SIGNAL FABRIC

UNDERSTANDING DYNAMIC SYSTEMS

Azure Observability Platform

What is Signal Fabric?

… to debug, reason and **understand dynamic system** behavior

in **context** of system of systems

driven in **real time** from ingestion to reasoning

across **interconnected domains**; OSes, apps, devices, services, users

serving multiple **personas**; engineers, business, marketing, data scientist

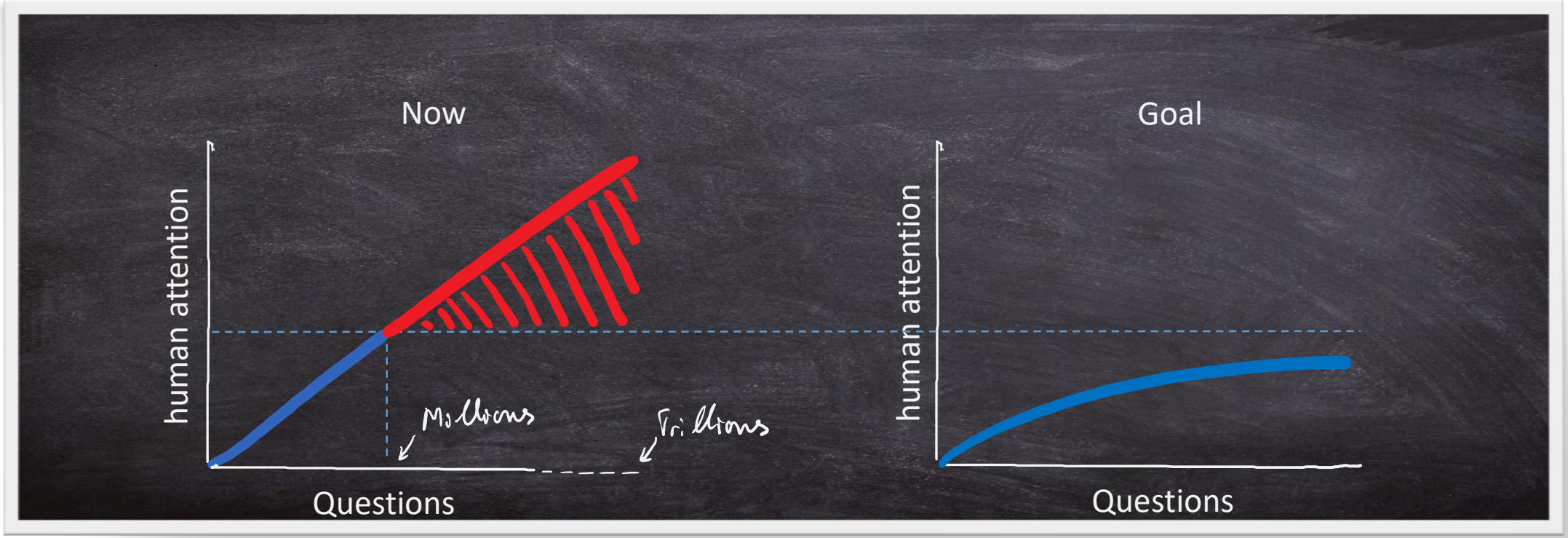
by **intelligence** delivered by AI micro-agents, from generic to domain specific

through **connected** and **directed** experiences

at massive **scale**

Human Scaling

Today is "**you get what you look for**". Human capacity determines bounds of explorations. Need to reverse the flow, let the system bring questions **prioritized** for human **attention**.



Ephemeral Knowledge

tribal knowledge about system is **ephemeral**, exists either in fragile heads of engineers or in **undiscoverable** and **unenforceable** documents. No long-term **memory.**

What is the square which when taken with ten of its roots will give a sum total of thirty nine? Now the roots in the problem before us are ten. Therefore take five, which multiplied by itself gives twenty five, an amount you add to thirty nine to give sixty four. Having taken the square root of this which is eight, subtract from this half the roots, five leaving three. The number three represents one root of this square, which itself, of course is nine. Nine therefore gives the square.



$$x^2 + 10x = 39$$

A spike in CPU load on the front-end web service boxes was caused by republishing application frameworks related to an RS3 feature. Since application frameworks are leveraged by some apps on every Win10 device, this republishing uncovered a perf bug/issue which required more CPU cycles than normal for automatic update scans.

The higher volume of requests received by the frontends resulted in increased latency with our Azure Table caching layer and hence that lead to increased concurrency and that lead to increased CPU cycles.

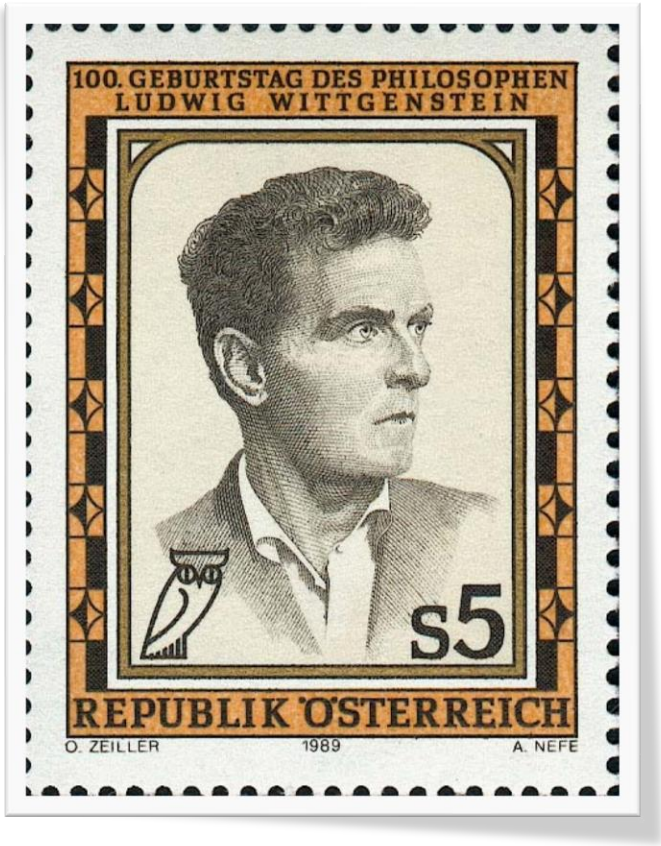


Meaning is Use

A **category** and it's **meaning** is not some concrete object or mental model, it is **behavior** born out of specific **usage**.

Capturing **user interactions** and **intentions** as users use the system; what they see, use and share, where navigate, when and how act.

