

PIR_EL2, Permission Indirection Register 2 (EL2)

The PIR_EL2 characteristics are:

Purpose

Stage 1 Permission Indirection Register for privileged access of the EL2 or EL2&0 translation regime.

Configuration

This register is present only when FEAT_S1PIE is implemented. Otherwise, direct accesses to PIR_EL2 are undefined.

Attributes

PIR_EL2 is a 64-bit register.

Field descriptions

63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
Perm15	Perm14	Perm13	Perm12	Perm11	Perm10	Perm9	Perm8																								
Perm7	Perm6	Perm5	Perm4	Perm3	Perm2	Perm1	Perm0																								
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Perm<m>, bits [4m+3:4m], for m = 15 to 0

Represents Stage 1 Base Permissions.

Perm<m>	Meaning
0b0000	No access, Overlay applied.
0b0001	Read, Overlay applied.
0b0010	Execute, Overlay applied.
0b0011	Read and Execute, Overlay applied.
0b0100	Reserved - treated as No access, Overlay applied.
0b0101	Read and Write, Overlay applied.
0b0110	Read, Write and Execute, Overlay applied.
0b0111	Read, Write and Execute, Overlay applied.

0b1000	Read, Overlay not applied.
0b1001	Read, GCS Read and GCS Write, Overlay not applied.
0b1010	Read and Execute, Overlay not applied.
0b1011	Reserved - treated as No access, Overlay not applied.
0b1100	Read and Write, Overlay not applied.
0b1101	Reserved - treated as No access, Overlay not applied.
0b1110	Read, Write and Execute, Overlay not applied.
0b1111	Reserved - treated as No access, Overlay not applied.

This field is permitted to be cached in a TLB.

When Stage 1 Indirect Permission mechanism is disabled, this register is ignored.

The reset behavior of this field is:

- On a Warm reset, this field resets to an architecturally unknown value.

Accessing PIR_EL2

When FEAT_VHE is implemented, and [HCR_EL2.E2H](#) is 1, without explicit synchronization, accesses from EL2 using the register name PIR_EL2 or [PIR_EL1](#) are not guaranteed to be ordered with respect to accesses using the other register name.

Accesses to this register use the following encodings in the System register encoding space:

MRS <Xt>, PIR_EL2

op0	op1	CRn	CRm	op2
0b11	0b100	0b1010	0b0010	0b011

```

if PSTATE.EL == EL0 then
    UNDEFINED;
elsif PSTATE.EL == EL1 then
    if EL2Enabled() && HCR_EL2.NV == '1' then
        AArch64.SystemAccessTrap(EL2, 0x18);
    else
        UNDEFINED;

```

```

elseif PSTATE.EL == EL2 then
    if Halted() && HaveEL(EL3) && EDSCR.SDD == '1'
    && boolean IMPLEMENTATION_DEFINED "EL3 trap priority
when SDD == '1'" && SCR_EL3.PIEEn == '0' then
        UNDEFINED;
    elseif HaveEL(EL3) && SCR_EL3.PIEEn == '0' then
        if Halted() && EDSCR.SDD == '1' then
            UNDEFINED;
        else
            AArch64.SystemAccessTrap(EL3, 0x18);
    else
        X[t, 64] = PIR_EL2;
elseif PSTATE.EL == EL3 then
    X[t, 64] = PIR_EL2;

```

MSR PIR_EL2, <Xt>

op0	op1	CRn	CRm	op2
0b11	0b100	0b1010	0b0010	0b011

```

if PSTATE.EL == EL0 then
    UNDEFINED;
elseif PSTATE.EL == EL1 then
    if EL2Enabled() && HCR_EL2.NV == '1' then
        AArch64.SystemAccessTrap(EL2, 0x18);
    else
        UNDEFINED;
elseif PSTATE.EL == EL2 then
    if Halted() && HaveEL(EL3) && EDSCR.SDD == '1'
    && boolean IMPLEMENTATION_DEFINED "EL3 trap priority
when SDD == '1'" && SCR_EL3.PIEEn == '0' then
        UNDEFINED;
    elseif HaveEL(EL3) && SCR_EL3.PIEEn == '0' then
        if Halted() && EDSCR.SDD == '1' then
            UNDEFINED;
        else
            AArch64.SystemAccessTrap(EL3, 0x18);
    else
        PIR_EL2 = X[t, 64];
elseif PSTATE.EL == EL3 then
    PIR_EL2 = X[t, 64];

