Session - 9

Advanced Microprocessor Features
- Study of Intel 80286 processor
Session Objectives

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

- Understand equivalent processors to Intel 80186.
- Conceptualize virtual memory and memory management unit.
- List the functional blocks that are available in 80286.
- Identify the architecture and programming issues in 80286.
- Compare and contrast 80186 with 80286.

Teaching Learning Material

- Board
- Presentations
- Manufacturer’s Data sheets
- Text Books
- Laboratory Manual
## Session Plan

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<td>Intrapersonal</td>
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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 evolution of processor.

Suggested Activity: Short Seminar

The teams will present for 5 minutes, the evolution of following processors.
Team A: AMD processor.
Team B: Free-scale Semiconductor/Motorola
Team C: IBM

With computing system applications requiring better and larger memory, it becomes essential for the supporting hardware to look for processors that support the need. To address more memory locations, more number of address lines is needed.

As memory chips are costly, we use secondary memory devices (less costly) for operation with the Microprocessor.

We shall give an analogy to explain the concept of memory addressing.

A Managing director of a Large Company stores his day to day usage files in his table, those files which he would need less frequently would be stored in his filing cabinet nearby and those files which he would be using rarely he would ask his secretary to store it in a common filing cabinet.

The above scenario could be used to introduce the concept of data that are directly addressed and are frequently used; as well as those data that are not so frequently used.

As we cannot have a large table that can store all files, we keep only the most frequently used file alone in the table. Even though we can address all
memory locations, we keep the most frequently used data in the memory that is very close to the ALU and the remaining data in the secondary storage memory.

With the help of the above analogy introduce the concepts of:
- Physical Memory
- Virtual Memory
- Virtual Address and
- Memory Management Unit

After having understood the memory units, we can now introduce the functional blocks in 80286 that support the above memory addressing modes.

The second generation of 16-bit processors, Intel 80286, was released in 1982. The major new feature of the 80286 microprocessor was protected mode.

When switched to this mode, the CPU could address up to 16 MB of operating memory (previous generation of 8086 microprocessors was limited to 1 MB). In the protected mode it was possible to protect memory and other system resources from user programs - this feature was necessary for real program multitasking.

**Functional blocks and organization of 80286**

We can show the block diagram of 80286 and highlight the different enhancements provided over 8086/80186.

Remember to highlight:
- Additional interrupt vectors
- Powerful I/O features
- On chip features provided
- Pins and signals

Apprise the learner's that 80286 processor is designed for use in multi user and multi-tasking environment. (Windows operating system supports multi user and multi-tasking environments)
With respect to 80286:
- Introduce concepts of Physical memory and virtual memory.
- Address pins and the size of memory it can access.

Now, we can ask the learner’s:
- Why is virtual memory needed?
- What are the new I/O supports in 80286?
- How much memory can 80286 address?

Having understood the Functional blocks, we can learn the architecture and programming issues.

**Architecture and Programming issues of 80286**

We can understand the architecture and programming improvements of 80286 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 80286 data sheet for 15 minutes. Form 2 teams A and B, Team A will fill in the left column of 80186 with respect to architecture, instruction set, registers, address and data lines. Team B shall write the same for 80286 processor.

<table>
<thead>
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<th>80186</th>
<th>80286</th>
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<tr>
<td><strong>Architecture</strong></td>
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<tr>
<td><strong>Instruction Set</strong></td>
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<td>.....</td>
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<td><strong>Number of Registers</strong></td>
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<td>.....</td>
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<td><strong>Address Lines</strong></td>
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<td>.....</td>
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<tr>
<td><strong>Data Lines</strong></td>
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We can also add the list and explain the additional instructions present in 80286 than its Intel’s predecessors.

With the help of a simple memory paging operation, explain how the 80286 machine maps larger memory space into a much smaller physical memory space. Addressing larger space is accomplished by the descriptors in the 80286 processor. We could also address the various versions of 80286 processors and their features.

Having seen the programming issues, we can look into the performance improvement over 80186.

**Performance improvement over its predecessors**

Emphasize that 80286 was created to handle the functionality of a typical PC-AT type of machine which was meant to address the needs of high end machine. It may be a good idea if we could ask students to prepare a short seminar to present the performance improvements over 80186.

**Suggested Activity: Short Seminar**

The teams will present for 5 minutes, the following performance features.
- Team A: Virtual memory access using memory management
- Team B: How instructions are optimized to perform execution in a fewer clocking periods?
- Team C: How built in memory manager helps memory accesses.

We could highlight the key features in their presentations and conclude the session.

**Conclusion**

To conclude the session, we can ask the following questions:
1. How many address pins are present in 80286 processor?
2. Are the address pins multiplexed?
3. What are the purpose of instructions like VERR and LSL?
4. How many physical memory and virtual memory can be accessed by 80286?
Summary

In this session, we learnt to:

- Address physical memory, virtual memory, virtual address and memory management unit.
- List and analyze the enhancements incorporated in the 80286 processor.
- Conceptualize virtual memory and memory management unit.
- List the functional blocks that are available in 80286 and identify the application that can exploit those enhancements.
- Compare and contrast 80186 with 80286.
- Analyze, distinguish and characterize various versions possible and available on a 80286 Processor.
Assignments

1. The same three teams of learners formed in the previous session shall find an equivalent processor to 80286 from other vendors like AMD, Free-scale, semiconductor/Motorola, IBM etc., and note down the key features.