Cereon

NGOFF supplement

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Revision history

Date	Comment
05 Aug 2008	Initial draft.
12 Nov 2008	Allowed veneer specification properties for relocations to use short indexes for target symbol references.

1 Contents

2 Introduction

This document describes enhancements to NGOFF object file format used by Cereon Development Suite (henceforth abbreviated as CDS).

3 NGOFF version header

The `machine` field of NGOFF version header always contains the value `0x0015`, which means that the target machine is Cereon.

4 Object module properties

In addition to standard NGOFF properties, Cereon NGOFF object modules can have additional properties specific to CDS. These properties are described in detail in the following chapters.

4.1 Cereon.PermittedFeatures

This property specifies the optional processor features that the target platform is guaranteed to have. Its value is a 64-bit bit mask stored in the object module's byte order, with individual bits assigned the following meanings:

Bit	Mask	Meaning
0	0x0000000000000001	If set to 1, the target platform is required to have a Base feature.
1	0x0000000000000002	If set to 1, the target platform is required to have a Floating Point feature.
2	0x0000000000000004	If set to 1, the target platform is required to have a Debug feature.
3	0x0000000000000008	If set to 1, the target platform is required to have a Unaligned Operands feature.
4	0x0000000000000010	If set to 1, the target platform is required to have a Protected Memory feature.
5	0x0000000000000020	If set to 1, the target platform is required to have a Virtual Memory feature.
6	0x0000000000000040	If set to 1, the target platform is required to have a Performance Monitoring feature.
63	0x8000000000000000	If set to 1, the target platform is required to have DMA channel(s).

This property is also applicable to segments and sections.

4.2 Cereon.UsedFeatures

This property specifies the optional processor features that the program actually uses. Its value is a 64-bit bit mask stored in the object module's byte order, with individual bits assigned the following meanings:

Bit	Mask	Meaning
0	0x0000000000000001	If set to 1, the program uses a Base feature.
1	0x0000000000000002	If set to 1, the program uses a Floating Point feature.
2	0x0000000000000004	If set to 1, the program uses a Debug feature.
3	0x0000000000000008	If set to 1, the program uses a Unaligned Operands feature.
4	0x0000000000000010	If set to 1, the program uses a Protected Memory feature.
5	0x0000000000000020	If set to 1, the program uses a Virtual Memory

		feature.
6	`0x0000000000000040`	If set to 1, the program uses a Performance Monitoring feature.
63	`0x8000000000000000`	If set to 1, the program uses DMA channel(s).

This property is also applicable to segments and sections.

If an object module has both `Cereon.RequiredFeatures` and `Cereon.UsedFeatures` properties, the set of used optional features must be a subset of the set of required features (i.e. a program cannot use features not guaranteed to be available on the target platform).

If an object module has only `Cereon.UsedFeatures` property but not `Cereon.RequiredFeatures` property, the set of required features is assumed to be the same as the set of used features.

If an object module has only `Cereon.RequiredFeatures` property but not `Cereon.UsedFeatures` property, the set of used features is assumed to be the same as the set of required features.

If an object module has neither of `Cereon.RequiredFeaures` and `Cereon.UsedFeatures` properties, both are assumed to be `0x800000000000007F` (all features required & used).

4.3 Cereon.MemoryModel

This property specifies memory model used by the object module. Its value is always a byte representing the memory model as shown in the following table:

Value	Memory model
`0`	Unspecified
`1`	`ILP64`
`2`	`LP64`
`3`	`IP32`

The memory model specified for an object module is inherited by all sections and segments of that object module (unless redefined for a specific section or segment).

If an object module does not have `Cereon.MemoryModel` property, `ILP64` is assumed.

This property can also be applied to segments and sections.

5 Segment properties

In addition to standard NGOFF properties, Cereon NGOFF segments can have additional properties specific to CDS. These properties are described in detail in the following chapters.

5.1 Cereon.PermittedFeatures

This property specifies the optional processor features that, as far as the given segment is concerned, the target platform is guaranteed to have. Its value is a 64-bit bit mask stored in the object module's byte order, with individual bits assigned the following meanings:

Bit	Mask	Meaning
0	0x0000000000000001	If set to 1, the target platform is required to have a Base feature.
1	0x0000000000000002	If set to 1, the target platform is required to have a Floating Point feature.
2	0x0000000000000004	If set to 1, the target platform is required to have a Debug feature.
3	0x0000000000000008	If set to 1, the target platform is required to have a Unaligned Operands feature.
4	0x0000000000000010	If set to 1, the target platform is required to have a Protected Memory feature.
5	0x0000000000000020	If set to 1, the target platform is required to have a Virtual Memory feature.
6	0x0000000000000040	If set to 1, the target platform is required to have a Performance Monitoring feature.
63	0x8000000000000000	If set to 1, the target platform is required to have DMA channel(s).

