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Common Language-Independent Datatypes
Editor's Notes for Working Draft 5

A. Overview

1. Working draft 5 is a revision of CLI Datatypes working draft 4, designated WG11 N190 (X3T2/90-211), per committee decisions of WG11 (September, 1990 and January, 1991). WD4 was circulated for CD ballot in SC22 (as SC22 N842), and WD5 contains all changes required by resolution of the SC22 ballot comments (SC22 N906). Not all such comments were, however, resolved.

The Outstanding Issues section remains in the draft until all officially raised issues have been resolved. The Outstanding Issues list must be empty and removed before the document is progressed beyond the Committee Draft stage.

Section B below, Annotations to Changes, identifies individual changes clause-by-clause and the source of those changes.

Section C below, Disposition of Comments, identifies all comment documents resolved by the committee since the release of WD.4 and the disposition of each comment.

2. The major changes from Working Draft 4 are:

a. The datatype definition syntax, and consequently many of the productions for individual datatypes, has been considerably revised.

b. The compliance rules have been revised to require partial direct compliance to support a specific list of datatypes and generators. The proper contents of this list is an open Issue (2).

c. The effect of type properties on mapping requirements is now detailed, although the text of this (in clause 6) should be regarded tentative.

3. Abbreviated references

All comment documents are referenced by both WG11 and X3T2 document number wherever they are applied. Abbreviated references are used for the following documents, which recommend many individual changes:

[FR n] refers to SC22 N906, comments on the CD ballot, from France. The n is the number of the French comment.

[US] refers to SC22 N906, comments on the CD ballot, from USA.

[N176] refers to a Greengrass proposal (WG11 N176) which the editor was directed to introduce into WD4 (committee decision, 6/90) and was unable to do. Greengrass expanded on the proposal in X3T2/90-293 (WG11 N???) and it is the expansion which is here incorporated.

[N196] refers to WG11 N196 from Mike Sykes.

[N208] refers to WG11 N208, the resolution of several comment documents by WG11 in September, 1990.

[IDN] refers to changes made to accommodate alignment with the March, 1991, RPC IDN working draft.

B. Annotations to Changes

In keeping with the view that the CLID has become a standing document of the committee, all changes from WD4 are indicated by "change bars" in the document margins. The editor apologizes that his text processing software felt compelled to change-bar all cross-references, even those which did not change, and to change-bar certain paragraphs because of formatting changes.

1. Resolution of Outstanding Issues in WD4:

1. Distinguished datatypes and generators.
Partially resolved, reformulated in WD5.

2. Required datatypes and generators.
Open, requires collaboration with RPC community.

3. Pragmata/Attributes.
Required, Resolved Issue 21.

4. Mappings.
Required, Resolved Issue 22.

5. Syntax.
CLID/CLIPC/RPC shall use a common syntax. Resolved Issue 23.

6. Ordering of CharacterString.
Partly resolved, reformulated in WD5. Outstanding Issue 3.

7. Table.
Open. Outstanding Issue 4.

8. Null values of Pointer.
Yes. Resolved Issue 24.

9. User-defined datatypes and generators.
Reformulated for proposed IDN. Outstanding Issue 5.

2. Outstanding Issues in WD5:

1. Slightly revised from WD4 Issue 1.
2. Carried over from WD4 Issue 2.
3. Reformulated from WD4 Issue 6.
4. Carried over from WD4 Issue 7.
5. Reformulated from WD4 Issue 9. [IDN]
6. Formally added by committee 9/90, and unresolved ballot comments. [N196] [US] [FR 39, 40, 42, 43, 44, 45].
7. Unresolved ballot comment. [FR 15]
8. Unresolved ballot comment. [FR 17]
9. Unresolved ballot comment. [FR 34]
10. Alignment issue with RPC, alignment issue with LCAS, and ballot comment. [FR 36] [IDN]
11. Unresolved ballot comments. [FR 41, 51], supported by Yellin (N221), Greengrass (N232), and Hamilton/Treat (N219).

