

[Note]

R20TS0650EJ0100

Rev.1.00

Jan. 16, 2021

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## C Compiler Package for RH850 Family (No.30-33)

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### Overview

When using the C compiler package for RH850 family CC-RH, note the following points.

1. Performing the tail call optimization (No.30)
2. Using the -Xintermodule option (No.31)
3. Using the -pic option (No.32)
4. Using the switch statement (No.33)

Note: The number following the note is an identification number for the precaution.

### 1. Performing the tail call optimization (No.30)

#### 1.1 Applicable products

CC-RH V1.00.00 to V2.02.00

#### 1.2 Details

Necessary type conversion may not be performed on the return value of a function.

#### 1.3 Conditions

This problem may arise if all of the conditions from (1) to (5) are met.

- (1) -Osize or -Ospeed is specified.
- (2) -Otail\_call=off is not specified.
- (3) There is an integer-type function with a return value of either 1 byte or 2 bytes. <sup>(Note 1)</sup>
- (4) There is an integer-type function whose return value type is the same size as the function (3) but with a different signedness. <sup>(Note 1)</sup>
- (5) In the function of (4), the result of type conversion of the return value of the function of (3) to the return type of the function of (4) is returned.  
\*:Implicit type conversion is also included.

Note 1: 1- or 2-byte integer type includes the boolean type and enumerated type when -Xenum\_type=auto is specified. The boolean type is regarded as a signed 1-byte type.

## 1.4 Examples

An example of the problem is shown below. The parts corresponding to the error conditions are shown in red.

ccrh -Osize tp.c (1) (2)

```
/* tp.c */
extern unsigned char callee(); /* (3) */
signed char caller() { /* (4) */
    signed char returnValue;
    returnValue = callee();
    return returnValue; /* (5) */
}
```

In this example, the return value of callee() is supposed to be sign-extended in caller() before returning, but this is not done and the upper bits are returned as 0.

## 1.5 Workaround

You can avoid this problem by one of the following methods. The workarounds are shown in blue.

(a) Specify the -Onothing or -Odefault option

(b) Specify the -Otail\_call=off.

(c) Assign the return value of the applicable function call a volatile-qualified automatic variable before it is passed to the return statement.

```
/* tp.c */
extern unsigned char callee(); /* (3) */
signed char caller() { /* (4) */
    volatile signed char returnValue; /* (c) */
    returnValue = callee();
    return returnValue; /* (5) */
}
```

(d) Change the type of the return value of the caller function to a 4-byte type.

```
/* tp.c */
extern unsigned char callee(); /* (3) */
signed long caller() { /* (d) */
    signed long returnValue; /* (d) */
    returnValue = callee();
    return returnValue; /* (5) */
}
```

## 1.6 Schedule for fixing the problem

This problem will be fixed in CC-RH V2.03.00. This version will be released in January 2021.

## 2. Using the -Xintermodule option (No.31)

### 2.1 Applicable products

CC-RH V1.00.00 to V2.02.00

### 2.2 Details

When the -Xintermodule option is used, access to static variables may be deleted incorrectly.

### 2.3 Conditions

If all of the conditions from (1) to (8) are met, access to a variable in condition (7) may be deleted incorrectly.

- (1) -Xintermodule or -Xwhole\_program is specified. <sup>(Note 1)</sup>
- (2) -Osize or -Ospeed is specified.
- (3) There is a structure-type or union-type having a pointer-type member.
- (4) The pointer-type member in (3) is not const-qualified.
- (5) There is a const-qualified static variable<sup>(Note 2)</sup> of the structure-type or union-type in (3).
- (6) The initial value of the pointer-type member (3) of the static variable in (5) is the address of a variable.
- (7) The variable with the address in (6) is a static variable<sup>(Note 2)</sup> that is not const-qualified.
- (8) There is a const-qualified pointer-type static variable<sup>(Note 2)</sup> whose initial value is the address of the static variable in (5).

Note 1: When -Xwhole\_program is specified, -Xintermodule is also implicitly specified.

