# PostgreSQL Performance
in Linux-containers
and on top of Parallels Cloud Storage

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PostgreSQL

# Agenda

1. About Parallels and Parallels products
2. Test stand description
3. PostgreSQL performance on native host
4. PostgreSQL performance in containers
5. About Parallels Cloud Storage
6. PostgreSQL performance on top Parallels Cloud Storage
7. How to try

# About Parallels

# Что такое Parallels

- Более 1000 сотрудников в мире
- Продажи в 125 странах из 16 офисов  по всему миру
- Более 150 полученных патентов
- 500 партнеров, включая Microsoft, Apple, Intel, AMD, Dell, HP и IBM

## Доказательства успеха

- В числе 100 крупнейших софтверных компаний мира
- Прибыльна, самофинансируема, 50% рост CAGR в течение 6 лет с ускорением темпов
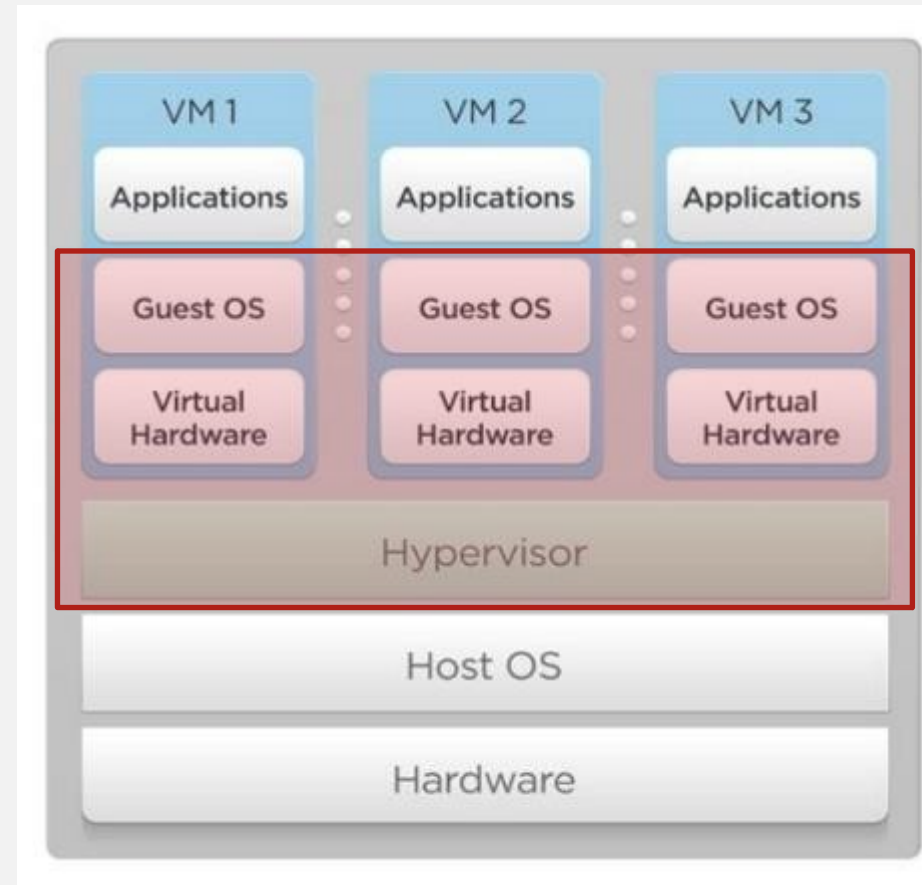
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# Made in Russia

- Конкурентоспособное ПО на мировом рынке

- Top-4 крупнейших компаний с центром разработки в России (Kaspersky, Acronis, Parallels, ABBYY)

- Единственный в России разработчик законченных коммерческих решений по виртуализации

- R&D центры в Москве, Новосибирске и Санкт-Петербурге

- Parallels – участник проекта «Сколково»

- Основана выпускниками лучших ВУЗов страны: МФТИ, НГУ, МГУ, академии ФАПСИ и др.

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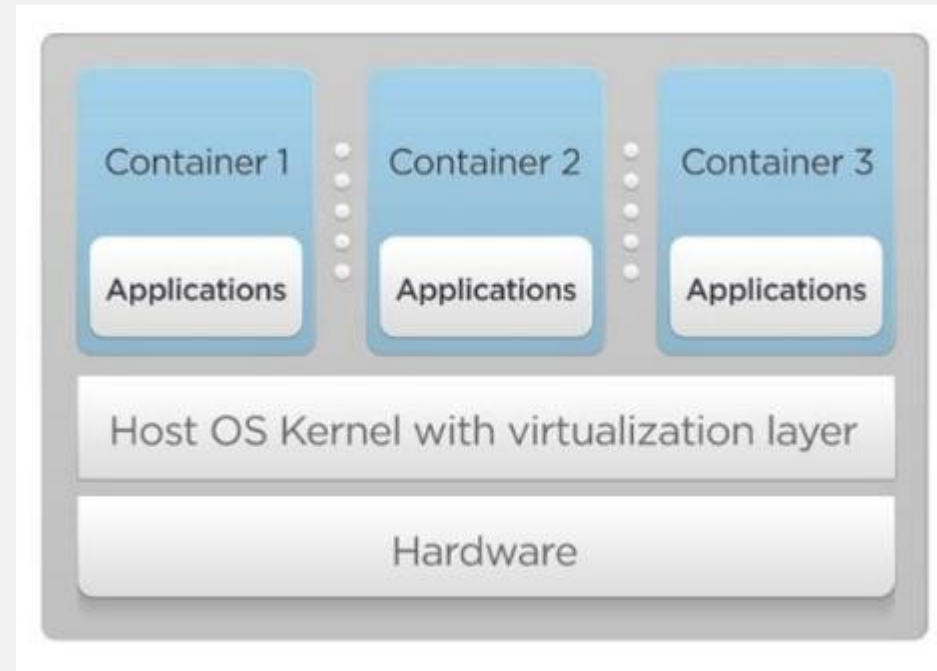
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# > Parallels Products

# Parallels Hypervisor Virtualization

- OS flexibility
- HW emulation
- Bare metal installation

# Parallels Containers

- More efficient memory management
- More efficient caching reduces I/O
- CT resource management
- Easy migration
- Easy backups&snapshots

# Benefits for PostgreSQL in Containers

Many features are out of the box:
- Security: environment isolation
- Backups
- Snapshots
- Live-migration
- Limits & resources management
- Online resource management:
  - RAM hot-plug
  - CPU hot-plug
  - Online disk expand
- And **High performance**

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# Test Stand Description

# Test environments

1. PostgreSQL on **native hosts**
   - Synchronous Streaming Replication

2. PostgreSQL in **containers** on the host
   - Synchronous Streaming Replication in Container

3. PostgreSQL in **containers** on top of **Parallels Cloud Storage**
   - HA by Parallels Cloud Storage

# Test Stand Hardware Description



Host #1  Host #2  Host #3  Client

| CPU | 1xQuadCore Intel Core i5 2400 |
|---|---|
| Memory | 16 GB (4x4GB), DDR3, 1333MHz |
| Disk | 3x1TB 7200 RPM SATA drives |
| SSD | Intel S3700 100G SATA |
| Network Card | Intel 82599 10Gbit Network Connection |
| Network Switch | DELL PowerConnect 8132 10 Gb |

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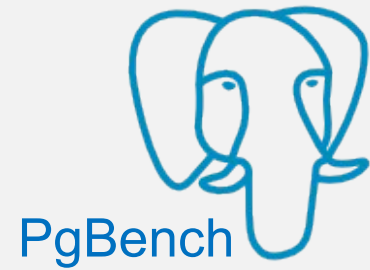
# Test Stand Software Description

PgBench

Host #1    Host #2    Host #3    Client
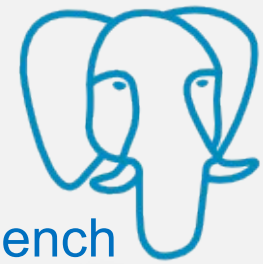
| Operating system | Parallels Cloud Server 6 Update 8 (REHL 6 compatible) |
|---|---|
| Linux kernel version | 2.6.32-042stab102.9 |
| PostgreSQL version | 9.4.0 |
| Pgbench version | 9.5devel |

