Real-Time GIS:
Applying Real-Time Analytics

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Agenda

1. Performing Analysis in Real Time
2. Use Case 1: Identifying Conditions
3. Use Case 2: Finding Patterns in Data
4. Use Case 3: Workforce Tracking
5. Summary & Resources

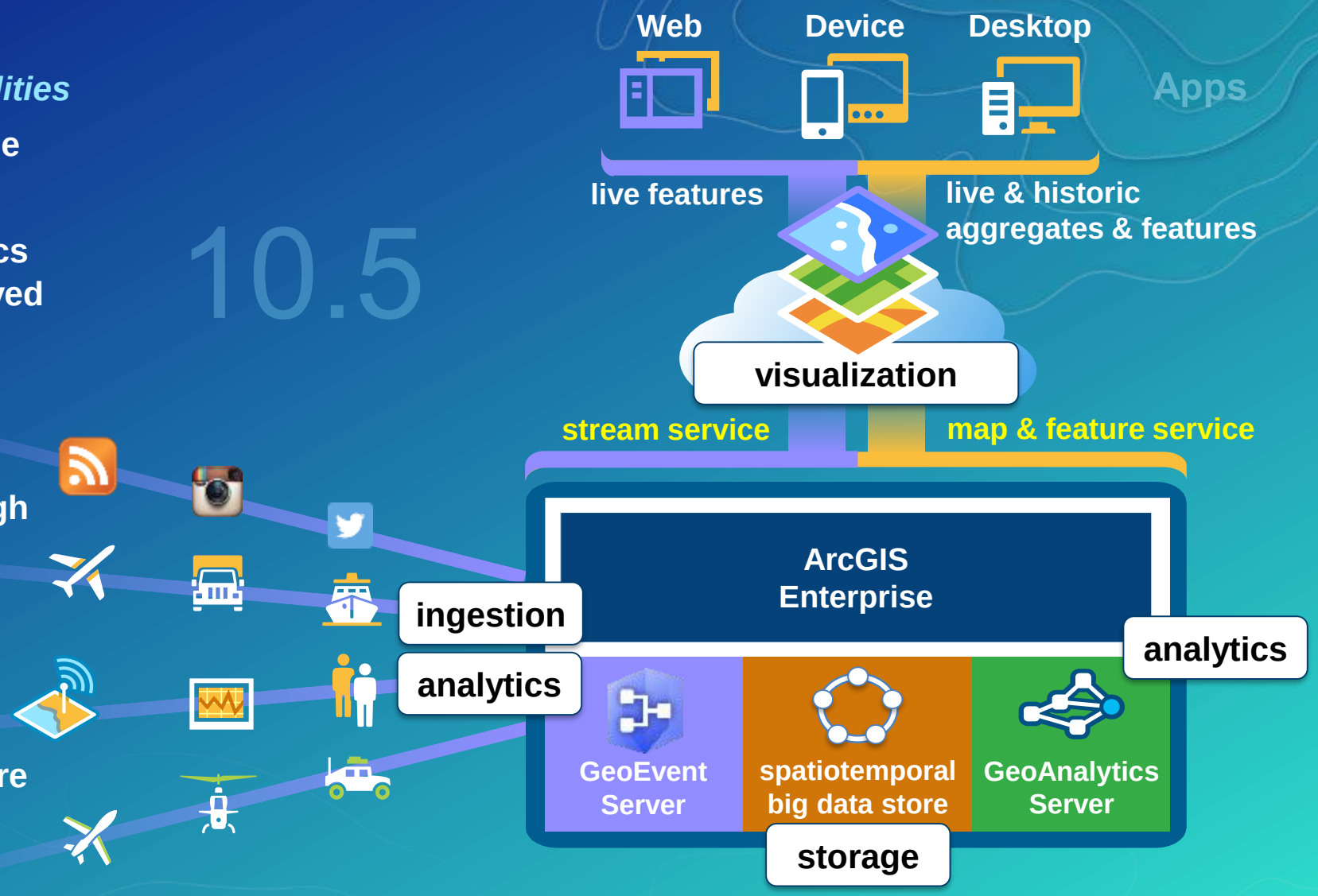
1
Performing Analysis in Real Time

ArcGIS Enterprise

with real-time & big data capabilities

- Ingest high velocity real-time data into ArcGIS
- Perform continuous analytics on events as they are received
- Notify those who need to know about patterns of interest
- Visualize high velocity & high volume data:
  - as an aggregation
  - as discrete features
- Store observations in a spatiotemporal big data store
- Run batch analytics on stored observations

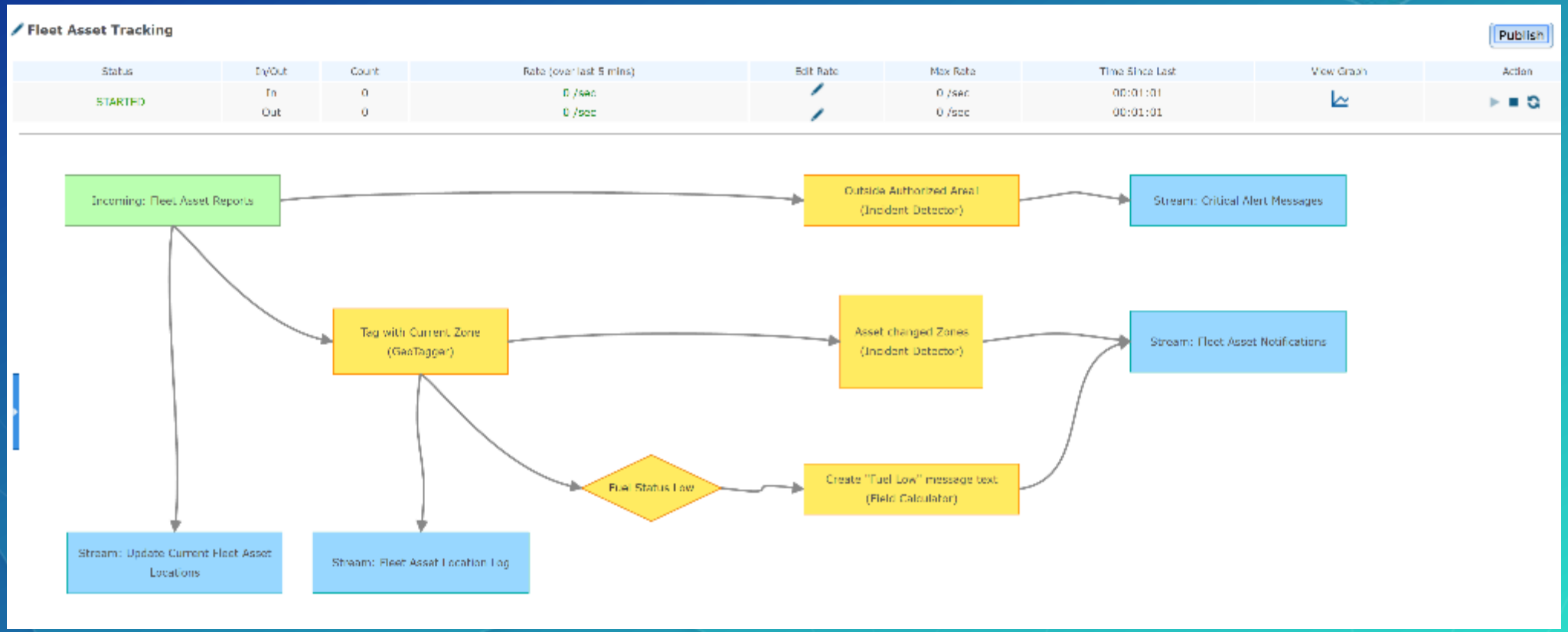
10.5



Applying real-time analytics

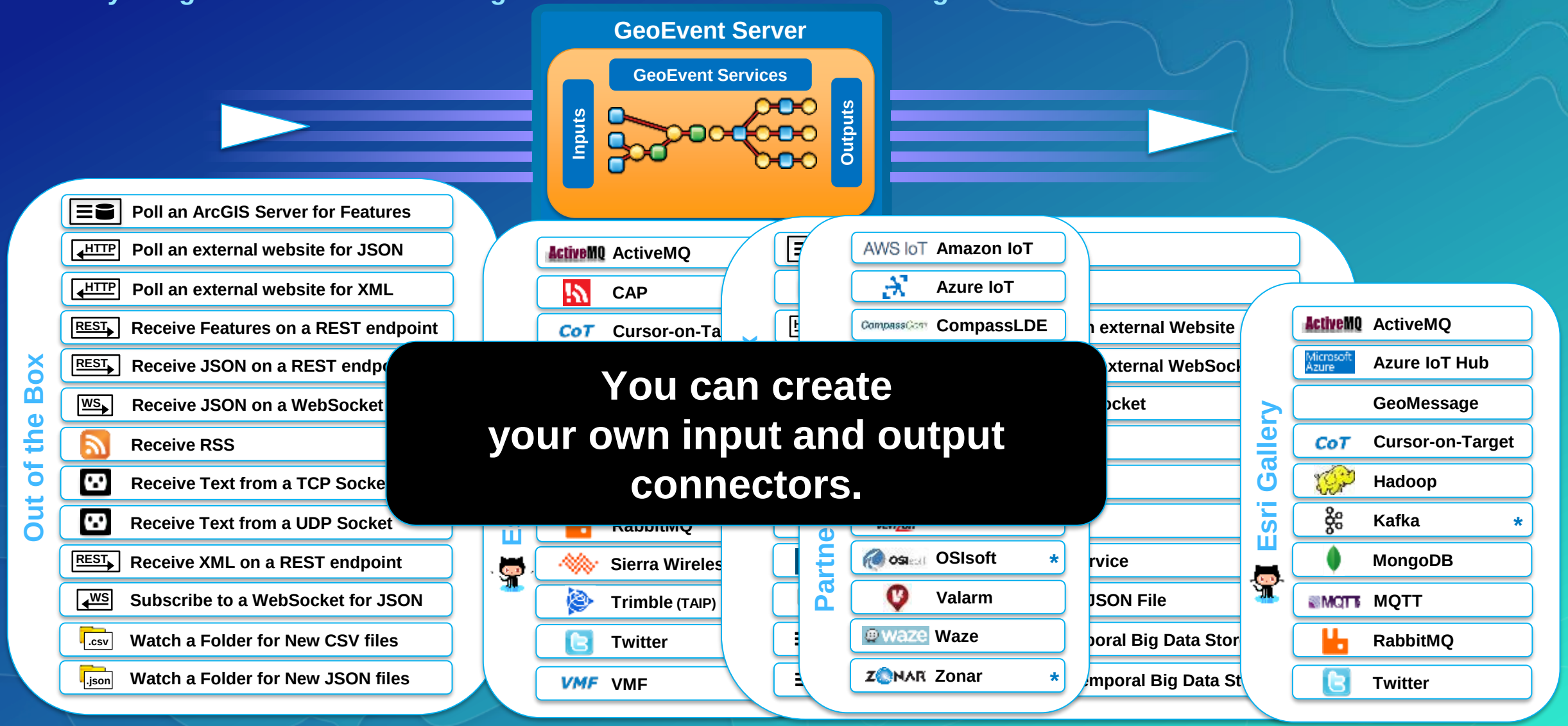
Perform real-time analytics by defining a GeoEvent Service

- A **GeoEvent Service** configures the flow of GeoEvents
  - The **Filtering** and **GeoEvent Processing** steps performed
  - The input(s) data comes from and the output(s) to which results are sent



Receiving and Sending Real-Time Data

Easily integrate real-time streaming data into and out of ArcGIS using Connectors

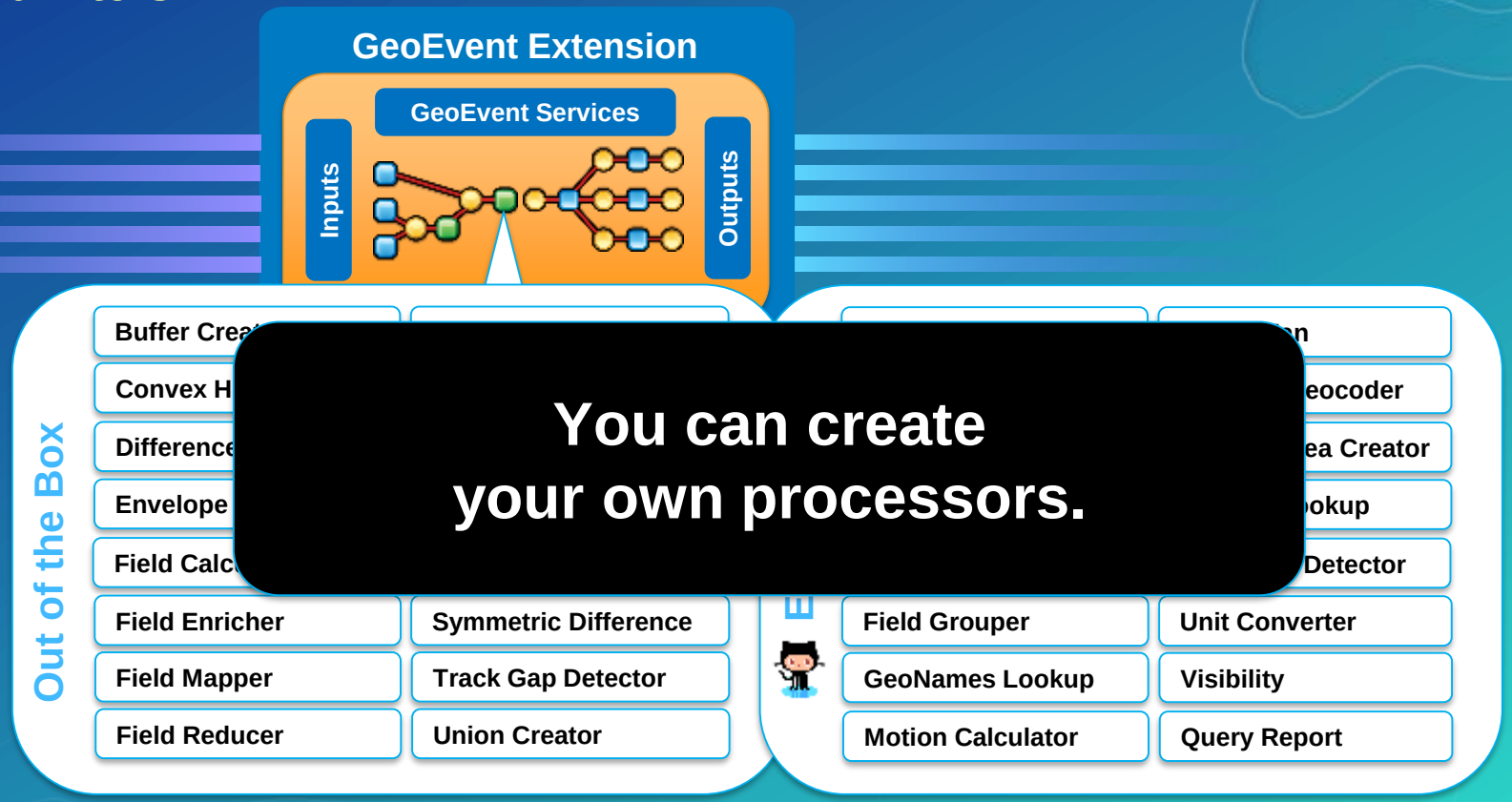


You can create your own input and output connectors.

