



GENIVI®

Open Source Big Data Management for Connected Vehicles

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Agenda

- GENIVI-Las Vegas Connected Vehicle Pilot
- Key Use Cases
- Data Flow
- Solution Architecture
- Open Source Data Management for Connected Vehicles
- Application Walk-Through
- Project Challenges and Lessons Learned
- Q & A

GENIVI-Las Vegas Connected Vehicle Pilot

Key Objectives



Press Release

FOR IMMEDIATE RELEASE

The GENIVI Alliance and Nevada Center for Advanced Mobility Partner for In-Vehicle Communication Pilot Project to Increase Awareness for Pedestrian Safety and Assist Traffic Flow in Las Vegas

In-Vehicle Communications Technology to be Deployed to Help Improve Vehicle-to-Pedestrian Awareness on High-Traffic and Multi-Modal Corridors

The Case for Change

- In 2016, the State of Nevada saw 213 vehicle, bicycle & pedestrian fatalities
 - 5% increase from 2015
- Approximately 50% of incidents occur midblock, not within marked crosswalks
- In March 2016, Nevada Department of Transportation launched awareness program to improve pedestrian safety
- Critical strategies identified to reduce pedestrian fatalities:
 - Reduce speeds along corridors with high pedestrian activity
 - Reduce pedestrian exposure while crossing street
 - Deploy pedestrian safety awareness campaigns
- City of Las Vegas pilot focuses on implementing these strategies

4 Pilot Use Cases

	Use Case	Description
UC1	Speeding warning	Display IVI warning to drivers exceeding current speed limit, lowering risk of pedestrian strikes
UC2	High-risk pedestrian area warning	Using the vehicle's position and time of day, display IVI warning when vehicle nearing area known to be high risk for pedestrians
UC3	Bus stop warning	Display IVI warning that a bus is stopped at a nearby bus stop, preventing potential accidents
UC4	Traffic jam warning	Collect data from stopped vehicles to determine potential jam, display IVI warning to approaching drivers, reduce chance of rear-end collisions

