

# Monitoring Linux Performance for the SQL Admin

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- **Founder and President of Centino Systems**
  - Specialize in system architecture and performance
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  - Microsoft MVP - Data Platform - 2017 - 2020
  - Linux Foundation Certified Engineer
  - Friend of Redgate - 2015-2019
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# Agenda

- **Linux System Architecture**
- **SQL on Linux Architecture**
- **System Components**
  - **CPU/Processes**
  - **Memory/Pages**
  - **Disk/File Systems**
- **Monitoring Tools**

# Things we're going to cover

- Linux OS concepts, how it works!
- Tools to view performance data
- What's good and what's bad

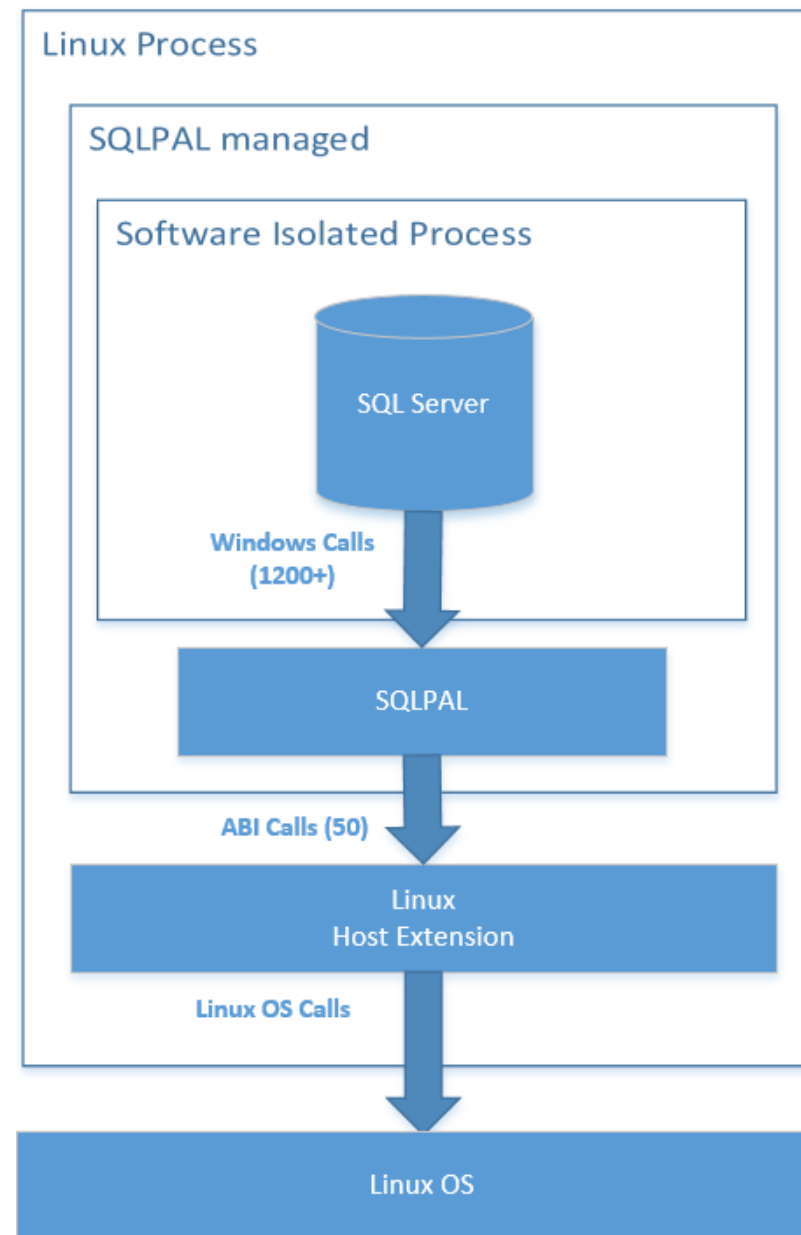
## Things we're NOT going to cover

- SQL Server internals
- Performance troubleshooting

# Linux Architecture

User Space	Users	Interact with the Shell	Cause Problems :)
	Shell	Executes Your Commands...Your Interface to the Kernel	Commands, Editors...any User Program
Kernel Space	Kernel	Resource Management and Access	Process, Pages and File Systems
	Hardware	Physical Resources	CPU, Memory and Disk

