# Real-Time GIS: Applying Real-Time Analytics

**Mark Bramer**

**Esri Professional Services**

**mbramer@esri.com**

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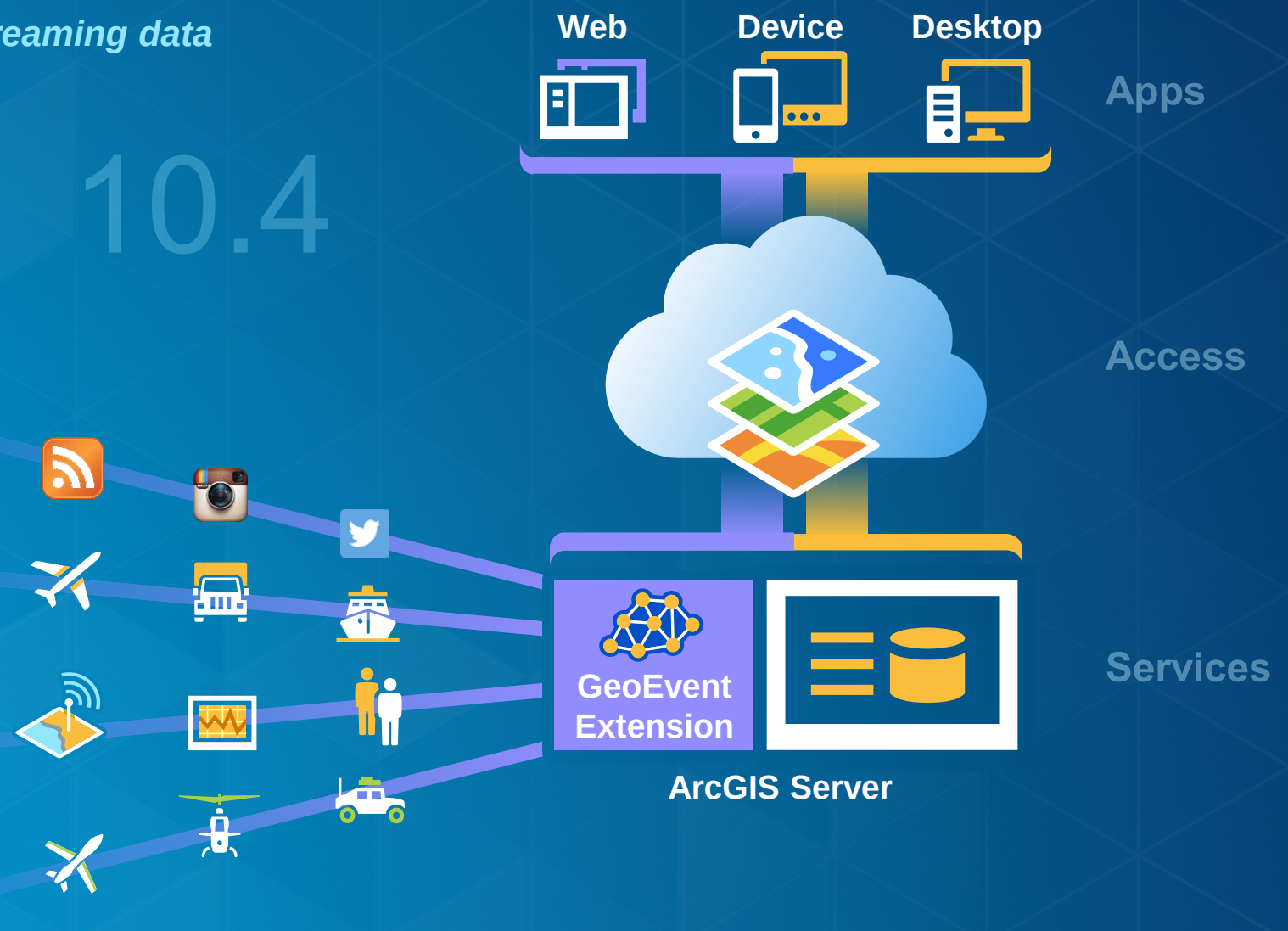
PETROLEUM
GIS CONFERENCE

# Real-Time GIS

*Integration and exploitation of streaming data*

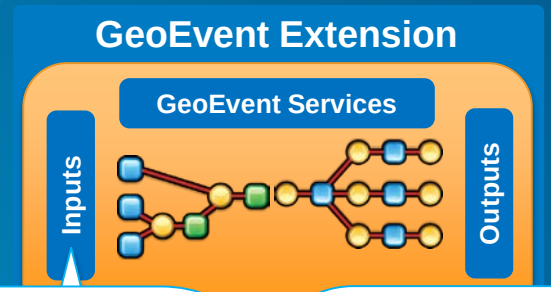
10.4

- Integrates real-time streaming data into ArcGIS
- Performs continuous processing and real-time analytics
- Sends updates and alerts to those who need it where they need it



# Receiving Real-Time Data

*Easily integrate real-time streaming data into ArcGIS using an Input Connector*




You can create your own connectors.

## Out of the Box

- Poll an ArcGIS Server for Features
- Poll an external website for JSON
- Poll an external website for XML
- Receive Features on a REST endpoint
- Receive JSON on a REST endpoint
- Receive JSON on a WebSocket
- Receive RSS
- Receive Text from a TCP Socket
- Receive Text from a UDP Socket
- Receive XML on a REST endpoint
- Subscribe to a WebSocket for JSON
- Watch a Folder for New CSV files
- Watch a Folder for New JSON files

## Esri Gallery

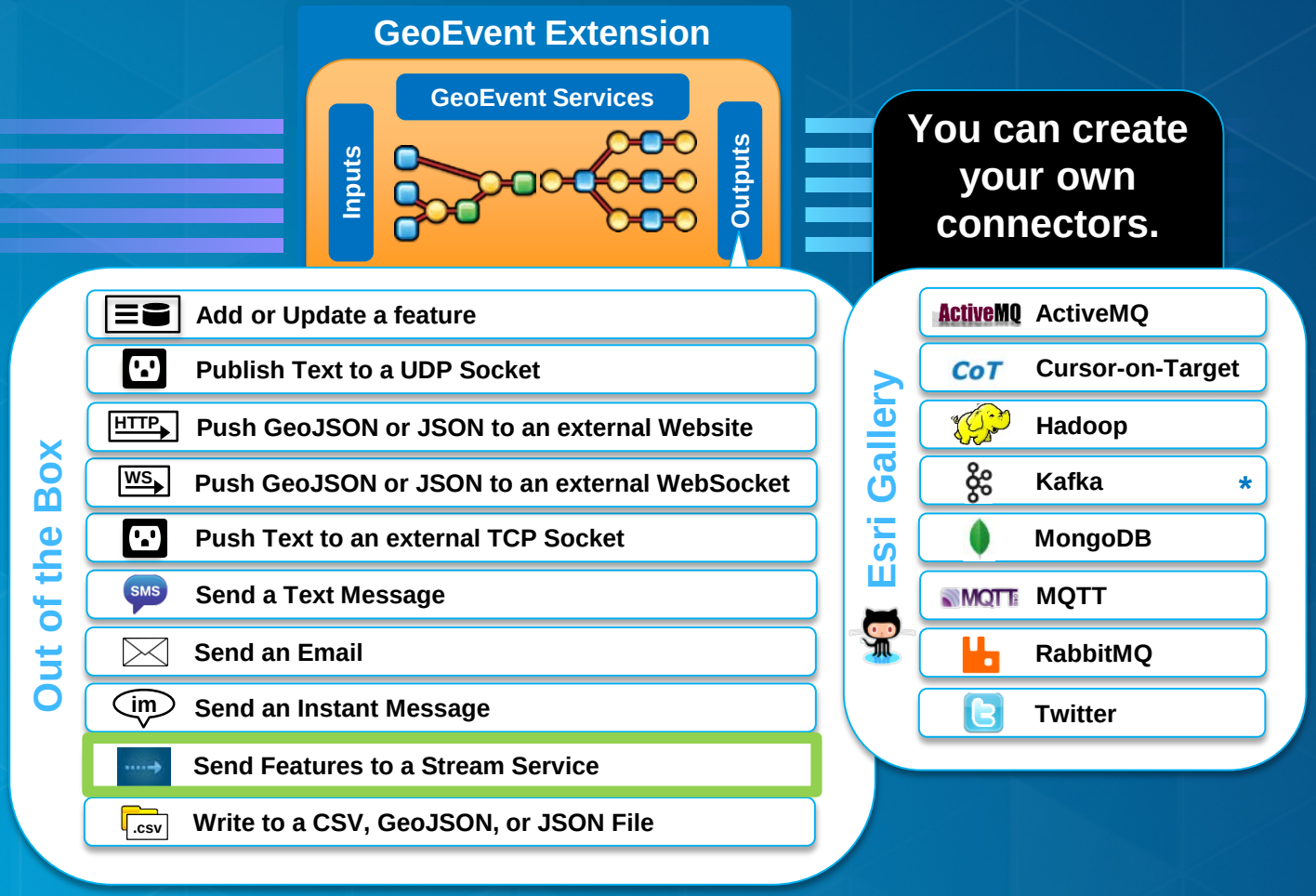
- ActiveMQ
- CAP
- Cursor-on-Target
- GeoMessage
- Instagram
- Kafka *
- NMEA
- RabbitMQ *
- Sierra Wireless (RAP)
- Trimble (TAIP)
- Twitter
- VMF

## Partner Gallery

- CompassCom
- exactEarth
- FAA (ASDI)
- Geofeedia
- GNIP
- Harris
- NetworkFleet
- OSIsoft
- Valarm
- Zonar

