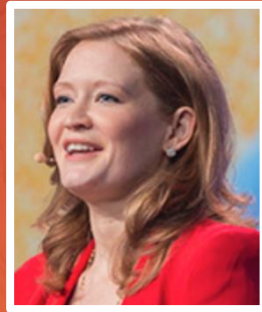


# GeoEvent Server: Best Practices



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@theTechieSagar

# Agenda

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- 1 Ingestion & analytics
  - 2 Dissemination & visualization
  - 3 Performance
  - 4 Resilience & scalability
  - 5 Storage
-



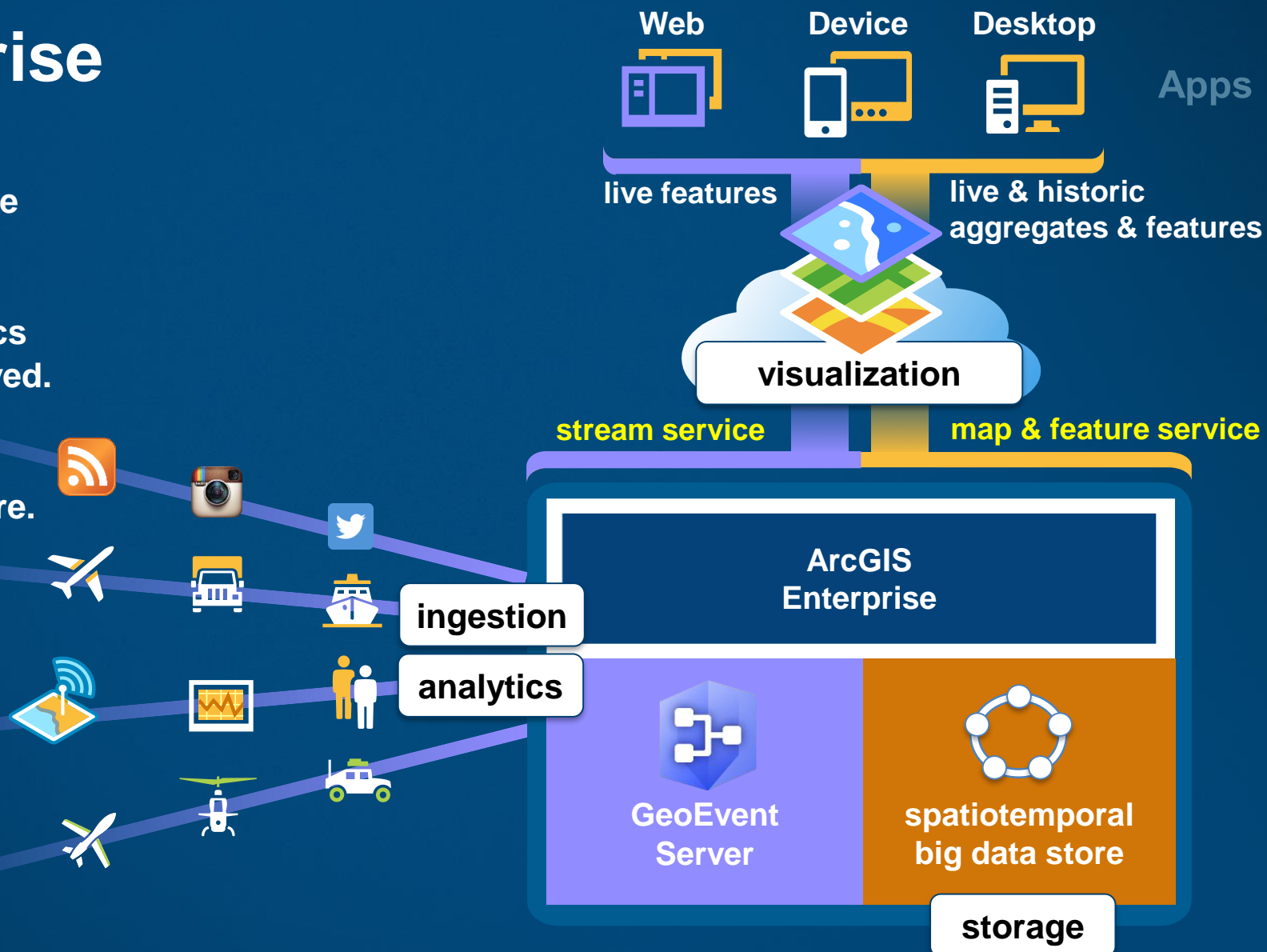
# Ingestion & analytics



# ArcGIS Enterprise

*with real-time 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.
- Visualize high velocity & volume data:
  - as an aggregation
  - or as discrete features.
- Notify about patterns of interest.

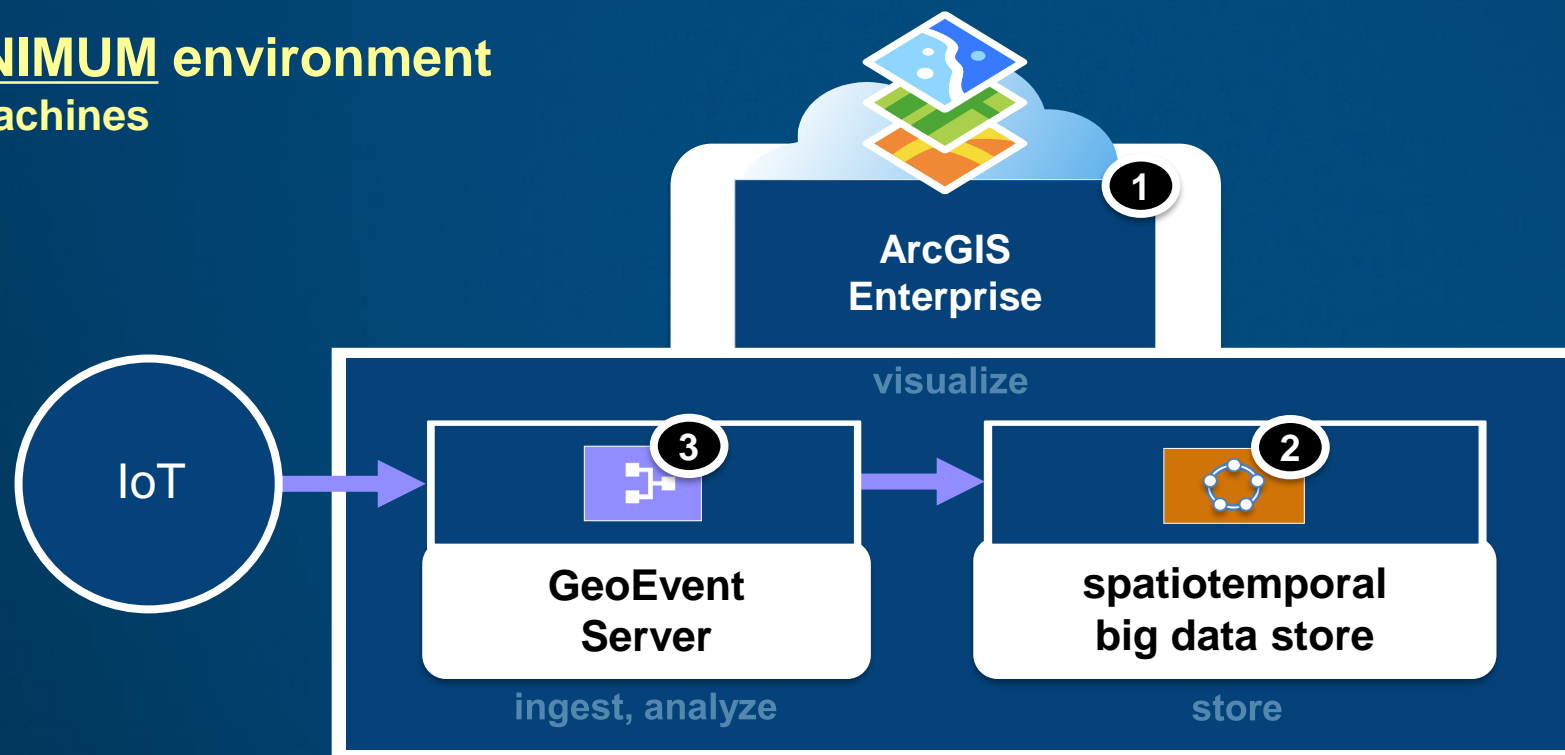


# ArcGIS Enterprise

*with real-time capabilities*

10.5

**MINIMUM** environment  
3 machines



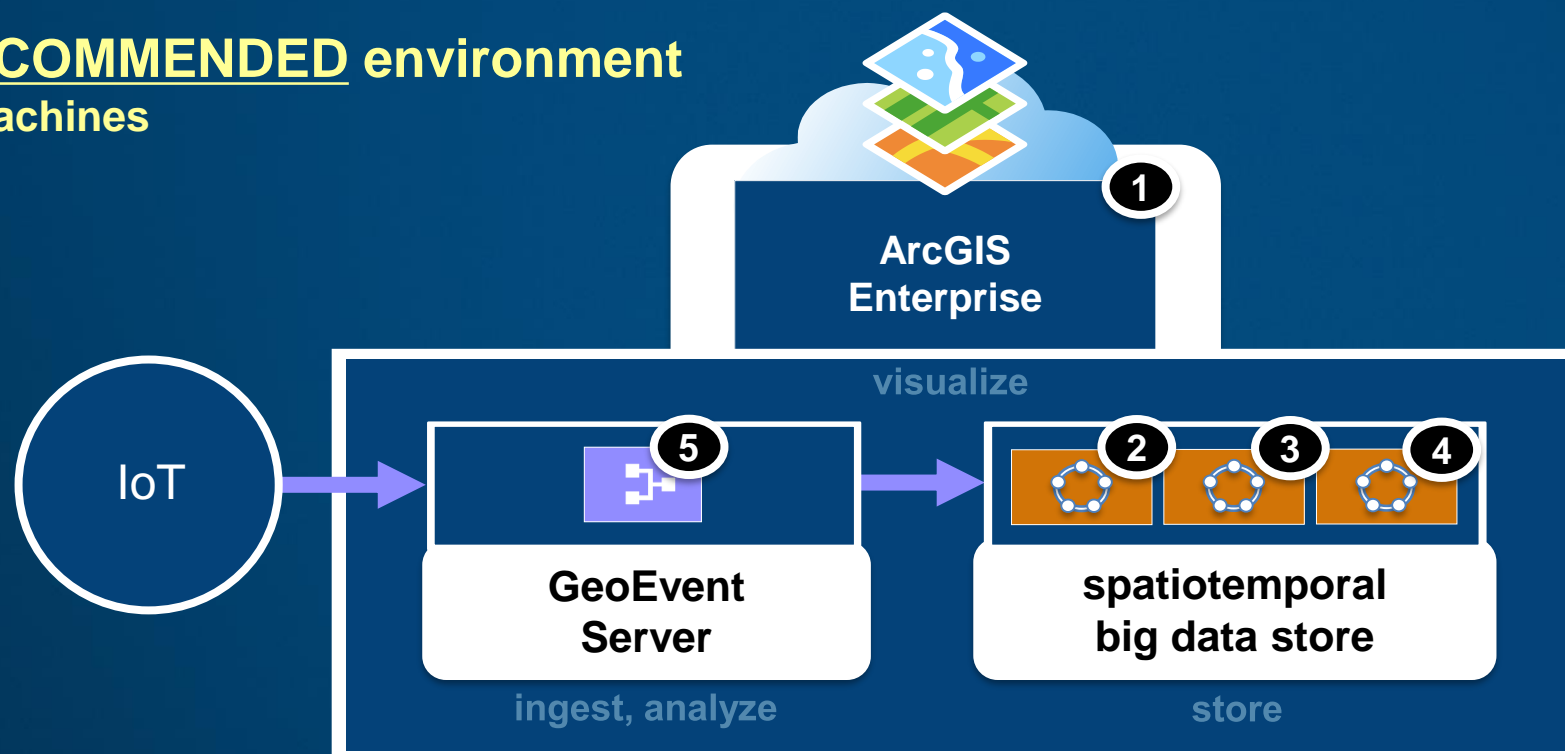
**functional servers & spatiotemporal big data store  
SHOULD BE on ISOLATED machines!!!**

