

# ISO/IEC 23415:2024-04 (E)

## Information technology - Data Format Description Language (DFDL) v1.0 Specification

---

Contents	Page
1 Introduction.....	9
1.1 Why is DFDL Needed? .....	10
1.2 What is DFDL?.....	10
1.2.1 Simple Example.....	10
1.3 What DFDL is not.....	13
1.4 Scope of version 1.0 .....	13
2 Overview of the Specification.....	15
3 Notational and Definitional Conventions .....	16
3.1 Glossary and Terminology .....	16
3.2 Failure Types .....	16
4 The DFDL Information Set (InfoSet).....	17
4.1 "No Value".....	18
4.2 Information Items .....	18
4.2.1 Document Information Item .....	18
4.2.2 Element Information Items.....	18
4.3 DFDL Information Item Order .....	19
4.4 DFDL Augmented InfoSet .....	19
5 DFDL Schema Component Model .....	20
5.1 DFDL Simple Types.....	20
5.2 DFDL Subset of XML Schema.....	21
5.3 XSD Facets, min/maxOccurs, default, and fixed .....	22
5.3.1 MinOccurs, MaxOccurs .....	23
5.3.2 MinLength, MaxLength .....	23
5.3.3 MaxInclusive, MaxExclusive, MinExclusive, MinInclusive, TotalDigits, FractionDigits.....	23
5.3.4 Pattern .....	23
5.3.5 Enumeration Values .....	23
5.3.6 Default.....	23
5.3.7 Fixed .....	24
5.4 Compatibility with Other Annotation Language Schemas .....	24
6 DFDL Syntax Basics .....	25
6.1 Namespaces .....	25
6.2 The DFDL Annotation Elements .....	25
6.3 DFDL Properties .....	26
6.3.1 DFDL String Literals .....	28
6.3.2 DFDL Expressions.....	32
6.3.3 DFDL Regular Expressions .....	32
6.3.4 Enumerations in DFDL .....	32
7 Syntax of DFDL Annotation Elements.....	33
7.1 Component Format Annotations.....	33
7.1.1 Property Binding Syntax .....	34
7.1.2 Empty String as a Representation Property Value.....	35
7.2 dfdl:defineFormat - Reusable Data Format Definitions.....	36

7.2.1	Using/Referencing a Named Format Definition: The dfdl:ref Property .....	36
7.2.2	Inheritance for dfdl:defineFormat.....	36
7.3	The dfdl:defineEscapeScheme Defining Annotation Element.....	37
7.3.1	Using/Referencing a Named escapeScheme Definition .....	37
7.4	The dfdl:escapeScheme Annotation Element.....	37
7.5	The dfdl:assert Statement Annotation Element.....	38
7.5.1	Properties for dfdl:assert .....	38
7.6	The dfdl:discriminator Statement Annotation Element.....	40
7.6.1	Properties for dfdl:discriminator .....	40
7.7	DFDL Variable Annotations.....	43
7.7.1	dfdl:defineVariable Annotation Element.....	43
7.7.2	The dfdl:newVariableInstance Statement Annotation Element.....	44
7.7.3	The dfdl:setVariable Statement Annotation Element.....	45
8	Property Scoping and DFDL Schema Checking .....	47
8.1	Property Scoping.....	47
8.1.1	Property Scoping Rules .....	47
8.1.2	Providing Defaults for DFDL properties .....	47
8.1.3	Combining DFDL Representation Properties from a dfdl:defineFormat.....	48
8.1.4	Combining DFDL Properties from References .....	48
8.2	DFDL Schema Checking.....	51
8.2.1	Schema Component Constraint: Unique Particle Attribution.....	51
8.2.2	Optional Checks and Warnings .....	51
9	DFDL Processing Introduction.....	53
9.1	Parser Overview .....	53
9.1.1	Points of Uncertainty .....	53
9.1.2	Processing Error .....	54
9.1.3	Recoverable Error .....	54
9.2	DFDL Data Syntax Grammar .....	54
9.2.1	Nil Representation.....	56
9.2.2	Empty Representation.....	56
9.2.3	Normal Representation .....	57
9.2.4	Absent Representation.....	57
9.2.5	Zero-length Representation .....	57
9.2.6	Missing .....	57
9.2.7	Examples of Missing and Empty Representation .....	58
9.2.8	Round Trip Ambiguities.....	58
9.3	Parsing Algorithm .....	58
9.3.1	Known-to-exist and Known-not-to-exist .....	59
9.3.2	Establishing Representation .....	60
9.3.3	Resolving Points of Uncertainty .....	61
9.4	Element Defaults .....	62
9.4.1	Definitions.....	62
9.4.2	Element Defaults When Parsing .....	62
9.4.3	Element Defaults When Unparsing.....	64
9.5	Evaluation Order for Statement Annotations.....	65
9.5.1	Asserts and Discriminators with testKind 'expression' .....	66
9.5.2	Discriminators with testKind 'expression' .....	66
9.5.3	Elements and setVariable .....	66
9.5.4	Controlling the Order of Statement Evaluation .....	66
9.6	Validation.....	66
9.7	Unparser Infoset Augmentation Algorithm .....	67
10	Overview: Representation Properties and their Format Semantics .....	68