# How do I update and alert those who need it where they need it?

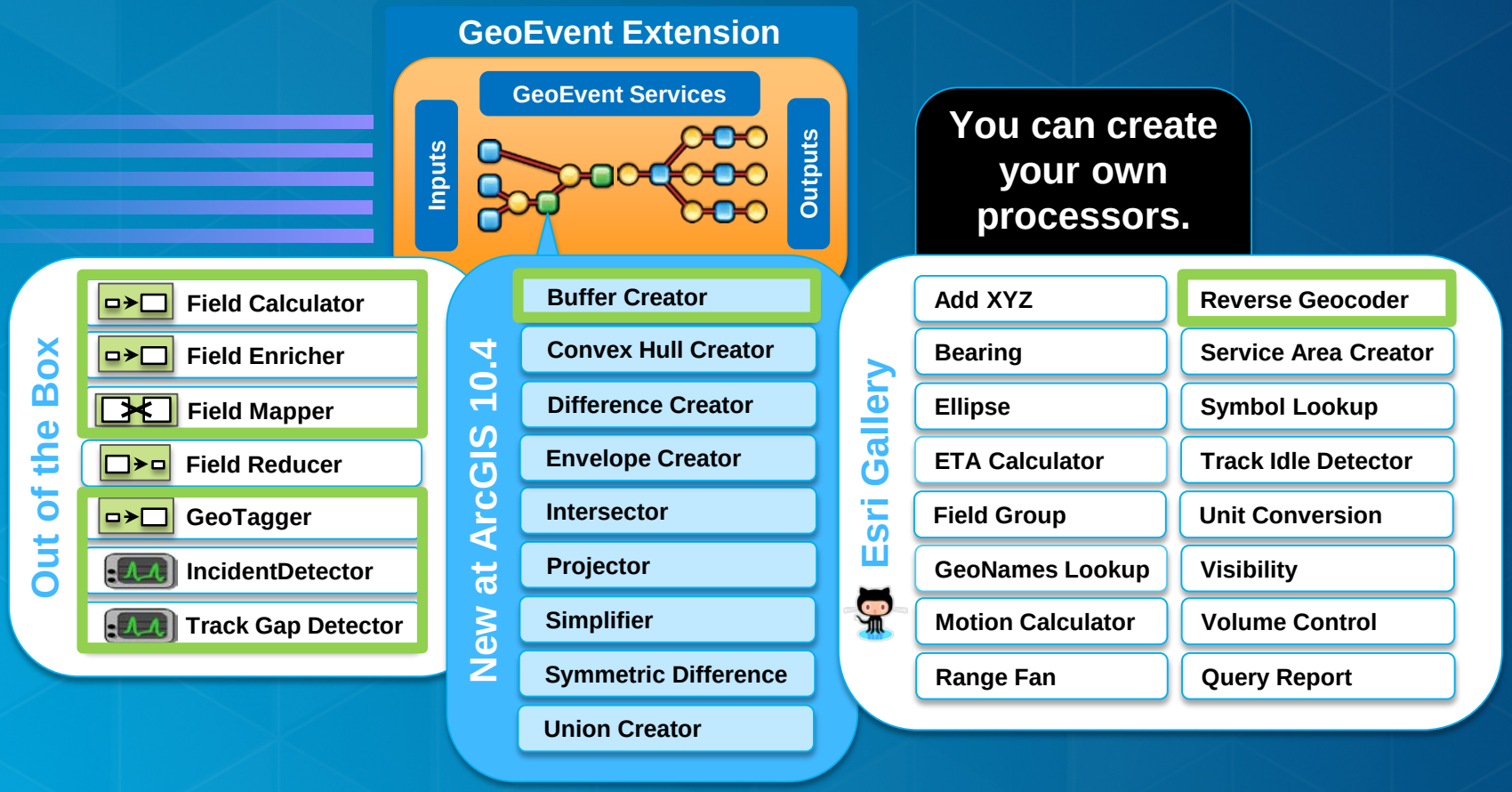
*Easily disseminate notifications, alerts, and updates using an Output Connector*



# Applying real-time analytics

*GeoEvent Processing*

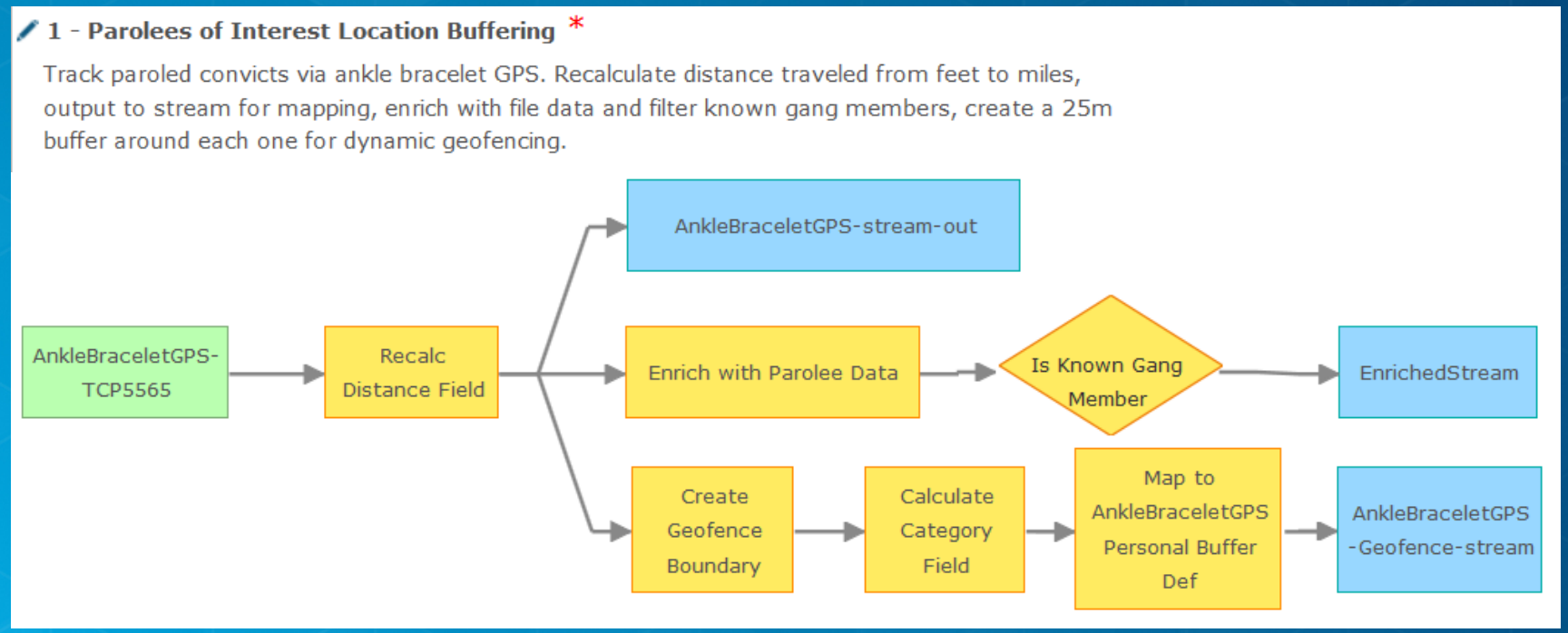
- You can perform continuous analytics on GeoEvents as they are received using a processor.



# Applying real-time analytics

*Perform real-time analytics by defining a GeoEvent Service*

- A **GeoEvent Service** configures the flow of GeoEvents,
  - The **Filtering** and **GeoEvent Processing** steps to perform,
  - what input(s) to apply them to,
  - and what output(s) to send the results to.

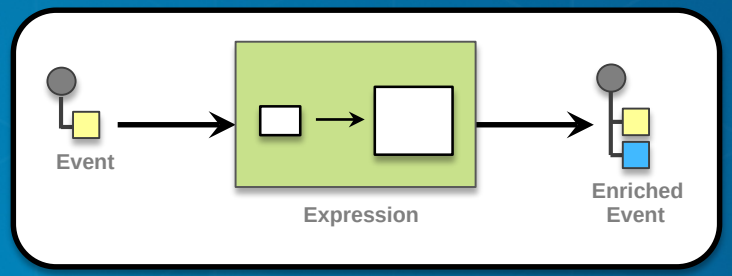


# GeoEvent Processing

*Calculate new fields on a GeoEvent*

- A **Field Calculator** processor uses an expression to
  - calculate a new field or update an existing field.
  - Expressions can be mathematical expressions, string operations, or regular expressions.

| | |
|---|---|
| SuspectID | V10987 |
| Date | 1405176845553 |
| BatteryLevel | Low |
| Distance | 105.6 |
| Speed | 1.2 |
| Course | 186.4 |
| geometry | -117.123…, 36.064… |




Convert from Feet to Miles Expression:

Distance / 5280

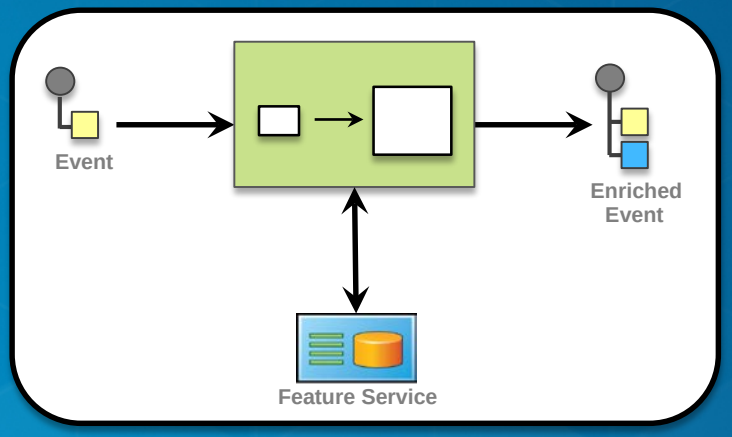
| | |
|---|---|
| SuspectID | V10987 |
| Date | 1405176845553 |
| BatteryLevel | Low |
| Distance | 0.02 |
| Speed | 1.2 |
| Course | 186.4 |
| geometry | -117.123…, 36.064… |

# GeoEvent Processing

*Enrich a GeoEvent with new fields*

- A **Field Enricher** processor
  - Uses a field on the incoming GeoEvent to join with another data source and retrieve fields.
  - After the Field Enricher retrieves the required data from a data source, it enriches the GeoEvent with new fields derived from the source.

| | |
|---|---|
| SuspectID | V10987 |
| Date | 1405176845553 |
| BatteryLevel | Low |
| Distance | 105.6 |
| Speed | 1.2 |
| Course | 186.4 |
| geometry | -117.123…, 36.064… |




| | | |
|---|---|---|
| SuspectID | NoContact | NoEntry |
| K90123 | | Temecula gangland |
| V10987 | F65432 | Pass Christian School |
| … | … | … |

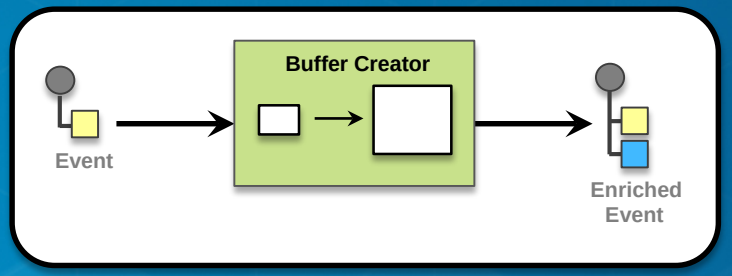
| | |
|---|---|
| SuspectID | V10987 |
| Date | 1405176845553 |
| BatteryLevel | Low |
| Distance | 105.6 |
| Speed | 1.2 |
| Course | 186.4 |
| geometry | -117.123…, 36.064… |
| NoContact | F65432 |
| NoEntry | Pass Christian School |

# GeoEvent Processing

*Enrich the geometry of a GeoEvent*

- A **Buffer Creator** processor
  - applies a geometric buffer to a geometry field on the incoming GeoEvent
  - and either:
    - enriches the GeoEvent with a new geometry field representing the buffered result
    - or replaces the geometry of the incoming GeoEvent with the new buffer

| | |
|---|---|
| SuspectID | S90909 |
| Date | 1405176845553 |
| BatteryLevel | High |
| Distance | 0.2 |
| geometry | -117.123…, 36.064… |



