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Splunkin' my Harley!

Bringing two passions together: Splunk
and motorcycles

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Geoffrey Martins

Splunk Senior Technical Instructor, consultant and Motorcycle Enthusiast

▶ 2,5 years instructor with **Splunk Education**

  • Teaching Data Science and other courses

▶ 6+ years working of active splunking, as a Splunk Architect

▶ MSc in Computing Sciences

▶ PhD student in Computing Sciences

▶ IoT enthusiast

▶ More than 15 years of motorcycle travels across South America.

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Bikers and Splunkers?

- ▶ Passionate
- ▶ Committed
- ▶ Focused
- ▶ Strong-minded
- ▶ Strong sense of community, brotherhood.
- ▶ Like to play with toys :D

What can possibly bring Splunkers and Bikers together?

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Splunkin' my Harley!

Motorcycle Sensor data in Splunk

▶ As cars, motorcycles have electronic control modules (ECM or ECU) and make sensor data available to anyone who knows how to read them.

▶ The objective is to create an affordable way to capture this information, push it to Splunk and transform it in intelligence.

▶ …and have a lot of fun in the process :D

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The Whole Idea

Using inexpensive hardware and/or hardware you already have.

Capture data from the Harley-Davidson data port sensors.

Parse/interpret data and push to Splunk

Splunk Enterprise indexes data and generates intelligence

Motivation and Possible Uses

Beyond the usual "**Because I Can**" of many IoT projects

▶ Fleet Management

- Real-time telemetry and statistics are ideal for centralized fleet management/monitoring.

- Advanced features like Geo-fencing, trip management, advanced statistics.

▶ Diagnostic and Analysis

- Intelligence allows a deeper understanding of the bike, its systems, pilot habits and more.

- Catch problems before they happen with Machine Learning

▶ Fun

- Keep detailed logs of your trips, use the most powerful software in the market to analyze them

SPLUNKIN' MY HARLEY

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Components and Parts

Components you'll need

A Deutsch connector for the motorcycle end of the custom cable.

▶ **Deutsch DT06-4S** connector

- 4-pin for Delphi-based bikes
- 2001 - 2010 Softail, 2001 - 2011 Dyna, 2001 - 2013 Touring, 2001 - 2013 Sportster, 2002 - Present V-ROD

▶ **Deutsch DT06-6S** connector

- 6-pin for CANBUS/HDLAN bikes.
- Compatible with 2011 and up Softail, 2012 and up Dyna, and 2014 and up Touring, Sportster and Street 500/750 models.

You can purchase the connector disassembled or a pre-assembled kit.

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Components you'll need

An **OBD-II Cable, J1962F** to open end or equivalent.

▶ This cable will be used to connect to the Bluetooth OBD-II reader.

▶ There are different variations of this cable/connector. Any variation will do as long as you can plug in your OBD reader.

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Components you'll need

An automotive **Bluetooth OBD-II** reader, also known as **ELM327**

- There are many different options in the market, with different price ranges.
  - The original ones, sold mostly in US, or
  - A multitude of Chinese clones that actually work.
- The ELM327 is a unit that reads the OBD stream from the motorcycle and transmits via Bluetooth to a receiver. In our case a regular Android cellphone.

130.60.4 - - [07/Jan 18:10:57:153] "GET /category.screen?category_id=GIFTS&JSESSIONID=SD15L4FF10ADFF10 HTTP 1.1" 404 720 "http://buttercup-shopping.com/cart.do?action=view&itemId=EST-6&product...
128.241.220.82 - - [07/Jan 18:10:57:123] "GET /product.screen?product_id=FL-DSH-01&JSESSIONID=SD5SL7FF6ADFF9 HTTP 1.1" 404 3322 "http://buttercup-shopping.com/cart.do?action=purchase&itemId=EST-26&product...
.317 27.160.0.0 - - [07/Jan 18:10:56:156] "GET /product.screen?product_id=FL-DSH-01&JSESSIONID=SD5SL9FF1ADFF3 HTTP 1.1" 200 1318 "http://buttercup-shopping.com/cart.do?action=changequantity&itemId=EST-6&JSESSIONID...
ows NT 5.1: SV1: - .NET CLR 1.1.4322) "GET /oldlink?item_id=EST-26&JSESSIONID=SD5SL9FF1ADFF3 HTTP 1.1" 200 2423 "http://buttercup-shopping...
itemId=EST-16&product_id=RP-LI-02" 468 125.17 14.106 "GET /oldlink?item_id=EST-26&JSESSIONID=SD5SL9FF1ADFF3 HTTP 1.1" 200 1318...

