Building Real-Time Web Applications Using ArcGIS GeoEvent Extension

Ryan Elliott
Software Engineer
ArcGIS GeoEvent Extension for Server
relliott@esri.com

Mark Bramer
Senior Technical Analyst
Esri Professional Services
mbramer@esri.com
Goal: Provide an overview of the tools and techniques used to deliver dynamic content to a web app.

• Activities Covered
  - Collecting live streams of data
  - Analyze and react to geographic events
  - Deliver analysis results to the user
  - Allow user to interact with the data

• Products Used
  - GeoEvent Extension for Server
  - ArcGIS API for JavaScript
ArcGIS GeoEvent Extension for Server

Integrates and Exploits real-time 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
ArcGIS Web API for JavaScript

• Gives developers tools to add GIS functionality to web applications
  - Interactive maps for visualizing data.
  - Widgets for finding addresses, editing data, making legends…
  - Analysis – Run a model and view results, enrich existing data with detailed demographic information
  - Embed into existing web page or make new focused application
Demonstration

International Space Station
Displaying Real-Time data with Feature Layer and Stream Layer
Sending Real-time Events to Clients

Patterns – pull and push

- **Pull from a Feature Services**
  - Must be backed by an enterprise geodatabase (EGDB)
  - Clients poll to get updates

- **Push via Web Socket output**
  - Low latency, high throughput
  - Clients subscribe to features of interest

GeoEvent Extension

ArcGIS Server

GeoEvent Services

Map Services

Feature Services...

EGDB

Your Applications

Stream Layer

Feature Layer

Polling (Pull)

Update a Feature
Add a Feature

Broadcast Features

ws://
Stream Layer
What is it?

- A layer in the Javascript API
  - Available since version 3.6
- Draws data on map using client-side graphics
Stream Layer

Lifecycle

Stream Layer (Constructor)

new StreamLayer( featureCollection, options )

FeatureCollection:

{ layerDefinition:
  { geometryType: esriGeometryPoint,
    timeInfo: {
      startTimeField: “StartTime”,
      trackIdField: “Name”
    },
    fields: [ ... ]
  },
  featureSet: null
}

Options

- webSocketUrl: ws://gep:6180/urlpath
- purgeOptions:
  { displayCount: 500 }
Stream Layer

Advantages

- More responsive
  - Features appear on the map right away.
- More efficient transfer of data.
  - Features are only sent once.
  - Messages sent without extra headers
Performance
Web Sockets versus Http Polling

- HTTP Headers can add a lot of overhead
- Polling overhead
  - One frame = 871 bytes
- Web Socket overhead
  - One frame = 2 bytes

Use case: 100,000 Stock Quotes / Second

(credit: www.websockets.org/quantum.html)
Stream Layer

*What is needed*

- GeoEvent Extension Output Connector
  - Feature JSON over Web Socket

- Browser that supports Web Sockets
  [http://caniuse.com/websockets](http://caniuse.com/websockets)

- Web Socket protocol allowed on network
  `ws://, wss://`

- No Plugins Required (standard JavaScript)
Demonstration

Consuming Streams of Features with the Stream Layer

```javascript
// Instantiate StreamLayer
// 1. socketUrl is the url to the GeoEvent Processor web socket.
// 2. purgeOptions.displayCount is the maximum number of features the
//    layer will display at one time
// 3. trackIdField is the name of the field that groups features

var layer = new StreamLayer(featureCollection, {
  socketUrl: txtWsUrl.value,
  purgeOptions: { displayCount: 500 },
  trackIdField: featureCollection.layerDefinition.timeInfo.trackIdField,
  infoTemplate: new InfoTemplate("Route Id: ${message}", "Timestamp: ${timestamp}")
});
```
Finding and Consuming Real-Time Data
Receiving Real-Time Data

Input Connectors

- Easily integrate real-time streaming data with ArcGIS by using an input connector.

You can create your own connectors.

Out of the Box

- Receive RSS
- Receive text from a TCP Socket
- Receive text from a UDP Socket
- Receive Features on a REST endpoint
- Receive JSON on a REST endpoint
- Receive JSON on a Web Socket
- Receive JSON on external Web Socket
- Poll an ArcGIS Server for Features
- Poll an external website for JSON
- Watch a folder for new .csv files
- Watch a folder for new .json files

Esri Gallery

- Twitter
- Instagram
- CAP
- Cursor-on-Target
- VMF
- GeoMessage
- ActiveMQ
- RabbitMQ
- NMEA
- TAIP (Trimble)
- RAP (Sierra Wireless)

Partner Gallery

- GNIP
- Geofeedia
- exactEarth
- ASDI (FAA)
- OSIsoft
- ASDI (FAA)
- exactEarth
- Zonar
- NetworkFleet
- CompassCom
- Harris
- CompassCom
- NetworkFleet
- Zonar
Demonstration

Connecting to Real-Time Data Feeds
Applying Real-Time Analytics
Applying real-time analytics

**GeoEvent Services**

- A **GeoEvent Service** configures the flow of GeoEvents,
  - the Filtering and GeoEvent Processing steps to perform,
  - what input(s) to apply them to,
  - and what outputs(s) to send the results to.
Applying real-time analytics

GeoEvent Processing

- You can perform continuous analytics on GeoEvents as they are received using a processor.

