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SQL Saturday 851 – Stockholm 2019

SQL Server installation cookbook

Apologies
French speaker

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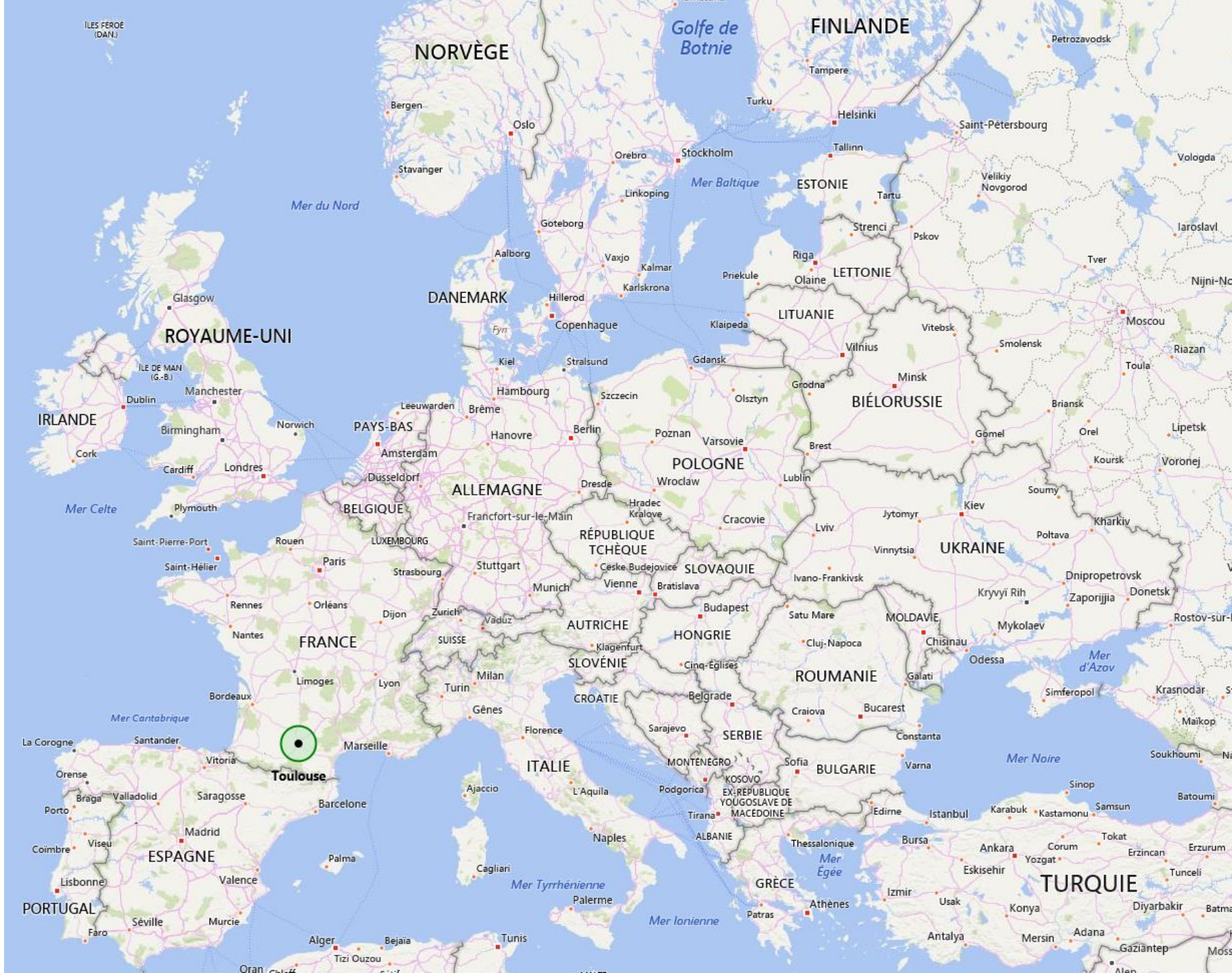
Microsoft Most Valuable Professional

Microsoft Certified Master

Microsoft Certified Trainer

~ since 1997 : SQL 6.5 / WinNT4



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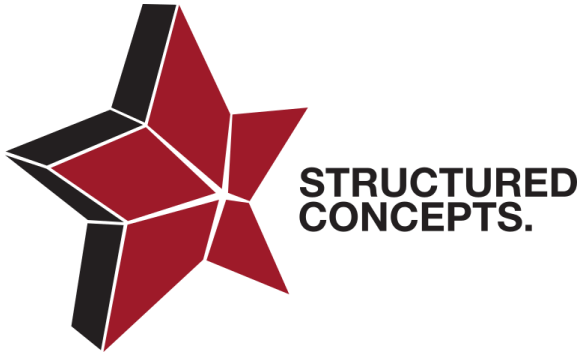


Agenda today

Quick recap on hardware

Host Configuration

SQL Server and virtualization

Windows Server configuration

SQL Server installation

SQL Server configuration

SQL Server maintenance

Quick recap on hardware - CPU

Frequency vs # cores

SQL Server editions

-> Impact on Licensing

Enterprise : OS Max

Standard : 24 cores / 4 socket

Web : 16 cores / 4 sockets

12 cores ?

