About this presentation

What's "better", AWS or Azure? AMD or Intel?

But wait, define "better": do you mean faster, or maybe cheaper, or is it something else?

Or do you simply want to know how much bang you get for your $ or €?

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Azure vs AWS, AMD vs Intel...

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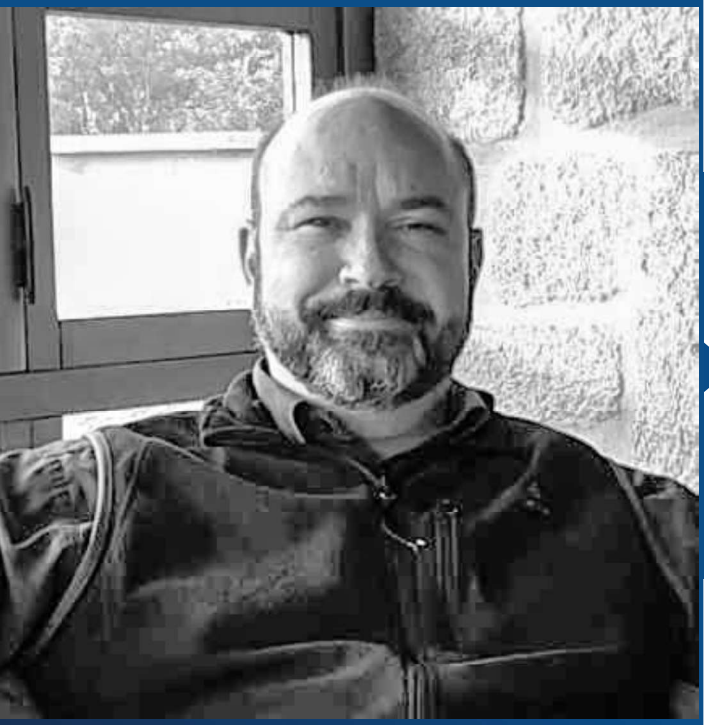
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CEO

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Carpenter, Roof Builder, Plumber,
Electrician, Chef, Welder, Biker…

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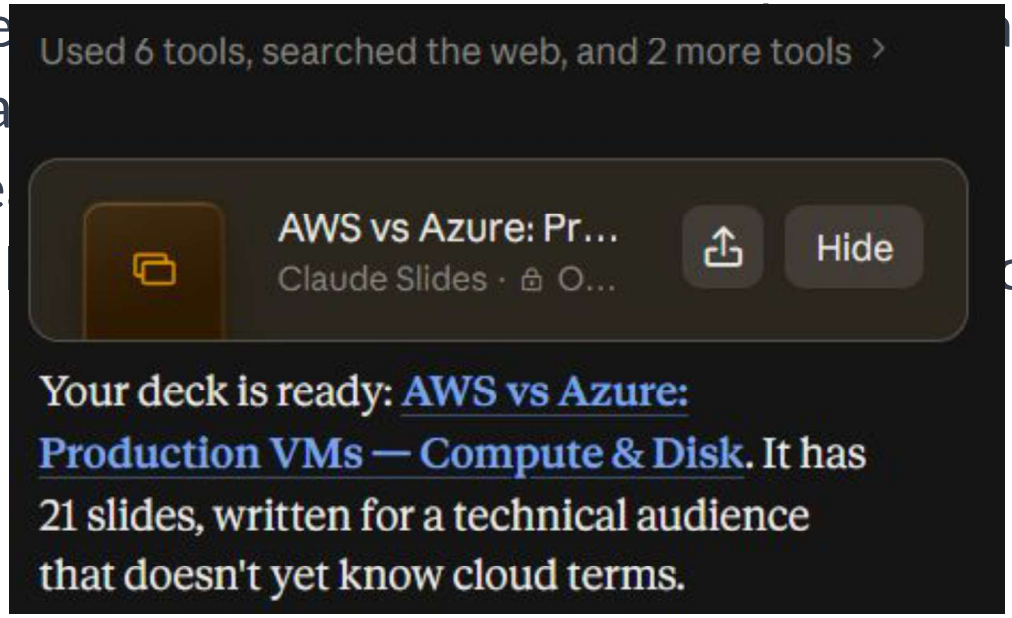
The Next Hour

- Basic Education - AWS vs Azure
- Benchmarking Methodology
- Results and Discussion
- Q&A

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<Insert Hard Work>

- Make a Slides artifact about the comparison of AWS and Azure for hosting production virtual machines. Focus on the differe nd how them compa disk options. The re of the basic terms c...



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Vocabulary - compute

Instance / VM
A virtual server. AWS calls it an EC2 instance; Azure calls it a virtual machine.

vCPU
One hardware thread. On most x86 sizes, 2 vCPUs = 1 core; on Arm, 1 vCPU = 1 core.

Instance type / VM size
The fixed bundle you rent: vCPUs, RAM, network and disk limits. e.g. m7i.xlarge, D4s_v5.

Family
Sizes tuned for one job: general purpose, compute, memory, storage or GPU.

