

# CM1604

# Computer Systems Fundamentals

## Master Boot Record

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# In this week lecture..

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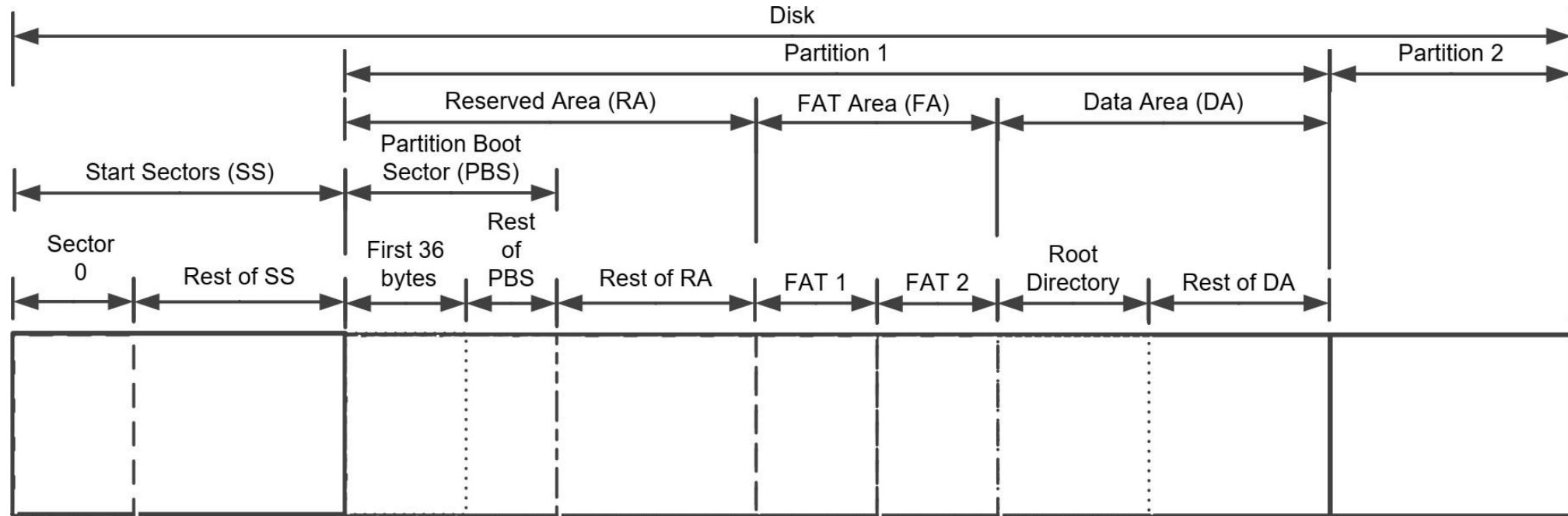
- PC based Partitions
- Schematic view of a Disk
- Disk Sector 0
- Endianness
- Partition Table Entry

# PC-based Partitions

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- DOS-styled partition & Master Boot Record (MBR) disks. MBR disks are limited to 2 TB sizes.
- GUID Partition Table (GPT) – used in Apple Macs and increasingly in modern PCs. GUID stands for Globally Unique ID. GUID disks can go up to about 9 ZB sizes. 1 ZB is approximately  $10^{21}$  B. Z stands for Zeta following kilo, Mega, Giga, Tera, Peta, Exa, Zeta, ...

# Schematic View of a Disk



# Disk Sector 0

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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 (0xAA55)	No

# Disk Sector 0 Diagrammatic

HxD - [C:\Users\Admin\Downloads\disk-sector-zero-3(1).dd]

