# Understanding Fabric Capacities

Benni De Jagere

Slides

CAT

b3

CEGAL

REBTECH

DATAmasterminds

Measure Killer

Snabbfoting

TIMEXTENDER

Telia

Microsoft

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sessionize /bennidejagere

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#SayNoToPieCharts

Microsoft Fabric
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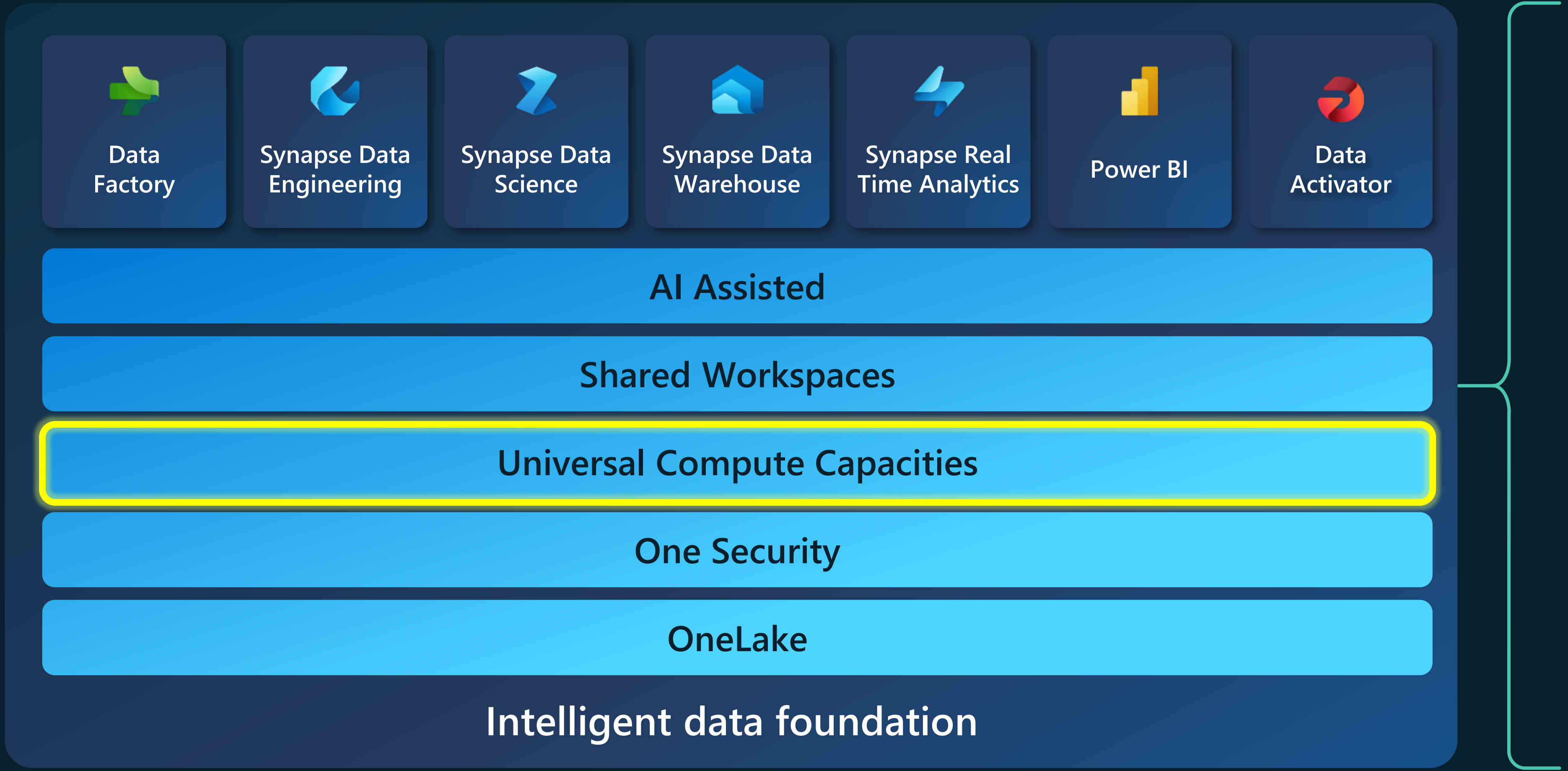
# Fabric Capacities Introduction

# Microsoft Fabric



Data Factory

Synapse Data Engineering

Synapse Data Science

Synapse Data Warehouse

Synapse Real Time Analytics

Power BI

Data Activator

AI Assisted

Shared Workspaces

Universal Compute Capacities

One Security

OneLake

Intelligent data foundation

**Single...**

Onboarding and trials  
Sign-on  
Navigation model  
UX model  
Workspace organization  
Collaboration experience  
Data Lake  
Storage format  
Data copy for all engines  
Security model  
CI/CD  
Monitoring hub  
Governance & Capacity Metrics  
Data Hub

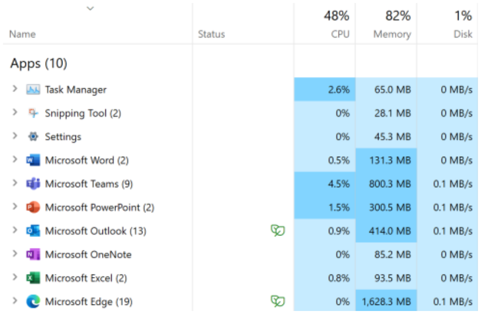
# Capacities are to Fabric what CPUs are to PCs

## Personal Computing

When you purchase a PC you choose the number of CPU cores. The more CPU cores the more load the PC can handle.

The CPU cores are dynamically shared across all applications with no need to pre-allocate by app.

The total consumption of the CPU across all the apps cannot exceed the number of cores. CPU overload causes a slowdown.



| Name | Status | 48%<br>CPU | 82%<br>Memory | 1%<br>Disk |
|---|---|---|---|---|
| Apps (10) | | | | |
| Task Manager | | 2.6% | 65.0 MB | 0 MB/s |
| Snipping Tool (2) | | 0% | 28.1 MB | 0 MB/s |
| Settings | | 0% | 45.3 MB | 0 MB/s |
| Microsoft Word (2) | | 0.5% | 131.3 MB | 0 MB/s |
| Microsoft Teams (9) | | 4.5% | 800.3 MB | 0.1 MB/s |
| Microsoft PowerPoint (2) | | 1.5% | 300.5 MB | 0.1 MB/s |
| Microsoft Outlook (13) | | 0.9% | 414.0 MB | 0.1 MB/s |
| Microsoft OneNote | | 0% | 85.2 MB | 0 MB/s |
| Microsoft Excel (2) | | 0.8% | 93.5 MB | 0 MB/s |
| Microsoft Edge (19) | | 0% | 1,628.3 MB | 0.1 MB/s |

## Fabric Capacities

In Fabric, you provision a Capacity with a number of “capacity units”.  The more capacity units provisioned, the more compute load handled.

Unlike the PC, capacity units can be scaled up or down as needed.

The capacity units are dynamically shared across all the Fabric workloads, with no pre-allocation necessary.

A single capacity can simultaneously drive BI, DW, Spark, ML and every other compute engine in Fabric

The total consumption of the capacity across all the workloads cannot exceed the capacity units provisioned.

Overloading the capacity will throttle it (slow down).

Auto scale can dynamically increase the available compute units avoiding the slowdown.

# Capacities are a shared resource

### Shared across workloads

A single capacity is providing the compute power for all Fabric workloads.

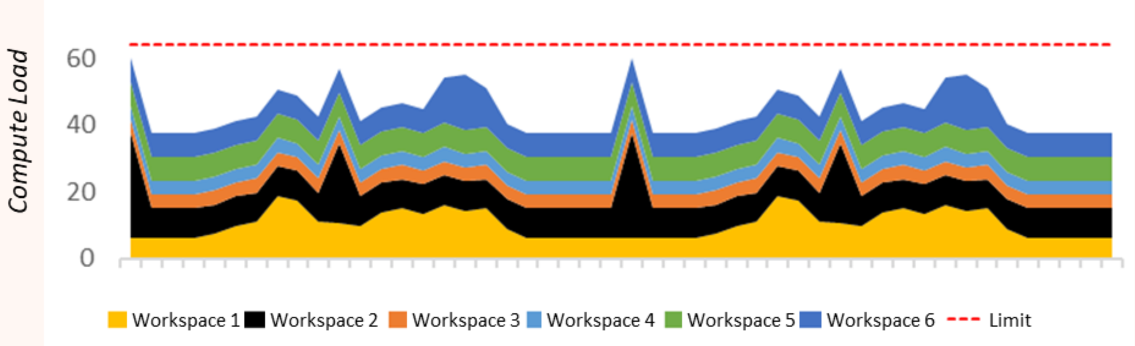
There is no need to allocate compute for each workload separately.

- Data Factory
- Synapse Data Engineering
- Synapse Data Science
- Synapse Data Warehouse
- Synapse Real Time Analytics
- Power BI
- Data Activator

### Shared Across Projects

A single capacity typically supports dozens of separate projects simultaneously, each managed in its own workspace.

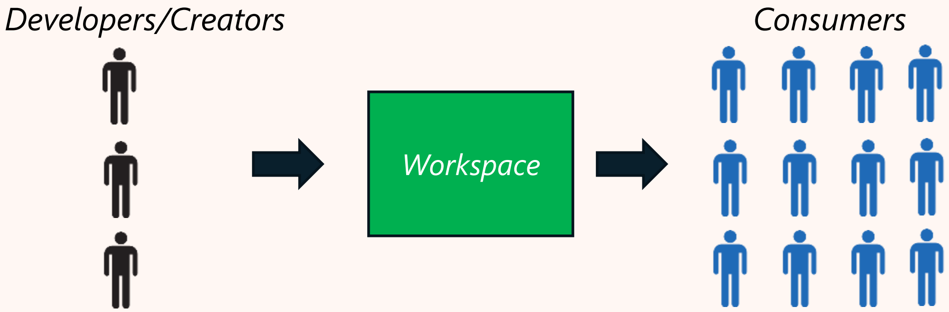
It is rare to have a capacity dedicated to a single project



### Shared across users

For each project, many developers will share a workspace where collaborative development and consumption at scale is managed.

Each creator can provision any artifact and run any job without the need for any pre-approval or planning



*Developers/Creators*

*Workspace*

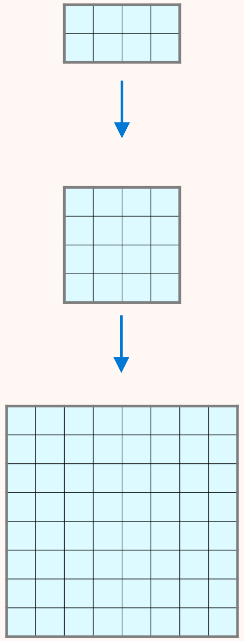
*Consumers*

# Capacities are flexible building blocks for growth

Capacities can be configured in endless ways to meet scale, usage and governance requirements while tuning to minimize TCO and performance goals

## Scale Vertically

Increased capacity size provides more throughput



F8 Capacity 8 CU's

F16 Capacity 16 CU's

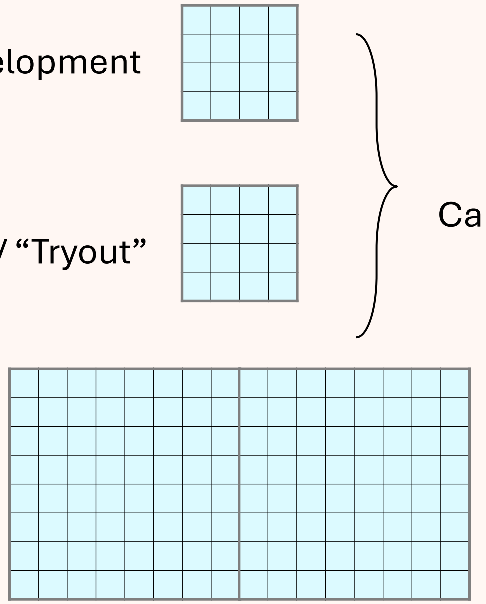
F64 Capacity 64 CU's

.
.
.
.

2048

## Scale Horizontally

Scale horizontally using the benefits of modular design for hardened isolation and governance



Development

Test / "Tryout"

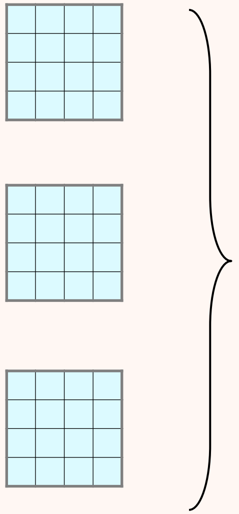
F16 Capacities

Prod

F128 Capacity

## Regional Availability

Use different capacities for different regions to support GDPR / Data residency requirements



Region:
UK South

Region:
France Central

Region:
Sweden Central

F16 Capacities

# Provisioning and Deploying Capacities

## Purchased in Azure

- **Purchased** either as a PAYG or RI resource
- **Provisioned with a certain amount of compute** units, analogous to CPU cores.
- The **more capacity units are provisioned, the more load** the capacity can support
  - Multiply SKU size by 30s to match platform evaluation in metrics app
- Capacities are **priced at a fixed hourly rate**, based on capacity units provisioned
- The RI commitment (1-year reserved instance) enjoys a **40% discount**

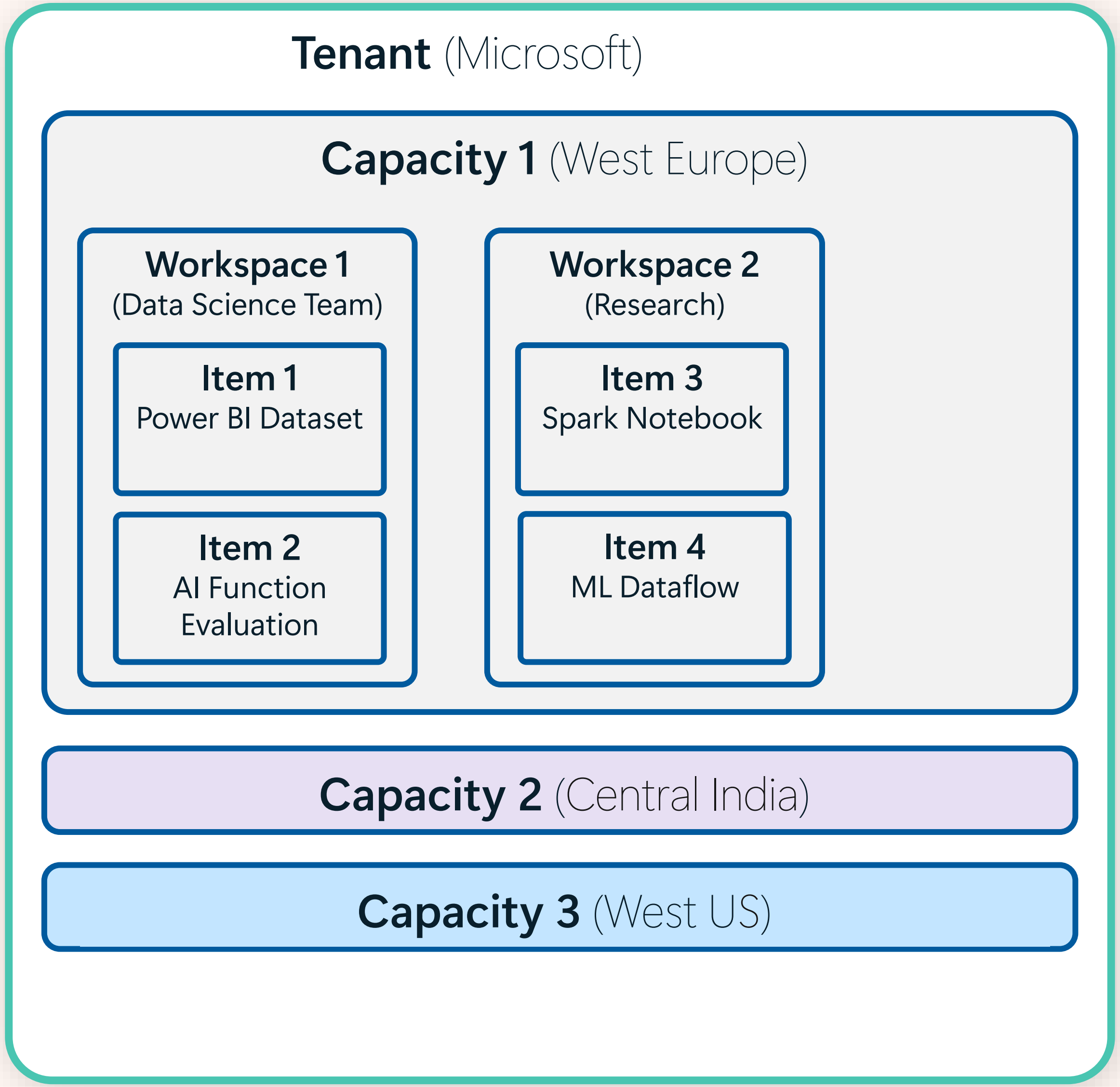
Universal Compute Capacities SKU Sizing

| SKU | Capacity Units (CU) | CU's (per 30s) | Power BI SKU | Power BI V-cores |
|---|---|---|---|---|
| F2 | 2 | 60 | - | 0.25 |
| F4 | 4 | 120 | - | 0.5 |
| F8 | 8 | 240 | A1 | 1 |
| F16 | 16 | 480 | A2 | 2 |
| F32 | 32 | 960 | A3 | 4 |
| F64 | 64 | 1920 | P1 | 8 |
| F128 | 128 | 3840 | P2 | 16 |
| F256 | 256 | 7680 | P3 | 32 |
| F512 | 512 | 15360 | P4 | 64 |
| F1024 | 1024 | 30720 | P5 | 128 |
| F2048 | 2048 | 61440 | - | 256 |

# Provisioning and Deploying Capacities

## Deployed to Regions

- Each capacity **resides in a specific region of the buyers’ choice** where both the data & compute reside
- **Workspaces are assigned to a capacity** that provides the compute and storage for all the workspace artifacts
- Multiple capacities can be purchased, deployed and managed by **different owners** residing in a single tenant allowing each business unit to pay for their own consumption


**Tenant** (Microsoft)
**Capacity 1** (West Europe)
**Workspace 1** (Data Science Team)
**Item 1** Power BI Dataset
**Item 2** AI Function Evaluation
**Workspace 2** (Research)
**Item 3** Spark Notebook
**Item 4** ML Dataflow
**Capacity 2** (Central India)
**Capacity 3** (West US)

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# Bursting and Smoothing

# Smoothing intro and benefits

**Load stabilization**

Smoothing helps capacities self-stabilize by flattening large spikey loads into a smooth load profile, eliminating temporal spikes

**Eliminates Scheduling contention**

Large/scheduled Jobs usage (not execution) are smoothed over 24 hours, eliminating the need to decide the timing and order of job execution

*Performance now, pay later.  Demo to follow.*

**Bad actor protection**

Interactive operations smoothed over several minutes, preventing a single user with a very demanding query from hogging the entire capacity

# What is Bursting?

## Job acceleration

Bursting provides extra compute resources to jobs and queries to accelerate their completion

## Go beyond

The extra resources of bursting allow jobs to **utilize far more resources than "face value"**

Instead of running a job on 64 CU and completing in 60 seconds, bursting could use 256 CUs to complete the job in 15 seconds.

Same amount of work, just completed faster

## No hassle, No overload

**Bursting is automatic** when the system reasons it can accelerate the job by applying extra resources. No settings are required.

