## 页表

typedef u32 pteval\_t;

typedef u32 pmdval\_t;

typedef pmdval\_t pmd\_t;

typedef pteval\_t pte\_t;

typedef pmdval\_t pgd\_t[2];

typedef pteval\_t pgprot\_t;

#define pgprot\_val(x) (x)

#define PTRS\_PER\_PTE 512

#define PTE\_HWTABLE\_PTRS (PTRS\_PER\_PTE)

#define PTE\_HWTABLE\_OFF (PTE\_HWTABLE\_PTRS \*sizeof(pte\_t))

#define PMD\_TYPE\_TABLE (\_AT(pmdval\_t, 1) << 0)

#define PMD\_BIT4 (\_AT(pmdval\_t, 1) << 4)

#define PMD\_DOMAIN(x) (\_AT(pmdval\_t, (x)) << 5)

#define \_PAGE\_KERNEL\_TABLE (PMD\_TYPE\_TABLE | PMD\_BIT4 | PMD\_DOMAIN(DOMAIN\_KERNEL))

static pte\_t bm\_pte[PTRS\_PER\_PTE + PTE\_HWTABLES\_PTRS]

\_\_aligned(PTE\_HWTABLE\_OFF +PTE\_HWTABLE\_SIZE)\_\_initdata;

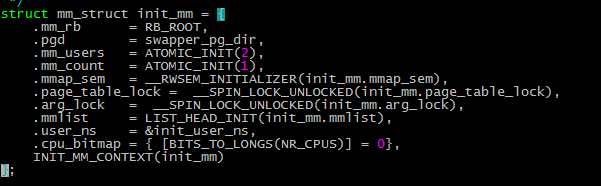
<https://programmer.help/blogs/linux-memory-management-arm-memory-layout-and-mmu-configuration.html>

struct mm\_struct {

pgd\_t \*pgd;

};

mm/init-mm.c



### pgd\_offset\_k

arch/arm/inclue/asm/pgtable-2level.h

/\*

PGDIR\_SHIFT 是21，所以一级页表的个数是11，每个页表大小是8字节。

\*/

#define PGDIR\_SHIFT 21

#define PMD\_SHIFT 21

arch/arm/include/asm/pgtable.h

#define pgd\_offset\_k(addr) pgd\_offset(&init\_mm,addr) ->

((mm)->pgd + pgd\_index(addr))

#define pgd\_index(addr) ((addr) >> PGDIR\_SHIFT)

### pud\_offset

include/asm-generic/pgtable-nopud.h

typedef struct { pgd\_t pgd; } p4d\_t;



static inline pud\_t \*pud\_offset(p4d\_t \*p4d,unsigned long address)

{

return (pud\_t \*)p4d;

}

### pmd\_offset

static inline pmd\_t \*pmd\_offset(pud\_t \*pud,unsigned long addr)

{

return (pmd\_t \*)pud;

}

### pmd\_offset\_k

static inline pmd\_t \*pmd\_off\_k(unsigned long virt)->

pmd\_offset(pud\_offset(pgd\_offset\_k(virt),virt),virt)

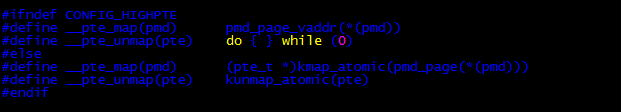
### pte\_index

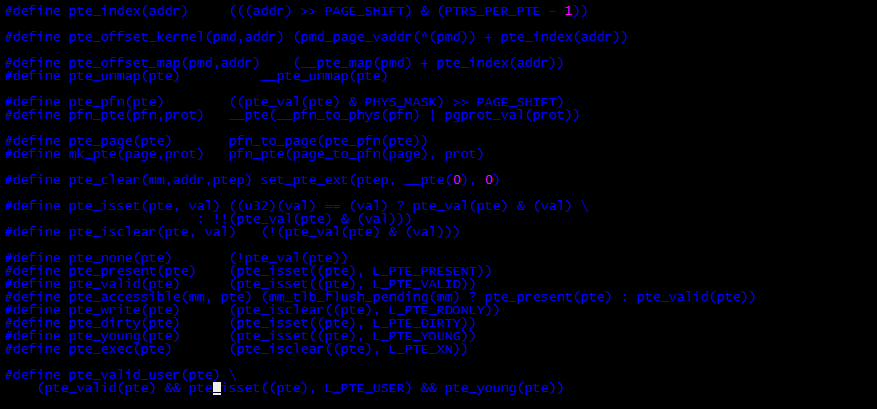
#define pte\_index(addr)

((addr)>>PAGE\_SHIFT)&(PTRS\_PER\_PTE-1)

### set\_pte\_at

arch/arm/include/asm/pgtable.h





#define (UL(CONFIG\_PAGE\_OFFSET) – UL(SZ\_16M))

void set\_pte\_at(struct mm\_struct \*mm,unsigned long addr,pte\_t \*ptep,pte\_t pteval)

