Real-Time GIS for 2D and 3D Mapping

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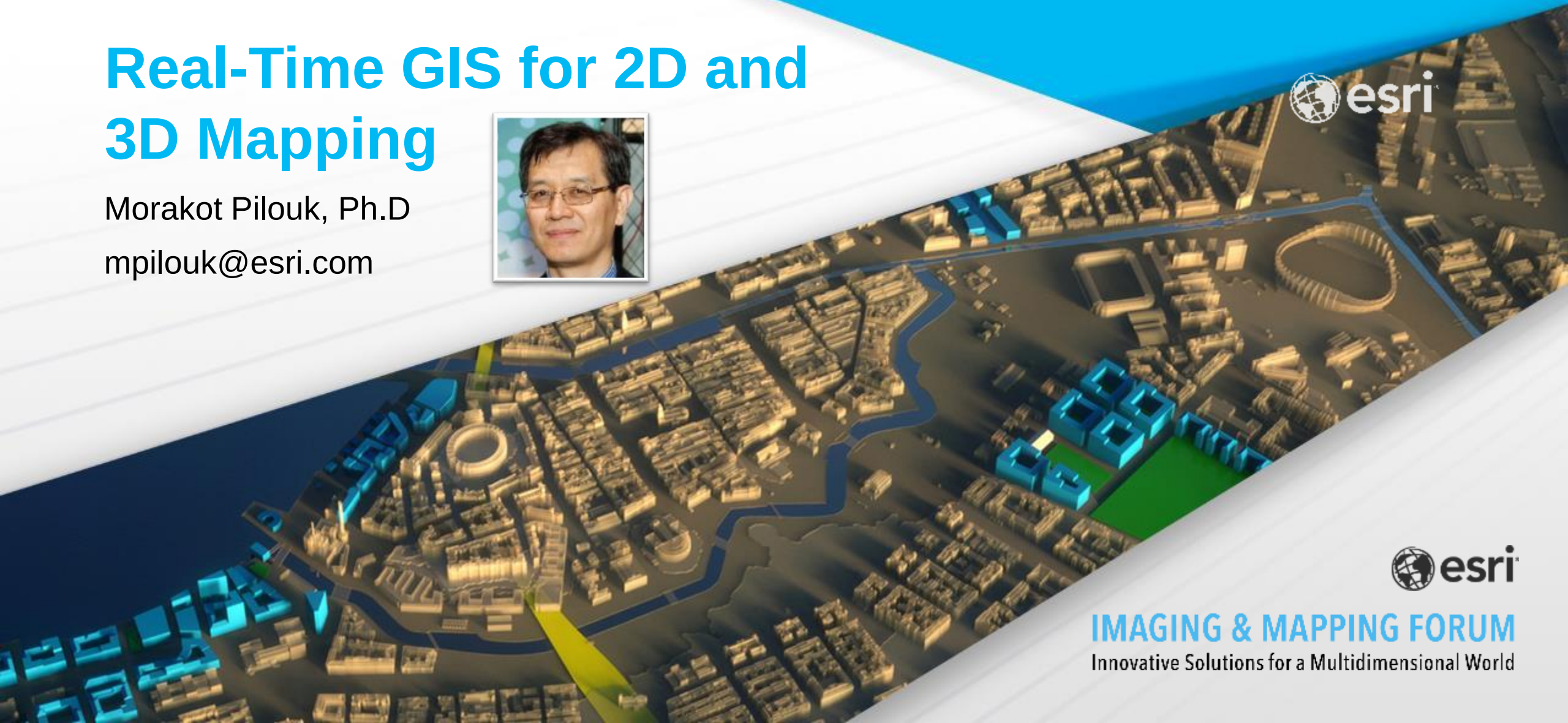


IMAGING & MAPPING FORUM

Innovative Solutions for a Multidimensional World

Agenda

1. Real-Time GIS
2. 2D and 3D Mapping in ArcGIS
3. Authoring static Map and Scene
4. Making Maps and Scenes Come Alive
5. Real-Time 2D and 3D Visualization
6. Conclusions

1 Real-Time GIS

Real-Time GIS

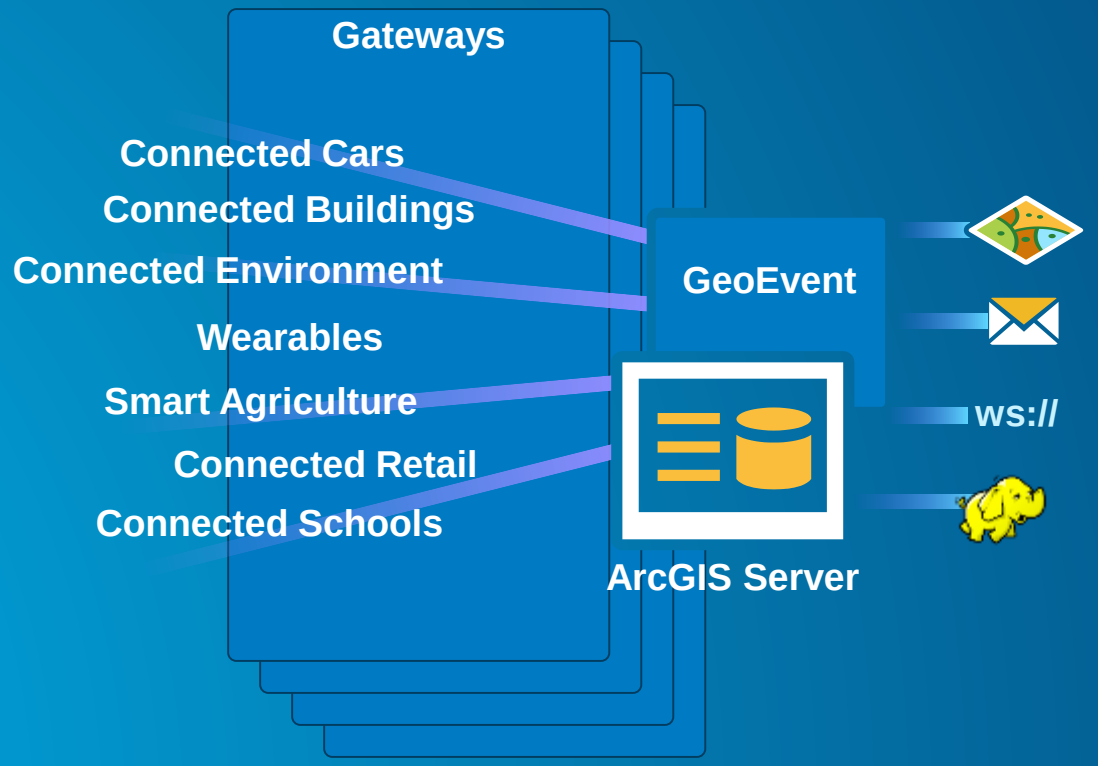
Concepts

- Awareness of events at the same rate or at the same time as they unfold
- No significant delay
- Real time in one scenario may not be real time to another
- Real-Time is often confused with frequency or interval
- Frequency is “temporal resolution”
  - Vary from one application to another
- A continuous stream of events flowing from sensors or data feeds
- Each event represents the latest state, e.g.:
  - Position, temperature, pressure, voltage, concentration, etc.

Real-Time GIS and The Internet of Things

Enable real-time spatial reasoning

- Spatial reasoning is needed amongst the Internet of Things (sensors)
- Performing continuous analytics closer to the things can improve their ability to sense
- When meaningful patterns are found things can send updates to those who need it



Observation Data

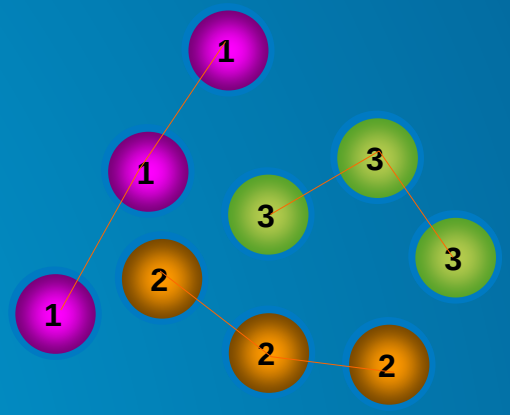
Defined

- **An observation is a recording of states of real world objects at a location and a specific moment in time.**
  - **Observations are immutable, they happen and are not editable**
  - **Observations can be replayed over space & time**
  - **Moving observations are identifiable by a unique attribute, known as a TRACK_ID**

Space & Time

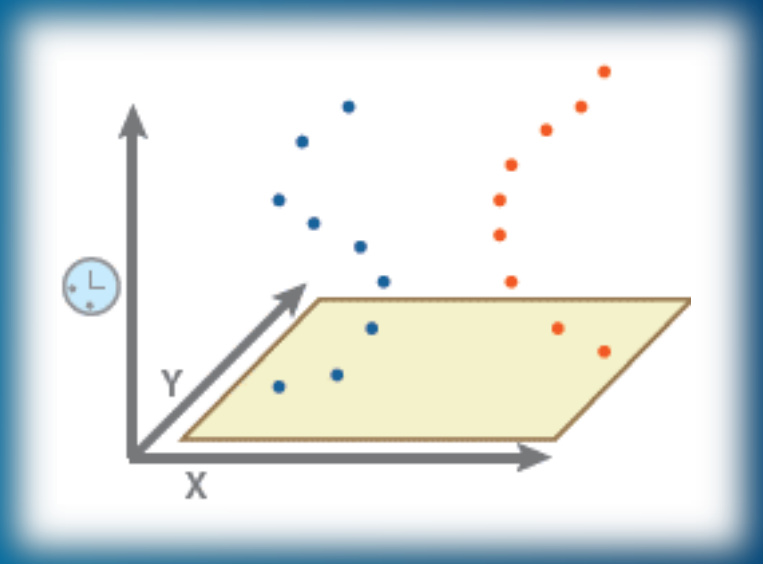
Observations can be shown at a specific time