Xeon Gold 5118 @2,3 Ghz

Xeon Gold 6126 @2,6 Ghz

Xeon Gold 6136 @3,0 Ghz

Xeon Gold 6146 @3,2 Ghz

Xeon Platinum 8158 @3,0Ghz

Intel® Xeon® Processor E5-2643 v4	Launched	Q1'16	6	3.70 GHz	3.40 GHz
Intel® Xeon® Processor E5-1680 v4	Launched	Q2'16	8	4.00 GHz	3.40 GHz
Intel® Xeon® Processor E5-2667 v4	Launched	Q1'16	8	3.60 GHz	3.20 GHz
Intel® Xeon® Processor E5-1660 v4	Launched	Q2'16	8	3.80 GHz	3.20 GHz
Intel® Xeon® Processor E5-2687W v4	Launched	Q1'16	12	3.50 GHz	3.00 GHz

Intel® Xeon® Gold 6144 Processor	Launched	Q3'17	8	4.20 GHz	3.50 GHz
Intel® Xeon® Gold 6128 Processor	Launched	Q3'17	6	3.70 GHz	3.40 GHz
Intel® Xeon® Gold 6146 Processor	Launched	Q3'17	12	4.20 GHz	3.20 GHz
Intel® Xeon® Gold 6134M Processor	Launched	Q3'17	8	3.70 GHz	3.20 GHz
Intel® Xeon® Gold 6134 Processor	Launched	Q3'17	8	3.70 GHz	3.20 GHz
Intel® Xeon® Platinum 8158 Processor	Launched	Q3'17	12	3.70 GHz	3.00 GHz
Intel® Xeon® Gold 6154 Processor	Launched	Q3'17	18	3.70 GHz	3.00 GHz
Intel® Xeon® Gold 6136 Processor	Launched	Q3'17	12	3.70 GHz	3.00 GHz
Intel® Xeon® Platinum 8168 Processor	Launched	Q3'17	24	3.70 GHz	2.70 GHz

Quick recap on hardware - memory

Huge impact on performance

- low cost performance improvement!
- No impact on licensing fees ☺

But some limitations based on sku ☹

- Express (<2016) : 1GB
- Express (>=2016) : 1,410 GB +
  352MB CSI +
  352MB per DB using Hekaton
- Standard (2012) : 64 GB
- Standard (2014) : 128 GB
- Standard (>=2016SP1) : 128 GB +
  32GB CSI +
  32GB per DB using Hekaton
- Enterprise (OS Limit) : 24 TB

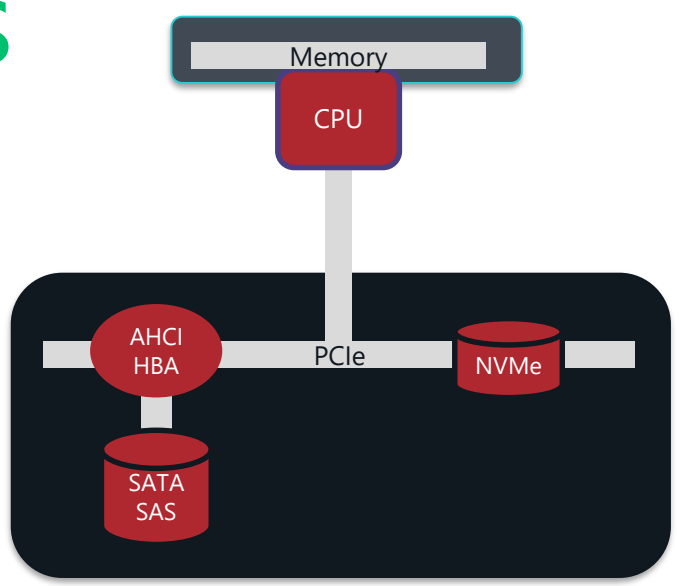
No “On Size fits all” configuration

- Based on the instance workload
- And on the working set

But, please …

- At least 6 to 8 GB per core

Quick recap on hardware - Disks



Time to say goodbye to spinning disks

Flash drives are your best friends now !

- (Very) low latency
- Less CPU needed (19% vs 37% for 100 000 IOPS 100% 4K reads)
- NVMe is even faster than SAS/ SATA SSD
  - Designed for flash drives
  - AHCI : 1 queue & 32 commands per queue
  - NVMe : 64**K** queues & 64**K** commands per queue

Think different

- $ per IOPS instead of $ per GB

Intel P3700	Intel S3700
800GB NMVe SSD	800GG SATA SSD
$1,9999	$1,425
$2,49 / GB	**$1,78 / GB**
$6,16 / 1K IOPS	$14,90 / 1K IOPS

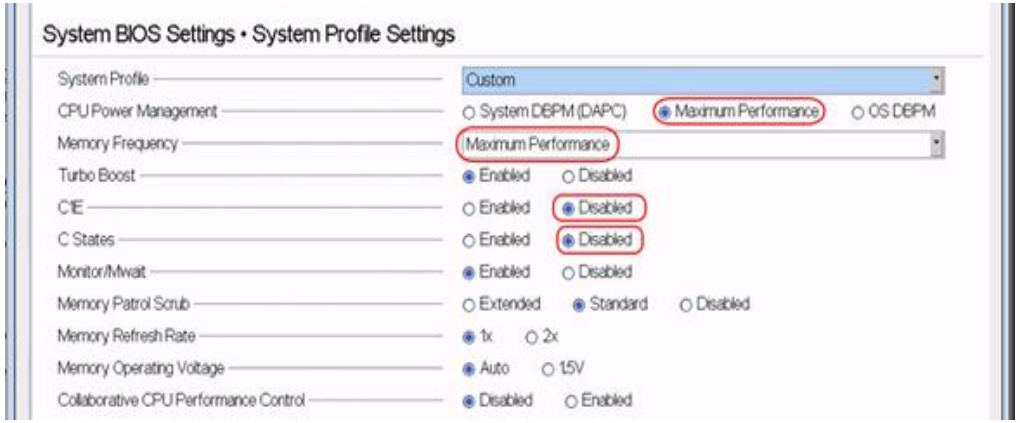
Operation	Duration	IOSize	IOType	PendingIO	FileSize	IOPS RAID SSD	MBs/Sec	Min_Lat(ms)	Avg_Lat(ms)	Max_Lat(ms)
Read	10	8	Random	8	20000	161 955,10	1 265,27	0	0	47
Write	10	8	Random	8	20000	61 224,10	478,31	0	1	36