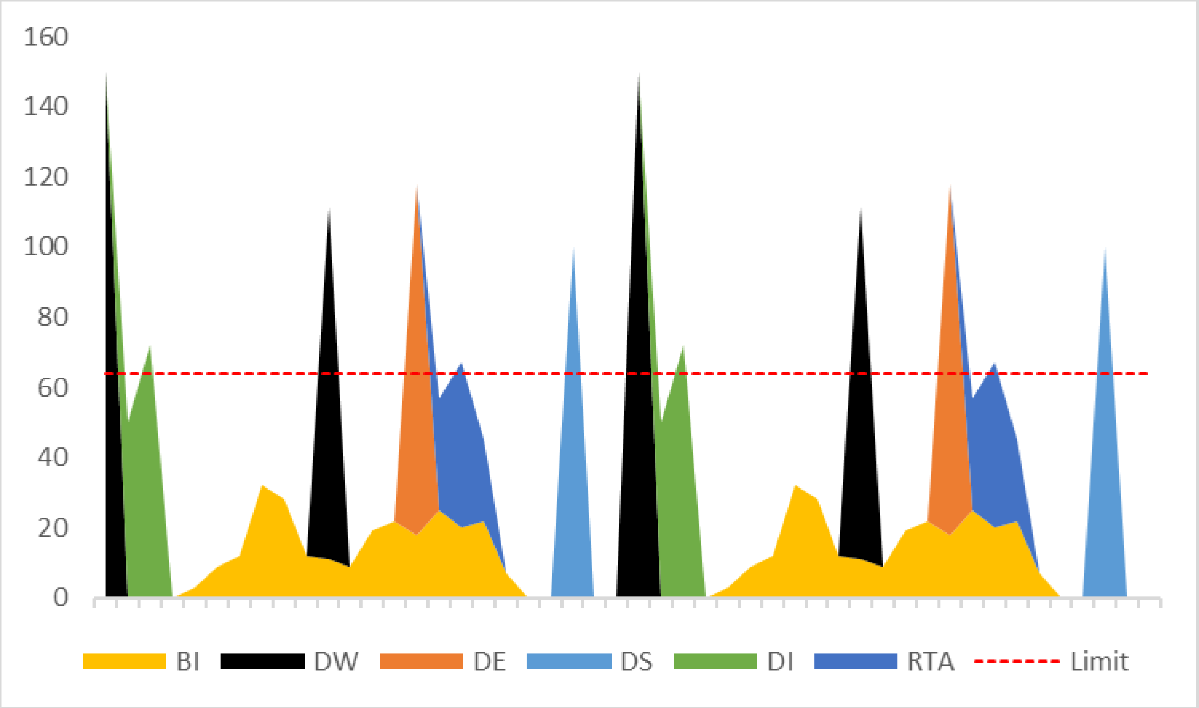
**Bursting prevents an overload** as the *smoothing* mechanism will always flatten the resource burst

# Bursting and smoothing | before and after

Looking at an example of a 64 CU capacity, running multiple workloads over a couple of days…

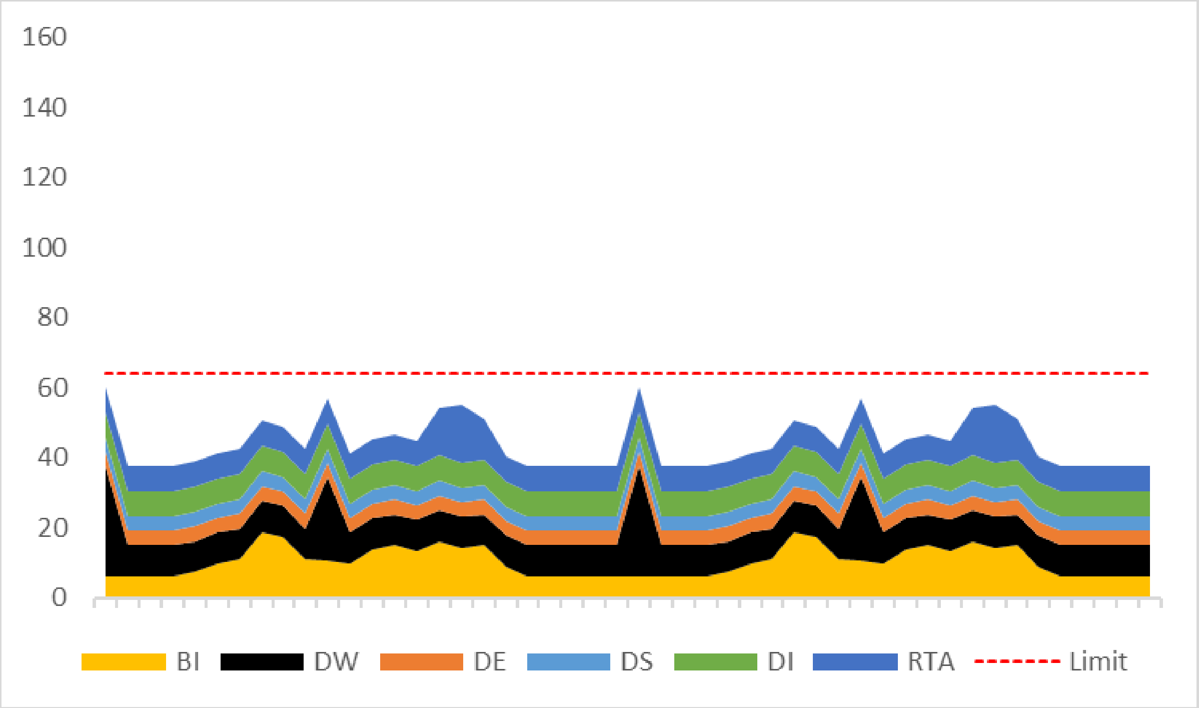
## Before Smoothing

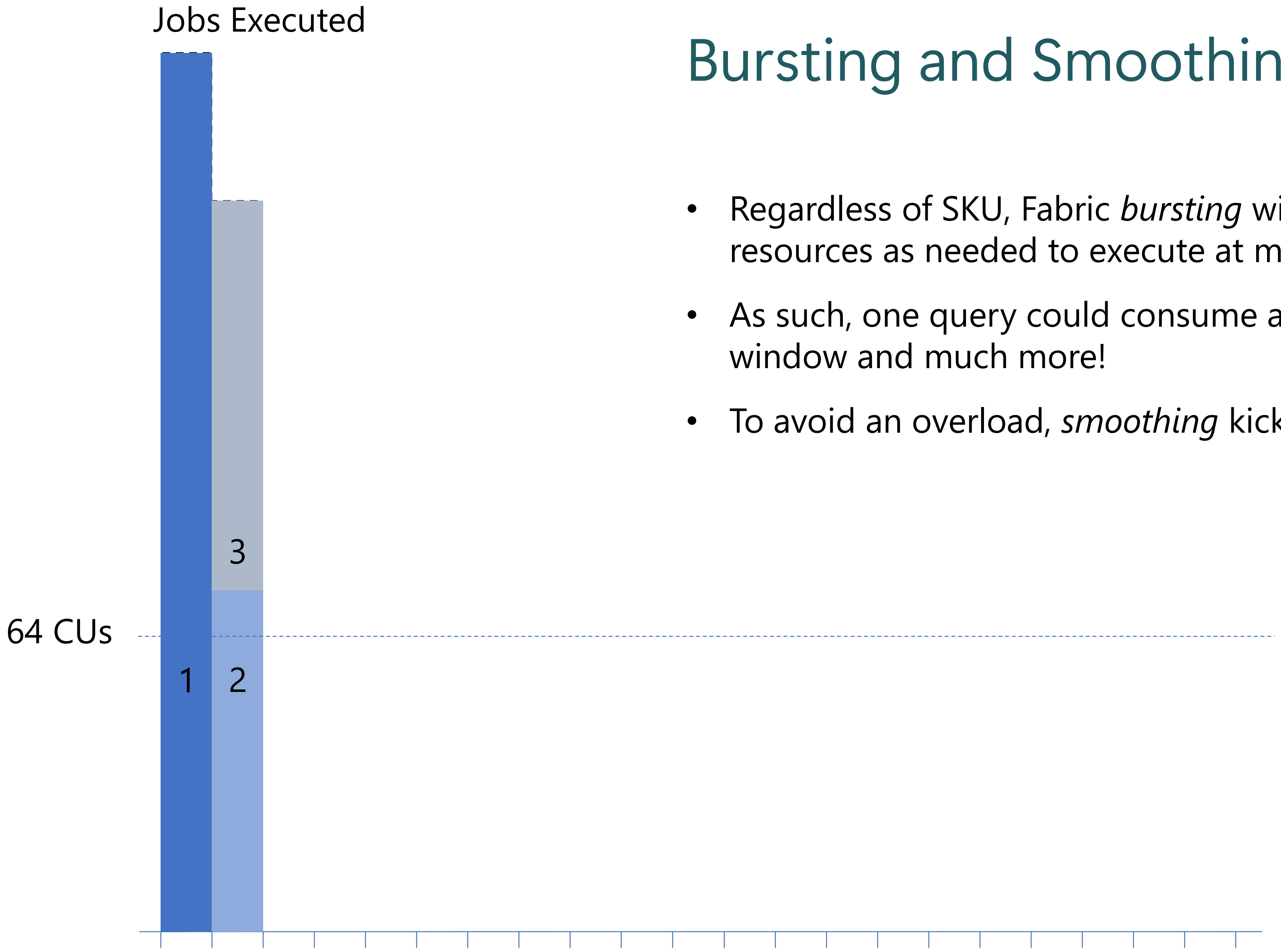
- Actual load as executed on the capacity before smoothing
- *Bursting* accelerates jobs execution by resource boosting
- The capacity could be overloaded 25% of the time
- Some of the overloads are more than 2x the limit
- There are periods of no/low usage



## After Smoothing

- Shows the reported load (not runtime execution) against the capacity limits
- There is NO overload, and consumption is more stable
- The smoothing of usage fills in gaps

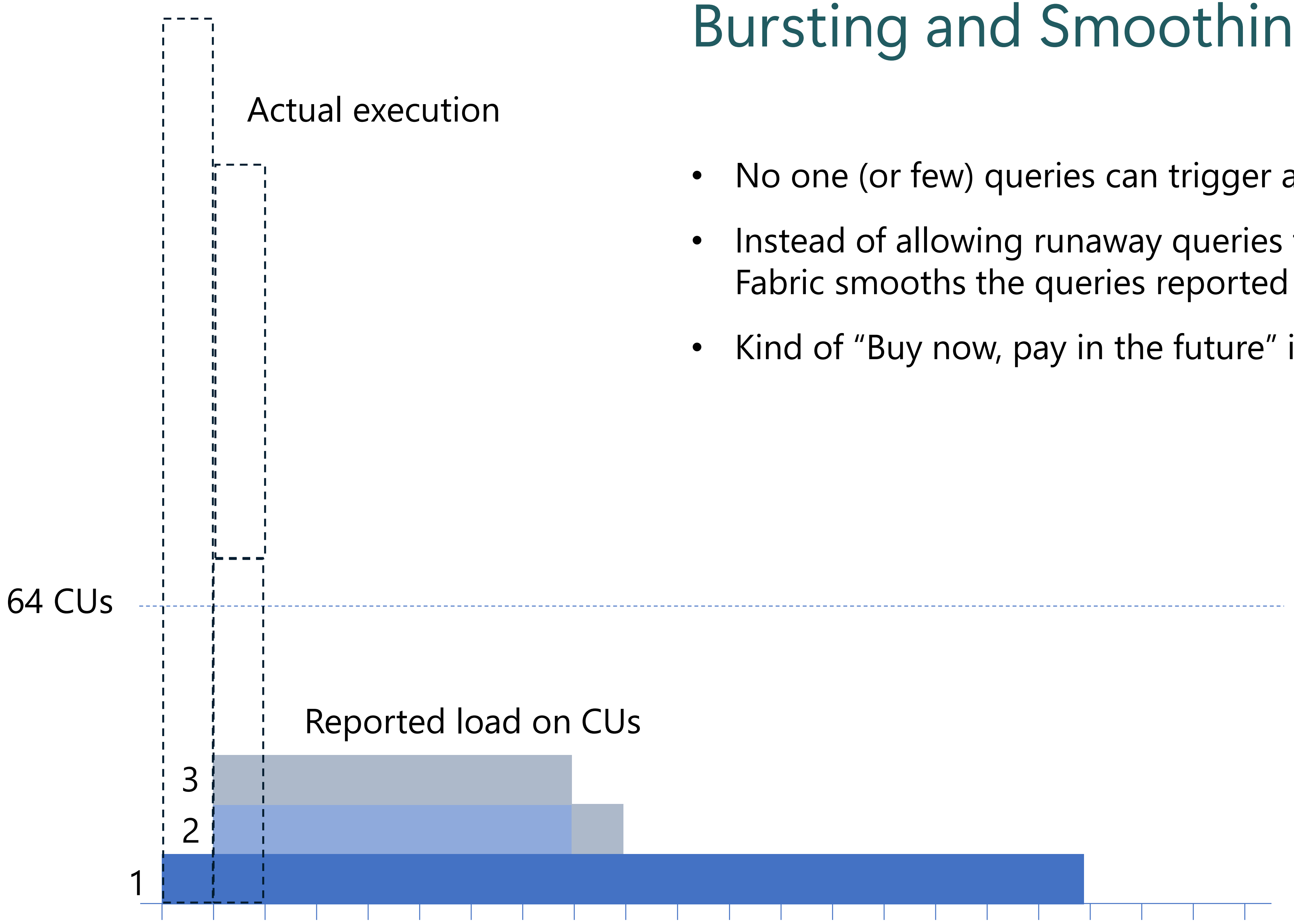




# Bursting and Smoothing

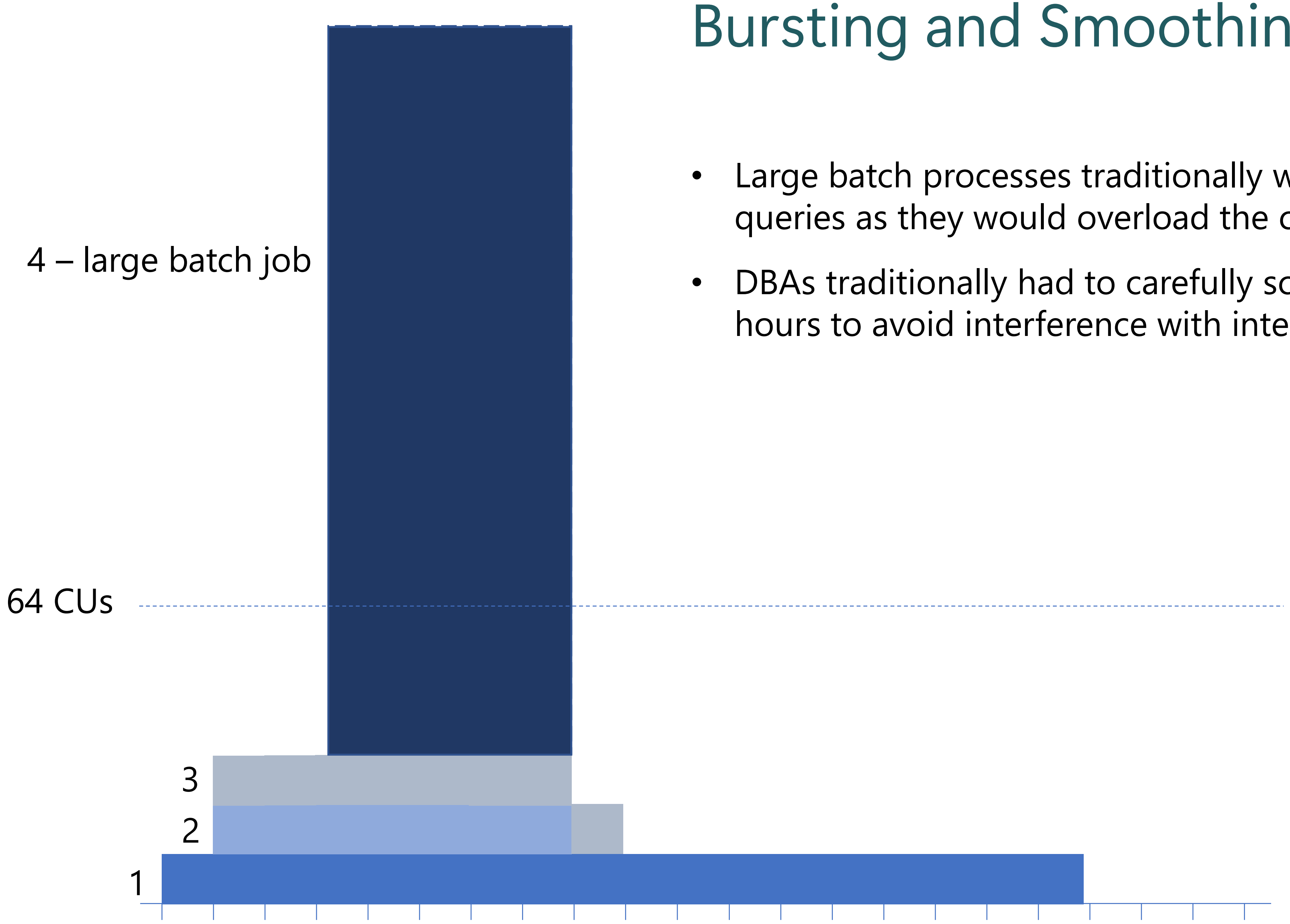
- Regardless of SKU, Fabric *bursting* will automatically allocate resources as needed to execute at maximum performance
- As such, one query could consume all the quota of a single time window and much more!
- To avoid an overload, *smoothing* kicks in

# Bursting and Smoothing



- No one (or few) queries can trigger an overload
- Instead of allowing runaway queries to create a local overload, Fabric smooths the queries reported usage to future time windows
- Kind of “Buy now, pay in the future” installment plan

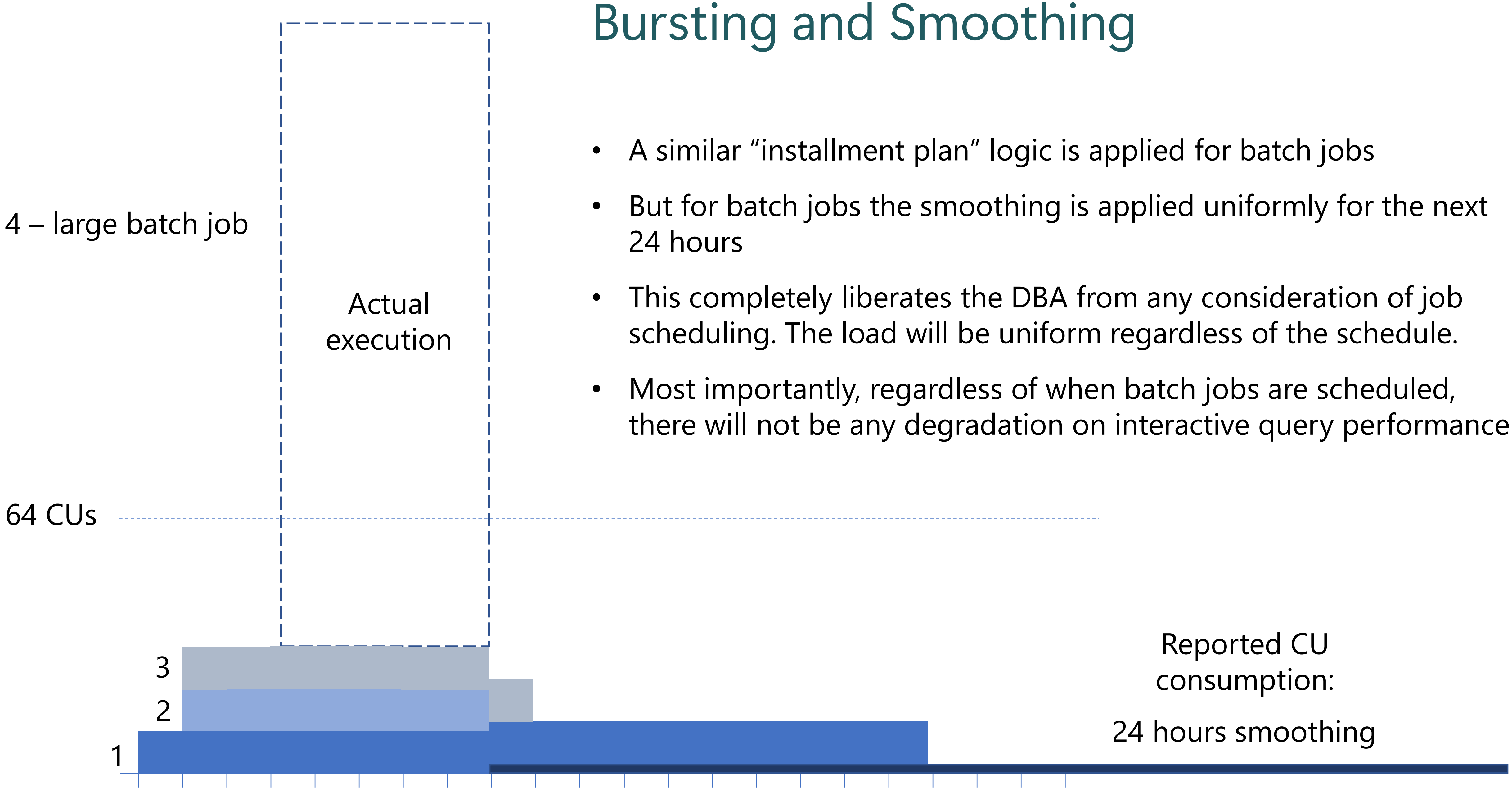
# Bursting and Smoothing



- Large batch processes traditionally were a threat to interactive queries as they would overload the compute resource
- DBAs traditionally had to carefully schedule these jobs to off-hours to avoid interference with interactive user experiences

# Bursting and Smoothing

- A similar “installment plan” logic is applied for batch jobs
- But for batch jobs the smoothing is applied uniformly for the next 24 hours
- This completely liberates the DBA from any consideration of job scheduling. The load will be uniform regardless of the schedule.
- Most importantly, regardless of when batch jobs are scheduled, there will not be any degradation on interactive query performance



