ASIS-for-GNAT Reference Manual

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GNAT, The GNU Ada Development Environment
The GNAT Ada Compiler
Version 2018

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CHAPTER

ONE

ABOUT THIS MANUAL

This Manual contains reference material for developers using ASIS-for-GNAT — GNAT's implementation of the Ada Semantic Interface Specification (ASIS). It provides information about ASIS-for-GNAT's implementation-specific characteristics and current implementation limitations. (The term 'implementation-specific' in ASIS means what is called 'implementation-defined' in the Ada Reference Manual.)

ASIS has been designed as a portable basis for many kinds of Ada code analysis tools. However, for situations where a developer may need to exploit the characteristics of a particular Ada compiler, ASIS also contains a number of implementation-specific features. These allow interfacing with the underlying Ada implementation, as well as exploiting the implementation permissions for particular queries.

Of course, any ASIS application that uses implementation-specific features may be nonportable. You should follow good programming practice and isolate and clearly document any sections of your program that make use of such features in a nonportable manner.

What This Manual Contains

This manual contains the following chapters:

- *ASIS-for-GNAT and the ASIS Standard*, describes the relationship between ASIS-for-GNAT and the existing ASIS International Standard.
- *ASIS Extensions*, describes the contents of the packages `Asis.Extensions`, `Asis.Extensions.Flat_Kinds` and `Asis.Extensions.Iterator`.
- *Implementation-Specific Features and Implementation Permissions*, presents the aspects of the ASIS definition that are implementation specific and describes their treatment in ASIS-for-GNAT.
- *Debugging Information*, describes the kinds of debugging information that you can generate with ASIS-for-GNAT.

What You Should Know Before Reading This Manual

This Reference Manual assumes that you are familiar with Ada 95 language as defined by the International Standard ISO/IEC-8652:1995, and with ASIS 95 as defined by the ASIS 95 International Standard ISO/IEC 15291:1999.

This Manual supplements the information presented in the ASIS-for-GNAT User's Guide and uses the terminology introduced there.

Related Information

For more information, please refer to the following documents:

- GNAT User's Guide
- ASIS-for-GNAT User's Guide
- Ada 95 Reference Manual
- ASIS 95 Standard

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CHAPTER

TWO

ASIS-FOR-GNAT AND THE ASIS STANDARD

ASIS-for-GNAT implements ASIS 95 and contains several extensions (see *ASIS Extensions*) as allowed by the ASIS Standard, Section 1.1.3.1.

The differences between the GNAT and standard ASIS are that ASIS-for-GNAT:

- includes GNAT-specific comment headers at the beginning of each source file;
- supplies additional context clauses;
- defines the packages' private parts;
- is formatted to comply with GNAT coding style;
- declares the `Is_Dispatching_Operation` query in `Asis.Declarations` rather than in `Asis.Expressions`.

  This query has `A_Declaration Element` as its argument and, according to the general principles of the ASIS package hierarchy, it should be in the `Asis.Declarations` spec;
- for the optional Data Decomposition Annex, the package `Asis.Data_Decomposition.Portable_Transfer` is not provided;
- includes extensions that support features introduced in Ada 2005.

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CHAPTER

THREE

ASIS EXTENSIONS

ASIS-for-GNAT provides some additional types and queries as ASIS extensions. All these queries are defined and documented in the hierarchy headed by package `Asis.Extensions`. They are referred as 'ASIS extensions' or 'ASIS extension queries' below.

All the ASIS extensions obey the general ASIS rules:

- When using ASIS extensions, you have to follow the required sequencing of calls
- Only ASIS-defined exceptions propagate outside ASIS extension queries

If the documentation of an ASIS extension query contains a list of 'appropriate' `Element` kinds, then the query can be applied only to `Element`s from this list, and it raises `ASIS_Inappropriate_Element` with `Value_Error` status otherwise. If the documentation of an ASIS extension query contains a list of 'expected' element kinds, then the query can be applied to an `Element` having any kind, but it returns a meaningful result only for `Element`s from this list.

The current set of ASIS extensions originated from the ASIS implementation needs and from the development of some ASIS tools inside the ASIS-for-GNAT team. The `Asis.Extensions` hierarchy is not necessarily frozen: some further extension queries may be added, and suggestions from ASIS application developers are welcome.

