Power Saturday

SQL Server installation cookbook

Christophe Laporte

Christophe Laporte

- Audit
- Conseil
  - Infrastructure / Architecture
  - Virtualisation / Cloud
  - Haute disponibilité
  - Performance / Optimisation
  - Dépannage / Migrations
- Formations
- Remote DBA

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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

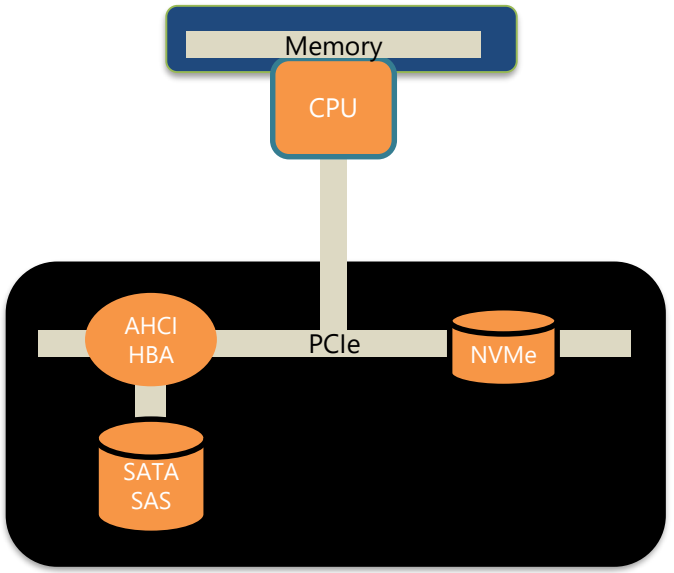
Quick recap on hardware - memory

- 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



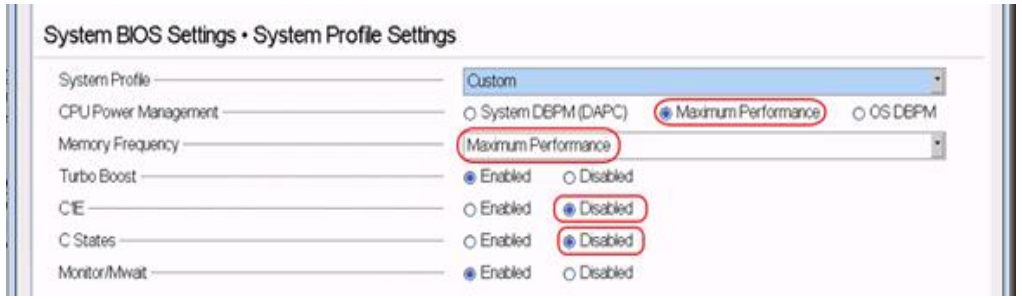
Intel P3700	Intel S3700
800GB NMVe SSD	800GG SATA SSD
$1,9999	$1,425
$2,49 / GB	**$1,78 / GB**
$6,16 / 1K IOPS	$14,90 / 1K IOPS