File Edit Search View Analysis Tools Window Help

16 Windows (ANSI) dec

disk-sector-zero-3(1).dd

Offset (d)	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	Decoded text
00000000	33	C0	8E	D0	BC	00	7C	FB	50	07	50	1F	FC	BE	1B	7C	3A2D4.  @P.P.4%.
00000016	BF	1B	06	50	57	B9	E5	01	F3	A4	CB	BD	BE	07	B1	04	z..PW^â.ôME%±.
00000032	38	6E	00	7C	09	75	13	83	C5	10	E2	F4	CD	18	8B	F5	8n. .u.fâ.âôî.<ô
00000048	83	C6	10	49	74	19	38	2C	74	F6	A0	B5	07	B4	07	8B	fE.It.8,tô p.'.<
00000064	F0	AC	3C	00	74	FC	BB	07	00	B4	0E	CD	10	EB	F2	88	ô-<.tû»..'.î.êô^
00000080	4E	10	E8	46	00	73	2A	FE	46	10	80	7E	04	0B	74	0B	N.èF.s*pF.ê~..t.
00000096	80	7E	04	0C	74	05	A0	B6	07	75	D2	80	46	02	06	83	ê~..t. q.uôEF..f
00000112	46	08	06	83	56	0A	00	E8	21	00	73	05	A0	B6	07	EB	F..fV..è!.s. q.è
00000128	BC	81	3E	FE	7D	55	AA	74	0B	80	7E	10	00	74	C8	A0	4.>p}U+t.ê~..tê
00000144	B7	07	EB	A9	8B	FC	1E	57	8B	F5	CB	BF	05	00	8A	56	..è@u.W<ôEê..šV
00000160	00	B4	08	CD	13	72	23	8A	C1	24	3F	98	8A	DE	8A	FC	..î.r#šâš?~špšû
00000176	43	F7	E3	8B	D1	86	D6	B1	06	D2	EE	42	F7	E2	39	56	C-â<N+ô±.ôîB+â9V
00000192	0A	77	23	72	05	39	46	08	73	1C	B8	01	02	BB	00	7C	.w#r.9F.s.,...>
00000208	8B	4E	02	8B	56	00	CD	13	73	51	4F	74	4E	32	E4	8A	<N.<V.î.sQôN2âš
00000224	56	00	CD	13	EB	E4	8A	56	00	60	BB	AA	55	B4	41	CD	V.î.èâšV.'>*U'Aî
00000240	13	72	36	81	FB	55	AA	75	30	F6	C1	01	74	2B	61	60	.r6.âU*uôâ.t+a`
00000256	6A	00	6A	00	FF	76	0A	FF	76	08	6A	00	68	00	7C	6A	j.j.ÿv.ÿv.j.h. j
00000272	01	6A	10	B4	42	8B	F4	CD	13	61	61	73	0E	4F	74	0B	.j.'B<ôî.aas.Ot.
00000288	32	E4	8A	56	00	CD	13	EB	D6	61	F9	C3	49	6E	76	61	2âšV.î.èôâûâInva
00000304	6C	69	64	20	70	61	72	74	69	74	69	6F	6E	20	74	61	lid partition ta
00000320	62	6C	65	00	45	72	72	6F	72	20	6C	6F	61	64	69	6E	ble.Error loadin
00000336	67	20	6F	70	65	72	61	74	69	6E	67	20	73	79	73	74	g operating syst
00000352	65	6D	00	4D	69	73	73	69	6E	67	20	6F	70	65	72	61	em.Missing opera
00000368	74	69	6E	67	20	73	79	73	74	65	6D	00	00	00	00	00	ting system.....
00000384	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
00000400	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....
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	54	D5	E1	35	00	00	00	01	.....,DcTôâ5....
00000448	01	00	01	FE	3F	00	3F	00	00	00	82	3E	00	00	00	00	...p?.?>....
00000464	01	01	0B	FE	3F	08	C1	3E	00	00	08	F6	01	00	00	00	...p?.â>...ô....
00000480	01	09	07	FE	FF	13	C9	34	02	00	4B	F5	BE	00	00	00	...pÿ.ê4..Kô%...
00000496	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	.....U^

Offset(d): 0

Overwrite

Special editors

Data inspector

Binary (8 bit)	Value
Int8	go to: 51
UInt8	go to: 51
Int16	go to: -16333
UInt16	go to: 49203
Int24	go to: -7421901
UInt24	go to: 9355315
Int32	go to: -795951053
UInt32	go to: 3499016243
Int64	go to: -325384262124650445
UInt64	go to: 18121359811584901171
AnsiChar / char8_t	3
WideChar / char16_t	윌
UTF-8 code point	3 (U+0033)
Single (float32)	-19159685120
Double (float64)	-6.66252122512465E286
OLETIME	Invalid
FILETIME	Invalid
DOS date	19-Jan-76
DOS time	Invalid
DOS time & date	Invalid
time_t (32 bit)	Invalid
time_t (64 bit)	Invalid

