Achieve Operational Efficiency in Car Manufacturing with Advanced Analytics

Dr. Sebastian Schmerl | Solution Manager Cyber Defense for Production and IoT
Philipp Drieger | Sr. Sales Engineer | SME BA IoT ML

28. September 2017 | Washington, DC

Forward-Looking Statements

During the course of this presentation, we may make forward-looking statements regarding future events or the expected performance of the company. We caution you that such statements reflect our current expectations and estimates based on factors currently known to us and that actual events or results could differ materially. For important factors that may cause actual results to differ from those contained in our forward-looking statements, please review our filings with the SEC.

The forward-looking statements made in this presentation are being made as of the time and date of its live presentation. If reviewed after its live presentation, this presentation may not contain current or accurate information. We do not assume any obligation to update any forward looking statements we may make. In addition, any information about our roadmap outlines our general product direction and is subject to change at any time without notice. It is for informational purposes only and shall not be incorporated into any contract or other commitment. Splunk undertakes no obligation either to develop the features or functionality described or to include any such feature or functionality in a future release.

Your 3 key takeaways from this session

Understand challenges in industrial production and data driven approaches

Learn how to collect low layer data from production environments

Get insights how to gain operational efficiency with data analytics

Agenda

Agenda

- Some brief words about us
- Challenges in industrial production environments based on car assembly lines
- Production data acquisition
  - High and low layers of production data
  - Active & passive data capturing
- Data collection infrastructure
- Data analytics for different levels of production data
  - Analysis of layer 3&4 data - MES, Historian Data
  - Analysis of layer 1&2 data – raw sensor and actuator data
- Some Splunk numbers
- Summary, Q&A

Computacenter AG & Co.

Europe‘s leading independent provider of IT Infrastructure services

Computacenter’s ambition is to be Europe’s preferred IT provider to enable users and their business in a digital world

Computacenter’s mission is to maximise user productivity and the business value of IT for Enterprise and Corporate organisations. In doing so, we deliver strong returns for our shareholders and enrich our employees’ careers.

WHAT WE DO

Manage & Transform

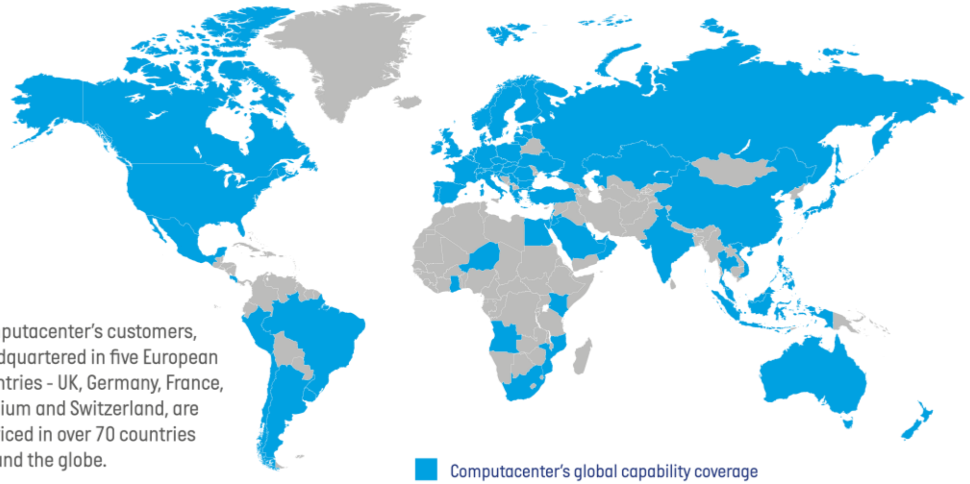
Consult & Change

Source & Deploy

4.2m Users Supported

NO.1 For satisfaction in end-user service provision

UK | Germany | France | Belgium **Whitelane Research, 2016, 2015**



Computacenter’s customers, headquartered in five European countries - UK, Germany, France, Belgium and Switzerland, are serviced in over 70 countries around the globe.

Computacenter’s global capability coverage

Dr. Sebastian Schmerl

Head of
Production Data Analytics,
Industrial Security,
Cyber Defense

Subject Matter Expert for:

- SOCs
- ICS & SCADA Security
- Industry 4.0 & Data Science

Contact: Sebastian.Schmerl@computacenter.com

Bio: Philipp Drieger

Sr. Sales Engineer

- Splunker since 2015.
- Subject Matter Expert for Business Analytics, IoT and Machine Learning
- Before Splunk: lots of software development, data analytics and visualization
- Enjoys this year .conf with 2 talks:
  - Automating Thread Hunting with Machine Learning (tomorrow 1:10pm!)
  - Achieve Operational Efficiency in Car Manufacturing with Advanced Analytics
- Good chance to meet me at ML or IoT Booths
- Questions? Feedback? Let me know: philipp@splunk.com

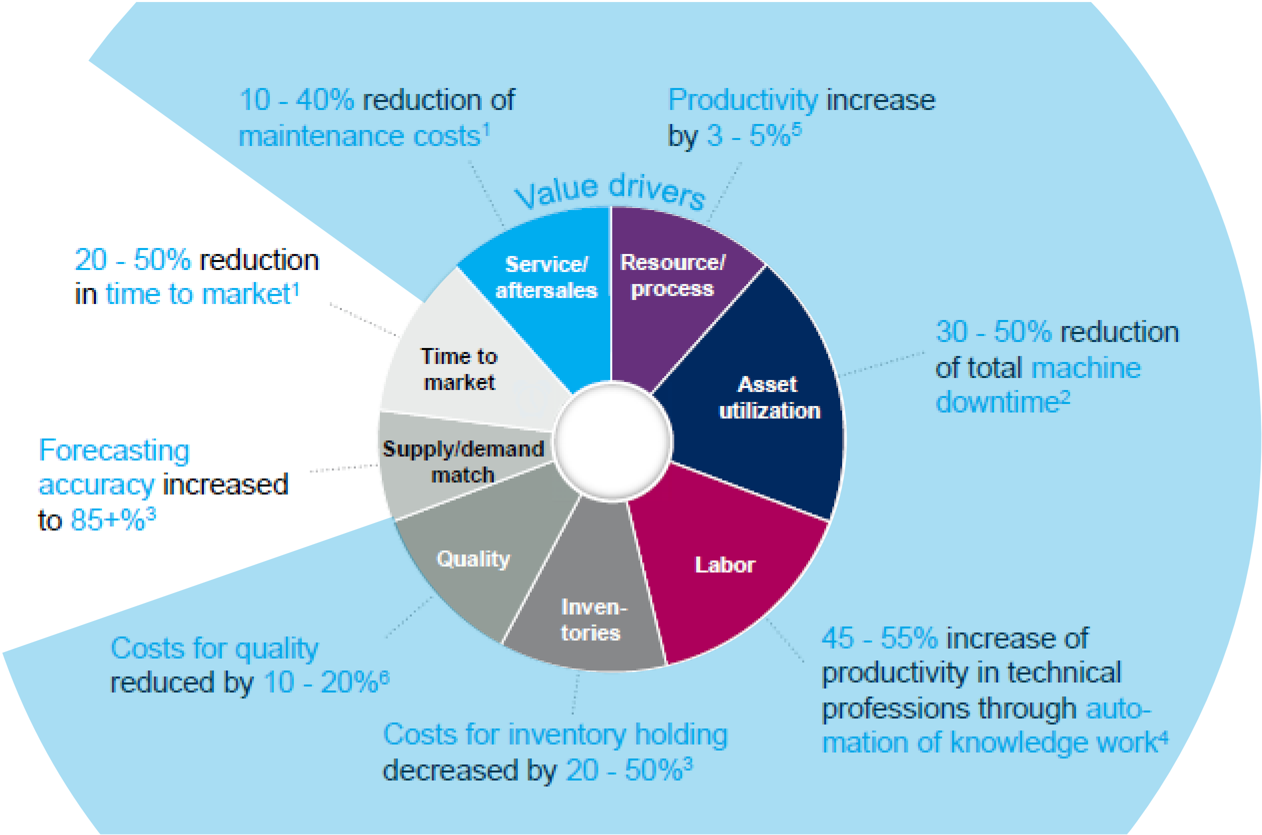
Challenges in industrial production environments based on car assembly lines

