RDS for PostgreSQL

# Performance White Paper

**Issue** 01

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# Contents



# 1 Test Method

PostgreSQL is an open-source object-relational database management system with an emphasis on extensibility and standards compliance. It is known as the most advanced open-source database. It excels in processing complex online transaction processing (OLTP) transactions and supports NoSQL (JSON, XML, or hstore) and geographic information system (GIS) data types. It has earned a reputation for reliability and data integrity, and is widely used for websites, location-based applications, and complex data object processing.

- RDS for PostgreSQL supports the PostGIS extension and provides excellent spatial performance.
- RDS for PostgreSQL is a good cost-effective solution for many different scenarios. You can flexibly scale resources based on your service requirements and pay for only what you use.

## Test Environment

- ECS: general computing | c3.2xlarge.2 | 8 vCPUs | 16 GB, CentOS7.4 64 bit image. Bind an EIP to the ECS because additional compilation tools need to be installed on stress testing tools.

  NOTE

  The test environment is as follows:

  - ECS: general computing-plus | c6.4xlarge.2 | 16 vCPUs | 32 GB, CentOS 7.6 (64-bit). Bind an EIP to the ECS because additional compilation tools need to be installed on stress testing tools.

## Test Tool

Sysbench is a multi-threaded benchmark tool based on LuaJIT. It is most frequently used for database benchmarks. With sysbench, you can quickly get an impression of database performance. For details, visit **https://github.com/akopytov/sysbench**.

**Sysbench 1.0.18** is used as an example. Run the following commands to install it:

```
#wget -c https://github.com/akopytov/sysbench/archive/1.0.18.zip
#yum install make automake libtool pkgconfig libaio-devel postgresql-devel
#unzip 1.0.18.zip
#cd sysbench-1.0.18
#./autogen.sh
```

```
#./configure --with-pgsql --without-mysql
#make
#make install
```

## Test Procedure

Replace the database name, connection IP address, and user password based on the site requirements.

**Step 1** Import data.

1. Run the following commands to log in to a database and create the test database **loadtest**:

   ```
   psql -h<host> -p5432 "dbname=postgres user=root password=<password>" <<TEST
   create database loadtest;
   TEST
   ```

2. Run the following command to import the test background data to the **loadtest** database:

   ```
   sysbench --test=/usr/local/share/sysbench/tests/include/oltp_legacy/oltp.lua --db-driver=pgsql --pgsql-db=loadtest --pgsql-user=root --pgsql-password=<password> --pgsql-port=5432 --pgsql-host=<host> --oltp-tables-count=64 --oltp-table-size=10000000 --num-threads=20 prepare
   ```

**Step 2** Run the following command to perform a stress testing:

```
sysbench --test=/usr/local/share/sysbench/tests/include/oltp_legacy/oltp.lua --db-driver=pgsql --pgsql-db=loadtest --pgsql-user=root --pgsql-password=<password> --pgsql-port=5432 --pgsql-host=<host> --oltp-tables-count=64 --oltp-table-size=10000000 --max-time=3600 --max-requests=0 --num-threads=64 --report-interval=3 --forced-shutdown=1 run
```

**Step 3** Run the following command to delete the test data:

```
sysbench --test=/usr/local/share/sysbench/tests/include/oltp_legacy/oltp.lua --db-driver=pgsql --pgsql-db=loadtest --pgsql-user=root --pgsql-password=<password> --pgsql-port=5432 --pgsql-host=<host> --oltp-tables-count=64 --oltp-table-size=10000000 --max-time=3600 --max-requests=0 --num-threads=200 cleanup
```

**----End**

## Testing Model

1. Table structure:

   ```
   CREATE TABLE `sbtest` (
   `id` INTEGER IDENTITY(1,1) NOT NULL,
   `k` INTEGER DEFAULT '0' NOT NULL,
   `c` CHAR(120) DEFAULT '' NOT NULL,
   `pad` CHAR(60) DEFAULT '' NOT NULL,
   PRIMARY KEY (`id`)
   )
   ```

2. Read/write ratio:

   The default transaction submitted by sysbench contains 18 SQL statements. The details are as follows:

   - Ten primary key SELECT statements:

     ```
     SELECT c FROM ${rand_table_name} where id=${rand_id};
     ```

   - Four range SELECT statements:

     ```
     SELECT c FROM ${rand_table_name} WHERE id BETWEEN ${rand_id_start} AND ${rand_id_end};
     SELECT SUM(K) FROM ${rand_table_name} WHERE id BETWEEN ${rand_id_start} AND ${rand_id_end};
     SELECT c FROM ${rand_table_name} WHERE id BETWEEN ${rand_id_start} AND ${rand_id_end} ORDER BY c;
     SELECT DISTINCT c FROM ${rand_table_name} WHERE id BETWEEN ${rand_id_start} AND ${rand_id_end} ORDER BY c;
     ```

   - Two UPDATE statements:

```
UPDATE ${rand_table_name} SET k=k+1 WHERE id=${rand_id}
UPDATE ${rand_table_name} SET c=${rand_str} WHERE id=${rand_id}
```

  - One DELETE statement:

    ```
    DELETE FROM ${rand_table_name} WHERE id=${rand_id}
    ```

  - One INSERT statement:

    ```
    INSERT INTO ${rand_table_name} (id, k, c, pad) VALUES (${rand_id},${rand_k},${rand_str_c},${rand_str_pad})
    ```

## Test Metrics

- Transactions per second (TPS) refers to the number of transactions executed per second by a database. Each transaction contains 18 SQL statements.
- Queries per second (QPS) refers to the number of SQL statements, including INSERT, SELECT, UPDATE, and DELETE statements, executed per second.

