Real-Time & Big Data GIS:
The Road Ahead

Josh Joyner
Suzanne Foss
Agenda

1. 10.6 current status
2. 10.6.1 themes
3. 10.7 epics
4. Embracing the Internet of Things (IoT)
5. Real-time & big data on ArcGIS Online

This road ahead content is provided for informational purposes only and is subject to change
10.6 current status
Real-Time GIS
ArcGIS Enterprise
with real-time GIS capabilities

MINIMUM environment
3 machines

ArcGIS Enterprise

IoT

GeoEvent Server

spatiotemporal big data store

<table>
<thead>
<tr>
<th>ArcGIS GeoEvent Server</th>
<th>10.2</th>
<th>10.3</th>
<th>10.4</th>
<th>10.5</th>
<th>10.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Velocity throughput</td>
<td>up to 500 e/s</td>
<td>up to 2,000 e/s</td>
<td>up to 3,000 e/s</td>
<td>up to 4,000 e/s</td>
<td>up to 6,000 e/s</td>
</tr>
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<td>measured in events per second (e/s)</td>
<td></td>
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</tbody>
</table>
ArcGIS Enterprise with real-time GIS capabilities

OPTIMIZED environment for a resilient & scaled out deployment 7 machines

ArcGIS GeoEvent Server

- 10.2 up to 500 e/s
- 10.3 up to 2,000 e/s
- 10.4 up to 3,000 e/s
- 10.5 up to 4,000 e/s
- 10.6 up to 6,000 e/s

Velocity throughput measured in events per second (e/s)

Resiliency & Scalability via multi-machine site

- 10.2 no
- 10.3 no
- 10.4 no
- 10.5 no
- 10.6 yes
GeoEvent Server
resiliency, scalability & performance

• ArcGIS 10.5
  - Resiliency (high availability) & scalability is only possible if users “bring their own gateway”
    - Barrier to entry is HIGH & typically requires a professional services engagement for success
    - Loses flexibility of input types

OPTIMIZED environment
for a resilient & scaled out deployment
GeoEvent Server
resiliency, scalability & performance

• ArcGIS 10.6
  - Provides users with a resilient & scalable Real-Time GIS deployment OUT-OF-THE-BOX
    - Introduces a gateway process that is automatically configured as part of GeoEvent Server installation
    - Provides flexibility for all input types
    - Increased event throughput performance

OPTIMIZED environment
for a resilient & scaled out deployment

ArcGIS Enterprise

IoT

GeoEvent Server

spatiotemporal big data store

6K e/s
6K e/s
6K e/s
18K e/s

visualize

store

ingest, analyze
ArcGIS Enterprise
with real-time GIS capabilities

OPTIMIZED environment
for a resilient & scaled out deployment
7 machines

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<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes up to 5 practically, so can scale to up to 30,000 e/s</td>
</tr>
</tbody>
</table>
GeoEvent Server

*best practices tutorial for multi-machine site deployment*

- **Available Now:** [http://links.esri.com/geoevent-multiplemachine](http://links.esri.com/geoevent-multiplemachine)

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**Tutorial - GeoEvent Server 10.6.x Multiple-Machine Site**

**Description**

ArcGIS GeoEvent Server 10.6.x now supports the creation of multiple-machine sites. In a multiple-machine site, two or more GeoEvent Server machines can be administered and used as a single logical unit, providing GeoEvent Server administrators with great flexibility to easily adjust the computing power of the site by adding or removing GeoEvent Server machines.

This tutorial will walk you through how to plan, setup, and work with a GeoEvent Server 10.6.x multiple-machine site. Also included is an appendix for administrators to learn how to monitor an existing GeoEvent Server multiple-machine site.

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**Details**

- **Size:** 1 KB
- **Owner:** GeoEventTeam
- **Tags:** arcgis, geoevent, server, real-time, real-time, multiple, machine, site, tutorial, scale, scaling.
GeoEvent Server
performance & scalability benchmark resources

- Significant efforts are underway to properly document performance & scalability benchmarks of the GeoEvent Server product:
  - Testing harness, scripts and all sample data used for benchmarking is in-progress of being made available on a public GitHub repo
    - Enabling you to recreate benchmarks & baseline your environment
  - Watch the ‘GeoEvent’ blog on GeoNet for details:
    http://links.esri.com/geoevent-multiplemachine
    note: expected to be released the week after DevSummit
10.6.1 themes
Real-Time GIS
GeoEvent Server

