

# MQTT, CEP And The Other Lmnop's Of The IoT

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# Agenda

- IoT and IIoT
- M2M, MQTT, COAP, AMQP and HTTP
- IaaS, PaaS and SaaS
- CEP
- ML
- WTF

# IoT and IIoT

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# The Evolution of the Internet

Internet of Documents

Internet of Commerce

Internet of People

Internet of Things





# Improving Navigation Accuracy

Real-time traffic feeds  
from road network



Compare in  
application route  
recommendations



Improved traffic profile  
for roads

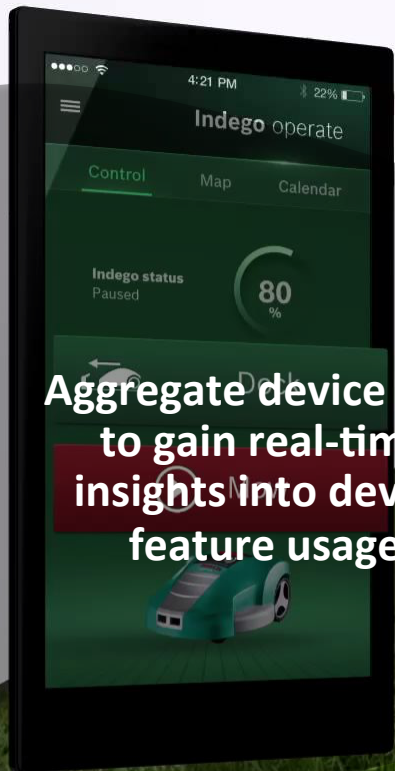


... it pauses at the  
**press of a button.**



**BOSCH**

Invented for life



Aggregate device data  
to gain real-time  
insights into device  
feature usage



Correlate device usage  
data with geo-location  
data



Drive customer  
engagement and  
marketing strategies



# Understanding Product Usage



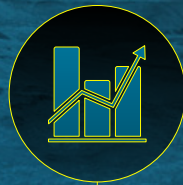
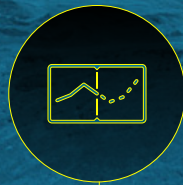
# Analyzing Robots to Improve Supply Chain

# 4%

Throughput Improvements



Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total	
Assembly Line 1000 - Base 1000	14	3	1	6	10	6	8	10	11	8	15	8	10	10	9	10	10	11	4	5	4	14	4	1	197	
Assembly Line 1000 - Base 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Assembly Line 1000 - Base 1000	3	7	3	8	9	8	2	0	4	2	23	12	1	1	1	8	4	1	5	3	0	0	0	0	0	89
Assembly Line 1000 - Base 1000	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Assembly Line 1000 - Base 1000	6	0	0	4	0	3	2	1	0	19	2	18	0	18	26	27	4	2	2	0	2	0	0	0	0	136
Assembly Line 1000 - Base 1000	105	173	73	85	86	117	85	71	150	96	67	85	96	65	77	95	88	75	62	117	61	11	26	7	182	
Assembly Line 1000 - Base 1000	15	15	19	12	22	17	19	30	18	19	11	14	16	24	20	17	9	12	3	11	0	0	0	0	0	247
Assembly Line 1000 - Base 1000	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Assembly Line 1000 - Base 1000	1	17	2	3	5	1	0	0	28	5	2	2	10	10	30	10	0	4	0	6	0	13	8	5	168	
Assembly Line 1000 - Base 1000	5	30	7	2	6	11	9	22	10	8	7	6	11	3	2	3	9	13	19	22	18	1	1	4	229	
Assembly Line 1000 - Base 1000	32	15	27	14	23	9	22	10	30	12	25	26	26	31	23	33	24	32	21	27	26	15	16	7	829	
Assembly Line 1000 - Base 1000	2	10	1	1	3	8	3	8	3	2	0	2	0	1	2	11	2	1	3	5	11	0	17	1	97	
Assembly Line 1000 - Base 1000	0	4	5	9	5	5	4	3	12	15	6	7	27	3	4	9	5	0	0	0	0	0	0	0	0	137
Assembly Line 1000 - Base 1000	0	4	5	9	5	5	4	3	12	15	6	7	27	3	4	9	5	0	0	0	0	0	0	0	0	137
Assembly Line 1000 - Base 1000	0	3	21	4	0	2	1	0	0	3	1	2	7	1	2	0	2	0	0	0	0	0	0	0	0	48
Assembly Line 1000 - Base 1000	13	24	17	19	19	21	23	36	43	29	31	19	23	28	24	19	23	20	20	20	18	9	6	2	0	602
Assembly Line 1000 - Base 1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Assembly Line 1000 - Base 1000	27	12	6	7	9	32	5	58	105	65	10	20	47	33	14	36	43	24	33	6	10	2	13	3	0	630
Assembly Line 1000 - Base 1000	2	0	3	3	2	2	2	2	2	2	1	2	4	3	1	1	0	0	1	2	0	0	0	0	0	39
Assembly Line 1000 - Base 1000	4	6	1	6	0	2	8	8	12	5	5	7	6	12	4	4	10	13	2	3	1	0	1	0	1	129