Note that some of the ASIS extensions are implemented as ASIS *secondary queries* — that is, the implementation of such a query is a sequence of primary ASIS queries. Some other extensions are *pure extensions*; that is, their implementation is based on direct access to GNAT's internal data structures.

3.1 Asis.Extensions

This package, whose spec is located in the file `asis-extensions.ads`, contains the declarations of various ASIS extensions, including dynamic `Element` and `Compilation_Unit` list types, placeholder actual parameters for `Asis.Iterator.Traverse_Element`, additional `Element` structural and semantic queries, queries that return information about the status of the source file for a `Compilation_Unit`, queries returning the (images of the) values of static expressions, etc.

3.2 Asis.Extensions.Flat_Kinds

The ASIS `Element` classification hierarchy is based on a set of Ada enumeration types, each corresponding to a 'level' in the hierarchy. The package `Asis.Extensions.Flat_Kinds`, whose spec is located in the file `asis-extensions-flat_kinds.ads`, defines the enumeration type `Flat_Element_Kinds`; this type combines the values of all these types and thus provides a 'flat' view onto the syntactic `Element` classification.

3.3 Asis.Extensions.Iterator

This package, whose spec is located in the file asis-extensions-iterator.ads, contains the declarations of Traverse_Unit generic procedure that is a generalization of the standard ASIS Asis.Iterator.Traverse_Element iterator. Traverse_Unit provides the depth-first traversal of the whole syntactical structure of the ASIS Compilation Unit.

CHAPTER

FOUR

IMPLEMENTATION-SPECIFIC FEATURES AND IMPLEMENTATION PERMISSIONS

ASIS permits four kinds of implementation-specific behavior.

First, ASIS subprograms that define an interface between an ASIS implementation and the underlying Ada implementation have implementation-specific parameters. There are three such queries — `Asis.Implementation.Initialize`, `Asis.Implementation.Finalize` and `Asis.Ada_Environments.Associate`.

Each has a string parameter named `Parameters` with an implementation-specific meaning. The meaning of the `Parameters` string in ASIS-for-GNAT is discussed in *Interacting with the Underlying Ada Implementation*.

Second, in some areas the ASIS standard explicitly grants the implementation permission to provide restricted functionality; generally this allows omitting features that could present considerable implementation difficulty. Such permissions usually affect more than one ASIS query. The ASIS package `Asis.Implementation.Permissions` contains boolean queries identifying the choices made by a given ASIS implementation. The ASIS-for-GNAT approach to these implementation permissions is discussed in *Implementation Permissions*.

Third, the ASIS standard defines specific implementation permissions for some queries. Also, the result of a query may be implementation specific because of the nature of the query. See *ASIS Queries Having Specific Implementation Permissions or Implementation-Specific Results*.

Finally, ASIS-for-GNAT provides special `Context` manipulation mechanisms that supplement those defined in the ASIS standard. These additional `Context` modes may be useful for some ASIS applications.

4.1 Interacting with the Underlying Ada Implementation

This section describes how to use the `Parameters` string to pass implementation-specific information to several ASIS subprograms.

4.1.1 Format of the `Parameters` String

A `Parameters` string is passed to three ASIS subprograms: `Asis.Implementation.Initialize`, `Asis.Implementation.Finalize`, and `Asis.Ada_Environments.Associate`.

The `Parameters` string comprises substrings delimited by separators. The substrings are called *parameters* (with lower-case 'p') below. A separator is a non-empty string comprising characters from the set <Space>, <LF>, and <CR>. There may be 0 or more parameters in a `Parameters` string, and there may be separators before the first and/or after the last parameter.

Each of the queries `Asis.Implementation.Initialize`, `Asis.Implementation.Finalize`, and `Asis.Ada_Environments.Associate` has specific rules for the format of its parameters. If some parameter is

not well-formed, then either a warning message is generated or else the `ASIS_Failed` exception is raised with the `Parameter_Error` status. The descriptions below explain the situations where `ASIS_Failed` is raised.

