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Turbo Charging the Elephant

Search Performance Optimization Techniques for Splunk Analytics for Hadoop

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Who we are

Holger Sesterhenn

- Staff Sales Engineer from Germany
- With Splunk for 6 years
- Focus on large accounts and complex architecture
- Loves craft beer
- Enjoys Marvel movies
- Pretends to do sports… sometimes

Raanan Dagan

- Principal Architect, Open Source
- Focused on open source technologies & integration
- 20+ years of experience building large scale data platforms
- Joined Splunk in 2012
- Avid soccer (football) player

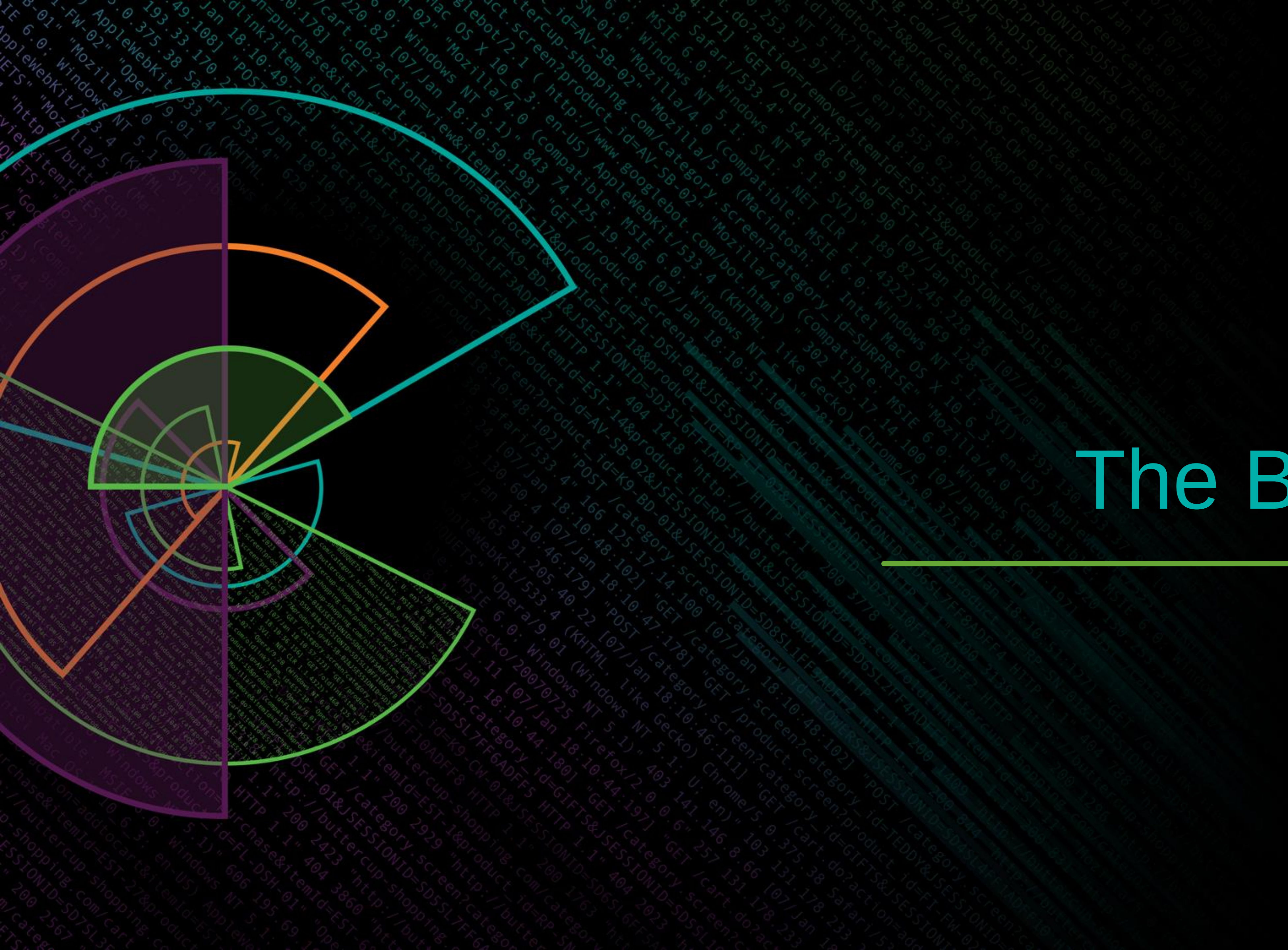
Splunk and Hadoop

What is slow and why it‘s different?

“Splunk Enterprise is optimized for time serialized data using an index –

Hadoop/HDFS/MR are for batch processing“

Don‘t mix the use cases!