Generation
The hardware revision (m6 → m7, v5 → v6). Newer usually means more work per dollar.

Burstable & CPU credits
Cheap VMs guaranteed only a slice of CPU. Idle time earns credits; busy time spends them.

Ephemeral storage
Disk inside the physical host. Very fast, but wiped when the VM stops, moves or is resized.

Spot
Spare capacity at a deep discount that the cloud can reclaim on short notice.

Availability Zone
A separate datacenter site within a region. VMs in 2+ zones survive a site outage.

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Instance Naming Conventions

AWS EC2

m	7	i	.2xlarge
Family general purpose	**Generation** 7th	**CPU vendor** i Intel · a AMD · g Graviton	**Size** 8 vCPU · 32 GiB

Azure

Standard_	D	8	a	d	s	_v5
Prefix	**Family**	**vCPUs**	**AMD** p = Arm	**Temp disk**	**Premium storage**	**Version**

Same machine class: **m7i.2xlarge ≈ Standard_D8s_v5** — 8 vCPU, 32 GiB, Intel.

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Compute Families

Workload	AWS EC2	Azure VMs	Typical production use
General purpose	M — m7i, m7a, m8g	D — Dsv5, Dasv6, Dpsv6	App servers, mid-size db
Compute optimized	C — c7i, c7a, c8g	F — Fsv2, Fasv6	Web tiers, batch, CPU hogs
Memory optimized	**R — r7i, r8g · X and U for very large RAM**	**E — Esv5, Easv6 · M for very large RAM**	**DB, caches, analytics**
Storage optimized	I — i4i, i7ie · D — d3	L — Lsv3, Lasv3	High-I/O DB on local NVMe
Burstable	T — t3, t3a, t4g	B — Bsv2, Basv2, Bpsv2	Dev/test, light steady load
GPU / accelerated	P, G, Inf, Trn	NC, ND, NV	AI, rendering, VDI
HPC	Hpc — hpc7a	HB, HC, HX	Tightly coupled simulation

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Processors

CPU	AWS letter & examples	Azure letter & examples	Trade-off
Intel Xeon	i — [m/c/r]7i	none — [D/E]sv5	Broadest support
AMD EPYC	a — [m/c/r]7a	a — [D/E/F]asv6	Cheaper than Intel
Arm	g — Graviton: [m/c/r]8g	p — Cobalt: [D/E]psv6	Needs arm64 builds

A vCPU is not always a vCPU

On Graviton, Cobalt and AWS 7th-gen AMD, each vCPU is a full physical core. On most other x86 sizes it is one SMT thread — half a core.

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Vocabulary - disk

Volume / managed disk
A network-attached virtual disk the OS formats like a local drive. AWS: EBS. Azure: Managed Disks.

IOPS
I/O operations per second: how many separate reads and writes the disk completes each second.

Throughput
Data moved per second (MB/s). Dominates large sequential work: backups, scans, restores.

Latency
Time for one I/O to finish. Network disks: about a millisecond. Local NVMe: a fraction of that.

I/O size & queue depth
Bytes per operation, and how many operations are in flight at once. Both shape real speed.

Provisioned performance
IOPS and MB/s you choose and pay for separately from capacity (gp3, io2, Premium SSD v2, Ultra).

Baseline vs burst
Baseline is the speed you can sustain. Burst is a temporary boost funded by credits or a fee.

Persistent vs ephemeral
Persistent disks survive stop/start and host failure. Ephemeral disks do not.

Snapshot
Incremental point-in-time copy of a disk, stored separately. The basis for backups and clones.

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Three Kinds of Storage

Block storage

Persistent. Lives on separate storage servers reached over the network. Holds the OS disk and data disks. Survives stop/start and host failure.

AWS: EBS volumes
Azure: Managed Disks

Local ephemeral

On the physical host. Lowest latency and highest IOPS, but erased on stop, move or resize.

AWS: Instance store (NVMe)
Azure: Temp disk, local NVMe

Shared file

Mounted by many VMs over NFS or SMB, or accessed over HTTP. Not covered in this deck.

AWS: EFS, FSx, S3
Azure: Azure Files, NetApp Files, Blob

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Throughput = IOPS × I/O size

I/O pattern	Math	On a 3,000 IOPS / 125 MB/s disk
4K random reads	3,000 × 4K ≈ 12 MB/s	IOPS-bound: throughput to spare
16K mixed OLTP	3,000 × 16K ≈ 49 MB/s	IOPS-bound
256K backup, scan, restore	3,000 × 256K ≈ 786 MB/s	Throughput-bound: capped at 125 MB/s, so only ~480 IOPS usable

Small random I/O
Buy IOPS. Typical of OLTP databases.

Large sequential I/O
Buy MB/s. Typical of backups, etc.