3. Global changes

Major revision to the syntax to match proposed IDN. The grammar is, for several reasons, not identical to the current IDN draft. It is believed, however, that the language described thereby is identical to that described by the current IDN draft, except for the following:

a. array-index supports index-type, not present in the IDN.

b. attribute-value-spec allows the equal-sign (=) character, to prevent having to rewrite Annex D in this draft. The feature may be otherwise desirable.

c. datatype-declaration and generator-declaration could not be

changed to the IDN syntax without committee decision on the semantic implications. The IDN syntax does not support the CLID concepts.

d. lowerbound, upperbound and select-range syntax was made uniform, to avoid the introduction of IDN "infinity" which does not generalize to non-numeric datatypes.

e. exponent added to real-literal.

f. "max" and "min" subtypes changed to "size" with syntax and semantics similar to the "limit-spec" in WD4, to support the semantics of WD4 limit-spec.

g. time-type changed to support WG11 semantic changes.

h. inclusion in the CLID of many intermediate productions needed to associate CLID semantic notions with syntactic objects, resulting in syntactic limitations on special cases to support the semantics.

The syntax notation used in the CLID also differs from that used in the draft IDN, both being convenient derivatives of classical BNF. While these should be aligned at all levels in the dIS, the notational change requires a rewrite of clause 4, which was not available.

Where possible, non-terminal symbols retained the same spelling as the IDN non-terminals, although in some cases the IDN abbreviation was expanded to the corresponding English word, as <value-expr> to "value-expression". The IDN <type-spec> was uniformly replaced by the WD4 "datatype", as being more consistent with the semantics of CLID. In WD4 and WD5, the words "parameter" and "parametric" appearing in symbols always refer to the parameters of defined-datatypes and defined-generators, while the word "argument" always refers to the parameters of declared procedures and procedure-types - the IDN symbols were replaced accordingly.

4. Specific changes:

Foreword.

Reference for PHIGS added. [FR 4]

Revised to correct the name of JTC1. [Ed.]

Revised the paragraphs on use of the standard to support the model discussed in committee jointly with RPC (1/91). The former text emphasized the outward mapping; the change emphasizes the inward mapping. The outward mapping alone is never sufficient; in the current view, the inward mapping may be. [Ed.]

Explanation that Notes are not normative added. [FR 6]

1. Scope. Example added to explain the difference between language semantics and program semantics. [FR 9]

2. Normative References. ISO 8824 and 9836 added because of OSI-Object-Id (B.9). [Ed.]

3. Definitions:
pragma changed to attribute and redefined. [IDN]
generated internal datatype added. [FR 10]
generated primitive datatype added. [FR 10]
mapping added. [FR 10]
primitive datatype redefined. [US]
variable added, to support Pointer [Ed.]

4.1. Syntax. Minor editorial changes. [FR 12]

4.2 any-character defined. [FR 13]
Many clarifications added to support the IDN. [Ed.]

5. Compliance. Note extended, per committee discussion of [FR 3].

5.1 Direct compliance.
Note 3 added, per committee discussion of [FR 3]. Text is from Meek.

5.2. Rewritten following committee discussion (9/90) of Tanner's comment (b) in WG11 N197. [N208]

5.3 Note 2. revised to define "generic". [FR 10]

6.1 Datatype.
"Relationships" changed to "properties" (see 6.3).
NOTE moved to 6.3. [FR 1]

6.2 Added statement that a value belongs to only one datatype. (Rabin, in committee, 1/91)

6.3 Value Relationships merged with 6.4 Datatype Properties.
Merger and mapping requirements derived from [N176].
Description of the abstract computational model added. Associated NOTE moved from 6.1. [FR 1]

6.3.1 "Equivalence" changed to "Equality". [FR 20]
(The word "equivalent" is used frequently in the text with other meanings.)
"Properties" changed to "rules", to avoid confusion [Ed.]
Mapping requirements added. [N176]

