Workshop 02 - BIOS to OS by our Bootstraps

This workshop re-enforces hardware skills developed in workshop 01.

- *How to troubleshoot and fix boot failure*
- *Customising the BIOS*
- *Installing an Operating System from a USB stick*

We introduce the next stage of self-reliance; understanding what happens in the few seconds between pressing the power button and seeing your computer is 'alive'.

The key to understanding this mysterious process is the concept of bootstrapping or 'booting'. Starting with the power button, your computer follows a series of steps, each more complex than the last, until you have a working Operating System.

Troubleshoot and Fix boot failure

Now your PC is back together we will:

- Make sure your computer powers on
- Troubleshoot any errors thrown up by the Power On Self Test (POST)
- Boot to the Basic Input Output System (BIOS), and finally
- Begin the install of our Operating System (OS).

By the end of this workshop you will be able to locate and identify all the hardware you've installed in the first workshop without opening the case.

Power On

- Make sure your case is closed, and fits tightly.
- Plug in your USB keyboard and mouse.
- Set-up your monitor, plug in the VGA cable.
- Plug the power cables into the monitor and case last.
- Then try the power button!

If you have assembled your computer correctly you should see:

- The green power and hard drive LEDs flash
- Then the power LED stays on and
- The fans start up (quietly)
- The BIOS screen flash up

Success!!

If your computer is working correctly, congratulations! Now it's time to give someone else a hand.

Fail....?

If your computer won't turn on, don't panic. There are a few simple steps to use to troubleshoot:

- Do you have an 'air gap'? This is a polite way of saying *is your computer plugged in?*

  Check the power cables are properly connected.

- Does the front panel power switch click?

  If not, take off the front panel and press the power button directly.

- The power switch connection to the motherboard is the next thing to check.

  Unplug the power lead then open your case and check the front panel power header is connected.

- Next check the power cables from the PSU to the motherboard.

  The plugs only fit in one direction, just jamming them in won't work. Trust us. We've tried.

Getting Past the POST

The Power On Self Test (POST) is a check your computer runs through every time it turns on. Most of the time we never notice the POST process. It takes a few seconds and only stops on errors.

If your computer turns on but doesn't pass POST, it will let you know through flashing lights and beeps.

The table below is adapted from the 8100 service manual and should give you an idea of what to try next. Most errors can be fixed using the things you learned in workshop 01.

Two Beeps

BEEPS	Power LED	Probable Cause
2 beeps	Blinks red 2 times @ 1 Hz	Processor thermal shut down. Check air flow, fan operation, and CPU heatsink

- Have you plugged the fan cable back in? Is the air guide installed correctly? Are the heatsink screws tight?

Three Beeps

3 beeps	Blinks red 3 times @ 1 Hz	Processor not installed. Install or reseat CPU.

- This usually means your processor is not sitting in the socket firmly, or the heatsink screws are not firmly tightened.

Four Beeps

4 beeps	Blinks red 4 times @ 1 Hz	Power failure (power supply is overloaded). Check storage devices, expansion cards and/or system board (CPU power connector P3).

- Have you plugged in the CPU power connector?

Five Beeps

5 beeps	Blinks red 5 times @ 1 Hz	Pre-video memory error. Incompatible or incorrectly seated RAM.

- This is an easy one, make sure your RAM is in the black slots and firmly clicked into place.
- Try testing the RAM one slot at a time.

Six, Seven or Eight Beeps

6 beeps	Blinks red 6 times @ 1 Hz	Pre-video graphics error. On system with integrated graphics, check/replace system board. On system with graphics card, check/replace graphics card.
7 beeps	Blinks red 7 times @ 1 Hz	PCA failure. Check/replace system board.
8 beeps	Blinks red 8 times @ 1 Hz	Invalid ROM (checksum error). Reflash ROM using CD or replace system board.

- All these errors are difficult to fix. Ask your facilitator for a hand.

Nine Beeps

9 beeps	Blinks red 9 times @ 1 Hz	System powers on but fails to boot. Check power supply, CPU, system board.

Check your PSU cable headers on the motherboard.

Ten Beeps

10 beeps	Blinks red 10 times @ 1 Hz	Bad option card

- This won't usually apply unless you have installed a PCI expansion card. If you have installed a PCI card, take it out and reboot.

BIOS

Powered on and got through POST? Great - your computer will now continue the booting process by activating the BIOS. So what is the BIOS?

- The BIOS is firmware, and works between the hardware and software of your computer.
- It is an *embedded* program, meaning it is permanently attached to your computer's hardware.
- A battery is used to keep BIOS settings for up to 10 years.
- The BIOS settings are accessed in the System Configuration.

The BIOS will now attempt to boot your computer, running a few further checks. As you have taken your computer apart it may be confused and ask for some information.