Operation	Duration	IOSize	IOType	PendingIO	FileSize	IOPS P3700	MBs/Sec	Min_Lat(ms)	Avg_Lat(ms)	Max_Lat(ms)
Read	30	8	Random	8	5000	293 653,32	2 294,16	0	0	3
Write	30	8	Random	8	5000	131 564,20	1 027,84	0	0	9

Host configuration

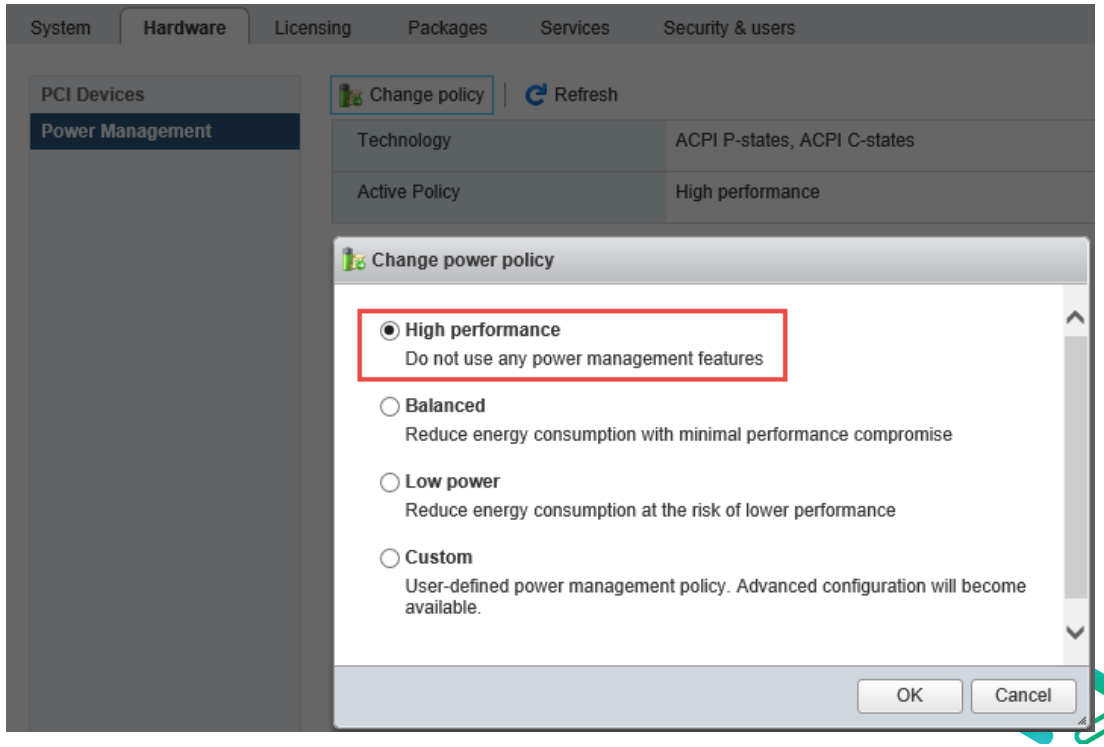
Install latest version for
- Bios
- Firmware
- Drivers

BIOS configuration
- Profile setting : max performance
- Enable Hyper-threading
- Enable Intel turbo boost



