

# MIBIB $\TeX$ : Reporting the Experience\*

Jean-Michel HUFFLEN

LIFC (EA CNRS 4157)

University of Franche-Comté

16, route de Gray

25030 BESANÇON CEDEX

FRANCE

[hufflen@lifc.univ-fcomte.fr](mailto:hufflen@lifc.univ-fcomte.fr)

<http://lifc.univ-fcomte.fr/~hufflen>

## Abstract

This article reports how the different steps of the MIBIB $\TeX$  project were conducted until the first public release. We particularly focus on the problems raised by reimplementing a program (BIB $\TeX$ ) that came out in the 1980's. Since this time, implementation techniques have evolved, new requirements have appeared, as well as new programs within  $\TeX$ 's galaxy. Our choices are explained and discussed.

**Keywords**  $\TeX$ ,  $\LaTeX$ , BIB $\TeX$ , reimplementatation, reverse engineering, implementation language, program update.

## Streszczenie

Artykuł omawia realizację poszczególnych kroków przedsięwzięcia MIBIB $\TeX$ , w czasie do przedstawienia pierwszej publicznej wersji. W szczególności skupiamy się na problemach powstałych przy reimplementacji programu (BIB $\TeX$ ), powstałego w latach 80 zeszłego wieku. Od tego czasu rozwinęły się techniki implementacyjne, powstały nowe wymagania oraz nowe programy w świecie  $\TeX$ -owym. Przedstawiamy i dyskutujemy dokonane wybory.

**Słowa kluczowe**  $\TeX$ ,  $\LaTeX$ , BIB $\TeX$ , reimplementacja, *reverse engineering*, język implementacji, aktualizacja programu.

## 0 Introduction

In 2003,  $\TeX$ 's 25th anniversary was celebrated at the TUG<sup>1</sup> conference, held at Hawaii [1].  $\LaTeX$  [28] and BIB $\TeX$  [35]—the bibliography processor usually associated with the  $\LaTeX$  word processor— are more recent, since they came out in the 1980's, shortly after  $\TeX$ . All are still widely used, such longevity being exceptional for software. However, these programs are quite ageing. Of course, recent versions have incorporated many features absent from the first versions, what proves the robustness of these systems. Nevertheless, they present some limitations due to the original conception, and a major reimplementatation may be needed to integrate some modern requirements. In addition, interactive word processors made important progress and are serious rivals, even if they do not yield typesetting of such professional quality. That is why some

projects aim to provide new programs, based on  $\TeX$  & Co.'s ideas.<sup>2</sup> A first representative example is the  $\LaTeX$  3 project [32], a second is  $\mathcal{M}\mathcal{T}\mathcal{S}$  [27].

MIBIB $\TeX$ —for 'MultiLingual BIB $\TeX$ '— belongs to such projects. Let us recall that this program aims to be a 'better BIB $\TeX$ ', especially about multilingual features. For an end-user, MIBIB $\TeX$  behaves exactly like 'classical' BIB $\TeX$ : it searches bibliography data base (.bib) files for citation keys used throughout a document and arranges the references found into a .bbl file suitable for  $\LaTeX$ , w.r.t. a bibliography style. MIBIB $\TeX$  is written in Scheme,<sup>3</sup> it uses XML<sup>4</sup> as a central format: when entries of .bib

<sup>2</sup> Concerning  $\TeX$ , an additional point is that  $\TeX$ 's development has been frozen by its author, Donald E. Knuth [26]. If incorporating new ideas to a 'new  $\TeX$ ' leads to a major reimplementatation, the resulting program must be named differently.

<sup>3</sup> The version used is described in [24].

<sup>4</sup> EXtensible Markup Language. Readers interested in an introductory book to this formalism can consult [37].

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<sup>1</sup>  $\TeX$  Users Group.

files are parsed, they result in an XML tree. Bibliography styles taking advantage as far as possible of MIBIB $\TeX$ 's new features are written using `nbst`,<sup>5</sup> a variant of XSLT<sup>6</sup> described in [15]. The `bst` language [34], based on handling a stack and used for writing bibliography styles of BIB $\TeX$ , can be used in a compatibility mode [20].

We think that the experience we have got in developing MIBIB $\TeX$  may be useful for other analogous projects. In a first section, we briefly recall the chronology of this development. As it could be seen, this development has not been linear, and the two next following sections focus on the problems we had to face. We explain how we have determined which criteria are accurate when a programming language is to be chosen for such an application. Then we show how the compatibility with 'old' data and the integration of modern features should be managed.

