



# ArcGIS GeoEvent Server: Applying Real-Time Analytics

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RJ Sunderman

**GIS  
INSPIRING  
WHAT'S  
NEXT**

# Agenda

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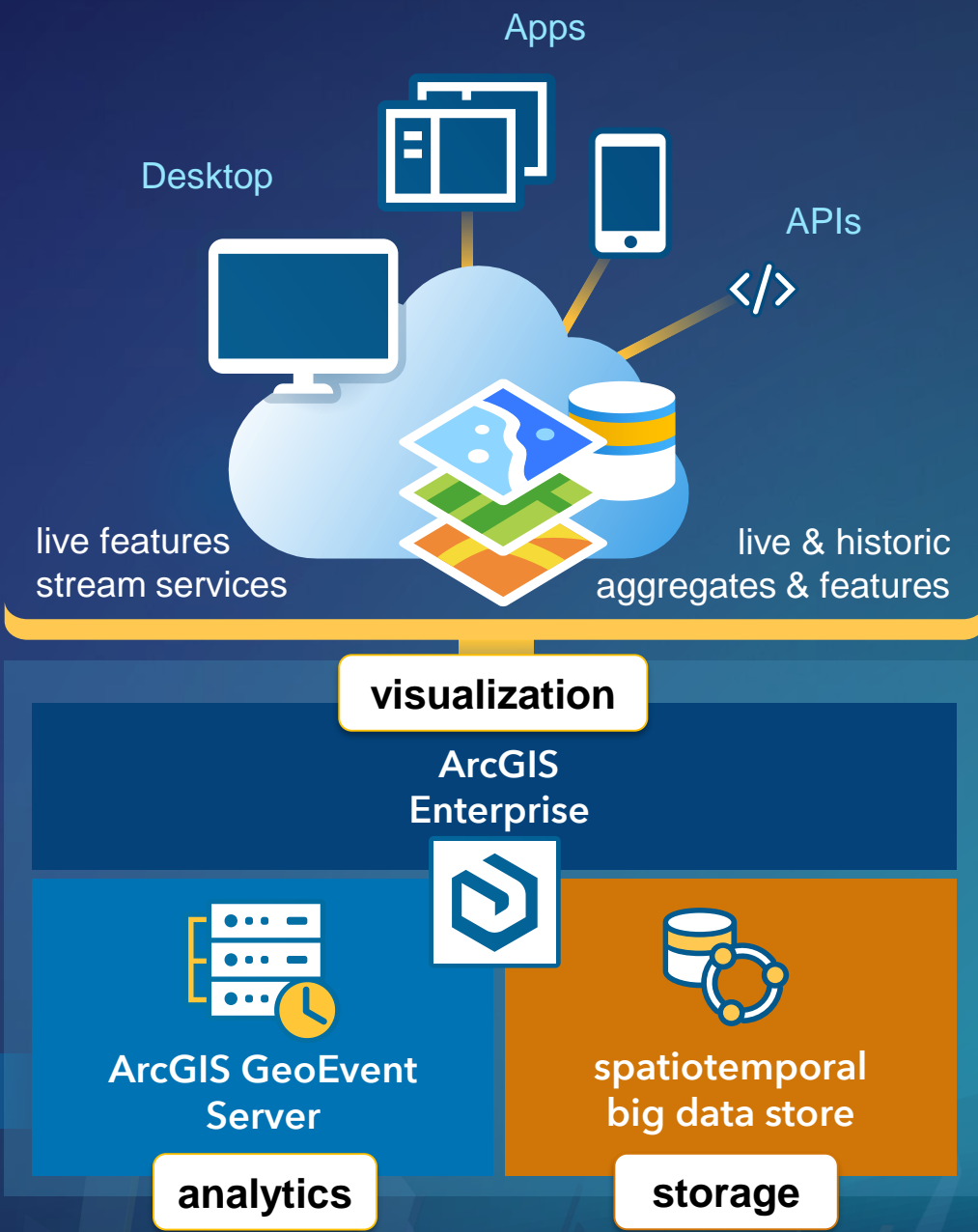
- 1 Performing Analysis in Real-Time
  - 2 Use Case 1: Identifying Conditions
  - 3 Use Case 2: Finding Patterns in Data
  - 4 Use Case 3: Tracking & Rendezvous Detection
  - 5 Summary & Resources
-



# Performing Analysis in Real Time

# ArcGIS Enterprise

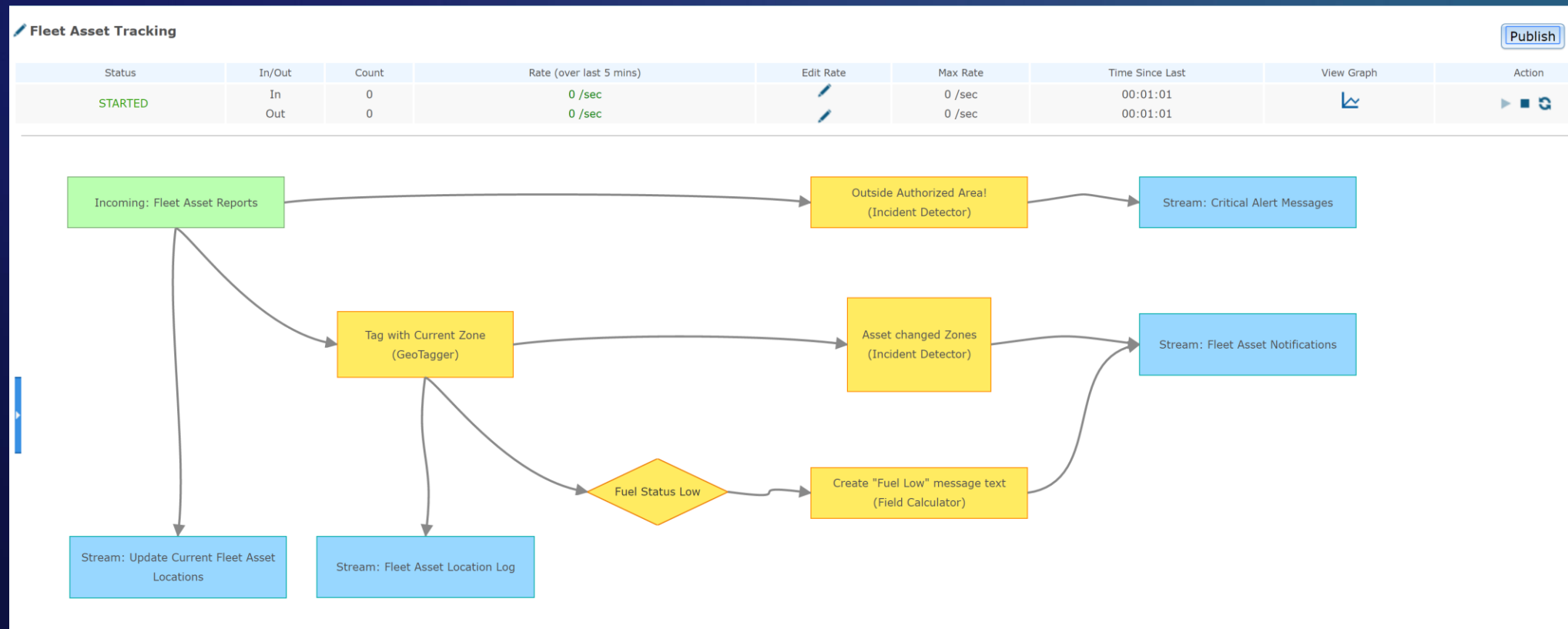
*with real-time capabilities*



# Applying real-time analytics

## GeoEvent Services

- 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

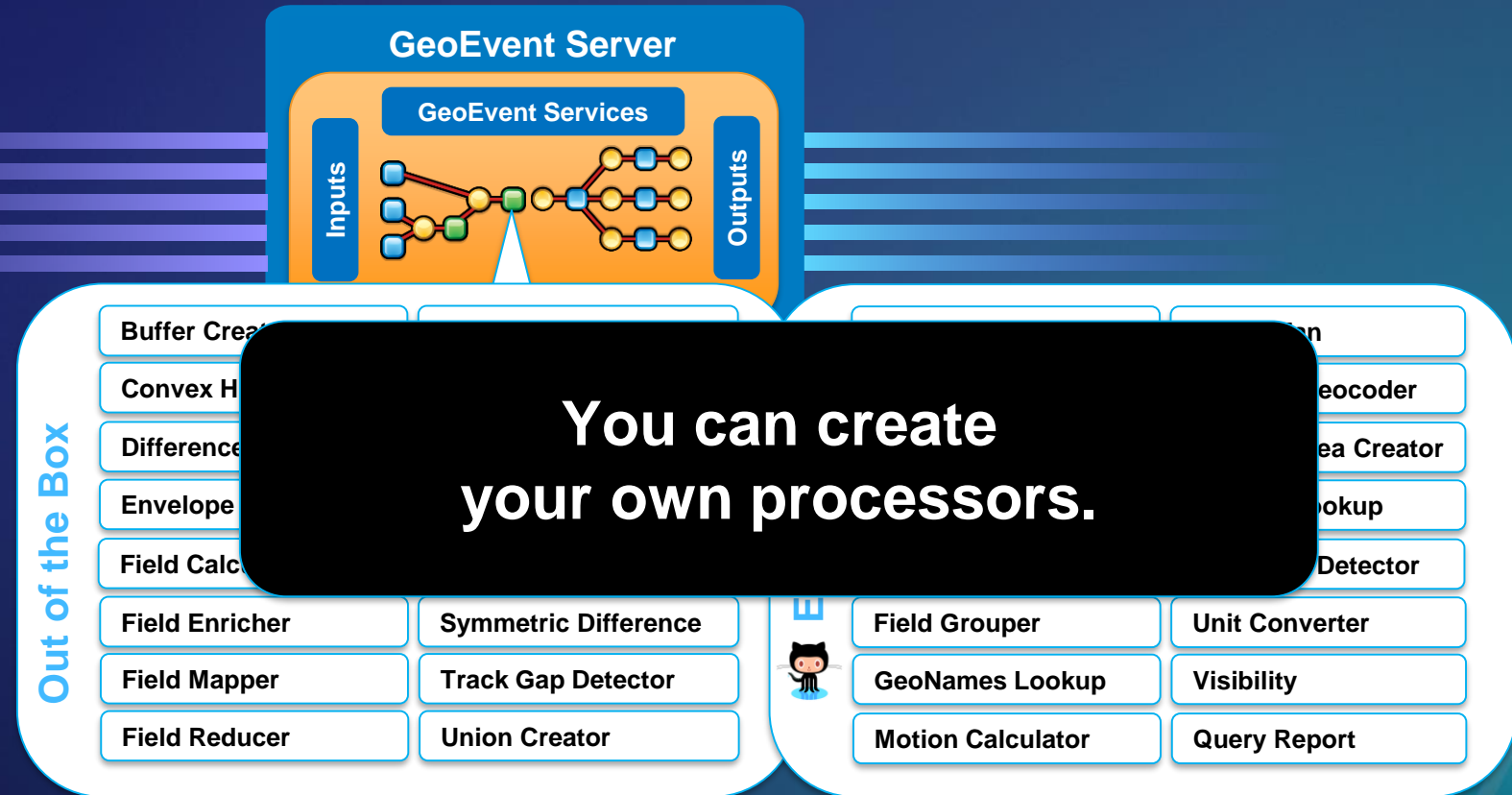




# Applying real-time analytics

## *processors and filters*

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







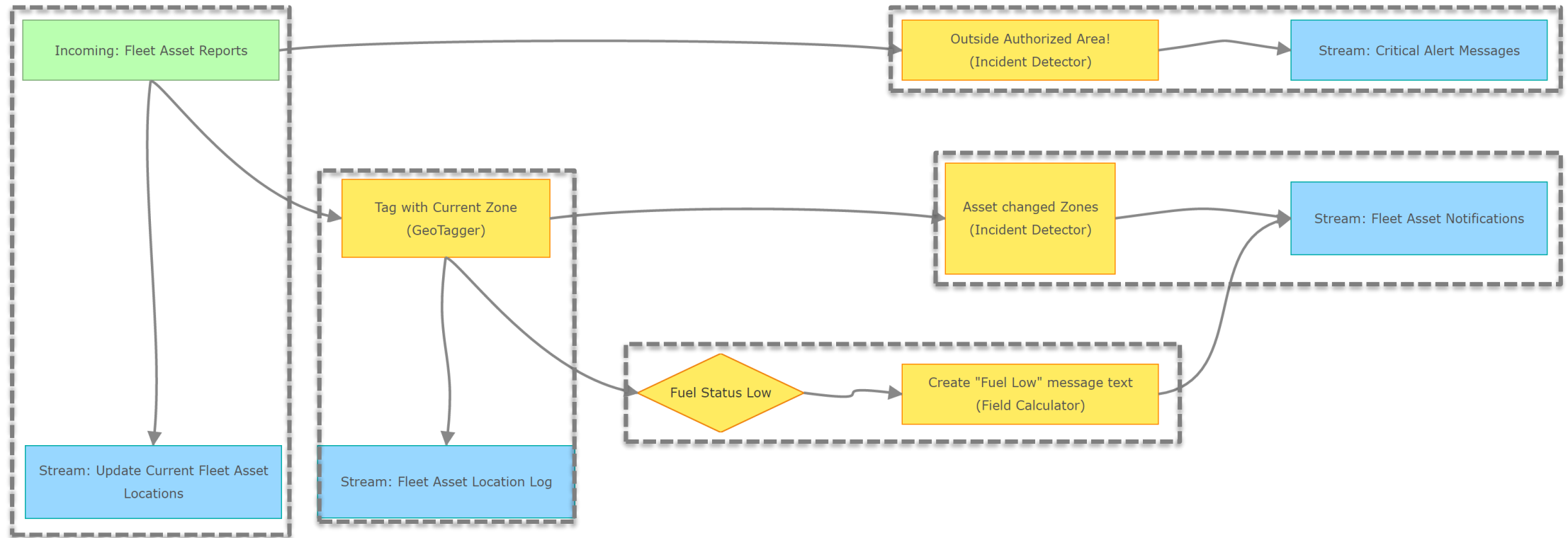
Alert(s)

Notification(s)



# Fleet Asset Tracking Pseudo Service

*real-time analytics design*



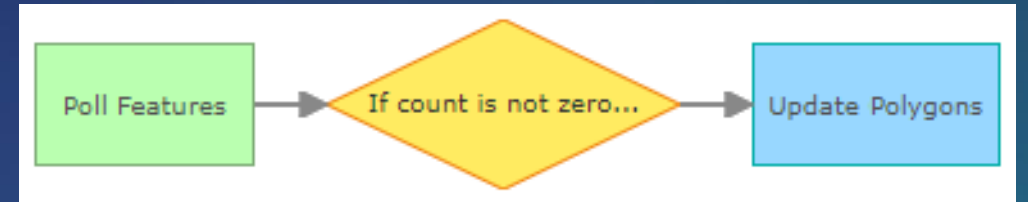


# Processors

- **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 event record being processed in some way**

