



# Real-Time GIS: Applying Real-Time Analytics



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# 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: Workforce Tracking
  - 5 Summary & Resources
-



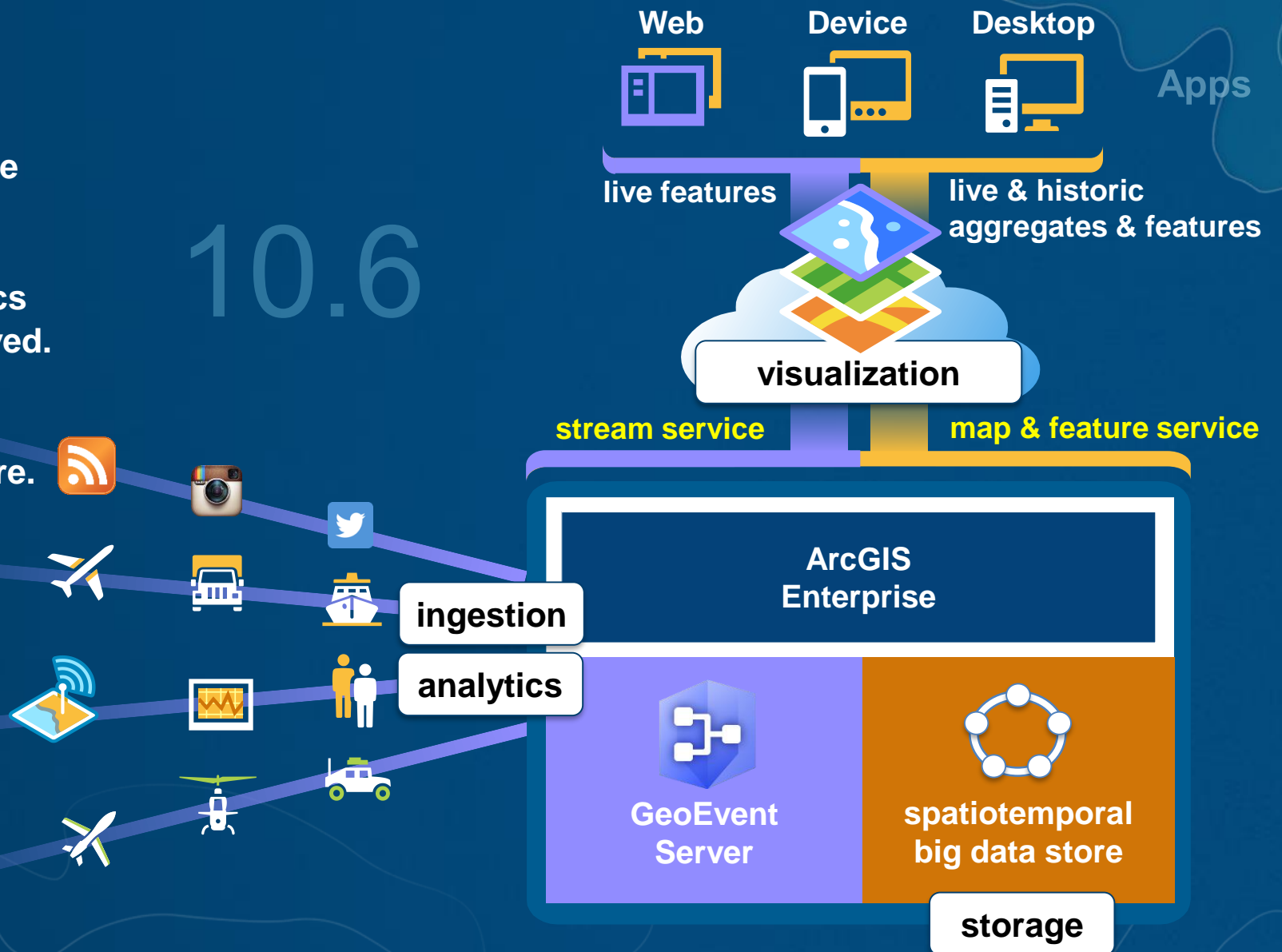
# Performing Analysis in Real Time

# 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.

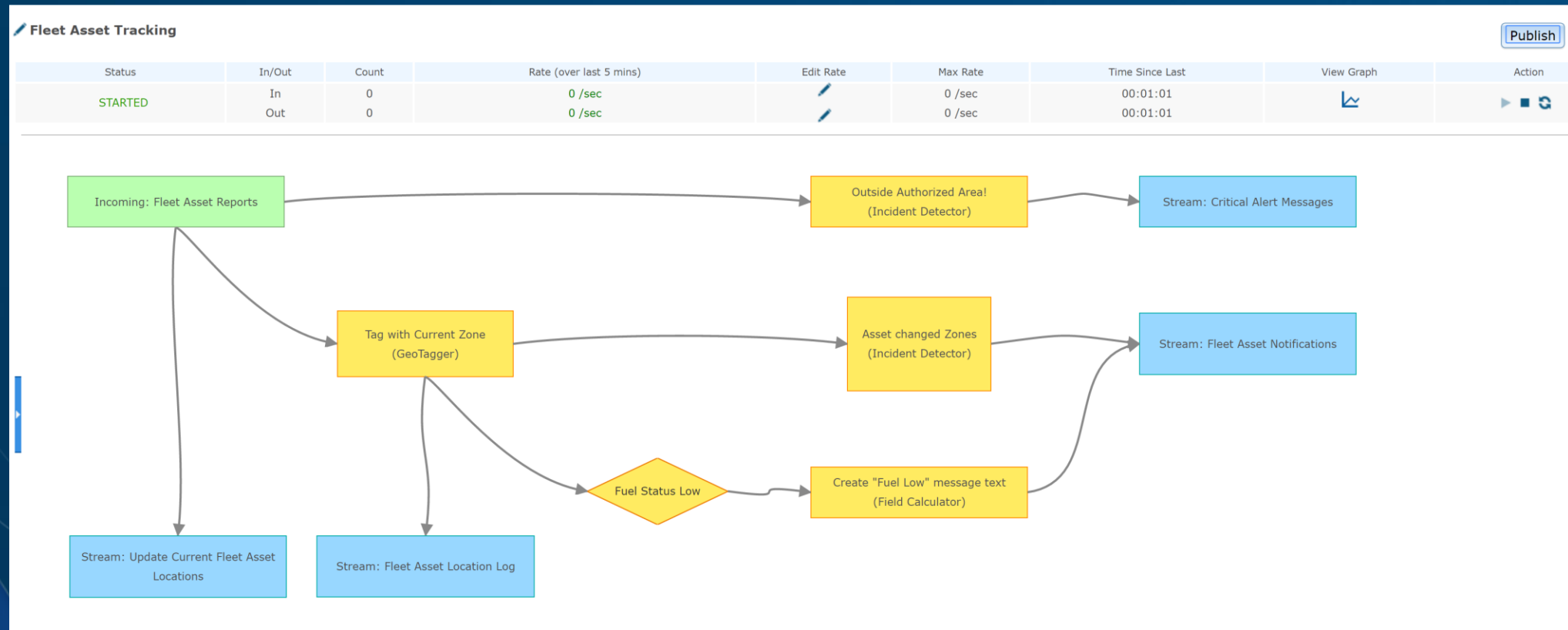
10.6



# Applying real-time analytics

## GeoEvent Services

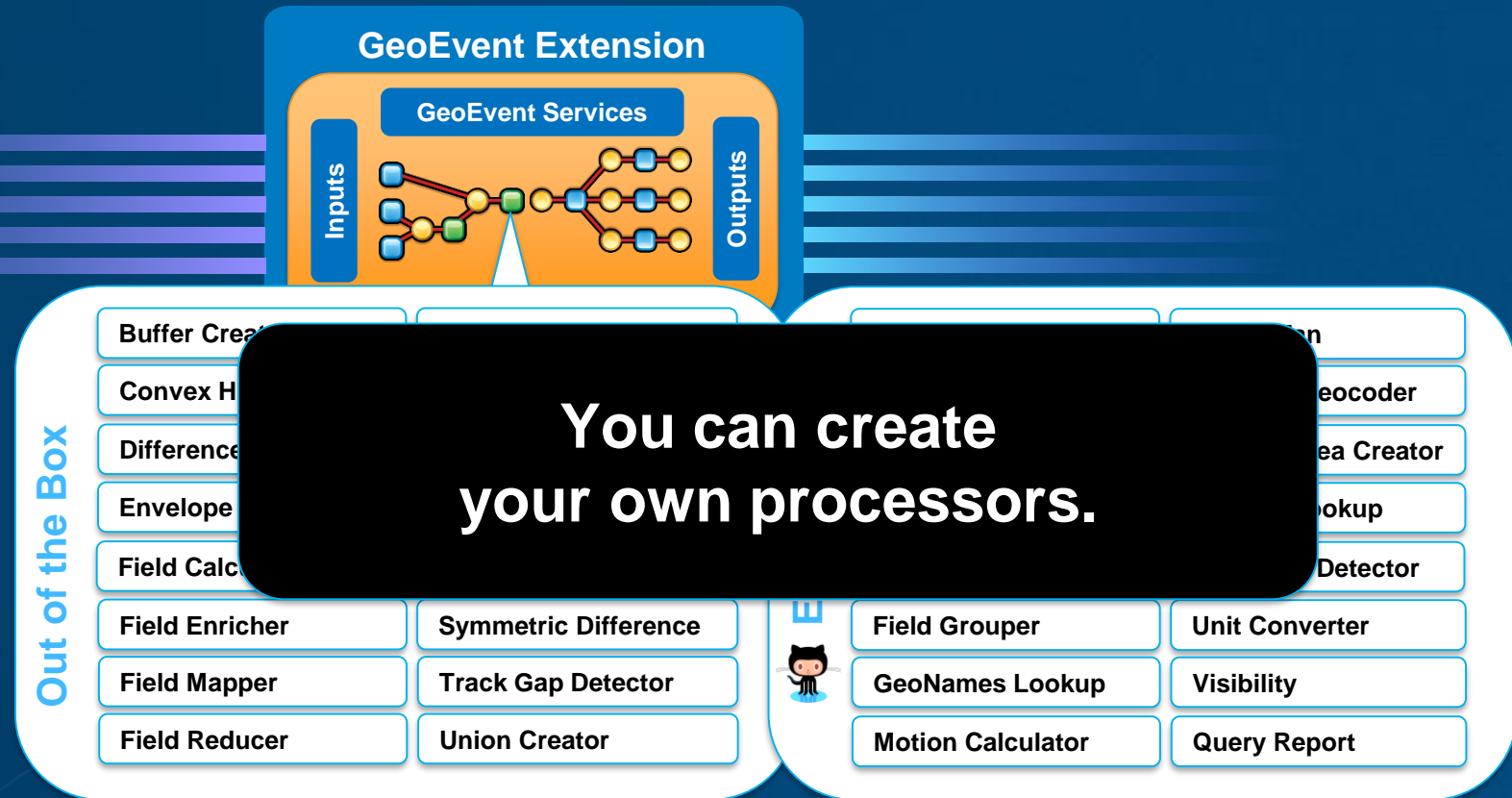
- A **GeoEvent Service** configures the flow of GeoEvents
  - The **Filtering** and **GeoEvent Processing** steps performed
  - The input(s) data comes from and the output(s) to which results are sent



# Applying real-time analytics

## *processors and filters*

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



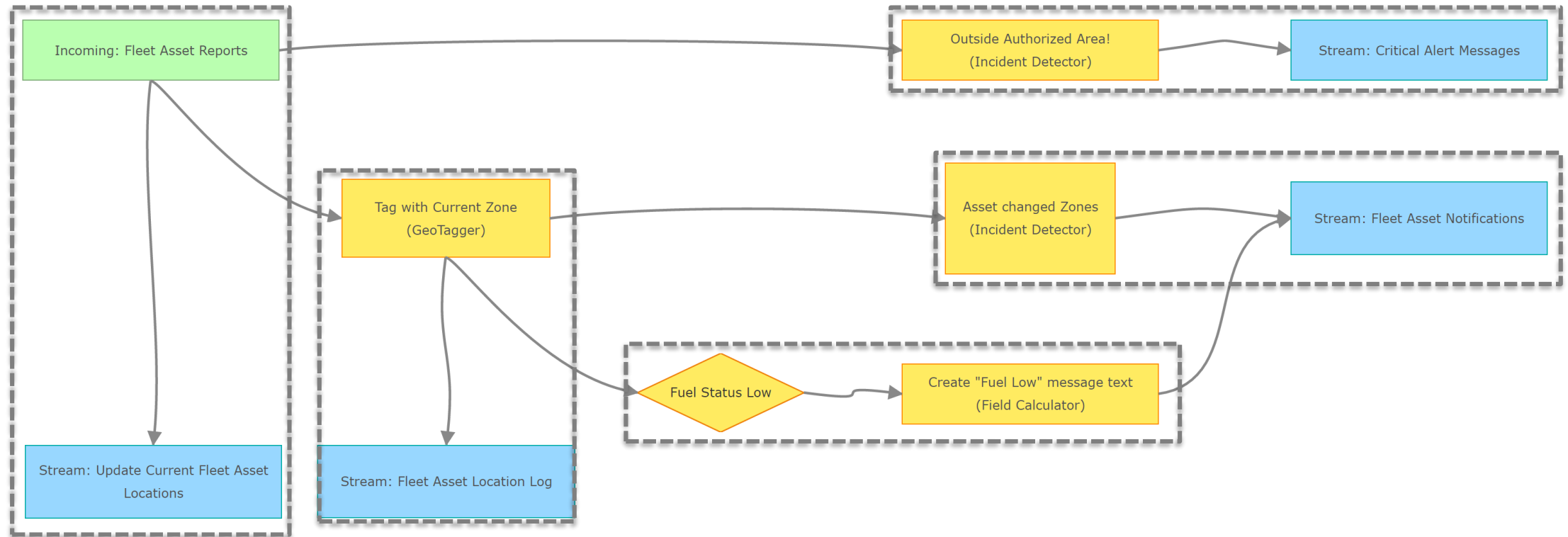


Alert(s)

Notification(s)

# Fleet Asset Tracking Pseudo Service

*real-time analytics design*



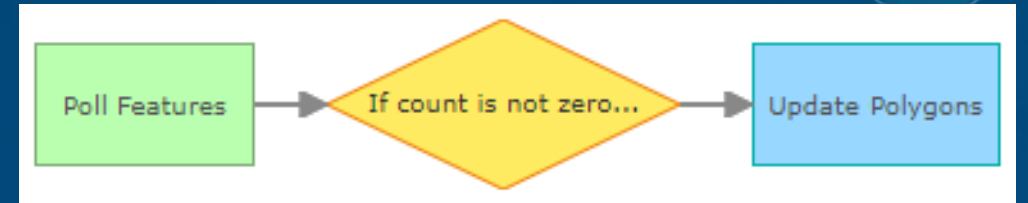


# Processors

- **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:

Ok Cancel

+()

This screenshot shows a "Filter Properties" dialog box. The "Name" field contains "If count is not zero...". Below the name field is a large text input area containing the expression "count != 0". To the left of this input area is a dropdown menu with a downward arrow. Below the input area is a green plus sign followed by "+()", and a blue "x" icon is visible at the end of the input field.