The Basics

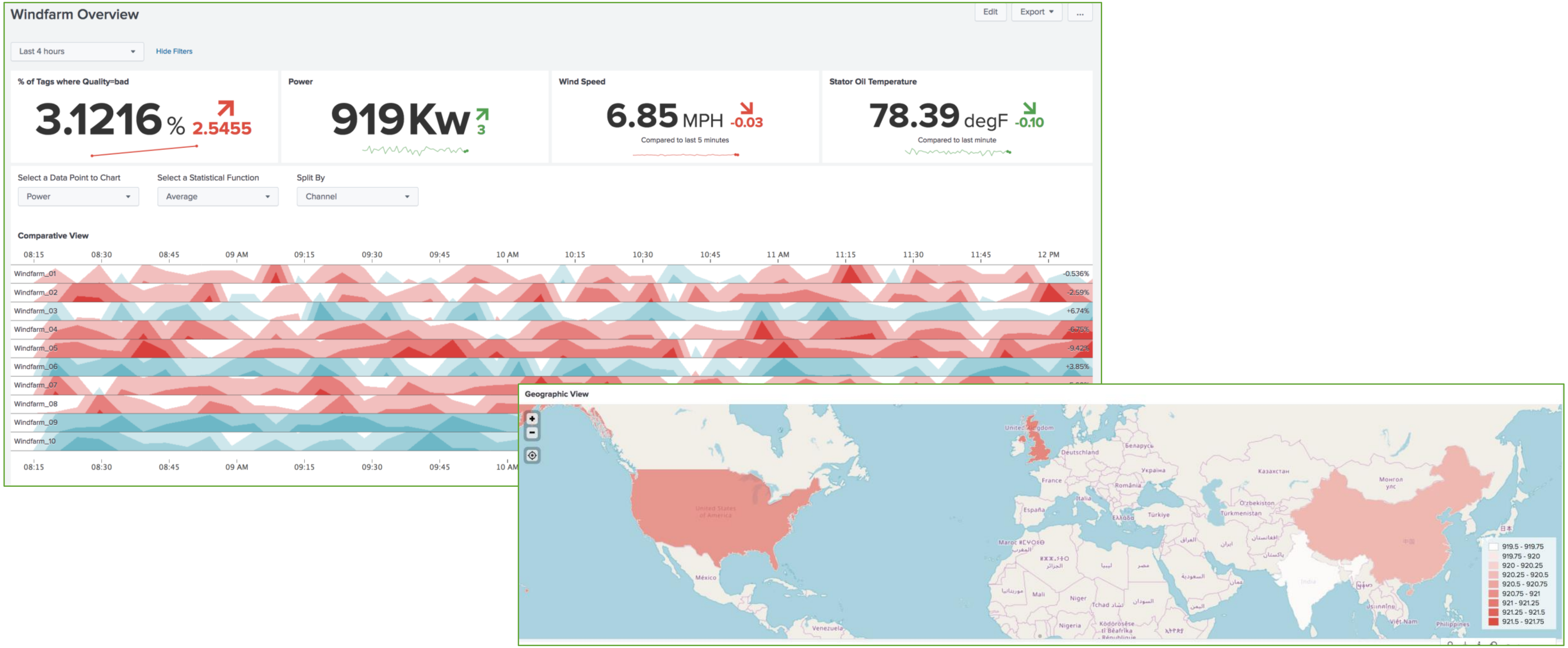
Splunk Analytics and Hadoop

What we are doing

- Main use case = Analyze Hadoop Data using Hadoop Processing (HDFS+MR)
  - It's just the search head… no Splunk Indexers anymore, but you can go hybrid
- Connect Splunk SH to Hadoop Cluster using a provider
  - You can connect multiple Hadoop Clusters to one Splunk SH
- Define a virtual index (VIX) for every data source you want to search
  - Usually you don't mix different sourcetypes in the same file/directory
- Schema on read is still used
  - `props.conf` and `transforms.conf` can be used to extract fields of interest

Use your SPL foo to search your data lake

UseCase: Windfarm



Windfarm Overview

Last 4 hours

Hide Filters

% of Tags where Quality=bad: 3.1216 % 2.5455

Power: 919 Kw 3

Wind Speed: 6.85 MPH -0.03 Compared to last 5 minutes

Stator Oil Temperature: 78.39 degF -0.10 Compared to last minute

Select a Data Point to Chart: Power

Select a Statistical Function: Average

Split By: Channel

Comparative View

Windfarm_01 -0.536%
Windfarm_02 -2.59%
Windfarm_03 +6.74%
Windfarm_04 -6.75%
Windfarm_05 -9.42%
Windfarm_06 +3.85%
Windfarm_07
Windfarm_08
Windfarm_09
Windfarm_10

Geographic View

919.5 - 919.75
919.75 - 920
920 - 920.25
920.25 - 920.5
920.5 - 920.75
920.75 - 921
921 - 921.25
921.25 - 921.5
921.5 - 921.75

Example Virtual Index

Connect a Hadoop HDFS cluster with a Splunk Analytics SearchHead

HDFS = /user/splunk/datalake/windfarm/20180824/09/windmill01/power.gz

```
[windfarm]
vix.provider = MyHadoopProvider
vix.input.1.path = /user/splunk/datalake/windfarm/*/*/${windmill}/...
vix.input.1.accept = \.gz$
vix.input.1.et.regex = .*?/datalake/windfarm/.*/(\d+)/(\d+)/.*?.gz
vix.input.1.et.format = yyyyMMddHH
vix.input.1.et.offset = 0
vix.input.1.lt.regex = .*?/datalake/windfarm/.*/(\d+)/(\d+)/.*?.gz
vix.input.1.lt.format = yyyyMMddHH
vix.input.1.lt.offset = 3600
```

http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Virtualindexes

Running a Splunk Analytics Search in Hadoop

Streaming, Hadoop MR and the like

1. `index=windfarm | head 1000`

   - A streaming search: just reading files from HDFS and stream them back to the splunkd process

2. `index=windfarm | stats count by windmill` (smart mode)

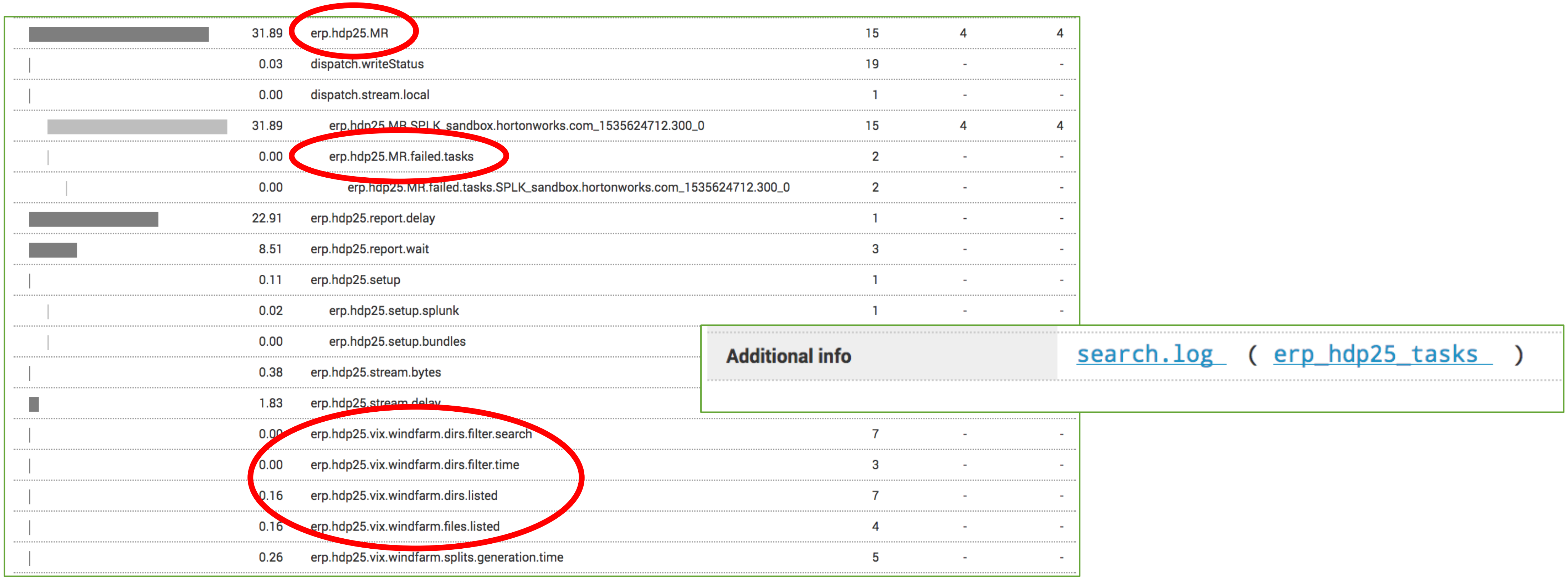
   - Read some files directly from HDFS - return results immediately / event timeline updates
   - Start MR jobs to search the majority of files (higher increments of events processed)

3. `index=windfarm | stats count by windmill` (verbose mode)

   - Don‘t start MR jobs at all! ONLY streaming!

