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Cell

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2006 7 21

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9 가 Cell (Cell Broadband Engine, CBE) . Cell CPU , 가 가 , IBM CBE Cell . Cell 가 . CBE SPE (CBE Embedded SPE Object Format, CESOF) , IBM (Sony, Toshiba, IBM Cell Broadband Engine Design Center, STIDC) Cell 가 CESOF (specification,) CESOF , , Cell (異種) 가 가

(workload)가 (SIMD)
, 가 , (DMA)
, ,
, ,
가 가
1 Cell (Power Processor)
Element, PPE) 8 (SPE)
(
. 8 SPE SIMD , SPE
가
8

Cell processor die photo

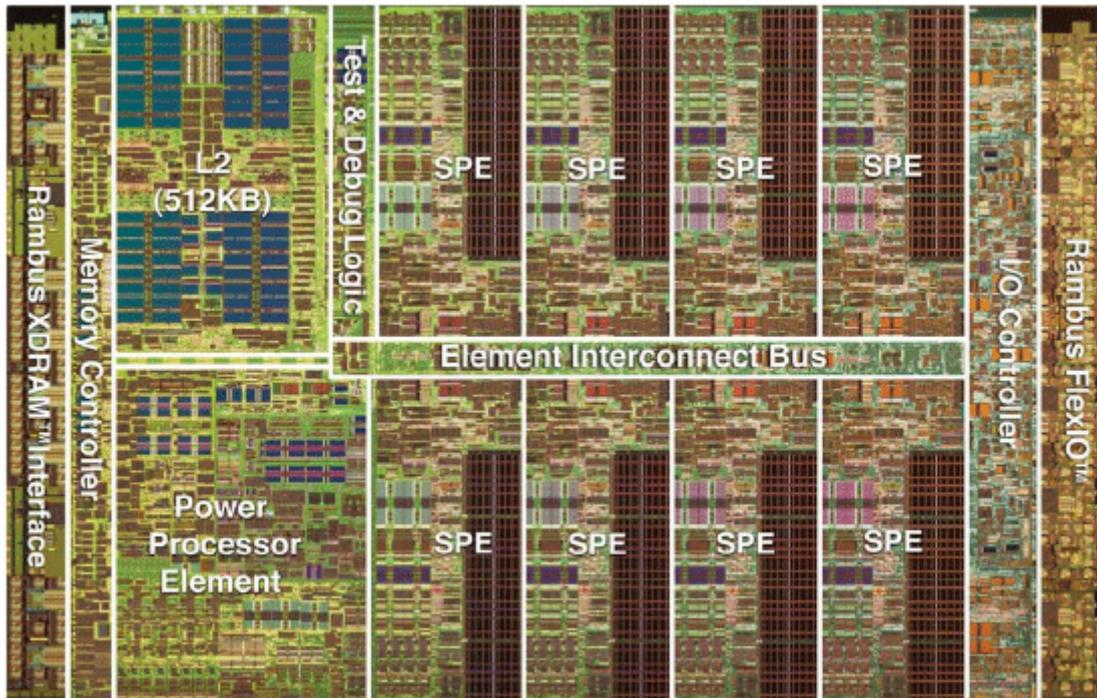
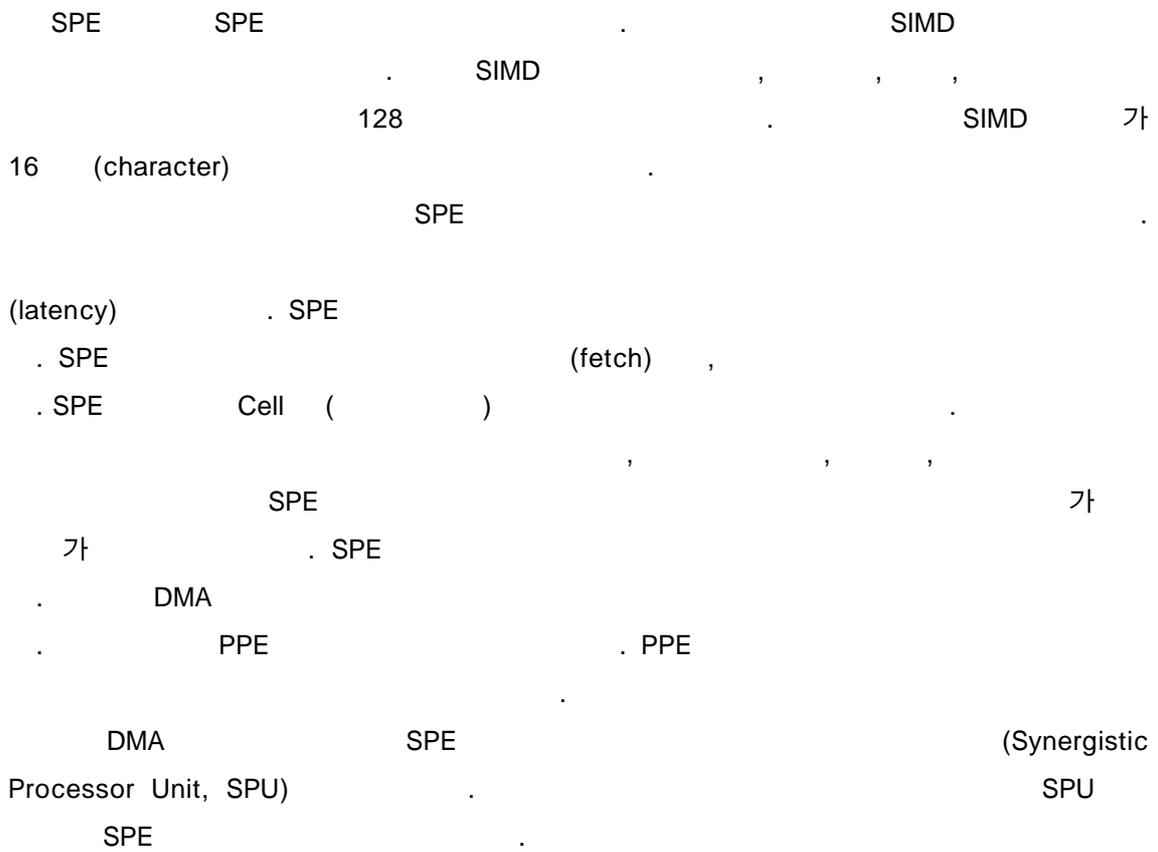


