Real-Time GIS for 2D and 3D Mapping

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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

- 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.
2D and 3D Mapping in ArcGIS
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


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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
Making Maps and Scenes Come Alive
Making Our Virtual World Smart

Seattle named smartest city in North America

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.

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.

Here is the complete list of top-10 cities:
1. Seattle
2. Boston
3. San Francisco
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
Real-Time GIS
Integration & exploitation of high velocity & volume data

- 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

10.4.1

Visualization

“Continuous” Analytics
GeoEvent Extension

“Batch” Analytics
GeoAnalytics Extension

Ingestion
tens of thousands e/s
high velocity and volume data

ArcGIS Server
Storage
ArcGIS Big Data Store

Desktop
Web
Device
Apps
Access
Services
High Velocity Analytics
Continuous Analytics

10.4

ArcGIS Server
- Map Service
- REST
- Feature Service

Aggregation on-the-fly
Raw features

Export Map
Query

High Volume Storage

ArcGIS Big Data Store

ArcGIS Big Data Store

ArcGIS Big Data Store

ArcGIS Big Data Store

GeoEvent Streaming Analytics

GeoEvent Streaming Analytics
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
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.