USING "STORAGE SPACES" IN WINDOWS 8.1 & 10 FOR REAL-TIME MIRRORING AND ARCHIVAL BACKUP

Tucson Computer Society

Winners Windows users

An International Association of Technology and Computer User Groups
Web location for this presentation:

http://aztcs.org

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EXECUTIVE SUMMARY

"Storage Spaces" is a new feature for Windows 8.1 and 10. This feature provides for various hard drive enhancements including real-time, automatic drive mirroring so that two hard drives can always contain the same data files and folders in real time. You can use a mirrored "Storage Space" to create complete copies of your data files to store offline at a secure, remote location.
TOPICS

• "Storage Spaces" Basics
• Creating a Two-Way Mirrored "Storage Space"
• Replacing a Hard Drive in a Two-Way Mirrored "Storage Space"
• Repairing a Corrupted Hard Drive That Used To Be Part of a "Storage Space"
"STORAGE SPACES" BASICS

• "Storage Spaces" is a feature of Windows 8.1 and 10 that is used to group physical hard drives into single logical "Storage Pool".

• A "Storage Pool" can then be used to create one or more "Storage Spaces" virtual hard drives.

• A "Windows 8" computer can have more than one "Storage Pool".
A "Storage Space" is a logical NTFS or ReFS hard drive or hard drive partition that is under the control of the "Storage Spaces" process.
"STORAGE SPACES" BASICS (continued)

- NTFS
  = "New Technology File System"
- ReFS
  = "Resiliant File System"
  (will take over from NTFS as the default drive partition format for "Windows" computers in the future)
  (mistakenly and jokingly called "Reliable File System")
"STORAGE SPACES" BASICS (continued)

• "Storage Spaces" is the very first end-user implementation of the new-fangled ReFS hard drive partition format. At the present time (September 2016) you cannot use the ReFS file system for formatting stand-alone physical hard drives that are not part of a "Storage Space".
"STORAGE SPACES" BASICS (continued)

• According to Microsoft vice presient Steven Sinofsky in his blog at https://blogs.msdn.microsoft.com/b8/2012/01/16/building-the-next-generation-file-system-for-windows.refs/:
As we described earlier, the combination of ReFS and Storage Spaces provides a high degree of data resiliency in the presence of disk corruptions and storage failures. A form of data loss that is harder to detect and deal with happens due to “bit rot,” where parts of the disk develop corruptions over time that go largely undetected since those parts are not read frequently.
By the time they are read and detected, the alternate copies may have also been corrupted or lost due to other failures. In order to deal with bit rot, we have added a system task that periodically scrubs all metadata and Integrity Stream data on a ReFS volume residing on a mirrored Storage Space. Scrubbing involves reading all the redundant copies and validating their correctness using the ReFS checksums. If checksums mismatch, bad copies are fixed using good ones.
Using the "Storage Spaces" applet in Windows 8.1 or 10, you start off by creating logical "Storage Pools"

"Storage Pools" are sets of actual physical hard drives.
"STORAGE SPACES" BASICS (continued)

• After creating a "Storage Pool", you can use it to create a "Storage Space" which is a virtual hard drive
• When you create a "Storage Space" virtual hard drive, you will be placing the actual physical hard drives into one, two, or three "columns".
"STORAGE SPACES" BASICS (continued)

• If you select "Two-way mirror" and for a "Storage Pool" that consists of two hard drives, you will end up with two hard drives that are real-time mirrors of each other: One hard drive will be assigned to the "left column" and the other hard drive will be assigned to the "right column".
"STORAGE SPACES" BASICS (continued)

- Your actual data files and folders are stored in "slabs" that reside on a real hard drive.
- Each "slab" is 256 megabytes in size.
Here is a diagram from http://windowsitpro.com/windows/navigating-storage-spaces-and-pools:
"STORAGE SPACES" BASICS
(continued)

• The "left column" = "left hard drive":
• The "right column" = "right hard drive":