11	Properties Common to both Content and Framing .....	69
11.1	Unicode Byte Order Mark (BOM).....	71
11.2	Character Encoding and Decoding Errors .....	71
11.2.1	Property dfdl:encodingErrorPolicy .....	72
11.2.2	Unicode UTF-16 Decoding/Encoding Non-Errors .....	73
11.2.3	Preserving Data Containing Decoding Errors.....	73
11.3	Byte Order and Bit Order .....	73
11.4	dfdl:bitOrder Example .....	73
11.4.1	Example Using Right-to-Left Display for 'leastSignificantBitFirst'.....	74
11.4.2	dfdl:bitOrder and Grammar Regions .....	74
12	Framing .....	75
12.1	Aligned Data.....	75
12.1.1	Implicit Alignment.....	76
12.1.2	Mandatory Alignment for Textual Data .....	76
12.1.3	Mandatory Alignment for Packed Decimal Data.....	77
12.1.4	Example: AlignmentFill .....	77
12.2	Properties for Specifying Delimiters.....	78
12.3	Properties for Specifying Lengths .....	81
12.3.1	dfdl:lengthKind 'explicit'.....	82
12.3.2	dfdl:lengthKind 'delimited' .....	82
12.3.3	dfdl:lengthKind 'implicit'.....	83
12.3.4	dfdl:lengthKind 'prefixed'.....	84
12.3.5	dfdl:lengthKind 'pattern' .....	87
12.3.6	dfdl:lengthKind 'endOfParent' .....	87
12.3.7	Elements of Specified Length .....	89
13	Simple Types.....	92
13.1	Properties Common to All Simple Types .....	92
13.2	Properties Common to All Simple Types with Text representation .....	93
13.2.1	The dfdl:escapeScheme Properties .....	94
13.3	Properties for Bidirectional support for All Simple Types with Text representation.....	97
13.4	Properties Specific to String.....	97
13.5	Properties Specific to Number with Text or Binary Representation.....	99
13.6	Properties Specific to Number with Text Representation .....	99
13.6.1	The dfdl:textNumberPattern Property .....	106
13.6.2	Converting logical numbers to/from text representation .....	110
13.7	Properties Specific to Number with Binary Representation.....	112
13.7.1	Converting Logical Numbers to/from Binary Representation .....	113
13.8	Properties Specific to Float/Double with Binary Representation .....	118
13.9	Properties Specific to Boolean with Text Representation.....	118
13.10	Properties Specific to Boolean with Binary Representation .....	119
13.11	Properties Specific to Calendar with Text or Binary Representation.....	120
13.11.1	The dfdl:calendarPattern property .....	122
13.11.2	The dfdl:calendarCheckPolicy Property .....	125
13.12	Properties Specific to Calendar with Text Representation .....	125
13.13	Properties Specific to Calendar with Binary Representation .....	126
13.14	Properties Specific to Opaque Types (xs:hexBinary).....	127
13.15	Nil Value Processing.....	127
13.16	Properties for Nillable Elements.....	127