# ArcGIS Enterprise

*with real-time capabilities*

10.5

**RECOMMENDED** environment  
5 machines



**functional servers & spatiotemporal big data store  
SHOULD BE on ISOLATED machines!!!**

# Ingestion of real-time data

*input connectors*

you can create  
your own  
connectors









## GeoEvent Server

### GeoEvent Services
















Inputs

Outputs

### 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

### Esri Gallery

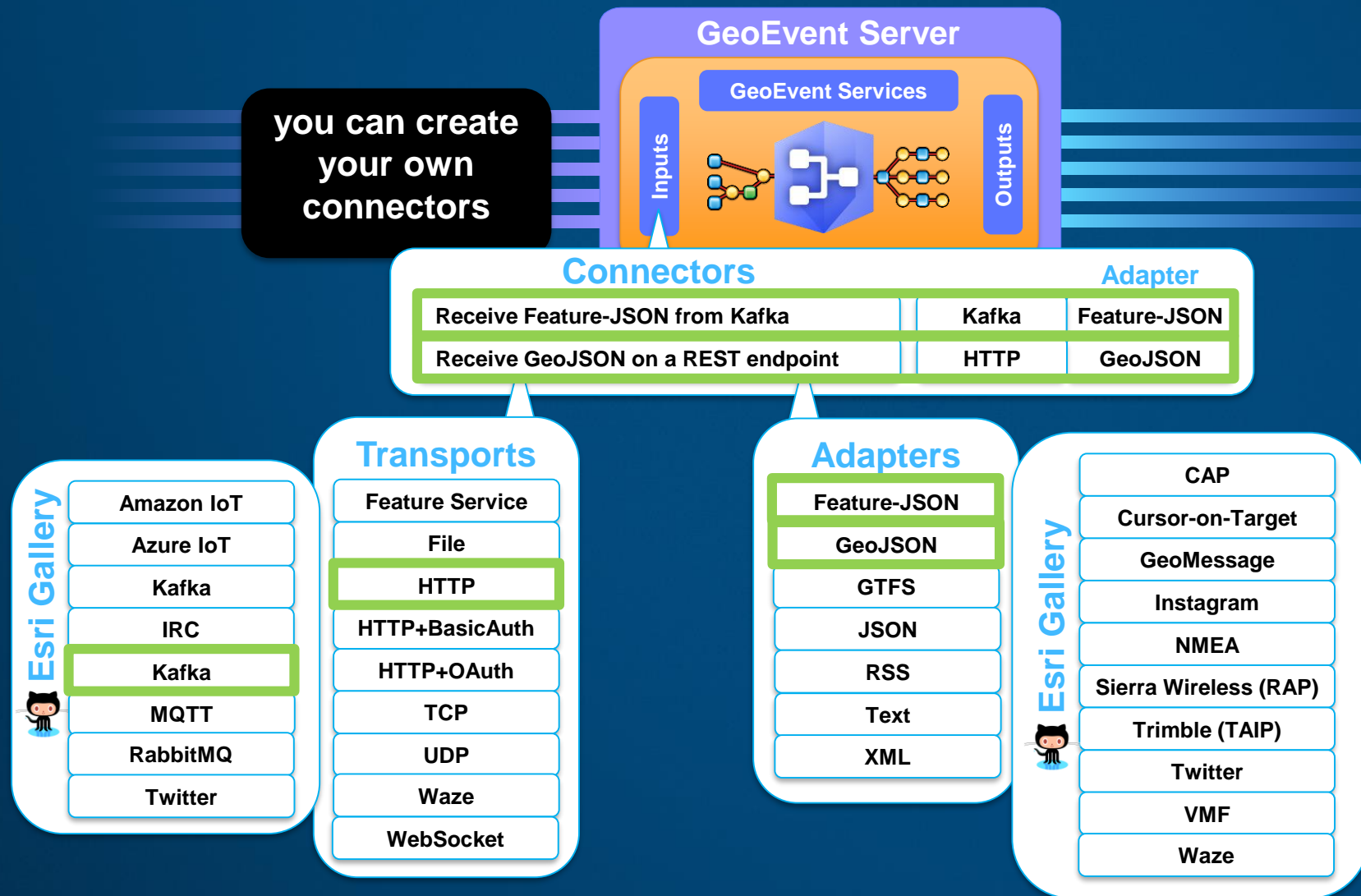
-  ActiveMQ
-  AIS
-  Common Alerting Protocol
-  Cursor-on-Target
-  Exploitation Support Data
-  GTFS
-  Instagram
-  Kafka
-  KML
-  MQTT
-  NMEA 0183
-  RabbitMQ
-  Sierra Wireless (RAP)
-  Trimble (TAIP)
-  Twitter

### Partner Gallery

-  Amazon IoT
-  Azure IoT
-  CompassLDE
-  enviroCar
-  exactEarth AIS
-  FAA (ASDI)
-  GNIP
-  Networkfleet
-  OSIsoft
-  Valarm
-  Waze
-  Zonar

# Ingestion of real-time data

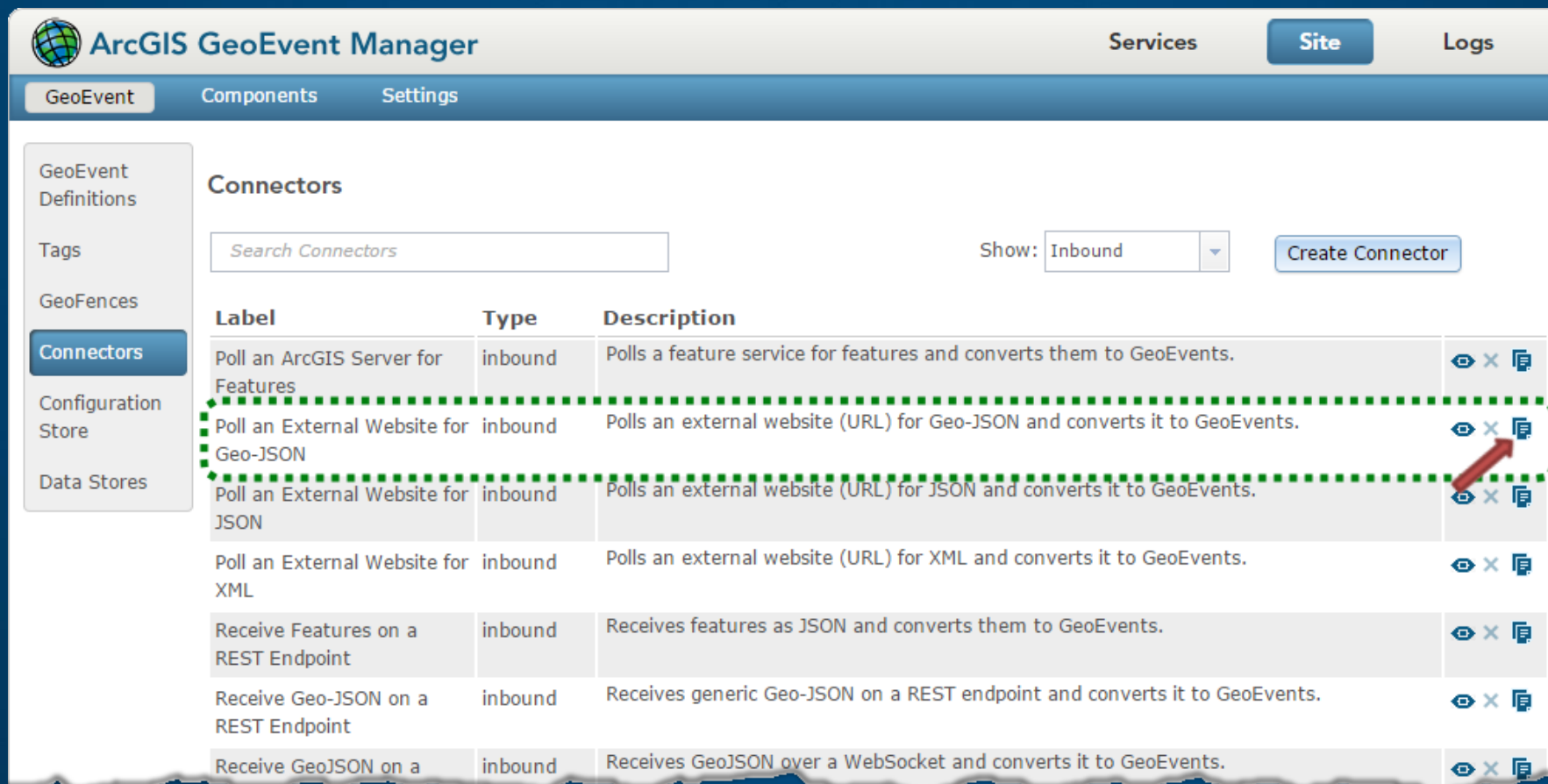
*configure a new input connector by pairing a transport & adapter together*


























# Ingestion of real-time data

*clone an existing connector & tailor it's properties to make a more specific connector*



The screenshot displays the ArcGIS GeoEvent Manager web interface. The top navigation bar includes 'Services', 'Site' (selected), and 'Logs'. Below this, a secondary bar shows 'GeoEvent' (selected), 'Components', and 'Settings'. A left-hand sidebar lists navigation options: 'GeoEvent Definitions', 'Tags', 'GeoFences', 'Connectors' (highlighted), 'Configuration Store', and 'Data Stores'.

The main content area is titled 'Connectors'. It features a search bar labeled 'Search Connectors', a 'Show:' dropdown menu set to 'Inbound', and a 'Create Connector' button. Below these elements is a table listing various connectors. The second row, 'Poll an External Website for Geo-JSON', is enclosed in a green dashed rectangular box. A red arrow points from the right side of this box to the 'Clone' icon (represented by two overlapping document icons) in the action column of that row.

Label	Type	Description	
Poll an ArcGIS Server for Features	inbound	Polls a feature service for features and converts them to GeoEvents.	  
Poll an External Website for Geo-JSON	inbound	Polls an external website (URL) for Geo-JSON and converts it to GeoEvents.	  
Poll an External Website for JSON	inbound	Polls an external website (URL) for JSON and converts it to GeoEvents.	  
Poll an External Website for XML	inbound	Polls an external website (URL) for XML and converts it to GeoEvents.	  
Receive Features on a REST Endpoint	inbound	Receives features as JSON and converts them to GeoEvents.	  
Receive Geo-JSON on a REST Endpoint	inbound	Receives generic Geo-JSON on a REST endpoint and converts it to GeoEvents.	  
Receive GeoJSON on a	inbound	Receives GeoJSON over a WebSocket and converts it to GeoEvents.	  

# Ingestion of real-time data

*clone an existing connector & tailor it's properties to make a more specific connector*

**ArcGIS GeoEvent Manager** Services Site Logs

GeoEvent Components Settings

**Editing Connector - custom-external-geojson-poll-copy** Save Cancel

Name:\* ? custom-external-geojson-poll-copy

Label:\* ? Poll USGS for earthquakes recorded during the past day

Description: ? Polls the USGS geoJSON feed for all earthquakes recorded during the past day.

Type: ? ☒ Input ☐ Output

Adapter: ? GeoJSON

Transport: ? HTTP

Default Input Name:\* ? USGS-Earthquakes-geojson

**Configure Properties** ?

**Shown Properties**

- URL
- GeoEvent Definition Name (Existing)
- HTTP Method

**Update Property Definition** X

Source: HTTP (Transport)

Type: String

Description: Base URL that the REST Transport will connect to

Name: clientURL

Label: URL

Source Default Value: [no default value defined]

Overwrite Default Value: ☒

Default Value: http://earthquake.usgs.gov/earthquakes/feed/v1.0/

Save Cancel

# Ingestion of real-time data

*extend GeoEvent by downloading additional transports & adapters*

ArcGIS GeoEvent Gallery

Overview Content Members

Refine Content

Item Type

- Maps
- Layers
- Scenes
- Apps
- Tools
- Files


> Date Modified

> Date Created


Connector

1 - 16 of 26


Sort by: Views




Connector - GTFS Realtime C...  
by GeoEventTeam  
Last Updated: Jul 3, 2017  
Created: Jul 3, 2017  
★★★★★ (0) 0




Connector - Trimble TAIP C...  
by GeoEventTeam  
Last Updated: May 3, 2016  
Created: Apr 28, 2016  
★★★★★ (0) 18




Connector - Kafka for GeoE...  
by GeoEventTeam  
Last Updated: May 11, 2017  
Created: Jul 31, 2016  
★★★★★ (0) 21




Tutorial - GeoEvent Server R...  
by GeoEventTeam  
Last Updated: Jun 21, 2017  
Created: Mar 16, 2017  
★★★★★ (0) 43




Connector - NMEA Connec...  
by GeoEventTeam  
Last Updated: Apr 28, 2016  
Created: Apr 28, 2016  
★★★★★ (0) 47



Connector - Waze for GeoE...  
by GeoEventTeam  
Last Updated: May 2, 2017  
Created: Oct 11, 2016  
★★★★★ (0) 49



Connector - Sierra Wireless ...  
by GeoEventTeam  
Last Updated: Jan 27, 2017  
Created: Mar 16, 2015  
★★★★★ (1) 127



Connector - RabbitMQ for ...  
by GeoEventTeam  
Last Updated: Apr 27, 2016  
Created: Mar 30, 2015  
★★★★★ (0) 134

## solutions-geoevent-java



The solutions-geoevent-java repository includes custom connectors for use with ArcGIS GeoEvent Extension for Server.

### Features

#### Adapters

- Common Alert Protocol (CAP) Adapter
- CoT Adapter
- Exploitation Support Data (ESD) Adapter
- Geomessage Adapter
- regex Text Adapter

#### Processors

- Add XYZ Processor
- Bearing Processor
- Buffer Processor
- Ellipse Processor
- Event Volume Control Processor
- Event Joiner Processor
- Extract Point from Line
- Extract Point from Polygon