Note 2: A static variable corresponds to a global variable or a 'static' variable.

## 2.4 Examples

An example of the problem is shown below. The parts corresponding to the error conditions are shown in red.

[Example]

ccrh **-Osize -Xintermodule** tp.c (1) (2)

```

/* tp.c */
int GGG;                                /* (7) */
typedef struct {                          /* (3) */
    int* mmm;                             /* (4) */
}Str;
const Str SSS = {                        /* (5) */
    &GGG                                   /* (6) */
};
const Str* PPP = &SSS;                 /* (8) */

int func(void) {
    GGG = 1;
    *(PPP->mmm) = 2;
    return GGG;
}

```

In this example, although function func() is supposed to return 2 because PPP->mmm points to the address of the variable GGG, it returns 1.

## 2.5 Workaround

You can avoid this problem by one of the following methods:

- (a) Do not specify either -Xintermodule or -Xwhole\_program.
- (b) Specify -Odefault or -Onothing.
- (c) Remove the const qualifier from the structure-type or union-type static variable in condition (5).
- (d) Remove the const qualifier from the pointer-type static variable in condition (8).

## 2.6 Schedule for fixing the problem

This problem will be fixed in CC-RH V2.03.00. This version will be released in January 2021.

### 3. Using the -pic option (No.32)

#### 3.1 Applicable products

CC-RH V1.07.00 to V2.02.00

#### 3.2 Details

When the -pic option is used, the value of a general-purpose register r14 may be overwritten incorrectly.

#### 3.3 Conditions

The value of a general-purpose register r14 may be overwritten incorrectly if all of the conditions from (1) to (4) are met.

- (1) -pic is specified.
- (2) Neither -Xswitch=ifelse nor -Xswitch=binary is specified.
- (3) A switch statement is used in a function.
- (4) The general-purpose register r14 is used in the output code of the function in (3).

#### 3.4 Examples

Examples of the problem are shown below. The parts corresponding to the error conditions are shown in red.

[Example]

ccrh -pic -pirod tp.c (1) (2)

```

/* tp.c */
void fun(int x, int *y) {
    int a0 = y[0];
    int a1 = y[1];
    int a2 = y[2];
    int a3 = y[3];
    int a4 = y[4];
    int a5 = y[5];
    int a6 = y[6];
    int a7 = y[7];
    int a8 = y[8];
    switch (x) {                /* (3) */
        case 0: a0 += 1; break;
        case 1: a1 += 1; break;
        case 2: a2 += 1; break;
        case 3: a3 += 1; break;
    }
    sub(a0, a1, a2, a3, a4, a5, a6, a7, a8);
}

```

[Output code example]

```

_fun:
    .stack _fun = 24
    prepare 0x00000001, 0x00000014
    cmp 0x00000003, r6
    ld.w 0x00000020[r7], r2
    ld.w 0x0000001C[r7], r5
    ld.w 0x00000018[r7], r10
    ld.w 0x00000014[r7], r11
    ld.w 0x00000010[r7], r12
    ld.w 0x0000000C[r7], r9
    ld.w 0x00000008[r7], r8
    ld.w 0x00000004[r7], r13
    ld.w 0x00000000[r7], r14          ; (4) The r14 value specified here is,
    bh9 .BB.LABEL.1_6
.BB.LABEL.1_1: ; entry
    shl 0x00000001, r6
    jarl .BB.LABEL.1_8, r14          ;   overwritten incorrectly here.
.BB.LABEL.1_8:
    add r6, r14
    jmp .SWITCH.LABEL.1_7-.BB.LABEL.1_8[r14]
.SWITCH.LABEL.1_7:
    br9 .BB.LABEL.1_2
    br9 .BB.LABEL.1_3
    br9 .BB.LABEL.1_4
    br9 .BB.LABEL.1_5
.SWITCH.LABEL.1_7.END:
.BB.LABEL.1_2: ; switch_clause_bb
    add 0x00000001, r14
    br9 .BB.LABEL.1_6
.BB.LABEL.1_3: ; switch_clause_bb30
    add 0x00000001, r13
    br9 .BB.LABEL.1_6
.BB.LABEL.1_4: ; switch_clause_bb33
    add 0x00000001, r8
    br9 .BB.LABEL.1_6
.BB.LABEL.1_5: ; switch_clause_bb36
    add 0x00000001, r9
.BB.LABEL.1_6: ; switch_break_bb
    mov r13, r7
    mov r14, r6                    ; This refers to an incorrectly
overwritten value.
    st.w r2, 0x00000010[r3]
    st.w r5, 0x0000000C[r3]
    st.w r10, 0x00000008[r3]
    st.w r11, 0x00000004[r3]
    st.w r12, 0x00000000[r3]
    jarl _sub, r31
    dispose 0x00000014, 0x00000001, [r31]

