

# ELF1 7E Relocation Experiments - ELF Study 1999

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- 1 Based on
- 2 Checking the effect of `static` keyword
- 3 1) `re1.c` Experiments and Results
  - a) Compiled with default option
  - b) Compiled with `-fPIC`
  - c) Compiled with `-fno-pic`
- 4 2) `re12.c` Experiments and Results
- 5 Dynamic Executables

"Study of ELF loading and relocs", 1999

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

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# Compiling 32-bit program on 64-bit gcc

- `gcc -v`
- `gcc -m32 t.c`
- `sudo apt-get install gcc-multilib`
- `sudo apt-get install g++-multilib`
- `gcc-multilib`
- `g++-multilib`
- `gcc -m32`
- `objdump -m i386`

# TOC: Checking the effect of `static` keyword

- `rel.c` and `rel2.c`
- Example library ecode - `rel.c`
- Removing `static` keyword - `rel2.c`
- Symbol tables
- Relocation sections `.rel.data.rel`
- Relocation sections `.rel.text`

# rel.c and rel2.c (no static)

rel.c - with static

```
static char fLocal(int b) {  
    return b;  
}
```

```
static char cLocal;
```

rel2.c - without static

```
char fLocal(int b) {  
    return b;  
}
```

```
char cLocal;
```

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

# Example library code - rel.c

```
typedef struct {
    char* p;
    char (*f)(int);
} _st;

char fPub(int a) {
    return a;
}

static char fLocal(int b) {
    return b;
}

char cPub;           // uninitialized
static char cLocal; // uninitialized

_st a[] = { { &cLocal, // 1
             fLocal }, // 2
            { &cPub, // 3
              fPub } }; // 4

int foo(int a) { // 5
    return fPub(a) // 6
        + fLocal(a) // 7
        + (int) &cPub // 8
        + cPub // 9
        + (int) &cLocal // 10
        + cLocal; // 11
}
```

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

# Removing static keyword - rel2.c ~

- static keyword removed (no local symbols)

```
typedef struct {
    char* p;
    char (*f)(int);
} _st;

char fPub(int a) {
    return a;
}

char fLocal(int b) {
    return b;
}

char cPub;    // uninitialized
char cLocal; // uninitialized

_st a[] = { { &cLocal, // 1
             fLocal }, // 2
            { &cPub, // 3
             fPub } }; // 4

int foo(int a) { // 5
    return fPub(a) // 6
        + fLocal(a) // 7
        + (int) &cPub // 8
        + cPub // 9
        + (int) &cLocal // 10
        + cLocal; // 11
}
```

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)



# Symbol tables

- **rel.o**

Symbol table '.symtab' contains 22 entries:

| Num: | Valor    | Tam | Tipo   | Unión  | Vis     | Nombre                    | Ind |
|------|----------|-----|--------|--------|---------|---------------------------|-----|
| 5:   | 00000012 | 18  | FUNC   | LOCAL  | DEFAULT | 3 fLocal                  |     |
| 6:   | 00000000 | 1   | OBJECT | LOCAL  | DEFAULT | 6 cLocal                  |     |
| 15:  | 00000000 | 18  | FUNC   | GLOBAL | DEFAULT | 3 fPub                    |     |
| 17:  | 00000000 | 0   | NOTYPE | GLOBAL | DEFAULT | UND _GLOBAL_OFFSET_TABLE_ |     |
| 18:  | 00000001 | 1   | OBJECT | GLOBAL | DEFAULT | COM cPub                  |     |
| 19:  | 00000000 | 16  | OBJECT | GLOBAL | DEFAULT | 7 a                       |     |
| 20:  | 00000024 | 96  | FUNC   | GLOBAL | DEFAULT | 3 foo                     |     |

- **rel2.o (no local symbols)**

Symbol table '.symtab' contains 22 entries:

| Num: | Valor    | Tam | Tipo   | Unión  | Vis     | Nombre                    | Ind |
|------|----------|-----|--------|--------|---------|---------------------------|-----|
| 13:  | 00000000 | 18  | FUNC   | GLOBAL | DEFAULT | 3 fPub                    |     |
| 15:  | 00000000 | 0   | NOTYPE | GLOBAL | DEFAULT | UND _GLOBAL_OFFSET_TABLE_ |     |
| 16:  | 00000012 | 18  | FUNC   | GLOBAL | DEFAULT | 3 fLocal                  |     |
| 17:  | 00000001 | 1   | OBJECT | GLOBAL | DEFAULT | COM cPub                  |     |
| 18:  | 00000001 | 1   | OBJECT | GLOBAL | DEFAULT | COM cLocal                |     |
| 19:  | 00000000 | 16  | OBJECT | GLOBAL | DEFAULT | 7 a                       |     |
| 20:  | 00000024 | 98  | FUNC   | GLOBAL | DEFAULT | 3 foo                     |     |

- **rel.o**

La sección de reubicación '.rel.data.rel' at offset 0x3d4 contains 4 entries:

| Desplaz  | Info     | Tipo     | Val.Símbolo | Nom. Símbolo |
|----------|----------|----------|-------------|--------------|
| 00000000 | 00000401 | R_386_32 | 00000000    | .bss         |
| 00000004 | 00000201 | R_386_32 | 00000000    | .text        |
| 00000008 | 00001201 | R_386_32 | 00000001    | cPub         |
| 0000000c | 00000f01 | R_386_32 | 00000000    | fPub         |

- **rel2.o (no local symbols)**

La sección de reubicación '.rel.data.rel' at offset 0x3e0 contains 4 entries:

| Desplaz  | Info     | Tipo     | Val.Símbolo | Nom. Símbolo |
|----------|----------|----------|-------------|--------------|
| 00000000 | 00001201 | R_386_32 | 00000001    | cLocal       |
| 00000004 | 00001001 | R_386_32 | 00000012    | fLocal       |
| 00000008 | 00001101 | R_386_32 | 00000001    | cPub         |
| 0000000c | 00000d01 | R_386_32 | 00000000    | fPub         |

