

SEGMENTATION

Chapter 4.4



SYLLABUS

- Implementation of Pure Segmentation
- Segmentation with Paging: MULTIC
- Segmentation with Paging: The Intel

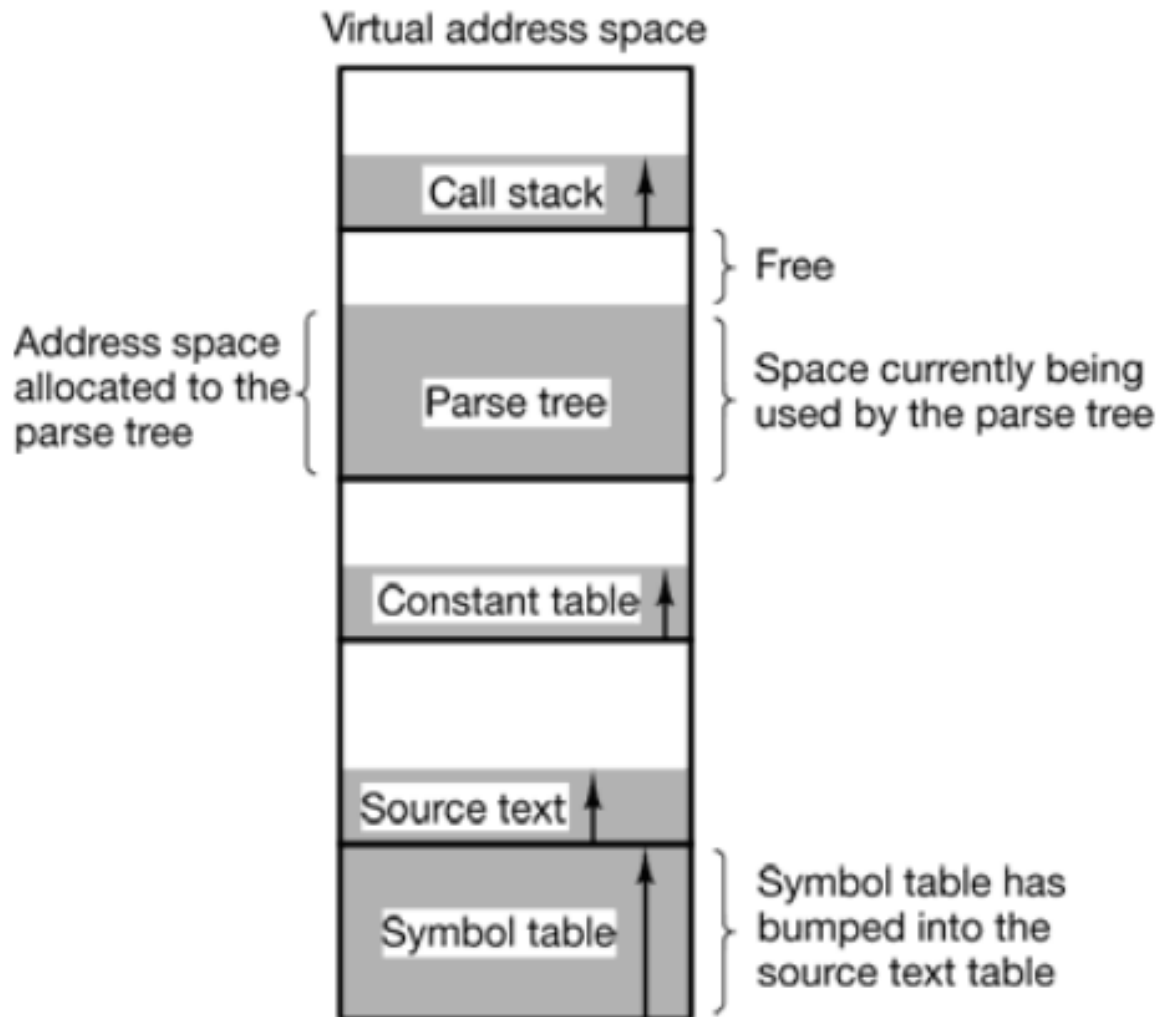


FRAGMENTATION

- **External Fragmentation** – total memory space exists to satisfy a request, but it is not contiguous.
- **Internal Fragmentation** – allocated memory may be slightly larger than requested memory; this size difference is memory internal to a partition, but not being used.
 - Eg, page size = 2048
 - If process size = 2060
 - Then two pages are required for 2060
 - First page is fully occupied
 - But next page is only occupied with 12bytes
 - 2036 bytes are unused in second page..totally wasted.



