

# **crystal\_facet\_uml user documentation**

**COLLABORATORS**

	<i>TITLE :</i> crystal_facet_uml user documentation		
<i>ACTION</i>	<i>NAME</i>	<i>DATE</i>	<i>SIGNATURE</i>
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**REVISION HISTORY**

NUMBER	DATE	DESCRIPTION	NAME

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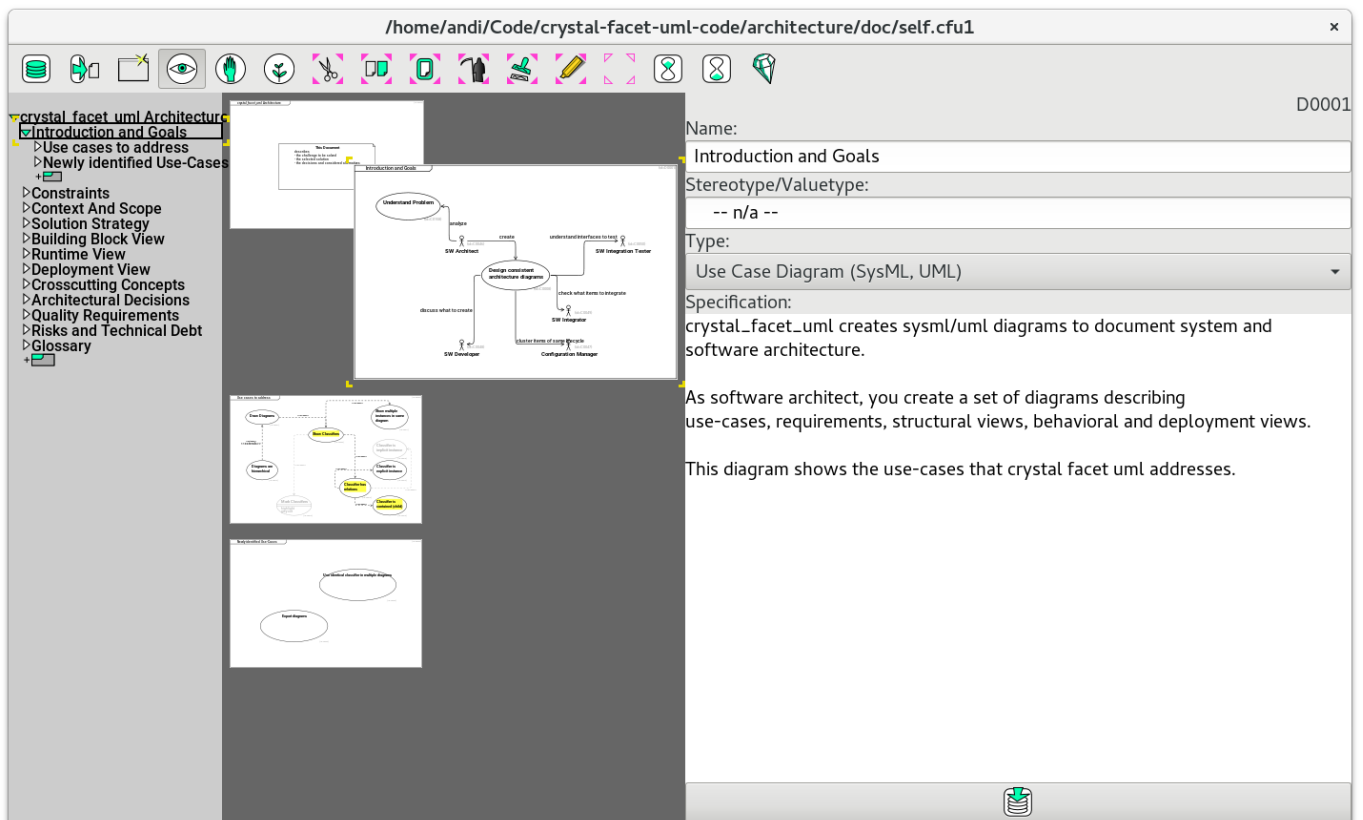
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# 1 Introduction



crystal\_facet\_uml creates diagrams to document system and software architecture.



## 1.1 Goal



As software architect, you create a set of diagrams describing use-cases, requirements, structural views, behavioral and deployment views.

crystal\_facet\_uml keeps element names and element hierarchies consistent. It exports diagrams in svg, pdf, ps and png formats to be used in text processing systems like docbook, html, latex. This tool runs on your local PC and is based on glib, gdk, gtk, cairo, pango, sqlite.

## 1.2 Features



crystal\_facet\_uml provides a graphical user interface to

- create diagrams  
(use-case, deployment, component, composite-structure, package, class, activity, state, timing, communication, sequence)
- create uml elements  
(actor, system-boundary, use-case, node, component, part, interface, package, class, activity, state, object, artifact, comment, requirement)
- move, modify and delete uml elements
- create, modify and delete relationships  
(dependency, association, aggregation, composition, generalization, realization, contains, sync-call, return-call, async-message, communication-path, control-flow, object-flow, deployment, manifest, include, extend)
- create, modify and delete features  
(port, field, operation)
- cut, copy, paste uml elements between diagrams
- undo and redo are supported
- multiple windows can show different or same parts of the uml model

Diagrams are layouted part-automatically:

- The user chooses the relative location of uml elements towards others
- crystal\_facet\_uml selects the exact locations of uml elements
- The user controls the positions of messages/transitions in sequence and timing diagrams
- crystal\_facet\_uml auto-layouts relationships in other diagrams

crystal\_facet\_uml manages a meta model:

- Diagrams are organized as a tree, similar to a book's table-of-contents
- Uml elements exist only once even if shown in many diagrams
- Relationships and features are consistent between all diagrams
- Diagram-local messages/transitions are supported in scenario-based diagrams  
(sequence, communication, timing)

crystal\_facet\_uml exports diagrams as

- vector graphics  
(pdf, ps, svg)
- pixel graphics  
(png)
- textual representation  
(utf-8-txt, docbook, xhtml)

crystal\_facet\_uml can also be started from command line to check and repair database files.

### 1.3 Usage Overview



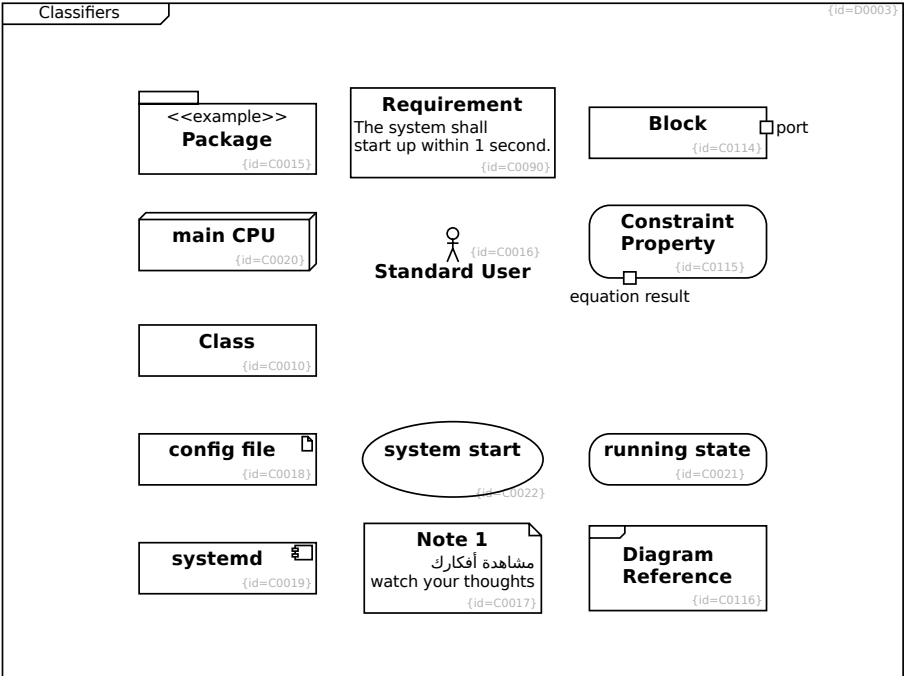
crystal\_facet\_uml can be started in graphical mode (see Section 3) or from command line (for help run **crystal\_facet\_uml -h**).