# 2 RDS for PostgreSQL 12 Test Data

## 2.1 General-Purpose DB Instances

### About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

### Test Data

**Table 2-1** vCPU:Memory = 1:2

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 1 | 2 | 172.88 | 3,457.69 | See **About IOPS**. |
| 2 | 4 | 387.63 | 7,752.63 | |
| 4 | 8 | 823.89 | 16,477.76 | |
| 8 | 16 | 1538.08 | 30761.58 | |

**Table 2-2** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 461.22 | 9,224.35 | See **About IOPS**. |
| 4 | 16 | 843.00 | 16,860.02 | |
| 8 | 32 | 1,786.72 | 35,734.52 | |

### Test Results

**Figure 2-1** vCPU:Memory = 1:2

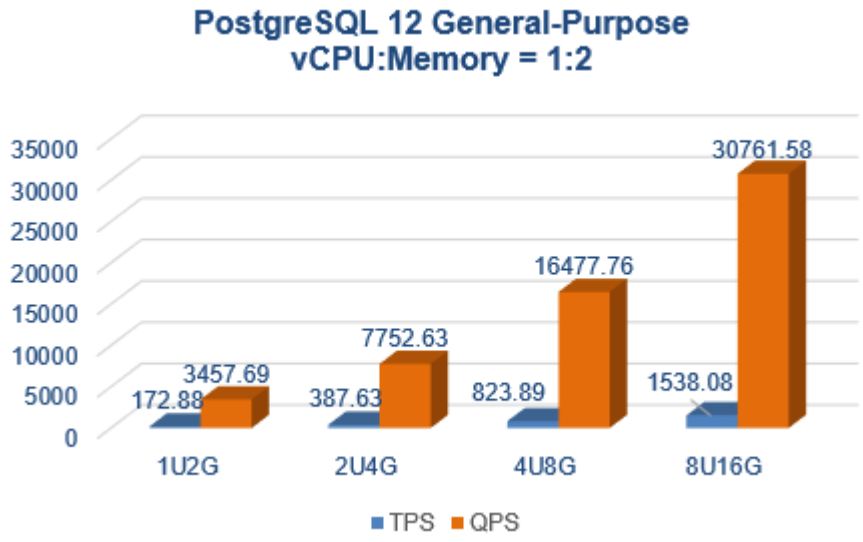
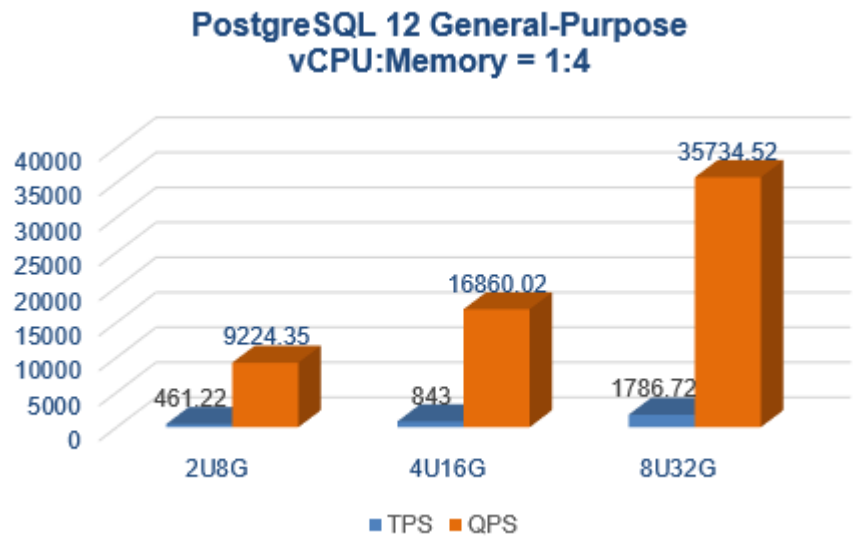



**Figure 2-2** vCPU:Memory = 1:4




## 2.2 Dedicated DB Instances

### About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

## Test Data

**Table 2-3** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 435.68 | 8,713.58 | See **About IOPS**. |
| 4 | 16 | 938.77 | 18,775.34 | |
| 8 | 32 | 1,735.35 | 34,707.2 | |
| 16 | 64 | 2,482.57 | 49,652.9 | |
| 32 | 128 | 4,875.01 | 97,508.19 | |
| 64 | 256 | 8,839.4 | 176,804.32 | |

