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)
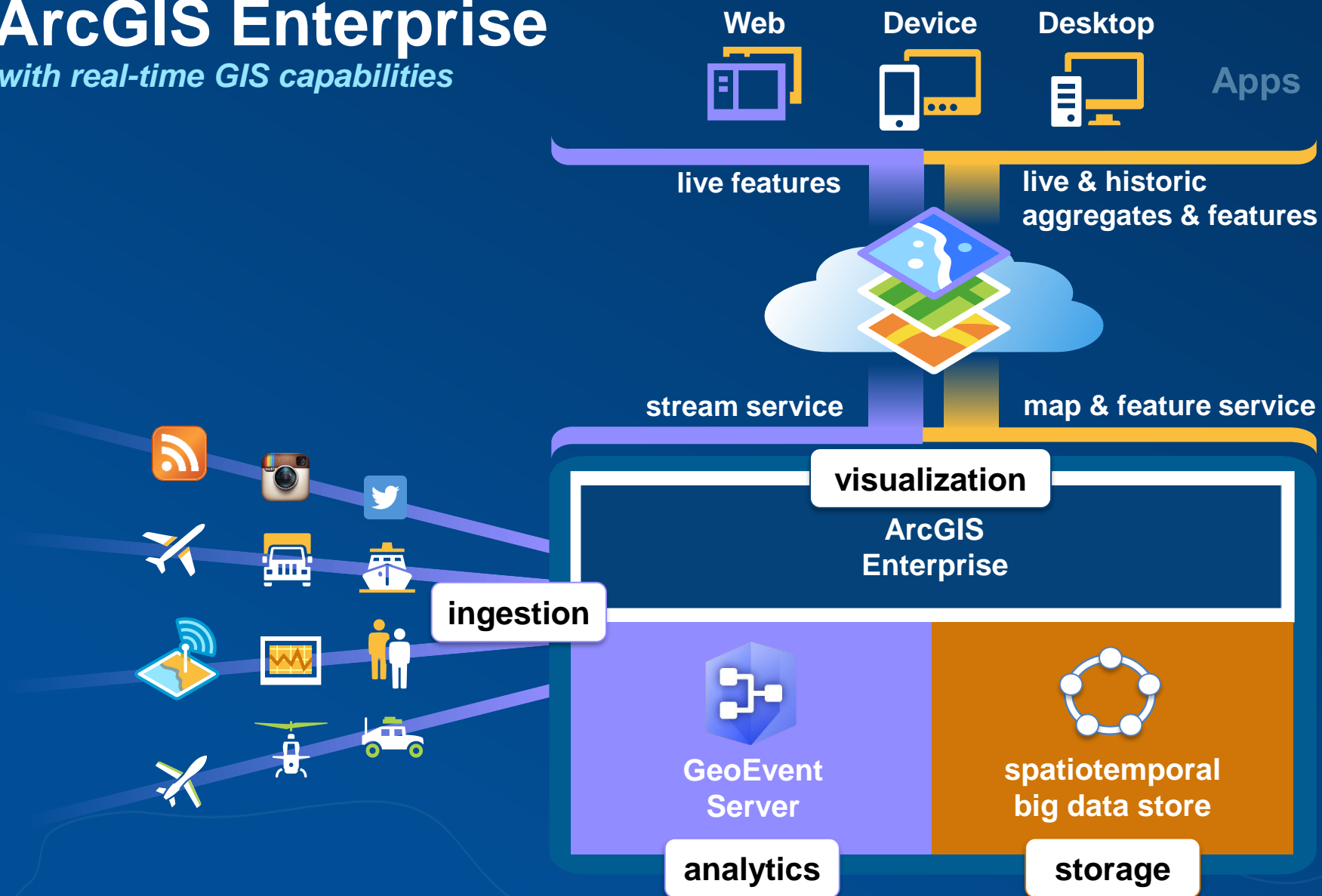
5. Real-time & big data on ArcGIS Online

This road ahead content is provided for informational purposes only and is subject to change
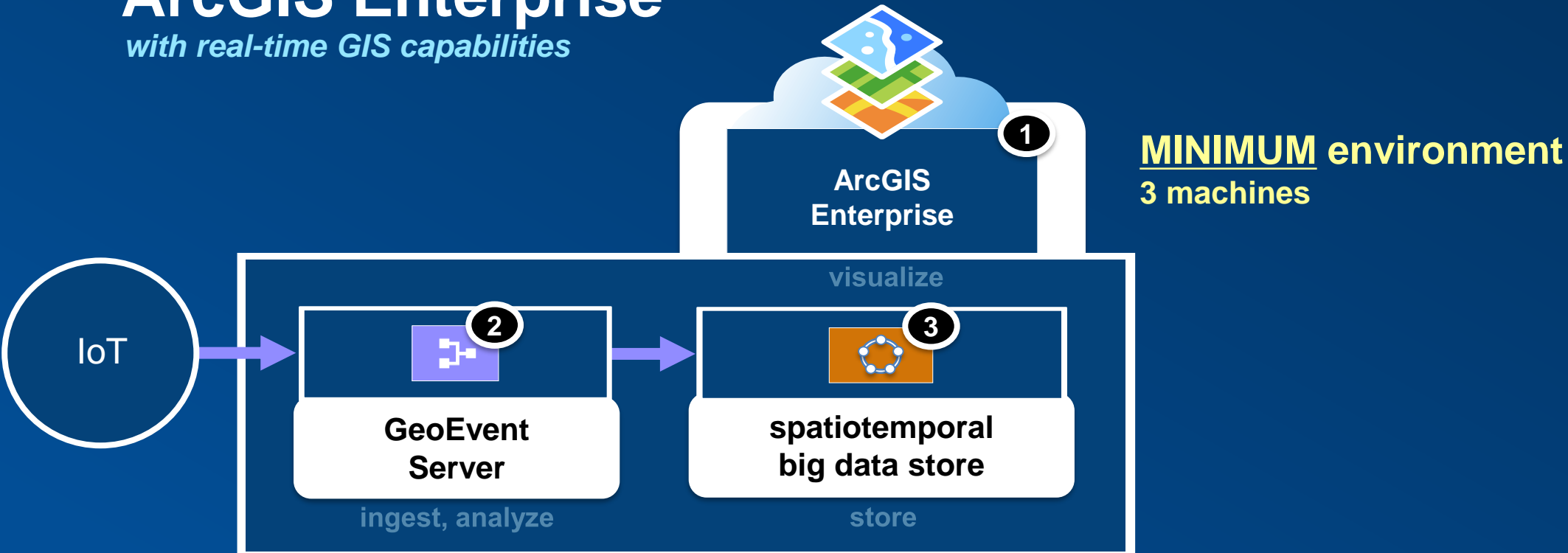
1 10.6 current status
Real-Time GIS

ArcGIS Enterprise
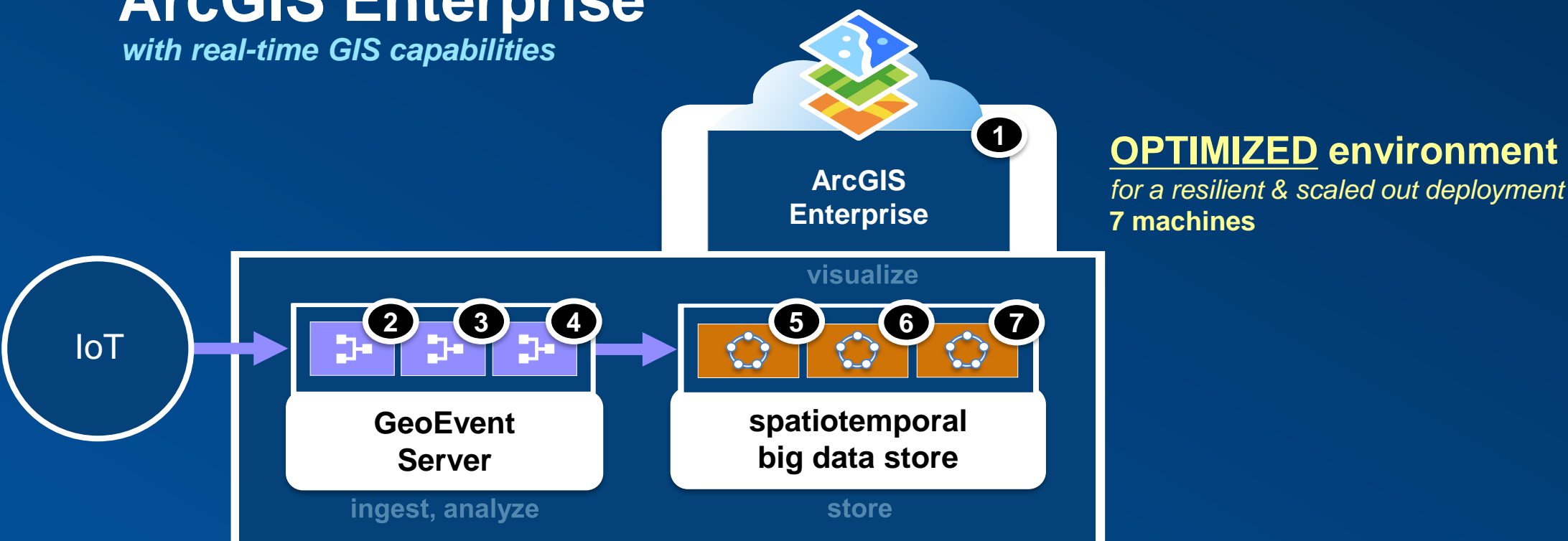*with real-time GIS capabilities*

ArcGIS Enterprise ①

MINIMUM environment
3 machines

visualize

IoT

GeoEvent Server ②

ingest, analyze

spatiotemporal big data store ③

store

ArcGIS GeoEvent Server	10.2	10.3	10.4	10.5	10.6
Velocity throughput *measured in events per second (e/s)*	*up to* 500 *e/s*	*up to* 2,000 *e/s*	*up to* 3,000 *e/s*	*up to* 4,000 *e/s*	*up to* 6,000 *e/s*

ArcGIS Enterprise
with real-time GIS capabilities

ArcGIS Enterprise ①

OPTIMIZED environment
for a resilient & scaled out deployment
7 machines

IoT → GeoEvent Server ② ③ ④ → spatiotemporal big data store ⑤ ⑥ ⑦

visualize

ingest, analyze

store

ArcGIS GeoEvent Server	10.2	10.3	10.4	10.5	10.6
Velocity throughput *measured in events per second (e/s)*	*up to* 500 e/s	*up to* 2,000 e/s	*up to* 3,000 e/s	*up to* 4,000 e/s	*up to* 6,000 e/s
Resiliency & Scalability *via multi-machine site*	no	no	no	no	yes