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Disk tiers side by side

Class	AWS EBS	Azure Managed Disks	How performance is set
HDD	st1 (throughput), sc1 (cold)	Standard HDD	Grows with size
Entry SSD		Standard SSD	Grows with size, plus burst
Size-tiered SSD		Premium SSD (P1–P80)	Grows with size, plus burst
Provisioned SSD	gp3	Premium SSD v2	Choose GiB, IOPS and MB/s separately
High-end provisioned	io2 Block Express	Ultra Disk	Choose all three; sub-ms latency

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A Quick Note on Disk Bursting

AWS

gp2 credit bucket

Volumes under 1 TiB burst to 3,000 IOPS from an I/O credit bucket that refills at 3 IOPS per GiB. gp3 and io2 don't burst: you get what you provision.

AZURE

Credit-based burst

Premium SSD P20 and smaller burst up to 3,500 IOPS and 170 MB/s for up to 30 minutes, on credits banked while idle. Free and on by default.

AZURE

On-demand burst

Premium SSD P30 and larger can burst up to 30,000 IOPS and 1,000 MB/s with no time limit, for an enablement fee plus per-burst charges.

VMs burst too: smaller EC2 sizes reach their max EBS bandwidth for 30 minutes a day, and many Azure sizes list a 30-minute disk burst. Size production on baseline — burst flatters benchmarks and runs out at month-end.

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A Quick Note on Ephemeral Storage

What survives?

Event	AWS instance store	Azure temp disk
Reboot from the OS	Kept	Kept
Stop / deallocate	Erased	Erased
Host failure or maintenance move	**Erased**	**Erased**
Resize	Erased (stop required)	Can be erased
Terminate / delete	Erased	Erased

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Benchmarking Overview

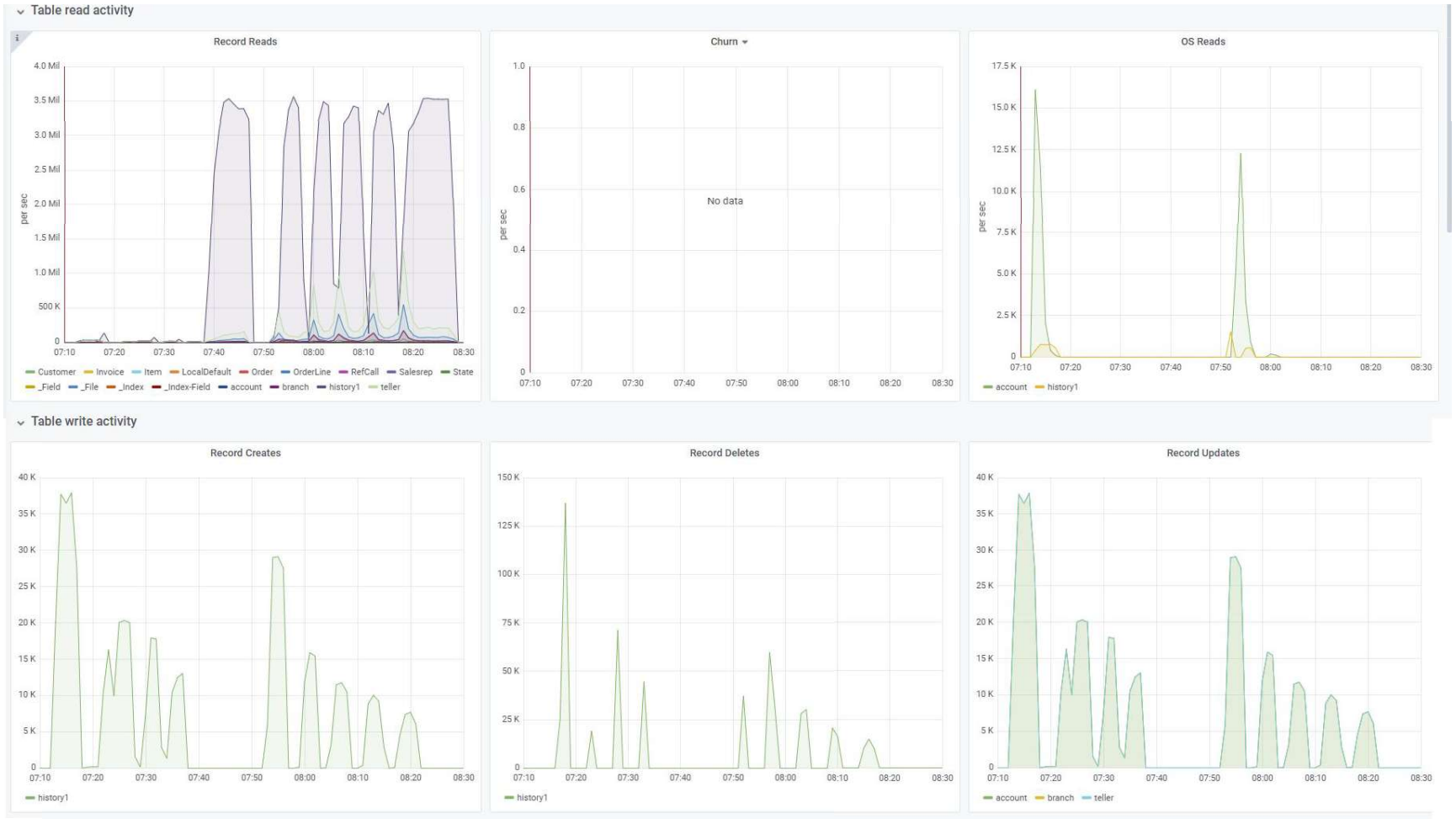
- ATM (for transactions and writes)
- Readprobe (for reads)
- Both benchmarks combined
- Approx 1.5 hours per run
- 14 AWS tests: AWS01 - AWS14
- 13 Azure tests: AZURE01 - AZURE13

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Why This Way?