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Components you'll need

A regular Android cellphone

▶ An Android cellphone with a working data connection and Bluetooth.

▶ The phone will run the "**Splunkin' my Harley**" app

- Receives data from the ELM327 via Bluetooth.

- The parser decodes the OBD feed, stores several values in memory builds JSON packages.

- The JSON packages are sent to Splunk via HTTP Event Collector

- App will be released as open source, as all IoT projects should be.

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Assembling the Cable (4-pin version)

The only soldering you'll have to do in this project.

J1962F:

- ► One end will have the **J1962F** and the other end will have the 4 pin Deutsch connector.

- ► Communicaton uses the **1-wire J1850** protocol

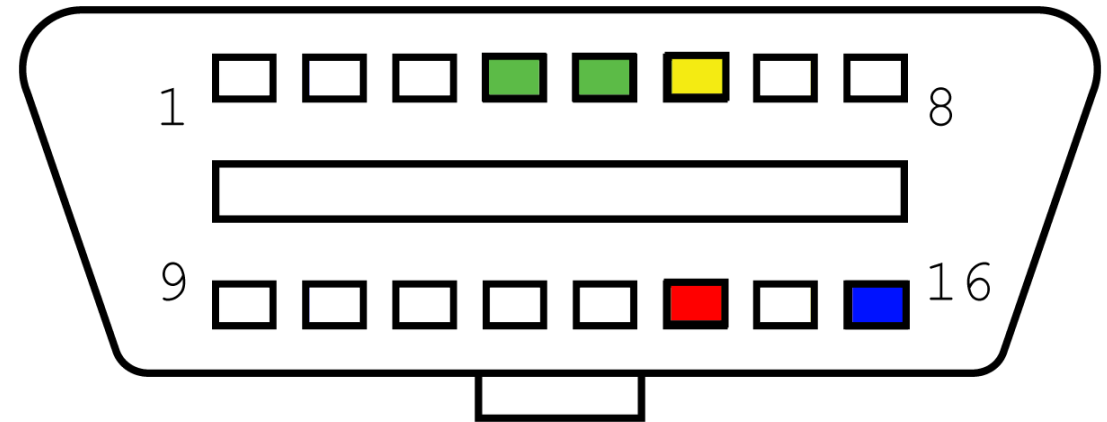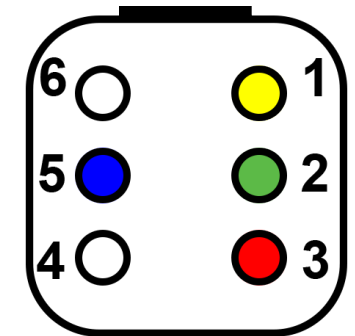- ► Use a shielded cable between the two connectors to avoid interference.

DT06-4S:

Ground

Data (J1850+)

+12v

Unused

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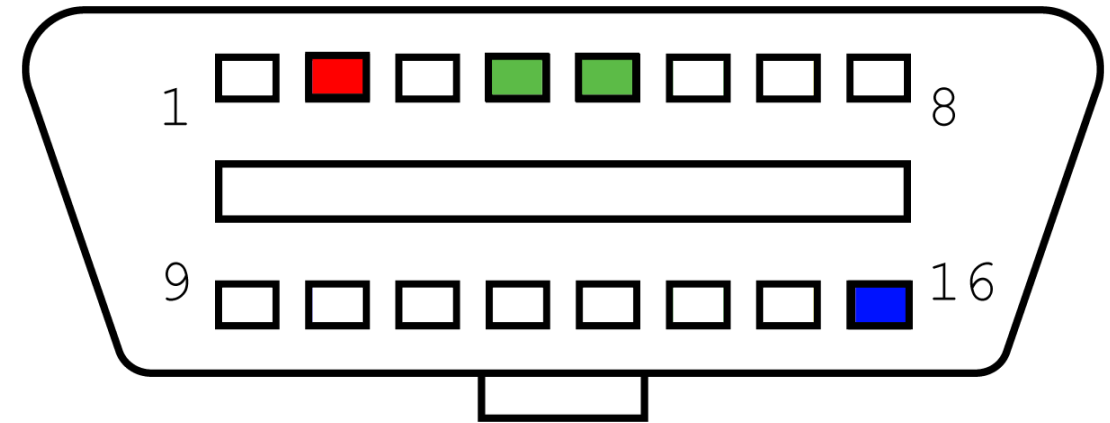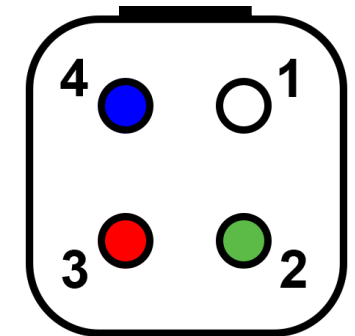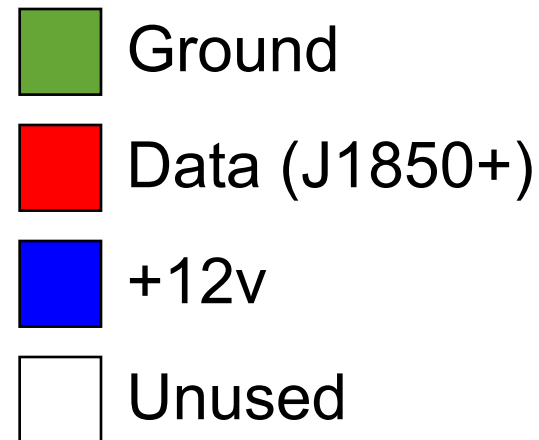
Assembling the Cable (6-pin version)