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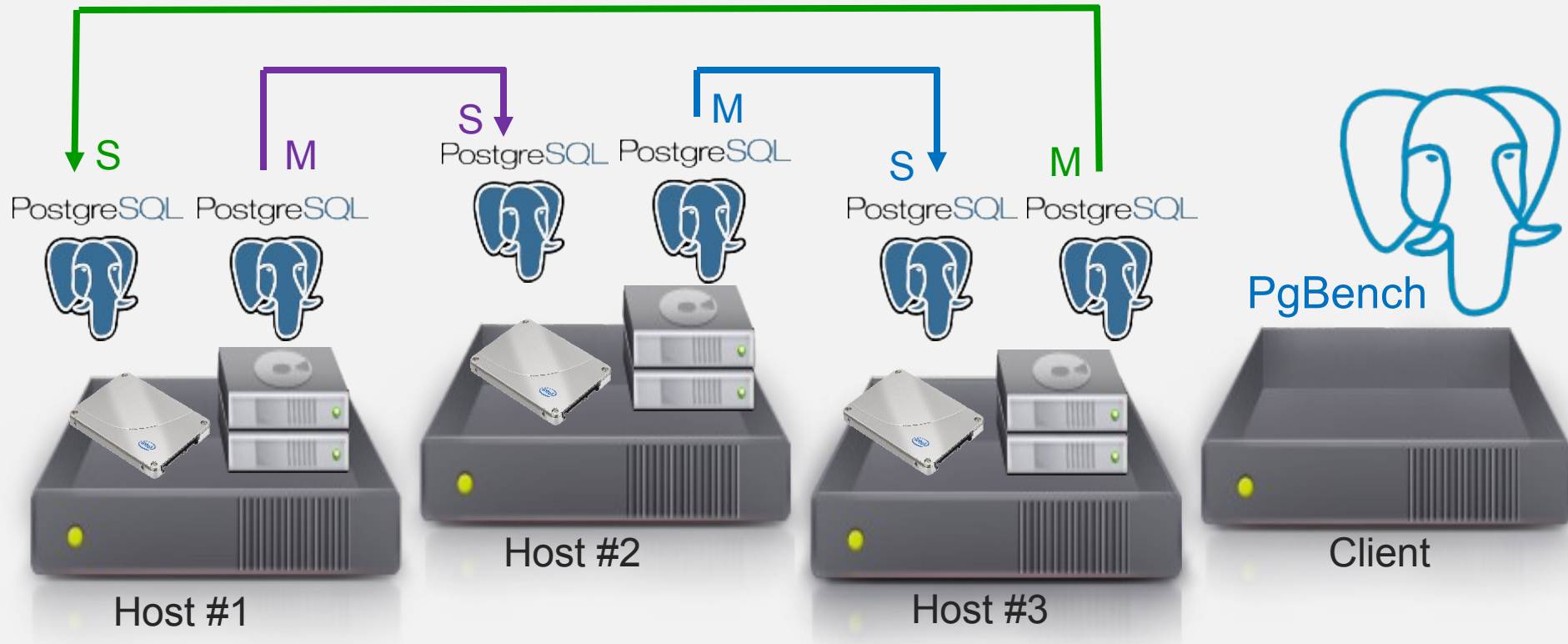
# Pgbench configuration

PgBench

- Databases initialization scale factor - 1000
- All tests were run with 50 clients
- Test time 600 seconds
- Each test was running 5 time

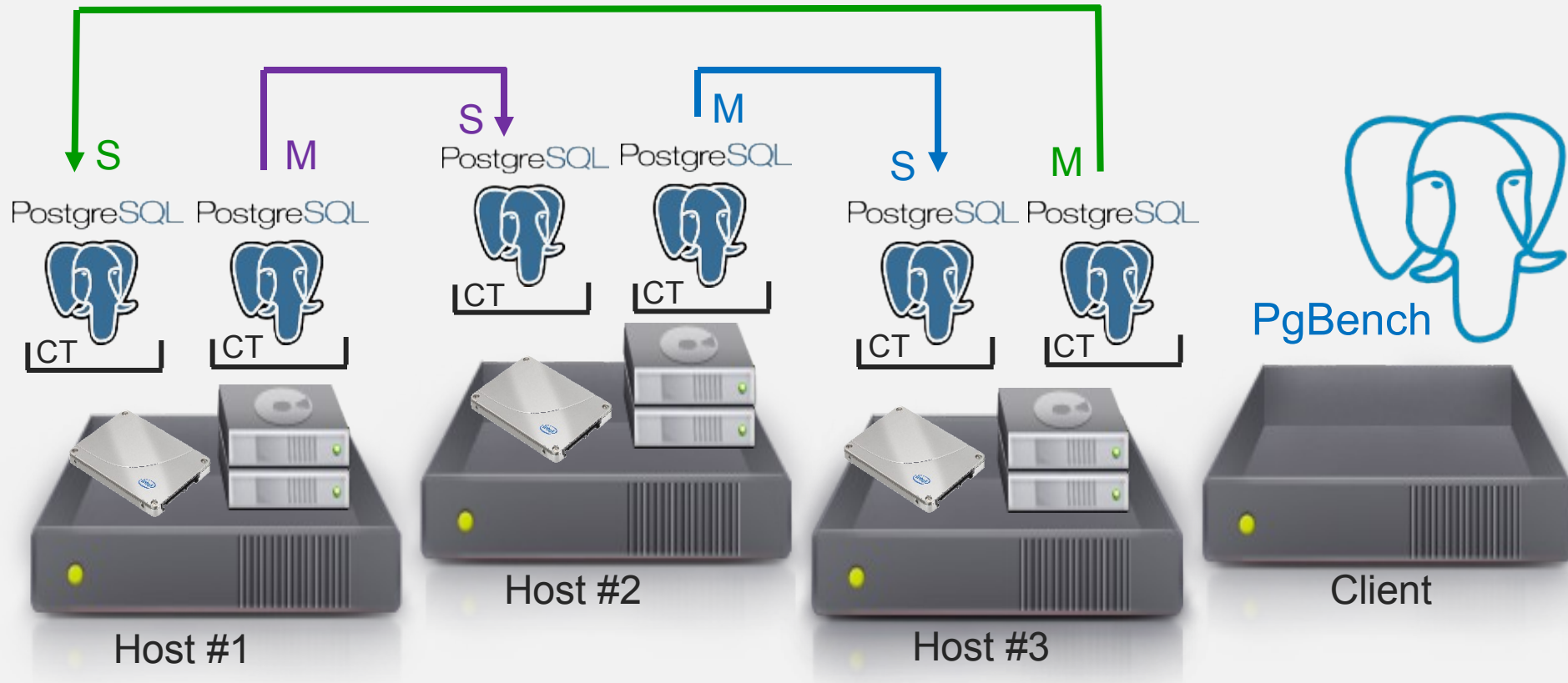Test client PgBench command line for your homework:
./pgbench -h 172.0.14.10 -p 5432 -U postgres -c 50 -P 1 -T 600 bench 2>/dev/null

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# PostgreSQL performance on native hosts and in containers

# Test Stand #1 Description - "Native hosts"

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# Test Stand #2 Description – "Containers"

