

## Course 401

# PC Hardware and Software Architecture

## A 4-day Hands-On Workshop

This workshop is designed for design, validation, and test engineers and highly experienced technicians. Based on the *PC Hardware and Software Overview* course, the content focuses on design and compatibility, rather than configuration and troubleshooting.

### You will benefit from this workshop if you

- Design, test, validate, specify, or configure PC hardware
- Develop test-, system-, or application software
- Need to be able to quickly distinguish between hardware and software problems
- Are responsible for the security of PCs and their data

### You will learn how to

- Approach design, test, and troubleshooting in a structured and systematic way
- Differentiate hardware problems from software problems quickly and accurately
- Increase the speed and the long term stability of the systems you work on
- Identify new products and services that will truly impact the way you work

### Prerequisites

Students are expected to have a technical background in hardware and/or software design or test. The goal is to give design, validation, and test engineers and technicians the ‘big picture’ of the PC, filling in gaps outside their focus and expertise.

### The training approach

- **Real Hands-On:** You will spend 50% of the time in labs. You will configure and troubleshoot the motherboard and expansion cards. You will install Windows (**XP Pro**, **Vista**, or **Windows 7 - your choice**). You will build a network in the classroom, configure Windows networking capabilities, and attach and log in to typical network resources such as printers and shared files. You will recover lost files and rescue data from corrupted disks  
**Note:** If you prefer to use **Linux** for the labs that can easily be arranged
- **Up to date information.** We update the materials before *every* event
- **Straightforward explanations.** Technical jargon is explained in plain English. You walk away with a deep understanding of how the PC works

## Workshop topics

### How a PC really works

- Computer architecture – CPU, ROM, RAM, Input/Output ports, the different buses
- Clocked digital logic
- What the major hardware and software components do
- Where are the performance bottlenecks?
- The Five Layer software model

### CPUs and chipsets

- Why we care about the older technologies
- Legacies from the – ‘286, ‘386, ‘486, and *Pentium*<sup>®</sup>
- The P6 architecture – *Pentium Pro, Pentium II, Pentium III*
- The Netburst architectures – *Willamette, Northwood, Prescott*
- The *Core*<sup>™</sup> and *Core 2* architectures and implementations
- AMD64 and Intel64 (IA-32e) features – 64-bit extensions to the 32-bit architecture
- Dual core CPUs – *Core 2 Extreme, Core 2 Duo, Pentium D, Celeron Dual Core*
- Quad core CPUs – *Core 2 Quad, Xeon*
- The AMD<sup>®</sup> competitors – *Phenom, Athlon, Turion, and Opteron* families
- Intel bus-based chipset architecture – MCH, ICH, FWH, and Super I/O
- AMD’s, and Intel’s new, system architecture
  - Integrated memory controller
  - Superfast connections to I/O
- Key functions and interfaces of each chipset component

### Memory technologies

- How memory is organized and how it works
- Memory timing and latency
- Interleaved paging
- Burst and pipelined memory
- Different kinds of memory: ROM, RAM, Flash, L1, L2, and L3 cache, SRAM, DRAM, SDRAM, VRAM, GRAM, DDR-, DDR2 & DDR3-SDRAM, Virtual memory...
- Memory modules: DIP, SIPP, SIMM, and DIMM
- The address map – How much of your installed memory is available to the operating system, and where does the rest go?

### System software

- The PC – A layered architecture
- What happens between pressing the power button and your desktop being available?
- PC operating system boot sequences: Similarities and differences between DOS, Windows XP, Windows Vista, and Linux
- Motherboard ROM functions
- System setup – Motherboard configuration
- BIOS, memory resident programs, TSRs, and GUIs
- What is a driver and how does it work?

## Networking

- Capacity and performance of Ethernet networks
- IP address ranges, subnet masks, Gateway and DNS server addresses
- Configuration of Network Interface Cards (NICs), hubs, and switches
- Troubleshooting physical connections
- Peer-to-Peer vs. Client/Server networking
- Sharing and protecting files and applications on a network
- Troubleshooting the Windows networking environment

## Buses and expansion slots

- The hidden ISA buses
- The different AGP, PCI, and PCI-Express slots
- Other connectors: eSATA, CardBus, USB, and Firewire (IEEE1394)
- How often is the bus the bottleneck?
- Avoiding potential problems when configuring video, sound, network, or SCSI adapters
- Shadowing expansion card ROMs

## Configuring add-in cards

- What to do when Plug-and-Play fails
- System resources add-in card can claim
- Explaining the hardware and software interrupt concepts
- The three different ways a PC can handle a hardware interrupt
- Who uses I/O ports and for what?
- The I/O port map
- What is DMA (Direct Memory Access)?
- What types of devices use DMA?
- Different DMA implementations in PCs

## Disk drives

- How data is stored on a disk
- What is a head, a track, a cylinder, a sector, and the landing zone
- What is LBA, and when do you need it?
- The different interfaces - Serial ATA (SATA), Parallel ATA (PATA or IDE), and SCSI
- Key features of each interface - Speed, flexibility, scalability, supported disk size...
- FAT directory, partition, and cluster sizes
- NTFS improvements over FAT16/32
- How file systems keep track of files
- Using FDISK and FORMAT options
- Third party disk management utilities
- Recovering lost clusters and cross-linked files
- File defragmentation

## Video

- Resolutions and system requirements
- Video accelerators
- How much memory is graphics stealing from your applications?
- WRAM, VRAM, GRAM, xGRAM, and xDRAM video memory
- Monitor size, dot pitch and refresh rates

## Viruses

- How you get infected by a virus
- How you know when you've been infected
- Kinds of viruses, and how dangerous they are
- Getting rid of viruses
- Inoculating against future virus attacks
- Recovering data after virus attacks
- *Special Feature: Live In-Class Virus Infection, Detection, and Removal Demo*

## Hands-On Labs

During the labs you install, configure and test industry standard components and troubleshoot realistic problems. You work at your own pace, and the instructor and easy-to-follow lab instructions are there to guide your every step (and to let you explore on your own when you want to).

- **NV-RAM ("CMOS") configuration** - What the options *really* mean, and how they can make your system run up to **30** times faster!
- How to **separate hardware problems from software problems**
- **Troubleshooting the boot-up sequence**
- **Install Windows XP Pro, Windows Vista, or Windows 7 from scratch.**  
**Note:** If you prefer to use **Linux** for the labs that is *no problem!*
- **Optimizing and customizing Windows** and installing custom drivers.
- **Setting up an Ethernet network** and activating and configuring Windows' networking features, including connecting to a network printer, sharing (and protecting) files, and installing and running applications over the network.
- **Hard disk management**, including how to select and create the most efficient partition sizes and how to use different formatting options.
- Investigate how the directory and FAT keep track of files, and use this knowledge to **recover lost, deleted, and damaged files** off crashed hard and floppy disks.