

MICHIGAN STATE
UNIVERSITY

Project Plan

Reducing Shoplifting Using Machine Learning

The Capstone Experience

Team Meijer

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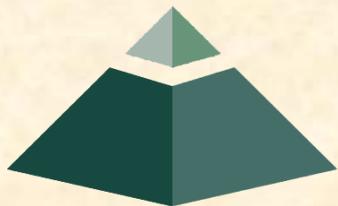
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*From Students...
...to Professionals*

Functional Specifications

- Monitors shopper's devices for shoplifting patterns.
- Translates information from Mist sensors to security cameras.
- Submits alerts to staff members, through email, and app notifications.
- Allows staff to report missing goods and find a likely time it was stolen.

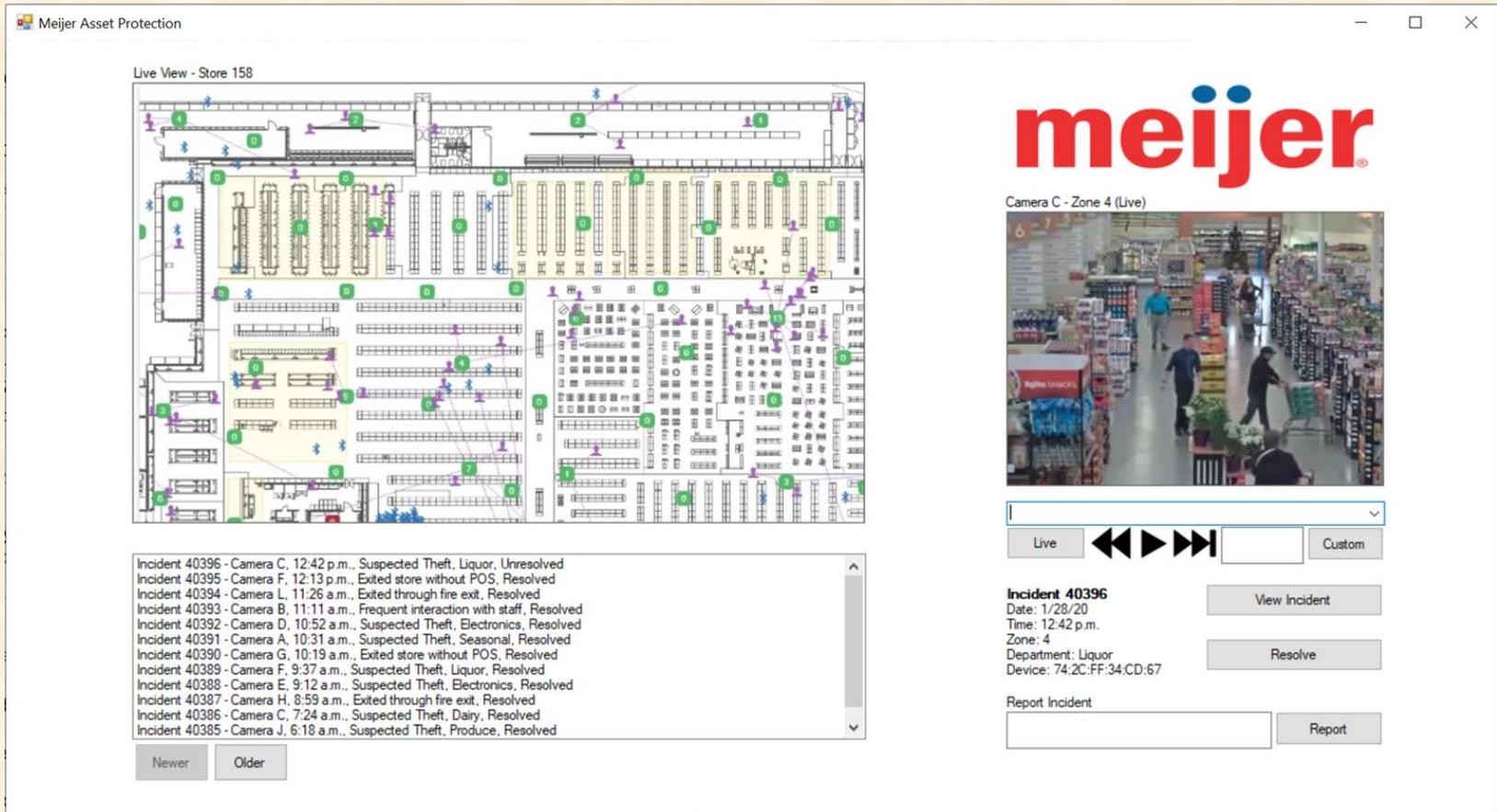


Design Specifications

- The Asset Protection team wants a desktop app that combines Mist data and security cameras in a single window.
- The design must simplify the translation between Mist and security footage, as well as allow reports.
- An app for floor workers receives notifications, and aids in resolving shoplifting incidents.



Screen Mockup: Desktop App



The mockup shows a desktop application window titled "Meijer Asset Protection". The main interface is divided into three sections:

- Live View - Store 158:** A detailed floor plan of a store with various camera locations marked by colored icons (green, purple, blue) and labeled with letters (A, B, C, D, E, F, G, H, J).
- Incident Log:** A scrollable list of recent incidents. The most recent entry is "Incident 40396 - Camera C, 12:42 p.m., Suspected Theft, Liquor, Unresolved".