# Single Test Node Structure



SSD

PostgreSQL

WAL

DB

PostgreSQL

WAL

DB

HDD #1

HDD #2

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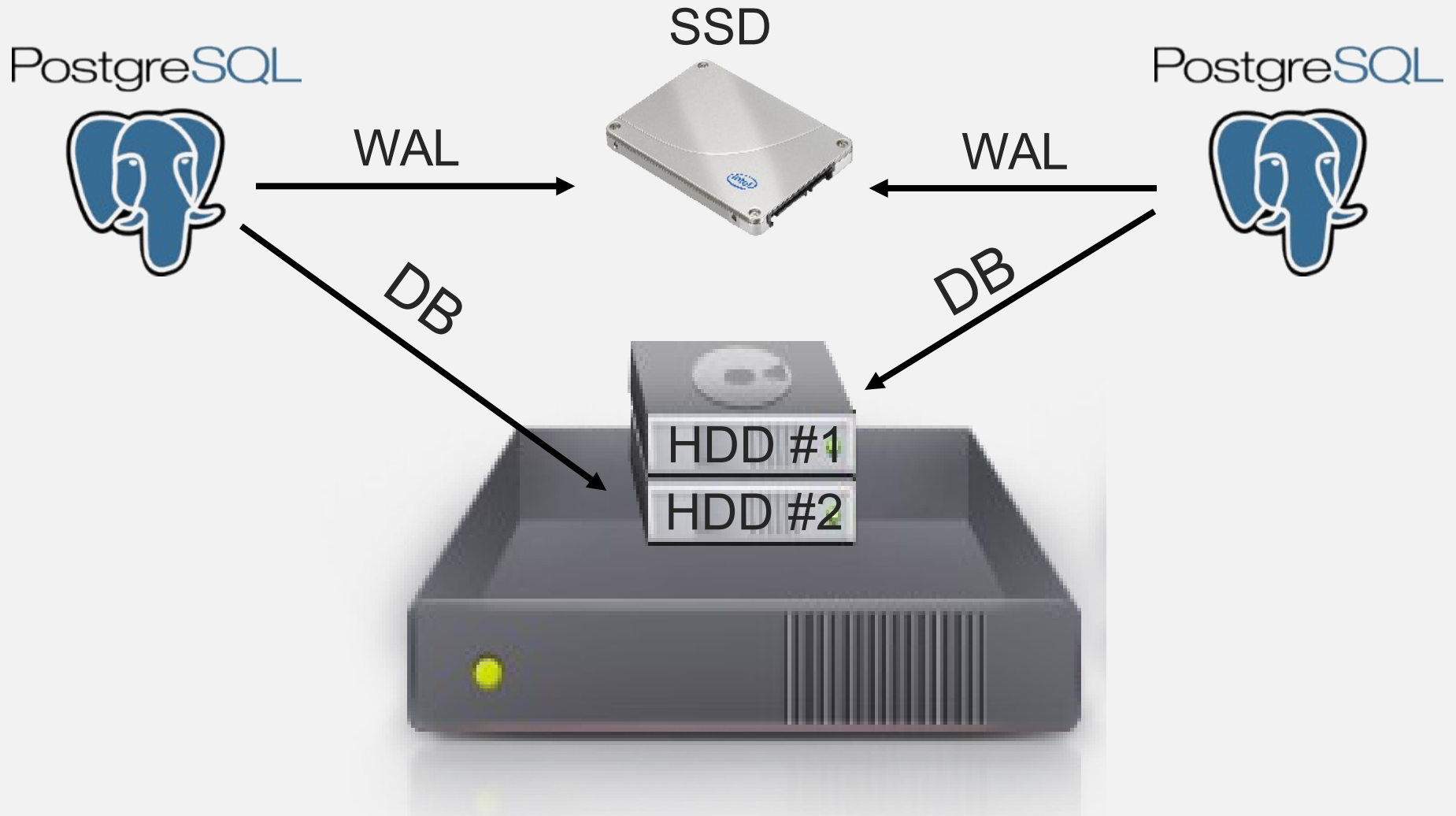
# Results: PostgreSQL on **native host vs containers**
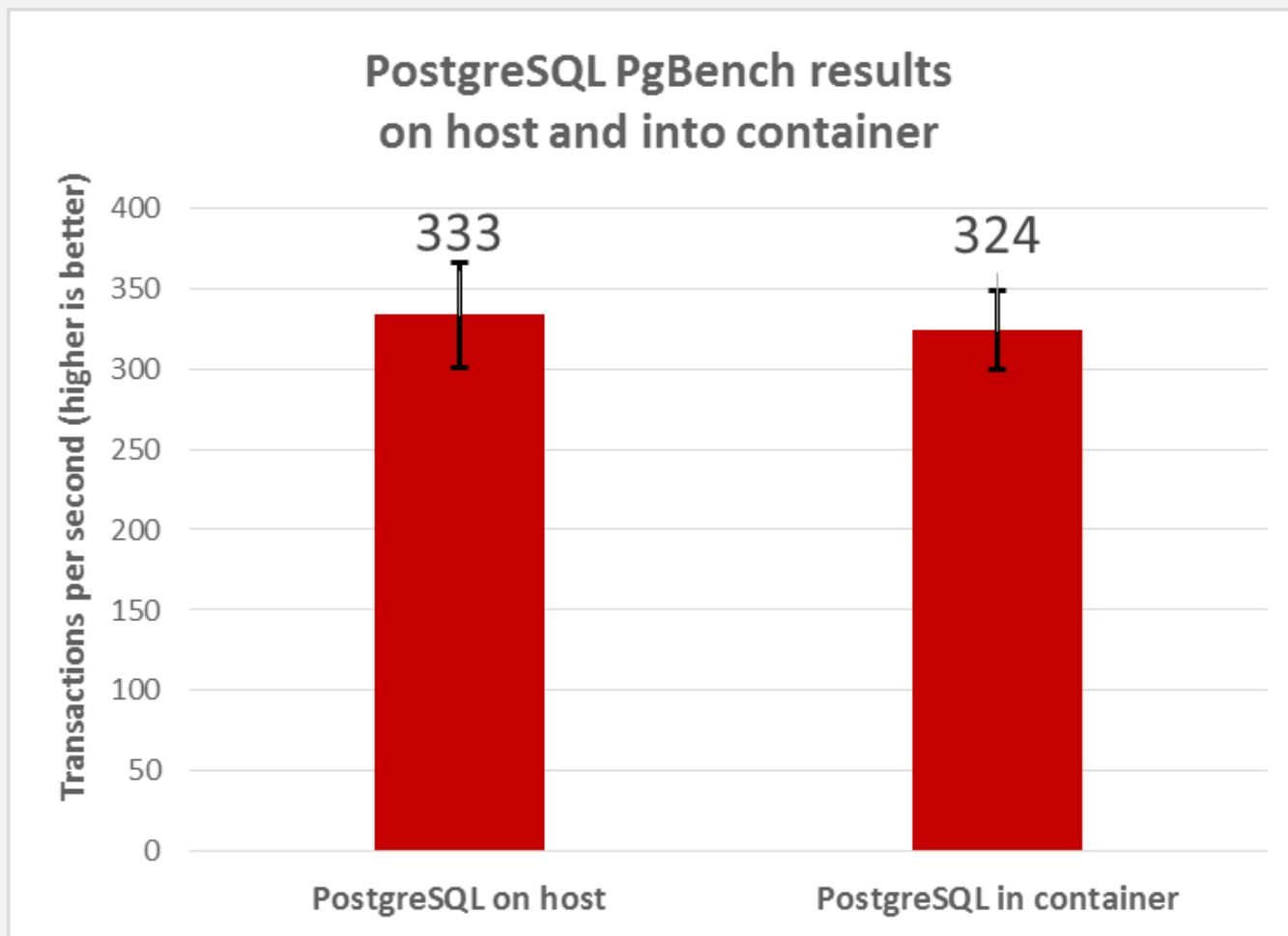


PostgreSQL in containers shows almost the same results as PostgreSQL shows on host

# Parallels Cloud Storage

# Parallels Cloud Storage

## The benefits of a SAN without the cost

**Cost-effective**

- Reuses existing hardware
- No vendor lock-in
- No need for dedicated, expensive hardware
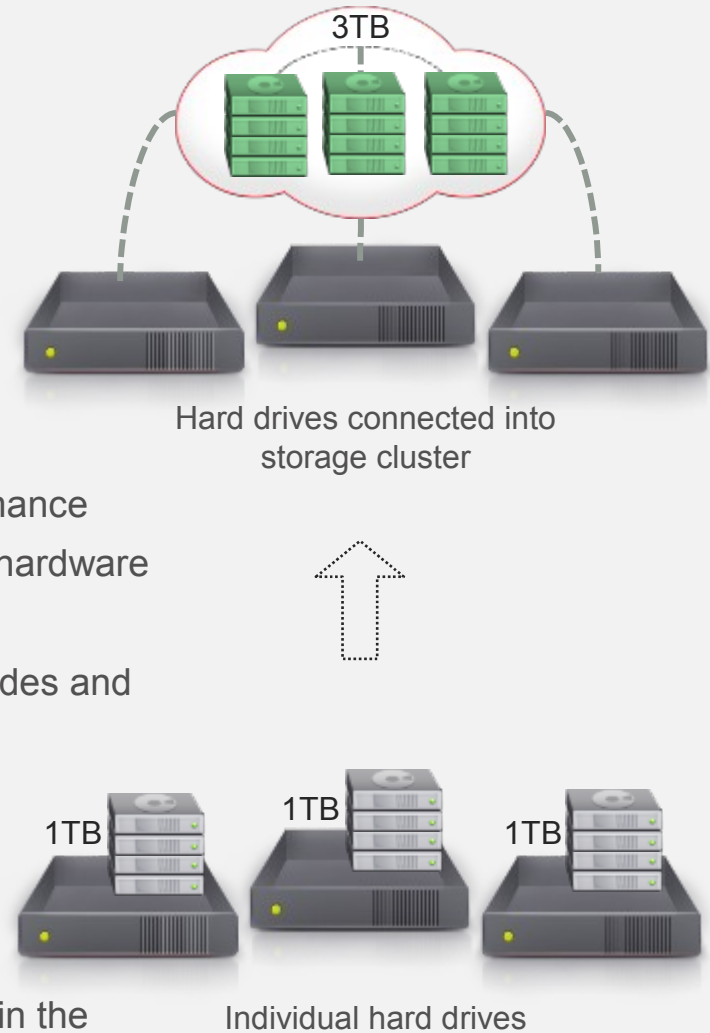
**High performance**

- Automatic data and load balancing
- Out-of-the-box SSD caching improves read and write performance
- Improve overall throughput by utilizing idle and underutilized hardware

**Scalable**

- Expands easily by automatically identifying new additional nodes and devices and rebalancing the cluster
- Server storage capacity and bandwidth no longer limited by individual nodes

**Fault tolerant and redundant**

- Automatically manages redundancy and recovery
- Transparent data replication across storage cluster to maintain the required redundancy level

