SD Card Map

The SD CARDs are SanDisk 512 MB and are preprogrammed with a Master Boot Record, Boot Record, FAT 1, FAT 2, Root Directory, and two files. The address and sector numbers for these entities are listed in Table 1.

Table 1 SD Card Road Map

Address	Sector	Cluster	Description
0:0000	0	N.A.	Master Boot Record which contains the Partition table)
1:DA00	1DA	N.A	Boot Record
1:DC00	1DC	N.A	File Allocation Table 1 with 16-bit FAT entries
2:CE00	2CE	N.A.	File Allocation Table 2 with 16-bit FAT entries
3:C000	3C0	N.A.	Root Directory with VFAT and directory entries
4:0000	400	2	Bill of Right.txt
4:4000	440	3	MyFile.txt

An image of the Master Boot Record is shown in Figure 1.
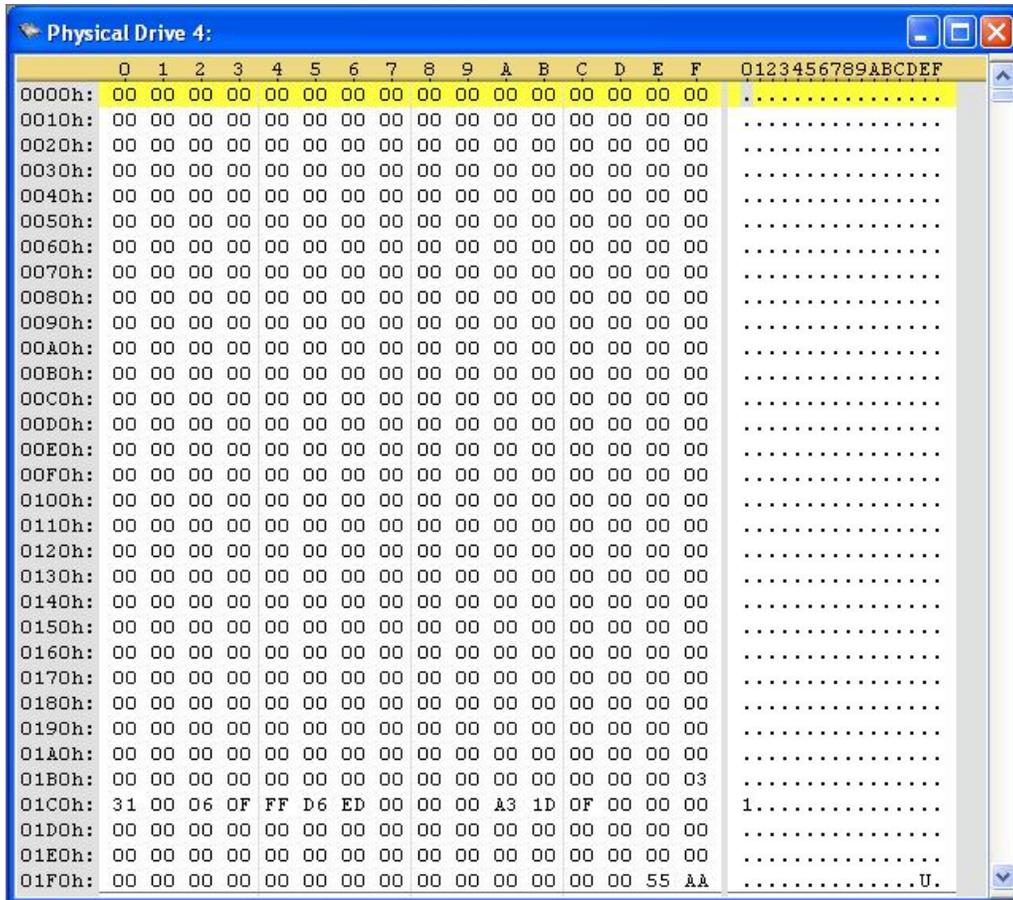
Figure 1 Master Boot Record

The Master Boot Record for the SD Cards starts at address 0:0000 of the physical drive. It contains the Partition Table stating at offset 0:01BE. This information is decoded in Table 2. Consult Microsoft's TechNet for further details

