



COMPUTER SYSTEMS FUNDAMENTALS (4COSC004W)

Week 5 Master Boot Record



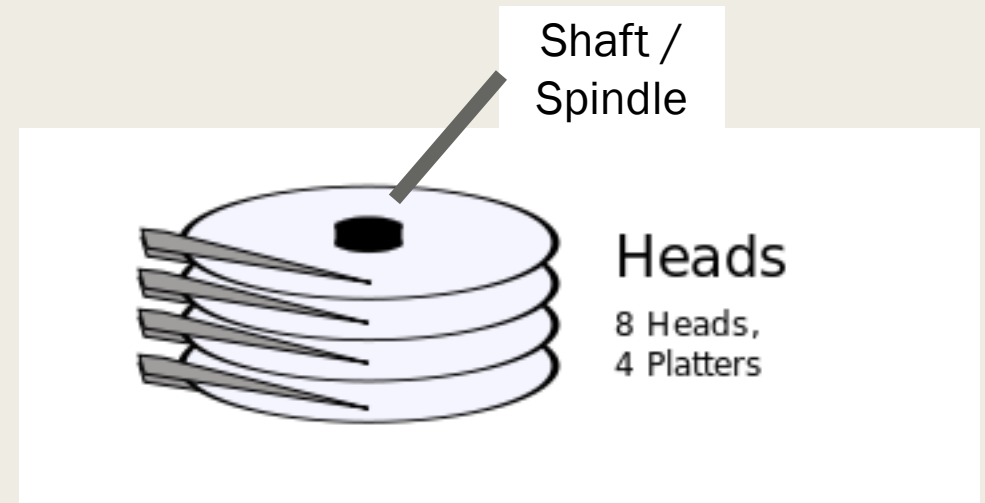
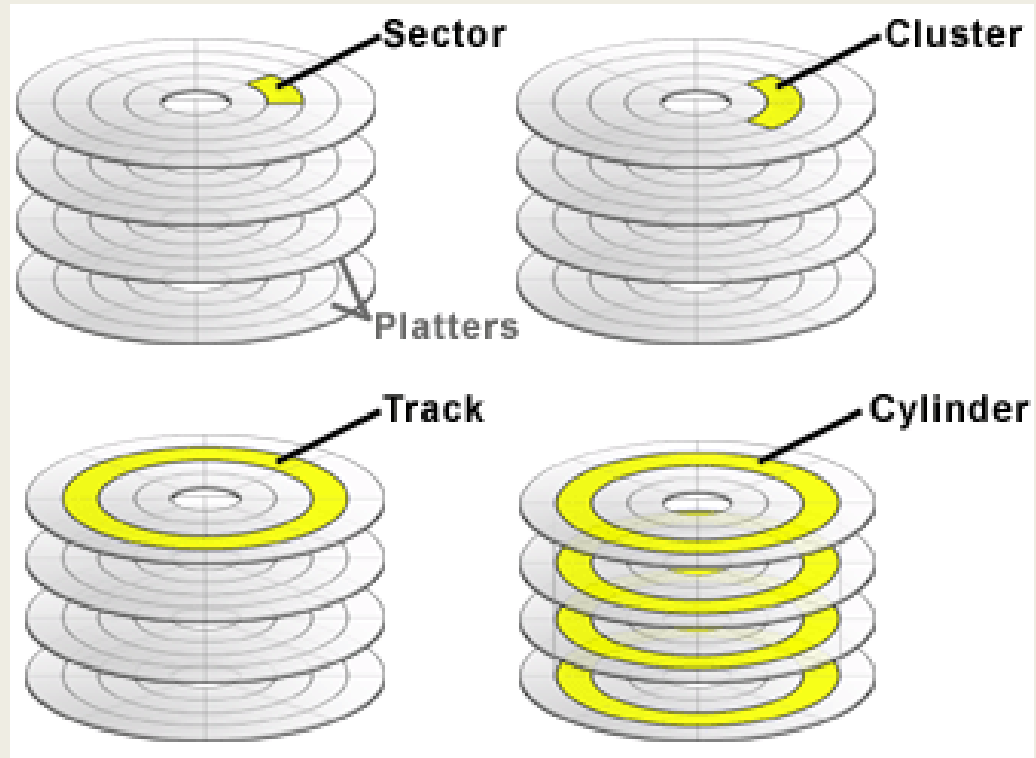
In this part we will cover:

- Sector addressing
- Disk partitioning
 - *Partition consistency*
 - *Formatting*
 - *PC-based partitions*
- **Master Boot Record (MBR) Partitions**
 - *Partition table*
 - *Disk Sector Zero*
 - Endianness

FILE SYSTEMS part a

Disk anatomy, MBR partitions & Disk Sector Zero

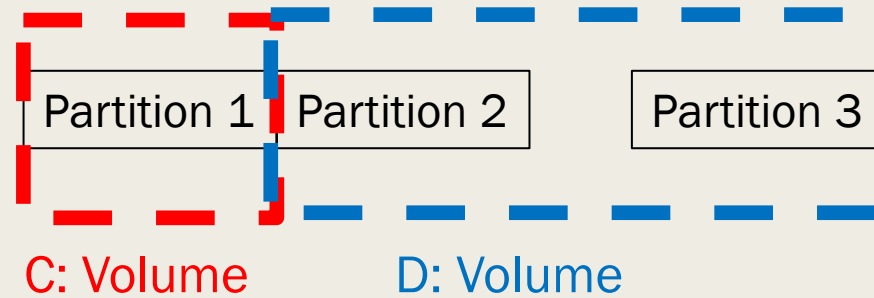
Anatomy of a disk



Sector addressing

- Sector
 - *Smallest addressable storage unit*
 - *Usually 512 Bytes*
- CHS (**C**ylinder **H**ead **S**ector) Addressing
 - *Upto $\frac{1}{2}$ GB*
- LBA (**L**ogical **B**lock Addressing)
 - *Directly linked to physical address*
 - *0, ...*

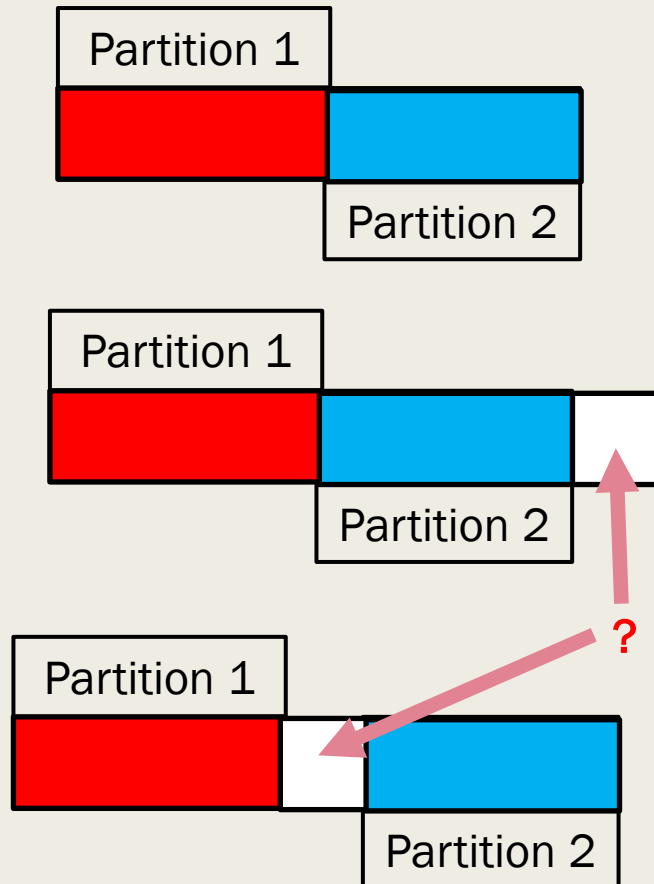
Disk partitioning



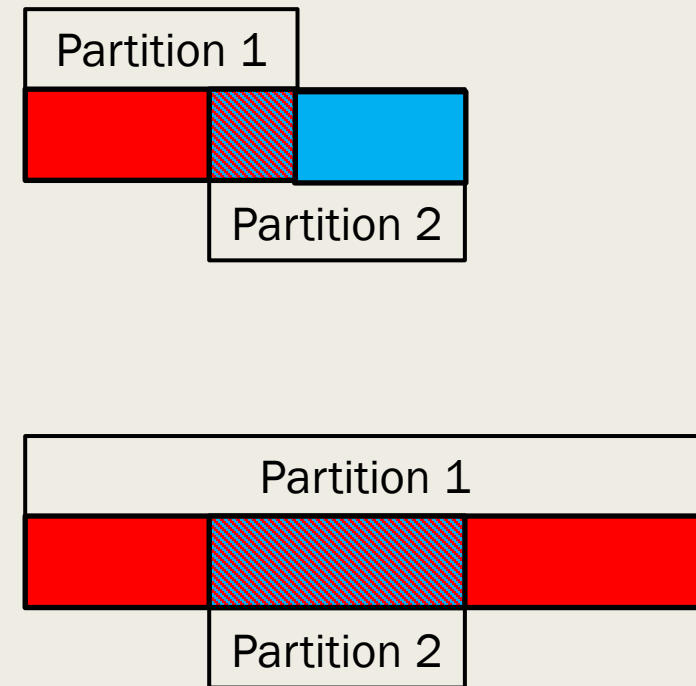
- Volume
 - *Collection of addressable sectors that an OS or application can use for data storage.*
- Partition
 - *Collection of **consecutive** sectors in a volume*