GeoEvent Server
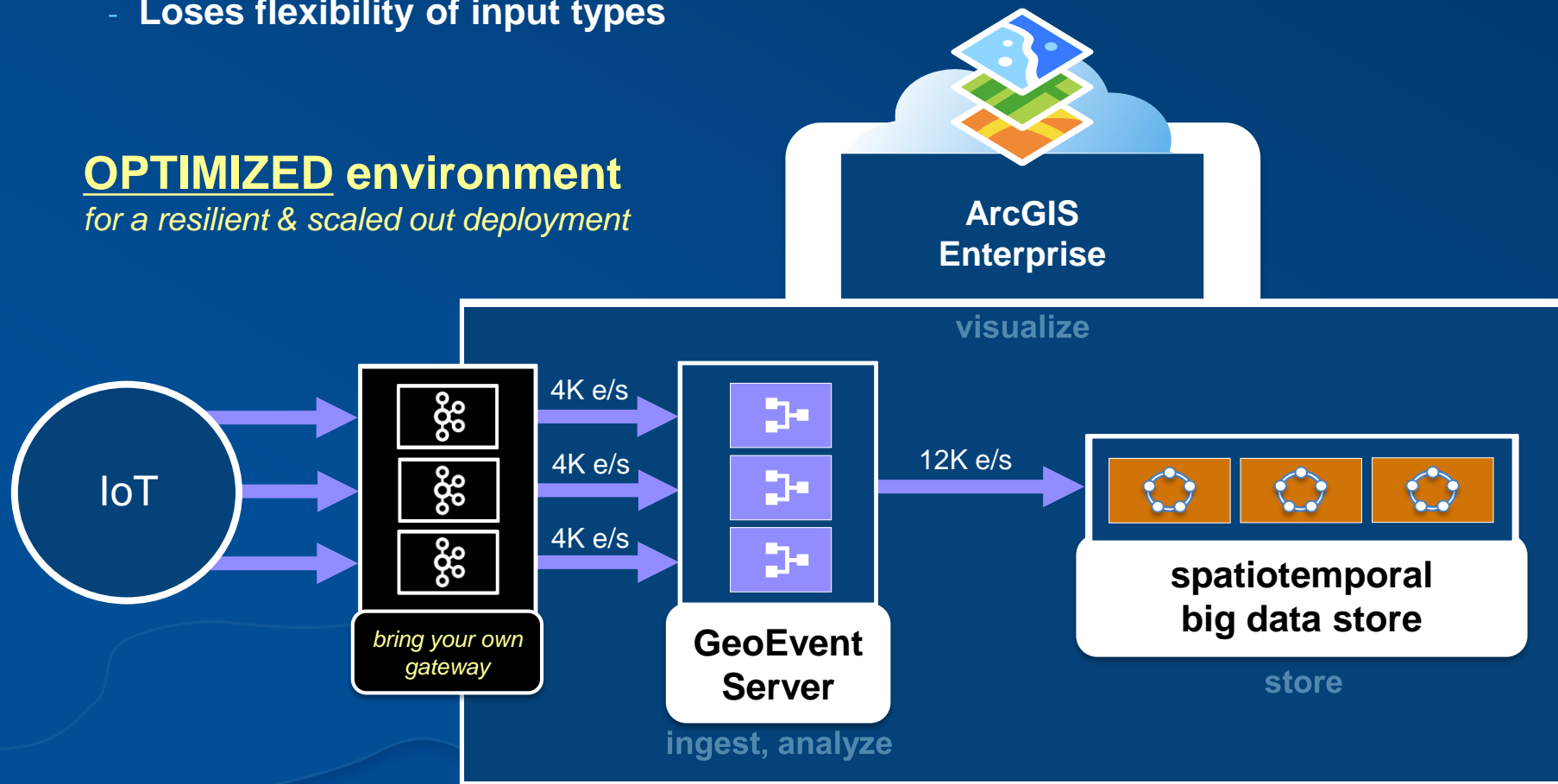*resiliency, scalability & performance*

10.5

- **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

ArcGIS Enterprise

visualize

IoT

4K e/s
4K e/s
4K e/s

bring your own gateway

GeoEvent Server

12K e/s

spatiotemporal big data store

store

ingest, analyze

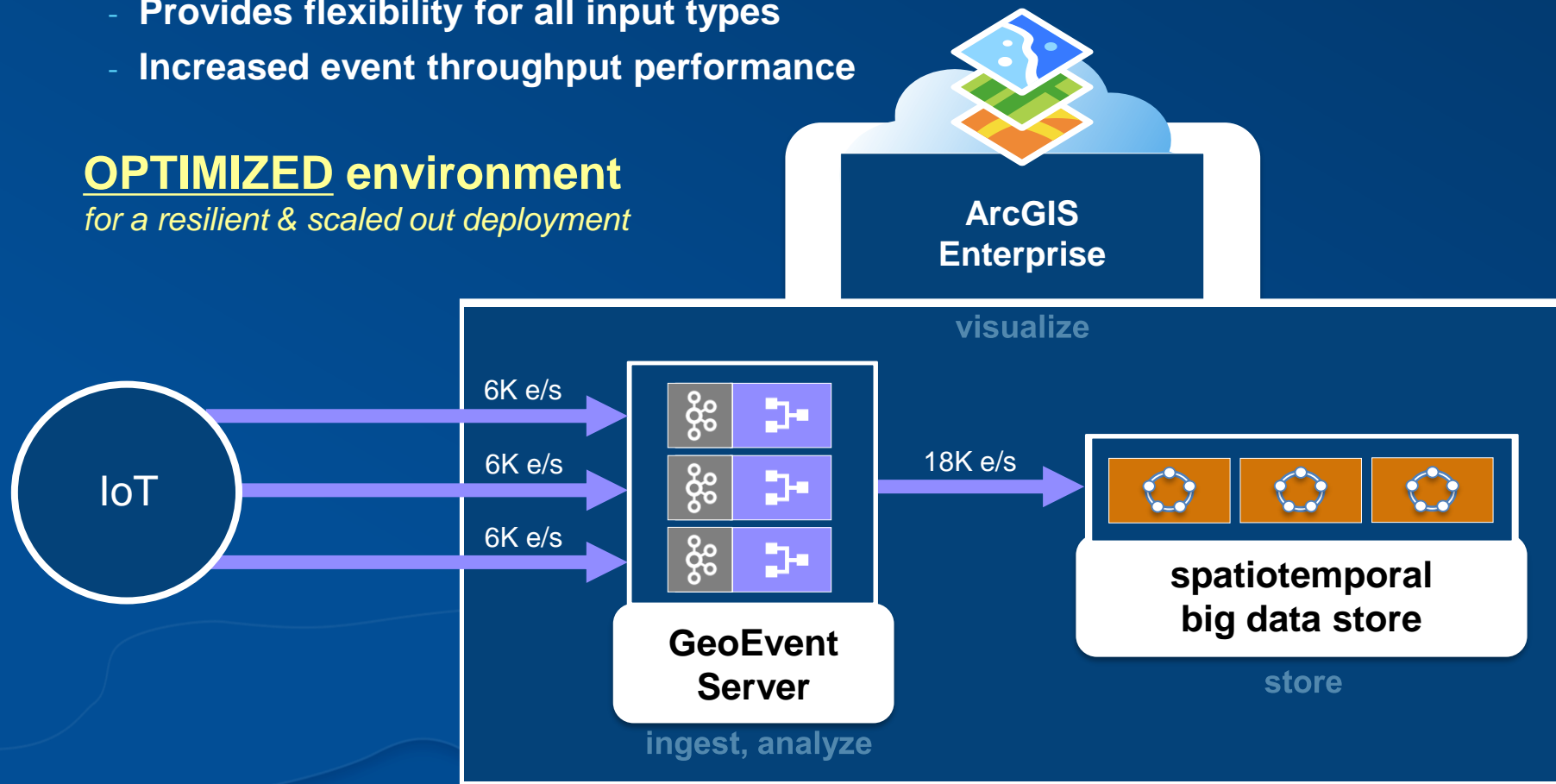# GeoEvent Server
resiliency, scalability & performance

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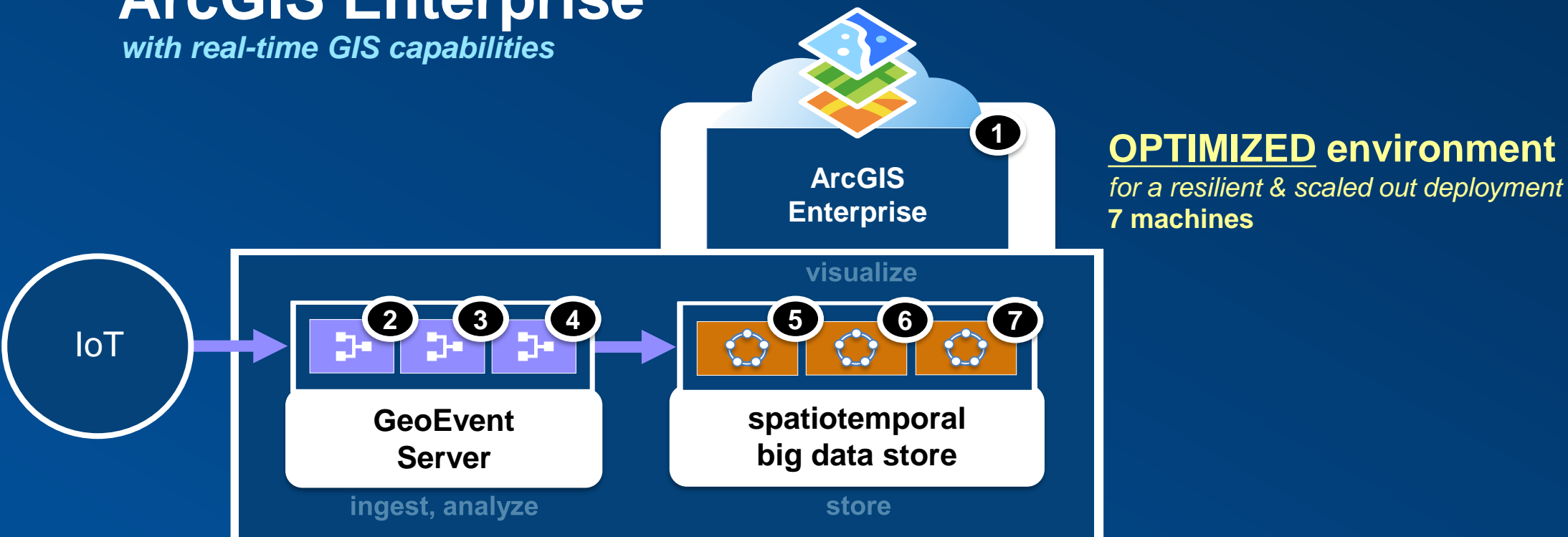 - Increased event throughput performance

<u>OPTIMIZED</u> **environment**
for a resilient & scaled out deployment

ArcGIS Enterprise

visualize

IoT

6K e/s

6K e/s

6K e/s

18K e/s

GeoEvent Server

ingest, analyze

spatiotemporal big data store

store

ArcGIS Enterprise
with real-time GIS capabilities

ArcGIS Enterprise ①

OPTIMIZED environment
for a resilient & scaled out deployment
7 machines

visualize

IoT → **GeoEvent Server** ② ③ ④ → **spatiotemporal big data store** ⑤ ⑥ ⑦

ingest, analyze

store

ArcGIS GeoEvent Server	10.2	10.3	10.4	10.5	10.6
Velocity throughput *measured in events per second (e/s)*	*up to* 500 *e/s*	*up to* 2,000 *e/s*	*up to* 3,000 *e/s*	*up to* 4,000 *e/s*	*up to* 6,000 *e/s*
Resiliency & Scalability *via multi-machine site*	no	no	no	no	yes *up to 5 practically, so can scale to up to* 30,000 *e/s*

