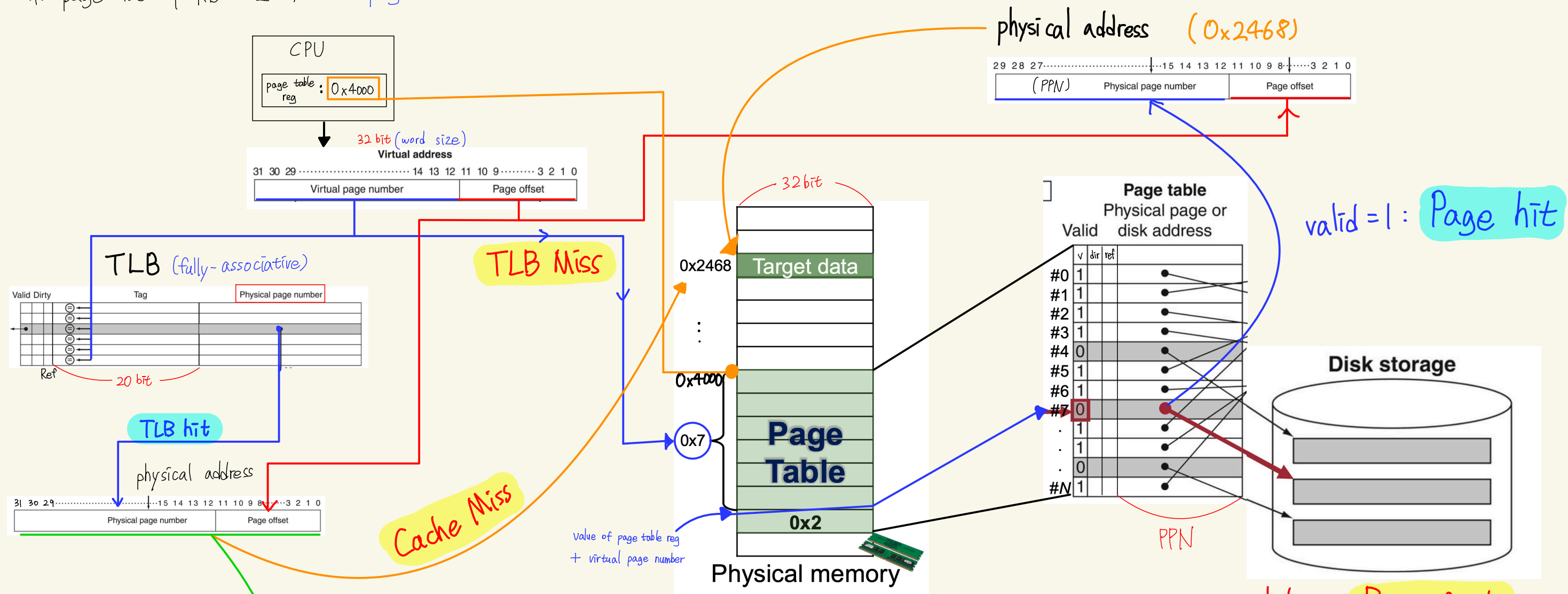
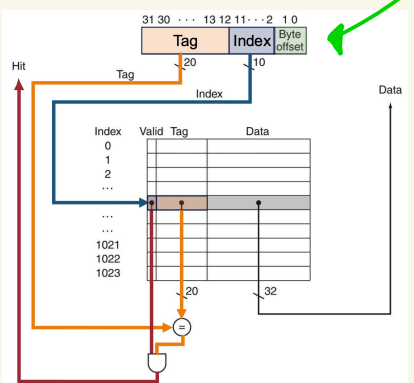


- * word size = 4 byte = 32 bit \Rightarrow byte offset = 2 bit
 - * physical memory size = 1 GB = 2^{30} byte \Rightarrow physical address = 30 bit
 - * page size = 4 KB = 2^{12} byte \Rightarrow page offset = 12 bit
- physical page number = 18 bit



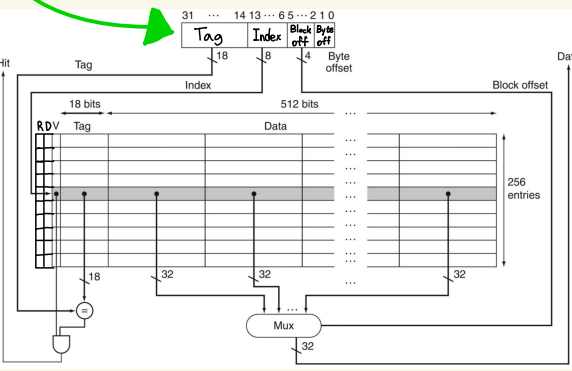
• Cache

- ① Direct \rightarrow spatial locality X
Write through, not LRU
block size: 1 word \rightarrow block offset = 0
entries: $1024 = 2^{10} \rightarrow$ index = 10 bit



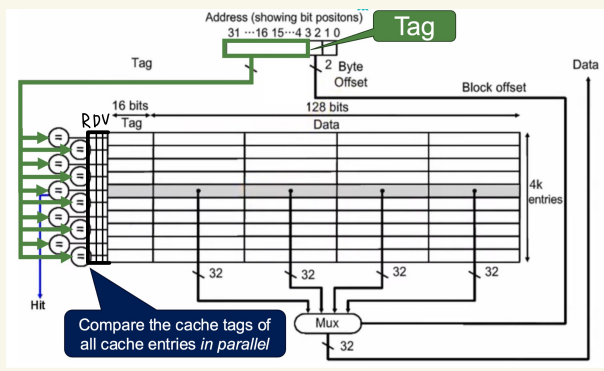
Tag: $32 - 10 - 0 - 2 = 20$
Cache size:

- ② Direct (several words) spatial locality \uparrow , index \downarrow
Write back, using LRU
block size: 16 word = $2^4 \rightarrow$ block offset = 4 bit
entries: $256 = 2^8 \rightarrow$ index = 8 bit



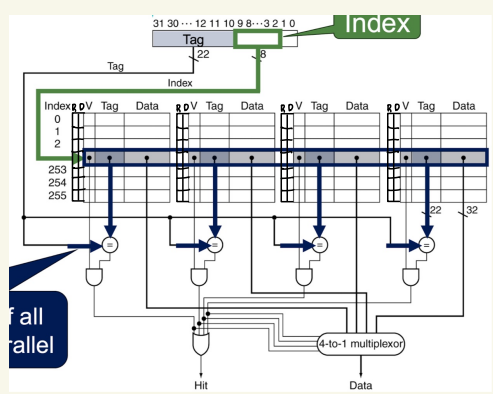
Tag = $32 - 8 - 4 - 2 = 18$ bit
Cache size = $(1+1+18+32 \cdot 16) \cdot 256$ bit

- ③ Fully associative
• Write back, using LRU
• block size: 4 word = $2^2 \rightarrow$ block offset = 2 bit
• entries: 4 K \rightarrow index $\frac{32}{8}$ 모든 entry 비교



Tag = $32 - 2 - 2 = 28$ bit
Cache size = $(1+1+16+32 \cdot 4) \cdot 4$ k bit

- ④ 4-way Set-associative
• Write back, using LRU
• block size: 1 word = $2^0 \rightarrow$ block offset = 0 bit
• 1024 blocks \rightarrow 4-way 4k $1024 \div 4 = 256$ entries



Tag = $32 - 8 - 2 = 22$ bit
Cache size = $1024 \times (1+1+1+22+32)$ bit