Agenda

1. Evolution of Real-Time GIS
2. Observation data
3. Visualizing observation data
4. ArcGIS Data Store
5. Storing observation data
6. A deeper dive
7. Capacity planning
1. Evolution of Real-Time GIS
Real-Time GIS
ArcGIS 10.2

- Provide the ability to ingest real-time streaming data into ArcGIS.
- Perform real-time analytics on event data as it is received.
- Send updates and alerts to those who need it, where they need it.
Real-Time GIS
ArcGIS 10.3

- Can ingest real-time high velocity data into ArcGIS but low volume storage.
- Can visualize high velocity & volume data in raw feature form live, but not historically.
- Visualization can’t scale beyond known constraints.
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.
2. Observation Data
Observation Data

Types

- Types of observation data include:

**Moving**
- something that moves
  - Planes
  - Vehicles
  - Animals
  - Satellites
  - Storms

**Stationary**
- stands still but attributes change
  - Water Gauges
  - Weather Stations
  - Traffic Sensors
  - Air Quality

**Discrete**
- something that “just happens”
  - Crimes
  - Lightning
  - Accidents

**Change**
- change or growth
  - Population
  - Distribution
  - Fire Perimeters
Observation Data

**Defined**

- An observation is a recording of a feature’s attribute values and location at a specific moment in time.
  - 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 cells in a filmstrip**

Moving observation illustration for two tracks over space (x, y) and time (t)
3. Visualizing Observation Data
**Visualizing Observation Data**

*ArcGIS for Server: Map Service*

- **High volume observation data can be visualized as an aggregation**
  - An on-the-fly aggregation (representation) of the data is prepared by the map service
  - Clients querying for high volumes of data are given a rendered representation of the data
  - Aggregations are calculated at various levels of detail and are specific to each user session.
Visualizing Observation Data

**ArcGIS for Server: Map Service**

- The map service’s aggregation can be configured to display discrete features
  - Big Data visualization is scalable based on the density of your data
  - Specify a *Feature Threshold* and filter to display a reasonable number of features at any map scale
Visualizing Observation Data

*ArcGIS for Server: Feature Service*

- High volume observation data can be visualized as discrete features
  - Data queried as features from a big data store can be symbolized by a client
  - Combine a map service and feature service for traditional scale dependent rendering
Visualizing Observation Data
ArcGIS for Server: Feature Service

• Efficiently query your observations with fast access
  - Query by any combination of id, time, space, and/or attribute value

• 1 Month worth of AIS shipping vessel data
  - 28,243,036 observations

• Query one vessel by ID (MMSI = ‘440411000’)
  - Within the time extent
    - From Jan 9, 2012 4:07:48 PM PDT
    - To Jan 23, 2012 7:27:08 PM PDT
  - Intersecting a spatial envelope
    - xmin: -117, ymin: 28 and xmax: -75, ymax=45, srid=4326
Visualizing Observation Data

ArcGIS for Server: Feature Service

Query: Exact-Earth (ID: 0)

Where: MMSI = '440411000'
Text: 
Object IDs: 
Time: 1326067668000;1327376628000

Input Geometry:

{"xmin": -117, "ymin": 28, "xmax": -75, "ymax": 45, "spatialReference": {"wkid": 4326} }

Geometry Type: Envelope
Input Spatial Reference: 
Spatial Relationship: Intersects
Relation: 
Out Fields: *

Return Geometry: True
Format: HTML

# records: 60

60 out of 28,243,036 in 83 ms!
4. ArcGIS Data Store
4a. ArcGIS Data Store
Relational Data Store
The ArcGIS 10.3 Data Store enables the storage of items via a Managed Database.