Computacenter

splunk> .conf2017

Digitization of Production

Analytics as main value drivers



Source: Industry 4.0 How to navigate digitization of the manufacturing sector

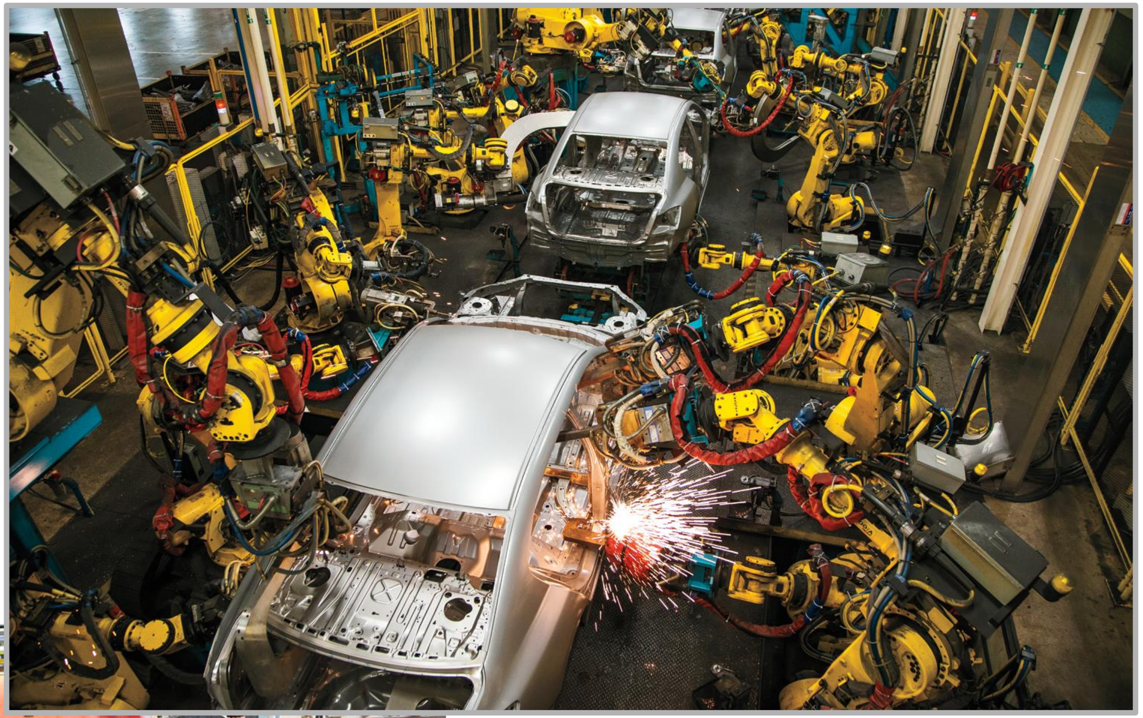
Industrie 4.0 - increase in productivity over 20 percent

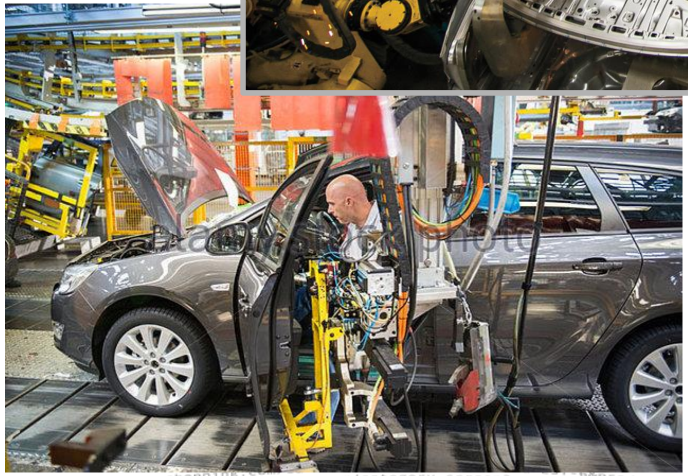
Plants and Analytics are in Focus

common sense in
all market analysis reports

Challenges in Car Production Environments

- Large and complex systems with plenty of components, e.g.:
  - Conveyor systems, robots, gripping systems, welding systems, cluing systems, screwing systems, and safety-system
- Unique systems, tailored to the production process
- Build by system integrators
- Long lifespan ~10 years
- Maintenance problems can’t be known at construction time.
- Leverage data analysis for process optimization