**Table 2-4** vCPU:Memory = 1:8

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 16 | 497.57 | 9,951.38 | See **About IOPS**. |
| 4 | 32 | 1,001.21 | 20,024.11 | |
| 8 | 64 | 1,978.29 | 39,566.03 | |
| 16 | 128 | 3,513.35 | 70,267.23 | |
| 64 | 512 | 12,032.16 | 240,671.39 | |

## Test Results

**Figure 2-3** vCPU:Memory = 1:4

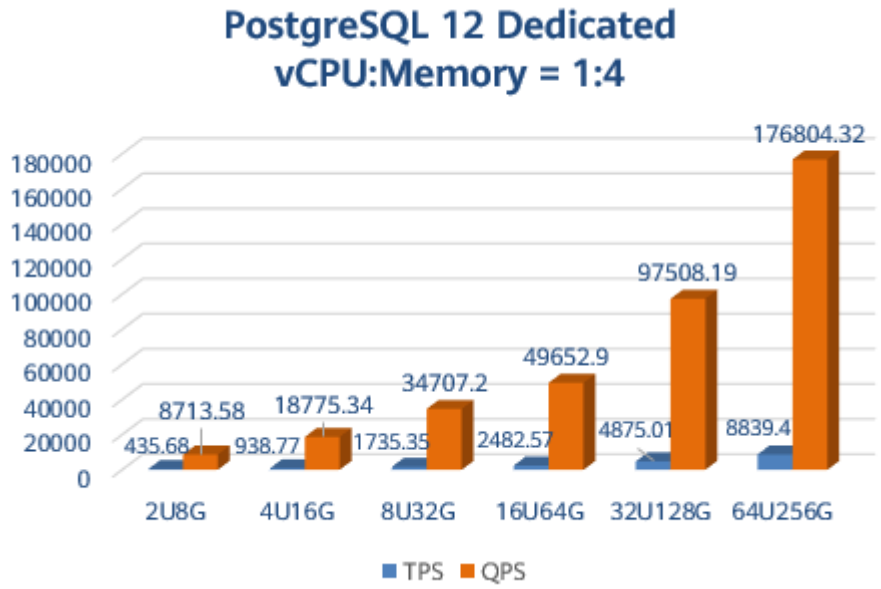
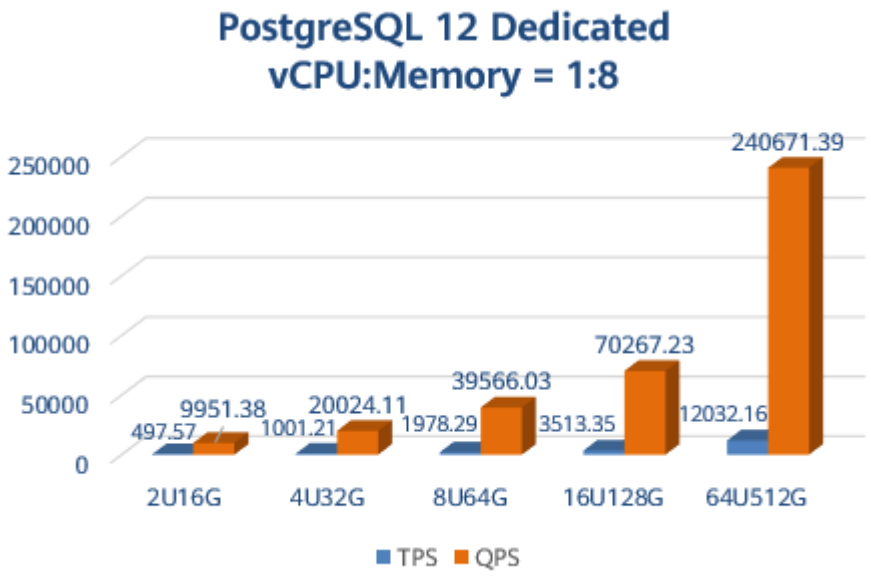


**Figure 2-4** vCPU:Memory = 1:8



# 3 RDS for PostgreSQL 13 Test Data

## 3.1 General-Purpose DB Instances

### About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

### Test Data

**Table 3-1** vCPU:Memory = 1:2

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 1 | 2 | 178.71 | 3,574.29 | See **About IOPS**. |
| 2 | 4 | 372.52 | 7,450.35 | |
| 4 | 8 | 848.15 | 16,963.08 | |
| 8 | 16 | 1,505.10 | 30,101.94 | |

**Table 3-2** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 425.26 | 8,505.16 | See **About IOPS**. |
| 4 | 16 | 879.52 | 17,590.53 | |
| 8 | 32 | 1,764.29 | 35,285.91 | |

