Flat page table example

Memory Size= 7 bits=> 2**7 = 126 bytes in my memory
Frame/page size=> number of bits per frame=> want 16 bytes/page
=> ln base 2 of 16 = 4 bits
Can address up to 2**3 VP's

0000000

VP # offset

What is the valid range of virtual addresses?
For P1 ->7 bit system, virtual addresses can go from
000 0000->010 1111 (see valid bits)
For P2
000 0000->001 1111

Page Table P1

VP #	valid	PP
0=000	1	2=010
1=001	1	5=101
2=010	1	3=011
3=011	0	
4	0	
5	:	
6		
7		

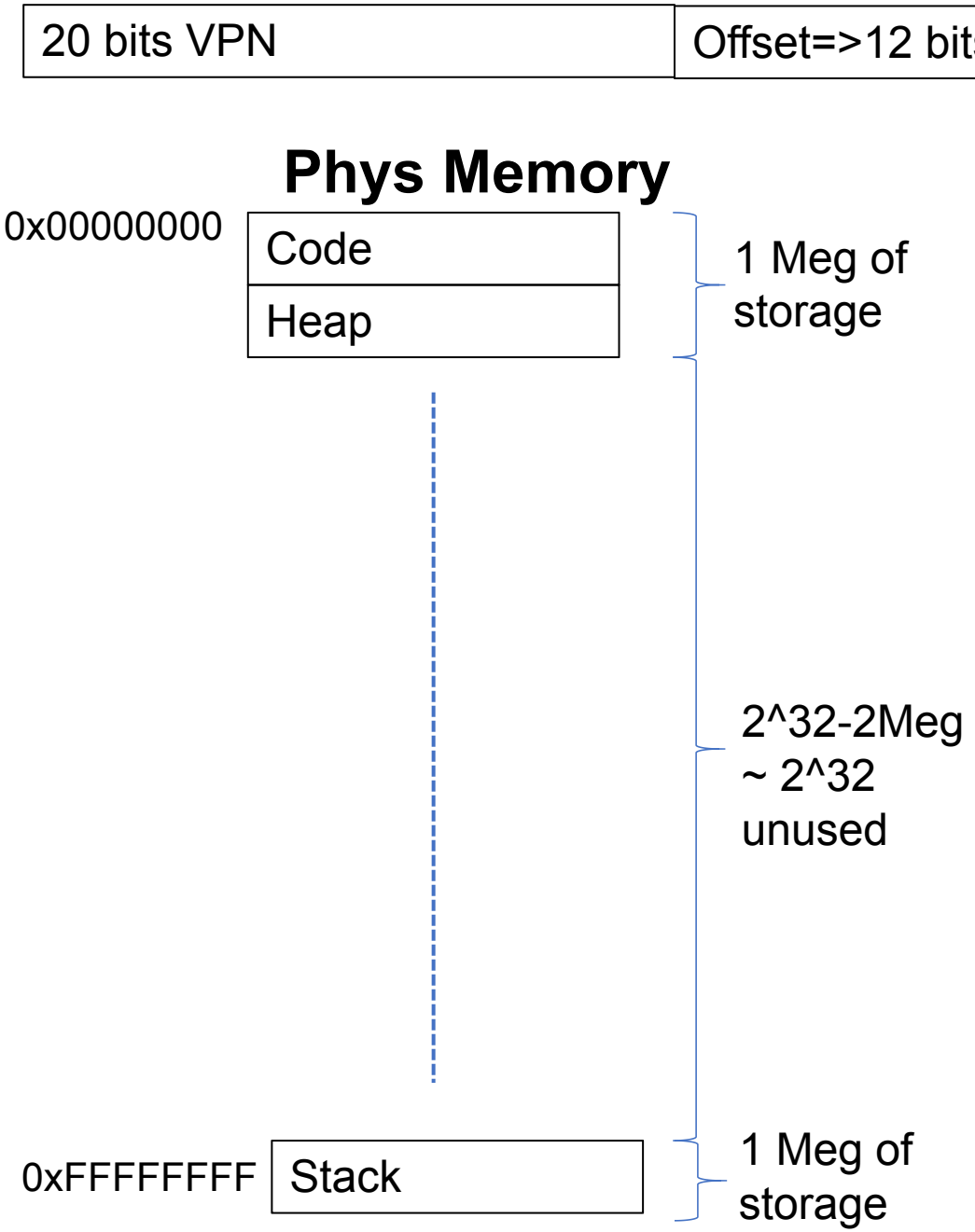
Page Table P2

VP #	valid	PP
0=000	1	100
1=001	1	110
2=010	0	
3=011	0	
4 0		
5	:	
6		
7		

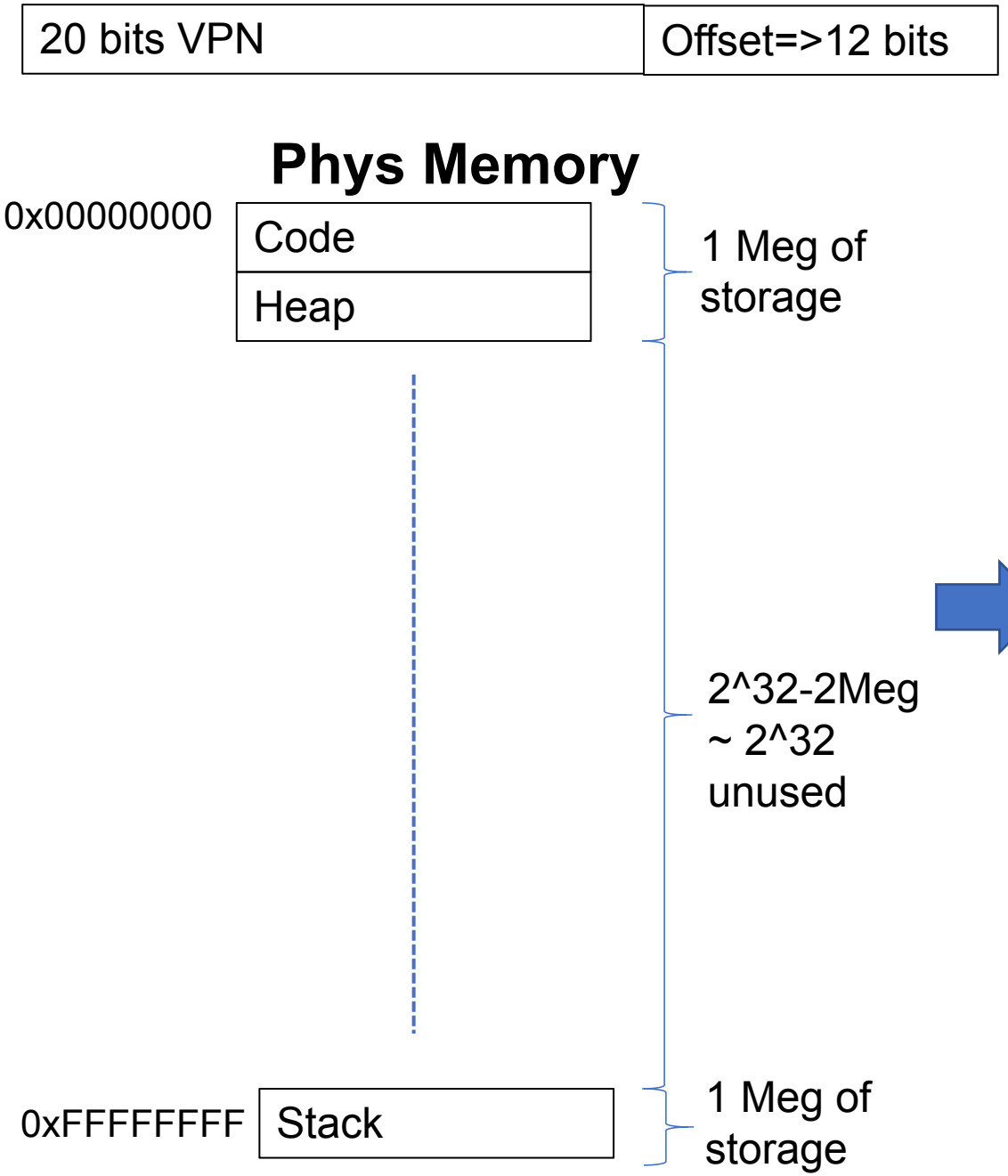
