

DOCKETED

Docket Number:	17-MISC-02
Project Title:	Potential Areas of Natural Gas Research and Development for the Proposed Program Plan and Funding Request for 2017/18
TN #:	220085
Document Title:	GPS Excavation Enroachment Notification System (GPS EENS)
Description:	N/A
Filer:	Gina Fontanilla
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	7/7/2017 12:07:41 PM
Docketed Date:	7/7/2017



GPS Excavation Enroachment Notification System (GPS EENS)

Project: PIR-15-015

Natural Gas Infrastructure Safety and Integrity Workshop

July 07, 2017

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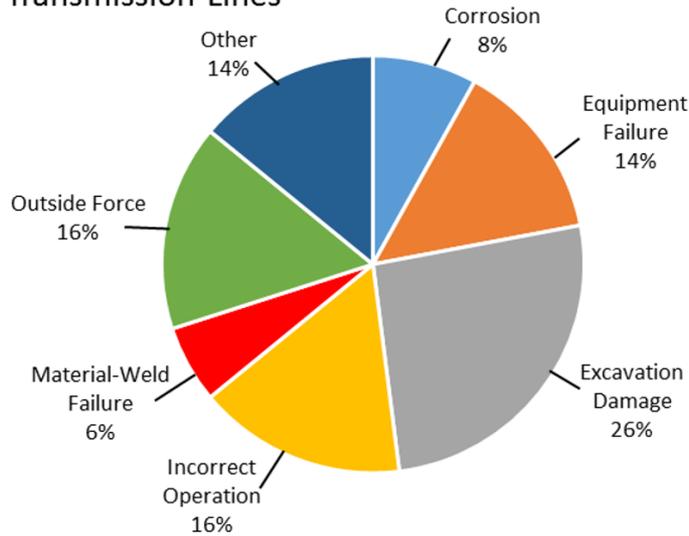
Robert Marros, PI

Gas Technology Institute

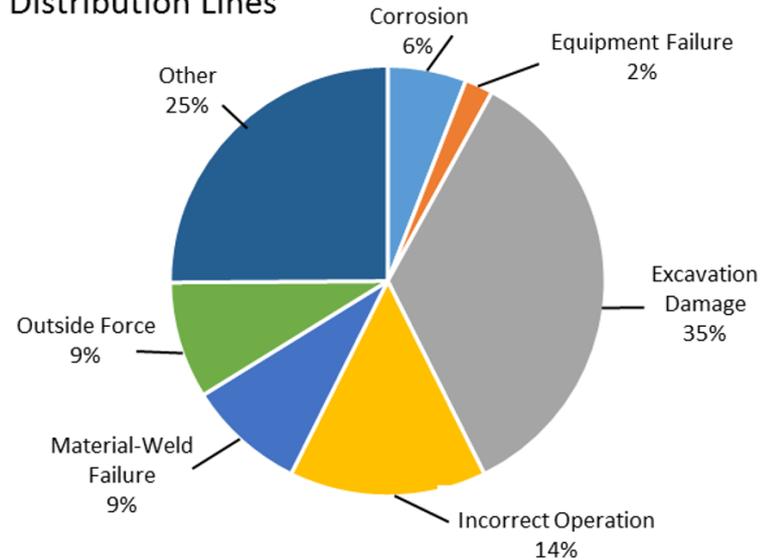


GPS Excavation Enroachment Notification System (GPS EENS)

Transmission Lines



Distribution Lines



- Excavation damage is the most leading cause of pipeline failure incidents

Source: PHMSA, National Pipeline Performance Measures, [2005-2016]
<https://phmsa.dot.gov/pipeline/library/data-stats/performance-measures>



GPS Excavation Enroachment Notification System (GPS EENS)

Background

- There is no current system that provides situational awareness of the excavator location, operating status, asset maps, related 811 Calls, or Right of Way (ROW) boundaries in real-time to operating utilities for effective monitoring and decision making.
- This project will provide utility operators with accurate GPS locations and operational status of excavating equipment in relation to their facilities in real-time. GPS, in conjunction with communications and other sensors, will be installed on excavators to provide real-time location and operational status.



GPS Excavation Enroachment Notification System (GPS EENS)

Project Objectives

- Deploy multiple-sensor units on excavation equipment within the utility service territory as well as the system architecture to support it. Both traditional excavation equipment and agricultural equipment will be included.
- Configure and deploy an operations dashboard showing excavator location, operational state, and alerts in real time.
- Utilize the system architecture to enhance emergency response situational awareness by providing a mobile platform for accurate incident location, targeted alerts and communications, and near real-time access to GIS asset maps.