6.3.2 Ordering
"Properties" changed to "rules", to avoid confusion [Ed.]
Mapping requirements added. [N176]

6.3.3 Bound
Mapping requirements added. [N176]

6.3.4 (former 6.4.1) Cardinality.
Mapping requirements added. [N176]
Computational notion described. [FR 1]

6.3.5 (former 6.4.2) Dense.
Mapping requirements added. [N176]
Computational notion described. [FR 1]

6.3.6 (former 6.4.3) Numeric.
Mapping requirements added. [N176]

6.5 renumbered 6.4.

6.5 (former 6.6) Note/example added to explain the need for characterizing operations. (Committee response to [FR 19]).

6.7 renumbered 6.6.

7. Datatypes (general).
"datatype-designator" introduced to accommodate attributes [IDN].
Paragraph added to defend the notation for values. [FR 11]

7.1. Description of "syntax" in the template changed to refer to datatype designator. [FR 23]
Definition of operation descriptions added. [FR 24]
Pseudo-definition of Equal deleted, per committee decision (1/91).

7.1.1. Boolean. Equal added, per committee decision (1/91).

7.1.2. State.
Syntax changes. [IDN] [FR 25]
References to "equivalence" changed to Equal, per committee decision

(1/91). [FR 27]

7.1.3. Enumerated.
Syntax changes. [IDN] [FR 25]
Equal added, per committee decision (1/91).
"Enumerated" in the operations expanded to a type reference. [Ed.]

7.1.4. Character.
Editorial change "alphabet" to "repertoire" and in some cases to "character set". [N208] following N196.
Equal added, per committee decision (1/91).
"Character" in the operations expanded to a type reference. [Ed.]
Note 2 added to relate CLID to the "registration problem" and explain the raison d'etre of Annex E. [Ed. per ISO directives.]
Example added. [FR 28]

7.1.5. Ordinal. Equal added, per committee decision (1/91).

7.1.6. Time.
Editorial changes to change "accuracy" to "resolution", which required changing the syntactic object "resolution" to "unit-type" to avoid confusion. [N208], following Sykes in WG11 N196.
Change "designating" to "whose values are". [FR 30]
Reference to UTC added to satisfy the Sykes comment on time-zones, [N196, N204, N208].
Equal added, per committee decision (1/91).
Extend and Round re-worded to improve clarity. [FR 31]

7.1.7. Bit. Equal added, per committee decision (1/91).

7.1.8. Integer.
Equal added, per committee decision (1/91).

7.1.9. Rational.
Equal added, per committee decision (1/91).
Measure removed, per committee decision (1/91).

7.1.10. Scaled.
radix**factor changed to radix**(- factor) uniformly. [Ed.]
Equal added, per committee decision (1/91).
A new Note 1 added to expand on the former Note 4. [FR 32]
Note 3 reworded. [FR 35]
Definition of scaled-literal (value) added and Note 6 added. [FR 34]

7.1.11. Real.
Syntax change, including the relative-error parameter. [IDN]
This required specification of the meaning of relative-error. Most of this was supplied by the editor, and is not necessarily either correct or consistent.
Definition of real-literal (value) added. [FR 36]
Equal added, per committee decision (1/91).
Measure removed, per committee decision (1/91).
Note 2 added, per committee decision (1/91).

7.1.12 Complex.
Syntax change, including the relative-error parameter. [IDN]
This required specification of the meaning of relative-error. Most of this was supplied by the editor, and is not necessarily either correct or consistent.
Equal added, per committee decision (1/91).
Measure removed, per committee decision (1/91). [FR 37]
Definition of complex-literal modified to match the style of the others. [Ed.]