Physical memory

000 0000 000 1111	
001 0000 001 1111	
010 0000 010 1111	P1-0
011	P1-2
100	P2-0
101	P1 -1
110	P2-1

Flat page table example

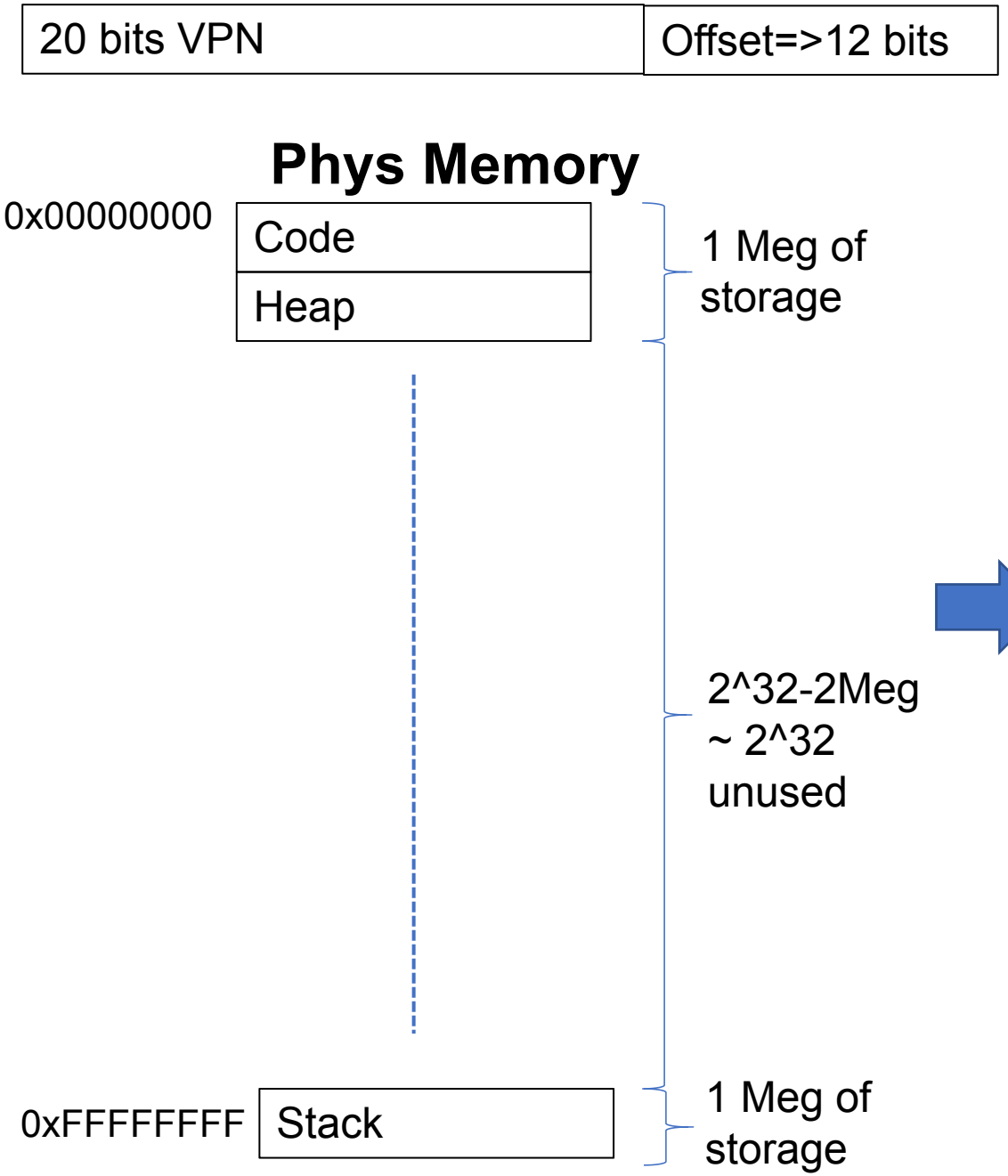


Flat page table example



If using single page table
2^12 =4K per page
If code and heap take up 1 meg of storage
Then how many pages will they need?

