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FN1916 - Splunk Machine Learning and Self Healing at Priceline

Forward-Looking Statement

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Agend

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- About Priceline
- Splunk + MLTK
- Legacy vs Current Architecture
- Numeric Outlier Detection on Errors Percentage
- Custom Apps/Alert Actions.
- Detecting KPI Performance Degradation
- Detecting New Errors – using clustering
- Takeaways
- Useful links & Resources
- Q&A

About Priceline

- Priceline.com is part of the Booking Holdings Group.
- The Booking Holdings Group is the world leader in online travel & related services.
- The Group's mission is to help people experience the world.

priceline.com®

Booking.com

KAYAK

priceline®

agoda

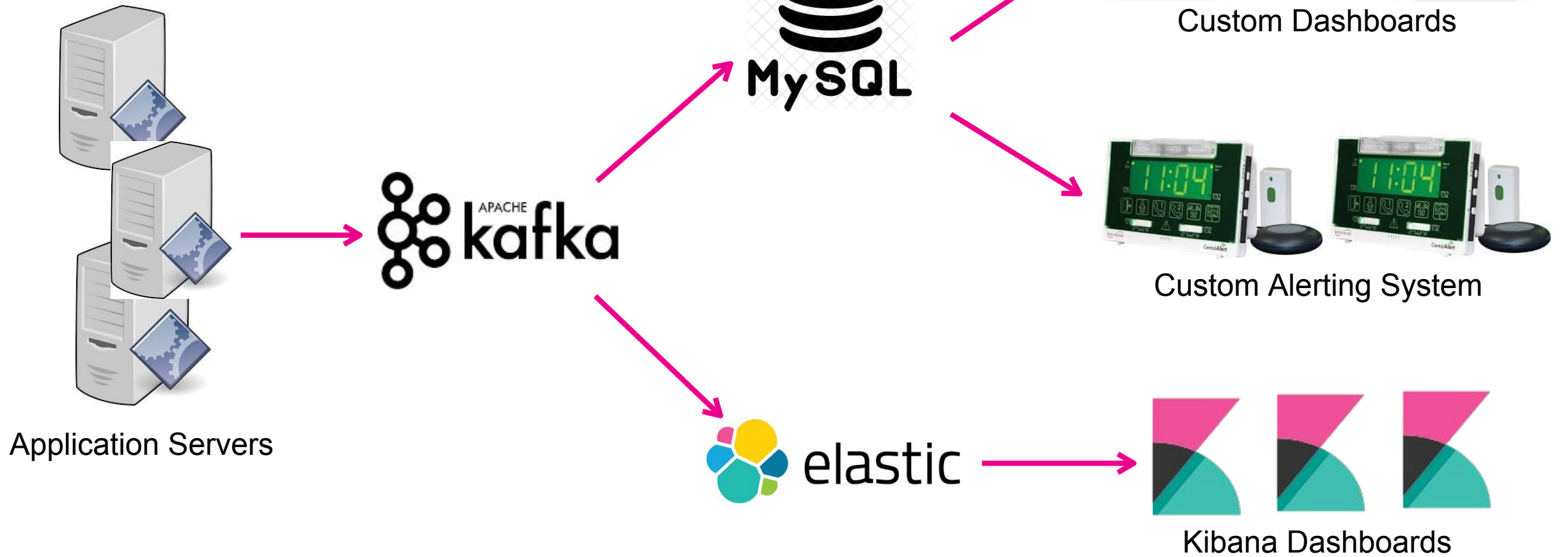
Rentalcars.com

• OpenTable™

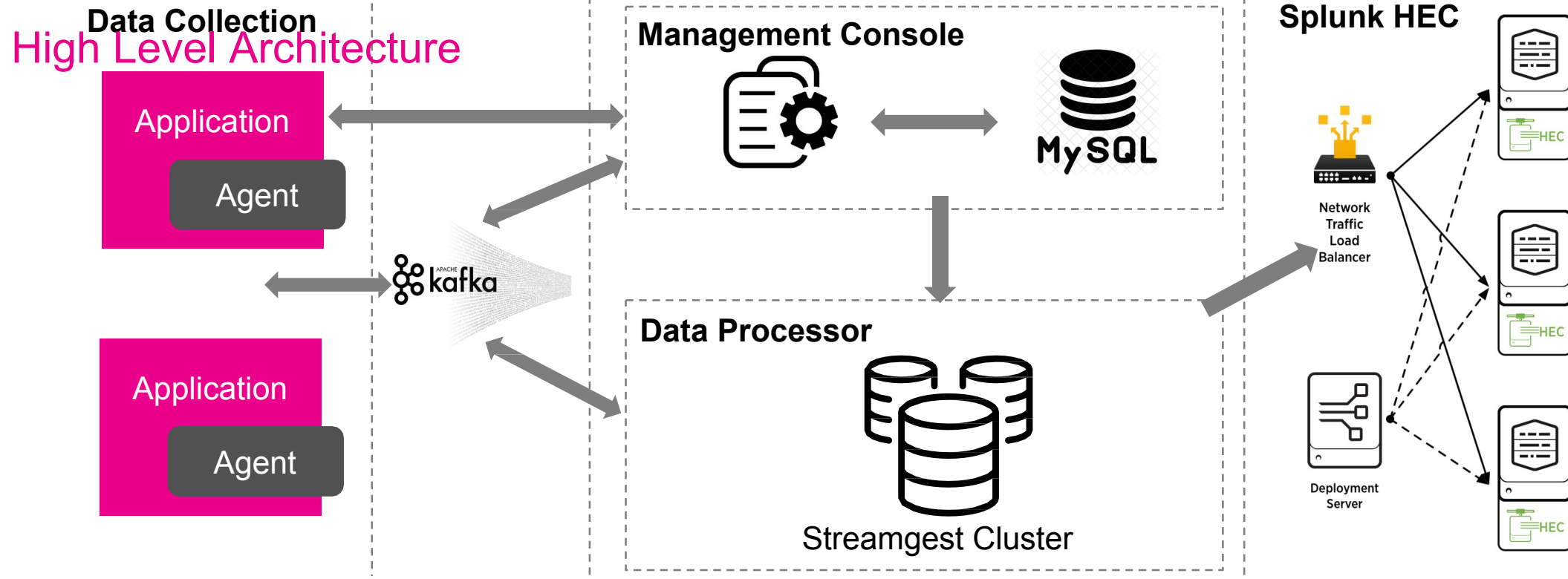


Legacy vs Current Architecture

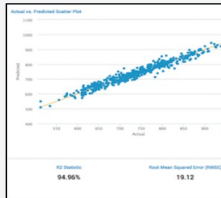
Legacy Architecture



Priceline Data Collection Platform



Splunk Machine Learning Toolkit (MLTK)

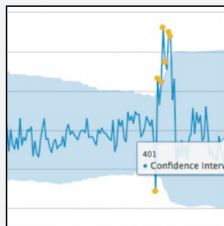


Predict Numeric Fields

Predict the value of a numeric field using a weighted combination of the values of other fields in that event. A common use of these predictions is to identify anomalies: predictions that differ significantly from the actual value may be considered anomalous.

