The following table describes common RAID levels:

|  |  |
| --- | --- |
| RAID Level | Description |
| RAID 0 (striping) | A *stripe set* breaks data into units and stores the units across a series of disks by reading and writing to all disks simultaneously. Striping: * Provides an increase in performance
* Does *not* provide fault tolerance. A failure of one disk in the set means all data is lost.
* Requires a minimum of two disks
* Has no overhead because all disk space is available for storing data

This is the fastest of all RAID types. However, it does not provide fault tolerance. |
| RAID 1 (mirroring) | A *mirrored volume* stores data to two duplicate disks simultaneously. If one disk fails, data is present on the other disk, and the system switches immediately from the failed disk to the functioning disk. Mirroring: * Provides fault tolerance for a single disk failure
* Does *not* increase performance
* Requires two disks
* Has a 50% overhead. Data is written twice, meaning that half of the disk space is used to store the second copy of the data. Overhead is 1 / *n* where *n* is the price of the second disk.
* RAID 1 is the most expensive fault tolerant system.
 |
| RAID 5 (striping with distributed parity) | A RAID 5 volume combines disk striping across multiple disks with parity for data redundancy. Parity information is stored on each disk. If a single disk fails, its data can be recovered using the parity information stored on the remaining disks. RAID 5: * Provides fault tolerance for a single disk failure.
* Provides an increase in performance for read operations. Write operations are slower with RAID 5 than with other RAID configurations because of the time required to compute and write the parity information.
* Requires a minimum of three disks.
* Has an overhead of one disk in the set for parity information: (1 / *n* - 1)
	+ A set with 3 disks has 33% overhead.
	+ A set with 4 disks has 25% overhead.
	+ A set with 5 disks has 20% overhead.
 |
| RAID 10 (stripe of mirrors) | A RAID 10 volume stripes data across mirrored pairs and across multiple disks with parity for data redundancy. If a single disk fails, its data can be recovered using the parity information stored on the remaining disks. If two disks in the same mirrored pair fail, all data will be lost, because there is no parity in the striped sets. RAID 10: * Provides fault tolerance for a single disk failure
* Provides redundancy and performance
* Is the best option for I/O-intensive applications like database, email, web servers, or any other system requiring high disk performance
* Uses 50% of the total raw capacity of the drives is due to mirroring
* Requires a minimum of four disks
 |

Be aware of the following facts about RAID:

* Some RAID controllers support combined levels of RAID. For example, RAID 0+1 is a striped array that is mirrored. Other combined configurations that might be supported include RAID 1+0 (also called RAID 10), RAID 5+0, and RAID 5+1.
* For all RAID configurations, the amount of disk space used on each disk must be of equal size. If disks in the array are of different sizes, the resulting volume will be limited to the smallest disk. Remaining space on other drives can be used in other RAID sets or as traditional storage.
* While some RAID configurations provide fault tolerance in the event of a disk failure, configuring RAID is not a substitute for regular backups.

Another term that is sometimes used with disk arrays is JBOD (just a bunch of disks). JBOD is not a RAID configuration, but like RAID configures multiple disks into a single logical storage unit.

* A JBOD configuration creates a single volume using space from two or more disks.
* *Spanning* is another term for JBOD because the volume spans multiple physical disks.
* Data is not striped between disks, but rather just saved to one or more disks (depending on how the operating system decides to save each file). On a new JBOD configuration, data is typically saved to the first disk until it is full, then additional data is saved to the second disk and so on.
* Disks used within the spanned volume can be of different sizes.
* JBOD uses the entire space available on all disks for data storage (no overhead).
* There are no performance or fault tolerance benefits with JBOD.
* If one drive fails, you might be able to use disk recovery tools to recover data from the remaining disks.

Configuring RAID array fact sheet
RAID can be implemented in the following ways:

|  |  |
| --- | --- |
| Method | Description |
| Hardware | Hardware RAID uses a special controller card that includes a RAID processor. Hardware RAID is the most expensive method but provides much better performance and is more reliable than other methods. |
| Software | Software RAID uses a driver and the system CPU for controlling RAID operations. This is the slowest form of RAID. * Some RAID controller cards support RAID configuration, but without the onboard RAID processor. These solutions are classified as software RAID (sometimes called *fake* RAID) even though you install a controller card to provide RAID capabilities.
* Many motherboards include built-in (onboard) support for RAID. RAID implemented in this way is typically software/driver RAID.
 |
| Operating system | Operating system RAID uses RAID features within the operating system. Like software RAID, the system CPU is used for RAID operations, but performance is typically better than software RAID because of integration with the operating system. |

Windows 7 supports creating RAID 0 and RAID 1 arrays in Disk Management, but does not support configuring RAID 5 arrays. To use RAID 5 on a client computer, you will need to use hardware or software RAID. The exact process you use to configure RAID depends on your motherboard and/or controller card. The following steps are a typical method for configuring software RAID included on many motherboards:

1. Install the RAID controller card and connect the drives to the controller.
2. If using an onboard RAID controller with SATA drives, edit the CMOS settings and identify the drive type as RAID. This tells the system to load the onboard BIOS/UEFI for accessing the connected drives.
3. Boot the computer. After the system BIOS/UEFI loads, the RAID BIOS will load. Press the key combination displayed to enter the RAID configuration utility (commonly **Ctrl** + **F**).
4. Within the configuration utility, define an array, add disks to the array, and identify the array type (RAID 0, 1, 5, or 10, etc.).
	* On some controller cards, you can create a RAID 1 set using an existing disk (with data) and a new disk. During the setup, data from the first disk is copied to the second disk.
	* Some controller cards cannot create mirrored drives using existing data on a drive. If you use drives with existing data, that data will be lost.
	* Some controller cards let you mirror an existing drive, but only from a utility that runs within the operating system.
	* When creating new RAID 0 and RAID 5 drives, all existing data on all disks will be lost.
5. Reboot the computer into the operating system and install the drivers for the RAID controller.
6. In Windows, the RAID array appears as a single disk with a partition already defined. Use Disk Management to format the partition and assign it a drive letter.

If you want to install the operating system on a RAID array, follow steps 1-4 above, then take the following steps:

1. Reboot the computer from the operating system installation disc.
2. During the first part of the installation, Windows loads the necessary files it needs to start the installation. You will need to manually load the controller driver so that Windows can see the RAID array. You will need to have the drivers on a flash drive.
3. After the drivers are loaded, select the partition that represents the RAID array. The installation process will format the partition and install the operating system.
4. Following installation, edit the CMOS settings to modify the boot order to boot from the RAID array.

5.4.7 Practice questions lab
 