Real-Time & Big Data Overview

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2017 European Transportation GIS Summit
Agenda

1. Development
2. Current release 10.5.x
3. Visualization & Resiliency/Scalability
4. Road Ahead (10.6)
5. R&D Project Trinity & Polly
1 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The ‘current’ snapshot is outdated almost as soon as it’s created...

Credit: iStockphoto/chris_lemmens
Real-Time GIS Requirements
*Ingestion, Analytics, Notifications and Alerting*

**Requirement #1**
- Continuous Analysis
- Inside Boundary

**Requirement #2**
- Features
  - Position
  - Alert

**Applications**

*Alert!*
- Incident: Insula No Falling tone
- Time: 1:34pm PST on 3/3/2024
- Type: Commercial vessel
- Operator: Robert Smith
- Vessel ID: 784542500
ArcGIS Server

with real-time capabilities

10.2

GeoEvent Server

BYO-RDBMS

ingest, analyze

store

ingest

real-time & big data

visualize

analyze

store
Web GIS
with real-time capabilities

10.3

GeoEvent Server

BYO-RDBMS

200 e/s

Stream Service

ingest, analyze

visualize

store

ingest 3K e/s

visualize thousands

analyze 3K e/s

store 200 e/s

real-time & big data

Web GIS

BYO-RDBMS

200 e/s
Web GIS
with real-time capabilities

10.3

Web GIS

GeoEvent Server

relational data store

ingest, analyze

200 e/s

PostgreSQL
Web GIS
with real-time capabilities

IoT

GeoEvent Server

spatiotemporal big data store

ingest, analyze

visualize

store

ingest 4K e/s
analyze 4K e/s
store 10Ks e/s
visualize millions

real-time & big data
Real-Time & Big Data @ 10.5.x
ArcGIS Enterprise
with real-time & big data capabilities

10.5

ArcGIS Enterprise

IoT

GeoEvent Server

spatiotemporal big data store

Big Data

GeoAnalytics Server

visualize

store

analyze

ingest

real-time & big data

store

millions

4K e/s

4K e/s

10Ks e/s

Big Data

IoT

GeoEvent Server

spatiotemporal big data store

GeoAnalytics Server

visualize

store

analyze

ingest

real-time & big data

store

millions

4K e/s

4K e/s

10Ks e/s
Writing analytic results from GeoAnalytics Server

- GeoAnalytics Server has the ability to:
  - perform analytics against data sources in the SBDS
  - and write the analytic results to the SBDS
Writing analytic results from GeoAnalytics Server

- GeoAnalytics Server has the ability to:
  - perform analytics against files in an external big data file share
  - and write the analytic results to the spatiotemporal big data store

GeoEvent Server

Spatiotemporal big data store

GeoAnalytics Server

ArcGIS Enterprise

new Web GIS layers

Web GIS layers

ArcGIS Enterprise

GeoEvent Server

spatiotemporal big data store

GeoAnalytics Server

visualize

Ingest, analyze

store

analyze

big data file shares

feature service

Hadoop file system

Hive

HDFS

Text files

Shapefiles
ArcGIS Enterprise with real-time & big data capabilities

- 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
- Run batch analytics on stored observations
- Visualize high velocity & volume data:
  - as an aggregation
  - as discrete features
- Notify those who need to know about patterns of interest
Visualization & Resiliency/Scalability
Getting Real-Time Data into Web Apps

*Two patterns*

- **Feature layers** pull from feature services
  - Web apps poll to get periodic updates
  - Must be backed by an enterprise geodatabase (EGDB) or spatiotemporal big data store (SBDS)

- **Stream layers** subscribe to stream services
  - Web apps subscribe to immediately receive data
  - Low latency and high throughput
On-the-fly aggregations of observations

- The spatiotemporal big data store enables you to aggregate data on-the-fly
  - aggregating on-the-fly accommodates for real-time data
  - you can perform exploratory analysis via any combination of space, time and attribute queries
  - toggle from aggregation to raw feature view
  - access feature level attributes in aggregate or feature level view
Preparing data for on-the-fly aggregations

**spatial indexing**

- as data is written to a data source in the spatiotemporal big data store:
  - up to four types of spatial indices are supported: geohash, square, pointy & flat hexagon/triangle
  - this is in addition to a temporal index on the time field
  - and an inverted index on each of the attribute fields
Visualizing on-the-fly aggregations

spatial projection

- some of the spatial indices support projection(s):
  - the **geohash** spatial index only supports GCS WGS 1984, however you can project on-the-fly
  - **square**, **pointy** & **flat hexagon/triangle** spatial indices are defined with a spatial reference
Visualizing Real-Time Data in Web Apps
Berlin S-Bahn & Waze Traffic
GeoEvent resilience & scalability

**best practices**

- GeoEvent clustering was introduced at 10.3

- However, observed to be brittle and subject to failure:
  - Required at least 3 nodes in a cluster
    - when a node goes down, it must be brought back up ASAP.
    - a 2-node cluster can cause a split-brain condition in cluster.
  - Must be physical hardware
    - many customers only have virtualized environments.
  - Network must be stable
    - network instabilities can result in intermittent membership.

