

ISO/IEC 17826:2016-07 (E)

Information technology - Cloud Data Management Interface (CDMI)

Contents	Page
SECTION 1 - CDMI Preamble	1
Introduction	2
1 Scope	4
2 Normative references	4
3 Terms, acronyms, and definitions	6
4 Conventions	10
4.1 Interface format	10
4.2 Typographical conventions	10
4.3 Request and response body requirements	11
4.4 Key word requirements	11
5 Overview of cloud storage	13
5.1 Introduction	13
5.2 What is cloud storage?	13
5.3 Data storage as a Service	13
5.4 Data management for cloud storage	15
5.5 Data and container management	16
5.6 Reference model for cloud storage interfaces	16
5.7 Cloud Data Management Interface	17
5.8 Object model for CDMI	18
5.9 CDMI metadata	19
5.10 Object ID	20
5.11 CDMI object ID format	20
5.12 Security	21
5.12.1 Security objectives	21
5.12.2 HTTP security	22
5.12.3 Client authentication	22
5.12.4 Use of TLS and HTTP	23
5.12.5 Further information	23
5.13 Required HTTP support	23
5.13.1 RFC 2616 support requirements	23
5.13.2 Content-type negotiation	23
5.13.3 Range support	23
5.13.4 URI escaping	24
5.13.5 Use of URLs	24
5.13.6 Reserved characters	25
5.14 Time representations	25
5.15 Backwards compatibility	25
5.15.1 Value transfer encoding	25
5.15.2 Container export capabilities	26
5.16 Object references	26
SECTION 2 - Basic Cloud Storage	28
6 Data object resource operations using HTTP	29
6.1 Overview	29
6.2 Create a data object using HTTP	29
6.2.1 Synopsis	29

6.2.2	Capabilities	29
6.2.3	Request headers	30
6.2.4	Request message body	30
6.2.5	Response headers	30
6.2.6	Response message body	30
6.2.7	Response status	30
6.2.8	Example	31
6.3	Read a data object using HTTP	31
6.3.1	Synopsis	31
6.3.2	Capabilities	31
6.3.3	Request header	31
6.3.4	Request message body	31
6.3.5	Response headers	32
6.3.6	Response message body	32
6.3.7	Response status	32
6.3.8	Examples	32
6.4	Update a data object using HTTP	33
6.4.1	Synopsis	33
6.4.2	Capabilities	33
6.4.3	Request headers	33
6.4.4	Request message body	34
6.4.5	Response header	34
6.4.6	Response message body	34
6.4.7	Response status	34
6.4.8	Examples	34
6.5	Delete a data object using HTTP	35
6.5.1	Synopsis	35
6.5.2	Capability	35
6.5.3	Request headers	35
6.5.4	Request message body	35
6.5.5	Response headers	35
6.5.6	Response message body	35
6.5.7	Response status	36
6.5.8	Example	36
7	Container object resource operations using HTTP	37
7.1	Overview	37
7.2	Create a container object using HTTP	37
7.2.1	Synopsis	37
7.2.2	Capability	37
7.2.3	Request headers	38
7.2.4	Request message body	38
7.2.5	Response headers	38
7.2.6	Response message body	38
7.2.7	Response status	38
7.2.8	Example	38
7.3	Read a container object using HTTP	38
7.4	Update a container object using HTTP	38
7.5	Delete a container object using HTTP	39
7.5.1	Synopsis	39
7.5.2	Capability	39
7.5.3	Request headers	39
7.5.4	Request message body	39
7.5.5	Response headers	39
7.5.6	Response message body	39
7.5.7	Response status	40
7.5.8	Example	40
7.6	Create (POST) a new data object using HTTP	40