```

### 3.5 Workaround

This problem can be avoided by specifying -Xswitch=ifelse or -Xswitch=binary.

### 3.6 Schedule for fixing the problem

This problem will be fixed in CC-RH V2.03.00. This version will be released in January 2021.

## 4. Using the switch statement (No.33)

### 4.1 Applicable products

CC-RH V2.02.00

### 4.2 Details

The value of a general-purpose register r1 may be overwritten incorrectly at runtime.

### 4.3 Conditions

This problem may arise if all of the conditions from (1) to (4) are met.

- (1) Neither `-Xswitch=ifelse` nor `-Xswitch=binary` is specified.
- (2) `-Onothing` is not specified.
- (3) A switch statement is used in a function.
- (4) One of the following conditions is met:
  - (4-a) The function in (3) is subject to the function for detecting stack smashing<sup>(Note 1)</sup>.
  - (4-b) The stack size of the program is 4 Mbytes or more. Also the general-purpose register r1 is used to access to the stack area in the function in (3).<sup>(Note 2)</sup>

Note 1: `-Xstack_protector` option, `-Xstack_protector_all` option, or `#pragma stack_protector` directive is used.

Note 2: The stack size is set in the startup routine.

The general-purpose register r1 is used when accessing a location that is 4-Mbytes or more away from the stack pointer.

### 4.4 Examples

Examples of the problem are shown below. The parts corresponding to the error conditions are shown in red.

[Example(A)]

ccrh tp1.c (1) (2)

```

/* tp1.c */
#pragma stack_protector funA /* (4-a) */
struct ST { char i; double d; };
int funA(struct ST x) {
    switch(x.i) { /* (3) */
        case 0: return x.i;
        case 1: return x.i;
        case 2: return x.i;
        case 3: return x.i;
    }
    return 0;
}

```

[Output code example(A)]

```

_funA:
    .stack _funA = 16
    add 0xFFFFFFFF, r3
    mov 0xDEADCCCC, r1
    st.w r1, 0x0000000C[r3]
    st.w r6, 0x00000000[r3]
    st.w r7, 0x00000004[r3]
    st.w r8, 0x00000008[r3]
    ld.b 0x00000000[r3], r10
    cmp 0x00000003, r10
    bh9 .BB.LABEL.1_14
.BB.LABEL.1_1: ; entry
    ld.w 0x0000000C[r3], r1 ; The r1 value specified here is
    mov 0xDEADCCCC, r12 ; overwritten incorrectly here.
    mov r10, r1
    shl 0x00000001, r1
    jmp #.SWITCH.LABEL.1_17[r1]
.SWITCH.LABEL.1_17:
    br9 .BB.LABEL.1_2
    br9 .BB.LABEL.1_5
    br9 .BB.LABEL.1_8
    br9 .BB.LABEL.1_11
.SWITCH.LABEL.1_17.END:
.BB.LABEL.1_2: ; switch_clause_bb
    cmp r12, r1 ; This refers to an incorrectly
overwritten value.
    bnz9 .BB.LABEL.1_4
.BB.LABEL.1_3: ; switch_clause_bb
    dispose 0x00000010, 0x00000000, [r31]
.BB.LABEL.1_4: ; switch_clause_bb
    jr __stack_chk_fail
.BB.LABEL.1_5: ; switch_clause_bb7
    cmp r12, r1 ; This refers to an incorrectly
overwritten value.
    bnz9 .BB.LABEL.1_7
.BB.LABEL.1_6: ; switch_clause_bb7
    dispose 0x00000010, 0x00000000, [r31]
.BB.LABEL.1_7: ; switch_clause_bb7
    jr __stack_chk_fail
.BB.LABEL.1_8: ; switch_clause_bb12
    cmp r12, r1 ; This refers to an incorrectly
overwritten value.
    bnz9 .BB.LABEL.1_10
.BB.LABEL.1_9: ; switch_clause_bb12
    dispose 0x00000010, 0x00000000, [r31]
.BB.LABEL.1_10: ; switch_clause_bb12
    jr __stack_chk_fail
.BB.LABEL.1_11: ; switch_clause_bb17
    cmp r12, r1 ; This refers to an incorrectly
overwritten value.
    bnz9 .BB.LABEL.1_13
.BB.LABEL.1_12: ; switch_clause_bb17
    dispose 0x00000010, 0x00000000, [r31]
.BB.LABEL.1_13: ; switch_clause_bb17
    jr __stack_chk_fail
.BB.LABEL.1_14: ; bb23
    mov 0x00000000, r10

