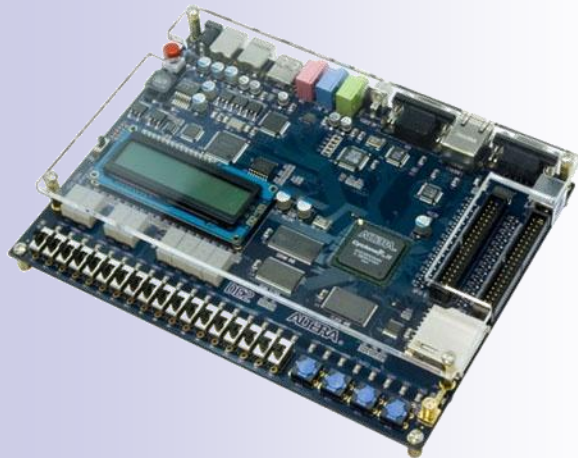


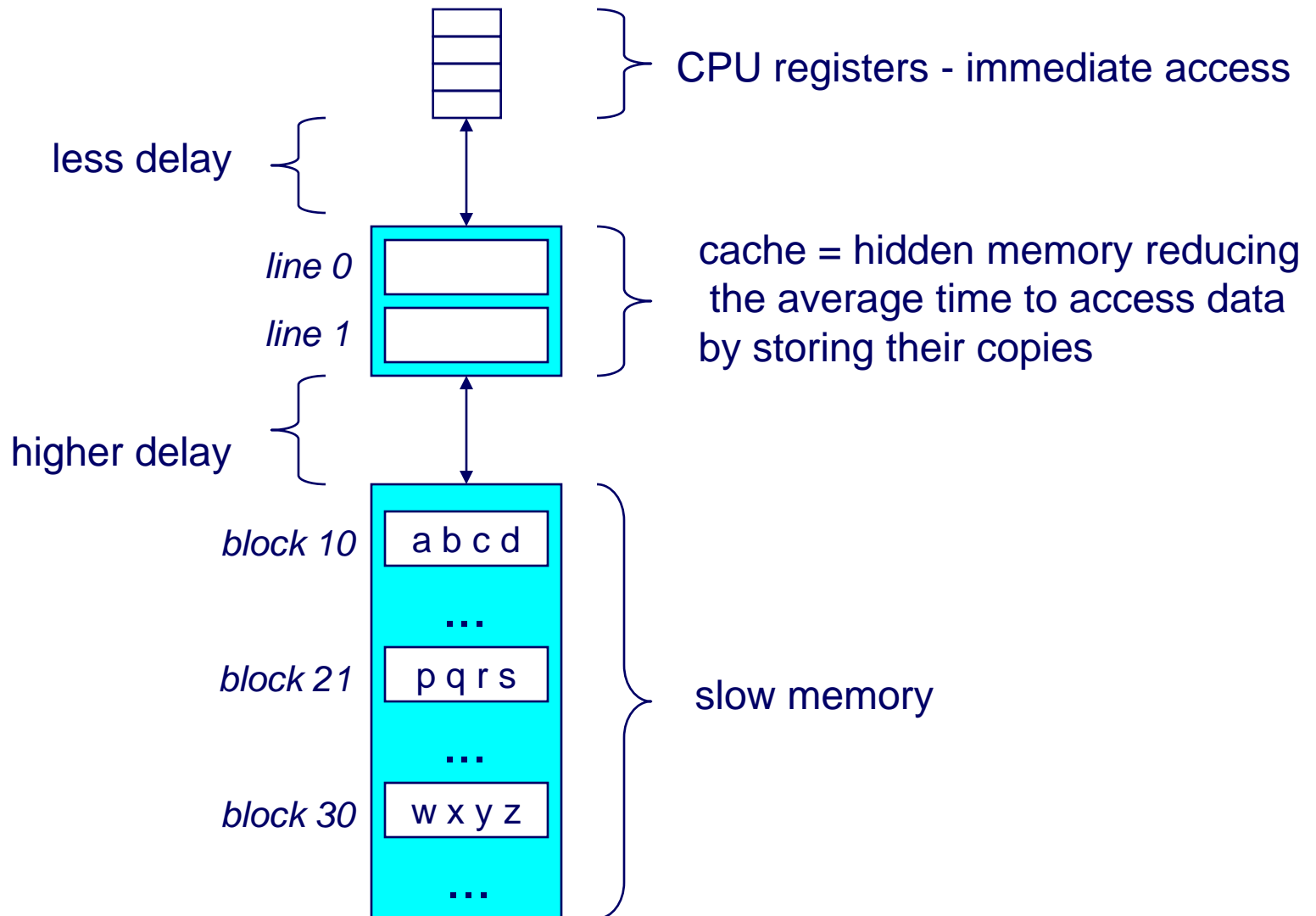
Selection from MIT:Computer Architecture and Organization FEL:Architektury počítačů

Version: 1.0



ČVUT-FEL in Prague,

Hidden memory- cache



Cache - etymology



cache (noun) "hiding place"

- from French Canadian trappers' slang, "hiding place for stores"
- from French *cache* "to hide, conceal"
- from Vulgar Latin **coacticare* "store up, collect, compress"
- related to Latin *cogere* "to collect"
- sense extended by 1830s to "anything stored in a hiding place."

