
To The Welcome Screen

Bootstrapping

to pull oneself up by one's bootstraps

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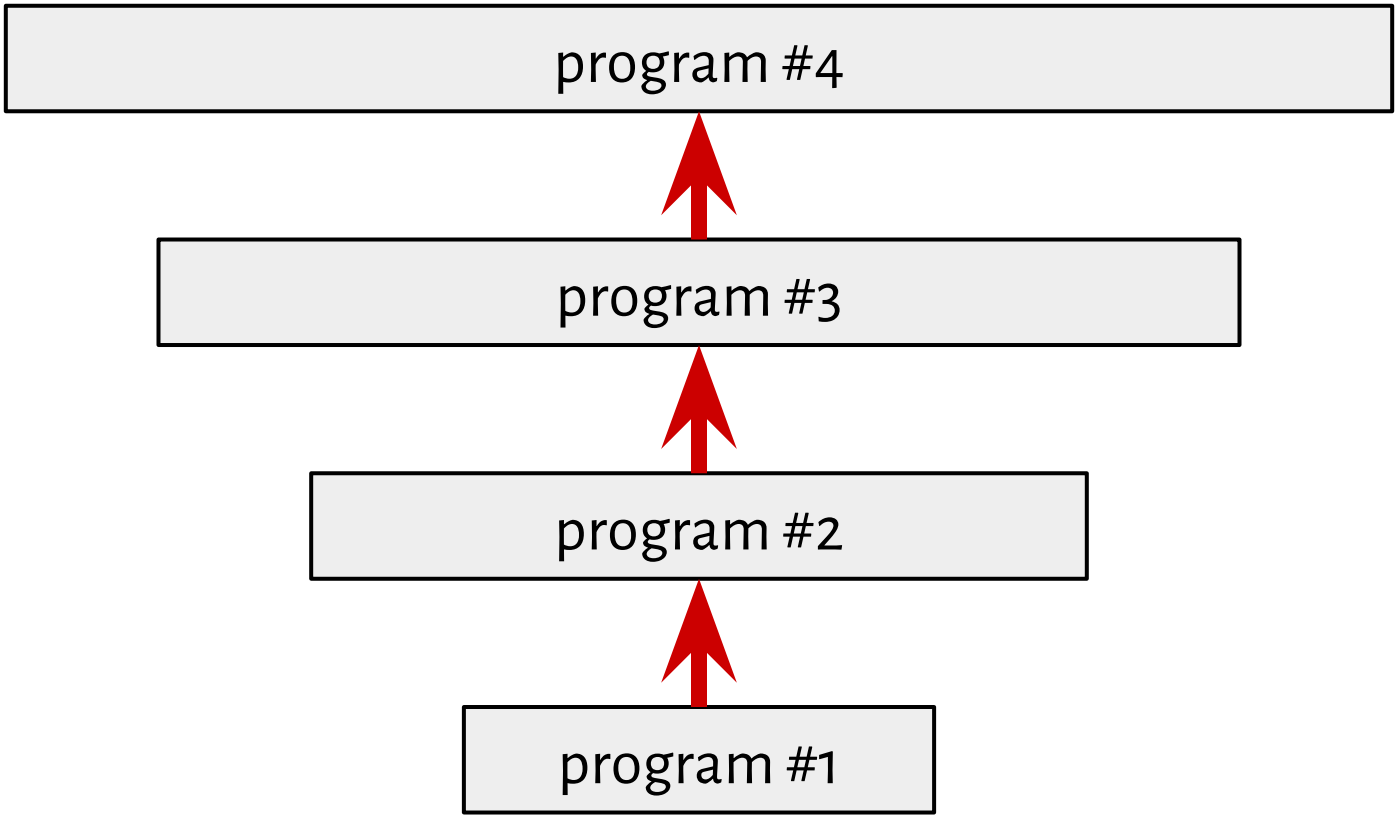
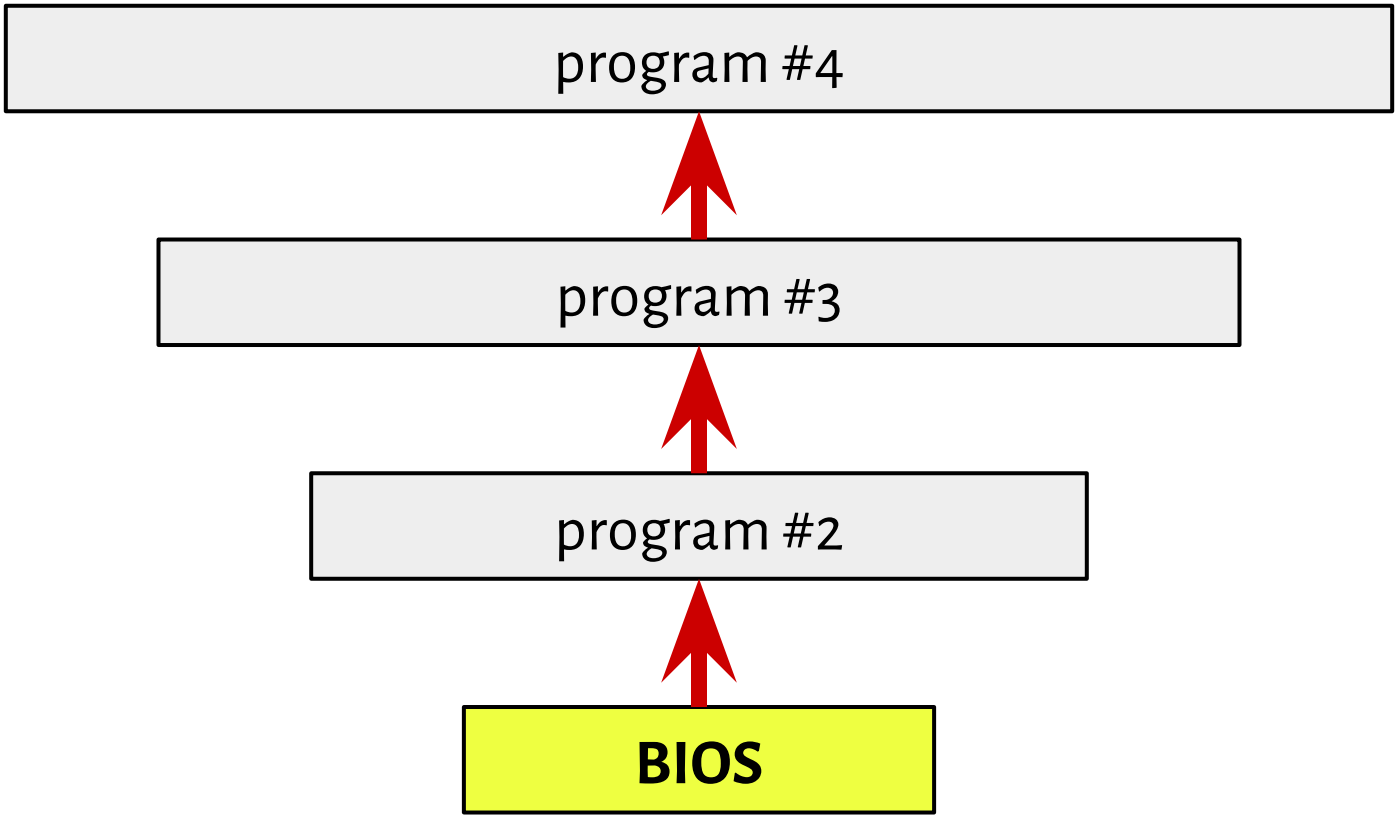
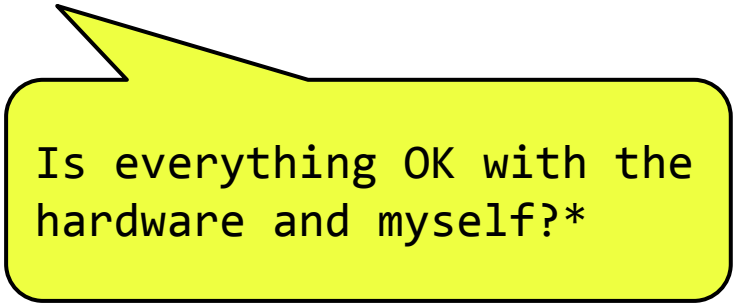
Bootstrapping