```

MRS <Xt>, PIR_EL1

op0	op1	CRn	CRm	op2
0b11	0b000	0b1010	0b0010	0b011

```

if PSTATE.EL == EL0 then
    UNDEFINED;
elsif PSTATE.EL == EL1 then
    if Halted() && HaveEL(EL3) && EDSCR.SDD == '1'
    && boolean IMPLEMENTATION_DEFINED "EL3 trap priority
when SDD == '1'" && SCR_EL3.PIEEn == '0' then
        UNDEFINED;
    elsif EL2Enabled() && HCR_EL2.TRVM == '1' then
        AArch64.SystemAccessTrap(EL2, 0x18);
    elsif EL2Enabled() &&
IsFeatureImplemented(FEAT_FGT) && (!HaveEL(EL3) ||
SCR_EL3.FGTEn == '1') && HFGTR_EL2.nPIR_EL1 == '0'
then
        AArch64.SystemAccessTrap(EL2, 0x18);
    elsif HaveEL(EL3) && SCR_EL3.PIEEn == '0' then
        if Halted() && EDSCR.SDD == '1' then
            UNDEFINED;
        else
            AArch64.SystemAccessTrap(EL3, 0x18);
    elsif EL2Enabled() && HCR_EL2.<NV2,NV1,NV> ==
'111' then
        X[t, 64] = NVMem[0x2A0];
    else
        X[t, 64] = PIR_EL1;
elsif PSTATE.EL == EL2 then
    if Halted() && HaveEL(EL3) && EDSCR.SDD == '1'
    && boolean IMPLEMENTATION_DEFINED "EL3 trap priority
when SDD == '1'" && SCR_EL3.PIEEn == '0' then
        UNDEFINED;
    elsif HaveEL(EL3) && SCR_EL3.PIEEn == '0' then
        if Halted() && EDSCR.SDD == '1' then
            UNDEFINED;
        else
            AArch64.SystemAccessTrap(EL3, 0x18);
    elsif HCR_EL2.E2H == '1' then
        X[t, 64] = PIR_EL2;
    else
        X[t, 64] = PIR_EL1;
elsif PSTATE.EL == EL3 then
    X[t, 64] = PIR_EL1;

```

MSR PIR_EL1, <Xt>

op0	op1	CRn	CRm	op2
0b11	0b000	0b1010	0b0010	0b011

```

if PSTATE.EL == EL0 then
    UNDEFINED;
elsif PSTATE.EL == EL1 then
    if Halted() && HaveEL(EL3) && EDSCR.SDD == '1'
    && boolean IMPLEMENTATION_DEFINED "EL3 trap priority
when SDD == '1'" && SCR_EL3.PIEEn == '0' then

```

```

        UNDEFINED;
    elsif EL2Enabled() && HCR_EL2.TVM == '1' then
        AArch64.SystemAccessTrap(EL2, 0x18);
    elsif EL2Enabled() &&
IsFeatureImplemented(FEAT_FGT) && (!HaveEL(EL3) ||
SCR_EL3.FGTEn == '1') && HFGWTR_EL2.nPIR_EL1 == '0'
then
        AArch64.SystemAccessTrap(EL2, 0x18);
    elsif HaveEL(EL3) && SCR_EL3.PIEn == '0' then
        if Halted() && EDSCR.SDD == '1' then
            UNDEFINED;
        else
            AArch64.SystemAccessTrap(EL3, 0x18);
        elsif EL2Enabled() && HCR_EL2.<NV2,NV1,NV> ==
'111' then
            NVMem[0x2A0] = X[t, 64];
        else
            PIR_EL1 = X[t, 64];
    elsif PSTATE.EL == EL2 then
        if Halted() && HaveEL(EL3) && EDSCR.SDD == '1'
&& boolean IMPLEMENTATION_DEFINED "EL3 trap priority
when SDD == '1'" && SCR_EL3.PIEn == '0' then
            UNDEFINED;
        elsif HaveEL(EL3) && SCR_EL3.PIEn == '0' then
            if Halted() && EDSCR.SDD == '1' then
                UNDEFINED;
            else
                AArch64.SystemAccessTrap(EL3, 0x18);
        elsif HCR_EL2.E2H == '1' then
            PIR_EL2 = X[t, 64];
        else
            PIR_EL1 = X[t, 64];
    elsif PSTATE.EL == EL3 then
        PIR_EL1 = X[t, 64];

```

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