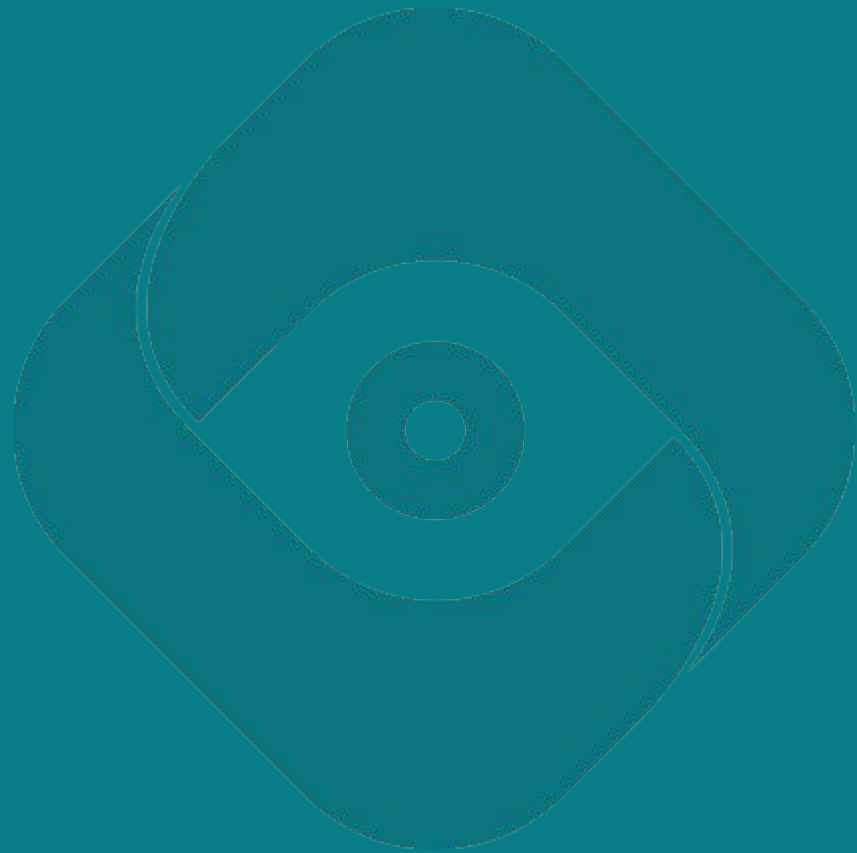


# Oden Bigtable

Devon Peticolas - Oden Technologies

# Devon Peticolas

Sr. Data Engineer

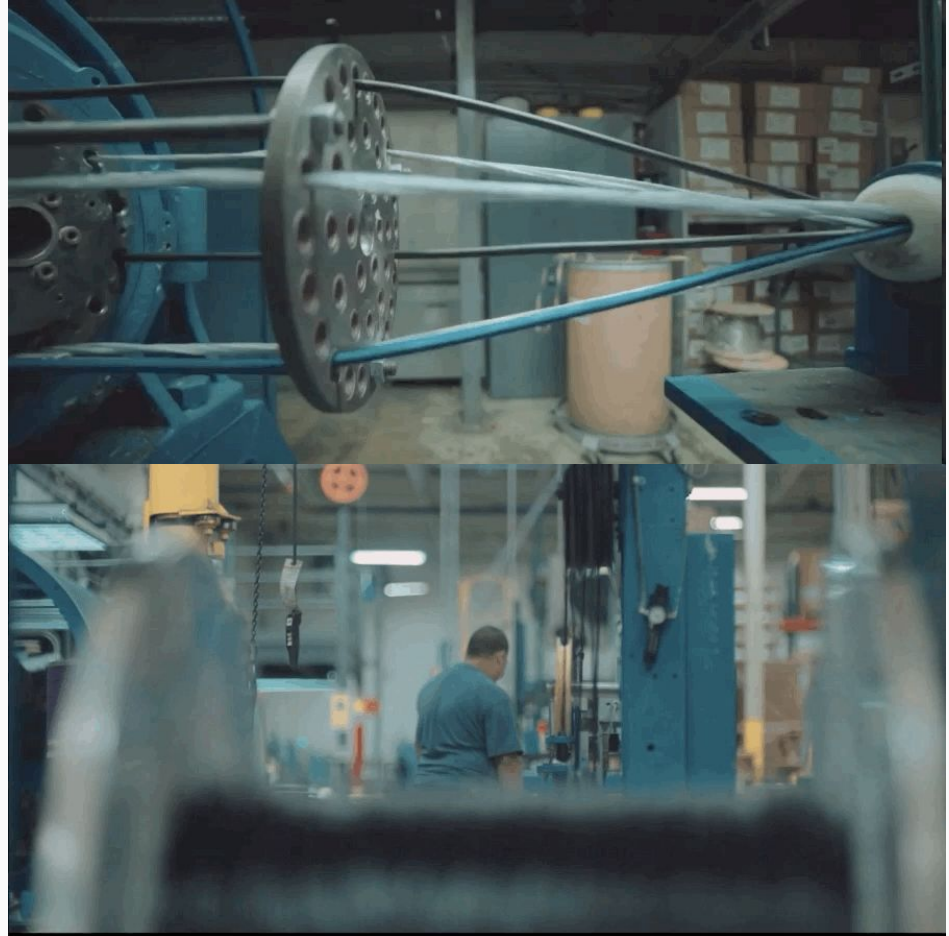


# Oden's Customers

Medium to large manufacturers in plastics, plastics extrusion, injection molding, and metal stamping.

Process and Quality engineers looking to centralize, analyze, and act on their data.

Plant managers who are looking to optimize logistics, output, and cost.