General organization of cache

Cache is field of **S sets**

Each set contains **E rows (blocks)**

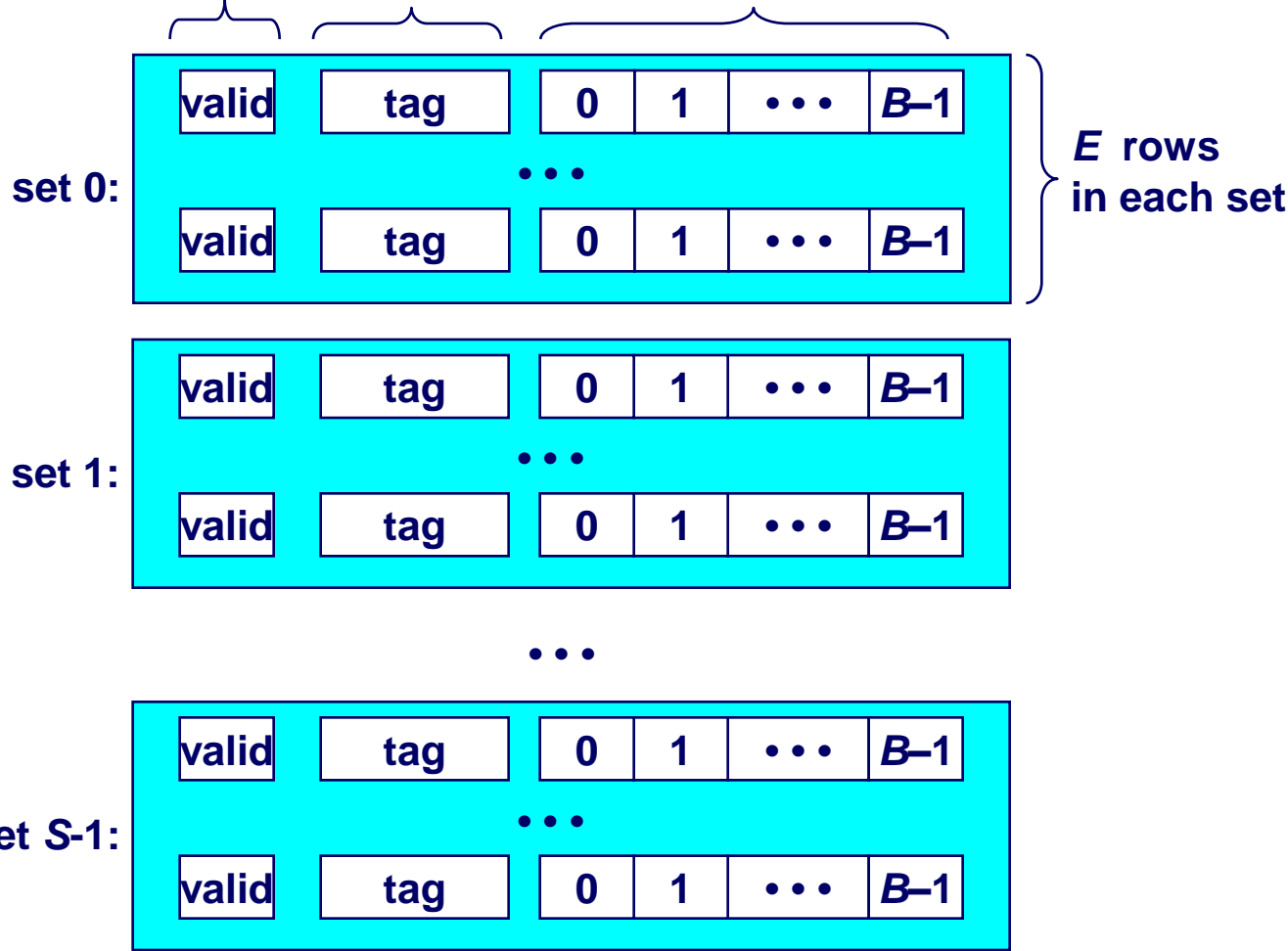
Each block has **B words/columns**

$S = 2^s$ sets

Set # \equiv hash code

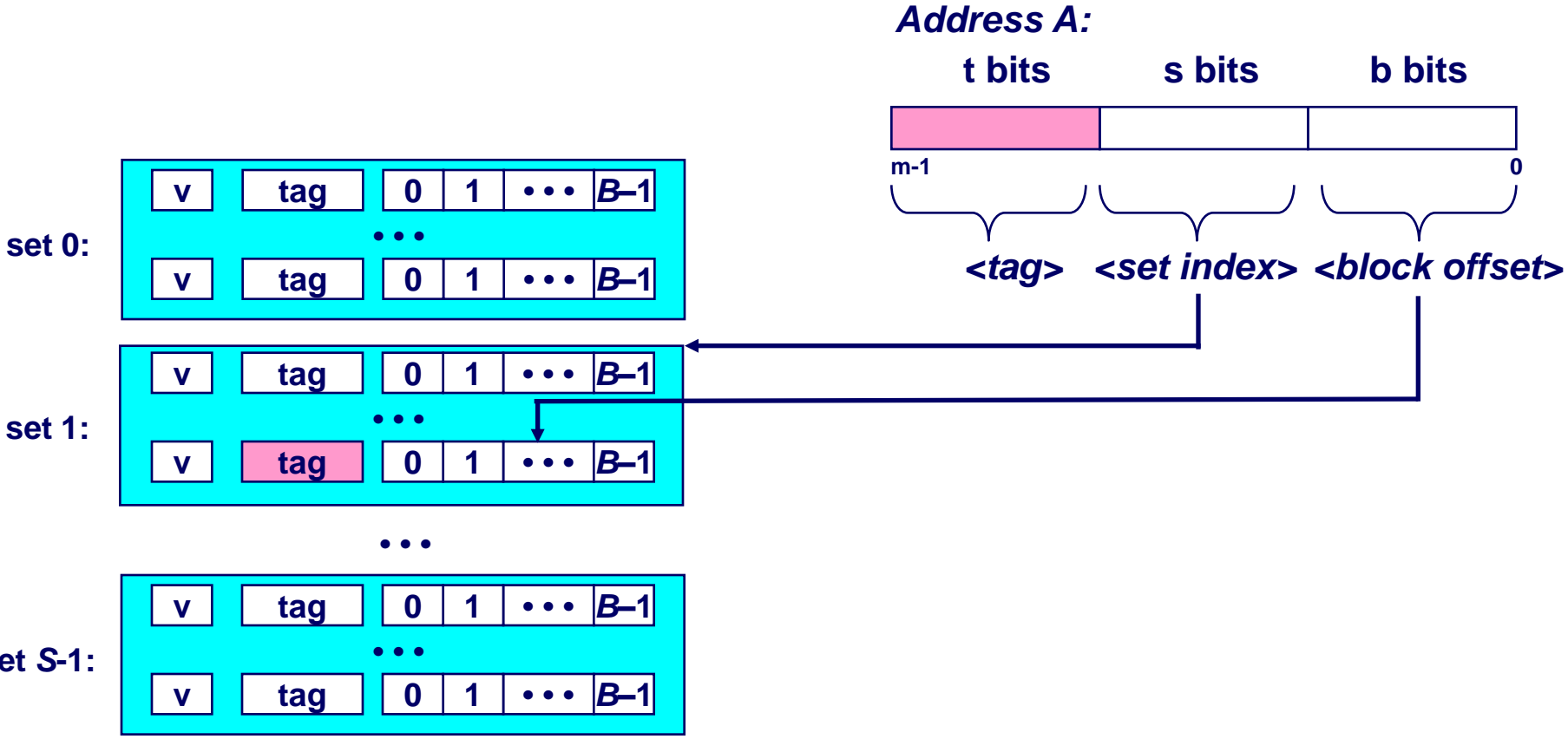
Tag \equiv hash key

1 valid bit in each row t tag bits in each row $B = 2^b$ columns (size of block) in each row



