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How to Recommend Fast, Reliable Server Setups

Sounds so easy, right? “Buy the big ones.” But no...

The big picture

1. What SQL Server edition should you recommend?
2. What hardware does the business’s RPO/RTO goal require?
3. Why shared storage is usually slower
4. Your solid state storage choices
5. The no-brainer answer for Standard Edition
6. Enterprise Edition’s socket choices

What SQL Server edition do you need?

Picking your SQL Server edition

	Standard	Enterprise
Cost per core	\$2k	\$7k
Cost for 2-socket, hex-core	\$24k	\$84k
Cost for 4-socket, hex-core	--	\$168k
Max logical processors (cores)	16	OS max
Max memory used by SQL Server	64GB	OS max
Backup compression	Yes	Yes
Data compression	No	Yes
Transparent data encryption	No	Yes
Partitioned tables	No	Yes
Faster storage access for big data	No	Yes

All prices USD.

Factor in the hardware costs

	SQL 2012 Standard	SQL 2012 Enterprise crippled	SQL 2012 Enterprise
Cores	12 (2x6)	12 (2x6)	12 (2x6)
Memory	64GB	64GB	768GB
Cool Stuff	No	Yes	Yes
Hardware w/TempDB SSDs	\$7k	\$7k	\$30k
Licensing	\$24k	\$84k	\$84k
Total Cost	\$31k	\$91k	\$114k

Signs you need Enterprise Edition

Your app requires table partitioning*

You have to offload reads to a second server*

Over 500GB of live, queried data (not logs/archives)

* - Don't be so sure.

Books Online “Reading Pages”

The storage engine uses prefetching to speed base table lookups from nonclustered indexes. The leaf rows of a nonclustered index contain pointers to the data rows that contain each specific key value. As the storage engine reads through the leaf pages of the nonclustered index, it also starts scheduling asynchronous reads for the data rows whose pointers have already been retrieved. This allows the storage engine to retrieve data rows from the underlying table before it has completed the scan of the nonclustered index. Prefetching is used regardless of whether the table has a clustered index. SQL Server Enterprise uses more prefetching than other editions of SQL Server, allowing more pages to be read ahead. The level of prefetching is not configurable in any edition. For more information about nonclustered indexes, see [Nonclustered Index Structures](#).

Advanced Scanning

In SQL Server Enterprise, the advanced scan feature allows multiple tasks to share full table scans. If the execution plan of a Transact-SQL statement requires a scan of the data pages in a table and the Database Engine detects that the table is already being scanned for another execution plan, the Database Engine joins the second scan to the first, at the current location of the second scan. The Database Engine reads each page one time and passes the rows from each page to both execution plans. This continues until the end of the table is reached.



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Merry-Go-Round Scans in Enterprise

tblSales – 1,000GB

My Query



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Merry-Go-Round Scans in Enterprise

tblSales – 1,000GB

My Query



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Merry-Go-Round Scans in Enterprise

tblSales – 1,000GB

My Query

Your Query



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Merry-Go-Round Scans in Enterprise

tblSales – 1,000GB

My Query

Your Query

Merry-Go-Round Scans in Enterprise

tblSales – 1,000GB

My Query

Your Query

Merry-Go-Round Scans in Enterprise

tblSales – 1,000GB

Continued

Your Query

What hardware does
the business's
RPO/RTO goal
require?

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High Availability	Disaster Recovery	"Oops" Deletions																																													
																																															
For isolated server failures: Windows crash, RAID controller failure, SQL or Windows patch fails, C drive full, bad memory chip, wrong box unplugged	For widespread outages: Data center power or network outage, domain controller failure, SAN failure, fire, quake, zombies in the data center	For human T-SQL error: DELETE without a where clause, bug in stored procedure for updates, end user needing a restore due to human error																																													
RPO: Max acceptable data loss: <table border="1"> <thead> <tr> <th>Biz Goal</th> <th>IT Goal</th> <th>Current</th> </tr> </thead> <tbody> <tr><td></td><td></td><td>Zero</td></tr> <tr><td></td><td></td><td>1 minute</td></tr> <tr><td></td><td></td><td>1 hour</td></tr> <tr><td></td><td></td><td>1 day</td></tr> </tbody> </table>	Biz Goal	IT Goal	Current			Zero			1 minute			1 hour			1 day	RPO: Max acceptable data loss: <table border="1"> <thead> <tr> <th>Biz Goal</th> <th>IT Goal</th> <th>Current</th> </tr> </thead> <tbody> <tr><td></td><td></td><td>Zero</td></tr> <tr><td></td><td></td><td>1 minute</td></tr> <tr><td></td><td></td><td>1 hour</td></tr> <tr><td></td><td></td><td>1 day</td></tr> </tbody> </table>	Biz Goal	IT Goal	Current			Zero			1 minute			1 hour			1 day	RPO: Max acceptable data loss: <table border="1"> <thead> <tr> <th>Biz Goal</th> <th>IT Goal</th> <th>Current</th> </tr> </thead> <tbody> <tr><td></td><td></td><td>Zero</td></tr> <tr><td></td><td></td><td>1 minute</td></tr> <tr><td></td><td></td><td>1 hour</td></tr> <tr><td></td><td></td><td>1 day</td></tr> </tbody> </table>	Biz Goal	IT Goal	Current			Zero			1 minute			1 hour			1 day
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Recovery Time Objective (RTO) - Downtime

