

EE4217 Test 2011/12 20th Apr 2012 (25 marks)

Solution

1 a) What is a physical connectivity component? State the key physical connectivity components of a small systems environment. Also, state the key logical components found in all computing environment “hosts”.

[8 marks]

Ans:

Physical connectivity component is an I/O device which allow a host to interact with the outside world by sending and receiving data.

[1 mark]

The basic I/O devices,

- 1) HID (Human Interface Device): such as the keyboard, mouse and monitor, allow users to enter data and view the results of operations.
- 2) Computer to Computer - allow hosts to communicate with each other, Network Interface Card (NIC)
- 3) Computer Peripheral Interface – or allow hosts with peripheral devices, such as printers and cameras.

[1 each total 3 marks]

Hosts generally include logical components such as:

- 1) Applications - provide a point of interaction either between the user and the host or between hosts
- 2) Operating system - controls all aspects of the computing environment. It manages the user interface and the internal operations of all hardware components of the system.

The Operating System:

- Provides the services required for applications to access data
- Monitors and responds to user actions and the environment

- Organizes and controls the hardware components
- Connects hardware components to the application program layer and the users
- Manages system activities such as storage and communication

3) File System (and Files) - provides a logical structure for data access and data storage

4) Device drivers:

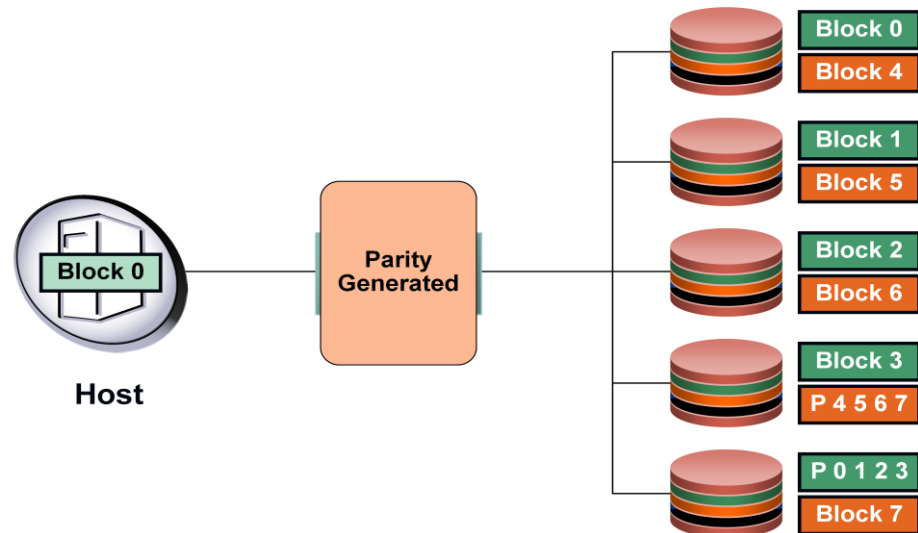
- Allows the operating system to be aware of, and use a standard interface to access and control a specific device (i.e., printer, speakers, mouse, keyboard, video, storage devices)
- Provides the appropriate protocols to the host to allow access to the device

[1 each total 4 marks]

1 b) What are the features of RAID5? Explain RAID5 operations. State the benefits, drawbacks, performance and Data Protection of RAID5.

[8 marks]

Ans:



[2 marks]

RAID 5 does not read and write data to all disks in parallel like RAID 3. Instead, it performs independent read and write operations. There is no dedicated parity drive; data and parity information is distributed across all drives in the group.

[2 marks]

Benefits: the most versatile RAID level. A transfer rate greater than that of a single drive but with a high overall I/O rate. Good for parallel processing (multi-tasking) applications/environments. Cost savings due to the use of parity over mirroring.

Drawbacks: slower transfer rate than RAID 3. Small writes are slow, because they require a readmodify-write (RMW) operation. There is degradation in performance in recovery and reconstruction modes and data loss if multiple drives within the same group are lost.

Performance – high read data transaction rate, medium write data transaction rate. Low ratio of parity disks to data disks. Good aggregate transfer rate

Data Protection – single disk failure puts volume in degraded mode. Difficult to rebuild (as compared to RAID level 1).

[1 each total 4 marks]

- 1 c) A Telecom company provides mobile wireless services across the region and has about 5000 employees in the region. This company is Hong Kong based and has 7 regional offices across the region. Although the company is doing well financially, they continue to feel competitive pressure. As a result, the company needs to ensure that the IT infrastructure takes advantage of fault tolerant features.

The company uses a number of different applications for communication, accounting, and management. All the applications were hosted on individual servers with disks configured as RAID 0. The company changed the RAID level of their accounting application based on your recommendations 6 months ago. It is now the beginning of a new financial year and the IT department has an increased budget. You are called in to recommend changes to their database environment.

After investigating their database environment closely, it is observed that the data is stored on a 6-disk RAID 0 set. Each disk has an advertised formatted capacity of 2 TB and the total size of their files is 9 TB. The amount of data is likely to change by 30 % over the next 6 months which needs to be addressed. The application performs around 40% write operations, and the remaining 60 % are reads. The average size of a read or write is small, at around 20 KB. [N.B. Each 2 TB drive can hold 1.863 TB data]

- i) Suggest how to restructure their environment if a new 2 TB disk drive costs HK\$1000 assuming the controller can handle all commonly used RAID levels, so it will not need to be replaced.

[3 marks]

- ii) Propose a RAID solution and calculate the cost of this new solution.

[3 marks]

- iii) Justify your choice based on cost, performance, and data availability of this proposed new solution.

[3 marks]

- i) Each 2T GB drive can hold 1.863 TB of data. There is currently 9 TB of data, which will increase to 11.70 TB (9×1.3) in the next 6 months.

That amount of data will fit on 7 disks ($6 \times 1.863 = 11.18 < 11.7$ thus 7 disks) , with space left over.

[3 marks]

- ii) The environment uses a high proportion of writes, so parity-based RAID is not an option. RAID 1 will not allow enough space, so our choices are limited to RAID 0+1, or RAID 1+0. Since RAID 0+1 does not have better availability, leaving only RAID 1+0. This RAID level uses mirroring, so for the 1170 GB of data, we need 7 disk pairs – 14 disks.

[2 marks]

They already have 5 disks, so need to purchase an additional 9, for a total cost of \$9000.

[1 mark]

- iii) Cost: RAID 1+0 is the most expensive amongst RAID 1 or RAID 0+1
Performance: Excellent protection, very good performance in environments with a high proportion of writes.

Data Availability: Minimal disruption in the event of a disk failure.[fast fail over]

[1 each total 3 marks]