GeoEvent Server
best practices tutorial for multi-machine site deployment

10.6

- **Available Now: http://links.esri.com/geoevent-multiplemachine**

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

2 **10.6.1 themes
Real-Time GIS**

GeoEvent Server

10.6.1 themes

10.6.1

- **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**

3

10.7 epics
Real-Time and Big Data GIS

GeoEvent Server
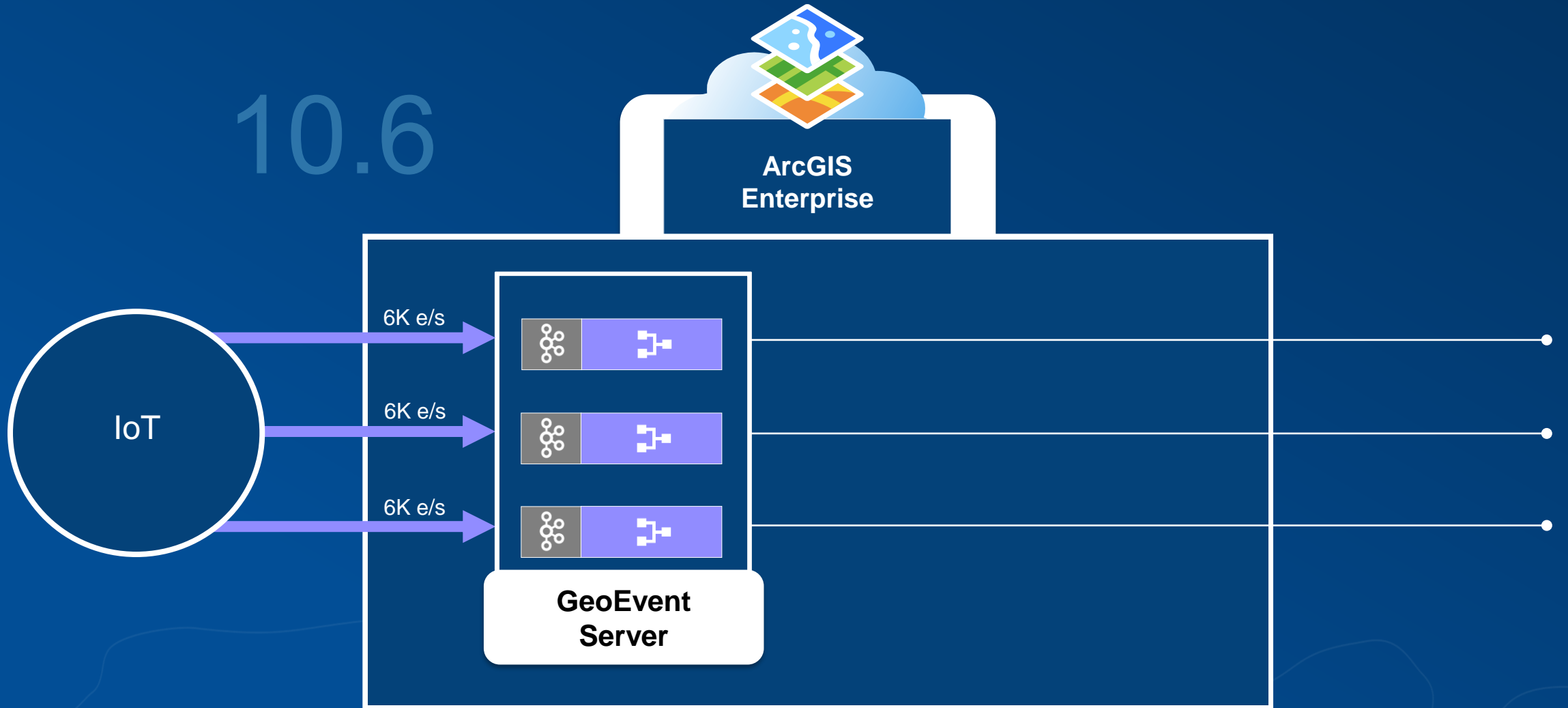### 10.7 major epics

10.7

- **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**

Stream Services
GeoEvent Server @10.6

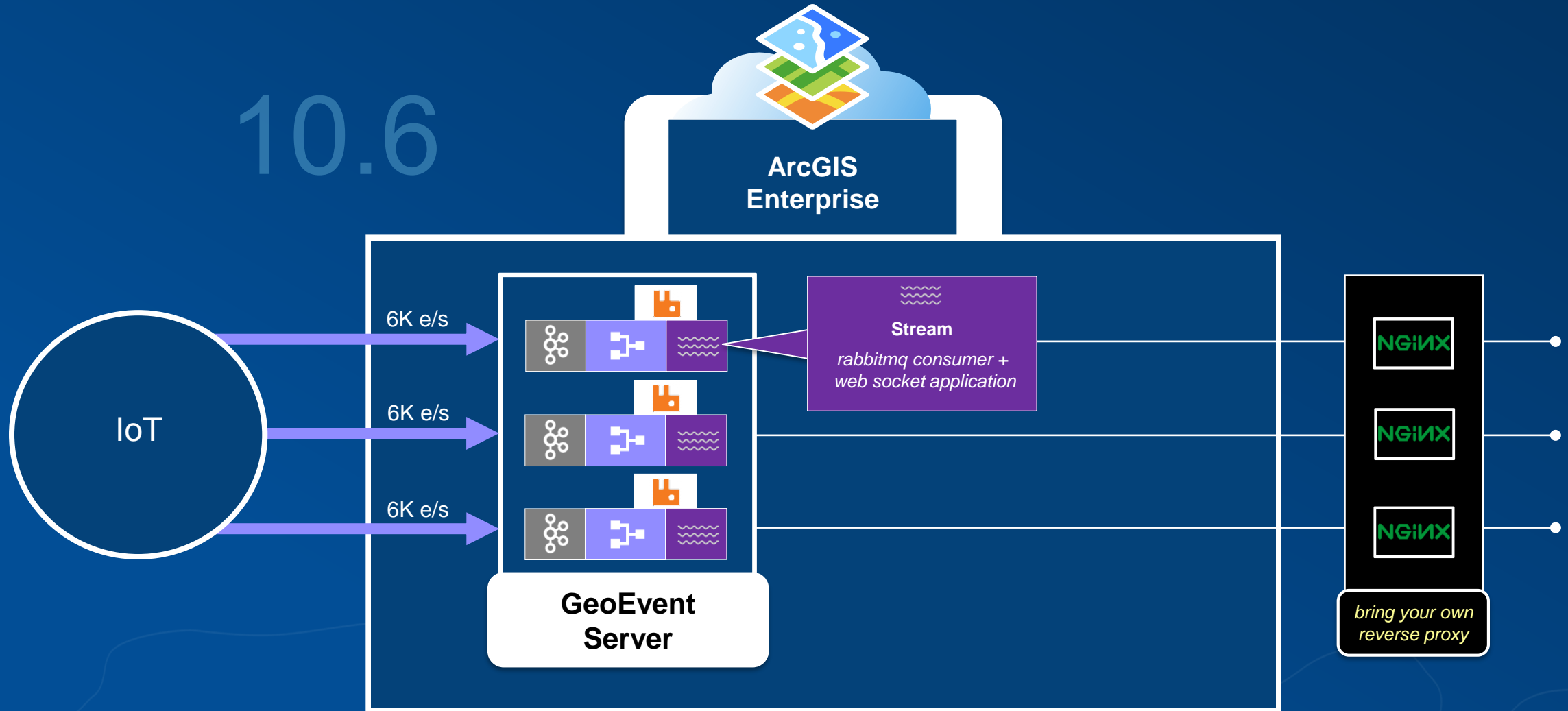Road Ahead content is provided for informational purposes only and is subject to change

R&D

10.6

ArcGIS
Enterprise

IoT

6K e/s

6K e/s

6K e/s

GeoEvent
Server

Stream
*rabbitmq consumer +
web socket application*

NGINX

NGINX

NGINX

*bring your own
reverse proxy*

Stream Services
GeoEvent Server @10.7

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

R&D

10.7

ArcGIS Enterprise

6K e/s

6K e/s

6K e/s

IoT

GeoEvent Server

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

NGINX

NGINX

NGINX

bring your own reverse proxy

Stream Services
GeoEvent Server @10.7

R&D

10.7

ArcGIS Enterprise

IoT

6K e/s

6K e/s

6K e/s

GeoEvent Server

spatiotemporal big data store
10.7 major epics
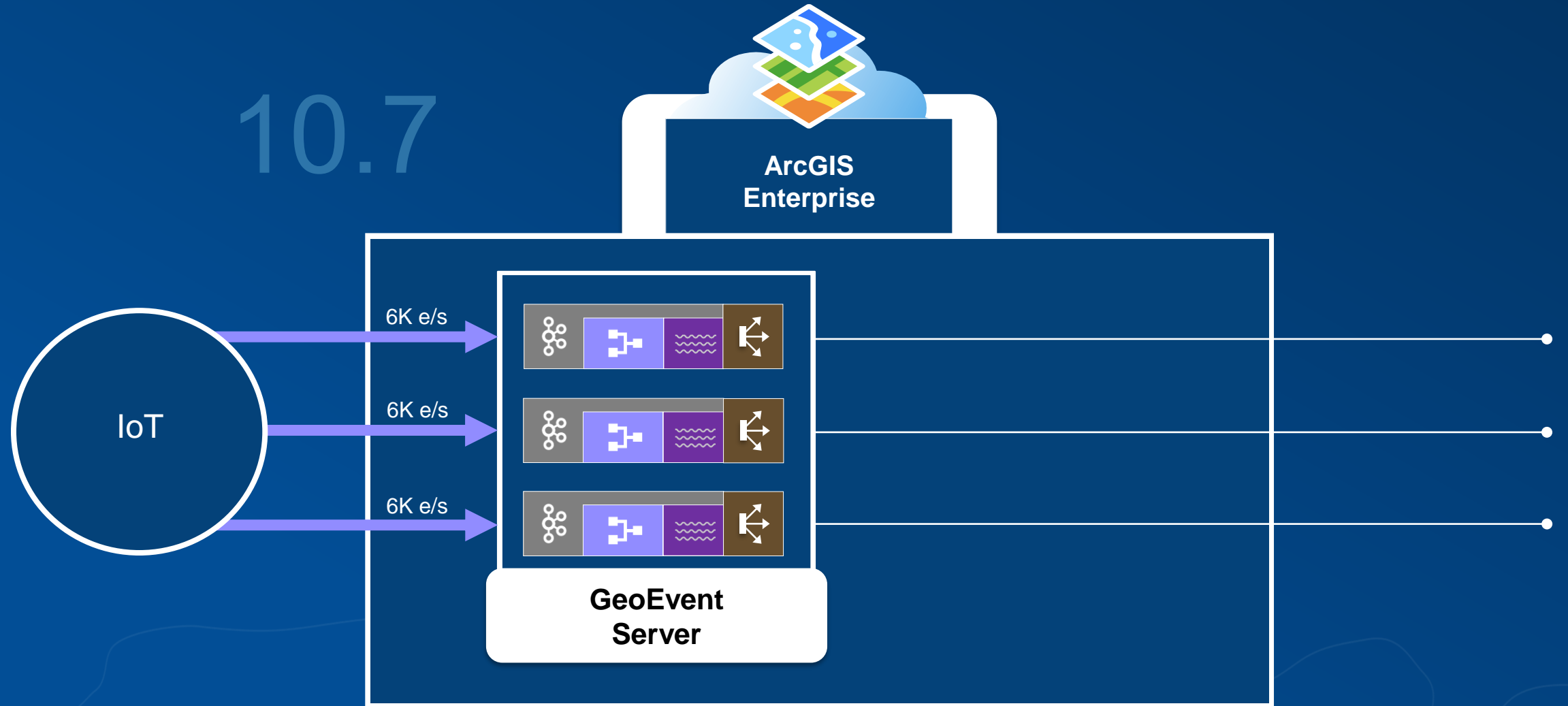
10.7

