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Greater Insight. Greater Value.

Networks Optimization with Intelligence

Stanley Kaplunov I Stephen Holt (

September 2017 I Washington DC

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Confidential Presentation

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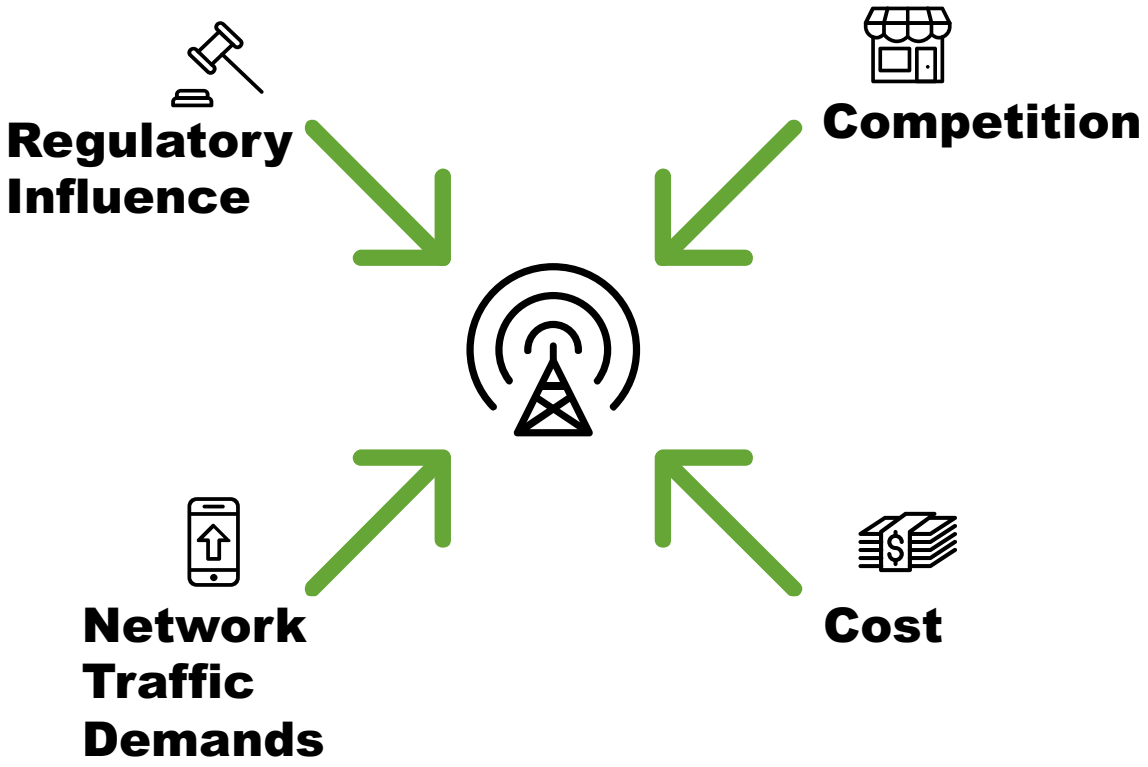
- Driving up business value and customer experiences in mobile telecommunications by combining machine learning and real-time analytics.

The situation



The solution: Splunk

- Ability to process millions of data points in real-time
- Capabilities to apply machine learning algorithms to support data-driven decisions
- Web framework and sdks (software development kits) to enable customized visualization and data analytics

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The Challenge

▶Utilising the power of machine learning, we set out to provide intelligent solutions to some of the industry's key challenges…

OPTIMISE SPEND

Within day-to-day operations where and how can spend be optimised, reducing OPEX and yielding improved ROI on CAPEX of deployed infrastructure. We looked at reducing energy spend and **data centre optimisation** to improve ROI and Spend.

IMPROVE CEX

Understanding the impact network performance can have on CEX, we looked at key indicators to asses their performance. These were correlated with CEX indices, and using **traffic forecasting**, we were able to deliver what subscribers want.

REDUCE CHURN

Performance could be dynamically optimised to ensure that customers receive the best customer experience, raising NPS and reducing churn. Utilising **performance insights**, we were able to target optimisation activities to achieve peak performance.

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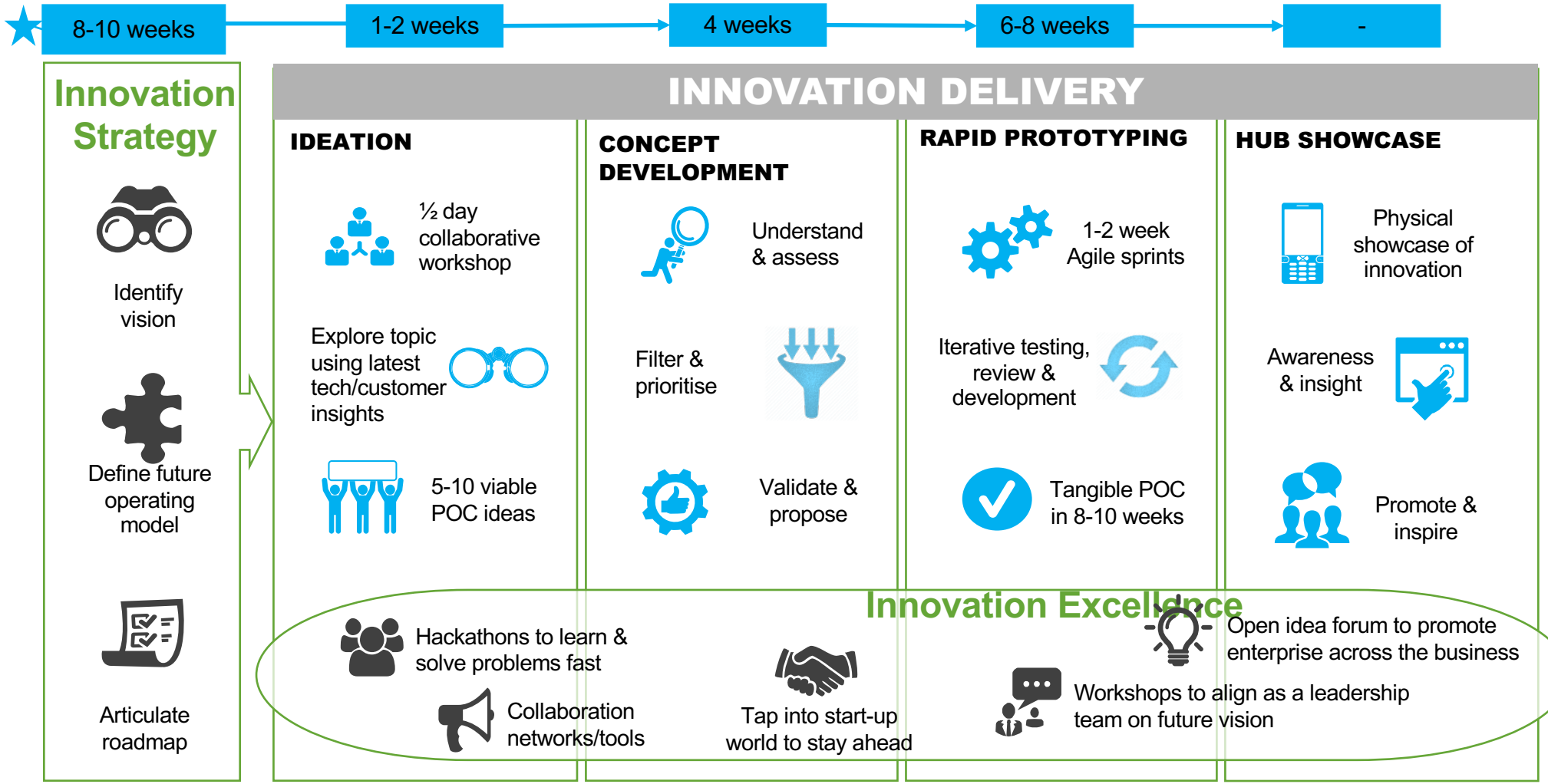
Innovation Programme Delivery



