Real-Time GIS: Applying Real-Time Analytics

Suzanne Foss
Real-Time & Big Data Product Engineer, Esri
sfoss@esri.com
@sfoss_esri

Ken Gorton
National Government Solution Engineer, Esri
kgorton@esri.com

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

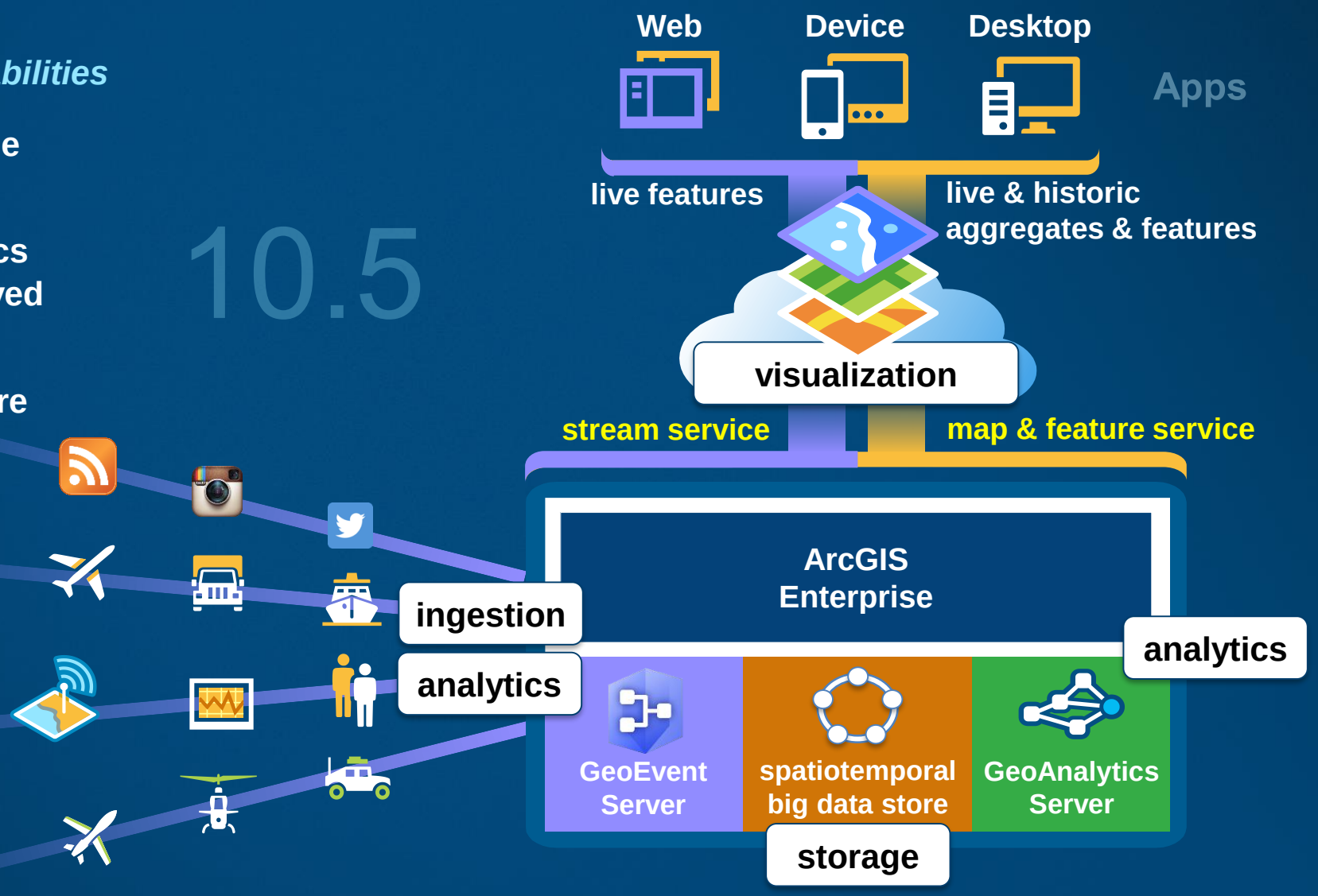
1 Performing Analysis in Real Time

ArcGIS Enterprise

with real-time & big data capabilities

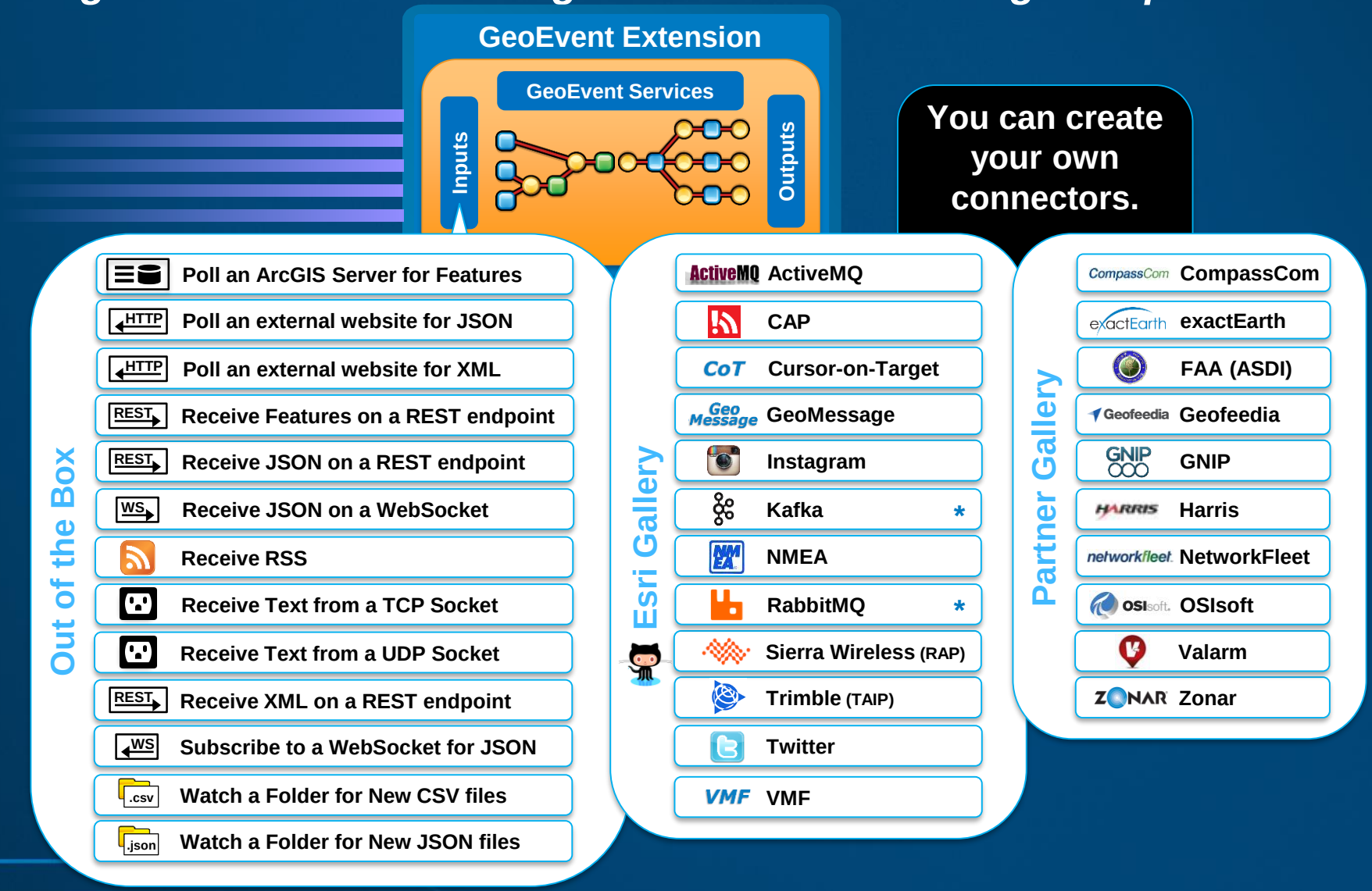
- Ingest high velocity real-time data into ArcGIS
- Perform continuous analytics on events as they are received
- Store observations in a spatiotemporal big data store
- Run batch analytics on stored observations
- Visualize high velocity & volume data:
  - as an aggregation
  - as discrete features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