Tracks



Moving observations can be identified by a unique attribute

Observations are like actors in a filmstrip

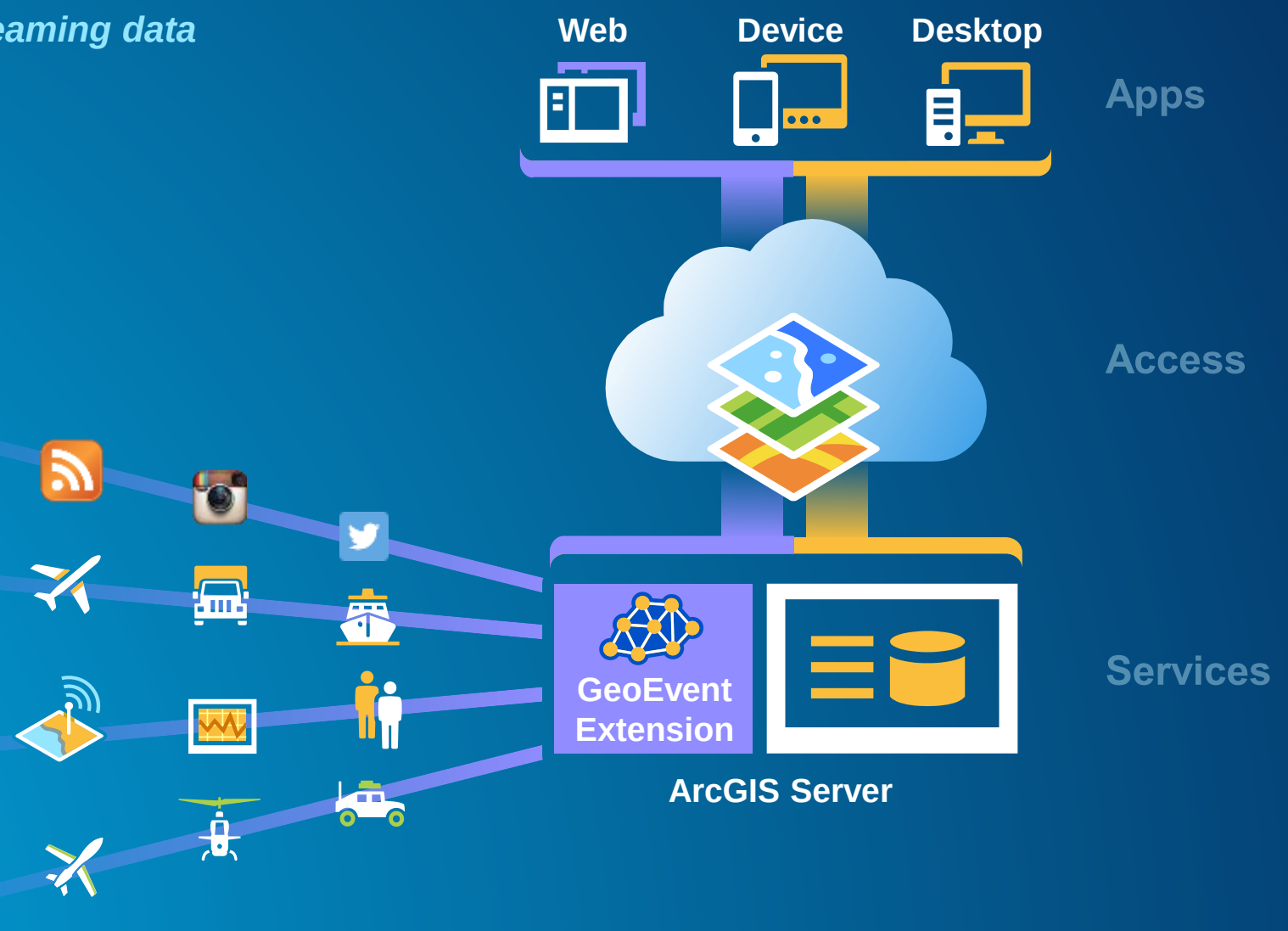


Moving observation illustration for two tracks over space (x, y) and time (t)

Real-Time GIS

Integration and exploitation of streaming data

- Integrates real-time streaming data into ArcGIS
- Performs continuous processing and real-time analytics
- Sends updates and alerts to those who need it where they need it

