HI7000/4, HI7700/4, HI7750/4, HI7200/MP

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Large Memory Pool

Introduction

This document explains the large memory pool function that is supported by following products.

- HI7000/4 V.2.03 Release 00 or later
- HI7700/4 V.2.04 Release 00 or later
- HI7750/4 V.2.03 Release 00 or later
- HI7200/MP V.1.01 Release 00 or later

Note, the contents of this document are not reflected in the user's manual of each product.

Contents

1. Summary

The large memory pool function is the implementation to improve the processing time of the variable-size memory pool function.

1.1 Improvement of Processing Time

(1) **Processing time for memory release**

- Variable-size memory pool : rel_mpl, irel_mpl
- Large memory pool : vrel_lmpl, ivrel_lmpl

In the variable-size memory pool, the processing time becomes long depending on the number of used memory blocks.

In the large memory pool, the worst processing time is fixation.

(2) **Processing time for memory acquisition**

- Variable-size memory pool : pget_mpl, ipget_mpl, get_mpl, tget_mpl
- Large memory pool : vpget_lmpl, ivpget_lmpl

In the variable-size memory pool, the processing time may become long depending on the number of free areas.

In the large memory pool, the number of cases where the processing time becomes long depending on the number of free areas when the size that can be managed by sector is required.

(3) **Processing time for memory pool reference**

- Variable-size memory pool : ref_mpl, iref_mpl
- Large memory pool : vref_lmpl, ivref_lmpl, vref_lmpl2, ivref_lmpl2

In the variable-size memory pool, the processing time may become long depending on the number of free memory blocks.

In the large memory pool, the processing time of the vref_lmpl and ivref_lmpl are not improved, but the vref_lmpl2 and ivref_lmpl2 are added for improved function.

The vref_lmpl2 and ivref_lmpl2 returns "the size close to size of the maximum contiguous free area" instead of " the size of the maximum contiguous free area", and the worst processing time is fixation.

1.2 Function difference with Variable-size Memory Pool

A big difference with the variable-size memory pool is not to support the function to wait for the acquisition of memory block. Table 1 shows function difference with variable-size memory pool.

Table 1 Function Difference with Variable-size Memory Pool

Item		Variable-size Memory Pool	Large Memory Pool
Number of memory pools		Multiple memory pools can be used.	1
Attribute		VTA_UNFRAGMENT can be specified.	None
Service call	Create	cre_mpl, icre_mpl, acre_mpl, iacre_mpl	vcre_lmpl, ivcre_lmpl
	Delete	del_mpl	vdel_lmpl
	Acquire (polling)	pget_mpl, ipget_mpl	vpget_lmpl, ivpget_lmpl
	Acquire (wait)	get_mpl	None
	Acquire (wait with time-out)	tget_mpl	None
	Release	rel_mpl, irel_mpl	vrel_lmpl, ivrel_lmpl
	Refer	ref_mpl, iref_mpl	vref_lmpl, ivref_lmpl, vref_lmpl2, ivref_lmpl2

2. Service Call

This chapter explains the specification of service calls for large memory pool by the same form as the manual.

Table 2 Service Calls for large Memory Pool

		System State [*1]
Service Call	**Description**	**T/N/E/D/U/L/C**
vcre_lmpl	Creates large memory pool	T/E/D/U
ivcre_lmpl		N/E/D/U
vdel_lmpl	Deletes large memory pool	T/E/D/U
vpget_lmpl	Acquires memory block	T/E/D/U
ivpget_lmpl		N/E/D/U
vrel_lmpl	Releases memory block	T/E/D/U
ivrel_lmpl		N/E/D/U
vref_lmpl	Refers to large memory pool state	T/E/D/U
ivref_lmpl		N/E/D/U
vref_lmpl2	Refers to large memory pool state (Simple version)	T/E/D/U
ivref_lmpl2		N/E/D/U

Notes: 1 T: Can be called from task context
N: Can be called from non-task context
E: Can be called from dispatch-enabled state
D: Can be called from dispatch-disabled state
U: Can be called from CPU-unlocked state
L: Can be called from CPU-locked state
C: Can be called from CPU exception handler

2.1 Creates Large Memory Pool (vcre_lmpl, ivcre_lmpl)

C-Language API:

ER ercd = vcre_lmpl(VT_CLMPL *pk_clmpl);

ER ercd = ivcre_lmpl(VT_CLMPL *pk_clmpl);

Parameters:

VT_CLMPL *pk_clmpl	R4	Pointer to the packet where the large memory pool creation information is stored

Return Parameters:

ER	ercd	R0	Normal end (E_OK) or error code

Packet Structure:

typedef struct {

SIZE	lmplsz;	+0	4	Size of the large memory pool (Number of bytes)
VP	lmpl;	+4	4	Start address of the large memory pool area
VP	lmplmb;	+8	4	Start address of the large memory pool management table area
UINT	minblksz;	+12	4	Minimum block size
UINT	sctnum;	+16	4	Maximum number of sectors