### Test Results

**Figure 3-1** vCPU:Memory = 1:2

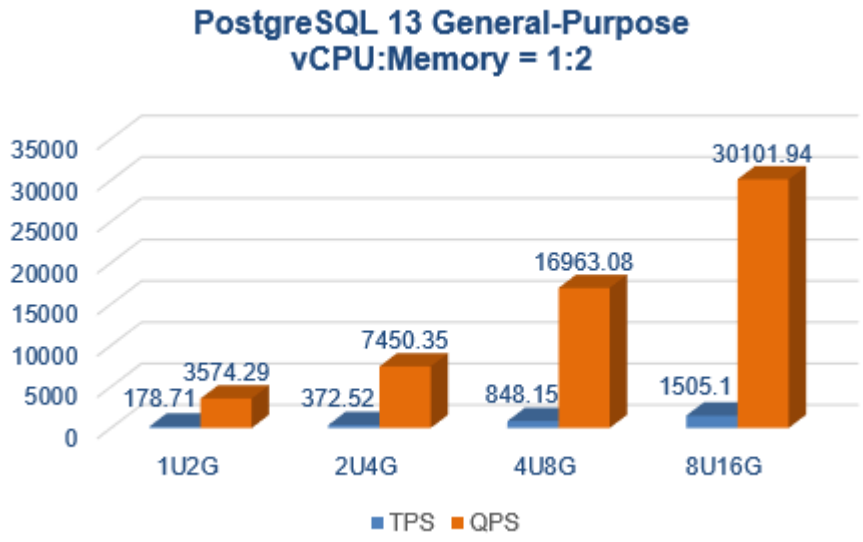
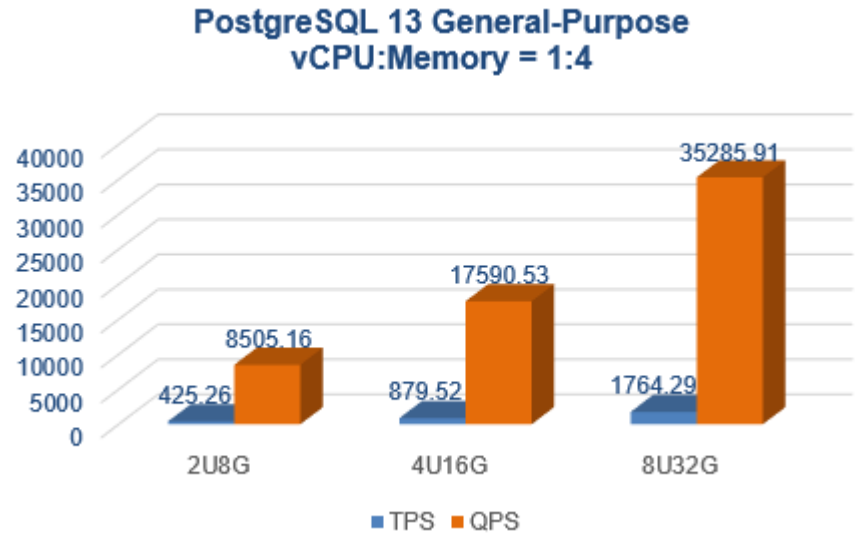



**Figure 3-2** vCPU:Memory = 1:4




## 3.2 Dedicated DB Instances

### About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

## Test Data

**Table 3-3** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 437.45 | 8,748.99 | See **About IOPS**. |
| 4 | 16 | 896.84 | 17,936.72 | |
| 8 | 32 | 1,819.93 | 36,398.77 | |
| 16 | 64 | 2,600.93 | 52,018.73 | |
| 32 | 128 | 5,428.06 | 108,572.08 | |
| 64 | 256 | 12,102.77 | 242,079.30 | |

**Table 3-4** vCPU:Memory = 1:8

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 16 | 528.85 | 10,577.07 | See **About IOPS**. |
| 4 | 32 | 1,002.06 | 20,041.23 | |
| 8 | 64 | 1,904.04 | 38,080.91 | |
| 16 | 128 | 3,928.59 | 78,572.08 | |
| 64 | 512 | 7,485.78 | 149,732.20 | |