10.6.1 themes

• Further improve OUT-OF-THE-BOX resilience (R), scalability (S) & performance (P) gains:
  - Targeted fixes for known issues with multi-machine deployments
    - 10.6.1 & 10.6 patch *(patch is targeted for availability in late March 2018)*
      - Fix Stream Services to work properly with a GeoEvent multi-machine site (RS)
      - Fix to detect number of machines in a multi-machine site consistently (RS)
    - 10.6.1 only
      - Added PKI Security certificate support when registering ArcGIS Server/Portal connections (security)

• Other quality fixes based on community reported issues
10.7 epics
Real-Time and Big Data GIS
GeoEvent Server

10.7 major epics

• Further improve OUT-OF-THE-BOX resilience (R), scalability (S) & performance (P) gains:
  - refactor Stream Services to utilize Gateway (RSP)
  - out-of-the-box reverse proxy & load balancer for Stream Services (RS)
  - out-of-the-box load balancer for GeoEvent REST inputs (RS)
  - out-of-the-box “web adapter” proxy for GeoEvent Manager ports :6180 & :6143 (S)
  - enhance Feature Service write path to be more tolerant of failures (R)
  - enhance Manager with site wide monitoring statistics when deployed as a multi-machine site (S)
  - enhance automatic backup of GeoEvent config with ability to export to Amazon S3 and Azure Blob Storage (R)

• Other incremental enhancements based on user feedback

Road Ahead content is provided for informational purposes only and is subject to change
**Stream Services**

*GeoEvent Server @10.6*

![Diagram](image)

- **IoT**
  - 6K e/s
  - 6K e/s
  - 6K e/s

- **GeoEvent Server**
  - Stream: rabbitmq consumer + web socket application

- **ArcGIS Enterprise**

- **R&D**

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Stream Services

GeoEvent Server @10.7

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GeoEvent Server

ArcGIS Enterprise

IoT

6K e/s

6K e/s

6K e/s

Stream kafka consumer + web socket application

NGINX

bring your own reverse proxy
Stream Services

GeoEvent Server @10.7

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10.7

ArcGIS Enterprise

Reverse Proxy & Load Balancer
- load balancing of web socket & HTTP applications
- a HTTP load balancer enables ...
- a "web adaptor" proxy for GeoEvent ports :6180, :6143
- load balancing of GeoEvent REST inputs

IoT

6K e/s

GeoEvent Server

Bring your own reverse proxy
Stream Services

GeoEvent Server @10.7

R&D

10.7

ArcGIS Enterprise

IoT

GeoEvent Server

6K e/s

6K e/s

6K e/s
Further improve spatiotemporal big data store (BDS) as follows:

- Enhance data retention policy with ability to automatically export prior to purge
- Enhance GeoEvent Manager and REST API with ability:
  - to export data on demand: including Delimited Text or Parquet to S3/Azure Blob
  - to import data on demand: including Delimited Text or Parquet from S3/Azure Blob
- Enhance on-the-fly-aggregation rendering capabilities with class breaks & manual breaks
- Enhance feature service to include unique value rendering

Other incremental enhancements based on user feedback
GeoAnalytics Server

10.7 major epics

• New tools

  - Append Data
    - Append results to an existing hosted feature layer
    - Map fields between different schemas
    - Use expressions to calculate values for destination fields

  - Overlay Layers
    - Compute geometric overlay between two vector datasets
    - Input and overlay layer must have same geometry type
    - Intersect, Erase
Embracing the Internet of Things (IoT)
Blueprint for IoT solutions

- An IoT Platform & Enterprise consists of the following capabilities:
  - Ingestion
  - Streaming Analytics & Policies
  - Actions (including Actuation)
  - Data Store
  - Device Management
  - Batch Analytics
  - Management Console
  - Visualization
  - Dashboards

![Blueprint Diagram]
ArcGIS as an IoT Platform
enabling geospatial insights with your IoT solution

• An ArcGIS based IoT Platform & Enterprise consists of the following capabilities:
  - **Ingestion**: GeoEvent server input connectors
  - **Streaming Analytics & Policies**: GeoEvent Services
  - **Actions** (including Actuation): GeoEvent output connectors
  - **Data Store**: spatiotemporal big data store
  - **Device Management**: for those requiring this functionality another IoT platform can be complemented with ArcGIS.
  - **Batch Analytics**: GeoAnalytics Server
  - **Management Console**: Portal & GeoEvent Manager
  - **Visualization**: Map & Feature Services
  - **Dashboards**: Operations Dashboard, Insights, Story Maps
Complementing an IoT platform with ArcGIS

enabling geospatial insights with your IoT solution

- The Edge of an IoT broadcasts into an IoT platform such as: Azure IoT, Amazon IoT, Cisco IoT, IBM Bluemix, ...
- The IoT platform integrates with ArcGIS to expand it’s capabilities with spatiotemporal analytics, visualization & dashboards
Complementing an IoT platform with ArcGIS