Filter Properties

Name:

Ok Cancel

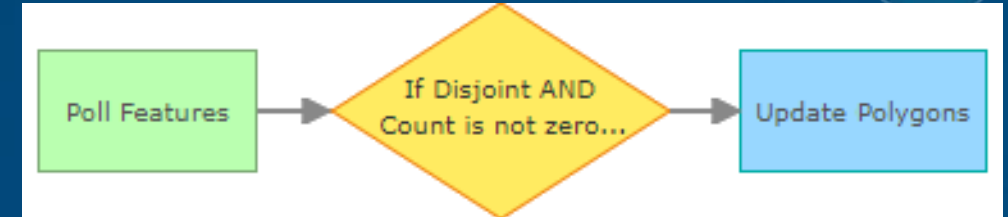
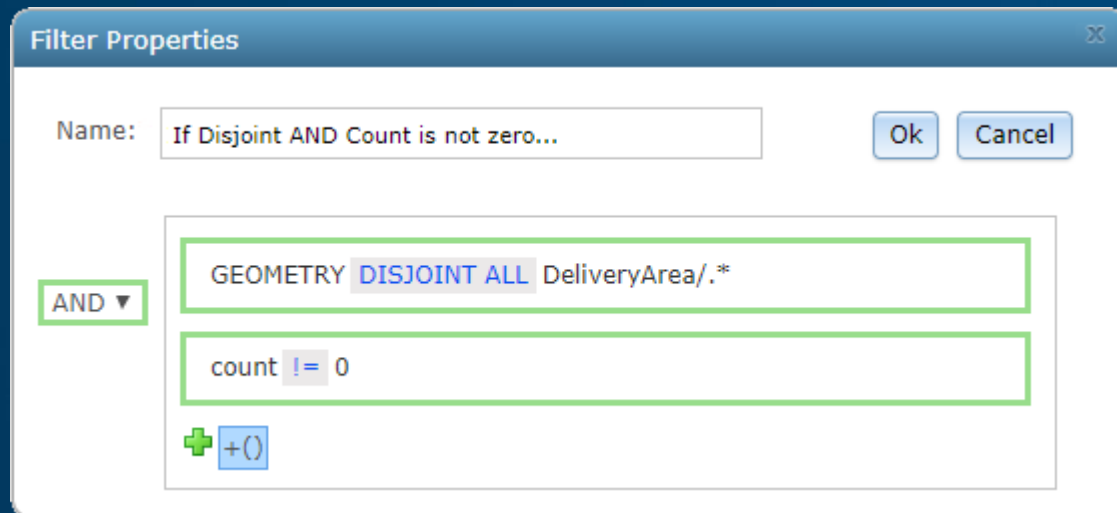
NOT

+()

This screenshot shows a "Filter Properties" dialog box. The "Name" field contains "If NOT Intersects...". Below the name field is a large text input area containing the expression "NOT GEOMETRY INTERSECTS ANY DeliveryArea/.\*". To the left of this input area is a dropdown menu with "NOT" selected and a downward arrow. Below the input area is a green plus sign followed by "+()", and a blue "x" icon is visible at the end of the input field.

# 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

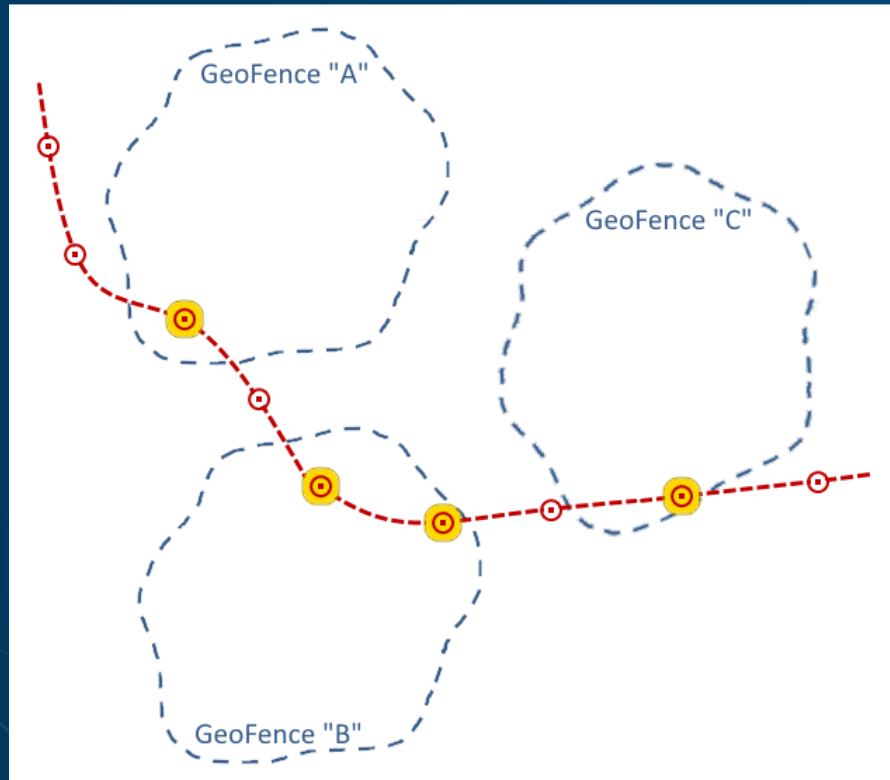
**GEOMETRY INTERSECTS ALL `.*/*.*`**

**GEOMETRY DISJOINT ANY `.*/*.*`**

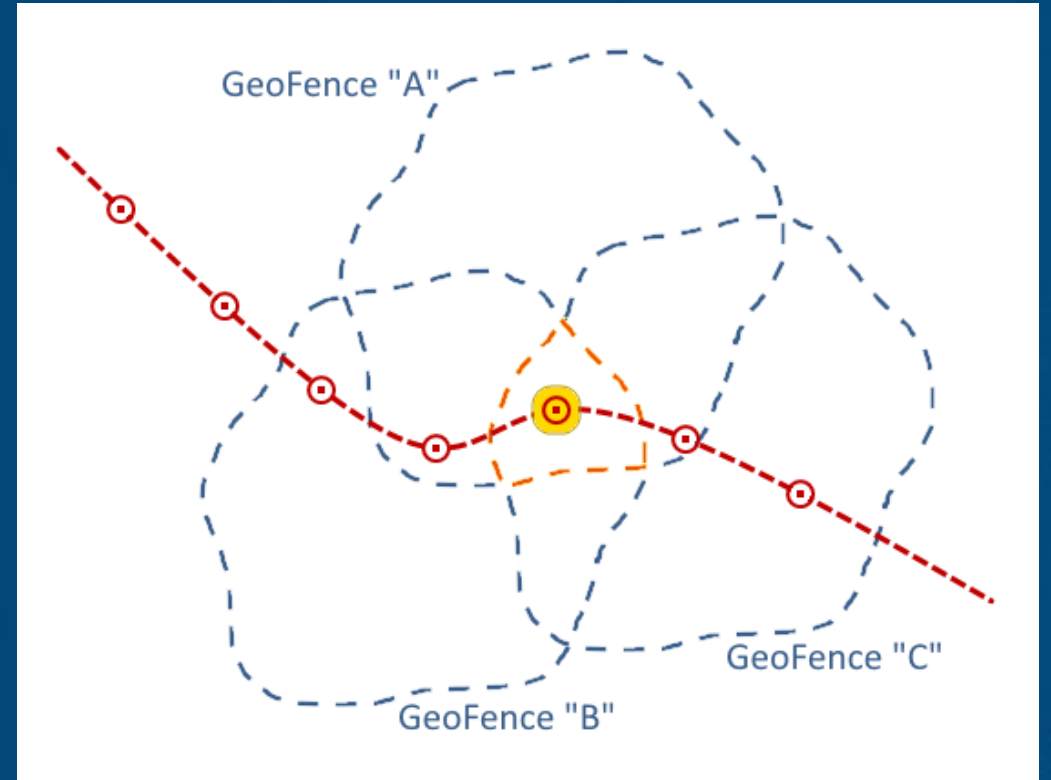
# Spatial Operators

## *overlapping geofences*

- **Intersects Any geofence**



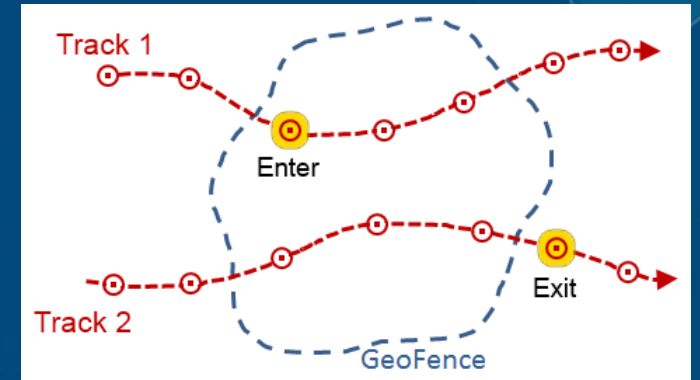
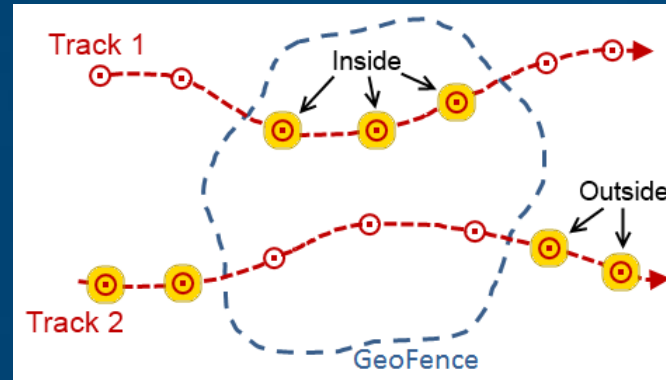
- **Intersects All geofences**



# Spatial Operators

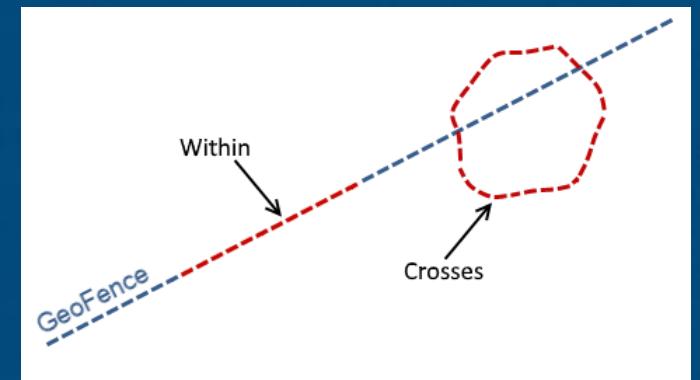
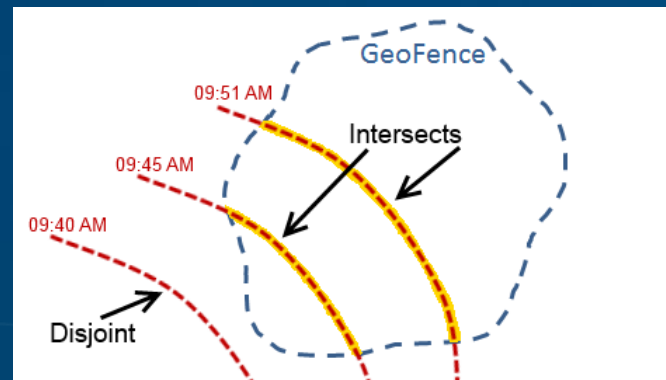
- Spatial operators at 10.2:

inside	outside
enter	exit



- Spatial operators at 10.3 and beyond:

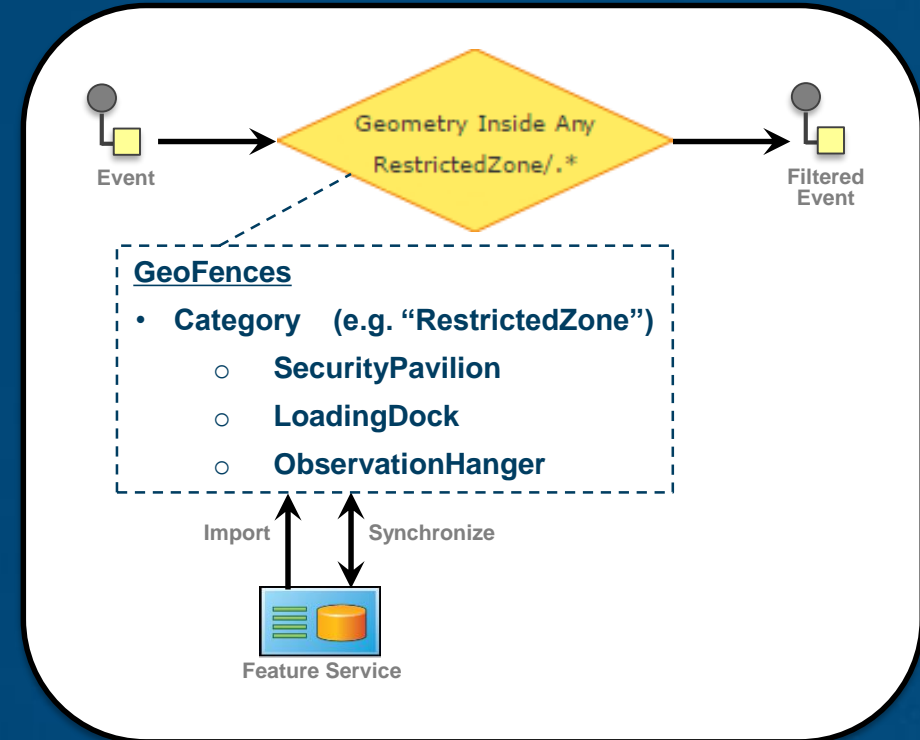
intersect	disjoint
touches	contains
crosses	equals
overlaps	within



# GeoFences

## *feature service synchronization*

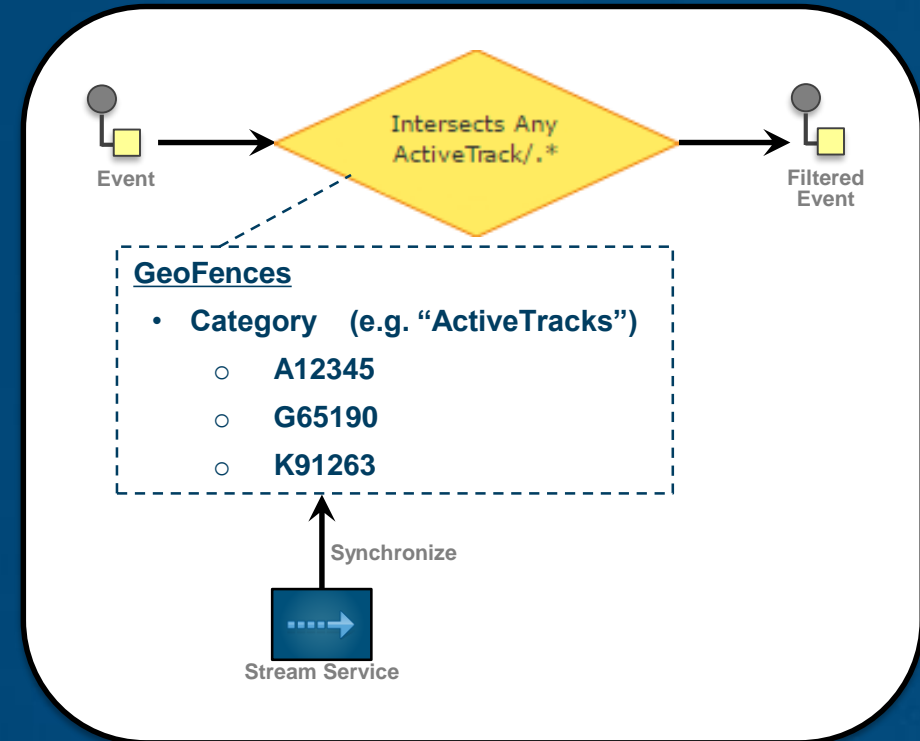
- **Import from a feature service**
  - Reads once (good for static geofences)
- **Synchronize with a feature service**
  - Periodically refreshes to update geofences