		Zero-1 Sec	1 Minute	1 Hour	1 Day
Recovery Point Objective (RPO) - Data Loss	Zero-1 Sec	>\$1,000,000 Multiple active servers with bidirectional replication (usually requires code change)	\$100k-\$500k Clustering w/SAN, synch AlwaysOn Availability Groups (EE), synch database mirroring	\$100k-\$250k Synch SAN replication, synch VM replication	
	1 Minute			\$50k-\$250k Async AlwaysOn Avail Groups (EE), async DB mirroring (EE)	\$5k-\$100k Log shipping, async SAN replication, async VM replication
	1 Hour			\$5k-\$100k Log shipping, async SAN replication, async VM	
	1 Day				

Comparison of SQL Server Availability Features											
	>\$1mm	\$100k-\$500k			\$100k-\$250k		\$50k-\$250k		\$5k-\$100k		
	Replication	Failover Clustered Instances (FCI)	AlwaysOn Availability Groups - Synch	Database Mirroring - Synch	SAN Replication - Synch	VM Replication - Synch	AlwaysOn Availability Groups - Asynch	Database Mirroring - Asynch	Log Shipping	SAN Replication - Asynch	VM Replication - Asynch
Recovery Point Objective (Data Loss)											
Data loss possible	Yes	No*	No*	No*	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Typical RPO goal	Zero	Zero	Zero	Zero	Zero	Zero	1 Minute	1 Minute	1 Hour	1 Hour	1 Hour
Recovery Time Objective (Downtime)											
Failover automatic or manual	Automatic	Automatic	Automatic	Automatic	Optional	Optional	Manual	Manual	Manual	Manual	Manual
Can be failed over by the DBA alone	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No
Easy to fail back and forth for patching	Some	Yes	Yes	Yes	No	No	Yes	Yes	Some	No	No
Multiple live writable servers	Optional	No	No	No	No	No	No	No	No	No	No
Fails over Agent jobs, SQL logins	No	Yes	No	No	Optional	Yes	No	No	No	Optional	Yes
3rd party apps fail over easily	No	Yes	Yes	Some	Yes	Yes	Yes	Some	No	Yes	Yes
Typical RTO goal	Zero	1 Minute	1 Minute	1 Minute	1 Hour	1 Hour	1 Hour	1 Hour	1 Day	1 Day	1 Day
Groups of Databases											
Are the same point in time	No	Yes	No*	No	Yes	Yes	No	No	No	No	No
Fail over together	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hardware & Software Requirements											
SQL Server minimum version supported	Apps vary	Any	2012	2005	Any	Any	2012	2005	Any	Any	Any
SQL Server minimum edition required	Apps vary	Any	Enterprise	Standard	Any	Any	Enterprise	Enterprise	Any	Any	Any
May require application changes	Yes	No	No	No	No	No	No	No	No	No	No
Req storage for multiple copies of DBs	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Requires shared storage (SAN)	No	Yes	No	No	Yes	Yes	No	No	No	Yes	Yes
Requires virtualization	No	No	No	No	No	Yes	No	No	No	No	Yes
Can use local solid state storage	Yes	No	Yes	Yes	No	No	Yes	Yes	Yes	No	No
Performance											
Has noticeable performance impact	Maybe	No	Yes	Yes	Maybe	Maybe	Minimal	Minimal	No	Maybe	Maybe
Can offload backups, DBCCs, reports	Yes	No	Yes	No	No	No	Yes	No	Some	No	No



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Easy to fail back and forth for patching	Some	Yes	Yes	Yes	No	No	Yes	Yes	Some	No	No
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Performance											
Has noticeable performance impact	Maybe	No	Yes	Yes	Maybe	Maybe	Minimal	Minimal	No	Maybe	Maybe
Can offload backups, DBCCs, reports	Yes	No	Yes	No	No	No	Yes	No	Some	No	No



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Can use local solid state storage	Yes	No	Yes	

Your budget is limited.