7.6.1	Synopsis	40
7.6.2	Capabilities	41
7.6.3	Request headers	41
7.6.4	Request message body	41
7.6.5	Response header	41
7.6.6	Response message body	42
7.6.7	Response status	42
7.6.8	Examples	42
SECTION 3 - CDMI Core	43	
8	Data object resource operations using CDMI	44
8.1	Overview	44
8.1.1	Data object metadata	45
8.1.2	Data object consistency	45
8.1.3	Data object representations	46
8.2	Create a data object using CDMI	46
8.2.1	Synopsis	46
8.2.2	Delayed completion of create	46
8.2.3	Capabilities	47
8.2.4	Request headers	47
8.2.5	Request message body	48
8.2.6	Response headers	51
8.2.7	Response message body	51
8.2.8	Response status	52
8.2.9	Examples	52
8.3	Read a data object using CDMI	55
8.3.1	Synopsis	55
8.3.2	Capabilities	55
8.3.3	Request headers	56
8.3.4	Request message body	56
8.3.5	Response headers	56
8.3.6	Response message body	57
8.3.7	Response status	59
8.3.8	Examples	59
8.4	Update a data object using CDMI	62
8.4.1	Synopsis	62
8.4.2	Capabilities	63
8.4.3	Request headers	63
8.4.4	Request message body	64
8.4.5	Response header	67
8.4.6	Response message body	67
8.4.7	Response status	67
8.4.8	Examples	67
8.5	Delete a data object using CDMI	71
8.5.1	Synopsis	71
8.5.2	Capability	71
8.5.3	Request header	71
8.5.4	Request message body	71
8.5.5	Response headers	71
8.5.6	Response message body	71
8.5.7	Response status	72
8.5.8	Example	72
9	Container object resource operations using CDMI	73
9.1	Overview	73

9.1.1	Container metadata	74
9.1.2	Reserved container names	74
9.1.3	Container object addressing	74
9.1.4	Container object representations	75
9.2	Create a container object using CDMI	75
9.2.1	Synopsis	75
9.2.2	Delayed completion of create	75
9.2.3	Capabilities	76
9.2.4	Request headers	76
9.2.5	Request message body	77
9.2.6	Response headers	79
9.2.7	Response message body	79
9.2.8	Response status	81
9.2.9	Examples	81
9.3	Read a container object using CDMI	83
9.3.1	Synopsis	83
9.3.2	Capabilities	83
9.3.3	Request headers	84
9.3.4	Request message body	84
9.3.5	Response headers	84
9.3.6	Response message body	84
9.3.7	Response status	86
9.3.8	Examples	86
9.4	Update a container object using CDMI	88
9.4.1	Synopsis	88
9.4.2	Delayed completion of snapshot	88
9.4.3	Capabilities	89
9.4.4	Request headers	89
9.4.5	Request message body	90
9.4.6	Response header	92
9.4.7	Response message body	92
9.4.8	Response status	92
9.4.9	Examples	92
9.5	Delete a container object using CDMI	93
9.5.1	Synopsis	93
9.5.2	Capability	93
9.5.3	Request header	94
9.5.4	Request message body	94
9.5.5	Response headers	94
9.5.6	Response message body	94
9.5.7	Response status	94
9.5.8	Example	94
9.6	Create (POST) a new data object using CDMI	95
9.6.1	Synopsis	95
9.6.2	Delayed completion of create	95
9.6.3	Capabilities	96
9.6.4	Request headers	97
9.6.5	Request message body	98
9.6.6	Response headers	101
9.6.7	Response message body	101
9.6.8	Response status	102
9.6.9	Examples	103
9.7	Create (POST) a new queue object using CDMI	105
9.7.1	Synopsis	105
9.7.2	Delayed completion of create	105
9.7.3	Capabilities	106
9.7.4	Request headers	107
9.7.5	Request message body	107

