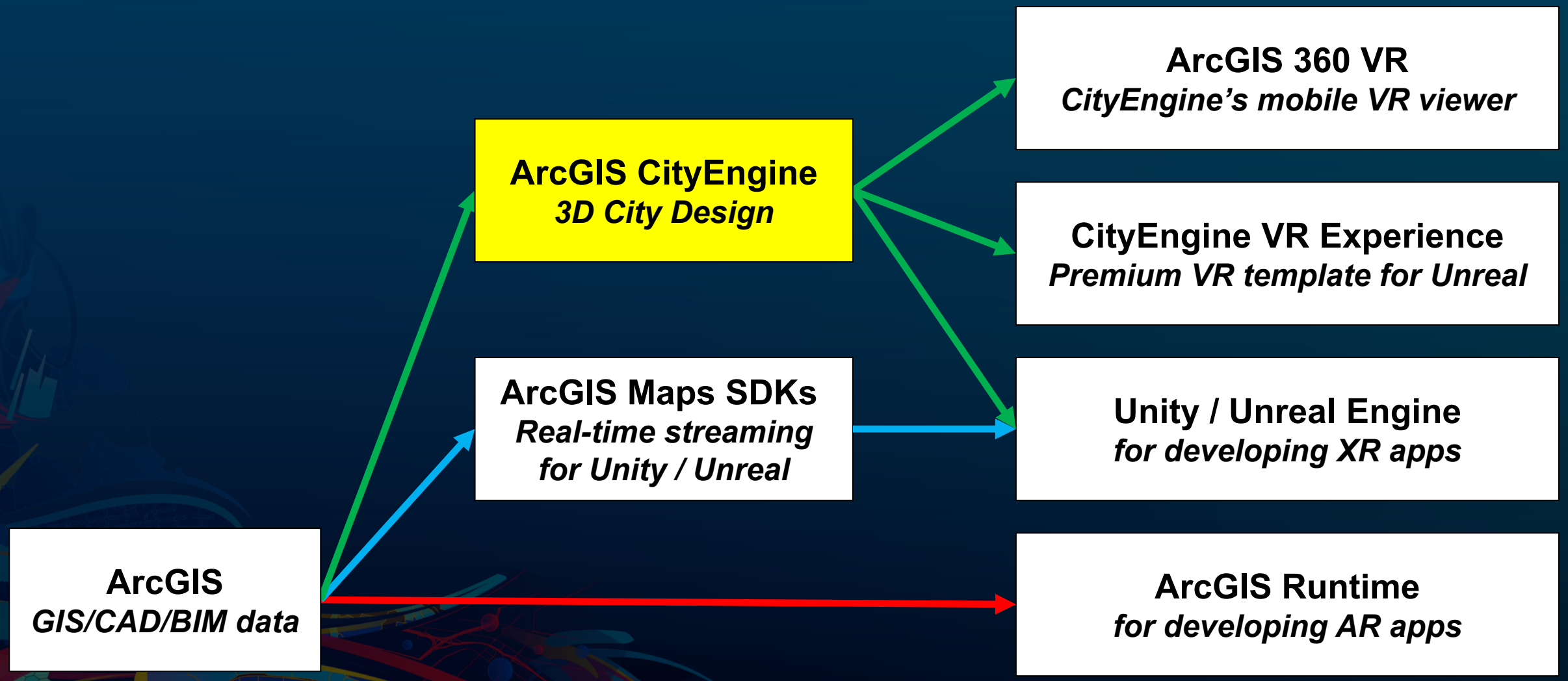
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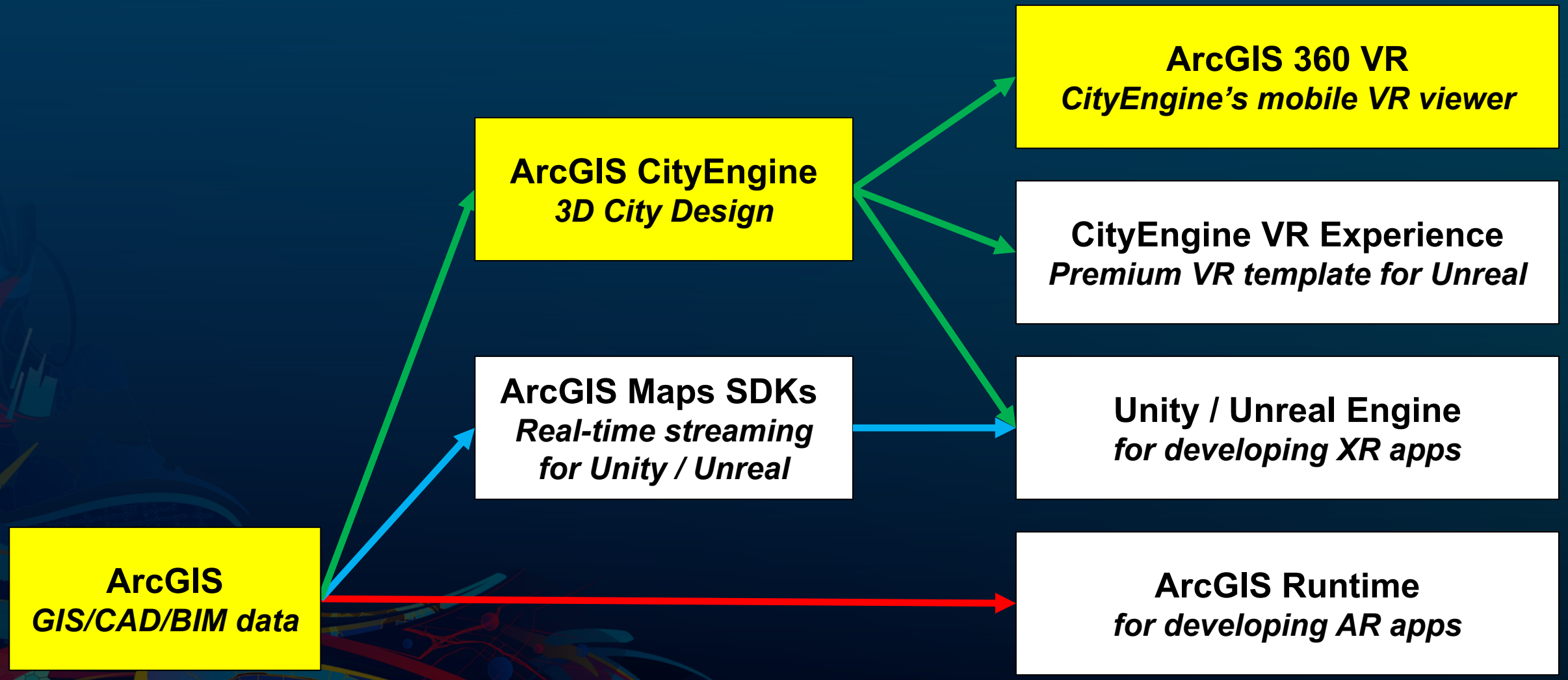
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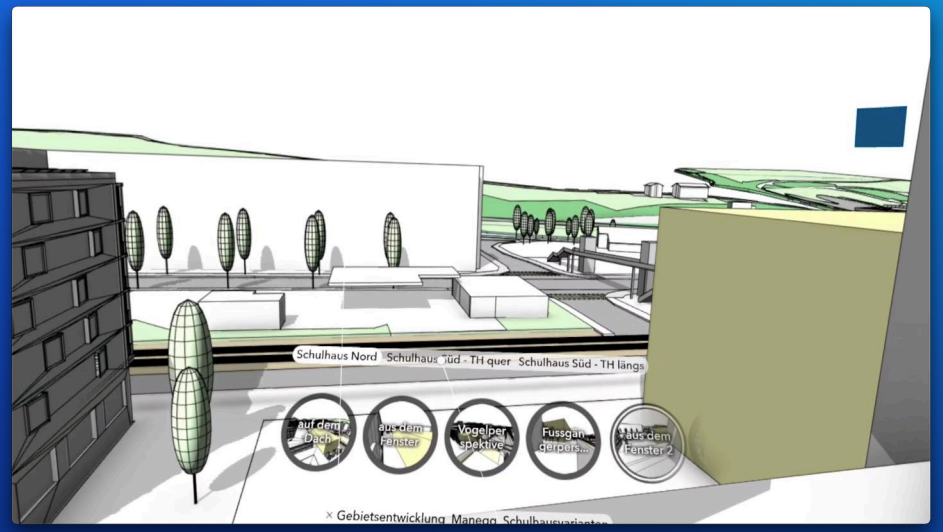
ArcGIS 360 VR: CityEngine's Mobile VR Viewer

Provides quick immersion into designs and lets users experience view impact:

"Does the new building obstruct my view from the balcony?"