"STORAGE SPACES" BASICS (continued)
• When you create or revise a file, the "Storage Spaces" applet writes the file into the same-numbered slab in each of the hard drives:
In other words, "Storage Spaces" defaults to a pair of synchronized hard drives when you create a single virtual hard drive from a "Storage Pool" that consists of two physical hard drives.
When "Disk 1" fails or when you physically disconnect it from your computer, Windows 8.1 or 10, will give you a warning but it will still "see" the "Storage Space" as a working hard drive:
When "Disk 2" fails or when you physically disconnect it from your computer, Windows 8.1 or 10, will give you a warning but it will still "see" the "Storage Space" as a working hard drive:
Mirror

Disk1

0
1
2
3

Disk2

0

Data Copy

Data Copy

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When you create a logical "Storage Space", you can give it a drive letter and the "Storage Space" shows up in "Disk Management" in the "Control Panel" as a single a hard drive with a "GUID Partition Table" ("GPT"). It also shows up in "File Explorer". It does not show up in "Device Manager" nor does it show up in "Devices and Printers".
The physical hard drives that are added to a "Storage Pool" disappear from "Disk Management" in the "Control Panel".

Instead, you see a new local "Storage Pool" drive in "Disk Management":

"STORAGE SPACES" BASICS (continued)
### Disk Management

<table>
<thead>
<tr>
<th>Volume</th>
<th>Layout</th>
<th>Type</th>
<th>File System</th>
<th>Status</th>
<th>Capacity</th>
<th>Free Space</th>
<th>% Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk 0</td>
<td>Basic</td>
<td>Basic</td>
<td>NTFS</td>
<td>Healthy (Primary Partition)</td>
<td>450 MB</td>
<td>450 MB</td>
<td>100 %</td>
</tr>
<tr>
<td>Disk 3</td>
<td>Basic</td>
<td>Basic</td>
<td>NTFS</td>
<td>Healthy (Primary Partition)</td>
<td>277.87 GB</td>
<td>277.75 GB</td>
<td>100 %</td>
</tr>
<tr>
<td>(C:)</td>
<td>Simple</td>
<td>Basic</td>
<td></td>
<td>Healthy (B:)</td>
<td>859.45 GB</td>
<td>837.03 GB</td>
<td>97 %</td>
</tr>
<tr>
<td>Storage space (E:)</td>
<td>Simple</td>
<td>Basic</td>
<td>NTFS</td>
<td>Healthy (E:)</td>
<td>277.87 GB</td>
<td>277.75 GB</td>
<td>100 %</td>
</tr>
</tbody>
</table>
Disk 3
Basic
277.88 GB
Online

Storage space (E:)
277.87 GB NTFS
Healthy (Primary Partition)
• You can create a logical "Storage Space" for any letter of the alphabet that is not already assigned.
"STORAGE SPACES" BASICS (continued)

• When a physical hard drive is added to a "Storage Pool":
  o The physical hard drive no longer has a drive letter
  o The physical hard drive no longer shows up in "File Explorer"
  o The physical hard drive no longer shows up in "Disk Management" in the "Control Panel".
"STORAGE SPACES" BASICS (continued)

- The main place where the physical hard drives show up will be the "Storage Spaces" list of "Physical Drives".

- The physical hard drives still shows up in the "Device Manager".

- The physical hard drives still show up in "Devices and Printers".
The C: hard drive or hard drive partition where Windows 8 or 10 resides cannot be used for one of the physical hard drives in a "Storage Pool".
"STORAGE SPACES" BASICS (continued)

After a hard drive is placed into "Storage Pool", you cannot use the "Safely Remove Hardware and Eject Media" icon in the "Notification Area" to eject the mirrored hard drives.
Open Devices and Printers

- Eject Standard Enhanced PCI to USB Host Controller
- Eject Standard Universal PCI to USB Host Controller
- Eject Standard SATA AHCI Controller
- Eject High Definition Audio Controller
- Eject VMware Virtual SATA Hard Drive

Eject USB Root Hub (xHCI)

Eject Intel(R) 82574L Gigabit Network Connection

Eject SAS Controller

- Eject USB to ATA/ATAPI Bridge
- Eject USB to ATA/ATAPI Bridge
Problem Ejecting USB Mass Storage Device

Windows is unable to stop the device 'USB Mass Storage Device'. Don't remove this device while it is still in use. Close any programs using this device and then remove it.
"STORAGE SPACES" BASICS (continued)

• To remove a hard drive from a "Storage Spaces" mirrored drive pair, wait for it to quit blinking, then disconnect the power cable or switch. Then disconnect the USB or eSATA cables from the hard drive.
• A healthy "Storage Pool" looks like this:
Manage Storage Spaces

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.