7.1.13. Null.
The null-value changed to "nil" [N195, N208].
Equal defined properly. [Ed.]

7.1.14 Undefined. Disposition in doubt - no changes. (change bars resulted from keystroke error).

7.1.15 Private.

7.1.16 Procedure.
Major syntax change with numerous consequences. [IDN]
"functions" changed to "algorithms" and "terminating" relegated to Note 1. [FR 46]
"Equals" changed to "Equal" [Ed.]
Note 2 added, deferring to the CLIPC to define the concept of Apply.

7.2.1 Range.
Major syntax change. [IDN]

7.2.2 Selected renamed Selecting, for symmetry with Excluding. [Ed.]
Syntax generalized, per committee decision (1/91).

7.2.3 Excluding. New. [US]
Syntax and semantics derived from those of Selected. [Ed.]

7.2.4 Extended. former 7.2.3.
Second sentence of the Note removed. In view of Excluding, it was no longer true. [Ed.]

7.2.5 Size subtype. New.
Introduced to conform to the handling of limits in the IDN syntax. Size also meets the requirement for a means of limiting the size of CharacterString and BitString types. [IDN] [FR 55]

7.2.6 Explicit subtypes. former 7.2.4.
Properties corrected. [Ed.]

7.3 Generators.
Reference to the description of operations added. [FR 24]
Syntax changes in the example in Note 3.

7.3.1. Choice.
Rewritten to describe Choice as a "discriminated union", per committee decision (1/91).
Add value denotation. [FR 53]

7.3.2 Record.
Correct "values" to "named values". [FR 49]
Add value denotation. [FR 53]

7.3.3. Pointer.
Null-value added. [US]
"instance" changed to "variable", because the term "instance of a value" is used frequently in the document in its more common mathematical meaning, which is not the meaning here. [Yellin, WG11 N221]

7.3.4. Set.
Limits syntax and semantics moved to "Size" subtype. [IDN]
Complement operation removed and replaced by Difference, to avoid the problem of infinite sets. Committee decision (1/91).
Add value denotation. [FR 53]

7.3.5 List.
Limits syntax and semantics moved to "Size" subtype. [IDN]

Add value denotation. [FR 53]

7.3.6 Bag.
Limits syntax and semantics moved to "Size" subtype. [IDN]
Add value denotation. [FR 53]

7.3.7 Array.
Array generalized to multidimensional. Major syntactic change with numerous side effects. Notes 1,2 replace former Note, explaining the change. Example replaced. [IDN]
Notes 3 and 4 added to defend choices (committee, 1/91).

7.3.8 Table.
Limits syntax and semantics moved to "Size" subtype. [IDN]
Add value denotation. [FR 53]

7.3.9 Declared-generator-types.
Syntax changes and corresponding wording changes. [IDN]

7.4 Declared-datatypes.
Syntax changes and corresponding wording changes. [IDN]

8.1 Datatype-declarations.
Syntax changes and corresponding wording changes. [IDN]

8.2 Generator-declarations.
Syntax changes and corresponding wording changes. [IDN]

8.3 Value-declarations.
Major syntax change and corresponding re-wording. [IDN]

9. Attributes. (formerly "Pragmata").
Rewritten. [IDN] [US]

10. Mappings. no changes.

A.1. Null removed. [US]

A.2. Array added. [US]

B.3. BitString.
Corrected list of operations inherited from List, per Pickett (WG11 N200). [N208] [FR 54]

B.4. CharacterString.
Changed "alphabet" to "repertoire" and in some cases to "character set". [N208] following Sykes (WG11 N196).
Corrected list of operations inherited from List, per Pickett (WG11 N200). Note 3 added to define "concatenate" per committee decision (9/90). [N208] [FR 54]
Definition of InOrder changed and Note 1 revised per committee resolution (9/90) of collating sequence issues raised in N196. [N208]

B.7 Interval (new).
Added after committee discussion of [N196].
The text is supplied by the editor and is tentative.

B.8 Octet (new).
Added to satisfy RPC requirement for the type. [IDN]
The text is supplied by the editor and is tentative.

B.9 OSI-Object-Id (new).
Added by committee decision, to support RPC (1/90).
The text is supplied by the editor and is tentative.

