Redundancy

Slide Set 5

Fault Tolerance and Redundancy

- Fault Tolerance – the ability to withstand a partial failure and to continue to operate even though it may impact upon performance
- Redundancy – used to provide an exact duplicate of the primary system in hardware and software. In a Windows NT or 2003 environment the BDC (Backup Domain Controller) provide the redundancy for the PDC (Primary Domain Controller)
- Support for the network infrastructure comes from:
  - Backup
  - Uninterruptible Power Supply
  - Redundancy

Backing Up Data

- The process of copying data stored on a computer, and making an exact duplicate of that data on another usually removable storage media.
- This may be achieved by simply copying the data to a floppy disk, a Tape backup device, an external hard disk drive, transferring to a remote system via a network, an optical media such as a DVD, etc..
- Speed is a critical factor, and since the process of backup can take several hours it is usually scheduled for off-peak hours, or when the system is not in use.

Backup and Archiving Software

In business environment, where data are usually held within servers, the backup process is performed via specialised software. The advantages are:

1. Backup process is automated and the data type, frequency, type of backup, etc. can be configured.
2. Compression can be used while backing up data. This uses smaller storage space on the target medium and also save time if data are being backup on network drive or cloud storage.
3. Encryption can be used while backing up data. This ensure confidentiality.
4. Data Integrity checks can be performed on the backup data for added security.

Chronology of Storage Technology

- Obsolete: LS-120 floppy drive (max 120 MB), Iomega Zip (max 200 MB), Jaz (max 2 GB) drives, 1.44 MB floppy drive.
- Nearing obsolescence: Digital Data Storage (DDS: max 160 GB) from HP superseded by LTO, DVD±R/W (max 8.4 GB), Advanced Intelligent Tape (AIT: max 400 GB), Digital Linear Tape (DLT: max 800 GB).
- Popular: Linear Tape Open (LTO: 800 GB), Super Advanced Intelligent Tape (SAIT: max 2 TB), T10000 from StorageTek with max 1 TB, USB Flash drive (max 2 TB), SSD HDD (max 100 TB), Cloud Storage (as required).

Most common types of Backup

- **Full Backup** – backs up all the data on the system, does not take in to account if the data has changed since the last backup, used for the first backup of a system. Data compression and confidentiality are also used.
- **Differential** – Uses the 'archive bit' to determine if the file has changed since the last **full** backup, takes longer than an incremental backup, but is quicker to restore.
- **Incremental** – uses the 'archive bit' to determine if a file has changed since the last **full**, **differential** or **incremental** backup, takes less time than differential backup, takes more time to restore as restoration requires the last full backup plus use of all incremental tapes

Backup Strategy

How far back do tapes need to be kept ?

- With little data a full backup each night is conceivable using a single tape (risky!!!)
- A different tape each day is more reliable, but not as practical
- A normal backup each evening is time consuming, the majority of data does not change from day to day, therefore duplicate data is being repetitively stored
- A rotation of tapes is the most common approach, four tapes being used Monday to Thursday (for either incremental or differential), a separate tape is used each Friday for a full backup
- On the last Friday of the month the tape is kept as an archive

Tape Backups

Incremental or Differential Backup

Normal Backup

MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	
1	2	3	4	5	WEEK 1
1	2	3	4	6	WEEK 2
1	2	3	4	7	WEEK 3
1	2	3	4	Monthly	WEEK 4

Uninterrupted Power

- UPS are categorized by their ability to cater for 9 common power problems (see next slide):
  - Level 3 UPS usually called Back-up or Stand-by UPS (1-3)
  - Level 5 UPS usually called Line-Interactive, Smart UPS (1-5)
  - Level 9 UPS usually called On-Line, Smart UPS (1-9)
- Which devices need to stay up and running? Usually only the server has UPS. Do workstations also need UPS?
- If you require the server to be running for more than 30 minutes, consider a high capacity UPS or a generator.
- Consider using software to perform a clean shutdown of systems if the power cut is at a time when the system is unattended, e.g. PowerChute

9 common Power problems

1 – Power Failure: A total Loss of Utility Power

2 – Power Sags: Short term low voltage

3 – Power Surge: Short term high voltage (spike)

4 – Undervoltage: Long term low voltage (brownouts)