PROBLEMS WITH VIRTUAL MEMORY



SEGMENTATION

- What happens if program increase their size in their execution?
- How to manage expanding and contracting tables?
- How to protect only data from the program?
- How to share data to other program or functions?
- *The general solution of these issues is **to provide the machine with many completely independent address spaces**, called segments.*

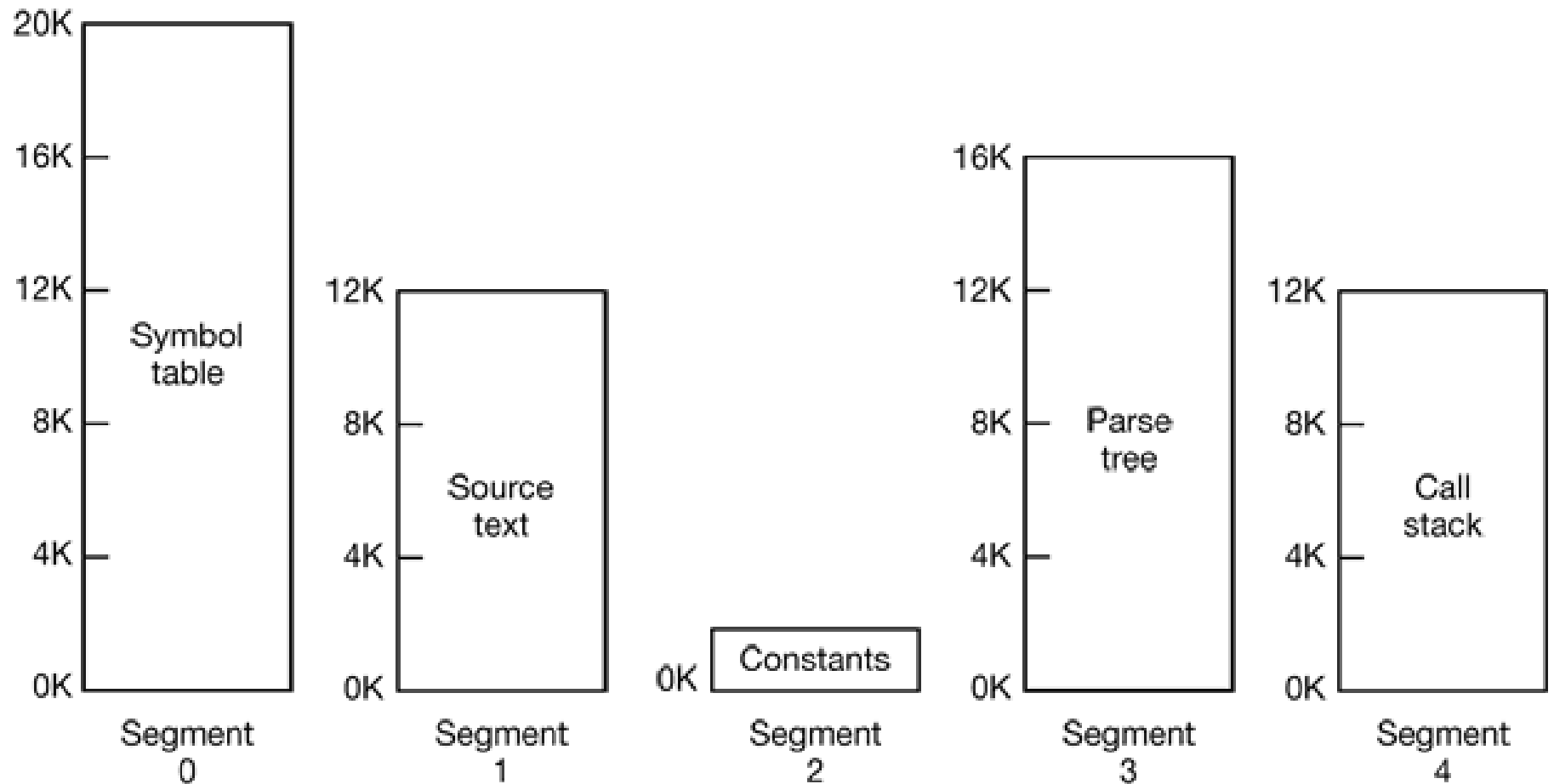


SEGMENTATION

- provide the machine with many completely independent address spaces, called **segments**.
- Each segment consists of a **linear sequence of addresses**, from 0 to some maximum.