It may ask you to confirm hardware changes.
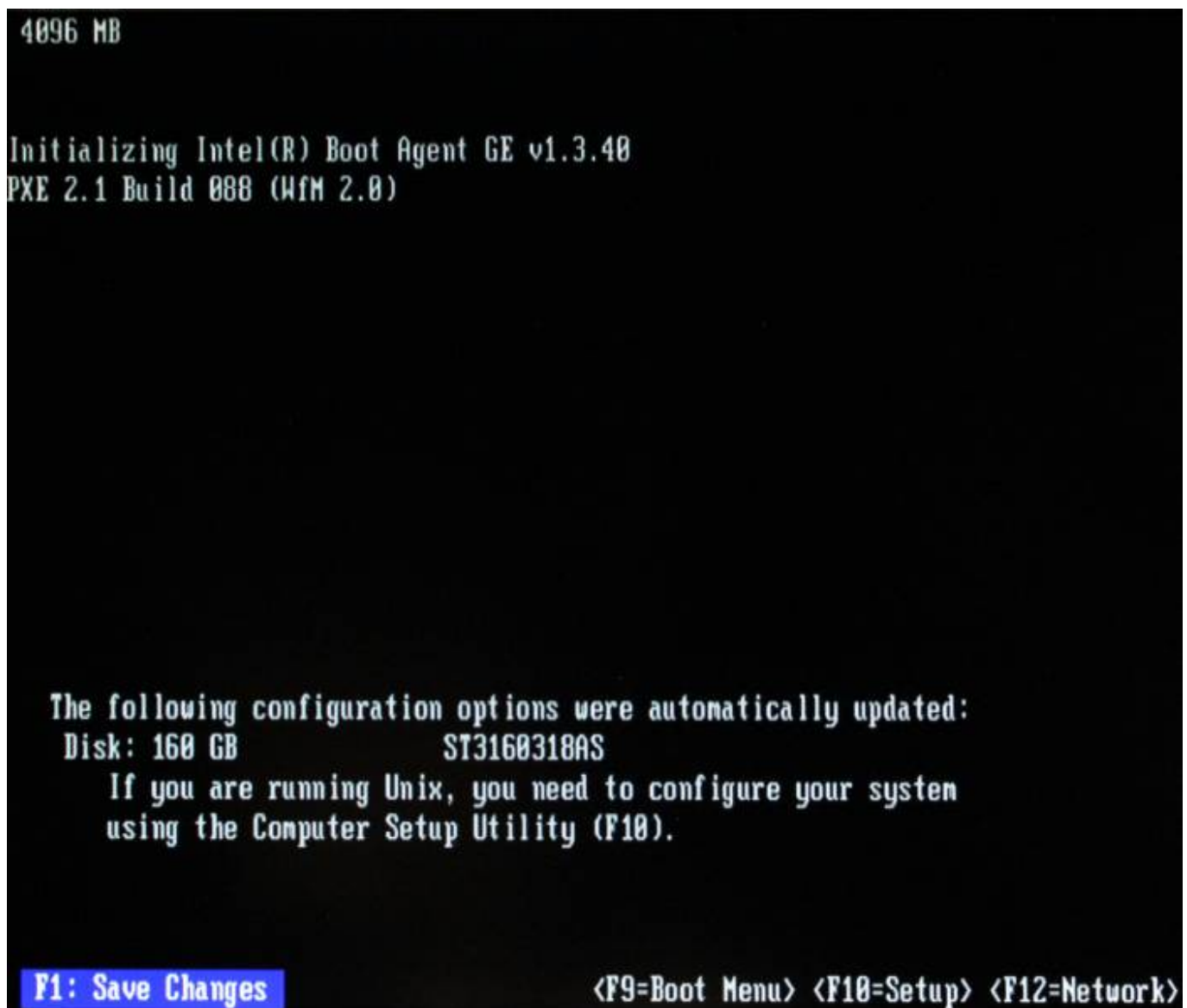
or warn you to set the date and time

```
4096 MB

162-System Options Not Set
   Your system configuration has changed since your last boot.  Addition
   of a hard drive, etc., or loss of power to the Real Time Clock has occurred.
   Pressing F1 will record the new configuration.  If this message persists,
   you may need to replace the onboard battery.


PXE 2.1 Build 088 (WfM 2.0)




   The following configuration options were automatically updated:
    Memory: 4096 MB
    Disk: 160 GB                    ST3160318AS
    CD-ROM:                         hp       DVD A   DH16AAL
       If you are running Unix, you need to configure your system
       using the Computer Setup Utility (F10).
    CMOS checksum invalid, default values loaded

F1: Save Changes
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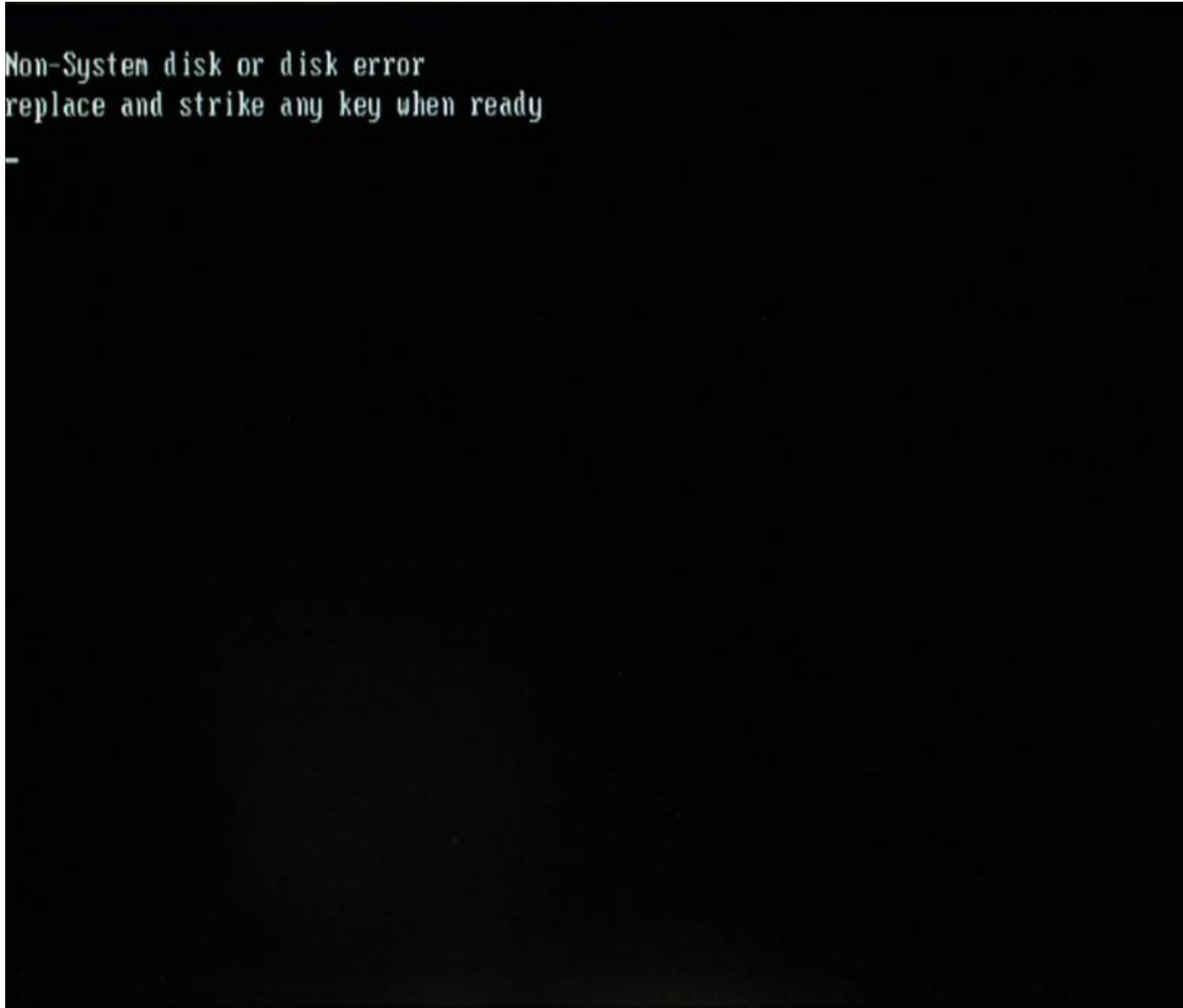
before trying the operating system from the internal hard drive.