9.7.6	Response headers	108
9.7.7	Response message body	108
9.7.8	Response status	110
9.7.9	Example	110
SECTION 4 - CDMI Advanced		112
10 Domain object resource operations using CDMI		113
10.1	Overview	113
10.1.1	Domain object metadata	114
10.1.2	Domain object summaries	114
10.1.3	Domain object membership	117
10.1.4	Domain usage in access control	119
10.1.5	Domain object representations	120
10.2	Create a domain object using CDMI	120
10.2.1	Synopsis	120
10.2.2	Capabilities	120
10.2.3	Request headers	120
10.2.4	Request message body	121
10.2.5	Response headers	122
10.2.6	Response message body	122
10.2.7	Response status	123
10.2.8	Example	123
10.3	Read a domain object using CDMI	124
10.3.1	Synopsis	124
10.3.2	Capabilities	124
10.3.3	Request headers	124
10.3.4	Request message body	124
10.3.5	Response headers	125
10.3.6	Response message body	125
10.3.7	Response status	126
10.3.8	Examples	126
10.4	Update a domain object using CDMI	127
10.4.1	Synopsis	127
10.4.2	Capability	128
10.4.3	Request headers	128
10.4.4	Request message body	128
10.4.5	Response header	129
10.4.6	Response message body	129
10.4.7	Response status	130
10.4.8	Example	130
10.5	Delete a domain object using CDMI	130
10.5.1	Synopsis	130
10.5.2	Capability	131
10.5.3	Request header	131
10.5.4	Request message body	131
10.5.5	Response headers	131
10.5.6	Response message body	131
10.5.7	Response status	131
10.5.8	Example	132
11 Queue object resource operations using CDMI		133
11.1	Overview	133
11.1.1	Queue object metadata	134
11.1.2	Queue object addressing	134
11.1.3	Queue object representations	134

11.2 Create a queue object using CDMI	134
11.2.1 Synopsis	134
11.2.2 Delayed completion of create	135
11.2.3 Capabilities	135
11.2.4 Request headers	136
11.2.5 Request message body	136
11.2.6 Response headers	138
11.2.7 Response message body	138
11.2.8 Response status	139
11.2.9 Examples	140
11.3 Read a queue object using CDMI	141
11.3.1 Synopsis	141
11.3.2 Capabilities	141
11.3.3 Request headers	142
11.3.4 Request message body	142
11.3.5 Response headers	142
11.3.6 Response message body	142
11.3.7 Response status	145
11.3.8 Examples	145
11.4 Update a queue object using CDMI	148
11.4.1 Synopsis	148
11.4.2 Capability	148
11.4.3 Request headers	148
11.4.4 Request message body	149
11.4.5 Response header	150
11.4.6 Response message body	150
11.4.7 Response status	150
11.4.8 Examples	150
11.5 Delete a queue object using CDMI	151
11.5.1 Synopsis	151
11.5.2 Capability	151
11.5.3 Request header	151
11.5.4 Request message body	152
11.5.5 Response headers	152
11.5.6 Response message body	152
11.5.7 Response status	152
11.5.8 Example	152
11.6 Enqueue a new queue value using CDMI	152
11.6.1 Synopsis	152
11.6.2 Capabilities	153
11.6.3 Request headers	153
11.6.4 Request message body	153
11.6.5 Response headers	155
11.6.6 Response message body	155
11.6.7 Response status	156
11.6.8 Examples	156
11.7 Delete a queue object value using CDMI	159
11.7.1 Synopsis	159
11.7.2 Capability	159
11.7.3 Request header	159
11.7.4 Request message body	159
11.7.5 Response headers	160
11.7.6 Response message body	160
11.7.7 Response status	160
11.7.8 Examples	160
Capability object resource operations using CDMI	161
12.1 Overview	161