- **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

10.7

- **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**
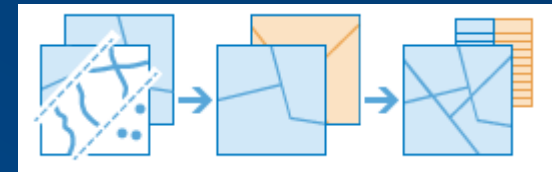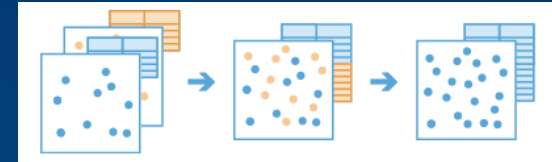
4 Embracing the Internet of Things (IoT)

ArcGIS & the IoT
enabling geospatial insights with your IoT

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

Weather
warnings   earthquakes
precipitation   icy conditions

Airports
flight status   queues
plane location   runway status

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

Public Safety
police   fire
surveillance

Buildings
lighting   hvac
occupancy counts

Transit
buses   taxis   rail
trains   crowds

People
health monitoring
social activity

Public Health
hospitals   ambulances

Energy Usage
electricity   gas   smart meters

City Workers
sanitation   snow plows

Telecommunications
cell phone signals   dropped calls

Internet of your Things

Web   **Device**   **Desktop**

ArcGIS Enterprise
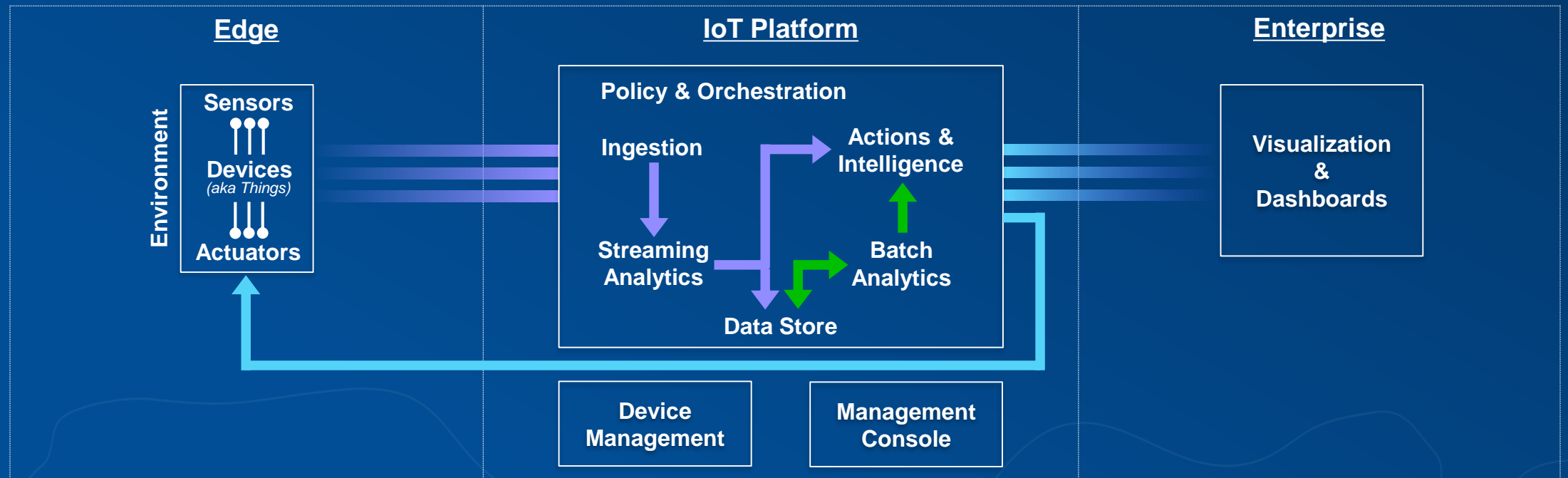**with real-time & big data capabilities**
ingest, store, analyze, visualize
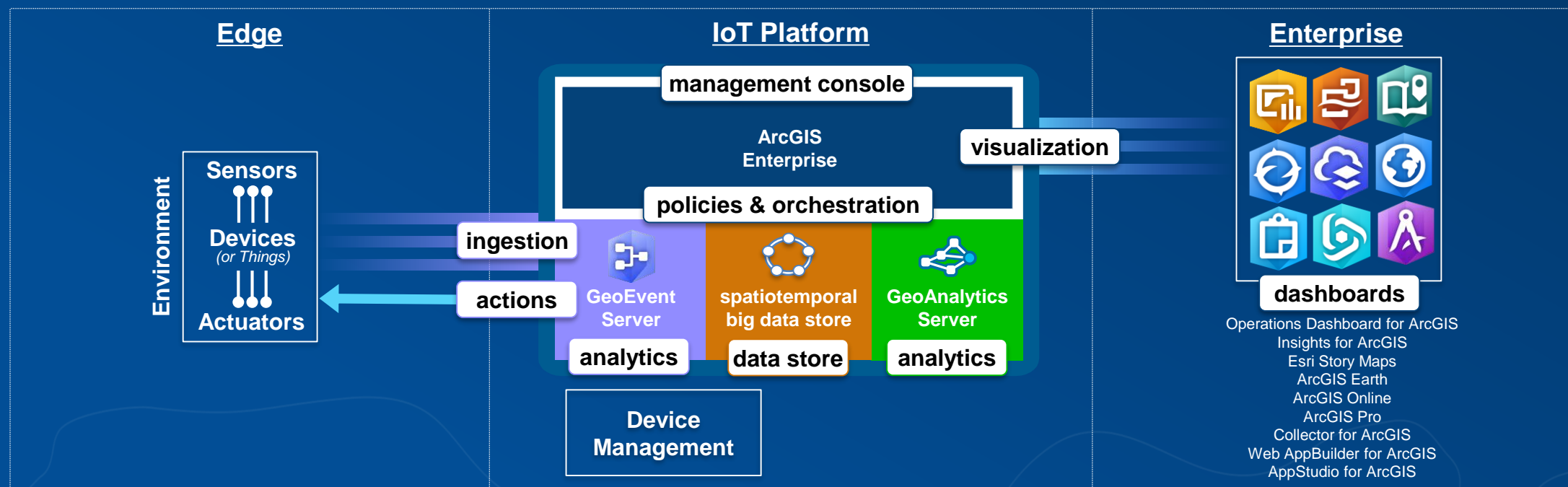
Blueprint
for IoT solutions

- **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**

ArcGIS as an IoT Platform
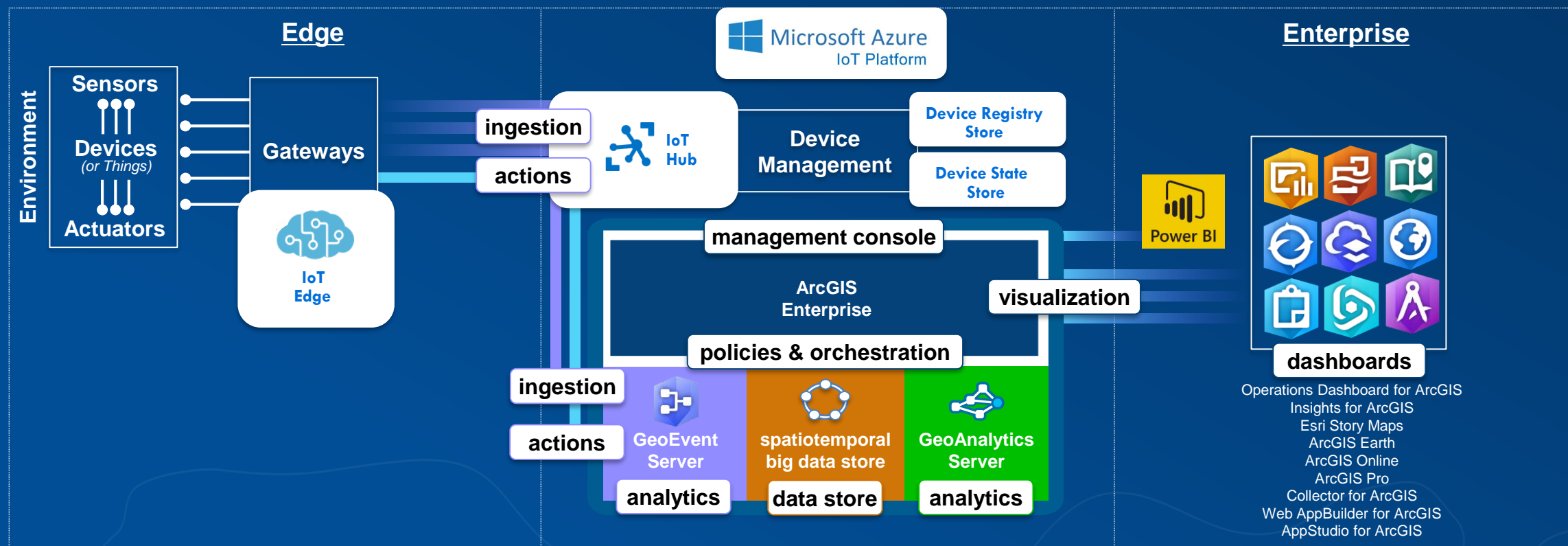*enabling geospatial insights with your IoT solution*

- **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

Operations Dashboard for ArcGIS
Insights for ArcGIS
Esri Story Maps
ArcGIS Earth
ArcGIS Online
ArcGIS Pro
Collector for ArcGIS
Web AppBuilder for ArcGIS
AppStudio for ArcGIS