Don't get SAN storage, switch gear,
and a SAN admin unless you have to.

Or do you just want a SAN?

Already have a SAN that performs very well

Plan to move the database between hardware soon

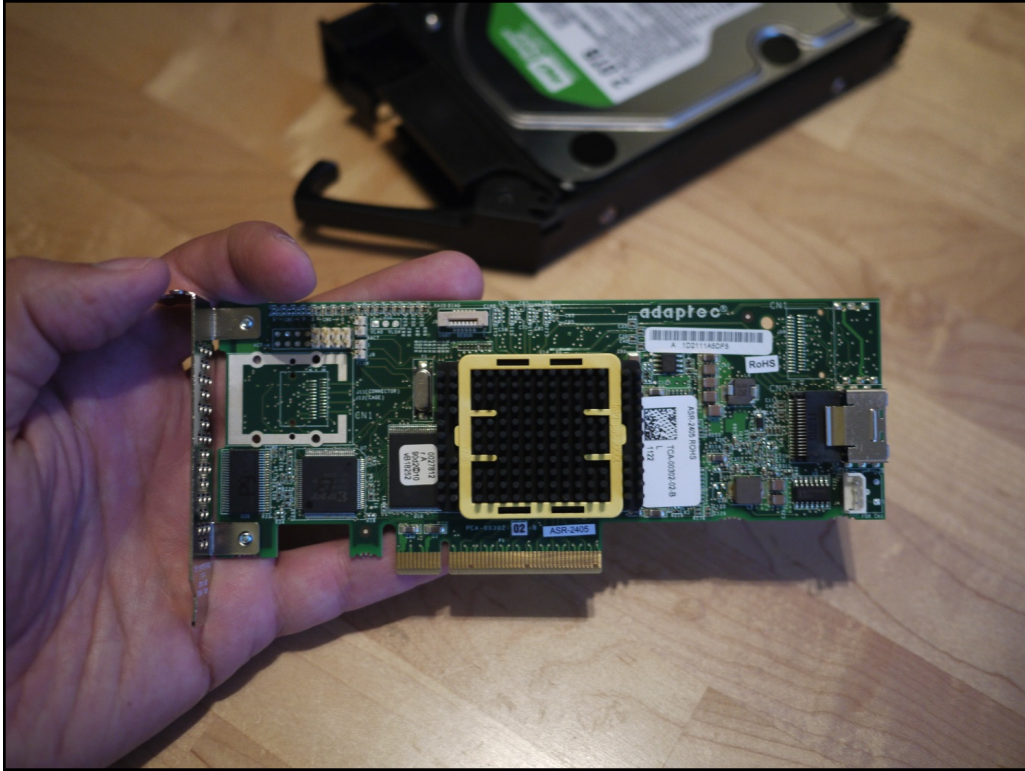
Data too large to fit in internal drives
(which is pretty unlikely these days, except blades)

Otherwise, local solid state is a shortcut to speed,
so your hardware choice should have local drive bays.