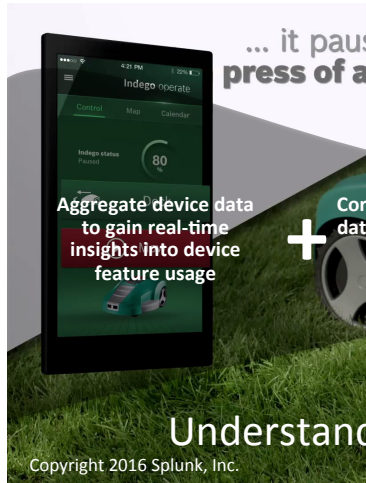
**Remote  
Freight Train  
Monitoring**

**Energy  
Efficiency  
Calculations**

**Driving Strategy  
Recommendations**

**>\$1B  
Saved**

# Challenge



CNN Opinion • Political Op-Eds Social Commentary Live TV • U.S. Edition + menu

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REPORT: Service Revenue: Unearth an Untapped Stream of Dollars ABERDEEN GROUP

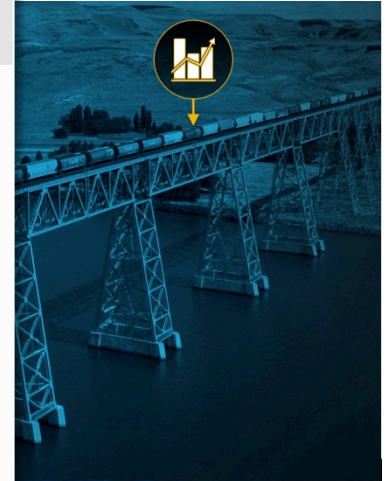
## When hackers turn your lights off

By Arun Vishwanath  
Updated 3:06 PM ET, Thu February 11, 2016

Top stories

- 46 prison guards arrested in sting
- Cruz pulls ad with porn actress

Koppel: Cyberattack on the grid could devastate U.S. 06:02



AVAILABILITY

PERFORMANCE

SECURITY

# Splunk Enables Real-time Insights

Industrial Assets



## Native Inputs

TCP, UDP, Logs, Scripts, Wire, Mobile

Consumer and Mobile Devices



## SDKs and APIs

Java, JS, C#, Python, Ruby, PHP

## Modular Inputs

MQTT, AMQP, COAP, REST, JMS

OT



## HTTP Event Collector

Token Authenticated Events

IT



## Technology Partnerships

Keypare, ThingWorx, Cisco, Palo Alto



Monitoring,  
Diagnostics



Security,  
Safety  
& Compliance



Predictive  
Maintenance



Asset  
Lifecycle  
Management

Real-time

splunk>enterprise splunk>cloud

Custom Alert  
Actions