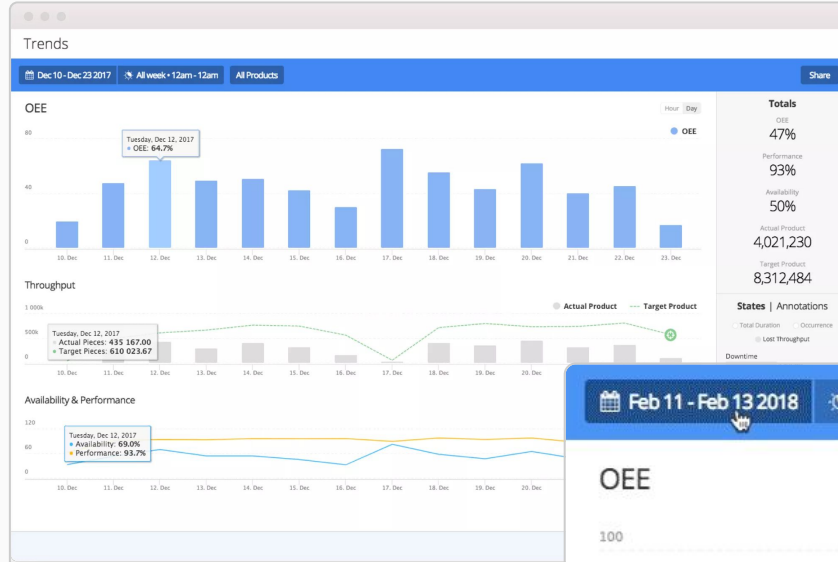


# \$3,200,000,000

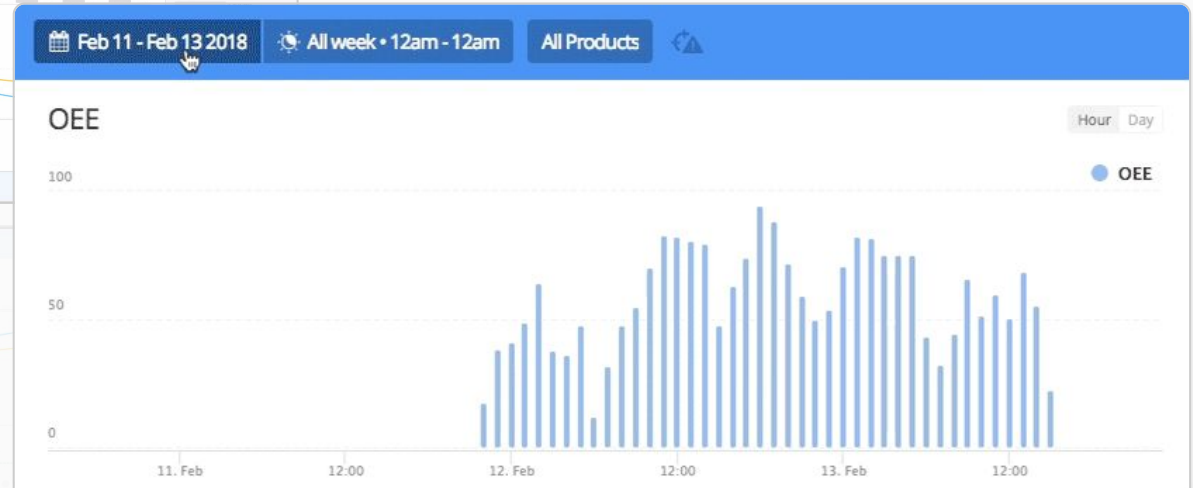
Projected impact on global GDP from manufacturing IoT over by 2031  