## 1 MIBIB $\TeX$ 's Chronology

**Oct. 2000** MIBIB $\TeX$ 's design begins: the syntax of `.bib` files is enriched with multilingual annotations. Version 1.1's prototype is written using the C programming language and tries to reuse parts of 'old BIB $\TeX$ 's program as far as possible.

**May 2001** The first article about MIBIB $\TeX$  is [9]. Later, the experience of developing MIBIB $\TeX$ 's Version 1.1 is described in [10].

**May 2002** By discussing with some people at the EuroBach $\TeX$  conference, we realise that the conventions for bibliography styles are too diverse, even if we consider only those of European countries. We realise that this first approach is quite unsuitable, unless defining a new version of the `bst` language. So we decide to explore two directions. First, we develop a questionnaire about problems and conventions concerning bibliography styles used within European countries. Second, we begin a prototype in Scheme implementing the `bst` language [11]. Initially, this prototype is devoted to experiments about improving this language in a second version (1.2).

**Jan. 2003** Version 1.2 is stalled. The new version (1.3) is built out of XML formats. The `nbst` language is designed and presented at [12, 13]. We explain in [14] how the results of our questionnaire have influenced this new direction.

**Feb. 2004** It appears to us that MIBIB $\TeX$  should be developed using a very high-level program-

ming language, higher than C. So we consider again the prototype in Scheme, we sketched in 2002. SXML<sup>7</sup> [25] is chosen as the representation of XML texts in Scheme. Some parts of MIBIB $\TeX$  are directly reprogrammed from C to Scheme. About the other parts, this prototype is a good basis for much experiment [16].

**Nov. 2004** The version written in C is definitely dropped out, whereas the version in Scheme is adapted in order to get much efficiency and becomes the 'official' MIBIB $\TeX$  [18].

**Sep. 2005** We decided to freeze MIBIB $\TeX$ 's design and concentrate only on finishing programming. Many Scheme functions are rewritten in conformity to SRFIs<sup>8</sup> [39].

**May 2006** A working version is almost finished, except for the interface with the `kpathsea` library.

**May 2007** Public availability of MIBIB $\TeX$ 's Version 1.3.

Besides, let us make precise that MIBIB $\TeX$  is not our only task. As an Assistant Professor in our university, we teach Computer Science. We also participate in other projects. As a consequence, MIBIB $\TeX$ 's development has been somewhat anarchic: we hardly worked on it for two or three months, put it aside for one or two months, and so on. Last, we have supervised some student projects about graphical tools around MIBIB $\TeX$  [2, 8], programmed using Ruby [31], but concerning the development of the MIBIB $\TeX$  program itself, we have done it alone.

## 2 Choice of an implementation language

There are several programming paradigms: imperative, functional, and logic programming. There are also several ways to implement a programming language: interpretation and compilation. Some paradigms are more accurate, according to the domain of interest. Likewise, some interpreted languages are more accurate if you want to program a prototype quickly and are just interested in performing some experiment.<sup>9</sup> But compiled languages are often preferable if programs' efficiency is crucial. Besides, the level of a programming language has some influence on development: in a high-level language, low-level details of structures' implementation do not have to be made explicit, so development is

<sup>7</sup> Scheme implementation of XML.

<sup>8</sup> Scheme **R**equests for **I**mplementation. That is an effort to coordinate libraries and other additions to the Scheme language between implementations.

<sup>9</sup> That is the case for the graphical tools around MIBIB $\TeX$  programmed in Ruby by our students [2, 8].

<sup>5</sup> New **B**ibliography **S**Tyles.

<sup>6</sup> e**X**tensible **L**anguage **S**tylesheet **T**ransformations, the language of transformations used for XML documents [43].

quicker, and programs that result in are more concise, nearer to a mathematical model.

In addition to these general considerations, let us recall that we aim to replace an existing program by a new one. This new program is supposed to do better than the ‘old’ one. ‘To do better’ may mean ‘to have more functionalities, more expressive power’, but for sake of credibility, it is preferable for the new program to be as efficient as the ‘old’ one. Let us not forget that  $\TeX$  and  $\text{BIB}\TeX$  are written using an old style of programming — more precisely, a monolithic style used in the 1970’s–1980’s — based on global variables mainly, without abstract data types. Choosing a language implemented efficiently is crucial: as a counter-example,  $\mathcal{N}\mathcal{S}$ , written using Java, has been reported 100 times slower than  $\TeX$  [42, § 5].