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

# Relocation sections .rel.text

- rel.o

|          |          |              |          |                       |
|----------|----------|--------------|----------|-----------------------|
| 00000009 | 0000110a | R_386_GOTPC  | 00000000 | _GLOBAL_OFFSET_TABLE_ |
| 0000001b | 0000110a | R_386_GOTPC  | 00000000 | _GLOBAL_OFFSET_TABLE_ |
| 00000030 | 0000110a | R_386_GOTPC  | 00000000 | _GLOBAL_OFFSET_TABLE_ |
| 00000038 | 00000f02 | R_386_PC32   | 00000000 | fPub                  |
| 00000055 | 0000122b | R_386_GOT32X | 00000001 | cPub                  |
| 0000005d | 0000122b | R_386_GOT32X | 00000001 | cPub                  |
| 0000006b | 00000409 | R_386_GOTOFF | 00000000 | .bss                  |
| 00000074 | 00000409 | R_386_GOTOFF | 00000000 | .bss                  |

- rel2.o (no local symbols)

|          |          |              |          |                       |
|----------|----------|--------------|----------|-----------------------|
| 00000009 | 00000f0a | R_386_GOTPC  | 00000000 | _GLOBAL_OFFSET_TABLE_ |
| 0000001b | 00000f0a | R_386_GOTPC  | 00000000 | _GLOBAL_OFFSET_TABLE_ |
| 00000030 | 00000f0a | R_386_GOTPC  | 00000000 | _GLOBAL_OFFSET_TABLE_ |
| 00000038 | 00000d02 | R_386_PC32   | 00000000 | fPub                  |
| 00000046 | 00001002 | R_386_PC32   | 00000012 | fLocal                |
| 00000055 | 0000112b | R_386_GOT32X | 00000001 | cPub                  |
| 0000005d | 0000112b | R_386_GOT32X | 00000001 | cPub                  |
| 0000006b | 0000122b | R_386_GOT32X | 00000001 | cLocal                |
| 00000073 | 0000122b | R_386_GOT32X | 00000001 | cLocal                |

# Example library code - rel.c

```
typedef struct {
    char* p;
    char (*f)(int);
} _st;

char fPub(int a) {
    return a;
}

static char fLocal(int b) {
    return b;
}

char cPub;           // uninitialized
static char cLocal; // uninitialized

_st a[] = { { &cLocal, // 1
             fLocal }, // 2
            { &cPub, // 3
              fPub } }; // 4

int foo(int a) { // 5
    return fPub(a) // 6
        + fLocal(a) // 7
        + (int) &cPub // 8
        + cPub // 9
        + (int) &cLocal // 10
        + cLocal; // 11
}
```

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

# readelf -S rel.o (1)

## Encabezados de Sección:

| [Nr] | Nombre            | Tipo     | Direc    | Desp   | Tam    | ES | Opt | En | Inf | Al |
|------|-------------------|----------|----------|--------|--------|----|-----|----|-----|----|
| [ 0] |                   | NULL     | 00000000 | 000000 | 000000 | 00 |     | 0  | 0   | 0  |
| [ 1] | .group            | GROUP    | 00000000 | 000034 | 000008 | 04 |     | 15 | 16  | 4  |
| [ 2] | .group            | GROUP    | 00000000 | 00003c | 000008 | 04 |     | 15 | 21  | 4  |
| [ 3] | .text             | PROGBITS | 00000000 | 000044 | 000084 | 00 | AX  | 0  | 0   | 1  |
| [ 4] | .rel.text         | REL      | 00000000 | 00037c | 000058 | 08 | I   | 15 | 3   | 4  |
| [ 5] | .data             | PROGBITS | 00000000 | 0000c8 | 000000 | 00 | WA  | 0  | 0   | 1  |
| [ 6] | .bss              | NOBITS   | 00000000 | 0000c8 | 000001 | 00 | WA  | 0  | 0   | 1  |
| [ 7] | .data.rel         | PROGBITS | 00000000 | 0000c8 | 000010 | 00 | WA  | 0  | 0   | 4  |
| [ 8] | .rel.data.rel     | REL      | 00000000 | 0003d4 | 000020 | 08 | I   | 15 | 7   | 4  |
| [ 9] | .text.__x86.get_p | PROGBITS | 00000000 | 0000d8 | 000004 | 00 | AXG | 0  | 0   | 1  |
| [10] | .text.__x86.get_p | PROGBITS | 00000000 | 0000dc | 000004 | 00 | AXG | 0  | 0   | 1  |
| [11] | .comment          | PROGBITS | 00000000 | 0000e0 | 00002b | 01 | MS  | 0  | 0   | 1  |

# readelf -S rel.o (2)

## Encabezados de Sección:

| [Nr] | Nombre          | Tipo     | Direc    | Desp   | Tam    | ES | Opt | En | Inf | Al |
|------|-----------------|----------|----------|--------|--------|----|-----|----|-----|----|
| [12] | .note.GNU-stack | PROGBITS | 00000000 | 00010b | 000000 | 00 |     | 0  | 0   | 1  |
| [13] | .eh_frame       | PROGBITS | 00000000 | 00010c | 0000a8 | 00 | A   | 0  | 0   | 4  |
| [14] | .rel.eh_frame   | REL      | 00000000 | 0003f4 | 000028 | 08 | I   | 15 | 13  | 4  |
| [15] | .symtab         | SYMTAB   | 00000000 | 0001b4 | 000160 | 10 |     | 16 | 15  | 4  |
| [16] | .strtab         | STRTAB   | 00000000 | 000314 | 000067 | 00 |     | 0  | 0   | 1  |
| [17] | .shstrtab       | STRTAB   | 00000000 | 00041c | 0000a4 | 00 |     | 0  | 0   | 1  |

## Key to Flags:

W (write), A (alloc), X (execute), M (merge), S (strings), I (info),  
L (link order), O (extra OS processing required), G (group), T (TLS),  
C (compressed), x (unknown), o (OS specific), E (exclude),  
p (processor specific)