GPS Excavation Enroachment Notification System (GPS EENS)

Technical Advisory Committee (TAC) Members:

	SME	Company/Affiliation
1	Francois Rongere	Pacific Gas & Electric (PG&E)
2	Aaron Rezendez	Pacific Gas & Electric (PG&E)
3	David Feliciano	Pacific Gas & Electric (PG&E)
4	Edward Newton	Southern California Gas Company (SoCal)
5	Rexford Cullen	Southern California Gas Company (SoCal)
6	James Merritt	U.S. DOT, PHMSA
7	Maureen Droessler	Operations Technology Development (OTD)
8	Thomas Young	CA CGA, SeeScan Inc.
9	Robert Smith	DigAlert , Southern CA

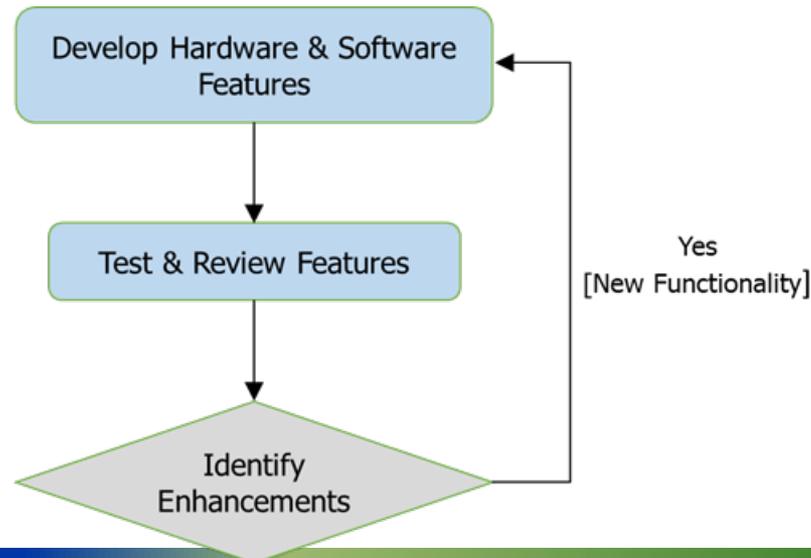


GPS Excavation Enroachment Notification System (GPS EENS)

Excavator Hardware Device

Utilize an Agile Process Management in the development of the hardware and software of the GPS-EEN System.

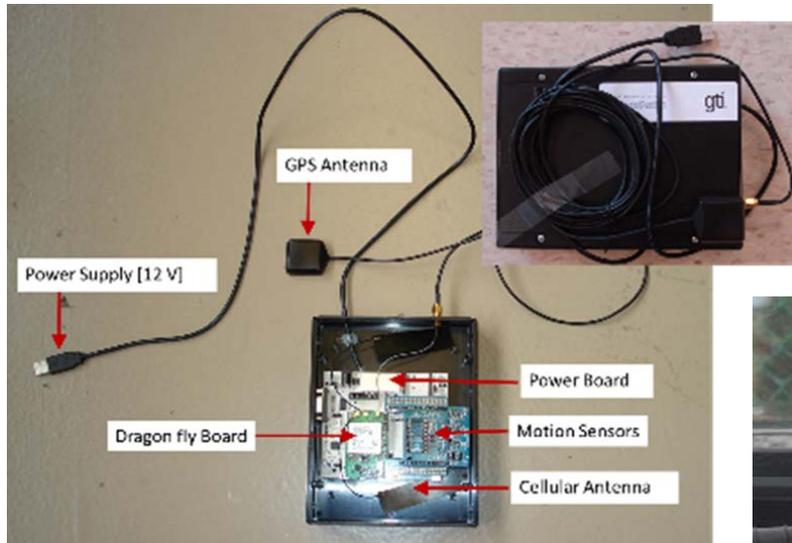
The process is an incremental method of managing the design of the system incorporating stakeholders feedback in staged development.





