



Accelerating Your Database Backups

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- SQL Server DBA & DB Developer
- Working with SQL Server since 2001
- Speaking since Early 2014
- Microsoft MVP (2017-2018)
- Chicago Suburban User Group Chapter Leader (former)
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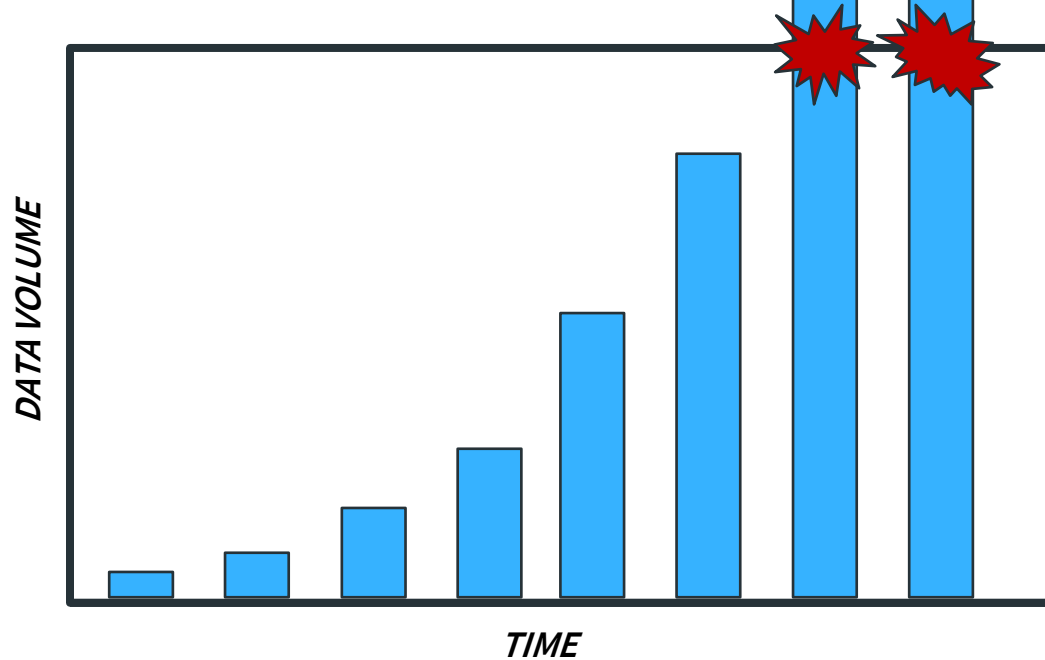
<https://www.github.com/sqlbek/>

A decorative network diagram at the top of the slide, featuring a series of interconnected nodes and lines. The nodes are represented by circles of varying sizes, some solid and some dashed, connected by thin lines. A central node is highlighted with a dashed circle and contains the opening quotation mark.

“

***This database will
only ever be
a few gigabytes in size.***

One Certainty...



A decorative network diagram at the top of the slide, featuring a central node with a dashed border and a double quote inside, connected to several other nodes by lines. The nodes are represented by circles of varying sizes and colors (gray, blue, and white), some with internal patterns. The background is white with a light gray grid.

“

***Everyone here is taking
Backups of ALL
of their Databases.
RIGHT?***

How Many Databases?



Ask Yourself

How long do your
database backups take?

Do you have enough time
in your backup window?

Can you parallelize them?



Today's Agenda

- ◎ Backup Internals

- ◎ Data

- ◎ SQL

Will **NOT** be covering
RESTORE,
different BACKUP strategies,
or Transaction Logging

- ◎ A Splash of **Pure Storage** Magic

A decorative network diagram in the top-left corner, featuring a complex web of interconnected nodes and lines. The nodes are represented by small circles, some of which are larger and have concentric circles, suggesting a hierarchical or central structure. The lines are thin and gray, connecting the nodes in a non-linear fashion.

