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Interface Definition Language

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Table of Contents

Preface	v
1 Scope	1
2 Conformance Criteria	1
3 Normative References	2
4 Terms and Definitions	2
5 Symbols	2
6 Additional Information	3
6.1 Acknowledgments	3
7 IDL Syntax and Semantics	5
7.1 Overview	5
7.2 Lexical Conventions	6
7.2.1 Tokens	9
7.2.2 Comments	9
7.2.3 Identifiers	10
7.2.4 Keywords	11
7.2.5 Other Characters Recognized by IDL	12
7.2.6 Literals	12
7.3 Preprocessing	15
7.4 IDL Grammar	16
7.4.1 Building-Block Core Data Types	16
7.4.2 Building-Block Any	34
7.4.3 Building-Block Interfaces – Basic	36
7.4.4 Building-Block Interfaces – Full	43
7.4.5 Building-Block Value Types	45
7.4.6 Building-Block CORBA-Specific – Interfaces	49
7.4.7 Building-Block CORBA-Specific – Value Types	55
7.4.8 Building-Block Components – Basic	61
7.4.9 Building-Block Components – Homes	65
7.4.10 Building-Block CCM-Specific	67
7.4.11 Building-Block Components – Ports and Connectors	73
7.4.12 Building-Block Template Modules	77
7.4.13 Building-Block Extended Data-Types	80
7.4.14 Building-Block Anonymous Types	84
7.4.15 Building-Block Annotations	85
7.4.16 Relationships between the Building-Blocks	89
7.5 Names and Scoping	89
7.5.1 Qualified Names	89
7.5.2 Scoping Rules and Name Resolution	91

7.5.3	Special Scoping Rules for Type Names	93
8	Standardized Annotations	97
8.1	Introduction	97
8.1.1	Rules for Defining Standardized Annotations	97
8.1.2	Rules for Using Standardized Annotations	97
8.2	Standardized Groups of Annotations	98
8.2.1	Group of Annotations General Purpose.....	98
8.2.2	Group of Annotations Data Modeling.....	100
8.2.3	Group of Annotations: Units and Ranges	100
8.2.4	Group of Annotations Data Implementation.....	102
8.2.5	Group of Annotations Code Generation	103
8.2.6	Group of Annotations Interfaces.....	104
9	Profiles	107
9.1	CORBA and CCM Profiles	107
9.1.1	Plain CORBA Profile	107
9.1.2	Minimum CORBA Profile.....	107
9.1.3	CCM Profile.....	108
9.1.4	CCM with Generic Interaction Support Profile	108
9.2	DDS Profiles.....	109
9.2.1	Plain DDS Profile	109
9.2.2	Extensible DDS Profile.....	109
9.2.3	RPC over DDS Profile.....	109
	Annex: Consolidated IDL Grammar	111

Tables

Table 7-1: IDL EBNF	6
Table 7-2: Characters	6
Table 7-3: Decimal digits	7
Table 7-4: Graphic characters	8
Table 7-5: Formatting characters	9
Table 7-6: All IDL keywords.....	11
Table 7-7: Punctuation	12
Table 7-8: Tokens.....	12
Table 7-9: Escape sequences.....	13
Table 7-10: List of pre-existing non-terminals in IDL rules.....	16
Table 7-11: Operations on fixed-point decimal constants	23
Table 7-12: 2's complement numbers	23
Table 7-13: Integer types	26
Table 7-14: Keywords specific to Building-Block Core Data Types	34
Table 7-15: Keywords specific to Building-Block Any	35
Table 7-16: Keywords specific to Building-Block Interfaces – Basic.....	42
Table 7-17: Keywords specific to Building-Block Value Types.....	48
Table 7-18: Keywords specific to Building-Block CORBA-Specific – Interfaces	54
Table 7-19: Possible inheritance relationships between value types and interfaces.....	58
Table 7-20: Keywords specific to Building-Block CORBA-Specific – Value Types.....	60
Table 7-21: Keywords specific to Building-Block Components – Basic	64
Table 7-22: Keywords specific to Building-Block Components – Homes.....	67
Table 7-23: Keywords specific to Building-Block CCM-Specific.....	73
Table 7-24: Keywords specific to Building-Block Components – Ports and Connectors...	76
Table 7-25: Keywords specific to Building-Block Template Modules	80
Table 7-26: Keywords specific to Building-Block Extended Data-Types	83
Table 7-27: Keywords specific to Building-Block Annotations.....	88

Figures

Figure 7-1: Examples of Legal Multiple Inheritance.....	39
Figure 7-2: Relationships between Building-Blocks	89

Preface

About the Object Management Group

OMG

Founded in 1989, the Object Management Group, Inc. (OMG) is an open membership, not-for-profit computer industry standards consortium that produces and maintains computer industry specifications for interoperable, portable and reusable enterprise applications in distributed, heterogeneous environments. Membership includes Information Technology vendors, end users, government agencies and academia.

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1 Scope

This document specifies the *OMG Interface Definition Language (IDL)*. Historically IDL was designed to specify CORBA interfaces, and then CORBA components, and was embedded in the CORBA documentation. However its expressive power made it very suitable for defining non-CORBA interfaces and data types. Therefore it was used in the DDS specification and extended for that purpose. For those new usages, as well as for future ones, IDL deserves now to be a first-class specification and not just a derivative product from CORBA.

This document completes the definition of *IDL as a separate specification* that was started by IDL 3.5.

As a first step, IDL 3.5 gathered in a single document the whole CORBA-dedicated IDL, formerly specified as a collection of chapters within the CORBA 3 specification. IDL 4.0 extends that corpus with the other source for IDL definitions, namely "Extensible and Dynamic Topic Types for DDS" in order to group all IDL constructs in a single comprehensive document. It also reorganizes the whole IDL description so that different levels of compliance are easier to state and understand and that future evolutions, if needed, are made possible with no side-effects on existing IDL usages.

This document was created from the following OMG specifications:

- IDL 3.5. Cf. [IDL 3.5].
- Extensible and Dynamic Topic Types for DDS. Cf. [DDS-XTypes].

There are no fundamental changes in this document relative to referenced specifications.

2 Conformance Criteria

This document defines IDL for other specifications to reference and contains no independent conformance points. It is up to the specifications that depend on this document to define their own conformance criteria. However, the general organization of the clauses (by means of atomic building-blocks and profiles that group them as detailed afterwards) is intended to ease conformance description and scoping. *That means that no specification using IDL 4.0 will be forced to be compliant with IDL constructs that are not relevant in its usage of IDL.*

Conformance to this standard must follow these rules:

1. Any future specification, using IDL must reference this standard.
2. Future revisions of current specifications using IDL may reference this standard.
3. Reference to this standard must result in a selection of building-blocks possibly complemented by groups of annotations.
 - a. All selected building-blocks must be supported entirely.
 - b. Selected annotations must be either supported as described in 8.1.2 Rules for Using Standardized Annotations, or fully ignored. In the latter case, the using specification shall not define a specific annotation, either with the same name and another meaning or with the same meaning and another name.

3 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments):

- ISO/IEC 14882:2003, Information Technology - Programming languages - C++.
- [RFC2119] IETF RFC 2119, "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997. Available from <http://ietf.org/rfc/rfc2119>.
- [CORBA] Common Open Request Broker Architecture. OMG specification: formal/2012-11-12 (part1), formal/2012-11-14 (part2), formal/2012-11-16 (part3).

The following referenced documents were used as input to this specification:

- [IDL3.5] Interface Definition Language 3.5. OMG specification : formal/2014-03-01.
- [DDS-XTypes]. Extensible and Dynamic Topic Types for DDS. OMG specification: formal/2014-11-03.
- [DDS] Data Distribution Service. OMG specification: formal/2007-01-01.
- [RPC over DDS] Remote Procedure Call over DDS. OMG specification: mars/2014-11-08.

4 Terms and Definitions

In this specification:

- A *building-block* is a consistent set of IDL rules that together form a piece of IDL functionality. Building-blocks are atomic, meaning that if selected, they must be totally supported. Building-blocks are described in clause 7, IDL Syntax and Semantics.
- A *group of annotations* is a consistent set of annotations, expressed in IDL. Groups of annotations are described in clause 8, Standardized Annotations.
- A *profile* is a selection of building-blocks possibly complemented with groups of annotations that determines a specific IDL usage. Profiles are described in clause 9, Profiles.

5 Symbols

The following acronyms are used in this specification

Acronym	Meaning
ASCII	American Standard Code for Information Interchange
BIPM	Bureau International des Poids et Mesures
CCM	CORBA Component Model
CORBA	Common Object Request Broker Architecture
DDS	Data Distribution Service

Acronym	Meaning
EBNF	Extended Backus Naur Form
IDL	Interface Definition Language
ISO	International Organization for Standardization
LwCCM	Lightweight CCM
OMG	Object Management Group
ORB	Object Request Broker
XTypes	eXtensible and dynamic topic Types (for DDS)

6 Additional Information

6.1 Acknowledgments

The following companies submitted this specification:

- Thales
- RTI

The following companies supported this specification:

- Mitre
- Northrop Grumman
- Remedy IT

7 IDL Syntax and Semantics

7.1 Overview

This clause describes OMG Interface Definition Language (IDL) middleware¹-agnostic semantics² and defines the syntax for IDL grammatical constructs.

OMG IDL is a language that allows unambiguously specifying interfaces that client objects³ may use and object implementations provide as well as all needed related constructs such as exceptions or data types. Data types are needed to specify parameters and return value of interfaces' operations. They can be used also as first class constructs.

IDL is a purely descriptive language. This means that invoking operations, implementing them or creating and accessing data cannot be written in IDL, but in a programming language, for which mappings from IDL constructs have been defined. The mapping of an IDL construct to a programming language construct will depend on the facilities available in the programming language. For example, an IDL exception might be mapped to a structure in a language that has no notion of exception, or to an exception in a language that does. The binding of IDL constructs to several programming languages is described in separate specifications.

The clause is organized as follows:

- The description of IDL's lexical conventions is presented in 7.2, Lexical Conventions.
- A description of IDL preprocessing is presented in 7.3, Preprocessing.
- The grammar itself is presented in 7.4, IDL Grammar.
- The scoping rules for identifiers in an IDL specification are described in 7.5, Names and Scoping.

IDL-specific pragmas may appear anywhere in a specification; the textual location of these pragmas may be semantically constrained by a particular implementation.

A source file containing specifications written in IDL must have a ".idl" extension.

The description of IDL grammar uses a syntax notation that is similar to Extended Backus-Naur Format (EBNF). However, to allow composition of specific parts of the description, while avoiding redundancy; a specific operator (::+) has been added. This operator allows adding alternatives to an existing definition (assuming $x ::= y$, $x ::=+ z$ means actually $x ::= y | z$).

¹ In this document the word *middleware* refers to any piece of software that will make use of IDL-derived artifacts. CORBA and DDS implementations are examples of middleware. The word *compiler* refers to any piece of software that produces these IDL-derived artifacts based on an IDL specification.

² I.e., abstract semantics that is applicable to all IDL usages. When needed, middleware-specific interpretations of that abstract semantics will be given afterwards in dedicated clauses.

³ Accordingly, *client objects* should be understood here as abstract clients, i.e., entities invoking operations provided by object implementations, regardless of the means used to perform this invocation or even whether those implementations are co-located or remotely accessible.

Table 7-1 lists the symbols used in this EBNF format and their meaning.

Table 7-1: IDL EBNF

Symbol	Meaning
::=	Is defined to be (<i>left part of the rule is defined to be right part of the rule</i>)
	Alternatively
::+	Is added as alternative (<i>left part of the rule is completed with right part of the rule as a new alternative</i>)
<text>	Nonterminal
"text"	Literal
*	The preceding syntactic unit can be repeated zero or more times
+	The preceding syntactic unit must be repeated at least once
{ }	The enclosed syntactic units are grouped as a single syntactic unit
[]	The enclosed syntactic unit is optional – may occur zero or one time

7.2 Lexical Conventions

This sub clause⁴ presents the lexical conventions of IDL. It defines tokens in an IDL specification and describes comments, identifiers, keywords, and literals – integer, character, and floating point constants and string literals.

An IDL specification logically consists of one or more files. A file is conceptually translated in several phases.

The first phase is preprocessing, which performs file inclusion and macro substitution. Preprocessing is controlled by directives introduced by lines having # as the first character other than white space. The result of preprocessing is a sequence of tokens. Such a sequence of tokens, that is, a file after preprocessing, is called a translation unit.

IDL uses the ASCII character set, except for string literals and character literals, which use the ISO Latin-1 (8859-1) character set. The ISO Latin-1 character set is divided into alphabetic characters (letters) digits, graphic characters, the space (blank) character, and formatting characters. Table 7-2 shows the ISO Latin-1 alphabetic characters; upper and lower case equivalences are paired. The ASCII alphabetic characters are shown in the left-hand column of Table 7-2.

Table 7-2: Characters

Char.	Description	Char.	Description
Aa	Upper/Lower-case A	Àà	Upper/Lower-case A with grave accent
Bb	Upper/Lower-case B	Áá	Upper/Lower-case A with acute accent
Cc	Upper/Lower-case C	Ââ	Upper/Lower-case A with circumflex accent

⁴This sub clause is an adaptation of The Annotated C++ Reference Manual, Clause 2; it differs in the list of legal keywords and punctuation

Char.	Description	Char.	Description
Dd	Upper/Lower-case D	Ãã	Upper/Lower-case A with tilde
Ee	Upper/Lower-case E	Ää	Upper/Lower-case A with dieresis
Ff	Upper/Lower-case F	Åå	Upper/Lower-case A with ring above
Gg	Upper/Lower-case G	Ææ	Upper/Lower-case diphthong A with E
Hh	Upper/Lower-case H	Çç	Upper/Lower-case C with cedilla
Ii	Upper/Lower-case I	Èè	Upper/Lower-case E with grave accent
Jj	Upper/Lower-case J	Éé	Upper/Lower-case E with acute accent
Kk	Upper/Lower-case K	Êê	Upper/Lower-case E with circumflex accent
Ll	Upper/Lower-case L	Ëë	Upper/Lower-case E with dieresis
Mm	Upper/Lower-case M	Îî	Upper/Lower-case I with grave accent
Nn	Upper/Lower-case N	Íí	Upper/Lower-case I with acute accent
Oo	Upper/Lower-case O	Îî	Upper/Lower-case I with circumflex accent
Pp	Upper/Lower-case P	Ïï	Upper/Lower-case I with dieresis
Qq	Upper/Lower-case Q	Ññ	Upper/Lower-case N with tilde
Rr	Upper/Lower-case R	Òò	Upper/Lower-case O with grave accent
Ss	Upper/Lower-case S	Óó	Upper/Lower-case O with acute accent
Tt	Upper/Lower-case T	Ôô	Upper/Lower-case O with circumflex accent
Uu	Upper/Lower-case U	Õõ	Upper/Lower-case O with tilde
Vv	Upper/Lower-case V	Öö	Upper/Lower-case O with dieresis
Ww	Upper/Lower-case W	Øø	Upper/Lower-case O with oblique stroke
Xx	Upper/Lower-case X	Ûû	Upper/Lower-case U with grave accent
Yy	Upper/Lower-case Y	Ýý	Upper/Lower-case U with acute accent
Zz	Upper/Lower-case Z	Ûû	Upper/Lower-case U with circumflex accent
		Üü	Upper/Lower-case U with dieresis
		ß	Lower-case German sharp S
		ÿ	Lower-case Y with dieresis

Table 7-3 lists the decimal digit characters.

Table 7-3: Decimal digits

0	1	2	3	4	5	6	7	8	9
---	---	---	---	---	---	---	---	---	---

Table 7-4 shows the graphic characters.

Table 7-4: Graphic characters

Char.	Description	Char.	Description
!	exclamation point	¡	inverted exclamation mark
"	double quote	¢	cent sign
#	number sign	£	pound sign
\$	dollar sign	¤	currency sign
%	percent sign	¥	yen sign
&	ampersand		broken bar
'	apostrophe	§	section/paragraph sign
(left parenthesis	¨	dieresis
)	right parenthesis	©	copyright sign
*	asterisk	ª	feminine ordinal indicator
+	plus sign	«	left angle quotation mark
,	comma	¬	not sign
-	hyphen, minus sign		soft hyphen
.	period, full stop	®	registered trade mark sign
/	solidus	¯	macron
:	colon	°	ring above, degree sign
;	semicolon	±	plus-minus sign
<	less-than sign	²	superscript two
=	equals sign	³	superscript three
>	greater-than sign	´	acute
?	question mark	µ	micro
@	commercial at	¶	pilcrow
[left square bracket	•	middle dot
\	reverse solidus	¸	cedilla
]	right square bracket	¹	superscript one
^	circumflex	º	masculine ordinal indicator
_	low line, underscore	»	right angle quotation mark
`	grave	¼	vulgar fraction 1/4

Char.	Description	Char.	Description
{	left curly bracket	½	vulgar fraction 1/2
	vertical line	¾	vulgar fraction 3/4
}	right curly bracket	¿	inverted question mark
~	tilde	×	multiplication sign
		÷	division sign

The formatting characters are shown in Table 7-5.

Table 7-5: Formatting characters

Description	Abbreviation	ISO 646 Octal Value
alert	BEL	007
backspace	BS	010
horizontal tab	HT	011
newline	NL, LF	012
vertical tab	VT	013
form feed	FF	014
carriage return	CR	015

7.2.1 Tokens

There are five kinds of tokens: identifiers, keywords, literals, operators, and other separators.

Blanks, horizontal and vertical tabs, newlines, form feeds, and comments (collective, "white space") as described below are ignored except as they serve to separate tokens. Some white space is required to separate otherwise adjacent identifiers, keywords, and constants.

If the input stream has been parsed into tokens up to a given character, the next token is taken to be the longest string of characters that could possibly constitute a token.

7.2.2 Comments

The characters `/*` start a comment, which terminates with the characters `*/`. These comments do not nest.

The characters `//` start a comment, which terminates at the end of the line on which they occur.

The comment characters `//`, `/*`, and `*/` have no special meaning within a `//` comment and are treated just like other characters. Similarly, the comment characters `//` and `/*` have no special meaning within a `/*` comment.

Comments may contain alphabetic, digit, graphic, space, horizontal tab, vertical tab, form feed, and newline characters.

7.2.3 Identifiers

An identifier is an arbitrarily long sequence of ASCII alphabetic, digit and underscore (`_`) characters. The first character must be an ASCII alphabetic character. All characters are significant.

IDL identifiers are case insensitive. However, all references to a definition must use the same case as the defining occurrence. This allows natural mappings to case-sensitive languages.

7.2.3.1 Collision Rules

When comparing two identifiers to see if they collide:

- Upper- and lower-case letters are treated as the same letter. Table 7-2 defines the equivalence mapping of upper- and lower-case letters.
- All characters are significant.

Identifiers that differ only in case collide, and will yield a compilation error under certain circumstances. An identifier for a given definition must be spelled identically (e.g., with respect to case) throughout a specification.

There is only one namespace for IDL identifiers in each scope. Using the same identifier for a constant and an interface, for example, produces a compilation error.

Example:

```
module M {
    typedef long Foo;
    const long thing = 1;
    interface thing { // Error: reuse of identifier thing
        void doit (
            in Foo foo // Error: Foo and foo collide...
        ); // ... and refer to different things
        readonly attribute long Attribute; // Error: Attribute collides with keyword...
        // ... attribute
    };
};
```

7.2.3.2 Escaped Identifiers

As all languages, IDL uses some reserved words called *keywords* (see 7.2.4, Keywords).

As IDL evolves, new keywords that are added to the IDL language may inadvertently collide with identifiers used in existing IDL and programs that use that IDL. Fixing these collisions will require not only the IDL to be modified, but programming language code that depends upon that IDL will have to change as well. The language mapping rules for the renamed IDL identifiers will cause the mapped identifier names (e.g., method names) to be changed.

To minimize the amount of work, users may lexically "escape" identifiers by prepending an underscore (`_`) to an identifier. *This is a purely lexical convention that ONLY turns off keyword checking.* The resulting identifier follows all the other rules for identifier processing. For example, the identifier `_AnIdentifier` is treated as if it were `AnIdentifier`.

Example:

```
module M {  
    interface thing {  
        attribute boolean abstract; // Error: abstract collides with keyword abstract  
        attribute boolean _abstract; // OK: abstract is an identifier  
    };  
};
```

Note – To avoid unnecessary confusion for readers of IDL, it is recommended that IDL specifications only use the escaped form of identifiers when the non-escaped form clashes with a newly introduced IDL keyword. It is also recommended that interface designers avoid defining new identifiers that are known to require escaping. Escaped literals are only recommended for IDL that expresses legacy items, or for IDL that is mechanically generated.

7.2.4 Keywords

The identifiers listed in Table 7-6 are reserved for use as keywords and may not be used for another purpose, unless escaped with a leading underscore.

Table 7-6: All IDL keywords

abstract	any	alias	attribute	bitset
boolean	case	char	component	connector
const	consumes	context	custom	default
double	exception	emits	enum	eventtype
factory	FALSE	finder	fixed	float
getraises	home	import	in	inout
interface	local	long	manages	map
mirrorport	module	multiple	native	Object
octet	oneway	out	primarykey	private
port	porttype	provides	public	publishes
raises	readonly	setraises	sequence	short
string	struct	supports	switch	TRUE
truncatable	typedef	typeid	typename	typeprefix
unsigned	union	uses	ValueBase	valuetype
void	wchar	wstring		

Keywords must be written exactly as shown in the above list. Identifiers that collide with keywords (see 7.2.3, Identifiers) are illegal. For example, **boolean** is a valid keyword; **Boolean** and **BOOLEAN** are illegal identifiers.

Example:

```

module M {
    typedef Long Foo;           // Error: keyword is long not Long
    typedef boolean BOOLEAN;   // Error: BOOLEAN collides with the keyword...
                                //     ...boolean;
};

```

Note – As the IDL grammar is now organized in building-blocks that dedicated profiles may include or not, some of these keywords may be irrelevant to some profiles. Each building-block description (see 7.4, IDL Grammar) includes the set of keywords that are specific to it. The minimum set of keywords for a given profile results from the union of all the ones of the included building-blocks. However, to avoid unnecessary confusion for readers of IDL and to allow IDL compilers supporting several profiles in a single tool, it is recommended that IDL specifications avoid using any of the keywords listed in Table 7-6: All IDL keywords.

7.2.5 Other Characters Recognized by IDL

IDL specifications use the characters shown in Table 7-7 as punctuation.

Table 7-7: Punctuation

;	{	}	:	,	=	+	-	()	<	>	[]
'	"	\		^	&	*	/	%	~	@			

In addition, the tokens listed in Table 7-8 are used by the preprocessor.

Table 7-8: Tokens

#	##	!		&&
---	----	---	--	----

7.2.6 Literals

This sub clause describes the following literals:

- Integer
- Character
- Floating-point
- String
- Fixed-point

7.2.6.1 Integer Literals

An integer literal consisting of a sequence of digits is taken to be *decimal* (base ten) unless it begins with **0** (digit zero).

A sequence of digits starting with **0** is taken to be an *octal integer* (base eight). The digits **8** and **9** are not octal digits and thus are not allowed in an octal integer literal.

A sequence of digits preceded by **0x** (or **0X**) is taken to be a *hexadecimal integer* (base sixteen). The hexadecimal digits include **a** (or **A**) through **f** (or **F**) with decimal values ten through fifteen, respectively.

For example, the number twelve can be written **12**, **014**, or **0XC**.

7.2.6.2 Character Literals

7.2.6.2.1 Wide and Non-wide Characters

Character literals may have type **char** (non-wide character) or **wchar** (wide character).

Both wide and non-wide character literals must be specified using characters from the ISO Latin-1 (8859-1) character set.

A **char** is an 8-bit quantity with a numerical value between 0 and 255 (decimal). The value of a space, alphabetic, digit, or graphic character literal is the numerical value of the character as defined in the ISO Latin-1 (8859-1) character set standard (see Table 7-2 on page 6, Table 7-3 on page 7 and Table 7-4 on page 8). The value of a **null** is 0. The value of a formatting character literal is the numerical value of the character as defined in the ISO 646 standard (see Table 7-5 on page 9). The meaning of all other characters is implementation-dependent.

A **wchar** (wide character) is intended to encode wide characters from any character set. Its size is implementation dependent.

A character literal is one or more characters enclosed in single quotes, as in:

```
const char C1 = 'X';
```

Wide character literals have in addition an **L** prefix, as in:

```
const wchar C2 = L'X';
```

Attempts to assign a wide character literal to a non-wide character constant, or to assign a non-wide character literal to a wide character constant, result in a compile-time diagnostic.

7.2.6.2.2 Escape Sequences to Represent Character Literals

Nongraphic characters must be represented using escape sequences as defined below in Table 7-9. Note that escape sequences must be used to represent single quote and backslash characters in character literals.

Table 7-9: Escape sequences

Description	Escape Sequence
newline	<code>\n</code>
horizontal tab	<code>\t</code>
vertical tab	<code>\v</code>
backspace	<code>\b</code>
carriage return	<code>\r</code>
form feed	<code>\f</code>

Description	Escape Sequence
alert	\a
backslash	\\
question mark	\?
single quote	\'
double quote	\"
octal number	\ooo
hexadecimal number	\xhh
Unicode character	\uhhhh

If the character following a backslash is not one of those specified, the behavior is undefined. An escape sequence specifies a single character.

The escape `\ooo` consists of the backslash followed by one, two, or three octal digits that are taken to specify the value of the desired character. The escape `\xhh` consists of the backslash followed by `x` followed by one or two hexadecimal digits that are taken to specify the value of the desired character.

A sequence of octal or hexadecimal digits is terminated by the first character that is not an octal digit or a hexadecimal digit, respectively. The value of a character constant is implementation dependent if it exceeds that of the largest `char`.

The escape `\uhhhh` consists of a backslash followed by the character `u`, followed by one, two, three, or four hexadecimal digits. This represents a Unicode character literal. For example, the literal `\u002E` represents the Unicode period `'.'` character and the literal `\u3BC` represents the Unicode Greek small letter `'μ'` (mu). The `\u` escape is valid only with `wchar` and `wstring` types. Because a wide string literal is defined as a sequence of wide character literals, a sequence of `\u` literals can be used to define a wide string literal.

Attempts to set a char type to a `\u` defined literal or a string type to a sequence of `\u` literals result in an error.

7.2.6.3 String Literals

Strings are null-terminated sequences of characters. Strings are of type `string` if they are made of non-wide characters or `wstring` (wide string) if they are made of wide characters.

A string literal is a sequence of character literals (as defined in 7.2.6.2, Character Literals), with the exception of the character with numeric value 0, surrounded by double quotes, as in:

```
const string S1 = "Hello";
```

Wide string literals have in addition an `L` prefix, for example:

```
const wstring S2 = L"Hello";
```

Both wide and non-wide string literals must be specified using characters from the ISO Latin-1 (8859-1) character set. A string literal shall not contain the character `'\0'`. A wide string literal shall not contain the wide character with value zero.