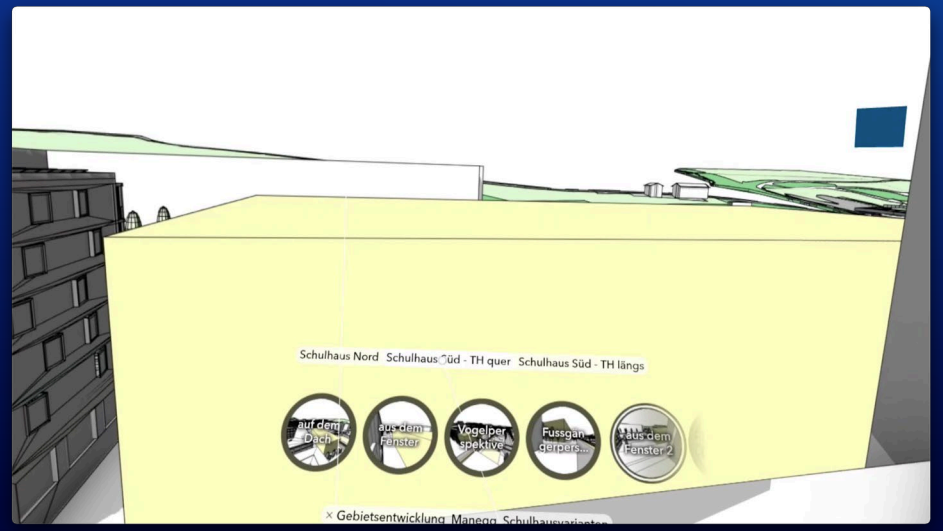


Easy workflow from CityEngine to ArcGIS:

Does not require programming / tweaking

Web-based, for a wide range of platforms:

Desktop, mobile, VR headsets



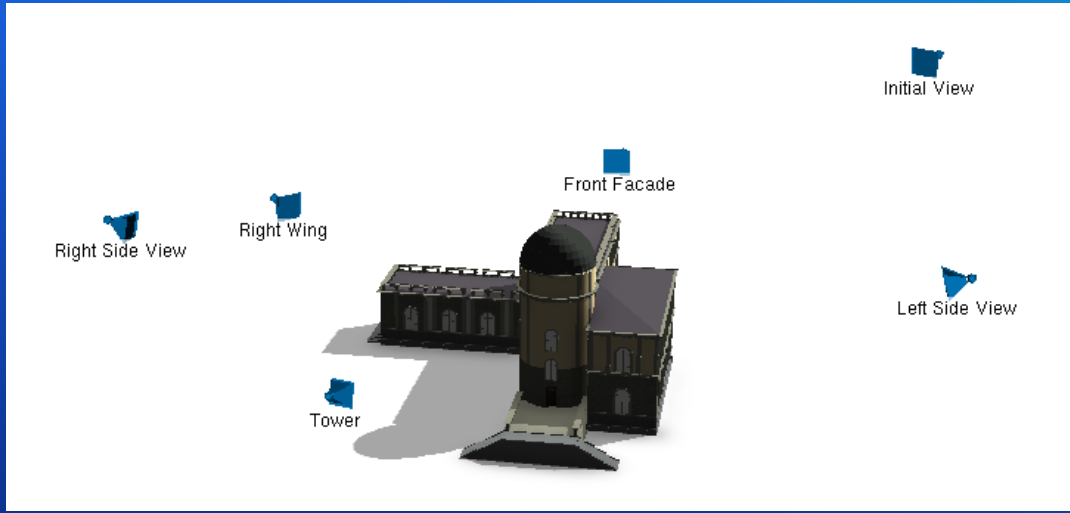
ArcGIS 360 VR: Workflow Details

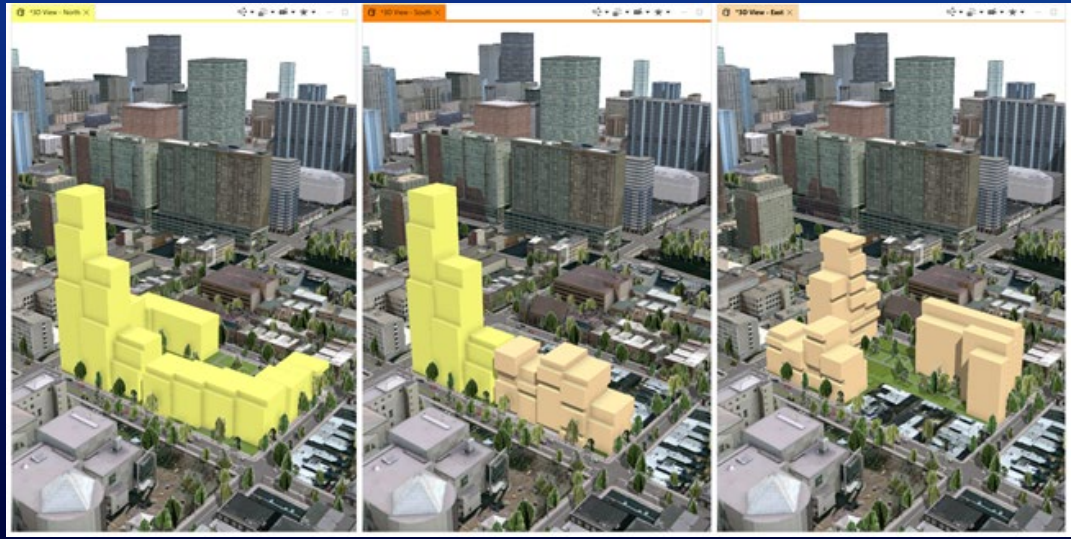
In CityEngine:

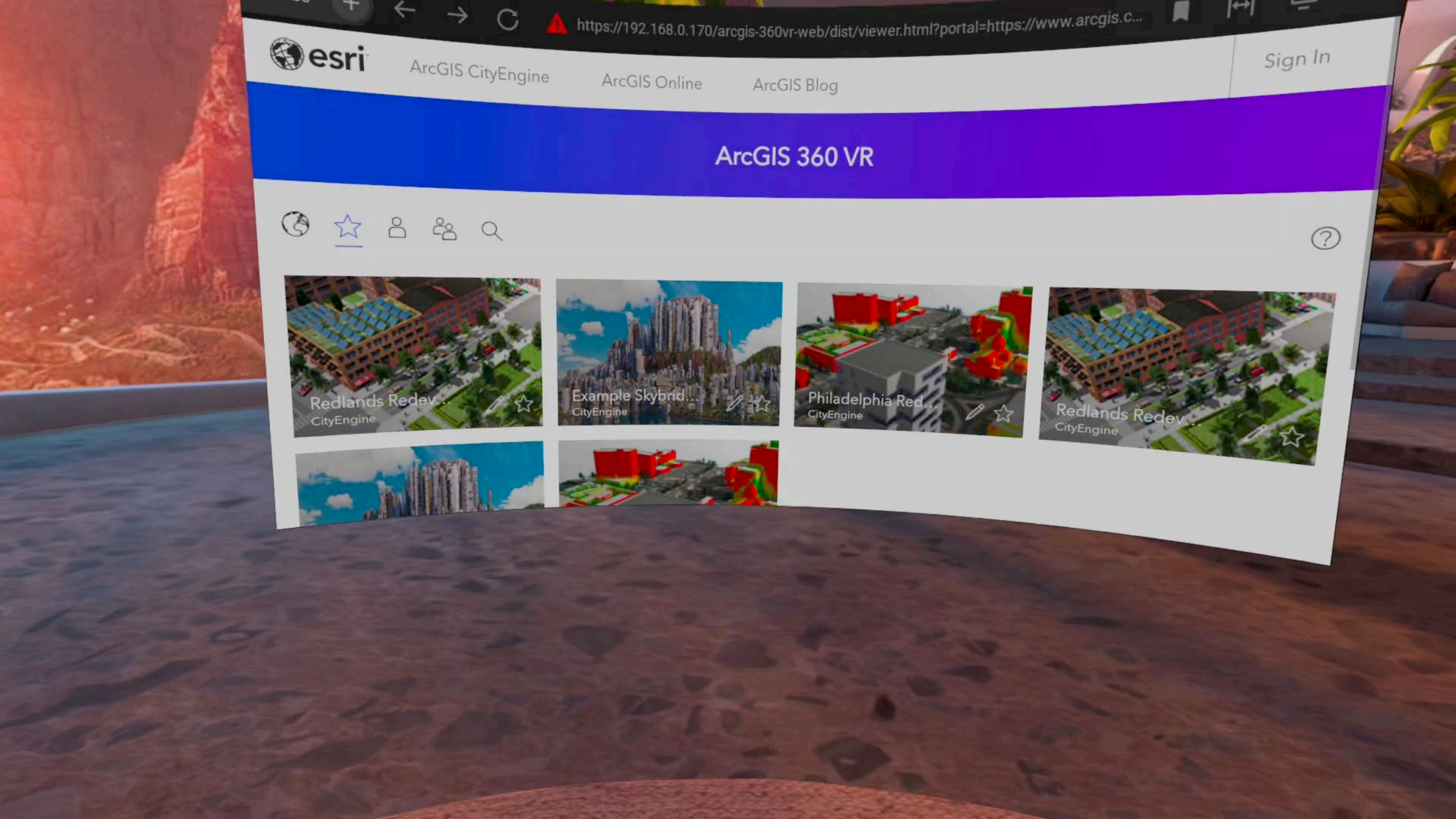
1. Define design, scenarios and views (bookmarks)
2. Create 3VR package containing 360-degree panoramas and metadata
3. Share to ArcGIS