Partition consistency

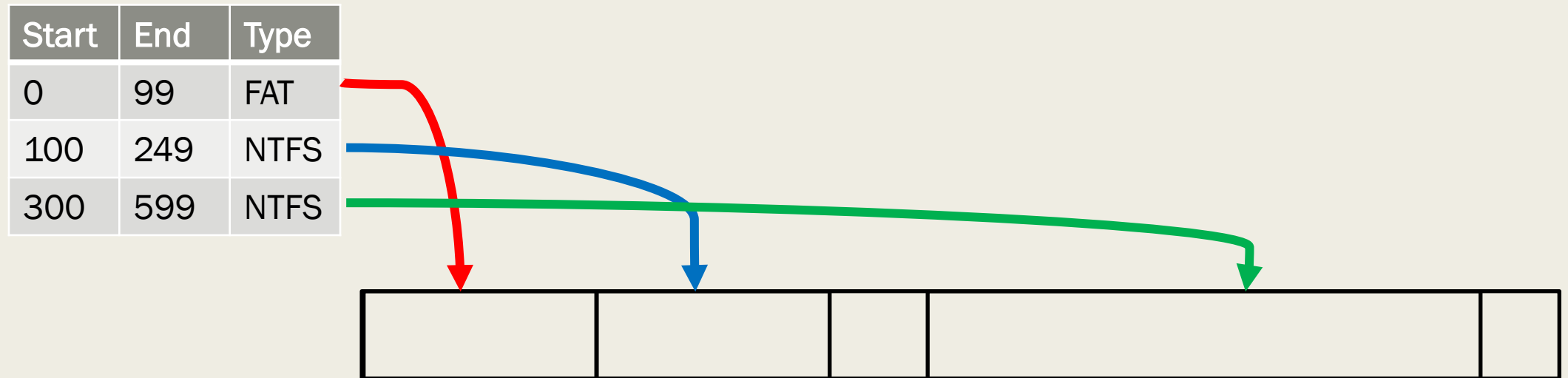
Healthy :



Problematic:



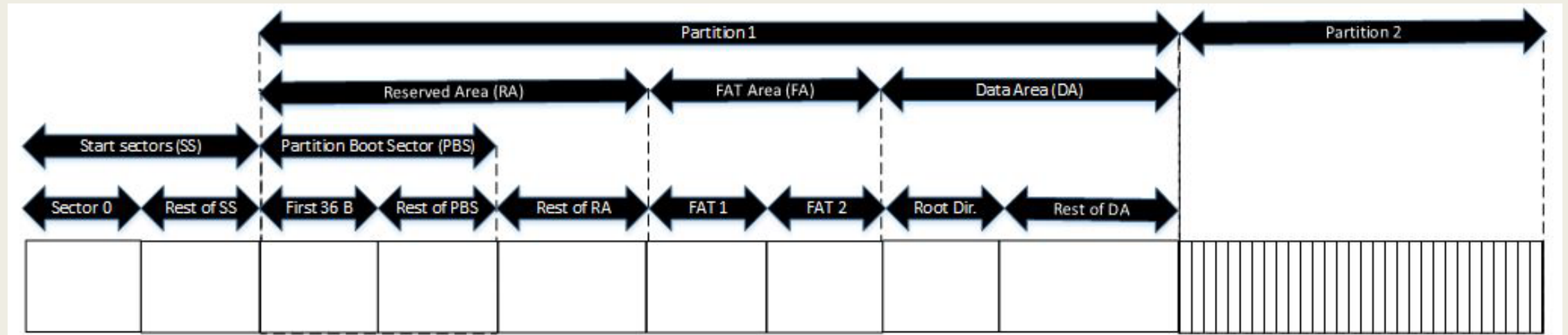
Disk formatting



PC-based partitions

- DOS-styled partition & MBR (**M**aster **B**oot **R**ecord) disks
 - *Partitions limited to 2TB*
- GUID (**G**lobal **U**nique **I**dentifier) Partition Table (GPT)
 - *Multiple ZetaBytes 10^{21}*

