

(2) Embedded Systems RTOS

uC/OS-II TASK, Time, Memory Management, IPC

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1. ...

RTOS uC/OS-II OS_task.c OS_core.c
uC/OS-II 가
TASK가).
TASK 가 uC/OS-II 64
TASK TASK
4 , 4
56 TASK
()
(1) TASK
1)STaskCreate () : TASK
C/OS-II TASK Ad-
dress 가 TASK Multitasking
TASK
가
TASK가
C malloc()
TASK
가

2. Task Management

uC/OS-II TASK
가 TASK
RAM C/OS-II
OSTaskStkChk()
Task ISR(Interrupt Ser-
vice Routine) TASK
OSTaskCreate() 4 argument



```
OSTaskCreate(
-task: Task 함수명
-pdata: TASK가 실행되었을 때, TASK가
지나간 argument를 지시한다.,
-ptos: 할당된 스택의 최상위 주소,
-prio: TASK priority를 지시
);
```

```
ex) OSTaskCreate(Task_1, (void *)0, (void
*)&AppTaskStk[255], 10);
```

argument OSTaskCreate() 가

C/OS-II

high memory low memory

low memory high memory 가

(2) TASK Stacks

TASK 가

OS_STK

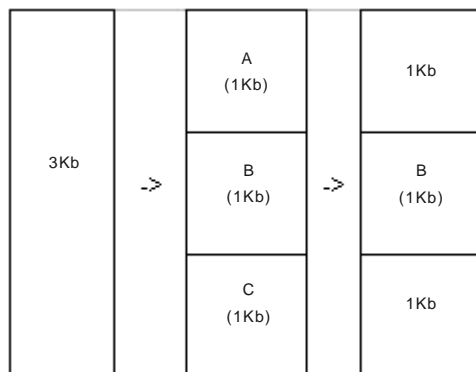
(Dynamic Locate)

Fragmentation

2) OSTaskCreateExt ()

```
OSTaskCreateExt(,,,
-id: TASK의 identifier를 표시함
-pbpos: TASK의 최하위 스택의 주소를
지시(Stack checking)
-stk_size: 스택의 크기를 표시(Stack
checking)
-pext: TASK의 OS_TCB가 확장되기 위해
쓰이는 Data 영역을 지시
-opt: Stack checking가능, 삭제 여부, floating
point지원 등을 표시
```

```
ex) OSTaskCreateExt(Task_2, (void *)0, (void
*)&AppTaskStk[255], 10, 2, &TaskExtStk[0],
200, (void *)0,
OS_TASK_OPT_STK_CHK|OS_TASK_OPT_S
TK_CLR)
```



1

Fragmentation 가

가 3kbyte

Malloc() 3kb 1kb 3 TASK

(A,B,C)가

TASK A C가 가 memory free()

2kb 가 1

가

2kb

TASK

가

OSTaskCreateExt() OSTaskCreate()

Over-

TASK

head

9

Argument

4

1) OSTaskStkChk () :

MANT state

가

C/OS-II

OSTaskStkChk()

schedule

TASK

C/OS-II

OSTaskStkChk()

TASK가

, OSTaskDel()

idle TASK

TASK가

ISR

OS_PRIO_SELF

OS_TCB

bottom-of-stack

가

가

TASK

가

2) OSTaskDelReq () : TASK

0

TASK

semaphore

resource

가

TASK가

TASK

, TASK resource

OSTaskStkChk()

TASK

RAM()

TASK

resource

TASK

Requestor TASK가

, OSTaskDelReq()

3) OSTaskChangerPrio () :

TASK

, TASK priority

OSTaskChangerPrio()

TASK

idle

TASK

(idle TASK

.)

