"Looking under the hood" of complex Murex Dashboards

Creating fast Splunk dashboards for a user friendly experience

Robert Lynch (Splunk Revolution award winner Ninja 2017) | Murex

October 2018

Disclaimer

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.

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- ▸ Who is Robert Lynch?
- ▸ A little about Murex
- ▸ What was the problem?
- ▸ What was the solution!
  - • Architecture discussions
  - • What does the SPL look like
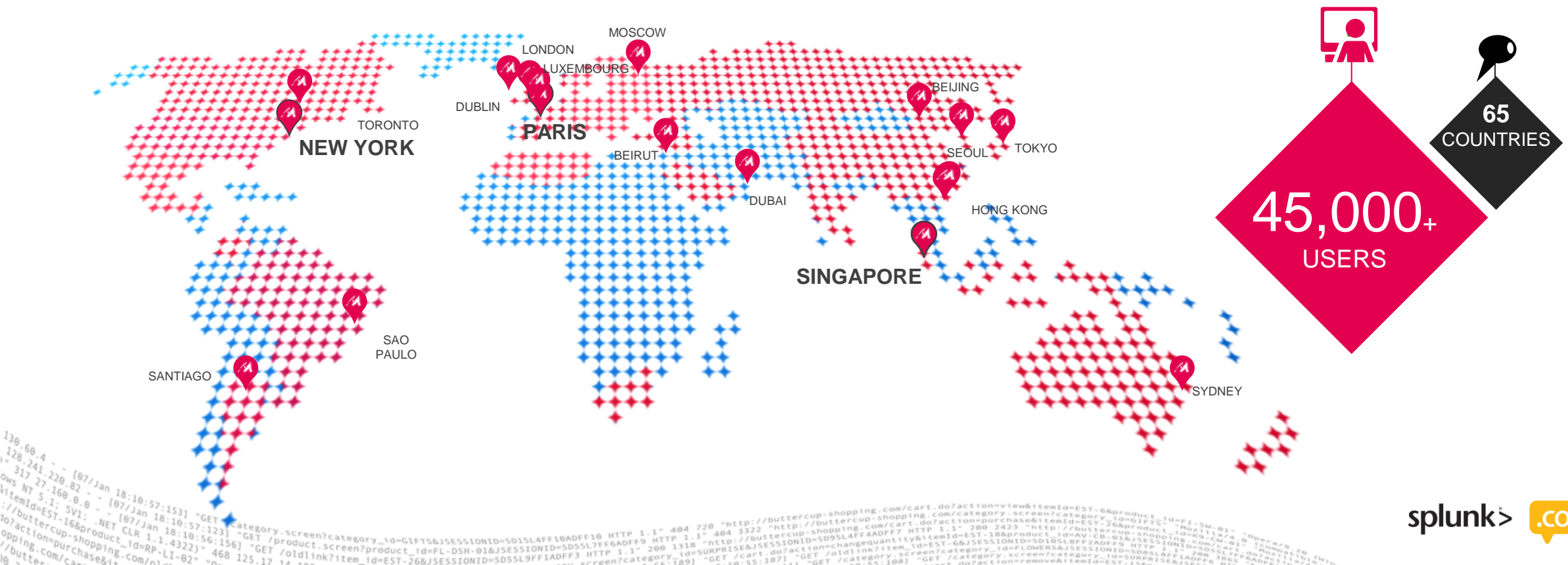 - • "Post-process search" vs. "Where clause"
  - • Don't forget we are human!

Who Am I ?

- ▶ Name:
  - • Robert Lynch
- ▶ Current Position:
  - • Global Splunk Manager @ Murex
  - • Non-Functional Test Manager @ Murex
- ▶ History:
  - • 2017 Splunk Revolution **Ninja** Award Winner
  - • Masters "High Performance Computing"
  - • 14 years working at Murex in Non-Functional Testing
  - • Introduced Splunk to Murex 4 Years

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A little about Murex

▸ Murex

3 REGIONAL HUBS, 17 OFFICES COVERING ALL TIME ZONES

MOSCOW

LONDON
LUXEMBOURG

DUBLIN

TORONTO

NEW YORK

PARIS

BEIRUT

BEIJING

SEOUL

TOKYO

DUBAI

HONG KONG

SINGAPORE

SANTIAGO

SAO PAULO

SYDNEY

45,000+ USERS

65 COUNTRIES

What was the Problem?

▸ MxTiming is a Performance log that is produced over multiple machines

▸ Millions of files, each containing thousands of lines of data

	Date	Time	UserName	iD		Context		Command		Elapsed	CPU	LAST |CPU%%| RDB+Com	RDB+C%%	
>	20180618	12:39:10.454	MUREXB0	6		RequestDocument3		MXINTERNAL.LOGINIMPL		0.038s|	0.002s|	5%|	0.036s|	95%	
>	20180618	12:39:09.932	MUREXB0	5		RequestDocument3		MXINTERNAL.LOGINIMPL		0.020s|	0.002s|	9%|	0.018s|	91%	
>	20180618	12:39:09.913	MUREXB0	4		SessionCreate		MXINTERNAL.LOGINIMPL		0.401s|	0.069s|	17%|	0.332s|	83%	
>	20180618	12:39:08.376	MUREXB0	3		RequestDocument3		MXDISPATCHER		0.006s|	0.001s|	16%|	0.005s|	84%	
>	20180618	12:39:08.369	MUREXB0	2		RequestDocument3		MXDISPATCHER		0.008s|	0.003s|	37%|	0.005s|	63%	
>	20180618	12:39:08.360	MUREXB0	1		SessionCreate		MXDISPATCHER		0.493s|	0.427s|	86%|	0.066s|	14%	