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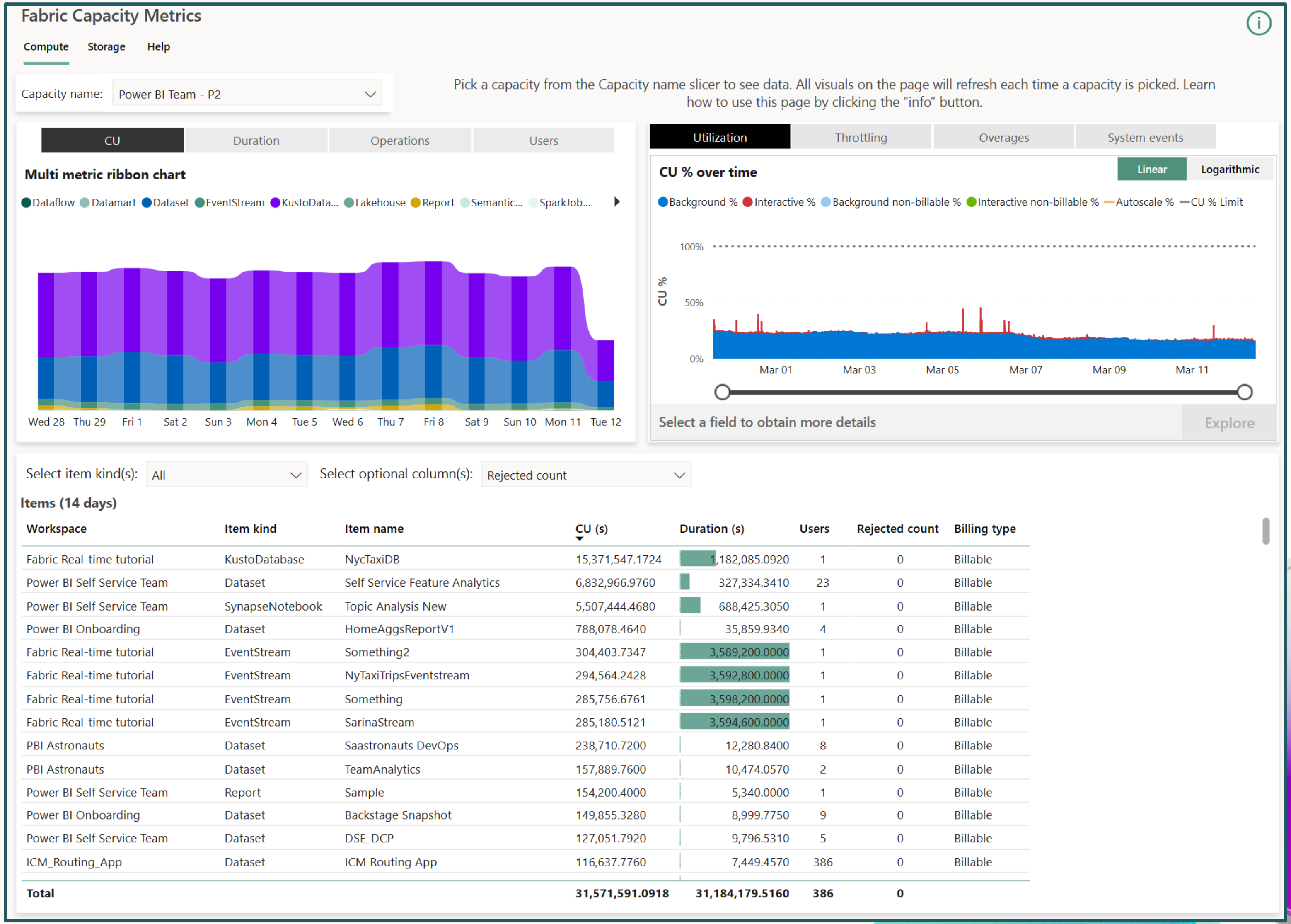
# Monitoring with Capacity Metrics

# Capacity Metrics

## Monitor Capacities and Plan capacity scale-up with confidence

- Tenant wide visibility into capacity usage for all Fabric experiences
- Identify resource usage trends and their impact to autoscale & throttling
- View preview workload usage alongside production workloads to make data-driven capacity sizing decisions



Fabric Capacity Metrics
Compute
Storage
Help
CU
Duration
Operations
Users
Multi metric ribbon chart
● Dataflow ● Datamart ● Dataset ● EventStream ● KustoData... ● Lakehouse ● Report ● Semantic... ● SparkJob...
Wed 28
Thu 29
Fri 1
Sat 2
Sun 3
Mon 4
Tue 5
Wed 6
Thu 7
Fri 8
Sat 9
Sun 10
Mon 11
Tue 12
Utilization
Throttling
Overages
System events
CU % over time
Linear
Logarithmic
● Background % ● Interactive % ● Background non-billable % ● Interactive non-billable % — Autoscale % — CU % Limit
CU %
100%
50%
0%
Mar 01
Mar 03
Mar 05
Mar 07
Mar 09
Mar 11
Select a field to obtain more details
Explore

Capacity name: Power BI Team - P2

Pick a capacity from the Capacity name slicer to see data. All visuals on the page will refresh each time a capacity is picked. Learn how to use this page by clicking the "info" button.

Select item kind(s): All

Select optional column(s): Rejected count

**Items (14 days)**

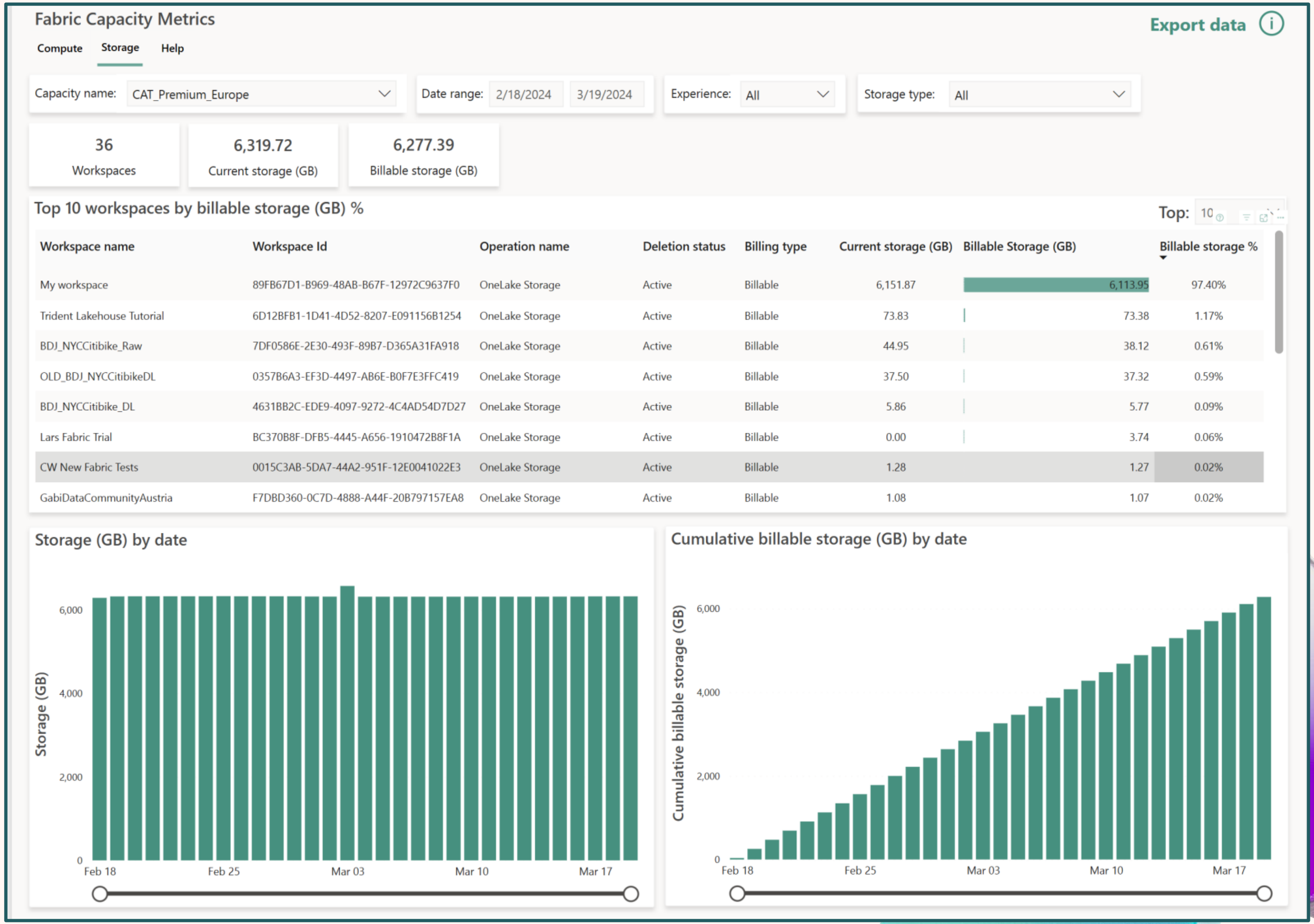
| Workspace | Item kind | Item name | CU (s) | Duration (s) | Users | Rejected count | Billing type |
|---|---|---|---|---|---|---|---|
| Fabric Real-time tutorial | KustoDatabase | NycTaxiDB | 15,371,547.1724 | 1,182,085.0920 | 1 | 0 | Billable |
| Power BI Self Service Team | Dataset | Self Service Feature Analytics | 6,832,966.9760 | 327,334.3410 | 23 | 0 | Billable |
| Power BI Self Service Team | SynapseNotebook | Topic Analysis New | 5,507,444.4680 | 688,425.3050 | 1 | 0 | Billable |
| Power BI Onboarding | Dataset | HomeAggsReportV1 | 788,078.4640 | 35,859.9340 | 4 | 0 | Billable |
| Fabric Real-time tutorial | EventStream | Something2 | 304,403.7347 | 3,589,200.0000 | 1 | 0 | Billable |
| Fabric Real-time tutorial | EventStream | NyTaxiTripsEventstream | 294,564.2428 | 3,592,800.0000 | 1 | 0 | Billable |
| Fabric Real-time tutorial | EventStream | Something | 285,756.6761 | 3,598,200.0000 | 1 | 0 | Billable |
| Fabric Real-time tutorial | EventStream | SarinaStream | 285,180.5121 | 3,594,600.0000 | 1 | 0 | Billable |
| PBI Astronauts | Dataset | Saastronauts DevOps | 238,710.7200 | 12,280.8400 | 8 | 0 | Billable |
| PBI Astronauts | Dataset | TeamAnalytics | 157,889.7600 | 10,474.0570 | 2 | 0 | Billable |
| Power BI Self Service Team | Report | Sample | 154,200.4000 | 5,340.0000 | 1 | 0 | Billable |
| Power BI Onboarding | Dataset | Backstage Snapshot | 149,855.3280 | 8,999.7750 | 9 | 0 | Billable |
| Power BI Self Service Team | Dataset | DSE_DCP | 127,051.7920 | 9,796.5310 | 5 | 0 | Billable |
| ICM_Routing_App | Dataset | ICM Routing App | 116,637.7760 | 7,449.4570 | 386 | 0 | Billable |
| **Total** | | | **31,571,591.0918** | **31,184,179.5160** | **386** | **0** | |

# Capacity Metrics

## Monitor OneLake consumption

Measure the trends of workspace storage consumption against capacity limits, by day or hour

Reconcile costs with internal chargeback processes



Fabric Capacity Metrics

Compute | Storage | Help

Export data

Capacity name: CAT_Premium_Europe

Date range: 2/18/2024 3/19/2024

Experience: All

Storage type: All

36 Workspaces

6,319.72 Current storage (GB)

6,277.39 Billable storage (GB)

Top 10 workspaces by billable storage (GB) %

Top: 10

| Workspace name | Workspace Id | Operation name | Deletion status | Billing type | Current storage (GB) | Billable Storage (GB) | Billable storage % |
|---|---|---|---|---|---|---|---|
| My workspace | 89FB67D1-B969-48AB-B67F-12972C9637F0 | OneLake Storage | Active | Billable | 6,151.87 | 6,113.95 | 97.40% |
| Trident Lakehouse Tutorial | 6D12BFB1-1D41-4D52-8207-E091156B1254 | OneLake Storage | Active | Billable | 73.83 | 73.38 | 1.17% |
| BDJ_NYCCitibike_Raw | 7DF0586E-2E30-493F-89B7-D365A31FA918 | OneLake Storage | Active | Billable | 44.95 | 38.12 | 0.61% |
| OLD_BDJ_NYCCitibikeDL | 0357B6A3-EF3D-4497-AB6E-B0F7E3FFC419 | OneLake Storage | Active | Billable | 37.50 | 37.32 | 0.59% |
| BDJ_NYCCitibike_DL | 4631BB2C-EDE9-4097-9272-4C4AD54D7D27 | OneLake Storage | Active | Billable | 5.86 | 5.77 | 0.09% |
| Lars Fabric Trial | BC370B8F-DFB5-4445-A656-1910472B8F1A | OneLake Storage | Active | Billable | 0.00 | 3.74 | 0.06% |
| CW New Fabric Tests | 0015C3AB-5DA7-44A2-951F-12E0041022E3 | OneLake Storage | Active | Billable | 1.28 | 1.27 | 0.02% |
| GabiDataCommunityAustria | F7DBD360-0C7D-4888-A44F-20B797157EA8 | OneLake Storage | Active | Billable | 1.08 | 1.07 | 0.02% |

Storage (GB) by date

Cumulative billable storage (GB) by date

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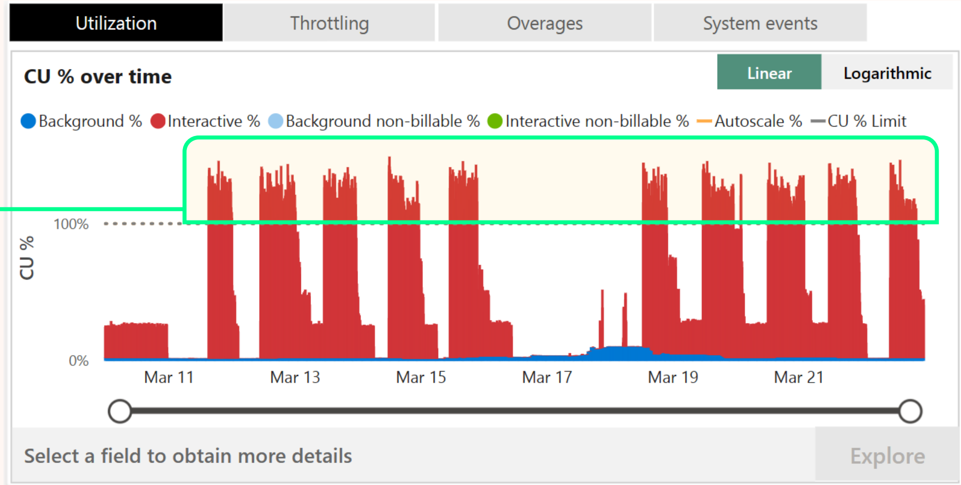
# Capacity Throttling Policies

# Throttling intro

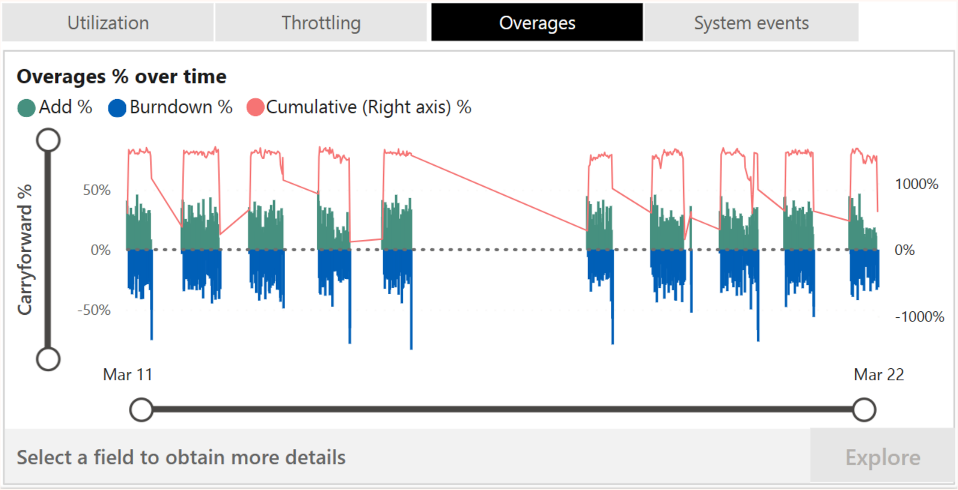
- Throttling is the platform policy for managing consumption that exceeds throughput is provided by SKU choice

- When workloads exceed the throughput of a capacity a cumulative debt is tracked to be burned down

- Cumulative debt is used to determine throttling policies and is burned down when resources are free

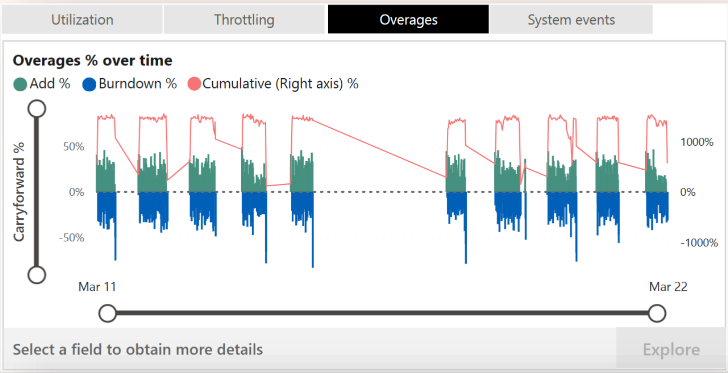


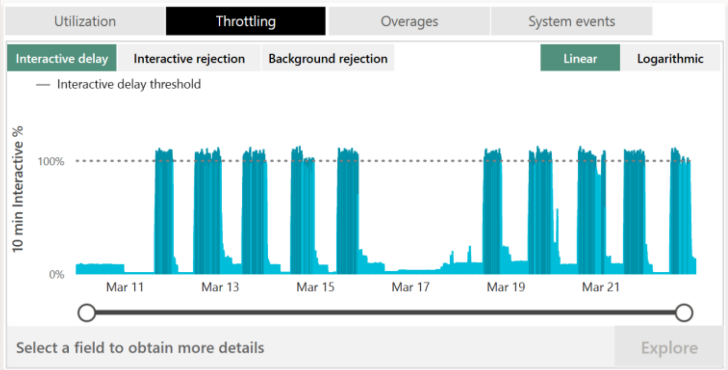
| Overage Operation | Description |
|---|---|
| 🟩 Overages - Added | • Timepoint when job requests exceed the throughput of a capacity, overages are was added to the cumulative buffer to burn down.<br>• This graph simplifies identification of the optimal timepoint to load timepoint drill to analyze the user operations that contributed to an overage. |
| 🟦 Overages - Burndown | • Overages being reconciled when future capacity is free to burn down |
| 🟥 Overages - Cumulative | • The total amount of queued work on the capacity to be burned down in the future when the capacity is not fully utilized |



# Capacity throttling evolution for Fabric

- For Fabric, throttling policies were refined to deliver multiple benefits
  - **Reduced throttling** for capacities that only experience occasional spikes
  - **Added overage protection** – rejection policies prevent overloaded capacities from irrecoverable overload
  - **Optimizations for long-running jobs:** We're optimizing the platform for long-running jobs, so if a job exceeds capacity limits, it will run to completion and the overage will be burned down against future capacity





| Smoothed Capacity - Future Use | Platform Policy | Customer Impact |
|---|---|---|
| <= 10m | Overage Protection | Jobs can consume 10 minutes of future capacity use without throttling |
| > 10m → <= 60m | Interactive Delay | User requested interactive type jobs will be throttled |
| > 60m → <= 24h | Interactive Rejection | User requested interactive type jobs will be rejected |
| > 24h | Background Rejection | User Scheduled background jobs will be rejected from execution |

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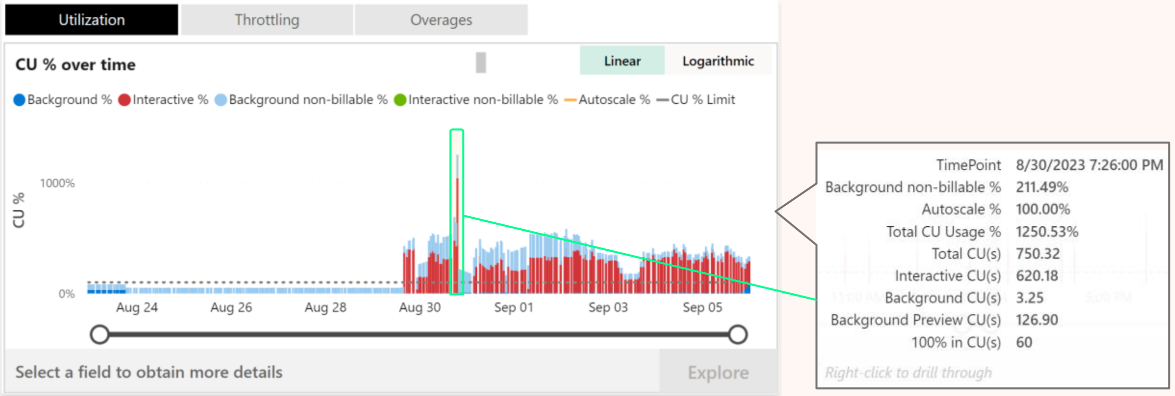
# Capacity Planning with Capacity Metrics

