OPERATING SYSTEM

Page Table Entries (PTE)

Definition

A **Page Table Entry (PTE)** is a **single record in the page table** that stores information about **where a page of a process is located in physical memory** and **how it can be accessed**.

Each page in a process has **one corresponding page table entry**.

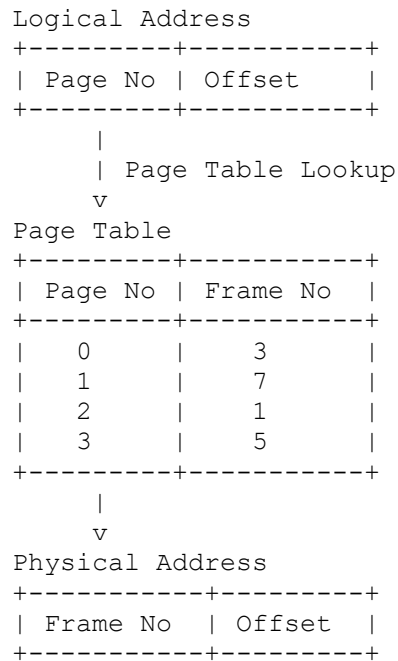## What Does a Page Table Entry Contain?

A typical **PTE** includes the following fields:

1. **Frame Number**
   - Indicates **which physical frame** holds the page
2. **Valid / Invalid Bit**
   - 1 → Page is present in memory
   - 0 → Page is not present (page fault)
3. **Protection Bits**
   - Read / Write / Execute permissions
4. **Modified (Dirty) Bit**
   - 1 → Page has been modified
   - 0 → Page not changed
5. **Reference (Accessed) Bit**
   - Set when the page is accessed
   - Used in page replacement algorithms

Simple Page Table Entry Format

```
+------------------------------------------------+
| Frame No | Valid | R/W/X | Dirty | Reference   |
+------------------------------------------------+
```

Paging with Page Table – Diagram

```
Logical Address
+--------+-----------+
| Page No | Offset    |
+--------+-----------+
     |
     | Page Table Lookup
     v
Page Table
+--------+-----------+
| Page No | Frame No  |
+--------+-----------+
|   0    |    3      |
|   1    |    7      |
|   2    |    1      |
|   3    |    5      |
+--------+-----------+
     |
     v
Physical Address
+----------+---------+
| Frame No  | Offset  |
+----------+---------+
```

Step-by-Step Working

1. CPU generates a **logical address**
2. Logical address is divided into:
   a. **Page number**
   b. **Offset**
3. Page number indexes the **page table**
4. Page table entry gives the **frame number**
5. Frame number + offset forms the **physical address**

Why Page Table Entries Are Important

- Enable **address translation**
- Support **memory protection**
- Help detect **page faults**
- Used in **page replacement algorithms**

Offset is the part of a logical address that specifies the exact location within a page. During address translation, the offset remains unchanged and is combined with the frame number to form the physical address.

A page table entry (PTE) stores information about a page, including its frame number, validity, protection bits, and status bits. It is used by the operating system to translate logical addresses into physical addresses and manage memory efficiently.