

# Dezyne IDE Manual

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Component based, formally verified.

The Dezyne developers

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# Table of Contents

<b>1</b>	<b>Introduction</b> .....	<b>1</b>
<b>2</b>	<b>Getting Started</b> .....	<b>2</b>
2.1	Set-up .....	2
2.2	System View .....	2
2.3	Sequence view and Watch window .....	3
<b>3</b>	<b>Using the Dezyne IDE</b> .....	<b>4</b>
3.1	Example IDEs .....	4
3.1.1	dezyne: the IDE .....	4
3.1.2	An Electron-based Dezyne-IDE .....	4
3.1.3	An Emacs-based Dezyne-IDE .....	4
3.2	Invoking dezyne .....	7
3.3	Dezyne IDE View Commands .....	7
3.3.1	Invoking dzn daemon .....	7
3.3.2	Invoking dzn check .....	8
3.3.3	Invoking dzn system .....	10
3.4	Component Simulator .....	12
<b>4</b>	<b>Dezyne Views</b> .....	<b>13</b>
4.1	System View .....	14
4.2	Trace View .....	15
<b>5</b>	<b>Working with Legacy Code</b> .....	<b>16</b>
5.1	ASD Converter .....	16
	<b>Index</b> .....	<b>17</b>
	<b>Appendix A GNU Free Documentation License</b> ..	<b>18</b>

# 1 Introduction

While the component-based approach of Dezyne (see *Dezyne Reference Manual*) helps to create an understandable, modular system architecture, working on a software system is not always easy. When the problem at hand gets more difficult, then all help, e.g., help from tooling, is welcome.

Working with the Dezyne Language, we think, is best done using the Dezyne IDE.

The Dezyne IDE provides two graphical views: a structural overview (see Section 4.1 [System View], page 14) that helps navigating the system architecture, and a dynamic view (see Section 4.2 [Trace View], page 15) that helps understanding your system's behaviour.

The Dezyne IDE consists of these elements:

- A Dezyne Language-Aware editor,
- An HTML renderer,
- A shell to run:
- The `dzn` command-line tools,
- And a (preferably) user-customizable integration between all these.

We provide a reference implementation for this: `dezyne` (see Section 3.1.1 [dezyne the IDE], page 4) that combines the Dezyne Language-Aware editor, the graphical views and the console and integrates these using GNU Guile (see Section “Using Guile in Emacs” in *GNU Guile Reference Manual*) into a pleasant, fully user-extensible, experience.

## 2 Getting Started

The dezyne core functionality delivers tool support for the dezyne language in parsing, verification and code generation. Results are delivered in text format only.

In order to gain more insight graphical feedback is delivered in the following cases:

- System view: a visual representation of the system composition of dezyne components.
- Sequence view: a message sequence chart showing the result of a simulation or verification trace. The sequence view is interactive, and allows the displayed trace to be extended and shortened.
- Watch window: the detailed state of component and interfaces at each point in a trace.

All views are initiated by the user from the command-line, and are presented in a web page.

### 2.1 Set-up

In order to use the web views a dedicated dzn daemon needs to be running. This daemon mediates between the command line and the web pages, and also stores the traces that are presented and modified in the sequence view.

For the time being the dzn daemon must be started by hand. It will keep running until it is aborted by the user. It is started by typing the command

```
dzn daemon
```

The expected response is

```
ide_port: 1024
view_port: 1025
setup done
```

For more details try `dzn daemon --help`, or see Section 3.3.1 [Invoking dzn daemon], page 7.

Once the daemon is running, views can be initiated.

### 2.2 System View

The system view is started from the command-line with the command

```
dzn system examples/Camera.dzn
```

The expected result is

```
setup done

initialization done
file://<PATH>/dzn/system.html
```

Opening the provided system.html page in a web browser delivers the system view of the Camera component.

For more details try `dzn system --help`, or see Section 3.3.3 [Invoking dzn system], page 10.