Complementing an IoT platform with ArcGIS

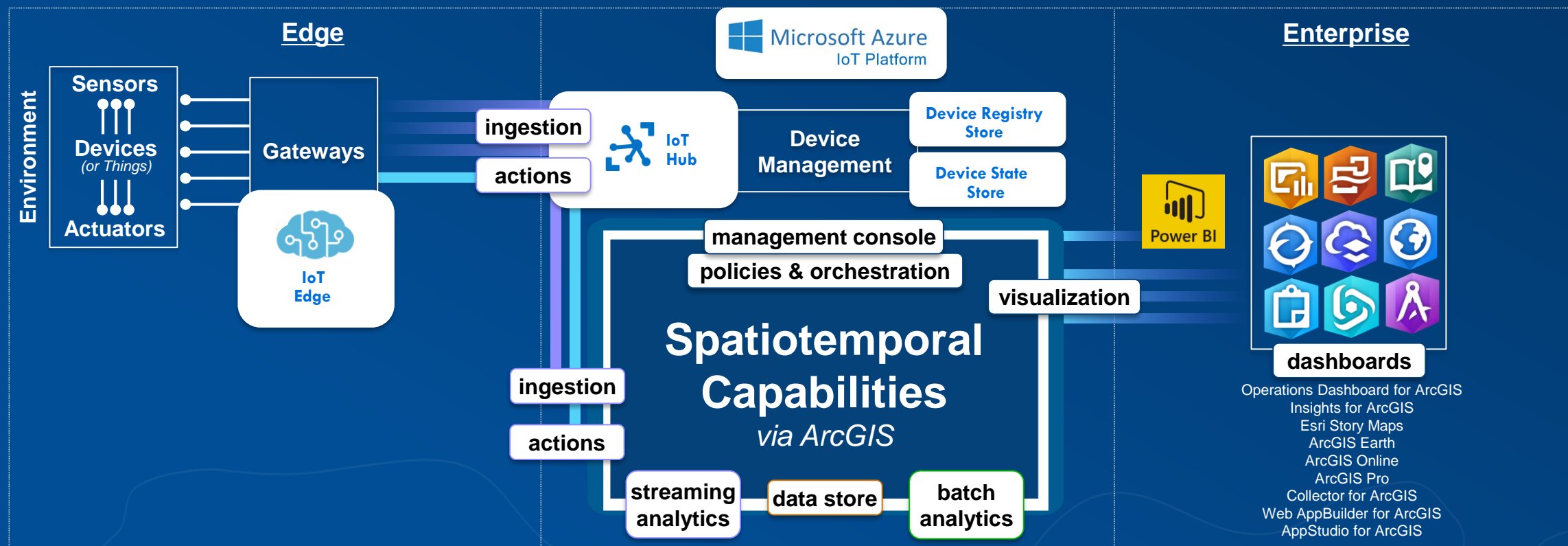*enabling geospatial insights with your IoT solution*

- **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**
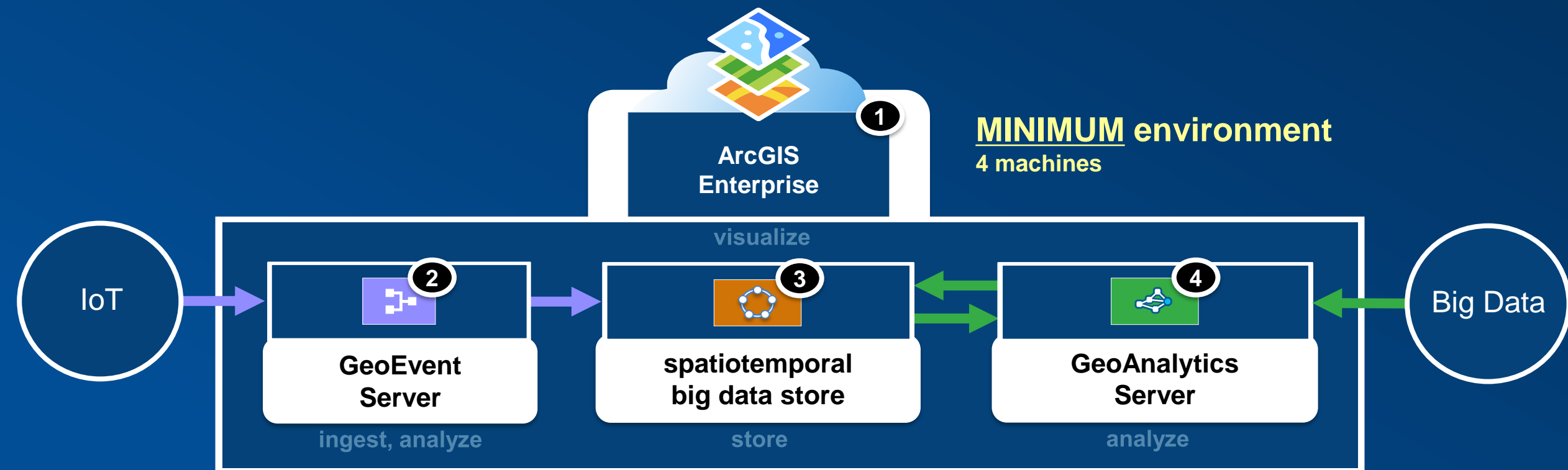
Complementing an IoT platform with ArcGIS

enabling geospatial insights with your IoT solution

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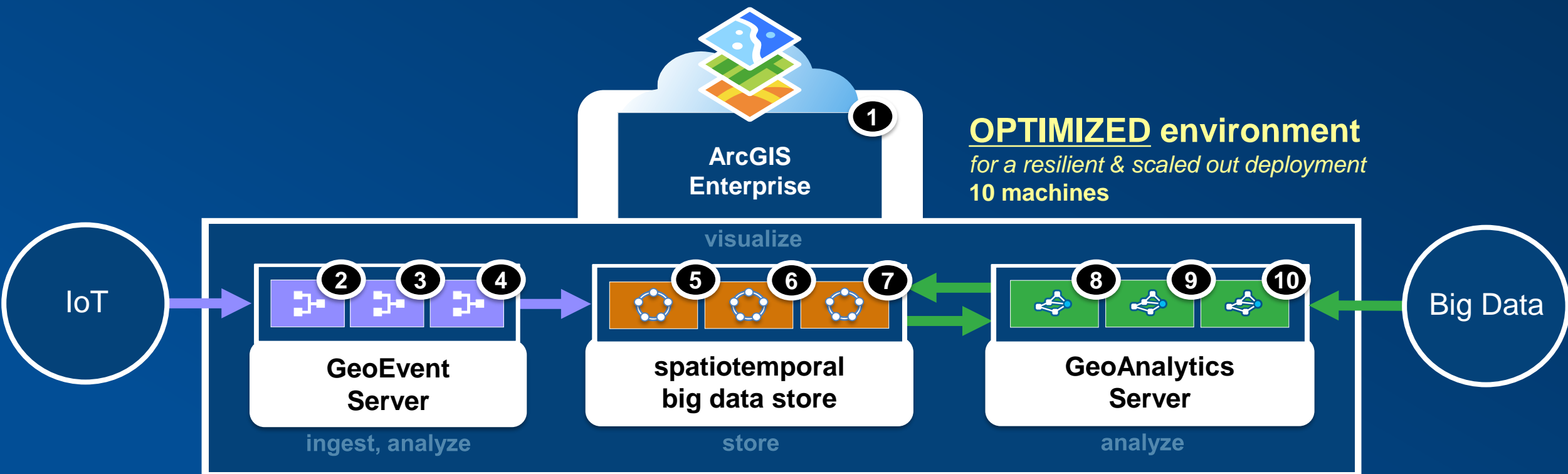

Operations Dashboard for ArcGIS
Insights for ArcGIS
Esri Story Maps
ArcGIS Earth
ArcGIS Online
ArcGIS Pro
Collector for ArcGIS
Web AppBuilder for ArcGIS
AppStudio for ArcGIS

5 **Real-Time and Big Data GIS on ArcGIS Online**

R&D

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 <u>AS A SERVICE</u>**

- **A new class of customer is demanding <u>MASSIVE</u> real-time & big data analytic capabilities**

ArcGIS Online
software-as-a-service (SaaS)

IoT

Big Data

ingest, analyze & visualize

store, analyze & visualize
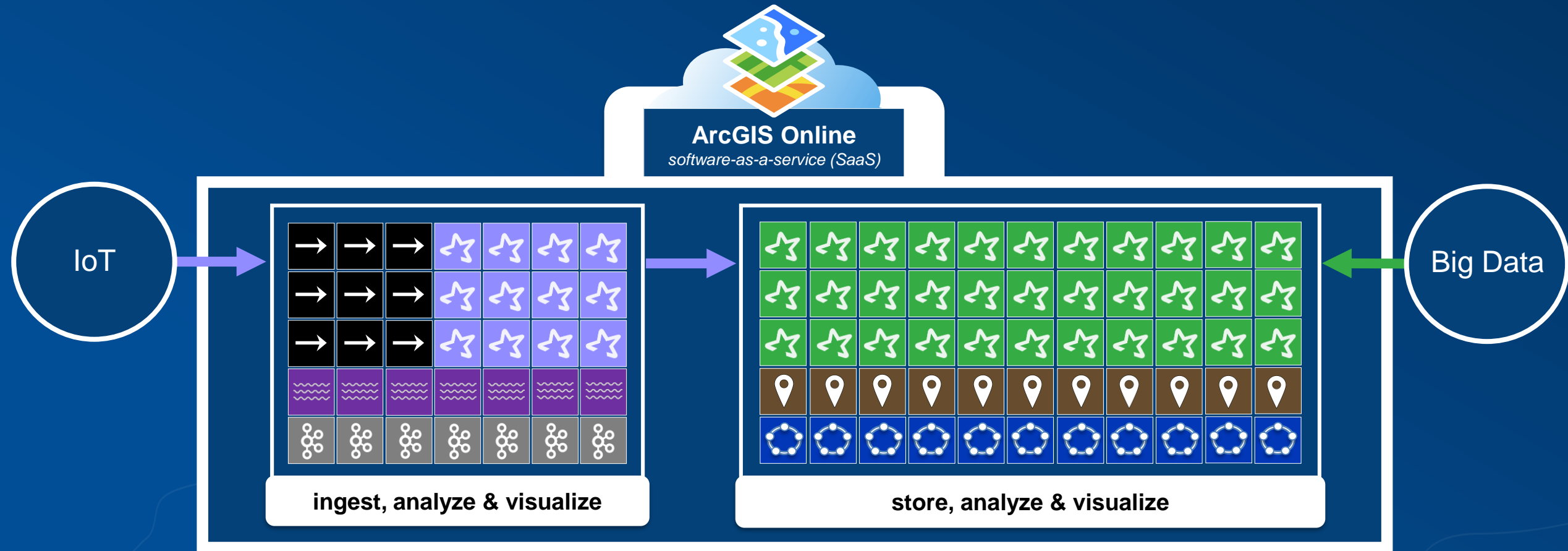
ArcGIS
*real-time & big data GIS **on-premise***