```
Non-System disk or disk error
replace and strike any key when ready

_
```

But remember, the hard drive in your computer has been wiped.

There is no way for the computer to continue to boot and so the boot process ends as soon as the BIOS discovers the hard drive is empty.

Now we need to access the System Configuration and set the BIOS to make your computer boot off a USB stick, where we will install our operating system.

System Configuration

To get into your computers System Configuration, we have to 'catch' your computer just at the right moment with a well-timed key press.

The exact keys to press are shown in a 'splash' screen, which displays the manufacturer's logo and a list of keys to press to interrupt the booting process. This splash usually goes by very quickly, so we'll show the screen here.

This may take a couple of attempts to catch, so it's time to learn the ***three-fingered salute*** to force your computer to reboot. Press and hold the Ctrl and Alt keys, then press the Delete key. You can keep doing this as many times as you like, there is no way to harm your computer by rebooting at this early stage of the boot process.

Lets step through the screens one by one before we choose an option. Reboot your computer and press F9 continuously....

* F9 will bring up the boot menu where you choose a device to boot from, instead of going with what is stored in the BIOS.

Now reboot and press F12.....

F12 forces the computer to boot from the network card. Network booting is an advanced option, your computer will look at the ethernet port for a connected network device to boot from.
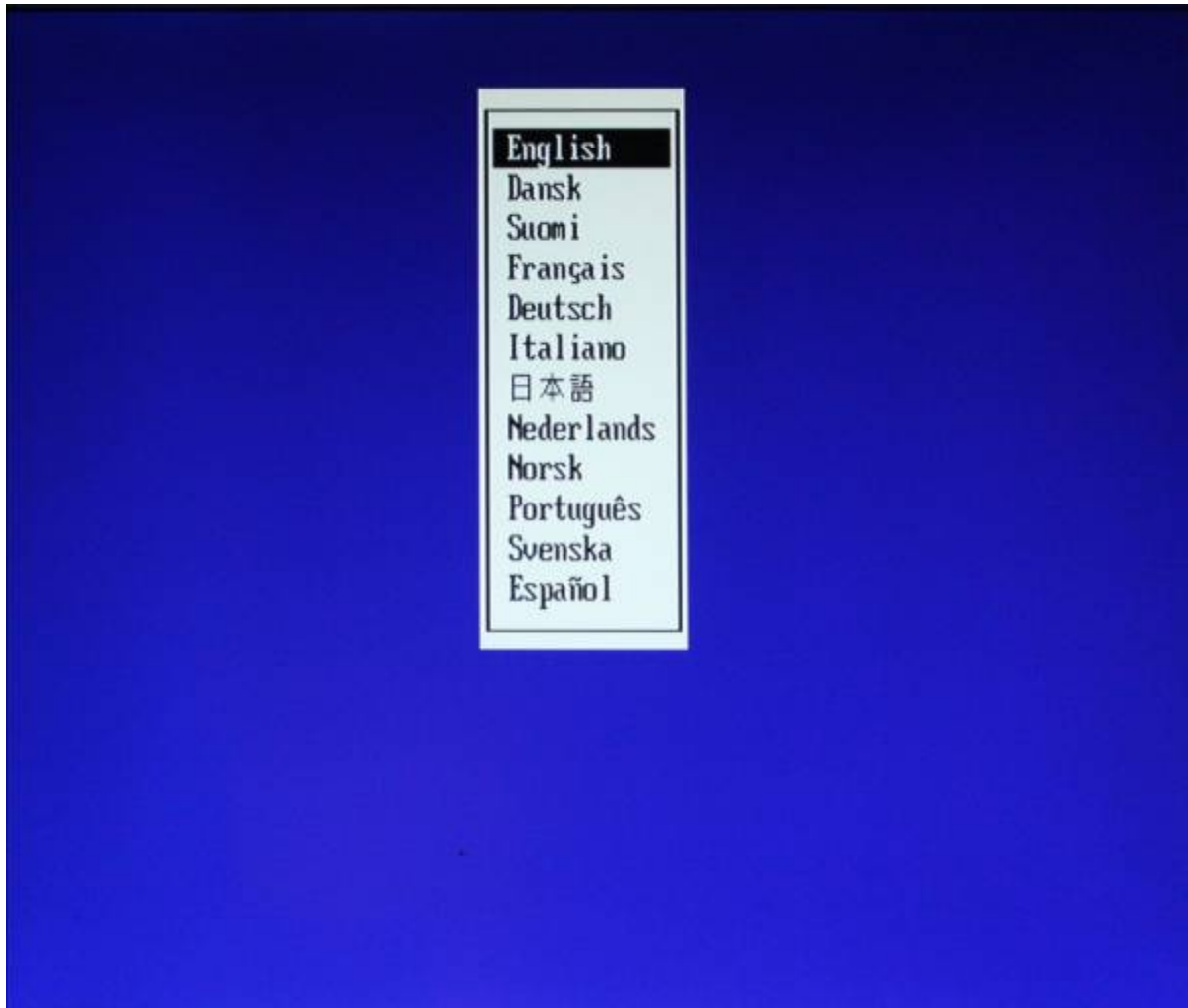
Now reboot and press F10...

F10 starts the BIOS set-up page where we customise how we want the computer to start and check on the hardware. If you miss the BIOS key set-up then just keep rebooting till you get it.
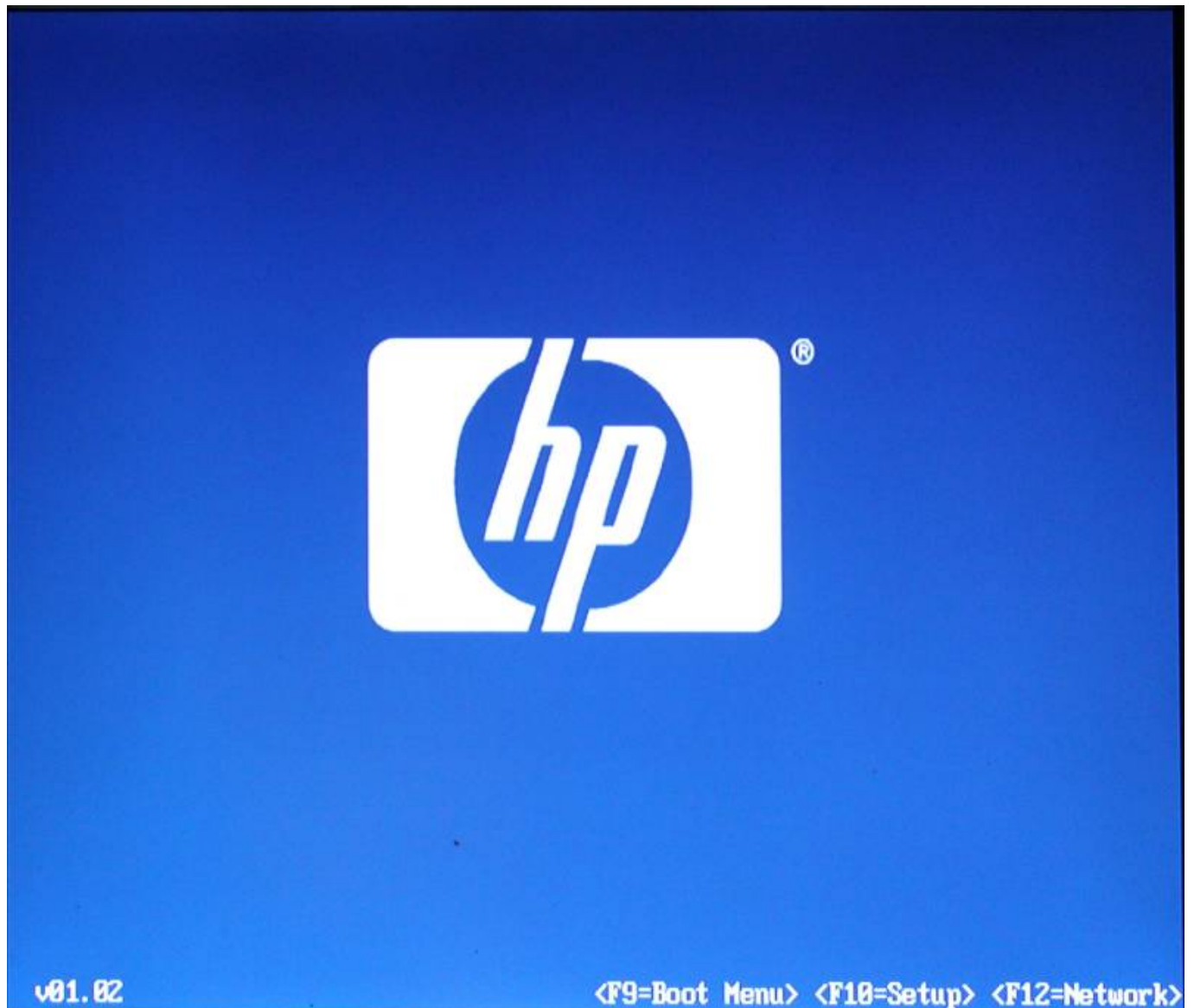
BIOS Set up

The first screen you'll get is for language selection. You move around by using the arrow keys, and press enter to select.
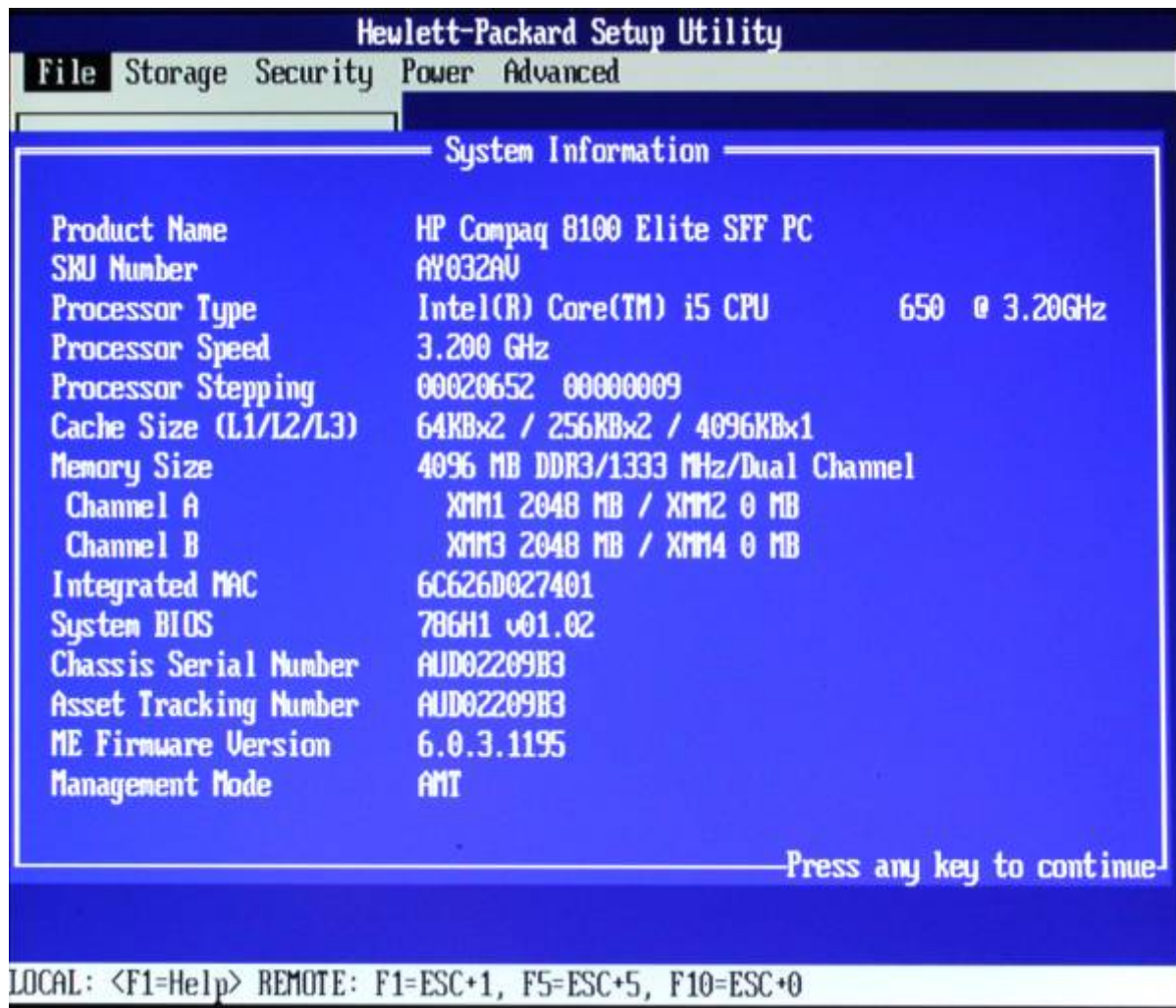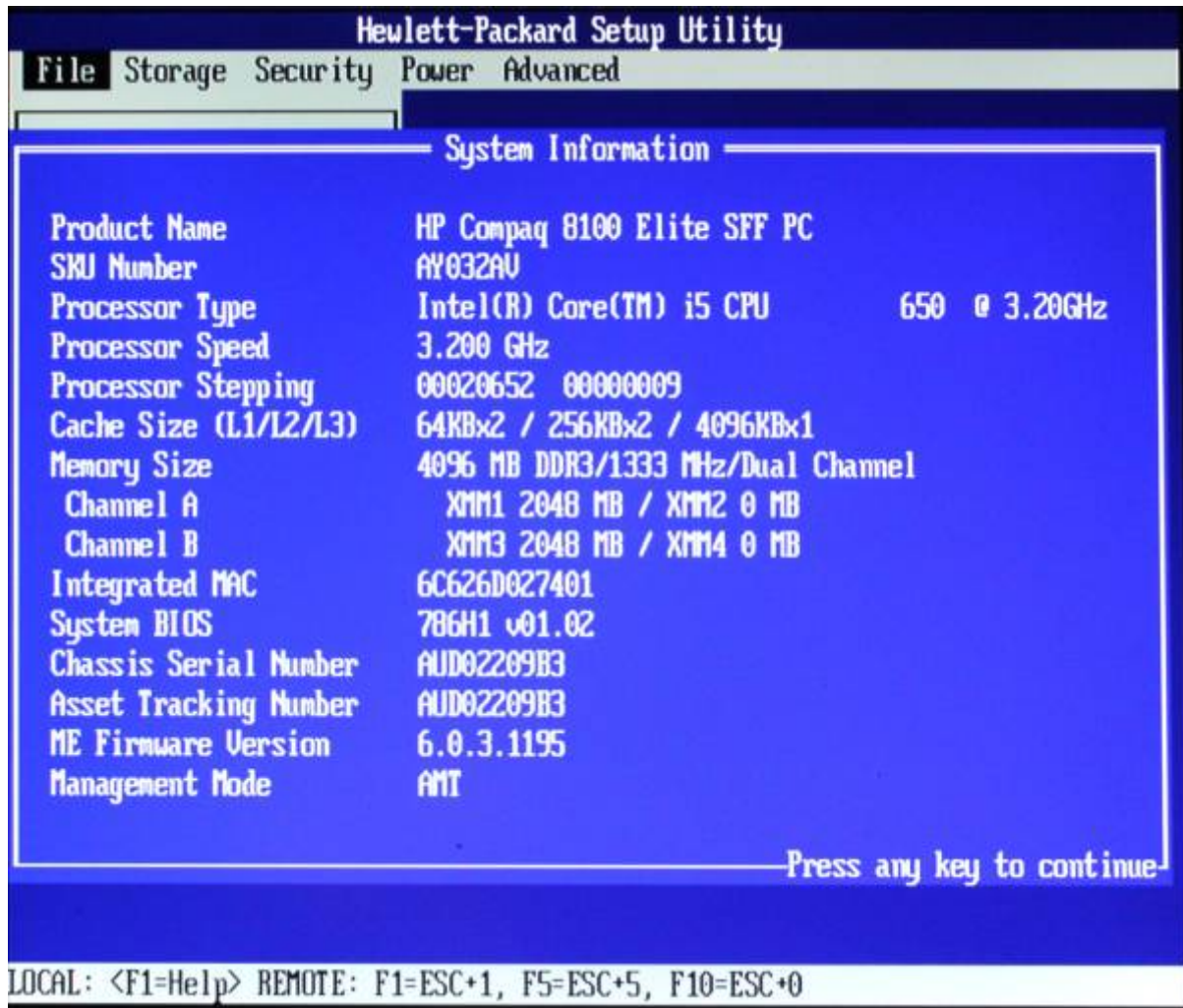
Select English

This is the main set-up utility menu. The first screen we want is System Information in the File menu. Select this option.

System Information displays information about the components in our computer, without having to open the case.

You should recognise the Processor Type and Processor speed from Workshop 01. Also the Memory Size will be familiar. Press any key to exit System Information.

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                    Hewlett-Packard Setup Utility
  File  Storage  Security  Power  Advanced

                         ═══ System Information ═══