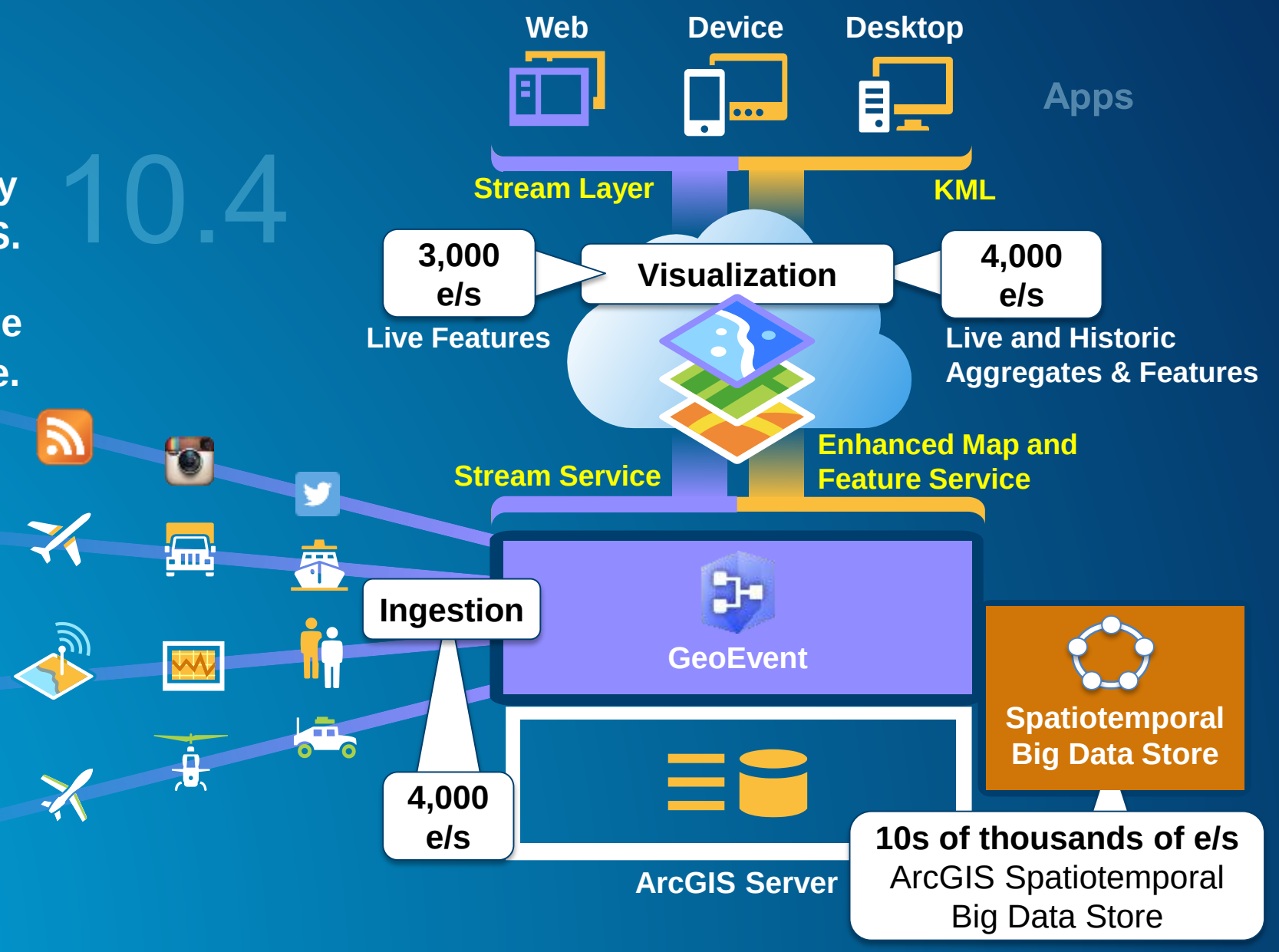


Real-Time GIS

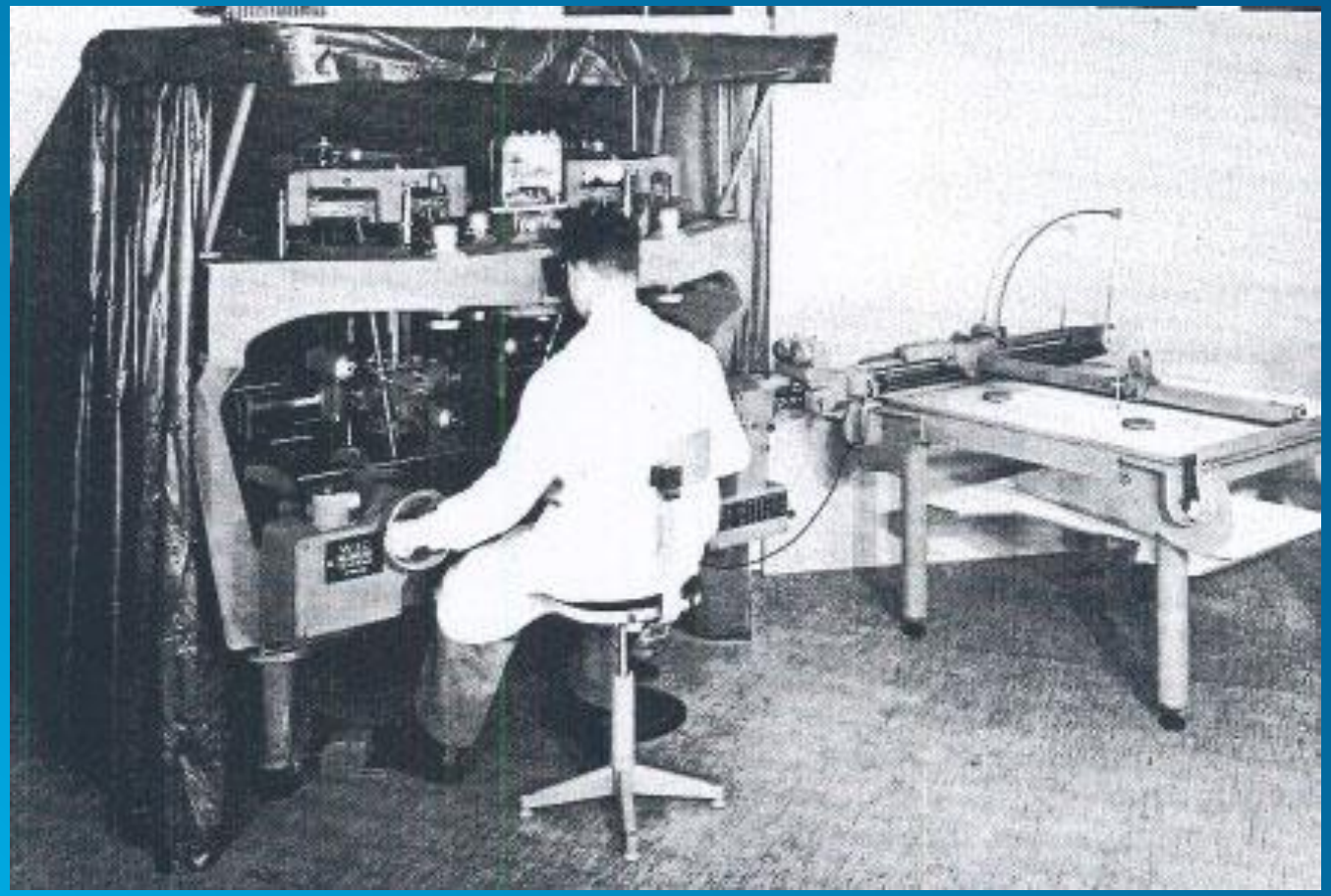
ArcGIS 10.4

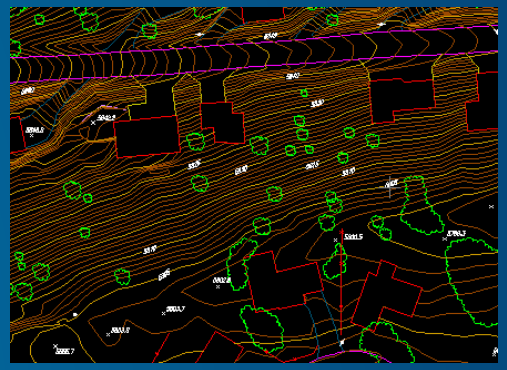
10.4

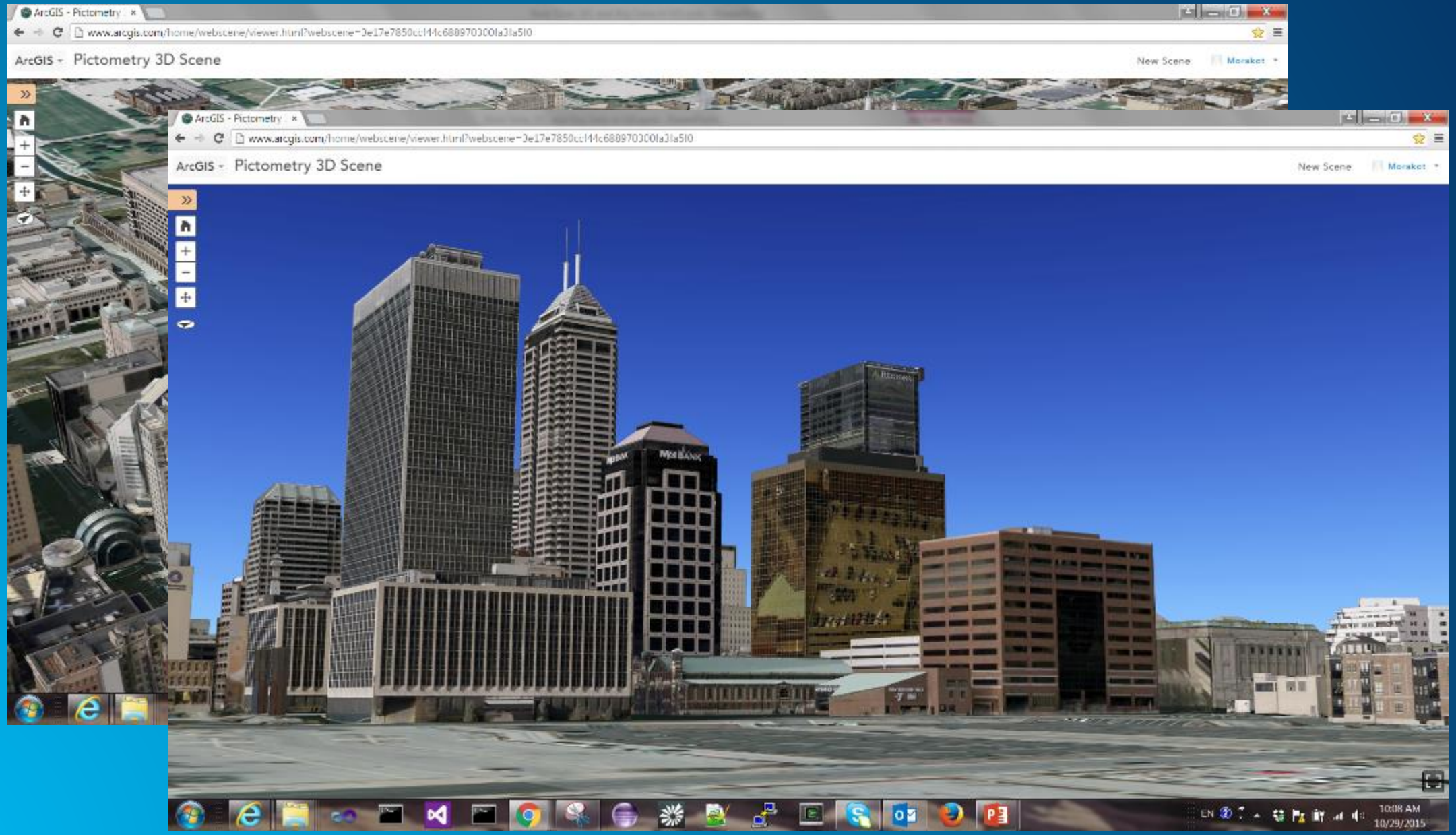
- Can ingest higher velocity real-time data into ArcGIS.
- Observations CAN now be stored in a Big Data Store.
- Can visualize high velocity and volume data
  - as an AGGREGATION,
  - as discrete FEATURES,
  - live & HISTORICALLY.
- Visualization CAN scale.

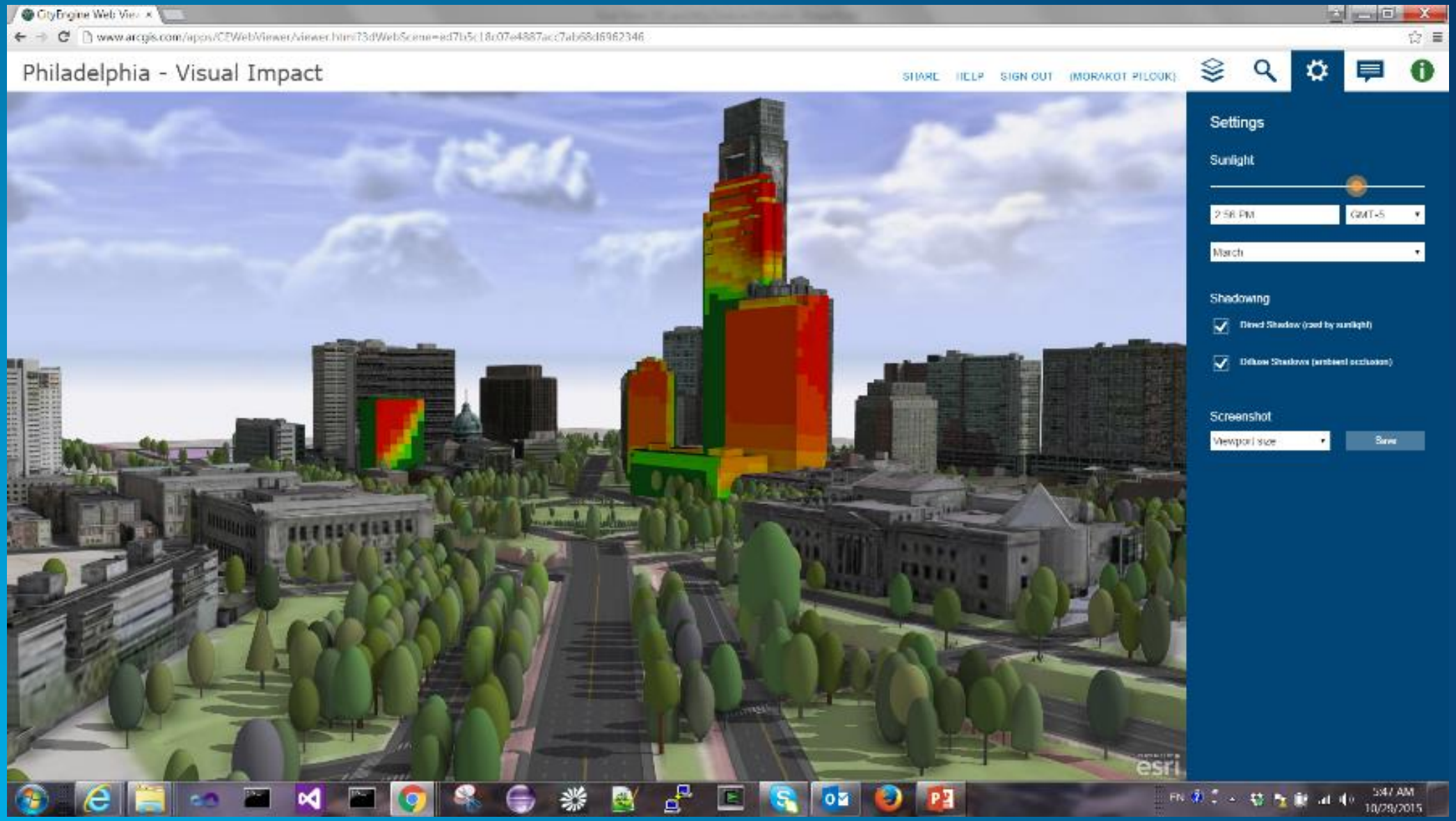


2 2D and 3D Mapping in ArcGIS



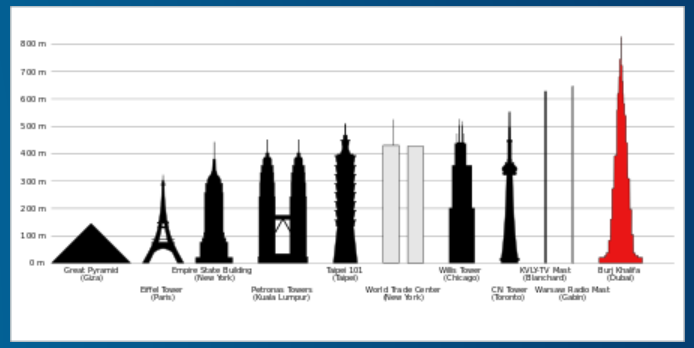



ArcGIS - Pictometry
ArcGIS
Pictometry 3D Scene
New Scene
Moraket
10:08 AM
10/29/2015


CityEngine Web Viewer
Philadelphia - Visual Impact
SHARE
HELP
SIGN OUT
Settings
Sunlight
2:58 PM
GMT-5
March
Shadowing
Screenshot
Viewport size
Save
esri

Smart Cities

Smart Dubai



2D Mapping

- Traditionally done on a desktop app like ArcMap
- Map is a container layers of different types
  - Feature Layer
  - Raster Layer
  - …
- Layer encapsulates a dataset with a renderer
- Renderer contains symbols
- Representing views from above

3D Mapping

- Traditionally done on desktop apps like ArcScene and ArcGlobe
- Scene is a container layers of different types
  - Feature Layer
  - Raster Layer
  - …
- Layer encapsulates a dataset with a renderer
- Renderer contains symbols
- Not limiting to views from above

Problems with Traditional 2D and 3D Mapping

- Too many apps to learn
- Lack of synchronization between 2D maps and scenes
- Limited reusability of layers, renderers, and symbols

