

POSTGRES 500

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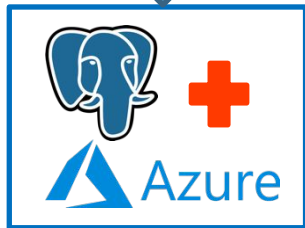
What is 'Postgres 500'?

Live benchmark so everyone can see 'behind the curtain'



HammerDB

Transactional Workload - Consistent workload, scale and concurrency



History of database benchmarking and sizing

- General workloads
 - Transactional
 - Analytical
- Vendor-specific workloads
 - Database-specific
 - Vendor-specific – SAP SD
- More fit-for-purpose
 - Load testing
 - Performance testing
 - IO performance
- Historically benchmarks were focused on **performance NOT economics**

TPC®

\$\$



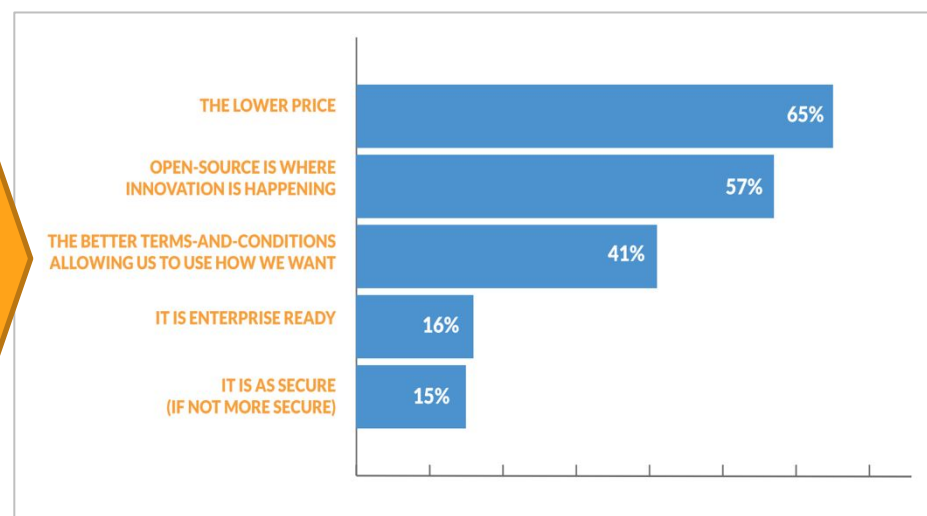
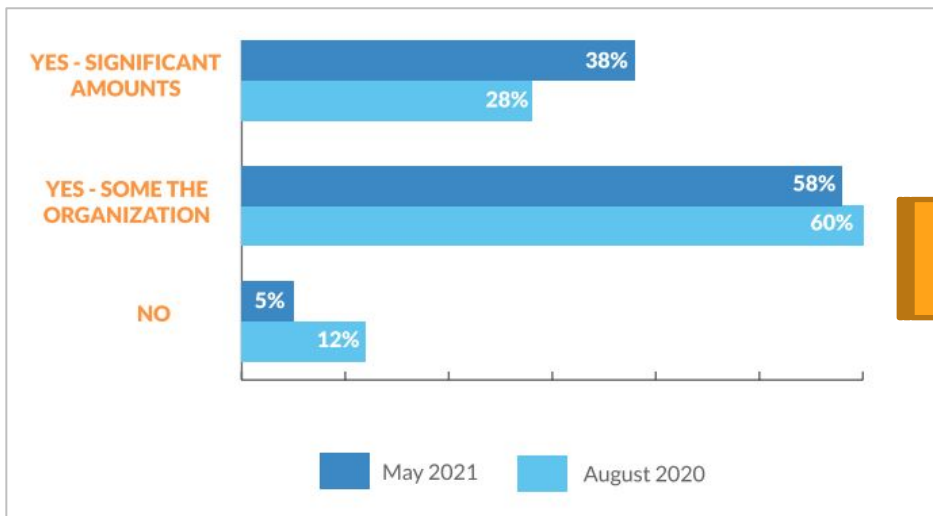
Trends and Joint research

“Driver and Impediments to Corporate Technology Change – 2021 and Beyond”



“Do you think there is wasted money in keeping old technology alive in your organization?”

“Why do you think open-source technology is thriving?”



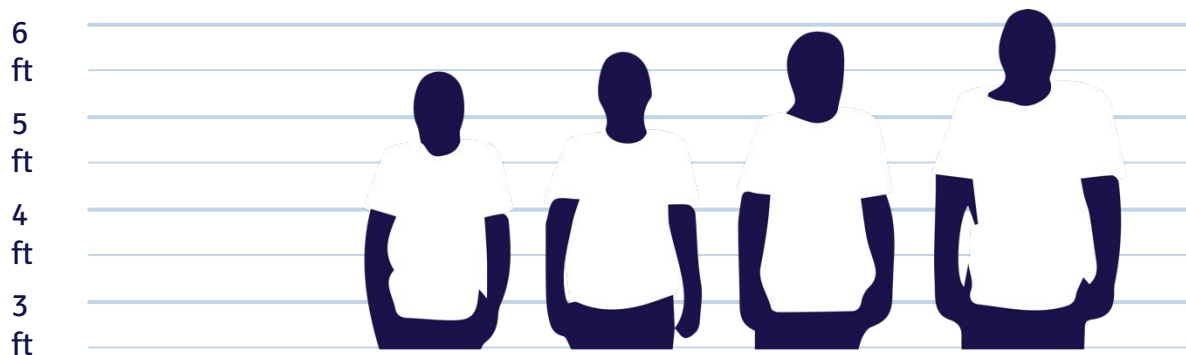
The IT world is no longer a ‘tailored suit’

Up to now:

‘Educated guesses’ and
‘release note analysis’
to understand sizing
and cost.