This property is also applicable to object modules and sections.

5.2 Cereon.UsedFeatures

This property specifies the optional processor features that the segment actually uses. Its value is a 64-bit bit mask stored in the object module's byte order, with individual bits assigned the following meanings:

Bit	Mask	Meaning
0	0x0000000000000001	If set to 1, the program uses a Base feature.
1	0x0000000000000002	If set to 1, the program uses a Floating Point feature.
2	0x0000000000000004	If set to 1, the program uses a Debug feature.
3	0x0000000000000008	If set to 1, the program uses a Unaligned Operands feature.
4	0x0000000000000010	If set to 1, the program uses a Protected Memory feature.

5	0x0000000000000020	If set to 1, the program uses a Virtual Memory feature.
6	0x0000000000000040	If set to 1, the program uses a Performance Monitoring feature.
63	0x8000000000000000	If set to 1, the program uses DMA channel(s).

This property is also applicable to object modules and sections.

If a segment has both `Cereon.RequiredFeatures` and `Cereon.UsedFeatures` properties, the set of used optional features must be a subset of the set of required features (i.e. a segment cannot use features not guaranteed to be available on the target platform).

If a segment does not have either or both of the `Cereon.UsedFeatures` and `Cereon.RequiredFeatures` properties, the corresponding property (or both) is inherited from the containing object module.

5.3 Cereon.MemoryModel

This property specifies memory model used by the segment. Its value is always a byte representing the memory model as shown in the following table:

Value	Memory model
0	Unspecified
1	ILP64
2	LP64
3	IP32

If an segment does not have `Cereon.MemoryModel` property, this property is inherited from the containing object module.

This property can also be applied to object module and sections.

5.4 Cereon.Loading

This property specifies how the segment is loaded. Its value is always a byte representing the segment loading mode as shown in the following table:

Value	Memory model
0	Unspecified
1	Preload
2	Load on demand
3	Noload

If a segment does not have `Cereon.Loading` property, Preload is assumed.

This property can also be applied to sections.

6 Section properties

In addition to standard NGOFF properties, Cereon NGOFF sections can have additional properties specific to CDS. These properties are described in detail in the following chapters.

6.1 Cereon.PermittedFeatures

This property specifies the optional processor features that, as far as the given sections is concerned, the target platform is guaranteed to have. Its value is a 64-bit bit mask stored in the object module's byte order, with individual bits assigned the following meanings:

Bit	Mask	Meaning
0	0x0000000000000001	If set to 1, the target platform is required to have a Base feature.
1	0x0000000000000002	If set to 1, the target platform is required to have a Floating Point feature.
2	0x0000000000000004	If set to 1, the target platform is required to have a Debug feature.
3	0x0000000000000008	If set to 1, the target platform is required to have a Unaligned Operands feature.
4	0x0000000000000010	If set to 1, the target platform is required to have a Protected Memory feature.
5	0x0000000000000020	If set to 1, the target platform is required to have a Virtual Memory feature.
6	0x0000000000000040	If set to 1, the target platform is required to have a Performance Monitoring feature.
63	0x8000000000000000	If set to 1, the target platform is required to have DMA channel(s).

This property is also applicable to object modules and segments.

6.2 Cereon.UsedFeatures

This property specifies the optional processor features that the sections actually uses. Its value is a 64-bit bit mask stored in the object module's byte order, with individual bits assigned the following meanings:

Bit	Mask	Meaning
0	0x0000000000000001	If set to 1, the program uses a Base feature.
1	0x0000000000000002	If set to 1, the program uses a Floating Point feature.
2	0x0000000000000004	If set to 1, the program uses a Debug feature.
3	0x0000000000000008	If set to 1, the program uses a Unaligned Operands feature.
4	0x0000000000000010	If set to 1, the program uses a Protected Memory feature.

5	0x0000000000000020	If set to 1, the program uses a Virtual Memory feature.
6	0x0000000000000040	If set to 1, the program uses a Performance Monitoring feature.
63	0x8000000000000000	If set to 1, the program uses DMA channel(s).

This property is also applicable to object modules and segments.

If a section has both `Cereon.RequiredFeatures` and `Cereon.UsedFeatures` properties, the set of used optional features must be a subset of the set of required features (i.e. a section cannot use features not guaranteed to be available on the target platform).

