KARNAVATI UNIVERSITY

Operating Systems

Course Code: **71203002004**

Partition & Address Space Management

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Memory Management Allocation Methods

When a process needs memory, the OS must decide where to put it.

There are different ways to do this:

1. Single Contiguous Allocation – Only one program in memory at a time (used in old systems like MS-DOS).
2. Partitioned Allocation – Memory is divided into blocks/partitions. Each process gets one partition.
3. Paging – Memory is split into equal fixed-size blocks (pages & frames).
4. Segmentation – Memory is divided based on logical parts (like code, data, stack).

Modern OS uses Segmentation + Paging together.

Partition Allocation Methods

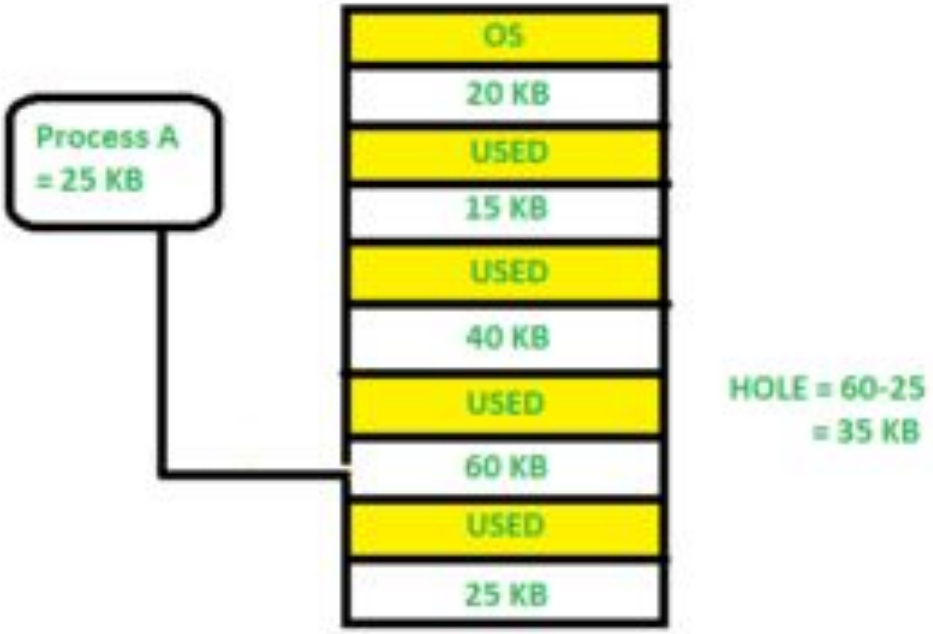
When a process arrives, OS must choose a partition to fit it.
There are 4 main strategies:

1. First Fit – Put the process in the first free block that is big enough. (Fast)
2. Best Fit – Find the smallest possible block that can hold the process. (Saves space but slow)
3. Worst Fit – Put the process in the largest available block. (Leaves big gaps)
4. Next Fit – Like First Fit, but starts searching from where the last allocation ended.

1. First Fit: In the first fit, the partition is allocated which is the first sufficient block from the top of Main Memory. It scans memory from the beginning and chooses the first available block that is large enough. Thus it allocates the first hole that is large enough.

2. Best Fit Allocate the process to the partition which is the first smallest sufficient partition among the free available partition. It searches the entire list of holes to find the smallest hole whose size is greater than or equal to the size of the process.

3. Worst Fit Allocate the process to the partition which is the largest sufficient among the freely available partitions available in the main memory. It is opposite to the best-fit algorithm. It searches the entire list of holes to find the largest hole and allocate it to process.



Comparison of Partition Allocation Methods

Partition Allocation Method	Advantages	Disadvantages
Fixed Partition	Simple, easy to use, no complex algorithms needed	Memory waste, inefficient use of memory resources
Dynamic Partition	Flexible, more efficient, partitions allocated as required	Requires complex algorithms for memory allocation
Best-fit Allocation	Minimizes memory waste, allocates smallest suitable partition	More computational overhead to find smallest split
Worst-fit Allocation	Ensures larger processes have sufficient memory	May result in substantial memory waste
First-fit Allocation	Quick, efficient, less computational work	Risk of memory fragmentation

Exercise: Consider the requests from processes in given order 300K, 25K, 125K, and 50K. Let there be two blocks of memory available of size 150K followed by a block size 350K.

Which of the following partition allocation schemes can satisfy the above requests?

A) Best fit but not first fit.
B) First fit but not best fit.
C) Both First fit & Best fit.
D) neither first fit nor best fit.

Solution:

Best Fit:
300K is allocated from a block of size 350K. 50 is left in the block.
25K is allocated from the remaining 50K block. 25K is left in the block.
125K is allocated from 150 K block. 25K is left in this block also.
50K can't be allocated even if there is 25K + 25K space available.

First Fit:
300K request is allocated from 350K block, 50K is left out.
25K is allocated from the 150K block, 125K is left out.
Then 125K and 50K are allocated to the remaining left out partitions.
So, the first fit can handle requests.