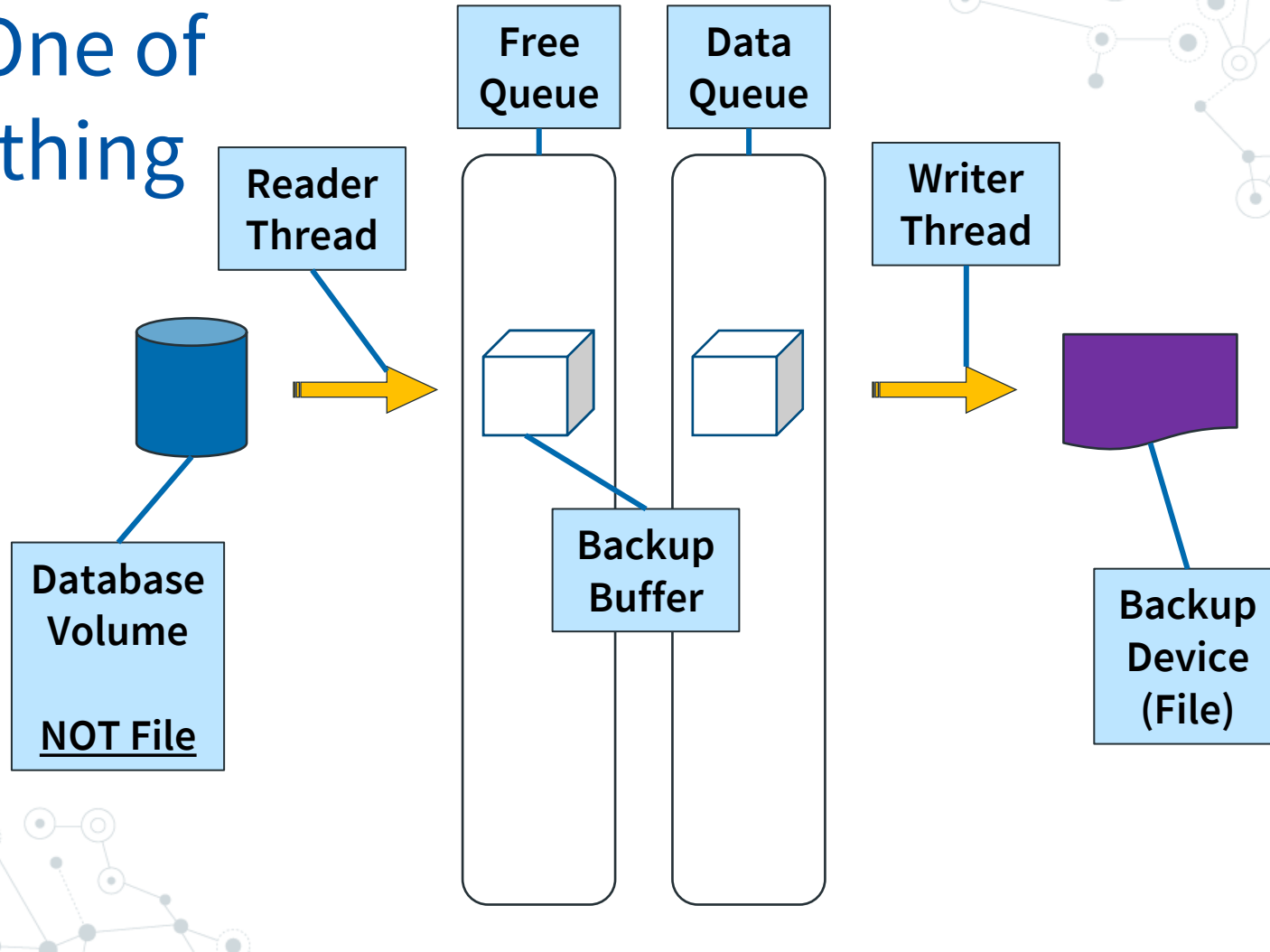
Backup Internals

A decorative network diagram in the bottom-right corner, similar to the one in the top-left. It shows a cluster of nodes connected by lines, with some nodes being larger and more prominent than others, indicating a central or hub-like node within the network.