Applying real-time analytics

GeoEvent Processing

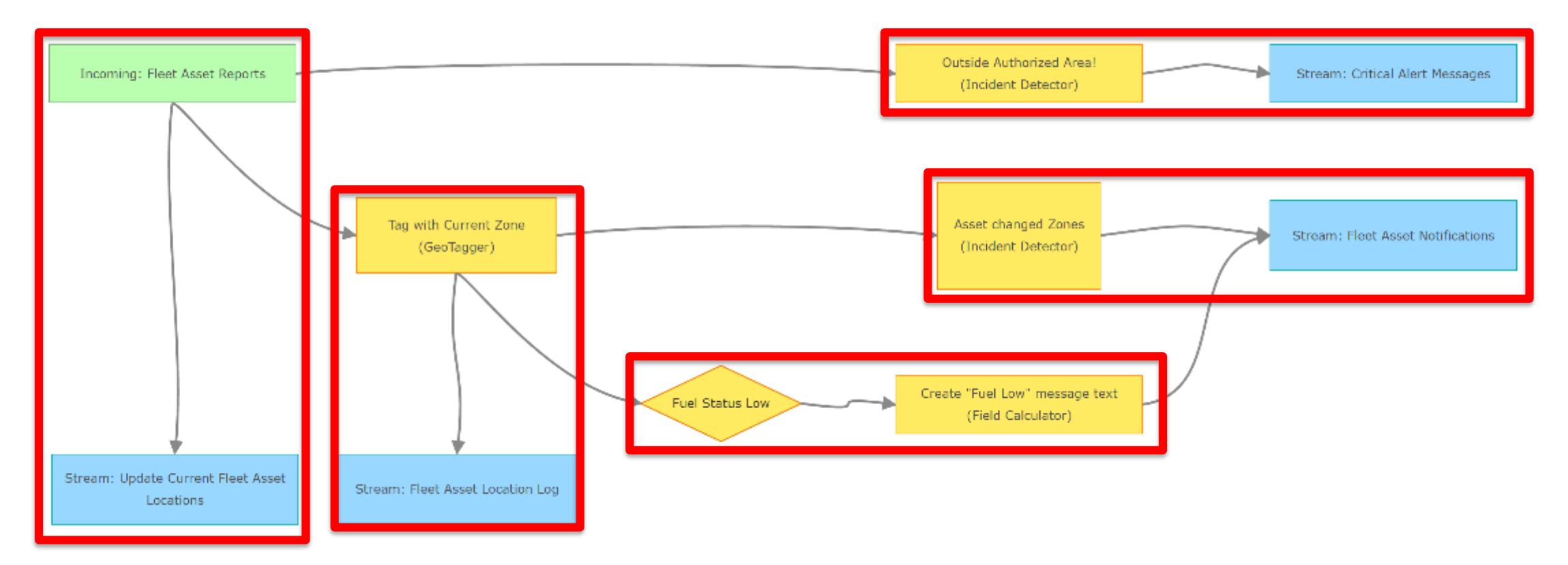
- Perform continuous analytics on GeoEvents as they are received using processors and filters.



+
−
Alert(s)
Notification(s)
DigitalGlobe, GeoEye, Microsoft
POWERED BY esri

Fleet Asset Tracking Pseudo Service

The analytics behind the construction site example

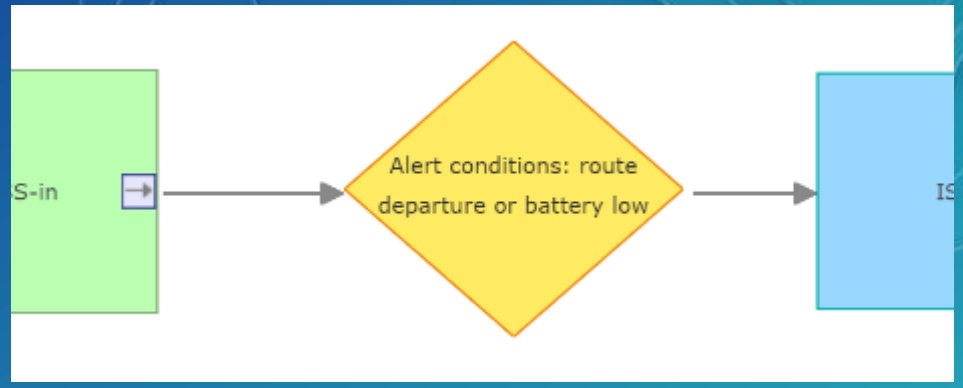


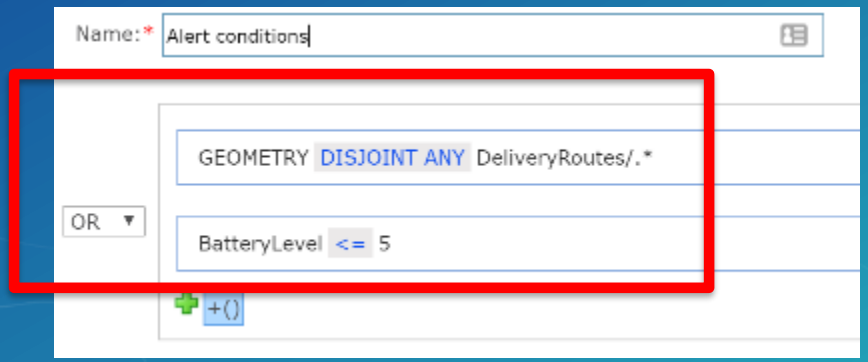
Processors

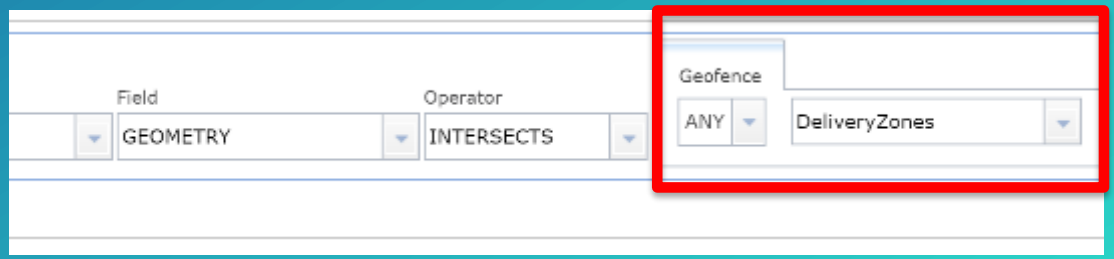
- Some work only on geometry
- Some work on geometry and/or attributes
- Some respond to spatial and/or attribute conditions and generate new messages
- Processors typically transform the GeoEvent in some way

Filters

- Only allow messages to pass that evaluate to true
- Can filter by spatial and/or attribute conditions
- Spatial filters operate on event geometry and GeoFences





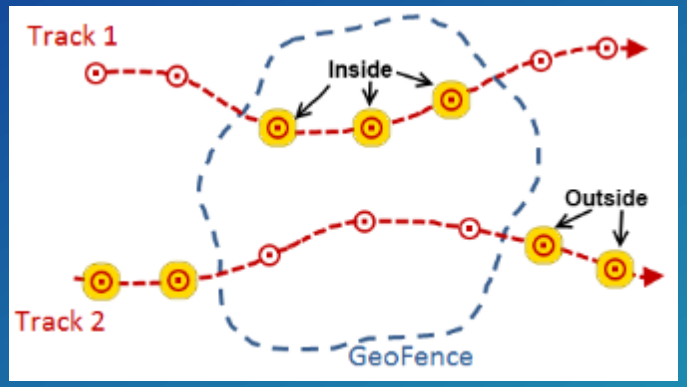


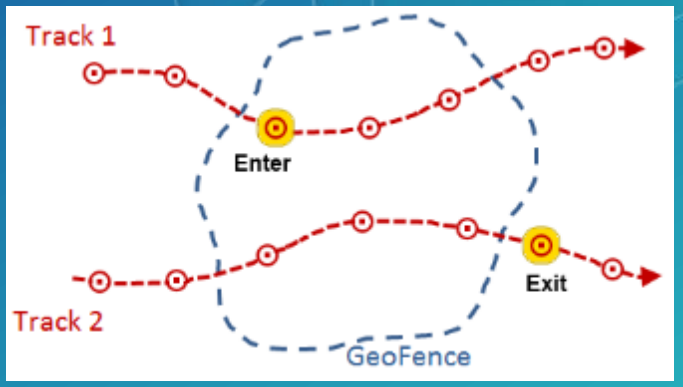
Use Boolean logic (AND, OR, NOT) to combine or negate expressions

Spatial Operators

- **Spatial operators at 10.2:**

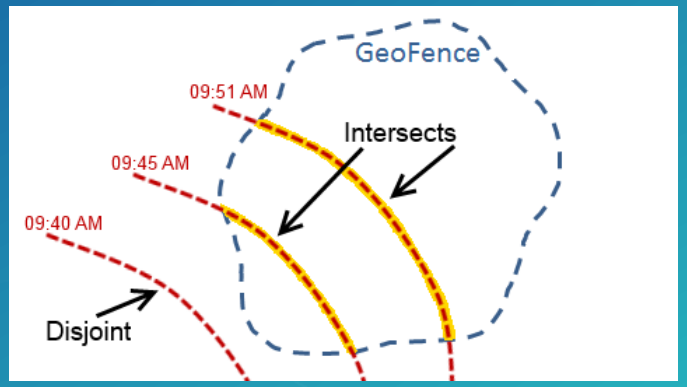
inside	outside
enter	exit

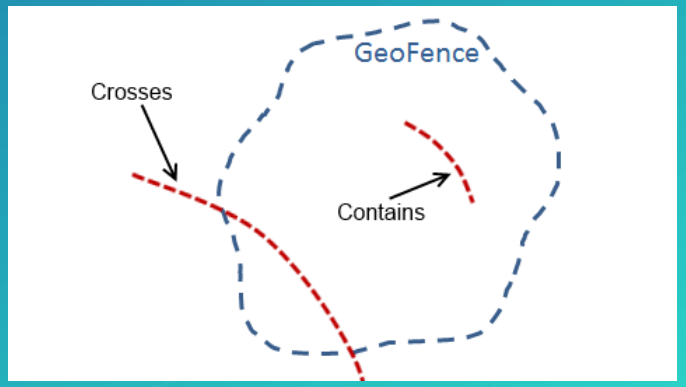




- **Spatial operators at 10.3 and beyond:**

intersect	disjoint
touches	contains
crosses	equals
overlaps	within





Spatial Operators

GeoFence selection vs. spatial operator scope

- Don’t confuse “ANY” and “ALL” with the regular expression pattern used to select a set of geofences

