CFIN

5th International Digital, Mobile, And Computer Forensics Conference & Training Exposition (Digifor2016) Lagos NIGERIA

CFIN

- **What is …. RAID**
- RAID (redundant array of independent disks; originally redundant array of inexpensive disks) provides a way of storing the same data
- – in different places (thus, redundantly)
- – on multiple hard disks (though not all RAID levels provide redundancy)
- – and to increase storage capacity in a system.
- In other way, RAID is the way of combining several independent and relatively small disks into a virtual single storage of a large size.
- The disks can be combined into the array in different ways, involving one or more of the above which are known as RAID levels.

CFIN

- **Characteristics that differentiate RAID**
- Fault-tolerances.
- Performance’.
- Higher capacity.
-
- **How RAID is organized**
- Two independent aspects are clearly distinguished in the RAID organization.
- The organization of data in the array (RAID storage techniques).
- Implementation of each particular RAID installation.

CFIN

- **Storage techniques in RAID**
- The main methods of storing data in the array are:
- Striping – splitting the flow of data into blocks of a certain size (called "block size") then writing of these blocks across the RAID one by one. This way of data storage affects on the performance.
- Mirroring is a storage technique in which the identical copies of data are stored on the RAID members simultaneously. This type of data placement affects the fault tolerance as well as the performance.
- Parity is a storage technique which is utilized striping and checksum methods. In parity technique, a certain parity function is calculated for the data blocks. If a drive fails, the missing block are recalculated from the checksum, providing the RAID fault tolerance.
- All the existing RAID types are based on striping, mirroring, parity, or combination of these storage techniques.
-

CFIN

- **Standard RAID Levels**
- RAID devices use many different architectures, called levels, depending on the desired balance between performance and fault tolerance. RAID levels describe how data is distributed across the drives. Standard RAID levels include the following:
- **Level 0**: Striped disk array without fault tolerance
- Provides data striping (spreading out blocks of each file across multiple disk drives) but no redundancy. This improves performance but does not deliver fault tolerance. If one drive fails then all data in the array is lost.
- **Level 1**: Mirroring and duplexing
- Provides disk mirroring. Level 1 provides twice the read transaction rate of single disks and the same write transaction rate as single disks.
- **Level 2**: Error-correcting coding
- Not a typical implementation and rarely used, Level 2 stripes data at the bit level rather than the block level.
- **Level 3**: Bit-interleaved parity
- Provides byte-level striping with a dedicated parity disk. Level 3, which cannot service simultaneous multiple requests, also is rarely used.

CFIN

- **Level 4**: Dedicated parity drive
- A commonly used implementation of RAID, Level 4 provides block-level striping (like Level 0) with a parity disk. If a data disk fails, the parity data is used to create a replacement disk. A disadvantage to Level 4 is that the parity disk can create write bottlenecks.
- **Level 5**: Block interleaved distributed parity
- Provides data striping at the byte level and also stripe error correction information. This results in excellent performance and good fault tolerance. Level 5 is one of the most popular implementations of RAID.

CFIN

- **Level 6**: Independent data disks with double parity
- Provides block-level striping with parity data distributed across all disks.
- **Level 10**: A stripe of mirrors
- Not one of the original RAID levels, multiple RAID 1 mirrors are created, and a RAID 0 stripe is created over these.

CFIN

-
- **Non-Standard RAID Levels**
- Some devices use more than one level in a hybrid or nested arrangement, and some vendors also offer non-standard proprietary RAID levels. Examples of non-standard RAID levels include the following:**ID S**
-
- **RAID implementations**
- RAID can be created by two different ways:
- with the use of operating system drivers, so called software RAID;
- with the use of special hardware, so called hardware RAID.

CFIN

- **7.1- Software RAID**
- Software RAID is one of the cheapest RAID solutions.
- Nowadays, almost any of the operating systems has a built-in capability to create RAID, though not for all RAID levels. Thus, Windows home editions allow user to create only RAID 0, while RAID 1 and RAID 5 can be created only using Windows server editions. RAID layout created by means of Windows is inseparably linked with the host operating system and so its partitions cannot be used, for example, in dual boot.
- Software RAID is created based on the user's computer and therefore it uses the host system CPU for implementation. It should be noted, that in case of RAID levels 0 and 1, CPU load is negligible, but for the RAID types based on parity, CPU load can vary from 1 to 5 percent depending on CPU power and the number of the disks, which is also negligible for practical purposes.

CFIN

- There are certain limitations on the use of the software RAID to boot the system. Only RAID 1 can contain boot partition, while system boot is impossible with a software RAID 5 and RAID 0.
- Keep in mind that in most cases software RAID doesn't implement the hot-swapping and so it cannot be used where continuous availability is required.
-
- **7.2- Hardware RAID**
- Hardware RAID is created using separate hardware. Basically there are two options:
-
  - inexpensive RAID chip possibly built into the motherboard,
  - more expensive option with a complex standalone RAID controller. Such controllers can be equipped with their own CPU, battery-backed up cache memory, and they typically support hot-swapping.

CFIN

- A hardware RAID has some advantages over a software RAID, such as:
  - doesn't use CPU of the host computer;
  - allows user to create boot partitions;
  - handles errors better, since communicates with the devices directly;
  - supports hot-swapping.
-
-
- **REFERENCE**
- Vangie Beal RAID – redundant array of independent disks http://www.webopedia.com/TERM/R/RAID.html
- Jon L. Jacobi, RAID Made Easy http://www.pcworld.com/article/194360/raid-made-easy.html
- Margaret Rouse, RAID (redundant array of independent disks) http://searchstorage.techtarget.com/definition/RAID