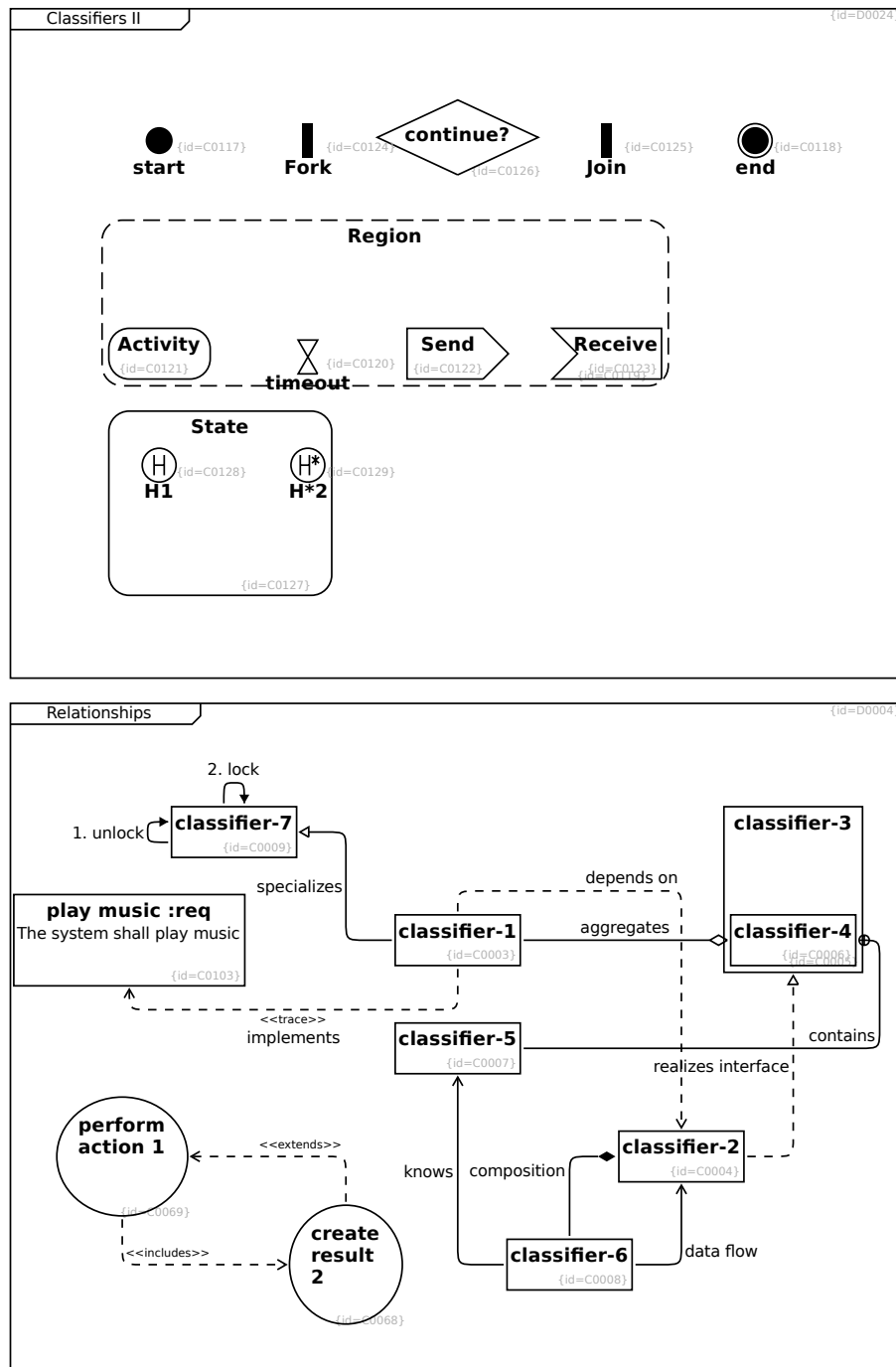
## 2 Example Diagrams

This sections presents the features of crystal\_facet\_uml.

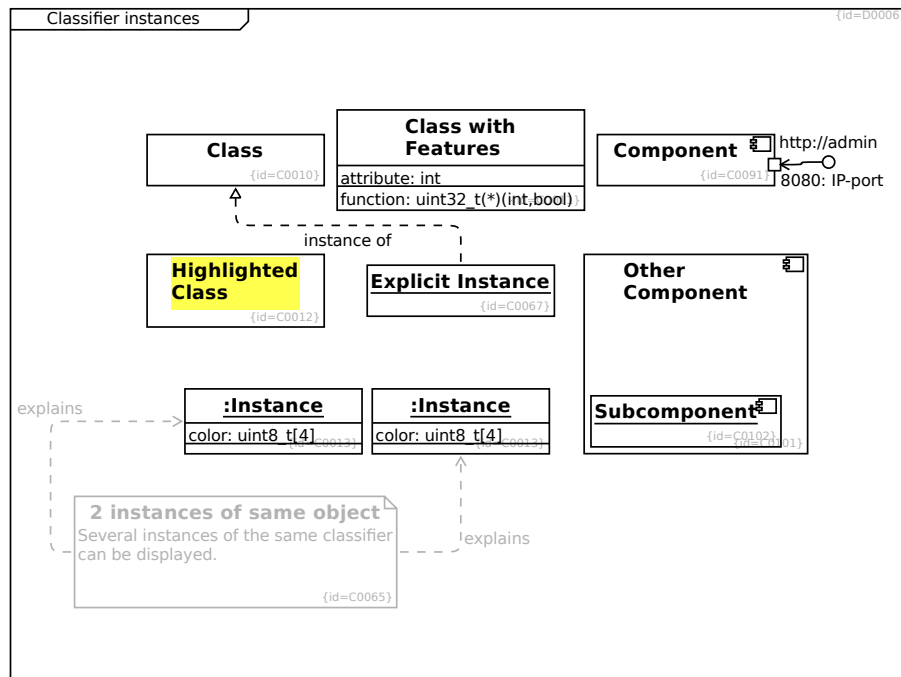
### 2.1 Feature List

This section lists what kind of elements crystal\_facet\_uml can draw in diagrams.