Examples

- Predict Server Power Consumption
- Predict VPN Usage
- Predict Median House Value
- Predict Power Plant Energy Output
- Predict Future Logins
- Predict Future VPN Usage (sinusoidal time)
- Predict Future VPN Usage (categorical time)



Detect Numeric Outliers

Find values that differ significantly from previous values.

Examples

- Detect Outliers in Server Response Time
- Detect Outliers in Number of Logins (vs. Predicted Value)
- Detect Outliers in Supermarket Purchases
- Detect Outliers in Power Plant Humidity
- Detect Cyclical Outliers in Call Center Data
- Detect Cyclical Outliers in Logins

2 Outlier(s)

Year	Contract (percent, unit%)	Initial, New, and changed (%)
1981	0.45	0.07
1982	0.45	0.07
1979	0.45	0.07
1980	0.45	0.07
1983	0.45	0.07
1984	0.45	0.07
1985	0.45	0.07
1986	0.45	0.07
1987	0.45	0.07

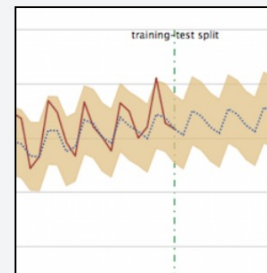
- Predict Future VPN Usage (categorical time)

Detect Categorical Outliers

Find events that contain unusual combinations of values.

Examples

- Detect Outliers in Disk Failures
- Detect Outliers in Bitcoin Transactions
- Detect Outliers in Supermarket Purchases
- Detect Outliers in Mortgage Contracts
- Detect Outliers in Diabetes Patient Records
- Detect Outliers in Mobile Phone Activity



Forecast Time Series

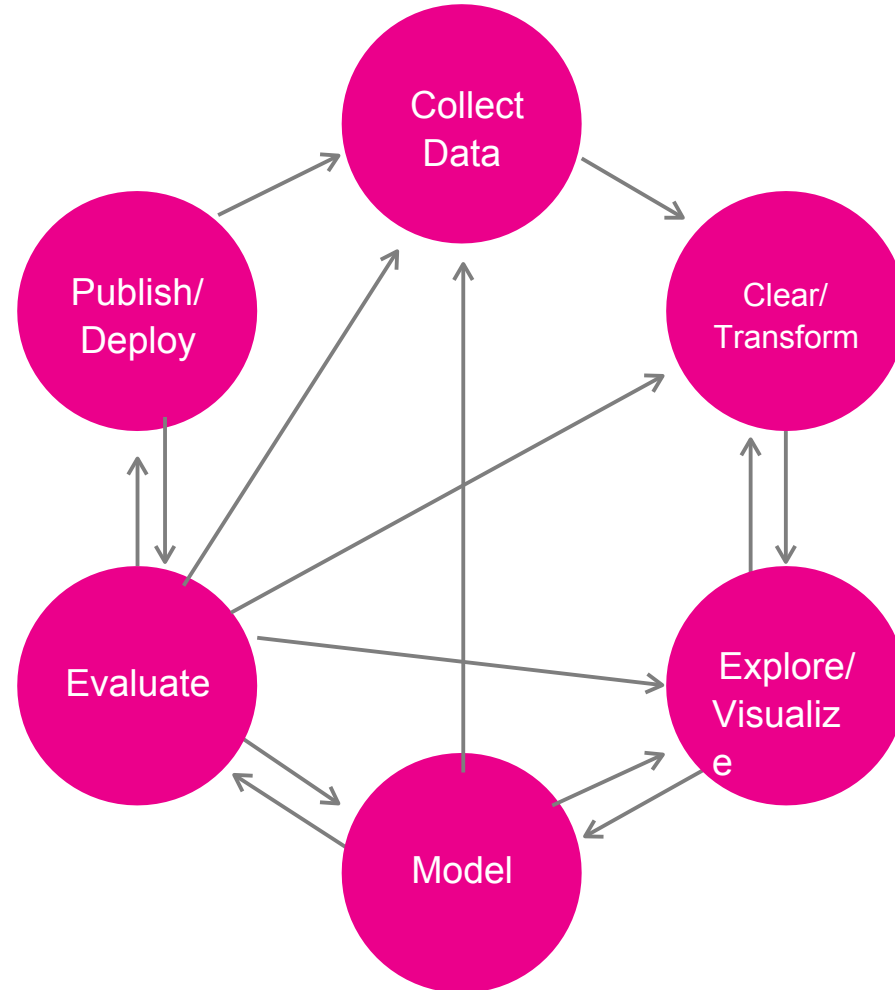
Forecast future values given past values of a metric (numeric time series).

