ArcGIS GeoEvent Server: Applying Real-Time Analytics
Stefan Jung, Thomas Paschke
Agenda

1. Real-Time Development
2. Working with Real-Time Data
3. GeoEvent Server SDK
4. Visualizing Real-Time Data
5. Summary
Real-Time (& Big Data) Development
GIS Data
What has happened, what is happening, what will happen

The ‘current’ snapshot is outdated almost as soon as it’s created...
Real-Time GIS Requirements

Ingestion, Analytics, Notifications and Alerting

Requirement #1

Continuous Analysis

Inside Boundary

Requirement #2

Features

Position

Alert

Applications

Alert

SkuCen: Inside fishing zone
Time: 03:47 PST on 3/15/2014
Type: Commercial vessel
Operator: Robert Smith
Vessel ID: 999450000002
ArcGIS Enterprise

with real-time GIS capabilities
ArcGIS Enterprise
with real-time & big data GIS capabilities

IoT ➔ GeoEvent Server ➔ spatiotemporal big data store ➔ GeoAnalytics Server ➔ Big Data

visualize

ingest, analyze

store

analyze

10.7
2 Working with Real-Time Data
GeoEvent Server
Real-Time Analytics
Ingestion of real-time data

**GeoEvent Server: input connectors**

**Out of the Box**
- Poll an ArcGIS Server for Features
- Poll an external website for GeoJSON, JSON, or XML
- Receive Features, GeoJSON, JSON, or XML on a REST endpoint
- Receive GeoJSON or JSON on a WebSocket
- Receive RSS
- Receive Text from a TCP or UDP Socket
- Subscribe to an external WebSocket for GeoJSON or JSON
- Watch a Folder for new CSV, GeoJSON, or JSON Files
- Subscribe to a Kafka Topic for JSON, GeoJSON, Text

**Esri Gallery**
- Azure IoT
- Amazon IoT
- ActiveMQ
- RabbitMQ
- GTFS
- NMEA 0183
- Kafka
- KML
- MQTT
- Instagram
- Twitter

**Partner Gallery**
- CompassLDE
- enviroCar
- exactEarth AIS
- FAA (ASDI)
- Networkfleet
- OSIsoft
- Valarm
- Waze
- ...
Dissemination of real-time data

**Outputs**

- Out of the Box
  - Add or Update a Feature
  - Add or Update a Feature to a SBDS
  - Send Features to a Stream Service
  - Push data to an external TCP Socket
  - Push data to a UDP Socket
  - Push data to an external Website
  - Push data to an external WebSocket
  - Send an Instant Message
  - Send a Text Message
  - Send an Email
  - Write to a CSV, GeoJSON, or JSON File
  - Write data to a Kafka Topic

- Esri Gallery
  - Amazon IoT
  - Azure IoT
  - ActiveMQ
  - RabbitMQ
  - Hadoop
  - Kafka
  - MongoDB
  - MQTT
  - Twitter
  - ...
Dissemination
configure a new output connector by pairing an adapter & transport together

GeoEvent Server

Connectors

<table>
<thead>
<tr>
<th>Transport</th>
<th>Adapter</th>
<th>Connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receive Feature-JSON from Kafka</td>
<td>Kafka</td>
<td>Feature-JSON</td>
</tr>
<tr>
<td>Poll GeoJSON on an external Website</td>
<td>HTTP</td>
<td>GeoJSON</td>
</tr>
</tbody>
</table>

Transports

- Feature Service
  - File
  - HTTP
  - HTTP+BasicAuth
  - HTTP+OAuth
- TCP
- UDP
- Waze
- WebSocket

Adapters

- Feature-JSON
- GeoJSON
- JSON
- RSS
- Text
- XML

you can create your own connectors

Connector = Adapter + Transport
Demo: Ingestion & Visualization
A GeoEvent Service configures the flow of real-time data,
- the filtering and geoevent processing steps to perform,
- the input(s) where data comes from and the output(s) to which results are sent.
Spatial Operators

**geofences**

- **Spatial operators:**

<table>
<thead>
<tr>
<th>inside</th>
<th>outside</th>
</tr>
</thead>
<tbody>
<tr>
<td>enter</td>
<td>exit</td>
</tr>
<tr>
<td>intersect</td>
<td>disjoint</td>
</tr>
<tr>
<td>touches</td>
<td>contains</td>
</tr>
<tr>
<td>crosses</td>
<td>equals</td>
</tr>
<tr>
<td>overlaps</td>
<td>within</td>
</tr>
</tbody>
</table>
GeoEvent Server

Beispiel: Konvoy Trennung
Demo: Incident Detection of Trains
Streaming analytics, policies & orchestration