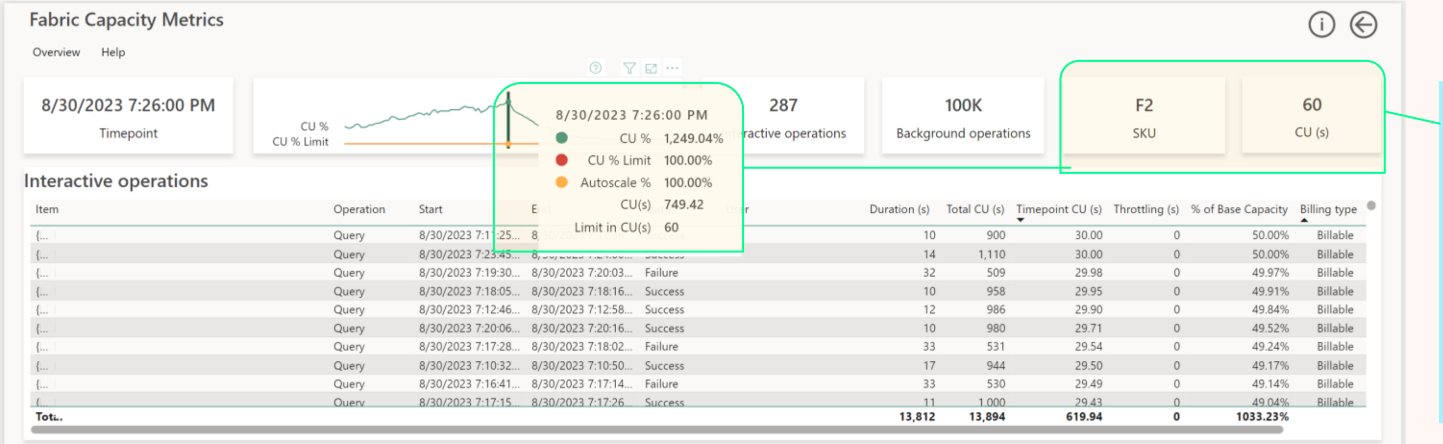
# Capacity planning case study - measurement

Start with a test or trial capacity to evaluate the load of specific Fabric Experiences i.e., Power BI Datasets, Spark Notebooks or a Datawarehouse


Utilization
Throttling
Overages
CU % over time
Linear
Logarithmic
● Background % ● Interactive % ● Background non-billable % ● Interactive non-billable % — Autoscale % — CU % Limit
CU %
1000%
0%
Aug 24
Aug 26
Aug 28
Aug 30
Sep 01
Sep 03
Sep 05
Select a field to obtain more details
Explore
Right-click to drill through

TimePoint 8/30/2023 7:26:00 PM
Background non-billable % 211.49%
Autoscale % 100.00%
Total CU Usage % 1250.53%
Total CU(s) 750.32
Interactive CU(s) 620.18
Background CU(s) 3.25
Background Preview CU(s) 126.90
100% in CU(s) 60

If usage is above the current capacity limits , choose the desired utilization rate to accommodate via capacity scale up



Fabric Capacity Metrics

8/30/2023 7:26:00 PM
Timepoint

8/30/2023 7:26:00 PM
CU % 1,249.04%
CU % Limit 100.00%
Autoscale % 100.00%
CU(s) 749.42
Limit in CU(s) 60

287
Interactive operations

100K
Background operations

F2
SKU

60
CU (s)

Interactive operations

| Item | Operation | Start | End | Status | User | Duration (s) | Total CU (s) | Timepoint CU (s) | Throttling (s) | % of Base Capacity | Billing type |
|---|---|---|---|---|---|---|---|---|---|---|---|
| {... | Query | 8/30/2023 7:11:25... | 8/30/2023 7:11:56... | Success | | 10 | 900 | 30.00 | 0 | 50.00% | Billable |
| {... | Query | 8/30/2023 7:23:45... | 8/30/2023 7:24:00... | Success | | 14 | 1,110 | 30.00 | 0 | 50.00% | Billable |
| {... | Query | 8/30/2023 7:19:30... | 8/30/2023 7:20:03... | Failure | | 32 | 509 | 29.98 | 0 | 49.97% | Billable |
| {... | Query | 8/30/2023 7:18:05... | 8/30/2023 7:18:16... | Success | | 10 | 958 | 29.95 | 0 | 49.91% | Billable |
| {... | Query | 8/30/2023 7:12:46... | 8/30/2023 7:12:58... | Success | | 12 | 986 | 29.90 | 0 | 49.84% | Billable |
| {... | Query | 8/30/2023 7:20:06... | 8/30/2023 7:20:16... | Success | | 10 | 980 | 29.71 | 0 | 49.52% | Billable |
| {... | Query | 8/30/2023 7:17:28... | 8/30/2023 7:18:02... | Failure | | 33 | 531 | 29.54 | 0 | 49.24% | Billable |
| {... | Query | 8/30/2023 7:10:32... | 8/30/2023 7:10:50... | Success | | 17 | 944 | 29.50 | 0 | 49.17% | Billable |
| {... | Query | 8/30/2023 7:16:41... | 8/30/2023 7:17:14... | Failure | | 33 | 530 | 29.49 | 0 | 49.14% | Billable |
| {... | Query | 8/30/2023 7:17:15... | 8/30/2023 7:17:26... | Success | | 11 | 1,000 | 29.43 | 0 | 49.04% | Billable |
| **Tot..** | | | | | | **13,812** | **13,894** | **619.94** | **0** | **1033.23%** | |

Load Capacity Metrics timepoint drill to analyze :

- Total CU's consumed : 749 CU(s)
- Capacity Size : (F2)
- CU(s) available on your capacity : 60 CU(s)

# Capacity planning case study – SKU selection

To accommodate a 749 CU(s) load the admin can purchase an F32 capacity providing 960 CU(s) of throughput

## Universal Compute Capacities SKU Sizing

| SKU | Capacity Units (CU) | CU's (per 30s) | Power BI SKU | Power BI V-cores |
|---|---|---|---|---|
| F2 | 2 | 60 | - | 0.25 |
| F4 | 4 | 120 | - | 0.5 |
| F8 | 8 | 240 | A1 | 1 |
| F16 | 16 | 480 | A2 | 2 |
| F32 | 32 | 960 | A3 | 4 |
| F64 | 64 | 1920 | P1 | 8 |
| F128 | 128 | 3840 | P2 | 16 |
| F256 | 256 | 7680 | P3 | 32 |
| F512 | 512 | 15360 | P4 | 64 |
| F1024 | 1024 | 30720 | P5 | 128 |
| F2048 | 2048 | 61440 | - | 256 |

# Pausing and Resuming Capacities

# Introduction to Pausing and Resuming Capacities

## Overview and Benefits

**Pause and Resume** lets you manage compute costs on F SKU capacities by suspending the execution of all workloads running on the capacity

- When a capacity administrator pauses a capacity:

Workloads stop execution

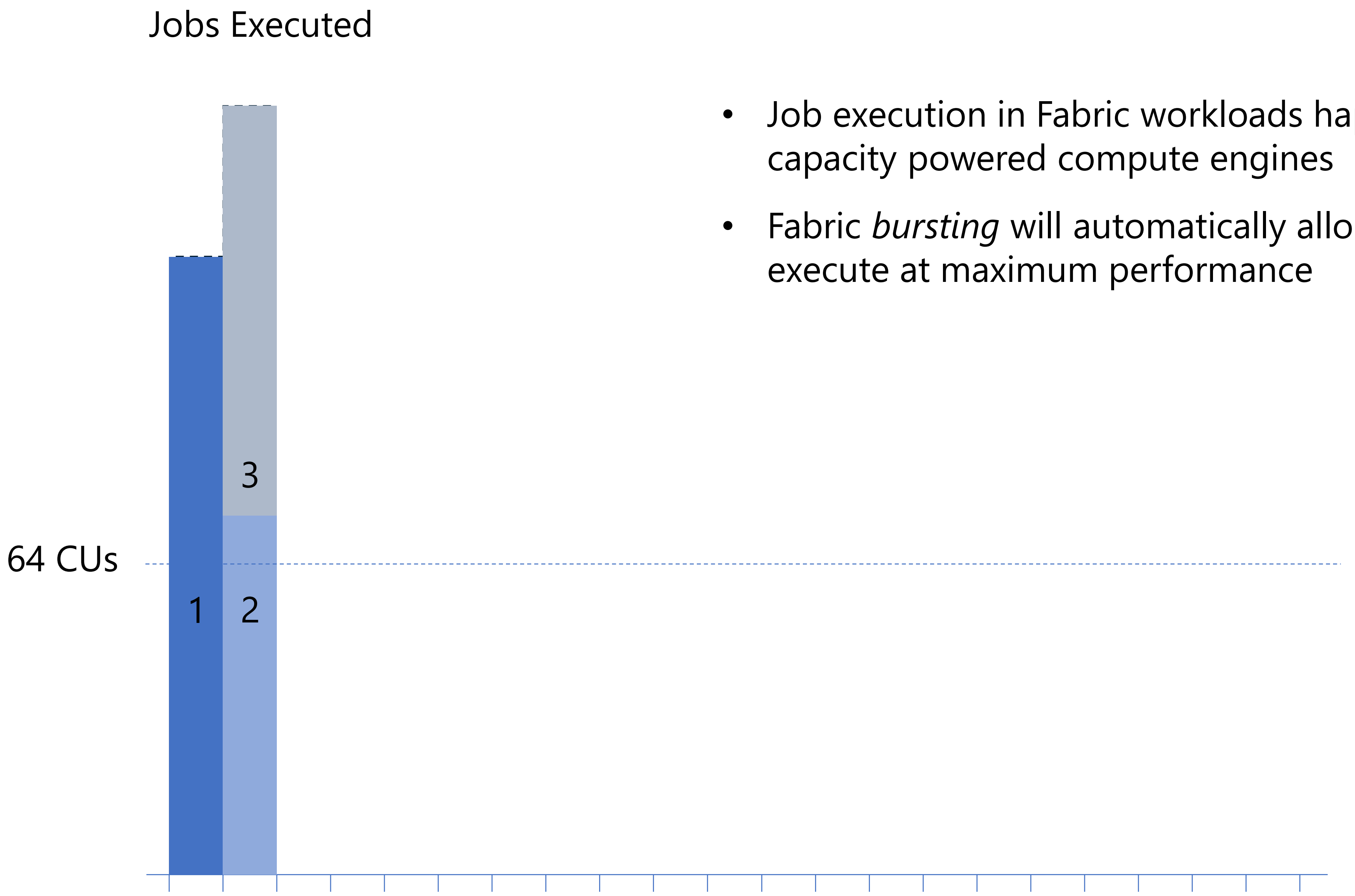
New requests are not run

Smoothed usage will be reconciled

(details in the next demo)

**Note:** OneLake storage will remain active and billable while  a capacity is paused

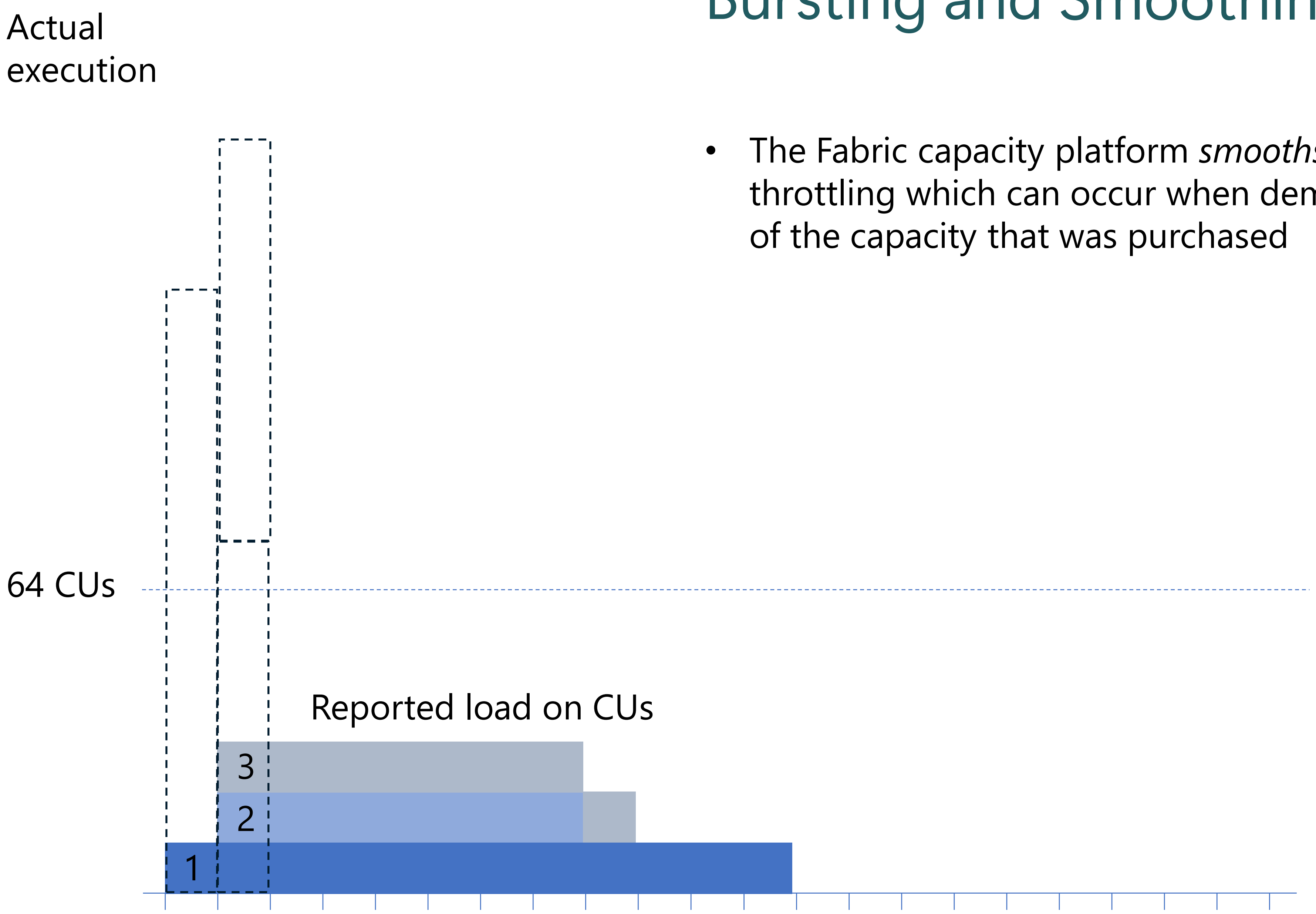
# Bursting and Smoothing



- Job execution in Fabric workloads happens on-demand via capacity powered compute engines
- Fabric *bursting* will automatically allocate resources as needed to execute at maximum performance

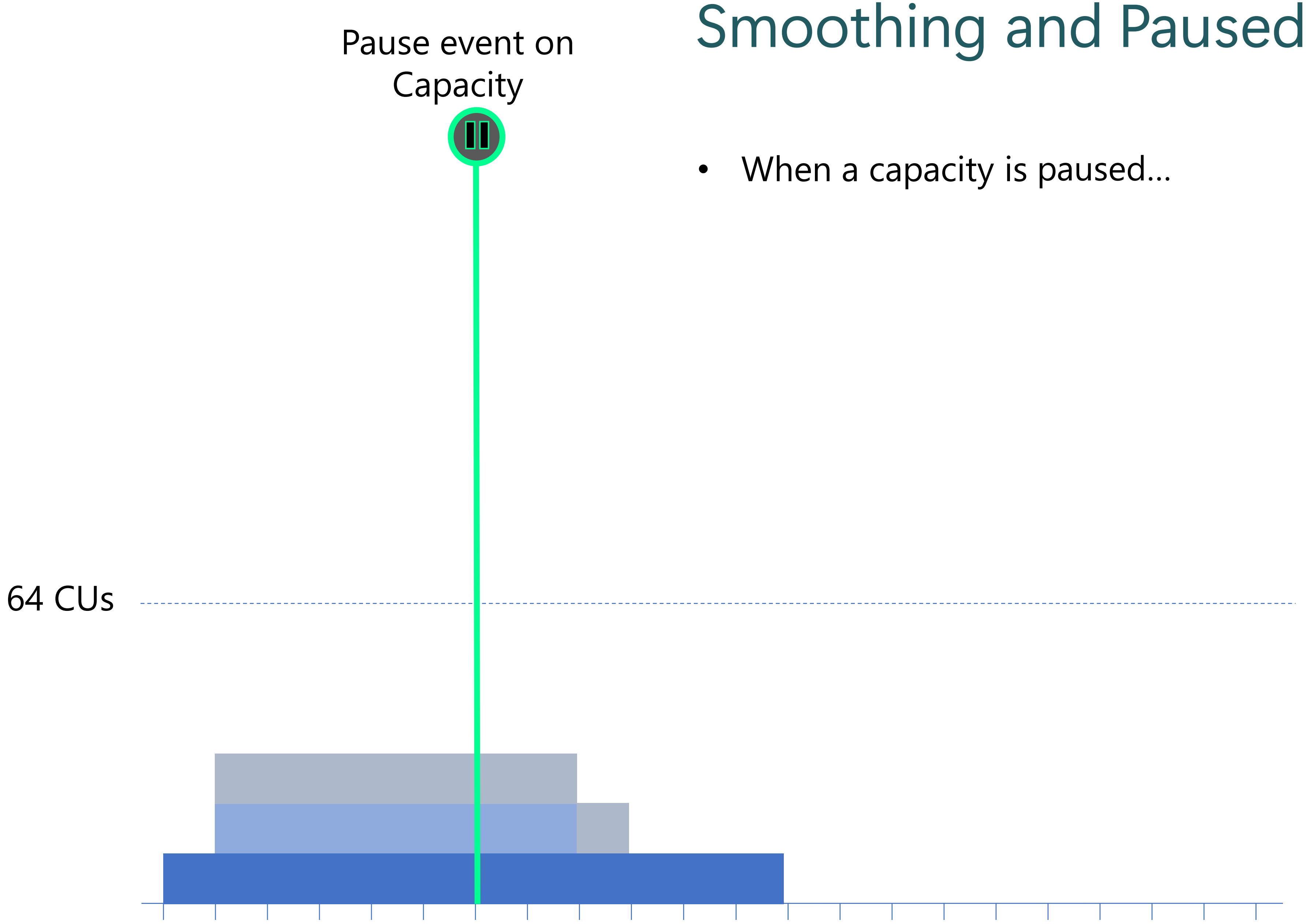
# Bursting and Smoothing

- The Fabric capacity platform *smooths* usage out to reduce throttling which can occur when demand exceeds the throughput of the capacity that was purchased