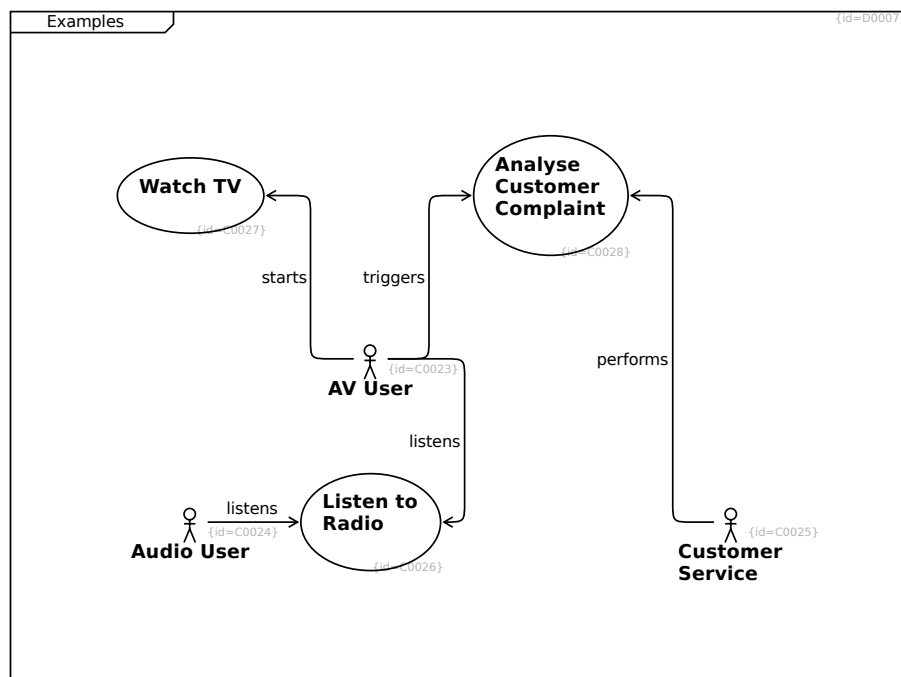




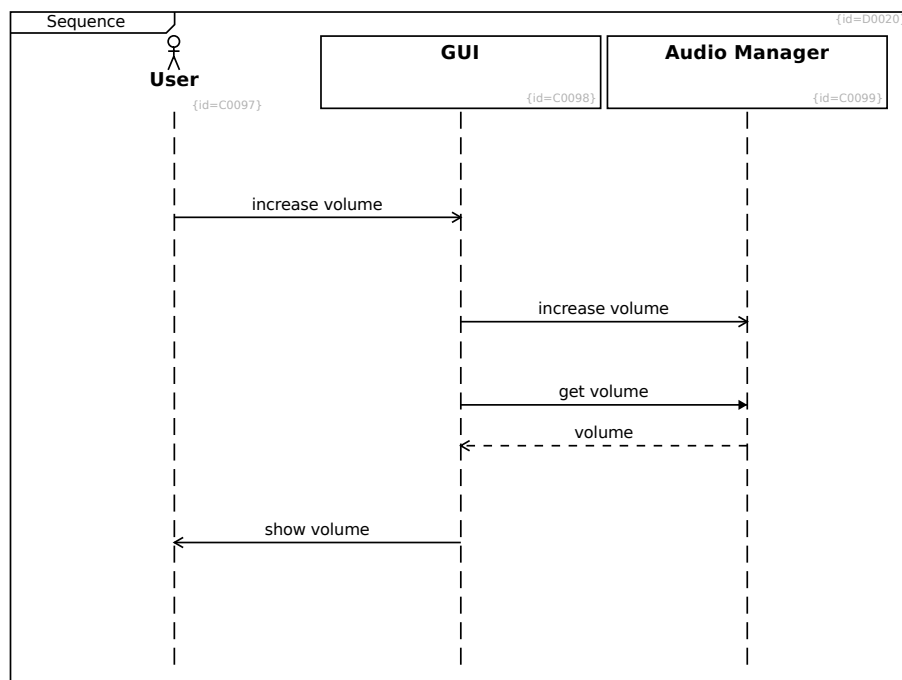
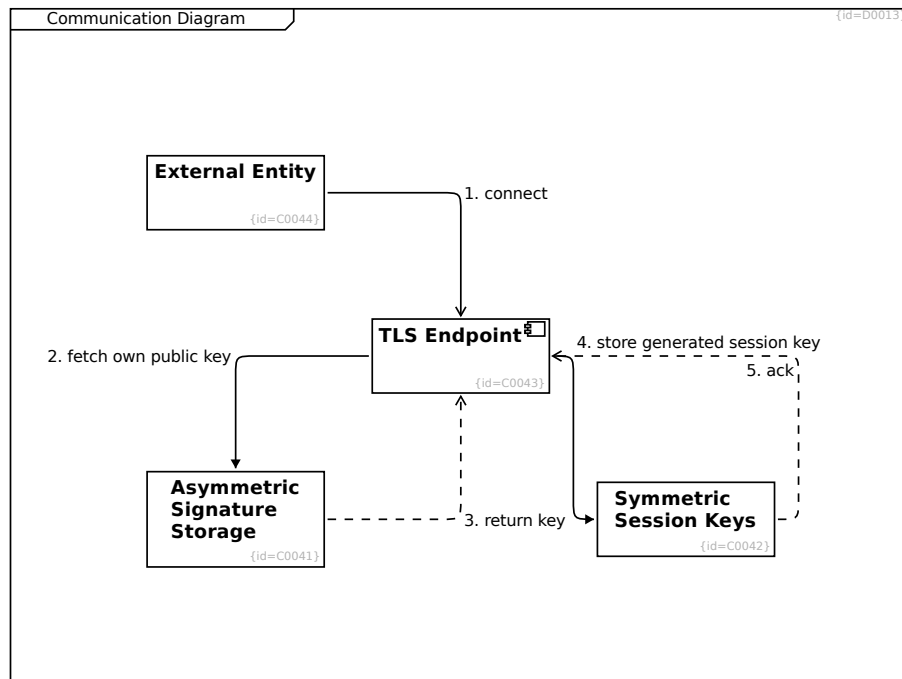


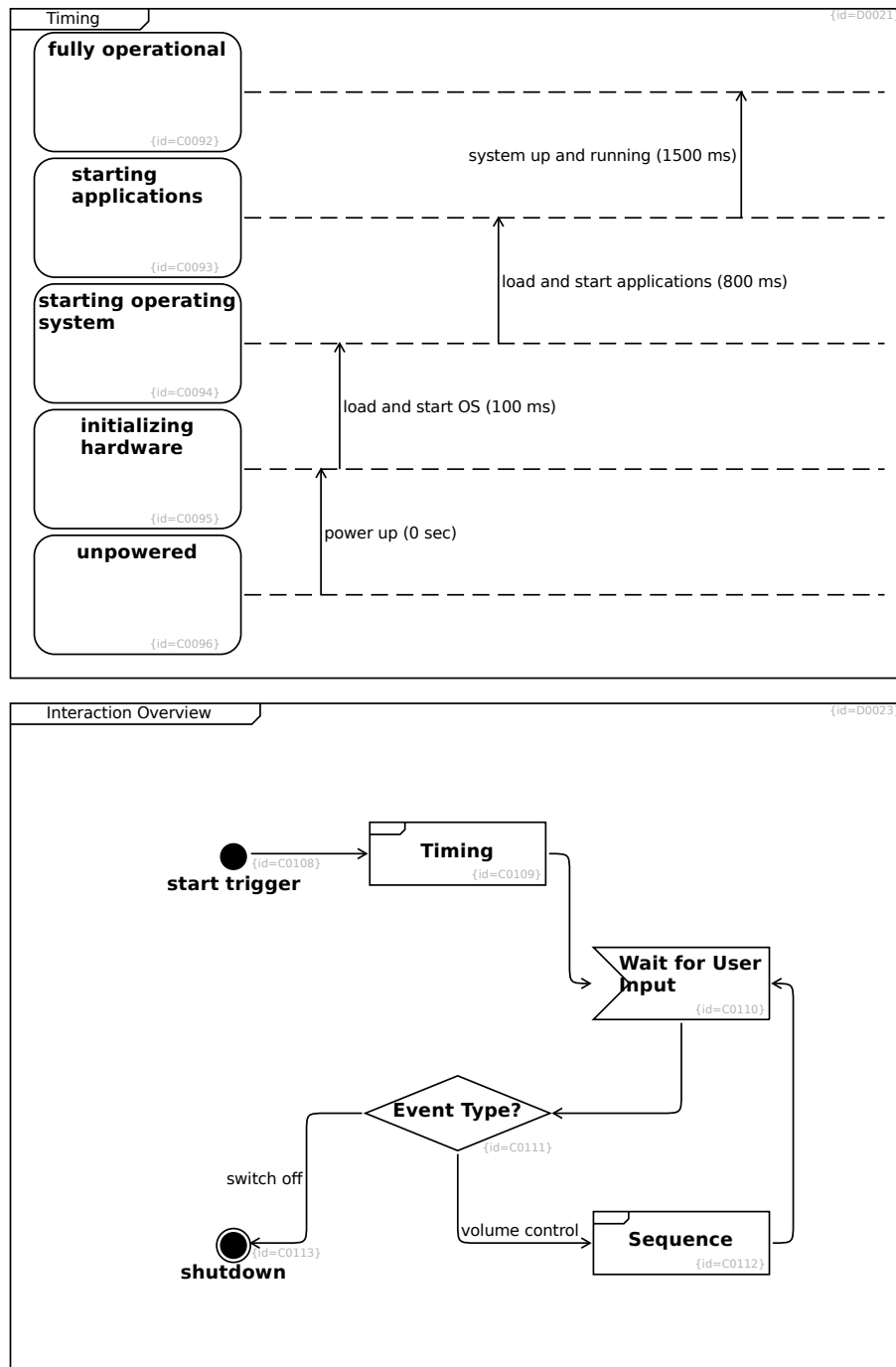
## 2.2 Example UML Behavioral Views

This section lists what kind of elements crystal\_facet\_uml can draw in diagrams.