OS_PRIO_SELF

TASK

TASK

. TASK

가

,

(3) TASK

1) OSTaskDel () : TASK

TASK

4) TaskSuspend () : TASK

OSTaskSuspend()

TASK

TASK

OSTaskResume()

TASK

가

,

ready

가

가

가

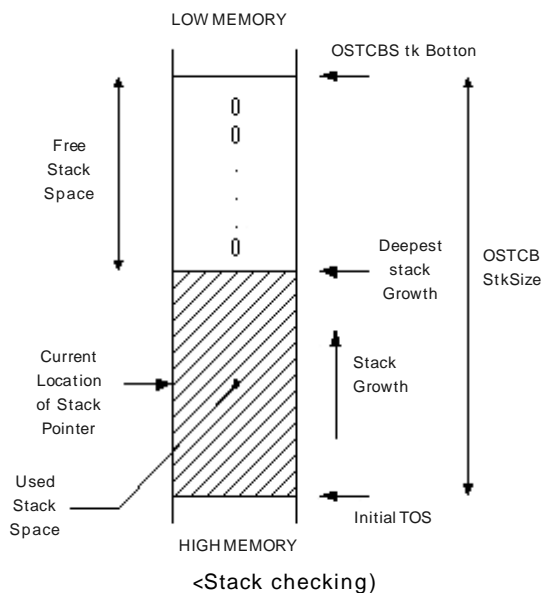
가

TASK

TASK

TASK

DOR-



5) OSTaskResume () : TASK 가 TASK
 OSTaskSuspend() TASK H
 OSTaskResume() (), M(), S() m(= 10^{-3})
 6) OSTaskQuery () : TASK 가
 OSTaskQuery() OSTimeDly() .
 TASK . OSTaskQuery 65,535 clock tick, (0,10,55,350)
 () TASK OS_TCB 가 OSTimeDlyHMSM() (resume)
 .(Query 가
 가
 .)
 3) OSTimeDlyResume() : TASK
 TASK ready
 TASK가 TASK wait
 ready
 (waiting for an event)
 TASK
 TASK
 uC/OS-II . uC/
 OS-II clock time OSTimeDly(),
 OSTimeDlyHMSM(), OSTimeDlyResume(),
 OSTimeGet(), OSTimeSet()
 OS_time.C
 1) OSTimeDly() : TASK
 가 Clock time
 TASK ready wait
 TASK . ,
 (OSTimeDly()
) , ready 가 가
 TASK가 . OSTime
 OSTimeDly() 가
 TASK가 OSTimeDlyResume()
 ready 가
 TASK TASK 가
 가
 tick
 OS_CFG.H OS_TICKS_PER_SEC
 tick
 2) OSTimeDlyHMSM()
 , TASK가

4) OSTimeGet(), OSTimeSet()
 . uC/OS-II Clock
 tick 32 bit Counter 가
 Counter OSStart()가 0
 4,294,967, 295 tick
 가 . Tick rate 100Hz 497
 . OSTimeGet()
 , OSTimeSet()
 가
 . OSTime 가

4. TASK (Intertask Communication)
 (Synchronization)
 uC/OS-II TASK
 가
 TASK

TASK가

able/enable scheduler lock/unlock
가 synchronization
coordination semaphore IPC
message mailbox, message queue

TASK Interrupt Service

Routine(ISR)

, TASK ECB

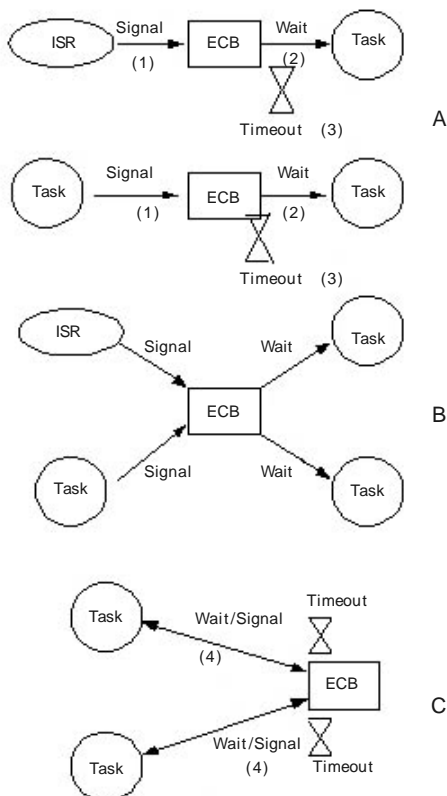
(signal), ECB (wait)