5 – Overvoltage: Long term high voltage

6 – Electrical Line Noise: caused by RFI or EMI (e.g. lightning)

7 – Frequency Variation: A change in frequency stability

8 – Switching Transients: very brief (nanos) undervoltage (notch)

9 – Harmonic Distortion: distortion caused by non-linear loads

Fault-Tolerant Servers

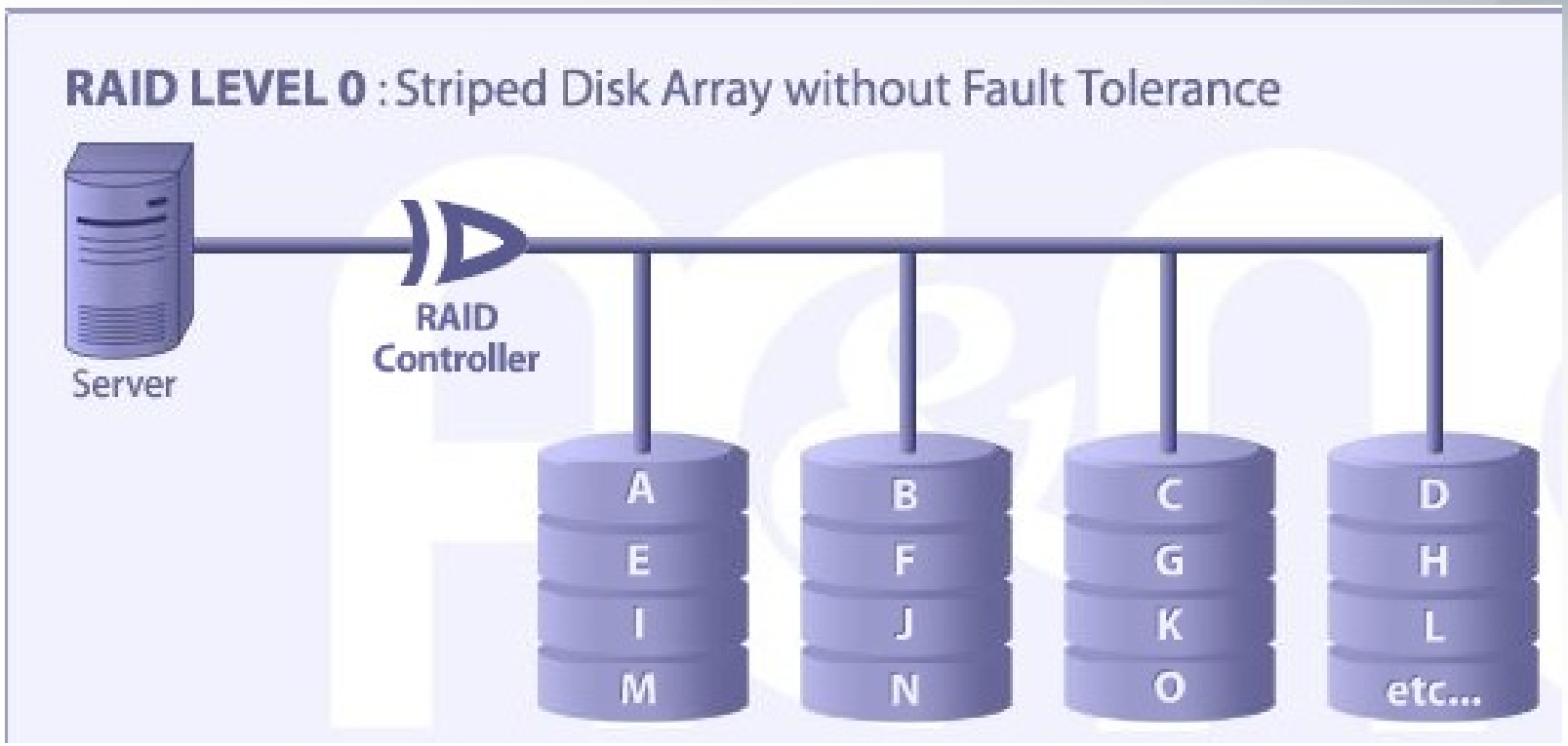
For high availability, fault-tolerance servers provide redundancy across major system components such as:

- Redundant power-supplies, fans, etc.
- Redundant processors, memory, hard disk drives, network interface cards, etc...