## 2.3 Sequence view and Watch window

The sequence view and watch window can be initiated from the command-line using the `dzn simulate` command:

```
dzn simulate -m Driver examples/Camera.dzn
Expected response is:
  setup done

  initialization done
  file://<PATH>/dzn/trace.html
  file://<PATH>/dzn/watch.html
```

Opening the provided `trace.html` and `watch.html` pages in a web browser delivers the views of the Driver sub component.

Optional input for the sequence view is a trace, which (among others) can be the result of a verification error. The `dzn check` command supports this scenario. As first step verification is done. In case an error is found, the error trace is used as input for simulation, and presented in the web views:

```
dzn check examples/compliance_provides_bool.dzn
results in:
  verify: ibool: check: deadlock: ok
  verify: ibool: check: livelock: ok
  verify: compliance_provides_bool: check: deterministic: ok
  verify: compliance_provides_bool: check: illegal: ok
  verify: compliance_provides_bool: check: deadlock: ok
  verify: compliance_provides_bool: check: livelock: ok
  verify: compliance_provides_bool: check: compliance: fail
  verification error

  initialization done
  file://<PATH>/dzn/trace.html
  file://<PATH>/dzn/watch.html
```

For more details try `dzn check --help` and `dzn simulate --help`, or see Section 3.3.2 [Invoking `dzn check`], page 8, and Invoking `dzn simulate`.

## 3 Using the Dezyne IDE

While the letter I in IDE stands for *integrated*, the level and type of integration that makes a person productive is a matter of taste, habit and experience.

The Dezyne IDE offers these levels towards integration (or if you like, desintegration):

**Full**            Integrated: Editor, Browser, Console, Window Management, Interpreter

Examples are `dezyne`, or `emacs` with `exwm`

**External Browser, External Window Mangement**

Integrated: Editor, Console, Interpreter

Examples are `Electron`-derivatives, `emacs`, `vim`

**External, Console, Browser, Window Management and Interpreter**

Integrated: -

Examples are `nano`, `vi`.

### 3.1 Example IDEs

Dezyne Language-Awareness is provided through the `dzn daemon`. Currently, it provides the following

Syntax coloring

Navigation

Go to definition, Show usage

Symbol completion

Lookup Documentation

#### 3.1.1 `dezyne`: the IDE

XXX TODO

The `dezyne` program provides a reference implementation of a fully integrated Dezyne-IDE.

See Section 3.2 [Invoking `dezyne`], page 7.

#### 3.1.2 An Electron-based Dezyne-IDE

XXX FIXME

There are several Electron (<https://github.com/Electron>)-based programmer's editors: Atom, VSCodium and Microsoft's non-free version: Visual Studio Code.

The `dzn daemon` provides Language-Awareness to the editor through the LSP-protocol.

#### 3.1.3 An Emacs-based Dezyne-IDE

Emacs can be used in Full or External Browser mode. `dzn-mode.el`.

Through the `dzn daemon` Emacs can provide full Dezyne Language-Awareness.

```
XXX TODO

// WITHOUT ANY WARRANTY; without even the implied warranty of
// MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU
// Affero General Public License for more details.
//
// You should have received a copy of the GNU Affero General Public
// License along with Dezyne. If not, see <http://www.gnu.org/licenses/>.
//
// Commentary:
//
// Code:

interface ihello
{
    in void hello();

    behaviour
    {
        on hello: {}
    }
}

component hello
{
    provides ihello h;
    behaviour
    {
        on h.hello(): {}
    }
}
}
```

```
U:--- hello.dzn|daemon Bot (42,0) Git-daemon [#gna,#guile,#e,#b,#h,#tcc,#gnu,#fsf,w
[*- mode: compilation; default-directory: "~/src/verun/ide/daemon/" *-
Compilation started at Mon Mar 23 19:37:06
```

```
dzn code hello.dzn
```

```
Compilation finished at Mon Mar 23 19:37:06
```