Storage pool

Using 3.00 GB of 1.18 TB pool capacity

Storage spaces

- Storage space (E:)
  - Two-way mirror
  - 278 GB
  - Using 2.00 GB pool capacity

Physical drives

- WDC WD10EAVS...
  - SN: 20130118077D
  - Attached via USB
  - 0.21% used
  - Providing 931 GB pool capacity

- Maxtor 6B30050U...
  - SN: 20150111012B
  - Attached via USB
  - 0.33% used
  - Providing 279 GB pool capacity

See also
- File History
Manage Storage Spaces

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.
Using 3.00 GB of 1.18 TB pool capacity
Storage spaces

- Storage space (E:)
  - Two-way mirror
  - 278 GB
  - Using 2.00 GB pool capacity

View files
- Change
- Delete

Physical drives
When you mirror two physical hard drives, the size of the "Two-way mirror" "Storage Space" virtual hard drive is constrained by the smaller of the two physical hard drives:
When you start running out of space on a "Storage Space" that consists of two mirrored physical hard drives, it is best for you to create a new, additional "Storage Pool" and then a new, additional "Storage Space", instead of adding to an existing "Storage Pool".
• If you put more than one hard drive in a "column" (for example for a total of 4 hard drives), you will be unable to tell which hard drives belong to a specific column:
• When a physical hard drive in a "Storage Pool" fails or when you physically disconnect the physical hard drive:
Manage Storage Spaces

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.

Storage pool

Using 3.50 GB of 1.18 TB pool capacity

Storage spaces

- Storage space (E:)
  - Two-way mirror
  - 278 GB
  - Using 2.50 GB pool capacity

Physical drives

- WDC WD10EAVS-32D7B7
  - SN: 201310180B7D
  - Attached via USB
  - 0.24 % used
  - Providing 931 GB pool capacity

- Maxtor 6 B300S0 USB DEVICE
  - SN: 20150811012B
  - Attached via USB
  - 0.72 % used
  - Providing 279 GB pool capacity

See also

File History
Manage Storage Spaces

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.

Storage pool

Using 3.50 GB of 1.18 TB pool capacity

Storage spaces

- Storage space (E):
  - Two-way mirror
  - 278 GB
  - Using 2.50 GB pool capacity
  - Warning
  - Reduced resiliency; check the Physical drives section

Physical drives

- WDC WD10 EAVS-32D7B1...
  - OK
  - Attached via USB
  - 0.24 % used
  - Providing 931 GB pool capacity

- Maxtor 6 B300S0 USB Devi...
  - Warning
  - 0.72 % used
  - Providing 279 GB pool capacity
Manage Storage Spaces

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.

<table>
<thead>
<tr>
<th>Storage pool</th>
<th>Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using 3.50 GB of 1.18 TB pool capacity</td>
<td>Drive issues; check the Physical drives section</td>
</tr>
<tr>
<td>Create a storage space</td>
<td>Add drives</td>
</tr>
<tr>
<td>Rename pool</td>
<td>Optimize drive usage</td>
</tr>
</tbody>
</table>