Why shared storage is usually slower

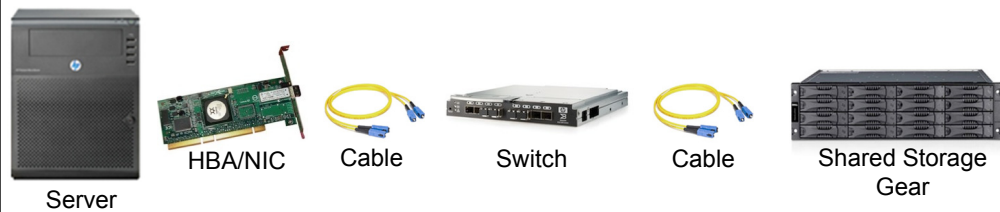




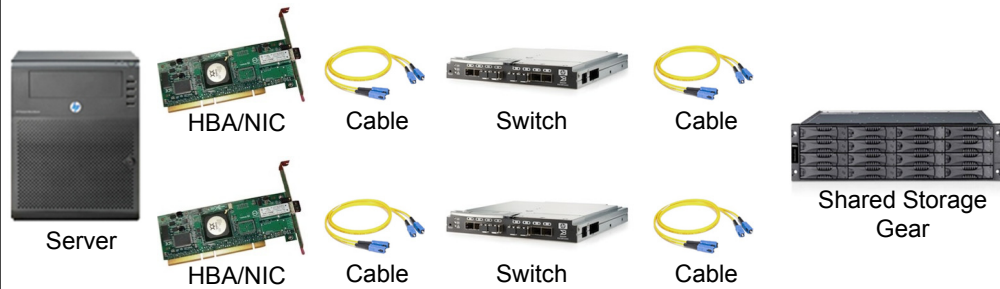




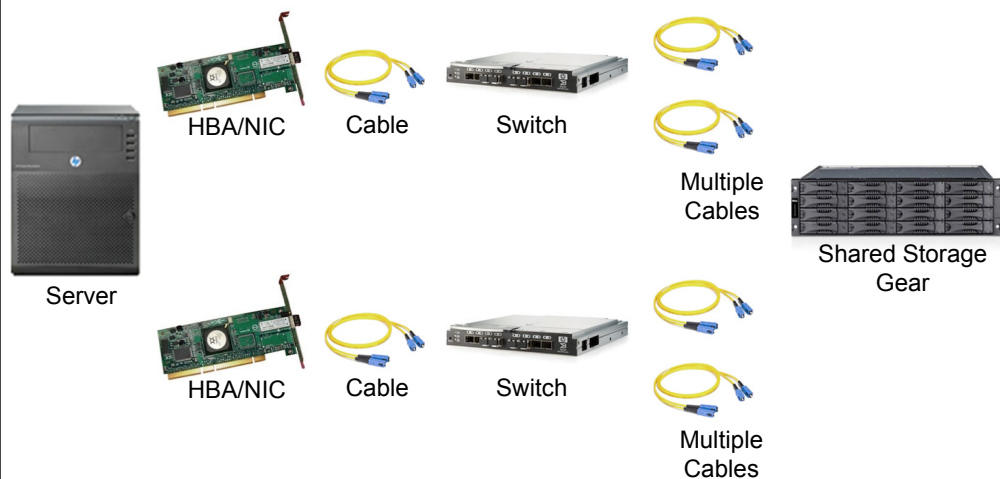
Simple SAN path



Two storage fabrics

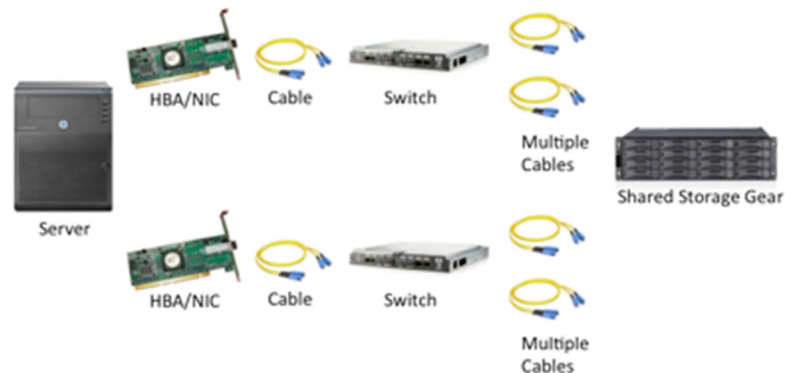


More paths, more throughput?



Active/Active Multipathing

Multiple active paths are actively carrying data, but they may only be carrying data for one drive letter, or they may only be active for writes or for reads.