The screenshot shows the Dezyne IDE interface. The menu bar includes File, Edit, Options, Buffers, Tools, Jabber, Dezyne, and Help. The Dezyne menu is open, showing options: Compile (C-c C-c), Goto index, Parse (C-c C-p), Register Emacs, Select view, Update views (C-c C-u), and Verify (C-c C-v). The Verify option is highlighted in blue.

```

optics.lens <=> lens.port;
optics.shutter <=> shutter.port;
optics.flash <=> flash.port;
flash_hardware.port <=> flash.hardware;
}
}
component Driver
{
  provides IControl control;
  requires IAcquisition acquisition;
  requires IOptics optics;

  behaviour
  {
    enum State {Idle, Setup, Ready, Acquire};
    enum Contrast {Down, Up, Max};
    enum Zoom {In, Out};

    State state = State.Idle;
    Contrast contrast = Contrast.Down;
    Zoom zoom = Zoom.In;
    bool ready = false;

    [state.Idle]
    {
      on control.setup(): {optics.prepare(); acquisition.contrast_gradient(); state = State.S
      on optics.ready(): {}
    }
    [state.Setup]
    {
      on acquisition.lower_contrast():
      {
        [contrast.Up]
        {
          if(zoom.In) {optics.focus_out(); zoom = Zoom.Out;}
          else      {optics.focus_in(); zoom = Zoom.In;}

          contrast = Contrast.Max;
        }
      }
    }
  }
}

```

```

U:--- Camera-Error.dzn 48% (230,27)  [*,#gna,#xr,#b,#guile,#lib,#gnu,#h,#lil,#tcc,#nix
-*- mode: compilation; default-directory: "~/src/verum/ide/wip/examples/" -*-
Compilation started at Fri Mar 27 08:41:33

-*- mode: compilation; default-directory: "~/src/verum/ide/wip/" -*-
Compilation started at Fri Mar 27 09:37:36

bash -c 'source .guix-env.sh; ~/src/verum/dzn/wip-release/pre-inst-env ./pre-inst-env dzn che
/Camera-Error.dzn'
verification error
ide_port: 1024
examples/Camera-Error.dzn:230:28:error: illegal
examples/Camera-Error.dzn:65:10:info: control.setup
examples/Camera-Error.dzn:64:5:info: control.state=State.Idle
examples/Camera-Error.dzn:65:10:info: control.setup
examples/Camera-Error.dzn:230:10:info: Driver.control.setup
examples/Camera-Error.dzn:228:5:info: Driver.receive.queue= state=State.Idle contrast=Contras
eady=false
examples/Camera-Error.dzn:230:10:info: Driver.control.setup
U:*** *dzn-compilation* Top (10,15)  [*,#gna,#xr,#b,#guile,#lib,#gnu,#h,#lil,#tcc,#nix

```

## 3.2 Invoking dezyne

The `dezyne` command starts the Dezyne IDE: an integrated Dezyne viewer, console and browser.

```
dezyne option... FILE...
```

The *options* can be among the following:

`--check`

`-c` After loading FILE, run `dzn check`.

`--editor-port=EDITOR-PORT`

`-e EDITOR-PORT`

The editor will listen on the editor port EDITOR-PORT for interaction with Dezyne Views, the default is 1026.

`--debug`

`-d` Enable debug output.

`--help`

`-h` Display help on invoking `dezyne`, and then exit.

`--ide-port=IDE-PORT`

`-i IDE-PORT`

The daemon will listen on the ide port IDE-PORT, the default is 1024.

`--import=DIR`

`-I DIR` Add directory *DIR* to import path.

`--view-port=VIEW-PORT`

`-b VIEW-PORT`

The daemon will listen on view port VIEW-PORT, the default is 1025.

`--verbose`

`-v` Be more verbose, show progress.

`--version`

`-V` Display the current version of `dezyne`, and then exit.

Note that currently, `dezyne` only supports loading one *FILE*.

