



virtutech

# Simics/Malta Target Guide

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# Chapter 1

## About Simics Documentation

### 1.1 Conventions

Let us take a quick look at the conventions used throughout the Simics documentation. Scripts, screen dumps and code fragments are presented in a monospace font. In screen dumps, user input is always presented in bold font, as in:

```
Welcome to the Simics prompt
simics> this is something that you should type
```

Sometimes, artificial line breaks may be introduced to prevent the text from being too wide. When such a break occurs, it is indicated by a small arrow pointing down, showing that the interrupted text continues on the next line:

```
This is an artificial ↴
line break that shouldn't be there.
```

The directory where Simics is installed is referred to as `[simics]`, for example when mentioning the `[simics]/README` file. In the same way, the shortcut `[workspace]` is used to point at the user's workspace directory.

### 1.2 Simics Guides and Manuals

Simics comes with several guides and manuals, which will be briefly described here. All documentation can be found in `[simics]/doc` as Windows Help files (on Windows), HTML files (on Unix) and PDF files (on both platforms). The new Eclipse-based interface also includes Simics documentation in its own help system.

#### Simics Installation Guide for Unix and for Windows

These guides describe how to install Simics and provide a short description of an installed Simics package. They also cover the additional steps needed for certain features of Simics to work (connection to real network, building new Simics modules, ...).

## **Simics User Guide for Unix and for Windows**

These guides focus on getting a new user up to speed with Simics, providing information on Simics features such as debugging, profiling, networks, machine configuration and scripting.

## **Simics Eclipse User Guide**

This is an alternative User Guide describing Simics and its new Eclipse-based graphical user interface.

## **Simics Target Guides**

These guides provide more specific information on the different architectures simulated by Simics and the example machines that are provided. They explain how the machine configurations are built and how they can be changed, as well as how to install new operating systems. They also list potential limitations of the models.

## **Simics Programming Guide**

This guide explains how to extend Simics by creating new devices and new commands. It gives a broad overview of how to work with modules and how to develop new classes and objects that fit in the Simics environment. It is only available when the DML add-on package has been installed.

## **DML Tutorial**

This tutorial will give you a gentle and practical introduction to the Device Modeling Language (DML), guiding you through the creation of a simple device. It is only available when the DML add-on package has been installed.

## **DML Reference Manual**

This manual provides a complete reference of DML used for developing new devices with Simics. It is only available when the DML add-on package has been installed.

## **Simics Reference Manual**

This manual provides complete information on all commands, modules, classes and haps implemented by Simics as well as the functions and data types defined in the Simics API.

## **Simics Micro-Architectural Interface**

This guide describes the cycle-accurate extensions of Simics (Micro-Architecture Interface or MAI) and provides information on how to write your own processor timing models. It is only available when the DML add-on package has been installed.

**RELEASENOTES and LIMITATIONS files**

These files are located in Simics's main directory (i.e., [simics]). They list limitations, changes and improvements on a per-version basis. They are the best source of information on new functionalities and specific bug fixes.

**Simics Technical FAQ**

This document is available on the Virtutech website at <http://www.simics.net/support>. It answers many questions that come up regularly on the support forums.

**Simics Support Forum**

The Simics Support Forum is the main support tool for Simics. You can access it at <http://www.simics.net>.

**Other Interesting Documents**

Simics uses Python as its main script language. A Python tutorial is available at <http://www.python.org/doc/2.4/tut/tut.html>. The complete Python documentation is located at <http://www.python.org/doc/2.4/>.

## **Chapter 2**

# **Simics/Malta Overview**

Simics/Malta models the Malta reference board from MIPS Technologies. The Malta board includes a MIPS 4Kc or 5Kc processor and additional devices. The 4Kc and 5Kc processors are set to run in little endian mode.

Simics/Malta loads the and executes the linux kernel directly without any bootloader (YAMON). The kernel includes a linked in initrd ramdisk with a few basic utilities, based on busybox. Since the bootloader normally sets up the PCI mappings, Simics/Malta cannot be equipped with PCI cards.



## Chapter 3

# Simulated Machines

Simics scripts for starting Malta machines are located in the `[workspace]/targets/malta/` directory, while the actual configuration scripts can be found in `[simics]/targets/malta/`.