# readelf -s rel.o (1)

Symbol table '.symtab' contains 22 entries:

| Num: | Valor    | Tam | Tipo    | Unión | Vis     | Nombre | Ind    |
|------|----------|-----|---------|-------|---------|--------|--------|
| 0:   | 00000000 | 0   | NOTYPE  | LOCAL | DEFAULT | UND    |        |
| 1:   | 00000000 | 0   | FILE    | LOCAL | DEFAULT | ABS    | rel.o  |
| 2:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 3      |        |
| 3:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 5      |        |
| 4:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 6      |        |
| 5:   | 00000012 | 18  | FUNC    | LOCAL | DEFAULT | 3      | fLocal |
| 6:   | 00000000 | 1   | OBJECT  | LOCAL | DEFAULT | 6      | cLocal |
| 7:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 7      |        |
| 8:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 9      |        |
| 9:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 10     |        |
| 10:  | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 12     |        |
| 11:  | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 13     |        |

# readelf -s rel.o (2)

Symbol table '.symtab' contains 22 entries:

| Num: | Valor    | Tam | Tipo    | Unión  | Vis     | Nombre                    | Ind |
|------|----------|-----|---------|--------|---------|---------------------------|-----|
| 11:  | 00000000 | 0   | SECTION | LOCAL  | DEFAULT |                           | 13  |
| 12:  | 00000000 | 0   | SECTION | LOCAL  | DEFAULT |                           | 11  |
| 13:  | 00000000 | 0   | SECTION | LOCAL  | DEFAULT |                           | 1   |
| 14:  | 00000000 | 0   | SECTION | LOCAL  | DEFAULT |                           | 2   |
| 15:  | 00000000 | 18  | FUNC    | GLOBAL | DEFAULT | fPub                      | 3   |
| 16:  | 00000000 | 0   | FUNC    | GLOBAL | HIDDEN  | __x86.get_pc_thunk.ax     | 9   |
| 17:  | 00000000 | 0   | NOTYPE  | GLOBAL | DEFAULT | UND _GLOBAL_OFFSET_TABLE_ |     |
| 18:  | 00000001 | 1   | OBJECT  | GLOBAL | DEFAULT | COM cPub                  |     |
| 19:  | 00000000 | 16  | OBJECT  | GLOBAL | DEFAULT | a                         | 7   |
| 20:  | 00000024 | 96  | FUNC    | GLOBAL | DEFAULT | foo                       | 3   |
| 21:  | 00000000 | 0   | FUNC    | GLOBAL | HIDDEN  | __x86.get_pc_thunk.bx     | 10  |



# Symbols and their sections

```
5: 00000012    18 FUNC    LOCAL  DEFAULT    3 fLocal  ---> .text
6: 00000000     1 OBJECT  LOCAL  DEFAULT    6 cLocal  ---> .bss
15: 00000000    18 FUNC    GLOBAL DEFAULT    3 fPub    ---> .text
18: 00000001     1 OBJECT  GLOBAL DEFAULT    COM cPub   ---> COMMON
19: 00000000    16 OBJECT  GLOBAL DEFAULT    7 a      ---> .data.rel
20: 00000024    96 FUNC    GLOBAL DEFAULT    3 foo    ---> .text
```

```
[ 3] .text          PROGBITS          00000000 000044 000084 00  AX  0   0  1
[ 4] .rel.text      REL              00000000 00037c 000058 08  I 15  3  4
[ 5] .data          PROGBITS          00000000 0000c8 000000 00  WA  0   0  1
[ 6] .bss           NOBITS           00000000 0000c8 000001 00  WA  0   0  1
[ 7] .data.rel      PROGBITS          00000000 0000c8 000010 00  WA  0   0  4
```

# readelf -r rel.o (1)

La sección de reubicación '.rel.text' at offset 0x37c contains 11 entries:

| Desplaz  | Info     | Tipo         | Val.Símbolo | Nom. Símbolo          |
|----------|----------|--------------|-------------|-----------------------|
| 00000004 | 00001002 | R_386_PC32   | 00000000    | __x86.get_pc_thunk.ax |
| 00000009 | 0000110a | R_386_GOTPC  | 00000000    | _GLOBAL_OFFSET_TABLE_ |
| 00000016 | 00001002 | R_386_PC32   | 00000000    | __x86.get_pc_thunk.ax |
| 0000001b | 0000110a | R_386_GOTPC  | 00000000    | _GLOBAL_OFFSET_TABLE_ |
| 0000002a | 00001502 | R_386_PC32   | 00000000    | __x86.get_pc_thunk.bx |
| 00000030 | 0000110a | R_386_GOTPC  | 00000000    | _GLOBAL_OFFSET_TABLE_ |
| 00000038 | 00000f02 | R_386_PC32   | 00000000    | fPub                  |
| 00000055 | 0000122b | R_386_GOT32X | 00000001    | cPub                  |
| 0000005d | 0000122b | R_386_GOT32X | 00000001    | cPub                  |
| 0000006b | 00000409 | R_386_GOTOFF | 00000000    | .bss                  |
| 00000074 | 00000409 | R_386_GOTOFF | 00000000    | .bss                  |

# readelf -r rel.o (2)

La sección de reubicación '.rel.data.rel' at offset 0x3d4 contains 4 entries:

| Desplaz  | Info     | Tipo     | Val.Símbolo | Nom. Símbolo |
|----------|----------|----------|-------------|--------------|
| 00000000 | 00000401 | R_386_32 | 00000000    | .bss         |
| 00000004 | 00000201 | R_386_32 | 00000000    | .text        |
| 00000008 | 00001201 | R_386_32 | 00000001    | cPub         |
| 0000000c | 0000f01  | R_386_32 | 00000000    | fPub         |

La sección de reubicación '.rel.eh\_frame' at offset 0x3f4 contains 5 entries:

| Desplaz  | Info     | Tipo       | Val.Símbolo | Nom. Símbolo           |
|----------|----------|------------|-------------|------------------------|
| 00000020 | 00000202 | R_386_PC32 | 00000000    | .text                  |
| 00000040 | 00000202 | R_386_PC32 | 00000000    | .text                  |
| 00000060 | 00000202 | R_386_PC32 | 00000000    | .text                  |
| 00000088 | 00000802 | R_386_PC32 | 00000000    | .text.__x86.get_pc_thu |
| 0000009c | 00000902 | R_386_PC32 | 00000000    | .text.__x86.get_pc_thu |

# readelf -S rel.o (-fPIC) (1)

There are 18 section headers, starting at offset 0x4c8:

Section Headers:

| [Nr] | Name              | Type     | Addr     | Off    | Size   | ES | Flg | Lk | Inf | Al |
|------|-------------------|----------|----------|--------|--------|----|-----|----|-----|----|
| [ 0] |                   | NULL     | 00000000 | 000000 | 000000 | 00 |     | 0  | 0   | 0  |
| [ 1] | .group            | GROUP    | 00000000 | 000034 | 000008 | 04 |     | 15 | 16  | 4  |
| [ 2] | .group            | GROUP    | 00000000 | 00003c | 000008 | 04 |     | 15 | 21  | 4  |
| [ 3] | .text             | PROGBITS | 00000000 | 000044 | 00008a | 00 | AX  | 0  | 0   | 1  |
| [ 4] | .rel.text         | REL      | 00000000 | 000384 | 000058 | 08 | I   | 15 | 3   | 4  |
| [ 5] | .data             | PROGBITS | 00000000 | 0000ce | 000000 | 00 | WA  | 0  | 0   | 1  |
| [ 6] | .bss              | NOBITS   | 00000000 | 0000ce | 000001 | 00 | WA  | 0  | 0   | 1  |
| [ 7] | .data.rel         | PROGBITS | 00000000 | 0000d0 | 000010 | 00 | WA  | 0  | 0   | 4  |
| [ 8] | .rel.data.rel     | REL      | 00000000 | 0003dc | 000020 | 08 | I   | 15 | 7   | 4  |
| [ 9] | .text.__x86.get_p | PROGBITS | 00000000 | 0000e0 | 000004 | 00 | AXG | 0  | 0   | 1  |
| [10] | .text.__x86.get_p | PROGBITS | 00000000 | 0000e4 | 000004 | 00 | AXG | 0  | 0   | 1  |
| [11] | .comment          | PROGBITS | 00000000 | 0000e8 | 00002b | 01 | MS  | 0  | 0   | 1  |

# readelf -S rel.o (-fPIC) (2)

There are 18 section headers, starting at offset 0x4c8:

Section Headers:

| [Nr] | Name            | Type     | Addr     | Off    | Size   | ES | Flg | Lk | Inf | Al |
|------|-----------------|----------|----------|--------|--------|----|-----|----|-----|----|
| [12] | .note.GNU-stack | PROGBITS | 00000000 | 000113 | 000000 | 00 |     | 0  | 0   | 1  |
| [13] | .eh_frame       | PROGBITS | 00000000 | 000114 | 0000a8 | 00 | A   | 0  | 0   | 4  |
| [14] | .rel.eh_frame   | REL      | 00000000 | 0003fc | 000028 | 08 | I   | 15 | 13  | 4  |
| [15] | .symtab         | SYMTAB   | 00000000 | 0001bc | 000160 | 10 |     | 16 | 15  | 4  |
| [16] | .strtab         | STRTAB   | 00000000 | 00031c | 000067 | 00 |     | 0  | 0   | 1  |
| [17] | .shstrtab       | STRTAB   | 00000000 | 000424 | 0000a4 | 00 |     | 0  | 0   | 1  |

Key to Flags:

W (write), A (alloc), X (execute), M (merge), S (strings), I (info),  
L (link order), O (extra OS processing required), G (group), T (TLS),  
C (compressed), x (unknown), o (OS specific), E (exclude),  
p (processor specific)

# readelf -s rel.o (-fPIC) (1)

Symbol table '.symtab' contains 22 entries:

| Num: | Value    | Size | Type    | Bind  | Vis     | Ndx | Name   |
|------|----------|------|---------|-------|---------|-----|--------|
| 0:   | 00000000 | 0    | NOTYPE  | LOCAL | DEFAULT | UND |        |
| 1:   | 00000000 | 0    | FILE    | LOCAL | DEFAULT | ABS | rel.o  |
| 2:   | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 3   |        |
| 3:   | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 5   |        |
| 4:   | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 6   |        |
| 5:   | 00000012 | 18   | FUNC    | LOCAL | DEFAULT | 3   | fLocal |
| 6:   | 00000000 | 1    | OBJECT  | LOCAL | DEFAULT | 6   | cLocal |
| 7:   | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 7   |        |
| 8:   | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 9   |        |
| 9:   | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 10  |        |
| 10:  | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 12  |        |
| 11:  | 00000000 | 0    | SECTION | LOCAL | DEFAULT | 13  |        |

# readelf -s rel.o (-fPIC) (2)

Symbol table '.symtab' contains 22 entries:

| Num: | Value    | Size | Type    | Bind   | Vis     | Ndx | Name                  |
|------|----------|------|---------|--------|---------|-----|-----------------------|
| 12:  | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 11  |                       |
| 13:  | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 1   |                       |
| 14:  | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 2   |                       |
| 15:  | 00000000 | 18   | FUNC    | GLOBAL | DEFAULT | 3   | fPub                  |
| 16:  | 00000000 | 0    | FUNC    | GLOBAL | HIDDEN  | 9   | __x86.get_pc_thunk.ax |
| 17:  | 00000000 | 0    | NOTYPE  | GLOBAL | DEFAULT | UND | _GLOBAL_OFFSET_TABLE_ |
| 18:  | 00000001 | 1    | OBJECT  | GLOBAL | DEFAULT | COM | cPub                  |
| 19:  | 00000000 | 16   | OBJECT  | GLOBAL | DEFAULT | 7   | a                     |
| 20:  | 00000024 | 102  | FUNC    | GLOBAL | DEFAULT | 3   | foo                   |
| 21:  | 00000000 | 0    | FUNC    | GLOBAL | HIDDEN  | 10  | __x86.get_pc_thunk.bx |