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Network Traffic Forecasting

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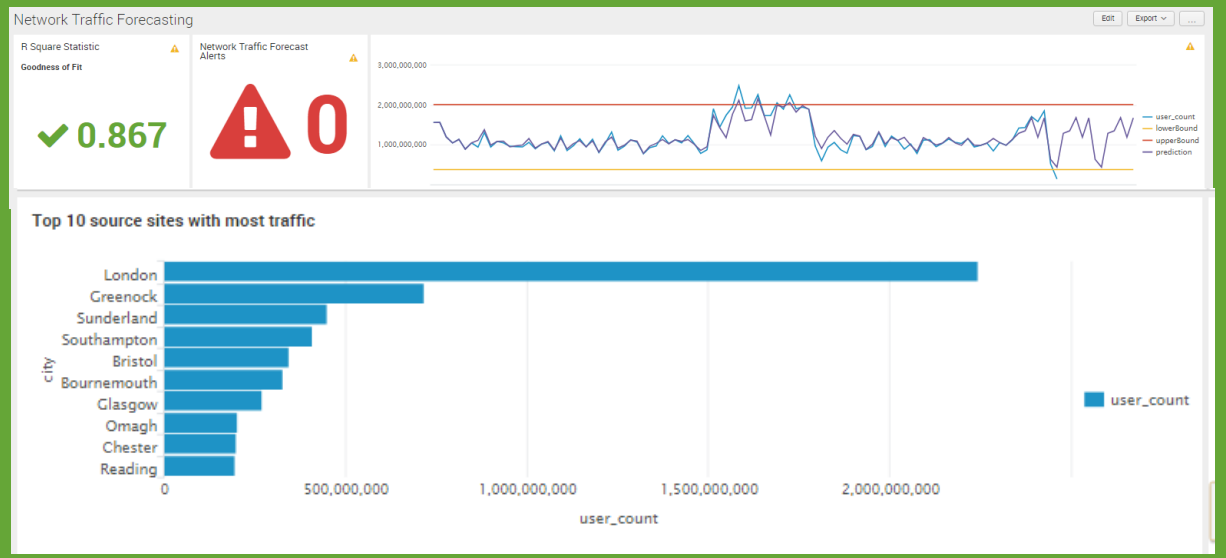
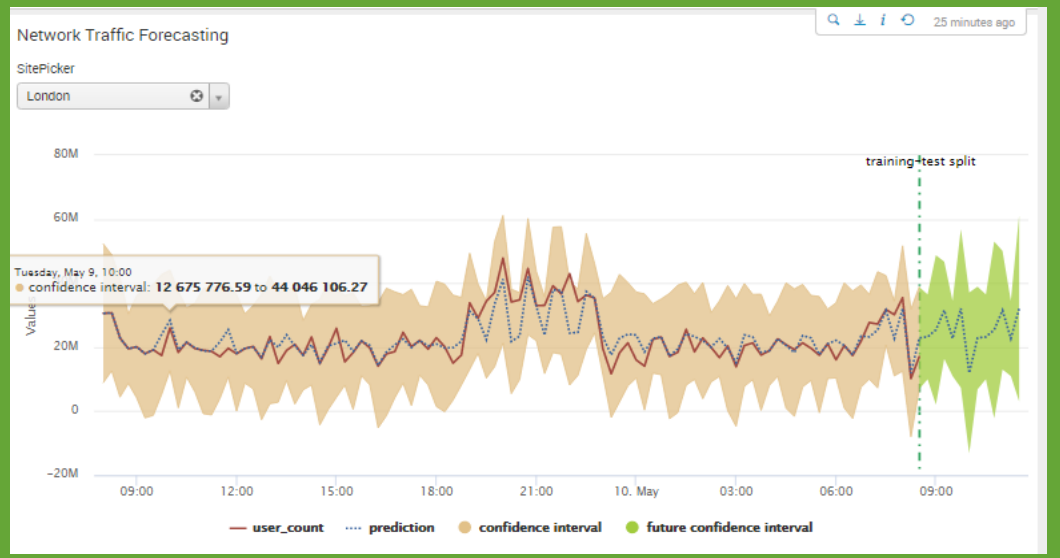
Network Traffic Forecasting…

- …is powered by linear regression algorithms to gain fast insights into traffic flow, including real-time alerts. Unexpected trends launch alerts and actions, reducing outages and improving the overall customer experience.





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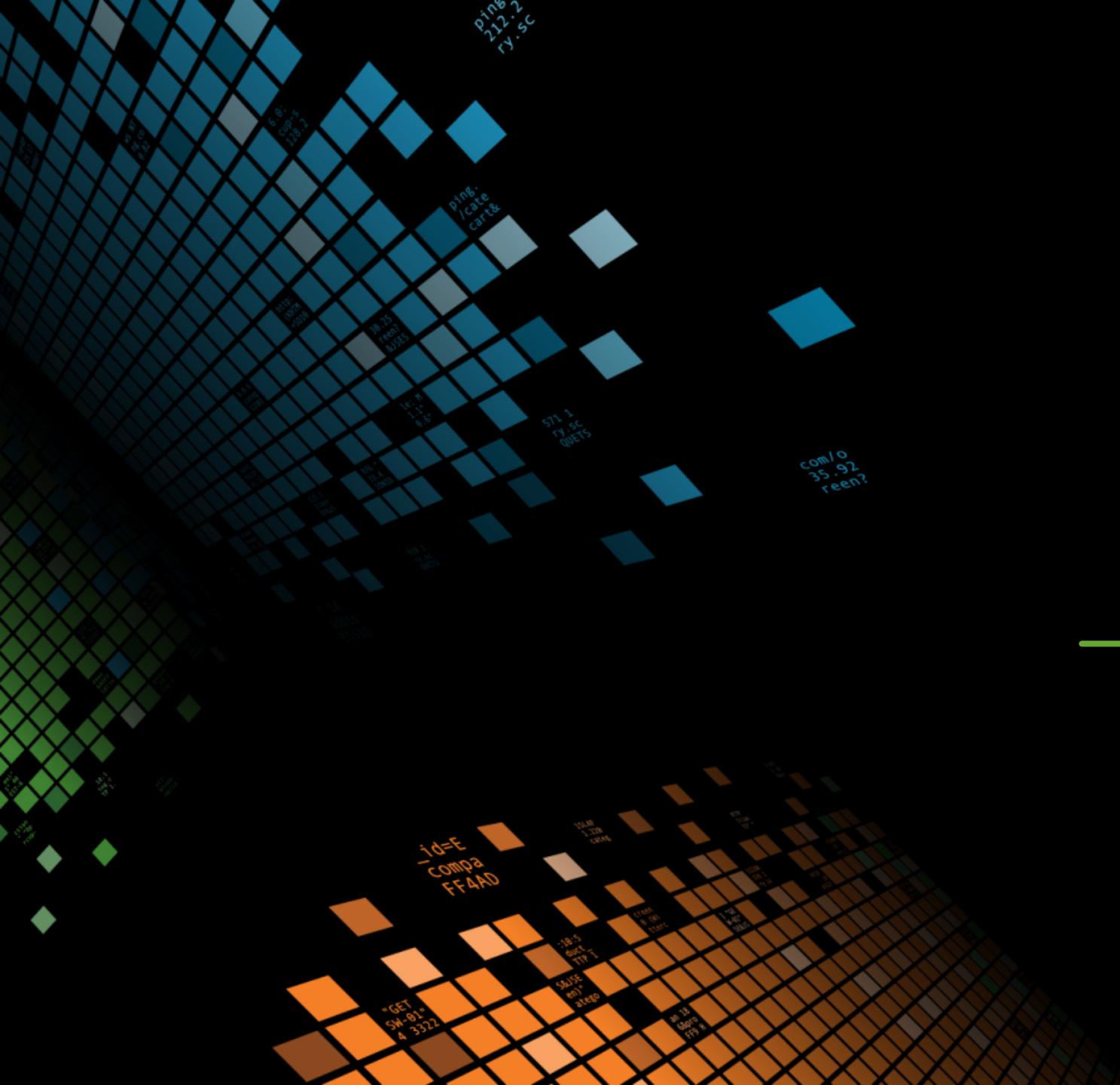

Data Centre Optimization

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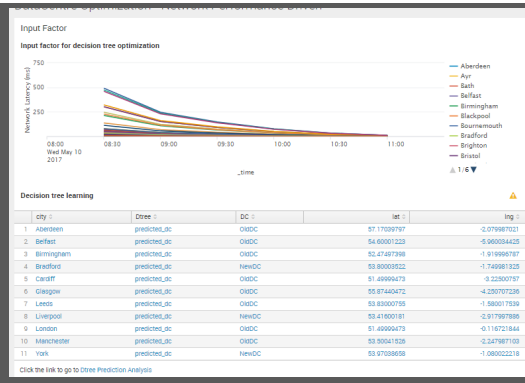
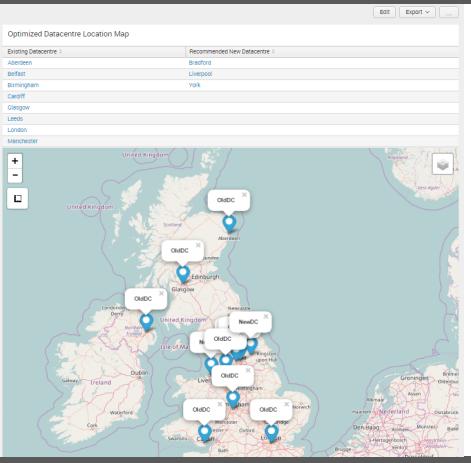
Data Centre Optimization

- …panels give a continuous, real-time view into how many data centres are needed to support current and forecasted traffic…

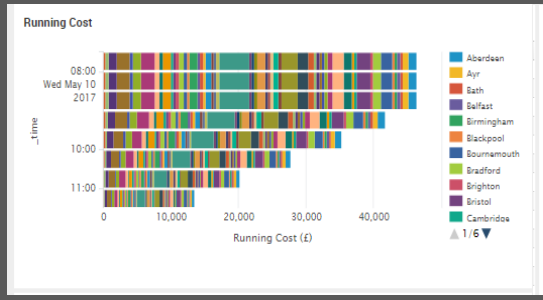


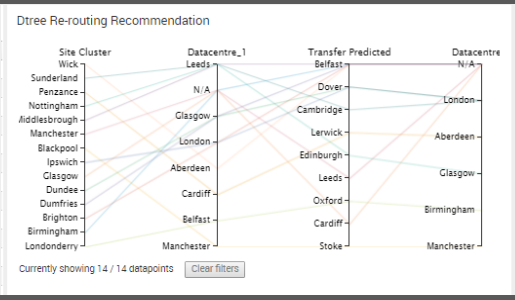


…and where these should be located to provide optimal CEX and performance.