### 3.1 Malta

The default configuration can be modified as described in section [3.2](#).

#### 3.1.1 Malta Scripts

This chapter explains the files used to boot Linux on Malta.

##### **`malta-linux-common.simics`**

Starts the Malta machine with the default configuration to boot linux.

### 3.2 Parameters for Machine Scripts

The following parameters can be set before running the `malta-linux-common.simics` scripts. Other `*-linux-*.simics` scripts may set some of the parameters unconditionally, and do not allow the user to override them.

#### 3.2.1 `malta-linux-common`

##### **`$cpu_class`**

MIPS processor to use (default `mips-4kc`).

##### **`$freq_mhz`**

The clock frequency in MHz for the processor.

##### **`$rtc_time`**

Date and time of the real-time clock at boot.

## Chapter 4

# Supported Components

The following sections list components that are supported for the Malta architecture. There also exist other components in Simics, such as various PCI devices, that may work for Malta but that have not been tested.

The default machines are constructed from components in the `-system.include` files in `[simics]/targets/malta/`. See the Configuration and Checkpointing chapter in the Simics User Guide for information on how to define your own machine, or make modifications to an existing machine.

### 4.1 Malta Components

#### 4.1.1 malta-system

##### Description

The “malta-system” component represents a MIPS Malta development board with a MIPS 4Kc or 5Kc processor and a Galileo GT64120 system controller.

##### Attributes

###### *cpu\_class*

**Required** attribute; **read/write** access; type: **String**.

Processor type, one of “mips-4kc” and “mips-5kc”

###### *cpu\_frequency*

**Required** attribute; **read/write** access; type: **Integer**.

Processor frequency in MHz.

###### *rtc\_time*

**Required** attribute; **read/write** access; type: **String**.

The data and time of the Real-Time clock.

##### Commands

**create-malta-system** [*name*] *cpu\_frequency* *cpu\_class* *rtc\_time*

Creates a non-instantiated component of the class "malta-system". If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<malta-system>.info**

Print detailed information about the configuration of the device.

**<malta-system>.status**

Print detailed information about the current status of the device.

**Connectors**

Name	Type	Direction
interrupt	sb-interrupt	down
pci-slot-sb	pci-bus	down
pci-slot[1-4]	pci-bus	down

**4.1.2 south-bridge-piix4****Description**

The "south-bridge-piix4" component represents an Intel PIIX4 PCI south bridge with the common legacy PC devices. It includes two IDE controllers, and a real-time clock. There is also a USB controller that is not supported in Simics.

**Commands****create-south-bridge-piix4** [*name*]

Creates a non-instantiated component of the class "south-bridge-piix4". If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<south-bridge-piix4>.info**

Print detailed information about the configuration of the device.

**<south-bridge-piix4>.status**

Print detailed information about the current status of the device.

**Connectors**

<b>Name</b>	<b>Type</b>	<b>Direction</b>
interrupt	sb-interrupt	up
pci-bus	pci-bus	up
ide0-master	ide-slot	down
ide0-slave	ide-slot	down
ide1-master	ide-slot	down
ide1-slave	ide-slot	down
isa-bus	isa-bus	down
usb[0-1]	usb-port	down

**4.1.3 std-super-io****Description**

The “std-super-io” component represents a generic Super I/O device with legacy PC devices such as two serial ports, one PS/2 keyboard and mouse controller, one floppy device and a parallel port

**Attributes***add\_par\_port*

**Optional** attribute; **read/write** access; type: **b**.

Set to TRUE to add a parallel port to the Super I/O device. Default is FALSE since the current implementation is a dummy device.

**Commands****create-std-super-io** [*“name”*] [*add\_par\_port*]

Creates a non-instantiated component of the class “std-super-io”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<std-super-io>.info**

Print detailed information about the configuration of the device.

**<std-super-io>.status**

Print detailed information about the current status of the device.

**Connectors**

<b>Name</b>	<b>Type</b>	<b>Direction</b>
isa-bus	isa-bus	up
reset	x86-reset-bus	up
com[1-2]	serial	down
kbd-console	keyboard	down
mse-console	mouse	down

**4.2 Standard Components****4.2.1 std-serial-link****Description**

The “std-serial-link” component represents a standard Serial link.