The Relational Data Store enables the storage of:
- traditional Feature Services, Map Services, and many other items.
ArcGIS Data Store

Relational Data Store

- The ArcGIS 10.3 Data Store enables the storage of items via a Managed Database.
- The Relational Data Store enables the storage of:
  - traditional Feature Services, Map Services, and many other items.
- You can enable high availability on the Relational Data Store by adding a standby.
4b. ArcGIS Data Store
Spatiotemporal Big Data Store
ArcGIS Data Store
Spatiotemporal Big Data Store

- The ArcGIS 10.4 Data Store now works with high velocity & volume observation data.
- The Big Data Store enables storage and archival of spatiotemporal observation data.
  - it can sustain tens of thousands of writes per second.
ArcGIS Data Store
Spatiotemporal Big Data Store

- The ArcGIS 10.4 Data Store now works with high velocity & volume observation data.
- The Big Data Store enables storage and archival of spatiotemporal observation data.
  - it can sustain tens of thousands of writes per second.
- You can enable higher volume storage on the Big Data Store by adding additional nodes.
Installation Experience
Spatiotemporal Big Data Store Pre-requisites

- Portal for ArcGIS has been installed and configured.
- ArcGIS Data Store has been installed and registered with an ArcGIS Server as a Relational Data Store.
- An ArcGIS Server has been registered with Portal as a “Hosting” server.
Installation Experience
Spatiotemporal Big Data Store Pre-requisites (continued)

- An ArcGIS Server with GeoEvent Extension for Server has been registered with Portal as a “Federated” server.
- Configure SSL security certificates.
Installation Experience

ArcGIS Data Store

Welcome to the ArcGIS Data Store Setup program

It is strongly recommended that you exit all Windows programs before running this setup program.

Click Cancel to quit setup and close any programs you have running. Click Next to continue the installation.

WARNING: This program is protected by copyright law and international treaties.

Unauthorized reproduction or distribution of this program, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under law.
Installation Experience

ArcGIS Data Store

ArcGIS 10.4 Data Store Setup

ArcGIS Data Store has been successfully installed.

Click the Finish button to exit this installation.
Installation Experience
Enabling the Spatiotemporal Big Data Store

cd %AGSDATASTORE%\tools
configuredatastore.bat https://webgis-server:6443/arcgis/admin your_username your_password C:\arcgisdatastore --stores spatiotemporal
Installation Experience

Enabling the Spatiotemporal Big Data Store
Installation Experience
Enabling the Spatiotemporal Big Data Store

Microsoft Windows [Version 6.3.9600]
© 2013 Microsoft Corporation. All rights reserved.
C: \ Users \ > cd \nC: > cd "Program Files\ArcGIS\DataStore\tools"
C: \ Program Files\ArcGIS\DataStore\tools\configuredatastore.bat https://ps000257.esri.com:6443/arcgis/admin admin admin C: \ cgsdatastore --stores spatiotemporal
Configuring data store(s). It may take a few minutes. Please wait...
Operation completed successfully
C: \ Program Files\ArcGIS\DataStore\tools\~
Verifying Installation
Admin API: nosqlDatabases
Verifying Installation

Admin API: nosqlDatabases
5. Storing Observation Data
Storing Observation Data

ArcGIS GeoEvent Extension for Server: output connectors

You can create your own connectors.

GeoEvent Extension

GeoEvent Services

Inputs

Outputs

Out of the Box

Add or Update a feature
Publish Text to a UDP Socket
Push GeoJSON or JSON to an external Website
Push GeoJSON or JSON to an external WebSocket
Push Text to an external TCP Socket
Send a Text Message
Send an Email
Send an Instant Message
Send Features to a Stream Service
Write to a CSV, GeoJSON, or JSON File
Add a Feature to a Spatiotemporal Big Data Store
Update a feature in a Spatiotemporal Big Data Store

Esri Gallery

ActiveMQ
CoT
Cursor-on-Target
Hadoop (HDFS)
Kafka
MongoDB
MQTT
RabbitMQ
Twitter
5a. Storing Observation Data
Add a Feature
**Storing Observation Data**

### Add a Feature to an ArcGIS Spatiotemporal Big Data Store

Add GeoEvents as new features to an ArcGIS Spatiotemporal Big Data Store.

