Unit 3   The Motherboard

Structure:

3.1 Introduction

In Unit 2 we have discussed about memory and its types and the method on how to troubleshoot it. In this unit, you will study motherboard concepts and different considerations to be taken care of while upgrading it. You will be able to perform the upgradation and identify the different functions and components of the modern motherboard.

Before troubleshooting, knowledge of how to identify the different components of motherboard is essential. The motherboard is considered to be the 'heart' of any PC. It provides you the system resources, supports the core components and handles the systems memory. The whole performance of the PC is judged by the motherboard. This unit will provide you the overall information about motherboards and help you in troubleshooting the problems which arise in the motherboard.

The motherboard is referred to as an active backplane because the board consists of chips which runfor various tasks. A lot of effort was made to grant upgradation and provide service to the motherboards. When this was

done, the one approach which came into picture was the modular approach. The modular motherboards have the facility to place CPU, math coprocessor and key support chips on a card that can be held inside the motherboard. Replacing this card is cheaper than installing the new motherboard. Expansion slots can be used when there is need for upgradation and jumper can be set. These expansion slots can be detached from the motherboard and parts can be connected to it

Objectives:
After studying this unit you will be able to:
- Describe the concepts in motherboards
- Identify the various components and considerations in motherboards
- Perform the motherboard upgradation
- Resolve the problems through troubleshooting

3.2 Components of Motherboards
Before getting into the problems in the motherboard first you must know how it works and what the components of the motherboards are. This section will help you in understanding the various components.

3.2.1 Socket and slots
Socket is a place where we can fit electric devices and *Slot* is an opening in the computer motherboard which will allow plugging in the circuit boards. Through this we can insert or connect the external devices into the motherboard.

The different classifications of the motherboards are based on sockets and slots. This is because a particular socket is used to refer to that particular CPU as each of them will have specific type of socket. There they are designated as Socket 7, Socket 8, Slot 1, Slot 2, socket 360, slot A, socket A, socket 432. Each of them is explained in brief as below.
- Socket 7: these motherboards serve Pentium MMX CPUs, AMD series, and Cyrix processors. They are available with AGP slot which are designated as *Super 7.*AGP or Accelerated Graphic Port is a port which is exclusively used for connecting video card to computer
- Socket 8: these motherboards serve Pentium Pro CPUs. These processors if available now are mostly used in older network servers and workstations.

- Slot 1: these motherboards serve Pentium II and III CPUs. They use Single Edge Cartridge (SEC) processors.

- Slot 2: these motherboards also use SEC processors for advanced PentiumII or III Xeon processors. These kinds of motherboards are used in high end network servers and workstations.

- Socket 360: these motherboards serve for Pentium III and above and also Celeron processors. These motherboards are easier to remove and have fewer problems in installation.

- Slot A: these motherboards serve AMD processors. They are mainly used to serve Athlon-based systems.

- Socket A: these motherboards serve later AMD Athlon and Duron processors.

- Socket 432: these motherboards are built to serve Pentium 4 processors.

Socket 432 is not compatible with other types of sockets and each of them has specific reason for each type of processors. You must always remember that each type of socket is designed to serve specific types of CPUs not only because of their types but when you use different sockets for different processors it even limits the speed. For example If you use slot 1 motherboard for 440 BX chipset based systems (Pentium II) it can support up to 233 MHz to 500 MHz. But if you use slot 1 with Pentium III processors it can support from 450 MHz to 730 MHz. Therefore even the same type of processor connector has different speeds for different range of processors. Therefore you must be very careful in using the slots for different processors.

3.2.2 Expansion slots

Whenever additional device is required for the system to perform at its full potential you would have to connect devices such as, video controller, SCSI host controller, network card etc. These devices are connected to the motherboard with the help of external connectivity called *expansion slots*. *Expansion slots* are slots that allow the system to communicate with the outside world with the help of additional boards. These expansion slots are present at the back of the computer and allow the ports in the card that go inside it to be accessed.

Types of expansion slots:

- ISA: *Industry Standard Architecture* is an older type of expansion slot which is not in use. You can use this slot to connect the system with video cards, sound cards, networking cards, etc. This is bigger in size than the PCI and is black in colour.