<http://links.esri.com/geoevent-gallery>

<https://github.com/esri/solutions-geoevent-java>



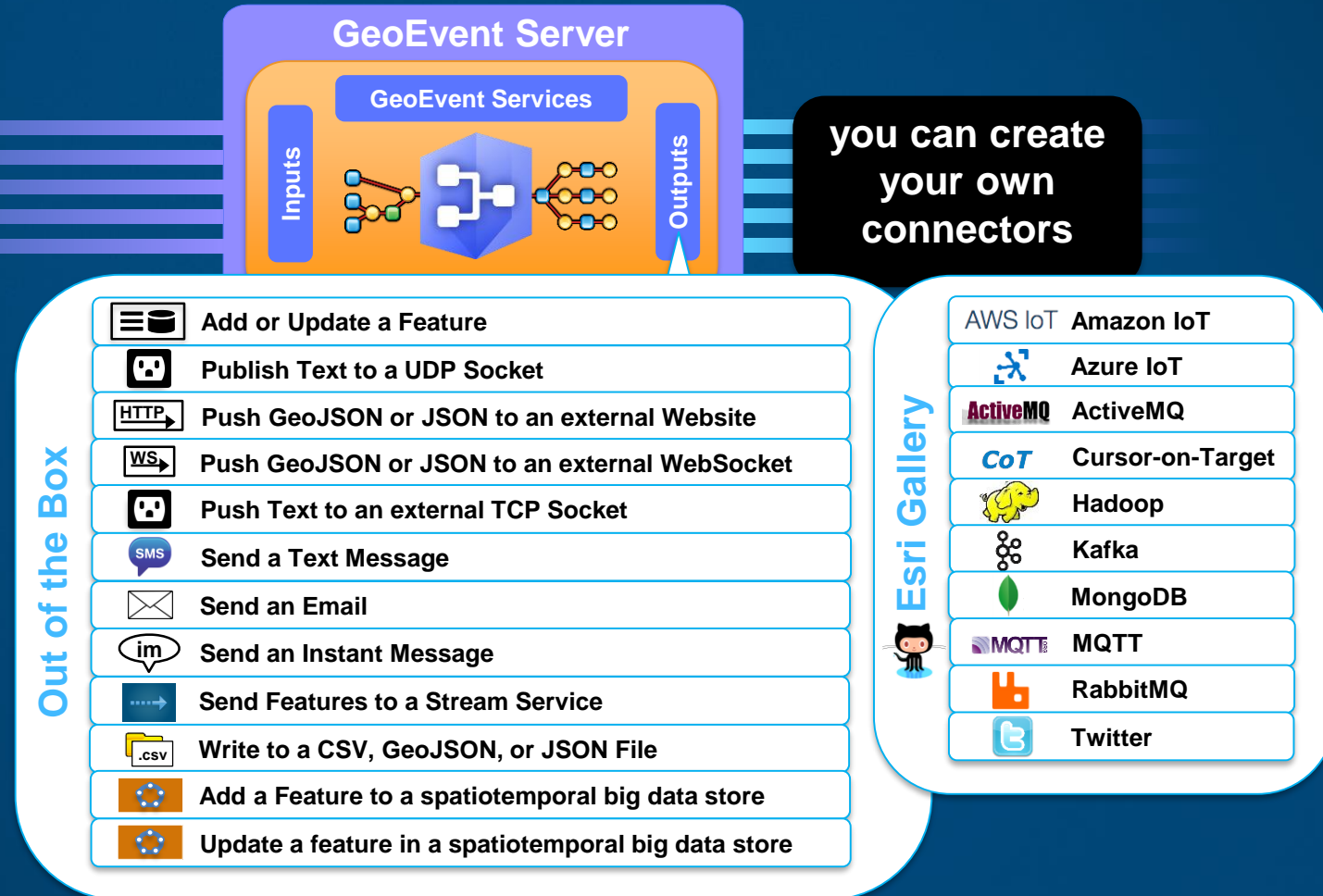
2

## Dissemination & visualization



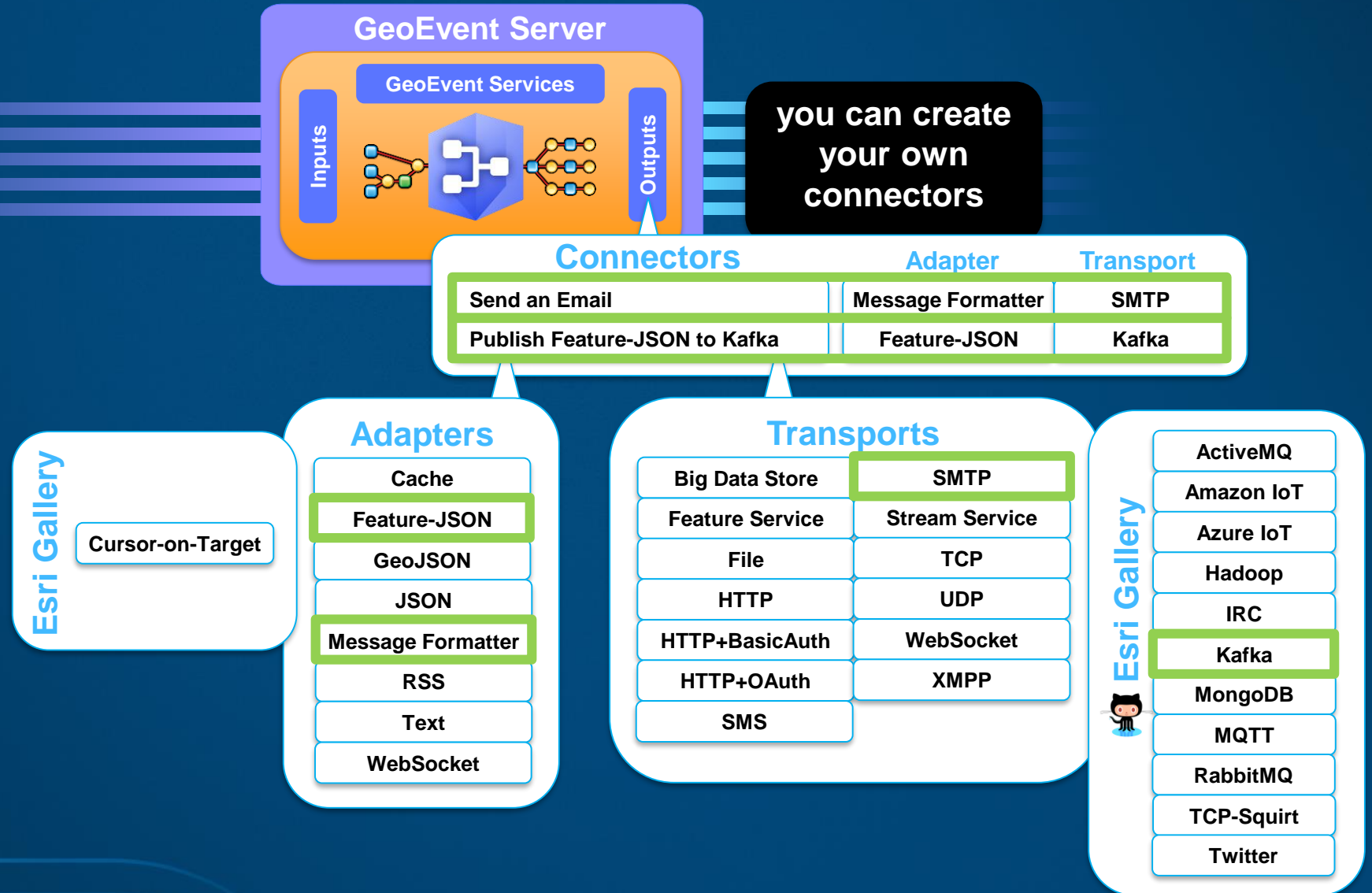
# Dissemination of real-time data

*output connectors*



# Dissemination of real-time data

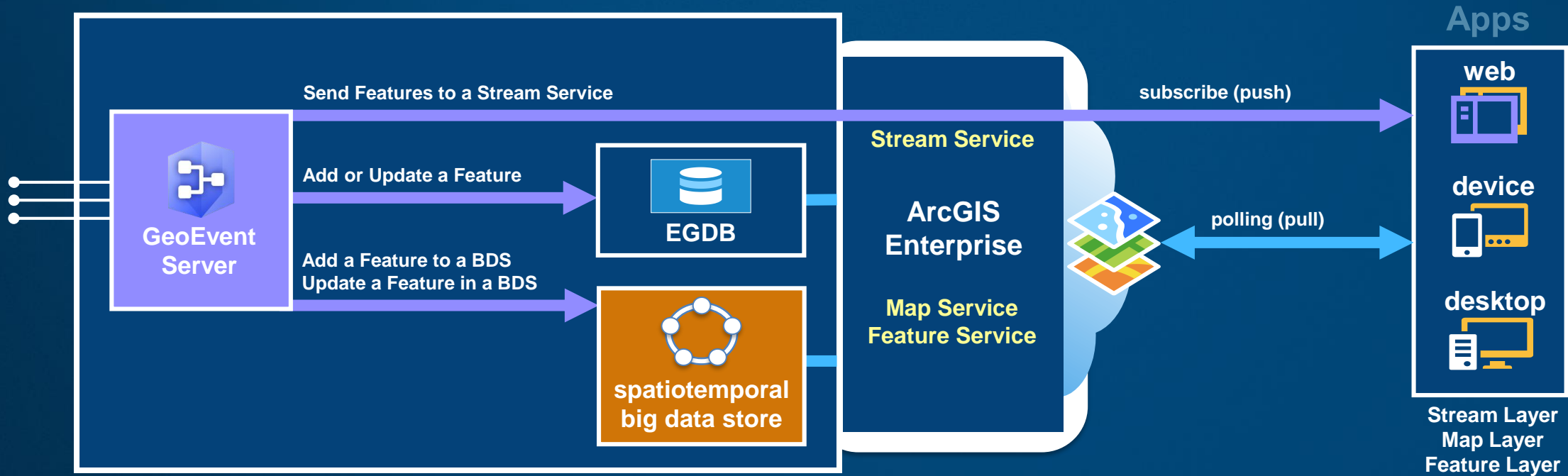
*configure a new output connector by pairing an adapter & transport together*



# Visualization of real-time data

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

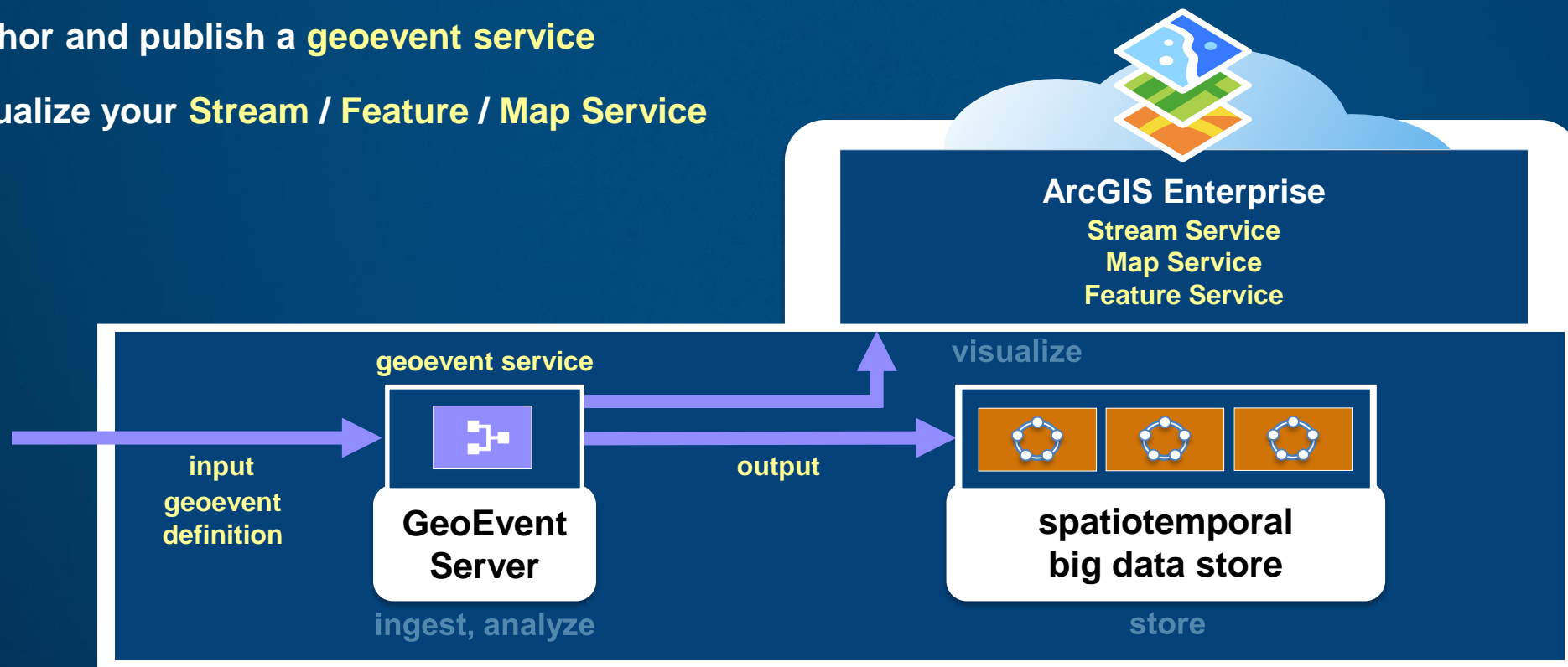
- Stream layers in apps **subscribe** to stream services to immediately visualize observations
  - does not require storage, low latency, no playback
- Map & Features layers in apps periodically **poll** to visualize most current observations
  - backed by an enterprise geodatabase (EGDB) or a spatiotemporal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



# Visualization of real-time data

*workflow for creating a real-time service using stream service, feature service, map service*

- Configure an **input** to receive real-time data & define a **geoevent definition** accordingly
- Create an **output** and publish a **Stream / Feature / Map Service** using the **geoevent definition**
- Author and publish a **geoevent service**
- Visualize your **Stream / Feature / Map Service**





**Demo**



# Performance

# Performance

*throughput: benchmarks*

- **GeoEvent Server throughput benchmarks by release:**
  - ArcGIS 10.2: 600 e/s
  - ArcGIS 10.3: 3,000 e/s
  - ArcGIS 10.4: 4,000 e/s
  - ArcGIS 10.5: 4,000 e/s
- **Benchmark environment consisted of:**
  - A physical machine running ArcGIS Server + GeoEvent Extension
    - Windows 7 (64-bit)
    - 3.70 GHz, 4 physical cores (8 virtual cores)
    - 16 GB RAM
    - 1 Gbps network

# Performance

*throughput: performance test harness for geoevent*

## Test Harness Orchestrator:

Runs a series of fixtures that specify:

- the GeoEvent host(s), input & output
- timed tests with a rate and stagger distribution
  - e.g. 100 e/s for 60 seconds with 10 staggers
- and where to record the resulting reports

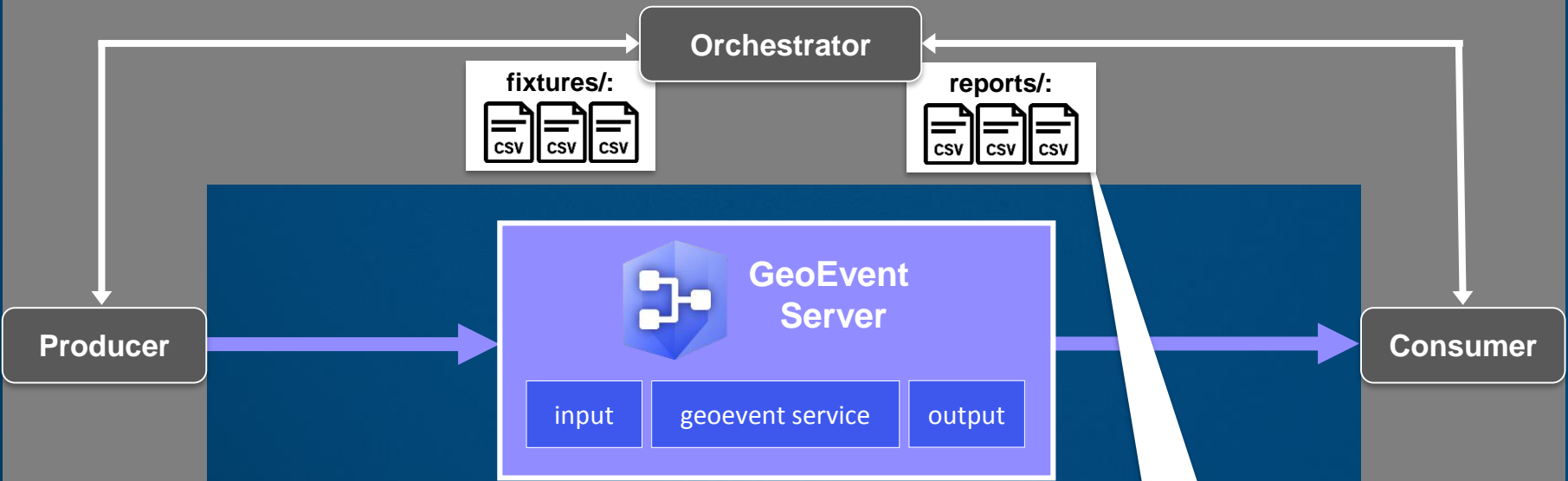
<https://github.com/Esri/performance-test-harness-for-geoevent>