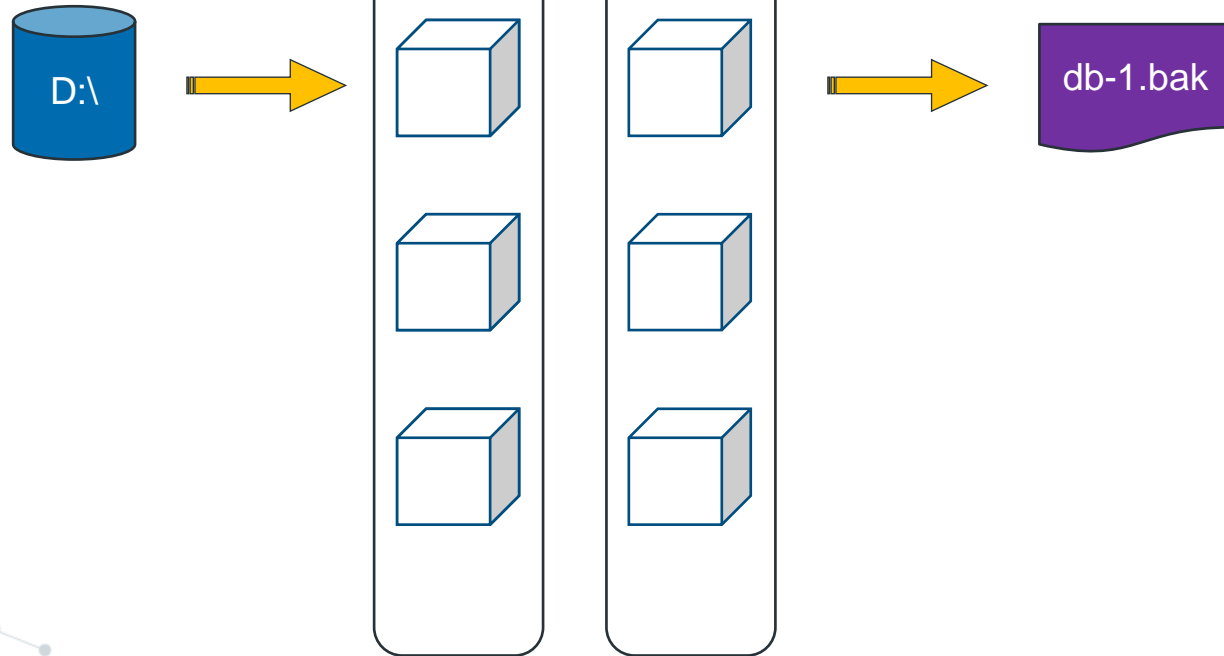
Meet the Players

- ◎ Database File(s)*
- ◎ Backup File(s)
- ◎ Threads: Reader(s) and Writer(s)
- ◎ Backup Buffers