## 3.3 Dezyne IDE View Commands

The View experience of Dezyne IDE is achieved through a the `dzn daemon` and three sub-commands `dzn check`, `dzn system`, and `dzn simulate`.

Usually, your Dezyne IDE takes care of running these commands; so if you are planning on using an IDE you can safely skip this section.

### 3.3.1 Invoking dzn daemon

All Dezyne View commands communicate with the Views and Editor through the `dzn daemon`. Before using a `dzn-view` command, the daemon must be started. Usually the Dezyne IDE will run a `dzn daemon` for you upon startup.

```
dzn dzn-option... daemon option... FILE
```

The *options* can be among the following:

`--debug`  
`-d` Enable debug output. Careful, this can produce a lot of text!

`--help`  
`-h` Display help on invoking `dzn daemon`, and then exit.

`--ide-port=IDE-PORT`  
`-i IDE-PORT`  
Listen to ide port IDE-PORT, the default is 1024.

`--view-port=VIEW-PORT`  
`-b VIEW-PORT`  
Listen to ide port VIEW-PORT, the default is 1025.

`--verbose`  
`-v` Be more verbose, show progress.

### 3.3.2 Invoking `dzn check`

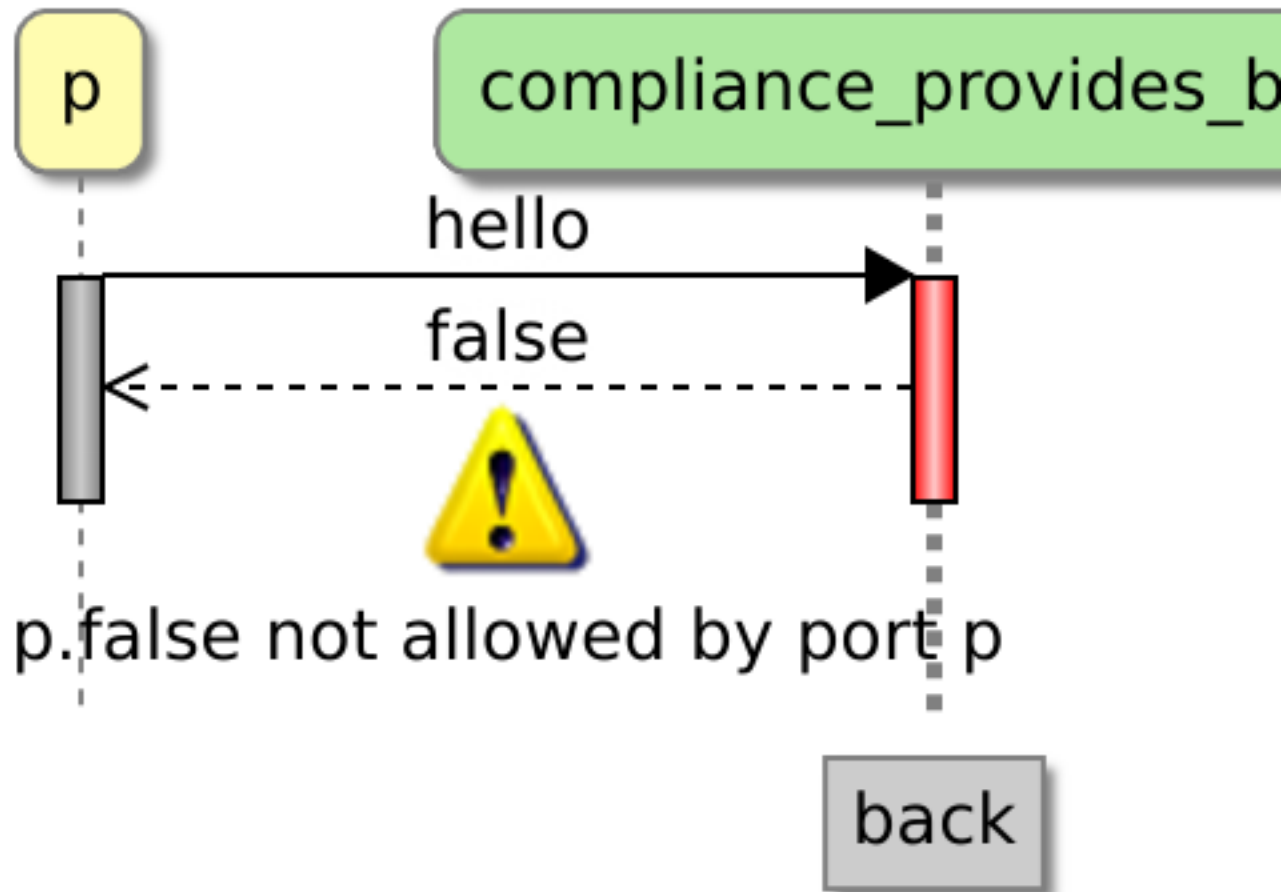
The `dzn check` command runs the `dzn verify` command. If verification errors are found, the `dzn daemon` provides a sequence view that can be viewed with a browser.

```
dzn dzn-option... check option... FILE
```

