The K Project

Userland

LSE Team

EPITA

March 21, 2016

Executable and Linkable Format

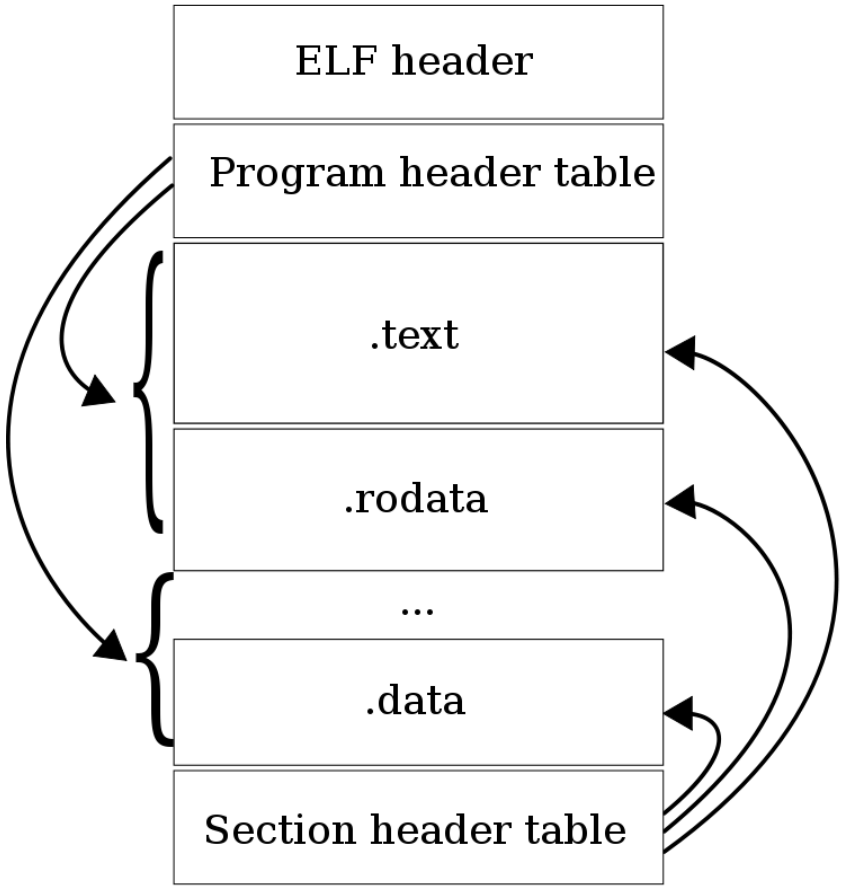


Figure:

Sections

- `.text`: program code
- `.rodata`: readonly data (ex: Constant strings)
- `.data`: global data
- `.bss`: unitialized data
- `.symtab`: symbols table
- `.init`: executable code for the initialization of the program
- `.fini`: executable code for the program termination