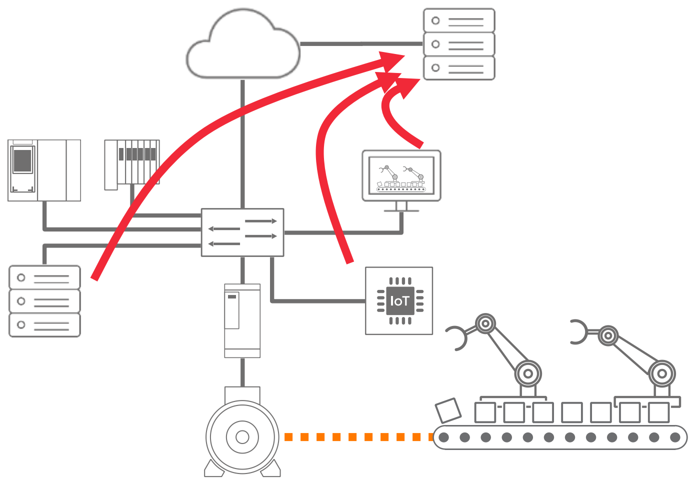


Sources: taqplayer.info, cnsanf.com, castrol.com

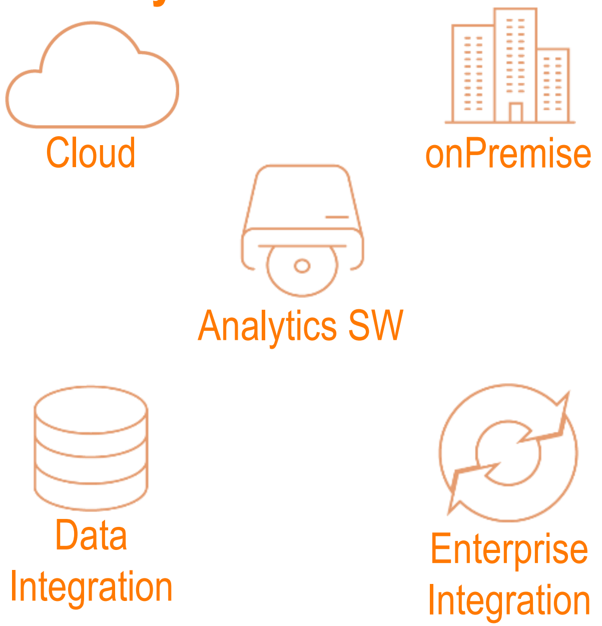
Production Analytics Challenges

No Data - No Analytics | No Analytics - No Progress

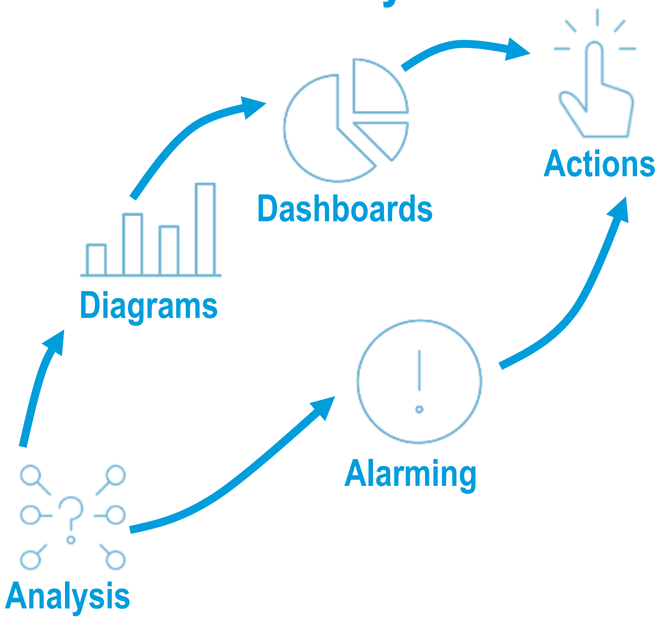
Data Acquisition



Analytics Infrastructure



Data Analytics

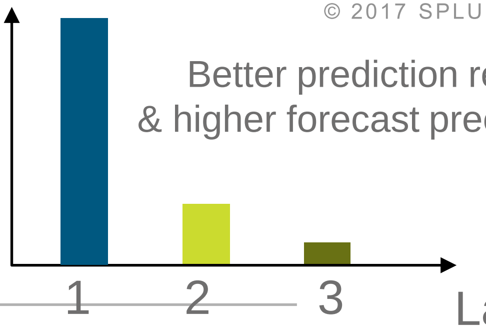


Production data acquisition

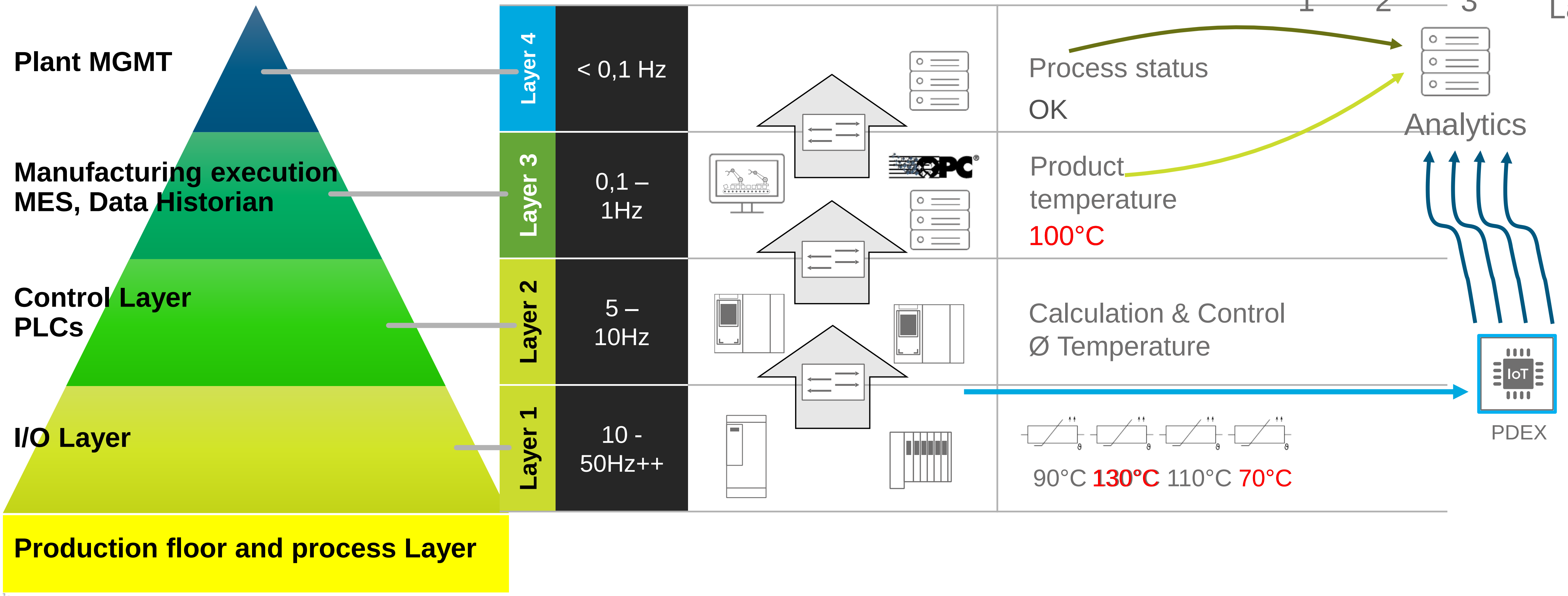
From data layers and
non-invasive production data extraction

Production Data Layers

Example from the process industry



High aggregated data
nearly status information only



Fine grained temporal & sensor values
of production data

Active and Passive Data Acquisition

	ACTIVE	PASSIVE
PRO	• no data transformation • no data dissection	• non invasive • no changes on automation cells • no discussions, no re-certifications • easy rollout
CON	• configuration changes • polling of information • PLC CPU time & memory	• more complex