If a bound section does not have either or both of the `Cereon.UsedFeatures` and `Cereon.RequiredFeatures` properties, the corresponding property (or both) is inherited from the segment containing the section.

If a roaming section does not have either or both of the `Cereon.UsedFeatures` and `Cereon.RequiredFeatures` properties, the corresponding property (or both) is inherited from the containing object module.

6.3 Cereon.MemoryModel

This property specifies memory model used by the section. Its value is always a byte representing the memory model as shown in the following table:

Value	Memory model
0	Unspecified
1	ILP64
2	LP64
3	IP32

If a bound section does not have `Cereon.MemoryModel` property, this property is inherited from the segment containing that section.

If a roaming section does not have `Cereon.MemoryModel` property, this property is inherited from the containing object module.

This property can also be applied to object module and segments.

6.4 Cereon.Loading

This property specifies how the segment is loaded. Its value is always a byte representing the segment loading mode as shown in the following table:

Value	Memory model
0	Unspecified
1	Preload
2	Load on demand

3	Noload

If an segment does not have `Cereon.Loading` property, Preload is assumed.

This property can also be applied to sections.

7 Relocation properties

In addition to standard NGOFF properties, Cereon NGOFF relocations can have additional properties specific to CDS. These properties are described in detail in the following chapters.

7.1 Cereon.Jump8

The value of this property is always 4 bytes long and is laid out as follows:

```
struct CereonJump8PropertyValue
{
    uint8_t symbol;
};
```

where:

- `symbol` refers to a symbol by its index in the object module's symbol table; the value is stored in the object module's byte order.

This property specifies that a relocation is actually a long jump (`j` or `jal`) to the location "`<address of symbol>`". If, during linking, the relocation produces an error (for example, when the jump target is out of range), the error is not reported and a long jump veneer is generated instead. This applies to both static and dynamic linker.

7.2 Cereon.Jump16

The value of this property is always 2 bytes long and is laid out as follows:

```
struct CereonJump16PropertyValue
{
    uint16_t symbol;
};
```

where:

- `symbol` refers to a symbol by its index in the object module's symbol table; the value is stored in the object module's byte order.

This property specifies that a relocation is actually a long jump (`j` or `jal`) to the location "`<address of symbol>`". If, during linking, the relocation produces an error (for example, when the jump target is out of range), the error is not reported and a long jump veneer is generated instead. This applies to both static and dynamic linker.

7.3 Cereon.Jump32

The value of this property is always 4 bytes long and is laid out as follows:

```
struct CereonJump32PropertyValue
```

```
{
    uint32_t symbol;
};
```

where:

- `symbol` refers to a symbol by its index in the object module's symbol table; the value is stored in the object module's byte order.

This property specifies that a relocation is actually a long jump (`j` or `jal`) to the location "`<address of symbol>`". If, during linking, the relocation produces an error (for example, when the jump target is out of range), the error is not reported and a long jump veneer is generated instead. This applies to both static and dynamic linker.

7.4 Cereon.Jump64

The value of this property is always 8 bytes long and is laid out as follows:

```
struct CereonJump64PropertyValue
{
    uint64_t symbol;
};
```

where:

- `symbol` refers to a symbol by its index in the object module's symbol table; the value is stored in the object module's byte order.

This property specifies that a relocation is actually a long jump (`j` or `jal`) to the location "`<address of symbol>`". If, during linking, the relocation produces an error (for example, when the jump target is out of range), the error is not reported and a long jump veneer is generated instead. This applies to both static and dynamic linker.

8 Mapping symbols

To allow NGOFF processing tools to determine the type of a section contents, Cereon NGOFF object modules use mapping symbols.

A mapping symbol is a local symbol hosted by a section. Depending on the name of the mapping symbol, all bytes from the mapping symbol's location until the end of the section or the closest following mapping symbol are assumed to represent contents of a given type. The following table summarizes supported content types:

Mapping symbol name	Content type
`$undef`	Bytes following the mapping symbol represent uninitialized data.
`$code`	Bytes following the mapping symbol represent code.
`$data`	Bytes following the mapping symbol represent initialized data.
`$dma`	Bytes following the mapping symbol represent DMA instructions.

The "size" property of each symbol is set to the number of consecutive bytes whose contents is defined by the symbol.

In the absence of mapping symbols, the following interpretation of section contents is used:

- All uninitialized bytes at the end of the section are considered undefined.
- All initialized bytes within executable sections are considered to be code.
- All initialized bytes within non-executable sections are considered to be data.

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