The only soldering you'll have to do in this project.

- One end will have the **J1962F** and the other end will have the 6 pin Deutsch connector.
- Communication will be done via **2-wire CAN bus** protocol.
- CAN is very susceptible to interference! Remember to use a shielded cable between connectors
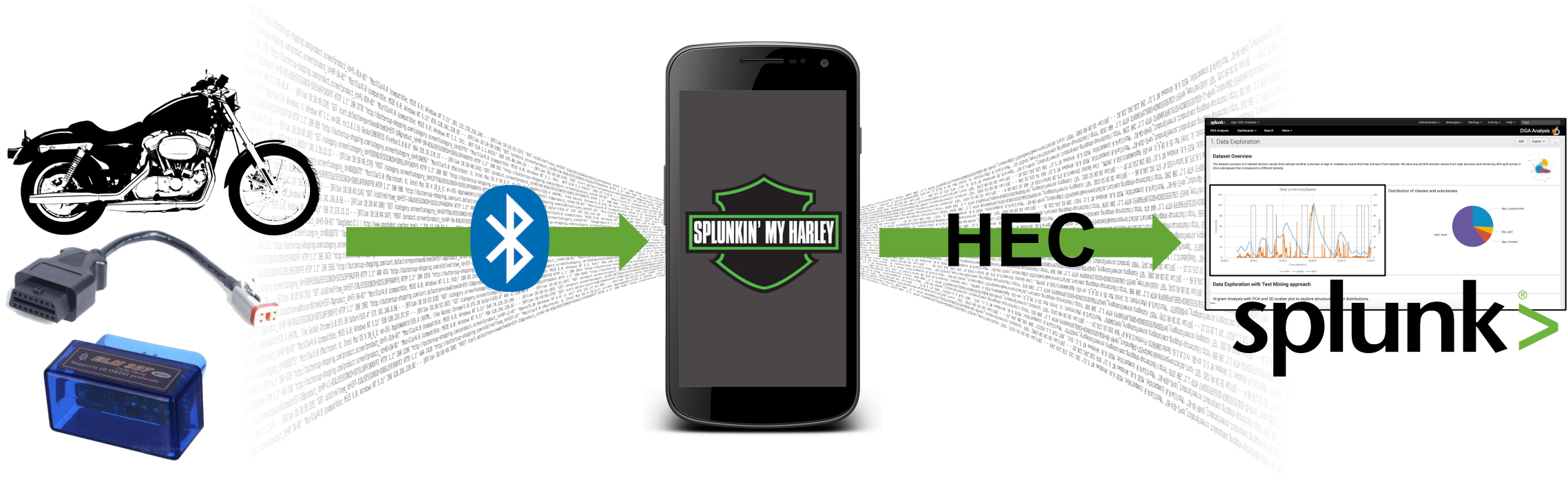
J1962F:

Ground

Data (CAN-)

+12v

Data (CAN+)

Unused

DT06-6S:

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The Data Port in your Harley-Davidson
Usually, the data port is located on the left side of the bike.

▶ Once the cable is assembled locate the data port in your bike and plug it in

▶ Plug the OBD-II reader on the other end.

▶ Turn the ignition and set the engine switch to "Run".

▶ Pair the Bluetooth reader with the phone and open the app.

