



## OVP Guide to Using Processor Models

### Model specific information for POWER\_m470

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## Model Release Status

This model is released as part of OVP releases and is included in OVPworld packages. Please visit [OVPworld.org](http://OVPworld.org).

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# Chapter 1

## Overview

This document provides the details of an OVP Fast Processor Model variant.

OVP Fast Processor Models are written in C and provide a C API for use in C based platforms. The models also provide a native interface for use in SystemC TLM2 platforms.

The models are written using the OVP VMI API that provides a Virtual Machine Interface that defines the behavior of the processor. The VMI API makes a clear line between model and simulator allowing very good optimization and world class high speed performance. Most models are provided as a binary shared object and also as source. This allows the download and use of the model binary or the use of the source to explore and modify the model.

The models are run through an extensive QA and regression testing process and most model families are validated using technology provided by the processor IP owners. There is a companion document (OVP Guide to Using Processor Models) which explains the general concepts of OVP Fast Processor Models and their use. It is downloadable from the OVPworld website documentation pages.

### 1.1 Description

PPC32 Family Processor Model. Providing PPC 400 family variants.

### 1.2 Licensing

Open Source Apache 2.0

### 1.3 Limitations

This model is currently under development

The FPU is incomplete

FPU exceptions are not implemented

Some Single Floating Point FPU instructions are not implemented

The MMU is not implemented

## **1.4 Verification**

Basic verification of ISA against golden reference has been performed

## **1.5 Features**

# Chapter 2

## Configuration

### 2.1 Location

This model's VLVN is `power.ovpworld.org/processor/powerpc32_400/1.0`.

The model source is usually at:

`$IMPERAS_HOME/ImperasLib/source/power.ovpworld.org/processor/powerpc32_400/1.0`

The model binary is usually at:

`$IMPERAS_HOME/lib/$IMPERAS_ARCH/ImperasLib/power.ovpworld.org/processor/powerpc32_400/1.0`

### 2.2 GDB Path

The default GDB for this model is: `$IMPERAS_HOME/lib/$IMPERAS_ARCH/gdb/powerpc-elf-gdb`.

### 2.3 Semi-Host Library

The default semi-host library file is `power.ovpworld.org/semihosting/powerpc32Newlib/1.0`

### 2.4 Processor Endian-ness

This model can be set to either endian-ness (normally by a pin, or the ELF code).

### 2.5 QuantumLeap Support

This processor is qualified to run in a QuantumLeap enabled simulator.

### 2.6 Processor ELF code

The ELF code supported by this model is: `0x14`.

## Chapter 3

# All Variants in this model

This model has these variants

| Variant | Description                  |
|---------|------------------------------|
| m476    |                              |
| m470    | (described in this document) |
| m460    |                              |
| m440    |                              |

Table 3.1: All Variants in this model



## Chapter 4

# Bus Master Ports

This model has these bus master ports.

| <b>Name</b> | min | max | Connect?  | Description |
|-------------|-----|-----|-----------|-------------|
| INSTRUCTION | 32  | 32  | mandatory |             |
| DATA        | 32  | 32  | optional  |             |

Table 4.1: Bus Master Ports

## Chapter 5

# Bus Slave Ports

This model has no bus slave ports.

## Chapter 6

# Net Ports

This model has these net ports.

| Name  | Type  | Connect? | Description |
|-------|-------|----------|-------------|
| reset | input | optional |             |

Table 6.1: Net Ports

## Chapter 7

# FIFO Ports

This model has no FIFO ports.

# Chapter 8

## Formal Parameters

| Name         | Type        | Description   |
|--------------|-------------|---|
| variant      | Enumeration | Selects variant (either a generic UISA or a specific model) |
| verbose      | Boolean     | Specify verbose output messages                             |
| endian       | Endian      | Specify Model endian  |
| UISA_I.B     | Boolean     | UISA Feature UISA_I.B                                       |
| UISA_I.BCDA  | Boolean     | UISA Feature UISA_I.BCDA                                    |
| UISA_I.S     | Boolean     | UISA Feature UISA_I.S                                       |
| UISA_I.E     | Boolean     | UISA Feature UISA_I.E                                       |
| UISA_I.E.PC  | Boolean     | UISA Feature UISA_I.E.PC                                    |
| UISA_I.E.PD  | Boolean     | UISA Feature UISA_I.E.PD                                    |
| UISA_I.EC    | Boolean     | UISA Feature UISA_I.EC                                      |
| UISA_I.FP    | Boolean     | UISA Feature UISA_I.FP                                      |
| UISA_I.DFP   | Boolean     | UISA Feature UISA_I.DFP                                     |
| UISA_I.MA    | Boolean     | UISA Feature UISA_I.MA                                      |
| UISA_I.SP    | Boolean     | UISA Feature UISA_I.SP                                      |
| UISA_I.V     | Boolean     | UISA Feature UISA_I.V                                       |
| UISA_I.LMA   | Boolean     | UISA Feature UISA_I.LMA                                     |
| UISA_I.WT    | Boolean     | UISA Feature UISA_I.WT                                      |
| UISA_I.VLE   | Boolean     | UISA Feature UISA_I.VLE                                     |
| ENABLE_FPU   | Uns32       | Enable FPU At Startup                                       |
| UNIMP_TO_NOP | Boolean     | Map Unimplemented Instructions to NOP                       |
| WARN_NOP     | Boolean     | Warn when executing nop-mapped instructions                 |

