Microsoft

SQL Server on Linux Fundamentals for DBAs

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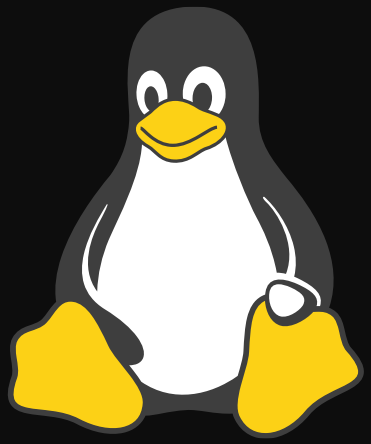
Abstract

I've been working with SQL Server on Windows for well over a decade, but now it can run on Linux. I had to learn a lot of things to ramp up. Let me share those with you, so you can successfully manage SQL Server on Linux! In this session, I'll cover basic Linux commands, what to prep for installation, how to install, how to configure, and what you need to know to monitor and troubleshoot.



Why SQL Server on Linux?

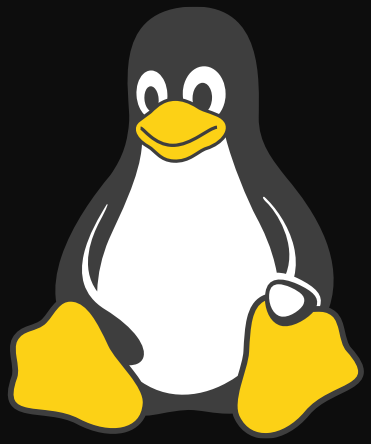
Choice

Containers

What you need to know about Linux

Distributions

Platform	Supported version(s)
Red Hat Enterprise Linux	7.3 or 7.4
SUSE Linux Enterprise Server	v12 SP2
Ubuntu	16.04
Docker Engine	1.8+

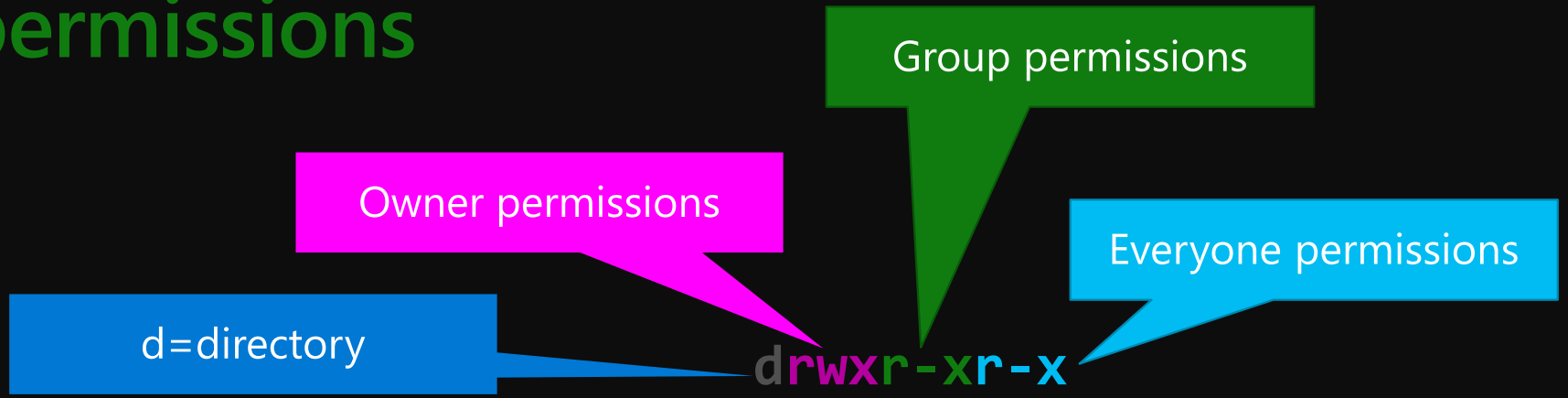


Basic Linux commands

Command	What it does
man	Manual – help files for a command
grep	Filter info from first data - sort of like POSH |
pwd	Present Working Directory – shows where you are
cd	Change directory
ls	List files in a directory
cat	Concatenate
chmod	Change directory or file read/write permissions
chown	Change directory or file owner
systemctl	Tool for controlling the init system – start and stop services

