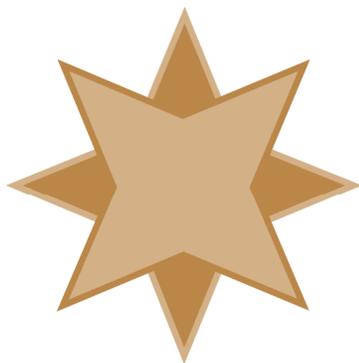


Selecting a Backup Method for Zen v15 Database Files

A White Paper From



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The Actian Zen database engine (formerly known as Actian PSQL) stores its data directly inside binary files, which are stored in a standard file system on a local hard disk on the server (or SAN). These files can be located in just about any location on the database server, because it is the application developer (or the end user) who actually configures the data file location.

From an end-user perspective, the most important part of managing an Actian Zen database is ensuring that the data gets properly backed up. These backups will provide you with protecting from a wide variety of threats, including malware attacks, vindictive users, and even silly mistakes made by system administrators. A proper backup (or replication solution) can also be your first and last lines of defense against server crashes and the file corruption that can be caused by defective hardware.

For much of the history of the product, the files are opened in a Sharable:Read mode, meaning that other applications (such as simple backup applications and scripts) can simply copy the files any time they need to. However, this ease of use has created problems for some users, who have found that attempting to restore the files resulting in even more damaged files – because the files were being modified at the time of the backup, and the shuffling of data file pages (caused by shadow paging) has resulted in a damaged copy. Unfortunately, once this issue is identified and the user realizes the backups have been damaged, it is often in an emergency when the backups are being restored due to some failure – and then it is too late, as massive data loss has been seen in both the production data files and in each backup copy.

Starting with the Actian Zen v15 release, Actian changed the default mode for opening files to prevent this “easy” (and potentially flawed) backup method. Instead of allowing other processes to open and read the files while they are active, the engine now blocks them by opening them in a Sharable:None mode. Because of this change, users and system administrators are having more difficulty getting a valid backup on the v15 environment.

Important Note: As of this writing, the Zen v15 engine uses this new open mode ONLY with the File Close Delay feature, which offers a performance gain for many applications by keeping files open for a short time (50 milliseconds by default) after a FileClose operation comes in. By doing this, a subsequent FileOpen command can be satisfied much more quickly, and a decent performance gain is seen throughout the system. It is currently possible to disable the File Close Delay feature (by setting this value to 0) and the engine will revert to the older Sharable:Read file access. However, Actian may elect to make this change permanently within the engine in some future release, so disabling this feature (and losing its performance gains) may not be a long-term solution.

Because the database files may be always open while users are in the system, you must take some special precautions to back up these database files. There are three common options to consider:

1. Force all users to exit the system, or shut down the database engine, either of which closes the database files. Once the files are closed, a normal full or incremental backup on the database folder and files will be successful.

2. Place any open files into Continuous Operations Mode. This special mode of the database closes the “base” file and starts writing changes to a second “delta” file. The backup application can then copy the base file knowing that the file is static and opened in a correct Sharable:Read mode. Once the backup finishes, the changes are moved from the delta file back to the base file, and the system is running in normal mode again.
3. Create a Volume Shadowcopy Services (VSS) snapshot and copy the static data from the snapshot location instead of from the production location.

So how do you choose which solution is best for you? Much will depend on your specific configuration (engine type) and needs (frequency of the backup, total backup size, availability of downtime, etc.), so let’s flip the script and discuss the types of file backups you are most likely to encounter. For simplicity, these examples all assume that the data is located in a folder called C:\MyApp\Data and backing up to a second drive (T:), so you can substitute your own data folders where needed.

COPYING ONE OR MORE FILES FROM AN UNUSED SYSTEM

As indicated above, when a database is not currently in use, all of the data files will be closed by the engine. These files can be safely backed up with any simple copy or backup operation. This could include batch files running built-in OS functions like XCOPY or ROBOCOPY, backup scripts running file synchronization tools like Beyond Compare, and full-fledged backup operations that copy files to either another folder, to another server, or to an external device like tape or USB hard drive. A simple batch file to copy the files could look like this:

```
C:
CD \MyApp\Data
XCOPY *.* T:\Backups\MyApp\Data /s /e
```

One important note about this solution: even if the database is closed at the start of the backup, it is important to make sure that it remains closed through the END of the backup as well, or else you could get a partial file set as many of the file copies will fail.

COPYING A SINGLE FILE FROM AN ACTIVE SYSTEM INTERACTIVELY

If you are unable to initiate a downtime window on your application, but you just need to copy off a few files (say to copy pertinent data to a test system), then the *Continuous Operations Mode* feature (a.k.a. ContOps) will come to your aid. By putting each file into ContOps mode, you will be able to secure a pristine and safe backup while users are in the system, and without downtime.