- The **length** of each segment may be anything from 0 to the maximum allowed.
- Different segments may, and usually do, have **different lengths**.
- Segment lengths may change during execution.
 - The length of a stack segment may be
 - increased whenever something is pushed onto the stack and
 - decreased whenever something is popped off the stack.

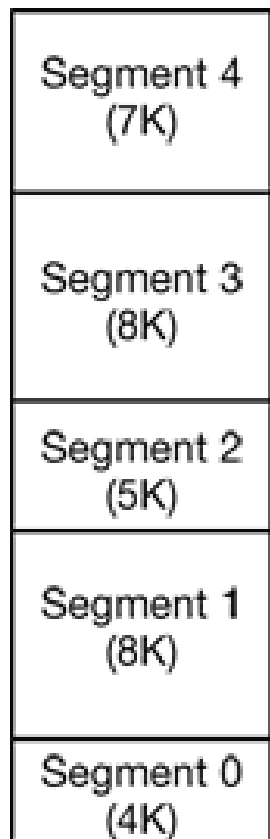


SEGMENTATION

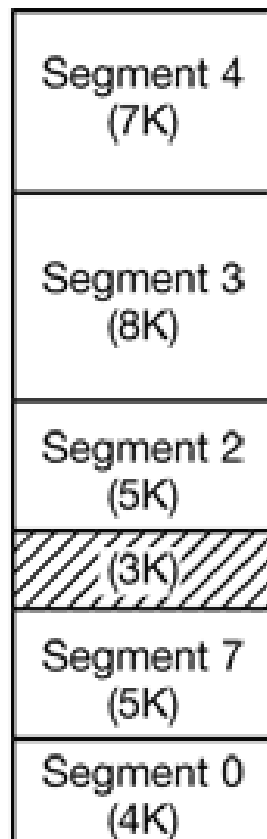


IMPLEMENTATION OF PURE SEGMENTATION

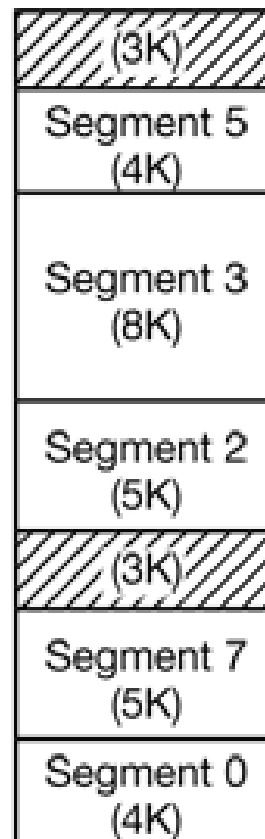
Development of checkerboarding and removal of checkerboarding by memory compaction



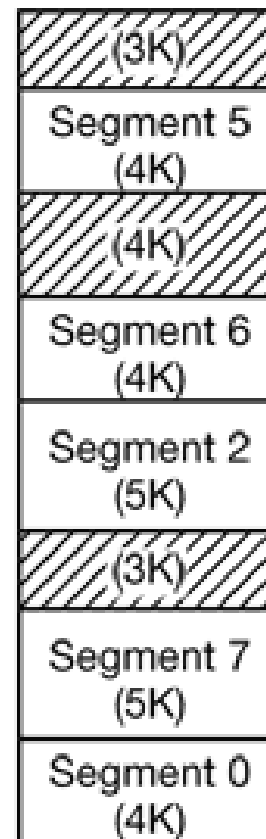
(a)