In Viewer:

1. Login to ArcGIS
2. Select experience in content browser
3. Explore scenarios and views in the experience



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ArcGIS CityEngine
ArcGIS Online
ArcGIS Blog
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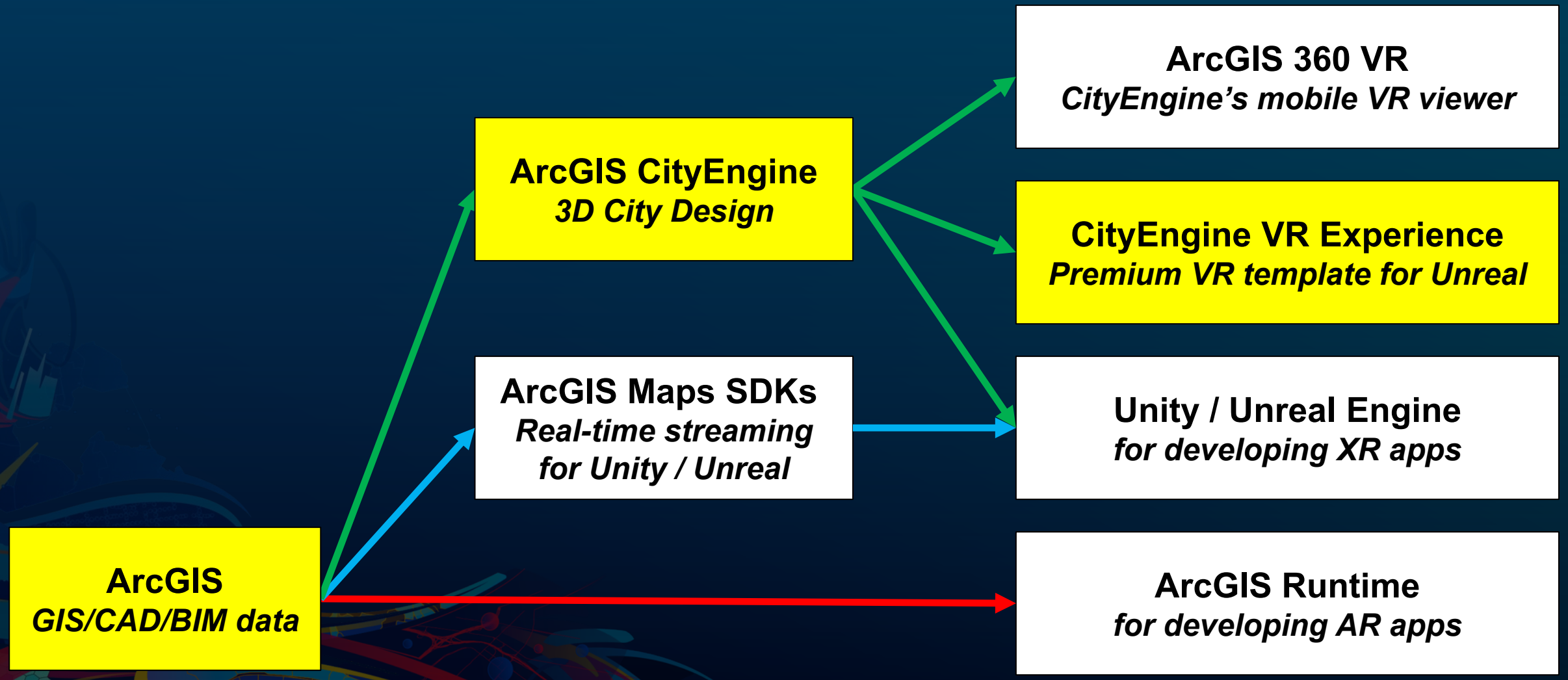
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The CityEngine VR Experience: Premium VR Unreal Engine Template

Use the CityEngine VR Experience template to

Quickly transform your CityEngine projects into interactive VR Experiences

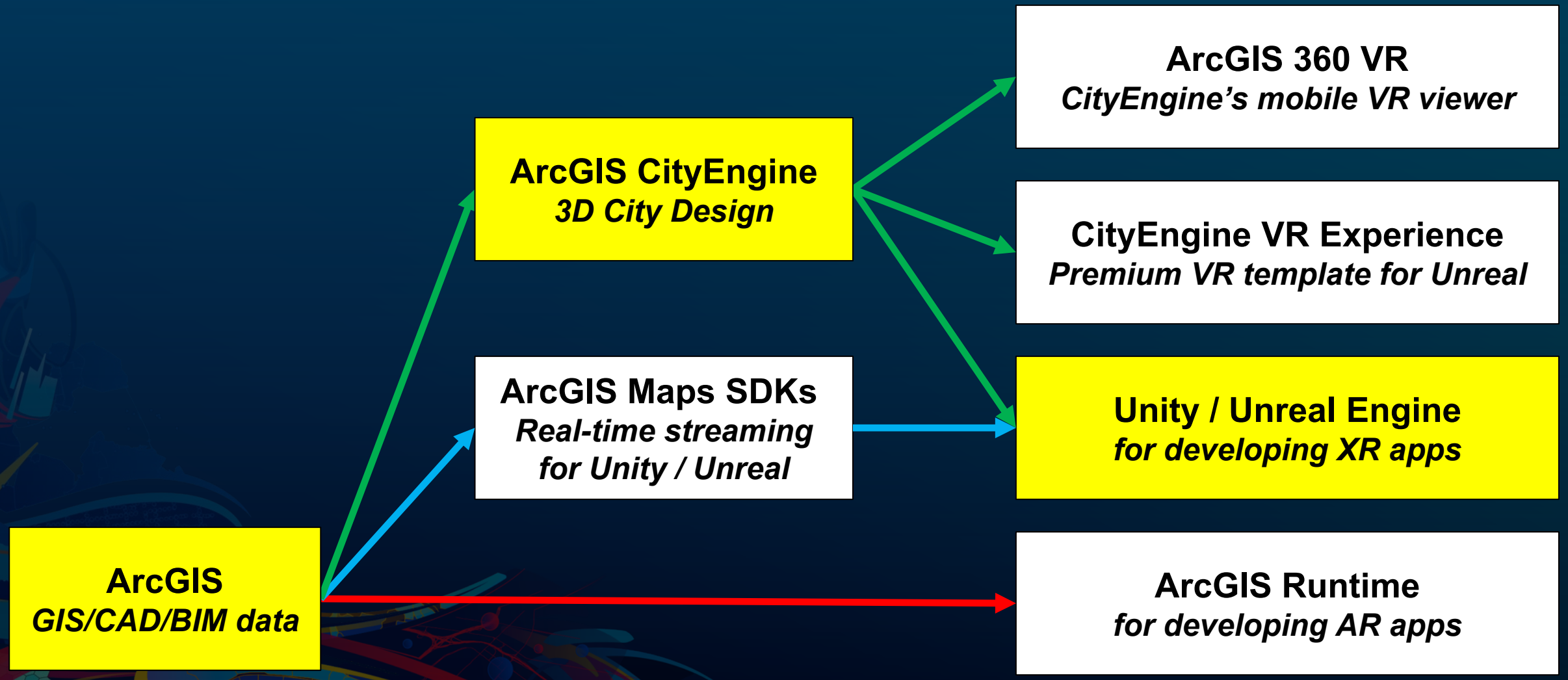
Support premium VR devices (Oculus Rift, HTC Vive, HP Reverb...) to