Mxtiming.log
Server 1
Murex End User

Nightly Recalculation of markets
Server N
Mxtiming.log
Mxtiming.log

Electronic trading
Server 2
Mxtiming.log
Mxtiming.log
Mxtiming.log
Mxtiming.log

splunk> .conf18
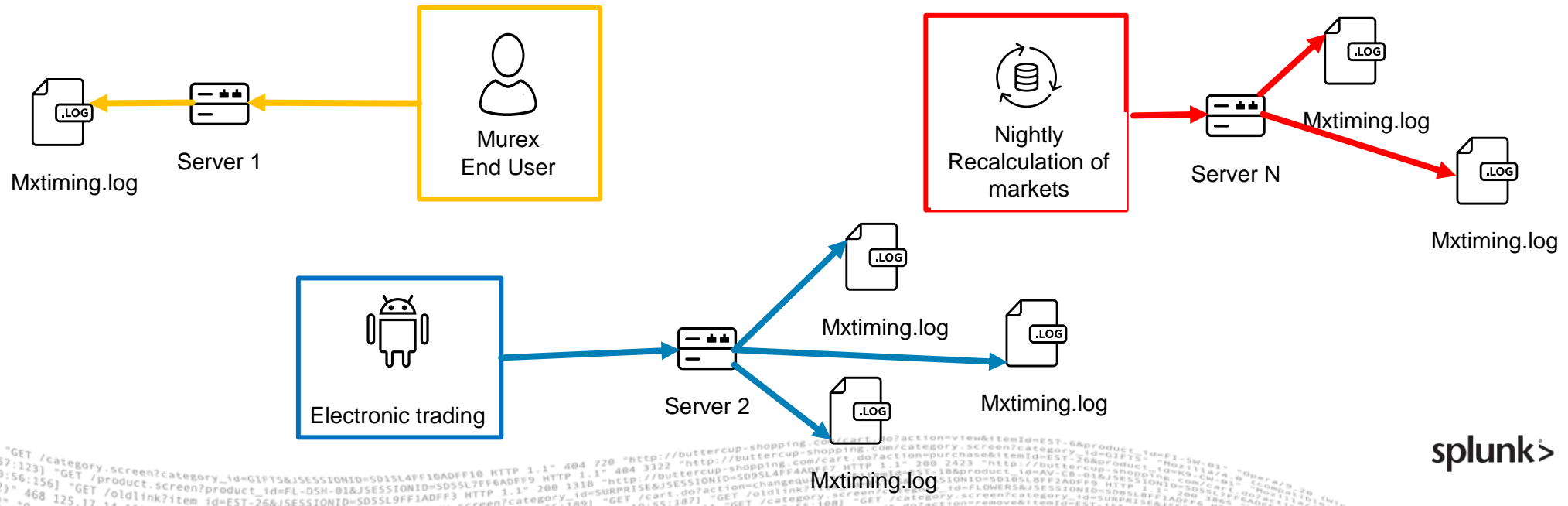
What was the solution?

- Bring all the Data into 2 main Data models
  - Create Multiple "Extracted" fields
  - Create Multiple "Calculated" fields (performance)
    - NO data is perfect so do the work at the data model level not in real time.
  - Accelerate the Data models for speed
  - In one week we can have **billions** of lines of data
- Start developing a dashboard that any user can use (Developers, Testers..etc)
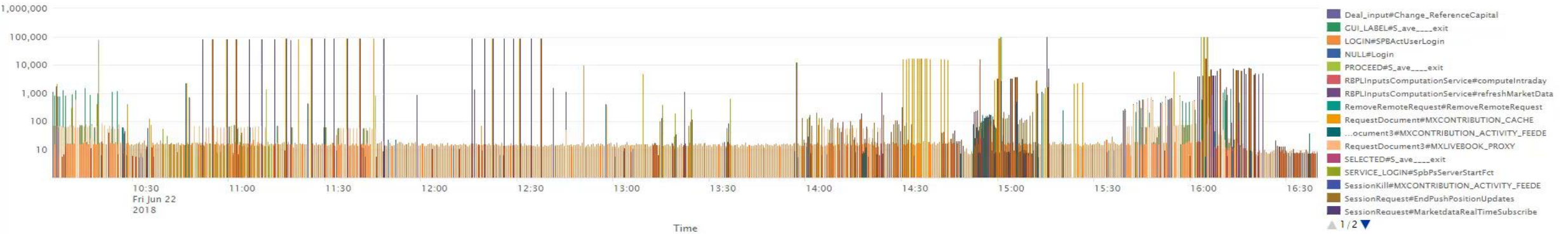 - Has to be fast, easy to use and users have to help you make it.

EXTRACTED

Command	String
Context	String
CPU	Number
CPU_PER	Number
Date	Number
Elapsed	Number
Elapsed_C	Number
ID	Number
Malloc	Number
Memory	Number
RDB_COM	Number
RDB_COM_PER	Number
Time	String
UserName	String
VmHWM	Number

CALCULATED

Context2	String	Required	Eval Expression
Context3	String	Required	Eval Expression
Command2	String	Required	Eval Expression
Command3	String	Required	Eval Expression
Context+Command	String	Required	Eval Expression
NPID	String		Regular Expression
source_path	String		Regular Expression
UserName2	String		Eval Expression
MX_TIMING_STRING	String		Regular Expression
STANDARD	String		Regular Expression
TRADE_REPOSITORY_ENGINE	String		Regular Expression
COMPLIANCE	String		Regular Expression
DATAPUBLISHER	String		Regular Expression
OBJECT_REPOSITORY_RISK_ENGINE	String		Regular Expression
REALTIMEREFRESH	String		Regular Expression
RATE_CURVE	String		Regular Expression
WAREHOUSE	String		Regular Expression
LIVEBOOK	String		Regular Expression

MXTIMING_ALERTS | Splu...

Robert

splunk:8000/en-GB/app/murex_mlc/mxtiming_alerts?form.save_tps_test_status=&form.save_test_time_token.earliest=1529654700&form.save_test_time_token.latest=1529678400&form.MXTIMING_ON_OFF=ON&form.TEST_EVENT...