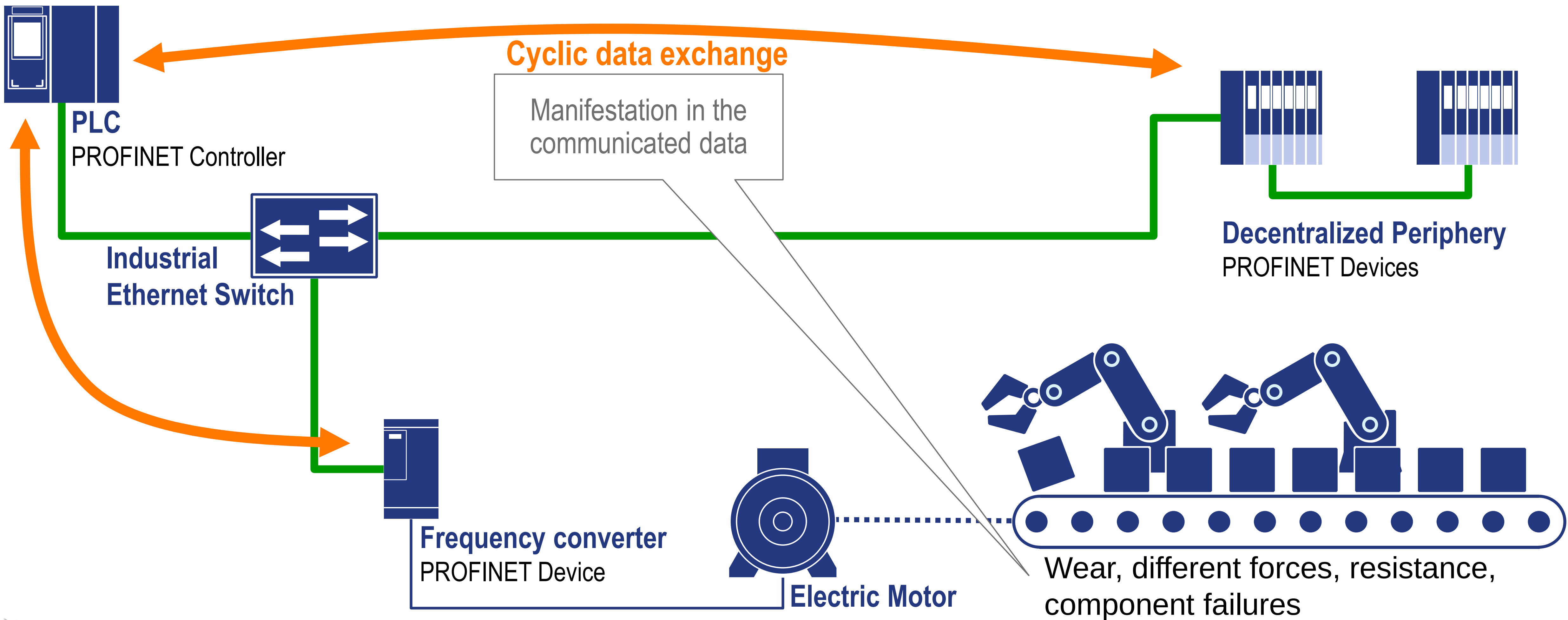
kepware®

PDEX

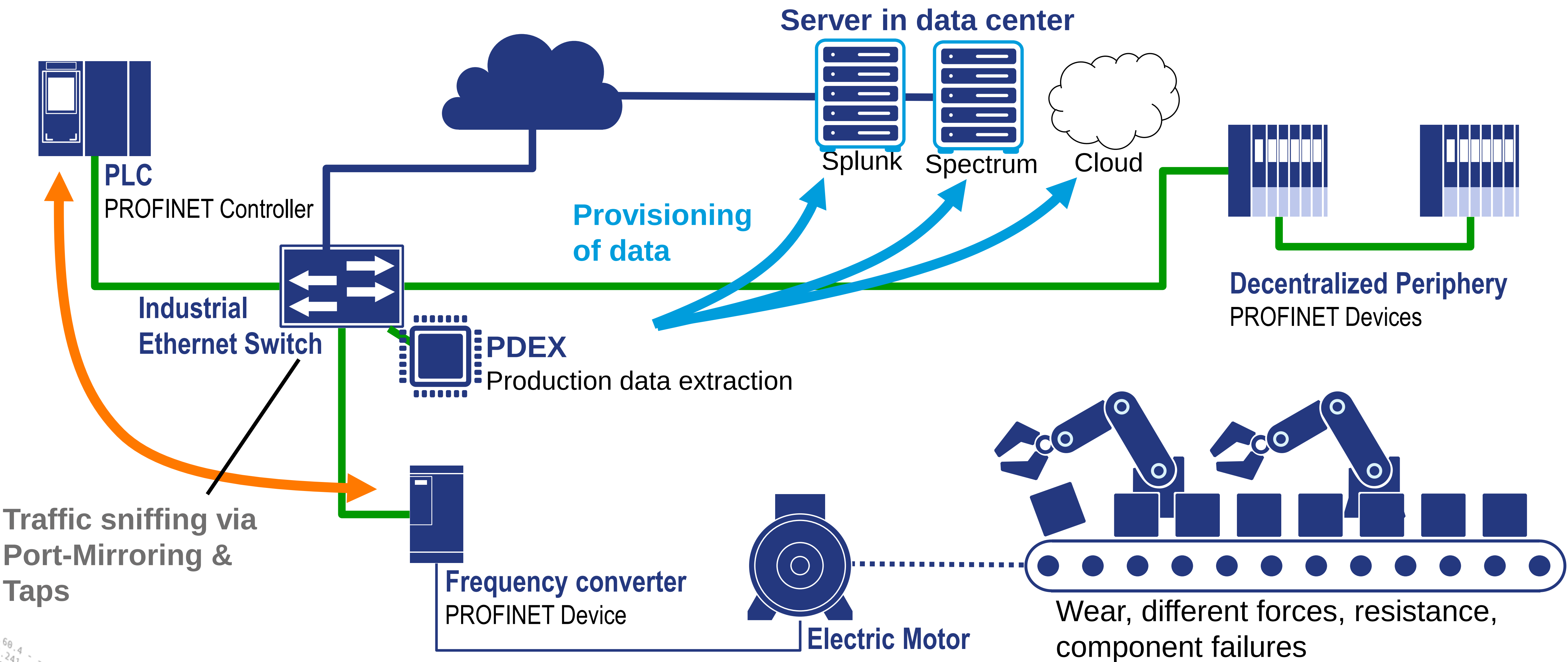
splunk> .conf2017

Computacenter

PDEX – Extraction of Production Data



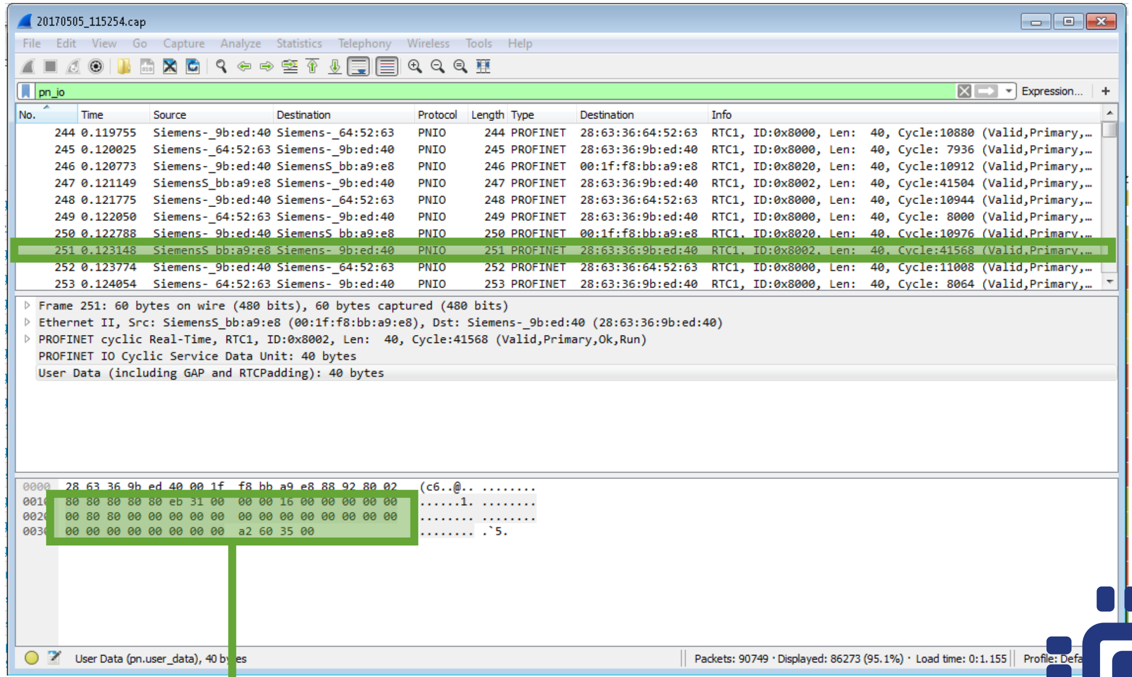
PDEX – Extraction of Production Data



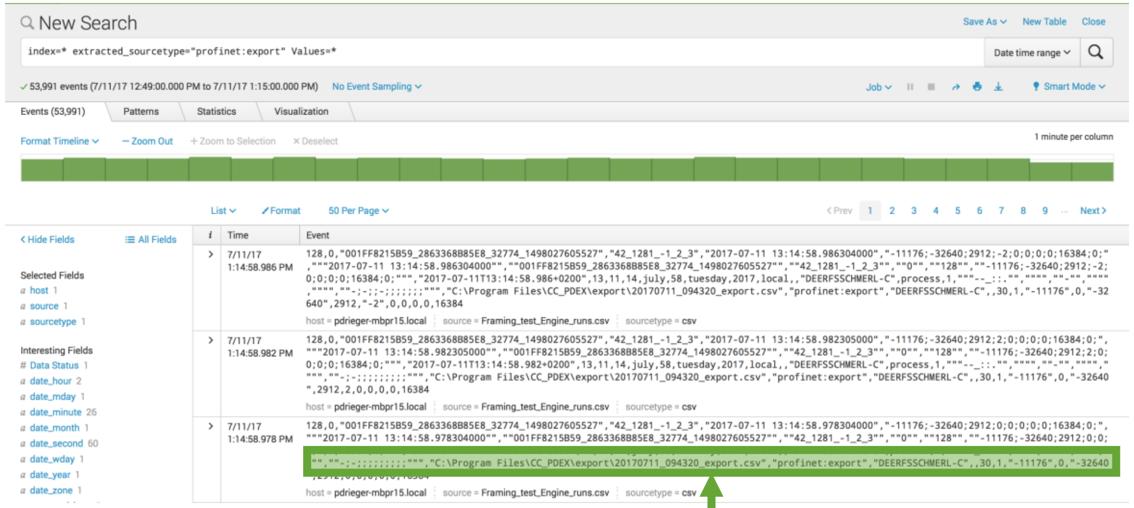
PDEX

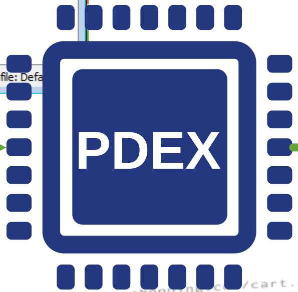
Extraction of production data from network traffic

Raw network traffic with production data



Production data in Splunk





- Communication monitoring
- Rolling Traffic Dumps
- Packet dissection
- Data Extraction
- Data Conversion
- Data Forwarding