Immerse into city scenarios and collaboratively review plans and projects

Access the templates source code to

Customize the experience to your own needs

Boston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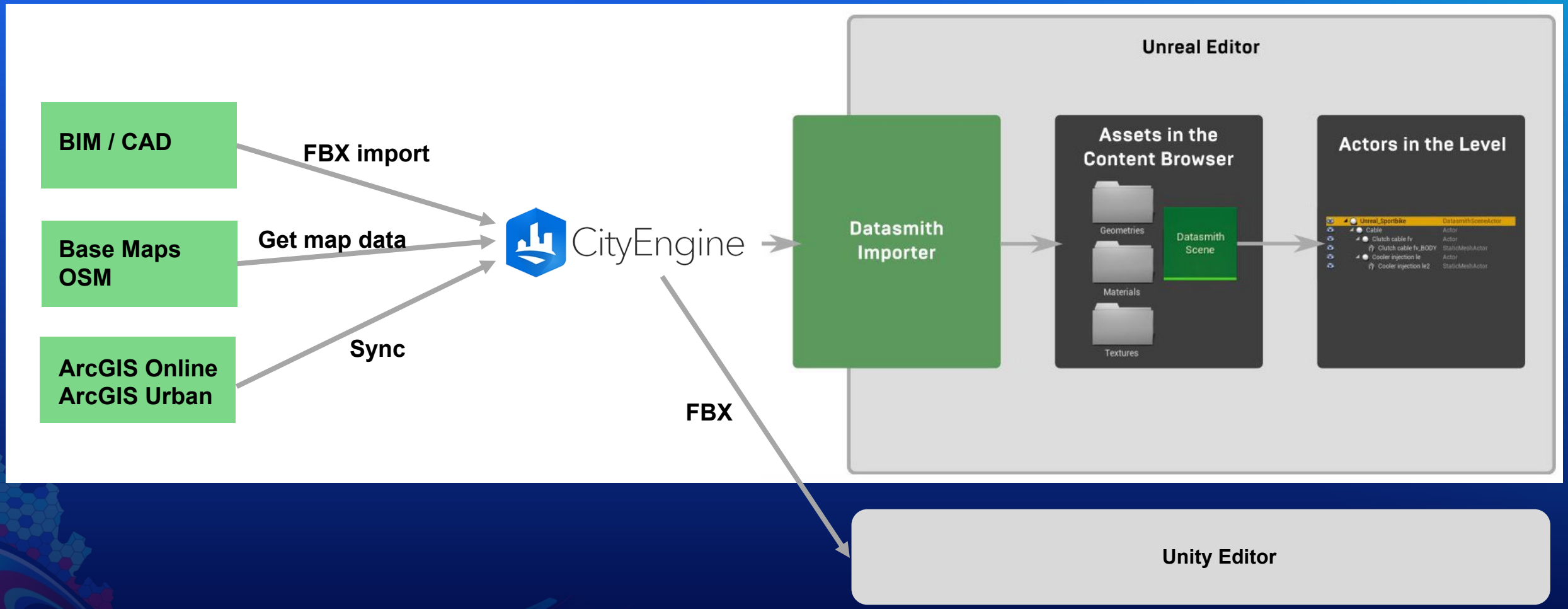
From CityEngine to Unreal Engine and Unity with Full Flexibility

CityEngine provides optimized exporters that scale:

Transfer models to game engines accurately and efficiently

Use Unreal, Unity or another game engine:

Create use-specific experiences with the platform of your choice


BIM / CAD
FBX import
Base Maps
OSM
Get map data
ArcGIS Online
ArcGIS Urban
Sync
CityEngine
FBX
Unreal Editor
Datasmith
Importer
Assets in the
Content Browser
Geometries
Materials
Textures
Datasmith
Scene
Actors in the Level
Unreal_Sportbike
Cable
Clutch cable fv
Clutch cable fv_BODY
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Cooler injection le2
Unity Editor

