Apollo Object Code Format Specification v1.0.0

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Contents

1 Introduction

Apollo is the official object code format for the Aphelion ISA, inspired by ELF and specialized for Aphelion code. Apollo is designed to accelerate and streamline the linking and assembly process. A notable feature of Apollo is lossless linking. Sections and symbols keep information regarding their object file of origin, so no information is lost. This allows incremental linking, object grouping & packaging, and the ability to unlink/decompose an Apollo file into its original components.

This document uses the syntax of the Odin programming language to define its structures when necessary. Odin syntax should be readable for all programmers. For more information, visit odin-lang.org.

2 File Structure

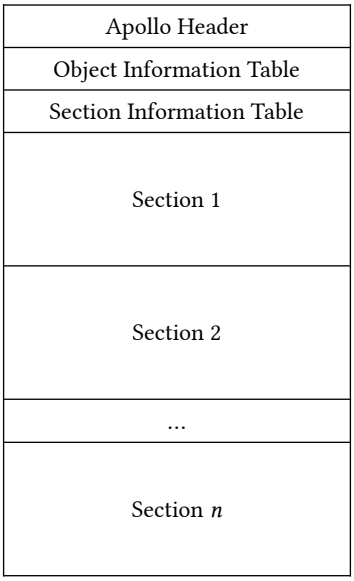

Figure 1: Apollo File Structure

The apollo header sits at the beginning of the file and contains the file's signature, version info, and information about the object and section information table.

The object information table contains information about the file's constituent objects, and is used as an anchor point for sections/symbols to reference.

The section information table contains information regarding each section's properties, size, and location within the file.

The rest of the file is dedicated to the sections themselves, which contain the majority of the file's data, including program code, the symbol table, and more.

All structures are packed with no padding added for type alignment.

2.1 Apollo Header

```
t_apollo_header :: struct {
    magic        : [4]u8,
    version      : [3]u8,
    aphel_version : [3]u8,
    object_count  : u64,
    section_count : u64,
}
```

magic	Apollo's file signature, {0xB2, 'a', 'p', 'o'}.
version	Apollo specification version, following {MAJOR, MINOR, PATCH}.
aphel_version	Aphelion specification version, following {MAJOR, MINOR, PATCH}.
object_count	Number of entries in the object information table. Entries are a constant size, so the size of the entire table can be determined by multiplying this by the size of a single entry.
section_count	Number of entries in the section information table. The size of the entire table can be determined in the same fashion as above.

2.2 Object Information Table

The object information table is made up of entries, structured like so:

```
t_object_info_entry :: struct {
    ident_offset : u64,
    ident_size   : u64,
}
```

obj_ident_offset	Offset of this object's identifier in this file's metadata pool section.
obj_ident_size	Size of this object's identifier.

The object information entries themselves do not hold much information, They are used as points for sections and symbols to reference.

2.3 Section Information Table

The section information table is made up of entries, structured like so:

```
t_section_info_entry :: struct {
    type       : e_section_type,
    ident_offset : u64,
    ident_size   : u64,
    obj_index    : u64,
    offset       : u64,
    size         : u64,
}
```

type	The kind of content this section contains. Represented with a u8.
ident_offset	Offset of this section's identifier in this file's metadata pool section.
ident_size	Size of this section's identifier.
obj_index	Index in the object information table that this section is associated with. Index 0xFFFF_FFFF is reserved for sections not associated with a specific object.
offset	Offset of this section's content from the start of the section array.
size	Size of this section's content.

2.4 Sections

Apollo supports 6 kinds of sections:

```
e_section_type :: enum u8 {
    program  = 1,
    blank    = 2,
    info     = 3,
    symtab   = 4,
    reftab   = 5,
    metapool = 6,
}
```

program	Program-defined information, such as code and data.
blank	Uninitialized program data. s_offset is ignored for this type, as this kind of section does not take up space in the section pool.
info	A table of key-value pairs for storing arbitrary metadata with objects.
symtab	Symbol table, stores information about symbols the code uses, and how to relocate those symbols.

reftab	Reference table, stores information about where symbols are referenced and how to modify those references.
metapool	Index of the file's metadata pool, which is used to store internal data, such as identifier strings.