Bootstrapping



BIOS



*Power-On Self Test

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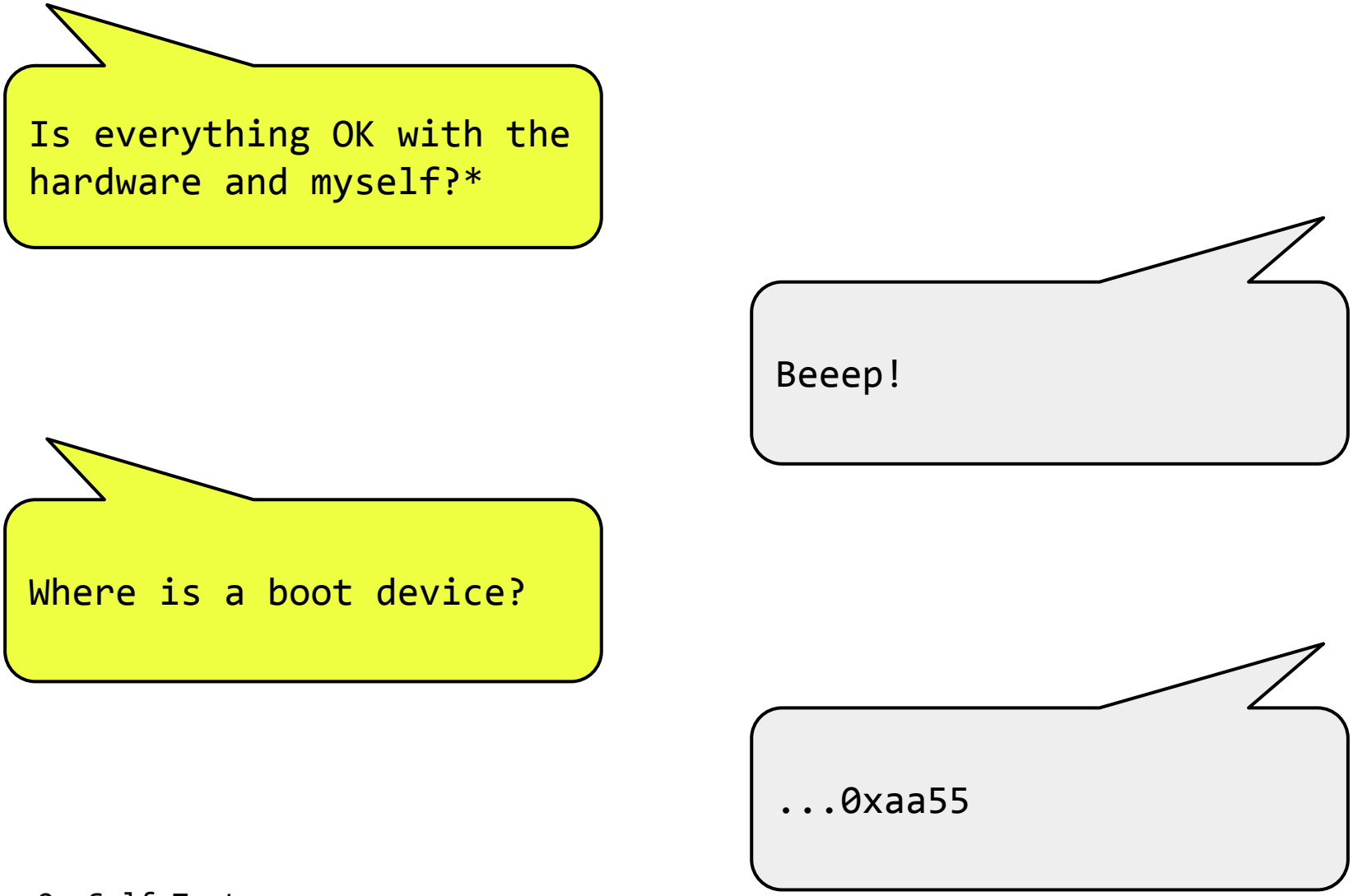

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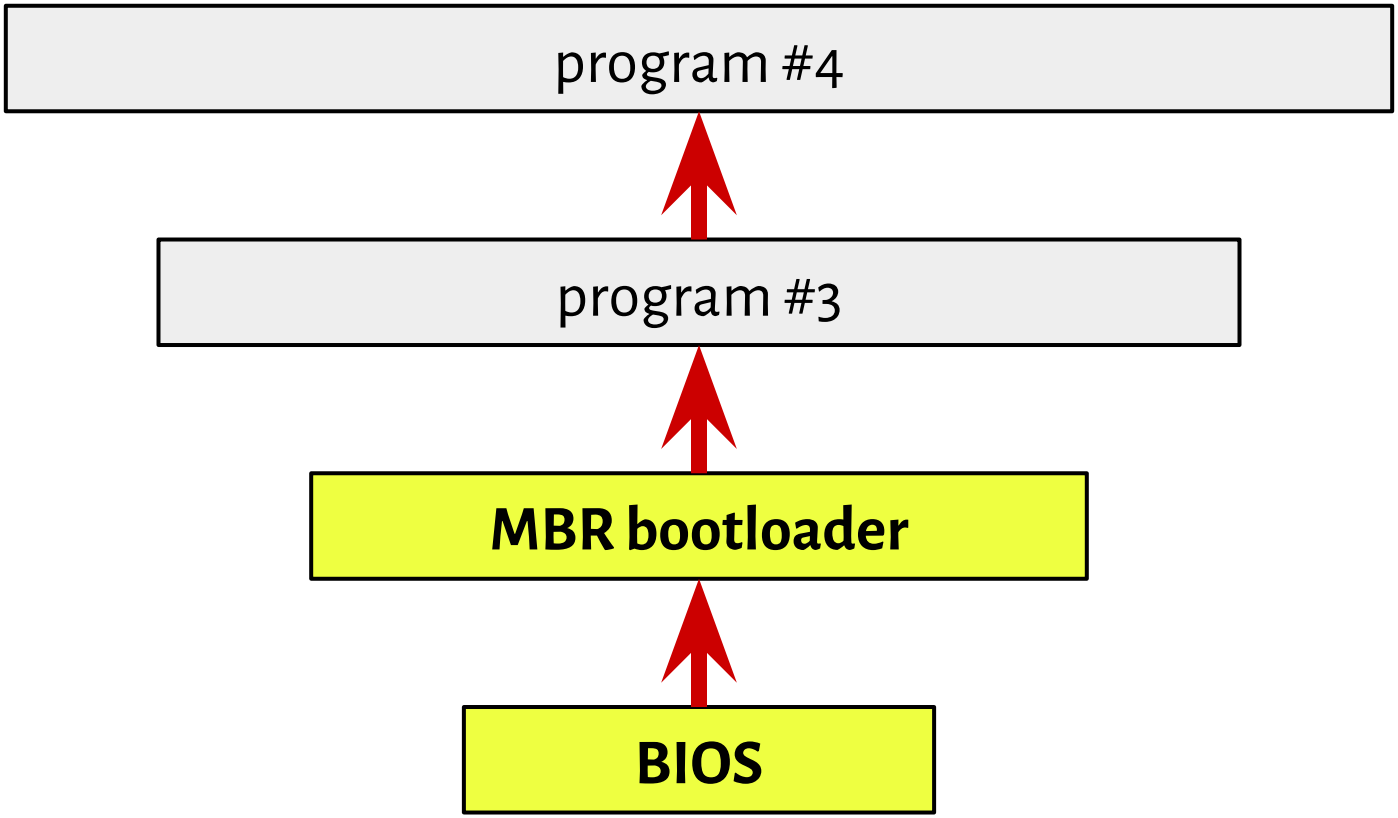
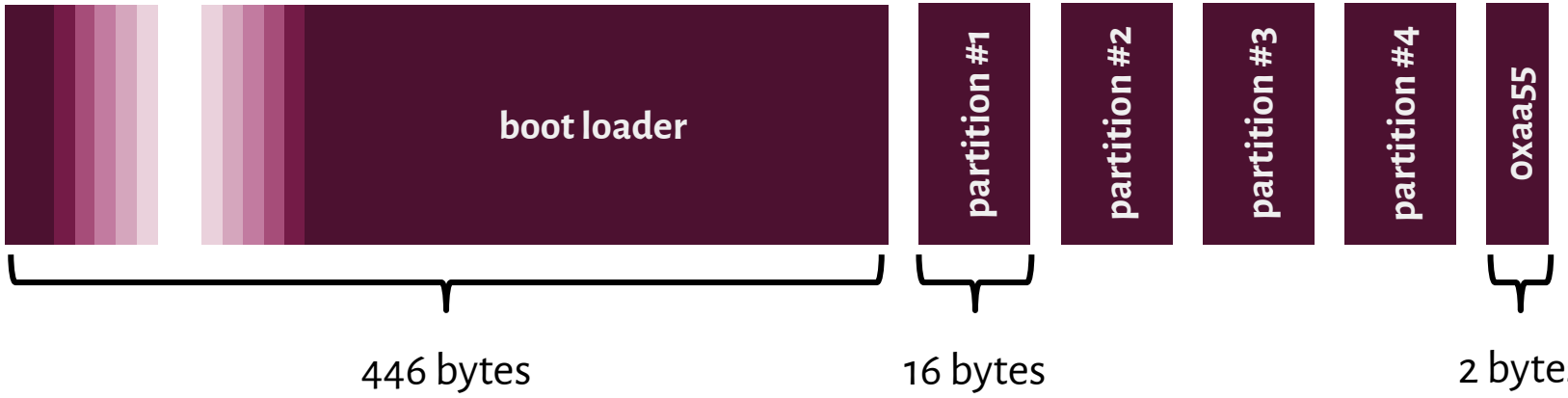