Examples

- Forecast Internet Traffic
- Forecast the Number of Employee Logins
- Forecast Monthly Sales
- Forecast the Number of Bluetooth Devices
- Forecast Exchange Rate TWI using ARIMA

Machine Learning is not Magic

...it's a process

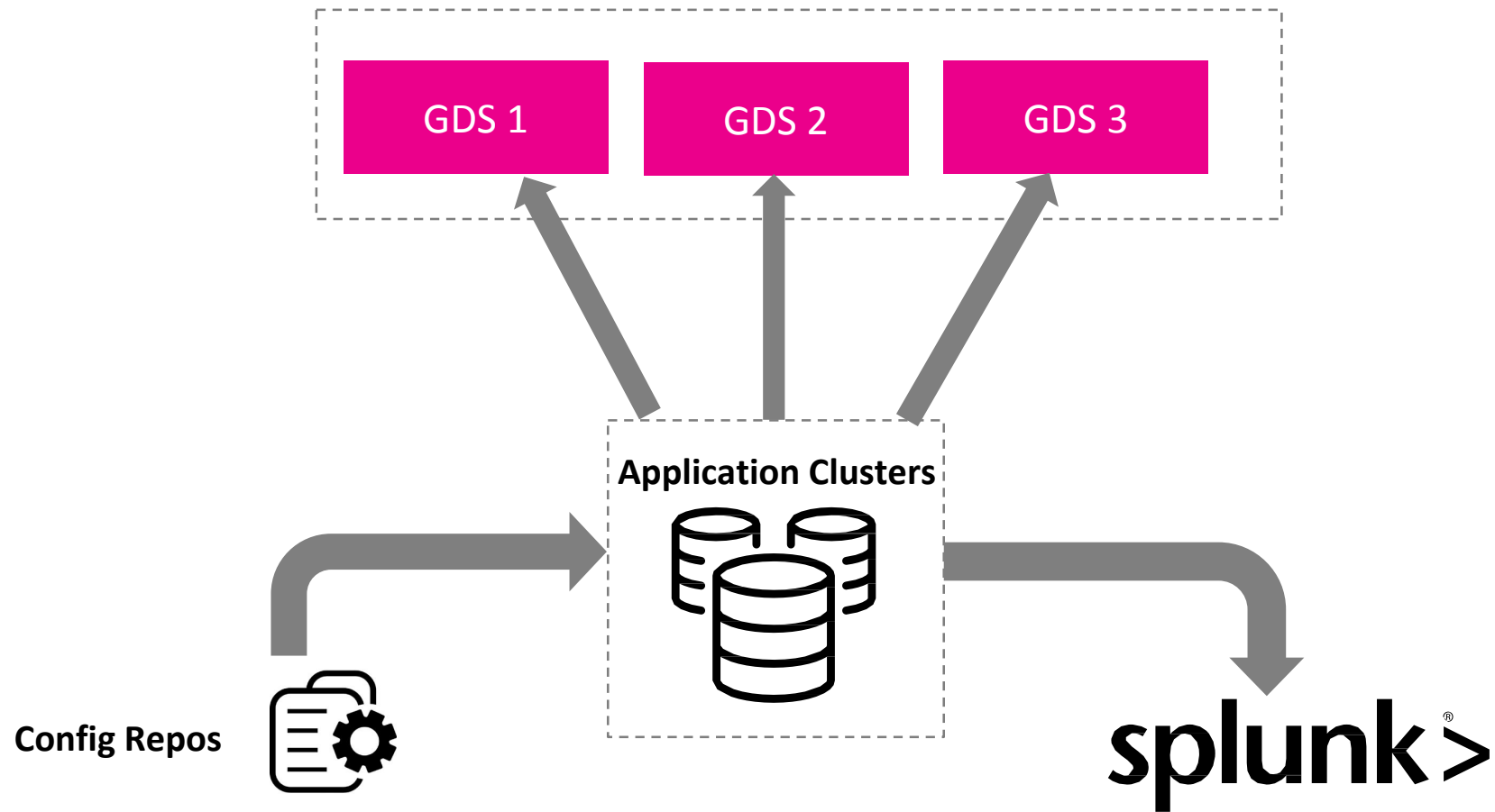




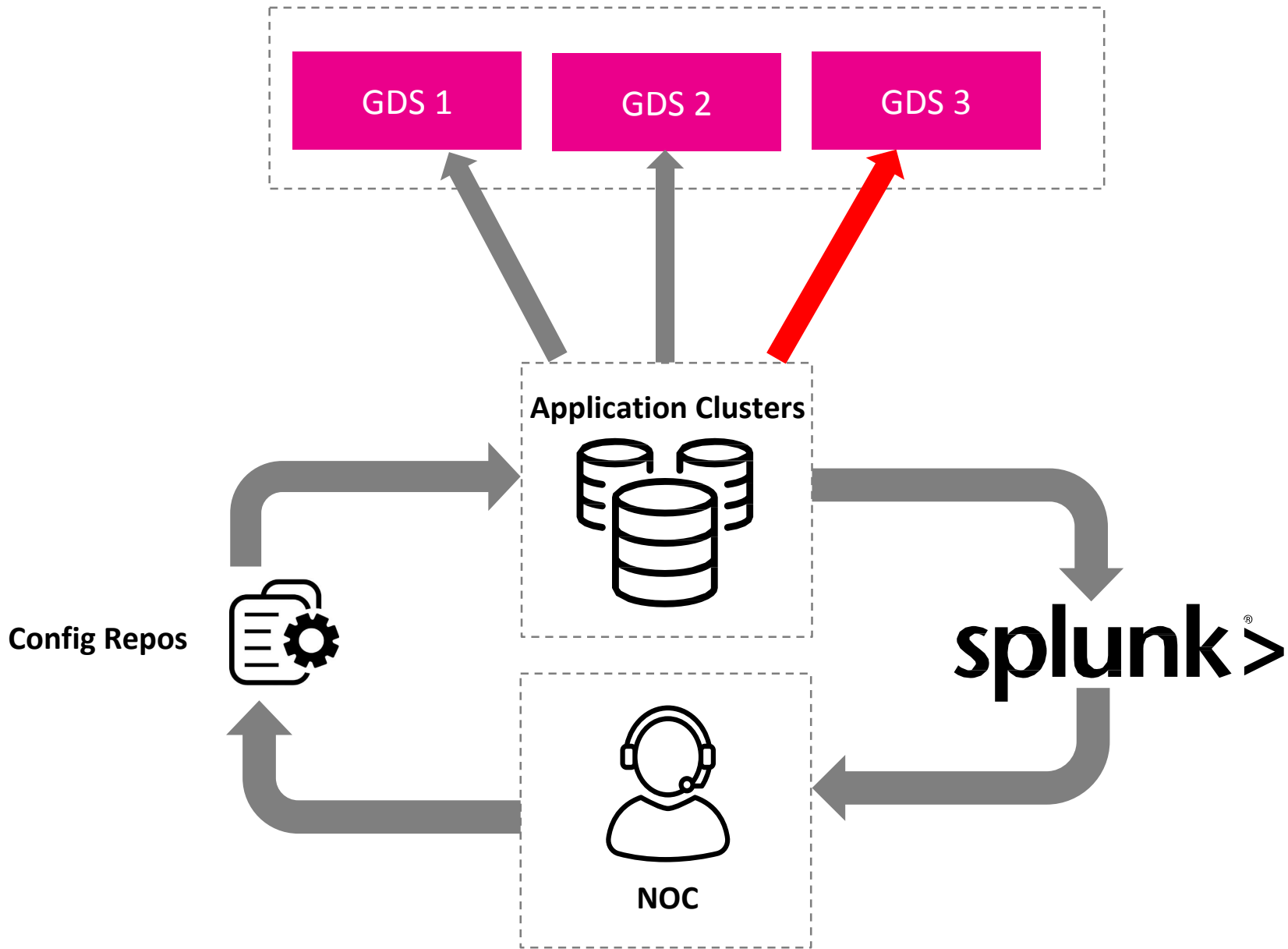
Numeric Outlier Detection on GDS Errors

Self Healing with Priceline's
Config Management Service

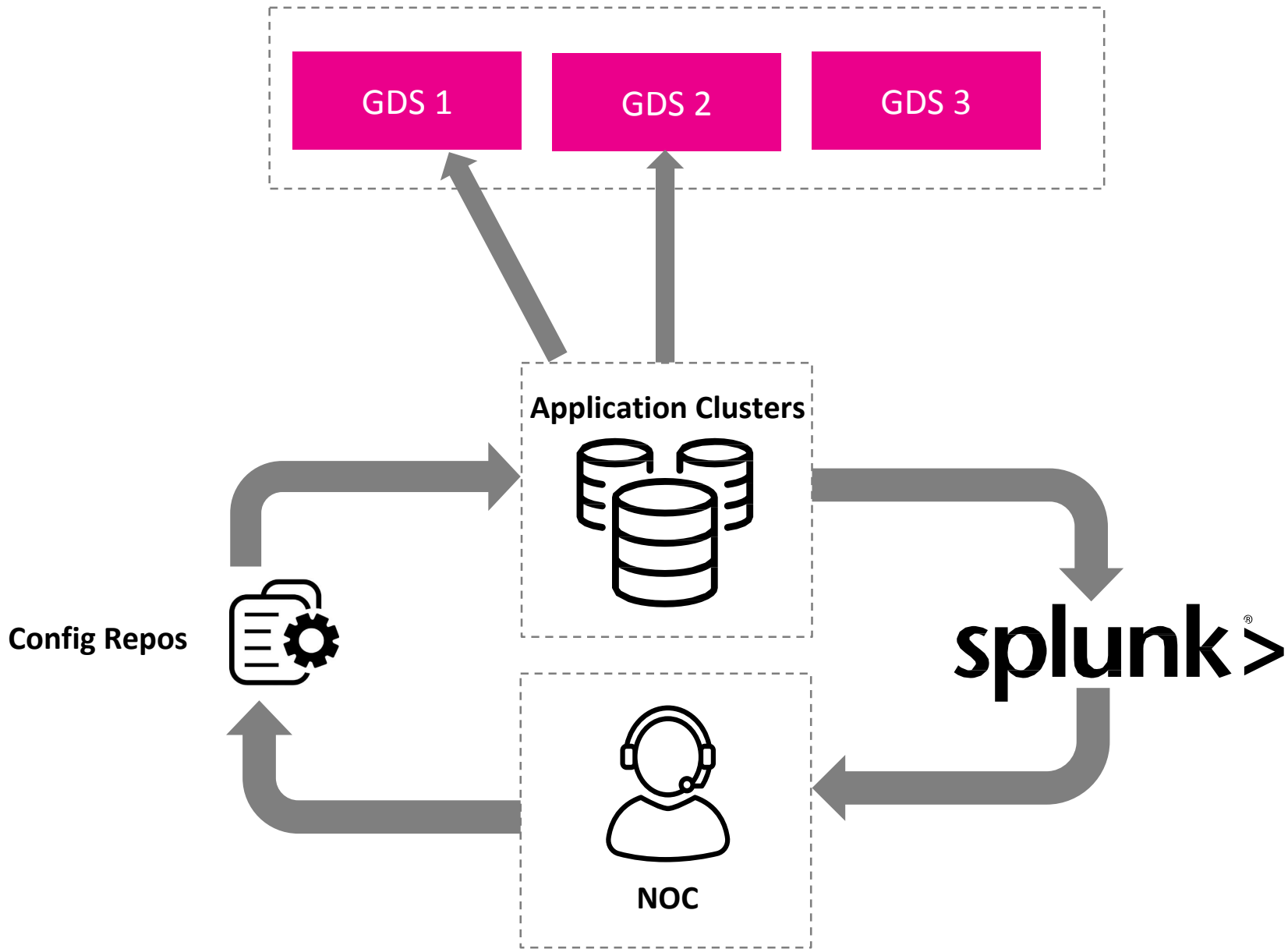
Before



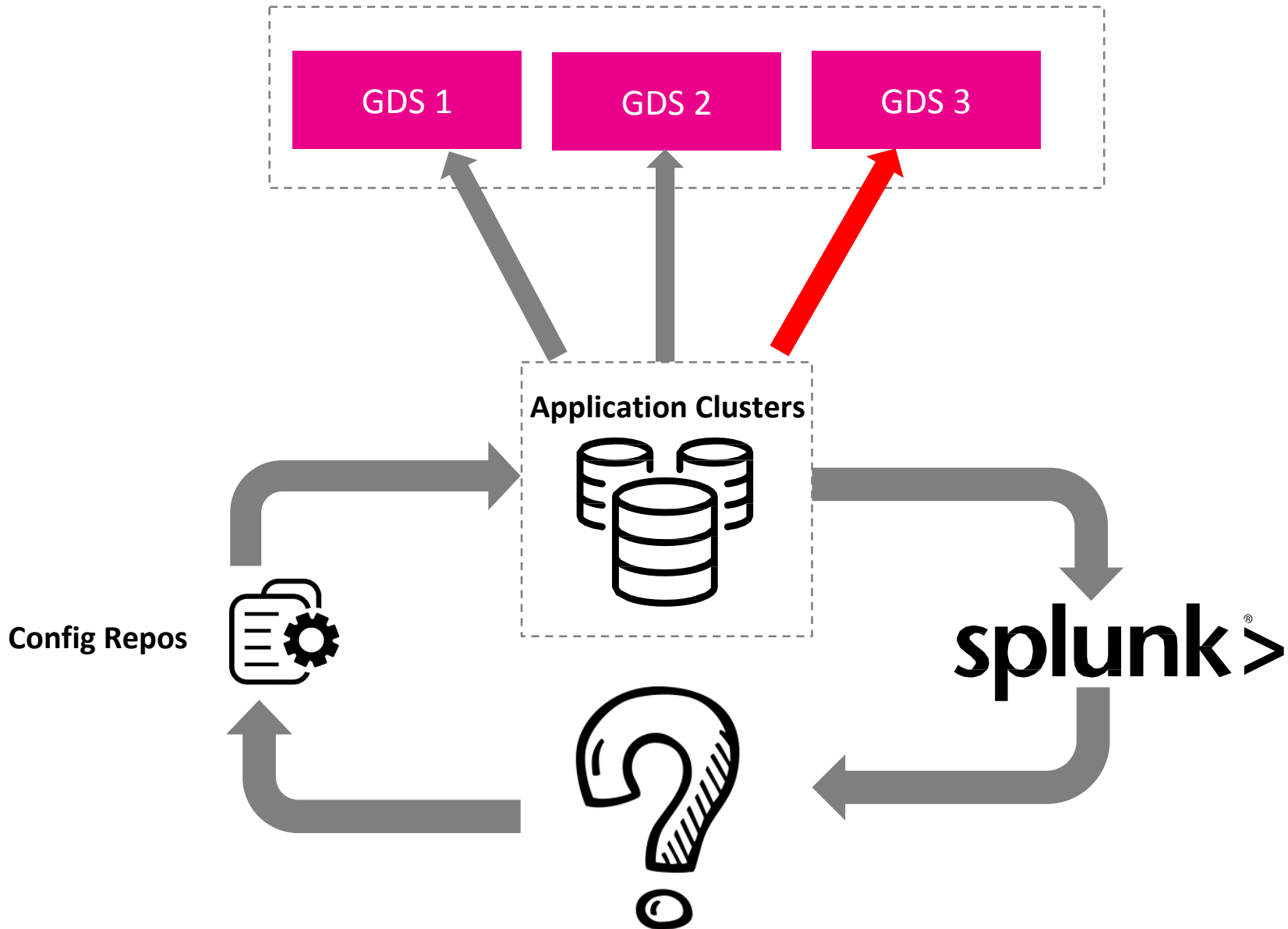
Before



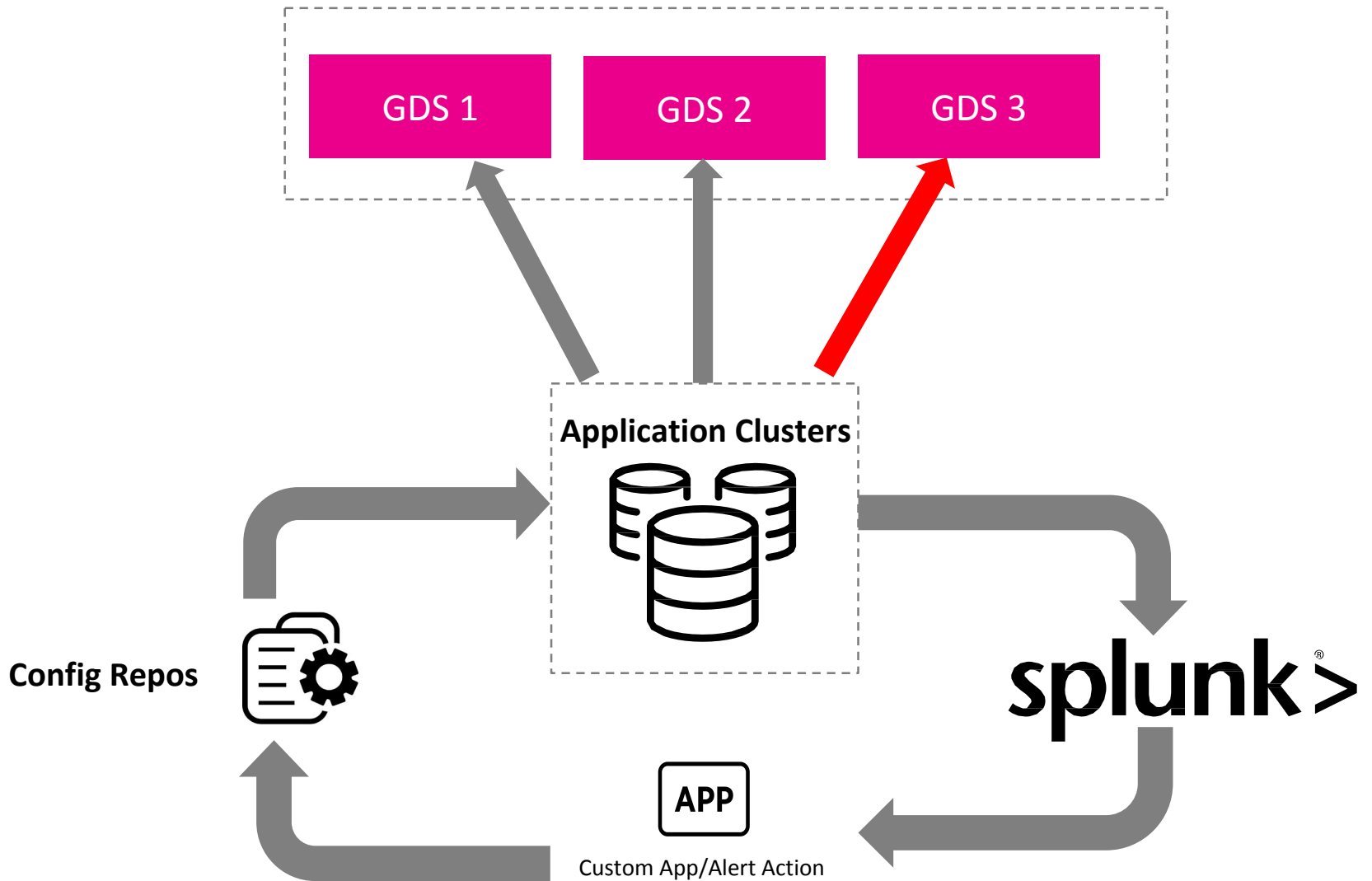
Before



After



After



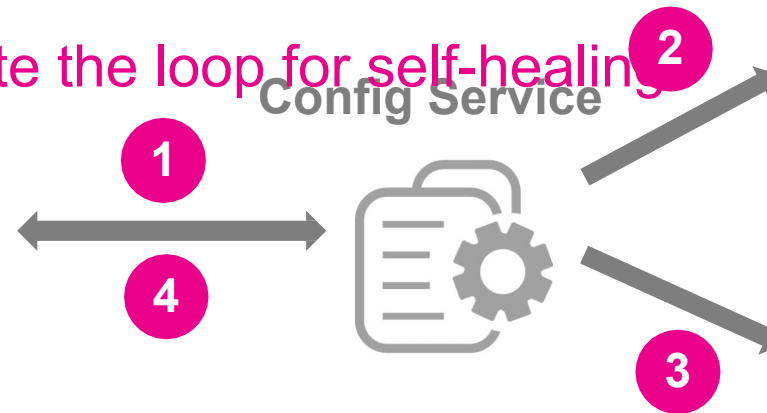


Custom Apps/Alert Actions

Config Management Service

Acts as a bridge to complete the loop for self-healing