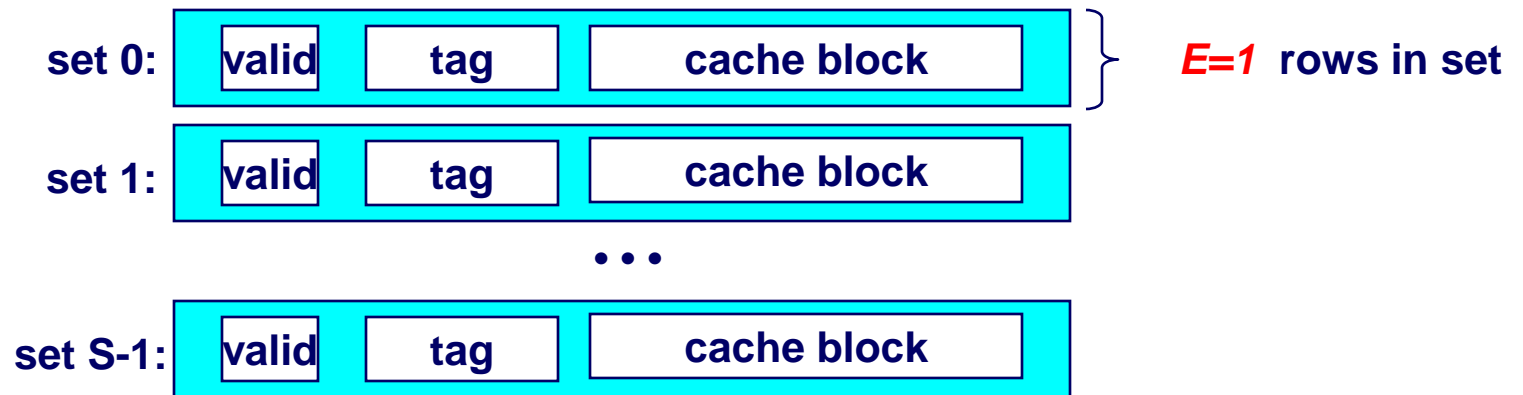
Size: $C = B \times E \times S$ words

Addressing cache



Direct-Mapped Cache

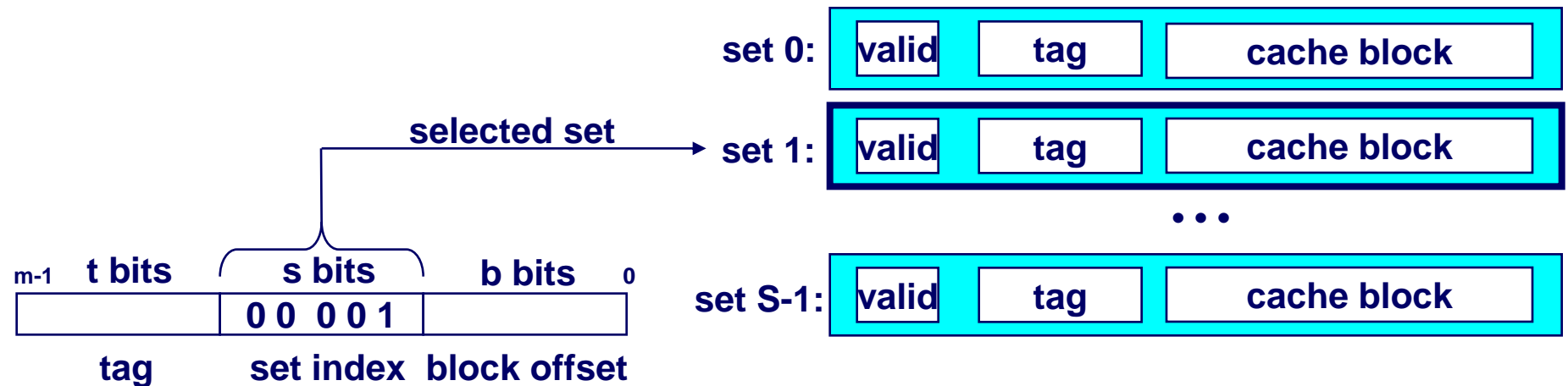
only **1** row (**block**) in each **set**



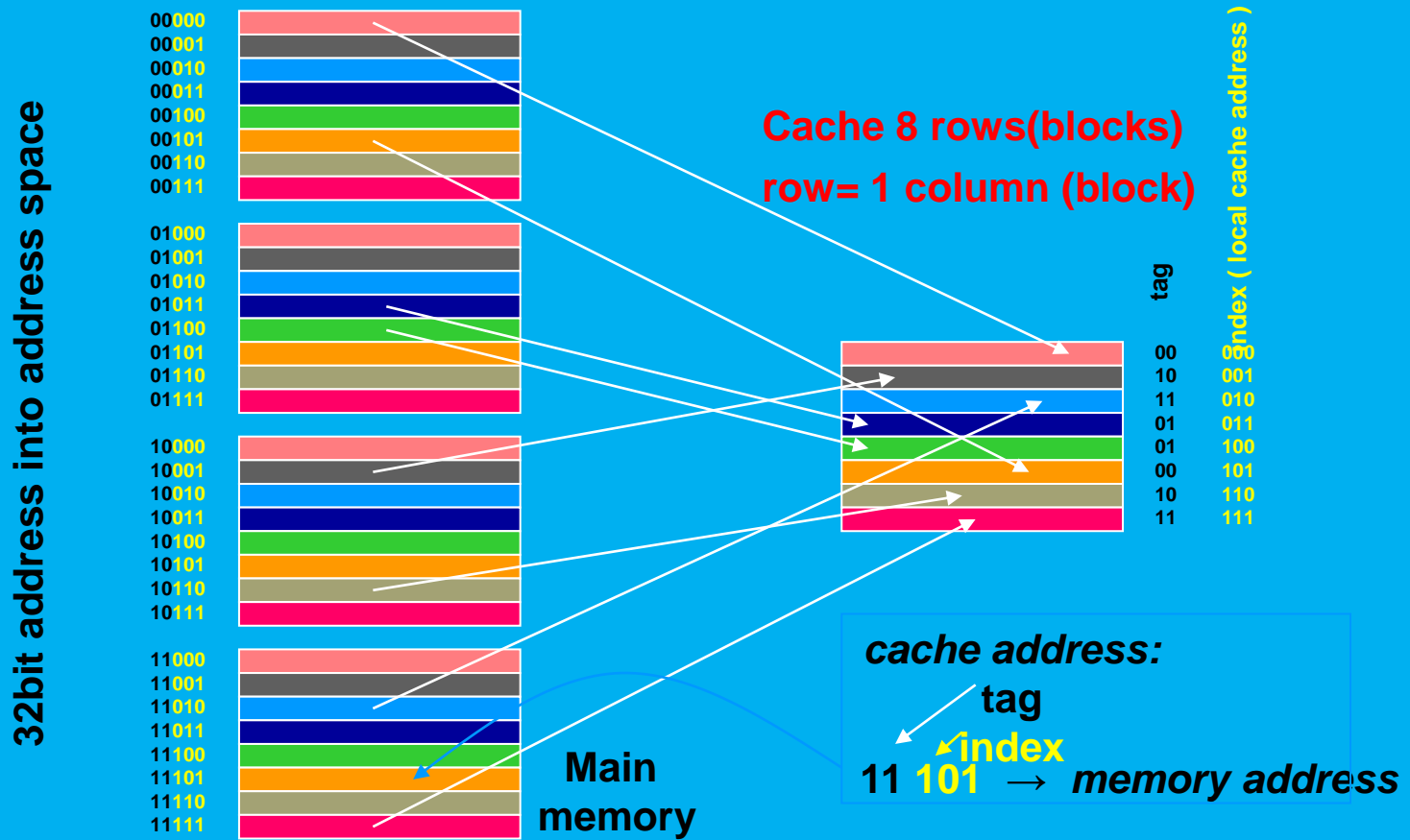
Accessing Direct Mapped Cache

Set selection

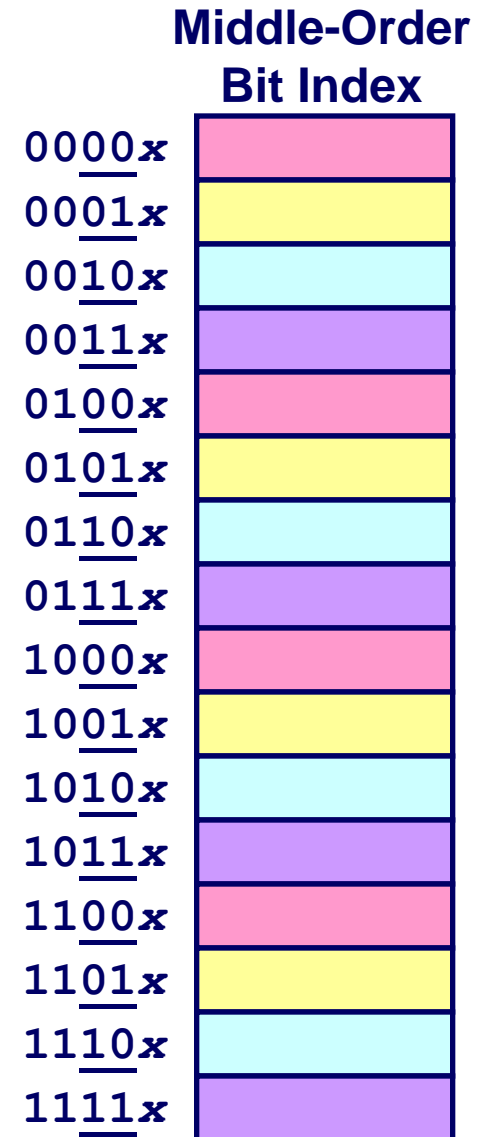
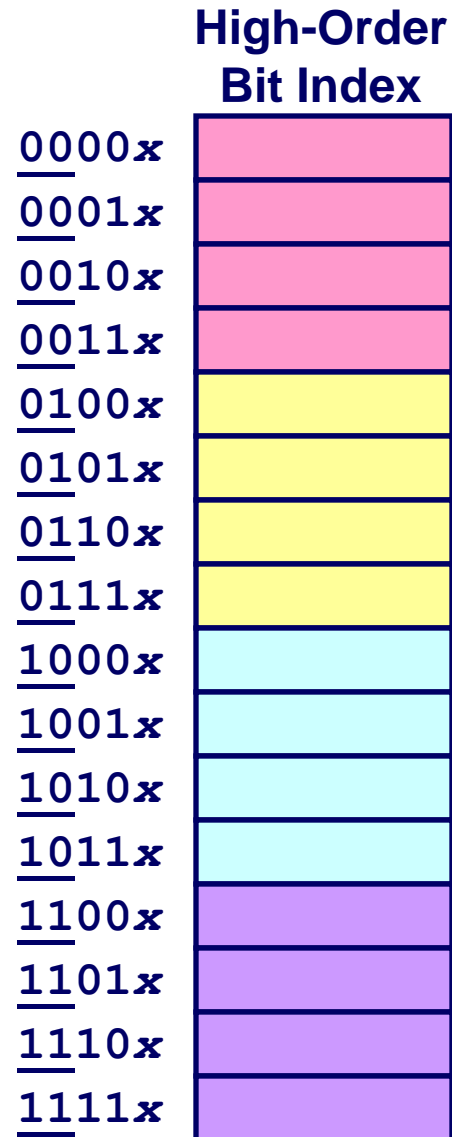
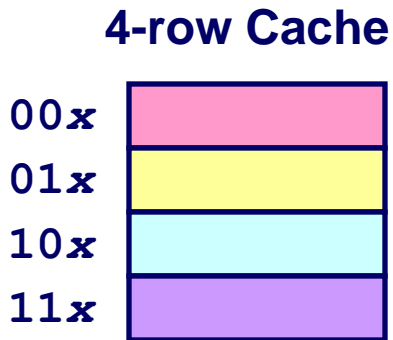
- index of set directly determines destination