Providing us with dynamic **categories** and their **importance** to user, team, organization and track a category **evolution** over time.



Blackboard

… is micro **agent** computational **framework**, enabling graph to become **reactive**.

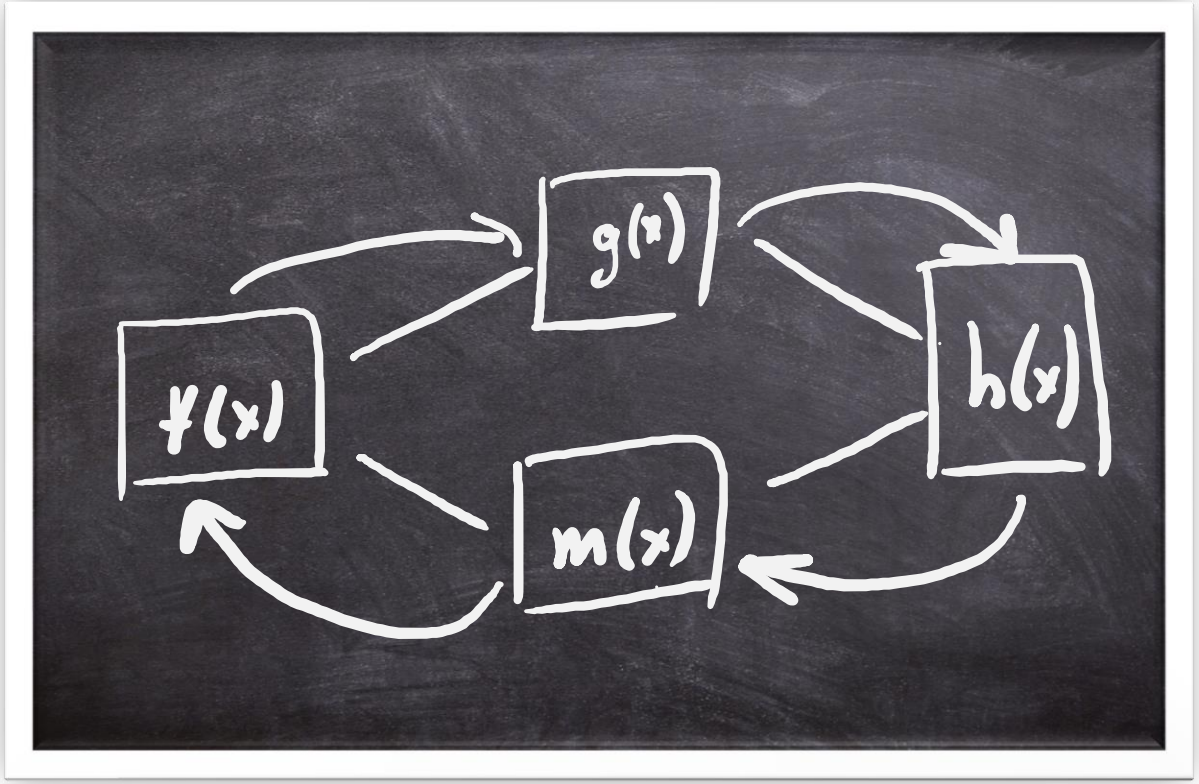
Allows **diverse** domain **experts** to contribute their **expertise** in **low cost** way to agent, that can **react** to **changes** in representation, make **local decision** and update representation.

Hosts anything from **ML** to **rules-based** agents, using **any** technology stack.

- Composition

- Adaptive Scheduling

- Explanations



Current



OBSERVING

"… able to create metrics and dashboards to observe my component …"

Metrics
If-then
Known Knowns
Local
Ad hoc DB queries

+ 2 Years



UNDERSTANDING

"… able to reason about the behavior my component in the context of the entire ecosystem …"

Relationships
Feedback loops
Known Unknowns
Collective
Auto Explorations

+ 5 Years



SIMULATION

"… able to explore the impact of my component decisions on the entire ecosystem, in silicon …"

Models
Dynamic Equilibrium
Unknown Unknowns
Simulations & Games
Massive Experiments

+ N Years



ACTING

"… able to describe high level business and engineering goals and the system optimizes in a self regulate manner …"

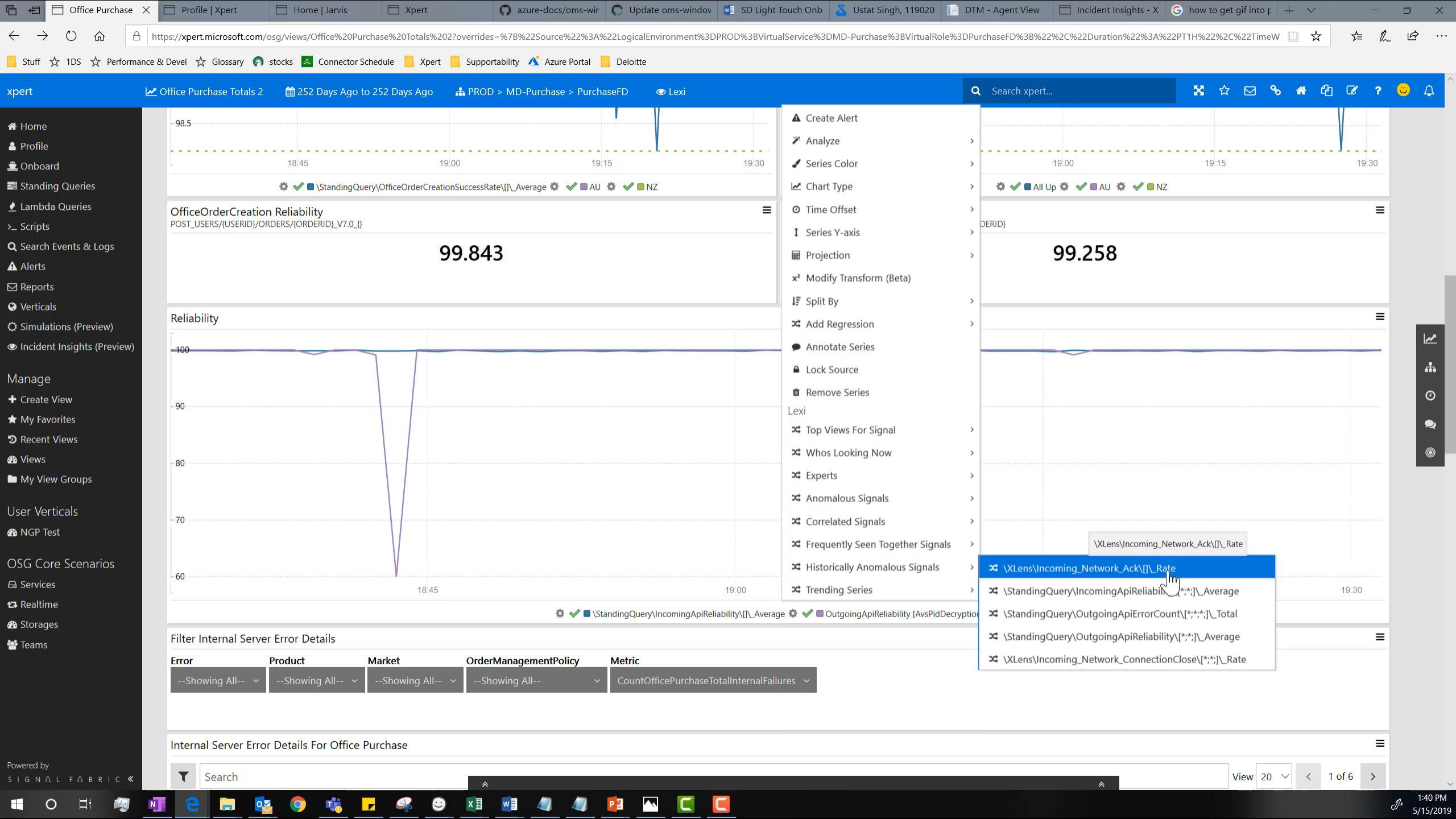
Acting
Self regulating
Adaptivity
Generative Designs

