

DATA PRESERVATION STRATEGIES

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SUMMARY

The stability and persistence of your data files and photo files is threatened by many vectors that arise from both human dishonesty and physical/chemical processes.

You can mitigate these threats by means of various redundancy and diversity processes.

TOPICS

- Data Degradation
- Lots of Hype From Manufacturers
- 3-2-1 Mantra Is Inadequate But Helpful
- Redundancy and Diversity To The Rescue
- Hard Drive Imaging and Cloning by Third-Party Software

TOPICS (continued)

- "Storage Spaces" Mirroring
- A Rigorous Data Preservation Plan for a Small Business
- Three Ways to Back Up A Data Hard Drive

DATA DEGRADATION

- <Start of quote:>
Data degradation is the gradual corruption of computer data due to an accumulation of non-critical failures in a data storage device.
The phenomenon is also known as data decay, data rot or bit rot.
<End of quote>

DATA DEGRADATION (continued)

- For details, see https://en.wikipedia.org/wiki/Data_degradation

LOTS OF HYPE FROM MANUFACTURERS

- **Do not be mislead by vendor hype:**
- "CD-R*s and DVD-R*s will last 500 years
- "Enterprise hard drives" and "NAS hard drives" will outlast Desktop hard drives"
- "RAID mirroring will prevent data loss from hard drive failures"

LOTS OF HYPE FROM MANUFACTURERS (continued)

- "CD-R*s and DVD-R*s will last 500 years **(Total lies!)**
- "Enterprise hard drives" and "NAS hard drives" will outlast Desktop hard drives" **(No empirical evidence!)**

LOTS OF HYPE FROM

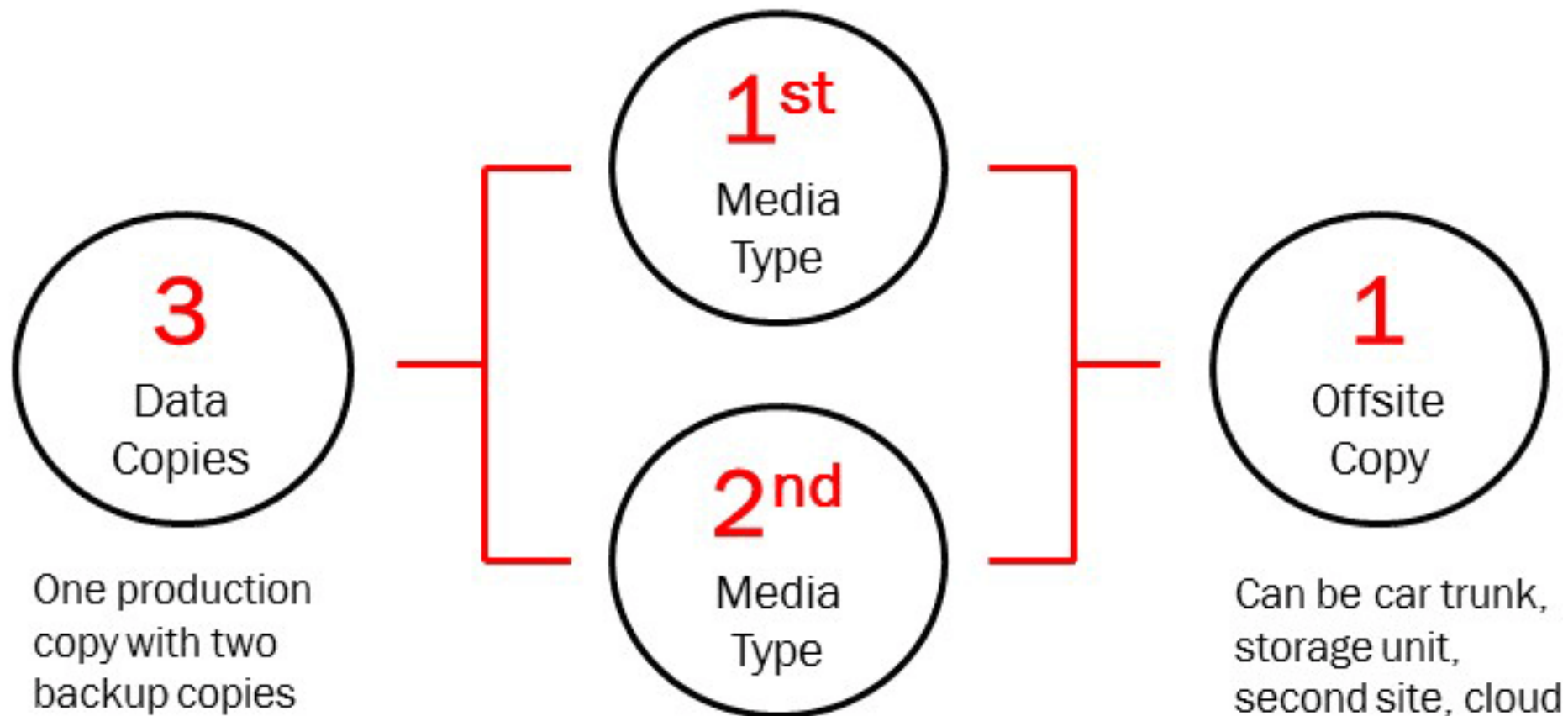
MANUFACTURERS (continued)