ISR ECB

가

ISR ready 가

(1) Event Control Block (ECB)



ECB semaphore, message mailbox, message queue 가 가 Kernel object
. ECB TASK
counter for a semaphore, pointer for a message

```
typedef struct {
    void *OSEventPtr;
    INT8U
    OSEventTbl[OS_EVENT_TBL_SIZE];
    INT16U OSEventCnt;
    INT8U OSEventType;
    INT8U OSEventGrp;
} OS_EVENT;
```

ECB

.OSEventPtr

ECB가 mailbox queue ,
message 가 .OSEventCnt

ECB가 semaphore counter

.OSEventType ECB

.OSEventTbl[] .OSEventGrp

.OSRdyTbl[] .OSRdyGrp

ECB

1) OSEventWaitListInit() : EBC

ECB semaphore, mailbox,
queue가 , OS***Create()가
(*** Sem, Mbox, Q 가
가). ECB

2) OSEventTaskRdy()

OS***Post() , ECB TASK
가 가 TASK ready

3) OSEventTaskWait()
 OS***Pend() , TASK
 ready , wait
 4) OSEventTO()
 OSTimeTick() TASK가 ready
 OS***Pend() ,
 timeout ,
 TASK wait ready
 가

(2) Semaphore

Semaphore count 16bit
 TASK , 가
 Semaphore OS_SEM_EN 1
 Semaphore
 0 ,
 1 N
 n sema-
 phore count Semaphore
 Key flag semaphore

Semaphore

- 1 (철도 등의) 가로대식 신호기;
- 2 【U】 수기(手旗) 신호.

semaphore TASK
 가 가
 TASK가
 가
 TASK가

semaphore

1) OSSemCreate() : Semaphore

Semaphore ECB free list
 Semaphore
 ECB Semaphore
 ECB Semaphore

ECB가 NULL

2) OSSemPend() : Signal

가 semaphore 가
 TASK ready
 (Pending ' ') sema-
 phore counter가 0 semaphore
 TASK ISR counter
 OSSemPend() ISR
 TASK
 counter가 0 ISR
 ISR ready

3) OSSemPost() : Signal

Semaphore resource
 가 semaphore
 가 TASK
 가 가 TASK OSEventTaskRdy
 () wait ready
 TASK ready semaphore count
 가

4) OSSemAccept() : ISR Signal

Semaphore OSSemPend()
 TASK ready
 Semaphore
 counter 0 semaphore가
 가 OSSemAccept()
 semaphore
 counter (Counter 0
 counter)

0 semaphore가
0 resource
ready semaphore ISR
OSSemPend()
ISR ready
5) OSSemQuery() : Semaphore
semaphore counter
ready . pevent
pdata, argument 가 pevent
semaphore 가 pdata sema-
phore counter ECB ready
data 가
ECB type semaphore
가.

Semaphore
. TASK1 ' 1. semaphore ' Displayer(
) TASK , TASK2 ' 2. message
mailbox ' TASK (message
mailbox
TASK
' 1. semaphore 가
, ' 2. message mailbox 가
, ' 1. semaphore ' ' 2. message mailbox '
가 semaphore
TASK2
TASK1
semaphore (OSSemCreate()) ,
TASK2 OSSemPend() . TASK1
OSSemPost()
. TASK2 가 OSSemPend()
semaphore counter 0
가 TASK1 ' 1.
semaphore ' , semaphore counter

가 OSSemPost() wait
TASK2 ready 가 가 (2.
message mailbox ') ' 1.
semaphore ' ' 2. message mailbox '
가

(3) Message Mailbox

Message mailbox Queue
Semaphore 가
Message mailbox TASK data(message)
TASK가
mailbox message
가 TASK
. Mailbox OS_MBOX_EN

1
Semaphore
mailbox message
. mailbox message
post pend binary semaphore
가 . Mailbox binary sema-
phore 가 binary semaphore
mailbox

Message mailbox
1) OSMboxCreate()
mailbox ECB type mail-
box semaphore
TASK가 mailbox
mailbox object TASK

2) OSMboxPend()
가 mailbox message가

mailbox

.