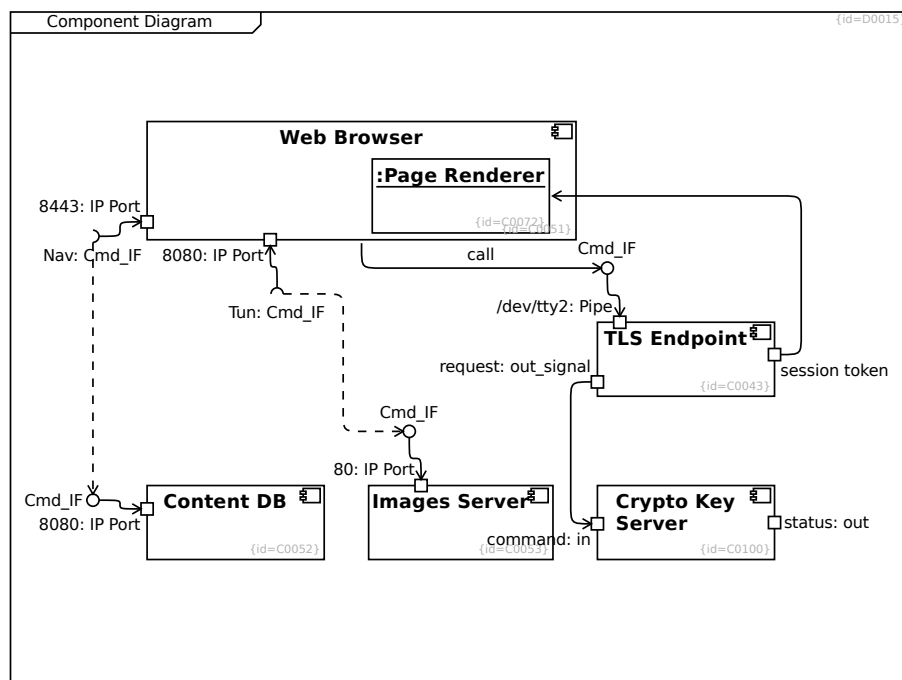
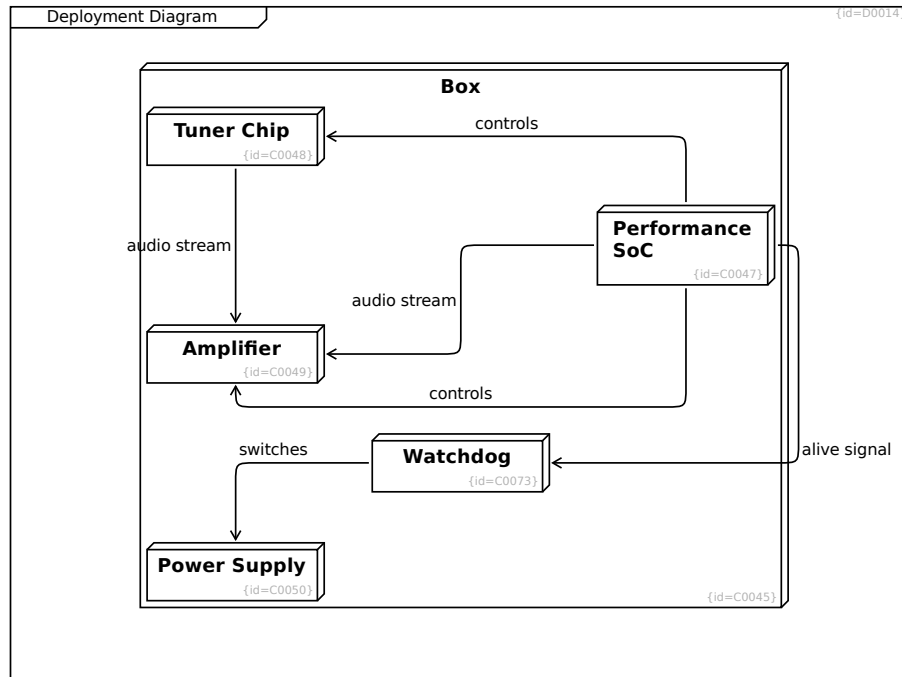