### Physical drives

<table>
<thead>
<tr>
<th>Device</th>
<th>Status</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDC WD10 EAVS-32D7B1...</td>
<td>OK</td>
<td>278 GB</td>
</tr>
<tr>
<td>SN: 20131018087D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attached via USB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.24 % used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing 931 GB pool capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxtor 6 B300S0 USB Device</td>
<td>Warning</td>
<td>279 GB</td>
</tr>
<tr>
<td>0.72 % used</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing 279 GB pool capacity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• If a hard drive belongs to a "Storage Space", and you physically remove the hard drive from your computer, you cannot logically remove the hard drive from the "Storage Pool" unless you first add in another physical hard drive to the "Storage Pool":
Once a "Storage Space" is created, you cannot change its "synchronization" option. Instead, you have to delete the "Storage Space" and use the freed up hard drives to make a new "Storage Space".
If you attach any "Storage Spaces" hard drive(s) to a "Windows XP", "Windows Vista", or "Windows 7" computer, it will show up in "Disk Management" but you will be unable to access the hard drive with "Windows Explorer":
"STORAGE SPACES" BASICS (continued)

- If any single drive fails in a "Storage Pool" that has "Two-way mirror" redundancy, the "Storage Pool" logical drive will not disappear from "File Explorer".

- If both drives fail, the "Storage Pool" logical drive will disappear from "File Explorer".
• If all drives fail, the "Storage Pool" logical drive will disappear from "File Explorer". If any single drive is restored, then the "Storage Pool" drive will be restored to "File Explorer".
If you add a hard drive that already contains data files to a new or existing "Storage Space", all data files on the hard drive will be deleted.
CREATING A TWO-WAY-MIRRORED "STORAGE SPACE"
Creating a Two-Way-Mirrored "Storage Space" (continued)

• A Two-Way-Mirrored "Storage Space" has two hard drives that are synchronized in real time: When you create or modify a file or folder for the virtual "Storage Space" hard drive, the change is immediately made on both hard drives.
Creating a Two-Way-Mirrored "Storage Space" (continued)

- All software and hardware inside your "Windows 8" computer treat the "Storage Space" as if it were a single hard drive:
  You have a single drive letter but you actually have two physical hard drives that contain the same exact data files and folders at the same time:
Physical Windows 8.1 or 10 Computer

Drive Pool

Storage Space S:

Hard Drive 2
= Top Left hard drive of L: Storage Space

Hard Drive 3
= Bottom Right hard drive of L: Storage Space

C: Drive
Here are the steps for creating a two-way-mirrored "Storage Space":

Creating a Two-Way Mirrored "Storage Space" (continued)
Creating a Two-Way Mirrored "Storage Space" (continued)

Step 1:
Attach two USB or eSATA hard drives to your existing "Windows 8.1" or "Windows 10" computer:
Real Physical “Windows 8.1 or 10 Computer

- existing C: Drive
- add Hard Drive 2
- add Hard Drive 3
Creating a Two-Way Mirrored "Storage Space" (continued)

Step 2: Press "Windows" key + x

Step 3: Click on "Control Panel".

Step 4: Locate the "Storage Spaces" applet and double-click on it.
Security and Maintenance

Storage Spaces

Taskbar and Navigation
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 5: Double-click on "Create a new pool and storage space".
Manage Storage Spaces

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.

Create a new pool and storage space
Do you want to allow this app to make changes to your device?

Storage Spaces Settings

Verified publisher: Microsoft Windows

Show more details

Yes  No
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 6: All data hard drives will be shown with the unformatted drives in the top section if there are any AND formatted drives will be shown in the bottom section if you click on the "drop down list button":

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Create a storage pool

Select drives to create a storage pool

<table>
<thead>
<tr>
<th>Unformatted drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware Virtual SATA Hard Disk 3</td>
</tr>
<tr>
<td>Attached via SATA</td>
</tr>
<tr>
<td>60.0 GB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Formatted drives</th>
</tr>
</thead>
<tbody>
<tr>
<td>! The following drives might contain files. If you use a formatted drive with a storage pool, Windows permanently deletes all the files on that drive. You can't recover the files by using the Recycle Bin.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disk 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDC WD10 EAVS-32D7B...</td>
</tr>
<tr>
<td>Attached via USB</td>
</tr>
<tr>
<td>931 GB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disk 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST310005 28AS USB Device...</td>
</tr>
<tr>
<td>Attached via USB</td>
</tr>
<tr>
<td>931 GB</td>
</tr>
</tbody>
</table>