Table 2 SD Card Partition Table

Offset	Size	Data	Description
0x1BE	1 Byte	0x00	Do not use for booting
0x01BF	1 Byte	0x03	Starting Head
0x1C0	6 Bits	0B110001	Starting Sector
0x1C0	10 Bits	0B000000000000	Staring Cylinder
0x1C2	1 Byte	0x06	System ID: BIGDOS FAT16 partition or logical drive
0x1C3	1 Byte	0x0F	Ending Head
0x1C4	6 bits	0B111111	Ending Sector
0x1C4	10 bits	0B1101011011	Ending Cylinder
0x1C6	4 Bytes	0x000000ED	Relative Sector
0x1CA	4 Bytes	0X000F1DA3	Total Sectors

The next non-zero bytes in the SD Card is the Boot Record. An image of the Boot Record is shown in Figure 2. A table that decodes the contents of the Boot Record is shown in Table 3.

Table 3 Boot Record Reference

Offset	Size	Data	Description
0x00	3 Bytes	0x00EB 0x90	Jump instruction
0x03	8 Bytes	"MSDOS5.0"	OEM name in text
0x0B	25 Bytes	See Figure 2	BIOS parameter block
0x24	26 Bytes	See Figure 2	Extended BIOS parameter clock
0x3E	448 Bytes	See Figure 2	Bootstrap code
0x1FE	2 Bytes	0x55AA	End of boot sector mark

The BIOS parameter block contains information used by the operating system to access information, such as location of FAT 1 and FAT 2. The extended BIOS parameter block was added for larger devices such as the 512 Megabyte SD Card.

Table 4 BIOS and Extended BIOS Parameter Block

Offset	Size	Data	Description
0x0B	2 Bytes	0x200	Bytes per sector (512)
0x0D	Byte	0x20	Sectors per cluster (32)
0x0E	2 Bytes	0x0001	Reserved sectors
0x10	1 Byte	0x02	Number of File Allocation Tables
0x11	2 Bytes	0x0200	Root entries (512)
0x13	2 Bytes	0x0000	Small sectors

Offset	Size	Data	Description
0x15	1 Byte	0xF8	Media type
0x16	2 Bytes	0x0079	Sectors per File Allocation Table (121)
0x18	2 Bytes	0x003F	Sectors per track (63)
0x1A	2 Bytes	0x0010	Number of heads (16)
0x1C	4 Bytes	0x000000ED	Hidden sectors (237)
0x20	4 Bytes	0x000F1DA3	Large sectors (990627)
0x24	1 Bytes	0x80	Physical drive number
0x25	1 Byte	0x00	Current head
0x26	1 Byte	0x29	Signature
0x27	4 bytes	0x63343362	Volume serial number
0x2B	11 Bytes	"NO NAME "	Volumn label
0x36	8 Bytes	"FAT16 "	System ID
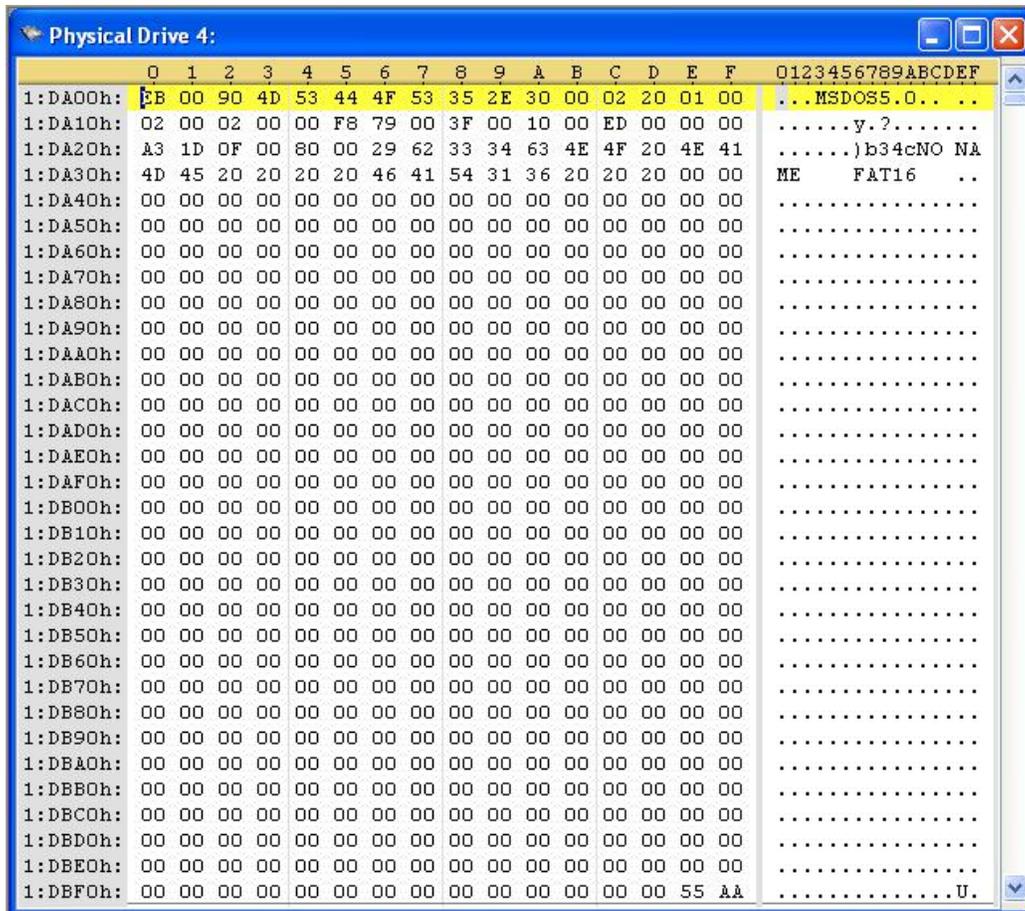
Figure 2 Boot Record