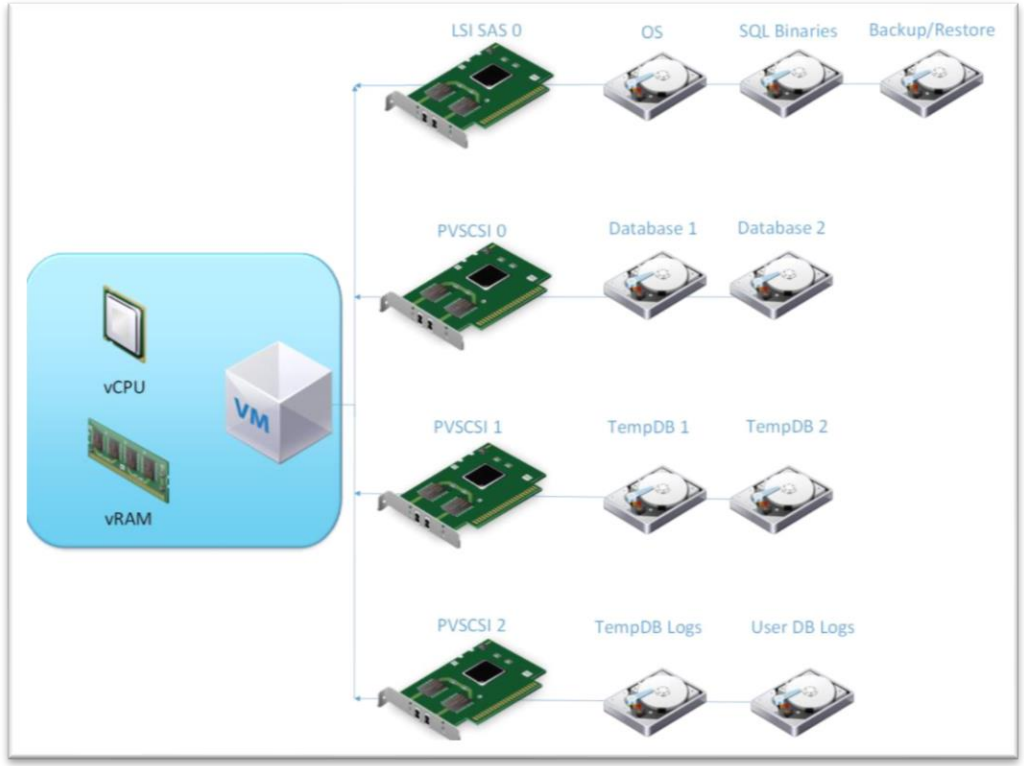
Host OS

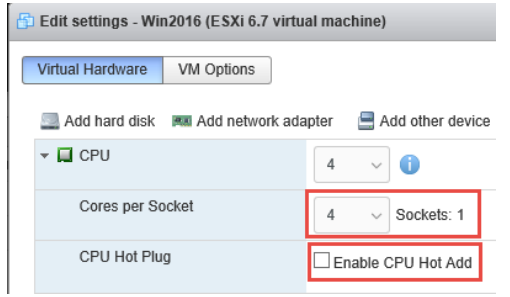
- Power setting high performance

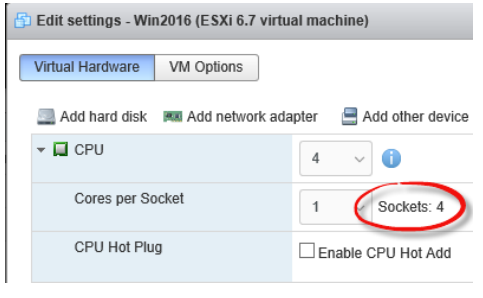


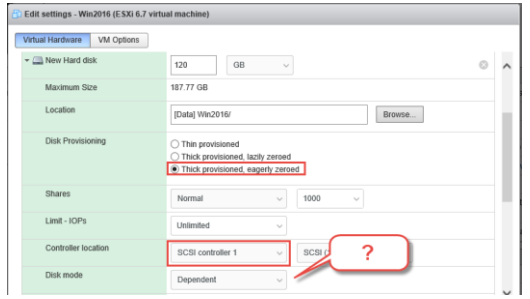
Virtualizing SQL Server

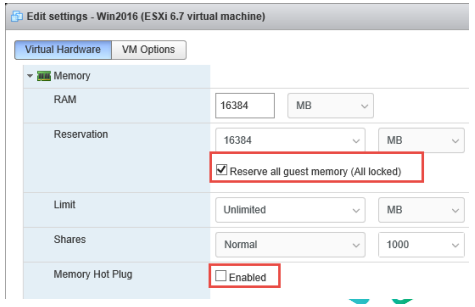
- Yes .. Of course
  - Dev / Test / Production
- But things should be done the right way
  - CPU
    - Disable Hot Add CPU
    - #sockets vs #cores (Next slide)
  - Memory
    - NO dynamic memory
    - Set reservation = allocated memory
  - Network
    - VMXNet3 mandatory (latency and performance)
  - IO subsystem for best performance
    - Add more paravirtual SCSI controllers (pvSCSI)
    - Attach multiple VMDKs to each controller
      - Thick provisioning eagerly zeroed
  - Disable unused devices
    - Floppy, DVD, COM, USB, LPT











