

# ISO/IEC 17826:2022-05 (E)

## Information technology - Cloud Data Management Interface (CDMI) Version 2.0.0

---

Contents	Page
<b>I CDMI Preamble</b>	<b>1</b>
<b>Clause 1: Scope</b>	<b>3</b>
<b>Clause 2: Normative references</b>	<b>4</b>
<b>Clause 3: Terms, acronyms, and definitions</b>	<b>6</b>
<b>Clause 4: Conventions</b>	<b>11</b>
4.1 Interface format . . . . .	11
4.2 Typographical conventions . . . . .	12
4.3 Request and response body requirements . . . . .	13
4.4 Key Word requirements . . . . .	14
<b>Clause 5: Overview of Cloud Storage</b>	<b>15</b>
5.1 Overview . . . . .	15
5.2 Reference model for cloud storage interfaces . . . . .	18
5.3 Cloud data management interface . . . . .	19
5.4 Security . . . . .	23
5.5 Required HTTP support . . . . .	25
5.6 Time representations . . . . .	28
5.7 Backwards compatibility . . . . .	29
5.8 Object references . . . . .	30
<b>II Basic Cloud Storage</b>	<b>32</b>
<b>Clause 6: Data Object Resource Operations using HTTP</b>	<b>33</b>
6.1 Overview . . . . .	33
6.2 Create a data object using HTTP . . . . .	34
6.3 Read a data object using HTTP . . . . .	36
6.4 Update a data object using HTTP . . . . .	39
6.5 Delete a data object using HTTP . . . . .	41
<b>Clause 7: Container Object Resource Operations using HTTP</b>	<b>43</b>
7.1 Overview . . . . .	43
7.2 Create a container object using HTTP . . . . .	44
7.3 Read a container object using HTTP . . . . .	46
7.4 Update a container object using HTTP . . . . .	47
7.5 Delete a container object using HTTP . . . . .	48
7.6 Create (POST) a new data object using HTTP . . . . .	50
<b>III CDMI Core</b>	<b>52</b>
<b>Clause 8: Data Object Resource Operations using CDMI</b>	<b>53</b>
8.1 Overview . . . . .	53
8.2 Data object details . . . . .	54
8.3 Create a data object using CDMI . . . . .	56
8.4 Read a data object using CDMI . . . . .	67
8.5 Update a data object using CDMI . . . . .	76
8.6 Delete a data object using CDMI . . . . .	85
<b>Clause 9: Container Object Resource Operations using CDMI</b>	<b>87</b>
9.1 Overview . . . . .	87
9.2 Container object details . . . . .	88
9.3 Create a container object using CDMI . . . . .	90
9.4 Read a container object using CDMI . . . . .	97
9.5 Update a container object using CDMI . . . . .	102

9.6 Delete a container object using CDMI . . . . .	107
9.7 Create (POST) a new data object using CDMI . . . . .	109
9.8 Create (POST) a new queue object using CDMI . . . . .	119

## **IV CDMI Advanced 125**

### **Clause 10: Domain object resource operations using CDMI 126**

10.1 Overview . . . . .	126
10.2 Domain object details . . . . .	128
10.3 Domain object summaries . . . . .	131
10.4 Domain object membership . . . . .	134
10.5 Create a domain object using CDMI . . . . .	137
10.6 Read a domain object using CDMI . . . . .	141
10.7 Update a domain object using CDMI . . . . .	145
10.8 Delete a domain object using CDMI . . . . .	149

### **Clause 11: Queue object resource operations using CDMI 151**

11.1 Overview . . . . .	151
11.2 Queue object details . . . . .	152
11.3 Create a queue object using CDMI . . . . .	155
11.4 Read a queue object using CDMI . . . . .	161
11.5 Update a queue object using CDMI . . . . .	168
11.6 Delete a queue object using CDMI . . . . .	172
11.7 Enqueue a new queue object value using CDMI . . . . .	174
11.8 Delete a queue object value using CDMI . . . . .	180

### **Clause 12: Capability object resource operations using CDMI 182**

12.1 Overview . . . . .	182
12.2 Capability object details . . . . .	183
12.3 Read a capabilities object using CDMI . . . . .	199