In fact, using our solution, the traditional plan and build of future Data Centres will be disrupted. Moving from classic network infrastructure design (static hardware allocation) to enable the adoption of Software Defined Networks…

…with an expectation to avoid physical builds. Concentrating CAPEX spend where it will provide optimised performance and ROI.





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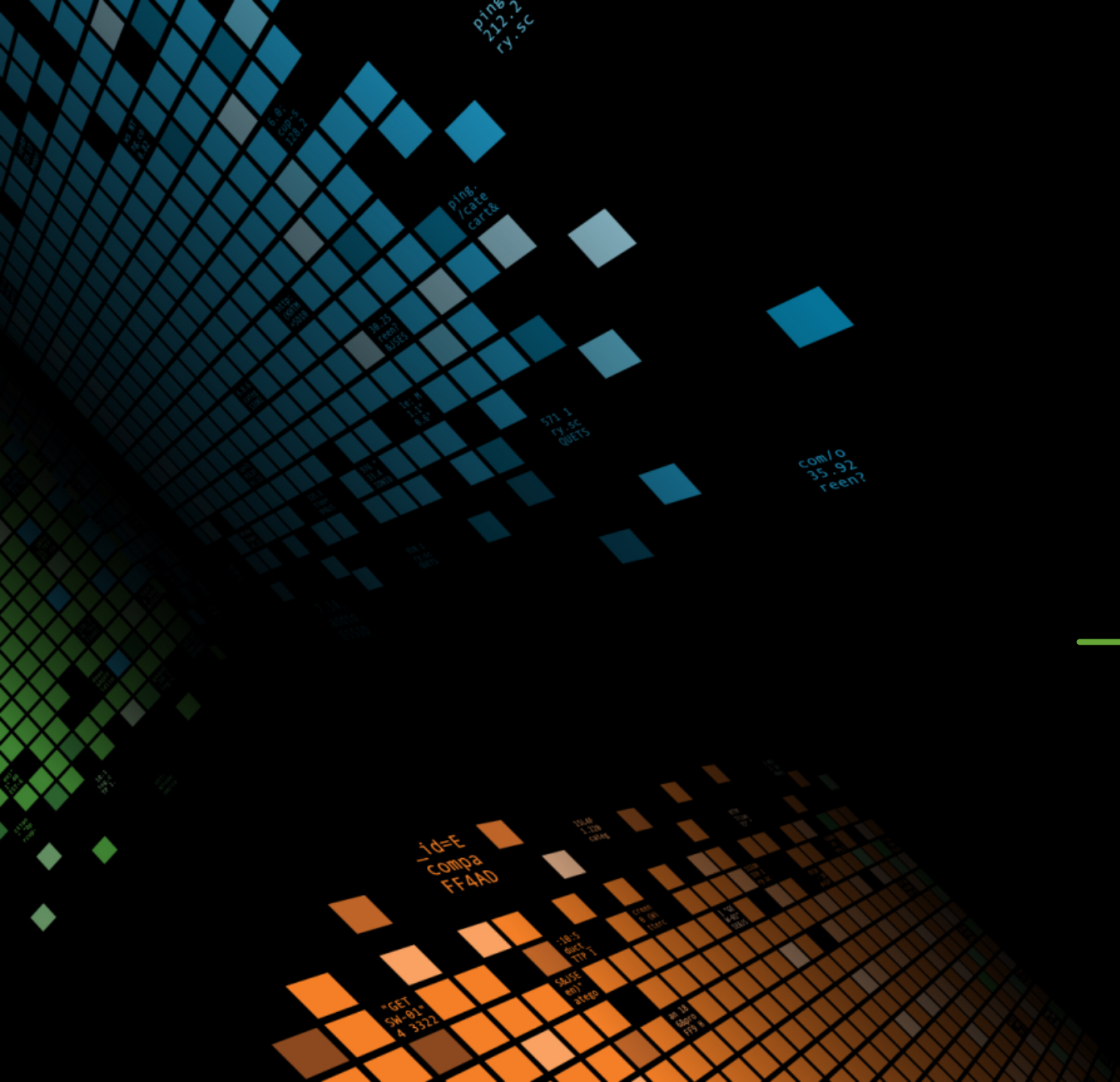

Insights

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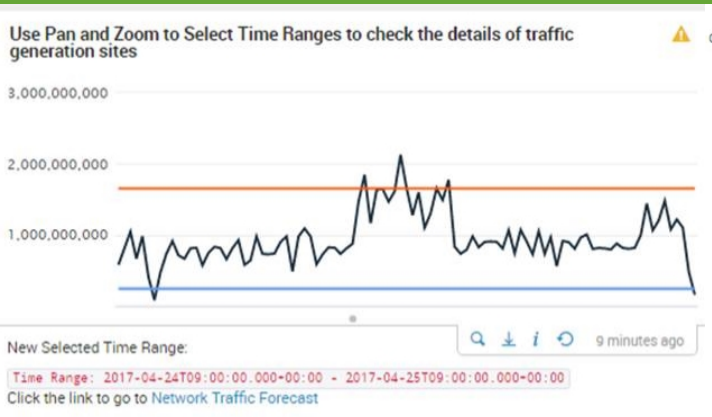
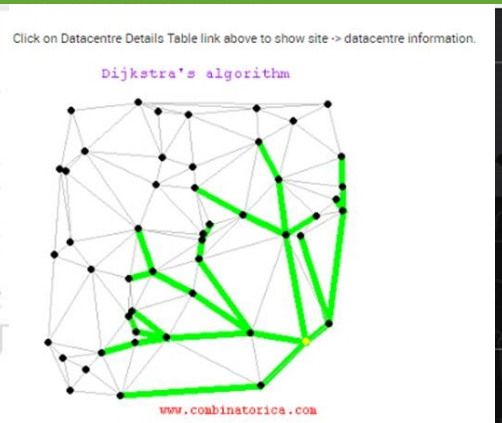
Insights Into Network Performance Optimization

- …can be gained by viewing the network route finder, powered by a customised Python pathfinding algorithm, based on Dijkstra's algorithm.





Top 10 Highest Utilization

city	sparkline	Utilization Rate
Leeds		0.913309
Cardiff		0.908585
Birmingham		0.905566
Belfast		0.905188
Manchester		0.904770
Glasgow		0.877842
Aberdeen		0.769038
London		0.435908

Top 10 Lowest Utilization

city	sparkline	Utilization Rate
London		0.435823
Aberdeen		0.768793
Glasgow		0.877778

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"We created Four network management personas, each configured with ML algorithms and dashboards…

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Site Cluster Manager

- Oversight of site cluster performance, traffic peak time and traffic forecasting.

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Site Cluster Manager

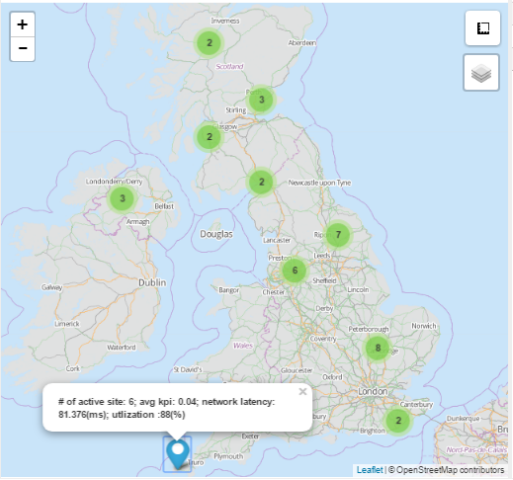
Edit | Export | ...

