THE UNIVERSITY COLLEGE OF THE CARIBOO

COMPUTING 253

Small Computer Systems: Organisation and Architecture

Workshop #4 – Anatomy: Diagnostics & Components

Marks: 5 marks | Due: Monday, February 7, 2005 in lecture class

Introduction

In this workshop, the goal is to examine the computer system through software diagnostics along with a visual inspection, attempting to specifically identify the major hardware components that make the system what it is.

Although the diagnostic tools help describe the components *exactly* (capacity, model, manufacturer, etc.), the tools are only as accurate as the data and knowledge of the software designers that wrote them. Due to out-dated software, improper hardware calls, or just plain bad programming, diagnostic software may incorrectly identify a component—*requiring a manual look inside*.

By opening the case, another aspect of the true computer system is revealed: the internal architecture, the components and their communication lines, the various processors, and the physical dimensions of the storage systems (memory (primary) and drives (secondary)).

The workshop continues with an examination of the connections and preparation of disks, with a focus on IDE hard disk drives.

This workshop covers the topics below, (see *Reference* for specific text sections.)

1. Use of software diagnostic tools to identify major system components.
2. Common bus architectures.
3. Data ribbon connectors (data cables) and how they attach; including the "floppy" twist.
4. System memory (RAM).
5. (Bus) expansion slots and expansion cards.
6. General discussion of hard disks, cylinders/heads/tracks/sectors, partitions, and IDE.
7. Basic installation and configuration of hard disks.
8. Basic BIOS/CMOS set-up, and comparison of different BIOSes.

Reference

This workshop references material from workshop #2. From the text book. the chapters: *2—Hardware & Software; 4—Electricity and Power; 5—Motherboard; Chapter 7—Floppy Drives; 9—Understanding &Installing Hard Drives.*

Concerns

Keep your team's work area organised. Do not confuse components or tools.

There are a lot of activities during this workshop; although efficiency and speed are important, so are care and patience.

You are encouraged to record observations on your activities--keep a pen and paper handy.

> **CAUTION**: When working with the system, **NEVER** remove or insert a component with the power on. This could damage not only the computer, but *you* as well.

Soft Boot - *important!*

A "soft boot" means pressing <CTRL><ALT>—<DELete>, which means holding down <CTRL><ALT> and tapping <DELete>. This is different than pressing the "Reset" button or turning the computer *off* then *on*.

Procedure

After your team (of 2 or 3), is assigned a cluster, proceed through the following **Observation and Tasks**.

Remember: your goal is not to only complete all tasks, but to understand what you have done—*ask questions, make notes*.

Documentation

With a cover page describing the *course, workshop (title, #), date,* and *list of group members*, attach a typed list of the results from the diagnostic tools (as stated), as well as answers to the questions listed at the end of the workshop.

Finishing

When finished, make sure that all the original expansion cards are in your machine, *in the original slots*, and that the original hard drive and floppy drive are connected and working. Ensure that all external cables are in place, and that the computer boots problem-free to Windows and lets you access the Internet.

Observations and Tasks

[Use only the *server* computer to run the software diagnostics.]

Part 1: Software-based Diagnostic Tools

1. From the various diagnostic tools, gather the following system information:
   BIOS manufacturer and version number (release date?)
   - CPU: model, speed, and physical type: socket/slot? (look up model)
   - mainboard information (model #, manufacturer, Chipset)
   - available buses (all types)
   - RAM (total physical memory, not included virtual memory), and Cache (if available and known)
   - video adapter (model/name, video adapter RAM)
   - input devices: keyboard, mouse
   - disk models: hard disk (total capacity), floppy, CD, other?
   - available ports (serial, parallel, USB, PS/2)
   - audio/sound adapter (model/name
   - list of devices attached to the IRQs (0 – 16) – *see page 65*

   The following tools will be used: *Microsoft System Information, SANDRA, HWInfo (a DOS diagnostic)*, and the *BIOS POST results*.

Microsoft System Information

2. Use the tool built-in to Windows 2000/XP, see **page 68**.
   (This tool is also available in Windows 98, if Microsoft Office is installed.)