# Symbols and their sections

```
5: 00000012    18 FUNC    LOCAL  DEFAULT    3 fLocal  ---> .text
6: 00000000     1 OBJECT  LOCAL  DEFAULT    6 cLocal  ---> .bss
15: 00000000    18 FUNC    GLOBAL DEFAULT    3 fPub   ---> .text
18: 00000001     1 OBJECT  GLOBAL DEFAULT    COM cPub   ---> COMMON
19: 00000000    16 OBJECT  GLOBAL DEFAULT    7 a      ---> .data.rel
20: 00000024    96 FUNC    GLOBAL DEFAULT    3 foo    ---> .text
```

```
[ 3] .text          PROGBITS          00000000 000044 000084 00  AX  0   0  1
[ 4] .rel.text      REL               00000000 00037c 000058 08  I  15  3  4
[ 5] .data          PROGBITS          00000000 0000c8 000000 00  WA  0   0  1
[ 6] .bss           NOBITS            00000000 0000c8 000001 00  WA  0   0  1
[ 7] .data.rel      PROGBITS          00000000 0000c8 000010 00  WA  0   0  4
```



# readelf -r rel.o (-fPIC) (1)

Relocation section '.rel.text' at offset 0x384 contains 11 entries:

| Offset   | Info     | Type         | Sym.Value | Sym. Name             |
|----------|----------|--------------|-----------|-----------------------|
| 00000004 | 00001002 | R_386_PC32   | 00000000  | __x86.get_pc_thunk.ax |
| 00000009 | 0000110a | R_386_GOTPC  | 00000000  | _GLOBAL_OFFSET_TABLE_ |
| 00000016 | 00001002 | R_386_PC32   | 00000000  | __x86.get_pc_thunk.ax |
| 0000001b | 0000110a | R_386_GOTPC  | 00000000  | _GLOBAL_OFFSET_TABLE_ |
| 0000002a | 00001502 | R_386_PC32   | 00000000  | __x86.get_pc_thunk.bx |
| 00000030 | 0000110a | R_386_GOTPC  | 00000000  | _GLOBAL_OFFSET_TABLE_ |
| 0000003b | 00000f04 | R_386_PLT32  | 00000000  | fPub                  |
| 0000005b | 0000122b | R_386_GOT32X | 00000001  | cPub                  |
| 00000063 | 0000122b | R_386_GOT32X | 00000001  | cPub                  |
| 00000071 | 00000409 | R_386_GOTOFF | 00000000  | .bss                  |
| 0000007a | 00000409 | R_386_GOTOFF | 00000000  | .bss                  |

## readelf -r rel.o (-fPIC) (2)

Relocation section '.rel.data.rel' at offset 0x3dc contains 4 entries:

| Offset   | Info     | Type     | Sym.Value | Sym. Name |
|----------|----------|----------|-----------|-----------|
| 00000000 | 00000401 | R_386_32 | 00000000  | .bss      |
| 00000004 | 00000201 | R_386_32 | 00000000  | .text     |
| 00000008 | 00001201 | R_386_32 | 00000001  | cPub      |
| 0000000c | 00000f01 | R_386_32 | 00000000  | fPub      |

Relocation section '.rel.eh\_frame' at offset 0x3fc contains 5 entries:

| Offset   | Info     | Type       | Sym.Value | Sym. Name              |
|----------|----------|------------|-----------|------------------------|
| 00000020 | 00000202 | R_386_PC32 | 00000000  | .text                  |
| 00000040 | 00000202 | R_386_PC32 | 00000000  | .text                  |
| 00000060 | 00000202 | R_386_PC32 | 00000000  | .text                  |
| 00000088 | 00000802 | R_386_PC32 | 00000000  | .text.__x86.get_pc_thu |
| 0000009c | 00000902 | R_386_PC32 | 00000000  | .text.__x86.get_pc_thu |

# readelf -S rel.o (-fno-pic)

here are 13 section headers, starting at offset 0x310:

## Section Headers:

| [Nr] | Name            | Type     | Addr     | Off    | Size   | ES | Flg  | Lk | Inf | Al |
|------|-----------------|----------|----------|--------|--------|----|------|----|-----|----|
| [ 0] |                 | NULL     | 00000000 | 000000 | 000000 | 00 |      | 0  | 0   | 0  |
| [ 1] | .text           | PROGBITS | 00000000 | 000034 | 00005d | 00 | AX   | 0  | 0   | 1  |
| [ 2] | .rel.text       | REL      | 00000000 | 000254 | 000028 | 08 | I 10 |    | 1   | 4  |
| [ 3] | .data           | PROGBITS | 00000000 | 000094 | 000010 | 00 | WA   | 0  | 0   | 4  |
| [ 4] | .rel.data       | REL      | 00000000 | 00027c | 000020 | 08 | I 10 |    | 3   | 4  |
| [ 5] | .bss            | NOBITS   | 00000000 | 0000a4 | 000001 | 00 | WA   | 0  | 0   | 1  |
| [ 6] | .comment        | PROGBITS | 00000000 | 0000a4 | 00002b | 01 | MS   | 0  | 0   | 1  |
| [ 7] | .note.GNU-stack | PROGBITS | 00000000 | 0000cf | 000000 | 00 |      | 0  | 0   | 1  |
| [ 8] | .eh_frame       | PROGBITS | 00000000 | 0000d0 | 00007c | 00 | A    | 0  | 0   | 4  |
| [ 9] | .rel.eh_frame   | REL      | 00000000 | 00029c | 000018 | 08 | I 10 |    | 8   | 4  |
| [10] | .symtab         | SYMTAB   | 00000000 | 00014c | 0000e0 | 10 |      | 11 | 10  | 4  |
| [11] | .strtab         | STRTAB   | 00000000 | 00022c | 000025 | 00 |      | 0  | 0   | 1  |
| [12] | .shstrtab       | STRTAB   | 00000000 | 0002b4 | 00005b | 00 |      | 0  | 0   | 1  |

## Key to Flags:

W (write), A (alloc), X (execute), M (merge), S (strings), I (info),  
L (link order), O (extra OS processing required), G (group), T (TLS),  
C (compressed), x (unknown), o (OS specific), E (exclude),  
p (processor specific)