Segments and Sections

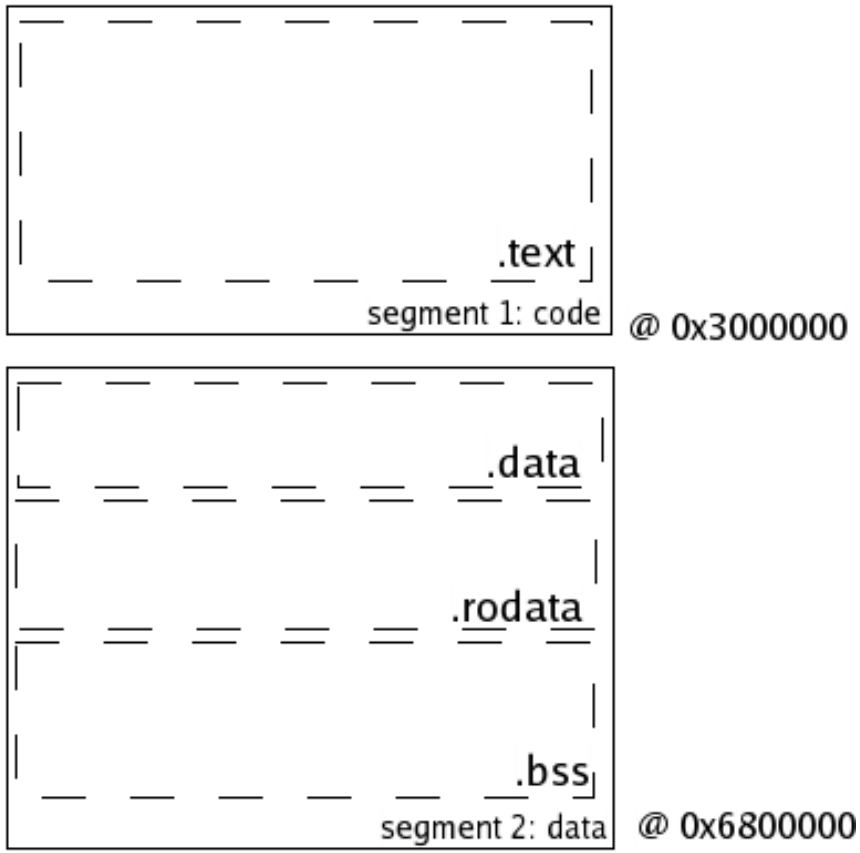


Figure:

Binary Loader

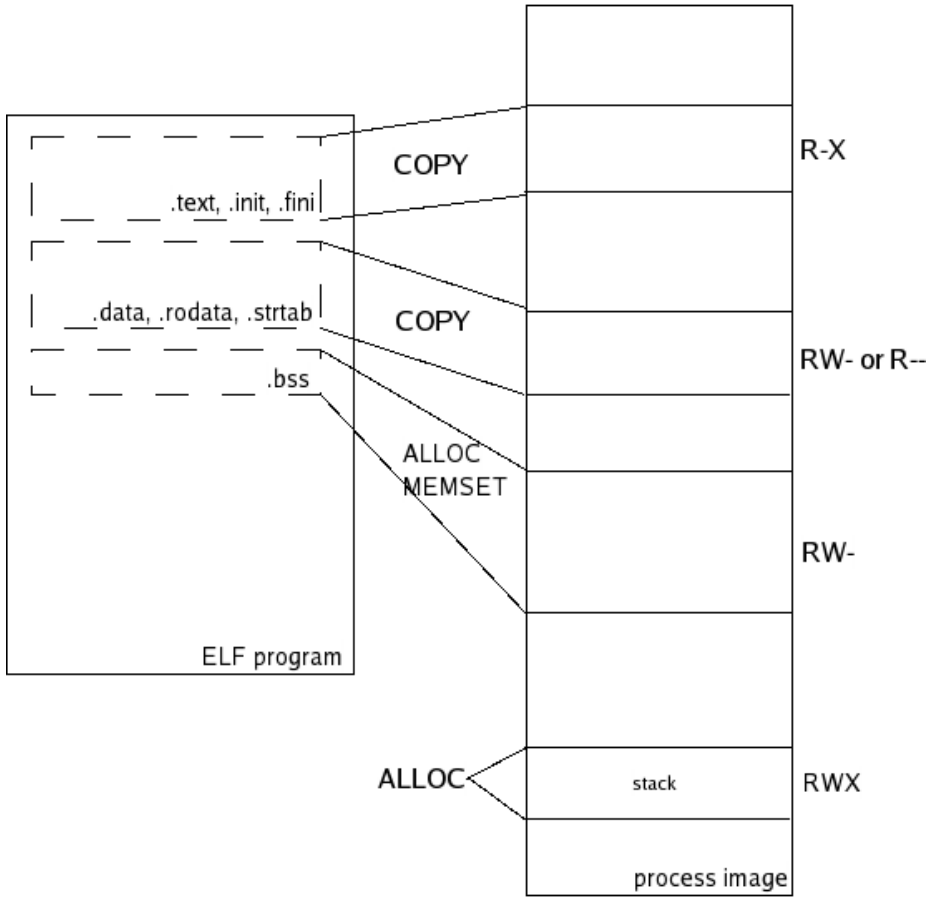


Figure:

Getting Elf program headers

- Program headers can be found directly from Elf header with these fields:
  - `e_phoff`: offset to program header structure array
  - `e_phentsize`: program header structure size in array
  - `e_phnum`: number of program header structures in array

Elf program headers information

- Program header structure then contains the following informations:
  - `p_type`: program header type
  - `p_flags`: memory flags associated with program header
  - `p_vaddr`: expected virtual memory address of program header
  - `p_off`: program header offset in Elf
  - `p_memsz`: in memory size of program header
  - `p_filesz`: in file size of program header. It can differ from `p_memsz`, then the remaining part must be filled with 0

Memory layout

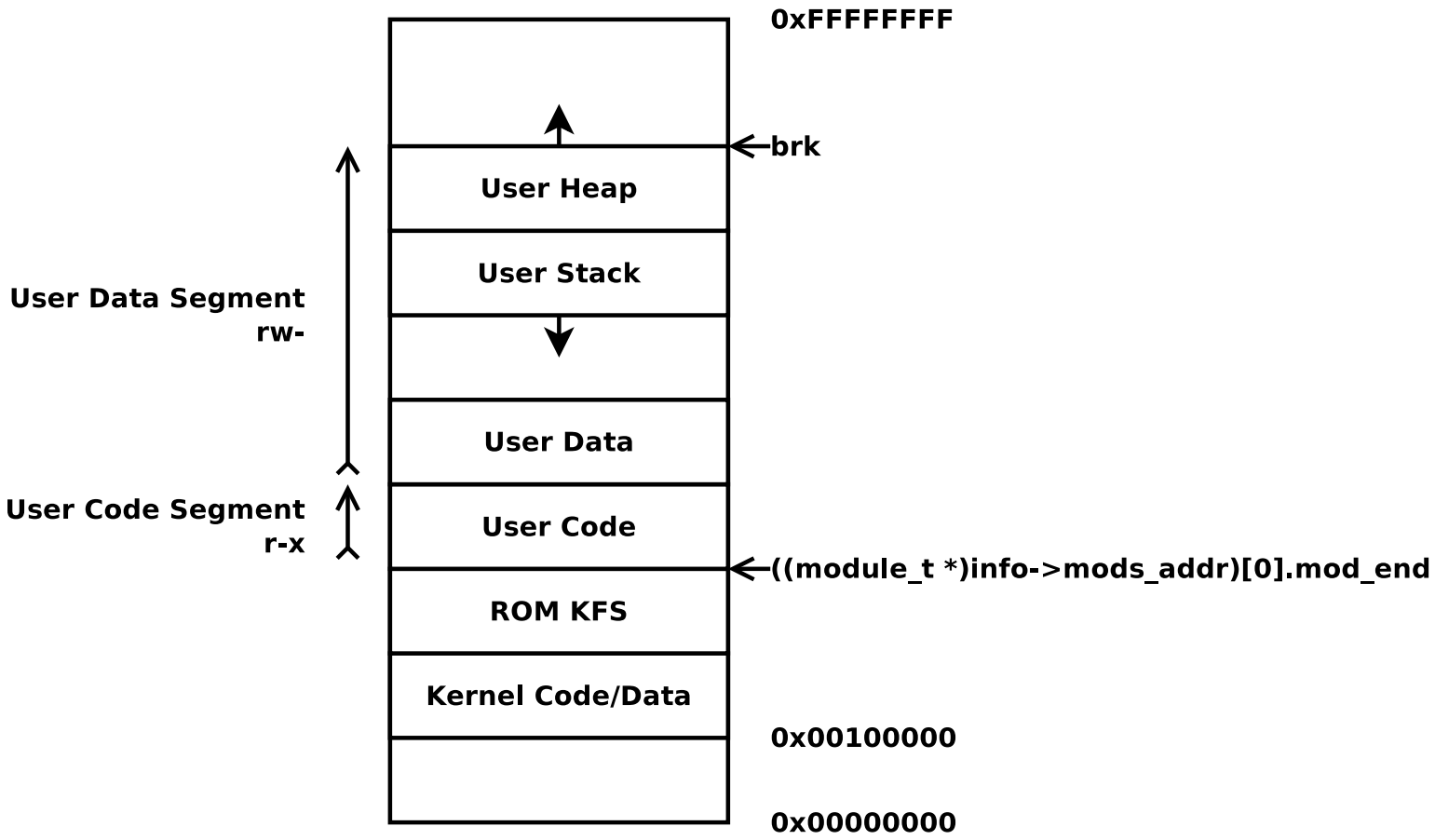


Figure:

Syscall

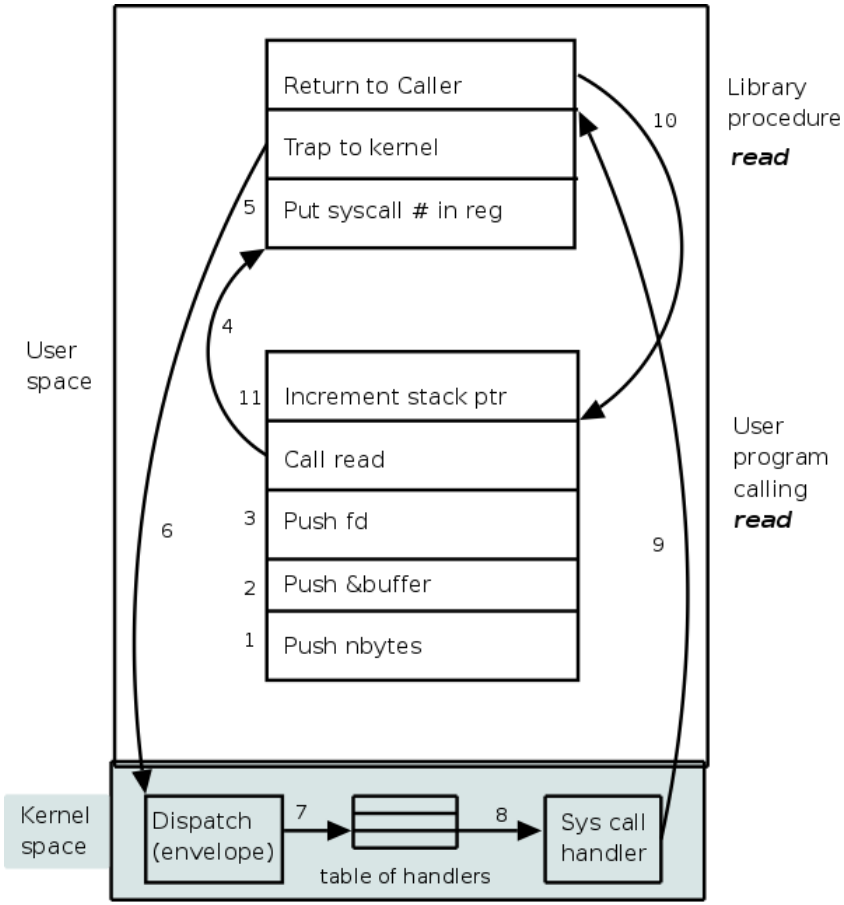


Figure:

Syscall Gate

- A unique syscall gate (0x80)
  - `int 0x80`
- `eax`: Syscall number
- `ebx`, `ecx`, `edx`: Syscall parameters