MBR

a special type of boot sector at the very beginning of partitioned computer mass storage devices



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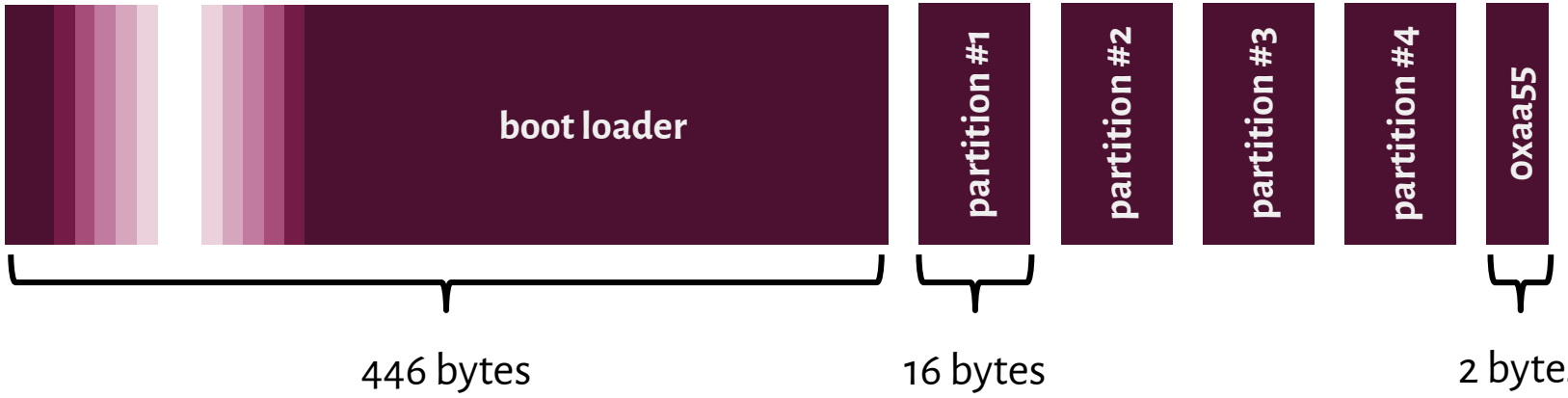

An ***extended partition*** is a ***primary partition*** that has been divided up into ***logical partitions*** as a means of creating more *partitions* than the four that would otherwise be possible.

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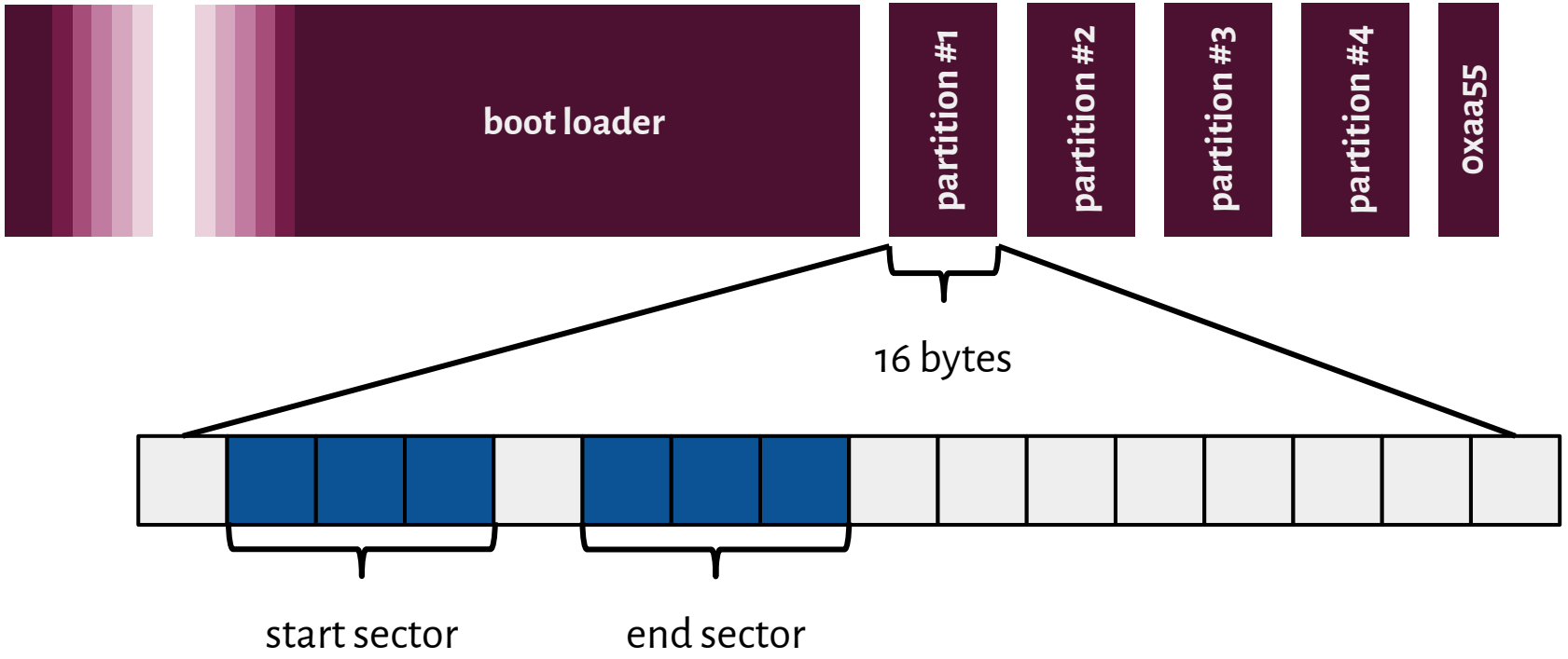
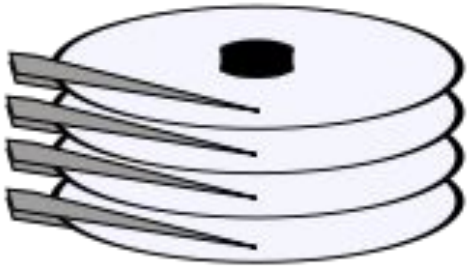
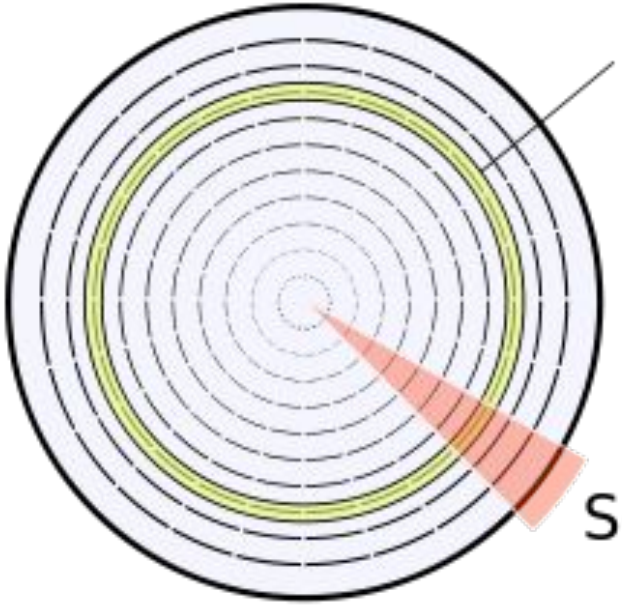