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

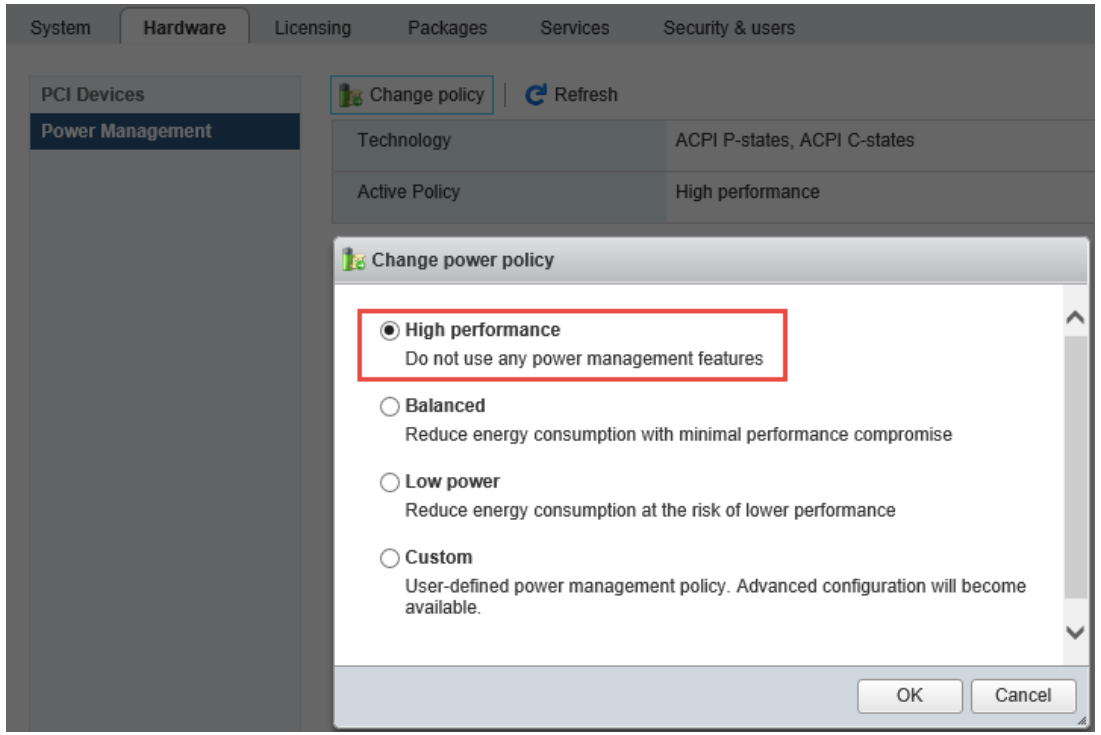
Operation	Duration	IOSize	IOType	PendingIO	FileSize	IOPS P3700	MBs/Sec	Min_Lat(ms)	Avg_Lat(ms)	Max_Lat(ms)
Read	30	8	Random	8	5000	293 653,32	2 294,16	0	0	3
Write	30	8	Random	8	5000	131 564,20	1 027,84	0	0	9

Host configuration

- Install latest version for
  - Bios
  - Firmware
  - Drivers
- BIOS configuration
  - Profile setting : max performance
  - Enable Hyper-threading
  - Enable Intel turbo boost

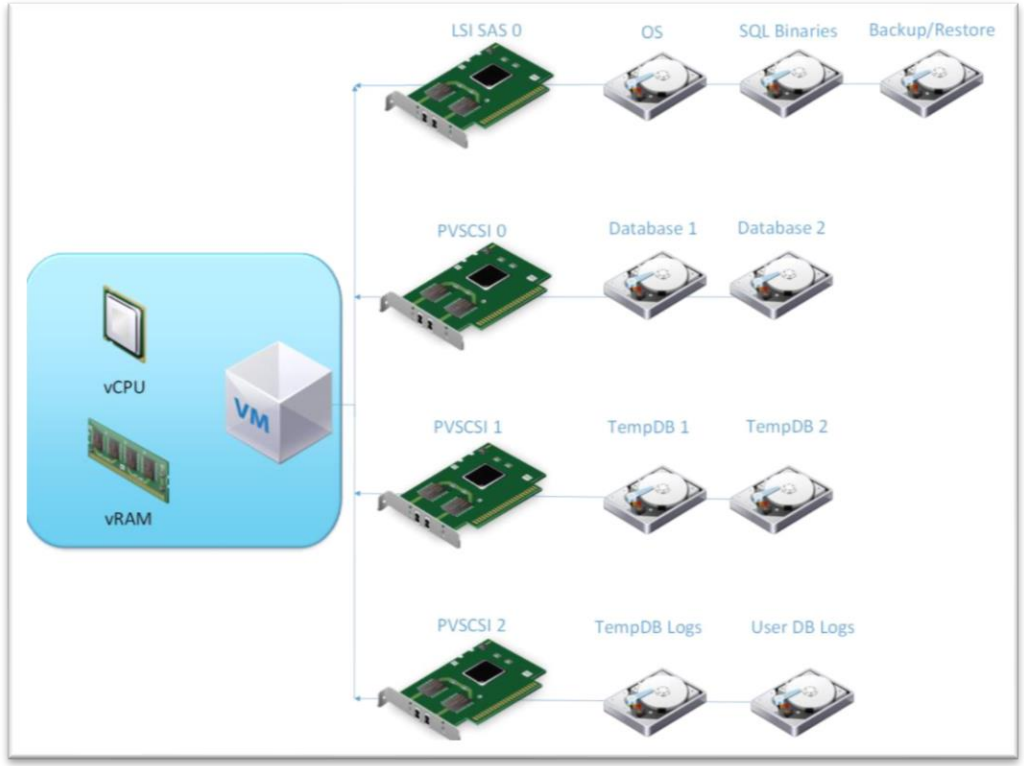


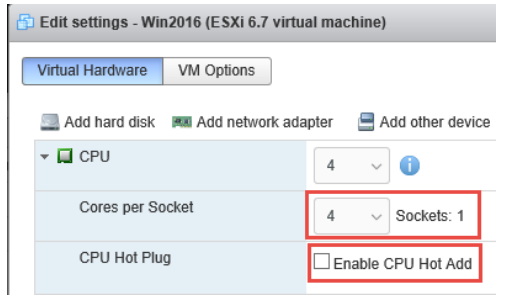
- Host OS
  - Power setting high performance

