

Session – 10

Advanced Microprocessor Features
- Study of Intel 80386 processor

Session Objectives

At the end of this session, the learner will be able to:

- ✚ Understand equivalent processors to Intel 80286.
- ✚ Conceptualize real mode, protected mode and virtual mode.
- ✚ List the functional blocks that are available in 80386.
- ✚ Identify the architecture and programming issues in 80386.
- ✚ Compare and contrast 80286 with 80386.

Teaching Learning Material

- ✚ Board
- ✚ Presentations
- ✚ Manufacturer's Data sheets
- ✚ Text Books
- ✚ Laboratory Manual

Session Plan

Time (in min)	Content	Learning Aid / Methodology	Faculty Approach	Typical Student Activity	Skill/Competency Developed
15	Introduction	Board Activity Short Seminar	Introduces Facilitates Monitors	Listens Participates Presents	Knowledge Comprehension Analysis Intrapersonal
10	Functional Blocks and Organization of 80386	Board Activity Data Sheet	Explains Facilitates	Listens Participates	Knowledge Comprehension Application
15	Architecture and Programming Issues of 80386	Board Activity Data Sheet Tit for Tat Activity	Explains Facilitates Monitors	Listens Discusses Participates	Knowledge Comprehension Application Analysis Interpersonal Intrapersonal
15	Performance Improvement over its predecessors	Board Activity Data Sheet	Explains Facilitates Monitors	Listens Discusses Participates	Knowledge Comprehension Application Analysis Interpersonal Intrapersonal
05	Conclusion and Summary	Board Activity Quiz	Explains	Listens Participates	Knowledge Comprehension Application Analysis Intrapersonal

Session Inputs

Introduction



Before starting this session, we can direct the three teams to whom we have given an assignment to present their findings on the equivalent of 80286 processor.

Suggested Activity: Short Seminar

The teams will present for 5 minutes, the equivalent of 80286 processor.

Team A: AMD processor.

Team B: Free-scale Semiconductor/Motorola

Team C: IBM

The learner's, being exposed to various processors may now be asked to identify those units that make a future processor that meets diversified needs of evolving computer systems.

Having revisited the 80286 processor and its equivalents, we can introduce the Intel 80386.



The third generation of Intel microprocessors, Intel 80386 (i386) was a 32-bit microprocessor backwards compatible with previous generations of 80x86 CPUs.

A new feature in the i386 CPU was the 80386 protected mode. This mode fixed many shortcomings that existed in the 80286 processor. In the protected mode:

- It included the complete set of 32-bit registers and 32-bit instructions.
- The CPU still used memory segment architecture similar to the one present in earlier x86 microprocessors; the size of memory segments was increased to 4 GB. This simplified development of 32-bit software, and in most cases applications could run without worrying about switching memory segments.
- It became possible to switch from protected mode back to real-mode without simulating processor reset.

Another new mode in the 80386 CPU was 8086 virtual mode. In this mode the CPU could run old 8086 applications while providing necessary protection of memory and other resources. Introduction of this mode and 80386 protected modes was very significant step. All current 32-bit operating systems use these modes to run legacy 16-bit and more modern 32-bit applications.

Having seen some key features of 80386, we can address its functional block.

Functional blocks and organization of 80386



We can show the block diagram of 80386 and highlight the different enhancements provided over 80186/80286.

Remember to highlight:

- ✚ Additional interrupt vectors
- ✚ Powerful I/O features
- ✚ On chip features provided
- ✚ Pins and signals
- ✚ Different versions of 80386 family



The 80386 added a 32-bit architecture and a paging translation unit, which made it much easier to implement operating systems which used virtual memory.

Also address distinct features of 80386 like:

- ✚ Memory organization
- ✚ Control signals associated
- ✚ Ability to handle switching between real mode and protected mode

After addressing the functional block diagram, we can now focus our attention into the architecture and programming issues.

Architecture & Programming issues of 80386

We can understand the architecture and programming improvements of 80386 with its predecessor with the help of an activity.

Suggested Activity: Tit-for-Tat

We can direct the learner's to study and understand the 80386 data sheet for 15 minutes. Form 2 teams A and B, Team A will fill in the left column of 80286 with respect to architecture, instruction set, registers, address and data lines. Team B shall write the same for 80386 processor.

80286	80386
Architecture	
....
Instruction Set	
....
Number of Registers	
....
Address Lines	
....
Data Lines	
....

We can also add the list and explain the additional instructions present in 80386 than its Intel's predecessors.



Announcement

Some of the key features of 80386 are:

- ✚ The organization and architecture is capable of handling and executing all the software written for its predecessors as it is without any change. Hence it is down ward compatible.
- ✚ The 80386 featured three operating modes: **real** mode, **protected** mode and **virtual** mode. The protected mode allows the use of all the possibilities of the 286 and the protected mode extension of the 386, especially addressing up to 4 GB of memory. Finally, the virtual 8086 mode

(or *VM86*) makes it possible to run one or more real mode programs in a protected environment.

- ✚ The various versions of 80386 processors and their features.

Having understood the programming issues, we can now see the performance improvements.

Performance improvement over its predecessors



Some of the key improvements that learner's should know are:

- ✚ 32-bit version and large word size.
- ✚ Multi tasking
- ✚ Memory management
- ✚ Virtual memory with or without paging
- ✚ Software protection
- ✚ Large memory system – physical 4GB and virtual 64 terra bytes
- ✚ Ability to switch between real mode to protected mode without resetting

Having highlighted the performance improvement over its previous Intel predecessor, we can conclude the session.

Conclusion



To conclude the session, we can ask the following questions:

1. What is the difference between protected mode and real mode?
2. List the different versions of 80386 and its effectiveness for different applications.
3. List of extended registers available in 80386.
4. How is Interrupt handling done in 80386?
5. What is a descriptor?
6. What is a selector?

Summary

In this session, we learnt to:

- ✚ List and analyze the enhancements incorporated in the 80386 processor.
- ✚ List the functional blocks that are available in 80386 and identify the application that can exploit those enhancements.
- ✚ Compare and contrast the capabilities with 8086, 80186 and 80286.
- ✚ Analyze, distinguish and characterize various versions possible and available on 80386 Processor.



Assignments

1. The same three teams of learners formed in the previous session shall find an equivalent processor to 80386 from other vendors like AMD, Free-scale, semiconductor/Motorola, IBM etc., and note down the key features.