10.5



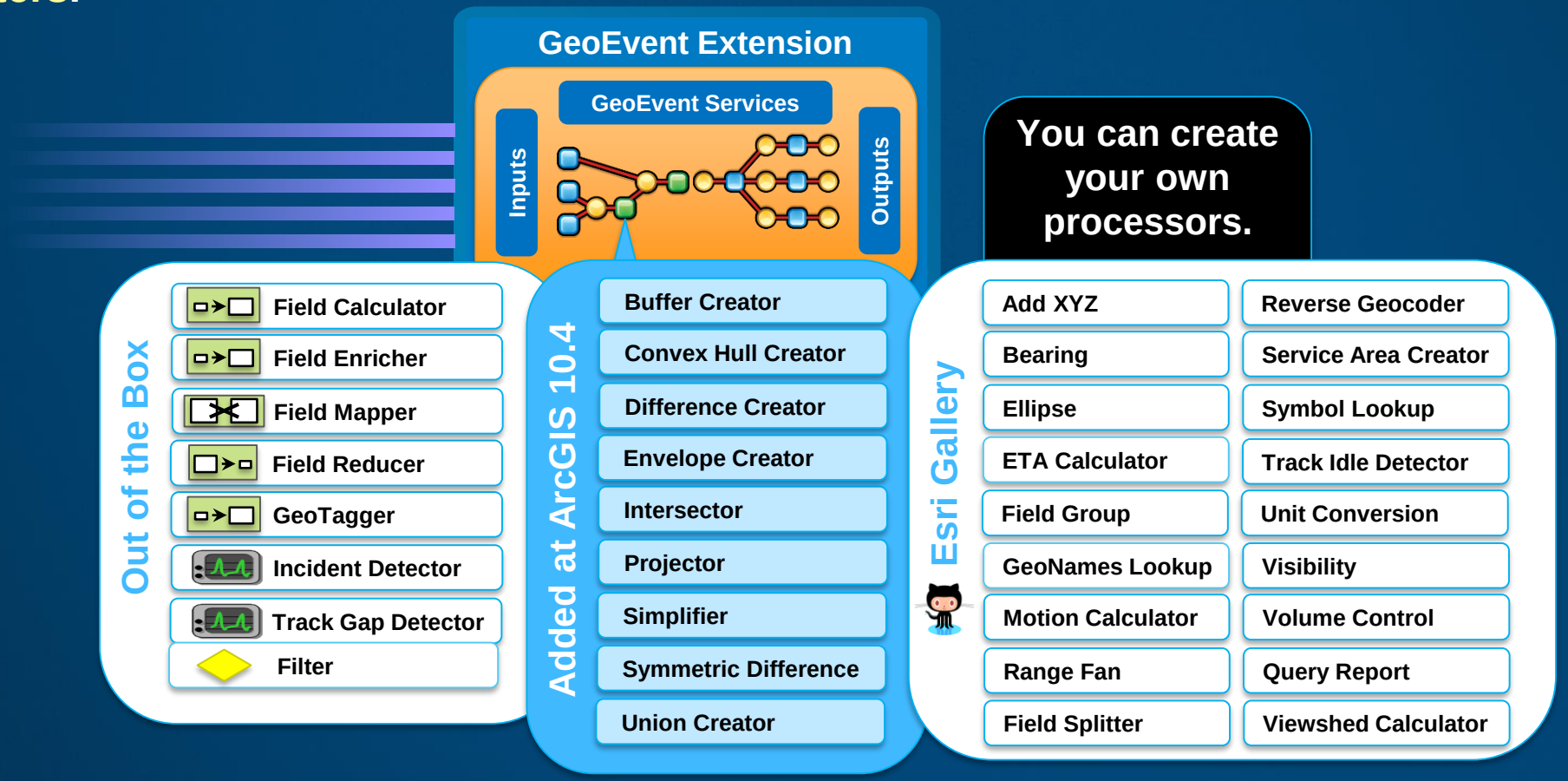
Receiving Real-Time Data

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



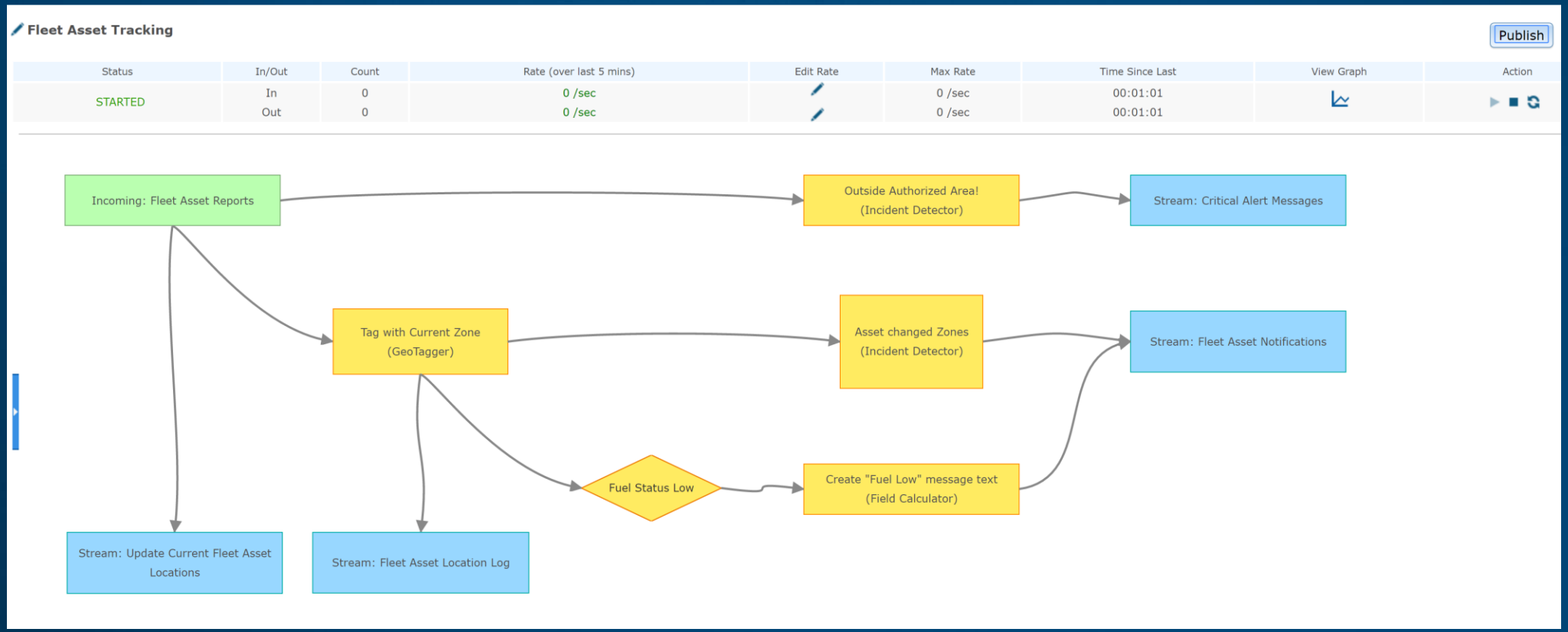
Applying real-time analytics

- *GeoEvent Processing*
- You can perform continuous analytics on GeoEvents as they are received using processors and filters.



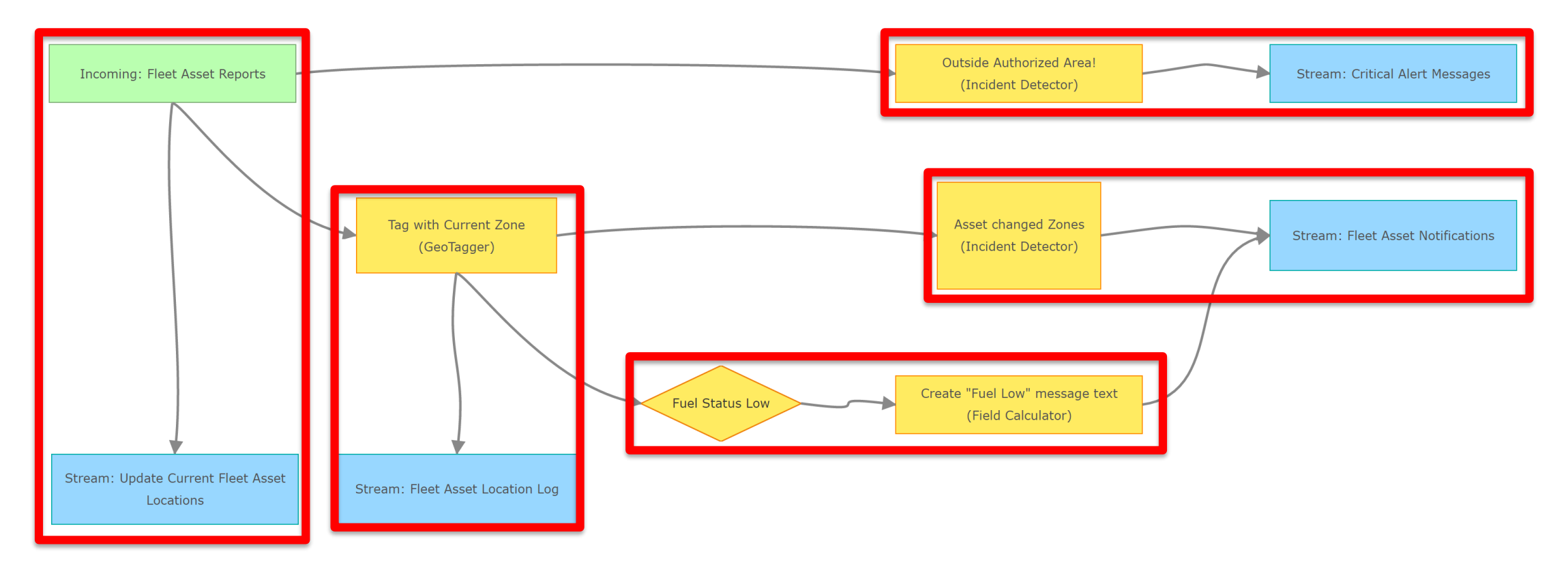
Applying real-time analytics

- *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.



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

Fleet Asset Tracking Pseudo Service

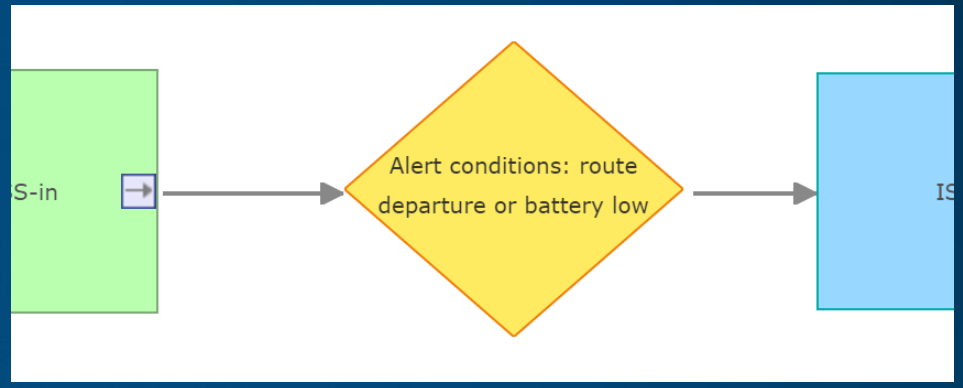


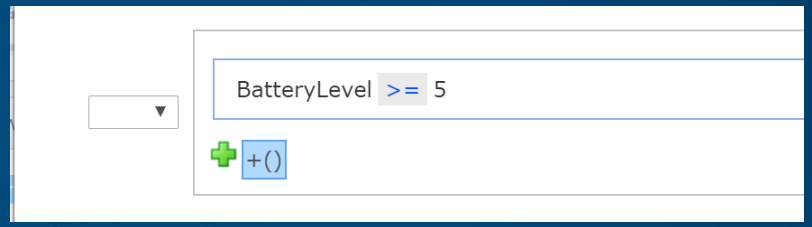
A Word about Processors

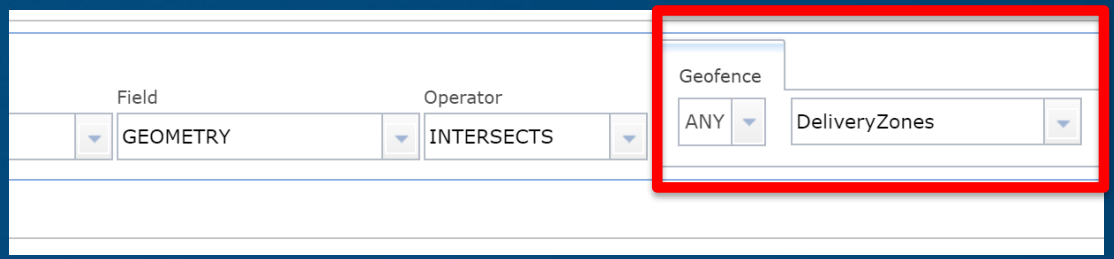
- Some work only on geometry
- Some work on geometry and/or attributes
- Some respond to spatial and/or attribute conditions and generate new messages
- Processors typically transform the GeoEvent in some way

…And 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







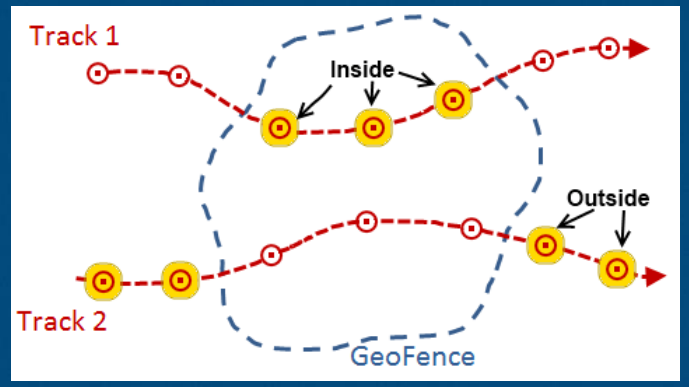
Spatial Operators

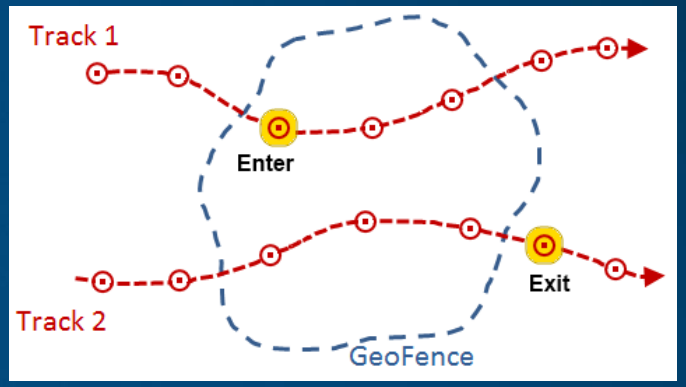
- **Spatial operators at 10.2:**

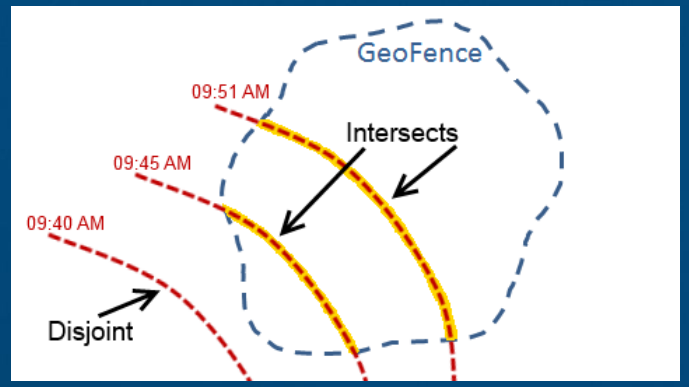
inside	outside
enter	exit

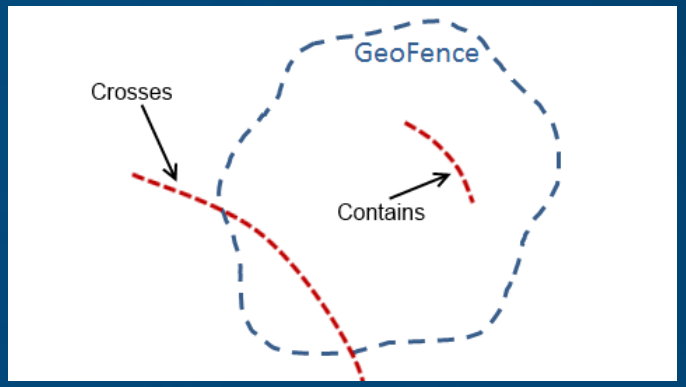
- **Spatial operators at 10.3 and beyond:**