Adjacent string literals are concatenated. Characters in concatenated strings are kept distinct. For example, "`\xA`" "`B`" contains the two characters '`\xA`' and '`B`' after concatenation (and not the single hexadecimal character '`\xAB`').

The size of a string literal is the number of character literals enclosed by the quotes, after concatenation. Within a string, the double quote character `"` must be preceded by a `\`.

Attempts to assign a wide string literal to a non-wide string constant or to assign a non-wide string literal to a wide string constant result in a compile-time diagnostic.

7.2.6.4 Floating-point Literals

A floating-point literal consists of an integer part, a decimal point (`.`), a fraction part, an `e` or `E`, and an optionally signed integer exponent. The integer and fraction parts both consist of a sequence of decimal (base ten) digits. Either the integer part or the fraction part (but not both) may be missing; either the decimal point or the letter `e` (or `E`) and the exponent (but not both) may be missing.

7.2.6.5 Fixed-Point Literals

A fixed-point decimal literal consists of an integer part, a decimal point (`.`), a fraction part and a `d` or `D`. The integer and fraction parts both consist of a sequence of decimal (base 10) digits. Either the integer part or the fraction part (but not both) may be missing; the decimal point (but not the letter `d` or `D`) may be missing.

7.3 Preprocessing

IDL shall be preprocessed according to the specification of the preprocessor in ISO/IEC 14882:2003. The preprocessor may be implemented as a separate process or built into the IDL compiler.

Lines beginning with `#` (also called "directives") communicate with this preprocessor. White space may appear before the `#`. These lines have syntax independent of the rest of IDL; they may appear anywhere and have effects that last (independent of the IDL scoping rules) until the end of the translation unit. The textual location of IDL-specific pragmas may be semantically constrained.

A preprocessing directive (or any line) may be continued on the next line in a source file by placing a backslash character (`\`), immediately before the newline at the end of the line to be continued. The preprocessor effects the continuation by deleting the backslash and the newline before the input sequence is divided into tokens. A backslash character may not be the last character in a source file.

A preprocessing token is an IDL token (see 7.2.1, Tokens), a file name as in a `#include` directive, or any single character other than white space that does not match another preprocessing token.

The primary use of the preprocessing facilities is to include definitions from other IDL specifications. Text in files included with a `#include` directive is treated as if it appeared in the including file.

Note – Generating code for included files is an IDL compiler implementation-specific issue. To support separate compilation, IDL compilers may not generate code for included files, or do so only if explicitly instructed.

7.4 IDL Grammar

The grammar for a well-formed IDL specification is described by rules expressed in Extended Backus Naur Form (EBNF) completed to support rule extensions as explained in clause 7.1. Table 7-1: IDL EBNF gathers all the symbols used in rules.

These rules are grouped in atomic *building-blocks* that will be themselves grouped to form dedicated *profiles*. Atomic means that they cannot be split (in other words a given profile will contain or not a given building-block, but never just parts of it).

In all the building-block descriptions, the normative rules are grouped in a sub-clause entitled "Syntax" and written in **Arial bold**. They are then detailed in a sub-clause entitled "Explanations and Semantics", where they are copied to ease understanding. These copies are actually hyperlinks to the originals and are written in **Arial bold-italics**.

In all the rules, the following non-terminals pre-exist and are not detailed.

Table 7-10: List of pre-existing non-terminals in IDL rules

Token	Explanation
<identifier>	A valid identifier, as explained in 7.2.3 Identifiers
<integer_literal>	A valid integer literal as explained in 7.2.6.1 Integer Literals
<string_literal>	A valid string literal as explained in 7.2.6.3 String Literals
<wide_string_literal>	A valid wide string literal as explained in 7.2.6.3 String Literals
<character_literal>	A valid character literal as explained in 7.2.6.2 Character Literals
<wide_character_literal>	A valid wide character literal as explained in 7.2.6.2 Character Literals
<fixed_pt_literal>	A valid fixed point literal as explained in 7.2.6.5 Fixed-Point Literals
<floating_pt_literal>	A valid floating point literal as explained in 7.2.6.4 Floating-point Literals

7.4.1 Building-Block Core Data Types

7.4.1.1 Purpose

This building-block constitutes the core of any IDL specialization (all other building-blocks assume that this one is included). It gathers all that allow defining most data types with what allows IDL basic structuring (i.e., modules) and, because it is the only building-block which is mandatory, the root nonterminal **<specification>** for the grammar itself.

7.4.1.2 Dependencies with other Building-Blocks

This building-block is the root for all other building-blocks and requires no other ones.

7.4.1.3 Syntax

The following set of rules form the building-block:

- (1) <specification> ::= <definition>+
- (2) <definition> ::= <module_dcl> ";"
| <const_dcl> ";"
| <type_dcl> ";"
- (3) <module_dcl> ::= "module" <identifier> "{" <definition>+ "}"
- (4) <scoped_name> ::= <identifier>
| "::" <identifier>
| <scoped_name> "::" <identifier>
- (5) <const_dcl> ::= "const" <const_type> <identifier> "=" <const_expr>
- (6) <const_type> ::= <integer_type>
| <floating_pt_type>
| <fixed_pt_const_type>
| <char_type>
| <wide_char_type>
| <boolean_type>
| <octet_type>
| <string_type>
| <wide_string_type>
| <scoped_name>
- (7) <const_expr> ::= <or_expr>
- (8) <or_expr> ::= <xor_expr>
| <or_expr> "|" <xor_expr>
- (9) <xor_expr> ::= <and_expr>
| <xor_expr> "^" <and_expr>
- (10) <and_expr> ::= <shift_expr>
| <and_expr> "&" <shift_expr>
- (11) <shift_expr> ::= <add_expr>
| <shift_expr> ">>" <add_expr>
| <shift_expr> "<<" <add_expr>
- (12) <add_expr> ::= <mult_expr>
| <add_expr> "+" <mult_expr>
| <add_expr> "-" <mult_expr>
- (13) <mult_expr> ::= <unary_expr>
| <mult_expr> "*" <unary_expr>
| <mult_expr> "/" <unary_expr>
| <mult_expr> "%" <unary_expr>
- (14) <unary_expr> ::= <unary_operator> <primary_expr>
| <primary_expr>
- (15) <unary_operator> ::= "-"
| "+"
| "~"

(16)	<primary_expr>	::= <scoped_name> <literal> "(" <const_expr> ")"
(17)	<literal>	::= <integer_literal> <floating_pt_literal> <fixed_pt_literal> <character_literal> <wide_character_literal> <boolean_literal> <string_literal> <wide_string_literal>
(18)	<boolean_literal>	::= "TRUE" "FALSE"
(19)	<positive_int_const>	::= <const_expr>
(20)	<type_dcl>	::= <constr_type_dcl> <native_dcl> <typedef_dcl>
(21)	<type_spec>	::= <simple_type_spec>
(22)	<simple_type_spec>	::= <base_type_spec> <scoped_name>
(23)	<base_type_spec>	::= <integer_type> <floating_pt_type> <char_type> <wide_char_type> <boolean_type> <octet_type>
(24)	<floating_pt_type>	::= "float" "double" "long" "double"
(25)	<integer_type>	::= <signed_int> <unsigned_int>
(26)	<signed_int>	::= <signed_short_int> <signed_long_int> <signed_longlong_int>
(27)	<signed_short_int>	::= "short"
(28)	<signed_long_int>	::= "long"
(29)	<signed_longlong_int>	::= "long" "long"
(30)	<unsigned_int>	::= <unsigned_short_int> <unsigned_long_int> <unsigned_longlong_int>
(31)	<unsigned_short_int>	::= "unsigned" "short"
(32)	<unsigned_long_int>	::= "unsigned" "long"
(33)	<unsigned_longlong_int>	::= "unsigned" "long" "long"
(34)	<char_type>	::= "char"
(35)	<wide_char_type>	::= "wchar"
(36)	<boolean_type>	::= "boolean"
(37)	<octet_type>	::= "octet"

(38)	<template_type_spec>	::= <sequence_type> <string_type> <wide_string_type> <fixed_pt_type>
(39)	<sequence_type>	::= "sequence" "<" <type_spec> "," <positive_int_const> ">" "sequence" "<" <type_spec> ">"
(40)	<string_type>	::= "string" "<" <positive_int_const> ">" "string"
(41)	<wide_string_type>	::= "wstring" "<" <positive_int_const> ">" "wstring"
(42)	<fixed_pt_type>	::= "fixed" "<" <positive_int_const> "," <positive_int_const> ">"
(43)	<fixed_pt_const_type>	::= "fixed"
(44)	<constr_type_dcl>	::= <struct_dcl> <union_dcl> <enum_dcl>
(45)	<struct_dcl>	::= <struct_def> <struct_forward_dcl>
(46)	<struct_def>	::= "struct" <identifier> "{" <member>+ "}"
(47)	<member>	::= <type_spec> <declarators> ";"
(48)	<struct_forward_dcl>	::= "struct" <identifier>
(49)	<union_dcl>	::= <union_def> <union_forward_dcl>
(50)	<union_def>	::= "union" <identifier> "switch" "(" <switch_type_spec> ")" "{" <switch_body> "}"
(51)	<switch_type_spec>	::= <integer_type> <char_type> <boolean_type> <scoped_name>
(52)	<switch_body>	::= <case>+
(53)	<case>	::= <case_label>+ <element_spec> ";"
(54)	<case_label>	::= "case" <const_expr> ":" "default" ":"
(55)	<element_spec>	::= <type_spec> <declarator>
(56)	<union_forward_dcl>	::= "union" <identifier>
(57)	<enum_dcl>	::= "enum" <identifier> "{" <enumerator> { "," <enumerator> } * "}"
(58)	<enumerator>	::= <identifier>
(59)	<array_declarator>	::= <identifier> <fixed_array_size>+
(60)	<fixed_array_size>	::= "[" <positive_int_const> "]"
(61)	<native_dcl>	::= "native" <simple_declarator>
(62)	<simple_declarator>	::= <identifier>
(63)	<typedef_dcl>	::= "typedef" <type_declarator>

- (64) **<type_declarator>** ::= { <simple_type_spec>
| <template_type_spec>
| <constr_type_dcl>
} <any_declarators>
- (65) **<any_declarators>** ::= <any_declarator> { "," <any_declarator> }
- (66) **<any_declarator>** ::= <simple_declarator>
| <array_declarator>
- (67) **<declarators>** ::= <declarator> { "," <declarator> }
- (68) **<declarator>** ::= <simple_declarator>

7.4.1.4 Explanations and Semantics

7.4.1.4.1 IDL Specification

An IDL specification consists of one or more definitions.

- (1) **<specification>** ::= <definition>+

In this building-block, supported definitions are: module definitions, constant definitions and (data) type definitions as expressed in the following rule:

- (2) **<definition>** ::= <module_dcl> ";"
| <const_dcl> ";"
| <type_dcl> ";"

7.4.1.4.2 Modules

A module is a grouping construct. Its definition satisfies the following rule:

- (3) **<module_dcl>** ::= "module" <identifier> "{" <definition>+ "}"

A module is declared with:

- The **module** keyword.
- An identifier (**<identifier>**) which is the name of the module. That name is then used to scope embedded IDL identifiers.
- A list of at least one definition (**<definition>+**) enclosed within braces (**{}**). Those definitions form the module body.

A scoped name is built according to the following rule:

- (4) **<scoped_name>** ::= <identifier>
| "::" <identifier>
| <scoped_name> "::" <identifier>

For more details on scoping rules, see 7.5, Names and Scoping.

An IDL module can be reopened, which means that when a module declaration is encountered with a name already given to an existing module, all the enclosed definitions are appended to that existing module: the two module statements are thus considered as subsequent parts of the same module description.

7.4.1.4.3 Constants

Well-formed constants must follow the following rules:

- (5) `<const_dcl>` ::= "const" `<const_type>` `<identifier>` "=" `<const_expr>`
- (6) `<const_type>` ::= `<integer_type>`
| `<floating_pt_type>`
| `<fixed_pt_const_type>`
| `<char_type>`
| `<wide_char_type>`
| `<boolean_type>`
| `<octet_type>`
| `<string_type>`
| `<wide_string_type>`
| `<scoped_name>`
- (7) `<const_expr>` ::= `<or_expr>`
- (8) `<or_expr>` ::= `<xor_expr>`
| `<or_expr>` "|" `<xor_expr>`
- (9) `<xor_expr>` ::= `<and_expr>`
| `<xor_expr>` "^" `<and_expr>`
- (10) `<and_expr>` ::= `<shift_expr>`
| `<and_expr>` "&" `<shift_expr>`
- (11) `<shift_expr>` ::= `<add_expr>`
| `<shift_expr>` ">>" `<add_expr>`
| `<shift_expr>` "<<" `<add_expr>`
- (12) `<add_expr>` ::= `<mult_expr>`
| `<add_expr>` "+" `<mult_expr>`
| `<add_expr>` "-" `<mult_expr>`
- (13) `<mult_expr>` ::= `<unary_expr>`
| `<mult_expr>` "*" `<unary_expr>`
| `<mult_expr>` "/" `<unary_expr>`
| `<mult_expr>` "%" `<unary_expr>`
- (14) `<unary_expr>` ::= `<unary_operator>` `<primary_expr>`
| `<primary_expr>`
- (15) `<unary_operator>` ::= "-"
| "+"
| "~"
- (16) `<primary_expr>` ::= `<scoped_name>`
| `<literal>`
| "(" `<const_expr>` ")"
- (17) `<literal>` ::= `<integer_literal>`
| `<floating_pt_literal>`
| `<fixed_pt_literal>`
| `<character_literal>`
| `<wide_character_literal>`
| `<boolean_literal>`
| `<string_literal>`
| `<wide_string_literal>`
- (18) `<boolean_literal>` ::= "TRUE"
| "FALSE"
- (19) `<positive_int_const>` ::= `<const_expr>`

According to those rules, a constant is defined by:

- The **const** keyword.
- A type declaration, which must denote a type suitable for a constant (**<const_type>**), i.e.,:
 - Either one of the following: **<integer_type>**, **<floating_pt_type>**, **<fixed_pt_const_type>**, **<char_type>**, **<wide_char_type>**, **<boolean_type>**, **<octet_type>**, **<string_type>**, **<wide_string_type>**, or a previously defined enumeration. For a definition of those types, see 7.4.1.4.4, Data Types.
 - Or a **<scoped_name>**, which must be a previously defined name of one of the above.
- The name given to the constant (**<identifier>**).
- The operator **=**.
- A value expression (**<const_expr>**), which must be consistent with the type declared for the constant.

For evaluating the value expression (right hand side of the constant declaration), the following rules are applied:

- If the type of an integer constant is **long** or **unsigned long**, then each sub-expression of the associated constant expression is treated as an **unsigned long** by default, or a signed **long** for negated literals or negative integer constants. It is an error if any sub-expression values exceed the precision of the assigned type (**long** or **unsigned long**), or if a final expression value (of type **unsigned long**) exceeds the precision of the target type (**long**).
- If the type of an integer constant is **long long** or **unsigned long long**, then each sub-expression of the associated constant expression is treated as an **unsigned long long** by default, or a signed **long long** for negated literals or negative integer constants. It is an error if any sub-expression values exceed the precision of the assigned type (**long long** or **unsigned long long**), or if a final expression value (of type **unsigned long long**) exceeds the precision of the target type (**long long**).
- If the type of a floating-point constant is **double**, then each sub-expression of the associated constant expression is treated as a **double**. It is an error if any sub-expression value exceeds the precision of **double**.
- If the type of a floating-point constant is **long double**, then each sub-expression of the associated constant expression is treated as a **long double**. It is an error if any sub-expression value exceeds the precision of **long double**.
- An infix operator can combine two integer types, floating point types or fixed point types, but not mixtures of these. Infix operators are applicable only to integer, floating point, and fixed point types.
- Integer expressions are evaluated using the imputed type of each argument of a binary operator in turn. If either argument is **unsigned long long**, use **unsigned long long**. If either argument is **long long**, use **long long**. If either argument is **unsigned long**, use **unsigned long**. Otherwise use **long**. The final result of an integer arithmetic expression must fit in the range of the declared type of the constant; otherwise an error shall be flagged by the compiler. In addition to the integer types, the final result of an integer arithmetic expression can be assigned to an **octet** constant, subject to it fitting in the range for **octet** type.
- Floating point expressions are evaluated using the imputed type of each argument of a binary operator in turn. If either argument is **long double**, use **long double**. Otherwise use **double**. The final result of a floating point arithmetic expression must fit in the range of the declared type of the constant; otherwise an error shall be flagged by the compiler.
- Fixed-point decimal constant expressions are evaluated as follows. A fixed-point literal has the apparent number of total and fractional digits. For example, **0123.450d** is considered to be **fixed<7,3>** and **3000.00d** is **fixed<6,2>**. Prefix operators do not affect the precision; a prefix **+** is optional, and does not change the result. The upper bounds on the number of digits and scale of the result of an infix expression, **fixed<d1 ,s1>** or **fixed<d2,s2>**, are shown in the following table.

Table 7-11: Operations on fixed-point decimal constants

Op	Result: fixed<d,s>
+	fixed<max(d1-s1,d2-s2) + max(s1,s2) + 1, max(s1,s2)>
-	fixed<max(d1-s1,d2-s2) + max(s1,s2) + 1, max(s1,s2)>
*	fixed<d1+d2, s1+s2>
/	fixed<(d1-s1+s2) + sinf , sinf>

- A quotient may have an arbitrary number of decimal places, denoted by a scale of sinf. The computation proceeds pairwise, with the usual rules for left-to-right association, operator precedence, and parentheses. All intermediate computations shall be performed using double precision (i.e., 62 digits) arithmetic. If an individual computation between a pair of fixed-point literals actually generates more than 31 significant digits, then a 31-digit result is retained as follows:

fixed<d,s> => fixed<31, 31-d+s>

- Leading and trailing zeros are not considered significant. The omitted digits are discarded; rounding is not performed. The result of the individual computation then proceeds as one literal operand of the next pair of fixed-point literals to be computed.
- Unary (+ -) and binary (* / + -) operators are applicable in floating-point and fixed-point expressions.
 - The + unary operator has no effect; the - unary operator indicates that the sign of the following expression is inverted.
 - The * binary operator indicates that the two operands are multiplied; the / binary operator indicates that the first operand is divided by the second one; the + binary operator indicates that the two operands are added; the - binary operator indicates that the second operand is subtracted from the first one.
- Unary (+ - ~) and binary (* / % + - << >> & | ^) operators are applicable in integer expressions.
 - The + unary operator has no effect; the - unary operator indicates that the sign of the following expression is inverted.
 - The * binary operator indicates that the two operands are multiplied; the / binary operator indicates that the first operand is divided by the second one; the + binary operator indicates that the two operands are added; the - binary operator indicates that the second operand is subtracted from the first one.
 - The ~ unary operator indicates that the bit-complement of the expression to which it is applied is to be generated. For the purposes of such expressions, the values are 2's complement numbers. As such, the complement can be generated as follows:

Table 7-12: 2's complement numbers

Integer Constant Expression Type	Generated 2's Complement Numbers
long	long -(value+1)
unsigned long	unsigned long (2**32-1) - value
long long	long long -(value+1)
unsigned long long	unsigned long (2**64-1) - value

- The % binary operator yields the remainder from the division of the first expression by the second. If the second operand of % is 0, the result is undefined; otherwise $(a/b)*b + a\%b$ is equal to **a**. If both operands are non-negative, then the remainder is non-negative; if not, the sign of the remainder is implementation dependent.
- The << binary operator indicates that the value of the left operand should be shifted left the number of bits specified by the right operand, with 0 fill for the vacated bits. The right operand must be in the range $0 \leq \text{right operand} < 64$.
- The >> binary operator indicates that the value of the left operand should be shifted right the number of bits specified by the right operand, with 0 fill for the vacated bits. The right operand must be in the range $0 \leq \text{right operand} < 64$.
- The & binary operator indicates that the logical, bitwise **AND** of the left and right operands should be generated.
- The | binary operator indicates that the logical, bitwise **OR** of the left and right operands should be generated.
- The ^ binary operator indicates that the logical, bitwise **EXCLUSIVE-OR** of the left and right operands should be generated.
- <positive_int_const> must evaluate to a positive integer constant.

The consistency rules between the value (right hand side of the constant declaration) and the constant type declaration (left hand side) are as follows:

- Integer literals have positive integer values. Constant integer literals are considered **unsigned long** unless the value is too large, then they are considered **unsigned long long**. Unary minus is considered an operator, not a part of an integer literal. Only integer values can be assigned to integer type (**short, long, long long**) constants, and **octet** constants. Only positive integer values can be assigned to unsigned integer type constants. If the value of an integer constant declaration is too large to fit in the actual type of the constant on the left hand side (for example **const short s = 655592;**) or is inappropriate for the actual type of the constant (for example **const octet o = -54;**) it shall be flagged as a compile time error.
- Octet literals have integer value in the range 0...255. If the right hand side of an octet constant declaration is outside this range it shall be flagged as a compile time error.
- An octet constant can be defined using an integer literal or an integer constant expression but values outside the range 0...255 shall cause a compile-time error.
- Floating point literals have floating point values. Only floating point values can be assigned to floating point type (**float, double, long double**) constants. Constant floating point literals are considered **double** unless the value is too large, then they are considered **long double**. If the value of the right hand side is too large to fit in the actual type of the constant to which it is being assigned, it shall be flagged as a compile time error. Truncation on the right for floating point types is OK.
- Fixed point literals have fixed point values. Only fixed point values can be assigned to fixed point type constants. If the fixed point value in the expression on the right hand side is too large to fit in the actual fixed point type of the constant on the left hand side, then it shall be flagged as a compile time error. Truncation on the right for fixed point types is OK.
- An **enum** constant can only be defined using a scoped name for the enumerator. The scoped name is resolved using the normal scope resolution rules (see 7.5 Names and Scoping). For example:

```

enum Color { red, green, blue };
const Color FAVORITE_COLOR = red;
module M {
    enum Size { small, medium, large };
};
const M::Size MYSIZE = M::medium;

```

- The constant name for the value of an enumerated constant definition must denote one of the enumerators defined for the enumerated type of the constant. For example:

```

const Color col = red;           // is OK but
const Color another = M::medium; // is an error

```

7.4.1.4.4 Data Types

A data type can be either a simple type or a constructed one. Those different kinds are detailed in the following clauses.

7.4.1.4.4.1 Simple Types

Simple types are types whose definition more or less pre-exists to any IDL specification. They can be split in two categories:

- Basic types that basically represent numbers and characters and fully pre-exist any IDL specification.
- Simple template types whose generic definition pre-exists any IDL specification but need to be *instantiated* with parameters, to become actual types

Those two categories are detailed in the subsequent clauses.

Note – Within this building-block, the actual type resulting from an instantiation of a template type cannot be used as is (anonymously). Instead, it needs to be given a name through a **typedef** declaration prior to any use. Therefore, as expressed in the following rules, referring to a simple type can be done either using directly its name, if it is a basic type, or through a scoped name, in all other cases:

```

(21) <type_spec> ::= <simple_type_spec>
(22) <simple_type_spec> ::= <base_type_spec>
    | <scoped_name>

```

7.4.1.4.4.1.1 Basic Types

Basic types are pre-existing types that represent numbers or characters. They are defined by the following rules:

```

(23) <base_type_spec> ::= <integer_type>
    | <floating_pt_type>
    | <char_type>
    | <wide_char_type>
    | <boolean_type>
    | <octet_type>

(24) <floating_pt_type> ::= "float"
    | "double"
    | "long" "double"

(25) <integer_type> ::= <signed_int>
    | <unsigned_int>

```

- (26) `<signed_int>` ::= `<signed_short_int>`
| `<signed_long_int>`
| `<signed_longlong_int>`
- (27) `<signed_short_int>` ::= "short"
- (28) `<signed_long_int>` ::= "long"
- (29) `<signed_longlong_int>` ::= "long" "long"
- (30) `<unsigned_int>` ::= `<unsigned_short_int>`
| `<unsigned_long_int>`
| `<unsigned_longlong_int>`
- (31) `<unsigned_short_int>` ::= "unsigned" "short"
- (32) `<unsigned_long_int>` ::= "unsigned" "long"
- (33) `<unsigned_longlong_int>` ::= "unsigned" "long" "long"
- (34) `<char_type>` ::= "char"
- (35) `<wide_char_type>` ::= "wchar"
- (36) `<boolean_type>` ::= "boolean"
- (37) `<octet_type>` ::= "octet"

7.4.1.4.4.1.1 Integer Types

IDL integer types are **short**, **unsigned short**, **long**, **unsigned long**, **long long**, and **unsigned long long** representing integer values in the range indicated below in Table 7-13.

Table 7-13: Integer types

Integer type	Value range
short	$-2^{15} \dots 2^{15} - 1$
long	$-2^{31} \dots 2^{31} - 1$
long long	$-2^{63} \dots 2^{63} - 1$
unsigned short	$0 \dots 2^{16} - 1$
unsigned long	$0 \dots 2^{32} - 1$
unsigned long long	$0 \dots 2^{64} - 1$

7.4.1.4.4.1.2 Floating-Point Types

IDL floating-point types are **float**, **double**, and **long double**. The **float** type represents IEEE single-precision floating point numbers; the **double** type represents IEEE double-precision floating point numbers. The **long double** data type represents an IEEE double-extended floating-point number, which has an exponent of at least 15 bits in length and a signed fraction of at least 64 bits. See IEEE Standard for Binary Floating-Point Arithmetic, ANSI/IEEE Standard 754-1985, for a detailed specification.

7.4.1.4.4.1.3 Char Type

IDL defines a **char** data type that is an 8-bit quantity that (1) encodes a single-byte character from any byte-oriented code set, or (2) when used in an array, encodes a multi-byte character from a multi-byte code set.

The ISO Latin-1 (8859-1) character set standard defines the meaning and representation of all possible graphic characters used in IDL (i.e., the space, alphabetic, digit, and graphic characters defined in Table 7-2 on page 6, Table 7-3 on page 7 and Table 7-4 on page 8). The meaning and representation of the null and formatting characters (see Table 7-5 on page 9) is the numerical value of the character as defined in the ASCII (ISO 646) standard. The meaning of all other characters is implementation-dependent.

7.4.1.4.4.1.1.4 Wide Char Type

IDL defines a **wchar** data type that encodes wide characters from any character set. The size of **wchar** is implementation-dependent.

7.4.1.4.4.1.1.5 Boolean Type

The **boolean** data type is used to denote a data item that can only take one of the values **TRUE** and **FALSE**.

7.4.1.4.4.1.1.6 Octet Type

The **octet** type is an opaque 8-bit quantity that is guaranteed not to undergo any change by the middleware.

