

Virtual Memory - Segmentation System Design

Terminology

Virtual memory	A storage allocation scheme in which secondary memory can be addressed as though it were part of main memory. The addresses a program may use to reference memory are distinguished from the addresses the memory system uses to identify physical storage sites, and program-generated addresses are translated automatically to the corresponding machine addresses. The size of virtual storage is limited by the addressing scheme of the computer system and by the amount of secondary memory available and not by the actual number of main storage locations.
Virtual address	The address assigned to a location in virtual memory to allow that location to be accessed as though it were part of main memory.
Virtual address space	The virtual storage assigned to a process.
Address space	The range of memory addresses available to a process.
Real address	The address of a storage location in main memory.

Real and Virtual Memory

- Real memory
 - Main memory, the actual RAM
- Virtual memory
 - Memory on disk
 - Allows for effective multiprogramming and relieves the user of tight constraints of main memory

Support Needed for Virtual Memory

- Hardware must support paging and segmentation
- Operating system must be able to manage the movement of pages and/or segments between secondary memory and main memory

Segmentation

- Segmentation allows the programmer to view memory as consisting of multiple address spaces or segments.
 - May be unequal, dynamic size
 - Simplifies handling of growing data structures
 - Allows programs to be altered and recompiled independently
 - Lends itself to sharing data among processes
 - Lends itself to protection

Segment Organization

- Starting address corresponding segment in main memory
- Each entry contains the length of the segment
- A bit is needed to determine if segment is already in main memory
- Another bit is needed to determine if the segment has been modified since it was loaded in main memory

Sr. No.	Key	Paging	Segmentation
1	Memory Size	In Paging, a process address space is broken into fixed sized blocks called pages.	In Segmentation, a process address space is broken in varying sized blocks called sections.
2	Accountability	Operating System divides the memory into pages.	Compiler is responsible to calculate the segment size, the virtual address and actual address.
3	Size	Page size is determined by available memory.	Section size is determined by the user.
4	Speed	Paging technique is faster in terms of memory access.	Segmentation is slower than paging.
5	Fragmentation	Paging can cause internal fragmentation as some pages may go underutilized.	Segmentation can cause external fragmentation as some memory block may not be used at all.
6	Logical Address	During paging, a logical address is divided into page number and page offset.	During segmentation, a logical address is divided into section number and section offset.
7	Table	During paging, a logical address is divided into page number and page offset.	During segmentation, a logical address is divided into section number and section offset.
8	Data Storage	Page table stores the page data.	Segmentation table stores the segmentation data.

Segment Table Entries

Virtual Address

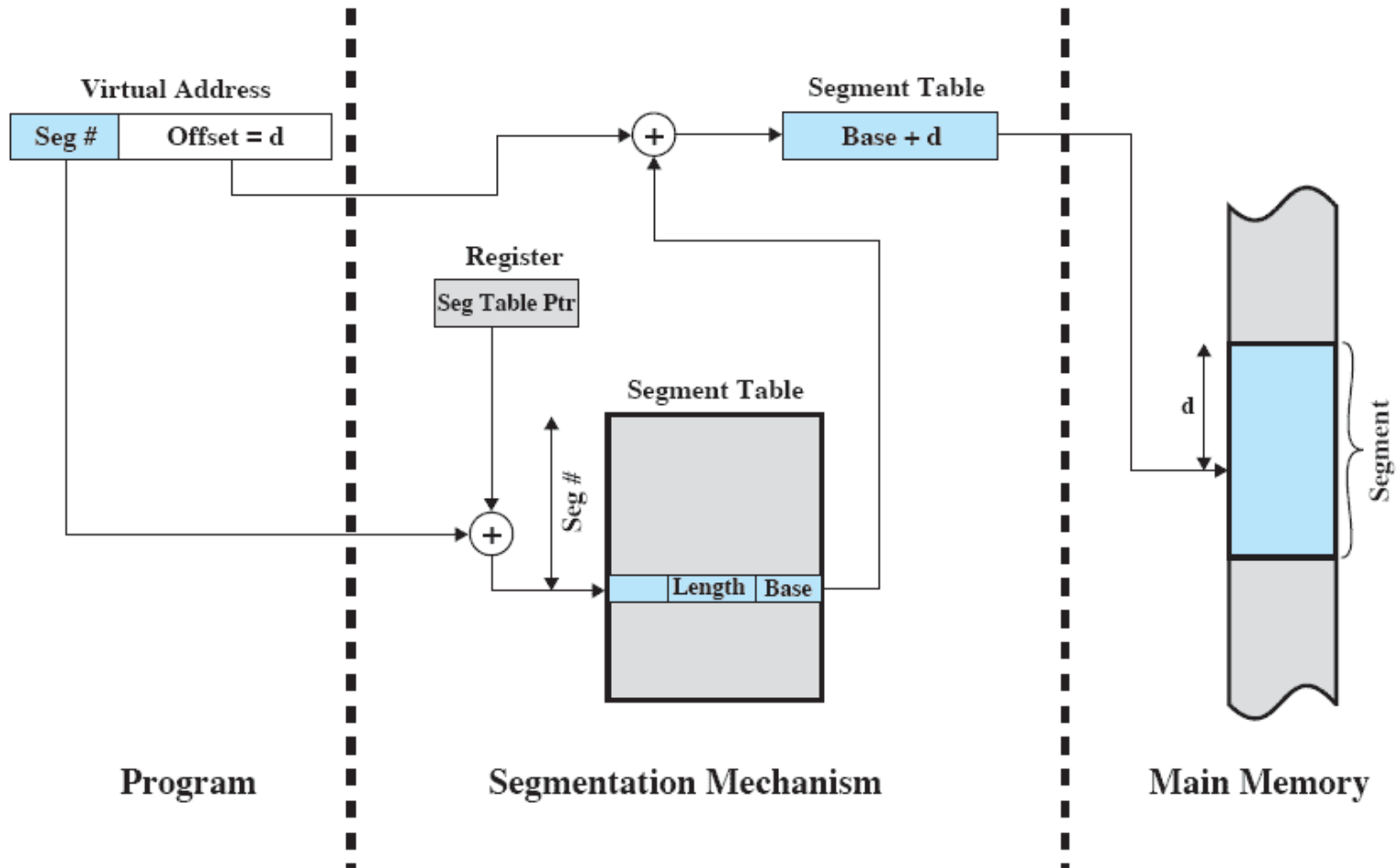


Segment Table Entry



(b) Segmentation only

Address Translation in Segmentation



Combined Paging and Segmentation

Virtual Address



Segment Table Entry



Page Table Entry



P= present bit
M = Modified bit

(c) Combined segmentation and paging