- View files
- Take offline

[Create pool] [Cancel]
Step 7: Use the check boxes to select drives for the mirrored hard drive set that you are about to create:
Select drives to create a storage pool

### Unformatted drives
- VMware Virtual SATA Hard Disk 3
  - Attached via SATA
  - 60.0 GB

### Formatted drives
- **Warning:** The following drives might contain files. If you use a formatted drive with a storage pool, Windows permanently deletes all the files on that drive. You can't recover the files by using the Recycle Bin.
- WDC WD10 EAVS-32D7B0 Disk 1
  - Attached via USB
  - 931 GB
  - Online
  - View files
  - Take offline
- ST310005 28AS USB Device Disk 2
  - Attached via USB
  - 931 GB
  - Online
  - View files
  - Take offline

[Red arrows point to the checked drives: VMware Virtual SATA Hard Disk 3, WDC WD10 EAVS-32D7B0, and ST310005 28AS USB Device.]
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 8: Click on the "Create pool" button:
Create a storage pool

Select drives to create a storage pool

Unformatted drives

VMware Virtual SATA Hard Disk Attached via SATA 60.0 GB

Formatted drives

⚠️ The following drives might contain files. If you use a formatted drive with a storage pool, Windows permanently deletes all the files on that drive. You can’t recover the files by using the Recycle Bin.

- WDC WD10 EAVS-32D7B Attached via USB 931 GB
  - View files
  - Take offline

- ST3150052AS USB Device Attached via USB 931 GB
  - View files
  - Take offline

Create pool Cancel
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 9: Change the name of the new "Storage Space" from "Storage Space" to your desired name:
Create a storage space

Enter a name, resiliency type, and size for the storage space

Name and drive letter
- Name: Storage space
- Drive letter: E:
- File system: NTFS

Resiliency
- Resiliency type: Two-way mirror

A two-way mirror storage space writes two copies of your data, helping to protect you from a single drive failure. A two-way mirror storage space requires at least two drives.

Size
- Total pool capacity: 1.81 TB
- Available pool capacity: 1.81 TB
- Size (maximum): 930 GB
- Including resiliency: 1.81 TB

A storage space can be larger than the amount of available capacity in the storage pool. When you run

Create storage space  Cancel
Create a storage space

Enter a name, resiliency type, and size for the storage space

Name and drive letter

Name: S_Storage_space20160924
Drive letter: E:
File system: NTFS

Resiliency

Resiliency type: Two-way mirror

A two-way mirror storage space writes two copies of your data, helping to protect you from a single drive failure. A two-way mirror storage space requires at least two drives.

Size

Total pool capacity: 1.81 TB
Available pool capacity: 1.81 TB
Size (maximum): 930 GB
Including resiliency: 1.81 TB

A storage space can be larger than the amount of available capacity in the storage pool. When you run
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 10: Select a drive letter for the new "Storage Space":

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Create a storage space

Enter a name, resiliency type, and size for the storage space

Name and drive letter

Name: S_Storage space20160924

Drive letter: E:

File system:

Resiliency

Resiliency type:

A two-way mirror storage space is designed to protect your data by keeping two copies of your data, helping to protect you from a single drive failure. A two-way mirror requires at least two drives.

Size

Total pool capacity:

Available pool capacity:

Size (maximum):

Including resiliency:

A storage space can be larger than the amount of available capacity in the storage pool. When you run out of available capacity, you can increase the size of the storage space.

Create storage space  Cancel
Step 11: Select where you want to have a NTFS or an ReFS file system:
Create a storage space

Enter a name, resiliency type, and size for the storage space

Name and drive letter
- Name: S_Storage space20160923
- Drive letter: S:
- File system: NTFS

Resiliency
- Resiliency type: Two-way mirror

A two-way mirror storage space writes two copies of your data, helping to protect you from a single drive failure. A two-way mirror storage space requires at least two drives.