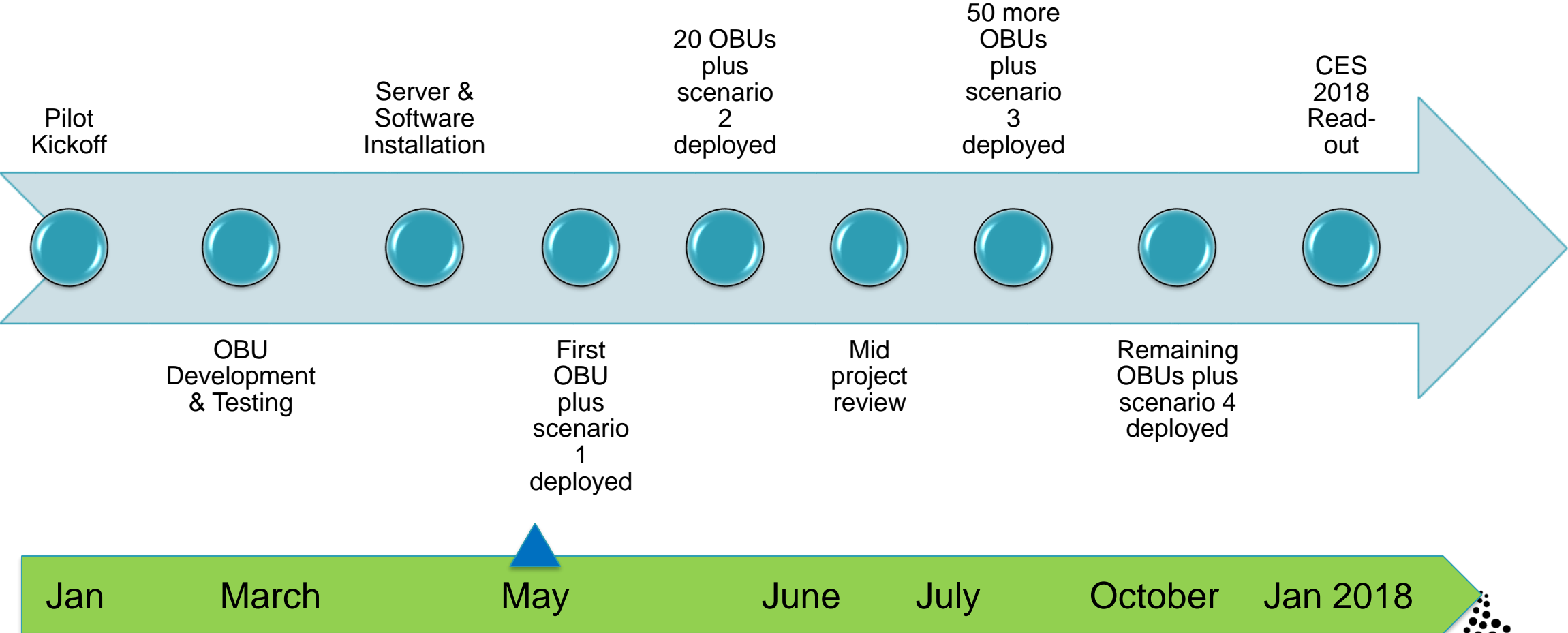
Key Measures of Success

- ✓ Using vehicle speed data, determine if drivers slow down in response to warnings. Measure and report success rates
- ✓ Gather qualitative feedback from drivers through interviews, surveys and in-car video



City of Las
Vegas Pilot

Pilot Status



OBU = On-board unit



GENIVI – Las Vegas Connected Vehicle Pilot Data Flow



CONNECTED VEHICLE

1. On-board units running GENIVI open source software gather and transmit fleet vehicle location/speed across a mobile network.

GENIVI RVI SERVER

2. City-hosted server running GENIVI Remote Vehicle Interaction(RVI) software receives vehicle data and serves as a data source for further analysis.

BIG DATA SERVERS

3. City-hosted servers running Hortonworks software combine vehicle data with other data provided by the city/region including bus stop locations and bus status. Certain data combinations result in actionable messages sent back to the vehicle via the RVI server.