} VT_CLMPL;

Error Codes:

E_PAR	[k]	Parameter error (1) pk_clmpl is other than a multiple of four (2) lmplsz is other than a multiple of four (3) lmplsz ≥ H'80000000 (4) lmpl is other than a multiple of four if lmpl is not NULL (5) minblksz is neither 8, 16, 32, 64, 128, 256, 512, 1024, 2048 nor 4096. (6) sctnum == 0 (7) lmplsz < minblksz × 32 + 64 (8) lmplmb is other than multiple of four
E_NOMEM	[k]	Insufficient memory (Memory pool area cannot be allocated in the memory)
E_OBJ	[k]	Object status is invalid (Large memory pool already exists)
E_NOSPT	[k]	No support (1) CFG_NEWMPL is not selected (2) Compiler option "-def=USE_LMPL" is not specified for "kernel_def.c"

Note : The context error (E_CTX) is not detected when this service call is called from the system state that is not permitted.

Function:

These service calls create the large memory pool.

Note, the large memory pool cannot be created by using the configurator.

(1) **lmplsz**

Parameter lmplsz specifies the size of the large memory pool to be created.

(2) **lmpl**

Parameter lmpl specifies the start address of a free area to be used as the large memory pool. The kernel manages lmplsz-byte area starting from address lmpl as the large memory pool.

When NULL is specified as lmpl, the kernel allocates lmplsz-byte area from the variable-size memory pool area (CFG_MPLSZ). After the large memory pool has been created, the free variable-size memory pool area will decrease by an amount given by the following expression:

Decrease in size = lmplsz + 16

(3) **lmplmb**

Allocate an area for the size calculated by the following macro, and specify the start address of the area as lmplmb.

VTSZ_LMPLMB(maximum sector number)

(4) **minblksz and sctnum**

In the large memory pool, minute memory blocks are continuously arranged, and this is managed as sector. As a result, the fragmentation is reduced.

The size required for lmplmb grows though minute memory block can be efficiently handled by enlarging sctnum.

The size of memory block that can be managed as sector is minblksz × 8 - 4 (bytes) or less.

When sctnum is set to a larger value than lmplsz / (minblksz × 32), lmplsz / (minblksz × 32) is assumed.

This service call is a function not defined in the µITRON4.0 specification.

Attention concerning Processing Time:

Refer to "2.3 Acquires Memory Block (vpget_lmpl, ivpget_lmpl)".

Supplement:

The standard alignment size for the address of a memory block is 4.

The method of making memory block address the boundary of 16, 32 or 64 is shown below. (N means the alignment size).

1. Allocate a pool area to the N-byte boundary address.
2. Specify N or more for minblksz.

2.2 Deletes Large Memory Pool (vdel_lmpl)

C-Language API:

ER ercd = vdel_lmpl(void);

Parameters:

None

Return Parameters:

ER	ercd	R0	Normal end (E_OK) or error code

Error Codes:

E_NOEXS	[k]	Undefined (The large memory pool does not exist)
E_CTX	[k]	Context error (Called from the system state that is not permitted)
E_NOSPT	[k]	No support (1) CFG_NEWMPL is not selected (2) Compiler option "-def=USE_LMPL" is not specified for "kernel_def.c"

Function:

This service call deletes the large memory pool.

When the large memory pool is allocated in the variable-size memory pool that is created with NULL as lmpl is deleted, the free variable-size memory pool area (CFG_MPLSZ) will increase by an amount given by the following expression:

Increase in size = (lmplsz specified at creation) + 16 bytes

The kernel will not perform any processing even when memory blocks have already been acquired.

This service call is a function not defined in the µITRON4.0 specification.

2.3 Acquires Memory Block (vpget_lmpl, ivpget_lmpl)

C-Language API:

ER ercd = vpget_lmpl(UINT blksz, VP *p_blk);

ER ercd = ivpget_lmpl(UINT blksz, VP *p_blk);

Parameters:

UINT	blksz	R4	Memory block size (Number of bytes)
VP	*p_blk	R5	Pointer to the area where the start address of the memory block is to be returned

Return Parameters:

ER	ercd	R0	Normal end (E_OK) or error code

Error Codes:

E_PAR	[k]	Parameter error (1) p_blk is other than a multiple of four (2) blksz is other than a multiple of four or 0 (3) lmplsz[1] - 64 < blksz
E_NOEXS	[k]	Undefined (The large memory pool does not exist)
E_TMOUT	[k]	Polling Fail (There is no free area with blksz bytes)
E_NOSPT	[k]	No support (1) CFG_NEWMPL is not selected (2) Compiler option "-def=USE_LMPL" is not specified for "kernel_def.c"

Note : The context error (E_CTX) is not detected when this service call is called from the system state that is not permitted.

