

An introduction to the L^AT_EX cross-referencing system

Thomas Thurnherr

Abstract

One of the most powerful features of L^AT_EX is the cross-referencing system. It allows referencing numbered structures, such as headings, figures, tables, or equations anywhere in the same document. Importantly, references are automatically updated by the system whenever necessary. This article provides an overview of the referencing system and introduces several packages that extend it.

1 Introduction

L^AT_EX provides a referencing system that allows referencing almost any numbered object in the same document. To do that, the system implements the `\label` and `\ref` macros. The `\label` macro sets a marker that uniquely identifies a numbered object, which can then be referenced through the `\ref` macro. The `\pageref` command is less frequently used. It prints the page number of the labeled object. An example is provided below, where a marker `sec:intro` is added to a section. This marker is then used in the next section to refer to the previous section. Assuming that “Introduction” is the first section in the document, `\ref{sec:intro}` just prints the number: ‘1’.

```
\section{Introduction}\label{sec:intro}
% Content

\section{Methods}
In section \ref{sec:intro} on page
\pageref{sec:intro} we introduced ...
```

2 Specifying a label or marker

The system imposes no restrictions on the format of a marker. However, it is common practice to add a prefix + colon (:) to every marker. A prefix helps the author to identify the kind of object that is referenced. For example, to reference a figure a possible marker might be `\label{fig:schema}`. Table 1 shows prefix suggestions for the most frequently referenced numbered objects. Although it is good practice to use a prefix, these are merely suggestions and an author is free to choose a different set of prefixes or omit them altogether.

3 Placement of labels

Ideally, the `\label` is placed right after the numbered object to be labeled. For floating environments such as `figure` or `table`, `\label` has to be placed after or

Table 1: Suggestions for marker prefixes.

Object	Prefix	Object	Prefix
Chapter	ch	Figure	fig
Section	sec	Table	tab
Subsection	ssec	List item	itm
Appendix	app	Equation	eqn

within the `\caption` macro, because the caption produces the figure or table number. Placing a `\label` before the numbered object almost certainly will produce the wrong reference. The same might happen if the `\label` is placed too far after the numbered object.

4 Generating/updating references

A document generally requires two typesetting runs to generate reference numbers. Behind the scenes, the system collects all markers in an `aux` meta-file while typesetting the document once. It then reads this `aux` file to update references during the second run of typesetting. Whenever references cannot be generated correctly by the system, double question marks (??) are produced in the output document.

If references are not updated correctly after re-typesetting, a quick look through the log file might help identify the problem. The next section (5) describes warnings related to the referencing system.

5 L^AT_EX warnings related to the referencing system

It is not uncommon to see warnings related to the referencing system in the `log` file. Two kinds of warnings may arise from ill-defined markers:

- 1) There were undefined references.
- 2) There were multiply-defined labels.

The first is due to a missing marker that is referenced, whereas the latter is due to a marker that is defined more than just once. Multiply-defined labels can happen when the author copies a piece of code, such as a figure environment, and forgets to replace the marker with a unique name.

6 Packages extending the referencing system

There are numerous packages that extend the L^AT_EX cross-referencing system. Here, I provide a brief introduction to `varioref`, `cleveref`, `hyperref` and `xr/xr-hyper`. I chose these particular packages because I think each of them extends the referencing system in a unique and comprehensive way. In general, these packages do not redefine the functions of the standard referencing system, but define new

macros with a slightly different and beneficial behavior. Therefore, the standard behavior of `\label`, `\ref` and `\pageref` is not affected by using these packages.

6.1 The varioref package

The `varioref` package [4] extends the basic referencing system with slightly more sophisticated commands. `\vref` combines `\ref` with `\pageref` to print the number of the referenced object together with the page number. If the referenced object is on the same page, the page number is omitted. The `\vpageref` macro extends this idea to `\pageref`. If the referenced object is on the same page, the output says: “on this page”. Otherwise, the output shows the page number. Finally, the package provides the `\vrefrange` and the `\vpagerefrange` commands to print a range of numbers and page numbers when multiple references are provided.

6.2 The cleveref package

Often, the author mentions the type of objects that is referenced in the text. For example, a figure could be referenced as follows: “This is shown in figure 1”. The `\ref` macro only prints the number of the referenced object. This is where the `cleveref` package [1] comes in. It automatically recognizes the type of object that is referenced and prints the reference accordingly. For this purpose, the package provides the `\cref` command. Similar to the `varioref` package, it also implements macros to print the page number of a referenced object (`\cpageref`) and a range of objects or page numbers (`\crefrange` and `\cpagerefrange`).

6.3 The hyperref package

The main function of `hyperref` [2] that is related to the cross-referencing system is to make references clickable. Clicking a reference navigates the reader to the page where the referenced object resides. For that, it is sufficient to load the package in the preamble. Moreover, the package defines the `\autoref` macro, which is equivalent to `\cref` in the `cleveref` package. It prints the type of reference together with the reference number. The package implements a plethora of other functions not necessarily related to the cross-referencing system. A discussion of these is out of the scope of this article. Nevertheless, I highly recommend browsing the package documentation to learn more about what you can do with the package.

6.4 The xr/xr-hyper packages

The eXternal References `xr` package [5] allows referencing objects in external documents. This is par-

ticularly useful for scientific articles, where supplementary materials are often provided together with the main text. The package allows referencing supplementary figures and tables in the main text. To do that, the external document has to be defined by `\externaldocument{filename}` in the preamble of the main text. If the external `tex` file is in a different folder, the path has to be added to the file name. With that, markers defined in the external document can be referenced in the main text. To produce the correct number, external documents need to be typeset whenever they are changed.

```
\documentclass{article}
\usepackage{xr}
\externaldocument{supplementary-materials}
\begin{document}
  See supplementary figure \ref{fig:abc}.
\end{document}
```

To create hyperlinks to referenced objects in external documents with `hyperref`, load the `xr-hyper` package instead of `xr`.

6.5 Package loading order

As all of these packages affect the behavior of the referencing system, loading multiple packages may give rise to conflicts. To omit these, packages need to be loaded in the right order, namely: 1) `xr/xr-hyper`, 2) `varioref`, 3) `hyperref`, and lastly 4) `cleveref`.

6.6 The showlabels package

Finally, I would like to mention the `showlabels` package [3], which shows all markers in the margins of the output document (PDF). This package is extremely useful to keep track of markers in long documents, with a large number of labels.

References

- [1] `cleveref` — Intelligent cross-referencing. <https://www.ctan.org/pkg/cleveref>.
- [2] `hyperref` — Extensive support for hypertext in L^AT_EX. <https://www.ctan.org/pkg/hyperref>.
- [3] `showlabels` — Show label commands in the margin. <https://www.ctan.org/pkg/showlabels>.
- [4] `varioref` — Intelligent page references. <https://www.ctan.org/pkg/varioref>.
- [5] `xr` — References to other L^AT_EX documents. <https://www.ctan.org/pkg/xr>.

◇ Thomas Thurnherr
 thomas.thurnherr (at) gmail dot com
<http://texblog.org>