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From the Harley into Splunk
The Splunkin' My Harley Android App

SPLUNKIN' MY HARLEY

HEC

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▶ The *Splunkin' my Harley* Android app receives the OBD stream via Bluetooth, parses it into JSON packages and pushes the information to Splunk via **HTTP Event Collector** frequently, at specified intervals.

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The OBD Data Feed

► The OBD data feed contains information from multiple ECU sensors, including **Engine**, **Display** and **Body Controller**.

- Different bikes have different components available.

► The stream needs to be constantly monitored and the readings are delivered in a single feed.

► All readings have a recognizable header and the information follows.

► Some information requires additional calculation

► The *Splunkin' my Harley* Android App parses the data, samples it on specified intervals and pushes data to Splunk via **HTTP Event Collector**
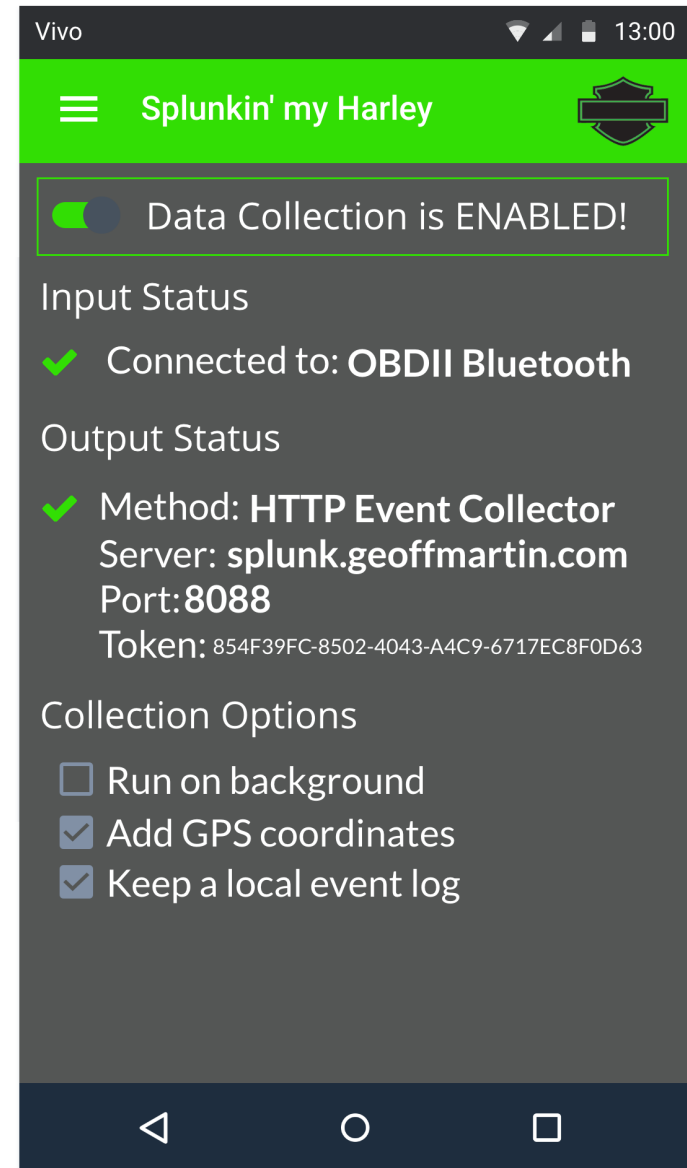
The OBD Data Feed

How data is interpreted by the parser

1) Intercepting Data:

header

| … | B6 | A4 | FF | A8 | 49 | 10 | 10 | 76 | A2 | F3 | DD | … |

data   checksum

2) Final Value Calculation:

hex2dec(**76**) – 40
118 - 40 = **78** (ºC)

3) Value is stored on buffer, awaiting transmission.

▶ The OBD feed is dispatched and parsed by the Android app.

▶ The feed does not follow a package structure, the parser has to watch for headers, then read the data that follows.

▶ Roughly, you get readings from a sensor every time its values change.

▶ The parser stores the last reading of each sensor, therefore the OBD is sampled to be sent to Splunk.

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The OBD Data Feed

Some samples of sensor readings from the OBD feed.

Sensor	Byte						Formula
	1	2	3	4	5	6	
RPM	28	1B	10	02	XX	YY	RPM = (hex2dec(XX)*256+hex2dec(YY)) / 4
Speed	48	29	10	02	XX	YY	KpH = (hex2dec(XX)*256+hex2dec(YY)) / 128
Gear	A8	3B	10	03	XX		0xXX = 0x01, 0x03, 0x07, 0x0F, 0x1F, 0x3F (decimal: 1,3,7,15,31,63) for 1st-5th gears
Engine Temperature	A8	49	10	10	XX		ºC = hex2dec(XX) - 40
Fuel Consumption	A8	83	10	0A	XX	XX	Resolution bit=0,00005 liters

… and many more.