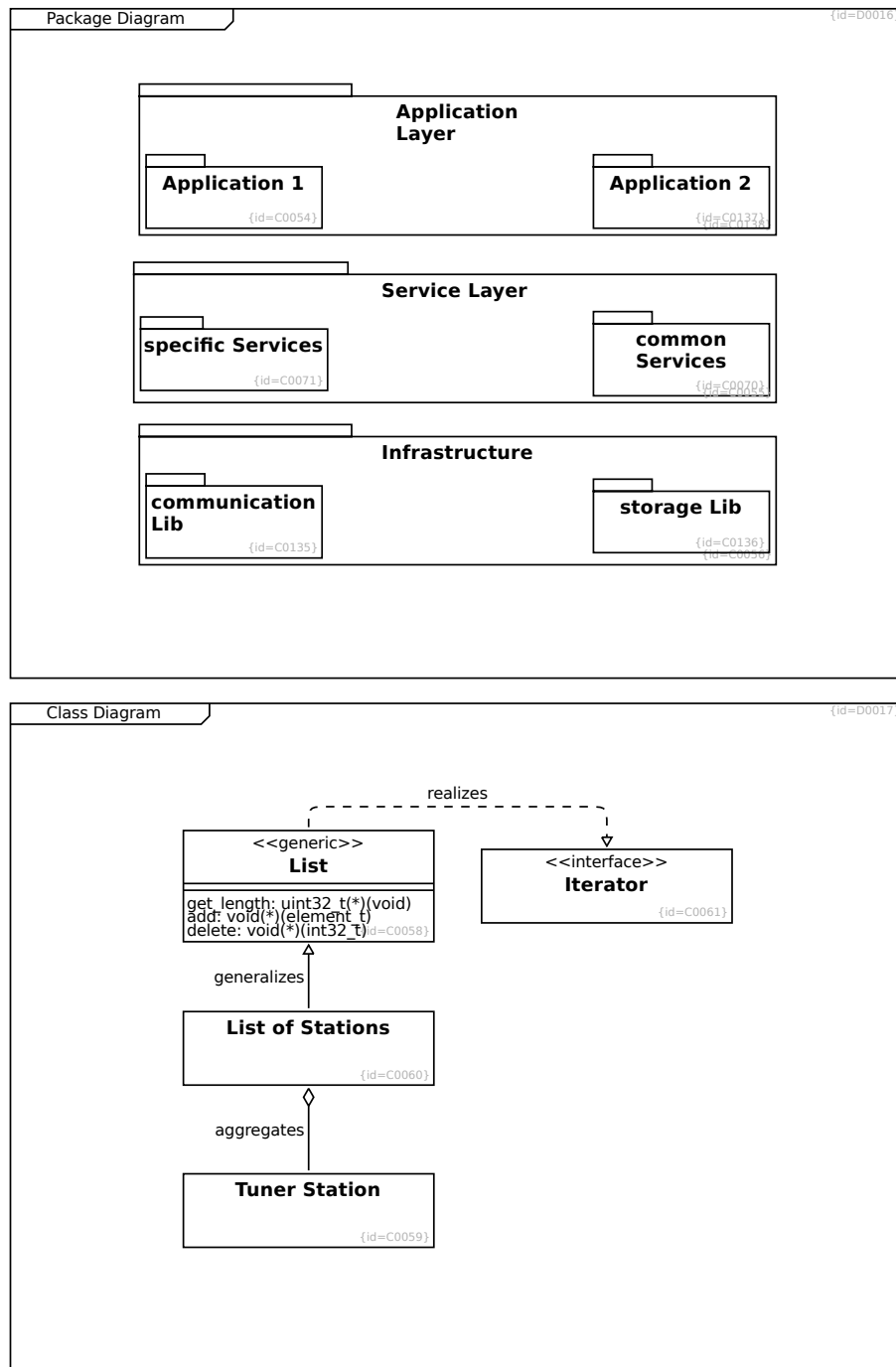




## 2.3 Example UML Static Views

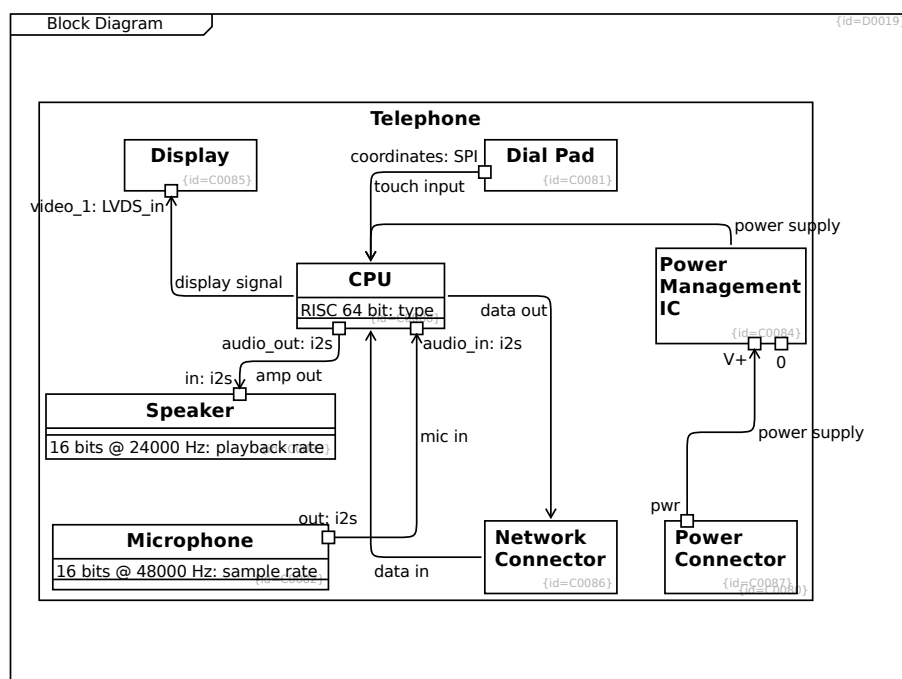
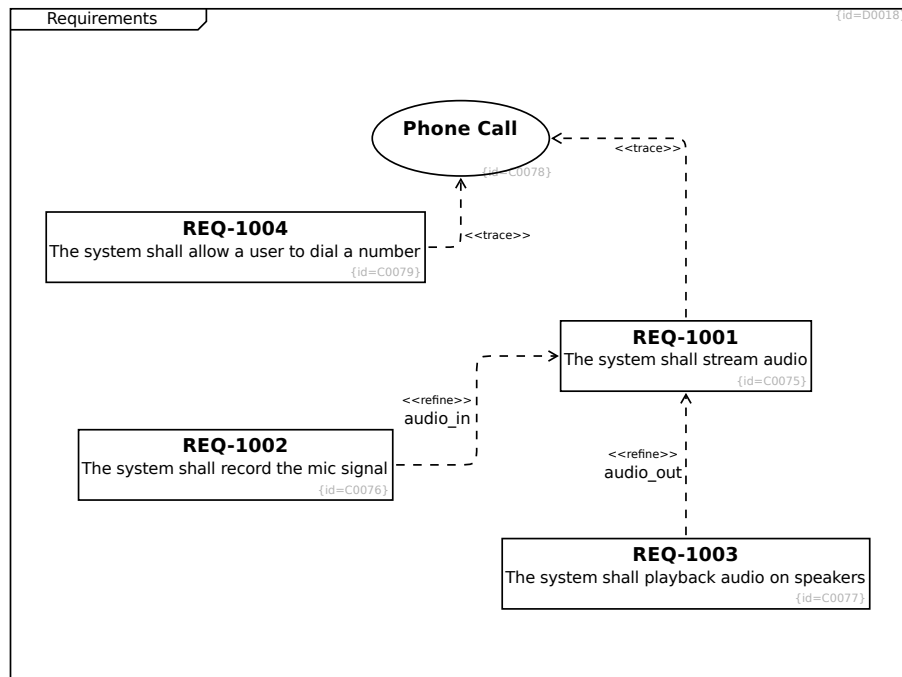
This section lists what kind of elements crystal\_facet\_uml can draw in diagrams.

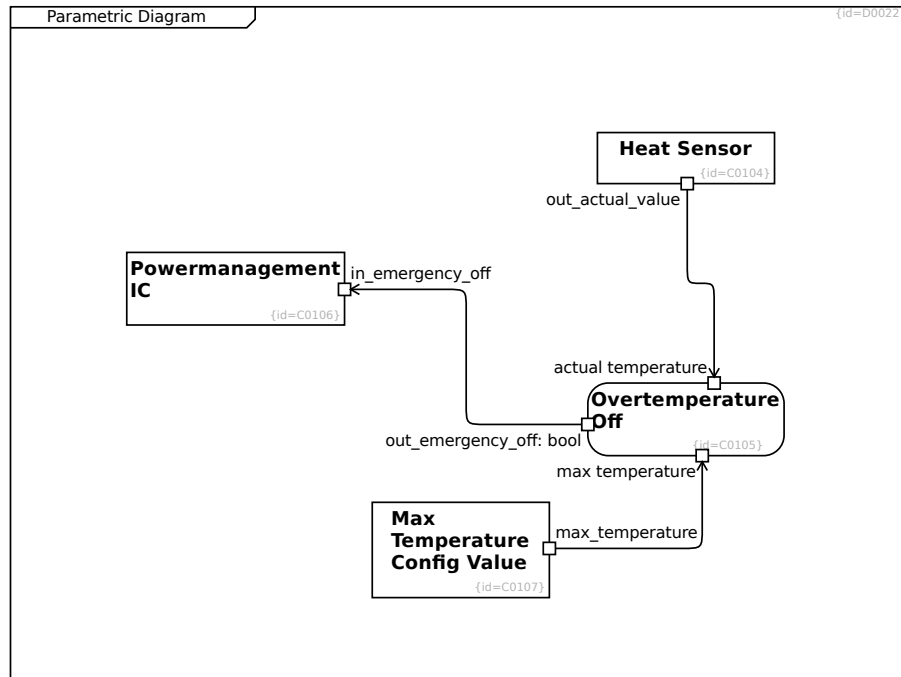




## 2.4 Example SysML Views

This section lists what kind of elements crystal\_facet\_uml can draw in diagrams.





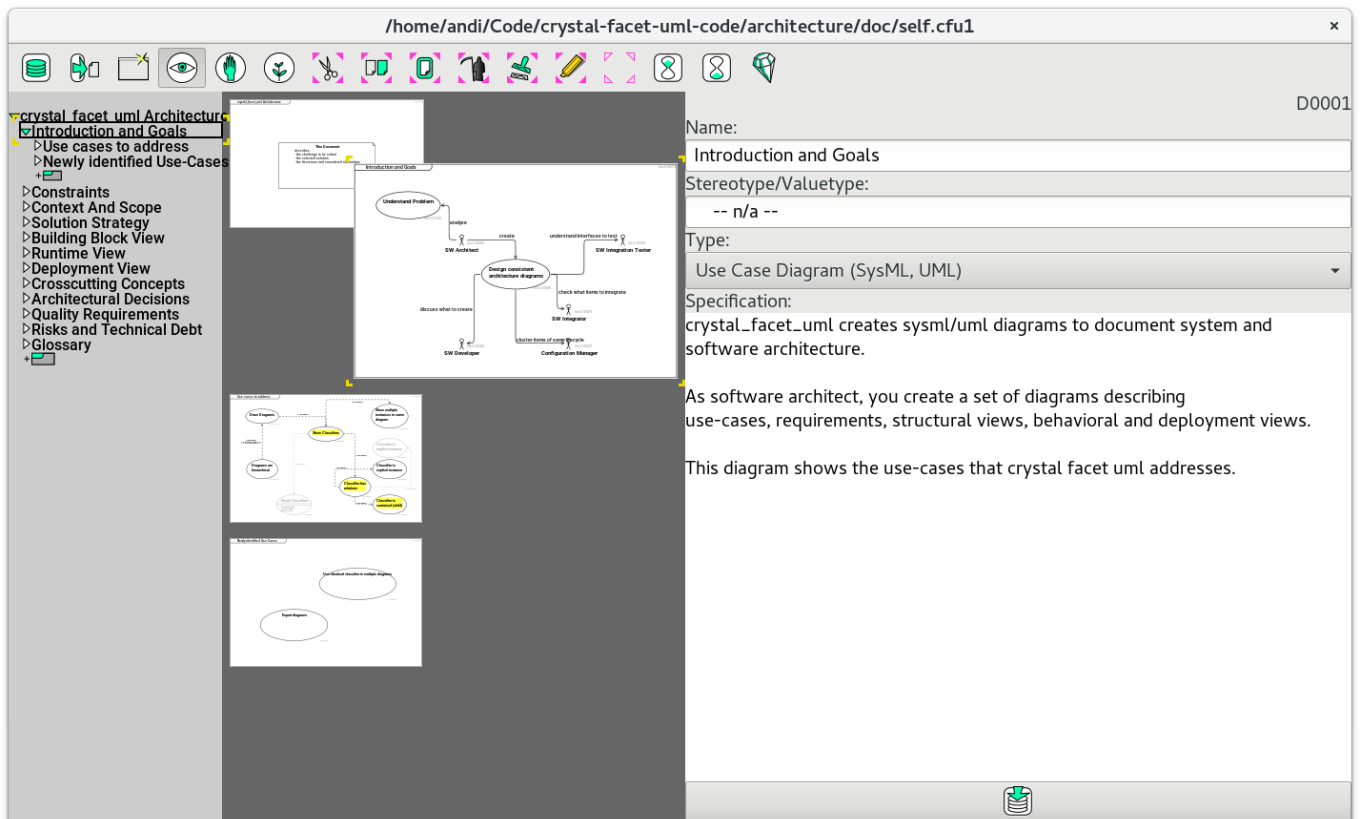
### 3 GUI / Usage Manual

#### 3.1 Window Area Overview

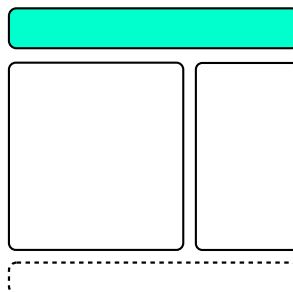
If started in graphical mode, crystal\_facet\_uml shows a window with

- toolbar on top,
- drawing area in the center,
- element configuration widgets to the right and
- an optional notification bar at the bottom.