3TB

Hard drives connected into storage cluster

1TB   1TB   1TB

Individual hard drives

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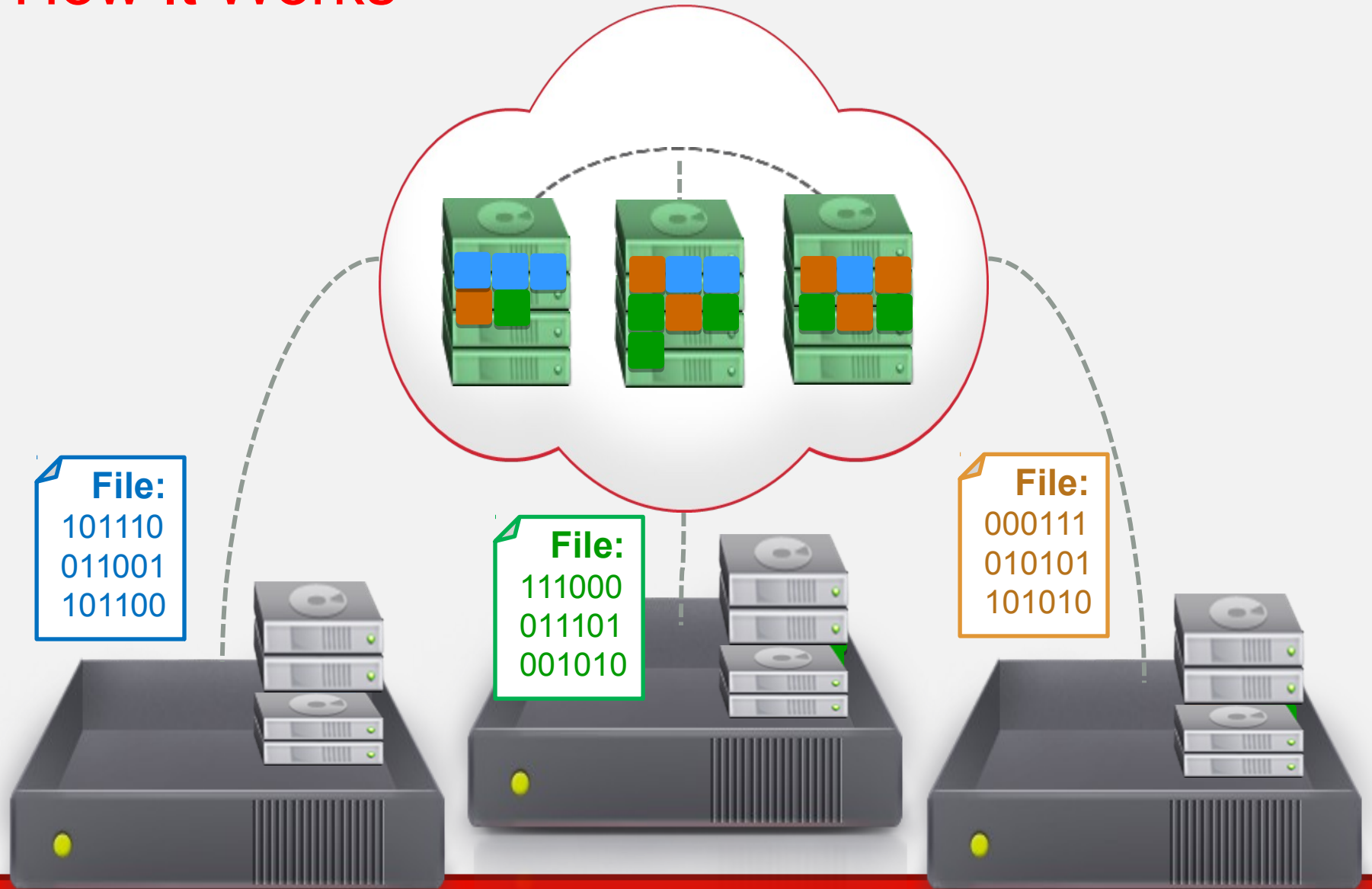# How It Works

# How It Works

File:
101110
011001
101100

File:
111000
011101
001010

File:
000111
010101
101010
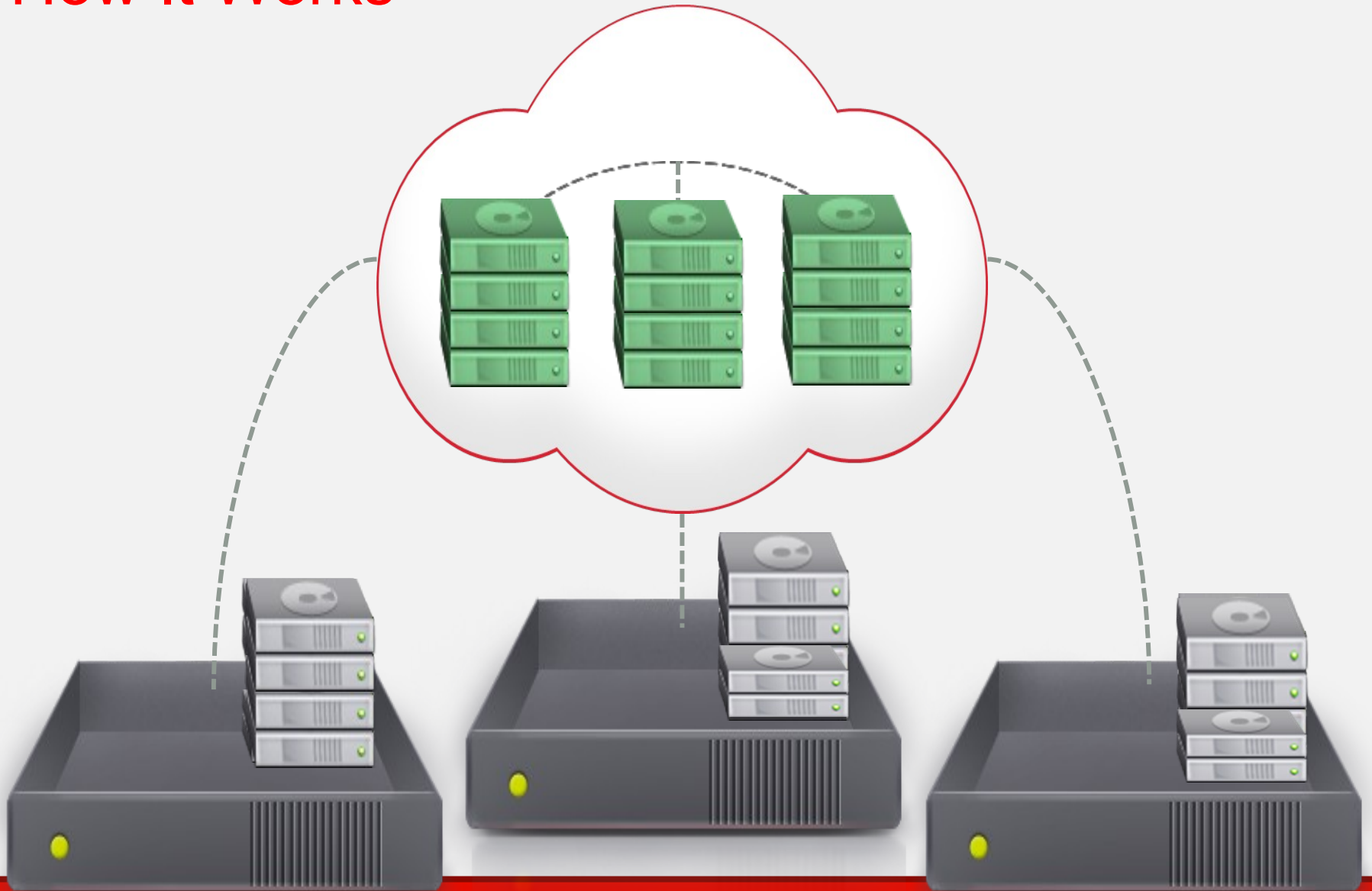
# How It Works