Apps | TECHNICAL_VIEW | S | TPS_VIEW | Splunk 7. | MAT-TEST(NF)(Non F | MLC PAC CS - Risk M | TPS_VIEW | Splunk 7. | MXTIMING_ALERTS | | Ask Questions, Subm | Bank of Ireland Life | MXIntra | https://neo.mykds.co | Customer Communit | Speaker Portal

MXTIMING Real-Time Activity: (Filtered By Command= Context= PATH= User= NPID=)-- GANTT Option will apear for 15 Minutes or Less

Display By:	Span (how much time per bucket)	Log_vs_linear - Y Axis	Quick Time Zoom	No Of Buckets	CC_OR_TAG
Duration (ms)[Default]	Auto	log	Time	20 Default	Context+Command

Seconds (If Duration is Picked)

MXTIMING OVER 5 Seconds (Filtered By Command= Context= PATH= User= NPID=)

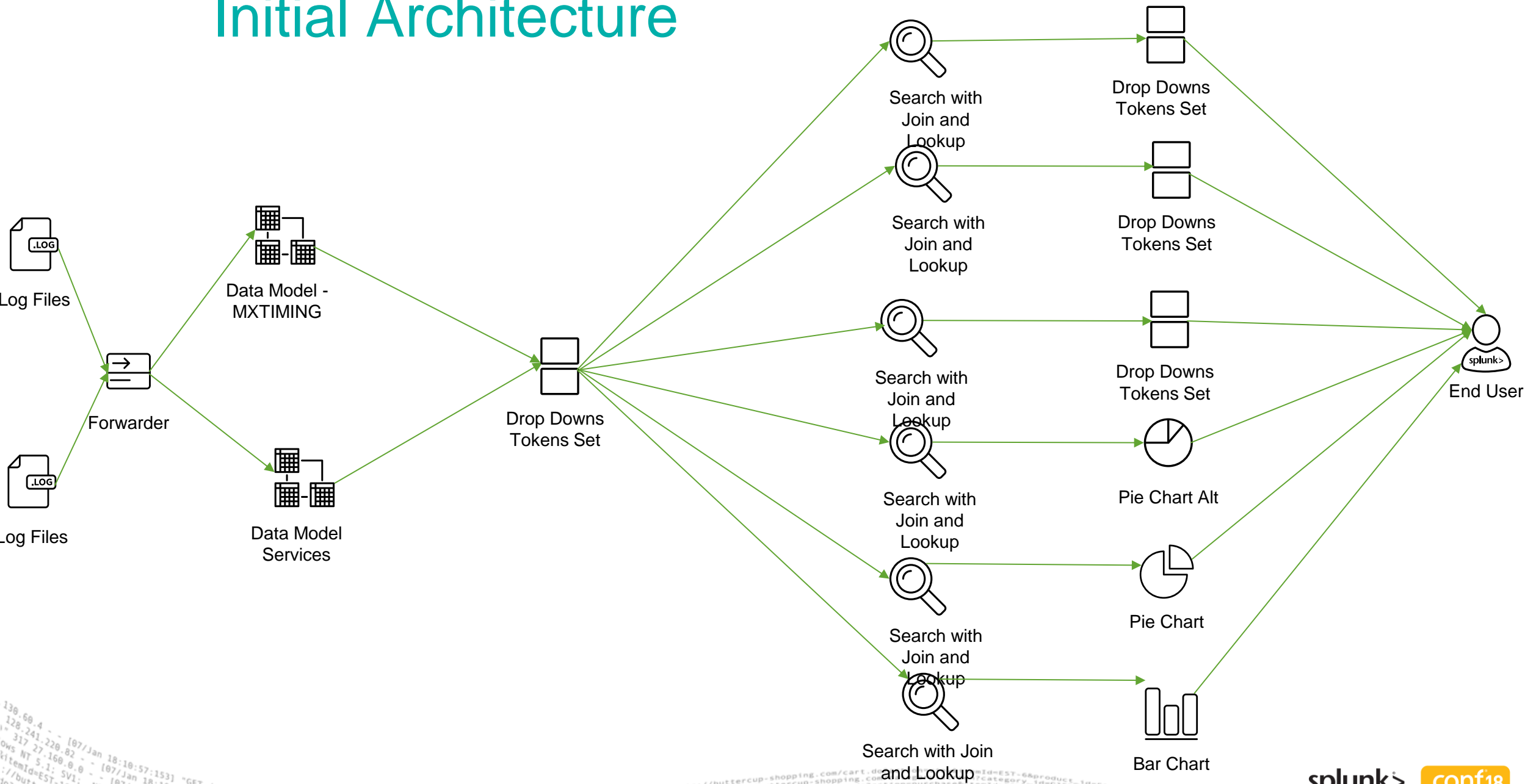| MAX_TIME Seconds	Context Source Search:	Command Source Search:	Source Path Source Search:	Users:	NPID	NICKNAME
5	All	All	All	All	All	All