The first File Allocation Table is shown in Figure 3. Each entry is 16 bits since this is a BIGDOS FAT16 based table. File Allocation Table indicates which clusters or allocation units are used. The reference for each entry is given in Table 5. For this CD Card each cluster is 8 Kbytes or 16 sectors of 512 bytes each.

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Table 5 FAT Entry Reference

Entry	Description
0x0000	Free cluster
0x0001	Reserved cluster
0x0002 - 0xFFEF	Used cluster; value points to next cluster
0xFFF0 - 0xFFF6	Reserved values
0xFFF7	Bad cluster
0xFFF8 - 0xFFFF	Last cluster in file

The first two entries are 0xFFF8 and 0xFFFF; notice the byte wrap. The word 0xFFF8 represents the last cluster in the file. The next entry is 0xFFFF, which also represents the last cluster in a file. In fact, 0xFFF8 through 0xFFFF represent the last cluster in a file. The next cluster entry is 0xFFFF because the *Bill of Right.txt* file is less than 1 cluster or 16,384 bytes (32 x 512). The next entry is 0xFFFF, because *My File.txt* is 8,196 or which is still less than 1 cluster (16,384 bytes).
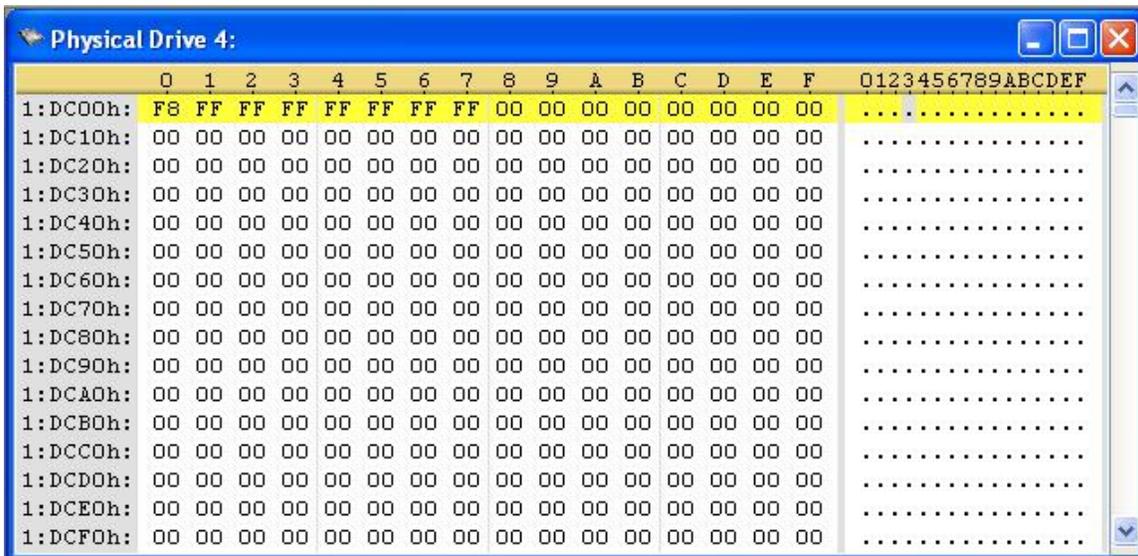
Figure 3 File Allocation Table 1 (FAT 1)