Click the link to go to Welcome Page
Click the link to go to Network Traffic Forecasting

Site Cluster Map

TimePicker: Last 15 minutes

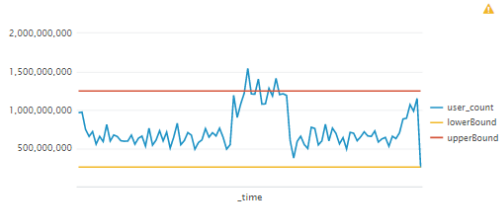
Inc details: active site number, avg kpi, network latency, utilization over last 15 mins



Site Cluster Peak Time

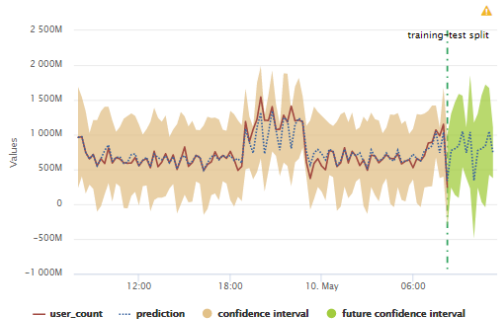
Site Cluster Peak Time last 24 hours

_time	user_count	range
2017-05-09 20:00:00	1542912870	!
2017-05-09 20:45:00	1403968980	!
2017-05-09 21:30:00	1280766010	!
2017-05-09 22:00:00	1410931310	!



Site Cluster Traffic Forecasting

Forecast Range: Next 3 hours



Site Cluster Manager

Site Cluster Status

TOP 10 Utilization

site cluster	utilization	sparkline
Edinburgh	91.09 %	
Oxford	91.08 %	
Wick	90.97 %	
Dover	90.97 %	
Newcastle	90.96 %	
Luton	90.79 %	
Stoke	90.78 %	
Kirkwall	90.76 %	
Portsmouth	90.73 %	
Peterborough	90.72 %	

« prev 1 2 3 4 5 next »

Top 10 Network Latency

site cluster	network latency	sparkline
Portsmouth	486.95 (ms)	
Bournemouth	484.95 (ms)	
Southampton	446.48 (ms)	
Reading	321.75 (ms)	
Bath	312.30 (ms)	
Bristol	306.41 (ms)	
Londonderry	247.27 (ms)	
Oxford	226.19 (ms)	
Omagh	215.70 (ms)	
Leicester	139.87 (ms)	

Problem Children

Choose a view

Problem Children: KPI
Problem Children: Utilization
Problem Children: Latency

Highest Utilization Rate in Red (>95% site clusters)

Luton Bradford Bournemouth Blackpool Lisburn Bristol Ayr Bath

Site Cluster Overall Performance

TimePicker: Last 60 minutes

Total Site Clusters

49

Site Cluster Overall KPI

Medium

Site Cluster Overall Utilization Rate (%)

Site Cluster Overall Network Latency

95.07 (ms) 4.17

Compared to 1 hour ago

Selected Cluster Performance

Site Cluster Picker: Greenock

Greenock

Site Cluster Overall KPI

Medium

Site Cluster Overall Utilization Rate (%)

Site Cluster Overall Network Latency

11.46 (ms) 0.11

Compared to 1 hour ago

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Data Centre Manager

- Monitors datacentre status, traffic peak time, and traffic forecasting.

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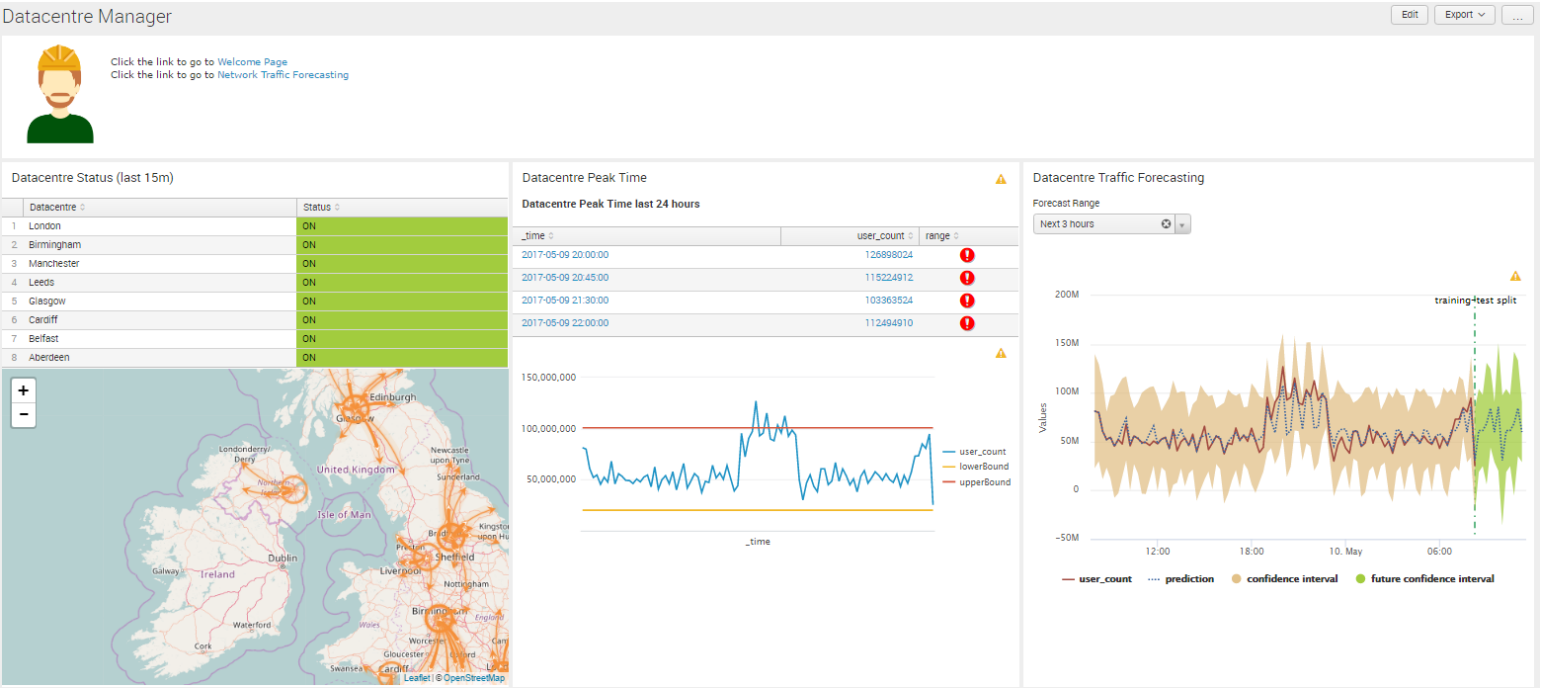
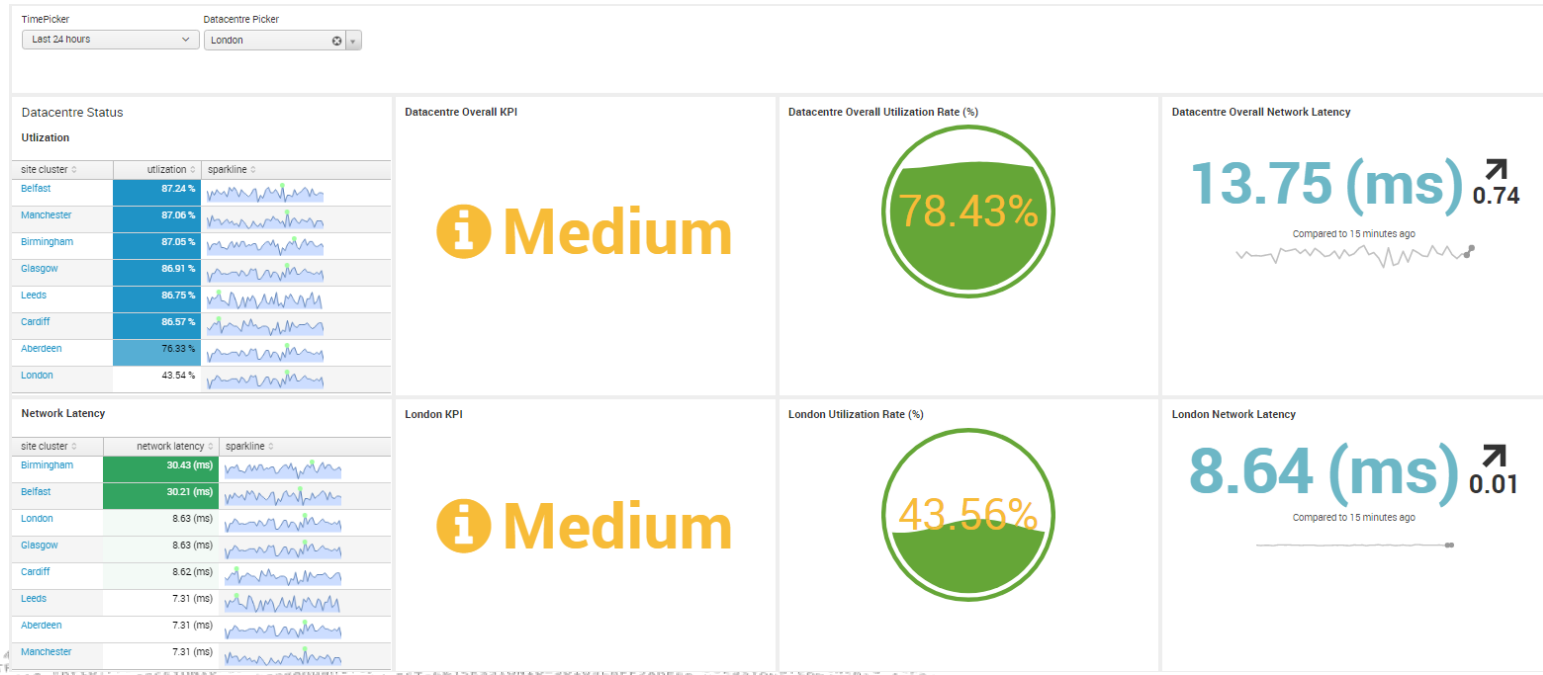