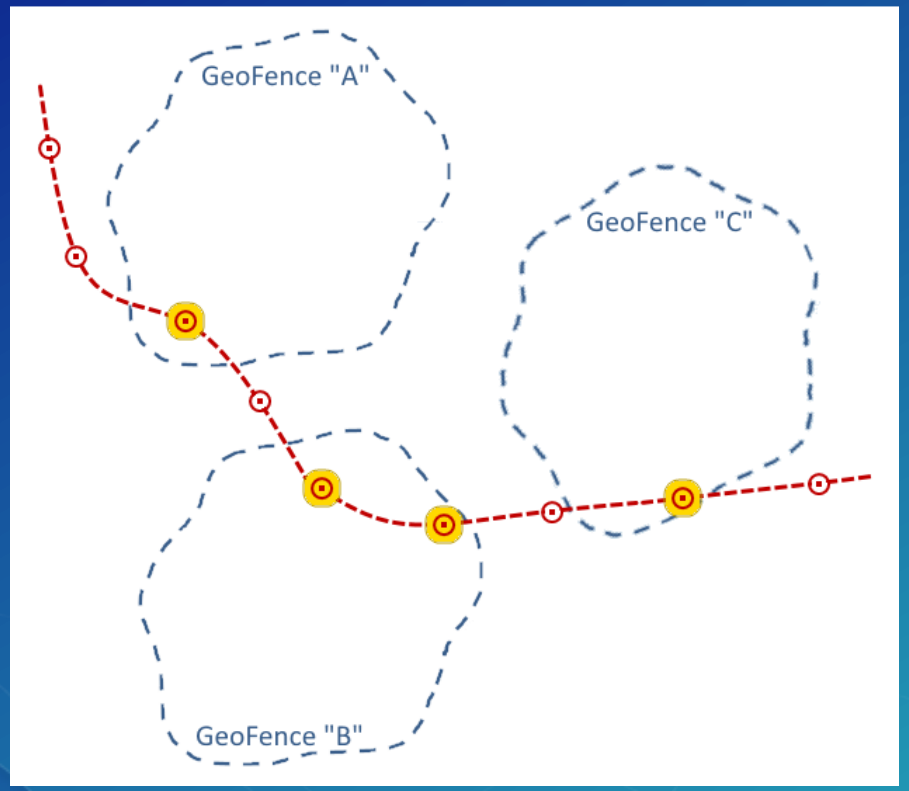
GEOMETRY INTERSECTS ALL .*/.*

GEOMETRY DISJOINT ANY .*/.*

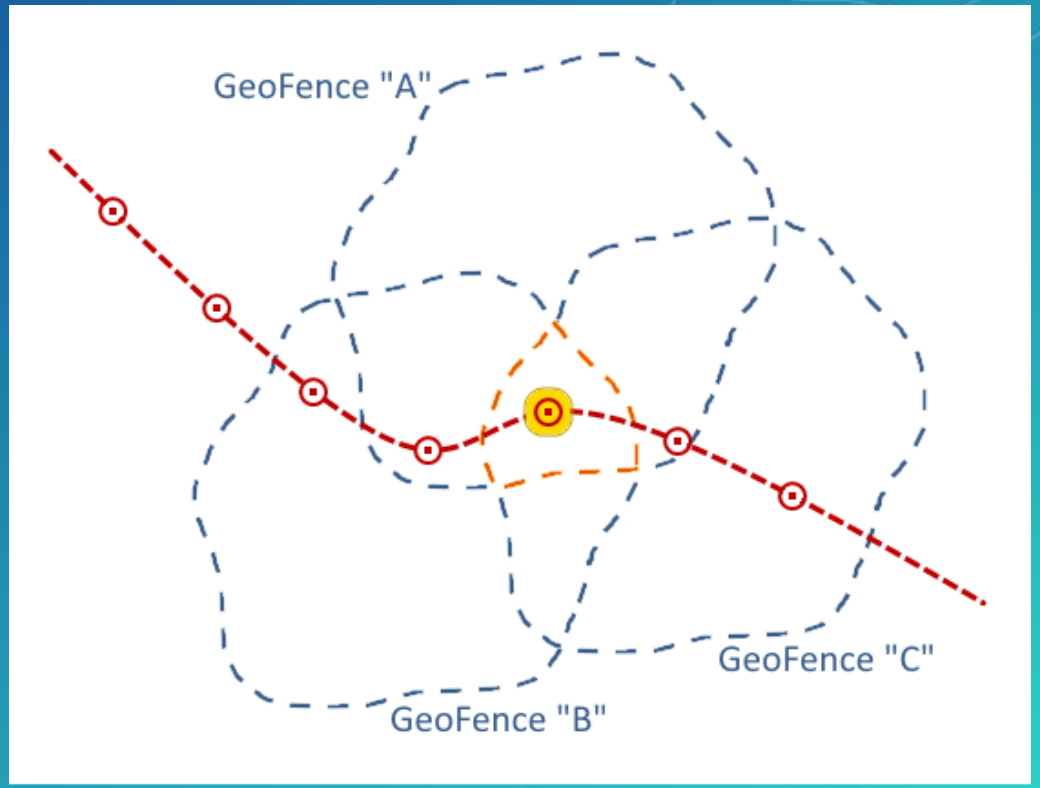
Spatial Operators

Example: Overlapping GeoFences

- **Intersects Any geofence**



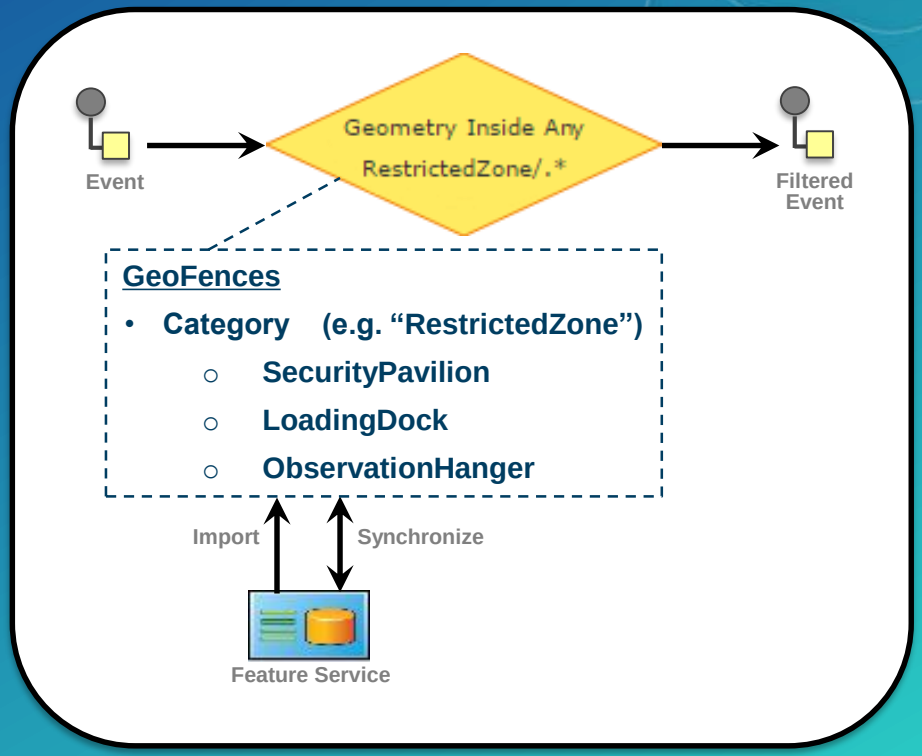
- **Intersects All geofences**



GeoFences

Load or synchronize GeoEvent Server with a feature service

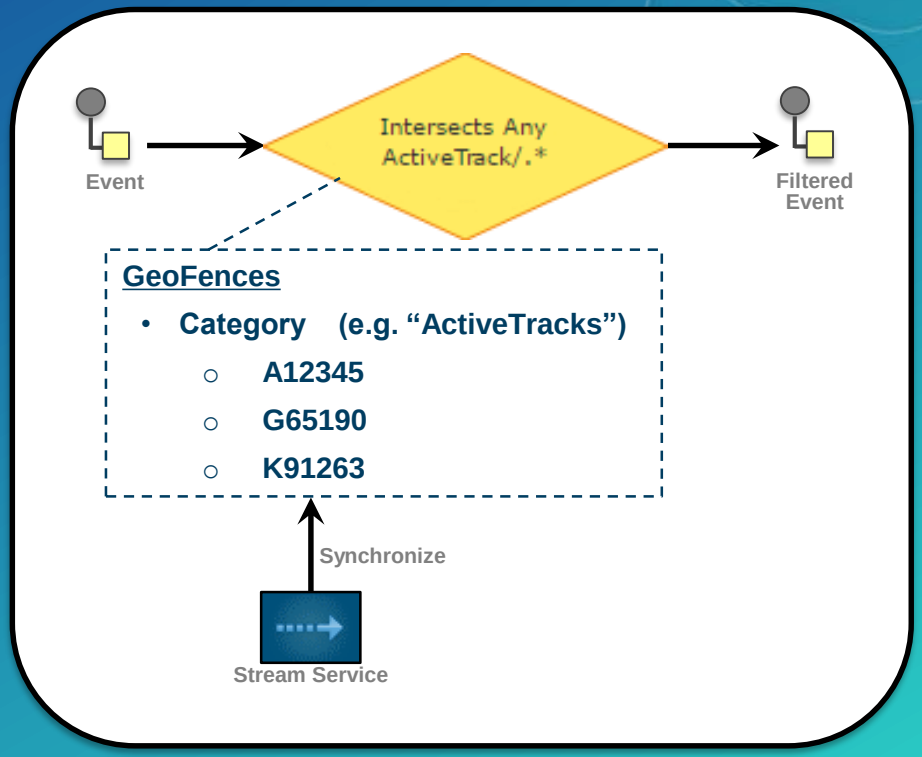
- **Import from a feature service**
  - Reads once (good for static geofences)
- **Synchronize with a feature service**
  - Periodically refreshes to update geofences