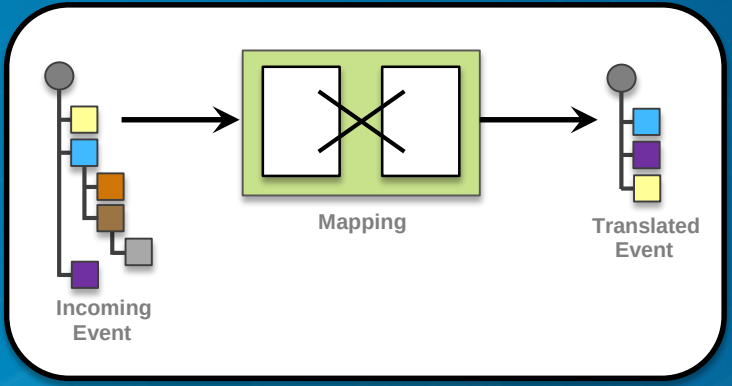

| | |
|---|---|
| SuspectID | S90909 |
| Date | 1405176845553 |
| BatteryLevel | High |
| Distance | 0.2 |
| geometry | -117.123…, 36.064… |
| buffer | rings" : [ [ [ -116.3175, 33.6703],[-116.3175, 33.6703]…]] |

# GeoEvent Processing

*Adjust the format of a GeoEvent*

- A **Field Mapper** processor
  - Translates from one GeoEvent Definition to another
  - Specifying how fields map across the GeoEvent Definitions

| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176845553 |
| Sensor | 2 |
| BatteryLevel | Medium |
| Latitude | 36.064 |
| Longitude | -117.123 |
| Distance | 0.01 |
| DurationMin | 1.03 |
| SpeedMPH | 0.62 |
| CourseDeg | 250.0 |
| Geometry | -117.123…, 36.064… |
| Category | AnkleBraceletGPS |



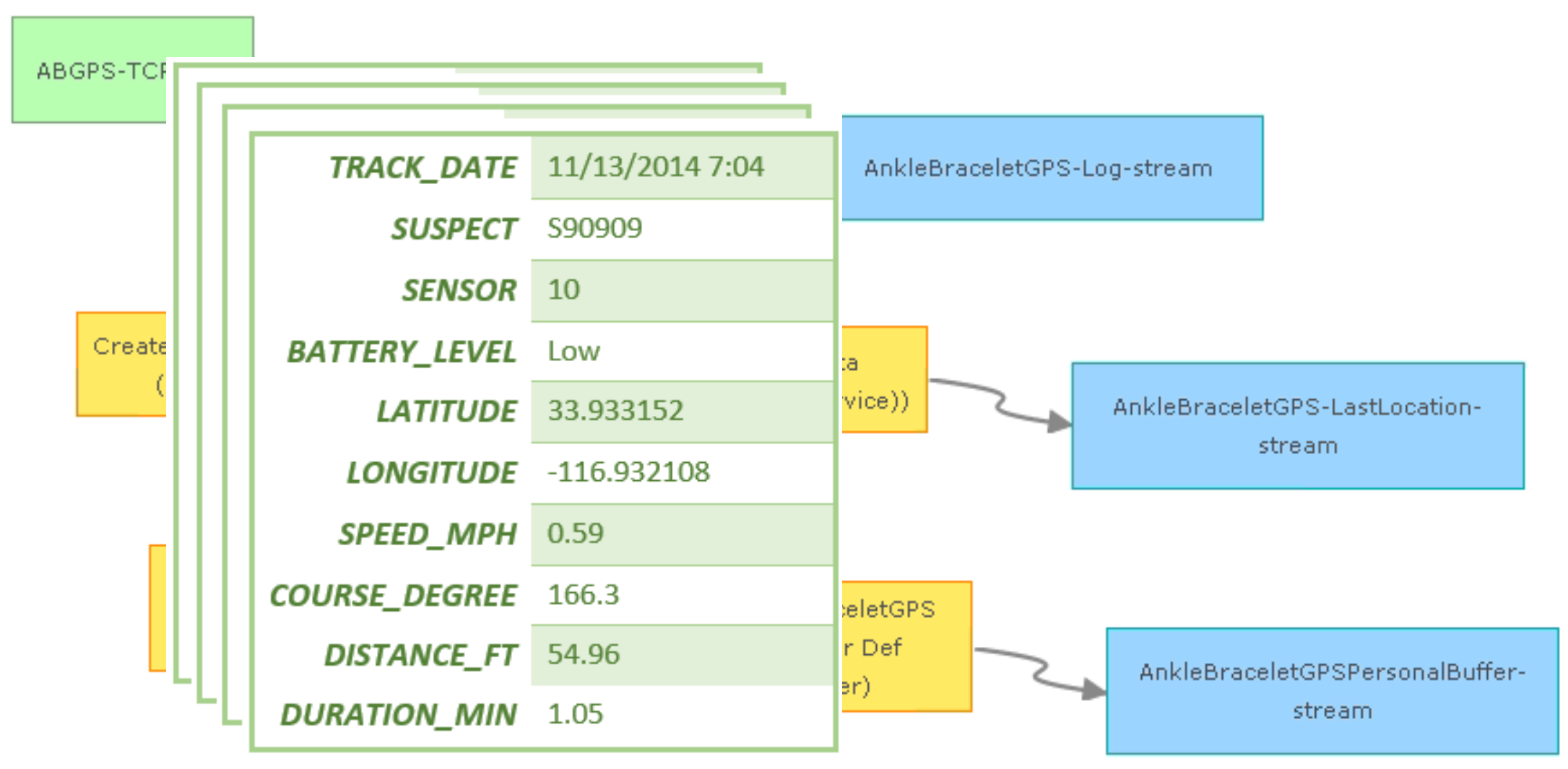

| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176845553 |
| Geometry | -117.123…, 36.064… |
| Category | AnkleBraceletGPS |

