

A horizontal banner with a dark, grayscale background. It shows a group of people in business attire, with some holding laptops. Overlaid on the image are several circular icons: a globe, a person with a checkmark, a person with a plus sign, and a group of three people. The text "Changed Block Comparison™ (CBC) Technology White Paper" is centered in white, bold, sans-serif font.

Changed Block Comparison™ (CBC) Technology White Paper

As of August, 2020

Actiphy, Inc.

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What is CBC?

Actiphy's proprietary Changed Block Comparison™ (CBC) technology identifies changed blocks by comprehensively analyzing a volume's file system to identify blocks that need backing up.

Main Features

- Free from potential conflicts caused by third party drivers.
- Deleted and identically rewritten data are not identified as changes and are not included in an incremental backup.
- Continuity of an incremental chain can be resumed if an incremental backup task is disabled.
- Clustered Shared Volume File System (CSVFS) incremental backup chains can be continued even if the primary or control node fails or changes.

Differences between tracking driver and CBC

Tracking drivers record the changed blocks by trapping write I/O to a volume. With this method, every write to the volume has to be monitored. This adds overhead to all I/O operations while a system is in use.

Actiphy's CBC technology identifies changed blocks by comparing volumes' previous and current states to determine incremental changes that need to be backed up, and subsequently reduces the overall storage requirements for the incremental backup file.

Unlike device drivers, CBC doesn't require a system restart upon completion of an install, update, or uninstall. This minimizes system downtime.

Continuity in the Incremental Chain

The CBC backup process behaves the same as a differential backup process. When there already exists a backup file, the changed blocks identified by comparing the previous and current states are saved in the incremental backup file. This behavior is the same as the reconcile image feature that keeps continuity in an incremental image set.

CBC uses Actiphy's differential backup process to create an incremental backup.

If saving backup files on a USB-HDD and the USB-HDD is removed, then the USB-HDD is reconnected, an incremental backup can be taken, keeping continuity in the incremental chain. If utilizing a disk cartridge or disk rotation for the backup designation storage, CBC CBC maintains incremental backup continuity.

Incremental backup of CSVFS volumes

Cluster Shared Volume File System (CSVFS) can be backed up incrementally in the same manner as an NTFS volume. However, since CSVFS enables multiple nodes to simultaneously have read-write access, device driver based I/O tracking is difficult to perform due to the complex interactions between the various nodes sharing the volume. CBC eliminates that complexity.

If the owner node has changed or when the node of a volume to back up has changed, the source continuity of the incremental backup chain is kept intact.

Performance Comparison

CBC is safe and has a number of advantages. However, CBC does not mean anything if the backup process becomes longer and the backup file size increases in comparison with that same backup using a tracking driver.

Actiphy tested to measure backup process times and incremental backup storage space requirements by using a tracking driver and CBC.

Case 1

- * Volume Size 2TB / uncompressed
- * Created full-sector base backup of the volume.
- * 2GB of data is added before creating an incremental backup.
- * Destination storage: NAS

	Tracking		CBC	
	Image size	Process time	Image size	Process time
Base	445568 KB	02:00	380032 KB	00:51
Inc1	2169792 KB	02:07	2101056 KB	01:24
Inc2	2169536 KB	02:08	2100992 KB	02:01
Inc3	2169600 KB	02:08	2100928 KB	01:20
Inc average		2:07		1:35

Case 2

By adding or deleting the same data before taking incremental backup, measured the change made in the same file.

1. Created base backup of an empty volume. (set to "standard compression")
2. Made a copy of 10GB file.
3. Created incremental backup file 1.
4. Deleted the file copied with the above step 2.
5. Made a copy of 10GB file.
6. Created incremental backup file 2.
7. Deleted the file copied with the above step 5.
8. Made a copy of 10GB file.
9. Created incremental backup file 3.

MBR(30GB)

GPT(2TB)

Image	Tracking	CBC	Tracking	CBC
Base	9344 KB	9472 KB	33280 KB	31936 KB
Inc1	10489920 KB	10490816 KB	10494976 KB	10491136 KB
Inc2	10489984 KB	10490880 KB	10494976 KB	10491200 KB
Inc3	10489984 KB	5120 KB	10494976 KB	5440 KB

The size of the incremental backup image using CBC became significantly smaller on the third incremental backup. This is because CBC identifies the same identically re-written file(s) and are unnecessary and not included in the backup.

Case 3

Comparing two scenarios in which there are checkpoints of a Hyper-V VHD versus no checkpoints in VHDs.

The following are the test results in which there are checkpoints of 2VM (fixed VHDX) out of 4VM and the scenario with no checkpoints of 4VM.

	CBC/checkpoint=2VM (Static VHDX)			CBC/no checkpoint		
	Processed size	Processed time	Image size	Processed size	Processed time	Image size
Base	638.15 GB	00:14:35	65.7 GB	637.22 GB	00:14:32	65.3 GB
Inc1	0.45 GB	00:02:26	69.0 MB	0.30 GB	00:14:44	283 MB

According to the test results, the incremental backup of VHD in which there are checkpoints, the incremental backup process is faster.

APPENDIX

ActiveImage Protector & Support Information

● **Actiphy's Web Site**

You will find the product information as well as direct links to download documentation, our full installers or update installers, etc:

<https://www.actiphy.com/en-us/>

● **ActiveImage Protector FAQ**

You can access the support FAQ.

<https://kb.actiphy.com/>

For your inquiry about ActiveImage Protector, please contact:

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