You can create your own processors.

GeoEvent Extension

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeoEvent Services</td>
<td>GeoEvent Services</td>
</tr>
</tbody>
</table>

Out of the Box

- Field Enricher
- Field Reducer
- Field Calculator
- GeoTagger
- Field Mapper
- Track Gap Detector
- Incident Detector

Esri Gallery

SDK

- Track Idle Detector
- ETA Calculator
- Service Area
- Buffer
- Ellipse
- Range Fan
- Visibility
- Query Report
- Slope Calculator
- Volume Control
Demonstration

Detecting GeoFence Violations
Worker Application Overview

GeoEvent Extension
  GeoEvent Services
  ArcGIS Server

Worker Location
  Geofence Alert

User Request
  Worker History

Alert List
  Feature Layer

Your Application
  Stream Layer
  Stream Layer
Road Ahead
Stream Services
Real-Time GIS Apps using Stream Services

• **Developer Productivity**
  - Make streams of data easy to discover and use.

• **Customizable**
  - Individualized client connections provide filtering and projection.

• **Scalable**
  - Features published to a stream services are accessible from any machine in the cluster.
Stream Services – The Future of Streaming Data

ArcGIS Server
GeoEvent Extension
Stream Service
ws://
Subscribe
Subscription changes
Stream Layer

ArcGIS Server
GeoEvent Extension
Stream Service
ws://
Subscribe
Subscription changes
Stream Layer
Demonstration

Stream Services
Stationary Sensor Data on a Real-Time Web App

- Stationary geographic feature with attributes that change over time.
Demonstration
Stream Gauge Sensor Display
What We Covered Today

• Consumed Live data from Sensors and a Web Service
• Filtered and generated incidents from spatial behavior
• Pushed events to a web app through feature services and web sockets

• Used JavaScript API Stream Layer to receive messages pushed from server and display them on a map
• Saw a preview of the Stream Service that will allow developers to easily receive data through a web socket and set filters that are processed on the server
Where to learn more?

Resources

• To learn more, visit the tutorial in the Esri Gallery:
  - http://links.esri.com/geoevent-processor
    - Introduction
    - Notifications
    - RSS
    - Web Sockets
    - Working with HTTP
    - GeoEvent Caches
    - REST Admin API
Where to learn more?

Remaining Sessions

- Applying **Real-Time Analytics**
  - Tue 1:30-2:45pm (Ballroom 6E), Wed 3:15-4:30pm (Ballroom 6A), Fri 9:00-10:15am (Room 7A/B)

- The **Internet of Things** (IoT)
  - Tue 3:15-4:30pm (Ballroom 6E)

- **ArcGIS GeoEvent Extension for Server: An Introduction**
  - Wed 8:30am-9:45am (Ballroom 6E)

- **Extending** with New Processors and Connectors
  - Wed 10:15-11:30am (Room 3)

- Using **Community Connectors**
  - Wed 12:30-1:00pm (Exhibit Hall C – Geodata Management Demo Theater)

- **ArcGIS for Server and Portal for ArcGIS: The Road Ahead**
  - Wed 1:30-2:45pm (Ballroom 6A)

- Applying **Real-Time GIS to Fire, Ice, and Sustainable Mobility**
  - Wed 3:15-4:30pm (Room 23C, Moderated Paper Session)

- **Real-Time GIS SIG**
  - Wed 5:30-7:00pm (Room 10)

- Applying **Real-Time GIS to Asset Protection**
  - Thu 3:15-4:30pm (Room 24A, Moderated Paper Session)
Additional resources

- ArcGIS API for JavaScript Resource Center
  https://developers.arcgis.com/javascript

- Stream Layer Code Samples
  https://developers.arcgis.com/javascript/jssamples/layers_streamlayer.html
ArcGIS API for JavaScript
Additional Workshops

• ArcGIS API for JavaScript: An Introduction
  Wed 8:30am – 9:45am Ballroom 6 C

• Strategies for Building Mobile Apps Using ArcGIS API for JavaScript
  Tue 3:15pm – 4:30pm Ballroom 6 F, Thurs 10:15am – 11:30am Ballroom 6 D

• ArcGIS Web APIs: The Road Ahead
  Wed 10:15am – 11:30 am Ballroom 6 F

• ArcGIS API for JavaScript: What’s New
  Wed 1:30pm – 2:45pm Room 16 B, Thurs 1:30pm – 2:45pm Room 14 B

• ArcGIS API for JavaScript: Mapping and Visualization
  Wed 3:15 – 4:30 Room 5 A

• Optimizing Your JavaScript Web App for Performance
  Thurs 10:15am – 11:30am Room 31 B
Thank you…

- Please fill out the session survey:

  Offering ID: 1135

Online – [www.esri.com/ucsessionsurveys](http://www.esri.com/ucsessionsurveys)
Paper – pick up and put in drop box
Questions / Feedback?

To learn more:
https://developers.arcgis.com/javascript
http://pro.arcgis.com/share/geoevent-processor

Ryan Elliott
Software Engineer
ArcGIS GeoEvent Extension for Server
relliott@esri.com

Mark Bramer
Senior Technical Analyst
Esri Professional Services
mbramer@esri.com
Understanding our world.