Figure 4 is a duplicate of FAT 1. The operating system's file system will try to keep FAT 1 and FAT 2 synchronized. If they do not agree, you will get the dreaded Fall Allocation Table error.
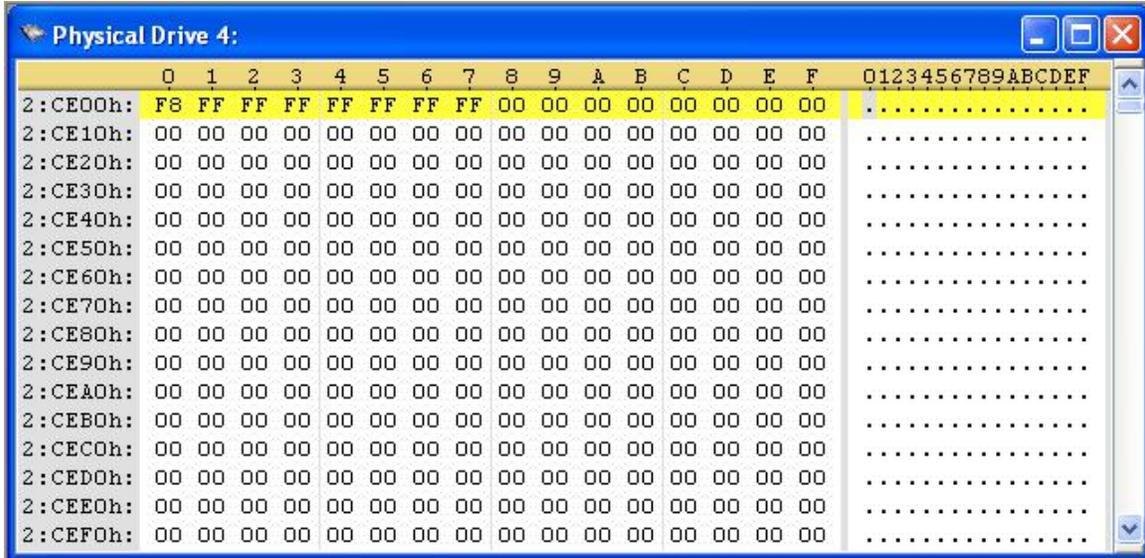
Figure 4 File Allocation Table 2 (FAT 2)

Immediately following FAT 2 is the Root Directory. The root directory for the SC Card is shown in Figure 5.   Each 32-byte block is a directory entry. The first two directory entries are the VFAT or LFN (Long Filename) entry for "Bill of Rights.txt". The next directory entry is the 8.3 filename for "Bill of Rights.txt". This entry also has information about date created, file length, and file attribute. This entry is decoded in Table 6. Note the times and dates may differ for your SD Card.