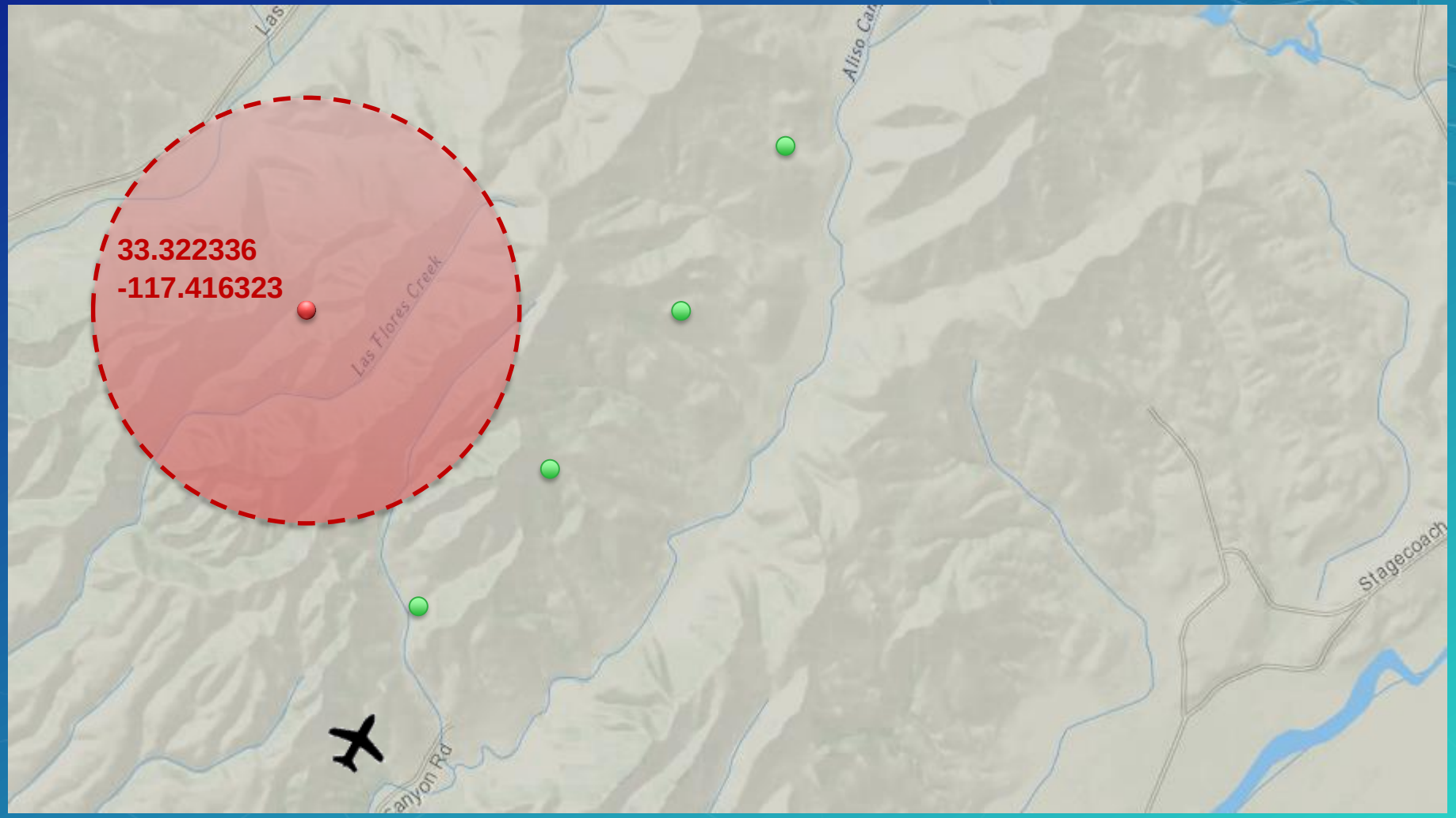
GeoFences

Synchronize GeoEvent Server with a stream service

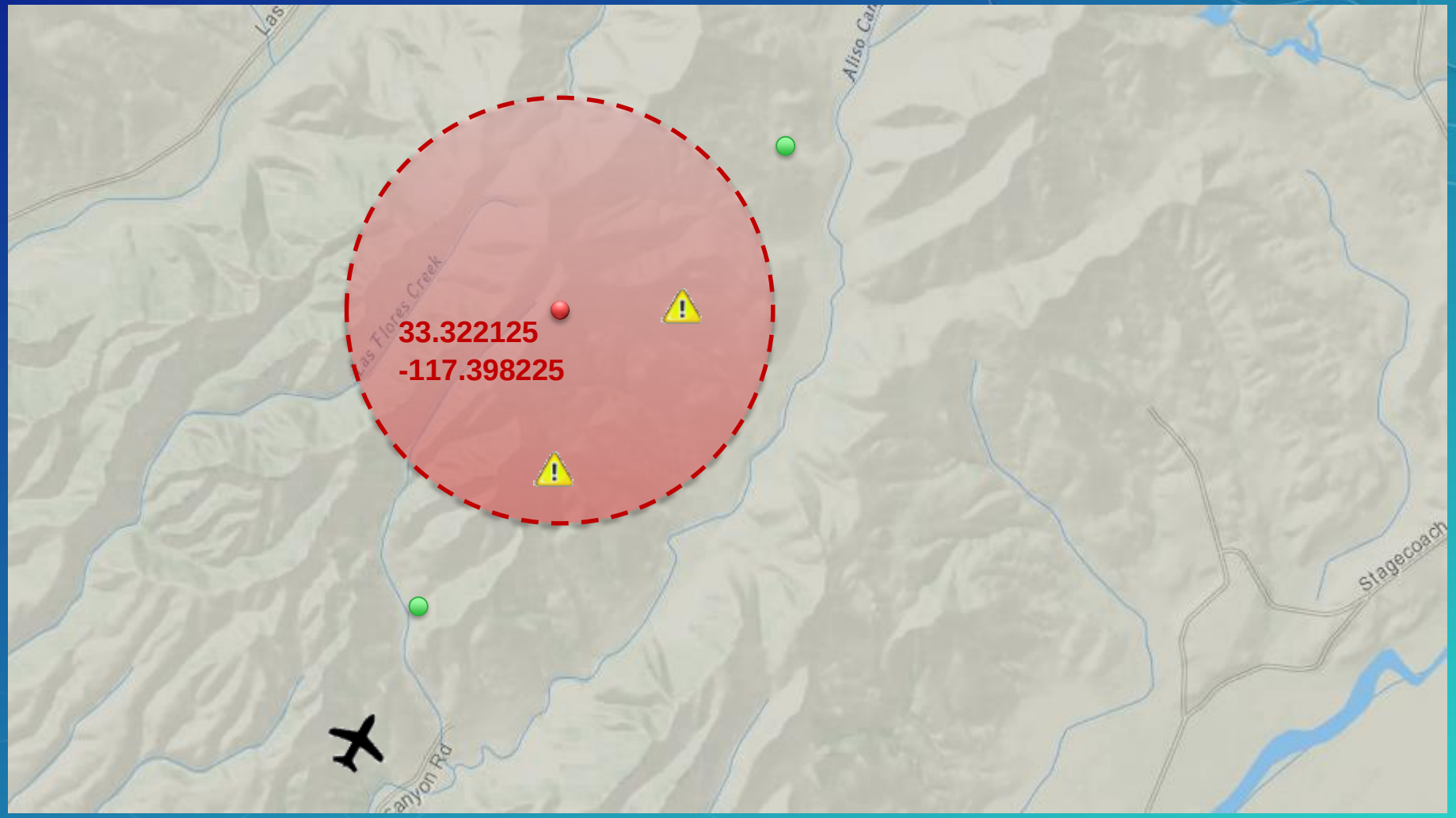
- GeoFences are constantly updated
  - Allows geofences to become dynamic
- Requires active management and purging of geofences as they expire



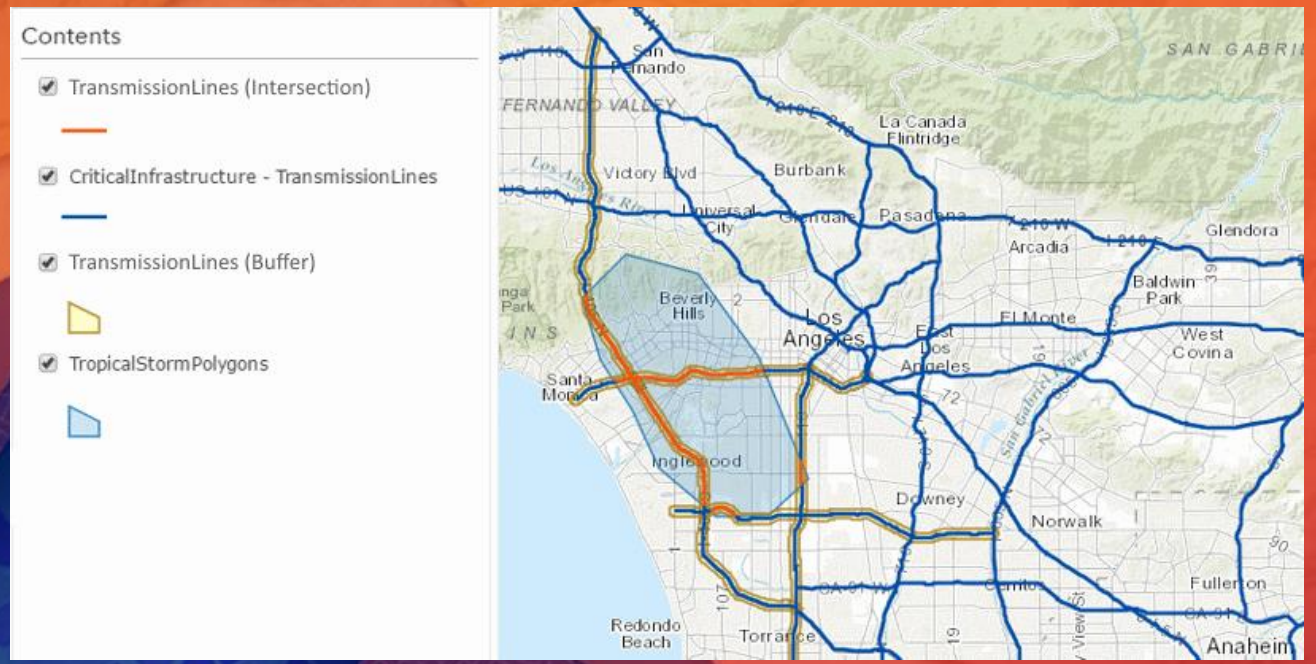
Dynamic GeoFences



Dynamic GeoFences

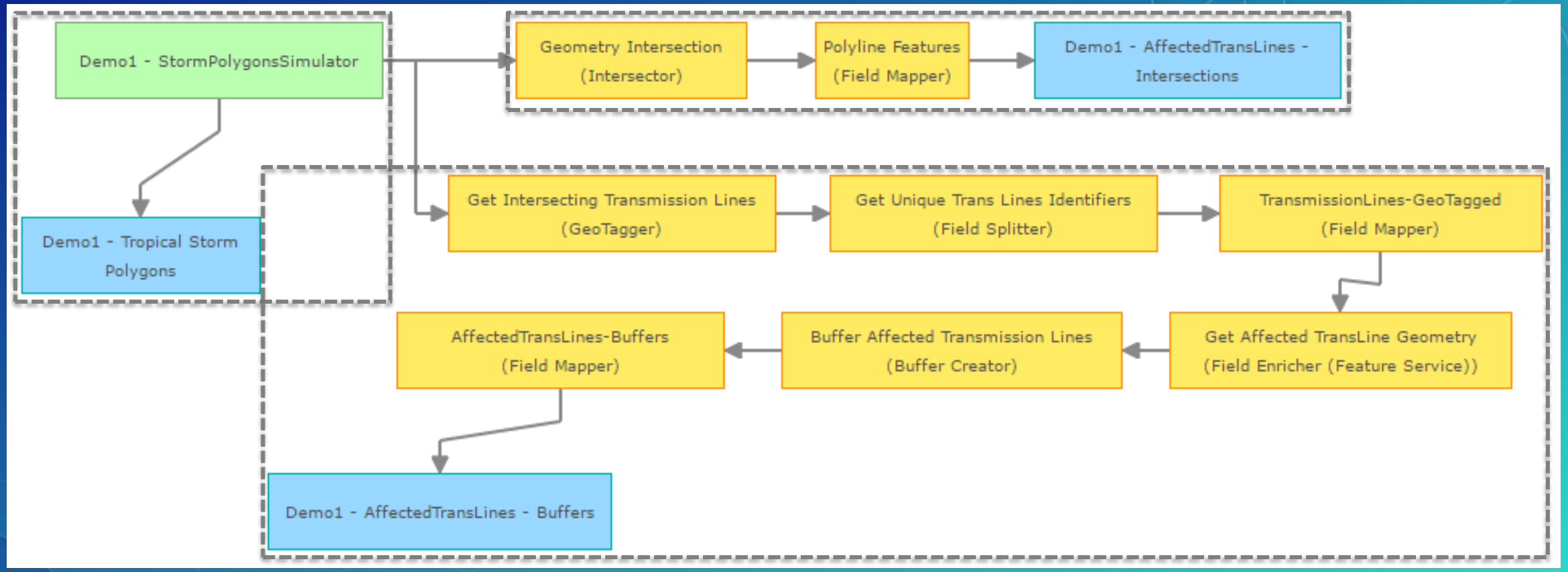


2 Identifying Conditions (demo)



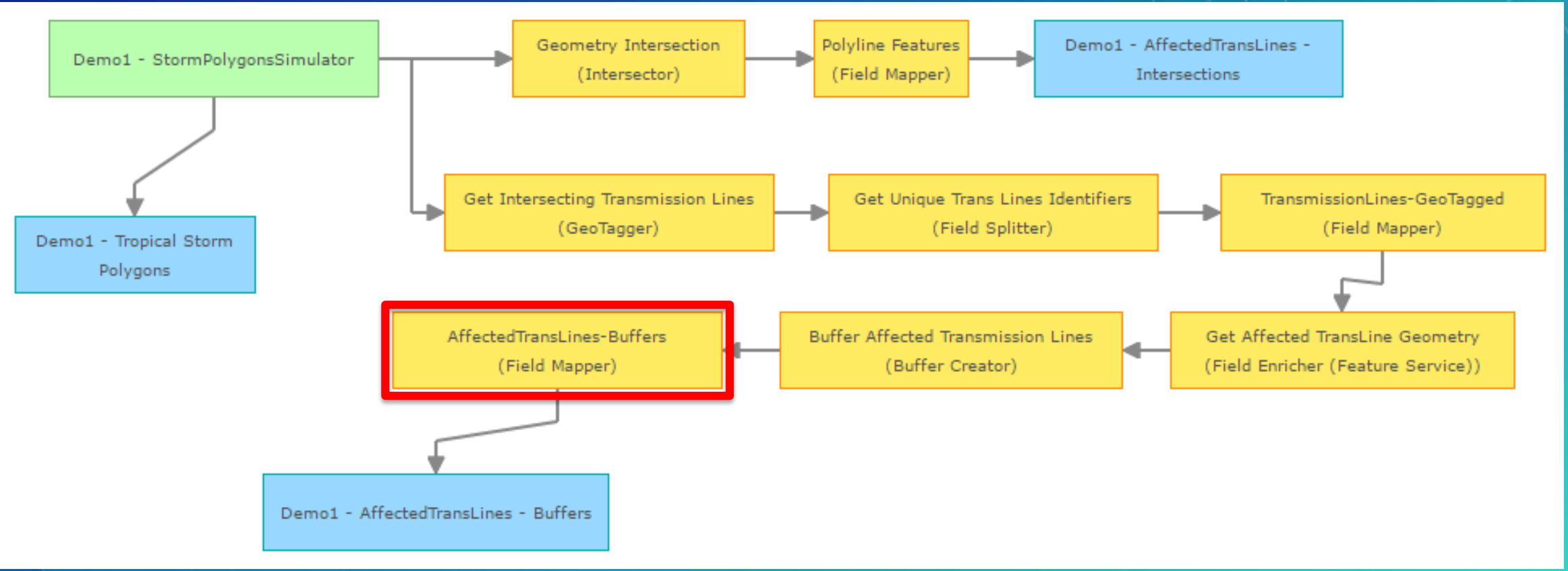
Identifying conditions with real-time data

GeoEvent Service example



Identifying conditions with real-time data

GeoEvent Service example

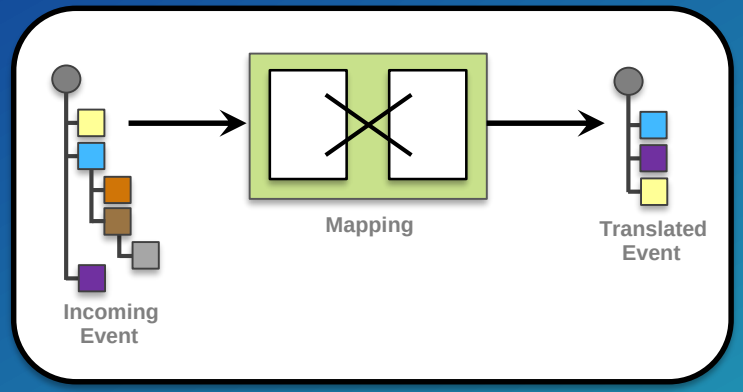


Field Mapper processor

- Adjust the format of a GeoEvent
- Translates from one GeoEvent Definition to another
- Specifies how fields map across the GeoEvent Definitions