# PStorage architecture



**Clients**

Ethernet

MDS 1
MDS 2
MDS 3

CS  CS  CS  CS
...N
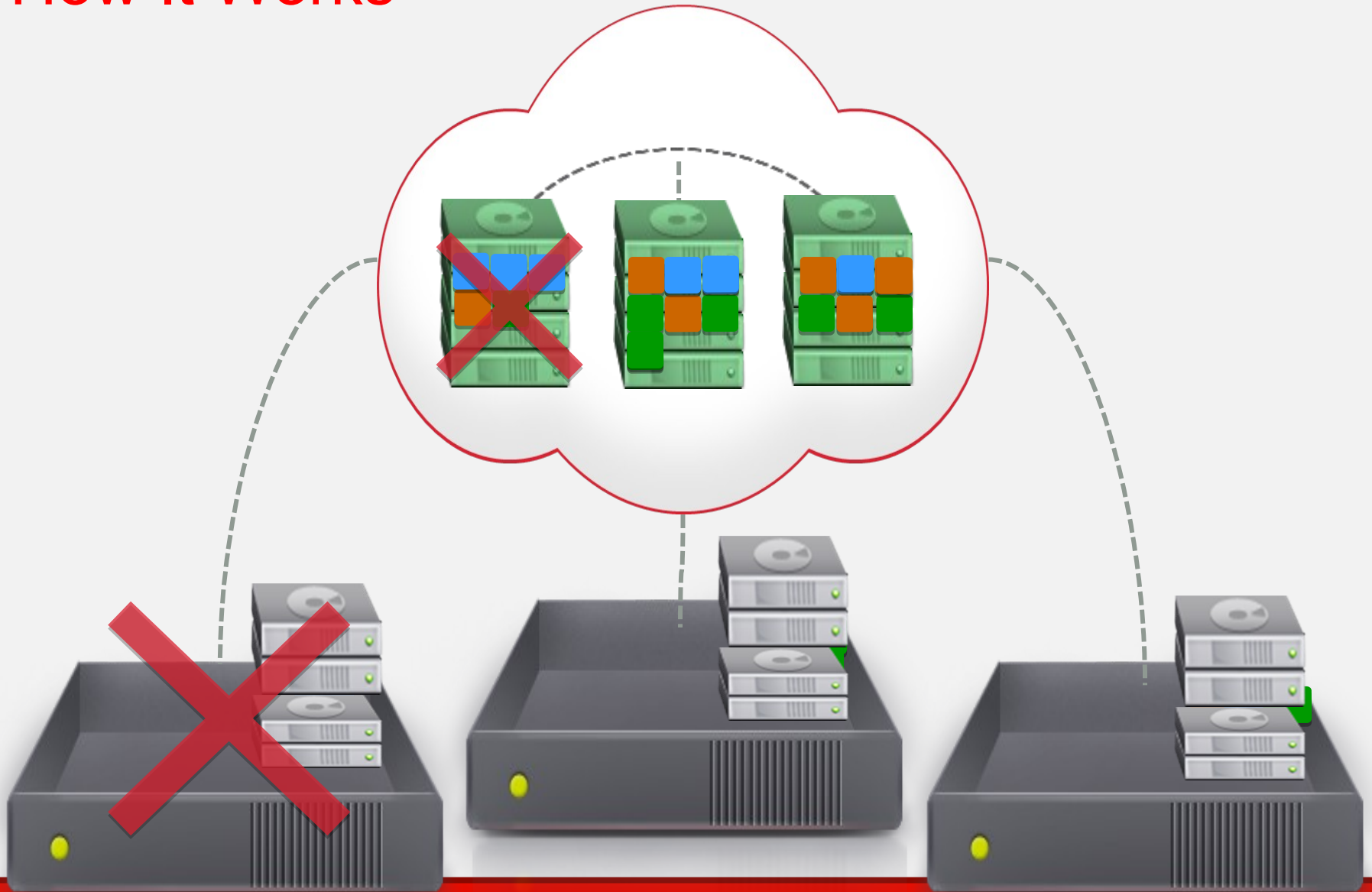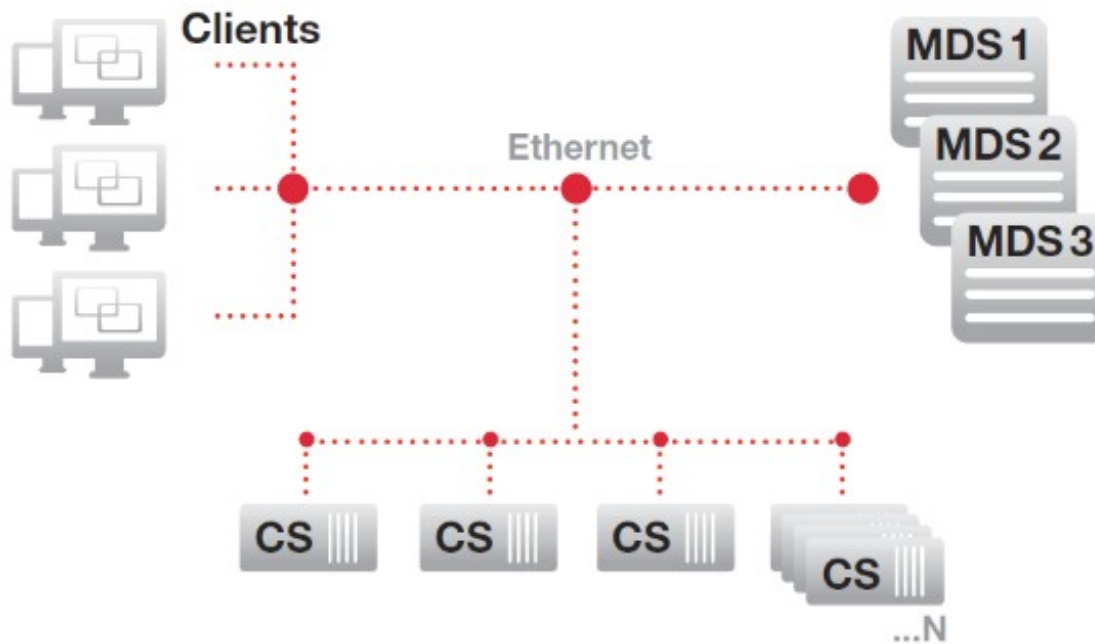
**Meta Data Server (MDS)**
- Stores metadata in memory
- Tracks data chunks and their versions
- Is highly available
- Can run on the same server as the chunk server and client

**Chunk Server (CS)**
- Stores data chunks
- Manages data chunks
- Performs read/write operations on data chunks
- Can run on the same server as the client

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# System Requirements



Parallels Cloud Storage
Distributed HA shared storage

Node1, Node2, Node3, Node4, Node5
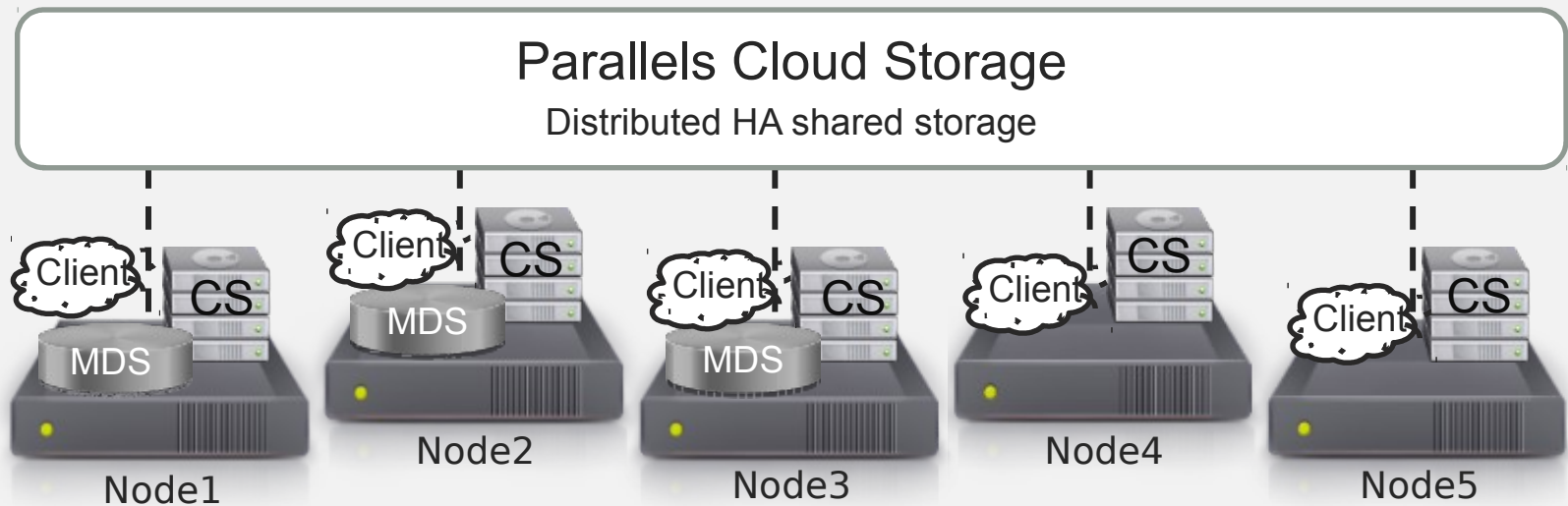
**System Requirements:**

- MDS: 1 GB free memory for each 100 TB stored data
- CS/client: 256 MB free memory
- Dedicated storage network (1GigE or faster)