R&D
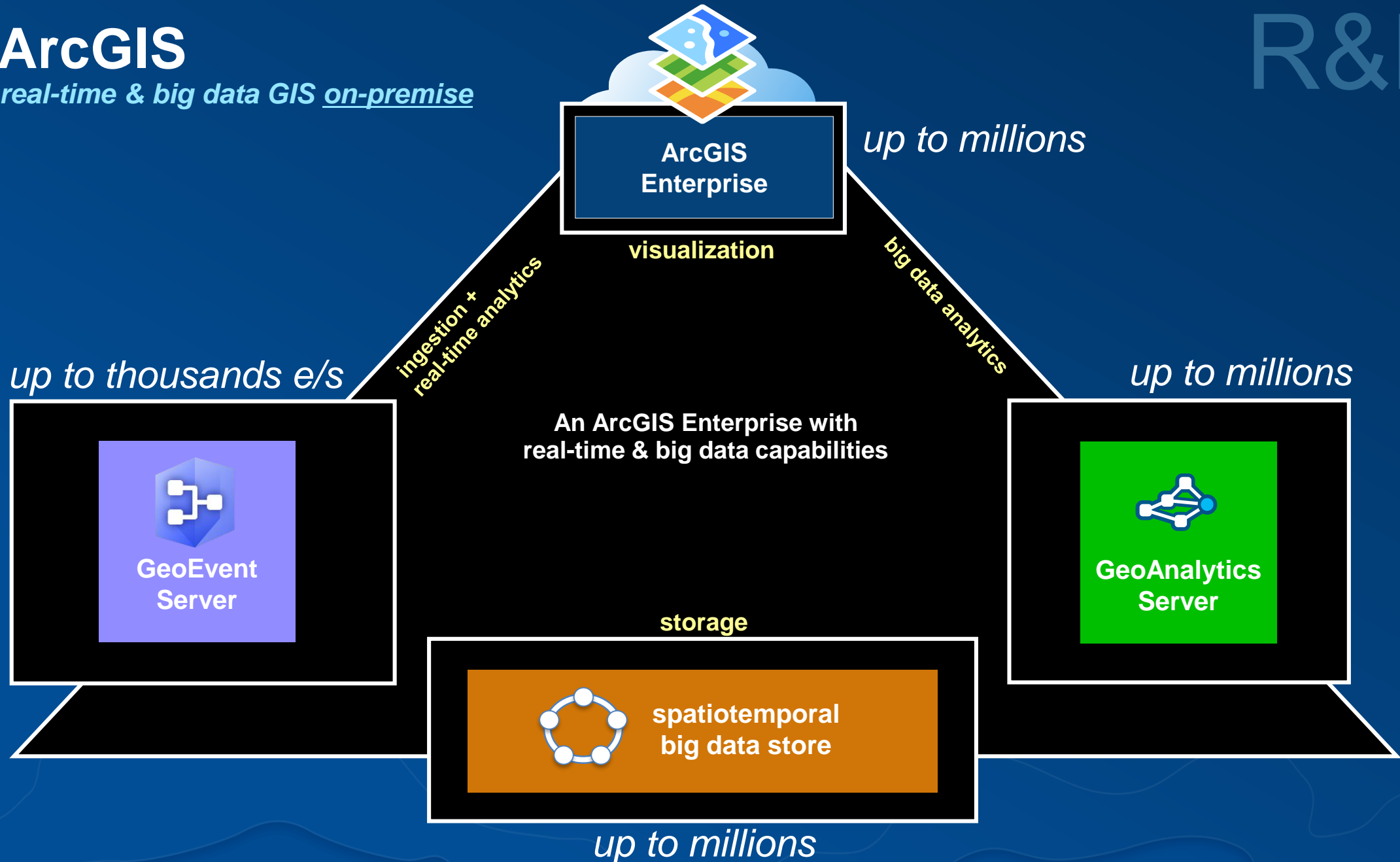
ArcGIS
Enterprise

up to millions

visualization

ingestion +
real-time analytics

big data analytics

up to thousands e/s

up to millions

An ArcGIS Enterprise with
real-time & big data capabilities

GeoEvent
Server

GeoAnalytics
Server

storage

spatiotemporal
big data store

up to millions

ArcGIS Online

ArcGIS Online
real-time & big data GIS as a service

R&D

up to billions

visualization

ingestion +
real-time analytics

big data analytics

up to millions e/s

up to billions

"ArcGIS
for IoT"

**powered by
project Trinity**

storage

cloud native storage

up to billions

R&D
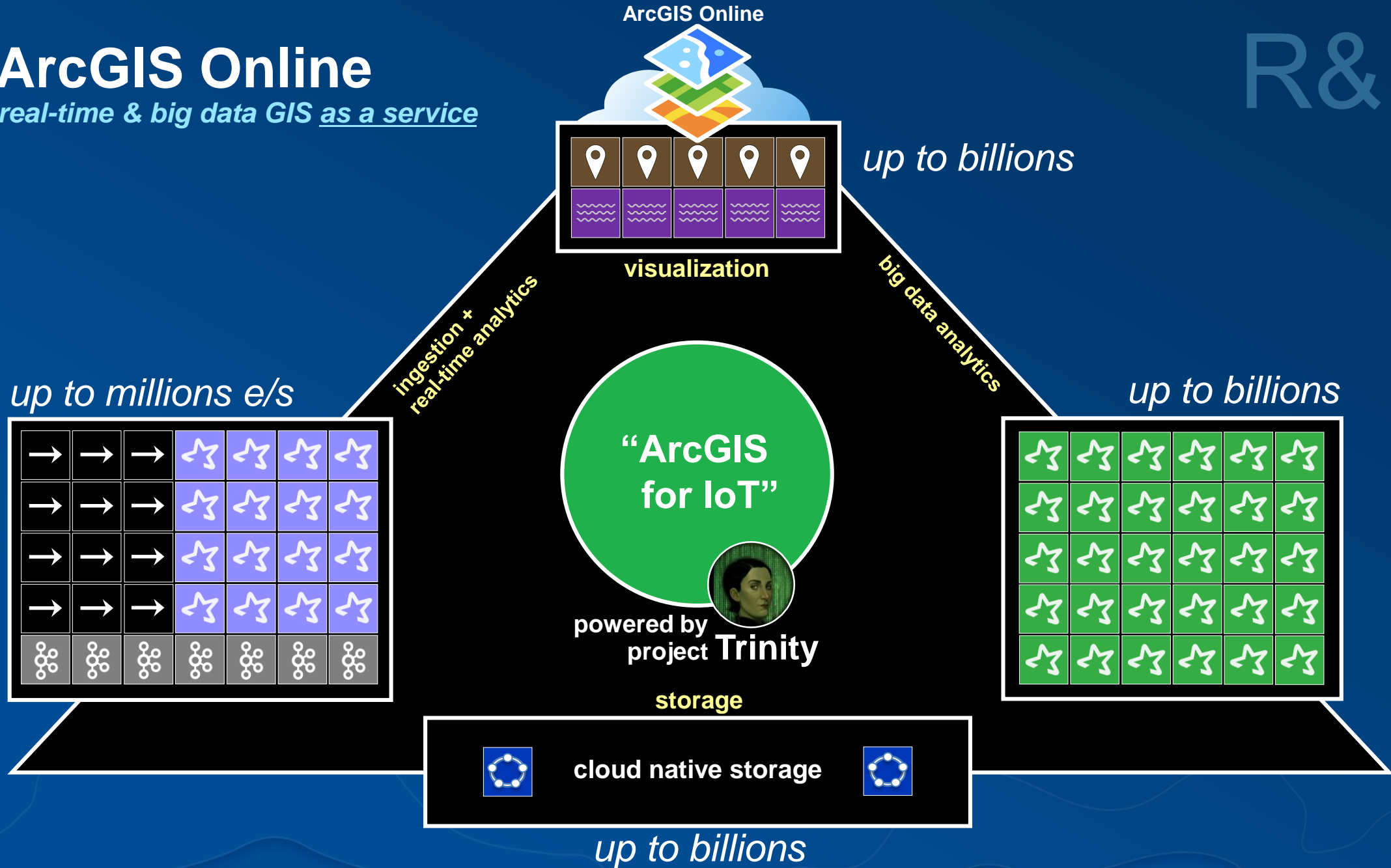
ArcGIS Online

with real-time & big data GIS as a service

- **"ArcGIS for IoT" is launched as an application on ArcGIS Online**
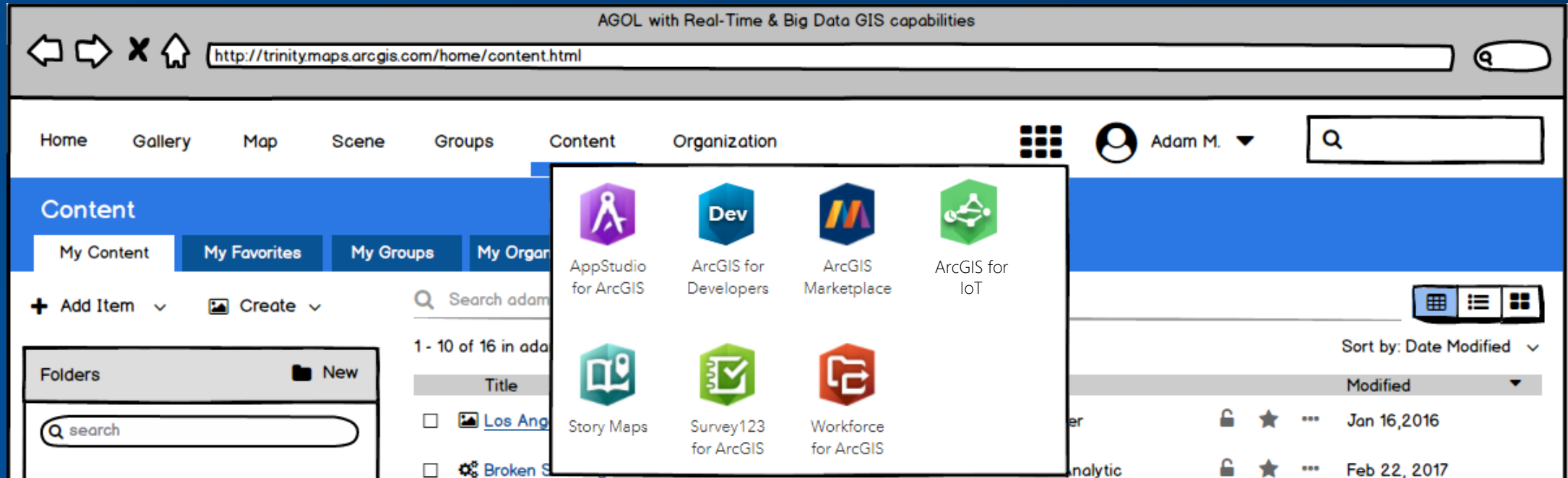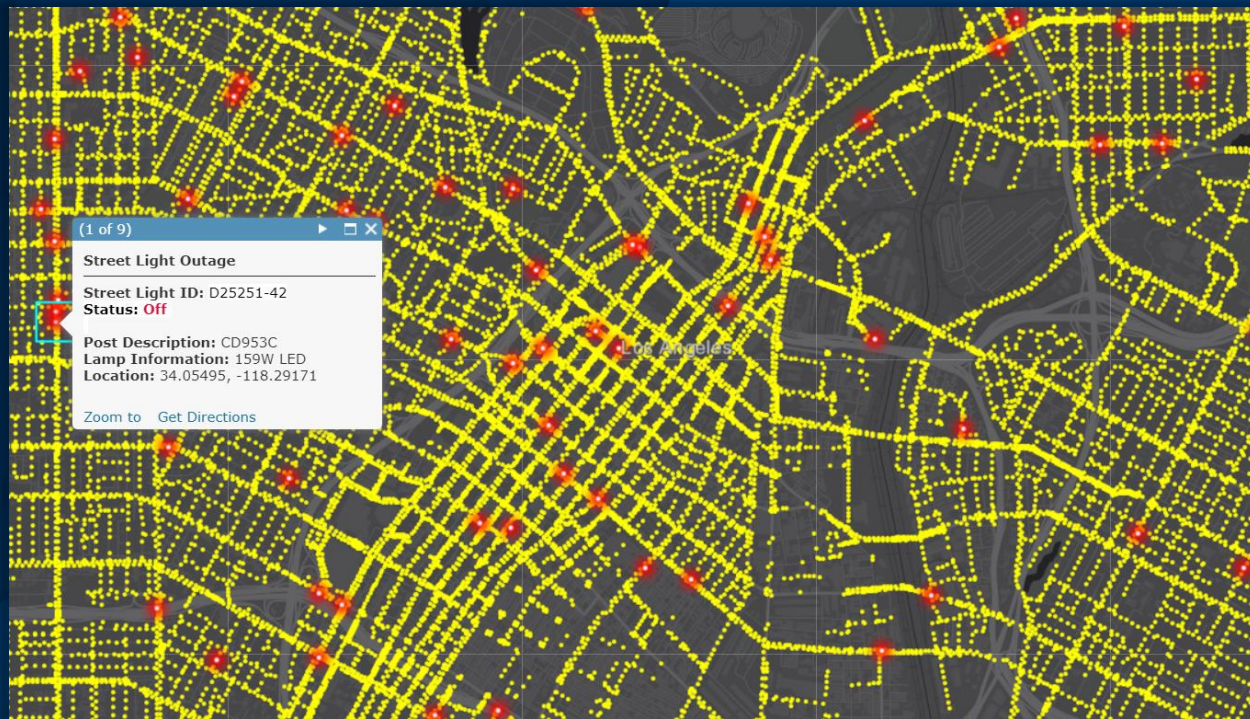
R&D