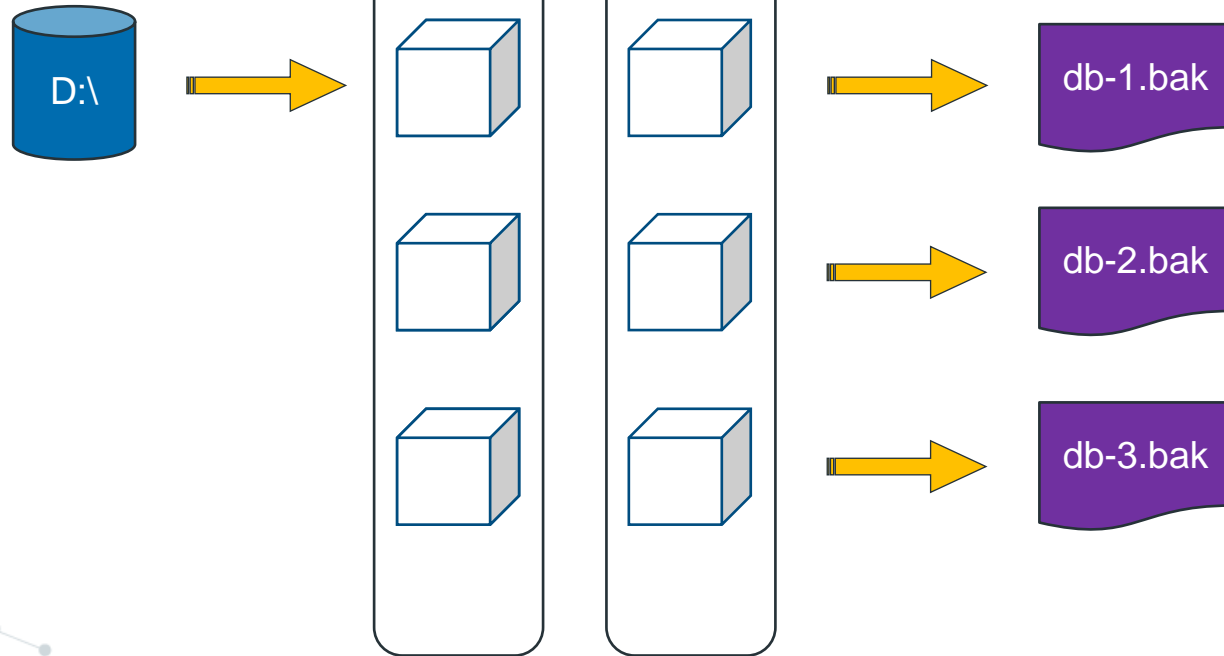
Just One of Everything



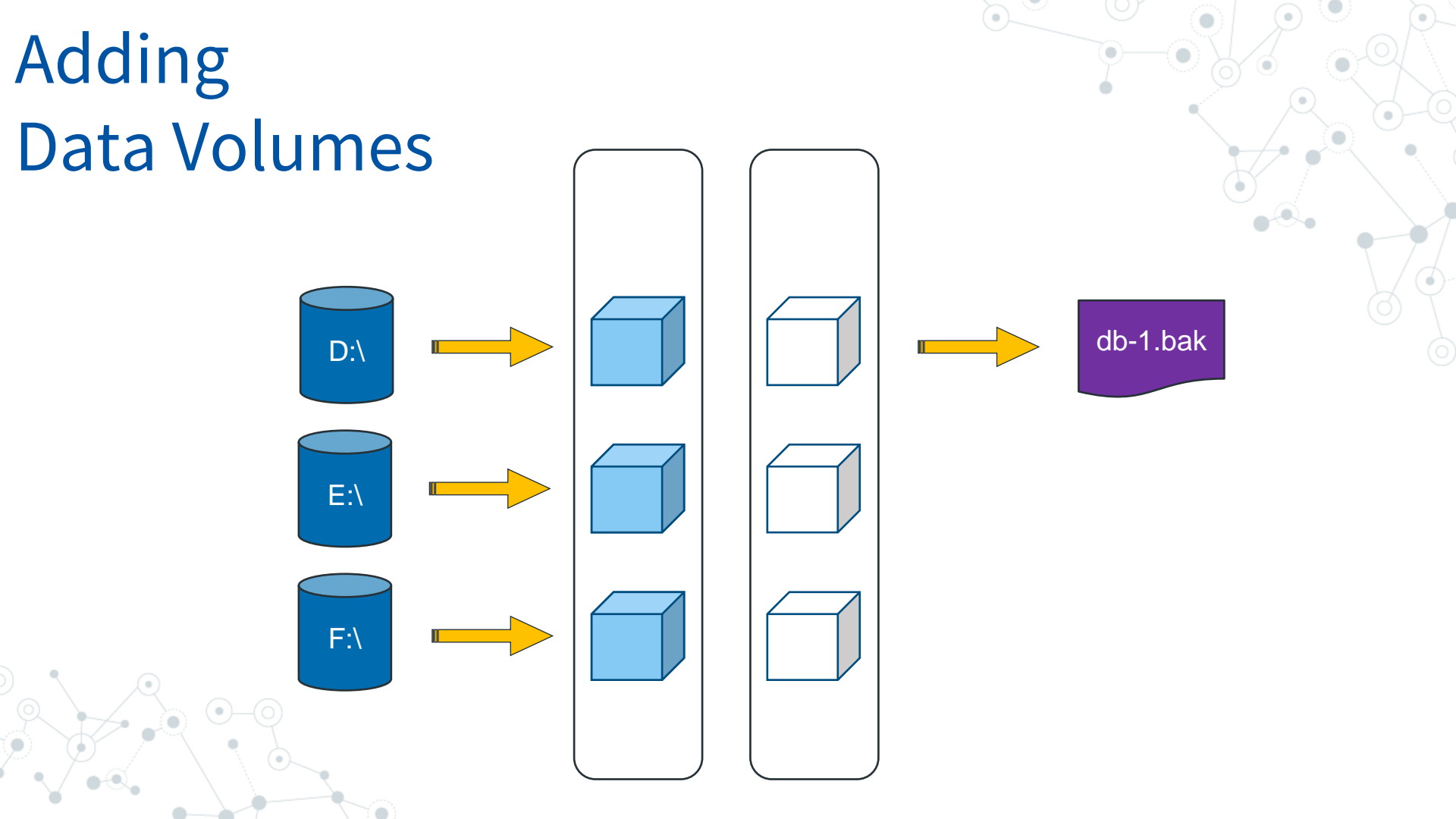
Adding Backup Buffers



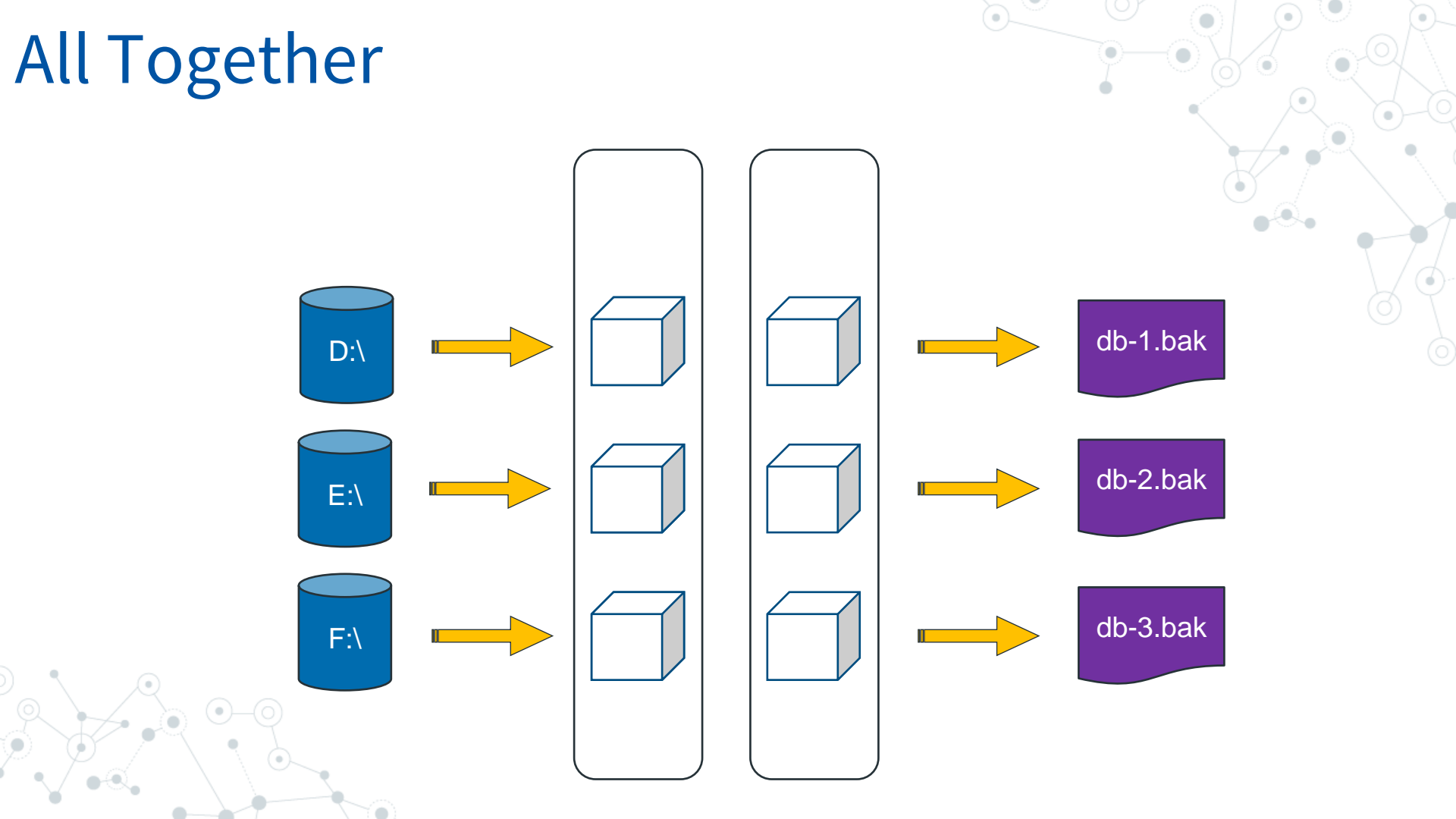
Adding Backup Files



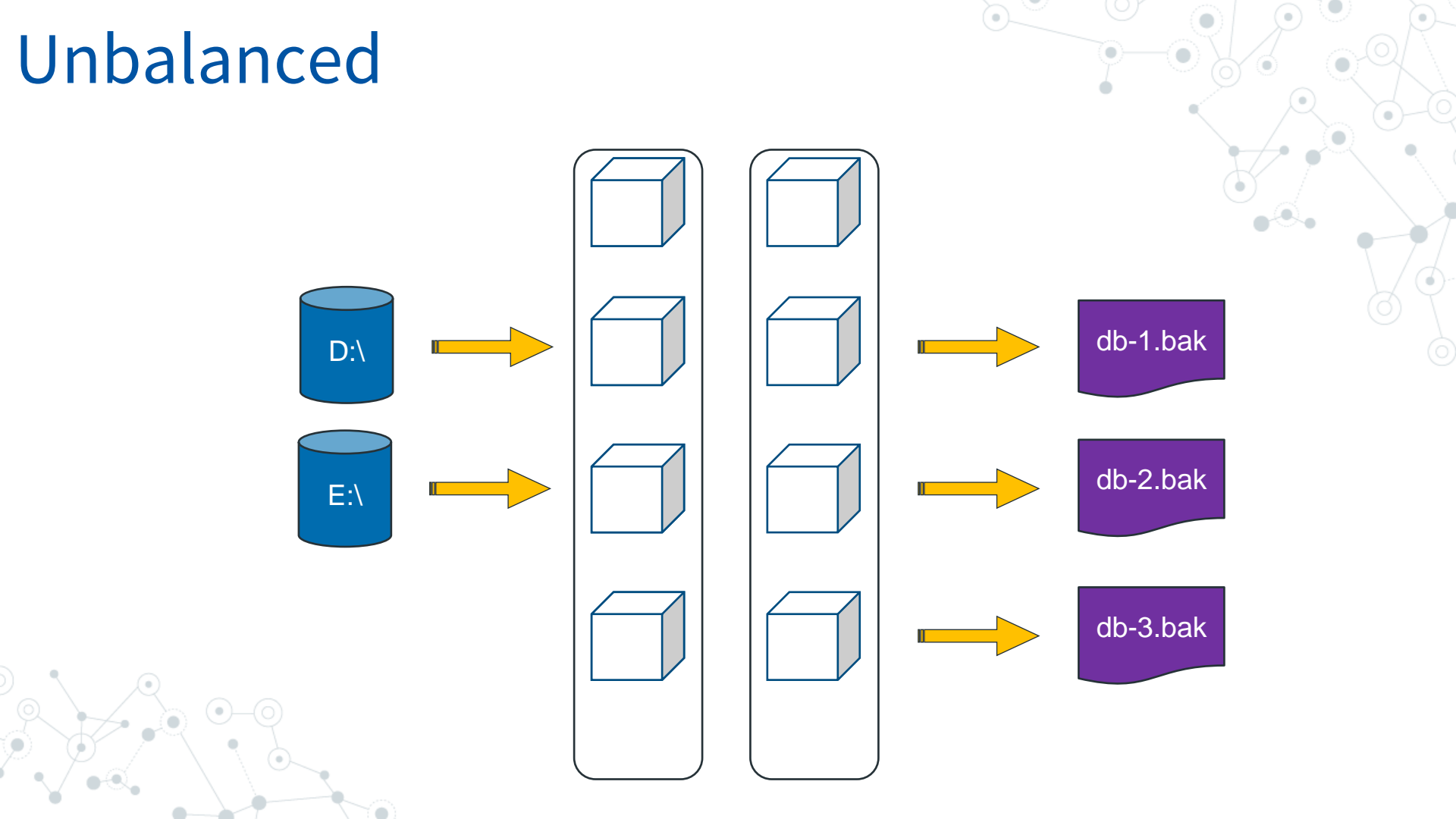
Adding Data Volumes



All Together



Unbalanced



Other Factors

- ◎ Source Disk Read
- ◎ Available CPU & RAM
- ◎ Target Connectivity
 - PCI bus, Fibre Channel, Ethernet, Internet...?
- ◎ Target Disk Write

A decorative network diagram in the top-left corner, featuring a complex web of interconnected nodes and lines. The nodes are represented by small circles, some of which are larger and have concentric circles, suggesting different levels of connectivity or data flow. The lines are thin and gray, creating a mesh-like structure.

Data Transfer Tuneables

A decorative network diagram in the bottom-right corner, similar to the one in the top-left. It shows a cluster of nodes connected by lines, with some nodes being larger and more prominent than others, indicating a hierarchical or central node structure.

What Can We Tune?