Verify a MapReduce job is running

Screenshot of JobInspector/Logfile



31.89	erp.hdp25.MR	15	4	4
0.03	dispatch.writeStatus	19	-	-
0.00	dispatch.stream.local	1	-	-
31.89	erp.hdp25.MR.SPLK_sandbox.hortonworks.com_1535624712.300_0	15	4	4
0.00	erp.hdp25.MR.failed.tasks	2	-	-
0.00	erp.hdp25.MR.failed.tasks.SPLK_sandbox.hortonworks.com_1535624712.300_0	2	-	-
22.91	erp.hdp25.report.delay	1	-	-
8.51	erp.hdp25.report.wait	3	-	-
0.11	erp.hdp25.setup	1	-	-
0.02	erp.hdp25.setup.splunk	1	-	-
0.00	erp.hdp25.setup.bundles			
0.38	erp.hdp25.stream.bytes			
1.83	erp.hdp25.stream.delay			
0.00	erp.hdp25.vix.windfarm.dirs.filter.search	7	-	-
0.00	erp.hdp25.vix.windfarm.dirs.filter.time	3	-	-
0.16	erp.hdp25.vix.windfarm.dirs.listed	7	-	-
0.16	erp.hdp25.vix.windfarm.files.listed	4	-	-
0.26	erp.hdp25.vix.windfarm.splits.generation.time	5	-	-

Additional info search.log (erp_hdp25_tasks)

```
08-30-2018 10:25:18.413 INFO ERP.hdp25 - SplunkBaseMapper - using class=com.splunk.mr.input.SplunkLineRecordReader
to process split=/user/root/data/windfarm/opc/20180804/12/Power/windfarm_03-20180804_12-Power.opc.txt.gz:0+24275
```

Behind the Scenes

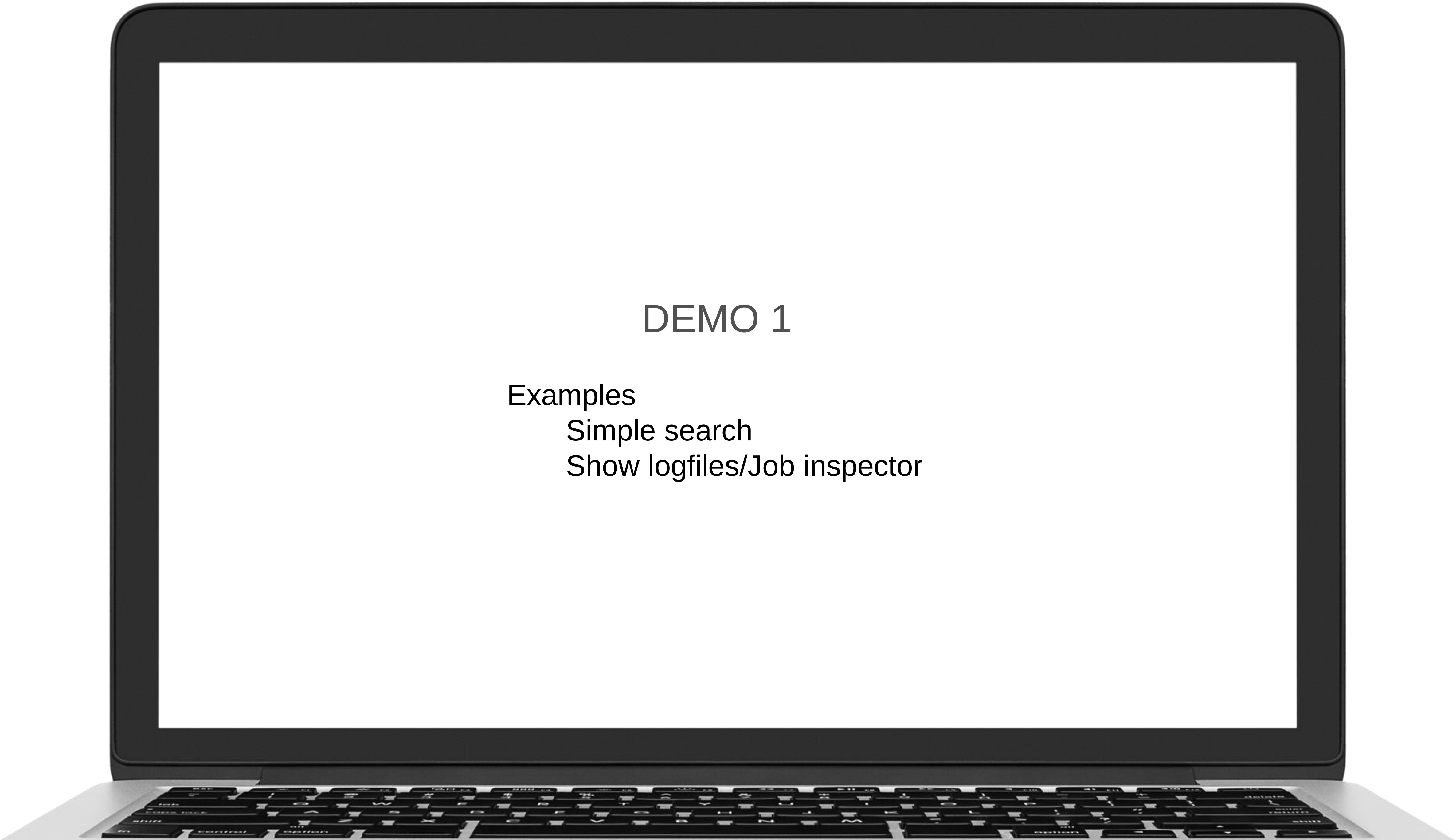
1. Splunk SH is creating search bundles for every Hadoop DataNode/TaskTracker

2. SplunkD process on every DataNode/TaskTracker either streams data or gets results from MapReduce jobs

3. SplunkD is processing the data (schema on read) and filters
   - Lookups are applied on the TaskTracker!

4. Data is sent back to Splunk SH (Hadoop Analytics)

This is a full event scan because there is no index (TSIDX) involved -
a lot of work to do if you just search for a “needle in a haystack” (AKA IP address e.g.)