NUMA Architecture

NUMA considerations

« Remote » or « foreign » memory access 2 to 5 times slower than local memory

sockets vs # cores

/!\ licensing SQL Web / Standard edition

4 sockets

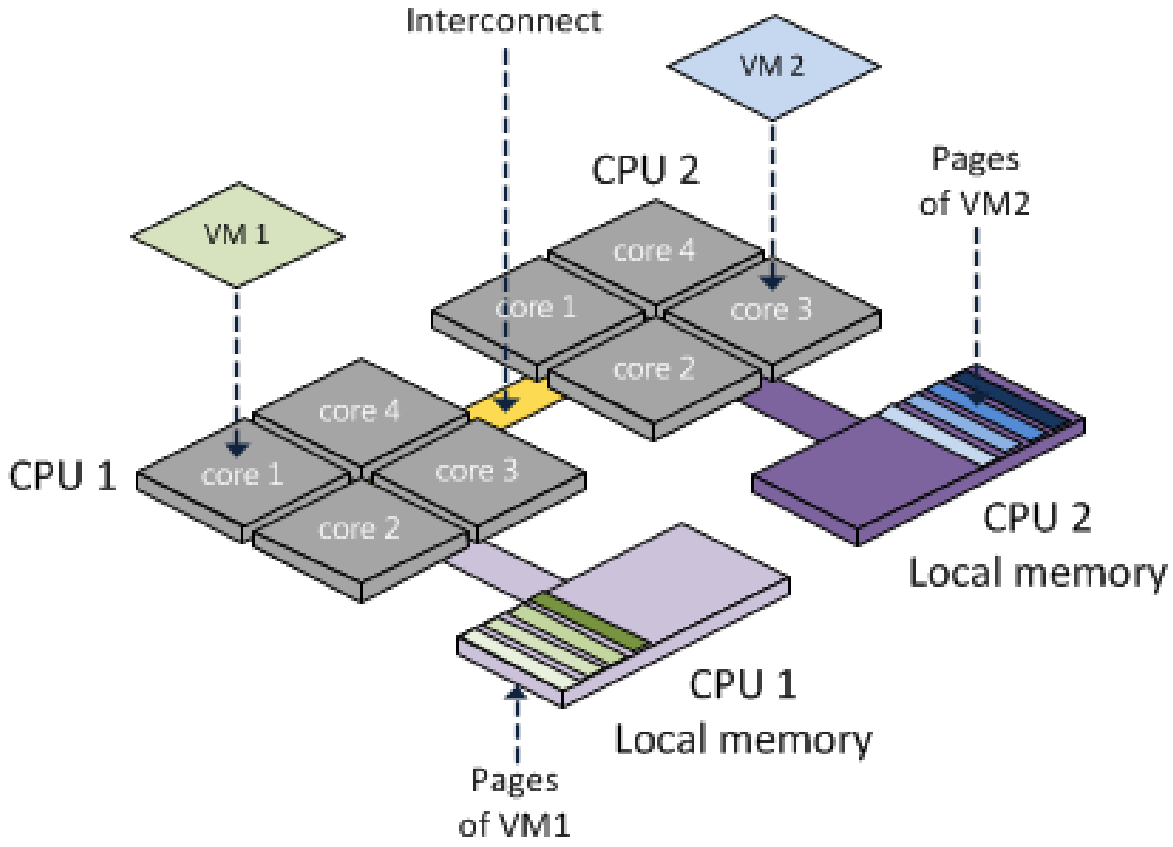
vNUMA

Disabled by CPU Hot Add option

By default enabled only if > 8 cores

Recommendation

Try to fit the VM on a NUMA node



SQLQuery1.sq... — Microsoft SQL Server Management Studio

Fichier Edition Affichage Projet Déboguer Outils Fenêtre ?

Nouvelle requête | master | Exécuter | Déboguer

Explorateur d'objets

Connecter

Unités de sauvegarde

Points de terminaison

```
select * from sys.dm_os_schedulers
```

236 %

Résultats | Messages

	scheduler_address	parent_node_id	scheduler_id	cpu_id	status	is_online	is_idle	preemptive_switches_count	context_switches_count	idle_switches_count	current_tasks_count	runnable_tasks_count	current_workers_count	active_workers_count	wor
1	0x00000003FF190040	0	0	0	VISIBLE ONLINE	1	0	20702270	691349150	-2092496937	7	2	10	7	0
2	0x00000003FF1A0040	0	1	1	VISIBLE ONLINE	1	1	5477957	428410291	1421157490	10	0	13	8	0
3	0x00000003FF1B0040	0	2	2	VISIBLE ONLINE	1	0	20671401	782641825	-1885117318	7	2	10	7	0
4	0x00000003FF1C0040	0	3	3	VISIBLE ONLINE	1	0	19632001	720758079						
5	0x00000003FF1D0040	0	4	4	VISIBLE OFFLINE	0	1	0	1						
				5	VISIBLE OFFLINE	0	1	0	1						
				6	VISIBLE OFFLINE	0	1	0	1						
				7	VISIBLE OFFLINE	0	1	1	3						
				0	HIDDEN ONLINE	1	0	259239440	0						
				0	VISIBLE ONLINE (DAC)	1	1	4	9						
				1	HIDDEN ONLINE	1	1	0	0						
				2	HIDDEN ONLINE	1	1	0	0						
				3	HIDDEN ONLINE	1	1	6	0						
				4	HIDDEN ONLINE	1	1	2	0						
				5	HIDDEN ONLINE	1	1	1315846	0						
				6	HIDDEN ONLINE	1	1	52353	0						
				7	HIDDEN ONLINE	1	1	37983	0						
				0	HIDDEN ONLINE	1	1	37093	0						
				1	HIDDEN ONLINE	1	1	35291	0						
				2	HIDDEN ONLINE	1	1	17532	0						
				3	HIDDEN ONLINE	1	1	27712	0						
				4	HIDDEN ONLINE	1	1	24279	0						
				5	HIDDEN ONLINE	1	1	26112	0						
				6	HIDDEN ONLINE	1	1	34948	0						
				7	HIDDEN ONLINE	1	1	26352	0						
				0	HIDDEN ONLINE	1	1	22144	0						
				1	HIDDEN ONLINE	1	1	27916	0						
				2	HIDDEN ONLINE	1	1	32432	0						
				3	HIDDEN ONLINE	1	1	28642	0						
				4	HIDDEN ONLINE	1	1	47826	0						
				5	HIDDEN ONLINE	1	1	33216	0						
				6	HIDDEN ONLINE	1	1	48436	0						
				7	HIDDEN ONLINE	1	1	47776	0						
				0	HIDDEN ONLINE	1	1	12174	0						

Gestionnaire des tâches

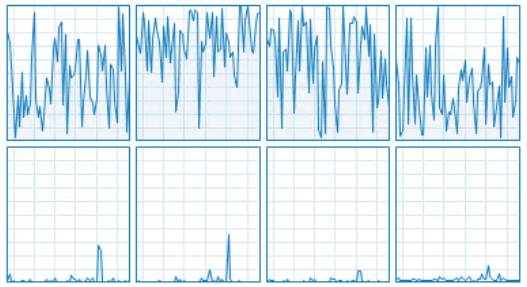
Fichier Options Affichage

Processus | Performance | Utilisateurs | Détails | Services

- Processeur 29% 2,20 GHz
- Mémoire 15,3/16,0 Go (96%)
- Ethernet E : 1,2 Mbits/s R : 272 Kbits/s

Processeur Intel(R) Xeon(R) CPU E5-2660 v...