7.4.1.4.4.1.2 Simple Template Types

Simple template types are template types whose generic definition pre-exists any IDL specification. To be used as an actual type, such a generic definition must be *instantiated*, i.e., given configuration parameters, whose nature depends on the template type.

As specified in the following rule, simple template types are sequences (**<sequence_type>**), strings (**<string_type>**), wide strings (**<wide_string_type>**) and fixed-point numbers (**<fixed_pt_type>**).

```
(38) <template_type_spec> ::= <sequence_type>
    / <string_type>
    / <wide_string_type>
    / <fixed_pt_type>
```

7.4.1.4.4.1.2.1 Sequences

Sequences are defined according to the following syntax.

```
(39) <sequence_type> ::= "sequence" "<" <type_spec> "," <positive_int_const> ">"
    / "sequence" "<" <type_spec> ">"
```

As a template type, **sequence** has two parameters:

- The first non-optional parameter (**<type_spec>**) gives the type of each item in the sequence.
- The second optional parameter (**<positive_int_const>**) is a positive integer constant that indicates the maximum size of the sequence. If it is given, the sequence is termed a *bounded* sequence. Otherwise the sequence is said *unbounded* and no maximum size is specified.

Before using a bounded or unbounded sequence, the length of the sequence must be set in a language-mapping dependent manner. If the bounded form is used, the length must be less than or equal to the maximum. Similarly after receiving a sequence, this value may be obtained in a language-mapping dependent manner.

7.4.1.4.4.1.2.2 Strings

IDL defines the string type **string** consisting of a list of all possible 8-bit quantities except null. A string is similar to a sequence of **char**. As with sequences of any type, prior to passing a string as a function argument (or as a field in a structure or union), the length of the string must be set in a language-mapping dependent manner. The syntax is:

```
(40) <string_type> ::= "string" "<" <positive_int_const> ">"  
      | "string"
```

The argument to the string declaration is the maximum size of the string (**<positive_int_const>**). If a positive integer maximum size is specified, the string is termed a *bounded* string. If no maximum size is specified, the string is termed an *unbounded* string. The actual length of a **string** is set at run-time and, if the bounded form is used, must be less than or equal to the maximum.

Note – Strings are singled out as a separate type because many languages have special built-in functions or standard library functions for string manipulation. A separate string type may permit substantial optimization in the handling of strings compared to what can be done with sequences of general types.

7.4.1.4.4.1.2.3 Wstrings

The **wstring** data type represents a sequence of **wchar**, except the wide character null. The type **wstring** is similar to that of type **string**, except that its element type is **wchar** instead of **char**. The syntax for defining a **wstring** is:

```
(41) <wide_string_type> ::= "wstring" "<" <positive_int_const> ">"  
      | "wstring"
```

7.4.1.4.4.1.2.4 Fixed Type

The **fixed** data type represents a fixed-point decimal number of up to 31 significant digits. The syntax to declare a fixed data type is:

```
(42) <fixed_pt_type> ::= "fixed" "<" <positive_int_const> "," <positive_int_const> ">"
```

The first parameter is the number of total digits (up to 31), the second one the number of fractional digits, which must be less or equal to the former.

In case the fixed type specification is used in a constant declaration, those two parameters are omitted as they are automatically deduced from the constant value. The syntax is thus as follows:

```
(43) <fixed_pt_const_type> ::= "fixed"
```

Note – The **fixed** data type will be mapped to the native fixed point capability of a programming language, if available. If there is not a native fixed point type, then the IDL mapping for that language will provide a fixed point data type. Applications that use the IDL fixed point type across multiple programming languages must take into account differences between the languages in handling rounding, overflow, and arithmetic precision.

7.4.1.4.4.2 Constructed Types

Constructed types are types that are created by an IDL specification.

As expressed in the following rule, structures (**<struct_dcl>**), unions (**<union_dcl>**) and enumerations (**<enum_dcl>**) are the constructed types supported in this building-block:

(44) `<constr_type_dcl>` ::= `<struct_dcl>`
 | `<union_dcl>`
 | `<enum_dcl>`

All those constructs are presented in the following clauses.

7.4.1.4.4.2.1 Structures

A structure is a grouping of at least one member. The syntax to declare a structure is as follows:

(45) `<struct_dcl>` ::= `<struct_def>`
 | `<struct_forward_dcl>`

(46) `<struct_def>` ::= `"struct" <identifier> "{" <member>+ "}"`

(47) `<member>` ::= `<type_spec> <declarators> ";"`

(67) `<declarators>` ::= `<declarator> { ";", <declarator> }`

(68) `<declarator>` ::= `<simple_declarator>`

A structure definition comprises:

- The **struct** keyword.
- The name given to the structure (`<identifier>`).
- The list of all structure members (`<member>+`) enclosed within braces (`{}`). Each member (`<member>`) is defined with a type specification (`<type_spec>`) followed by a list of at least one declarator (`<declarators>`). At least one member is required.

The name of a structure defines a new legal type that may be used anywhere such a type is legal in the grammar.

Note – Members may be of any data type, including sequences or arrays. However, except when anonymous types are supported (cf. 7.4.14, Building-Block Anonymous Types for more details), sequences or arrays need to be given a name (with **typedef**) to be used in the member declaration.

Structures may be forward declared, in particular to allow the definition of recursive structures. Cf. "Constructed Recursive Types and Forward Declarations" page 31 for more details.

7.4.1.4.4.2.2 Unions

IDL unions are a cross between C unions and switch statements. They may host a value of one type to be chosen between several possible cases. IDL unions must be discriminated: they embed a discriminator that indicates which case is to be used for the current instance. The possible cases as well as the type of the discriminator are part of the union declaration, whose syntax is as follows:

(49) `<union_dcl>` ::= `<union_def>`
 | `<union_forward_dcl>`

(50) `<union_def>` ::= `"union" <identifier> "switch" "(" <switch_type_spec> ")"`
 `"{" <switch_body> "}"`

(51) `<switch_type_spec>` ::= `<integer_type>`
 | `<char_type>`
 | `<boolean_type>`
 | `<scoped_name>`

(52) `<switch_body>` ::= `<case>+`

- (53) **<case>** ::= **<case_label>+ <element_spec> ";"**
- (54) **<case_label>** ::= **"case" <const_expr> ":"**
| "default" ":"
- (55) **<element_spec>** ::= **<type_spec> <declarator>**

A union declaration comprises:

- The **union** keyword.
- The name given to the union (**<identifier>**).
- The type for the discriminator (**<switch_type_spec>**). That type may be either one of the following types: **integer**, **char**, **boolean** or an enumeration, or a reference (**<scoped_name>**) to one of these.
- The list of all possible cases for the union (**<switch_body>**), enclosed within braces (**{}**). At least one case is required. Each possibility (**<case>**) comprises the form that the union takes (**<element_spec>**) when the discriminator takes the list of specified values (**<case_label>+**). Several case labels may be associated in a single case.
 - A case label must be:
 - Either a constant expression (**<const_expr>**) matching (or automatically castable) to, the defined type of the discriminator.
 - Or the **default** keyword, to tag the case when the discriminator's value does not match the other possibilities. A default case can appear at most once.
 - Each possible form for the union value is made of an existing IDL type (**<type_spec>**) followed by the name given to that form (**<declarator>**).

The name of a union defines a new legal type that may be used anywhere such a type is legal in the grammar.

It is not required that all possible values of the union discriminator be listed in the **<switch_body>**. The value of a union is the value of the discriminator together with one of the following:

1. If the discriminator value was explicitly listed in a case statement, the value of the element associated with that case statement.
2. If a default case label was specified, the value of the element associated with the default case label.
3. No additional value.

Access to the discriminator and to the related element is language-mapping dependent.

Note – Name scoping rules require that the element declarators (all the **<declarator>** in the different **<element_spec>**) in a particular union be unique. If the **<switch_type_spec>** is an enumeration, the identifier for the enumeration is as well in the scope of the union; as a result, it must be distinct from the element declarators. The values of the constant expressions for the case labels of a single union definition must be distinct. A union type can contain a default label only where the values given in the non-default labels do not cover the entire range of the union's discriminant type.

Note – While any ISO Latin-1 (8859-1) IDL character literal may be used in a **<case_label>** in a union definition whose discriminator type is **char**, not all of these characters are present in all code sets that may be used by implementation language compilers and/or runtimes, which may lead to some interoperability issue (typically leading to a **DATA_CONVERSION** system exception). Therefore, to ensure portability and interoperability, care must be exercised when assigning the **<case_label>** for a union member whose discriminator type is **char**. Due to this potential issue, use of char types as the discriminator type for unions is not recommended.

7.4.1.4.4.2.3 Enumerations

Enumerated types (enumerations) consist of ordered lists of enumerators. The syntax to create such a type is as follows:

```
(57) <enum_dcl> ::= "enum" <identifier>
           {"<enumerator> { "," <enumerator> } * "}"
(58) <enumerator> ::= <identifier>
```

An enumeration declaration comprises:

- The **enum** keyword.
- The name given to the enumeration (<identifier>).
- The list of the possible values (*enumerators*) that makes the enumeration, enclosed within braces (**{}**). Each enumerator is identified by a specific name (<identifier>). In case there are several enumerators, their names are separated by commas (,). An enumeration must contain at least one enumerator and no more than 232.

The name of an enumeration defines a new legal type that may be used anywhere such a type is legal in the grammar.

Note – The enumerated names must be mapped to a native data type capable of representing a maximally-sized enumeration. The order in which the identifiers are named in the specification of an enumeration defines the relative order of the identifiers. Any language mapping that permits two enumerators to be compared or defines successor/predecessor functions on enumerators must conform to this ordering relation.

7.4.1.4.4.2.4 Constructed Recursive Types and Forward Declarations

The IDL syntax allows the generation of recursive structures and unions via members that have a sequence type. For example, the following:

```
struct Foo; // Forward declaration
typedef sequence<Foo> FooSeq;
struct Foo {
    long value;
    FooSeq chain; // Recursive
};
```

The forward declaration for the structure enables the definition of the sequence type **FooSeq**, which is used as the type of the recursive member.

Forward declarations are legal for structures and unions. Their syntax is as follows:

```
(48) <struct_forward_dcl> ::= "struct" <identifier>
(56) <union_forward_dcl> ::= "union" <identifier>
```

A structure or union type is termed *incomplete* until its full definition is provided; that is, until the scope of the structure or union definition is closed by a terminating **};**. For example:

```
struct Foo; // Introduces Foo type name,
           // Foo is incomplete now
// ...
struct Foo {
    // ...
}; // Foo is complete at this point
```

If a structure or union is forward declared, a definition of that structure or union must follow the forward declaration in the same compilation unit. Compilers shall issue a diagnostic if this rule is violated. Multiple forward declarations of the same structure or union are legal.

If a sequence member of a structure or union refers to an incomplete type, the structure or union itself remains incomplete until the member's definition is completed. For example:

```

struct Foo;
typedef sequence<Foo> FooSeq;
struct Bar {
    long value;
    FooSeq chain;           // Use of incomplete type
};                          // Bar itself remains incomplete
struct Foo {
    // ...
};                          // Foo and Bar are complete

```

Compilers shall issue a diagnostic if this rule is violated.

Recursive definitions can span multiple levels. For example:

```

union Bar;                  // Forward declaration
typedef sequence<Bar> BarSeq;
union Bar switch (long) {  // Define incomplete union
case 0:
    long l_mem;
case 1:
    struct Foo {
        double d_mem;
        BarSeq nested;    // OK, recurse on enclosing incomplete type
    } s_mem;
};

```

An incomplete type can only appear as the element type of a sequence definition. A sequence with incomplete element type is termed an *incomplete sequence type*. For example:

```

struct Foo;
typedef sequence<Foo> FooSeq; // Forward declaration
// Incomplete

```

An incomplete sequence type can appear only as the element type of another sequence, or as the member type of a structure or union definition. Compilers shall issue a diagnostic if this rule is violated.

7.4.1.4.4.3 Arrays

IDL defines multidimensional, fixed-size arrays. An array includes explicit sizes for each dimension. The syntax for arrays is very similar to the one of C or C++ as stated in the following rules:

- (59) **<array_declarator>** ::= **<identifier>** **<fixed_array_size>****+**
(60) **<fixed_array_size>** ::= **"["** **<positive_int_const>** **"]"**

The array size (in each dimension) is fixed at compile time. The implementation of array indices is language mapping specific.

Declaring an array with all its dimensions creates an anonymous type. Within this building-block, such a type cannot be used as is but needs to be given a name through a **typedef** declaration prior to any use.

7.4.1.4.4.4 Native Types

IDL provides a declaration to define an opaque type whose representation is specified by the language mapping.

As stated in the following rules, declaring a native type consist in just prefixing the type name (`<simple_declarator>`) with the **native** keyword:

(61) `<native_dcl>` ::= "native" `<simple_declarator>`

(62) `<simple_declarator>` ::= `<identifier>`

This declaration defines a new type with the specified name. A native type is similar to an IDL basic type. The possible values of a native type are language-mapping dependent, as are the means for constructing and manipulating them. Any IDL specification that defines a native type requires each language mapping to define how the native type is mapped into that programming language.

Note – It is recommended that native types be mapped to equivalent type names in each programming language, subject to the normal mapping rules for type names in that language.

7.4.1.4.4.5 Naming Data Types

IDL provides constructs for naming types; that is, it provides C language-like declarations that associate an identifier with a type. The syntax for type declaration is as follows:

(63) `<typedef_dcl>` ::= "typedef" `<type_declarator>`

(64) `<type_declarator>` ::= { `<simple_type_spec>`
| `<template_type_spec>`
| `<constr_type_dcl>`
} `<any_declarators>`

(65) `<any_declarators>` ::= `<any_declarator>` { ", " `<any_declarator>` }

(66) `<any_declarator>` ::= `<simple_declarator>`
| `<array_declarator>`

(59) `<array_declarator>` ::= `<identifier>` `<fixed_array_size>`⁺

(60) `<fixed_array_size>` ::= "[" `<positive_int_const>` "]"

Such a declaration is made of:

- The **typedef** keyword
- The type specification, which may be a simple type specification (`<simple_type_spec>`), that is either a basic type or a scoped name denoting any IDL legal type, or a template type specification (`<template_type_spec>`), or a declaration for a constructed type (`<constr_type_dcl>`).
- A list of at least one declarator, which will provide the new type name. Each declarator can be either a simple identifier (`<simple_declarator>`), which will be then the name allocated to the type, or an array declarator (`<array_declarator>`), in which case the new name (`<identifier>` enclosed within the array declarator) will denote an array of specified type.

Note – As previously seen, a name is also associated with a data type via the **struct**, **union**, **enum**, and **native** declarations.

Note – Within this building block where anonymous types are forbidden, a **typedef** declaration is needed to name, prior to any use, an array or a template instantiation.

7.4.1.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-14: Keywords specific to Building-Block Core Data Types

boolean	case	char		
const				default
double			enum	
	FALSE		fixed	float
		long		
	module		native	
octet				
			sequence	short
string	struct		switch	TRUE
	typedef			
unsigned	union			
void	wchar	wstring		

7.4.2 Building-Block Any

7.4.2.1 Purpose

This building-block adds the ability to declare a type that may represent any valid data type.

7.4.2.2 Dependencies with other Building-Blocks

This building-block relies on Building-Block Core Data Types.

7.4.2.3 Syntax

The following rules are added by this building-block:

(69) `<base_type_spec> ::=+ <any_type>`

(70) <any_type> ::= "any"

7.4.2.4 Explanations and Semantics

An **any** is a type that may represent any valid data type. At IDL level, it is just declared with the keyword **any**.

An **any** logically contains a value and some means that specifies the actual type of the value. This means is middleware-specific⁵. Each IDL language mapping provides operations that allow programmers to insert and access the value contained in an **any** as well as the actual type of that value.

7.4.2.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-15: Keywords specific to Building-Block Any

	any			

⁵ For CORBA, this mean is a TypeCode (see [CORBA], Part1, Sub clause 8.11 “TypeCodes”).

7.4.3 Building-Block Interfaces – Basic

7.4.3.1 Purpose

This building-block gathers all the rules needed to define basic interfaces, i.e., consistent groupings of operations. At this stage, there is no other implicit behavior attached to interfaces.

7.4.3.2 Dependencies with other Building-Blocks

This building-block relies on Building-Block Core Data Types.

7.4.3.3 Syntax

The following rules form the building-block:

- (71) `<definition>` ::= `<except_dcl>` ";"
| `<interface_dcl>` ";"
- (72) `<except_dcl>` ::= "exception" `<identifier>` "{" `<member>`* "}"
- (73) `<interface_dcl>` ::= `<interface_def>`
| `<interface_forward_dcl>`
- (74) `<interface_def>` ::= `<interface_header>` "{" `<interface_body>` "}"
- (75) `<interface_forward_dcl>` ::= `<interface_kind>` `<identifier>`
- (76) `<interface_header>` ::= `<interface_kind>` `<identifier>`
[`<interface_inheritance_spec>`]
- (77) `<interface_kind>` ::= "interface"
- (78) `<interface_inheritance_spec>`
::= ":" `<interface_name>` { "," `<interface_name>` }*
- (79) `<interface_name>` ::= `<scoped_name>`
- (80) `<interface_body>` ::= `<export>`*
- (81) `<export>` ::= `<op_dcl>` ";"
| `<attr_dcl>` ";"
- (82) `<op_dcl>` ::= `<op_type_spec>` `<identifier>` "(" [`<parameter_dcls>`] ")" [`<raises_expr>`]
- (83) `<op_type_spec>` ::= `<type_spec>`
| "void"
- (84) `<parameter_dcls>` ::= `<param_dcl>` { "," `<param_dcl>` }*
- (85) `<param_dcl>` ::= `<param_attribute>` `<type_spec>` `<simple_declarator>`
- (86) `<param_attribute>` ::= "in"
| "out"
| "inout"
- (87) `<raises_expr>` ::= "raises" "(" `<scoped_name>` { "," `<scoped_name>` } * ")"
- (88) `<attr_dcl>` ::= `<readonly_attr_spec>`
| `<attr_spec>`
- (89) `<readonly_attr_spec>` ::= "readonly" "attribute" `<type_spec>` `<readonly_attr_declarator>`

(90)	<code><readonly_attr_declarator></code>	<code>::= <simple_declarator> <raises_expr> <simple_declarator> { "," <simple_declarator> }*</code>
(91)	<code><attr_spec></code>	<code>::= "attribute" <type_spec> <attr_declarator></code>
(92)	<code><attr_declarator></code>	<code>::= <simple_declarator> <attr_raises_expr> <simple_declarator> { "," <simple_declarator> }*</code>
(93)	<code><attr_raises_expr></code>	<code>::= <get_except_expr> [<set_except_expr>] <set_except_expr></code>
(94)	<code><get_except_expr></code>	<code>::= "getraises" <exception_list></code>
(95)	<code><set_except_expr></code>	<code>::= "setraises" <exception_list></code>
(96)	<code><exception_list></code>	<code>::= "(" <scoped_name> { "," <scoped_name> } * ")"</code>

7.4.3.4 Explanations and Semantics

7.4.3.4.1 IDL specification

With that building-block, an IDL specification may declare exceptions and interfaces (that are merely groups of operations):

```
(71) <definition>          ::=+ <except_dcl> ";"  
| <interface_dcl> ";"
```

7.4.3.4.2 Exceptions

Exceptions are specific data structures, which may be returned to indicate that an exceptional condition has occurred during the execution of an operation. The syntax to declare an exception is as follows:

```
(72) <except_dcl>          ::= "exception" <identifier> "{" <member>* "}"
```

An exception declaration is made of:

- The **exception** keyword.
- An identifier (`<identifier>`). Each exception is typed with its exception identifier.
- A body enclosed within braces (`{}`). The body may be void or comprise members (`<member>*`), very similar to structure members. See 7.4.1.4.4.2, Constructed Types for more details on member declaration.

If an exception is returned as the outcome to an operation invocation, then the value of the exception identifier is accessible to the programmer for determining which particular exception was raised.

If an exception is declared with members, a programmer will be able to access the values of those members when such an exception is raised. If no members are specified, no additional information is accessible when such an exception is raised.

The way this information is made available is language-mapping specific.

An identifier declared to be an exception identifier may thereafter appear only in a **raises** expression of an operation or attribute declaration, and nowhere else.

7.4.3.4.3 Interfaces

Interfaces are groupings of elements (in this building block operations and attributes).

As defined by the following rules, an interface is made of a header (**<interface_header>**) and a body (**<interface_body>**) enclosed in braces (**{}**). An interface may also be declared with no definition with a forward declaration (**<interface_forward_dcl>**).

(73) **<interface_dcl>** ::= **<interface_def>**
| **<interface_forward_dcl>**

(74) **<interface_def>** ::= **<interface_header>** **"{" <interface_body> "}"**

All those constructs are detailed in the following clauses.

7.4.3.4.3.1 Interface Header

An interface header is declared with the following syntax:

(76) **<interface_header>** ::= **<interface_kind>** **<identifier>**
[**<interface_inheritance_spec>**]

(77) **<interface_kind>** ::= **"interface"**

An interface header comprises:

- The **interface** keyword.
- The interface name (**<identifier>**).
- Optionally an inheritance specification (**<interface_inheritance_spec>**).

The **<identifier>** that names an interface defines a new legal type. Such a type may be used anywhere a type is legal in the grammar, subject to semantic constraints as described in the following sub clauses. A parameter or structure member, which is of an interface type, is actually semantically as a *reference* to an object implementing that interface. Each language binding describes how the programmer must represent such interface references.

7.4.3.4.3.2 Interface Inheritance

Interface inheritance is introduced by a colon (**:**) and must follow the following syntax:

(78) **<interface_inheritance_spec>** ::= **":" <interface_name> { "," <interface_name> }***

(79) **<interface_name>** ::= **<scoped_name>**

Each **<scoped_name>** in an **<interface_inheritance_spec>** must be the name of a previously defined interface or an alias to a previously defined interface (defined using a **typedef** declaration).

7.4.3.4.3.2.1 Inheritance Rules

An interface can be derived from another interface, which is then called a *base interface* of the derived interface. A derived interface, like all interfaces, may declare new elements (in this building-block, operations and attributes). In addition the elements of a base interface can be referred to as if they were elements of the derived interface.

An interface is called a *direct base* if it is mentioned in the **<interface_inheritance_spec>** and an *indirect base* if it is not a direct base but is a base interface of one of the interfaces mentioned in the **<interface_inheritance_spec>**.

An interface may be derived from any number of base interfaces. Such use of more than one direct base interface is often called *multiple inheritance*. The order of derivation is not significant.

An interface may not be specified as a direct base interface of a derived interface more than once; it may be an indirect base interface more than once. Consider the following example:

```
interface A { ... };
interface B: A { ... };
interface C: A { ... };
interface D: B, C { ... };    // OK
interface E: A, B { ... };   // OK
```

The relationships between these interfaces are shown in Figure 7-1. This "diamond" shape is legal, as is the definition of E on the right.

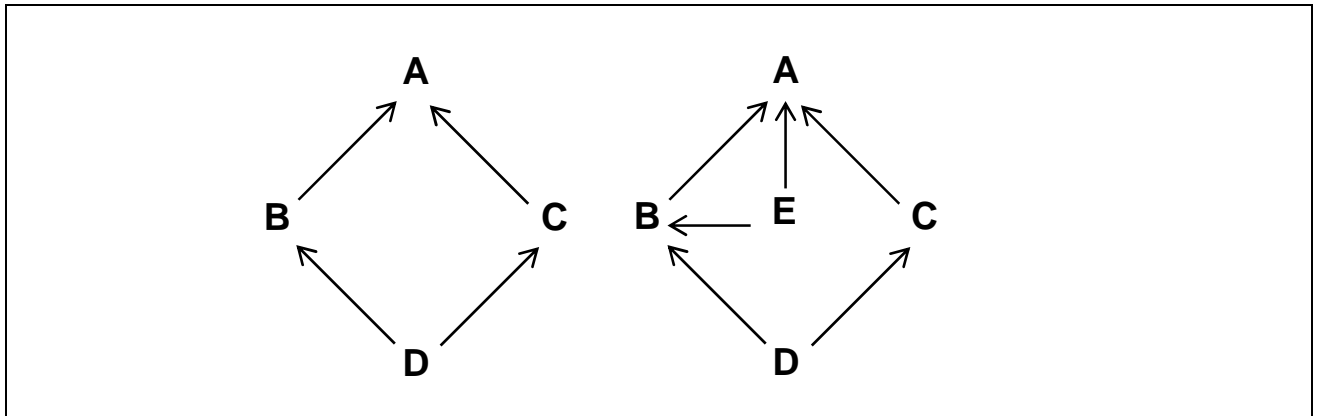


Figure 7-1: Examples of Legal Multiple Inheritance

It is forbidden to redefine an operation or an attribute in a derived interface, as well as inheriting two different operations or attributes with the same name.

```
interface A {
    void make_it_so();
};
interface B: A {
    short make_it_so(in long times);    // Error: redefinition of make_it_so
};
```

7.4.3.4.3.3 Interface Body

As stated in the following rules, within an interface body, can be defined operations and attributes. Those constructs are defined in the scope of the interface and exported (i.e., accessible outside the interface definition through their name scoped by the interface name).

```
(80) <interface_body> ::= <export>*
(81) <export> ::= <op_dcl> ";"
                | <attr_dcl> ";"
```

Operations and attributes are detailed in the following sub-clauses.

7.4.3.4.3.3.1 Operations

Operation declarations in IDL are similar to C function declarations. To define an operation, the syntax is:

- (82) `<op_dcl>` ::= `<op_type_spec> <identifier> "(" [<parameter_dcls>] ")" [<raises_expr>]`
- (83) `<op_type_spec>` ::= `<type_spec>`
| `"void"`
- (84) `<parameter_dcls>` ::= `<param_dcl> { "," <param_dcl> } *`
- (85) `<param_dcl>` ::= `<param_attribute> <type_spec> <simple_declarator>`
- (86) `<param_attribute>` ::= `"in"`
| `"out"`
| `"inout"`
- (87) `<raises_expr>` ::= `"raises" "(" <scoped_name> { "," <scoped_name> } * ")"`

An operation declaration consists of:

- The type of the operation's return result (`<op_type_spec>`); the type may be any type that can be defined in IDL. Operations that do not return a result must specify **void** as return type.
- An identifier (`<identifier>`) that names the operation in the scope of the interface in which it is defined.
- A parameter list that specifies zero or more parameter declarations. The parameter list is enclosed between brackets (`()`). In case more than one parameter is declared, parameter declarations are separated by commas (`,`). Each parameter declaration is made of:
 - A qualifier (`<param_attribute>`) that specifies the direction in which the parameter is to be passed. The possible values are:
 - **in** - the parameter is passed from caller to operation.
 - **out** - the parameter is passed from operation to caller.
 - **inout** - the parameter is passed in both directions.
 - The type of the parameter (`<type_spec>`) that may be any valid IDL type specification.
 - The name of the parameter (`<simple_declarator>`).
- An optional expression that indicates which exceptions may be raised as a result of an invocation of this operation. This expression is made of:
 - The **raises** keyword.
 - The list of the operation-specific exceptions, enclosed between brackets (`()`) and separated by commas (`,`) in case more than one exception is specified. Each of the scoped names (`<scoped_name>`) in the list must denote a previously defined exception.