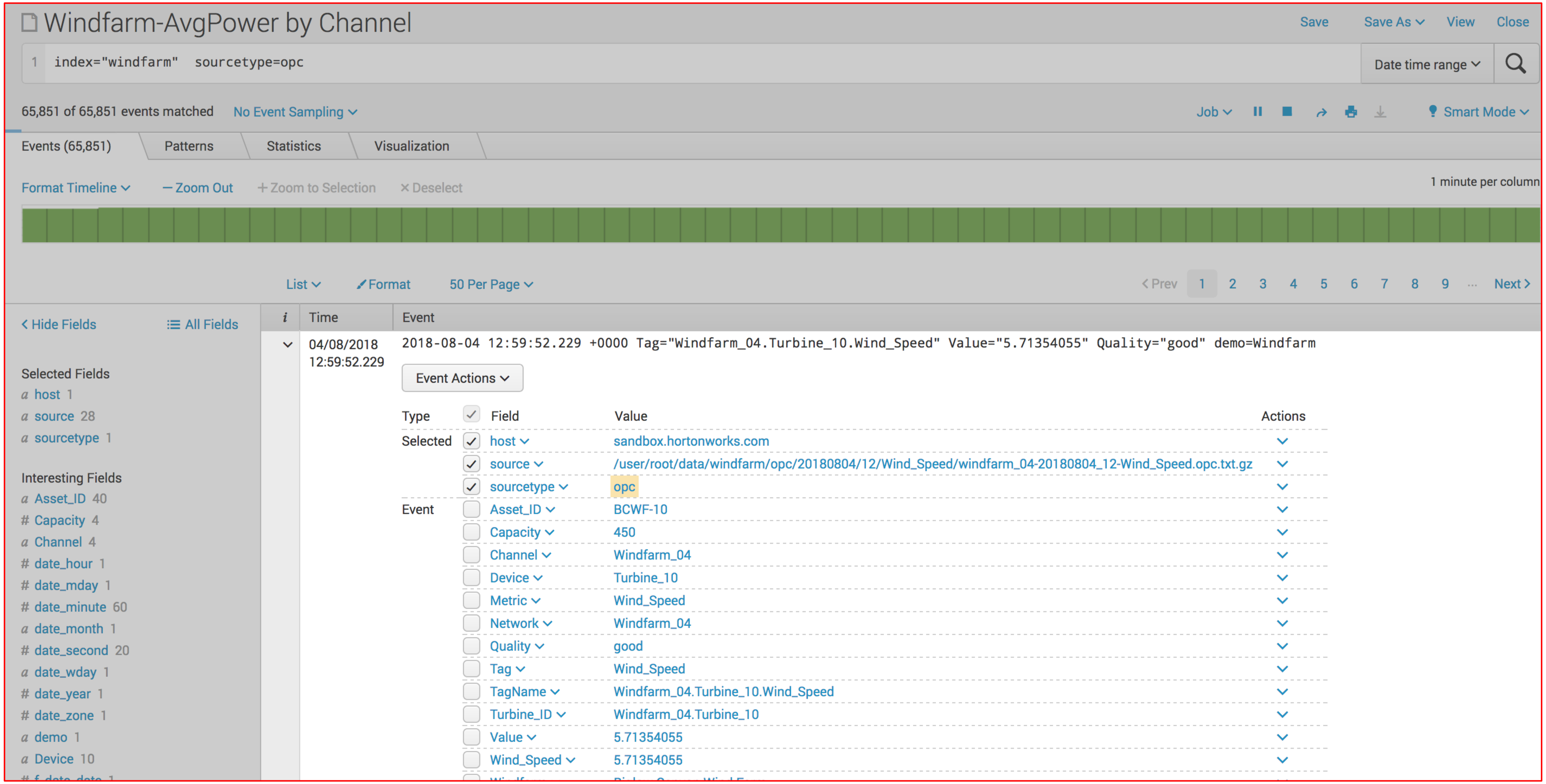
DEMO 1

Examples

- Simple search
- Show logfiles/Job inspector

Backup Screenshot

Simple search with lookup data



Windfarm-AvgPower by Channel

```
index="windfarm"  sourcetype=opc
```

65,851 of 65,851 events matched   No Event Sampling

Events (65,851)   Patterns   Statistics   Visualization

1 minute per column

i	Time	Event
	04/08/2018 12:59:52.229	2018-08-04 12:59:52.229 +0000 Tag="Windfarm_04.Turbine_10.Wind_Speed" Value="5.71354055" Quality="good" demo=Windfarm

Type	✓	Field	Value	Actions
Selected	☑	host	sandbox.hortonworks.com	
	☑	source	/user/root/data/windfarm/opc/20180804/12/Wind_Speed/windfarm_04-20180804_12-Wind_Speed.opc.txt.gz	
	☑	sourcetype	opc	
Event	□	Asset_ID	BCWF-10	
	□	Capacity	450	
	□	Channel	Windfarm_04	
	□	Device	Turbine_10	
	□	Metric	Wind_Speed	
	□	Network	Windfarm_04	
	□	Quality	good	
	□	Tag	Wind_Speed	
	□	TagName	Windfarm_04.Turbine_10.Wind_Speed	
	□	Turbine_ID	Windfarm_04.Turbine_10	
	□	Value	5.71354055	
	□	Wind_Speed	5.71354055	

Selected Fields

	Field	Count
a	host	1
a	source	28
a	sourcetype	1

Interesting Fields

	Field	Count
a	Asset_ID	40
#	Capacity	4
a	Channel	4
#	date_hour	1
#	date_mday	1
#	date_minute	60
a	date_month	1
#	date_second	20
a	date_wday	1
#	date_year	1
#	date_zone	1
a	demo	1
a	Device	10

Backup Screenshot

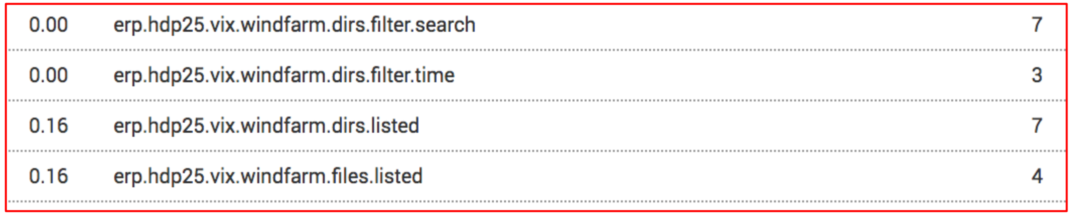
Loglines to show partition pruning

```
Search: index="windfarm"  sourcetype=opc f_tag="Power"
```

```
08-30-2018 10:49:55.384 DEBUG ERP.hdp25 - VirtualIndex - Updating source in search context to a
dir=/user/root/data/windfarm/opc/20180804/12/Power/
08-30-2018 10:49:55.384 DEBUG ERP.hdp25 - VirtualIndex - Dir meets the search criteria. Will consider it,
path=hdfs://172.17.0.1:8020/user/root/data/windfarm/opc/20180804/12/Power
08-30-2018 10:49:55.384 DEBUG ERP.hdp25 - VirtualIndex - Dir meets time heuristic
path=hdfs://172.17.0.1:8020/user/root/data/windfarm/opc/20180804/12/Power, search.et=1533384000, search.lt=1533387600,
file.et=1533384000, file.lt=1533387600, file.mtime=1534341390
```

```
08-30-2018 10:49:55.384 DEBUG ERP.hdp25 - VirtualIndex - Updating source in search context to a
dir=/user/root/data/windfarm/opc/20180804/12/Wind_Speed/
08-30-2018 10:49:55.384 DEBUG ERP.hdp25 - VirtualIndex - Dir does not meet the search criteria. Will not
consider it, path=hdfs://172.17.0.1:8020/user/root/data/windfarm/opc/20180804/12/Wind_Speed
```

```
08-30-2018 10:49:55.469 DEBUG ERP.hdp25 - VirtualIndex - Dir meets the search criteria.
Will consider it, path=hdfs://172.17.0.1:8020/user/root/data/windfarm/opc/20180804/10
08-30-2018 10:49:55.469 DEBUG ERP.hdp25 - VirtualIndex - Dir does not satisfy time
heuristic, path=hdfs://172.17.0.1:8020/user/root/data/windfarm/opc/20180804/10,
search.et=1533384000, search.lt=1533387600, file.et=1533376800, file.lt=1533380400,
file.mtime=1534341389
```



0.00	erp.hdp25.vix.windfarm.dirs.filter.search	7
0.00	erp.hdp25.vix.windfarm.dirs.filter.time	3
0.16	erp.hdp25.vix.windfarm.dirs.listed	7
0.16	erp.hdp25.vix.windfarm.files.listed	4

Best Practices - Part 1 -

Make sure the directory structure is useful

This is BAD

- /datalake/user/dir/<allfiles>...

This is GOOD (use the time picker to prune directories)

- /datalake/windfarm/opc/**20180801/0900**/<somefiles>....
- /datalake/windfarm/opc/**20180802/1000**/<otherfiles>....

This is BETTER (automatic field extraction!)

- /datalake/windfarm/${sourcetype}/**20180801/0900**/**metric=power**/<fewer files>...
- /datalake/windfarm/${sourcetype}/**20180801/1000**/**metric=wind_speed**/<fewer files>...