# Tracking Parolees and Buffering Location

**Field Calculator, Field Enricher, Buffer Creator, Field Mapper**

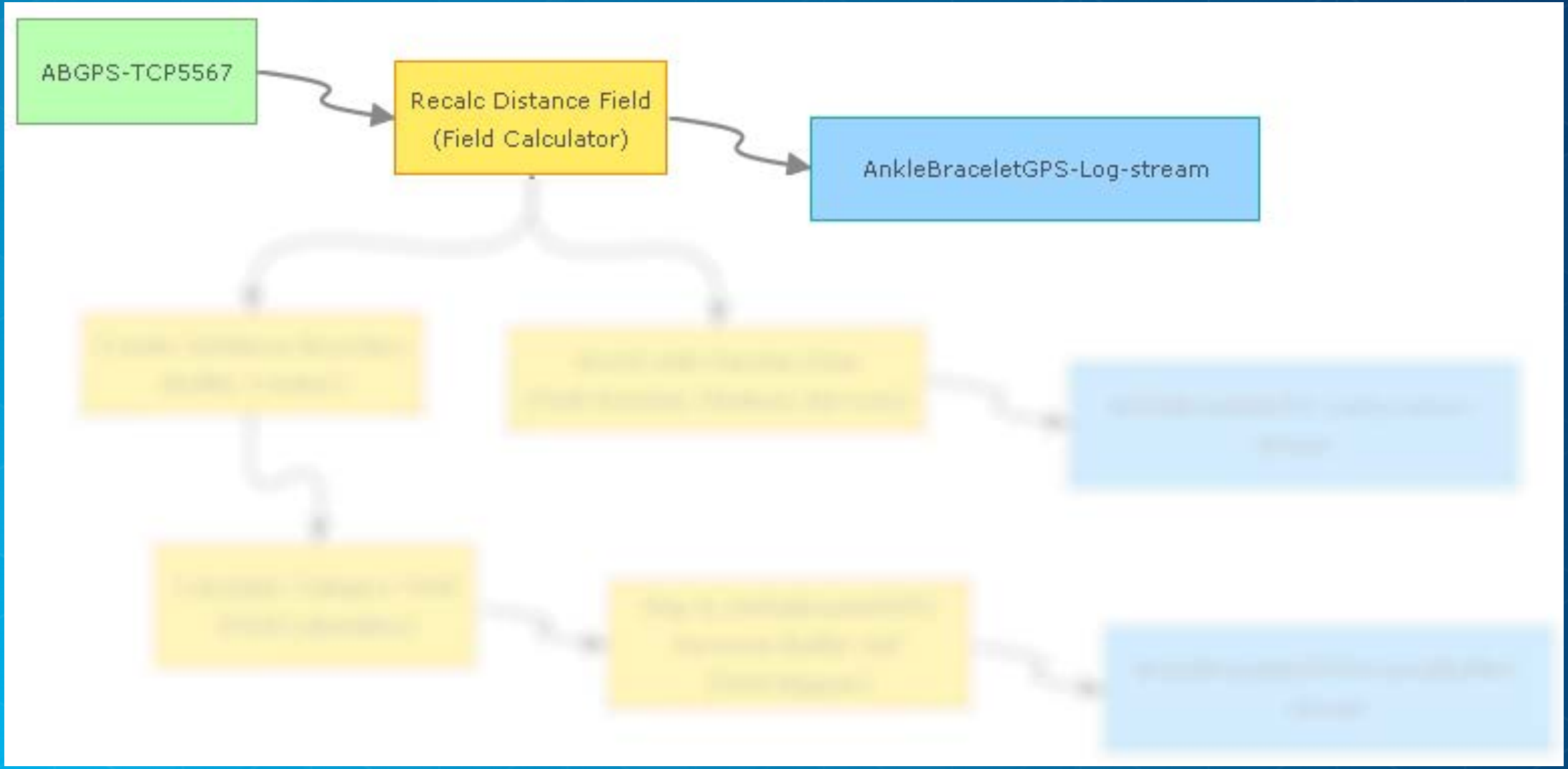
# Applying real-time analytics

*Perform real-time analytics by defining a GeoEvent Service*



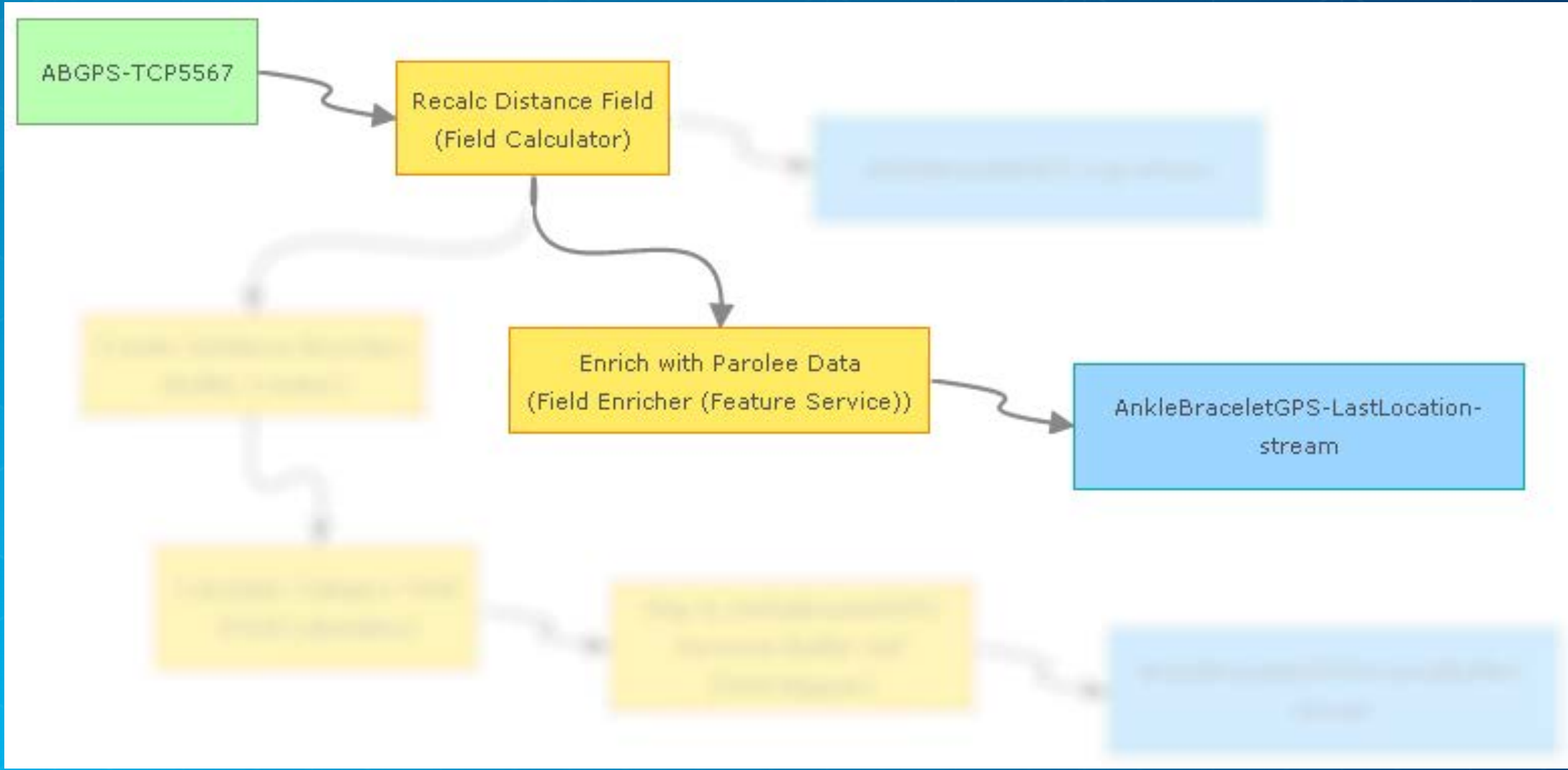
# Applying real-time analytics

*Perform real-time analytics by defining a GeoEvent Service*



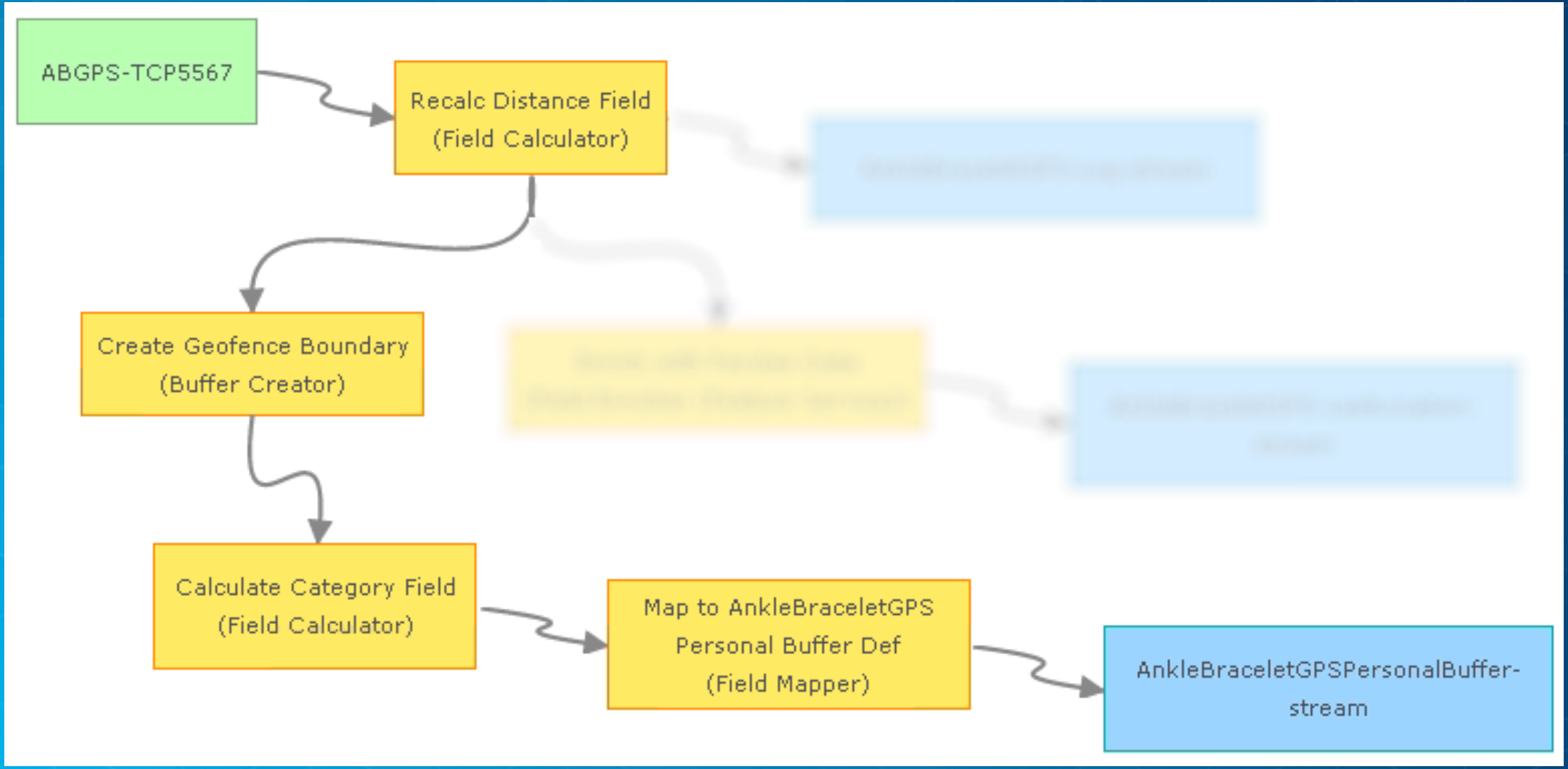
# Applying real-time analytics

*Perform real-time analytics by defining a GeoEvent Service*



# Applying real-time analytics

*Perform real-time analytics by defining a GeoEvent Service*



# Video Demo

## Tracking Parolees and Buffering Location

**Field Calculator, Field Enricher, Buffer Creator, Field Mapper**

# Parolee Geofencing

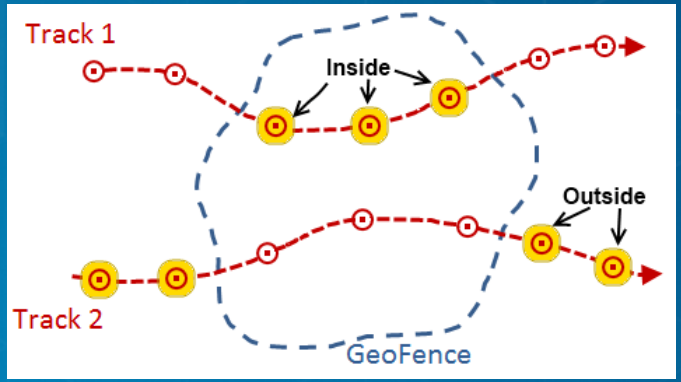
## Geofences, Geotagging, Incident Detection and Reverse Geocoding

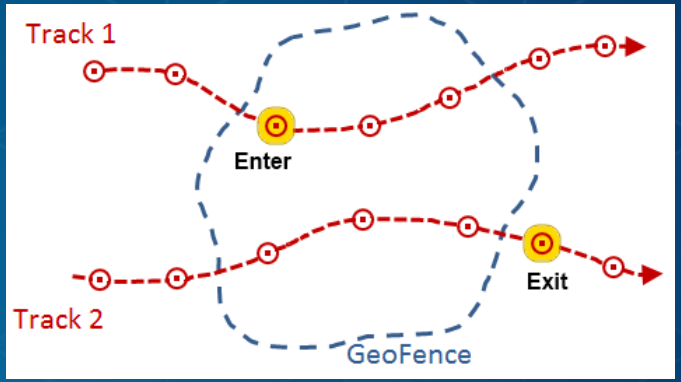
# GeoEvent filtering

*Geofencing*

- **Spatial operators at 10.2:**

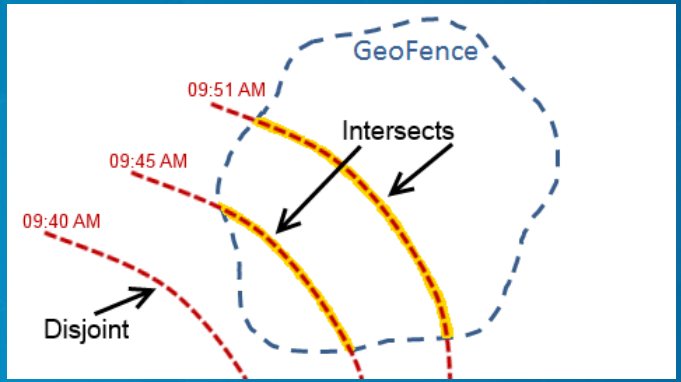
| | |
|---|---|
| inside | outside |
| enter | exit |

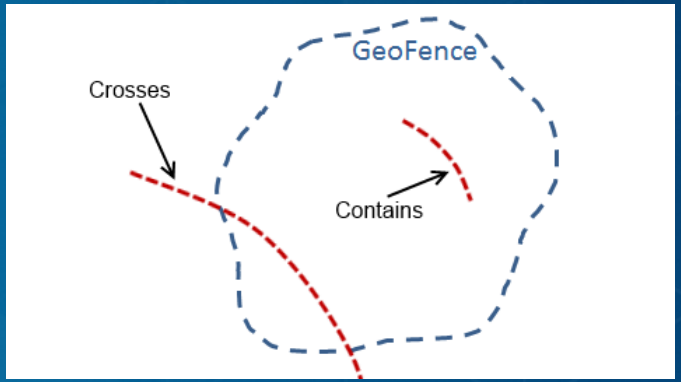



- **Spatial operators at 10.3 & 10.4:**

| | |
|---|---|
| intersect | disjoint |
| touches | contains |
| crosses | equals |
| overlaps | within |