Cylinder-Head-Sector



Heads

8 Heads,
4 Platters



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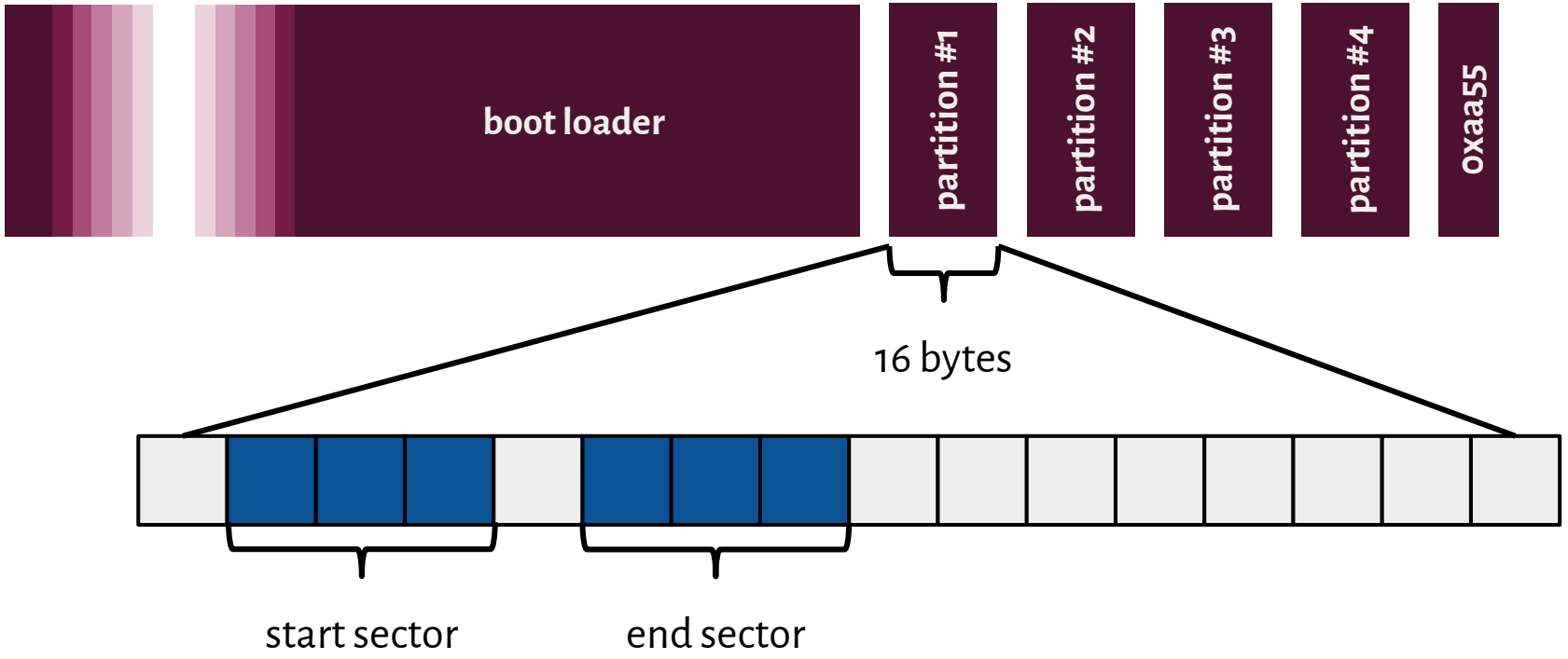

Cylinder:	0 - 1023
Head:	0 - 254
Sector:	1 - 63

```
1024*255*63*512 bytes = ~7,84 GiB
```

MASTER BOOT RECORD

>_INVOKE-IR

BY: JARED ATKINSON
TEMPLATE BY: ANGE ALBERTINI

```
000: 33 C0 8E D0 BC 00 7C 8E C0 8E D8 BE 00 7C BF 00
010: 06 B9 00 02 FC F3 A4 50 68 1C 06 CB FB B9 04 00
020: BD BE 07 80 7E 00 00 7C 0B 0F 85 0E 01 83 C5 10
030: E2 F1 CD 18 88 56 00 55 C6 46 11 05 C6 46 10 00
040: B4 41 BB AA 55 CD 13 5D 72 0F 81 FB 55 AA 75 09
050: F7 C1 01 00 74 03 FE 46 10 66 60 80 7E 10 00 74
060: 26 66 68 00 00 00 00 66 FF 76 08 68 00 00 68 00
070: 7C 68 01 00 68 10 00 B4 42 8A 56 00 8B F4 CD 13
080: 9F 83 C4 10 9E EB 14 B8 01 02 BB 00 7C 8A 56 00
090: 8A 76 01 8A 4E 02 8A 6E 03 CD 13 66 61 73 1C FE
0A0: 4E 11 75 0C 80 7E 00 80 0F 84 8A 00 B2 80 EB 84
0B0: 55 32 E4 8A 56 00 CD 13 5D EB 9E 81 3E FE 7D 55
0C0: AA 75 6E FF 76 00 E8 8D 00 75 17 FA B0 D1 E6 64
0D0: E8 83 00 B0 DF E6 60 E8 7C 00 B0 FF E6 64 E8 75
0E0: 00 FB B8 00 BB CD 1A 66 23 C0 75 3B 66 81 FB 54
0F0: 43 50 41 75 32 81 F9 02 01 72 2C 66 68 07 BB 00
100: 00 66 68 00 02 00 00 66 68 08 00 00 00 66 53 66
110: 53 66 55 66 68 00 00 00 00 66 68 00 7C 00 00 66
120: 61 68 00 00 07 CD 1A 5A 32 F6 EA 00 7C 00 00 CD
130: 18 A0 B7 07 EB 08 A0 B6 07 EB 03 A0 B5 07 32 E4
140: 05 00 07 8B F0 AC 3C 00 74 09 BB 07 00 B4 0E CD
150: 10 EB F2 F4 EB FD 2B C9 E4 64 EB 00 24 02 E0 F8
160: 24 02 C3 49 6E 76 61 6C 69 64 20 70 61 72 74 69
170: 74 69 6F 6E 20 74 61 62 6C 65 00 45 72 72 6F 72
180: 20 6C 6F 61 64 69 6E 67 20 6F 70 65 72 61 74 69
190: 6E 67 20 73 79 73 74 65 6D 00 4D 69 73 73 69 6E
1A0: 67 20 6F 70 65 72 61 74 69 6E 67 20 73 79 73 74
1B0: 65 6D 00 00 00 63 7B 9A 82 D4 BA 7D 00 00 00 20
1C0: 21 00 07 FE FF FF 00 08 00 00 00 90 36 06 80 FE
1D0: FF FF 07 FE FF FF 00 A0 36 06 00 60 09 00 00 00
1E0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
1F0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 55 AA
```