Function:

These service calls acquire a memory block with the size specified by blksz (number of bytes) from the large memory pool, and returns the start address of the acquired memory block to the area indicated by p_blk.

This service call is a function not defined in the µITRON4.0 specification.

Attention concerning Processing Time:

1. blksz ≤ minblksz[2] × 8 - 4(the blksz can be managed as sector)
   (1) sctnum[3] ≥ lmplsz/(minblksz × 32)
   The worst processing time fixation when the maximum free memory size is larger than or equal to (minblksz × 32). In other case, the processing time depends on the number of free area of the size at the same level with blksz. When the majority of large memory pool are used, the latter may be caused.
   (2) sctnum < lmplsz/(minblksz × 32)
   The processing time depends on the number of free area of the size at the same level with blksz.
2. blksz ≥ minblksz × 8 (the blksz cannot be managed as sector)
   The processing time depends on the number of free area of the size at the same level with blksz.

1 Large memory pool size specified by vcre_lmpl or ivcre_lmpl

2 Minimum block size specified by vcre_lmpl or ivcre_lmpl

3 Maximum number of sectors specified by vcre_lmpl or ivcre_lmpl

2.4 Releases Memory Block (vrel_lmpl, ivrel_lmpl)

C-Language API:

ER ercd = vrel_lmpl(VP blk);

ER ercd = ivrel_lmpl(VP blk);

Parameters:

VP	blk	R4	Start address of memory block

Return Parameters:

ER	ercd	R0	Normal end (E_OK) or error code

Error Codes:

E_PAR	[k]	Parameter error
		(1) blk is other than a multiple of four
		(2) blk is other than the memory block start address
E_NOEXS	[k]	Undefined (The large memory pool does not exist)
E_NOSPT	[k]	No support
		(1) CFG_NEWMPL is not selected
		(2) Compiler option "-def=USE_LMPL" is not specified for "kernel_def.c"

Note : The context error (E_CTX) is not detected when this service call is called from the system state that is not permitted.

Function:

These service calls release a memory block to the large memory pool.

The start address of the memory block acquired by service call vpget_lmpl or ivpget_lmpl must be specified as parameter blk.

This service call is a function not defined in the µITRON4.0 specification.

Attention concerning Processing Time:

The worst processing time is fixation.

2.5 Refers to Large Memory Pool State (vref_lmpl, ivref_lmpl, vref_lmpl2, ivref_lmpl2)

C-Language API:

ER ercd = vref_lmpl(T_RMPL *pk_rlmpl)

ER ercd = ivref_lmpl(T_RMPL *pk_rlmpl)

ER ercd = vref_lmpl2(T_RMPL *pk_rlmpl)

ER ercd = ivref_lmpl2(T_RMPL *pk_rlmpl)

Parameters:

T_RMPL *pk_rlmpl	R4	Pointer to the packet where the large memory pool state is to be returned	

Return Parameters:

ER	ercd	R0	Normal end (E_OK) or error code

Packet Structure:

typedef struct {

ID	wtskid;	+0	4	Wait task ID
SIZE	fmplsz;	+4	4	Total size of free memory (Number of bytes)
UINT	fblksz;	+8	4	Maximum free memory size (Number of bytes)

} T_RMPL;

Error Codes:

E_PAR	[k]	Parameter error (1) pk_rlmpl is other than a multiple of four
E_NOEXS	[k]	Undefined (The large memory pool does not exist)
E_NOSPT	[k]	No support (1) CFG_NEWMPL is not selected (2) Compiler option "-def=USE_LMPL" is not specified for "kernel_def.c"

Note : The context error (E_CTX) is not detected when this service call is called from the system state that is not permitted.

Function:

These service calls return the large memory pool state to the area indicated by pk_rlmpl.

(1) **wtskid**

Always TSK_NONE(0) is returned.

(2) **fmplsz**

Total size of free memory is returned.

(3) **fblksz**

The free area is usually fragmented. The block up to the size fblksz can be acquired immediately by calling service call vpget_lmpl or ivpget_lmpl.

The vref_lmpl and ivref_lmpl return the size of the maximum contiguous free area.

The vref_lmpl2 and ivref_lmpl2 return the size close to size of the maximum contiguous free area. There is a possibility where a free area that is larger than fblksz.

This service call is a function not defined in the µITRON4.0 specification.

Attention concerning Processing Time:

1. vref_lmpl, ivref_lmpl
   The processing time depends on the number of free area.
2. vref_lmpl2, ivref_lmpl2
   The worst processing time is fixation.

3. Configuration

Please do the following to use the large memory pool.

(1) **Configurator Setting (CFG_NEWMPL)**

Check CFG_NEWMPL check box in the [Variable-size Memory Pool] page.

When cfg file is used on the HI7200/MP, specify “system.newmpl = NEW”.

(2) **Compiler option for "kernel_def.c"**

Specify "-def=USE_LMPL" for "kernel_def.c".

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