Schematic view of a Disk



MBR Partitions

Disk Sector Zero

Byte range		Description	Essential
Denary	Hex		
0 - 445	0-1BD	Boot code	No
446 - 461	1BE-1CD	Partition table entry # 1	Yes
462 - 477	1CE-1DD	Partition table entry # 2	Yes
478 - 493	1DE-1ED	Partition table entry # 3	Yes
494 - 509	1EE-1FD	Partition table entry # 4	Yes
510 - 511	1FE-1FD	Signature Value 0xAA55	No

MBR Partitions – Sector Zero

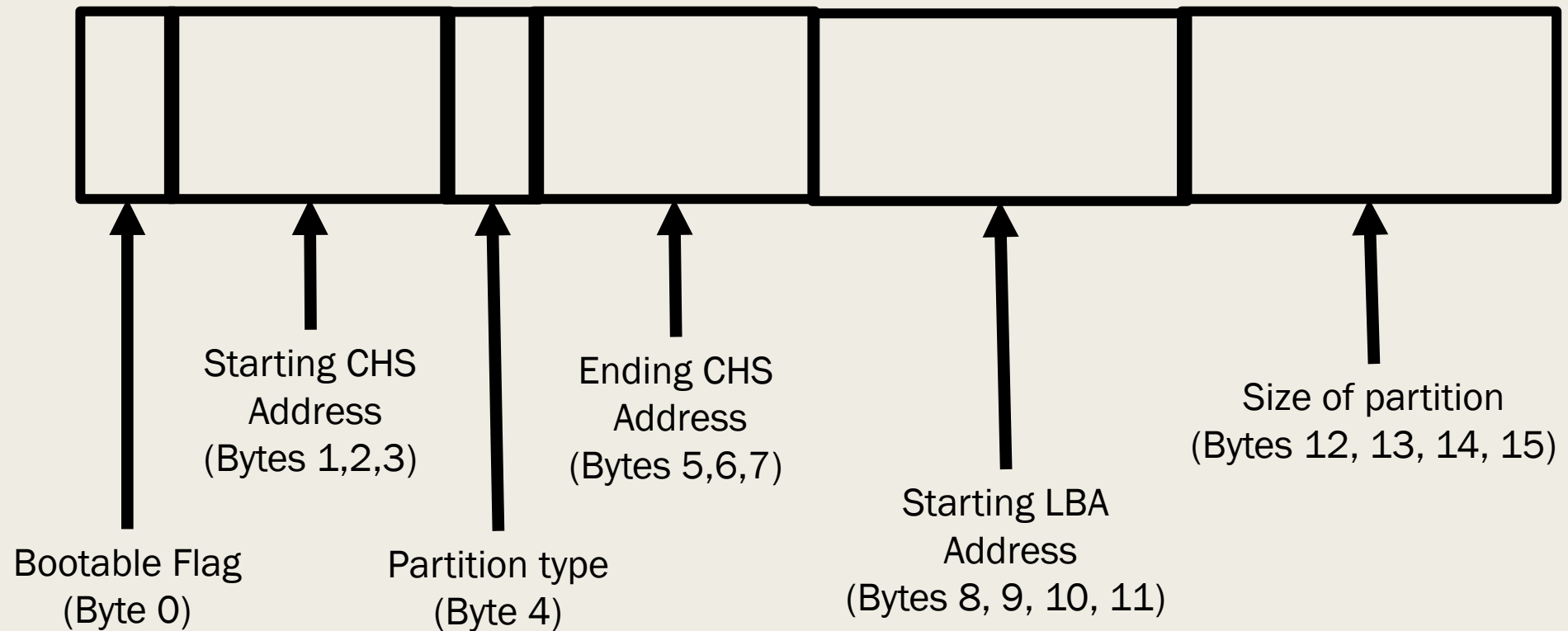
[illegible]

MBR Partitions

00000416	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000432	00	00	00	00	00	2C	44	63	F1	AA	B5	54	00	00	80	01
00000448	01	00	07	40	E0	BC	20	00	00	00	E0	DF	1D	00	00	00
00000464	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000480	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00000496	00	00	00	00	00	00	00	00	00	00	00	00	00	00	55	AA