12.1.1	Cloud storage system-wide capabilities	162
12.1.2	Storage system metadata capabilities	165
12.1.3	Data system metadata capabilities	165
12.1.4	Data object capabilities	168
12.1.5	Container capabilities	169
12.1.6	Domain object capabilities	171
12.1.7	Queue object capabilities	172
12.1.8	Capability object representations	172
12.2	Read a capabilities object using CDMI	173
12.2.1	Synopsis	173
12.2.2	Capability	173
12.2.3	Request headers	173
12.2.4	Request message body	173
12.2.5	Response headers	174
12.2.6	Response message body	174
12.2.7	Response status	175
12.2.8	Examples	175
13	Exported protocols	177
13.1	Overview	177
13.2	Exported protocol structure	178
13.2.1	Mapping names from CDMI to another protocol	179
13.2.1.1	Capabilities	179
13.2.1.2	Domains	179
13.2.1.3	Caching	179
13.2.1.4	Groups	180
13.2.1.5	Synopsis	180
13.2.2	Administrative users	181
13.2.3	User and groupname mapping syntax and evaluation rules	182
13.3	Discovering and mounting containers via foreign protocols	183
13.4	NFS exported protocol	184
13.5	CIFS exported protocol	186
13.6	OCCI exported protocol	187
13.7	iSCSI export modifications	187
13.7.1	Read container	187
13.7.2	Create and update containers	188
13.7.3	Modify an export	188
13.8	WebDAV exported protocol	188
14	CDMI snapshots	190
15	Serialization/deserialization	191
15.1	Overview	191
15.2	Exporting serialized data	191
15.3	Importing serialized data	191
15.3.1	Canonical format	192
15.3.2	Example JSON canonical serialized format	192
16	Metadata	194
16.1	Access control	194
16.1.1	ACL and ACE structure	194
16.1.2	ACE types	194
16.1.3	ACE who	194
16.1.4	ACE flags	195
16.1.5	ACE bit masks	196
16.1.6	ACL evaluation	198
16.1.7	Example ACE mask expressions	200
16.1.8	Canonical format for ACE hexadecimal quantities	201

16.1.9	JSON format for ACLs	201
16.2	Support for user metadata	202
16.3	Support for storage system metadata	202
16.4	Support for data system metadata	204
16.5	Support for provided data system metadata	210
16.6	Metadata update operations	211
17	Retention and hold management	212
17.1	Introduction	212
17.2	Retention management disciplines	212
17.3	CDMI retention	212
17.3.1	Overview	212
17.3.2	Examples	213
17.4	CDMI hold	214
17.4.1	Overview	214
17.4.2	Examples	216
17.5	CDMI auto-deletion	217
17.6	Retention security considerations	217
18	Scope specification	219
18.1	Introduction	219
18.2	Examples	219
18.3	Query matching expressions	221
19	Results specification	226
19.1	Introduction	226
19.2	Examples	226
20	Logging	228
20.1	Overview	228
20.2	Object logging	228
20.3	Security logging	228
20.4	Data management logging	229
20.5	Logging queues	229
20.6	Logging security considerations	231
21	Notification queues	232
21.1	Overview	232
21.2	Required metadata	232
21.3	System-created metadata	235
22	Query queues	236
22.1	Overview	236
22.2	Required metadata	236
22.3	System-created metadata	237
22.4	Extending CDMI query	238

SECTION 5 - CDMI Annexes **239**

Annex A		
(informative)		
Extensions	240	
A.1	Overview	240
A.2	Summary metadata for bandwidth	240
A.2.1	Overview	240

A.2.2 Changes to CDMI 1.1	240
A.3 Expiring Access Control Entries (ACEs)	242
A.3.1 Overview	242
A.3.2 Changes to CDMI 1.1	242
A.4 Group storage system metadata	243
A.4.1 Overview	243
A.4.2 Changes to CDMI 1.1	243
A.5 Versioning	244
A.5.1 Overview	244
A.5.2 Changes to CDMI 1.1	244
Bibliography	259

Bibliography	264
---------------------------	------------

Figures

Figure 1 – Existing data storage interface standards	14
Figure 2 – Storage interfaces for object storage client data	15
Figure 3 – Cloud storage reference model	16
Figure 4 – CDMI object model	18
Figure 5 – Object transitions between named and ID-only	19
Figure 6 – Object ID format	20
Figure 7 – Hierarchy of capabilities	161
Figure 8 – CDMI and OCCI in an integrated cloud computing environment	177
Figure 9 – Snapshot container structure	190
Figure 10 – Object retention	213
Figure 11 – Object hold	215
Figure 12 – Object hold on object with retention	215
Figure 13 – Object with multiple holds	215
Figure 14 – Updates to a non-version-enabled data object	249
Figure 15 – Updates to a version-enabled data object	250
Figure 16 – Linkages between a version-enabled data object and data object versions	251
Figure 17 – Overlapping concurrent updates	252
Figure 18 – Linkages for overlapping updates	252
Figure 19 – Nested concurrent updates	253
Figure 20 – Linkages for nested updates	253
Figure 21 – Version to capabilityURI relationships	254