Direct-Mapped Cache

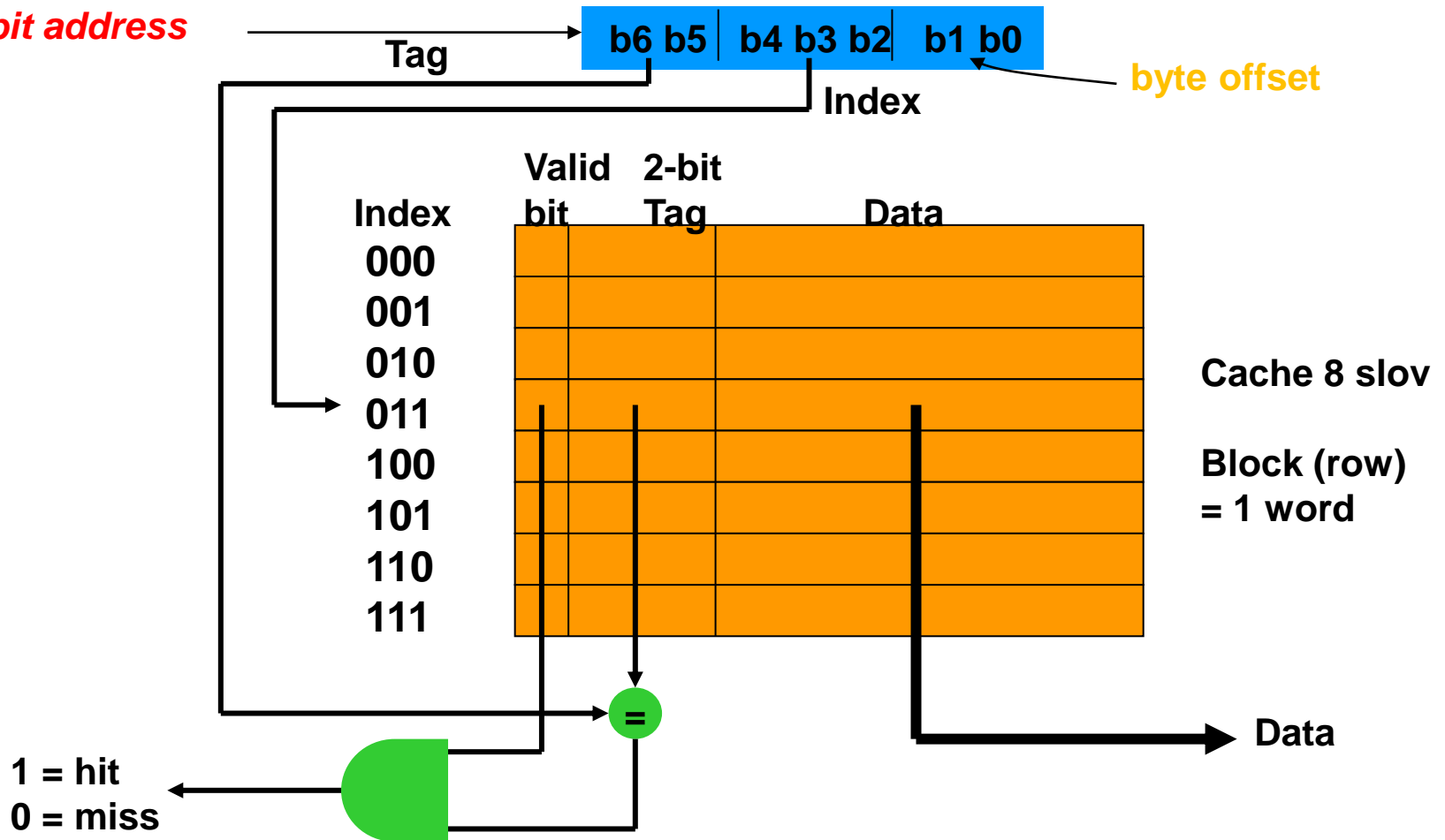


Why do we use middle bits?