- PCI: Peripheral Component Interconnect is a high speed, intelligent bus. This slot has 64 connections on the motherboard and each connection is capable of handling data of 1 bit at a time. Expansion slot changes with technology changes. The video cards can be inserted along with the older network cards and the computer. It is preferred that bus architecture that supports the different cards and adapters are used more.

- AGP: *Accelerated GraphicsPort* provides a high speed data path between video card and the motherboard. Motherboard has only one 1.5 V AGP slot.

- PCIe: PCI express is a new technology that is slowly replacing AGP. PCI express x 16 can transfer data up 4 GB on the motherboard which is twice as fast as the AGP slot. It comes in five different sizes such as PCIe x1, PCIe x2, PCIe x4, PCIe x8, PCIe x16

Always keep in mind that when you perform motherboard upgradation these expansion slots are of equal importance. It is very important to retain the existing card to be added to the new motherboard. If the motherboard doesn't accept the expansion slots then you need to add the suitable slots and raise the cost and complexity of the upgrade.

3.2.3 Memory slots

Memory slots are the small holes orgaps which are used to connect external memory devices to the motherboards. RAM in today's motherboards must be added to the motherboard through slots. These are known as memory slots. The memory slot used to add base RAM is DIMM/RIMM slot. RIMM is the new generation memory slot which offers high access memory speed. It is easy to install the memory slot to the motherboard but when it comes to upgradation it involves more of adding larger modules than adding slots. This has a direct effect on the expense of the memory. It is important to understand the actual size of memory the motherboard can accommodate.

3.2.4 The power of chipsets

The main difference between modern computers and old computers is that modern computers have less chips. This is because most of the functions are handled by two or three chips on the motherboard that are integrated as chipset. The chipset connects the memory and the CPU to drive controllers, expansion buses, I/O ports, and video and sound controllers.

Figure 3.1 explains to you the detailed structure of the chipset on the Intel pentium 4 motherboard. The block diagram illustrates working of D850 GB Pentium processor for your understanding. Accordingly at the heart of the motherboard functionality, you have the 82850 memory controller hub which is connected and interfaces between processor, system memory and AGP bus. I/O controller hub is responsible for managing the hard drive controllers, USB ports, hardware monitor, PCI bus and sound subsystem. The Firmware hub is responsible for managing the system BIOS and CMOS functions.
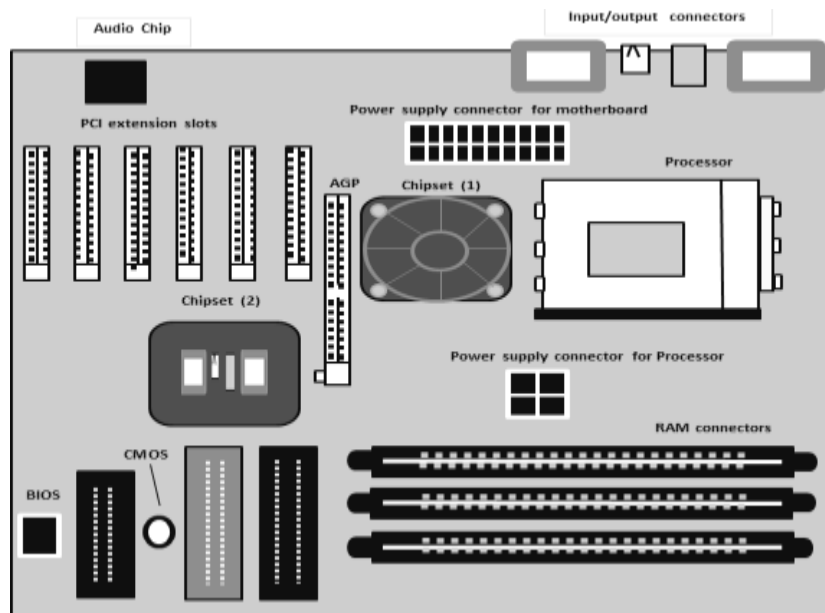

Figure 3.1: Block diagram of the Intel Pentium 4 Motherboard

3.2.5 Form factor

Form factor is defined as the physical position that the system components like motherboard, and its holder, the key components such as CPU, memory modules, the different slots and ports have. There are three types of form

factors. They are AT, ATX, and BTX. You should know that form factors do not directly contribute to the performance of the motherboard. In that way if you consider the first evolution baby AT and the advanced BTXboth have same characteristics in performance.