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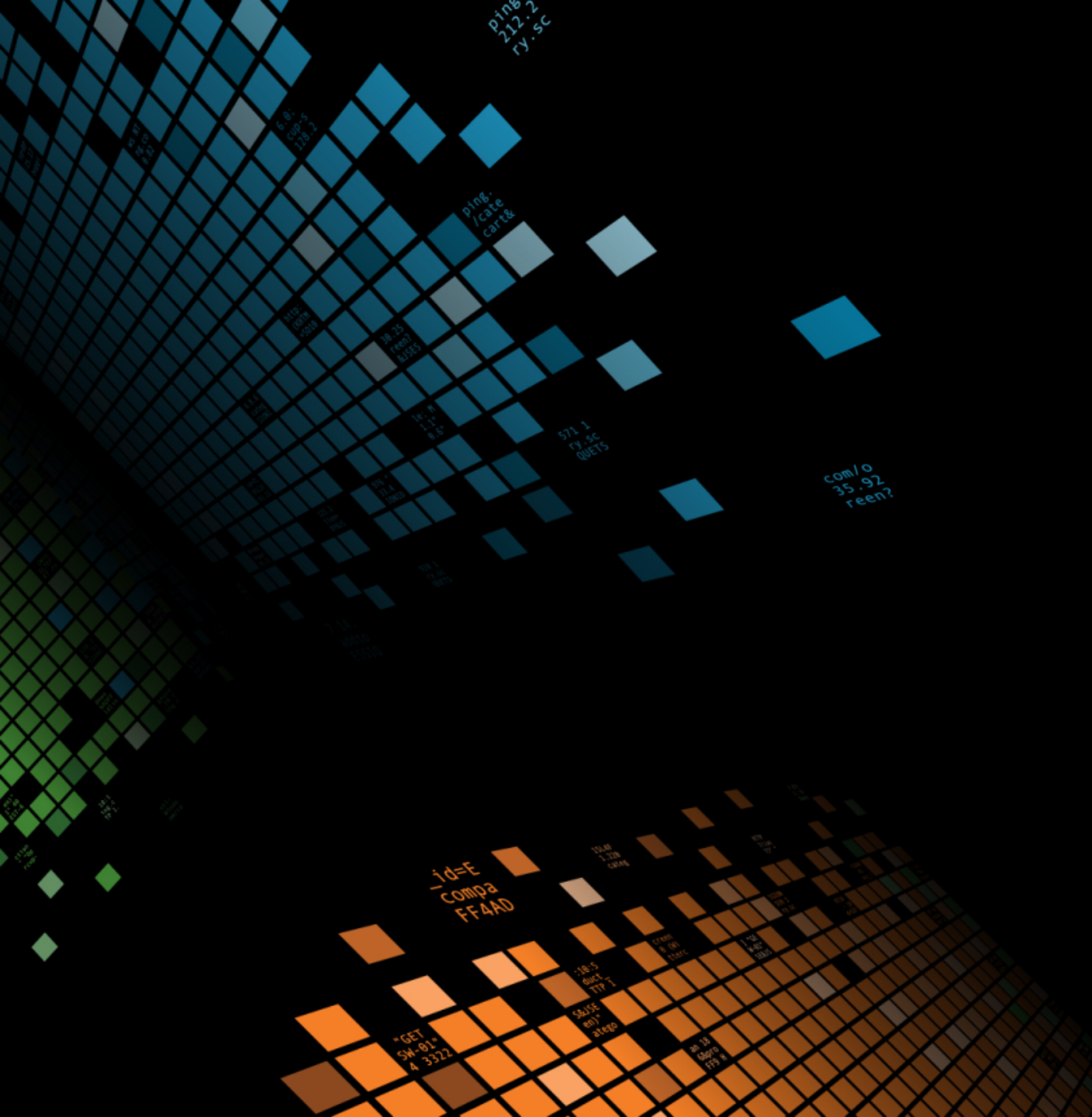
The JSON Package