~ McKinsey, 2016



# Interactive Time-series Analysis

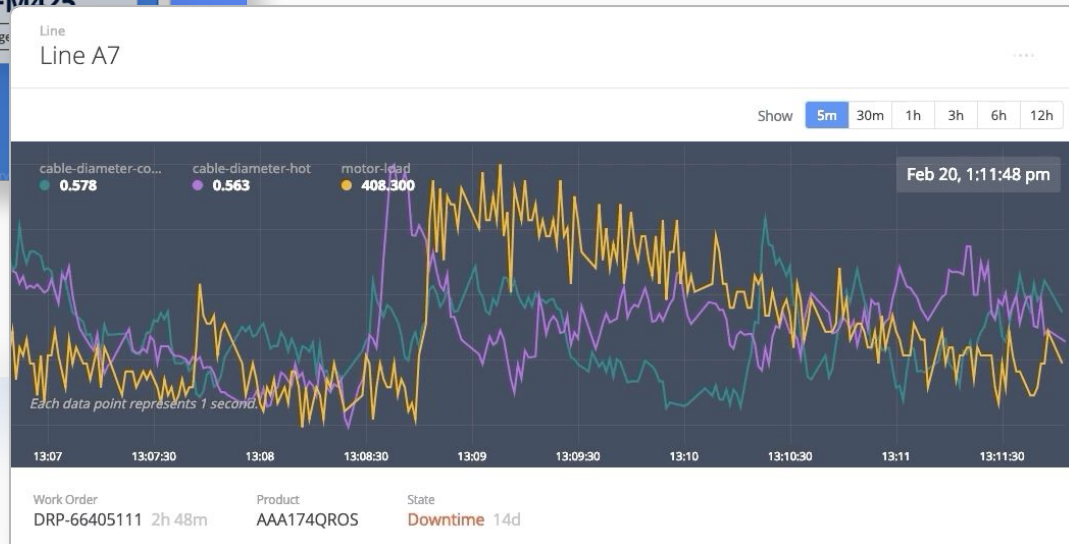
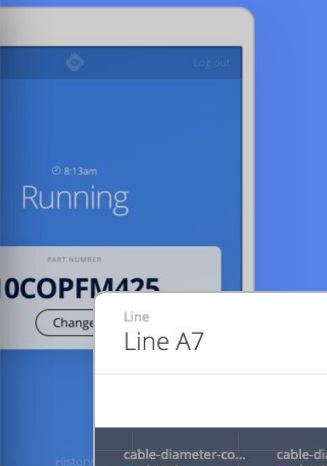
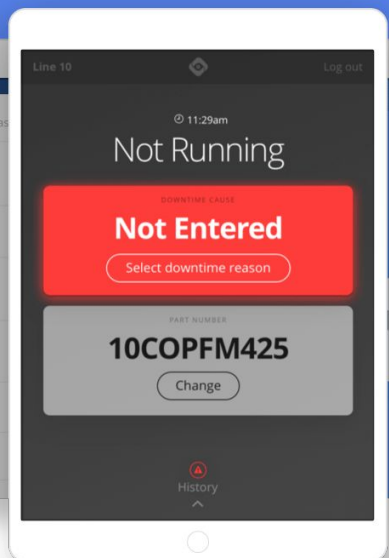