Reduce the amount of files scanned/read from HDFS

Structure by directory not by filename!

http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Setupvirtualindexes

Get results faster

Want your dashboards fast? Cache is king

Overview of options

1. Splunk (scheduled) saved search
   - https://docs.splunk.com/Documentation/Splunk/latest/SearchReference/Loadjob
   - http://docs.splunk.com/Documentation/Splunk/latest/Report/Schedulereports

2. Splunk summary index
   - Store the results of a search in Splunk Enterprise
   - http://docs.splunk.com/Documentation/Splunk/latest/Knowledge/Usesummaryindexing

3. Hadoop Analytics Report Acceleration
   - http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Workwithreportacceleration

4. Datamodel Acceleration, not just nice looking..
   - http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Datamodelacceleration

Hadoop Analytics Report Acceleration

Some more details

- You need a transforming search
- Don‘t work in verbose mode
- Store the results in HDFS
  - hdfs:///user/root/splunkmr702/cache/windfarm/d5b3fea992e7a90fabd20e71e2bf269c/_no_id/compacts/78967737-5757-44e9-a8f2-e7d258e8b97f
- Files are stored in `vix.splunk.search.cache.path`
- Works like Splunk Enterprise Report Acceleration

http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Configurereportacceleration

Hadoop Analytics Data Model Acceleration

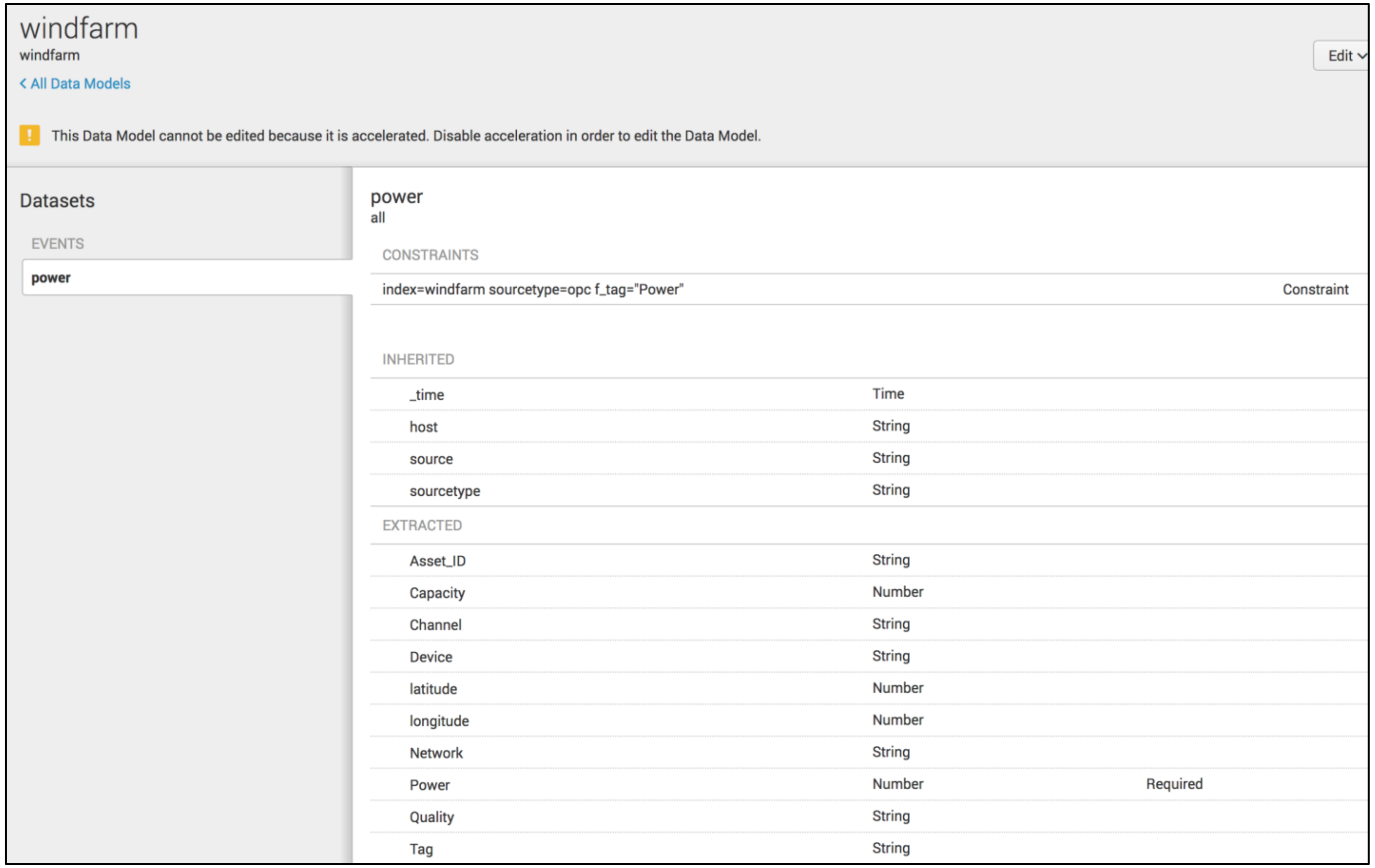
Some more details

- Configure a Splunk Enterprise Data Model
  - The constraint is using a VIX!
- Switch on accleleration
  - Mapreduce jos are running on a fixed schedule
  - Results are stored in ORC or Parquet file format
- Information about the DMA summary files stored in KV Store!
- Actual DMA files are stored in HDFS
- You can use „|tstats“ to search
  - http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Configuredatamodelacceleration

Hadoop Analytics DMA does not use TSIDX files!

The Windfarm Data Model

- Take fields from the lookup
- No need to do a lookup on TaskTracker anymore
- Store summary in HDFS structure
- TSTATS will run MR jobs on pre-computed summaries



windfarm

windfarm

< All Data Models

! This Data Model cannot be edited because it is accelerated. Disable acceleration in order to edit the Data Model.

