An Introduction to Computer Hardware With Linux

Presentation to Linux Users of Victoria Beginner's Workshop

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Dedicated to Christopher Espinosa
0.1 Assume Nothing. This presentation will assume that you know nothing about computer hardware. It will also assume you are all very fast learners.

0.2 The Apple II Lesson. If you want people to really understand computers they must become familiar with it. See the Apple II Users Manual.

0.2 “Yield To The Hands On Imperative”. Part of the Hacker Ethic, with sharing, collaborating and building. Steven Levy, Hackers: Heroes of the Computer Revolution, (1984). It is part of the GNU/Linux tradition.
1.1 The System Unit. The system unit contains the power supply, motherboard, CPU, RAM, hard disk, peripheral controllers.

1.2 Standard Input and Standard Output. Refer to the basic input (typically the keyboard and mouse) and output devices (the monitor); in operating system terms is also refers the preconnected input and output channels between a computer program and its environment.

1.3 Redirection. In a GNU/Linux operating system standard input, output and error streams can be redirected to a file, device etc.
2.1 The Case/Chassis. The case or chassis is the box that houses the motherboard, power supply and other components of the system unit. Three main styles; desktop, tower and mini.

2.2 Power Supply. The power supply provides the necessary voltage for operation to the motherboard with leads to requisite components (hard disk drive, DVD).

Often a much underrated part of the computer system.

2.3 Linux has support for ACPI (Advanced Configuration & Power Interface)
3.1 The Motherboard: Or system board is a printed circuit board that holds the main components of a system and connections for peripherals. Contemporary styles include a large range of the latter; keyboard, mouse, serial and parallel ports, audio, video and networking devices, which were previously handled by expansion cards.

3.2 Computer form factor: Motherboards come in different sizes. Smaller motherboards will have issues with power supply. Common versions include Standard-ATX, Micro-ATX, Mini-ITX, Nano-ITX, Pico-ITX.
4.1 **The CPU:** Attached to a motherboard socket the processor performs the basic arithmetical, logical, and input/output operations of the system according to program requirements. Usually include an arithmetic logic unit (ALU) and a control unit (CU), which manages memory, decoding, and execution.

4.2 **Speed and Width:** Main specifications are speed (in gigahertz) and width (internal registries, data bus size, memory address bus).

4.3 **Parallelisation, Threading and Multicore:** Subscalar processors are very inefficient! Alternatives include instruction level and thread-level parallelism. Processing performance of computers has been further increased by using multi-core processors, added two or more individual processors ("cores") into one integrated circuit.
5.1 **POST and Bootstrapping:** The BIOS is the first code run by a PC when powered, initialising core devices (video, keyboard, mouse, HDD, DVD) and locating the operating system.

5.2 **Nonvolatile BIOS memory:** A small memory on PC motherboards that is used to store BIOS settings. It was traditionally called CMOS RAM.

5.3 **Coreboot:** is a free software project which seeks to replace proprietary BIOS firmware with a minimalist system. Coreboot simply copies the kernel to RAM, jumps to the entry point and let's Linux do the rest of the hardware initialisation.
6.1 **RAM and ROM:** Which memory do you remember? RAM is Random Access Memory, that holds all the programs and data that the processor is using at a given time. It can differentiated from Read Only Memory (ROM) which usually can't be modified or disk memory (also known as storage).

6.2 **Static and Dynamic RAM:** The former is inexpensive and has higher memory capacity on each chip. SRAM is faster and used in the processor cache.

6.3 **Double Data Rate RAM:** Transfers data on both the rising and falling edges of the clock cycle. Four levels of DDR RAM. DDR4 will be released next year.
7.1 **Hard Disk Drive:** High capacity non-volatile storage for the operating system, applications and user-data. Rigid platters on a spindle, information written to sectors in parallel tracks.

7.2 **Optical Drive:** Most common is the DVD Drive, Neither has the capacity or speed of fixed disk. Slot loading or tray loading.
8.1 **Video and Audio Components**: Two major components in each, the VDU (e.g., CRT or LCD) and the video controller (on-board or card) and the speakers and sound card (on-board or card). The controller acts as an interface between the system and the peripheral. Can include own BIOS, processor, memory, driver etc.

8.2 **Drivers**: Device Drivers: A computer program allowing higher-level computer programs to interact with a hardware device. When a calling program invokes a routine in the driver, the driver issues commands to the device; a translator between a hardware device and the applications or operating systems that use it.
9.1 **Serial and Parallel**: Typically associated with different types of peripheral hardware. Serial was asynchronous in 9 and 25 pin standard. Parallel ports, in comparison, typical for printers to a PC were initially one-way. The name 'parallel' port comes from the fact that they have eight lines for sending one bit of data (one byte total) simultaneously.

9.2 **Universal Serial Bus**: USB is an external peripheral bus standard that eliminates the needs to install cards into the computer and saves system resources such as interrupts (IRQs).
10.1 Your Hardware (GUI): On the GUI use GNOME Device Manager (install, System | Tools) or System > Preferences && Administration. Or with KDE use KMenu -> Applications -> System -> System Monitor.

10.2 Your Hardware (command line): /proc/cpuinfo, /proc/filesystems, /proc/kmsg, /proc/meminfo; df -h; free; /sbin/lspci, /sbin/lsusb, dmesg, dmicode