- Compare performance across different equipment.
- Visualize hourly uptime and key custom metrics.
- OEE calculations for analyzing and optimizing factory performance.



# Real Time Manufacturing Data

- Streaming second-by-second metrics
- Interactive app that prompts on production state changes and collects operator input.



# Reporting and Alerting

- Daily summaries on key process metrics from continuous intervals of production work.
- Real-time email and text alerts on target violations and concerning trends.



## Daily Run Report

Runs completed 9:00am EST February 12, 2019 – 9:00am EST February 13, 2019

Runs sorted by worst Cpk for Cold OD Avg

### SWJNG519-LQ8

Line 10 · 10 Reels · 06:11 2/12 – 11:42 2/12 · 3h 16m uptime

[View run →](#)

METRIC	MEAN	STD DEV	TARGET	NON CON*	Cpk
Cold OD Avg	0.403	0.010	0.391 - 0.411	4.235%	0.274
Feet per min	274.794	194.059	-	-	-

### SWHD72Y-R4

Line 10 · 10 Reels · 10:08 2/12 – 12:34 2/13 · 1h 35m uptime

[View run →](#)

METRIC	MEAN	STD DEV	TARGET	NON CON*	Cpk
Cold OD Avg	0.141	0.002	0.135 - 0.145	0.242%	0.782
Feet per min	829.680	492.109	-	-	-



ALERT

## Downtime violation on Line 1

As of 12:55pm, Line 1 has been in Downtime for more than 15 minutes.

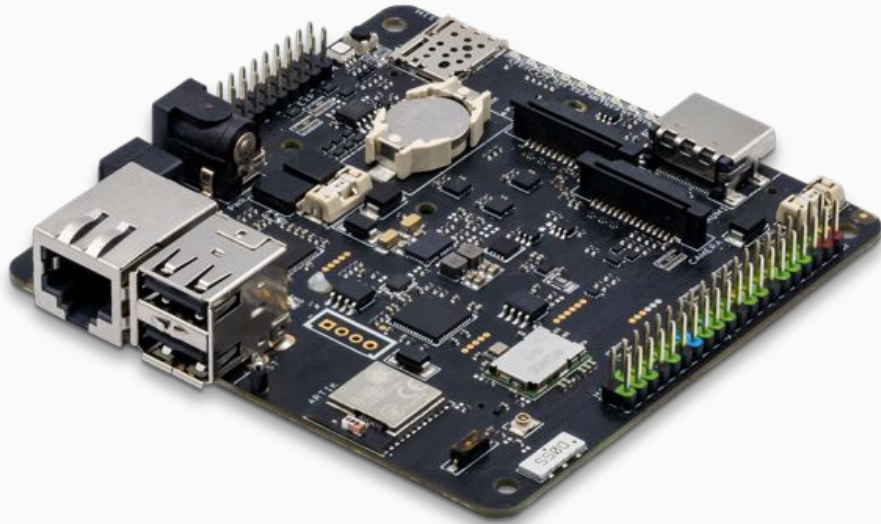
[View line](#)