Vitruvio: CityEngine's Procedural Modeling Technology in Unreal Engine

Model buildings in CityEngine

Use existing rules and assets

Import CityEngine rule packages in Unreal

Generate buildings instantly

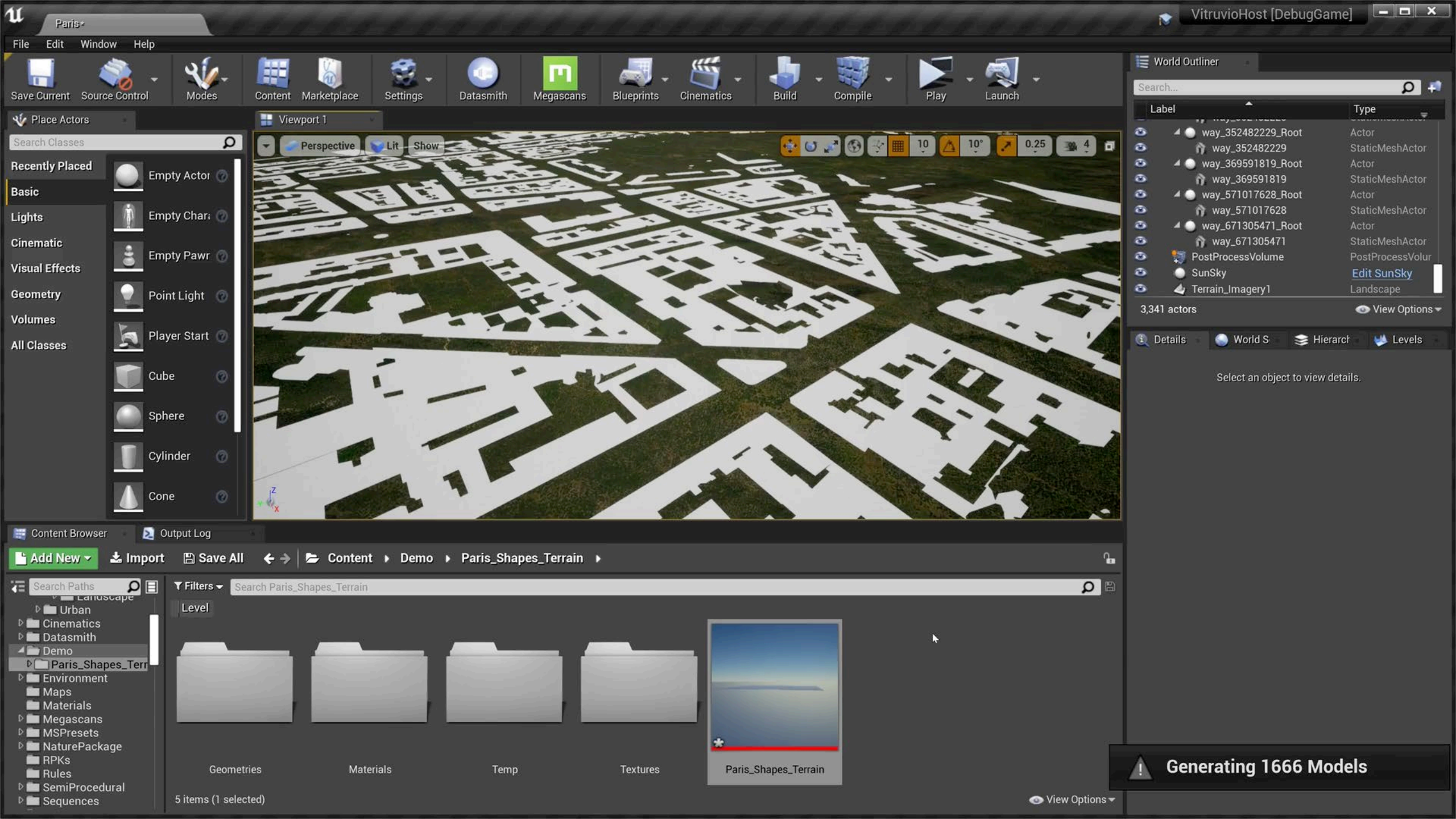
Modify appearance on the fly

Visualize buildings in real-time

Highest visual quality in editor and at runtime

Available on github and Unreal Marketplace

https://esri.github.io/cityengine/vitruvio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MSPresets