- Camera C - Zone 4 (Live):** A live video feed showing a store aisle with customers and staff. Below the feed are playback controls (Live, Previous, Play, Next, Custom) and incident details for "Incident 40396".

Incident Log:

- Incident 40396 - Camera C, 12:42 p.m., Suspected Theft, Liquor, Unresolved
- Incident 40395 - Camera F, 12:13 p.m., Exited store without POS, Resolved
- Incident 40394 - Camera L, 11:26 a.m., Exited through fire exit, Resolved
- Incident 40393 - Camera B, 11:11 a.m., Frequent interaction with staff, Resolved
- Incident 40392 - Camera D, 10:52 a.m., Suspected Theft, Electronics, Resolved
- Incident 40391 - Camera A, 10:31 a.m., Suspected Theft, Seasonal, Resolved
- Incident 40390 - Camera G, 10:19 a.m., Exited store without POS, Resolved
- Incident 40389 - Camera F, 9:37 a.m., Suspected Theft, Liquor, Resolved
- Incident 40388 - Camera E, 9:12 a.m., Suspected Theft, Electronics, Resolved
- Incident 40387 - Camera H, 8:59 a.m., Exited through fire exit, Resolved
- Incident 40386 - Camera C, 7:24 a.m., Suspected Theft, Dairy, Resolved
- Incident 40385 - Camera J, 6:18 a.m., Suspected Theft, Produce, Resolved

Incident 40396 Details:

- Date: 1/28/20
- Time: 12:42 p.m.
- Zone: 4
- Department: Liquor
- Device: 74:2C:FF:34:CD:67

Buttons: View Incident, Resolve, Report Incident, Report



Screen Mockup: Missing Item Report

Missing Item Report

meijer

Device ID: A3194125BCA

Zone D Incidents

Incident 40396 - Camera C, 12:42 p.m., Suspected Theft, Liquor, Unresolved
Incident 30388 - Camera C, 8:11 a.m., Suspected Theft, Liquor, Resolved