Full AT was the first form of the motherboard that covered the large area in the system. AT stands for advanced technology and the name is because there was new introduction of various technologies in the family of motherboards. Full AT was 11 inch in length and 12 inch in breadth. This created problem with heat absorption due to the lack of ventilation. It was also not able to access some of the items in the motherboards because some of the drive bays were hung on the motherboard.

Due to this *Baby AT* was built which became very popular. It was 10 inch long and 8.5 inch wide. This form has DIN keyboard connector in the top-corner of the board which differentiates it from other types. This was reduced almost to 2/3rd of the size of the full AT board and also contained 7 ZIF (Zero Insertion Force)slot for classic Pentium processors. It is the way to connect Pentiums processors on the motherboards to the data bus.

Intel wanted to make a motherboard that would support Pentium II processors. Therefore *ATX* with new AGP slot was built. ATX stands for advanced technology extended and intended to use easily, support for current and future I/O, support for current and future processor technology, and reduced total system cost. It was 7.5 wide and 12 inches long which included I/O and USB ports. This was intended to support to current and future technology, current and future I/O and reduce the cost.

Though ATX was supporting Pentium processors; it failed in cooling the system. Therefore *BTX* was built by Intel to support Pentium processor with proper heat liberation. BTX stands for balanced technology extended. The BTX will come primarily from taking the advantage of in-line airflow. This layout allows many of the main board components to utilize the same primary fan airflow, thereby reducing the need for, and noise from, additional system fans. In some cases this also allows fewer and/or less expensive heat sinks to be used when compared to ATX solutions.

Apart from this you can classify chipset into two types. They are North-bridge and South-bridge which are basically used for the communication

between various components is done by FSB through the Chipset. This is explained in the section 4.6.

Self Assessment Questions

1. _____ can be called as active back plane.
2. What are the different designated sockets used in the motherboard?
3. Additional components are connected to motherboard with the help of _____.
4. What is the main difference between old and modern computers?
5. State whether the following statements are true or false:
   a. Motherboard has only one 1.5 V AGP slot
   b. RIMM offers high access memory speed
   c. Form factor directly contributes to the performance of the motherboard
   d. BTX defines In-line airflow.

3.3 Motherboard Up-gradation

In previous section, we have discussed the meaning of motherboards and how to make motherboard active with the help of various concepts such as chipsets and slots. When the systems get older the motherboard has a very limited feature for its upgradation. However, you can add RAM and upgrade a CPU which has very less impact on motherboard's performance. These days the prices of the motherboard have dropped to such an extent that upgrading a motherboard is more cost effective. In this section 3.3, you will learn when to upgrade a motherboard, how to do it and what problems that you might encounter when upgradation process begins.

3.3.1 Considerations

Motherboard upgradation is not a very difficult process rather it is a time consuming and detail-oriented process. Therefore, whenever youstart this process you need to have a plan for perfect execution to obtain its full benefit. The following are the points you need to consider whenever you have to upgrade PC. They are:

- When you upgrade the motherboard we must be careful in specifications since each of them has unique features. Here the number of I/O ports and its types will determine the feature of expandability.

- While talking about the characteristics, it is very important to consider the place and space available for the motherboard to fit in the system. The nuts and bolts which you use to connect the motherboard and during upgradation are important. What is of concern is the size of the motherboard because it has to be placed inside the system space. You should take care that the size of the motherboard is suitable as it should not get crushed with drives and the power supply.

- While upgrading you must take care that you have place for the expansion slots and new processor. If the main purpose of your upgradation is to add AMD or dual core then there is a need for heat sink to remove the extra heat produced by two or more processors. Therefore you must plan the motherboard is such a ways that this sink easily fits in along with one or more expansion slots.

- Before considering to buy a new motherboard you make sure that all the rest of the components are working properly or whether there is any need for further upgradation of the other components. The main components to be taken care of is to see whether the old hard drive supports the new motherboard and functions to its full potential; whether the video controller card supports the full favour or new AGP 3D graphics card is needed; whether the existing memory type supports the mother board or new memory modules like EDO RAMs, SDRAM DIMMs etc., have to be upgraded. It is necessary to look at these because at a lesser cost you can boost the performance of the motherboard to its maximum.