GPS Excavation Enroachment Notification System (GPS EENS)

Excavator Hardware Device



Prototype 1

Prototype 2



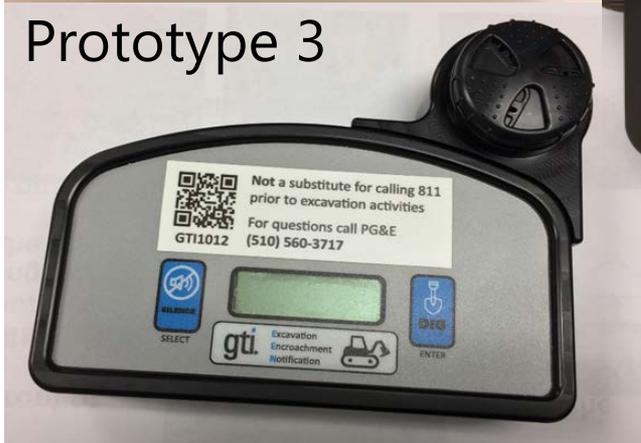


GPS Excavation Enroachment Notification System (GPS EENS)

Excavator Hardware Device



Prototype 3



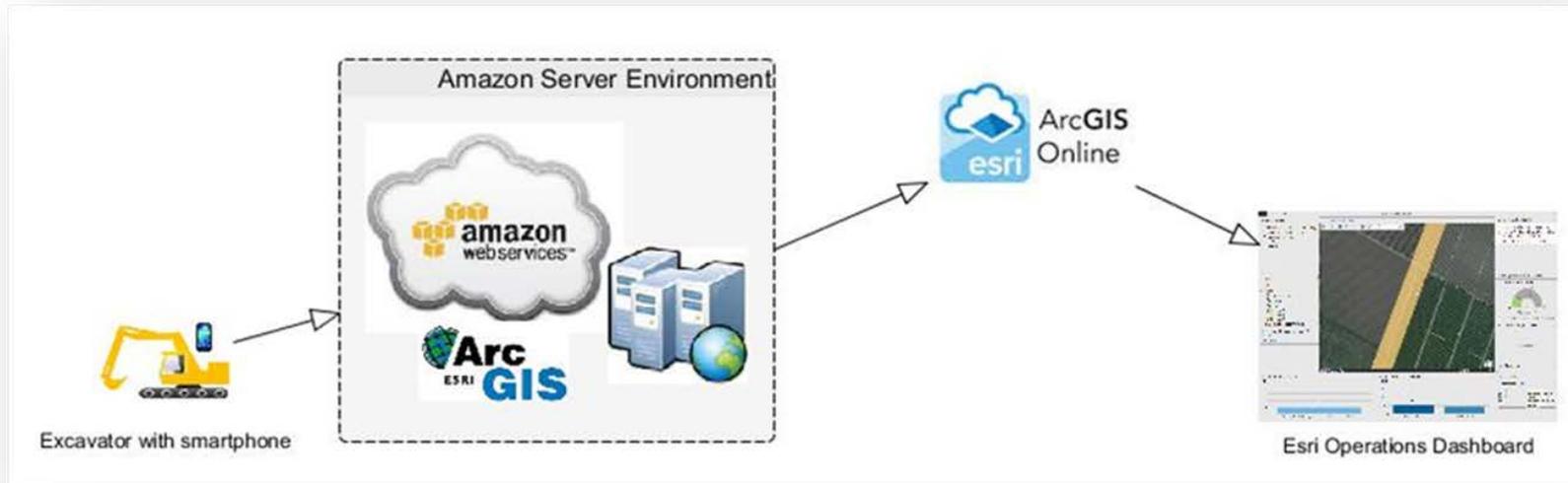
Prototype 4



GPS Excavation Enroachment Notification System (GPS EENS)

System Communication Protocol

- Take advantage of available technologies
- Create a cost-effective platform
- Size of data is a key system requirement
- Get information, provide awareness...





GPS Excavation Enroachment Notification System (GPS EENS)

System Communication Protocol

Device is installed in the excavator's cabin

Sensors in the device monitor:

- GPS location, speed
- Motion sensors to characterize equipment activities.