## 3.2 Tool Bar



### 3.2.1 Create/Use DB



- Opens an existing database file or creates a new database file

### 3.2.2 Export



- Exports all diagrams to the selected folder (supported formats are txt, png, pdf, ps and svg)

### 3.2.3 New Window



- Opens another window on the same database.

This option allows you to work reliably with multiple windows on the same database.

### 3.2.4 Navigate



- Navigate to parent or child diagrams
- Create a new diagram (see Section [3.3.1](#))

### 3.2.5 Edit



- Modify elements in the diagram (see Section [3.3.2](#))

### 3.2.6 Create



- Create elements in the diagram (see Section [3.3.3](#))

### 3.2.7 Cut



- Cut all pink-cornered elements to the clipboard (features of classifiers are copied if the classifier is selected)

### 3.2.8 Copy



- Copy all pink-cornered elements to the clipboard (features of classifiers are copied if the classifier is selected)

### 3.2.9 Paste



- If the clipboard contains a diagram, this diagram is pasted below the current diagram. All other elements are pasted into the new diagram.
- If the clipboard does not contain diagrams, classifiers and relationships from the clipboard are copied into the current diagram.
- If the name of a classifier is identical to an existing one, an instance of the existing classifier is pasted to the diagram. Otherwise a new classifier is created.

### 3.2.10 Delete



- Deletes all pink-cornered elements. This operation may fail if a marked diagram contains unmarked elements.

### 3.2.11 Instantiate



- Toggles the pink-cornered classifiers between classes, named instances and anonymous instances.
- No effect on relationships and features.

### 3.2.12 Highlight



- Toggles the pink-cornered classifiers between yellow-marked, greyed-out and normal. (Does not work for relationships and features)

### 3.2.13 Reset Selection



- Resets the pink-cornered selection

### 3.2.14 Undo



- Un-does the last operation (Opening a database and exporting files cannot be undone)
-

### 3.2.15 Redo



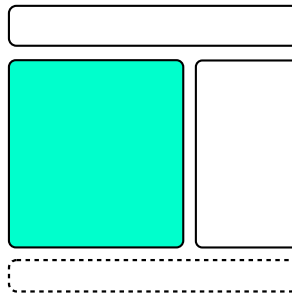
- Re-does the last un-done operation

### 3.2.16 About



- Shows version, license and copyrights



## 3.3 Drawing Area



Diagrams are layouted automatically. You can influence the locations of classifiers only. When adding too many classifiers or relations, auto layouting may not achieve the expected results. In many cases, splitting the diagram into two or more diagrams solves the layouting issues and at the same time improves understandability by focusing on one aspect/topic per diagram.

### 3.3.1 Navigate



- To navigate to parent, sibling or children diagrams, click on the diagram.
- To create a new diagram, click on the  icon, or the smaller  icon for a new child-diagram.
- To restructure the diagram tree, drag a diagram name to the new location.

### 3.3.2 Edit

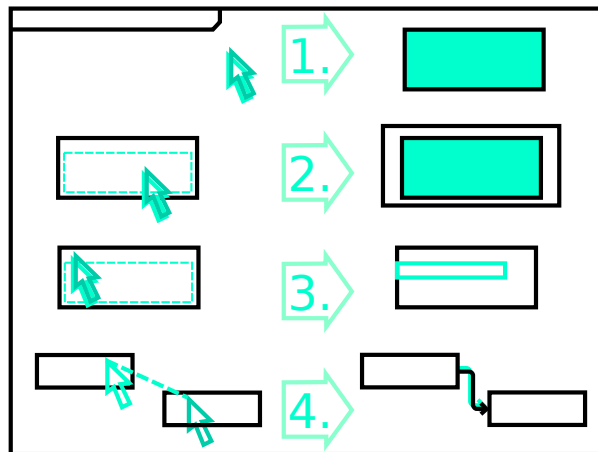


- To select the diagram or a classifier or a feature or a relationship with yellow corners, click on this object.
- To mark an element with pink corners, click on these objects twice.
- To move classifiers within the diagram, 1.) press, 2.) drag and 3.) release the mouse button.

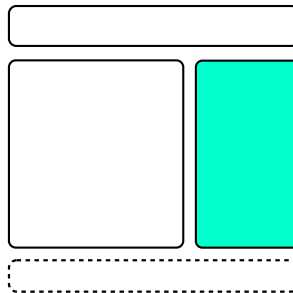
### 3.3.3 Create



1. To create a classifier, click at an empty space in the diagram.
2. To create a child classifier, click into the white space of a classifier. (Alternatively, create a classifier (see 1) and a containment relationship (see 4).)
3. To create a feature, click onto a classifier (name or border).
4. To create a relationship, press on the source classifier and drag it to the destination classifier.



## 3.4 Element Configuration Area



Edit the properties of the yellow-cornered object.

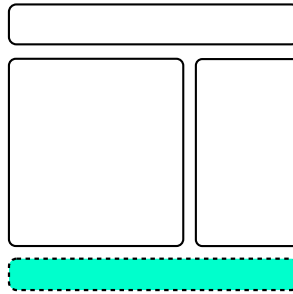
- name of the focused object
- stereotype/valuetype of the focused object (deactivated depending on object-type)
- type of the focused object
- description of the focused object

### 3.4.1 Commit



- Stores the latest changes to the database immediately. This feature is optional, it is not necessary to explicitly save the file.

### 3.5 Notification Bar



#### 3.5.1 Information



- Informs on success of an operation, e.g. an export

#### 3.5.2 Warning



- Informs on a possible problem

#### 3.5.3 Error



- Informs on an error

## 4 Diagrams and Elements Spec



This program creates diagrams that strive for compatibility to

- UML 2.5
- SysML 1.5
- MOF 1.4.1

In some cases, it deviates from these standards for several reasons:

- Reduce complexity to be able to handle such models in a small open source project
- Reduce feature-set to improve understandability of diagrams even to non-software-architects
- Reduce feature-set to enhance usability of the program

This section gives an overview on standards and implementation-status of crystal\_facet\_uhl. It may be incomplete.

## 4.1 Classifiers

Classifiers are the nodes in the model-graph.

The table shows the classifier types introduced by different specifications, if they filter/hide their features and a comment stating how this is implemented in crystal\_facet\_uml.

	Spec	Filter Features	Comment
Block	SysML	-	Limitations: Compartment Order is "properties, operations" instead of "constraints, operations, receptions, parts, (bound) references, values, properties, stereotype-tagged-values, behavior, namespace, structure" Limitations: No labeled compartments Limitations: no Multiplicities of Block-Instances.
Constraint Property/Equation	SysML	-	Limitations: Only the rounded-rect symbol is supported, ports are not completely inside the rounded-rect.
Node	UML	-	
Component	UML	-	
Part	UML	-	
Interface	UML	-	
Package	UML, SysML	-	
Class	UML	-	
Object	UML	-	
Artifact	UML	-	
Comment	UML, SysML	unconditional features	
Feature	-	-	Represents a group of requirements
Requirement	SysML	-	
Actor	UML, SysML	unconditional features	
Use Case	UML, SysML	-	Limitations: No SysML extension points
System Boundary	UML, SysML	unconditional features	
Diagram Reference	UML	unconditional features	
Activity	UML	-	
Interruptable Region	UML	unconditional features	
Fork	UML, SysML	unconditional features	
Join	UML, SysML	unconditional features	
Accept Event	UML, SysML	unconditional features	
Accept Time Event	UML, SysML	unconditional features	
Send Signal	UML, SysML	unconditional features	
Decision	UML, SysML	unconditional features	
Initial Node	UML, SysML	unconditional features	Limitations: There is no distinction in ActivityInitial and FlowInitial
Final Node	UML, SysML	unconditional features	Limitations: There is no distinction in ActivityFinal and FlowFinal

	Spec	Filter Features	Comment
State	UML, SysML	-	
Shallow History	UML, SysML	unconditional features	
Deep History	UML, SysML	unconditional features	
Value Type	SysML	-	not supported. Limitations: Compartment Order of Classifiers is "properties, operations" instead of "operations, properties, stereotype-tagged-values"
Enumeration	UML, SysML	-	not supported. Note: Use a class instead.
ActivityParameterNode	SysML	-	not supported.
MergeNode	UML, SysML	unconditional features	not supported. Note: Either directly connect to the target activity or use a decision node.
ActivityPartition	UML, SysML	unconditional features	not supported. Note: Use a parent activity instead.