### Update a Feature in an ArcGIS Spatiotemporal Big Data Store

Updates features in an ArcGIS Spatiotemporal Big Data Store with the latest field values from the GeoEvents.
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store

Creating Output - Add a Feature to an ArcGIS Spatiotemporal Big Data Store

- **Name**: bds-out
- **GeoEvent Definition**: FAA-Stream
- **ArcGIS Server Connection**: Default
- **Data Source Name**:

**Advanced**

- **Flush Interval (Milliseconds)**: 100
- **Maximum Features Per Transaction**: 1000

[Register ArcGIS Server]

[Create Data Source]
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store

[Diagram of creating a data source with fields and settings for aggregation and feature rendering]
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store

[Image of ArcGIS interface showing the process of adding a feature to an ArcGIS Spatiotemporal Big Data Store]
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store

Creating Output - Add a Feature to an ArcGIS Spatiotemporal Big Data Store

- **Name**: bds-out
- **GeoEvent Definition**: FAA-Stream
- **ArcGIS Server Connection**: Default
- **Data Source Name**: FAA-Stream

**Advanced**

- **Flush Interval (Milliseconds)**: 100
- **Maximum Features Per Transaction**: 1000
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store

ArcGIS GeoEvent Manager

Creating Output - Add a Feature to an ArcGIS Spatiotemporal Big Data Store

"FAA-Stream-Adds" was published successfully.

Name*: bds-out
GeoEvent Definition: FAA-Stream
ArcGIS Server Connection*: Default
Data Source Name*: FAA-Stream-Adds

Advanced
Storing Observation Data

Add a Feature to an ArcGIS Spatiotemporal Big Data Store
5b. Storing Observation Data

Update a Feature
Storing Observation Data

Update a feature in an ArcGIS Spatiotemporal Big Data Store

Add a Feature to an ArcGIS Spatiotemporal Big Data Store

Add GeoEvents as new features to an ArcGIS Spatiotemporal Big Data Store.

Update a Feature in an ArcGIS Spatiotemporal Big Data Store

Updates features in an ArcGIS Spatiotemporal Big Data Store with the latest field values from the GeoEvents.
Storing Observation Data

Update a feature in an ArcGIS Spatiotemporal Big Data Store

ArcGIS GeoEvent Manager

Creating Output - Update a Feature in an ArcGIS Spatiotemporal Big Data Store

- Name*: bds-out-updates
- GeoEvent Definition: FAA-Stream
- ArcGIS Server Connection*: Default
- Data Source Name*: 
- Unique Feature Identifier Field: UID Integer

Advanced
- Flush Interval (Milliseconds): 100
- Maximum Features Per Transaction: 1000

Save  Cancel
Storing Observation Data

Update a feature in an ArcGIS Spatiotemporal Big Data Store
Storing Observation Data

Update a feature in an ArcGIS Spatiotemporal Big Data Store

ArcGIS GeoEvent Manager

Outputs

<table>
<thead>
<tr>
<th>Output</th>
<th>Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>bds-out</td>
<td>Add a Feature to an ArcGIS Spatiotemporal Big Data Store</td>
<td>Started</td>
</tr>
<tr>
<td>bds-out-updates</td>
<td>Update a Feature in an ArcGIS Spatiotemporal Big Data Store</td>
<td>Started</td>
</tr>
</tbody>
</table>
5c. Storing Observation Data

Managing a Big Data Store
### Storing Observation Data

Managing a Big Data Store

**ArcGIS GeoEvent Manager**

#### Manage Spatiotemporal Big Data Stores

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Map Services</th>
<th>Feature Services</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAA-Stream-Adds</td>
<td>FAA-Stream-Adds</td>
<td>FAA-Stream-Adds</td>
<td></td>
</tr>
<tr>
<td>FAA-Stream-BDS</td>
<td>FAA-Stream-BDS</td>
<td>FAA-Stream-BDS</td>
<td></td>
</tr>
<tr>
<td>FAA-Stream-Updates</td>
<td>FAA-Stream-Updates</td>
<td>FAA-Stream-Updates</td>
<td></td>
</tr>
</tbody>
</table>
Visualizing Observation Data
Map & Feature Service reading from Big Data Store
6. A Deeper Dive
6a. A Deeper Dive
Data Reliability
Data Reliability

Replication Factor

Replication Factor: 1

Object Id Option: ArcGIS 10.4 and later (Int64)

Create: Map Service, Feature Service

Display Field Name: Capacity (Integer)

Feature Threshold: 0

Time Info:
- Time Interval: 10
- Time Interval Units: Seconds
- Has Live Data: Yes
Data Reliability