Data Centre Manager



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C-RAN Manager

- Combines site cluster performance information with datacentre performance.

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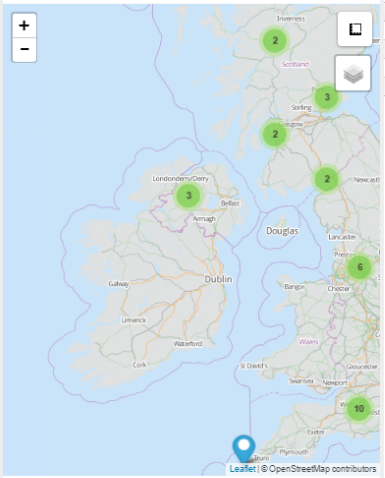
TimePicker

Last 15 minutes Hide Filters

Click the link to go to Welcome Page
Click the link to go to Network Traffic Forecasting

Site Cluster Map

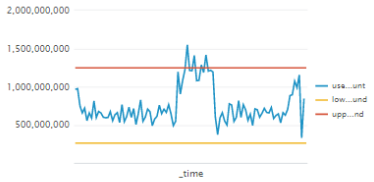
Inc details: active site number, avg kpi, network latency, utilization over last 15 mins



Site Cluster Peak Time

Site Cluster Peak Time last 24 hours

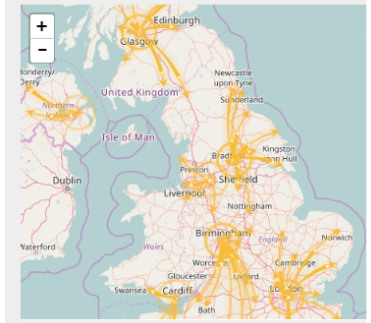
	_time	user_count
1	2017-05-09 20:00:00	1548091422
2	2017-05-09 20:45:00	1408681188
3	2017-05-09 21:30:00	1285064706
4	2017-05-09 22:00:00	1415666886



Datacentre Status

Datacentre Status last 24 hours

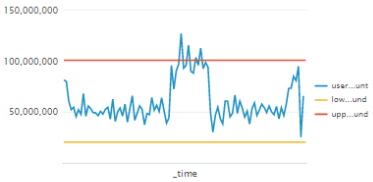
	Datacentre	Status
1	London	ON
2	Birmingham	ON
3	Manchester	ON
4	Leeds	ON
5	Glasgow	ON
6	Cardiff	ON
7	Belfast	ON
8	Aberdeen	ON



Datacentre Peak Time

Datacentre Peak Time last 24 hours

	_time	user_count
1	2017-05-09 20:00:00	127361736
2	2017-05-09 20:45:00	115645968
3	2017-05-09 21:30:00	103741236
4	2017-05-09 22:00:00	112905990



C-RAN Manager

Datacentre: London

Site Cluster: *

Group	Datacentre	Site Cluster
Group: 5	London	Southend-on-Sea Brighton Luton Norwich Peterborough Ipswich Cambridge Dover

Site Cluster Status — Utilization

site cluster	utilization	sparkline
Edinburgh	91.15 %	
Oxford	90.93 %	
Portsmouth	90.89 %	
Kirkwall	90.85 %	
Stoke	90.84 %	
Luton	90.76 %	
Dover	90.74 %	
Nottingham	90.71 %	
Newcastle	90.65 %	
Wick	90.60 %	

« prev 1 2 3 4 5 next »

Site Cluster Status — Network Latency

site cluster	network latency	sparkline
Portsmouth	487.46 (ms)	
Bournemouth	484.77 (ms)	
Southampton	446.42 (ms)	
Reading	321.54 (ms)	
Bath	312.17 (ms)	
Bristol	306.23 (ms)	
Londonderry	247.51 (ms)	
Oxford	226.09 (ms)	
Omagh	215.71 (ms)	
Leicester	140.00 (ms)	

« prev 1 2 3 4 5 next »

Datacentre Status — Utilization

site cluster	utilization	sparkline
Belfast	87.50 %	
Manchester	87.12 %	
Birmingham	86.93 %	
Leeds	86.92 %	
Glasgow	86.88 %	
Cardiff	86.54 %	
Aberdeen	76.38 %	
London	43.62 %	

Datacentre Status — Network Latency

site cluster	network latency	sparkline
Birmingham	30.56 (ms)	
Belfast	30.39 (ms)	
Glasgow	8.63 (ms)	
London	8.62 (ms)	
Cardiff	8.62 (ms)	
Aberdeen	7.31 (ms)	
Manchester	7.31 (ms)	
Leeds	7.31 (ms)	

London KPI

Medium

Site Cluster KPI :: London

Site Cluster	KPI
Brighton	Low
Cambridge	Medium
Dover	Low
Ipswich	Low
Luton	Low
Norwich	Medium
Peterborough	Low
Southend-on-Sea	Medium

London Utilization Rate (%)

Site Cluster Utli :: London

Site Cluster	Utilization (%)
Brighton	88.83 %
Cambridge	75.67 %
Dover	91.50 %
Ipswich	88.17 %
Luton	91.25 %
Norwich	88.80 %
Peterborough	92.00 %
Southend-on-Sea	87.67 %

London Network Latency

8.64 (ms)

Compared to 15 minutes ago

Site Cluster Latency :: London

	Site Cluster	Network Latency	sparkline
1	Brighton	27.308333	
2	Cambridge	28.358333	
3	Dover	38.670000	
4	Ipswich	40.248333	
5	Luton	17.000000	
6	Norwich	57.348000	
7	Peterborough	44.486667	
8	Southend-on-Sea	20.961667	

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C-Suite Portal

- Integrates network performance information with financial performance to support executive's decision-making.