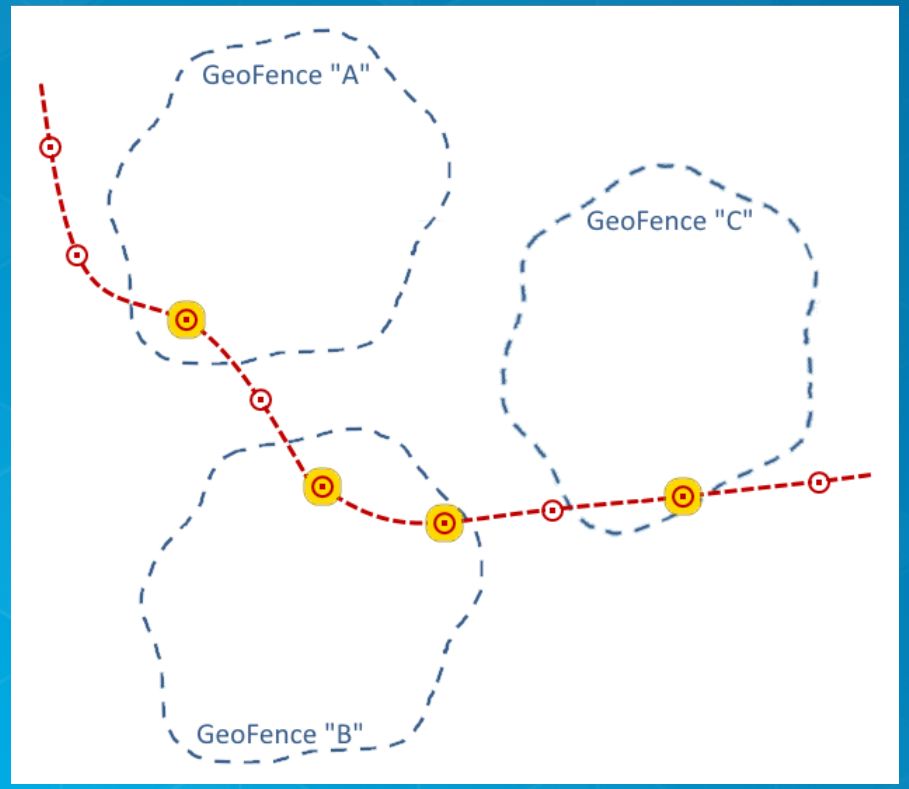


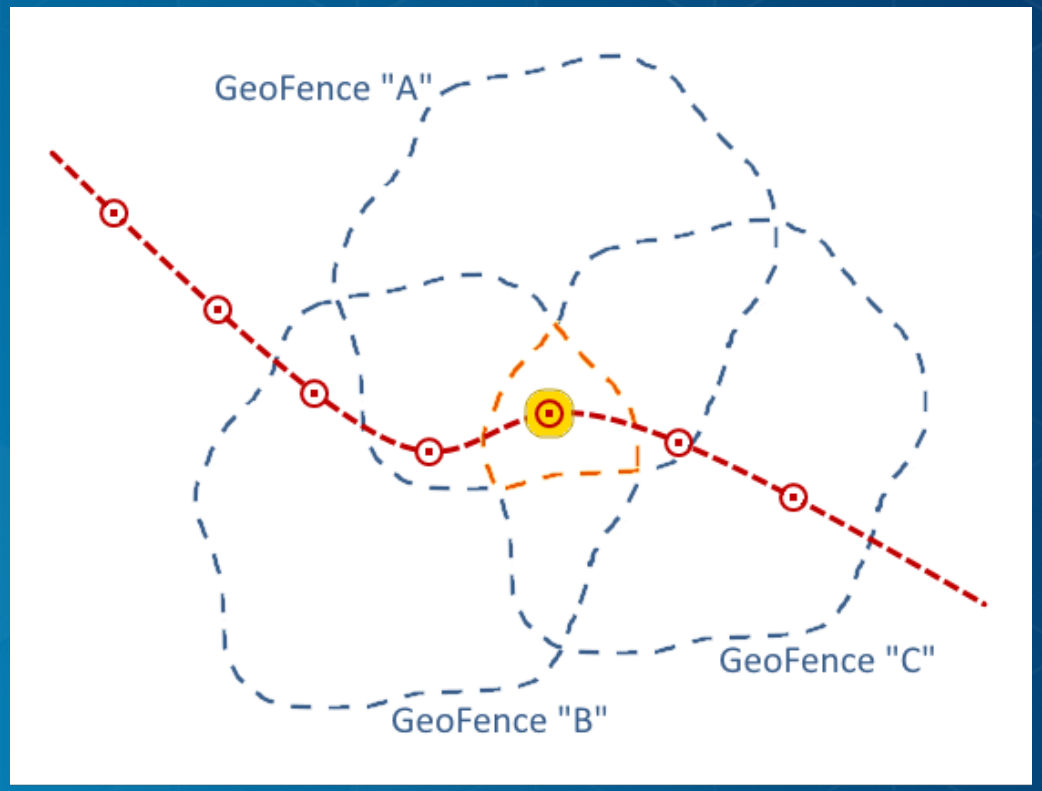
# GeoEvent filtering

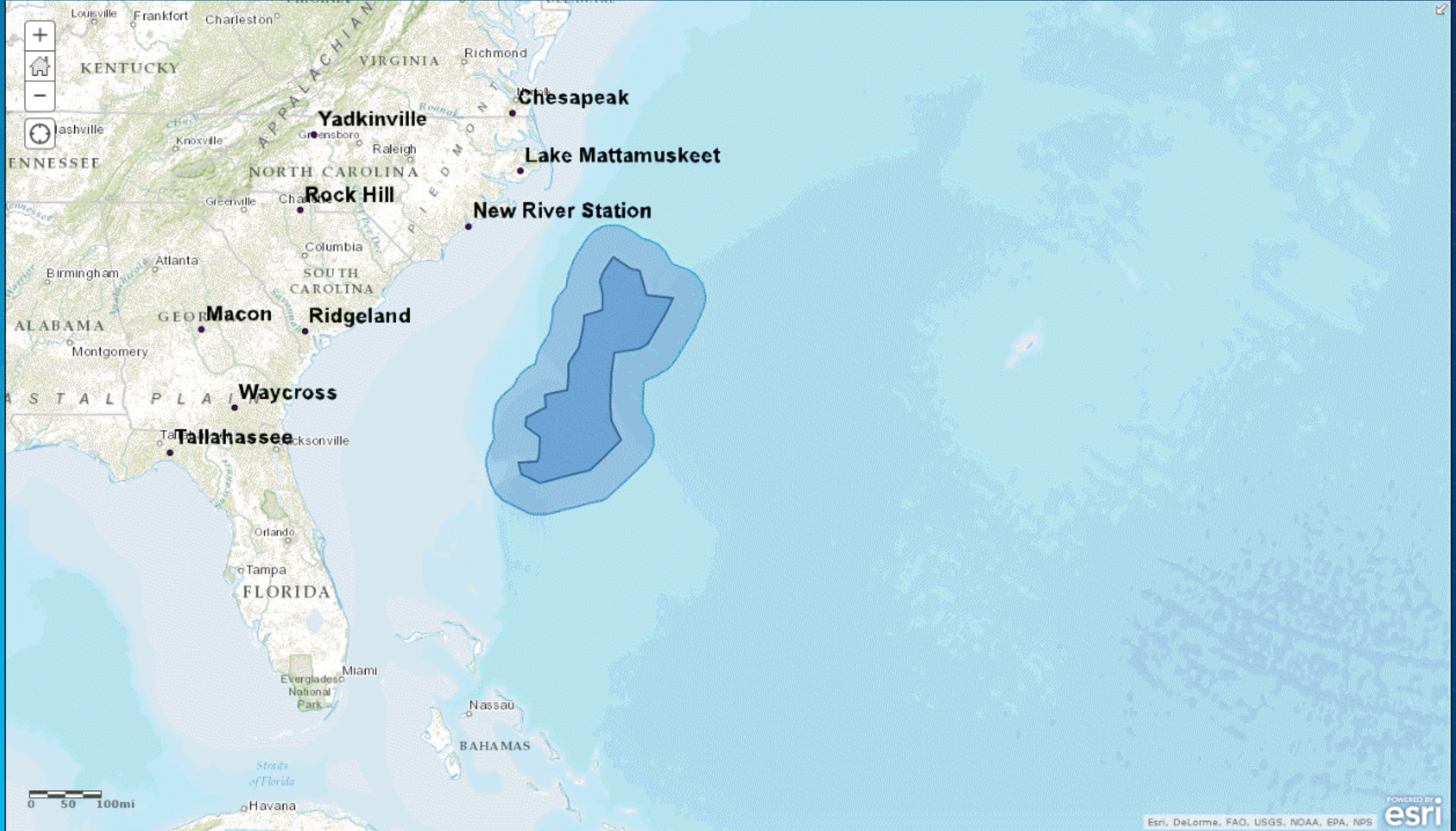
*Geofencing scope*

- **Geofencing scope:  Any or All**
- **Any geofence**




- **All geofences**

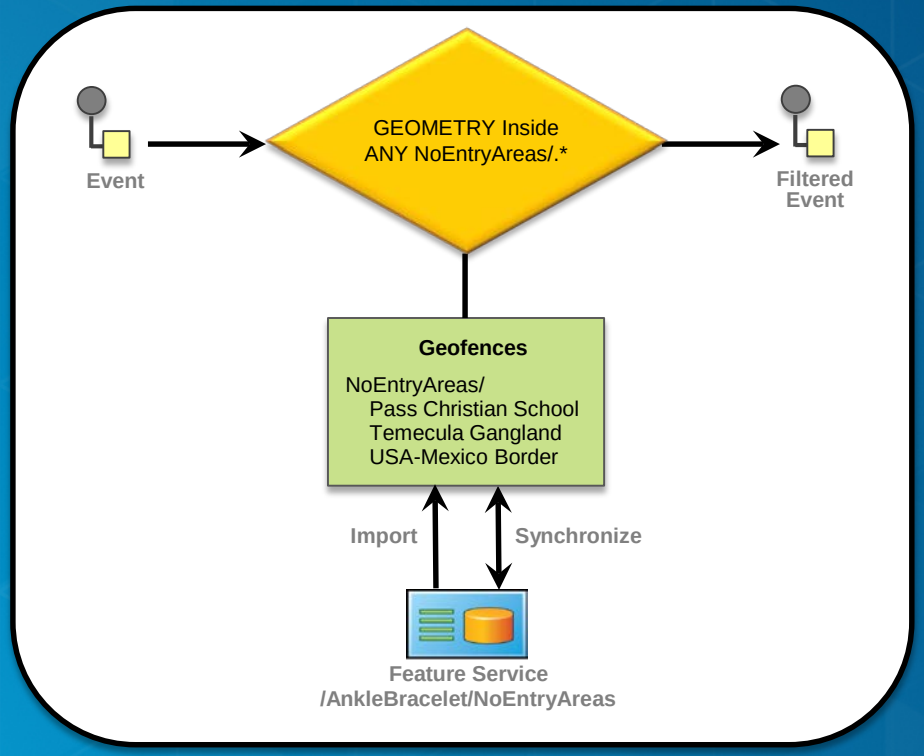



Chesapeak
Yadkinville
Lake Mattamuskeet
Rock Hill
New River Station
Macon
Ridgeland
Waycross
Tallahassee
Louisville
Frankfort
Charleston
KENTUCKY
VIRGINIA
Richmond
Nashville
Knoxville
Greensboro
Raleigh
NORTH CAROLINA
Greenville
Columbia
Atlanta
Birmingham
SOUTH CAROLINA
ALABAMA
Montgomery
Orlando
Tampa
FLORIDA
Miami
Everglades National Park
Nassau
BAHAMAS
Straits of Florida
Havana
0 50 100mi
Esri, DeLorme, FAO, USGS, NOAA, EPA, NPS