Running

```
dzn check compliance_provides_bool.dzn
```

will have the `trace.html` view show



The *options* can be among the following:

```
--import=DIR
-I DIR      Add directory DIR to import path.

--help
-h          Display help on invoking dzn check, and then exit.

--model=MODEL
-m MODEL   Limit verification to MODEL, and for behavioural component model, to its
            interfaces.
            XXX: Verification cannot be limited to system components models; verifying a
            system model is a no-op. XXX

--port=PORT
-p PORT   Connect to IDE port PORT, the default is 1024.
```

`--queue_size=SIZE`  
`-q SIZE` Use queue size *SIZE* for verification, the default is 3.

XXX: queue\_size is actually not supported yet XXX XXX: the underscore in  
-queue\_size is weirdXXX

`--verbose`  
`-v` Be more verbose, show progress.

### 3.3.3 Invoking dzn system

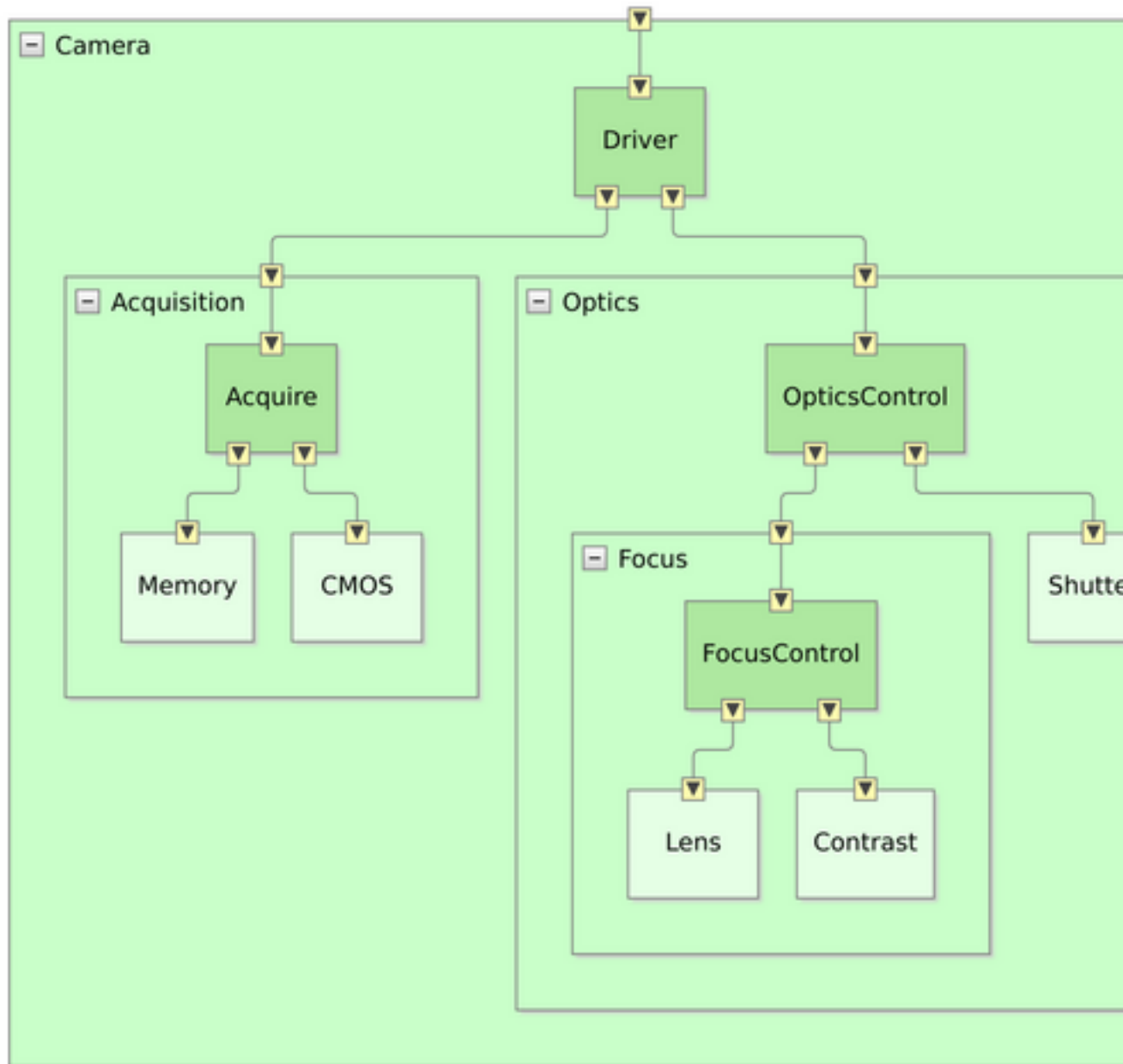
The `dzn system` command runs the `dzn parse` command. It produces an AST to the `dzn daemon` to provide a system view can be viewed with a browser.

```
dzn dzn-option... system option... FILE
```

Running

```
dzn check Camera.dzn
```

will have the `system.html` view show



The *options* can be among the following:

`--import=DIR`

`-I DIR` Add directory *DIR* to import path.

```
--help
-h          Display help on invoking dzn system, and then exit.
--port=PORT
-p PORT   Connect to IDE port PORT, the default is 1024.
--verbose
-v          Be more verbose, show progress.
```