## Test Results

**Figure 3-3** vCPU:Memory = 1:4

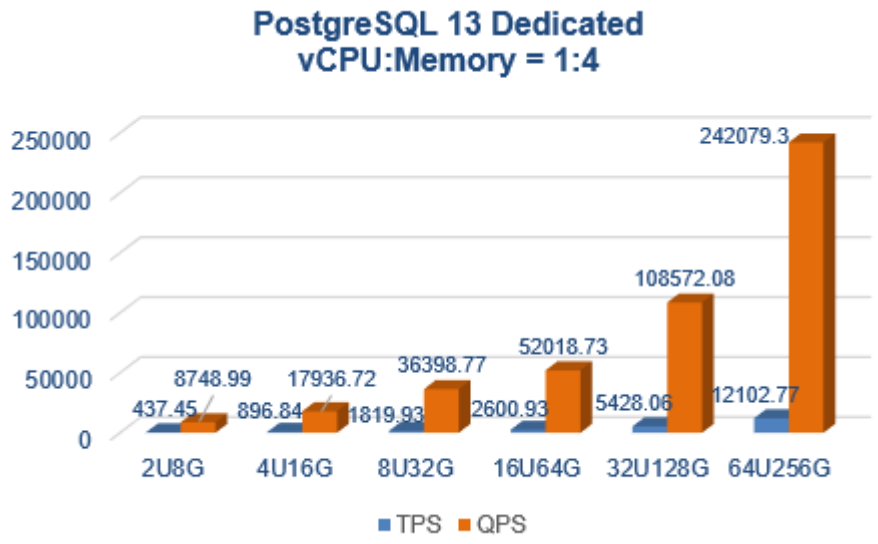
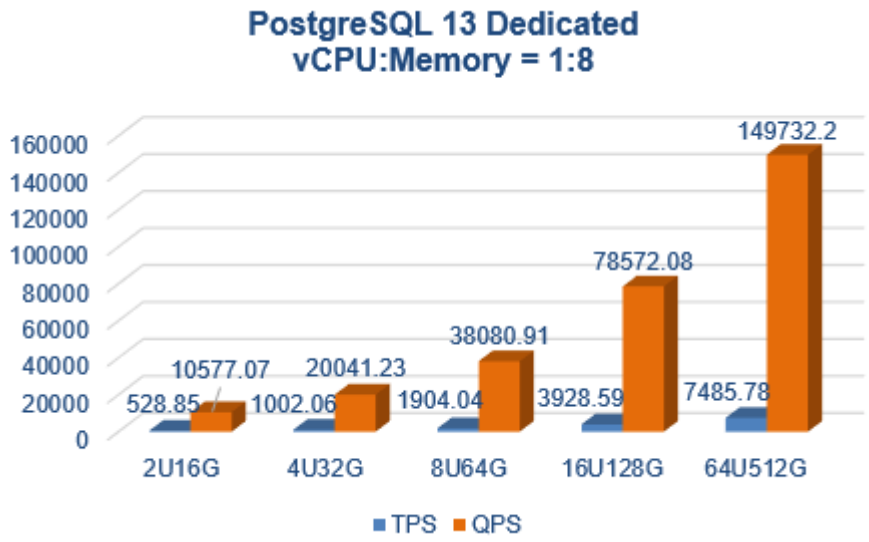


**Figure 3-4** vCPU:Memory = 1:8



# 4 RDS for PostgreSQL 14 Test Data

## 4.1 General-Purpose DB Instances

This section provides test data of RDS for PostgreSQL 14 x86-based general-purpose instances using cloud SSDs.

### About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

### Test Data

**Table 4-1** vCPU:Memory = 1:2

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 1 | 2 | 176.26 | 3,525.27 | See **About IOPS**. |
| 2 | 4 | 385.70 | 7,713.97 | |
| 4 | 8 | 784.54 | 15,690.82 | |
| 8 | 16 | 1,560.41 | 31,208.18 | |

**Table 4-2** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 429.02 | 8,580.42 | See **About IOPS**. |
| 4 | 16 | 999.26 | 19,985.14 | |

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 8 | 32 | 1,788.29 | 35,765.97 | |

## Test Results

**Figure 4-1** vCPU:Memory = 1:2

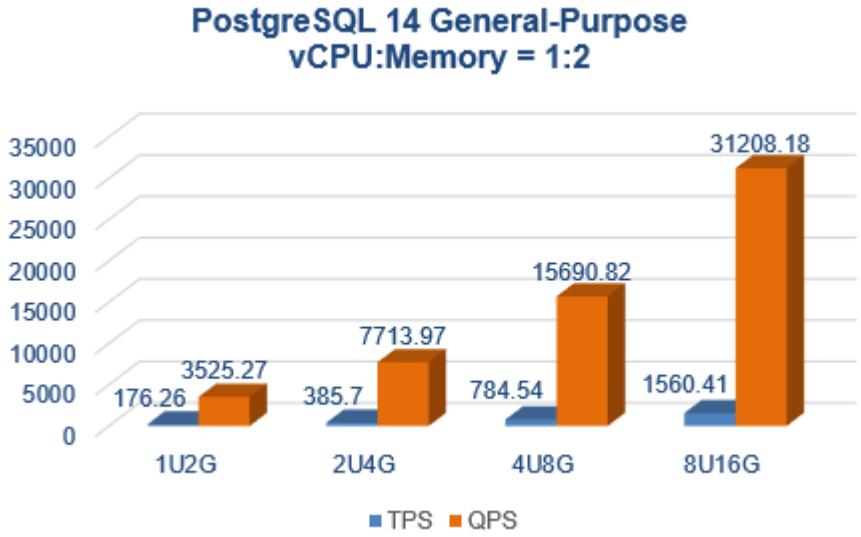
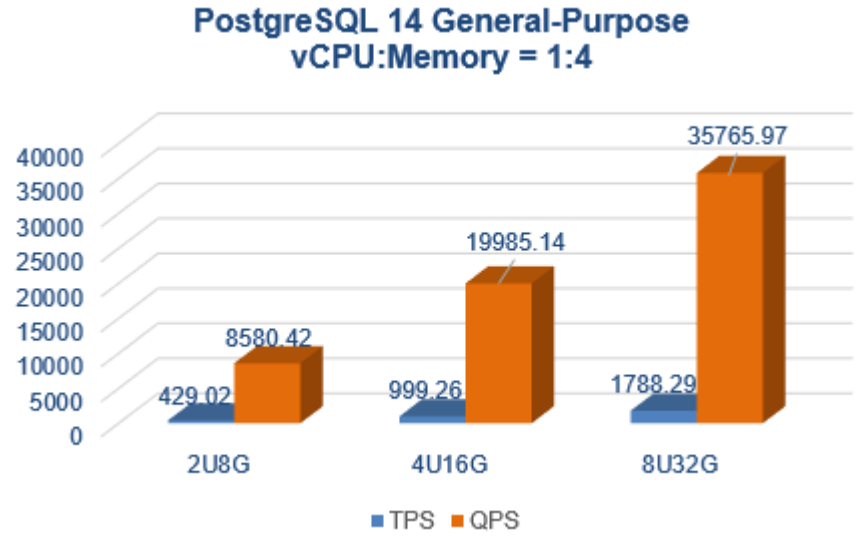



**Figure 4-2** vCPU:Memory = 1:4




# 4.2 Dedicated DB Instances

This section provides test data of RDS for PostgreSQL 14 x86-based dedicated instances using cloud SSDs.