{

unsigned long ext =0;

if(addr < TASK\_SIZE &&pte\_valid\_usr(pteval))

{

}

set\_pte\_ext(ptep,pteval,ext);

}

set\_pte\_ext(ptep,pteval,ext)->

cpu\_set\_pte\_ext(ptep,pte,ext)->

/\*

arch/arm/include/asm/glue-proc.h

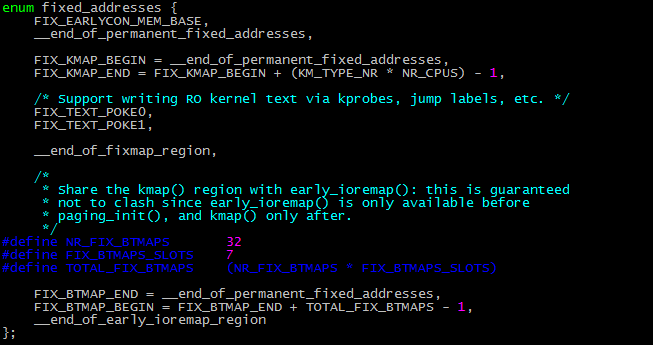
比如armv7，在arch/arm/mm/proc-v7-2level.S中定义

cpu\_v7\_set\_pte\_ext

\*/

\_\_glue(CPU\_NAME,\_set\_pte\_ext)

## fixmap



arch/arm/include/asm/fixmap.h



0xff80\_0000 - 0xffc0\_0000，未知区域

0xffc0\_0000 – 0xfff0\_0000，是fixmap区域。3M

setup\_arch->

early\_fixmap\_init()

arch/arm/mm/mmu.c

early\_fixmap\_init()

{

pmd\_t \*pmd;

pmd = fixmap\_pmd(FIXADDR\_TOP);

pmd\_populate\_kernel(&init\_mm,pmd,bm\_pte);

pte\_offset\_fixmap = pte\_offset\_early\_fixmap;

}

fixmap\_pmd(FIXADDR\_TOP)

{

pgd\_t \*pgd = pgd\_offset(addr);

pud\_t \*pud = pud\_offset(pgd,addr);

pmd\_t \*pmd = pmd\_offset(pud,addr);

return pmd;

}

pmd\_populate\_kernel(&init\_mm,pmd,bm\_pte)->

\_\_pmd\_populate(pmdp,\_\_pa(ptep),\_PAGE\_KERNEL\_TABLE)  
{

pmdval\_t pmdval = (pte+ PTE\_HWTABLE\_OFF) | prot;

pmdp[0] = \_\_pmd(pmdval);

pmdp[1] = \_\_pmd(pmdval+256\*sizeof(pte\_t);

flush\_pmd\_entry(pmdp);

}

arch/arm/include/asm/tlbflush.h

pte\_offset\_early\_fixmap(pmd\_t \*dir,unsigned long addr)

{

return &bm\_pte[pte\_index(addr)];

}

include/asm-generic/fixmap.h

### earlycon

drivers/tty/serial/earlycon.c

bootargs指定earlycon

early\_param(“earlycon”,param\_setup\_earlycon);

param\_setup\_earlycon(char \*buf)

->setup\_earlycon(buf)

->register\_earlycon(buf,match)

->earlycon\_map(port->mapbase,64)

{

void \_\_iomem \*base;

/\*

如果CONFIG\_FIX\_EARLYCON\_MEM，则使用fixmap

fixmap的通用定义在include/asm-generic/fixmap.h

\*/

set\_fixmap\_io(FIX\_EARLYCON\_MEM\_BASE,paddr &PAGE\_MASK);

base = (void \_\_iomem\*)\_\_fix\_to\_virt(FIX\_EARLYCON\_MEM\_BASE);

base +=paddr &~PAGE\_MASK;

return base;

}

set\_fixmap\_io(FIX\_EARLYCON\_MEM\_BASE,paddr &PAGE\_MASK)->

\_\_set\_fixmap(FIX\_EARLYCON\_MEM\_BASE,paddr&PAGE\_MASK,FIXMAP\_PAGE\_IO)->

{

/\*

\_\_fix\_to\_virt的含义是按照4KB对齐的。

\*/

unsigned long vaddr = \_\_fix\_to\_virt(idx);

pte\_t \*pte = pte\_offset\_fixmap(pmd\_off\_k(vaddr),vaddr);

if(pgprot\_val(prot))

set\_pte\_at();

else

pte\_clear(NULL,vaddr,pte);

local\_flush\_tlb\_kernel\_range(vaddr,vaddr+PAGE\_SIZE);

}

#define \_\_fix\_to\_virt(idx)

(FIXADDR\_TOP- ((x)<<PAGE\_SHIFT))