Replication Factor

![Diagram showing data reliability and replication factor](image)
Data Reliability
Replication Factor
Data Reliability

Replication Factor

10.4
Data Reliability

Replication Factor
Data Reliability

Replication Factor
Data Reliability

Replication Factor

![Diagram of Data Reliability and Replication Factor]

- Portal
- GeoEvent Federated Server
- GeoEvent
- Spatiotemporal Big Data Store
  - Node 1
  - Node 2
  - Node 3
  - Node 4
  - Node 5
  - r = 1

- 4,000 e/s to GeoEvent

10.4
Data Reliability

Replication Factor
Data Reliability

Node Failure
Data Reliability

Auto-rebalancing of data upon node membership changes, + or -, in the Big Data Store
Data Reliability

Auto-rebalancing of data upon node membership changes, + or -, in the Big Data Store
Data Reliability

Auto-rebalancing of data upon node membership changes, + or -, in the Big Data Store
Data Reliability
Auto-rebalancing of data upon node membership changes, + or -, in the Big Data Store
6b. A Deeper Dive

Rolling Data Option
Rolling Data
Enabling fast access & queries

Create Data Source

- Name: FAA-Stream
- Geometry Type: Point
- Replication Factor: 1
- Object Id Option: ArcGIS 10.4 and later (Int64)
- Rolling Data Option: Yearly
- Create: Map Service, Feature Service
- Display Field Name: Capacity (Integer)
- Feature Threshold: 0

Aggregation Rendering

Feature Rendering

Time Info
- Time Interval: 10
- Time Interval Units: Seconds
- Has Live Data: true
6c. A Deeper Dive
Observations and ObjectID
Observations and ObjectID
Choosing an ObjectID Option: Int32, Int64, or UniqueStringID

What type (if any) Object Id to generated.

**ArcGIS 10.4 and later (Int64)**: Generates objectIds which will be supported by the following clients:

**ArcGIS prior to 10.4 (Int32)**: Generates objectIds which will be supported by most clients including: ArcMap, ArcGIS Pro, Operational Dashboard, etc.

**Custom client applications (String)**: The Object Id is represented by a string field which holds unique identifier string values. This is the optional write throughput setting. Javascript Clients and Custom applications will support this approach.
Observations and ObjectID

Choosing an ObjectID Option: Int32, Int64, or UniqueStringID

<table>
<thead>
<tr>
<th>ObjectID</th>
<th>Max Value</th>
<th># of IDs</th>
<th>ArcGIS Clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Int32</td>
<td>2,147,483,647</td>
<td>2.1 billion</td>
<td>Pro, Desktop, Ops Dashboard, ...</td>
</tr>
<tr>
<td>Int64 (signed)</td>
<td>9,223,372,036,854,775,807</td>
<td>9.2 quintillion</td>
<td>JavaScript, custom apps</td>
</tr>
<tr>
<td>UniqueStringID</td>
<td>n/a</td>
<td>unlimited</td>
<td>JavaScript, custom apps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>events per day</th>
<th>Int32</th>
<th>Int64 (signed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 e/s</td>
<td>86,400,000</td>
<td>292,472,000 years</td>
</tr>
<tr>
<td>10,000 e/s</td>
<td>864,000,000</td>
<td>29,247,200 years</td>
</tr>
<tr>
<td>100,000 e/s</td>
<td>8,640,000,000</td>
<td>2,924,720 years</td>
</tr>
<tr>
<td>1,000,000 e/s</td>
<td>86,400,000,000</td>
<td>292,472 years</td>
</tr>
<tr>
<td>10,000,000 e/s</td>
<td>864,000,000,000</td>
<td>29,248 years</td>
</tr>
</tbody>
</table>
7. Capacity Planning
7a. Capacity Planning
Big Data Store Performance
Big Data Store Performance
ArcGIS 10.4 Benchmarks
c4.2xlarge (Windows 2012 Server R2): 8 vCPU, 15 GiB, 100GB local SSD, 1,000 Mbps EBS

High Velocity Ingression

106k writes per second
Add features to a Spatiotemporal Big Data Store or Update features in a Spatiotemporal Big Data Store