PARTITION TYPES

0x00 - EMPTY	0x83 - LINUX
0x01 - FAT12	0x84 - HIBERNATION
0x04 - FAT16	0x85 - LINUX_EXTENDED
0x05 - MS_EXTENDED	0x86 - NTFS_VOLUME_SET
0x06 - FAT16	0x87 - NTFS_VOLUME_SET_1
0x07 - NTFS	0xa0 - HIBERNATION_1
0x0b - FAT32	0xa1 - HIBERNATION_2
0x0c - FAT32	0xa5 - FREEBSD
0x0e - FAT16	0xa6 - OPENBSD
0x0f - MS_EXTENDED	0xa8 - MACOSX
0x11 - HIDDEN_FAT12	0xa9 - NETBSD
0x14 - HIDDEN_FAT16	0xab - MAC_OSX_BOOT
0x16 - HIDDEN_FAT16	0xb7 - BSDI
0x1b - HIDDEN_FAT32	0xb8 - BSDI_SWAP
0x1c - HIDDEN_FAT32	0xee - EFI_GPT_DISK
0x1e - HIDDEN_FAT16	0xef - EFI_SYSTEM_PARTITION
0x42 - MS_MBR_DYNAMIC	0xfb - VMWARE_FILE_SYSTEM
0x82 - SOLARIS_X86	0xfc - VMWARE_SWAP
0x82 - LINUX_SWAP	

BOOT CODE

FIELDS	VALUES
jump to boot program	
disk parameters	
boot program code	
disk signature	82D4BA7D

CHS ADDRESSING

```
00100000 00100001 00000000
00100000 100001 0000000000
  Head - 1st byte
Sector - 2nd byte (0-5 bits)
Cylinder - 2nd byte (6-7 bits)
           3rd byte
```

PARTITION TABLE

status	0x00 - Non-Bootable
starting head	0x20
starting sector	0x21
starting cylinder	0x00
partition type	0x07 - NTFS
ending head	0xFE
ending sector	0x3F
ending cylinder	0x3FF
relative start sector	0x800
total sectors	0x6369000
status	0x80 - Bootable
starting head	0xFE
starting sector	0x3F
starting cylinder	0x3FF
partition type	0x07 - NTFS
ending head	0xFE
ending sector	0x3F
ending cylinder	0x3FF
relative start sector	0x636A000
total sectors	0x96000
partition type	0x00 - EMPTY
partition type	0x00 - EMPTY

END OF MBR

marker	0x55AA

$(2^{32} + 2^{32}) * 512\ B = 2\ TB$

http://www.invoke-ir.com/2015/05/ontheforensictrail-part2.html

GUID Partition Table

- ★ 64-bit values for addressing purposes (Logical Block Addresses instead of CHS system), which can address up to **9.4 zettabytes (ZB)**
- ★ Support for multiple partitions, **128 partitions** in most configurations.
- ★ **Backup GPT header tables** (the secondary header table can still be accessed, if the GPT header at the beginning of the device has been deleted by accident).
- ★ Use of a protective MBR at LBA Sector 0 for assuring **backwards compatibility**.

https://www.thomas-krenn.com/en/wiki/GUID_Partition_Table

MBR

a special type of boot sector at the very beginning of partitioned computer mass storage devices

Bootloader

★ Moves the context flow to the kernel.

Bootloader

- ★ Sends the kernel code to the physical memory.
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Bootloader

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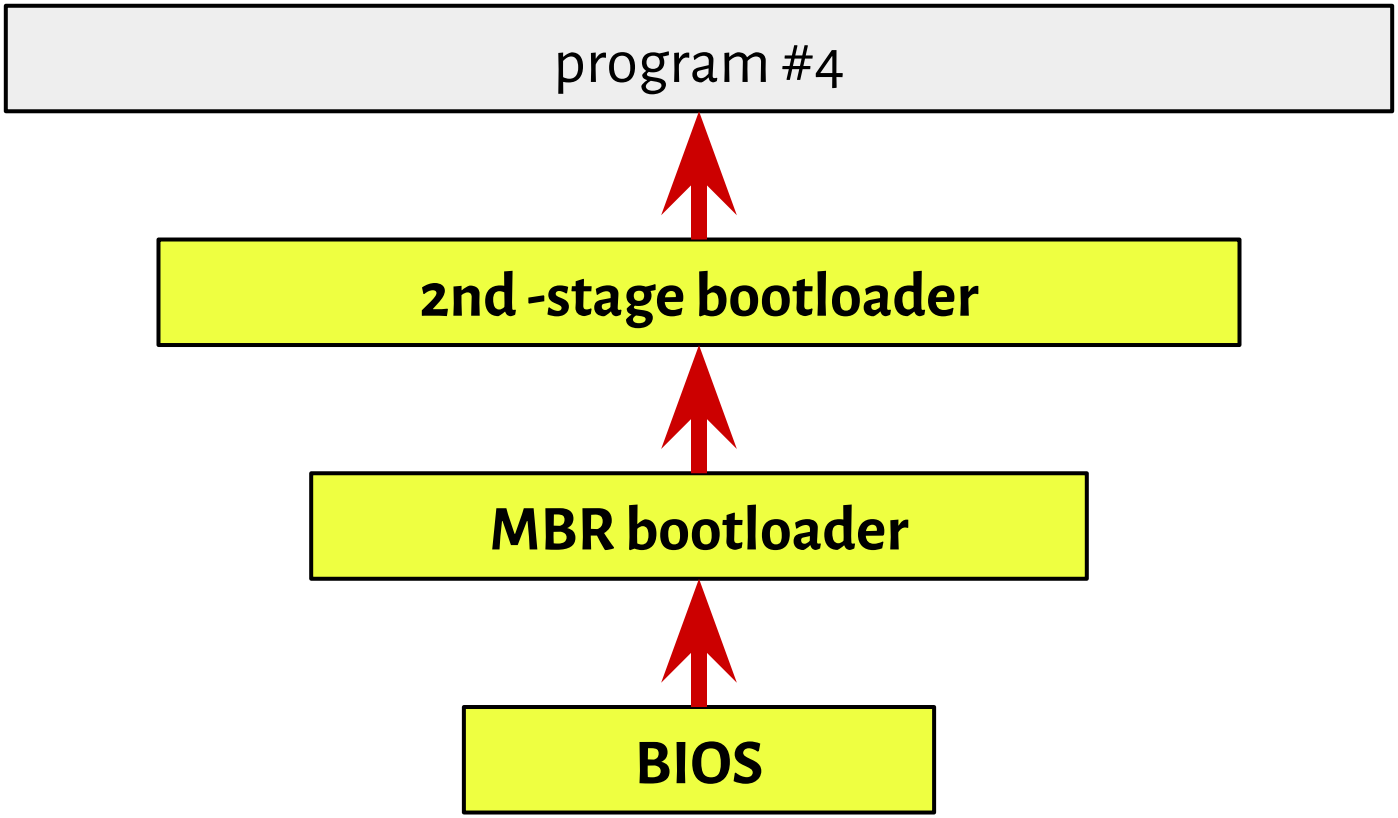
Bootstrapping