Figure 1



9 (PPE SPE 8)

(Element Interconnect Bus, EIB)

SPE DMA

(SPE 가)

가

가
CESOF

CESOF

가

CESOF

가

가

CESOF

가

가

2

가 가

가

가

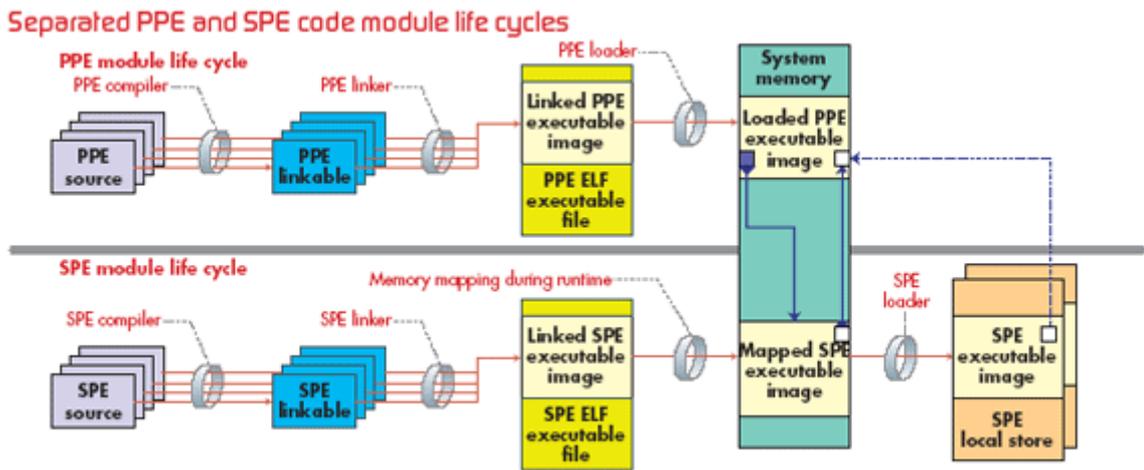


Figure 3

PPE SPE

CESOF가 CBE

가

가

Cell

(PPE)

CESOF ELF

PPE

SPE

PPE

SPE

가

PPE

2가

PPE

3

SPE PPE
 PPE CBE PPE
 SPE PPE
 3 SPE SPE
 SPE (가
 PPE) PPE
 SPE SPE
 SPE (DMA) CBE
 SPE SPE
 PPE SPE
 가 ,
 가
 PPE SPE
 SPE
 가 DMA
 SPE
 가 DMA
 SPE
 CESOF EA() SPE
 SPE (4)
 (effective-address reference, EAR) EAR PPE
 (EAR EA 가 .)
 CESOF EAR SPE , PPE
 CESOF PPE _EAR_