## About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

## Test Data

**Table 4-3** vCPU:Memory = 1:2

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 4 | 373.53 | 7,470.64 | See **About IOPS**. |
| 4 | 8 | 748.80 | 14,976.09 | |
| 8 | 16 | 1,563.35 | 31,266.94 | |
| 16 | 32 | 1,873.68 | 37,473.69 | |

**Table 4-4** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 472.01 | 9,440.15 | See **About IOPS**. |
| 4 | 16 | 994.46 | 19,889.28 | |
| 8 | 32 | 1,806.45 | 36,129.18 | |
| 16 | 64 | 2,551.62 | 51,032.43 | |

**Table 4-5** vCPU:Memory = 1:8

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 16 | 463.48 | 9,269.67 | See **About IOPS**. |
| 4 | 32 | 1,103.30 | 22,065.92 | |
| 8 | 64 | 1,996.53 | 39,930.74 | |
| 16 | 128 | 3,778.67 | 75,573.89 | |

## Test Results

**Figure 4-3** vCPU:Memory = 1:2

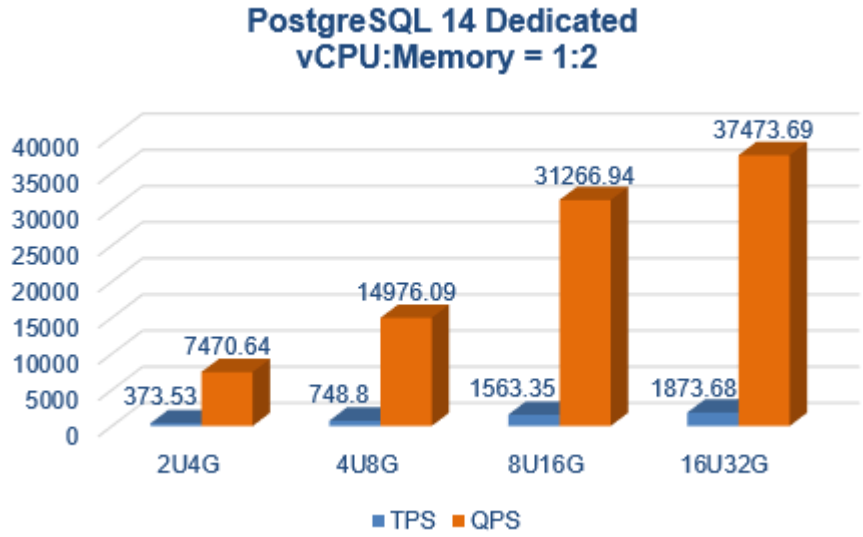



**Figure 4-4** vCPU:Memory = 1:4

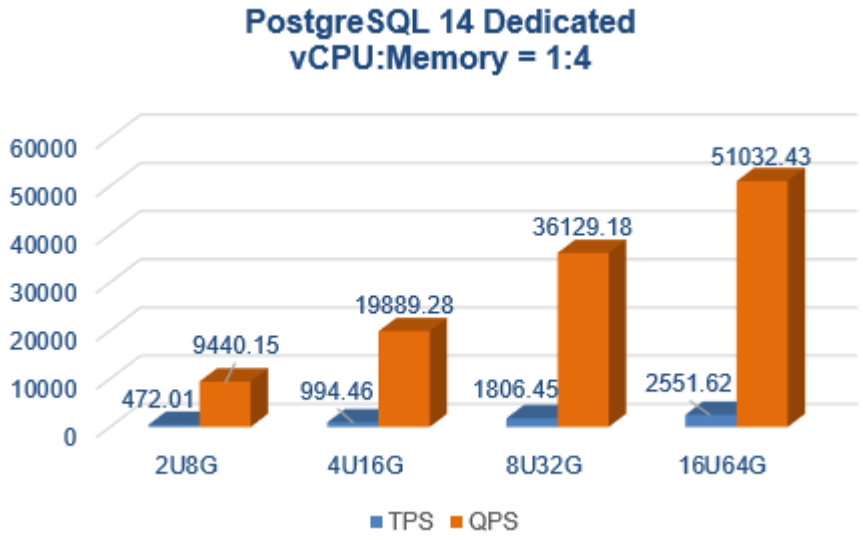
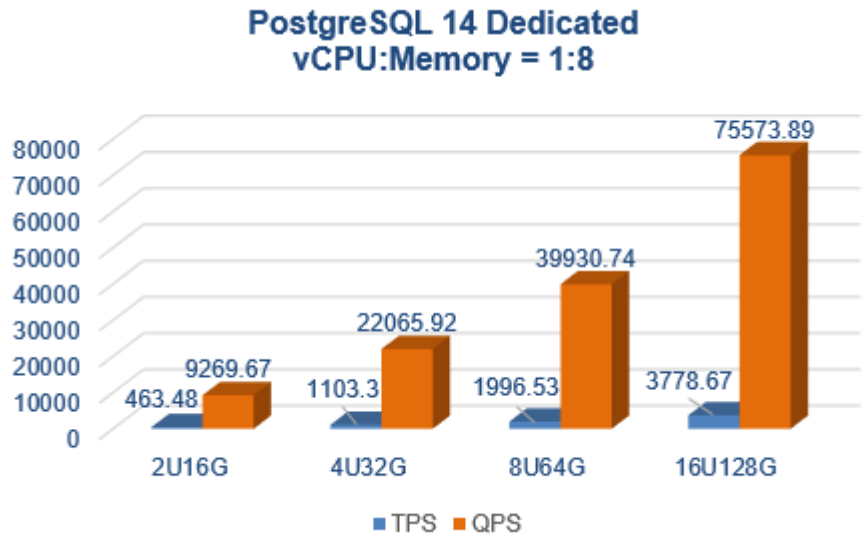