GPS Excavation Enroachment Notification System (GPS EENS)

System Communication Protocol



Absolute Orientation
Integrates accelerometer,
gyroscope and magnetometer



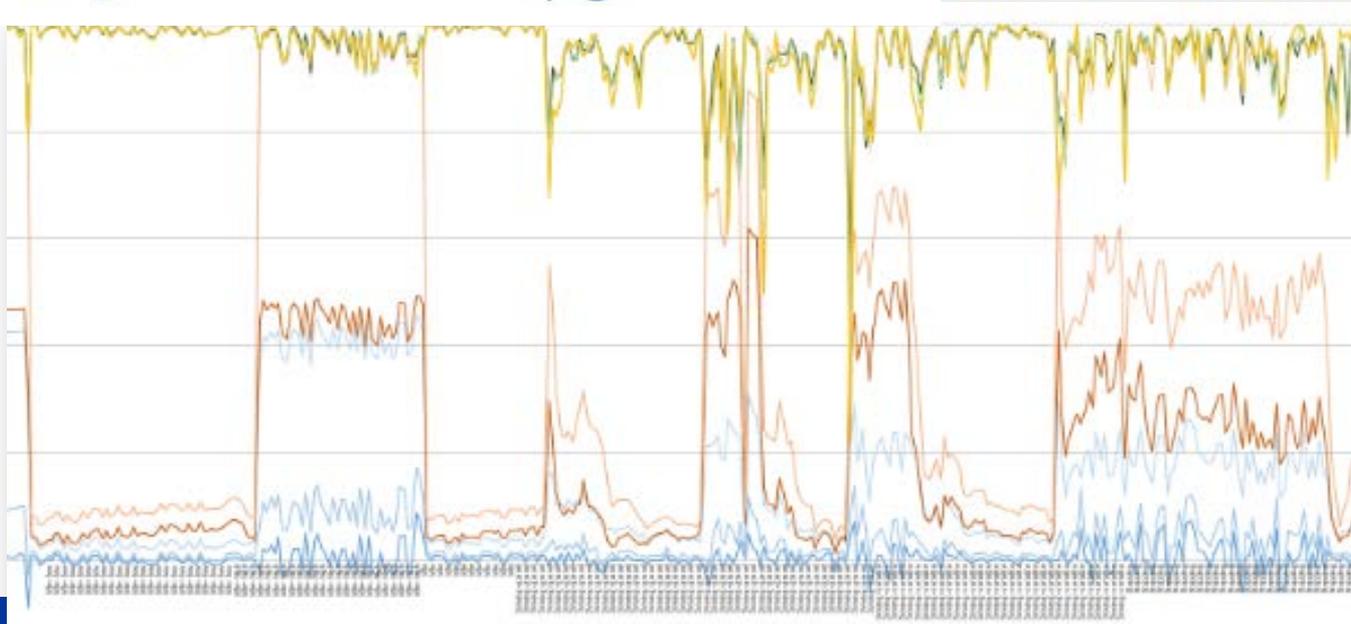
Accelerometer
Detects linear motion
and gravitational forces



Gyroscope
Measures the rate of rotation
in space (roll, pitch, yaw)



Magnetometer
Measures the terrestrial
earth's magnetic fields



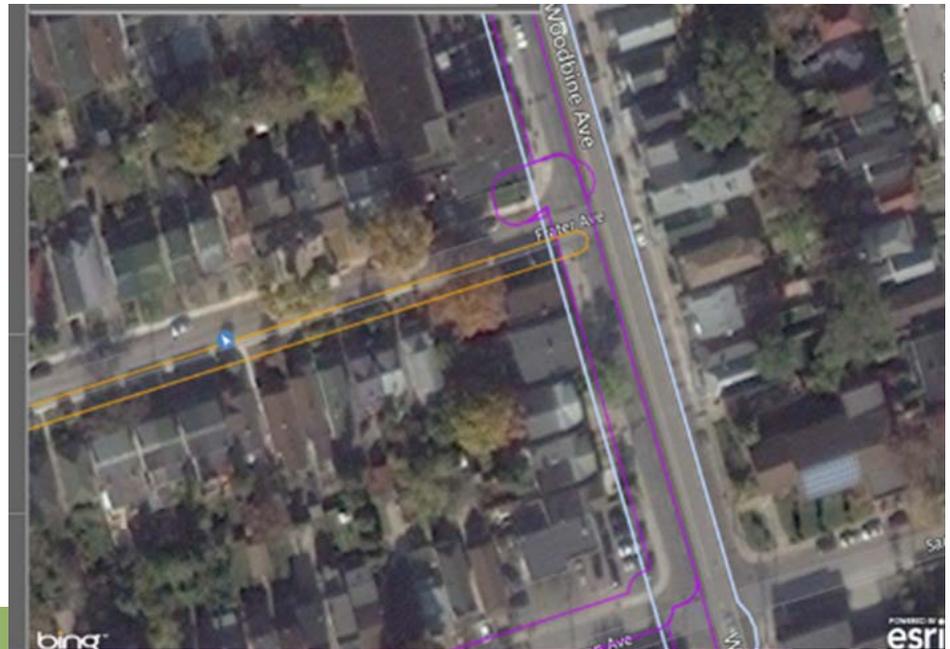


GPS Excavation Enroachment Notification System (GPS EENS)

