

CFFI-SYS Interface Specification

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1 Introduction

CFFI, the Common Foreign Function Interface, purports to be a portable foreign function interface for Common Lisp.

This specification defines a set of low-level primitives that must be defined for each Lisp implementation supported by CFFI. These operators are defined in the **CFFI-SYS** package.

The **CFFI** package uses the **CFFI-SYS** interface to implement an extensible foreign type system with support for typedefs, structures, and unions, a declarative interface for defining foreign function calls, and automatic conversion of foreign function arguments to/from Lisp types.

Please note the following conventions that apply to everything in **CFFI-SYS**:

- Functions in **CFFI-SYS** that are low-level versions of functions exported from the **CFFI** package begin with a leading percent-sign (eg. `%mem-ref`).
- Where “foreign type” is mentioned as the kind of an argument, the meaning is restricted to that subset of all foreign types defined in Chapter 2 [Built-In Foreign Types], page 2. Support for higher-level types is always defined in terms of those lower-level types in **CFFI** proper.

2 Built-In Foreign Types

<code>:char</code>	[Foreign Type]
<code>:unsigned-char</code>	[Foreign Type]
<code>:short</code>	[Foreign Type]
<code>:unsigned-short</code>	[Foreign Type]
<code>:int</code>	[Foreign Type]
<code>:unsigned-int</code>	[Foreign Type]
<code>:long</code>	[Foreign Type]
<code>:unsigned-long</code>	[Foreign Type]
<code>:long-long</code>	[Foreign Type]
<code>:unsigned-long-long</code>	[Foreign Type]

These types correspond to the native C integer types according to the ABI of the system the Lisp implementation is compiled against.

<code>:int8</code>	[Foreign Type]
<code>:uint8</code>	[Foreign Type]
<code>:int16</code>	[Foreign Type]
<code>:uint16</code>	[Foreign Type]
<code>:int32</code>	[Foreign Type]
<code>:uint32</code>	[Foreign Type]
<code>:int64</code>	[Foreign Type]
<code>:uint64</code>	[Foreign Type]

Foreign integer types of specific sizes, corresponding to the C types defined in `stdint.h`.

<code>:size</code>	[Foreign Type]
<code>:ssize</code>	[Foreign Type]
<code>:ptrdiff</code>	[Foreign Type]
<code>:time</code>	[Foreign Type]

Foreign integer types corresponding to the standard C types (without the `_t` suffix).

Implementor's note: I'm sure there are more of these that could be useful, let's add any types that can't be defined portably to this list as necessary.

<code>:float</code>	[Foreign Type]
<code>:double</code>	[Foreign Type]

The `:float` type represents a C `float` and a Lisp `single-float`. `:double` represents a C `double` and a Lisp `double-float`.

<code>:pointer</code>	[Foreign Type]
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A foreign pointer to an object of any type, corresponding to `void *`.

<code>:void</code>	[Foreign Type]
--------------------	----------------

No type at all. Only valid as the return type of a function.

3 Operations on Built-in Foreign Types

`%foreign-type-size` *type* \Rightarrow *size* [Function]

Return the *size*, in bytes, of objects having foreign type *type*. An error is signalled if *type* is not a known built-in foreign type.

`%foreign-type-alignment` *type* \Rightarrow *alignment* [Function]

Return the default alignment in bytes for structure members of foreign type *type*. An error is signalled if *type* is not a known built-in foreign type.

Implementor's note: Maybe this should take an optional keyword argument specifying an alternate alignment system, eg. :mac68k for 68000-compatible alignment on Darwin.

4 Basic Pointer Operations

`pointerp ptr` \Rightarrow *boolean* [Function]

Return true if *ptr* is a foreign pointer.

`null-pointer` \Rightarrow *pointer* [Function]

Return a null foreign pointer.

`null-pointer-p ptr` \Rightarrow *boolean* [Function]

Return true if *ptr* is a null foreign pointer.

`make-pointer address` \Rightarrow *pointer* [Function]

Return a pointer corresponding to the numeric integer *address*.

`inc-pointer ptr offset` \Rightarrow *pointer* [Function]

Return the result of numerically incrementing *ptr* by *offset*.

5 Foreign Memory Allocation

foreign-alloc *size* \Rightarrow *pointer* [Function]

Allocate *size* bytes of foreign-addressable memory and return a *pointer* to the allocated block. An implementation-specific error is signalled if the memory cannot be allocated.

foreign-free *ptr* \Rightarrow *unspecified* [Function]

Free a pointer *ptr* allocated by **foreign-alloc**. The results are undefined if *ptr* is used after being freed.

with-foreign-pointer (*var size* **&optional** *size-var*) **&body** *body* [Macro]

Bind *var* to a pointer to *size* bytes of foreign-accessible memory during *body*. Both *ptr* and the memory block it points to have dynamic extent and may be stack allocated if supported by the implementation. If *size-var* is supplied, it will be bound to *size* during *body*.

6 Memory Access

`%mem-ref ptr type &optional offset` [Accessor]
 Dereference a pointer *offset* bytes from *ptr* to an object for reading (or writing when used with `setf`) of built-in type *type*.

Example

```
;; An impractical example, since time returns the time as well,
;; but it demonstrates %MEM-REF. Better (simple) examples wanted!
(with-foreign-pointer (p (foreign-type-size :time))
  (foreign-funcall "time" :pointer p :time)
  (%mem-ref p :time))
```

7 Foreign Function Calling

`%foreign-funcall` *name* {*arg-type* *arg*}* **&optional** *result-type* \Rightarrow *object* [Macro]

`%foreign-funcall-pointer` *ptr* {*arg-type* *arg*}* **&optional** *result-type* \Rightarrow *object* [Macro]

Invoke a foreign function called *name* in the foreign source code.

Each *arg-type* is a foreign type specifier, followed by *arg*, Lisp data to be converted to foreign data of type *arg-type*. *result-type* is the foreign type of the function's return value, and is assumed to be `:void` if not supplied.

`%foreign-funcall-pointer` takes a pointer *ptr* to the function, as returned by `foreign-symbol-pointer`, rather than a string *name*.

Examples

```
;; Calling a standard C library function:
(%foreign-funcall "sqrtf" :float 16.0 :float)  $\Rightarrow$  4.0

;; Dynamic allocation of a buffer and passing to a function:
(with-foreign-ptr (buf 255 buf-size)
  (%foreign-funcall "gethostname" :pointer buf :size buf-size :int)
  ;; Convert buf to a Lisp string using MAKE-STRING and %MEM-REF or
  ;; a portable CFFI function such as CFFI:FOREIGN-STRING-TO-LISP.
  )
```

8 Loading Foreign Libraries

`%load-foreign-library` *name* \Rightarrow *unspecified*

[Function]

Load the foreign shared library *name*.

Implementor's note: There is a lot of behavior to decide here. Currently I lean toward not requiring NAME to be a full path to the library so we can search the system library directories (maybe even get LD_LIBRARY_PATH from the environment) as necessary.

9 Foreign Globals

`foreign-symbol-pointer` *name* \Rightarrow *pointer*
Return a pointer to a foreign symbol *name*.

[Function]

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