4.1.2 Parameters of `Asis.Implementation.Initialize`

The allowed parameters for `Asis.Implementation.Initialize` are as follows:

`-d<flag>` The specific ASIS-for-GNAT debug flag named `<flag>` is set ON

`-dall` All the ASIS-for-GNAT debug flags are set ON

`-k` Keep going even if an internal implementation error is detected. When a non-ASIS exception is raised, it is replaced by raising `ASIS_Failed` with `Unhandled_Exception_Error` status (this is the only case when `Unhandled_Exception_Error` is set) and the `Diagnosis` string containing the name and the message from the non-ASIS exception originally raised

`-nbb` No bug box. Do not output to `Standard_Error` the bug box containing the description of the internal implementation bug. Implies `-k`

`-sv` Set the strong GNAT/ASIS version check when reading the tree files

`-wv` Set the weak GNAT/ASIS version check when reading the tree files

`-we` All ASIS warnings are treated as errors.

When execution reaches the point where the warning would occur, the `ASIS_Failed` exception is raised; the warning message is the ASIS `Diagnosis` string.

`-ws` All ASIS warning messages are suppressed.

The `<flag>` value for the `-d` parameter may be any lower case letter from `a` through `z` or any digit from `0` through `9`, although not all of the 36 possible flags are implemented. For more information, refer to the documentation in the source file `a4g-a_debug.adb`. See also *ASIS Debug Flags*.

If more then one parameter controlling the warning mode is set in the `Parameters` string, all but the last one are ignored.

4.1.3 Parameters of `Asis.Implementation.Finalize`

No parameters are allowed for `Asis.Implementation.Finalize`.

`Asis.Implementation.Finalize` resets all the general ASIS-for-GNAT parameters to their default values (that is, all the debug flags are set OFF, and the warning mode is set to the default warning mode).

4.1.4 Parameters of `Asis.Ada_Environments.Associate`

The following parameters are allowed:

`-C1` The `Context` comprises a single tree file, whose name is given as the next parameter in the `Parameters` string.

`-CN` The `Context` comprises a set of one or more tree files, whose names are given as the next set of parameters in the `Parameters` string.

`-CA` The `Context` comprises all the tree files in the tree search path.

`-FS` All the trees considered as making up a given `Context` are created 'on the fly', whether or not the corresponding tree file already exists. Once created, a tree file then is reused as long as the `Context` remains open.

`-FT` Only pre-created trees are used; no tree files are created by ASIS.

-FM Mixed approach: if a needed tree does not exist, an attempt is made to create it 'on the fly'.

-SA Source files for all the `Compilation_Units` belonging to the `Context` (except the predefined `Standard` package) are considered in the consistency check when opening the `Context`.

-SE Only existing source files for all the `Compilation_Units` belonging to the `Context` are considered in the consistency check when opening the `Context`.

-SN No source files from the underlying file system are taken into account when checking the consistency of the set of tree files making up the `Context`.

-I<dir> Defines the directory in which to search for source files when compiling sources to create a tree 'on the fly'.

--GCC=compiler_name Defines the program to be called to create the tree on the fly

-gnatec<file> Defines the additional configuration file to be used when calling GNAT to create the tree on the fly for `-FS` or `-FM` Context

-gnatA Avoid processing `gnat.adc` when calling GNAT to create the tree on the fly for `-FS` or `-FM` Context

-T<dir> Defines the directory in which to search for a tree file.

<file_name> Defines the name of a tree file (used in conjunction with `-C1` or `-CN`).

For the `-I` and `-T` parameters, `<dir>` should denote an existing directory in the underlying file system. The '.' and '..' notations are allowed, as well as relative or absolute directory names. If `<dir>` does not denote an existing directory, `ASIS_Failed` with `Parameter_Error` status is raised.

For ASIS `-FS` or `-FM` Context, Context parameters `-I`, `-gnatec` and `-gnatA` are passed to the GNAT call to create the tree on the fly and these parameters have exactly the same meaning as they have for GNAT.

A tree file name given by a `<file_name>` parameter may or may not contain directory information.

Any relative directory name or file name containing relative directory information should start from '.' or '..'.

If a directory or a file name used as a part of some Context parameter contains space characters, this name should be quoted.