intersect	disjoint
touches	contains
crosses	equals
overlaps	within



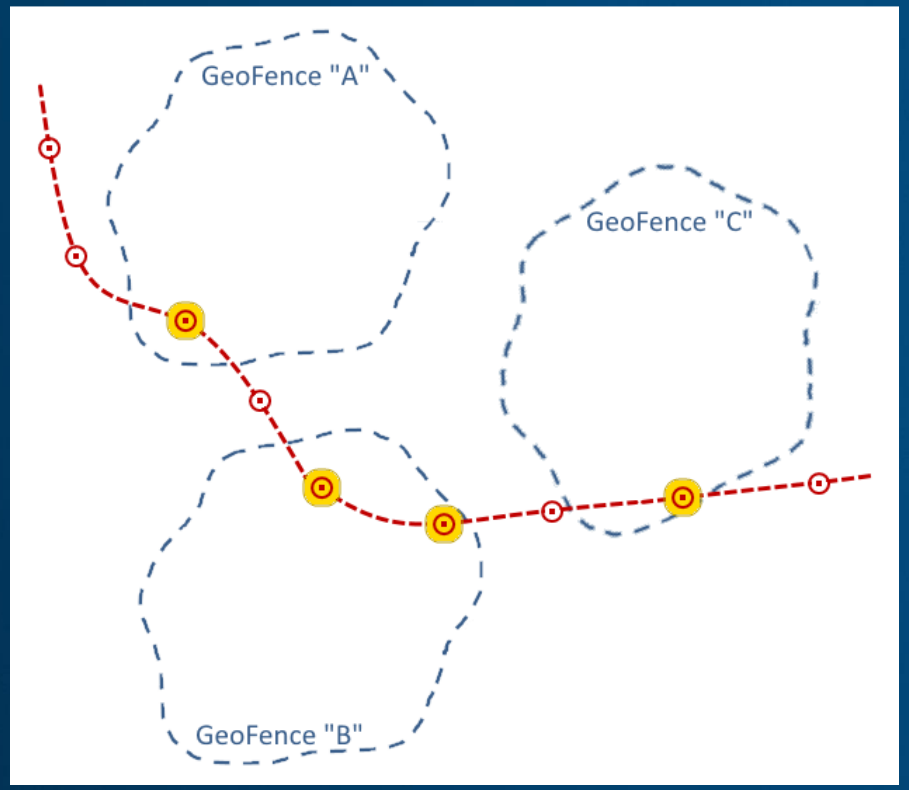




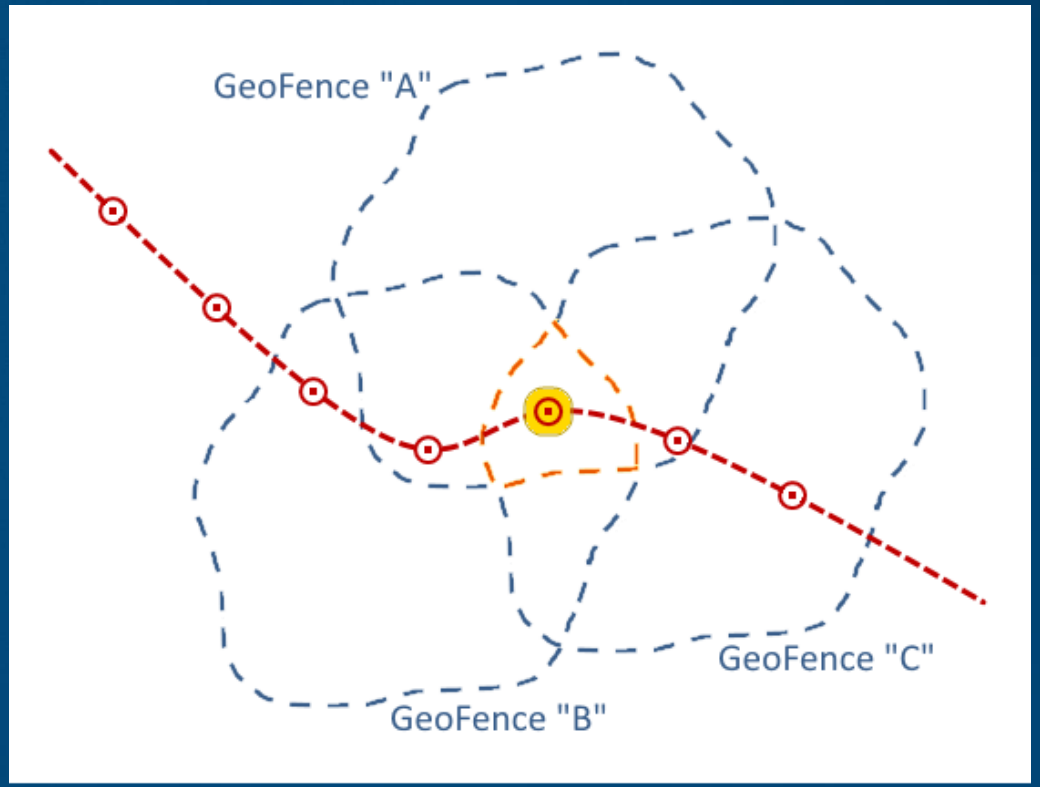


Spatial Operators: Scope

- Geofencing scope: Any or All
- Any geofence

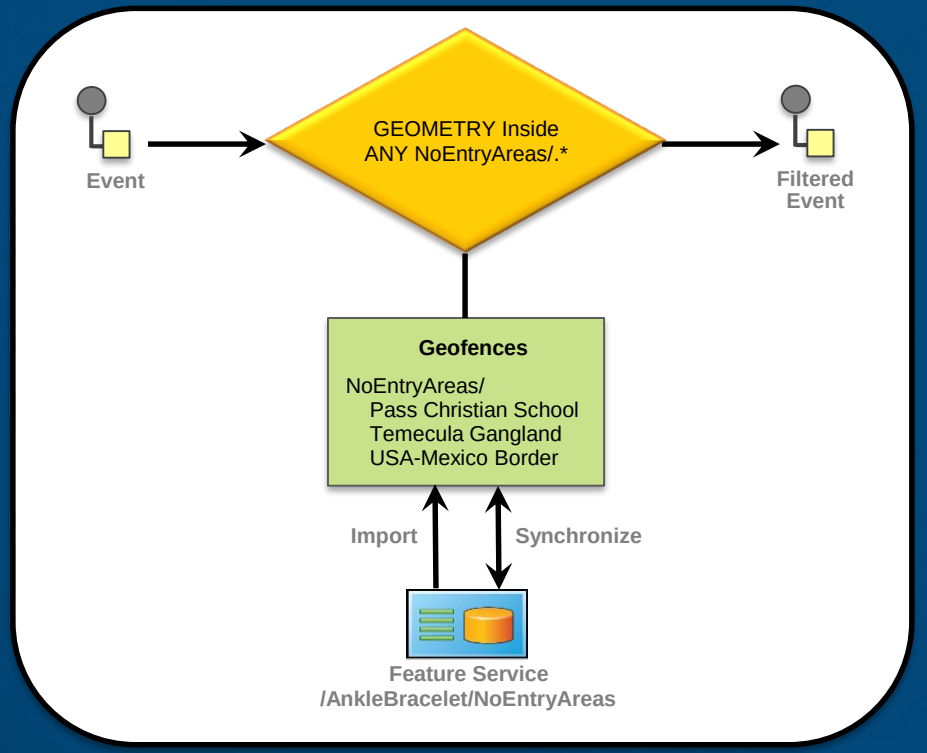


- All geofences



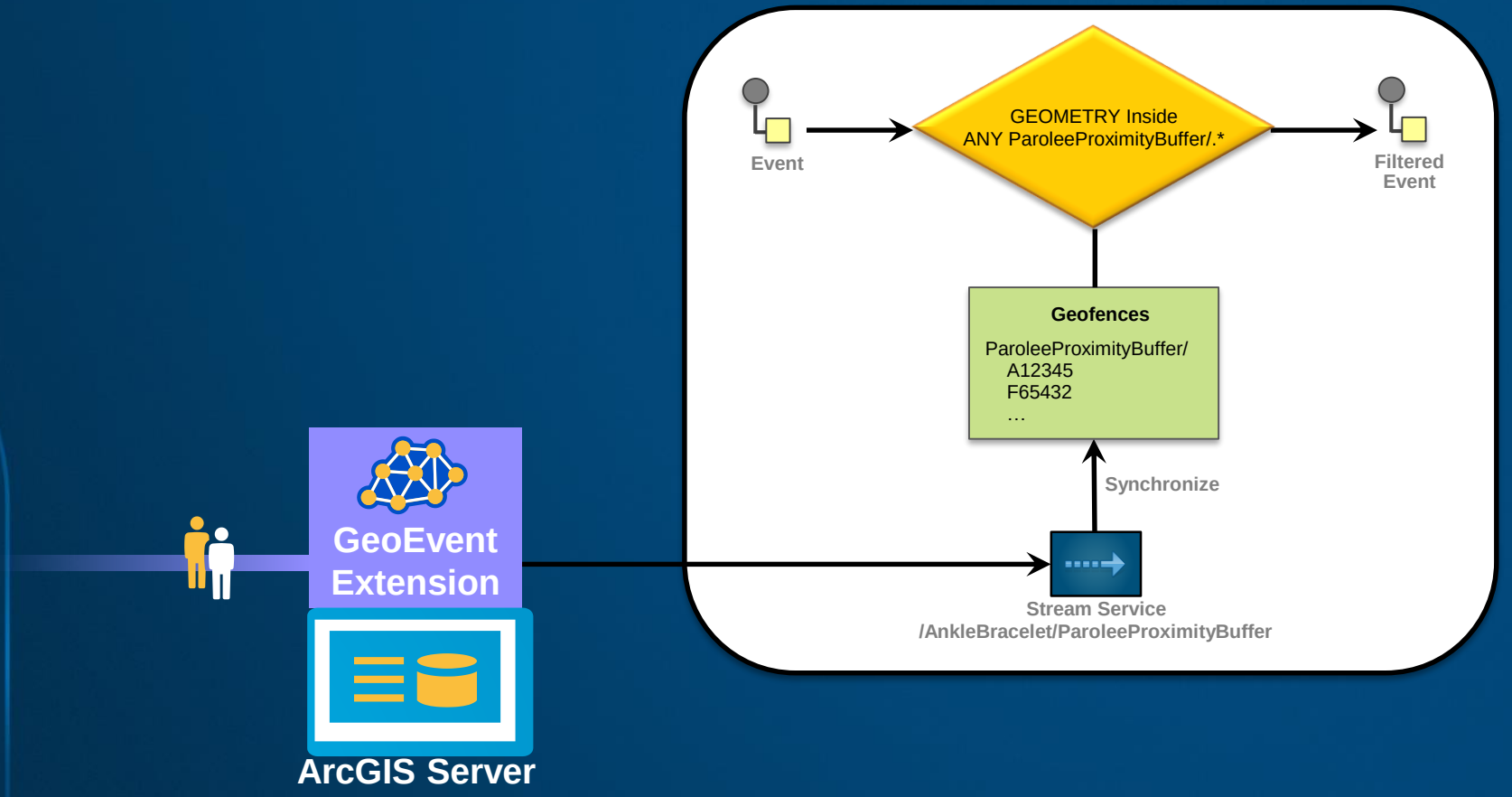
Geofencing

- **Import geofences from a feature service – reads once: static geofence**
- **Synchronize geofences with a feature service – refreshes periodically: updating geofence**