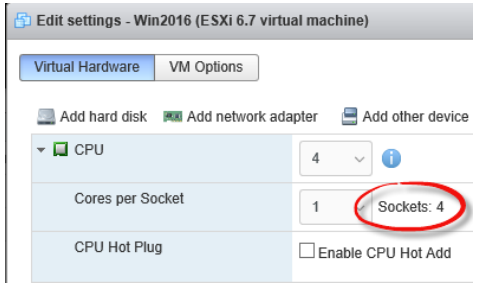


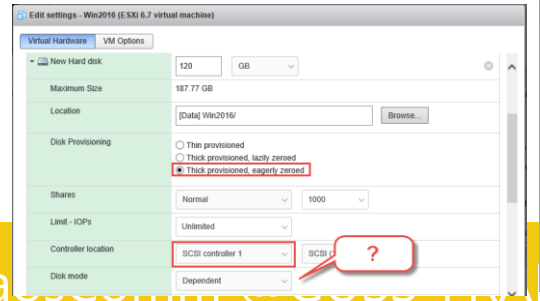
Virtualizing SQL Server

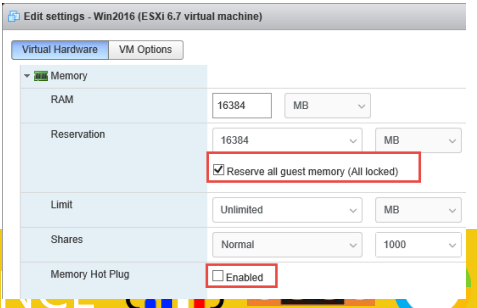
- Yes .. Of course
  - Dev / Test / Production
- But things should be done the right way
  - CPU
    - Disable Hot Add CPU
    - #sockets vs #cores (Next slide)
  - Memory
    - NO dynamic memory
    - Set reservation = allocated memory
  - Network
    - VMXNet3 mandatory (latency and performance)
  - 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