2.4.1 program | Program

A program section is for unstructured program-defined information, such as executable code and data.

2.4.2 blank | Blank

A blank section is for a blank, uniform block of uninitialized space, most often used for uninitialized static variables in programs. They are listed in the section information table, but do not correspond to an actual block of data in the section pool, so (section_info_entry).offset may be ignored.

2.4.3 info | Information

An info section is an array of entries:

```
t_info_entry :: struct {
    key_offset   : u64,
    key_size     : u64,
    value_offset : u64,
    value_size   : u64,
}
```

key_offset	Offset of key in this file's metadata pool section.
key_size	Size of key.
value_offset	Offset of value in this file's metadata pool section.
value_size	Size of value.

2.4.4 symtab | Symbol Table

The symbol table is an array of symbol table entries:

```
t_symtab_entry :: struct {
    ident_offset : u64,
    ident_size   : u64,
    sect_index   : u64,
    value        : u64,
    size         : u64,
    type         : t_sym_type,
    bind         : t_sym_bind,
    reloc        : t_sym_reloc,
}
```

ident_offset	Offset of identifier in this file's metadata pool section.
ident_size	Size of identifier.
sect_index	Index of associated section in section information table.
value	Value of the symbol, usually the offset from the start of its associated section.
size	Size of associated data, if applicable.
type	Type of associated data. Represented with a u8.
bind	Scope and precedence information. Represented with a u8.
reloc	Information for how to change the symbol's value during linking. Represented with a u8.

```
e_sym_type :: enum u8 {
    untyped  = 1,
    function = 2,
    variable = 3,
}
```

untyped	No type information available.
function	Program code, like a function or some other executable data.
variable	Program data, like a variable, array, struct, etc.
section	Stores the base address for the associated section for relocation purposes. Must always have bind set to t_sym_bind.local and reloc to t_sym_reloc.base.

```
e_sym_bind :: enum u8 {
    undefined = 1,
    global    = 2,
    local     = 3,
    weak      = 4,
}
```

undefined	Symbol is referenced but not defined.
global	Symbol is defined and visible to every object.
local	Symbol is defined and only visible within the object it is defined in.
weak	Symbol is defined and visible to every object, but may be overwritten by a global symbol with the same identifier.

```
e_sym_reloc :: enum u8 {
    absolute = 1,
    base     = 2,
    location = 3,
}
```

absolute	Symbol value is absolute and does not change during relocation.
base	Symbol value is the base address of its associated section.
location	Symbol value relocates to maintain its offset from the section base.

2.4.5 reftab | Reference Table

The reference table is an array of reference table entries:

```
t_reftab_entry :: struct {
    sym_index  : u64,
    sect_index : u64,
    offset     : u64,
    bit_offset : u8,
    width      : u8,
    type       : e_ref_type,
}
```

sym_index	Index of symbol referenced in symbol table.
sect_index	Index of section where symbol is referenced.

offset	Location where the reference should be inserted, relative to the start of its associated section.
bit_offset	Bit offset from byte_offset where reference should be inserted. May not be greater than or equal to 8.
width	Bit width of the reference. May not be greater than 64.
type	How the symbol's value should be modified/transformed before insertion.

```
e_ref_type :: enum u8 {
    pc_offset      = 1,
    pc_offset_div4 = 2,
    absolute       = 3,
}
```

pc_offset	Current position is subtracted from symbol value
pc_offset_div4	Current position is subtracted from symbol value, and divided by four. Used by branch and jump instructions. Should throw error if result is not an integer.
absolute	Do not modify the symbol's value.

2.4.6 metapool | Metadata Pool

The metadata pool is not explicitly structured, like the other sections. It is a repository of raw data, most often in the form of text, though this is not enforced. The metadata pool stores the data for all strings used throughout the file, such as object, section, and symbol identifiers. It also stores keys and values used in an information section, where the value may be an integer or other data type/structure. The metadata pool is permitted to be optimized and bytes may belong to multiple data items (ex. two strings, "object_one" and "this_object" may overlap), so information should be extracted/detangled before editing, and the metadata pool should be rebuilt afterwards.