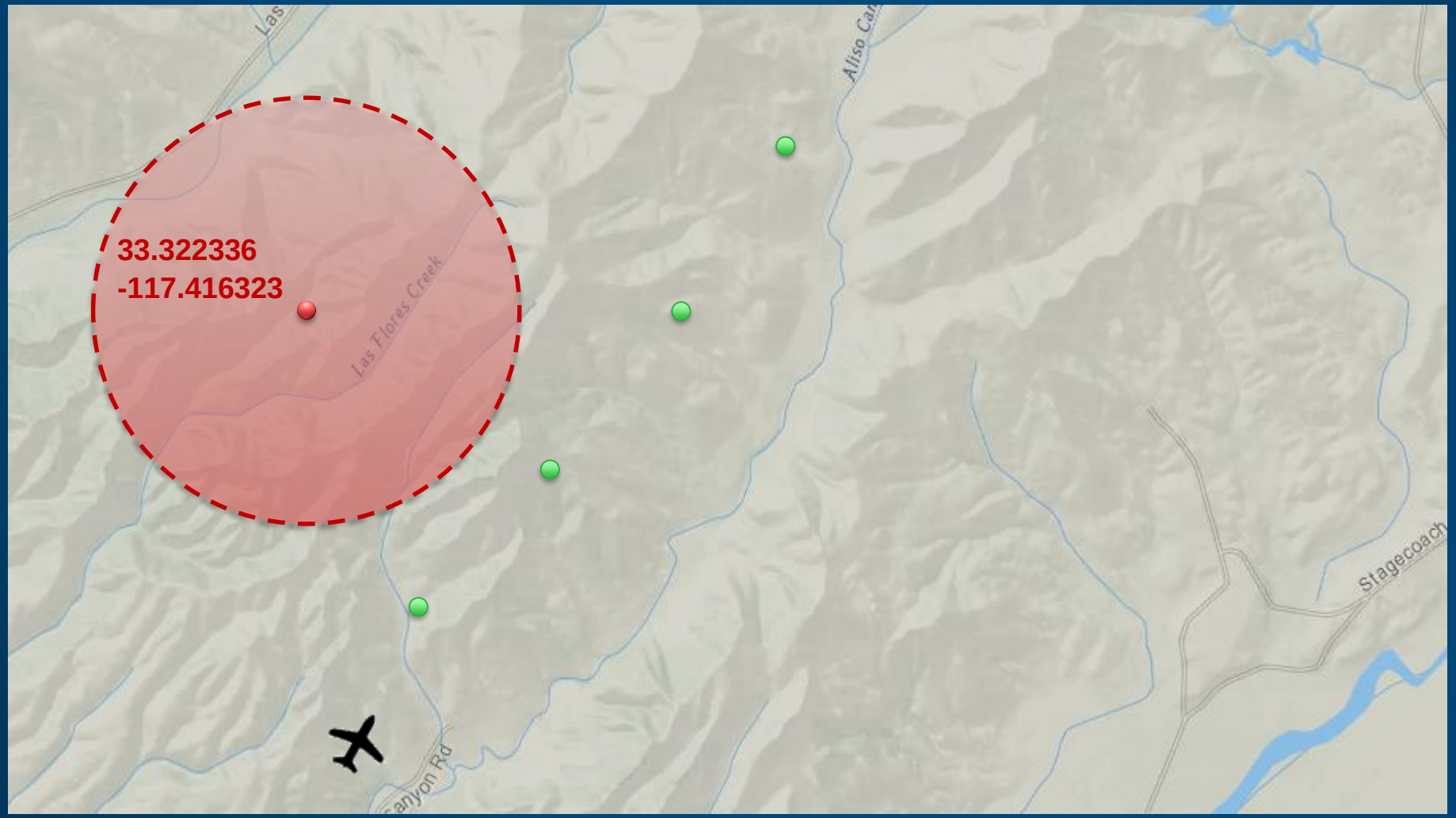


Geofencing

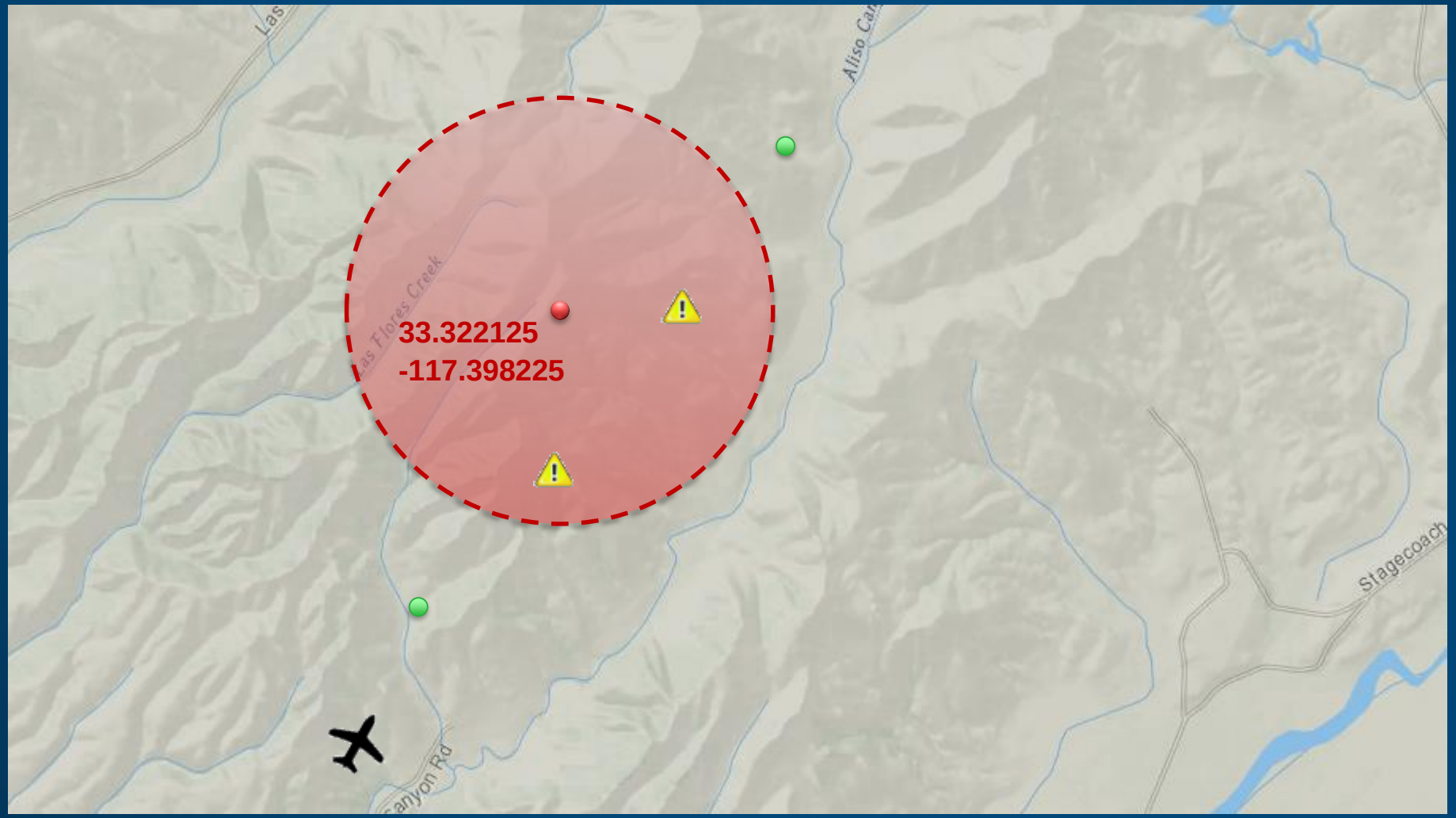
- **Synchronize geofences with a stream service – updates continuously: dynamic geofence**



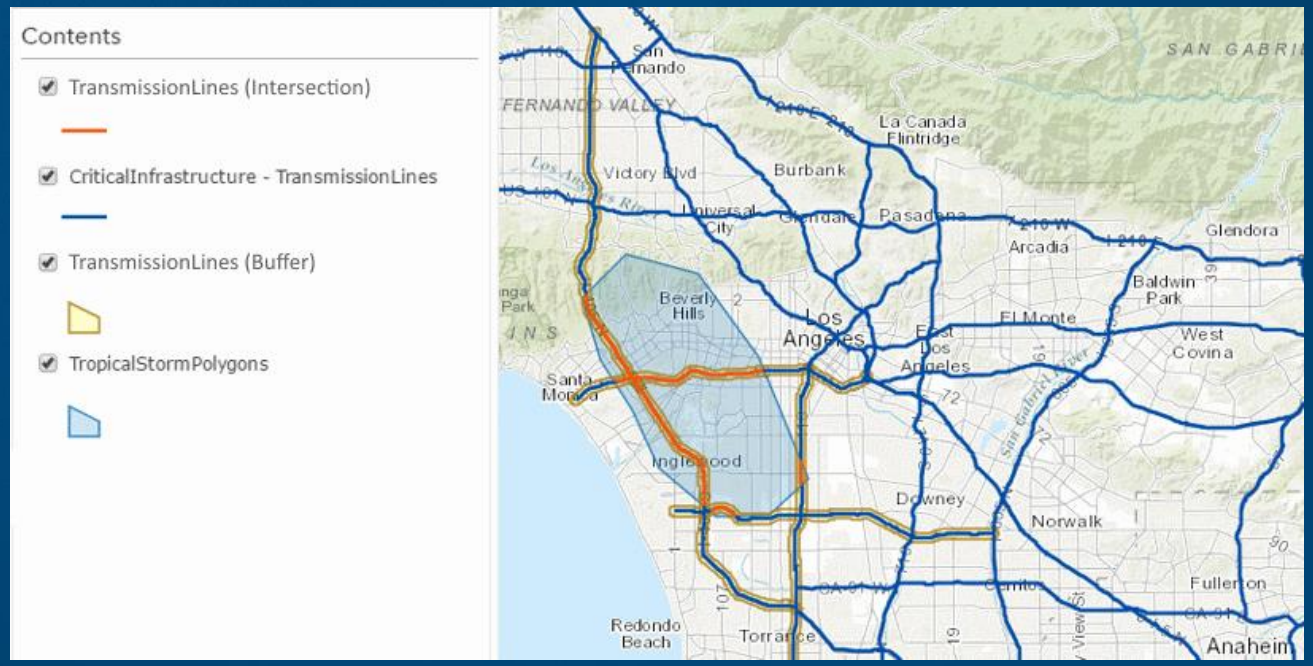
Dynamic GeoFences



Dynamic GeoFences

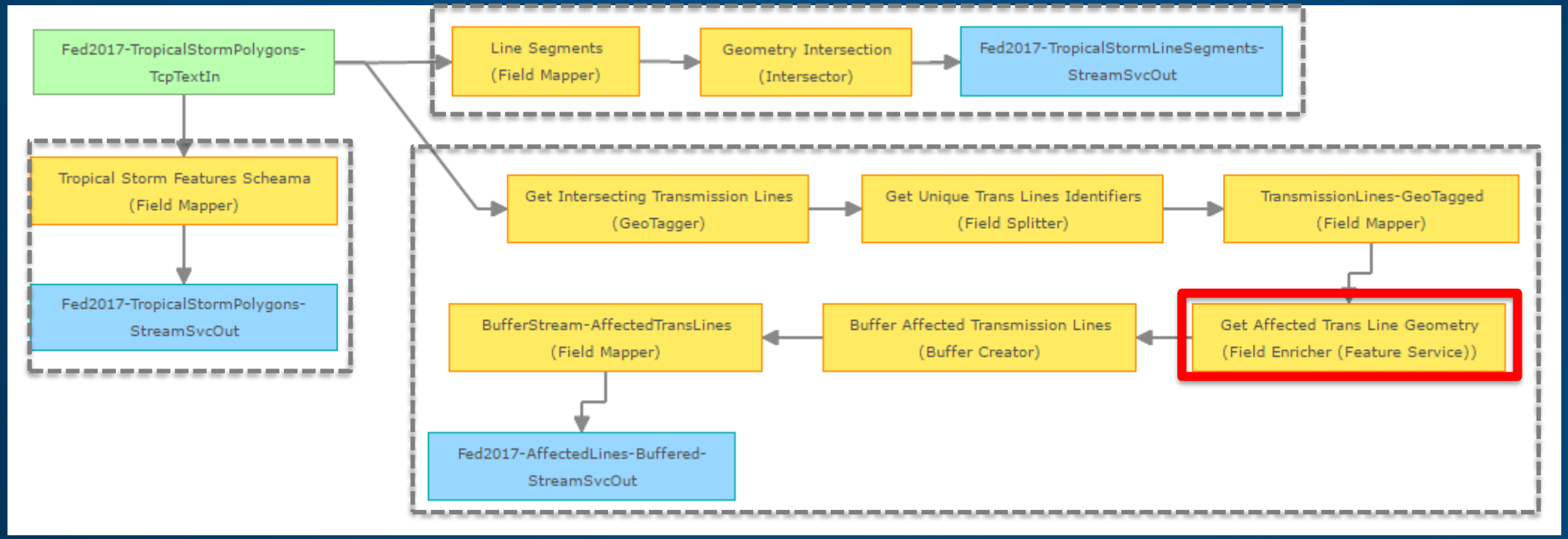


2 Identifying Conditions (demo)



Identifying conditions with real-time data

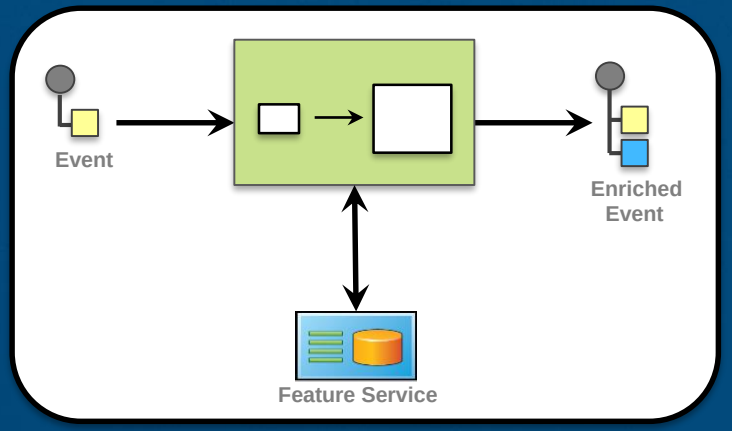
GeoEvent Service example



Field Enricher processor

- *Enrich a GeoEvent with new fields*
  - 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.

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

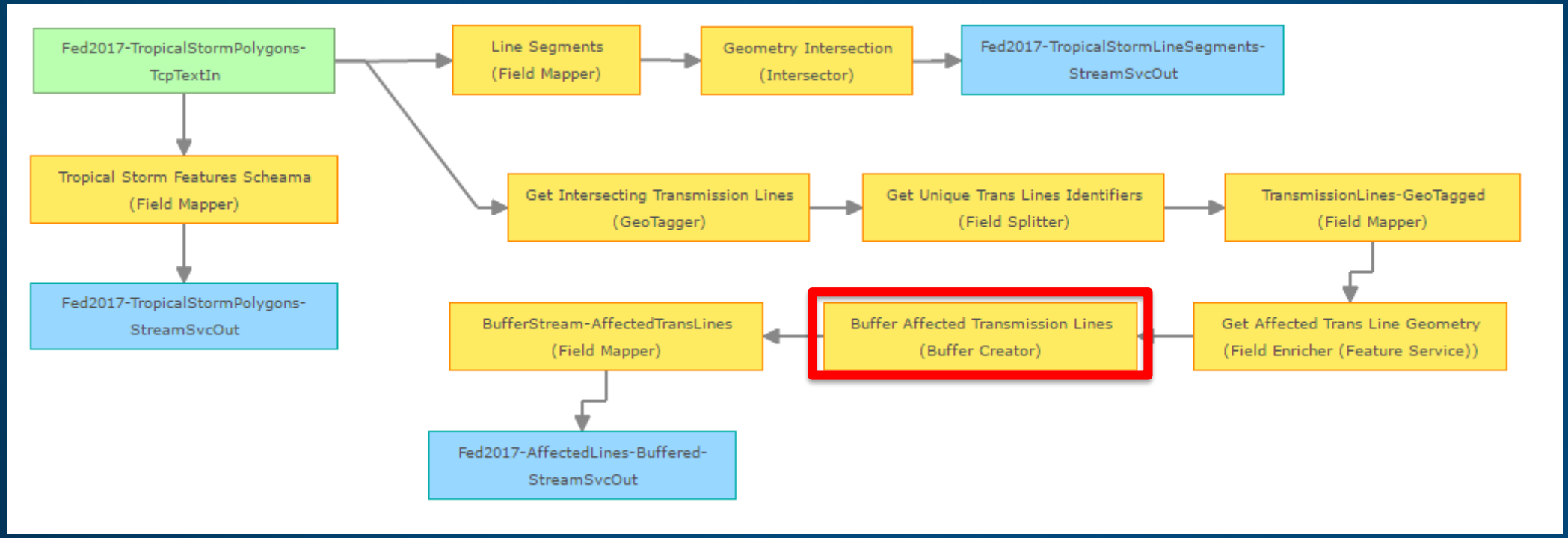


TrackID	NoContact	NoEntry
K90123		Temecula gangland
V10987	F65432	Pass Christian School
…	…	…