# Filters

- Allow event records to pass only if a conditional expression evaluates *TRUE*
- The expression can use attributes or geometries you have established as geofences



Filter Properties

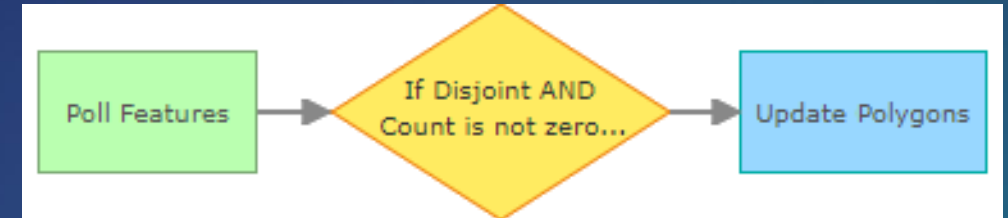
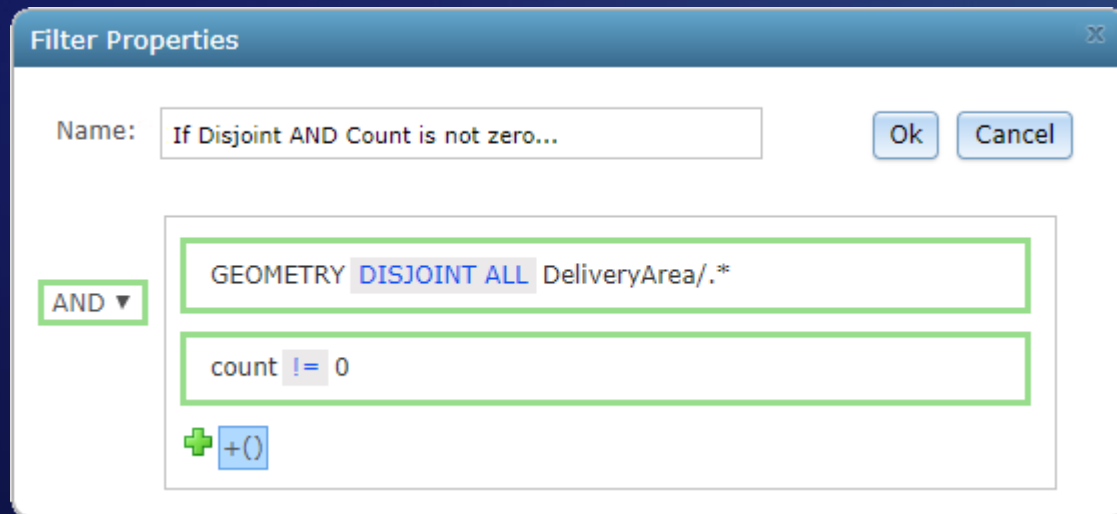
Name:

Filter Properties

Name:

# Filters

- You can use Boolean logic (AND, OR, NOT) to combine expressions





# 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

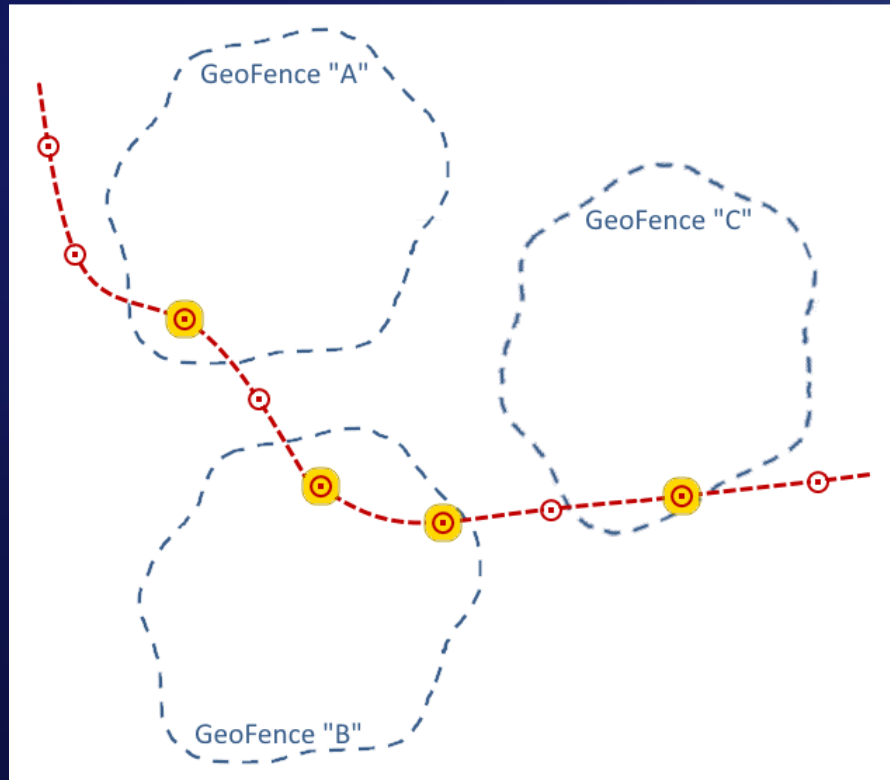
**GEOMETRY INTERSECTS ALL .\*/.\***

**GEOMETRY DISJOINT ANY .\*/.\***

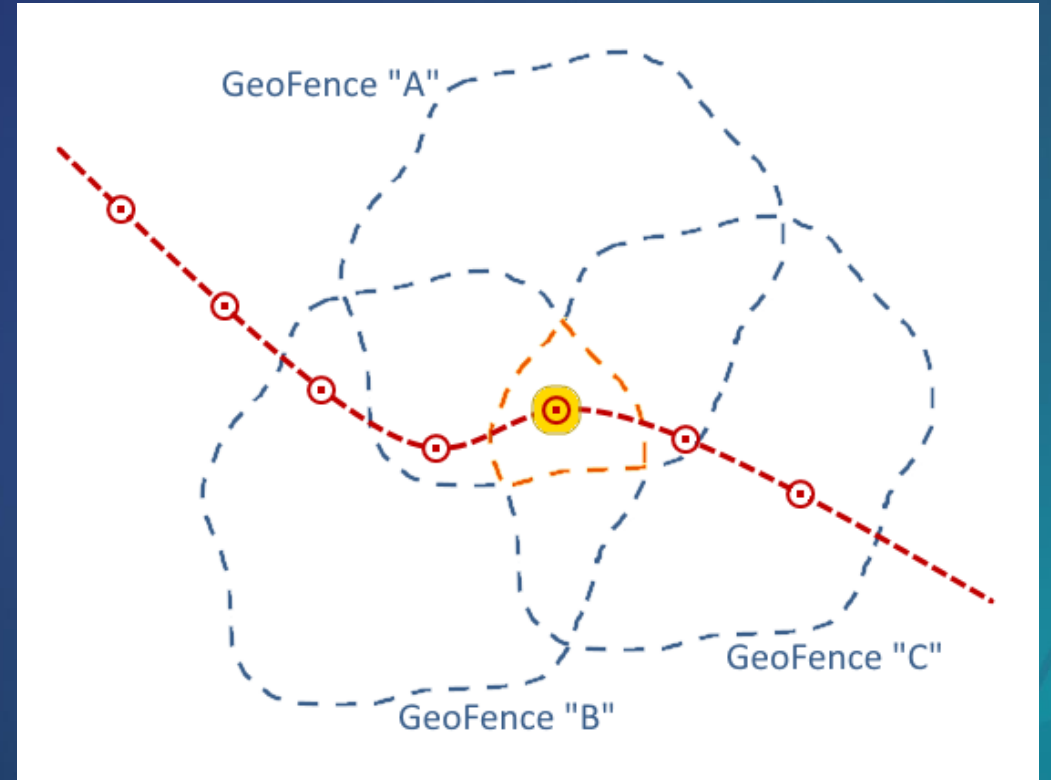
# Spatial Operators

## *overlapping geofences*

- **Intersects Any geofence**

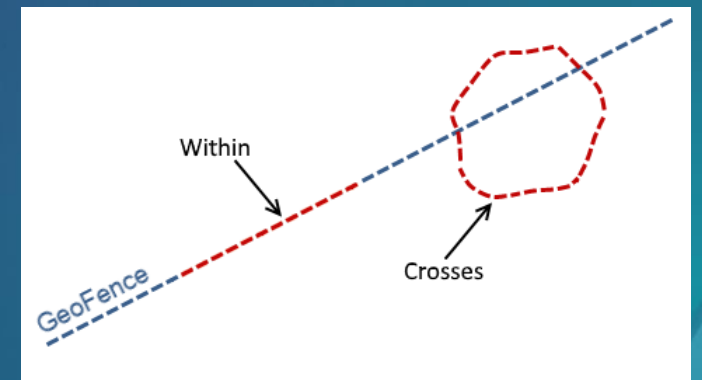
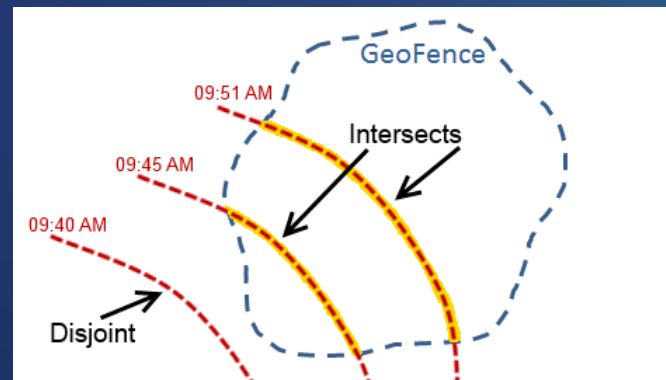
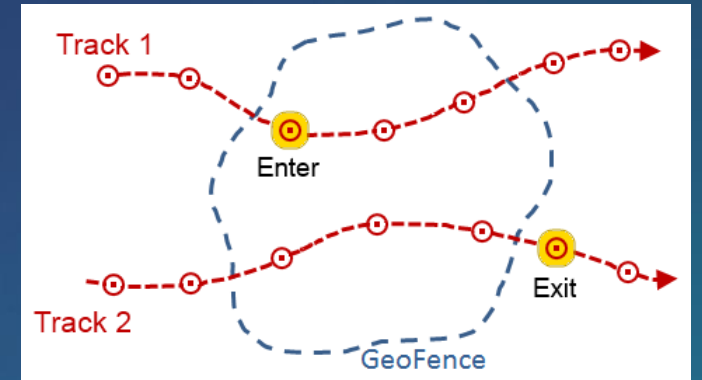
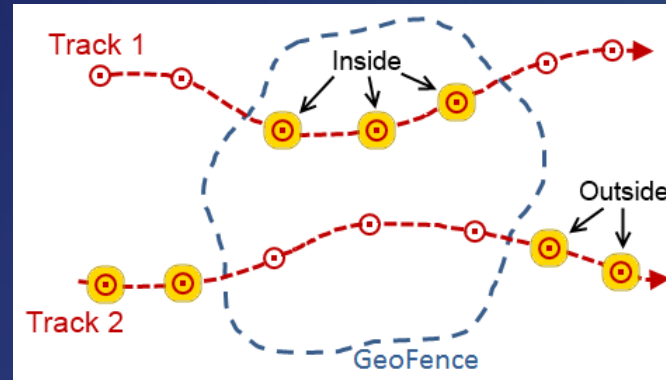


- **Intersects All geofences**



# Spatial Operators

<b>inside</b>	<b>outside</b>
<b>enter</b>	<b>exit</b>
<b>intersect</b>	<b>disjoint</b>
<b>touches</b>	<b>contains</b>
<b>crosses</b>	<b>equals</b>
<b>overlaps</b>	<b>within</b>