  Product Name              HP Compaq 8100 Elite SFF PC
  SKU Number                AY032AV
  Processor Type            Intel(R) Core(TM) i5 CPU         650  @ 3.20GHz
  Processor Speed           3.200 GHz
  Processor Stepping        00020652  00000009
  Cache Size (L1/L2/L3)     64KBx2 / 256KBx2 / 4096KBx1
  Memory Size               4096 MB DDR3/1333 MHz/Dual Channel
   Channel A                  XMM1 2048 MB / XMM2 0 MB
   Channel B                  XMM3 2048 MB / XMM4 0 MB
  Integrated MAC            6C626D027401
  System BIOS               786H1 v01.02
  Chassis Serial Number     AUD02209B3
  Asset Tracking Number     AUD02209B3
  ME Firmware Version       6.0.3.1195
  Management Mode           AMT

                                          ─Press any key to continue─

  LOCAL: <F1=Help> REMOTE: F1=ESC+1, F5=ESC+5, F10=ESC+0
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Now go to Set Time and Date and make sure your system clock is correct. This is important for your computer to function correctly and be able to 'talk' on the internet.

No other computers will trust yours if your system clock is set to 2001...
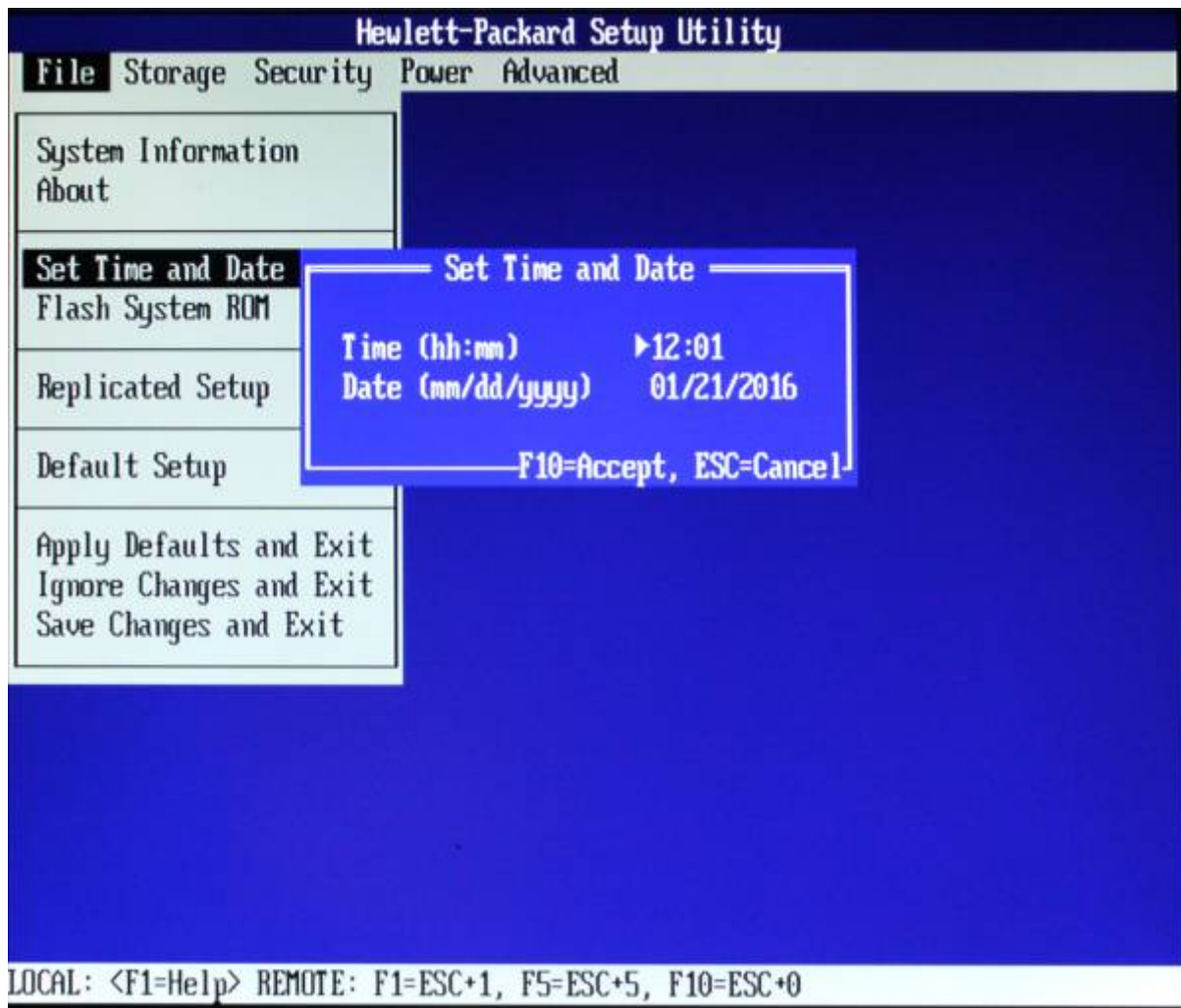
Now select the Storage menu, then Device Configuration.

You should recognise your hard disk and DVD drive. Once again you can identify the type of component without opening your case.