Logical vs Physical Address

1. Logical Address

- Generated by the CPU when a program runs.
- Also called Virtual Address.
- Seen by the process (user program).
- Does not exist physically in memory.
- The CPU uses this as a reference, which the OS + MMU (Memory Management Unit) later converts into a physical address.
- All logical addresses together = Logical Address Space.

Example: Suppose your program says “store data at address 1000” → that’s a *logical address*.

Logical vs Physical Address

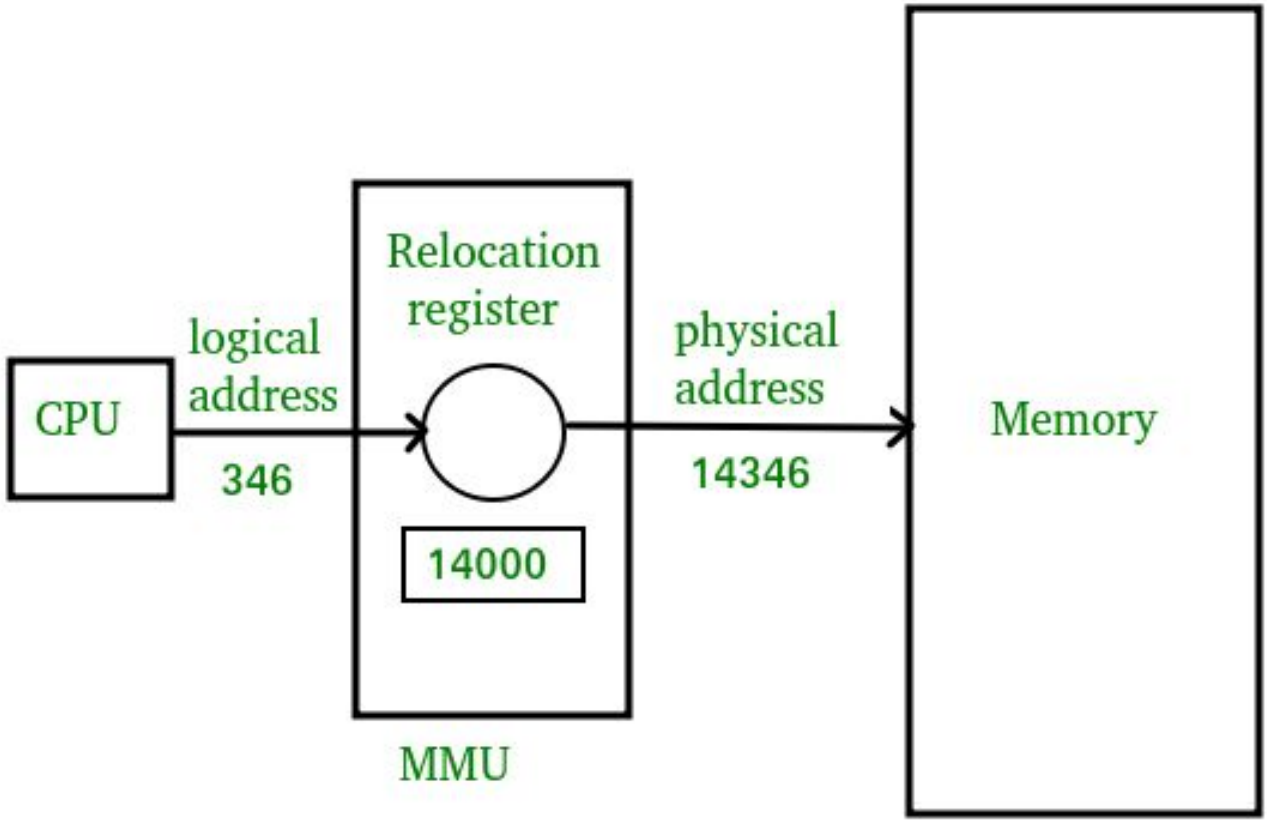
2. Physical Address

- The actual location in RAM (main memory) where data is stored.
- Managed by the MMU, not directly by the program.
- The user cannot see or directly access physical addresses.
- All physical addresses together = Physical Address Space.

Example: The MMU maps logical address 1000 → frame at 5000 in RAM. That's the *physical address*.

Important Points

1. **Abstraction** – Logical addresses give a process the feeling it has its own memory, without worrying about where data is actually stored in RAM.
2. **Mapping** – Logical addresses are converted to physical addresses using a page table.
3. **MMU Role** – The Memory Management Unit (MMU) performs this translation automatically and transparently (the program doesn't know it's happening).
4. **Efficiency** – This system allows the OS to use memory efficiently by applying paging and segmentation.
5. **Security & Protection** – Logical addressing prevents programs from directly accessing each other's memory (isolation).
6. **Flexibility** – Programs can be relocated in memory without changing the logical addresses, since mapping is handled by MMU.