1. Removing all barriers, how fast can we read?
    a. No disk IO, just pure shared memory reads from buffer cache
2. Removing all barriers, how fast can we write?
    a. Bottleneck is always disk IO
3. Real world is a combination of both
    a. How do reads affect writes, and vice-versa?

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Table read activity
Record Reads
4.0 Mil
3.5 Mil
3.0 Mil
2.5 Mil
2.0 Mil
1.5 Mil
1.0 Mil
500 K
0
per sec
07:10
07:20
07:30
07:40
07:50
08:00
08:10
08:20
08:30
Customer
Invoice
Item
LocalDefault
Order
OrderLine
RefCall
Salesrep
State
_Field
_File
_Index
_Index-Field
account
branch
history1
teller
Churn
1.0
0.8
0.6
0.4
0.2
0
per sec
No data
OS Reads
17.5 K
15.0 K
12.5 K
10.0 K
7.5 K
5.0 K
2.5 K
0
per sec
account
history1
Table write activity
Record Creates
40 K
35 K
30 K
25 K
20 K
15 K
10 K
5 K
0
history1
Record Deletes
150 K
125 K
100 K
75 K
50 K
25 K
0
history1
Record Updates
40 K
35 K
30 K
25 K
20 K
15 K
10 K
5 K
0
account
branch
teller

Benchmarking Overview

- ~7 GB sports database
- Fit entire DB in -B
- Fixed DB configuration
- Variable instance and disk configuration

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DB Configuration

- Key parameters:

  -B 2,000,000 -lruskips 100 -bibufs 1024 -spin 10,000

  - There are a LOT of other important parameters, but these were the key ones for this exercise
- DB Block size 8 kb
- BI Block size 16 kb
- BI Cluster Size 256 MB
- 2 APW 1 BIW

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Cloud Configuration - General

- 16 - 64 GB RAM
- 4 vCPU - 32 vCPU
- Reminder:
  - 1 Intel vCPU = 1 H/T
  - 1 AMD vCPU = 1 core
- Non-burst CPU

- Detailed XLS results available upon request

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Cloud Configurations - CPU

Intel CPU	Passmark	AMD CPU	Passmark
Xeon Platinum 8000 series	~ 30,000	EPYC 7571	~ 29,000
Xeon 6 / Granite Rapids	~ 31,000	EPYC 9575F	~ 148,000
Xeon Platinum 8573C	~ 90,000	EPYC 9R45 / Turin	~ 7,000
Xeon 6 6973PC	~ 4,000	EPYC 9005 / Turin	~ 54,000
		EPYC 9004 / Genoa	~ 73,000

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Cloud Configurations - Disk

- AWS gp3 (various IOPS)
- AWS io2 (various IOPS)
- AWS ephemeral
- Azure Standard SSD
- Azure Premium SSD V2 (various IOPS)
- Azure Ultra Disk (various IOPS)
- Azure ephemeral

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The Cheapest Machines

- AWS
  - AWS01: t3.xlarge (Intel): $127/month
    - Xeon Platinum 8000 (passmark 30K)
  - AWS02: t3a.xlarge (AMD): $114/month
    - EPYC 7000 (passmark 29K)
- Azure
  - AZURE01: Standard_B4s_v2 (Intel): $127/month
    - Xeon Platinum 8573C (passmark 90K)
  - AZURE02: Standard_D4as_v7 (AMD): $121/month
    - EPYC 9005 (passmark 54K)

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The Cheapest Machines

- AWS01:
  - 83B DBRec/$ (#4 overall)
  - 13B UsrRec/$ (#4 overall)
  - 92M Tx/$ (#3 overall)
  - 4M Peak Rec/s (2nd last)
- AWS02:
  - 55B DBRec/$ (# overall)
  - 11B UsrRec/$ (#6 overall)
  - 91M Tx/$ (#6 overall)
  - 2.5M Peak Rec/s (last overall)

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The Cheapest Machines

- AZURE01:
  - 87B DBRec/$ (#2 overall)
  - 24B UsrRec/$ (#3 overall)
  - 52M Tx/$ (#11 overall)
  - 4.3M Peak Rec/s (3rd last)
- AZURE02:
  - 171B DBRec/$ (#1 overall)
  - 37.5B UsrRec/$ (#1 overall)
  - 55M Tx/$ (#10 overall)
  - 8.2M Peak Rec/s (7th last)