**Figure 4-5** vCPU:Memory = 1:8



# 5 RDS for PostgreSQL 15 Test Data

## 5.1 General-Purpose DB Instances

This section provides test data of RDS for PostgreSQL 15 x86-based general-purpose instances using cloud SSDs.

### About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

### Test Data

**Table 5-1** vCPU:Memory = 1:2

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 1 | 2 | 185.21 | 3,704.27 | See **About IOPS**. |
| 2 | 4 | 371.97 | 7,439.43 | |
| 4 | 8 | 821.00 | 16,420.05 | |
| 8 | 16 | 1,517.95 | 30,358.98 | |

**Table 5-2** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 431.72 | 8,634.30 | See **About IOPS**. |
| 4 | 16 | 926.94 | 18,538.85 | |

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 8 | 32 | 1,827.36 | 36,547.27 | |

## Test Results

**Figure 5-1** vCPU:Memory = 1:2

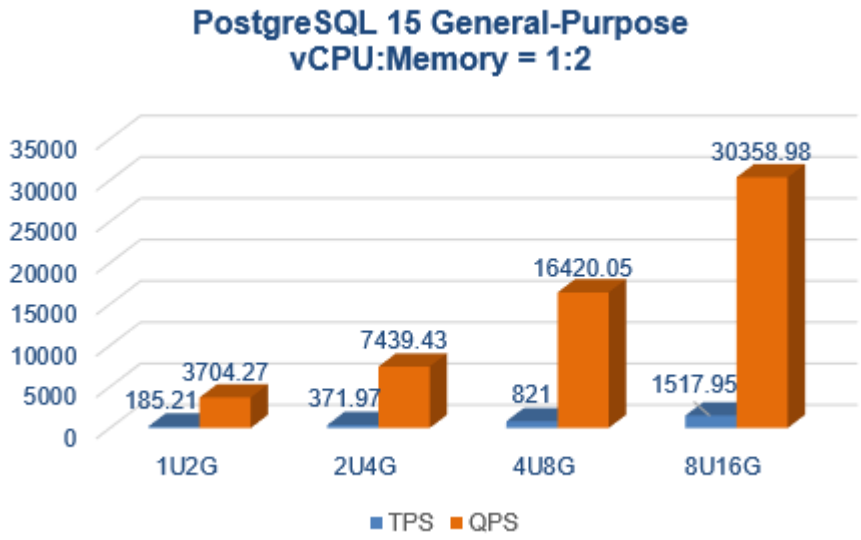
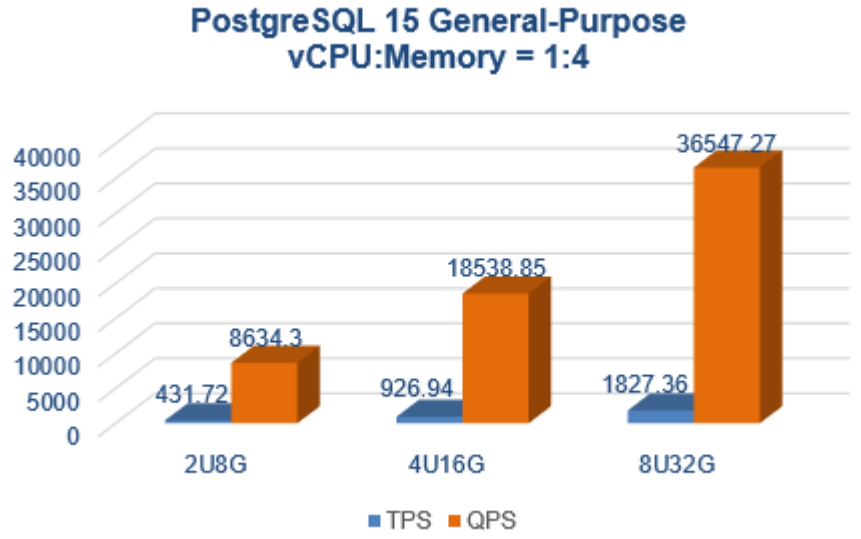



**Figure 5-2** vCPU:Memory = 1:4




# 5.2 Dedicated DB Instances

This section provides test data of RDS for PostgreSQL 15 x86-based dedicated instances using cloud SSDs.