TYPE	Tags	MEMORY_ISSUES
All	All	☐ ON

Time	NICKNAME	TYPE	NPID	Tags	Context+Command	CC_Description	Elapsed	Threshold	CPU	CPU_PER	RDB_COM	RDB_COM_PER	Memory
22/06/2018 16:05:18.790		OBJECT_REPOSITORY_RISK_ENGINE	378955	RiskEngineUpdatePosition	SessionRequest#UpdatePosition	UpdatePosition	104,431.63 Sec	60	90.28 Sec	0.00 %			6,620.73 MB
22/06/2018 16:05:18.414		OBJECT_REPOSITORY_RISK_ENGINE	378955	PLEASE_ADD_TAG	RequestDocument#MXCONTRIBUTION_CACHE		104,416.24 Sec		89.67 Sec	0.00 %			6,620.73 MB
22/06/2018 16:03:09.023		OBJECT_REPOSITORY_RISK_ENGINE	380006	RiskEngineUpdatePosition	SessionRequest#UpdatePosition	UpdatePosition	104,311.87 Sec	60	94.26 Sec	0.00 %			4,531.64 MB
22/06/2018 16:03:08.737		OBJECT_REPOSITORY_RISK_ENGINE	380006	PLEASE_ADD_TAG	RequestDocument#MXCONTRIBUTION_CACHE		104,311.07 Sec		93.78 Sec	0.00 %			4,531.64 MB
22/06/2018 15:15:19.810		RBPL_INPUTSCALCULATOR	352824	RBPL calculator	RBPLInputsComputationService#refreshMarketData	RBPL calculator	103,362.99 Sec	100	221.39 Sec	0.00 %			4,783.38 MB
22/06/2018 15:00:40.851	ETRADEPADDAILYBA	STANDARD	384023	PLEASE_ADD_TAG	NULL#Login		102,140.32 Sec		147.75 Sec	0.00 %			3,493.04 MB
22/06/2018 15:00:39.778	ETRADEPADDAILYBA	STANDARD	384023	PLEASE_ADD_TAG	RequestDocument#MXCONTRIBUTION_CACHE		102,086.67 Sec		133.67 Sec	0.00 %			3,379.80 MB
22/06/2018 16:04:02.357		OBJECT_REPOSITORY_RISK_ENGINE	380650	RiskEngineUpdatePosition	SessionRequest#UpdatePosition	UpdatePosition	101,958.56 Sec	60	94.98 Sec	0.00 %			6,169.25 MB
22/06/2018 16:04:02.132		OBJECT_REPOSITORY_RISK_ENGINE	380650	PLEASE_ADD_TAG	RequestDocument#MXCONTRIBUTION_CACHE		101,957.43 Sec		94.22 Sec	0.00 %			6,169.25 MB
22/06/2018 15:00:41.240	ETRADEPADDAILYBA	STANDARD	386192	PLEASE_ADD_TAG	Deal_input#Change_ReferenceCapital		101,889.11 Sec		124.73 Sec	0.00 %			3,456.70 MB
22/06/2018 15:00:39.778	ETRADEPADDAILYBA	STANDARD	386192	PLEASE_ADD_TAG	RequestDocument#MXCONTRIBUTION_CACHE		101,882.42 Sec		122.89 Sec	0.00 %			3,432.95 MB
22/06/2018 15:15:04.782		RBPL_INPUTSCALCULATOR	275210	PLEASE_ADD_TAG	RBPLInputsComputationService#computeIntraday		101,653.92 Sec		122.34 Sec	0.00 %			4,355.98 MB
22/06/2018 15:15:04.314	MXRBPL_CALCULATOR	RBPL_INPUTSCALCULATOR	206335	RBPL calculator	RBPLInputsComputationService#refreshMarketData	RBPL calculator	101,364.01 Sec	100	286.24 Sec	0.00 %			4,051.83 MB
22/06/2018 15:15:04.189	MXRBPL_CALCULATOR	RBPL_INPUTSCALCULATOR	206317	RBPL calculator	RBPLInputsComputationService#refreshMarketData	RBPL calculator	101,204.37 Sec	100	303.68 Sec				4,530.10 MB

Introducing MxTiming Dashboard

▶ Introducing MxTiming Dashboard

- 8 Global dropdowns
- 12 searches running in parallel

▶ Initial Architecture

- All searches ran separately (Difficult to manage SPL for new updates)

▶ Current Architecture

- 2 Base searches
- "Post-process search" vs. "where clause"
- Human readable Tags (Lookup tables)