External Lookups/Enrichment

Asset  
Info



Maintenance  
Info



Data  
Stores



# M2M: MQTT, AMQP, CoAP and HTTP

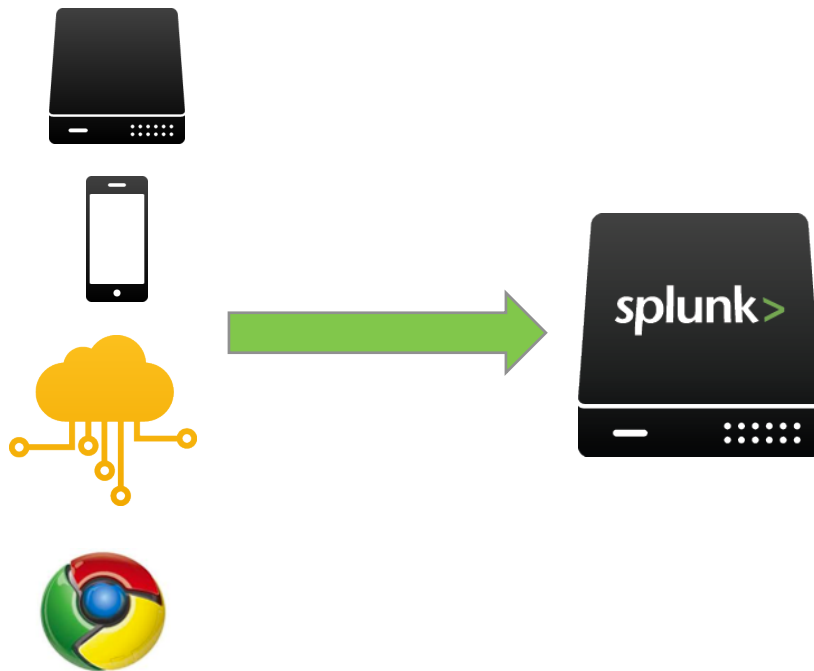
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# M2M Trends



# HTTP Event Collector

- A new token-based API for events
- Send events *directly* from anywhere (servers, mobile devices, IOT)
- Easy to configure / works out of the box.
- Easy to secure
- Highly performant, scalable and available



# MOAR LETTERS!

\*aaS, CEP and ML



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# Technology Trends



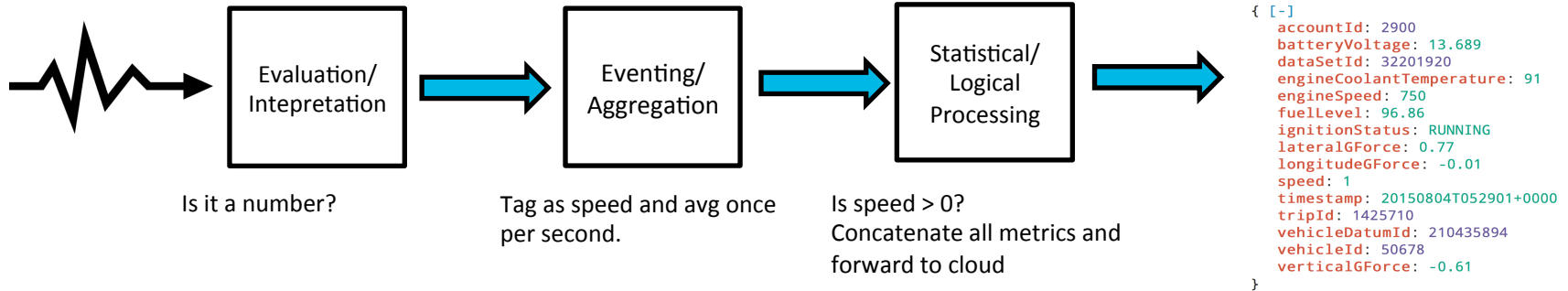
Components  
Sensors  
Actuators  
Micro-Compute

Gateways  
Controllers  
Routers

Servers  
Applications  
Infrastructure

Virtualization  
Containers  
IaaS  
PaaS  
SaaS

# Complex Event Processing

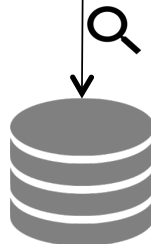


# Real-time Enrichment



```
{ [-]
  accountId: 2900
  batteryVoltage: 13.689
  dataSetId: 32201920
  engineCoolantTemperature: 91
  engineSpeed: 750
  fuelLevel: 96.86
  ignitionStatus: RUNNING
  lateralGForce: 0.77
  longitudeGForce: -0.01
  speed: 1
  timestamp: 20150804T052901+0000
  tripId: 1425710
  vehicleDatumId: 210475894
  vehicleId: 50678
  verticalGForce: -0.61
}
```

vehicleId: 50678



Average Speed of Hondas in last 24 hours?