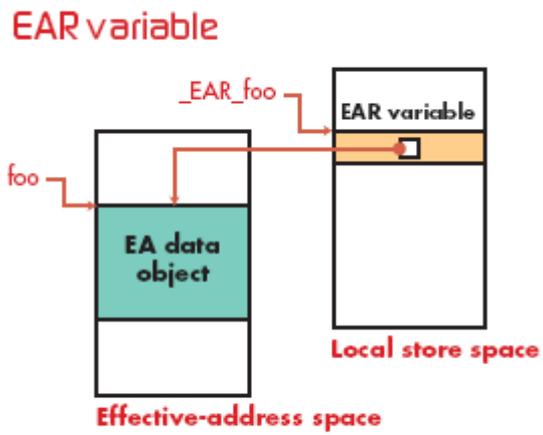


Figure 4

가()
 SPE) EAR 가
 PPE SPE 가 SPE ()
) SPE 가 . SPE SPE
 PPE SPE
 . PPE
 () . CESOF

CESOF 가
 PPE PPE

CESOF 가 PPE PPE
 가 SPE . CESOF PPE 가
 (Tool Interface Standard, TIS)
 PPE (ELF) 가 PPE 가
 가 PPE 가

CBE
 5 6 CESOF 가 가 SPE PPE
 CBE 가

Wrapping an SPE executable into a CESOF linkable

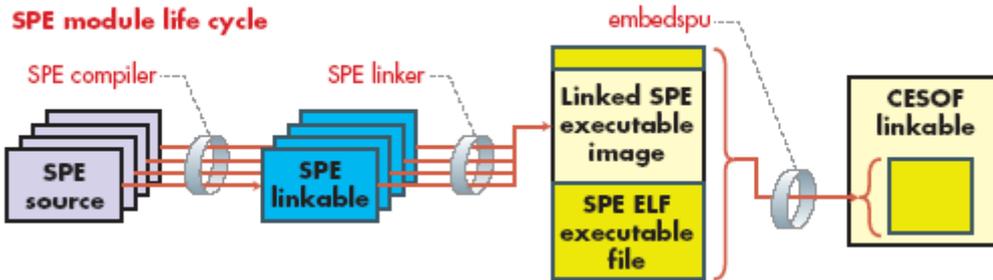


Figure 5

CESOF linkable life cycle

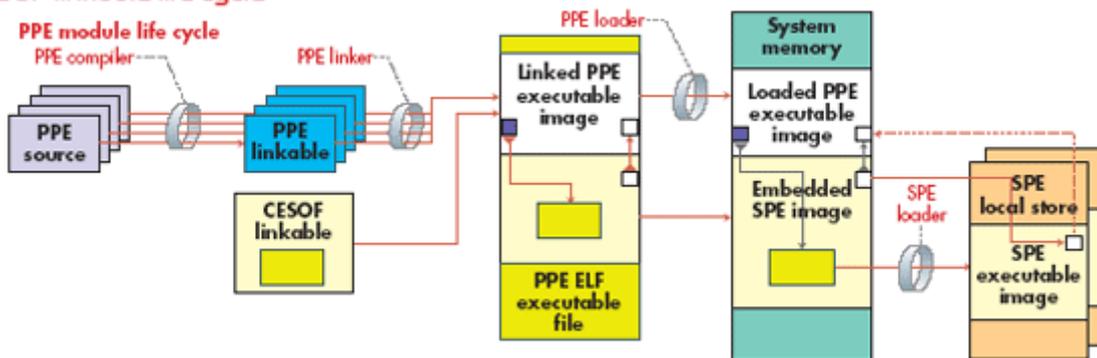


Figure 6

5 embedspu SPE CESOF 가

. CESOF SPE

PPE

6 PPE 가 CESOF 가

PPE 가 . PPE PPE

SPE 가 . SPE PPE

CBE . PPE PPE 가

SPE CBE

SPE 가 SPE (target)