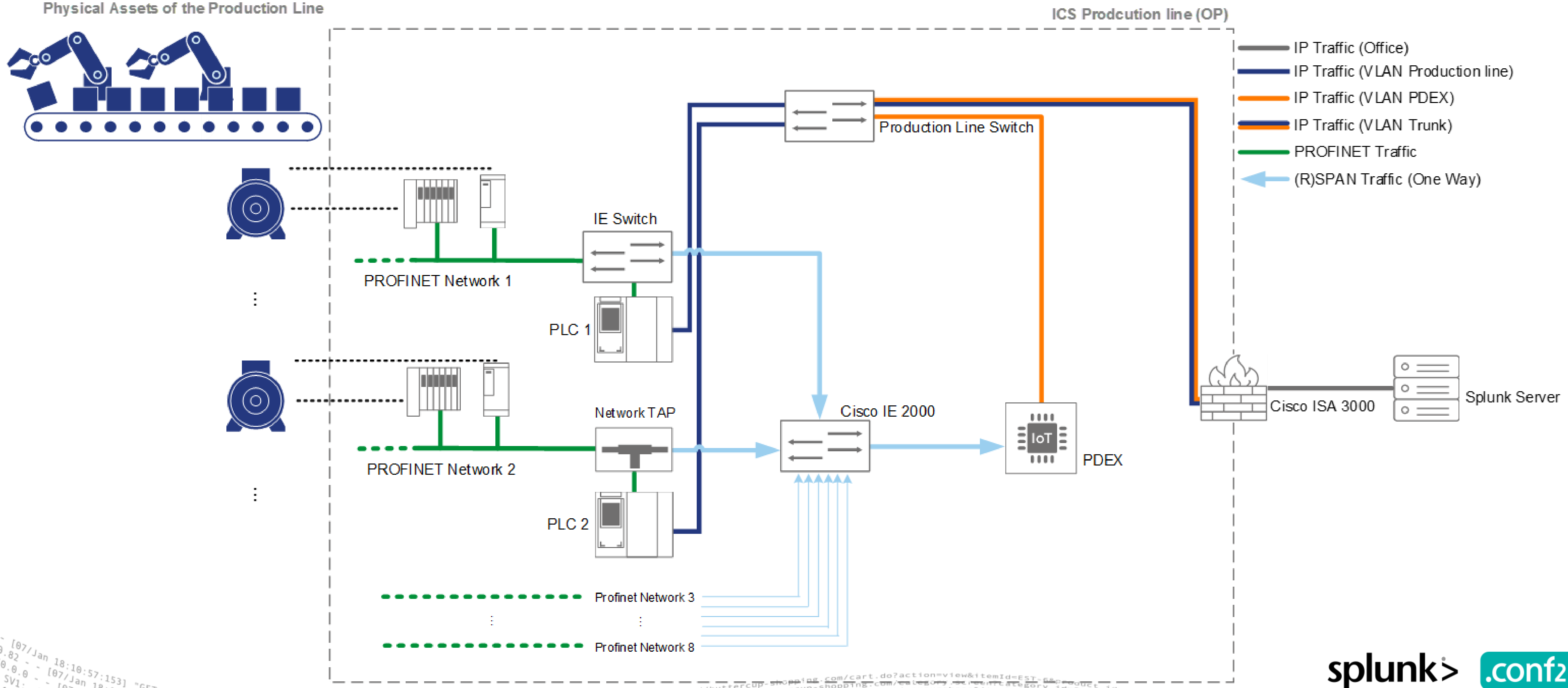
splunk> .conf2017
Computacenter

Data collection Infrastructure

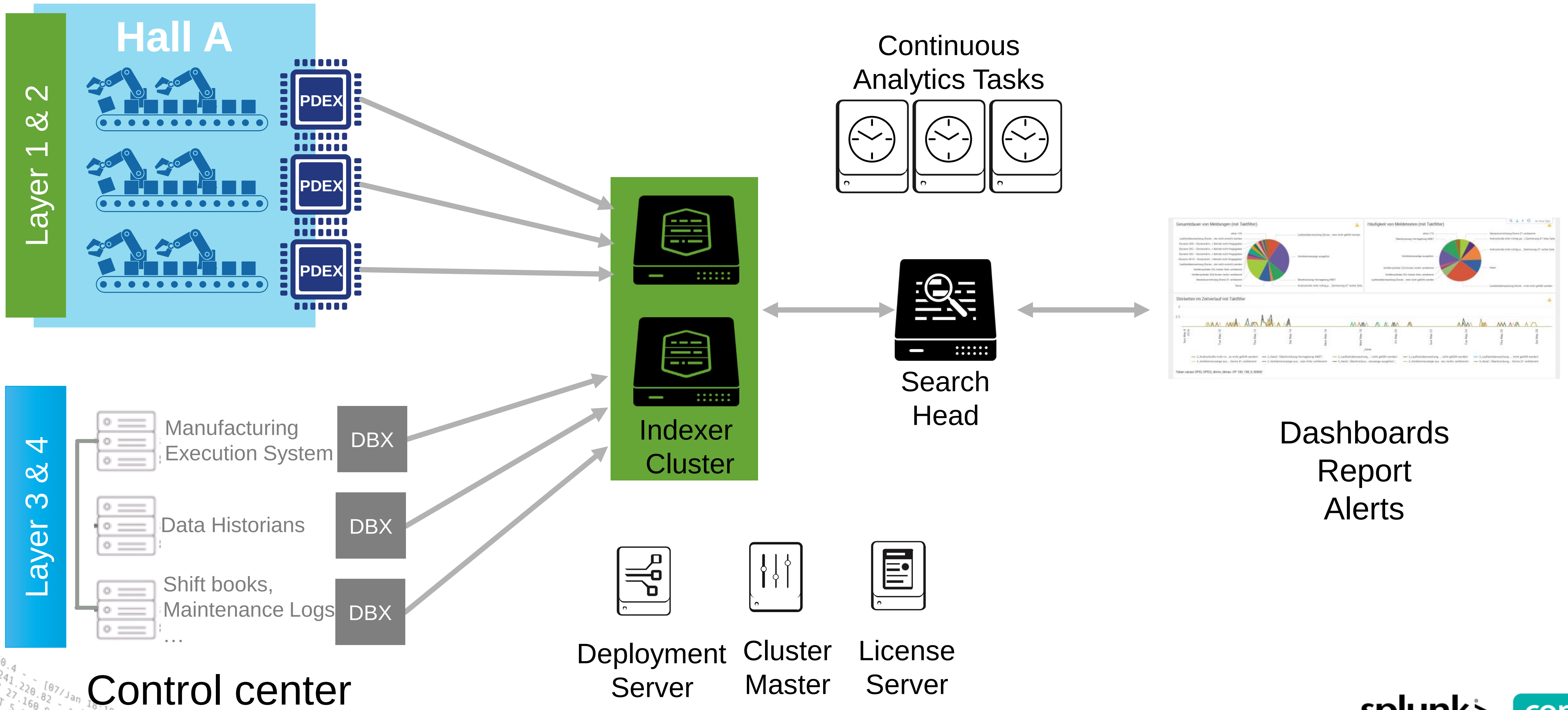
From aggregation and dissection of network traffic

Production Data Collection Infrastructure

for layer 1 & 2 data



Splunk Analytics Infrastructure



Analysis of working cycles and PLC errors

Analysis of layer 3&4 data production data from automation cells

Predict Production Incidents on Assembly Line

Conveyors, screwing, gluing, robots, humans … in one line

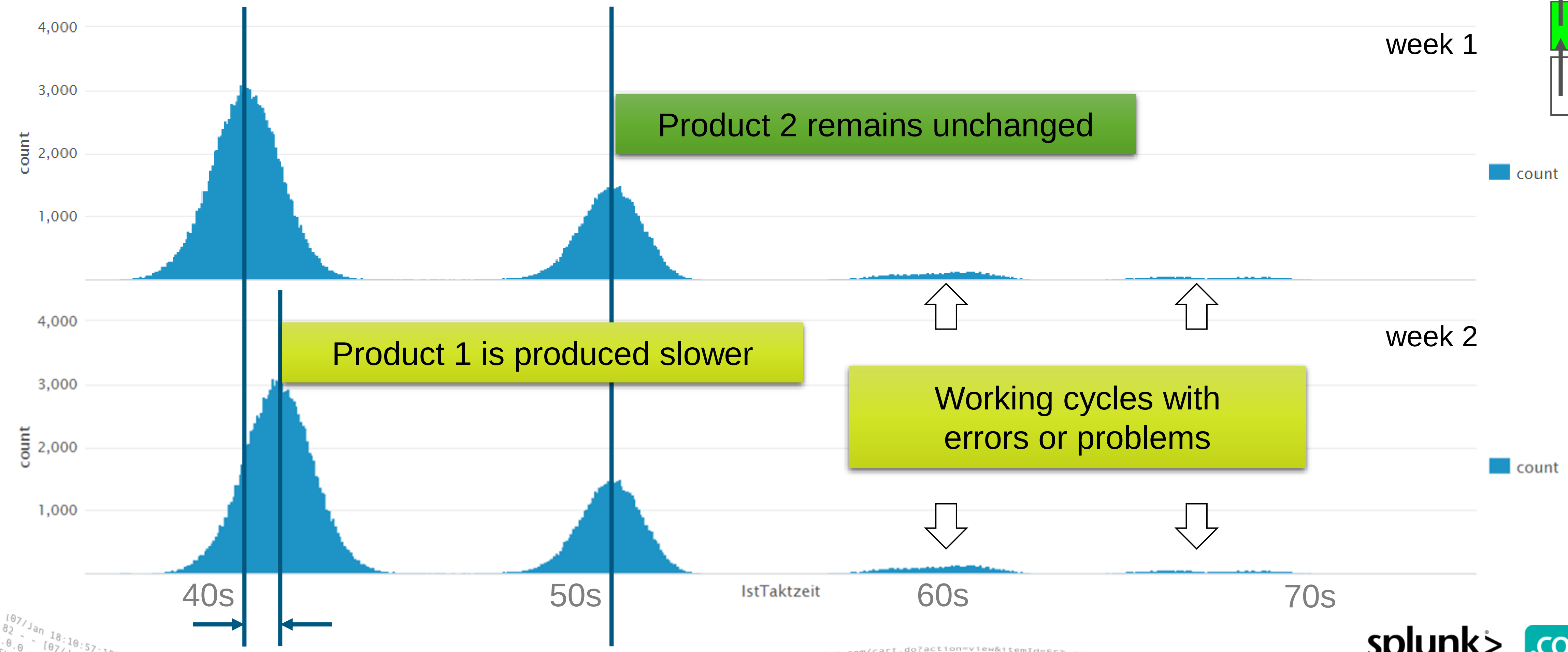
- Assembly line with 19 automation cells and 160 PLCs
- 1 year data
- 350MB logs from shift books, maintenance protocols etc.
- Goal: Predict incidents at least 8 hours ahead and reduce maintenance costs

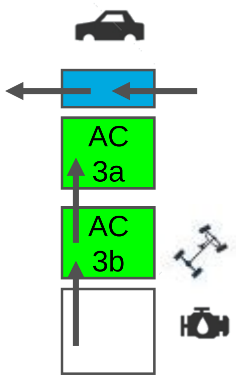
splunk> .conf2017

Computacenter

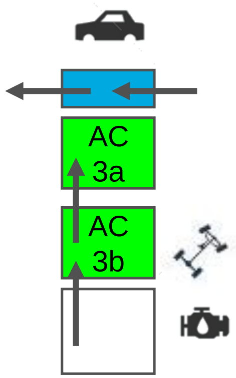
Analysis of Working Cycles of an Automation Cell