,

. $Y = X + 7$

TASK가 . 가

TASK

가 X 7

. 가

TASK



. OSQEnd queue circular buffer
 OSQEnd OSQIn 가
 OSQStart . OSQIn
 message가 가 . OSQOut
 message 가 가 . OSQEntries
 queue entry , queue
 0 (empty) .
 OSQSize 가 (full) .
 Queue . OSQEnd, OSQStart
 circular buffer . OSQIn . OSQOut 가
 message
 FIFO LIFO queue
 (.). Queue resource
 message counting semaphore
 . Queue semaphore
 queue semaphore
 .
 2가

1) OSQCreate()

queue . message
 가
 . OSQEntries 0 , OSQSize queue
 , OSQEnd queue
 , start .

2) OSQPend()

Queue message가
 TASK ready . OSMboxPend()
 . OSQEntries가 0
 가 .

3) OSQPost()

Queue message .
 OSMboxPost() , 가
 ready TASK가 message queue
 . queue가 full message
 queue .

4) OSQPostFront()

Queue . OSQPend() .
 OSQOut message .
 OSQPost() queue message . OSQIn
 가 First-Input-
 First-Out(FIFO) queue OSQPostFront
 () . OSQOut message (message가 message
 가) Last-Input-First-Out(LIFO)
 . Message

OSQPost()

5) OSQAccept()

Queue
 queue . OSQEntries가 0
 message .
 . ready
 message , ISR OSQPend()
 .

6) OSQQuery()

OSMboxQuery()

7) OSQFlush()

queue OSQFlush() 가 .
 queue message
 queue queue

analog Queue
 . Analog ADC
 digital . Data
 TASK OSQPost() queue
 data message ready

. Queue 가
 (timeout) OSQPend() TASK
 data .
 TASK ,



uC/OS-II TASK

가 semaphore,

message mailbox, queue

가

TASK

(1) Memory Control Blocks

uC/OS-II Memory Control Block

Try & Error

- OSMemAddr

- OSMemFreeList

5. Memory Management

! RTOS

가

C

ANSI C

- OSMemBlkSize

malloc() free()

가

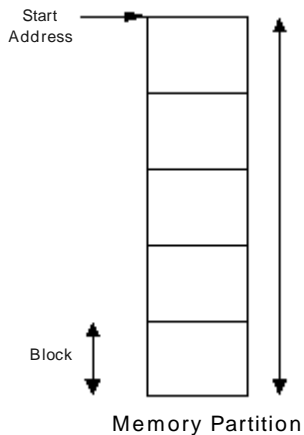
- OSMemNBkls

(fragmentation)

가

- OSMemNFree

TASK



가

uC/OS-II

1) OSMemInit() :

uC/OS-II OS_CFG.H OS_MEM_EN 1

Memory mangement

Linked List

OS_MAX_MEM_PART

2) OSMemCreate() :

OSMemCreate()

32byte 100

4 Argument(

malloc() free()

```
OS_MEM *CommTxBuf;
INT8U CommTxPart[100][32];
```

```
Void main (void)
```

```
{
```

```
    INT8U      err;
```

```
    OSInit();
```

```
    .
```

```
    .
```

```
    CommTxBuf=
```

```
        OSMemCreate(CommTxPart,
```

```
            100,32, &err);
```

```
    .
```

```
    .
```

```
    OSStart();
```

```
}
```

120byte

32byte

120byte

32byte

120byte

120byte

32byte

32byte가

88byte

TASK

가

5) OSMemQuery() :

OSMemQuery()

OS_MEM_DATA

OSMemCreate()

6.

(OSMemGet(), OSMemPut

()), OSMemQuery())

3) OSMemGet() :

OSMemGet()

, 2

RTOS

가 . 32kbyte가

가 . Intel, Motorola, Arm

가

4) OSMemPut() :

. OSMemPut()

OSMemPut()

32byte