#### LEGEND

**Filter** Defines which elements related to a classifier are not visible

An InstanceSpecification (UML) denotes an instantiation of a classifier. crystal\_facet\_uml allows any classifier to appear in different diagrams as classifier, as anonymous InstanceSpecification or as named InstanceSpecification. (Rationale: If a classifier is an instance may depend on the context: An M1-class may be an instance if shown in an M2-meta-class diagram, an XML-parser-class may be an instance if shown in the context of stream processors.)

## 4.2 Features

Features are elements attached to one classifier.

The table shows the feature types introduced by different specifications, if they are visible in any diagram or just once, and a comment stating how this is implemented in crystal\_facet\_uml.

	Spec	Scope	Comment
Property	UML, SysML	unconditional	Limitations: no SysML Flow-Properties refinement
Operation	UML, SysML	unconditional	
Port	UML, SysML	unconditional	Limitations: no SysML-compartment Notation supported Limitations: no SysML-nested-ports, SysML-proxy-port, SysML full-ports supported
Provided Interface	UML, SysML	unconditional	
Required Interface	UML, SysML	unconditional	
Lifeline	UML, SysML	scenario, 1 per diagram	Limitations: One lifeline is visible only in one diagram

#### LEGEND

**Scope** scope is unconditional if a feature belongs to a classifier unconditionally, scenario if only applicable in 1 diagram



### 4.3 Relationships

Relationships are the edges of the model-graph.

The table shows the relationship types introduced by different specifications, a classification in which diagram type to use them preferably, and a comment stating how this is implemented in crystal\_facet\_uml.

	Spec	Diagram Types	Comment
Dependency	UML, SysML	any	
Containment	UML, SysML	Deployment, Package	
Deploy	UML	Deployment	
Manifest	UML	Deploy	
Communication Path	UML, SysML	Component, Use Case	
Association	UML, SysML	Class Diag	Note: SysML calls this ReferenceAssociation Limitations: no AssociationClass(SysML: ParticipantProperty) exists. Limitations: no AssociationEnd Classes exist, no Multiplicities, no Roles.
Aggregation	UML, SysML	Class Diag	Note: SysML calls this SharedAssociation
Composition	UML, SysML	Class Diag	Note: SysML calls this PartAssociation
Generalization	UML, SysML	Class Diag, Use Case	Limitations: no Generalization-Sets supported
Realization	UML	Class Diag	
Trace	SysML	Requirement	
Refine	SysML	Requirement	
Extend	UML, SysML	Use Case	Limitations: no SysML-condition-notes can be attached to this relationship
Include	UML, SysML	Use Case	
Control Flow	UML, SysML	Activity	
Object Flow	UML, SysML	Activity	
Async. Call	UML, SysML (?)	Sequence	
Sync. Call	UML, SysML (?)	Sequence	
Return Call	UML, SysML (?)	Sequence	
Connector	UML, SysML	Internal Block Diag.	not supported. Limitations: No Bi-directional Connectors Note: SysML calls this BindingConnector Note: Use a Communication Path instead.
Item Flow	SysML	Block Definition	not supported. Note: Use an Object Flow instead.

### 4.4 Diagrams

Diagrams are views on the model-graph. They select classifiers and may filter their features and relationships.

The table shows the diagram types introduced by different specifications, if they filter/hide their features and/or relationships and a comment stating how this is implemented in crystal\_facet\_uml.

	Spec	Filter	Comment
List Diagram	-	any feature, any relationship	This is an overview diagram showing only classifiers without features and without relationships
Box Diagram	-	any feature, any relationship	This is an overview diagram showing only classifiers without features and without relationships

	<b>Spec</b>	<b>Filter</b>	<b>Comment</b>
Block Definition Diagram	SysML	lifelines	
Internal Block Diagram	SysML	lifelines	
Parametric Diagram	SysML	lifelines	
Deployment Diagram	UML	lifelines	
Component Diagram	UML	lifelines	
Composite Structure Diagram	UML	lifelines	
Package Diagram	UML, SysML	lifelines	
Class Diagram	UML	lifelines	
Profile Diagram	UML	lifelines	not supported
Requirements Diagram	SysML	lifelines	
Use Case Diagram	UML, SysML	lifelines	
Interaction Overview Diagram	UML	lifelines	Limitations: There is no link from Diagram-References to referenced Diagrams
Activity Diagram	UML, SysML	lifelines	
State Machine Diagram	UML, SysML	lifelines	
Communication Diagram	UML	unconditional relationships (Scenario), unconditional features	
Sequence Diagram	UML, SysML	unconditional relationships (Scenario), unconditional features	
Timing Diagram	UML	unconditional relationships (Scenario), unconditional features	

## LEGEND

**Filter** Defines which elements are not visible in the diagram

**Scenario** Diagrams show only relationships associated with a lifeline of a visible classifier.

## 4.5 Maximum stringlengths

All strings (names, descriptions, stereotypes) have a maximum length.

Ascii characters require one, most other characters two bytes. Current sizes in bytes are:

Classifiers:

- DATA\_CLASSIFIER\_MAX\_NAME\_LENGTH = 47,
- DATA\_CLASSIFIER\_MAX\_STEREOTYPE\_LENGTH = 47,
- DATA\_CLASSIFIER\_MAX\_DESCRIPTION\_LENGTH = 4095,

Features:

- DATA\_FEATURE\_MAX\_KEY\_LENGTH = 47, (name)

- DATA\_FEATURE\_MAX\_VALUE\_LENGTH = 255, (type)
- DATA\_FEATURE\_MAX\_DESCRIPTION\_LENGTH = 1023,

Relationships:

- DATA\_RELATIONSHIP\_MAX\_NAME\_LENGTH = 47,
- DATA\_RELATIONSHIP\_MAX\_DESCRIPTION\_LENGTH = 1023,

Diagrams:

- DATA\_DIAGRAM\_MAX\_NAME\_LENGTH = 47,
- DATA\_DIAGRAM\_MAX\_DESCRIPTION\_LENGTH = 8191,

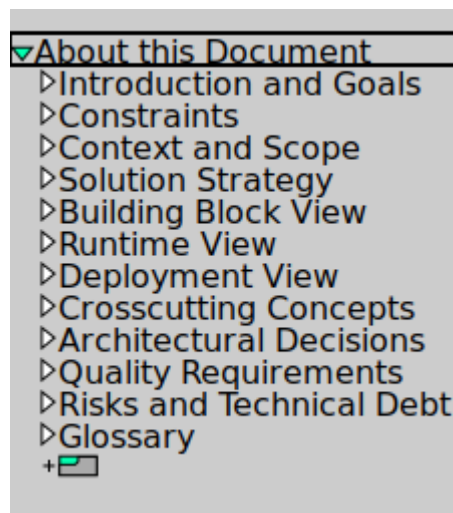
## 5 Modeling Guidelines

This page lists remarks on creating a software architecture and design document in general and it lists hints on getting along with the tool crystal\_facet\_uml. As all tools, this program has its strengths and weaknesses. This page helps in making use of the strenghts.

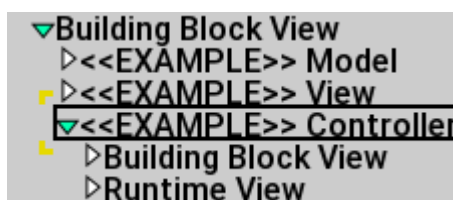
### 5.1 crystal\_facet\_uml Hints

#### 5.1.1 Tree Structure

Diagrams are organized as a tree. Start the root of the tree explaining the document structure. At the second level of the tree, list the main areas to be shown, for example based on the arc42 template <https://arc42.org/overview/> :



In case you show several layers of abstraction, each building block may contain its sub-blocks, sub-blocks may again show sub-sub-blocks. In this case, structure the specification of the sub-blocks in the same way: apply the proposed folder structure recursively, omitting possibly empty or superfluous folders.