D. Recommended Representation Attributes (formerly "Recommended Pragmata").
Major change in format and terminology. [IDN]
The few substantive changes are identified below.

D.3. Floating-point.
Missing text at end supplied. (Burch, private communication).

D.8. Alignment. Added sync-point "both". [FR 56]

Annex F. Draft Syntax for the IDN. replaces Collected Syntax. [IDN]

Annex G. Issue 20. Paragraph added to reflect committee consensus on "file objects", arising from [FR 22].

C. Disposition of Comments

N208 from WG11: resolution of comments N196, N197, N200, N204.
The document describes the disposition of the comments. All changes indicated in N208 have been made to WD5.

JTC1/SC22 N906, Ballot comments on Proposal to Register CLI Datatypes WD4 as a Committee Draft.

France:

1. The intended model is an "abstract computational model". The recommendation that the model should be defined is accepted. See revisions to 6.4.

2. Accepted.

3. Accepted.

4. accepted.

5. not accepted. The paragraph was rewritten.

6. accepted. ISO directives say that Notes are not normative.

7. rejected. ISO requires Annexes to indicate whether they are normative or informative. The reason for consolidating the "minimum" datatype set in Annex A was to locate it in a single place and avoid placing it in clause 5, to avoid unintentional implications and allow the relationships between Compliance and Annex A to be carefully described. Annexes B and C contain the datatypes which are less "fundamental" than those in Clauses 7 and 8. It is expected that the contents of Annexes B and C may change considerably over drafts of this standard and future addenda, while it is hoped that Clauses 7 and 8 will remain largely unchanged.

8. accepted.

9. accepted.

10. accepted, references to "generic datatype" have been removed, and "generic mapping" is now explained in the Note which contains its only occurrence.

11. accepted in principle. The rationale for value notations is now given in clause 7. Value notations for all datatypes but Private, Procedure, and Pointer are given.

12. not accepted. The unnecessary phrase was struck.

13. accepted.

14. agreed. Informative annexes to be provided before further circulation of this document, although not in WD5.

15. No consensus. This is Outstanding Issue 7.

16. It is expected that datatype definitions will occur in at least the following places:
    a. the CLID Annexes
    b. standards containing the outward mappings of programming languages
    c. standards defining service interfaces
    d. the CLI Procedure Calling and Remote Procedure Calling standards
    e. users using the Interface Definition Notation for the CLIPC/RPC.
    f. other user applications

In all of cases a-d, the reference to a STANDARD ensures common understanding of the name and meaning of the defined-datatype. In case e, it is expected that all users of the same procedure interface will share a common IDN description - a kind of "local standard" ensuring common understanding. In case f, if the application is private to a particular user, it is not necessary for it to be shared, and if it is not private, then one of the means a-e should be sought.

The committee recognizes that, over time, multiple definitions of a common datatype will occur in cases b and c. This would certainly be grounds for modifying Annexes B and C of the CLID itself. On the other hand, definitions of different datatypes with the same name can be expected in cases b, c and e as well. This is unfortunate and cannot be avoided in the general case, but it does not affect the interchange of datatypes, except when conflicting standards are used in the same application. A work-around for this should be provided in the CLIPC/RPC, but in general, this situation is probably grounds for a defect report for the standards in question.

17. no consensus. The functionality of outward mappings and the contents of Annex A are still unresolved. The committee agreed that programming languages should not be required to support any particular CLI datatypes for the purpose of identifying the datatype semantics of the language, and thus the "outward mapping of COBOL" should not be required to contain Boolean. But to the extent that mappings play a part in the definition of procedure interfaces, it is necessary to have a minimum list, in order to achieve the greatest possible commonality among language datatypes, especially where they may be used to define the interfaces to standard services. In essence, the minimum list may become the maximum list from which argument datatypes for standard procedures may be chosen. In this sense, it can be argued that COBOL must provide a datatype which can be mapped into Boolean for standard procedure calls. Alternatively, it can be argued that Boolean should not be a member of the minimum list, implying that it should be avoided in defining interfaces to ISO standard procedures. See Outstanding Issues 2 and 8.