LIMITATIONS

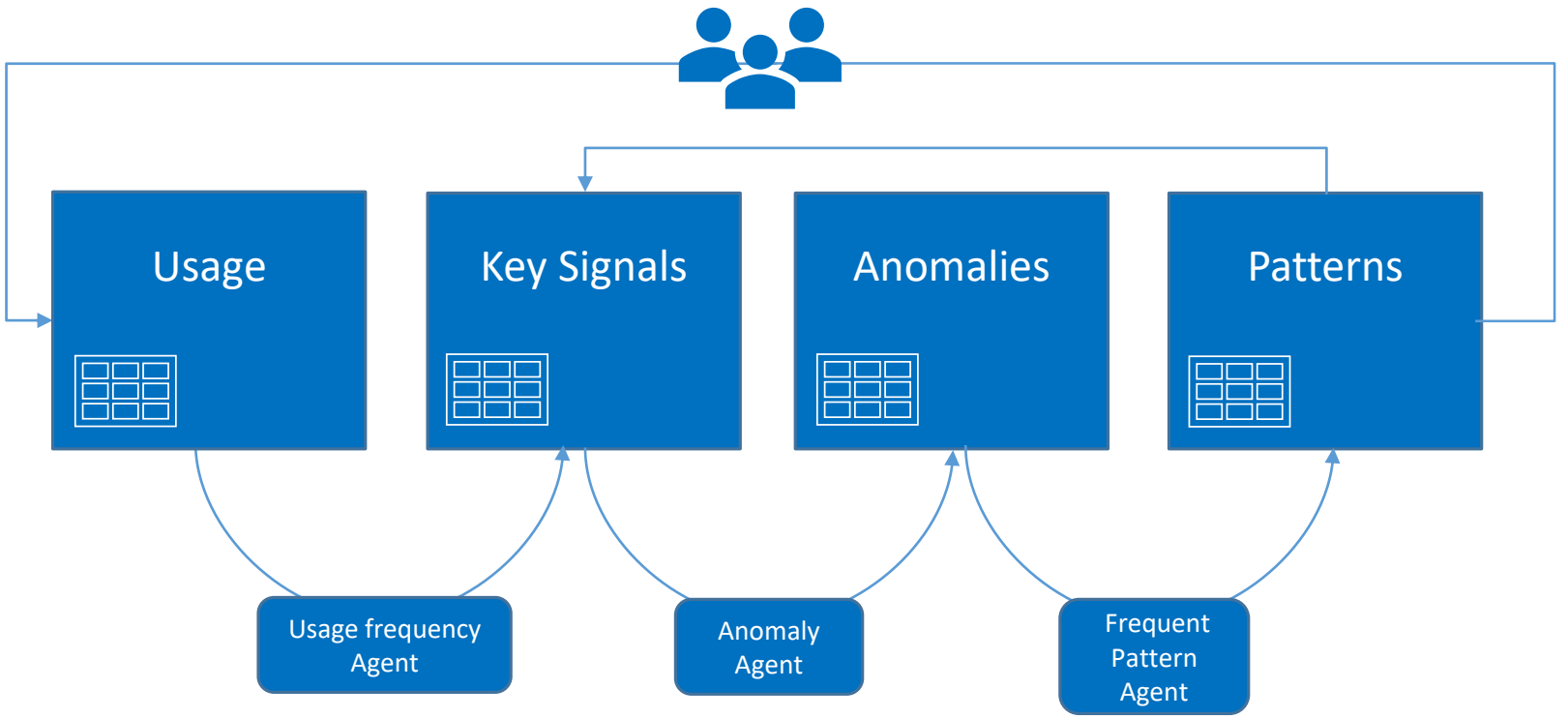
Data Silos
Ephemeral Knowledge
Hardware Scaling
Telemetry Paradox
DB Technologies
Human Scaling