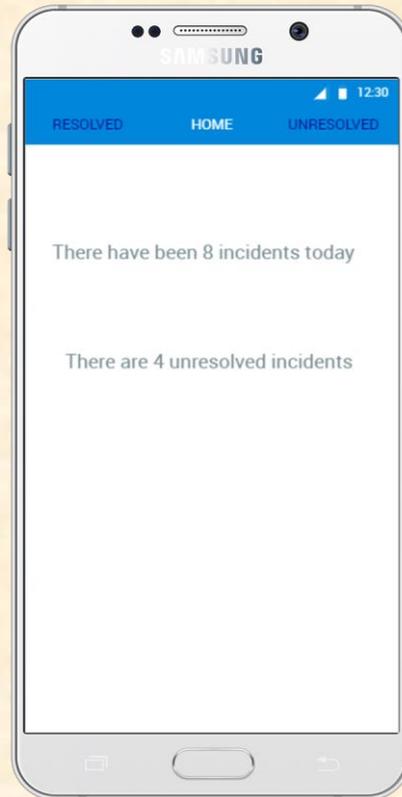
Customers in Zone D

Customer 113419 - Camera C, 33 seconds dwell time, 10:14 p.m.
Customer 113406 - Camera C, 48 seconds dwell time, 8:52 p.m.
Customer 113387 - Camera C, 12 seconds dwell time, 8:13 p.m.
Customer 113315 - Camera C, 44 seconds dwell time, 7:37 p.m.
Customer 113299 - Camera C, 18 seconds dwell time, 6:44 p.m.

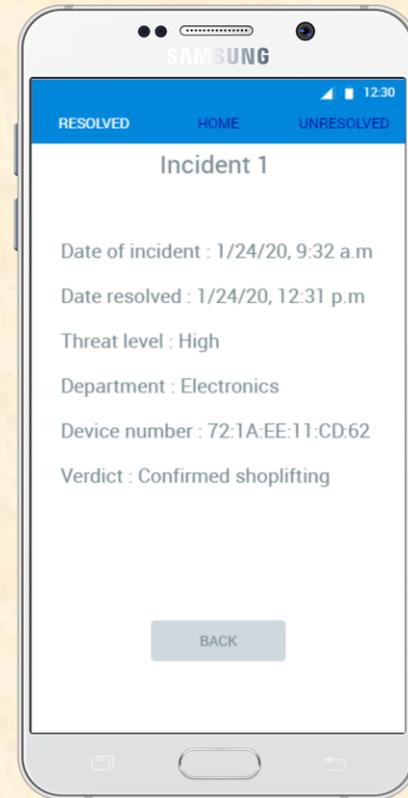
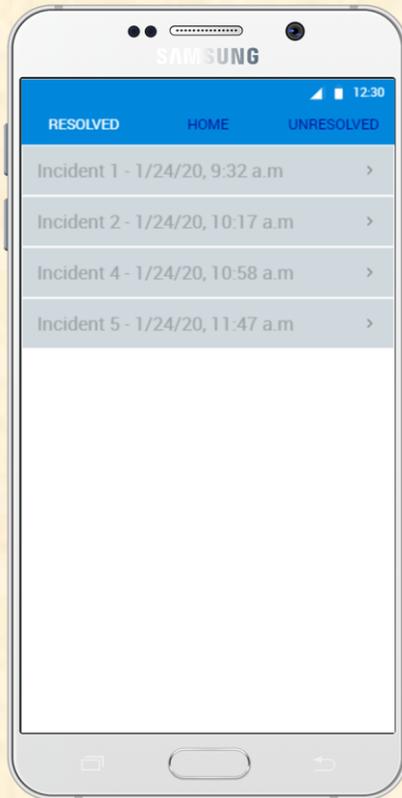
Newer Older Home Report Newer Older