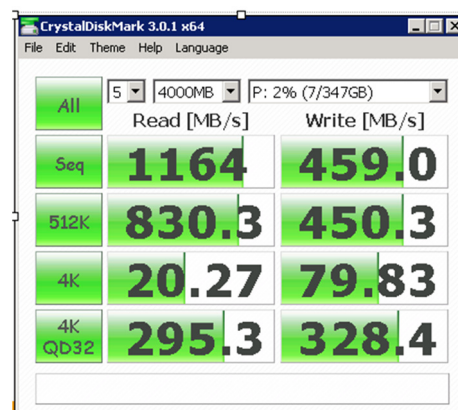
CrystalDiskMark

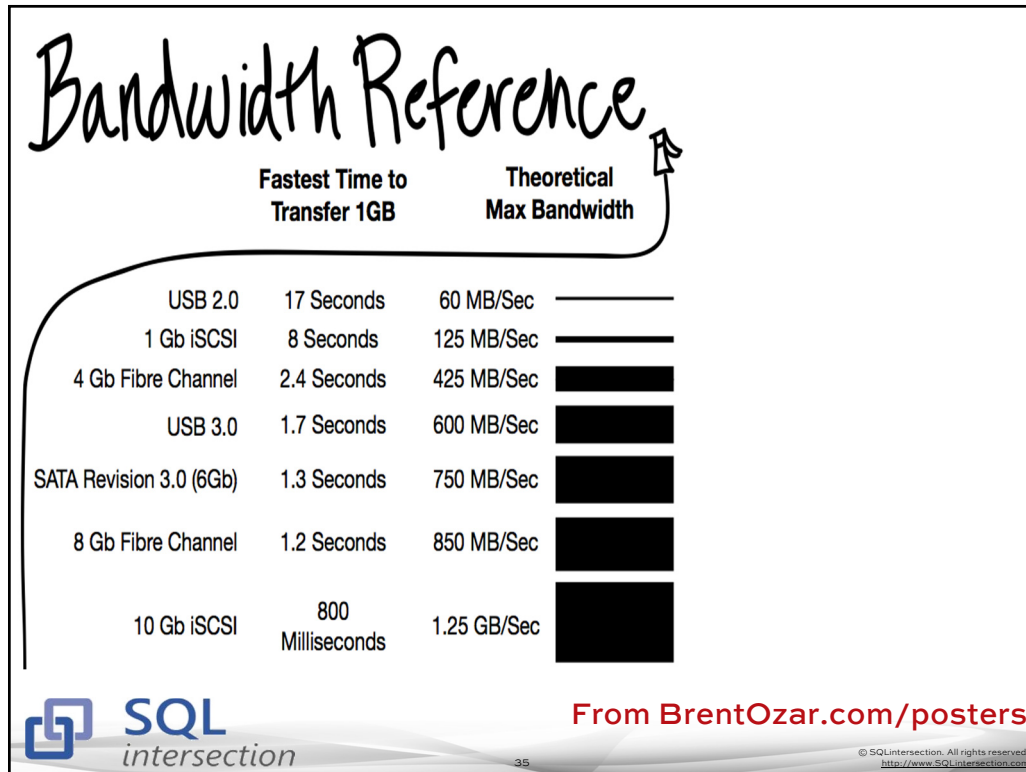
Free tool with instructions:
BrentOzar.com/go/cdm

Pick 5 tests, 4000MB test
file, drive letter

Sequential:
roughly akin to backups,
large table scans

4K QD32:
vaguely similar to active
OLTP server or TempDB





Your goals

Aim for 200MB per second of read throughput, per core of SQL Server

Example: 8 cores need at least 1,600MB/sec reads

Got less? Don't waste money on SQL licensing.

If you quickly and consistently hit a bottleneck lower than that, check your SAN fabric's throughput

Try using multiple paths, active/active multipathing

Easier way: cache the data in RAM, or ...

Storing the data locally on SSDs

“But SSDs aren’t reliable!”

News flash: neither are hard drives.

Mitigations:

- Backups
- DBCCs
- 2 hot spare drives (hey, we’ve got all those bays in the server chassis, might as well use them)
- Xanax

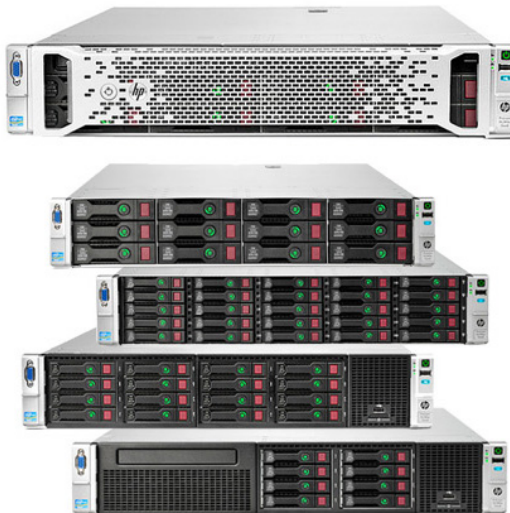
Dell PowerEdge 720XD



Top version: holds 26 2.5" drives (2 are on the back)

Bottom version: old 3.5" drives, holds 12

HP DL380e G8



Similar, has models for different drive sizes.