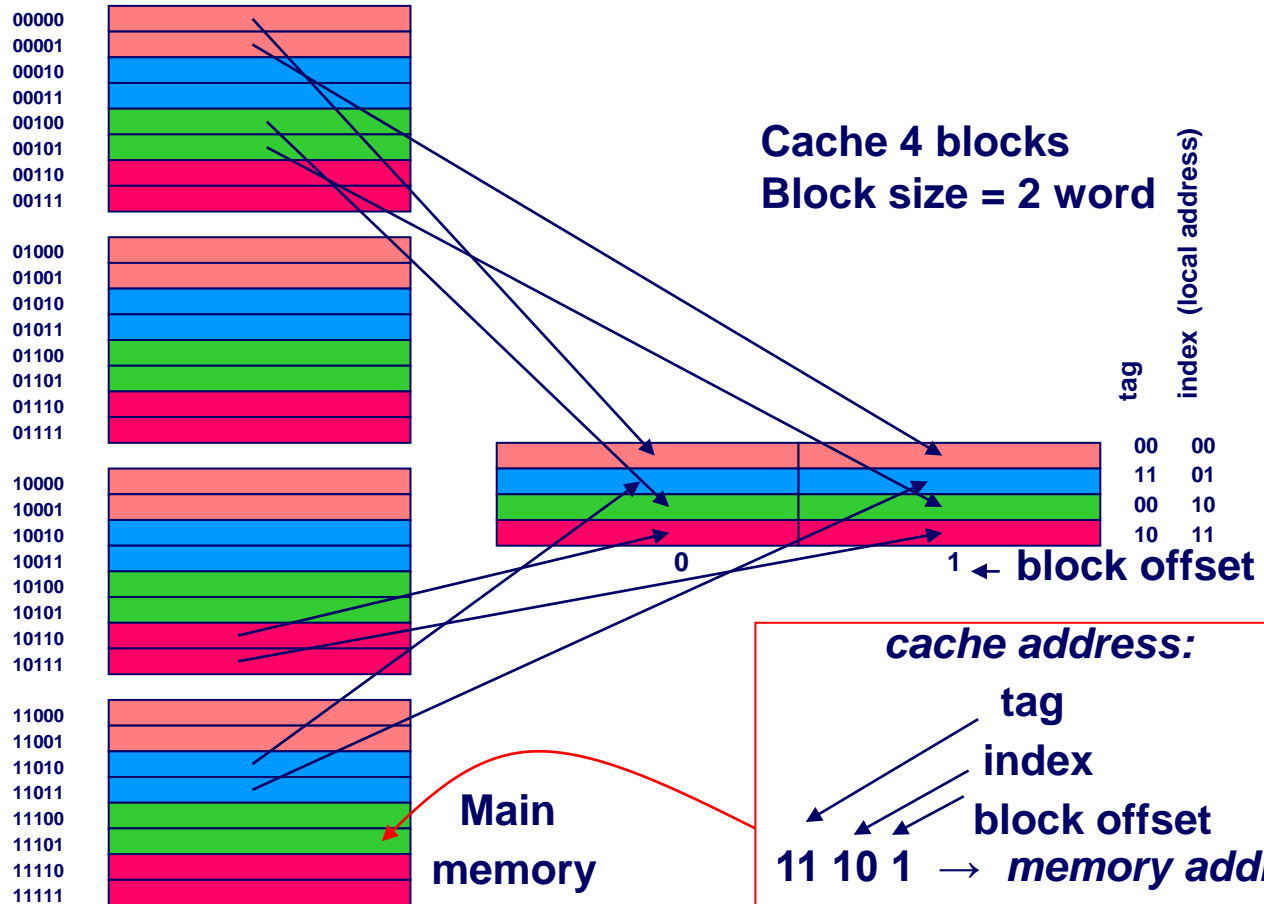
Selections of words

32bit address

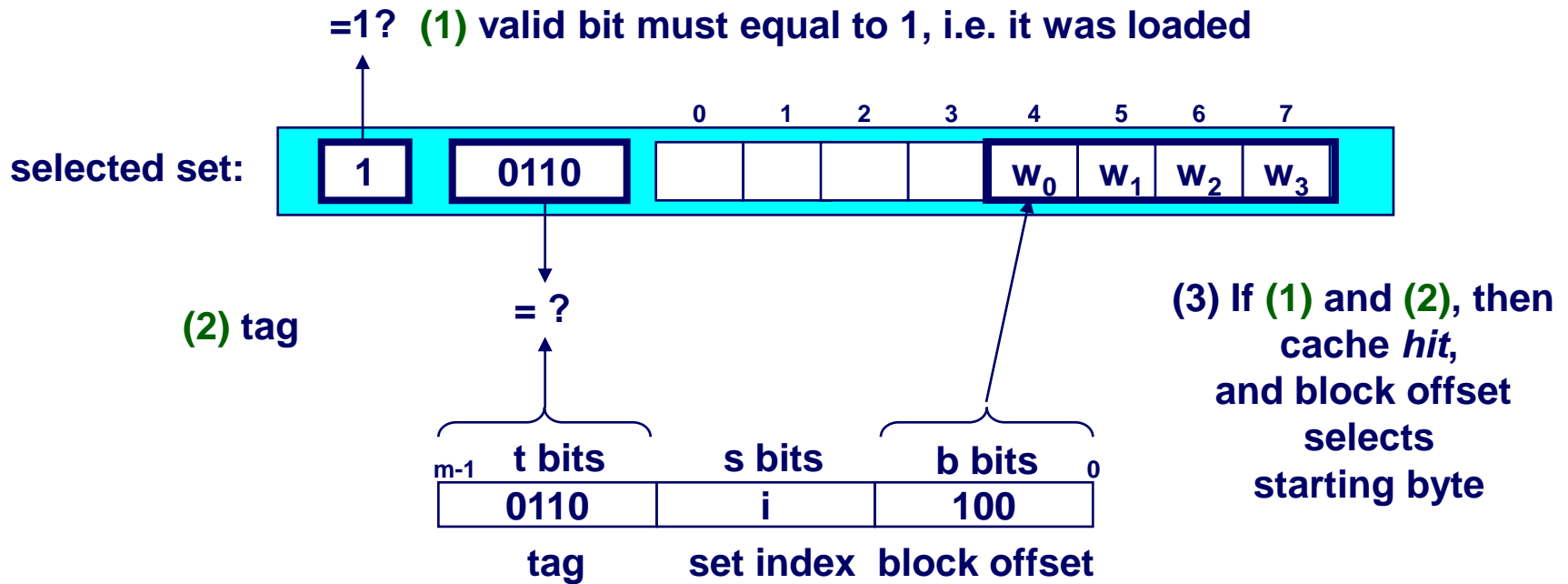


Direct-Mapped Cache

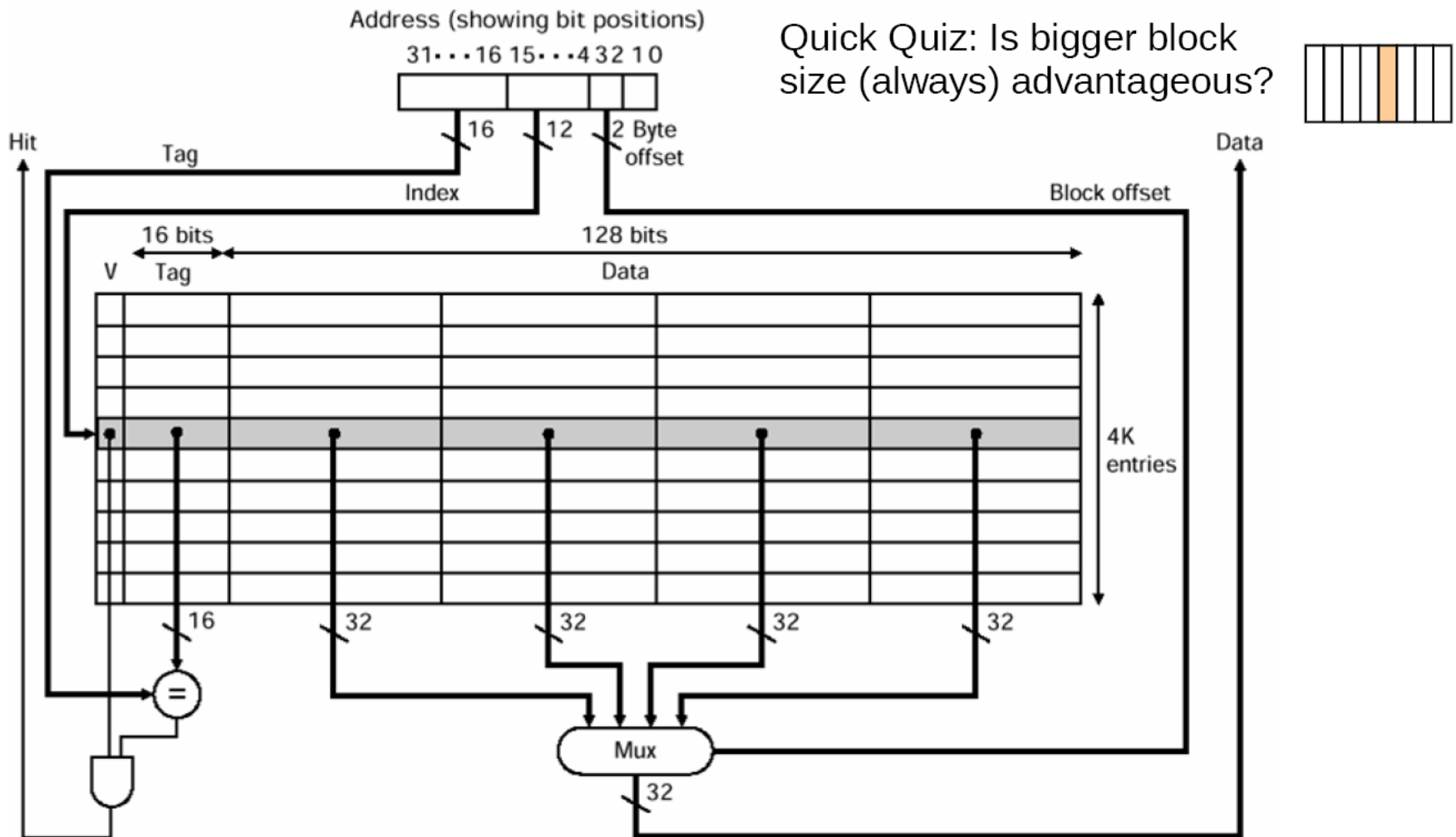
32-word word-addressable memory