It is expected that an implementation will not attempt to modify an **in** parameter. The ability to even attempt to do so is language-mapping specific; the effect of such an action is undefined.

In addition to any operation-specific exceptions specified in the **raises** expression, other middleware-specific standard exceptions may be raised. These exceptions are described in the related profiles.

The absence of a **raises** expression on an operation implies that there are no operation-specific exceptions. Invocations of such an operation are still liable to receive one of the middleware-specific standard exceptions.

If an exception is raised as a result of an invocation, the values of the **return** result and any **out** and **inout** parameters are undefined.

Note – A native type (cf. 7.4.1.4.4.4) may be used to define operation parameters, results, and exceptions. If a native type is used for an exception, it must be mapped to a type in a programming language that can be used as an exception.

7.4.3.4.3.3.2 Attributes

Attributes can also be declared within an interface. Declaring an attribute is logically equivalent to declaring a pair of accessor functions; one to retrieve the value of the attribute and one to set the value of the attribute.

To create an attribute, the syntax is as follows:

- (88) **<attr_dcl>** ::= **<readonly_attr_spec>**
| **<attr_spec>**
- (89) **<readonly_attr_spec>** ::= **"readonly" "attribute" <type_spec> <readonly_attr_declarator>**
- (90) **<readonly_attr_declarator>**
::= **<simple_declarator> <raises_expr>**
| **<simple_declarator> { "," <simple_declarator> }***
- (91) **<attr_spec>** ::= **"attribute" <type_spec> <attr_declarator>**
- (92) **<attr_declarator>** ::= **<simple_declarator> <attr_raises_expr>**
| **<simple_declarator> { "," <simple_declarator> }***
- (93) **<attr_raises_expr>** ::= **<get_except_expr> [<set_except_expr>]**
| **<set_except_expr>**
- (94) **<get_except_expr>** ::= **"getraises" <exception_list>**
- (95) **<set_except_expr>** ::= **"setraises" <exception_list>**
- (96) **<exception_list>** ::= **"(" <scoped_name> { "," <scoped_name> } * ")"**

An attribute declaration is made of:

- An optional qualifier (**readonly**) that indicates that the attribute cannot be written. In this case, the attribute is said *read-only* and the declaration is equivalent to only a read accessor.
- The **attribute** keyword.
- The type of the attribute that may be any valid IDL type specification (**<type_spec>**).
- The name of the attribute (**<simple_declarator>**).
- An optional raises expression.

The optional raises expressions take different forms according to the attribute kinds:

- For read-only attributes, raises expressions are similar to those of operations (cf. rule (90) above).
- For plain attributes, raises expressions allow to indicate which the potential user-defined exceptions are when the attribute is read (**getraises**) and which the ones are when the attribute is written (**setraises**). A plain attribute may have a **getraises** expression, a **setraises** expression or both of them. In the latter case, the **getraises** expression must be declared in first place.

The absence of a raises expression (**raises**, **getraises** or **setraises**) on an attribute implies that there are no attribute-specific exceptions. Accesses to such an attribute are still liable to receive middleware-specific standard exceptions.

As a shortcut, several attributes can be declared in a single attribute declaration, provided that there are no attached raises clauses. In that case, the names of the attributes are listed, separated by a comma (,).

Note – A native type (cf. 7.4.1.4.4.4) may be used to define attribute types, and exceptions. If a native type is used for an exception, it must be mapped to a type in a programming language that can be used as an exception.

7.4.3.4.3.4 Forward Declaration

A forward declaration declares the name of an interface without defining it. This permits the definition of interfaces that refer to each other.

As stated in the following rule, the syntax for a forward declaration is simply the declaration of the kind of interface⁶, followed by the interface name:

(75) `<interface_forward_dcl> ::= <interface_kind> <identifier>`

(77) `<interface_kind> ::= "interface"`

It is illegal to inherit from a forward-declared interface not previously defined.

```

module Example {
  interface base;           // Forward declaration
  // ...
  interface derived : base {}; // Error
  interface base {};         // Define base
  interface derived : base {}; // OK
};

```

Multiple forward declarations of the same interface name are legal, provided that they are all consistent.

7.4.3.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-16: Keywords specific to Building-Block Interfaces – Basic

			attribute	
	exception			
getraises			in	inout
interface				

⁶ The definition of a forward-declared interface must be consistent with the forward declaration: they must share the same interface kind. With this building-block, there is only one interface kind (namely **interface**) however other interface-related building-blocks will add other kinds (such as **abstract interface**).

		out		
raises	readonly	setraises		

7.4.4 Building-Block Interfaces – Full

7.4.4.1 Purpose

This building-block complements the former one with the ability to embed in the interface body, additional declarations such as types, exceptions and constants.

7.4.4.2 Dependencies with other Building-blocks

This building-block complements Building-Block Interfaces – Basic. Transitively, it relies on Building-Block Core Data Types.

7.4.4.3 Syntax

The following rule is added by this building-block:

```
(97) <export>          ::=+ <type_dcl> ";"
                       | <const_dcl> ";"
                       | <except_dcl> ";"
```

7.4.4.4 Explanations and Semantics

This building-block adds the possibility to embed inside an interface declaration, declarations of types, constants and exceptions.

The syntax for those embedded elements is exactly the same as if they were top-level constructs.

All those elements are exported (i.e., visible under the scope of their hosting interface). As opposed to attributes and operations, they may be redefined in a derived interface, which has the following consequences:

- In a derived interface, all elements of a base class may be referred to as if they were elements of the derived class, unless they are redefined in the derived class. The name resolution operator (::) may be used to refer to a base element explicitly; this permits reference to a name that has been redefined in the derived interface. The scope rules for such names are described in 7.5, Names and Scoping.

- References to base interface elements must be unambiguous. A reference to a base interface element is *ambiguous* if the name is declared as a constant, type, or exception in more than one base interface. Ambiguities can be resolved by qualifying a name with its interface name (that is, using a **<scoped_name>**). It is illegal to inherit from two interfaces with the same operation or attribute name, or to redefine an operation or attribute name in the derived interface.

For example in:

```

interface A {
    typedef long L1;
    short opA (in L1 l_1);
};

interface B {
    typedef short L1;
    L1 opB (in long l);
};

interface C: B, A {
    typedef L1 L2;           // Error: L1 ambiguous
    typedef A::L1 L3;       // A::L1 is OK
    B::L1 opC (in L3 l_3);  // All OK no ambiguities
};

```

- References to constants, types, and exceptions are bound to an interface when it is defined (i.e., replaced with the equivalent global scoped names). This guarantees that the syntax and semantics of an interface are not changed when the interface is a base interface for a derived interface.

Consider the following example:

```

const long L = 3;
interface A {
    typedef float coord[L];
    void f (in coord s);      // s has three floats
};

interface B {
    const long L = 4;
};

interface C: B, A { };      // What is C::f()'s signature?

```

The early binding of constants, types, and exceptions at interface definition guarantees that the signature of operation **f** in interface **C** is **typedef float coord[3]; void f (in coord s);** which is identical to that in interface **A**. This rule also prevents redefinition of a constant, type, or exception in the derived interface from affecting the operations and attributes inherited from a base interface.

- Interface inheritance causes all identifiers defined in base interfaces, both direct and indirect, to be visible in the current naming scope. A type name, constant name, enumeration value name, or exception name from an enclosing scope can be redefined in the current scope. An attempt to use an ambiguous name without qualification produces a compilation error. Thus in:

```

interface A {
    typedef string<128> string_t;
};

interface B {
    typedef string<256> string_t;
};

interface C: A, B {
    attribute string_t Title;      // Error: string_t ambiguous
    attribute A::string_t Name;   // OK
    attribute B::string_t City;   // OK
};

```

7.4.4.5 Specific Keywords

There are no additional keywords with this building-block.

7.4.5 Building-Block Value Types

7.4.5.1 Purpose

This building-block adds the ability to declare plain value types.

As opposed to interfaces which are merely groups of operations⁷, values carry also state contents. A value type is, in some sense, half way between a "regular" IDL interface type and a structure.

Value types add the following features to the expressive power of structures:

- Single derivation (from other value types).
- Supports a single interface.
- Arbitrary recursive value type definitions, with sharing semantics providing the ability to define lists, trees, lattices, and more generally arbitrary graphs using value types.
- Null value semantics.

Designing a value type requires that some additional properties (state) and implementation details be specified beyond that of an interface type. Specification of this information puts some additional constraints on the implementation choices beyond that of interface types. This is reflected in both the semantics specified herein, and in the language mappings.

An essential property of value types is that their implementations are always collocated with their clients. That is, the explicit use of values in a concrete programming language is always guaranteed to use local implementations, and will not require remote calls. They have thus no system-wide identity (their value is their identity).

7.4.5.2 Dependencies with other Building-Blocks

This building-block requires Building-Block Interfaces – Basic. Transitively, it relies on Building-Block Core Data Types.

7.4.5.3 Syntax

The following rules are added by this building-block:

- | | | |
|-------|--------------|---|
| (98) | <definition> | ::+ <value_dcl> ";" |
| (99) | <value_dcl> | ::= <value_def>
 <value_forward_dcl> |
| (100) | <value_def> | ::= <value_header> "{" <value_element>* "}" |

⁷ Interface attributes are actually equivalent to accessors.

(101) <value_header>	::= <value_kind> <identifier> [<value_inheritance_spec>]
(102) <value_kind>	::= "valuetype"
(103) <value_inheritance_spec>	::= [":" <value_name>] ["supports" <interface_name>]
(104) <value_name>	::= <scoped_name>
(105) <value_element>	::= <export> <state_member> <init_dcl>
(106) <state_member>	::= ("public" "private") <type_spec> <declarators> ";"
(107) <init_dcl>	::= "factory" <identifier> "(" [<init_param_dcls>] ")" [<raises_expr>] ";"
(108) <init_param_dcls>	::= <init_param_dcl> { "," <init_param_dcl> }*
(109) <init_param_dcl>	::= "in" <type_spec> <simple_declarator>
(110) <value_forward_dcl>	::= <value_kind> <identifier>

7.4.5.4 Explanations and Semantics

With that building-block, an IDL specification may additionally declare value types, as expressed in:

(98) <definition> ::=+ <value_dcl> ";"

There are two kinds of value type declarations: definitions of concrete (stateful) value types, and forward declarations.

(99) <value_dcl> ::= <value_def>
| <value_forward_dcl>

7.4.5.4.1 Concrete (Stateful) Value Types

Regular value types (also named *concrete* or *stateful*) are declared with the following syntax:

(100) <value_def> ::= <value_header> "{" <value_element>* "}"

A value declaration consists in a header (<value_header>) and a body, made of value elements (<value_element>*) enclosed within braces ({}). Those constructs are detailed in the following clauses.

7.4.5.4.1.1 Value Header

The value header is declared with the following syntax:

(101) <value_header> ::= <value_kind> <identifier> [<value_inheritance_spec>]

(102) <value_kind> ::= "valuetype"

The value header consists of:

- The **valuetype** keyword.
- An identifier (<identifier>) to name the value type. Value types may also be named by a **typedef** declaration.
- An optional value inheritance specification (<value_inheritance_spec>).

The name of a value type defines a new legal type that may be used anywhere such a type is legal in the grammar.

7.4.5.4.1.2 Value Inheritance Specification

As expressed in the following rules, value types may inherit from one value type and may support one interface:

(103) `<value_inheritance_spec>` ::= [":" <value_name>] ["supports" <interface_name>]

(104) `<value_name>` ::= <scoped_name>

The value inheritance specification is thus made of two parts (both being optional):

- The inheritance from another value types, introduced by a colon sign (:) where the `<value_name>` must be the name of a previously defined value type or an alias⁸ to a previously defined value type.
- The inheritance from an interface, introduced by the **supports** keyword, where the `<interface_name>` must be the name of a previously defined interface or an alias to a previously defined interface.

7.4.5.4.1.3 Value Element

A value can contain all the elements that an interface can (`<export>` in the following rule) as well as definitions of state members and initializers for that state.

(105) `<value_element>` ::= <export>
| <state_member>
| <init_dcl>

7.4.5.4.1.3.1 State Members

State members follow the following syntax:

(106) `<state_member>` ::= ("public" | "private") <type_spec> <declarators> ";"

Each `<state_member>` defines an element of the state, which is transmitted to the receiver when the value type is passed as a parameter. A state member is either **public** or **private**. The annotation directs the language mapping to expose or hide the different parts of the state to the clients of the value type. While its public part is exposed to all, the private part of the state is only accessible to the implementation code and the marshaling routines.

Note – Some programming languages may not have the built in facilities needed to distinguish between public and private members. In these cases, the language mapping specifies the rules that programmers are responsible for.

7.4.5.4.1.3.2 Initializers

In order to ensure portability of value implementations, designers may also define the signatures of *initializers* (or constructors) for concrete value types. Syntactically these look like local operation signatures except that they are prefixed with the keyword **factory**, have no return type, and must use only **in** parameters.

(107) `<init_dcl>` ::= "factory" <identifier> "(" [<init_param_dcls>] ")" [<raises_expr>] ";"

(108) `<init_param_dcls>` ::= <init_param_dcl> { "," <init_param_dcl> }*

(109) `<init_param_dcl>` ::= "in" <type_spec> <simple_declarator>

⁸ i.e., created by a **typedef** declaration.

There may be any number of factory declarations. The names of the initializers are part of the name scope of the value type. Initializers defined in a value type are not inherited by derived value types, and hence the names of the initializers are free to be reused in a derived value type.

7.4.5.4.2 Forward Declarations

Like interfaces, value types may be forward-declared, with the following syntax:

(110) `<value_forward_dcl> ::= <value_kind> <identifier>`

A forward declaration declares the name of a value type without defining it. This permits the definition of value types that refer to each other. The syntax consists simply of the keyword **valuetype** followed by an **<identifier>** that names the value type.

Multiple forward declarations of the same value type name are legal.

It is illegal to inherit from a forward-declared value type not previously defined.

It is illegal for a value type to support a forward-declared interface not previously defined.

7.4.5.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-17: Keywords specific to Building-Block Value Types

factory				
				private
			public	
		supports		
				valuetype

7.4.6 Building-Block CORBA-Specific – Interfaces

7.4.6.1 Purpose

This building-block adds the syntactical elements that are specific to CORBA as well as provides explanations specific to a CORBA usage of the imported elements.

7.4.6.2 Dependencies with other Building-Blocks

This building-block is based on Building-Block Interfaces – Full. Transitively, it relies on Building-Block Interfaces – Basic and Building-Block Core Data Types.

7.4.6.3 Syntax

This building-block adds the following rules:

(111) <definition>	::+ <type_id_dcl> ";" <type_prefix_dcl> ";" <import_dcl> ";"
(112) <export>	::+ <type_id_dcl> ";" <type_prefix_dcl> ";" <import_dcl> ";" <op_oneway_dcl> ";" <op_with_context> ";"
(113) <type_id_dcl>	::= "typeid" <scoped_name> <string_literal>
(114) <type_prefix_dcl>	::= "typeprefix" <scoped_name> <string_literal>
(115) <import_dcl>	::= "import" <imported_scope>
(116) <imported_scope>	::= <scoped_name> <string_literal>
(117) <base_type_spec>	::+ <object_type>
(118) <object_type>	::= "Object"
(119) <interface_kind>	::+ "local" "interface"
(120) <op_oneway_dcl>	::= "oneway" "void" <identifier> "(" [<in_parameter_dcls>] ")"
(121) <in_parameter_dcls>	::= <in_param_dcl> { "," <in_param_dcl> } *
(122) <in_param_dcl>	::= "in" <type_spec> <simple_declarator>
(123) <op_with_context>	::= {<op_dcl> <op_oneway_dcl>} <context_expr>
(124) <context_expr>	::= "context" "(" <string_literal> { "," <string_literal> } ")"

7.4.6.4 Explanations and Semantics

This building-block adds mainly:

- Constructs related to Interface Repository.
- A named root for all interfaces (Object).

- Local interfaces.
- Oneway interfaces.
- Operations with context.
- CORBA module.

All these constructs are presented in the following sub-clauses as far it is needed to understand their syntax. For more details on their precise semantics, refer to the CORBA documentation.

7.4.6.4.1 Interface Repository Related Declarations

A few new constructs related to the Interface Repository are parts of this building-block:

```
(111) <definition>          ::=+ <type_id_dcl> ";"
                               | <type_prefix_dcl> ";"
                               | <import_dcl> ";"

(112) <export>              ::=+ <type_id_dcl> ";"
                               | <type_prefix_dcl> ";"
                               | <import_dcl> ";"
                               | <op_oneway_dcl>
```

7.4.6.4.1.1 Repository Identity Declaration

The syntax of a repository identity declaration is as follows:

```
(113) <type_id_dcl>         ::= "typeid" <scoped_name> <string_literal>
```

A repository identifier declaration includes the following elements:

- The **typeid** keyword.
- A **<scoped_name>** that denotes the named IDL construct to which the repository identifier is assigned. It must denote a previously-declared name of one of the IDL constructs that may define a scope, as explained in clause 7.5.2 Scoping Rules and Name Resolution.
- A string literal (**<string_literal>**) that must contain a valid repository identifier value. This value will be assigned as the repository identity of the specified type definition.

At most one repository identity declaration may occur for any named type definition. An attempt to redefine the repository identity for a type definition is illegal, regardless of the value of the redefinition.

7.4.6.4.1.2 Repository Identifier Prefix Declaration

The syntax of a repository identifier prefix declaration is as follows:

```
(114) <type_prefix_dcl>     ::= "typeprefix" <scoped_name> <string_literal>
```

A repository identifier declaration includes the following elements:

- The **typeprefix** keyword.
- A **<scoped_name>** that denotes an IDL name scope to which the prefix applies. It must denote a previously-declared name of one of the following IDL constructs: module, interface (including abstract or local interface),

value type⁹ (including abstract, custom, and box value types) or event type⁹ (including abstract and custom value types). A void scope ("::" as scoped name) denotes the specification scope.

- A string literal (**<string_literal>**) that must contain the string to be prefixed to repository identifiers in the specified name scope. The specified string shall be a list of one or more identifiers, separated by slashes (/). These identifiers are arbitrarily long sequences of alphabetic, digit, underscore (_), hyphen (-), and period (.) characters. The string shall not contain a trailing slash (/), and it shall not begin with the characters underscore (_), hyphen (-) or period (.).

Note – "prefixed to the body of a repository identifier" means that the specified string is inserted into the default IDL format repository identifier immediately after the format name and colon ("**IDL:**") at the beginning of the identifier. A forward slash (/) character is inserted between the end of the specified string and the remaining body of the repository identifier.

Note – The prefix is only applied to repository identifiers whose values are not explicitly assigned by a **typeid** declaration. The prefix is applied to all such repository identifiers in the specified name scope, including the identifier of the construct that constitutes the name scope.

7.4.6.4.1.3 Repository Id Conflict

In IDL that contains pragma prefix/ID declarations (as defined in [CORBA], Part1, Sub clause 14.7.5 "Pragma Directives for RepositoryId") and **typeprefix/typeid** declarations as explained below, both mechanisms must return the same repository id for the same IDL element otherwise an error should be raised.

Note that this rule applies only when the repository id value computation uses explicitly declared values from declarations of both kinds. If the repository id computed using explicitly declared values of one kind conflicts with one computed with implicit values of the other kind, the repository id based on explicitly declared values shall prevail.

7.4.6.4.1.4 Imports

Imports may be specified according to the following syntax:

(115) **<import_dcl>** ::= "import" **<imported_scope>**
(116) **<imported_scope>** ::= **<scoped_name>** | **<string_literal>**

The **<imported_scope>** non-terminal may be either a fully-qualified scoped name denoting an IDL name scope, or a string containing the interface repository ID of an IDL name scope, i.e., a definition object in the repository whose interface derives from **CORBA::Container**.

The definition of import obviates the need to define the meaning of IDL constructs in terms of "file scopes." This standard defines the concepts of a specification as a unit of IDL expression. In the abstract, a specification consists of a finite sequence of ISO Latin-1 (8859-1) characters that form a legal IDL sentence. The physical representation of the specification is of no consequence to the definition of IDL, though it is generally associated with a file in practice.

Any scoped name that begins with the scope token (::) is resolved relative to the global scope of the specification in which it is defined. In isolation, the scope token represents the scope of the specification in which it occurs.

A specification that imports name scopes must be interpreted in the context of a well-defined set of IDL specifications whose union constitutes the space from within which name scopes are imported. A "well-defined set of IDL

⁹ Assuming that those constructs are part of the current profile.

specifications," means any identifiable representation of IDL specifications, such as an interface repository. The specific representation from which name scopes are imported is not specified, nor is the means by which importing is implemented, nor is the means by which a particular set of IDL specifications (such as an interface repository) is associated with the context in which the importing specification is to be interpreted.

The effects of an import statement are as follows:

- The contents of the specified name scope are visible in the context of the importing specification. Names that occur in IDL declarations within the importing specification may be resolved to definitions in imported scopes.
- Imported IDL name scopes exist in the same space as names defined in subsequent declarations in the importing specification.
- IDL module definitions may re-open modules defined in imported name scopes.
- Importing an inner name scope (i.e., a name scope nested within one or more enclosing name scopes) does not implicitly import the contents of any of the enclosing name scopes.
- When a name scope is imported, the names of the enclosing scopes in the fully-qualified pathname of the enclosing scope are exposed within the context of the importing specification, but their contents are not imported. An importing specification may not redefine or reopen a name scope that has been exposed (but not imported) by an import statement.
- Importing a name scope recursively imports all name scopes nested within it.
- For the purposes of this International Standard, name scopes that can be imported (i.e., specified in an **import** statement) include the following: modules, interfaces, value types¹⁰, and event types¹⁰.
- Redundant imports (e.g., importing an inner scope and one of its enclosing scopes in the same specification) are disregarded. The union of all imported scopes is visible to the importing program.
- This International Standard does not define a particular form for generated stubs and skeletons in any given programming language. In particular, it does not imply any normative relationship between units of specification and units of generation and/or compilation for any language mapping.

7.4.6.4.2 Object

In a CORBA scope, all interfaces inherit either directly or indirectly from a common root named **Object** (**CORBA::Object**). The IDL **Object** keyword allows designating that common root in any place where an interface is allowed. This is expressed by the following additional rules:

(117) **<base_type_spec> ::=+ <object_type>**

(118) **<object_type> ::= "Object"**

7.4.6.4.3 Local Interfaces

In a CORBA scope, interfaces are by default potentially remote interfaces. The keyword **local** allows declaring interfaces that cannot be remote.

(119) **<interface_kind> ::=+ "local" "interface"**

¹⁰ Assuming that these constructs are part of the current profile.

An interface declaration containing the keyword **local** in its header declares a *local interface*. An interface declaration not containing the keyword **local** is referred to as an *unconstrained interface*. An object implementing a local interface is referred to as a *local object*. The following special rules apply to local interfaces:

- A local interface may inherit from other local or unconstrained interfaces.
- An unconstrained interface may not inherit from a local interface. An interface derived from a local interface must be explicitly declared local.
- A value type¹¹ may support a local interface.
- Any IDL type, including an unconstrained interface, may appear as a parameter, attribute, return type, or exception declaration of a local interface.
- A local interface is a local type, as is any non-interface type declaration constructed using a local interface or other local type. For example, a structure, union, or exception with a member that is a local interface is also itself a local type.
- A local type may be used as a parameter, attribute, return type, or exception declaration of a local interface or of a value type.
- A local type may not appear as a parameter, attribute, return type, or exception declaration of an unconstrained interface.

See the [CORBA], Part1, Sub clause 8.3.14 "Local Object Operations" for CORBA implementation semantics associated with local objects.

7.4.6.4.4 Use of Native types

In a CORBA context, native type parameters are not permitted in operations of remote interfaces. Any attempt to transmit a value of a native type in a remote invocation may raise the MARSHAL standard system exception.

Note – The native type declaration is provided specifically for use in object adapter interfaces, which require parameters whose values are concrete representations of object implementation instances. It is strongly recommended that it not be used in service or application interfaces. The native type declaration allows object adapters to define new primitive types without requiring changes to the IDL language or to the IDL compiler.

7.4.6.4.5 Oneway Operations

By default calling applications are blocked until the called operations are complete. One-way operations are special operations that return the control to the calling applications immediately after the call. How this semantics is implemented is middleware-specific but in all cases one-way operations

- Cannot have a result (return type must be **void**, no **out** or **inout** parameters).
- Cannot trigger exceptions.

One-way operations are declared with the following syntax:

```
(120) <op_oneway_dcl> ::= "oneway" "void" <identifier> "(" [ <in_parameter_dcls> ] ")"
(121) <in_parameter_dcls> ::= <in_param_dcl> { ",", <in_param_dcl> } *
(122) <in_param_dcl> ::= "in" <type_spec> <simple_declarator>
```

¹¹ Assuming that this construct is part of the current profile.

7.4.6.4.6 Context Expressions

In a CORBA scope, operations may be added a context expression, as specified in the following additional rules:

- (123) `<op_with_context>` ::= {`<op_dcl>` | `<op_oneway_dcl>`} `<context_expr>`
 (124) `<context_expr>` ::= "context" "(" `<string_literal>` { "," `<string_literal>` } ")"

A context expression specifies which elements of the client's context may affect the performance of a request by the object. The run-time system guarantees to make the value (if any) associated with each `<string_literal>` in the client's context available to the object implementation when the request is delivered. The ORB and/or object is free to use information in this request context during request resolution and performance.

The absence of a context expression indicates that there is no request context associated with requests for this operation.

Each `<string_literal>` is a non-empty string. If the character * appears in a `<string_literal>`, it must appear only once, as the last character of the `<string_literal>`, and must be preceded by one or more characters other than *.

The mechanism by which a client associates values with the context identifiers is described in [CORBA], part 1, Sub clause 8.6 "Context Object" .

7.4.6.4.7 CORBA Module

Names defined by the CORBA specification are in a module named **CORBA**. In an IDL specification, however, IDL keywords such as **Object** must not be preceded by a "CORBA::" prefix. Other interface names such as **TypeCode** are not IDL keywords, so they must be referred to by their fully scoped names (e.g., **CORBA::TypeCode**) within an IDL specification.