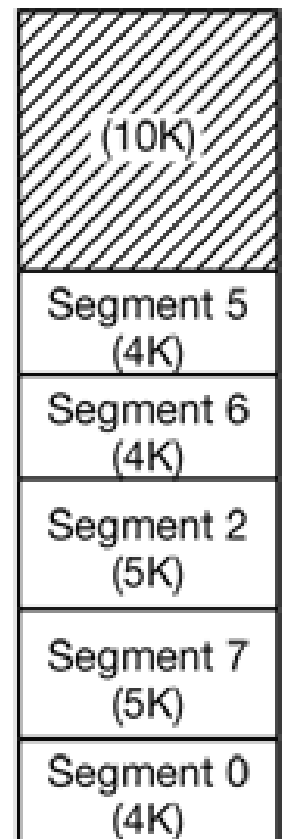
(b)



(c)



(d)



(e)

CHECKERBOARDING OR EXTERNAL FRAGMENTATION

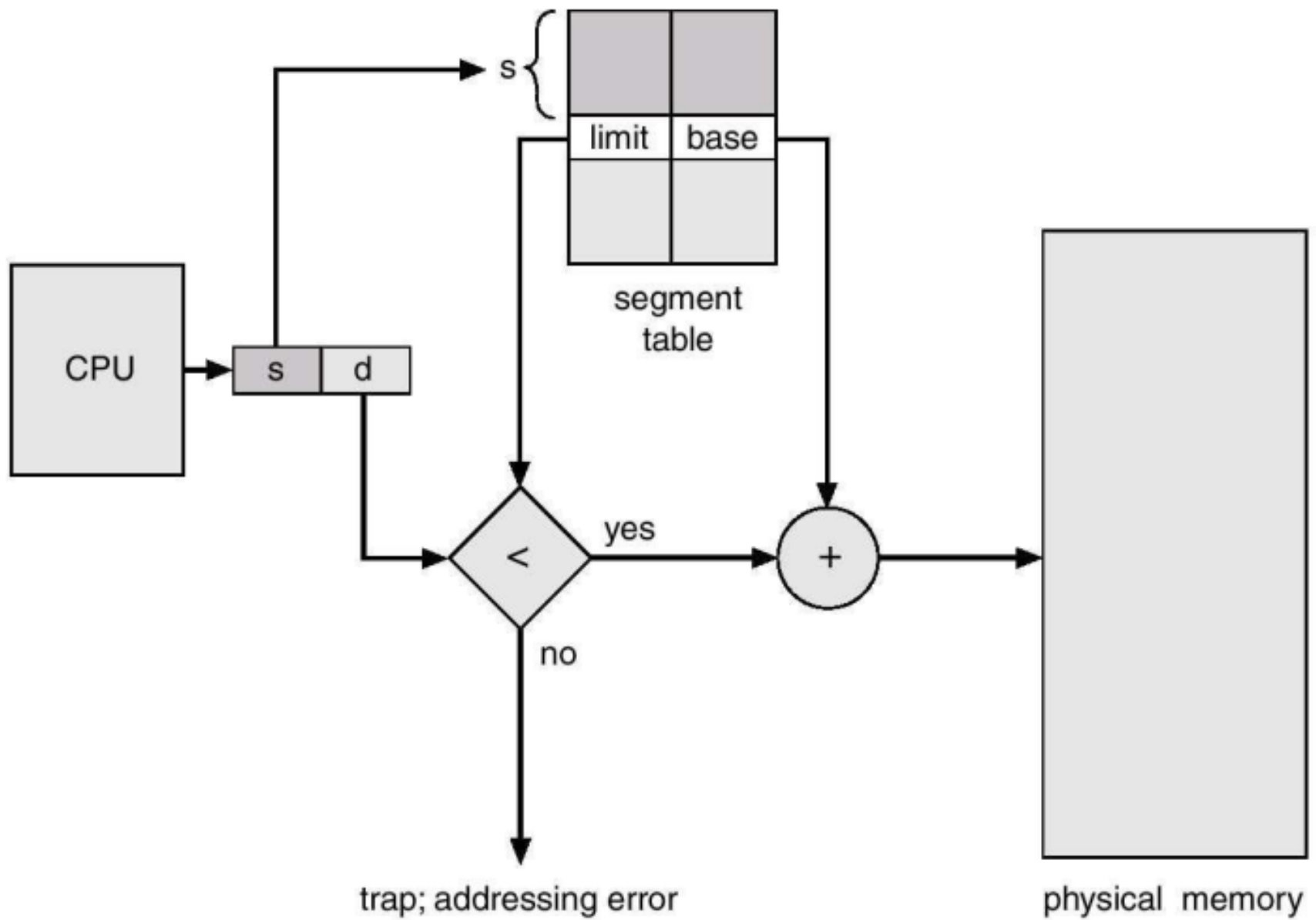
- pages are fixed size and segments are not
- After the system has been running for a while, memory will be divided up into a number of chunks, some containing segments and some containing holes this phenomenon, called **checkerboarding** or **external fragmentation**
 - It can be dealt with by compaction.