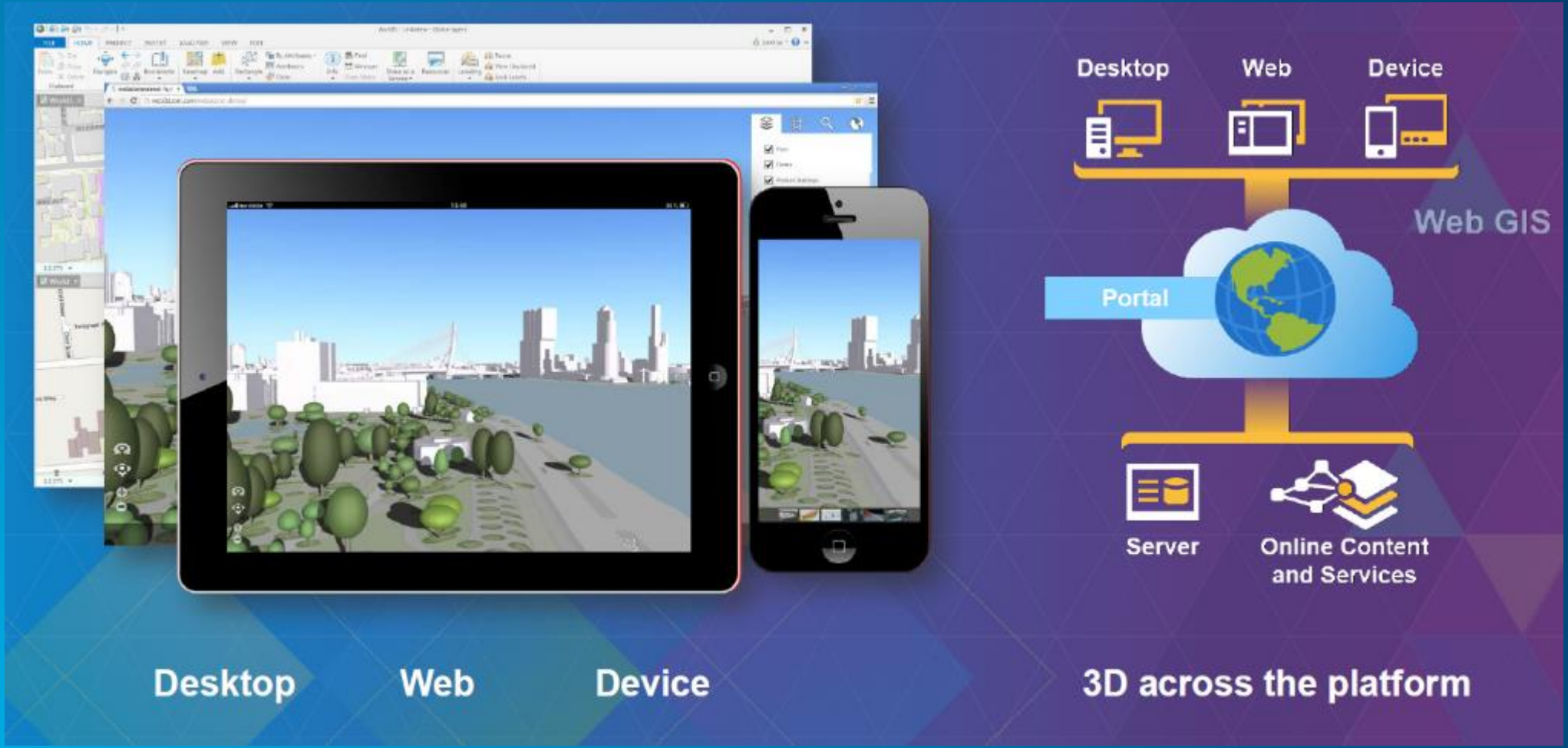
Combine 2D and 3D Mapping

- ArcGIS Pro
- ArcGIS Online/Portal WebMap and WebScene
- ArcGIS Explorer (Desktop)
- 2D and 3D in one environment
- Approaching seamless transition between
  - Map
  - 3D Flat Earth
  - 3D Round Earth
- Supports synchronization of views

3D across the Esri product family

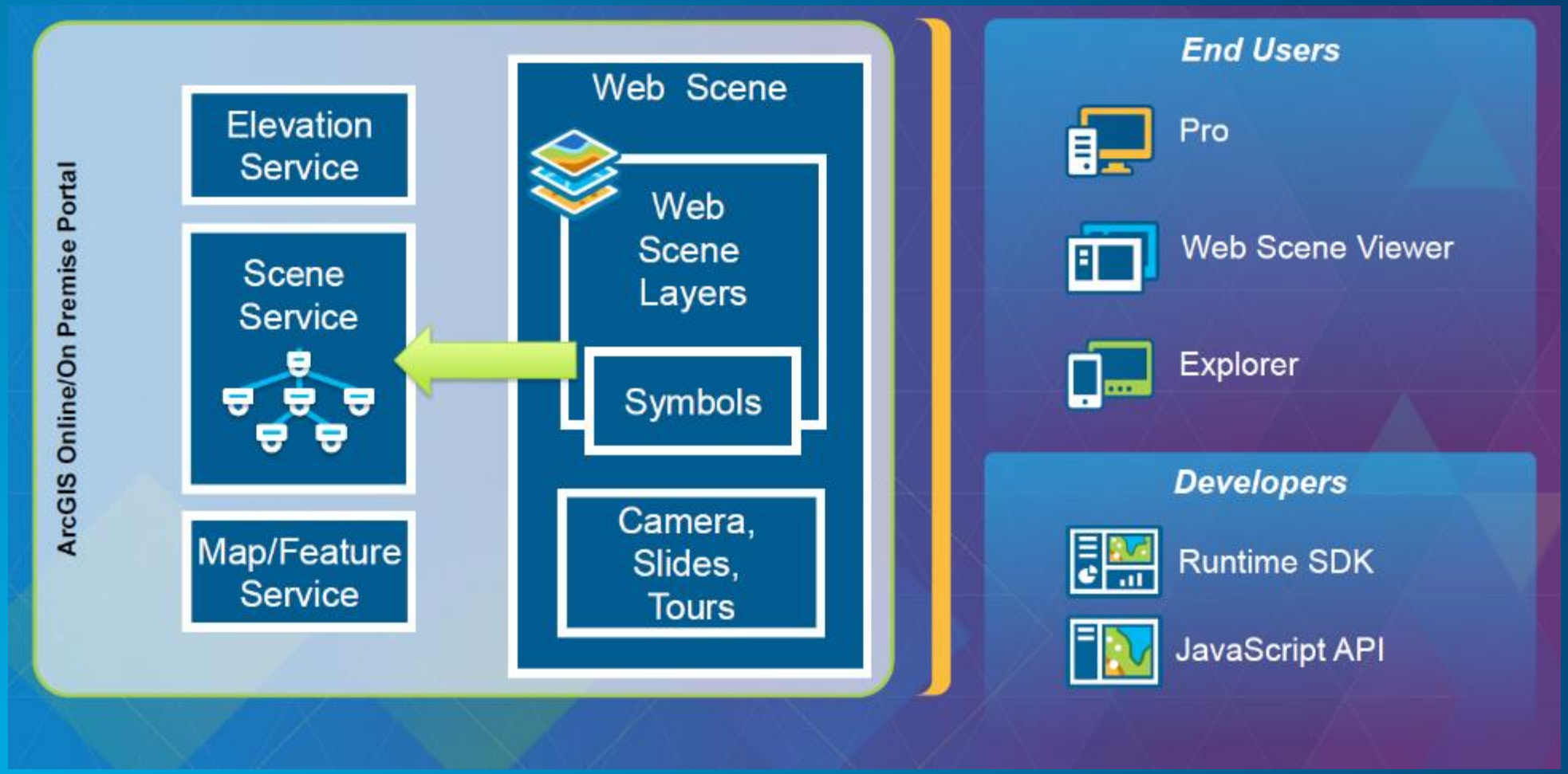
ArcGIS Pro	**Powerful 2D/3D desktop authoring and data management**
3D Analyst	**Rich analysis for advanced 3D workflows**
CityEngine	**Advanced editing tool for Urban Designers**
ArcGIS for Server	**Scalable 2D/3D enterprise content distribution and geoprocessing**
ArcGIS Online	**Content and services for sharing ideas in 2D and 3D**
ArcGIS Earth	**Easy-to-use 3D data exploration for Enterprise users**
ArcGIS Runtime	**Developer tools for 2D and 3D custom solutions**
ArcGIS Marketplace	**3rd party geospatial apps and data for the enterprise**

3D Across the Platform



A new way of working in 3D

ArcGIS 3D Components



3D Application Development

3D Runtime SDK

- Full 3D Runtime functions
- High performance
- Large data set
- Machine Native code
- Mobile and desktop
- Multiple codebases

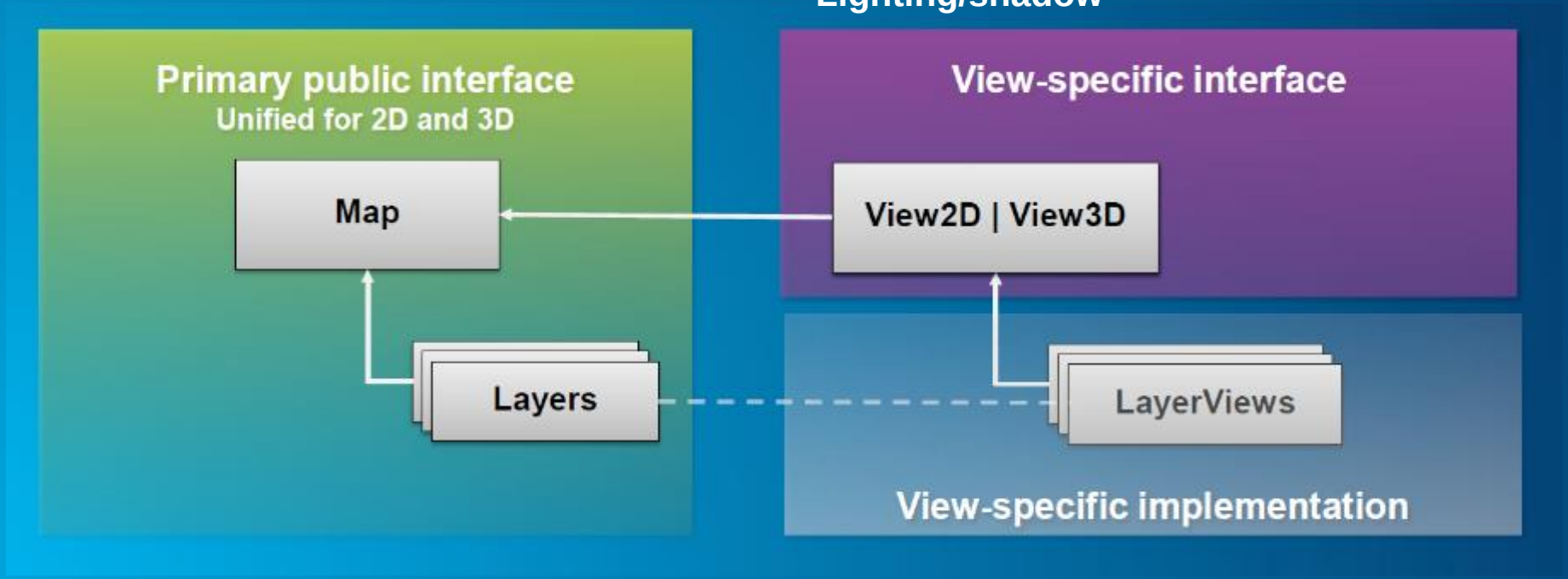
JavaScript (WebGL)

- Pure browser-based
- No plugin
- Rapidly maturing
- Acceptable performance
- Works on most platforms
- One codebase