File and folder permissions

- Permission groups
  - Owner
  - Group
  - Everyone
- Permission types
  - Read (r)
  - Write (w)
  - Execute (x)




```
svaneyck@ubuntu3:/var/opt$ cd /var/opt && sudo ls -l ./mssql
total 28
drwxr-xr-x 2 mssql mssql 4096 Feb 24 14:38 backups
drwxr-xr-x 3 mssql mssql 4096 Feb 26 13:22 data
drwxr-xr-x 2 mssql mssql 4096 Feb 26 14:35 log
drwxr-xr-x 2 mssql mssql 4096 Feb 25 11:16 logs
-rw-rw-r-- 1 mssql mssql  334 Feb 26 13:13 mssql.conf
drwxr-xr-x 2 mssql mssql 4096 Feb  6 17:46 secrets
drwxr-xr-x 2 mssql mssql 4096 Feb 22 11:23 system
```

root

- Every Linux server has an administrator account named root
- You don't want to log in as and run commands as root
- Instead, use "sudo" – super user do!
- Example: restart the SQL Server service

```
sudo systemctl restart mssql-server
```

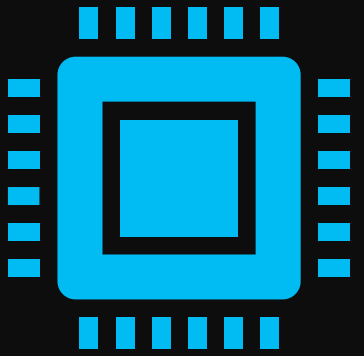
File system basics

/	root (equivalent of C:\)
/bin	system binaries
/dev	devices
/etc	host-specific system-wide config files
/home/*username*	user's directory
/opt	optional software packages - like SQL Server
/var	files with frequently varying content – like data and log files

Pre-installation considerations

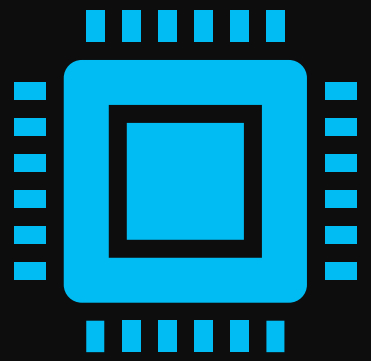
CPU settings

- CPU frequency governor - set to performance – highest clock frequency but no power saving
- energy_perf_bias - set to performance
- min_perf_pct - set to 100
  - Similar to setting the Windows power to High Performance
- C-States - set to C1
  - C-states allow systems to save power by decreasing CPU functionalities
  - C1: The processor doesn’t execute any instruction but can start working again without any delay.



Auto NUMA balancing

- NUMA – non-uniform memory access
- Most servers today have each processor set to access local memory first
- Automatic NUMA balancing moves tasks (threads or processes) closer to the memory they are accessing
  - This is a Linux kernel setting – not an application setting
- It also moves application data to memory closer to the tasks that reference it
- Enabled by default, should be disable (set to 0)



Disk settings

- Disk readahead – loading file contents into cache
- Set to 4096

noatime

- “No access time" - disables the OS from tracking when the files were last accessed
- Add to data and log files for optimal performance

Virtual Address Space

- Each process from an OS runs in its own memory “sandbox”, or space – the VAS
- Default vm.max_map_count is 65536 bytes – that’s not high enough
- Should be set to 256K

Transparent Huge Pages

- By default a page in memory is 4096 bytes. To better manage lots of memory, you can either change hardware memory management unit, or increase page size.
- The second option is called "huge pages" - blocks of memory in 2MB or 1GB instead of 4K.
- Can be difficult to manage so Transparent Huge Pages was implemented as an abstraction layer.
- Should be enabled for consistent performance experience.

Swapfile

- Similar to the Windows paging file
- Ensure it's properly configured – consult your Linux administrator

Dynamic Memory on VMs

- Do not use

Installing SQL Server on Linux

Knowing what version to download and install

- When you install SQL Server on Linux, you must configure a Microsoft repository
- This repository is used to acquire the database engine package, **mssql-server**, and related SQL Server packages
- There are currently three main repositories:

Preview (2019)	mssql-server-preview	SQL Server 2019 preview and RC repository.
CU - base package + bug fixes	mssql-server-2017	SQL Server 2017 Cumulative Update (CU) repository.
GDR - base package + critical fixes/security updates	mssql-server-2017-gdr	SQL Server 2017 GDR repository for **critical updates only**.