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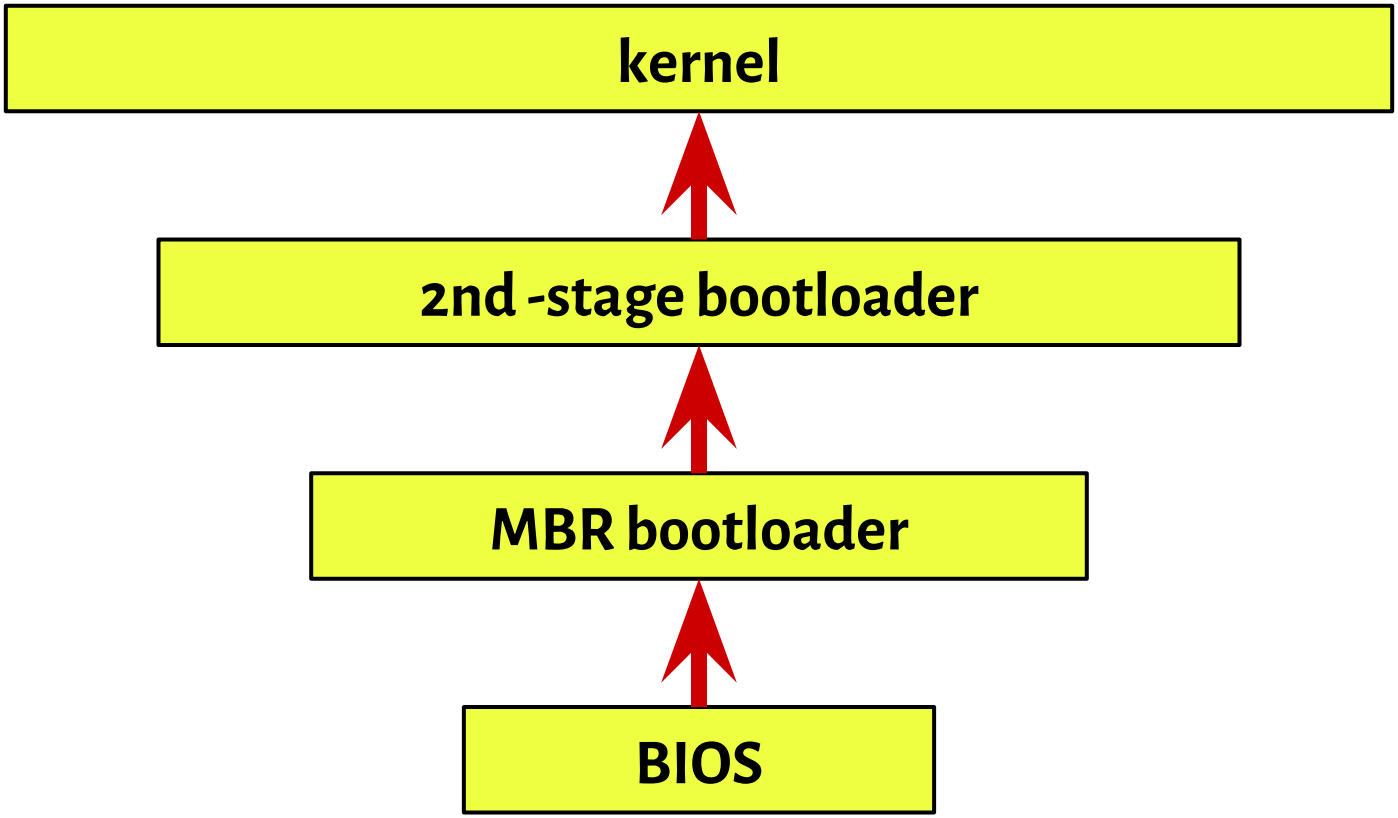
LILO: LInux LOader

https://www.centos.org/docs/rhel-rg-en-3/s1-grub-lilo.html

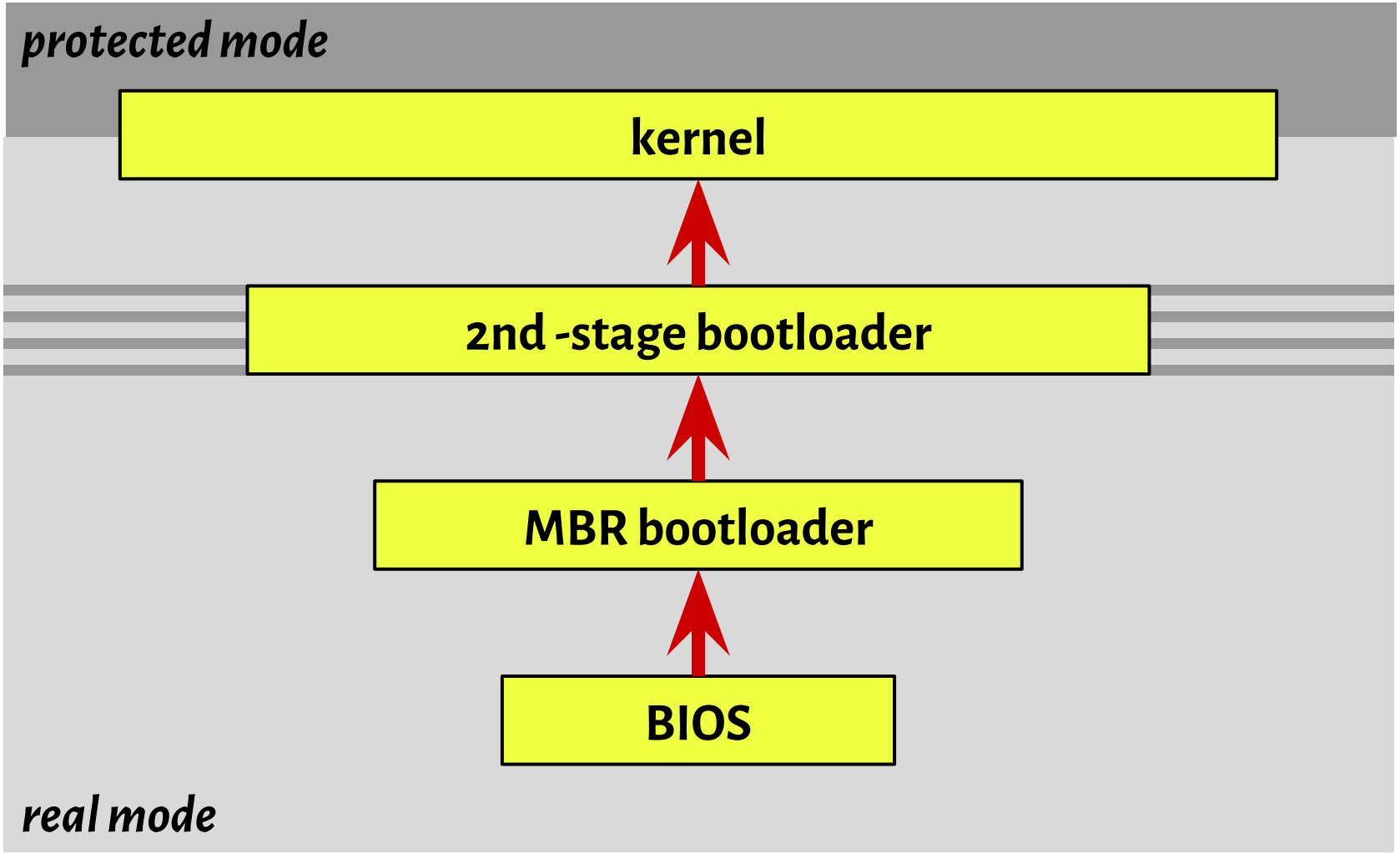
GRUB: GRand Unified Boot loader

https://www.centos.org/docs/rhel-rg-en-3/s1-grub-whatis.html

Bootstrapping



Real-mode


protected mode
kernel
2nd -stage bootloader
MBR bootloader
BIOS
real mode

Real-mode

The mode of 8086 architectures:

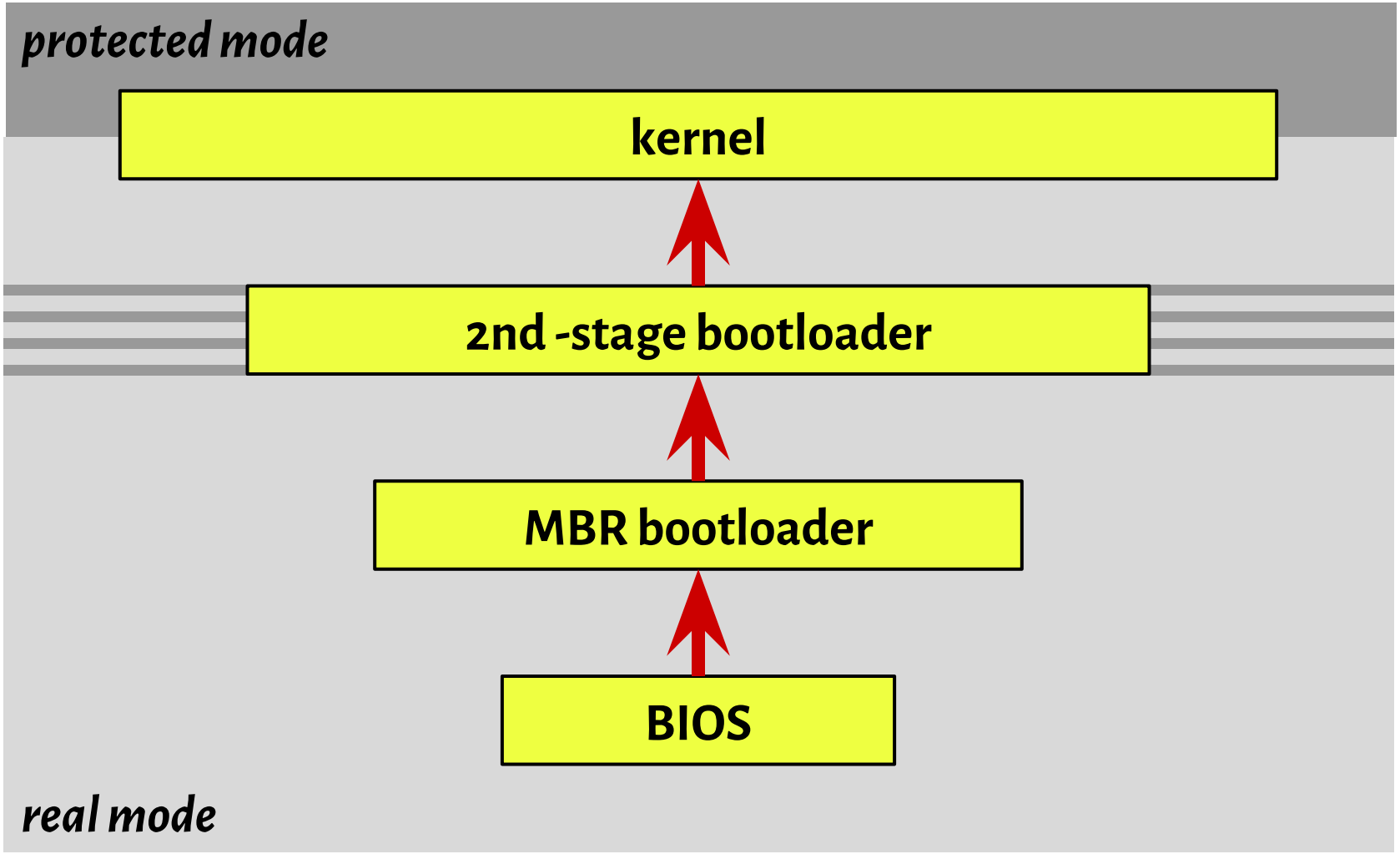
- ★ 1 MiB of memory
- ★ 16-bit registers

```
address = segment * 16 + offset
```

```
12ab:34cd
```

```
mov es:[si], ax
```

Real-mode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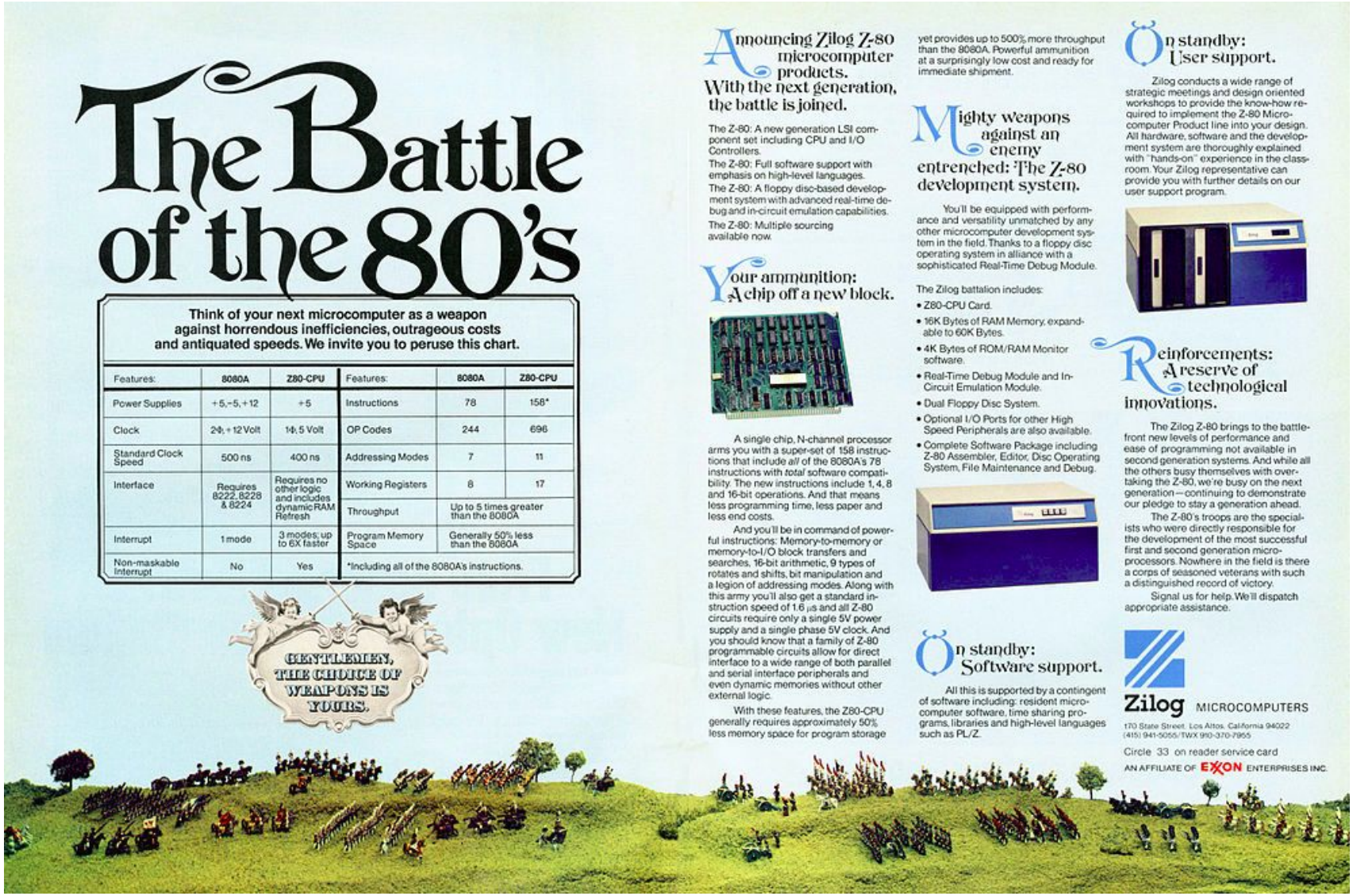
Why x86?



The Battle of the 80's

Think of your next microcomputer as a weapon against horrendous inefficiencies, outrageous costs and antiquated speeds. We invite you to peruse this chart.

