# ENSURING THE RELIABILITY OF INFORMATION IN A DISTRIBUTED DATABASE

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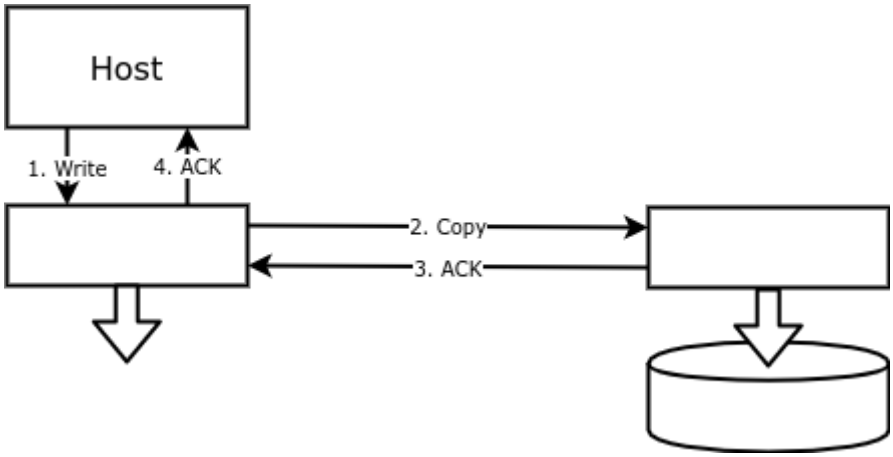
**Abstract**
Block systems are so named because the data stored in them is split into blocks of the same size. A data block is not a file, not a complete object, but just some data in a chunk of a fixed size (in English - chunk). The data file can be placed in a finite number of blocks, and if the last of these blocks is left unfilled, it will still have the same fixed size as the filled blocks. The server accesses these blocks through a storage attached network (SAN).

**Keywords:** Block systems, Internet, database, statistics, replication, lan, replication, Disk arrays, social networks, virtual world, computer games, digital technologies.

The dictionary defines replication as the process of maintaining two (or more) sets of data in a consistent state. What is "consistent state of datasets" is a separate big question, so let's reformulate the definition in a simpler way: the process of changing one dataset, called a replica, in response to changes in another dataset, called the master. The sets are not necessarily the same.
Database replication support is one of the most important tasks of an administrator: almost every database of any importance has a replica, or even more than one.
Replication tasks include at least:
support of the backup database in case of loss of the main one;
reducing the load on the base due to the transfer of part of the requests to replicas;
transfer of data to archival or analytical systems.

There are three approaches to replication:
Block replication at the storage system level;
Physical replication at the DBMS level;
Logical replication at the DBMS level.

Block replication. With block replication, each write operation is performed not only on the primary disk, but also on the backup. Thus, a volume on one array corresponds to a mirrored volume on another array, repeating the main volume up to a byte:




The advantages of such replication include ease of setup and reliability. Data can be written to a remote disk either by a disk array or by something (a device or software) between the host and the disk.

Disk arrays can be supplemented with options to enable replication. The option name depends on the array manufacturer:

| Manufacturer | Trademark |
|---|---|
| EMC | SRDF (Symmetrix Remote Data Facility) |
| IBM | Metro Mirror – синхронная репликация |
| Global Mirror | - asynchronous replication |
| Hitachi | TrueCopy |
| Hewlett-Packard | Continuous Access |
| Huawei | HyperReplication |

If the disk array is not capable of replicating data, an agent can be installed between the host and the array, which writes to two arrays at once. An agent can be either a standalone device (EMC VPLEX) or a software component (HPE PeerPersistence, Windows Server Storage Replica, DRBD). Unlike a disk array, which can only work with the same array, or at least with an array from the same manufacturer, an agent can work with completely different disk devices.

The main purpose of block replication is to provide fault tolerance. If the database is lost, you can restart it using the mirrored volume.

Block replication is great for its versatility, but versatility comes at a price.