For example in:

```
#include <orb.idl>
module M {
    typedef CORBA::Object myObjRef;           // Error: keyword Object scoped
    typedef TypeCode myTypeCode;             // Error: TypeCode undefined
    typedef CORBA::TypeCode TypeCode;       // OK
};
```

The file **orb.idl** contains the IDL definitions for the **CORBA** module. Except for **CORBA::TypeCode**, the file **orb.idl** must be included in IDL files that use names defined in the **CORBA** module. IDL files that use **CORBA::TypeCode** may obtain its definition by including either the file **orb.idl** or the file **TypeCode.idl**.

7.4.6.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-18: Keywords specific to Building-Block CORBA-Specific – Interfaces

		context		

		import		
	local			
				Object
	oneway			
		typeid		typeprefix

7.4.7 Building-Block CORBA-Specific – Value Types

7.4.7.1 Purpose

This building-block adds the syntactical elements that are specific to value types when used in CORBA as well as provides explanations specific to a CORBA usage of the imported elements.

Note – This building-block has been designed as separated from Building-Block CORBA-Specific – Interfaces, to allow CORBA profiles without value types.

7.4.7.2 Dependencies with other Building-Blocks

This building-block is based on Building-Block Value Types and complements Building-Block CORBA-Specific – Interfaces. Transitively, it relies on Building-Block Interfaces – Full, Building-Block Interfaces – Basic and Building-Block Core Data Types.

7.4.7.3 Syntax

This building-block adds the following rules:

- (125) `<value_dcl>` `::+ <value_box_def>`
 `| <value_abs_def>`
- (126) `<value_box_def>` `::= "valuetype" <identifier> <type_spec>`
- (127) `<value_abs_def>` `::= "abstract" "valuetype" <identifier> [<value_inheritance_spec>]`
 `"{" <export>* "}"`
- (128) `<value_kind>` `::+ "custom" "valuetype"`
- (129) `<interface_kind>` `::+ "abstract" "interface"`

```

(130) <value_inheritance_spec>      ::=+ ":" ["truncatable"] <value_name> { ",", <value_name> }*
                                     [ "supports" <interface_name> { ",", <interface_name> }* ]
(131) <base_type_spec>              ::=+ <value_base_type>
(132) <value_base_type>             ::= "ValueBase"

```

7.4.7.4 Explanations and Semantics

Main additions concern:

- Boxed value types.
- Abstract value types and interfaces as well as their impact on inheritance rules.
- Custom marshaling.
- Truncatable value types.
- ValueBase as a root for all value types.

All these constructs are presented in the following sub-clauses as far it is needed to understand their syntax. For more details on their precise semantics, refer to the CORBA documentation.

7.4.7.4.1 Boxed Value Types

It is often convenient to define a value type with no inheritance or operations and with a single state member. A shorthand IDL notation is used to simplify the use of value types for this kind of simple containment, referred to as a *value box*. Such boxed value types are defined with the following syntax:

```
(126) <value_box_def> ::= "valuetype" <identifier> <type_spec>
```

A boxed value type declaration simply consists in:

- The **valuetype** keyword.
- An identifier (**<identifier>**) to name the boxed value type.
- The type specification of the unique state member of the boxed value type. (**<type_spec>**).

Since "boxing" a value type would add no additional properties to the value type, it is an error to box value types. Any IDL type may be used to declare a value box except a value type.

Value box are particularly useful for strings and sequences. Basically they avoid creating what would actually be an additional namespace that would contain only one name.

An example is the following IDL:

```

module Example {
    interface Foo {
        ... /* anything */
    };
    valuetype FooSeq sequence<Foo>;
    interface Bar {
        void dolt (in FooSeq seq);
    };
};

```

The above IDL provides similar functionality to writing the following one. However the type identities would be different.

```
module Example {
  interface Foo {
    ... /* anything */
  };
  valuetype FooSeq {
    public sequence<Foo> data;
  };
  interface Bar {
    void dolt (in FooSeq seq);
  };
};
```

The former is easier to manipulate after it is mapped to a concrete programming language.

Note – The declaration of a boxed value type does not open a new scope. Thus a construction such as: **valuetype FooSeq sequence <FooSeq>**; is not legal IDL. The identifier being declared as a boxed value type cannot be used subsequent to its initial use and prior to the completion of the boxed value declaration.

7.4.7.4.2 Abstract Value Types and Interfaces

In this building-block, value types as well as interfaces may be abstract. They are called *abstract* because they cannot be instantiated. Only concrete types derived from them may be actually instantiated and implemented.

Abstract types may be used to specify a type where a type specification is required (for example as a return type of an operation).

7.4.7.4.2.1 Abstract Value Types

As opposed to concrete value types, abstract value types are stateless (essentially they are a bundle of operation signatures with a purely local implementation). To create an abstract value type, the following syntax applies:

```
(127) <value_abs_def> ::= "abstract" "valuetype" <identifier> [ <value_inheritance_spec> ]
                        "{" <export> * "}"
```

No **<state_member>** or **<initializers>** may be specified. However, local operations may be specified.

Because no state information may be specified (only local operations are allowed), abstract value types are not subject to the single inheritance restrictions placed upon concrete value types. Therefore a value type may inherit from several abstract value types. In return an abstract value type cannot inherit from a concrete one.

Note – A concrete value type with an empty state is not an abstract value type.

7.4.7.4.2.2 Abstract Interfaces

An abstract interface is an entity, which may at runtime represent either a regular interface or a value type. Like an abstract value type, it is a pure bundle of operations with no state. It is declared with specifying abstract interface as interface kind.

```
(129) <interface_kind> ::= "abstract" "interface"
```

Unlike an abstract value type, it does not imply pass-by-value semantics, and unlike a regular interface type, it does not imply pass-by-reference semantics. Instead, the entity's runtime type determines which of these semantics are used.

An abstract interface may only inherit from abstract interfaces.

A value type may support several abstract interfaces (and only one concrete one).

7.4.7.4.3 Value Inheritance Rules

The terminology that is used to describe value type inheritance is directly analogous to that used to describe interface inheritance (see Inheritance Rules, page 38).

The name scoping and name collision rules for value types are identical to those for interfaces.

Values may be derived from other values and can support an interface.

Once implementation (state) is specified at a particular point in the inheritance hierarchy, all derived value types (which must of course implement the state) may only derive from a single (concrete) value type. They can however support an additional interface.

The single immediate base concrete value type, if present, must be the first element specified in the inheritance list of the value declaration's IDL. The interfaces it supports are listed following the **supports** keyword.

While a value type may only directly support one interface, it is possible for the value type to support other interfaces as well through inheritance. In this case, the supported interface must be derived, directly or indirectly, from each interface that the value type supports through inheritance. For example:

```

interface I1 { };
interface I2 { };
interface I3: I1, I2 { };

abstract valuetype V1 supports I1 { };
abstract valuetype V2 supports I2 { };
valuetype V3: V1, V2 supports I3 { };    // Legal
valuetype V4: V1 supports I2 { };      // Illegal

```

Boxed value types may not be derived from, nor may they derive from, anything else.

These rules are summarized in the following table.

Table 7-19: Possible inheritance relationships between value types and interfaces

May inherit from →	Abstract Interface	Interface	Abstract Value	Concrete Value	Boxed value
Abstract Interface	multiple	no	no	no	no
Interface	multiple	multiple	no	no	no
Abstract Value	supports multiple	supports single	multiple	no	no

May inherit from →	Abstract Interface	Interface	Abstract Value	Concrete Value	Boxed value
Concrete Value	supports multiple	supports single	multiple	single	no
Boxed Value	no	no	no	no	no

7.4.7.4.4 Custom Marshaling

In a CORBA context, a value type may optionally indicate that its marshaling is custom-made by prefixing the **valuetype** keyword with **custom**.as shown in the following rule:

(128) *<value_kind>* ::= "custom" "valuetype"

By this mean, value types can override the default marshaling/unmarshaling model and provide their own way to encode/decode their state. Custom marshaling is intended to be used to facilitate integration of existing "class libraries" and other legacy systems. It is explicitly not intended to be a standard practice, nor used in other OMG specifications to avoid "standard ORB" marshaling.

The fact that a value type has some custom marshaling code is declared explicitly in the IDL. This explicit declaration has two goals:

- Type safety - stubs and skeleton can know statically that a given type is custom marshaled and can then do a sanity-check on what is coming over the wire;
- Efficiency - for value types that are not custom marshaled no run time test is necessary in the marshaling code.

If a custom marshaled value type has a state definition, the state definition is treated the same as that of a non-custom value type for mapping purposes (i.e., the fields show up in the same fashion in the concrete programming language). It is provided to help with application portability.

A custom marshaled value type is always a stateful value type.

Custom value types can never be safely truncated to base (i.e., they always require an exact match for their **RepositoryId** in the receiving context).

Once a value type has been marked as **custom**, it needs to provide an implementation that marshals and unmarshals the value type. The marshaling code encapsulates the application code that can marshal and unmarshal instances of the value type over a stream using the CDR encoding. It is the responsibility of the implementation to marshal the state of all of its base types.

For more details regarding the implementation of custom marshaling, refer to [CORBA].

7.4.7.4.5 Truncatable

A stateful value that derives from another stateful value may specify that it is truncatable by prefixing the inheritance specification with the **truncatable** keyword as shown on the following rule:

(130) *<value_inheritance_spec>*
 ::= ":" ["truncatable"] <value_name> { "," <value_name> }*
 ["supports" <interface_name> { "," <interface_name> }*]

This means that the middleware is allowed to "truncate" an instance to become an instance of any of its truncatable parent (stateful) value types under certain conditions (see the CORBA documentation for more details). Note that all the intervening types in the inheritance hierarchy must be truncatable in order for truncation to a particular type to be allowed.

Because custom values require an exact type match between the sending and receiving context, **truncatable** may not be specified for a custom value type.

Non-custom value types may not (transitively) inherit from custom value types. Boxed value types may not be derived from, nor may they derive from, anything else.

7.4.7.4.6 Value Base

In a CORBA context, all value types have a conventional base type called **ValueBase**. This is a type, which fulfills a role that is similar to that played by **Object** for interfaces. That root may be used in an IDL specification wherever a value type may be used.

(131) `<base_type_spec> ::=+ <value_base_type>`

(132) `<value_base_type> ::= "ValueBase"`

Conceptually it supports the common operations available on all value types. See Value Base Type Operation for a description of those operations. In each language mapping **ValueBase** will be mapped to an appropriate base type that supports the marshaling/unmarshaling protocol as well as the model for custom marshaling.

The mapping for other operations, which all value types must support, such as getting meta information about the type, may be found in the specifics for each language mapping.

7.4.7.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-20: Keywords specific to Building-Block CORBA-Specific – Value Types

abstract				
			custom	

truncatable				
			ValueBase	

7.4.8 Building-Block Components – Basic

7.4.8.1 Purpose

Purpose of that building-block is to gather the minimal subset of CCM that would be useful to any component model.

7.4.8.2 Dependencies with other Building-Blocks

This building-block complements Building-Block Interfaces – Basic. Transitively, it relies on Building-Block Core Data Types.

7.4.8.3 Syntax

Thus building-block adds the following rules:

- (133) **<definition>** ::=+ **<component_dcl>** ";"
- (134) **<component_dcl>** ::= **<component_def>**
| **<component_forward_dcl>**
- (135) **<component_forward_dcl>**
::= "component" **<identifier>**
- (136) **<component_def>** ::= **<component_header>** "{" **<component_body>** "}"
- (137) **<component_header>** ::= "component" **<identifier>** [**<component_inheritance_spec>**]
- (138) **<component_inheritance_spec>**
::= ":" **<scoped_name>**
- (139) **<component_body>** ::= **<component_export>***
- (140) **<component_export>** ::= **<provides_dcl>** ";"
| **<uses_dcl>** ";"
| **<attr_dcl>** ";"
- (141) **<provides_dcl>** ::= "provides" **<interface_type>** **<identifier>**
- (142) **<interface_type>** ::= **<scoped_name>**
- (143) **<uses_dcl>** ::= "uses" **<interface_type>** **<identifier>**

7.4.8.4 Explanations and Semantics

This building-block allows declaring simple components with basic ports.

- (133) **<definition>** ::=+ **<component_dcl>** ";"

The salient characteristics of a component declaration are as follows:

- A component declaration specifies the name of the component.
- A component may inherit from another component.
- A component declaration may include in its body any attribute declarations that are legal in normal interface declarations, together with declarations of facets and receptacles that the component defines (facets and receptacles are also called *basic ports*).

The syntax for declaring a component is as follows:

```
(134) <component_dcl>      ::= <component_def>
                               | <component_forward_dcl>
(136) <component_def>     ::= <component_header> "{" <component_body> "}"
```

Basically a component definition comprises:

- A component header (<component_header>).
- Followed with a body (<component_body>) enclosed within braces ({}).

Those constructs are detailed in the following clauses.

7.4.8.4.1 Component Header

A <component_header> declares the primary characteristics of a component interface. Its syntax is as follows:

```
(137) <component_header> ::= "component" <identifier> [ <component_inheritance_spec> ]
(138) <component_inheritance_spec>
       ::= ":" <scoped_name>
```

A component header comprises the following elements:

- The **component** keyword.
- An identifier (<identifier>) that names the component type.
- An optional inheritance specification (<component_inheritance_spec>), consisting of a colon (:) and a single <scoped_name> that must denote a previously-defined component type.

Note – A component may inherit from at most one component. The features that are inherited by the derived component are its attributes and basic ports (facets and/or receptacles).

Note – A component forms a naming scope, nested within the scope in which the component is declared.

7.4.8.4.2 Component Body

Its syntax is as follows:

```
(139) <component_body>    ::= <component_export> *
(140) <component_export> ::= <provides_dcl> ";"
                               | <uses_dcl> ";"
                               | <attr_dcl> ";"
```

A component body can contain the following declarations:

- Facet declarations (**provides**).

- Receptacle declarations (**uses**).
- Attribute declarations (**attribute** and **readonly attribute**).

Note – Facets and receptacles are jointly called *basic ports*.

7.4.8.4.2.1 Facets

A component type may provide several independent interfaces to its clients in the form of *facets*. Facets are intended to be the primary vehicle through which a component exposes its functional application behavior to clients during normal execution. A component may exhibit zero or more facets.

A facet is declared with the following syntax:

(141) **<provides_dcl>** ::= "provides" **<interface_type>** **<identifier>**

(142) **<interface_type>** ::= **<scoped_name>**

A facet declaration comprises the following elements:

- The **provides** keyword.
- An **<interface_type>**, which must be a scoped name that denotes the interface type that is provided by the facet. The scoped name must denote a previously-defined non-component interface type.
- An **<identifier>** that names the facet in the scope of the component, thus allowing multiple facets of the same type to be provided by the component.

7.4.8.4.2.2 Receptacles

A component definition can describe the ability to accept object references upon which the component may invoke operations. When a component accepts an object reference in this manner, the relationship between the component and the referent object is called a *connection*; they are said to be *connected*. The conceptual point of connection is called a *receptacle*. A receptacle is an abstraction that is concretely manifested on a component as a set of operations for establishing and managing connections. A component may exhibit zero or more receptacles.

The syntax for describing a receptacle is as follows:

(143) **<uses_dcl>** ::= "uses" **<interface_type>** **<identifier>**

A receptacle declaration comprises the following elements:

- The **uses** keyword.
- An **<interface_type>**, which must be a scoped name that denotes the interface type that the receptacle will accept. The scoped name must denote a previously-defined non-component interface type.
- An **<identifier>** that names the receptacle in the scope of the component.

7.4.8.4.2.3 Attributes

In addition to basic ports, components may be given attributes, which are declared exactly as interface attributes. For more details see the related clause (Attributes page 41).

Note – Component attributes are intended to be used during a component instance's initialization to establish its fundamental behavioral properties. Although the component model does not constrain the visibility or use of attributes

defined on the component, it is generally assumed that they will not be of interest to the same clients that will use the component after it is configured. Rather, it is intended for use by component factories or by deployment tools in the process of instantiating an assembly of components.

7.4.8.4.3 Forward Declaration

Components may be forward-declared, which allows the definition of components that refer to each other.

As expressed in the following rule, a forward declaration consists simply of the **component** keyword followed by an **<identifier>** that names the component. The actual definition must follow later in the specification.

(135) **<component_forward_dcl>**
::= "component" <identifier>

Multiple forward declarations of the same component name are legal.

It is illegal to inherit from a forward-declared component not previously defined.

7.4.8.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-21: Keywords specific to Building-Block Components – Basic

			component	
		provides		
		uses		

7.4.9 Building-Block Components – Homes

7.4.9.1 Purpose

This building-block adds to the former the concept of homes. Homes are special interfaces for creating and managing instances of components.

7.4.9.2 Dependencies with Other Building-Blocks

This building-block complements Building-Block Components – Basic. Transitively, it relies on Building-Block Interfaces – Basic and Building-Block Core Data Types.

7.4.9.3 Syntax

The following set of rules form the building-block:

- (144) `<definition>` ::= `<home_dcl> ";"`
- (145) `<home_dcl>` ::= `<home_header> "{" <home_body> "}"`
- (146) `<home_header>` ::= `"home" <identifier> [<home_inheritance_spec>] "manages" <scoped_name>`
- (147) `<home_inheritance_spec>` ::= `":" <scoped_name>`
- (148) `<home_body>` ::= `<home_export>*`
- (149) `<home_export>` ::= `<export>`
| `<factory_dcl> ";"`
- (150) `<factory_dcl>` ::= `"factory" <identifier> "(" [<factory_param_dcls>] ")" [<raises_expr>]`
- (151) `<factory_param_dcls>` ::= `<factory_param_dcl> {" , " <factory_param_dcl> }*`
- (152) `<factory_param_dcl>` ::= `"in" <type_spec> <simple_declarator>`

7.4.9.4 Explanations and Semantics

A home declaration describes an interface for managing instances of a specified component type. The salient characteristics of a home declaration are as follows:

- A home declaration must specify exactly one component type that it manages. Multiple homes may manage the same component type.
- Home declarations may include any declarations that are legal in normal interface declarations.
- Home declarations support single inheritance from other home definitions.

The syntax for a home definition is as follows:

- (145) `<home_dcl>` ::= `<home_header> "{" <home_body> "}"`

Basically a home definition comprises:

- A home header (`<home_header>`).
- Followed with a body (`<home_body>`) enclosed within braces (`{}`).

Those constructs are detailed in the following clauses.

7.4.9.4.1 Home Header

A home header describes fundamental characteristics of a home interface. It is declared according to the following syntax:

(146) **<home_header>** ::= "home" <identifier> [<home_inheritance_spec>]
"manages" <scoped_name>

(147) **<home_inheritance_spec>** ::= ":" <scoped_name>

A home header consists of the following elements:

- The **home** keyword.
- An identifier (**<identifier>**) that names the home in the enclosing name scope.
- An optional inheritance specification (**<home_inheritance_spec>**), consisting of a colon (:) and a single scoped name that denotes a previously defined home type.
- The **manages** keyword followed by a scoped name that denotes the previously defined component type that is under the home's management.

7.4.9.4.2 Home Body

Its syntax is as follows:

(148) **<home_body>** ::= <home_export>*

(149) **<home_export>** ::= <export>
| <factory_dcl> ";"

In addition to plain operations and attributes, identical to the ones an interface body may comprise, a home body may also comprise factory operations, which are specific operations dedicated to creating component instances.

The syntax of a factory operation is as follows:

(150) **<factory_dcl>** ::= "factory" <identifier> "(" [<factory_param_dcls>] ")" [<raises_expr>]

(151) **<factory_param_dcls>** ::= <factory_param_dcl> {"," <factory_param_dcl>}*

(152) **<factory_param_dcl>** ::= "in" <type_spec> <simple_declarator>

A factory operation declaration consists of the following elements:

- The **factory** keyword.
- An identifier (**<identifier>**) that names the operation in the scope of the home declaration.
- An optional list of initialization parameters (**<factory_param_dcls>**) enclosed in parentheses (**()**). These parameters are similar to **in** parameters for operations. In case there are several parameters, they must be separated by a comma (,).
- An optional list of exceptions that may be raised by the operation (**<raises_expr>**).

A factory declaration has an implicit return value of type reference to component.

7.4.9.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-22: Keywords specific to Building-Block Components – Homes

factory				
	home			
			manages	

7.4.10 Building-Block CCM-Specific

7.4.10.1 Purpose

This building-block complements the former one in order to support the full CCM extension to CORBA.

7.4.10.2 Dependencies with other Building-Blocks

This building-block relies on Building-Block Components – Basic and Building-Block CORBA-Specific – Value Types. Transitively, it relies on Building-Block CORBA-Specific – Interfaces, Building-Block Value Types, Building-Block Interfaces – Full, Building-Block Interfaces – Basic and Building-Block Core Data Types.

7.4.10.3 Syntax

Thus building-block adds the following rules:

(153) <definition> ::=+ <event_dcl> ";"

(154) <component_header>	::+ "component" <identifier> [<component_inheritance_spec>] <supported_interface_spec>
(155) <supported_interface_spec>	::= "supports" <scoped_name> { ", " <scoped_name> }*
(156) <component_export>	::+ <emits_dcl> ";" <publishes_dcl> ";" <consumes_dcl> ";"
(157) <interface_type>	::+ "Object"
(158) <uses_dcl>	::+ "uses" "multiple" <interface_type> <identifier>
(159) <emits_dcl>	::= "emits" <scoped_name> <identifier>
(160) <publishes_dcl>	::= "publishes" <scoped_name> <identifier>
(161) <consumes_dcl>	::= "consumes" <scoped_name> <identifier>
(162) <home_header>	::+ "home" <identifier> [<home_inheritance_spec>] [<supported_interface_spec>] "manages" <scoped_name> [<primary_key_spec>]
(163) <primary_key_spec>	::= "primarykey" <scoped_name>
(164) <home_export>	::+ <finder_dcl> ";"
(165) <finder_dcl>	::= "finder" <identifier> "(" [<init_param_dcls>] ")" [<raises_expr>]
(166) <event_dcl>	::= (<event_def> <event_abs_def> <event_forward_dcl>)
(167) <event_forward_dcl>	::= ["abstract"] "eventtype" <identifier>
(168) <event_abs_def>	::= "abstract" "eventtype" <identifier> [<value_inheritance_spec>] "{" <export>* "}"
(169) <event_def>	::= <event_header> "{" <value_element> * "}"
(170) <event_header>	::= ["custom"] "eventtype" <identifier> [<value_inheritance_spec>]

7.4.10.4 Explanations and Semantics

This building-block adds mainly the following:

- Event ports.
- Finder operations in homes and keys for managed components.
- Multiple uses.
- Alignment with other CORBA specificities regarding interfaces and value types.

All these constructs are presented in the following sub-clauses as far it is needed to understand their syntax. For more details on their precise semantics, refer to [CORBA], Part3.

7.4.10.4.1 Event Support

The main addition of this building-block consists in support for event interactions, namely

- The ability to define event types.
- The ability to add ports to send (publish or emit) and receive (consume) events.

The following rules express these additions:

```
(153) <definition>          ::=+ <event_dcl> ";"
(156) <component_export>    ::=+ <emits_dcl> ";"
                               / <publishes_dcl> ";"
                               / <consumes_dcl> ";"
```

7.4.10.4.1.1 Event Types

Event type is a specialization of value type dedicated to asynchronous component communication. There are several kinds of event type declarations: "regular" event types, abstract event types, and forward declarations.

An event declaration satisfies the following syntax:

```
(166) <event_dcl>          ::= ( <event_def>
                               / <event_abs_def>
                               / <event_forward_dcl> )
```

7.4.10.4.1.1.1 Regular Event Types

A regular event type satisfies the following syntax:

```
(169) <event_def>          ::= <event_header> "{" <value_element> * "}"
(170) <event_header>      ::= [ "custom" ] "eventtype" <identifier> [ <value_inheritance_spec> ]
```

The event header consists of the following elements:

- An optional modifier (**custom**) specifying whether the event type uses custom marshaling.
- The **eventtype** keyword.
- The event type's name (<identifier>).
- An optional value inheritance specification as described in 7.4.7.4.3 Value Inheritance Rules.

An event can contain all the elements that a value can as described in 7.4.5.4.1.3 Value Element (i.e., attributes, operations, initializers, state members).

7.4.10.4.1.1.2 Abstract Event Types

Event types may also be *abstract*. They are called abstract because an abstract event type may not be instantiated. No state members or initializers may be specified. However, local operations may be specified. Essentially they are a bundle of operation signatures with a purely local implementation.

Such an event type is declared according to the following syntax:

```
(168) <event_abs_def>      ::= "abstract" "eventtype" <identifier> [ <value_inheritance_spec> ]
                               "{" <export> * "}"
```

Note – A concrete event type with an empty state is not an abstract event type.

7.4.10.4.1.1.3 Forward Declarations

A forward declaration declares the name of an event type without defining it. This permits the definition of event types that refer to each other. The syntax consists simply of the **eventtype** keyword followed by an **<identifier>** that names the event type, as expressed in the following rule:

(167) **<event_forward_dcl>** ::= ["abstract"] "eventtype" **<identifier>**

Multiple forward declarations of the same event type name are legal.

It is illegal to inherit from a forward-declared event type not previously defined.

7.4.10.4.1.1.4 Event Type Inheritance

As event type is a specialization of value type then event type inheritance is directly analogous to value inheritance (see 7.4.7.4.3 Value Inheritance Rules for a detailed description of the analogous properties for value types). In addition, an event type could inherit from a single immediate base concrete event type, which must be the first element specified in the inheritance list of the event declaration's IDL. It may be followed by other abstract values or events from which it inherits.

7.4.10.4.1.2 Event Ports

Event ports can be split into event sources and event sinks.

7.4.10.4.1.2.1 Event Sources – Publishers and Emitters

An event source embodies the potential for the component to generate events of a specified type, and provides mechanisms for associating consumers with sources.

There are two categories of event sources, *publishers* and *emitters*. Both are implemented using event channels supplied by the container. An emitter can be connected to at most one consumer. A publisher can be connected through the channel to an arbitrary number of consumers, who are said to subscribe to the publisher event source. A component may exhibit zero or more emitters and publishers.

7.4.10.4.1.2.1.1 Publishers

The syntax for an event publisher is as follows:

(160) **<publishes_dcl>** ::= "publishes" **<scoped_name>** **<identifier>**

A publisher declaration consists of the following elements:

- The **publishes** keyword.
- A **<scoped_name>** that denotes a previously-defined event type.
- An **<identifier>** that names the publisher event source in the scope of the component.

7.4.10.4.1.2.1.2 Emitters

The syntax for an emitter declaration is as follows:

(159) **<emits_dcl>** ::= "emits" **<scoped_name>** **<identifier>**

An emitter declaration consists of the following elements:

- The **emits** keyword.
- A **<scoped_name>** that denotes a previously-defined event type.
- An **<identifier>** that names the event source in the scope of the component.