Lexi 

A SYSTEM FOR DEEP REASONING OVER "THINGS" IN REAL TIME


Office Purchase
Profile | Xpert
Home | Jarvis
Xpert
azure-docs/oms-wir
Update oms-windov
SD Light Touch Onb
Ustat Singh, 119020
DTM - Agent View
Incident Insights - X
how to get gif into p
https://xpert.microsoft.com/osg/views/Office%20Purchase%20Totals%202?overrides=%7B%22Source%22%3A%22LogicalEnvironment%3DPROD%3BVirtualService%3DMD-Purchase%3BVirtualRole%3DPurchaseFD%3B%22%2C%22Duration%22%3A%22PT1H%22%2C%22TimeW
Stuff
1DS
Performance & Devel
Glossary
stocks
Connector Schedule
Xpert
Supportability
Azure Portal
Deloitte
xpert
Office Purchase Totals 2
252 Days Ago to 252 Days Ago
PROD > MD-Purchase > PurchaseFD
Lexi
Search xpert...
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User Verticals
NGP Test
OSG Core Scenarios
Services
Realtime
Storages
Teams
Powered by
SIGNAL FABRIC
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18:45
19:00
19:15
19:30
\StandingQuery\OfficeOrderCreationSuccessRate\[]_Average
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NZ
All Up
OfficeOrderCreation Reliability
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99.258
Reliability
100
90
80
70
60
\StandingQuery\IncomingApiReliability\[]_Average
OutgoingApiReliability [AvsPidDecryptio
Create Alert
Analyze
Series Color
Chart Type
Time Offset
Series Y-axis
Projection
Modify Transform (Beta)
Split By
Add Regression
Annotate Series
Lock Source
Remove Series
Lexi
Top Views For Signal
Whos Looking Now
Experts
Anomalous Signals
Correlated Signals
Frequently Seen Together Signals
Historically Anomalous Signals
Trending Series
\XLens\Incoming_Network_Ack\[]_Rate
\XLens\Incoming_Network_Ack\[]_Rate
\StandingQuery\IncomingApiReliabi[*;*;]_Average
\StandingQuery\OutgoingApiErrorCount\[*;*;*;]_Total
\StandingQuery\OutgoingApiReliability\[*;*;]_Average
\XLens\Incoming_Network_ConnectionClose\[*;*;]_Rate
Filter Internal Server Error Details
Error
Product
Market
OrderManagementPolicy
Metric
--Showing All--
--Showing All--
--Showing All--
--Showing All--
CountOfficePurchaseTotalInternalFailures
Internal Server Error Details For Office Purchase
Search
View 20
1 of 6
1:40 PM
5/15/2019

Agents & Data Flows



Service Summar | Profile | Xpert | Home | Jarvis | Xpert | azure-docs/oms-wir | Update oms-windov | SD Light Touch Onb | Ustat Singh, 119020 | DTM - Agent View | Incident Insights - X | how to get gif into p

https://xpert.microsoft.com/osg/viewgroups/Services/Service%20Summary?overrides=%7B%22Source%22%3A%22LogicalEnvironment%3DPROD%3BVirtualService%3DMD-Purchase%3BVirtualRole%3DPurchaseFD%3B%22%2C%22Duration%22%3A%22PT1H%22%2C%22TimeV

Stuff | 1DS | Performance & Devel | Glossary | stocks | Connector Schedule | Xpert | Supportability | Azure Portal | Deloitte

xpert | Service Summary | 252 Days Ago to 252 Days Ago | PROD > MD-Purchase > PurchaseFD | Lexi | Search xpert...

- Home
- Profile
- Onboard
- Standing Queries
- Lambda Queries
- Scripts
- Search Events & Logs
- Alerts
- Reports
- Verticals
- Simulations (Preview)
- Incident Insights (Preview)

Manage

- Create View
- My Favorites
- Recent Views
- Views
- My View Groups

User Verticals

- NGP Test

OSG Core Scenarios

- Services
- Realtime
- Storages
- Teams

Powered by SIGNAL FABRIC

RECOMMENDED VIEWS | TOP VIEWS | WHOS LOOKING NOW | EXPERTS | TOP SEARCHES


Doug Lenox

epassmor@microsoft.cc


Nuda Lu


Rishab Jolly


Roopesh Kelambeth


Satish Kumar Maddala v-elguti@microsoft.com

Error Summary

Error	Warning	Information
10.979M	6.645M	991.201M

Count	Sample
9,435,378	IPMILib GetNMGlobalPower call failed!
554,378	Cannot log measure metric value 5993681 for account OsFlight metric Disk_Write_Bytes_Rate dimension names {FeatureTeam, TestSuite, Test, ExpandedParameterCombination, ParameterCombinationId, TriggerRollbackLevel, OsImage, ClusterName, ClusterAliases, EnvironmentName, MachineName, PodName, MachineFunction, SKU, ScaleUnit, ConnectedTo, Enclosure, StaticIP, PhysicalMachineName, PhysicalIP, RackName, CoreSwitchPair, PodType} values {OsFlightPerfCounters, AutopilotPerfCounters, APServer2016TP5, {}, BCCA4092B6B15
318,622	Get: error code 12002 has occurred..
159,378	Failure to fetch file: /PingmeshGenService/heartbeat.txt after being unable to find /PingmeshGenService/CY1SCH030031442_scanlist.xml, attempt#: 10, error: Unable to execute Get on (server = 10.8.76.15, port = 80, Uri = /PingmeshGenService/heartbeat.txt) HttpStatus: Code Text =
102,897	Failed to load ActionConfiguration at D:\data\GenericFirmwareUpgrade\ActionConfigurations\ActionConfiguration_SeagateDiskFW.xml. Error: System.ArgumentException: CurrentVersionScript is null, empty, or consists of only white-space characters... at Microsoft.Search.Autopilot.GenericFirmwareUpgrade.Lib.Common.Throw`1.If(Boolean condition, String message).. at Microsoft.Search.Autopilot.GenericFirmwareUpgrade.Lib.ActionConfiguration.ActionConfiguration.TryLoad(String configFilePath, ActionConfiguration& ac
97,163	Failed to locate valid certificates for this account. Metrics will not be published., [PID:20124,TID:2164]
	Metrics data publication failed with an HTTP exception after receiving a server response. PublicationEndpoint:https://104.214.70.219/api/v1/data/metrics/mdm-stream/monitoringAccount/Time?replicate=false[ap-prod-south.

Log Type

Service

Exceptions



Service Logs



2:16 PM
5/15/2019

Lexi Skills

Experts\Power Users

Habits

Recommendations

Frequently Seen Together

Trending

Personal History

Who's Looking Now

Top Log Search

Top View for Alert

Views in context of Alert

Key Signals

Anomalies

Historically Correlated

Historically Anomalous Together

Top Used Entities

Signals, Views, Services, Users, Teams, etc.

Incident Insights 

POWERED BY SIGNAL FABRIC

Home
Profile
Onboard
Standing Queries
Lambda Queries
Scripts
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Teams

Powered by
SIGNAL FABRIC

Lexi Incident Insights

49 INCIDENTS FOUND

Only Active | Enable Grouping

Sort By: StartTime: Newest to Oldest

Search incidents...

These 4 incidents have occurred together 5 times and are related with medium confidence.

MITIGATED | SEVERITY 2 | [redacted] Find correlated incidents
[redacted]
Active from [redacted] until [redacted]

MITIGATED | SEVERITY 2 | [redacted] Find correlated incidents
[redacted]
Active from [redacted] until [redacted]

ACTIVE | SEVERITY 3 | [redacted] Find correlated incidents
Xpert Alert: [redacted]
Started [redacted]

MITIGATED | SEVERITY 3 | [redacted] Find correlated incidents
Xpert Alert: [redacted]
Active from [redacted] until [redacted]

These 2 incidents seem to be triggered on the same source.