% Utilisation sur 60 secondes 100 %



Utilisation	Vitesse		Vitesse maximale :	2,20 GHz
29%	2,20 GHz		Sockets :	8
			Processeurs virtuels :	8
Processus	Threads	Handles	Ordinateur virtuel :	Oui
125	1408	47244	Cache de niveau 1 :	N/D

Durée de fonctionnement

329:12:41:43

Moins de détails | Ouvrir le Moniteur de ressources

Propriétés du serveur

Sélectionner une page

- Général
- Mémoire
- Processeurs
- Sécurité
- Connexions
- Paramètres de base de donnée
- Avancé
- Autorisations

Script | Aide

Nom	
Produit	Microsoft SQL Server Standard (64-bit)
Système d'exploitation	Microsoft Windows NT 6.3 (9600)
Plate-forme	NT x64
Version	11.0.3412.0
Langue	Français (France)
Mémoire	16384 (MB)
Processeurs	8
Répertoire racine	c:\Program Files\Microsoft SQL Server\MSSQL11.
Classement du serveur	French_CI_AS
Est un cluster	False
Is HADR Enabled	False

Produit
Nom du produit.

Connexion

Afficher les propriétés de connexion

Progression

Prêt

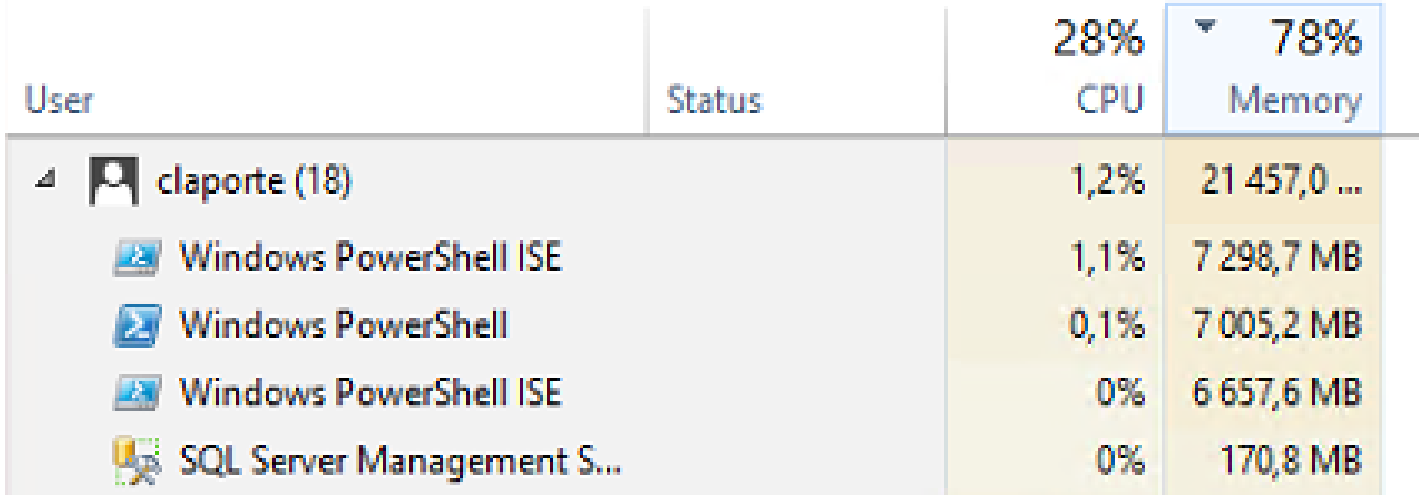
Les modifications apportées aux propriétés et paramètres du serveur peuvent affecter les performances, la sécurité et la disponibilité de cette instance SQL Server. Consultez la documentation du produit avant d'effectuer de telles modifications.

OK | Annuler

Windows Server configuration

- Security
  - Windows admins
    - Very strong passwords !
  - Limit RDP access to OS
    - Windows Serveur Core ?
    - Change default RDP tcp port
- Network
  - Enabling RSS ?
  - Increase max port number
  - Increase SMB Timeout
- Page file
  - Why large file ?
  - 4GB max !