Table 6 "Bill of Right.txt" Directory Entry

| Offset	Size	Data	Description
0x00	8 Bytes	"BILLOF~1	8.3 Filename.
0x08	3 Bytes	"TXT	8.3 File extension
0x0B	1 Byte	0x20	Attribute
0x0C	1 Byte	0x00	Reserved
0x0D	1 Byte	0x68	Creation time milliseconds
0x0E	2 Bytes	0x4209	Creation time in hours, minutes and seconds
0x10	2 Bytes	0x3574	Creation date in years since 1980, months, and day.
0x12	2 Bytes	0x3574	Last accessed date
0x14	2 Bytes	0x0000	EA-index
0x16	2 Bytes	0x42EF	Last modified time
0x18	2 Bytes	0x3571	Last modified date
0x1A	2 Bytes	0x0002	First cluster
0x1C	4 Bytes	0x00000F23	File size in bytes.
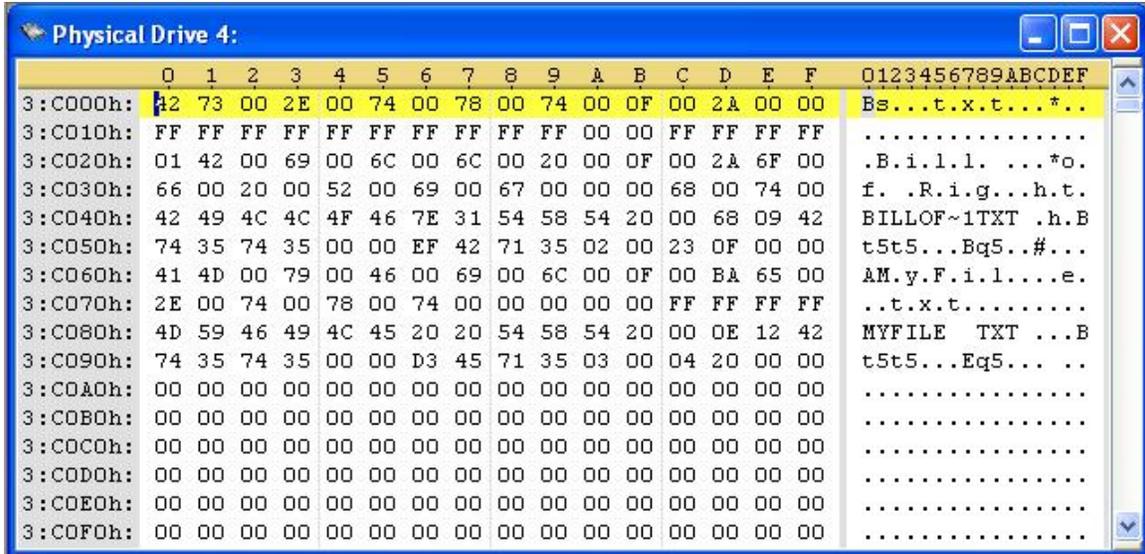
Figure 5 Root Directory

The VFAT or LFN entries may be decoded using Table 7. Note the "s .txt" part is in the previous LFN entry. The VFAT system just adds as many LFN entries as needed before the 8.3 filename directory entry.

Table 7 Long Filename Reference

Offset	Size	Data	Description
0x00	1 Byte	01	Sequence number
0x01	10 Bytes	"Bill "	Name characters as five UTF-16 characters
0x0B	1 Byte	0x0F	Attribute
0x0C	1 Byte	0x00	Reserved
0x0D	1 Byte	0x2A	Checksum of DOS file name
0x0E	12 Bytes	"of Right"	Name characters as six UTF-16 characters
0x1A	2 Bytes		First cluster which is always 0x0000