Field Mapper processor

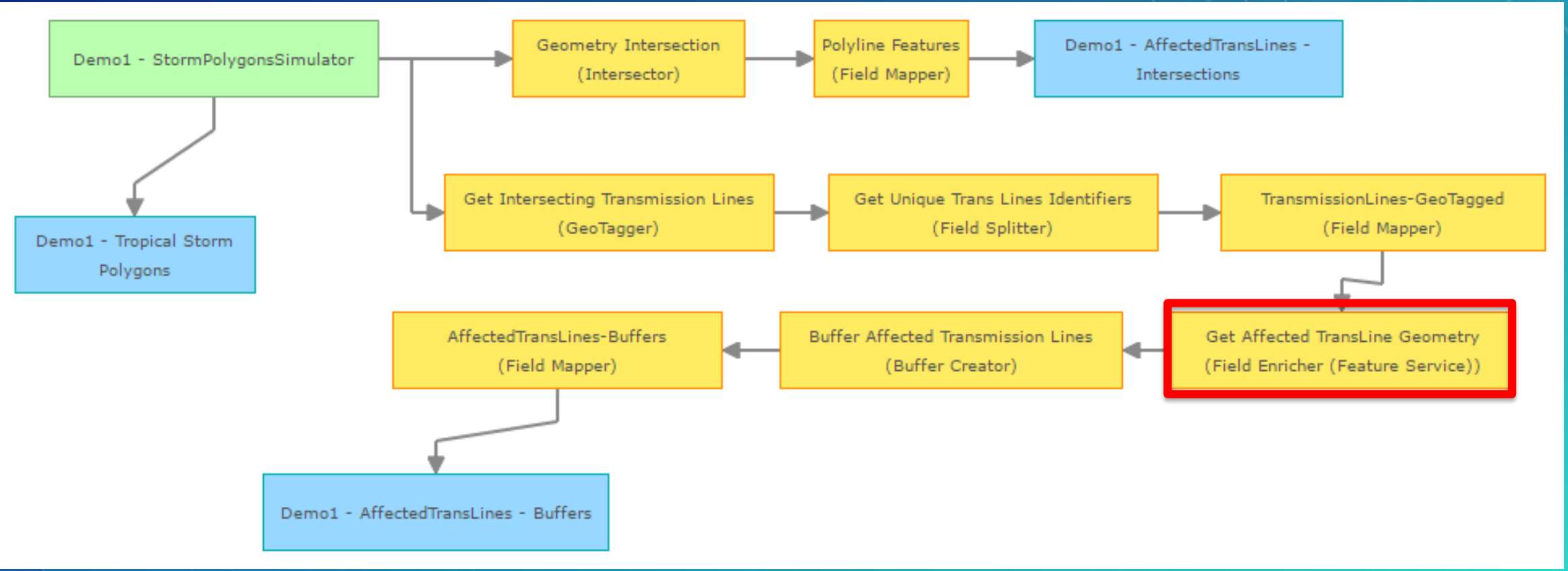
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS



TrackID	J7890
Date	1405176845553
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS

Identifying conditions with real-time data

GeoEvent Service example

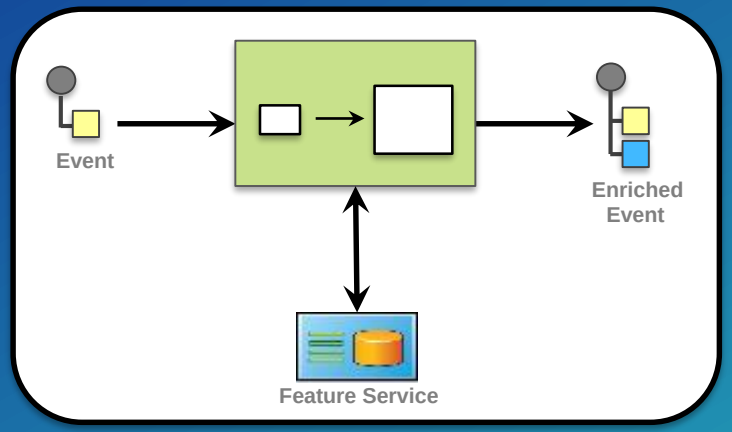


Field Enricher processor

- Enrich a GeoEvent with new fields
- Uses an attribute join to retrieve values from an external table
- After the Field Enricher retrieves the required data from a data source it enriches the GeoEvent with new fields derived from the source

Field Enricher processor

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

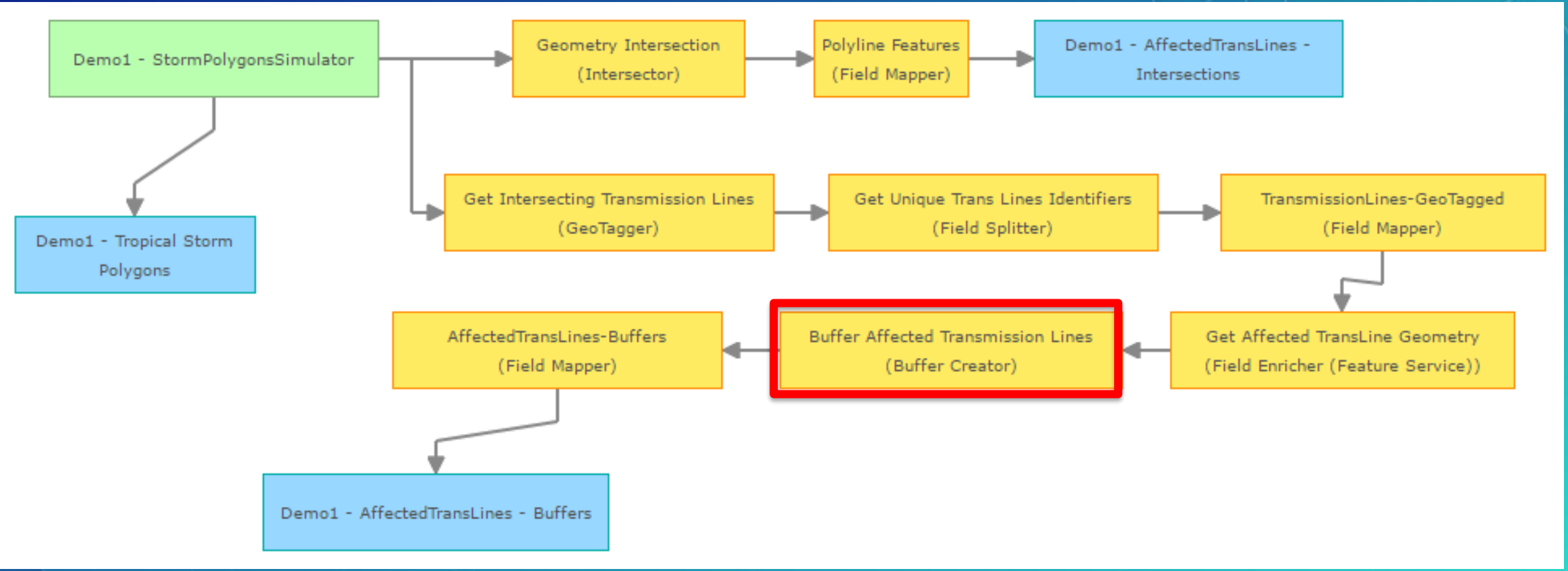


TrackID	NoContact	NoEntry
K90123		Temecula gangland
V10987	F65432	Pass Christian School
…	…	…

TrackID	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

Identifying conditions with real-time data

GeoEvent Service example

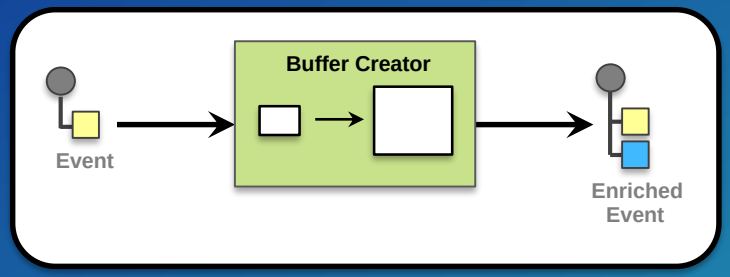


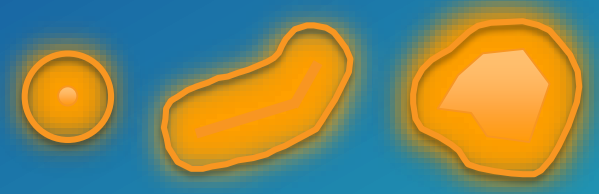
Buffer Creator processor

- Constructs a polygon around an event's point, polyline, or polygon geometry
- Can enrich an event record (adding a new geometry field)
- Can also replace an event record's geometry

Buffer Creator processor

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

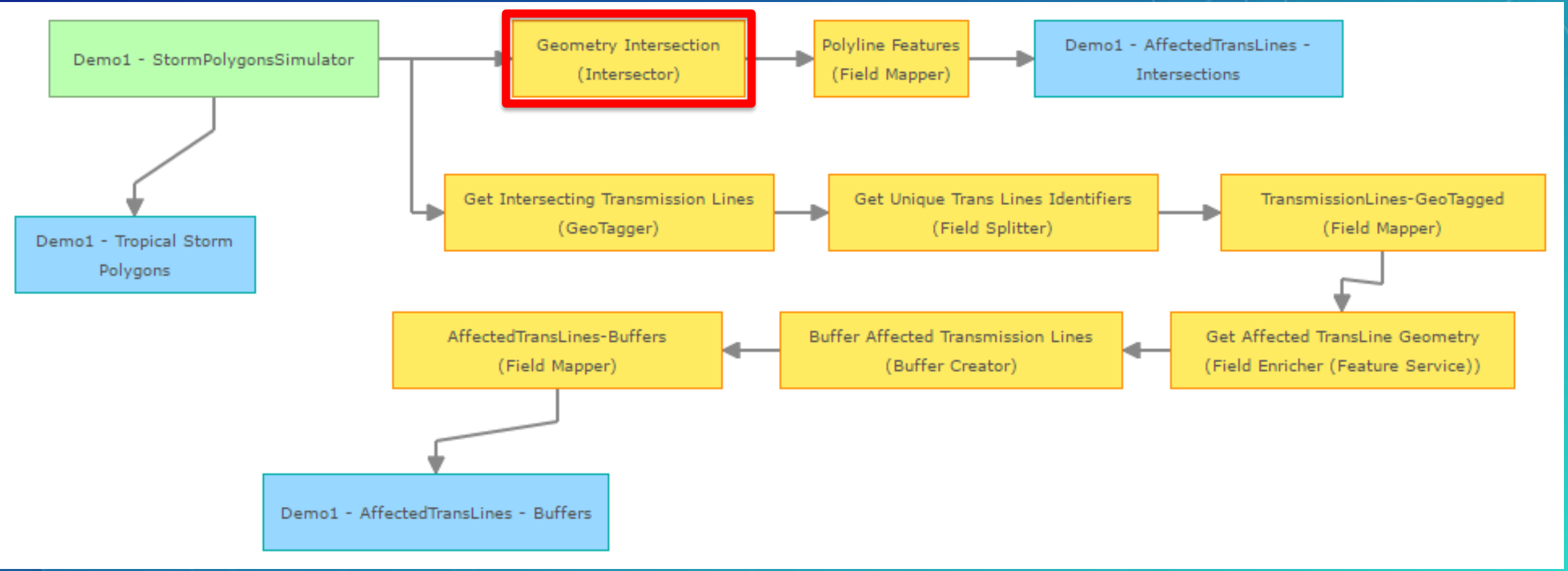




TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	-117.123…, 36.064…
buffer	rings" : [[[-116.3175, 33.6703],[-116.3175, 33.6703]…]]

Identifying conditions with real-time data

GeoEvent Service example

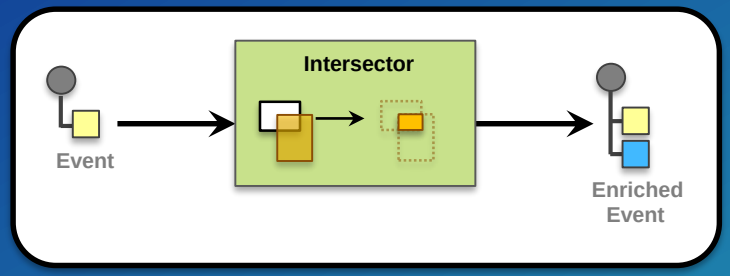


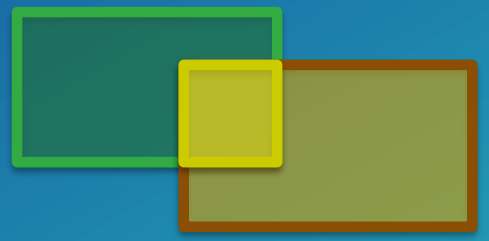
Intersector processor

- Generates a geometry representing the intersection between a event record’s geometry and a set of specified geofences
- Can enrich an event record (adding a new geometry field)
- Can also replace an event record’s geometry

Intersector processor

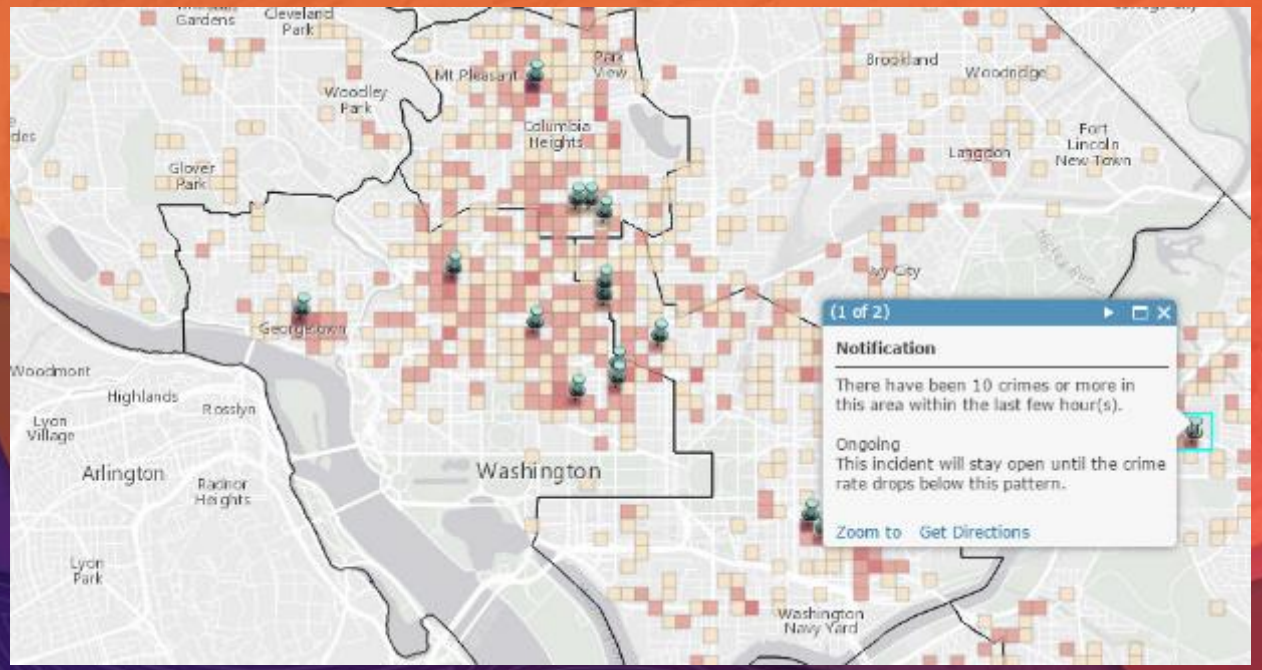
TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	rings" : [[[-114.3175, 33.6703],[-114.3175, 33.6703]…]]