- "RAID mirroring will prevent data loss from hard drive failures".

(RAID mirroring does not prevent slow, intermittent errors on one hard drive to spread like a cancer to the other hard drive which then create even more errors which then spread back to the originating hard drive.)

3-2-1 MANTRA IS INADEQUATE BUT HELPFUL

- Legacy 3-2-1 backup strategy from computer experts



One production copy with two backup copies

First media is typically disk; second media can be rotational tape, disk, NAS, SAN, etc.

Can be car trunk, storage unit, second site, cloud

3-2-1 MANTRA IS INADEQUATE BUT HELPFUL (continued)

- Source for all diagrams about 3-2-1 strategy:
<https://www.unitrends.com/blog/3-2-1-backup-sucks>

3-2-1 MANTRA IS INADEQUATE BUT HELPFUL (continued)

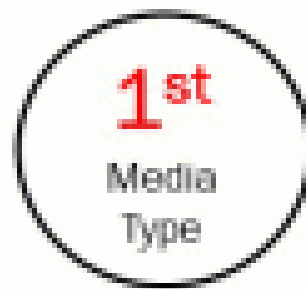
- 3-2-1 strategy is now obsolete because of
 - ❑ Weekly operating system upgrades, especially for "Windows.."
 - ❑ Shorter average life spans of hard drives
 - ❑ Delayed "payloads" of ransomware

3-2-1 MANTRA IS INADEQUATE BUT HELPFUL

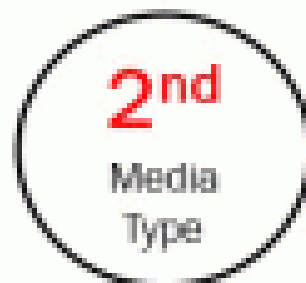
- Expanded variants of 3-2-1 are now used:



One production
copy with two
backup copies



Two geographically
separated copies in
the cloud



First media is disk;
second media can be
rotational or fixed tape,
disk, NAS, SAN, etc.

Can be car trunk,
storage unit,
second site, etc

REDUNDANCY AND DIVERSITY TO THE RESCUE

- **Redundancy** means more than one copy of a data file or picture file: The more copies you have, the lower your chances of losing all copies of a data file or picture due to malware, hardware failure, or software failure.

REDUNDANCY AND DIVERSITY TO THE RESCUE (continued)

- **Diversity** means using multiple technologies, formats, software programs, hardware types, locations, and manufacturers to reduce data losses caused by any single failure of any of the above.

REDUNDANCY AND DIVERSITY TO THE RESCUE (continued)

- **Diversity** means (continued)
 - ❑ Manufacturer and model diversity for hard drives,
 - ❑ Manufacturer and model diversity for optical storage media

REDUNDANCY AND DIVERSITY TO THE RESCUE (continued)

- The strategy of "**Georedundancy**" combines the two strategies of "Redundancy" and "Diversity"
 - "**Georedundancy**" means copies of data files stored at two physical location to reduce the odd of data losses due to fires, tornados, earthquakes, explosions,etc.