Size
- Total pool capacity: 1.81 TB
- Available pool capacity: 1.81 TB
- Size (maximum): 930 GB
- Including resiliency: 1.81 TB

A storage space can be larger than the amount of available capacity in the storage pool. When you run out of capacity, you can add drives to your storage space.
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 12: Click on the drop down list button at the right end of the "Resiliency type" field:
Creating a Two-Way-Mirrored "Storage Space" (continued)

- If you select "Two-way mirror", the "Storage Pool" has to have at least two physical drives. (Otherwise, the "Create storage space" button will be grayed out.)

- If you select "Three-way mirror", the "Storage Pool" has to have at least five physical drives. (Otherwise, the "Create storage space" button will be grayed out.)
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 13: Change the "Resiliency type" to "Two-way mirror":
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 14: Click on the "Create storage space" button:
Two-way mirror

Data storage space writes two copies of your data, helping to protect you from a single way mirror storage space requires at least two drives.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>y:</td>
<td>1.81 TB</td>
</tr>
<tr>
<td>y:</td>
<td>1.81 TB</td>
</tr>
<tr>
<td>y:</td>
<td>930 GB</td>
</tr>
<tr>
<td>y:</td>
<td>1.81 TB</td>
</tr>
</tbody>
</table>

The storage space size must be larger than the amount of available capacity in the storage pool. When you run...
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 15: Your new "Storage Space" will be displayed. In our example, our "Storage Space" is a virtual S: drive:
Creating a Two-Way-Mirrored "Storage Space" (continued)

Step 16: To see the individual hard drives of the "Storage Space", click on the downward pointing triangle that is to the left of "Physical Drives":

Manage Storage Spaces

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.

Storage pool

Using 3.00 GB of 1.81 TB pool capacity

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

S_Storage space20160923
(Sx)
Two-way mirror
930 GB
Using 2.00 GB pool capacity

Physical drives

See also
File History
Manage Storage Spaces

Use Storage Spaces to save files to two or more drives so that your files remain safe, even when a drive fails. Storage Spaces also enables you to easily add more drives if you run low on capacity.

Storage Pool

Using 3.00 GB of 1.58 TB pool capacity

Storage Spaces

StorageSpace07 (S:) Two-way mirror
814 GB logical size
Using 200 GB

Physical Drives

ST310003 33AS USB Dev... Attached via USB
930 GB
0.16 % used

Seagate FreeAgent Pro U... Attached via USB
698 GB
0.21 % used
Physical Windows 8.1 or 10 Computer

Drive Pool

Storage Space S:

Hard Drive 2
= Left
hard drive of S: Storage Space

Hard Drive 3
= Right
hard drive of S: Storage Space

C: Drive

Hard Drive 2

Hard Drive 3
REPLACING A PHYSICAL HARD DRIVE IN A TWO-WAY-MIRRORED "STORAGE SPACE"
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

• You cannot logically remove a physical hard drive from a mirrored "Storage Space" unless you first add in another hard drive to the "Storage Pool":

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Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 0: Physically remove one of the hard drives from a two-way-mirrored "Storage Space". (If the activity light of the hard drive is blinking, it is best for you to wait for it to stop blinking.)
Replacing A Physical Hard Drive In A.."Storage Space" (continued)
Step 0 (continued):
This hard drive can be read by any "version" of "Windows.." that is the same or higher "version" as the "version" of "Windows.." that the hard drive resided originally. Store this hard drive in a safe place, preferably "off site" in a safe deposit box in a fire-proof bank vault.
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 1: Attach a "known good" USB 2, USB 3, or eSATA hard drive to your computer.
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 2: Use "Disk Management" to make sure that the external hard drive that you added has at least one NTFS or ReFS partition on it.
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 3: Press Windows + x.
Step 4: Click on "Control Panel" in the pop-up "Power Users Menu".
Step 5: Locate and double-click on the "Storage Spaces" applet.

Step 6: A "Storage Spaces" window will be displayed.

Step 7: Click on "Change settings".
Do you want to allow this app to make changes to your device?