Events in userland

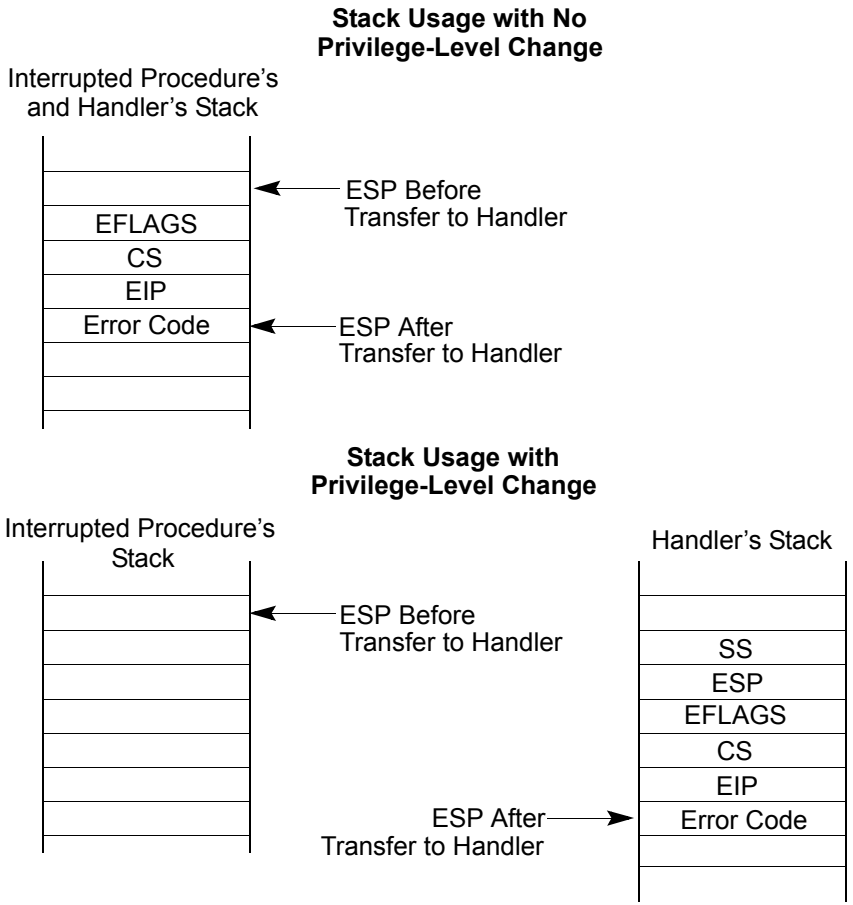


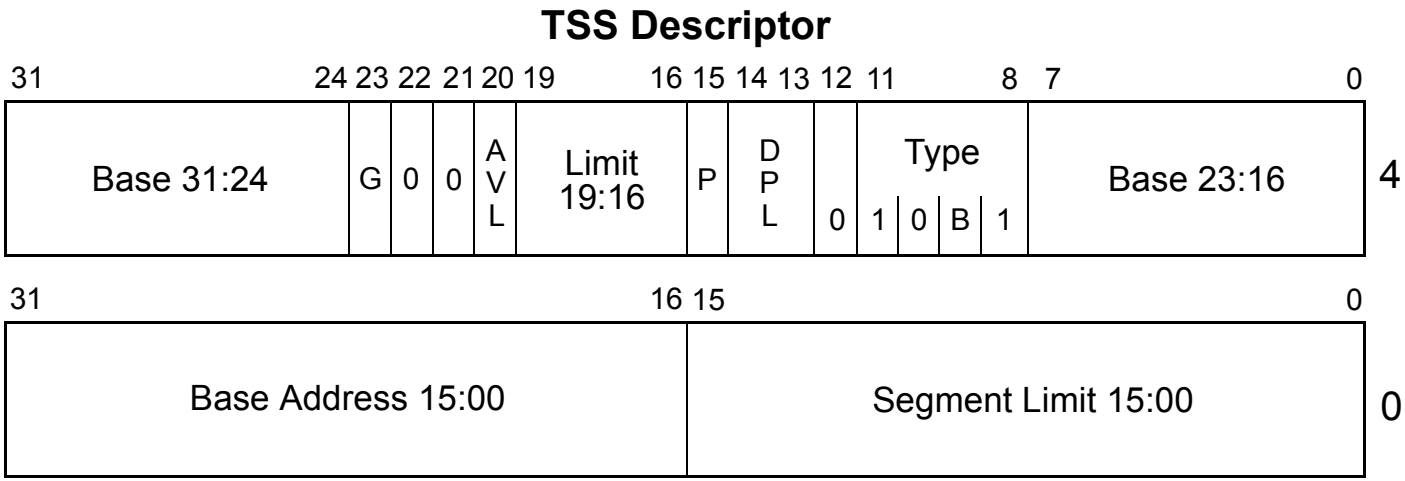
Figure:

31	15	0	
I/O Map Base Address	Reserved	T	100
Reserved	LDT Segment Selector		96
Reserved	GS		92
Reserved	FS		88
Reserved	DS		84
Reserved	SS		80
Reserved	CS		76
Reserved	ES		72
EDI			68
ESI			64
EBP			60
ESP			56
EBX			52
EDX			48
ECX			44
EAX			40
EFLAGS			36
EIP			32
CR3 (PDBR)			28
Reserved	SS2		24
ESP2			20
Reserved	SS1		16
ESP1			12
Reserved	SS0		8
ESP0			4
Reserved	Previous Task Link		0

Reserved bits. Set to 0.

Figure:

TSS Descriptor



AVL	Available for use by system software
B	Busy flag
BASE	Segment Base Address
DPL	Descriptor Privilege Level
G	Granularity
LIMIT	Segment Limit
P	Segment Present
TYPE	Segment Type

Figure:

Load TSS


```
movw $0x10, %ax
ltr %ax /* The second GDT entry describe the TSS */
```

GDT requirements

- GDT should then contain:
  - Null descriptor
  - Kernel code segment
  - Kernel data segment
  - Userland code segment
  - Userland data segment
  - TSS

Register setting to go to Userland

- To jump to Userland, register values must be:
  - `cs`, `ds`, `ss`
  - `esp` must be set to a task stack address
  - `eip` must be set to program entry point

Events in userland

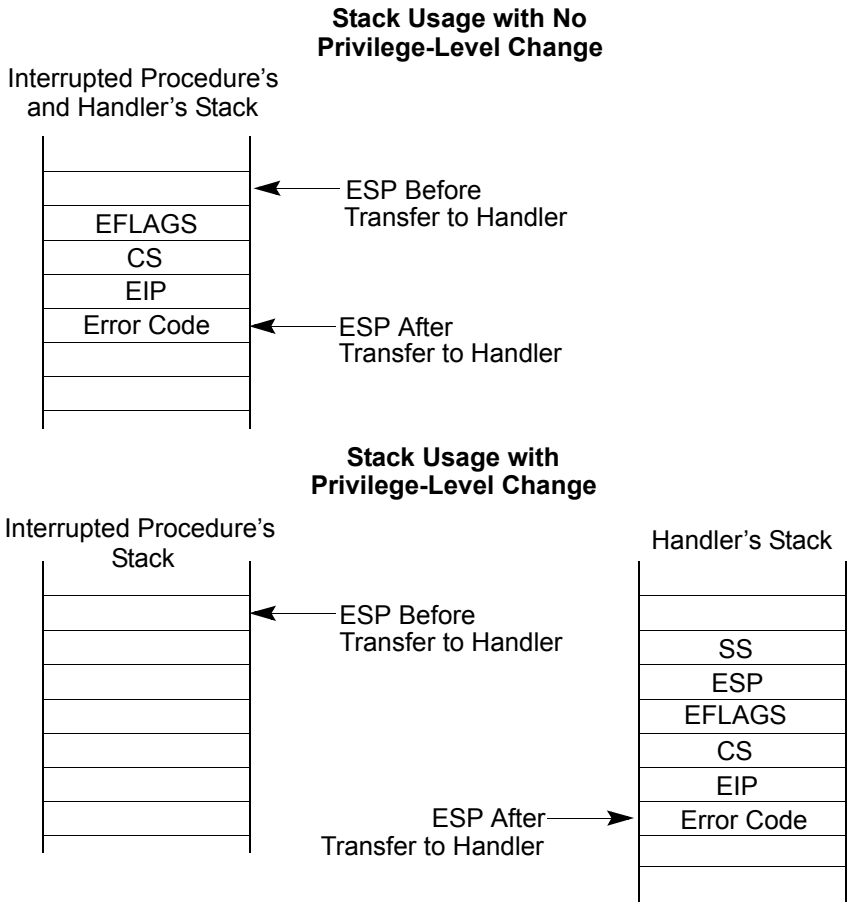


Figure:

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