CESOF 가

CESOF PPE ELF , PPE 가

SPE PPE ELF

7 embedspu가 3 CESOF CESOF

CESOF linkable layout

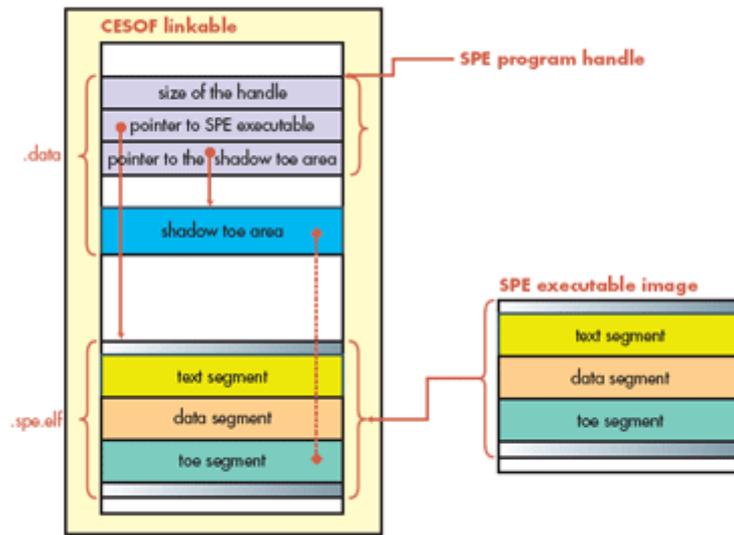


Figure 7

1. SPE ELF :

.spe.elf SPE SPE
 SPE ELF () 가 .SPE ELF SPE
 가 .embedspu spe.elf. PPE
 CBE SPE

CESOF 가

2. SPE toe :

CESOF (shadow)
 SPE SPE SPE
 64
 (EAR) EAR
 .toe (EAR) .SPE 가 가
 SPE , .toe SPE TOE
 SPE toe SPE TOE
 TOE EAR embedspu PPE
 .PPE CESOF 가 가 PPE 가
 PPE
 SPE SPE SPE

SPE TOE

SPE EAR

가

가 가 .data

가

SPE

3. SPE :

CESOF CESOF

가 SPE PPE

가 CESOF 가

Embedspu SPE

EAR 가 SPE

CESOF

CESOF가 Cell SPE PPE

spe_hello SPE SPE PPE

foo DMA (target)

. DMA foo "Hello World!"

IBM SDK SPE SPE

. SPE foo

CESOF SPE foo 가

foo CESOF _EAR_

가 "unsigned long long" 64

. (EAR 128 .)

SPE (post-processing) 가 EAR

. EAR .toe PPE

가 CESOF 가

1 SPE _EAR_foo foo EAR

1 SPE

```
/*
*****
/*      : spe_hello.c      */
*****
#include <cpio.h>
/*      foo      EAR      */
extern unsigned long long _EAR_foo;
char hello_string[] = "Hello World!";
int main(long long spuid, char** argp, char** envp)
{
/*      foo      */
copy_from_ls(_EAR_foo, hello_string, sizeof(hello_string));
return 0;
}
/*      SPE      가      */
*****
/*      : spe_hello_toe.s      */
*****
section .toe, "a", @progbits
.align 4
.global _EAR_foo
_EAR_foo:
.octa 0x0
```

```
SPE      SPE
spe_hello
$ spu-gcc -c spe_hello.c
$ spu-gas spe_hello_toe.s -o spe_hello_toe.o
$ spu-gcc -o spe_hello spe_hello.o spe_hello_toe.o

SPE      spe_hello_toe.s      EAR
.toe      EAR      (_EAR_foo)
EAR      (attribute)
SPE      가      (      SPE      가
```

```

        .)
spe_hello가 PPE CESOF 가

$ embedspu spe_hello_handle spe_hello spe_hello_csf.o
    spe_hello_handle SPE spe_hello embedspu
        spe_hello_csf.o CESOF 가

embedspu SPE SPE EAR
(spe_hello ) _EAR_ PPE
        PPE PPE
        PPE SPE TOE
        EAR EAR 가

2 spe_hello_handle PPE

2 spe_hello_handle PPE

/*****/
/* : ppe_main.c */
/*****/
/* spe_hello_csf.o "spe_foo_handle" */
extern spe_program_handle_t spe_hello_handle;
/* */
char foo[512]; /* spe_hello가 foo */
int main()
{
int rc, status;
speid_t spe_id;
/* SPE spe_hello */
spe_id = spe_create_thread(0, &spe_hello_handle, 0, NULL, -1, 0);
/* spe */
rc = spe_wait(spe_id, &status, 0);
printf("string from spe_hello: %s \n", foo);
return status;
}

```