REDUNDANCY AND DIVERSITY TO THE RESCUE (continued)

- **Diversity** also means
 - Diversity of backup methods:
 - ❖ mirroring,
 - ❖ drive imaging,
 - ❖ drive imaging --> restore to a different real or virtual hard drive
 - ❖ RAID breaking followed by RAID rebuild

REDUNDANCY AND DIVERSITY TO THE RESCUE (continued)

- The strategy of "**Georedundancy**" combines the two strategies of "Redundancy" and "Diversity"
 - "**Georedundancy**" means copies of data files stored at two physical location to reduce the odd of data losses due to fires, tornados, earthquakes, explosions,etc.

REDUNDANCY AND DIVERSITY TO THE RESCUE (continued)

- The strategy of "**Georedundancy**"..
(continued)
 - ❑ Almost all cloud storage services claim to have "**Georedundancy**"
 - ❑ However, it is best to be skeptical of their claims and using two separate cloud storage services is usually a guarantee of "**Georedundancy**"

HARD DRIVE IMAGING & CLONING BY THIRD-PARTY SOFTWARE

- "Sectors" (512 bytes or 4096 bytes each, are created by the hard drive manufacturer, = "low level format")
- "Clusters" (are groups of sectors created by format function of "Windows...", = "high level format")
- Your data files and folders are groups of clusters which are what is used by third-party software for making drive images and for cloning hard drive partitions

"STORAGE SPACES" MIRRORING

- "Sectors" (512 bytes or 4096 bytes each, created by the hard drive manufacturer)
- "Clusters" (are groups of sectors that are created by the format function of "Windows..")
- "Slabs" (256MB each, are groups of clusters created by "Storage Spaces" of Windows 8.1 & 10)

"STORAGE SPACES" MIRRORING (continued)

- "Interleaves" (256K each, are segments of "Slabs" that are defined by the "Mirroring" function inside "Storage Spaces")
- Your data files and folders reside inside the "Interleaves".
- "Storage Spaces" uses the "Interleaves" to mirror your data files and folders on the "left" hard drive and the "right" hard drive.

"STORAGE SPACES" MIRRORING (continued)

- Each of the two mirrored hard drives in "Storage Spaces" looks like this:

Hard drive

Slab 0	Storage Spaces metadata		
Slab 1	Filesystem metadata		
Slab 2	File 1 File 2		
Slab 3	File 3, part 1 File 3, part 2	Accessible in Storage Spaces	
Slab 4	File 3, part 3 File 4		
Slab 5	File 5		
Slab 6			Not visible in Storage Spaces, pool of available slabs
Slab N			

"STORAGE SPACES" MIRRORING (continued)

- You have a "Left hard drive" and a "Right hard drive" so it actually look like this:

LEFT HARD DRIVE

Hard drive

Slab 0	Storage Spaces metadata
Slab 1	Filesystem metadata
Slab 2	File 1 File 2
Slab 3	File 3, part 1 File 3, part 2
Slab 4	File 3, part 3 File 4
Slab 5	File 5
Slab 6	
Slab N	

RIGHT HARD DRIVE

Hard drive

Slab 0	Storage Spaces metadata
Slab 1	Filesystem metadata
Slab 2	File 1 File 2
Slab 3	File 3, part 1 File 3, part 2
Slab 4	File 3, part 3 File 4
Slab 5	File 5
Slab 6	
Slab N	

AGILE SHIFTS IN BACKUP METHODOLOGY

- Microsoft (and Apple and Linux OS developers) reserve the right to break your in-use backup strategy at any time so you have to "roll with the punches" as updates roll in from the manufacturer or developer of your operating system
- Ditto for developers of backup software programs

AGILE SHIFTS FOR BACKUP METHODOLOGY

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- Ditto for developers of backup software programs

AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- January 2013 to April 3, 2019:
I did daily backups of a mission-critical data hard drive by the "break a RAID"--> "RAID rebuild" method using "Storage Spaces" in "Windows 10":

A RIGOROUS DATA PRESERVATION PLAN FOR A SMALL BUSINESS

- Create a new or modified data file or photo file on drive Z:
- Immediately copy the new or modified data or photo file to drive Y:
- Daily backup of the new or modified data file to a "daily backup hard drive" at close of business

A RIGOROUS DATA PRESERVATION PLAN FOR A SMALL BUSINESS

(continued)

- Daily backup of the new or modified data file to a "daily backup hard drive" at close of business
- At daily close of business, label store the "daily backup hard drive" in a on-premise safe and retain it for at least 14 days. (After 14 days, re-use the "daily backup hard drive" for a new "daily backup".)