ArcGIS API for JavaScript 4.0

- One API for 2D and 3D

- Elevation
- 3D symbology
- Camera manipulation
- Animation
- Lighting/shadow



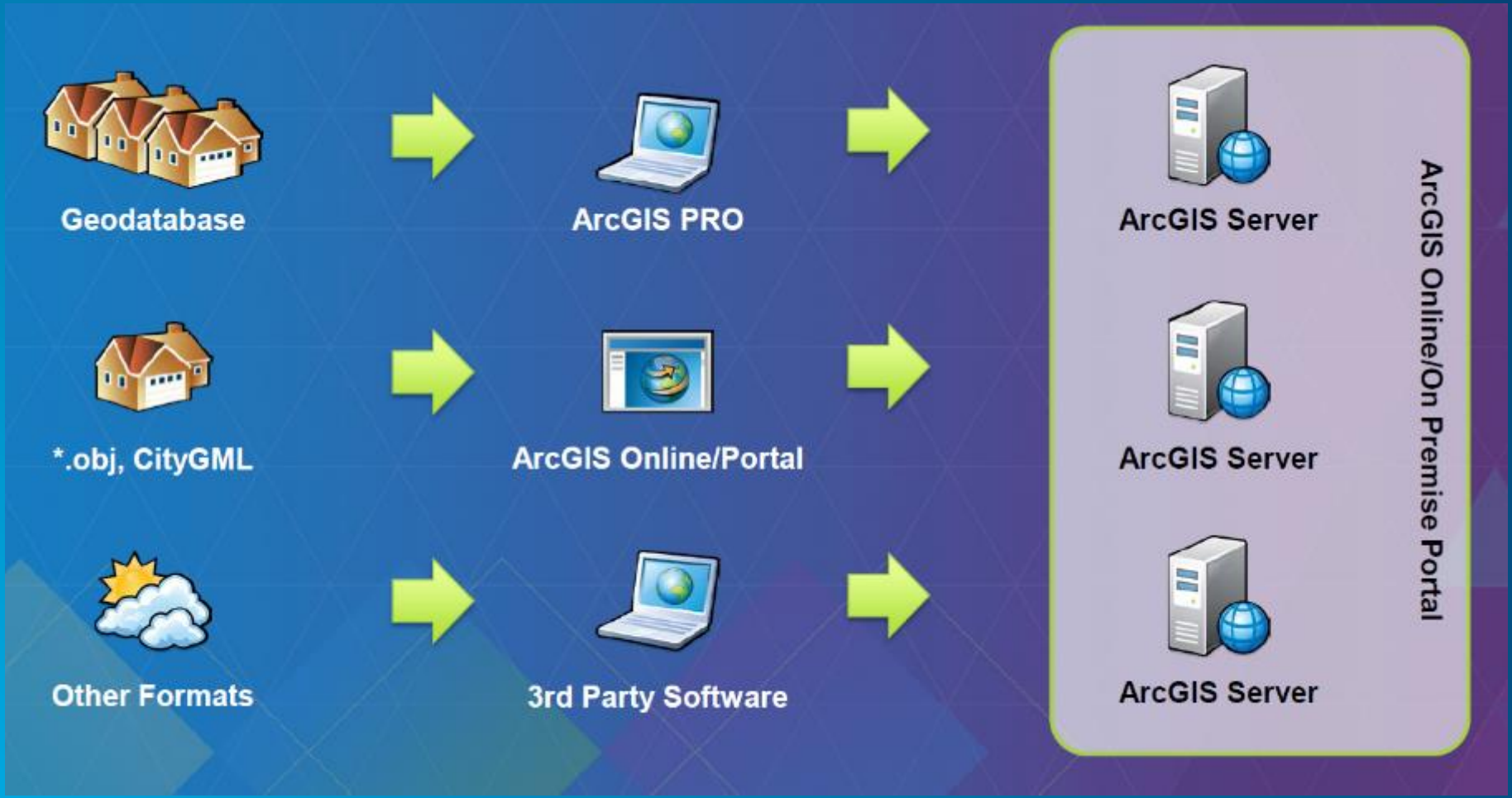
Supported Real-Time Data

- StreamLayer (from GeoEvent Stream Service) – JavaScript API 4.0
- KML
- Other data streamings (custom code)
  - REST
  - WebSocket
  - WebRTC

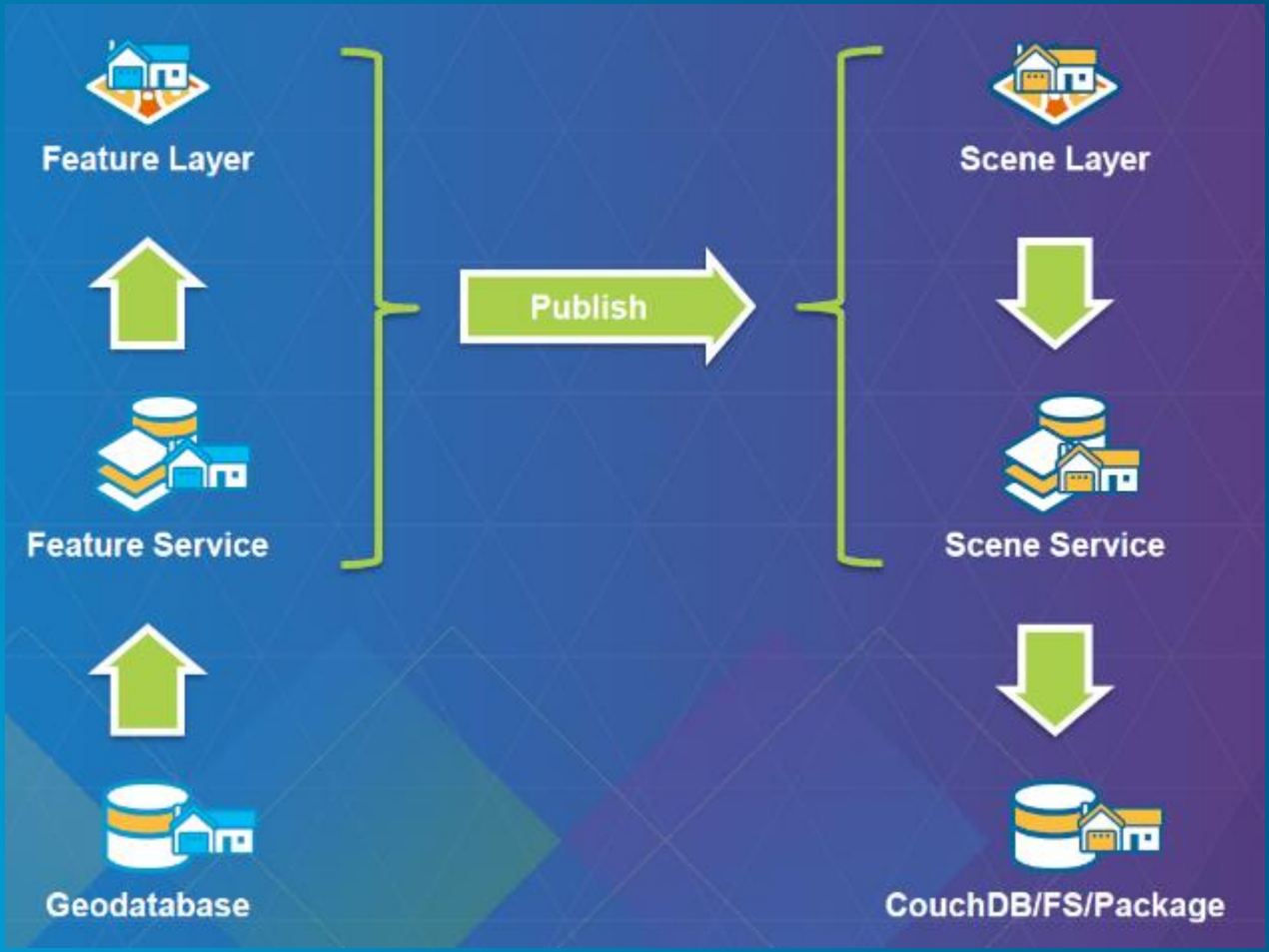
3

Authoring Static Map and Scene

Creating Map/Scene Services



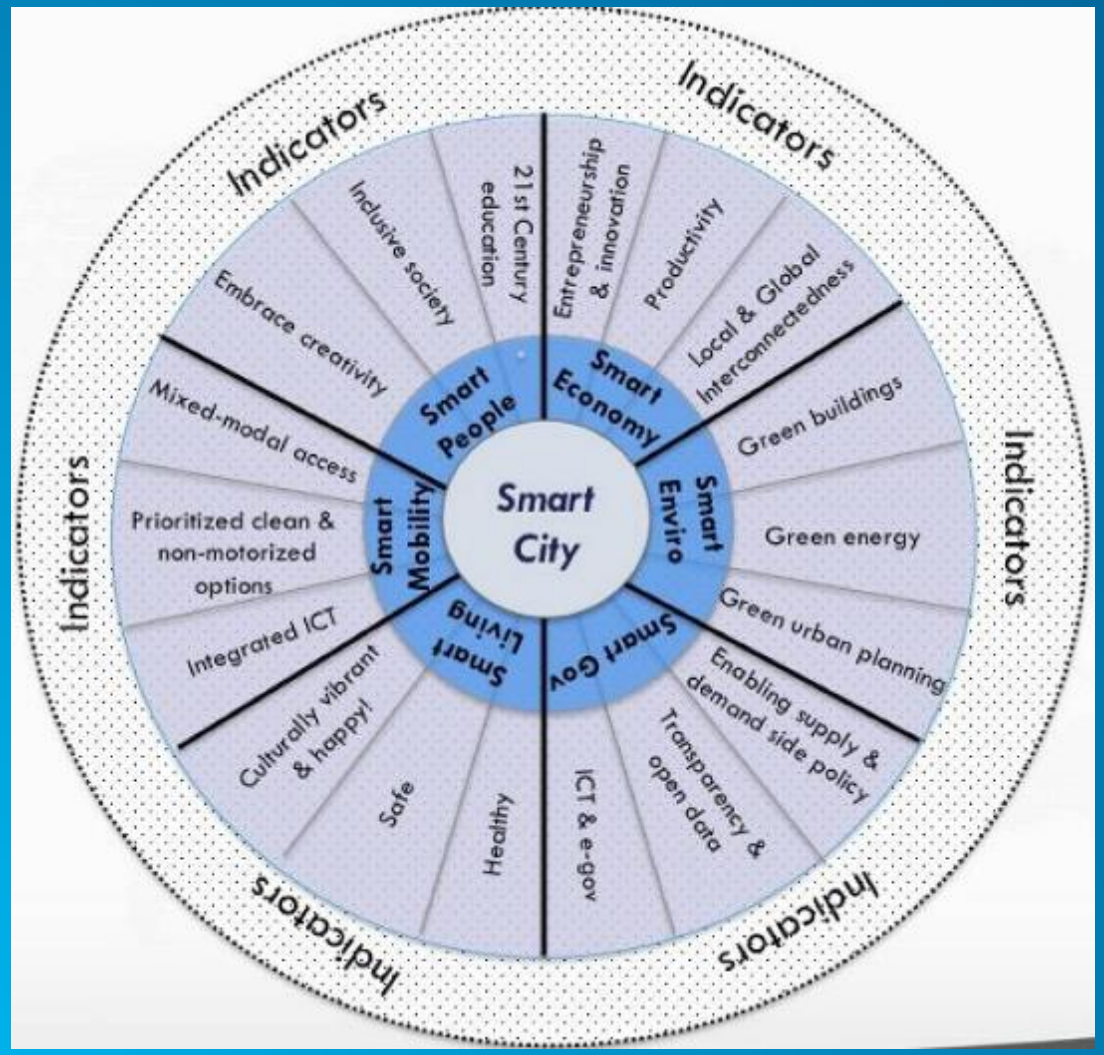
Publishing a Map/Scene Service



4

Making Maps and Scenes Come Alive

Making Our Virtual World Smart



November 14, 2013 at 5:49 PM

Seattle named smartest city in North America

Posted by Gene Balk

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Recommend 5.3k

0 Comments

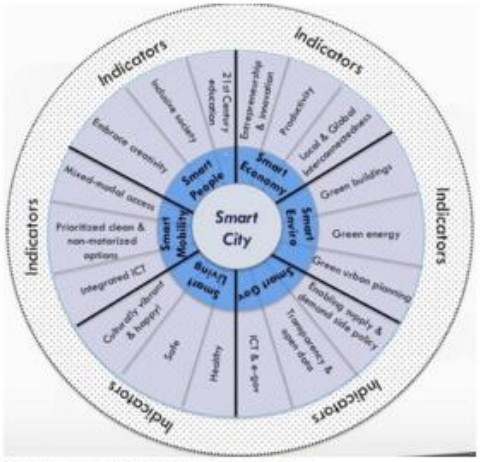
Print

Seattle is the continent's smartest city, according to new rankings by the business magazine Fast Company. The Emerald City moved into the top spot from last year's third-place showing.