System Communication Protocol

Signal is analyzed and triggers alarm if sensors in the device identify:

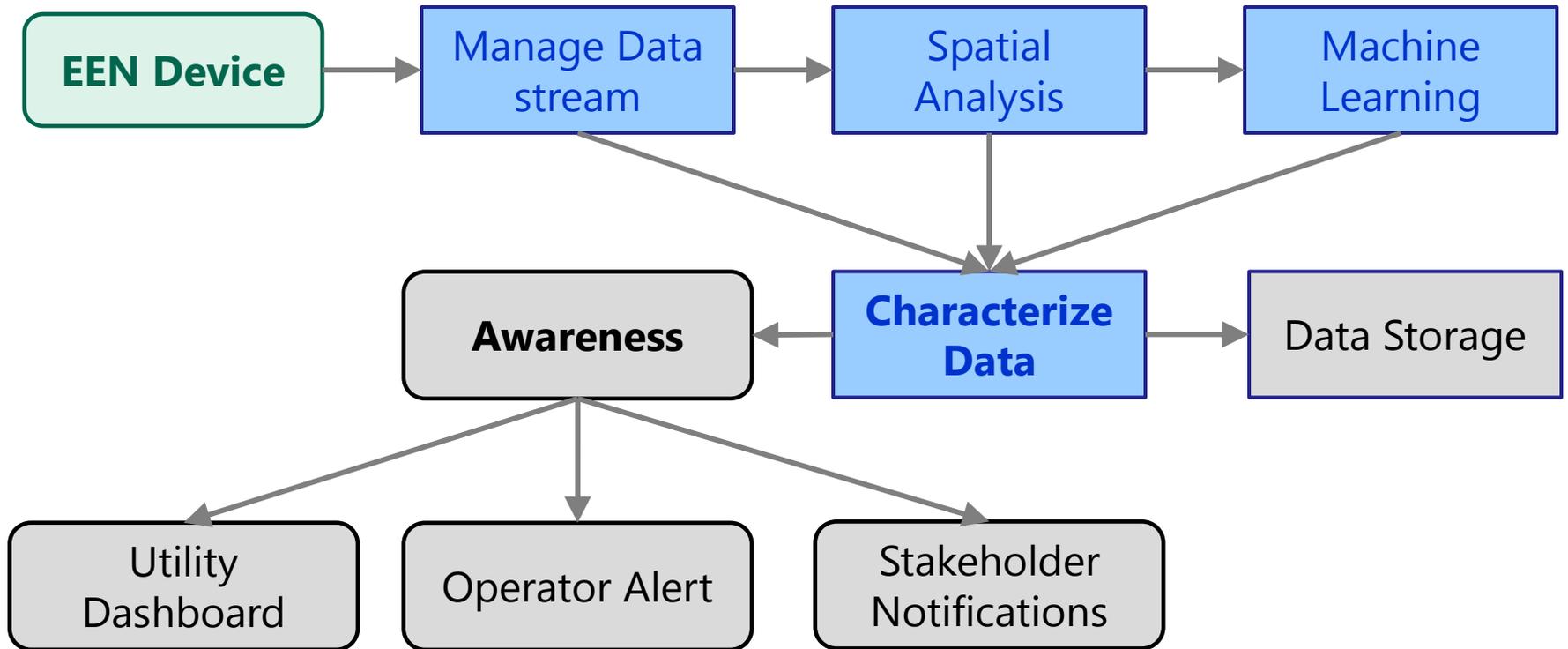
- Excavator inside utility-set 'Geo-fence' around pipeline,
- Speed less than 4 mph,
- Excavator motion and activities.





GPS Excavation Enroachment Notification System (GPS EENS)

Situation Awareness





GPS Excavation Enroachment Notification System (GPS EENS)

Situation Awareness, Dash Board

The dashboard provides a comprehensive overview of GPS EENS operations. It includes a list of active excavators with their IDs, timestamps, speeds, and sensor data. A central map displays the geographic distribution of these devices across California. A bar chart shows historical data collected over the last 24 hours for various device IDs. A detailed view of a specific device (GTI1029) shows its registration information, including creation date, installer, and operator details.