# SQL on Linux Architecture - Process Layout



From: <https://blogs.technet.microsoft.com/dataplatforminsider/2016/12/16/sql-server-on-linux-how-introduction/>

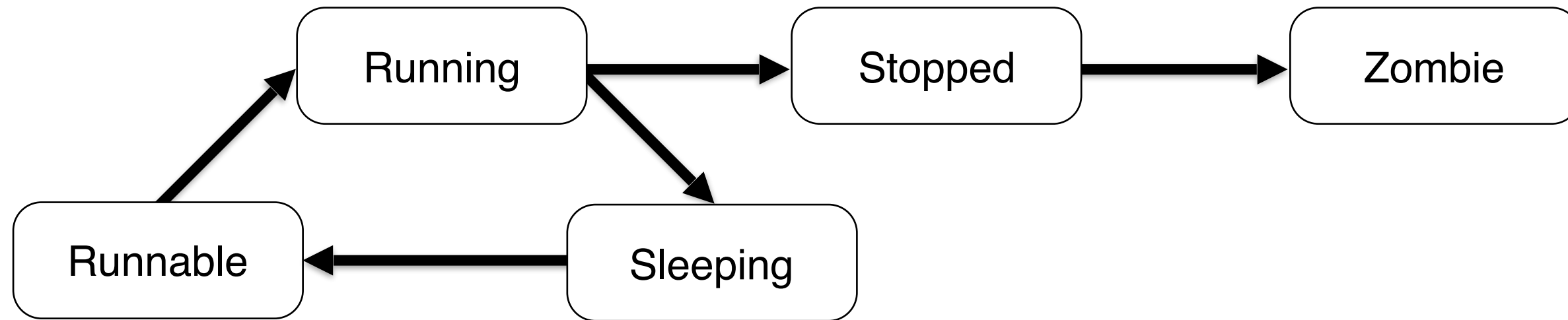
# CPU and Processes

# What is a Process?

- Process
  - Executing program, program code, memory and resources
- Thread (LWP)
  - Shared access to resources
- Process Tree
  - The hierarchy of parent and it's child processes
- Scheduling
  - Unit of scheduling is the thread
  - Preemptive
  - Dynamic priority list, based on niceness



# Process States



# CPU - What to look for?

- Percentage of what?
- Load average
- Run queue length and I/O waits
- Spikes aren't bad
- Long waits

# Tools to use for process monitoring

- **top/htop**
- **dstat**
- **pidstat**
- **procfs**

# Demo: CPU and Processes

- Processes and threads
- Run load average under CPU saturation
- Exploring **procfs**

# Memory and Pages

# Memory

- **Memory Layout and Architecture**
  - Physical and Virtual Memory
  - NUMA - free lists per node
  - Pages (Anonymous)
- **Demand Paging**
  - Allocation, Minor Page Fault
  - Swap out
    - Time and Pressure
  - Swap in, Major Page Fault
- **File System Cache and swappiness** - <http://red.ht/2cHg9Vk>

# Memory - What to Look For?

- High consumers of space
  - Physical
  - Virtual
- External memory pressure on SQL Server
- Excessive swapping
  - Swapping in/out
- No swap file?
  - OOM Killer
  - Kubernetes and Containers?