Datasets

EVENTS

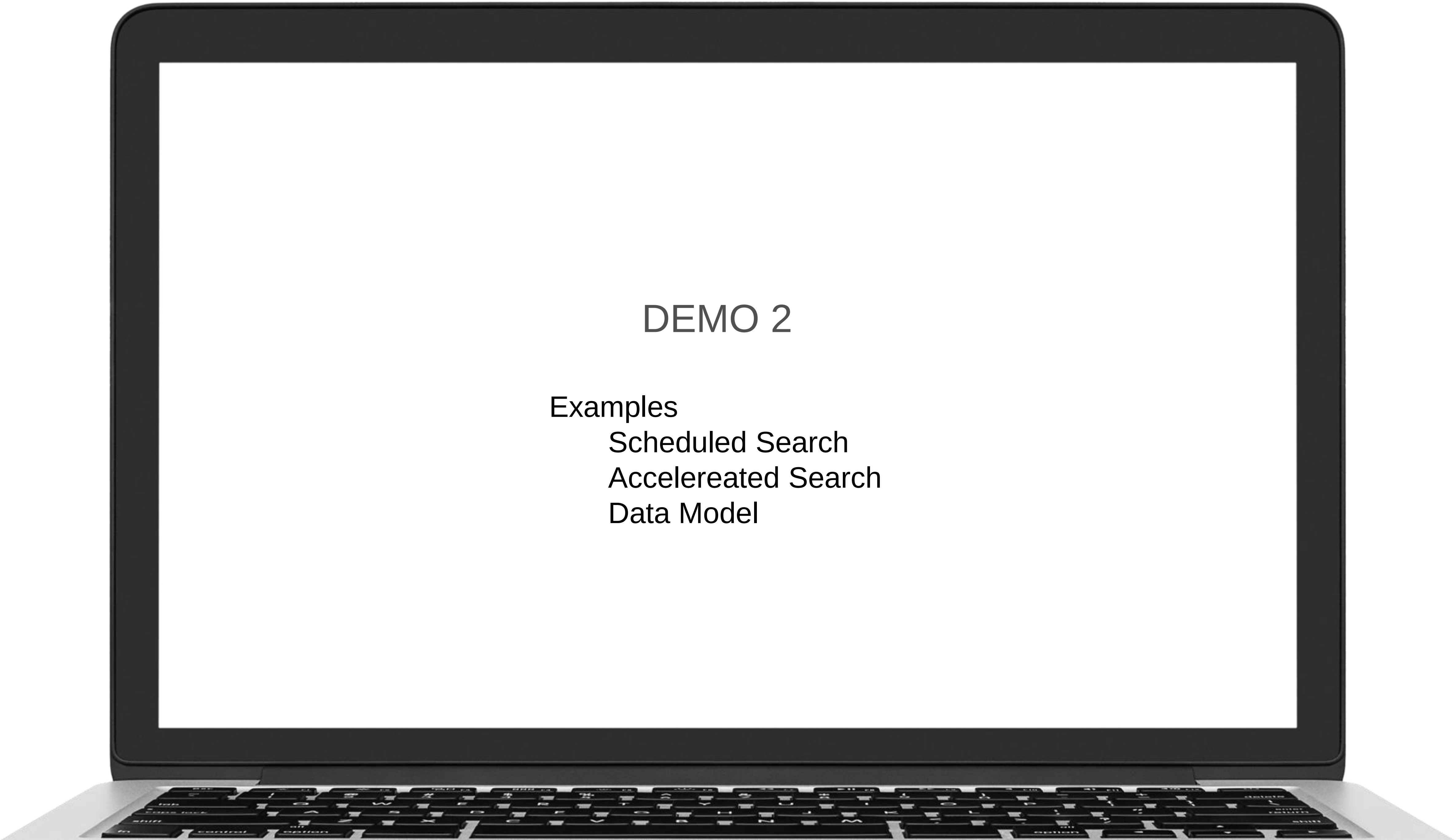
power

power

all

CONSTRAINTS		
index=windfarm sourcetype=opc f_tag="Power"		Constraint
INHERITED		
_time	Time	
host	String	
source	String	
sourcetype	String	
EXTRACTED		
Asset_ID	String	
Capacity	Number	
Channel	String	
Device	String	
latitude	Number	
longitude	Number	
Network	String	
Power	Number	Required
Quality	String	
Tag	String	

```
hdfs://localhost:8020/user/root/splunkmr702/datamodel/6026C1EB-B03C-405E-92F4-
7EB40D25D0F0_DM_demo_hadoop_windfarm_windfarm/windfarm
```