- Given this, GeoEvent clustering
  - has been deprecated at the 10.5 release
  - should be avoided and is discouraged

- Instead, if resiliency or addt’l scalability is required:
  - isolated deployments should be employed
  - this is true at 10.3, 10.4 & 10.5
ArcGIS Enterprise
with real-time & big data capabilities

RESILIENT environment

ArcGIS Enterprise

IoT

kafka
kafka
kafka

GeoEvent Server
bring-your own message broker

spatiotemporal big data store

GeoAnalytics Server
analyze

Big Data

store

visualize
4 Road Ahead (10.6)
ArcGIS Enterprise
with real-time & big data capabilities

RESILIENT environment

ArcGIS Enterprise

input relay
gateway

input relay
gateway

input relay
gateway

GeoEvent Server

spatiotemporal
big data store

GeoAnalytics Server

IoT

Big Data

visualize

store

analyze

ingest, analyze
R&D Project Trinity & Polly
Real-Time GIS
bringing geospatial insights to your

Public Safety
- police
- fire
- surveillance

Public Health
- hospitals
- ambulances

Transit
- buses
- taxis
- rail
- trains
- crowds

Connected Cars
- autonomous driving
- traffic conditions
- holes
- parking meters
- road conditions
- slippery areas
- network improvements

Environment
- noise
- gases
- co2
- temperature
- radiation
- nitrates
- humidity
- atmospheric pressure
- electromagnetic feedback
- rain gauges
- water level gauges
- air quality

Airports
- flight status
- queues
- plane location
- runway status

Buildings
- lighting
- hvac
- occupancy counts

Internet of your Things

Energy Usage
- electricity
- gas
- smart meters

City Workers
- sanitation
- snow plows

Telecommunications
- cell phone signals
- dropped calls

People
- health monitoring
- social activity

ArcGIS Enterprise
with real-time & big data capabilities

Desktop
Web
Device
project Trinity
an ArcGIS Enterprise bundled with massive real-time & big data capabilities

- project Trinity is a capability that enables existing customers and prospects with the ability to:
  - Reliably ingest, analyze & store up to millions of sensor events per second.
  - Quickly visualize, replay & explore observations that are billions of features.
  - Perform fast analytics on billions of observations.
project Trinity

Internet of your Things

on Amazon C2S

on Amazon

on Azure

ArcGIS Enterprise with real-time & big data

50 nodes
400 cores, 1.4 TB ram, 20 TB ssd

f( Sources + Hubs + Real-Time Analytics )

8 cores, 28 GB ram, 400 GB ssd

50 nodes
480 cores, 1.6 TB ram, 30 TB ssd

30 nodes
400 cores, 1.4 TB ram, 20 TB ssd

f( Spatiotemporal Archive + Batch Analytics )

16 cores, 56 GB ram, 1 TB ssd

30 nodes
400 cores, 1.4 TB ram, 20 TB ssd

2 cores, 4 GB ram, 50 GB ssd

2 cores, 10 GB ram, 200 GB ssd

4 cores, 14 GB ram, 150 GB ssd

8 cores, 28 GB ram, 400 GB ssd

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project Trinity

bringing geospatial insights to your IoT

on Amazon C2S

on Amazon

on Azure

ArcGIS Enterprise with real-time & big data
880 cores, 3TB memory, 50TB storage

ArcGIS Enterprise

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Web

Device

Desktop

R&D

Apps
**project Trinity**

*motivation from international distributors, customers & prospects*

- Locality requirement, deploy & run a managed service nearest to the things
  - Latency must be reduced as much as possible
  - Data must be kept local or near the country of origination: *e.g. Netherlands, Germany, Japan*
project Polly
spatial indexing: polygon

- as data is written to the spatiotemporal big data store:
  - a spatial index for **polygon** aggregation is continuously updated
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Esri Burundi

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