Data is parsed into a JSON package and then dispatched to Splunk via HTTP Event Collector

```
1  {
2      "time": 1502229644,
3      "host": "9321KEMJ1DD000000",
4      "source": "OBDII Bluetooth",
5      "sourcetype": "SMHdata",
6      "event": {
7          "parser": "SMH Android App",
8          "Speed": "6",
9          "RPM": "878",
10         "Latitude": "-25.4635931",
11         "Longitude": "-49.2846911",
12         "Gear": "3",
13         "Neutral": "false",
14         "VIN": "9321KEMJ1DD000000",
15         "Odometer": "1324500",
16         "TurnSignal": "Left",
17         "CheckEngine": "false",
18         "FuelGauge": "5",
19         "FuelConsumption:": "1234600"
20     }
21 }
```

- ▶ Last reading is captured and cached;
- ▶ Cached entries are formatted on a JSON package;
- ▶ Some info from cellphone is merged
  - GPS Coordinates, SMH App version, timestamp, etc…
- ▶ JSON package is dispatched to Splunk via HTTP Event collector
  - Simple and elegant method for data transmission
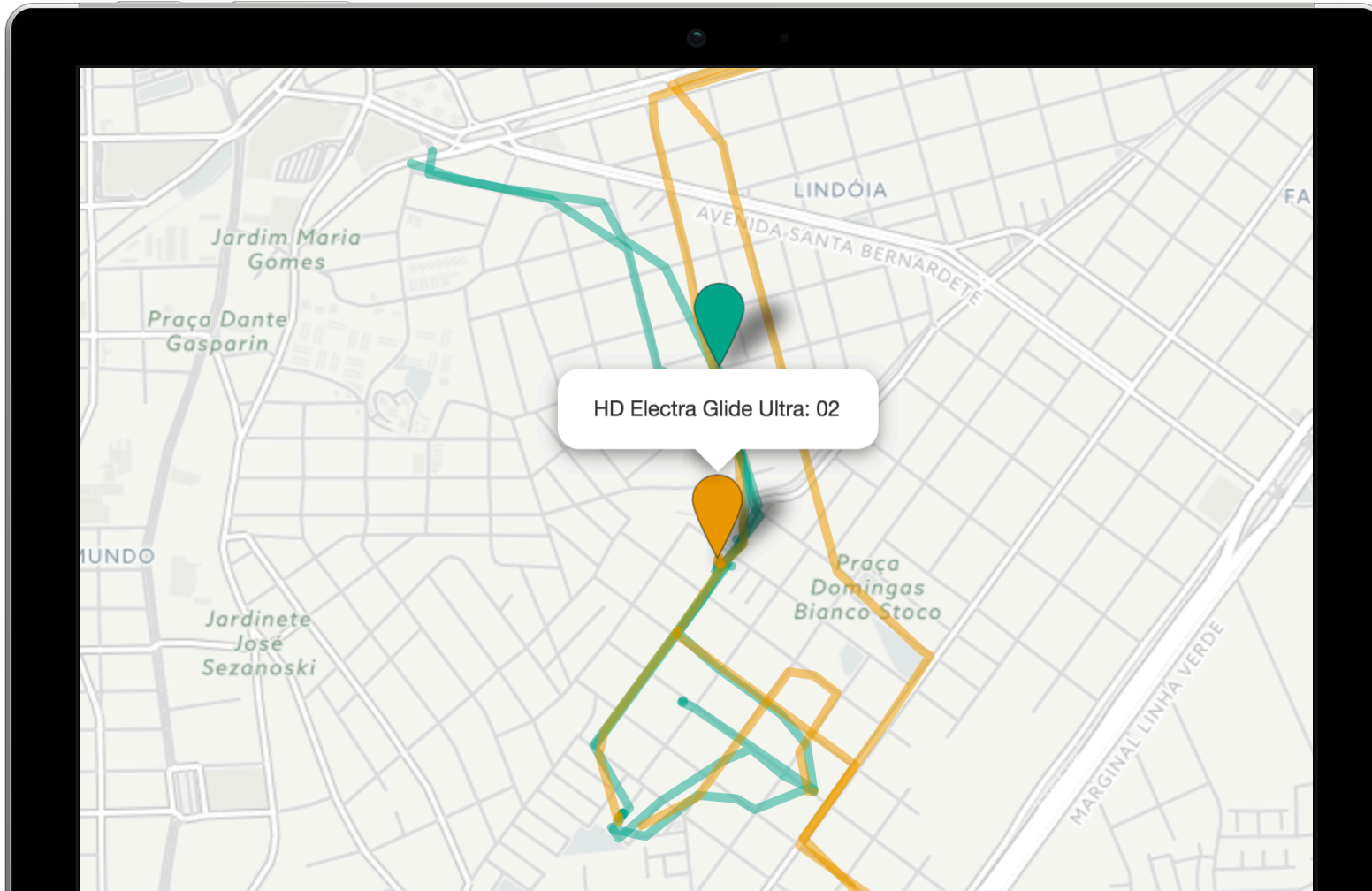 - Fit for IoT and compact projects.