Installing SQL Server if your server has internet access

- Import public repository keys
- Configure a source repository
- Update the repository
- Install SQL Server

Demo

Install SQL Server from a repository

Installing SQL Server without internet access

- Download the package
- Move to the server
- Install with distribution-specific command
- Example: Ubuntu

```
sudo dpkg -i mssql-server_versionnumber_amd64.deb
```

- Install dependencies if needed

Private repositories

- Your Linux administrators may have an enterprise repository for software packages
- If so, work with your administrators to have the SQL Server packages you need added to the repository

Post-installation

For SQL Server

- Set PROCESS AFFINITY for nodes/CPUs
  - Enables hardware threads to be associated with CPUs
  - Done via T-SQL
- Multiple tempdb data files - same guidelines as Windows
  - 1 per core, up to 8 cores
  - If contention is identified, add in multiples of 4
- Configure memory – the default limit is 80%
  - We don’t recommend using sp_configure to set max memory
  - Change with mssql-conf memory.memorylimitmb
  - There is no Lock Pages in Memory for Linux
- Instant File Initialization - comparable functionality is enabled by default in Linux

Install tools

- sqlcmd – command-line query utility
- bcp – bulk import/export utility

Connect to the instance

- Local instance

```
sqlcmd -S localhost -U <username> -P <password>
```

- Remote instance
  - SQL Server Management Studio or Azure Data Studio
    - Pass in server name or IP address, and port number if necessary
  - From Linux machine
    - Start openSSH-server
    - Open inbound port 22
    - Connect using bash or putty

Configure

- mssql-conf - the equivalent of SQL Server Configuration Manager on Windows
- View settings

```
sudo cat /var/opt/mssql/mssql.conf
```

- Example - enable SQL Server Agent

```
sudo /opt/mssql/bin/mssql-conf set sqlagent.enabled true
```

mssql-conf

Enable SQL Server Agent

Change default file directories

Enable Availability Groups

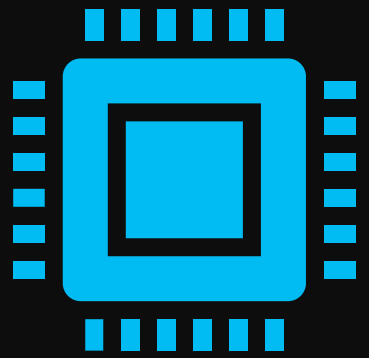
Set the memory limit for SQL Server

Set trace flags

...and more

Monitoring and troubleshooting tools

- Monitor the same things - CPU, memory, I/O
- You have the same SQL Server tools like DMVs, Extended Events, Performance Dashboard Reports, Activity Monitor



Useful Linux monitoring commands

df	file system disk usage
dstat	system statistics - sort of like PerfMon!
free	free and used memory
htop	interactive process viewer
iostat	CPU and I/O statistics
mpstat	processor-related statistics
pidstat	statistics for tasks

Resources

Linux

- An Introduction to Linux Basics https://www.digitalocean.com/community/tutorials/an-introduction-to-linux-basics
- Get started with CPU Governor https://www.certdepot.net/rhel7-get-started-cpu-governor/
- Understanding Automatic NUMA balancing https://www.thegeekdiary.com/understanding-automatic-numa-balancing/
- Understanding Linux File Permissions https://www.linux.com/learn/understanding-linux-file-permissions

SQL Server

- Performance best practices and configuration guidelines for SQL Server on Linux https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-performance-best-practices?view=sql-server-2017
- SQL Server Instant File Initialization: SetFileValidData (Windows) vs fallocate (Linux) https://blogs.msdn.microsoft.com/bobsql/2018/12/10/sql-server-instant-file-initialization-setfilevaliddata-windows-vs-fallocate-linux/
- Installation guidance https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-setup?view=sql-server-2017#platforms
- Offline install https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-setup?view=sql-server-2017#offline

SQL Server

- Configure SQL Server on Linux with the mssql-conf tool
  https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-configure-mssql-conf?view=sql-server-2017
- Linux PSSDIAG
  https://github.com/Microsoft/DiagManager/tree/master/LinuxPSSDiag
- How the SQLCAT Customer Lab is Monitoring SQL on Linux
  https://techcommunity.microsoft.com/t5/DataCAT/How-the-SQLCAT-Customer-Lab-is-Monitoring-SQL-on-Linux/ba-p/305467

  https://github.com/Microsoft/mssql-monitoring

FRIDAY NIGHT, SQLBITS

PROHIBITION PARTY

FEEDBACK FORMS

PLEASE FILL OUT AND PASS TO YOUR ROOM
HELPER BEFORE YOU LEAVE THE SESSION

Questions?

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http://github.com/grrlgeek/azure-sql-server