# GeoEvent filtering

*Geofencing*

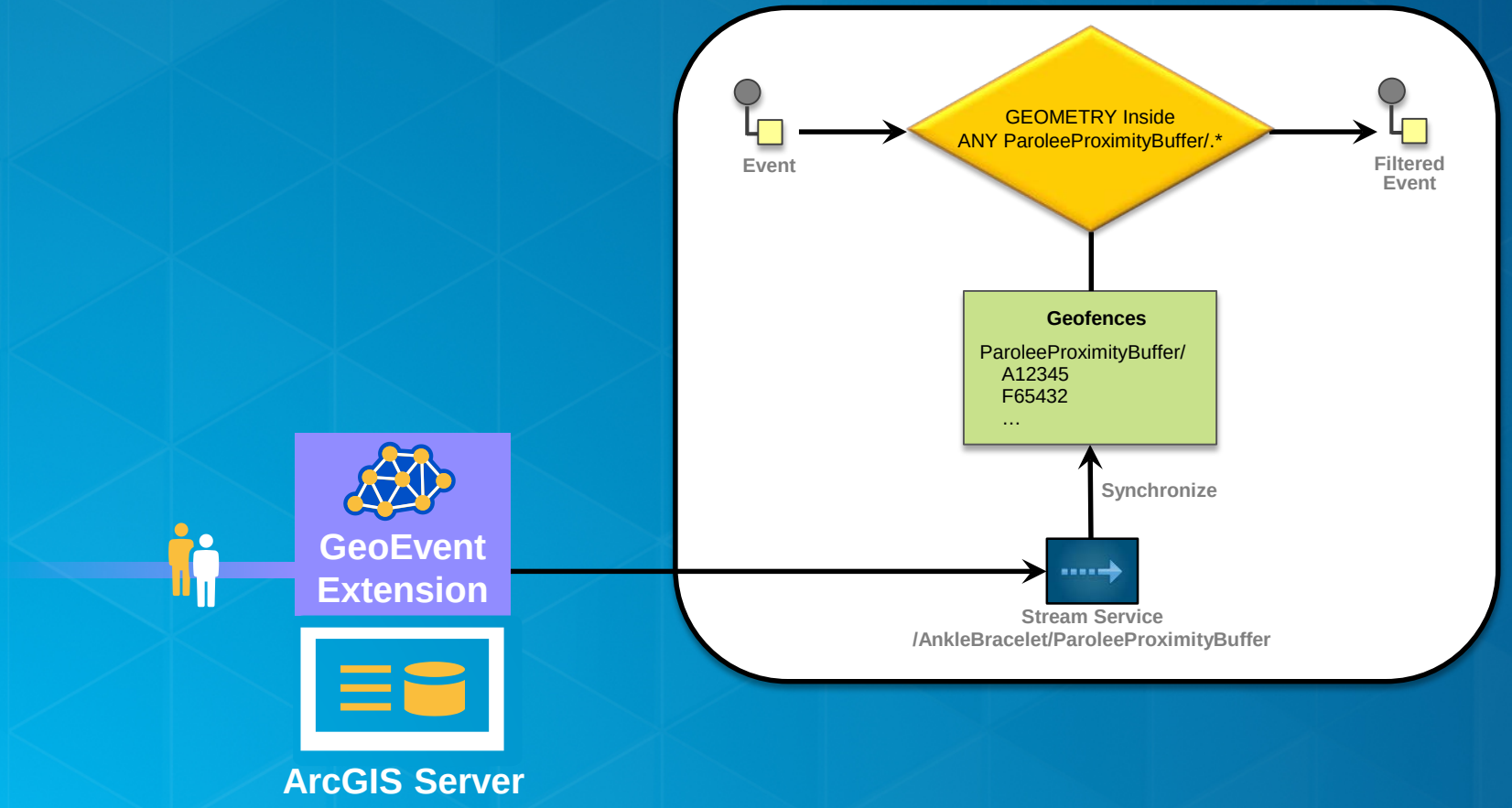
- Import geofences from a feature service – reads once
- Synchronize geofences with a feature service – refreshes periodically



# GeoEvent filtering

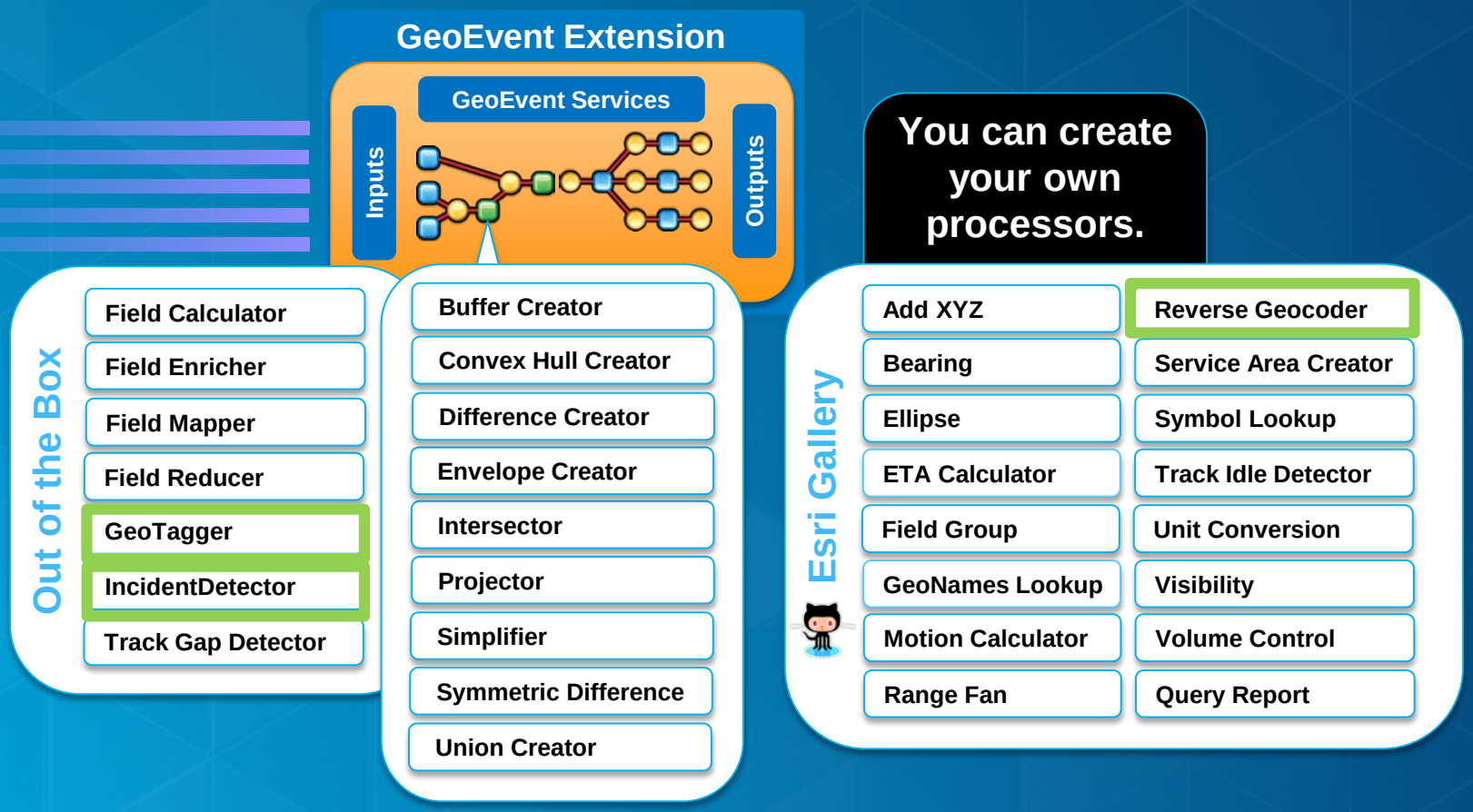
*Geofencing*

- **Synchronize geofences with a stream service – updates continuously**



# Applying real-time analytics

*Perform continuous analytics on GeoEvents as they are received using processors*

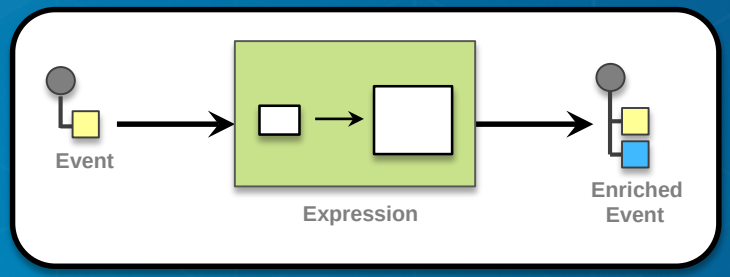


# GeoEvent processing

*Enrich a GeoEvent with geographic context*

- A GeoTagger processor
  - uses a spatial expression to tag the event with related geometries.

| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176845553 |
| Sensor | 2 |
| BatteryLevel | Medium |
| Latitude | 36.064 |
| Longitude | -117.123 |
| Distance | 0.01 |
| DurationMin | 1.03 |
| SpeedMPH | 0.62 |
| CourseDeg | 250.0 |
| Geometry | -117.123…, 36.064… |
| Category | AnkleBraceletGPS |