- Power option
  - High performance
- Antivirus exclusions
  - Mandatory *.MDF *.NDF *.LDF
  - Potentially *.BAK *.TRN



Windows Server configuration

- Volumes
  - Naming rules
  - Mount points ?
  - Text file in the root folder
    - Quickly Identify the volume
  - Formatting
    - GPT / MBR
    - NTFS 64K
    - Disable Indexation
    - Disable 8.3
    - Disable Last Access
    - LargeFRS

```
function FormatVolumes ()
{
    # Online disks
    Get-Disk | Where-Object IsOffline -Eq $True | Set-Disk -IsOffline $False

    $DiskList = Get-Disk | Where-Object partitionstyle -eq "raw"
    ForEach ($CurrentDisk in $DiskList)
    {
        # affect volume label
        switch ($CurrentDisk.Number)
        {...}

        Get-Disk $CurrentDisk.Number | Initialize-Disk -PartitionStyle GPT
        $Part = Get-Disk $CurrentDisk.Number | new-Partition -UseMaximumSize -AssignDriveLetter
        $Part | Format-volume  -FileSystem NTFS -AllocationUnitSize 65536 -ShortFileNameSupport:$false `
                               -Confirm:$false -NewFileSystemLabel $DiskLabel -UseLargeFRS | Out-Null
    }


    # for each drive, disable indexing
    $DriveList = Get-WmiObject -Class Win32_Volume  | Where-Object Label -Like '*SQL*'
    ForEach ($CurrentDrive in $DriveList)
    {
        $indexing = $CurrentDrive.IndexingEnabled
        if ("$indexing" -eq $True)
        {
            $CurrentDrive | Set-WmiInstance -Arguments @{IndexingEnabled=$False} | Out-Null
        }
    }

    Get-WmiObject -Class Win32_Volume | Select-Object Name,Label,IndexingEnabled,BlockSize,FileSystem `
                                      | Where-Object Label -Like '*SQL*' | Format-Table -AutoSize

}
```

SQL Server installation

- Next Next Next ???
  - Better now than previous versions
- Default or named Instance
  - No matters
- Collation
  - Should satisfy business goals
- Sysadmin accounts
  - Windows groups instead of users
- Service account
  - For each service
  - Lock Page In Memory
  - Perform Maintenance Volume Tasks (IFI)
  - Kerberos
    - Allow read / write SPN : DSACLS
    - Fine for double hop authentication

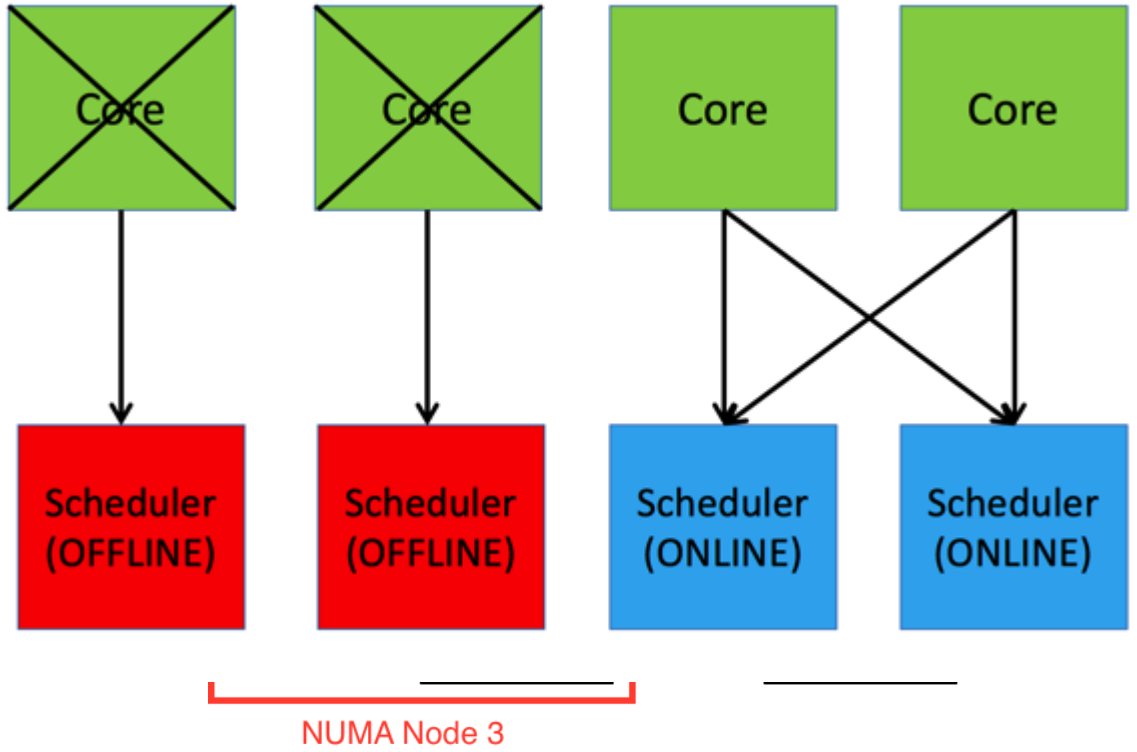
```
D:\Setup.exe /ACTION=Install `
             /FEATURES=SQLEngine,Replication,IS,Conn,FullText `
             /INSTANCENAME=MSSQLSERVER `
             /SQLSVCACCOUNT="NT Service\MSSQLServer" `
             /AGTSVCACCOUNT="NT Service\SQLServerAgent" `
             /FTSVCACCOUNT="NT Service\MSSQLFDLauncher" `
             /ISSVCACCOUNT="NT Service\MsDtsServer140" `
             /AGTSVCSTARTUPTYPE="Automatic" `
             /TCPENABLED="1" `
             /FILESTREAMLEVEL="3" `
             /FILESTREAMSHARENAME="MSSQLSERVER" `
             /UpdateEnabled=FALSE `
             /SECURITYMODE=SQL /SAPWD="#####" `
             /SQLSYSADMINACCOUNTS="#####" `
             /INSTALLSQLDATADIR="F:" `
             /SQLBACKUPDIR="F:\MSSQL\Backup" `
             /SQLUSERDBDIR="F:\MSSQLServer\Data" `
             /SQLUSERDBLOGDIR="G:\MSSQLServer\Log" `
             /SQLTEMPDBDIR="H:\MSSQLServer\Data" `
             /SQLTEMPDBLOGDIR="H:\MSSQLServer\Log" `
             /SQLTEMPDBFILECOUNT=4 `
             /SQLTEMPDBFILESIZE=256 `
             /SQLTEMPDBFILEGROWTH=64 `
             /SQLTEMPDBLOGFILESIZE=256 `
             /SQLTEMPDBLOGFILEGROWTH=256 `
             /SQLSVCINSTANTFILEINIT=TRUE `
             /HELP="False" /INDICATEPROGRESS="False" `
             /QUIET="True" /QUIETSIMPLE="False" `
             /X86="False"  /ENU="True" `
             /ERRORREPORTING="False" /SQMREPORTING="False" `
             /IACCEPTSQLSERVERLICENSETERMS
```