Exit device configuration and select Storage Options. Make sure Removable Media Boot is enabled. We need this to boot your computer from the USB stick later in this workshop.
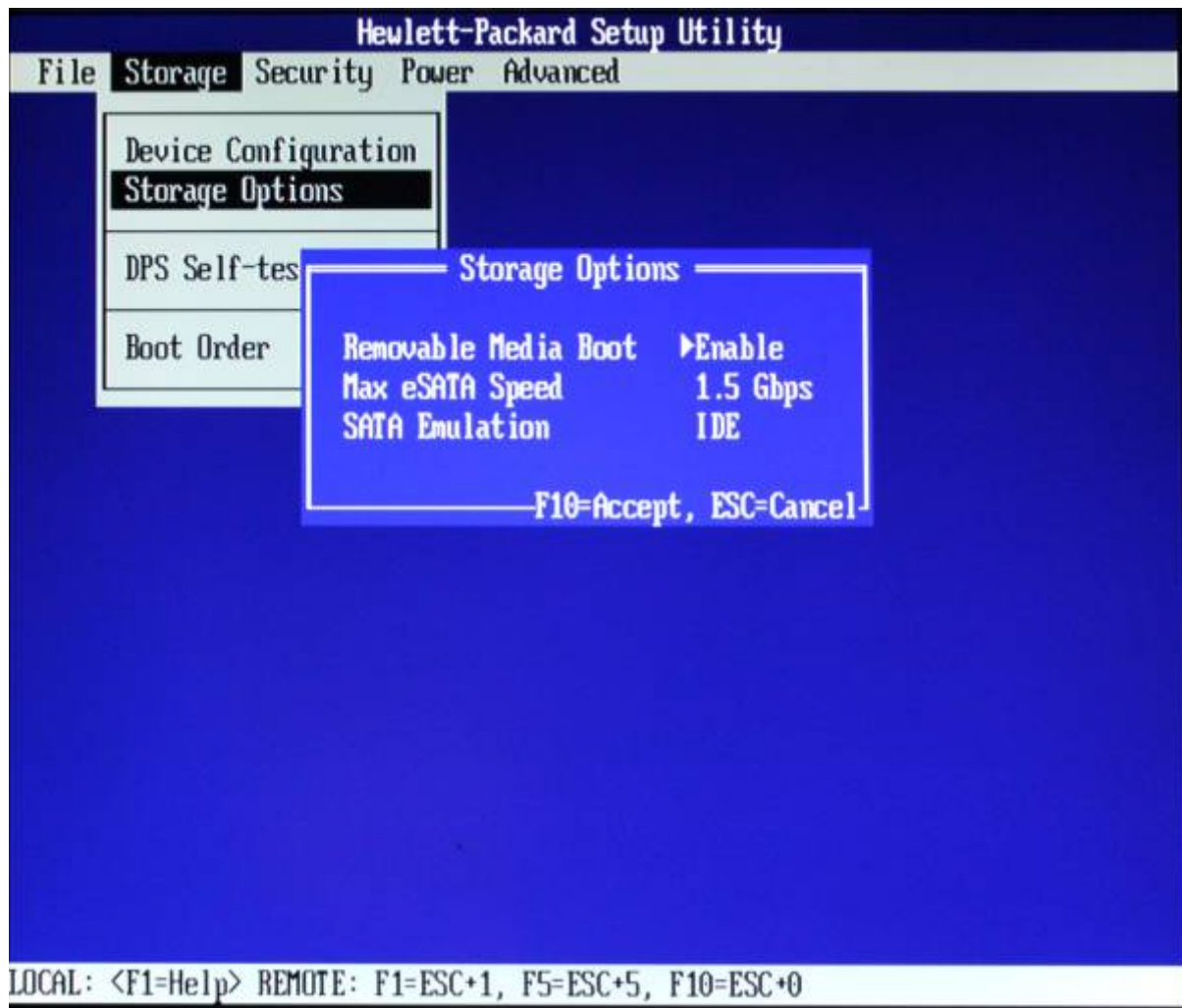
Exit Storage Options and Select Boot Order. Here you will see a list of devices your computer can use to boot.

We will be booting from a USB stick, so let's move the USB device to the top by pressing Enter, then the up arrow.

We can also disable network booting if you don't need it.

Press F10 to confirm and exit Boot Order.

Go back to File menu, then down to Save Changes and Exit.

Press F10 to confirm, and your computer will restart and begin the boot process again, looking for a USB device. Will it find one?

Installing the Operating System

For this series of workshops we will being using an Operating System (OS) called Xubuntu. Your facilitator has a USB stick for you which contains a Xubuntu Live System and Installer.

We will learn all about your OS in the next workshop, all you need to know right now is:

- A Live System means that we can boot and use your computer from just the USB stick with no need to use the internal hard drive.
- The installer is used to install the Xubuntu onto your hard drive.

In later workshops you will use the live system process to make your own custom version of Xubuntu. Right now we will go straight to installing the OS.