Max Speed of Nate's in last 24 hours?

Any New Drivers?

Selected  driver   
 make   
 model   
 number

# Time-series Statistical Processing

Edge

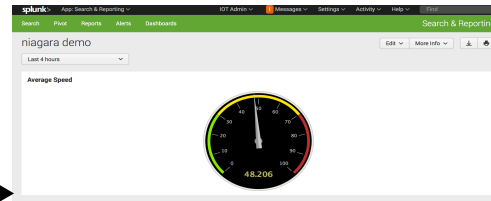
Fog ✓

Datacenter ✓

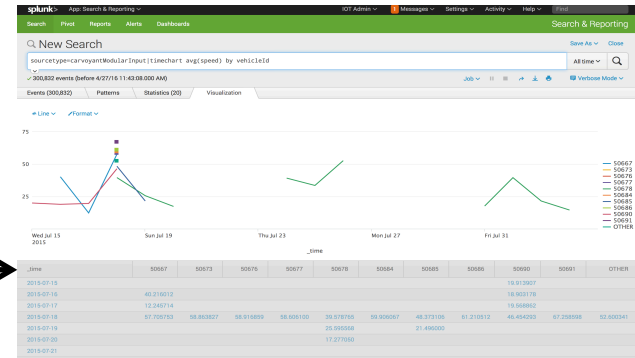
Cloud ✓

```
{ [-]  
  accountId: 2900  
  batteryVoltage: 13.689  
  dataSetId: 32201920  
  engineCoolantTemperature: 91  
  engineSpeed: 750  
  fuelLevel: 96.86  
  ignitionStatus: RUNNING  
  lateralGForce: 0.77  
  longitudeGForce: -0.01  
  speed: 1  
  timestamp: 201508041052901+0000  
  tripId: 1425710  
  vehicleDatumId: 210435894  
  vehicleId: 50678  
  verticalGForce: -0.61  
}
```

Average Speed (across vehicles)