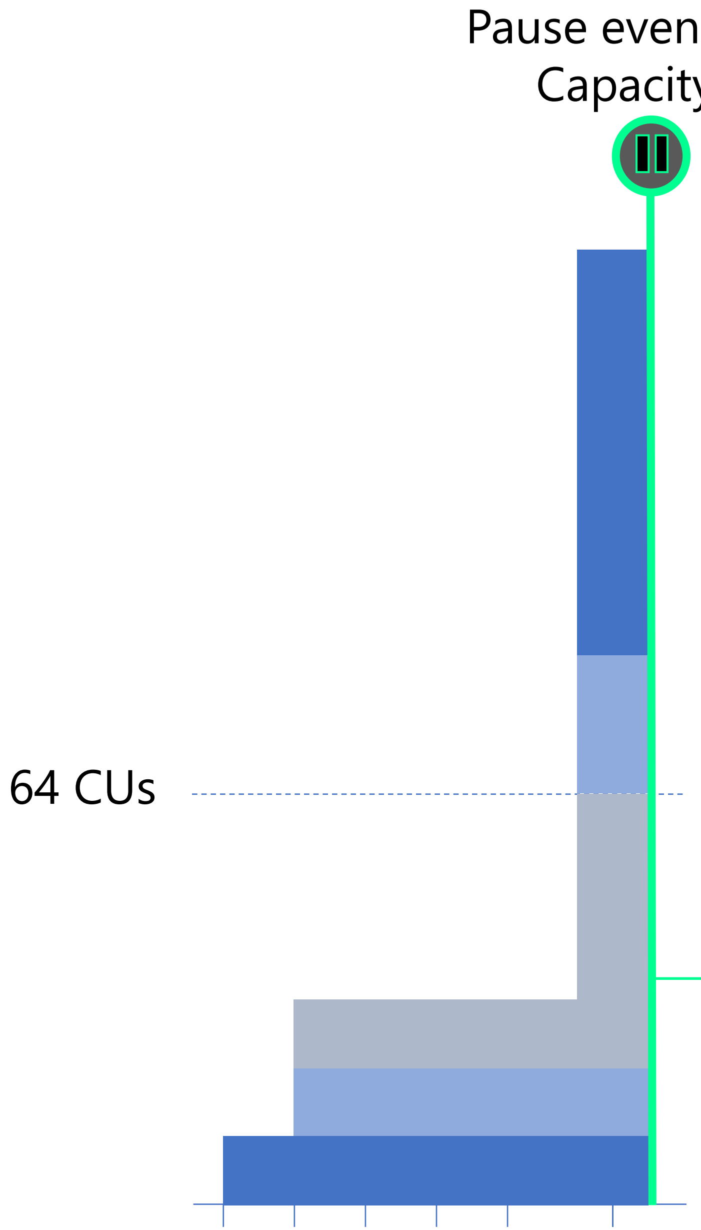
# Smoothing and Paused Capacities

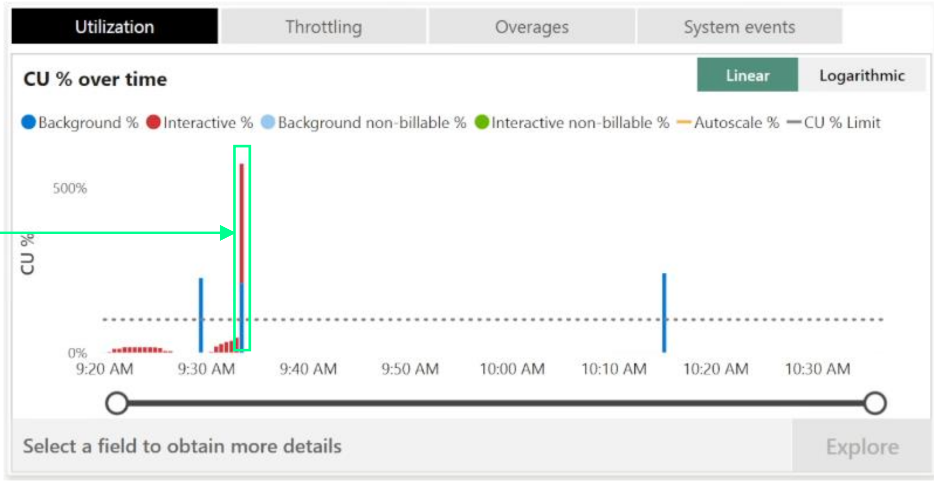
- When a capacity is paused…



# Smoothing and Paused Capacities

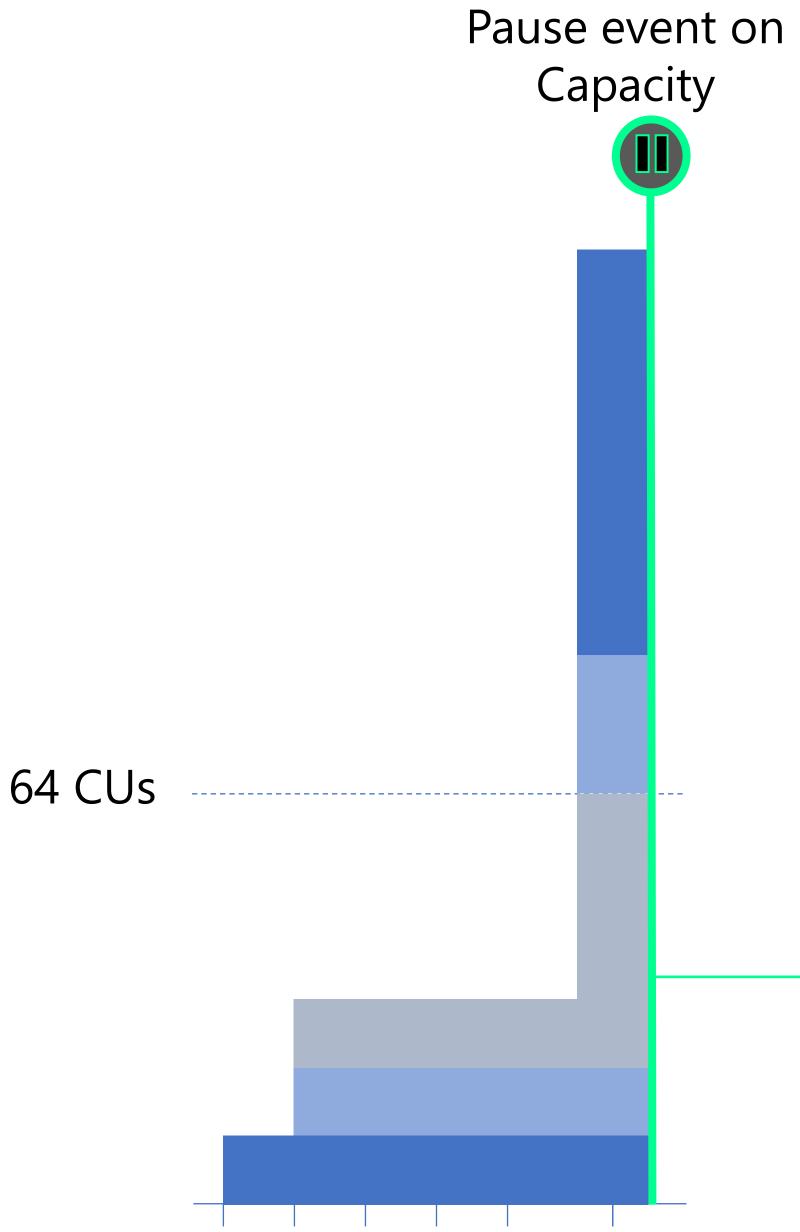
- When a capacity is paused…
- Usage that was smoothed into the future will be “reconciled” and charged against the capacity at the timestamp the capacity was paused
- Reconciled usage will show up as a spike in capacity metrics



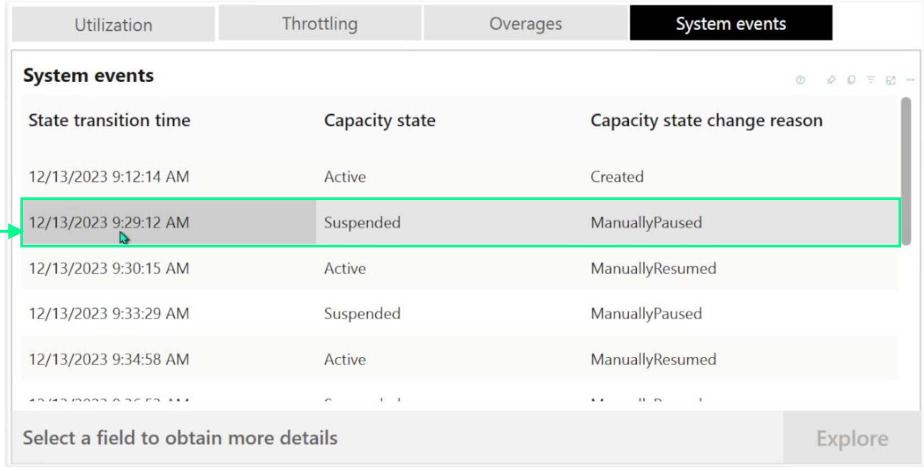


Select a field to obtain more details

# Smoothing and Paused Capacities



- When a capacity is paused…
- Usage that was smoothed into the future will be “reconciled” and charged against the capacity at the timestamp the capacity was paused
- Pause events can be viewed in the new System events tab

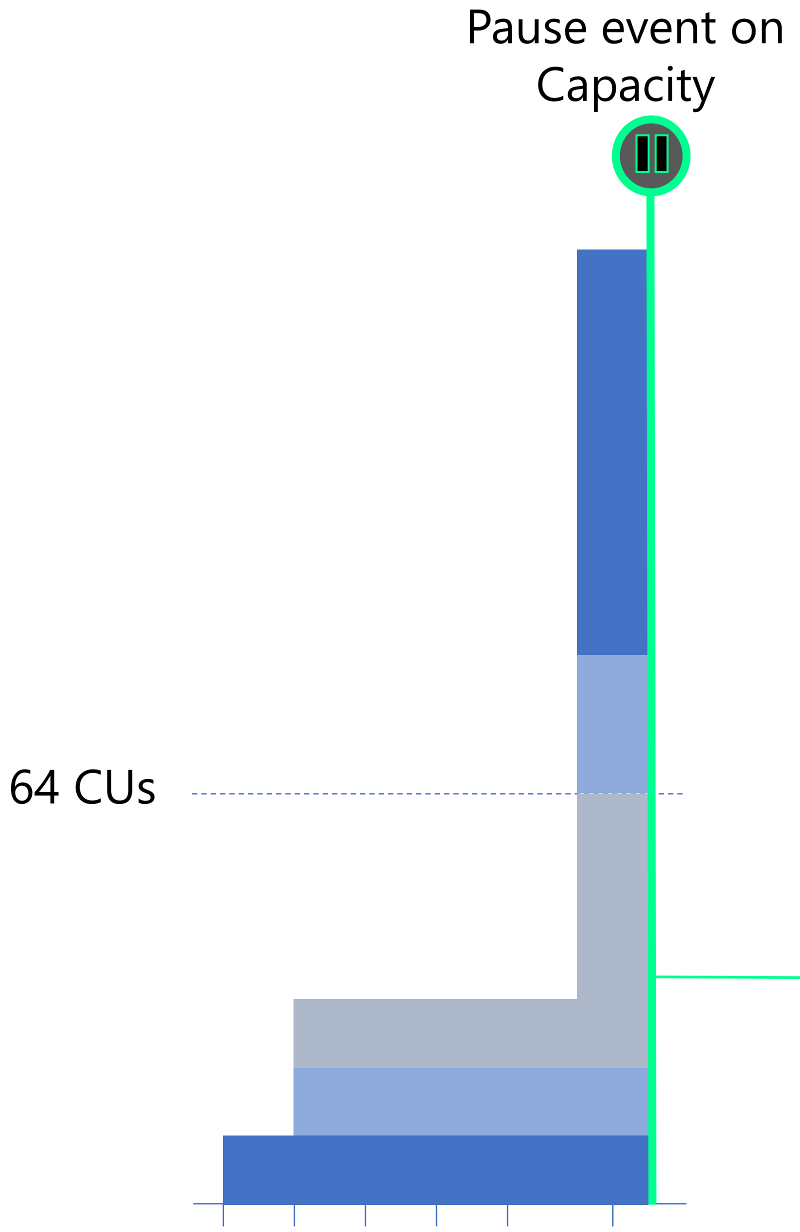


**System events**

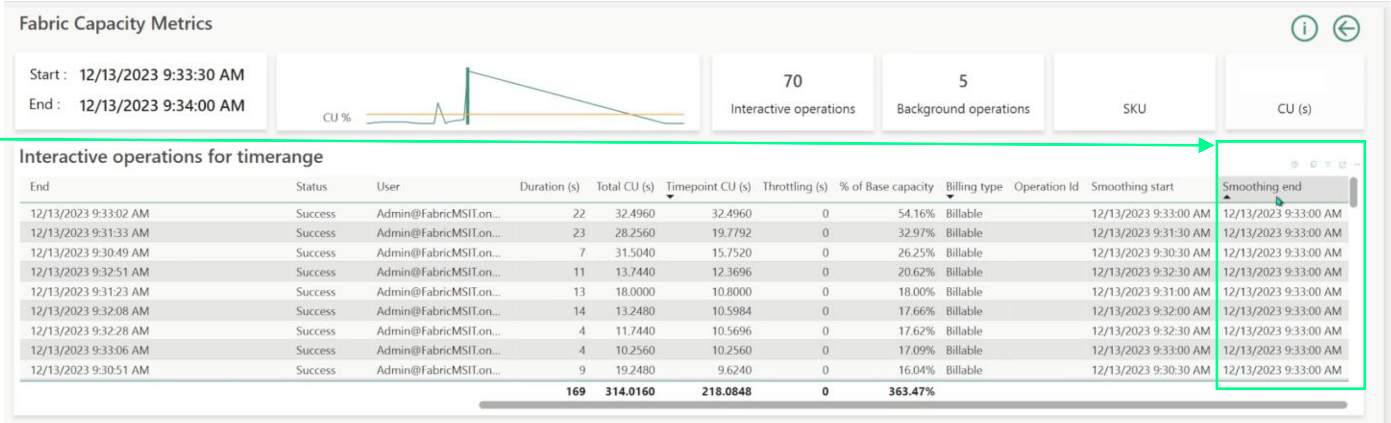
| State transition time | Capacity state | Capacity state change reason |
|---|---|---|
| 12/13/2023 9:12:14 AM | Active | Created |
| 12/13/2023 9:29:12 AM | Suspended | ManuallyPaused |
| 12/13/2023 9:30:15 AM | Active | ManuallyResumed |
| 12/13/2023 9:33:29 AM | Suspended | ManuallyPaused |
| 12/13/2023 9:34:58 AM | Active | ManuallyResumed |

Select a field to obtain more details

# Smoothing and Paused Capacities



- When a capacity is paused…
- Usage that was smoothed into the future will be “reconciled” and charged against the capacity at the timestamp the capacity was paused
- Pause events timestamp is shown in the smoothing end field in timepoint drill views



Fabric Capacity Metrics

Start : 12/13/2023 9:33:30 AM

End : 12/13/2023 9:34:00 AM

70 Interactive operations

5 Background operations

SKU

CU (s)

Interactive operations for timerange

| End | Status | User | Duration (s) | Total CU (s) | Timepoint CU (s) | Throttling (s) | % of Base capacity | Billing type | Operation Id | Smoothing start | Smoothing end |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/13/2023 9:33:02 AM | Success | Admin@FabricMSIT.on... | 22 | 32.4960 | 32.4960 | 0 | 54.16% | Billable | | 12/13/2023 9:33:00 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:31:33 AM | Success | Admin@FabricMSIT.on... | 23 | 28.2560 | 19.7792 | 0 | 32.97% | Billable | | 12/13/2023 9:31:30 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:30:49 AM | Success | Admin@FabricMSIT.on... | 7 | 31.5040 | 15.7520 | 0 | 26.25% | Billable | | 12/13/2023 9:30:30 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:32:51 AM | Success | Admin@FabricMSIT.on... | 11 | 13.7440 | 12.3696 | 0 | 20.62% | Billable | | 12/13/2023 9:32:30 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:31:23 AM | Success | Admin@FabricMSIT.on... | 13 | 18.0000 | 10.8000 | 0 | 18.00% | Billable | | 12/13/2023 9:31:00 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:32:08 AM | Success | Admin@FabricMSIT.on... | 14 | 13.2480 | 10.5984 | 0 | 17.66% | Billable | | 12/13/2023 9:32:00 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:32:28 AM | Success | Admin@FabricMSIT.on... | 4 | 11.7440 | 10.5696 | 0 | 17.62% | Billable | | 12/13/2023 9:32:30 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:33:06 AM | Success | Admin@FabricMSIT.on... | 4 | 10.2560 | 10.2560 | 0 | 17.09% | Billable | | 12/13/2023 9:33:00 AM | 12/13/2023 9:33:00 AM |
| 12/13/2023 9:30:51 AM | Success | Admin@FabricMSIT.on... | 9 | 19.2480 | 9.6240 | 0 | 16.04% | Billable | | 12/13/2023 9:30:30 AM | 12/13/2023 9:33:00 AM |
| | | | 169 | 314.0160 | 218.0848 | 0 | 363.47% | | | | |

Microsoft Fabric
COMMUNITY CONFERENCE

# Bonus: Tips and Tricks for capacity management and monitoring

# *“Fabric leverages the Power BI capacity model to bring even more powerful tools to your organization”*

😎 Citizen Devs

😁 BI Specialists

😄 Data Scientists

😃 Data Engineers

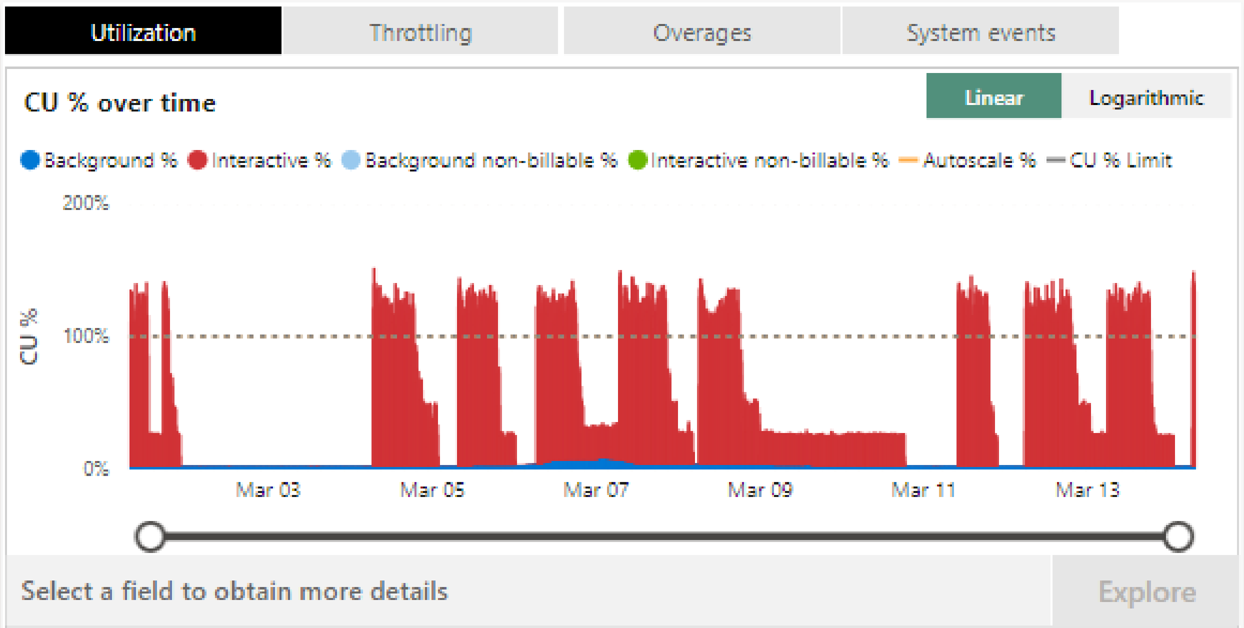
😊 DW/SQL Professionals

🤔 😮 😫 😠 😊 Capacity Admins

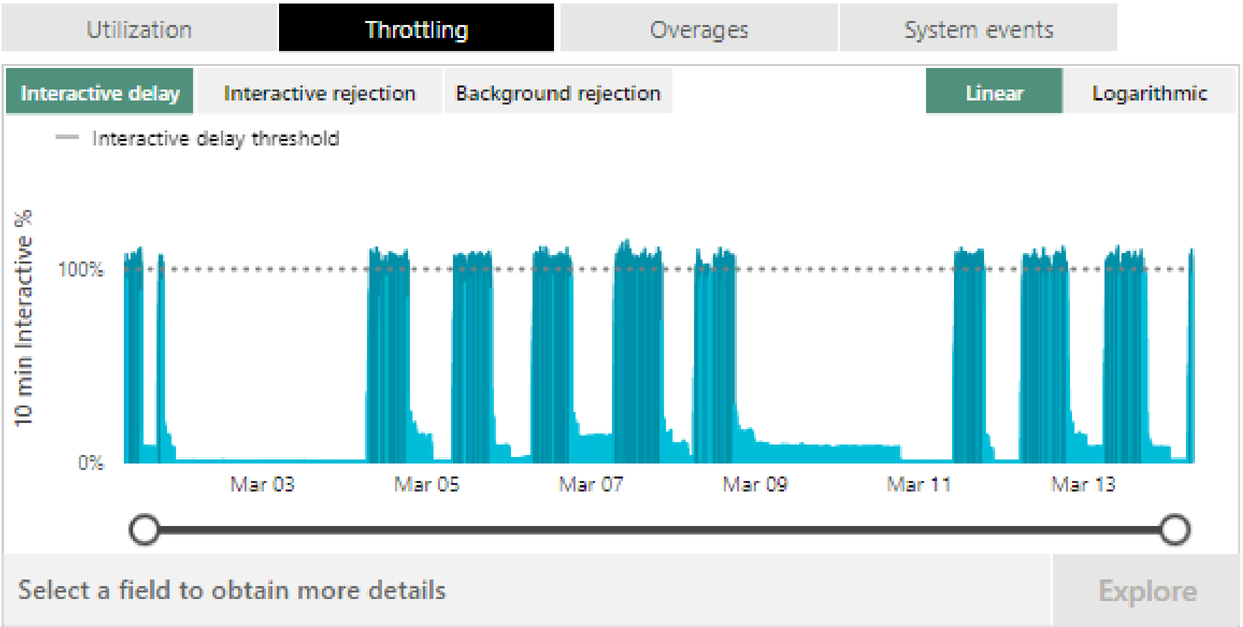
🙂 Business Leaders

😆 Employees (Content Consumers)