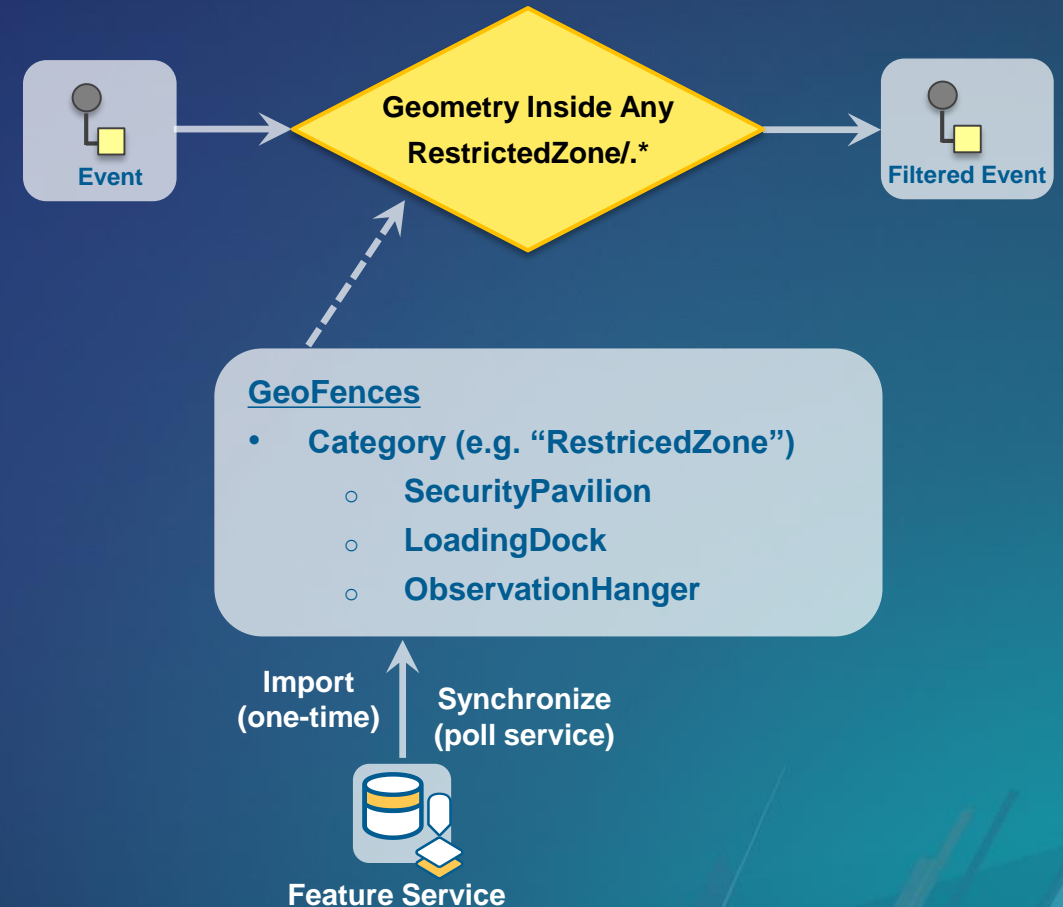




# GeoFences

## *feature service synchronization*

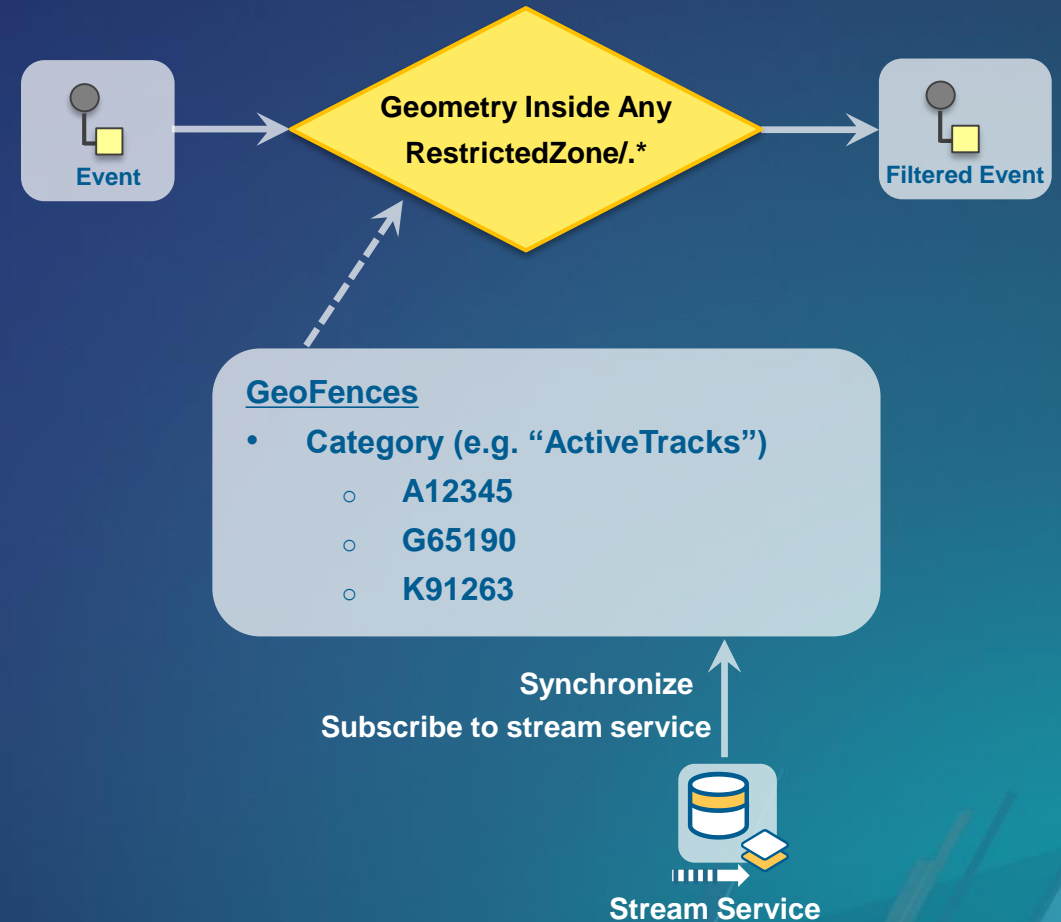
- **Import from a feature service**
  - Reads once (good for static geofences)
- **Synchronize with a feature service**
  - Periodically refreshes to update geofences



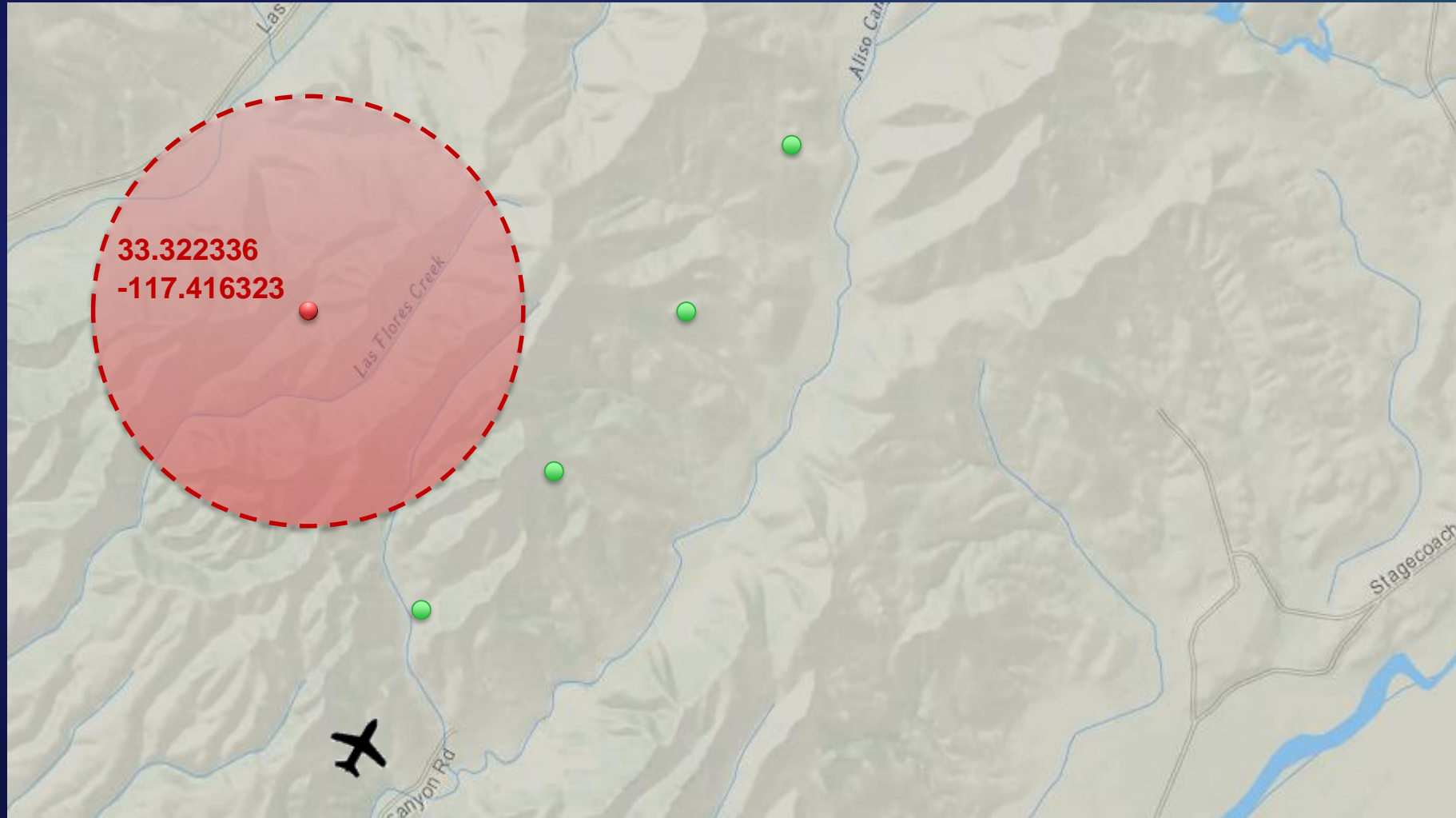
# GeoFences

*feature service synchronization*

- Synchronize with a stream service
  - Allows geofences to become dynamic
- Requires active management and purging of geofences as they expire

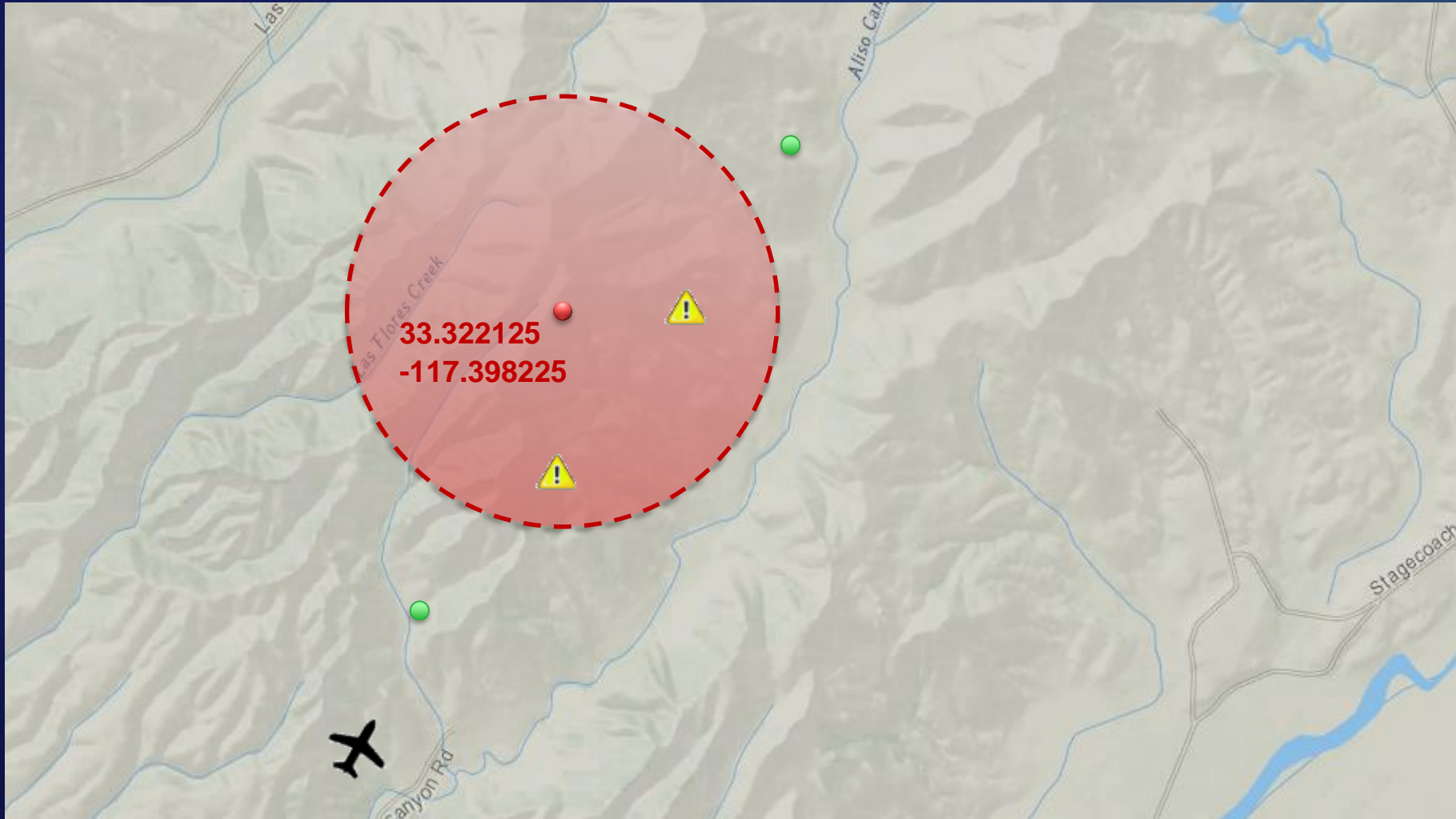


# Dynamic GeoFences








# Dynamic GeoFences

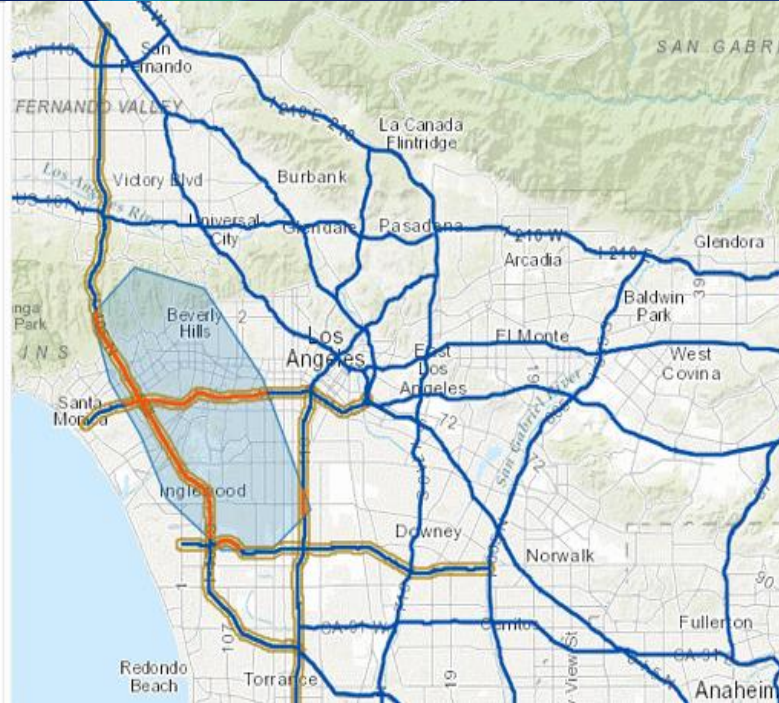




# Use Case 1: Identifying Conditions

## Contents

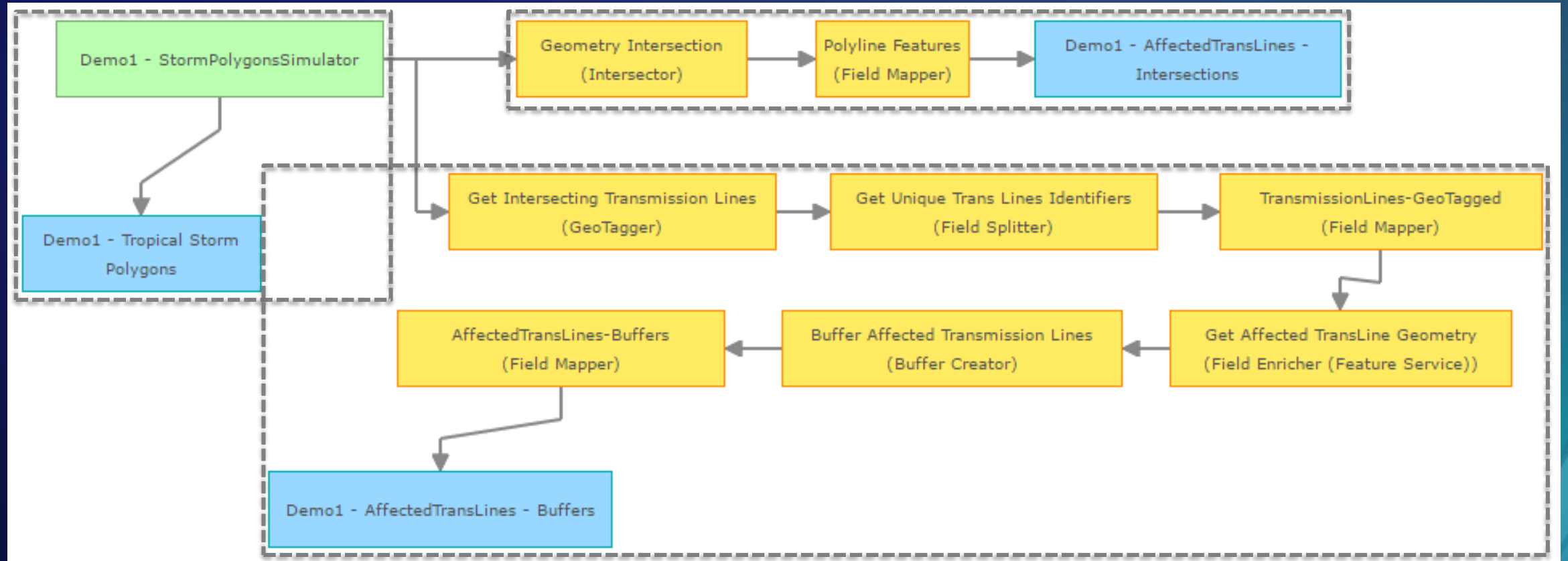
- TransmissionLines (Intersection)  