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Initial Architecture

Log Files

Log Files

Forwarder

Data Model -
MXTIMING

Data Model
Services

Drop Downs
Tokens Set

Search with
Join and
Lookup

Search with
Join and
Lookup

Search with
Join and
Lookup

Search with
Join and
Lookup

Search with
Join and
Lookup

Search with Join
and Lookup

Drop Downs
Tokens Set

Drop Downs
Tokens Set

Drop Downs
Tokens Set

Pie Chart Alt

Pie Chart

Bar Chart

End User

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Current Architecture
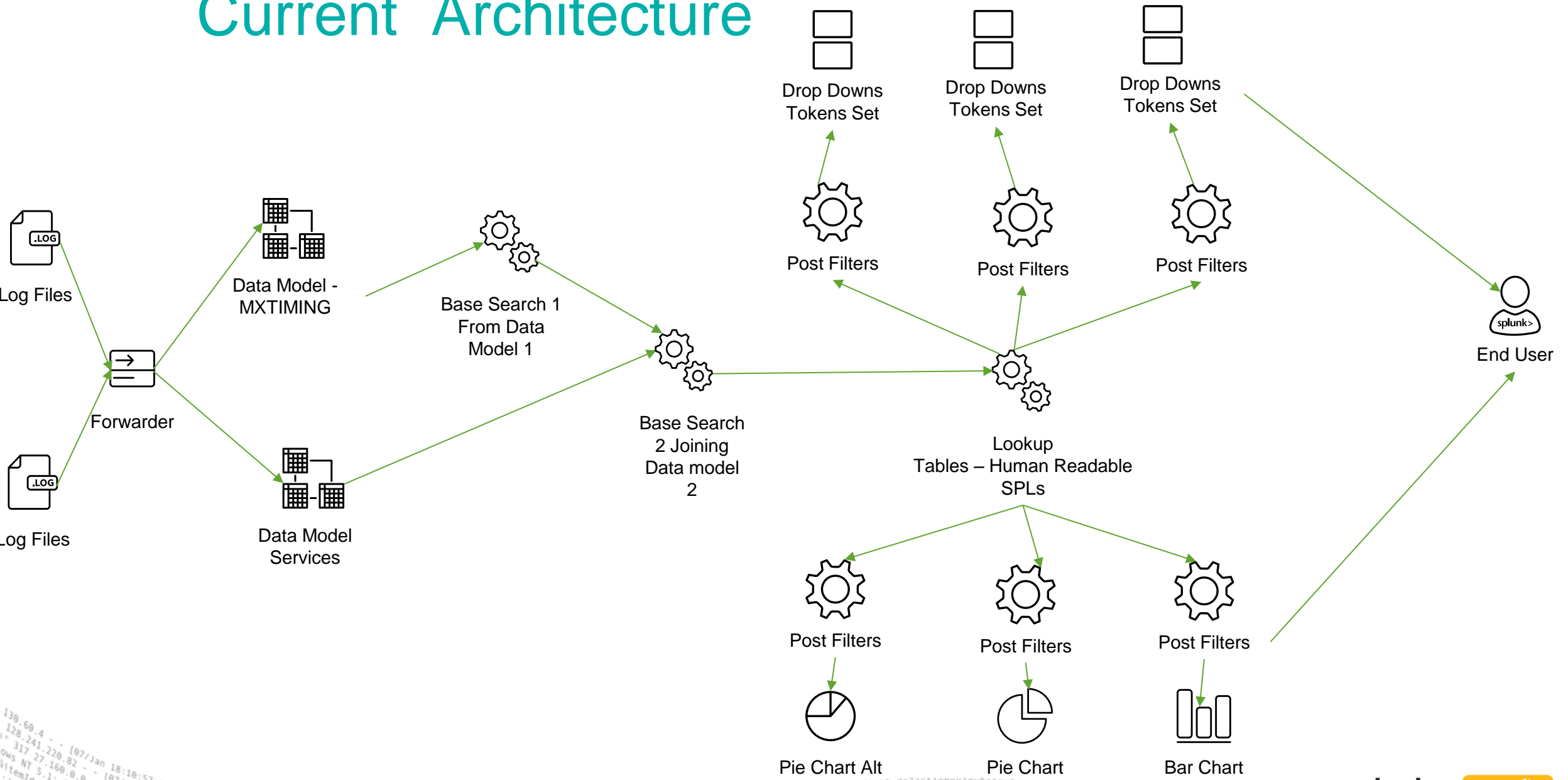
What does the SPL look like?

```
<search id="baseSearch">
  <query>| tstats summariesonly=$summariesonly_token$ max(MXTIMING.Elapsed) AS Elapsed max(MXTIMING.CPU) AS CPU max(MXTIMING.CPU_PER) AS CPU_PER values(MXTIMING.RDB_COM1) AS RDB_COM values(MXTIMING.RDB_COM_PER1) AS
  RDB_COM_PER max(MXTIMING.Memory_V2) AS Memory max(MXTIMING.Elapsed_C) AS Elapsed_C values(source) AS source_MXTIMING avg(MXTIMING.Elapsed) AS average, count(MXTIMING.Elapsed) AS count, stdev(MXTIMING.Elapsed) AS stdev,
  median(MXTIMING.Elapsed) AS median, exactperc95(MXTIMING.Elapsed) AS perc95, exactperc99.5(MXTIMING.Elapsed) AS perc99.5, min(MXTIMING.Elapsed) AS min,earliest(_time) as start, latest(_time) as stop FROM
  datamodel=$MXTIMING_DATASET$ WHERE
  host=$host_token$
AND MXTIMING.Elapsed &gt; $MAX_TIME$
GROUPBY _time MXTIMING.Machine_Name MXTIMING.Context+Command MXTIMING.NPID MXTIMING.Date MXTIMING.Time MXTIMING.MXTIMING_TYPE_DM source MXTIMING.UserName2 MXTIMING.source_path MXTIMING.Command3 MXTIMING.Context3 span=1s
| rename MXTIMING.Context+Command as Context+Command
| rename MXTIMING.NPID as NPID
| rename MXTIMING.MXTIMING_TYPE_DM as TYPE
| rename MXTIMING.Date as Date
| rename MXTIMING.Time as Time
| rename MXTIMING.Machine_Name as Machine_Name
| rename MXTIMING.UserName2 as UserName
| rename MXTIMING.source_path  as source_path
| eval Date=strftime(strptime(Date,"%Y%m%d"),"%d/%m/%Y")
| eval Time = Date." ".Time
| eval FULL_EVENT=Elapsed_C
| eval FULL_EVENT=replace(FULL_EVENT,"\d+.\d+","FULL_EVENT")</query>
  <earliest>$time_token.earliest$</earliest>
  <latest>$time_token.latest$</latest>
```

1st Base search

tstats command on data model
Gets most of the data

```
<search base="baseSearch" id="First_Base_Search">
  <query>| join Machine_Name NPID type=$join_type_token$ [| tstats summariesonly=$summariesonly_token$ count(SERVICE.NPID) AS count2 values(source) AS source_SERVICES FROM datamodel=SERVICE_V6 WHERE ( host=$host_token$
  earliest=$service_earliest_time$ latest=$service_latest_time$) AND SERVICE.NICKNAME IN ($NICKNAME_TOKEN$)
GROUPBY SERVICE.Machine_Name SERVICE.NICKNAME SERVICE.NPID
| rename SERVICE.NPID AS NPID
| rename SERVICE.NICKNAME AS NICKNAME
| rename SERVICE.Machine_Name as Machine_Name
| table NICKNAME NPID source_SERVICES Machine_Name ]
| lookup $Tags_Table_token$ Context_Command AS "Context+Command" Type as "TYPE" OUTPUT Tags CC_Description Threshold Alert
| appendpipe
[ | where isnull(Threshold)
| rename TYPE AS BACKUP_TYPE
| eval TYPE="*"
| lookup $Tags_Table_token$ Context_Command AS "Context+Command" Type as "TYPE" OUTPUT Tags CC_Description Threshold Alert
| rename BACKUP_TYPE AS TYPE]
| sort Threshold
| dedup Time, NPID,Context+Command
| where Elapsed &gt; Threshold OR isnull('Threshold')
| fillnull Tags
| eval Tags=if(Tags=0,"PLEASE_ADD_TAG",Tags)
| makemv Tags delim=","
| eval Tags=split(Tags,",")
| search Tags IN ($TAG_TOKEN$)
| eval source_SERVICES_count=mvcount(split(source_SERVICES, " ")) | eval NICKNAME=if(source_SERVICES_count &gt; 1, "MULTIPLE_OPTIONS_FOUND",NICKNAME)</query>
  </search>
```