That is why we wrote MIBIB $\TeX$ ’s first version using C, because of its efficiency. In addition, this language is portable on most operating systems. And to make our program modular, we defined precise rules for naming procedures [10, § 3]. But two problems appeared.

First, MIBIB $\TeX$ ’s development has not been a daily task, as abovementioned. Even if we are personally able to program large applications in C, it was difficult to put aside a C program and resume it later: from this point of view, C is not a very high-level language. Besides, let us not forget that we are working within an open domain, as natural languages are. Some change may be needed because of new features concerning languages that had not yet been integrated into MIBIB $\TeX$ ’s framework. The higher the level, the more easy such change will be applied.

Second, we want end-users of MIBIB $\TeX$  to be able to influence the behaviour of this program. For example, many  $\text{BIB}\TeX$  users put  $\LaTeX$  commands inside values associated with fields of `.bib` files, in order to increase expressive power within bibliographical data. These users should be able to specify how to handle such commands when `.bib` files are converted into XML trees. In particular, that is useful if MIBIB $\TeX$  is used to produce outputs for other word processors than  $\LaTeX$  [21]. How to do that in C? unless defining a mini-language to express such functions? In this case, using a script language is a better choice . . . provided that this language is efficient. Another choice is a Lisp<sup>10</sup> dialect, as did in `emacs` [40]: end-users can customise `emacs`’ behaviour by expressions using the Emacs Lisp language [30]. This choice is homogeneous: the whole of the `emacs` pro-

gram is expressed using Emacs Lisp, except for the implementation of low-level functionalities.

Finally, our choice was Scheme, the modern dialect of Lisp. We confess that we are personally attracted by functional programming languages, because they can abstract procedures as well as data: in this sense, they are very high-level programming languages. Concerning Scheme, it seems to us to be undebatable that it has very good expressive power. In addition, it allows some operations to be programmed ‘impurely’, by side effects, like in imperative programming, in order to increase efficiency. However, we use this feature parsimoniously, on local variables, because it breaks principles of functional programming. We have defined precise rules for naming variables, as we did in C for the first version, in order to emphasise the modular decomposition of our program [19]. Last but not least, Scheme programs may be interpreted — when software is being developed — or compiled, in which case they are more efficient. As a good example of Scheme implementation, `bigloo` [38] compiles Scheme functions by transforming them into C functions, then these C functions are compiled, in turn.

If we compare the two developments in C and Scheme, the latter is better, as it is expected from a very high-level programming language. But programming an application related to  $\TeX$  using a language other than C reveals a drawback: the `kpathsea` library [3] is written in C. Let us recall that `kpathsea` implements functions navigating through the TDS.<sup>11</sup> In particular, such functions localise the files containing the specification of a class for a  $\LaTeX$  document or a bibliography style when  $\text{BIB}\TeX$  runs. If there is a compatibility mode, for ‘old’ bibliography styles written in `bst`, the functions of this compatibility mode should be able to localise such files, too. Likewise, ‘new’ bibliography styles written in `nbst`, should be localised by means of an analogous method. This implies that the language — or, at least, an implementation of the language — used for our software includes an interface with C.

Of course, what we expose above proceeds from general considerations. After all, we do not know if  $\text{BIB}\TeX++$  [4] — a successor of  $\text{BIB}\TeX$  based on Java, bibliography styles are written in Java — is very less efficient than  $\text{BIB}\TeX$ . This may not be the case. The advantages of script languages in such development appear if we consider `Bibulus` [45], another successor of  $\text{BIB}\TeX$ , written using Perl.<sup>12</sup> It has developed quicker than MIBIB $\TeX$ , but is

<sup>11</sup>  $\TeX$  Directory Structure.

<sup>12</sup> Practical Extraction Report Language. A didactic introduction to this language is [44].

<sup>10</sup> L $\text{I}\text{S}\text{T}$  Processor.

‘less’ multilingual and uses `BIBTEX` when it runs. That is, `Bibulus` does not replace `BIBTEX` wholly, as `MLBIBTEX` attempts to do. In addition, there is an example where the need of a programming language with higher level than C appeared: the project of moving  $\Omega$  — a successor of `TEX` — into a C++ platform [36].