NaturePackage
RPKs
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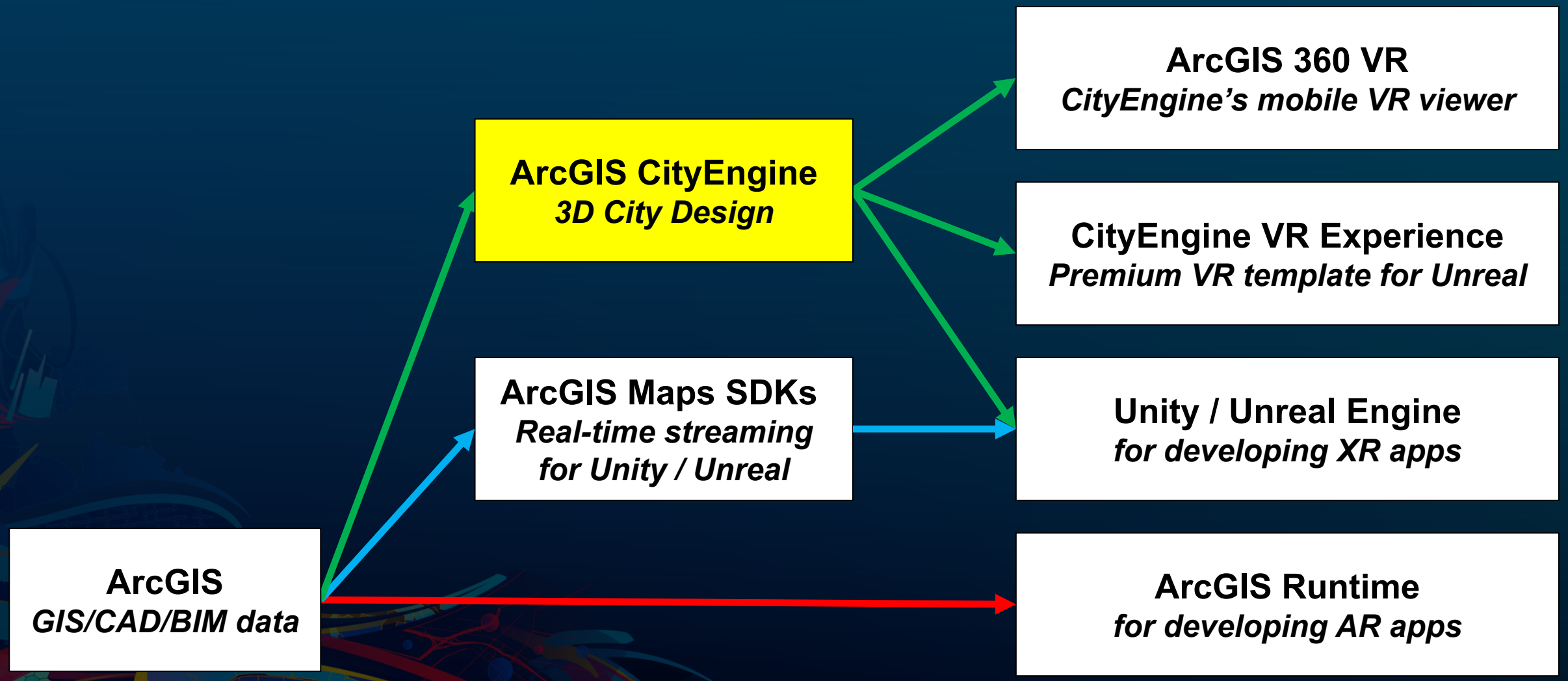
Temp
Textures
Paris_Shapes_Terrain
5 items (1 selected)
View Options
Generating 1666 Models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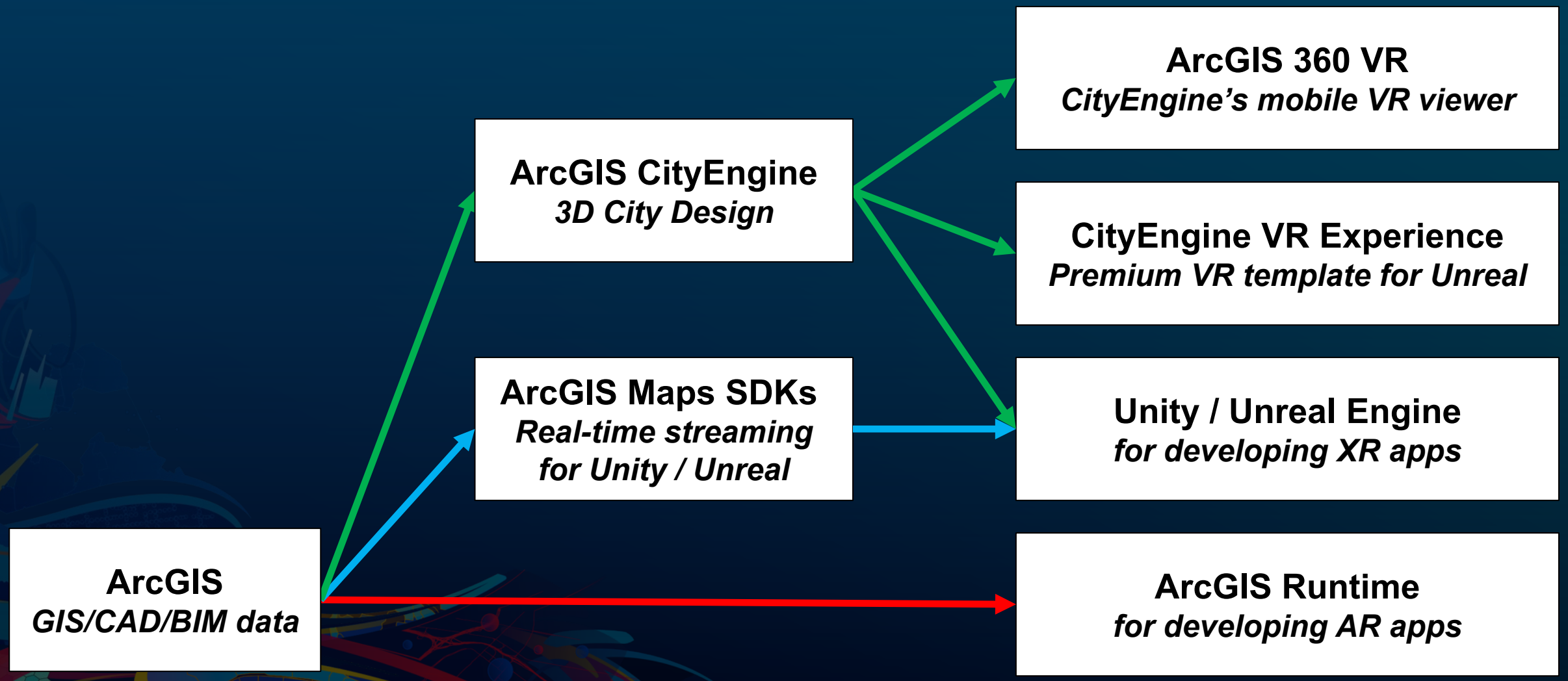
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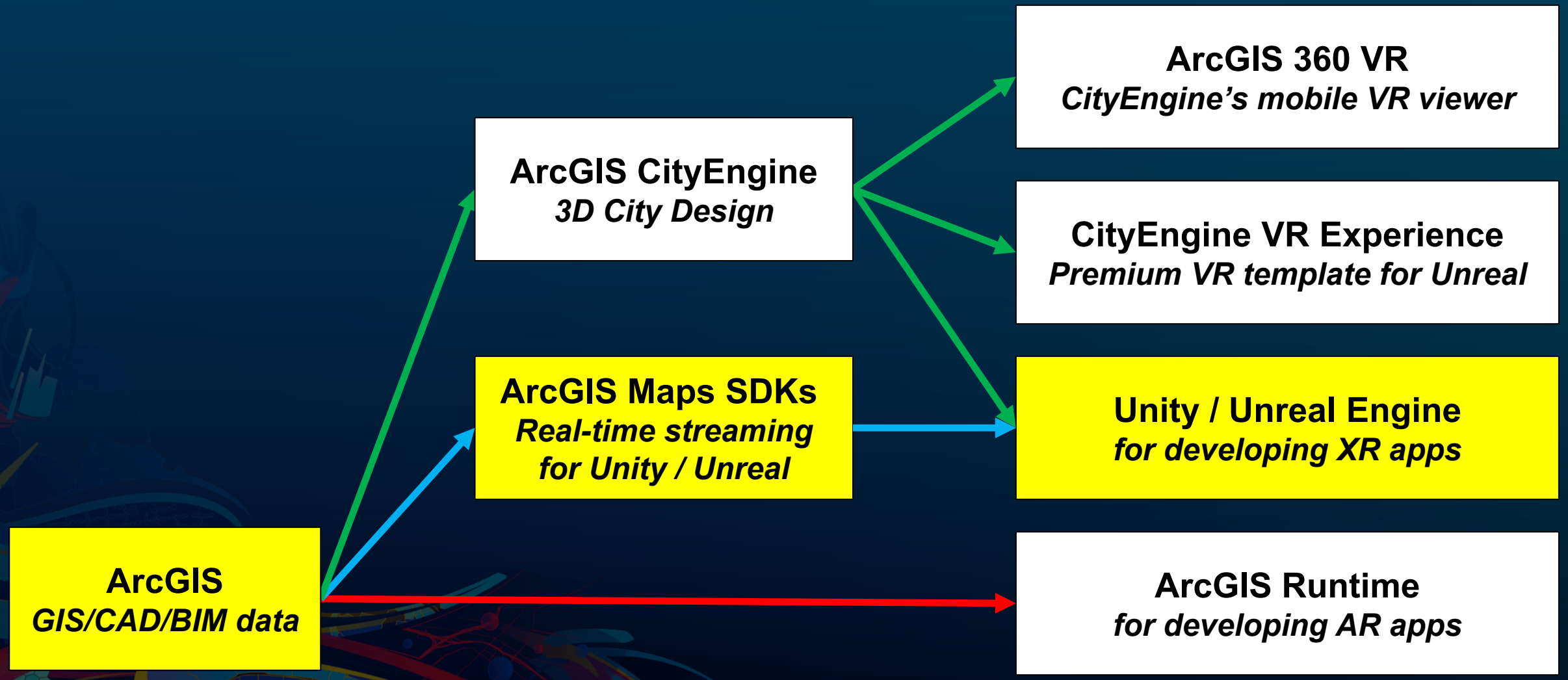
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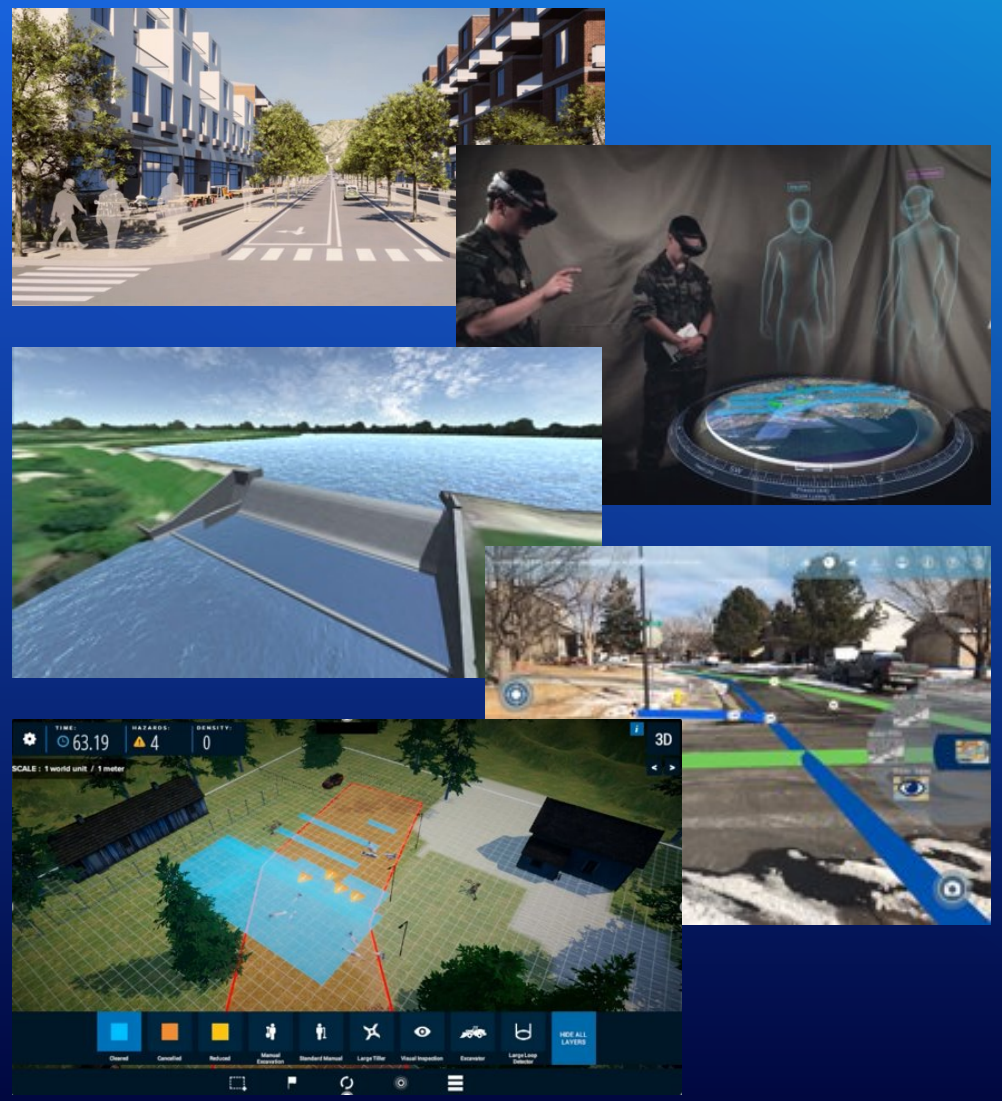
Next generation 3D GIS solutions