2nd Base search
Uses 1st Base and a Join on second
data model

2 tokens can be updated
Re-driving only 2nd Base search

Post-process search to filter

"Post-process search" vs. "Where clause"

- ▸ Initially, we used filtering clauses (Where) in 12 different Splunk searches
  - • E.G User = MUREXBO, CONFIG…MUREXFO -
- ▸ For GUI performance reasons use a Post-process search
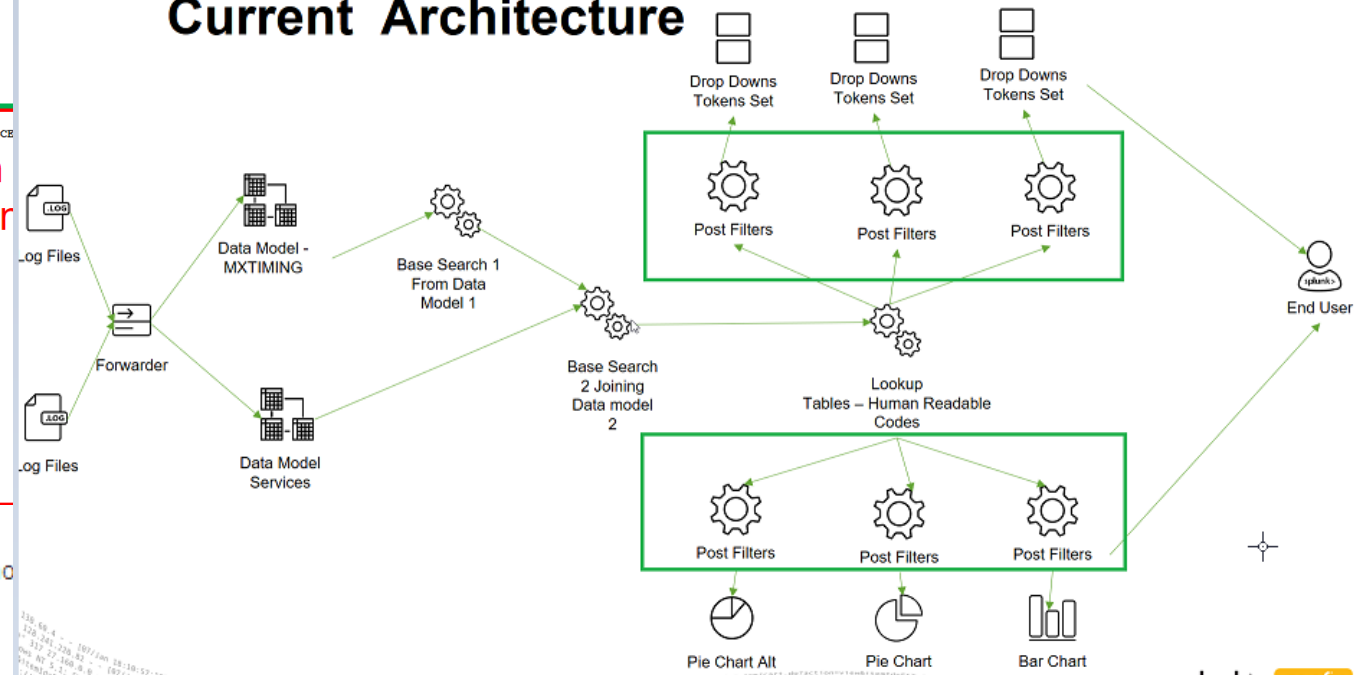
Don't forget we are human!

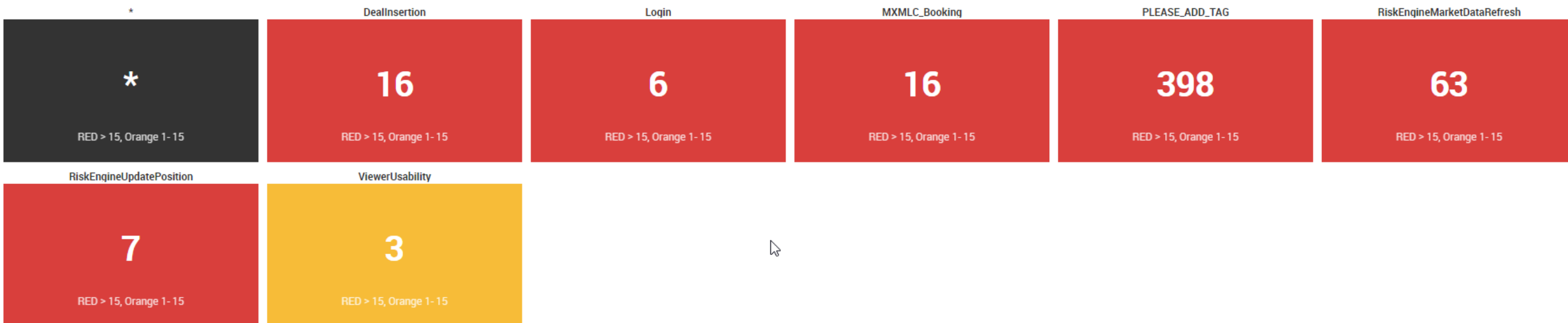▶ The data inside the log files can be very technical and not human readable
  - People find it hard to understand and wont use the system

▶ By creating an interactive Tagging system (lookup tables), people can update the data by themselves to display
  - Developer's Code -> Human Readable Data

Filters: Command= Context= PATH= User= NPID= TYPE= Services=* Tags=*

TAG's Over 5 and Threshold : Services=*

*	DealInsertion	Login	MXMLC_Booking	PLEASE_ADD_TAG	RiskEngineMarketDataRefresh
*	16	6	16	398	63
RED > 15, Orange 1-15	RED > 15, Orange 1-15	RED > 15, Orange 1-15	RED > 15, Orange 1-15	RED > 15, Orange 1-15	RED > 15, Orange 1-15

| RiskEngineUpdatePosition	ViewerUsability
7	3
RED > 15, Orange 1-15	RED > 15, Orange 1-15