Starting at 0x40000 is the contents of the "Bill of Right.txt" file. You can read the right hand column of Figure 6 to see what its contents are.
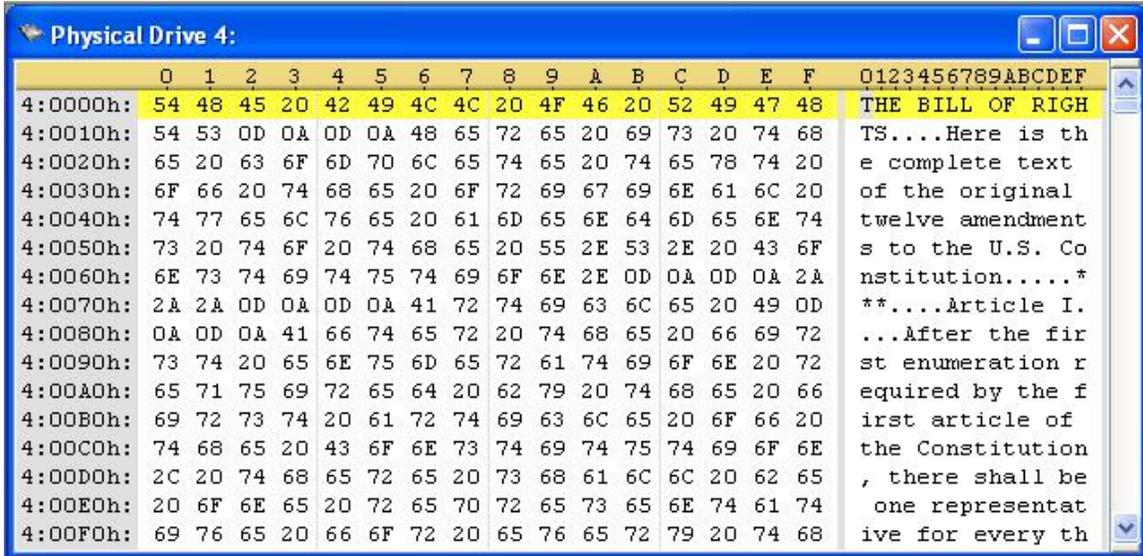
Figure 6 First Sector of "Bill of Right.txt"

The next file starts at 0x44000and is the file "MyFile.txt". This file contains 8,196 bytes of 0x20. This is the ASCII blank character. The first few bytes of this file are shown in Figure 7.
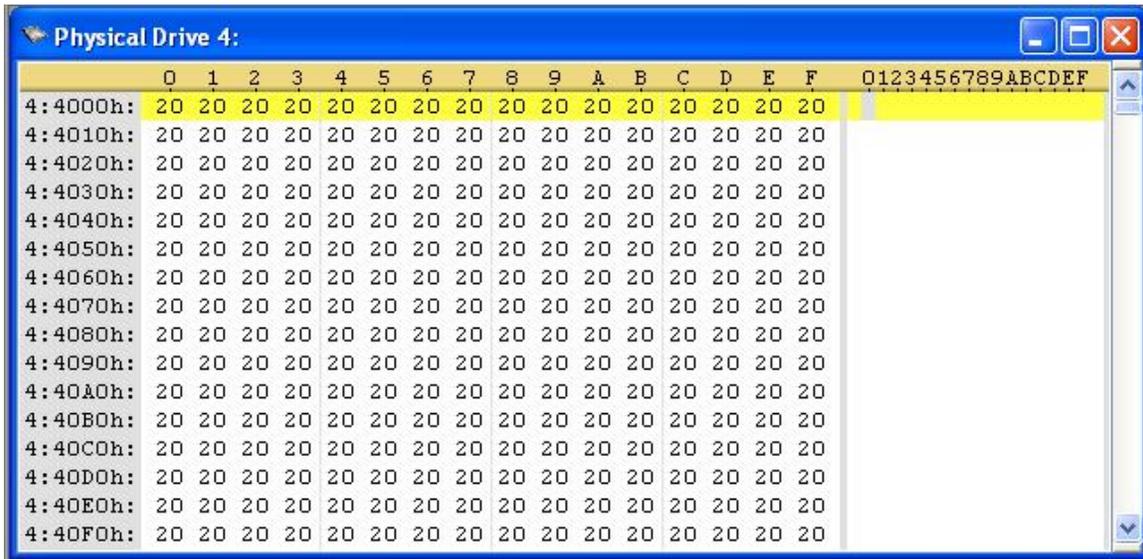
Figure 7 First Sector of "MyFile.txt"

This completes the discussion of the SD Card contents. Consult Wikipedia and Microsoft for more details.