## About IOPS

The IOPS supported by RDS for PostgreSQL depends on the I/O performance of Elastic Volume Service (EVS) disks. For details, see **Disk Types and Performance** in the *Elastic Volume Service Service Overview*.

## Test Data

**Table 5-3** vCPU:Memory = 1:2

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 4 | 378.99 | 7,579.83 | See **About IOPS**. |
| 4 | 8 | 838.37 | 16,767.38 | |
| 8 | 16 | 1,577.04 | 31,540.74 | |
| 16 | 32 | 1,850.72 | 37,014.46 | |

**Table 5-4** vCPU:Memory = 1:4

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 8 | 465.93 | 9,318.54 | See **About IOPS**. |
| 4 | 16 | 994.98 | 19,899.65 | |
| 8 | 32 | 1,825.27 | 36,505.56 | |
| 16 | 64 | 2,582.68 | 51,653.81 | |

**Table 5-5** vCPU:Memory = 1:8

| vCPUs | Memory (GB) | TPS | QPS | IOPS |
|---|---|---|---|---|
| 2 | 16 | 495.95 | 9,919.00 | See **About IOPS**. |
| 4 | 32 | 1,096.84 | 21,936.72 | |
| 8 | 64 | 1,924.42 | 38,488.57 | |
| 16 | 128 | 3,943.78 | 78,875.96 | |

## Test Results

**Figure 5-3** vCPU:Memory = 1:2

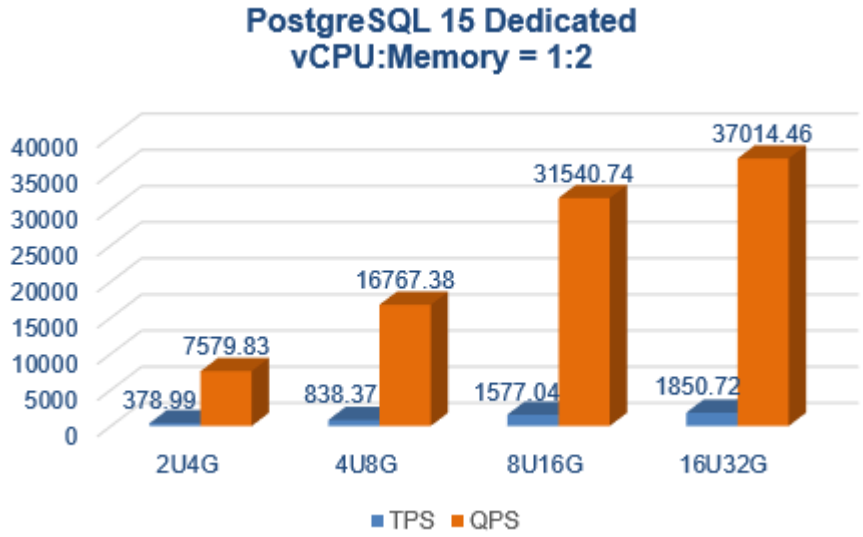



**Figure 5-4** vCPU:Memory = 1:4

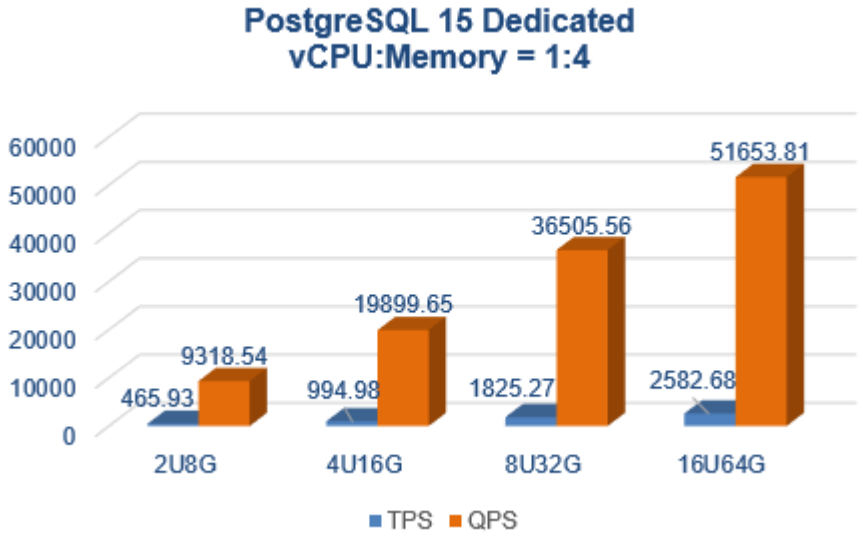


**Figure 5-5** vCPU:Memory = 1:8