Snooze this alert for: [30m](#) [2h](#) [8h](#) [24h](#)

Powered by Oden Technologies

Is this alert useful? [Let us know!](#)



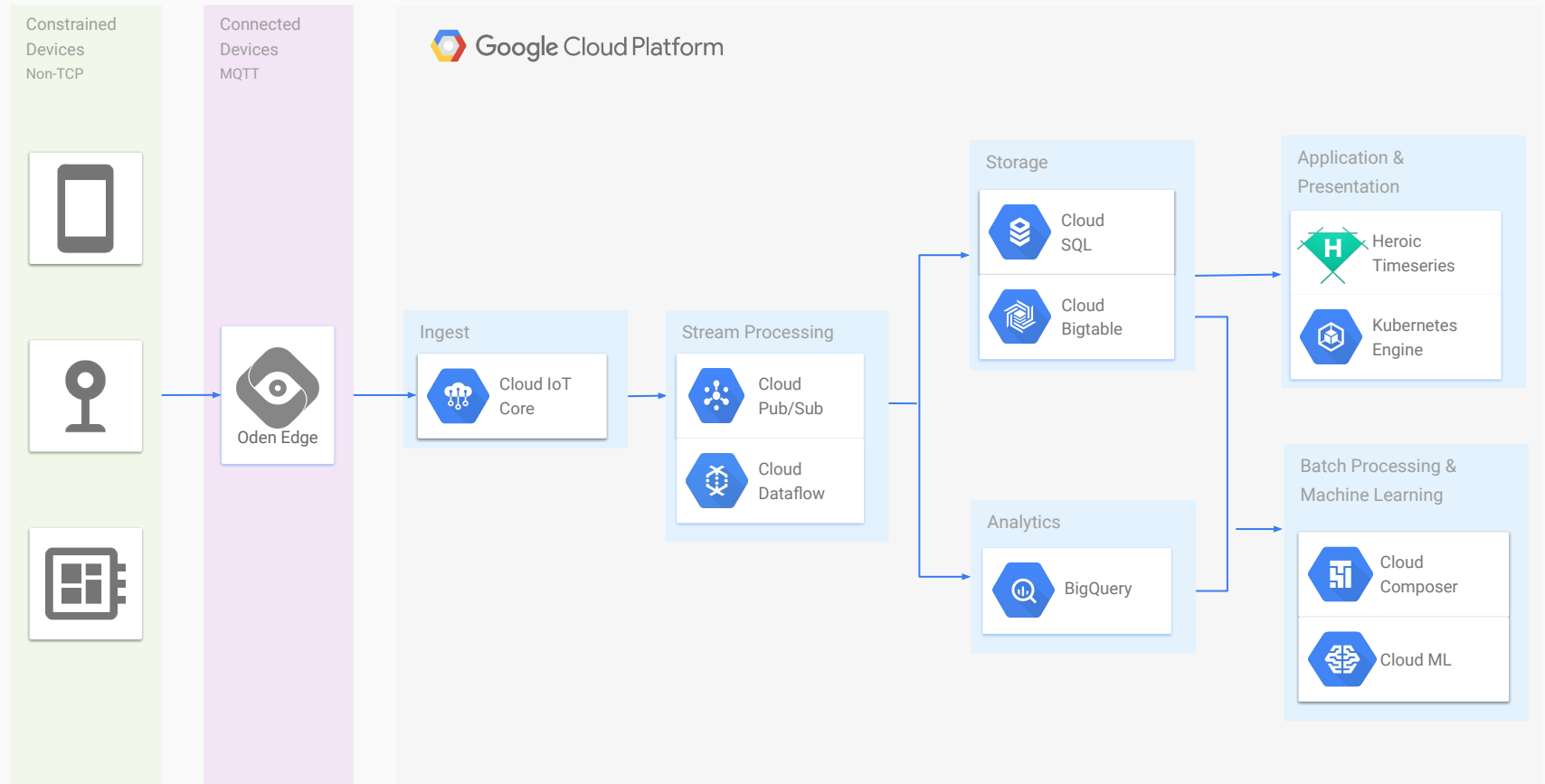


## Oden Edge Device

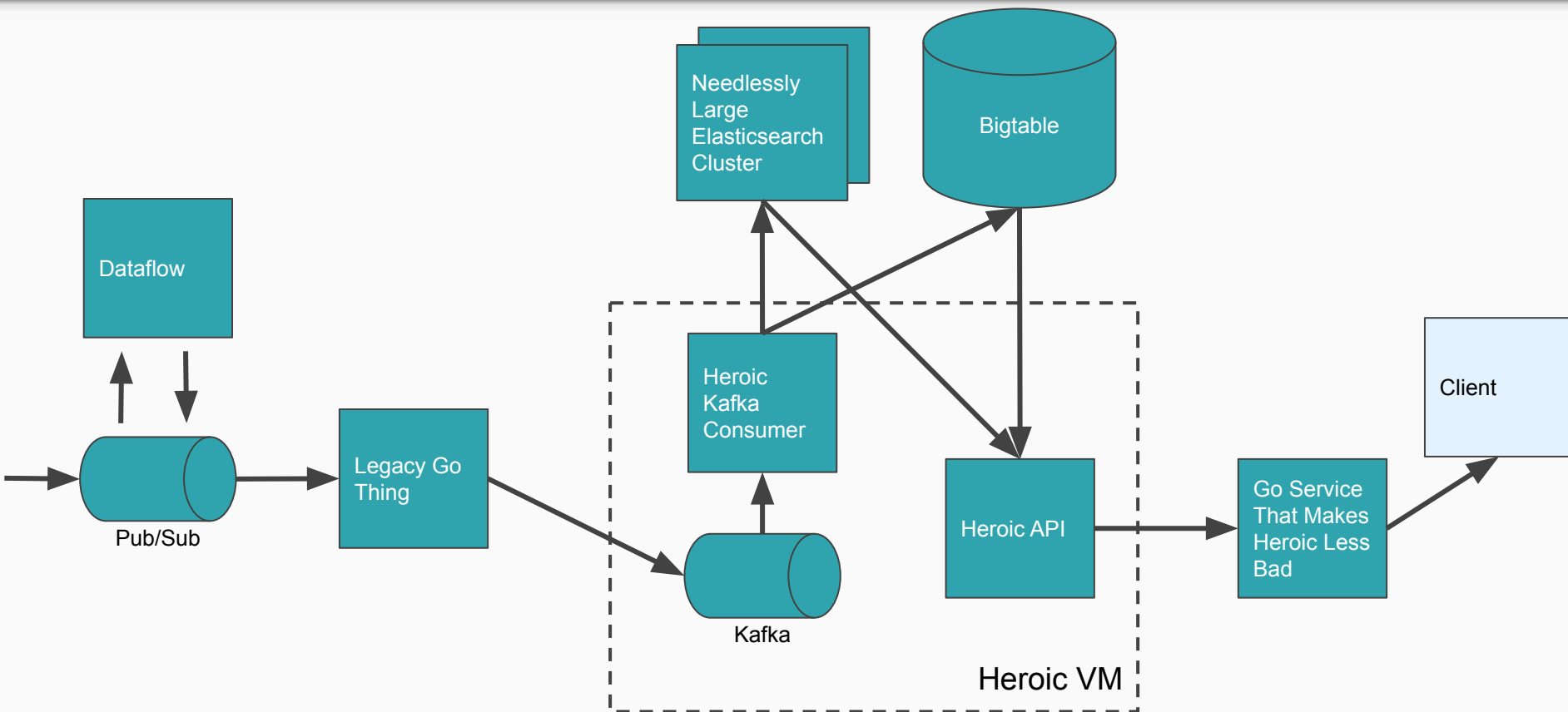
- Embedded Linux device
- Python and Go docker containers that interact with industrial protocols over serial and ethernet
- Connects to cloud via Google IoT and wired, wifi, and cellular networks



