

Operating System: Performance of Paging & TLB

By: Vishvadeep Gothi



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Time Required in Paging

Effective mem. access time = Page table access time + Content access time from m.m.

By default P.T. is stored in mm

$$T_{eff.} = 2t_{mm}$$

t_{mm} = mm access time

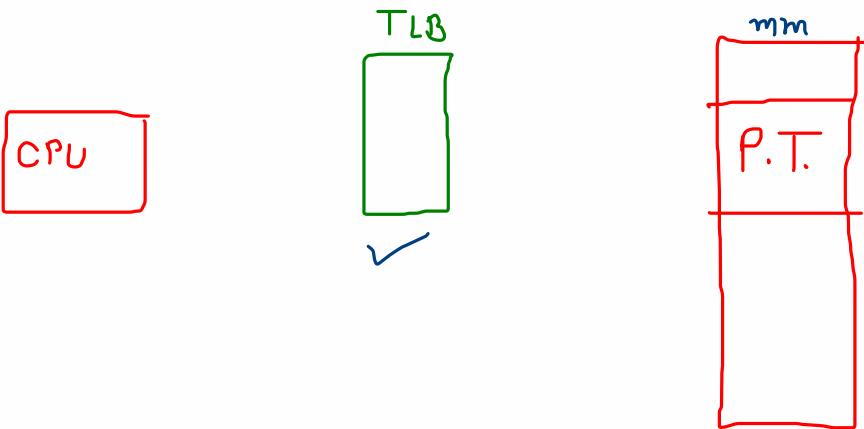
Special case:- If P.T. is very small and is stored in register

$$T_{eff} = t_{mm}$$

Reg. access time is negligible.

Performance Improvement

→ TLB is used to improve the performance of paging



TLB (Translation lookaside buffer)

TLB

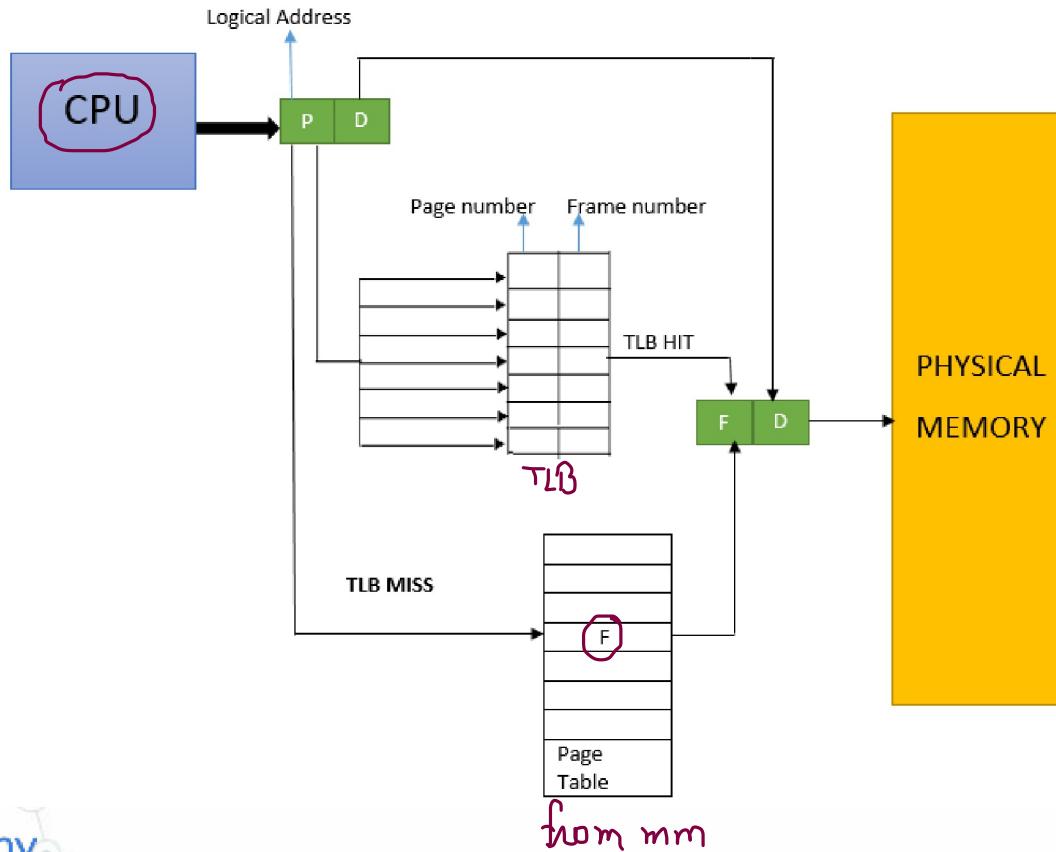
A translation lookaside buffer is a memory hardware that is used to reduce the time taken to access a user memory location