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

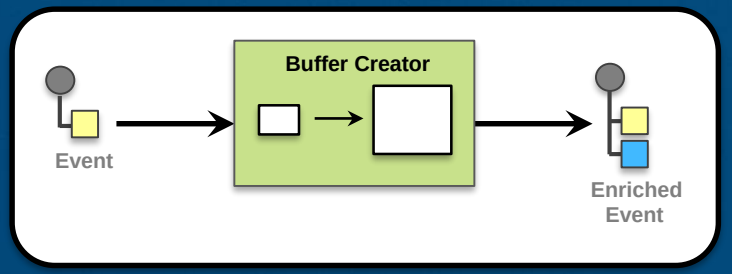
GeoEvent Service example



Buffer Creator processor

- *Enrich the geometry of a GeoEvent*
  - 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

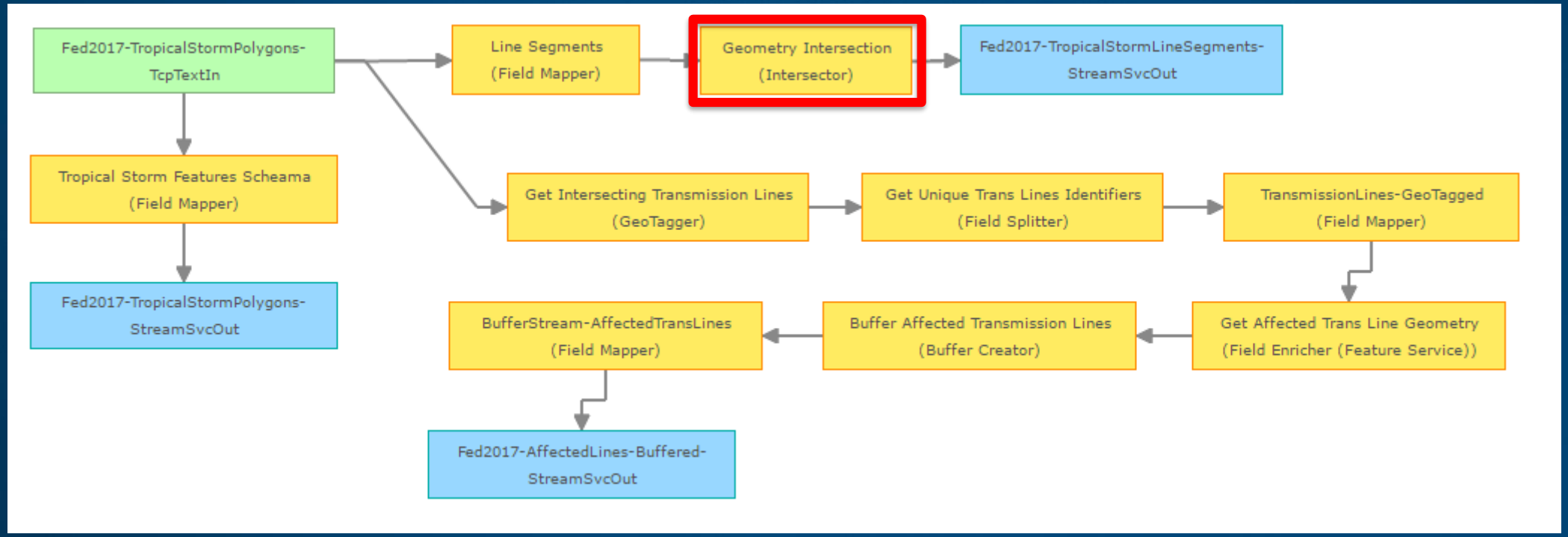
TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	-117.123…, 36.064…



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

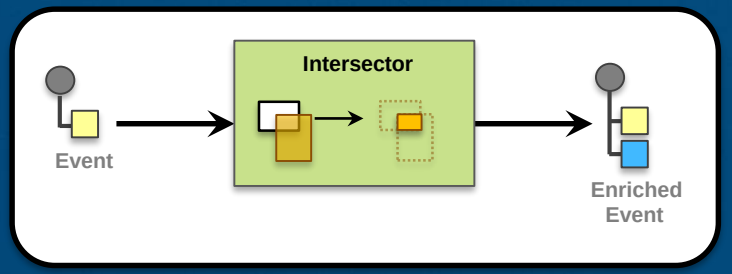
GeoEvent Service example



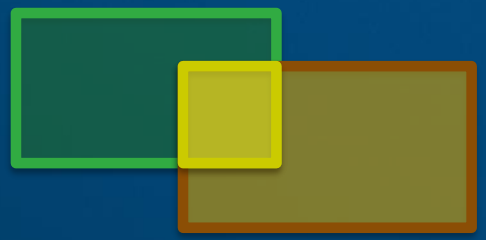
Intersector processor

- *Enrich the geometry of a GeoEvent*
  - generate a geometry representing the intersection between a geofence and a GeoEvent's geometry and either:
    - enriches the GeoEvent with a new geometry field representing the intersection result
    - or replaces the geometry of the incoming GeoEvent with the new geometry

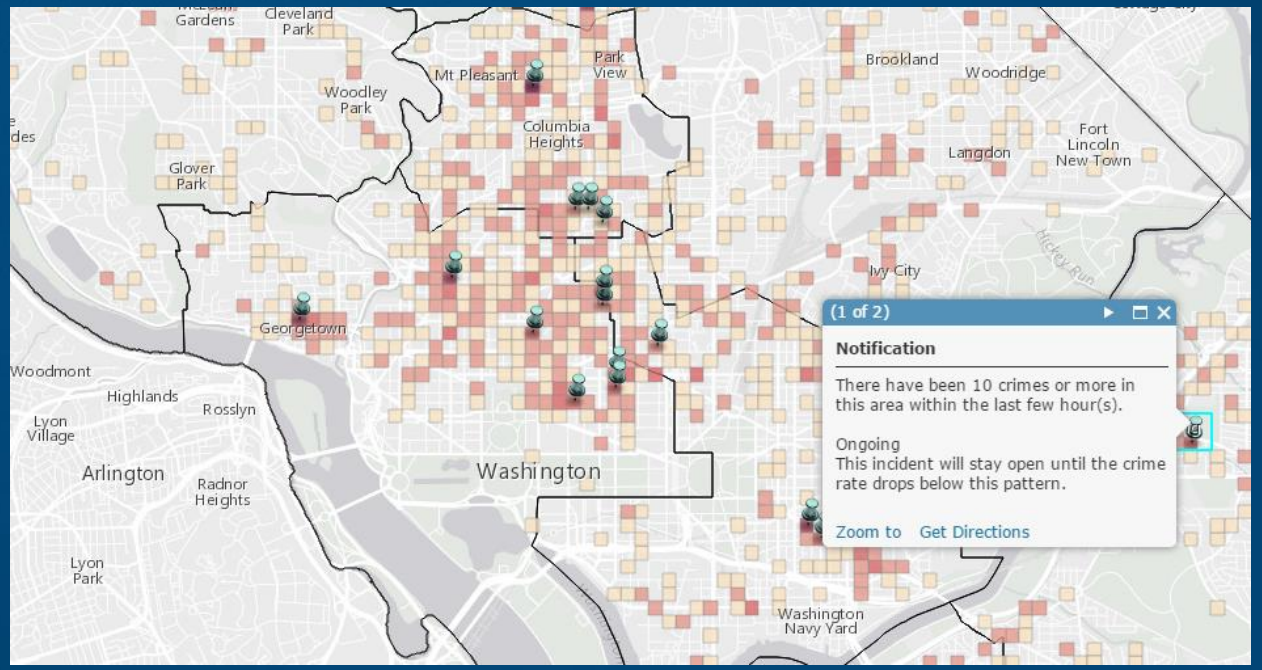
TrackID	S90909
Date	1405176845553
BatteryLevel	High
Distance	0.2
geometry	rings" : [[[-114.3175, 33.6703],[-114.3175, 33.6703]…]]



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

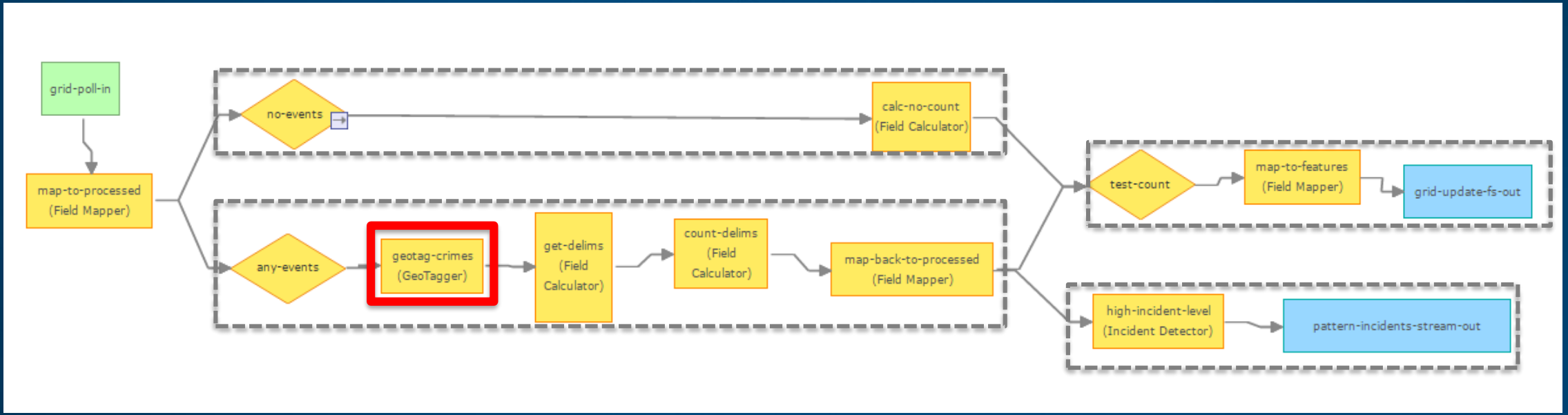


3 Finding Patterns in Data (demo)



Finding patterns in real-time data

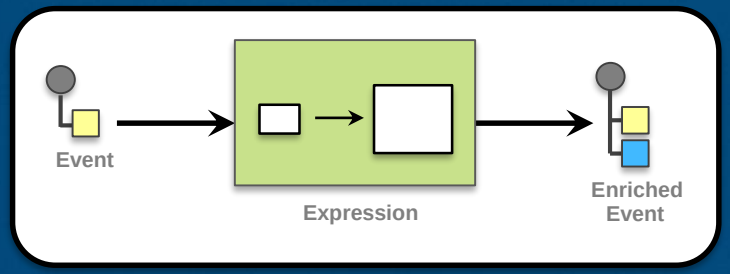
GeoEvent Service example



GeoTagger processor

- *Enrich a GeoEvent with geographic context*
  - uses a spatial expression to tag the event with related geometries.