SANDRA

3. Open SANDRA from the desktop icon. This is the shareware version, so some modules may not be available.

HWInfo

4. Shutdown Windows and restart the computer with the HWInfo diagnostic floppy diskette. Follow the directions on the disk, or from your instructor.
5. HWInfo is a DOS-based diagnostic, so Windows is not loaded and does not interfere. Confirm (or correct) the component information identified so far. *This diagnostic performs at a very low-level, so it may seem to have limited information, but what it does indicate is very accurate.*

BIOS POST (Power-On Selft Test)

6. As a computer boots up, one of the first functions of the BIOS is to run a "Power-on Self Test" (see **page 79**). The results of this diagnostic are shown before the operating system is loaded.
7. To keep the results on the screen, as soon as the rectangle with the POST results is displayed, ***quickly press the* PAUSE *key***. *(If you miss it, soft boot the system and try again; if not visible, try it on the Workstation Computer).* Once finished with the information, press ENTER to continue booting.

Part 2: Computer Interior -- *using both computers*

[start with the *server* computer.]

1. **CAUTIOUSLY** disconnect all cables from the rear of the system case. Move to the worktable and place the system on its side. Open the access panel.
2. **CAREFULLY** remove the ribbons and power cables from the hard disk and floppy drive (not from the mainboard), and record on which side of the drives the RED LINE on the data ribbon connects. The data ribbon's red line always connects to "pin 1" on the device and mainboard.
   (*Note: The term "ribbon" and "cable" commonly refer to the same item.*)

Part 3: The Bus and Bus Expansion Slots

1. Identify the keyboard, mouse, serial, parallel, video, sound, network, and other external ports on the back of the system. *Which ports are connected to the mainboard and which to expansion cards?*
2. **Without removing any components**, and for your own information, visually locate the following mainboard components ,
   - power connector (AT or ATX?)
   - BIOS chip and Chipset Chips
   - CPU (slot or socket?) and RAM (SIMM or DIMM)?
   - front Panel Connectors
   - floppy and IDE connectors
   - RTC & BIOS battery
   - BUS types (determined through the Expansion Slot types)

Part 4: Data Ribbons

1. Consider the data cables for the floppy and hard disks.
   Notice the difference in widths, and that the floppy connector has a **twist**.
   What is the floppy twist for? Why do the IDE cables lack the twist?
   *(see **pages 163 & 296**)*
2. Examine the cables closely to see where on the mainboard each connects and how each cable reaches the hard drive, CD-ROM drive, and floppy drives.
   Are the cables facing the same direction on the mainboard (hint: pin 1)?

Part 5: Memory

1. Identify the location of the System Memory (RAM).
   What physical type is inserted? (SIMM, or DIMM).
   Does the system have Cache RAM on the main board? If so, where is it?
   (see text for Cache and different CPU: AMD Athlon and Intel Pentium 4.)
2. For the amount of system memory, the BIOS performs a check at power-up (part of the POST) to determine the total RAM.
   How much memory was indicated in the POST?
3. Is there physically any room available for more memory? *(any open slots?)*

Part 6: Expansion Cards

[Since the Server has no expansion cards, do only with the Workstation.]

1. Identify the purpose of each expansion card currently installed, as well as identify the slots each is plugged into (in terms of the bus type).
2. After recording in which slot each card is connected, **CAREFULLY** remove all expansion cards and lay them flat on an anti-static Mylar sheet.
3. Examine the cards and determine the purpose and, if possible, the name/model of the card.
4. Carefully replace each card into its original slot, remembering to also replace the bracket screw keeping the card in place.
5. Replace the access panel. Reattach the system to the cluster.

Repeat Parts 2 through 6 for the Workstation Computer

Part 7: Hard Disk Installation

[Consult Chapter 8, starting on **page 333** for "Installing a Hard Drive"]

1. With the workstation computer already open, obtain one of the workshop experiment hard disks from your instructor.
2. Examine the disk, looking for information regarding the dimensions of the disk: *cylinders, heads, sectors, and capacity*.
   If available, record them. If not, the BIOS can still determine them.
   (see text for the description of each dimension.)

Physically Installing the Hard Drive

3. Mount the experiment hard disk in an open bay next to the existing disk—do not remove the existing disk. Borrow the power and data cables from the existing disk, connecting them to the experimental in the correct direction.
   (ask, or see the text, for help in determining the correct direction)
4. For help with physically installing the hard drive, consult **pages 336-343**.
5. Ask your instructor to verify that the new hard disk is correctly mounted.
   Return the system back in the cluster and reconnect the power, keyboard, and monitor cables (leave the mouse and network cables disconnected).

BIOS/CMOS Setup

6. Modern computers have BIOSes that perform a disk "autodetect" (for floppies, hard disks, and CD-ROMs), meaning they load the configuration information about the drives from the *drives themselves*.
   If the hard disk is not identified correctly (or at all), or for older BIOSes, the settings must be set manually using HDD Autodetect.
7. Power up the computer and enter the "Setup" by pressing either <F2> or <DEL>, depending on which instructions are the bottom of the screen.
8. For help on using the setup, consult **page 345-348**.
   Although nothing will change, perform a manual drive detect.
   Examine the features in the setup, then exit (DO NOT save changes).