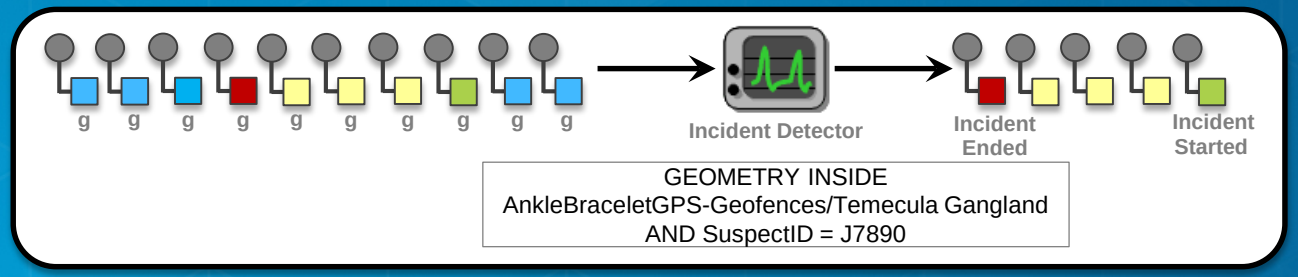



| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176845553 |
| Sensor | 2 |
| BatteryLevel | Medium |
| Latitude | 36.064 |
| Longitude | -117.123 |
| Distance | 0.01 |
| DurationMin | 1.03 |
| SpeedMPH | 0.62 |
| CourseDeg | 250.0 |
| Geometry | -117.123…, 36.064… |
| Category | AnkleBraceletGPS |
| IsInside | Temecula gangland |

# GeoEvent processing

*Notify about a pattern of interest*

- An **Incident Detector** Processor
  - creates an Incident upon an opening expression being met,
  - maintains state for the duration of an incident,
  - closes the incident based on a closing expression, or expiration.




| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176935553 |
| BatteryLevel | Medium |
| Distance | 0.01 |
| DurationMin | 1.03 |
| SpeedMPH | 0.62 |
| Geometry | -117.1....., 36.0..... |

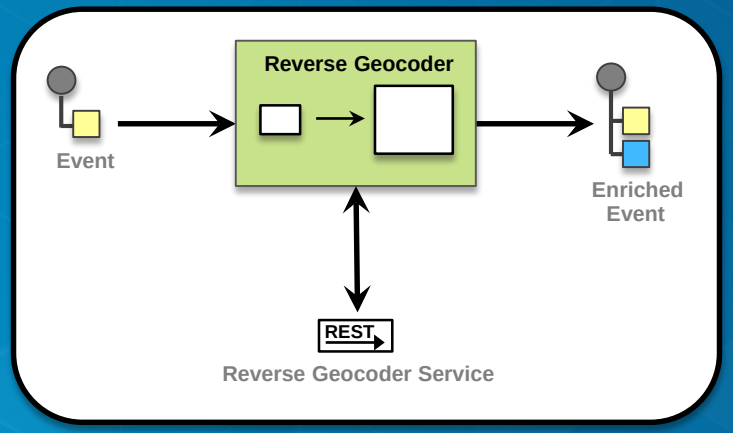
| | |
|---|---|
| id | c982db54-…-3bbb61211eb6 |
| name | Geofence violation |
| type | Cumulative |
| status | Ended |
| alertType | Warning |
| openCondition | (INSIDE(AnkleBraceletGPS/Temecula gangland) AND (SuspectID = J7890)) |
| closeCondition | |
| description | Ended at 7/12/14 10:54 AM and lasted for 40 seconds |
| timestamp | 1405176905553 |
| definitionName | incident |
| definitionOwner | com.esri.ges.processor/IncidentDetector/10.3.0 |
| trackId | J7890 |
| geometry | -117.123…, 36.064… |
| duration | 40000 |
| dismissed | false |
| assignedTo | |
| note | |

# GeoEvent processing

*Enrich a GeoEvent with the nearest street address*

- A **Reverse Geocoder** processor
  - Uses a point geometry on the incoming GeoEvent to perform a reverse geocode
  - and enriches the GeoEvent with new field(s) representing matched address.

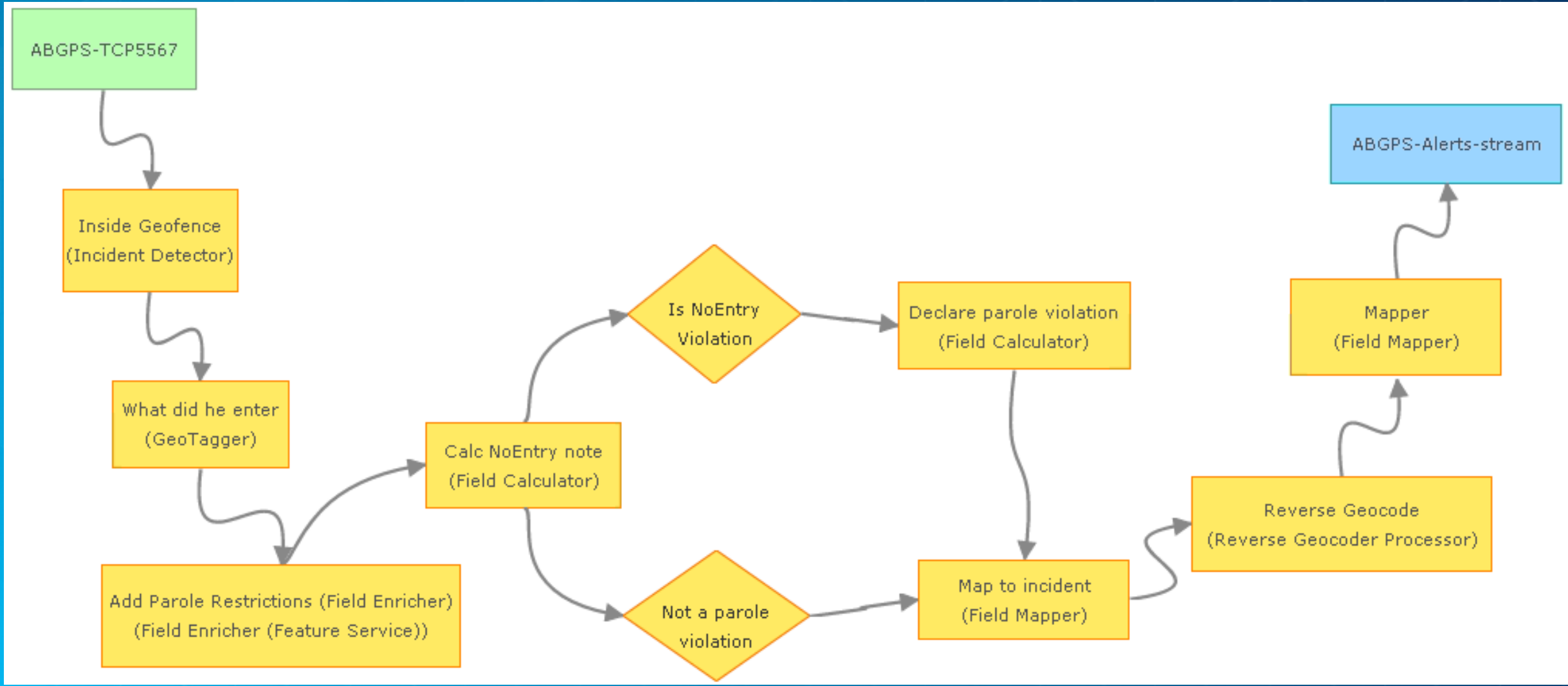
| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176845553 |
| Sensor | 2 |
| BatteryLevel | Medium |
| SpeedMPH | 1.79 |
| Geometry | -116.97…, 33.98… |




| | |
|---|---|
| SuspectID | J7890 |
| Date | 1405176845553 |
| Sensor | 2 |
| BatteryLevel | Medium |
| SpeedMPH | 0.01 |
| Geometry | -116.97…, 33.98… |
| Address | 39583 Avenida Sonrisa |
| Neighborhood | |
| City | Beaumont |
| Subregion | |
| Region | California |
| Postal | 92223 |
| PostalExt | |
| CountryCode | USA |
| Match_addr | 39583 Avenida Sonrisa, Beaumont, California, 92223 |
| Loc_name | USA.PointAddress |

# GeoEvent Filtering

*Enriching events to determine areas a tracked felon is not allowed to enter*



# Video Demo

## Parolee Geofencing

Geofencing, Geotagging, Reverse Geocoding

# Meet up Detection and Alerting

## Dynamic Geofences and Incident Detection

# Video Demo

## Parolee Meetup Detection and Geotagging

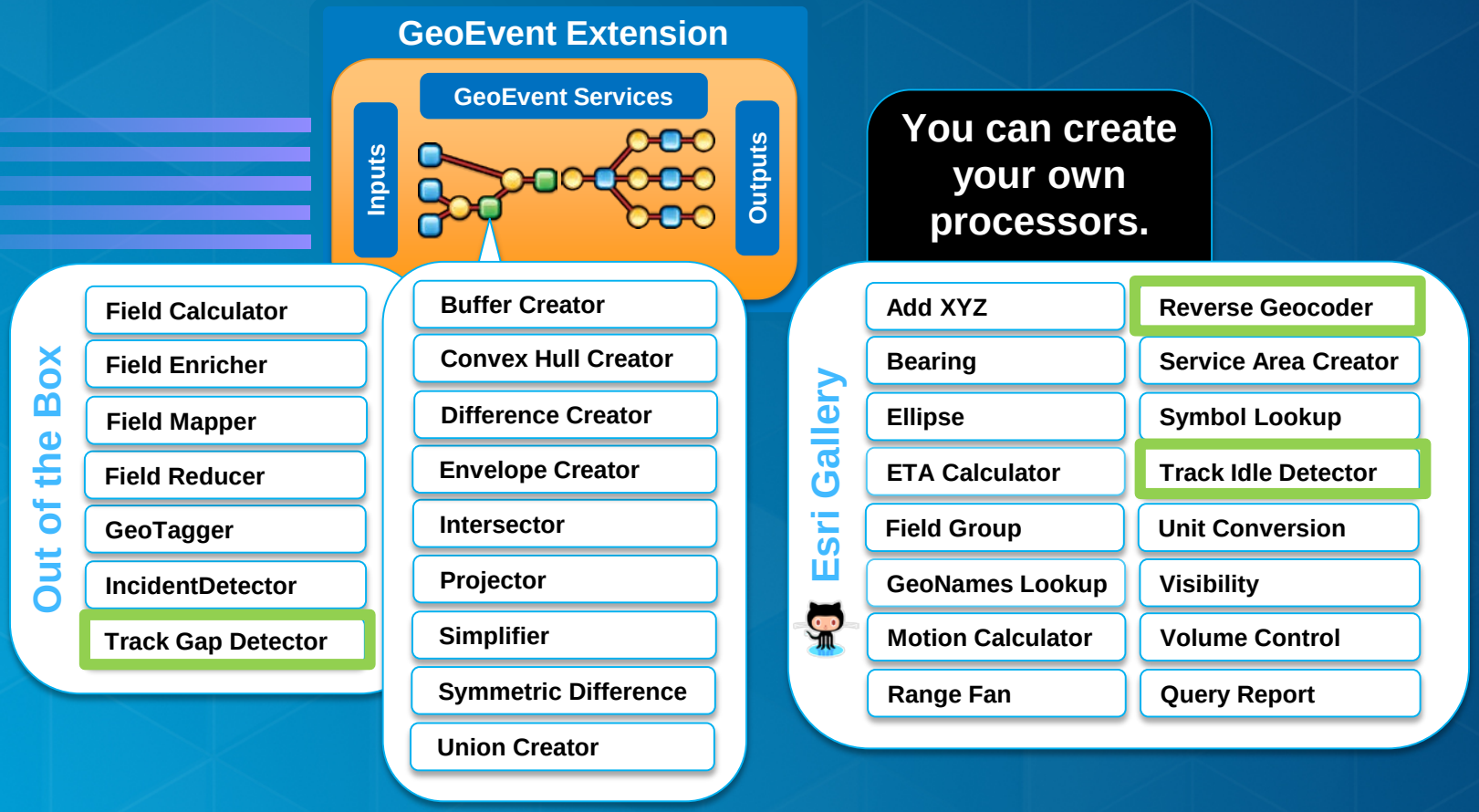
**Geofencing, Incident Detection, Geotagging, Filtering, Reverse Geocoding**