Note that the above cater primarily for hardware failures not software failures.

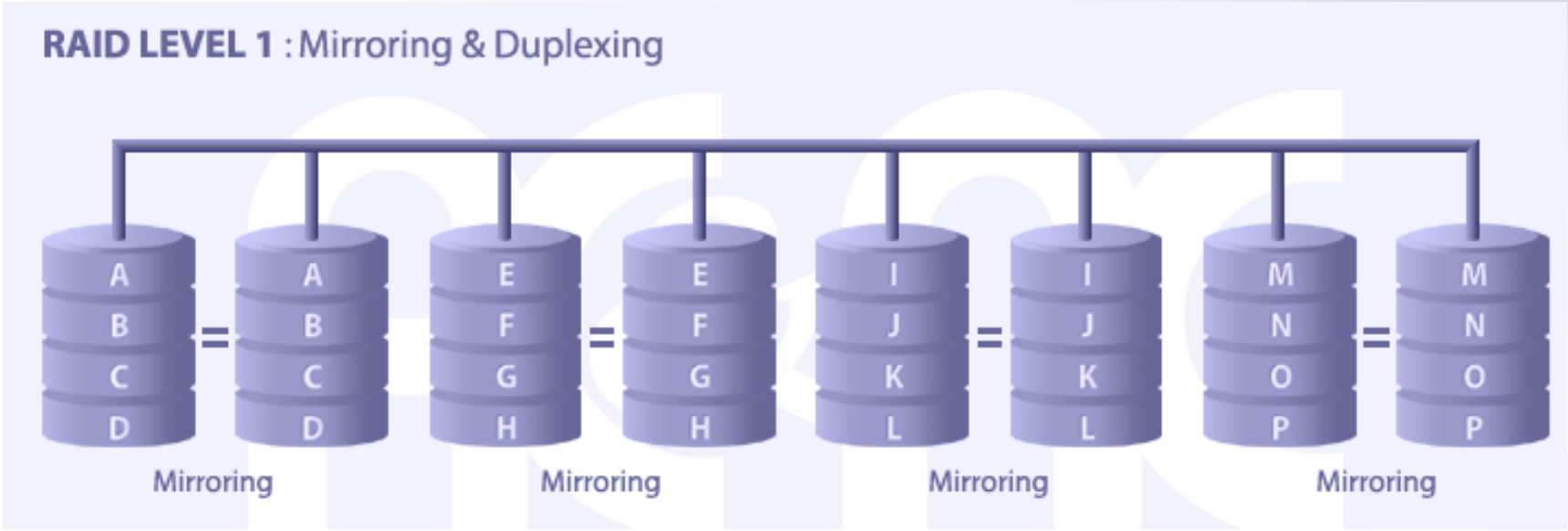
Clustering as well as virtualization is another approach for minimizing software failures and thus increase uptime.