It stores few frequently accessed page-table entries so that CPU can get physical add. w/o accessing the mm in less time.

TLB hit = Required P.T. entry is present in TLB

TLB miss = ————— "————— not —————

TLB



Effective Access Time With TLB

$$T_{\text{effective}} = H * (t_{\text{TLB}} + t_{\text{mm}}) + (1-H) (t_{\text{TLB}} + 2*t_{\text{mm}})$$

\downarrow \downarrow \downarrow \downarrow

Translat'n Content to ensure
it's a miss Translat'n
Content

$$= H t_{\text{TLB}} + H t_{\text{mm}} + t_{\text{TLB}} - H t_{\text{TLB}} + t_{\text{mm}} - H t_{\text{mm}} +$$
$$t_{\text{mm}} - H t_{\text{mm}}$$

$$\boxed{T_{\text{effective}} = t_{\text{TLB}} + t_{\text{mm}} + (1-H) t_{\text{mm}}}$$



Question

Main memory access time = 300ns

TLB access time = 20ns

TLB Hit ratio = 80%

Effective memory access time?

$$= 0.8 * (20 + 300) + 0.2 * (20 + 2 * 300)$$

$$= 380 \text{ nsec}$$

$$= 20 + 300 + 0.2 * 300$$

$$= 380 \text{ nsec}$$

Question

Consider a system using TLB for paging with TLB access time of 40ns. What hit ratio is ~~needed~~ used for TLB to reduce the effective memory access time from 400ns to 280ns?

$$t_{TLB} = 40 \text{ nsec}$$

$$H = ?$$

$$t_{eff} = 280 \text{ nsec}$$

$$280 = 40 + 200 + (1-H) * 200$$

$$H = 0.8$$

$$t_{eff \text{ w/o TLB}} = 400 \text{ nsec} = 2 * t_{mm}$$

$$t_{mm} = 200 \text{ nsec}$$

Next Class

TLB Implementation

✓ TLB Mappings & Tag



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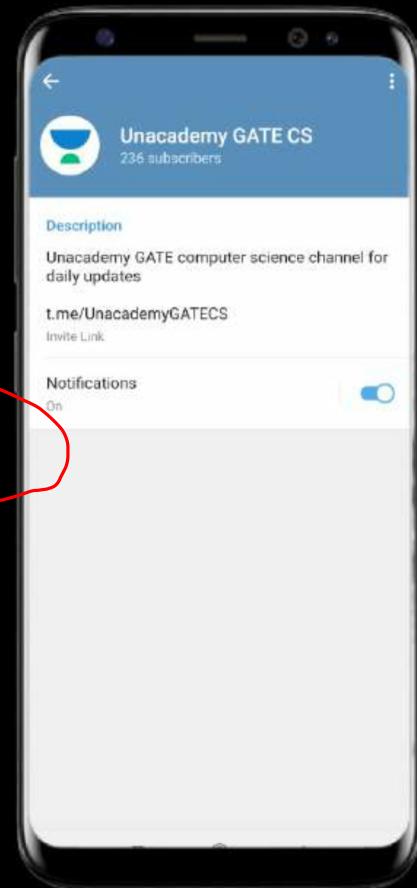
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