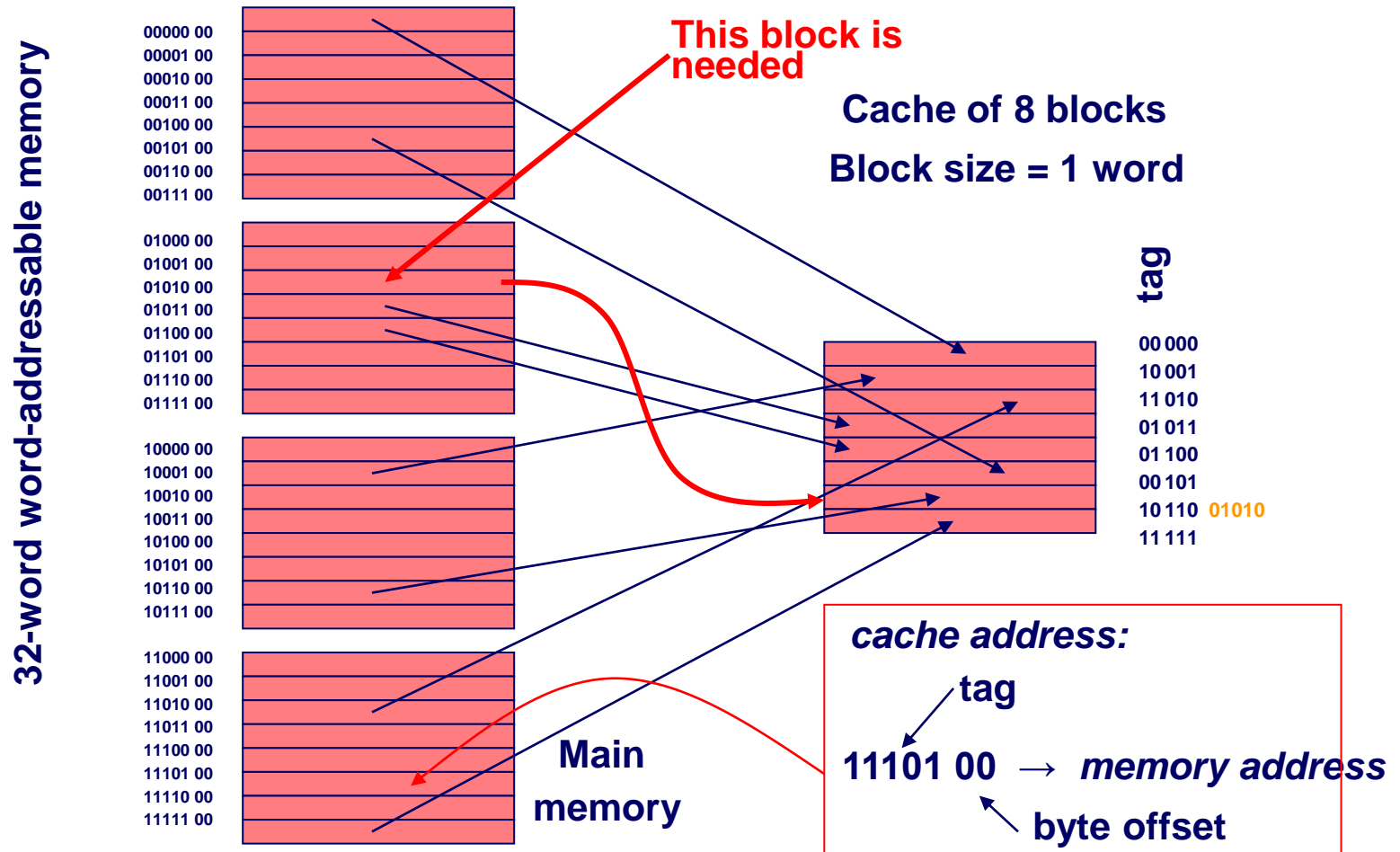
Accessing Direct-Mapped Cache



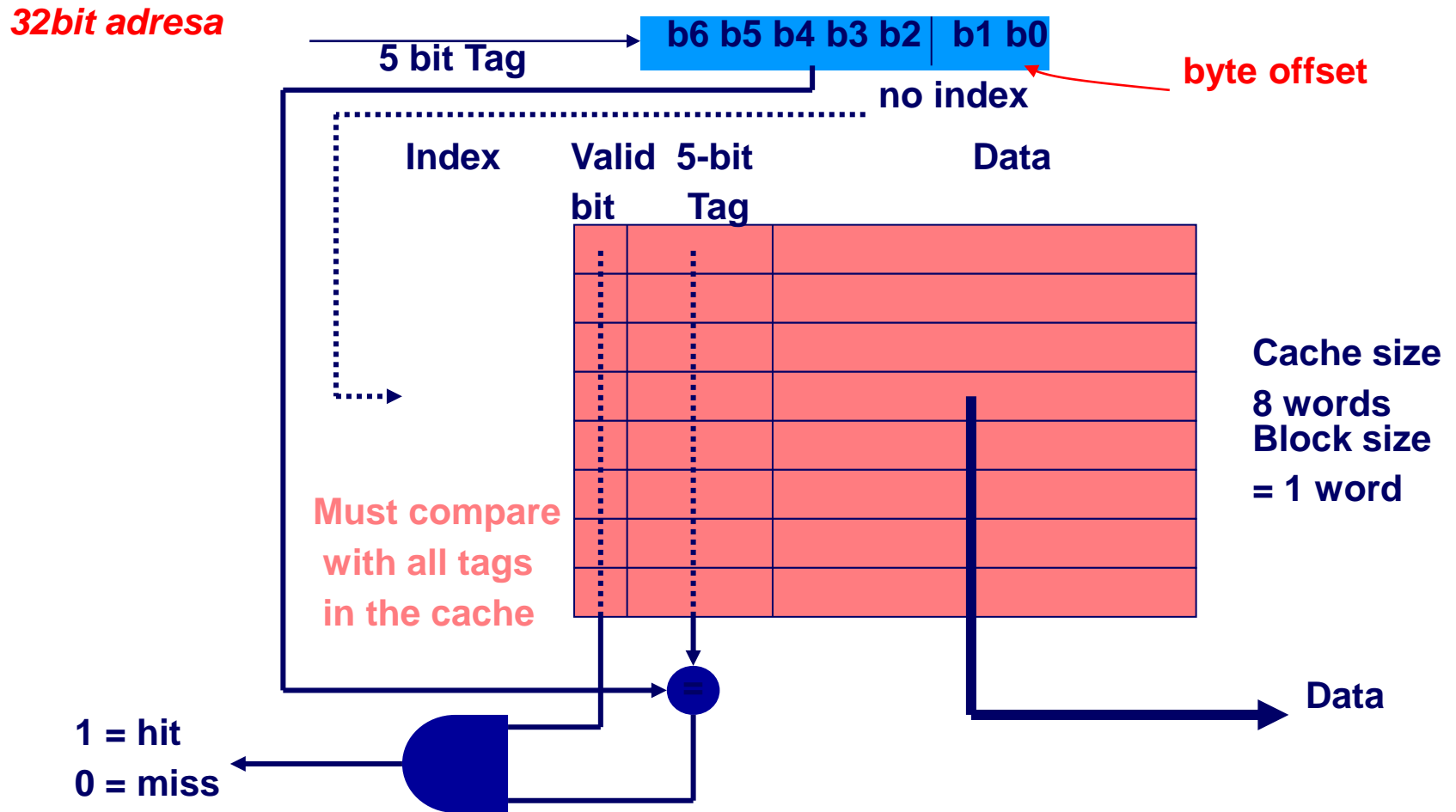
Direct mapped cache implementation



Fully-Associative Cache (8-Way Set Associative)