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Config Repo(s)

LDAP

CONSUL

Applications

App 1

App 2

...

1. Trigger Webhook Plus Alert Action to invoke config service
2. Update Config Repo(s)
3. Trigger Remote Events to Applications
4. Audit config changes to Splunk

Webhook Plus – Custom App/ Alert Action Developed

Original Webhook is capable of making just Rest call.

This is an extension to Webhook alert action that can post payloads in different formats to any end-point:

Use Case – 1:

- Turn off GDS by sending respective payload to config management micro-service

Use Case – 2:

- Turn off a consumer group when too many errors are noticed while processing messages into Splunk

The screenshot displays the 'Trigger Actions' configuration window in Splunk. The 'Webhook Plus' action is selected and expanded, showing its configuration options. The 'When triggered' dropdown is set to 'Webhook Plus'. The 'URL' field contains 'https://your.server.com/foo/bar'. The 'Content Type' is set to 'JSON'. The 'Proxy' is set to 'ENABLED'. The 'Payload' field is empty. A note at the bottom states 'Payload is sent via HTTP Post to the above URL.'.

Trigger Actions

+ Add Actions ▾

- Send Remote Event**
This alert action will send remote events to Java applications.
- Send email**
Send an email notification to specified recipients.
- Send to Google Drive**
Upload results to Google Drive.
- Webhook**
Generic HTTP POST to a specified URL.