RAID 0 – Disk Striping



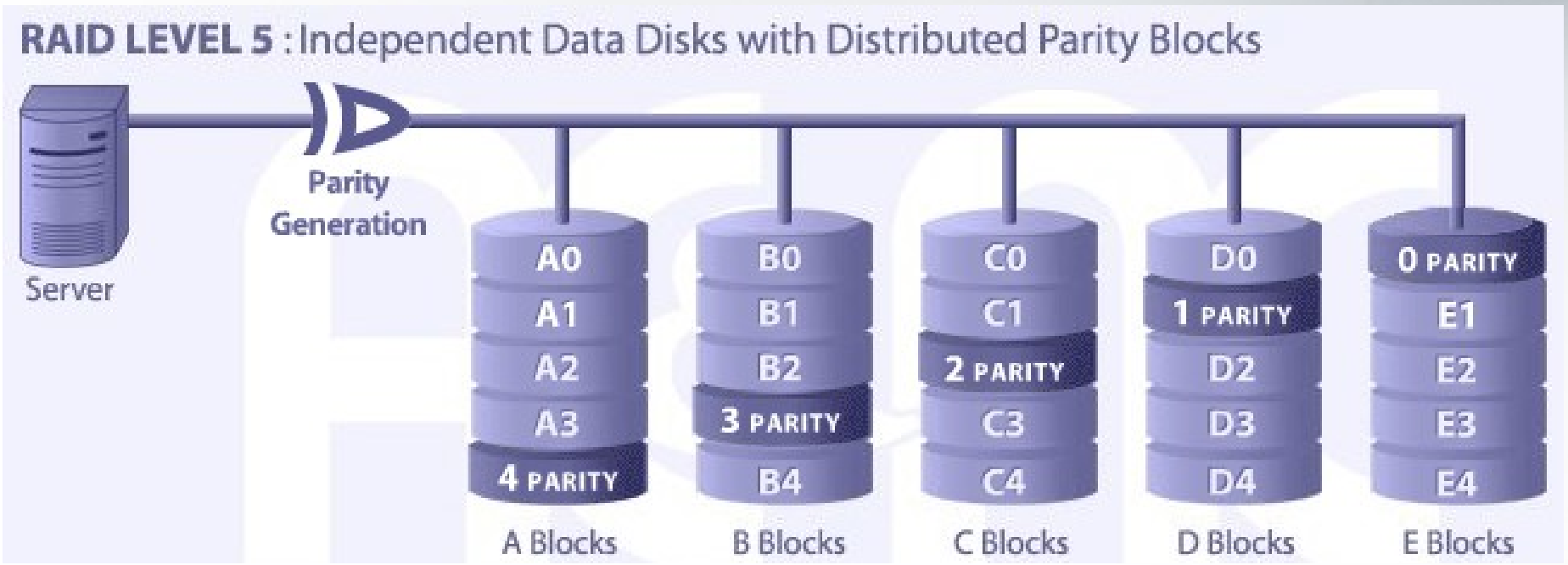
RAID Level 0 requires a minimum of 2 drives to implement

RAID 1 – Disk Mirroring



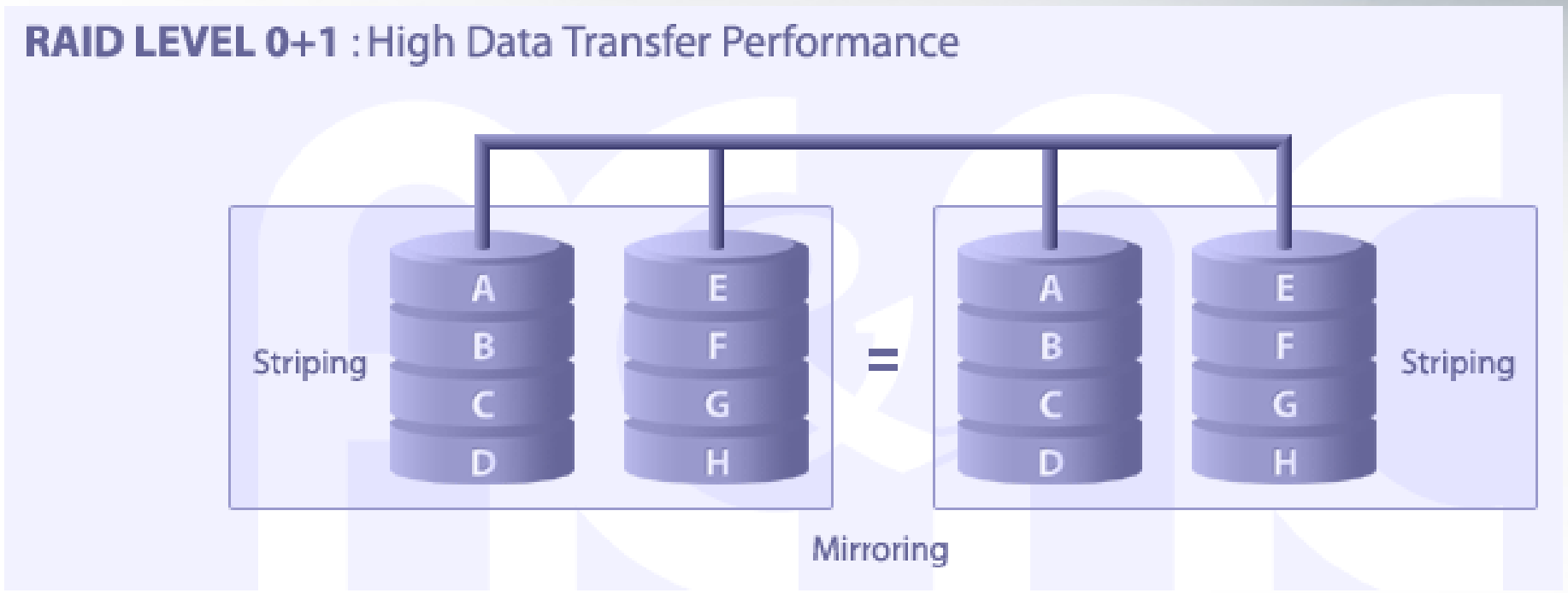
RAID Level 1 requires a minimum of 2 drives to implement