# Technology - Architecture (Pretty Overview)



# Technology - Closer Look (The Dirty Reality)



# Rolling Up Metrics to Reduce Scanning

Raw Metrics	t0	t1	t2	t3	t4	t5	t6	t7	t8	t9	t10	t11	t12	t13	t14	t15	t16	t17	t18	t19
First Rollups	rollup [t0, t2)		rollup [t2, t4)		rollup [t4, t6)		rollup [t6, t8)		rollup [t8, t10)		rollup [t10, t12)		rollup [t12, t14)		rollup [t14, t16)		rollup [t16, t18)		rollup [t18, t20)	
Second Rollups	rollup [t0, t4)				rollup [t4, t8)				rollup [t8, t12)				rollup [t12, t16)				rollup [t16, t20)			

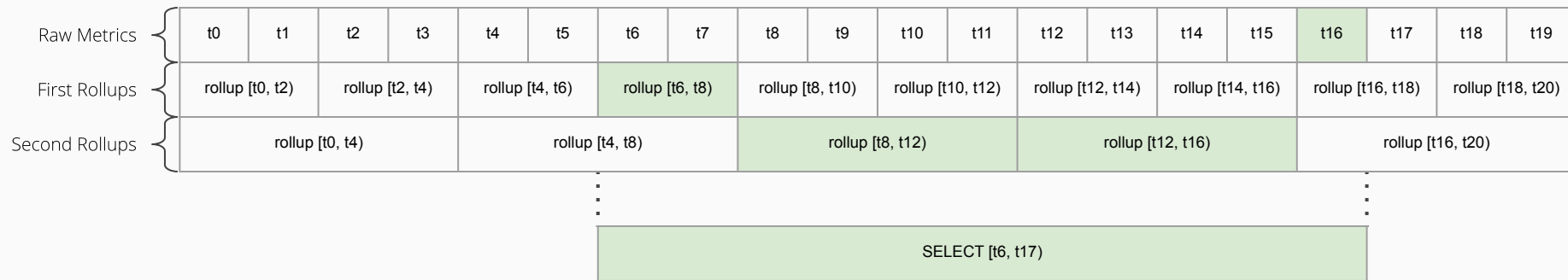
Rollup stepping window of metrics using  
*associative aggregates*.

- Count
- Sum
- Min, Max
- Sum2 - sum of x squared

$(x * y) * z = x * (y * z)$  for all  $x, y, z$  in  $S$

$f(A \cup B) = g(f(A), f(B))$

# Rolling Up Metrics to Reduce Scanning



Rollup stepping window of metrics using *associative aggregates*.