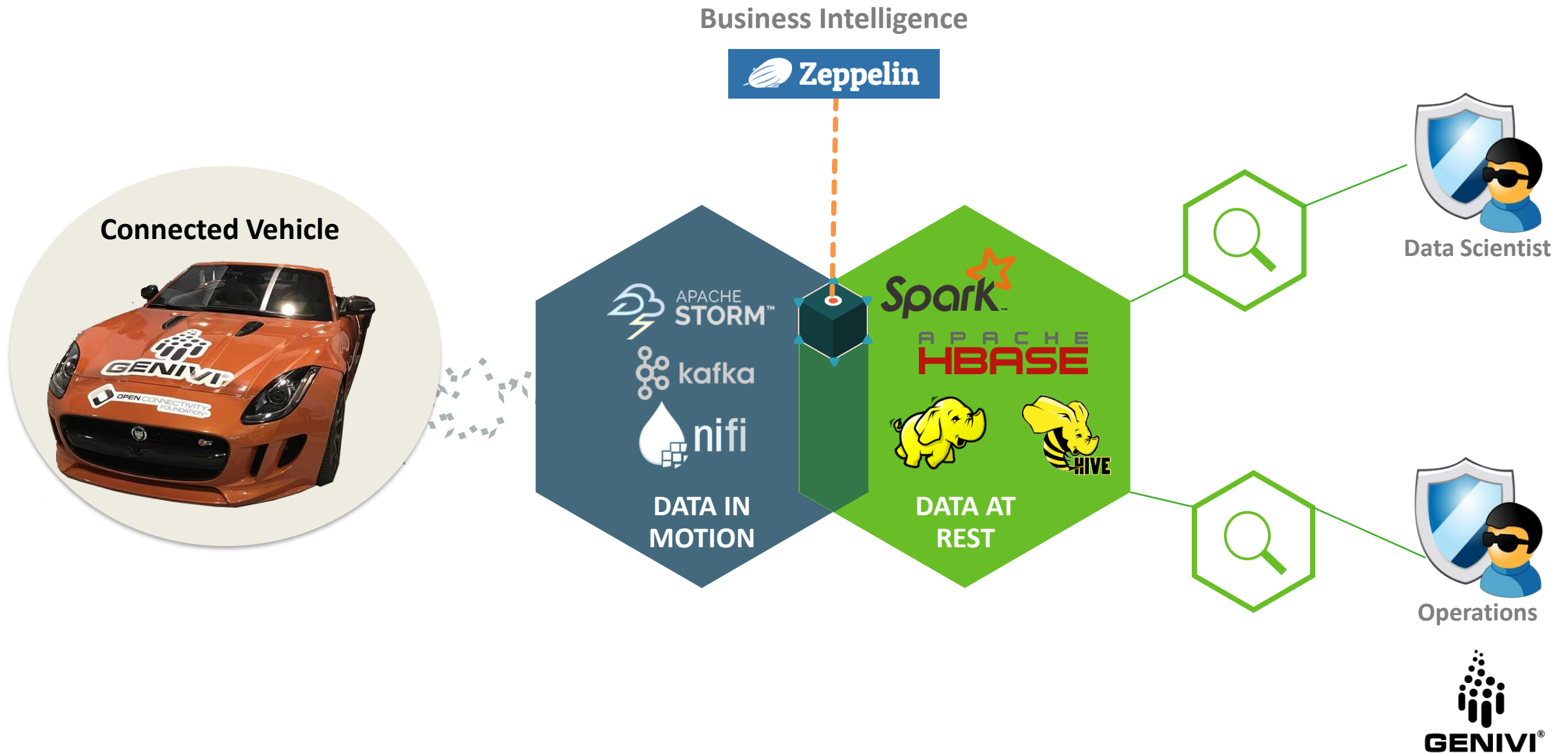
DRIVER AWARENESS

4. Actionable messages are displayed on the on-board units to increase driver awareness of upcoming pedestrian traffic.

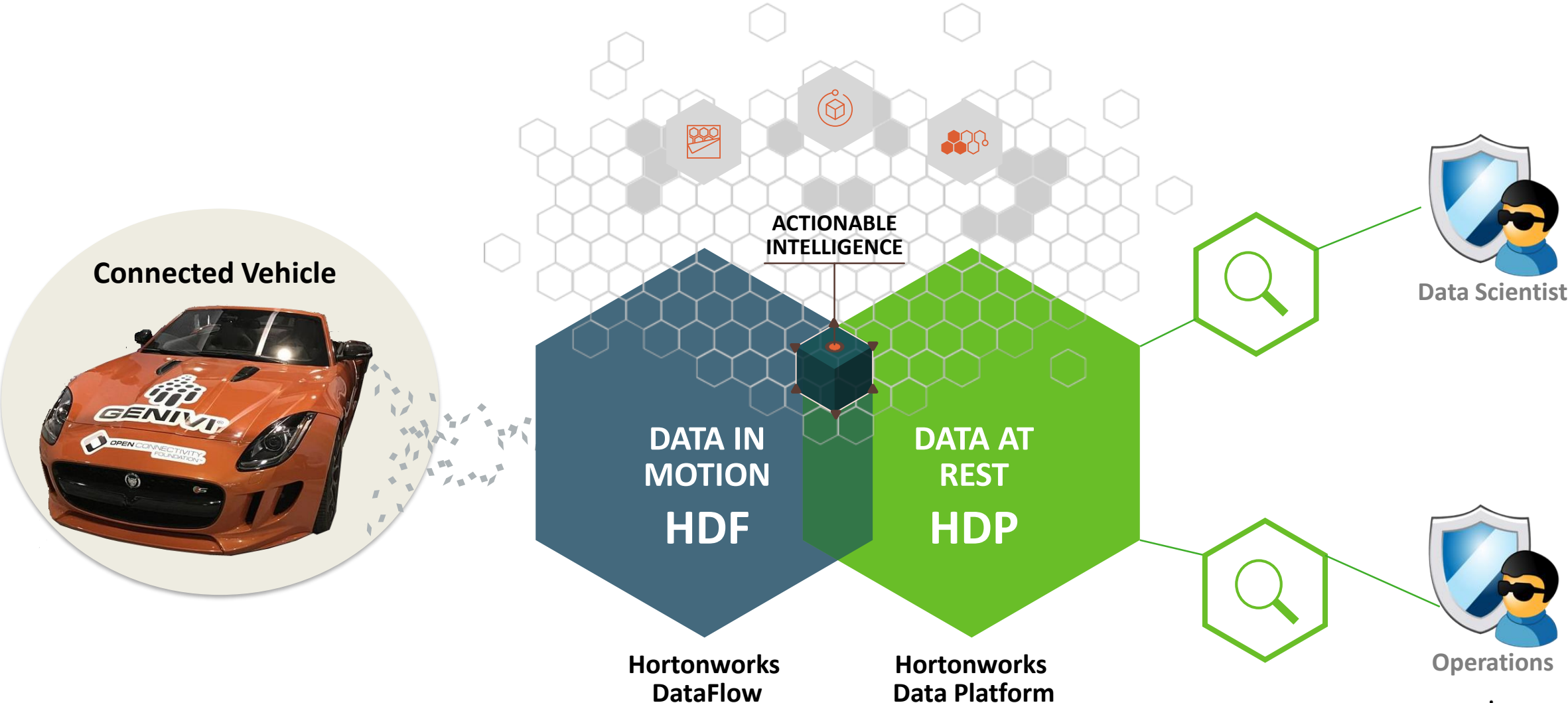
DATA ANALYTICS

5. Data is archived so that analytics and visualization tools can be used for future planning by the city/region.

Open Source Data Management for Connected Vehicles



Hortonworks Connected Data Platform



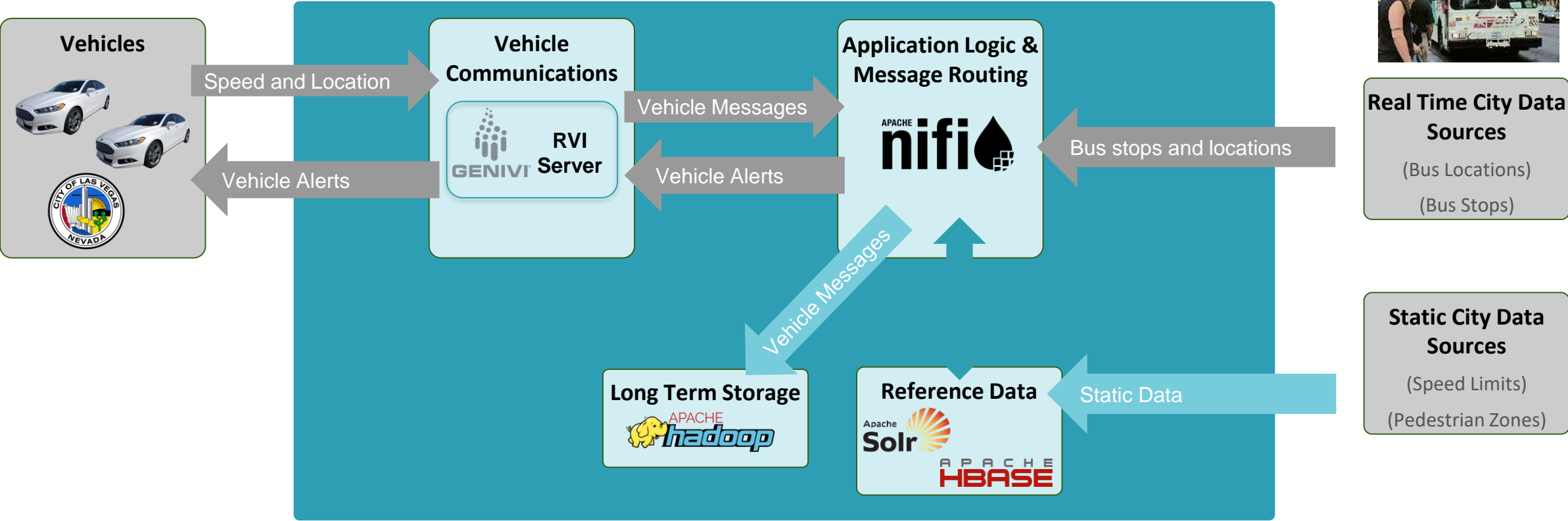
Tested, Certified and Supported Distribution of Open Source Components



Solution Walk Through



City of Las Vegas - System Architecture



Hortonworks DataFlow V 2.1
Hortonworks Data Platform V 2.5



Real Time City Data Sources
 (Bus Locations)
 (Bus Stops)

Static City Data Sources
 (Speed Limits)
 (Pedestrian Zones)



Navigate

City of Las Vegas
Process Group
d8ca2fe1-015b-1000-1232-6e9836e41370

DELETED

1. Receive Vehicle Data

Receive Vehicle Data

Queued	0 (0 bytes)
In	0 (0 bytes) → 0 5 min
Read/Write	0 bytes / 0 bytes 5 min
Out	3 → 0 (0 bytes) 5 min