# readelf -s rel.o (-fno-pic)

Symbol table '.symtab' contains 14 entries:

| Num: | Value    | Size | Type    | Bind   | Vis     | Ndx | Name   |
|------|----------|------|---------|--------|---------|-----|--------|
| 0:   | 00000000 | 0    | NOTYPE  | LOCAL  | DEFAULT | UND |        |
| 1:   | 00000000 | 0    | FILE    | LOCAL  | DEFAULT | ABS | rel.o  |
| 2:   | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 1   |        |
| 3:   | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 3   |        |
| 4:   | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 5   |        |
| 5:   | 00000008 | 8    | FUNC    | LOCAL  | DEFAULT | 1   | fLocal |
| 6:   | 00000000 | 1    | OBJECT  | LOCAL  | DEFAULT | 5   | cLocal |
| 7:   | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 7   |        |
| 8:   | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 8   |        |
| 9:   | 00000000 | 0    | SECTION | LOCAL  | DEFAULT | 6   |        |
| 10:  | 00000000 | 8    | FUNC    | GLOBAL | DEFAULT | 1   | fPub   |
| 11:  | 00000001 | 1    | OBJECT  | GLOBAL | DEFAULT | COM | cPub   |
| 12:  | 00000000 | 16   | OBJECT  | GLOBAL | DEFAULT | 3   | a      |
| 13:  | 00000010 | 77   | FUNC    | GLOBAL | DEFAULT | 1   | foo    |

# Symbols and their sections

```
5: 00000008      8 FUNC      LOCAL  DEFAULT      1 fLocal  ---> .text
6: 00000000      1 OBJECT    LOCAL  DEFAULT      5 cLocal  ---> .bss
10: 00000000      8 FUNC      GLOBAL DEFAULT      1 fPub    ---> .text
11: 00000001      1 OBJECT    GLOBAL DEFAULT    COM cPub    ---> COMMON
12: 00000000     16 OBJECT    GLOBAL DEFAULT      3 a      ---> .data
13: 00000010     77 FUNC      GLOBAL DEFAULT      1 foo    ---> .text
```

```
[ 1] .text          PROGBITS          00000000 000034 00005d 00 AX 0 0 1
[ 3] .data          PROGBITS          00000000 000094 000010 00 WA 0 0 4
[ 5] .bss           NOBITS            00000000 0000a4 000001 00 WA 0 0 1
```

# readelf -r rel.o (-fno-pic)

Relocation section '.rel.text' at offset 0x254 contains 5 entries:

| Offset   | Info     | Type       | Sym.Value | Sym. Name |
|----------|----------|------------|-----------|-----------|
| 00000018 | 00000a02 | R_386_PC32 | 00000000  | fPub      |
| 00000033 | 00000b01 | R_386_32   | 00000001  | cPub      |
| 0000003c | 00000b01 | R_386_32   | 00000001  | cPub      |
| 00000046 | 00000401 | R_386_32   | 00000000  | .bss      |
| 0000004f | 00000401 | R_386_32   | 00000000  | .bss      |

Relocation section '.rel.data' at offset 0x27c contains 4 entries:

| Offset   | Info     | Type     | Sym.Value | Sym. Name |
|----------|----------|----------|-----------|-----------|
| 00000000 | 00000401 | R_386_32 | 00000000  | .bss      |
| 00000004 | 00000201 | R_386_32 | 00000000  | .text     |
| 00000008 | 00000b01 | R_386_32 | 00000001  | cPub      |
| 0000000c | 00000a01 | R_386_32 | 00000000  | fPub      |

Relocation section '.rel.eh\_frame' at offset 0x29c contains 3 entries:

| Offset   | Info     | Type       | Sym.Value | Sym. Name |
|----------|----------|------------|-----------|-----------|
| 00000020 | 00000202 | R_386_PC32 | 00000000  | .text     |
| 00000040 | 00000202 | R_386_PC32 | 00000000  | .text     |
| 00000060 | 00000202 | R_386_PC32 | 00000000  | .text     |

# Example library code - rel2.c

```
typedef struct {
    char* p;
    char (*f)(int);
} _st;

char fPub(int a) {
    return a;
}

char fLocal(int b) {
    return b;
}

char cPub;      // uninitialized
char cLocal;   // uninitialized

_st a[] = { { &cLocal, // 1
             fLocal }, // 2
            { &cPub, // 3
              fPub } }; // 4

int foo(int a) { // 5
    return fPub(a) // 6
        + fLocal(a) // 7
        + (int) &cPub // 8
        + cPub // 9
        + (int) &cLocal // 10
        + cLocal; // 11
}
```

- no static variable

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

# readelf -S rel2.o (1)

## Encabezados de Sección:

| [Nr] | Nombre            | Tipo     | Direc    | Desp   | Tam    | ES | Opt | En | Inf | Al |
|------|-------------------|----------|----------|--------|--------|----|-----|----|-----|----|
| [ 0] |                   | NULL     | 00000000 | 000000 | 000000 | 00 |     | 0  | 0   | 0  |
| [ 1] | .group            | GROUP    | 00000000 | 000034 | 000008 | 04 |     | 15 | 14  | 4  |
| [ 2] | .group            | GROUP    | 00000000 | 00003c | 000008 | 04 |     | 15 | 21  | 4  |
| [ 3] | .text             | PROGBITS | 00000000 | 000044 | 000086 | 00 | AX  | 0  | 0   | 1  |
| [ 4] | .rel.text         | REL      | 00000000 | 000380 | 000060 | 08 | I   | 15 | 3   | 4  |
| [ 5] | .data             | PROGBITS | 00000000 | 0000ca | 000000 | 00 | WA  | 0  | 0   | 1  |
| [ 6] | .bss              | NOBITS   | 00000000 | 0000ca | 000000 | 00 | WA  | 0  | 0   | 1  |
| [ 7] | .data.rel         | PROGBITS | 00000000 | 0000cc | 000010 | 00 | WA  | 0  | 0   | 4  |
| [ 8] | .rel.data.rel     | REL      | 00000000 | 0003e0 | 000020 | 08 | I   | 15 | 7   | 4  |
| [ 9] | .text.__x86.get_p | PROGBITS | 00000000 | 0000dc | 000004 | 00 | AXG | 0  | 0   | 1  |
| [10] | .text.__x86.get_p | PROGBITS | 00000000 | 0000e0 | 000004 | 00 | AXG | 0  | 0   | 1  |
| [11] | .comment          | PROGBITS | 00000000 | 0000e4 | 00002b | 01 | MS  | 0  | 0   | 1  |