**Commands****create-std-serial-link** [*“name”*]

Creates a non-instantiated component of the class “std-serial-link”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**new-std-serial-link** [*“name”*]

Creates an instantiated component of the class “std-serial-link”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<std-serial-link>.info**

Print detailed information about the configuration of the device.

**<std-serial-link>.status**

Print detailed information about the current status of the device.

**Connectors**

<b>Name</b>	<b>Type</b>	<b>Direction</b>
serial[0-1]	serial	any

### 4.2.2 std-scsi-bus

#### Description

The “std-scsi-bus” component represents a 16 slot SCSI bus.

#### Commands

##### **create-std-scsi-bus** [*“name”*]

Creates a non-instantiated component of the class “std-scsi-bus”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

##### **<std-scsi-bus>.info**

Print detailed information about the configuration of the device.

##### **<std-scsi-bus>.status**

Print detailed information about the current status of the device.

#### Connectors

Name	Type	Direction
scsi-bus	scsi-bus	any

### 4.2.3 std-scsi-disk

#### Description

The “std-scsi-disk” component represents a SCSI-2 disk.

#### Attributes

##### *file*

**Optional** attribute; **read/write** access; type: **String**.

File with disk contents for the full disk Either a raw file or a CRAFF file.

##### *scsi\_id*

**Required** attribute; **read/write** access; type: **Integer**.

The ID on the SCSI bus.

##### *size*

**Required** attribute; **read/write** access; type: **Integer**.

The size of the SCSI disk in bytes.

#### Commands

**create-std-scsi-disk** [*name*] *scsi\_id* *size* [*file*]

Creates a non-instantiated component of the class "std-scsi-disk". If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<std-scsi-disk>.info**

Print detailed information about the configuration of the device.

**<std-scsi-disk>.status**

Print detailed information about the current status of the device.

### Connectors

Name	Type	Direction
scsi-bus	scsi-bus	up

## 4.2.4 std-scsi-cdrom

### Description

The "std-scsi-cdrom" component represents a SCSI-2 CD-ROM.

### Attributes

*scsi\_id*

**Required** attribute; **read/write** access; type: **Integer**.

The ID on the SCSI bus.

### Commands

**create-std-scsi-cdrom** [*name*] *scsi\_id*

Creates a non-instantiated component of the class "std-scsi-cdrom". If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<std-scsi-cdrom>.info**

Print detailed information about the configuration of the device.

**<std-scsi-cdrom>.status**

Print detailed information about the current status of the device.

### Connectors

Name	Type	Direction
scsi-bus	scsi-bus	up

### 4.2.5 std-text-console

#### Description

The “std-text-console” component represents a serial text console.

#### Attributes

##### *bg\_color*

**Optional** attribute; **read/write** access; type: **String**.

The background color.

##### *fg\_color*

**Optional** attribute; **read/write** access; type: **String**.

The foreground color.

##### *height*

**Optional** attribute; **read/write** access; type: **Integer**.

The height of the console window.

##### *title*

**Optional** attribute; **read/write** access; type: **String**.

The Window title.

##### *width*

**Optional** attribute; **read/write** access; type: **Integer**.

The width of the console window.

##### *win32\_font*

**Optional** attribute; **read/write** access; type: **String**.

Font to use in the console on Windows host.

##### *x11\_font*

**Optional** attribute; **read/write** access; type: **String**.

Font to use in the console when using X11 (Linux/Solaris host).

#### Commands

**create-std-text-console** [*“name”*] [*“title”*] [*“bg\_color”*] [*“fg\_color”*] [*“x11\_font”*] [*“win32\_font”*] [*w*]

Creates a non-instantiated component of the class “std-text-console”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.



**new-std-text-console** [*name*] [*title*] [*bg\_color*] [*fg\_color*] [*x11\_font*] [*win32\_font*] [*win32\_title*]

Creates an instantiated component of the class “std-text-console”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<std-text-console>.info**

Print detailed information about the configuration of the device.

**<std-text-console>.status**

Print detailed information about the current status of the device.

### Connectors

Name	Type	Direction
serial	serial	up

## 4.2.6 std-server-console

### Description

The “std-server-console” component represents a serial console accessible from the host using telnet.

### Attributes

*telnet\_port*

**Required** attribute; **read/write** access; type: **Integer**.

TCP/IP port to connect the telnet service of the console to.