Hard Disk *Partitioning*

9. Boot the system from the DOS/System Boot disk.
   Assuming the hard disk is new and has never been used. This means the hard disk needs to be partitioned and high-level formatted.
10. Run FDISK to reconfigure the hard disk's partition table. Using this tool, delete any existing partitions. Once cleared, save the new partition table and exit FDISK, then soft boot the computer.
    For help on using **FDISK**, see **page 348**.
11. Run FDISK again to create partitions.
    Without any partition information to organise disk space, a hard disk can not be formatted and hence is unusable (at least one partition is required).
12. When creating partitions, there must be at least one *Primary Partition* (which could be all available space) containing the operating system.
    To divide the physical disk beyond the 4 primary partitions limitation, an *Extended Partition* must be created to hold *Logical Partitions* (logical partitions are placed inside extended partitions).
13. On the experimental drive:
    - create one Primary partition and one Extended partition
    - create three (3) Logical partitions within the extended partition
14. When the Primary partition is created, FDISK warns that "A partition must be set active." This means that a primary partition must be set as *bootable*. Set the Primary partition as **active**.
15. Once you have created the partitions, exit FDISK and soft boot the system. After each partition modification, the system must restarted. The reason is that *partition* data is written and stored in the hard drive's partition table (boot sector), and read by the BIOS only during the boot-up sequence.

Hard Disk *Formatting* (or formatting any disk or diskette)

16. A high-level format, or regular format, (**page 349**) of the hard disk is commonly performed with the DOS command FORMAT .
    Format the Primary partition (as C:), type: FORMAT C: /S /U
17. Also, format all Logical partitions (labelled drives: D:, E:, etc.) in the Extended partition, format them accordingly: FORMAT D: /U
    Why is the /S *not required for the other drives other than* C: *?*
18. ***Interesting Note:*** *DOS and Win9x are not able to create multiple Primary (boot) partitions on one hard disk (for any OS, there is a maximum of 4 primaries per hard disk). Multiple primary partitions, and multi-boot features, are provided in operating systems like UNIX/Linux, Windows 2000/XP, or through special "multi-boot partition loader" utilities.*
19. When all drives are properly formatted, remove the DOS/System Boot disk and soft boot the system.
20. If the partitioning and formatting went correctly, the computer will start up and show the DOS prompt for the C:\ drive.
21. To examine if all drives have been prepared successfully, simple attempt to display a directory listing for each one,
    type: dir C:, then dir D:. then dir E:
    Did all drives get displayed without error messages? Great!

Part 8: Finishing UP

1. Remove the experimental hard disk from the workstation and reconnect the original hard disk. Ensure that all necessary system cables are reattached.
2. Replace the access panel. Return and reattach the system to the cluster.
3. Power up the computers and ensure they connect to the network.
4. Return any diskettes, hard disks, tools, or equipment used.
5. Gather your materials, ask any last minute questions, and do not forget to answer the following questions and submit them by the due date.

Questions:

1. What were the amounts of CPU Cache present in the server and workstations systems? Was there any indication of which: L1, L2, and L3?
2. Why does the floppy data cable have a "twist"?
3. What is the purpose of partitioning a drive, and formatting a drive? Which is done first?
4. How is an IDE drive identified as master or slave?
5. Match the definitions below with the terms: "warm boot", "soft boot", and "cold boot."
   a) using the power button
   b) using the reset button
   c) pressing <CTR><ALT><DEL>
6. Who uses the POST?
7. From the DOS/System Boot disk, identify the lines in CONFIG.SYS and AUTOEXEC.BAT that permit the CD-ROM to work.
   As the Config.sys and Autoexec.bat files stand, which drive letter does the CD-ROM obtain once the driver is loaded, and why?
8. How many primary partitions are possible on a hard drive?
9. Provide definitions for the hard disk translation modes: CHS, Large/ECHS, LBA.
   What does the term "dimensions" (or "geometry") refer to when talking about hard disks?
10. Is the list of IRQs from within Windows (using System Information or SANDRA) the same as the list of IRQs from within DOS (using HWinfo)?
11. What is the purpose of IRQ 2?
12. What is the function of the Master Boot Record (MBR)?

Words of wisdom in computer repair, "Never throw away the 'extra screw.' With computers, there are no unnecessary 'extra' screws!