- ◎ CPU Threads
- ◎ Number of Backup Buffers
- ◎ Size of Backup Buffers

CPU Threads - Writers

- ◎ Add more Backup Target
- ◎ a.k.a. Backup Striping

CPU Threads - Readers

- ◎ Add more Logical Volumes
 - Number of Data Files irrelevant
- ◎ Not always practical
- ◎ Be careful of underlying physical infrastructure

Number of

Backup w. all defaults
will use 7 backup buffers

◎ BUFFERCOUNT

```
Default = (  
    Num_of_Backup_Devices * (  
        1 + Suggested_IO_Depth  
    )  
    ) + Num_of_Backup_Devices + (  
        2 * Database_Device_Count  
    )
```

- ◎ Num_of_Backup_Devices
 - Output Backup Files
- ◎ Suggested_IO_Depth
 - 3 for “DISK = ”
- ◎ Database_Device_Count
 - Database Volumes

Size of Backup Buffers

- ◎ MAXTRANSFERSIZE
- ◎ Range = 64 KB to 4MB
- ◎ Default Size = 1MB
- ◎ Default is 64KB if TDE, VDI, and/or TAPE

Got RAM?

- ◎ $\text{BUFFERCOUNT} * \text{MAXTRANSFERSIZE}$
- ◎ Backing up in parallel?

Remember

What does your
underlying ***physical***
infrastructure look like?





Demo

Backup Wait Statistics – Reference

◎ BACKUPBUFFER

- A reader thread waiting for an available empty backup buffer to fill/write to
<https://www.sqlskills.com/help/waits/backupbuffer/>

◎ ASYNC_IO_COMPLETION

- Reader thread discrete reading time from data file to free backup buffer
- This is an overloaded wait type!
https://www.sqlskills.com/help/waits/async_io_completion/

◎ BACKUPPIO

- Writer thread discrete writing time from backup buffer to backup file.
<https://www.sqlskills.com/help/waits/backuppio/>

◎ BACKUPTHREAD

- When a backup thread is waiting for other threads to finish operations during a backup or restore.
<https://www.sqlskills.com/help/waits/BACKUPTHREAD>

How to Find the Best Settings?

◎ Automated Backup Tuning by Nicholas Cain – SirSQL

<https://sirsql.net/2012/12/13/20121212automated-backup-tuning/>

- Backup Test Harness.sql

<https://gist.github.com/sirsql/6a6603b1348f61c6a6aa854ee920485f>

- Parse Backup Perf Tests.ps1

<https://gist.github.com/sirsql/929a822dd7ee6475edb5633822c27e14>

Remember

Tuneable values should
strike a balance due to
resource consumption



A decorative network diagram in the top-left corner, consisting of a complex web of interconnected nodes and lines. The nodes are represented by small circles, some of which are larger and have concentric circles, while others are smaller and solid. The lines are thin and gray, connecting the nodes in a non-linear fashion.

SQL Server 2022 & Compression

A decorative network diagram in the bottom-right corner, similar to the one in the top-left. It features a cluster of interconnected nodes and lines, with nodes of varying sizes and some having concentric circles, all connected by thin gray lines.

To Compress or Not To Compress?

- ◎ CPU utilization
- ◎ How much data are you backing up?
- ◎ When are you backing up?
- ◎ What are you backing up to?

SQL Server 2022

- ◎ Intel QuickAssist (Intel QAT)
- ◎ Hardware Acceleration
- ◎ Software Emulation
- ◎ Enterprise AND Standard Edition!



Demo

Think At Scale

Backup Size
Uncompressed
(GB)
1,724.93

Backup Files = 8
MAXTRANSFERSIZE = 4MB
BUFFERCOUNT = 100

Compression Type	Backup Size Compressed (GB)	Compression Savings (GB)	% CPU Total - Avg	Elapsed Time (Minutes)
NO_COMPRESSION	1,724.93	-	2.8	12.2
MS_XPRESS	566.57	1,158.36	62.1	9.9
QAT_DEFLATE (Software)	489.94	1,234.99	36.0	9.7
QAT_DEFLATE	502.91	1,222.02	8.7	9.5

13.5%
Backup Size
Reduction

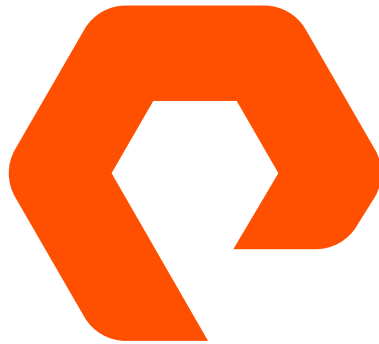
42%
Reduction
in CPU

Remember

SQL Server 2022
QAT compression
benefits backups,
especially at scale!