### 3.4 Component Simulator

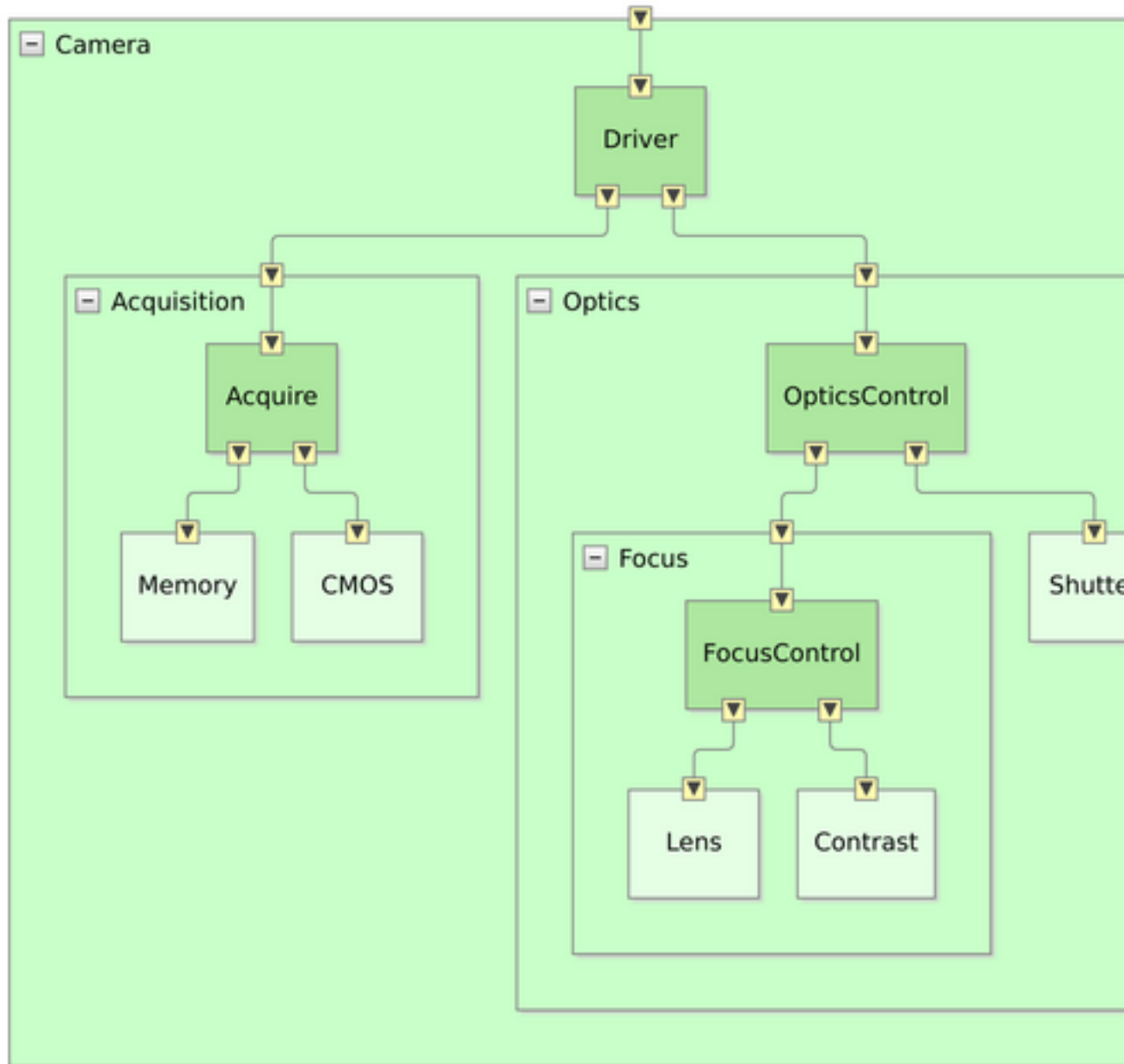
Input for the component simulator is a trace of events of a single component and its ports; such a trace is either a witness of a verification error, or a hand-crafted use case description. The simulator interprets the trace, using the Dezyne semantics, and outputs a more detailed trace, where the state of the component and its interfaces is included. It also outputs a list of 'eligible' events: events that are a valid extension of the input trace.