We personally think that an implementation of `NS` in `Common Lisp` [41] — what was planned initially — would have been preferable. As mentioned in [46], the object-oriented features of `Common Lisp` (`CLOS`<sup>13</sup>) have been added to the language’s basis — like C++ object-oriented functionalities have been added to C — but the language itself is not actually object-oriented. In [46], this point is viewed as a drawback. First, we personally think that everything is not an object, from a point of view related to conception. Second, `Common Lisp`, even if it is a functional programming language, allows some operations to be performed more efficiently by means of side effects, like `Scheme`.<sup>14</sup> But `Common Lisp`’s standard does not specify an interface with C, like `Scheme`’s, although some implementations provide this service. However, we personally prefer `Scheme`, simpler and more modern.

### 3 Choice of strategy

#### 3.1 Languages

`TEX` & Co. have been wonderful programs since the date they came out. However, they behave very nicely, but syntaxes are quite archaic. `TEX`’s is not homogeneous — although `LATEX 2 $\epsilon$`  and `LATEX 3` [32] try to correct this point — for example, different delimitations are used to change size (`{\small ...}`) or face (`{\textbf{...}}`). `BIBTEX`’s syntax suffers from lack of expressive power: for example, the only way to put a brace within a field’s value is to give its code number by `{\symbol{...}}`. ‘Semantically’, `TEX`’s language provides many intelligent features, as mentioned in [6], but does not meet a modern style of programming. Likewise, `.bib` files’ syntax can express only ‘verbatim’ values, except for some ‘tricks’ like inserting some ‘-’ characters for a range of page numbers. The specification of structured values like person or organisation names is easy for simple cases, but quickly becomes obscure in more complicated cases [22].

In addition, new syntactic sugar may be needed to meet some new requirements. As an example, [23] points out that the arguments of some macros — e.g., `\catcode` — are not easily parseable. As an

<sup>13</sup> `Common Lisp Object System`.

<sup>14</sup> `Emacs Lisp`, too, and the programs of `emacs` largely use this feature.

other example, the `ConTeXt` format [7] put good settlement into action for an homogeneous expression of setup commands, by means of ‘`key=value`’ syntax:

```
\setuplayout[backspace=4cm,topspace=2.5cm]
```

Nevertheless, is it reasonable to add more and more syntactic sugar to such old-fashioned syntax? Would the definition of new languages not be preferable? Of course, the present languages of `TEX` and `BIBTEX` will still remain to be used, due to the huge number of files using them and developed by end-users. But if a new language is designed, it should become the usual way to deal with the new program. Of course, end-users will have to get used with the new language. But that can be done progressively and some synergy between developers and users may cause this new language to be improved if need be.

In addition, let us remark that in our case, the new language for bibliography styles (`nbst`) is close to `XSLT`, so we think that users familiar with the former can get used to the latter easily.

#### 3.2 New services

Now it is admitted that composite tasks are not to be done by a monolithic program, but by means of a cooperation among several programs. From this point of view, the cooperation between `LATEX` and `BIBTEX` is exemplar. But `BIBTEX` is too strongly related to `LATEX`. `BIBTEX` can be used to build bibliography for `ConTeXt` documents, but because this word processor belongs to `TEX` family. On the contrary, writing a converter from `BIBTEX` to `HTML`<sup>15</sup> by means of the `bst` language is impossible without loss of quality: for example, the unbreakable space character is represented by ‘~’ — as in `TEX` — when names are formatted [22], and this convention cannot be changed.<sup>16</sup> We see that such problems can be avoided by considering an XML-like language as a central format. In our case, generating bibliographies according to other formats than `LATEX`’s should be easy since the `LATEX` commands end-users put into `.bib` files are removed when these files are parsed. This point is detailed in [17, 21].

### 4 Conclusion

Last but not least, we have enjoyed to design and implement `MLBIBTEX`, even if this development backtracked several times. In addition, we think that this development shows the difficulties related to such a

<sup>15</sup> `HyperText Markup Language`. Readers interested in an introduction to this language can refer to [33].

<sup>16</sup> In fact, there are such converters, an example being `BIBTEX2HTML` [5], written using `Objective Caml` [29], a functional programming language.

task. Two parts have to be managed in parallel. The first part is *reverse engineering*, that is, guessing the conception from the program. The second: enlarging what already exists. In comparison with ‘classical’ development of a new program from scratch, tests concerning the compatibility mode are easy to perform: just comparing what is given by the two programs, the ‘old’ one becoming an oracle. But reaching homogeneous conception is not obvious if we want to keep backward compatibility. Nevertheless, we hope that we have done some satisfactory work.

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