Photo: ERIKA SCHULTZ/THE SEATTLE TIMES

The rankings, calculated with the help of a scoring rubric that Fast Company calls the "Smart Cities Wheel," factor six main components of a city's smartness: government, people, economy, mobility, and quality of life issues.

Seattle took top honors for its smart economy and smart government, and came in second behind Washington, D.C. in the smart people category. Seattle was also lauded for promoting sustainable development, fostering start-ups and attracting entrepreneurial talent.



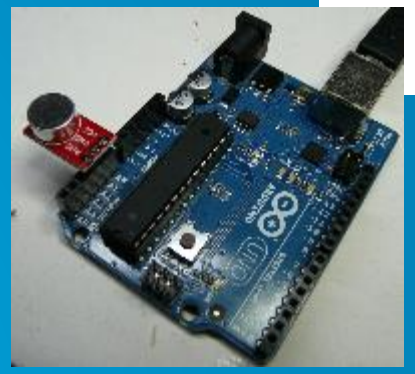
Fast Company's "Smart Cities Wheel"

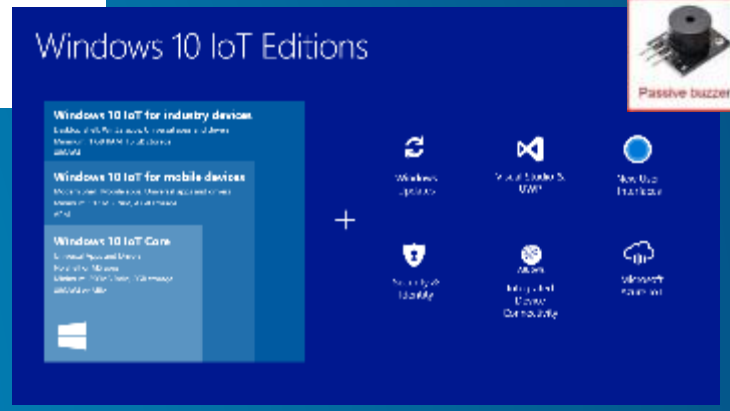
Here is the complete list of top-10 cities:

1. Seattle
2. Boston (tie)
2. San Francisco (tie)
4. Washington D.C.
5. New York
6. Toronto
7. Vancouver
8. Portland
9. Chicago
10. Montreal

Geo-smart/Geo-intelligence

- Sensors
- Internet of Things
- Smart home/office
- Connected car
- Smart airport
- …





Predictions are that 25 billion devices will be connected by 2015, and 50 billion by 2020.

Smartphones

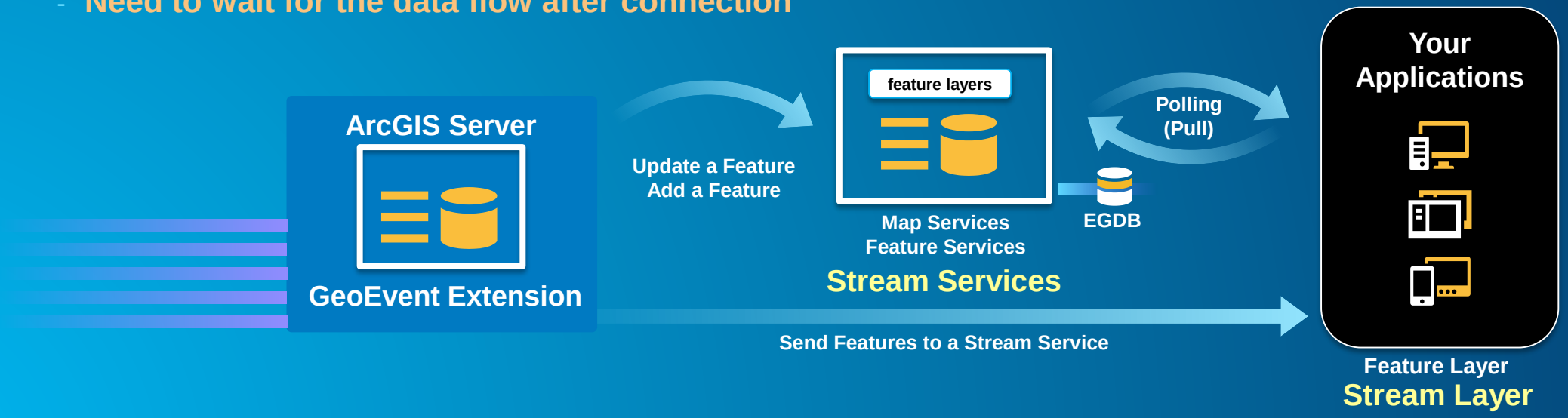
- Accelerometer
- Gyroscope
- Magnetometer
- Proximity sensor
- Light sensor
- Barometer
- Pedometer
- Heart rate monitor
- Camera
- …

Microsoft Hololens

Stream services vs. traditional feature services

Two patterns of Real-time GIS

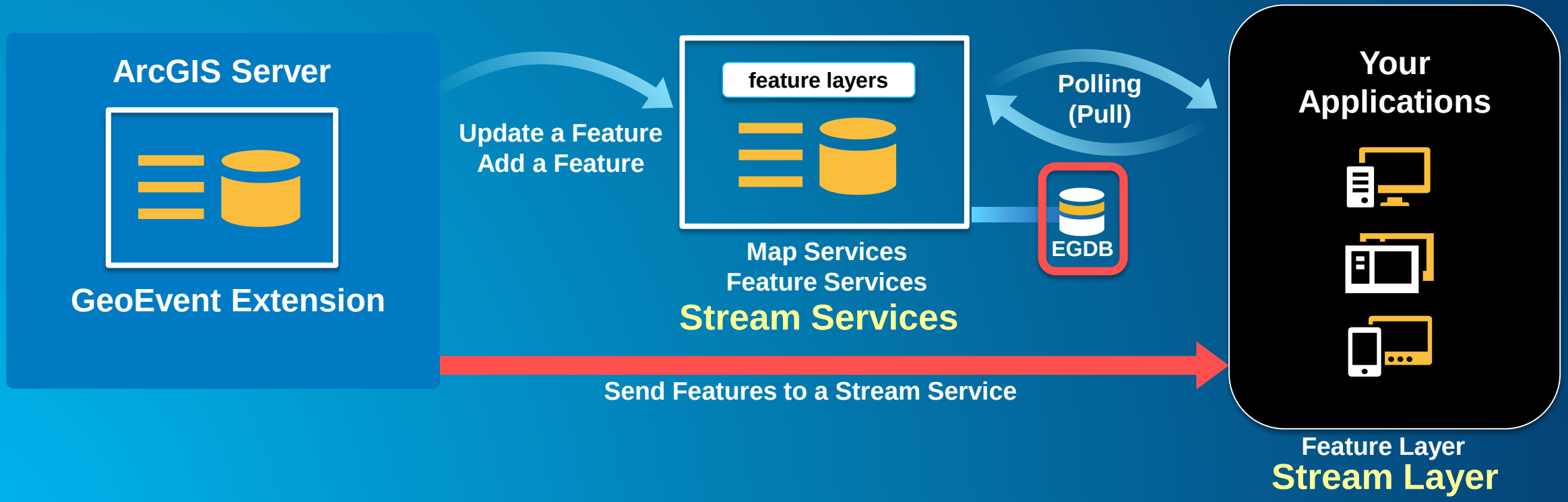
- Feature layers pull from feature services
  - Web apps poll to get periodic updates
  - Data is persisted, last known snapshots are always available for retrieving
- Stream layers subscribe to stream services
  - Web apps subscribe to immediately receive data
  - Low latency and high throughput
  - Need to wait for the data flow after connection



Stream services vs. traditional feature services

Two patterns, two important differences

- Feature services **persist** their data in a Geodatabase
- Stream services **broadcast** their data without first persisting the data



Support for stream services (since the 10.3 product release)

What can I use to consume stream services?

- ArcGIS Online and Portal for ArcGIS Web Maps
- ArcGIS Online and Portal for ArcGIS web application templates
- Web applications built using Web AppBuilder
- Your own web apps that use the ArcGIS API for JavaScript

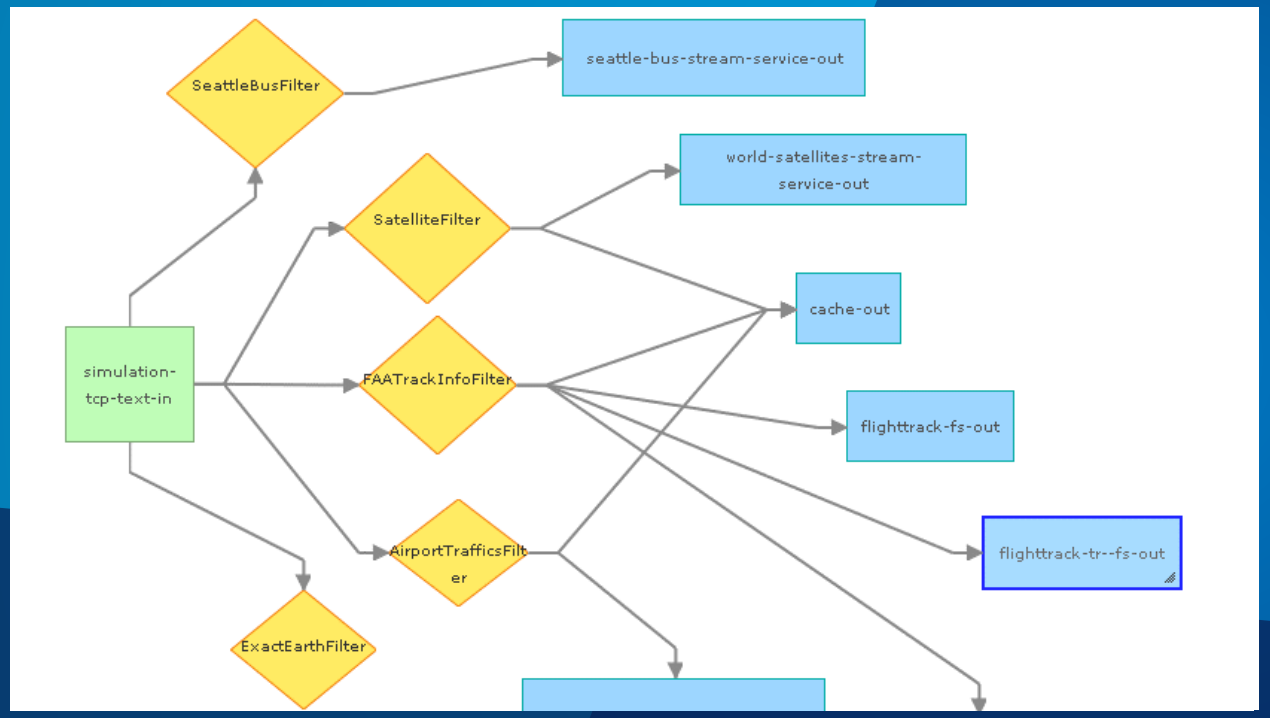
KML Service

How to enable KML service

- Not available out-of-box!
- Obtain the KML Connector for GeoEvent on GeoEvent Gallery (10.2.x)

  http://www.arcgis.com/home/item.html?id=8ddf65e2d9894d37ae19856671392c45
- Obtain source code from GitHub (updated to 10.4) and build it

  https://github.com/Esri/kml-for-geoevent
- Deploy the jar to GeoEvent\deploy folder
- Create Output