# My capacity is being throttled! What can I do?



Select a field to obtain more details



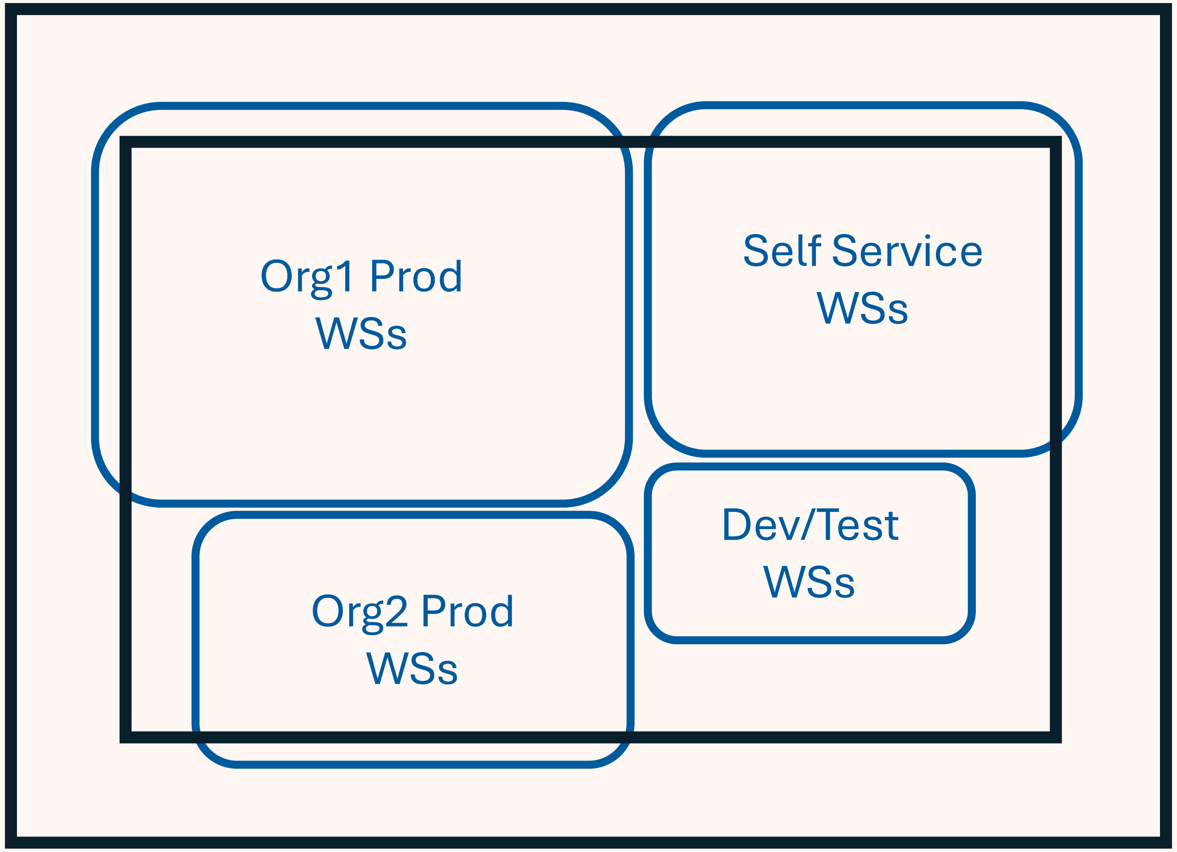
Select a field to obtain more details

Over 100% utilization doesn't always result in throttling

No penalty until you hit 100% on one of the throttling tabs

Note: For F SKU, if throttled, you can pause/resume to pay now and clear the carry forward, but that is not a long-term solution

# When Capacity Units Run Out
# Option 1 – Scale Up



WSs = Workspaces Capacity

Options to add compute

- Move to a bigger P SKU or RI F SKU
- Turn on autoscale (P SKU)
- Manual/Dynamic change size (F SKU)

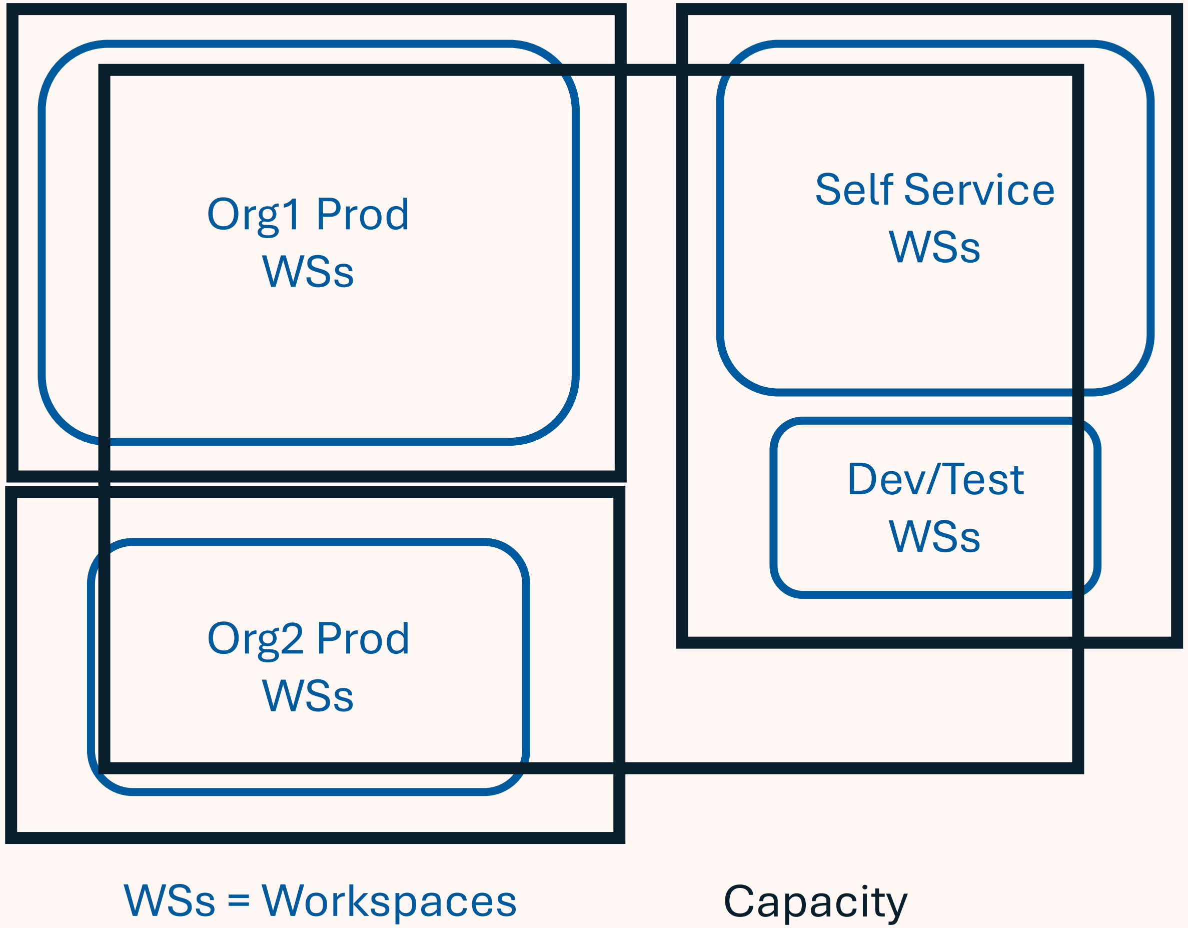
Pros

- Add CUs for all items
- Easy

Cons

- Cost
- Bad actors (items with unintentionally high CU burn) can still be a problem

# When Capacity Units Run Out
# Option 2 – Scale Out



Options

- Create multiple smaller P or F SKUs based on organization, type of work, etc.

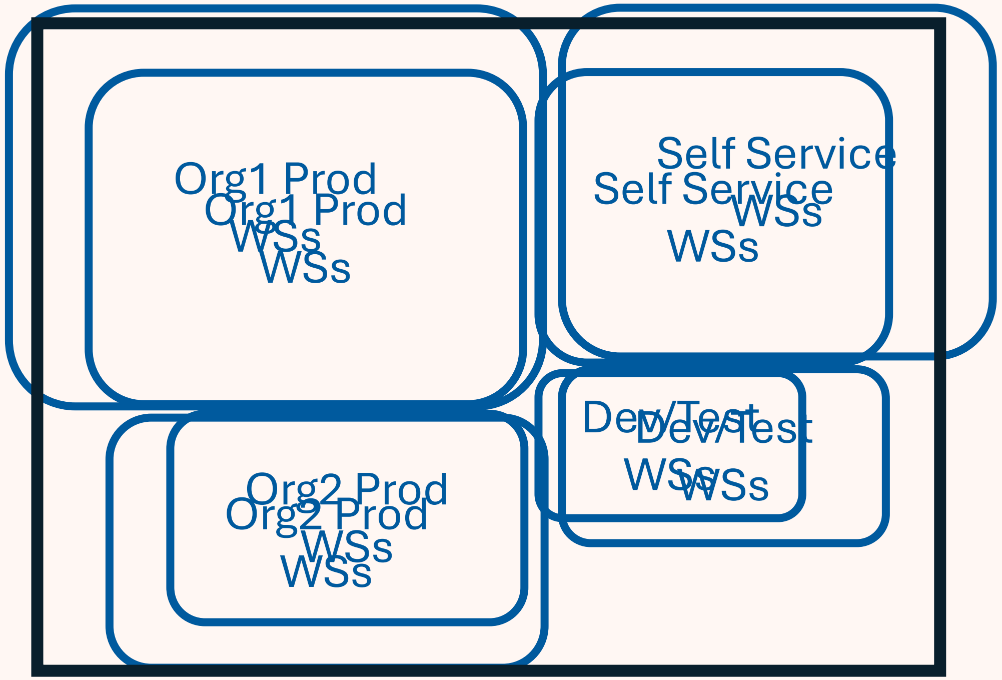
Pros

- Easy
- Provides some isolation from bad actors (items with unintentionally high CU burn)
- Flexibility in capacity settings/governance

Cons

- Cost
- High CU items have increased chance of throttling

# When Capacity Units Run Out
# Option 3 – Optimize



WSs = Workspaces

Capacity

Approach

- Work with content creators to follow best practices and reduce CU consumption

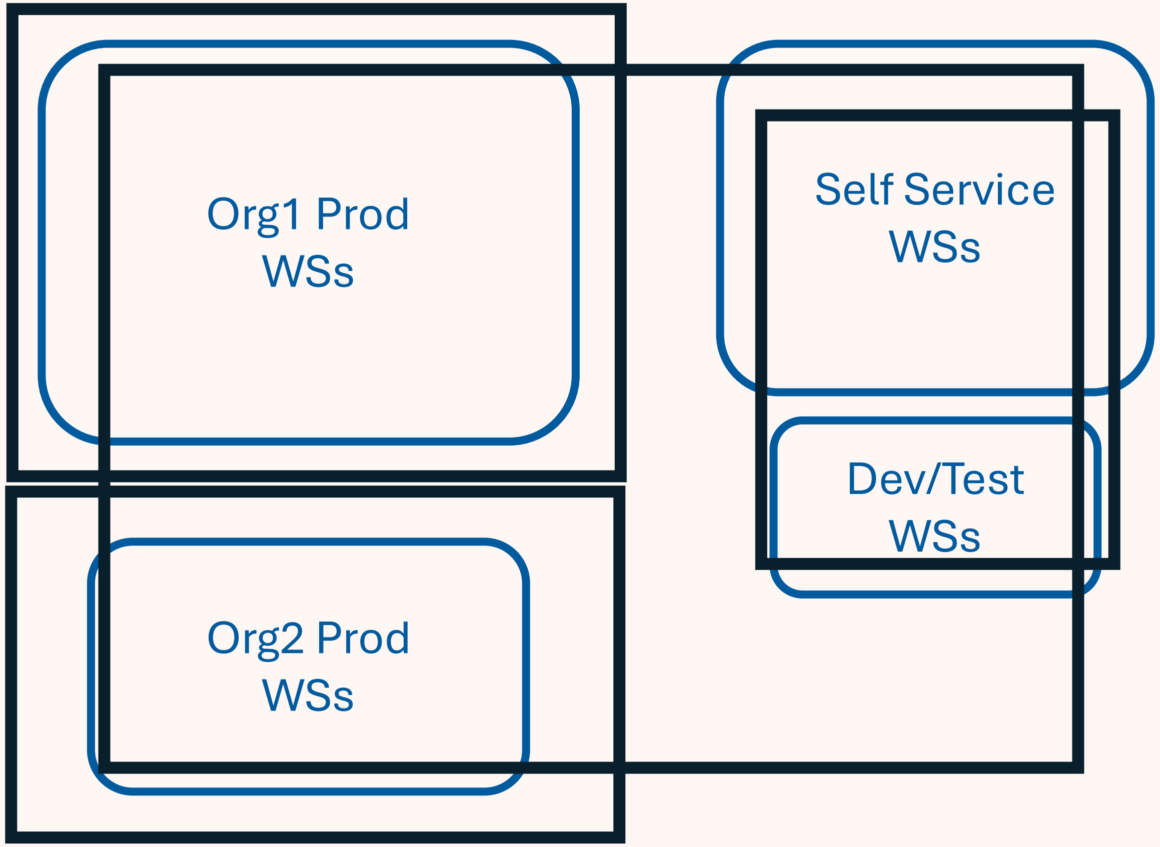
Pros

- Avoids increased cost
- Learning carries over to future content

Cons

- Can be difficult/time consuming

# When Capacity Units Run Out
# Option 4 – Isolate



WSs = Workspaces

Capacity

Approach

- Provide isolated capacity for key items built by experienced developers

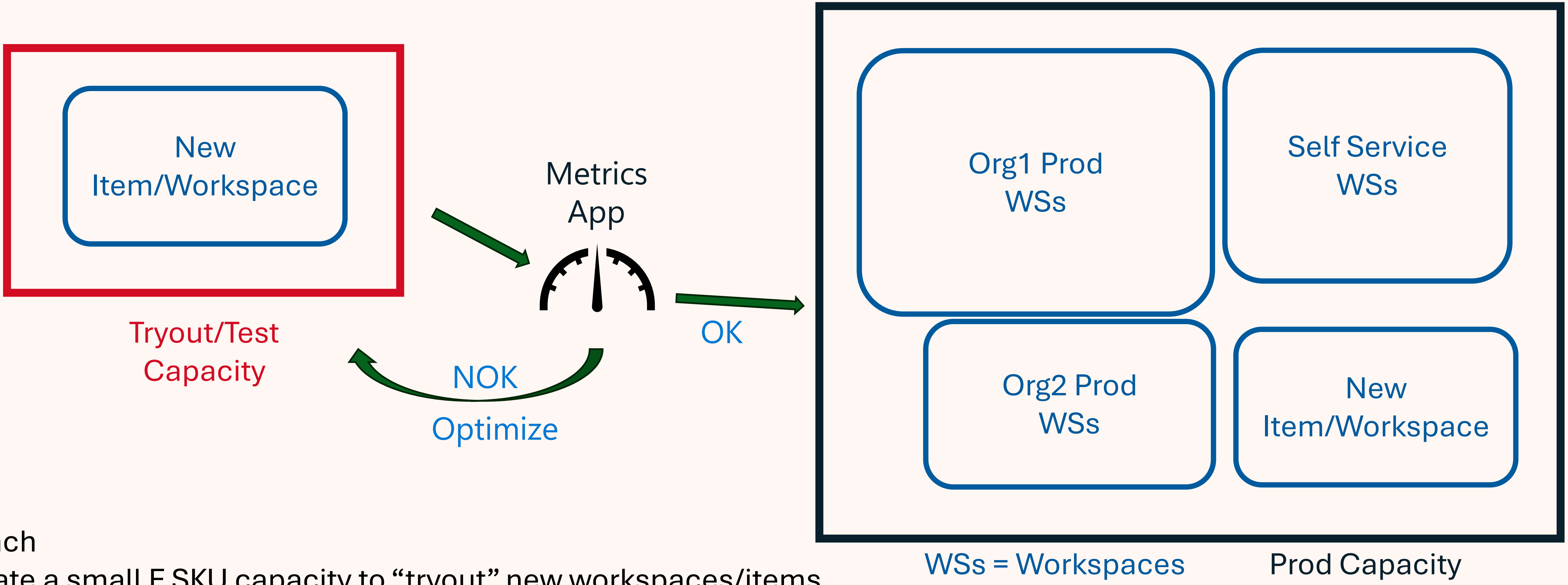
Pros

- Easy
- Provides isolation from items built by inexperienced developers and/or rapid unplanned usage growth
- Flexibility in capacity settings/governance

Cons

- Cost
- May lead to frustration of lower priority content developers/consumers

# Isolation Strategy #4a – Tryout Capacity



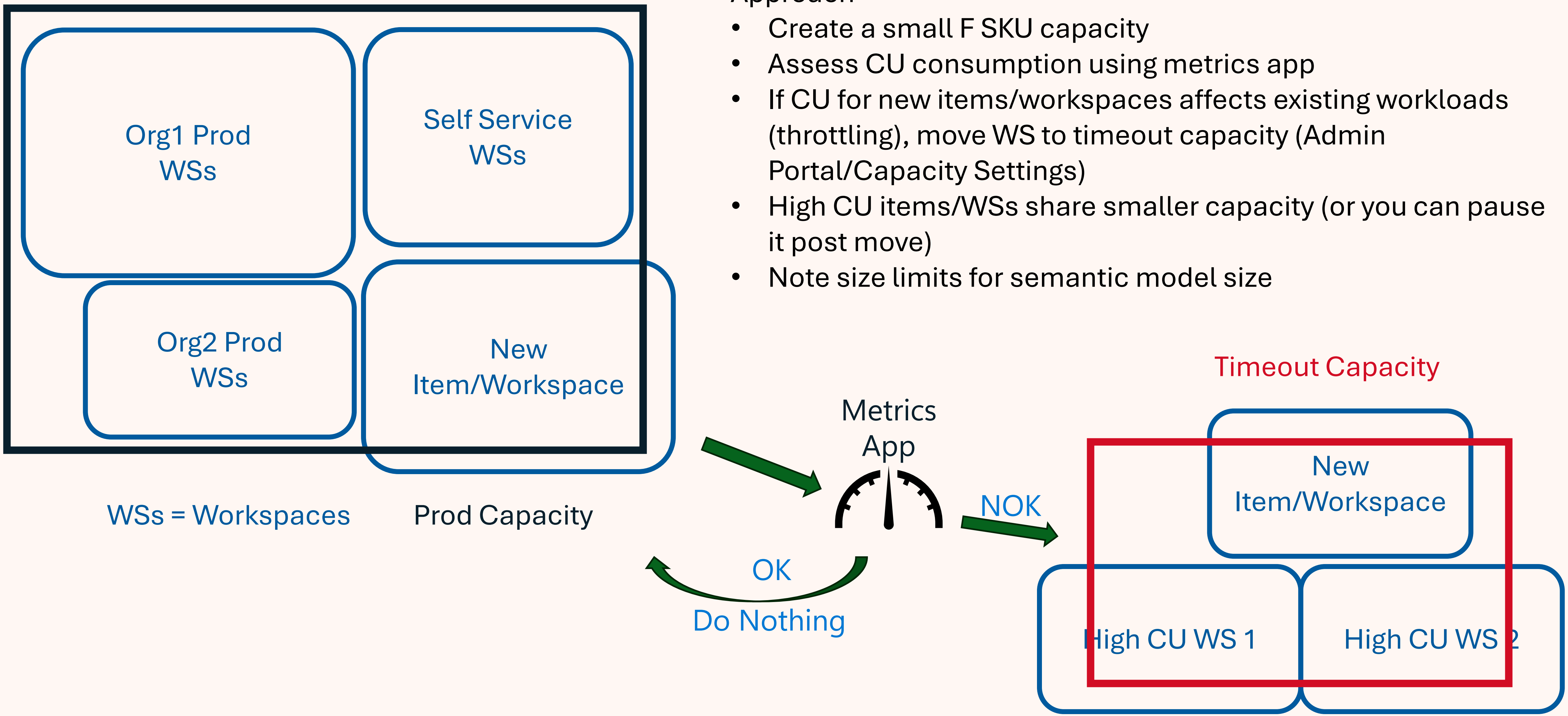
Approach

- Create a small F SKU capacity to “tryout” new workspaces/items
- Assess CU consumption using metrics app
- If acceptable, move to prod capacity
- If not, optimize
- Pause tryout capacity when not in use, if possible
- Note size limits for semantic model size