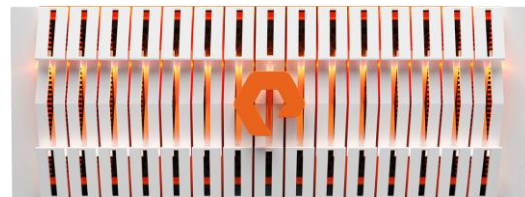


A Splash of Pure Storage Magic



Pure Storage – More Than Just Storage

- ◎ FlashArray
 - Super low **LATENCY**
- ◎ FlashBlade
 - Super-fast **PARALLEL WRITE**
- ◎ Software-Enhanced Storage
 - Deduplication
 - Encryption-At-Rest



One



Snapshots Re-visited

- ◎ Application Consistent Snapshots
- ◎ Crash Consistent Snapshots
- ◎ More than just a recovery mechanism

Who has...?

Spent countless hours
copying backup files to
restore to non-prod
environments?





Demo

Remember

Instead of **COPYING**
Why not **CLONE** instead?





Parting Thoughts

Recap

- ◎ Backup Internals
- ◎ Data Transfer Tuneables
- ◎ SQL Server 2022 & Compression
- ◎ A Splash of Pure Storage Magic

Remember

Many BACKUP tuneables

Most have a diminishing
rate of return and
performance trade-offs



Learn More: Resources

How It Works: SQL Server Backup Buffer Exchange (a VDI Focus): Bob Dorr

<https://learn.microsoft.com/en-us/archive/blogs/psssql/how-it-works-sql-server-backup-buffer-exchange-a-vdi-focus>

How It Works: How does SQL Server Backup and Restore select transfer sizes: Bob Dorr

<https://learn.microsoft.com/en-us/archive/blogs/psssql/how-it-works-how-does-sql-server-backup-and-restore-select-transfer-sizes>

A Look at Backup Internals: Jonathan Kehayias

<https://www.sqlskills.com/blogs/jonathan/an-xevent-a-day-17-of-31-a-look-at-backup-internals-and-how-to-track-backup-and-restore-throughput-part-1/>

<https://www.sqlskills.com/blogs/jonathan/an-xevent-a-day-18-of-31-a-look-at-backup-internals-and-how-to-track-backup-and-restore-throughput-part-2/>

Backup Reads and Writes: Yeoh Ray Mond

<https://www.sqlbackuprestore.com/backupreadsandwrites.htm>

Automated Backup Tuning

<https://sirsql.net/2012/12/13/20121212automated-backup-tuning/>

<https://github.com/sqlbek>



Learn More: QAT Resources

SQL Server 2022 – QAT Backups: Andy Yun

<https://sqlbek.wordpress.com/2022/09/26/sql-server-2022-qat-backups/>

Some Intel QAT Backup Compression Results: Glenn Berry


<https://glennsqlperformance.com/2022/08/28/some-intel-qat-backup-compression-results/>

SQL Server 2022: Intel® QuickAssist Technology overview: David Pless

<https://cloudblogs.microsoft.com/sqlserver/2023/03/09/sql-server-2022-intel-quickassist-technology-overview/>

Integrated acceleration and offloading: Learn Microsoft

<https://learn.microsoft.com/en-us/sql/relational-databases/integrated-acceleration/overview>



<https://github.com/sqlbek>

Learn More: Pure Storage



How Volumes Work on FlashArray

<https://www.youtube.com/watch?v=r5k2L5QnvEY>

Microsoft SQL Server - How do snapshots make your life easier?

<https://www.youtube.com/watch?v=WA91reRrWcl>


Duplicate an 8TB database from Prod to Dev in less than 60 seconds

<https://www.satola.tech/2023/duplicate-an-8tb-sql-database-from-prod-to-dev-in-less-than-60-seconds-part-1/>

SQL Server 2022 & T-SQL Snapshots

<https://www.nocentino.com/posts/2022-05-26-seed-ag-replica-from-snapshot/#take-the-snapshot-backup-on-the-primarys-flasharray>

<https://github.com/sqlbek>



Thank You!

Any Questions?

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awesome resources for free:
Presentation template by [SlidesCarnival](#)
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& [pexels.com](#)