Esri / [performance-test-harness-for-geoevent](https://github.com/Esri/performance-test-harness-for-geoevent)

## Benchmark Metrics

production time	= 3 - 1
consumption time	= 4 - 2
total time	= 4 - 1
latency of first receipt	= 2 - 1
latency of last receipt	= 4 - 3



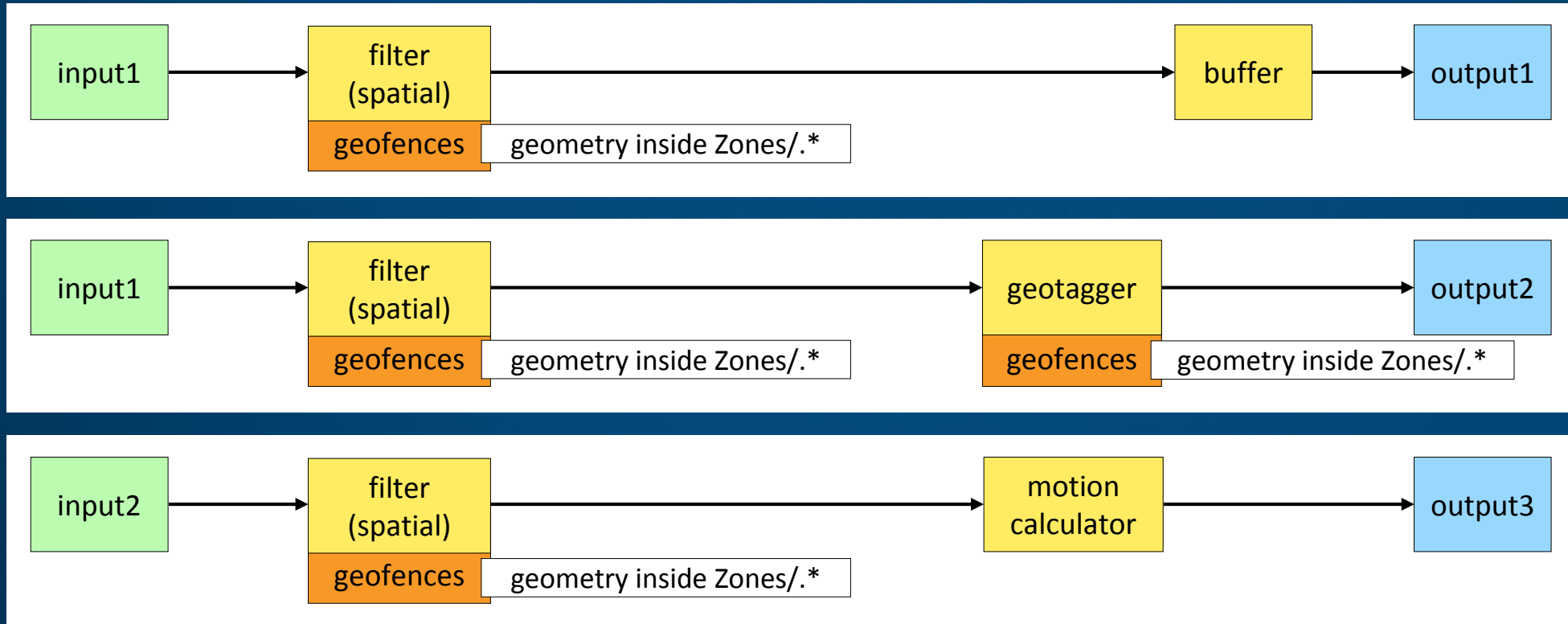
Test Name	Rate	totalEvents	successes	expectedResultCount	failures	avgTotalTime	avgEventsPerSec	%
1000 e/s	1000	30000	30000	30000	0	30278	990.818416	0.990818416
2000 e/s	2000	60000	59996	60000	0	30189	1987.346384	0.993673192
3000 e/s	3000	90000	89999	90000	0	30194	2980.691528	0.993563843
Total Testing Time:		01:55.666						



# Performance

*analytics: geoevent services*

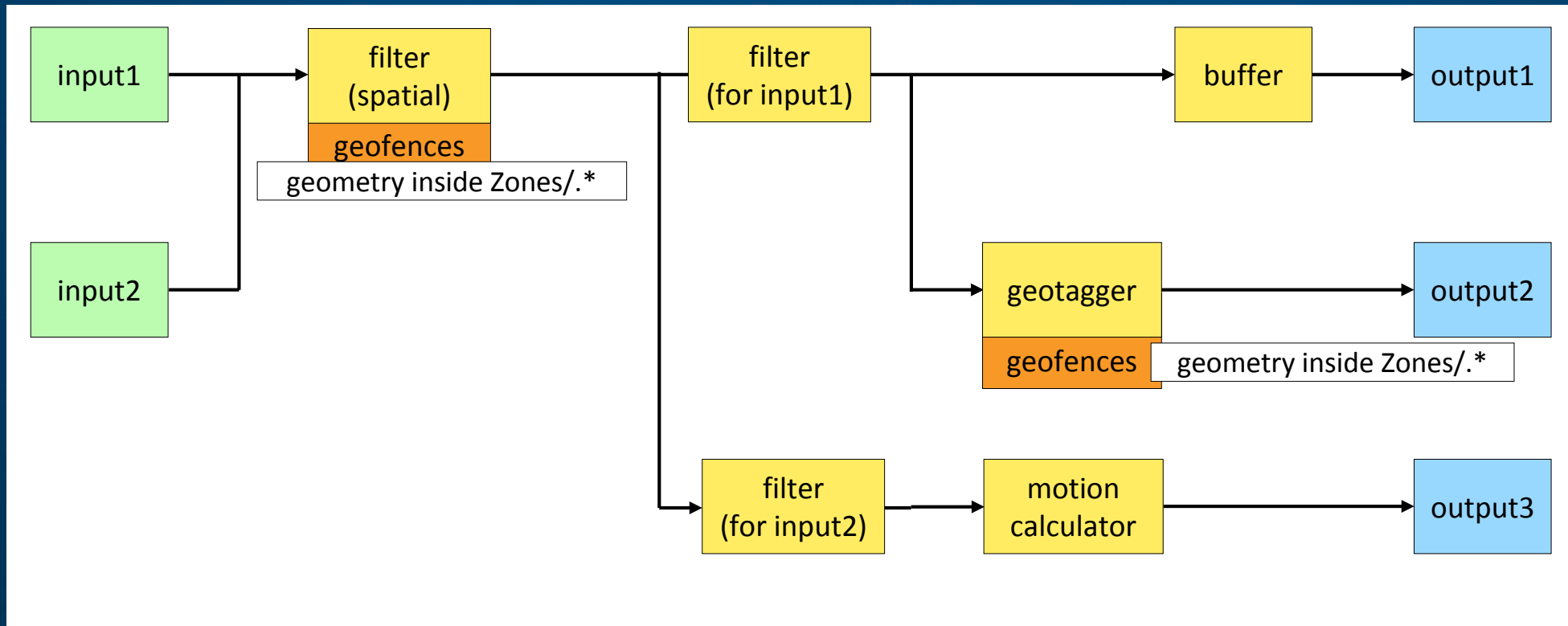
- Which is better?
  - have fewer but more complex GeoEvent Services
  - or have more but simpler GeoEvent Services



# Performance

*analytics: geoevent services*

- In general, it is better to have fewer and more complex GeoEvent Services
  - especially when working with Geofences
  - or Processors that change the schema of an event: e.g. Field Enricher, Geotagger, Motion Calculator, ...



# Performance

*throughput & analytics: primary factors to consider*

- **Operating environment:**
  - **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.

***Bare Metal = Windows 7 (64 bit) Enterprise***
- **Network**
  - **Speed (Gbps)** – the faster the better.

***1 Gbps***
- **RAM**
  - **size (GB)** – 8GB has been required since 10.3.
  - **type** – minimum of DDR3 is recommended.
  - **clock speed (MHz) and transfer rate (Mbps)** – the faster the better.

***16GB, default JVM max heap size is 4 GB***  
***DDR3***
- **Processors**
  - **speed (GHz)** – the faster the better.
  - **# of cores** – the more the better.

***3.70GHz, Intel Xeon E5-1620 v2***  
***4 physical (8 Virtual)***



4

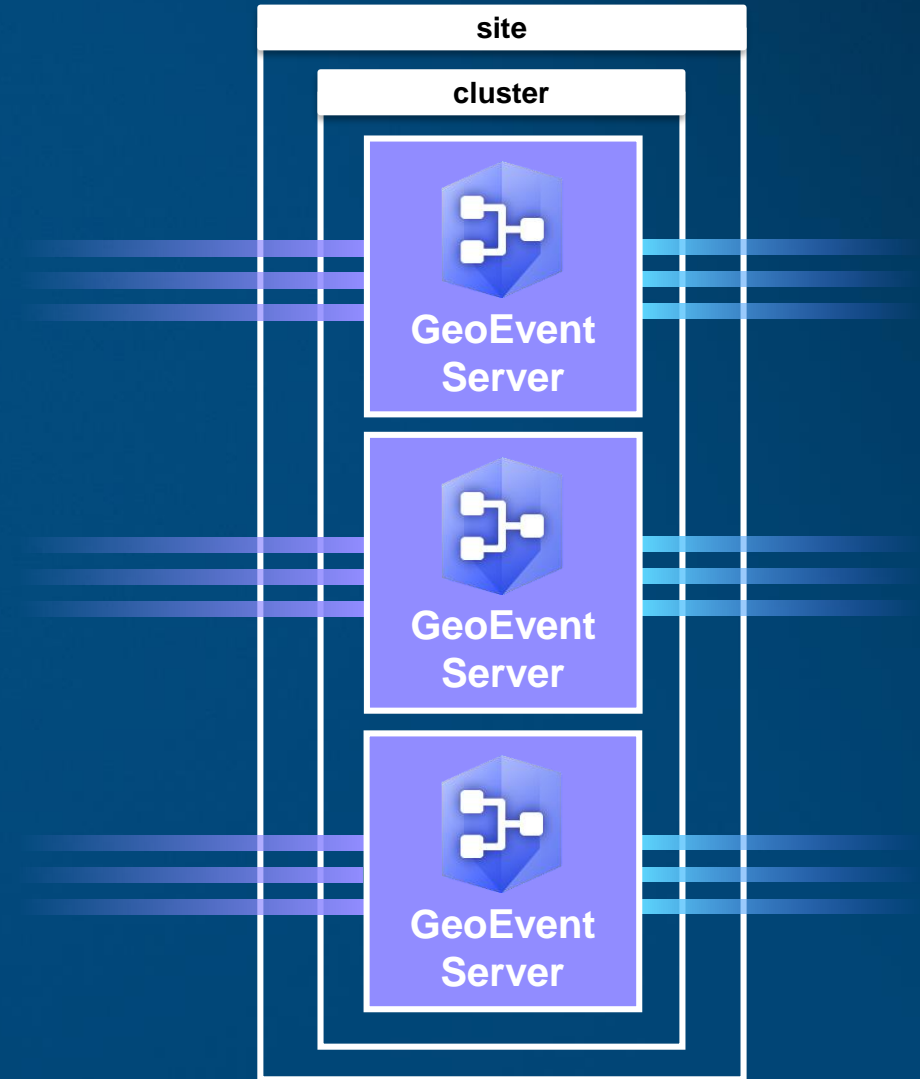
## Resilience & scalability



# GeoEvent Server resilience & scalability

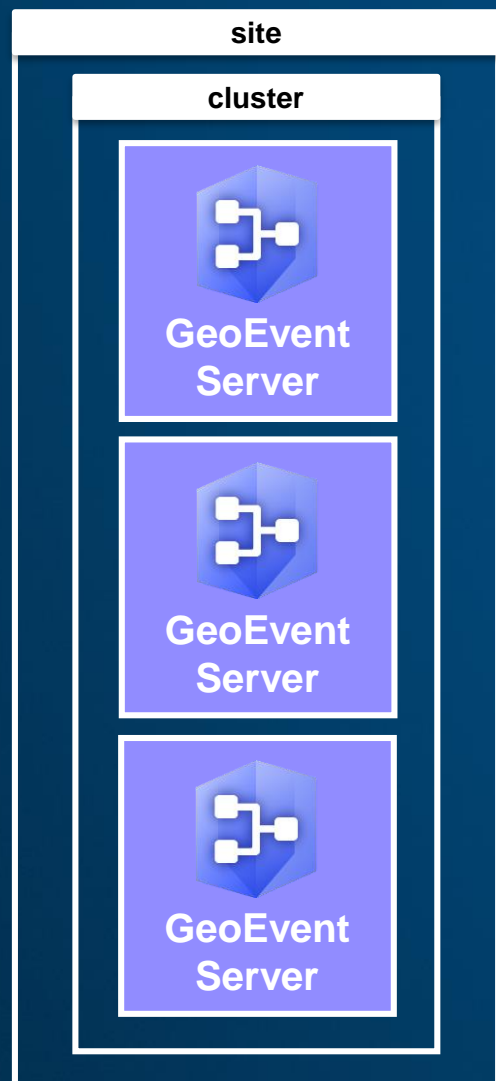
*clustering is DISCOURAGED*

- **Clustering was introduced at ArcGIS 10.3.**
- **However, observed to be brittle & subject to failure:**
  - **Required at least a 3-node cluster:**
    - When a node goes down, it had to be brought back up ASAP
    - as a 2-node cluster can cause a split-brain condition in cluster.
  - **Must be physical hardware:**
    - Many customers only have virtual environments.
  - **Network must remain stable:**
    - Network instabilities can result in intermittent cluster membership.
- **Given this, GeoEvent Server clustering:**
  - is strongly discouraged at ArcGIS 10.3, 10.4 & 10.5
  - and should be avoided.
- **Instead, if resiliency or additional scalability is required:**
  - isolated deployments should be employed.