- Count
- Sum
- Min, Max
- Sum2 - sum of x squared

$(x * y) * z = x * (y * z)$  for all  $x, y, z$  in  $S$

$f(A \cup B) = g(f(A), f(B))$

$\text{sum}(A \cup B) = \text{sum}(A) + \text{sum}(B)$

$\text{count}(A \cup B) = \text{count}(A) + \text{count}(B)$

$\text{max}(A \cup B) = \text{max}(\text{max}(A), \text{max}(B))$

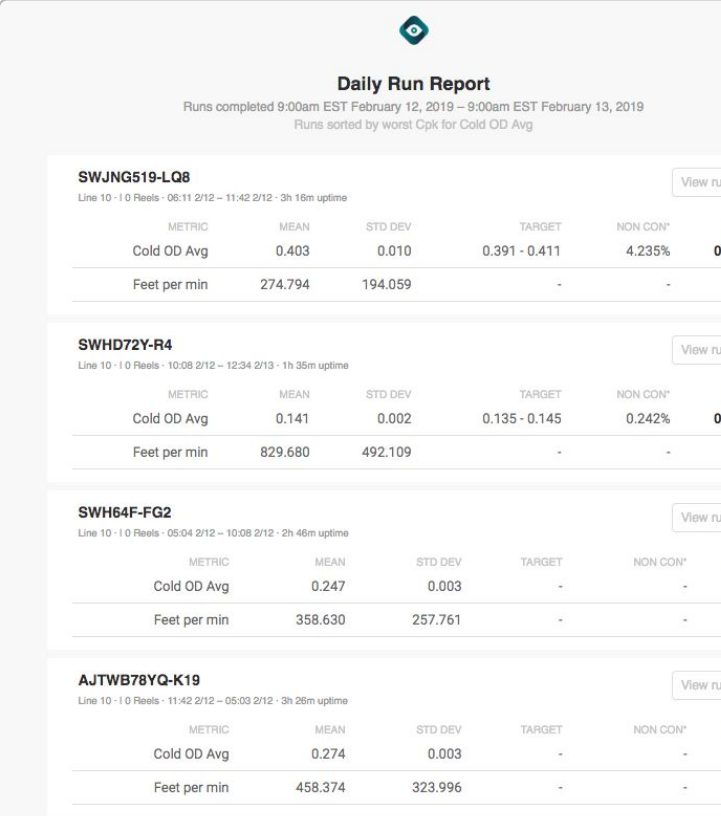
$\text{sum2}(A \cup B) = \text{sum2}(A \cup B) + \text{sum2}(A \cup B)$

$\text{mean}(A \cup B) = \text{sum}(A \cup B) / \text{count}(A \cup B)$

$\text{stddev}(A \cup B) = 1/(\text{count}(A \cup B) * (\text{count}(A \cup B) - 1)) * (\text{sum2}(A \cup B) - \text{sum}(A \cup B)^2)$

# Our Future With Bigtable

- Low maintenance, low cost, resilient way of storing *any* series data
  - Maintenance has been near zero
  - Regional replication means no manual replication
  - Possibly a good *single-source-of-truth* event-store
- Keeping BigQuery in sync with Bigtable is hard
  - Bigtable + Heroic solves deduplication, BigQuery doesn't
  - External tables for time series data are non-performant
- Need to solve window joins
  - Growing product need for join queries such as...  
"Sort windows when different products were manufactured by stddev of their quality control metric"
- Not leaving our stack any time soon.



**Daily Run Report**  
Runs completed 9:00am EST February 12, 2019 – 9:00am EST February 13, 2019  
Runs sorted by worst Cpk for Cold OD Avg

SWJNG519-LQ8					
Line 10 - 10 Reels - 06:11 2/12 – 11:42 2/12 - 3h 16m uptime					
METRIC	MEAN	STD DEV	TARGET	NON CON*	
Cold OD Avg	0.403	0.010	0.391 - 0.411	4.235%	0
Feet per min	274.794	194.059	-	-	

SWHD72Y-R4					
Line 10 - 10 Reels - 10:08 2/12 – 12:34 2/13 - 1h 35m uptime					
METRIC	MEAN	STD DEV	TARGET	NON CON*	
Cold OD Avg	0.141	0.002	0.135 - 0.145	0.242%	0
Feet per min	829.680	492.109	-	-	

SWH64F-FG2					
Line 10 - 10 Reels - 05:04 2/12 – 10:08 2/12 - 2h 46m uptime					
METRIC	MEAN	STD DEV	TARGET	NON CON*	
Cold OD Avg	0.247	0.003	-	-	
Feet per min	358.630	257.761	-	-	

AJTWB78YQ-K19					
Line 10 - 10 Reels - 11:42 2/12 – 05:03 2/13 - 3h 26m uptime					
METRIC	MEAN	STD DEV	TARGET	NON CON*	
Cold OD Avg	0.274	0.003	-	-	
Feet per min	458.374	323.996	-	-	

See all runs for day

# Thank You

We're hiring! [oden.io/jobs](https://oden.io/jobs)