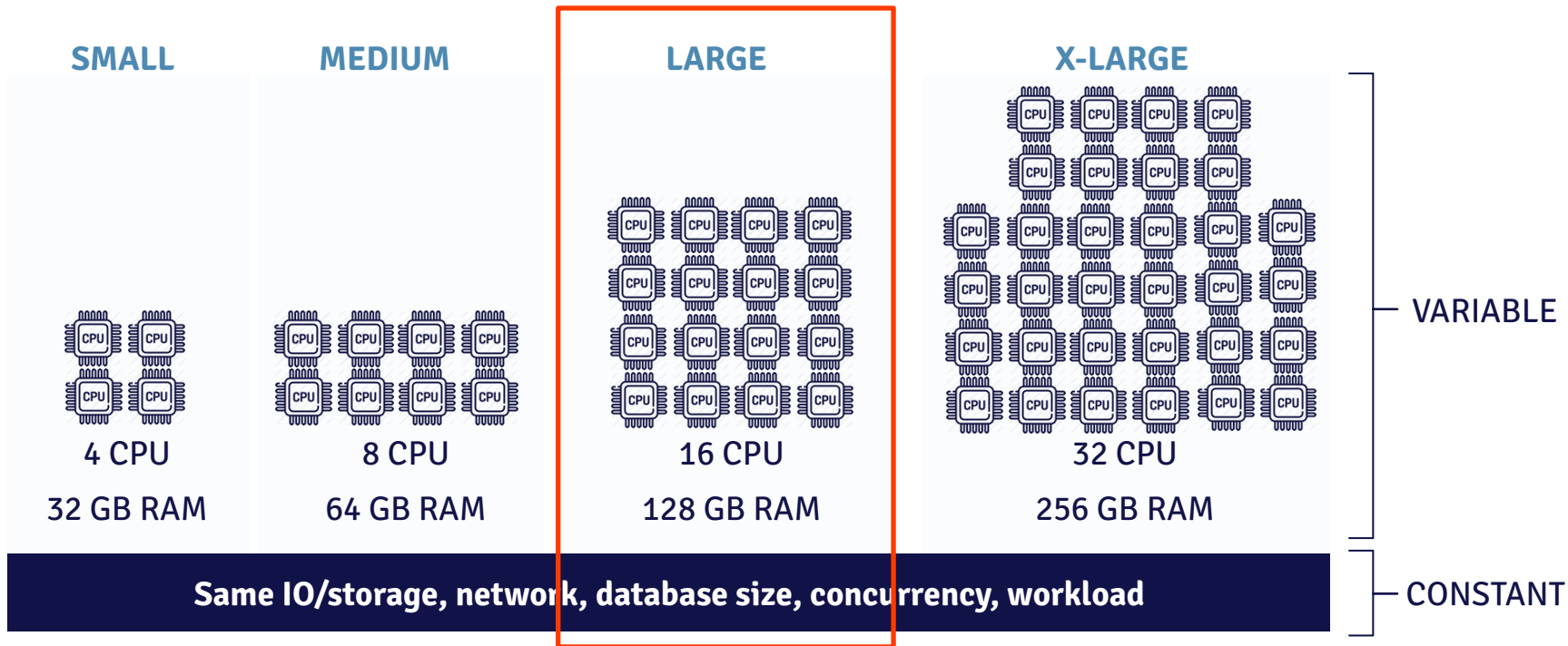


The cloud allows a more elastic 't-shirt' sizing



	S	M	L	XL
Name	Hecto	Jo	Dan	Marcus
Height	5, 4	5, 7	5, 10	6, 1
Weight	125	160	170	225
Chest	33lbs	33lbs	35lbs	42lbs
Waist	32	32	36	38

Think of cloud provisioning as 't-shirt' sizes





LET'S START THE RACE

PowerPoint Slide Show - [header for pg500 race - Sept 10]

Azure VM: E16ds_v4
Intel Platinum 8272CL
(Model 85-Cascade Lake) 16 CPUs - 2.6 Ghz
128GB RAM
600 GB Ultra-7500 IOPS/100MBps
Postgres 13.4

Azure VM: E16s_v3
?Intel UNKNOWN - Any of the last 3 generations (Cascade Lake, Skylake or Broadwell)? - 16 CPUs
128GB RAM
2048 GB - 7500 IOPS
Postgres 13.2

AWS VM: r5n.4xlarge
Intel UNKNOWN - Any of the last 2 generations (Model 85-Cascade Lake) 16 CPUs - 2.5 Ghz
128GB RAM
600 GB io2 @ 7500 IOPS
Postgres 13.2

AWS VM: db.r5.xlarge
Intel UNKNOWN - Any of the last 2 generations (Cascade Lake, r5, ylake) 16 CPUs
128GB RAM
?DISK?
Postgres Compatible 13.3

AWS VM: db.r5.xlarge
Intel UNKNOWN - Any of the last 2 generations (Cascade Lake or Skylake) 16 CPUs
128GB RAM
600 GB io1 @ 7500 IOPS
Postgres 13.3

```

User 5:...1000
User 5:...2000
User 1:Workers: 1 Active 3 Done
User 5:...3000
User 5:Orders Done
User 5:Loading Orders for D=10 W=600
User 5:...1000
User 5:...2000
User 5:...3000
User 5:Orders Done
User 5:End:Thu Sep 09 20:00:49 UTC 2021
User 5:FINISHED SUCCESS
User 1:Workers: 0 Active 4 Done
User 1:CREATING TPCC INDEXES
User 1:CREATING TPCC STORED PROCEDURES
User 1:GATHERING SCHEMA STATISTICS
User 1:TPCC SCHEMA COMPLETE
User 1:FINISHED SUCCESS
ALL VIRTUAL USERS COMPLETE
TPCC-C Driver Script
hammerdb>quit
Shutting down HammerDB CLI
[enterprise@hammerdb-edb ~]$

```

```

User 2:...1000
User 2:...2000
User 2:...3000
User 2:Orders Done
User 2:Loading Orders for D=10 W=150
User 2:...1000
User 2:...2000
User 1:Workers: 1 Active 3 Done
User 2:...3000
User 2:End:Thu Sep 09 20:12:53 UTC 2021
User 2:FINISHED SUCCESS
User 1:Workers: 0 Active 4 Done
User 1:CREATING TPCC INDEXES
User 1:CREATING TPCC STORED PROCEDURES
User 1:GATHERING SCHEMA STATISTICS
User 1:TPCC SCHEMA COMPLETE
User 1:FINISHED SUCCESS
ALL VIRTUAL USERS COMPLETE
TPCC-C Driver Script
hammerdb>quit
Shutting down HammerDB CLI
[enterprise@hammerdb-flex ~]$

```

```

User 4:Loading Orders for D=9 W=450
User 4:...1000
User 4:...2000
User 4:...3000
User 4:Orders Done
User 4:Loading Orders for D=10 W=450
User 4:...1000
User 4:...2000
User 4:...3000
User 4:Orders Done
User 4:End:Thu Sep 09 20:05:04 UTC 2021
User 4:FINISHED SUCCESS
User 1:Workers: 9 Active 4 Done
User 1:CREATING TPCC INDEXES
User 1:CREATING TPCC STORED PROCEDURES
User 1:GATHERING SCHEMA STATISTICS
User 1:TPCC SCHEMA COMPLETE
User 1:FINISHED SUCCESS
ALL VIRTUAL USERS COMPLETE
TPCC-C Driver Script
hammerdb>quit
Shutting down HammerDB CLI
[centos@ip-172-31-81-77 ~]$

```

```

User 4:Loading Orders for D=9 W=450
User 4:...1000
User 4:...2000
User 4:...3000
User 4:Orders Done
User 4:Loading Orders for D=10 W=450
User 4:...1000
User 4:...2000
User 4:...3000
User 4:Orders Done
User 4:End:Thu Sep 09 20:17:08 UTC 2021
User 4:FINISHED SUCCESS
User 1:Workers: 0 Active 4 Done
User 1:CREATING TPCC INDEXES
User 1:CREATING TPCC STORED PROCEDURES
User 1:GATHERING SCHEMA STATISTICS
User 1:TPCC SCHEMA COMPLETE
User 1:FINISHED SUCCESS
ALL VIRTUAL USERS COMPLETE
TPCC-C Driver Script
hammerdb>quit
Shutting down HammerDB CLI
[centos@ip-172-31-80-165 ~]$

```

```

User 5:Loading Orders for D=10 W=600
User 5:...1000
User 5:...2000
User 5:...3000
User 5:Orders Done
User 5:Loading Orders for D=10 W=600
User 5:...1000
User 5:...2000
User 5:...3000
User 5:Orders Done
User 5:End:Thu Sep 09 20:06:20 UTC 2021
User 5:FINISHED SUCCESS
User 1:Workers: 0 Active 4 Done
User 1:CREATING TPCC INDEXES
User 1:CREATING TPCC STORED PROCEDURES
User 1:GATHERING SCHEMA STATISTICS
User 1:TPCC SCHEMA COMPLETE
User 1:FINISHED SUCCESS
ALL VIRTUAL USERS COMPLETE
TPCC-C Driver Script
hammerdb>quit
Shutting down HammerDB CLI
[centos@ip-172-31-81-251 ~]$