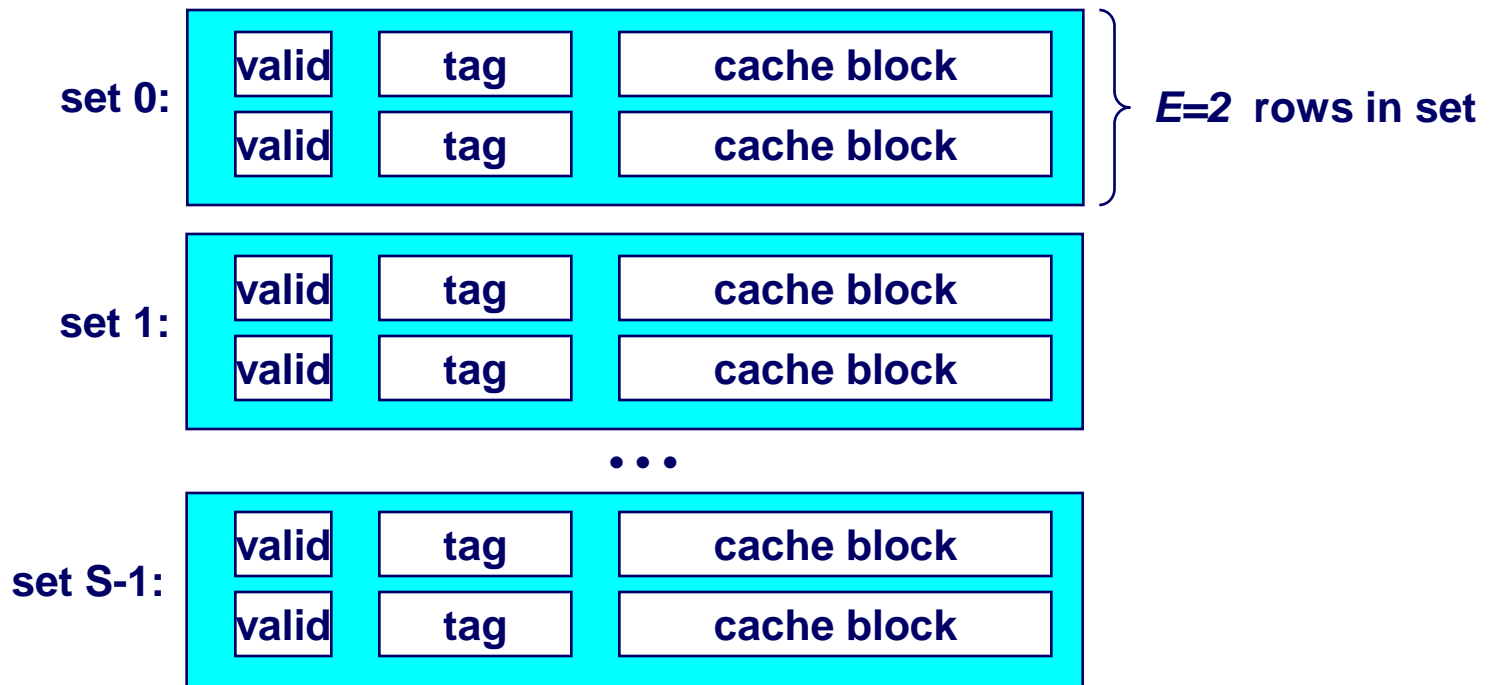


Finding a Word in Fully Associative Cache

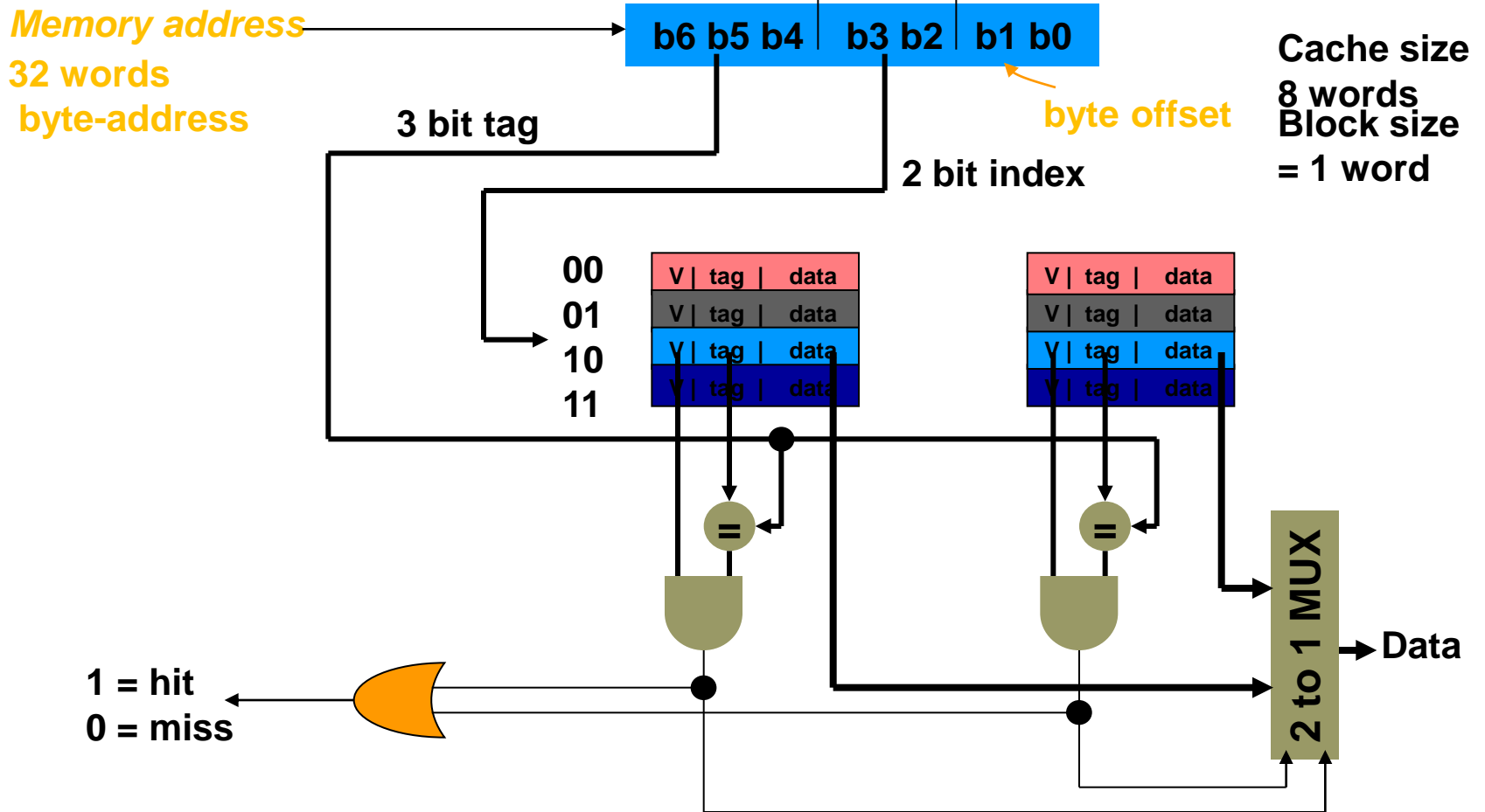


Set-Associative Cache with N-way set

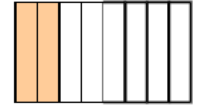
More rows (blocks) in set (set)