- It is always better during upgradation to change the motherboard to a new motherboard rather than changing alone the defected part because a new motherboard gives good support with respect to cache, space and RAM availability.

- To overcome the cost effect of time, many of the organisations have designed a device that mounts processor, cache, and RAM on a readily accessible module which is called as *daughtercard.* It is based on modular mother board. This can be replaced in few minutes once the upgradation is done. Only disadvantage of this module is that each daughter card needs to be designed for a particular motherboard which is specific and sometimes it becomes costlier than the conventional motherboard.

- There is one more way of overcoming the disadvantage. Instead of taking more time to replace the motherboard you could install MicroChannel systems to any of the expansion slots. This system is also called as *Processor card.* It helps in logging out of the original processor by taking whole control of the resident CPU. This allows upgrading the motherboard. Though the cost of the processor card is more than another CPU itself, it is more standardized than daughterr boards.

3.3.2 Performing the upgradation

An upgradation is a process that involves many steps starting from pre upgradation to postupgradation. From unit 1, you have got the knowledge of overclocking the CPU and have seen that it does not involve many processes to follow. This section takes you through the different processes involved in upgradation. You also need to remember a few things before upgradation. The following are the preliminary steps which you need to take:

- When a standardized program is executed we should try to get some result out of it so that it becomes a yardstick for you after motherboard upgradation. For example, *BIOS agent* is a program which is used to automatically identify your computers BIOS and other system information. Using this program you can easily identify BIOSdate, CPU data, BIOS type, CPU data, etc.

- You need to have a backup of the whole system before you start preparing for upgradation. Because there is a severe chance of collateral system damage.

Electrostatic protection

Motherboards are extremely sensitively to electrostatic discharges. You need to follow some of the precautionary measures to ensure the safe handling of motherboards and other components during the process of upgradation.

- You need to cable the antistatic mat to the motherboard and do proper grounding for its connections. You must have enough mats to cover the entire place. Don't place the motherboard on electrostatic area for any reason.

- While handling the motherboard and its components use antistatic strap to rescue yourself from the shock which can be produced when your

body comes in contact with the static motherboard. You should also have a proper arrangement for the grounding to the strap.

- Do not touch the circuit chip or pins and try to hold it from the edges.

- When the components are disassembled for upgradation, place all the componentsin antistatic bags.

- Try to avoid upgradation process in dry weather because there is possibility of creation of electrostatic charges in clothes and bodies.

After you have taken all these precautions you need to have the updated CMOS settings so that it needs to be loaded on the new motherboard's CMOS. Current BIOS versions allow you to enter BIOS defaults in the CMOS setup. Some of the CMOS may be loaded manually.

The following are the steps for motherboard upgradation which you need to follow.

- You must be very careful while handling the screw driver blades. If the blade accidentally slips on the motherboard then it can cause severe damage by even a scar or scratch on the chip.

- You should turn off the system and unplug it from AC receptacle before opening the cover of the cabinet. This will help you in taking measures to avoid accidental power supply when you are working on the system.

- When you remove the screws by holding the outer cover place it is a safe place. Place the outer cover place in a safe place where it is not damaged. Now you can see the inside of the PC.

- You need to label the things which you can see inside the PC which helps you in connecting back the cable to specific points after upgradation.

- Now it is the time for you to remove your original motherboard. Therefore, make a safe place for keeping your motherboard. This involves few steps.
  o You can start removing the expansion boards and place it inside the antistatic bag and keep the bag on the antistatic mat.Remove all the screws gently and then try to lift the motherboard. If you get a tight feeling in lifting the motherboard then it means there are some screws which you have overlooked while detaching. Doesn't forceopen the motherboard hard otherwise it canget damage.

- o   Remove the cable connected to the motherboard.
- o   Detach the drives if any for floppy and hard drive.
- o   Disconnect the power cables.

Installing the new motherboard

Now your system is ready for installing the new motherboard. A little effort is required to see that the motherboard fit inside the system and work properly. You must follow the instructions given below to place your motherboard inside the system.