```

```

CREATE PROFILE ROLLBACK PREPARE;
CREATE PUBLICATION ROLLBACK TO SAVEPOINT;
CREATE QUEUE SAVEPOINT;
CREATE QUEUE TABLE SECURITY LABEL;
CREATE REDACTION POLICY SELECT;
CREATE RESOURCE GROUP SET;
CREATE ROLE SET CONSTRAINTS;
CREATE RULE SET ROLE;
CREATE SCHEMA SET SESSION AUTH;
CREATE SEQUENCE SET TRANSACTION;
CREATE SERVER SHOW;
CREATE STATISTICS START TRANSACTION;
CREATE SUBSCRIPTION TABLE;
CREATE TABLE AS TRUNCATE;
CREATE TABLESPACE UNLISTEN;
CREATE TEXT SEARCH CONFIGURATION UPDATE;
CREATE TEXT SEARCH DICTIONARY VACUUM;
CREATE TEXT SEARCH PARSER VALUES;
CREATE TEXT SEARCH TEMPLATE WITH;
CREATE TRANSFORM;
tpcc# analyze;
ANALYZE;
tpcc#

```

```

WARNING: skipping 'pg_db_role_setting_databases'
analyze it
WARNING: skipping 'pg_shseclabel_object_index'
analyze it
WARNING: skipping 'pg_replication_origin_oid'
analyze it
WARNING: skipping 'pg_replication_origin_name'
analyze it
WARNING: skipping 'pg_subscription_oid_index'
analyze it
WARNING: skipping 'pg_subscription_subname_index'
analyze it
WARNING: skipping 'pg_authid' --- only superuser
WARNING: skipping 'pg_subscription' --- only super
WARNING: skipping 'pg_database' --- only super
WARNING: skipping 'pg_db_role_setting' --- only su
WARNING: skipping 'pg_tablespace' --- only super
WARNING: skipping 'pg_auth_members' --- only super
WARNING: skipping 'pg_shdepend' --- only super
WARNING: skipping 'pg_subscription' --- only su
WARNING: skipping 'pg_replication_origin' --- on
WARNING: skipping 'pg_shseclabel' --- only super
tpcc#
tpcc#
tpcc#

```

```

wal_buffers = '16384 MB'
wal_writer_delay = '200ms'
wal_writer_flush_after = '1MB'
bgwriter_delay = '200ms'
bgwriter_lru_maxpages = 100
bgwriter_lru_multiplier = 2.0
bgwriter_flush_after = 0
parallel_leader_participation = on
enable_partitionwise_join = on
enable_partitionwise_aggregate = on
log_lock_waits = on
log_temp_files = 0
log_autovacuum_min_duration = 0
log_checkpoints = on
shared_preload_libraries = 'pg_stat_statements'
jit = on
bash-4.4$ psql
psql (13.4.8, server 13.4.8)
Type "help" for help.

tpcc# analyze;
ANALYZE;
tpcc#

```

```

Password:
psql (13.4.8, server 13.3)
SSL connection (protocol: TLSv1.2, cipher: ECDHE-RSA-AES256-GCM-SHA384
&, compression: off)
Type "help" for help.

tpcc#> drop database tpcc;
DROP DATABASE
tpcc#> drop role tpcc;
DROP ROLE
tpcc#> quit
[centos@ip-172-31-89-145 ~]$ psql --host=large.ce.pxrxz4yf.us-east-1
aws.com --port=5432 --username=postgres --password --dbname=tpcc
Password:
psql (13.4.8, server 13.3)
SSL connection (protocol: TLSv1.2, cipher: ECDHE-RSA-AES256-GCM-SHA384
&, compression: off)
Type "help" for help.

tpcc#> analyze;
ERROR: syntax error at or near "analyze"
LINE 1: analyze;
          ^
tpcc#> analyze;
ANALYZE
tpcc#>

```

```

INFO: "customer": scanned 30000 of 284657
nd 0 dead rows; 30000 rows in sample, 10000
INFO: analyzing "public.district"
INFO: "district": scanned 1006 of 1006 pa
ead rows; 6000 rows in sample, 6000 estima
INFO: analyzing "public.history"
INFO: "history": scanned 30000 of 428213
d 0 dead rows; 30000 rows in sample, 17999
INFO: analyzing "public.item"
INFO: "item": scanned 2711 of 2711 pages,
& rows; 30000 rows in sample, 100000 estima
INFO: analyzing "public.warehouse"
INFO: "warehouse": scanned 110 of 110 pag
& rows; 600 rows in sample, 600 estimated
INFO: analyzing "public.stock"

```


The effort at hand

- Evaluate the optimal mix of CPU, RAM, storage and network AND comparable DBaaS
- Use a defensible, standards-based workload that clients can also utilize in their own environment
- Run side-by-side benchmark
- Review the technical and economic result



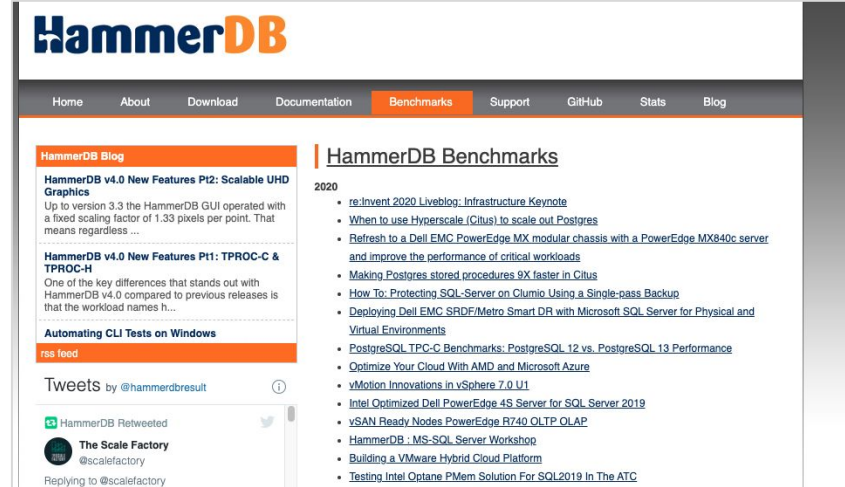
HammerDB TPC[®]



Workloads for this effort – Why?