ID	Timestamp	Speed	# of Sats	Temp
GTI1002 (28457562)	6/16/2017 11:31:42 AM	0 mph	18	100°
GTI2005 (63721179)	6/16/2017 11:31:39 AM	0 mph	11	98°
GTI2009 (58108390)	6/16/2017 11:31:39 AM	0 mph	11	102°
GTI2012 (78059985)	6/16/2017 11:31:38 AM	0 mph	11	94°

ID	Data Value
GTI1001	68
GTI1002	1,181
GTI1007	45
GTI1014	30
GTI1015	11,917
GTI1028	2,804
GTI1029	1,044
GTI2005	28,475
GTI2009	22,391
GTI2010	13,644
GTI2012	28,004

CreationDate	4/12/2017
Device Name	GTI1029
Installer's Name	Robert Marros
Installer's Company	GTI
Operator's Company	Irish Construction
Point of Contact	Pete Cerda
Contact's Phone Number	9168268767



GPS Excavation Enroachment Notification System (GPS EENS)

System Deployment



GTI Test Site

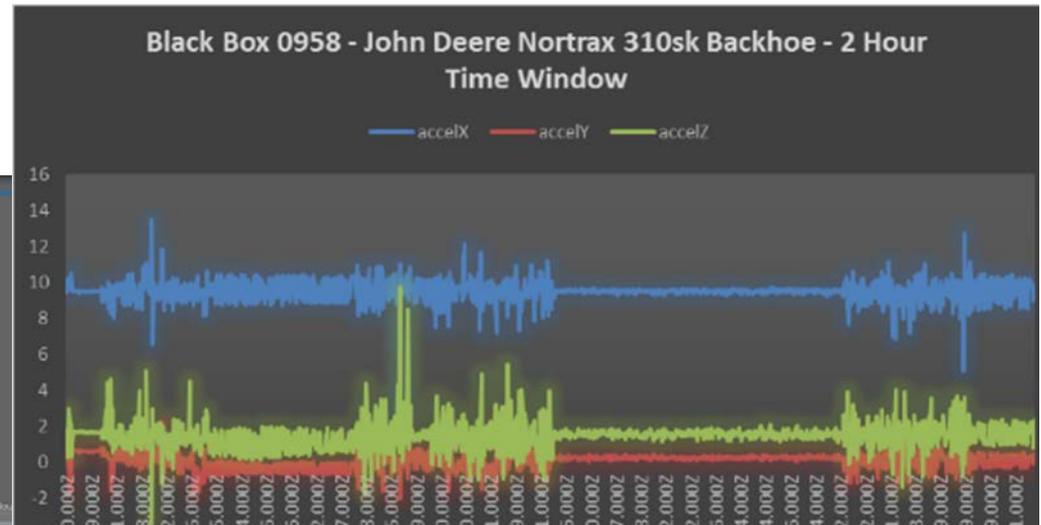
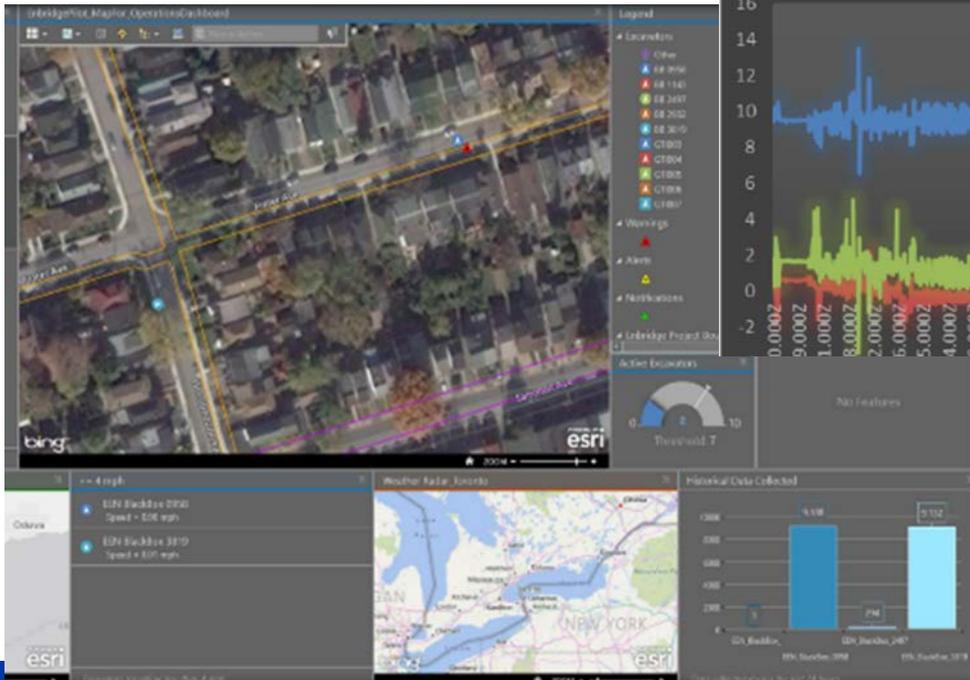