# GeoFences

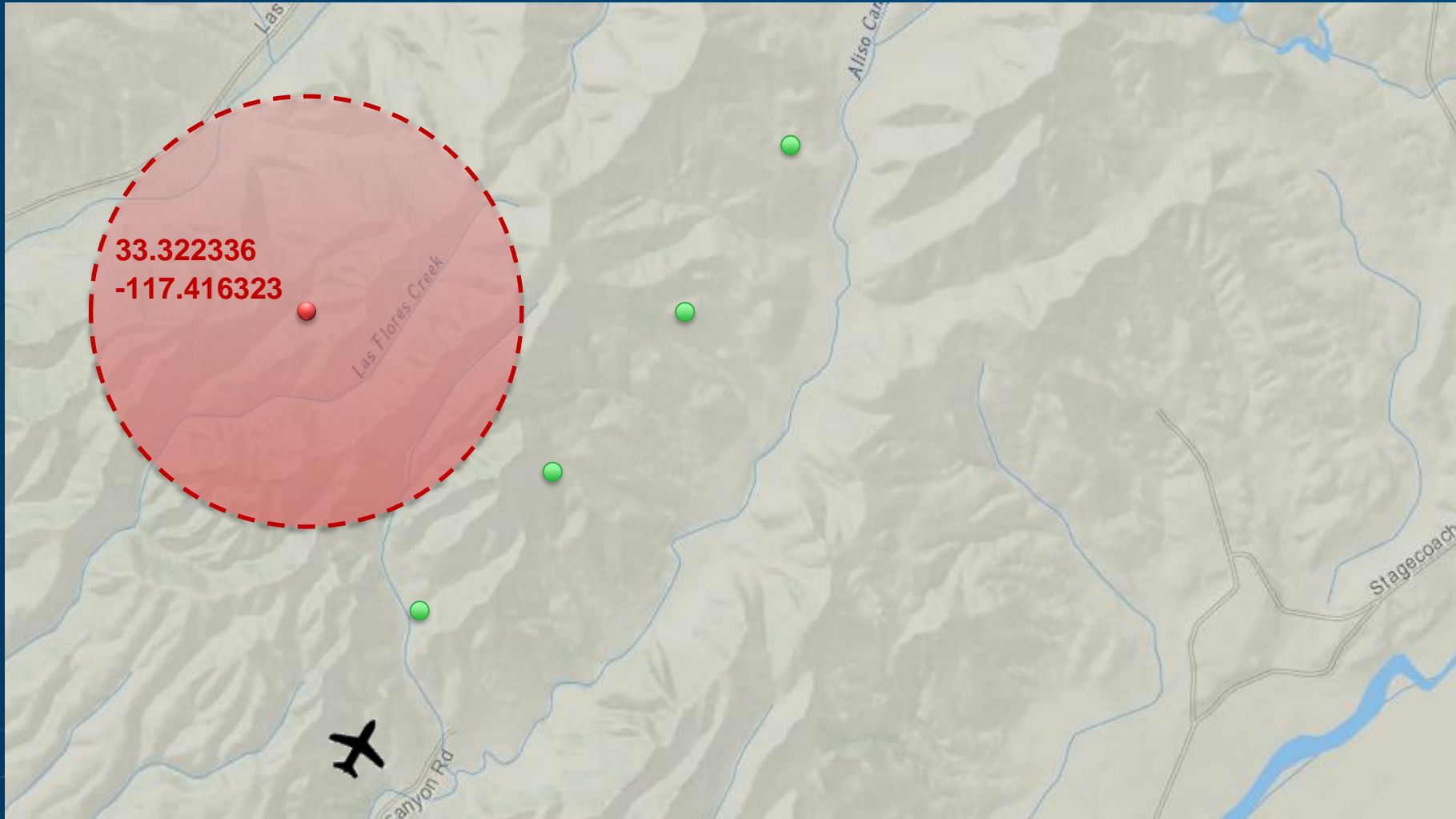
## *stream service synchronization*

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

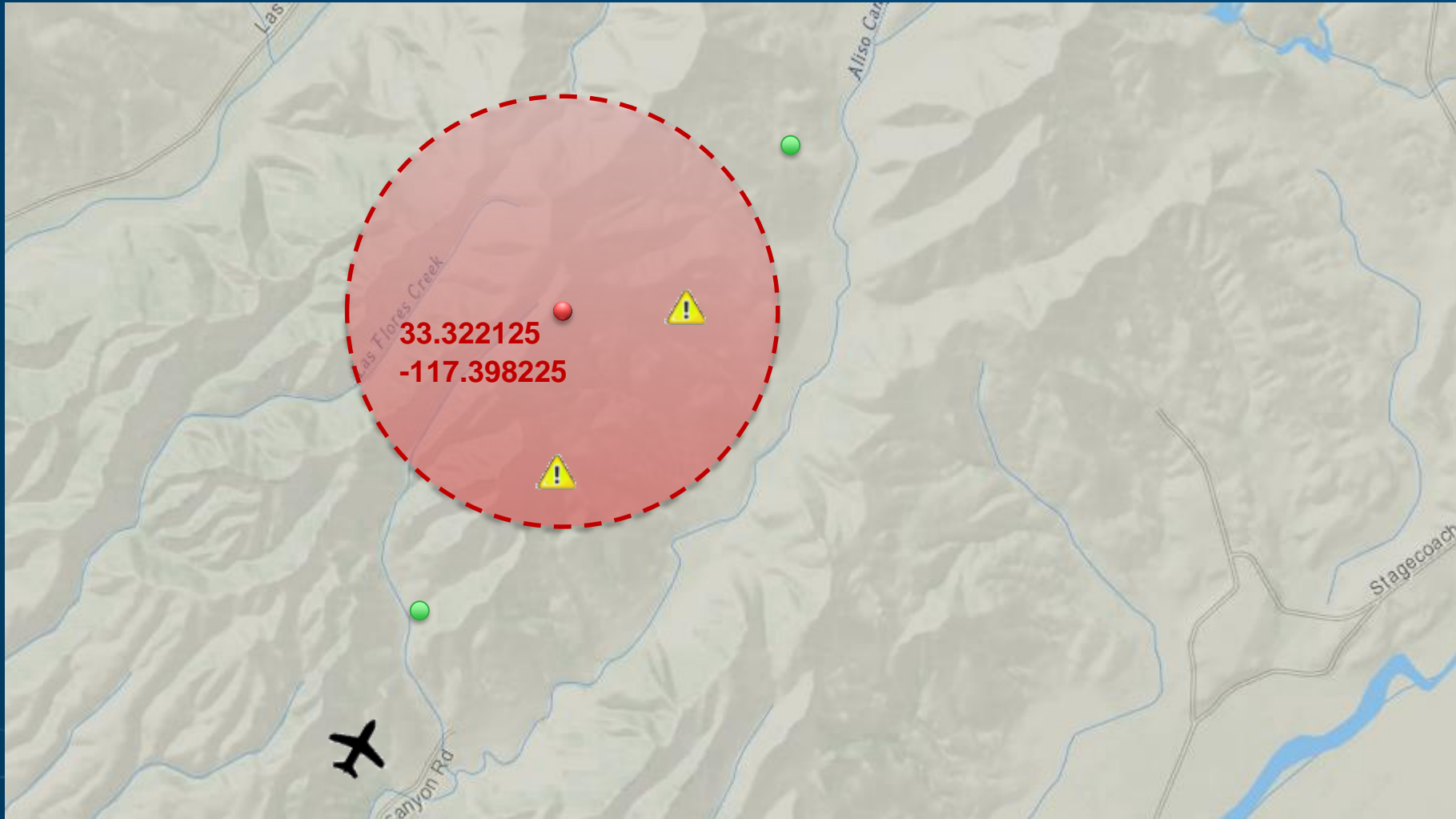




# Dynamic GeoFences

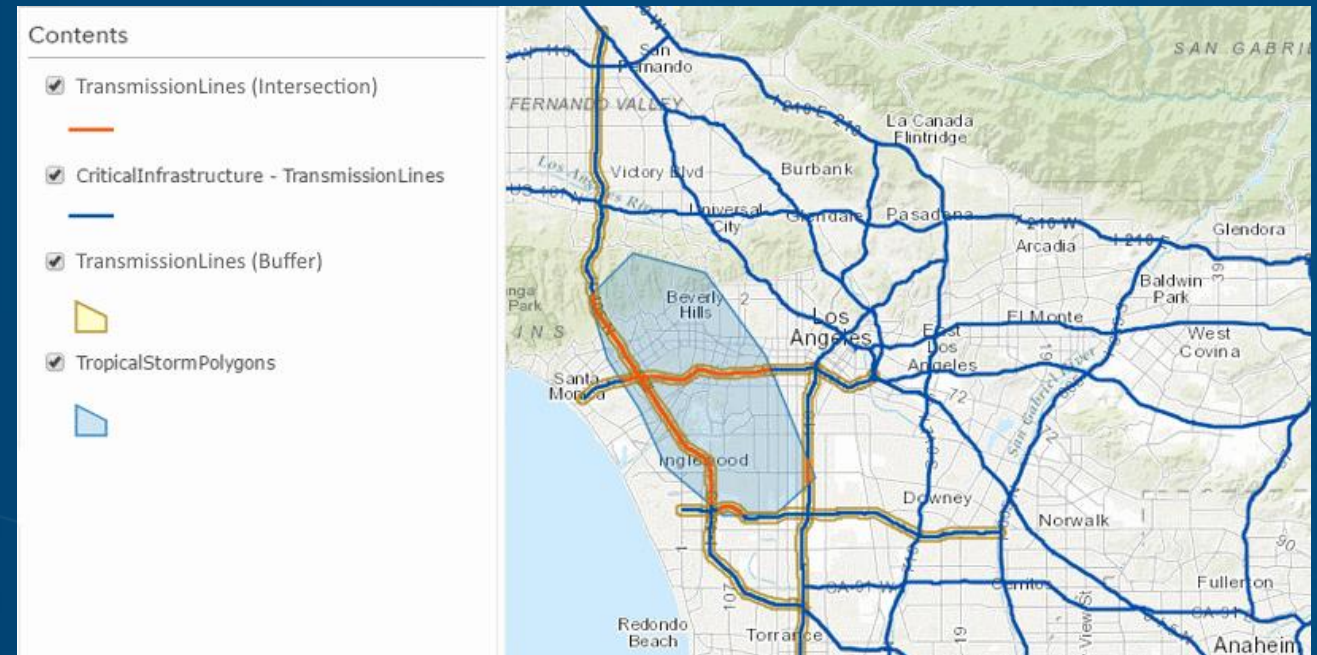


# Dynamic GeoFences



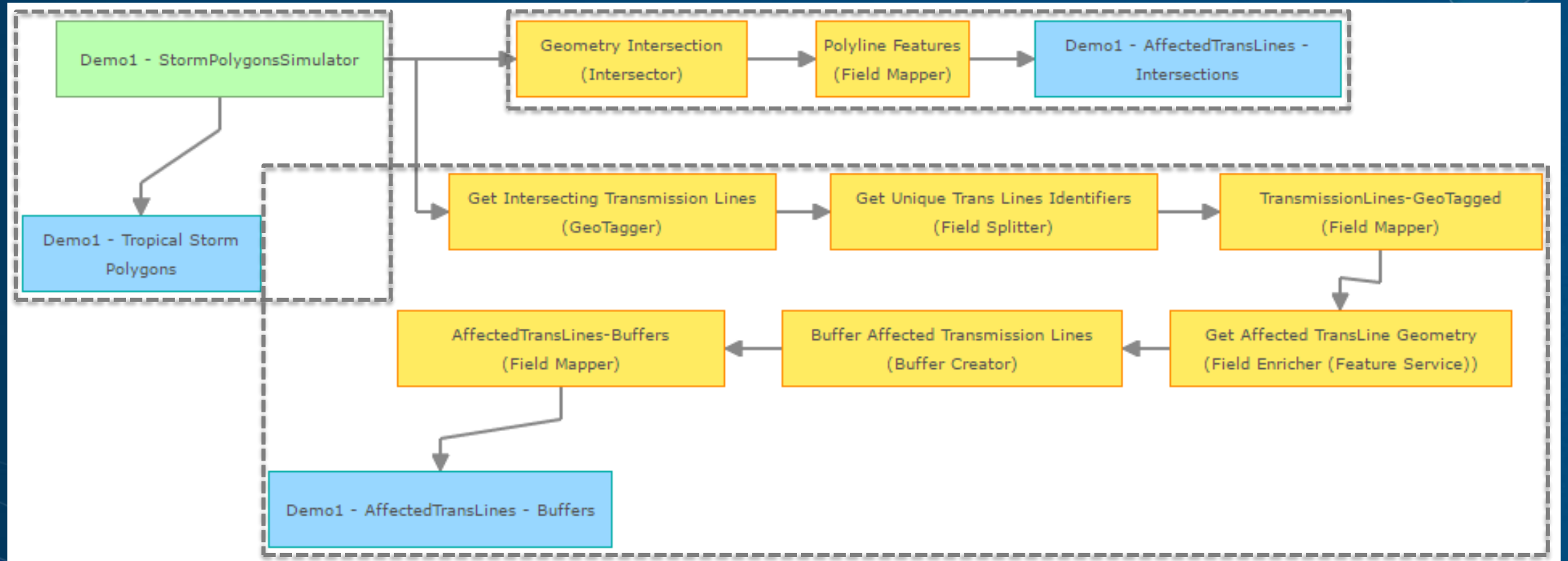
# 2

## Identifying Conditions (demo)



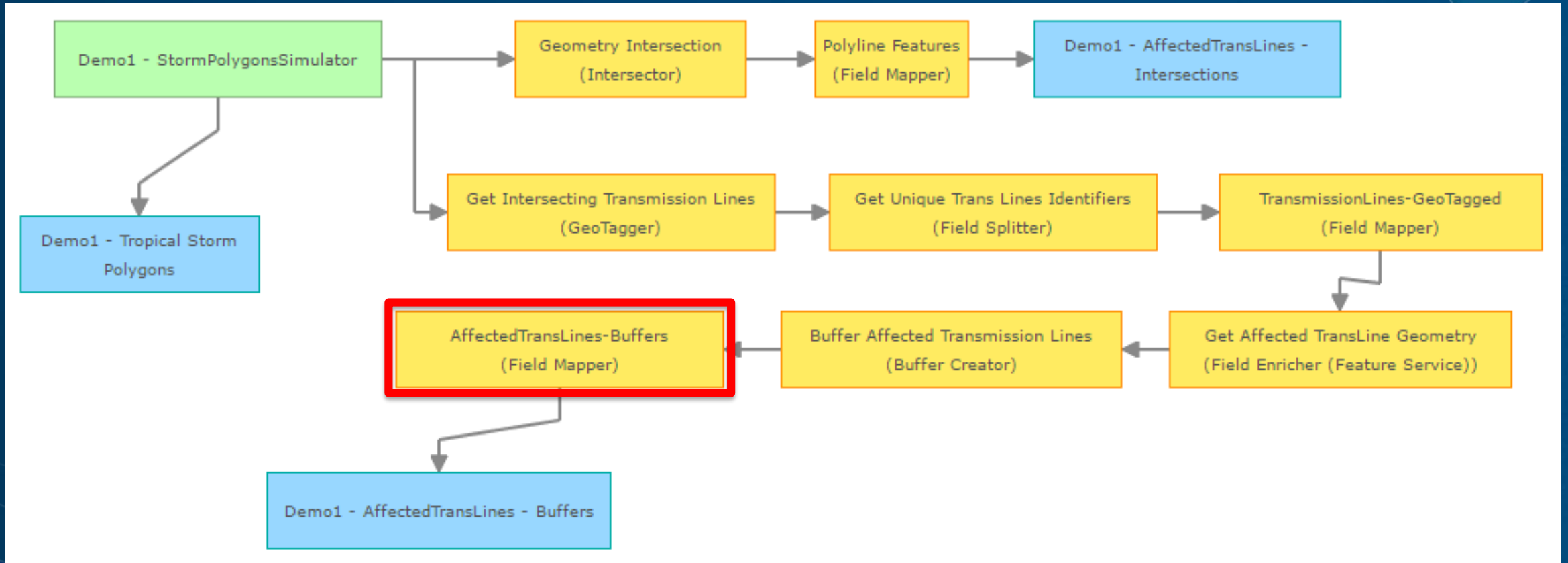
# Identifying conditions with real-time data

*real-time analytics design*



# Identifying conditions with real-time data

*real-time analytics design*

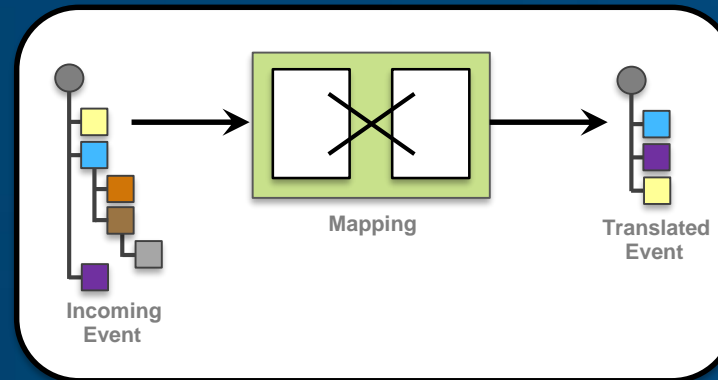


# Field Mapper processor

- 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

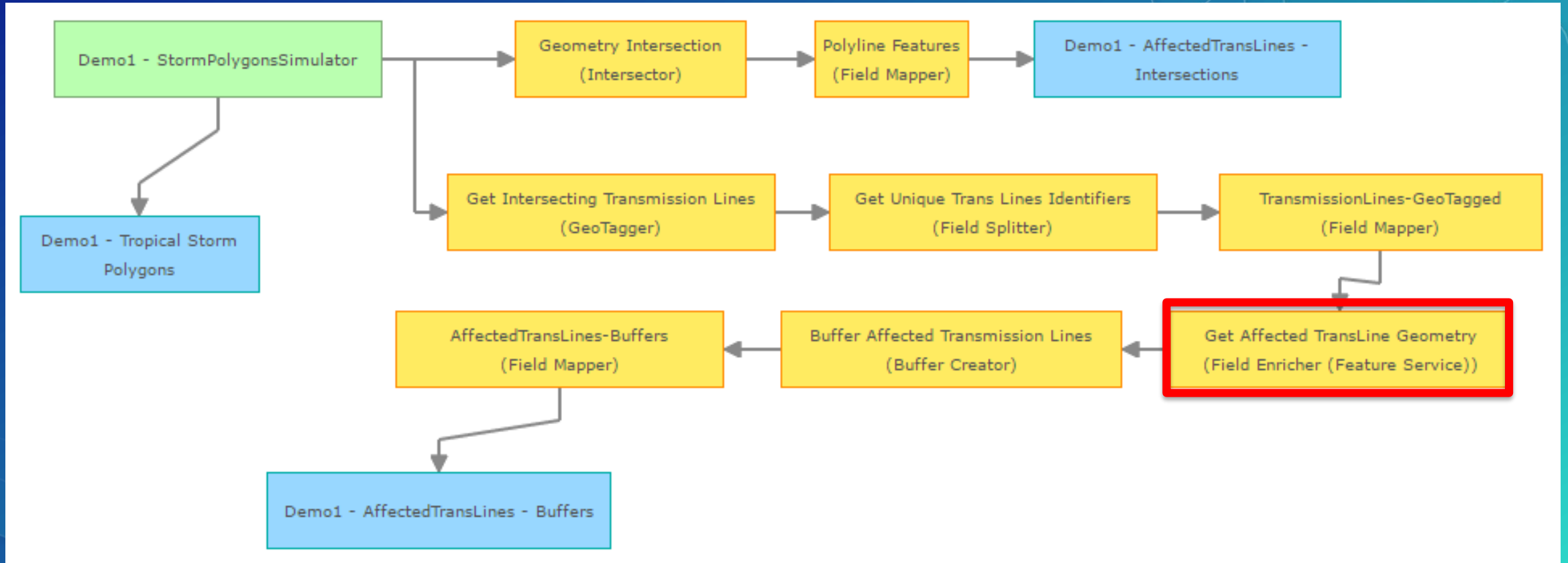
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123..., 36.064...
Category	AnkleBraceletGPS



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

# Identifying conditions with real-time data

*real-time analytics design*





## Field Enricher processor

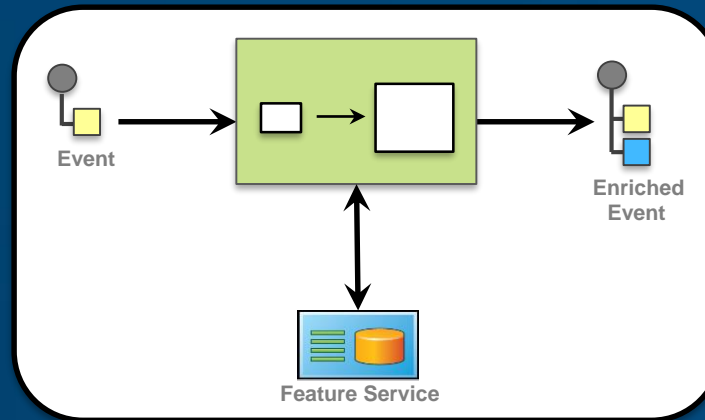
- Use a **Field Enricher** when you need to:
  - Enrich an event record with new attribute values from an secondary source

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...