- HammerDB is open-source – evolving, community and free
- Standards based
 - TPC-C for transactional
 - TPC-H for analytical
- Works with all major databases – Oracle, SQLServer, DB2, MySQL, Postgres

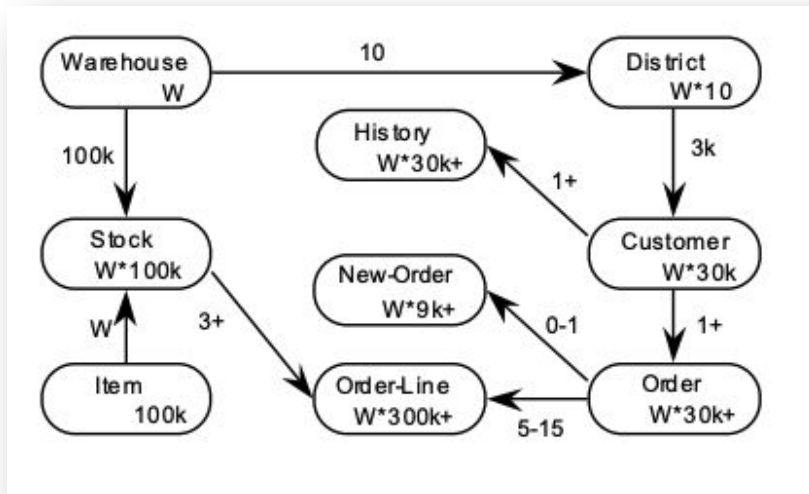
<https://hammerdb.com/>



The screenshot shows the HammerDB website homepage. At the top is the HammerDB logo. Below it is a navigation bar with tabs: Home, About, Download, Documentation, Benchmarks (highlighted), Support, GitHub, Stats, and Blog. The main content area is split into two columns. The left column is titled 'HammerDB Blog' and contains three articles: 'HammerDB v4.0 New Features Pt2: Scalable UHD Graphics', 'HammerDB v4.0 New Features Pt1: TPROC-C & TPROC-H', and 'Automating CLI Tests on Windows'. The right column is titled 'HammerDB Benchmarks' and lists various benchmarks and articles from 2020, including 're:invent 2020 Liveblog: Infrastructure Keynote', 'When to use Hyperscale (Citrus) to scale out Postgres', 'Refresh to a Dell EMC PowerEdge MX modular chassis with a PowerEdge MX840c server and improve the performance of critical workloads', 'Making Postgres stored procedures 9X faster in Citrus', 'How To: Protecting SQL Server on Clumio Using a Single-pass Backup', 'Deploying Dell EMC SRDF/Metro Smart DR with Microsoft SQL Server for Physical and Virtual Environments', 'PostgreSQL TPC-C Benchmarks: PostgreSQL 12 vs. PostgreSQL 13 Performance', 'Optimize Your Cloud With AMD and Microsoft Azure', 'vMotion Innovations in vSphere 7.0 U1', 'Intel Optimized Dell PowerEdge 4S Server for SQL Server 2019', 'vSAN Ready Nodes PowerEdge R740 OLTP OLAP', 'HammerDB : MS-SQL Server Workshop', 'Building a VMware Hybrid Cloud Platform', and 'Testing Intel Optane PMem Solution For SQL2019 In The ATC'. At the bottom left of the screenshot, there is a 'Tweets by @hammerdbresult' section showing a tweet from 'The Scale Factory' retweeting the 'Automating CLI Tests on Windows' article.

Quick Anatomy of TPC-C

- Order Processing Use-case
- Typical Transactional use case
 - Simple SQL
 - Large in volume
- Two primary ‘knobs’ to size the effort
 - Warehouses – database size
 - User Concurrency
- **Resulting measure:**
Transactions-per-minute (TPM)

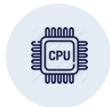


Action Type	Mix
SELECT	75%
INSERT	8%
UPDATES	16%
DELETE	1%



Example: Amazon brings a lot of choices

44 different
choices with '8
cores'



Purpose	Instance Name	CPU	RAM	EBS bandwidth	Network bandwidth	Storage	PER MONTH
General Purpose	a1.2xlarge	8	16		Up to 10	EBS Only	\$93.81
General Purpose	t4g.2xlarge	8	32	Up to 2,780	Up to 5 Gbps	EBS Only	\$123.08
General Purpose	c6g.2xlarge	8	16	Up to 4,750	Up to 10	EBS Only	\$125.12
General Purpose	t3a.2xlarge	8	32		Up to 5 Gbps	EBS Only	\$137.68
General Purpose	m6g.2xlarge	8	32	Up to 4,750	Up to 10	EBS Only	\$141.04
General Purpose	c6gd.2xlarge	8	16	Up to 4,750	Up to 10	1 x 474 NVMe SSD	\$141.25
General Purpose	c5a.2xlarge	8	16	Up to 3,170	Up to 10	EBS Only	\$141.62
General Purpose	t3.2xlarge	8	32		Up to 5 Gbps	EBS Only	\$152.28
General Purpose	c5.2xlarge	8	16	Up to 4,750	Up to 10	EBS Only	\$156.22
General Purpose	c6gn.2xlarge	8	16	Up to 9.5	Up to 25 Gbps	EBS Only	\$159.21
General Purpose	t2.2xlarge	8	32		Moderate	EBS Only	\$167.90
General Purpose	c5d.2xlarge	8	16	Up to 4,750	Up to 10	1 x 200 NVMe SSD	\$176.66
General Purpose	m5.2xlarge	8	32	Up to 4,750	up to 10Gbps	EBS Only	\$176.66
General Purpose	m4.2xlarge	8	32	1,000	High	EBS Only	\$180.89
General Purpose	c4.2xlarge	8	15	1,000	High	EBS Only	\$183.96
Memory Optimized	r6g.2xlarge	8	64	Up to 4,750	Up to 10	EBS Only	\$185.42
General Purpose	c5n.2xlarge	8	16	Up to 4,750	Up to 25 Gbps	EBS Only	\$198.56
Memory Optimized	r5a.2xlarge	8	64	Up to 2,880	Up to 10	EBS Only	\$208.05
General Purpose	m5d.2xlarge	8	32	Up to 4,750	Up to 10Gbps	1 x 300 NVMe	\$208.05
Memory Optimized	r6gd.2xlarge	8	64	Up to 4,750	Up to 10	1 x 474 NVMe SSD	\$211.92
General Purpose	m5n.2xlarge	8	32	Up to 4,750	Up to 25 Gbps	EBS Only	\$219.00
Storage Optimized	h1.2xlarge	8	32		Up to 10 Gigabit	1 x 2,000GB HDD	\$232.14
Memory Optimized	r5.2xlarge	8	64	Up to 4,750	Up to 10 Gbps	EBS Only	\$232.14
Memory Optimized	r5ad.2xlarge	8	64	Up to 2,880	Up to 10	1 x 300 NVMe SSD	\$240.90
Memory Optimized	r4.2xlarge	8	61		Up to 10	EBS Only	\$245.28
General Purpose	m5dn.2xlarge	8	32	Up to 4,750	Up to 25 Gbps	1 x 300 NVMe	\$250.39
Memory Optimized	r5d.2xlarge	8	64	Up to 4,750	Up to 10 Gbps	1 x 300 NVMe	\$264.99
Accelerated Computing	inf1.2xlarge	8	16	Up to 4.75 Gbps	Up to 25 Gbps	EBS Only	\$268.64
Accelerated Computing	f1.2xlarge	8	122		Up to 10	470 GB	\$268.64
Memory Optimized	r5n.2xlarge	8	64	Up to 4,750	Up to 25 Gbps	EBS Only	\$273.75
Memory Optimized	r5b.2xlarge	8	64	Up to 10,000	Up to 10	EBS Only	\$274.12
Memory Optimized	r5b.2xlarge	8	64	Up to 10,000	Up to 10 Gbps	EBS Only	\$274.12
General Purpose	m5zn.2xlarge	8	32	3,170	Up to 25 Gbps	EBS Only	\$303.83
Memory Optimized	r5dn.2xlarge	8	64	Up to 4,750	Up to 25 Gbps	1 x 300 NVMe	\$307.33
Storage Optimized	i3.2xlarge	8	61		Up to 10 Gbps	1 x 1,900 NVMe	\$312.44
Memory Optimized	z1d.2xlarge	8	64		Up to 10 Gigabit	1 x 300 NVMe SSD	\$342.27
Accelerated Computing	g4dn.2xlarge	8	32		Up to 25 Gbps	225 GB	\$346.02
Storage Optimized	i3en.2xlarge	8	64		Up to 25 Gbps	2 x 2,500 NVMe SSD	\$449.68
Storage Optimized	d3.2xlarge	8	64	1,700	Up to 15	6 x 2TB HDD	\$459.17
Storage Optimized	d2.2xlarge	8	61		High	6 x 2000 HDD	\$586.92
Memory Optimized	x1e.2xlarge	8	122	Dedicated 500 Mbps	Up to 10 Gbps	EBS + 120GB SSD	\$750.44
Accelerated Computing	p3.2xlarge	8	61	14 Gbps	Up to 25 Gbps	EBS Only	\$1,524.24
General Purpose	c5ad.2xlarge	8	16	Up to 3,170	Up to 10	1 x 300 NVMe SSD	??
Storage Optimized	d3en.2xlarge	8	32	1,700	Up to 25 Gbps	4 x 14TB HDD	??