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The Most Expensive Machines

- AWS
  - AWS14: (Intel): $4,172/month (75% storage)
    - Xeon 6 / Granite Rapids (passmark 31K)
  - AWS10: (AMD): $1,059/month
    - EPYC 9575F (passmark 148K)
- Azure
  - AZURE11: (Intel): $4,403/month (69% storage)
    - Xeon Platinum 8573C (passmark 90K)
  - AZURE09: (AMD): $1,220/month
    - EPYC 9004 (passmark 73K)

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The Most Expensive Machines

- AWS14:
  - 6.4B DBRec/$ (2nd LAST overall)
  - 468M UsrRec/$ (2nd LAST overall)
  - 4M Tx/$ (LAST overall)
  - 10M Peak Rec/s (#12 overall)
- AWS10:
  - 21.5B DBRec/$ (#19 overall)
  - 2.8B UsrRec/$ (#15 overall)
  - 39M Tx/$ (#17 overall)
  - 8.7M Peak Rec/s (#19 overall)

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The Most Expensive Machines

- AZURE11:
  - 6.6B DBRec/$ (#25 overall)
  - 394M UsrRec/$ (LAST overall)
  - 17M Tx/$ (#24 overall)
  - 11M Peak Rec/s (#7 overall)
- AZURE09:
  - 33.7B DBRec/$ (#12 overall)
  - 3B UsrRec/$ (#14 overall)
  - 44M Tx/$ (#14 overall)
  - 15.6M Peak Rec/s (#1 overall)

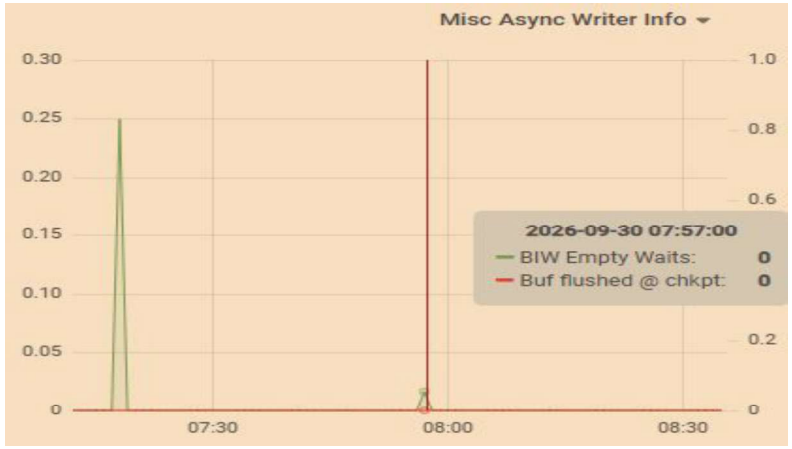
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Peak Performance - Tx/sec

- AZURE12 38K Tx/sec $1002/month
  - Ephemeral drives
  - 16 x EPYC 9005
- AZURE11 29K Tx/sec $4,400/month
  - Ultra disks
  - 32 x Xeon Platinum 8573C
- Azure09 28.3K Tx/sec $1,220/month
  - Premium V2 drives
  - 32 X EPYC 9004

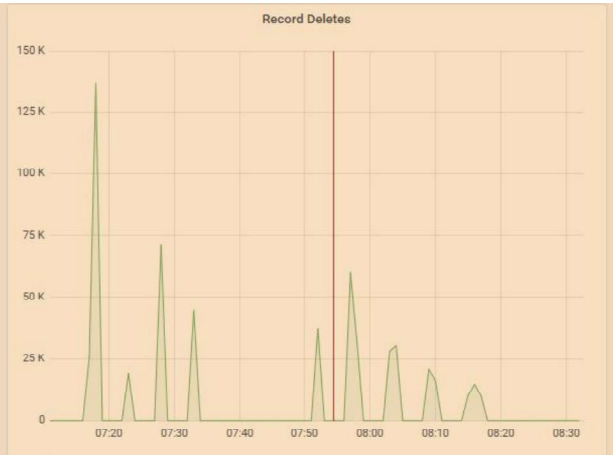
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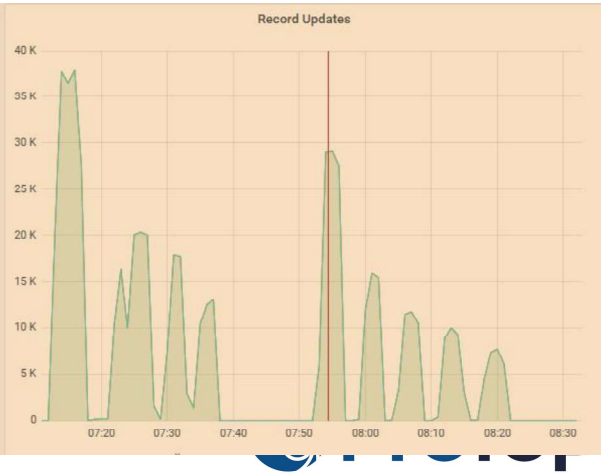
Peak Writes on Ephemeral Drives