# Flexibility & Scalability



Parallels Cloud Storage
Distributed HA shared storage
PostgreSQL

Node1 · Node2 · Node3 · Node4 · Node5 · Node6 · Node7
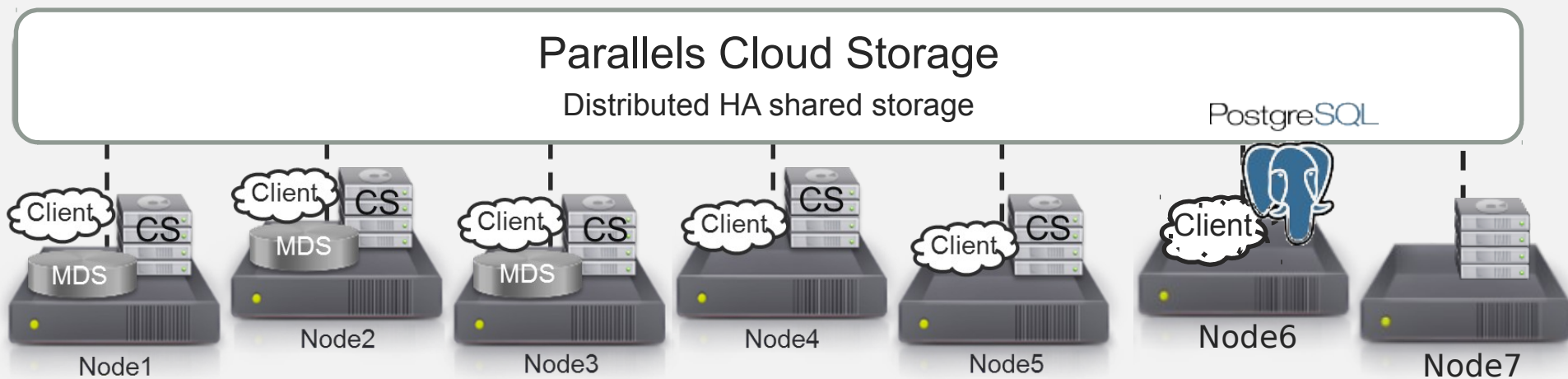
- Any mix of roles in one node
- Any mix of HDDs in a cluster
- Easy to add new node
- Scalable up to hundreds nodes
- Scalable up to PBs
- Automatic data and performance balancing
- The bigger cluster – the better performance
- The bigger cluster – the better reliability

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# High Availability (HA)

Parallels Cloud Server enables HA of VMs and Containers. When a node fails, all CTs/VMs are distributed to working nodes
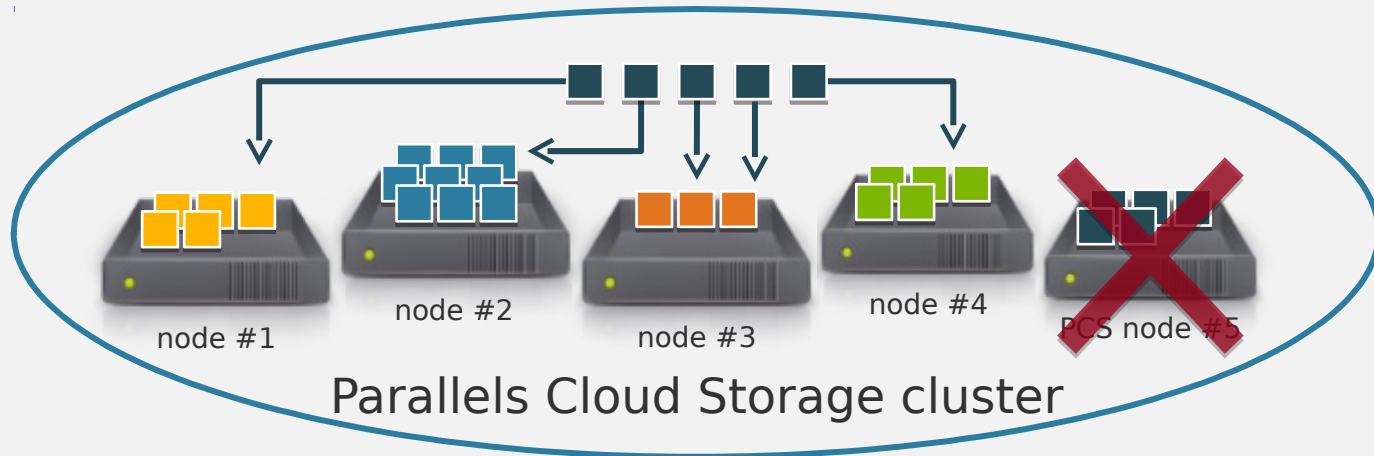
Relocation algorithms:

- DRS (based on resource usage)

- To spare node

- Round-robin

Fencing:

- Node reboot

- Network disconnect



node #1    node #2    node #3    node #4    PCS node #5

Parallels Cloud Storage cluster

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# PStorage Performance

# Performance Comparison :: HW

## iSCSI SAN Storage
### DELL EqualLogic PS6510E



x1 HW SAN EQL PS6510E

**48 SATA Disks**: 1TB 7200rpm
(Seagate ST31000524NS)

Network: **10Gbit**
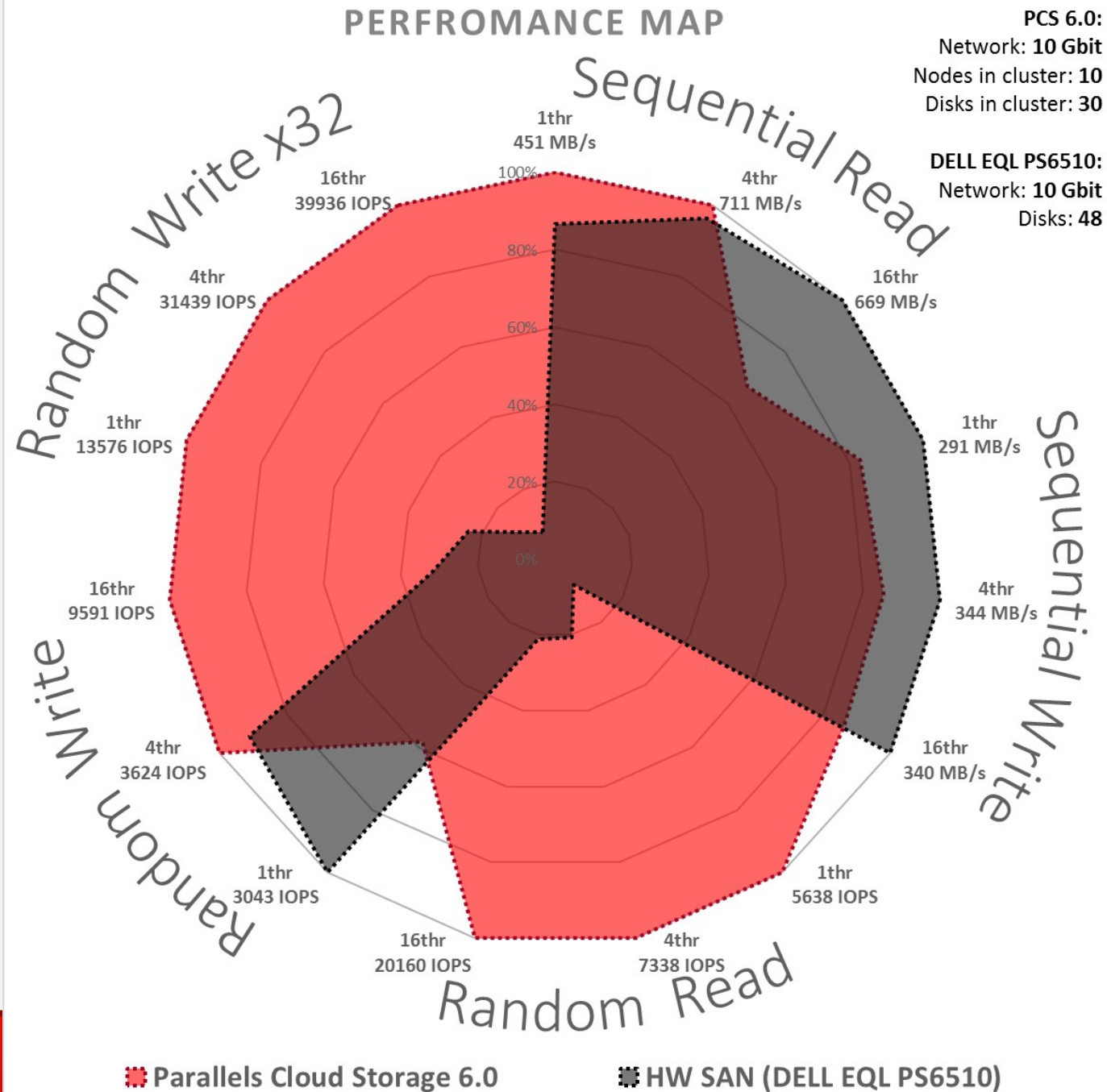(Dell Force10 S4810)

vs.