GPS Excavation Enroachment Notification System (GPS EENS)

System Deployment

Utility Site



Equipment Activity



GPS Excavation Enroachment Notification System (GPS EENS)

System Deployment

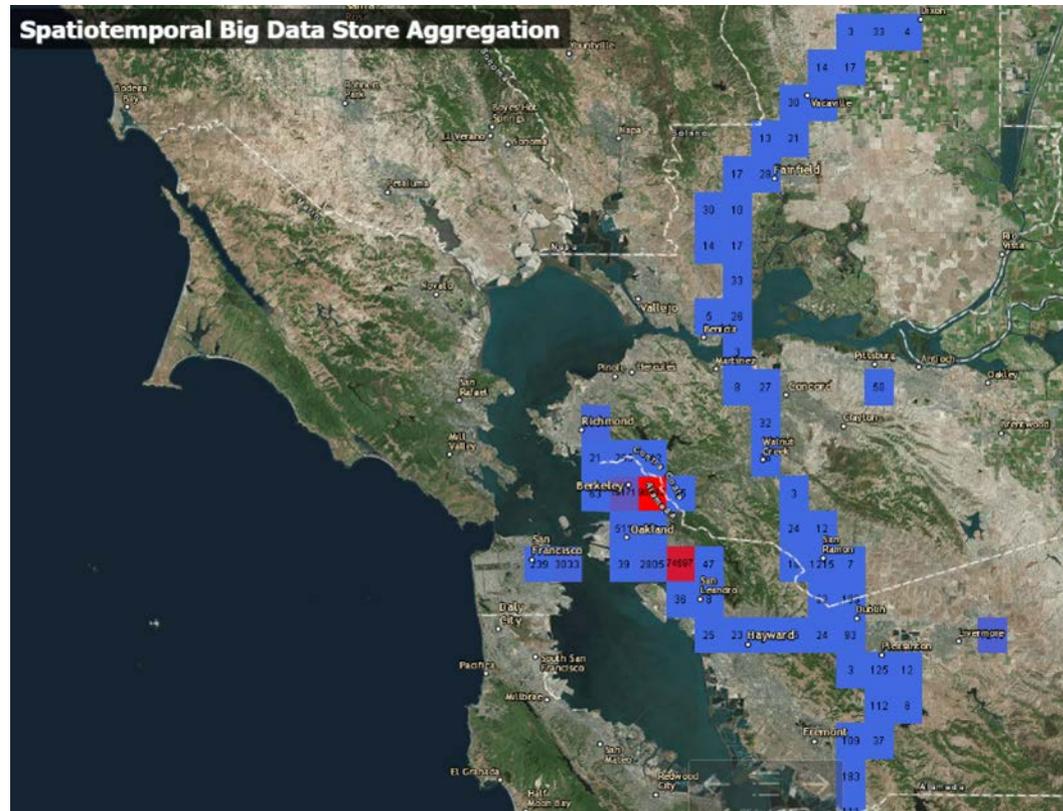


Devices Installations at PG&E



GPS Excavation Enroachment Notification System (GPS EENS)

System Deployment



Dashboard showing grids along utility lines with number of data points



GPS Excavation Enroachment Notification System (GPS EENS)

Implementation Plan

- Provide key assumptions to estimate “Projected Benefits”: including, increased safety, enhance operation, baseline and projected use and cost, and operating conditions.
- Prepare “Production Readiness Plan” to include: critical production processes, targeted market, selected suppliers technologies and capacity, estimated cost of production, and expected investment to reach market.

END