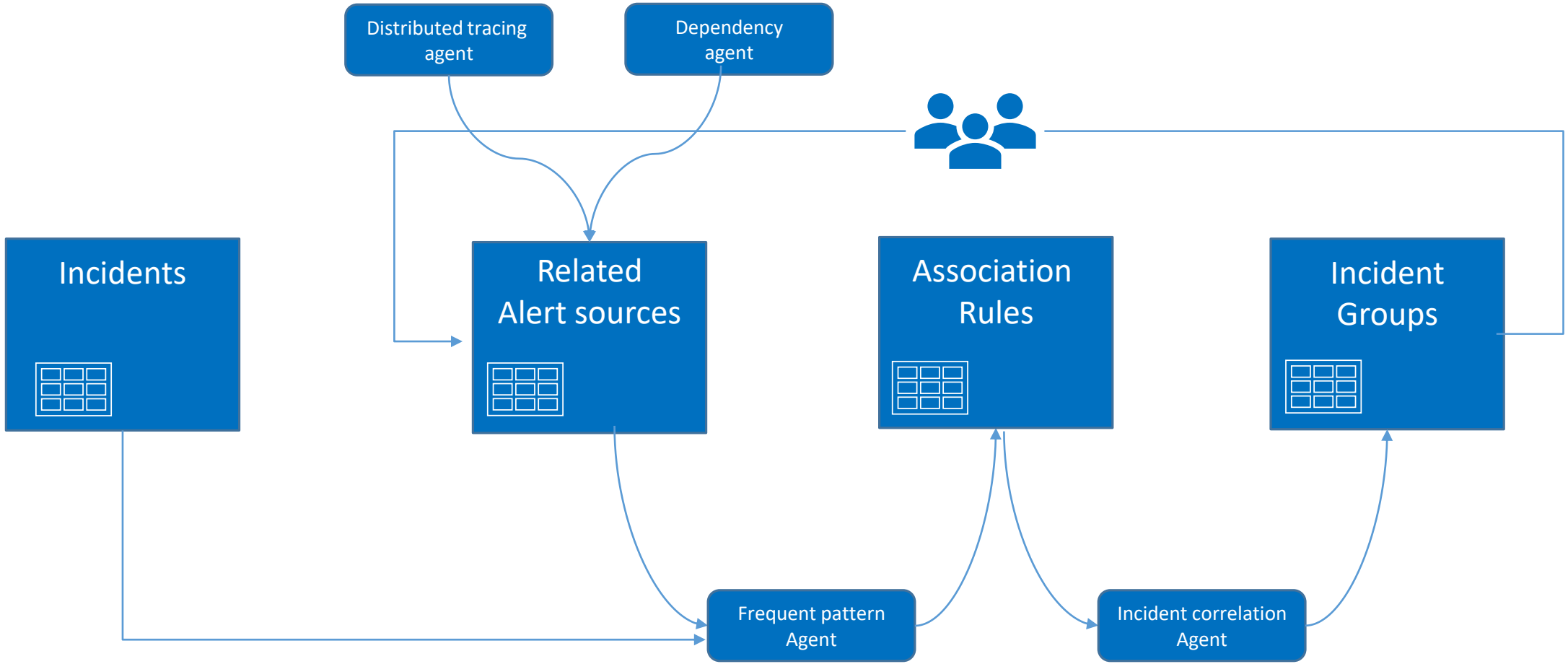
MITIGATED | SEVERITY 2 | [redacted] Find correlated incidents
Xpert Alert: [redacted]
Active from [redacted] until [redacted]

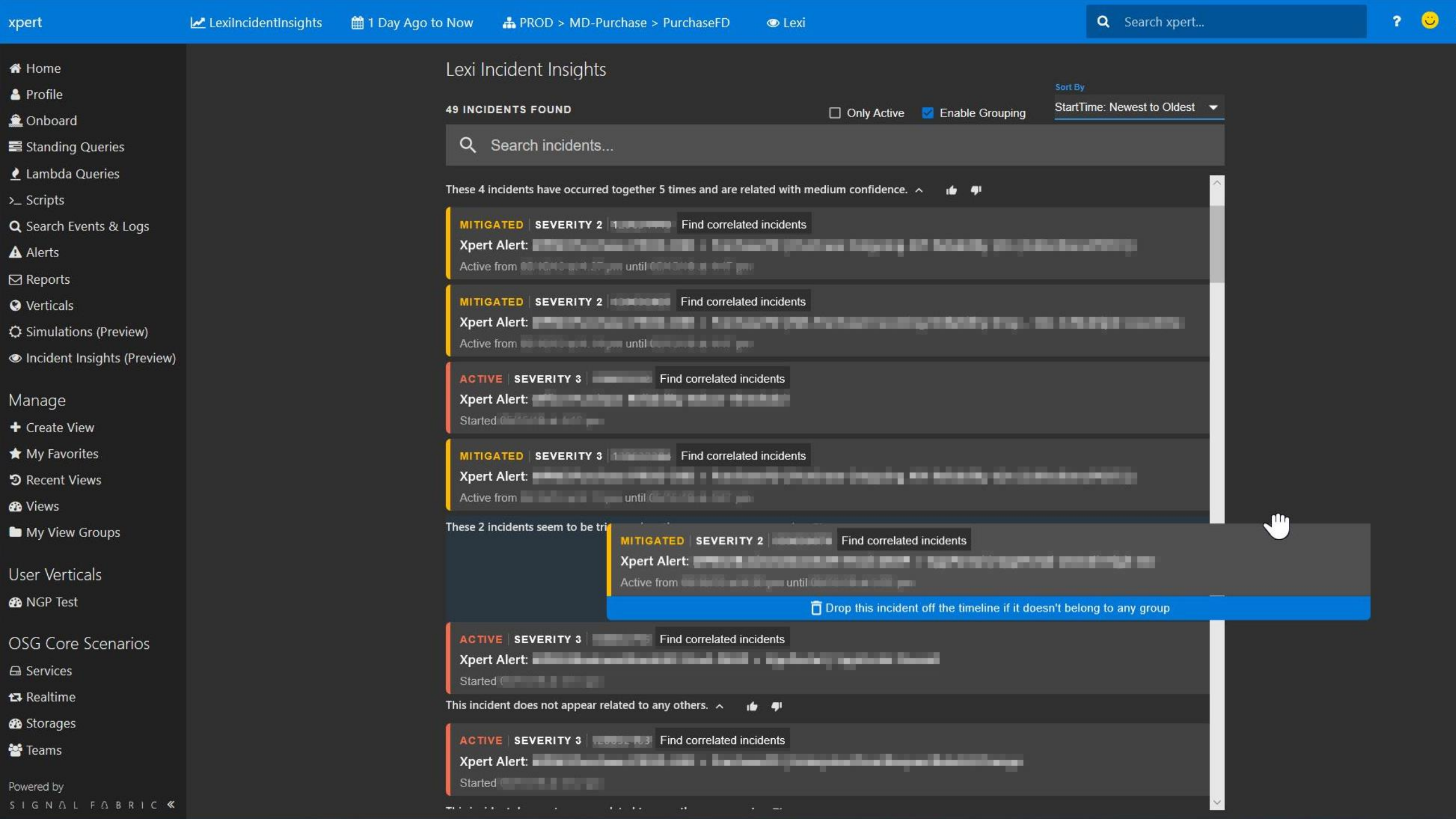
ACTIVE | SEVERITY 3 | [redacted] Find correlated incidents
Xpert Alert: [redacted]
Started [redacted]