93.81/
month



\$1,524.24/
month

The real abstract topic - STORAGE



Google Cloud



- No performance control
- Quoted for **600GB**

Type	MAX 'sustained' IOPS	MAX 'sustained' Throughput
Standard	Read: 450 Write: 900	Read: 72 MB/sec Write: 72 MB/sec
Balanced	Read: 3,600 Write: 3,600	Read: 72 MB/sec Write: 72 MB/sec
SSD	Read: 15,000 Write: 15,000	Read: 240 MB/sec Write: 240 MB/sec

https://cloud.google.com/compute/docs/disks/?&_ga=2.62767211.-658045011.1598996595#pdperformance

- All about which level and what you are willing to pay – **600GB sizing**

Type	MAX 'sustained' IOPS	MAX Throughput
Optimized HDD (st1)		MAX 147 MB/s max
General Purpose SSD (gp2)	3000	
General Purpose SSD (gp3)	3000	500 MB/sec
Provisioned IOPS SSD (io1)	MAX 30,000	
Provisioned IOPS SSD (io2)	MAX 64,000	

https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/ebs-volume-types.html?icmpid=docs_ec2_console

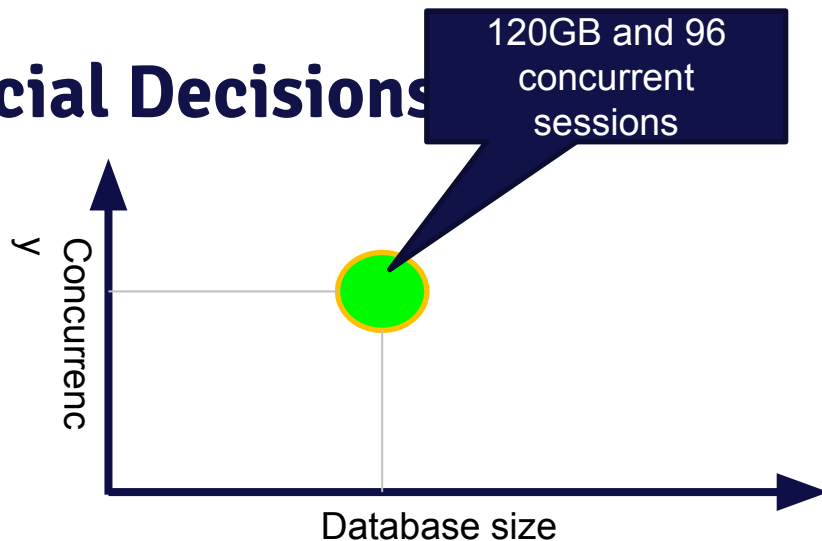
- Azure has 'binary' pricing = 128GB, 256, 512GB, etc.
- **Assume 1024 GB**

Type	MAX 'sustained' IOPS	MAX Throughput
Standard HDD	500	60 MB/sec
Standard SSD	500	60 MB/sec
Premium SSD	5000	200 MB/sec
Ultra Disk	51,200*	768 MB/sec*

<https://docs.microsoft.com/en-us/azure/virtual-machines/disks-types>

NEXT STEP: Technical/Financial Decisions

- Two Dimensions – database size and concurrent sessions
- What virtual machines to use
- What storage to use and how to tune it (where possible)



Storage in the cloud – and price/performance

Example:

Microsoft Azure

$$((\# \text{ of GB} * \$0.15) + (\# \text{ of IOPS} * \$0.06) + (\# \text{ of MBps} * \$1.23)) * 12$$

- Top performing storage: **Ultra Disk**
- You pay for it in discrete increments: 256GB, 512GB, 1024GB, etc
 - i.e. Even if you want a volume of 300GB you pay for 512GB
- You configure:
 - IOPS = operations/sec
 - Throughput = MBps