# Isolation Strategy #4b – Timeout Capacity

Approach

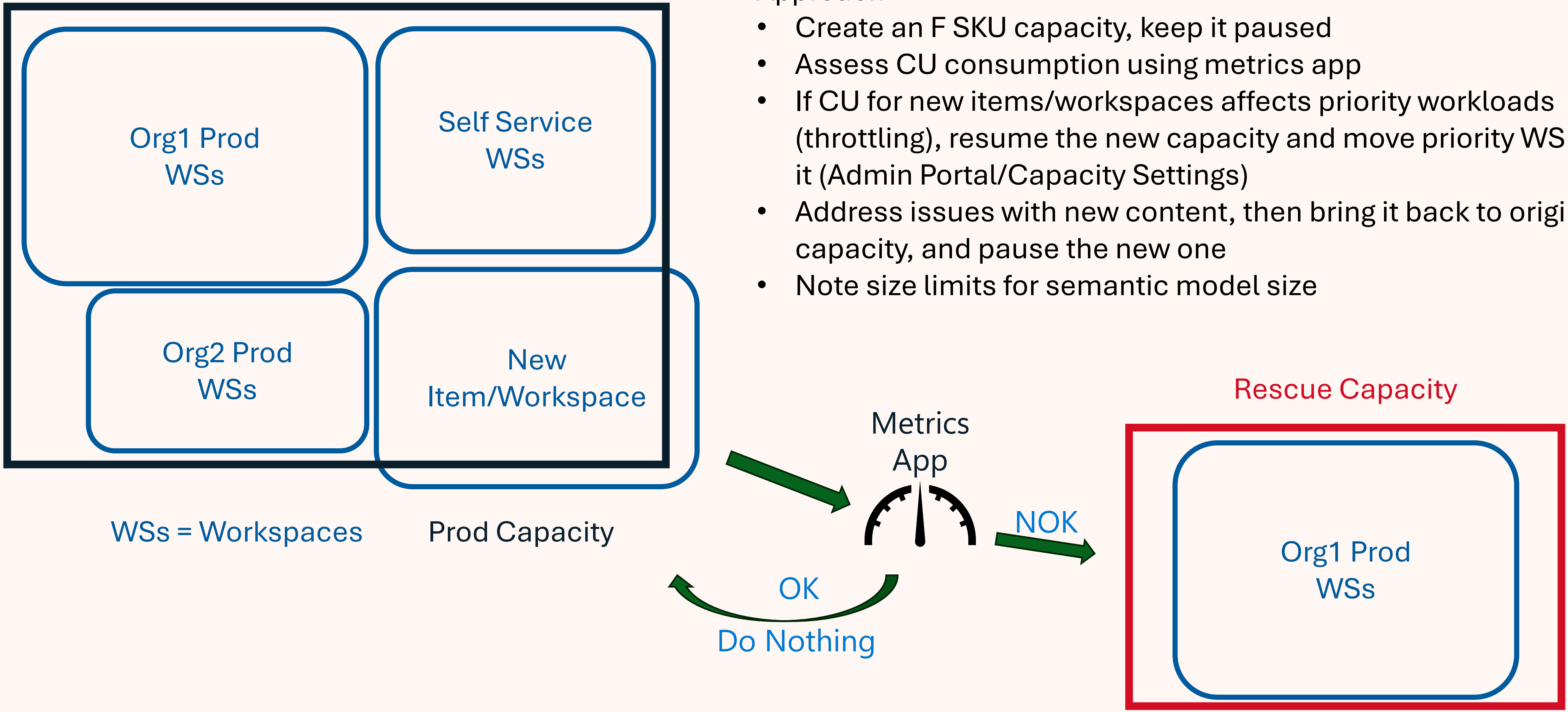
- Create a small F SKU capacity
- Assess CU consumption using metrics app
- If CU for new items/workspaces affects existing workloads (throttling), move WS to timeout capacity (Admin Portal/Capacity Settings)
- High CU items/WSs share smaller capacity (or you can pause it post move)
- Note size limits for semantic model size



# Isolation Strategy #4c – Rescue Capacity

Approach

- Create an F SKU capacity, keep it paused
- Assess CU consumption using metrics app
- If CU for new items/workspaces affects priority workloads (throttling), resume the new capacity and move priority WS to it (Admin Portal/Capacity Settings)
- Address issues with new content, then bring it back to original capacity, and pause the new one
- Note size limits for semantic model size

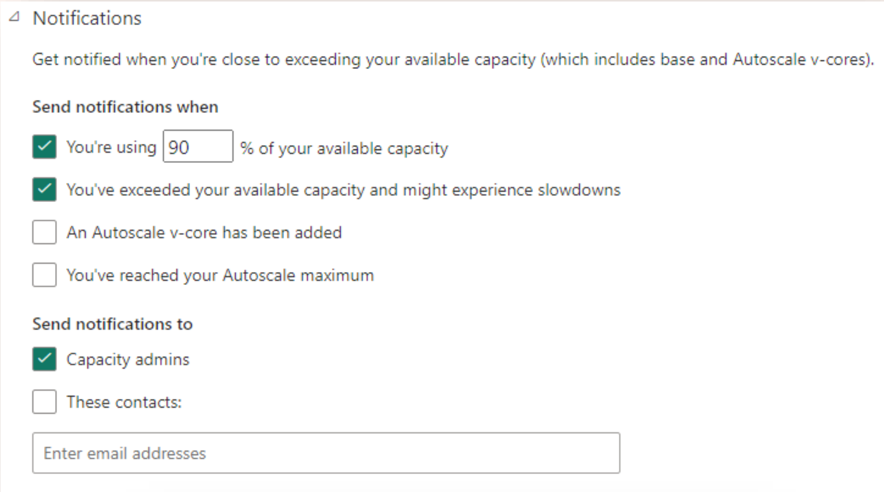


# Recommendations for Cost/CU Savings

- Invest in education, knowledge/best practice sharing, COE, etc. for creators and consumers (proactive optimization)
- Avoid data/report sprawl (leverage certified/promoted models, OneLake shortcuts, etc.)
- Leverage a multi-capacity strategy (isolate, tryout, timeout, etc.)
- Right size your capacities and leverage F SKUs for pause/resume/resize, or reserved instances for discounts
  - Consider a combo of RI and PAYGO (for predictable surge activity)
- Choose the right tool for the job and stay up to date on Fabric feature releases
  - High concurrency mode for notebooks

# Leverage the capacity settings in the UI

- Notifications on CU overuse
- Power BI workloads settings (e.g., query limits, page refresh)



Notifications

Get notified when you're close to exceeding your available capacity (which includes base and Autoscale v-cores).

**Send notifications when**

☑ You're using 90 % of your available capacity

☑ You've exceeded your available capacity and might experience slowdowns

□ An Autoscale v-core has been added

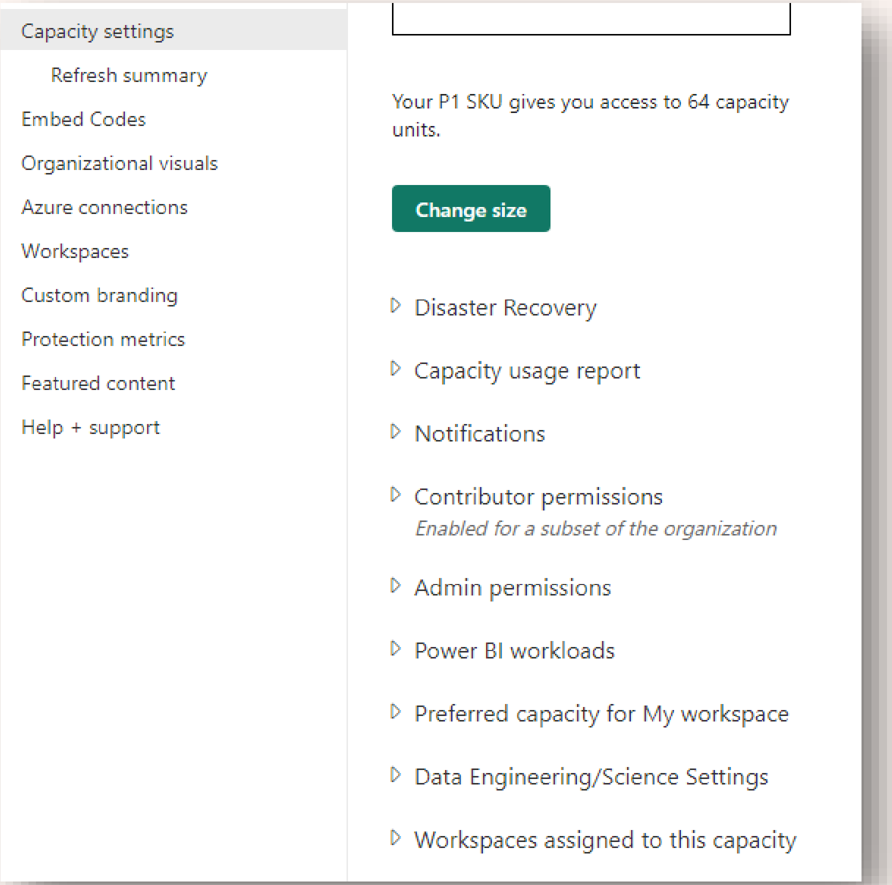
□ You've reached your Autoscale maximum

**Send notifications to**

☑ Capacity admins

□ These contacts:

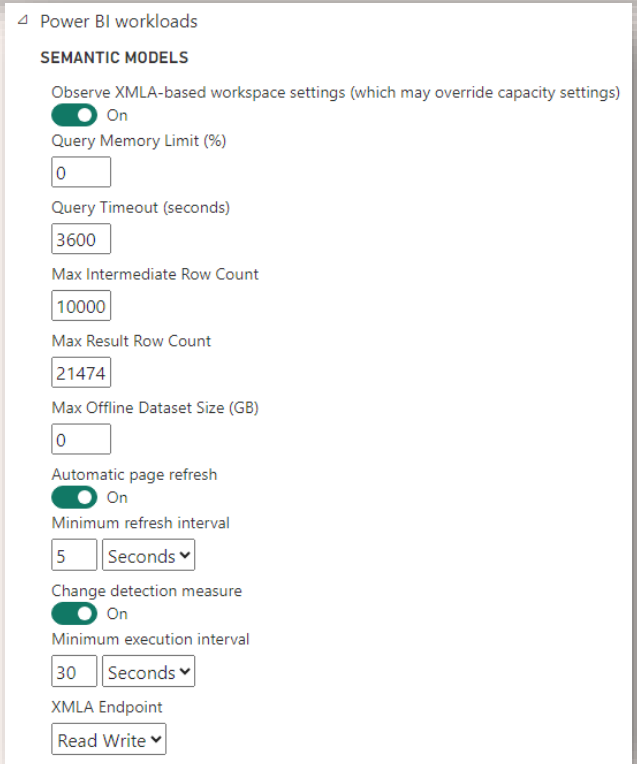
Enter email addresses



Your P1 SKU gives you access to 64 capacity units.

Contributor permissions
*Enabled for a subset of the organization*

Admin permissions
Power BI workloads
Preferred capacity for My workspace
Data Engineering/Science Settings
Workspaces assigned to this capacity



Power BI workloads

**SEMANTIC MODELS**

Observe XMLA-based workspace settings (which may override capacity settings): On

Query Memory Limit (%): 0

Query Timeout (seconds): 3600

Max Intermediate Row Count: 10000

Max Result Row Count: 21474

Max Offline Dataset Size (GB): 0

Automatic page refresh: On

Minimum refresh interval: 5 Seconds

Change detection measure: On

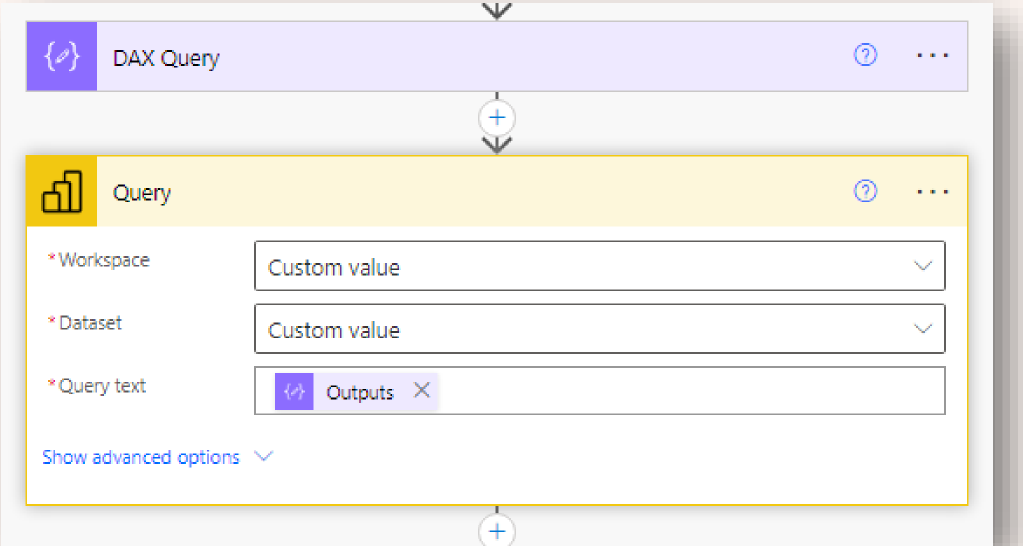
Minimum execution interval: 30 Seconds

XMLA Endpoint: Read Write

# Custom Solutions

- Modify the Metrics App to meet your needs
- Build a custom report off the semantic model
- Send DAX queries to the metrics app semantic model in your own solution
    - Power Automate, Notebook (SemPy), PowerShell, etc.
    - Get throttling % values (Interactive Delay, Interactive Rejection, and/or Background Rejection)
    - Latest values and/or trends over time
    - Best for summarized data only (e.g., hour, day)

Incorporate Metrics App queries into custom solutions



DAX Query

Query

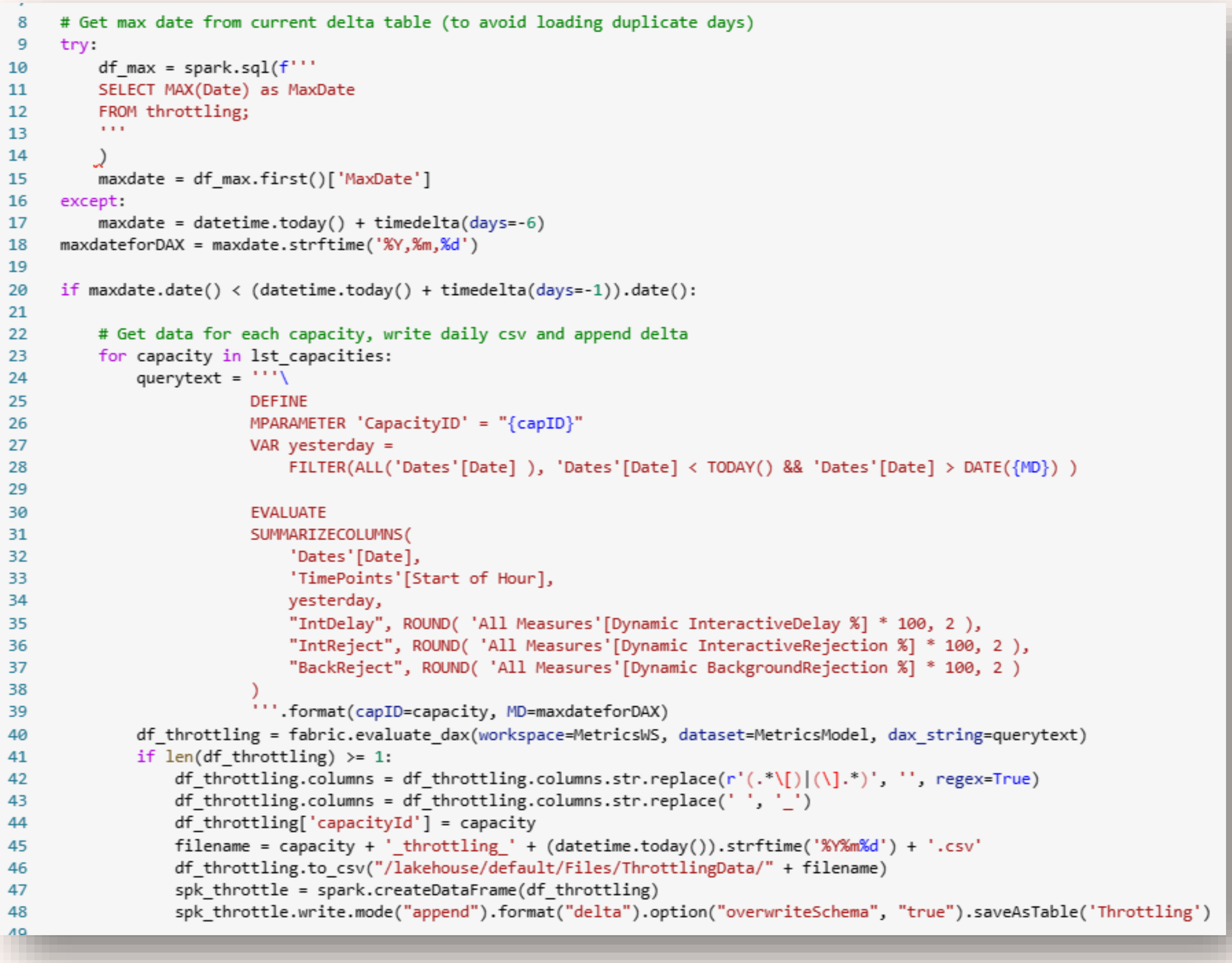
*Workspace: Custom value

*Dataset: Custom value

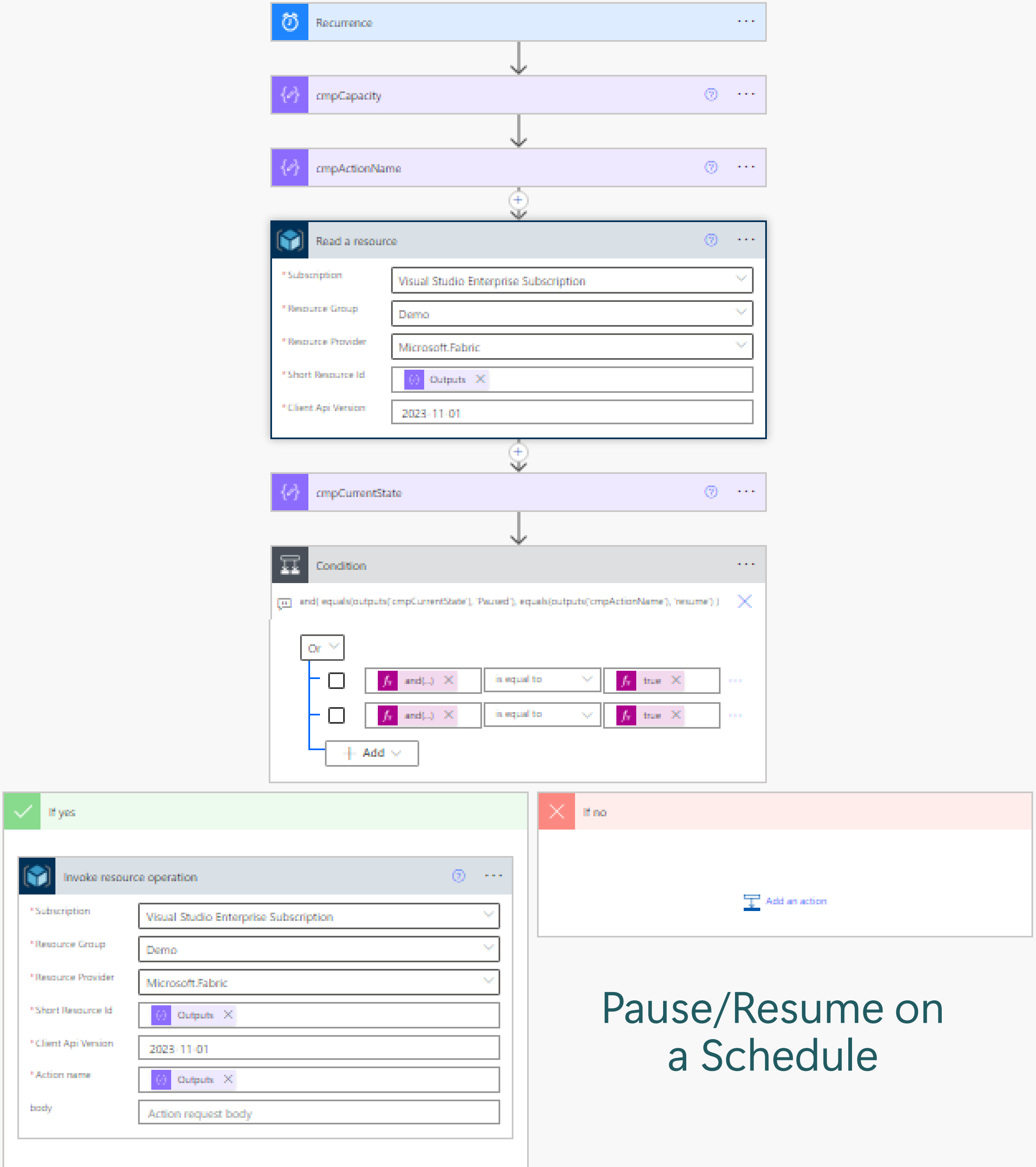
*Query text: Outputs

Show advanced options

Collect data from multiple capacities and store it long term



```python
# Get max date from current delta table (to avoid loading duplicate days)
try:
    df_max = spark.sql(f'''
    SELECT MAX(Date) as MaxDate
    FROM throttling;
    '''
    )
    maxdate = df_max.first()['MaxDate']
except:
    maxdate = datetime.today() + timedelta(days=-6)
maxdateforDAX = maxdate.strftime('%Y,%m,%d')

if maxdate.date() < (datetime.today() + timedelta(days=-1)).date():

    # Get data for each capacity, write daily csv and append delta
    for capacity in lst_capacities:
        querytext = '''\
                    DEFINE
                    MPARAMETER 'CapacityID' = "{capID}"
                    VAR yesterday =
                        FILTER(ALL('Dates'[Date] ), 'Dates'[Date] < TODAY() && 'Dates'[Date] > DATE({MD}) )

                    EVALUATE
                    SUMMARIZECOLUMNS(
                        'Dates'[Date],
                        'TimePoints'[Start of Hour],
                        yesterday,
                        "IntDelay", ROUND( 'All Measures'[Dynamic InteractiveDelay %] * 100, 2 ),
                        "IntReject", ROUND( 'All Measures'[Dynamic InteractiveRejection %] * 100, 2 ),
                        "BackReject", ROUND( 'All Measures'[Dynamic BackgroundRejection %] * 100, 2 )
                    )
                    '''.format(capID=capacity, MD=maxdateforDAX)
        df_throttling = fabric.evaluate_dax(workspace=MetricsWS, dataset=MetricsModel, dax_string=querytext)
        if len(df_throttling) >= 1:
            df_throttling.columns = df_throttling.columns.str.replace(r'(.*\[)|(\].*)', '', regex=True)
            df_throttling.columns = df_throttling.columns.str.replace(' ', '_')
            df_throttling['capacityId'] = capacity
            filename = capacity + '_throttling_' + (datetime.today()).strftime('%Y%m%d') + '.csv'
            df_throttling.to_csv("/lakehouse/default/Files/ThrottlingData/" + filename)
            spk_throttle = spark.createDataFrame(df_throttling)
            spk_throttle.write.mode("append").format("delta").option("overwriteSchema", "true").saveAsTable('Throttling')
```