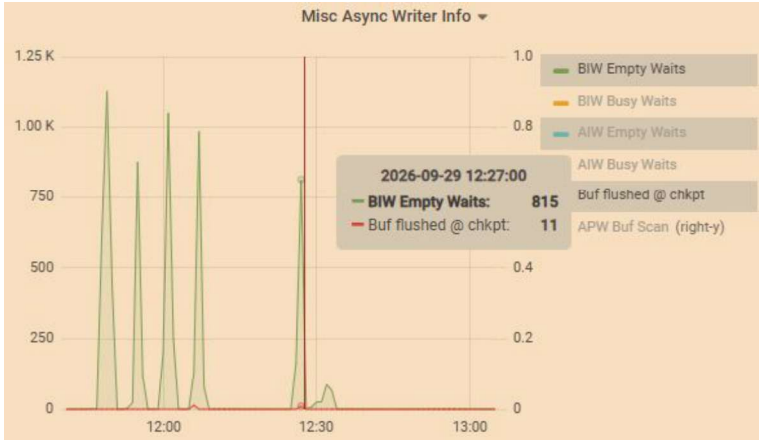








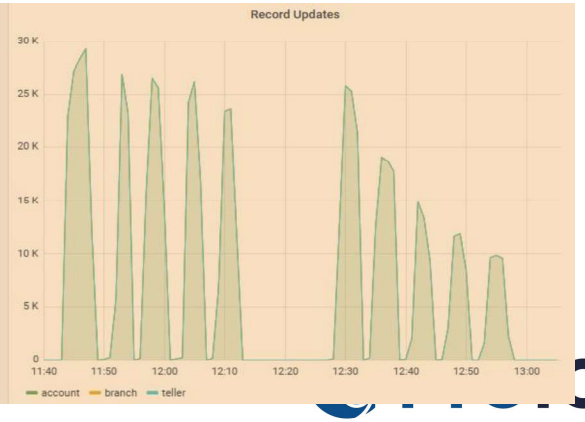
Peak Writes on Premium V2 Drives



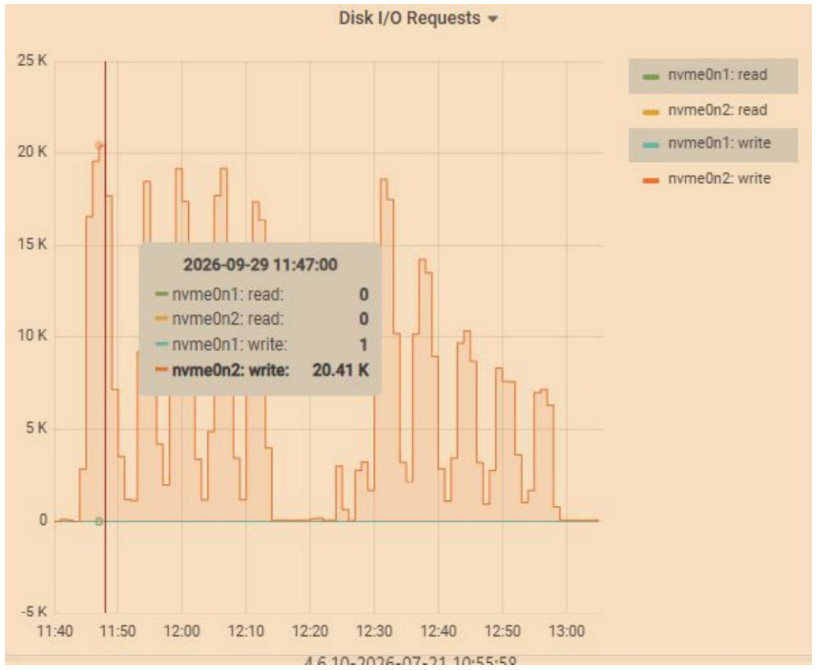


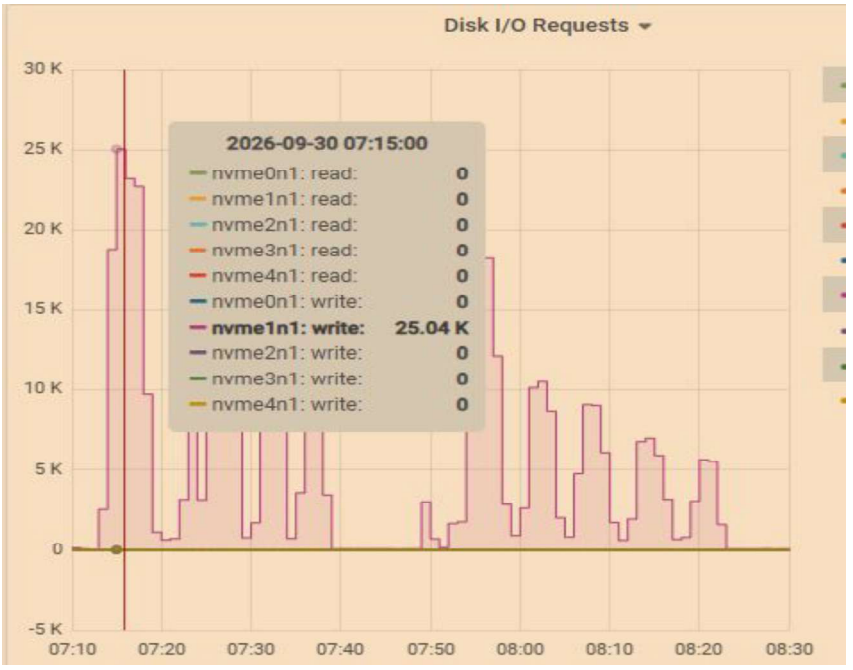






Premium V2 vs Ephemeral





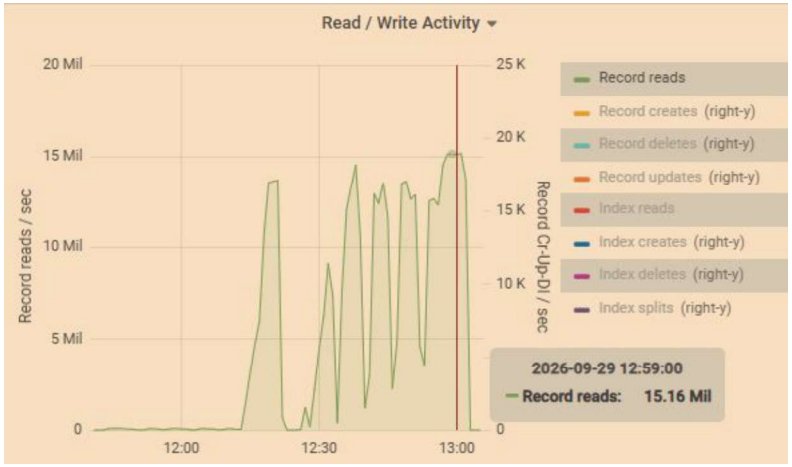