# Tools to use for memory monitoring

- **/proc/meminfo**
- **free**
- **top/htop**
- **ps**
- **vmstat**
- **pidstat**



# Demo: Memory

- Memory layout
- Isolating a memory hog
- Identifying external memory pressure
- External memory pressure on SQL Server
- Swapping in/Swapping out

# **Disks and File Systems**

# Disks

- Sectors (physical)
  - Actual storage unit of the disk, 512B or 4KB
- Blocks (logical)
  - Fundamental unit of I/O, allocation
- Disks have finite performance characteristics
  - Bandwidth - how much data
  - Latency - how fast
- Storage Interconnects
  - Internal
  - External

# File Systems

- XFS
  - Default file system - <http://red.ht/2dBXccx>
- EXT4
- Block size
  - Impact utilization and performance nominally
  - 4KB default block size

# Disks - What to Look For?

- Saturated disks and I/O subsystems
- Swapping
- Caching is your friend (generally, but not in an RDBMS)
- Baseline!

# Tools to use for disk monitoring

- **iostat**
- **iotop**
- **pidstat**
- **dstat**

# Demo: Disks

- Finding high I/O processes
- Measuring disk latency

# Monitoring Tools



# Baselining Tools

- Nearly everything we've talked about so far has been point in time...what about baselining?
  - **sar** - System Activity Reporter
  - **dstat** - writes to CSV

# Performance Monitoring

System	Windows	Linux Tool	Linux
<b>CPU</b>	%Processor Time	<code>top</code>	CPU usage, load average
<b>Memory</b>	%Committed bytes in use	<code>free -m</code>	Total, used, free, cache
<b>Disk - Space</b>	%Free Space	<code>df -h</code>	Total, used, available, mount
<b>Disk - IOs</b>	Disk Transfers/sec	<code>iostat -dx</code>	tps, r/s, w/s
<b>Disk - Latency</b>	Avg. Disk Sec/Transfer	<code>iostat -dx</code>	await, svctm***
<b>Disk - IO Size</b>	Avg. Disk Bytes/Transfer	<code>iostat -dx</code>	avgrq-sz
<b>Interface</b>	Bytes/Sec	<code>ifstat/bwm-ng/nload</code>	Packets/sec, bits/sec

Check out `dstat` it will do most of these



# Tools for Monitoring SQL Server

- You have all of the same tools you're used to for SQL Server
  - Because of SQLOS we get
    - DMVs
    - Extended Events

# Tools Available for SQL on Linux

- **PSSDiag**

- <https://blogs.msdn.microsoft.com/sqlcat/2017/08/11/collecting-performance-data-with-pssdiag-for-sql-server-on-linux/>

- **DBFS**

- <https://github.com/Microsoft/dbfs>
- <http://www.centinosystems.com/blog/sql/dbfs-command-line-access-to-sql-server-dmvs/>

- **Grafana**

- <https://blogs.msdn.microsoft.com/sqlcat/2017/07/03/how-the-sqlcat-customer-lab-is-monitoring-sql-on-linux/>

# Review

- Linux System Architecture
- SQL on Linux Architecture
- System Components
  - CPU/Processes
  - Memory/Pages
  - Disk/File Systems
- Monitoring Tools

# More Resources

- **Contact me!**
  - **email: [aen@centinosystems.com](mailto:aen@centinosystems.com)**
  - **Twitter: @nocentino**
- **Blog**
  - **[www.centinosystems.com/blog](http://www.centinosystems.com/blog)**
- **Pluralsight**
  - **Understanding and Using Essential Tools for Enterprise Linux 7**
    - Linux basics, system architecture, file and directory management
  - **LFCE: Advanced Network and System Administration**
    - systemd, Performance and Tools
  - **SQL Server on Linux Administration Fundamentals**
    - Installation, Configuration, Linux for DBAs and Backup/Restore

# Need more data or help?

**<http://www.centinosystems.com/blog/talks/>**

Links to resources

Demos

Presentation

Pluralsight

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Thank You!



# References

- Many of the man pages
- <https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-performance-best-practices>
- [https://access.redhat.com/documentation/en-us/red\\_hat\\_enterprise\\_linux/7](https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7)
- [https://access.redhat.com/documentation/en-us/red\\_hat\\_enterprise\\_linux/7/html/performance\\_tuning\\_guide/index](https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/performance_tuning_guide/index)
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