A RIGOROUS DATA PRESERVATION PLAN FOR A SMALL BUSINESS (continued)

- At end of week, take the most recent daily backup to bank safe deposit box and take the oldest of the three hard drives in the bank safe deposit box back to the business premise for re-use as a daily backup

A RIGOROUS DATA PRESERVATION PLAN FOR A SMALL BUSINESS

(continued)

- Z: data drive stays inside the computer
- Y: data drive stays inside the computer
- 14 daily backup drives are stored inside an on-premise safe
- 3 daily backup drives are stored at a safe deposit box at a bank₃₇

A RIGOROUS DATA PRESERVATION PLAN FOR A SMALL BUSINESS (continued)

- If the Z: drive fails during a business day, replace it with the most recent "daily backup drive" and use the copies of data files on the Y: drive update the "new" Z: drive.

MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- January 2013 to April 3, 2019:
I did daily backups of a mission-critical "Z:" data hard drive by the "break a RAID"--> "RAID rebuild" method using "Storage Spaces" in "Windows 10":

MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- On April 3, 2019, "Windows Update" applied the following update to my "Windows 10 Pro" computer:

2019-03 Cumulative Update for Windows 10 Version 1809 for x64-based Systems (KB4490481)

Successfully installed on 4/3/2019

MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- See <https://support.microsoft.com/en-us/help/4490481/windows-10-update-kb4490481>



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April 2, 2019—KB4490481 (OS Build 17763.404)

Applies to: Windows 10, version 1809, Windows Server 2019, all versions

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Windows 10 version 1809 and Windows Server 2019

Windows 10 version 1803

Windows 10 version 1709

Windows 10 version 1703

Windows 10 version 1607 and Windows Server 2016

Windows 10 version 1511

Windows 10 (initial version released July 2015)

Release Date:	April 2, 2019
Version:	OS Build 17763.404

Improvements and fixes

This update includes quality improvements. Key changes include:

- Addresses an issue that occurs on machines that have multiple audio devices. Applications that provide advanced options for

Site feedback

Did this solve your problem?

Yes

No

MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- "spaceport.sys" is the main part of the "Storage Spaces" function in "Windows 10" (and "Windows 8")
During the application of this update, my "spaceport.sys" file was updated:

C_CP1-HV1-WDSSD-2 (C:) > Windows > System32 > drivers

spaceport.sys	4/3/2019 1:52 PM	System file	637 KB
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spaceport.sys	4/3/2019 1:52 PM	System file	637 KB
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MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- After Microsoft issued a "Patch Tuesday" "Windows Update" for the "Storage Spaces" function inside my "Windows 10 Pro" computer on April 3, 2019, I started getting unexplainable error messages whenever I tried to do the "break a RAID"--> "RAID rebuild" procedure at the end of each business day :

MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- Sometimes, the "Storage Spaces" GUI window will tell me that a drive was bad but the drive checked out fine with various hard drive utilities after I formatted it in other Windows.. and/or MacOS computers:

Control Panel Home

Create a new pool and storage space

pool capacity
the Physical drives and Storage spaces sections
Add drives
Rename pool
Optimize drive usage

Storage spaces

Storage space (L:) Error
Two-way mirror check the Physical drives section
5.62 TB
Using 5.64 TB pool capacity

[View files](#)
[Change](#)
[Delete](#)

Physical drives

WDC WD60 ... OK [Rename](#)
SN: 2017011250D
Attached via USB
51.7% used
Providing 5.45 TB pool capacity



TOSHIBA HD... Warning [Rename](#)
SN: 20150810002 Error; consider replacing [Reset](#)
Attached via USB
51.7% used
Providing 5.45 TB pool capacity

See also



[File History](#)



[BitLocker Drive Encryption](#)