*enabling geospatial insights with your IoT solution*

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**Spatiotemporal Capabilities via ArcGIS**

**Environment**

- Sensors
- Gateways
- IoT Edge
- Devices (or Things)
- Actuators

**Edge**

- Ingestion actions

**Enterprise**

- Management console
- Policies & orchestration
- Visualization
- Data store
- Batch analytics
- Streaming analytics

- **Dashboards**
  - Operations Dashboard for ArcGIS
  - Insights for ArcGIS
  - Esri Story Maps
  - ArcGIS Earth
  - ArcGIS Pro
  - Collector for ArcGIS
  - Web AppBuilder for ArcGIS
  - ArcGIS Online
  - ArcGIS Pro
  - Collector for ArcGIS
  - Web AppBuilder for ArcGIS
  - AppStudio for ArcGIS
ArcGIS Enterprise
with real-time & big data GIS capabilities

1. ArcGIS Enterprise
   4 machines

2. GeoEvent Server
   ingest, analyze

3. spatiotemporal big data store
   store

4. GeoAnalytics Server
   analyze

IoT

Big Data

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

OPTIMIZED environment
for a resilient & scaled out deployment
10 machines
ArcGIS Enterprise
with real-time & big data GIS capabilities on Microsoft Azure

ArcGIS Enterprise Cloud Builder for Microsoft Azure

GeoEvent Server
ingest, analyze

spatiotemporal big data store
store

GeoAnalytics Server
analyze

Big Data

10.6.1
ArcGIS Enterprise
with real-time & big data GIS capabilities on Amazon EC2

1. ArcGIS Enterprise
2. GeoEvent Server
3. ingest, analyze
4. visualize
5. spatiotemporal big data store
6. store
7. analyze
8. GeoAnalytics Server
9. 10. Big Data

ArcGIS Enterprise Cloud Builder for Amazon EC2
Real-Time and Big Data GIS on ArcGIS Online
ArcGIS Online

real-time & big data GIS capabilities as a service to enable IoT applications

- Existing customers & prospects are demanding real-time & big data capabilities *AS A SERVICE*
- A new class of customer is demanding **MASSIVE** real-time & big data analytic capabilities
ArcGIS
real-time & big data GIS on-premise

An ArcGIS Enterprise with real-time & big data capabilities

- GeoEvent Server
- GeoAnalytics Server
- spatiotemporal big data store
- up to millions
- up to thousands e/s
- up to millions
- visualization
- big data analytics
- Ingestion + real-time analytics

Road Ahead content is provided for informational purposes only and is subject to change
ArcGIS Online
real-time & big data GIS as a service

ArcGIS for IoT
powered by project Trinity

cloud native storage

Road Ahead content is provided for informational purposes only and is subject to change
ArcGIS Online

*with real-time & big data GIS as a service*

- “ArcGIS for IoT” is launched as an application on ArcGIS Online
ArcGIS Online with real-time & big data GIS as a service

- “ArcGIS for IoT” application enables authoring new ArcGIS Online items including:
  - Feed and its companion Stream Layer
  - Real-Time Analytic
  - Analytic
  - Analytic (scheduled)
Street Lights - LA

Visualizing and analyzing street light device status

Optimizing street light maintenance priority based on context
Real-Time Analytic

receiving and updating streetlight status

<table>
<thead>
<tr>
<th>Feed</th>
<th>Receive streetlight status from Azure IoT Hub</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select Fields</td>
<td>Select fields of interest (STLID, LIGHTING_STATUS, …)</td>
</tr>
<tr>
<td>Calculate Field</td>
<td>Calculate if status represents outage (…)</td>
</tr>
<tr>
<td>Output</td>
<td>Keep latest feature in streetlight_status feature service</td>
</tr>
</tbody>
</table>
Batch Analytic

finding bus stops near streetlight outages

<table>
<thead>
<tr>
<th>Input</th>
<th>Load streetlights where LIGHTING_STATUS = ‘Off’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Join Features</td>
<td>Join streetlights to bus stops (Near Geodesic, 50 m)</td>
</tr>
<tr>
<td>Calculate Field</td>
<td>Calculate WEIGHT field (…)</td>
</tr>
<tr>
<td>Output</td>
<td>Keep latest feature in streetlight_priority feature service</td>
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Batch Analytic