The search path associated with an ASIS `Context` consists of the directories listed as parameters for the `Asis.Ada_Environments.Associate` query, in the same order as they are included in the actual `Parameters` string. The ASIS source search path consists only of the directories following `-I`, and the ASIS tree search path consists only of the directories following `-T`. If no source (tree) directories are present in the value of the `Parameters` string, then the ASIS source (tree) search path consists of the current directory only. Otherwise the current directory is included in the ASIS search path if and only if it is set explicitly as `-I.` or `-T.` respectively.

If an ASIS `Context` is associated with an `-FS` or `-FM` option, the `Context` source search path is used to locate sources of the units for which tree files need to be created, and to locate other source files needed during compilation. For example, if we have:

```
Asis.Ada_Environments.Associate
  (My_Context,
  "My_Context_Name",
  "-CA -FS -I./dir -I.");
```

then, when processing a call:

```
My_Unit := Asis.Compilation_Units.Library_Unit_Declaration
             ("Foo", My_Context);
```

ASIS first tries to locate the source file `foo.ads` in `./dir`, and if this attempt fails, it tries to locate it in the current directory. If there is no such file in the current directory, ASIS continues the search by looking into the directories listed in the value of `ADA_INCLUDE_PATH` environment variable. If the source file is found (say in the current directory), ASIS creates the tree file by calling the compiler:

```
$ gcc -c -gnatc -gnatt -I./dir -I. -I- foo.ads
```

If an ASIS `Context` is associated with `-CA` option, then, when this `Context` is opened, ASIS processes all the tree files located in the tree search path associated with the `Context`.

The following further rules define the required combinations of parameters in the actual `Parameters` string:

- `-C1` and `-CN` require `-FT`
- `-FS` and `-FM` require `-SA`

In case an incompatible combination is set, `ASIS_Failed` with `Parameter_Error` status is raised.

If the actual `Parameters` string passed to `Associate` contains no parameters, the default parameters are `-CA`, `-FT`, and `-SA`.

The `-FS` and `-FM` options define *dynamic Context modes*; they allow the content of a `Context` (that is, the set of ASIS `Compilation_Unit`s contained in the `Context`) to be changed while the `Context` is open. See *Dynamic Context Modes* for more details.

For the `Name` parameter of the `Asis.Ada_Environments.Associate` query, any string can be passed as an actual parameter. No verification is performed on the contents, and no semantics are associated with this parameter.

4.2 Implementation Permissions

This section describes how ASIS-for-GNAT deals with implementation permissions.

4.2.1 `Asis.Implementation.Permissions` Queries

The Boolean queries defined in the `Asis.Implementation.Permissions` package return the following results:

Query	*Value*
Is_Formal_Parameter_Named_Notation_Supported	True
Default_In_Mode_Supported	True
Generic_Actual_Part_Normalized	False
Record_Component_Associations_Normalized	False
Is_Prefix_Call_Supported	True
Function_Call_Parameters_Normalized	False
Call_Statement_Parameters_Normalized	False
Discriminant_Associations_Normalized	False
Is_Line_Number_Supported	True
Is_Span_Column_Position_Supported	True
Is_Commentary_Supported	True
Attributes_Are_Supported	False
Implicit_Components_Supported	False (*)
Object_Declarations_Normalized	False
Predefined_Operations_Supported	False (*)
Inherited_Declarations_Supported	True (*)
Inherited_Subprograms_Supported	True (*)
Generic_Macro_Expansion_Supported	True

(*) See also *Processing Implicit Elements*.

4.2.2 Processing Implicit `Elements`

ASIS `Elements` represent both explicit and implicit components of Ada programs. (An example of an implicit construct is an inherited subprogram of a derived type.) Some ASIS queries can return implicit `Elements` (that is, `Elements` representing implicit Ada constructs). Any syntactic or semantic query should accept an implicit `Element` as an `Element` parameter, but the ASIS Standard allows an implementation not to support implicit `Elements` at all, or to support them only partially. If an implementation does not support the implicit `Element` representing a particular kind of construct, then an ASIS query that is supposed to process this implicit `Element` should return either a `Nil_Element` or a `Nil_Element_List` depending on whether the query returns a single `Element` or an `Element_List`.

Implicit `Elements` are partially supported by ASIS-for-GNAT.