# readelf -S rel2.o (2)

## Encabezados de Sección:

| [Nr] | Nombre          | Tipo     | Direc    | Desp   | Tam    | ES | Opt | En | Inf | Al |
|------|-----------------|----------|----------|--------|--------|----|-----|----|-----|----|
| [12] | .note.GNU-stack | PROGBITS | 00000000 | 00010f | 000000 | 00 |     | 0  | 0   | 1  |
| [13] | .eh_frame       | PROGBITS | 00000000 | 000110 | 0000a8 | 00 | A   | 0  | 0   | 4  |
| [14] | .rel.eh_frame   | REL      | 00000000 | 000400 | 000028 | 08 | I   | 15 | 13  | 4  |
| [15] | .symtab         | SYMTAB   | 00000000 | 0001b8 | 000160 | 10 |     | 16 | 13  | 4  |
| [16] | .strtab         | STRTAB   | 00000000 | 000318 | 000068 | 00 |     | 0  | 0   | 1  |
| [17] | .shstrtab       | STRTAB   | 00000000 | 000428 | 0000a4 | 00 |     | 0  | 0   | 1  |

## Key to Flags:

W (write), A (alloc), X (execute), M (merge), S (strings), I (info),  
L (link order), O (extra OS processing required), G (group), T (TLS),  
C (compressed), x (unknown), o (OS specific), E (exclude),  
p (processor specific)

# readelf -s rel2.o (1)

Symbol table '.symtab' contains 22 entries:

| Num: | Valor    | Tam | Tipo    | Unión | Vis     | Nombre | Ind    |
|------|----------|-----|---------|-------|---------|--------|--------|
| 0:   | 00000000 | 0   | NOTYPE  | LOCAL | DEFAULT | UND    |        |
| 1:   | 00000000 | 0   | FILE    | LOCAL | DEFAULT | ABS    | rel2.c |
| 2:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 3      |        |
| 3:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 5      |        |
| 4:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 6      |        |
| 5:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 7      |        |
| 6:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 9      |        |
| 7:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 10     |        |
| 8:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 12     |        |
| 9:   | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 13     |        |
| 10:  | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 11     |        |
| 11:  | 00000000 | 0   | SECTION | LOCAL | DEFAULT | 1      |        |

La sección de reubicación '.rel.text' at offset 0x380 contains 12 entries:

# readelf -s rel2.o (2)

Symbol table '.symtab' contains 22 entries:

| Num: | Valor    | Tam | Tipo    | Unión  | Vis     | Nombre                    | Ind |
|------|----------|-----|---------|--------|---------|---------------------------|-----|
| 12:  | 00000000 | 0   | SECTION | LOCAL  | DEFAULT |                           | 2   |
| 13:  | 00000000 | 18  | FUNC    | GLOBAL | DEFAULT | fPub                      | 3   |
| 14:  | 00000000 | 0   | FUNC    | GLOBAL | HIDDEN  | __x86.get_pc_thunk.ax     | 9   |
| 15:  | 00000000 | 0   | NOTYPE  | GLOBAL | DEFAULT | UND _GLOBAL_OFFSET_TABLE_ |     |
| 16:  | 00000012 | 18  | FUNC    | GLOBAL | DEFAULT | fLocal                    | 3   |
| 17:  | 00000001 | 1   | OBJECT  | GLOBAL | DEFAULT | COM cPub                  |     |
| 18:  | 00000001 | 1   | OBJECT  | GLOBAL | DEFAULT | COM cLocal                |     |
| 19:  | 00000000 | 16  | OBJECT  | GLOBAL | DEFAULT | a                         | 7   |
| 20:  | 00000024 | 98  | FUNC    | GLOBAL | DEFAULT | foo                       | 3   |
| 21:  | 00000000 | 0   | FUNC    | GLOBAL | HIDDEN  | __x86.get_pc_thunk.bx     | 10  |

# Symbols and their sections

```
13: 00000000    18 FUNC    GLOBAL DEFAULT    3 fPub   ---> .text
16: 00000012    18 FUNC    GLOBAL DEFAULT    3 fLocal ---> .text
17: 00000001     1 OBJECT  GLOBAL DEFAULT    COM cPub ---> COMMON
18: 00000001     1 OBJECT  GLOBAL DEFAULT    COM cLocal ---> COMMON
19: 00000000    16 OBJECT  GLOBAL DEFAULT     7 a     ---> .data.rel
20: 00000024    98 FUNC    GLOBAL DEFAULT    3 foo   ---> text
```

```
[ 3] .text          PROGBITS          00000000 000044 000086 00 AX 0 0 1
[ 4] .rel.text      REL               00000000 000380 000060 08 I 15 3 4
[ 5] .data          PROGBITS          00000000 0000ca 000000 00 WA 0 0 1
[ 6] .bss           NOBITS            00000000 0000ca 000000 00 WA 0 0 1
[ 7] .data.rel      PROGBITS          00000000 0000cc 000010 00 WA 0 0 4
[ 8] .rel.data.rel  REL               00000000 0003e0 000020 08 I 15 7 4
```

# readelf -r rel2.o (1)

La sección de reubicación '.rel.text' at offset 0x380 contains 12 entries:

| Desplaz  | Info     | Tipo         | Val.Símbolo | Nom. Símbolo          |
|----------|----------|--------------|-------------|-----------------------|
| 00000004 | 00000e02 | R_386_PC32   | 00000000    | __x86.get_pc_thunk.ax |
| 00000009 | 00000f0a | R_386_GOTPC  | 00000000    | _GLOBAL_OFFSET_TABLE_ |
| 00000016 | 00000e02 | R_386_PC32   | 00000000    | __x86.get_pc_thunk.ax |
| 0000001b | 00000f0a | R_386_GOTPC  | 00000000    | _GLOBAL_OFFSET_TABLE_ |
| 0000002a | 00001502 | R_386_PC32   | 00000000    | __x86.get_pc_thunk.bx |
| 00000030 | 00000f0a | R_386_GOTPC  | 00000000    | _GLOBAL_OFFSET_TABLE_ |
| 00000038 | 00000d02 | R_386_PC32   | 00000000    | fPub                  |
| 00000046 | 00001002 | R_386_PC32   | 00000012    | fLocal                |
| 00000055 | 0000112b | R_386_GOT32X | 00000001    | cPub                  |
| 0000005d | 0000112b | R_386_GOT32X | 00000001    | cPub                  |
| 0000006b | 0000122b | R_386_GOT32X | 00000001    | cLocal                |
| 00000073 | 0000122b | R_386_GOT32X | 00000001    | cLocal                |