- Pricing
 - \$0.15/mon per GB
 - \$0.06/mon per IOPS
 - \$1.23/mon per MBps



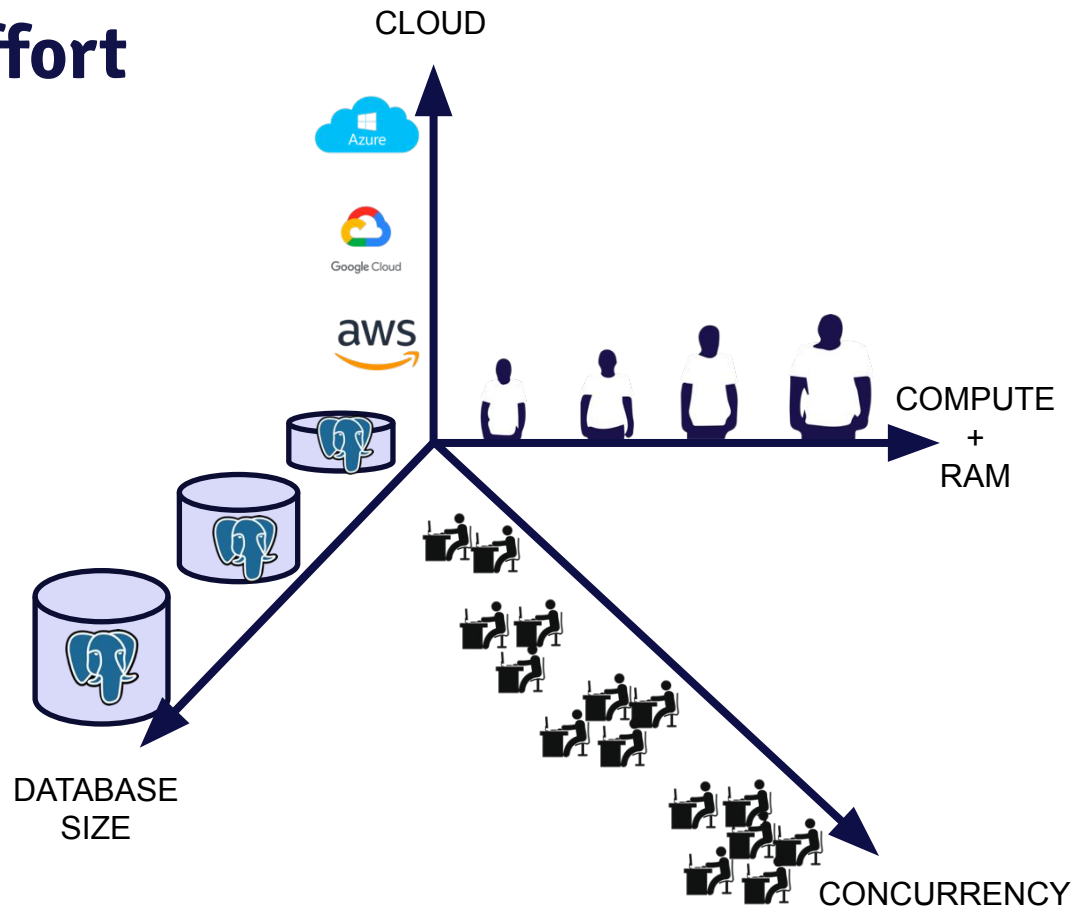
- For our sizing efforts we used the

Name	Size	“Max uncached disk throughput IOPS/MBps”
E4ds_v4	4 CPU/32 GB	6400/96
E8ds_v4	8 CPU/64 GB	12800/192
E16ds_v4	16 CPU/128 GB	25600/384
E32ds_v4	32 CPU/256 GB	51200/768

- Each VM has published ‘limits’

The dimensions of the effort

- HammerDB 3.3 running on its own 4-way server
- Ran over 370 separate benchmark runs across AWS, Azure and Google
- Generated over 34TBs of data/ across different sized instances
- Evaluated different storage, Postgres configurations and more



Storage in the cloud – and price/performance



Example:
Microsoft Azure

- MEDIUM T-Shirt
- 120GB database
- 96 concurrent sessions
- 5 minute 'warm-up' and 30 minute run
- Started with a fresh database each time
- ONLY VARIABLE CHANGE WAS DISK PERFORMANCE!

IOPS	MBps	Result: TPM	Monthly Storage Cost	\$/TPM
35,000	2,000	303,163	\$9,378	\$0.42
20,000	1,000	293,734	\$5,071	\$0.26
15,000	750	285,979	\$3,841	\$0.21
12,800	500	293,383	\$2,954	\$0.17
12,800	200	288,399	\$2,214	\$0.14
10,000	200	286,854	\$1,870	\$0.13
9,000	100	285,301	\$1,624	\$0.12
7,000	100	292,939	\$1,256	\$0.10
6,000	80	287,503	\$1,084	\$0.09

Storage in the cloud – and price/performance

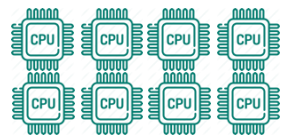


AWS EC2 and
lo2 disk

- MEDIUM T-Shirt
- 120GB database
- 96 concurrent sessions
- 5 minute ‘warm-up’ and 30 minute run
- Started with a fresh database each time
- **ONLY VARIABLE CHANGE WAS DISK PERFORMANCE!**

IOPS	Result: TPM	Monthly Storage Cost	\$/TPM
35,000	352,863	\$2,291	\$0.12
30,000	351,260	\$2,025	\$0.11
20,000	357,431	\$1,375	\$0.09
15,000	354,238	\$1,050	\$0.08
10,000	353,212	\$725	\$0.07
7,000	355,717	\$530	\$0.06
5,000	353,743	\$400	\$0.05
4,000	349,428	\$335	\$0.05
3,500	340,057	\$302	\$0.05
3,000	327,774	\$270	\$0.06

AWS RDS – IOPS, tuning and cost



8 CPU

64 GB
RAM

IO1 IOPS	Storage Cost	Total Annual Cost	Out of the Box Results (TPM)	\$/TPM	EDB Best Efforts Results (TPM)	\$/TPM
30,000	\$36,900	\$45,531	204,145	\$0.22	314,926	\$0.14
20,000	\$24,900	\$32,331	209,761	\$0.15	325,910	\$0.10
15,000	\$18,900	\$25,731	209,485	\$0.12	333,219	\$0.08
10,000	\$12,900	\$19,131	169,537	\$0.11	314,832	\$0.06
7,000	\$9,300	\$15,171	126,055	\$0.12	316,606	\$0.05
5,000	\$6,900	\$12,531	104,271	\$0.12	291,526	\$0.04
4,000	\$5,700	\$11,211	87,239	\$0.13	277,107	\$0.04



Show calculations

600 GB x 0.10 USD = 60.00 USD (Storage Cost)
 10,000 Reads/Second + 10,000 Writes/Second = 20,000 Number of I/Os per second
 20,000 I/Os per second x 730 hours x 60 minutes x 60 Seconds = 52,560,000,000 Number of I/Os per month
 52,560,000,000 x 0.0000002 USD = 10,512.00 USD (I/O Rate Cost)
 60.00 USD + 10,512.00 USD = 10,572.00 USD
Storage pricing (monthly): 10,572.00 USD

Other Observations - AWS

- RDS - 180 Postgres Conf parameters **cannot** be changed
- Limited in how often you can change the instance
- Death-by-monitoring tools – Cloud Watch, Performance Insights....\$\$\$\$



Modify DB instance: xl

Summary of modifications
 You are about to submit the following modifications. Only values that will change are displayed. Carefully verify your changes and click Modify DB Instance.

Attribute	Current value	New value
Allocated storage	600 GiB	600 GiB
Provisioned IOPS	7000	10000

Scheduling of modifications

When to apply modifications

Apply during the next scheduled maintenance window
 Current maintenance window: March 11, 2021 02:19 - 02:49 UTC-6

Apply immediately
 The modifications in this request and any pending modifications will be asynchronously applied as soon as possible, regardless of the maintenance window setting for this database instance.

We're sorry, your request to modify DB instance xl has failed.
 You can't currently modify the storage of this DB instance. Try again after approximately 1 hours.

nsensit 300 Provisioned IOPS SSD (io1) 15000 N/A

nsensit 300 Provisioned IOPS SSD (io2) 64000 N/A

Modify Volume

Error
 You've reached the maximum modification rate per volume limit. Wait at least 6 hours between modifications per EBS volume.
 Learn more about resizing an EBS volume on [Linux](#) and [Windows](#).

Cancel Back **Retry**

Provisioned IOPS SSD volumes can range in size from 4 GiB to 16 TiB. You can provision from 100 IOPS up to 64,000 IOPS per volume on **Instances built on the Nitro System** and up to 32,000 on other instances. The maximum ratio of provisioned IOPS to requested volume size (in GiB) is **50:1** for io1 volumes, and 500:1 for io2 volumes. For example, a 100 GiB io1 volume can be provisioned with up to 5,000 IOPS, while a 100 GiB io2 volume can be provisioned with up to 50,000 IOPS. On a supported instance type, the following volume sizes allow provisioning up to the 64,000 IOPS maximum:

- io1 volume 1,280 GiB in size or greater (50 × 1,280 GiB = 64,000 IOPS)
- io2 volume 128 GiB in size or greater (500 × 128 GiB = 64,000 IOPS)

Other interesting observations



AWS Database Blog

Common administrator responsibilities on Amazon RDS and Amazon Aurora for PostgreSQL databases

by John Solomon | on 18 MAY 2020 | in Amazon Aurora, Amazon RDS, PostgreSQL Compatible, RDS For PostgreSQL | Permalink | Comments | Share

Monitoring the database

Monitoring is an integral part of maintaining the reliability, availability, and performance of Amazon RDS and your AWS solutions. Collect monitoring data from all the parts of your AWS solution so that you can debug a multi-point failure if one occurs. One of the major tasks is to set up a detailed level of monitoring for your Amazon RDS and Aurora instances.