Tables

Table 1 – Interface format	10
Table 2 – Key word requirements	11
Table 3 – Types of resources in the model	18
Table 4 – Creation/consumption of storage system metadata	19
Table 5 – Relative URIs resolved against root URIs	24
Table 6 – Request headers - Create a data object using HTTP	30
Table 7 – HTTP status codes - Create a data object using HTTP	30
Table 8 – Request header - Read a data object using HTTP	31
Table 9 – Response headers - Read a data object using HTTP	32
Table 10 – HTTP status codes - Read a data object using HTTP	32
Table 11 – Request headers - Update a data object using HTTP	33
Table 12 – Response header - Update a data object using HTTP	34
Table 13 – HTTP status codes - Update a data object using HTTP	34
Table 14 – HTTP status codes - Delete a data object using HTTP	36
Table 15 – HTTP status codes - Create a container object using HTTP	38
Table 16 – HTTP status codes - Delete a container object using HTTP	40
Table 17 – Request headers - Create a new data object using HTTP	41
Table 18 – Response header - Create a new data object using HTTP	41
Table 19 – HTTP status codes - Create a new data object using HTTP	42
Table 20 – Request headers for creating a data object using CDMI	47
Table 21 – Request message body - Create a data object using CDMI	48
Table 22 – Response headers - Create a data object using CDMI	51
Table 23 – Response message body - Create a data object using CDMI	51
Table 24 – HTTP status codes - Create a data object using CDMI	52
Table 25 – Request headers - Read a data object using CDMI	56
Table 26 – Response headers - Read a data object using CDMI	56
Table 27 – Response message body - Read a data object using CDMI	57
Table 28 – HTTP status codes - Read a data object using CDMI	59
Table 29 – Request headers - Update a data object using CDMI	63
Table 30 – Request message body - Update a data object using CDMI	64
Table 31 – Response header - Update a data object using CDMI	67
Table 32 – HTTP status codes - Update a data object using CDMI	67
Table 33 – Request header - Delete a data object using CDMI	71
Table 34 – HTTP status codes - Delete a data object using CDMI	72
Table 35 – Container metadata	74
Table 36 – Request headers - Create a container object using CDMI	76
Table 37 – Request message body - Create a container object using CDMI	77
Table 38 – Response headers - Create a container object using CDMI	79
Table 39 – Response message body - Create a container object using CDMI	79
Table 40 – HTTP status codes - Create a container object using CDMI	81
Table 41 – Request headers - Read a container object using CDMI	84
Table 42 – Response headers - Read a container object using CDMI	84
Table 43 – Response message body - Read a container object using CDMI	84
Table 44 – HTTP status codes - Read a container object using CDMI	86
Table 45 – Request headers - Update a container object using CDMI	89
Table 46 – Request message body - Update a container object using CDMI	90
Table 47 – Response header - Update a container object using CDMI	92
Table 48 – HTTP status codes - Update a container object using CDMI	92
Table 49 – Request header - Delete a container object using CDMI	94
Table 50 – HTTP status codes - Delete a container object using CDMI	94
Table 51 – Request headers - Create a new data object using CDMI	97
Table 52 – Request message body - Create a new data object using CDMI	98
Table 53 – Response headers - Create a new data object using CDMI	101
Table 54 – Response message body - Create a new data object using CDMI	101
Table 55 – HTTP status codes - Create a new data object using CDMI	102
Table 56 – Request headers - Create a new queue object using CDMI	107