UC1 Speeding Warning

Check Speeding warning

Queued	0 (0 bytes)
In	0 (0 bytes) → 1 5 min
Read/Write	0 bytes / 0 bytes 5 min
Out	1 → 0 (0 bytes) 5 min

UC2 High-Risk Pedestrian Area

UC2 High-risk pedestrian area warning

Queued	0 (0 bytes)
In	0 (0 bytes) → 1 5 min
Read/Write	0 bytes / 0 bytes 5 min
Out	1 → 0 (0 bytes) 5 min

UC3 Bus Stop Warning

UC3 Bus stop warning

Queued	0 (0 bytes)
In	0 (0 bytes) → 1 5 min
Read/Write	0 bytes / 0 bytes 5 min
Out	1 → 0 (0 bytes) 5 min

2. Process Use Cases

From Check Speeding warning
To Receive RVI Data
Queued 0 (0 bytes)

From UC2 High-risk pedestrian area warning
To Receive RVI Data
Queued 0 (0 bytes)

From UC3 Bus stop warning
To Receive RVI Data
Queued 0 (0 bytes)

From Warn Driver Speed
To Receive Warning
Queued 0 (0 bytes)

From Warn Driver of High Ri...
To Receive Warning
Queued 0 (0 bytes)

From Post Warning to Driver
To Receive Warning
Queued 0 (0 bytes)

Warn Driver

Queued	0 (0 bytes)
In	0 (0 bytes) → 1 5 min
Read/Write	0 bytes / 0 bytes 5 min
Out	0 → 0 (0 bytes) 5 min

3. Warn Driver

Navigate

Search, Home, Back, Forward icons

Operate

Receive Vehicle Data
Process Group
de77560c-015b-1000-6f9b-3579589b154d

Settings, Refresh, Stop, Play, Pause, Delete icons

1. Receive Vehicle Data (ListenHTTP)

Receive RVI Data ListenHTTP		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

2. Fork Data

Route obd or gps Data RouteOnContent		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

MergeContent MergeContent		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

3a. Extract GPS Data

Extract GPS Coordinates EvaluateJsonPath		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

3b. Extract Vehicle Data

Extract OBD Coordinates EvaluateJsonPath		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

PutHDFS PutHDFS		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

6. Store in Hadoop

Format Vehicle Data UpdateAttribute		
In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

4. Reformat for each use case

5. Output Data to Use Cases

Check Speeding war...

To UC1

UC2 High-risk pedestrian area...

To UC2

UC3 Bus stop warning

To UC3

UC1 – Speed Warning

Navigate

Operate

Check Speeding warning
Process Group
e8337aac-015b-1000-9b55-575a3008b33a

DELETED

Receive RVI Data

1. Receive UC1 RVI Data (Location, Speed)

Queued 0 (0 bytes)

Build Speed Limit Geo Query
UpdateAttribute

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

2. Build location based Query

Name success
Queued 0 (0 bytes)

3. Query location for speed limit

Query Solr for street speed limit
InvokeHTTP

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

Name Response
Queued 0 (0 bytes)

Determine Speed Difference
EvaluateJsonPath

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

4. Calculate if speeding

Name matched
Queued 0 (0 bytes)