- Shift in histogram of average working cycles in week by week comparison

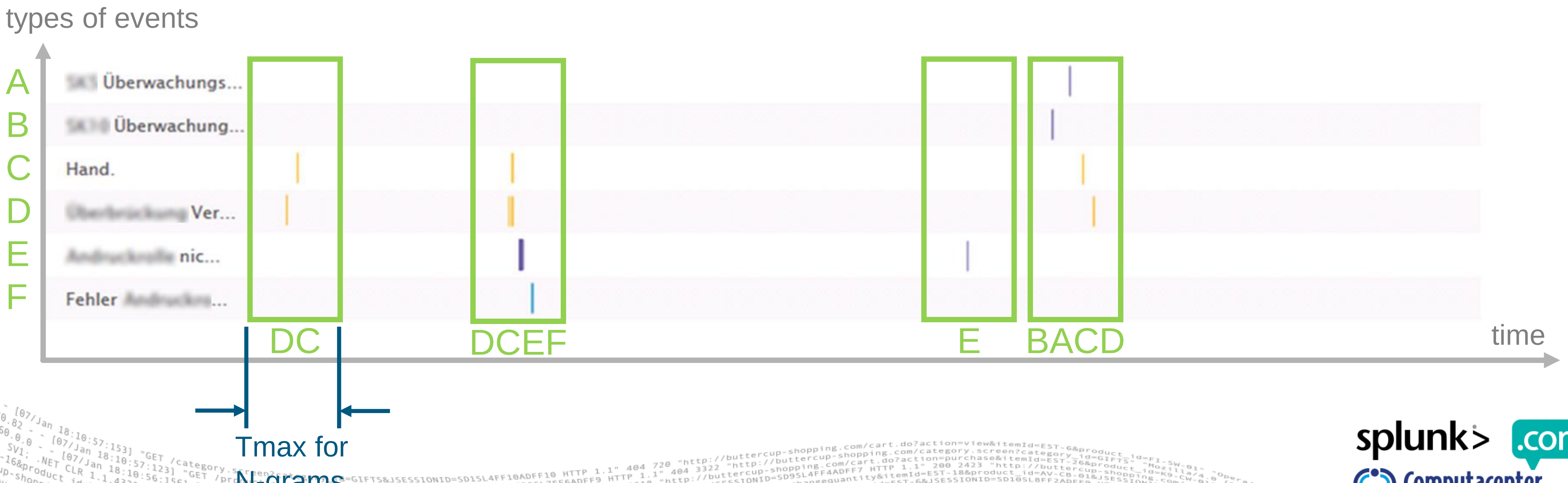




N-gram Analysis to Detect Frequent Error Chains

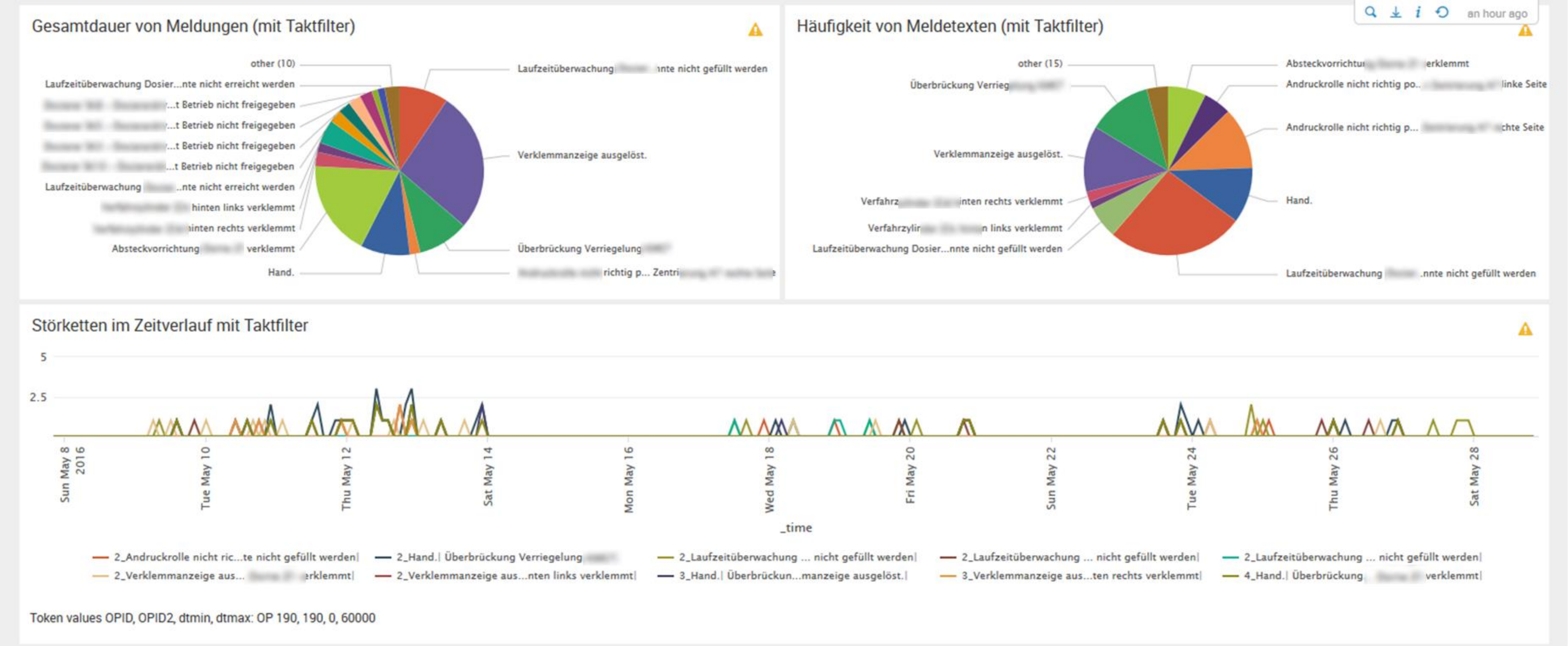


- N-gram analyses let us construct combinations of sequential categorical events in a given window in time
- Statistics can be applied to count frequencies, detect frequent patterns
- Correlate subsequent event patterns to identify more complex root cause



N-Gram Statistics

What happens when and how often



splunk> .conf2017
Computacenter

N-gram Analysis

Which error chains causing production impacts?

ng	c_orig	count	mean(DeltaTakt)
[illegible]	1	6.00	1488.270000
[illegible]	1	6.00	544.890000
[illegible]	1	6.00	544.890000
[illegible]	1	6.00	544.890000
[illegible]	1	6.00	505.010000
[illegible]	1	18.00	436.360000
[illegible]	1	12.00	436.360000
[illegible]	1	6.00	436.360000
[illegible]	1	6.00	431.690000
[illegible]	1	6.00	423.380000
[illegible]	1	6.00	423.380000
[illegible]	1	6.00	418.725000
[illegible]	1	9.00	418.541875

N-Gram with huge Impact, but rare
→ Not that interesting for the customer

ng	c_orig	count	mean(DeltaTakt)
[illegible]	3	1,233.00	30.934540
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	123	1,055.00	39.34164
[illegible]	38	795.00	52.246714
[illegible]	1	744.00	31.759020
[illegible]	71	735.00	39.210742
[illegible]	112	701.00	33.512859
[illegible]	18	580.00	45.739061
[illegible]	42	569.00	48.057805
[illegible]	13	532.00	45.684134
[illegible]	23	523.00	56.360415
[illegible]	40	505.00	52.984544
[illegible]	2	505.00	21.971052
[illegible]	64	487.00	22.533667
[illegible]	26	482.00	51.218565
[illegible]	2	416.00	58.289528
[illegible]	8	410.00	51.510310
[illegible]	30	312.00	108.670359
[illegible]	38	305.00	28.219177
[illegible]	2	294.00	52.347096

« prev 1 2 3 4

N-grams with smaller impact, but very often
→ Highly interesting for the customer