ArcGIS Online

with real-time & big data GIS as a service

- **"ArcGIS for IoT" application enables authoring new ArcGIS Online items including:**

  - **Feed** *and it's companion Stream Layer*   - **Analytic**

  - **Real-Time Analytic**   - **Analytic (scheduled)**

R&D

Street Lights - LA

Visualizing and analyzing street light device status

Optimizing street light maintenance priority based on context

R&D

Real-Time Analytic
receiving and updating streetlight status

Feed	Receive streetlight status from Azure IoT Hub

Select Fields	Select fields of interest (STLID, LIGHTING_STATUS, …)

Calculate Field	Calculate if status represents outage (…)

Output	Keep latest feature in <u>streetlight_status</u> feature service

R&D
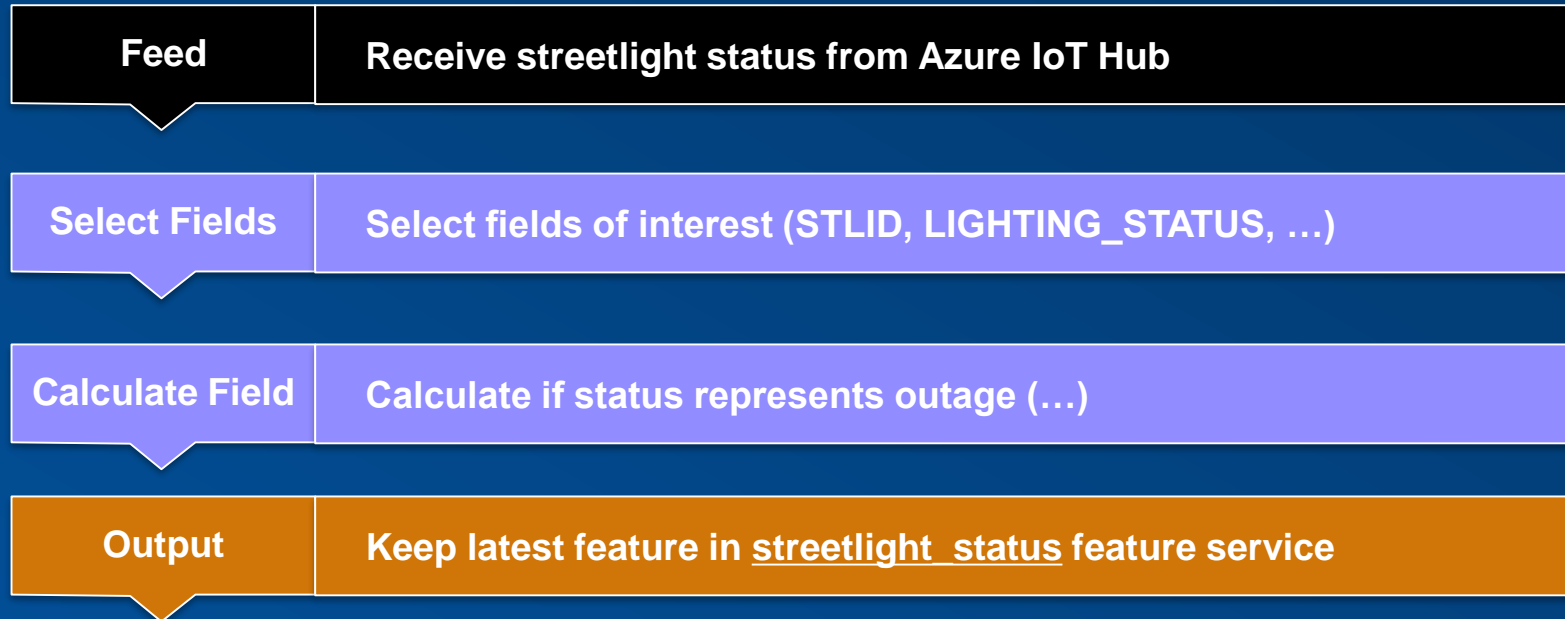
Batch Analytic
finding bus stops near streetlight outages

Input	Load streetlights where LIGHTING_STATUS = 'Off'

Join Features	Join streetlights to bus stops (Near Geodesic, 50 m)

Calculate Field	Calculate WEIGHT field (…)

Output	Keep latest feature in streetlight_priority feature service

R&D
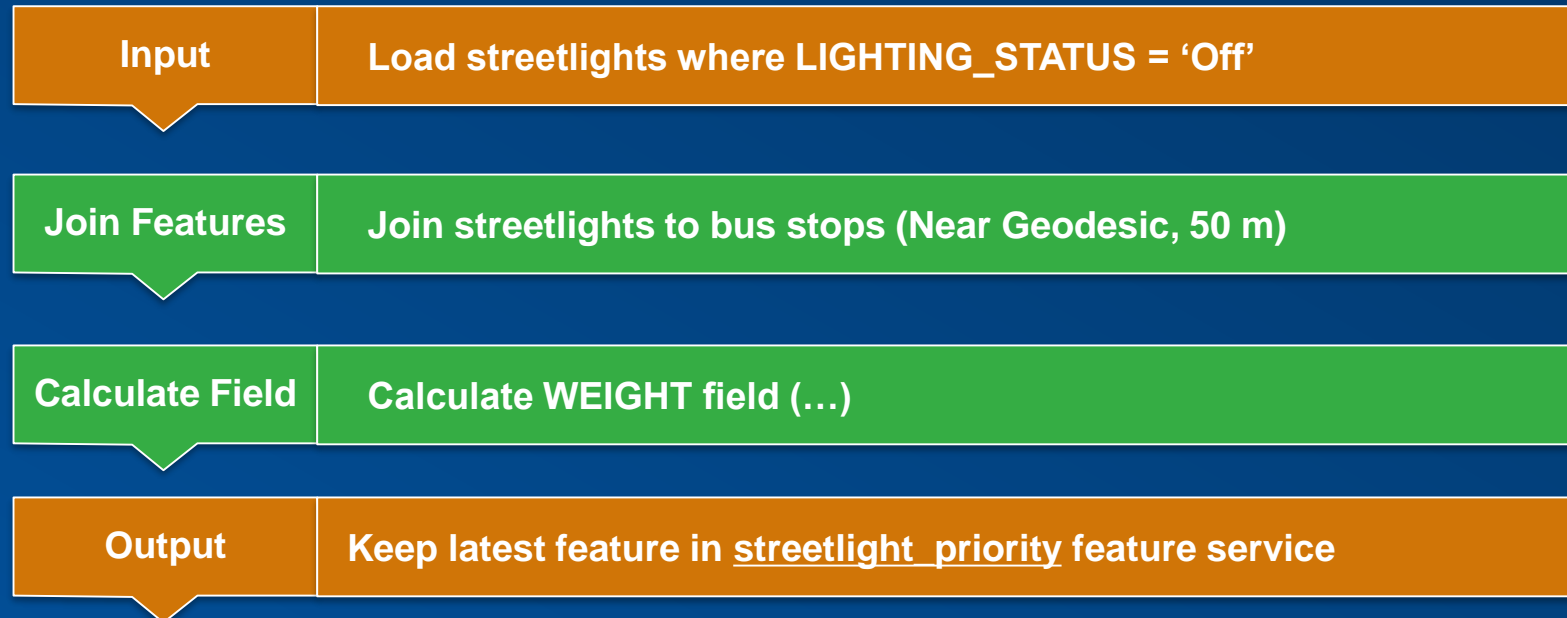
Batch Analytic
analyzing businesses near streetlight outages

Input	Load streetlights where LIGHTING_STATUS = 'Off'

Join Features	Join streetlights to **businesses** (Near Geodesic, 50 m)

Calculate Field	Calculate WEIGHT field (…)