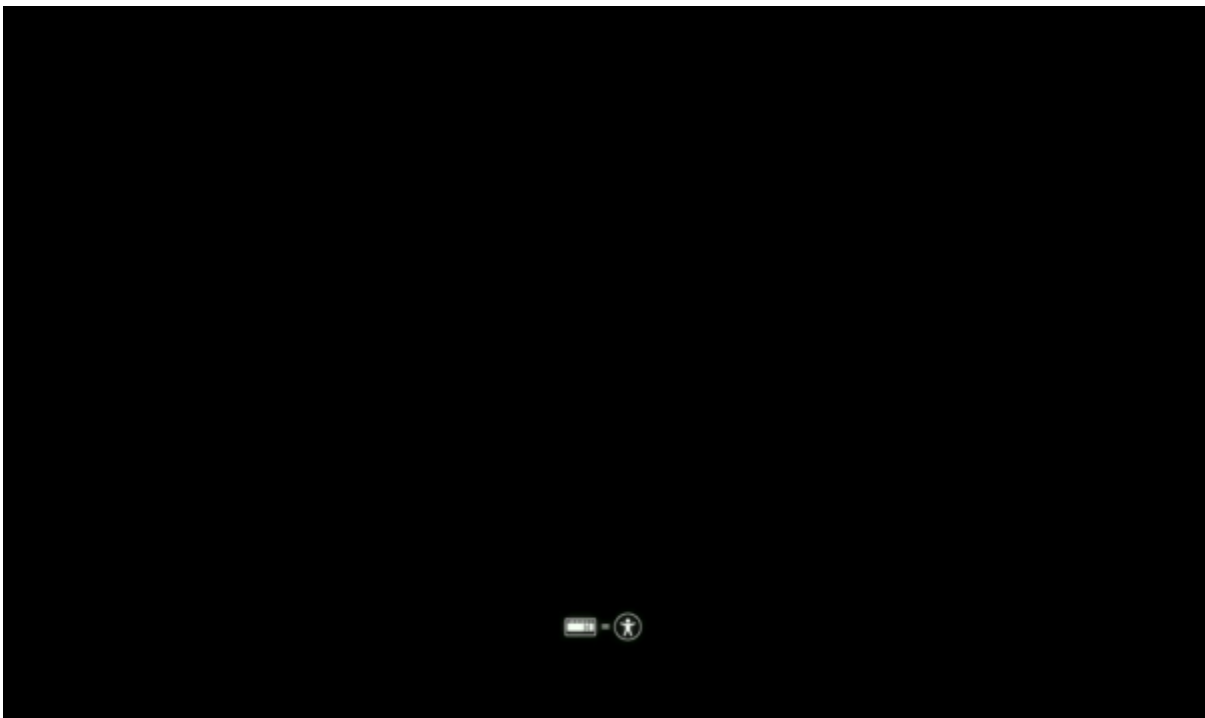
Boot From USB

Take a USB stick from your facilitator and plug it into any USB port and restart your computer using ctrl-alt-delete.

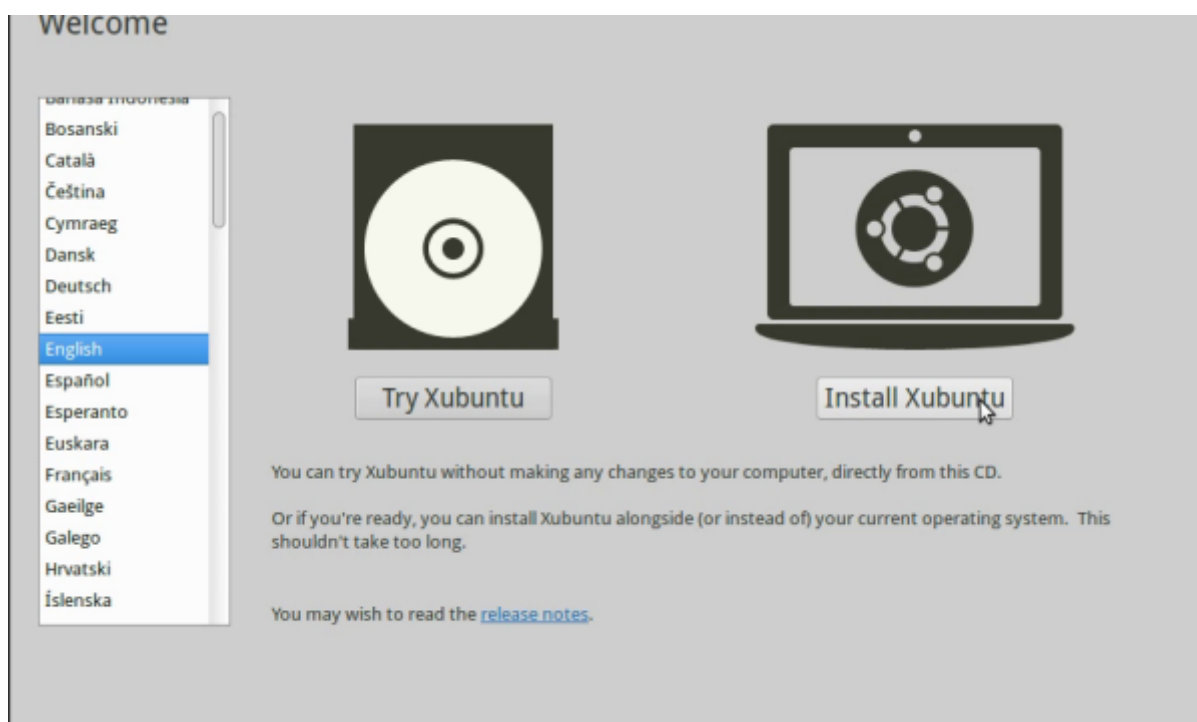If you see a small logo down the bottom,

then a Xubuntu flash screen,

you are booting from USB.

If not, you'll need to double check your BIOS settings. Ask your facilitator for help.

Installing Xubuntu

You can use your mouse or keyboard to select options here. Select English, then select Install Xubuntu.


The next menu suggests the amount of hard disk space Xubuntu should use and the installer recommends connecting to the internet while installing. We usually don't have internet access for this

workshop. Finally, check the box 'install this third-party software' - this will let us use MP3s.
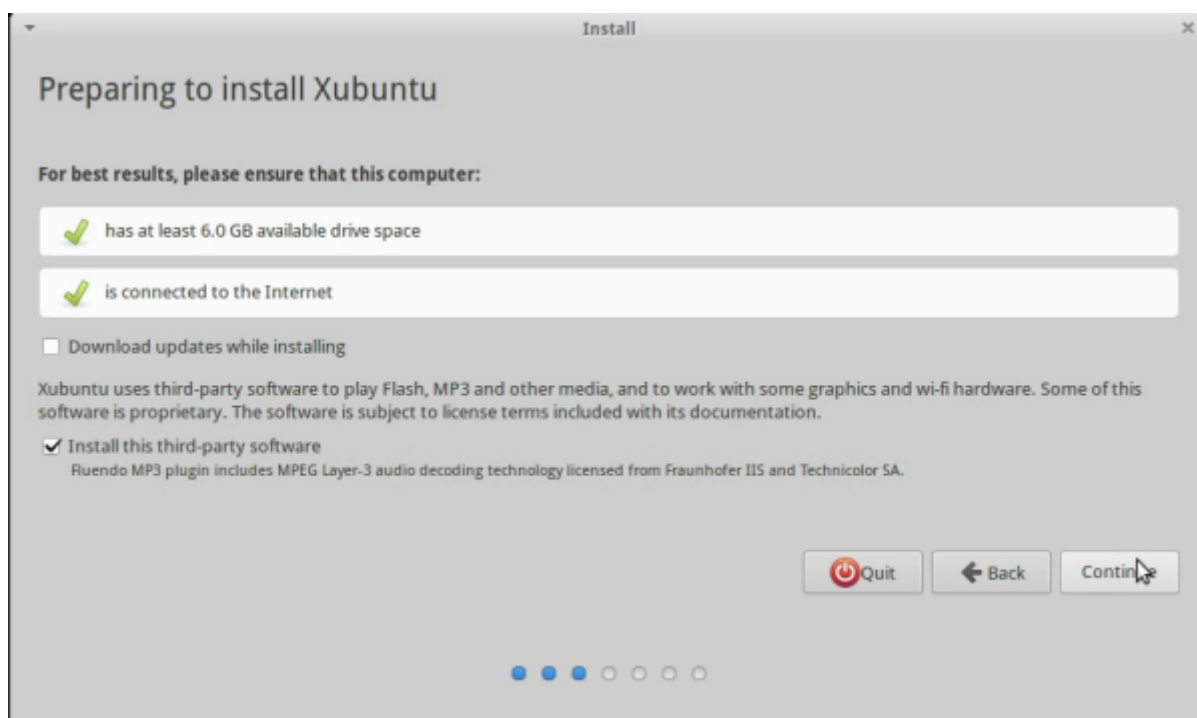

Installation Type

This menu lets you select how you to treat the hard disk you are installing onto. As you are starting from scratch with a new system you select 'Erase and install', then click 'Install now'.
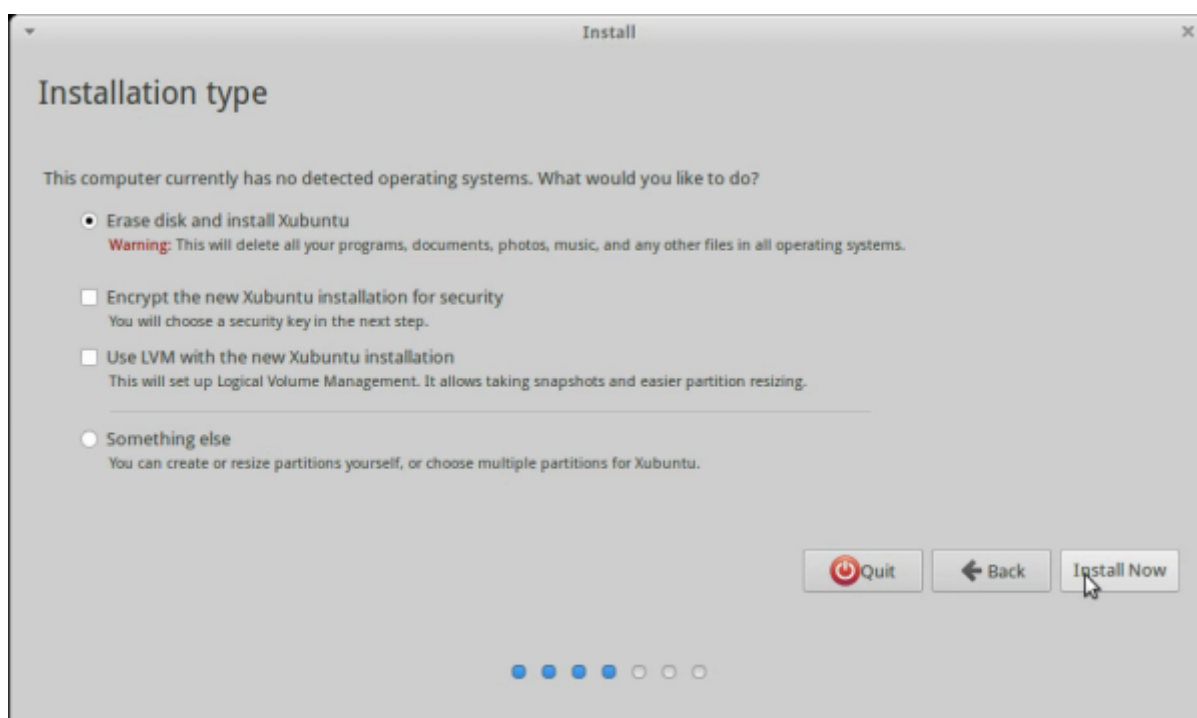
Where are You?

Now you need to tell your computer where in the world you are. The installer will recognise all standard timezones and Australian State Capitals.

In this case we are in Queensland, so begin typing Brisbane in the text box, then select Brisbane time. Or use your mouse to click on the map, then continue.