Table 8.1: Parameters

### 8.1 Parameter values

These are the current parameter values.

| Name            | Value |
|-----------------|-------|
| <b>(Others)</b> |       |
| variant         | m470  |
| verbose         | T     |
| endian          | none  |
| UISA_I.B        | F     |
| UISA_I.BCDA     | F     |
| UISA_I.S        | F     |
| UISA_I.E        | F     |

|              |   |
|--------------|---|
| UISA_I_E_PC  | F |
| UISA_I_E_PD  | F |
| UISA_I_EC    | F |
| UISA_I_FP    | F |
| UISA_I_DFP   | F |
| UISA_I_MA    | F |
| UISA_I_SP    | F |
| UISA_I_V     | F |
| UISA_I_LMA   | F |
| UISA_I_WT    | F |
| UISA_I_VLE   | F |
| ENABLE_FPU   | 0 |
| UNIMP_TO_NOP | F |
| WARN_NOP     | F |

Table 8.2: Parameter values

## Chapter 9

# Execution Modes

This model does not have different execution modes.

## Chapter 10

# Exceptions

| <b>Exception</b> | <b>Code</b> |
|------------------|-------------|
| Reset            | 0           |
| Undefined        | 1           |
| Arith            | 2           |
| RdAlign          | 3           |
| WrAlign          | 4           |
| RdAbort          | 5           |
| WrAbort          | 6           |
| RdPriv           | 7           |
| WrPriv           | 8           |
| Fetch            | 9           |

Table 10.1: Exceptions implemented by this processor



# Chapter 11

## Hierarchy of the model

A CPU core may be configured to instance many processors of a Symmetrical Multi Processor (SMP). A CPU core may also have sub elements within a processor, for example hardware threading blocks.

OVP processor models can be written to include SMP blocks and to have many levels of hierarchy. Some OVP CPU models may have a fixed hierarchy, and some may be configured by settings in a configuration register. Please see the register definitions of this model.

This model documentation shows the settings and hierarchy of the default settings for this model variant.

### 11.1 Level 1

This level in the model hierarchy has 2 commands.

This level in the model hierarchy has 3 register groups:

| Group name    | Registers |
|---------------|-----------|
| User          | 32        |
| FloatingPoint | 32        |
| System        | 7         |

Table 11.1: Register groups

This level in the model hierarchy has no children.

# Chapter 12

## Model Commands

A Processor model can implement one or more **Model Commands** available to be invoked from the simulator command line, from the OP API or from the Imperas Multiprocessor Debugger.

### 12.1 Level 1

#### 12.1.1 isync

specify instruction address range for synchronous execution

| Argument   | Type  | Description                                  |
|------------|-------|--|
| -addresshi | Uns64 | end address of synchronous execution range   |
| -addresslo | Uns64 | start address of synchronous execution range |

Table 12.1: isync command arguments

#### 12.1.2 itrace

enable or disable instruction tracing

| Argument          | Type    | Description   |
|-------------------|---------|---|
| -after            | Uns64   | apply after this many instructions  |
| -enable           | Boolean | enable instruction tracing  |
| -instructioncount | Boolean | include the instruction number in each trace  |
| -memory           | String  | show memory accesses by this instruction. Argument can be any combination of X (execute), L (load or store access) and S (system) |
| -off              | Boolean | disable instruction tracing   |
| -on               | Boolean | enable instruction tracing  |
| -processorname    | Boolean | Include processor name in all trace lines   |
| -registerchange   | Boolean | show registers changed by this instruction  |
| -registers        | Boolean | show registers after each trace   |