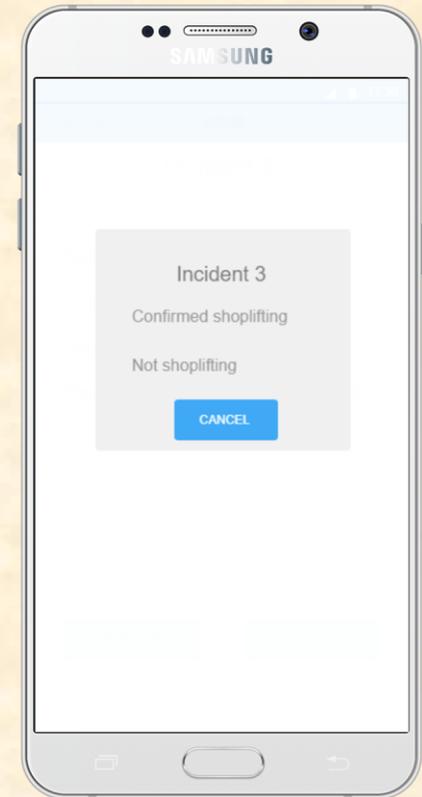
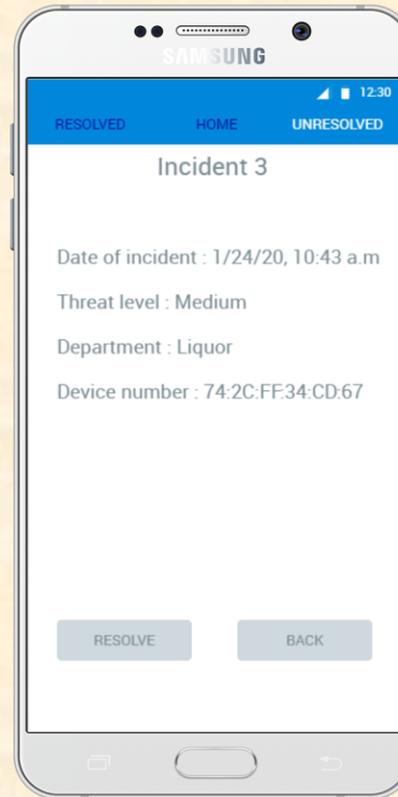
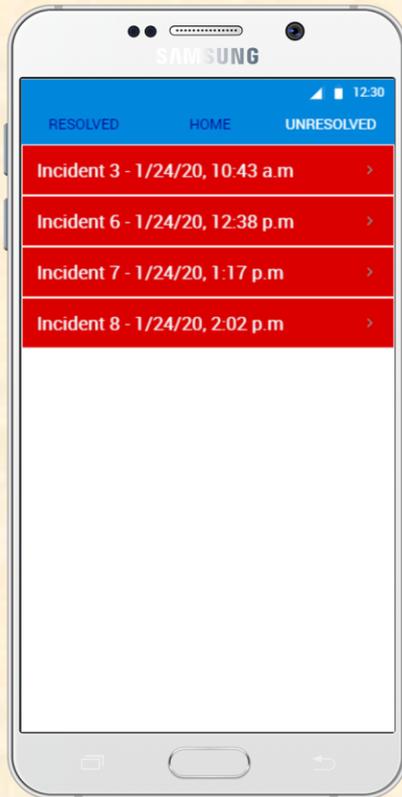
Screen Mockup: Home Page