Output	Keep latest feature in streetlight_priority feature service

R&D
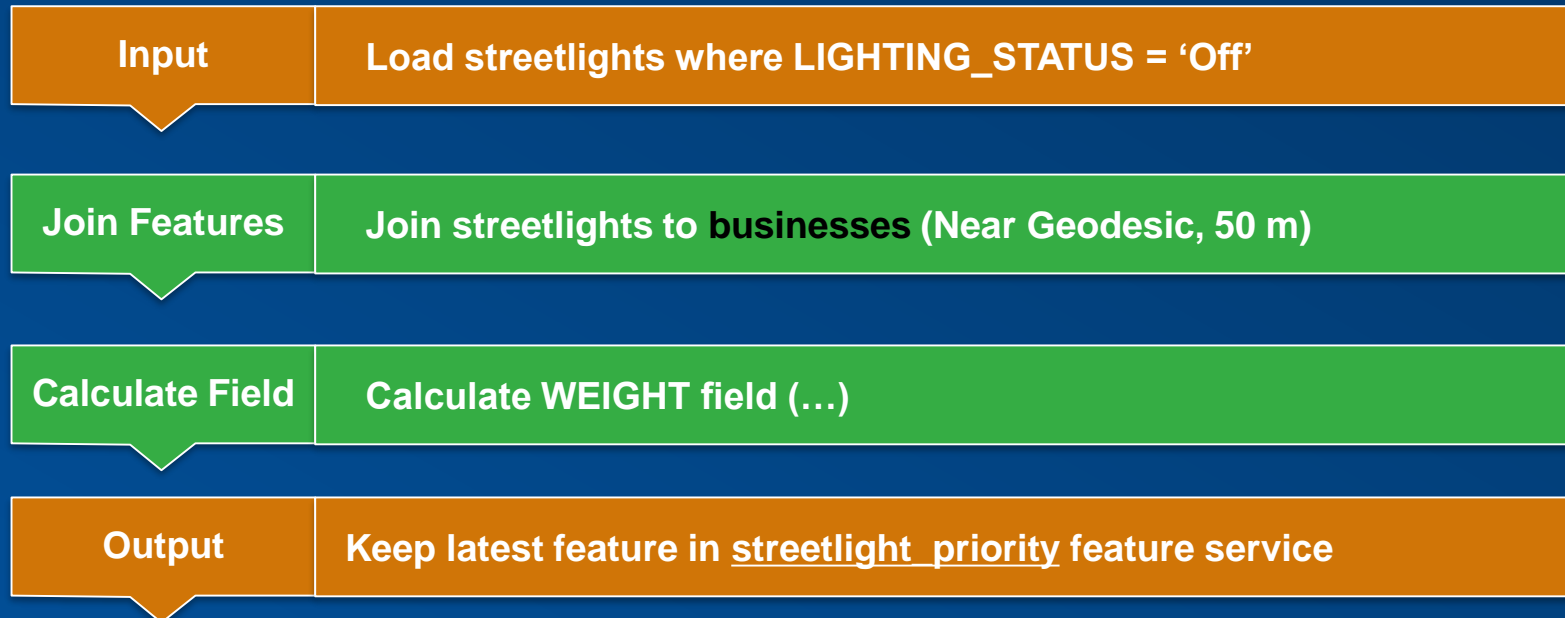
Batch Analytic

analyzing human movement near streetlight outages
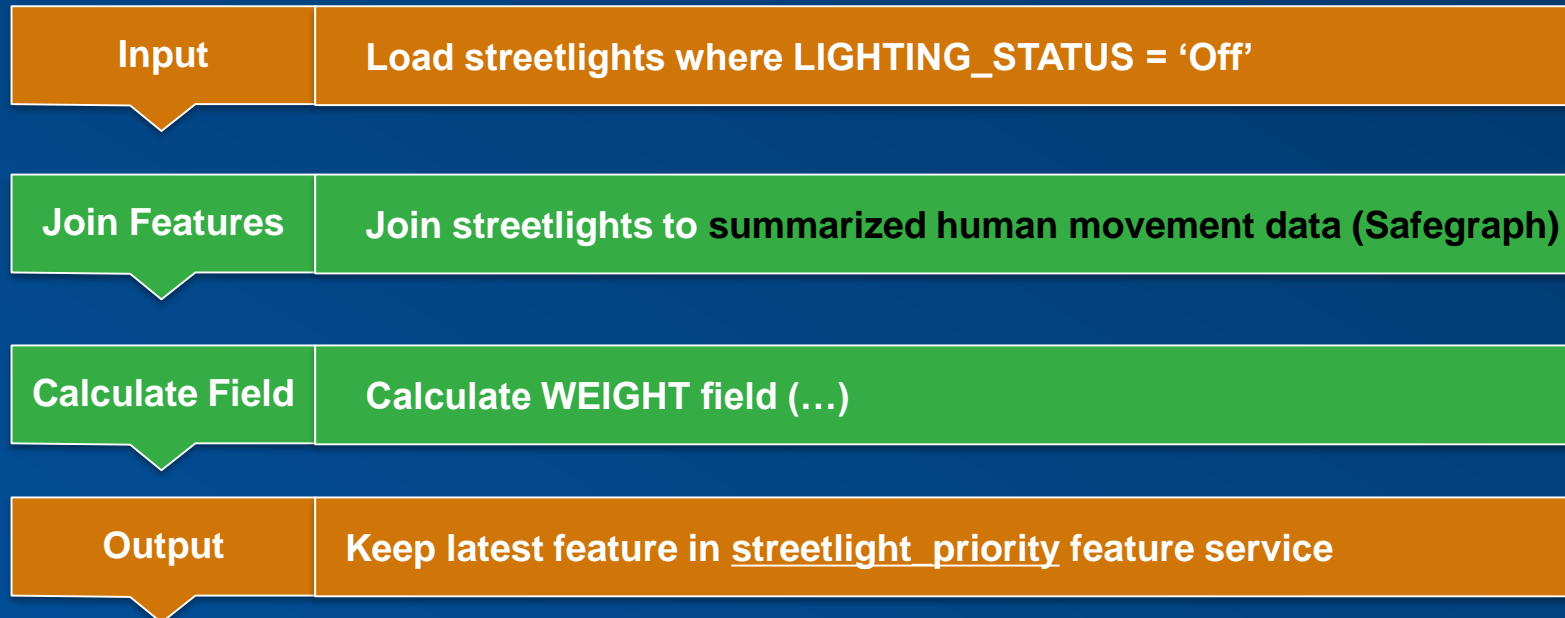
Input	Load streetlights where LIGHTING_STATUS = 'Off'
Join Features	Join streetlights to **summarized human movement data (Safegraph)**
Calculate Field	Calculate WEIGHT field (…)
Output	Keep latest feature in <u>streetlight_priority</u> feature service

R&D

Street Lights - LA

Visualizing and analyzing street light device status

Optimizing street light maintenance priority based on context

R&D

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

R&D

- **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**!

- **Real-Time GIS:** Best Practices

  Tue, 1:45 - 2:45 pm, 152 B
  Wed, 2:45 - 3:45 pm, 152 B

- **ArcGIS GeoEvent Server:** Configuring Real-Time Web Apps

  Tue, 3:00 - 4:00 pm, 152 B
  Wed, 5:15 - 6:15 pm, 152 B

- **ArcGIS GeoEvent Server:** An Introduction

  Wed, 8:15 - 9:15 am, 152 B

- **Real-Time & Big Data GIS:** The Road Ahead

  Wed, 1:30 - 2:30 pm, 152 B

- **ArcGIS GeoEvent Server:** Applying Real-Time Analytics

  Wed, 4:00 – 5:00 pm, 152 B

- **Real-Time and Big Data:**
  Leveraging the Spatiotemporal Big Data Store

  Tue, 4:15pm - 5:15 pm, 152 B
  Wed, 11:00 am -12:00 pm, 152 B

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
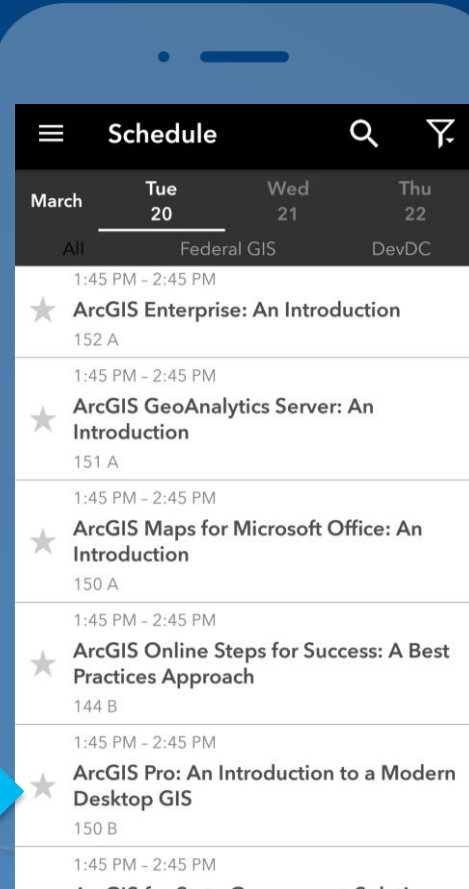Hall B

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

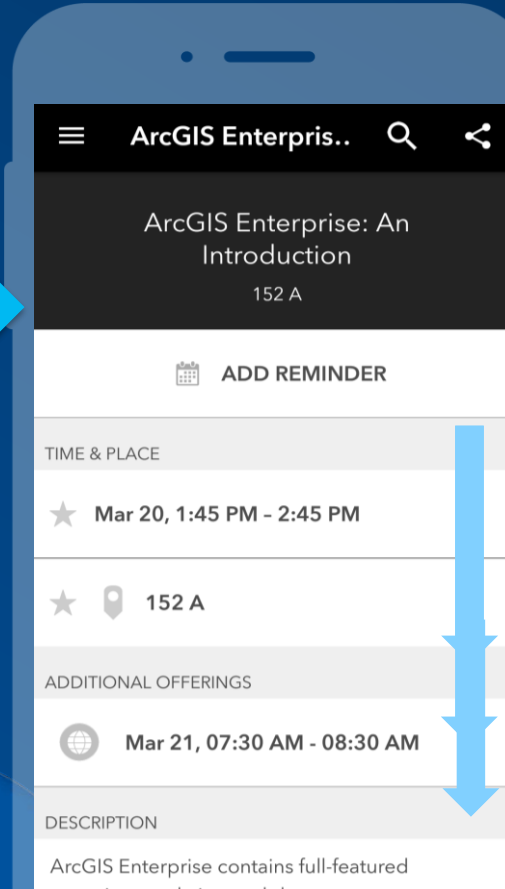# Please Take Our Survey in the Esri Events App

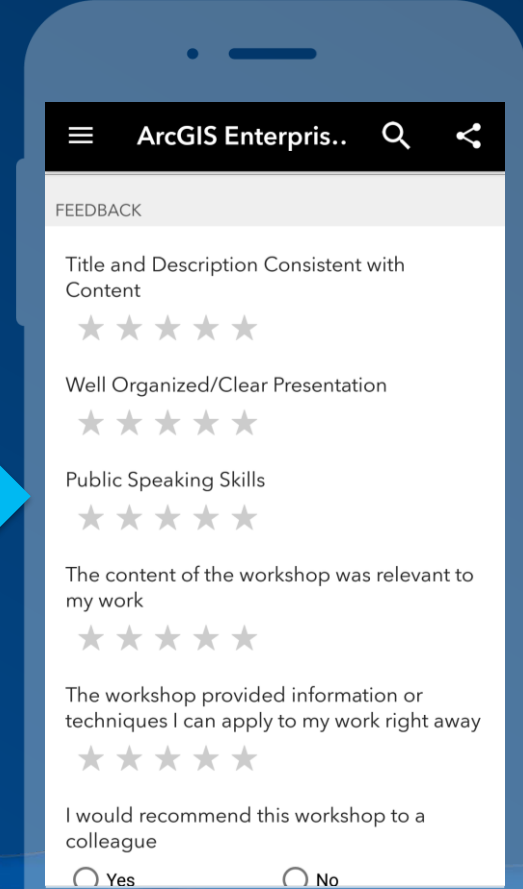**Download the Esri Events app and find your event**

Select the session you attended

Scroll down to find the feedback section

Complete answers and select "Submit"