**analyzing businesses near streetlight outages**

<table>
<thead>
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<th>Input</th>
<th>Load streetlights where LIGHTING_STATUS = ‘Off’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Join Features</td>
<td>Join streetlights to businesses (Near Geodesic, 50 m)</td>
</tr>
<tr>
<td>Calculate Field</td>
<td>Calculate WEIGHT field (…))</td>
</tr>
<tr>
<td>Output</td>
<td>Keep latest feature in streetlight_priority feature service</td>
</tr>
</tbody>
</table>
Batch Analytic
analyzing human movement near streetlight outages

Input
- Load streetlights where LIGHTING_STATUS = ‘Off’

Join Features
- Join streetlights to summarized human movement data (Safegraph)

Calculate Field
- Calculate WEIGHT field (…)

Output
- Keep latest feature in streetlight_priority feature service
Street Lights - LA

Visualizing and analyzing street light device status

Optimizing street light maintenance priority based on context
ArcGIS Online

summary of planned real-time & big data GIS as a service capabilities

• Feed
  - find & use publicly shared data feeds, *e.g.* Waze, Weather, Transit, …
    - drag a feed onto a web map to immediately visualize it as a live layer
  - configure a new Feed & share it

• Analytics
  - authoring an Analytic is a simple guided user experience:
    - Real-Time Analytics work on a feed
    - Analytics can work on data in ArcGIS Online, an ArcGIS Enterprise or a Big Data file share
    - Analytics can be scheduled to run on a recurring basis, *e.g.* once a day, every hour, every five minutes
  - Analytics can be used to detect patterns of interest and:
    - alert those interested
    - send an actuation command to adjust the behavior of a device in the world
    - kick off more analysis
  - **Analytic results are shared** as Stream Services, Feature Services and/or Map Services
Real-Time GIS: Road Ahead

summary

- **Real-Time GIS:**
  - Enables real-time data to be ingested, analyzed, stored & visualized within ArcGIS
  - At 10.6, supports reliability & scalability out-of-the-box via deployment of a multi-machine site
  - At 10.7, Stream/Feature Services will be more reliable & scalable out-of-the-box

- **You can embrace the Internet of Things:**
  - Today, by deploying a reliable & scalable on-premise real-time & big data GIS
  - Today, by complementing your ArcGIS deployment with popular IoT cloud platforms
  - In the future, as a service on ArcGIS Online
### Real-Time & Big Data Sessions!

<table>
<thead>
<tr>
<th>Session</th>
<th>Dates</th>
<th>Time</th>
<th>Room</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Real-Time GIS:</strong> Best Practices</td>
<td>Tue, 1:45 - 2:45 pm</td>
<td>152 B</td>
<td></td>
</tr>
<tr>
<td><strong>ArcGIS GeoEvent Server:</strong> Configuring Real-Time Web Apps</td>
<td>Wed, 2:45 - 3:45 pm</td>
<td>152 B</td>
<td></td>
</tr>
<tr>
<td><strong>ArcGIS GeoEvent Server:</strong> An Introduction</td>
<td>Tue, 3:00 - 4:00 pm</td>
<td>152 B</td>
<td></td>
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<tr>
<td><strong>ArcGIS GeoEvent Server:</strong> An Introduction</td>
<td>Wed, 5:15 - 6:15 pm</td>
<td>152 B</td>
<td></td>
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<tr>
<td><strong>Real-Time &amp; Big Data GIS:</strong> The Road Ahead</td>
<td>Wed, 8:15 - 9:15 am</td>
<td>152 B</td>
<td></td>
</tr>
<tr>
<td><strong>ArcGIS GeoEvent Server:</strong> Applying Real-Time Analytics</td>
<td>Wed, 4:00 – 5:00 pm</td>
<td>152 B</td>
<td></td>
</tr>
<tr>
<td><strong>Real-Time and Big Data:</strong> Leveraging the Spatiotemporal Big Data Store</td>
<td>Tue, 4:15pm - 5:15 pm</td>
<td>152 B</td>
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<td></td>
<td>Wed, 11:00 am -12:00 pm</td>
<td>152 B</td>
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Print Your Certificate of Attendance
Print stations located in the 140 Concourse

Tuesday
12:30 pm - 6:30 pm
GIS Solutions Expo
Hall B

5:00 pm - 6:30 pm
GIS Solutions Expo Social
Hall B

Wednesday
10:30 am - 5:15 pm
GIS Solutions Expo
Hall B

6:30 pm - 9:00 pm
Networking Reception
Smithsonian National Portrait Gallery
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