Screen Mockup: Resolved Pages



Screen Mockup: Unresolved Pages

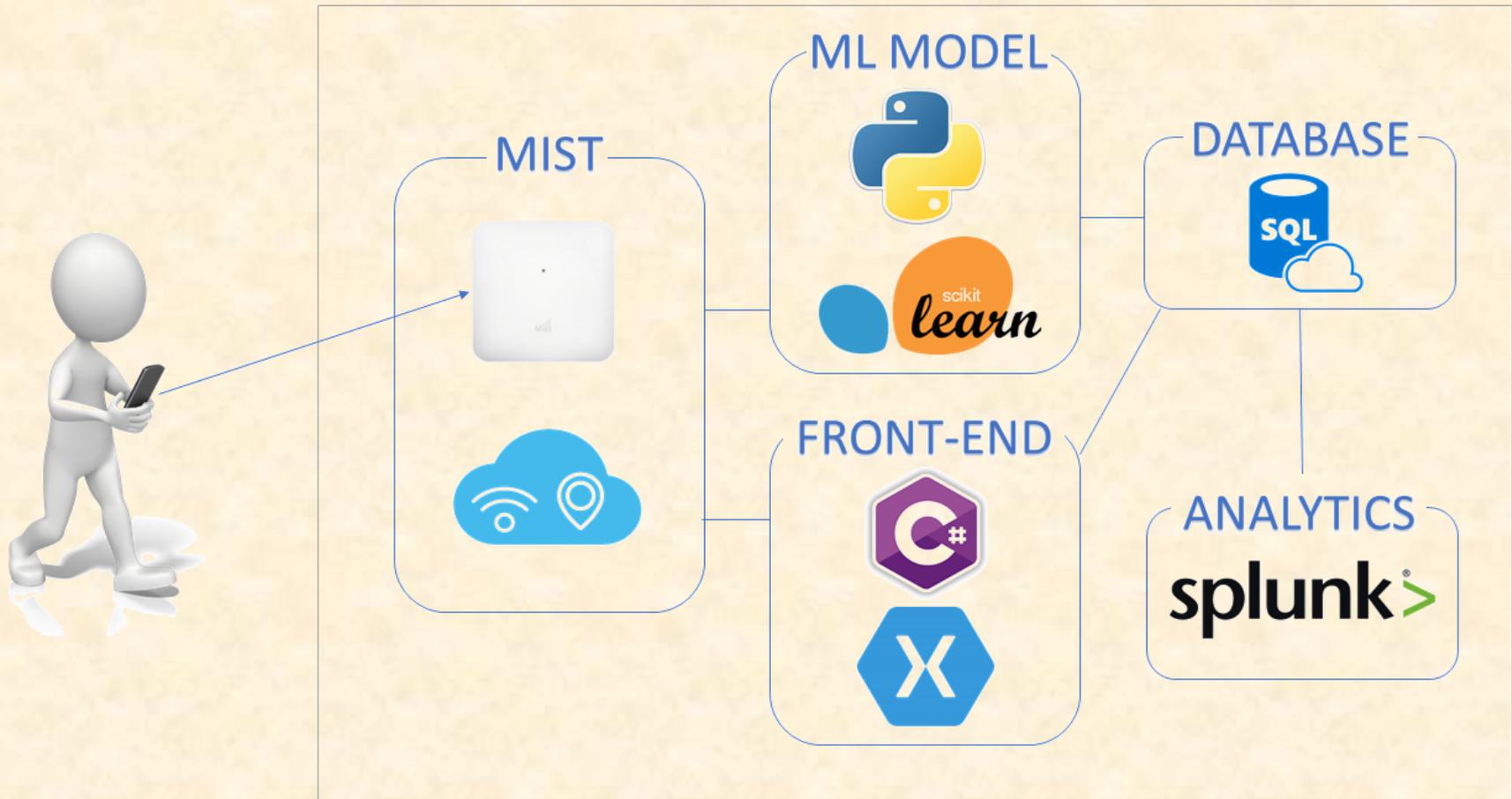


Technical Specifications

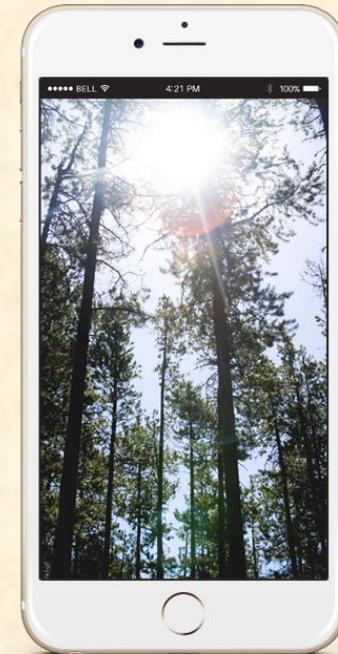
- Mist
- Machine Learning Model
- Front-End
- Database
- Analytics