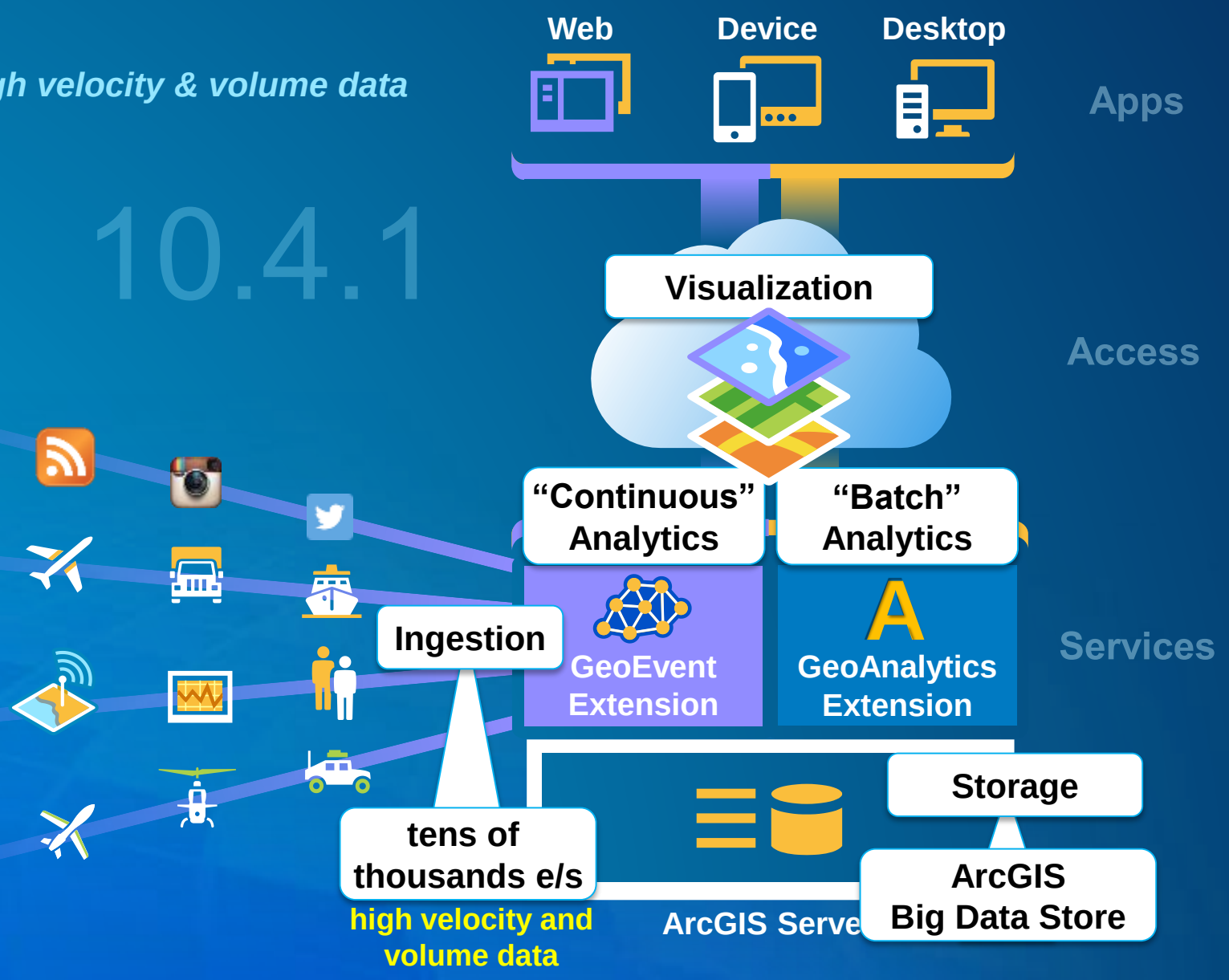
Demo Publishing Real-Time Services

Real-Time GIS

Integration & exploitation of high velocity & volume data

10.4.1

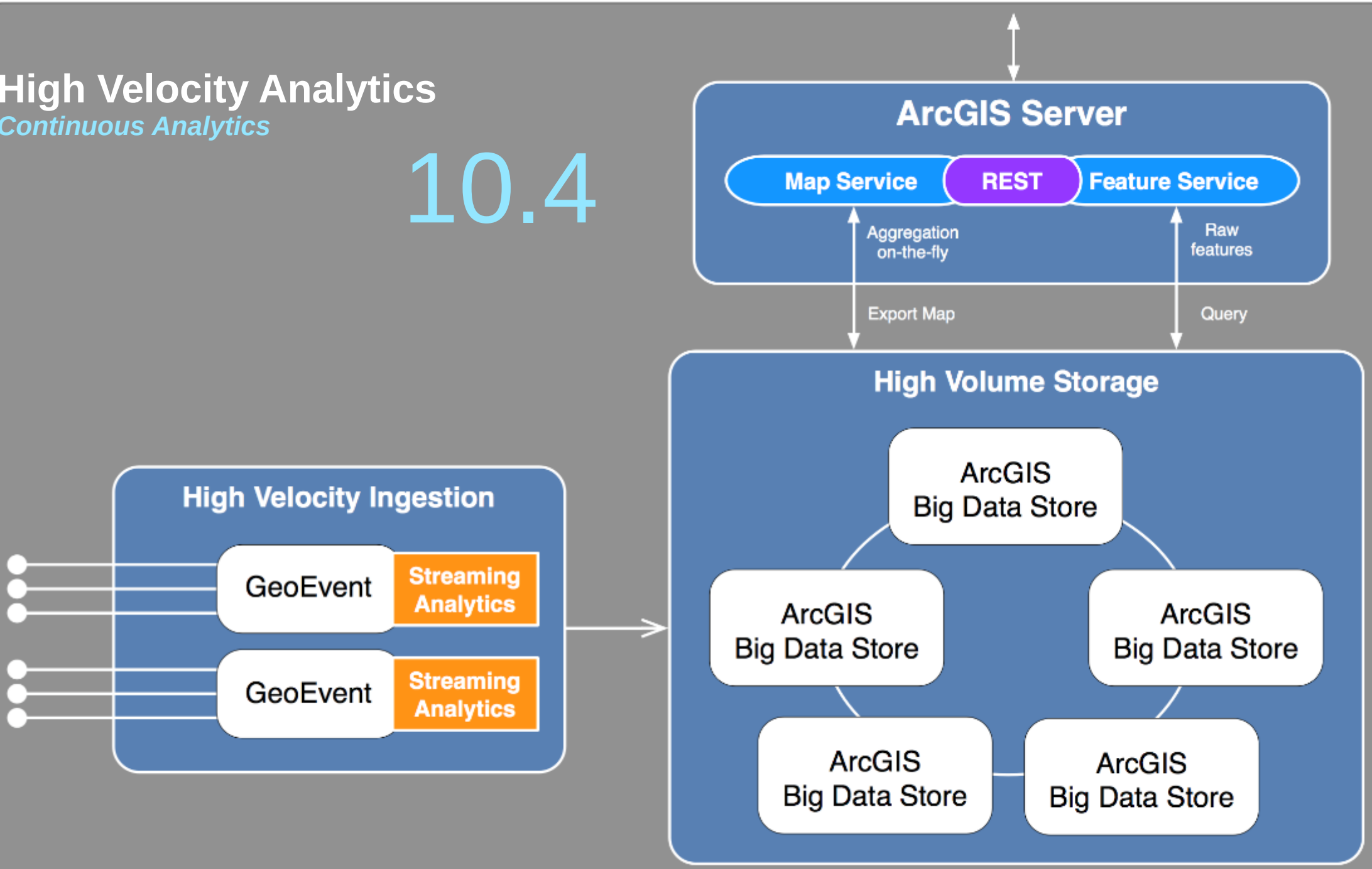
- Integrates real-time high velocity & volume data into ArcGIS
- Performs continuous processing & real-time analytics
- Sends updates & alerts to those who need it where they need it