Byte range	Description	Essential
0 - 445	Boot code	No
446 - 461	Partition table entry # 1	Yes
462 - 477	Partition table entry # 2	Yes
478 - 493	Partition table entry # 3	Yes
494 - 509	Partition table entry # 4	Yes
510 - 511	Signature Value 0x55AA	No

Partition Table Data Diagrammatic



Partition Table data

01	00	07	40	E0	BC	20	00	00	00	E0	DF	1D	00	80	01
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Byte range	Description	Value
0 - 0	Bootable Flag	80
1 - 3	Starting CHS Address	01 01 00
4 - 4	Partition Type	07
5 - 7	Ending CHS Address	40 E0 BC
8 - 11	Starting LBA Address	20 00 00 00
12 - 15	Size in Sectors	E0 DF 1D 00

Endianness

- Byte ordering for the representation of data
- **Big Endian**
 - *Most significant Byte first*
 - *10 25 03 is written as 10 25 03*
- **Little Endian**
 - *Least significant Byte first*
 - *10 25 03 is written as 03 25 10*
- So knowing the endianness used by a particular computer, we can read the information stored in it.

Partition Table data

Byte range	Description	Value	
		Little Endian	Big Endian
0 - 0	Bootable Flag	80	
1 - 3	Starting CHS Address	01 01 00	00 01 01
4 - 4	Partition Type	07	
5 - 7	Ending CHS Address	40 E0 BC	BC E0 40
8 - 11	Starting LBA Address	20 00 00 00	00 00 00 20
12 - 15	Size in Sectors	E0 DF 1D 00	00 1D DF E0

Type values for DOS Partitions

Type	Description
0x00	Empty
0x01	FAT 12, CHS
0x04	FAT 16, 16-32 MB , CHS
0x06	FAT 16, 32 MB – 2 GB , CHS
0x07	NTFS
0x0b	FAT 32, CHS
0x0c	FAT 32, LBA
0x82	Solaris x86
0x83	Linux
0xa5	FreeBSD
0xa6	OpenBSD
0xa8	Mac OSX

Partition Table data

Byte range	Description	Value			
		Little Endian	Big Endian		
0 - 0	Bootable Flag	80		Bootable	
1 - 3	Starting CHS Address	01 01 00	00 01 01		
4 - 4	Partition Type	07		NTFS	
5 - 7	Ending CHS Address	40 E0 BC	BC E0 40		
8 - 11	Starting LBA Address	20 00 00 00	00 00 00 20	Sector: 32	16 KB
12 - 15	Size in Sectors	E0 DF 1D 00	00 1D DF E0	Sectors: 1957856	978928 KB

$$(1 \times 1048576) + (13 \times 65536) + (13 \times 4096) + (15 \times 256) + (14 \times 16)$$

$$1048576 + 851968 + 53248 + 3840 + 224 = 1957856$$

Using the Information sheet:

1

D

D

F

E

0

Multiplication tables:

1048576 table	
1	1048576
2	2097152
3	3145728
4	4194304
5	5242880
6	6291456
7	7340032
8	8388608
9	9437184
10	10485760
11	11534336
12	12582912
13	13631488
14	14680064
15	15728640

65536 table	
1	65536
2	131072
3	196608
4	262144
5	327680
6	393216
7	458752
8	524288
9	589824
10	655360
11	720896
12	786432
13	851968
14	917504
15	983040

4096 table	
1	4096
2	8192
3	12288
4	16384
5	20480
6	24576
7	28672
8	32768
9	36864
10	40960
11	45056
12	49152
13	53248
14	57344
15	61440

256 table	
1	256
2	512
3	768
4	1024
5	1280
6	1536
7	1792
8	2048
9	2304
10	2560
11	2816
12	3072
13	3328
14	3584
15	3840

16 table	
1	16
2	32
3	48
4	64
5	80
6	96
7	112
8	128
9	144
10	160
11	176
12	192
13	208
14	224
15	240

Converting from Sectors to KB and MB

- There are 512 Bytes in a Sector
- To convert from Sectors to KB:
 - *Divide no. Sectors by 2*
- To convert from KB to MB:
 - *Divide no. KB by 1024*

In this lecture we looked at:

- Sector addressing
- Disk partitioning
 - *Partition consistency*
 - *Formatting*
 - *PC-based partitions*
- **Master Boot Record (MBR) Partitions**
 - *Partition table*
 - *Disk Sector Zero*
 - Endianness

Thank you

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These slides have been reviewed and amended by Adem Coskun, Izzet Kale and George Charalambous.
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