7.4.10.4.1.2.2 Event Sinks

An event sink embodies the potential for the component to receive events of a specified type. An event sink is, in essence, a special-purpose facet whose type is an event consumer. External entities, such as clients or configuration services, can obtain the reference for the consumer interface associated with the sink.

The syntax for an event sink declaration is as follows:

```
(161) <consumes_dcl> ::= "consumes" <scoped_name> <identifier>
```

An event sink declaration contains the following elements:

- The **consumes** keyword.
- A scoped name (**<scoped_name>**) that denotes a previously-defined event type.
- An identifier (**<identifier>**) that names the event sink in the component's scope.

A component may exhibit zero or more consumers.

7.4.10.4.2 Home Extensions

The second extension concerns homes.

```
(162) <home_header> ::=+ "home" <identifier> [ <home_inheritance_spec> ]  
[ <supported_interface_spec> ]  
"manages" <scoped_name> [ <primary_key_spec> ]
```

```
(164) <home_export> ::=+ <finder_dcl> ";"
```

In this profile:

- A home declaration may specify a list of interfaces that the home supports.
- A home declaration may specify a primary key type. *Primary keys* are values assigned by the application environment that uniquely identify component instances managed by a particular home.
- Home operations may include finder operations. *Finder* operations aim at retrieving components managed by the home.

7.4.10.4.2.1 Supported Interfaces

The syntax to add supported interfaces declaration within the home header is as follows:

```
(155) <supported_interface_spec>  
::= "supports" <scoped_name> { "," <scoped_name> }*
```

Such a declaration consists in:

- The **supports** keyword.

- A list of **<scoped_name>**, separated by a comma (,). These scoped names must denote previously declared interfaces.

7.4.10.4.2.2 Primary Keys

The syntax for adding a primary key definition within the home header is as follows:

(163) **<primary_key_spec>** ::= "primarykey" **<scoped_name>**

Such a declaration consists in:

- The **primarykey** keyword.
- A scoped name (**<scoped_name>**) that denotes the primary key type. Primary key types must be value types derived from **Components::PrimaryKeyBase**. There are more specific constraints placed on primary key types, which are specified in [CORBA], Part3, "Primary key type constraints" sub clause.

7.4.10.4.2.3 Finder Operations

The syntax of a finder operation is as follows:

(165) **<finder_dcl>** ::= "finder" **<identifier>** "(" [**<init_param_dcls>**] ")" [**<raises_expr>**]

A finder operation declaration consists of the following elements:

- The **finder** keyword.
- An identifier that names the operation in the scope of the storage home declaration.
- An optional list of initialization parameters (**<init_param_decls>**) enclosed in parentheses.
- An optional **<raises_expr>** declaring exceptions that may be raised by the operation.

A finder declaration has an implicit return value of type reference to component.

7.4.10.4.3 Multiple Uses

The third extension consists in the ability for a receptacle to be connected to several facets. This is indicated by adding the **multiple** keyword in the receptacle definition as shown in the following rule:

(158) **<uses_dcl>** ::=+ "uses" "multiple" **<interface_type>** **<identifier>**

The presence of this keyword indicates that the receptacle may accept multiple connections simultaneously, and results in different operations on the component's associated interface.

7.4.10.4.4 Alignment with CORBA-specific Features related to Interfaces and Value Types

7.4.10.4.4.1 Supported Interfaces in Components

As expressed in the following grammar elements, in this profile components may also support interfaces:

(154) **<component_header>** ::=+ "component" **<identifier>** [**<component_inheritance_spec>**] **<supported_interface_spec>**

(155) **<supported_interface_spec>** ::= "supports" **<scoped_name>** { ", " **<scoped_name>** }*

Within the component header such a declaration consists in:

- The **supports** keyword.
- A list of **<scoped_name>**, separated by a comma (,). These scoped names must denote previously declared interfaces.

7.4.10.4.4.2 Object Root

As for all other CORBA interfaces, in this building-block, **Object** may be used wherever an interface is required. Object denotes the root for all CORBA interfaces.

(157) **<interface_type> ::+ "Object"**

7.4.10.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-23: Keywords specific to Building-Block CCM-Specific

	consumes			
		emits		eventtype
		finder		
		multiple		
			primarykey	
				publishes

7.4.11 Building-Block Components – Ports and Connectors

7.4.11.1 Purpose

This building block complements the Building-Block Components – Basic with the ability to define extended ports and connectors.

7.4.11.2 Dependencies with other Building-Blocks

This building-block relies on the Building-Block Components – Basic. Transitively, it relies on Building-Block Interfaces – Basic and Building-Block Core Data Types.

7.4.11.3 Syntax

The following set of rules forms the syntax of this building-block:

- (171) **<definition>** ::=+ **<porttype_dcl>** ";"
| **<connector_dcl>** ";"
- (172) **<porttype_dcl>** ::= **<porttype_def>**
| **<porttype_forward_dcl>**
- (173) **<porttype_forward_dcl>** ::= "porttype" **<identifier>**
- (174) **<porttype_def>** ::= "porttype" **<identifier>** "{ " **<port_body>** "}"
- (175) **<port_body>** ::= **<port_ref>** **<port_export>***
- (176) **<port_ref>** ::= **<provides_dcl>** ";"
| **<uses_dcl>** ";"
| **<port_dcl>** ";"
- (177) **<port_export>** ::= **<port_ref>**
| **<attr_dcl>** ";"
- (178) **<port_dcl>** ::= {"port" | "mirrorport"} **<scoped_name>** **<identifier>**
- (179) **<component_export>** ::=+ **<port_dcl>** ";"
- (180) **<connector_dcl>** ::= **<connector_header>** "{" **<connector_export>**+ "}"
- (181) **<connector_header>** ::= "connector" **<identifier>** [**<connector_inherit_spec>**]
- (182) **<connector_inherit_spec>** ::= ":" **<scoped_name>**
- (183) **<connector_export>** ::= **<port_ref>**
| **<attr_dcl>** ";"

7.4.11.4 Explanations and Semantics

As expressed in the following rule, this building block allows creating new port types (aka *extended ports*) and connectors.

- (171) **<definition>** ::=+ **<porttype_dcl>** ";"
| **<connector_dcl>** ";"

7.4.11.4.1 Extended Ports

An *Extended Port* is a grouping of basic ports (facets and/or receptacles) that are to be used jointly to support consistently a given interaction. Those basic ports formalize the programming contract between a component with this extended port and the connector's fragment (see below) that will realize the related interaction on behalf of the component. As such, those basic ports are always local and correspond to interfaces to be called (receptacles) or call-back interfaces (facets).

7.4.11.4.1.1 Port Type Declaration

Before it can be used in a component, an extended port has to be defined through the declaration of its type.

A port type may be defined or forward declared as expressed in the following rule:

```
(172) <porttype_dcl> ::= <porttype_def>
      | <porttype_forward_dcl>
```

A forward declaration is made of the **porttype** keyword followed by the name of the port type (<identifier>). Such declarations allow attaching ports to components or connectors as well as embedding them inside other extended ports while their port types are not fully defined yet.

```
(173) <porttype_forward_dcl> ::= "porttype" <identifier>
```

A port type is defined with the following syntax:

```
(174) <porttype_def> ::= "porttype" <identifier> "{ " <port_body> "}"
```

```
(175) <port_body> ::= <port_ref> <port_export>*
```

```
(176) <port_ref> ::= <provides_dcl> ";"
      | <uses_dcl> ";"
      | <port_dcl> ";"
```

```
(177) <port_export> ::= <port_ref>
      | <attr_dcl> ";"
```

Such a declaration comprises:

- The **porttype** keyword.
- An identifier that gives a name to the port type (<identifier>).
- A body that comprises between braces ({}):
 - At least one facet (<provides_dcl>) or receptacle (<uses_dcl>) or port declaration (<port_dcl>) of an already declared port type (collectively called <port_ref>).
 - Optionally other facets receptacles or ports as well as attributes (<attr_dcl>).

Note – An extended port may thus embed another extended port. However no cycles are allowed among port type definitions.

7.4.11.4.2 Port Declaration

Once a port type has been declared, ports of that kind may be attached to components with the following syntax:

```
(178) <port_dcl> ::= {"port" | "mirrorport"} <scoped_name> <identifier>
```

```
(179) <component_export> ::=+ <port_dcl> ";"
```

A port declaration comprises:

- The **port** keyword or the **mirrorport** keyword.
Ports attached with the **port** keyword are normal extended ports. Ports attached with the **mirrorport** keyword are *reverse* extended ports. A reverse extended port is an extended port where all its facets are turned into receptacles, all its receptacles turned into facets, all its extended ports turned into reverse extended ports and its reverse extended ports into extended ports. Therefore an extended port and its reverse will match. Reverse extended ports may be used for components' ports although they are especially useful in connectors.

- A scoped name that identifies the port type (**<scoped_name>**). That scoped name must denote a previously declared port type.
- A name that identifies that port within the component (**<identifier>**). Several ports of the same port type may thus be attached to a single component.

7.4.11.4.3 Connectors

Connectors are used to specify interaction mechanisms between components. Connectors can have ports in the same way as components. They can be composed of simple ports (**provides** and **uses**) or extended ports (very likely in their reverse form).

Syntax to create connectors is as follows:

```
(180) <connector_dcl> ::= <connector_header> "{" <connector_export+> "}"
(181) <connector_header> ::= "connector" <identifier> [ <connector_inherit_spec> ]
(181) <connector_inherit_spec> ::= ":" <scoped_name>
(183) <connector_export> ::= <port_ref>
| <attr_dcl> ";"
```

A connector declaration comprises:

- The **connector** keyword.
- An identifier which is the name of the connector (**<identifier>**).
- An optional inheritance specification made of a colon (:) followed by the name of an existing connector (**<scoped_name>**).
- A body that comprises between braces ({}):
 - At least one port (**<provides_dcl>**, **<uses_dcl>** or **<port_dcl>**).
 - Optionally other ports as well as attributes (**<attr_dcl>**).

A connector will concretely be composed of several parts (called fragments) that will consist of executors, each in charge of realizing a part of the interaction. Each fragment will be co-localized to the component using it.

7.4.11.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-24: Keywords specific to Building-Block Components – Ports and Connectors

				connector

mirrorport				
port	porttype			

7.4.12 Building-Block Template Modules

7.4.12.1 Purpose

The purpose of this building block is to allow embedding constructs in *template modules*. Template modules may be parameterized by a variety of parameters (called *formal parameters*), which by transition makes all the embedded constructs parameterized by the same parameters. Before using it, a template module needs to be instantiated with values suited for the formal parameters. A template module instantiation results in a de facto instantiation of all its embedded constructs.

7.4.12.2 Dependencies with other Building-Blocks

Although this building-block relies only on Building-Block Core Data Types, it can be seen as orthogonal to all the other ones, meaning that all the constructs that are selected for a profile that embeds this specific building-block may be embedded in a template module and thus benefit from parameterization.

7.4.12.3 Syntax

- (184) `<definition>` ::= `<template_module_dcl> ";"`
| `<template_module_inst> ";"`
- (185) `<template_module_dcl>` ::= `"module" <identifier> "<" <formal_parameters> ">"`
`"{" <tpl_definition> "+"}`
- (186) `<formal_parameters>` ::= `<formal_parameter> {"," <formal_parameter>}*`
- (187) `<formal_parameter>` ::= `<formal_parameter_type> <identifier>`
- (188) `<formal_parameter_type>` ::= `"typename" | "interface" | "valuetype" | "eventtype"`
| `"struct" | "union" | "exception" | "enum" | "sequence"`
| `"const" <const_type>`
| `<sequence_type>`
- (189) `<tpl_definition>` ::= `<definition>`
| `<template_module_ref> ";"`
- (190) `<template_module_inst>` ::= `"module" <scoped_name> "<" <actual_parameters> ">" <identifier> ";"`
- (191) `<actual_parameters>` ::= `<actual_parameter> {"," <actual_parameter>}*`

- (192) `<actual_parameter>` ::= `<type_spec>`
| `<const_expr>`
- (193) `<template_module_ref>` ::= "alias" `<scoped_name>` "<" `<formal_parameter_names>` ">" `<identifier>`
- (194) `<formal_parameter_names>`
::= `<identifier>` { ", " `<identifier>` }*

7.4.12.4 Explanations and Semantics

This building-block adds the facility to declare and instantiate template modules:

- (184) `<definition>` ::=+ `<template_module_dcl>` ";"
| `<template_module_inst>` ";"

7.4.12.4.1 Template Module Declaration

A template module is declared according to the following rules:

- (185) `<template_module_dcl>` ::= "module" `<identifier>` "<" `<formal_parameters>` ">"
"{" `<tpl_definition>` "+" }
- (186) `<formal_parameters>` ::= `<formal_parameter>` {" , " `<formal_parameter>` }*
- (187) `<formal_parameter>` ::= `<formal_parameter_type>` `<identifier>`
- (188) `<formal_parameter_type>` ::= "typename" | "interface" | "valuetype" | "eventtype"
| "struct" | "union" | "exception" | "enum" | "sequence"
| "const" `<const_type>`
| `<sequence_type>`
- (189) `<tpl_definition>` ::= `<definition>`
| `<template_module_ref>` ";"

A template module specification comprises:

- The **module** keyword.
- An identifier for the module name (`<identifier>`).
- The specification of the formal parameters between angular brackets (< >), each of those formal parameters consisting of:
 - A type classifier (`<formal_parameter_type>`), which can be:
 - **typename**, to indicate that any valid type can be passed as parameter.
 - **interface**, **valuetype**, **eventtype**, **struct**, **union**, **exception**, **enum**, **sequence** to indicate that a more restricted type must be passed as parameter.
 - A constant type, to indicate that a constant of that type must be passed as parameter.
 - A sequence type declaration, to indicate that a compliant sequence type must be passed as parameter (the formal parameters of that sequence must appear previously in the module list of formal parameters).
 - An identifier (`<identifier>`) for the formal parameter.
- The module body (`<tpl_definition>`+), which may contain, within braces ({} any declarations that form a classical template body (`<definition>`) as well as other template module references (`<template_module_ref>` – cf. 7.4.12.4.3 References to a Template Module). A template module cannot embed another template module. A template module cannot be re-opened (as opposed to a classical one).

7.4.12.4.2 Template Module Instantiation

A module template instantiation consists in providing values to the template parameters and a name to the resulting module. Once instantiated, the resulting module is exactly as a classical module.

The following rules allow template module instantiations:

(190) `<template_module_inst> ::= "module" <scoped_name> "<" <actual_parameters> ">" <identifier> ";"`

(191) `<actual_parameters> ::= <actual_parameter> { "," <actual_parameter> }*`

(192) `<actual_parameter> ::= <type_spec>
| <const_expr>`

A template module instantiation comprises:

- The **module** keyword.
- The name of the template module to be instantiated (`<scoped_name>`). This name must refer to a previously declared template module.
- Enclosed within angle brackets (`< >`), the values given to the template parameters (`<actual_parameters>`). The provided values must fit with the parameter specification as described in the previous sub clause. In particular, if the template parameter is of type "sequence type declaration," then an instantiated compliant sequence must be passed.
- The name given to the resulting module (`<identifier>`).

7.4.12.4.3 References to a Template Module

The following rules allow referencing template modules:

(193) `<template_module_ref> ::= "alias" <scoped_name> "<" <formal_parameter_names> ">" <identifier>`

(194) `<formal_parameter_names> ::= <identifier> { "," <identifier> }*`

An **alias** directive allows referencing an existing template module inside a template module definition.

This directive allows providing an alias name (which can be identical to the template module name) to the existing template module and the list of formal parameters to be used for the referenced module instantiation. Note that that list must be a subset of the formal parameters of the embedding module and that each specified formal parameter must be of a compliant type for the required one. For example:

```
module MyTempModule <typename T, struct S, long n > {  
    interface Foo {...}  
    ...  
}  
  
module MySecondTempModule <typename T1, typename T2, struct S1, struct S2, long m> {  
    alias MyTempModule<T2, S2, m> MyTempModule; // OK  
    alias MyTempModule2<S1, S2, m> MyTempModule; // OK (S1 < T)  
    alias MyTempModule3<T2, T1, m> MyTempModule2; // Error (T1 not compliant for S)  
  
    interface Bar : MyTempModule::Foo {...}  
    ...  
}
```

When the embedding module will be instantiated, then the referenced module will be instantiated in the scope of the embedding one (i.e., as a sub-module).

7.4.12.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-25: Keywords specific to Building-Block Template Modules

		alias		

7.4.13 Building-Block Extended Data-Types

7.4.13.1 Purpose

This building-block adds a few data constructs that are proven to be useful for describing data models.

7.4.13.2 Dependencies with other Building-Blocks

This building block complements the Building-Block Core Data Types.

7.4.13.3 Syntax

- (195) <struct_def> ::+ "struct" <identifier> ":" <scoped_name> "{" <member>+ "}"
- (196) <switch_type_spec> ::+ <wide_char_type>
 | <octet_type>
- (197) <template_type_spec> ::+ <map_type>
 | <bitset_type>

```

(198) <map_type>          ::= "map" "<" <simple_type_spec> ","
                           <simple_type_spec> "," <positive_int_const> ">"
                           | "map" "<" <simple_type_spec> ","
                           <simple_type_spec> ">"

(199) <bitset_type>      ::= "bitset" "<" <positive_int_const> ">"
                           | "bitset" "<" <positive_int_const> "," <integer_type> ">"

```

7.4.13.4 Explanations and Semantics

Those complements are:

- Addition of single inheritance for structures.
- Ability to discriminate a union with other types (wide char and octet).
- Additional template types (maps and bitsets).

7.4.13.4.1 Structures with Single Inheritance

The following rule complements the structure definition with the possibility to add a single inheritance specification:

```

(195) <struct_def>        ::=+ "struct" <identifier> ":" <scoped_name> "{" <member>+ "}"

```

Single inheritance is denoted by a colon (:) followed by a scoped name that must correspond to the name of a previously defined structure.

When a structure type inherits from another structure type, it is considered as *extending* the latter, which is then considered as its *base type*. Members of such a structure consist in all the members of its base type plus all the ones that are declared locally.

7.4.13.4.2 Union Discriminators

In the Building-Block Core Data Types, union discriminators could be the following (cf. rule (51))

- Either one of the following types: **integer**, **char**, **boolean** or an **enum** type.
- Or a reference (<scoped_name>) to one of these.

Within this building block the following rule adds the following types: **wchar** (wide char) or **octet**

```

(196) <switch_type_spec>  ::=+ <wide_char_type>
                           | <octet_type>

```

Accordingly, the scoped name may also reference one of these types.

7.4.13.4.3 Additional Template Types

As expressed in the following rule, maps and bit sets are new template type provided by this building-block:

```

(197) <template_type_spec> ::=+ <map_type>
                           | <bitset_type>

```

7.4.13.4.3.1 Maps

Maps are collections similar to sequences but where items are registered (and thus retrieved) associated with a *key*. As sequences, maps may be bounded or unbounded. As expressed in the following rule, the syntax to define map types is the same as that for sequence types with two exceptions:

- The **sequence** keyword is replaced by the new **map** keyword.
- The single type parameter that appears in a sequence definition is replaced by two type parameters in a map definition: the first one is the key element type; the second one is the value element type.

```
(198) <map_type> ::= "map" "<" <simple_type_spec> ","  
                  <simple_type_spec> "," <positive_int_const> ">"  
                  | "map" "<" <simple_type_spec> ","  
                  <simple_type_spec> ">"
```

7.4.13.4.3.2 Bit Sets (and Bit Fields)

Bit sets are fixed-sized sequences of bits (i.e., items that can only take two values). They are thus very similar to one-dimension arrays – in the sense that their size is known at compile time – but whose storage is optimized due to the binary nature of each stored item.

Bit set types are defined with the following syntax:

```
(199) <bitset_type> ::= "bitset" "<" <positive_int_const> ">"  
                    | "bitset" "<" <positive_int_const> "," <integer_type> ">"
```

where **<positive_int_const>** is the number of bits that will be stored and **<integer_type>** an optional integer type to be used to manipulate internally the bit set as a whole. By default, this type is **unsigned long long**.

- When an integer type is given, the number of stored bits cannot exceed the size of the type (e.g., 16 for **short** or **unsigned short**, 32 for **long** or **unsigned long** and 64 for **long long** or **unsigned long long**).
- When no integer type is given, the bit set can be manipulated as a whole only if its number of bits is lower than or equal to the size of an **unsigned long long** (i.e., 64).

Bit sets can be used as is, but they can be grouped in structures to form *bit fields*. A bit field is a sequence of bit sets, itself managed as a bit set, i.e., stored optimally. When a structure gathers members which are bit sets with members which are not, all consecutive bit sets shall form bit fields.

For example the following structure:

```
struct MyStruct {  
    bitset<1>    foo1;  
    bitset<3>    foo2;  
    bitset<4>    foo3;  
    long        anotherMember;  
    bitset<1>    bar1;  
    bitset<1>    bar2;  
};
```

contains actually two bit fields, the first one made of **foo1**, **foo2** and **foo3** (whose size is 8) and the second one made of **bar1** and **bar2** (whose size is 2).

Note – Although it is possible to mix in a structure bits sets with other members, it is recommended, for readability purpose, to group all members of a bit field in a dedicated structure. The former example could be better written as follows:

```

struct MyBitField1 {
    bitset<1>    foo1;
    bitset<3>    foo2;
    bitset<4>    foo3;
};

struct MyBitField2 {
    bitset<1>    bar1;
    bitset<1>    bar2;
};

struct MyStruct {
    MyBitField1 foo;
    long        anotherMember;
    MyBitField2 bar;
};

```

7.4.13.5 Specific Keywords

The following table selects in Table 7-6 the keywords that are specific to this building-block and removes the others.

Table 7-26: Keywords specific to Building-Block Extended Data-Types

				bitset
				map

7.4.14 Building-Block Anonymous Types

7.4.14.1 Purpose

The only purpose of this building-block is to allow the use of anonymous types, i.e., template types or arrays that were not given a name by a **typedef** directive.

Anonymous types may cause a number of problems for language mappings and were therefore deprecated in a previous version of CORBA IDL. However, they offer an increased expression power that proves to be useful in many occasions.

The new IDL organization in building-blocks allows defining profiles where anonymous types are forbidden as well as others where they will be supported:

- Profiles that do not support use of anonymous types must not embed this building-block. With such a profile, all anonymous types must be given a name with a **typedef** directive before any use (see 7.4.1.4.4.5, Naming Data TypesNaming Data Types).
- Profiles that do support use of anonymous types must embed this building-block.

7.4.14.2 Dependencies with other Building-Blocks

This building-block relies on Building-Block Core Data Types.

7.4.14.3 Syntax

The two additional rules allow using anonymous types:

(200) **<type_spec>** **::+ <template_type_spec>**

(201) **<declarator>** **::+ <array_declarator>**

7.4.14.4 Explanations and Semantics

With the following rule, template types may be used at any place where a type specification is required:

(200) **<type_spec>** **::+ <template_type_spec>**

Note – A template type may be used as the type parameter for another template type. For instance, the following: **sequence<sequence<long> >** declares the type "unbounded sequence of unbounded sequence of long". For those nested template declarations, white space must be used to separate the two **>** tokens ending the declaration so they are not parsed as a single **>>** token.

With the following rule, arrays may be directly declared:

(201) **<declarator>** **::+ <array_declarator>**

7.4.14.5 Specific keywords

There are no additional keywords with this building-block.

7.4.15 Building-Block Annotations

7.4.15.1 Purpose

This building-block defines a framework to add meta-data to IDL constructs, by means of annotations. This facility, very similar to the one provided by Java, is a powerful mean to extend the language without changing its syntax.

7.4.15.2 Dependencies with other Building-Blocks

This building-block only relies on Building-Block Core Data Types. It is actually orthogonal to all others. This means that once defined, annotations may be applied to almost all IDL constructs, brought by all the other building-blocks that are selected to form a profile jointly with this building-block.

7.4.15.3 Syntax

The following rules form the building-block:

- (202) **<definition>** ::+ <annotation_dcl> " ;"
 | <annotation_appl> <definition>
- (203) **<annotation_dcl>** ::= <annotation_header> "{" <annotation_body> "}"
- (204) **<annotation_header>** ::= "@annotation" <identifier>
- (205) **<annotation_body>** ::= { <annotation_member>
 | <enum_dcl> " ;"
 | <const_dcl> " ;"
 | <typedef_dcl> " ;" }*
- (206) **<annotation_member>** ::= <annotation_member_type> <simple_declarator>
 ["default" <const_expr>] " ;"
- (207) **<annotation_member_type>** ::= <const_type> | <any_const_type> | <scoped_name>
- (208) **<any_const_type>** ::= "any"
- (209) **<annotation_appl>** ::= "@" <scoped_name> ["(" <annotation_appl_params> ")"]
- (210) **<annotation_appl_params>** ::= <const_expr>
 | <annotation_appl_param> { " , " <annotation_appl_param> }*
- (211) **<annotation_appl_param>** ::= <identifier> "=" <const_expr>

7.4.15.4 Explanations and Semantics

This building-block specifies how to 1) define annotations and 2) attach previously defined annotations to most IDL constructs:

0 The following rules form the building-block:

- <definition>** ::+ <annotation_dcl> " ;"
 | <annotation_appl> <definition>

7.4.15.4.1 Defining Annotations

An annotation type is a form of aggregated type similar to a structure with members that could be given constant values. An annotation is defined with a header (**<annotation_header>**) and a body (**<annotation_body>**) enclosed within braces (**{ }**):

(203) **<annotation_dcl>** ::= **<annotation_header>** "{ **<annotation_body>** }"

As expressed in the following rule:

(204) **<annotation_header>** ::= "**@annotation**" **<identifier>**

The annotation header consists of the **@annotation** keyword, followed by an identifier that is the name given to the annotation (**<identifier>**).

As expressed in the following rule:

(205) **<annotation_body>** ::= { **<annotation_member>**
| **<enum_dcl>** ";"
| **<const_dcl>** ";"
| **<typedef_dcl>** ";" }*

An annotation body may contain:

- Annotation members (**<annotation_member>**).
- Declarations of enumeration types (**<enum_dcl>**).
- Declarations of constant values (**<const_dcl>**).
- Typedef declarations (**<typedef_dcl>**).

An annotation body may be void.

As stated in the following rules:

(206) **<annotation_member>** ::= **<annotation_member_type>** **<simple_declarator>**
["default" **<const_expr>**] ";"

(207) **<annotation_member_type>**
::= **<const_type>** | **<any_const_type>** | **<scoped_name>**

(208) **<any_const_type>** ::= "any"

An annotation member is ended by a semi-colon (;) and consists of:

- The member type (**<annotation_member_type>**), which must be a constant type (**<const_type>**) or the **any** keyword that means in this context any constant type¹² or a scoped name (**<scoped_name>**) which must refer to a constant type.
- The name given to the member (**<simple_declarator>**).
- An optional default value, given by a constant expression (**<const_expr>**) prefixed with the **default** keyword. The constant expression must be compatible with the member type.