### **Clause 13: Exported protocols 204**

13.1 Overview . . . . .	204
13.2 Container object export details . . . . .	205
13.3 NFS exported protocol . . . . .	208
13.4 SMB exported protocol . . . . .	210
13.5 iSCSI exported protocol . . . . .	211
13.6 WebDAV exported protocol . . . . .	212
13.7 OCCI exported protocol . . . . .	213

### **Clause 14: CDMI snapshots 215**

14.1 Overview . . . . .	215
14.2 Creating a snapshot . . . . .	216
14.3 Deleting a snapshot . . . . .	217

### **Clause 15: Serialization/deserialization 218**

15.1 Overview . . . . .	218
15.2 Canonical format . . . . .	219
15.3 Exporting serialized data . . . . .	221
15.4 Importing serialized data . . . . .	222

### **Clause 16: Metadata 223**

16.1 Overview . . . . .	223
16.2 Support for storage system metadata . . . . .	224
16.3 Support for data system metadata . . . . .	226
16.4 Support for provided data system metadata . . . . .	234
16.5 Support for user metadata . . . . .	236
16.6 Metadata update operations . . . . .	237

### **Clause 17: Access control 238**

17.1 Overview . . . . .	238
17.2 Access control flow . . . . .	239

### **Clause 18: Retention and hold management 251**

18.1 Overview . . . . .	251
18.2 Retention management disciplines . . . . .	252
18.3 CDMI retention . . . . .	253
18.4 CDMI hold . . . . .	255
18.5 CDMI auto-deletion . . . . .	258

18.6 Retention security considerations . . . . .	259
<b>Clause 19: Scope specification</b>	<b>260</b>
19.1 Overview . . . . .	260
19.2 Examples . . . . .	261
19.3 Query matching expressions . . . . .	263
<b>Clause 20: Results specification</b>	<b>266</b>
20.1 Overview . . . . .	266
20.2 Examples . . . . .	267
<b>Clause 21: Notification queues</b>	<b>268</b>
21.1 Overview . . . . .	268
21.2 Metadata . . . . .	269
<b>Clause 22: Query queues</b>	<b>273</b>
22.1 Overview . . . . .	273
22.2 Extending CDMI query . . . . .	275
<b>Clause 23: Encrypted objects</b>	<b>276</b>
23.1 Overview . . . . .	276
23.2 Encryption operations . . . . .	277
23.3 Example uses of encrypted objects . . . . .	280
23.4 KMS integration . . . . .	281
23.5 CMS format . . . . .	282
23.6 JOSE format . . . . .	283
23.7 Signature/digest verification . . . . .	284
23.8 Error handling . . . . .	285
<b>Clause 24: Delegated access control</b>	<b>286</b>
24.1 Overview . . . . .	286
24.2 Delegated access control (DAC) . . . . .	288
24.3 Delegated access control message exchange . . . . .	290
24.4 Client header passthrough . . . . .	292
24.5 DAC request . . . . .	293
24.6 Packaged DAC request . . . . .	295
24.7 DAC response . . . . .	296
24.8 Packaged DAC response . . . . .	297
24.9 Error handling . . . . .	299
24.10 Examples . . . . .	300
<b>Clause 25: Data object versions</b>	<b>311</b>
25.1 Overview . . . . .	311
25.2 Traversing version-enabled data objects . . . . .	313
25.3 Concurrent updates and version-enabled data objects . . . . .	314
25.4 Capabilities for version-enabled data objects . . . . .	316
25.5 Updates triggering version creation . . . . .	317
25.6 Operations on version-enabled data objects . . . . .	318
25.7 Operations on data object versions . . . . .	319
25.8 Query of data object versions . . . . .	320
25.9 Version-enabled data object serialization . . . . .	321
<b>V CDMI Annexes</b>	<b>323</b>
<b>Clause 26: Extensions</b>	<b>324</b>
26.1 Overview . . . . .	324
26.2 Summary metadata for bandwidth . . . . .	325
26.3 Expiring access control entries (ACEs) . . . . .	327
26.4 Group storage system metadata . . . . .	328
26.5 Header-based metadata . . . . .	329
26.6 Immediate query . . . . .	337
<b>VI References</b>	<b>340</b>
<b>Bibliography</b>	<b>341</b>