Flat page table example



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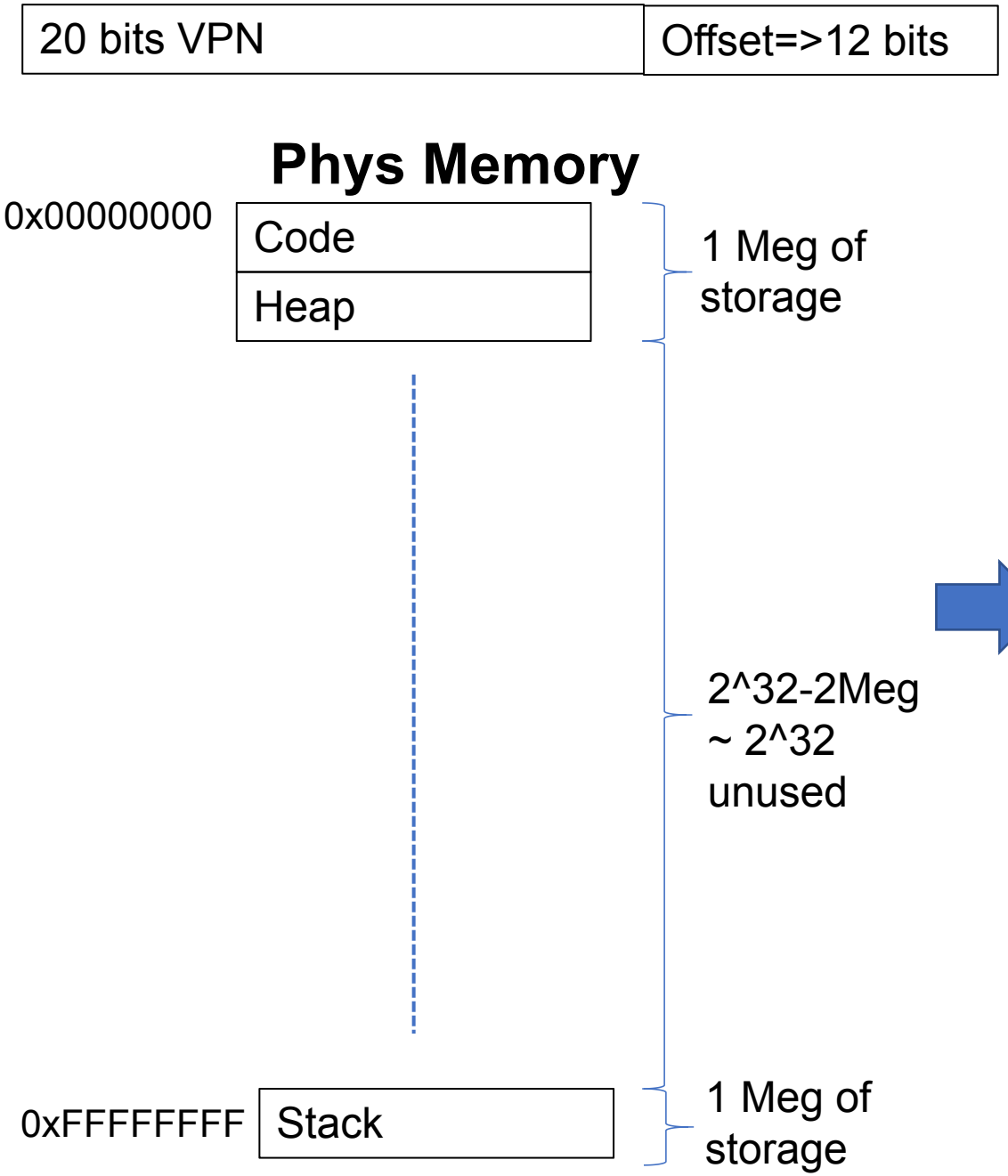
1 meg/4K=>2^20/2^12 = 2^8 pages or 256 pages
Need 256 pages for stack too

Flat page table example



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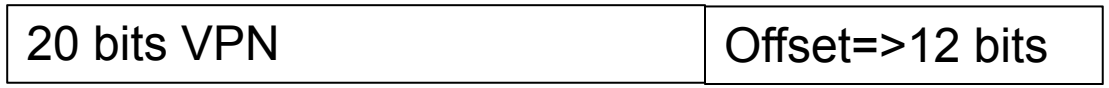
But have 2^20 = 1,000,000 Virtual pages, which means the page table will have 1,000,000 rows
Of which only 512 are needed