18. rejected. The word "value" is, in English at least, commonly used in both mathematical and computational discourse to have exactly the sense in which it is used in the CLID. It may be that the proper French equivalent is not obvious, and this then is an important matter for translation of the eventual standard. The word "element" implies a set or structure, which is inappropriate. The word "object" is more general than intended, and therefore less acceptable - it was proposed and discarded in discussing Brown's commentary on WD3 (WG11 N172, N191).

19. accepted in principle. The rationale for character 'ng operations is now in 6.6.

20. not clear what is wanted. The term "equivalence" was changed to "equality" in WD5 and certain related editorial changes were made.

21. accepted. The Note and the definition of dense have been considerably revised in WD5.

22. rejected. This point is addressed in Resolved Issue 20.

23. accepted.

24. accepted.

25. accepted. The production was in 8.3.

26. rejected. The production is on page 40.

27. accepted in principle. Equal is now defined for every datatype.

28. accepted.

29. There is a difference in the characterizing operations. Note, however, that this is a part of Outstanding Issue 1.

30. accepted in principle. Several changes made to 7.1.6.

31. accepted.

32. Yes, but that is deprecated. See 7.1.10 Note 1.

33. Yes, and that is preferred. See 7.1.10 Note 1.

34. Unresolved. The value notation problem is part of Issue 9.

35. Accepted. The Note has been reworded.

36. Unresolved. This is a part of Outstanding Issue 10.

37. Measure has been removed. "Dense" has been redefined.

38. Accepted. Reworded.

39. No consensus. Outstanding Issue 6.

40. Rejected. Resolved Issue 10. (But see outstanding issue 6.)

41. a. Pointer can be Null. Accepted.
    b. Is Pointer primitive? Unresolved. Outstanding issue 11.

42-45. No consensus. Outstanding Issue 6.

46. accepted.

47. No, but Choice has been considerably revised.

48. accepted. Is the new text satisfactory?

49. accepted.

50. Yes.

51. Unresolved. See Outstanding Issue 11.

52. rejected. Sele[illegible]s a necessary characterizing operation corresponding to t[illegible]tion of Choice. In practice Sets are ordered

by some implementation-dependent algorithm and some form of Select is a supported operation.

53. accepted. Value notations are now provided for everything but Private, Pointer and Procedure.

54. accepted.

55. not accepted. Resolved by limits subtype from IDN.

56. accepted.

57. accepted.

58. agreed, but it is not available at this time.

59. agreed, an informative annex containing one mapping will be provided.

60. agreed, see response to 59.

United States:

With regard to the U.S. principal objection, the committee agrees that the outstanding issues must be resolved before this document can be processed BEYOND the Committee Draft stage. Nevertheless, it is the consensus of the committee that the document does include all main elements in the scope of the work item, and is presented in a form which is that envisaged for the eventual International Standard, and that therefore this document is suitable for registration as a CD. The outstanding issues which might have significantly affected the scope of the document, namely the inclusion of mappings and pragmata, have been resolved to the satisfaction of the U.S. delegation.

Specific bulleted comments:

1. Add Array to A.2. accepted.

2. Remove Null. No consensus. This is outstanding issue 6.

3. Remove Null from A.1. accepted.

4. Keep mappings. accepted.

5a. Annotation mechanism. accepted.
b. Module concept. Not accepted. This is an IDN problem which goes beyond the scope and needs of the CLID itself. There is agreement that the CLID syntax will be compatible with that of the IDN.

6. Null value of Pointer. accepted.

7. Add "exclude" subtype. accepted.

8. change 3.32. accepted.

9. add definitions.
data interchange format. rejected. Does not appear in the draft.
datatype identifier. rejected. Does not appear in the draft.