Table 12.2: itrace command arguments

# Chapter 13

## Registers

### 13.1 Level 1

#### 13.1.1 User

Registers at level:1, group:User

| Name  | Bits | Initial-Hex | RW | Description |
|-------|------|-------------|----|-------------|
| GPR0  | 32   | 0           | rw |             |
| GPR1  | 32   | 0           | rw |             |
| GPR2  | 32   | 0           | rw |             |
| GPR3  | 32   | 0           | rw |             |
| GPR4  | 32   | 0           | rw |             |
| GPR5  | 32   | 0           | rw |             |
| GPR6  | 32   | 0           | rw |             |
| GPR7  | 32   | 0           | rw |             |
| GPR8  | 32   | 0           | rw |             |
| GPR9  | 32   | 0           | rw |             |
| GPR10 | 32   | 0           | rw |             |
| GPR11 | 32   | 0           | rw |             |
| GPR12 | 32   | 0           | rw |             |
| GPR13 | 32   | 0           | rw |             |
| GPR14 | 32   | 0           | rw |             |
| GPR15 | 32   | 0           | rw |             |
| GPR16 | 32   | 0           | rw |             |
| GPR17 | 32   | 0           | rw |             |
| GPR18 | 32   | 0           | rw |             |
| GPR19 | 32   | 0           | rw |             |
| GPR20 | 32   | 0           | rw |             |
| GPR21 | 32   | 0           | rw |             |
| GPR22 | 32   | 0           | rw |             |
| GPR23 | 32   | 0           | rw |             |
| GPR24 | 32   | 0           | rw |             |
| GPR25 | 32   | 0           | rw |             |
| GPR26 | 32   | 0           | rw |             |
| GPR27 | 32   | 0           | rw |             |
| GPR28 | 32   | 0           | rw |             |
| GPR29 | 32   | 0           | rw |             |
| GPR30 | 32   | 0           | rw |             |
| GPR31 | 32   | 0           | rw |             |

Table 13.1: Registers at level 1, group:User

### 13.1.2 FloatingPoint

Registers at level:1, group:FloatingPoint

| Name  | Bits | Initial-Hex | RW | Description |
|-------|------|-------------|----|-------------|
| FPR0  | 64   | 0           | rw |             |
| FPR1  | 64   | 0           | rw |             |
| FPR2  | 64   | 0           | rw |             |
| FPR3  | 64   | 0           | rw |             |
| FPR4  | 64   | 0           | rw |             |
| FPR5  | 64   | 0           | rw |             |
| FPR6  | 64   | 0           | rw |             |
| FPR7  | 64   | 0           | rw |             |
| FPR8  | 64   | 0           | rw |             |
| FPR9  | 64   | 0           | rw |             |
| FPR10 | 64   | 0           | rw |             |
| FPR11 | 64   | 0           | rw |             |
| FPR12 | 64   | 0           | rw |             |
| FPR13 | 64   | 0           | rw |             |
| FPR14 | 64   | 0           | rw |             |
| FPR15 | 64   | 0           | rw |             |
| FPR16 | 64   | 0           | rw |             |
| FPR17 | 64   | 0           | rw |             |
| FPR18 | 64   | 0           | rw |             |
| FPR19 | 64   | 0           | rw |             |
| FPR20 | 64   | 0           | rw |             |
| FPR21 | 64   | 0           | rw |             |
| FPR22 | 64   | 0           | rw |             |
| FPR23 | 64   | 0           | rw |             |
| FPR24 | 64   | 0           | rw |             |
| FPR25 | 64   | 0           | rw |             |
| FPR26 | 64   | 0           | rw |             |
| FPR27 | 64   | 0           | rw |             |
| FPR28 | 64   | 0           | rw |             |
| FPR29 | 64   | 0           | rw |             |
| FPR30 | 64   | 0           | rw |             |
| FPR31 | 64   | 0           | rw |             |

Table 13.2: Registers at level 1, group:FloatingPoint

### 13.1.3 System

Registers at level:1, group:System

| Name  | Bits | Initial-Hex | RW | Description     |
|-------|------|-------------|----|-----------------|
| PC    | 32   | 0           | rw | program counter |
| MSR   | 32   | 0           | rw |                 |
| CR    | 32   | 0           | rw |                 |
| LR    | 32   | 0           | rw |                 |
| CTR   | 32   | 0           | rw |                 |
| XER   | 32   | 0           | rw |                 |
| FPSCR | 32   | 0           | rw |                 |

Table 13.3: Registers at level 1, group:System