# List of Figures

Fig. 1:	Existing data storage interface standards . . . . .	16
Fig. 2:	Storage interfaces for object storage client data . . . . .	16
Fig. 3:	Cloud storage reference model . . . . .	18
Fig. 4:	CDMI object model . . . . .	20
Fig. 5:	Object transitions between named and ID-only . . . . .	21
Fig. 6:	CDMI URI Components . . . . .	26
Fig. 7:	Hierarchy of domains . . . . .	126
Fig. 8:	Hierarchy of capabilities . . . . .	183
Fig. 9:	CDMI and OCCI in an integrated cloud computing environment . . . . .	213
Fig. 10:	Snapshot container structure . . . . .	215
Fig. 11:	Access control flow . . . . .	239
Fig. 12:	Object retention . . . . .	253
Fig. 13:	Object hold . . . . .	255
Fig. 14:	Object hold on object with retention . . . . .	255
Fig. 15:	Object with multiple holds . . . . .	256
Fig. 16:	Encrypted object state transistions . . . . .	277
Fig. 17:	Non-delegated (ACL-based) access control data flow . . . . .	286
Fig. 18:	Delegated access control data flow example for non-encrypted object . . . . .	290
Fig. 19:	Delegated access control data flow example for encrypted object . . . . .	291
Fig. 20:	Updates to a non-version-enabled data object . . . . .	311
Fig. 21:	Updates to a version-enabled data object . . . . .	312
Fig. 22:	Linkages between a version-enabled data object and data object versions . . . . .	313
Fig. 23:	Overlapping concurrent updates . . . . .	314
Fig. 24:	Linkages for overlapping updates . . . . .	314
Fig. 25:	Nested concurrent updates . . . . .	315
Fig. 26:	Linkages for nested updates . . . . .	315
Fig. 27:	Version to <code>capabilityURI</code> relationships . . . . .	316

# List of Tables

Table 1:	Overview of this document . . . . .	2
Table 2:	Interface format . . . . .	11
Table 3:	Key word requirements . . . . .	14
Table 4:	Types of resources in the CDMI object model . . . . .	20
Table 5:	Creation/consumption of storage system metadata . . . . .	21
Table 6:	Object ID format . . . . .	22
Table 7:	Relative URIs resolved against root URIs . . . . .	27
Table 8:	Capabilities - Create a CDMI data object using HTTP . . . . .	34
Table 9:	Request headers - Create a CDMI data object using HTTP . . . . .	34
Table 10:	HTTP status codes - Create a data object using HTTP . . . . .	35
Table 11:	Capabilities - Read a CDMI data object using HTTP . . . . .	36
Table 12:	Request header - Read a CDMI data object using HTTP . . . . .	36
Table 13:	Response headers - Read a CDMI Data Object using HTTP . . . . .	37
Table 14:	HTTP status codes - Read a CDMI data object using HTTP . . . . .	37
Table 15:	Capabilities - Update a CDMI data object using HTTP . . . . .	39
Table 16:	Request headers - Update a CDMI data object using HTTP . . . . .	39
Table 17:	Response header - Update a CDMI data object using HTTP . . . . .	40
Table 18:	HTTP status codes - Update a CDMI data object using HTTP . . . . .	40
Table 19:	Capabilities - Delete a CDMI data object using HTTP . . . . .	41
Table 20:	HTTP status codes - Delete a CDMI data object using HTTP . . . . .	41
Table 21:	Capabilities - Create a CDMI container object using HTTP . . . . .	44
Table 22:	HTTP status codes - Create a container object using HTTP . . . . .	44
Table 23:	Capabilities - Delete a CDMI container object using HTTP . . . . .	48
Table 24:	HTTP status codes - Delete a CDMI container object using HTTP . . . . .	49
Table 25:	Capabilities - Create a CDMI data object using HTTP POST . . . . .	50
Table 26:	Request header - Create a new data object using HTTP . . . . .	50
Table 27:	Response header - Create a new data object using HTTP . . . . .	51
Table 28:	HTTP status codes - Create a new data object using HTTP . . . . .	51
Table 29:	Capabilities - Create a CDMI data object using CDMI . . . . .	57
Table 30:	Request headers - Create a CDMI data object using CDMI . . . . .	57
Table 31:	Request message body - Create a data object using CDMI . . . . .	58
Table 32:	Response headers - Create a data object using CDMI . . . . .	61
Table 33:	Response message body - Create a data object using CDMI . . . . .	61
Table 34:	HTTP status codes - Create a data object using CDMI . . . . .	62
Table 35:	Capabilities - Read a CDMI data object using CDMI . . . . .	67
Table 36:	Request headers - Read a CDMI data object using CDMI . . . . .	67
Table 37:	Response headers - Read a CDMI data object using CDMI . . . . .	68
Table 38:	Response message body - Read a CDMI data object using CDMI . . . . .	68
Table 39:	HTTP status codes - Read a CDMI data object using CDMI . . . . .	70
Table 40:	Capabilities - Update a CDMI data object using CDMI . . . . .	76
Table 41:	Request headers - Update a CDMI data object using CDMI . . . . .	77
Table 42:	Request message body - Update a CDMI data object using CDMI . . . . .	77
Table 43:	Response header - Update a CDMI data object using CDMI . . . . .	80
Table 44:	HTTP status codes - Update a CDMI data object using CDMI . . . . .	80
Table 45:	Capabilities - Delete a CDMI data object using CDMI . . . . .	85
Table 46:	HTTP status codes - Delete a CDMI data object using CDMI . . . . .	85
Table 47:	Container metadata . . . . .	89
Table 48:	Capabilities - Create a CDMI container object using CDMI . . . . .	91
Table 49:	Request headers - Create a container object using CDMI . . . . .	91
Table 50:	Request message body - Create a container object using CDMI . . . . .	91
Table 51:	Response headers - Create a container object using CDMI . . . . .	93
Table 52:	Response message body - Create a container object using CDMI . . . . .	93