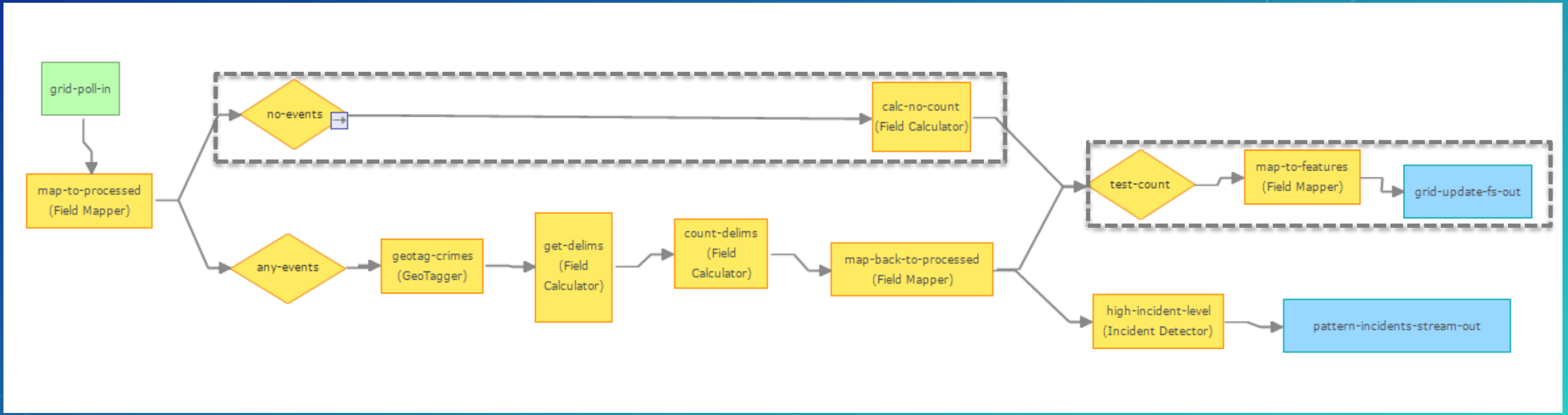
TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	-117.123…, 36.064…
intersection	rings" : [[[-116.3175, 33.6703],[-116.3175, 33.6703]…]]

3 Finding Patterns in Data (demo)



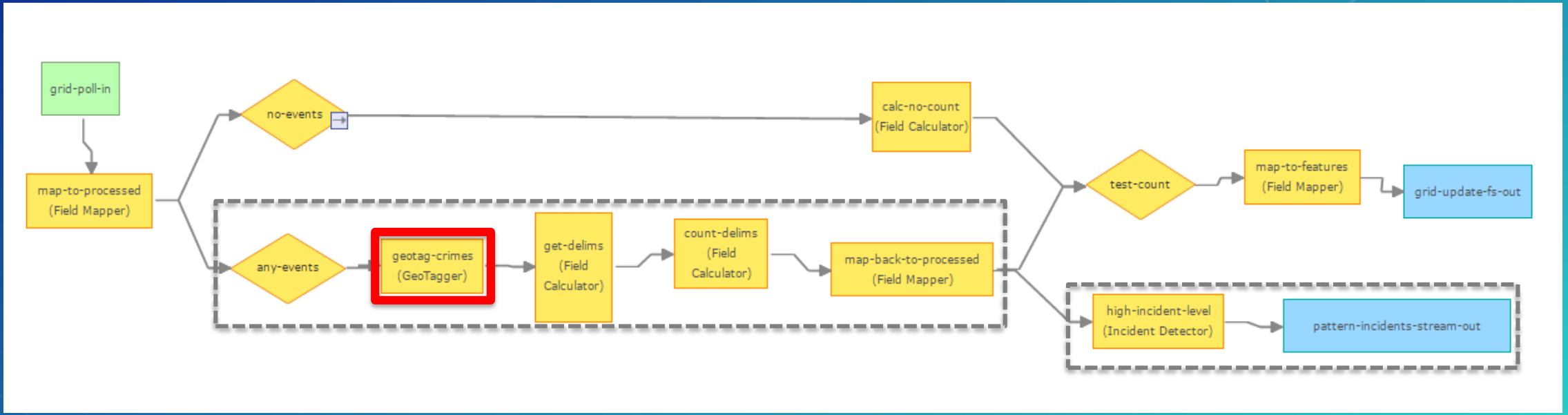
Finding patterns in real-time data

GeoEvent Service example



Finding patterns in real-time data

GeoEvent Service example

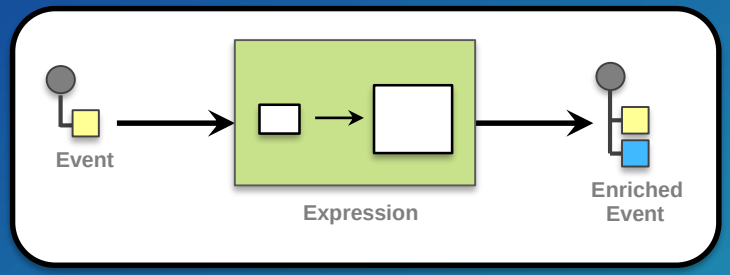


GeoTagger processor

- Enrich a GeoEvent with geographic context
- Uses a spatial expression to tag the event with related geometries

GeoTagger processor

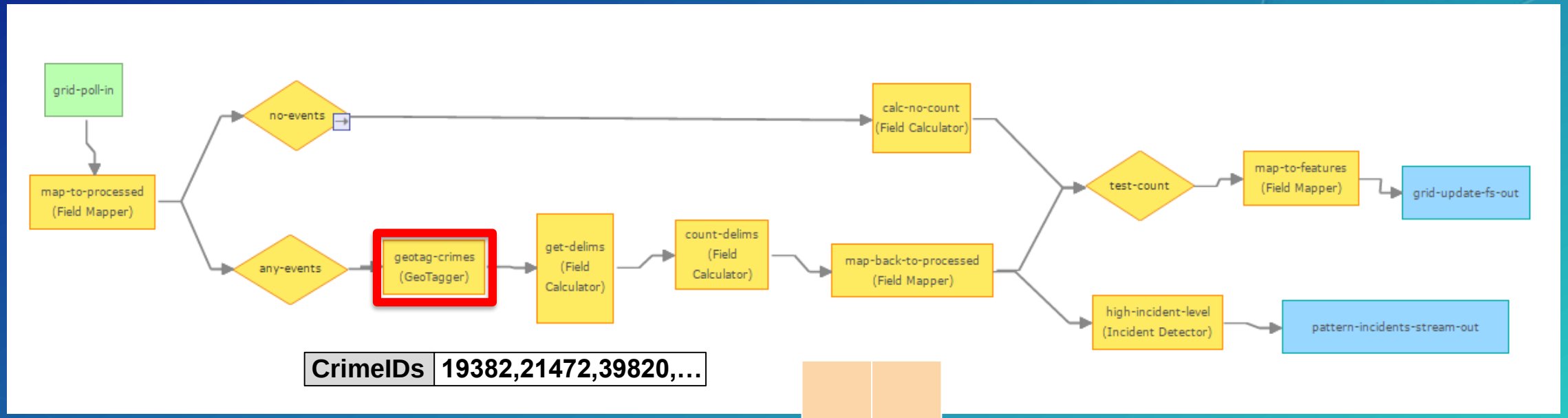
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS

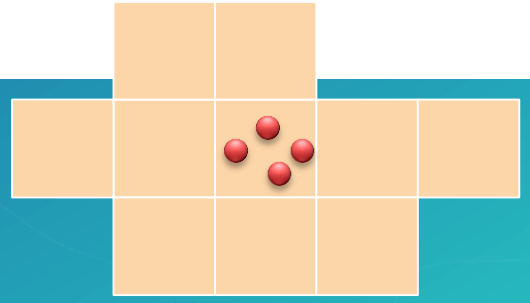


TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS
IsInside	Temecula gangland

Finding patterns in real-time data

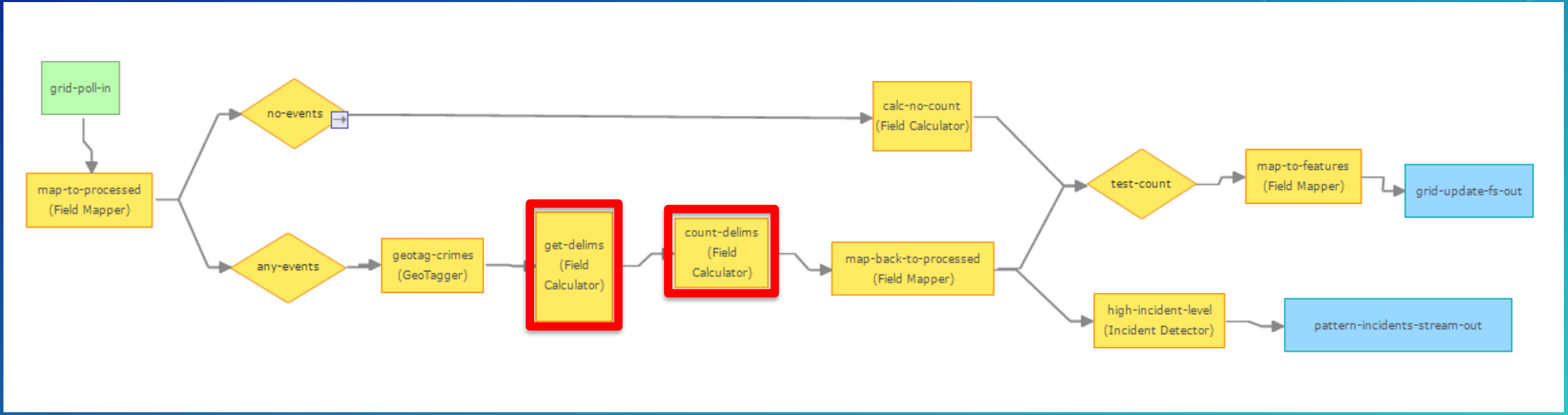
GeoEvent Service example





Finding patterns in real-time data

GeoEvent Service example

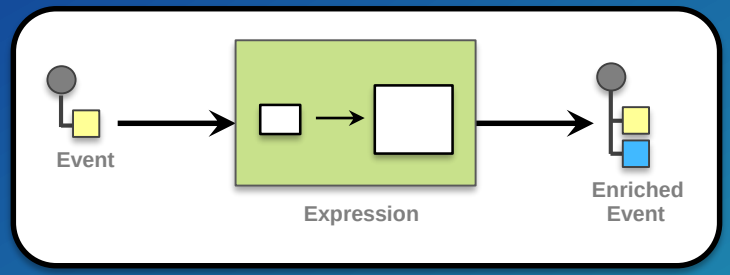


Field Calculator processor

- Calculate new fields on a GeoEvent
- Uses an expression to calculate a new field or update an existing field
- Expressions can be mathematical expressions, string operations, or function invocations which use regular expressions

Field Calculator processor

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



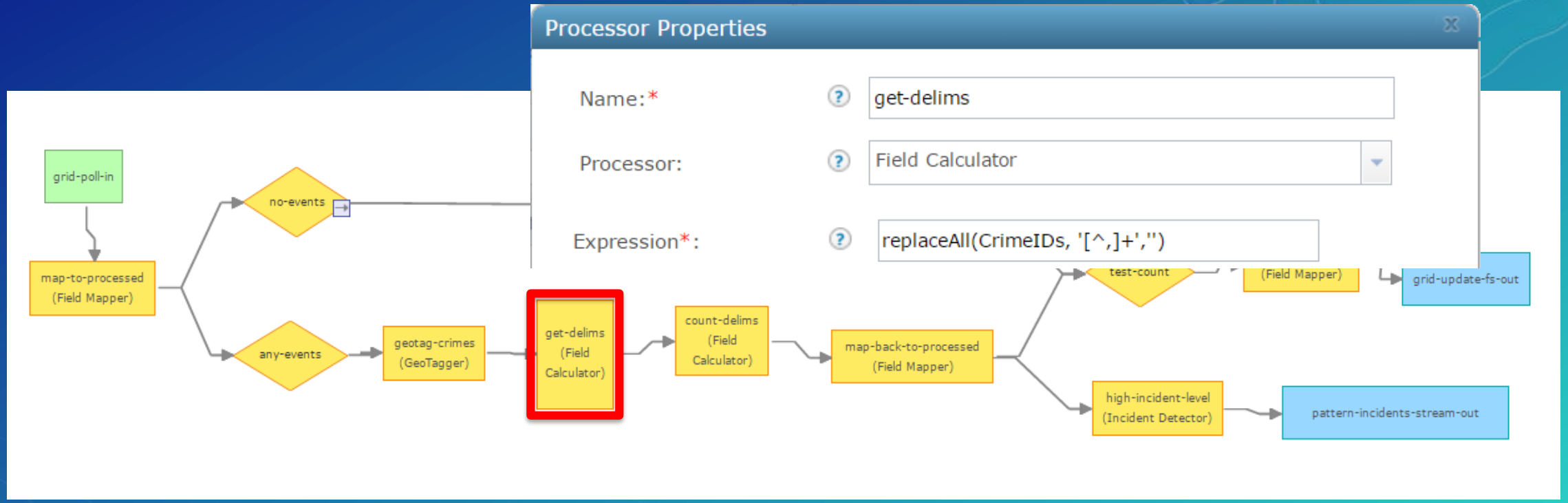
Convert from Feet to Miles Expression:

Distance / 5280

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

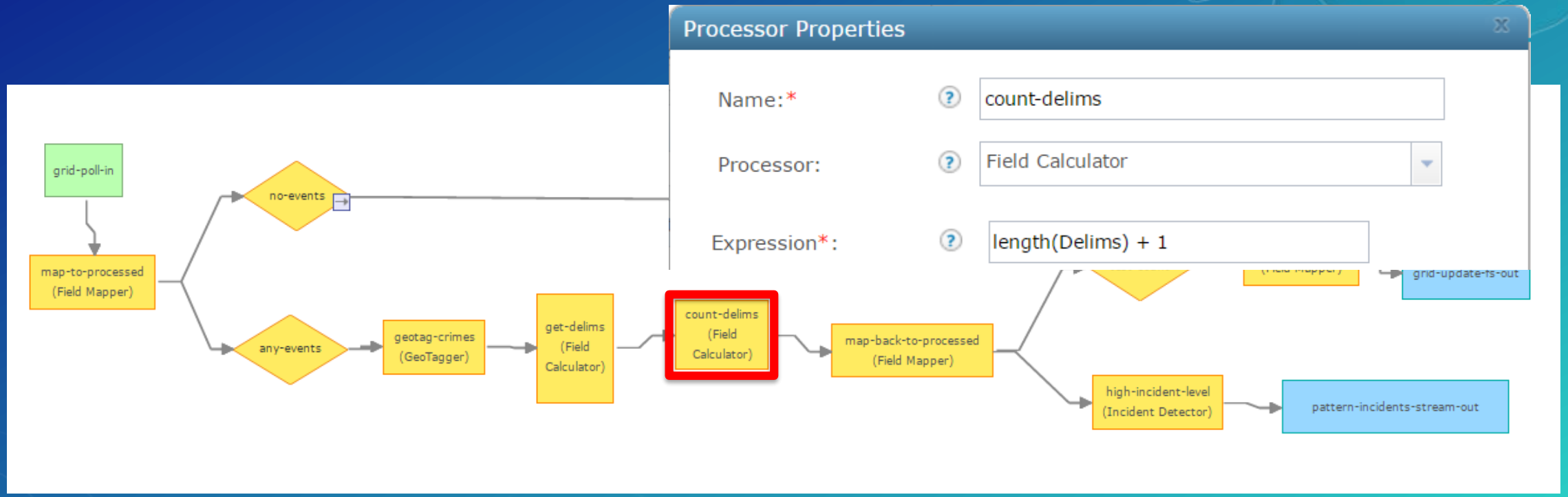
Finding patterns in real-time data

GeoEvent Service example



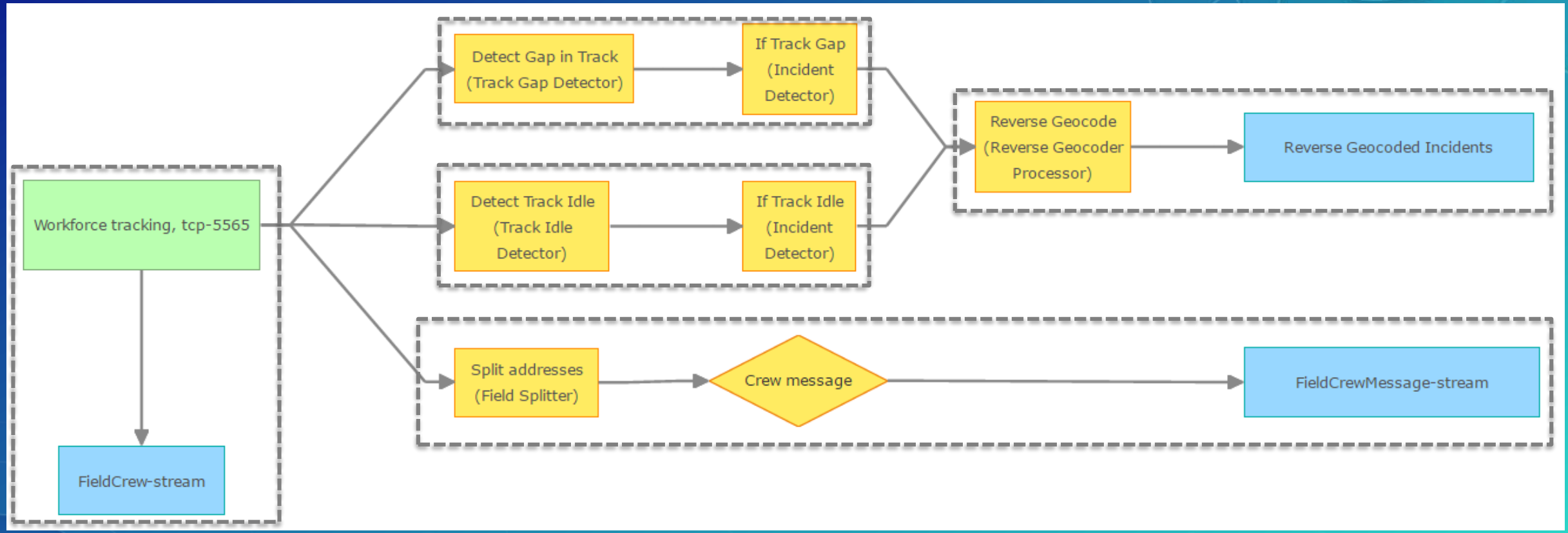
Finding patterns in real-time data

GeoEvent Service example

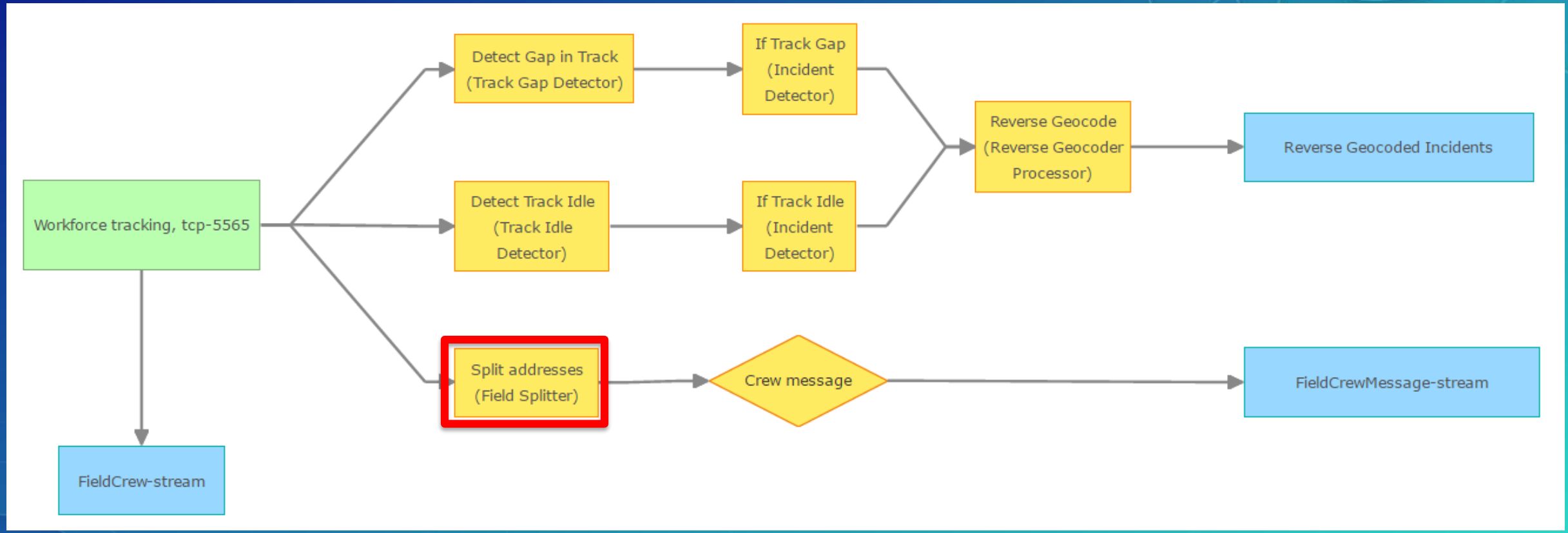


4 Workforce Tracking (demo)

Workforce Tracking



Workforce Tracking – Field Splitter

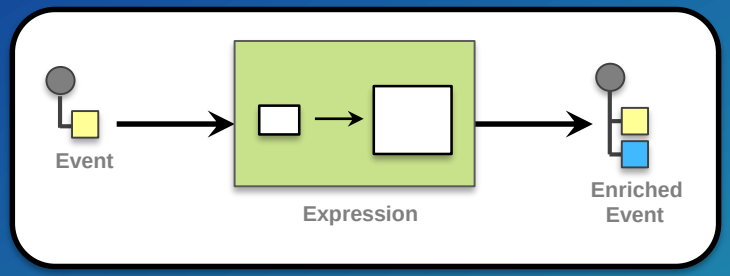


Field Splitter processor

- Splits delimited lists into multiple GeoEvents
- Lists can be a single delimited string (e.g. comma delimited values)
- A multicardinal version of this processor can handle more complex lists

Field Splitter processor

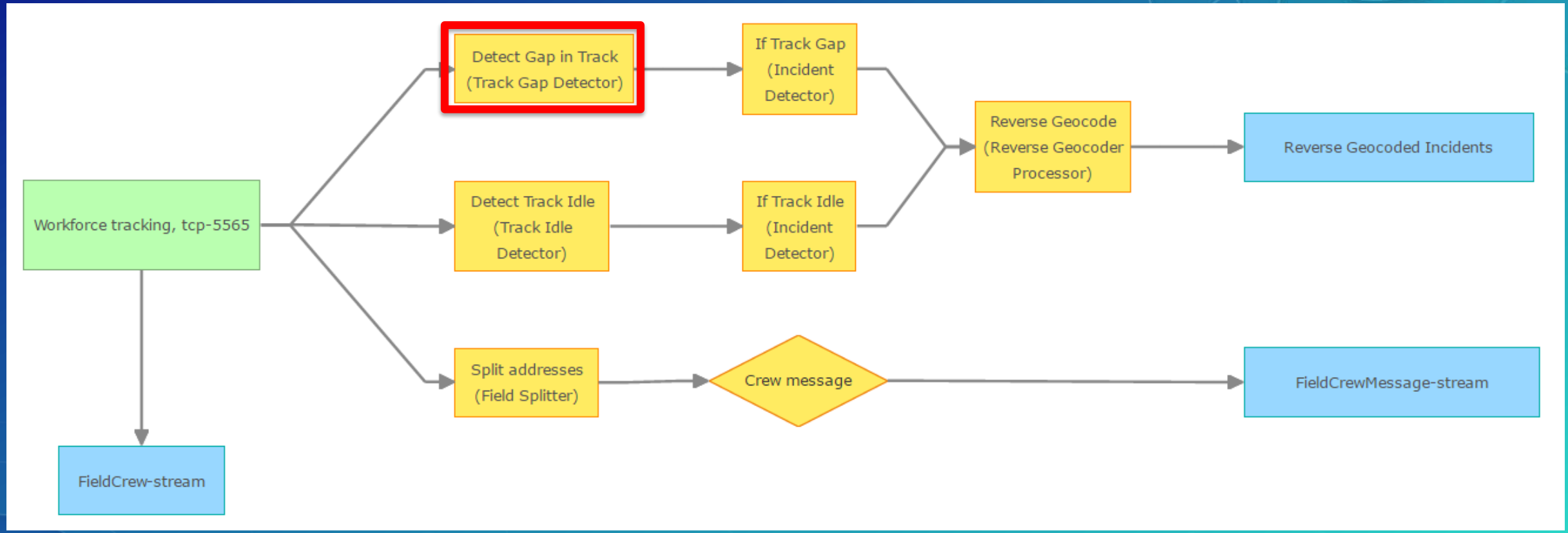
TrackID	V10987
Date	1405176845553
BatteryLevel	Low
msgCode	1
freeText	“stopped for fuel and lunch”
Addresses	“5712940342, admin@inspections.com"
geometry	-117.123…, 36.064…



TrackID	V10987
Date	1405176845553
BatteryLevel	Low
msgCode	1
freeText	“stopped for fuel and lunch”
Addresses	“5712940342”
geometry	-117.123…, 36.064…

TrackID	V10987
Date	1405176845553
BatteryLevel	Low
msgCode	1
freeText	“stopped for fuel and lunch”
Addresses	“admin@inspections.com”
geometry	-117.123…, 36.064…

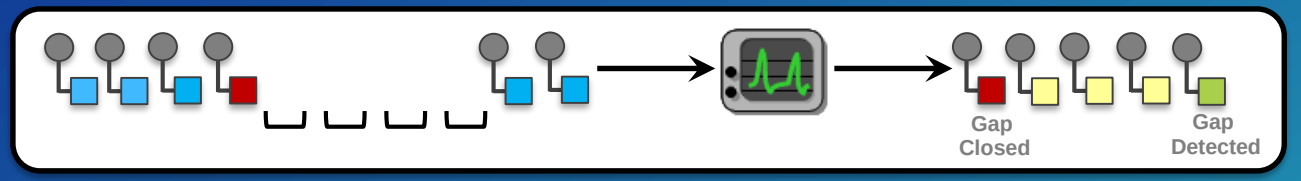
Workforce Tracking – Track Gap Detector



Track Gap Detector

- Detects the absence of events
- Enables alerts and notifications that expected data was not received