Features:	8080A	Z80-CPU	Features:	8080A	Z80-CPU
Power Supplies	+5,−5,+12	+5	Instructions	78	158*
Clock	2Φ; +12 Volt	1Φ; 5 Volt	OP Codes	244	696
Standard Clock Speed	500 ns	400 ns	Addressing Modes	7	11
Interface	Requires 8222, 8228 & 8224	Requires no other logic and includes dynamic RAM Refresh	Working Registers	8	17
			Throughput	Up to 5 times greater than the 8080A	
Interrupt	1 mode	3 modes; up to 6X faster	Program Memory Space	Generally 50% less than the 8080A	
Non-maskable Interrupt	No	Yes	*Including all of the 8080A's instructions.		

GENTLEMEN, THE CHOICE OF WEAPONS IS YOURS.

Announcing Zilog Z-80 microcomputer products. With the next generation, the battle is joined.

The Z-80: A new generation LSI component set including CPU and I/O Controllers.
The Z-80: Full software support with emphasis on high-level languages.
The Z-80: A floppy disc-based development system with advanced real-time debug and in-circuit emulation capabilities.
The Z-80: Multiple sourcing available now.

Your ammunition: A chip off a new block.

A single chip, N-channel processor arms you with a super-set of 158 instructions that include *all* of the 8080A's 78 instructions with *total* software compatibility. The new instructions include 1, 4, 8 and 16-bit operations. And that means less programming time, less paper and less end costs.

And you'll be in command of powerful instructions: Memory-to-memory or memory-to-I/O block transfers and searches, 16-bit arithmetic, 9 types of rotates and shifts, bit manipulation and a legion of addressing modes. Along with this army you'll also get a standard instruction speed of 1.6 μs and all Z-80 circuits require only a single 5V power supply and a single phase 5V clock. And you should know that a family of Z-80 programmable circuits allow for direct interface to a wide range of both parallel and serial interface peripherals and even dynamic memories without other external logic.

With these features, the Z80-CPU generally requires approximately 50% less memory space for program storage yet provides up to 500% more throughput than the 8080A. Powerful ammunition at a surprisingly low cost and ready for immediate shipment.

Mighty weapons against an enemy entrenched: The Z-80 development system.

You'll be equipped with performance and versatility unmatched by any other microcomputer development system in the field. Thanks to a floppy disc operating system in alliance with a sophisticated Real-Time Debug Module.

The Zilog battalion includes:

- Z80-CPU Card.
- 16K Bytes of RAM Memory, expandable to 60K Bytes.
- 4K Bytes of ROM/RAM Monitor software.
- Real-Time Debug Module and In-Circuit Emulation Module.
- Dual Floppy Disc System.
- Optional I/O Ports for other High Speed Peripherals are also available.
- Complete Software Package including Z-80 Assembler, Editor, Disc Operating System, File Maintenance and Debug.

On standby: Software support.

All this is supported by a contingent of software including: resident microcomputer software, time sharing programs, libraries and high-level languages such as PL/Z.

On standby: User support.

Zilog conducts a wide range of strategic meetings and design oriented workshops to provide the know-how required to implement the Z-80 Microcomputer Product line into your design. All hardware, software and the development system are thoroughly explained with "hands-on" experience in the classroom. Your Zilog representative can provide you with further details on our user support program.

Reinforcements: A reserve of technological innovations.

The Zilog Z-80 brings to the battlefront new levels of performance and ease of programming not available in second generation systems. And while all the others busy themselves with overtaking the Z-80, we're busy on the next generation—continuing to demonstrate our pledge to stay a generation ahead.

The Z-80's troops are the specialists who were directly responsible for the development of the most successful first and second generation microprocessors. Nowhere in the field is there a corps of seasoned veterans with such a distinguished record of victory.

Signal us for help. We'll dispatch appropriate assistance.

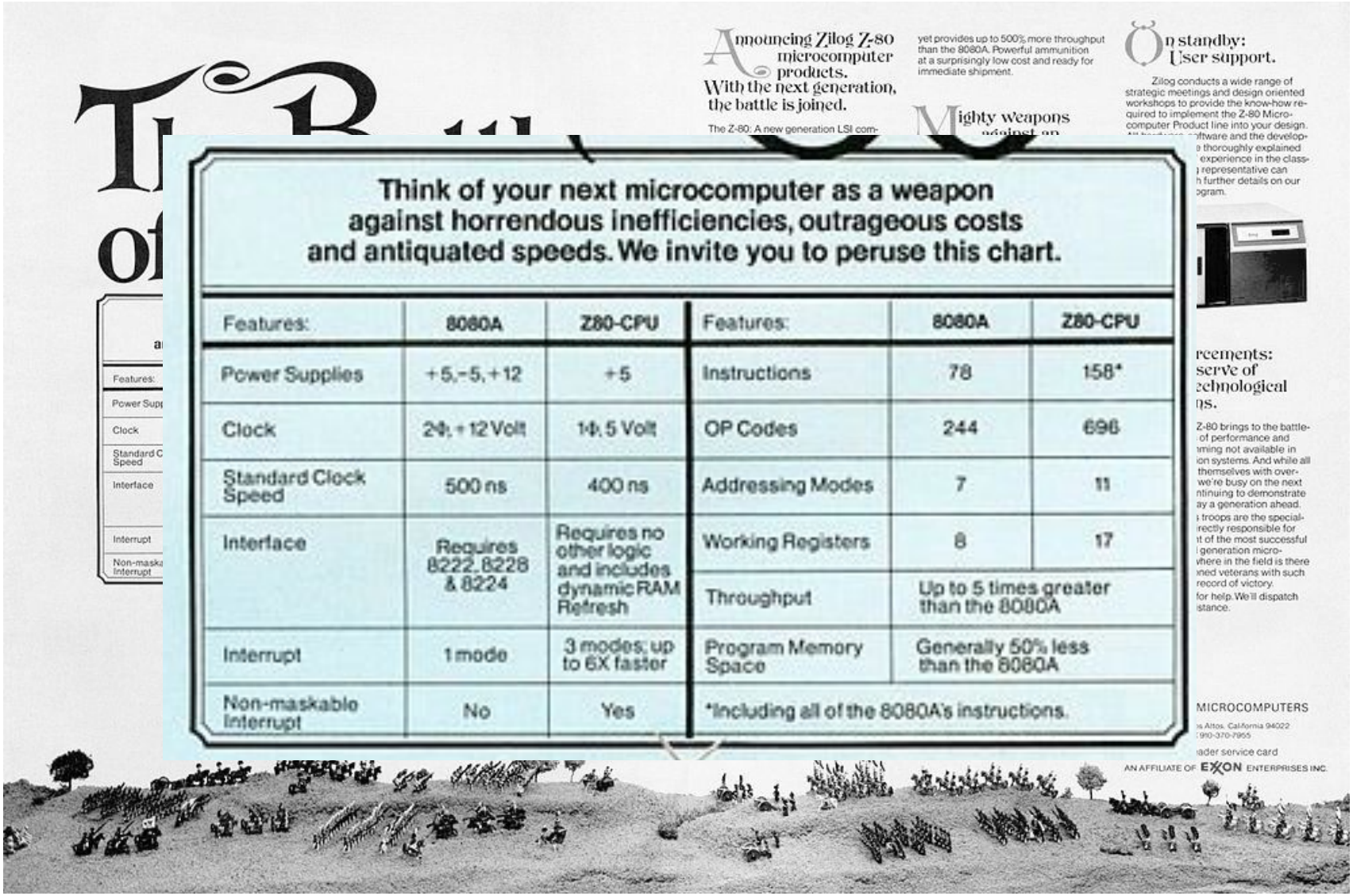
Zilog MICROCOMPUTERS

170 State Street, Los Altos, California 94022
(415) 941-5055/TWX 910-370-7955

Circle 33 on reader service card

AN AFFILIATE OF EXXON ENTERPRISES INC.

Why x86?



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Unified Extensible Firmware Interface

https://www.howtogeek.com/56958/htg-explains-how-uefi-will-replace-the-bios/

https://www.happyassassin.net/2014/01/25/uefi-boot-how-does-that-actually-work-then/

http://www.uefi.org/specifications

```
$ efibootmgr -v
```