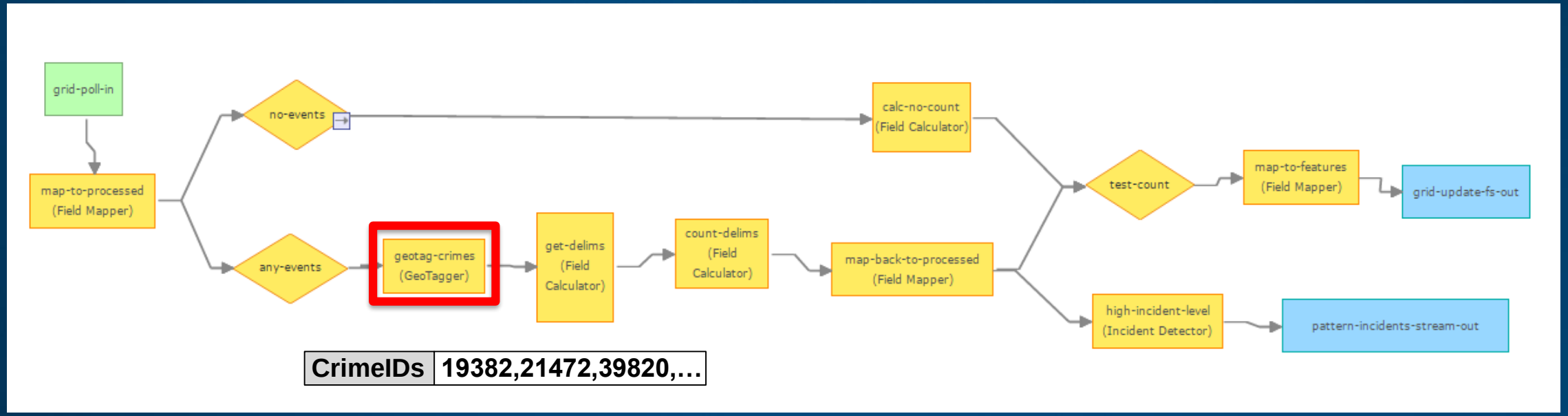
TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS

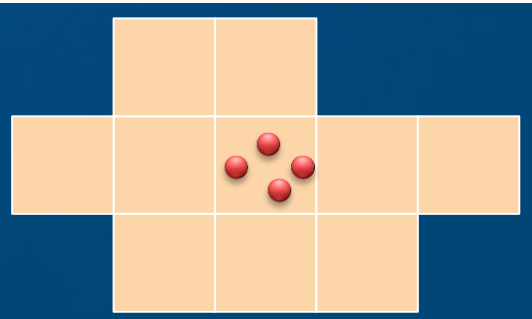


TrackID	J7890
Date	1405176845553
Sensor	2
BatteryLevel	Medium
Latitude	36.064
Longitude	-117.123
Distance	0.01
DurationMin	1.03
SpeedMPH	0.62
CourseDeg	250.0
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS
IsInside	Temecula gangland

Finding patterns in real-time data

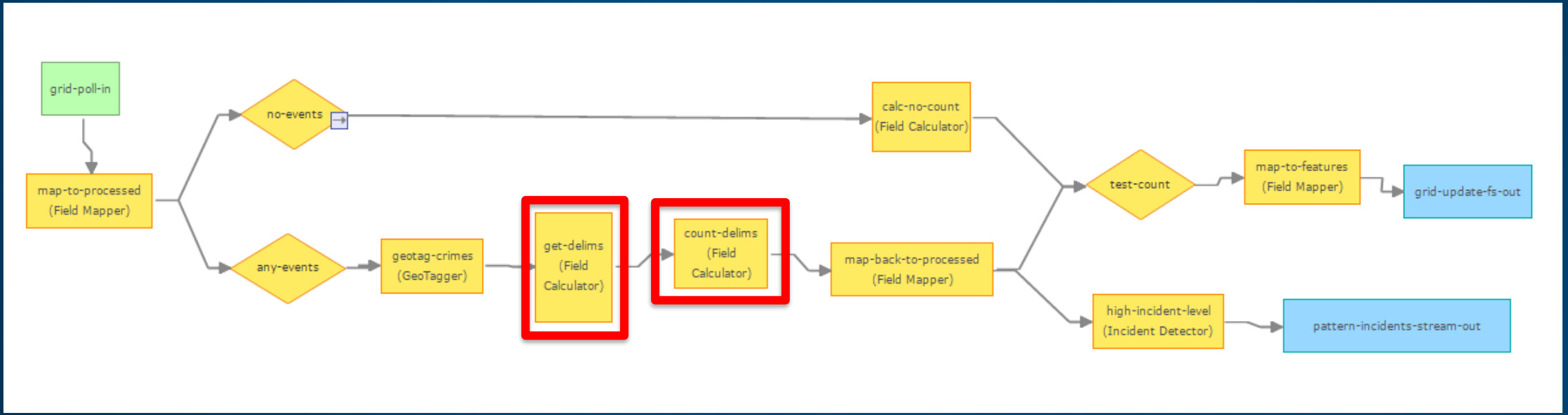
GeoEvent Service example





Finding patterns in your real-time data

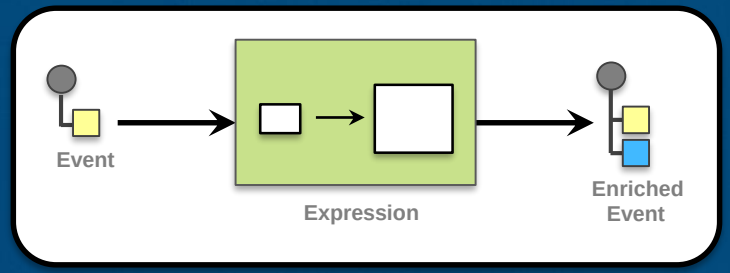
GeoEvent Service example



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 regular expressions.

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



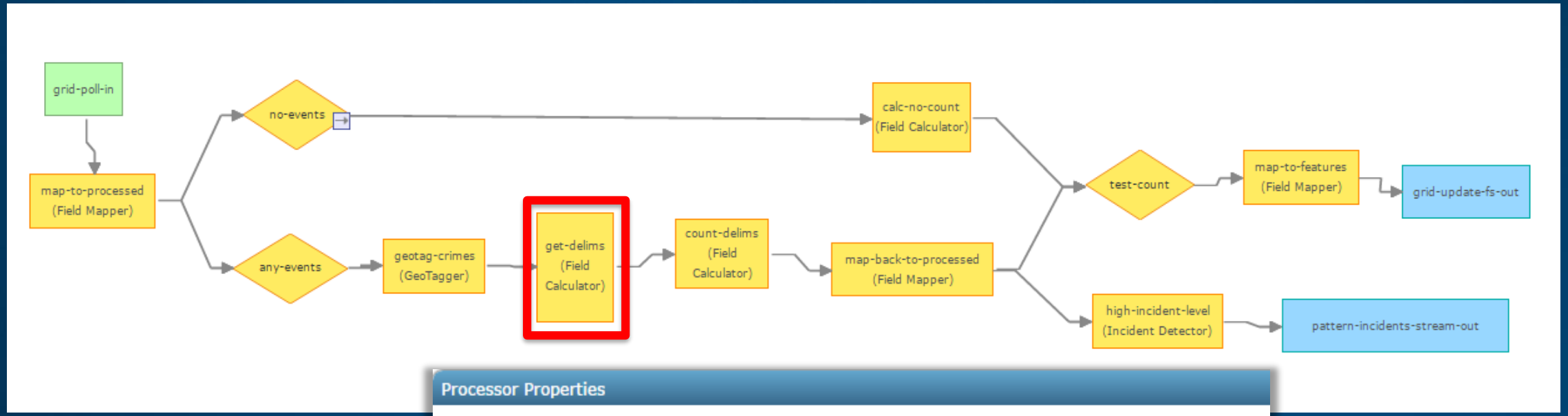
Convert from Feet to Miles Expression:

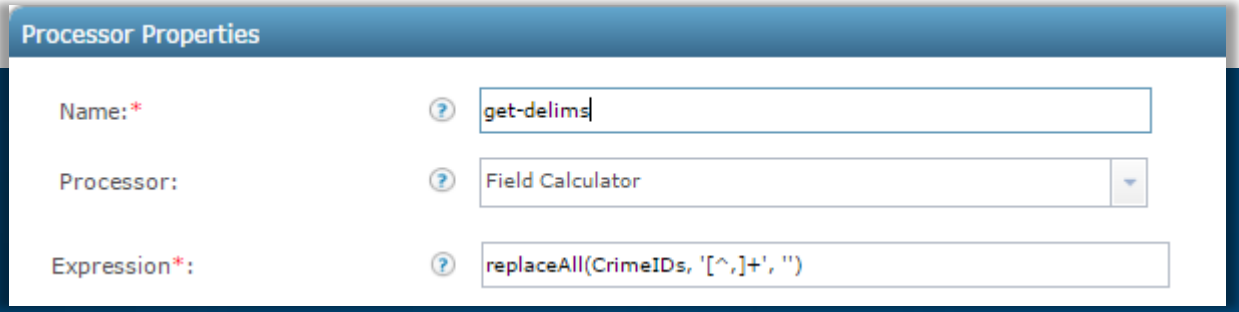
Distance / 5280

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

Finding patterns in your real-time data

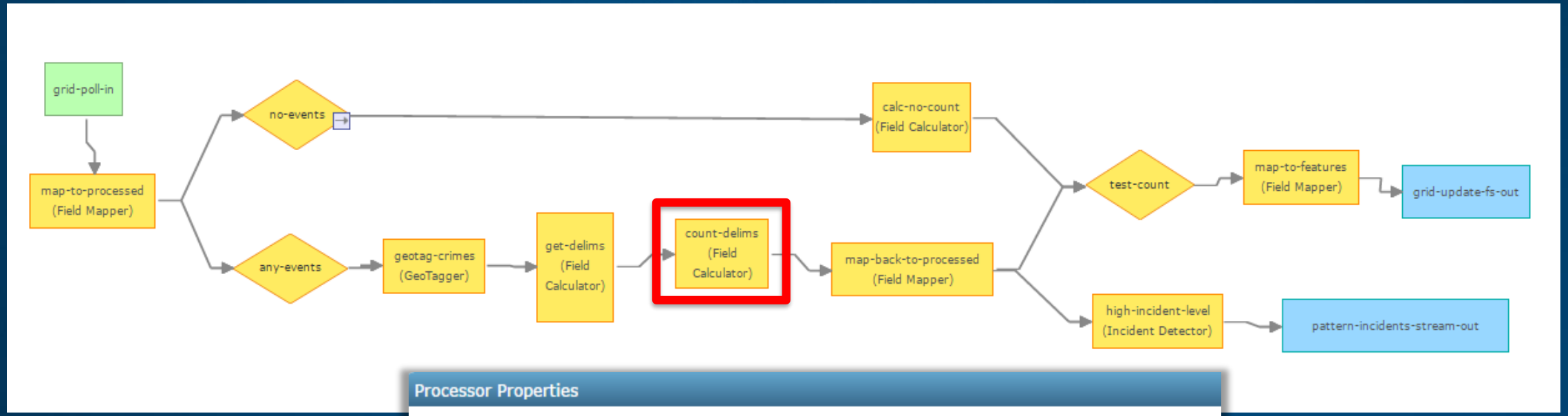
GeoEvent Service example

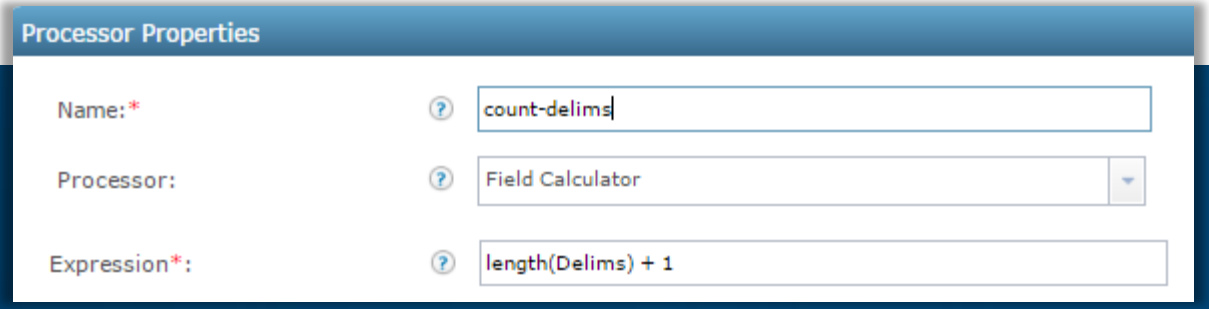




Finding patterns in your real-time data

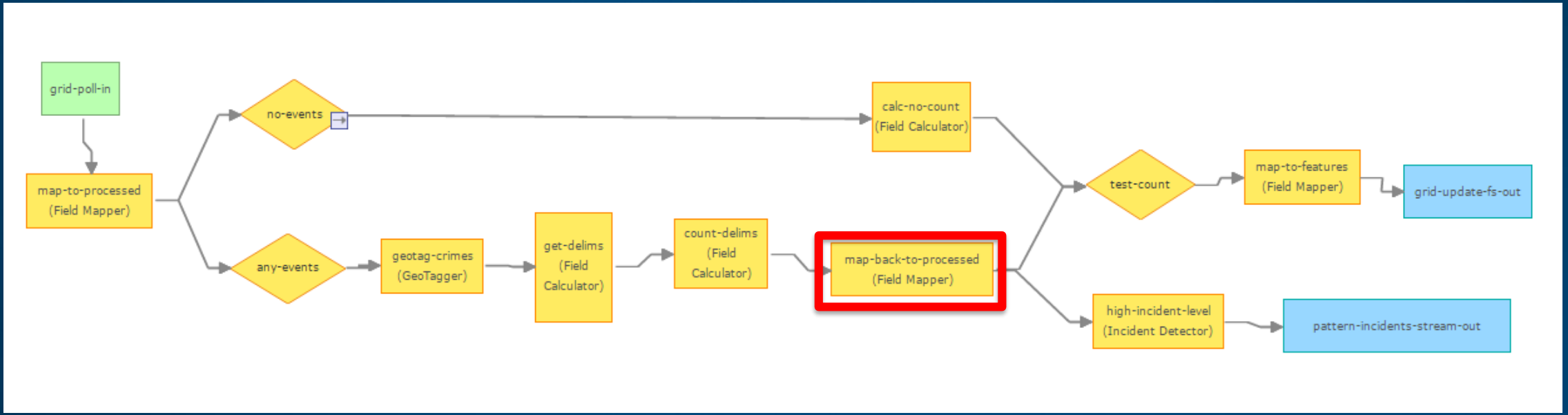
GeoEvent Service example





Finding patterns in your real-time data

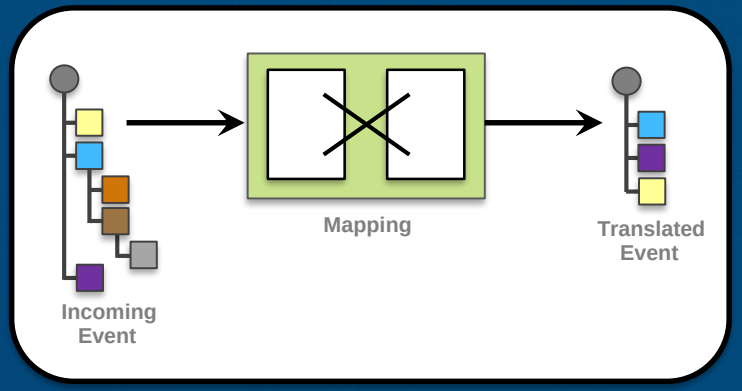
GeoEvent Service example



Field Mapper processor

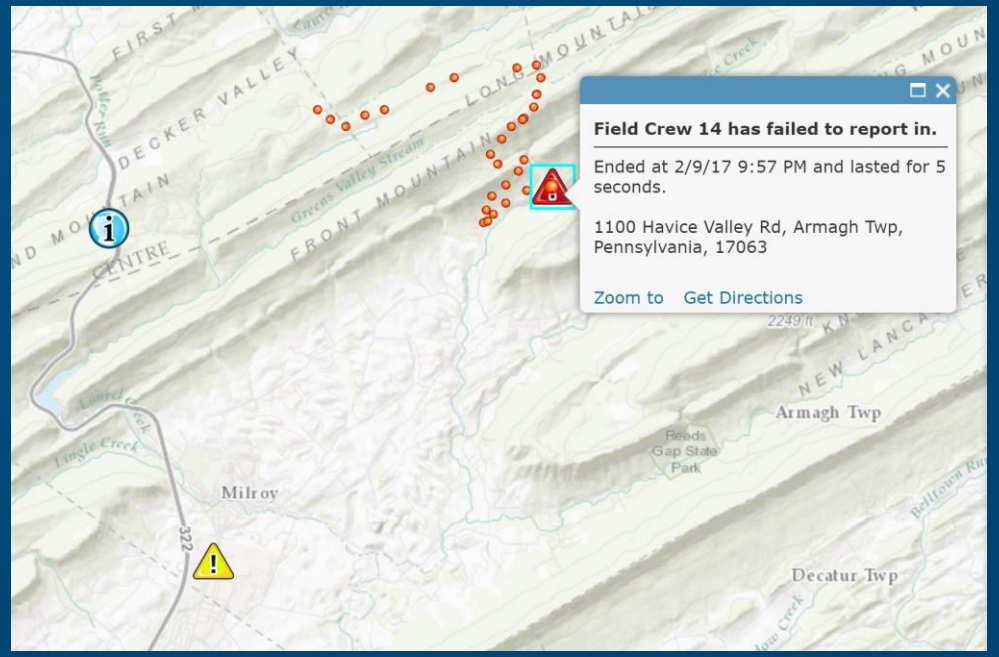
- *Adjust the format of a GeoEvent*
  - Translates from one GeoEvent Definition to another
  - Specifies how fields map across the GeoEvent Definitions

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

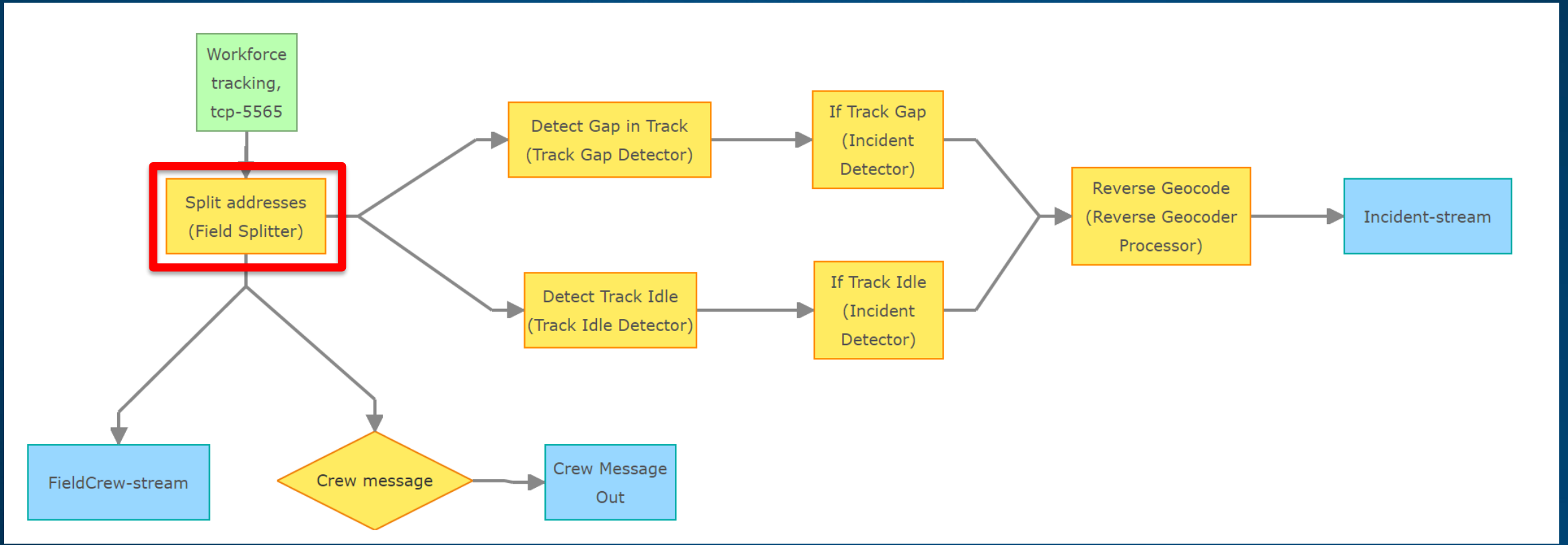


TrackID	J7890
Date	1405176845553
Geometry	-117.123…, 36.064…
Category	AnkleBraceletGPS

4 Workforce Tracking (demo)



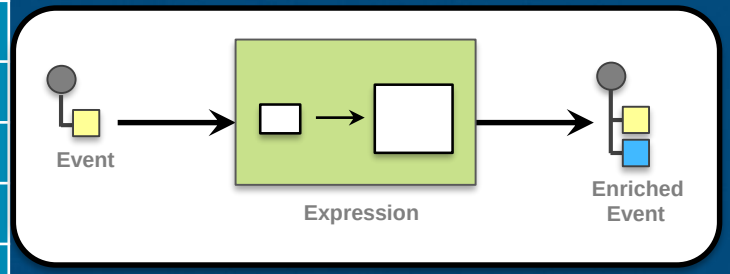
Field Splitter



Field Splitter processor

- *Splits multi-value fields into multiple GeoEvents*
- Field values can be
  - delimited values
  - multicardinal values

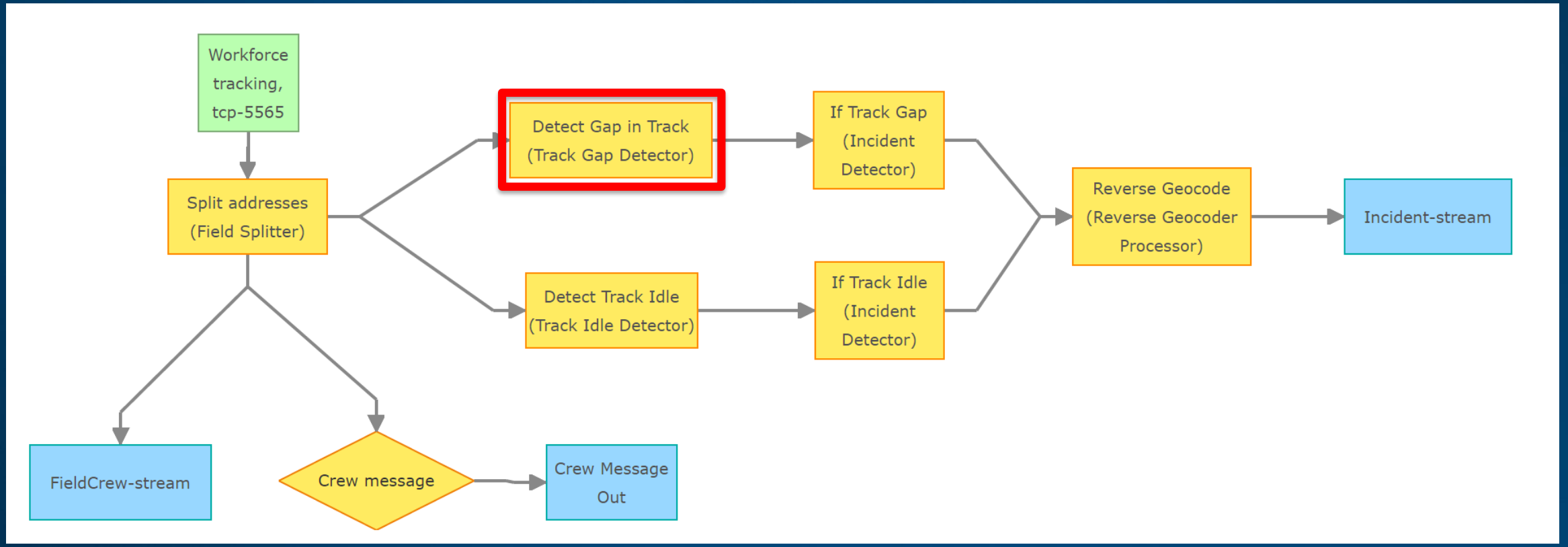
TrackID	V10987
Date	1405176845553
BatteryLevel	Low
messageCode	1
freeText	“stopped for fuel and lunch”
Addresses	“5712940342, admin@inspections.com"
geometry	-117.123…, 36.064…



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

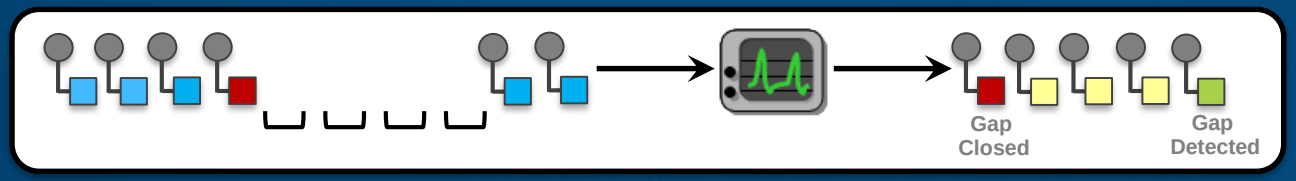
TrackID	V10987
Date	1405176845553
BatteryLevel	Low
messageCode	1
freeText	“stopped for fuel and lunch”
Addresses	“admin@inspections.com”
geometry	-117.123…, 36.064…

Track Gap Detector



Track Gap Detector processor

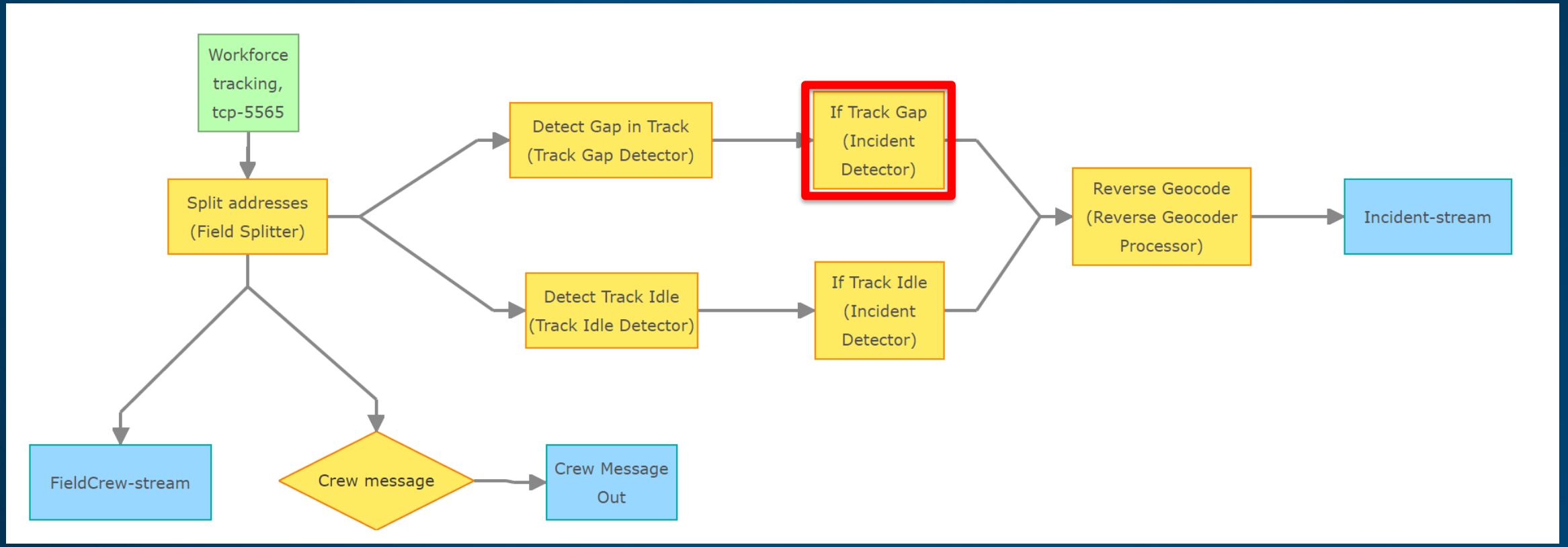
- *Notify about the absence of events*
  - Detects the absence of events and alerts about the situation.