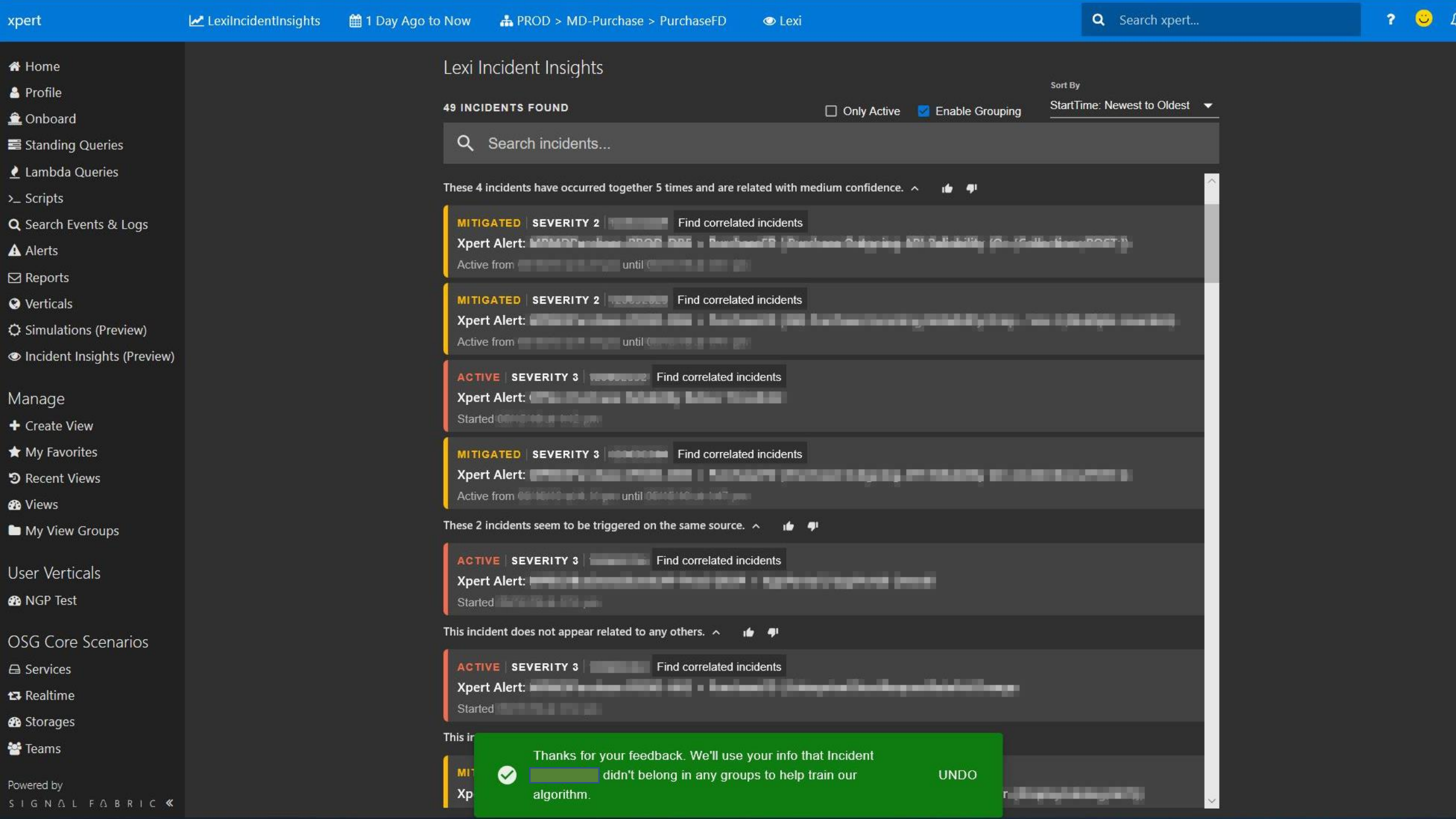
This incident does not appear related to any others.