To protect a file with Continuous Operations mode, we use the BUTIL application with the STARTBU function, and then pass the pathname of the file to the engine. Once the file is in Continuous Mode, we can safely copy it, and then take the file back out of ContOps mode, like this:

```
BUTIL -STARTBU C:\MyApp\Data\filename.MKD
XCOPY C:\MyApp\Data\filename.MKD T:\Backups\MyApp\Data
BUTIL -ENDBU C:\MyApp\Data\filename.MKD
```

If you have several files to do, then this can simply be repeated for each one. However, if you want to back up a larger set of data files, or if ensuring that all files are snapshotted at the same time is important to you, then you need to take this up one notch. Note that if you still have any files in the Btrieve 5.x or older format, these files MUST be rebuilt into the newer format to be included in this process.

COPYING MULTIPLE FILES FROM AN ACTIVE SYSTEM INTERACTIVELY

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One of the problems with the above approach is that each file must be specified individually, so doing a large number of files like this is difficult. Goldstar Software's *GSBackup* utility can bridge this gap by accepting a filespec (i.e. a wildcard) to specify the files to include in the mix. Suppose you want to back up all files from the Accounts Receivable section of your application, and these files all start with the two-letter abbreviation "AR". By using the GSBackup tool, you can do this quickly and easily:

```
C:  
CD \MyApp\Data  
GSBACKUP AR*.MKD  
XCOPY AR*.MKD T:\Backups\MyApp\Data  
GSBACKUP /E
```

The GSBackup utility also supports directory recursion with the /S switch, which can be handy when your database is split across multiple folders.

COPYING MULTIPLE FILES FROM AN ACTIVE SYSTEM REPEATEDLY

Whether you are doing a few files at a time or using GSBackup to place multiple files into ContOps mode quickly, the fact is that the database is still putting these files into ContOps mode at slightly different points in time. This can cause any interactive backup like this to have some files slightly older than others. While this is not a problem in a fairly quiet system, if you take a very active system and put the files into ContOps mode separately like this, then your backup may be incorrect, as some files may be newer than others.

The way to fix this is to build a ContOps script and pass the BUTIL command a complete list of all database files from your application. This ensures that ALL files are put into ContOps at the same time, and therefore will all have transaction-consistent data. In order for this to work correctly, though, the file list you submit must have complete engine-relative pathnames specified within, as shown in this example:

```
C:\MyApp\Data\filename1.mkd  
C:\MyApp\Data\filename2.mkd  
C:\MyApp\Data\filename3.mkd  
...
```

Once you have the right file list saved into a FILELIST.TXT file, you pass it to the BUTIL command like so:

```
BUTIL -STARTBU @C:\MyApp\Data\FILELIST.TXT  
XCOPY C:\MyApp\Data\*.MKD T:\Backups\MyApp\Data  
BUTIL -ENDBU @C:\MyApp\Data\FILELIST.TXT
```

There are a few important caveats about this process that you need to be aware of:

1. If your application creates a new data file and you forget to add it to the list, then that file will NOT be put into Continuous Operations Mode, and your backup may not include this file.
2. If your application deletes a data file that is still in your file list, then the BUTIL operation may fail due to the missing file and the entire process may unwind, causing the entire backup to fail.
3. Because ContOps mode requires that every file have a unique base file name, this solution is not compatible with some applications. If your application uses files like DATAFILE.V01 and DATAFILE.V02, only ONE of these can be in ContOps mode at a time. You can work around this with multiple, smaller file lists, but it can get more complicated with proper timing of the backup processes.
4. If your server crashes due to power failure or other issue during a backup, then you may have a manual recovery process to get the entire system back into normal mode. This is a critical step

and cannot be ignored! Failure to properly recover the environment may lead to slowness and data loss.

You can check the validity of your backups with two simple checks. First, use Notepad to check the number of lines in the FILELIST.TXT, and verify that this matches the number of files in your backup folder. Second, check the file timestamps of each file in the backup folder. Because the ContOps process resets the timestamp of every file to the current time, every file in your backup folder should share the same date and time. If you find files that have a different timestamp, then they are likely missing from your FILELIST.TXT file or otherwise not being protected properly.

Finally, ContOps also has some manual recovery steps when the system crashes or the power is cut, which makes it less hands-off as well. If you are interested in this solution, check the online docs or our web site at <http://www.goldstarsoftware.com/whitepapers-database-protection.asp> for additional details about Continuous Operations Mode and how to recover after a failure.

AUTOMATING CONTINUOUS OPERATIONS MODE WITH THE BACKUP AGENT

There is a way to simplify Continuous Operations Mode further by using the *Actian Zen Backup Agent*. The Backup Agent is a component that is installed separately, but the license is built into the Server Engine. (For a Workgroup Engine, the license must be purchased separately.) Once installed, it integrates into the engine itself, where it can monitor the open files and use that information to place files into ContOps mode when required.

This solution shines because it eliminates the need to create and maintain a list of open database files at all. Since the engine already knows which files are currently open, the Backup Agent can put those files into ContOps mode for you when you need to start a backup. It can then monitor the engine for new files being opened, and automatically place those files into ContOps mode before each FileOpen command is processed.