- CriticalInfrastructure - TransmissionLines  

- TransmissionLines (Buffer)  

- TropicalStormPolygons  

# Identifying Conditions (demo)

# Identifying conditions with real-time data

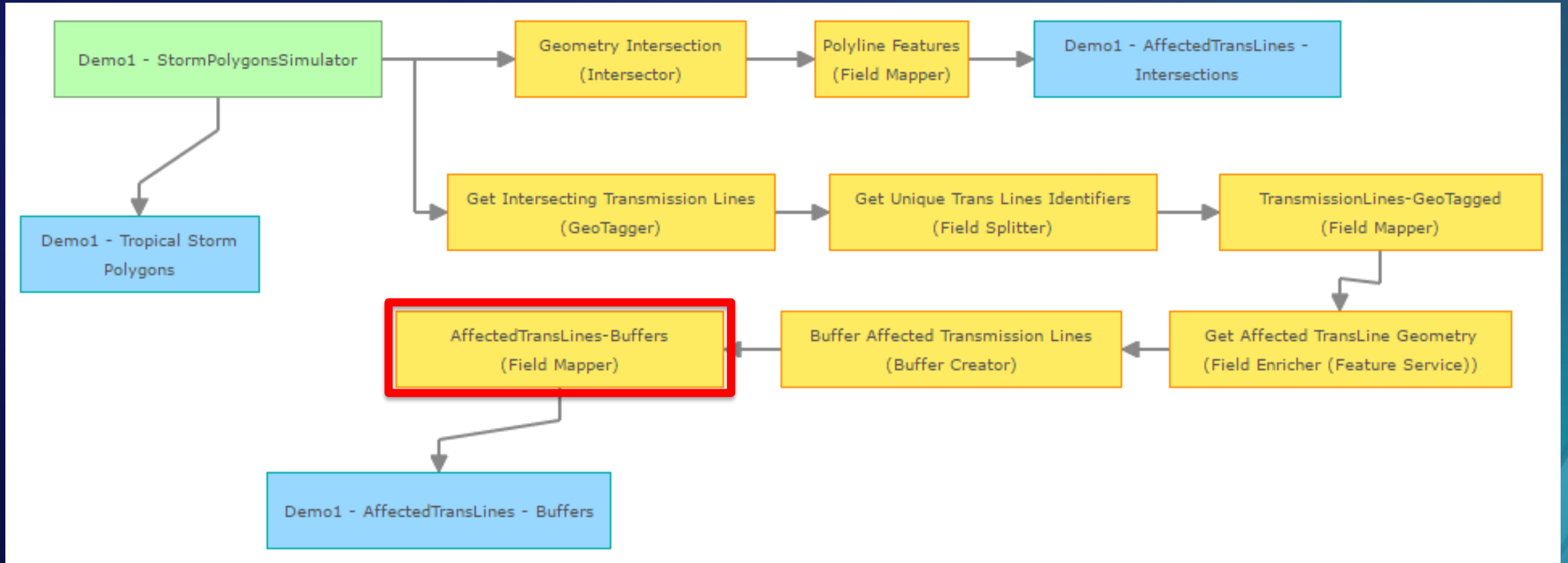
*real-time analytics design*





# Identifying conditions with real-time data

*real-time analytics design*

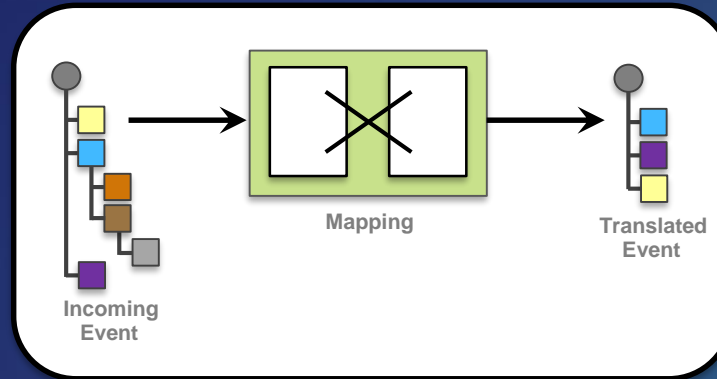


# Field Mapper processor

- Use a **Field Mapper** when you need to:
  - Change the schema or structure of an event record
  - Translate from one GeoEvent Definition to another
  - Specify how attribute values map from an inbound to an outbound event record

# Field Mapper processor

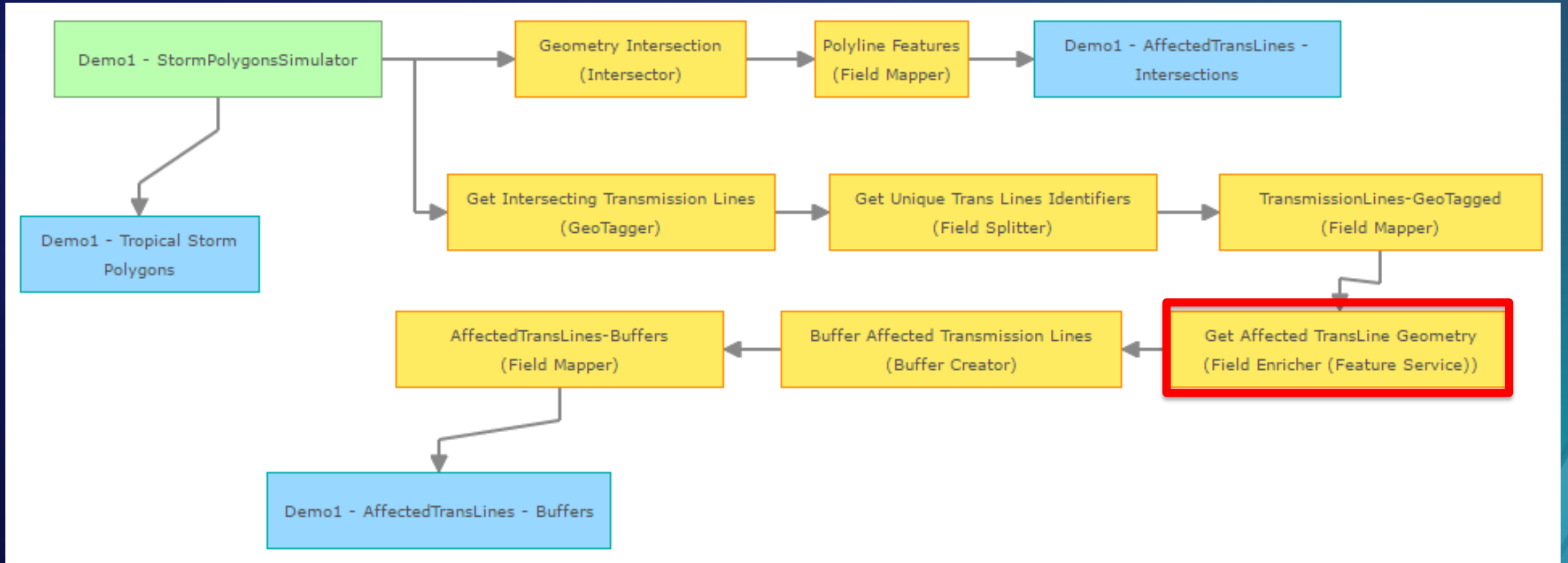
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123..., 36.064...
Category	AnkleBraceletGPS



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

# Identifying conditions with real-time data

*real-time analytics design*





# Field Enricher processor

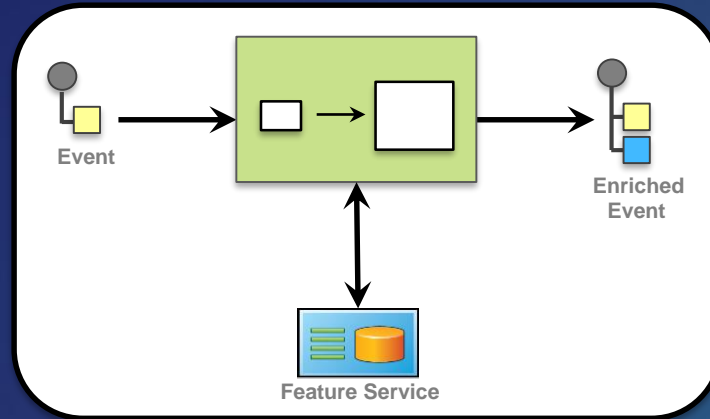
- Use a **Field Enricher** when you need to:
  - Enrich an event record with new attribute values from an secondary source

An attribute join is used to retrieve values from the secondary table.

The processor retrieves specified data values and then enriches an event record by either appending new fields or writing the data to new fields.

# Field Enricher processor

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

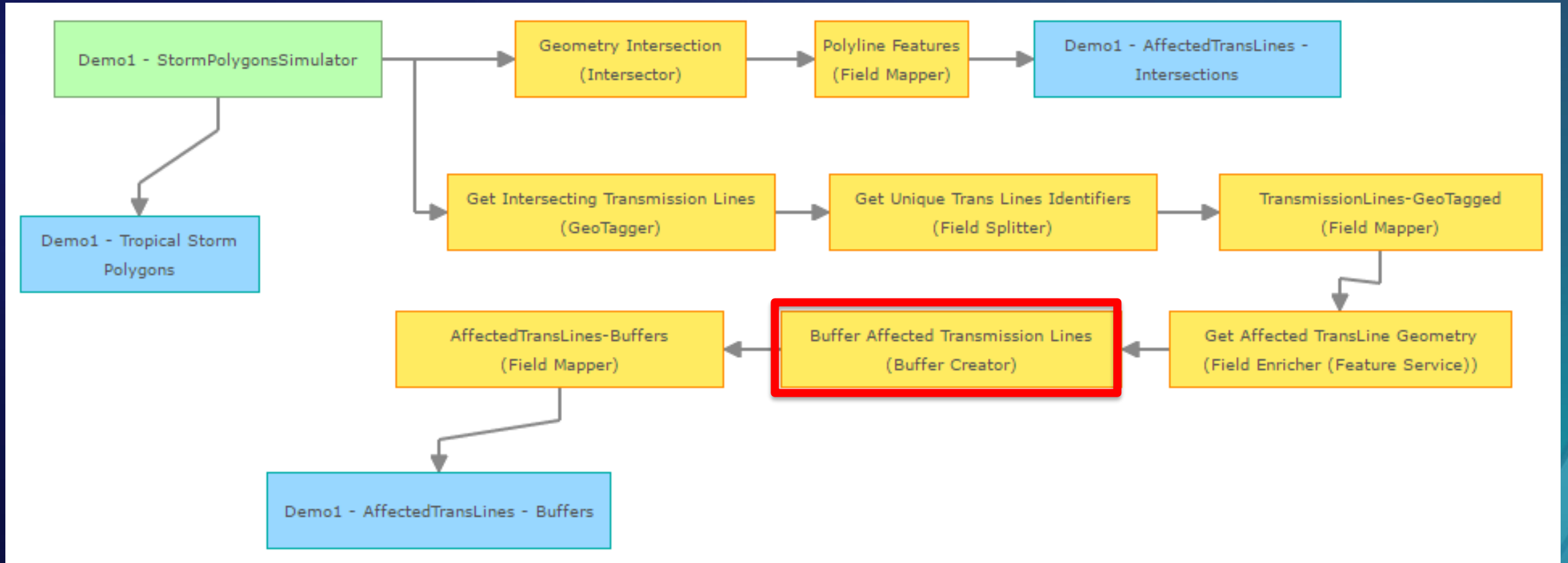


TrackID	V10987
Date	1405176845553
BatteryLevel	Low
Distance	105.6
Speed	1.2
Course	186.4
geometry	-117.123..., 36.064...
NoContact	F65432
NoEntry	Pass Christian School

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

# Identifying conditions with real-time data

*real-time analytics design*



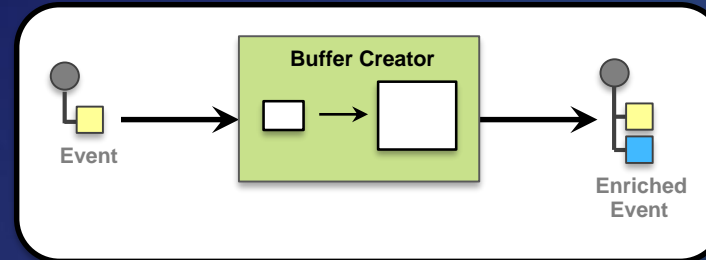
# Buffer Creator processor

- Use a **Buffer Creator** when you need to:
  - Construct a polygon around an event's point, polyline, or polygon geometry
  - Enrich an event record by adding a new geometry field
  - Replace an event record's geometry with a derivative