- Place the motherboard gently inside the system and ensure that the slots and ports are properly aligned. You need to check that the holes from the case match with the holes from the motherboard. You should not apply force while inserting the motherboard into the case. This can damage your motherboard itself or result in upgradation failure.

- While fixing the bolts you should always make sure that the motherboard is away from contact with conductive materials. Always use a nonconductive washer between the bolt and the motherboard.

- Refer to the user manual for any kind of clarifications. Now you need to check for some basic connections. You can check the jumper for each module or DIP switch. These include the case switch off/on, case indicator lights, reset buttons and speakers.

- After installing you need to reassemble the original system which you have disconnected. You must ensure that all the memory modules, BIOS, RAM, CMOS are fixed appropriately; the memory modules must snap gently into the place. Also connect the external devices like keyboard, mouse and monitor.

- The last and final step in testing the system. You may have installed the best settings but there is always a chance of working away from the requirement once it is assembled. Therefore, there is a need for testing the system to ensure that all the components and cabling are well jelled with each other. It initially starts with POST that displays the message asking for you to start the set up. POST stands for Power-On-Self-Test which performs the preliminary checking for the availability of the various components that are essential to boot the system and ensures the correctness of the operating system. You must click ok for starting the set up. You have to be very careful in reviewing the CMOS. You need to

download as many CMOS as possible as the CMOS is responsible for booting your system and helps in maintaining performance. You will be studying CMOS in detail in unit 5.

- You must set the variables in their default state for now and reboot the system. Then ensure that the system completes POST successfully and boot the system.

- Finally install the hardware drives for any of the components newly installed. Ensure that the device managers are free from errors or problems.

Now you have completed the motherboard upgradation successfully.

Activity 1:

Try to upgrade any old PC motherboard and note down the problems that arise while performing the upgradation.

Self Assessment Questions

6. _____determines the features of expandability.
7. How will youremove the extra heat produced by the processors?
8. Why is it always better to go in for new motherboards rather than changing one or more componentsinthe old one?
9. State whether the following statements are true or false:
    a. CMOS settings needs to be loaded on the new motherboard's CMOS.
    b. You need not worry about screw driver blades since they are very small.
    c. Labelling the things inside the PC create confusion.
    d. We must always use non-conductorbetween mother board and any metal attached to it.
    e. If the motherboard doesnot fit gently inside the system then you need to apply force to fix it.

3.4 Troubleshooting

In the earlier sections you have studied the motherboard upgradation process. You have studied the basic consideration to be kept in mind before and while upgrading the motherboard. By now you would have been able to

perform the upgradation. In any of the technical systemswhen you install or upgrade there is a chance of motherboard encountering faults and errors. Most of the errors and failures will be detected in the POST itself. But, apart from the POST detection of errors there are some faults which need to be identified and solved. In this unit you will learn when and how to choose between repair and replacement of the motherboard. You will also learn how to carry out inspections to identify the problems.

3.4.1 Steps to identify whether to repair or replace the motherboard

When any key component of the motherboard fails or shows problem in its working you will be faced with the question of either replacing that particular component with a spare or to change the whole motherboard and replace it with a new one. You might assume that it is comfortable to change the components and replace them. But when it comes to the availability of the spare parts it is difficult to find them when they come to the higher end processors. Therefore, it is always better to install a new motherboard because it is readily available in the market and easy to buy. The only problem is the cost. Buying a new motherboard is several times costlier than replacing the defected part.

Since the motherboard replacement is an expensive idea. Therefore we need to verify whether we need to replace or repair. In order to take decision on whether to replace or repair we need to follow the below steps for inspecting the PC. Based on which you can take confirmed decision.

- You should ensure that all the connectors are properly connected. Check for the power cable attached to the motherboard. Other cables must be attached tightly.

- You should check out that the CPU chips, ROM chip and CMOS and RTC module are mounted on the socket properly.

- You should ensure that the AC power supply is in proper order. If the AC is connected with heavy loads of water motor or boiler, use the other connecter supply for the PC. Take proper measure to protect yourself from injury as described in section 3.3.2.

- As mentioned above in the electrostatic precaution, take care of the screws, paper clip or any conducting wire which can cause short circuit in the motherboard or cause motherboard failure.