### Commands

**create-std-server-console** [*name*] *telnet\_port*

Creates a non-instantiated component of the class “std-server-console”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**new-std-server-console** [*name*] *telnet\_port*

Creates an instantiated component of the class “std-server-console”. If *name* is not specified, the component will get a class-specific default name. The other arguments correspond to class attributes.

**<std-server-console>.info**

Print detailed information about the configuration of the device.

**<std-server-console>.status**

Print detailed information about the current status of the device.

**Connectors**

Name	Type	Direction
serial	serial	up

## 4.3 Base Components

The base components are abstract classes that contain generic component attributes and commands available for all components.

### 4.3.1 component

**Description**

Base component class, should not be instantiated.

**Attributes***connections*

**Optional** attribute; **read/write** access; type: **[[sos]\*]**.

List of connections for the component. The format is a list of lists, each containing the name of the connector, the connected component, and the name of the connector on the other component.

*connectors*

**Pseudo class** attribute; **read-only** access; type: **D**.

Dictionary of dictionaries with connectors defined by this component class, indexed by name. Each connector contains the name of the connector "type", a "direction" ("up", "down" or "any"), a flag indicating if the connector can be "empty", another flag that is set if the connector is "hotplug" capable, and finally a flag that is TRUE if multiple connections to this connector is allowed.

*instantiated*

**Optional** attribute; **read/write** access; type: **b**.

Set to TRUE if the component has been instantiated.

*object\_list*

**Optional** attribute; **read/write** access; type: **D**.

Dictionary with objects that the component consists of.

*object\_prefix*

**Optional** attribute; **read/write** access; type: **String**.

Object prefix string used by the component. The prefix is typically set by the **set-component-prefix** command before the component is created.

*top\_component*

**Optional** attribute; **read/write** access; type: **Object**.

The top level component. Attribute is not valid until the component has been instantiated.

*top\_level*

**Optional** attribute; **read/write** access; type: **b**.

Set to TRUE for top-level components, i.e. the root of a hierarchy.

### 4.3.2 top-component

#### Description

Base top-level component class, should not be instantiated.

#### Attributes

*components*

**Optional** attribute; **read/write** access; type: [**o\***].

List of components below the the top-level component. This attribute is not valid until the object has been instantiated.

*cpu\_list*

**Optional** attribute; **read/write** access; type: [**o\***].

List of all processors below the the top-level component. This attribute is not valid until the object has been instantiated.

## Chapter 5

# Miscellaneous Notes

### 5.1 Changing the Processor Clock Frequency

The clock frequency of a simulated processor can be set arbitrarily in Simics. This will not affect the actual speed of simulation, but it will affect the number of instructions that need to be executed for a certain amount of simulated time to pass. If your execution only depends on executing a certain number of instructions, increasing the clock frequency will take the same amount of host time (but a shorter amount of target time). However, if there are time based delays of some kind in the simulation, these will take longer to execute.

At a simulated 1 MHz, one million target instructions will correspond to a simulated second (assuming the simple default timing of one cycle per instruction). At 100 MHz, on the other hand, it will take 100 million target instructions to complete a simulated second. So with a higher clock frequency, less simulated target time is going to pass for a certain period of host execution time.

If Simics is used to emulate an interactive system (especially one with a graphical user interface) it is a good idea to set the clock frequency quite low. Keyboard and mouse inputs events are handled by periodic interrupts in most operating systems, using a higher clock frequency will result in longer delays between invocations of periodic interrupts. Thus, the simulated system will feel slower in its user response, and update the mouse cursor position etc. less frequently. If this is a problem, the best technique for running experiments at a high clock frequency is to first complete the configuration of the machine using a low clock frequency. Save all configuration changes to a disk diff (like when installing operating systems). Then change the configuration to use a higher a clock frequency and reboot the target machine.

Note that for a lightly-loaded machine (for example, working at an interactive prompt on a serial console to an embedded Linux system), Simics will often execute quickly enough at the real target clock frequency that there is no need to artificially lower it.

## **Chapter 6**

# **Limitations**

Since Simics/Malta does not currently support the YAMON bootloader which sets up the initial PCI mappings, no PCI cards can be added to the model. Without a PCI network adapter you cannot run any kind of networking on Simics/Malta.

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