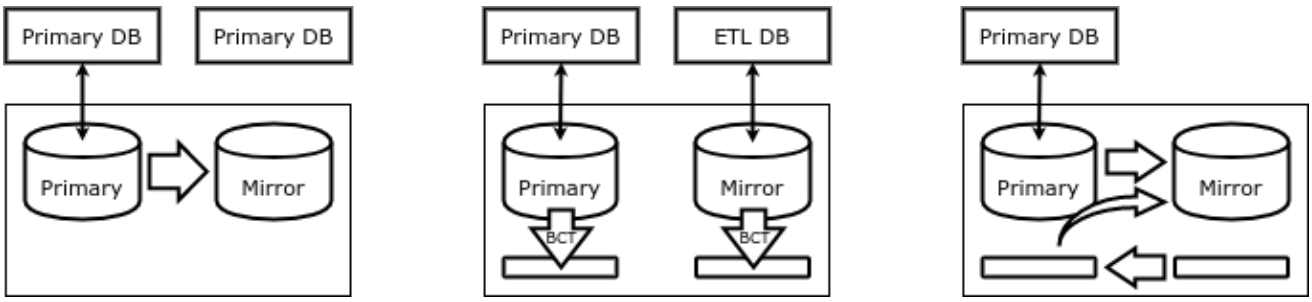
First, no server can handle a mirrored volume, because its operating system cannot control writes to it; from an observer's point of view, the data on the mirrored volume appears by itself. In the event of a disaster (failure of the primary server or the entire data center where the primary server is located), you should stop replication, unmount the primary volume, and mount the mirrored volume. As soon as possible, you should restart replication in the opposite direction.

In the case of using an agent, all these actions will be performed by the agent, which simplifies configuration, but does not reduce the switching time.

Secondly, the DBMS itself on the standby server can be started only after the disk is mounted. In some operating systems, for example, in Solaris, the memory for the cache is marked up during allocation, and the marking time is proportional to the amount of allocated memory, that is, the start of the instance will not be instantaneous. Plus, the cache will be empty after restart.

Thirdly, after starting on the backup server, the DBMS will find that the data on the disk is inconsistent, and you need to spend a significant amount of time recovering using redo logs: first, repeat those transactions, the results of which were saved in the log, but did not have time to be saved to data files and then roll back the transactions that did not have time to complete at the time of the failure.

Block replication cannot be used for load balancing, and a similar scheme is used to upgrade the datastore with the mirrored volume on the same array as the primary. EMC and HP call this scheme BCV, only EMC stands for Business Continuance Volume, and HP stands for Business Copy Volume. IBM does not have a special trademark for this case, this scheme is called "mirrored volume".




Two volumes are created in the array and write operations are performed synchronously on both (A). At a certain time, the mirror breaks (B), that is, the volumes become independent. The mirrored volume is mounted to a server dedicated to storage upgrades and a database instance is raised on that server. The instance will take the same amount of time to take up as it would with a block replication restore, but this time can be significantly reduced by breaking the mirror during off-peak periods. The point is that breaking the mirror in its consequences is equivalent to an abnormal termination of the DBMS, and the recovery time in case of abnormal termination depends significantly on the number of active transactions at the time of the crash. The database intended for unloading is available for both reading and writing. The identifiers of all blocks changed after a mirror break on both the primary and the mirrored volumes are stored in a special Block Change Tracking area - BCT.

After the end of the unloading, the mirrored volume is unmounted (C), the mirror is restored, and after a while the mirrored volume again catches up with the main one and becomes its copy.

## CONCLUSIONS

Block storage is a very popular service of cloud providers. It makes it possible to use such a useful quality as elasticity. That is, the user does not need to purchase storage equipment with a "reserve for the future." He can order the storage capacity from the provider in accordance with the current needs and then quickly "re-order" it if necessary. In most cases, this process can take several minutes. At the same time, the data will be well protected by the high availability of the cloud storage service and the technology of replication in the cloud. In addition, the encryption provided by the cloud provider will prevent other servers using the same cloud storage system from accessing other people's data. Thus, when you need to quickly and inexpensively expand your existing block storage, using a block storage service in the cloud may be the best option.

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