Amazon Aurora and Amazon RDS offer two types of monitoring by default: [Amazon CloudWatch](#) and [Amazon RDS Performance Insights](#).

Monitoring with CloudWatch

CloudWatch offers the following metrics available for Amazon RDS and Aurora PostgreSQL:

- High CPU or RAM consumption
- Disk space consumption
- Network traffic
- Database connections
- IOPS metrics
- Maximum Used Transaction IDs
- Queue Depth

For more information, see [Monitoring Amazon Aurora DB Cluster Metrics](#).

CloudWatch has many metrics available to monitor the health of the Amazon RDS and Aurora instances at the hardware level. However, you must configure [Amazon SNS](#) (alarm) on each metric.

Monitoring with Performance Insights



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How can I decrease the total provisioned storage size of my Amazon RDS DB instance?

Last updated: 2020-06-22

I want to decrease the total allocated storage size of my Amazon Relational Database Service (Amazon RDS) DB instance. How can I do this?

Short description

After you create an Amazon RDS DB instance, you can't modify the allocated storage size of the DB instance to decrease the total storage space it uses. To decrease the storage size of your DB instance, create a new DB instance that has less provisioned storage size. Then, migrate your data into the new DB instance using one of the following methods:

- Use the database engine's native dump and restore method.
Note: This method causes some downtime.
- Use AWS Database Migration Service (AWS DMS) for minimal downtime.

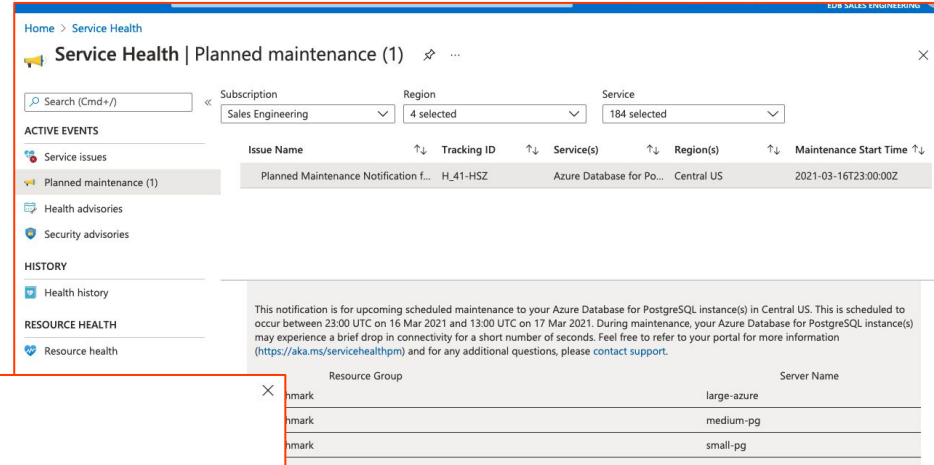
Resolution

DB dump and restore



Other Observations - Azure

- 155 Postgres Conf parameters **cannot** be changed
- **Single Server** is built on:
 - Old 7 year old Broadwell CPU
 - 3 IOPS/GB storage performance
 - Postgres 11.6
 - Built on Windows Server
- **Flexible Server** is built on:
 - Not sure – you don't get to choose
 - 4-5 IOPS/GB storage performance



Home > Service Health

Service Health | Planned maintenance (1)

Search (Cmd+/) Subscription: Sales Engineering Region: 4 selected Service: 184 selected

ACTIVE EVENTS

- Service issues
- Planned maintenance (1)
- Health advisories
- Security advisories

HISTORY

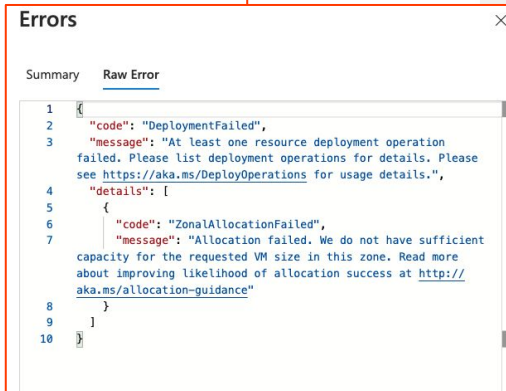
- Health history

RESOURCE HEALTH

- Resource health

This notification is for upcoming scheduled maintenance to your Azure Database for PostgreSQL instance(s) in Central US. This is scheduled to occur between 23:00 UTC on 16 Mar 2021 and 13:00 UTC on 17 Mar 2021. During maintenance, your Azure Database for PostgreSQL instance(s) may experience a brief drop in connectivity for a short number of seconds. Feel free to refer to your portal for more information (<https://aka.ms/servicehealthpm>) and for any additional questions, please contact support.

Resource Group	Server Name
hmark	large-azure
hmark	medium-pg
hmark	small-pg



Errors

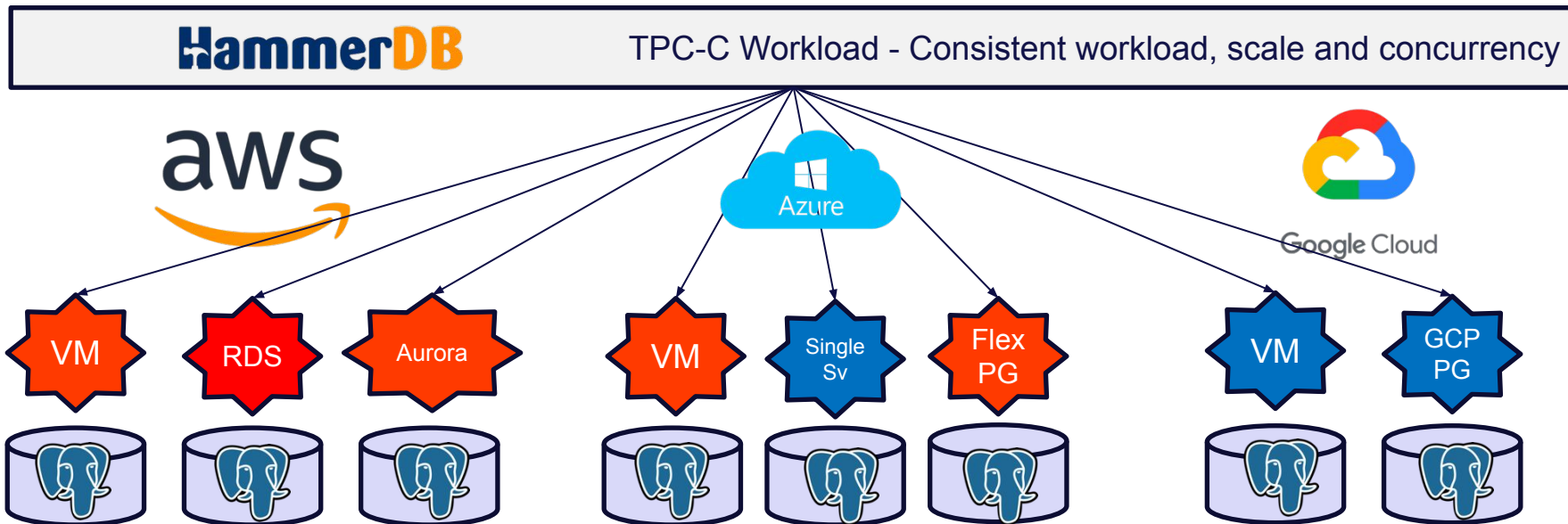
Summary Raw Error

```

1  {
2    "code": "DeploymentFailed",
3    "message": "At least one resource deployment operation
4    failed. Please list deployment operations for details. Please
5    see https://aka.ms/DeployOperations for usage details.",
6    "details": [
7      {
8        "code": "ZonalAllocationFailed",
9        "message": "Allocation failed. We do not have sufficient
10       capacity for the requested VM size in this zone. Read more
11       about improving likelihood of allocation success at http://
12       aka.ms/allocation-guidance"
13     }
14   ]
15 }