Warn Driver Speed

5. To Speed Warning

UC2 – High Risk Pedestrian Area

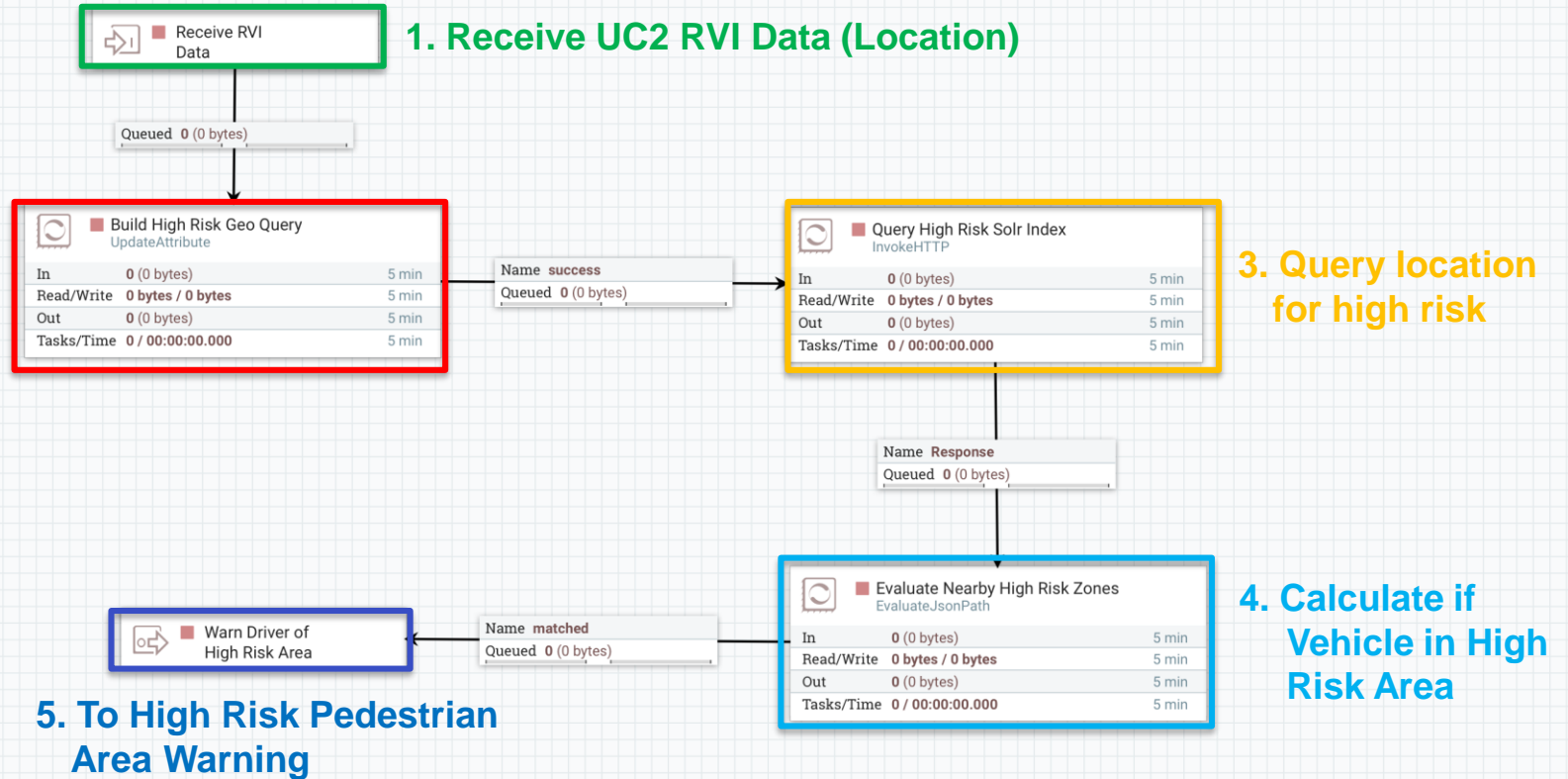
Navigate

Operate

UC2 High-risk pedestrian area w...
Process Group

e83b4bb3-015b-1000-9a7b-609a6fdaa0ab

2. Build location based Query



UC3 – Active Bus Stop Warning

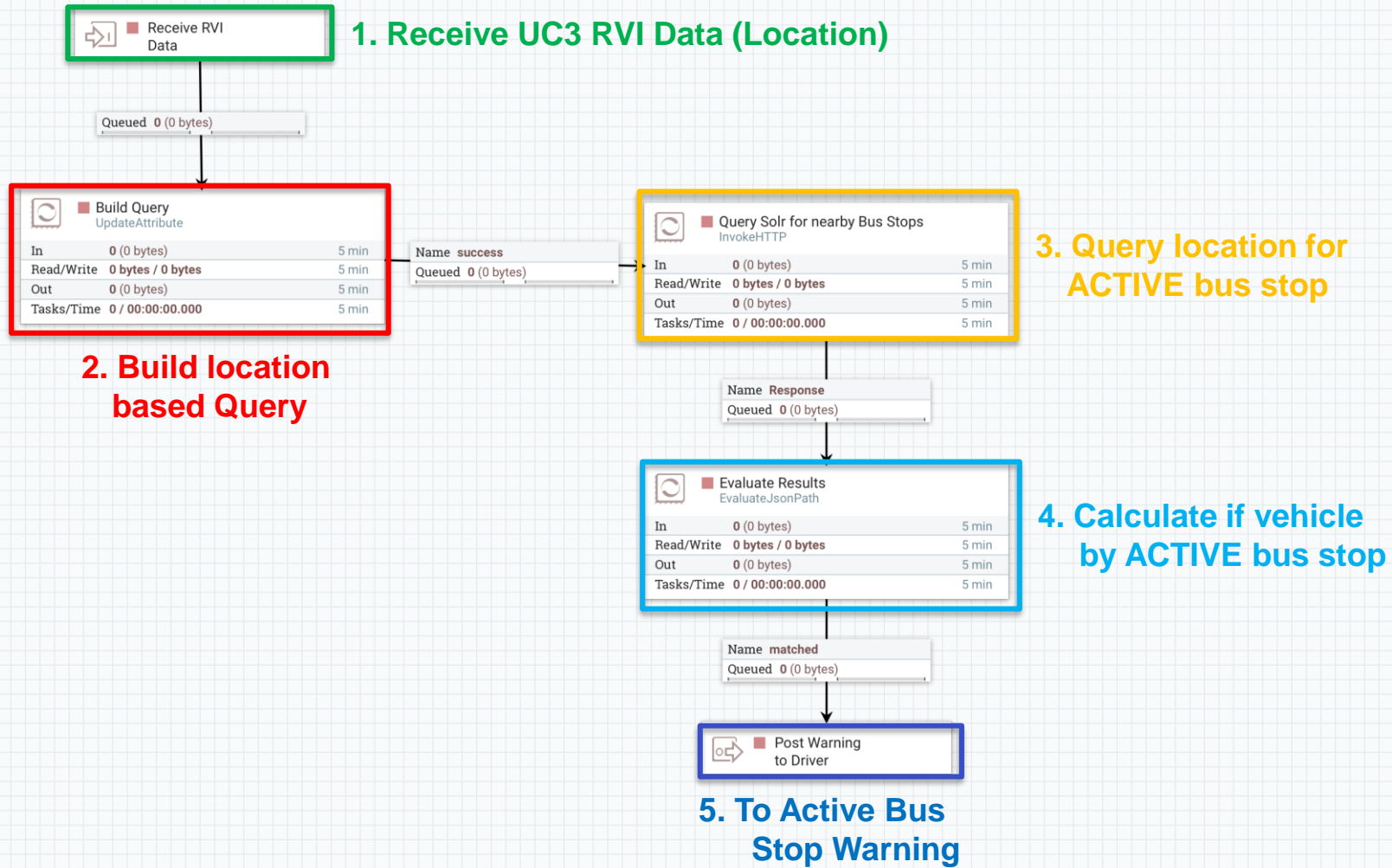
Navigate

Operate

UC3 Bus stop warning
Process Group

e83b2aef-015b-1000-0002-3526ebdc22b1

DELETED



Navigate

0 / 0 bytes

Operate

Warn Driver
Process Group

e853524f-015b-1000-65bd-f1a761af7c88

Settings | Stop | Start | Refresh | Delete

Receive Warning

Queued 0 (0 bytes)

1. Receive Warning

Extract Warning Type
EvaluateJsonPath

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

2. Determine Warning Type

Name matched

Queued 0 (0 bytes)

3. Build Warning Message

Build Warning Message
UpdateAttribute

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

Name success

Queued 0 (0 bytes)

Warn Driver
InvokeHTTP

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

4. Warn Driver

Name Original

Queued 0 (0 bytes)

5. Index Warnings By Driver

Index Driver Warning
PutSolrContentStream

In	0 (0 bytes)	5 min
Read/Write	0 bytes / 0 bytes	5 min
Out	0 (0 bytes)	5 min
Tasks/Time	0 / 00:00:00.000	5 min

Project Challenges and Lessons Learned

- Initial GENIVI JLR RVI POC (1 year ago), provided foundation for vehicle command and control
- Current pilot focused on communications, warnings and recommendations
- Capability Ramp-Up
 - Available infrastructure
 - Linux and Hadoop expertise
 - Distributed system knowledge
 - System configuration requirements
 - Roles and responsibilities
- Cloud solutions can help

Thank you!

Visit GENIVI at <http://www.genivi.org> or <http://projects.genivi.org>

Contact us: help@genivi.org

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