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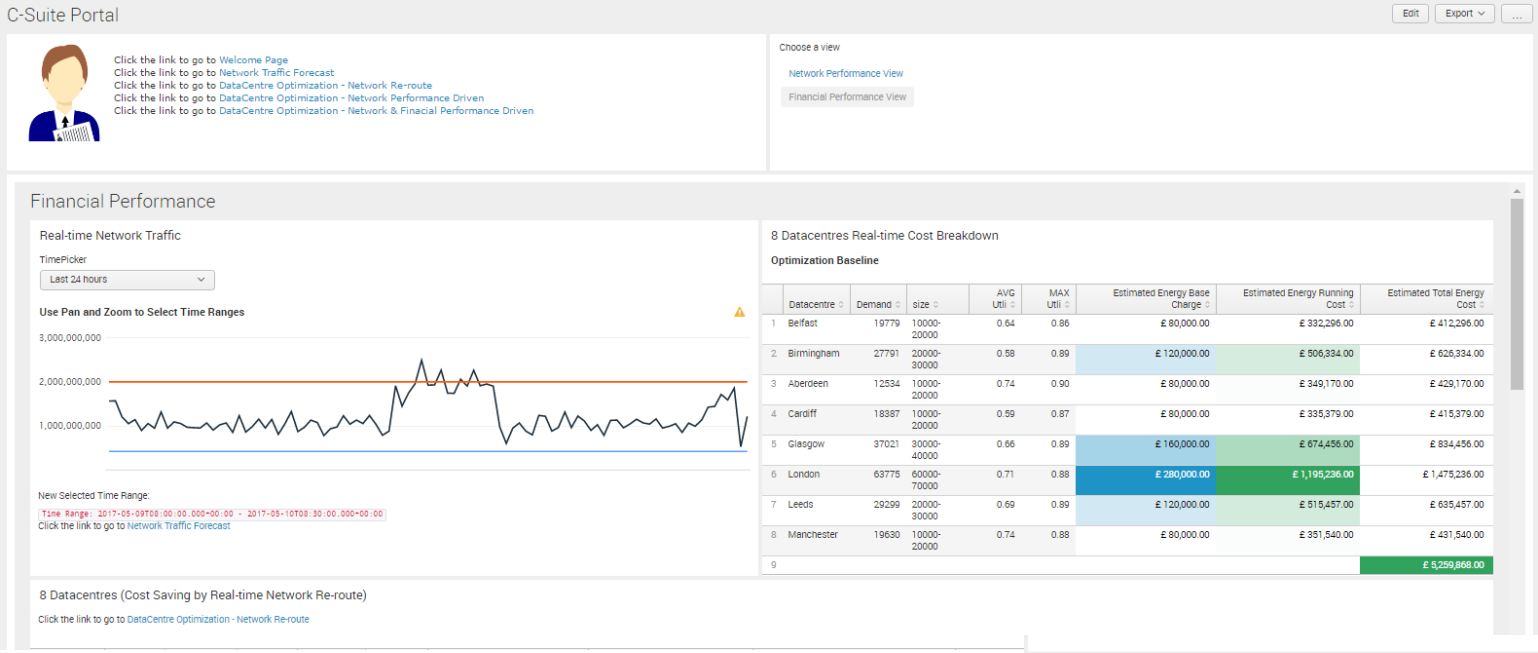
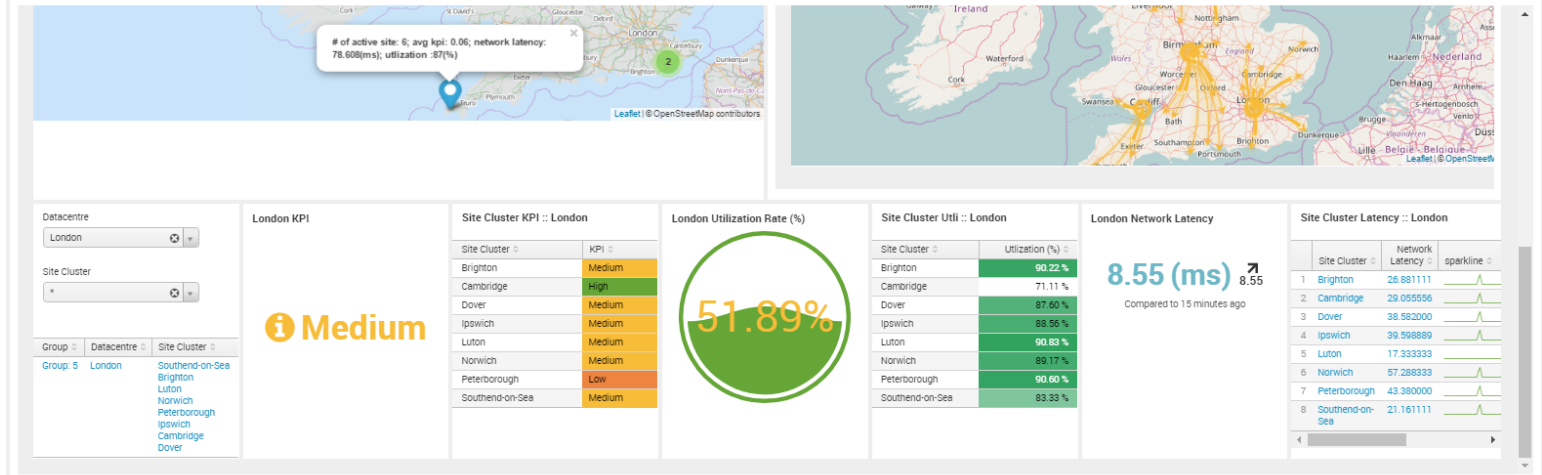
C-Suite Portal





8 Datacentres (Cost Saving by Real-time Network Re-route)

Click the link to go to DataCentre Optimization - Network Re-route

Datacentre	Demand	size	AVG Util	Target Util	MAX Util	Estimated Energy Base Charge	Estimated Energy Running Cost	Estimated Energy Running Cost (Target)	Estimated Total Energy Cost	Estimated Total Energy Cost (Target)	Target Savings	Target Savings (%)
Belfast	19967	10000-20000	0.64	0.67	0.86	£ 80,000.00	£ 340,518.00	£ 299,134.00	£ 420,518.00	£ 379,134.00		
Birmingham	28067	20000-30000	0.58	0.67	0.88	£ 120,000.00	£ 512,244.00	£ 444,345.00	£ 632,244.00	£ 564,345.00		
Aberdeen	12639	10000-20000	0.74	0.67	0.89	£ 80,000.00	£ 357,114.00	£ 307,847.00	£ 437,114.00	£ 387,847.00		
Cardiff	18553	10000-20000	0.59	0.67	0.86	£ 80,000.00	£ 333,906.00	£ 293,326.00	£ 413,906.00	£ 373,326.00		
Glasgow	37363	30000-40000	0.66	0.67	0.88	£ 160,000.00	£ 716,472.00	£ 621,503.00	£ 876,472.00	£ 781,503.00		
London	64338	60000-70000	0.71	0.67	0.88	£ 280,000.00	£ 1,265,544.00	£ 1,097,794.00	£ 1,545,544.00	£ 1,377,794.00		
Leeds	29590	20000-30000	0.69	0.67	0.88	£ 120,000.00	£ 542,376.00	£ 470,483.00	£ 662,376.00	£ 590,483.00		
Manchester	19799	10000-20000	0.74	0.67	0.88	£ 80,000.00	£ 368,280.00	£ 319,464.00	£ 448,280.00	£ 399,464.00		
									£ 5,436,454.00	£ 4,853,896.00	£ 582,558.00	10.72 %

11 Datacentres (Network Performance Driven)

10 Datacentres (Network Performance + Cost Efficient)

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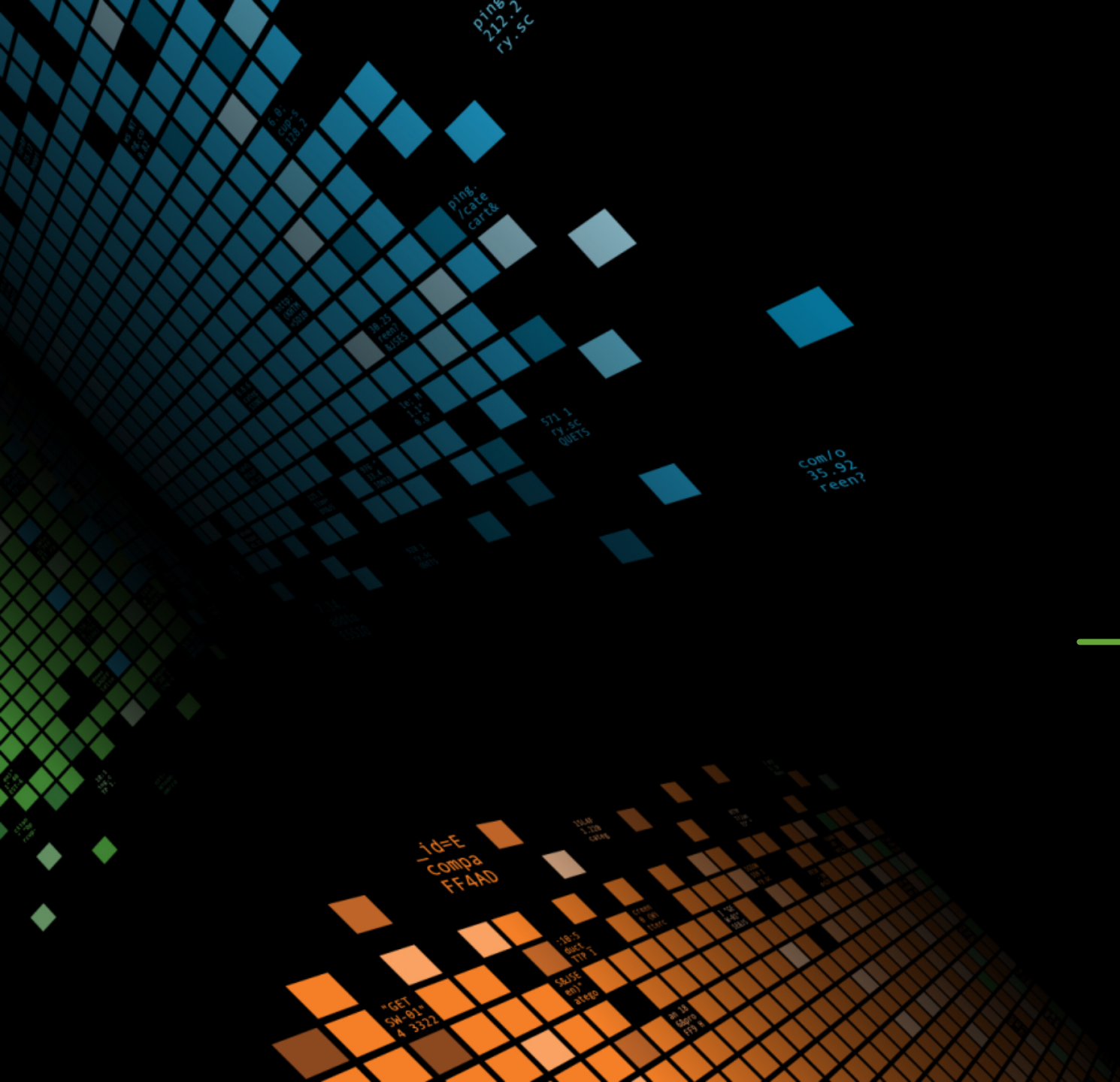