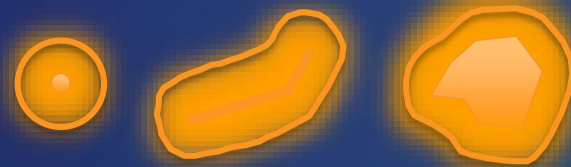


# Buffer Creator processor

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

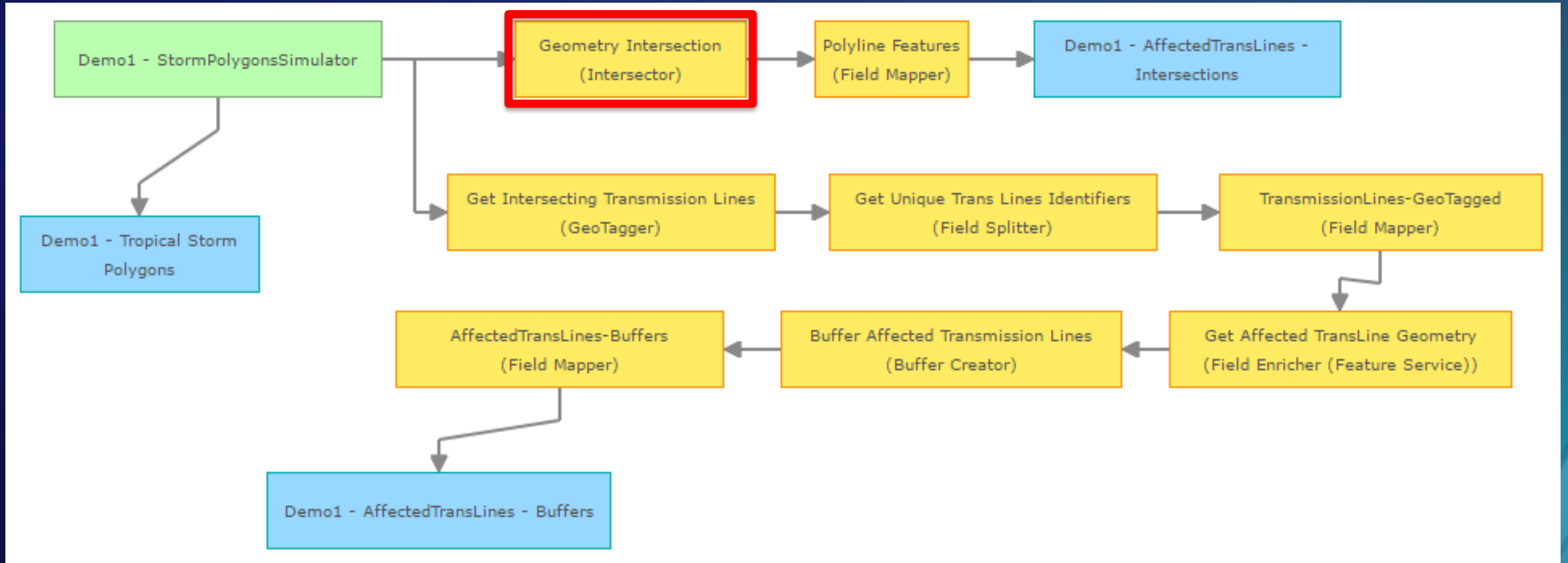


TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	-117.123..., 36.064...
buffer	rings" : [ [ [-116.3175, 33.6703], [-116.3175, 33.6703]...]]



# Identifying conditions with real-time data

*real-time analytics design*



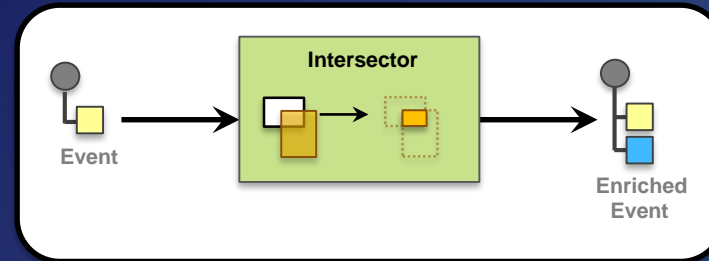
# Intersector processor

- Use an **Intersector** processor when you need to:
  - Generate a geometry representing the intersection between a event record's geometry and a set of specified geofences

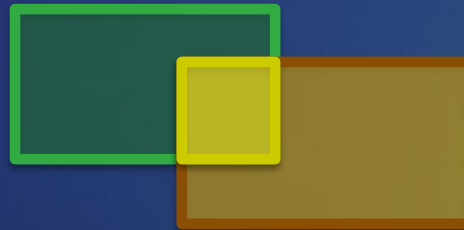
Geometry processors can either enrich an event record by adding a new geometry field or replace an event record's geometry with a derivative geometry.

# 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]...]]



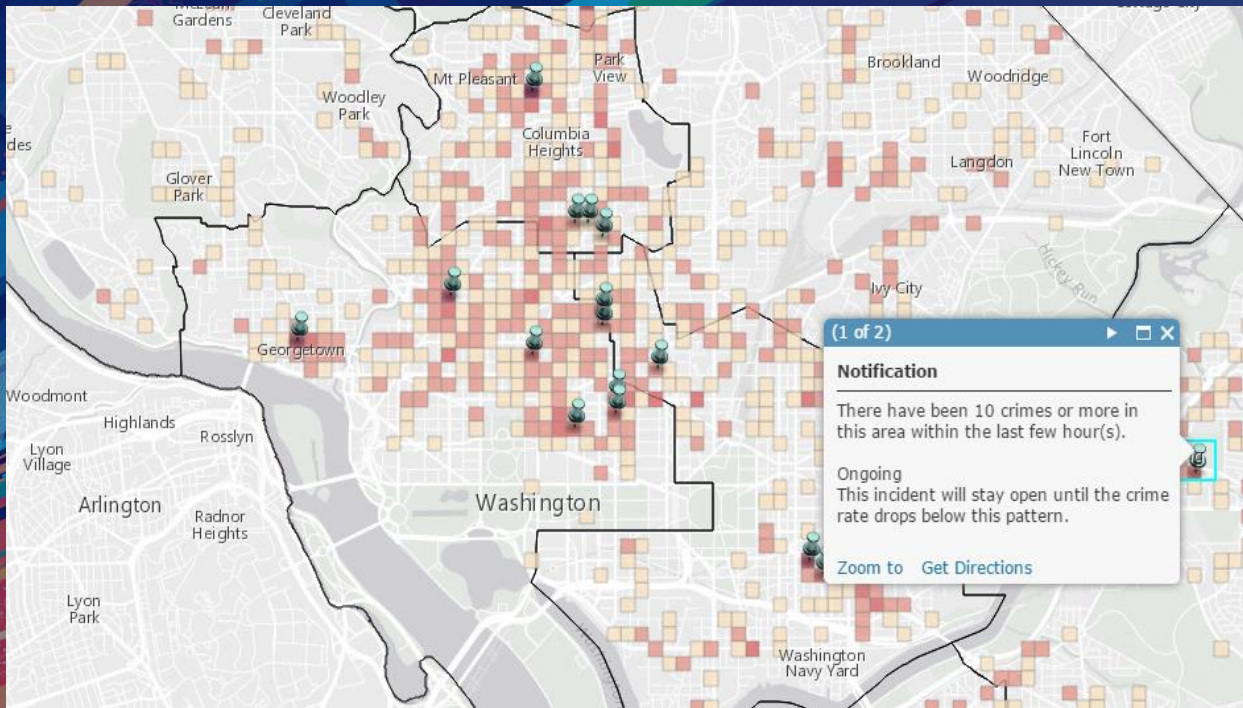




3

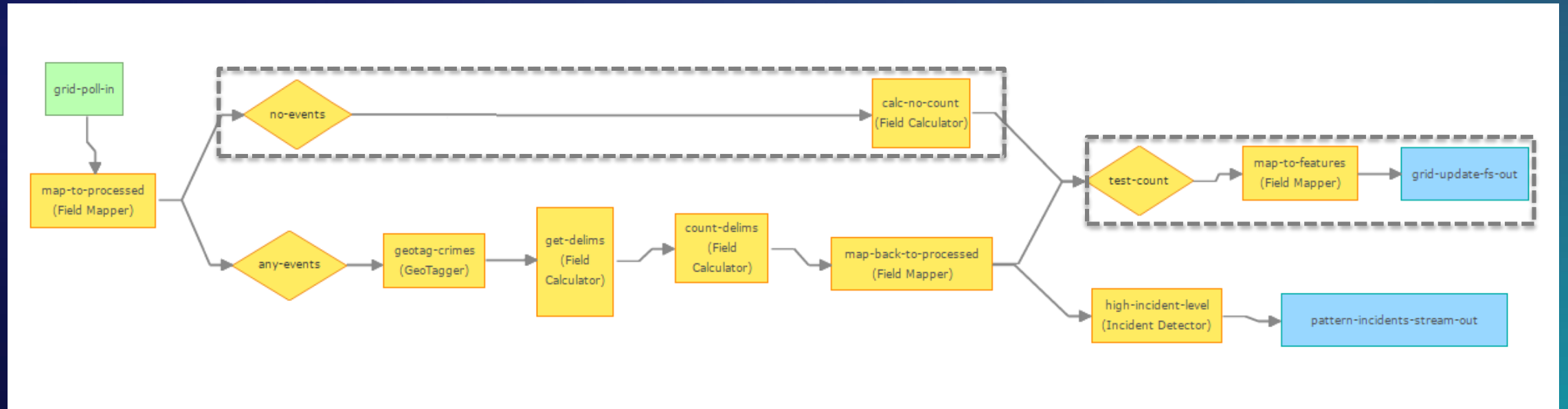
## Use Case 2: Finding Patterns in Data

# Finding Patterns in Data (demo)



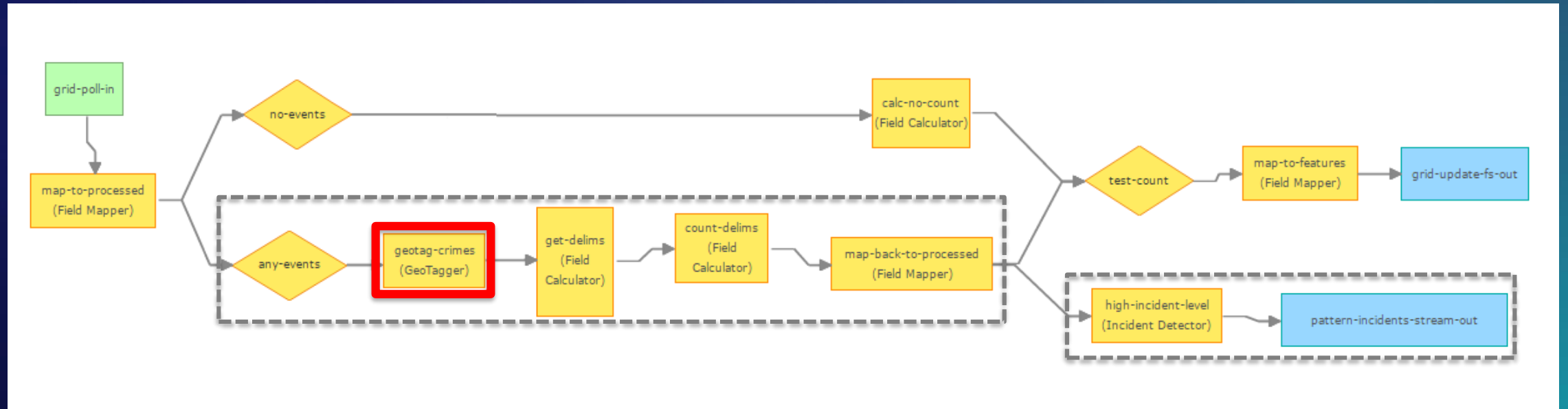
# Finding patterns in real-time data

*real-time analytics design*



# Finding patterns in real-time data

*real-time analytics design*



# GeoTagger processor

- Use a **GeoTagger** when you need to:
  - Enrich an event record with the name of a geofence with which the event has a spatial relationship

The processor uses a spatial expression to identify related geometries.

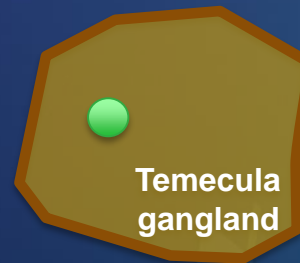
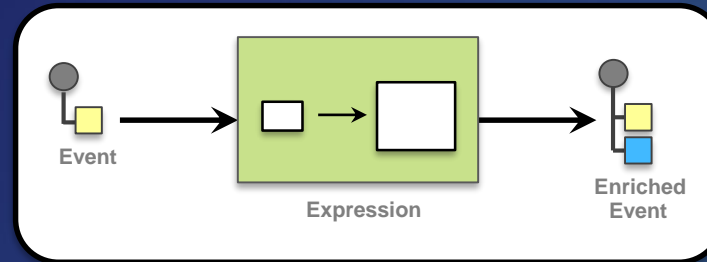
The “name” or unique identifier of the related geofences is appended to the event record.

A GeoTagger is essentially a spatial join.



# 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

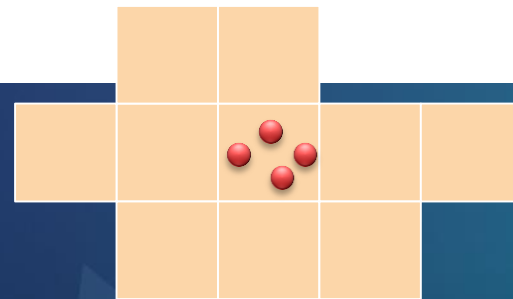
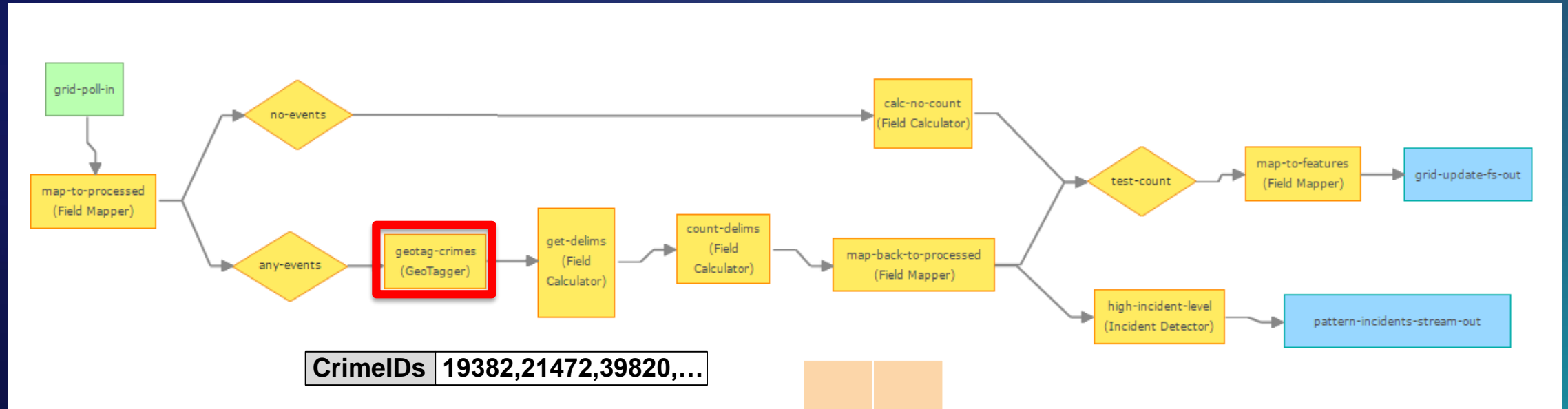


TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123..., 36.064...
Category	AnkleBraceletGPS
IsInside	Temecula gangland



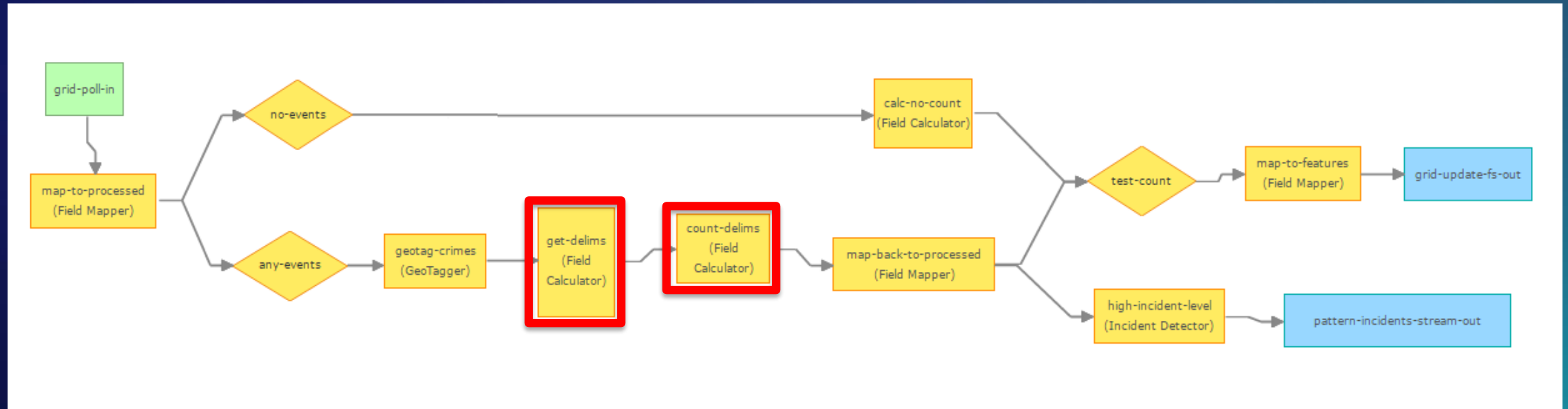
# Finding patterns in real-time data

*real-time analytics design*



# Finding patterns in real-time data

*real-time analytics design*



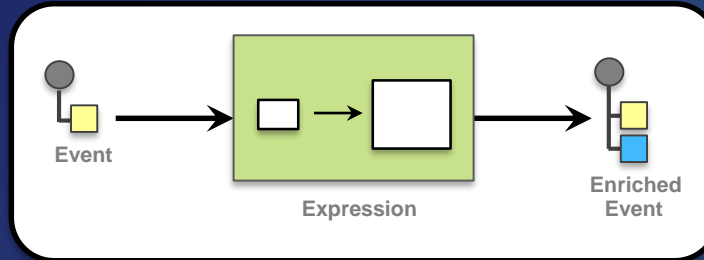
# Field Calculator processor

- Use a **Field Calculator** when you need to:
  - Calculate new values using data from a received event record
  - An expression is evaluated and used to calculate the new values
  - Results can be written to a new field or used to update an existing attribute

Expressions can be mathematical, 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...



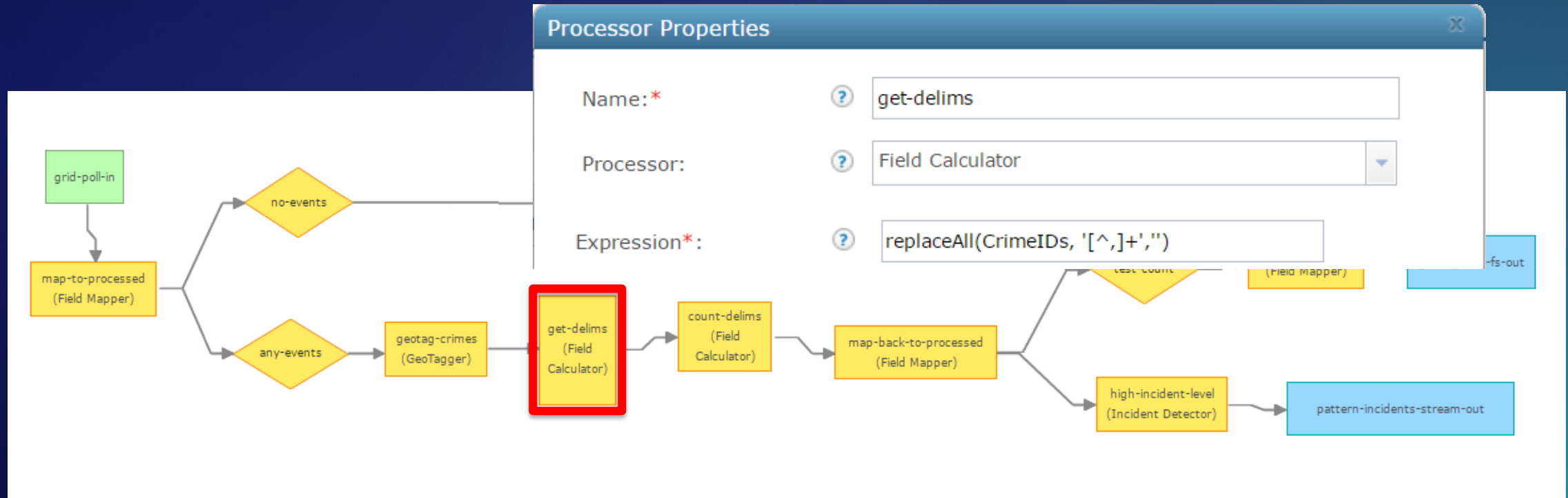
Convert from  
Feet to Miles  
Expression:

$\text{Distance} / 5280$

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

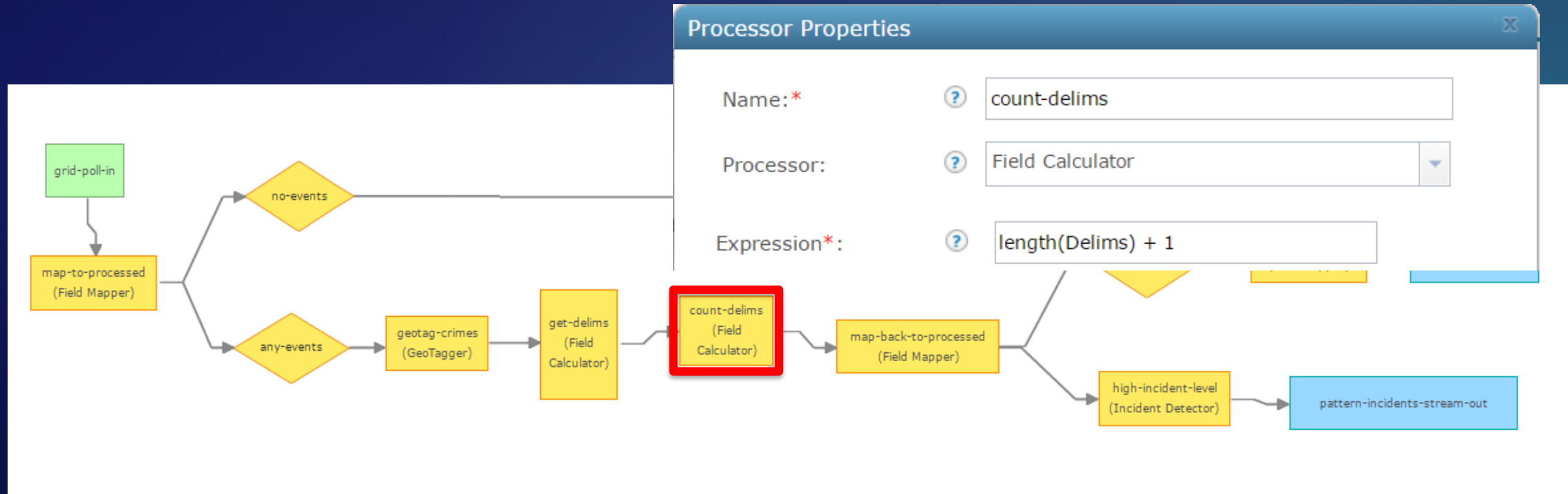
*real-time analytics design*





# Finding patterns in real-time data

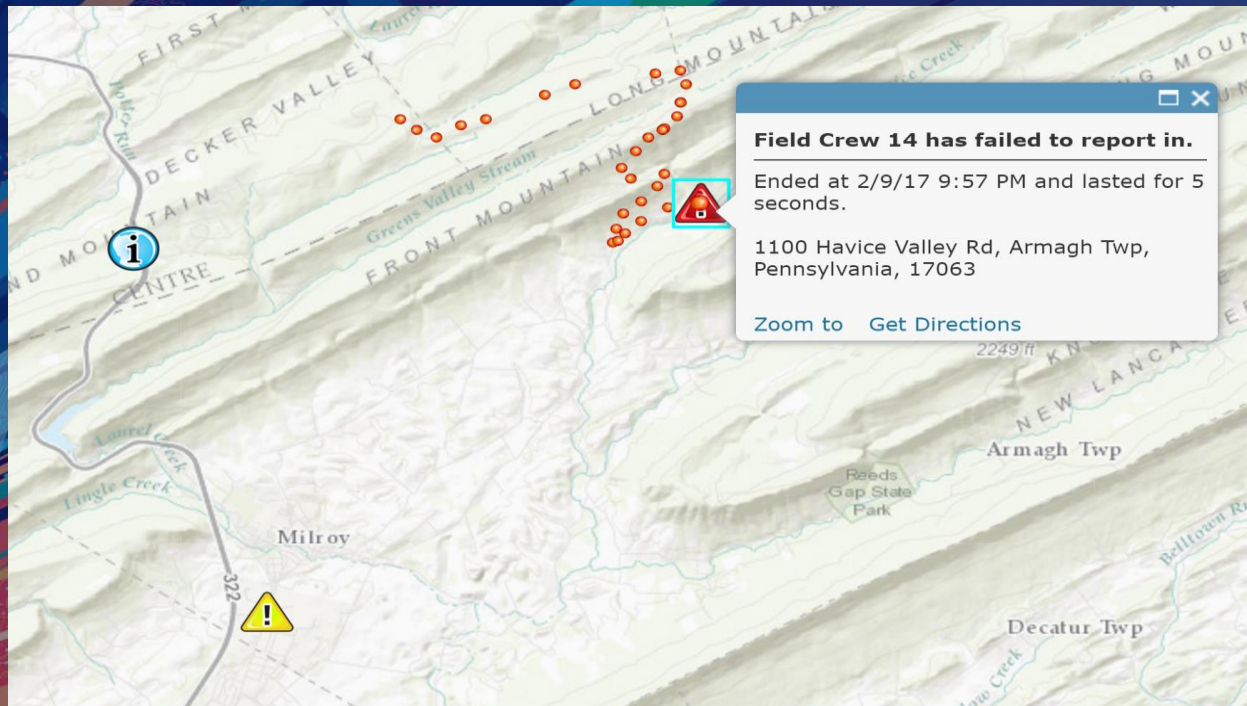
*real-time analytics design*





4

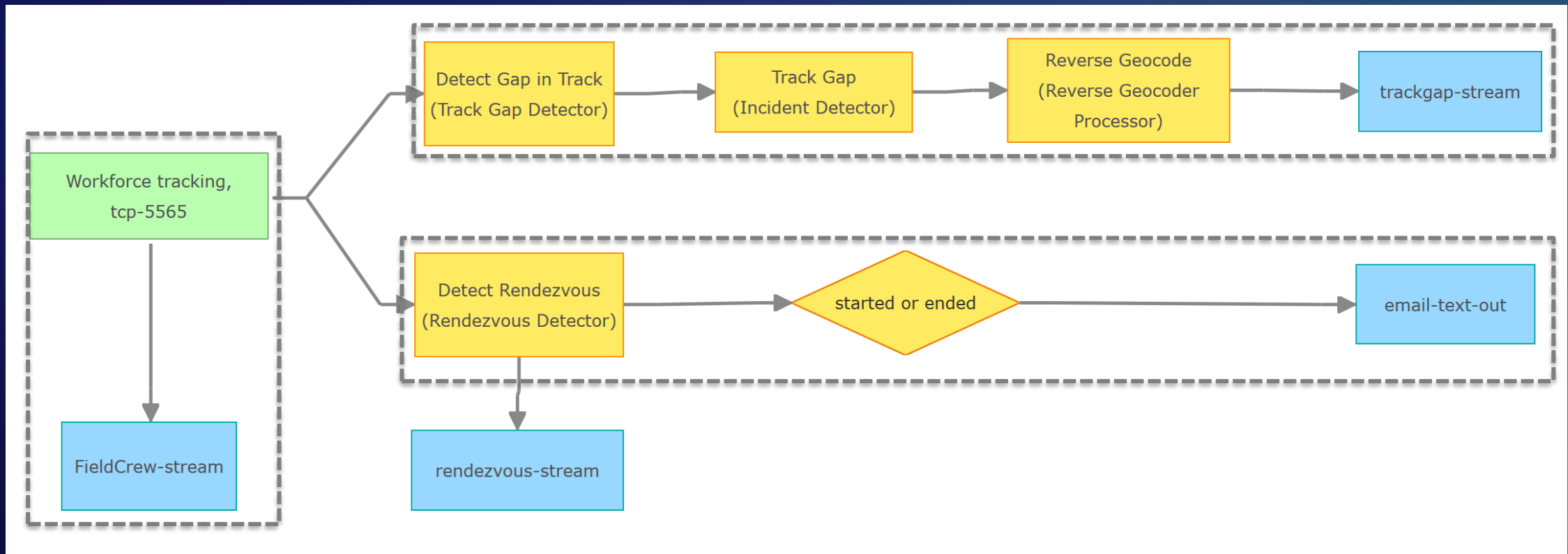
Use Case 3:  
**Entity Tracking and  
Rendezvous Detection**