- Webhook Plus**
Generic HTTP POST to send payloads in json or xml formats.

[Manage Actions](#) ▹

Manage available actions and browse new actions.

When triggered ▾ Webhook Plus

URL

Content Type PLAIN TEXT JSON XML

Proxy ENABLED DISABLED

Payload

Payload is sent via HTTP Post to the above URL.

Self Healing Loop – Example in Hotels GDS Alert

HOTEL_GDS_ERROR_ALERT

new messages



GDS3 has been disabled using config micro service

Weighted Threshold= 60
Previous Threshold = 62
ErrorPercent= 65
Alert Type=Outlier

[Trigger History](#) | [Search Results](#)

CONFIG

EnableGDSControl

Name	Value
GDS1	true
GDS2	true
GDS3	false



Detecting KPI Performance Degradation

Brownou

t

- Brownout is a Gradual degradation in KPI over time.
- Are difficult to detect unless they are sudden and last for an extended period of time.
- Summarize data.
- Forecast for next day.
- Count number of times it lower bound is breached.



ML for Brownout Use Case...

Saturday, October 27th



Splunk APP 4:00 AM

Trigger History Search Results

Brownout detected for [REDACTED]

o/l : 31

<https://priceline.atlassian.net/wiki/spaces/HTL/pages/341706158/2018-04-15+-+ML+Opportunities+for+GDS+Anomaly+Detection>

https://splunk.prod.pcln.com/en-US/app/pcln_summary_reports/brownouts



Scott Settembre 8:23 AM

This brownout alarm will continue for the next week on Worldspan and can be ignored. We reduced gds search volume by [REDACTED] properties.