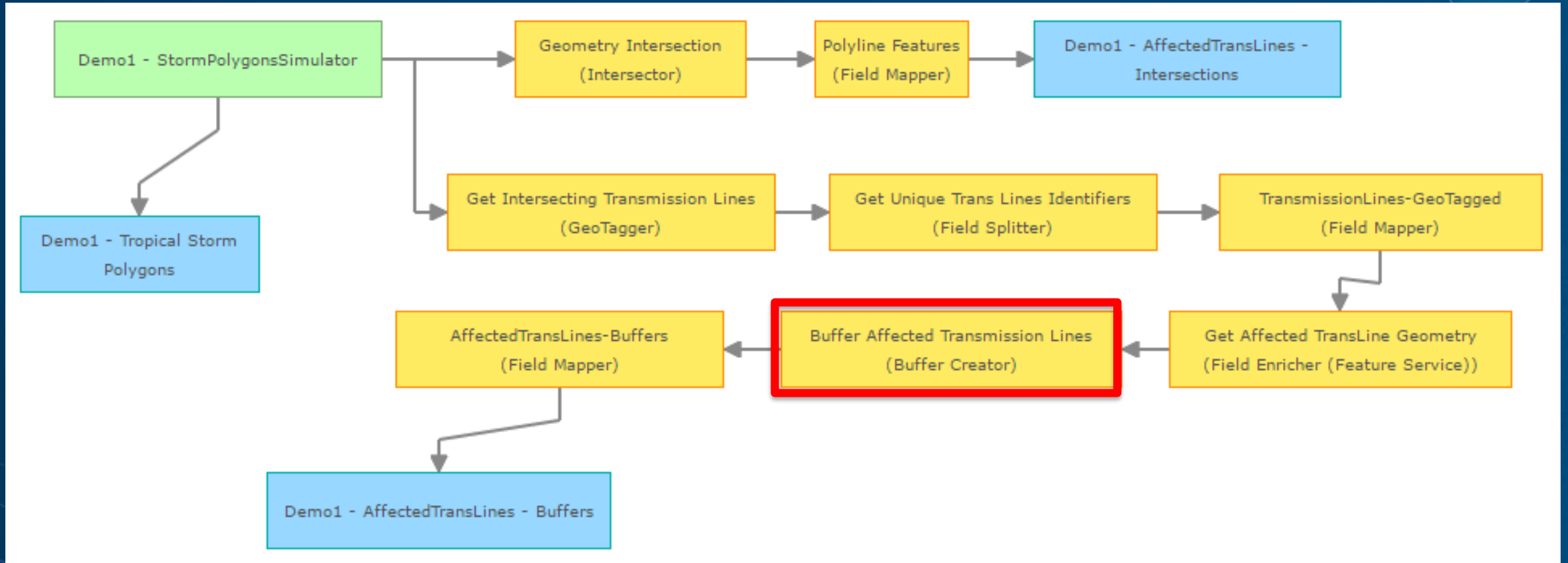


TrackID	V10987
Date	1405176845553
BatteryLevel	Low
Distance	105.6
Speed	1.2
Course	186.4
geometry	-117.123..., 36.064...
NoContact	F65432
NoEntry	Pass Christian School

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

# Identifying conditions with real-time data

*real-time analytics design*

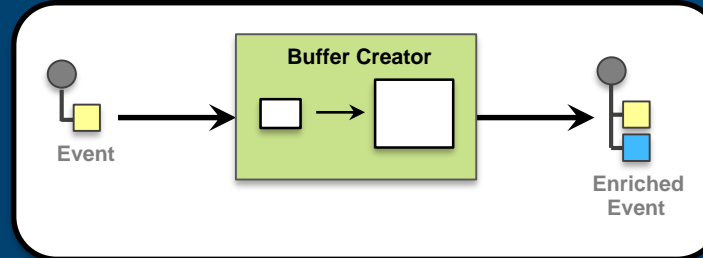


## Buffer Creator processor

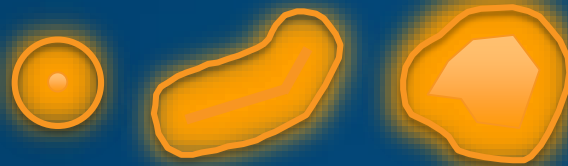
- Use a **Buffer Creator** when you need to:
  - Construct a polygon around an event's point, polyline, or polygon geometry
  - Enrich an event record by adding a new geometry field
  - Replace an event record's geometry with a derivative

# Buffer Creator processor

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

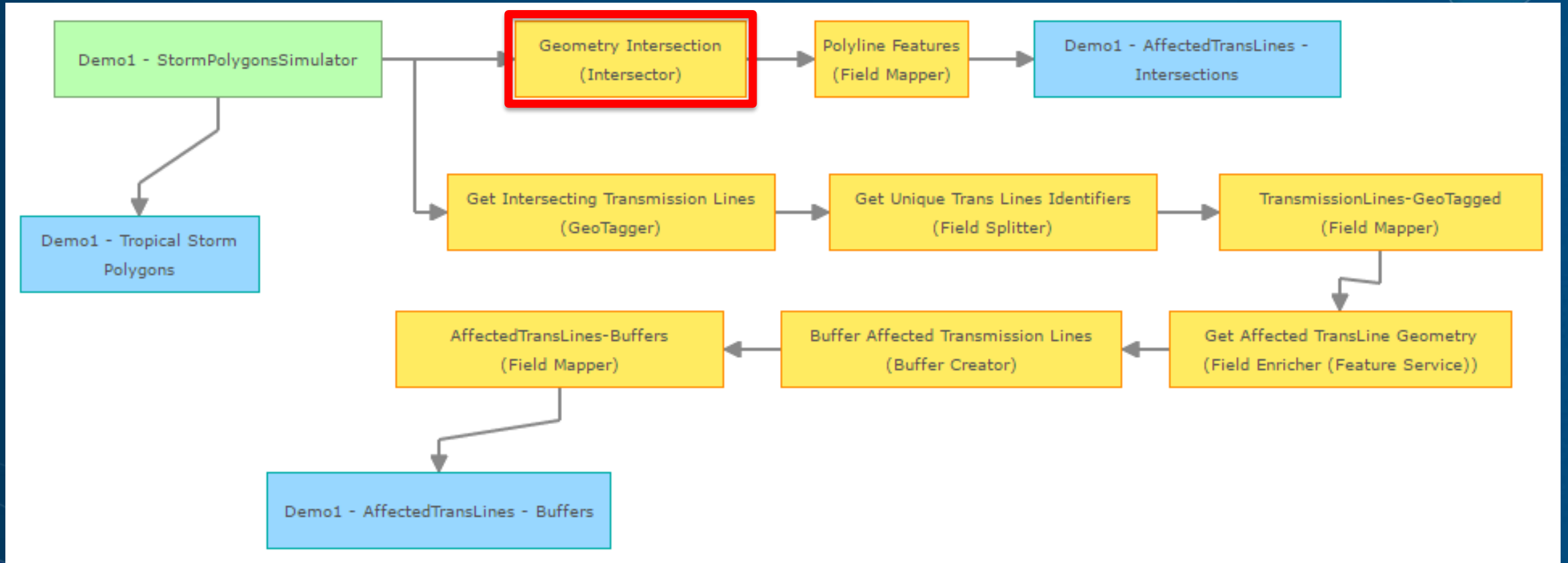


TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	-117.123..., 36.064...
buffer	rings" : [ [ [ -116.3175, 33.6703], [-116.3175, 33.6703]...]



# Identifying conditions with real-time data

*real-time analytics design*



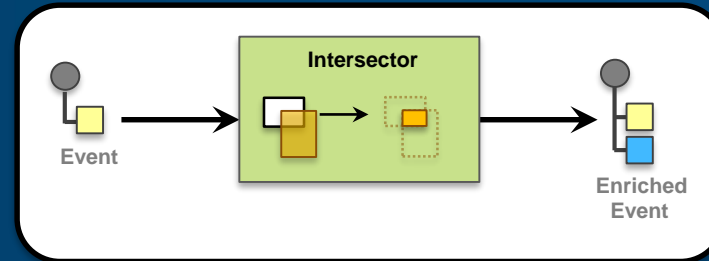
## Intersector processor

- 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]...]]

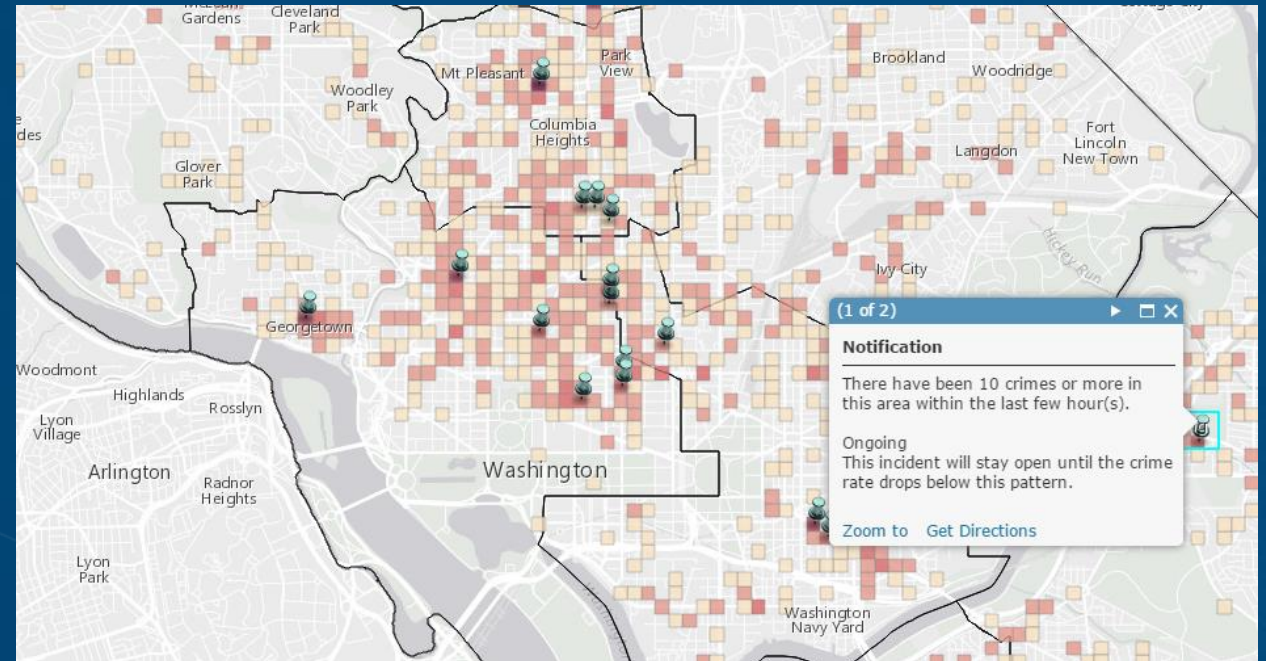


TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	-117.123..., 36.064...
intersection	rings" : [ [ [ -116.3175, 33.6703],[-116.3175, 33.6703]...]]



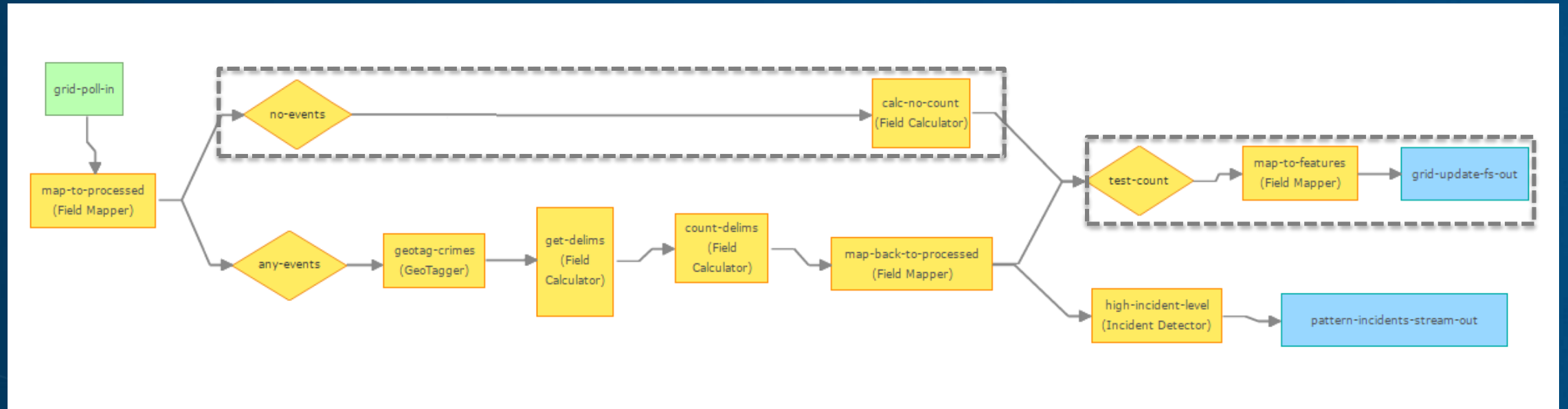
# 3

## Finding Patterns in Data (demo)



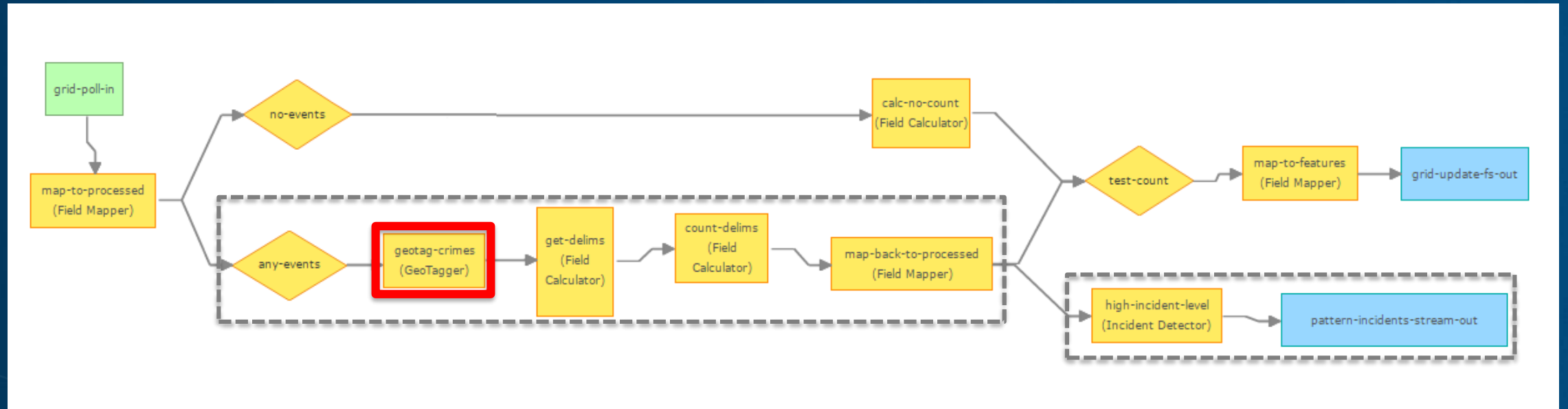
# Finding patterns in real-time data

*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

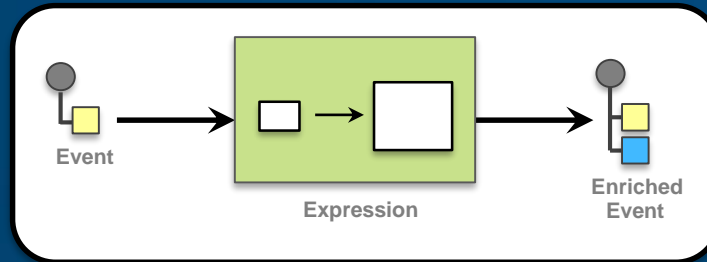
The processor uses a spatial expression to identify related geometries.