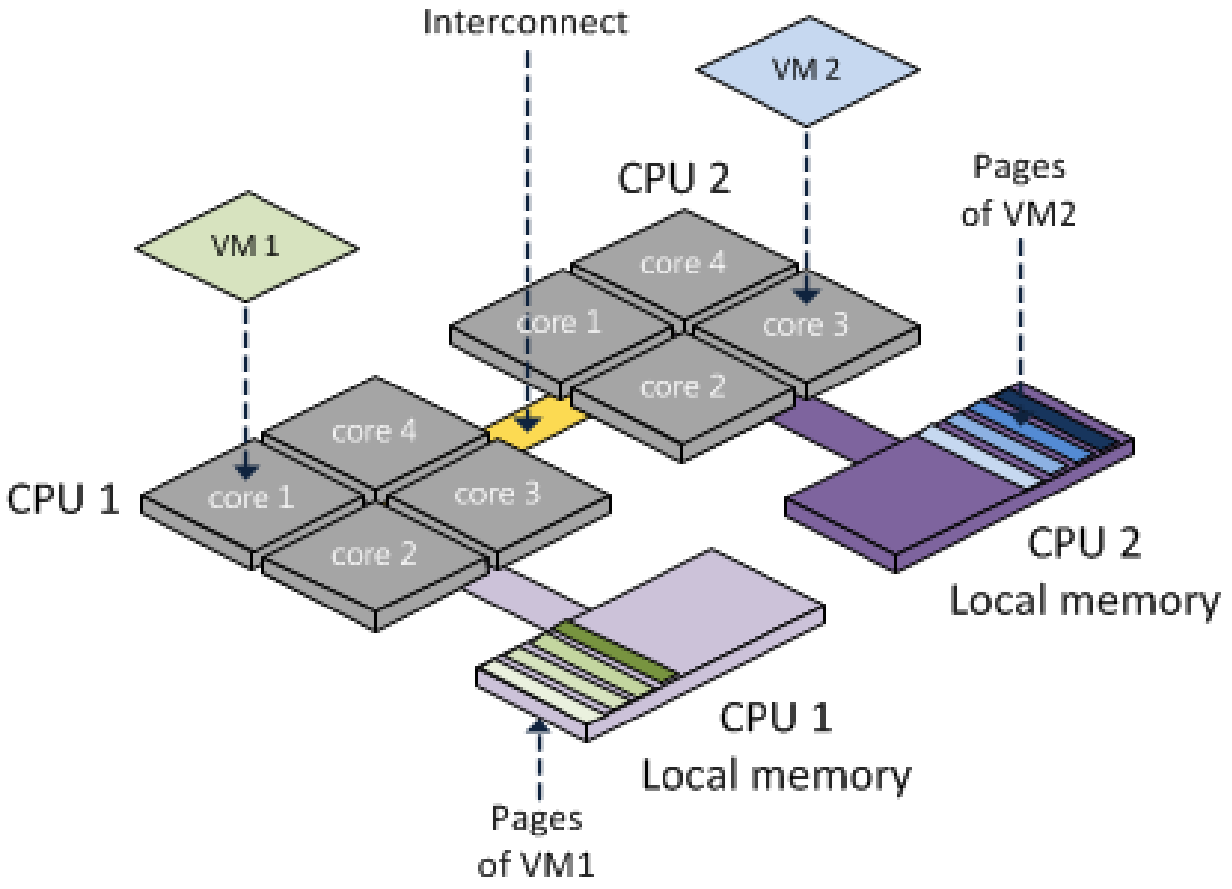


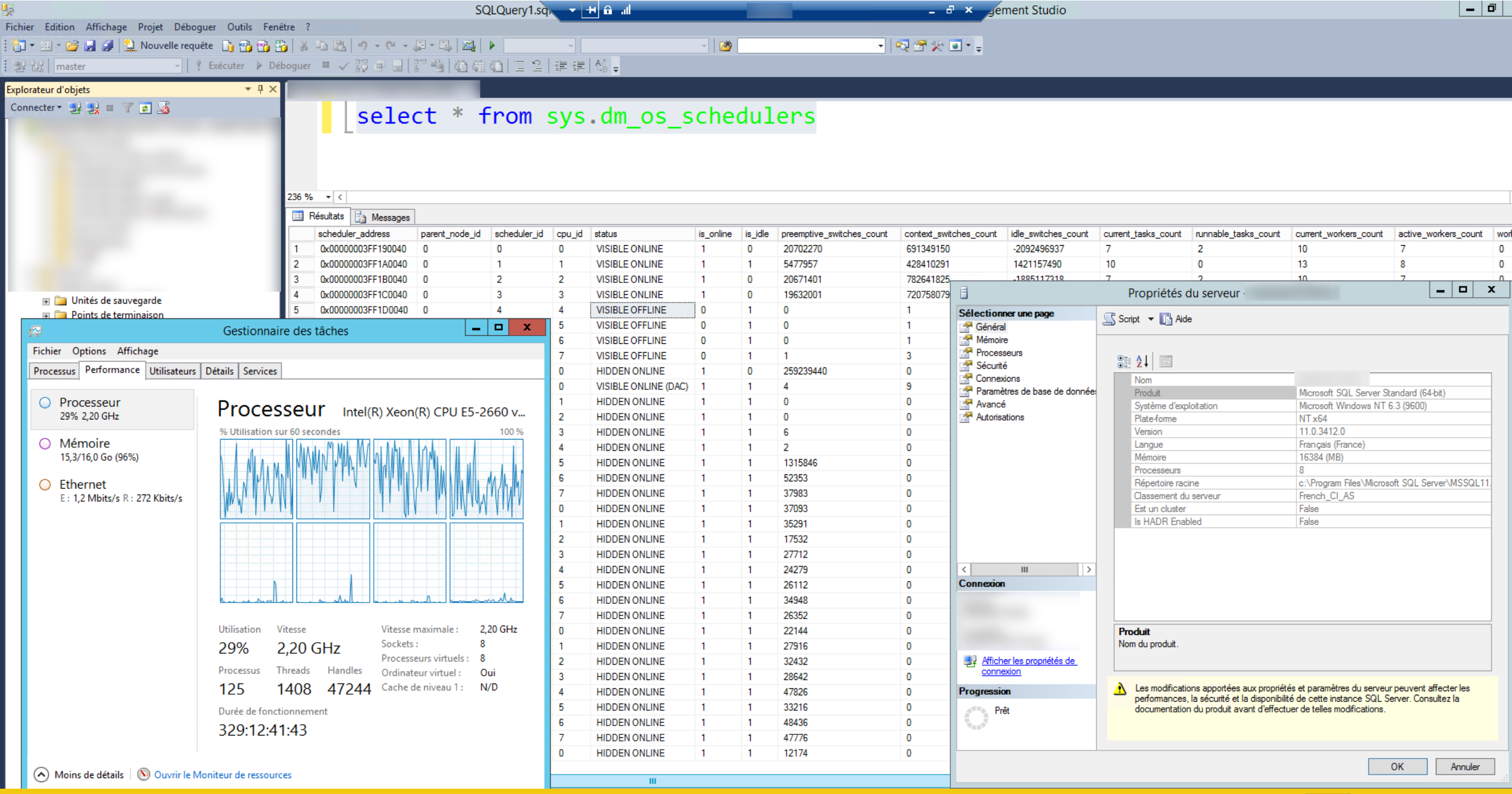




NUMA Architecture

- 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

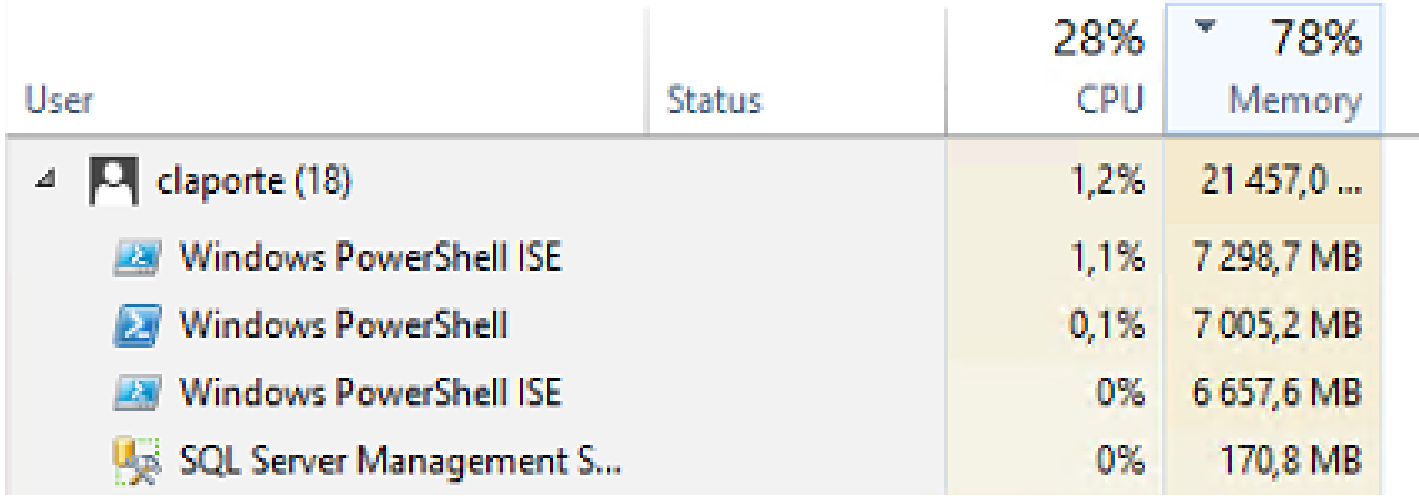



SQLQuery1.sq
Fichier Edition Affichage Projet Déboguer Outils Fenêtre ?
Nouvelle requête
master
Exécuter
Déboguer
Explorateur d'objets
Connecter
Unités de sauvegarde
Points de terminaison
select * from sys.dm_os_schedulers
236 %
Résultats
Messages
scheduler_address parent_node_id scheduler_id cpu_id 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
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
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 29%
Vitesse 2,20 GHz
Processus 125
Threads 1408
Handles 47244
Durée de fonctionnement 329:12:41:43
Vitesse maximale : 2,20 GHz
Sockets : 8
Processeurs virtuels : 8
Ordinateur virtuel : Oui
Cache de niveau 1 : N/D
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
Connexion
Afficher les propriétés de connexion
Progression
Prêt
Produit
Nom du produit.
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 volum
  - 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