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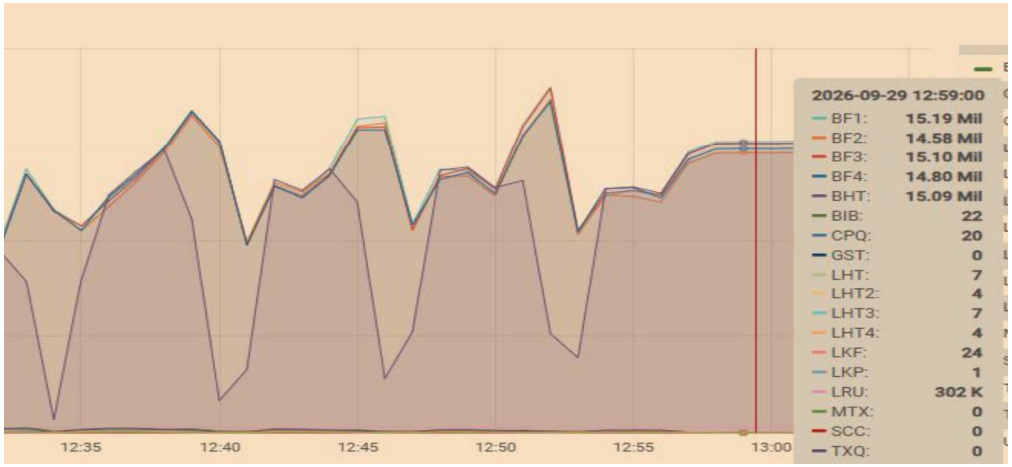
Peak Performance - Record Reads/sec

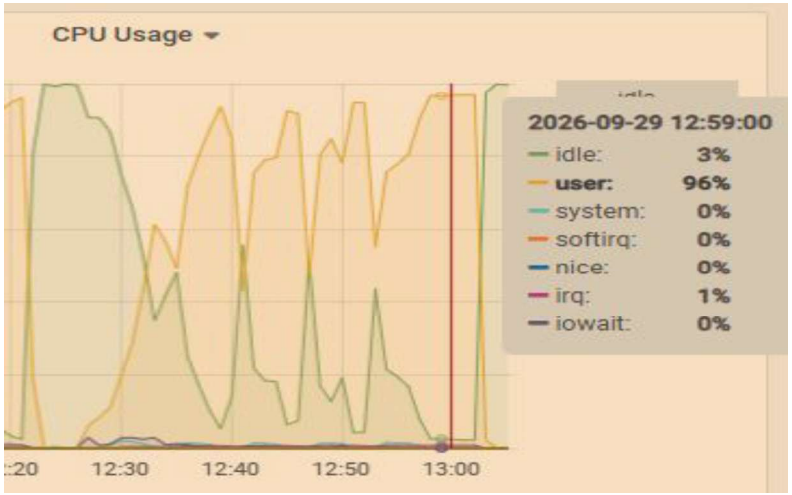
- Azure09 15.6M recRd/sec $1,220/month
  - 32 x EPYC 9004
- Azure03 12.3M recRd/sec $426/month
  - 8 X EPYC 9005
- AWS11 12.2M recRd/sec $1,306/month
  - 32 X Intel Xeon 6 / Granite Rapids