IMPLEMENTATION OF SEGMENTATION

- logical address consist:
segment number and *offset*
- The segment table (like page table but each entry consist **limit and base register value**) is used to map the logical address to physical address.





SEGMENTATION VS PAGEING

Consideration	Paging	Segmentation
Need the programmer be aware that this technique is being used?	No	Yes
How many linear address spaces are there?	1	Many
Can the total address space exceed the size of physical memory?	Yes	Yes
Can procedures and data be distinguished and separately protected?	No	Yes
Can tables whose size fluctuates be accommodated easily?	No	Yes
Is sharing of procedures between users facilitated?	No	Yes
Why was this technique invented?	To get a large linear address space without having to buy more physical memory	To allow programs and data to be broken up into logically independent address spaces and to aid sharing and protection



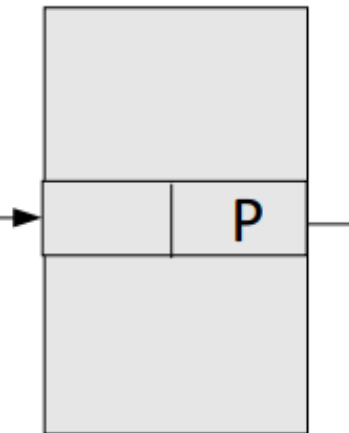
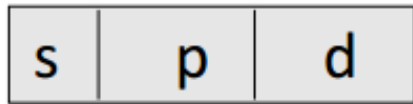
SEGMENTATION WITH PAGING

- If the segments are large, it may be inconvenient, or even impossible, to keep them in main memory in their entirety.
- This leads to the idea of paging them, so that only those pages that are actually needed have to be around.

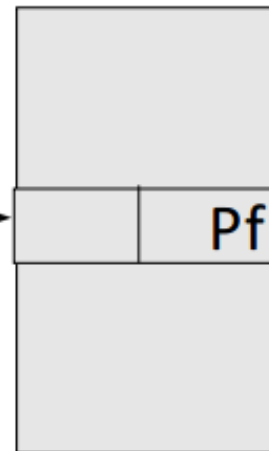
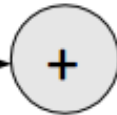