Flat page table example



Phys Memory

0x00000000

Code

Heap

1 Meg of storage

2^32-2Meg ~ 2^32 unused

0xFFFFFFFF

Stack

1 Meg of storage

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Page table

Code

Heap

256 Used rows

1048064 Unused rows

If 4 bytes per row then 4192256 bytes wasted

Stack

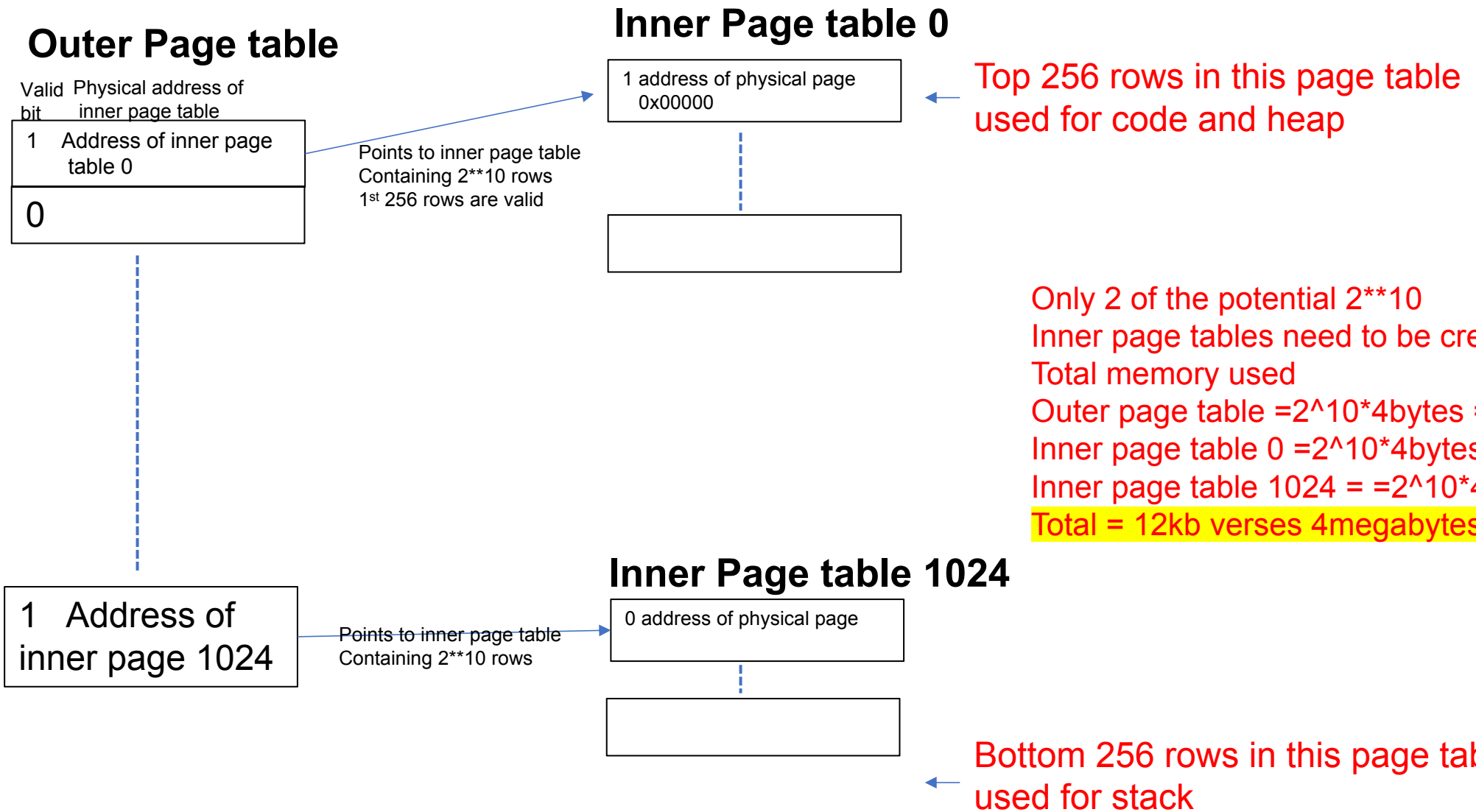
256 Used rows

Page table size = 2^20 *4bytes page = 4Megabytes

Multilevel page table version

Outer=10 bits	Inner=10 bits	Offset=>12 bits

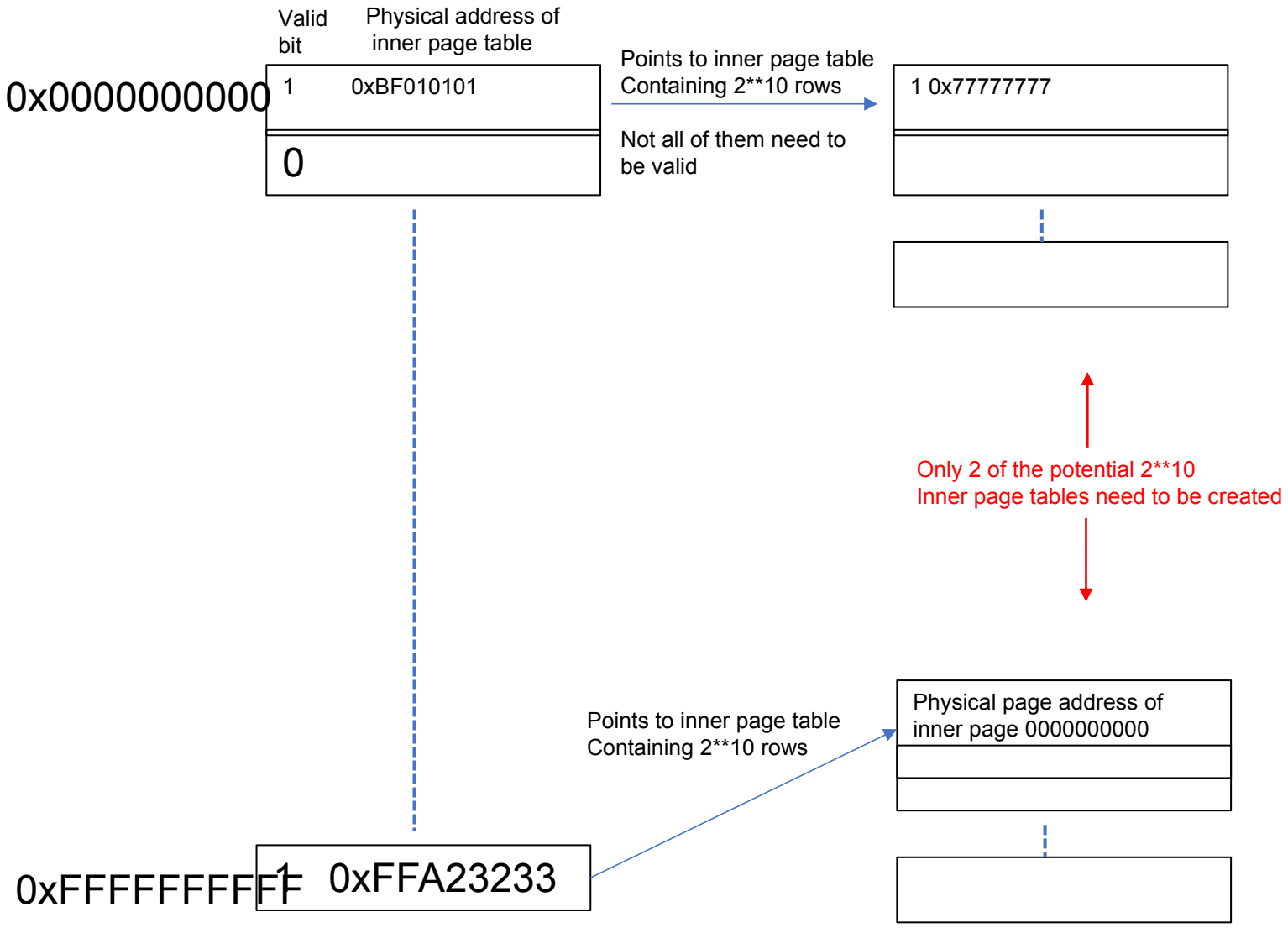
1 Outer page table has 2^10 or 1000 rows, each row holds the address of an inner page table
1000 ***potential*** inner page tables, each with 2^10 or 1000 rows (only allocate the ones needed, ie valid bit=1 in outer page table)



Multilevel page table example

For a 32 bit system; 20 bits VPN, 12 bits offset

Outer=10 bits	Inner=10 bits	Offset=>12 bits



If using 4K pages=> (2^12 bits)
2^10 ~1000
2^20 ~1,000,000

<u>If using multilevel page table</u>

Remember a single level page table uses 2^20 * 4bytes entry = 4M

Multilevel page table uses
Outer = 2^10*4bytes = 4kB
Inner? Only 2 inner pages Allocated
2 * 2^10*4bytes = 8kB
Total= 12kB