You want 2.5" drive bays.

Lots of drive bays for SSDs

Option 1: vendor-approved, enterprise-class drives.

- Vendor supports them, replaces when they break
- Well-tested – but this also means old and slow, because vendors don't test the latest and greatest
- Redonkulously expensive: 4TB capacity \$25K

Option B: off-the-shelf consumer drives

- You support them when they break (but they're dirt cheap, so buy spares)
- Redonkulously fast, cheap: 9TB capacity \$9K

The right hardware for Standard Edition

The Standard Standard

2-socket, 4-6 cores (get fastest cores possible)

128GB-192GB memory (SQL will use 64GB-128GB)

2 local SSDs in a mirrored pair for TempDB

Same spec kit whether you're doing cluster, non-clustered with a SAN, or non-clustered with local disks

Example: Dell PowerEdge 720 with 3.5GHz processors and 128GB memory: \$7K

On Enterprise, how many CPU sockets do you need?

Do you even need sockets?

	Standard Edition	Enterprise Edition
Physical	2 quad-core processors Licensing: \$14,344 Hardware: \$10,775 Total: \$25,119	2 quad-core processors Licensing: \$54,992 Hardware: \$23,206 Total: \$78,198
Virtual	Guest with 4 cores Licensing: \$7,172 Hardware: FREE* Total: Unknown	Host with 2 quad-core processors Licensing: \$54,992 Hardware: \$23,206 Total: \$78,198

Source: BrentOzar.com/go/smallest

Physical servers

Summary				
	Sockets	2	4	8
	Memory	768GB	3TB	4TB
	PCI Express slots	6	9	16
	Drive bays	26	10	8
Fastest low-core, low-licensing				
	Total speed, GHz	28	82	89
	Total cost	\$ 80,489	\$ 335,430	\$ 688,939
Most cores available				
	Total speed, GHz	65	168	192
	Total cost	\$ 192,613	\$ 569,547	\$ 965,267

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# of CPU Sockets	2	4	8
Models	Dell R720		
	HP DL380 G8	HP DL580 G8	HP DL980 G7
Memory	768GB	3TB	4TB
PCI Express slots	6	9	16
Drive bays	26 Dell, 25 HP	10	8
Rack space required	2U	4U	8U
Fastest low-core, low-licensing			
Processor speed, GHz	3.5	3.4	1.86
# of cores	4	6	6
Total speed, GHz	28	82	89
Boost, theoretical		291%	319%
Cache, MB	15	38	18
Cache per core	3.8	6.3	3.0
Model	E5-2637 v2	E7-8893 v2	E7-4807
Hardware cost	\$ 25,497	\$ 170,454	\$ 358,987
SQL Server licensing	\$ 54,992	\$ 164,976	\$ 329,952
Total cost	\$ 80,489	\$ 335,430	\$ 688,939

# of CPU Sockets	2	4	8
Models	Dell R720		
	HP DL380 G8	HP DL580 G8	HP DL980 G7
Memory	768GB	3TB	4TB
PCI Express slots	6	9	16
Drive bays	26 Dell, 25 HP	10	8
Rack space required	2U	4U	8U
Most cores available			
Processor speed, GHz	2.7	2.8	2.4
# of cores	12	15	10
Total speed, GHz	65	168	192
Boost, theoretical		259%	296%
Cache, MB	30	38	30
Cache per core	2.5	2.5	3.0
Model	E5-2697 v2	E7-4890 v2	E7-4870
Hardware cost	\$ 27,637	\$ 157,107	\$ 415,347
SQL Server licensing	\$ 164,976	\$ 412,440	\$ 549,920
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Boiling it down

Need <768GB RAM and <82GHz CPU? 2-socket.
The 25-26 local drive bays give you great options.

Need 1-3TB RAM and 8-10 PCI slots? 4-socket.
The March CPU updates beat 8-socket boxes.

Need over 3TB RAM or over 10 PCI slots?
8-socket, but start making plans to split this monster.

Recap

The top 5 things we covered

1. Low RPO/RTO goals? Standard Edition VM.
2. If your RPO/RTO doesn't require shared storage, try local SSDs.
3. If you have to have a SAN, pathing is incredibly important. Get lots of fast paths.
4. CrystalDiskMark test for 200MB/sec/core.
5. In mid-2014, 2-sockets are an amazing deal.

Learn more: BrentOzar.com/go/faster