- Access to real-world, geospatial data
- Photo-realistic 3D and **XR** experiences
- Interactive and immersive
- Modeling and simulation
- Real-time analysis

- Primary industries
  - AEC
  - Defense/Public Safety
  - Natural resources
  - Utilities
  - Transportation
  - Education



Game engine benefits

- Premium rendering experience
- Physics, animation, special effects
- Cross hardware development
- Existing developer community

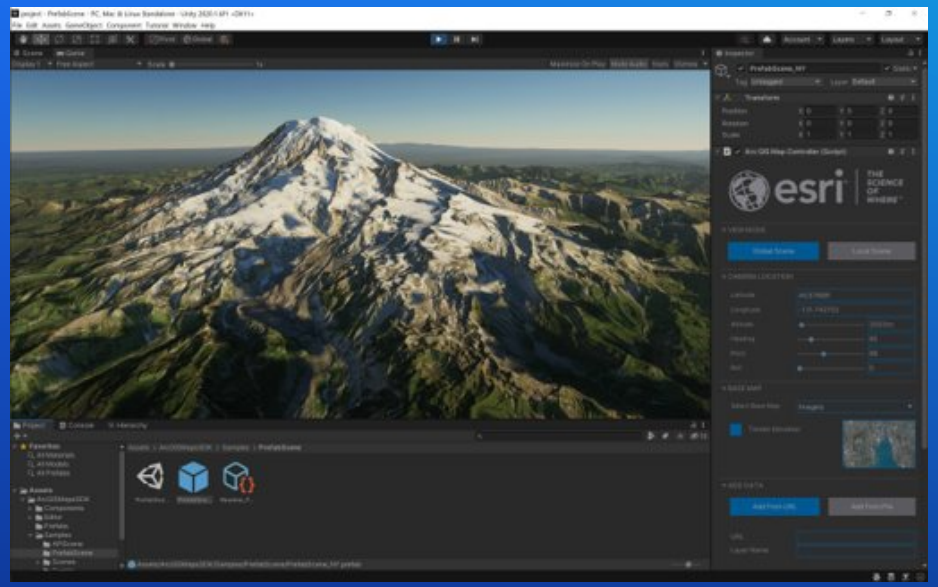
ArcGIS Maps SDK for game engines

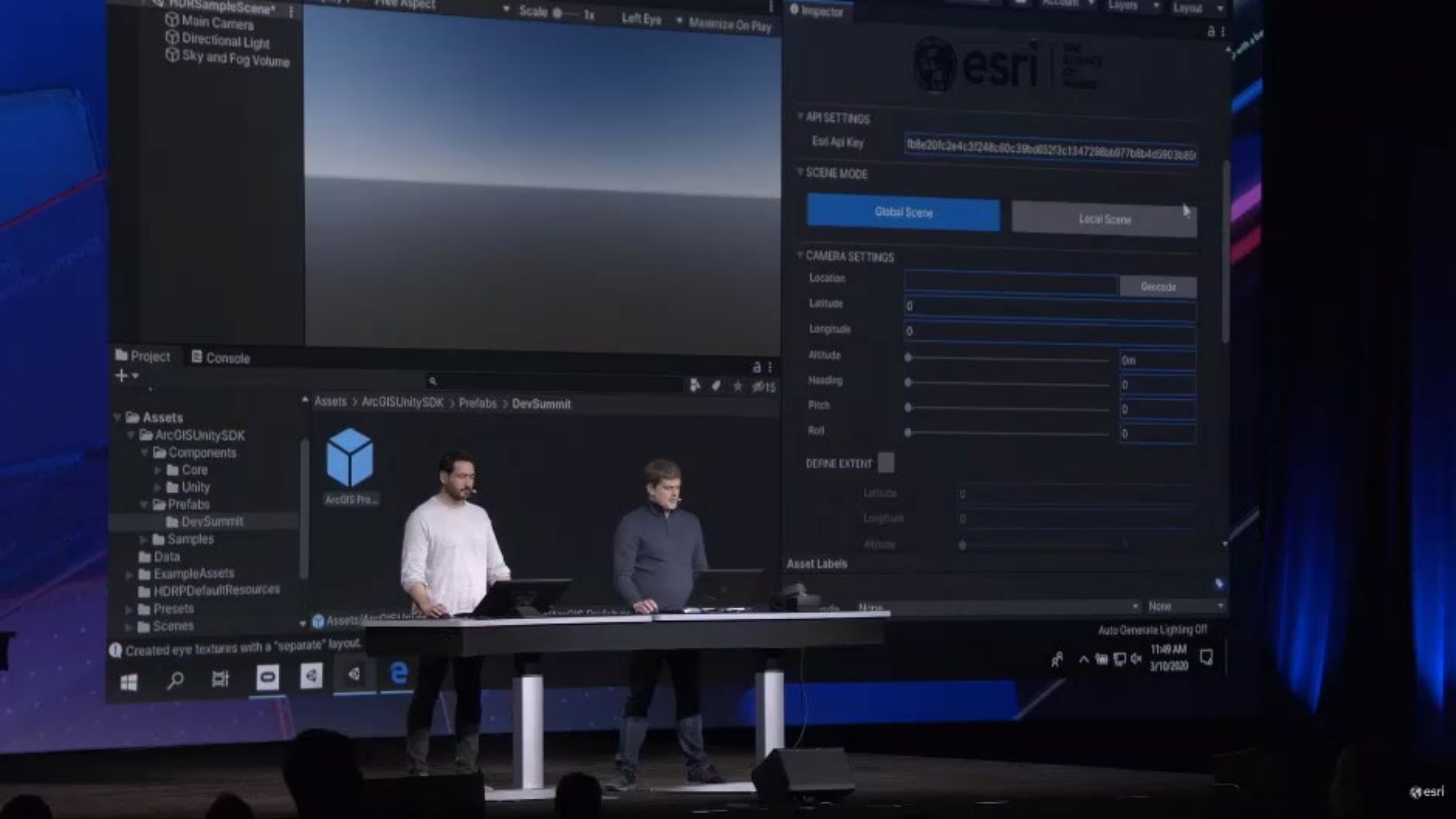
- ArcGIS Maps SDK for Unity
- ArcGIS Maps SDK for Unreal Engine

- Delivered as plugins
- APIs to access ArcGIS services and local data
- Support local and global (open world) 3D experiences
- Work in real world, geographic coordinate space
- Include SDK resources

Beta capabilities

- Development
  - Windows, macOS
- Deployment
  - Windows. macOS, Android, iOS
- Developer experience
  - UI, Blueprints, API
- Local and global scenes
- Data sources
  - ArcGIS elevation layers
  - ArcGIS raster tile layers
  - ArcGIS scene layers
  - Location component for custom data