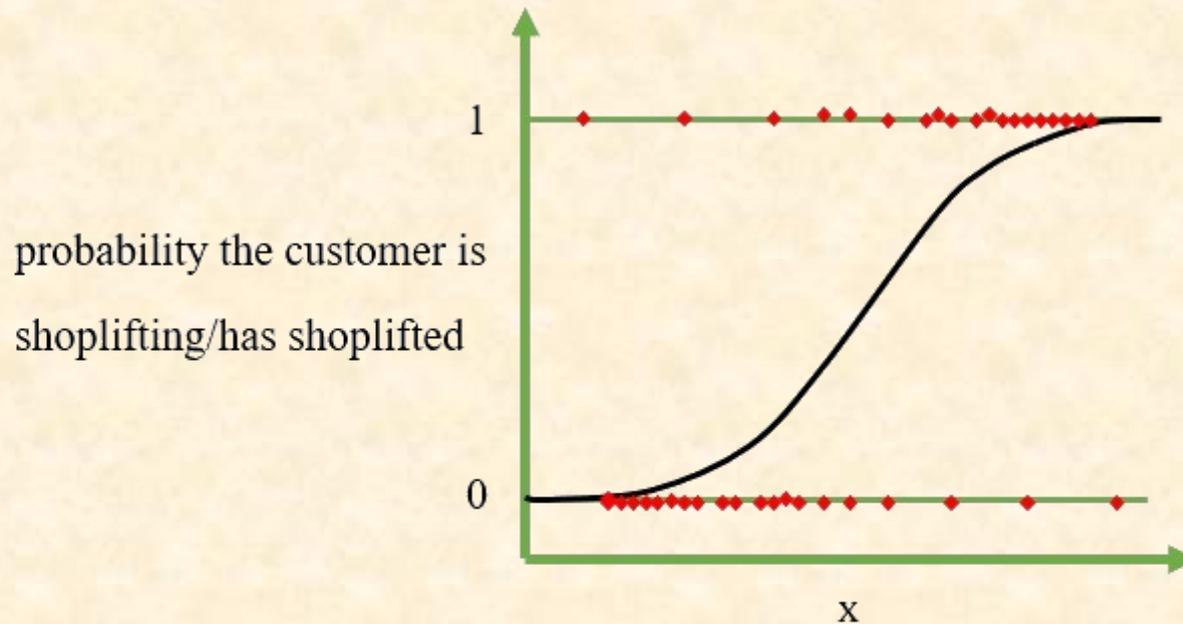
System Architecture



Suspicious Activity



ML Model



$$x = w_1(\text{dwell time in high value area}) + w_2(\text{dwell time in quiet area}) + w_3(\text{total time of trip})$$

System Components

- Hardware Platforms
 - Mist AP41 Access Points.
 - Meijer Asset Protection Team Desktop PC.
 - iOS devices for upper management, Android devices for floor workers.
- Software Platforms / Technologies
 - Xamarin
 - Mist API/Machine Learning
 - Azure SQL Database
 - C#/.net Framework
 - Splunk

Risks

- Sensor imprecision
 - Without the installation of the Mist SDK, sensors are only precise within 10-20 meters.
 - We've organized the store into zones and we are basing our solution on finding dwell times.
- Can we detect phones that are not discoverable?
 - Previous projects that used Mist access points required the phone to return a signal to clearly identify the location.
 - Met with James to discuss other options if we weren't able to detect phones that were not discoverable.



Risks

- **Gathering and Classifying Data**
 - A large part of this project revolves around creating a pattern, and detecting anomalies. We don't have any real data to train our model, and we are afraid that we won't get enough data collected before the due date.
 - We can generate "fake data" to test our machine learning algorithms, but this cannot be used to train the model itself. For this, we need to continue to work with Team Meijer to acquire and categorize real in-store shopper data.
- **Combining Machine Learning with Splunk**
 - After we discover these outlier patterns, we need to use Splunk to create some charts that indicate how often this anomaly indicates a shoplifter.
 - We plan to go to a Splunk presentation to further understand the utility of Splunk.