```

Multi-Cloud Sizing and Benchmarking – to help you decide



Deliverables to you

Make it all more predictable and prescriptive



“How to” –
Legacy workload
evaluation
documents and
reproducible scripts



“eBook” - Best practices
around cloud setup and
database configuration



GitHub Scripts

- To allow you to execute your own ‘race’ and sizing effort.



Calculator - Financial
business case formulas
and documents to help
speak in ‘debit/credit’
lexicon

Key Takeaways

- It is difficult to technically compare cloud database offerings – but **cost-per-transaction** is the most important measure.
- Most enterprises inadvertently **over-provision and over-pay** for databases-in-the-cloud.
- Cloud-as-a-service offerings **restrict** your flexibility to tune, configure and optimize based on your unique workloads.
- Some DBaaS offerings are built on obsolete hardware and older releases of Postgres
- ***Let us know if you want to have a specific conversation by cloud and need***
- **MORE TO COME!!**



HANDS ON COMPARISON: Are the cloud Postgres database-as-a-service all they are cracked up to be?

Register for
POSTGRES

JUNE 22 - 23

postgresvision.com

Wednesday, June 23 • 10:15am - 11:00am

[Back To Schedule](#)

HANDS ON COMPARISON: Are the cloud Postgres database-as-a-service all they are cracked up to be?

<https://sched.co/j8M4>

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How do you measure what makes sense from the cloud today? EDB has taken a standard workload and completed extensive comparisons-and-contrasts of AWS, Azure and Google Cloud and want to make sure you know how they stack up. It is easy to think they have turned Postgres into 'a service', but this session will review the technical and economics of each of these options - with a resulting \$/transaction you can take to the bank.

Speakers



Tom Rieger

Senior Sales Engineer, EDB

Tom Rieger is a senior solutions engineer for EDB and brings over 30 years of technology experiences across the data landscape always focused on relational technologies. Working in information technologies for companies like Textron and Labatt (yes - the beer) along with vendors like... [Read More](#) →



Mark Wong

Performance Engineer, EDB

Mark Wong is currently employed by EDB as a Performance Engineer and is a PostgreSQL Major Contributor. His background is in database systems solutions and performance. He first introduced himself to the PostgreSQL community in 2003 with open source benchmarking kits and performance... [Read More](#) →

and customers

gues

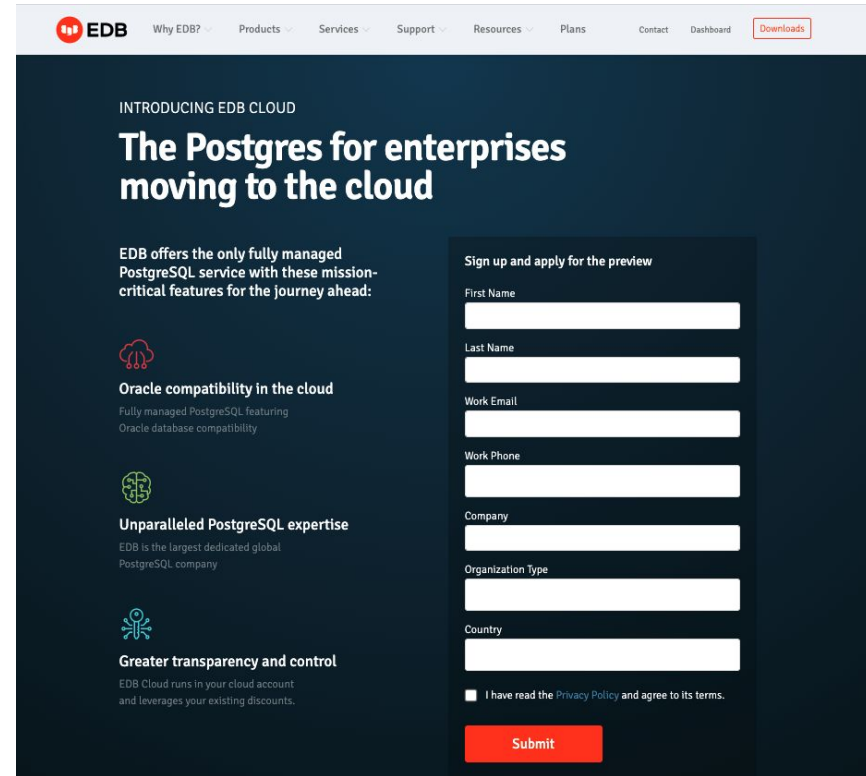


PostgreSQL community connection

You are invited to try something

EDB brings you the best of both worlds

- EDB brings to you a ‘preview’ of what a real database-as-a-services offering should be
- Enterprise focus on the database
- Greater transparency and control – to optimize your cost/transaction!
- www.enterprisedb.com



The screenshot shows the EDB Cloud landing page. At the top, there is a navigation bar with the EDB logo and links for 'Why EDB?', 'Products', 'Services', 'Support', 'Resources', 'Plans', 'Contact', 'Dashboard', and a 'Downloads' button. The main content area has a dark blue background with the heading 'INTRODUCING EDB CLOUD' and a large sub-heading 'The Postgres for enterprises moving to the cloud'. Below this, there is a paragraph stating 'EDB offers the only fully managed PostgreSQL service with these mission-critical features for the journey ahead:'. This is followed by four feature sections, each with an icon and a title: 'Oracle compatibility in the cloud' (with a cloud icon), 'Unparalleled PostgreSQL expertise' (with a brain icon), and 'Greater transparency and control' (with a person icon). The fourth section is partially cut off. On the right side of the page, there is a sign-up form titled 'Sign up and apply for the preview' with input fields for 'First Name', 'Last Name', 'Work Email', 'Work Phone', 'Company', 'Organization Type', and 'Country'. At the bottom of the form, there is a checkbox for 'I have read the Privacy Policy and agree to its terms.' and a red 'Submit' button.

What you can expect after the webinar

An email from me with.....

- Access to a recording of this webinar
- Access to the slides presented today
- Where you can find the Github library which include repeatable scripts
- Fundamental HammerDB how-to guide to try this yourself
- Where to find the research paper referenced
- Answer any questions



In closing



Questions

Please make sure if you have questions to type them into the tool



Exit survey

There is an exit survey that will pop up – please tell us your thoughts on this webinar



Contact us

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tom.rieger@enterprisedb.com
CALL ME – 952-221-6514
<LINKEDIN>