## 4 Dezyne Views

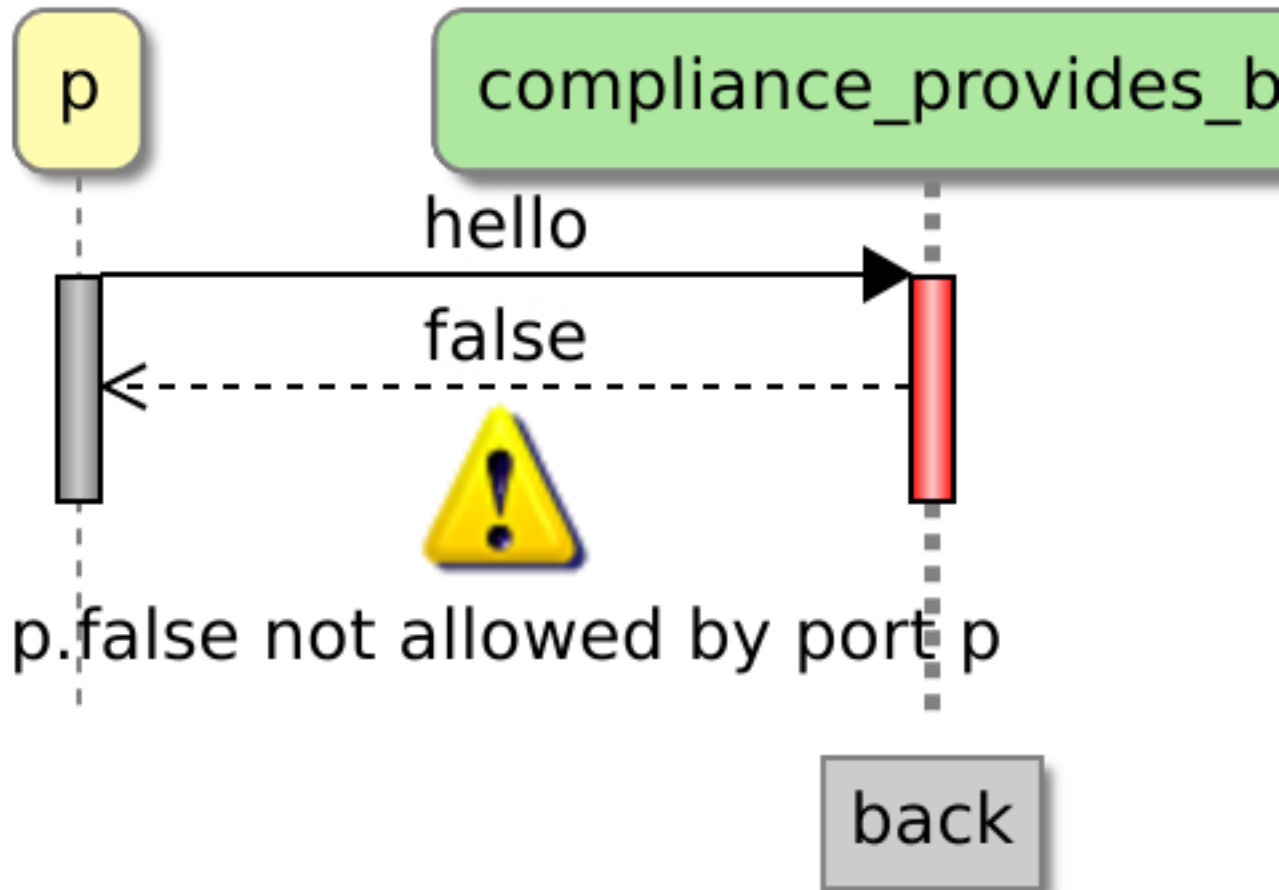


## 4.1 System View

The system view shows a static view of a system component and all its sub components.



## 4.2 Trace View



The Trace View and Watch Window are used to visualize a detailed trace resulting from the component simulator; the Trace View displays all events that are communicated, and displays the eligible events; the watch window shows the value of all state variables; both views enable 'stepping' through the trace in more or less detail. The Trace View can be used to extend the trace by selecting one of the eligible events.

## 5 Working with Legacy Code

XXX: TODO

### 5.1 ASD Converter

The semantics of ASD and Dezyne largely overlap. This enables automatic conversion from ASD models to Dezyne models. Work has to be done for multi-threaded ASD models. Also the readability of the generated Dezyne models needs improvement.

# Index

## A

ASD ..... 16  
automatic conversion ..... 16

## C

conversion ..... 16

## E

eligible events ..... 15

## G

glue code ..... 16

## S

sequence chart ..... 15  
sequence view ..... 15  
system architecture ..... 14  
system view ..... 14

## T

trace view ..... 15

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