# readelf -r rel2.o (2)

La sección de reubicación '.rel.data.rel' at offset 0x3e0 contains 4 entries:

| Desplaz  | Info     | Tipo     | Val.Símbolo | Nom. Símbolo |
|----------|----------|----------|-------------|--------------|
| 00000000 | 00001201 | R_386_32 | 00000001    | cLocal       |
| 00000004 | 00001001 | R_386_32 | 00000012    | fLocal       |
| 00000008 | 00001101 | R_386_32 | 00000001    | cPub         |
| 0000000c | 00000d01 | R_386_32 | 00000000    | fPub         |

La sección de reubicación '.rel.eh\_frame' at offset 0x400 contains 5 entries:

| Desplaz  | Info     | Tipo       | Val.Símbolo | Nom. Símbolo           |
|----------|----------|------------|-------------|------------------------|
| 00000020 | 00000202 | R_386_PC32 | 00000000    | .text                  |
| 00000040 | 00000202 | R_386_PC32 | 00000000    | .text                  |
| 00000060 | 00000202 | R_386_PC32 | 00000000    | .text                  |
| 00000088 | 00000602 | R_386_PC32 | 00000000    | .text.__x86.get_pc_thu |
| 0000009c | 00000702 | R_386_PC32 | 00000000    | .text.__x86.get_pc_thu |

# Example code - print.c

```
#include <stdio.h>

int main(void) {
    printf("hello\n");
}
```

```
gcc -m32 t.c
gcc -m32 -fno-pic t.c
gcc -m32 -no-pie t.c
```

```
readelf -r a.out
```

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

# default compile

Relocation section '.rel.dyn' at offset 0x328 contains 8 entries:

| Offset   | Info     | Type           | Sym.Value | Sym. Name                  |
|----------|----------|----------------|-----------|----------------------------|
| 00001ed8 | 00000008 | R_386_RELATIVE |           |                            |
| 00001edc | 00000008 | R_386_RELATIVE |           |                            |
| 00001ff8 | 00000008 | R_386_RELATIVE |           |                            |
| 00002004 | 00000008 | R_386_RELATIVE |           |                            |
| 00001fec | 00000106 | R_386_GLOB_DAT | 00000000  | _ITM_deregisterTMClone     |
| 00001ff0 | 00000206 | R_386_GLOB_DAT | 00000000  | __cxa_finalize@GLIBC_2.1.3 |
| 00001ff4 | 00000406 | R_386_GLOB_DAT | 00000000  | __gmon_start__             |
| 00001ffc | 00000606 | R_386_GLOB_DAT | 00000000  | _ITM_registerTMCloneTa     |

Relocation section '.rel.plt' at offset 0x368 contains 2 entries:

| Offset   | Info     | Type            | Sym.Value | Sym. Name                   |
|----------|----------|-----------------|-----------|-----------------------------|
| 00001fe4 | 00000307 | R_386_JUMP_SLOT | 00000000  | puts@GLIBC_2.0              |
| 00001fe8 | 00000507 | R_386_JUMP_SLOT | 00000000  | __libc_start_main@GLIBC_2.0 |

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)



# compile with -fno-pic

Relocation section '.rel.dyn' at offset 0x328 contains 10 entries:

| Offset   | Info     | Type           | Sym.Value | Sym. Name                  |
|----------|----------|----------------|-----------|----------------------------|
| 00000542 | 00000008 | R_386_RELATIVE |           |                            |
| 00001ed0 | 00000008 | R_386_RELATIVE |           |                            |
| 00001ed4 | 00000008 | R_386_RELATIVE |           |                            |
| 00001ff8 | 00000008 | R_386_RELATIVE |           |                            |
| 00002004 | 00000008 | R_386_RELATIVE |           |                            |
| 00000547 | 00000302 | R_386_PC32     | 00000000  | puts@GLIBC_2.0             |
| 00001fec | 00000106 | R_386_GLOB_DAT | 00000000  | _ITM_deregisterTMClone     |
| 00001ff0 | 00000206 | R_386_GLOB_DAT | 00000000  | __cxa_finalize@GLIBC_2.1.3 |
| 00001ff4 | 00000406 | R_386_GLOB_DAT | 00000000  | __gmon_start__             |
| 00001ffc | 00000606 | R_386_GLOB_DAT | 00000000  | _ITM_registerTMCloneTa     |

Relocation section '.rel.plt' at offset 0x378 contains 2 entries:

| Offset   | Info     | Type            | Sym.Value | Sym. Name                   |
|----------|----------|-----------------|-----------|-----------------------------|
| 00001fe4 | 00000307 | R_386_JUMP_SLOT | 00000000  | puts@GLIBC_2.0              |
| 00001fe8 | 00000507 | R_386_JUMP_SLOT | 00000000  | __libc_start_main@GLIBC_2.0 |

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)

Relocation section '.rel.dyn' at offset 0x290 contains 1 entry:

| Offset   | Info     | Type           | Sym.Value | Sym. Name      |
|----------|----------|----------------|-----------|----------------|
| 08049ffc | 00000206 | R_386_GLOB_DAT | 00000000  | __gmon_start__ |

Relocation section '.rel.plt' at offset 0x298 contains 2 entries:

| Offset   | Info     | Type            | Sym.Value | Sym. Name                   |
|----------|----------|-----------------|-----------|-----------------------------|
| 0804a00c | 00000107 | R_386_JUMP_SLOT | 00000000  | puts@GLIBC_2.0              |
| 0804a010 | 00000307 | R_386_JUMP_SLOT | 00000000  | __libc_start_main@GLIBC_2.0 |

-

[http://netwinder.osuosl.org/users/p/patb/public\\_html/elf\\_relocs.html](http://netwinder.osuosl.org/users/p/patb/public_html/elf_relocs.html)