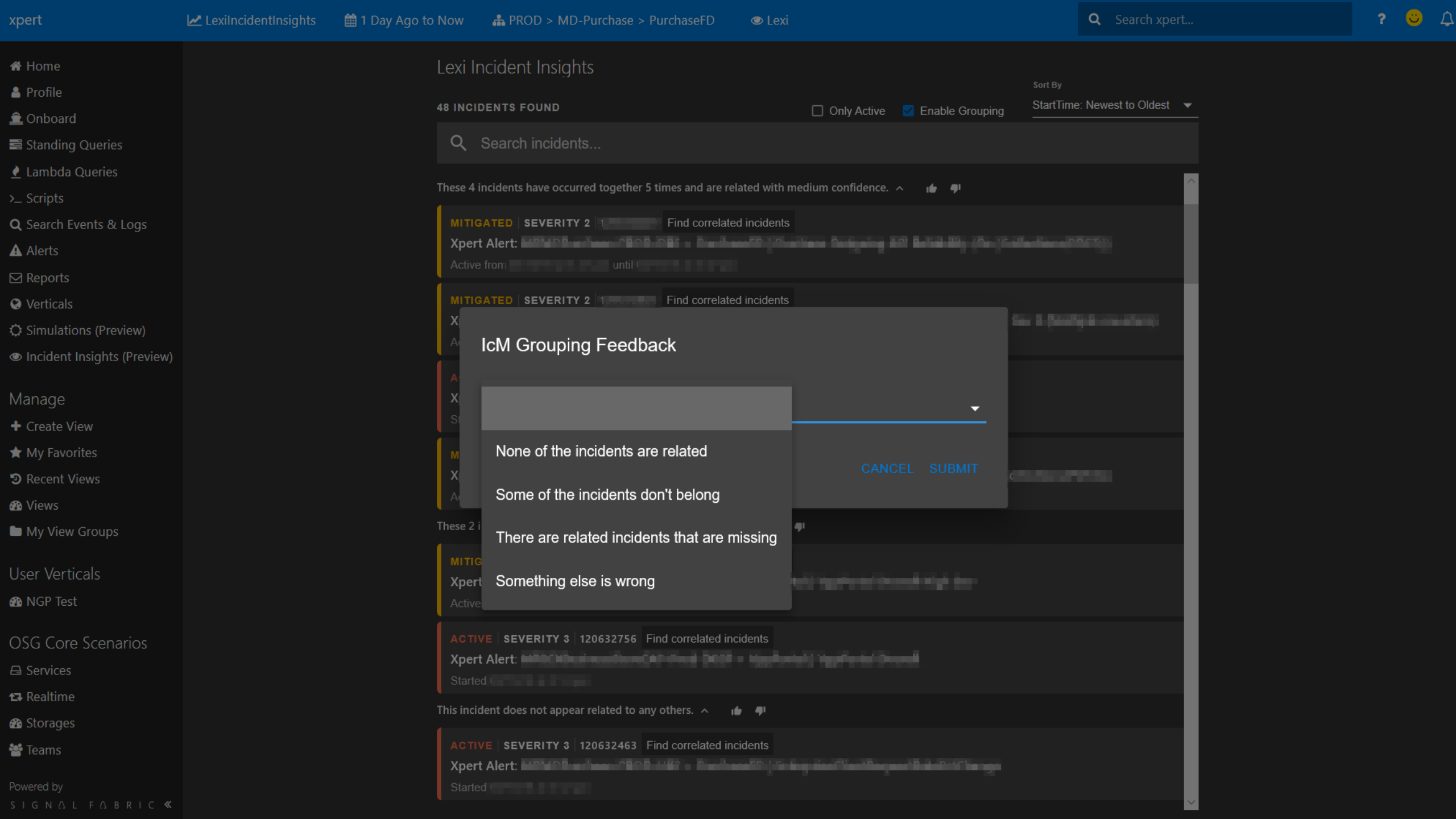
ACTIVE | SEVERITY 3 | [redacted] Find correlated incidents
Xpert Alert: [redacted]
Started [redacted]

Agents & Data Flows




xpert
LexiIncidentInsights
1 Day Ago to Now
PROD > MD-Purchase > PurchaseFD
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49 INCIDENTS FOUND
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Sort By
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Search incidents...
These 4 incidents have occurred together 5 times and are related with medium confidence.
MITIGATED | SEVERITY 2
Find correlated incidents
Xpert Alert:
Active from
until
MITIGATED | SEVERITY 2
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Xpert Alert:
Active from
until
ACTIVE | SEVERITY 3
Find correlated incidents
Xpert Alert:
Started
MITIGATED | SEVERITY 3
Find correlated incidents
Xpert Alert:
Active from
until
These 2 incidents seem to be tri
MITIGATED | SEVERITY 2
Find correlated incidents
Xpert Alert:
Active from
until
Drop this incident off the timeline if it doesn't belong to any group
ACTIVE | SEVERITY 3
Find correlated incidents
Xpert Alert:
Started
This incident does not appear related to any others.
ACTIVE | SEVERITY 3
Find correlated incidents
Xpert Alert:
Started


xpert
LexiIncidentInsights
1 Day Ago to Now
PROD > MD-Purchase > PurchaseFD
Lexi
Search xpert...
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MITIGATED | SEVERITY 3
Find correlated incidents
Xpert Alert:
Active from
until
These 2 incidents seem to be triggered on the same source.
ACTIVE | SEVERITY 3
Find correlated incidents
Xpert Alert:
Started
This incident does not appear related to any others.
ACTIVE | SEVERITY 3
Find correlated incidents
Xpert Alert:
Started
Thanks for your feedback. We'll use your info that Incident
didn't belong in any groups to help train our algorithm.
UNDO


xpert
LexiIncidentInsights
1 Day Ago to Now
PROD > MD-Purchase > PurchaseFD
Lexi
Search xpert...
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StartTime: Newest to Oldest
Search incidents...
These 4 incidents have occurred together 5 times and are related with medium confidence.
MITIGATED SEVERITY 2
Find correlated incidents
Xpert Alert:
Active from
until
IcM Grouping Feedback
None of the incidents are related
Some of the incidents don't belong
There are related incidents that are missing
Something else is wrong
CANCEL
SUBMIT
ACTIVE SEVERITY 3 120632756
Find correlated incidents
Started
This incident does not appear related to any others.
ACTIVE SEVERITY 3 120632463
Find correlated incidents
Started

Q&A

Extensibility Platform : Weaver

- Example of Friedman Smoothing as a Transform

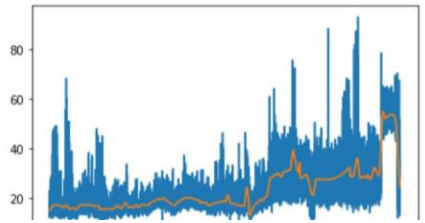
```
[ ]: from xpert import hydrant
     import matplotlib.pyplot as plt
     from supersmoother import SuperSmoother
     import numpy as np
     import datetime
     import pandas as pd
```

```
[ ]: def transform(series, params):
         return friedman(series)

     def friedman(series):
         smoother = SuperSmoother()
         smoothSeries = []
         for ts in series:
             y = ts.values.flatten()
             x = np.arange(len(ts))
             smoother.fit(x, y)
             ts = pd.Series(smoother.predict(x), index = ts.index)
             smoothSeries.append(ts)
         return smoothSeries
```

```
[6]: ######### Get the data from hydrant ##############
     source = 'LogicalEnvironment=PROD;Team=Operating Systems Group;VirtualService=Groups-Prod;'
     instance_id = r"Log\Exceptions"
     end_time = datetime.datetime.utcnow()
     start_time = end_time - datetime.timedelta(days=14)
     zoom = datetime.timedelta(minutes=1)
     counters = await hydrant.load_series_async(source, instance_id, start_time, end_time, zoom, 'self')
```

```
[48]: # Smoothing Transform
      counters = await hydrant.load_series_async(source, instance_id, start_time, end_time, zoom, 'self')
      counters[0].plot()
      counters = await hydrant.load_series_async(source, instance_id, start_time, end_time, zoom, 'self.AzureFunc("\Asimov.Ai.Friedman\")')
      #counters = transform(counters, "2")
      counters[0].plot()
      plt.show()
```