### 5.1.2 Focus

Put only few elements into each diagram. This increases understandability of the main purpose of the diagram. Put further aspects of a topic into a separate diagram. Do not hesitate to copy an element from one diagram to the next. This is what crystal\_facet\_uml is good at: it keeps the model in sync.

### 5.1.3 Namespaces

Put a prefix to all your elements denoting its namespace. You can then distinguish a GLOBAL\_START\_STATE from an AUDIO\_START\_STATE. Or global::start from audio::start.

### 5.1.4 Attic/Storage room

If you are not sure if you really want to delete elements, 1) copy them to an attic-diagram and then 2) delete them from the original diagram.

## 5.2 General Hints on Architecture Documentation

### 5.2.1 Problem vs. Solution

Distinguish things that are

- given constraints (problem space),
- decisions, chosen and rejected alternatives and
- the designed solution

### 5.2.2 Names

Names of things are crucial: If the reader gets a wrong understanding by the name of an element, a hundred correct sentences of describing text cannot set this straight again.

### 5.2.3 Description

Every design element needs a description, maybe a list of responsibilities: What shall this element do, what is it for? Names alone cannot explain a system part.

### 5.2.4 Precise sentences

Be precise: Write in active form, e.g. The persistence component shall store and retrieve binary data records identified by string-based keys.

### 5.2.5 Distinguish similar things

Things that are similar but not the same shall be different entities when modelling. E.g. The process in which an example application runs may be different from the storage location and may be different from the software-component. These are three things: Example\_App\_Process (Type: Node), Example\_App\_ObjectFile (Type:Artifact) and Example\_App\_SWComponent (Type:Component).

## A Configuration

### A.1 Download, Installation and License

#### A.1.1 Download Links

Find the latest version of crystal\_facet\_uml at:

- <https://www.heise.de/download/product/crystal-facet-uml/>
- <https://sourceforge.net/projects/crystal-facet-uml/>
- [https://github.com/awarnke/crystal\\_facet\\_uml](https://github.com/awarnke/crystal_facet_uml)
- [https://build.opensuse.org/package/show/home:awarnke/crystal\\_facet\\_uml](https://build.opensuse.org/package/show/home:awarnke/crystal_facet_uml)
- <https://salsa.debian.org/debian-edu-pkg-team/crystal-facet-uml>

User documentation is available here:

- [http://www.andreaswarnke.de/crystal\\_facet\\_uml/crystal\\_facet\\_uml\\_user\\_documentation.pdf](http://www.andreaswarnke.de/crystal_facet_uml/crystal_facet_uml_user_documentation.pdf)
- [https://github.com/awarnke/crystal\\_facet\\_uml/blob/master/user\\_doc/crystal\\_facet\\_uml\\_user\\_documentation.pdf](https://github.com/awarnke/crystal_facet_uml/blob/master/user_doc/crystal_facet_uml_user_documentation.pdf)

#### A.1.2 Installation on Linux

The .deb and .rpm packages can be installed by the package installers of your system.

For installation on ubuntu, debian or raspbian, you may e.g. invoke **sudo dpkg --install <filename>** on the command line:

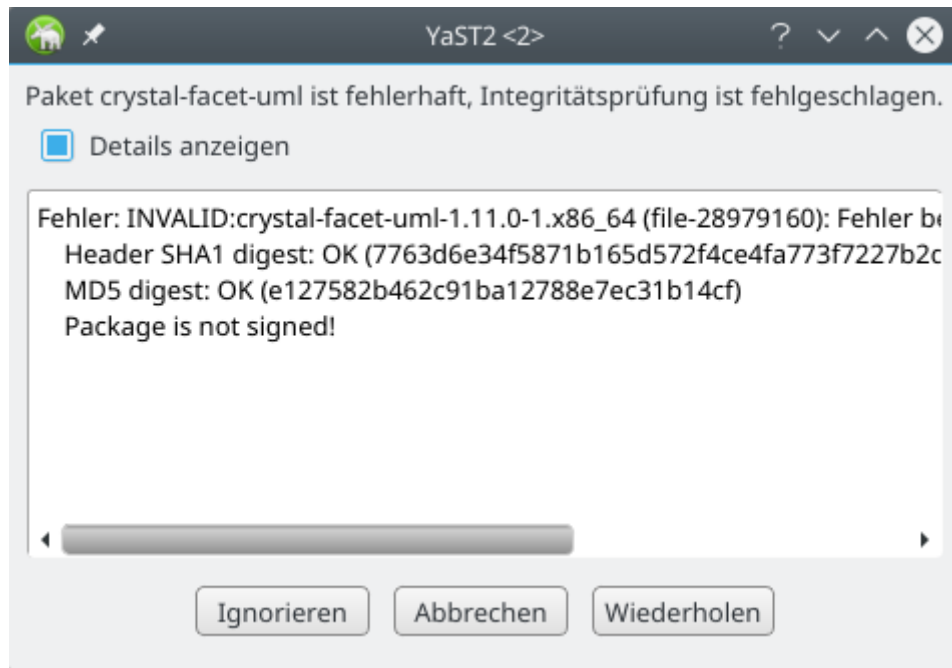
```
andi@debian1zotac:~/Downloads$ sudo dpkg --install crystal-facet-uml_1.12.0-1_amd64.deb

We trust you have received the usual lecture from the local System
Administrator. It usually boils down to these three things:

#1) Respect the privacy of others.
#2) Think before you type.
#3) With great power comes great responsibility.

[sudo] password for andi:
Selecting previously unselected package crystal-facet-uml.
(Reading database ... 198990 files and directories currently installed.)
Preparing to unpack crystal-facet-uml_1.12.0-1_amd64.deb ...
Unpacking crystal-facet-uml (1.12.0-1) ...
Setting up crystal-facet-uml (1.12.0-1) ...
Processing triggers for gnome-menus (3.13.3-9) ...
Processing triggers for desktop-file-utils (0.23-1) ...
Processing triggers for mime-support (3.60) ...
Processing triggers for man-db (2.7.6.1-2) ...
andi@debian1zotac:~/Downloads$
```

For installation you may use a gui-installation tool like yast. Because the packages are not signed, you may want to ignore the warning.



For installation on openSUSE, you may e.g. invoke **sudo zypper install <filename>** on the command line:

```
andi@linux-uv90:~/Downloads> sudo zypper install crystal-facet-uml-1.13.1-1.x86_64.rpm
[sudo] Passwort für root:
Repository-Daten werden geladen...
Installierte Pakete werden gelesen...
Paketabhängigkeiten werden aufgelöst...

Das folgende Paket wird aktualisiert:
crystal-facet-uml

1 Paket wird aktualisiert.
Gesamtgröße des Downloads: 698,6 KiB. Bereits im Cache gespeichert: 0 B. Nach der
  Operation werden zusätzlich 8,8 KiB belegt.
Fortfahren? [j/n/...? zeigt alle Optionen] (j): j
Paket crystal-facet-uml-1.13.1-1.x86_64 abrufen
(1/1), 698,6 KiB
( 1,2 MiB entpackt)
crystal-facet-uml-1.13.1-1.x86_64.rpm:
Package is not signed!

crystal-facet-uml-1.13.1-1.x86_64 (Einfacher Cache für RPM-Dateien): Fehler beim
  Überprüfen der Signatur [6-File is unsigned]
Abbrechen, wiederholen, ignorieren? [a/w/i] (a): i
Überprüfung auf Dateikonflikte läuft:
.....
fertig]
(1/1) Installieren: crystal-facet-uml-1.13.1-1.x86_64
.....
fertig]
andi@linux-uv90:~/Downloads>
```

Alternatively, you may want to build the software from the .orig source-package and then install it by **sudo make install**; see the readme file for more information.

### A.1.3 Installation on Windows/Wine



- On windows, doubleclick on **crystal\_facet\_uml.exe**,
- or using the wine emulation, call **wine crystal\_facet\_uml.exe** to start.

### A.1.4 License

License of crystal\_facet\_uml is Apache-2.0. (c) 2016-2019 Andreas Warnke; Email-contact: cfu-at-andreaswarnke-dot-de