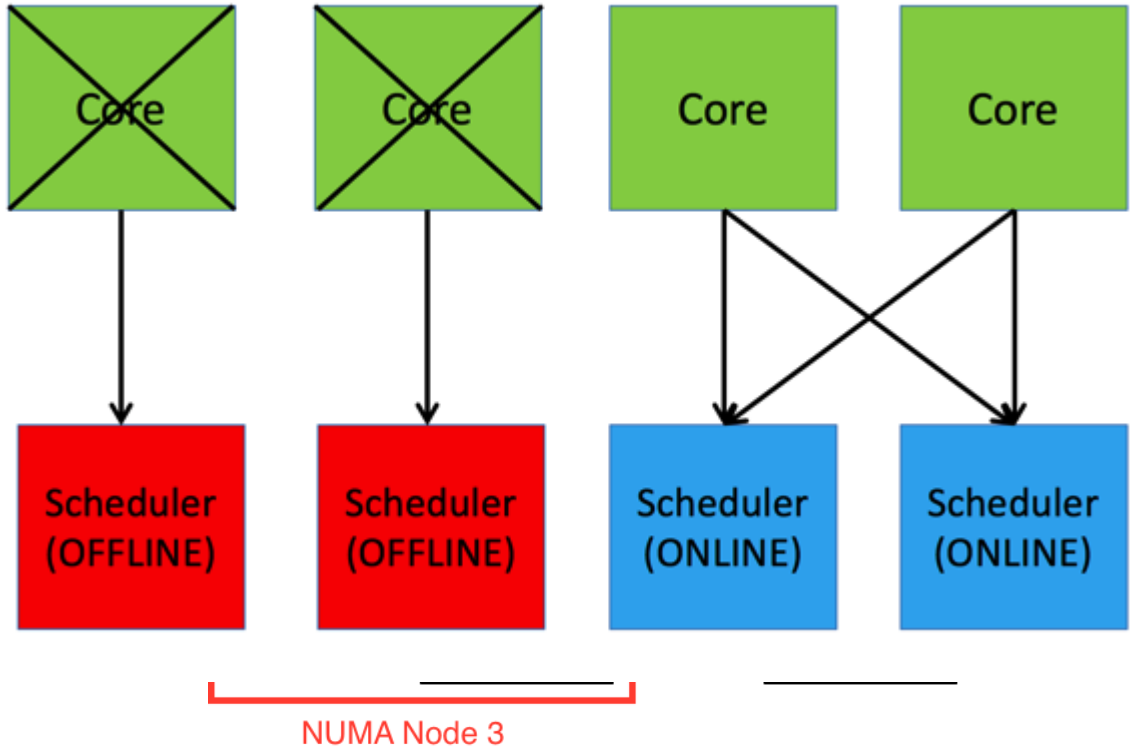
```
D:\Setup.exe /ACTION=Install `
/FEATURES=SQLEngine,Replication,IS,Conn,FullText `
/INSTANCENAME=MSSQLSERVER `
/SQLSVCACCOUNT="NT Service\MSSQLServer" `
/AGTSVCACCOUNT="NT Service\SQLServerAgent" `
/FTSVCACCOUNT="NT Service\MSSQLFDLauncher" `
/ISSVCACCOUNT="NT Service\MsDtsServer140" `
/AGTSVCSTARTUPTYPE="Automatic" `
/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 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

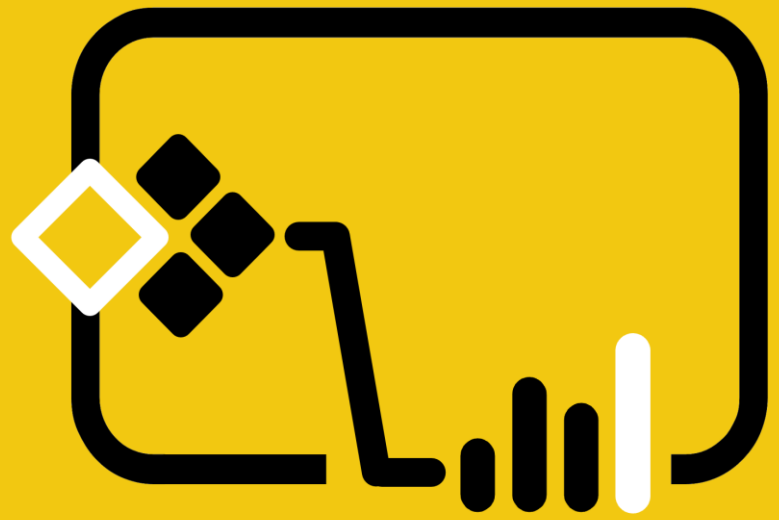
Quick database settings considerations

- 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 !



Merci!

Thank you for attending