Ok, now we know the pain,
but we have no data to predict

Predictive Maintenance for Electro Motors

Analysis of layer 1 production data from automation cells

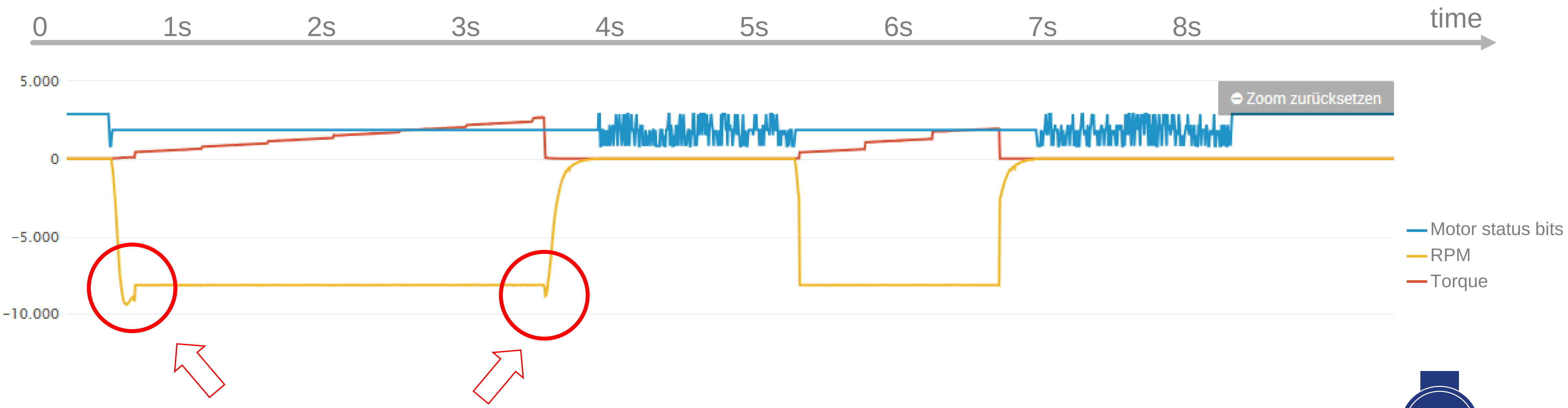
Computacenter

splunk> .conf2017

Analysis of Motor Profiles

Wear of mechanics detected by RPM monitoring

- Lag in mechanic transmission is detected with continuous RPM monitoring

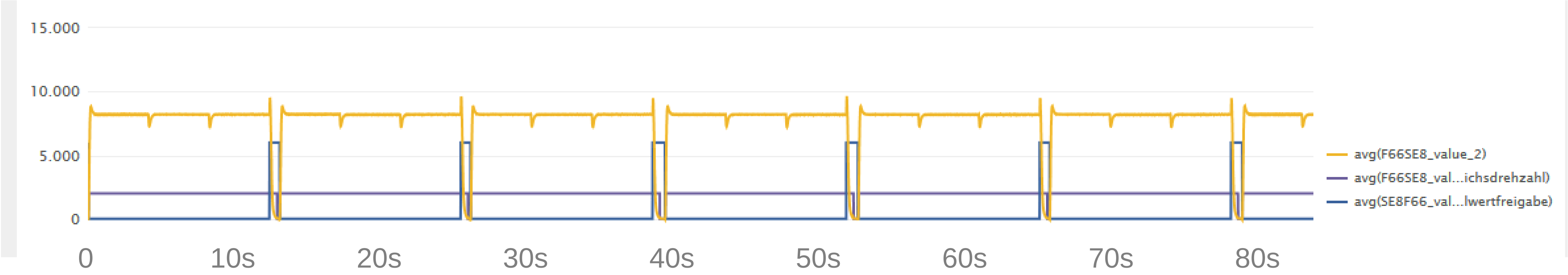


Effects from
slack & mechanical wear

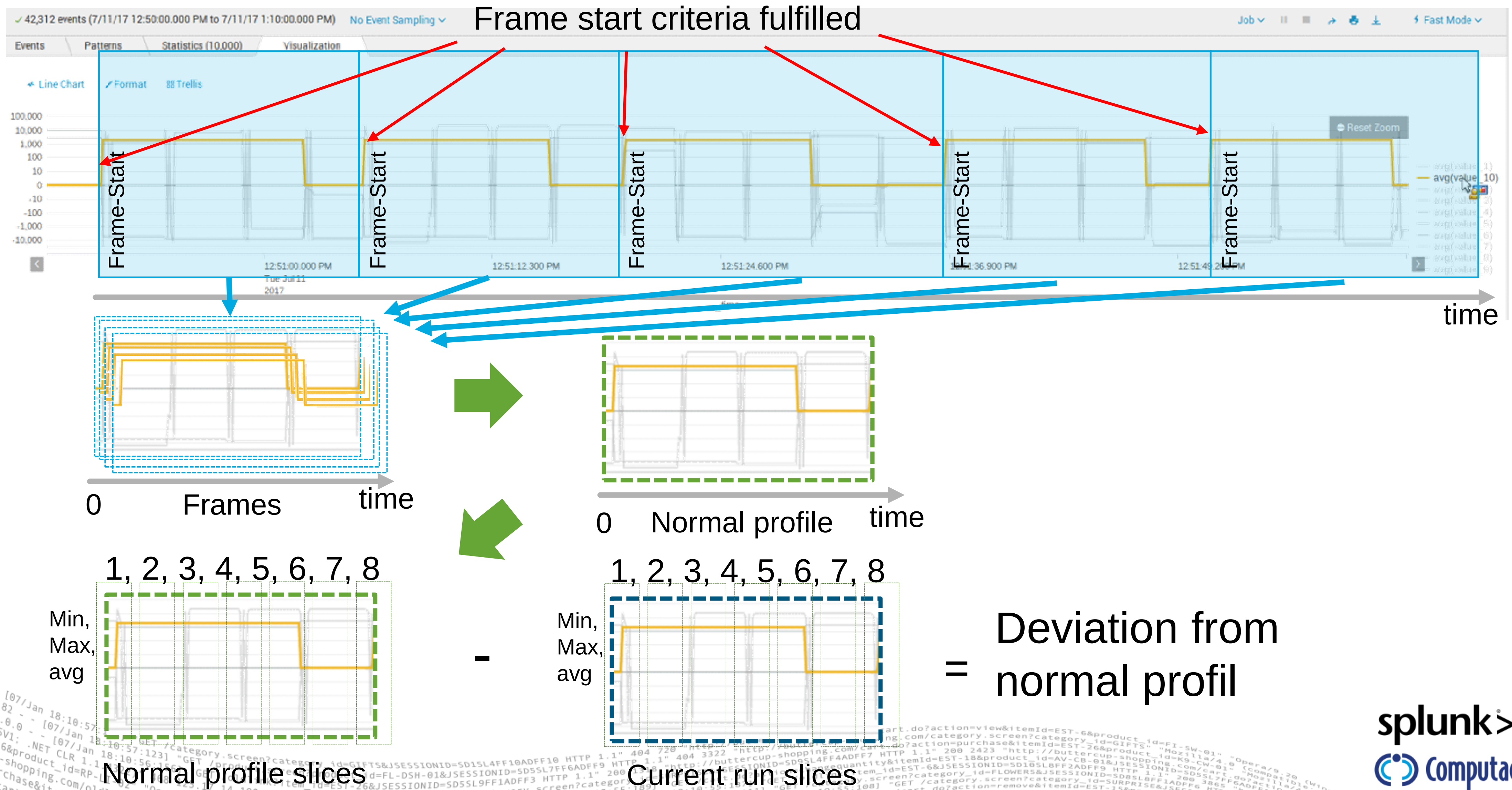
splunk> .conf2017
Computacenter

Analysis of Motor Profiles

- 10 Hz frequency raw data from the motor
- we have 8 OK & 3 NOK motor runs which look very similar

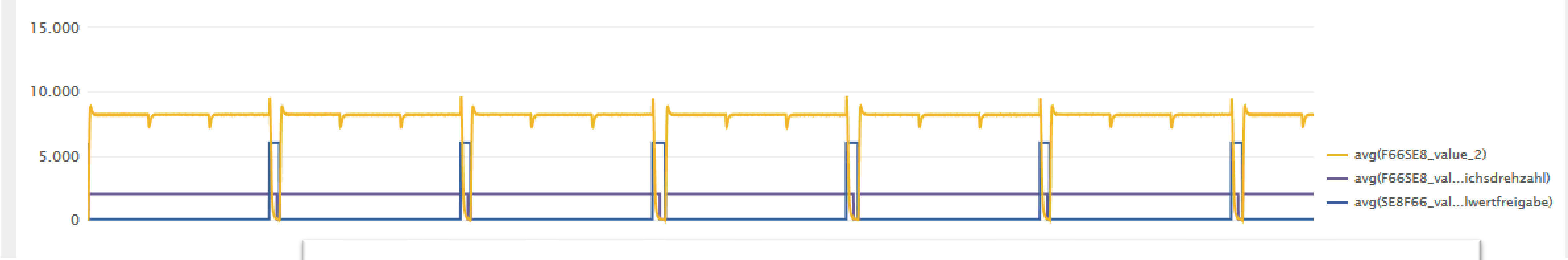


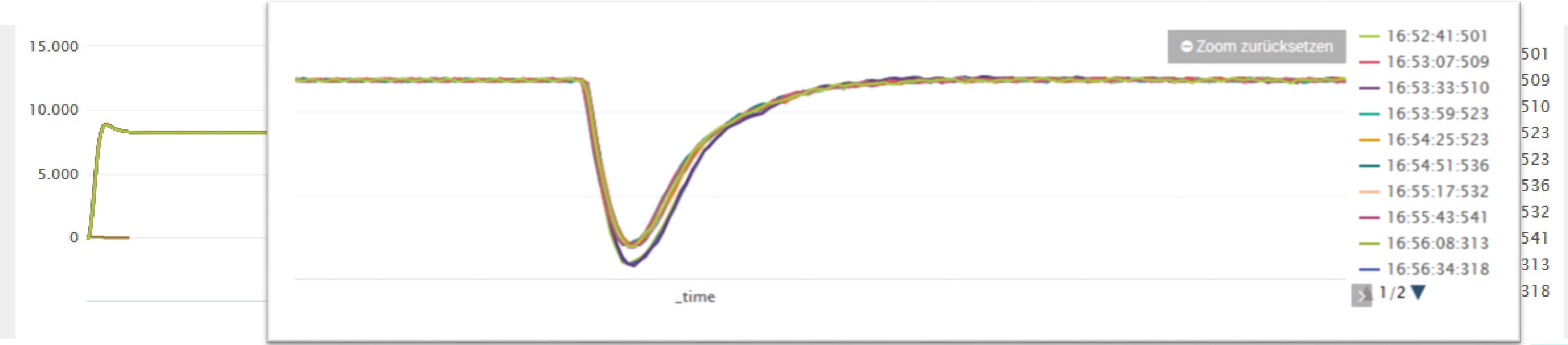
Framing and Slicing Motor Profiles



Analysis of Motor Profiles

- 10 Hz frequency raw data from the motor
- we have 8 OK & 3 NOK motor runs which look very similar