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

A GeoTagger is essentially a spatial join.

# GeoTagger processor

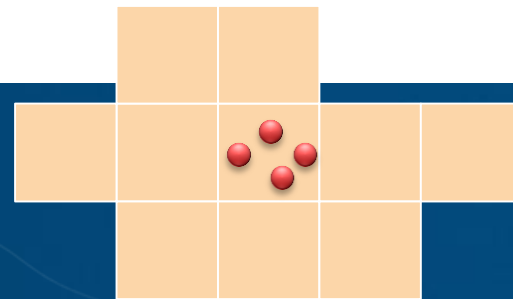
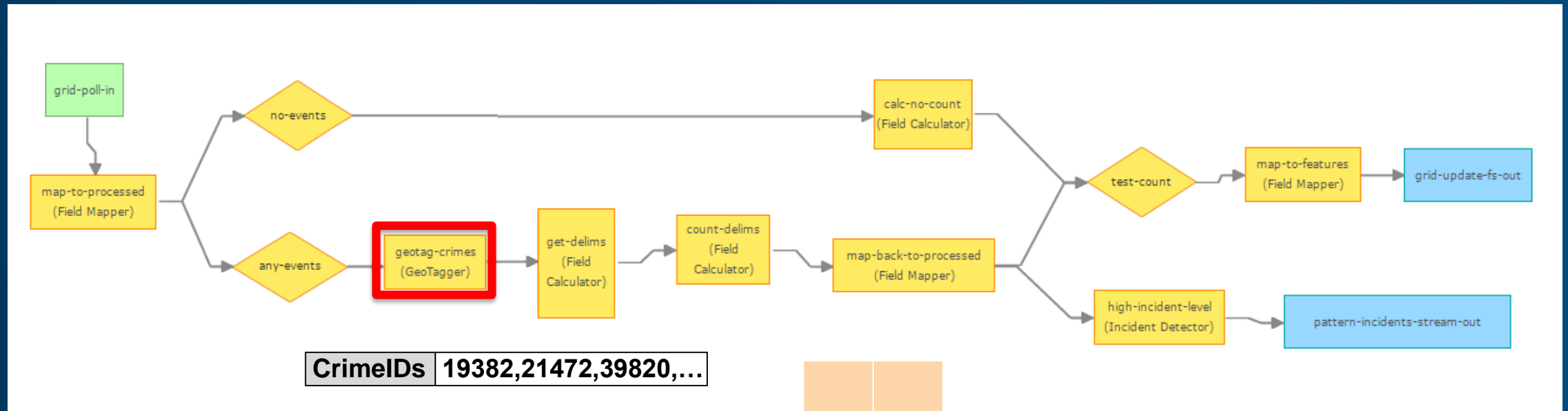
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123..., 36.064...
Category	AnkleBraceletGPS



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

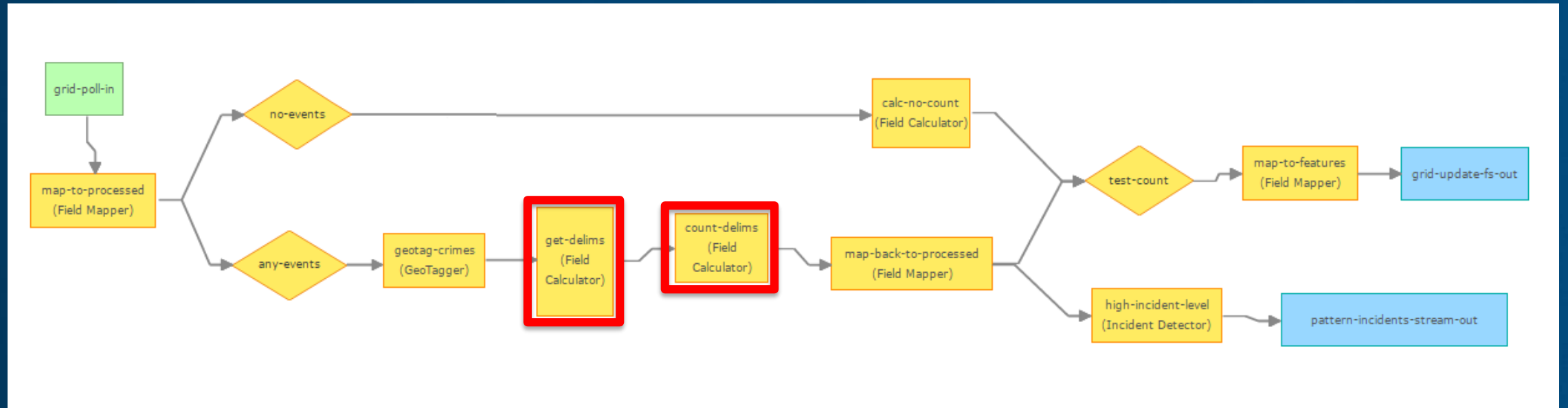
# Finding patterns in real-time data

*real-time analytics design*



# Finding patterns in real-time data

*real-time analytics design*



# Field Calculator processor

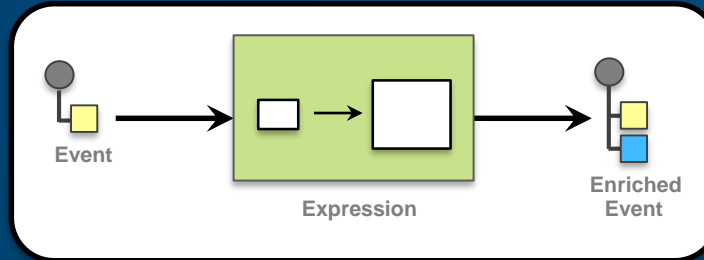
- Use a **Field Calculator** when you need to:
  - Calculate new values using data from a received event record
  - An expression is evaluated and used to calculate the new values
  - Results can be written to a new field or used to update an existing attribute

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...



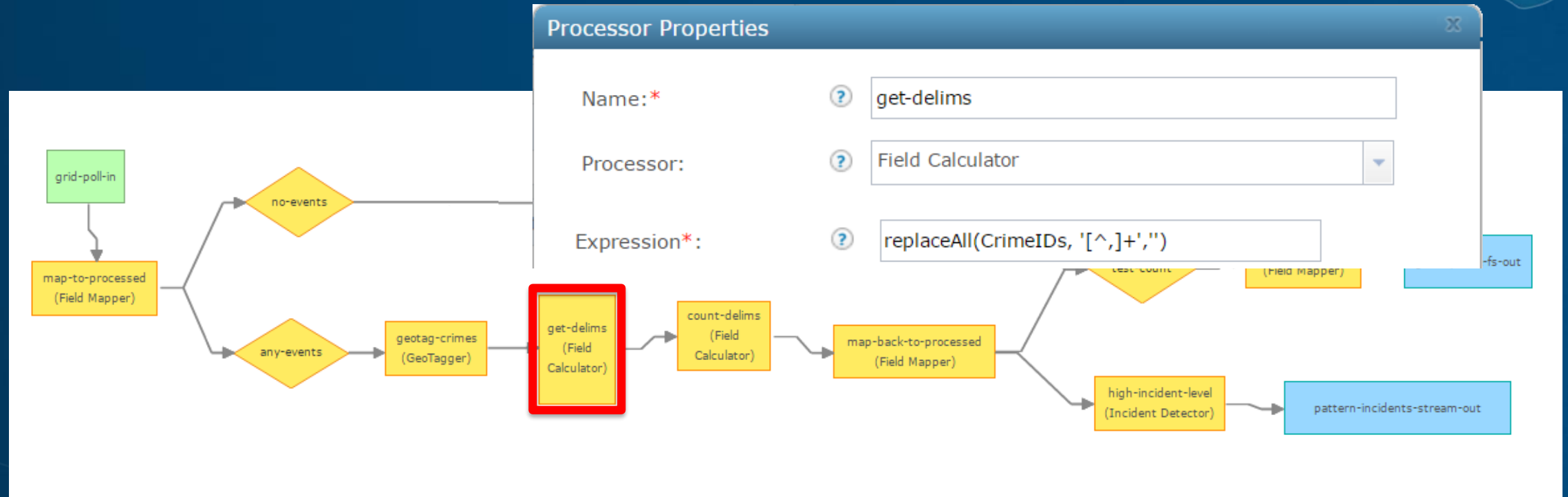
Convert from  
Feet to Miles  
Expression:

$\text{Distance} / 5280$

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

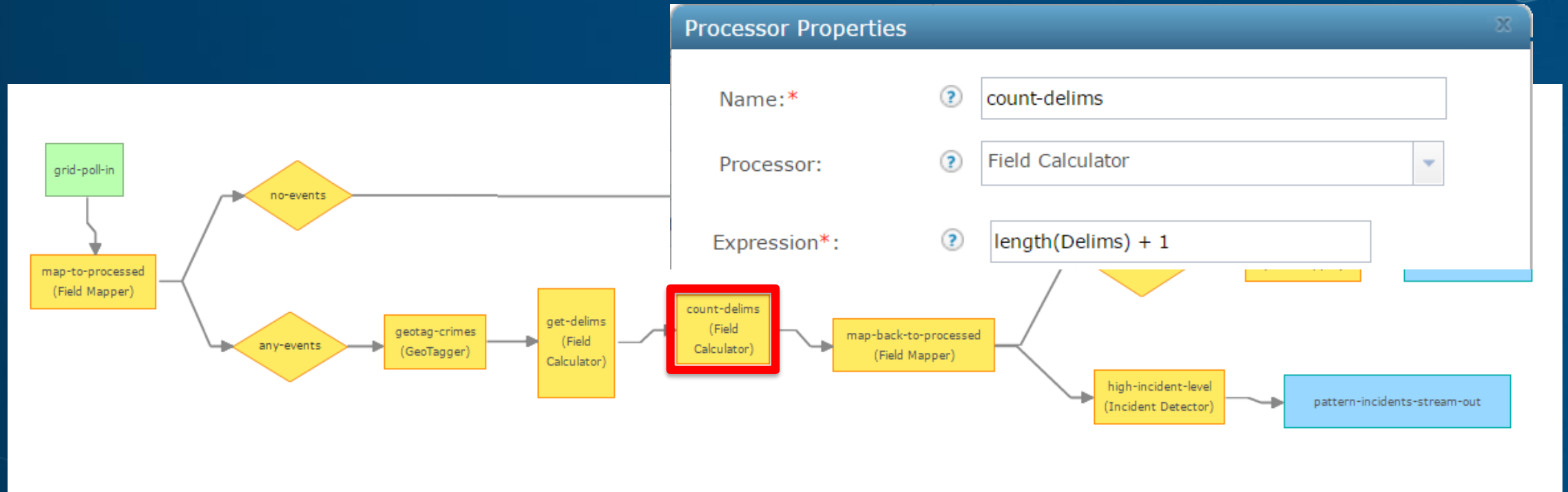
# Finding patterns in real-time data

*real-time analytics design*



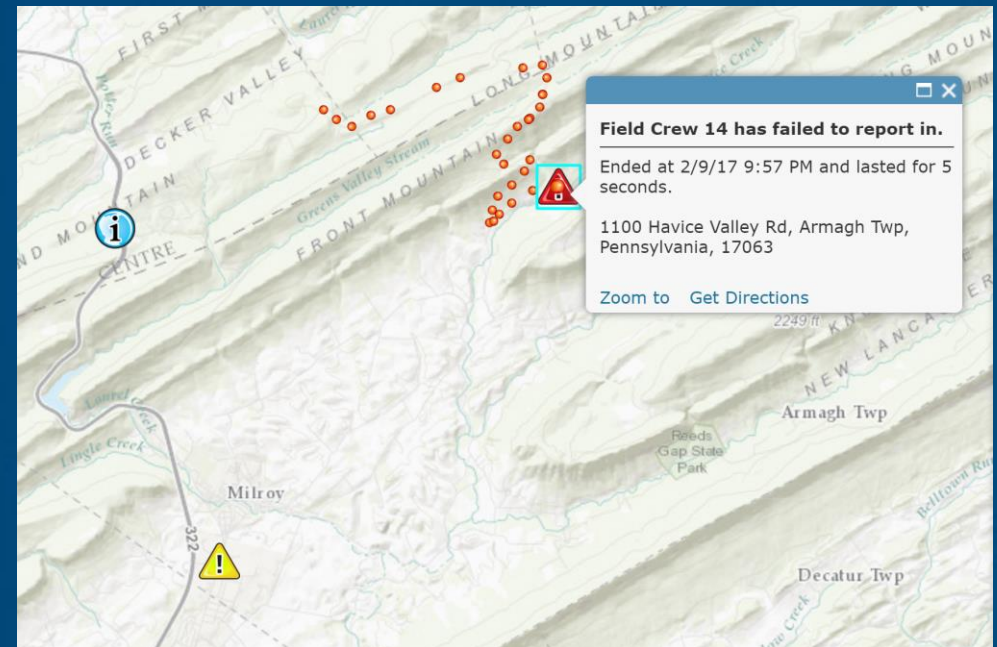
# Finding patterns in real-time data

*real-time analytics design*



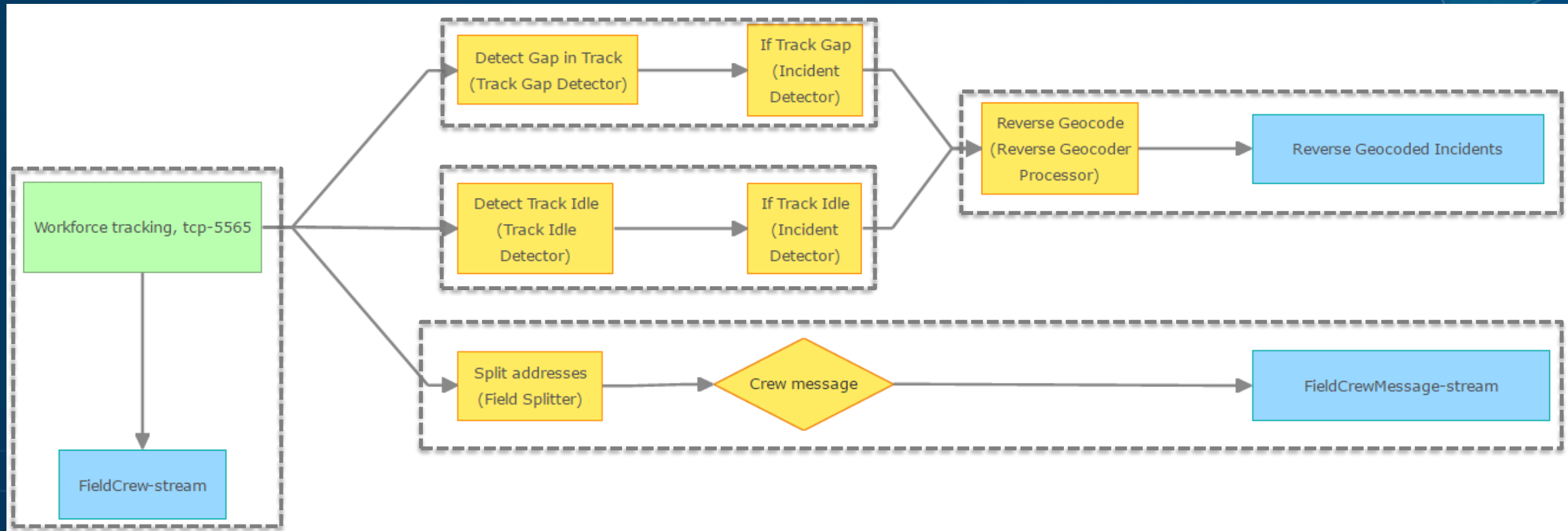
# 4

## Workforce Tracking (demo)



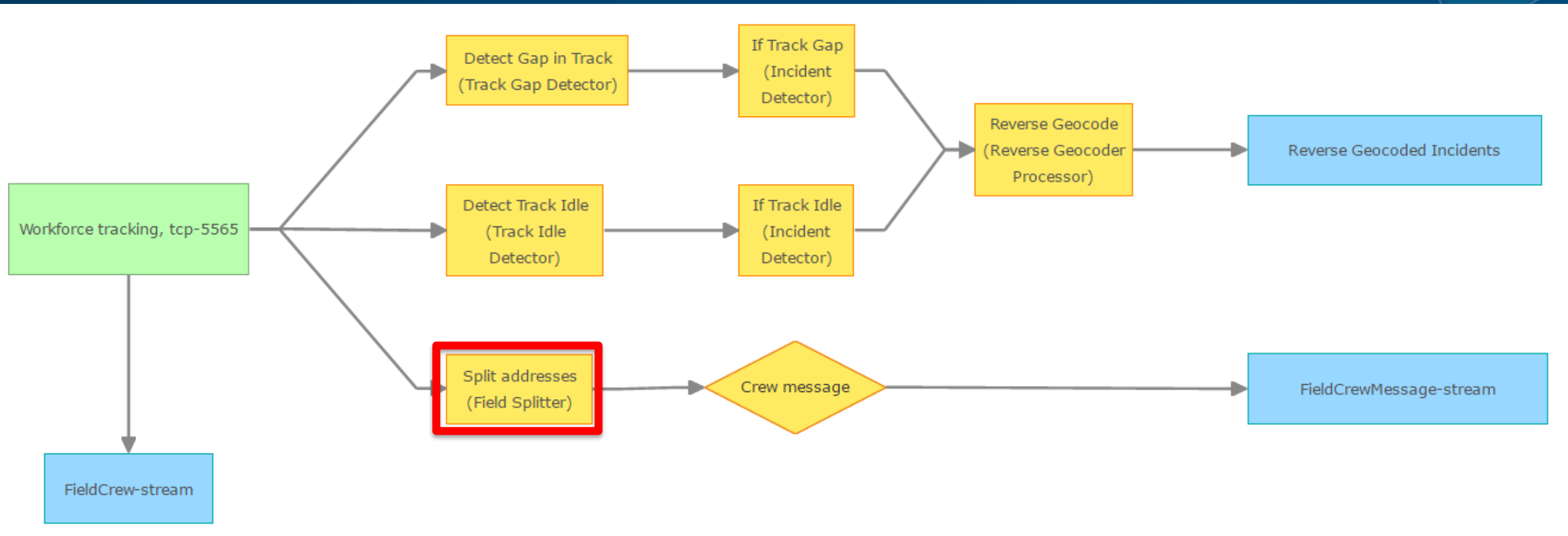
# Workforce Tracking

*real-time analytics design*



# Workforce Tracking

*real-time analytics design*



# Field Splitter processor

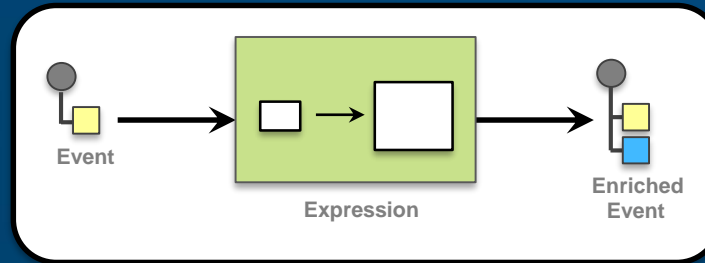
- Use a **Field Splitter** when you need to:
  - Split a list of delimited into multiple event records

Lists are normally a single delimited string (e.g. comma delimited values).

A multiscardinal 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...



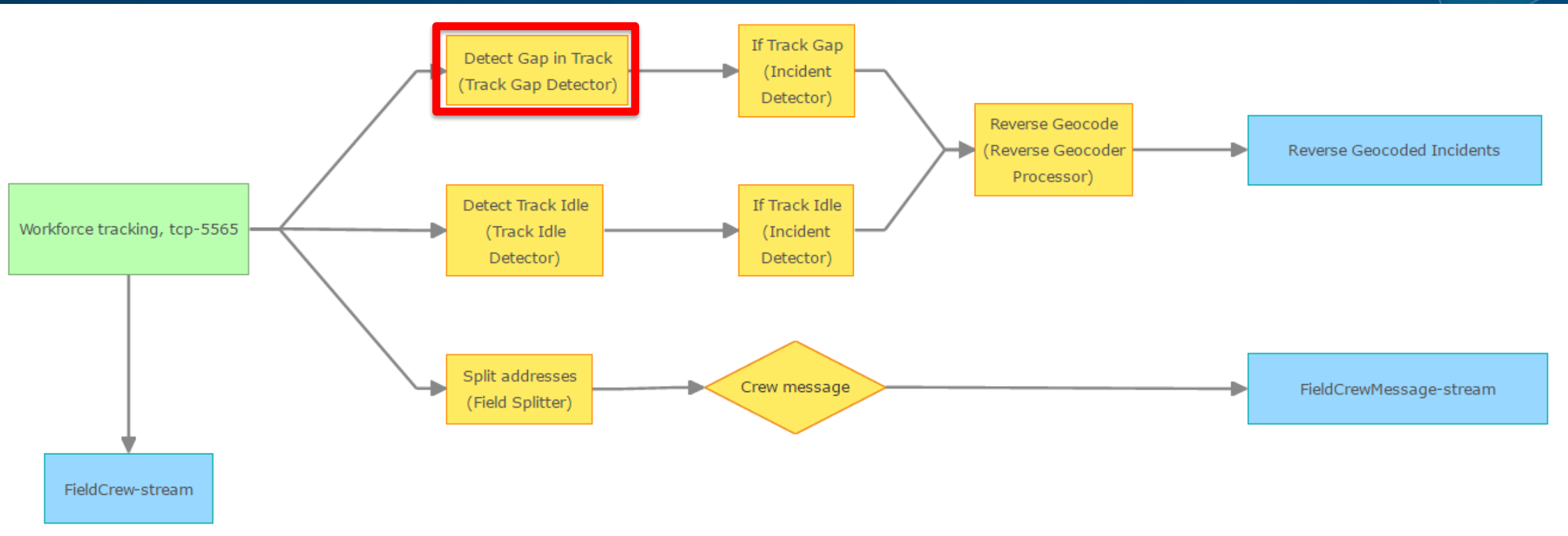
TrackID	V10987
Date	1405176845553
BatteryLevel	Low
msgCode	1
freeText	"stopped for fuel and lunch"
Addresses	"5712940342"
geometry	-117.123..., 36.064...

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

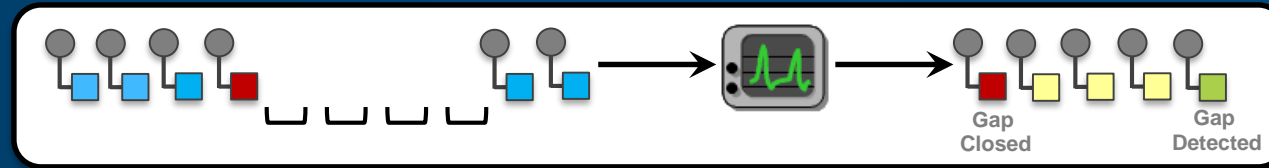
*real-time analytics design*



# 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

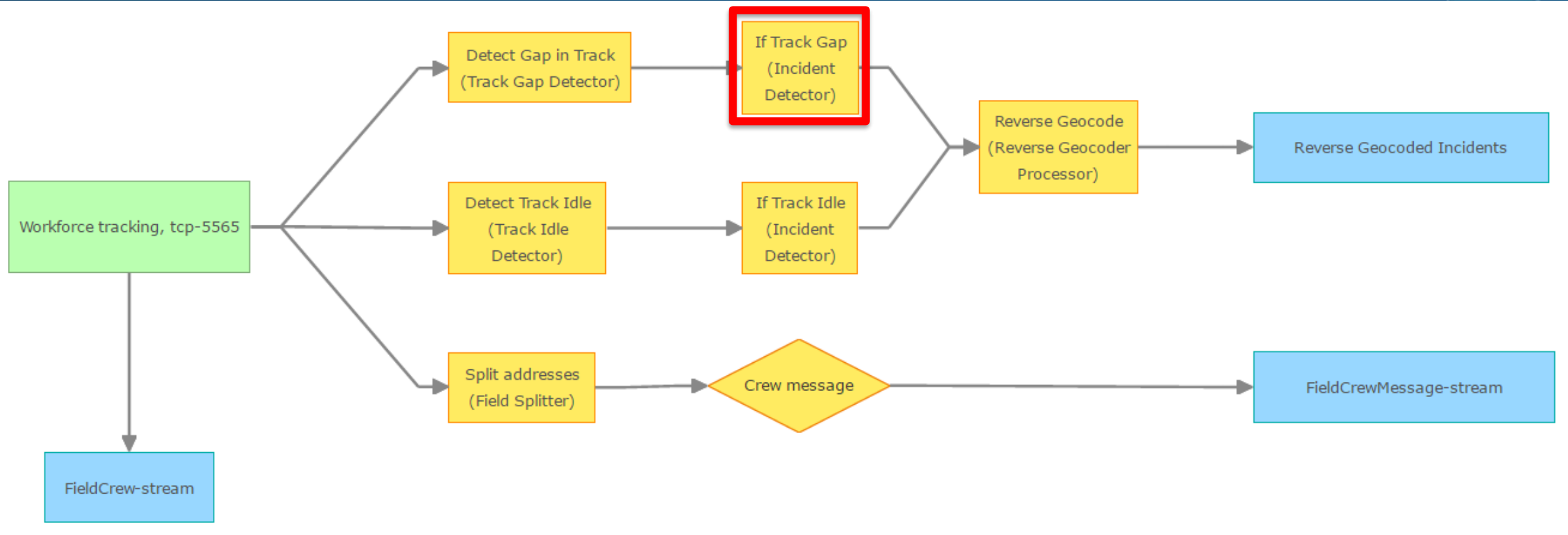


TrackID	V10987
Date	1405176945553
Geometry	-117.123..., 36.064...