## Parallels Cloud Storage



x10 compute nodes

**30 SATA Disks**: 2TB 7200rpm
(Seagate ST2000DM001)
+ 10 SSD for caching
(Intel SSD 520)

Network: **10Gbit**
(Brocade FastIron SuperX SX-F42XG)

PERFROMANCE MAP

**PCS 6.0:**
Network: **10 Gbit**
Nodes in cluster: **10**
Disks in cluster: **30**

**DELL EQL PS6510:**
Network: **10 Gbit**
Disks: **48**

**PCS FASTER than HW SAN**

Just 10 nodes PCS cluster faster than DELL EQL SAN ($97000) in most workloads

Random Write x32
- 16thr 39936 IOPS
- 4thr 31439 IOPS
- 1thr 13576 IOPS

Sequential Read
- 1thr 451 MB/s
- 4thr 711 MB/s
- 16thr 669 MB/s

Sequential Write
- 1thr 291 MB/s
- 4thr 344 MB/s
- 16thr 340 MB/s

Random Write
- 16thr 9591 IOPS
- 4thr 3624 IOPS
- 1thr 3043 IOPS

Random Read
- 16thr 20160 IOPS
- 4thr 7338 IOPS
- 1thr 5638 IOPS

100% 80% 60% 40% 20% 0%

**Parallels Cloud Storage 6.0**    **HW SAN (DELL EQL PS6510)**

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# Parallels Cloud Storage Reliability Performance

**High availability and fast recovery**

- **Replication performance** defines time of reduced redundancy level. Critical!
- The shorter period of replication leads to the less probability to **lose data**
- In theory **M**ean **T**ime **T**o **D**ata **L**oss ~ **1/T^2**, where **T** is time to recover

**Time to Replicate 1TB (minutes)**

Bar chart — Time to Replicate 1TB (minutes):
- RAID1: ~ 3 hrs (100 MB/s) — ~170
- 7 hosts: 64 min (273 MB/s)
- 14 hosts: 33 min (535 MB/s)
- 21 hosts: 20 min (881 MB/s)

Y-axis: 0, 20, 40, 60, 80, 100, 120, 140, 160, 180

Legend: ■ 1GBit network, SATA SW RAID0, 2 drivers
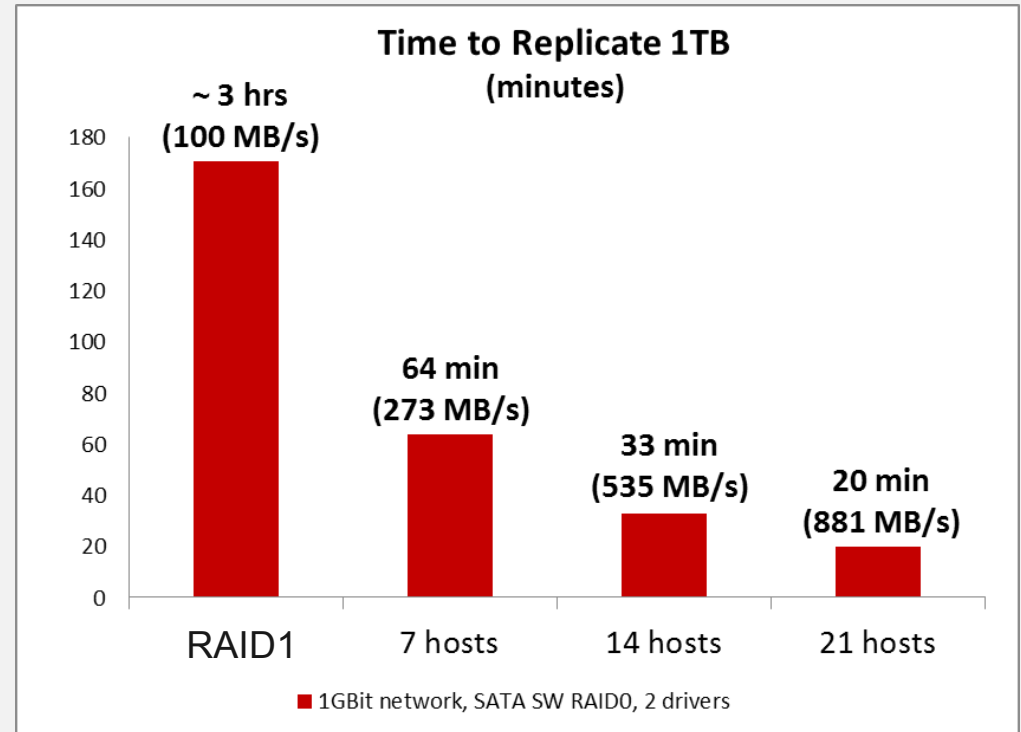
**The bigger the cluster, the faster recovery process is!**

**Cloud Storage performs replication in parallel.**

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# Benefits for PostgreSQL

- Replication on storage layer
- No special PostgreSQL configuration
- Automatic cluster recovery
- Fast replication/recovery
- Instant live-migration
- Access whole cluster space form single server
- Access whole cluster IOPS
- Easy add new disks
- Built-in SSD-caching/journaling
- And **High performance**

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# PostgreSQL performance in **containers** on top of Parallels Cloud Storage