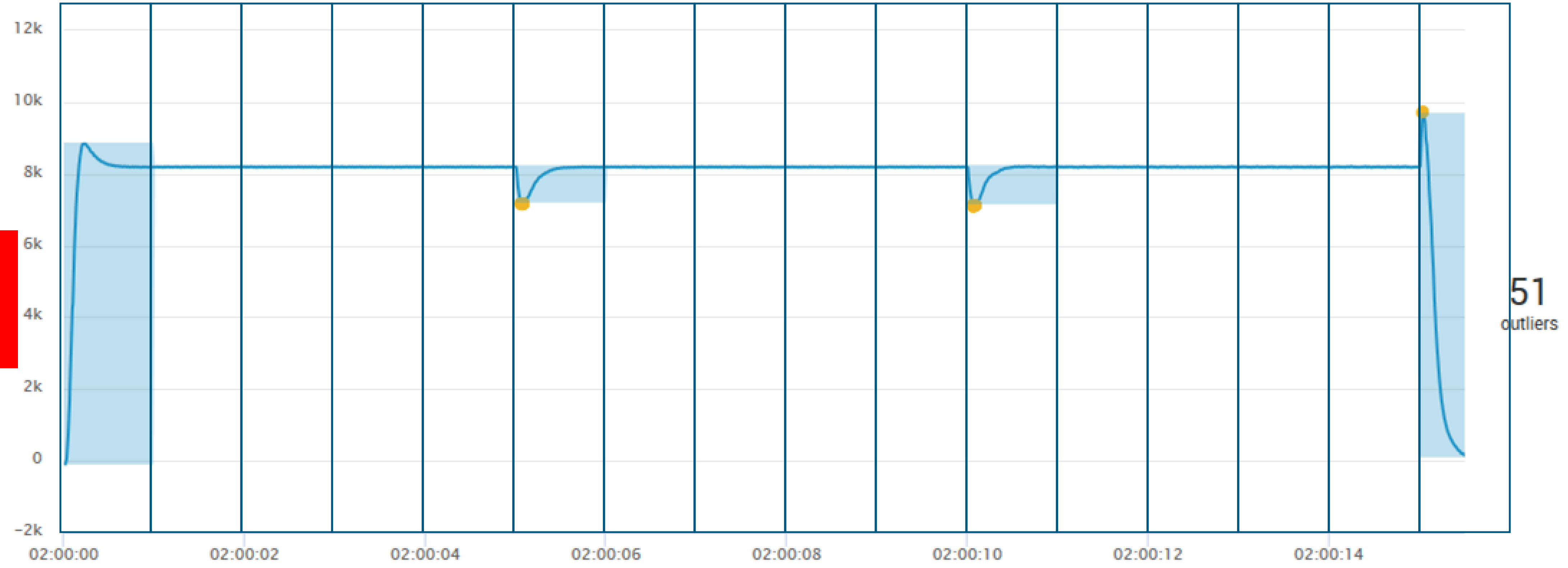




Compare frames against the normal profile

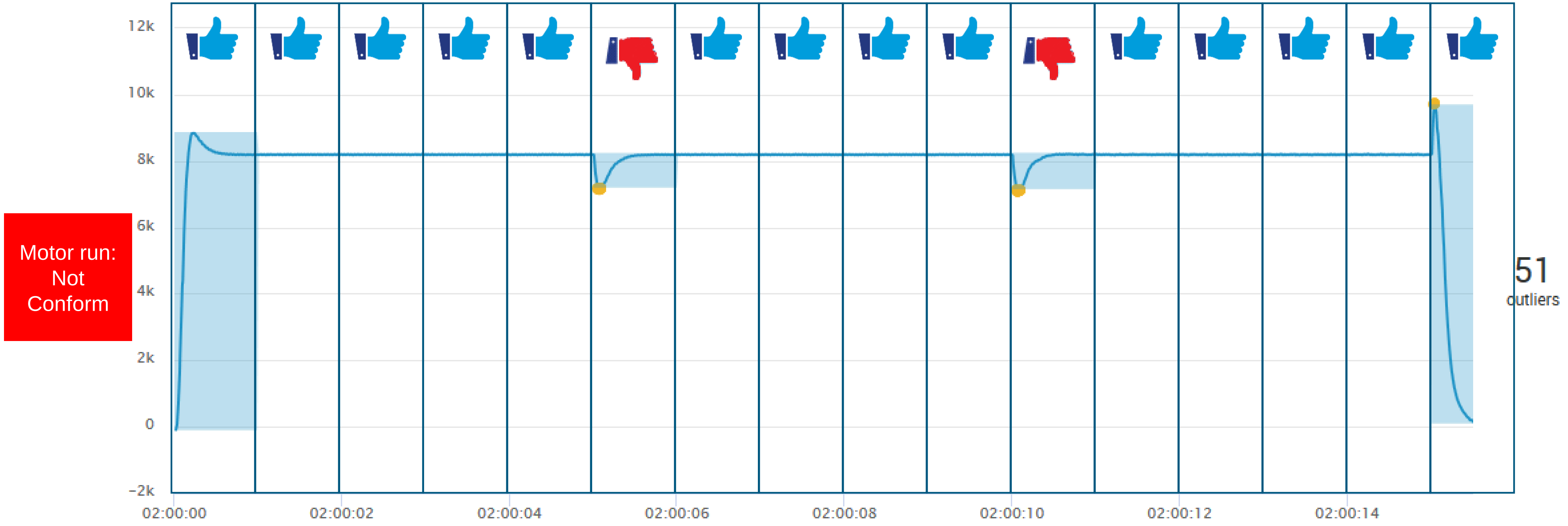
A non-conform motor run

Motor run: Not Conform



How we can visualize it…

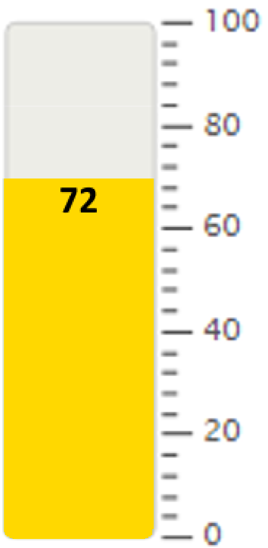
… and how we visualize it to the customer mainly



How we can visualize it…

… and how we visualize it to the customer mainly

But information reduction is key ☺

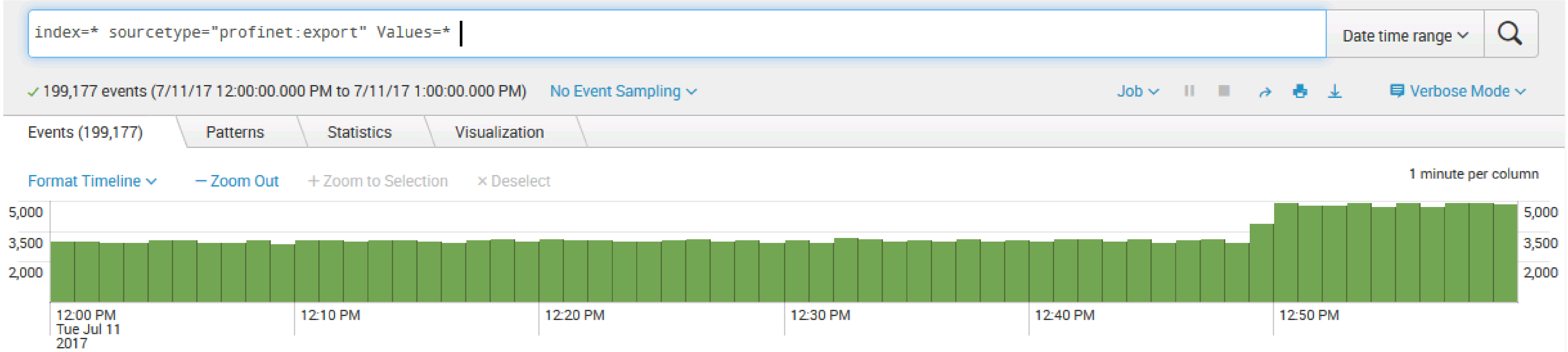


Motor run conformity

Wrap up

Data Volume – Business Value

- 1 assembly line with 160 PLCs a ~4 electric motors-> 400 ~ 800 GB per day



Summary

Key takeaways

- Analytics of layer 3&4 data:
  - Data often already exist
  - This layer is good to identify the pain
  - Data often not sufficient for prediction
- Analytics of layer 1&2 data:
  - Active data collection results often in configuration, service, guarantee discussions
  - Passive data collection is complex
  - The data volume is challenging
- Data analytics
  - n-grams, wave transformations, differences, profiles, …

Thank You!

Don't forget to rate this session in the .conf2017 mobile app

Computacenter

splunk> .conf2017