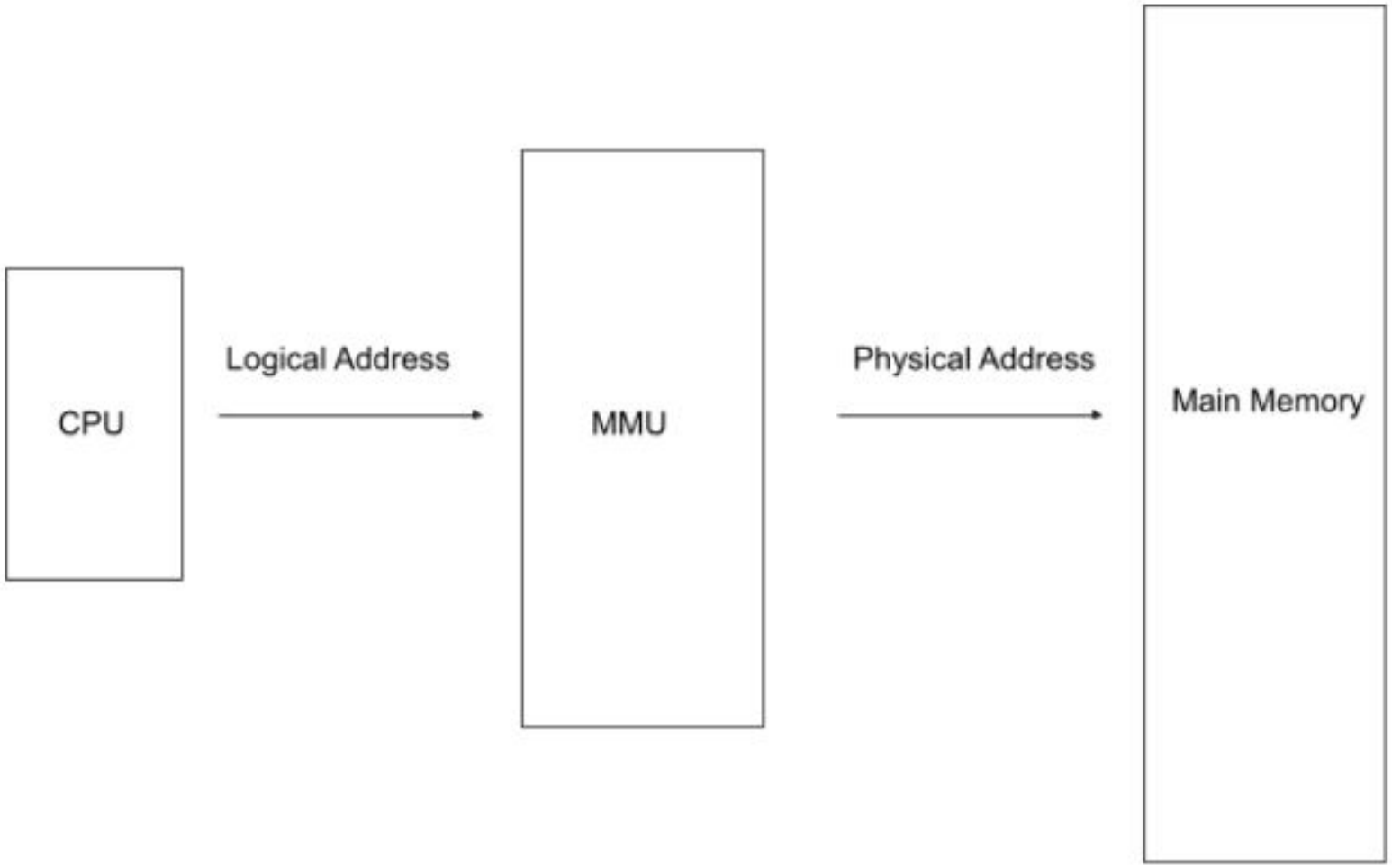

Relocation register
logical address
CPU
346
14000
physical address
14346
Memory
MMU

Role of MMU (Memory Management Unit)

- Hardware inside the CPU.
- Translates logical address → physical address using a **page table**.
- Ensures memory protection & efficient use of RAM.
- Transparent to the user (happens automatically).

Similarities

- Both identify a **memory location**.
- Both can be written in binary/hex/decimal.
- Both have a limited range (depends on number of bits).


CPU
Logical Address
MMU
Physical Address
Main Memory

Comparison of Logical & Physical Address

Parameter	Logical Address	Physical Address
Basic	Generated by CPU	Actual location in memory (RAM)
Other Name	Virtual Address	Real Address
Address Space	Set of all addresses generated by CPU (program's view)	Set of all addresses in RAM (hardware's view)
Visibility	Visible to the user/program	Hidden from the user
Generation	Created by CPU during execution	Computed by MMU (from logical address)
Access	User/program works with it	User cannot directly access
Editable	Can change (e.g., relocation, paging)	Fixed, does not change

DISCUSSION & REVISION

1. Which unit converts a logical address into a physical address?
2. Logical address is also called _____ address.
3. Physical address is also called _____ address.
4. Which partition allocation method chooses the first suitable free block?
5. Which allocation method chooses the smallest suitable free block?

REFERENCES

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