High Volume Storage

ArcGIS Big Data Store

Storage Write Throughput 1 node

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS Big Data Store</td>
<td>106k</td>
</tr>
<tr>
<td>ArcGIS Relational Data Store</td>
<td>0.2k</td>
</tr>
</tbody>
</table>
Big Data Store Performance
ArcGIS 10.4 Benchmarks

- **ArcGIS Big Data Store**
  - 1 node: 106k
  - 2 node: 143k

- **ArcGIS Relational Data Store**
  - 1 node: 0.2k
  - 2 node: n/a

*High Volume Storage*

Add features to a Spatiotemporal Big Data Store or Update features in a Spatiotemporal Big Data Store

**143k writes per second**
Big Data Store Performance

ArcGIS 10.4 Benchmarks
c4.2xlarge (Windows 2012 Server R2): 8 vCPU, 15 GiB, 100GB local SSD, 1,000 Mbps EBS

Storage Write Throughput

<table>
<thead>
<tr>
<th></th>
<th>1 node</th>
<th>2 node</th>
<th>3 node</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS Big Data Store</td>
<td>106k</td>
<td>143k</td>
<td>192k</td>
</tr>
<tr>
<td>ArcGIS Relational Data Store</td>
<td>0.2k</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Big Data Store Performance

ArcGIS 10.4 Benchmarks

Storage Write Throughput

<table>
<thead>
<tr>
<th></th>
<th>1 node</th>
<th>2 node</th>
<th>3 node</th>
<th>4 node</th>
</tr>
</thead>
<tbody>
<tr>
<td>ArcGIS Big Data Store</td>
<td>106k</td>
<td>143k</td>
<td>192k</td>
<td>224k</td>
</tr>
<tr>
<td>ArcGIS Relational Data Store</td>
<td>0.2k</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

c4.2xlarge (Windows 2012 Server R2): 8 vCPU, 15 GiB, 100GB local SSD, 1,000 Mbps EBS
### Big Data Store Performance

**ArcGIS 10.4 Benchmarks**

- **c4.2xlarge (Windows 2012 Server R2):** 8 vCPU, 15 GiB, 100GB local SSD, 1,000 Mbps EBS

<table>
<thead>
<tr>
<th>Storage Write Throughput</th>
<th>1 node</th>
<th>2 node</th>
<th>3 node</th>
<th>4 node</th>
<th>5 node</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ArcGIS Big Data Store</strong></td>
<td>106k</td>
<td>143k</td>
<td>192k</td>
<td>224k</td>
<td>249k</td>
</tr>
<tr>
<td><strong>ArcGIS Relational Data Store</strong></td>
<td>0.2k</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**High Volume Storage**

- **ArcGIS Big Data Store**
- **ArcGIS Big Data Store**
- **ArcGIS Big Data Store**

**High Velocity Ingestion**

- 249k writes per second

**a 529-1,245x increase in write throughput**
7b. Capacity Planning
Primary Factors to Consider
Big Data Store Performance
What are the primary factors I should consider?

• Operating environment: Amazon EC2 c4.2xlarge
  - Virtual Machines – beware! resources need to be shared in an effective way, like EC2 or Azure.
  - Bare-Metal machines – dedicated resources and public cloud instances are much more deterministic.

• Disk
  - Speed (Mbps) – the faster the better
    1,000 Mbps EBS, note: local SSD is much better

• Network
  - Speed (Gbps) – the faster the better.
    10 Gbps

• RAM
  - size (GB) – minimum of 16GB is recommended.
    15GiB, the Big Data Store was allocated 8GiB
  - type – minimum of DDR3 is recommended.
  - clock speed (MHz) and transfer rate (Mbps) – the faster the better.