Technical Highlights

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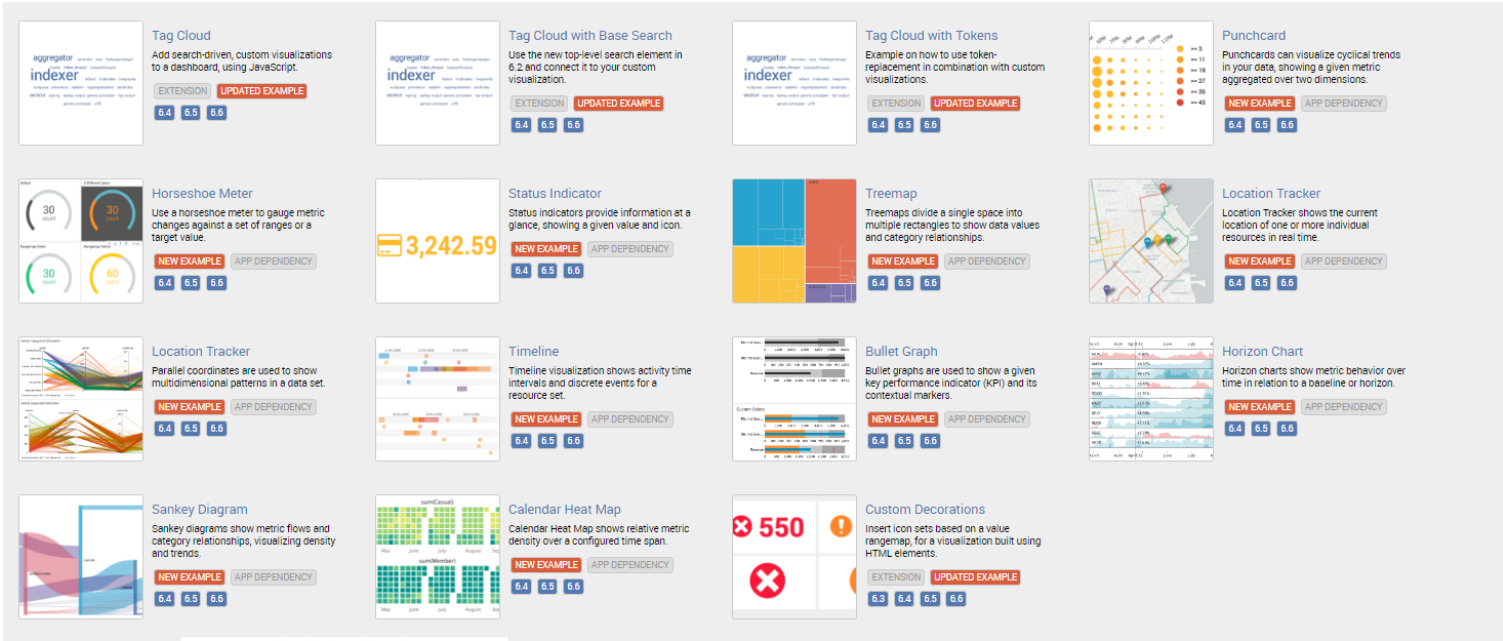
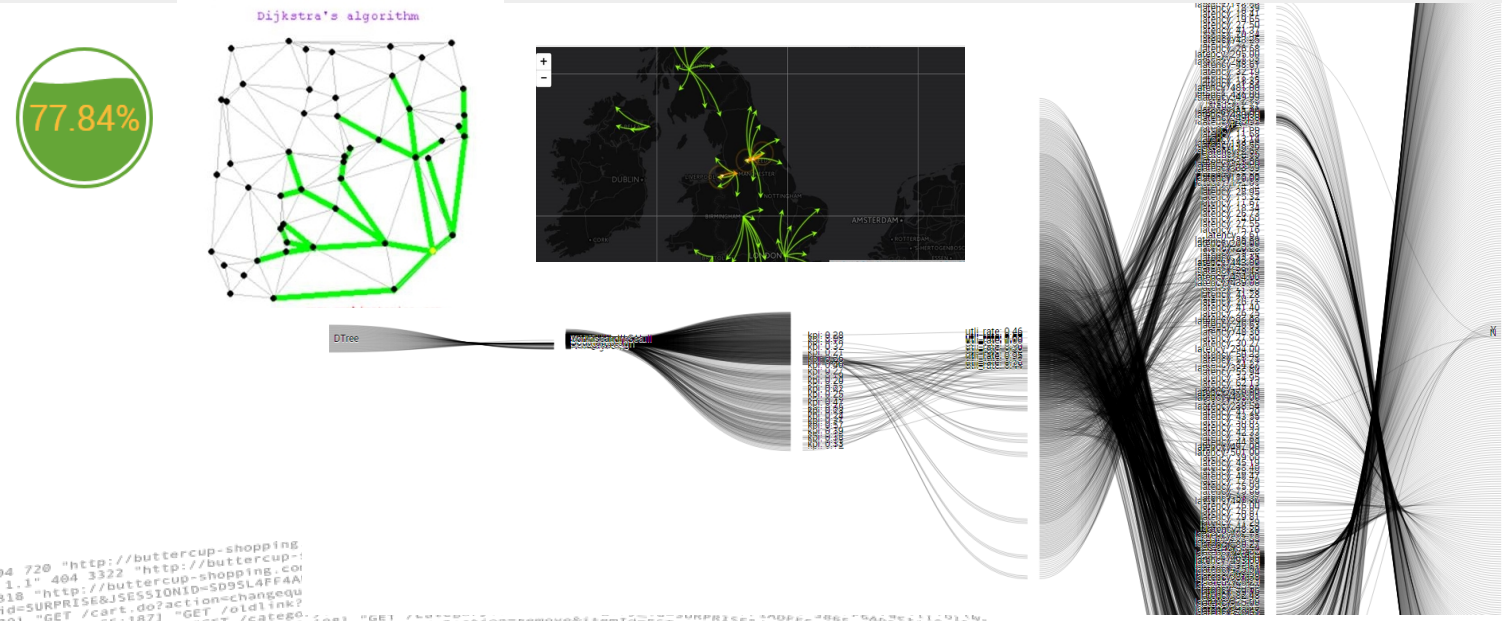
The Best Bits