Table 53:	HTTP status codes - Create a CDMI container object using CDMI	94
Table 54:	Capabilities - Read a CDMI Container Object using CDMI	97
Table 55:	Request headers - Read a container object using CDMI	97
Table 56:	Response headers - Read a container object using CDMI	98
Table 57:	Response message body - Read a container object using CDMI	98
Table 58:	HTTP status codes - Read a container object using CDMI	99
Table 59:	Capabilities - Update a CDMI container object using CDMI	103
Table 60:	Request headers - Update a container object using CDMI	103
Table 61:	Request message body - Update a container object using CDMI	103
Table 62:	Response header - Update a container object using CDMI	105
Table 63:	HTTP status codes - Update a container object using CDMI	105
Table 64:	Capabilities - Delete a CDMI container object using CDMI	107
Table 65:	HTTP status codes - Delete a container object using CDMI	108
Table 66:	Capabilities - Create a CDMI data object using CDMI	110
Table 67:	Request headers - Create a new data object Using CDMI	111
Table 68:	Request message body - Create a new data object Using CDMI	111
Table 69:	Response headers - Create a new data object using CDMI	115
Table 70:	Response message body - Create a new data object using CDMI	115
Table 71:	HTTP status codes - Create a new data object using CDMI	116
Table 72:	Capabilities - Create a CDMI Queue object using CDMI	120
Table 73:	Request headers - Create a new queue object using CDMI	120
Table 74:	Request message body - Create a new queue object using CDMI	121
Table 75:	Response headers - Create a new queue object using CDMI	122
Table 76:	Response message body - Create a new queue object using CDMI	122
Table 77:	HTTP status codes - Create a new queue object using CDMI	123
Table 78:	Required metadata for a domain object	129
Table 79:	Contents of domain summary objects	132
Table 80:	Required settings for domain member user objects	134
Table 81:	Required settings for domain member delegation objects	135
Table 82:	Capabilities - Create a CDMI domain object using CDMI	137
Table 83:	Request headers - Create a domain object using CDMI	137
Table 84:	Request message body - Create a domain object using CDMI	138
Table 85:	Response headers - Create a domain object using CDMI	139
Table 86:	Response message body - Create a domain object using CDMI	139
Table 87:	HTTP status codes - Create a domain object using CDMI	140
Table 88:	Capabilities - Read a CDMI domain object using CDMI	141
Table 89:	Request headers - Read a domain object using CDMI	141
Table 90:	Response headers - Read a domain object using CDMI	142
Table 91:	Response message body - Read a domain object using CDMI	142
Table 92:	HTTP status codes - Read a domain object using CDMI	143
Table 93:	Capabilities - Update a CDMI domain object using CDMI	145
Table 94:	Request headers - Update a domain object using CDMI	145
Table 95:	Request message body - Update a domain object using CDMI	146
Table 96:	Response header - Update a domain object using CDMI	147
Table 97:	HTTP status codes - Update a domain object using CDMI	147
Table 98:	Capabilities - Delete a CDMI domain object using CDMI	149
Table 99:	HTTP status codes - Delete a domain object using CDMI	150
Table 100:	Capabilities - Create a CDMI queue object using CDMI	155
Table 101:	Request headers - Create a queue object Using CDMI	156
Table 102:	Request message body - Create a queue object using CDMI	156
Table 103:	Response headers - Create a queue object Using CDMI	158
Table 104:	Response message body - Create a queue object using CDMI	158
Table 105:	HTTP status codes - Create a queue object using CDMI	159
Table 106:	Capabilities - Read a CDMI queue object using CDMI	161
Table 107:	Request headers - Read a queue object using CDMI	162
Table 108:	Response headers - Read a queue object using CDMI	162
Table 109:	Response message body - Read a queue object using CDMI	162
Table 110:	HTTP status codes - Read a queue object using CDMI	165
Table 111:	Capabilities - Update a queue object using CDMI	168
Table 112:	Request headers - Update a queue object Using CDMI	168
Table 113:	Request message body - Update a queue object Using CDMI	168
Table 114:	Response header - Update a queue object Using CDMI	170
Table 115:	HTTP status codes - Update a queue object using CDMI	170
Table 116:	Capabilities - Delete a queue object using CDMI	172
Table 117:	HTTP status codes - Delete a queue object Using CDMI	173
Table 118:	Capabilities - Enqueue a new queue object value using CDMI	174
Table 119:	Request headers - Enqueue a new queue object value using CDMI	174
Table 120:	Request message body - Enqueue a new queue object value using CDMI	175