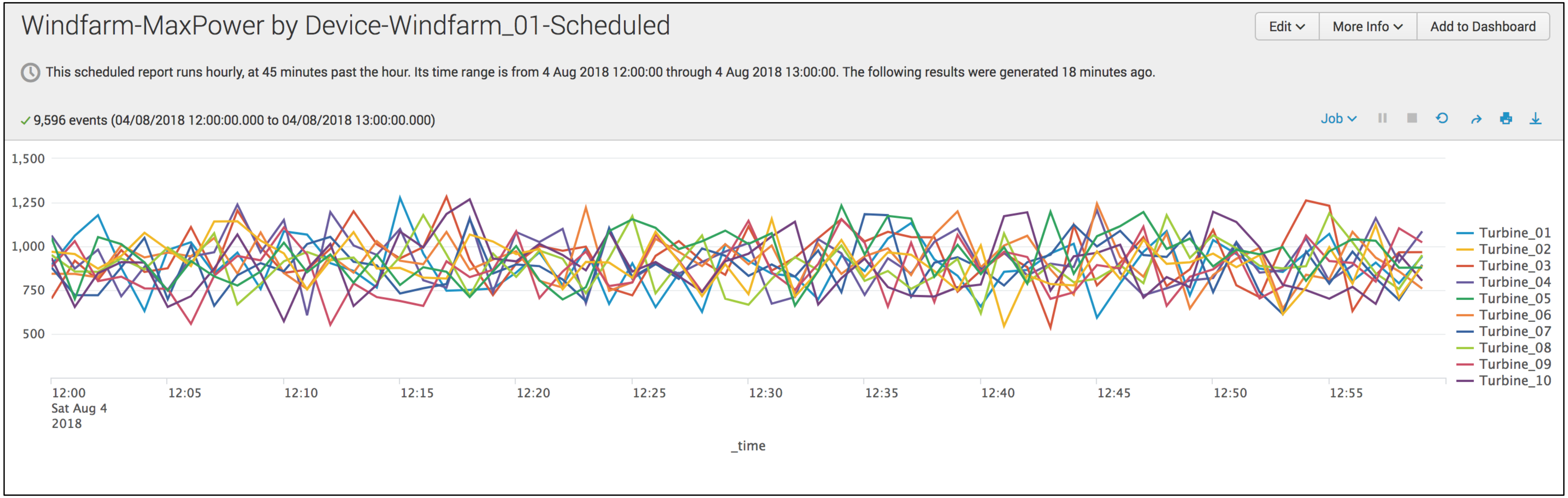
DEMO 2

Examples

- Scheduled Search
- Accelereated Search
- Data Model

Backup Screenshots

Scheduled Search



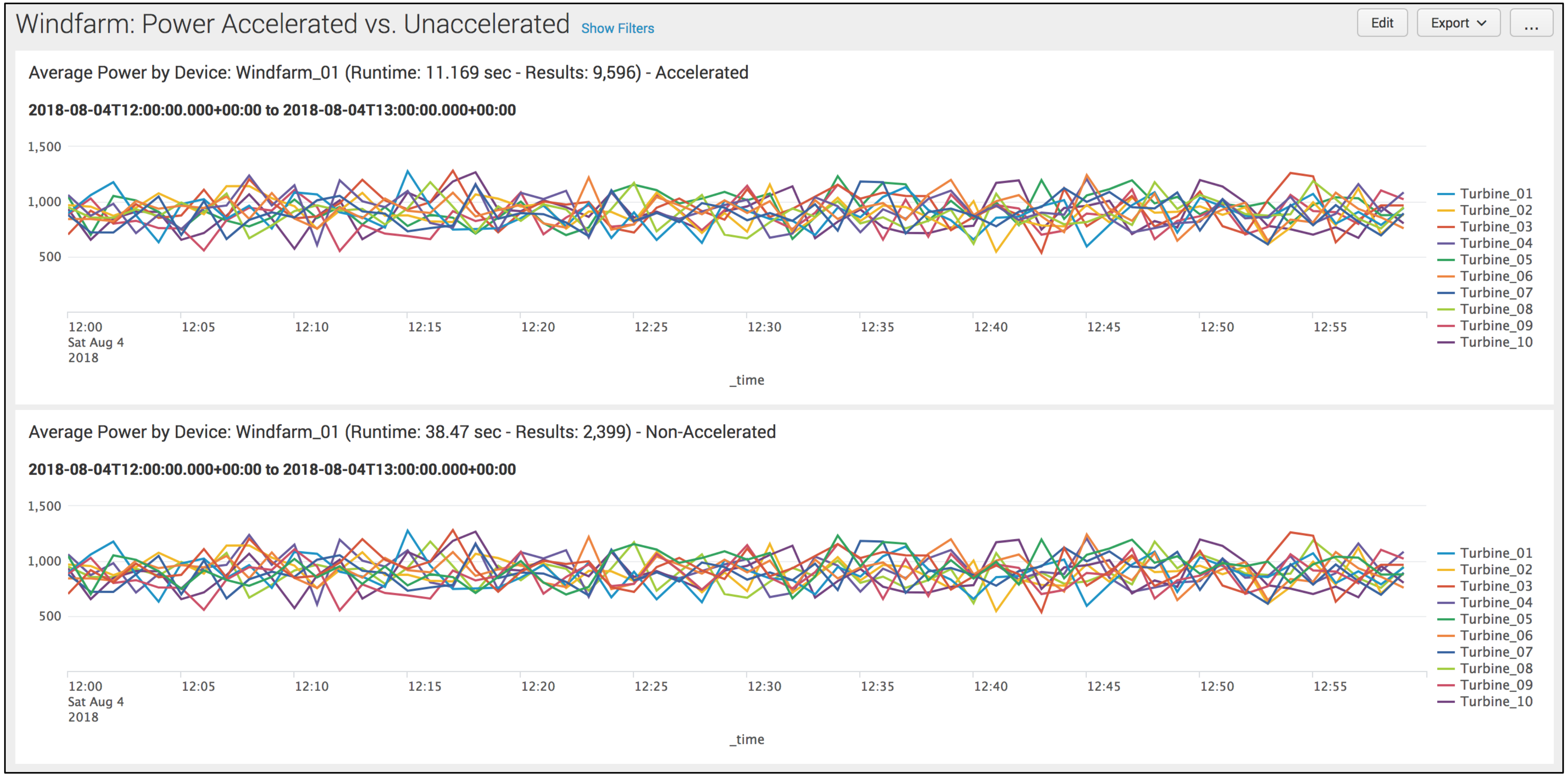
Windfarm-MaxPower by Device-Windfarm_01-Scheduled

This scheduled report runs hourly, at 45 minutes past the hour. Its time range is from 4 Aug 2018 12:00:00 through 4 Aug 2018 13:00:00. The following results were generated 18 minutes ago.

✓ 9,596 events (04/08/2018 12:00:00.000 to 04/08/2018 13:00:00.000)

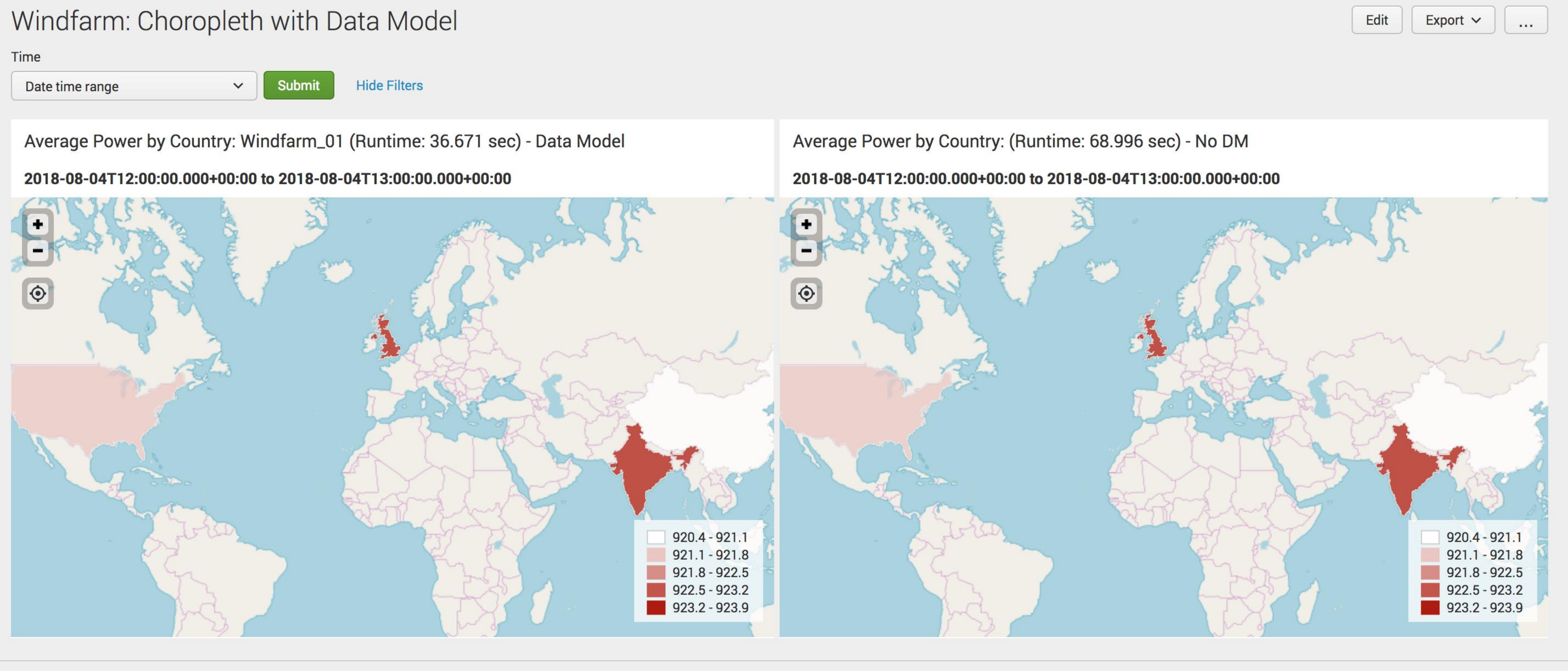
Backup Screenshots

Accelerated vs. Non-Accelerated Dashboard Panel



Backup Screenshots

Choropleth Example with Data Model



Windfarm: Choropleth with Data Model

Time: Date time range

Average Power by Country: Windfarm_01 (Runtime: 36.671 sec) - Data Model

2018-08-04T12:00:00.000+00:00 to 2018-08-04T13:00:00.000+00:00

Average Power by Country: (Runtime: 68.996 sec) - No DM

2018-08-04T12:00:00.000+00:00 to 2018-08-04T13:00:00.000+00:00

Best Practices - Part 2 -

Choose the right method for your use case

- Summary Indexing and Saved Searches store data on the SH!
  - Fast but not flexible
- Report Acceleration stores data on HDFS
  - Enough storage available
  - Not Flexible (only similar searches are accelerated)
  - Quite fast because just streaming no MR jobs
- Data Model Acceleration stores data on HDFS but creates summary files per original data file and spawn MR jobs
  - More flexible but slower than Report Acceleration
  - Remember, no TSIDX, no Random Access

What if the elephant burbs?