Storage spaces

	Storage space (L:) Two-way mirror 5.62 TB Using 5.64 TB pool capacity	 Error No resiliency; check the Physical drives section	View files Change Delete
---	--	---	--

Physical drives

	WDC WD60 ... SN: 2017011250D Attached via USB 51.7% used Providing 5.45 TB pool capacity	 OK	Rename
---	---	--	------------------------

	TOSHIBA HD... SN: 20150810002 Attached via USB 51.7% used Providing 5.45 TB pool capacity	 Warning Error; consider replacing	Rename Reset
---	--	---	---

Storage spaces



Storage space

(L:)

Two-way mirror

5.62 TB

Using 5.64 TB
pool capacity



Error

No resiliency;
check the
Physical drives
section

[View files](#)

[Change](#)

[Delete](#)

MAKE AGILE SHIFTS IN BACKUP METHODOLOGY (continued)

- Sometimes, the "Storage Spaces" GUI window will tell me that the virtual "Storage Space" hard drive was bad while stating the the two mirrored hard drives were okay:

Control Panel Home

Create a new pool and storage space

Use Storage Spaces to save files to two or more drives to help protect you from a drive failure. Storage Spaces also lets you easily add more drives if you run low on capacity. If you don't see task links, click Change settings.

Change settings

New L SS Warning

Using 5.63 TB of 10.9 TB pool capacity

Create a storage space
Add drives
Rename pool
Optimize drive usage

Storage spaces

Storage space (L:) Two-way mirror 5.62 TB Using 5.63 TB pool capacity	Warning Reduced resiliency; check the Physical drives section	View files Change Delete
--	--	--------------------------------

Physical drives

WDC WD60EZRZ... SN: WD-WX11DB514P, Attached via SATA 51.6% used Providing 5.45 TB pool capacity	OK	Rename
JMicron Generic ... SN: 012345678933 Attached via USB 51.6% used Providing 5.45 TB pool capacity	OK	Rename

See also

File History



BitLocker Drive Encryption







Using 5.63 TB of 10.9 TB pool capacity

- Create a storage space
- Add drives
- Rename pool
- Optimize drive usage

Storage spaces

	Storage space (L:) Two-way mirror 5.62 TB Using 5.63 TB pool capacity	 Warning Reduced resiliency; check the Physical drives section	View files Change Delete
--	--	--	--

▼ Physical drives

	WDC WD60EZRZ... SN: WD-WX11DB514P Attached via SATA 51.6% used Providing 5.45 TB pool capacity	 OK	Rename
	JMicron Generic ... SN: 012345678933 Attached via USB 51.6% used Providing 5.45 TB pool capacity	 OK	Rename

THREE WAYS TO BACK UP A DATA HARD DRIVE

- Method 1:
Break a mirrored RAID-->Raid Rebuild
- Method 2:
Use third-party software to image the
hard drive
- Method 3:
Use third-party software to clone the
hard drive or hard drive partition

THREE WAYS TO BACK UP A DATA HARD DRIVE (continued)

- Since "Method 1" was failing, I chose to do "Method 3" so I now use "Macrium Reflect Free" clone the hard drive or hard drive partition at the end of each business day

THREE WAYS TO BACK UP A DATA HARD DRIVE (continued)

- Many free third-party software utilities can clone a data hard drive:
I chose "Macrium Reflect Free".
Terry Carrier recommends "Minitool Partition Wizard".
- Many computer professionals recommend the not-free "Acronis True Image 2019".

THREE WAYS TO BACK UP A DATA HARD DRIVE (continued)

- I prefer "Method 3" over "Method 2" because at the end of the backup process, I can immediately use "File Explorer" in "Windows 10.." to make sure that the newly-created clone of my Z: drive is a valid copy of my Z: drive.

THREE WAYS TO BACK UP A DATA HARD DRIVE (continued)

- I actually prefer "Method 1" over the other two backup methods because I get an exact copy of my Z: data drive in seconds when

I Break a mirrored RAID

-->Raid Rebuild

However, as of today (April 24, 2019), "Method 1" is broken!!

THREE WAYS TO BACK UP A DATA HARD DRIVE (continued)

- When one uses "Method 2" or "Method 3", you get a completed backup 4 to 8 hours later when the third-party program finishes it's imaging or cloning process`