Federated signal relationship graph

Types of Relationships:

1. Human-defined
   - Explicit dependency models (service tree, xpert models)
   - Explicitly entered links (IcM Linkages)
2. Observed
   - Agent-discovered topology (dependency agents, distributed tracing)
   - Key signals
3. Learned
   - Algorithmically inferred (correlations, frequent co-occurrence patterns in anomalies, alerts, incidents)



High Level Architecture

Graph **identities**

augmented by **context**

guided by **dynamic ontology**

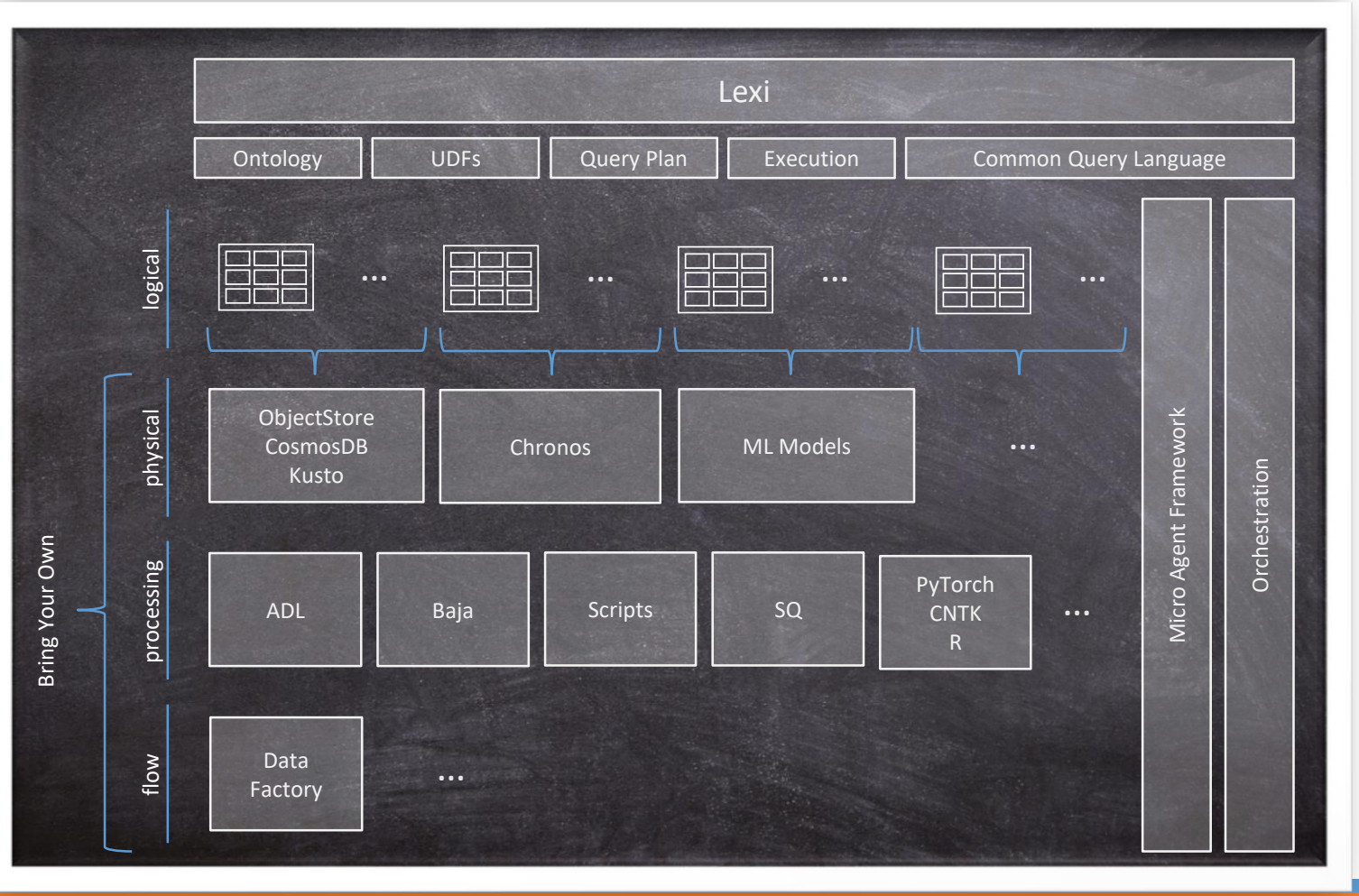
federated data

stored in **most appropriate storage**

integrated with **ingestion** pipeline

Bring Your Own storage, pipeline and orchestration

glued by **micro agent** computational **framework,** enabling graph to become **reactive**.



Simulations & Games

- Executable designs

- Stress large scale, chaos monkey, system invariants, network partitioning Jepsen tests, FxCop for DS, play with thousands parameters, find bottlenecks and failures, explore flows, what-if, etc

- 1K nodes on single core

Prototype build upon

- Communicating Sequential Processes

- Discreet Event Simulation

- Async Time Synchronization
  - allows for massive parallelism

```
IEnumerable<Event> cacheService(IProcessContext ctx)
{
    do
    {
        yield return ctx.GetRequest(out Promise<Message> promise);

        switch (promise.Result)
        {
            case CacheMessage msg when msg.Method == "GET":
                yield return this.cpuResource.Allocate(this.cacheCPUDist.SampleTimeSpan());
                bool response = this.cache.TryGetValue(msg.Id, out int cacheContent);
                ctx.ReplyToMessage(msg, new CacheResponseMessage { success = response, content = cacheContent });
                break;

            case CacheMessage msg when msg.Method == "SET":
                yield return this.cpuResource.Allocate(this.cacheCPUDist.SampleTimeSpan());

                var memResult = this.memResource.Allocate(this.cacheMemDist.Sample());
                if (memResult.NotEnoughResources)
                {
                    ctx.ReplyToMessage(msg, new CacheResponseMessage { success = false });
                    break;
                }

                this.cache[msg.Id] = msg.Content;
                ctx.ReplyToMessage(msg, new CacheResponseMessage { success = true });
                break;
        }

    } while (true);
}
```