ASIS-for-GNAT supports implicit `Elements` for the following constructs:

- Derived user-defined subprograms
- Derived enumeration literals
- Derived record components

ASIS-for-GNAT does not support implicit `Elements` representing implicit declarations of predefined type operations (such as '=', or the '+' operation for numeric types).

4.2.3 Processing Several Contexts at a Time

According to the ASIS Standard, the number of ASIS `Contexts` that can be associated and opened at a time, as well as the number of ASIS `Compilation_Units` that can be processed at a time, are implementation specific. ASIS-for-GNAT does not impose any restriction on the number of `Contexts` opened at the same time, or on the number of `Compilation_Units` that can be obtained from all the opened `Contexts`, as long as the application does not go beyond general system resource limitations.

However, for a `Context` associated with an `-FS` or `-FM` option, all the trees created 'on the fly' while obtaining `Compilation_Units` from this `Context` are placed in the current directory. If the current directory also contains

some tree files belonging to another Context, the latter may become corrupted. To process more than one Context safely, an application should have at most one Context associated with the -FS or -FM option. Moreover, if among Contexts processed at the same time there is one that can create trees 'on the fly', then the other Contexts should not use tree files located in the current directory.

4.2.4 Implementation-Defined Types and Values

All the implementation-defined types, subtypes and values depend on the subtype Implementation_Defined_Integer_Type and on the Implementation_Defined_Integer_Constant defined in package Asis. ASIS-for-GNAT's declarations for these entities are the same as in the ASIS Standard:

```
subtype Implementation_Defined_Integer_Type is Integer;
Implementation_Defined_Integer_Constant : constant := 2**31-1;
```

All the ASIS (sub)types used as list indexes for ASIS array types have Implementation_Defined_Integer_Constant as an upper bound.

4.3 ASIS Queries Having Specific Implementation Permissions or Implementation-Specific Results

This section documents queries having implementation permissions (given under --|IP sentinel in the ASIS definition) and queries whose behavior is otherwise implementation specific. Such queries are presented below in their order of appearance in the ASIS Standard. The clause and subclause numbers shown are those from the ASIS Standard.

The results returned by the ASIS Debug_Image queries are discussed in *Interpreting Debug Images*.

ASIS 8 package Asis.Ada_Environments

ASIS 8.1 function Default_Name

- Null string is returned.

ASIS 8.2 function Default_Parameters

- Null string is returned;.

ASIS 8.4 procedure Open

- For a Context associated with the -CA option:
  - If -FS is also set, nothing is done.
  - If the -FT or -FM is set, all the tree files (that is, files having .adt suffix) in the tree search path associated with the Context are processed. ASIS reads in each tree file and checks that it was created with the -gnatc option. Tree files that cannot be read in or that were not created with the -gnatc option are ignored. For each other tree ASIS collects some 'black-box' information about the Compilation_Units that it represents, and performs a consistency check for every unit it encounters in the tree (see ASIS-for-GNAT User's Guide for a discussion of the consistency problem). If any consistency check fails, ASIS_Failed is raised and the Context remains closed.
- For a Context associated with a -C1 or -CN option, ASIS processes all the tree files associated with the Context, collecting 'black-box' information and performing consistency checks for all the encountered Compilation Units. If for any reason a tree file cannot be successfully read in for a Context associated with a -C1 option, ASIS_Failed is raised and the Context remains closed. If a tree read fails for a Context

associated with a `-CN` option, an ASIS warning is generated and the `Context` opening process continues. If any consistency check fails, `ASIS_Failed` is raised and the `Context` remains closed.

ASIS 9 `package Asis.Ada_Environments.Containers`

- ASIS-for-GNAT supports the trivial `Container` model. Every `Context` contains exactly one `Container`, whose content and name are the same as its enclosing `Context`

ASIS 10 `package Asis.Compilation_Units`

ASIS 10.3 `function Unit_Origin`

- `A_Predefined_Unit` origin is returned for those compilation units listed in RM95, Annex A(2), and only for these units.
- `An_Implementation_Unit` origin is returned for compilation units that are the components of the GNAT Run-Time Library, but that are not listed in RM95, Annex A(2).
- `An_Application_Unit` origin is returned for all other compilation units.