High Velocity Analytics

Continuous Analytics

10.4



5

Real-Time 2D and 3D Visualization

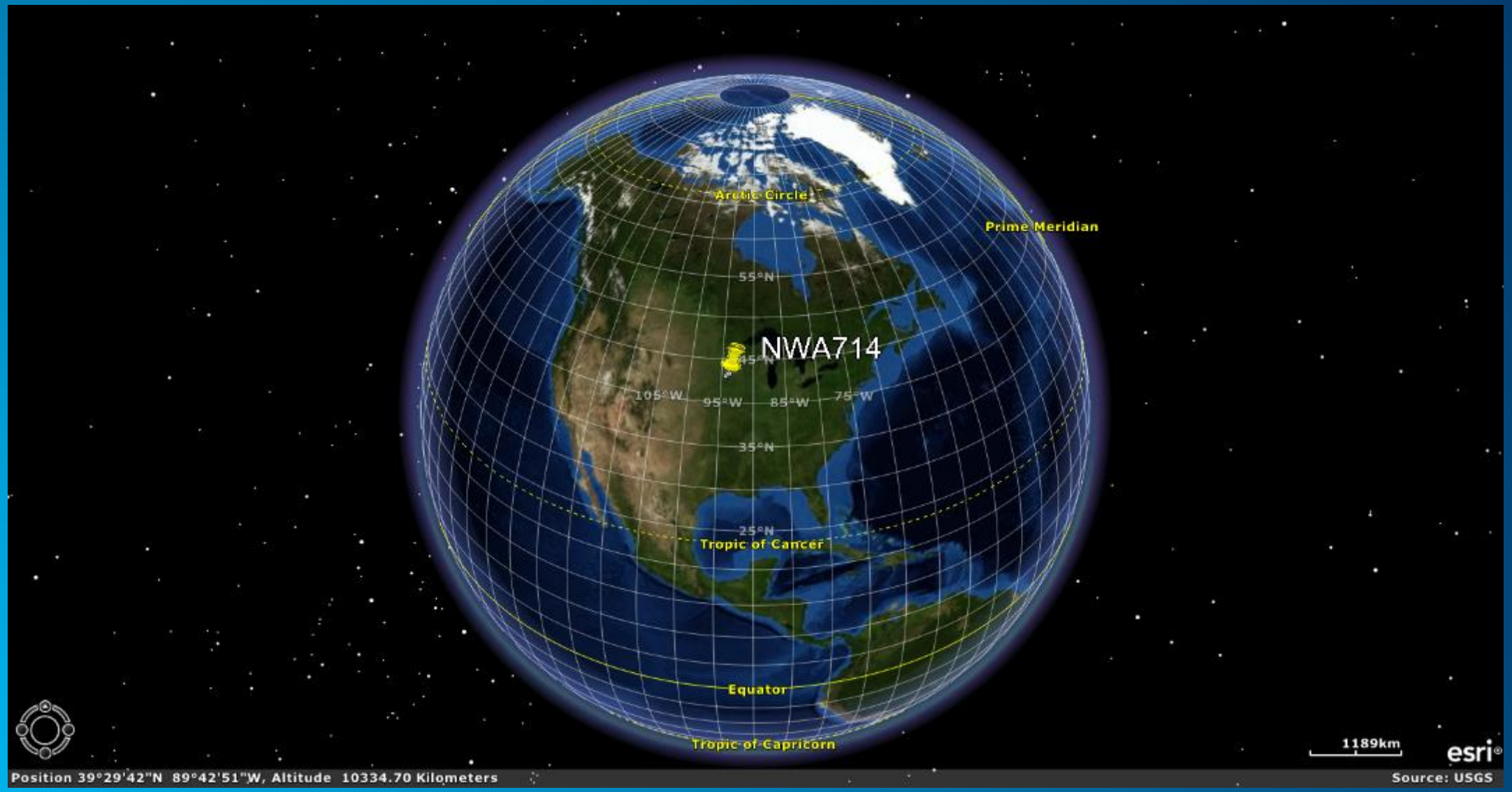
3D Visualization Techniques

Keeping up the 3D display performance

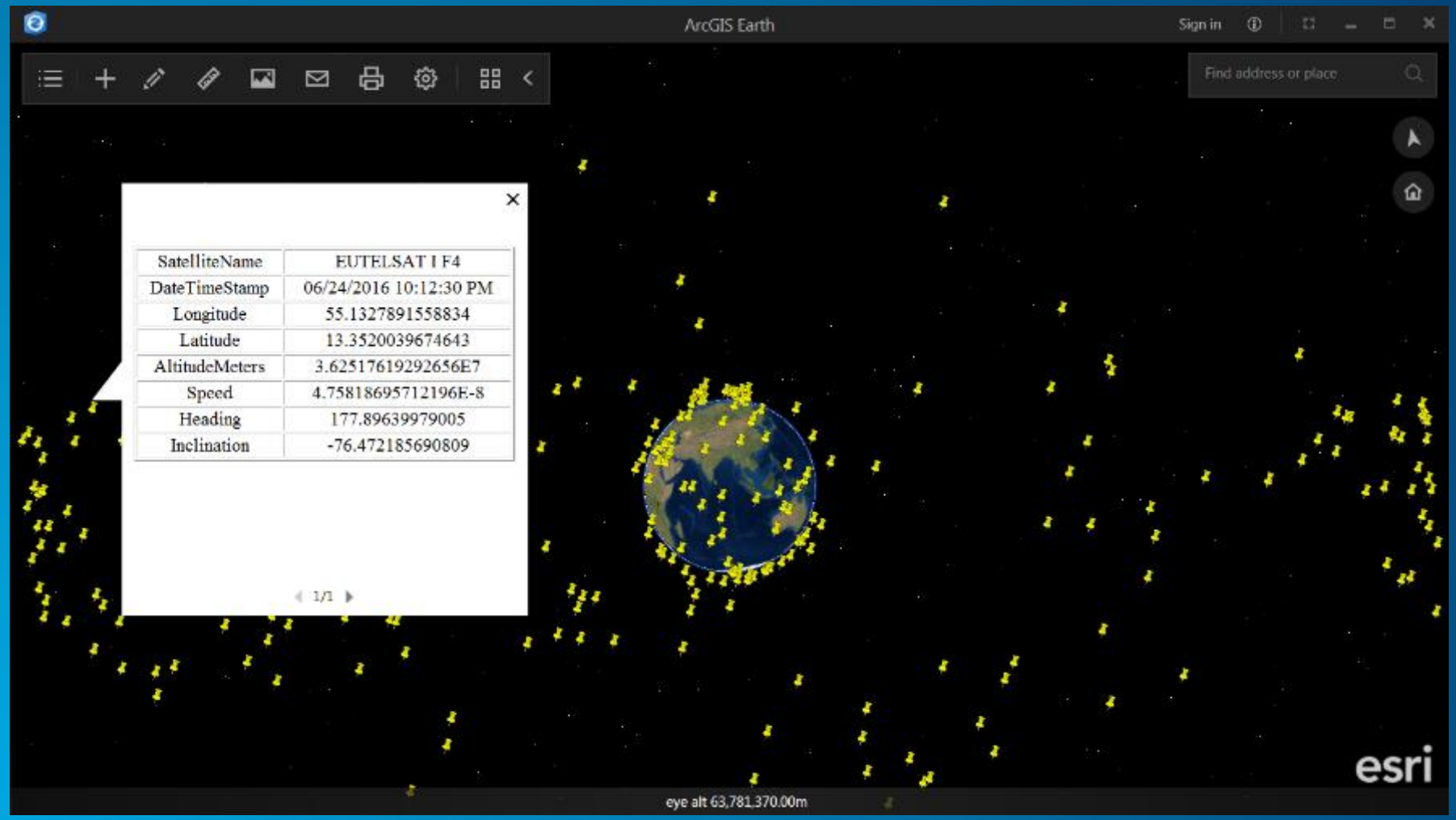
- 3D scene contains continuous scale
  - depending on the positions of viewer and target
- Use high LOD 3D symbol to represent objects close to the viewer
- Use low LOD symbol for objects that are further away from the viewer
  - Billboard 2D graphics
  - Simple geometric shape (e.g. spheres)
- Remove objects that are too close or too far from the scene
  - Use view volume culling
  - Use fog (particle system)

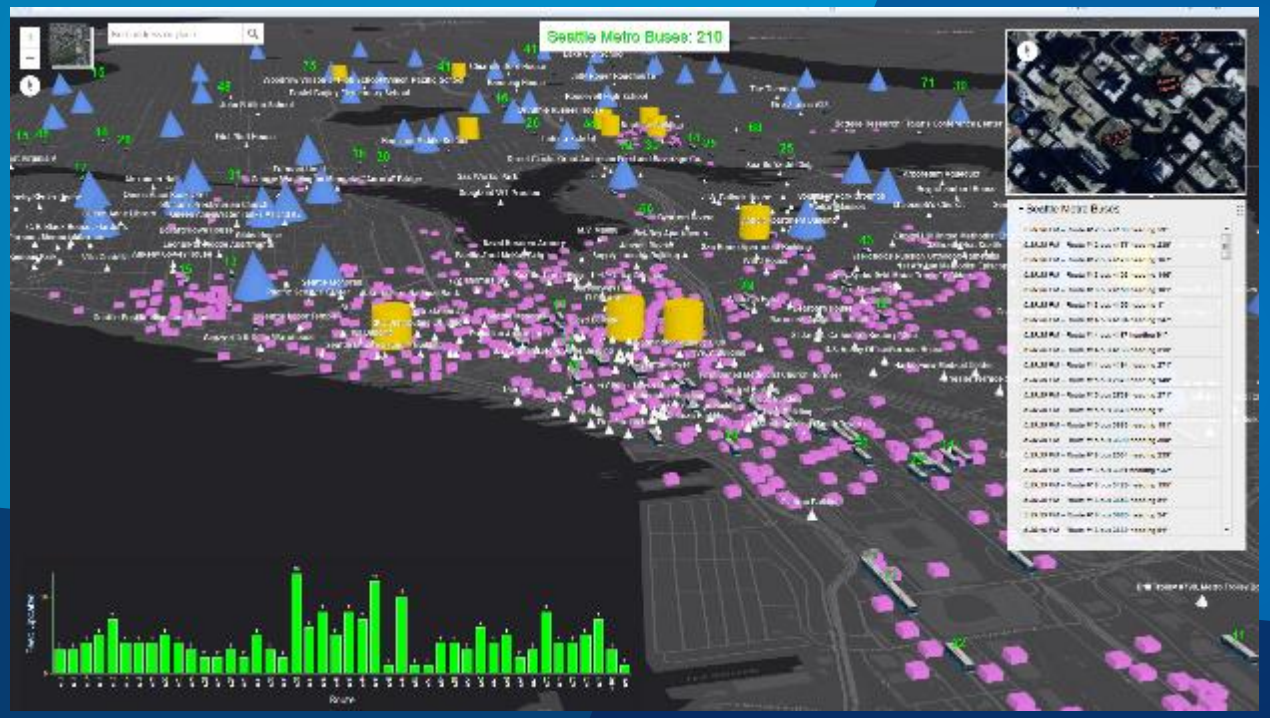
Demo Visualization Techniques

KML on ArcGIS Explorer

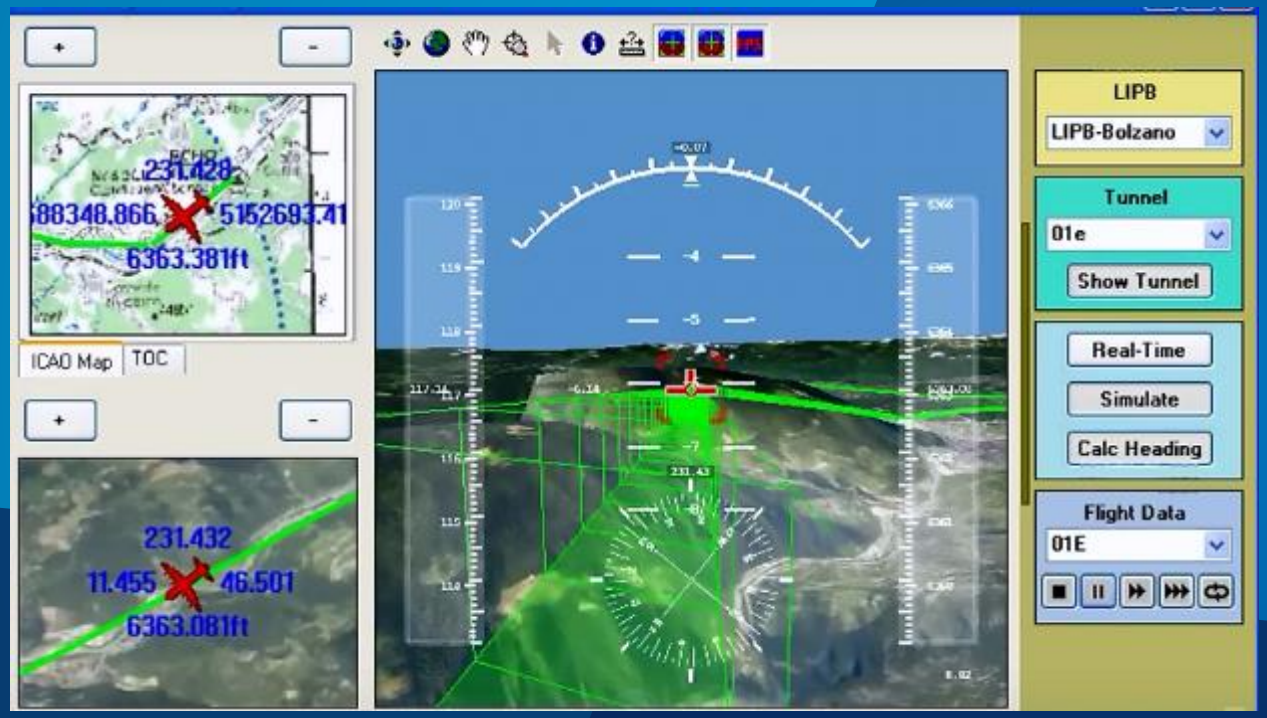


KML on ArcGIS Earth (1.2)





Demo 3D Seattle Buses



Demo Esri Real-Time 3D Apps

6 Conclusions

Conclusions

- GeoEvent can support Real-Time GIS for 2D and 3D mapping
- Rendering of large and realistic 3D scenes have become pretty common
- Integrating real-time data into the 3D city model to make it comes alive
- Big data that provides efficient storage with fast spatial indexing is being worked on
- Analysis on real-time archiving into big data will perform in a much shorter time
  - Understand the past
  - Better predict the future

Who do you want to be?

Questions / Feedback?

To learn more:
http://links.esri.com/geoevent
https://links.esri.com/geoevent-forum

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Understanding our world.