# Entity Tracking and Rendezvous Detection (demo)

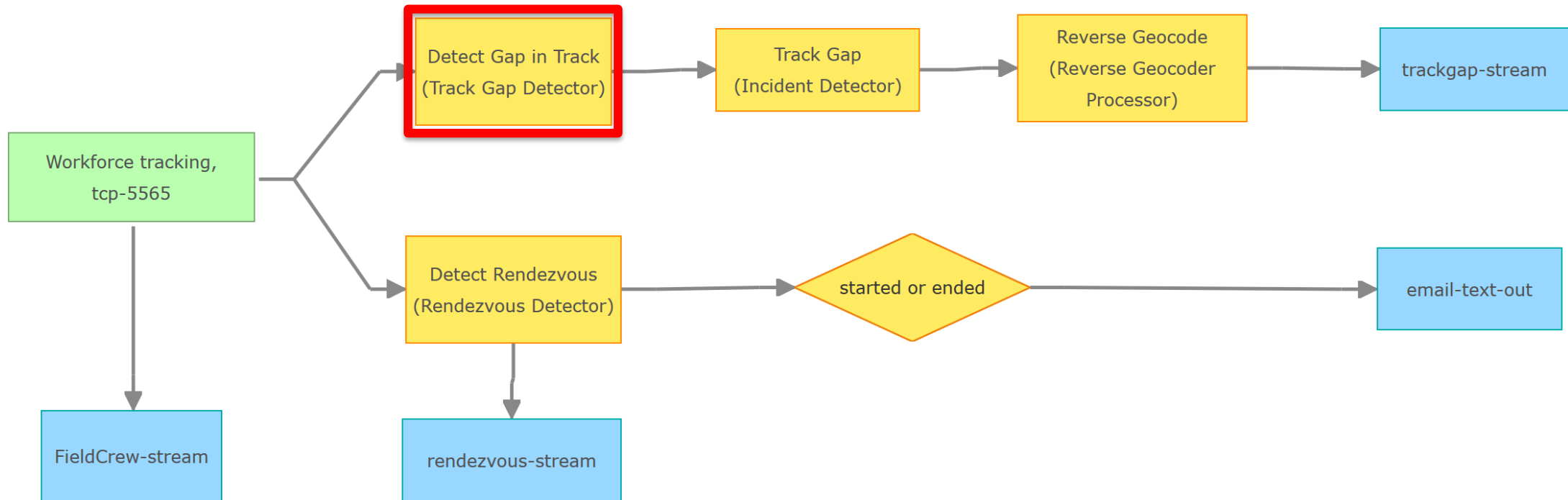
# Entity Tracking & Rendezvous Detection

*real-time analytics design*



# Entity Tracking & Rendezvous Detection

*real-time analytics design*

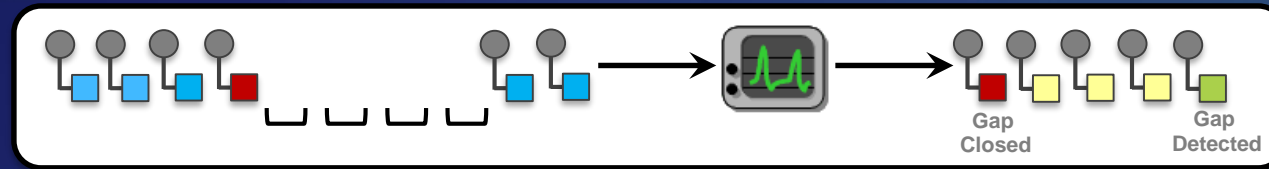




# Track Gap Detector

- Use a **Track Gap Detector** when you need to:
  - Detect the absence of event record reporting
  - Alert or notify someone that expected data was not received

# Track Gap Detector

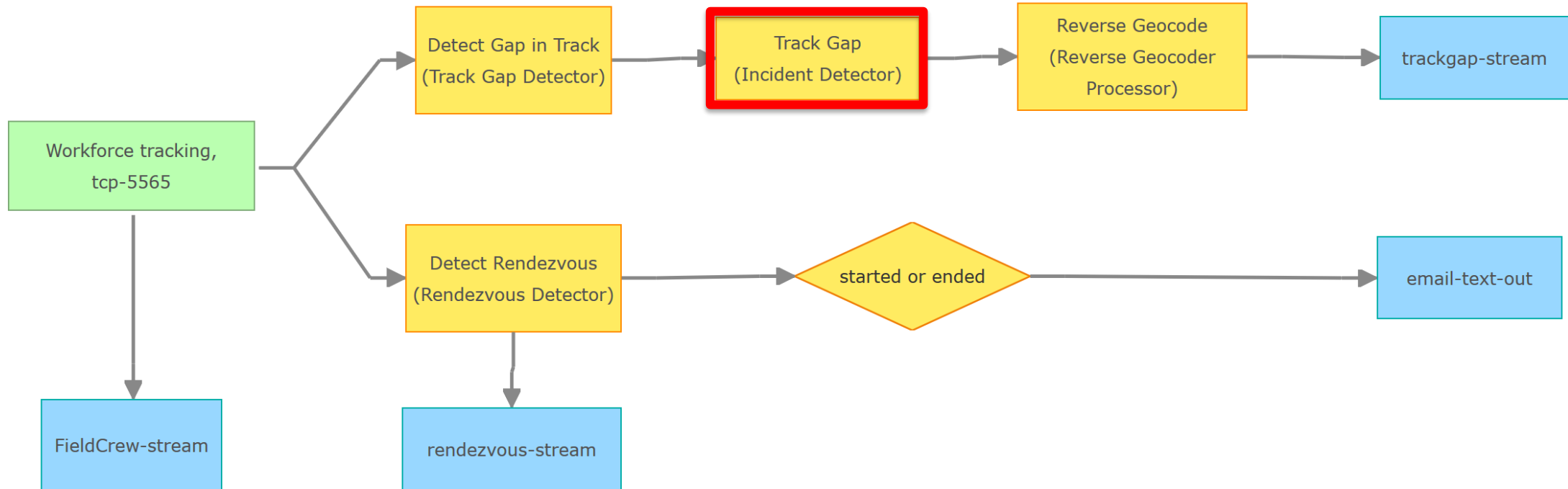


TrackID	V10987
Date	1405176945553
Geometry	-117.123..., 36.064...

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

# Entity Tracking & Rendezvous Detection

*real-time analytics design*



# Incident Detector

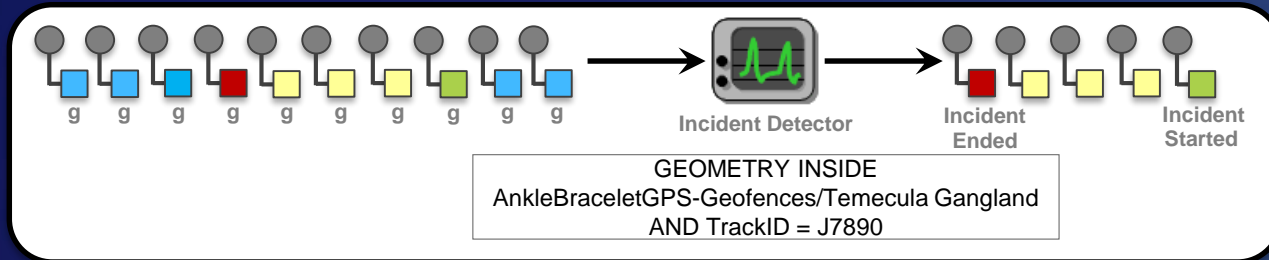
- Use an **Incident Detector** when you need to:
  - Detect that a condition has occurred and monitor its duration

Uses a filter expression to specify an opening and (optional) closing condition.

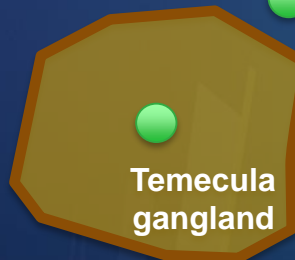
Maintains state for the duration of the incident, closing the incident when a specific closing condition is observed.

Incidents may also close (expire) when no further events are received for the TRACK\_ID associated with the incident.

# Incident Detector



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

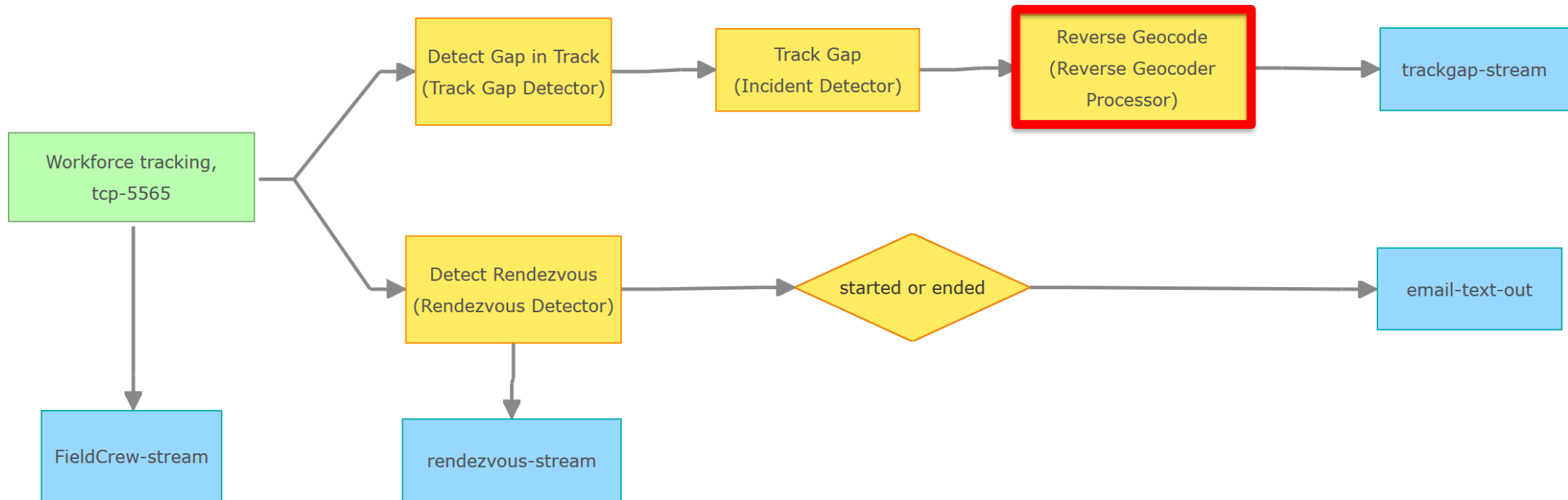


id	c982db54-...-3bbb61211eb6
name	Geofence violation
type	Cumulative
status	Ended
alertType	Warning
openCondition	(INSIDE(AnkleBraceletGPS/Temecula gangland) AND (TrackID = J7890))
closeCondition	
description	Ended at 7/12/14 10:54 AM and lasted for 40 seconds
timestamp	1405176905553
definitionName	incident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



# Entity Tracking & Rendezvous Detection

*real-time analytics design*



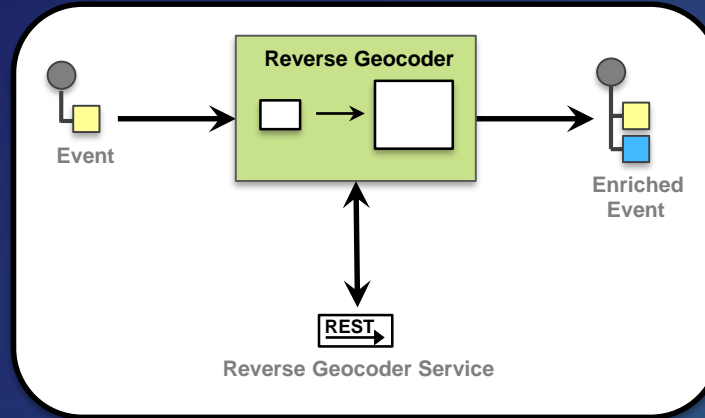
# Reverse Geocoder processor

- A **Reverse Geocoder** is an example of a custom processor
  - Enriches an event record with the street address nearest the event's location

Uses a point geometry from a received event to enrich the event record with new attribute field(s) representing a matched address.

# Reverse Geocoder processor

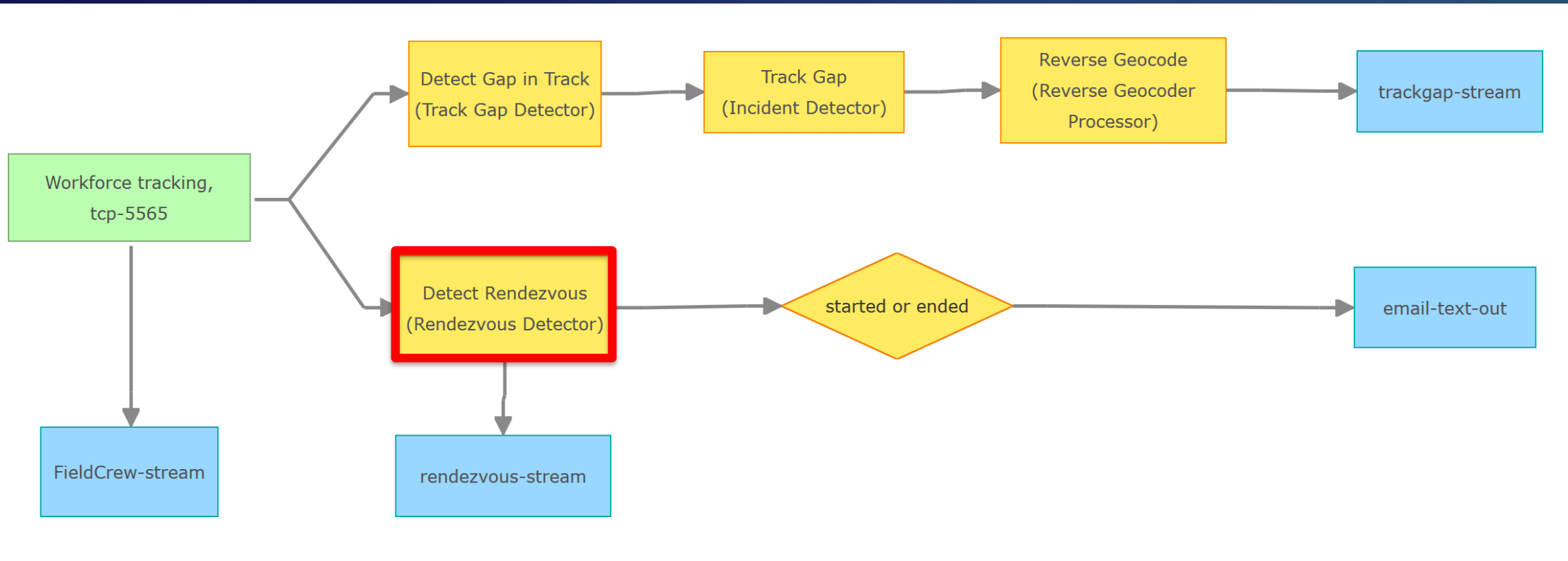
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
SpeedMPH	1.79
Geometry	-116.97..., 33.98...