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Meanwhile in Splunk…

Meanwhile, in Splunk…

All sorts of intelligence can be generated with the captured OBD data:

▶ The "**Splunkin' my Harley**" Splunk app gives the OBD data meaning, and provides a number of dashboards and reports on:

• Performance comparison.

• Engine, Acceleration, Fuel Efficiency, Trip Duration, Total Fuel Used...

• Location (with real-time option)

• Alerts on error codes and trip summaries

• Motorcycle system properties, including VIN number and Engine error codes

• Machine learning reports

• … and more!

Tracking Features

Using a cellphone as middleware pays off: GPS Tracking

HD Electra Glide Ultra: 02

- ▶ The app includes GPS information from the cellphone in the packages.

- ▶ Real-time tracking feature allows monitoring of the whole trip and provides quick access to each of the motorcycles' information

Meanwhile, in Splunk…

All sorts of intelligence can be generated with the captured OBD data:

5
outliers
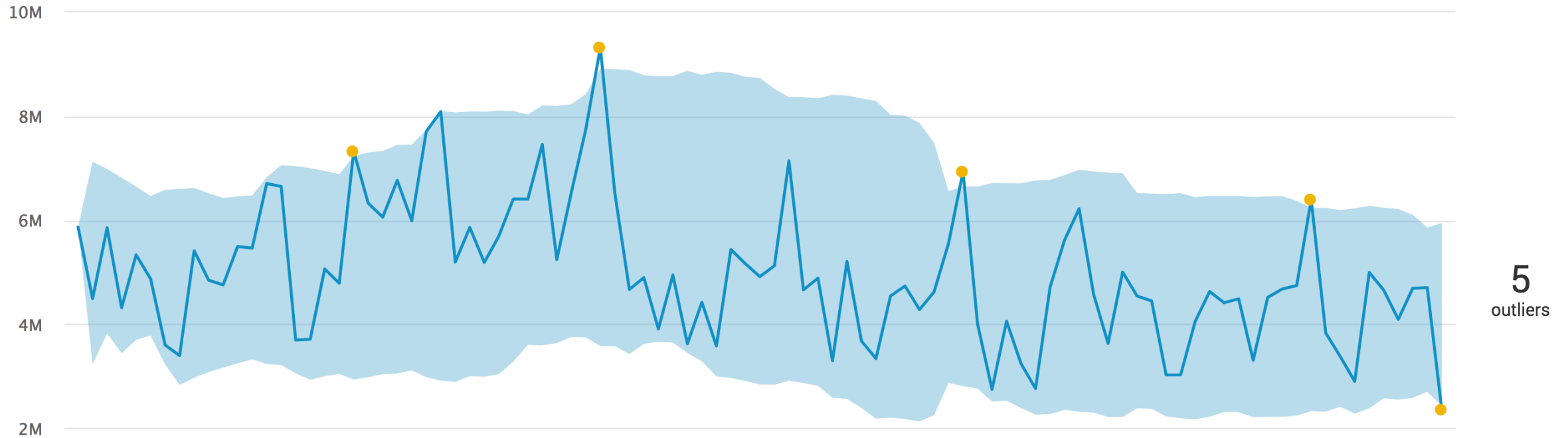
▶ Features like **Outlier Detection**, **Prediction** and **Forecasting** from the *Splunk Machine Learning Toolkit* add value to the reports and delivers advanced analytics.

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Motorcycle Summary   Motorcycle Statistics ∨   Splunk ∨   Search

SPLUNKIN' MY HARLEY

Motorcycle Summary
Bikes Registered in the last 24 hours

Edit   Export ∨   ...

Abstract

Splunkin My Harley receives OBD telemetry from Harley-Davidson Motorcycles and keeps track of several key sensors, error codes, live parameters and more.