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Peak Reads/sec







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Winners - Reads/$

M-DBRec/$	M-UsrRec/$	M-Tx/$	Cost / Hour	Total / mo	Instance	CPU	vCPU/C/TPC	SMT/HT	RAM	
171094	37495	55	$0.17	$121.60	Standard_D4as_v7	AMD	4 / 2 / 2	Yes	16 GiB	AMD EPYC 9005 (Turin), up to 4.
87454	23738	52	$0.17	$127.18	Standard_B4s_v2	Intel	4 / 2 / 2	Yes	16 GiB	Intel Xeon Platinum 8573C / 847
87223	28644	42	$0.47	$342.63	m8azn.xlarge	AMD	4 / 4 / 1	No	16 GiB	5th-gen AMD EPYC 9575F, up to
83643	13226	92	$0.17	$126.71	t3.xlarge	Intel	4 / 2 / 2	Yes	16 GiB	Intel Xeon Platinum 8000, up to
76023	13020	104	$0.58	$426.10	Standard_F8als_v7	AMD	8 / 8 / 1	No	16 GiB	AMD 5th-gen EPYC 9005 Turin, u
55584	11275	91	$0.16	$114.59	t3a.xlarge	AMD	4 / 2 / 2	Yes	16 GiB	AMD EPYC 7000, 2.5 GHz all-cor
46574	8492	90	$0.63	$458.95	Standard_D8s_v7	Intel	8 / 4 / 2	Yes	32 GiB	Intel Xeon 6 6973PC Granite Rap
41953	7621	23	$0.76	$551.75	c8ib.2xlarge	Intel	8 / 4 / 2	Yes	16 GiB	Intel Xeon 6 / Granite Rapids, 3.9
40374	5648	132	$0.89	$648.34	c8id.4xlarge ephemeral	Intel	16 / 8 / 2	Yes	32 GiB	Intel Xeon 6 Granite Rapids, 3.9
36700	4139	55	$1.03	$749.31	Standard_D16s_v6	Intel	16 / 8 / 2	Yes	64 GiB	Intel Xeon Platinum 8573C Emer

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Winners - Tx/$

M-DBRec/$	M-UsrRec/$	M-Tx/$	Cost / Hour	Total / mo	Instance	CPU	vCPU/C/TPC	SMT/HT	RAM	CPU
40374	5648	132	$0.89	$648.34	c8id.4xlarge ephemeral	Intel	16 / 8 / 2	Yes	32 GiB	Intel Xeon 6 Granite Rapids, 3.9 GHz sustain
76023	13020	104	$0.58	$426.10	Standard_F8als_v7	AMD	8 / 8 / 1	No	16 GiB	AMD 5th-gen EPYC 9005 Turin, up to 4.5 GH
83643	13226	92	$0.17	$126.71	t3.xlarge	Intel	4 / 2 / 2	Yes	16 GiB	Intel Xeon Platinum 8000, up to 3.1 GHz all-
55584	11275	91	$0.16	$114.59	t3a.xlarge	AMD	4 / 2 / 2	Yes	16 GiB	AMD EPYC 7000, 2.5 GHz all-core
46574	8492	90	$0.63	$458.95	Standard_D8s_v7	Intel	8 / 4 / 2	Yes	32 GiB	Intel Xeon 6 6973PC Granite Rapids, 3.6 GH
35477	4616	72	$1.03	$749.31	Standard_D16s_v6	Intel	16 / 8 / 2	Yes	64 GiB	Intel Xeon Platinum 8573C Emerald Rapids,
23643	1844	68	$1.37	$1,002.76	Standard_F16ads_v7 eph	AMD	16 / 16 / 1	No	64 GiB	AMD 5th Gen EPYC 9005 Turin, up to 4.5 GH
22280	4601	56	$1.19	$867.57	Standard_F16als_v7	AMD	16 / 16 / 1	No	32 GiB	AMD 5th-gen EPYC 9005 Turin, up to 4.5 GH
36700	4139	55	$1.03	$749.31	Standard_D16s_v6	Intel	16 / 8 / 2	Yes	64 GiB	Intel Xeon Platinum 8573C Emerald Rapids,
171094	37495	55	$0.17	$121.60	Standard_D4as_v7	AMD	4 / 2 / 2	Yes	16 GiB	AMD EPYC 9005 (Turin), up to 4.5 GHz

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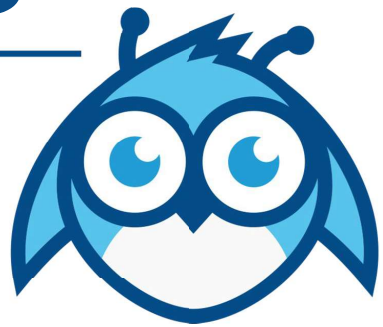
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QUESTIONS ?



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Thank you!