How to troubleshot if something goes wrong

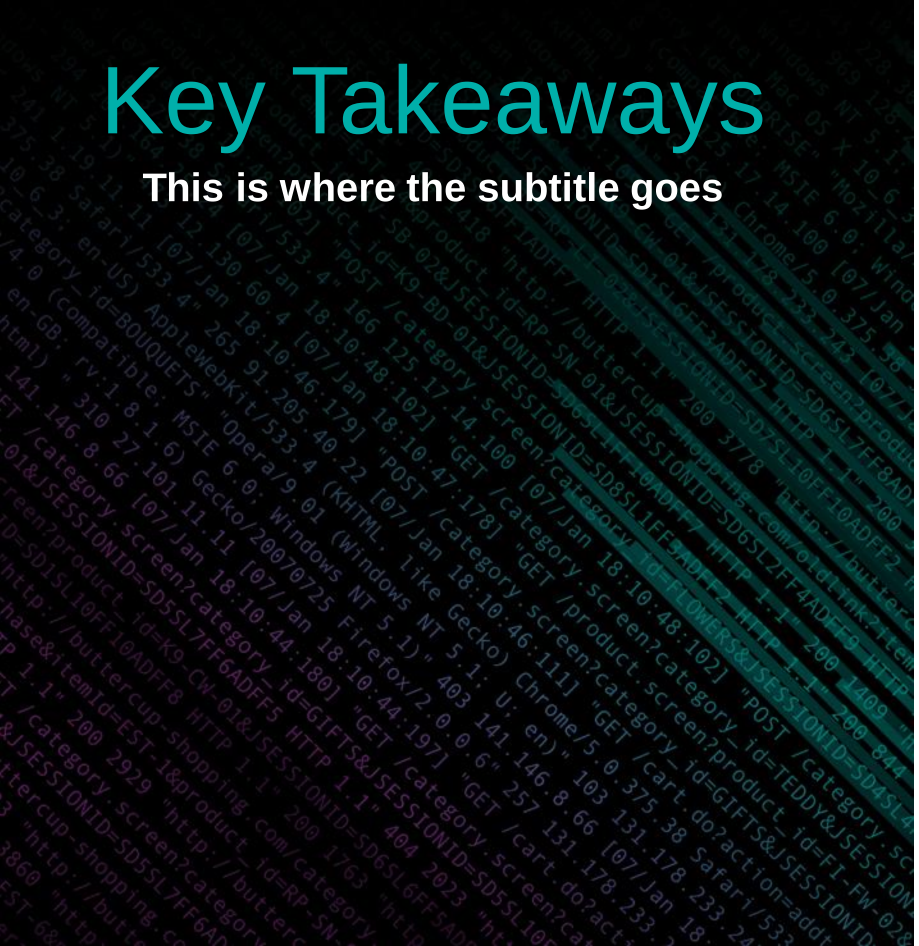
Troubleshooting Splunk Analytics for Hadoop

- Open the JobInspector first! -> search.log (maybe create an input?)
- Switch on debugging: `vix.splunk.search.debug=1` (provider)
- Doublecheck the provider settings (ports mixed?)
- Check: does a simple search works? HDFS streaming
  - `index=hadoop|head 10`
- Hadoop resource manager web page checked ("All Applications")?
  - Ressource Manager runs usually on <RM-IP>:8088/cluster
- Monitor the YARN logs
  - https://www.splunk.com/blog/2014/05/14/hunkonhunk.html
- https://conf.splunk.com/session/2015/conf2015_RDagan_Splunk_BigData_HUNKPerformanceandTroubleshooting.pdf

For Reference

If you want to read more…

- http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/Performancebestpractices
- http://docs.splunk.com/Documentation/Splunk/latest/HadoopAnalytics/TroubleshootSplunkAnalyticsforHadoop
- https://www.splunk.com/blog/2015/05/05/caching-hadoop-data-with-splunk-and-hunk.html

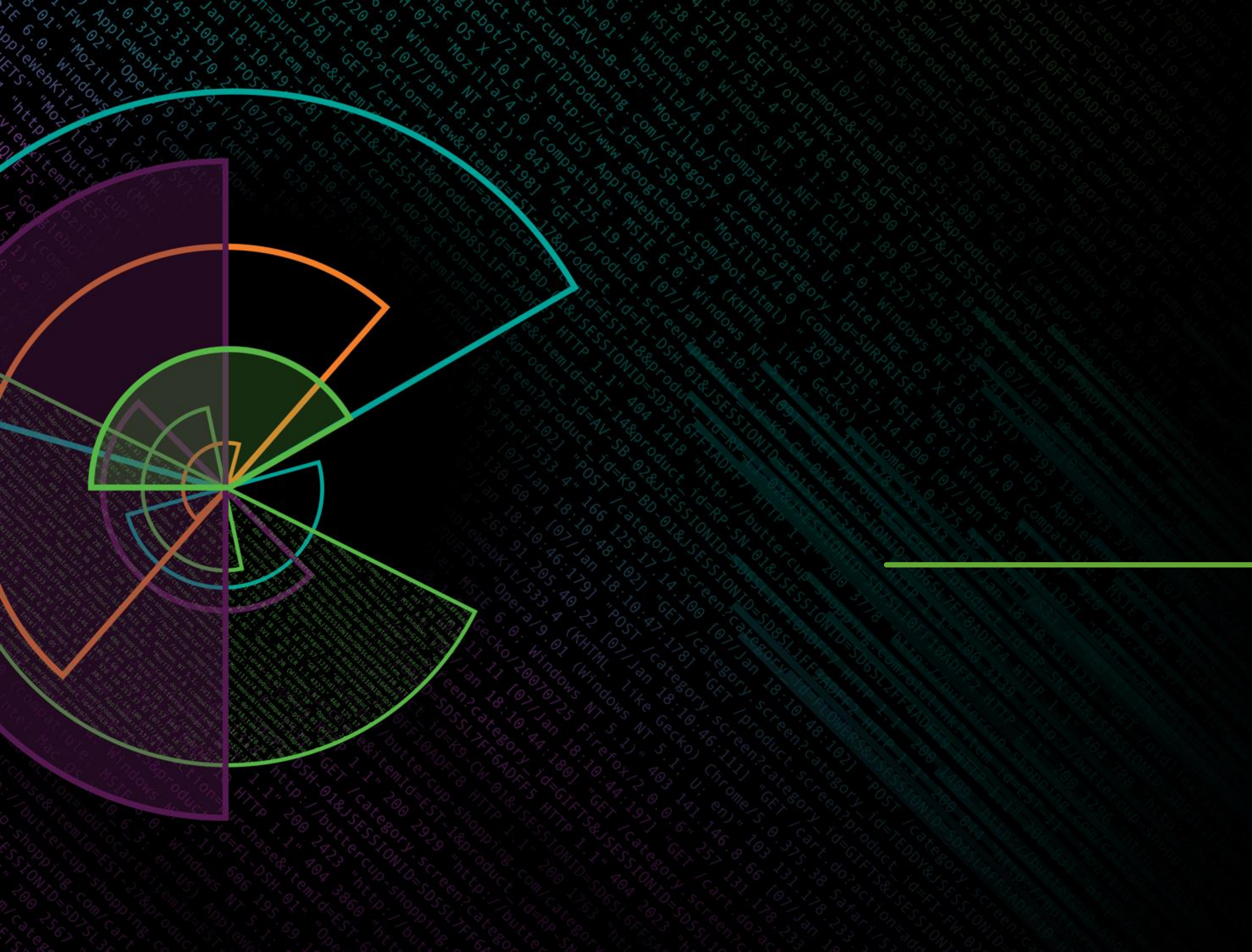


Key Takeaways

This is where the subtitle goes

1. Understand your use case
2. Structure your data in HDFS
3. Cache is KING!

Happy splunking!!!



Q&A

Thank You

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