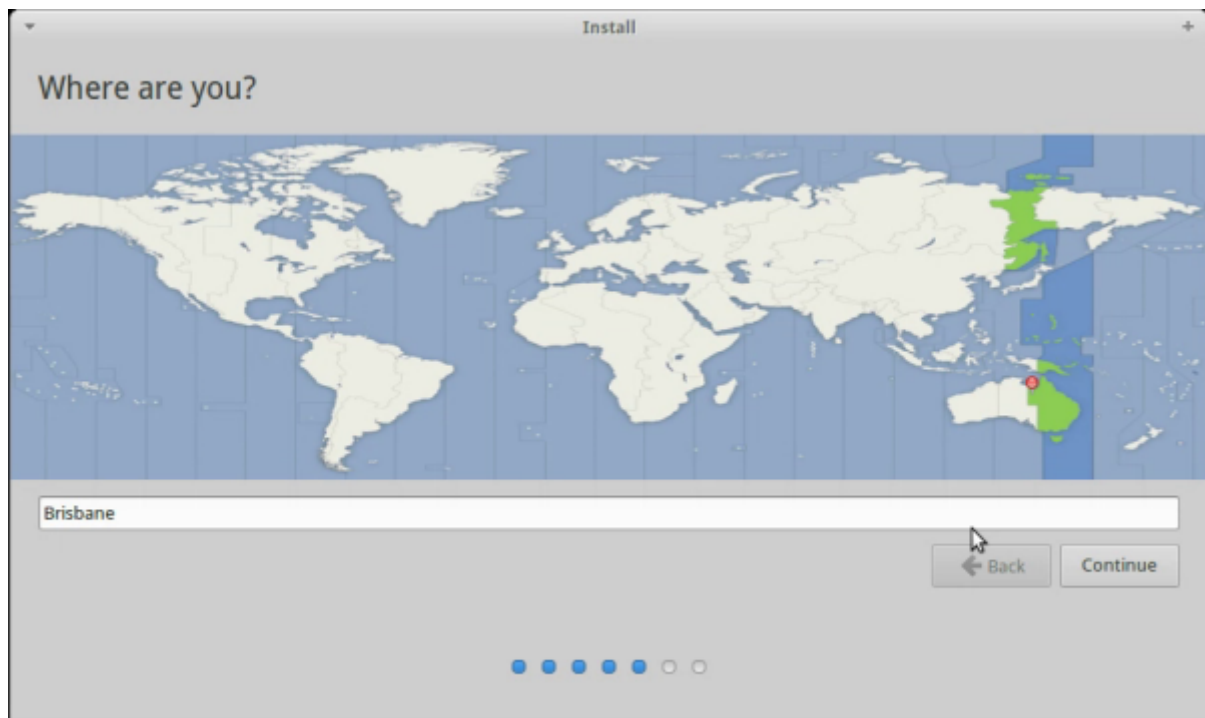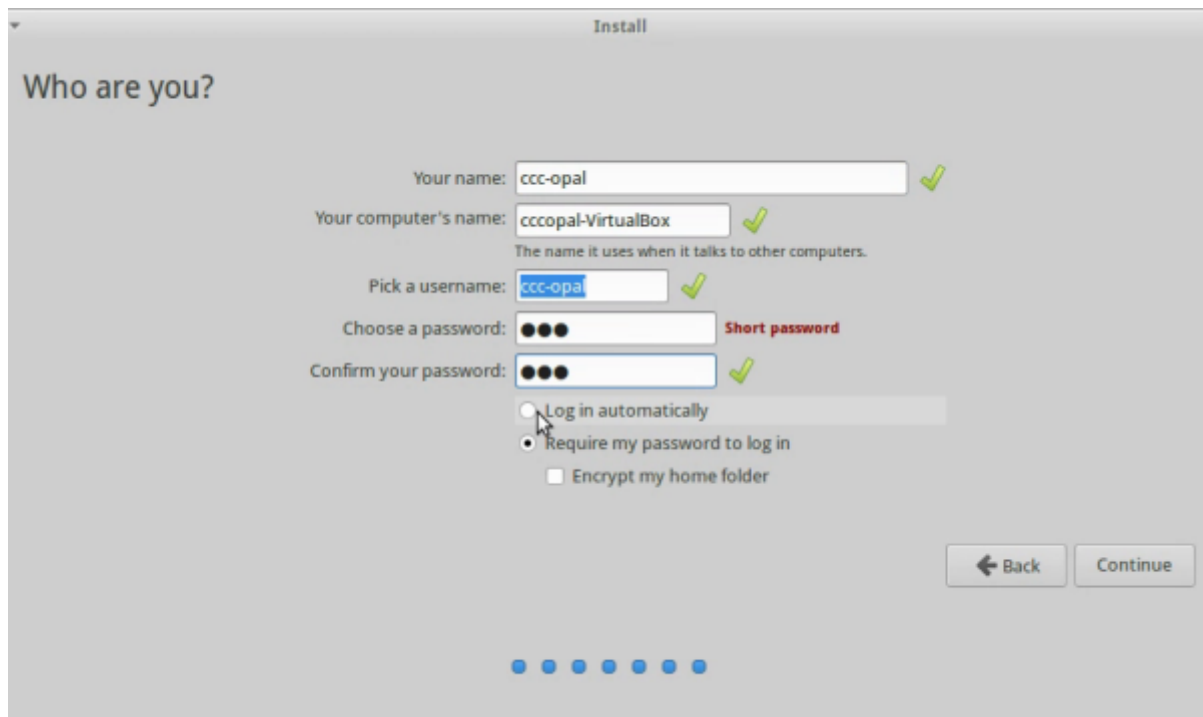

Keyboard Layout

Please keep the default keyboard layout as English (US). This is the most compatible layout for us. Then click continue.

Who are you?

Fill in your personal details and create a password. Please do not forget your password, you will need it regularly! Select log in automatically, and then click continue. Your system will begin installing.

Complete the Install

When the install is completed you will be prompted to 'Remove the installation media' - this is your USB stick - and restart your computer. At this point you should go into the BIOS again and change your first boot device to your internal hard disk.

Setting Up the CCC Network

Before we go any further, it's time to setup our local CCC network. We will use this network for updating and installing software, without having to use an internet connection.

The CCC facilitator laptop will act as a server, and store all the files you need. You'll also be able to access this wiki and our version of simple wikipedia. Your facilitator will show you where to find the network cables and explain what to do next.

End of Workshop 02

Well done! You've made it through Workshop 02. Your facilitator will have workshop 03 printed out for you to read as homework.

NEXT WORKSHOP -->