Two-Way Set-Associative Cache



2-way set associative cache



Capacity – C

Number of sets – S

Block size – b

Number of blocks – B

Degree of associativity – N

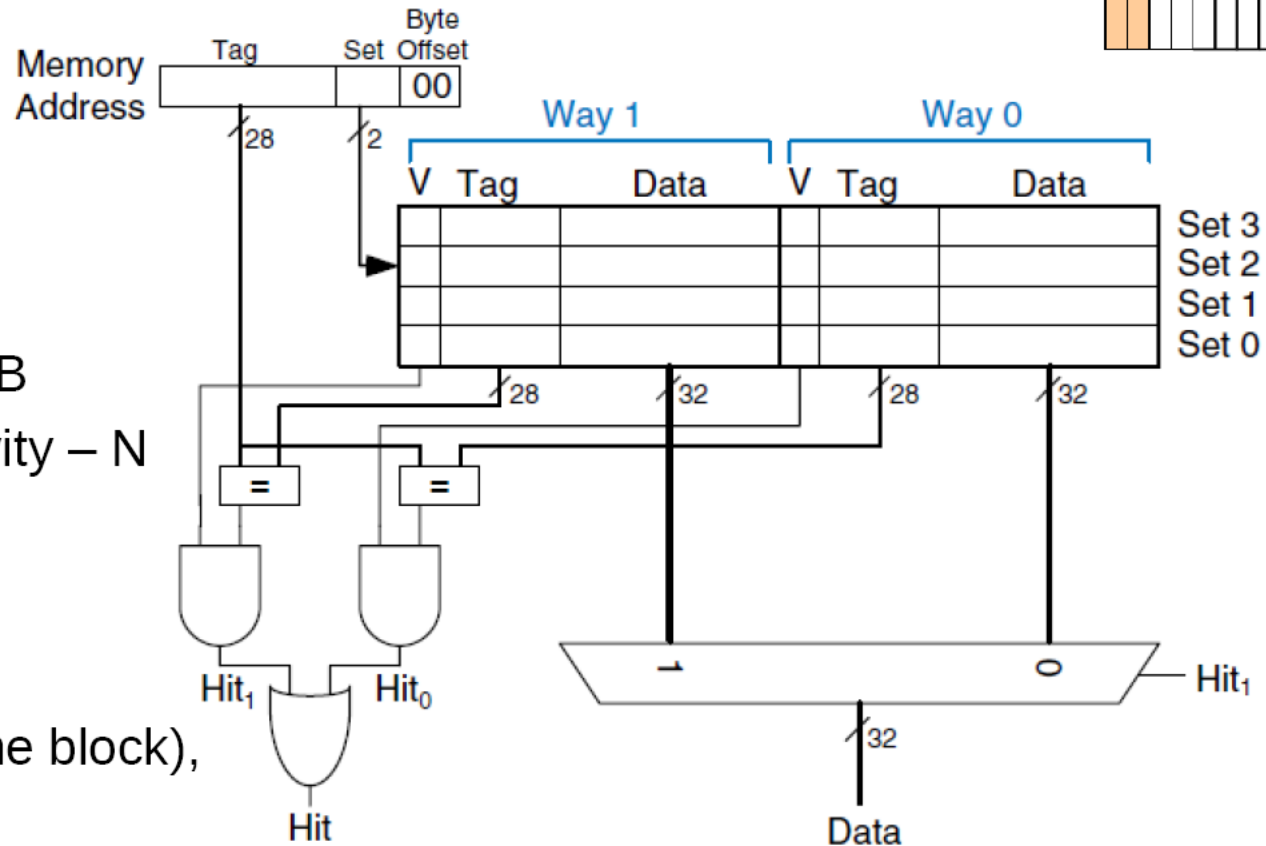
$C = 8$ (8 words),

$S = 4$,

$b = 1$ (one word in the block),

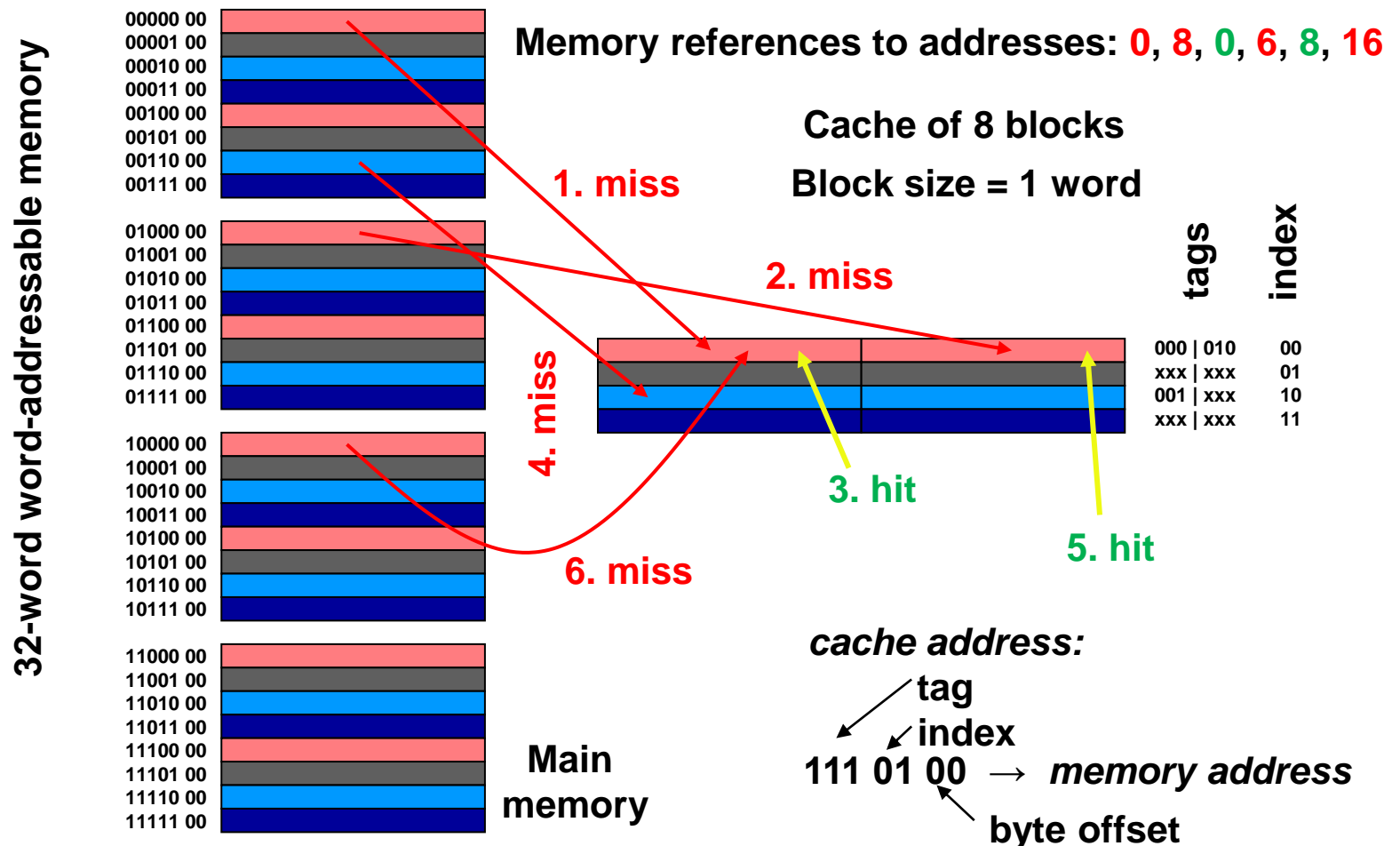
$B = 8$

$N = 2$



What is main advantage of higher associativity?

Miss Rate: Two-Way Set-Associative Cache



Eight-Way Set-Associative Cache