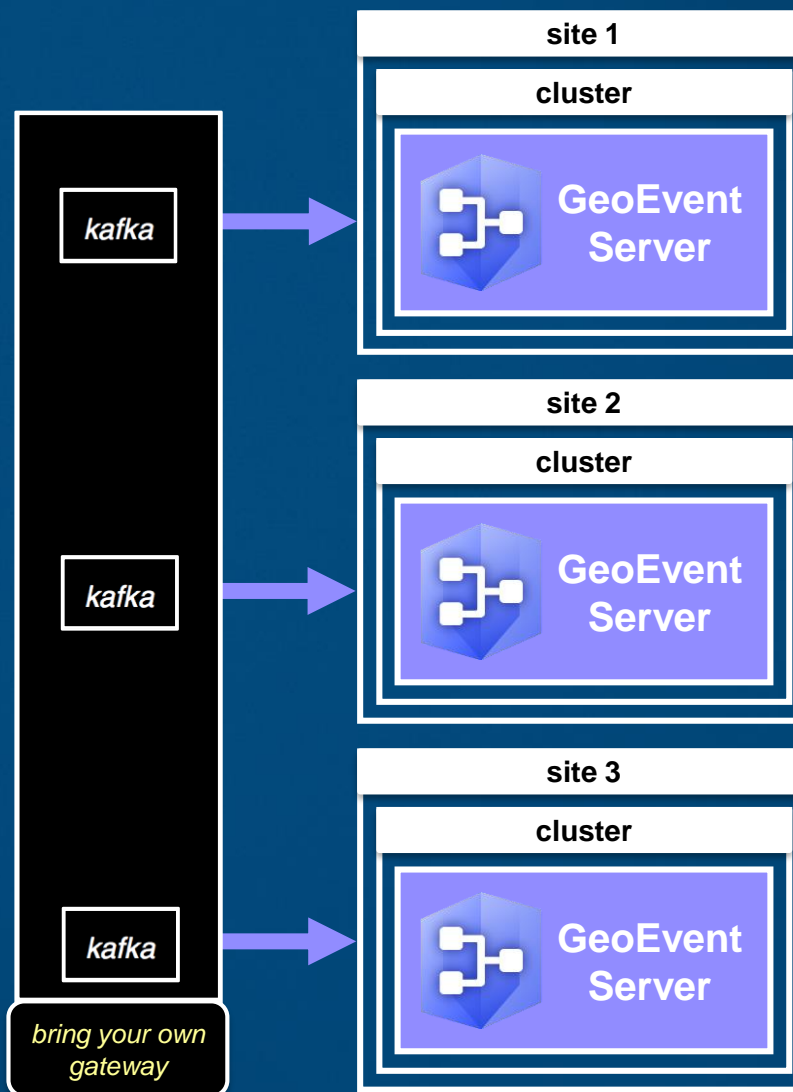


# GeoEvent Server resilience & scalability

*Clustered*



*Isolated*

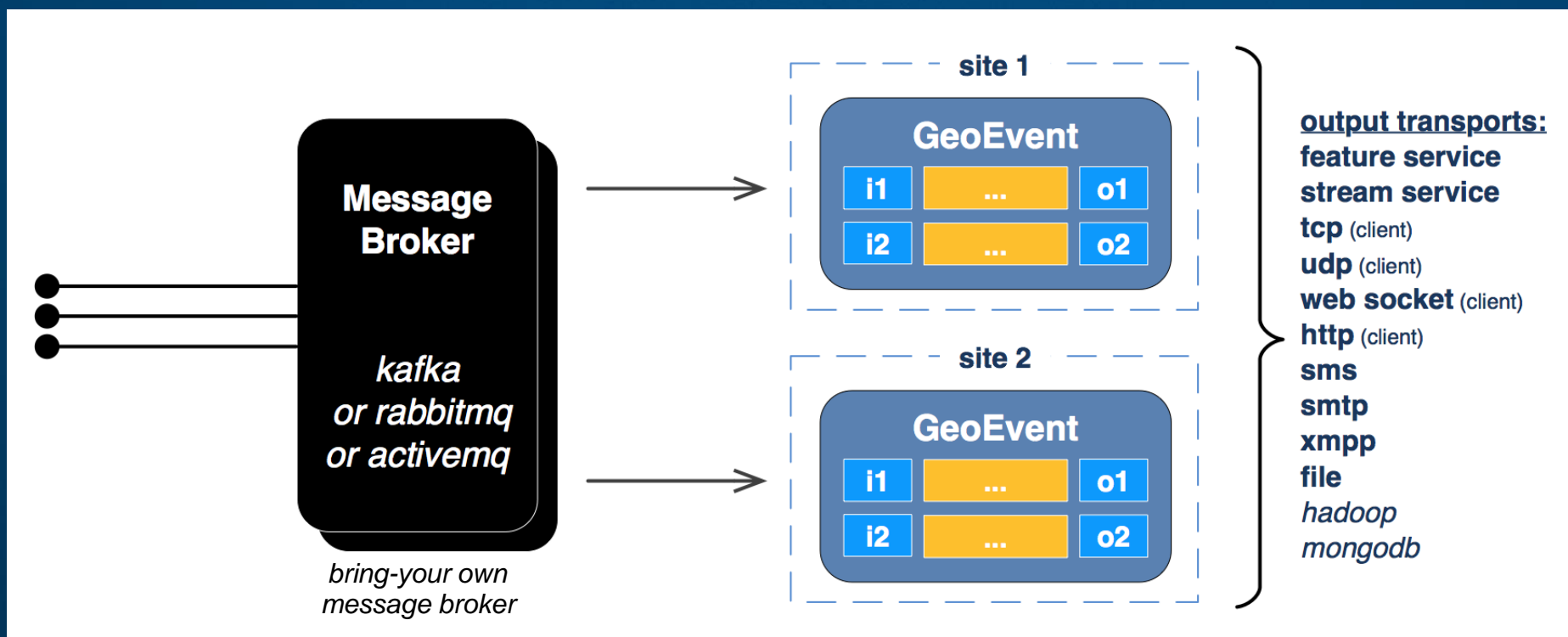


10.3,  
10.4  
&  
10.5

# GeoEvent Server resilience & scalability

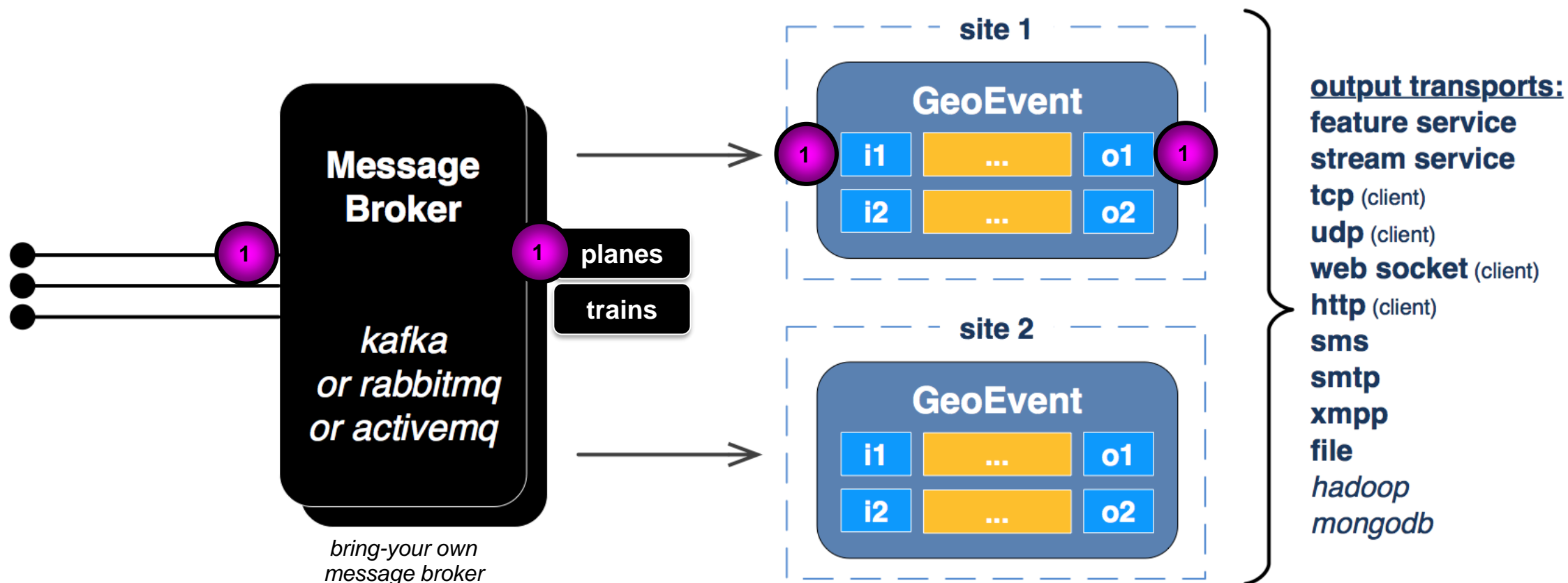
*isolated deployment*

- Each GeoEvent instance exists in it's own site and shares a common configuration manually.
- A message broker must be stood up in front to provide a common event source.
- GeoEvent instances share a common message broker and run active/active competing to consume events.



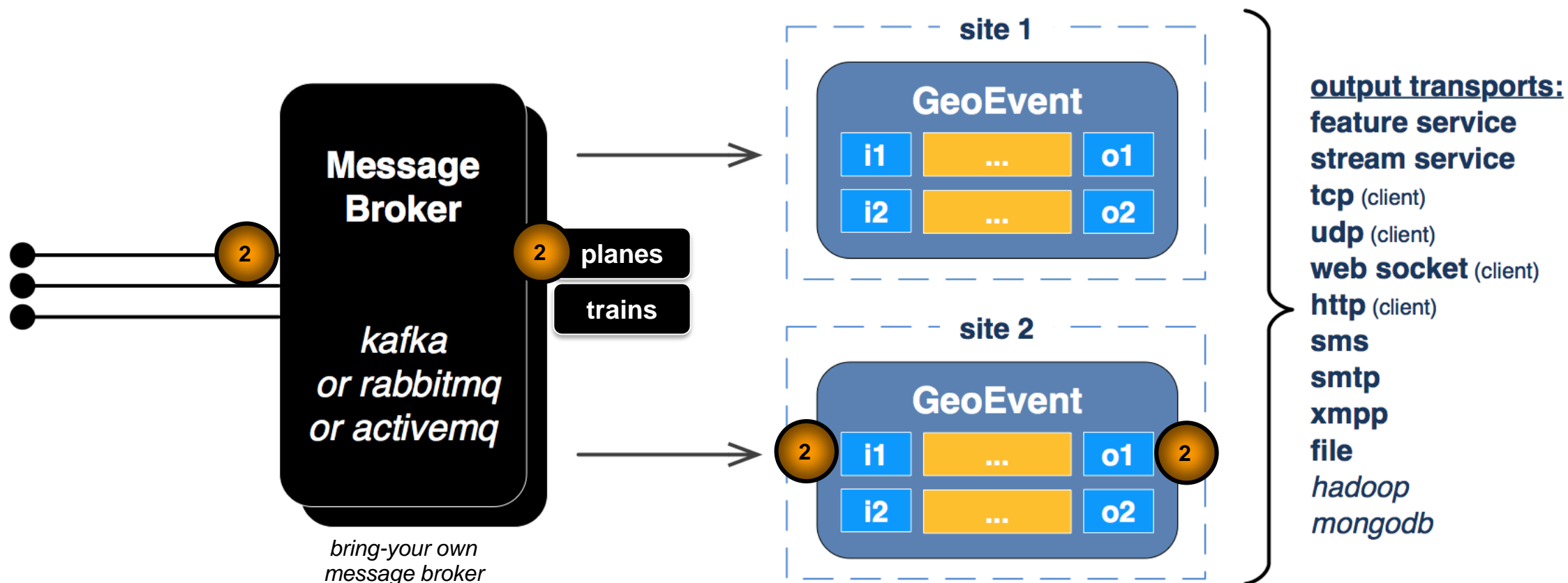
# GeoEvent Server resilience & scalability