Byte order

☒ Little endian ☐ Big endian

☐ Show integers in hexadecimal base

# Disk Sector 0 – Partition Table Entry

```

00000432  00 00 00 00 00 2C 44 63 54 D5 E1 35 00 00 00 01
00000448  01 00 01 FE 3F 00 3F 00 00 00 82 3E 00 00 00 00
00000464  01 01 0B FE 3F 08 C1 3E 00 00 08 F6 01 00 00 00
00000480  01 09 07 FE FF 13 C9 34 02 00 4B F5 BE 00 00 00
00000496  00 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 (0xAA55)	No



# Partition Table Data

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Byte Range	Description
0–0	Bootable Flag
1–3	Starting CHS Address
4–4	Partition Type
5–7	Ending CHS Address
8–11	Starting LBA Address
12–15	Size in Sectors



# Disk Sector 0 – Partition Table Entry #1

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	01	01	00	01	FE	3F	00	3F	00	00	00	82	3E	00	00
00000432	00	00	00	00	00	2C	44	63	54	D5	E1	35	00	00	00 01
00000448	01	00	01	FE	3F	00	3F	00	00	00	82	3E	00	00	00 00
00000464	01	01	0B	FE	3F	08	C1	3E	00	00	08	F6	01	00	00 00
00000480	01	09	07	FE	FF	13	C9	34	02	00	4B	F5	BE	00	00 00
00000496	00	00	00	00	00	00	00	00	00	00	00	00	00	00	55 AA

# Partition Table #1 Data (i)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	00	01	01	00	01	FE	3F	00	3F	00	00	00	82	3E	00	00
Byte Range	Description			Value												
0-0	Bootable Flag			00												
1-3	Starting CHS Address			01 01 00												
4-4	Partition Type			01												
5-7	Ending CHS Address			FE 3F 00												
8-11	Starting LBA Address			3F 00 00 00												
12-15	Partition Size in Sectors			82 3E 00 00												

# Endianness

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- Little Endian - Little-endian is an order in which the “little end” (least significant value in the sequence) is stored first.
  - Ex: 10 7D 00 stored as 00 7D 10
- Big Endian - Big-endian is an order in which the "big end" (most significant value in the sequence) is stored first
  - Ex: 10 7D 00 stored as 10 7D 00

# Partition Table #1 Data (ii)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	01	01	00	01	FE	3F	00	3F	00	00	00	82	3E	00	00
Byte Range	Description		Little Endian		Big Endian										
0-0	Bootable Flag		00	00											
1-3	Starting CHS Address		01 01 00	00 01 01											
4-4	Partition Type		01	01											
5-7	Ending CHS Address		FE 3F 00	00 3F FE											
8-11	Starting LBA Address		3F 00 00 00	00 00 00 3F											
12-15	Partition Size in Sectors		82 3E 00 00	00 00 3E 82											

# Partition Table #1 Data (iii)

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
00	01	01	00	01	FE	3F	00	3F	00	00	00	82	3E	00	00
Byte Ra Description		Little Endian			Big Endian										
0-0	Bootable Flag		00		00		Non Bootable								
1-3	Starting CHS Address		01 01 00		00 01 01										
4-4	Partition Type		01		01			FAT12							
5-7	Ending CHS Address		FE 3F 00		00 3F FE										
8-11	Starting LBA Address		3F 00 00 00		00 00 00 3F			63 Sectors							
12-15	Partition Size in Sectors		82 3E 00 00		00 00 3E 82			16,002 Sectors							

# Type Values for DOS Partitions

- Table

# Questions

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- (i) Number of Bootable Partitions?
- (ii) File System installed in the first partition?
- (iii) First partition starting LBA address in little endian format?
- (iv) First partition starting LBA address in big endian format?
- (v) First partition starting LBA address in sectors?
- (vi) Size of the first partition in little endian format?
- (vii) Size of the first partition in sectors?
- (viii) Size of the first partition in KB?