MXTIMING Real-Time Activity: (Filtered By Command= Context= PATH= User= NPID=)-- GANTT Option will apear for 15 Minutes or Less

Display By:	Span (how much time per bucket)	Log_vs_linear - Y Axis	Quick Time Zoom	No Of Buckets	CC_OR_TAG
Duration (ms)[Default]	Auto	log	Time	20 Default	Context+Command

Seconds (If Duration is Picked)
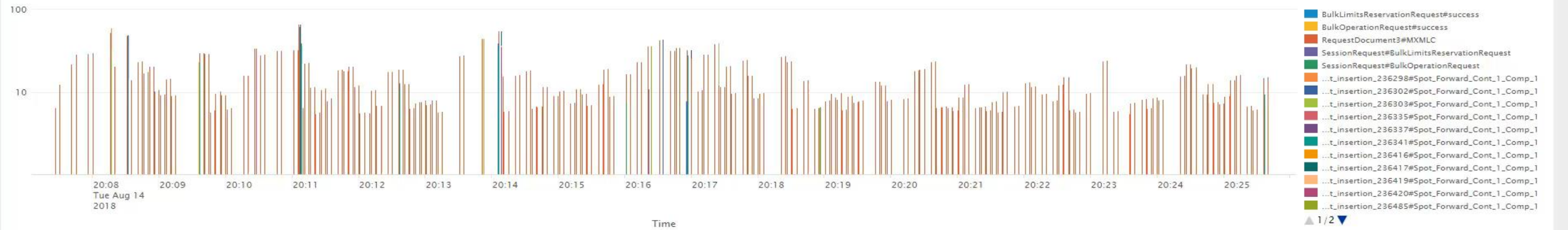
MXTIMING OVER 5 Seconds (Filtered By Command= Context= PATH= User= NPID=)

MAX_TIME Seconds	Context Source Search:	Command Source Search:	Source Path Source Search:	Users:	NPID	NICKNAME
5	All	All	All	All	All	All

TYPE	Tags	MEMORY_ISSUES	Filter Duplicate Trades
All	All	ON	RDB_COM > 0

Time	NICKNAME	TYPE	NPID	Tags	Context+Command	CC_Description	Elapsed	Threshold	CPU	CPU_PER	RDB_COM	RDB_COM_PER	Memory	FULL_EVENT
14/08/2018 20:11:05.543	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135373	Trade_Insertion	contract_insertion_236337#Spot_Forward_Cont_1_Comp_1	Trade_Insertion	67.70 Sec	0	0.18 Sec	0.00 %	67.52	100.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:11:05.493	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135373	MXMLC_Booking	RequestDocument3#MXMLC	Trade_Insertion	67.43 Sec	0	0.06 Sec	0.00 %	67.37	100.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:11:06.017	SMCOBJECTREPOSITORY_ENGINE	NOT_ASSIGNED	137017	DealInsertion_API	BulkOperationRequest#success	Trade_Insertion	62.93 Sec	0	0.12 Sec	0.00 %	62.81	100.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:11:06.017	SMCOBJECTREPOSITORY_ENGINE	OBJECT_REPOSITORY_RISK_ENGINE	137017	PLEASE_ADD_TAG	SessionRequest#BulkOperationRequest	Trade_Insertion	62.93 Sec		0.12 Sec	0.00 %	62.81	100.00 %	3,301.91 MB	FULL_EVENT
14/08/2018 20:11:06.014	SMCOBJECTREPOSITORY_ENGINE	NOT_ASSIGNED	137017	MXMLC_Booking	RequestDocument3#MXMLC	Trade_Insertion	62.92 Sec	0	0.12 Sec	0.00 %	62.80	100.00 %	0.00 MB	
14/08/2018 20:08:15.977	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135372	Trade_Insertion	contract_insertion_236298#Spot_Forward_Cont_1_Comp_1	Trade_Insertion	60.54 Sec	0	3.91 Sec	6.00 %	56.63	94.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:14:06.602	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135371	Trade_Insertion	contract_insertion_236417#Spot_Forward_Cont_1_Comp_1	Trade_Insertion	55.08 Sec	0	0.11 Sec	0.00 %	54.97	100.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:14:06.550	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135371	MXMLC_Booking	RequestDocument3#MXMLC	Trade_Insertion	54.94 Sec	0	0.04 Sec	0.00 %	54.90	100.00 %	0.00 MB	
14/08/2018 20:08:15.404	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135372	MXMLC_Booking	RequestDocument3#MXMLC	Trade_Insertion	53.50 Sec	0	0.04 Sec	0.00 %	53.46	100.00 %	0.00 MB	
14/08/2018 20:08:32.537	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135371	Trade_Insertion	contract_insertion_236302#Spot_Forward_Cont_1_Comp_1	Trade_Insertion	50.09 Sec	0	0.42 Sec	0.00 %	49.67	100.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:08:32.487	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135371	MXMLC_Booking	RequestDocument3#MXMLC	Trade_Insertion	49.13 Sec	0	0.05 Sec	0.00 %	49.09	100.00 %	0.00 MB	
14/08/2018 20:13:53.112	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135373	Trade_Insertion	contract_insertion_236416#Spot_Forward_Cont_1_Comp_1	Trade_Insertion	44.96 Sec	0	0.13 Sec	0.00 %	44.83	100.00 %	0.00 MB	FULL_EVENT
14/08/2018 20:13:53.061	MXTRADEREPOSITORY_ENGINE	TRADE_REPOSITORY_ENGINE	135373	MXMLC_Booking	RequestDocument3#MXMLC	Trade_Insertion	44.77 Sec	0	0.04 Sec	0.00 %	44.73	100.00 %	0.00 MB	