SQL Server Configuration

- Min / Max server Memory = Total OS memory
  - Minus 1GB for OS
  - Minus 1GB for each 4 GB block from 4 to 16 GB
  - Minus 1GB for each 8 GB block beyond 16 GB
- Optimize for adhoc workload
- Default backup compression
- Default backup checksum
  - Configuration since 2014 +
  - TF3023 for older versions of SQL Server
- Remote Admin Connection
- Network packet size
  - For large data movement through linked servers
- Min memory per query
  - Default 1MB
  - Can be reduced to 512KB according to the workload

SQL Server Configuration

- By default no CPU affinity
  - But if you do so
  - Add TF8002
- Cost threshold for parallelism
  - 5 is really … bad
  - 25, 35 or even 50 is better
  - Can adjust the value live
- MaxDop
  - Depends on NUMA architecture
    - Basic rule
      - MaxDop = #core in NUMA node
    - Or adjust
      - Accordingly to software editor requirements
      - Accordingly to the workload (BI vs OLTP)



Post-installation

- Adjust TempDB (SQL2014-)
  - # of files
  - Same size and auto growth
- Increase the size of MSDB Database
- Eventually alter Model Database
- Increase the # of Errorlog files
- Adjust System_Health xEvent retention
  - increase # of files and / or file size for better troubleshooting experience

- Configure Database Mail
  - Profile
  - Accounts
- SQL Agent
  - Configure jobs history
  - Configure mail profile
  - Create operators
  - Create basic alerts

Post-installation – Trace Flags

Trace Flags

Some basic ones

- 834 : large page allocations (do not use if columnstore indexes)
- 1117 : auto growth all files simultaneously
- 1118 : remove single page allocations
- 2371 : update statistics threshold
- 3226 : Remove every successful backup message
- 7806 : Enable DAC on SQL Server Express
- 7412 : lightweight query execution statistics profiling
  - Might involve 2% CPU overhead
  - Valid for SQL Serve 2017 and SQL Server 2016 SP1
  - Enabled by default on SQL Server 2019

And also

- 272 : SQL2012+ : no gap for identity after restart or failover

PowerShell is your friend

Scripting all the configuration steps

- Time saving
- Ease to standardize configuration

PowerShell

- SQL Server specific cmdlets
- SMO library available

dbatools.io

- DBA must-have toolbox
- Hundreds PowerShell modules
  - Migration, configuration, administration

dbatools

Post-installation - Security

Hide instance ?

Enable SQL Browser in case of named instance ?

Change TCP port for default instance ?

Always keep Windows Firewall enabled

- And add required rules

Disable SA account ?

Remove all files in the Setup Bootstrap folder ?

SQL Server maintenance

Maintenance routine

- Backup (database, differential, transaction log)
- Integrity checks, on primary and secondary for AGs
- Index maintenance according to fragmentation level
- Index statistics updates

Archive LOG folder

- xEvents files
- Errorlog files
- Default trace

Test your backups !

- Daily / Weekly restore critical databases
- A DBA is ranked on restore, not backup

SQL Server maintenance plans

- performs well
- But are difficult to migrate
- And could be more customizable

Ola Hallengren scripts

- Definitively a standard
- Highly customizable

NEVER collocate data and backups on the same disk array

Quick database settings considerations

- Recovery model
  - Depends on RPO
- Auto Shrink
  - Always False, ALWAYS
- Auto Close
  - Always False
- Read Committed Snapshot Isolation
  - seriously consider
- Delayed durability
  - might give it a try
- Containment

- Database scoped configuration
  - MAXDop
  - Legacy Cardinality Estimator
  - Parameter sniffing
  - Query optimizer fixes

Conclusion

- Do not trust power savings
- As a baseline
  - No Windows deep configuration changes
    - Difficult to maintain / might change with OS upgrades
  - No fancy Trace Flag or SQL Server configuration option
    - SQL Server is fast
      - Good HW choices, well understanding of SQL Server features (CI, Hekaton, Delayed Durability …)
    - Highlight your DBA skills by right indexing your DBs/improving T-SQL statements
      - Much more efficient than changing an improbable parameter somewhere in SQL Server
  - KISS
    - Keep It Simple (Stupid)
- The future
  - SQL Server in containers / K8s cluster : same configuration options ?
  - No configuration available on Azure SQL Database at instance level !

Thank you for attending

Q&A