¹² This form is useful when the annotation carries a value whose actual type depends on the element under annotation (a default value for instance).

Enumerations, constants, and typedefs declared within the annotation body may be used unscoped subsequently in the annotation body or further when applying the annotation. They are not significant anywhere else.

Note – Annotations may be user-defined, using this syntax. They can also be implicitly defined by a compiler. In the latter case, the behavior should be as if the related definitions were included at the beginning of the IDL specification.

Note – Annotations should not cause more compile errors than strictly needed. Therefore, in case of multiple definitions of the same annotation in one IDL specification¹³, the compiler should accept them, provided that they are consistent. In return, compilers should raise an error in case of malformed definitions.

7.4.15.4.2 Applying Annotations

An annotation, once its type defined, may be applied with the following syntax:

```
(209) <annotation_appl> ::= "@" <scoped_name> [ "(" <annotation_appl_params> ")" ]
(210) <annotation_appl_params>
      ::= <const_expr>
      | <annotation_appl_param> { "," <annotation_appl_param> }*
(211) <annotation_appl_param>
      ::= <identifier> "=" <const_expr>
```

Applying an annotation consists in prefixing the element under annotation with:

- The annotation name (<scoped_name>) prefixed with a commercial at (@).
- Followed by the list of values given to the annotation's members within parentheses (()) and separated by a comma (,). Each parameter value consists in:
 - The name of the member (<identifier>).
 - The symbol =.
 - A constant expression, whose type must be compatible with the member's declaration (<const_expr>).

Members may appear in any order.

Members with no default value must be given a value. Members with default value may be omitted. In that case, the member is considered as valued with its default value.

Two shortened forms exist:

- In case, there is no member or only one member with a default value, the annotation application may be shortened to just the name of the annotation prefixed with @.
- In case there is only one member, the annotation application may be shortened to the name of the annotation prefixed with @ and followed with the constant value of that unique member within (). The type of the provided constant expression must compatible with the member's declaration.

An annotation may be applied to almost any IDL constructs or sub-constructs. Applying an annotation consists actually in adding the related meta-data to the element under annotation.

¹³ This may happen in particular when IDL files are included.

Note – In case the applied annotation contains a member of type **any**, the value provided for that member must match with the element under annotation.

Note – Annotations should not cause more compile errors than strictly needed. Therefore, in case an unknown annotation is encountered, it should be simply ignored by the compiler. In return, compilers should raise an error in case of malformed annotations.

7.4.15.5 Specific Keywords

This building-block reuses the **any** keyword. There is no other new keyword, if keyword is taken as "*a word, built as a valid identifier, but with a specific meaning within the language*". However, any word starting with a commercial at (@) will now potentially denote an annotation, starting with **@annotation** that allows creating annotation types.

Table 7-27: Keywords specific to Building-Block Annotations

	any			

7.4.16 Relationships between the Building-Blocks

Even if the building-blocks have been designed as independent as possible, they are linked by some dependencies. The following figure represents the graph of their relationships (actually a lattice).

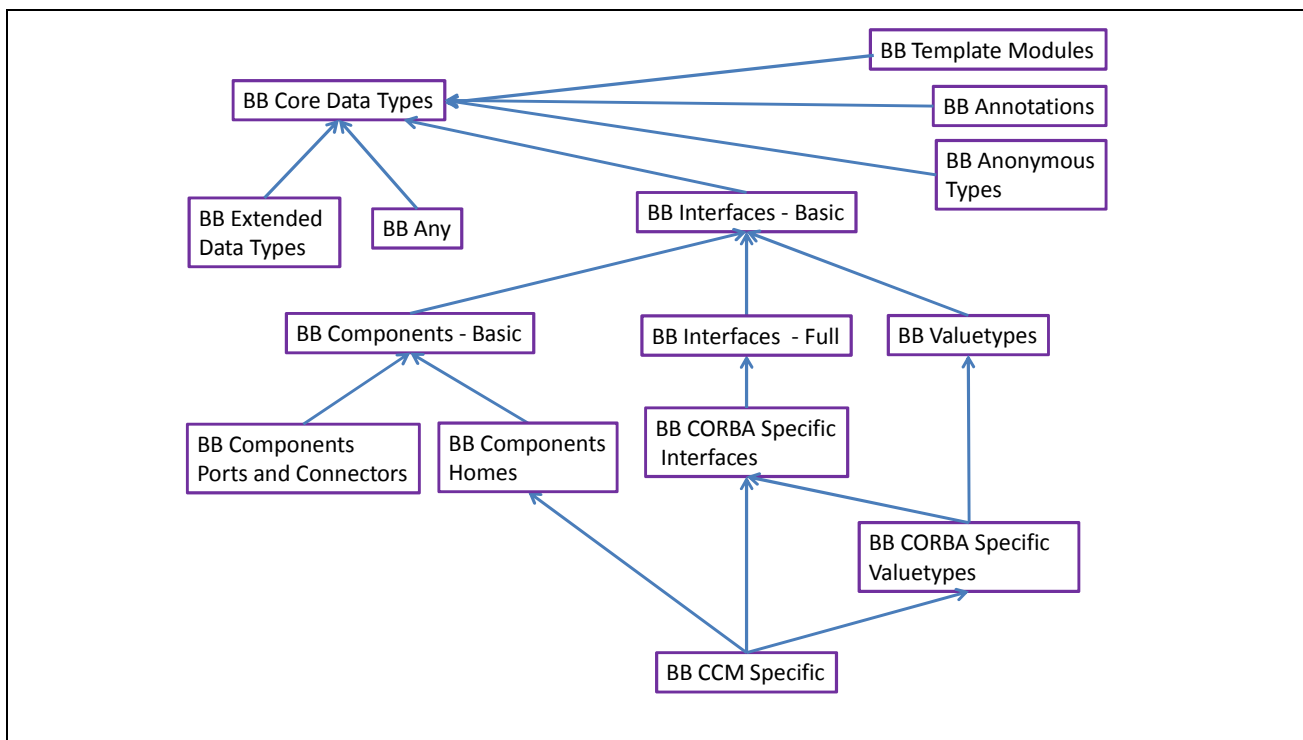


Figure 7-2: Relationships between Building-Blocks

7.5 Names and Scoping

This clause defines the visibility rules that apply to names. Those rules are considering the whole IDL grammar (i.e., the union of all building-blocks). In case only a subset is used, all the considerations that apply to constructs that are not part of that subset may be simply ignored.

7.5.1 Qualified Names

A qualified name (one of the form `<scoped_name>::<identifier>`) is resolved by first resolving the qualifier `<scoped_name>` to a scope *S*, and then locating the definition of `<identifier>` within *S*. The identifier must be directly defined in *S* or (if *S* is an interface) inherited into *S*. The `<identifier>` is not searched for in enclosing scopes.

When a qualified name begins with `::`, the resolution process starts with the file scope and locates subsequent identifiers in the qualified name by the rule described in the previous paragraph.

Every IDL definition in a file has a global name within that file. The global name for a definition is constructed as follows:

- Prior to starting to scan a file containing an IDL specification, the name of the current root is initially empty ("") and the name of the current scope is initially empty ("").
- Whenever a **module** keyword is encountered, the string "::" and the associated identifier are appended to the name of the current root; upon detection of the termination of the module, the trailing "::" and module identifier are deleted from the name of the current root.
- Whenever an **interface**, **struct**, **union**, or **exception** keyword is encountered, the string "::" and the associated identifier are appended to the name of the current scope; upon detection of the termination of the **interface**, **struct**, **union**, or **exception**, the trailing "::" and associated identifier are deleted from the name of the current scope.
- Additionally, a new, unnamed, scope is entered when the parameters of an operation declaration are processed; this allows the parameter names to duplicate other identifiers; when parameter processing has completed, the unnamed scope is exited.
- The global name of an IDL definition is the concatenation of the current root, the current scope, a "::", and the **<identifier>**, which is the local name for that definition.

Inheritance causes all identifiers defined in base interfaces, both direct and indirect, to be visible in derived interfaces. Such identifiers are considered to be semantically the same as the original definition. Multiple paths to the same original identifier (as results from the diamond shape in Figure 7-1: Examples of Legal Multiple Inheritance on page 39) do not conflict with each other.

Inheritance introduces multiple global IDL names for the inherited identifiers. Consider the following example:

```
interface A {
    exception E {
        long L;
    };
    void f () raises(E);
};
interface B: A {
    void g () raises(E);
};
```

In this example, the exception is known by the global names **::A::E** and **::B::E**.

Ambiguity can arise in specifications due to the nested naming scopes. For example:

```
interface A {
    typedef string<128> string_t;
};

interface B {
    typedef string<256> string_t;
};

interface C: A, B {
    attribute string_t Title; // Error: Ambiguous
    attribute A::string_t Name; // OK
    attribute B::string_t City; // OK
};
```

The declaration of attribute **Title** in interface **C** is ambiguous, since the compiler does not know which **string_t** is desired. Ambiguous declarations yield compilation errors.

7.5.2 Scoping Rules and Name Resolution

Contents of an entire IDL file, together with the contents of any files referenced by **#include** statements, forms a *naming scope*. Definitions that do not appear inside a scope are part of the *global scope*. There is only a single global scope, irrespective of the number of source files that form a specification.

The following kinds of definitions form scopes: modules, structures, unions, maps¹⁴, interfaces¹⁴, value types¹⁴, operations¹⁴, exceptions¹⁴, event types¹⁴, components¹⁴, homes¹⁴. Scope applies as follows:

- The scope for a module, structure, map, interface, value type, event type, exception or home begins immediately following its opening **{** and ends immediately preceding its closing **}**.
- The scope of an operation begins immediately following its opening **(** and ends immediately preceding its closing **)**.
- The scope of a union begins immediately following the **(** following the **switch** keyword, and ends immediately preceding its closing **}**.

The appearance of the declaration of any of these kinds in any scope, subject to semantic validity of such declaration, opens a nested scope associated with that declaration.

An identifier can only be defined once in a scope. However, identifiers can be redefined in nested scopes.

An identifier declaring a module is considered to be defined by its first occurrence in a scope. Subsequent occurrences of a module declaration with the same identifier within the same scope reopens the module and hence its scope, allowing additional definitions to be added to it.

The name of a module, structure, union, map, interface, value type, event type, exception or home may not be redefined within the immediate scope of the module, structure, union, map, interface, value type, event type, exception or home. For example:

```
module M {
    typedef short M;           // Error: M is the name of the module...
                              // ...in the scope of which the typedef is.
    interface I {
        void i (in short j);  // Error: i clashes with the interface name I
    };
};
```

An identifier from a surrounding scope is introduced into a scope if it is used in that scope. An identifier is not introduced into a scope by merely being visible in that scope. The use of a scoped name introduces the identifier of the outermost scope of the scoped name.

¹⁴Assuming that these constructs are part of the current profile.

For example in:

```
module M {
    module Inner1 {
        typedef string S1;
    };
    module Inner2 {
        typedef string inner1;    // OK
    };
};
```

The declaration of **Inner2::inner1** is OK because the identifier **Inner1**, while visible in module **Inner2**, has not been introduced into module **Inner2** by actual use of it. On the other hand, if module **Inner2** were:

```
module Inner2 {
    typedef Inner1::S1 S2;    // Inner1 introduced
    typedef string inner1;    // Error
    typedef string S1;    // OK
};
```

The definition of **inner1** is now an error because the identifier **Inner1** referring to the module **Inner1** has been introduced in the scope of module **Inner2** in the first line of the module declaration. Also, the declaration of **S1** in the last line is OK since the identifier **S1** was not introduced into the scope by the use of **Inner1::S1** in the first line.

Only the first identifier in a qualified name is introduced into the current scope. This is illustrated by **Inner1::S1** in the example above, which introduces **Inner1** into the scope of **Inner2** but does not introduce **S1**. A qualified name of the form **::X::Y::Z** does not cause **X** to be introduced, but a qualified name of the form **X::Y::Z** does.

Enumeration value names are introduced into the enclosing scope and then are treated like any other declaration in that scope. For example:

```
interface A {
    enum E { E1, E2, E3 };    // line 1
    enum BadE { E3, E4, E5 };    // Error: E3 is already introduced...
                                // ...into the A scope in line 1 above
};
interface C {
    enum AnotherE { E1, E2, E3 };
};
interface D : C, A {
    union U switch (E) {
        case A::E1 : boolean b;    // OK.
        case E2 : long l;    // Error: E2 is ambiguous (notwithstanding...
                                // ... the switch type specification)
    };
};
```

Type names defined in a scope are available for immediate use within that scope. In particular, see Constructed Recursive Types and Forward Declarations page 31 on cycles in type definitions.

A name can be used in an unqualified form within a particular scope; it will be resolved by successively searching farther out in enclosing scopes, while taking into consideration inheritance relationships among interfaces.

For example:

```
module M {
    typedef long ArgType;
    typedef ArgType AType;           // line I1
    interface B {
        typedef string ArgType;     // line I3
        ArgType opb(in AType i);    // line I2
    };
};

module N {
    typedef char ArgType;           // line I4
    interface Y : M::B {
        void opy(in ArgType i);    // line I5
    };
};
```

The following scopes are searched for the declaration of **ArgType** used on **line I5**:

1. Scope of **N::Y** before the use of **ArgType**.
2. Scope of **N::Y**'s base interface **M::B**. (inherited scope).
3. Scope of module **N** before the definition of **N::Y**.
4. Global scope before the definition of **N**.

M::B::ArgType is found in step 2 in **line I3**, and that is the definition that is used in **line I5**, hence **ArgType** in **line I5** is string. It should be noted that **ArgType** is not **char** in **line I5**. Now if **line I3** were removed from the definition of interface **M::B**, then **ArgType** on **line I5** would be **char** from **line I4**, which is found in step 3.

Following analogous search steps for the types used in the operation **M::B::opb** on **line I2**, the type of **AType** used on **line I2** is long from the **typedef** in **line I1** and the return type **ArgType** is **string** from **line I3**.

7.5.3 Special Scoping Rules for Type Names

Once a type has been defined anywhere within the scope of a module, interface or value type, it may not be redefined except within the scope of a nested module, interface or value type, or within the scope of a derived interface or value type. For example:

```
typedef short TempType;           // Scope of TempType begins here
module M {
    typedef string ArgType;       // Scope of ArgType begins here
    struct S {
        ::M::ArgType a1;          // Nothing introduced here
        M::ArgType a2;           // M introduced here
        ::TempType temp;         // Nothing introduced here
    };                             // Scope of (introduced) M ends here
    // ...
};                                 // Scope of ArgType ends here
// Scope of global TempType ends here (at end of file)
```

The scope of an introduced type name is from the point of introduction to the end of its enclosing scope.

However, if a type name is introduced into a scope that is nested in a non-module scope definition its potential scope extends over all its enclosing scopes out to the enclosing non-module scope. (For types that are defined outside a non-module scope, the scope and the potential scope are identical.) For example:

```

module M {
  typedef long ArgType;
  const long I = 10;
  typedef short Y;
  interface A {
    struct S {
      struct T {
        ArgType x[]; // ArgType and I introduced
        long y; // a new y is defined, the existing Y is not used
      } m;
    };
    typedef string ArgType; // Error: ArgType redefined
    enum I { I1, I2 }; // Error: I redefined
    typedef short Y; // OK
  }; // Potential scope of ArgType and I ends here

  interface B : A {
    typedef long ArgType // OK, redefined in derived interface
    struct S { // OK, redefined in derived interface
      ArgType x; // x is a long
      A::ArgType y; // y is a string
    };
  };
};

```

A type may not be redefined within its scope or potential scope, as shown in the preceding example. This rule prevents type names from changing their meaning throughout a non-module scope definition, and ensures that reordering of definitions in the presence of introduced types does not affect the semantics of a specification.

Note – In the following, the definition of **M::A::U::I** is legal because it is outside the potential scope of the **I** introduced in the definition of **M::A::S::T::ArgType**. However, the definition of **M::A::I** is still illegal because it is within the potential scope of the **I** introduced in the definition of **M::A::S::T::ArgType**.

```

module M {
  typedef long ArgType;
  const long I = 10;
  interface A {
    struct S {
      struct T {
        ArgType x[]; // ArgType and I introduced
      } m;
    };
    struct U {
      long I; // OK, I is not a type name
    };
    enum I { I1, I2 }; // Error: I redefined
  }; // Potential scope of ArgType and I ends here
};

```


Note – Redefinition of a type after use in a module is OK as in the example:

```
typedef long ArgType;
module M {
    struct S {
        ArgType x;      // x is a long
    };
    typedef string ArgType; // OK!
    struct T {
        ArgType y;      // Ugly but OK, y is a string
    };
};
```


8 Standardized Annotations

The syntax to define annotations is given in the clause 7.4.15, Building-Block Annotations. Any profile that embeds that building-block will support annotations.

In addition, this clause defines some annotations and groups them in Groups of Annotations. Groups of annotations may be part of a given profile to complement the selected building-blocks.

Any profile that includes such a group of annotations must include the Building-Block Annotations.

8.1 Introduction

8.1.1 Rules for Defining Standardized Annotations

The annotations that are standardized here have been selected for their general purpose nature, meaning that their application can be considered in various contexts.

For each annotation is given:

- Its precise syntax.
- Its meaning as general as possible while remaining significant.
- The kinds of elements on which applying the annotation may make sense. Even if, from the syntactical viewpoint, an annotation may be applied on any IDL construct or sub-construct, a specific annotation is often meaningful only for a subset of those.

Proposed groups of annotations gather annotations per concern, in order to ease their selection.

8.1.2 Rules for Using Standardized Annotations

The fact that a standardized annotation is proposed in its largest possible scope doesn't mean that any specification deciding to make use of such an annotation (and thus selecting it in its compliance profile) is forced to support its whole possible set of applications. In return it must specify the actual usage of the annotation in its specific context. This actual usage must remain compliant with the standardized description provided here but may be more restrictive. More precisely the using specification:

- Must respect totally the standardized annotation syntax.
- May clarify the actual meaning of the annotation in the specific targeted context. That actual meaning may be more precise than, but must remain compliant with, the general one expressed here.
- May precise on which elements the annotation is valid in that specific context. That list may be only a subset of all the possible ones.

- Must indicate the default behavior when no annotation is placed on an element that may be annotated. Note that this default is never identical to the default values provided for annotation members (when these default values exist) as the later ones are just intended to be the most logical when the annotation is present.

8.2 Standardized Groups of Annotations

8.2.1 Group of Annotations General Purpose

The following standardized annotations are of general purpose. They may be applied on almost all kinds of elements.

8.2.1.1 @id Annotation

This annotation allows assigning a 32-bit integer identifier to an element, with the underlying assumption that an identifier should be unique inside its scope of application. The precise scope of uniqueness depends on the type of element on which the annotation is applied and the purpose of such an identification. It has to be given by the specification making use of it.

```
@annotation id {
    unsigned long value;
};
```

This annotation is applicable to any elements that are parts of a set, such as data members within a constructed type or operations within an interface.

8.2.1.2 @autoid Annotation

This annotation complements the former and is applicable to any set containing elements to which allocating a 32-bit integer identifier makes sense. It instructs to automatically allocate identifiers to the elements.

```
@annotation autoid {
    enum AutoidKind {
        SEQUENTIAL,
        HASH
    };
    AutoidKind value default HASH;
};
```

The parameter allows choosing the way the identifiers are created. It could be as follows:

- **SEQUENTIAL** indicates that the next identifier should be computed by incrementing the previous one.
- **HASH** indicates that the identifiers should be computed with a hashing algorithm that gives values regardless the order on which the elements are declared. This is the default value.

8.2.1.3 @optional Annotation

This annotation allows setting an element as optional.

```
@annotation optional {
    boolean value default TRUE;
};
```

Note – The default value (**TRUE**) is significant when the annotation is present (this means that using the compact form **@optional** will set the element as optional, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is present) an element is optional.

This annotation may be used to set optionality on any element that makes sense to be optional.

8.2.1.4 @value Annotation

This annotation allows setting a constant value to any element that may be given a constant value. As opposed to **@id**, **@value** is more versatile as it may carry any constant value. In return it does not carry any concept of uniqueness among a set.

```
@annotation value {
    any value;
};
```

When applied, the provided value must be compliant with the type of the annotated element.

This annotation may be used to set a constant value each time it is relevant. One classical example is to set specific values to members of enumerations.

8.2.1.5 @extensibility Annotation

This annotation applies to any element that is constructed such as a data type or an interface. It allows specifying how the element is allowed to evolve.

```
@annotation extensibility {
    enum ExtensibilityKind {
        FINAL,
        APPEND ,
        MUTABLE
    };
    ExtensibilityKind value;
};
```

The possibilities are:

- **FINAL**: no evolution is allowed.
- **APPEND**: the type may be complemented (elements may be appended at the end) but not reorganized.
- **MUTABLE**: the type may evolve.

8.2.1.6 @final Annotation

This annotation is a shortcut for **@extensibility(FINAL)**.

```
@annotation final {  
    };
```

8.2.1.7 @mutable Annotation

This annotation is a shortcut for `@extensibility(MUTABLE)`.

```
@annotation mutable {  
    };
```

8.2.2 Group of Annotations Data Modeling

This group of annotations gathers annotations that are especially useful to define a data model. They can thus either concern data types (i.e., constructed types) or elements of those (i.e., members of constructed types).

8.2.2.1 @key Annotation

This annotation allows indicating that a data member is part of the key for the objects whose type is the constructed data type owning this element. The key allows identifying an object among the set of objects of a given type. All data items sharing the same key value are assumed to represent the same object.

```
@annotation key {  
    boolean value default TRUE;  
};
```

Note – The default value (**TRUE**) is significant when the annotation is present (this means that using the compact form `@key` will set the element as part of the key definition, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is present) an element is part of the key.

8.2.2.2 @must_understand Annotation

The annotation allows indicating that the data member must be understood by any application making use of that piece of data. This does not mean that the data member cannot be optional. It just means that if the member is present, then it cannot be unknown to the recipient.

```
@annotation must_understand {  
    boolean value default TRUE;  
};
```

Note – The default value (**TRUE**) is significant when the annotation is present (this means that using the compact form `@must_understand` will set the element as needed to be understood, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is present) an element is of that kind.

8.2.3 Group of Annotations: Units and Ranges

This group of annotations gathers means to qualify any element that can be given a constant value. Those annotations can be applied directly to data elements such as members of constructed types or parameters of interfaces.

They can also be applied to a new type created based on a constant type (using a **typedef** declaration). This means that all restrictions brought by the annotations placed on the created type will apply to all future members declared with that new type, as shown in the following example.

```
@range (min=10, max=20)
typedef long MyLong;
...
Struct Foo {
    @range (min=10, max=20)
    long bar1;           // direct application

    MyLong bar2;       // indirect application trough type MyLong
};
```

8.2.3.1 @default Annotation

This annotation allows specifying a default value for the annotated element.

```
@annotation default {
    any value;
};
```

The provided value must be compliant with the type of the annotated element.

8.2.3.2 @range Annotation

This annotation allows specifying a range of allowed values for the annotated element.

```
@annotation range {
    any min;
    any max;
};
```

The provided values (**min** and **max**) must be compliant with the type of the annotated element. The **max** value must be greater or equal to the **min** value.

8.2.3.3 @min Annotation

This annotation allows specifying a minimum value for the annotated element.

```
@annotation min {
    any value;
};
```

The provided value must be compliant with the type of the annotated element.

8.2.3.4 @max Annotation

This annotation allows specifying a maximum value for the annotated element.

```
@annotation max {  
    any value;  
};
```

The provided value must be compliant with the type of the annotated element.

8.2.3.5 @unit Annotation

This annotation allows specifying a unit of measurement for the annotated element.

```
@annotation unit {  
    string value;  
};
```

Note – This standard does not define specific values for given units. However, it is recommended to use standardized abbreviations defined by BIPM¹⁵, whenever applicable.

8.2.4 Group of Annotations Data Implementation

8.2.4.1 @bit_bound Annotation

This annotation allows setting a size (expressed in bits) to an element or a group of elements.

```
@annotation bit_bound {  
    unsigned short value;  
};
```

Note – Typically it may be used to force a size, smaller than the default one to members of an enumeration or to integer elements.

8.2.4.2 @external Annotation

Usually when a data object is mapped in memory, it is implemented as a whole, meaning that, when feasible, its data members are placed next to each other in a single data space. This annotation forces the annotated element to be put elsewhere, in a dedicated place. This is useful for instance to save resources when the element may be huge and is not always present or to allow sharing of the element between data objects.

```
@annotation external {  
    boolean value default TRUE;  
};
```

¹⁵ Bureau International des Poids et Mesures. Cf. <http://www.bipm.org/en/measurement-units/>

Note – The default value (**TRUE**) is significant when the annotation is present (this means that using the compact form **@external** will set the element as external, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is present) an element is external

8.2.4.3 @nested Annotation

This annotation applies to constructed types only. It allows indicating that the objects from the type under annotation will always be nested within other ones one (i.e., as members of their owning object) and thus never used as top-level objects.

```
@annotation nested {
    boolean value default TRUE;
};
```

Note – The default value (**TRUE**) is significant when the annotation is present (this means that using the compact form **@nested** will set the element as nested, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is present) an element is nested

8.2.5 Group of Annotations Code Generation

8.2.5.1 @verbatim Annotation

This annotation allows injecting some user-provided information into what the compiler will generate.

```
@annotation verbatim {
    enumeration PlacementKind {
        BEGIN_FILE,
        BEFORE_DECLARATION,
        BEGIN_DECLARATION,
        END_DECLARATION,
        AFTER_DECLARATION,
        END_FILE
    };
    string language default "*";
    PlacementKind placement default BEFORE_DECLARATION;
    string text;
};
```

In addition to the text to be injected (**text**), this annotation has two parameters:

- The **language** parameter allows indicating to which language this injection applies. The defined values are as follows:
 - **"c"** indicates the C language.
 - **"c++"** indicates the C++ language.
 - **"java"** indicates the Java language.
 - **"idl"** indicates OMG IDL.
 - **"*"** (an asterisk) indicates any language. This is the default value.

Note – Other values may be used when relevant.

- The **placement** parameter allows indicating where in the generated code, this injection is to be made. The defined values are as follows:
 - **BEGIN_FILE**: The text string shall be copied at the beginning of the file containing the declaration of the annotated element, before any type declarations. For example, a system implementer may use such an annotation to inject import statements into the output.
 - **BEFORE_DECLARATION**: The text string shall be copied immediately before the declaration of the annotated element. For example, a system implementer may use such an annotation to inject documentation comments into the output. This is the default value.
 - **BEGIN_DECLARATION**: The text string shall be copied into the body of the declaration of the annotated element before any members or constants. For example, a system implementer may use such an annotation to inject additional declarations or implementations into the output.
 - **END_DECLARATION**: The text string shall be copied into the body of the declaration of the annotated element after all members or constants.
 - **AFTER_DECLARATION**: The text string shall be copied immediately after the declaration of the annotated element.
 - **END_FILE**: The text string shall be copied at the end of the file containing the declaration of the annotated element after all type declarations.