Data Visualization

- Splunk's web framework enabled us to create a customized dashboard view
- Integrates with D3.js to create stunning dashboards and leaflet API which creates interactive map views
- Ample visualization components available in Splunkbase






```
$ less *.xml | grep -F "viz type"  | sort --unique
      <viz type="cuviz_water_gauge.water_gauge">
      <viz type="geo_heatmap_app.geo_heatmap">
      <viz type="horizon_chart_app.horizon_chart">
      <viz type="leaflet_maps_app.leaflet_maps">
      <viz type="missile_map.missile_map">
      <viz type="parallel_coordinates_app.parallel_coordinates">
      <viz type="scatterplot3d_app.scatter3d">
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      <viz type="viz_halo.halo">
      <viz type="wordcloud_app.wordcloud">
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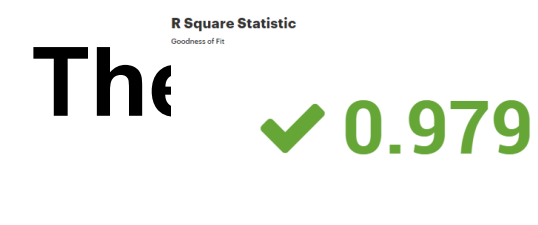
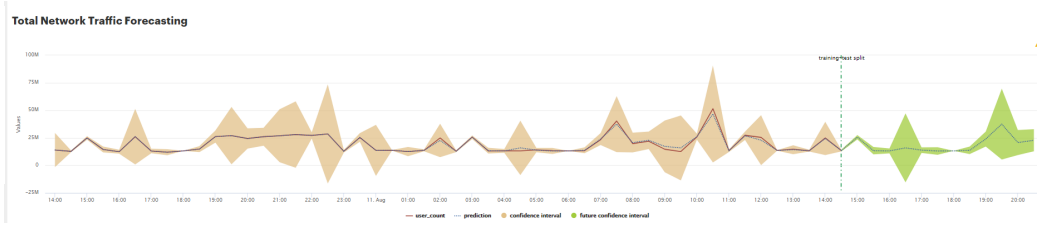
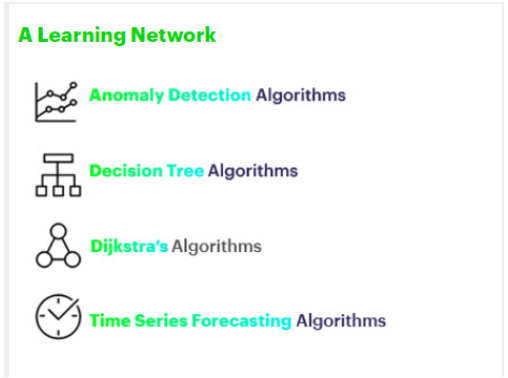
Machine Learning

- To build our own time series forecasting algorithms to forecast network service demand over time
- Decision tree algorithms to suggest how many data centres are needed and where they should be
- To create customized algorithm with Splunk ML Toolkit(i.e. Dijkstra's algorithm to calculate the best network reroute path)





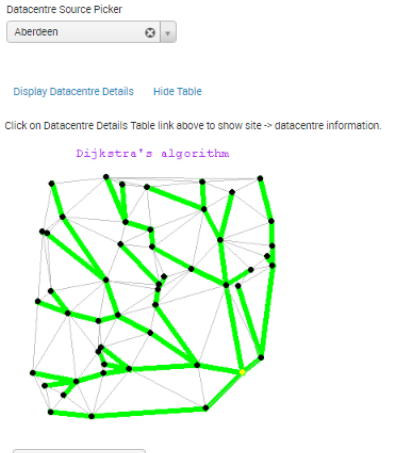


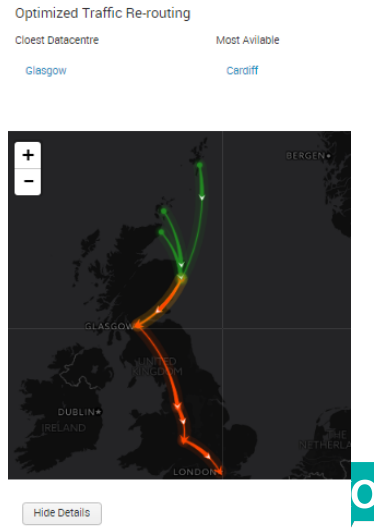
Decision tree learning

	Datacentre	Status	Dtree	lat	lng
1	London	Old DC	predicted_dc	51.49999473	-0.116721844
2	Birmingham	Old DC	predicted_dc	52.47497398	-1.919996787
3	Manchester	Decom		53.50041526	-2.247987103
4	Leeds	Old DC	predicted_dc	53.83000755	-1.580017539
5	Glasgow	Old DC	predicted_dc	55.87440472	-4.250707236
6	Liverpool	New DC	predicted_dc	53.41600181	-2.917997886
7	Cardiff	Old DC	predicted_dc	51.49999473	-3.22500757
8	Bradford	New DC	predicted_dc	53.80003522	-1.749981325
9	Belfast	Old DC	predicted_dc	54.60001223	-5.960034425
10	Aberdeen	Old DC	predicted_dc	57.17039797	-2.079987021
11	York	New DC	predicted_dc	53.97038658	-1.080022218

Click the link to go to Dtree Prediction Analysis

- How to run customized python algorithm:
- Register the algorithm
- Create the algorithm python script file
- Write an algorithm class





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The Best Bits

Real Time Data

- Due to the complexity of network infrastructure, it is very difficult to collect real-time data from various endpoints. As an end-to-end solution, Splunk's ability to collect, parse and index terabytes of data from various network devices and endpoints regardless of the data type in real-time is tremendously valuable.

- Various Network Data sources can be integrated with Splunk:
- Network Performance Management (i.e. Cisco Element Manager, OSS)
- Billing System
- Alarm logs
- Support tickets
- Marketing Tools (i.e. CRM, salesforces)
- External data (i.e. social media feeds)

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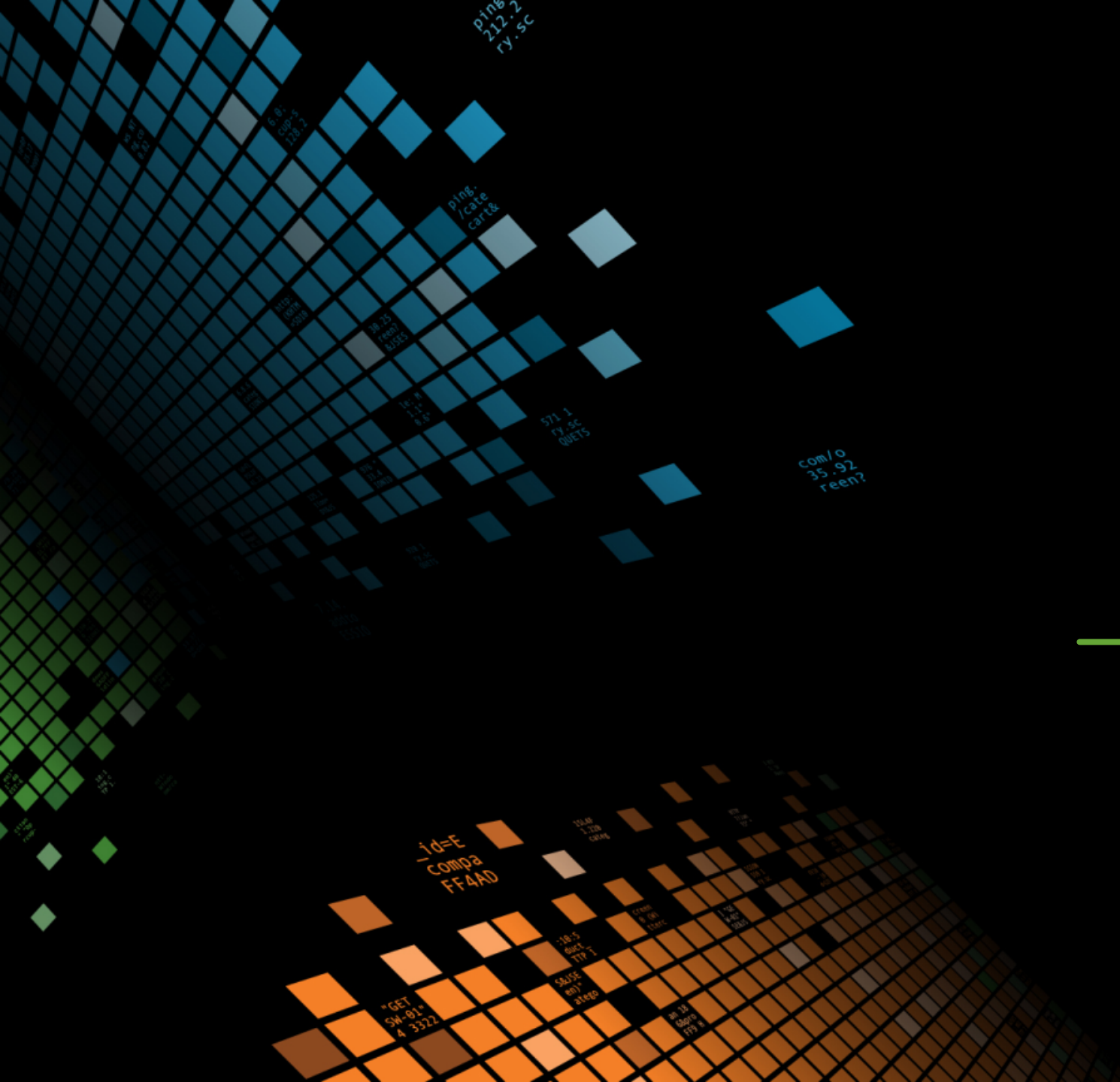

Conclusion

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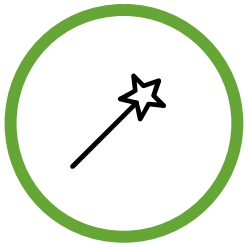
Conclusion

BETTER CUSTOMER EXPERIENCE



LOWER OPERATIONAL COSTS

LOWER CAPITAL INVESTMENT

WIN, WIN, WIN!

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Thank You

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