# Test Stand Description

# Test Stand Hardware Description



Parallels Cloud Storage

PgBench

Host #1

Host #2

Host #3

Client

CT

CT

CT

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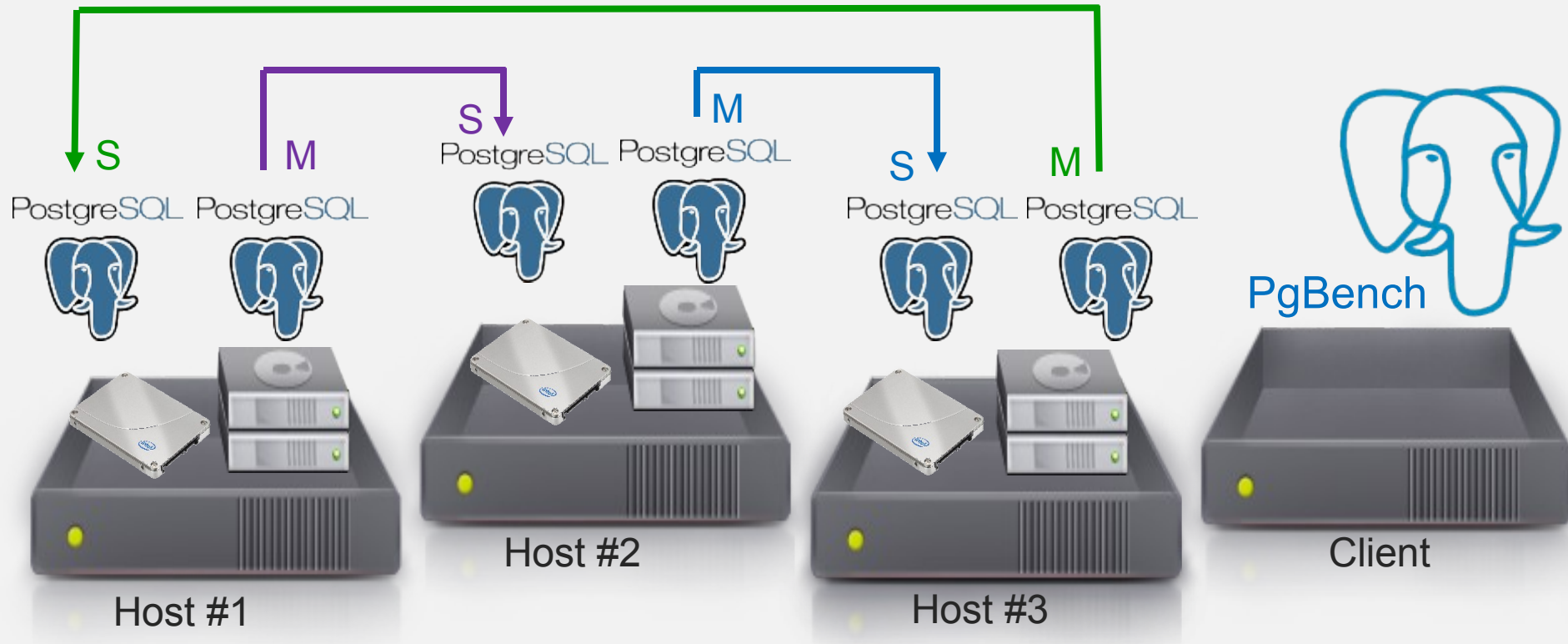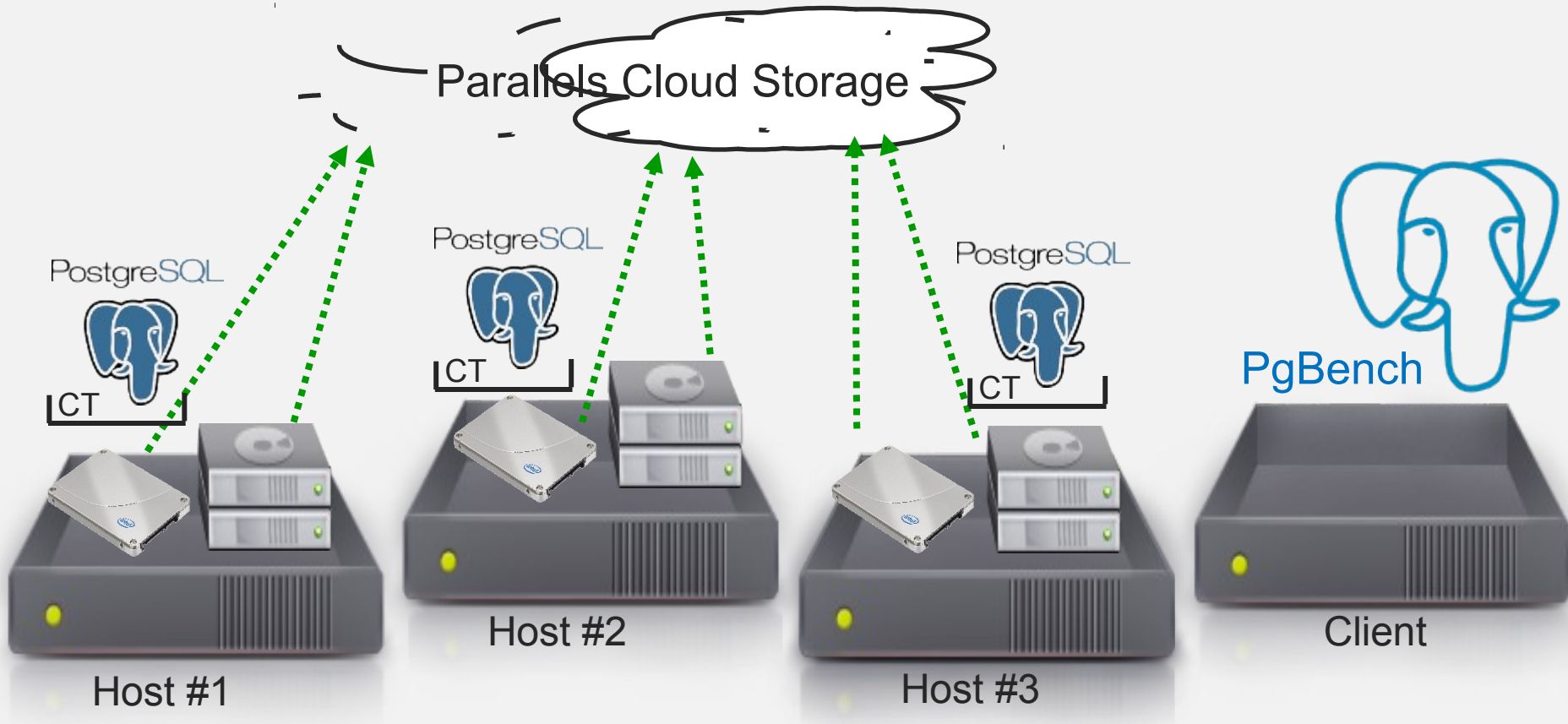
# Results and Conclusion
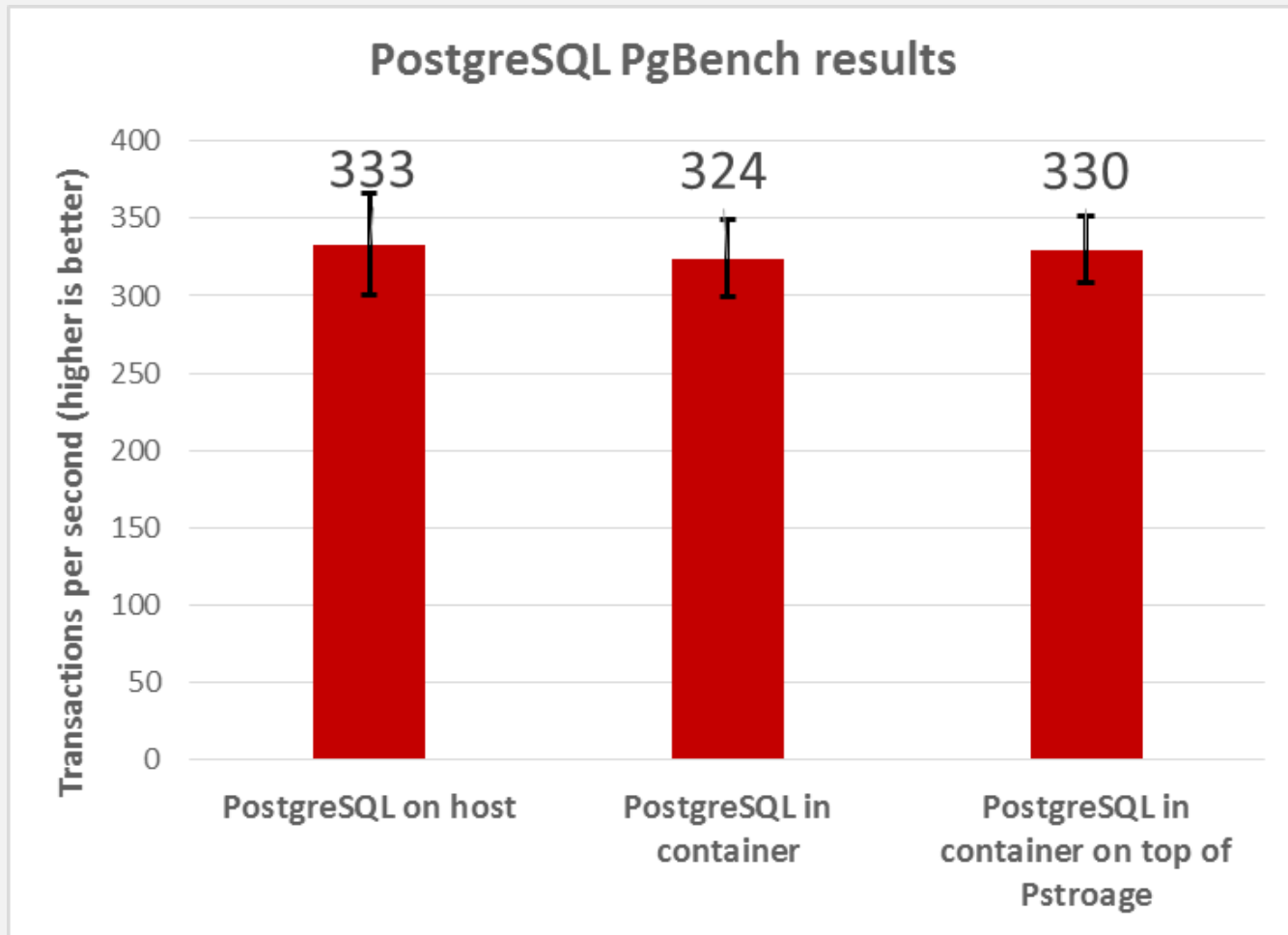


PostgreSQL in container on top of Parallels Cloud Storage shows almost the same results as PostgreSQL shows on host

# Conclusion

- PostgreSQL in Parallels containers shows almost the same results as PostgreSQL on host
- PostgreSQL on top of Parallels Cloud Storage shows almost the same results as PostgreSQL on host
- Containers provide security, resource management, migration, backups
- Parallels Cloud Storage provide scalability, redundancy, HA

# How to try

# How to use it for FREE

Cloud Storage:

Parallels Cloud Storage: FREE up to 100 GB
http://sp.parallels.com/products/pcs/cloud-storage/

Virtualization:

OpenVZ: FREE
http://openvz.org

Parallels Cloud Server: License is required
http://parallels.com/products/pcs/

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# How to install Parallels Cloud Storage

Parallels Cloud Storage is available on the following distributives:

OpenVZ:
https://openvz.org/Parallels_Cloud_Storage

Parallels Cloud Server:
http://sp.parallels.com/products/pcs/cloud-storage/

Red Hat 7, CentOS 7: Coming soon…
http://download.pstorage.parallels.com/standalone/packages/rhel/7/x86_64/
Mail to: pstorage@parallels.com

Ubuntu 14.04: Coming soon…
http://download.pstorage.parallels.com/standalone/packages/ubuntu/pool/main/p/pcs/
Mail to: pstorage@parallels.com

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> Q&A

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