GeoEvent Server: processors

you can create your own processors

GeoEvent Server

GeoEvent Services

Inputs

Outputs

GeoEvent Services

Add XYZ

Event Volume Control

Range Fan

Feature To Point

Event Joiner

Out of the Box

Buffer Creator
Convex Hull Creator
Difference Creator
Envelope Creator
Field Calculator
Field Enricher
Field Mapper
Field Reducer

Geotagger
Incident Detector
Intersector
Projector
Simplifier
Symmetric Difference
Track Gap Detector
Union Creator

Add XYZ

Event Volume Control

Range Fan

Feature To Point

Event Joiner

Esri Gallery

HTTP Handler
Field Splitter
Ellipse
Spatial Query
Extent Enricher
Field Grouping
GeoNames Lookup
Motion Calculator

Event Counter
Reverse Geocoder
Service Area Creator
Symbol Lookup
Track Idle Detector
Unit Converter
Visibility
Update Only
Extending GeoEvent
Software Development Kit (SDK)
3 GeoEvent SDK
Creating a custom GeoEvent Processor

You can create your own custom connectors and processors using the GeoEvent Software Development Kit (SDK)
Getting Started

Install and Configure

• Java Development Kit (JDK 8+)
• Apache Maven (Build Management Tool)
• Eclipse (IDE)
GeoEvent Server SDK

- api: JavaDoc content associated with GeoEvent Server SDK
- repository: Local maven repository
- samples: Sample connectors (and processors)
- GeoEvent Developer Guide
Define your own Processor

Input → Filter → Processor → Output

Which data passed the filter?
Define your own Processor

Input → Filter → Processor → Output

Output 2
Define your own Processor

- Input
- Filter
- Processor
- Output
- Logging
Demo: Custom GeoEvent Processor
## GeoEvent Admin REST API

*Script based administration*

### Adapters

<table>
<thead>
<tr>
<th>Method</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>/adapters</td>
<td>Gets all adapters</td>
</tr>
<tr>
<td>GET</td>
<td>/adapters/inbound</td>
<td>Gets all inbound adapters</td>
</tr>
<tr>
<td>GET</td>
<td>/adapters/outbound</td>
<td>Gets all outbound adapters</td>
</tr>
<tr>
<td>POST</td>
<td>/adapters/reset</td>
<td>Resets all of the adapters</td>
</tr>
</tbody>
</table>

### Connectors

<table>
<thead>
<tr>
<th>Method</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DELETE</td>
<td>/connector/{name}</td>
<td>Deletes a connector by name</td>
</tr>
<tr>
<td>GET</td>
<td>/connector/{name}</td>
<td>Gets a connector by name</td>
</tr>
<tr>
<td>GET</td>
<td>/connectors</td>
<td>Gets all connectors</td>
</tr>
<tr>
<td>POST</td>
<td>/connectors</td>
<td>Adds a new connector</td>
</tr>
<tr>
<td>PUT</td>
<td>/connectors</td>
<td>Updates a connector</td>
</tr>
<tr>
<td>GET</td>
<td>/connectors/inputs</td>
<td>Gets all input connectors</td>
</tr>
<tr>
<td>GET</td>
<td>/connectors/outputs</td>
<td>Gets all output connectors</td>
</tr>
</tbody>
</table>

### Datastores

<table>
<thead>
<tr>
<th>Method</th>
<th>Path</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GET</td>
<td>/datastores</td>
<td>Gets all datastores</td>
</tr>
</tbody>
</table>
4 Visualizing Real-Time Data
Visualization

*choosing a service type: stream service, feature service, map service*

- Map & Features layers in apps periodically **poll** to visualize most current observations
  - backed by an enterprise geodatabase (EGDB) or a spatiotemporal big data store (BDS)
  - history can be retrieved & queried for playback and analysis
- Stream layers in apps **subscribe** to stream services to immediately visualize observations
  - does not require storage, low latency, no playback
Demo: StreamLayer in ArcGIS Pro
Summary
Summary

GeoEvent Server – real-time analytics for your ArcGIS Enterprise

- Ingest high velocity real-time data into ArcGIS.
- Perform continuous analytics on events as they are received.
- Store observations in a spatiotemporal big data store.
- Visualize high velocity & volume data:
  - as an aggregation
  - or as discrete features.
- Notify about patterns of interest.
Summary

self-paced training and resources

- Step-by-Step Tutorials, free to download
  - Introduction
  - Stream services
  - Spatiotemporal Big Data Store
  - Notifications

- Blogs and discussions on the forum
  - http://links.esri.com/geoevent-forum

- Video recordings of technical workshops
  - http://www.esri.com/videos