ASIS 10.6 `function Library_Unit_Declaration` and ASIS 10.7 `function Compilation_Unit_Body`

- When processing a `Context` associated with an `-FS` or `-FM` option, if ASIS cannot find a needed unit in the tree files that have been already processed, it tries to create the needed tree by locating the source of the unit and compiling it 'on the fly'. If this attempt fails for any reason, `Nil_Compilation_Unit` is returned.

ASIS 10.13 `function Corresponding_Declaration`

- ASIS-for-GNAT does not make use of ASIS `Compilation_Units` of `An_Unknown_Unit` kind.
- If an argument is of `A_Public_Declaration_And_Body` class, `Nil_Compilation_Unit` is returned.

ASIS 10.14 `function Corresponding_Body`

- ASIS-for-GNAT does not make use of ASIS `Compilation_Units` of `An_Unknown_Unit` kind.

ASIS 10.22 `function Can_Be_Main_Program`

- For GNAT, any parameterless library procedure and any parameterless library function returning a result of an integer type is classified by this query as a (possible) main subprogram for a partition.
- If for such a library subprogram both spec and body exist as ASIS `Compilation_Units` retrievable from a given ASIS `Context`, both are considered as `Can_Be_Main_Program`.

ASIS 10.24 `function Text_Name`

- This function returns the name of the source file containing the source of `Compilation_Unit`. This name may or may not contain a prefix denoting the directory in the underlying file system. If present, the directory may be given in absolute or relative form, depending on the command line options that were used for the call to GNAT that created the corresponding tree file.
- This function does not check the existence of the corresponding source file in the underlying file system, it just reflects the situation which was in effect when the corresponding tree file was created. Thus, if you delete or move the corresponding source file after creating the tree, the full file name returned by this function will be incorrect.
- Use the query `Asis.Extensions.Source_File_Status` to get the information about the current status of the source file for a `Compilation_Unit`.

ASIS 10.25 `function Text_Form`

- In the GNAT compilation model all source files are ordinary text files in the underlying file system. Therefore this function always returns a `Nil_Asis_String` to indicate that `Text_IO.Open` uses the default options for manipulating Ada sources.

ASIS 10.26 `function Object_Name`

- Returns a null string. In the GNAT environment, creating an object file has no connection with creating trees for ASIS.

ASIS 10.27 `function Object_Form`

- Returns a null string.

ASIS 10.29 `function Has_Attribute`

- Returns `False`. ASIS-for-GNAT does not provide any additional attributes for Compilation Units.

ASIS 10.30 `function Attribute_Value_Delimiter`

- Returns a wide string of length one containing the `LF` wide character.

ASIS 10.31 `function Attribute_Values`

- A null string is returned.

ASIS 11 `package Asis.Compilation_Units.Times`

ASIS 11.2 `function Time_Of_Last_Update`

- This function returns the time stamp (the time of the latest change) of the corresponding source file. The corresponding source file is the source file whose name is returned by `Asis.Compilation_Units.Text_Name`.

ASIS 11.3 `function Compilation_CPU_Duration`

- This function always returns zero duration, because the CPU compilation duration concept does not apply to ASIS-for-GNAT

ASIS 11.4 `function Attribute_Time`

- This function always returns `Nil_ASIS_Time` because ASIS-for-GNAT does not provide any `Compilation_Unit` attributes

ASIS 13 `package Asis.Elements`

ASIS 13.3 `function Context_Clause_Elements`

- This function returns exactly those clauses and pragmas that are in the source for the unit.
- Returns `Nil_Element_List` if the argument unit is of `A_Nonexistent_Declaration`, `A_Nonexistent_Body` or `An_Unknown_Unit` kind
- Returns `Nil_Element_List` for the predefined package `Standard`. For all other predefined Ada compilation units, returns their context clauses as they appear in the sources held in the GNAT Run-Time Library.

ASIS 13.4 `function Configuration_Pragmas`

- This function always returns `Nil_Element_List`, because in the GNAT compilation environment "a list of pragmas that apply to all future compilation_unit elements compiled into `The_Context`" essentially depends on the GNAT options set when compiling a unit (in particular the `-gnatA` and `-gnatec` options), and this cannot be determined from the content of the given `Context`.