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

# Entity Tracking & Rendezvous Detection

*real-time analytics design*



# Rendezvous Detector processor

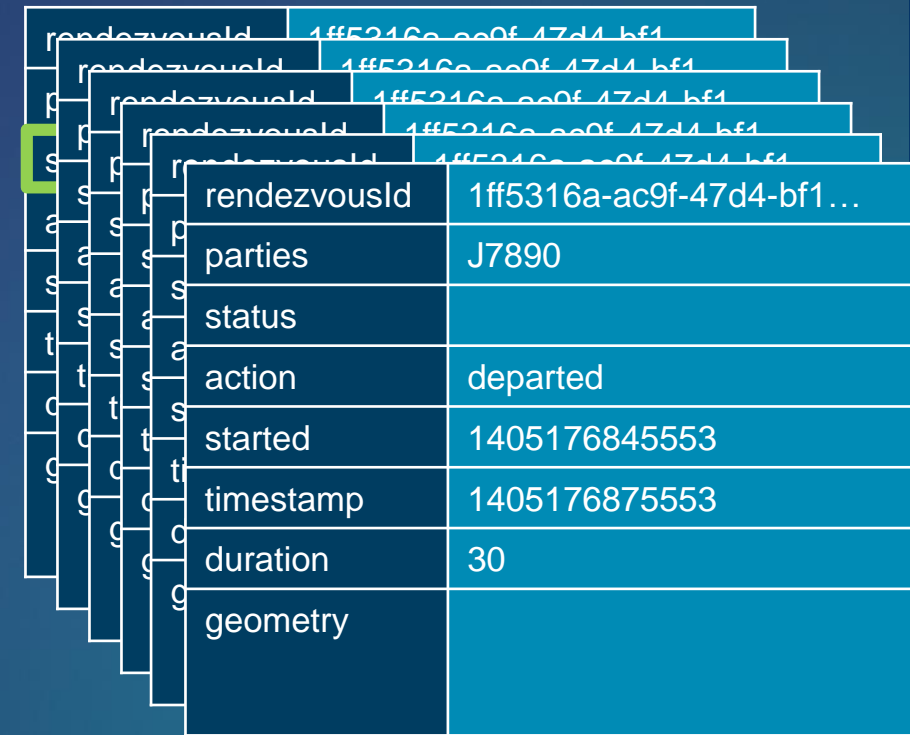
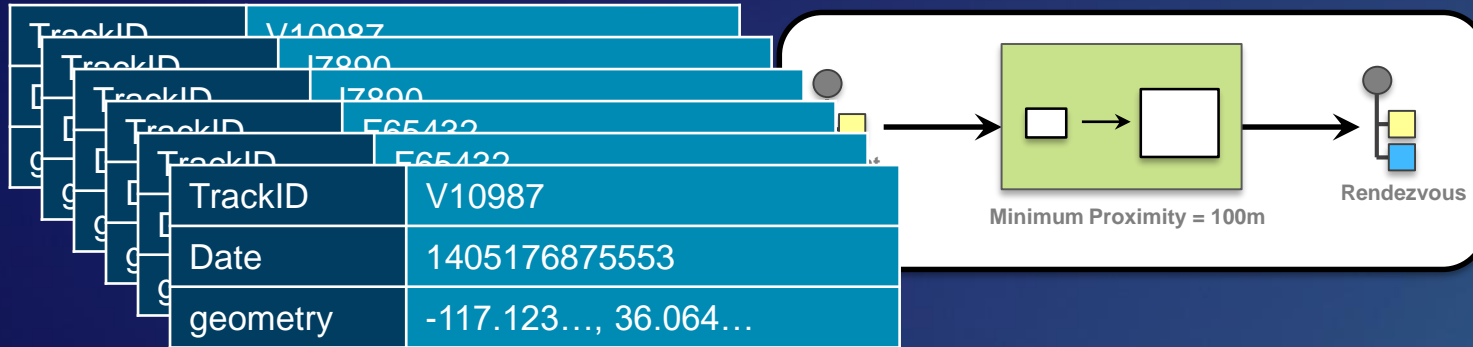
- Use a **Rendezvous Detector** when you need to:
  - Identify when two or more objects come into close proximity
  - Detect when other parties join or leave an ongoing rendezvous

User-defined parameter sets the proximity threshold.

Sends geoevents for:

- New rendezvous detected
- Party joined existing rendezvous
- Party departed rendezvous
- Rendezvous ended

# Rendezvous Detector processor







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# Summary & Resources



# Summary

*GeoEvent Server – real-time analytics for your ArcGIS Enterprise*

- **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 resources*

- **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>

ArcGIS® GeoEvent Server  
Introduction Tutorial

ArcGIS® GeoEvent Server  
Stream Services

ArcGIS® GeoEvent Server  
Spatiotemporal Big Data Store



## Please Attend Our Other Sessions!

WORKSHOP	LOCATION	DAY	TIME FRAME
ArcGIS GeoEvent Server: An Introduction	SDCC - Room 03 SDCC - Room 04	Tuesday	8:30 am - 9:30 am 4:00 pm - 5:00 pm
ArcGIS and the Internet of Things (IoT)	SDCC - Room 04 SDCC - Room 03	Tuesday Wednesday	10:00 am - 11:00 am 10:00 am - 11:00 am
ArcGIS GeoEvent Server: Applying Real-Time Analytics	SDCC - Room 31 SDCC - Room 15 B	Tuesday Wednesday	2:30 pm - 3:30 pm 4:00 pm - 5:00 pm
Real-Time & Big Data GIS: Leveraging the Spatiotemporal Big Data Store	SDCC - Room 05 B SDCC - Room 14 B	Wednesday Thursday	8:30 am - 9:30 am 1:00 pm - 2:00 pm
Real-Time & Big Data GIS: Road Ahead	SDCC - Room 05 B SDCC - Room 15 A	Wednesday Thursday	1:00 pm - 2:00 pm 10:00 am - 11:00 am
Real-Time & Big Data GIS: Best Practices	SDCC - Room 17 B SDCC - Room 14 B	Wednesday Thursday	2:30 pm - 3:30 pm 2:30 pm - 3:30 pm
ArcGIS GeoEvent Server: Leveraging Stream Services	SDCC - Room 33 C	Thursday	2:30 pm - 3:30 pm

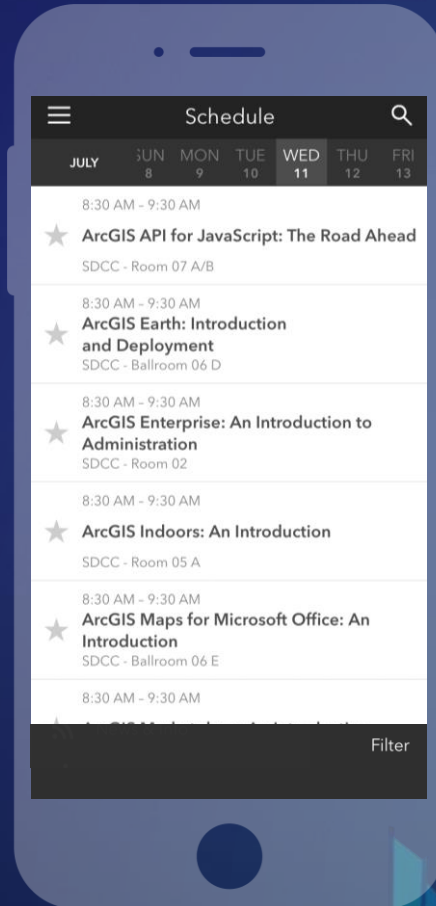


# Please Take Our Survey on the App

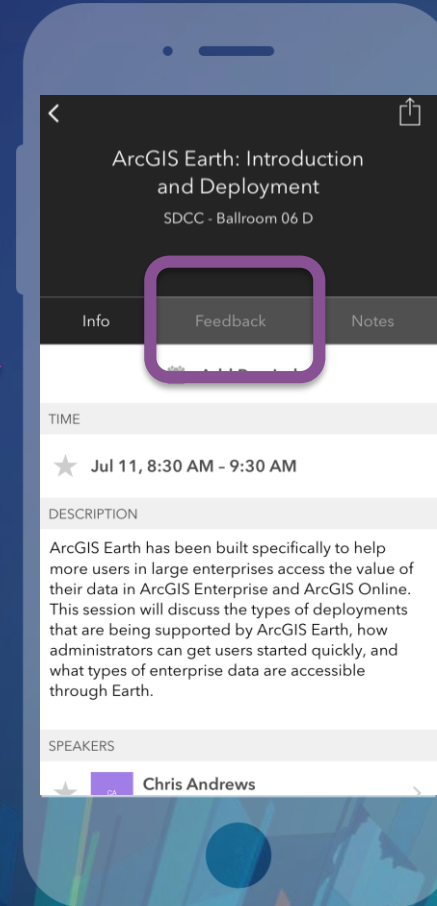
Download the Esri Events app and find your event



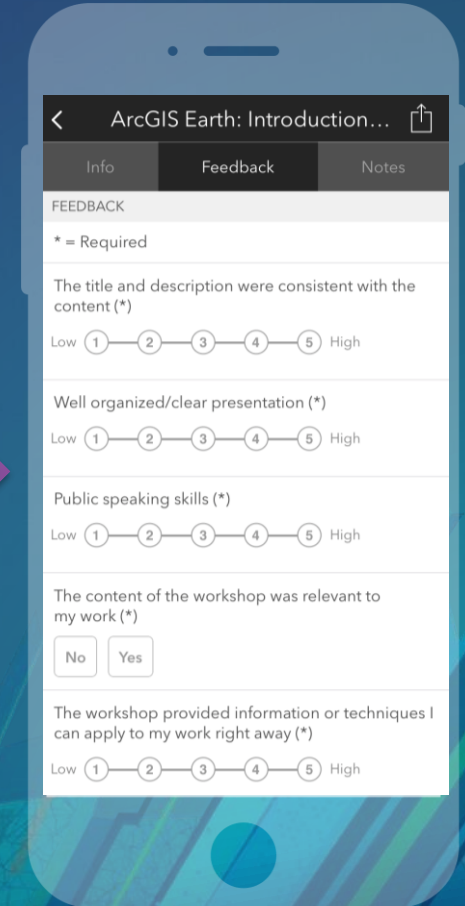
Select the session you attended



Scroll down to find the feedback section

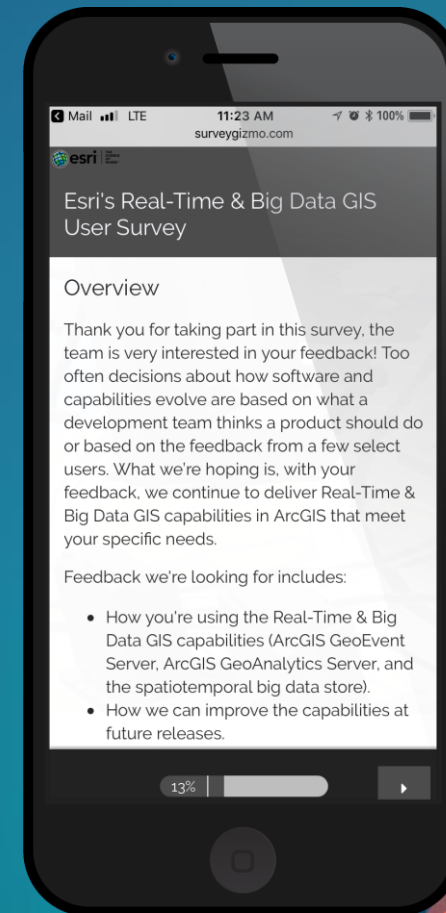
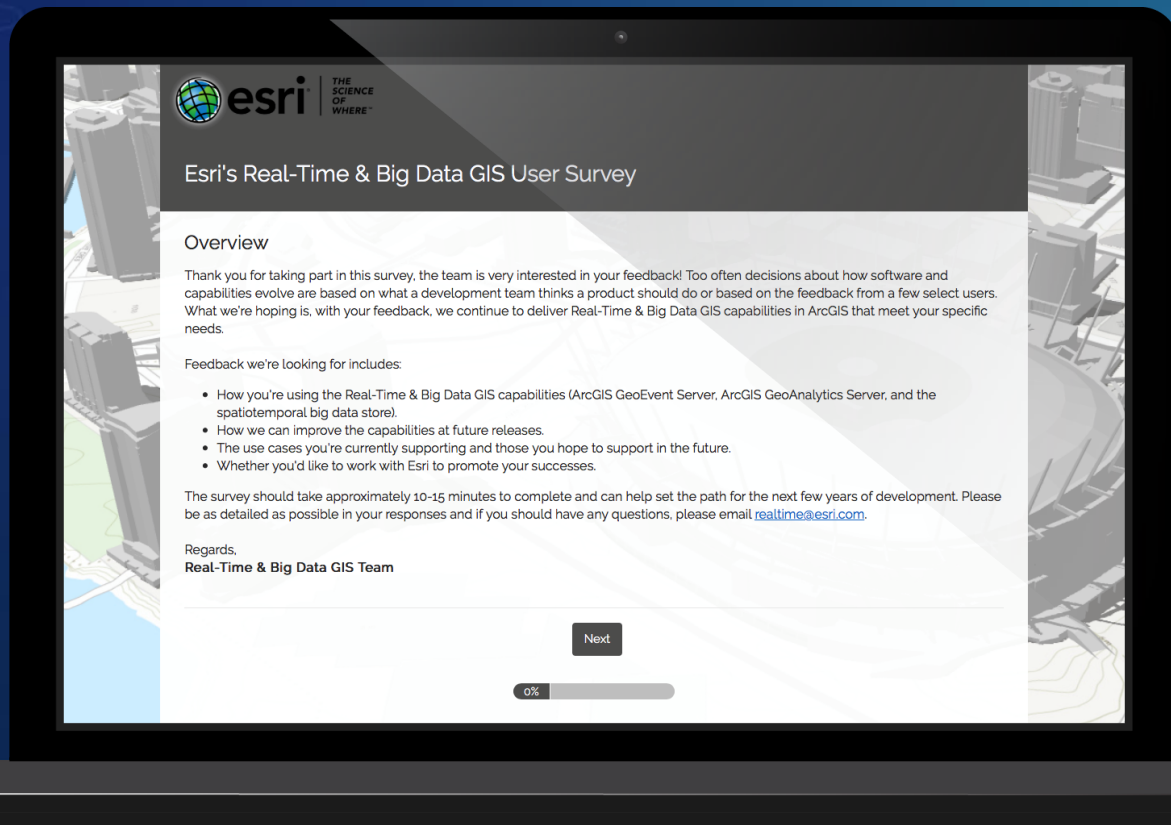


Complete answers and select "Submit"



# Help us improve the Real-Time & Big Data GIS Capabilities

<http://esriurl.com/RealTimeSurvey>





# Questions / Feedback?



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