```



```

        ld.w 0x0000000C[r3], r1
        mov 0xDEADCCCC, r12
        cmp r12, r1
        bnz9 .BB.LABEL.1_16
.BB.LABEL.1_15: ; bb23
        dispose 0x00000010, 0x00000000, [r31]
.BB.LABEL.1_16: ; bb23
        jr     stack_chk_fail
    
```

[Example(B)]

ccrh tp2.c

(1) (2)

```

/* tp2.c */
void funB(int i) {
    volatile char d[0x400002];
    switch(i) {          /* (3) */
    case 0: d[0x400001] = 0; sub(i); break;
    case 1: d[0x400000] = 0; break;
    case 2: d[0x400000] = 0; break;
    case 3: d[0x400000] = 0; break;
    }
}
    
```

[Output code example(B)]

```

_funB:
    .stack _funB = 4194312                ; (4-b)
    prepare 0x00000001, 0x0000007C
    movhi 0x0000FFC0, r3, r1
    movea 0x00000078, r1, r3
    cmp 0x00000003, r6
    bh9 .BB.LABEL.1_4
.BB.LABEL.1_1: ; entry
    movhi 0x00000040, r3, r1                ; (4-b)The r1 value specified here is
    mov r6, r1                            ; overwritten incorrectly here.
    shl 0x00000001, r1
    jmp #.SWITCH.LABEL.1_5[r1]
.SWITCH.LABEL.1_5:
    br9 .BB.LABEL.1_2
    br9 .BB.LABEL.1_3
    br9 .BB.LABEL.1_3
    br9 .BB.LABEL.1_3
.SWITCH.LABEL.1_5.END:
.BB.LABEL.1_2: ; switch_clause_bb
    st.b r0, 0x00000003[r1]                ; (4-b) This refers to an incorrectly
overwritten value.
    jarl _sub, r31
    br9 .BB.LABEL.1_4
.BB.LABEL.1_3: ; switch_clause_bb11
    st.b r0, 0x00000002[r1]                ; This refers to an incorrectly
overwritten value.
.BB.LABEL.1_4: ; return
    movhi 0x00000040, r3, r1
    movea 0xFFFFF88, r1, r3
    dispose 0x0000007C, 0x00000001, [r31]

```

#### 4.5 Workaround

This problem can be avoided by one of the following methods.

- (a) Specify -Xswitch=ifelse or -Xswitch=binary.
- (b) Specify -Onothing.

#### 4.6 Schedule for fixing the problem

This problem will be fixed in CC-RH V2.03.00. This version will be released in January 2021.

**Revision History**

Rev.	Date	Description	
		Page	Summary
1.00	Jan.16.21	-	First edition issued

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