ASIS 13.5 `function Compilation_Pragmas`

- If the argument unit has been compiled on its own to produce a corresponding tree file, then the result contains the configuration pragmas from the GNAT configuration file(s) involved in this compilation. Otherwise (that is, if the argument unit has been compiled only as an effect of compiling some other unit), the result contains only those pragmas that belong to the unit's source file.
- A pragma that appears in the unit's context clause is included in the result list only if it is a configuration pragma.
- Returns `Nil_Element_List` for the predefined package `Standard`.

ASIS 13.31 `function Is_Equal`

- Two elements representing configuration pragmas belonging to `A_Configuration_Compilation` unit (or components thereof) are considered as being equal only if they are created by the same compilation (belong to the same tree).

ASIS 13.36 `function Enclosing_Element`

- ASIS-for-GNAT does not require the `Element_Context` parameter. The `Enclosing_Element` function with two parameters just calls the `Enclosing_Element` function with one parameter for its `Element` parameter.

ASIS 15 `package Asis.Declarations`

ASIS 15.24 `function Body_Block_Statement`

- If the body passed as the actual parameter has no declarative items of its own, `Asis.Statements.Is_Declare_Block` returns `False`.

ASIS 18 `package Asis.Statements`

ASIS 18.14 `function Is_Declare_Block`

- If the argument represents the dummy block statement created by `Asis.Declarations.Body_Block_Statement` function, the result will be `True` if and only if the corresponding body has declarative items.

ASIS 20 `package Asis.Text`

ASIS 20.1 `type Line`

- Lines in ASIS-for-GNAT do not contain any end-of-line characters (see RM95, 2.2(2)).

ASIS 20.22 `function Delimiter_Image`

- Returns a wide string of length one, containing the `LF` wide character.

4.4 Processing of Predefined Input-Output Packages

The GNAT compiler transforms the structure of the predefined input-output packages (*Ada.Text_IO*, `Ada.Wide_Text_IO` and `Ada.Wide_Wide_Text_IO`) to optimize compilations of their clients. The documentation of `Ada.Text_IO` says:

```
--  Note: the generic subpackages of Text_IO (Integer_IO, Float_IO, Fixed_IO,
--  Modular_IO, Decimal_IO and Enumeration_IO) appear as private children in
--  GNAT. These children are with'ed automatically if they are referenced, so
--  this rearrangement is invisible to user programs, but has the advantage
--  that only the needed parts of Text_IO are processed and loaded.
```

The same happens for `Ada.Wide_Text_IO` and `Ada.Wide_Wide_Text_IO`. In this situation ASIS follows not the Ada Standard, but the actual code contained in the GNAT Run-Time Library. That is, the `Enclosing_Compilation_Unit` for an ASIS `Element` representing `Ada.Text_IO.Integer_IO` will be not the `Compilation_Unit` that contains the whole package `Ada.Text_IO`, but the `Compilation_Unit` representing its private child as it is described above.

The `Asis.Extensions` package contains a query named `Is_Sub_Package_Implemented_As_Child_Unit` that allows to detect such private children of predefined Ada text input-output packages.

4.5 Representation clauses and `-gnatI` GNAT option

GNAT `-gnatI` allows to ignore all the representation clauses in the code being compiled. This allows to compile the code if it contains representation clauses that are illegal in the given compilation environment. ASIS can process tree files created with `-gnatI`, and for the ASIS `Context` that is based on such trees, ASIS does not yield `Elements` that correspond to representation clauses.

Note that you will see these representation clauses in the text images of the enclosing `Elements`, but nevertheless you will not be able to get them as subcomponents of such `Elements`.

4.6 Dynamic `Context` Modes

If an ASIS `Context` is defined with an `-FS` or `-FM` option, then ASIS may compile sources 'on the fly' to obtain `Compilation_Unit`s. Thus the content of the `Context` will not necessarily remain frozen when the `Context` is open — when ASIS gets a new `Compilation_Unit`, it 'adds' it to the `Context`. The `-FS` and `-FM` options are referred to as *dynamic Context modes*.