Verified publisher: Microsoft Windows

Storage Spaces Settings

Show more details

Yes  No
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 7: Click on "Add drives".
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 8: A "Select drives to add to the storage pool" window will be displayed:
Select drives to add to the storage pool

Unformatted drives

ST31000528AS USB Device
Attached via USB
931 GB

Drive usage

- Optimize drive usage to spread existing data across all drives

Information:
Optimization might slow down your PC for a while, but you can stop it anytime without losing your progress.

Add drives  Cancel
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 9: Place a checkmark for the hard disk drive that you wish to add to the storage pool:
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 10: Click on the "Add drives" button:
Adding the drives to the pool...
Replacing A Physical Hard Drive In A.."Storage Space" (continued) Step 11: "Storage Spaces" will start "Repairing.." the newly-added hard drive by copying data files and folders from the existing hard drive to the newly-added hard drive.
Replacing A Physical Hard Drive In A.. "Storage Space" (continued)
• The new drive will now show up in the list of drives belonging to the "Storage Space":

"STORAGE SPACES" BASICS (continued)
Using ST310005 28AS USB Device
SN: 201508110131
Attached via USB
0.24 % used
Providing 931 GB pool capacity

Maxtor 6 B300S0 USB Device
SN: 201310180B7D
Attached via USB
0.36 % used
Providing 279 GB pool capacity

WDC WD10 EAVS-32D7B...
SN: 201310180B7D
Attached via USB
0.24 % used
Providing 931 GB pool capacity

Rename
Remove
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 12: Click on "Remove" for the hard drive that you wish to logically remove from the "Storage Space".
Using 21.9 GB pool capacity

<table>
<thead>
<tr>
<th>Physical drives</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WDC WD10 EAVS-32D7B...</td>
<td>![OK]</td>
<td>OK</td>
<td>Rename</td>
</tr>
<tr>
<td>SN: 201310180B7D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attached via USB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.24 % used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing 931 GB pool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxtor 6 B300S0 USB Dev...</td>
<td>![Warning]</td>
<td>Warning</td>
<td>Remove</td>
</tr>
<tr>
<td>0.36 % used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Providing 279 GB pool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST310005 28AS USB Device</td>
<td>![OK]</td>
<td>OK</td>
<td>Rename</td>
</tr>
<tr>
<td>SN: 201508110131</td>
<td></td>
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<tr>
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<td>capacity</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 13: Click on the "Remove drive" button:
Removing the drive from the pool...
Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 14: Click on the downward pointing caret to the left of "Physical Drives":


Replacing A Physical Hard Drive In A.."Storage Space" (continued)

Step 15: Note that the hard drive that you wanted logically-removed from the "Storage Space" is no longer displayed:
REPAIRING A CORRUPTED HARD DRIVE THAT USED TO BE PART OF A "STORAGE SPACE"
REPAIRING A CORRUPTED HARD DRIVE THAT USED TO BE PART OF A "STORAGE SPACE"

• If a hard drive was part of a "Storage Space" in the past, you have to remove the "metadata" files from it before you re-use the drive either as a separate hard drive or as part of another "Storage Space".
REPAIRING A CORRUPTED HARD DRIVE THAT USED TO BE PART OF A "STORAGE SPACE"

• When a hard drive that used to be part of a "Storage Space" gets corrupted, you cannot use the "Storage Spaces" applet by itself in the "Control Panel" to clean up the hard drive.
• When a hard drive that used to be part of a "Storage Space" gets corrupted, if you use the "Diskpart" command in an elevated command prompt window to "clean" the drive, the hidden "metadata" files on the drive (that were originally put on the drive by "Storage Spaces") will remain on the drive and cause trouble.
• When a hard drive that used to be part of a "Storage Space" gets corrupted, you have to clean the drive as follows:
  Use the "clean" command in an elevated command prompt window to "clean" the corrupted drive.
  Then using a computer that has no other "Storage Spaces" attached to it, run the "Storage Spaces" applet to remove the "Storage Space" metadata files from the corrupted hard drive.