Recurrence

cmpCapacity

cmpActionName

Read a resource

- *Subscription: Visual Studio Enterprise Subscription
- *Resource Group: Demo
- *Resource Provider: Microsoft.Fabric
- *Short Resource Id: Outputs
- *Client Api Version: 2023-11-01

cmpCurrentState

Condition

```
and( equals(outputs('cmpCurrentState'), 'Paused'), equals(outputs('cmpActionName'), 'resume') )
```

Or

- □ and(...) is equal to true
- □ and(...) is equal to true

If yes

Invoke resource operation

- *Subscription: Visual Studio Enterprise Subscription
- *Resource Group: Demo
- *Resource Provider: Microsoft.Fabric
- *Short Resource Id: Outputs
- *Client Api Version: 2023-11-01
- *Action name: Outputs
- body: Action request body

If no

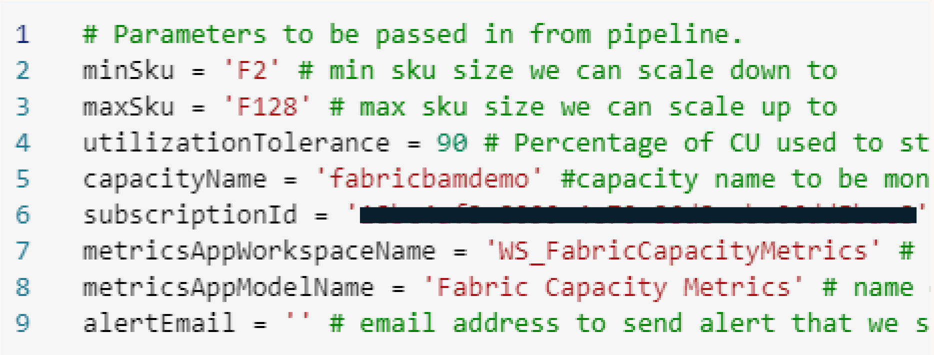
Pause/Resume on a Schedule

# Automate With F SKUs

- Pause/resume on a schedule
  - Automate with Power Automate, Logic Apps, or a Notebook
- Resize at peak/slow times
  - Mix with Reserved Instance (PAYGO when at increased size)
  - Query the metrics app and respond to actual demand (DIY autoscale)

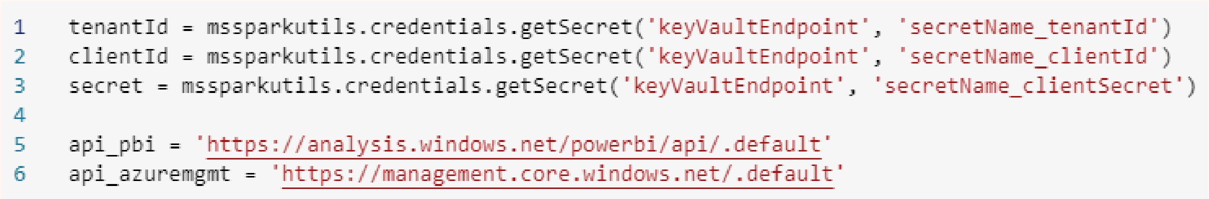
# DIY Autoscale – Fabric Notebook
(Bret Myers)

## Set SKU Ranges and Values



```python
# Parameters to be passed in from pipeline.
minSku = 'F2' # min sku size we can scale down to
maxSku = 'F128' # max sku size we can scale up to
utilizationTolerance = 90 # Percentage of CU used to st
capacityName = 'fabricbamdemo' #capacity name to be mon
subscriptionId = '[redacted]'
metricsAppWorkspaceName = 'WS_FabricCapacityMetrics' #
metricsAppModelName = 'Fabric Capacity Metrics' # name
alertEmail = '' # email address to send alert that we s
```

## Get credentials

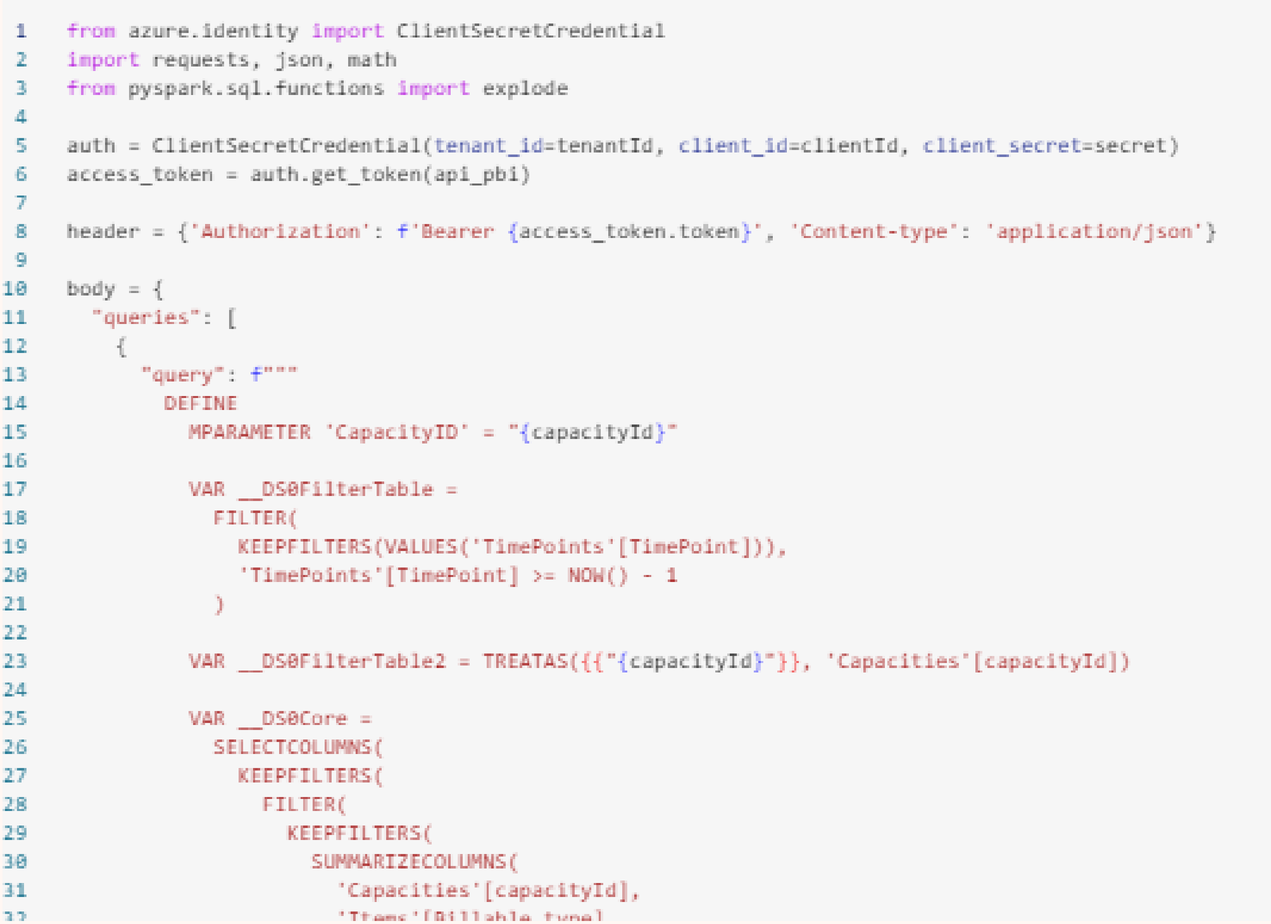


```python
tenantId = mssparkutils.credentials.getSecret('keyVaultEndpoint', 'secretName_tenantId')
clientId = mssparkutils.credentials.getSecret('keyVaultEndpoint', 'secretName_clientId')
secret = mssparkutils.credentials.getSecret('keyVaultEndpoint', 'secretName_clientSecret')

api_pbi = 'https://analysis.windows.net/powerbi/api/.default'
api_azuremgmt = 'https://management.core.windows.net/.default'
```

## Not all code shown

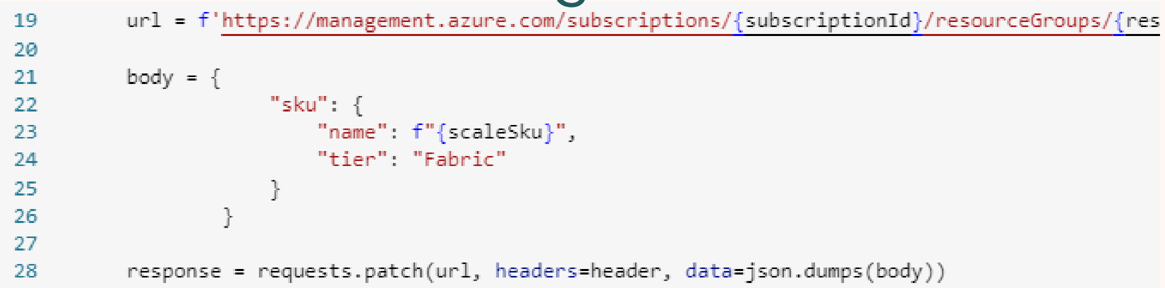
FabricTools/CapacityAutoScale at main · bretamyers/FabricTools · GitHub

## Query metrics app model



```python
from azure.identity import ClientSecretCredential
import requests, json, math
from pyspark.sql.functions import explode

auth = ClientSecretCredential(tenant_id=tenantId, client_id=clientId, client_secret=secret)
access_token = auth.get_token(api_pbi)

header = {'Authorization': f'Bearer {access_token.token}', 'Content-type': 'application/json'}

body = {
  "queries": [
    {
      "query": f"""
        DEFINE
          MPARAMETER 'CapacityID' = "{capacityId}"

          VAR __DS0FilterTable =
            FILTER(
              KEEPFILTERS(VALUES('TimePoints'[TimePoint])),
              'TimePoints'[TimePoint] >= NOW() - 1
            )

          VAR __DS0FilterTable2 = TREATAS({{"{capacityId}"}}, 'Capacities'[capacityId])

          VAR __DS0Core =
            SELECTCOLUMNS(
              KEEPFILTERS(
                FILTER(
                  KEEPFILTERS(
                    SUMMARIZECOLUMNS(
                      'Capacities'[capacityId],
                      'Items'[Billable type]
```

## Change SKU Size



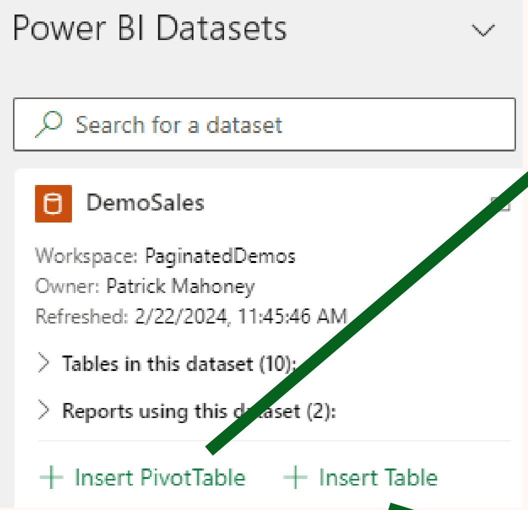
```python
    url = f'https://management.azure.com/subscriptions/{subscriptionId}/resourceGroups/{res

    body = {
            "sku": {
                "name": f"{scaleSku}",
                "tier": "Fabric"
            }
        }

    response = requests.patch(url, headers=header, data=json.dumps(body))
```

# Most Common Capacity Issues (Power BI)

| Bad Practice | Recommendations/Typical Resolution |
|---|---|
| Model issues (M:M, bi-di, snowflake, etc.) and/or inefficient DAX | Follow best practices (e.g., BPA), star schema |
| Too many visuals | Multi card, small multiples, Deneb, PowerPoint background, etc. |
| Big single visual (i.e., matrix with lots of rows, columns, and/or measures) | Improve report design (e.g., drillthrough, apply all Slicers, report page tooltip), field parameters, calc group guardrails, etc. |
| Complex RLS | Remodel to enable simple filter like Table[Email] = USERPRINCIPALNAME() |
| Very high concurrency | Optimize reports, DAX, etc. (big multiplier)<br>Consider QSO, data subsets |
| Direct Query | Switch to import or Direct Lake, if possible. Aggregations, hybrid tables, etc. |
| Analyze in Excel | Automate downstream analytics with a Power BI report instead, subscriptions, DAX connected table, slicers/measures first, etc. |
| Excessive refresh | Don't "break the fold", incremental refresh, reduce frequency, optimize M code |

# Save Those CUs – Getting Data Into Excel

Analyze in Excel



Power BI Datasets

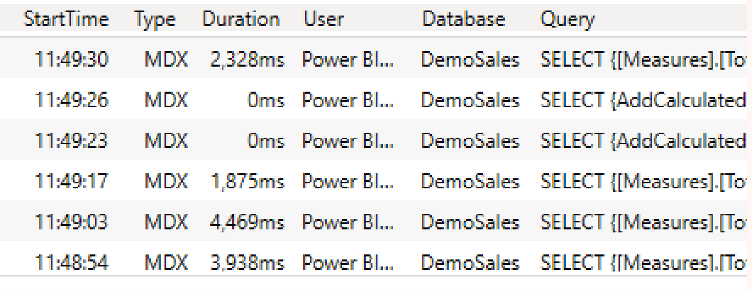
Search for a dataset

DemoSales

Workspace: PaginatedDemos
Owner: Patrick Mahoney
Refreshed: 2/22/2024, 11:45:46 AM

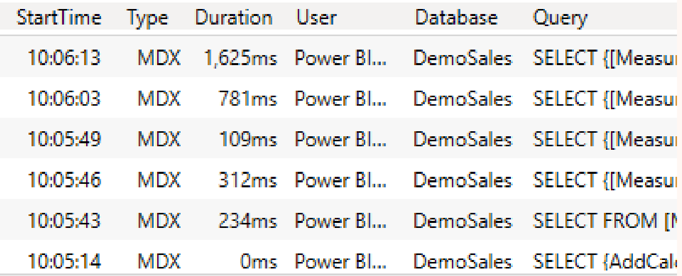
Connected Table

## ❌ Rows, Measures, Filter



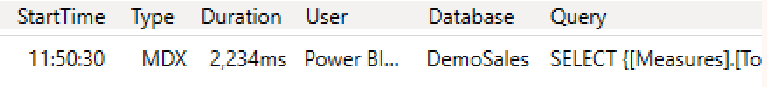
| StartTime | Type | Duration | User | Database | Query |
|---|---|---|---|---|---|
| 11:49:30 | MDX | 2,328ms | Power BI... | DemoSales | SELECT {[Measures].[To |
| 11:49:26 | MDX | 0ms | Power BI... | DemoSales | SELECT {AddCalculated |
| 11:49:23 | MDX | 0ms | Power BI... | DemoSales | SELECT {AddCalculated |
| 11:49:17 | MDX | 1,875ms | Power BI... | DemoSales | SELECT {[Measures].[To |
| 11:49:03 | MDX | 4,469ms | Power BI... | DemoSales | SELECT {[Measures].[To |
| 11:48:54 | MDX | 3,938ms | Power BI... | DemoSales | SELECT {[Measures].[To |

## ✅ Filter, measures, rows



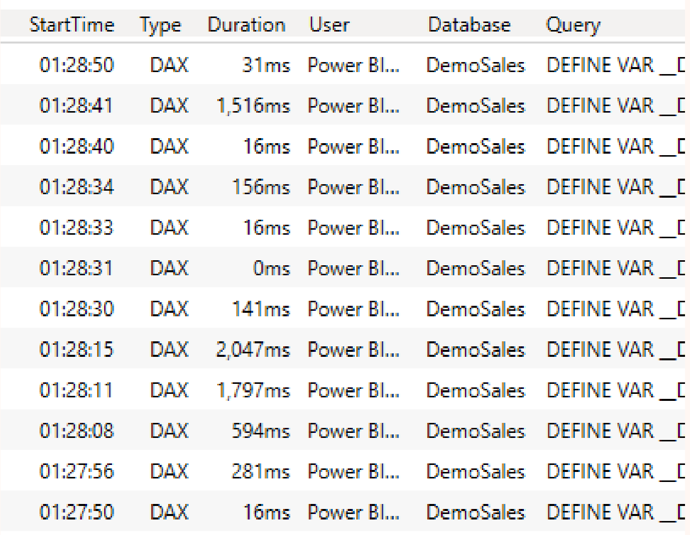
| StartTime | Type | Duration | User | Database | Query |
|---|---|---|---|---|---|
| 10:06:13 | MDX | 1,625ms | Power BI... | DemoSales | SELECT {[Measu |
| 10:06:03 | MDX | 781ms | Power BI... | DemoSales | SELECT {[Measu |
| 10:05:49 | MDX | 109ms | Power BI... | DemoSales | SELECT {[Measu |
| 10:05:46 | MDX | 312ms | Power BI... | DemoSales | SELECT {[Measu |
| 10:05:43 | MDX | 234ms | Power BI... | DemoSales | SELECT FROM [N |
| 10:05:14 | MDX | 0ms | Power BI... | DemoSales | SELECT {AddCal |

## Refresh (same for both)



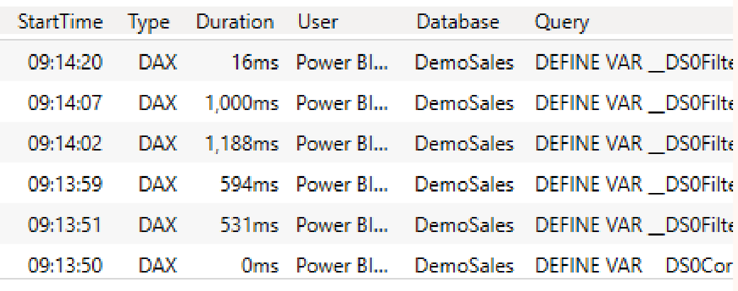
| StartTime | Type | Duration | User | Database | Query |
|---|---|---|---|---|---|
| 11:50:30 | MDX | 2,234ms | Power BI... | DemoSales | SELECT {[Measures].[To |

## ❌ Rows, Measure, Filter



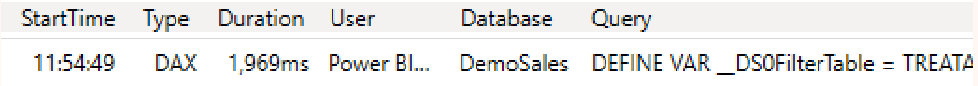
| StartTime | Type | Duration | User | Database | Query |
|---|---|---|---|---|---|
| 01:28:50 | DAX | 31ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:41 | DAX | 1,516ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:40 | DAX | 16ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:34 | DAX | 156ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:33 | DAX | 16ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:31 | DAX | 0ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:30 | DAX | 141ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:15 | DAX | 2,047ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:11 | DAX | 1,797ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:28:08 | DAX | 594ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:27:56 | DAX | 281ms | Power BI... | DemoSales | DEFINE VAR _D |
| 01:27:50 | DAX | 16ms | Power BI... | DemoSales | DEFINE VAR _D |

## ✅ Filter, measures, rows



| StartTime | Type | Duration | User | Database | Query |
|---|---|---|---|---|---|
| 09:14:20 | DAX | 16ms | Power BI... | DemoSales | DEFINE VAR _DS0Filte |
| 09:14:07 | DAX | 1,000ms | Power BI... | DemoSales | DEFINE VAR _DS0Filte |
| 09:14:02 | DAX | 1,188ms | Power BI... | DemoSales | DEFINE VAR _DS0Filte |
| 09:13:59 | DAX | 594ms | Power BI... | DemoSales | DEFINE VAR _DS0Filte |
| 09:13:51 | DAX | 531ms | Power BI... | DemoSales | DEFINE VAR _DS0Filte |
| 09:13:50 | DAX | 0ms | Power BI... | DemoSales | DEFINE VAR DS0Cor |

## Refresh (same for both)



| StartTime | Type | Duration | User | Database | Query |
|---|---|---|---|---|---|
| 11:54:49 | DAX | 1,969ms | Power BI... | DemoSales | DEFINE VAR _DS0FilterTable = TREATA |

Key Takeaways

- How you build it matters
  - Filters & measures first!
- This shows durations but it’s CU that matters (test your use cases/models)
- Opt for DAX Connected Tables
  - Create pivot table from that, if needed

I PITY THE FOOL
THAT DOESN'T GIVE SESSION FEEDBACK
imgflip.com

# Slides

**https://github.com/BenniDeJagere/Presentations/{Year}/{YYYYMMDD}_{Event}**

# Thank you