# Failure to Report and Loitering

## Track Gap Detector, Track Idle Detector, Reverse Geocoder

# Applying real-time analytics

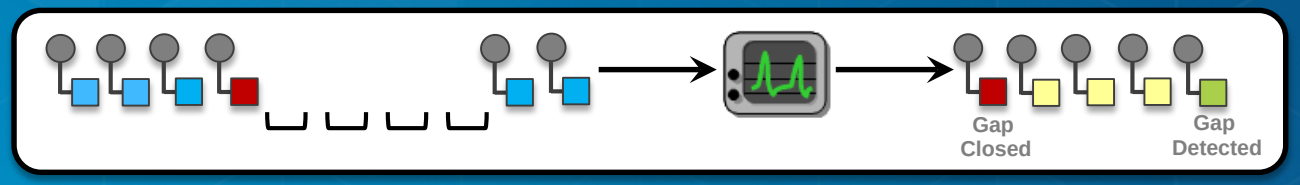
*Perform continuous analytics on GeoEvents as they are received using processors*



# GeoEvent processing

*Notify about the absence of events*

- A **Track Gap Detector** processor
  - Detects the absence of events and alerts about the situation.



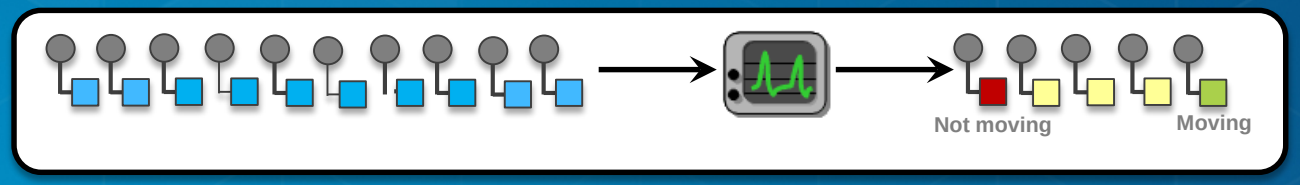

| | |
|---|---|
| SuspectID | V10987 |
| Date | 1405176945553 |
| Geometry | -117.123…, 36.064… |

| | |
|---|---|
| trackId | V10987 |
| gap | false |
| lastReceived | 1405176915553 |
| geometry | -117.123…, 36.064… |

# GeoEvent processing

*Notify about the persistence of events at the same location*

- A **Track Idle Detector** processor
  - Detects lack of expected movement and alerts about the situation.

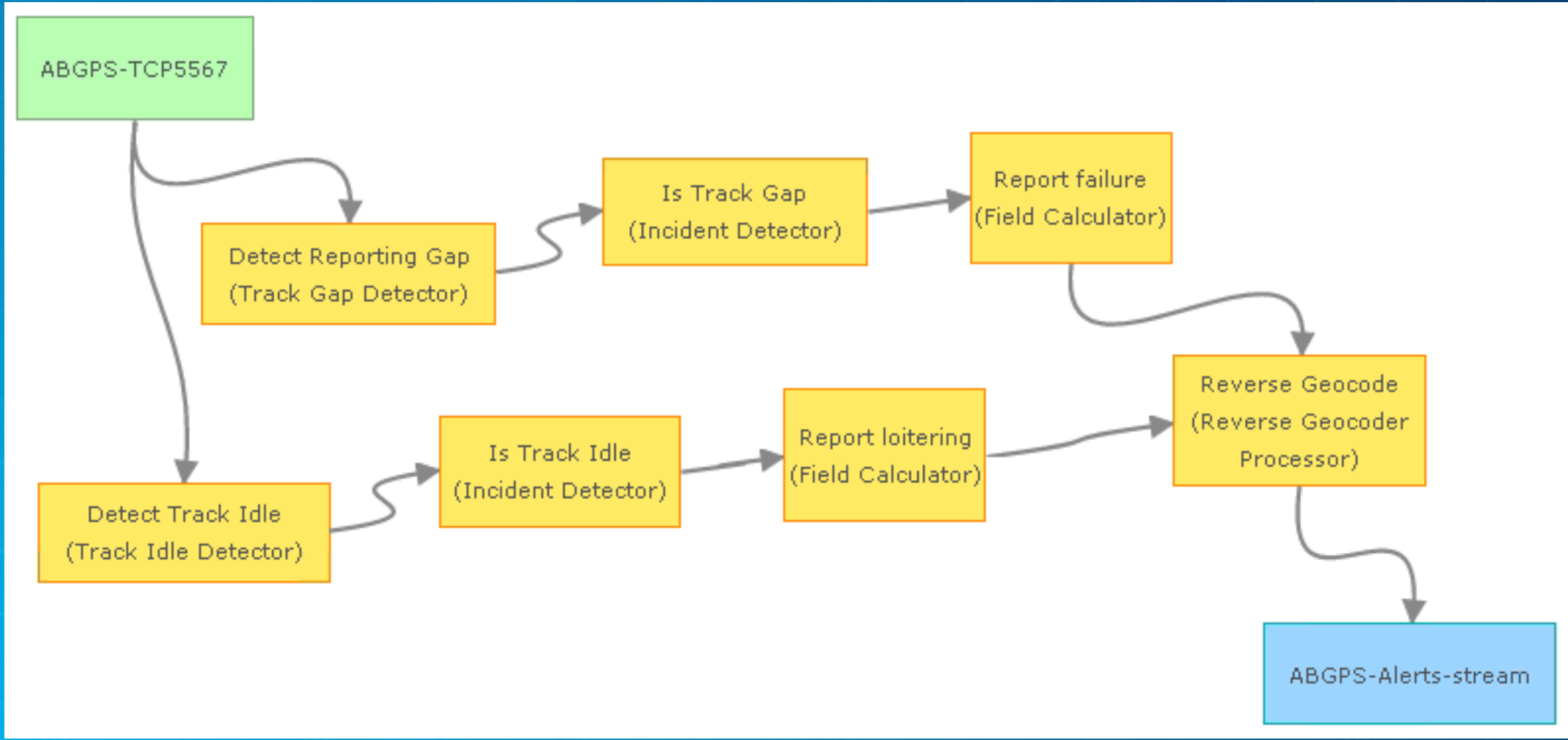



| | |
|---|---|
| SuspectID | V10987 |
| Date | 1405176945553 |
| Geometry | -117.123…, 36.064… |

| | |
|---|---|
| trackId | V10987 |
| idle | true |
| lastReceived | 1405176915553 |
| geometry | -117.123…, 36.064… |

# Applying real-time analytics

*Detect when a parolee hasn't moved from an area or position reports are no longer being received*



# Video Demo

## Failure to Report and Loitering

**Track Gap Detector, Track Idle Detector, Reverse Geocoder**

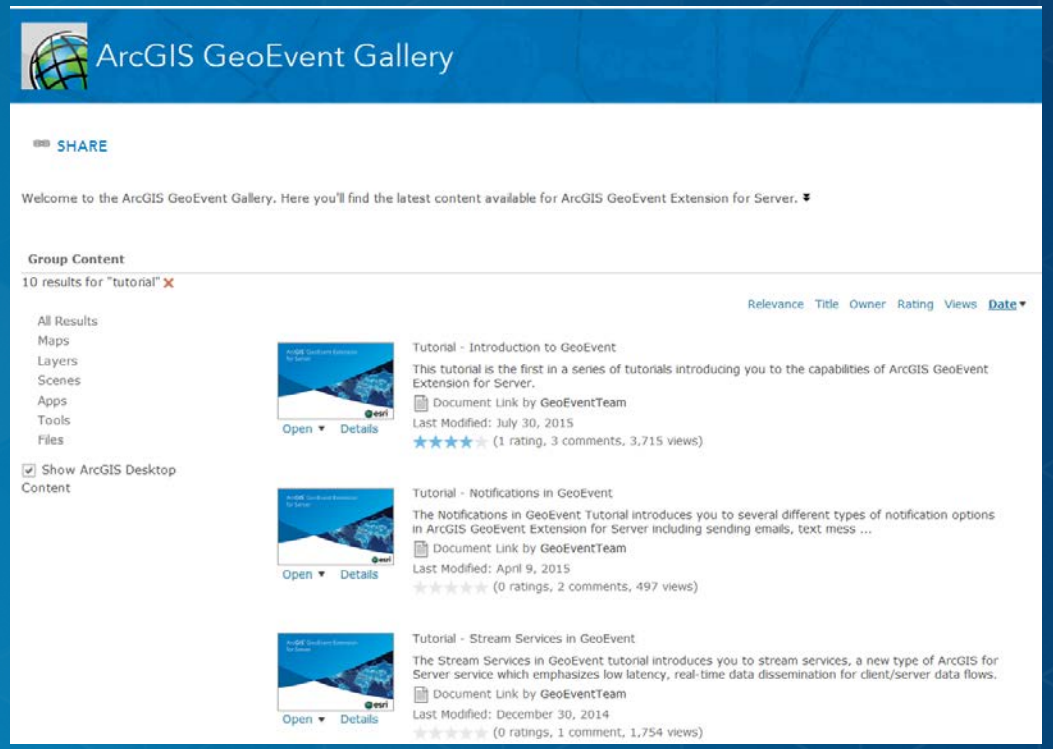
# Applying real-time analytics

*Summary*

- ArcGIS is a dynamic platform that enables continuous analytics and real-time visualization for better understanding of our world.

- The ArcGIS GeoEvent Extension for Server allows you to:
  - know what is happening, as it happens
  - react and make smarter decisions faster
  - be notified when interesting events occur

- To learn more:
  - See the tutorials:
    'ArcGIS GeoEvent Gallery'
  - http://arcg.is/13HRlFJ



Thank you!

Mark Bramer

mbramer@esri.com