While you can use the GUI dialog box to enable and disable the Backup Agent on the fly, it is far more common to use this within a script. The above BUTIL script now degenerates to:

```
PVBACKUP -ON
XCOPY C:\MyApp\Data\*.MKD T:\Backups\MyApp\Data
PVVBACKUP -OFF
```

Of course, there are still some possible problems with this solution that you might run into:

1. If you have multiple databases hosted on a server, this command puts ALL open files into ContOps mode. There is no way to limit it to a specific folder. If you need that extra granularity, stick to a STARTBU script with file list.
2. If you have files that you do NOT want to put into ContOps mode (i.e. rapidly changing temporary files that don't store data long-term, and thus are useless in a backup), then you have to create and maintain an Exclude File List, called EFL.TXT. This file is formatted similarly to the STARBU file list, covered above.
3. It is possible to be running a backup when the call comes down to open a new data file. If your backup solution is holding a file open, it can prevent the Backup Agent from putting that file into ContOps mode. This prevents the engine from opening the file and returns an error to the user. If you see this problem, you may need to create and maintain an Include File List (IFL.TXT) that is used to place those files into ContOps mode every time you start a backup, even if they are not open.

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4. Because ContOps mode requires that every file have a unique base file name, this solution is not compatible with some applications. Unlike with the file list solution, if you had files DATAFILE.V01 and DATAFILE.V02 both open at the same time, Backup Agent will fail.

One last thing – note that because only OPEN files are placed into ContOps mode and therefore get a new file timestamp, you can safely perform an incremental or differential backup with this solution. However, you can no longer use the file timestamps of the backed up files to ensure that all is working as expected.

Finally, as discussed in the previous section, ContOps also has some manual recovery steps when the system crashes or the power is cut, which makes it less hands-off as well. If you are interested in this solution, check the online docs or our web site at <http://www.goldstarsoftware.com/whitepapers-database-protection.asp> for additional details about Continuous Operations Mode and how to recover after a failure.

TAKING FULL BACKUPS WITH VOLUME SHADOWCOPY SERVICES (VSS) SNAPSHOTS

VSS, or Volume Shadowcopy Services, is a built-in component within the Windows operating system environment that can facilitate backups of data on a server. It is commonly used for features such as “Previous Versions” (allowing you to track old versions of files) and the snapshots that take place when you install software or OS updates (allowing you to roll back the system if something doesn’t work correctly).

The Zen v15 Server Engine includes the VSS Writer component and installs it by default, but the VSS Writer is not included (nor available separately) for the Workgroup Engine. You can confirm that it is operational by checking your Zen.LOG file and looking for the message “MKDE-2140: Zen VSS Writer successfully started.”

When you take a snapshot of your database volume, the VSS Writer will work with the database engine to quiesce the disk write activity (i.e. “freeze” the database) for the duration of the snapshot. Although this process *can* take up to 75 seconds, it is typically completed in just a few seconds and is typically invisible to the users. Once the snapshot has been taken by the OS, the VSS Writer will “thaw” the database and allow disk writes to occur once again.

VSS eliminates the extra management of ContOps backups, as well as the extra recovery efforts in the event a failure of the server occurs while in backup mode. However, VSS is the most complicated of the backup solutions, requiring OS configuration in advance of the backups, as well as either a VSS-enabled backup solution or a script using the VSVSC and DOSDEV utilities. As such, implementing VSS is best discussed inside its own white paper, so head over to <http://www.goldstarsoftware.com/whitepapers-database-protection.asp> for additional step-by-step instructions and other important information on implementing VSS in your environment.

As with the other backup solutions, though, there are important caveats to consider with VSS:

1. You must have administrative access to set up and manage VSS snapshots. If you are a database administrator without such access to the OS, then you will need to work with the server administrator to coordinate backups.

2. VSS snapshots do NOT update the data file timestamps (like ContOps does). Because of this, it is NOT valid to perform a differential or incremental backup while using VSS snapshots. If you do this, and if the System Cache setting within the engine is disabled, then your backups will likely be incomplete, especially in a system which remains in use 24x7. We'll even put this in big, bold, shouty-script for you, because it is so important: **VSS BACKUPS MUST LEVERAGE FULL BACKUPS ONLY.**
3. If you write your own script, be sure to mount and use the snapshot volume as the source of your backup. I have seen people enable VSS snapshots and then try to copy from the production file location, and this will not work properly.

DISASTER RECOVERY REPLICATION SOLUTIONS

In some cases, your data may be considered mission-critical to your business, and this may require a more advanced solution. While these solutions are outside the scope of this paper, there are several replication solutions that can be considered.

- **Active-Passive Replication:** There are many solutions that offer true active-passive replication, but the one that we have come to know and love is **Carbonite Availability**. This solution can be used to replicate the entire hard disk (or portion thereof) of the server to a secondary server, either on the same network, across the WAN, or across the globe.
- **Active-Active Replication:** Some database environments simply require active-active replication, where BOTH sides are in active use at the same time. The ONLY solution for this is Actian's DataExchange product, but we consider this to be a solution of last resort – to be used ONLY if there are no other options available for your environment.

For additional information on these solutions, give us a shout today!

Finding More Help

If you need some additional help with selecting the right backup method for your environment, Goldstar Software may be able to assist you further as well. Contact us at 1-708-647-7665 or at <http://www.goldstarsoftware.com>.