What does the SPL look like?
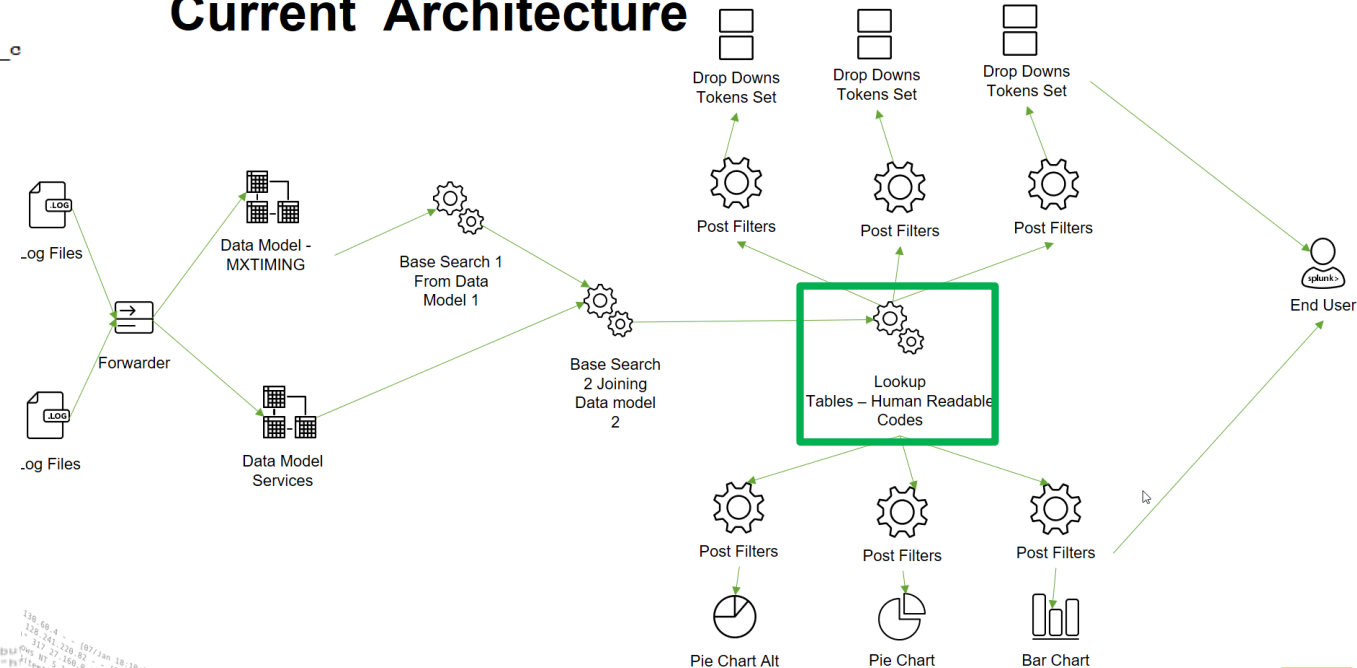
▶ The lookups are in the second base search

```
<search base="baseSearch" id="First_Base_Search">
    <query>| join Machine_Name NPID type=$join_type_token$ [| tstats summariesonly=$summariesonly_token$ count(SERVICE.NPID) AS count2 values(source) AS source_SERVICES FROM datamodel=SERVICE_V6 WHERE ( host=$host_token$
    earliest=$service_earliest_time$ latest=$service_latest_time$) AND SERVICE.NICKNAME IN ($NICKNAME_TOKEN$)
GROUPBY SERVICE.Machine_Name SERVICE.NICKNAME SERVICE.NPID
| rename SERVICE.NPID AS NPID
| rename SERVICE.NICKNAME AS NICKNAME
| rename SERVICE.Machine_Name as Machine_Name
| table NICKNAME NPID source_SERVICES Machine_Name ]
| lookup $Tags_Table_token$ Context_Command AS "Context+Command" Type as "TYPE" OUTPUT Tags CC_Description Threshold Alert
| appendpipe
[ | where isnull(Threshold)
| rename TYPE AS BACKUP_TYPE
| eval TYPE="*"
| lookup $Tags_Table_token$ Context_Command AS "Context+Command" Type as "TYPE" OUTPUT Tags CC_Description Threshold Alert
| rename BACKUP_TYPE AS TYPE]
| sort Threshold
| dedup Time, NPID,Context+Command
| where Elapsed &gt; Threshold OR isnull('Threshold')
| fillnull Tags
| eval Tags=if(Tags=0,"PLEASE_ADD_TAG",Tags)
| makemv Tags delim=","
| eval Tags=split(Tags,",")
| search Tags IN ($TAG_TOKEN$)
| eval source_SERVICES_count=mvcount(split(source_SERVICES, " ")) | eval NICKNAME=if(source_SERVICES_c
</search>
```

▶ If there is an update in the second base search, it won't rerun the 1ˢᵗ base search

Current Architecture

Conclusion SPLUNK "MXTIMING"

Problem:

- We needed to View <u>Millions</u> and <u>Millions</u> of MXTIMING Tracing quickly

▸ **Solution:**

- Using Data models ….15 Million Lines of Data (Sliced and Diced) in 15 seconds!!

Problem:

- Updating 12 searches in the SPL was difficult

▸ **Solution:**

- Bringing together all searches to 2 base searches is easer to manage

Problem

- The Data was not human readable

▸ **Solution:**

- Using lookups we made it an open system to add Human Tags

😎

splunk> .conf18

MUREX™

Thank

You

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- 32 years dedicated to our domain and clients
- Around 50,000 users and 250+ clients in 65 countries
- 3 Regional Hubs , 17 offices covering all time zones
- Staff of 2,200, over 60 nationalities
- Revenue of USD 580 Million in 2017
- Over USD 1 billion invested in R&D over the last 10 years
- #1 Overall Vendor: Risk Magazine Technology Awards 2017
- #7 in Chartis RiskTech100 for 2017 (highest ranked non-US headquartered company)

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Thank You

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