RAID 5 – Disk striping with Parity



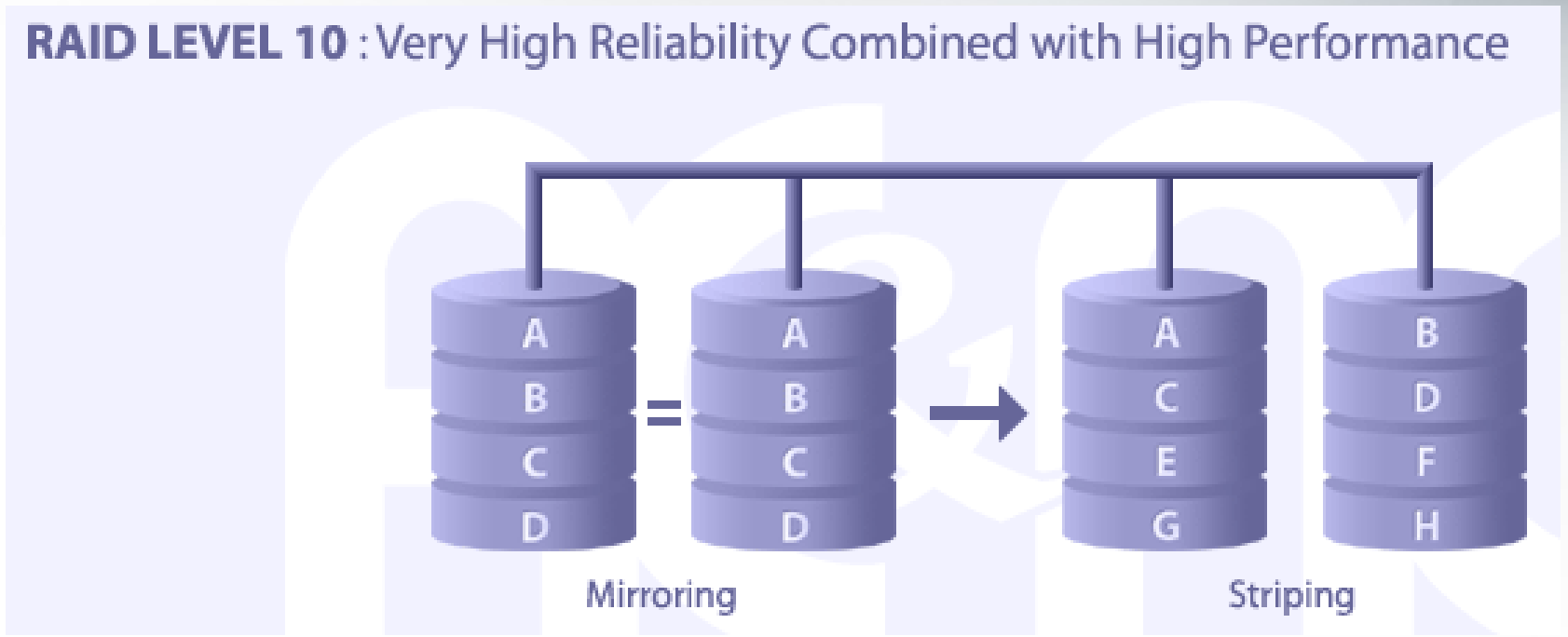
RAID Level 5 requires a minimum of 3 drives to implement

RAID 0+1 – Mirroring of Disk Stripes



RAID Level 0+1 requires a minimum of 4 drives to implement

RAID 10 – Disk mirroring with striping



RAID Level 10 requires a minimum of 4 drives to implement