• Processors
  - speed (GHz) – the faster the better.
  - # of cores – the more the better.
    8 vCPU
Capacity Planning your Spatiotemporal Big Data Store

Factors to consider

• Event Velocity
  - # of events per second
  - Message size (in bytes)
  - Sensor active time per day
  - % of sensors active per day
  - # of peak hours

• Real-Time node resources:
  - Real-Time throughput (in e/s)
  - Real-Time additional redundancy (# of nodes)

• Storage node resources:
  - Storage total disk size per node (in TBs)
  - Storage retention (in months)
  - Storage replication factor (# of nodes)
7c. Capacity Planning

Estimator Tool
### Parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track events per minute when active</td>
<td>1</td>
</tr>
<tr>
<td>Track active time per day (in minutes)</td>
<td>480</td>
</tr>
<tr>
<td>Message size (in bytes)</td>
<td>1024</td>
</tr>
<tr>
<td>Peak duration (in hours)</td>
<td>4</td>
</tr>
<tr>
<td>Peak % of tracks active</td>
<td>0.8</td>
</tr>
<tr>
<td>Non-GPS messages per Track per day</td>
<td>0</td>
</tr>
<tr>
<td>GeoEvent assumed throughput e/s</td>
<td>2500</td>
</tr>
<tr>
<td>GeoEvent desired addtl redundancy</td>
<td>1</td>
</tr>
<tr>
<td>Storage total disk size per node (in TBs)</td>
<td>3</td>
</tr>
<tr>
<td>Storage retention (in # of months)</td>
<td>1</td>
</tr>
<tr>
<td>Storage replication factor</td>
<td>1</td>
</tr>
</tbody>
</table>

### Calculations:

<table>
<thead>
<tr>
<th>Year</th>
<th>Events per day</th>
<th>Events per second on avg</th>
<th>Events per second during peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>38,400,000</td>
<td>444</td>
<td>2,133</td>
</tr>
<tr>
<td>2017</td>
<td>76,800,000</td>
<td>889</td>
<td>4,267</td>
</tr>
<tr>
<td>2018</td>
<td>115,200,000</td>
<td>1,333</td>
<td>6,400</td>
</tr>
<tr>
<td>2019</td>
<td>153,600,000</td>
<td>1,778</td>
<td>8,533</td>
</tr>
<tr>
<td>2020</td>
<td>192,000,000</td>
<td>2,222</td>
<td>10,667</td>
</tr>
<tr>
<td>2021</td>
<td>230,400,000</td>
<td>2,667</td>
<td>12,800</td>
</tr>
<tr>
<td>2022</td>
<td>268,800,000</td>
<td>3,111</td>
<td>14,933</td>
</tr>
<tr>
<td>2023</td>
<td>307,200,000</td>
<td>3,556</td>
<td>17,067</td>
</tr>
<tr>
<td>2024</td>
<td>345,600,000</td>
<td>4,000</td>
<td>19,200</td>
</tr>
<tr>
<td>2025</td>
<td>384,000,000</td>
<td>4,444</td>
<td>21,333</td>
</tr>
<tr>
<td>2026</td>
<td>422,400,000</td>
<td>4,889</td>
<td>23,467</td>
</tr>
</tbody>
</table>

### Node Estimates:

<table>
<thead>
<tr>
<th>Year</th>
<th># of GeoEvent nodes</th>
<th># of Big Data Store nodes</th>
<th>Total nodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
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**Note:** To determine your throughput you should benchmark with illustrative real-time analytics representing your planned usage.

**Note:** GeoEvent nodes = (events per second during peak / throughput) + addtl redundancy, note: assumes linear scalability and an 8 core, 32GB RAM machines

**Note:** Storage nodes = (events per day * message size * 30 days * retention months) / storage size + additional redundancy, note: assumes no compression

**Note:** Storage volume capacity needed is completely dependent on the retention requirements of the data, the longer the retention the more nodes that will be needed.
Summary
Archiving & Visualizing Observation Data

- ArcGIS 10.4 has been enhanced so you:
  - Can ingest real-time HIGHER velocity data and CAN store it.
  - Can visualize high velocity & volume data in feature form, in AGGREGATE form, LIVE & HISTORICALLY.
  - Visualization CAN work with high volume data.

- To learn more:
  - See the tutorial: ‘ArcGIS Spatiotemporal Big Data Store’
Real-Time GIS

Other session

- Real-Time GIS: Applying Real-Time Analytics
  Thu Apr 28, 8:30 – 10:00, Grand Ballroom B
Thank you!
Mark Bramer
mbramer@esri.com