TrackID	V10987
Date	1405176945553
Geometry	-117.123…, 36.064…

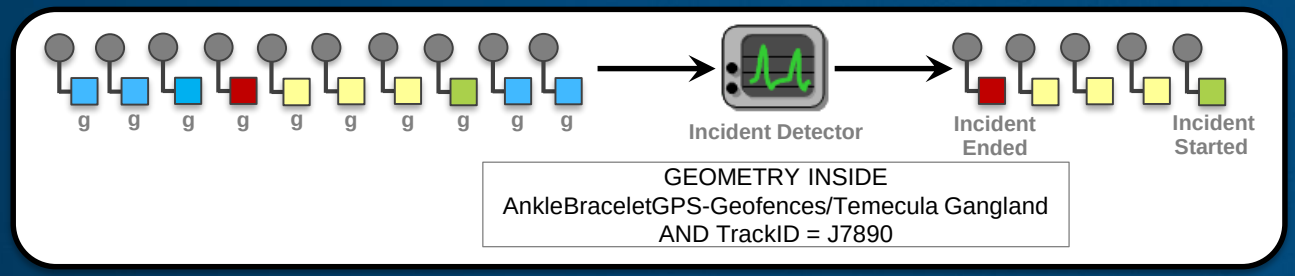
trackId	V10987
gap	false
lastReceived	1405176915553
geometry	-117.123…, 36.064…

Incident Detector



Incident Detector Processor

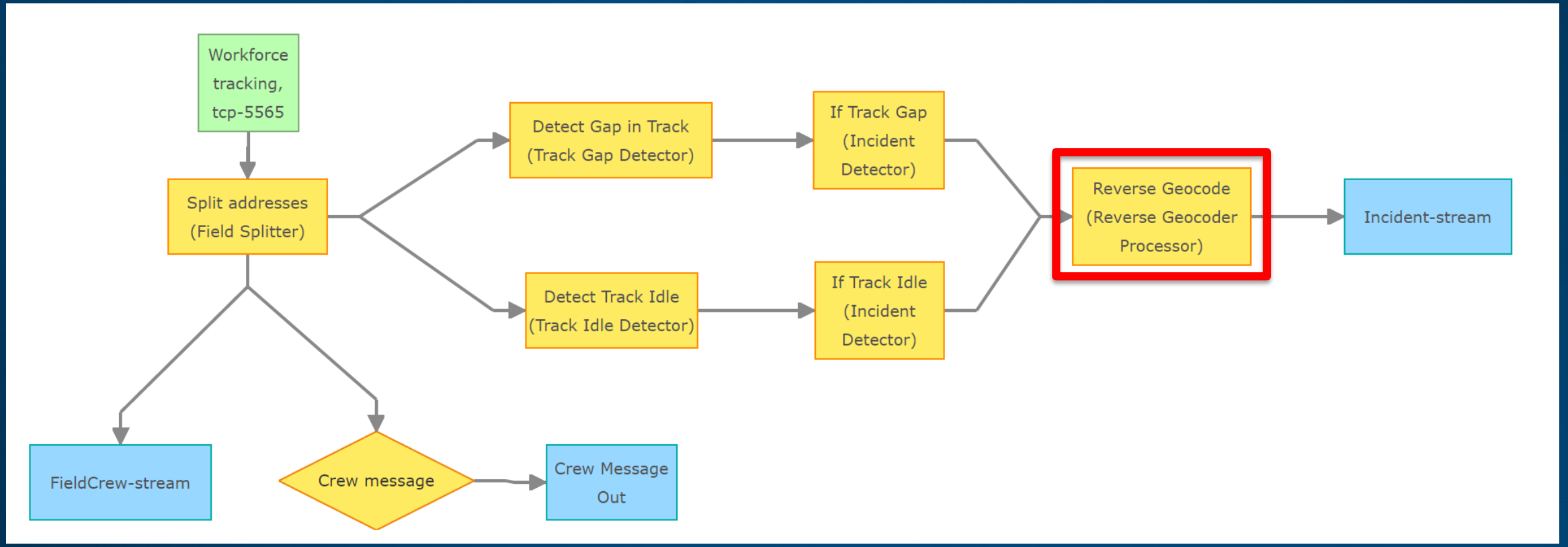
- *Notify about a pattern of interest*
- creates an Incident upon an opening expression being met,
  - maintains state for the duration of an incident,
  - closes the incident based on a closing expression, or expiration.



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	

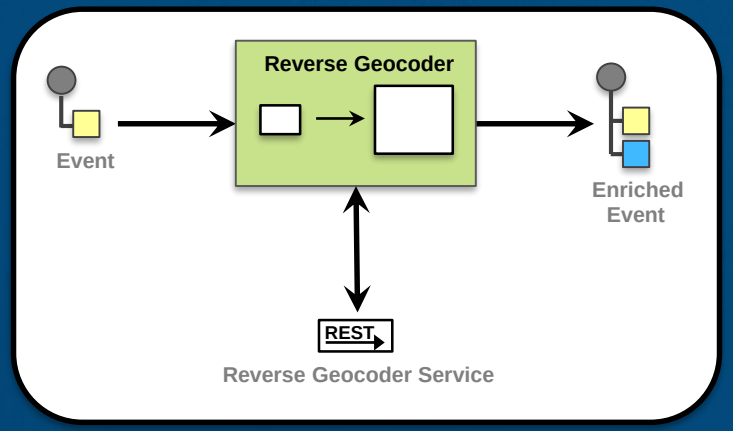
Reverse Geocoder Processor



Custom Component: Reverse Geocoder processor

- *Enrich a GeoEvent with the nearest street address*
  - Uses a point geometry on the incoming GeoEvent to perform a reverse geocode
  - and enriches the GeoEvent with new field(s) representing matched address.

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
Neighborhood	
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

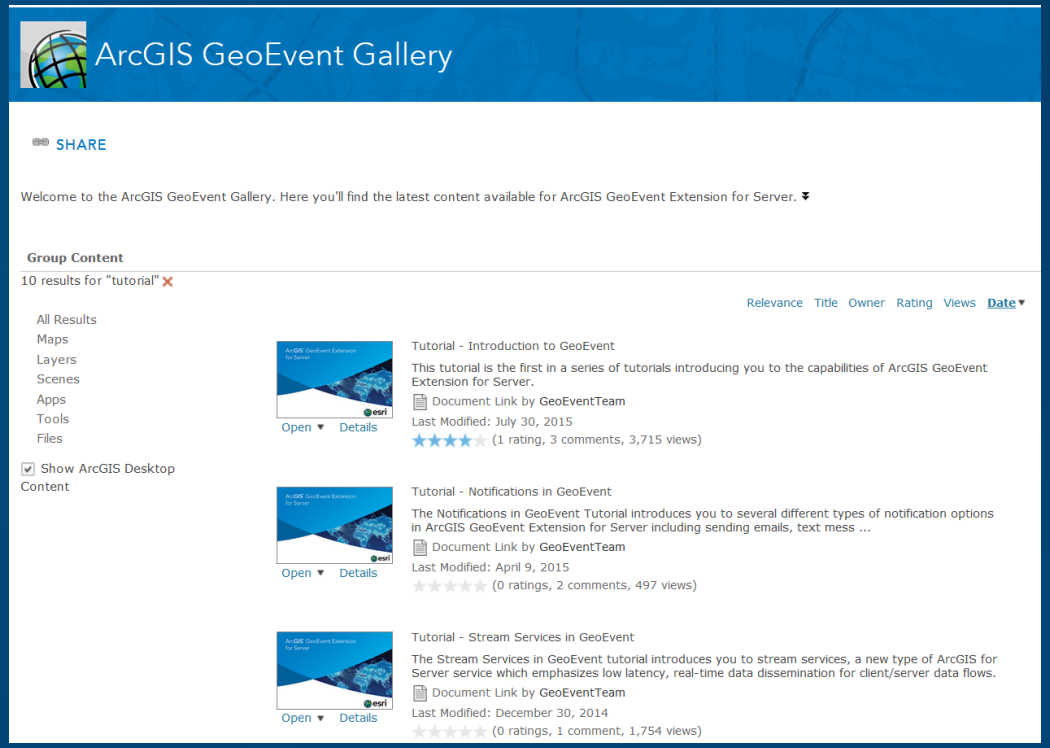
Summary

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**

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



Real-Time & Big Data GIS

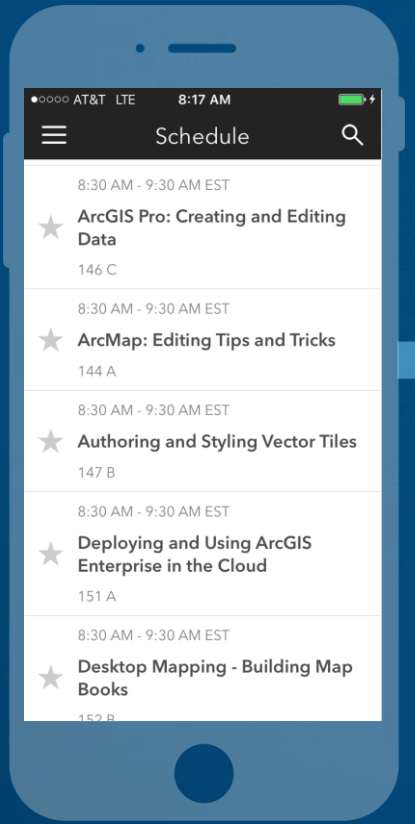
other sessions

• **Applying Real-Time Analytics**	Mon, 1:45pm-2:45pm, Room 147B Tue, 11:00am-12:00pm, Room 151B
• **Leveraging the Spatiotemporal Big Data Store**	Mon, 3:00pm-4:00pm, Room 147B Tue, 1:30pm-2:30pm, Room 151B
• **ArcGIS GeoAnalytics: Intro to Big Data Feature Analytics**	Mon, 4:15pm-5:15pm, Room 147B Tue, 2:45pm-3:45pm, Room 147A
• **Leveraging Stream Services**	Tue, 2:45pm-3:45pm, Room 151A
• **ArcGIS GeoEvent Server: Best Practices**	Tue, 4:00pm-5:00pm, Room 151A
• **Real-Time & Big Data GIS at a Massive Scale**	Tue, 5:15pm-6:15pm, Room 151A

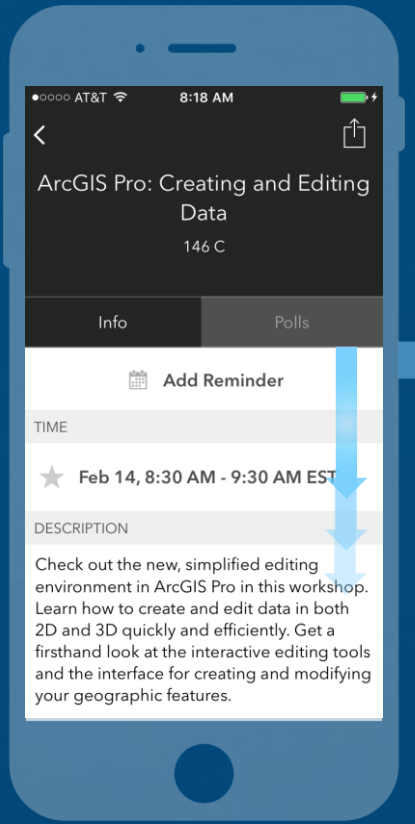
Please Take Our Survey on the **Esri Events App!**

Download the Esri Events app and find your event

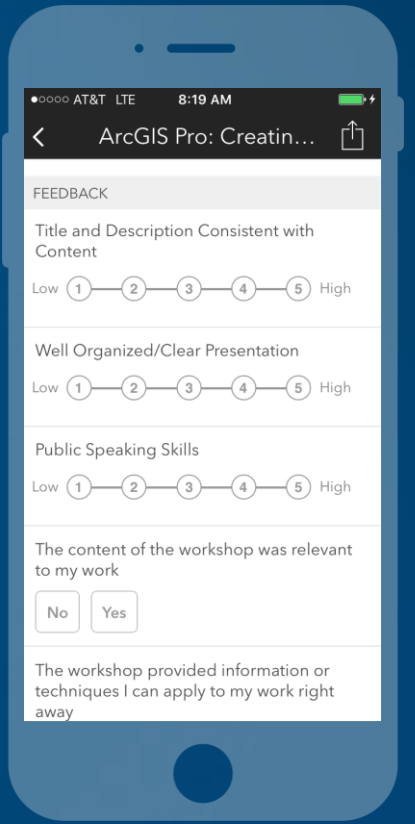
Select the session you attended



Scroll down to find the survey



Complete Answers and Select “Submit”



Print Your Certificate of Attendance

Print stations located in the 140 Concourse

Monday

12:30 PM – 6:30 PM

GIS Solutions Expo,
Hall B

5:15 PM – 6:30 PM

Expo Social,
Hall B

Tuesday

10:45 AM – 5:15 PM

GIS Solutions Expo,
Hall B

6:30 PM – 9:30 PM

Networking Reception,
Smithsonian National Air and Space Museum

Questions / Feedback?

Suzanne Foss
Real-Time & Big Data Product Engineer, Esri
sfoss@esri.com
@sfoss_esri

Ken Gorton
National Government Solution Engineer, Esri
kgorton@esri.com