- If your motherboard is having any port connected please make sure that those are disabled by setting jumpers or switch. For example video port must be disabled otherwise there will be a problem of hardware conflict and motherboard may crash or can cause interference in the motherboard performance. Always refer to a PC guide to set the jumper.

- You must verify that the screws connected to the motherboard do lead to grounding. Also ensure that there is enough space between the conducting material and the motherboard. Do not turn the screw so tight that the motherboard may suffer from erratic connections.

The above general guidelines help you in identifying the faults and failures and help in correcting those errors. These help in identifying most the problems that a motherboard can encounter. Even after following the above steps if you encounter motherboard failure then it is time to replace it.

Activity 2:
a. Find out why your system automatically powers back on after a power failure
b. Find out why your system is not turning off when you press the power button
c. Identify why your system is not booting even after installing a motherboard.
Hint: Refer the concept of symptoms of motherboard inthe book on troubleshooting, maintaining, and repairing PCs by S.J.Bigelow

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Self Assessment Questions
10. Why do you think replacing the motherboard is better than replacing the components in the motherboard?

3.5 Summary
Motherboard being the heart of any PC provides the system resourcesand supports many important components of CPU and handles memory. There is always aimmediate need for upgrading motherboard. Therefore, modular motherboards are used for upgradation. There are different slots and sockets which are used in different PCs to connect various components into the motherboard. In modern motherboards there is an absence of chips or

some cases very negligible. Expansion devices are used to give the motherboard the added features. The memory size must be adoptable by the motherboard.

When you upgrade a motherboard you can include additional RAM, and upgrade a CPU. You should consider many factors like dimensions and mounting; feature comparison; CPU and slot locations; cost; traditional upgrades; daughtercard upgrades; processor card, etc. When you want to upgrade you must undertake pre and post upgradation preparation which involves, electrostatic protections, downloading CMOS settings, physical preparation of the system cabinet, removing the original motherboard, installing and reassembling the motherboard and finally testing the motherboard for working conditions.

In every installation there is always a scope for errors. When any such error occurs you must check for various components for their performance. Also you need to take a decision whether to replace the components or the motherboard itself with a new piece. In this unit you studied the various inspecting points before starting the motherboard repair. By now you would have got the knowledge of how to identify the problem in the motherboard and to troubleshoot the same.

3.6 Glossary

Term	Description
Math Coprocessor	Secondary processor which helps in doing lots of calculations and helps in saving lot of precious time of the CPU
SCSI	Small computer system interface is a set of interface or set of standards which communicates data transfer between computer and other peripheral devices
I/O port	Input-Output port connects the devices such as keyboard, monitor, printer to communicate with computer system
Processor card	It manages the resources and data for expansion by performing required operations
Daughter card	It is an extension motherboard which is circuitry
CMOS	It is an semiconductor chip and holds data without requiring external power supply

POST	When the computer system is on, it performs a self test to check whether the keyboard, RAM, disk drives are connected properly. This is called Power On Self-Test
BIOS	It is a collection of programs that is present on the chip and tells the computer how to start.
RTC module	Real Time Clock module is specially designed for DS1307 clock. This comes with the pre-programmed current system clock.

3.7 Terminal Questions
1. Explain the classification of sockets and slots.
2. What are the points to be kept in mind while upgrading motherboard?
3. How do you perform upgrading?
4. What is the use of trouble shooting motherboard?
5. What are the basic points to be taken care of while troubleshooting a motherboard?

3.8 Answers

Self Assessment Questions
1. Motherboard
2. Socket 7, socket 8, slot 1, slot 2, socket 360, slot A, socket A, socket 432.
3. Expansion slots
4.   a. True
      b. True
      c. False
      d. True
5. Less chips
6. Number of I/O ports
7. With the help of sink
8. New motherboards give good support with respect to cache, space & RAM availability.
9. a. True
      b. False
      c. False
      d. True
      e. False

10. New motherboards are readily available in the market and spare components are difficult to obtain.

Terminal Questions
1. Refer Section 3.2.1. Sockets and slots
2. Refer section 3.3.1. Considerations
3. Refer Section 3.3.2. Performing the upgradation
4. Refer Section 3.4. Troubleshooting
5. Refer Section 3.4. Troubleshooting

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