Average Speed by Vehicle



# Machine Learning



- Data Preparation
- Model Fitting
- Validating
- Refining
- Deploying



- Anomalies
- Clusters
- Conditions
- Patterns
- Outliers
- Forecasts

# Data Preparation



# Going From This...

```
{
  "verticalGForce": 1.06,
  "fuelLevel": 47.05,
  "accountId": 2900,
  "vehicleId": 50648,
  "longitudeGForce": 0.02,
  "engineSpeed": 3090,
  "speed": 54,
  "tripId": null,
  "vehicleDatumId": 193858534,
  "lateralGForce": 0.46,
  "batteryVoltage": 12.495,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 90,
  "dataSetId": 29927561,
  "timestamp": "20150718T225959+0000",
  "longitude": -122.45213,
  "latitude": 38.159863,
  "heading": 162.98
},
{
  "verticalGForce": -2.0,
  "fuelLevel": 65.49,
  "accountId": 2900,
  "vehicleId": 50677,
  "longitudeGForce": 0.01,
  "engineSpeed": 760,
  "tripId": null,
  "vehicleDatumId": 193858485,
  "lateralGForce": 0.93,
  "batteryVoltage": 13.592,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 86,
  "dataSetId": 29927552,
  "timestamp": "20150718T225959+0000",
  "longitude": -122.4539,
  "latitude": 38.16015,
  "heading": 51.17
},
{
  "verticalGForce": 0.18,
  "fuelLevel": 18.43,
  "accountId": 2900,
  "vehicleId": 50685,
  "longitudeGForce": 0.38,
  "engineSpeed": 4048,
  "speed": 78,
  "tripId": 1363721,
  "vehicleDatumId": 193858471,
  "lateralGForce": 1.08,
  "batteryVoltage": 14.167,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 91,
  "dataSetId": 29927551,
  "timestamp": "20150718T225959+0000",
  "longitude": -122.4553,
  "latitude": 38.161987,
  "heading": 298.08
},
{
  "verticalGForce": 1.01,
  "fuelLevel": 69.01,
  "accountId": 2900,
  "vehicleId": 50676,
  "longitudeGForce": 0.07,
  "engineSpeed": 3816,
  "speed": 67,
  "tripId": 1363723,
  "vehicleDatumId": 193858393,
  "lateralGForce": -0.11,
  "batteryVoltage": 14.157,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 87,
  "dataSetId": 29927541,
  "timestamp": "20150718T225959+0000",
  "longitude": -122.4642,
  "latitude": 38.1682,
  "heading": 340.69
},
{
  "verticalGForce": -0.25,
  "fuelLevel": 71.37,
  "accountId": 2900,
  "vehicleId": 50660,
  "longitudeGForce": -0.32,
  "engineSpeed": 2769,
  "speed": 19,
  "tripId": 1363654,
  "vehicleDatumId": 193858326,
  "lateralGForce": 0.99,
  "batteryVoltage": 13.643,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 86,
  "dataSetId": 29927532,
  "timestamp": "20150718T225959+0000",
  "longitude": -122.44953,
  "latitude": 38.15109,
  "heading": 204.26
},
{
  "verticalGForce": -0.17,
  "massAirflow": 23.81,
  "fuelLevel": 61.96,
  "accountId": 2900,
  "vehicleId": 50667,
  "longitudeGForce": -0.04,
  "engineSpeed": 3282,
  "speed": 73,
  "tripId": 1363635,
  "vehicleDatumId": 193858200,
  "intakeTemperature": 34,
  "lateralGForce": -0.06,
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  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 102,
  "dataSetId": 29927517,
  "timestamp": "20150718T225959+0000",
  "manifoldPressure": 22,
  "longitude": -122.4566,
  "latitude": 38.161934,
  "instantaneousMpg": 35.1,
  "heading": 167.27
},
{
  "verticalGForce": -2.0,
  "fuelLevel": 65.49,
  "accountId": 2900,
  "vehicleId": 50677,
  "longitudeGForce": 0.01,
  "engineSpeed": 773,
  "tripId": null,
  "vehicleDatumId": 193858468,
  "lateralGForce": 0.93,
  "batteryVoltage": 13.592,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 86,
  "dataSetId": 29927550,
  "timestamp": "20150718T225958+0000",
  "longitude": -122.4539,
  "latitude": 38.16015,
  "heading": 51.17
},
{
  "verticalGForce": 0.21,
  "fuelLevel": 18.43,
  "accountId": 2900,
  "vehicleId": 50685,
  "longitudeGForce": 0.61,
  "engineSpeed": 4019,
  "speed": 78,
  "tripId": 1363721,
  "vehicleDatumId": 193858444,
  "lateralGForce": 1.11,
  "batteryVoltage": 14.167,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 91,
  "dataSetId": 29927547,
  "timestamp": "20150718T225958+0000",
  "longitude": -122.45495,
  "latitude": 38.16177,
  "heading": 306.42
},
{
  "verticalGForce": 0.93,
  "fuelLevel": 69.01,
  "accountId": 2900,
  "vehicleId": 50676,
  "longitudeGForce": -0.12,
  "engineSpeed": 3883,
  "speed": 68,
  "tripId": 1363723,
  "vehicleDatumId": 193858358,
  "lateralGForce": -0.5,
  "batteryVoltage": 14.157,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 87,
  "dataSetId": 29927537,
  "timestamp": "20150718T225958+0000",
  "longitude": -122.4642,
  "latitude": 38.16802,
  "heading": 332.44
},
{
  "verticalGForce": 0.05,
  "fuelLevel": 71.37,
  "accountId": 2900,
  "vehicleId": 50660,
  "longitudeGForce": -0.22,
  "engineSpeed": 2493,
  "speed": 18,
  "tripId": 1363654,
  "vehicleDatumId": 193858301,
  "lateralGForce": 1.0,
  "batteryVoltage": 13.643,
  "ignitionStatus": "RUNNING",
  "engineCoolantTemperature": 86,
  "dataSetId": 29927530,
  "timestamp": "20150718T225958+0000",
  "longitude": -122.44951,
  "latitude": 38.151134,
  "heading": 209.75
}
```