14	Sequence Groups.....	131
14.1	Empty Sequences .....	131
14.2	Sequence Groups with Separators .....	132
14.2.1	Separators and Suppression.....	133
14.2.2	Parsing Sequence Groups with Separators.....	134
14.2.3	Unparsing Sequence Groups with Separators .....	136
14.3	Unordered Sequence Groups .....	138
14.3.1	Restrictions for Unordered Sequences .....	138
14.3.2	Parsing an Unordered Sequence.....	138
14.3.3	Unparsing an Unordered Sequence .....	140
14.4	Floating Elements.....	140
14.5	Hidden Groups .....	141
15	Choice Groups.....	143
15.1	Resolving Choices.....	144
15.1.1	Resolving Choices via Speculation.....	144
15.1.2	Resolving Choices via Direct Dispatch .....	145
15.1.3	Unparsing Choices.....	145
16	Properties for Array Elements and Optional Elements.....	146
16.1	The dfdl:occursCountKind property.....	146
16.1.1	dfdl:occursCountKind 'fixed' .....	146
16.1.2	dfdl:occursCountKind 'implicit'.....	147
16.1.3	dfdl:occursCountKind 'parsed'.....	147
16.1.4	dfdl:occursCountKind 'expression'.....	147
16.1.5	dfdl:occursCountKind 'stopValue' .....	147
16.2	Default Values for Arrays .....	148
16.3	Arrays with DFDL Expressions.....	148
16.4	Points of Uncertainty .....	148
16.5	Arrays and Sequences.....	148
16.6	Forward Progress Requirement .....	148
16.7	Parsing Occurrences with Non-Normal Representation .....	149
16.8	Sparse Arrays.....	149
17	Calculated Value Properties .....	150
17.1	Example: 2d Nested Array .....	151
17.2	Example: Three-Byte Date .....	151
18	DFDL Expression Language .....	154
18.1	Expression Language Data Model .....	154
18.2	Variables.....	155
18.2.1	Rewinding of Variable Memory State.....	155
18.2.2	Variable Memory State Transitions.....	155
18.3	General Syntax.....	156
18.4	DFDL Expression Syntax .....	157
18.5	Constructors, Functions and Operators .....	158
18.5.1	Constructor Functions for XML Schema Built-in Types .....	158
18.5.2	Standard XPath Functions .....	159
18.5.3	DFDL Functions .....	162
18.5.4	DFDL Constructor Functions.....	164
18.5.5	Miscellaneous Functions.....	165
18.6	Unparsing and Circular Expression Deadlock Errors.....	166

19	DFDL Regular Expressions.....	167
20	External Control of the DFDL Processor.....	168
21	Built-in Specifications .....	169
22	Conformance.....	170
23	Optional DFDL Features .....	171
24	Security Considerations .....	173
25	Authors and Contributors .....	174
26	Intellectual Property Statement.....	175
27	Disclaimer.....	176
28	Full Copyright Notice.....	177
29	References.....	178
30	Appendix A: Escape Scheme Use Cases.....	181
30.1	Escape Character Same as dfdl:escapeEscapeCharacter .....	181
30.2	Escape Character Different from dfdl:escapeEscapeCharacter.....	181
30.2.1	Example 1 - Separator ';'.....	181
30.2.2	Example 2 - Separator 'sep'.....	182
30.3	Escape Block with Different Start and End Characters .....	182
30.4	Escape Block with Same Start and End Characters.....	183
31	Appendix B: Rationale for Single-Assignment Variables .....	185
32	Appendix C: Processing of DFDL String literals .....	186
32.1	Interpreting a DFDL String Literal .....	186
32.2	Recognizing a DFDL String Literal.....	186
32.3	Recognizing DFDL String Literal Part.....	186
33	Appendix D: DFDL Standard Encodings.....	188
33.1	Purpose.....	188
33.2	Conventions .....	188
33.3	Specification Template.....	188
33.4	Encoding X-DFDL-US-ASCII-7-BIT-PACKED .....	188
33.4.1	Name .....	188
33.4.2	Translation table .....	188
33.4.3	Width.....	188
33.4.4	Alignment.....	189
33.4.5	Byte Order.....	189
33.4.6	Example 1.....	189
33.4.7	Example 2.....	189
33.5	Encoding X-DFDL-US-ASCII-6-BIT-PACKED .....	191
33.5.1	Name .....	191
33.5.2	Translation Table .....	191
33.5.3	Width.....	192
33.5.4	Alignment.....	192
33.5.5	ByteOrder.....	192
33.5.6	Example 1.....	192
33.6	References for Appendix D.....	193
34	Appendix E: Glossary of Terms .....	194
35	Appendix F: Specific Errors Classified .....	200
36	Appendix G: Property Precedence.....	202
36.1	Parsing .....	202
36.1.1	dfdl:element (simple) and dfdl:simpleType .....	202

36.1.2	dfdl:element (complex).....	205
36.1.3	dfdl:sequence and dfdl:group (when reference is to a sequence).....	206
36.1.4	dfdl:choice and dfdl:group (when reference is to a choice) .....	207
36.2	Unparsing .....	208
36.2.1	dfdl:element (simple) and dfdl:simpleType .....	208
36.2.2	dfdl:element (complex).....	212
36.2.3	dfdl:sequence and dfdl:group (when reference is a sequence).....	213
36.2.4	dfdl:choice and dfdl:group (when reference is a choice) .....	213