*isolated deployment*



# GeoEvent Server resilience & scalability

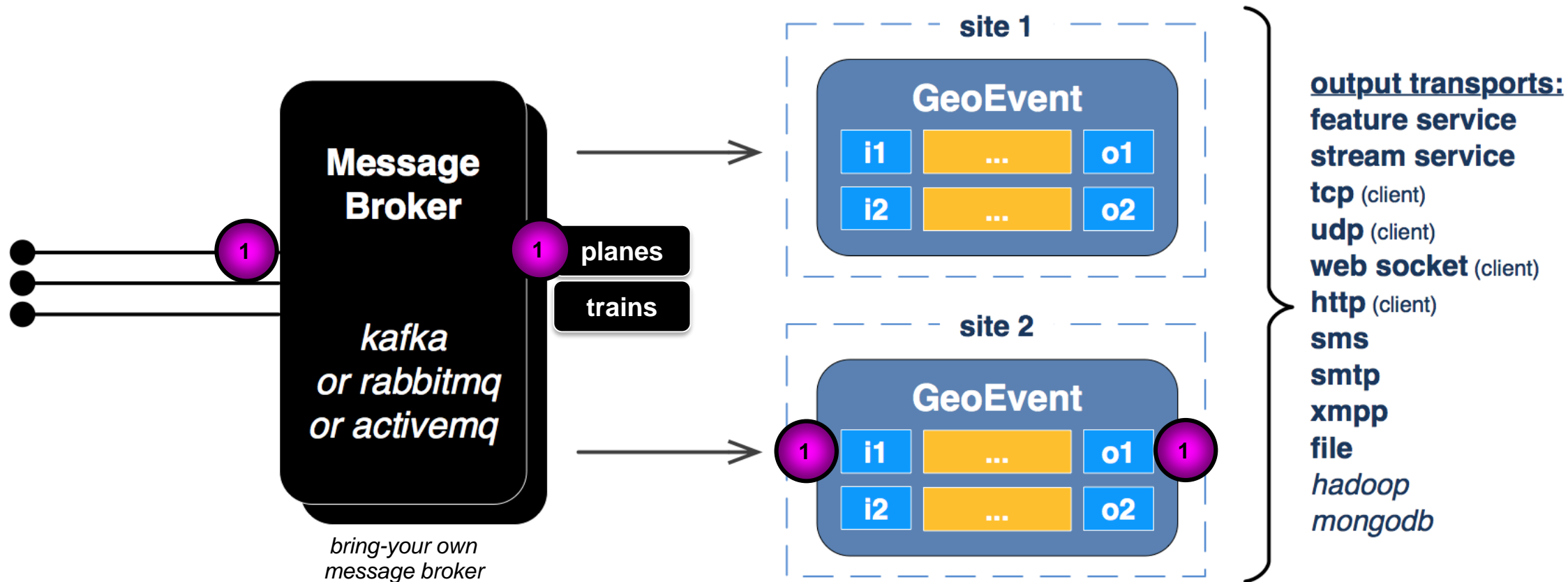
*isolated deployment*





# GeoEvent Server resilience & scalability

*isolated deployment*

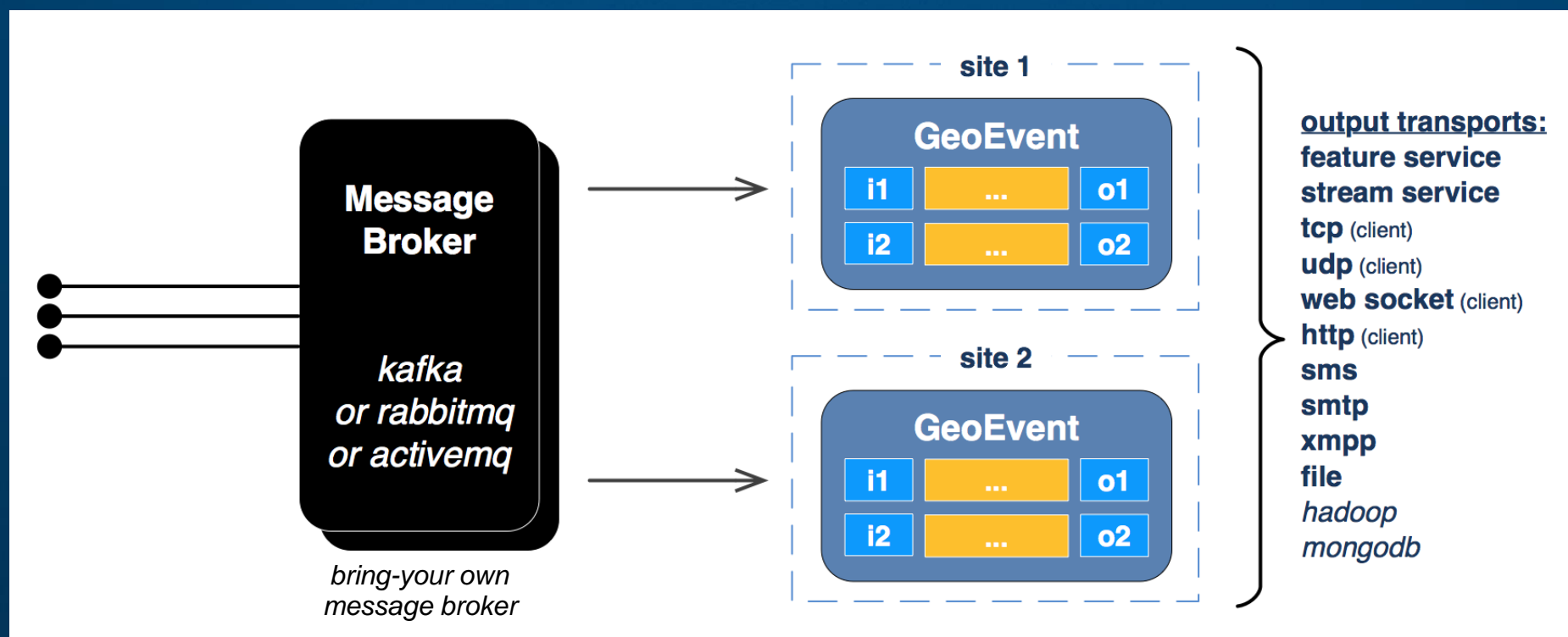


# GeoEvent Server resilience & scalability

*isolated deployment*

- **Known constraints:**

- project team/IT staff needed to setup/configure message broker and get all sensor events into it
- input to GeoEvent is the message broker only, lose flexibility of all the input connectors available
- does not support failover of state: enter, exit, track gap detection, idle detector

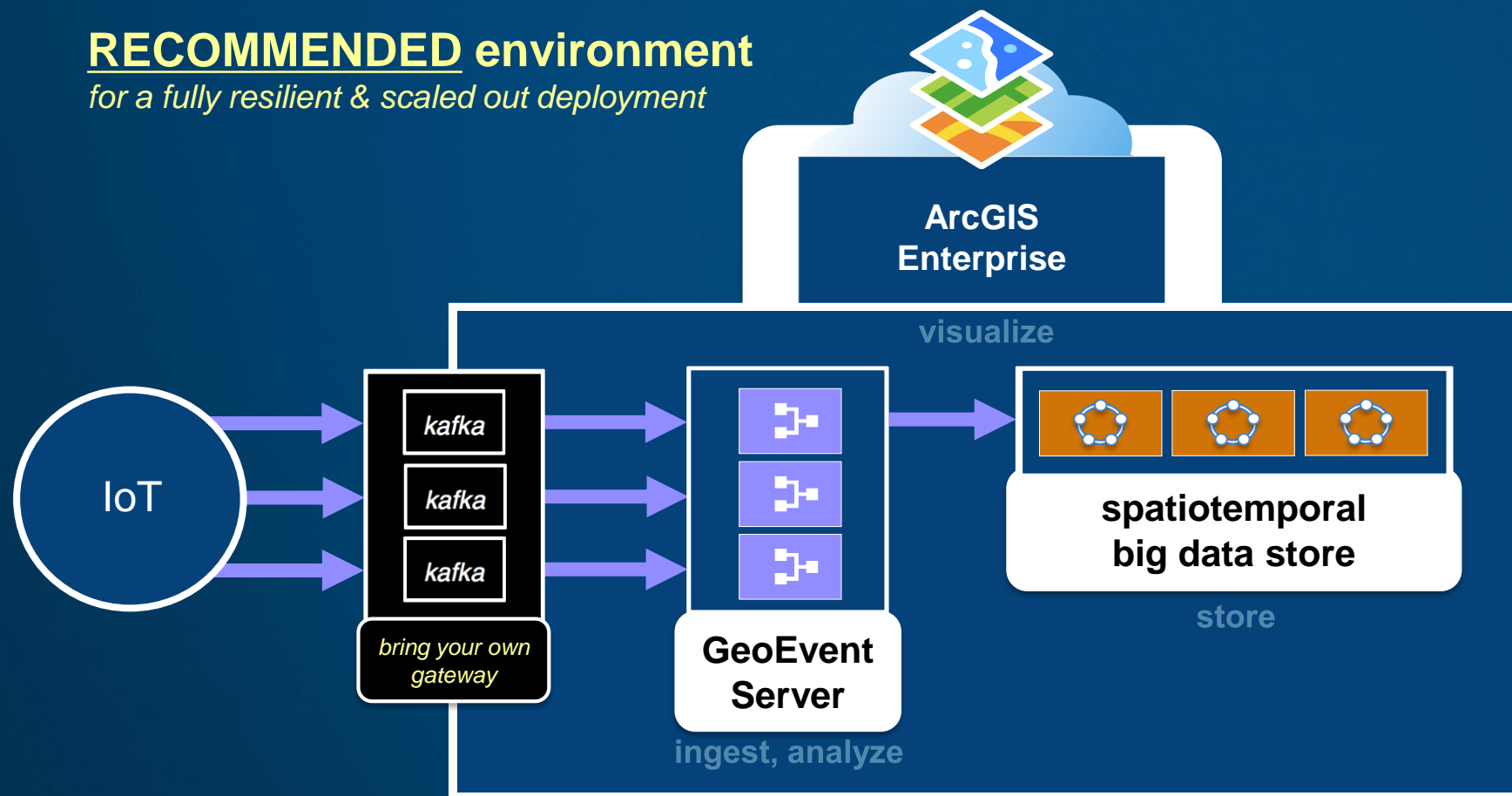


# ArcGIS Enterprise

*with real-time capabilities*

10.5

**RECOMMENDED** environment  
*for a fully resilient & scaled out deployment*

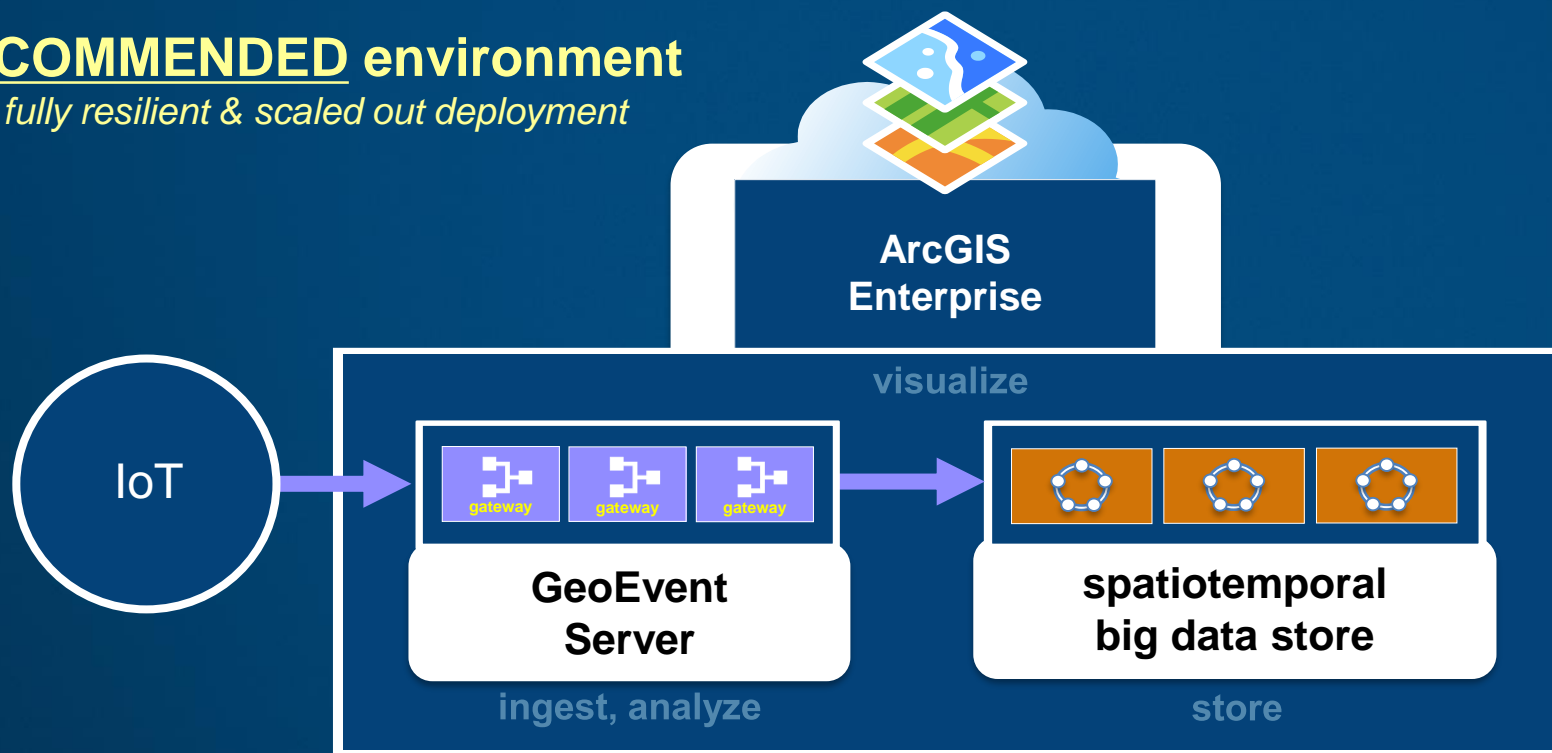


# ArcGIS Enterprise

*with real-time capabilities*

10.6

**RECOMMENDED** environment  
*for a fully resilient & scaled out deployment*



**Clustering is supported again!**



# Storage



# Spatiotemporal 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*

# spatiotemporal big data store

## *operating system requirements*

resource	minimum	<u>RECOMMENDED</u>	notes
64-bit operating system (Windows)	Windows Server: 2012 R2 Standard & Datacenter (Sep 2016) 2012 Standard & Datacenter (Sep 2016) 2008 R2 Standard, Enterprise & Datacenter (sp1) 2008 Standard, Enterprise & Datacenter (sp2)	Windows Server: 2012 R2 Standard & Datacenter (Sep 2016)	'_' characters are not allowed in machine names
64-bit operating system (Linux)	Red Hat Enterprise Linux Server 7 (update 8) Red Hat Enterprise Linux Server 6 (update 2) CentOS Linux 7 (7.2) CentOS Linux 6 (6.8) Scientific Linux 7 (7.2) Scientific Linux 6 (6.8) Ubuntu Server LTS (16.04.1) SUSE Linux Enterprise Server 12 (sp1) SUSE Linux Enterprise Server 11 (sp4) Oracle Linux 7 (update 2) Oracle Linux 6 (update 8)	Use your Linux flavor of choice with the latest update version Esri has certified.	

<http://server.arcgis.com/en/data-store/latest/install/windows/arcgis-data-store-system-requirements.htm>

<http://server.arcgis.com/en/data-store/latest/install/linux/arcgis-data-store-system-requirements.htm>

# spatiotemporal big data store

*resource requirements: processors*

resource	minimum	<u>RECOMMENDED</u>	notes
processors	8 cores	16 cores	More processors results in faster writes (indexing time), higher write throughput & faster query response time.

<http://server.arcgis.com/en/data-store/latest/install/windows/arcgis-data-store-system-requirements.htm>

<http://server.arcgis.com/en/data-store/latest/install/linux/arcgis-data-store-system-requirements.htm>

# spatiotemporal big data store

*resource requirements: processors, memory*

resource	minimum	<u>RECOMMENDED</u>	notes
processors	8 cores	16 cores	More processors results in faster writes (indexing time), higher write throughput & faster query response time.
storage	400 GB	1 TB or more	Storage need is dictated by data velocity & size. SSD results in much faster writes & queries.