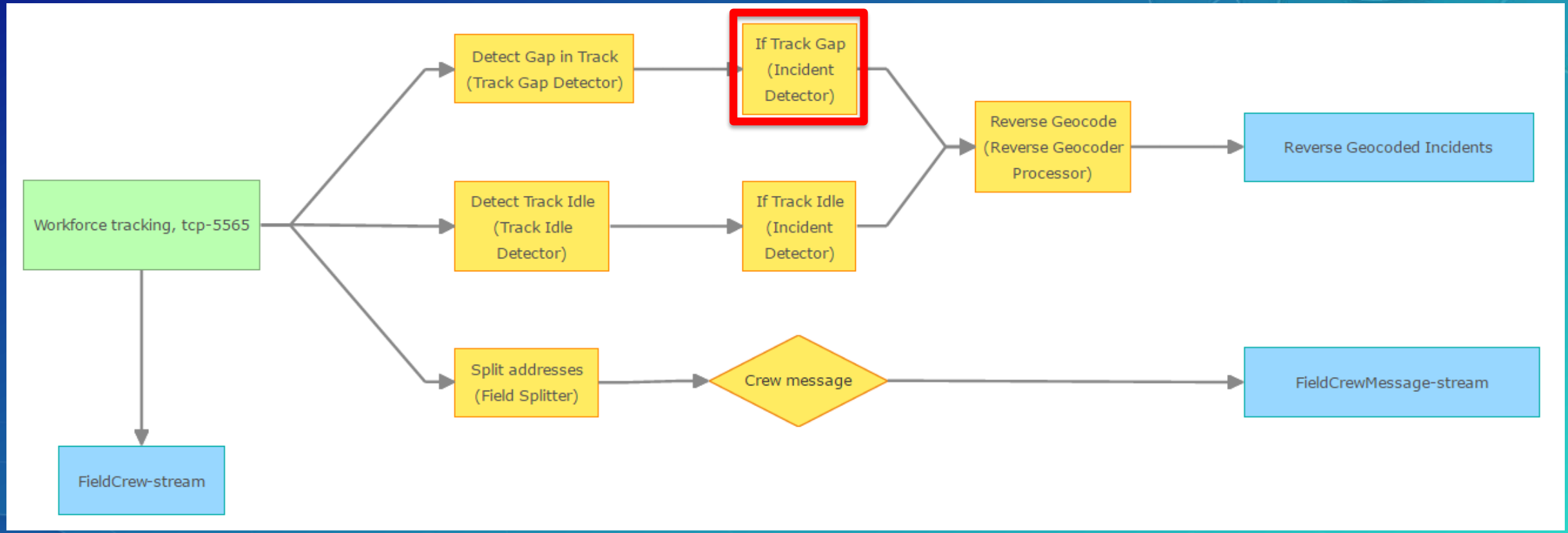
Track Gap Detector



TrackID	V10987
Date	1405176945553
Geometry	-117.123…, 36.064…

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

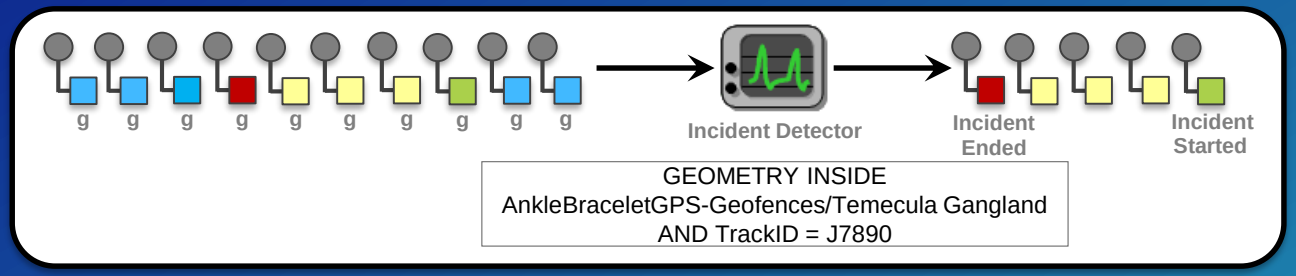
Workforce Tracking – Incident Detector



Incident Detector

- Detect that a condition has occurred and monitor its duration
- Uses filter expressions as opening and closing conditions
  - Maintains state for the duration of an incident
  - Closes the incident based on a closing expression or expiration

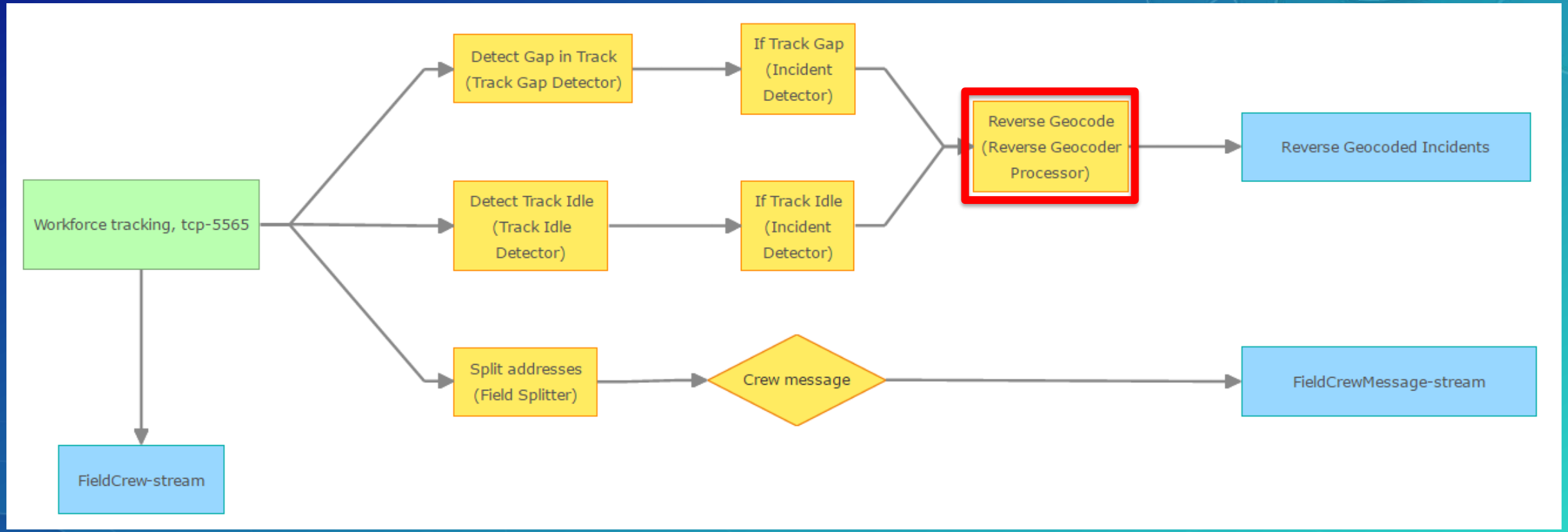
Incident Detector



TrackID	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 (TrackID = 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	

Workforce Tracking – Reverse Geocoder

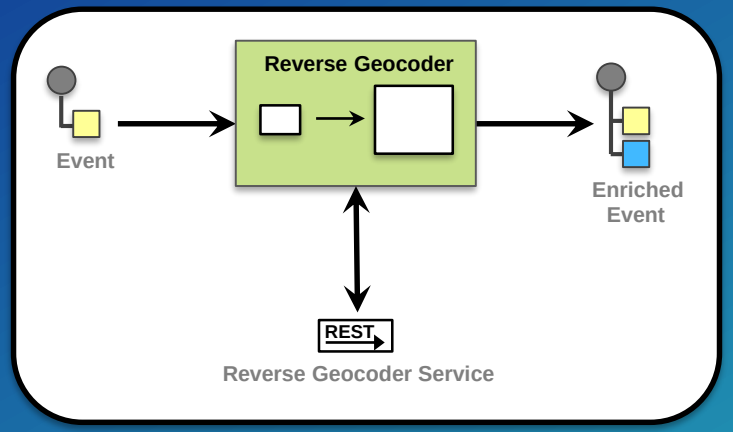


Reverse Geocoder processor

- An example of a custom processor
- Enrich a GeoEvent with the street address nearest to the event's location
  - Uses a point geometry on the incoming event record to perform a reverse geocode
  - Enriches the event record with new field(s) representing a matched address

Reverse Geocoder processor

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



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

5
Summary & Resources

Summary

Applying real-time analytics

- **ArcGIS is a dynamic platform that enables continuous analytics and real-time visualization for better understanding of our world**
- **The ArcGIS GeoEvent Server allows you to:**
  - **know what is happening, as it happens**
  - **react and make smarter decisions faster**
  - **be notified when interesting events occur**

Summary

Self-paced training and introductions to GeoEvent Server

- **Step-by-Step Tutorials, free to download**
  - **Introduction**
  - **Stream services**
  - **Spatiotemporal Big Data Store**
  - **Notifications**
- **Blogs and discussions on the forum**
  - **http://links.esri.com/geoevent-forum**
- **Video recordings of technical workshops**
  - **http://www.esri.com/videos**

GeoEvent Technical Presentations

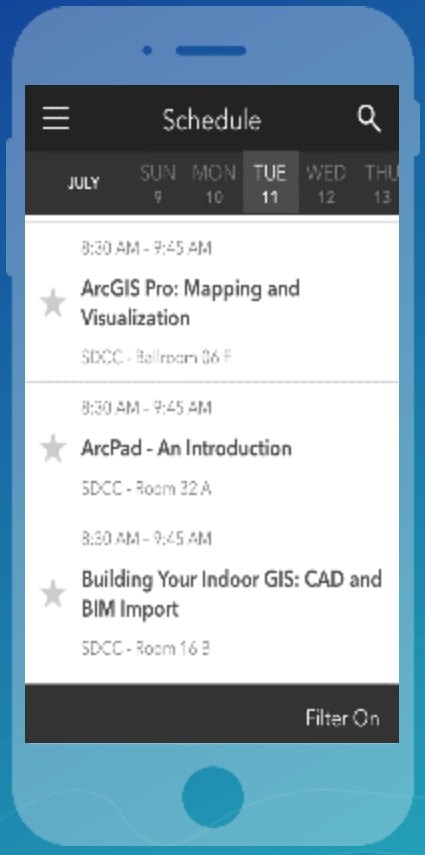
Remaining Sessions

- GeoEvent Server: Best Practices
- Developing Real-Time Web Apps with JavaScript
- Big Data: Leveraging the Spatiotemporal Big Data Store
- Building Android Location Awareness with GeoEvent Server
- GeoEvent Server: Making 3D Scenes Come Alive
- GeoEvent Server: Internet of Things (IoT)

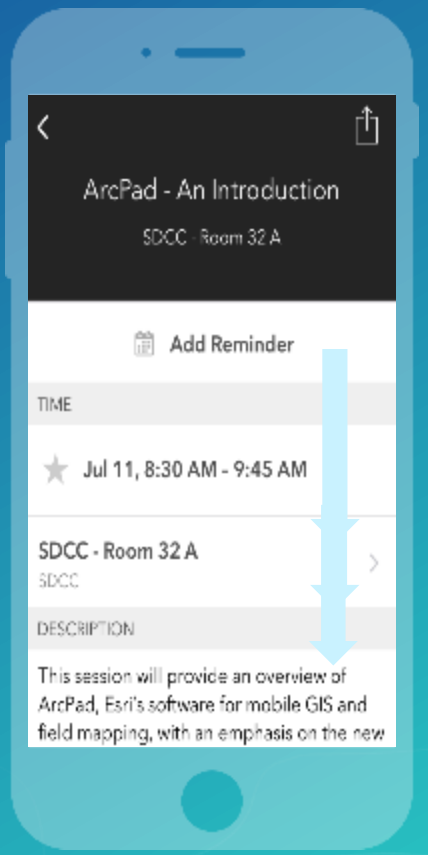
Please Take Our Survey on the **Esri Events App!**

Download the Esri Events app and find your event

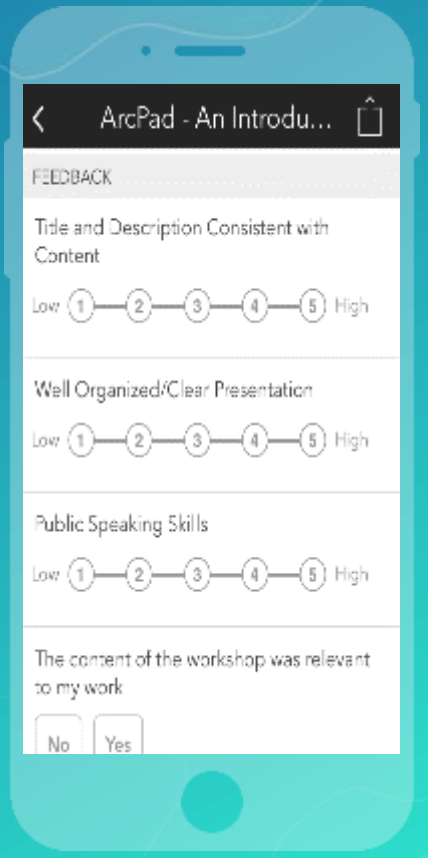
Select the session you attended



Scroll down to find the survey



Complete Answers and Select "Submit"



Questions / Feedback?

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kgorton@esri.com