8.2.6 Group of Annotations Interfaces

8.2.6.1 @service Annotation

This annotation allows indicating that an interface is to be treated as a service. An optional parameter allows indicating by which platform that service invocation is to be supported.

```
@annotation service {
    string platform default "**";
};
```

The defined values for the **platform** parameter are as follows:

- "CORBA" indicates that the service should be made accessible via CORBA.
- "DDS" indicates that the service should be made accessible via DDS.
- "*" (an asterisk) indicates any platform. This is the default value.

Note – Other values may be defined if relevant.

8.2.6.2 @oneway Annotation

This annotation allows indicating that an operation is one way only, meaning that related information flow will go from the client to the server providing the related service, but not back from the server to the client.

```
@annotation oneway {
    boolean value default TRUE;
};
```

This annotation may only concern operations without any return value (**void** return type) and without any **out** or **inout** parameters.

Note – The default value (**TRUE**) is significant when the annotation is used (this means that using the compact form **@oneway** will set the operation as one-way, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is used) the operation is one-way.

8.2.6.3 @ami Annotation

This annotation allows indicating that an interface or an operation is to be made callable asynchronously.

```
@annotation ami {  
    boolean value default TRUE;  
};
```

Note – The default value (**TRUE**) is significant when the annotation is used (this means that using the compact form **@ami** will set the element as asynchronously callable, which is what is expected intuitively). It does not mean that by default (i.e., when no annotation is used) it is the case.

Note – The way asynchronous invocations are implemented is middleware dependent.

9 Profiles

This clause defines some relevant combinations of building-blocks, called *profiles*. Profiles are just sets of building-blocks, possibly complemented with groups of annotations. The given profiles correspond to current usages of IDL. They are split in two categories, the ones that are related to CORBA (including CCM) and the ones that are related to DDS.

These profiles are not normative for the related middleware solutions (the reference for their compliance to IDL is to be found in their respective specifications). However they are given here for illustration and a check of the relevant break-down in building-blocks.

9.1 CORBA and CCM Profiles

In this clause are grouped all the profiles that are related to CORBA.

9.1.1 Plain CORBA Profile

This profile correspond to the plain CORBA usage, without Components (i.e., the latest IDL 2 version)

It is made of:

- Building-Block Core Data Types.
- Building-Block Any.
- Building-Block Interfaces – Basic.
- Building-Block Interfaces – Full.
- Building-Block Value Types.
- Building-Block CORBA-Specific – Interfaces.
- Building-Block CORBA-Specific – Value Types.

9.1.2 Minimum CORBA Profile

This version corresponds to CORBA minimum profile. As opposed to Plain CORBA Profile, it does not embed **Any** nor **Valuetypes**.

It is made of:

- Building-Block Core Data Types.
- Building-Block Interfaces – Basic.
- Building-Block Interfaces – Full.
- Building-Block CORBA-Specific – Interfaces.

9.1.3 CCM Profile

This profile corresponds to CCM (or Lw-CCM) mandatory usage (i.e., the latest IDL3 version without optional Generic Interaction Support)

It is made of:

- Building-Block Core Data Types.
- Building-Block Any.
- Building-Block Interfaces – Basic.
- Building-Block Interfaces – Full.
- Building-Block Value Types.
- Building-Block CORBA-Specific – Interfaces.
- Building-Block CORBA-Specific – Value Types.
- Building-Block Components – Basic.
- Building-Block CCM-Specific.

9.1.4 CCM with Generic Interaction Support Profile

This profile adds to CCM Profile, the Generic Interaction Support; which is an optional CCM compliance point (also known as IDL3+).

It is made of:

- Building-Block Core Data Types.
- Building-Block Any.
- Building-Block Interfaces – Basic.
- Building-Block Interfaces – Full.
- Building-Block Value Types.
- Building-Block CORBA-Specific – Interfaces.
- Building-Block CORBA-Specific – Value Types,.
- Building-Block Components – Basic.
- Building-Block CCM-Specific.
- Building-Block Components – Ports and Connectors.
- Building-Block Template Modules.

9.2 DDS Profiles

In this clause are gathered the DDS-related profiles.

9.2.1 Plain DDS Profile

This profile corresponds to what is basically supported by DDS.

It is made of:

- Building-Block Core Data Types.
- Building-Block Anonymous Types.

9.2.2 Extensible DDS Profile

This profile extends Plain DDS Profile with the features provided by Extensible and Dynamic Topic Types for DDS.

It is made of:

- Building-Block Core Data Types.
- Building-Block Extended Data-Types.
- Building-Block Anonymous Types.
- Building-Block Annotations.
- Group of Annotations General Purpose.
- Group of Annotations Data Modeling.
- Group of Annotations Data Implementation.
- Group of Annotations Code Generation.

9.2.3 RPC over DDS Profile

This profile allows describing interfaces that may be considered as services by RPC over DDS.

It is made of:

- Building-Block Core Data Types.
- Building-Block Extended Data-Types.
- Building-Block Anonymous Types.
- Building-Block Interfaces – Basic.
- Building-Block Annotations.
- Group of Annotations General Purpose.
- Group of Annotations Interfaces.

Annex: Consolidated IDL Grammar

This annex gathers all the rules from all the building-blocks.

From Building-Block Core Data Types:

- (1) **<specification>** ::= **<definition>+**
- (2) **<definition>** ::= **<module_dcl> ";"**
| **<const_dcl> ";"**
| **<type_dcl> ";"**
- (3) **<module_dcl>** ::= **"module" <identifier> "{" <definition>+ "}"**
- (4) **<scoped_name>** ::= **<identifier>**
| **"::" <identifier>**
| **<scoped_name> "::" <identifier>**
- (5) **<const_dcl>** ::= **"const" <const_type> <identifier> "=" <const_expr>**
- (6) **<const_type>** ::= **<integer_type>**
| **<floating_pt_type>**
| **<fixed_pt_const_type>**
| **<char_type>**
| **<wide_char_type>**
| **<boolean_type>**
| **<octet_type>**
| **<string_type>**
| **<wide_string_type>**
| **<scoped_name>**
- (7) **<const_expr>** ::= **<or_expr>**
- (8) **<or_expr>** ::= **<xor_expr>**
| **<or_expr> "|" <xor_expr>**
- (9) **<xor_expr>** ::= **<and_expr>**
| **<xor_expr> "^" <and_expr>**
- (10) **<and_expr>** ::= **<shift_expr>**
| **<and_expr> "&" <shift_expr>**
- (11) **<shift_expr>** ::= **<add_expr>**
| **<shift_expr> ">>" <add_expr>**
| **<shift_expr> "<<" <add_expr>**
- (12) **<add_expr>** ::= **<mult_expr>**
| **<add_expr> "+" <mult_expr>**
| **<add_expr> "-" <mult_expr>**
- (13) **<mult_expr>** ::= **<unary_expr>**
| **<mult_expr> "*" <unary_expr>**
| **<mult_expr> "/" <unary_expr>**
| **<mult_expr> "%" <unary_expr>**
- (14) **<unary_expr>** ::= **<unary_operator> <primary_expr>**
| **<primary_expr>**
- (15) **<unary_operator>** ::= **"-"**
| **"+"**
| **"~"**

(16)	<code><primary_expr></code>	<code>::= <scoped_name> <literal> "(" <const_expr> ")"</code>
(17)	<code><literal></code>	<code>::= <integer_literal> <floating_pt_literal> <fixed_pt_literal> <character_literal> <wide_character_literal> <boolean_literal> <string_literal> <wide_string_literal></code>
(18)	<code><boolean_literal></code>	<code>::= "TRUE" "FALSE"</code>
(19)	<code><positive_int_const></code>	<code>::= <const_expr></code>
(20)	<code><type_dcl></code>	<code>::= <constr_type_dcl> <native_dcl> <typedef_dcl></code>
(21)	<code><type_spec></code>	<code>::= <simple_type_spec></code>
(22)	<code><simple_type_spec></code>	<code>::= <base_type_spec> <scoped_name></code>
(23)	<code><base_type_spec></code>	<code>::= <integer_type> <floating_pt_type> <char_type> <wide_char_type> <boolean_type> <octet_type></code>
(24)	<code><floating_pt_type></code>	<code>::= "float" "double" "long" "double"</code>
(25)	<code><integer_type></code>	<code>::= <signed_int> <unsigned_int></code>
(26)	<code><signed_int></code>	<code>::= <signed_short_int> <signed_long_int> <signed_longlong_int></code>
(27)	<code><signed_short_int></code>	<code>::= "short"</code>
(28)	<code><signed_long_int></code>	<code>::= "long"</code>
(29)	<code><signed_longlong_int></code>	<code>::= "long" "long"</code>
(30)	<code><unsigned_int></code>	<code>::= <unsigned_short_int> <unsigned_long_int> <unsigned_longlong_int></code>
(31)	<code><unsigned_short_int></code>	<code>::= "unsigned" "short"</code>
(32)	<code><unsigned_long_int></code>	<code>::= "unsigned" "long"</code>
(33)	<code><unsigned_longlong_int></code>	<code>::= "unsigned" "long" "long"</code>
(34)	<code><char_type></code>	<code>::= "char"</code>
(35)	<code><wide_char_type></code>	<code>::= "wchar"</code>
(36)	<code><boolean_type></code>	<code>::= "boolean"</code>
(37)	<code><octet_type></code>	<code>::= "octet"</code>

(38)	<code><template_type_spec></code>	<code>::= <sequence_type> <string_type> <wide_string_type> <fixed_pt_type></code>
(39)	<code><sequence_type></code>	<code>::= "sequence" "<" <type_spec> "," <positive_int_const> ">" "sequence" "<" <type_spec> ">"</code>
(40)	<code><string_type></code>	<code>::= "string" "<" <positive_int_const> ">" "string"</code>
(41)	<code><wide_string_type></code>	<code>::= "wstring" "<" <positive_int_const> ">" "wstring"</code>
(42)	<code><fixed_pt_type></code>	<code>::= "fixed" "<" <positive_int_const> "," <positive_int_const> ">"</code>
(43)	<code><fixed_pt_const_type></code>	<code>::= "fixed"</code>
(44)	<code><constr_type_dcl></code>	<code>::= <struct_dcl> <union_dcl> <enum_dcl></code>
(45)	<code><struct_dcl></code>	<code>::= <struct_def> <struct_forward_dcl></code>
(46)	<code><struct_def></code>	<code>::= "struct" <identifier> "{" <member>+ "}"</code>
(47)	<code><member></code>	<code>::= <type_spec> <declarators> ","</code>
(48)	<code><struct_forward_dcl></code>	<code>::= "struct" <identifier></code>
(49)	<code><union_dcl></code>	<code>::= <union_def> <union_forward_dcl></code>
(50)	<code><union_def></code>	<code>::= "union" <identifier> "switch" "(" <switch_type_spec> ")" "{" <switch_body> "}"</code>
(51)	<code><switch_type_spec></code>	<code>::= <integer_type> <char_type> <boolean_type> <scoped_name></code>
(52)	<code><switch_body></code>	<code>::= <case>+</code>
(53)	<code><case></code>	<code>::= <case_label>+ <element_spec> ","</code>
(54)	<code><case_label></code>	<code>::= "case" <const_expr> ":" "default" ":"</code>
(55)	<code><element_spec></code>	<code>::= <type_spec> <declarator></code>
(56)	<code><union_forward_dcl></code>	<code>::= "union" <identifier></code>
(57)	<code><enum_dcl></code>	<code>::= "enum" <identifier> "{" <enumerator> { "," <enumerator> } * "}"</code>
(58)	<code><enumerator></code>	<code>::= <identifier></code>
(59)	<code><array_declarator></code>	<code>::= <identifier> <fixed_array_size>+</code>
(60)	<code><fixed_array_size></code>	<code>::= "[" <positive_int_const> "]"</code>
(61)	<code><native_dcl></code>	<code>::= "native" <simple_declarator></code>
(62)	<code><simple_declarator></code>	<code>::= <identifier></code>
(63)	<code><typedef_dcl></code>	<code>::= "typedef" <type_declarator></code>

- (64) `<type_declarator>` ::= { `<simple_type_spec>`
| `<template_type_spec>`
| `<constr_type_dcl>`
} `<any_declarators>`
- (65) `<any_declarators>` ::= `<any_declarator>` { "," `<any_declarator>` }
- (66) `<any_declarator>` ::= `<simple_declarator>`
| `<array_declarator>`
- (67) `<declarators>` ::= `<declarator>` { "," `<declarator>` }
- (68) `<declarator>` ::= `<simple_declarator>`

From Building-Block Any:

- (69) `<base_type_spec>` ::=+ `<any_type>`
- (70) `<any_type>` ::= "any"

From Building-Block Interfaces – Basic:

- (71) `<definition>` ::=+ `<except_dcl>` ";"
| `<interface_dcl>` ";"
- (72) `<except_dcl>` ::= "exception" `<identifier>` "{" `<member>`* "}"
- (73) `<interface_dcl>` ::= `<interface_def>`
| `<interface_forward_dcl>`
- (74) `<interface_def>` ::= `<interface_header>` "{" `<interface_body>` "}"
- (75) `<interface_forward_dcl>` ::= `<interface_kind>` `<identifier>`
- (212) (76) `<interface_header>` ::= `<interface_kind>` `<identifier>`
[`<interface_inheritance_spec>`]
- (77) `<interface_kind>` ::= "interface"
- (78) `<interface_inheritance_spec>`
::= ":" `<interface_name>` { "," `<interface_name>` }*
- (79) `<interface_name>` ::= `<scoped_name>`
- (80) `<interface_body>` ::= `<export>`*
- (81) `<export>` ::= `<op_dcl>` ";"
| `<attr_dcl>` ";"
- (82) `<op_dcl>` ::= `<op_type_spec>` `<identifier>` "(" [`<parameter_dcls>`] ")" [`<raises_expr>`]
- (83) `<op_type_spec>` ::= `<type_spec>`
| "void"
- (84) `<parameter_dcls>` ::= `<param_dcl>` { "," `<param_dcl>` } *
- (85) `<param_dcl>` ::= `<param_attribute>` `<type_spec>` `<simple_declarator>`
- (86) `<param_attribute>` ::= "in"
| "out"
| "inout"
- (87) `<raises_expr>` ::= "raises" "(" `<scoped_name>` { "," `<scoped_name>` } * ")"
- (88) `<attr_dcl>` ::= `<readonly_attr_spec>`
| `<attr_spec>`
- (89) `<readonly_attr_spec>` ::= "readonly" "attribute" `<type_spec>` `<readonly_attr_declarator>`

- (90) `<readonly_attr_declarator>`
`::= <simple_declarator> <raises_expr>`
`| <simple_declarator> { "," <simple_declarator> }*`
- (91) `<attr_spec>` `::= "attribute" <type_spec> <attr_declarator>`
- (92) `<attr_declarator>`
`::= <simple_declarator> <attr_raises_expr>`
`| <simple_declarator> { "," <simple_declarator> }*`
- (93) `<attr_raises_expr>`
`::= <get_except_expr> [<set_except_expr>]`
`| <set_except_expr>`
- (94) `<get_except_expr>` `::= "getraises" <exception_list>`
- (95) `<set_except_expr>` `::= "setraises" <exception_list>`
- (96) `<exception_list>` `::= "(" <scoped_name> { "," <scoped_name> } * ")"`

From Building-Block Interfaces – Full:

- (97) `<export>`
`::+ <type_dcl> ","`
`| <const_dcl> ","`
`| <except_dcl> ","`

From Building-Block Value Types:

- (98) `<definition>` `::+ <value_dcl> ","`
- (99) `<value_dcl>`
`::= <value_def>`
`| <value_forward_dcl>`
- (100) `<value_def>` `::= <value_header> "{" <value_element> * "}"`
- (101) `<value_header>` `::= <value_kind> <identifier> [<value_inheritance_spec>]`
- (102) `<value_kind>` `::= "valuetype"`
- (103) `<value_inheritance_spec>`
`::= [":" <value_name>] ["supports" <interface_name>]`
- (104) `<value_name>` `::= <scoped_name>`
- (105) `<value_element>`
`::= <export>`
`| <state_member>`
`| <init_dcl>`
- (106) `<state_member>` `::= ("public" | "private") <type_spec> <declarators> ","`
- (107) `<init_dcl>` `::= "factory" <identifier> "(" [<init_param_dcls>] ")" [<raises_expr>] ","`
- (108) `<init_param_dcls>` `::= <init_param_dcl> { "," <init_param_dcl> }*`
- (109) `<init_param_dcl>` `::= "in" <type_spec> <simple_declarator>`
- (110) `<value_forward_dcl>` `::= <value_kind> <identifier>`

From Building-Block CORBA-Specific – Interfaces:

- (111) `<definition>`
`::+ <type_id_dcl> ","`
`| <type_prefix_dcl> ","`
`| <import_dcl> ","`
- (112) `<export>`
`::+ <type_id_dcl> ","`
`| <type_prefix_dcl> ","`
`| <import_dcl> ","`
`| <op_oneway_dcl>`

(113) <type_id_dcl> ::= "typeid" <scoped_name> <string_literal>
(114) <type_prefix_dcl> ::= "typeprefix" <scoped_name> <string_literal>
(115) <import_dcl> ::= "import" <imported_scope>
(116) <imported_scope> ::= <scoped_name> | <string_literal>
(117) <base_type_spec> ::=+ <object_type>
(118) <object_type> ::= "Object"
(119) <interface_kind> ::=+ "local" "interface"
(120) <op_oneway_dcl> ::= "oneway" "void" <identifier> "(" [<in_parameter_dcls>] ")"
(121) <in_parameter_dcls> ::= <in_param_dcl> { "," <in_param_dcl> } *
(122) <in_param_dcl> ::= "in" <type_spec> <simple_declarator>
(123) <op_with_context> ::= { <op_dcl> | <op_oneway_dcl> } <context_expr>
(124) <context_expr> ::= "context" "(" <string_literal> { "," <string_literal> } ")"

From Building-Block CORBA-Specific – Value Types:

(125) <value_dcl> ::=+ <value_box_def>
| <value_abs_def>
(126) <value_box_def> ::= "valuetype" <identifier> <type_spec>
(127) <value_abs_def> ::= "abstract" "valuetype" <identifier> [<value_inheritance_spec>]
"{" <export>* "}"
(128) <value_kind> ::=+ "custom" "valuetype"
(129) <interface_kind> ::=+ "abstract" "interface"
(130) <value_inheritance_spec>
::+ ":" ["truncatable"] <value_name> { "," <value_name> } *
["supports" <interface_name> { "," <interface_name> } *]
(131) <base_type_spec> ::=+ <value_base_type>
(132) <value_base_type> ::= "ValueBase"

From Building-Block Components – Basic:

(133) <definition> ::=+ <component_dcl> ";"
(134) <component_dcl> ::= <component_def>
| <component_forward_dcl>
(135) <component_forward_dcl>
::= "component" <identifier>
(136) <component_def> ::= <component_header> "{" <component_body> "
(137) <component_header> ::= "component" <identifier> [<component_inheritance_spec>]
(138) <component_inheritance_spec>
::= ":" <scoped_name>
(139) <component_body> ::= <component_export>*
(140) <component_export> ::= <provides_dcl> ";"
| <uses_dcl> ";"
| <attr_dcl> ";"
(141) <provides_dcl> ::= "provides" <interface_type> <identifier>

(142) <interface_type> ::= <scoped_name>
(143) <uses_dcl> ::= "uses" <interface_type> <identifier>

From Building-Block Components – Homes:

(144) <definition> ::=+ <home_dcl> ";"
(145) <home_dcl> ::= <home_header> "{" <home_body> "
(146) <home_header> ::= "home" <identifier> [<home_inheritance_spec>]
"manages" <scoped_name>
(147) <home_inheritance_spec> ::= ":" <scoped_name>
(148) <home_body> ::= <home_export> *
(149) <home_export> ::= <export>
| <factory_dcl> ";"
(150) <factory_dcl> ::= "factory" <identifier> "(" [<factory_param_dcls>] ")" [<raises_expr>]
(151) <factory_param_dcls> ::= <factory_param_dcl> { "," <factory_param_dcl> } *
(152) <factory_param_dcl> ::= "in" <type_spec> <simple_declarator>

From Building-Block CCM-Specific:

(153) <definition> ::=+ <event_dcl> ";"
(154) <component_header> ::=+ "component" <identifier> [<component_inheritance_spec>]
<supported_interface_spec>
(155) <supported_interface_spec>
::= "supports" <scoped_name> { "," <scoped_name> } *
(156) <component_export> ::=+ <emits_dcl> ";"
| <publishes_dcl> ";"
| <consumes_dcl> ";"
(157) <interface_type> ::=+ "Object"
(158) <uses_dcl> ::=+ "uses" "multiple" <interface_type> <identifier>
(159) <emits_dcl> ::= "emits" <scoped_name> <identifier>
(160) <publishes_dcl> ::= "publishes" <scoped_name> <identifier>
(161) <consumes_dcl> ::= "consumes" <scoped_name> <identifier>
(162) <home_header> ::=+ "home" <identifier> [<home_inheritance_spec>]
[<supported_interface_spec>]
"manages" <scoped_name> [<primary_key_spec>]
(163) <primary_key_spec> ::= "primarykey" <scoped_name>
(164) <home_export> ::=+ <finder_dcl> ";"
(165) <finder_dcl> ::= "finder" <identifier> "(" [<init_param_dcls>] ")" [<raises_expr>]
(166) <event_dcl> ::= (<event_def>
| <event_abs_def>
| <event_forward_dcl>)
(167) <event_forward_dcl> ::= ["abstract"] "eventtype" <identifier>
(168) <event_abs_def> ::= "abstract" "eventtype" <identifier> [<value_inheritance_spec>]
"{" <export> * "}"
(169) <event_def> ::= <event_header> "{" <value_element> * "}"

(170) `<event_header>` ::= ["custom"] "eventtype" `<identifier>` [`<value_inheritance_spec>`]

From Building-Block Components – Ports and Connectors:

(171) `<definition>` ::=+ `<porttype_dcl>` ";"
| `<connector_dcl>` ";"

(172) `<porttype_dcl>` ::= `<porttype_def>`
| `<porttype_forward_dcl>`

(173) `<porttype_forward_dcl>` ::= "porttype" `<identifier>`

(174) `<porttype_def>` ::= "porttype" `<identifier>` "{ " `<port_body>` "}"

(175) `<port_body>` ::= `<port_ref>` `<port_export>`*

(176) `<port_ref>` ::= `<provides_dcl>` ";"
| `<uses_dcl>` ";"
| `<port_dcl>` ";"

(177) `<port_export>` ::= `<port_ref>`
| `<attr_dcl>` ";"

(178) `<port_dcl>` ::= {"port" | "mirrorport"} `<scoped_name>` `<identifier>`

(179) `<component_export>` ::=+ `<port_dcl>` ";"

(180) `<connector_dcl>` ::= `<connector_header>` "{" `<connector_export>`+ "}"

(181) `<connector_header>` ::= "connector" `<identifier>` [`<connector_inherit_spec>`]

(181) `<connector_inherit_spec>` ::= ":" `<scoped_name>`

(183) `<connector_export>` ::= `<port_ref>`
| `<attr_dcl>` ";"

From Building-Block Template Modules:

(184) `<definition>` ::=+ `<template_module_dcl>` ";"
| `<template_module_inst>` ";"

(185) `<template_module_dcl>` ::= "module" `<identifier>` "<" `<formal_parameters>` ">"
"{" `<tpl_definition>` + "}"

(186) `<formal_parameters>` ::= `<formal_parameter>` {"," `<formal_parameter>`}*

(187) `<formal_parameter>` ::= `<formal_parameter_type>` `<identifier>`

(188) `<formal_parameter_type>` ::= "typename" | "interface" | "valuetype" | "eventtype"
| "struct" | "union" | "exception" | "enum" | "sequence"
| "const" `<const_type>`
| `<sequence_type>`

(189) `<tpl_definition>` ::= `<definition>`
| `<template_module_ref>` ";"

(190) `<template_module_inst>` ::= "module" `<scoped_name>` "<" `<actual_parameters>` ">" `<identifier>` ";"

(191) `<actual_parameters>` ::= `<actual_parameter>` {"," `<actual_parameter>`}*

(192) `<actual_parameter>` ::= `<type_spec>`
| `<const_expr>`

(193) `<template_module_ref>` ::= "alias" `<scoped_name>` "<" `<formal_parameter_names>` ">" `<identifier>`

(194) `<formal_parameter_names>` ::= `<identifier>` {"," `<identifier>`}*

From Building-Block Extended Data-Types:

- (195) `<struct_def>` ::= "struct" `<identifier>` ":" `<scoped_name>` "{" `<member>+ "`"
- (196) `<switch_type_spec>` ::= `<wide_char_type>`
| `<octet_type>`
- (197) `<template_type_spec>` ::= `<map_type>`
| `<bitset_type>`
- (198) `<map_type>` ::= "map" "<" `<simple_type_spec>` ","
 `<simple_type_spec>` "," `<positive_int_const>` ">"
| "map" "<" `<simple_type_spec>` ","
 `<simple_type_spec>` ">"
- (199) `<bitset_type>` ::= "bitset" "<" `<positive_int_const>` ">"
| "bitset" "<" `<positive_int_const>` "," `<integer_type>` ">"

From Building-Block Anonymous Types:

- (200) `<type_spec>` ::= `<template_type_spec>`
- (201) `<declarator>` ::= `<array_declarator>`

From Building-Block Annotations:

- (202) `<definition>` ::= `<annotation_dcl>` ";"
| `<annotation_appl>` `<definition>`
- (203) `<annotation_dcl>` ::= `<annotation_header>` "{" `<annotation_body>` "}"
- (204) `<annotation_header>` ::= "@annotation" `<identifier>`
- (205) `<annotation_body>` ::= { `<annotation_member>`
 | `<enum_dcl>` ";"
 | `<const_dcl>` ";"
 | `<typedef_dcl>` ";" }*
- (206) `<annotation_member>` ::= `<annotation_member_type>` `<simple_declarator>`
 ["default" `<const_expr>`] ";"
- (207) `<annotation_member_type>` ::= `<const_type>` | `<any_const_type>` | `<scoped_name>`
- (208) `<any_const_type>` ::= "any"
- (209) `<annotation_appl>` ::= "@" `<scoped_name>` ["(" `<annotation_appl_params>` ")"]
- (210) `<annotation_appl_params>` ::= `<const_expr>`
 | `<annotation_appl_param>` { "," `<annotation_appl_param>` }*
- (211) `<annotation_appl_param>` ::= `<identifier>` "=" `<const_expr>`