<http://server.arcgis.com/en/data-store/latest/install/windows/arcgis-data-store-system-requirements.htm>

<http://server.arcgis.com/en/data-store/latest/install/linux/arcgis-data-store-system-requirements.htm>

# spatiotemporal big data store

*resource requirements: processors, memory, storage*

resource	minimum	<u>RECOMMENDED</u>	notes
processors	8 cores	16 cores	More processors results in faster writes (indexing time), higher write throughput & faster query response time.
storage	400 GB	1 TB or more	Storage need is dictated by data velocity & size. SSD results in much faster writes & queries.
memory	16 GB	32 GB	More memory results in higher likelihood of query cache hits. 32 GB is the maximum due to JVM limitations.

<http://server.arcgis.com/en/data-store/latest/install/windows/arcgis-data-store-system-requirements.htm>

<http://server.arcgis.com/en/data-store/latest/install/linux/arcgis-data-store-system-requirements.htm>



# spatiotemporal big data store

*resource requirements: processors, memory, storage & instances*

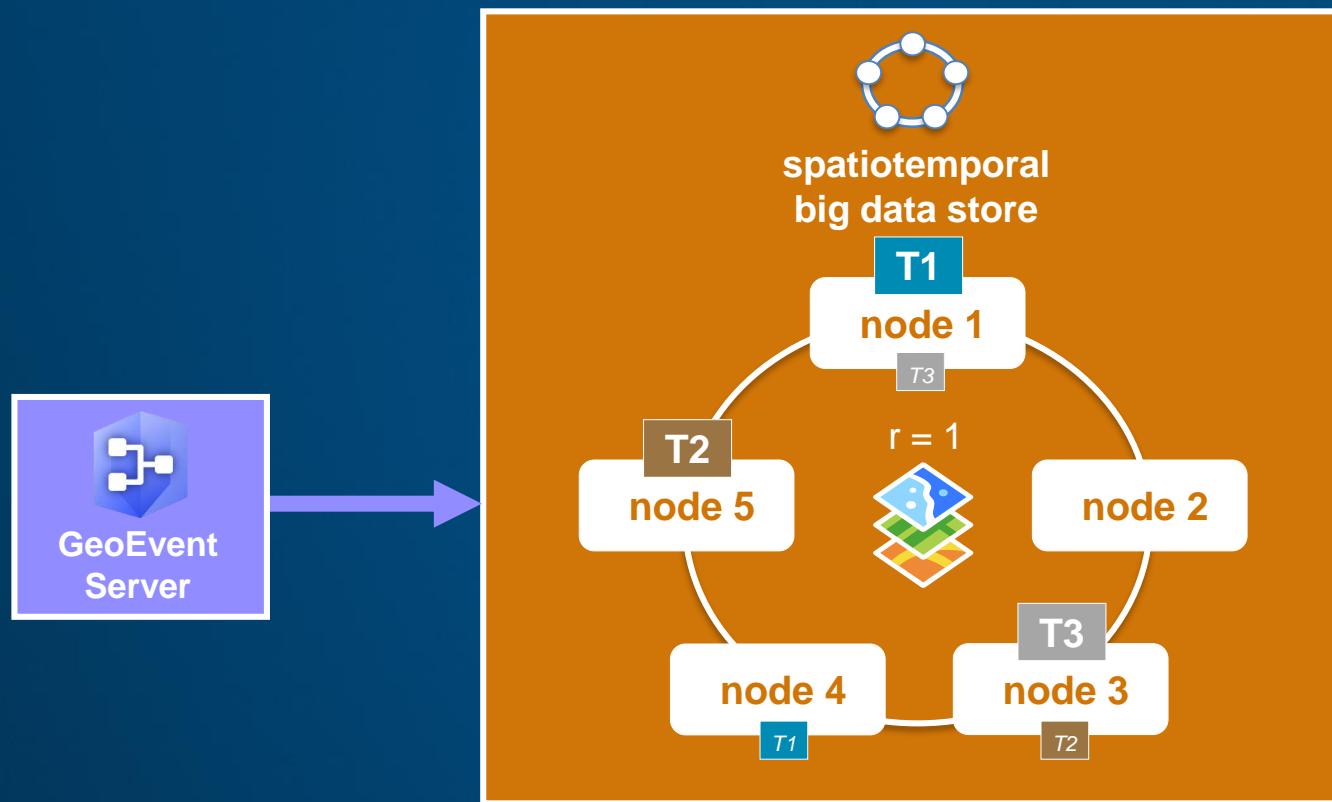
resource	minimum	<u>RECOMMENDED</u>	notes
processors	8 cores	16 cores	More processors results in faster writes (indexing time), higher write throughput & faster query response time.
storage	400 GB	1 TB or more	Storage need is dictated by data velocity & size. SSD results in much faster writes & queries.
memory	16 GB	32 GB	More memory results in higher likelihood of query cache hits. 32 GB is the maximum due to JVM limitations
# of <b><u>ISOLATED</u></b> instances	1	3 or more	With one instance there is risk of data loss. With three instances replicas are written increasing data reliability. The # of instances will vary based on the velocity of incoming data as well as the data retention policy configured on each data source.

<http://server.arcgis.com/en/data-store/latest/install/windows/arcgis-data-store-system-requirements.htm>

<http://server.arcgis.com/en/data-store/latest/install/linux/arcgis-data-store-system-requirements.htm>

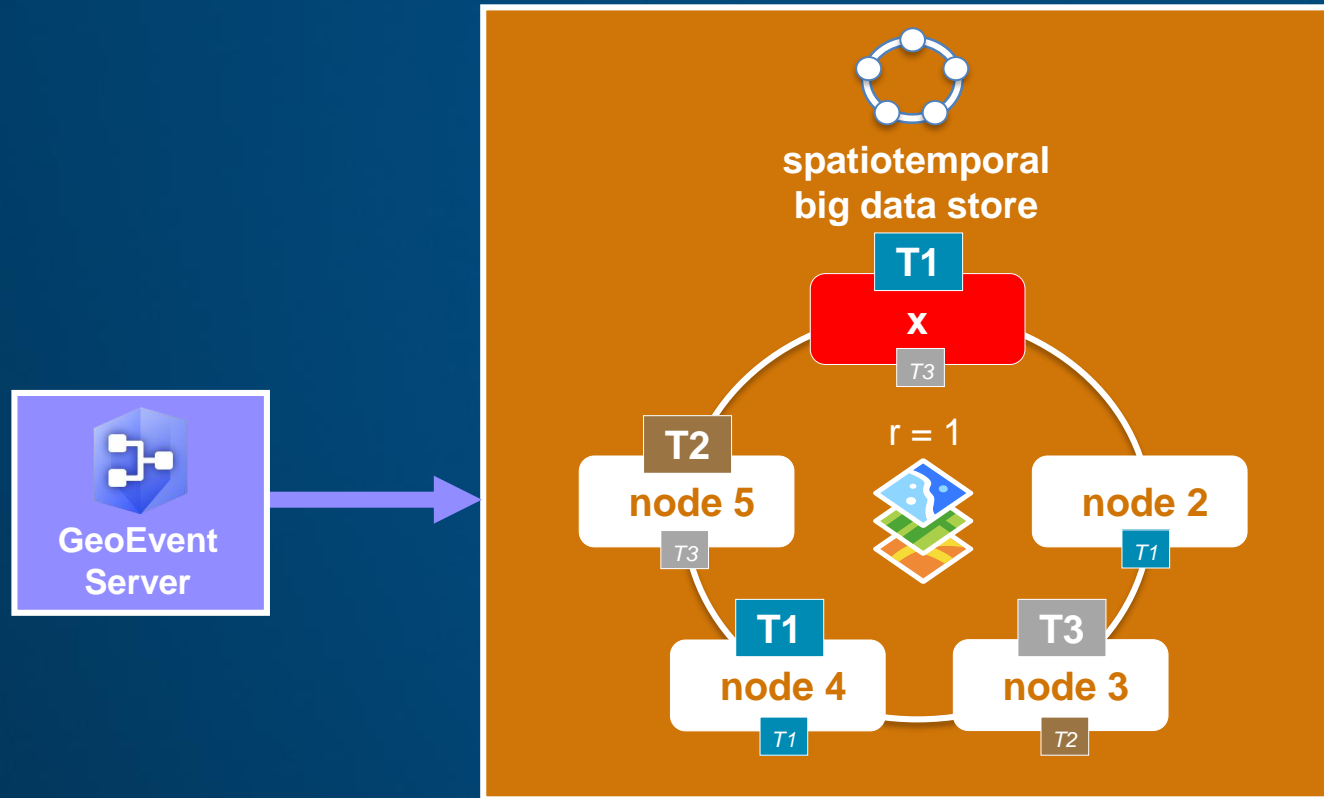
# spatiotemporal big data store

*shards & replication factor*



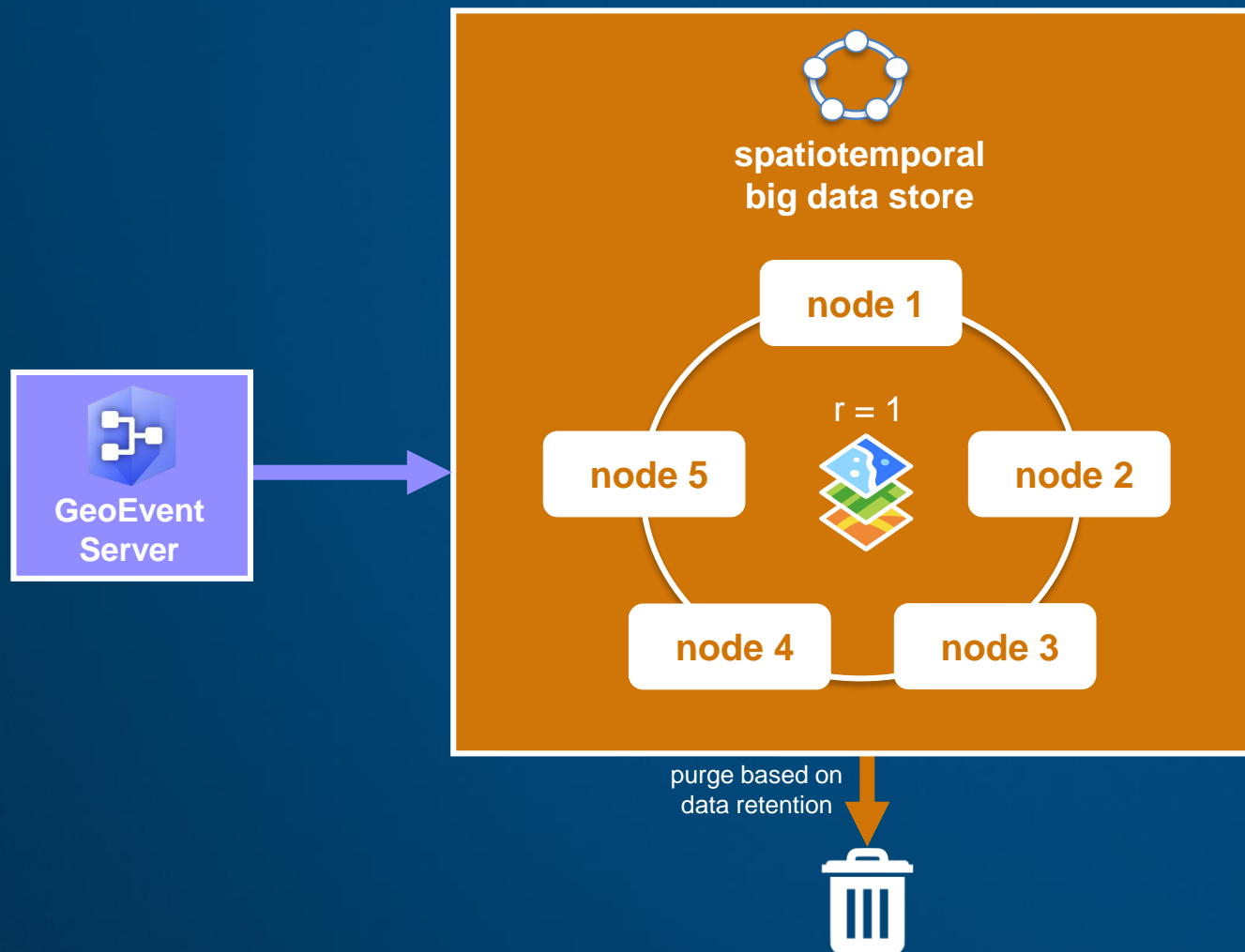
# spatiotemporal big data store

*auto-rebalancing of data upon node membership changes, + or -, in the big data store*