SEGMENTATION WITH PAGING

Logical address



Segment Table



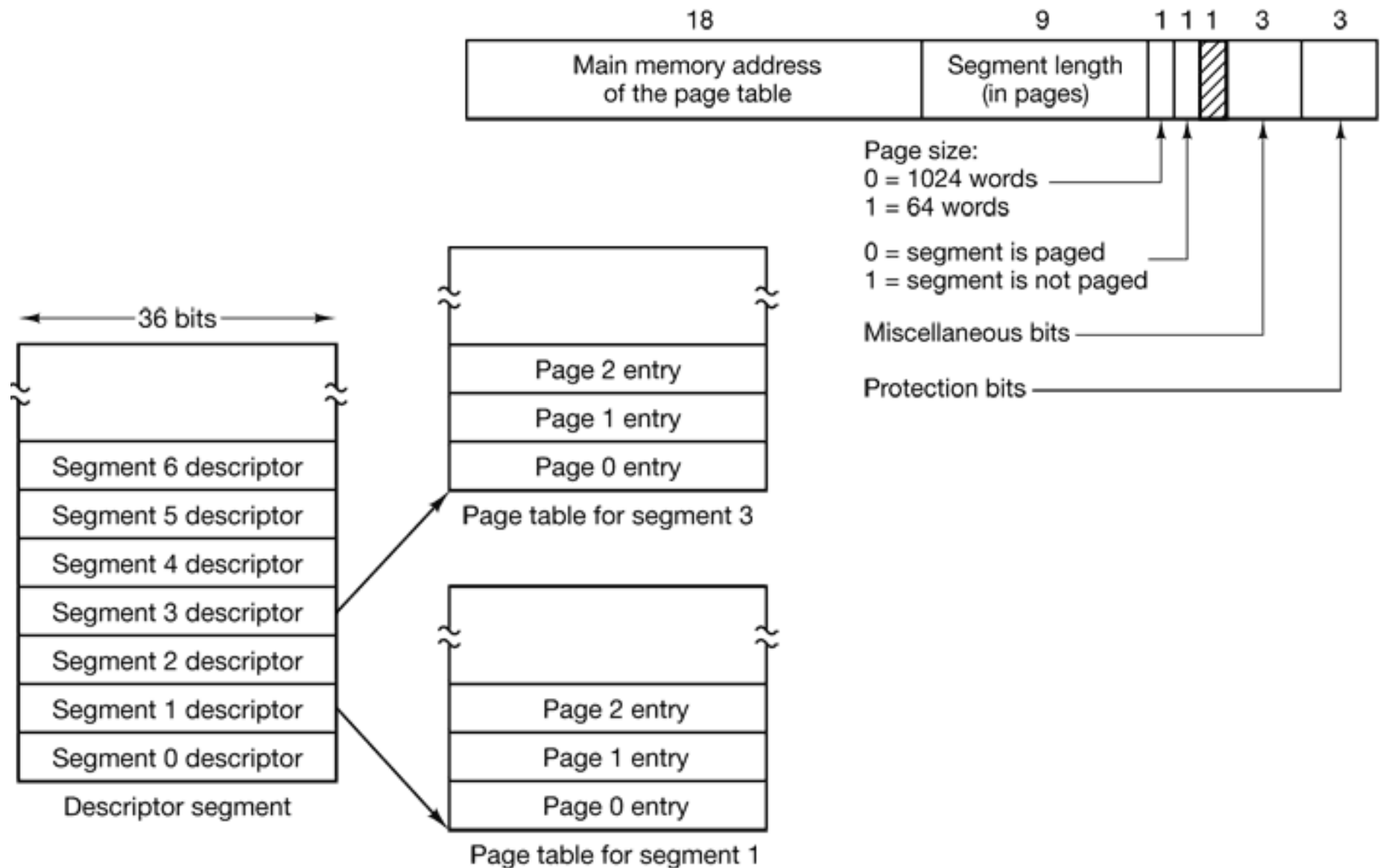
Page Table



Physical address



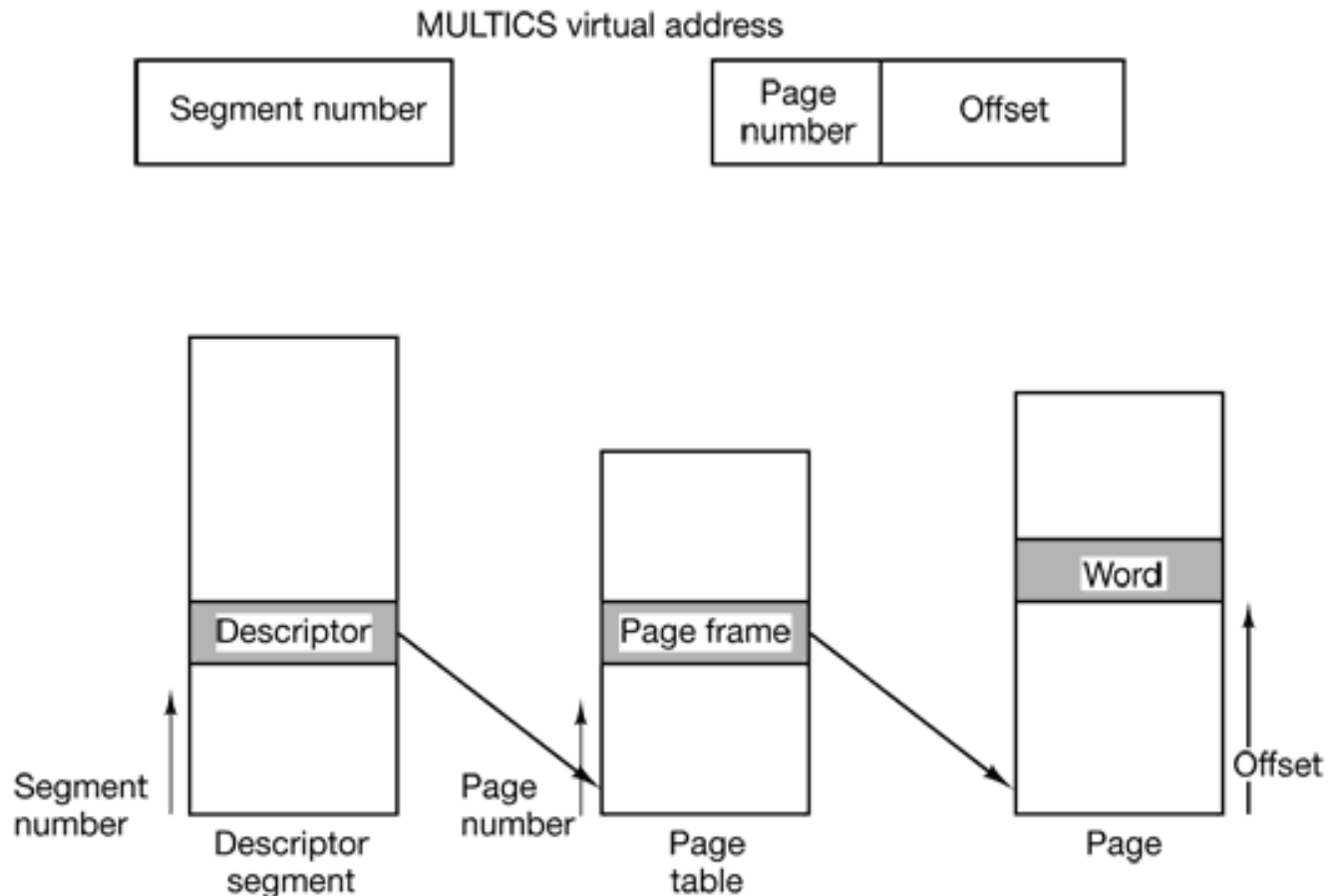
SEGMENTATION WITH PAGING: MULTICS ARCHITECTURE



- The MULTICS virtual memory. (a) The descriptor segment points to the page tables. (b) A segment descriptor. The numbers are the field lengths.



SEGMENTATION WITH PAGING: MULTICS



Comparison field		Page frame	Protection	Age	Is this entry used?
Segment number	Virtual page				↓
4	1	7	Read/write	13	1
6	0	2	Read only	10	1
12	3	1	Read/write	2	1
					0
2	1	0	Execute only	7	1
2	2	12	Execute only	9	1

- Multics maintains TLB with 16 most recently referenced pages.
- If the page is not in the TLB, the descriptor and page tables are actually referenced.



REFERENCES

- <http://www.osinfoblog.com/post/137/segmentation-with-paging:-the-intel-pentium/>
- <https://cs.nyu.edu/courses/spring09/V22.0202-002/lectures/lecture-22.html>
- <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKEwiogNWTgtnZAhVKuI8KHZTsBuYQFgg2MAI&url=http%3A%2F%2Fcodex.cs.yale.edu%2Favi%2Fos-book%2FOS9%2Fslide-dir%2FPPT-dir%2Fch8.ppt&usg=AOvVaw0ost8BSRngCvhYlC3V1Std>