3	55 ↘ -13	28 km	0	1257 Avg RPM	181 ↗ 36
Registered Bikes	Readings per minute	Distance on Last Trip	Kilometers Travelled Today		Average Monthly Travelled Kilometers

6m ago
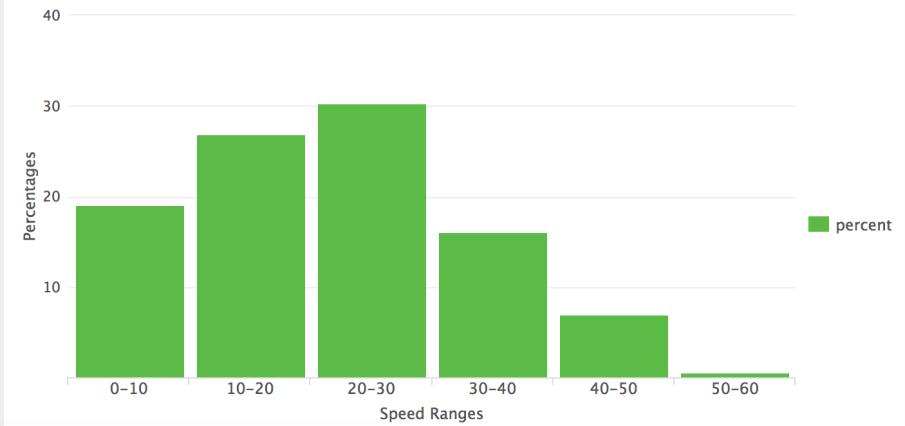
Last Sensor Sweep on Active Bike

Active Motorcycle

FLHTK - Electra Glide Ulltr... ⊗ ▾

Sensor ⇅	Reading Value ⇅	Reading Time ⇅
6th speed light	Off	2017-09-09 13:35:02
ABS active	No	2017-09-09 13:34:18
ABS pump power supply voltage	0.00	2017-09-09 13:34:59
Absolute pressure	26.5	2017-09-09 13:41:50
Air temp.	76	2017-09-09 13:41:50
Air temp. sensor	1.35	2017-09-09 13:41:50
Average length ABS events	0.00	2017-09-09 13:34:18
Battery charger signal lamp	Off	2017-09-09 13:35:00
Battery power supply	14.01	2017-09-09 13:34:18
Battery voltage	14.10	2017-09-09 13:41:39

« prev   1   2   3   4   5   6   next »

6m ago

Speed Range Distribution (MPH)

■ percent

Percentages (y-axis: 10, 20, 30, 40)

Speed Ranges (x-axis): 0–10, 10–20, 20–30, 30–40, 40–50, 50–60

Last Reported Location

What about the future?

This is only the first prototype, there's always room for improvement

- ▶ iOS app for **Wi-Fi** ELM327 readers
- ▶ Other brands/models of motorcycles
- ▶ Pushing data to Splunk without a cellphone/app
  - • Raspberry Pi with GPS and GSM modules? Who knows…
- ▶ Build a Splunk-based parser for OBD info
- ▶ Smartwatch instead of cellphone
- ▶ ITSI monitoring
- ▶ Evolve the ML algorithms to map driving habits
- ▶ The possibilities are endless…

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Want to know more?
Valuable information about ELM327, OBD and other projects

- http://momex.cat/en/tachometerHD – DIY Tachometer project, lots of info about OBD codes, ELM and motorcycle-specific entries.
- https://interfusellc.com/elm327/ - Information about the ELM327 module in a very comprehensive way.
- https://github.com/stelian42/HarleyDroid - The HarleyDroid project, the basis for the "Splunkin' my Harley" android app.
- http://www.tabperformance.com/harley-davidson-vin-reference-guide-s/224.htm - Parsing the VIN number for Harley-Davidson Motorcycles.
- http://gersic.com/connecting-your-raspberry-pi-to-a-bluetooth-obd-ii-adapter/ - Connecting to ELM327 from a Raspberry Pi

Key Takeaways

Splunkin' my Harley

1. "Splunkin' My Harley" aims to be a simple but powerful tool to extract information from motorcycles, analyze in Splunk and deliver valuable intelligence;

2. IoT is not a nerd thing! It's a largely unexplored area and anyone can do it!

3. You can have tons of fun building and using projects like this. Maybe make money too? Who knows…

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Q&A

Splunkin' my Harley!

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Acknowledgements

Thanks to people and companies who helped making the project possible

- Alex from Diagnostica

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- Rich Acosta & Erica Feldman
  - Splunk for your car project

- Xavier Morales
  - HD Digital Tachometer Project

- Ed Lecco, Sue Flemming and my colleagues at **Splunk Education**

- **Harley-Davidson** of America

- Silvio Laerte & Rogerio Boschini
  - For the awesome trip pictures*!

- Nate McKervey
  - For the cutest baby ever(and pic)!

SPLUNK THIS! LET'S RIDE!

*all pictures in this presentation were taken in motorcycle trips through the beautiful roads of South America.
This project is fully open-source and it is purely educational. Support open-source software and small, homemade projects.

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