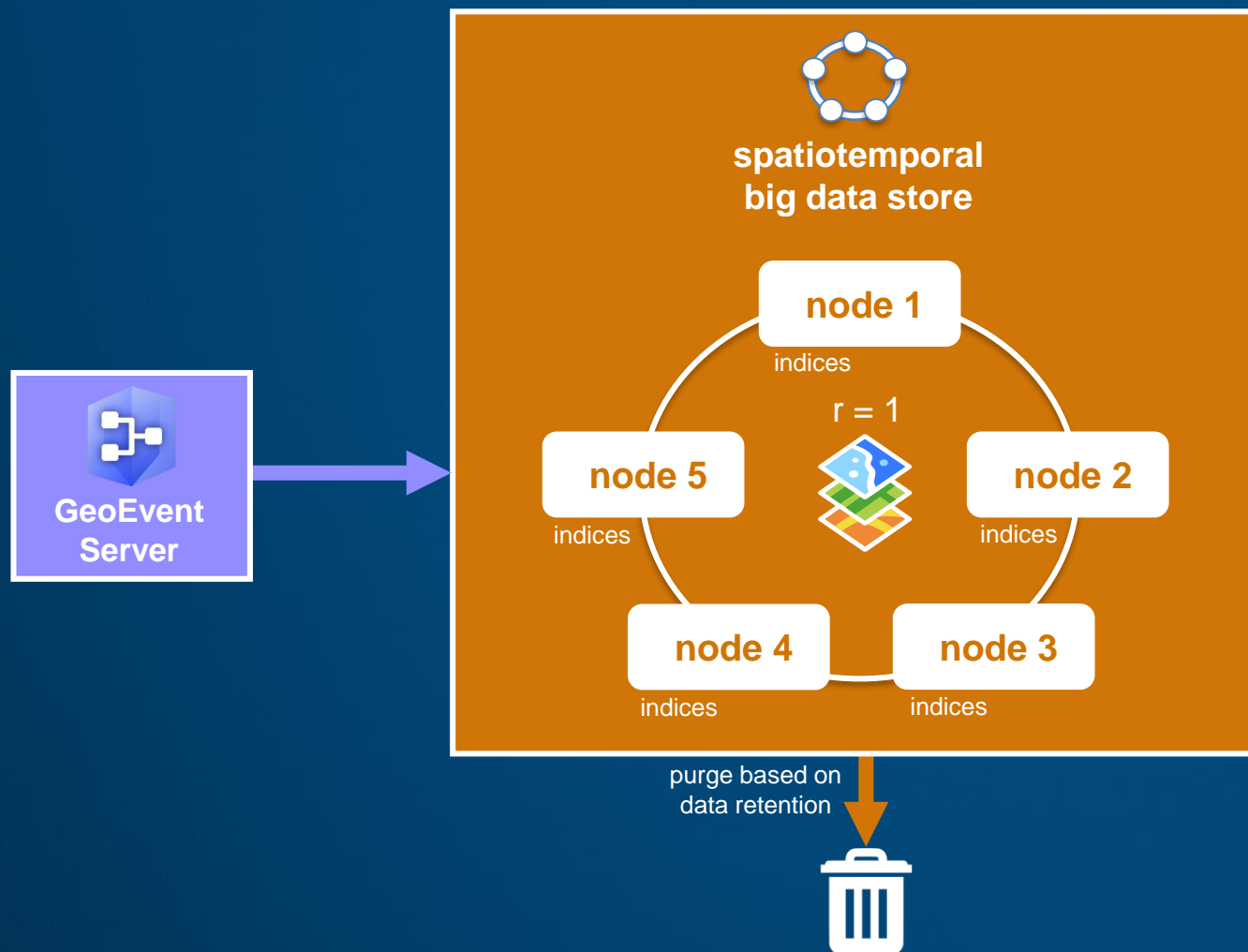
# spatiotemporal big data store

*data retention policies, configured per data source*



# spatiotemporal big data store

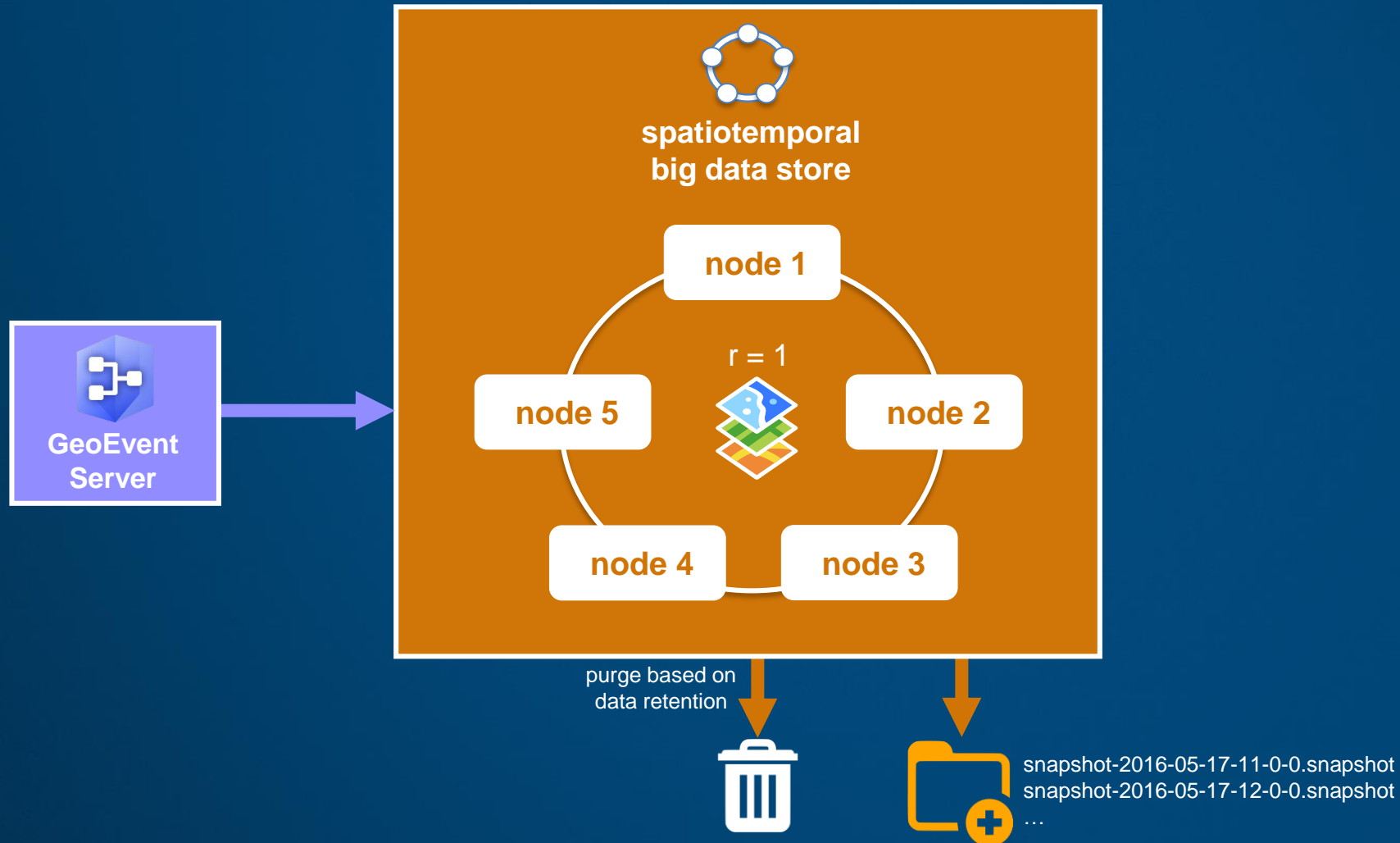
*rolling index option, set appropriately to the velocity of your observation data*





# spatiotemporal big data store

*automatic data backups using periodic snapshots, including ability to restore from a snapshot*



# spatiotemporal big data store

*choosing an Object Id option*

Create Data Source

Name:

?

faa

GeoEvent Definition:

?

faa

▼

Folder:

?

Root

▼

Geometry Type:

?

Point

▼

Replication Factor:

?

1

Number of Shards:

?

☒ Auto

Refresh Interval (seconds):

?

1

Object Id Option:

?

ArcGIS 10.4 and later (Int64)

▼

Object Id Block Size:

?

**ArcGIS 10.4 and later (Int64)**

ArcGIS prior to 10.4 (Int32)

Custom client applications (String)



**Demo**

# spatiotemporal big data store

*choosing an Object Id option*

	Max Value	# of IDs	ArcGIS Clients
Int32	2,147,483,647	2.1 billion	Pro, Desktop, Ops Dashboard, ...

	events per day	Int32
1,000 e/s	86,400,000	25 days
10,000 e/s	864,000,000	2.5 days
100,000 e/s	8,640,000,000	6 hours
1,000,000 e/s	86,400,000,000	36 minutes
10,000,000 e/s	864,000,000,000	4 minutes



# spatiotemporal big data store

*choosing an Object Id option*

	Max Value	# of IDs	ArcGIS Clients
Int32	2,147,483,647	2.1 billion	Pro, Desktop, Ops Dashboard, ...
Int64 (signed)	9,223,372,036,854,775,807	9.2 quintillion	JavaScript, custom apps

	events per day	Int32
1,000 e/s	86,400,000	25 days
10,000 e/s	864,000,000	2.5 days
100,000 e/s	8,640,000,000	6 hours
1,000,000 e/s	86,400,000,000	36 minutes
10,000,000 e/s	864,000,000,000	4 minutes

# spatiotemporal big data store

*choosing an Object Id option*

	Max Value	# of IDs	ArcGIS Clients
Int32	2,147,483,647	2.1 billion	Pro, Desktop, Ops Dashboard, ...
Int64 (signed)	9,223,372,036,854,775,807	9.2 quintillion	JavaScript, custom apps

	events per day	Int32	Int64 (signed)
1,000 e/s	86,400,000	25 days	292,472,000 years
10,000 e/s	864,000,000	2.5 days	29,247,200 years
100,000 e/s	8,640,000,000	6 hours	2,924,720 years
1,000,000 e/s	86,400,000,000	36 minutes	292,472 years
10,000,000 e/s	864,000,000,000	4 minutes	29,248 years

# spatiotemporal big data store

*choosing an Object Id option*

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

	events per day	Int32	Int64 (signed)
1,000 e/s	86,400,000	25 days	292,472,000 years
10,000 e/s	864,000,000	2.5 days	29,247,200 years
100,000 e/s	8,640,000,000	6 hours	2,924,720 years
1,000,000 e/s	86,400,000,000	36 minutes	292,472 years
10,000,000 e/s	864,000,000,000	4 minutes	29,248 years

# Summary

## *GeoEvent Server: best practices*

- When applying Real-Time GIS there are many best practices for
  - ingestion & analytics
  - dissemination & visualization
  - storage
  - resilience & scalability
- To learn more:
  - See the tutorial:  
‘ArcGIS GeoEvent Server: Resiliency’



# Real-Time & Big Data GIS

## *other sessions*

- **GeoEvent Server: An Introduction**  
Tue, 10:15-11:30am, Room 10  
Thu, 1:30-2:45pm, Hilton – Sapphire Ballroom I
- **Real-Time & Big Data: Leveraging the Spatiotemporal Store**  
Tue, 10:15-11:30am, Room 15 A  
Thu, 1:30-2:45pm, Room 15 A
- **GeoEvent Server: Applying Real-Time Analytics**  
Tue, 1:30-2:45pm, Room 17 B  
Thu, 3:15-4:30pm, Room 14 A
- **Real-Time & Big Data GIS at a Massive Scale**  
Wed, 3:15-4:30pm, Room 3  
Fri, 9:00-10:15am, Room 8
- **GeoEvent Server: Leveraging Stream Services**  
Wed, 3:15-4:30pm, Room 14 B
- **GeoEvent Server: Best Practices**  
Thu, 10:15-11:30am, Room 9
- **GeoEvent Server: Internet of Things (IoT)**  
Thu, 10:15-11:30am, Room 14 B
- **GeoEvent Server: Making 3D Scenes Come Alive**  
Wed, 1:30-2:15pm, Demo Theater 05 - Real-Time
- **GeoAnalytics Server: An Introduction**  
Wed, 10:15-11:30am, Room 4  
Thu, 10:15-11:30am, Hilton – Sapphire Ballroom E

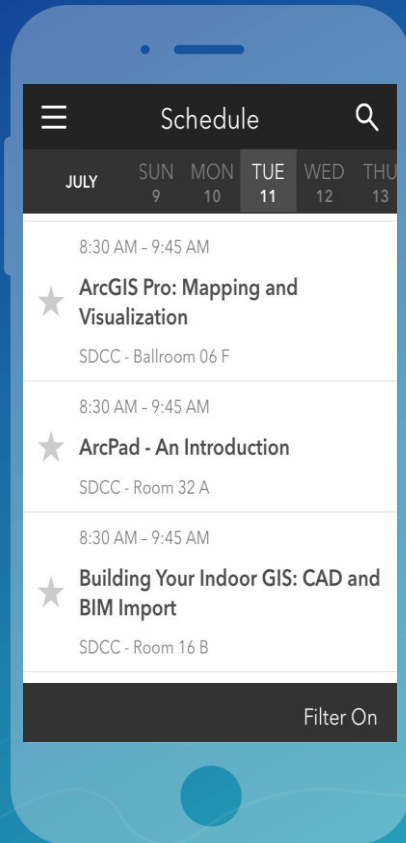


# Please Take Our Survey on the Esri Events App!

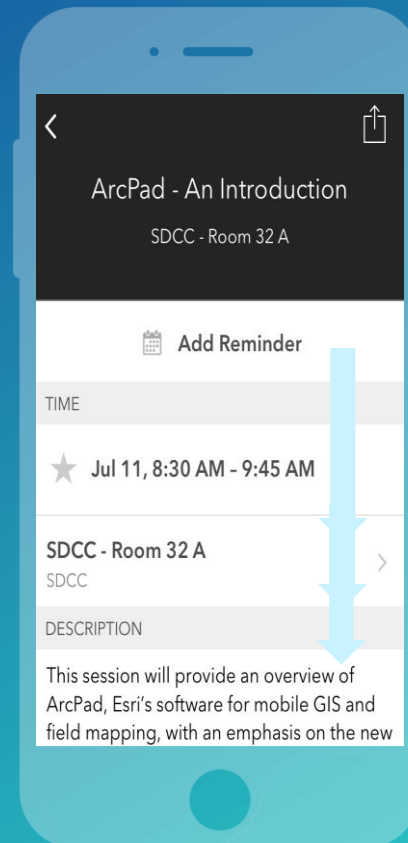
**Download the Esri Events app and find your event**



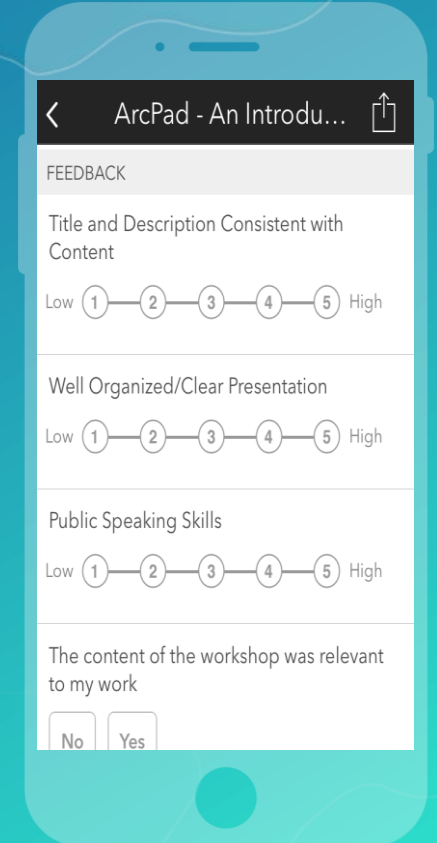
**Select the session you attended**



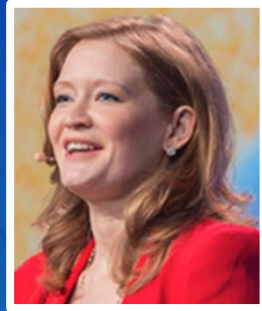
**Scroll down to find the survey**



**Complete Answers and Select "Submit"**



# Questions / Feedback?



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