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

# Workforce Tracking

*real-time analytics design*



# Incident Detector

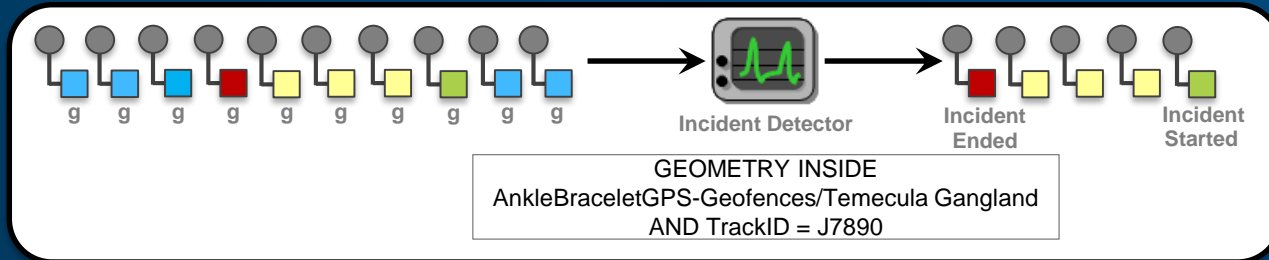
- Use an **Incident Detector** when you need to:
  - Detect that a condition has occurred and monitor its duration

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



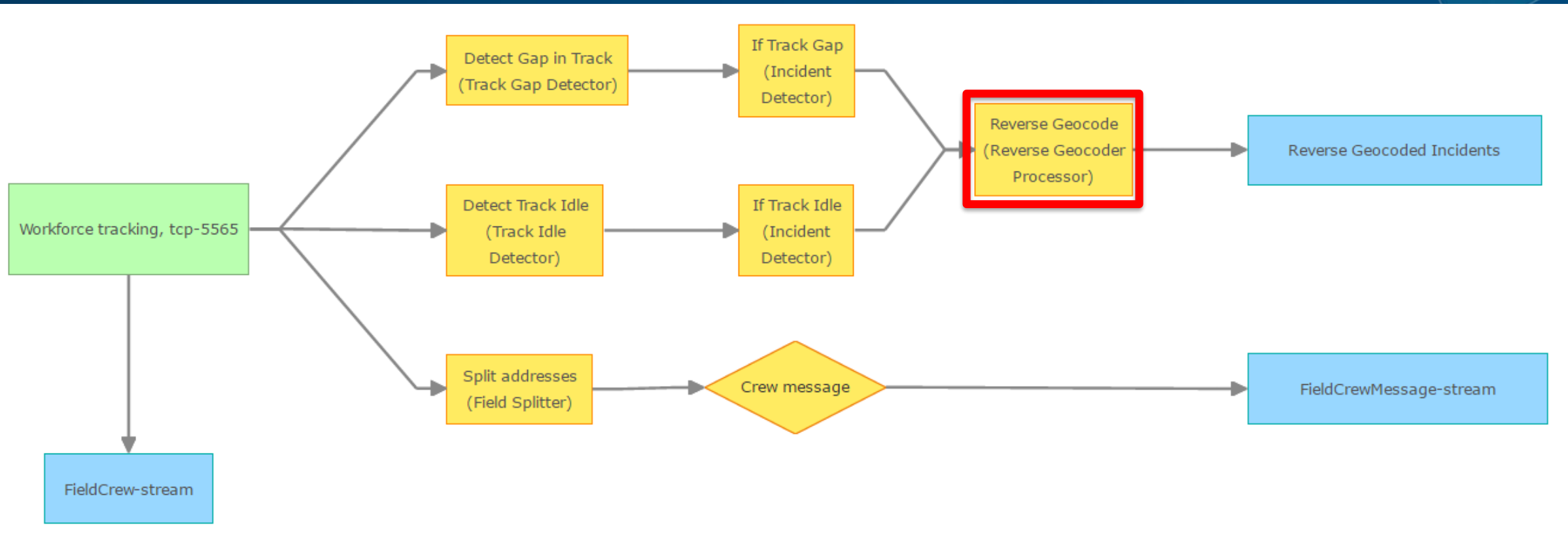
TrackID	J7890
Date	1405176935553
BatteryLevel	Medium
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
Geometry	-117.1....., 36.0.....



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	

# Workforce Tracking

*real-time analytics design*



## Reverse Geocoder processor

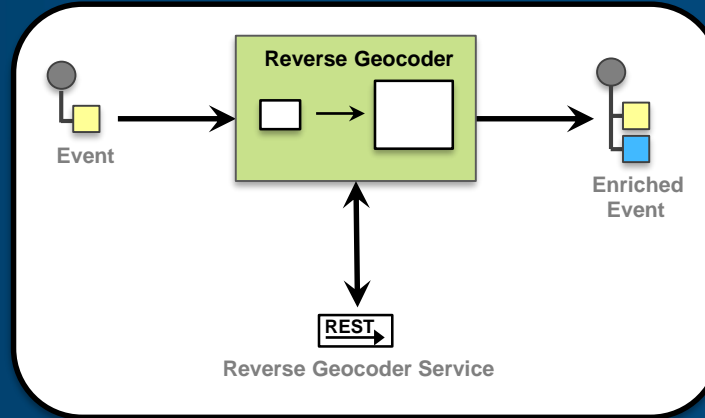
- A **Reverse Geocoder** is an example of a custom processor
  - Enriches an event record with the street address nearest the event's location

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



# 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

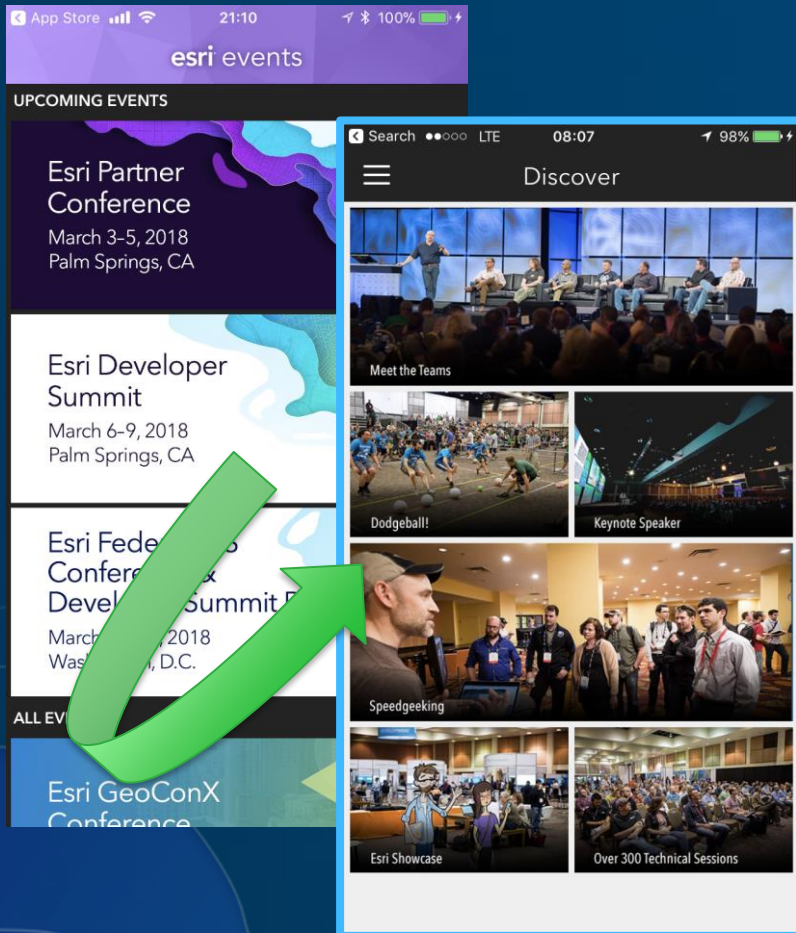


## Please Attend Our Other Sessions!

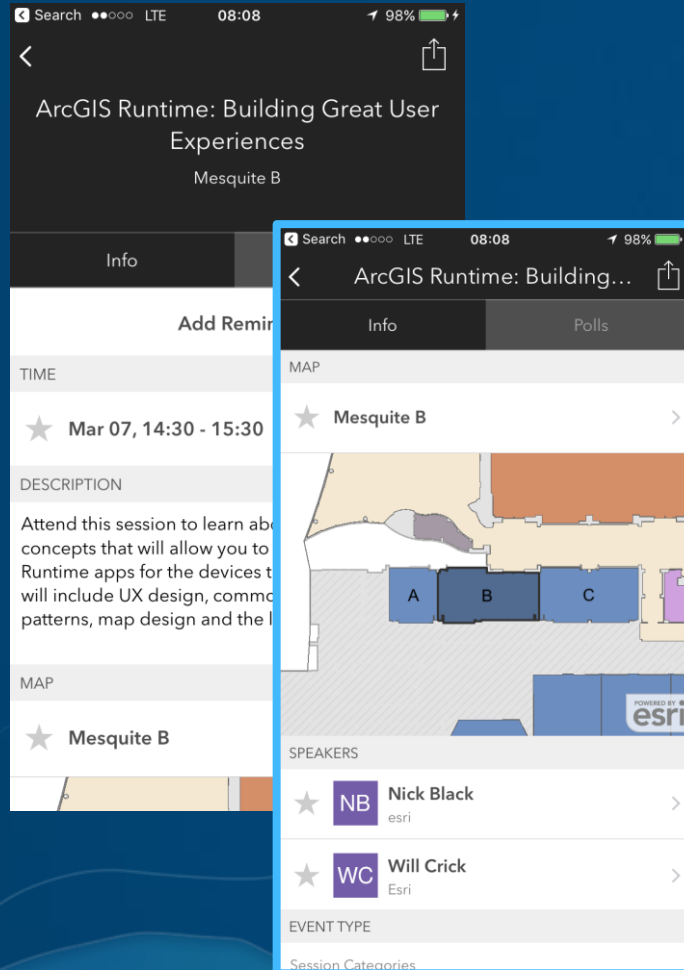
- **GeoEvent Server: An Introduction**  
Tue, 2:30-3:30 pm, Primrose B
- **GeoEvent Server: Applying Real-Time Analytics**  
Tue, 5:30pm-6:30 pm, Primrose A
- **Real-Time and Big Data GIS: Best Practices**  
Wed, 10:30-11:30 am, Primrose B  
Fri, 1:00-2:00 pm, Catalina/Madera
- **ArcGIS and the Internet of Things (IoT)**  
Wed, 2:30-3:30 pm, Primrose B
- **Real-Time and Big Data GIS: Leveraging the Spatiotemporal Big Data Store**  
Wed, 4:00-5:00 pm, Primrose A
- **Developing Real-Time Web Apps with the ArcGIS API for JavaScript**  
Thu, 9:00-9:30 am, Demo Theater 1: Oasis 1-2
- **Real-Time GIS: Road Ahead**  
Thu, 4:00-5:00 pm, Pasadena/Sierra/Ventura
- **GeoEvent Server: Creating Connectors and Processors Using the GeoEvent SDK**  
Fri, 8:30-9:30 am, Mesquite B

# Please Take Our Survey!

Download the Esri Events app  
and find your event

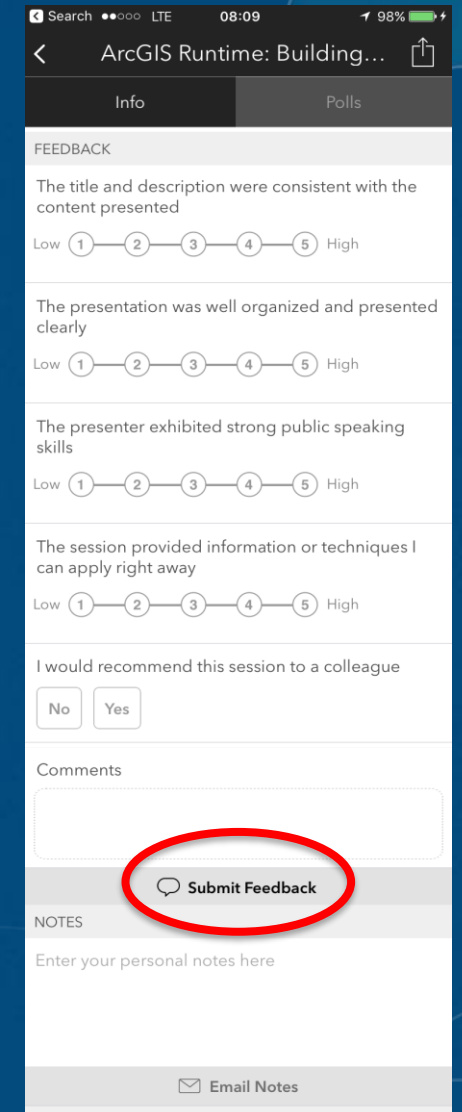


Select the session you  
attended



Scroll down to the  
“Feedback” section

Complete Answers,  
add a Comment,  
and Select “Submit”



# Esri.com Proceedings page

<http://proceedings.esri.com>

Where users can find PDF'ed  
slides after DevSummit

The screenshot shows the Esri.com website's Events page. At the top, there is a navigation bar with the Esri logo and links for Industries, Products, Support & Services, About, and Community. A search bar is located on the right. Below the navigation is a red banner with the word 'Events' and three tabs: 'Main', 'Recent Proceedings', and 'User Groups'. The main content area is a grid of event listings, each with a title and dates. The 'DevSummit (International)' entry, dated March 8–11, 2016, is circled in red. Other events include the Esri User Conference (June 27–30, 2016), European Petroleum GIS Conference (November 1–2, 2016), and Mid Atlantic User Conference (December 7–9, 2015).

Event Title	Dates
Esri User Conference	June 27–30, 2016
European Petroleum GIS Conference	November 1–2, 2016
Mid Atlantic User Conference	December 7–9, 2015
AEC Summit	July 20–24, 2015
European Transportation GIS Summit	May 19–20, 2016
National Security and Public Safety	June 25–28, 2016
10th Asia Pacific User Conference	January 27–28, 2015
Federal GIS Conference	February 24–25, 2016
Ocean GIS Forum	November 1–3, 2016
Business Summit	Jun 25–28, 2016
GeoConX Conference	October 17 20, 2016
Petroleum GIS Conference	April 26–28, 2016
<b>DevSummit (International)</b>	March 8–11, 2016
Geodesign Summit	January 24–26, 2017
Public Sector CIO Summit	March 25–26, 2015
DevSummit Europe	December 6–8, 2016
Geodesign Summit Europe	November 1–2, 2016
Southeast User Conference	May 2–4, 2016
DevSummit, Washington DC	February 24-25, 2016
GIS for a Sustainable World	May 2–4, 2016
Southwest User Conference	January 19–21, 2016
Education User Conference	June 27–30, 2016
Health GIS Conference	September 14–16, 2015
Water Conference	February 9–11, 2016
Electric & Gas GIS Conference	October 5–8, 2015
Imaging & Mapping Forum	June 27–30, 2016

# Questions / Feedback?



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