Table 57 – Request message body - Create a new queue object using CDMI	107
Table 58 – Response headers - Create a new queue object using CDMI	108
Table 59 – Response message body - Create a new queue object using CDMI	108
Table 60 – HTTP status codes - Create a new queue object using CDMI	110
Table 61 – Required metadata for a domain object	114
Table 62 – Contents of domain summary objects	115
Table 63 – Required settings for domain member user objects	118
Table 64 – Required settings for domain member delegation objects	119
Table 65 – Request headers - Create a domain object using CDMI	120
Table 66 – Request message body - Create a domain object using CDMI	121
Table 67 – Response headers - Create a domain object using CDMI	122
Table 68 – Response message body - Create a domain object using CDMI	122
Table 69 – HTTP status codes - Create a domain object using CDMI	123
Table 70 – Request headers - Read a domain object using CDMI	124
Table 71 – Response headers - Read a domain object using CDMI	125
Table 72 – Response message body - Read a domain object using CDMI	125
Table 73 – HTTP status codes - Read a domain object using CDMI	126
Table 74 – Request headers - Update a domain object using CDMI	128
Table 75 – Request message body - Update a domain object using CDMI	128
Table 76 – Response header - Update a domain object using CDMI	129
Table 77 – HTTP status codes - Update a domain object using CDMI	130
Table 78 – Request header - Delete a domain object using CDMI	131
Table 79 – HTTP status codes - Delete a domain object using CDMI	131
Table 80 – Request headers - Create a queue object using CDMI	136
Table 81 – Request message body - Create a queue object using CDMI	136
Table 82 – Response headers - Create a queue object using CDMI	138
Table 83 – Response message body - Create a queue object using CDMI	138
Table 84 – HTTP status codes - Create a queue object using CDMI	139
Table 85 – Request headers - Read a queue object using CDMI	142
Table 86 – Response headers - Read a queue object using CDMI	142
Table 87 – Response message body - Read a queue object using CDMI	142
Table 88 – HTTP status codes - Read a queue object using CDMI	145
Table 89 – Request headers - Update a queue object using CDMI	148
Table 90 – Request message body - Update a queue object using CDMI	149
Table 91 – Response header - Update a queue object using CDMI	150
Table 92 – HTTP status codes - Update a queue object using CDMI	150
Table 93 – Request header - Delete a queue object using CDMI	151
Table 94 – HTTP status codes - Delete a queue object using CDMI	152
Table 95 – Request headers - Enqueue a new queue object value using CDMI	153
Table 96 – Request message body - Enqueue a new queue object value using CDMI	153
Table 97 – HTTP status codes - Enqueue a new queue object value using CDMI	156
Table 98 – Request header - Delete a queue object value using CDMI	159
Table 99 – HTTP status codes - Delete a queue object value using CDMI	160
Table 100 – System-wide capabilities	162
Table 101 – Capabilities for storage system metadata	165
Table 102 – Capabilities for data system metadata	166
Table 103 – Capabilities for data objects	168
Table 104 – Capabilities for containers	169
Table 105 – Capabilities for domain objects	171
Table 106 – Capabilities for queue objects	172
Table 107 – Request headers - Read a capabilities object using CDMI	173
Table 108 – Response headers - Read a capabilities object using CDMI	174
Table 109 – Response message body - Read a capabilities object using CDMI	174
Table 110 – HTTP status codes - Read a capabilities object using CDMI	175
Table 111 – Required members of the NFS protocol structure	184
Table 112 – Optional NFS export parameters	184
Table 113 – Required members of the CIFS protocol structure	186
Table 114 – ACE types	194

Table 115 – Who identifiers	195
Table 116 – ACE flags	195
Table 117 – ACE bit masks	196
Table 118 – Storage system metadata	202
Table 119 – Data system metadata	204
Table 120 – Provided values of data systems metadata items	210
Table 121 – Query matching expressions	221
Table 122 – Required metadata for a logging queue	230
Table 123 – Logging status metadata	231
Table 124 – Required metadata for a notification queue	232
Table 125 – Notification status metadata	235
Table 126 – Required metadata for a query queue	236
Table 127 – Query status metadata	237