# ...To This...

batteryVoltage	engineCoolantTemperature	engineSpeed	lateralGForce	longitudeGForce	speed	vehicleType	verticalGForce
13.785	93	6060	1.11	0.5	69	2015 Porsche GT3	-2.0
13.937	94	4957	0.56	0.7	56	2013 Audi RS5	0.95
13.827	93	6163	0.71	0.26	70	2015 Porsche GT3	-2.0
14.035	87	2846	0.81	-0.71	47	2011 Ford Mustang GT500	-2.0
13.827	93	6542	0.49	-0.18	76	2015 Porsche GT3	-2.0
14.624	105	4425	0.32	0.05	100	2014 Chevrolet Corvette	-0.17
13.827	93	7763	0.24	-0.18	91	2015 Porsche GT3	-2.0
13.827	93	6365	0.38	-0.2	95	2015 Porsche GT3	-2.0
13.827	93	6713	0.04	0.13	100	2015 Porsche GT3	-2.0
14.262	-10	1508	0.65	-0.01	6	2013 Audi RS5	0.77
13.931	6	4374	0.9	-0.82	49	2013 Audi RS5	0.6
13.808	92	5217	-0.3	0.57	86	2015 Porsche GT3	-2.0
13.808	92	4303	-0.27	0.54	60	2015 Porsche GT3	-2.0
13.808	92	4472	-0.64	0.25	47	2015 Porsche GT3	-2.0
13.808	92	4472	-0.89	-0.31	47	2015 Porsche GT3	-2.0
13.808	92	3536	-0.86	-0.39	40	2015 Porsche GT3	-2.0
13.808	92	3499	-0.78	-0.42	39	2015 Porsche GT3	-2.0
13.716	93	3663	-0.79	-0.54	42	2015 Porsche GT3	-2.0
13.716	93	3810	-0.81	-0.46	44	2015 Porsche GT3	-2.0
14.625	105	3526	0.63	0.57	56	2014 Chevrolet Corvette	-0.17



# ...To THIS!

Search Showcase Assistants Docs ML Toolkit and Showcase

New Search Save As Close

```
| inputlookup track_day.csv | apply "example_vehicle_type" | `confusionmatrix("vehicleType","predicted(vehicleType)")`
```

✓ 6 results (7/26/16 10:52:00.000 AM to 7/26/16 11:52:18.000 AM) No Event Sampling

Events Patterns Statistics (6) Visualization

20 Per Page Format Preview

Predicted actual	Predicted 2008 BMW M3	Predicted 2011 Ferrari 458	Predicted 2011 Ford Mustang GT500	Predicted 2013 Audi RS5	Predicted 2014 Chevrolet Corvette	Predicted 2015 Porsche GT3
2008 BMW M3	8826	0	0	15	0	3
2011 Ferrari 458	0	6672	0	227	9	0
2011 Ford Mustang GT500	0	0	7296	0	1	175
2013 Audi RS5	143	170	0	6918	369	0
2014 Chevrolet Corvette	50	38	0	20	10833	0
2015 Porsche GT3	0	0	185	0	0	7030

# Demo



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# What Now?

## Related breakout sessions and activities...

- Monitoring the Industrial Internet of Things, EnerNOC:  
Thursday 12:25 PM-1:10 PM
- Listen to the Wind – Monitoring Wind Energy and SCADA:  
Tuesday 10:30 AM-11:15 AM
- Splunk on the Shopfloor: Improving Plant Operations:  
Wednesday 2:15 PM-3:00 PM
- Internet of Big Rolling Things – DB Cargo's European Rolling Stock:  
Wednesday 1:10 PM-1:55 PM

# THANK YOU

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