Table 121: HTTP status codes - Enqueue a new queue object value Using CDMI . . . . .	177
Table 122: Capabilities - Delete a queue object value using CDMI . . . . .	180
Table 123: HTTP status codes - Delete a queue object value using CDMI . . . . .	181
Table 124: System-wide capabilities . . . . .	185
Table 125: Capabilities for storage system metadata . . . . .	189
Table 126: Capabilities for data system metadata . . . . .	190
Table 127: Capabilities for data objects . . . . .	193
Table 128: Capabilities for container objects . . . . .	194
Table 129: Capabilities for domain objects . . . . .	196
Table 130: Capabilities for queue objects . . . . .	198
Table 131: Capabilities - Read a capabilities object using CDMI . . . . .	199
Table 132: Request headers - Read a capabilities object using CDMI . . . . .	199
Table 133: Response headers - Read a capabilities object Using CDMI . . . . .	200
Table 134: Response message body - Read a capabilities object using CDMI . . . . .	200
Table 135: HTTP status codes - Read a capabilities object using CDMI . . . . .	201
Table 136: Elements of the NFS protocol export structure . . . . .	208
Table 137: Elements of the SMB protocol export structure . . . . .	210
Table 138: Elements of the iSCSI protocol export structure . . . . .	211
Table 139: Elements of the WebDAV protocol export structure . . . . .	212
Table 140: Serialization import behaviour . . . . .	222
Table 141: Storage system metadata . . . . .	224
Table 142: Data system metadata . . . . .	226
Table 143: Provided values of data system metadata . . . . .	234
Table 144: ACE types . . . . .	241
Table 145: Who identifiers . . . . .	241
Table 146: ACE flags . . . . .	241
Table 147: ACE masks bits . . . . .	243
Table 148: ACE bit mask/string . . . . .	249
Table 149: Query matching expressions . . . . .	263
Table 150: Required metadata for a notification queue . . . . .	269
Table 151: Notification status metadata . . . . .	272
Table 152: Required metadata for a query queue . . . . .	273
Table 153: Query status metadata . . . . .	274
Table 154: Access modes for DAC . . . . .	288
Table 155: DAC request . . . . .	293
Table 156: Packaged DAC request . . . . .	295
Table 157: DAC response . . . . .	296
Table 158: Packaged DAC response . . . . .	297
Table 159: Version-enabled data object metadata items . . . . .	313
Table 161: Response headers - Inspect a data object using HTTP . . . . .	330
Table 162: HTTP status codes - Inspect a data object using HTTP . . . . .	331
Table 163: Request headers - Create a container object using HTTP . . . . .	333
Table 164: Response Headers - Inspect a container object using HTTP . . . . .	334
Table 165: HTTP status codes - Inspect a container object using HTTP . . . . .	334
Table 167: Required metadata for a query queue . . . . .	338