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Directional Light
Sky and Fog Volume
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SCENE MODE
Global Scene
Local Scene
CAMERA SETTINGS
Location
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Pitch
Roll
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Asset Labels
Project
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Core
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Prefabs
DevSummit
Samples
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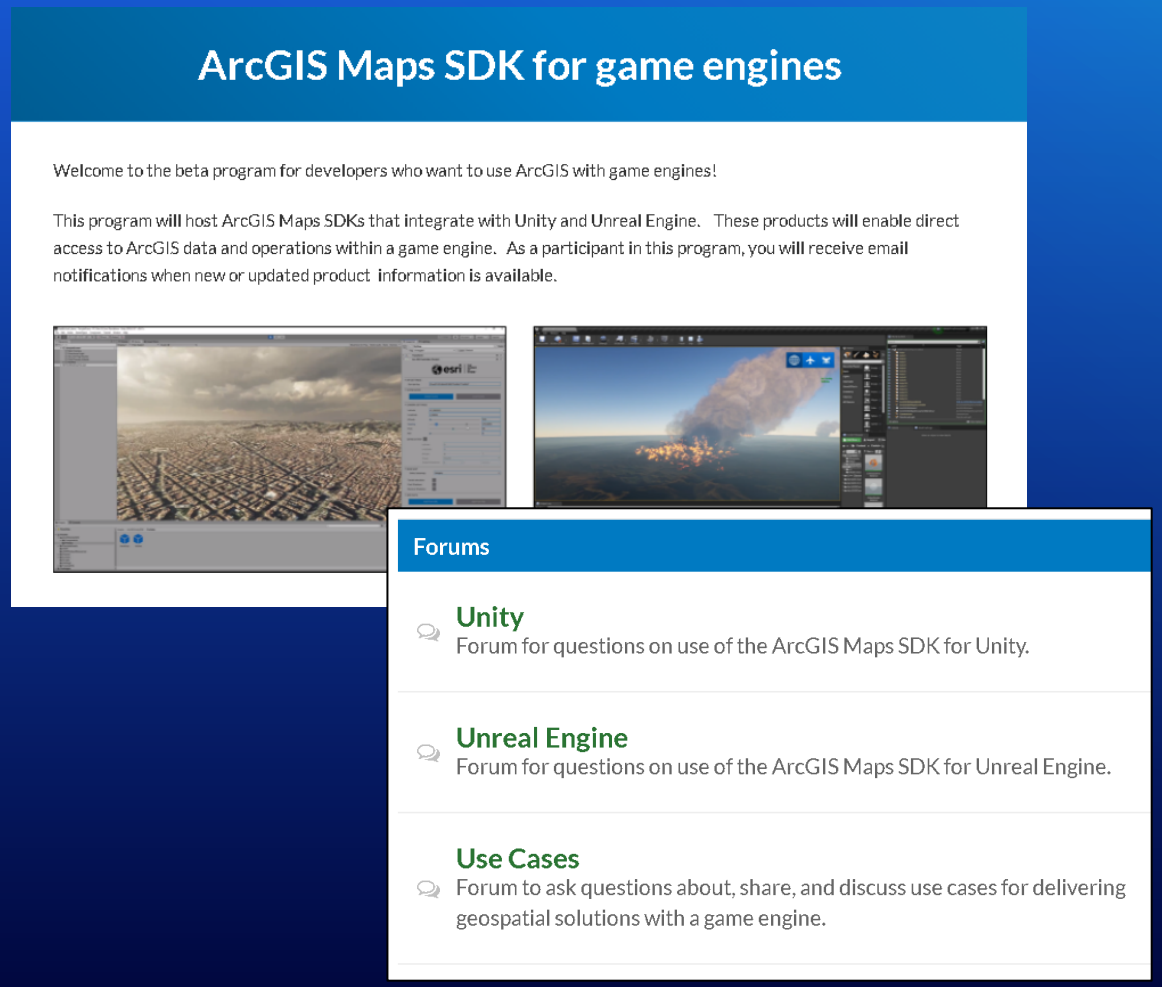
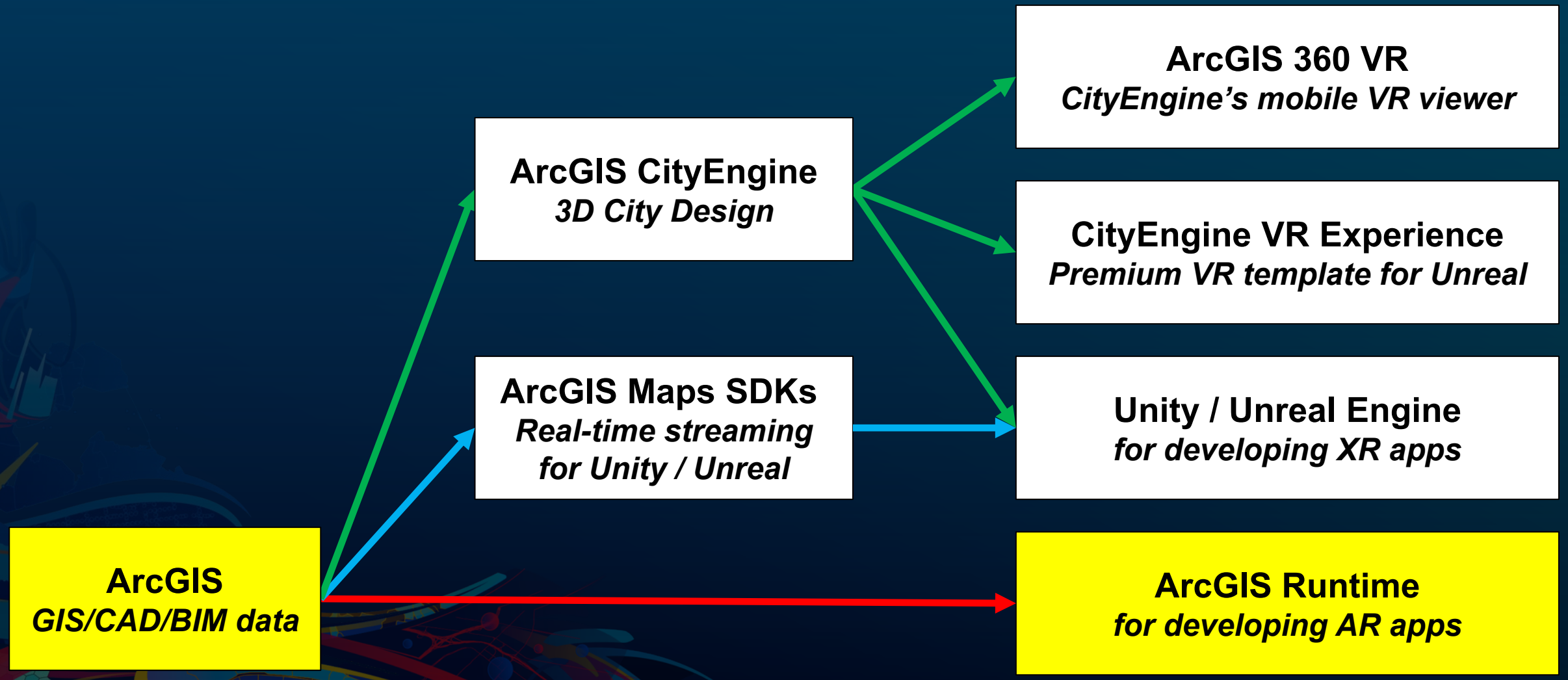
Assets > ArcGISUnitySDK > Prefabs > DevSummit
Created eye textures with a "separate" layout.
Auto Generate Lighting Off
11:49 AM
3/10/2020

ArcGIS Maps SDK for game engines Beta program

- **esriurl.com/a4ge**
  - Open to the public
- Release timeline
  - Beta 1 – Oct 2020
  - Beta 2 – Feb 2021
  - . . .

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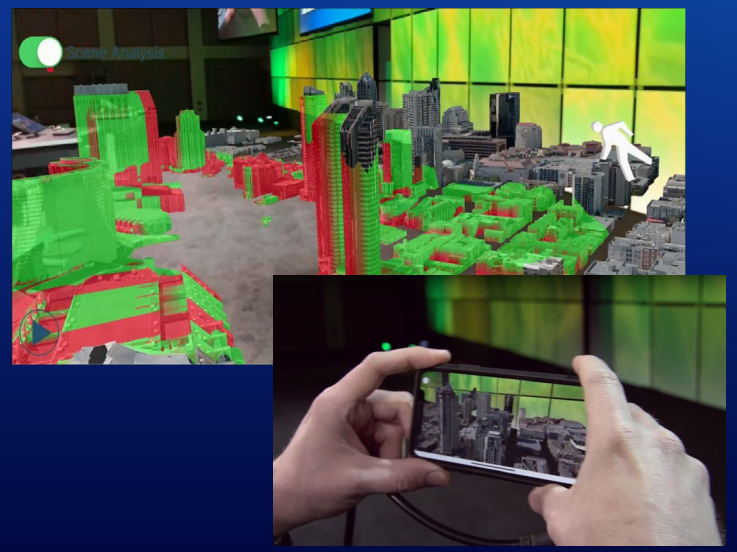
Augmented Reality with ArcGIS Runtime

- Available for production use
  - AR for mobile platforms
    - iOS, Android devices
  - Not for VR or MR

- AR capabilities delivered with:
  - ArcGIS Runtime SDKs for Android, iOS, Qt, and .NET
  - Open source toolkits to work with hardware



Supported Experiences and Use Cases

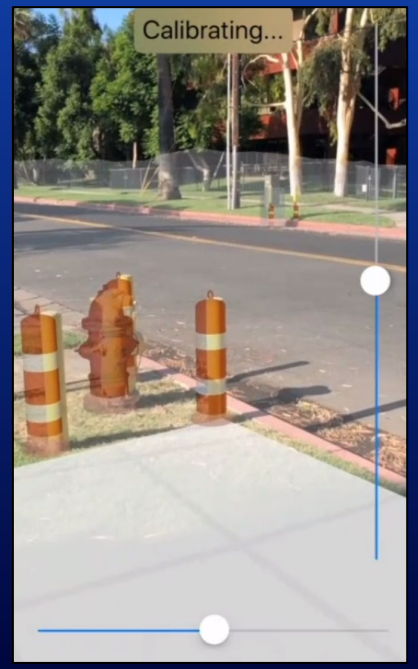
- **Flyover**
  - Use case: Education
  - Intuitive navigation of a scene
- **Tabletop**
  - Use case: Design
  - Lock scene to a surface
- **World scale**
  - Use case: Inspection
  - Overlay scene on the real world

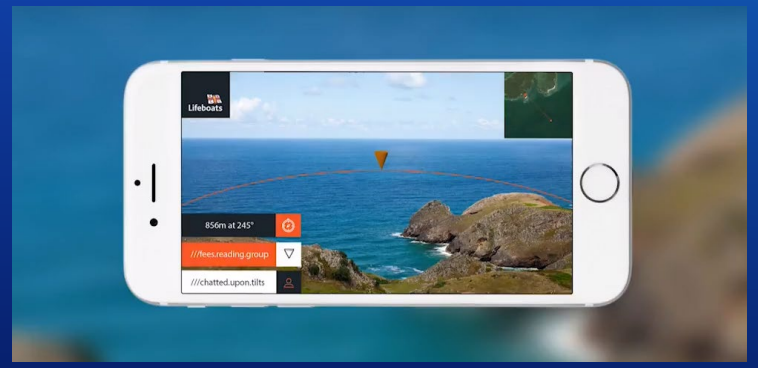
ArcGIS Runtime
Augmented Reality Demo

https://devpost.com/software/sonderfly

Challenges and considerations

- Your user's ability and expectations
- Device capabilities
  - AR sensors
  - Positional accuracy
- Data accuracy in 2D and 3D space





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