The difference between the two modes is as follows:

`-FS` ASIS does not take into account any existing tree file when opening a `Context`.

`-FM` ASIS first processes the tree files in the tree search path. If a given `Compilation_Unit` is present in the existing set of tree files, these tree files are used; otherwise ASIS tries to locate the source of the unit and to compile it to produce a tree file.

For both `-FS` and `-FM` `Context`s, once a tree file is created it is added to the set of tree files making up the `Context` and then it is reused (without recreating it from sources again) for the queries dealing with `Compilation_Unit`s represented by this tree.

An advantage of these dynamic `Context` modes is that you do not have to create the tree files explicitly; to users of an ASIS application based on such `Context` modes the application appears to operate directly from source files. But there is also a drawback, a consequence of the fact that the content of a `Context` may change while the `Context` is open: some ASIS queries dealing with `Compilation_Unit`s or returning lists of `Compilation_Unit`s raise the `ASIS_Failed` exception (with `Use_Error` status).

These queries are as follows:

```
Asis.Compilation_Units:
     Library_Unit_Declarations
     Compilation_Unit_Bodies
     Compilation_Units
     Corresponding_Children
```

Another limitation of the dynamic `Context` mode is that ASIS uses the standard GNAT naming scheme to compute the name of the source to be compiled from the name of the corresponding Ada compilation unit. That is, if the name of the source containing the code of some unit does not follow the GNAT naming scheme, then ASIS will not locate this source, and it will treat this unit as `Nil_Compilation_Unit`.

CHAPTER

FIVE

DEBUGGING INFORMATION

There are two kinds of the debugging information available in ASIS-for-GNAT — debug images returned by the ASIS query `Debug_Image` (for `Context`s, `Compilation_Unit`s and `Element`s); and debug output generated by ASIS queries when the corresponding implementation debug flag is set ON during ASIS initialization (see *Parameters of Asis.Implementation.Initialize*).

5.1 Interpreting Debug Images

It is straightforward to interpret the debug images generated for the main ASIS abstractions, because most of the information directly corresponds to ASIS concepts. The following details of debug images are implementation specific.

- `Context`
  - **`Context` Id** This is the internal `Context` Id used in the implementation data structures. This Id is assigned to a `Context` when it is associated for the first time, and it remains unchanged and unique until ASIS is finalized.
  - **All tree files** The number of tree files making up the given `Context`.
- `Compilation_Unit`
  - **`Compilation_Unit` Id** This is the internal `Compilation_Unit` Id used in the implementation data structures. This Id remains unchanged and unique until the unit's enclosed `Context` is closed.
  - **Is consistent** `True` if the same version of the unit's source was used for all the tree files making up the enclosed unit's context, and `False` otherwise
- `Element`
  - **Node, R_Node, Node_Field_1** Tree nodes on which the internal representation of a given `Element` is based. They are meaningful only in the tree file indicated in the `Enclosing_Tree` field of the debug image
  - **Special Case** Implementation-specific indication of the cases when the `Element` needs some special processing.
  - **Obtained from the tree** The Id and the name of the tree file from which the tree-specific fields of the internal representation of given `Element` were obtained
  - **`Rel_Sloc`** Indicates the (relative) position of the source text of the `Element`, counting from the beginning of the source of its enclosing compilation unit. Applies to implicit `Element`s also.

5.2 ASIS Debug Flags

ASIS provides several internal debug flags, which are described in `a_debug.adb`. When one or more of these flags is set, useful internal debugging information is directed to `Standard_Output`. Although this information is not always user-oriented, you may find the following debug flags helpful when you are developing an ASIS application:

-dc Outputs the content of the internal data structures for a `Context`, when the `Context` is closed and dissociated. By analyzing this information, you may map other debug information onto unit and tree Ids.

-di Turns off including the location of an `Element` into the result generated by `Debug_Image`. This may be useful if an ASIS program crashes because of some problem with ASIS structural queries (structural queries are used by `Element`'s `Debug_Image` query to compute the source location of the argument).

-do When the `Context` is opened, lists the tree files being processed, and the ones selected to represent a given `Context`

-dt Outputs a message whenever a tree file is read in. This information may be useful for analyzing and reducing the tree swapping profile of your application.

APPENDIX

A

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