PRE10-C. Wrap multistatement macros in a do-while loop

Macros are often used to execute a sequence of multiple statements as a group.

Inline functions are, in general, more suitable for this task (see PRE00-C. Prefer inline or static functions to function-like macros). Occasionally, however, they are not feasible (when macros are expected to operate on variables of different types, for example).

When multiple statements are used in a macro, they should be bound together in a do-while loop syntactically, so the macro can appear safely inside if clauses or other places that expect a single statement or a statement block. (Alternatively, when an if, for, or while statement uses braces even for a single body statement, then multiple statements in a macro will expand correctly even without a do-while loop (see EXP19-C. Use braces for the body of an if, for, or while statement).

Noncompliant Code Example

This noncompliant code example contains multiple, unbound statements:

```c
/*
 * Swaps two values and requires
 * tmp variable to be defined.
 */
#define SWAP(x, y) \    
    tmp = x; \    
    x = y; \    
    y = tmp
```

This macro expands correctly in a normal sequence of statements but not as the then clause in an if statement:

```c
test x, y, z, tmp;
if (z == 0)
    SWAP(x, y);
```

It expands to the following, which is certainly not what the programmer intended:

```c
int x, y, z, tmp;
if (z == 0)
    tmp = x;
    x = y;
    y = tmp;
```

Furthermore, this macro violates PRE02-C. Macro replacement lists should be parenthesized.

Noncompliant Code Example

This noncompliant code example parenthesizes its macro arguments, but inadequately bounds multiple statements:

```c
/*
 * Swaps two values and requires
 * tmp variable to be defined.
 */
#define SWAP(x, y) { tmp = (x); (x) = (y); (y) = tmp; }
```

This macro fails to expand correctly in some case, such as the following example, which is meant to be an if statement with two branches:

```c
if (x > y)
    SWAP(x, y); /* Branch 1 */
else
    do_something(); /* Branch 2 */
```

Following macro expansion, however, this code is interpreted as an if statement with only one branch:
if (x > y) { /* Single-branch if-statement!!! */
   tmp = x; /* The one and only branch consists */
   x = y; /* of the block. */
   y = tmp;
 }
 /* Empty statement */
else /* ERROR!!! "parse error before else" */
   do_something();

The problem is the semicolon (;) following the block.

Compliant Solution

Wrapping the macro inside a do-while loop mitigates the problem:

```c
/* Swaps two values and requires
* tmp variable to be defined.
*/
#define SWAP(x, y) \
   do { \
       tmp = (x); \
       (x) = (y); \
       (y) = tmp; } \
   while (0)
```

The do-while loop will always be executed exactly once.

This macro still violates the recommendation PRE12-C. Do not define unsafe macros, because both macro arguments are evaluated twice. It is expected that the arguments are simple lvalues.

Risk Assessment

Improperly wrapped statement macros can result in unexpected and difficult to diagnose behavior.

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<td>Medium</td>
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Automated Detection

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<td>Axivion Bauhaus Suite</td>
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<td>LDRA tool suite</td>
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Related Vulnerabilities

Search for vulnerabilities resulting from the violation of this rule on the CERT website.

Related Guidelines

ISO/IEC TR 24772:2013 Pre-processor Directives [NMP]

Bibliography

Linux Kernel Newbies FAQ FAQ/DoWhile0