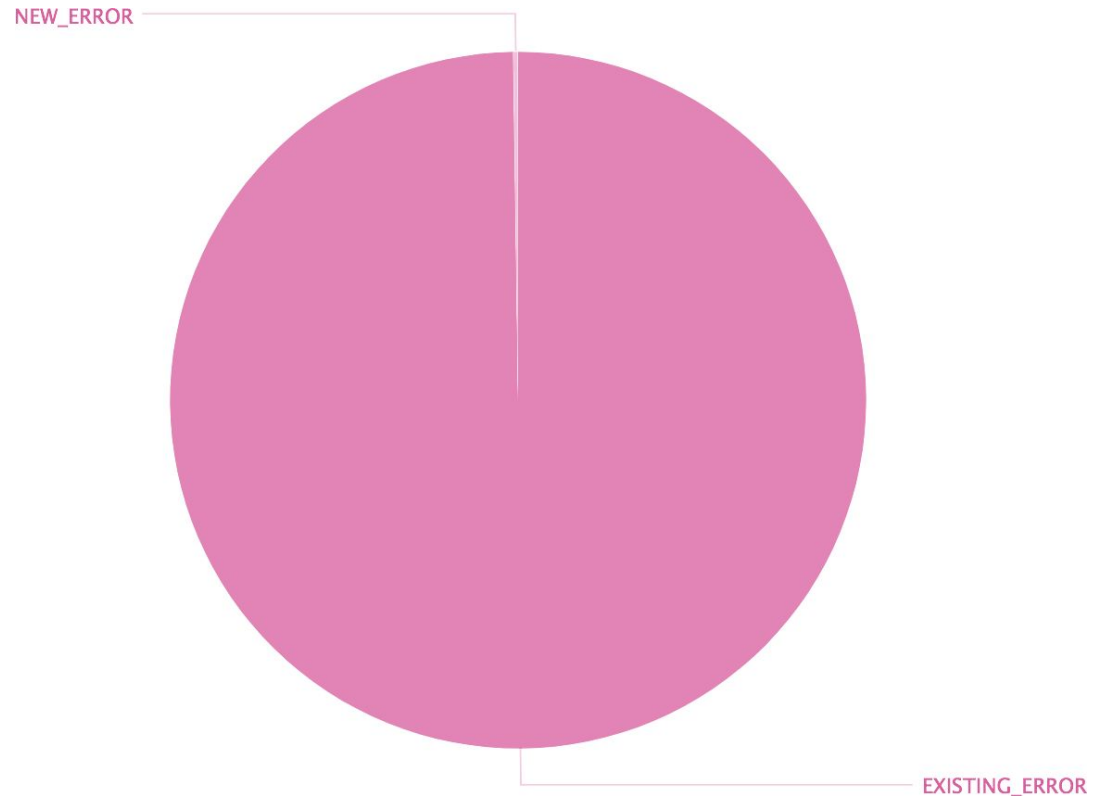


Detecting New Errors – using clustering

Needle in a haystack

Cluster command

- groups events together based on how similar they are to each other.
- Identifying new errors that crop up over time, for instance – any post deploy
- errors or errors that are triggered due to config issues



Error Monitoring – Finding New Errors - Needle In A Haystack

1. Finding anomalies through the concept of clustering
2. Leverage Splunk KVStore to keep track of incoming errors and tag them NEW vs OLD (again through clustering) and only alerts when new errors are triggered.

Send Remote Event – Custom App/Alert Action Developed

This custom alert action will simulate “Send Remote Events” functionality of LDAP browser, when splunk alerts are triggered.

Use Case – 1:
Change logging levels

Use Case – 2:
Trigger refresh/reload events when certain criteria are met

Trigger Actions

+ Add Actions ▾

- Trigger incidents in PagerDuty
- Ping host**
Given one or more ITSI Notable Event, ping the `host` in it.
- Run a script**
Invoke a custom script
- Send Remote Event**
This alert action will send remote events to Java applications.
- Send email**
Send an email notification to specified recipients
- Send to Google Drive**
Upload results to Google Drive
- Webhook**
Generic HTTP POST to a specified URL

Trigger Actions

+ Add Actions ▾

When triggered ▾

- Send Remote Event**

Hostname

Port

Target App

Event Code

Payload

Key Takeaway s

1. Super intuitive to get started with Splunk MLTK in order to build proactive trustworthy alerts without static thresholds.
2. Power of building custom Apps in Splunk to help take corrective actions
3. Self healing use cases are heavily dependent on iteratively tuning and re-training of your alerts
4. All KPI alerts involving multi cyclic /seasonal time Series Metrics can mostly be tackled using Numeric outlier detection

Useful Links

From Zero To 100 In 100 Days – Story on Priceline's Splunk Adoption | .conf2017

- <https://conf.splunk.com/files/2017/slides/from-zero-to-100-in-100-days-or-how-quickly-can-you-drive-splunk-adoption.pdf>

HEC Yeah!! How Priceline Uses HEC to Ingest 4TB of Data Every Day? | .conf2018

- https://static.rainfocus.com/splunk/splunkconf18/sess/1523585518806001Vs1b/finalPDF/HEC-Yeah-How-Priceline-1868_1538788919830001YKjX.pdf

Splunk resources

- <https://www.splunk.com/blog/2018/01/19/cyclical-statistical-forecasts-and-anomalies-part-1.html>
- <https://www.splunk.com/blog/2018/02/05/cyclical-statistical-forecasts-and-anomalies-part-2.html>
- <https://splunkbase.splunk.com/app/2890>

Detect Numerical Outliers | .conf2017

<https://conf.splunk.com/files/2017/slides/detect-numeric-outliers-advances.pdf>



Thank You!

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